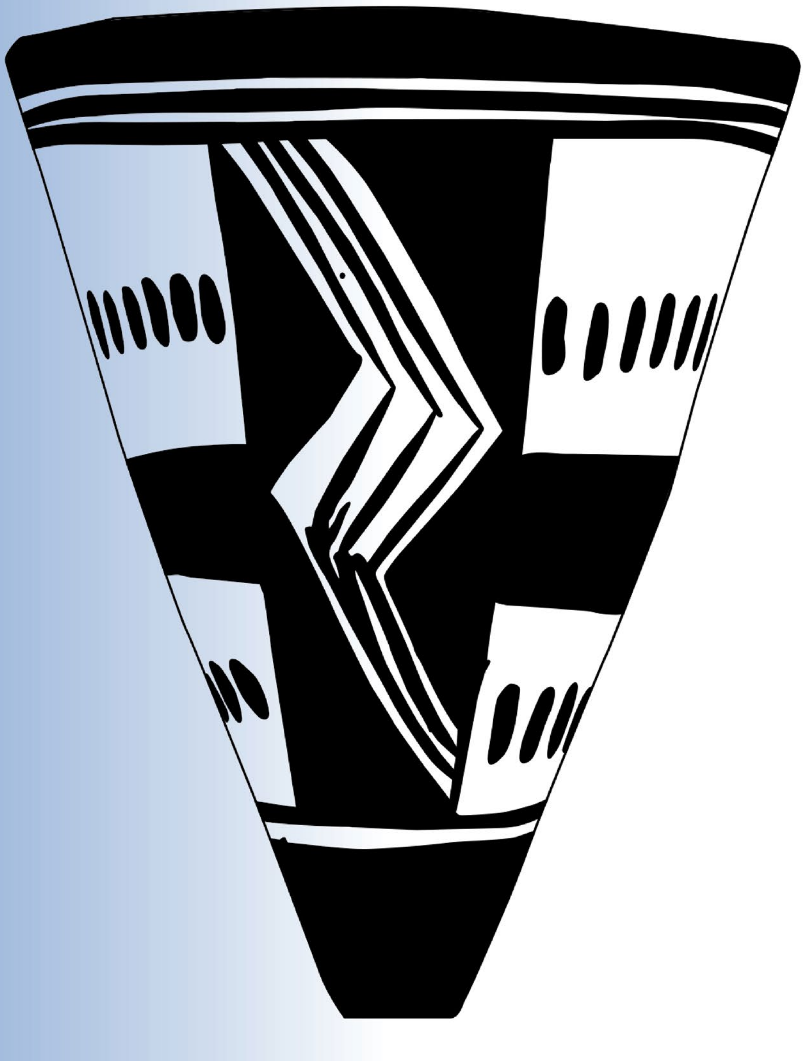
Pottery Making and Communities During the 5th Millennium BCE in Fars Province, Southwestern Iran



Takehiro Miki

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A man who is trying to learn some art is apt to say, " I won't rush things and tell people I am practicing while I am still a beginner. I'll study by myself, and only when I have mastered the art will I perform before people. How impressed they'll be then!"

People who speak in this fashion will never learn any art. The man who, even while still a novice, mixes with the experts, not ashamed of their harsh comments or ridicule, and who devotedly persists at his practice, unruffled by criticism, will neither become stultified in his art nor careless with it. Though he may lack natural gifts, he will with the passage of the years outstrip the man who coasts on his endowments, and in the end will attain the highest degree of skill, acquire authority in his art and the recognition of the public, and win an unequaled reputation.

The performers who now rank as the most skilled in the whole country were at the beginning considered incompetent, and, indeed, had shocking faults. However, by faithfully maintaining the principles of their art and holding then in honor, rather than indulging in their own fancies, they have become paragons of the age and teachers for all. This surely holds true for every art.

Kenkō (1283?-1352?)
Essays in Idleness CL (translated by Donald Keene)

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Analysis of pottery-making techniques

Discussion: reassembling the organisation of pottery production

Preface

This book explores pottery making and communities during the Bakun period (c. 5,000 – 4,000 BCE) in the Kur River Basin, Fars province, southwestern Iran. It analyses ceramic materials collected at Tall-e Jari A, Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A, housed in the University Museum, the University of Tokyo and the Oriental Institute of the University of Chicago. At the beginning of the 5th millennium BCE, black-on-buff painted pottery spread from Mesopotamia and Susiana to Fars province, and the study investigates four research questions about black-on-buff pottery in the Kur River Basin:

1) Chronological relations of the Bakun-period sites: when were the sites dated in the chronological sequence of the Bakun period?
2) When and how were black-on-buff ceramics adopted and developed in the Bakun period?
3) How were black-on-buff ceramics and other pottery produced?
4) How was pottery production organised during the Bakun period?

First, the chronological relations between four main Bakun-period sites varied depending on previous studies which proposed a tripartite subdivision system of the Bakun period (The Early, Middle, and Late Bakun). The absence of one well-preserved site with long stratigraphy ranging from the beginning to the end of the Bakun period made the chronological discussion more severe. I reconsidered the stratigraphy and radiocarbon dates of the four Bakun-period sites by reviewing and comparing the description of excavation trenches. As a result, a new chronological relationship of four sites was presented independently of the former tripartite subdivision system.

Second, diachronic changes of the Bakun pottery were not well-studied, excluding painted motifs and vessel forms. There were also few quantitative approaches to pottery changes. Hence, I expanded the number of pottery attributes to be quantitatively and qualitatively analysed, such as wares, rim and base shapes, horizontal design structures, and pottery-making techniques. I also presented unpublished ceramic materials. Consequently, I could present the increase of black-on-buff ware, the gradual shift from an interior-painted open vessel with an interior base band to an exterior-painted one without a body band, and the increased production of large jars.

Third, few studies tackled the whole steps of pottery-making techniques. I separated pottery-making techniques into two portions: the explicit sequence of technical steps from clay acquisition to firing and the degree of technical skills. As a result of the chaîne opératoire analysis, it turned out that technical steps/options in the chaînes opératoires of pottery-making showed few diachronic changes except for minor and rare options. On the other hand, I clarified diachronic changes of technical skills toward successful execution and longer apprenticeship from the analysis of painting errors. I also conducted petrographic analysis using thin-section petrography and geochemical analyses using ICP-OES (inductivity coupled plasma optical emission spectrometer), XRD (X-ray diffraction), and powder XRD. These results provide new information about the technical steps of clay acquisition and preparation.

Fourth, the organisation of pottery production during the Bakun period was investigated by previous researchers to clarify the degree of craft specialisation. I proposed an alternative approach, “relational perspective” to the organisation of craft production through reviewing community of practice, Actor-Network-Theory, and entanglement theory. In this perspective, the organisation of craft production is regarded as numerous relations between things and humans. On the basis of this relational standpoint, I discussed diachronic change in the organisation of pottery production during the Bakun period. After the adoption of black-on-buff ceramics, relations between humans and pottery changed, and the community of pottery making became more fixed and imposed longer apprenticeships over time, thereby generating beautifully and elaborately decorated vessels. The Neolithic lifeworld where social inequality was suppressed through the low variability of the material culture was replaced with the Chalcolithic lifeworld where social inequality was visualised through the high variability of the material culture represented by black-on-buff ceramics.

Acknowledgements

This book is based on my submission to the Free University of Berlin as a PhD dissertation in 2019. It owes much to the advice of professors, colleagues, and institutions. I want to begin by thanking Reinhard Bernbeck, who allowed me to study at Berlin, one of the best places to study west Asian archaeology, and kindly advised me on this work, especially regarding his profound theoretical thought and knowledge about pottery. It was in May 2013 at the international workshop about the 5th millennium BCE Iran held at Berlin that I became acquainted with him for the first time. I also thank the organisers of this workshop, Helen Taylor, Mohammad Karami, and Barbara Helwing for giving me a special opportunity to see him and develop my study.

I express my gratitude to Yoshihiro Nishiaki, who allowed me to study the collection curated in the University Museum, the University of Tokyo. My first encounter with the Bakun pottery curated in the museum was fortunately brought about by him in April 2010. My eleven-year-period exploration of Bakun pottery blossomed into this monograph with his gentle support. His rigorous and professional expertise as a lithic specialist of west Asian archaeology had a great effect on my pottery studies.

I want to thank Susan Pollock who kindly commented on this work with her wonderful scholarship on the Chalcolithic of west Asian archaeology and practice theory. She introduced me to “communities of practice”, one of the significant theoretical concepts in this work. This was a major turning point of my theoretical thinking, a takeoff from craft-specialisation studies.

The observation of ceramic materials curated in the Oriental Institute of the University of Chicago was kindly permitted by Abbas Alizadeh. Helen McDonald and James Green kindly arranged my visit to the Oriental Institute, for which I am grateful. I thank Iranian colleagues who supported this study. Mohammad Hossein Azizi Kharanagi generously provided me with the pottery samples from Rahmatabad for the thin-section petrography and geochemical analysis of this study. I also thank Akira Tsuneki and Osamu Maeda to permit the observation of the collection curated in University of Tsukuba.

My interdisciplinary work with petrography and geochemical analysis would have been impossible without the support of professional specialists. Toshiyasu Shinmen, Shuji Ninomiya, Natsuki Murakami, Midori Hamada kindly helped me conduct geochemical analyses. Patrick Quinn taught me the methods of thin-section petrography in an intensive workshop at London. Pamera Fragnoli kindly checked my petrographic classification and gave me advice. Ralf Milke and Sabine Meister allowed me to use the ZEISS polarized microscope with camera for taking pictures of thin sections. I thank these colleagues for their support with professional expertise.

The members of the laboratory of Professor Nishiaki supported this study from Japan. At the colloquium in the University of Tokyo, professors and colleagues gave me comments from the perspective of Japanese archaeology. Their advice from different viewpoints was also fruitful for me. The participants in the colloquium hosted by Reinhard Bernbeck and Susan Pollock in Free University of Berlin gave me stimulating comments and ideas.

This work was funded by the German Academic Exchange Service: DAAD Research Grant (Research Grants - Doctoral Programs in Germany, Funding program number 57129429, 2015-2019), Yoshida Manabu Memorial Foundation for Scientific Studies on Cultural Properties (2014-2015), Kobayashi Setsutaro Memorial Foundation: Kobayashi Fellowship (2014-2015), and The University of Tokyo fellowship for Ph. D student (2014). I thank them for both their financial support and generous understanding towards my study.

Finally, from a relational perspective, this book is an outcome of numerous relations between me, the colleagues whom I mention above, including archaeologists, non-archaeologists, and other people, and other things which are not mentioned in this acknowledgement. I thank all who contributed to this work.

Takehiro Miki

Part I: Introduction and raising research questions

Chapter 1

Introduction

My research project is intended to elucidate the pottery making, pottery-making communities, and village communities during the Chalcolithic, especially the Bakun period (c. 5000 BCE – 4100 BCE) in the Kur River Basin, Fars province, southwestern Iran. Craft making in the prehistoric period is an interesting topic in which interdisciplinary concerns are crossed, including philosophy, anthropology, psychology, architecture, art, and archaeology.[1] This research was motivated by my incessant interest in what craft making is and was in modern and ancient times. The beautifully decorated Bakun pottery stimulates our imagination of craft making during the 5th millennium BCE and of village life in southwestern Iran. Who made it? How was it made? Why did the producers paint such a complex motif on the surface of the pottery? What did the esoteric motifs represent? Throughout this research, I will introduce the established answers to these questions and cast doubts on them. Below, via various methods, unpublished data, and an alternative theoretical perspective, I will explore pottery making and its communities in the Bakun period.

In this chapter, I will present the general research background of the Bakun period in Fars province in terms of long-term archaeological and geographical context including neighbouring regions. I will then raise four research questions and establish the framework of this research.

Table 1.1 Chronology of Fars, Susiana, and Mesopotamia (taken from Petrie 2011: Table 8.1 and Delougaz and Kantor 1996: Table 42 and modified by Miki)

BCE	Fars	Susiana	Mesopotamia
3000	Banesh	Susa III	Late Uruk
3500		Susa II	Early Uruk
	Lapui	Terminal Susiana	Terminal Ubaid
4000		Late Susiana/Susa I	
			Ubaid 4
4500	Bakun		
		Middle Susiana	Ubaid 3
5000			
	Shamsabad	Early Susiana	Ubaid 2
5500			
	Jari	Archaic Susiana 3	Ubaid 1
6000	Bashi	Archaic Susiana 2	
	Mushki		Ubaid 0
6500		Archaic Susiana 1	
		Archaic Susiana 0	
7000		Formative Susiana?	

1-1. Archaeological and geographical context of the Kur River Basin, Fars province, Iran

Archaeological context of the Kur River Basin, Fars province, Iran

Neolithic: the Mushki period

First, as a general introduction, I will introduce the long-term chronological framework of archaeology in Fars province ranging from the Neolithic to the Chalcolithic periods (c. 6300 BCE – 2700 BCE)(Table 1.1) to position the Bakun period in the history of village communities, drawing attention to subsistence practices, pottery, and social aspects. The earliest farming community (Neolithic) was dated to the Mushki period (c. 6300 BCE – 6100 BCE).[2] Tall-e Mushki is the type-site of this period[3]: architectural remains at Tall-e Mushki suggest short-term and less sedentary habitation than in the following period.[4] Subsistence in the Mushki period was characterised by hunting equids and gazelles.[5] The importance of hunting is also demonstrated by flint tools.[6] Mushki pottery was painted with red slip, burnished surfaces, and geometric black decorations.[7] The presence of vegetal temper (straw and chaff) inside the fabric and macro-botanical remains (einkorn, bread wheat, two-row barley) indirectly indicates that cereal agriculture was conducted in this period.[8]

Neolithic: the Bashi period

The Mushki period is followed by the Bashi period (c. 6100 BCE – 6000 BCE). This short cultural period was named after the type-site Tol-e Bashi.[9] Bashi pottery was buff-slipped and black-painted with vegetal

[1] Ingold 2013.
[2] Alizadeh 2006: 8; Bernbeck 2010; Nishiaki 2010a; Weeks 2013.
[3] Vanden Berghe 1954; Fukai et al. (eds.) 1973.
[4] Fukai et al. 1973; Nishiaki 2010a: 7. Sumner 1977; Hole 1987: 54.
[5] Fukai et al. (eds.) 1973; Mashkour et al. 2006.
[6] Abe 2011.
[7] Fukai et al. (eds.) 1973.
[8] Miller and Kimiaie 2006; Weeks 2013: 101.
[9] Pollock et al. (eds.) 2010; Weeks 2013.

temper and a 'Bashi motif' of high frequency and low variability.[10] Reinhard Bernbeck argues that pottery production in the Bashi period was a seasonal activity and the production amount was limited.[11] The faunal assemblage at Tol-e Bashi showed more focus on herding than that of Tall-e Mushki.[12] Considering the excavated materials and remains at Tol-e Bashi, it seems that production of durable materials was limited and that durable materials were not possessed but shared, as durable objects were regarded as a threat to social relations and a step toward social inequality.[13]

Neolithic: the Jari period

The Jari period (c. 6000 BCE – 5500 BCE) follows the Bashi period.[14] This period was previously poorly known because only a brief excavation report of the type-site Tall-e Jari B had been published.[15] However, since the 2000s, excavation data, especially pottery, lithics, architecture, animal bones, and botanical samples, have been reanalysed.[16] Archaeologists contrasted its subsistence with the Mushki period and showed a shift from hunted animals to domesticates, such as cattle, goats, and sheep, the replacement of hunting tools by sickle elements, and the presence of sedentary buildings.[17] Jari pottery was characterised by buff-slipped ware with vegetal temper and black decoration. The major motif of the paint decoration was the diagonal ladder motif with short slashes.[18] Yoshihiro Nishiaki argues that the rapid cultural changes from the Mushki to the Bashi and Jari periods were related to an 8.2 ka climatic deterioration event and the subsequent amelioration.[19]

Neolithic: the Shamsabad period

The final Neolithic period is called the Shamsabad period (c. 5400 BCE – 5200 BCE) [20] and was originally confirmed in Level BI of Tall-e Bakun B[21] but named the Shamsabad period by William Sumner after the surface survey of the locality.[22] Unpainted thick, coarse, vegetal-tempered pottery is the characteristic of this cultural period. Although the subsistence is not well understood, Sumner reported that the number of the Shamsabad-period sites in the Kur River Basin increased from 50 (the Jari-period sites) to 108, implying the development of agriculture.[23]

Chalcolithic: the Bakun period

Here, to make a comparison to the Neolithic periods and the other Chalcolithic periods, I will cover some general information on the Bakun period in the Chalcolithic. I limit the explanation to the existing representative studies about the subsistence, pottery production, and social organisation of the Bakun period; details and problems of the previous studies will be explained in the next chapter. The cultural period is called the Bakun period after the first excavated site, Tall-e Bakun A. Beautifully painted fine pottery appeared after the plain vegetal-tempered coarse ceramics. This black-on-buff fine ware culture, which used high-temperature facilities such as pottery kilns, was a new technology from Mesopotamia and Khuzestan.[24] From a broader point of view, this period is contemporaneous to the Ubaid period in Mesopotamia, the Middle-Late Susiana period in Khuzestan, and the Transitional Chalcolithic in the Iranian Central Plateau.[25] Whereas the black-on-buff ceramics were also observed in Mesopotamia and Khuzestan, black-on-red ceramics were distributed in the Iranian Central Plateau.

Recent excavation at Tall-e Bakun A collected animal bones and botanical samples, contributing to our knowledge of the subsistence economy of the Bakun period.[26] The predominant proportion of goat and sheep in the faunal assemblage was distinctive in comparison to the Neolithic animal exploitation. Domesticated botanical species such as barley, bread wheat, and einkorn were confirmed. As for the social organisation and subsistence economy of the Bakun period, two main arguments exist. On one hand, William Sumner investigated the transformation of the Bakun society and analysed changes in regional demography and settlement patterns to understand changes in land use and organisational patterns. The number of sites increased distinctively in the Bakun period. He concluded that population growth based on sedentary villages, interregional integration, increases in scale, and growth of productive specialisation led the development of a centralized control system in the Bakun period.[27]

On the other hand, Abbas Alizadeh analysed stone stamp seals and sealings from Tall-e Bakun A and insists that limited numbers of people conducted administrative

[10] Bernbeck 2010.
[11] Bernbeck 2010.
[12] Mashkour and Bailon 2010.
[13] Pollock and Bernbeck 2010.
[14] Vanden Berghe 1954; Nishiaki 2010a; Sumner 1972; Bernbeck 2010; Weeks 2013.
[15] Egami 1967.
[16] Hori and Maeda 1984; Maeda 1986; Hori 1989; Alizadeh 2004; Alizadeh et al. 2004; Alizadeh 2006; Nishiaki 2003; Nishiaki 2010a, b.
[17] Mashkour et al. 2006; Nishiaki 2010b; Abe 2011.
[18] Hori and Maeda 1984; Nishiaki 2010b.
[19] Nishiaki 2010a: 9.
[20] Alizadeh 2006: 10.
[21] Schmidt 1939: 124; McCown 1942: 23. Sumner 1977: 300.
[22] Sumner 1994; Voigt and Dyson 1992: 138.
[23] Sumner 1994.
[24] Alizadeh 2006; Weeks et al. 2010; Mutin 2012.
[25] Carter and Phillip (eds.) 2010; Delougaz and Kantor 2008; Vidale et al. 2018.
[26] Mashkour et al. 2006; Miller and Kimiaie 2006.
[27] Sumner 1994.

activities there.[28] On the basis of the result and an ethnography of modern nomadic tribes, he argued that the nomadic elites did exist, dominated the site, and stimulated the development of economic complexity at Tall-e Bakun A. Sumner and Alizadeh differ in their assessments of the economic base of the development of Bakun society; Sumner emphasises farming and land use as the economic base, whereas Alizadeh emphasises economic activities with a focus on nomads.

As for the organisation of pottery production in the Bakun period, there are two main interpretations. Both Sumner and Alizadeh have proposed models in which a small group controlled the production of the Bakun ceramics by attached specialists.[29] In contrast to Sumner and Alizadeh, Fraser argues that the production of the Bakun pottery may not have been limited to specific production centres and that pottery making was not necessarily an élite-controlled activity. He suggests that goods (including ceramics) were produced at a household level in a heterarchy of extended households.[30]

Chalcolithic: the Lapui period

After the Bakun period, a new cultural period called the Lapui (c. 4100 – 3500 BCE) appeared.[31] The type-site Lapui was not excavated but was surveyed by Sumner.[32] At present, archaeological contexts of the Lapui period are confirmed at Tall-e Nokhodi, Tol-e Spid, Tol-e Nurabad, and Tappeh Mehr Ali.[33] In contrast to the Bakun period, plain red-burnished fine ware and grit-tempered common ware are typical of this period.[34] Petrie has suggested the presence of low-speed wheels for pottery production, and geochemical analysis indicates that the Lapui fine wares were produced at specific locations and then distributed to other settlements while the coarse wares were locally produced and consumed.[35] Regarding settlement patterns and subsistence, whereas Sumner argued that the number of sites decreased in the Lapui period, Alizadeh did not think so.[36] In the faunal assemblages at Tol-e Spid, Tol-e Nurabad, and Tappeh Mehr Ali, sheep and goat were dominant, followed by cattle, in line with examples from Tall-e Bakun A.[37] Charred plant remains at Tol-e Spid and Tol-e Nurabad also showed similarity to Tall-e Bakun A, though those from Tappeh Mehr Ali presented a large proportion of almond and pistachio.[38]

[28] Alizadeh 1988, 2006.
[29] Alizadeh 1988; Sumner 1994.
[30] Fraser 2008: 15.
[31] Alizadeh 2006; Petrie 2011: 173.
[32] Sumner 1972.
[33] Goff 1963, 1964; Petrie et al. 2013; Sardari 2013.
[34] Sumner 1988; Petrie et al. 2013.
[35] Petrie et al. 2013: 187.
[36] Sumner 1972, 1994; Alizadeh 2003, 2006.
[37] Petrie et al. 2013; Sardari 2013.
[38] Petrie et al. 2013; Sardari 2013.

Chalcolithic: the Banesh period

I will close this long-term overview of archaeological contexts in the Kur River Basin with the Banesh period (c. 3400 – 2700 BCE).[39] First, the most remarkable aspect of this period is the emergence of a quite a large site, Tal-e Malyan. John Alden estimates the occupation area of Tal-e Malyan in the Middle Banesh phase to be between 23 ha and 75 ha (median: 50 ha). This size is distinguished from contemporaneous villages (1-2 ha) and mean site areas in the Shamsabad and Bakun periods.[40] In the Late Banesh phase, the Malyan city wall[41] was constructed at this site. Second, it is argued that the Banesh grit-tempered ware and vegetal-tempered ware were produced at specific production sites. Alden argues for the existence of itinerant specialist potters based on the geochemical analysis of potters' tools.[42] Third, the archaeological evidence showing administrative activity, such as Proto-Elamite tablets, sealings, and bullae were confirmed in the Banesh period. Fourth, as for animal exploitation, sheep and goats were predominant in the faunal assemblage.[43] In addition, specialised systems of meat distribution at Tal-e Malyan have been suggested based on the intra-site difference of preserved parts of animal bones. Fifth, Sumner and Alden have proposed that seasonally mobile pastoralism played a great role in the development of socio-political organisation during the Banesh period, sometimes called 'Proto-Elamite civilization'.[44]

Above, I briefly reviewed the long-term history of village communities from the Neolithic to the Chalcolithic (c. 6300 BCE – 2700 BCE) periods by describing subsistence practices, pottery, and social organisation. This long-term perspective induces readers to interpret the village history in the Kur River Basin as a unilinear developmental sequence from simpler villages to complex cities. As village life became established in the Neolithic period (the Mushki, Bashi, Jari, and Shamsabad) after the adoption of agriculture and animal husbandry and the origin of urbanism in the Kur River Basin was clearly confirmed in the Banesh period, it is valid to deduce that the Bakun period, being sandwiched between the Neolithic and the Banesh periods, was a period of increasing social complexity and craft specialisation. Throughout this research, I am critical of this kind of top-down approach, which makes a priori assumptions about Bakun society. Rather, I will reconsider communities in the Bakun period through bottom-up approaches.

[39] Sumner 1986; Zeder 1991; Alden 2013.
[40] Sumner 1986: Table 3; Alden 2013: Fig. 12.9.
[41] Sumner 1986: 206.
[42] Alden and Minc 2016.
[43] Zeder 1991.
[44] Sumner 1986.

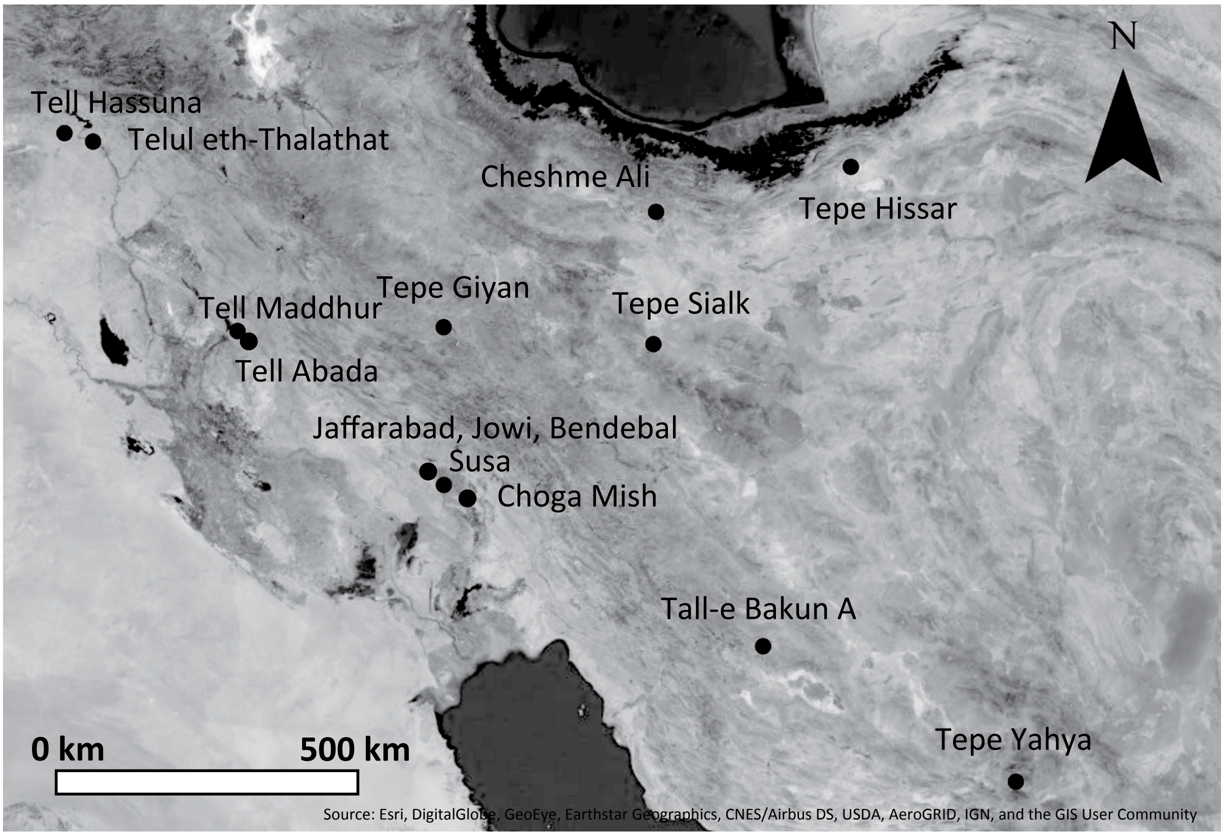

Figure 1.1 Map of West Asia and prehistoric sites mentioned in this thesis (Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, AeroGRID, IGN, and the GIS User Community)

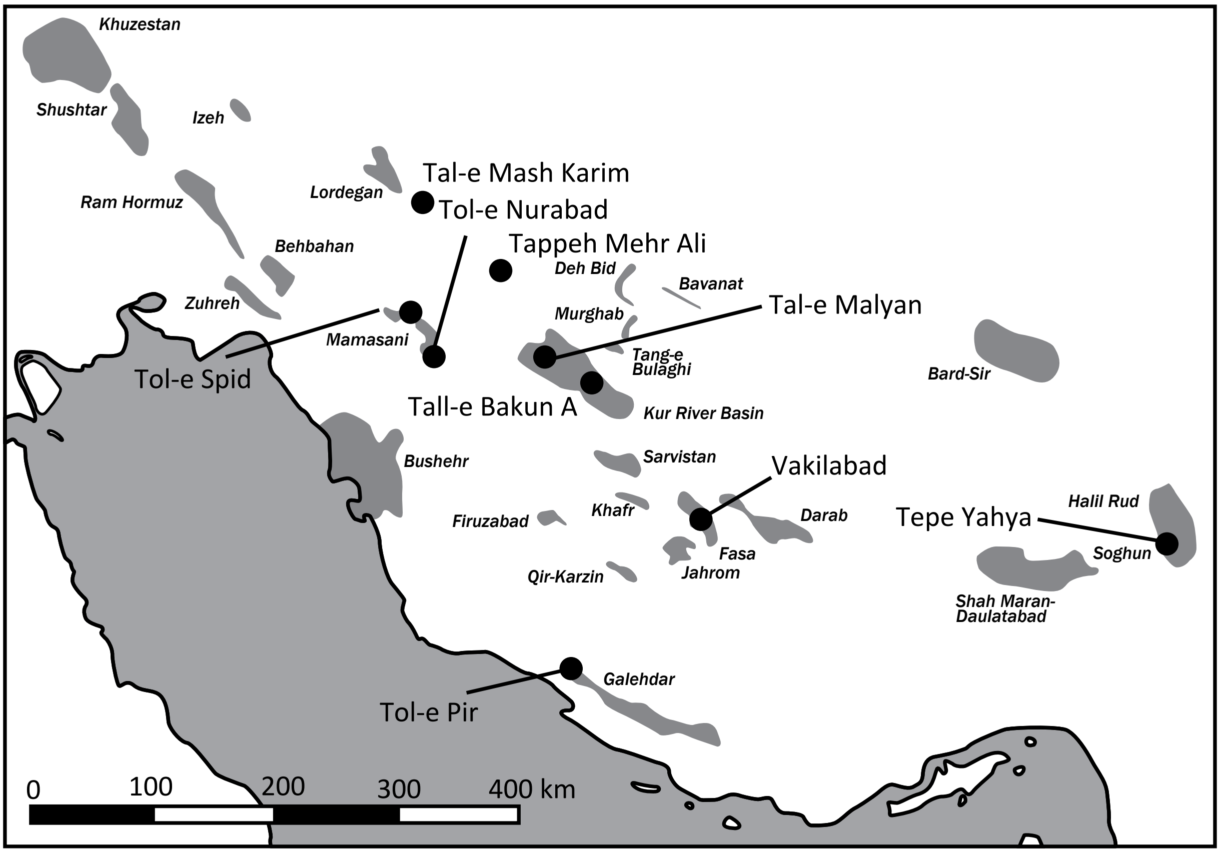

Figure 1.2 Map of intermontane valleys and prehistoric sites in southern Iran
(traced from Petrie 2011: Figure 8.1 and modified by Miki)

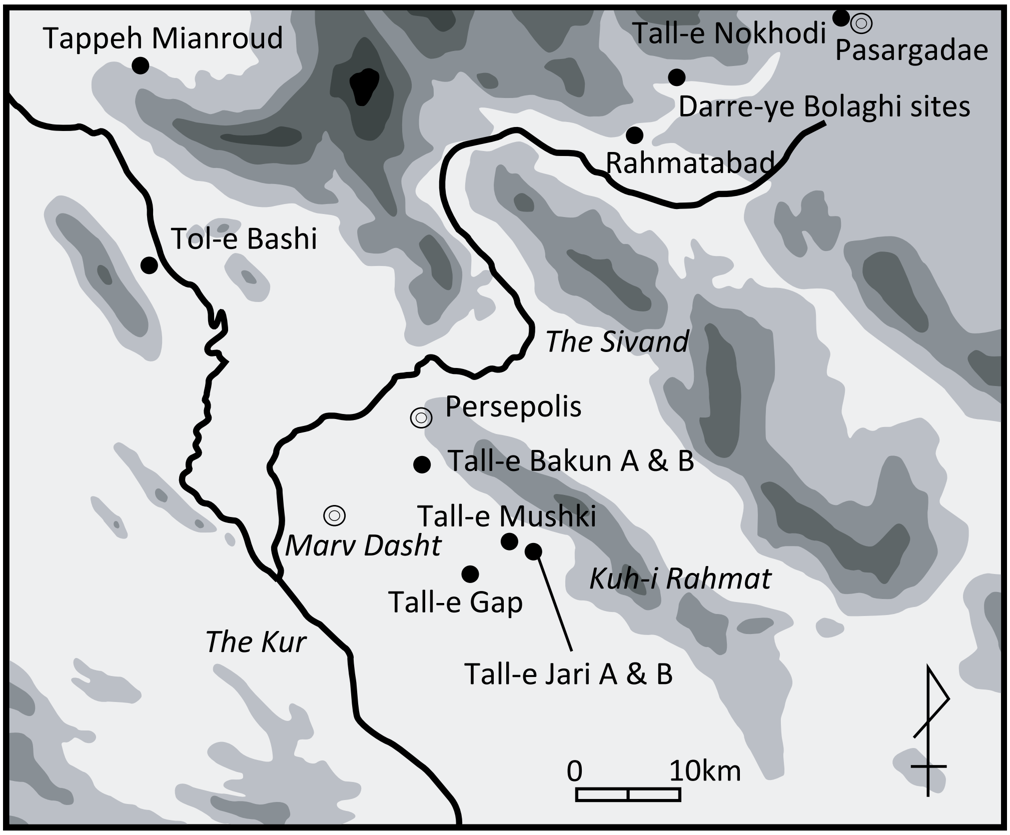

Figure 1.3 Map of the Kur River Basin and prehistoric and historic sites

Geographic context of the Kur River Basin, Fars province, Iran

Geographic context

From a macroscopic geographic perspective, southwestern Iran is located between the Persian Gulf and the Zagros Mountains, which contact southern Iran in a northwest-southeast direction. The Zagros fold and thrust belt was formed by the collision between the Arabian Plate and the Eurasian Plate; this created geographic contrasts to the alluvial large-sized plains of southern Mesopotamia in the form of small, separated intermontane valleys, plains, and basins (Figs. 1.1, 1.2). Although these intermontane valleys are connected by paths and roads, inter-valley communications were restrained by this topography. The Kur River Basin (Figs. 1.2, 1.3) is one of the largest endorheic basins in southwest Iran.[45] The area is about 3,600 km^2 and the elevation is 1,600 m above sea level.[46] In addition, this basin was surrounded by other intermontane valleys, such as the Mamasani Plain, the Kamin Plain, and the Plain of Sarvistan. Unlike the Plain of Bushehr and Plain of Galedar, the other isolated large intermontane valleys, its location played a great role in developing the prehistoric villages in the Kur River Basin.

The Kur River Basin

The four main sites discussed in this research (Tall-e Jari A, Tall-e Bakun A, Tall-e Bakun B, and Tall-e Gap) were distributed in the eastern part of the Kur River Basin (Fig. 1.3). The nearest modern town is Marv Dasht. The famous Persepolis attracted both ancient people and modern archaeologists, leading to the first discovery of the Bakun site, Tall-e Bakun A. Two main rivers, the Kur and the Sivand (Pulvar), flow in the Kur River Basin. These rivers incise the alluvial plain to depths of 5 to 20 m.[47] The four sites are closer to the left bank of the Sivand than the Kur, lying in the southern piedmont of the Kuh-i Rahmat and covered by the Daryan and Sarvak Formations of limestone. The annual rainfall in the Kur River Basin is 334-340 mm on average, concentrated in the term from December to March.[48]

The geographic regions surrounding Fars Province in the Chalcolithic period

Next, I will briefly explain the geographic and archaeological contexts of the regions surrounding

[45] The Kur River Basin is also called the Marv Dasht Plain mainly by Japanese archaeologists (Egami and Sono 1962; Egami and Masuda 1962; Alizadeh 2006; Nishiaki 2010). In this research, I use the Kur River Basin.
[46] Alizadeh 2006: 29.
[47] Alizadeh 2006: 29; Heydari and Bernbeck 2010: 14.
[48] Alizadeh 2006: 29; Heydari and Bernbeck 2010: 15.

Fars Province in the Chalcolithic period: Khuzestan and southeastern Iran, especially the regions where black-on-buff ceramics were present. First, the Susiana Plain (2280 km^2)[49], located west of Fars Province, is the largest alluvial plain in Khuzestan Province. In addition, Susiana Plain has a close relationship with the large alluvial plains of southern Mesopotamia, where black-on-buff ceramics were also present as early as the seventh millennium BCE.[50] Delougaz and Kantor subdivided the Susiana chronology of the Neolithic and Chalcolithic as follows: Formative Susiana, Archaic Susiana 0-3, Early Susiana, Middle Susiana, Late Susiana/ Susa I/Susa A, Terminal Susiana, Susa II and Susa III.[51] Among these, Middle Susiana, Late Susiana/Susa I/Susa A were contemporaneous with the Bakun period in Fars Province. The representative contemporaneous sites are as follows: Susa, Choga Mish, Bendebal, Jowi, and Jaffarabad.[52] Some researchers argue that black-on-buff ceramics spread from the Khuzestan region to Fars.[53] The production of black-on-buff ceramics, especially at the stage of Susa I, has been studied in terms of painted decoration and geochemical composition.[54] Judith Berman suggests that the funeral pottery found at Susa Necropole had several provenances, meaning that these locally produced ceramics were imported to the necropolis.[55] A survey analysis conducted by Johnson and Wright suggests that there was a complex chiefdom in the Middle and Late Susiana period.[56] One of the interesting architectural features at Susa is the large foundation or platform, possibly used as a religious centre.[57] Evidence of administration has also been confirmed in Khuzestan in the form of stamp seals from the Susa A period. These pieces of evidence show clear differences in the social complexity of Susiana and Fars Province.

Around the Susiana Plain and Fars Province lie several smaller intermontane valleys, including the regions of Deh Luran, Ram Hormuz, Zuhreh, Behbahan and Bakhtiari. The Deh Luran Plain (940 km^2) is located approximately 60 km to the west of Susa; its geographic character is similar to Susiana as it is the piedmont of the Zagros Mountains.[58] The long chronological sequence of the Deh Luran Plain, ranging from the Neolithic to the Chalcolithic, was established following excavations of Ali Kosh, Chaga Sefid, Tepe Sabz, Farukhabad and Musiyan. Black-on-buff ceramics appeared in the Sabz phase, parallel to the Early Susiana period. The change in pottery in the Deh Luran Plain shows a trend similar to that of the Susiana Plain. It is also similar to that of the Ram Hormuz Plain (445-620 km^2), south of the Susiana Plain, where black-on-buff ceramics were clearly confirmed to date from Late Middle Susiana following the excavation of Tall-e Geser.[59] While Tepe Sohz (13 ha) is the largest site in the Behbahan Plain of the fifth millennium BCE, Tol-e Chega Sofla (20 ha) is the largest site in the Zuhreh Plain from the end of the fifth millennium BCE. This fact provides indirect evidence that these areas had more social complexity than Fars Province.[60]

Black-on-buff ceramics also extends beyond Fars Province toward the east. The excavation of Tepe Yahya in the Soghun Valley and Tal-i Iblis in the Baldsir Plain of Kerman Province, approximately 400 km to the east of the Kur River Basin, reveals the presence of black-on-buff ceramics in the later fifth millennium BCE. Benjamin Mutin suggests the possibility that Lapui red burnished ware appeared in Kerman earlier than in Fars. In Tepe Yahya, black-on-buff ceramics appeared together with Lapui red burnished ware during Period VC.[61] There are also sites with pottery similar to black-on-buff ceramics near the modern boundary between Iran and Pakistan, for example in Miri Qalat and Shahi-Tump of the Kech Valley, Kech-Makran.[62] One should bear in mind that the following chapters explore only a small part of Chalcolithic Iran and its diverse geographic, environmental and cultural characteristics.

1-2. Research questions

An overview of the broad background of the Bakun period and pottery within the archaeological framework of the Neolithic and the Chalcolithic periods in Fars province reveals problems concerning the Bakun period and its pottery production. Below, I present four research questions that concern pottery production during the 5th millennium in southwestern Iran:

Research Question No. 1: '*Chronological relations of the Bakun-period sites: Where in the chronological sequence of the Bakun period do Bakun period sites fall*?'

To what period can the main Bakun-period sites for this research (Tall-e Jari A, Tall-e Gap, and Tall-e Bakun A and B) be dated? As reviewed in Chapter 2, the chronology of the Bakun period is still debated. Why is there still a problem with the chronology? What exactly is the problem of the Bakun chronology? How did previous

[49] Johnson 1973; Wright and Johnson 1975.
[50] Le Breton 1957; Wright and Johnson 1975; Wright 1984; Dollfus 1978; Hole 1987; Delougaz and Kantor 1996.
[51] Alizadeh 1992, 2008; Delougaz and Kantor 1996.
[52] Pottier et al. 1912; Le Breton 1957; Dyson 1966; Dollfus 1971, 1975, 1978, 1983; Delougaz and Kantor 1996; Alizadeh 2008; Bridey 2011; Moghaddam 2012.
[53] Alizadeh 2006; Weeks et al. 2010; Petrie 2011; Mutin 2012.
[54] Pollock 1983; Hole 1984, 2010a; Berman 1987, 1994.
[55] Berman 1987.
[56] Wright and Johnson 1975.
[57] Hole 2010b.
[58] Hole et al. 1969; Hole 1977, 1987.
[59] Alizadeh et al. 2014.
[60] Dittmann 1984; Moghaddam 2018, 2020, Pollock and Moghaddam 2018; Ruschel 2020.
[61] Lamberg-Karlovsky and Beale 1986; Caldwell 1967; Mutin 2012: 166-169.
[62] Besenval 1994; Besenval et al. 2005.

researchers attempt to solve these problems? How can we establish a better chronology?

Research Question No. 2: '*When and how were black-on-buff ceramics adopted and developed in the Bakun period*?'

Black-on-buff ceramics initially appeared in the Bakun period at the Kur River Basin, Fars province, southwestern Iran. This pottery required knowledge of a new type of firing in a pottery kiln, different from the Late Neolithic plain vegetal-tempered coarse ceramics that previously existed in that region. It is argued that this technological innovation came from western regions, such as Mesopotamia and Khuzestan. When and how were black-on-buff ceramics adopted by villagers in the Kur River Basin? How were unpainted vegetal-tempered coarse ceramics replaced with black-on-buff painted ceramics? Next, in the process of this pottery permeating village life of the Kur River Basin, when and how were black-on-buff ceramics developed? In attempts to answer these questions, how have previous researchers discussed the adoption and development of black-on-buff ceramics? What are the problems with the previous approaches to this topic? What are better solutions for revealing the adoption and development process of black-on-buff ceramics?

Research Question No. 3: '*How were black-on-buff ceramics and other pottery produced?*'

There are two types of questions regarding pottery-making techniques: questions related to technique and those related to skill. On one hand, how many technical steps were there in pottery making? What kind of technical options were available? On the other hand, in what degrees of quality and dexterity were black-on-buff ceramics produced? Can we find mistakes or differences of skill among archaeological materials?

Research Question No. 4: '*How was pottery production organised during the Bakun period?*'

As I quickly reviewed in the former section, there are several views regarding the organisation of pottery production in the Bakun period, especially taking craft specialisation into consideration. Why did these previous researchers discuss the organisation of pottery production in terms of craft specialisation? How did they develop their arguments and establish the organisation of pottery production in the broader social organisation of the Bakun period? Where do problems lie in these studies, either in their evidence or their theoretical frameworks (or both)? What are better approaches to discussing the organisation of pottery production?

1-3. Framework

This research, which is intended to answer these main research questions, comprises four parts:

- Part I: introduction and raising research questions (this chapter)
- Part II: reviewing previous studies and presenting theoretical frameworks and methodology (Chapters 2-4)
- Part III: analyses (Chapters 5-7)
- Part IV: discussion and conclusion (Chapters 8 and 9)

Below, I briefly explain the contents of each chapter.

In Chapter 2, to make the four research questions I raised in this chapter (chronology, diachronic change of pottery, pottery-making technique, and organisation of pottery production) clearer, especially the extent of existing research, I will overview previous studies in chronological order and find their problems, which will be presented at the end of the chapter.

In Chapter 3, I will explain the theoretical framework of this research, focusing especially on the organisation of pottery production. In the first half of this chapter, I will review the history of the concept of craft specialisation to find the problems with this concept and the systemic perspective behind it. In the second half of this chapter, I will introduce an alternative approach for craft-production studies; a relational perspective referring to Lave and Wenger's community of practice, a concept of skill proposed by Ingold, Latour's actor-network-theory, and Hodder's entanglement theory.

In Chapter 4, methodology, I will present terminology and analytical methods of wares, vessel forms, painted decoration, pottery-making techniques, thin-section petrography, and geochemical analysis. Especially in pottery-making techniques, methods of approaching the explicit sequence of technical steps (what was done: technique) and those of approaching the degree of technical skills (how it was done: skill) will be explained. I will provide the foundation for analysis of this research in Chapters 2, 3, and 4 (Part II).

I will conduct analyses of pottery and sites from Chapters 5 to 10 (Part III). In Chapter 5, I will describe the stratigraphy, architectural remains, and radiocarbon dates found at Tall-e Jari A, Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A. I will tackle **Research Question No. 1** (chronology) and explain the approach to the reconstruction of stratigraphy from the collection curated by the University Museum at the University of Tokyo (UMUT). I will also mention architecture and mobile artefacts related to pottery production, such as pottery kilns, pottery kiln-related artefacts, and misfired ceramics.

In Chapter 6, the main research question is, '*When and how were black-on-buff ceramics adopted and developed in the Bakun period?*' (**Research Question No. 2**). Here, I will introduce the analysed ceramic materials curated by UMUT and University of Tsukuba. I will conduct quantitative analyses of wares, vessel forms, rim and base shapes, and vessel sizes and approach diachronic changes of these attributes through the comparison of ceramic assemblages in each level at each site and the inter-site comparison.

Then, to pursue other aspects of pottery changes, I will move on to the diachronic change of painted decoration. I will discuss horizontal design structures of painted decoration from published reports and unpublished drawings and classify several horizontal design-structure patterns, followed by a comparison of the inter-site horizontal design-structure patterns.

In Chapter 7, I will analyse pottery-making techniques. The main question in this chapter is 'How were black-on-buff ceramics and other pottery produced?' (**Research Question No. 3)**. I will begin with an observation of technical traces on the well-preserved materials from Tall-e Bakun A curated by the Oriental Institute of Chicago (OIC). Then, I will move on to the observation of potsherds from Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap curated in UMUT. In this chapter, I will separate pottery-making techniques into two sections: a sequence of technical steps and a degree of technical skill. As for the former portion (technique), I will analyse the chaîne opératoire of pottery making from clay acquisition to firing. Regarding the latter portion (skill), I will conduct skill-score analysis as a quantitative method and a qualitative observation of painting traces.

In the next section of Chapter 7, I will address the rest of the chaîne opératoire of pottery making, such as the technical steps of acquiring clay and tempering and preparing clay, using thin-section petrography. I will classify 60 thin-section samples from five sites, including Rahmatabad, into fabric types from a petrographic perspective. I will also conduct an inter-site comparison of these fabric types and explore the provenances of the clay and minerals.

Furthermore, I will conduct geochemical analyses using ICP-OES (inductivity coupled plasma optical emission spectrometer), XRD (X-ray diffraction), and powder XRD to supplement the petrographic analysis concerning provenance studies and to investigate firing temperatures of pottery. I will discuss geochemical compositions of pottery using hierarchical cluster analysis, principal component analysis, and linear discriminant analysis. As for XRD, I will compare the results with the previous study at Rahmatabad.

Finally, I will develop the discussion about organisation of pottery production in Part IV (Chapters 8 and 9). In Chapter 8, I will integrate the results from Chapters 5-7 using tanglegrams to reassemble and discuss communities of pottery making and village entanglement in each site. Next, I will discuss diachronic changes of communities of pottery making and village entanglement by comparing tanglegrams from Tall-e Jari A to Tall-e Bakun B, from Tall-e Bakun B to Tall-e Gap, and from Tall-e Gap to Tall-e Bakun A. The new interpretation will be compared to the systemic perspective representative of craft-specialisation studies. In the last conclusion chapter (Chapter 9), I will summarise each chapter by answering four main research questions and present relevance, limits, and future studies.

In the next chapter, I begin the process of problem-finding in the previous studies.

Part II: Reviewing previous studies and presenting theoretical frameworks and methodology

Chapter 2

Previous Studies

In Chapter 1, I raised four main research questions regarding the Bakun period, especially pottery making:

Research Question No. 1: '*Chronological relations of the Bakun-period sites: Where in the chronological sequence of the Bakun period do Bakun period sites fall?*'

Research Question No. 2: '*When and how were black-on-buff ceramics adopted and developed in the Bakun period?*'

Research Question No. 3: '*How were black-on-buff ceramics and other pottery produced?*' and

Research Question No. 4: '*How was pottery production was organised during the Bakun period?*'

For the purpose of clarifying these research questions regarding the pottery production during the Bakun period—that is, what was studied, and what was debated, and what was not studied yet—I will view the previous studies of chronology (Section 2-1); pottery, especially wares, vessel forms, and painted motifs (Section 2-2); pottery production (Section 2-3); and social aspects of the Fars province in the Bakun period (Section 2-4), with each section corresponding to four research questions. I will explain these previous studies in chronological order.

2-1. Previous studies of chronology

First, in this section, I will tackle **Research Question No. 1:** '*Chronological relations of the Bakun-period sites: Where in the chronological sequence of the Bakun period do Bakun period sites fall?*' I will review the excavation history and approaches to the chronological sequence of the excavated Bakun-period sites, subdividing the research history into three phases, (1) the 1920–1940s, (2) the 1950–1980s, and (3) the 1990–2010s. This subdivision of the chronological studies enables me to understand more clearly how the definition of the Bakun period appeared and how much effort archaeologists mobilized to set up the chronological framework of the Bakun period to explain the temporal dynamics of settlement pattern, social organisation, and pottery. At the beginning of the previous studies, the chronology was an end unto itself.[1]

The discovery of the Bakun period site: the 1920s-1940s

Ernst Herzfeld

The 1920–40s was the discovery of the Bakun-period culture and the first scientific excavation. Ernst Herzfeld was the first excavator of Tall-e Bakun A, and he originally worked on the excavation of Persepolis, which was his major interest.[2] He discovered the site that we now call Tall-e Bakun A in 1923. With the goal of clarifying the origin of the Elamite civilization, he started the excavation of Tall-e Bakun A in 1928. At that time, he did not use the word 'Bakun' but instead he used the word 'Persepolis'. He explained that the site had no name because of a legal contest concerning the ownership, and thus the Persepolis expedition created the new name '*Tol e Bakun*'.[3] He claimed that the culture of Tall-e Bakun A was still Neolithic, although Erich Schmidt claimed that the site belonged to the Copper Age based on the presence of copper tools.[4]

Alexander Langsdorff and Donald E. McCown

With the support of the Oriental Institute of the University of Chicago and Herzfeld, Alexander Langsdorff started the excavation of the northern part of Tall-e Bakun A in 1932.[5] Then, in 1937, Donald E. McCown, field assistant and subsequently assistant field director of the Persepolis expedition, excavated the southern central part of Tall-e Bakun A.[6] Langsdorff subdivided the stratigraphy of Tall-e Bakun A into four building levels, I to IV, and a fifth, V, containing red plain pottery.[7] McCown carried out the first detailed chronological approach in his book '*The Comparative stratigraphy of Early Iran*'.[8] In this book, he briefly reported the excavation of the central part of Tall-e Bakun B during the 1932 season. He confirmed two strata in Tall-e Bakun B, namely Bakun BI of McCown stratigraphy with crude unpainted pottery and Bakun

[1] McCown 1942.

[2] Herzfeld 1929, 1932, 1941; Cool Root 2005.

[3] Herzfeld 1941: note 8. He explained that 'At a legal contest concerning the ownership, it was ascertained that the mound had no name. Tol e Bakun, the name recently given it by the Persepolis expedition, must be a newly created one (Herzfeld 1941: note 8).'

[4] Schmidt 1939.

[5] Langsdorff and McCown 1942: 1; Schmidt 1939: 17, note 3.

[6] Schmidt 1939: xi.

[7] Although Langsdorff assigned a wall fragment to 'Level V', McCown considered it Level IV (Langsdorff and McCown 1942: 32). 'Level V' with red plain pottery was not confirmed at Tall-e Bakun A and I do not use the term in this book.

[8] McCown 1942.

BII of McCown stratigraphy with painted pottery. The excavated material was lost before the publication of detailed descriptions because of a German submarine's attack on the ship transporting the materials.[9]

With the intention of placing Tall-e Bakun A and B chronologically, McCown referred to the excavated materials from Mesopotamia and Iranian sites, such as Cheshme Ali, Tepe Sialk, Tepe Giyan, Tepe Hissar in the highlands, and Susa in the lowlands. He considered that the Bakun BII phase, which was thought to be in part contemporaneous with the Samarra culture, the Halaf culture, and Cheshme Ali, was earlier than Tall-e Bakun A. With his chronological criteria based on painted decoration and the presence of seals, copper, and red ware, he concluded that the excavated ceramics from Tall-e Bakun A Levels I–IV were in parallel to Cheshme Ali IB, Tepe Sialk III1–5, Tepe Giyan VC, and Tepe Hissar IB. He thought Tepe Sialk III6–7 and Hissar IC corresponded to Tall-e Bakun A Level V. He regarded Tall-e Bakun A Levels IV–V and Susa I as contemporaneous. He also noticed that the archaeological sequence at Tall-e Bakun A and B is broken, with a chronological gap between the latest level at Tall-e Bakun B, Level BII, and the earliest level at Tall-e Bakun A, Level AI.[10] He presented his chronological view in the 1954 symposium '*The Integration of Relative Chronologies in Old World Archaeology*'.[11] Although he compared new archaeological evidence from Jaffarabad, Jowi, and Bendebal in the Susiana Plain, the general framework of the Bakun chronology remained the same as before.

McCown also presented a cultural–historical interpretation that buff ware culture derived from the Fars province and then spread towards western and northern Iran, possibly due to the movement of the buff ware people pushed by the red ware (Bakun AV) people. He further considered that the change of buff ware culture of Tall-e Bakun A and B implied no important external influence, mentioning that

> 'With our present knowledge the sequence of Bakun B and A suggests simple development without significant external influence.'[12]

Behind this argument lies the simplistic, cultural–historical interpretation that regards pots as peoples.[13]

Sir Aurel Stein

Besides the scientific excavation of Tall-e Bakun A, in 1932-34, Sir Aurel Stein conducted an archaeological survey at Sarvistan, Fasa, and Darab in Fars province and did trial excavation in some sites such as Tall-e Regi, Vakilabad, Kanakan, Do Tulan, Deh-bid, and Tol-e Pir.[14]

Approaches to the relative chronology of the Bakun period: the 1950-80s

In the next research phase of the 1950–1980s, with the increase of the number of excavations of Bakun-period sites, there appeared various chronological approaches to compare the sites inside Fars province at a smaller scale and outside Fars in Iran at a broader perspective. These efforts became the basis of setting the chronological framework with a tripartite subdivision for studying temporal change within the Bakun period.

Louis Vanden Berghe

In the 1950s, Louis Vanden Berghe carried out soundings in several sites near Marv Dasht, such as Tall-e Jari A, Tall-e Jari B, Tall-e Mushki, and Tall-e Gap, to establish the chronology of prehistoric sites in Marv Dasht.[15] As a result, he defined the Mushki and Jari periods for the first time, both preceding the Bakun period. He also claimed that the ceramics from Tall-e Bakun B Level BII, Tall-e Bakun A, and Tall-e Gap were similar to each other, and then he integrated and defined them as Chalcolithic, or '*Talli Bakun Cultuur*'.[16]

Namio Egami, Toshihiko Sono, and Seiichi Masuda

Soon after Vanden Berghe, Namio Egami of the University of Tokyo Iraq–Iran Expedition excavated several sites. He did soundings at Tall-e Gap, Tall-e Jari A, Tall-e Jari B, and Tall-e Mushki. The main goal of the Japanese expedition was to explore the origin of the civilization and its development in an incipient stage, and they chose the archaeological sites that Vanden Berghe had explored to clarify in detail the chronological relationship among those sites.[17] When the Japanese expedition did soundings at Tall-e Bakun A and B in 1956 during their short visit to Persepolis, they numbered the building levels with a different system than McCown's.[18] The excavation supervisor, Seiichi Masuda, evaluated the chronological position of these sites by comparing the ceramic materials from Tall-e Bakun A and B with Tepe Sialk. He thought that Tall-e Bakun B Level BI of McCown's stratigraphy was contemporaneous with, or earlier than, Tepe Sialk I,

[9] Alizadeh 2006: 39-40.
[10] McCown 1942: 33.
[11] McCown 1954.
[12] McCown 1942: 33.
[13] Kramer 1977.
[14] Stein 1936, 1937 on Vakilabad cf. Kerner 1993.
[15] Vanden Berghe 1952, 1954.
[16] Vanden Berghe 1952: 214; 1954: 401.
[17] Egami and Sono 1962: 3.
[18] Egami and Masuda 1962. In this book below I usually use McCown's stratigraphy and if necessary I describe 'Tall-e Bakun BII of Japanese stratigraphy'.

while Tall-e Bakun B Level BII of McCown's stratigraphy was regarded as Tepe Sialk III.[19] Tepe Sialk II was considered earlier than Tall-e Bakun B Level BII based on the absence of large jars.

Toshihiko Sono, the excavation supervisor of Tall-e Gap in 1959, approached the chronological position of Tall-e Gap by comparing the ceramic materials from Tall-e Bakun A and other sites in Iran.[20] Sono subdivided the stratigraphy of Tall-e Gap (20 levels) into two large periods (I and II) and further divided the periods into five shorter phases (Ia, Ib, IIa, IIb, and IIc) based on the results of a motif analysis.[21] He concluded that the upper levels of Tall-e Gap (phases IIb and IIc) were contemporaneous with Tall-e Bakun A Levels I–II of McCown's stratigraphy. He thought that motif type I (painted decoration in the entire part of the exterior surface) was a good chronological marker of ceramics from Tall-e Bakun A. He did not compare the materials with ceramics from Tall-e Bakun B. [22]

In the excavation of Tall-e Jari A in 1959, Masuda and Egami found three cultural levels contemporaneous with Sialk I (Level III), Hassuna Ia (Level II), and Tall-e Gap and Tall-e Bakun A.[23] When the preliminary result was briefly reported in 1967, the excavation supervisor originally subdivided the stratigraphy into seven levels.[24]

Other fieldworks in the 1950-80s

Beyond the sites investigated by Vanden Berghe, other sites were also excavated in other regions of Fars province. In 1951, Ali Sami excavated Tall-e Nokhodi and Tall-e Khari in the Pasargadae Plain, north of the Kur River Basin.[25] Claire Goff excavated Tall-e Nokhodi in 1961 and 1962, recognised the layers as contemporaneous with Tall-e Bakun A Levels I–V, and identified these layers as a Chalcolithic site.[26] Archaeological research of Chalcolithic sites with black-on-buff ceramics was carried out in the northeast Bakhtiyari Mountains[27], the Fasa and Darab regions[28], and the Behbehan-Zuhreh region.[29]

Table 2.1 Chronological framework of the Bakun period proposed by Dyson 1965

<table>
<tr><th colspan="3">sites</th><th>phase</th></tr>
<tr><td>Bakun A IV</td><td rowspan="5"></td><td rowspan="2">Gap II b, c</td><td rowspan="2">(Gap II b (Bakun AIII) phase)</td></tr>
<tr><td>Bakun A III</td></tr>
<tr><td>Bakun A II</td><td rowspan="2">Gap II a</td><td></td></tr>
<tr><td>Bakun A I</td><td></td></tr>
<tr><td></td><td>Gap I</td><td>(Gap Ia phase)</td></tr>
<tr><td></td><td>Bakun B II</td><td></td><td>(Bakun B II phase)</td></tr>
<tr><td></td><td>Bakun B I</td><td></td><td></td></tr>
</table>

Robert H. Dyson Jr.

Although Robert H. Dyson Jr. never excavated any Bakun period sites in Fars province, he approached the comparative chronology of the Kur River Basin in 1965 using the excavation results of Tall-e Gap and Tall-e Bakun A and B (Table 2.1).[30] Unlike McCown, Dyson adopted the hypothesis that the Bakun pottery belonged to an Ubaid-related horizon that originated in the south-western lowland plains of Khuzestan at Jaffarabad and spread out to the north (Luristan, Kermanshah), the north-west of Iran (the Pisdeli culture), the east (central plateau), and the southeast to Fars province at Tall-e Gap Period I.[31] According to Dyson, the Ubaid-related cultures still existed in other regions, even after the end of the Susa A culture by the intrusion of the Uruk culture in the Susiana Plain.[32] When he described the chronology of buff ware in Fars province, he set up three phases: '*Bakun BII—Giyan VB*', '*Gap Ia—Bakun BII-AI*', and '*Gap IIb1—Bakun AIII-Susa A*'. He insisted that Tall-e Gap Period Ia would fill the hiatus between Bakun BII and AI. This is the oldest reference of the tripartite subdivision of the Bakun period, which inspired Voigt and Dyson later to formulate the concept of '*the Early, Middle, and Late Bakun phases*'.[33]

William M. Sumner

William M. Sumner set up the chronology of the Neolithic and Chalcolithic periods in Marv Dasht as Mushki, Jari, Bakun BI of McCown stratigraphy (Sumner's phase II), Bakun (Sumner's phase III), and Lapui (Sumner's phase IVA) for his dissertation concerning survey studies in

[19] Egami and Masuda 1962: 9.
[20] Egami and Sono 1962.
[21] Egami and Sono 1962: 2.
[22] Strangely, neither Sono nor Masuda mention each other's works even when they had a lot of time to discuss and compare the results in Iran and Japan.
[23] Egami et al. 1977.
[24] Egami 1967.
[25] Sami 1956: 24-25.
[26] Goff 1963, 1964.
[27] Zagarell 1982.
[28] Miroschedji 1973.
[29] Nissen 1976; Dittmann 1984.
[30] Dyson 1965.
[31] Dyson 1965: 218-219.
[32] Dyson: 1965: 219.
[33] Voigt and Dyson 1992: 137.

1972.[34] He mentioned that the Bakun phase could be divided into two or more subphases, though he did not carry out the subdivision of the Bakun phase for his analysis of the survey.[35]

Reinhard Dittmann

The Revolution of 1979 and the subsequent elimination of the old regime caused stagnation of archaeological research by Iranian archaeologists, as well as foreign expeditions.[36] As a result, the fieldwork of the Chalcolithic period sites in Fars slowed down. Nevertheless, the political event provided opportunities for archaeologists to analyse and consider the excavation and survey data gathered in the 1960s and 1970s.[37] Reinhard Dittmann was one of the archaeologists who analysed the data, and in the 1980s, he arranged the chronologies of Khuzestan and Fars with detailed comparison of ceramics excavated from each site in his dissertation (Table 2.2).[38] His conclusion was that Tall-e Gap Period I, as proposed by Sono, was contemporaneous with Tall-e Bakun B Level BII of McCown's stratigraphy, but he doubted that Tall-e Bakun A Levels I–II were more or less contemporaneous with Tall-e Gap Period IIc proposed by Sono. His classification was based on the results from the Susiana Plain, and he subdivided the buff ware phase into five phases (Dittmann's Bakun B IIa, Bakun B IIb, Gap II, Bakun Aa, and Bakun Ab).

Table 2.2 Chronological framework of the Bakun period proposed by Dittmann 1986

<table>
<tr><th colspan="3">sites</th><th>phase</th></tr>
<tr><td>Bakun A IV</td><td rowspan="5"></td><td rowspan="2"></td><td rowspan="2">Bakun Ab phase</td></tr>
<tr><td>Bakun A III</td></tr>
<tr><td>Bakun A I-II</td><td>Gap II c?</td><td>Bakun Aa phase</td></tr>
<tr><td rowspan="5"></td><td>Gap II b</td><td rowspan="2">Gap II phase</td></tr>
<tr><td>Gap II a</td></tr>
<tr><td>Bakun B II b</td><td>Gap I b</td><td>Bakun B II b phase</td></tr>
<tr><td>Bakun B II a</td><td>Gap I a?</td><td>Bakun B II a phase?</td></tr>
<tr><td>Bakun B I</td><td></td><td>Bakun B I phase</td></tr>
</table>

Tripartite subdivision and the problem of the Bakun chronology: the 1990-2010s

With the increasing interest in the socioeconomic complexity[39] and the ceramic production of the Bakun period, a clear chronological subdivision of the Bakun period came to be required for more detailed archaeological interpretations. As explained in detail below, Mary Voigt and Dyson attempted to subdivide the Bakun period. Some archaeologists proceeded to consider the diachronic change of the social organisation with their subdivision.

Tripartite subdivision by Mary M. Voigt

In 1992, Mary M. Voigt and Robert. H. Dyson Jr. published a massive work, a comparative chronology of all of Iran including the Bakun period of Fars province (Table 2.3).[40] Their work also presented a list of the radiocarbon dates from the published data for the discussion of the Bakun chronology, although Frank Hole had presented the same list in 1987 (Table 2.4).[41] Voigt and Dyson proposed a tripartite subdivision of the Bakun period, namely the Early Bakun, the Middle Bakun, and the Late Bakun phases. Although this tripartite subdivision was based on Dyson's 1965 subdivision system, they modified it. It is different from the previous subdivision in that they defined the Early Bakun phase as broadly contemporaneous with Tall-e Bakun BII of McCown's stratigraphy, Tall-e Jari A Level I of Masuda's stratigraphy, and Tall-e Gap Periods Ia–b proposed by Sono.

Table 2.3 Chronological framework of the Bakun period proposed by Voigt and Dyson 1992

<table>
<tr><th colspan="3">sites</th><th>phase</th></tr>
<tr><td>Bakun A IV</td><td rowspan="4"></td><td rowspan="2">Gap II b, c?</td><td rowspan="2">Late Bakun phase</td></tr>
<tr><td>Bakun A III</td></tr>
<tr><td>Bakun A II</td><td rowspan="2">Gap II a</td><td rowspan="2">Middle Bakun phase</td></tr>
<tr><td>Bakun A I</td></tr>
<tr><td rowspan="2"></td><td>Bakun B II</td><td>Gap I</td><td>Early Bakun phase</td></tr>
<tr><td>Bakun B I</td><td></td><td>Shamsabad phase</td></tr>
</table>

[34] Sumner 1972.
[35] Sumner 1972.
[36] Abdi 2001: 69-72.
[37] Hole 1987.
[38] Dittmann 1986.

[39] Alizadeh 1988.
[40] Voigt and Dyson 1992: 137-140.
[41] Voigt and Dyson 1992: 131 in Volume II, Hole 1987: 60.

Table 2.4 Published radiocarbon samples of the Bakun-period sites

Site	Level	Context	Type of sample	sample No.	uncalibrated date (BP)	Reference	calibrated date (2σ) (calBCE)
Jari A	Shamsabad	Stratigraphic trench, 0.2 m above virgin soil	bone	AA63492	6280±69	Alizadeh 2006	5465-5443 (1.7%) 5423-5408 (1.0%) 5382-5052 (92.7%)
Jari A	Shamsabad	Sounding, Feature 13, oven	charred seeds	Beta-207564	6170±40	Alizadeh 2006	5221-5000
Jari A	Shamsabad	Sounding, Feature 9, oven	charred seeds	Beta-210982	6010±40	Alizadeh 2006	5000-4796
Bakun B	Shamsabad, Ash point	Japanese trench		P-931	6264±70	Radiocarbon 8:350	5461-5451 (0.5%) 5377-5029 (94.9%)
Bakun B	Shamsabad	Stratigraphic trench, 1.40 m above virgin soil	charred seeds	AA63489	6234±72	Alizadeh 2006	5353-5001
Bakun B	Early Bakun	Stratigraphic trench, 1.90 m above virgin soil	charred seeds	Beta-210985	6160±40	Alizadeh 2006	5217-5000
Bakun B	3m below surface	Japanese trench	charcoal	P-438	5990±81	Radiocarbon 5:90	5205-4690
Rahmatabad	Middle Bakun	Trench H, 8032	charcoal	Beta-310997	5840±40	Azizi Kharanagi 2014	4798-4580
Rahmatabad	Middle Bakun	Trench G, 7020	charcoal	Tka-15309	5965±40	Azizi Kharanagi et al. 2014	4946-4729
Rahmatabad	Middle Bakun	Trench G, 7026, ash layer	charcoal		5910±40	Azizi Kharanagi et al. 2014	4897-4866 (4.7%) 4852-4705 (90.7%)
Nurabad	A19 (Late Neolithic)	Trench A, above floor (113)	charcoal	OZI129	5910±50	Weeks et al. 2010	4932-4919 (1.3%) 4913-4688 (94.1%)
Nurabad	A19 (Late Neolithic)	Trench A, hearth (117)	charcoal	WK13994	5850±49	Weeks et al. 2010	4835-4581 (94.8%) 4566-4559 (0.6%)
Nurabad	A16 (Middle Bakun)	Trench A, hearth (103)	charcoal	WK13996	5785±51	Weeks et al. 2010	4769-4753 (1.7%) 4745-4502 (93.7%)
Gap	17	Trench GAT-1	charcoal	GAK-197	5870±160	Egami and Sono 1962, Radiocarbon 5: 115	5207-5149 (2.3%) 5137-5128 (0.3%) 5121-5095 (0.9%) 5081-4442 (89.8%) 4424-4372 (2.1%)
Gap	6	Trench GAI-5	charcoal	GAK-198	5440±120	Egami and Sono 1962, Radiocarbon 5: 115	4502-3988
Bakun A	3	Sq. BB27, Trash Heap near oven	charred seeds	Beta-207562	5560±40	Alizadeh 2006	4462-4338
Bakun A	4	Sq. BB27, Trash Deposit	charred seeds	Beta-210983	5570±40	Alizadeh 2006	4486-4476
Bakun A	III	Sq. BB27, Trash Heap near oven/Kiln	bone	AA63491	5612±63	Alizadeh 2006	4582-4339
Nokhodi	4c	Trench B	charcoal	BM-171	5050±150	Radiocarbon 10:3-4	4238-3627 (92.6%) 3594-3527 (2.8%)

Tripartite subdivision by Susanne Kerner

Soon after their work, Susanne Kerner re-evaluated the ceramic materials excavated from Vakilabad, Fasa, where Stein conducted soundings. She also presented the tripartite terminology '*Früh-Bakun, Mittel-Bakun, Spät-Bakun*'.[42] She followed Dittmann's results for the chronological consideration and adopted just the tripartite terminology from Voigt and Dyson's paper.

[42] Kerner 1993: Fig. 63, 77, 78.

Tripartite subdivision by William Sumner

In 1994, Sumner also adopted the tripartite subdivision system and divided his past survey results of the Bakun period into '*the Early, Middle, and Late Bakun Stages*'.[43] However, his criteria of judging the Early Bakun phase, the Middle Bakun phase, and the Late Bakun phase were very rough. He defined the Early Bakun stage sites as the sites with a presence of the precursor Shamsabad pottery and the Bakun pottery on their surfaces. The sites with Bakun pottery and the successor the Lapui pottery were defined as belonging to the Late Bakun stage. Furthermore, he regarded the Middle Bakun stage sites either as sites where only the Bakun pottery could be found or as sites where all the Shamsabad, the Bakun, and the Lapui ceramics were found.

New fieldwork since the 2000s

Since the 2000s, new excavation projects of the Bakun period sites started in Fars province, such as, Tol-e Bashi in the Kur River Basin[44], Rahmatabad in the Kamin Plain,[45] sites in the plain of Darreyeh Bolaghi,[46] Tol-e Nurabad and Tol-e Spid in the Mamasani Plain,[47] and Tappe Mehr Ali in the Eghlid district.[48] These projects initiated new discussions of the Bakun chronology because of the rapid increase of radiocarbon samples as clues for absolute dating (Table 2.4).

Abbas Alizadeh and his chronology

Since 1988, Abbas Alizadeh has been eager to demonstrate the presence of nomadic people as elites in the fifth millennium of Fars province.[49] For that reason, he conducted an archaeological survey of northwestern Fars in 1995. Furthermore, in 2004, he carried out re-excavations at five sites—Tall-e Bakun A, Tall-e Bakun B, Tall-e Jari A, Tall-e Jari B, and Tall-e Mushki—to collect radiocarbon samples, which contributed to a better sense of the absolute chronology of the Bakun period and its preceding phases.[50] I will review his arguments in more detail in Section 2-4.

In 2006, Alizadeh published a reconsideration of the past excavation at Tall-e Bakun A and B conducted by the Oriental Institute of the University of Chicago with a discussion of mobile pastoralism. In that book, Alizadeh argued that ceramic assemblages of Tall-e Bakun A and B and Tall-e Gap were distinct from each other. Apart from Voigt and Dyson, he created a new chronological terminology: 'Middle Fars 1 phase, Middle Fars 2 phase, and Late Fars phase' (Table 2.5). His system of designating prehistoric Fars originated from the system in the Susiana Plain developed by the Choga Mish project, in which he also was involved in editing the excavation reports.[51] He regarded his system as neutral, simple, and inclusive saying,

Table 2.5 Chronological framework of the Bakun period proposed by Alizadeh 2006

Sites			phase
Bakun A			Late Fars phase
		Gap	Middle Fars 2 phase
	Bakun B II		Middle Fars 1 phase
	Bakun B I		Early Fars phase

> 'This type of terminology is neutral, simple, and inclusive; more importantly, it also avoids site names as identification of cultural phases and thus reduces further confusion in an array of Iranian chronological charts already filled with esoteric site names. In addition, this terminology can be easily amended to include discoveries of unknown cultural phases without introducing new names.'[52]

However, Alizadeh's relative chronological order of sites and their levels was the same as that of Voigt and Dyson. He just changed the labels of the Bakun phases, and currently, his followers are limited.[53]

Alizadeh also criticised what Voigt and Dyson called 'the Middle Bakun period', which regards Tall-e Bakun A Levels I–II and Tall-e Gap Period IIa proposed by Sono as contemporaneous on the grounds that the classical Bakun A shapes and the elaborate painted motifs are absent in Tall-e Gap.[54] In addition, he criticised Sono's subdivision of the Tall-e Gap sequence not only because the description of the stratigraphy of the building levels was very brief but also because the motif types, which Sono regarded as the main criteria for a subdivision of the Gap sequence, were problematic due to the calculating method of grouping together the ceramic materials found in all trenches of each level.[55] Based on the radiocarbon data collected from the soundings in 2004 (Table 2.4), Alizadeh stated that Middle Fars 1/

43 Sumner 1994: 49.
44 Pollock et al. (eds.) 2010.
45 Bernbeck et al. 2005, Azizi Kharanaghi et al. 2014a,b.
46 Helwing and Seyedin 2010.
47 Potts and Roustaei (eds.) 2006.
48 Hojabri Nobari et al. 2011.
49 Alizadeh 1988.
50 Alizadeh 2004; Alizadeh 2006: Tables 9-11.

51 Delougaz and Kantor 1996.
52 Alizadeh 2006: 7.
53 Helwing and Seyedin 2010.
54 Alizadeh 2006: 46-47.
55 Alizadeh 2006: 46-47.

Bakun BII ranges from ca. 5200 to 4800 BCE, Middle Fars 2/Gap from ca. 4800 to 4500 BCE, and Late Fars/Bakun A ranges from ca. 4500 to 4100 BCE. He thought that there was no overlap between the duration of Tall-e Gap and that of Tall-e Bakun A.

Daniel Potts, Lloyd Weeks, and Cameron A. Petrie and their chronology

At the same time, the excavation projects under Daniel Potts started in the Mamasani plain, west of the Kur River Basin (Table 2.6).[56] He provisionally defined Tall-e Bakun B Level BII and Tall-e Jari A Level I as the Early Bakun, Tall-e Gap and Tall-e Bakun A Levels I-II as the Middle Bakun, and finally Bakun A Levels III-IV as the Late Bakun, although they recognised the chronological lack of clarity and its disputed status.[57] They collected several radiocarbon samples of the Bakun period, which also contributed to the discussion of the absolute chronology.

Lloyd Weeks, Cameron Petrie, and Daniel Potts took into consideration the absolute date of the adoption of black-on-buff ware in the Mamasani plain and the adoption mechanism of black-on-buff ceramics.[58] Using radiocarbon dates obtained from the excavation at Tol-e Nurabad, they concluded that the adoption of black-on-buff ceramics occurred at the beginning of the fifth millennium B.C. in southwestern Iran, saying,

> 'One possible conclusion to be drawn from the new chronological evidence is that the origins of the black-on-buff Bakun ceramic tradition lie in the lowlands, whence some degree of stylistic and technological influence spread to the highlands of Fars in the early fifth millennium B.C.'[59]

In addition, they mentioned the continuity from the Neolithic to the Bakun period in terms of settlement pattern, architecture, subsistence practices, and pottery.[60] Unlike McCown or Alizadeh's arguments that the appearance of the black-on-buff ceramics was a result of the migration of other peoples or specialised potters, they rather interpreted that the appearance of the black-on-buff ceramics was caused by the contact with black-on-buff ceramic-using communities in regions neighbouring Fars province.

Reinhard Bernbeck and his chronology

Reinhard Bernbeck and his colleague presented the chronological framework of the Bakun period in the excavation report of Tol-e Bashi, also mentioning the current problem of the chronological subdivision (Table 2.7).[61] Following mainly Dittmann, they separated the chronological positions of Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A clearly on the grounds that there were rare frequencies of abstract bird motifs and diagonal wavy line motifs inside bowls from Tall-e Bakun B and Tall-e Jari A. Bernbeck and his colleague assigned Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A to Early, Middle, and Late Bakun, respectively. They also classified Tall-e Gap and Bakun A into two phases (Middle Bakun 1 and 2 to Tall-e Gap Periods Ia–b and IIa–c proposed by Sono, Late Bakun 1 and 2 to Tall-e Bakun A Levels I–II and III–IV). They also raised three problems of the chronology of the Bakun period:

Table 2.6 Chronological framework of the Bakun period proposed by Potts and Roustaei 2006

<table>
<tr><th colspan="3">sites</th><th>phase</th></tr>
<tr><td>Bakun A IV</td><td rowspan="6"></td><td rowspan="2"></td><td rowspan="2">Late Bakun phase</td></tr>
<tr><td>Bakun A III</td></tr>
<tr><td>Bakun A II</td><td rowspan="2">Gap II b, c?</td><td rowspan="4">Middle Bakun phase</td></tr>
<tr><td>Bakun A I</td></tr>
<tr><td rowspan="4"></td><td>Gap II a</td></tr>
<tr><td>Gap I</td></tr>
<tr><td>Bakun B II</td><td rowspan="2"></td><td>Early Bakun phase</td></tr>
<tr><td>Bakun B I</td><td>Shamsabad phase</td></tr>
</table>

Table 2.7 Chronological framework of the Bakun period proposed by Bernbeck et al. 2010

<table>
<tr><th colspan="3">sites</th><th>phase</th></tr>
<tr><td>Bakun A IV</td><td rowspan="6"></td><td rowspan="4"></td><td rowspan="2">Late Bakun 2 phase</td></tr>
<tr><td>Bakun A III</td></tr>
<tr><td>Bakun A II</td><td rowspan="2">Late Bakun 1 phase</td></tr>
<tr><td>Bakun A I</td></tr>
<tr><td rowspan="4"></td><td>Gap II</td><td>Middle Bakun 2 phase</td></tr>
<tr><td>Gap I</td><td>Middle Bakun 1 phase</td></tr>
<tr><td>Bakun B II</td><td></td><td>Early Bakun phase</td></tr>
<tr><td>Bakun B I</td><td></td><td>Shamsabad phase</td></tr>
</table>

56 Potts and Roustaei (eds.) 2006.
57 Potts and Roustaei (eds.) 2006: 8.
58 Weeks et al. 2010.
59 Weeks et al. 2010: 263.
60 Weeks et al. 2010: 263-264.
61 Bernbeck et al. 2010.

1) the unbalanced amount of information in the publication records,
2) few radiocarbon dates, and
3) a possible functional difference between sites.[62]

Summary: problems of the Bakun chronology

In this section, I overviewed the excavation history of the Bakun-period sites and many proposals for the chronological frameworks of the Bakun period. There are two problems in the chronology of the Bakun period, other than those Bernbeck pointed out. First, archaeologists currently favour a tripartite subdivision system, especially since the 1990s. However, the boundaries between these three subphases are ambiguous and still debated. This situation is evident from Tables 2.1–3, 5–7, where chronological relationships between Tall-e Bakun A, Tall-e Bakun B, and Tall-e Gap, whether chronologically contemporaneous or not, varied depending on researchers. It is likely that specific issues created this ambiguity of boundaries between each phase of the Bakun period. Each phase was assigned to one type-site (Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A). As mentioned above, the tripartite subdivision is based not on a single site but on three separate sites. This implies that the transition of one phase to another, which helps us identify the nature of transitional cultural changes, has not been clarified by means of stratigraphic evidence. Petrie also pointed out the lack of evidence for transitions between cultural periods in Fars.[63]

The second problem lies in the archaeological attributes used for establishing the chronology. Previously, painted motifs and design structures on black-on-buff ceramics have been used primarily by archaeologists as chronological markers for the Bakun period. Painted motifs, however, add confusion when we tackle the problem of the Bakun period chronology because so many patterns of painted motifs exist, but the diagnostic motifs showing diachronic changes are still unclear. Besides, the classification system of the painted motifs varied depending on researchers, as reviewed in Section 2-2.

2-2. Previous studies of pottery

The second research question in this research is '*When and how were black-on-buff ceramics adopted and developed in the Bakun period?*' This section, in which I review previous studies of pottery during the Bakun period, will contribute to finding diachronic changes of previous researchers' understandings and interests in the Bakun pottery concerning wares, vessel forms, and painted motifs. I set up three research phases of the Bakun period pottery studies: (1) the 1920–1940s, (2) the 1950–1980s, and (3) the 1990–2010s.

[62] Bernbeck et al. 2010: 153.
[63] Petrie 2011: 158.

General description and motif analysis: the 1930 -1940s

Pottery studies by Ernst Herzfeld

Ernst Herzfeld published a report that contributed to the description of the ceramic materials excavated from Tall-e Bakun A in 1932.[64] He described general characteristics of finds, including production techniques, the presence of painted motifs, and the thickness of ceramic vessels.[65] He classified vessel forms into 17 types and shapes based on complete vessels or well-preserved potsherds (Klasse Aa–M).[66] He also subdivided the painted motifs into 22 types (A–N), and then categorised all of the published materials, which were photographed or drawn into these types with the information of similarly painted motifs discovered from other sites.[67]

In his book '*Iran in the Ancient East*' from his lecture in 1936, Herzfeld discussed the prehistoric painted motifs of ceramic materials from Tall-e Bakun A. With ethnographic analogies of decorations that the tribes all over the world depicted, he evaluated the painting as follows;

> 'Painted pottery produced at home is the main field of artistic activity. The decoration is entirely juvenile, sometimes infantile. In most cases conventions have not yet been established. The degree of abstraction in rendering the subjects varies widely, although the whole material is strictly contemporary. Animal designs have a tendency towards realism; pseudo-geometric configurations are often interpreted as animals by the addition of animal parts. On the other hand, there is a wealth of purely abstract symbols, which are mutable and may go over into each other. Everything may be represented totally or partly, a principle that suggests magic notions behind the abstract designs. The entire symbolism of the paintings is highly expressive, evidently meant to convey thoughts. Therefore, in essence, it is connected with later writing, of which it represents a stage more primitive than pictographic signs.'[68]

Behind Herzfeld's texts, there was an evolutionary paradigm which misunderstood that humanity is growing up through time and that the diachronic change from painted decoration to pictographic signs reflected the growth of humanity.

[64] Herzfeld 1932.
[65] Herzfeld 1932: 5-6.
[66] Herzfeld 1932: 6-7.
[67] Herzfeld 1932: 8-11.
[68] Herzfeld 1941: 62.

Pottery studies by Donald E. McCown

The history of detailed descriptions of the Bakun pottery dates back to McCown. In the excavation report of Tall-e Bakun A, he described and classified the vessel form, painted decoration, relationship between vessel form and decoration, and the diachronic change of frequencies of decoration types.[69] He recognised fine ware and thick red-surfaced ceramics with small grits, or cooking pots. He classified the vessel forms of black-on-buff ceramics into more than 16 vessel forms.[70] The well-preserved complete vessel forms of black-on-buff ceramics from Tall-e Bakun A enabled him to propose this detailed subdivision. He also classified the painted designs into more than 20 groups.[71] His classification was based mainly on the structure of the designs. He also paid attention to the relationship between vessel form and decorative structure.[72]

McCown's interest in the painted design was so enthusiastic that he also studied the artistic qualities of the ceramic producers at Tall-e Bakun A.[73] He considered that, because of the geometrical shape of the decorated pottery, the painters had to solve the problem of painting designs on the vessels, which have surfaces difficult to paint precisely, and that the painters came up with various solutions by using limiting bands, repetition of motifs, centrifugal and radial painting, and keeping symmetries, with the mention of the importance of rhythm.

In addition, McCown attempted to interpret diachronic changes of pottery during the occupation period of Tall-e Bakun A.[74] He mentioned the slight changes, such as the new motifs and the established designs in the later phases. When McCown compared the paintings of Tall-e Bakun A with those of Tall-e Bakun B Level BII, he noticed the diachronic change of the painted animal style, that is,

> 'One of the more marked changes is in the animal style, where the less flowing forms of Bakun BII are replaced by a type with sweeping line in Bakun A.' [75]

[69] Langsdorff and McCown 1942.
[70] Deep bowls, broad bowls, small bowls, hemispherical bowls, conical bowls, campaniform bowls, inverted rim bowls, squat pots, globular and ovoid pots, jars, beakers, cups, miniature cones and saucers, cooking vessels, and varia.
[71] Overall patterns (I), suspended elements (II), vertical design (III, IV), zones divided into fields or panels(VI-VIII), checkered zones (IX), joined or unjoined elements (V, X, XI) plain horizontal bands (XII), elements on a central line (XIII), horizontal zigzags (XIV), reversing triangles (XV), and meanders or wavy bands (XVI) and VARIA.
[72] Langsdorff and McCown 1942: 33-34.
[73] Langsdorff and McCown 1942: 53-56.
[74] Langsdorff and McCown 1942: 59-60.
[75] McCown 1942: 23.

Data accumulation and description: the 1950–1980s

Since the first description of the Bakun ceramics by McCown, researchers during the 1950–1980s put much effort into writing general descriptions of the excavated pottery. This trend was in accord with the cultural–historical paradigms that demanded much more elaborate archaeological data to trace more precisely the history of particular human societies or groups in particular times.[76] Their main purpose of describing the wares, vessel forms, and painted decoration in the excavation reports was to solve the chronological problems and relative dating. However, unlike McCown, the research in this period (e.g., Sono and Masuda) did not pursue 'the particular human groups' but the process of development towards complex societies.

Pottery studies by Sono

In the excavation report of Tall-e Gap, Sono adopted a style of description similar to McCown's, and he subdivided the vessel forms into 25 forms based on the complete vessels and the painted designs into more than 60 motif types.[77] The unique approach in his report was the calculation of frequencies of motif types during the occupation periods of Tall-e Gap Levels 1–17. As a result, he could discover the chronological indicators among the painted designs, which had specific lifespans in the stratigraphy of Tall-e Gap.[78] For example, the painted ceramics decorated over the entire surface became more popular than those decorated only on the upper part after Level 12b. Designs IVb (cross-hatched lozenge), VI (rectangle filled with short articulated lines), and XIII (comb motif) appeared more frequently in levels earlier than Level 14b. Design I and its variants (various types of elements in zones bordered by two thick horizontal bands) are more popular in Gap II (Levels 1–12b) than in Gap I (Levels 14a –17). The stratigraphic distribution of design Ic5 (rectangle filled with short lines), Ig (zigzag and lozenge), and Ii (filled rectangle and vertical lines) concentrated on Levels 9–12b. Most samples with designs Ib (bands and horizontal lines) and Ie (lozenge structure filled with diagonal short lines) appeared only between Levels 5b and 9. However, he did not study the diachronic changes of wares and vessel forms at Tall-e Gap.

Pottery studies by Masuda and Goff

In the excavation report of Tall-e Bakun A and B, Masuda defined a more restricted number of vessel forms and motif types.[79] Rather, he devoted his effort to comparing the ceramic materials and other artefacts

[76] Trigger 2006: 311-313.
[77] Egami and Sono 1962: 5-10.
[78] Egami and Sono 1962: 11-20.
[79] Egami and Masuda 1962.

from Tall-e Bakun A with those from Tall-e Bakun B. The pottery studies of Tall-e Jari A and Tall-e Nokhodi remained brief descriptions of excavated materials.[80] Goff classified the ware types of ceramics found at Tall-e Nokhodi into six types.[81] She also considered the temporal change of wares during the occupation period of Tall-e Nokhodi and noticed the transition from buff ware to red ware. She classified the shapes of buff ware into seven types,[82] referring to McCown's form of classification. She described the painted motifs on buff ware, comparing them with the patterns found in Tall-e Bakun A. She paid special attention to the animal designs, mentioning the more realistic character of the painted motifs at Tall-e Nokhodi than at Tall-e Bakun A or Susa.

Pottery studies after the tripartite subdivision system: the 1990s-2010s

Since the 1990s, with the appearance of the tripartite subdivision explained in Section 2-1-3, the approaches to identifying wares, vessel forms, and painted motifs in each phase (the Early, Middle, and Late Bakun) became popular. I will provide an overview of pottery studies based on the tripartite subdivision system, focusing mainly on Voigt, Dyson, and Alizadeh. Below, I will explain what these researchers argue concerning the pottery characteristics in each phase (A: Early, B: Middle, and C: Late) during the Bakun period. After that, I will introduce the recent pottery studies by Bernbeck, Potts, Weeks, Petrie, and Mutin, and then point out the problems of the previous pottery studies.

A) Early Bakun phase/Middle Fars 1 phase[83]

On the basis that not only Tall-e Bakun B but also Tall-e Gap Periods Ia–b proposed by Sono belonged to the Early Bakun phase, Voigt and Dyson pointed out the characteristics of this phase;[84]

1) both the coarse, chaff-tempered Shamsabad ware and the Bakun buff slipped and painted ware existed;
2) large jars were painted with isolated motifs on the shoulder and with straight, everted necks painted as a solid zone; and
3) deep bowls were painted in a wide zone composed of thick and thin bands with a central band of geometric elements.

On the other hand, with the opinion that Middle Fars 1 was represented by the ceramics only from Tall-e Bakun BII, Alizadeh thought the features of this phase were as follows:[85]

1) there were three ware types, fine buff ware, standard buff ware, and coarse ware;
2) the diagnostic motifs were dot-centred circle motif, double zigzag bands with vertical strokes motif, and suspended chevrons and loops on the interior of bowls; and
3) jars with a solid painted band on flaring high-neck, hemispherical jars with an everted rim existed.

Alizadeh considered that the Bakun BII ceramics were influenced by the ceramics of the Middle Susiana phase in Khuzestan. This consideration led him to his argument that the Bakun pottery was brought to Fars by the migration of specialised potters, as explained in more detail in Section 2-4.[86]

B) Middle Bakun phase/Middle Fars 2 phase

Voigt and Dyson raised five main features of this phase, in which Tall-e Gap IIa and Tall-e Bakun AI-II were included.[87]

1) More than one-half of the exterior surface of the ceramics were covered by painted motifs set in one to three horizontal registers.
2) Stylized humans and animals, such as caprines, birds, fish, and plants were diagnostic motifs.
3) Circular Maltese cross patterns and dotted motifs frequently appeared.
4) One diagnostic design structure composed of a band and solid and dash-filled rectangles (Motif-type Ic5 of Sono's classification) showed a relationship with the Middle Farukh period in the Deh Luran plain.
5) The first appearance of conical bases dates back to this phase.

C) Late Bakun phase/Late Fars phase

Voigt and Dyson explained the ceramics of the final phase below, which includes Tall-e Bakun A Levels III-IV and Tall-e Gap Periods IIb-c proposed by Sono.[88]

[80] Goff 1963, 1964; Egami et al. 1977.
[81] Red ware, Grey and black wares, Unpainted buff wares, Painted wares, Grit-tempered coarse wares, and Straw-tempered coarse wares.
[82] Ring-based bowls, Saucers, simple Bowls with flat or rounded bases, Conical bowls, Beakers, Cups, and Jars.
[83] Below I arrange the terminology of Voigt and Dyson (the Early Bakun, the Middle Bakun, and the Late Bakun) and that of Alizadeh (Middle Fars 1, Middle Fars 2, and Late Fars) in a line. However, strictly speaking, there is a bit difference between these terminologies in time range and material culture.
[84] Voigt and Dyson 1992: 138.
[85] Alizadeh 2006: 67-68.
[86] Alizadeh 2006: 11.
[87] Voigt and Dyson 1992: 138-139.
[88] Voigt and Dyson 1992: 139-140.

1) The painted motifs became more elaborate and complicated with geometric and representational designs, sometimes covering the entirety of the vessels.
2) Negative patterns appeared.
3) The vessel walls of bowls were very thin.
4) Red burnished coarse ware appeared.
5) Strange and impractical pottery forms also appeared, such as funnel-shaped vessels and bowls with painted decoration on their interiors and surfaces.

On the other hand, Alizadeh regarded only the pottery from Tall-e Bakun A as Late Fars phase. Following McCown, he redescribed the five ware types (fine buff ware, standard buff ware, coarse buff ware, coarse ware, fine and coarse red ware) and vessel forms (open forms, closed forms, and special forms).[89] He approached the description of painted motifs in this phase by paying attention to the grammar of design and artistic qualities. He emphasised the artistic quality of the painter of this phase, similar to McCown's emphasis, and his conclusion was basically the same as McCown's conclusion.[90] In addition, as a quantitative approach, he subdivided the vessel forms at Tall-e Bakun A into seven types and calculated the frequencies of the main elements of design (animal, human, plant, non-linear and geometric, linear, miscellaneous, and uncertain) on each vessel excavated from each level of each locus in the appendix.[91]

Pottery studies by Bernbeck and his colleagues

In the discussion of the chronological position of Tol-e Bashi during the Chalcolithic, Bernbeck and his colleagues analysed the motif parallels of Tol-e Bashi with those of the other sites[92]. In the analysis, they adopted the premise that each motif had a specific lifespan, which dated back to Sono's motif analysis of Tall-e Gap[93]. Their results were presented in the form of lifespan tables chronologically subdivided into Early Bakun, Middle Bakun 1, Middle Bakun 2, Late Bakun 1, and Late Bakun 2.[94]

Pottery studies by Weeks, Petrie, and Mutin

In the excavation report of Tol-e Nurabad, Lloyd Weeks and his colleagues described registered sherds based on 10 categories, namely (1) vessel form, (2) forming technique, (3) firing, (4) fabric colour, (5) inclusions, (6) finishing, (7) exterior coating, (8) interior coating, (9) decoration (exterior and interior), and (10) parallels discovered at the other sites.[95] Besides the description of drawn sherds, they also described the ceramic assemblage phase by phase, paying attention to wares, shapes, and decorations. Unlike McCown and Sono, they adopted a flexible description system without fixed categorisation of vessel forms and decoration. Rather, they concentrated on finding parallels from previous publications.

In 2010, Weeks and his colleagues provided the Bakun pottery studies with a spatially broader perspective.[96] They raised a question to the use of terminology '*Ubaid related*', pointing out the presence of core-periphery bias and the vague boundary of the '*Ubaid related*' sites caused by the adoption of that terminology. They argued that it led to overstating the similarity between southern Mesopotamia and Susiana based only on the black-on-buff ware. They present the term '*Ubaid-related-related*' as one example of '*reductio ad absurdum*' caused by the terminology '*Ubaid related*' and its theoretical background. The problem is also serious when we approach the black-on-buff ceramic horizon not only in pan-southwest Asian scales but also in smaller regional scales (e.g., a 'Bakun-style' ceramic horizon).

They also proposed that one theoretical approach to tackle the broad-scale distribution of black-on-buff ceramics is the perspective of materiality. As one approach to explain the widespread distribution of the black-on-buff pottery, they paid attention to the cultural values of the black-on-buff ceramics by using the modern example of the widespread distribution of the Coke bottle, saying that,

> 'Could not a future archaeologist glimpse the dramatic political and economic transformations of the twentieth century through an analysis of the distribution of the Coke bottle? This simple beverage container remains an icon of the ideology of capitalist free enterprise and a material embodiment of its spread.'[97]

Then they argue that,

> 'It is only an understanding of the cultural values that structured these behaviours that can provide insight into the significance of such material remains, and by extension the significance of specific black-on-buff pottery traditions and the black-on-buff ceramic horizon that they define. '[98]

[89] Alizadeh 2006: 68-75.
[90] Alizadeh 2006: 75; Langsdorff and McCown 1942: 56.
[91] Alizadeh 2006: Chart 2-42.
[92] Bernbeck et al. 2010: 159-161.
[93] Egami and Sono 1962.
[94] Bernbeck et al. 2010: Table 6.5.
[95] Weeks et al. 2006: 40-41.
[96] Weeks et al. 2010.
[97] Weeks et al. 2010: 266.
[98] Weeks et al. 2010: 266-267.

In recent studies, Cameron Petrie discussed the pottery change in a long-term perspective by comparing the former and later period ceramics and in a short-term perspective by comparing each phase within the Bakun period;[99]

1) Technological innovation in ceramics of the Bakun period was (a) the use of calcareous clay, (b) the use of basic turning device, (c) black painted decoration, and (d) firing temperature ranging between 850 and 1000 °C.
2) Continuity of motifs existed in the Mamasani region between the Late Neolithic and the Early Bakun phase, thereby criticising Alizadeh's potter-migration hypothesis.
3) There was little technological change in the buff ware ceramic production between the Middle Bakun phase and the Late Bakun phase, except for the elaboration of the decoration and vessel forms.

Benjamin Mutin compared the black-on-buff ceramics in broad regions ranging from southern Mesopotamia to south-east Pakistan, and then attempted to understand the local aspects of the black-on-buff ceramics in the Fars province.[100]

Pottery studies by Hassan Talai

The pottery studies of the Bakun period flourished not only in European–American academic societies but also in Iranian academia. Iranian archaeologist Hassan Talai published two books in Persian about Iranian prehistoric pottery in 2006 and 2011.[101] The former one, '*Eight Thousand years of Iran Pottery*', reviewed and discussed prehistoric pottery found throughout Iran. Chapter 5 of the book introduced the prehistoric pottery of southwestern Zagros, ranging from the Neolithic to the Bronze Age. Especially, he paid attention to the painted motifs of animals, plants, and human figurines and discussed symbolism. In the latter book, he focused on material cultures of the Chalcolithic period in Iran, introduced the Chalcolithic ceramics of the Fars region in Chapter 3 of the book,[102] and assessed that the potters were devoted intensively to artistic activities in the form of painting pottery.[103] In Chapter 4 of this book, he also discussed metallurgy, subsistence economy, potter's wheel, painted decoration of the ceramics, architectures, stone and bone tools, stamp seals, and clay figurines.

[99] Petrie 2011:162, 166.
[100] Mutin 2012.
[101] Talai 2006, 2011.
[102] Talai 2011: 108-119.
[103] Talai 2011: 114-115.

Summary: problems of the Bakun pottery studies

The above-explained review indicated that the pottery studies before the 1990s aimed to accumulate data for establishing a chronology. It was after the 1990s that research interests shifted from chronology to pottery and its diachronic change under the tripartite subdivision system. The current research interests extend to broad-scale and longer-term pottery studies. I present three problems of the Bakun pottery studies, which I tackle in this research. First, the studies of diachronic change of the Bakun pottery was not enough, except for the general description of diachronic changes of painted motifs and vessel forms conducted by Voigt and Dyson. Second, until now, there has been scarce research that quantitatively approaches the diachronic change of pottery from the early phase to the final phase of the Bakun period. Finally, the previous typological and morphological classification systems, especially those of vessel forms and painted motifs varied according to researchers. The comparison of these classification systems is required for a new analysis.

2-3. Pottery production and the recent findings of workshops

This section corresponds to **Research Question No. 3:** '*How were black-on-buff ceramics and other pottery produced?*' To clarify what was studied and what was debated regarding the pottery production, I picked up the previous studies of pottery production and separated them from those of wares, vessel forms, and painted motifs (Section 2-2). I will review the pottery-production studies in the Bakun period following three research phases of the Bakun-period pottery-production studies: (1) the 1930–1980s, (2) the 1990–2000s, and (3) recent findings of pottery production.

Description of pottery making technique: the 1930-1980s

Several researchers have studied pottery production during the Bakun period. The main ongoing dispute is the degree of craft specialization of the pottery production, namely household-based or workshop-based. Below, I will summarise the description of ceramic production-related materials, the evaluation of pottery production techniques, and the interpretation of the production system tackled by various archaeologists.

The first description about pottery production during the Bakun period dates back to the 1930s and was based on the excavation results from Tall-e Bakun A. In 1928, Herzfeld discovered one pottery kiln in the northern part of the site.[104] He noticed the vaporisation phenomenon of the painted motifs inside a pottery kiln

[104] Herzfeld 1932: 5, Langsdorff and McCown 1942: Fig. 4.

caused by piling up vessels.[105] Alexander Langsdorff also reported the excavated kiln from Tall-e Bakun A and hand-sized clay-pieces with perforations found in nearby kilns, which he interpreted either as support for pots during firing or as the floor of the firing chamber.[106]

In 1941, Herzfeld presented his interpretation of the pottery production and its organisation in a lecture about prehistoric Iran.[107] He thought that pottery production was not a specialised activity but a usual practice by every man and woman dwelling in a village, on the grounds that several pottery kilns were found at Tall-e Bakun A.[108] He did not think that the use of a potter's wheel for the production of ceramics existed during the Bakun period. He thought that the pottery surface was scratched off to make it thinner after drying.

On the other hand, in the excavation report from Tall-e Bakun A, McCown described technical details of the ceramic materials.[109] He found technical traces by direct observation in the course of drawing the materials and arranging the materials for publication. He presented some important remarks about the production technique as follows:

1) the presence of vaporised paint on the surface of the ceramics;
2) the absence of the use of a potter's wheel from the evidence of off-centring pottery, which was identified from base sherds or complete vessels;
3) extra layers of clay inside large jars for strengthening the joint; and
4) traces of surface treatment, such as wet smoothing and scraping.

Contrary to Herzfeld, McCown emphasised the high quality of painting technique of the potters of Tall-e Bakun A as follows:

> 'A few observations may be made on the technique of painting. In many cases the outline of the design, drawn with thinner paint than the interior, may be clearly distinguished, particularly if the vessel has been overfired, when almost every brush stroke stands out plainly. It is hardly necessary to remark that much of the painting was done by highly competent artists with exceptional draftsmanship.'[110]

From the 1950s until the end of the 1980s, as mentioned before, the research interest about pottery production techniques was restricted to the descriptions in the excavation reports, such as those of Tall-e Bakun A and B by the Japanese expedition,[111] Tall-e Gap,[112] Tall-e Nokhodi,[113] and Tall-e Jari A.[114] They did not discuss the production system during the Bakun period. For example, in the excavation report of Tall-e Gap, Sono mentioned several apparent traces of pottery-making techniques observed from ceramic materials:

1) coiling method;
2) joining the neck, body, and base after forming these parts separately;
3) joining the ring of the base and body after separately forming these parts;
4) possible use of turntable, not potter's wheel;
5) presence of two types of pigments, black and reddish brown;
6) possible use of two types of paint brushes, a soft one and a hard one; and
7) vaporisation of the painted motif.[115]

In 1972, under the powerful processual archaeological paradigm, Sumner reported in his dissertation that kiln wasters were collected from five sites during his archaeological survey in the Kur River Basin, which would be indicators of pottery production.[116] Among the sites with kiln wasters, there was only one large site, and the others are small sites of less than 2.5 ha extent. Considering this with the settlement-pattern studies, he concluded that pottery production in the Bakun period was not restricted to large sites.

Growing interest in pottery production and craft specialisation: the 1980–2000s

As the discussion of sociopolitical complexity in the Chalcolithic period of west Asia flourished in the 1980s, archaeologists came to pay more attention to the beginning of craft specialisation of ceramics. Alizadeh re-evaluated the excavation of Tall-e Bakun A and argued for a segregation of an accounting quarter with storerooms (northern part) from the craft workshop (central-southern part) in Tall-e Bakun A, indicating specialised craft production. Then, Alizadeh assumed a model in which small groups of elites, who had strong ties with nomads, controlled the production of ceramics by attached specialists at Tall-e Bakun A.[117]

105 Herzfeld 1932: 5.
106 Langsdorff and McCown 1942: 7.
107 Herzfeld 1941.
108 Herzfeld 1941: 19.
109 McCown 1942: 24-26.
110 Langsdorff and McCown 1942: 25.
111 Egami and Masuda 1962.
112 Egami and Sono 1962.
113 Goff 1963, 1964.
114 Egami et al. 1977.
115 Egami and Sono: 1962: 39-40.
116 Sumner 1972: 257.
117 Alizadeh 1988.

In 1994, Sumner supported Alizadeh's argument about craft specialisation in the Bakun period.[118] He raised the evidence of specialised pottery production, such as the widespread distribution of the production-related materials at Tall-e Bakun A, and the absence of evidence for pottery production at large portions of surveyed sites. He also mentioned that the advanced production technique and elaborateness of Bakun pottery evidenced skilled craftsmanship.[119] He did not mention a degree of craft specialisation in the Bakun period.

In contrast to Alizadeh and Sumner, from the reconsideration of excavated materials from Tall-e Bakun A, James Fraser argued that the beautifully decorated black-on-buff pottery may not have been limited to specific production centres, such as Tall-e Bakun A, and that pottery making was not necessarily an élite-controlled activity.[120] He suggested that goods, including ceramics, were produced at a household level, though he mentioned the possibility of specialised craft manufacture conducted by specific families at Tall-e Bakun A.[121]

In 2010, Weeks and his colleagues also reviewed and evaluated the stages of the pottery production during the Bakun period.[122] They posited the presence of specialist potters due to evidence showing a high degree of pottery-making skills and the time-consuming work.[123] In addition, citing Sumner's survey results that there are limited numbers of sites that show ceramic production, they suggested a few specialised ceramic production sites existed and manufactured pottery for exchange. In conclusion, they envisaged local exchange of pottery taking place within limited parts of the Kur River Basin and the Mamasani Plain.

Recent findings of production-related remains of pottery

Pottery-production studies by Bernbeck and Pollock

There have been recent findings of installations related to pottery production in the Bakun period. Reinhard Bernbeck, Susan Pollock, and Hassan Fazeli found one pottery kiln from the excavation of Rahmatabad.[124] There was a thick, round pottery disk with large holes inside the kiln, which may have been the dividing floor between the firing chamber and the loading chamber. Outside the kiln, many well-preserved vessels and three misfired bowls, which were fused together, were found. There were no houses contemporaneous with the pottery kiln, except for many small pits that were covered with potsherds and pebbles. They also found vessels, possibly made by children and apprentices, and discussed how the potters learned their craft at the site.[125]

Based on the evidence from Rahmatabad, Pollock further discussed the ceramic production in terms of learning.[126] She suggested that the potters of the Bakun period had more mental space that allowed them to create new pottery designs, in contrast to the Neolithic potters. Citing McCown's statement about how to paint the motifs, she argued that '*Bakun potters were free to experiment with the kinds of designs they painted; stricter limits were set on how they painted them*'.[127] She presented the evidence of unbaked clay with small fingerprints as children playing and imitating the adults potting. In addition, she presented a fine pottery vessel with too-thick walls, inconsistent shape, and unskilful painting. She identified it as the pottery made by an apprentice. She suggests that this evidence implies that '*learning to pot proceeded by children's mimetic actions, followed later on by experimentation and observation*'.[128]

In addition, she supposed that there were no formal or step-by-step instructions on how to form vessels and paint them. Instead, apprentices learned by close observation and imitation of the gestures and techniques the senior potters used. Thus, she concluded that there was more latitude on the appearance of the product in the Bakun period than in the Neolithic, although how the vessels were painted was very restricted, and that the apprentices were allowed to be members of potting groups that could access fine clay and equipment.

Pottery-production studies by Helwing and Seyedin

During the rescue excavation projects for the construction of the Sivand Dam in 2005, Barbara Helwing and Mozhgan Seyedin excavated Sites 73, 91, and 131 in Darre-ye Bolaghi, where they found various types of kilns.[129] From site 91, where the Bakun-period cultural deposits were largely disturbed by a later occupation, one single-chamber pottery kiln and two 'pomegranate' or 'keyhole-shaped' pottery kilns with two chambers were discovered. A geomagnetic survey confirmed the presence of at least nine pottery kilns in Site 73. They excavated five kilns (two-chamber pomegranate type)

118 Sumner 1994: 59.
119 Sumner 1994: 59.
120 Fraser 2008: 14-16.
121 Fraser 2008: 15. In 2001, a Japanese archaeologist also re-analysed the excavation report of Tall-e Bakun A and reached a similar conclusion that the pottery production was part-time household-based specialised production with comparison to a Chalcolithic site in Syria (Kume 2001).
122 Weeks et al. 2010.
123 Weeks et al. 2010: 264.
124 Bernbeck et al. 2005: 98, 102.
125 Bernbeck et al. 2005: 103-104.
126 Pollock 2015.
127 Pollock 2015: 56.
128 Pollock 2015: 58.
129 Helwing and Seyedin 2010, Karami 2015.

there and also found one burial under one pottery kiln. These kilns help us to reconstruct the construction process of pottery kilns. They found one more circular-type kiln with a central column in Site 131. However, despite a wide range of excavations, they did not find the remains of buildings, such as pisé walls, around the kiln. They suggested two possibilities of the occupation at Site 131:

1) the excavated area was situated on the periphery of the settlement, or
2) the architecture in 131 was made of organic materials.

They concluded that all the sites at which pottery kilns were excavated were not necessarily specialised workshop sites but may have had domestic dwellings. However, they thought the presence of a seasonal pastoral population and sedentary population is possible in these sites.[130]

Pottery-production studies by Marghussian

Since the 2000s, archaeometric analysis methods have been used to investigate the pottery production of the Bakun period. Armineh K. Marghussian, Hassan Fazeli, and Hossein Sarpoolaky performed archaeometrical analyses (XRF, XRD, and microstructural study using SEM) of black-on-buff ceramics from Rahmatabad to clarify their chemical and mineralogical compositions.[131] They concluded that black-on-buff ceramics are homogeneous in chemical and mineralogical perspectives and have very fine, dense, and uniform microstructures. They estimated the firing temperature of black-on-buff ware as 950–1050 °C, demonstrating a good quality of skill in pottery production techniques from clay acquisition to firing, which they further interpret indicated a high degree of specialisation in the Bakun society.[132]

Summary: problems of the Bakun pottery production studies

As shown above, many studies have discussed the pottery production of the Bakun period in Fars province. I can point out four problems from these reviews. First, similar to the studies of other pottery attributes, there are few studies that tackle the pottery-production techniques from the beginning to the end of the Bakun period. Second, the previous researchers have adopted various ways of describing the ceramic production technique. The former research also seldom examined the entirety of production stages from clay acquisition to firing.

Third, the discussion of craft specialisation concerning the pottery production during the Bakun period has flourished since 1988. At present, however, the degree of craft specialisation concerning the pottery production is still debated. Its degree ranged between élite-attached specialists (Alizadeh) and specialists among extended households (Fraser). One of the problems lies in the systemic framework of craft-specialisation studies, which will be explained in Chapter 3 in more detail. On the other hand, Pollock's approach to pottery production from a learning perspective is suggestive for the pottery-production studies of next generations. Her study also resonates with a concept of a 'community of practice', which I will introduce in Chapter 3. Finally, archaeometric research for the Bakun pottery production is currently in the building stage. In Chapter 4, I will present methodologies of chemical and petrographic analyses that shed new light on the pottery-production studies of the Bakun period.

2-4. Previous studies of social aspects of the Bakun village communities

Finally, the previous studies of social organisation or social aspects during the Bakun period will be reviewed in a chronological order. This review pursues how previous studies considered **Research Question No. 4:** '*How were pottery production and village organised during the Bakun period?*' Here, I will critically review evidence and theoretical perspectives on which previous archaeologists were predicated for discussing the social organisation. Proceeding in this review, I will show that previous archaeologists discussed the social organisation with the assistance of various theoretical perspectives, especially the perspective exploring 'chiefdom' and 'craft specialisation and social complexity', since the 1980–90s (Sumner and Alizadeh).

The 1930–1960s: cultural–historical archaeology

In the 1930s, two archaeologists approached the social background of the Bakun pottery. One was Donald E. McCown and another was Ernst Herzfeld. Both researchers had a cultural–historical perspective in interpreting the social background of the Bakun pottery. McCown interpreted the change of the ceramics as a movement of the people, as explained in the section on chronology.[133] Herzfeld argued that the residents of Tall-e Bakun A were not monogamic families but clans with strange marriage customs based on the house plan of Tall-e Bakun A.[134] At that time, the archaeologists had little interest in social organisation, and the discussion remained only a guess.

[130] Helwing and Seyedin 2010: 289.
[131] Marghussian et al. 2009.
[132] Marghussian et al. 2009: 746.

[133] McCown 1942: 33.
[134] Herzfeld 1941: 10.

In the 1960s, Sono, who also took part in the expedition of the Ubaid-period site Telul eth-Thalathat in Iraq, interpreted a building built of pisé at Trench GAI of Tall-e Gap as one for some religious purpose, such as a shrine or temple.[135] The evidence on which he based this conjecture were architectural layouts, a rectangular fire place enclosed by walls found at the centre of the building, and traces of repetitive repairs of the building itself and the fireplace. To date, no similar remains have been discovered from other Bakun-period sites, and it is still difficult to examine his hypothesis about the religious building.

William Sumner: settlement pattern and processual archaeology

Sumner's study of social aspects in 1972

Researchers had to wait until the 1970s for further discussion on social organisation during the Bakun period. In 1972, William Sumner analysed long-term diachronic changes of settlement patterns in the Kur River Basin, ranging from what he called Phase II (the Mushki, Jari, and the Shamsabad period) to Phase VII (the Achaemenid period), to understand changes of land use and organisational patterns.[136] Characteristic of Sumner's approach was a statistical analysis and estimate of survey results.[137] Sumner was affected heavily by processual archaeology, which analyses settlement patterns for pursuing the relationships between demography and ecological and geographical settings.[138] He paid attention to social organisation with an interest in the relationship between population and environment. He interpreted that the driving force of the social transformation was economic growth. He estimated the population density during the Bakun period (200 persons per hectare) based on the excavated building complex of Tall-e Bakun A Level III and then considered the regional demography in each phase.[139] The topics that he examined for settlement pattern analyses were as follows: (1) population growth and settlement hierarchies, (2) site location pattern by nearest neighbour analysis, (3) zonal density pattern, (4) locational continuity, (5) ecological correlations, (6) population density and length of fallow, and (7) pastoral nomadism.

In the concluding part of his research, Sumner evaluated the change from Phase II (the Neolithic period) to Phase III (the Bakun period) as '*Early Population Growth*'.[140] He stressed that the general trend towards population growth in Phase II continued until the Bakun period. However, he mentioned that the Bakun period showed less geographical differentiation (less stylistic unity) of the Bakun painted pottery style than Phase II did. In addition, he argued that the evidence of long-range trade and the presence of three large sites—8H8 (Tol-e Bashi), 8I7, and 9H21—were observed in the Bakun period.[141] Immediately after the Bakun period, he observed a drastic decrease of population.[142] At this time, he speculated that the change to Phase IV was a result of newcomers using the Lapui ware arriving at the Kur River Basin, where there were few villages.

Sumner's study of social aspects in 1994

In 1994, Sumner specifically investigated the transformation of social organisation during the Bakun period in the proceedings of '*Chiefdoms and Early States in the Near East*'.[143] Unlike his dissertation, he subdivided the Bakun-period settlement-pattern into three subphases, namely the Early, Middle, and Late Bakun phases. He used the Kur River Basin gazetteer, which was a synthesis of surveys, including fieldworks after his dissertation.[144] However, as already stated in Section 2-1, his chronological criteria for the tripartite subdivision were very rough.

In the first half of this paper, Sumner considered settlement patterns and their correlation with land use in the Kur River Basin. For that analysis, he subdivided the Kur River Basin into three main districts—the Soon district, the Baiza District, and the Zargan District—and other districts where large parts of excavated sites (Tall-e Bakun A, etc.) are located. He calculated the number of sites, mean settlement area, mean distance to the first nearest neighbour, mean village territory area, and mean area of available land for cultivation per person,[145] thereby pursuing diachronic change of productive intensification in each district.

His results concerning settlement patterns during the Bakun period are summarised below.[146]

1) A steady growth of population was observed from the diachronic change of settlement patterns. Except for the Soon District, the growth was caused by the fissioning of villages and the foundation of new villages.

135 Egami and Sono 1962: 3; Helwing 2012: 508.
136 Sumner 1972. He updated this analysis in 1990 in the approach to estimate of population trends (Sumner 1990). In this paper, he subdivided 'Early Bakun, Middle Bakun, and Late Bakun' in Table 2. However, he did not mention the criteria at that time.
137 Grewe (2002) extended the statistical analysis of the survey data in his dissertation.
138 Adams 1965, Trigger 2006: 372-382.
139 Sumner 1972: 188.
140 Sumner 1972: 254.
141 Sumner 1972: 258. At that time, he did not argue that these large sites played special roles for political activity.
142 Sumner 1972: 260, Sumner 1988: 41.
143 Sumner 1994.
144 Sumner 1994: 47.
145 Sumner 1994: 52.
146 Sumner 1994: 58.

2) In the Soon district, there was a rapid population growth in the Middle Bakun phase, which caused more intensive cultivation. The linear pattern of site distribution suggests irrigation.
3) The number and mean area of settlements decreased in the Late Bakun phase of the Soon District. It is suggested that the decrease of fallow, because of productive intensification, resulted in the population decrease.[147]
4) In the Soon district, for the construction and maintenance of the irrigation system, the solidarity of all villages would have become stronger.

Moreover, Sumner discussed the political structure in the Bakun period in the latter half of the article, especially regional organisation, productive specialisation (as already stated in Section 2-3), and administrative control. First, he pointed out the difference of the regional diversity within the Fars province between '*the Archaic Period* (the Mushki and the Jari period)' and the Bakun period in terms of population and pottery style. He argued for the interregional integration of the Bakun period throughout Fars, saying,

> 'These patterns (subtle but complex stylistic variation with the motifs shared throughout Fars) would suggest intense communications between districts in the Bakun Period and a greatly increased level of symbolic complexity, in contrast to the simple interdistrict variation characteristic of the Archaic Period.'[148]

Second, Sumner discussed the administrative control in a different way from Alizadeh's argument, which will be explained in Section 2-4. He named the building complex with sealing fragments discovered at Tall-e Bakun A as 'Building Unit A'. From the fact that 43 types of seal designs could be reconstructed from the sealings from Unit A, he assumed that 43 seal holders, including their families, amounting to 130–170 in sum, used the storerooms in Unit A. From this result, he assumed administrative activity was conducted there, in which the residents other than Unit A of Tall-e Bakun A also were engaged. Furthermore, he attempted to model the Bakun administrative structure, especially the number of administrative centres in the Middle Bakun-phase settlement-hierarchy. He assumed two models of the Bakun administrative structure:

1) two large sites were the administrative centres, and
2) two large sites and four kiln sites represent the active Middle Bakun administrative centres, with one dominant centre in control of five sub-centres.[149]

Thus, Sumner concluded that, by the Bakun period, population growth, interregional integration, increases in scale, and growth of productive specialisation had allowed a centralized control system to evolve. He attempted to consider the type of the social organisation in the Bakun period similar to a complex chiefdom. As I review in Chapter 3, his exploration for complex chiefdom derived from neoevolutionism of the processual archaeology. He could not find any evidence indicating the complex chiefdom, such as mortuary practices, settlement hierarchy, and residential segregation of elites. Nevertheless, he claimed that the discussion in his paper supported the presence of authority to lead to cooperative works for an irrigation system and to administer the redistribution of materials, as he suggested below:

> 'It is reasonable to propose that the individuals who filled leadership roles were drawn from the most powerful and successful kinship units. Thus, Bakun political organisation can be tentatively viewed as composed of hierarchically ranked kinship units, probably lineages, that competed for power and authority within the system.'[150]

Summary of Sumner's study

Sumner's exploration of the social organisation began from the discussion of settlement patterns. In his view, population increase and agricultural development played a role in discussing the complex social organisation, although he took interregional integration, craft specialisation, and administrative control into consideration. It is clear that he relied on the neoevolutionist perspective when he discussed the detail of social organisation as indicated by his concern of chiefdom.

Abbas Alizadeh: 'Nomadic Hypothesis' and processual archaeology

Next, I will review the 'Nomadic Hypothesis'[151] presented by Abbas Alizadeh especially by introducing his papers and books written in 1988, 2003, and 2006. His hypothesis originated from the paper regarding the reanalysis of excavated materials from Tall-e Bakun

[147] See also Sumner 1990: 13.
[148] Sumner 1994: 58-59. Although the Mushki and Bashi pottery styles showed more homogeneity in the Kur River Basin and the Bolaghi Plain than the Bakun pottery style, the Mushki and the Bashi style did not reach beyond the Kur River Basin and the Bolaghi Plain.
[149] Sumner 1994: 62.
[150] Sumner 1994: 63.
[151] Helwing and Seyedin: 2010: 280.

A, especially stone stamp-seals and clay sealings.[152] His main argument was that nomads (or mobile pastoralists) did exist in the fifth millennium BCE in Fars province. The nomads were dominant elites and played a great role in trading crafts made by sedentary specialised craftspeople. Then, they stimulated the development of economic complexity at Tall-e Bakun A, represented by the administrative technology, and finally, they promoted state-level organisations.[153] Alizadeh's research was influenced to a great deal by the processual approach conducted in the Susiana Plain and the application of types of social organisation (e.g., complex chiefdom) to past societies.[154] As reviewed later, he supposed that the nomads had played special roles in expanding pottery production of black-on-buff ceramics. In a recent paper, he developed his hypothesis of nomadism and presented a model that ancient mobile highland pastoralists were in a position to dominate the lowlands and create a diversified political economy that included farming, herding, and trade.

Alizadeh's study in 1988

The commencement of his study was the re-evaluation of a well-preserved building unit found at the northern part of Tall-e Bakun A.[155] First, he conducted a spatial analysis of sealings, particularly door sealings. As a result of the analysis, he suggested that the buildings were warehouses. On the other hand, pointing out the absence of clay sealings and the presence of unfinished materials and pottery kilns in the central-southern quarter of Tall-e Bakun A, he asserted that the central-southern quarter was the large workshop area. He argued that the site was functionally segregated, that is the northern part for administration and the southern part for craftspeople. He insisted that limited numbers of people conducted administrative activities there.

Second, Alizadeh further proceeded to explore the social organisation of the Bakun period and nomads. He started a discussion from a deductive hypothesis:

> 'Since it is my contention that socio-economic and political developments in Fars during the late fifth and early fourth millennia B.C. were influenced by the pastoral nomads and their interaction with the sedentary population, it is necessary to outline briefly socio-cultural developments of the late fifth and early fourth millennia in southwestern Iran, and the modern demographical components of this region'.[156]

[152] Alizadeh 1994.
[153] Alizadeh 2010.
[154] Wright 1984.
[155] Alizadeh 1988.
[156] Alizadeh 1988: 27.

Alizadeh argued that modern tribes' pastures correspond to the wide geographical distribution of the Bakun painted pottery based on the ethnography of modern nomadic tribes. He assumed that current environmental restriction would be the same as that in the Bakun period and that the wide distribution of the fragile Bakun painted pottery was not the result of long-distance trade. He argued that the nomadic tribes played a great role in spreading Bakun A culture, including the pottery-making technique. He suggested the existence of nomads from the presence of flat sites, which was possibly a nomadic campsite in the Bakun period. He also argued that the trade, control, and administration of craft products conducted by nomads could bear surplus for supporting specialised craftspeople.

Third, he applied the types of social organisation (especially, complex chiefdom) to the social organisation of the Bakun period when nomadic people and specialised potters were present. He examined whether the social organisation in the Bakun period satisfied the three requirements for the model of complex chiefdom: (1) settlement hierarchy, (2) residential segregation, and (3) mortuary segregation.[157] As a result of his examination, the actual evidence confirmed in Bakun-period sites did not fulfil these requirements for complex chiefdom. However, Alizadeh considered that the absence of the requirements for complex chiefdom reflected the presence of nomads. He argued that the nomadic population adds the potential of consumers regardless of the settlement size, although the social organisation was unstable. He also argued that, to overcome the instability of this organisation, Bakun A society must have been a stratified society, at the same time evolving into a more powerful institution.

Alizadeh's study in 2003

Alizadeh reinforced his hypothesis in 2003.[158] To make the distribution map of sites in north-west of Marv Dasht, to know the features of the archaeological sites and their spatial relations, and to clarify the spatial extent of the Bakun A ceramics and whether it overlapped with the Qashqaii territories, he conducted a survey of the north-west Kur River Basin in 1995. As a result, he found 77 sites ranging from the early Neolithic to the Safavid periods. As regards the distribution of surveyed sites, he found that modern villages and ancient sites were located in the large intermontane valleys, whereas he discovered fewer modern villages in narrower valleys.

In addition, with the purpose of reinforcing his argument that mobile pastoralists existed in the Bakun

[157] Alizadeh 1988: 31.
[158] Alizadeh 2003.

period, he critically reviewed Sumner's argument that mobile pastoralists appeared after the Bakun period.[159] Alizadeh criticised Sumner's rough chronological classification of the Bakun period to re-examine the decrease in the number of sites in the Lapui period. Later, Alizadeh reanalysed the potsherds collected at 36 sites surveyed by Sumner.[160] He argued that the number of sites increased from the Bakun period to the Lapui. In a conclusion of his paper, he pointed out the correspondence between the population decline in the Susiana Plain by the end of the Middle Susiana period and the emergence of mobile pastoralists in the Fars highlands.[161] He further stated the mobile population accelerated the political developments towards states in Iran.

Alizadeh's study in 2006

In 2006, with the additional data of soundings conducted at the sites in the Kur River Basin and the unpublished excavation materials from Tall-e Bakun A, Alizadeh rehashed his hypothesis in the report of Tall-e Bakun A.[162] This report comprised 11 chapters and two appendixes. Several chapters presented new data and arguments. In particular, the last two chapters were the zooarchaeological and archaeobotanical analyses, which shed new light on the subsistence economy in the Neolithic and Chalcolithic periods of Fars province. At the beginning of this publication, Alizadeh explained why he started to use the term '*mobile pastoralism*' rather than '*nomadism*'.[163] Although he originally used the term '*pastoral nomads*'[164] in 1988, he changed it to '*mobile pastoralism*'[165] in 2003 without previously mentioning any reason for doing so. He changed this term to distinguish his main ethnographic examples in the Zagros Mountains (the Bakhtiyari and the Qashqaii) from those in Sinai, Negev, and the Sahara, who stay in one place for a limited term. He thought that the ethnography of the Bakhtiyari and the Qashqaii modest examples of nomadism, or mobile pastoralists who are only mobile during migration and stay one place for a longer term than those in desert regions.

The shift of the concept from '*nomadism*' to '*mobile pastoralism*' also affected his interpretation about pottery production. He questioned the belief that '*an essentially mobile way of life does not engage in pottery production*.'[166] Then, he cited the ethnography of the pottery production by highly mobile tribes in North America, Negev, and Iranian Baluchistan to indicate that their ceramics seemed to be technologically and aesthetically inferior to those produced by sedentary people. However, because the mobile pastoralists in the Zagros region stay longer (several months) in winter pastures in contrast to the potters belonging to the highly mobile tribes, he argued that it allowed the mobile pastoralists in the fifth millennium BCE at Fars province to manufacture and distribute the beautiful pottery.[167] To strengthen his hypothesis, Alizadeh also introduced traditional geographic zones in Fars, namely *sardsir* (the summer pasture of the Qashqaii and Khamseh tribes located in the northern part of Fars), *motadel* (the temperate land between *sardsir* and *garmsir*), and *garmsir* (the winter pasture located in the southernmost part of Fars).[168]

Alizadeh presented additional information about the unpublished excavation of Tall-e Bakun A conducted in 1937, with the purpose of strengthening his argument that there was the segregation of residential, administrative, and industrial quarters at Tall-e Bakun A. An interesting point concerning the context of Tall-e Bakun A is the discussion of conflagration at the site. The original report written by Langsdorff in 1942 mentioned that there was conflagration at Level III of Tall-e Bakun A.[169] However, Alizadeh argued against Langsdorff's report:

> 'There is little evidence for rebuilding of the building complex in Level III; moreover, some walls in this level are preserved to a height of more than a meter. No traces of conflagration were found and the inhabitants must have simply abandoned the site.'[170]

Summary of Alizadeh's study

I introduced Alizadeh's arguments of Nomadic Hypothesis and the social organisation during the Bakun period. For Alizadeh, the presence of mobile pastoralists was highly significant when discussing the social organisation, in which mobile pastoralists as dominant elites controlled specialised craftspeople. Although Alizadeh argued for the presence of mobile pastoralists based on the modern ethnography and flat sites, his argument about mobile pastoralists is criticised by other researchers, as stated below in this chapter. Furthermore, as with Sumner, Alizadeh's discussion of the social organisation was built on the neoevolutionist perspective searching for chiefdom and craft specialisation.

159 Alizadeh 2003: 90.
160 Alizadeh 2006: 49.
161 Alizadeh 2003: 91-92. See also Alizadeh 1992.
162 Alizadeh 2006.
163 Alizadeh 2006: 1.
164 Alizadeh 1988: 27.
165 Alizadeh 2003: 83.
166 Alizadeh 2006: 22.
167 Alizadeh 2006: 23.
168 Alizadeh 2006: 30.
169 Langsdorff and McCown 1942: 15.
170 Alizadeh 2006: 64.

Daniel Potts, Lloyd Weeks, and Cameron Petrie: Critique of Nomadic Hypothesis

Critique of 'Nomadic Hypothesis' by Daniel Potts

Daniel Potts, Lloyd Weeks, and Cameron Petrie are now posing many questions about Alizadeh's hypothesis that nomads did exist at the fifth millennium BCE in Iran and that the nomads dominated and conducted administrative activities at Tall-e Bakun A. They are especially criticising the archaeological evidence and Alizadeh's interpretation. In the review of Alizadeh's articles and book, Potts evaluated Alizadeh's hypothesis concerning nomads.[171] The core of Potts's argument was that people lived sedentary lives in Iran until the first millennium BCE, and then, nomadism appeared in Iran after the first millennium BCE. The main problems he pointed out are as follows.

1) The distribution of Bakun A-type pottery is just indirect evidence supporting the existence of nomads. Alizadeh rejected the possibility of the exchange between sedentary communities, pointing out its fragility. Alizadeh might be also unaware of the non-pottery tradition of the modern Bakhtiyari.
2) There is a leap in the logical relation between the proximity of ancient sites with Bakun A-type pottery and modern tribes of the Qashqaii campsites and pastures. If we followed Alizadeh's logic, the Sasanian archaeological sites, which also geographically overlap with the territory of the Qashqaii during the 1940s and early 1950s, and the Sasanian ways of life would have been similar to those of Qashqaii.

Lloyd Weeks and his colleagues' critique of Nomadic Hypothesis

In 2010, Lloyd Weeks, Cameron Petrie, and Daniel Potts reviewed previous studies about the Bakun period, such as settlement pattern, society, and the Nomadic Hypothesis argued by Alizadeh.[172] The authors had some doubts about Alizadeh's Nomadic Hypothesis and criticised his hypothesis as follows:

1) an increase of caprids during the Late Bakun phase does not necessarily imply the absence of agricultural surplus without irrigation;
2) the bioarchaeological samples collected from settled communities do not contribute to the question of nomadic pastoralism; and
3) his conception of the development of social complexity minimises the role of kinship relations in political interactions.

[171] Potts 2014.
[172] Weeks et al. 2010.

The discussion in their paper proceeded particularly towards explaining the mechanism of expansion of black-on-buff pottery, rather than directly approaching social organisation of the Bakun period. For example, they also questioned Alizadeh's argument that specialised potters brought black-on-buff ceramics into the Kur River Basin when they migrated to the area.[173] Instead, they proposed exogamous marriage relationships between villages as one possible background of the dispersal of black-on-buff ceramics, exemplifying the recent studies of the Bell Beaker phenomenon in Europe by using isotopic studies of human skeletal remains.[174] However, they admitted the difficulty in demonstrating the role of intermarriage in technology transfer of the pottery-production technique. They did not totally reject the importance of mobility and pastoralism for cultural transmission in the fifth millennium BCE.

Cameron A. Petrie's study of innovation and cultural transmission

Although I review previous studies of the social organisation in this section, here I introduce a paper discussing long-term change of pottery and innovation in Fars province published by Cameron Petrie.[175] Petrie's discussion of innovation is related deeply to the social context of the Bakun period. His standpoint is based on a theory of cultural transmission represented by Steven Shennan, J. McGlade, and J. M. McGlade.[176] This theory explores and sets up models for mechanisms of cultural transmission, getting inspiration from biological inheritance, which derives from the Darwinian evolutionary perspective. Petrie explained that the mechanism of innovation is a complicated phenomenon consisting of constraining and facilitating processes, such as diffusion, perception, attractiveness, resistance, adaptation, and adoption. He tackled the pace and nature of change in pottery-production technology and decorative style from 6000 BCE to 2000 BCE in Fars to explore the processes of cultural change, innovation, and cultural transmission.

Petrie proposed a multilinear model that intermittent, punctuated innovation took place in pottery-production technology during the Neolithic, the Chalcolithic, and the Bronze Age. In other words, there were open-minded social situations when innovation was accepted. Then, after the open-minded situations, there were long periods during which no requirement for change in the social contexts. He proposed two critical factors for the history of innovation in southern Iran, namely the

[173] Weeks et al. 2010: 263.
[174] Weeks et al. 2010: 265; Price et al. 2004.
[175] Petrie 2011.
[176] Shennan 1989; McGlade and McGlade 1989.

geography of the Zagros and the mobility of people.[177] He also criticised Alizdadeh's hypothesis about the migration of specialised potters from Khuzestan to Fars in the Early Bakun period in terms of innovation. He argued that Alizadeh's explanation, which regards migration as a major factor for culture change, was simple and straightforward from a cultural–historical standpoint. Instead, he interpreted that complicated socio-economic processes were in operation during the Early Bakun period.

Petrie also presented one hypothesis that, since as early as the Pottery Neolithic in southern Iran, relatively few potters with particular knowledge in several villages were engaged in pottery production, rather than every household in every village. This hypothesis was based on the interrelated operational sequences from clay preparation to firing, the skills, and the quality of pottery-production technique observed from the ceramic materials. He further argued that relatively small numbers of people were engaged in the transmission of the innovations in pottery production, possibly in the form of face-to-face contact.

Summary of the studies of Potts, Weeks, and Petrie

In summary, I introduced the critiques of 'Nomadic Hypothesis' from Potts, Weeks, and Petrie. The main subject of their criticism was the ways of interpreting the evidence of nomads rather than the organisation that placed nomads in a central position. Weeks and Petrie turned their interests to the mechanism of expansion and adoption of the black-on-buff ware, rather than the perspective towards social organisation with the neoevolutionist background. Specifically, Petrie adopted the theory of cultural transmission to explain the mechanism of pottery adoption.

James Fraser: Extended household model

Following Potts' critique of the Nomadic Hypothesis, James Fraser reconsidered Alizadeh's argument of '*Tall-e Bakun A as a specialised manufacturing centre controlled by an élite group*'.[178] He reanalysed (1) the distribution of administrative artefacts, (2) the distribution of prestige items, (3) the presence of distinctive architecture, and (4) the segregation of areas in Tall-e Bakun A based on the old data and the new evidence published in 2006.

His results obtained from reanalysis of Tall-e Bakun A are as follows.

1) Familiarity of stamp seals at Tall-e Bakun A and an example of the use of stamp seals without hierarchy[179] shows that stamp seals were used to mark property, rather than to administer storage of materials. In addition, Alizadeh's distinction between multiple-used seals and miscellaneous seals that appeared once was vague. His interpretation of 'door sealing' lacks evidence. It is probable that the seals and sealings are also found in the centre and southern parts of the mound. The stored goods in the 'storerooms' had domestic characters and were not always found with sealings.
2) Copper objects, semi-precious stones, and the elaborately decorated vessels were evenly distributed in Tall-e Bakun A.
3) The character of Building VIII as an elite residence or temple was ambiguous.
4) There are some questions concerning the spatial segregation between the northern complex and the central-southern quarters in Tall-e Bakun A in terms of architectural layout and manufacturing tools. As already reviewed in Section 2-3, although Fraser asserted that the presence of attached specialists supported by elite patronage was unlikely, the presence of craft specialists is still open to further discussion, with the likelihood that goods were produced at a household level.

In his discussion, citing Flannery's paper about extended households,[180] Fraser suggested Tall-e Bakun A was organised as '*a heterarchy of extended family households rather than a hierarchy controlled by a dominant élite*'.[181] He points out that the northern complex in Tall-e Bakun A consists of at least four compounds, which each separate open area. He interpreted that each compound belonged to each extended family household based on the architectural evidence, food preparation, and storage. In addition, he interpreted that all sealings were utilized for movable objects, and sealed objects were secured in storerooms. Furthermore, he argued that extended households mobilized a large labour force, enabling a multifaceted economy, then leading to increasing specialisation of individuals or groups within extended family households. He suggested the possibility of cooperative works with other members of the extended households, such as farming, herding, and hunting. Whereas Alizadeh regarded nomads as external stimuli for the development of societies, Fraser argued for the economic diversification of extended households as internal stimuli for the Bakun society to evolve. Fraser did not see mobile pastoralism playing an important role in the sociopolitical development of states, mentioning that '*its occupants (at Tall-e Bakun*

[177] Petrie 2011: 170.
[178] Fraser 2008: 3; Alizadeh 1988, 2006.
[179] Nissen 2000: 212.
[180] Flannery 2002.
[181] Fraser 2008: 15.

A) may have been nothing more than village-based herders engaging in short-range transhumance'.[182]

Summary of Fraser's study of social aspects

Through careful consideration of the excavated buildings and finds at Tall-e Bakun A, Fraser provided a different interpretation of the social organisation of the Bakun period from those proposed by Sumner and Alizadeh. Although he denies the presence of elites and nomads, he still suggests the possibility that craft specialisation existed at a household level. To examine his interpretation of a heterarchy of extended family households and craft specialists at a household level, we need not only new excavations of well-preserved large buildings, such as Tall-e Bakun A, but also detailed analyses of craft production conducted at Tall-e Bakun A, such as pottery making, textile making, seals carving, and so on.

Yosef Garfinkel: Post-processual approach focusing on dancing

Yosef Garfinkel did an interesting approach to the painted motifs decorated on the black-on-buff ceramics, especially dancing.[183] He mentioned a bowl from Tall-e Jari A discovered from a grave as '*the best example of a dancing scene from the protohistoric Near East*'.[184] This bowl has a decoration of a circle of 15 dancing naked men. Each male is bent and forms a clockwise circle with his hands on the shoulder of the person in front of him. He suggested that the form of dancing was a circle dance, with gender clearly separated, and that clockwise dancing was performed in mourning ceremonies.[185] I also will consider this special vessel found at Tall-e Jari A in my analysis chapters.

Garfinkel interpreted that the net-covered rhombus or diamond motifs with limbs seen in the ceramics from Khuzestan, Luristan, Fars, and Kerman also represented dancing humans or '*dancing diamonds*', as a result of the stylistic analysis of the motifs in terms of shapes and structures (Cat. 6.18: 4).[186] His main concern was the importance of the dancing activity in prehistoric West Asia to mitigate social tension. His studies can be located into a post-processual approach among the previous studies of the social organisation of the Bakun period.

Susan Pollock and Reinhard Bernbeck: approach from daily practices

A visit to fifth-millennium BCE Rahmatabad

Finally, I will review the approach to the social aspects of the Bakun period from daily practices. This approach dated back to a short essay written in the excavation report of Rahmatabad by Reinhard Bernbeck, Hassan Fazeli, and Susan Pollock in 2005.[187] The title of this essay is '*A Visit to Fifth-Millennium (BCE) Rahmatabad*'. In this essay, the authors reconstructed one scene in daily practice of the ancient village of Rahmatabad based on the material evidence with lyrical imagination. The scene was an invitation of a guest to the house of a host, and the authors delineated surroundings from the point of view of the guest. This essay ended with the last sentences asking about the impressions of ancient life at Rahmatabad from the modern perspective:

> 'What a strange way of living! Why would anyone close themselves up in such small, dark spaces, instead of remaining outdoors, camping in open tents and following herds of goats and sheep? It could be an option in winter, when deep snow covers the valleys and mountains, but who would trade a life of wandering for an eternal residence in these obscure boxes, far from trees, sun, and air?'[188]

Pollock's study of social aspects in 2010

In 2010, Susan Pollock proposed the approach to practices of daily life during the Bakun period.[189] As one alternative approach to consider similarities and dissimilarities of material culture in the fifth millennium BCE West Asia, she analysed and compared food-related practices at three sites in two regions—central Mesopotamia, Tell Abada and Tall Madhhur, and southern Iran, Tall-e Bakun A—especially focusing on the use of space for food preparation and consumption and the uses of pottery. For analysis, she classified vessel shapes, paying attention to the general function. She pointed out that similar food preparation and consumption inside houses were confirmed in the two sites in Hamrin and in Tall-e Bakun A. However, as a result of the calculation of the proportions of serving and eating vessels, she found differences of the group sizes engaged in food-related activities between the two regions, namely a greater tendency to individual or small-group food preparation and consumption at Tall-e Bakun A than in the Hamrin sites.

[182] Fraser 2008: 17.
[183] Garfinkel 2003: 161-203.
[184] Vanden Berghe 1952: 214 and Plate XLIX, 1966 Plate 50 and 52a; Garfinkel 2003: 201.
[185] Garfinkel 2003: 99.
[186] Garfinkel 2005.
[187] Bernbeck et al. 2005.
[188] Bernbeck et al. 2005: 100.
[189] Pollock 2010.

Pollock's study of social aspects in 2012

In 2012, Pollock also considered differences in ways of utilizing pottery between the Neolithic and the Early Chalcolithic in Fars province.[190] Especially, she focused on the difference of commensalities between these two periods. According to Pollock, commensality is defined as follows: '*commensality refers to far more than just fulfilling the essential biological need of every person for food and drink; it draws our attention to the strongly social elements of eating together*'.[191] For the analysis of the ceramic materials from Tall-e Bakun A in terms of commensality, she classified vessel forms into seven types. In addition, she presented the range of rim diameters, heights, and volumes, thereby pointing out the existence of several size classes in some forms, suggesting '*a growing specialization of particular vessels for specific uses*'.[192] She also paid attention to the tendency towards individualization of vessels, namely smaller vessels for individual servings. She concluded that the Early Chalcolithic people cooked and ate meals within each household, whereas the Neolithic people prepared and took meals together beyond households.

Pollock's study of social aspects in 2015

In the most recent paper written in 2015, Pollock examined the development of social inequalities in Late Neolithic and Early Chalcolithic Fars by using evidence of built space, pottery production, the ornamentation of bodies, and sealing practices.[193] The key theoretical topic in this paper is subjectivation. She defined subjects as the people who make everyday practices in '*the dialectical relationships between limitations within which people live their lives and the room they have to act within those limitations*'.[194] She regarded subjects neither as just entities nor as simple individuals but as networks of relationships. Then, she approached social inequalities in terms of '*Handlungsraum*', a space for action in which people as subjects are not only limited but also have possibilities to modify them. When she applied it to the material remains, she assumed a dialectical relationship between subjects and objects, namely she asked not only how people produced objects but also how the object world in turn contributed to the definition of '*Handlungsräume*' and subjects.

In the analysis of Bakun-period sites, Pollock pointed out the importance of middle rooms at Tall-e Bakun A for food preparation, serving food, and hosting guests, thereby developing the relationship of two subjectivities: hosts and guests. I already mentioned her discussion of pottery production in Section 2-3-3. She also interpreted the appearance of the animal and human painted decoration on pots and figurines as '*an attempt to categorize the natural world as a means to control or possess it*'.[195] She argued that naturalistic portrayal in the Bakun period points to the appearance of representation, or of '*separating depictions of living beings from their actual living existence*',[196] which means '*categorization of what were continually changing beings into stable, fixed representations*'.[197] She supported Fraser's interpretation that stamp seals were used to mark property; however, she interpreted that the existence of seals indicates mistrust among people. Finally, she concluded that the Neolithic restrictions on innovation in the pottery production contributed to preventing social inequalities, as well as maintaining and creating egalitarian subjectivities, whereas the latitude on innovation in the Bakun period '*corresponded to a growing concern with material objects as property of particular houses*'.[198]

Summary of Pollock's study

Pollock's discussion of the social aspects in the Bakun period, focusing on daily practices and relations between subjects and objects, was different from those by the other previous researchers who attempted to grasp the social organisation of the Bakun period as a static structure. She argued for increasing social inequalities in the Bakun period. There is also room for improvement in her analysis. Although her approach mainly took the form of a comparison between the daily practices of the Late Neolithic and those of the Chalcolithic, there are also differences in daily practices within the Neolithic (the Mushki, the Bashi, the Jari, and the Shamsabad) and within the Chalcolithic (the Early, Middle, and Late Bakun and the Lapui), as she acknowledged in her articles. A more detailed discussion considering these subperiods will provide a better understanding of the diachronic change of the social aspects.

Summary: problems of previous studies of the Bakun-period social aspects

I have reviewed the previous studies of Bakun-period social aspects, in other words, the ways of organising villages and pottery production. The debate continues in terms of three aspects, as I summarise below. The first aspect is a degree of social stratification. On the one hand, Alizadeh argued for a high degree of hierarchy represented by the presence of elite mobile-pastoralists, and Sumner suggested political organisation composed of hierarchically ranked kinship units. On the other hand, Fraser insisted that the social organisation at Tall-e Bakun A was organised as a heterarchy of extended family

190 Pollock 2012.
191 Pollock 2012: 32.
192 Pollock 2012: 37.
193 Pollock 2015.
194 Pollock 2015: 40.
195 Pollock 2015: 58.
196 Pollock 2015: 59.
197 Pollock 2015: 60.
198 Pollock 2015: 59.

households. These researchers discussed hierarchy of the social organisation as a static structure. On the other hand, Pollock interpreted the Bakun village-communities as proceeding towards social inequalities in terms of daily practices and relations between subjects and objects.

The second aspect is the degree of mobility. Especially, Alizadeh had a great role in bringing the concept of mobility into the discussion of the social organisation of the Bakun period. Alizadeh emphasised the presence of mobile pastoralists and argued that mobile pastoralists were driving forces for developing social organisation during the Bakun period. After the appearance of his hypothesis, Potts, Weeks, Petrie, and Fraser criticised his Nomadic Hypothesis and the evidence on which the hypothesis was based. Whereas Alizadeh argued that mobile pastoralists' mobilities of the Bakun period were routinised as subsistence practices and long-distance trade, Petrie regarded the mobility of the Bakun period as one of the factors in modelling the innovation diffusion process.

Finally, the third aspect is the theoretical perspective on which previous studies were based in reconstructing the social organisation. Sumner and Alizadeh were strongly influenced by the neoevolutionist perspective, which reconstructs the social organisation as a static structure. This perspective was based on the studies of chiefdom, social complexity, and craft specialisation that were obtained mainly from ethnography. After Sumner and Alizadeh, researchers avoided this perspective by drawing attention to either cultural transmission (Petrie) or daily practices and relations between subjects and objects (Pollock). This aspect is still in need of review, including the previous studies of social organisation and craft specialisation in other regions and periods. Hence, this is what I will tackle in Chapter 3. I need not only to find problems of the neoevolutionist perspective but also to propose another perspective. One of the candidates is a perspective of relations, as indicated by Pollock.

2-5. Summary of Chapter 2

At the beginning of this chapter, four research questions were presented: (1) chronology, (2) diachronic change of the pottery, (3) pottery production, and (4) social organisation. Above in each section, I reviewed what was discussed, what was debated, and what was not studied yet in these four topics. These reviews are summarised as follows.

1) As for the chronology of the Bakun period, although a tripartite subdivision system based on three type-sites (Tall-e Bakun A, Tall-e Bakun B, and Tall-e Gap) was established, problems of this subdivision system lie in the transition between these type-sites and the unclear chronological markers, such as painted motifs. Further discussion of site stratigraphy and radiocarbon dates is required.
2) The diachronic change of the Bakun pottery was not studied well before the 1990s because the ceramics, especially painted motifs and vessel forms, were studied as chronological markers. There is little research that quantitatively compares pottery attributes from the early phase to the final phase of the Bakun period. In addition, the classification systems of painted decoration and vessel forms differed by researcher. The integration of these classification systems is also required.
3) Regarding the previous studies of pottery production, the diachronic change of pottery-making techniques during the Bakun period also was not studied in the same manner as other pottery attributes. In addition, studies of the entirety of production stages, from clay acquisition to firing, were not conducted. The most serious problem lies in the discussion of craft specialisation, which interpreted various degrees of craft specialists in the Bakun period. The framework of craft specialisation needs to be further explored in Chapter 3.
4) The previous studies of social organisation were reviewed in more detail than other topics. The debate continues regarding degrees of social stratification and mobility. These two aspects were discussed based on the neoevolutionist perspective searching for 'chiefdom' and 'social complexity', mainly by Sumner and Alizadeh. As with craft specialisation, further review of the neoevolutionist perspective is required to proceed with an alternative perspective. The review of the neoevolutionist perspective and exploration into an alternate perspective will be developed in Chapter 3.

Chapter 3

The theoretical framework for craft-production studies

As mentioned in the review of previous studies on pottery production and social organisation during the Bakun period (Chapter 2), the widespread idea that the Bakun pottery production was in a specialised stage arose within the context of the exploration of 'chiefdom' and 'craft specialisation and social complexity' in the 1980–90s. To date, the idea has survived with relatively scant criticism, except for the views of Pollock and Bernbeck. In this chapter, I will review:

1) Where were the studies of craft production positioned within the archaeological disciplines, and how did archaeologists study craft production? What are problems of craft-production studies?
2) Are there better paths towards an investigation for craft-production studies? How will the craft production be studied in this research?

In the first section, I will identify the problems of previous craft-production studies, especially craft-specialisation studies through reviewing the previous studies. Then, in the second section, I will introduce a relational perspective on craft-production studies, drawing on Latour's actor–network theory and Hodder's entanglement theory. Furthermore, I will update the relational perspective by integrating communities of practice and Tim Ingold's concept of skill.

3-1. Reconsidering craft specialisation and social complexity

To find the problems in studies of craft-specialisation studies and social complexity, I will review the previous studies of craft specialisation internationally. Throughout this review, three questions will be asked of the previous studies:

1) For what reason did researchers study 'the craft specialisation and the social complexity'?
2) Which methodology did they adopt for exploring the topic? and
3) What were the problems of their studies?

Fig. 3.1 shows the result of Google Ngram viewer for the term 'craft specialization'. This term was scarcely found in the Google Ngram viewer before the 1920s, possibly because it did not appear in the books scanned by Google, and the term suddenly emerged in the 1920s. From that point, its frequency of appearance gradually increased and reached a peak in the late 1990s. After the 2000s, it rapidly decreased. Considering this trend and the relevant previous studies, I separated the review of the previous researchers into four sections by time period: (1) the 1950–60s, (2) the 1970–80s, (3) the 1990s, and (4) the 2000–10s.

The 1950–60s

V. Gordon Childe

The narrative of craft specialisation in archaeology began with V. Gordon Childe, whose approach shifted from the culture-historical to the Marxist.[1] In his article on 'the urban revolution' that sought to define the earliest cities, he established ten criteria that can be deduced from archaeological data.[2] Among the ten criteria, two of them are related to craft specialisation and the presence of full-time craft specialists, namely that 1) they are supported by the surplus produced by the peasants living in the city and the villages,[3] and 2) their securities were guaranteed by a state organisation such that they do not need to move any more.[4] His main concern was to explain the urban revolution rather than craft specialisation itself. He assumed that at the early stage full-time specialists were itinerant and moved around from village to village at the early stage and that there were scant surpluses to keep them in each village, as indicated by an ethnography of the Maori. According to Childe, these itinerant specialists lost their membership in the sedentary kinship group that provided the members with security; thus, they needed a substitute for the kinship group.

Thus, the key difference is between itinerancy and the presence of support from a state organisation, which the later archaeologists named the distinction between 'independent' and 'attached' craftspeople'. This also indicates that Childe assumed that the surplus was important for maintaining craft specialisation rather than political power.

Childe also coined another classification of craft production. In his book '*Social Evolution*', he explained the 'part-time specialist' and 'full-time specialist'. His definition of both terms are as follows;

[1] Childe 1950, Trigger 1986, Wailes 1996.
[2] Childe 1950.
[3] Childe 1950: 9.
[4] Childe 1950: 16.

Figure 3.1 The occurrence of term 'craft specialization' in the literature since 1900 (made by Google Books Ngram Viewer)

> '...part-time specialists; they are primarily hunters, or fishers, or farmers, and exercise their special skill not in place of getting their food directly, but in addition thereto, and in return merely for a supplement to the produce of their own labour. Such part-time specialists could not be recognized in the archaeological record and are perhaps not very important for a stadial classification.'

> 'Full-time specialists are those who do not themselves produce food, but are fed from the social surplus in return for the exercise or products of their special skill. They are not appreciably easier to recognize archaeologically, but have generally to be inferred from the ethnographic and historical analogies. '[5]

His studies were relevant because he applied the concept 'craft specialisation' to prehistoric archaeology for the first time, defined it, and presented the basic classification: part-time, full-time, intracommunal, intercommunal, full-time supported by villages, and full-time supported by the state organisation.

However, Childe's original concept of 'craft specialisation' has been criticised in the last 70 years. In a volume on craft specialisation published in 1996, Bernard Wailes examined the validity of Childe's argument concerning craft specialisation, especially metalworking in Europe and the Near East.[6] He acknowledged that some of Childe's postulates were now clearly wrong, in particular his thesis that metalworking in the Near East had an elite-controlled character and was less innovative, while metalworkers in Europe were the itinerants who could be innovative and were independent of elites. However, Wailes argued that the theoretical parts of Childe's thesis (i.e., the social relations of production) still play an important role in discussing craft specialisation and social evolution. Sarah Milliken called Childe's narrow definition of craft specialisation, which is related only to the urban revolution, '*the ghost of Childe*', and she discussed the presence of craft specialisation in the Palaeolithic from the perspective of the social embeddedness of technology.[7]

Neoevolutionism

In addition to Childe's archaeology, I will also discuss another theoretical topic that affected our understanding of social complexity and craft specialisation in the 1950–60s. Neoevolutionism emerged from cultural anthropology in the United States in the 1950–60s as a reappraisal of the social evolutionism discussed by Lewis Henry Morgan during the 19th century and led mainly by Leslie White.[8] Neoevolutionism was a theory against the cultural relativism insisted on by Franz Boas. White argued that a technological apparatus allows societies to use, control, and capture more energy. Hence, he argued that societies that efficiently harnessed energy using the apparatus evolved faster.

White's and Childe's approaches were criticised by Julian Steward as ideas of 'universal evolution'.[9] Instead, he proposed a 'multilinear evolution' and cultural ecology in terms of environmental determinism. In 1960, Marshall Sahlins proposed with a new model by defining 'general evolution' (White's universal evolution) and 'specific evolution' (Steward's multilinear evolution) as components of cultural evolution.[10] Elman R. Service

[5] Childe 1951: 62-63.
[6] Wailes 1996.
[7] Milliken 1998.
[8] White 1959.
[9] Steward 1955.
[10] Sahlins and Service 1960.

followed this evolutionary perspective and applied it to the evolution of 'social organisation', using 'groups' and 'statuses' as key markers to understanding.[11] He classified the evolution of the social organisation into five stages — 'primate sociality', 'bands', 'tribes', 'chiefdoms', and 'states' — based on the general evolution. Drawing on Service's evolutionary perspective, Morton H. Fried discussed the evolution of political society.[12] He also established the episodic stages of political society, which started from 'egalitarian society', and moved through 'rank society', 'stratified society', and 'the states'. These typological approaches to social organisation, following the neoevolutionist background, affected craft-specialisation studies in the 1970–80s in terms of its correlation with social complexity and the methodology of typological classification.

The 1970–80s

Robert K. Evans

Before the 1970s, craft specialisation was studied using the earliest cities and neoevolutionism. The study of craft specialisation in itself appeared in the 1970s. Robert K. Evans, who developed his dissertation on the craft specialisation in the Balkan Chalcolithic,[13] was one of the first archaeologists to study craft specialisation from the archaeological evidence. His idea was influenced by the general systems theory. He thought that the development of craft specialisation was concomitant with the growth of complex sociocultural systems in the Chalcolithic. Evans paid attention to efficiency as a particular merit of craft specialisation in a technological subsystem: '*Specialists are more efficient in the long run in a multitude of activities. This has been demonstrated in modern farming, business, industry, science, etc.*'.[14]

Evans' analytical method also reflected a systems-theoretical assumption. Citing a definition of craft specialisation from the American anthropologist William B. Rodgers,[15] he defined craft specialisation based on four conditions;

'1. The manufacture of certain craft products is limited to a small percentage of the total number of individuals in any given community.
2. These individuals devote some of their productive time to the manufacture of these craft products.
3. Consequently, they must withdraw themselves from some or all of the basic subsistence activities.
4. Thus, they must obtain some or all of their subsistence goods through some kind of exchange system for their craft products.'[16]

Evans further assumed that craft specialisation was interrelated with population size, technological complexity, efficiency, spatial differentiation of the workspace, and functional differentiation of tools. Moreover, he presented a list of expected phenomena of craft specialisation that can be sought from the archaeological evidence:

'1. Workshops: specialised areas for craft activities.
2. Tool kits: specialised tools for craft activities.
3. Storage facilities and/ or hoards: delimited locations for strong completed craft products.
4. Resource exploitation: regular exploitation of particular resources.
5. Exchange and trade: distribution of resources or craft products.
6. Differential distributions.'[17]

Prudence M. Rice

Prudence M. Rice approached specialised pottery production in 1981.[18] She pointed out that the archaeological definitions of craft specialisation were poorly developed in comparison to the ethnographical ones. She defined craft specialisation as follows:

> 'Craft specialization is here considered an adaptive process (rather than a static structural trait) in the dynamic interrelationship between a nonindustrialized society and its environment. Through this process, behavioral and material variety in extractive and productive activities is regulated or regularized. (...) craft specialization represents a situation in which access to a certain kind of resource is restricted to a particular social segment.'[19]

As her definition indirectly showed, she focused on the degree of variety in artefacts (standardisation and diversity), which can be approached archaeologically. She then proposed a trial model in which the ceramic variability (from diverse to standardised) is correlated with the degree of cultural complexity (from acephalous to stratified).[20] She emphasised the practical advantage of her model: '*The advantage of the model is its capacity for making craft specialization operational for archaeological study diachronically and synchronically*'.[21]

[11] Service 1962.
[12] Fried 1967.
[13] Evans 1978.
[14] Evans 1978: 126.
[15] Rodgers 1966.
[16] Evans 1978: 115.
[17] Evans 1978: 115.
[18] Rice 1981.
[19] Rice 1981: 219-220.
[20] Rice 1981: 222-223, Table 1.
[21] Rice 1981: 227.

David Peacock

The interest in craft-production studies and the modelling and classification of modes of craft production using the ethnography can also be observed in the Roman pottery study by David Peacock.[22] He proposed a production mode hierarchy comprised of eight modes of production, from simplest to most complex: (1) household production, (2) household industry, (3) individual workshop, (4) nucleated workshops, (5) the manufactory, (6) the factory, (7) estate production, and (8) military and other official production. The criteria of the production modes were primarily based on the scale of craft production. However, it should be noted that Peacock understood the risk as well as the merit of his classification:

> 'However, it must be remembered that we are attempting to impose a conceptual framework upon a situation that in practice may be almost infinitely variable, with many examples falling between rather than within the modes here defined, but it is only when the rules have been made that the exceptions can be recognized.'[23]

Elizabeth M. Brumfiel and Timothy K. Earle

By the late 1980s, the number of craft-specialisation studies had increased enough for the publication of the first edited volume focusing on craft specialisation. In 1987, Elizabeth M. Brumfiel and Timothy K. Earle edited the book '*Specialization, exchange, and complex societies*' based on a meeting in 1983. In the introduction, they reviewed the previous studies on craft specialisation and classified them into three models: (1) the commercial development model, (2) the adaptationist model, and (3) the political model.[24] The first model was that of Childe, who argued that specialisation and exchange appeared spontaneously because of economic surplus. The second adaptationist model assumed that specialisation, exchange, and social complexity developed because political elites intervened in the economy in the form of redistribution, intervention in market exchanges, management of production, and sponsorship of long-distance trade. The third political model argued that the political elites consciously and strategically organised specialisation and exchange to receive benefits from creating and maintaining social inequality, reinforcing political coalitions, and establishing new institutions of control. Brumfiel and Earle's main concern was how archaeologists could refine the third political model.

Brumfiel and Earle proposed some topics useful for the better comprehension of craft specialisation and social complexity, especially those related to the political model: subsistence goods/wealth, independent/attached specialist, and staple/wealth finance. Among the three proposed dichotomies, 'independent/attached specialist' and 'staple/wealth finance' were developed by Earle himself for their application to archaeology.[25] They also included the intensity of specialisation (part-time/full-time), the scale of the production unit, and the volume of output per individual specialist in the dimensions of variation presented by specialisation.

Brumfiel and Earle paid more attention to attached specialists than independent specialists since they thought that attached specialists emerged from the control by elite. The keyword connecting the attached specialist and the political leader is 'wealth', which was described as follows: '*Wealth includes primitive valuables used in display, ritual, and exchange and special, rare and highly desired subsistence products*.'[26] They argued that wealth could not only become a means for a finance system in the political economy of complex societies, but also played a role in justifying the political authority when the production of wealth by attached specialists was controlled by political elites. Furthermore, Brumfiel and Earle mentioned the ideological and symbolic messages implicit in wealth and used to maintain the political authority.

Problems of craft-specialisation studies in the 1970–80s

After reviewing several works, I will summarise and problematise the craft-specialisation studies in the 1970–80s. In this period, archaeologists started to focus on craft specialisation. To apply the concept of craft specialisation to the archaeological analysis more neatly, they defined what craft specialisation was and set up criteria for how archaeologists can approach craft specialisation from the archaeological evidence. Above I presented two definitions of craft specialisation defined by Evans and Rice, which were influenced by systems theory and processual perspectives. Apart from those, there was another definition proposed by Maurizio Tosi from a Marxist perspective;

> '... degree of craft specialization is best determined as variability of output per capita for a given product within the population sampled. (...) At least five parameters are involved: (1) population; (2) kind of commodity; (3) output of commodity; (4) time range; (5) spatial distribution.'[27]

[22] Peacock 1982.
[23] Peacock 1982.
[24] Brumfiel and Earle 1987: 1-4.
[25] Earle 1981; D'Altroy and Earle 1985.
[26] Brumfiel and Earle 1987: 4.
[27] Tosi 1984: 23.

Although the definitions proposed by Evans, Rice, and Tosi run the risk of limiting the potential of craft specialisation or craft production, they enabled archaeologists to approach craft specialisation from the archaeological materials. The archaeologists classified the archaeological materials linked to craft specialisation into several types according to their quantitative and the qualitative character. These quantitative and qualitative variables in craft specialisation are best exemplified in Brumfiel and Earle's review, which set up the dimensions of craft specialisation and consisted of the specialist affiliation (independent/attached), the intensity and scale of the production unit, and so forth.[28] These variables are all related to the models of production-modes, as Peacock showed. Furthermore, the archaeologists who had maintained a neoevolutionist perspective since the 1950–60s proceeded to seek a correlation between craft specialisation and social complexity. Rice assumed a correlation between the variability of ceramic materials and social complexity. The political model argued by Brumfiel and Earle was another form of this assumption and emphasised the importance of elite control of the attached specialists. The neoevolutionist perspective influenced the understanding of the production mode as well, such as the line of developmental evolving the developing stages from household production to factory production.

There were no doubt many arguments against the correlation of craft specialisation and the sociopolitical complexity in that period. The presence of these opposing arguments was clear in the comments to Rice's 1981 paper. Ian Hodder, the founder of post-processual archaeology commented on Rice's paper, emphasising the significance of cultural context and symbolic meaning.[29]

The 1990s

John E. Clark in the 1990s

The 1990s was the decade in which the term 'craft specialisation' was the most frequently mentioned in the archaeological books (Fig. 3.1). In this section, I will mainly review two archaeologists, John E. Clark and Cathy Costin, who continued to discuss craft specialisation until the 2000s. John E. Clark collaborated with statistics researcher William J. Parry and published an important article about the relationship between craft specialisation and sociopolitical complexity in 1990.[30] His study started from a suspicion that craft specialisation was closely related to cultural complexity. To examine this relationship, Clark conducted a statistical analysis of the correlation using the cross-cultural data from 53 societies available from the Human Relations Area Files (HRAF) and the historical texts. However, it should be mentioned that there are many critiques about the use of ethnographic data from the standpoint of feminist archaeology.[31]

Clark defined craft specialisation in a wider sense for the purpose of coding of different types of data and tracing it in the archaeological evidence: *'craft specialization is production of alienable, durable goods for nondependent consumption'*.[32] His first classification of variants was in terms of *independent* craft specialisation and *attached* craft specialisation, depending on whether the craftsperson retains the right of alienation. He also added the scale of the production (ad hoc, part-time, and full-time) to the criteria. As a result, 12 variants of craft specialisation were set up (independent: prestation, barter, commercial, small shop, and factory; and attached: patronised, precinct, state sponsored, putting out, tributary, servile, and corvée). It should be mentioned that these classifications were only for the coding and the subsequent analyses to examine the relationship between craft specialisation and social complexity. He acknowledged that '*[t]hese types are analytical, not descriptive. A particular craft person can participate in several types of craft specialization, as is often the case*'.[33]

The results of the statistical analysis for approaching the correlation between the degree of cultural complexity and the degree of craft specialisation showed that (1) the intensity of craft specialisation was associated with the degree of cultural complexity; (2) the numbers of craft specialists and specialties were strongly correlated with the community size; (3) the attached and patronised craft specialisations were more correlated with all of the variables of cultural complexity than full-time craft specialisation; and (4) hypertrophic goods were significantly associated with political integration, social stratification, and population density, even when tested without the cases of highly complex societies. It should be noted that Clark acknowledged that these correlations did not necessarily indicate a causal relationship.

Cathy Costin in the 1990s

Soon after Clark and Parry's work, Cathy Costin published a methodological paper on craft specialisation in 1991.[34] Nearly at the same time, Christopher Pool also presented a paper concerning the

[28] Brumfiel and Earle 1987: 5.
[29] Hodder 1981: 231.
[30] Clark and Parry 1990. Because the original draft of this paper was submitted in 1985, the content was closer to the trend in the 1980s.
[31] Conkey and Gero 1991: 13.
[32] Clark and Parry 1990: 297.
[33] Clark and Parry 1990: 301-302.
[34] Costin 1991.

methodology of the analysis of craft specialisation in pottery production.[35] Costin's original concern in this paper was that the previous studies on production were less systematised than those on distribution. Through the review and critique of the previous definitions of craft specialisation, she pointed out the necessity for a united definition and vocabulary of craft specialisation for cross-cultural comparison. This view was related to her stance that craft specialisation is parametrical: '*A methodological point I will stress in this paper is the need for comparative material. Specialization is a relative state, not an absolute one.*'[36]

Costin distinguished specialisation from production: '*Production is the transformation of raw materials and/ or components into usable objects. Specialization is a way to organize this production.*'[37] Her definition of craft specialisation was based on integrating the previous definitions and her critique of the definition proposed by Clark and Parry, as she wrote: '*With such a loose definition, 'specialization' is present in almost every society.*' [38] Thus, Costin's definition was narrower than theirs:

> 'Hence, I would argue that specialisation is a differentiated, regularized, permanent, and perhaps institutionalized production system in which producers depend on extra-household exchange relationships at least in part for their livelihood, and consumers depend on them for acquisition of goods they do not produce themselves.'[39]

The significant difference from Clark was that she established the dependency between producers and consumers inside the definition of craft specialisation. As is clear from her definition, she stressed the embeddedness of production within social systems.

Costin then reviewed the previous studies of craft specialisation in terms of *degrees* (the ratio of producers to consumers) and *types* (the way which specialisation is organised). The previous studies of craft specialisation proposed many typologies and terminologies. She pointed out that these criteria depended on the theoretical backgrounds of the authors, the different terminologies used for each type of craft specialisation, and the misuses of the terms. After the review, she proposed four general parameters to describe the organisation of production (context, concentration, scale, and intensity) and eight parameter-based types of specialisation (individual specialisation, dispersed workshop, community specialisation, nucleated workshops, dispersed corvée, individual retainers, nucleated corvée, and retainer workshop).[40] I would like to point out here that her classification of craft specialisation emphasised parametrics that were oriented towards universal applicability to data and at the same time was founded upon theory:

> 'Ideally, typologies should be extracted from a wide range of ethnographic, historic, and archaeological cases in order to make them as universally applicable as possible. Furthermore, the typology should have some basis in theory, reflecting the social, economic, political, and environmental conditions under which different forms of production are expected to arise. Thus, the framework will be both descriptive and explanatory.'[41]

She then explained direct and indirect evidence as clues to reconstructing the organisation of production in detail. Direct evidence includes not only production loci and debris but also their context, concentration, scale, and intensity, while indirect evidence includes standardisation, skill, and regional variation. According to Costin, the crucial difference between direct evidence and indirect evidence is that indirect evidence must be used with theoretical assumptions and understanding of the social, technological, and natural milieu in which production occurred.[42]

Problems of craft-specialisation studies in the 1990s

As I will review below, the methodology for studying craft specialisation proposed by Costin became the standard of craft-specialisation studies in the 1990–2000s. Many researchers have mentioned and cited her paper in discussing craft specialisation, as well as the paper written by Clark and Parry.[43] She updated her methodology with corrections in 2001 and 2005 (see in Section 3-1-4).[44] However, the problems of her methodology started to be pointed out beginning in the 2000s.[45] These criticisms will be reviewed in the next section. Here, I will discuss one of the first criticisms to her methodology, which was published by Clark in 1995. This paper, titled '*Craft specialization as an archaeological category*', was also a counterargument to her paper that criticised the definitions of craft specialisation proposed by Clark and Parry in 1990.

At the beginning of his paper, he problematises the assumptions that previous researchers made about 'craft specialisation' and the common notions of specialised

35 Pool 1992.
36 Costin 1991: 2.
37 Costin 1991: 3.
38 Costin 1991: 3.
39 Costin 1991: 4.
40 Costin 1991: Fig. 1.4.
41 Costin 1991: 8.
42 Costin 1991: 32.
43 Wailes 1996, Milliken 1998, Patterson 2005, Kerner 2010.
44 Costin 2001, 2005.
45 Patterson 2005, Clark 2007, Sinopoli 2003, Arnold 2008.

production prevalent in the Western tradition.[46] He stated the problems of craft specialisation as an archaeological category, focusing on (1) its systemic character, (2) the problems of setting up parameters, (3) the theory of demand/value in the prehistoric period, and (4) the conflation of the description of the explanandum with the explanans and the lack of theoretical background. Below, I will explain the four problems in more detail.

Clark began with the problem of the categorical boundary of craft specialisation in the definitions proposed by Childe, Evans, and Costin, which included the mutual dependency between elites and specialists.[47] Where is the boundary between specialised production and non-specialised production? It is actually blurred. Clark pointed out that the problem lay in the very restrictive and systemic definition of craft specialisation, which assumed the mutual dependency of specialists within a bounded social framework.

Second, Clark mentioned the problems in Costin's definition of attached craft-specialisation. He pointed out that her definition assumes the presence of elites, and therefore, she cannot approach the co-evolution of attached craft-specialisation and social inequality.[48] In addition, context (the degree of elite sponsorship, independent to attached), one of the parameters Costin used to classify the types of craft specialisation, was criticised by Clark because independent and attached specialisation were not points on a single continuum but categorically different. Costin's parameter 'context' was thus a mixture of distinct variables.

Third, Clark turned to Costin's focus on demand/value in her classification of craft specialisation as derived from the market economy. He argued that her focus could become a hurdle when archaeologists interpreted craft production in non-market contexts:

> 'I am deeply concerned with what appears to be uncritical and inconsistent borrowing from formal economics to inform cross-cultural categories of craft specialisation. Market economies and ready access to goods, services, and economic information seem implied. The notion of a self-regulating system of supply and demand involves the notion of price, as supply and demand for certain goods reach equilibrium points only at certain prices. I think it would be highly useful to construct an analogous concept that could serve in non-market contexts.'[49]

Although Clark did not present a counterproposal to Costin in this paper, he outlined his own theoretical approach to the study of value, which he then discussed ten years later.[50]

Fourth, Clark criticised the absence of the ontological status of the categories of craft specialisation in Costin's scheme and the 'UCLA scheme' of other authors, including Brumfiel and Earle.[51] Here, Clark used the term 'ontological basis for the categories of craft specialisation' in a sense similar to 'a developmental mechanism of craft specialisation'. He criticised the fact that the UCLA scheme lacked such mechanisms, unlike the standard origin story of craft specialisation up to the late 1960s. In that period, surplus and leisure time were a developmental mechanism of craft specialisation. According to Clark, Costin and the UCLA scheme emphasised describing craft specialisation rather than explaining it with theory.

I pointed out four problems of craft-specialisation studies following Clark. In addition to Clark's critique, the critical perspective on craft specialisation started to increase from the late 1990s. At the end of the edited volume discussing the assessment of Childes' narrative and the current global studies of craft specialisation (edited by Bernard Wailes), Ruth Tringham reviewed the volume.[52] She pointed out that Childe's narrative and the studies of craft specialisation provided in the volume only paid attention to macroscale social action between polities, classes, and social categories, such as elites and craft producers, which were reduced to 'faceless blobs':

> 'A consideration of social complexity at a microscale involves especially the interpretation of the data in terms of social action at a microscale. This means interpretation (even if the data are ambiguous) of the data in terms of the gender, age, and day-to-day actions of the people engaged in production. Micro scale interpretation of data on production, redistribution, and consumption is becoming the topic of an increasing number of papers on prehistoric technology, but few of these have yet reached the topic of craft specialisation in the ancient political economy.[53]

She argued that there is a need for a multi-scalar approach to craft specialisation considering the social process from both a macro-scalar and a micro-scalar viewpoint (e.g. gender, age, and role in a household).

[46] Clark 1995: 268.
[47] Clark 1995: 271.
[48] Clark 1995: 280-281.
[49] Clark 1995: 287.
[50] Clark 2007.
[51] Clark 1995: 288.
[52] Tringham 1996.
[53] Tringham 1996: 236.

In sum, during the 1990s, craft specialisation studies acquired a methodological systematic framework through the work of Costin, who adopted a parametric approach. Some archaeologists, in particular Clark, pointed out the problems of Costin's methodology: (1) its systemic character, (2) the problems of setting up parameters, (3) the theory of demand/ value in the prehistoric period, and (4) conflation of the description of the explanandum with the explanans and the lack of theoretical background. The insights into the craft producer her/himself, focusing on her/his gender, age, and role in a household—rather than a faceless production system—also increased in prominence.

The 2000–10s

From the 2000s, craft specialisation studies started to decrease (Fig. 3.1). The theoretical orientation of craft specialisation sought a connection with other theoretical approaches, such as agency, practice theory, and values. As I will introduce below, there was an increase in the critiques of the field of craft specialisation studies, which presented clear counterexamples with solid archaeological evidence, increased. After the publication of the proceedings '*Rethinking Craft Specialization in Complex Societies*' edited by Zachary Hruby and Rowan Flad,[54] integrative work focusing only on craft specialisation ended.

Cathy Costin in the 2000s

As mentioned above, Costin continued to update her methodological framework for studying craft specialisation during the 2000s.[55] In her paper about the methodology for craft-production systems written in 2001, she accepted Clark's criticisms of her 1991 published paper. However, she still used his criticisms, she still used her updated parametrical approach. As of 2001, she argued that *production system* constitutes six components: artisans, the means of production, the organisation and social relationships of production, the objects, the relationships of distribution, and consumers.[56] She then reviewed each component in detail. In the process of reviewing these components, she also mentioned the lack of attention to gender, social rank, and social identity of an artisan as criticised by Tringham.

In her review and methodological paper written in 2005, she classified and labelled the previous approaches of craft production, including her own works, into five types: (1) the typological-organisational approach; (2) the typological-contextual approach in terms of modes of production; (3) the descriptive approach, with axes and parameters; (4) the production system, studying an integrated whole; and (5) multicraft and holistic studies of production.[57] The final approach type to craft production considered that multi-types of craft production (e.g., pottery, lithics, and bronzes) intersected at archaeological sites and influenced each other. Costin also considered theoretical frameworks for explaining technology, organisation, and demand.[58] Her focus on theoretical frameworks was a response to Clark's fourth critique concerning the lack of theory for explaining craft specialisation. Costin further upgraded her methodological frameworks of craft production and discussed the three basic components of production systems: the technology (the technological component), the artisans (the human component), and the organisation (the organisational components). Although her classification framework differed from that of 2001, each component followed the form of 2001.

John E. Clark in the 2000s

Above, I presented one important advocate of craft specialisation studies in the 2000–2010s, Cathy Costin. The critiques against Costin led her to change and upgrade her methodology. However, despite this, new critiques emerged, which can be located under the four categories of Clark's criticisms of 1995. One of the criticisms was again from Clark from the preceding '*Rethinking Craft Specialization in Complex Societies*'.[59] He continued to criticise the systemic character of craft specialisation studies;

> 'Current categories of craft specialisation grew out of systems-thinking, neoevolutionism, and holistic views of social change. Categories were instrumental and accorded explanatory power. Subsystems, such as craft specialisation, were thought critical to system maintenance or change of the body politic. System perspectives have since been abandoned by many scholars, but their conceptual legacy endures in myriad subtle ways in lingering concepts from the 1960s, such as craft specialisation. Even a cursory appraisal of recent craft-specialisation studies reveals a cascading concern for social action and agents (Costin 2001, 2005), notions corrosive to postulates of holism, systems, society, and neoevolutionism. Our categories of craft specialisation still represent generic summaries of typifying behavior of constituent human entities involved in subsystems.'[60]

Clark again pointed out that current craft specialisation studies lacked theory, especially a theory of value. He

[54] Hruby and Flad (eds.) 2007.
[55] Costin 2001, 2005.
[56] Costin 2001: 277.
[57] Costin 2005.
[58] Costin 2001: 308; Costin 2005: 1043-1047.
[59] Clark 2007.
[60] Clark 2007: 20.

then discussed a theory of value, introducing the distinction between objects and values proposed by C.A. Gregory, namely between gifts and commodities (objective concepts of political economy) and goods (a subjective concept of neoclassical economics).[61] The introduction of Gregory's distinction was important for Clark because it favoured the reconsideration of his original definition of craft specialisation in terms of alienability, a concept that was related to exchange rather than production. Through his self-criticism of the theoretical framework of his previous studies about value, Clark had moved towards a goods-based or an 'economy'-based (derived from neoclassical economics), view of subjective value in terms of the principle of marginal utility and price theory. This stance led to a new argument that value, a theoretical challenge for craft specialisation to overcome, could be approached from the analysis of the contexts in which materials were used and that craft specialisation studies contributed less to the identification of value. Costin criticised Clark's extreme argument for the importance of studying the context of which materials were used as too extreme because he downplayed the relevance of craft production in past communities.[62]

Rowan Flad and Zachary Hruby

Rowan Flad and Zachary Hruby also presented the need for rethinking craft specialisation studies in the same volume.[63] They discussed three main theoretical topics of craft-specialisation studies: (1) a definition of craft specialisation, (2) practice theory and specialised production, and (3) the theory of value of the products. At first, they reviewed the definition of craft specialisation from the 1970s to the 2000s. They proposed two types of definitions of craft specialisation: One was 'producer specialisation', and it corresponded roughly with the narrower definition of craft specialisation proposed by Costin, as stated before. Another was 'product specialisation', and it referred to the broader definition of craft specialisation proposed by Clark. They viewed the two definitions as not qualitatively different but as differing in degrees, as shown in the diagram, with producer specialisation considered a subset of product specialisation.[64] They even visualised both definitions as two extremes on the same axis ('complete producer specialisation' and 'complete product specialisation').[65] Their solution was an answer to Clark's critique of the systemic view of craft specialisation, namely the boundary between specialised and non-specialised production. However, even after they presented this solution, they still expressed questions about craft specialisation studies, which nevertheless provide useful tools.[66]

Their second topic, also relevant for my concern here, was the introduction of practice theory to the discussion of specialised production. The viewpoint of practice theory, which argues that the underlying structures and the actions of individuals bound within the structures reflexively redefine and recreate one another, was a hopeful candidate to overcome the systemic perspective of craft specialisation studies. They focused on the usefulness of practice theory in connection with the craft producer's social identity and esoteric knowledge, ritual performanc, and value and meaning. For example, the fame (a kind of social identity) of a craft producer or the esoteric knowledge concerning the production process affects the value of the skilled production and the end-product in a specific context (structure). At the same time, the execution of the skilled production within the context also reflexively enhances the fame and the importance of the knowledge. This viewpoint emphasises the labour of individuals rather than that of communities.

Flad and Hruby' application of practice theory to the craft-production study emphasises the importance of the analysis of the social context rather than craft production itself. Their emphasis focuses on the (re-)production of meaning and value. They discuss the theoretical topic of value[67] like Clark and their discussion basically follows Clark's one about value. The shift of the concern from craft production as a system to the value and the social context within which the craft production and its value were produced and reproduced was partly characteristic of the craft production studies during the 2000s.

Critiques of craft specialisation studies in the 2000s

Above, I reviewed the major works of craft specialisation in the 2000s. There are still many arguments against craft-specialisation studies. The critical studies of craft specialisation during the 2000s can be classified into two types:

1) counterexamples that do not follow the systemic framework of craft-specialisation studies, and
2) a practice approach to craft production.

Carla Sinopoli discussed both aspects of craft production in her 2003 book. She briefly problematised the assumed correlation between sociopolitical complexity and craft production using the counterexamples from case studies of craft production in South India during the Vijayanagara period, with volumes of written

[61] Gregory 1982; Clark 2007: 24.
[62] Costin 2007.
[63] Flad and Hruby 2007.
[64] Flad and Hruby 2007: 5, Fig. 1.1.
[65] Flad and Hruby 2007: 5, Fig. 1.2.
[66] Flad and Hruby 2007: 6.
[67] Flad and Hruby 2007: 8-12.

documents.[68] She also criticised Costin's parametric approach because of the difficulty of tackling it on the basis of archaeological evidence.[69] Her main standpoint was a concern with social contexts of craft production stressing individual artisans as social actors. Her approach could be located in the same trajectory as the application of a practice approach to craft-production studies. Part of her discussion was also influenced by the idea of communities of practice, which draws attention to the learning of a practice within communities, and which I will introduce it in the next section.

Below, I briefly mention some critiques of craft specialisation studies during the 2000s, which fortify critical arguments against craft specialisation studies. The critiques of Jaya Menon against craft specialisation studies in archaeology belong to the first type (presenting counterexamples)[70] presented above. Menon pointed out the difficulty and the limit of reconstructing craft production from archaeological materials (especially part-time/full-time) by contrasting the archaeological record with the ethnographic record of smelting iron. Menon presented plenty of concrete counterexamples to the markers of 'specialisation' in craft-specialisation studies, with regards to mass-production, standardisation, and craft location, based on ethnographies and case studies from a Harappan period site of Mohenjodaro. Menon concludes:

> 'As pointed out earlier, problems arise when it is assumed that specialisation is associated with mass production, economizing behaviour, sponsored work, workshop production, sub-specialisation and so forth. The patchiness of the archaeological data can inhibit a complete understanding of ancient production, but far more problematic is that a disregard of the context of production can lead to misinterpretation.'[71]

Izumi Shimada and Ursel Wagner pointed out that the researchers of craft specialisation studies narrowly focus on a single craft without taking the relationship to other crafts into consideration. They emphasized instead the empirical and interdisciplinary aspects of craft-production studies and alternatively proposed a holistic approach.[72] This approach was similar to Costin's 'multicraft and holistic studies of production' and Ann Brysbaert's 'cross-craft interaction'.[73] Peter Day, Maria Relaki, and Simona Todaro also cast doubts on the usefulness of the existing models of political economy, social complexity, and specialisation in the case of Minoan Prepalatial society. They pointed out that craft specialisation studies assume a seemingly inevitable relationship between craft specialisation and social organisation.[74]

While some researchers strongly criticise craft specialisation studies with counterexamples, others still admit their validity. In 2008, Dean Arnold published a book that dealt with his ethnoarchaeological work from 1965 to 1997 in the Maya potters' community of Ticul, Yucatán, Mexico.[75] In the introduction, he cast doubt on Costin's parametric approach, which regarded efficiency as an explanation for changing complexity. He evaluated Costin's parameters through the analysis of social change and 'evolution' of ceramic production and distribution during 30 years in Ticul. As a result of the evaluation, Arnold admitted the usefulness of Costin's parameters in discussing the evolution of ceramic production, although he pointed out the necessity for further refinements.[76] Gwendolyn Kelly, who studied craft production during the Iron Age of Tamil Nadu, India, criticised Costin's framework following Sinopoli's argument, presenting counterexamples and highlighting the difficulty of reconstruction from archaeological data. However, she admitted the validity of Costin's framework as a starting point of craft-production studies.[77]

Critiques of craft specialisation studies in the 2010s

Maikel H. G. Kuijpers tackled craft-specialisation studies from the perspective of metalworking skill of Bronze Age Europe.[78] At first, he reconsidered the concept of a specialist, especially the specialist/non-specialist categorisation in terms of skill, which roughly corresponded to Clark's criticism of the way the boundary between specialised/unspecialized was divided:

> 'In this configuration, the specialist/non- specialist categorisation is used to model social development through the socio-economic building block of craft specialisation and used to explain increased complexity and social inequality (Brumfiel & Earle, 1987; Earle & Kristiansen, 2010). .... Within these, noticeably Marxist, perspectives a distinction between specialist and non-specialist suffices, even though it fails to address skill not merely as social capital but a concept worth of enquiry itself. ... How much skill is needed to become a specialist? The threshold between the two textual premises of

68 Sinopoli 2003.
69 Sinopoli 2003: 24.
70 Menon 2008.
71 Menon 2008: 156.
72 Shimada and Wagner 2007: 165.
73 Bernbeck 1995; Costin 2005; Brysbaert 2007.
74 Day et al. 2010: 206.
75 Arnold 2008.
76 Arnold 2008: 322.
77 Kelly 2009: 5.
78 Kuijpers 2018.

> specialists versus non- specialists is far less clear-cut than the distinction suggests (i.e. essentially a Sorites paradox).[79] It is, for instance, unclear how one ought objectively to recognize a high standard within archaeological material.'[80]

Kuijpers proposed solving the problem of the specialist/non-specialist categorisation by distinguishing material specialisation (skill of the specialist, his main interest) from economic specialisation (division of labour).[81] This solution was similar to Clark's definition of craft specialisation, which did not assume the mutual dependency between producer and consumer. Kuijpers discussed the problems of economic specialisation from the perspective of the specialists' skill and time. His purpose was to caution against the approach that assumes a direct relationship between skill (material specialisation), time, and economic specialisation.[82]

In her review of pottery-production organisation studies, Kim Duistermaat labelled these studies in the 1970–80s 'typological approaches'.[83] The main problem she pointed out is that '*the production type is a label that obscures the complex, continuously moving, multifaceted, and multilayered reality behind it. Types are limiting and prescriptive rather than helping us to understand*'.[84] In particular, these production types assumed universal links between variables, such as the assumed link between part-time specialist (intensity of specialisation), household (production location), and the small amount of pottery production (scale of production). These assumed links were generated from the ethnographies of craft production. Duistermaat also criticised the facilely assumed link between the craft specialisation and the types of societies.[85] With these assumptions it was no wonder the researchers came to assume that there was a (strong or weak) correlation between the production types and the sociopolitical complexity or the neoevolutionist process of the societal types from simple to complex.

Kim Duistermaat also labelled Costin's and Pool's methodology '*Characterizational Approaches: Typologies in Disguise*'.[86] She identified the problems of these approaches in terms of the criticism offered in the 1990s and 2000s, for example the difficulty of operationalising the parameters to operationalise in the archaeological record, the difficulty of positioning a specific case located between some parameters, and the neglect of the value of things, time, and skill. She especially draws attention to the fact that each parameter conflates several aspects that are not necessarily causally related, such as the relation of potters to authorities (attached), the types and quality of products (luxury), and the access to products (elite-controlled). She concluded that Costin's approach was overly reductive. After reviewing these previous studies to overcome the problems raised above, she proposed a relational approach to the organisation of pottery production, which draws attention to relationships between humans and things. I positively evaluate her relational approach, which will be elaborated in the next section.

Critiques of neoevolutionism

I have reviewed the problems of craft-specialisation studies in the 2000–2010s. There are also critical perspectives on neoevolutionism, or social evolutionary theory and social complexity, which were strongly combined with craft specialisation studies until the 1990s. In '*Myths of the Archaic state: Evolution of the Earliest Cities, States, and Civilizations*', Norman Yoffee criticised neoevolutionary theory as 'factoid' or 'old rules of the game' because it classified past societies in an evolutionary order of the abstract social 'types' (e.g., chiefdom), which were modelled based on the analogies of modern societies reported by ethnographers, and it merely confirmed the existence of these types in past societies and did not advance the studies of the theory of social change.[87] One of his strong criticisms against neoevolutionism was represented in his invention of 'Yoffee's Rule', that is: '*If you can argue whether a society is a state or isn't, then it isn't*'.[88] Nevertheless, Yoffee still advocated social evolutionary theory and transformed it by drawing attention to the process of social differentiation, political integration, and power. His 'new rules of the game' were the comparison of 'evolutionary trajectories' of ancient states in consideration of the contextually appropriate history. One of the reasons he argued for social evolutionary theory was the decline of studies in the theory of social change studies among post-processualists, who had emphasised particularist aspects of the past, since the 1990s.[89]

Timothy R. Pauketat further criticised social evolutionary theory in his book, '*Chiefdoms and Other Archaeological Delusions*'.[90] He criticised Yoffee's minimalist approach, well exemplified in 'Yoffee's rule',

[79] When someone takes a single grain at a time from a heap of sand and repeats the action many times, where is the boundary between a heap of sand and a non-heap? This paradox arises from quantitative analyses of ambiguous predicates, such as a heap of sand or a specialist.

[80] Kuijpers 2018: 2.

[81] Kuijpers 2018: 4.

[82] Kuijpers 2018: 4.

[83] Duistermaat 2016: 116.

[84] Duistermaat 2016: 116.

[85] Duistermaat 2016: 117.

[86] Duistermaat 2016: 117.

[87] Yoffee 2005: 20.

[88] Yoffee 2005: 41.

[89] Yoffee 2005: 195.

[90] Pauketat 2007.

which prevents further consideration of ancient states or civilisation. Pauketat also problematises the other aspects of minimalism embedded in social evolutionary theory, such as the 'building-block' approach. This approach '*recognizes households and communities as static and uniform organizational units, building blocks with typical forms from which societies were constructed*'.[91] According to Pauketat, this approach downplays the dynamic character of communities and households. He proposed an alternative approach to social evolutionary theory, what he called a 'backdoor approach', opposed to the standard evolutionary theory that describes political administration with a priori (front door) categories. Rather, he argued for an approach towards the imagined and invented character of political organisation in the historical trajectories of communities' relationships.

> 'Instead of looking to check off the attributes of institutions or organisations – were there palaces, royal tombs, writing? – we look instead for a series of relationships that played out historically. How were central places built, central orders memorialized, and producer autonomy sacrificed? Was there evidence of pluralism, widespread participation, or resistance? Not only are such historical patterns intriguing, but archaeologists can see them, find them in the ground, and measure them: they have a material form and occupy space. They are hidden in the building blocks of walls and platform mounds, in the communal yet restricted-access storehouses, and in the design of public space. They demand an explanation.'[92]

In summary, in the last twenty years and despite the clear refection of neoevolutionism, the social evolutionary theory or the theory of social change has thrived, with few critiques similar to Pauketat's critique against the 'building block' approach. The theoretical framework of social change has been upgraded by improving the comparative approach and 'cultural trajectory' approach, as seen in Yoffee's work and '*The Comparative Archaeology of Complex Societies*' edited by Michael E. Smith.[93] The demand for the systemic frameworks for the social evolution among the current (mainly Anglophone) archaeologists is clear from the twenty-five 'grand challenges' for archaeology proposed by Keith W. Kintigh and his colleagues,[94] for example '*A3: Why do market systems emerge, persist, evolve and, on occasion, fail*?' or '*A6: How can systematic investigations of prehistoric and historic urban landscapes shed new light on the social and demographic processes that drive urbanism and its consequences*?'. Geoff Emberling has distinguished these large-scale and long-term generalising perspectives of social evolutionary theory from small-scale and local perspectives, as well as non-evolutionary large-scale perspectives or counter narratives;

> 'Archaeology now addresses a much wider scope of questions about the past, ranging from the activities of individual agents to the ways that power and ideologies have structured past societies (and archaeological narratives) or how ethnic and gender identities (among others) have structured lives, the ways that societies interact with their landscapes, and how material things function in social life. These represent one set of what we might call counternarratives – new stories that challenge a previously hegemonic understanding. ... One result of these more recent directions in the field has been that much archaeology conducted today is focused on the small scale and the local at the expense of the possibilities for broader cross-cultural and transhistorical understanding.'[95]

It is true that the systemic, or 'building block', perspective is still useful in illustrating the history of humankind through cross-cultural and transhistorical comparison, even though one cannot avoid the framework of social evolutionary theory. If one were to adopt the strategy for the small-scale perspective to an analysis of the large-scale perspective, the amount of data to be processed and studied would become astronomical. Of course, it is possible that this point can be mastered with a big data approach in the future. The same has occurred in craft-specialisation studies: although the systemic perspective of craft-specialisation studies has been criticised in the last twenty years through the case studies of small-scale perspectives, it is still valid in terms of cross-cultural comparisons at the large scale with the rejection of neoevolutionary theory, the modification of comparative approaches, and the adoption of the view of 'cultural trajectories'. Although I have reviewed the critiques of craft specialisation, it should be noted that the systemic method is still a better method for cross-comparison.

Summary: problems with the study of craft specialisation

Overview of the research history of craft specialisation

I have reviewed the studies on craft-specialisation studies and social complexity in the last 60 years. The research histories of craft-specialisation studies can be summarised as follows:

[91] Pauketat 2007: 45.
[92] Pauketat 2007: 192-194.
[93] Smith (ed.) 2012, Smith and Peregrine 2012.
[94] Kintigh et al. 2014.
[95] Emberling 2016.

a) In the 1950–60s, the relationship between social change and craft production started to be addressed. Neoevolutionism played a great role in connecting social change with craft production using the developmental-stage approach, which was derived from historic and ethnographic studies.
b) In the 1970–80s, craft specialisation started to be analysed mainly by archaeologists with systemic perspectives. The lists of markers/variables useful for identifying production types or production modes were proposed by anthropological archaeologists.
c) In the 1990s, the number of craft specialisation case studies increased. Further systemic frameworks of craft-specialisation studies, which introduced parameters and were oriented to cross-cultural comparison, were conceptualised by Costin. The criticisms of the systemic framework of craft specialisation studies appeared in the late 1990s.
d) Finally, in the 2000–10s, while some archaeologists admitted the validity of craft-specialisation studies and upgraded the frameworks in response to critical comments, others continued to present critical arguments against craft-specialisation studies using their global case studies as counterexamples. The increase of these critical views demonstrates that the studies of craft production became much more prominent than before. Some of these small-scale case studies were concerned with practice theory, which is also related to my concern with communities of practice, as stated below.

Four problems of craft specialisation studies

The critiques of craft specialisation studies, especially those raised against Costin's framework, were offered in the 1990–2010s. The arguments can be classified into four types, following the four critiques proposed by Clark in 1995. I will briefly illustrate these problems and potential solutions below.

The first problem of craft specialisation is the systemic perspective, as exemplified in Costin's narrow definition of craft specialisation, including the mutual dependency between producers and consumers. This definition confused 'material specialisation' with 'economic specialisation' in Kuijpers' terms, thereby falling into the 'Sorites paradox' of the boundary between specialised/unspecialised or specialist/nonspecialist. This is very difficult to solve because the systemic perspective is still valid in large-scale cross-cultural comparisons. In the next section, I will propose communities of practice and actor–network theory as an alternative approach to this systemic perspective. I emphasise that I do not intend to deny the utility of a systemic perspective on craft specialisation studies as a starting point for the analysis of craft-production on the large or small scale, or as an analytical concept.

The second problem is that parameters, components, or variables within the framework of craft-specialisation studies were in many cases actually mixtures of more than two separate attributes and several conflated aspects. The parameters turned out to be difficult to apply to the archaeological materials and to the activities of past societies. One simple solution is to subdivide them into as many parameters as possible and consider them again. Costin also upgraded her framework in this way in the last 20 years. Further subdivision might make archaeological application of the parameters easier.

The third problem is that craft specialisation studies downplayed the value of the goods in the prehistoric world and discussed their value through a capitalist sense of value, which assumes *a priori* equilibrium between demand and supply. It should be noted that this argument ran the risk of undermining craft production studies insofar as scholars were closely following the use contexts and distribution of the objects as a clue to the meaning/value of the objects. One of the potential solutions is to balance out the studies of production with those of consumption and distribution.

Finally, the fourth problem is that the craft specialisation studies just describe and classify the past craft production based on existing frameworks, and are thereby unable to find new aspects of craft production or new theories for craft production. This problem is similar to the problem of neoevolutionism, which described and classified past social organisation based on modern ethnographies. As with social evolutionary theory, the potential solution is to (1) restrict it to local perspectives or (2) propose 'evolutionary trajectories' of craft production or large-scale non-evolutionary perspectives.

3-2. Another perspective of organisation of craft production: a relational perspective

I have reviewed craft specialisation studies and found four problems. One of the problems lies in the systemic perspective, which through its categorises generates boundaries such as specialised/unspecialised in the seamless continuum of craft-production organisation. Below, I will introduce one perspective that focuses not on a system but on relationality for studying the craft-production organisation. This approach was briefly mentioned above in my review of Duistermaat's work. It is quite relevant to solving the systemic and reductive aspects of previous studies of craft specialisation. Below, I will introduce Bruno Latour's actor-network theory and Ian Hodder's entanglement theory, on which Duistermaat's relational approach was based. I will then describe in detail what a relational perspective of organisation is for craft production.

Bruno Latour's Actor-Network-Theory

Materials as actors

Although actor–network theory (ANT) has 'theory' in the end of its name, ANT is not a theory that offers social explanations, such as neoevolutionism, but a theory of how to research the social. According to Latour, the social should be reassembled as associations or collectives composed of actors (or actants), including humans and non-humans.[96] The most important contribution of ANT is to give a thing a position as an actor in an association of humans and non-humans when discussing the social.[97] Below, I will explain ANT in more detail, following Latour's criticism of the social in sociology.

From intermediaries to mediators

Latour begins by stating that in sociology, a social entity (e.g., group, family, or company) has a clear boundary between other social entities and that sociology explains how the social entity is formed using an '*intermediary*', '*what transports meaning or force without transformation*', and what can be counted as one. Latour argued that this intermediary is a black box that simply provides sociologists with a social explanatory framework to explain how the social entity was formed. Instead of intermediaries, Latour focused instead on the associations of actors/actants as '*mediators*', which '*distort and modify the meaning or the elements they are supposed to carry*' and which '*cannot be counted as just one*'.[98] Understanding the associations of actors/actants as mediators is important in reassembling the social.

'Localizing the global' and 'globalizing the local'

Furthermore, Latour argued that we should use mediators instead of intermediaries in reassembling the social to overcome the dualism between the global and the local. He proposed '*localizing the global*' and '*globalizing the local*'. There is no hierarchical relationship between the global and the local, between the macro and the micro, and between a group and a participant. In ANT, the global and the local are located in the same status within an actor–network, in other words, '*we have to try to keep the social domain completely flat*'.[99] In ANT, the global and the local are decomposed into actors in an actor–network of humans and non-humans.

Social theory in Actor-Network-Theory: standard

Latour also proposed a methodology for tracing connections between those actors. One of the things that the researchers have to be careful about when they trace the connections between actors is not to conflate the explanandum (object to be explained, the association of humans and non-humans) with the explanans (the object that explains the object to be explained, i.e. social theory as a power of social explanation).[100] This is where his criticism of social theory in sociology ends and reapproaches it by using a metaphor of a standard in metrology. According to Latour, the social theory or social category discussed in sociology is the standard or the quasi-standard that circulates in an actor–network and allows actors to become comparable and commensurable.[101] He stated that the social as a standard makes it difficult to reassemble the social as associations because it stabilises definitions of the social and suspends the circulation of actors. As a result, actors are bound together in a specific pattern called society.

Ian Hodder's entanglement theory and relational approaches in archaeology

Dependence and dependency

I will turn now to the application of ANT in archaeology. There have been many archaeological studies inspired by ANT since the 2010s, some of which are called 'symmetrical archaeology'.[102] One of the critical applications of Latour's ANT to archaeology was Ian Hodder's entanglement theory.[103] Nicholas Thomas' '*Entangled Objects*' inspired Hodder's notion of 'entanglement'.[104] The basic concepts in Hodder's entanglement theory are 'dependence' and 'dependency'. Dependence means the positive relationship between humans and things, which gives one side a benefit, while dependency refers to the negative relationship in which one side constraints another side. He reviews dependences and dependencies between humans and things —(H–T), T–T, and T–H— with abundant examples. Hodder defined entanglement as the dialectic relationships

[96] Latour 2005: 171.
[97] Latour 2005: 70-72.
[98] Latour 2005: 39.
[99] Latour 2005: 171-172.
[100] Latour 2005: 100.
[101] Latour 2005: 229-230.
[102] Witmore 2007; Webmoor and Witmore 2008; Olsen 2010; Olsen et al. 2012; Duistermaat 2017, Hamilakis and Jones 2017, Harris and Cipolla 2017.
[103] Hodder 2012.
[104] Thomas 1991.

(dependence and dependency) between humans and things:

> 'If we add the obvious point that humans depend on humans (HH), then entanglement, at one level, is simply the addition of these four sets of dependences and dependencies. Entanglement = (HT) + (TT) + (TH) + (HH) [...] Entanglement can thus be defined as the dialectic of dependence and dependency.'[105]

Characteristics of an entanglement

Hodder explained several key characters of entanglement.[106] First, humans and things have different temporalities within an entanglement. Second, humans gradually take the presence of things for granted and forget them within the entanglement. Third, humans become 'entrapped' in the specific entanglement of humans and things due to these above-mentioned characteristics and because of path dependence.[107] Roughly speaking, path dependence is the idea that switching from one path to another path becomes more difficult through time because the switching costs increase over time. Fourth, there exist cores and peripheries in the entanglement because of the power of dominant groups in the centres. Fifth, the inside of an entanglement is filled with a large degree of uncertainty and contingency for humans due to the different temporalities of things and the forgetfulness of humans.

Hodder's critique of Actor-Network-Theory: asymmetry

Hodder borrowed ideas of open-endedness, relationality, and anti-reductionism from Latour's ANT.[108] However, through his criticisms of ANT, he also attempted to fit ANT into archaeological analyses, which mainly study things. The first critique was that the relational perspective of ANT, which rejects the dichotomies of culture/nature, humans/non-humans, and subjects/objects, is extreme. The second critique was that Latour did not seriously take the object nature of things into consideration because Latour regarded the relationship between humans and non-humans as 'symmetrical'. Hodder instead argued that things made humans asymmetrically stacked in an entanglement:

> 'In ANT everything is relational and this insight is important. But it is also the case that materials and objects have affordances that are continuous from context to context. These material possibilities (whether instantiated or not) create potentials and constraints. Rather than networks we seem caught; humans and things are stuck to each other. Rather than focusing on the web as a network we can see it as a sticky entrapment.'[109]

Hodder's third criticism concerns power and agency in ANT. Hodder thought that power was the differential flow of matter, energy and information through entanglements,[110] thereby reinforcing dominant groups and entrapping those who had no access to resources. However, ANT was relatively unconcerned with power possibly because it emphasised an extreme relationality between actors and considered power as what is to be explained rather than the factor of driving force for social explanation. These criticisms clearly bring out the difference between Latour's ANT and Hodder's entanglement theory, namely the asymmetrical relations between things and humans. This point will be discussed further in the summary of this section.

Entanglement and Darwinian evolutionary theory

As reviewed below, Hodder adopted parts of Darwinian evolutionary theory. To discuss the links between humans and things in a long-term entanglement, Hodder defined the concept of 'fittingness', which originally came from adaptive fitness in evolutionary archaeology. In the concept of fittingness, material traits are adopted and reproduced in an entanglement when they not only operate '*in relation to some project*'[111] (affordance) but also seemed appropriate within a phenomenal world of concepts, emotions, and feelings (coherence). He intended to upgrade the idea of fitness in evolutionary studies by proposing fittingness, which proposes that survival and selection occurrs within an interaction between affordance and coherence.[112]

Hodder adopted parts of Darwinian evolutionary theory because it provides entanglement theory with a long-term historical perspective and decentres humans using ideas, such as variation, adaptation, natural selection, genetic drift, and persistence.[113] He pointed out two problems with the evolutionary approach: (1) the simple modelling of inheritance and cultural transmission, as opposed to the contributions from anthropological studies about learning, and (2) the identification of cultural sequences with lineages. He argued that entanglement theory could approach the transformation of an entanglement through a non-reductive evolutionary theory by taking into consideration that material properties that were selected and survived within an interaction

105 Hodder 2012: 89.
106 Hodder 2012: 94-112.
107 Mahoney 2000: 510-511.
108 Hodder 2012: 91, 105-108.
109 Hodder 2012: 94.
110 Hodder 2012: 214.
111 Hodder 2012: 113.
112 Hodder 2012: 137.
113 Hodder 2012: 139. This idea is reiterated on his recent book 'Where are we heading?' (Hodder 2018).

between affordance and coherence. He also avoided a teleological point of view in social evolutionary theory, but argued for directionality of entanglement and the positive correlation between the complexity of an entanglement and its rate of change through the consideration of human entrapment by different temporalities of things.[114]

System in entanglement

I discuss separately the standpoint of 'system, structure, and culture' in entanglement theory because this standpoint will be useful when I present an approach to craft specialisation studies instead of a systemic perspective. Hodder clearly argued that an entanglement is open-ended and not like a culture or a system with a clear boundaries. He thought regulation appeared because of the unruliness caused by the different temporalities between humans and things, which are not inert but active. His proposal of fittingness, affordance, and coherence in an entanglement helped to argue that repetitive practices, routines, or cultures are not static, conservative, and established wholes that somehow determine what we do but dynamic, in that humans are always seeking and searching to find solutions that 'work' in a particular context within a particular strategy.[115] Hodder did not think that traditions and routines could be assumed to be universal characteristics of humans; rather, they had to be explained within an entanglement. Thus, according to Hodder, structure is an active more-entangled part of dependences and dependencies within an open-ended entanglement of humans and things.

Tanglegram

Hodder proposed drawing a simple diagram, called a 'tanglegram', to support visualising dependences and dependencies in an entanglement between humans and things.[116] In the example of the clay entanglement at Çatalhöyük, he presented things as nodes—as many as possible—and connected them by threads as relationships based on interpretations of the material evidence from the site.[117] He expressed the types of relationships between things using arrows to show the directions of dependences/dependencies. As he pointed out, a tanglegram could visualise a part of an entanglement and a real-world mapping would be infinitely more complex. Hodder also attempted to consider the spatial information of things by connecting things that have shared attributes in the excavated plan, and to depict graphically different temporalities of things from shorter temporalities in the *chaîne opératoire* of things to longer temporalities, including life histories of things, historical sequences of thing categories, and legacies by connecting things in a sequential order.[118]

The relational approach in pottery-production studies

Kim Duistermaat developed relational approaches drawing on Latour's ANT and Hodder's entanglement theory for the study of pottery-production organisation.[119] She proposed four strategies for tracing the entanglement of pottery production: (1) tracing material properties, (2) tracing *chaînes opératoires*, (3) tracing biographies (of pottery), and (4) locating entanglements in space and time. She proposed a tanglegram of material properties related to pottery-making and a tanglegram of the life history of ceramics.[120] Her diagram of the *chaîne opératoire* of pottery production described the situations where communication with 'outsiders' is necessary and the moments of task division and the presence of assistants using grey and open circles.[121] As shown in her tanglegrams, the merit of using this visualisation is to add as much heterogeneous information as possible. Tracing entanglements is not the goal of the analysis; she proposed that, after tracing entanglements, it is necessary to not only discuss the characters of relations between actors in an entanglement but also to consider the patterns of connections should be considered using network analyses.[122] Duistermaat reified entanglement theory into a useful methodology for the analysis of pottery-production organisation. However, she did not discuss the debate about the symmetry between humans and things, the critical difference between Latour and Hodder, in her discussion of organisation of pottery production.

Summary of ANT and entanglement theory

I introduced ANT as an approach that investigates organisation as relational networks rather than as a system. The significant points for Latour's actor-network theory are (1) the idea of symmetrical relationships between humans and things and (2) the replacement of social explanation by reassembling the social as associations of actants. On the other hand, Ian Hodder's entanglement theory emphasised an asymmetrical relationship in which humans and things become entrapped in an entanglement. He provided entanglement theory with a long-term perspective by integrating Darwinian evolutionary theory. In addition,

[114] Hodder 2012: 168-171, 174-177.
[115] Hodder 2012: 123.
[116] Hodder 2012: 181.
[117] Hodder 2012: Fig. 9.2.
[118] Hodder 2012: 189-195.
[119] Duistermaat 2016: 124-135.
[120] Duistermaat 2016: Figs. 9.1-2.
[121] Duistermaat 2016: Fig. 9.3.
[122] Duistermaat 2016: 134-135.

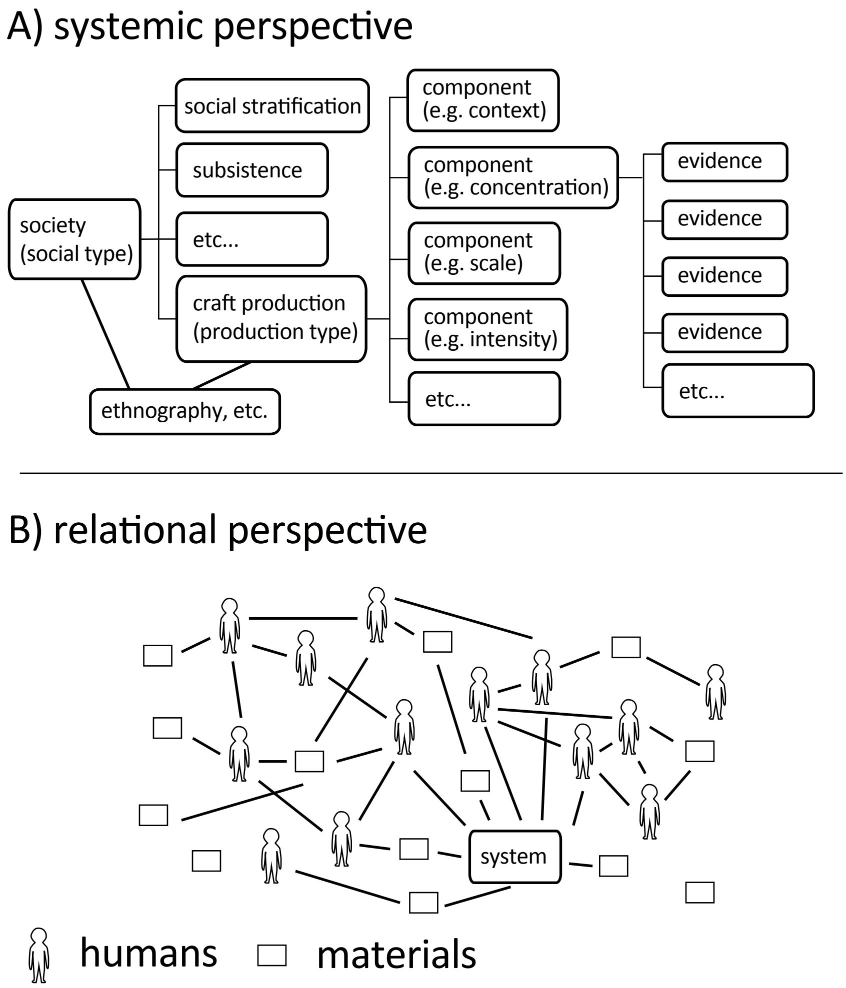

Figure 3.2 Diagrams of organisation A) systemic perspective, B) relational perspective

However, whether relations between humans and things are symmetrical or asymmetrical is still under debate.[124] As stated above, Hodder criticised the symmetrical view in Latour's actor–network theory as too extreme. On the other hand, Graham Harman criticised that Hodder's asymmetrical view, arguing that it '*overstates the difficulty of renegotiation, the asymmetry of dependency, and the perilous character of fiddling and fixing: the only technique on which any reinvention of the human can draw*'.[125] This debate was important for the future development of a relational approach to craft-production organisation. Thus, in the next section of this chapter, to contribute to the debate on symmetrical/asymmetrical relationships between humans and things in actor–network theory/ entanglement theory, I will attempt to update this relational approach from the perspective of learning within craft-production organisation and the skills that can be cultivated within the organisation. Below, I will introduce the concept 'communities of practice' and Tim Ingold's concept of skill, as well as several case studies. Then I will discuss the ways in which these concepts can be eclectically integrated into the relational approach of craft-production organisation.

he introduced the tanglegram as one method for visualising an entanglement.

The difference in organisation between (A) a systemic perspective and (B) these relational perspectives is presented in Fig 3.2. Fig. 3.2: A summarises what I reviewed in Section 3-1. A society and a craft-production system is thought to consist of several separate components or 'building blocks'.[123] Through the analysis of these components, a social type and a production type of the past are interpreted with the help of ethnography and neoevolutionist studies. On the other hand, in relational perspectives (Fig. 3.2: B), relations between humans, things, and systems are discussed. System is a standard that stabilises relations between actants in Latour's sense, whereas system is a dynamic more-entangled part of dependences and dependencies between humans and things in Hodder's sense.

3-3. Updating the relational approach

Communities of practice

From learning as internalisation to communities of practice

The theoretical concept 'communities of practice' originated from social anthropology. First, Jean Lave and Etienne Wenger raised a question about learning theories—that learning is a cognitive process and that an individual internalises the knowledge from a teacher or textbook into their brain, mainly a research topic of psychology and pedagogy.[126] Instead, through

[123] Pauketat 2007.

[124] Pollock et al. 2014; Harris and Cipolla 2017; Hodder 2014, 2016, 2018; Hodder and Lucas 2017.

[125] Harman 2014: 48.

[126] Lave and Wenger 1991; Wenger 1998.

the reconsideration of the concept 'apprenticeship' as a broader term from the social–anthropological point of view, they emphasised participation in communities of practice, which played a great role in learning a practice:

> 'In contrast with learning as internalisation, learning as increasing participation in communities of practice concerns the whole person acting in the world. Conceiving of learning in terms of participation focuses attention on ways in which it is an evolving, continuously renewed set of relations; this is, of course, consistent with a relational view, of persons, their actions, and the world, typical of a theory of social practice.'[127]

Communities of practice are here given a meaning not as a systemic framework of a practice but as a set of relations of persons, activities, and world connected to a practice to various degrees.

Legitimate peripheral participation

The most significant idea in their learning theory was participation in communities of practice as 'legitimate peripheral participation'. This refers to the idea that an apprentice was legitimately allowed to join a community of practice and that she/he developed her/his skill starting from observation and a trivial work. Finally, it leads to the most important work in the community, namely 'full participation';

> "Legitimate peripheral participation' provides a way to speak about activities, identities, artifacts, and communities of knowledge and practice. It concerns the process by which newcomers become part of a community of practice. A person's intentions to learn are engaged and the meaning of learning is configured through the process of becoming a full participant in a sociocultural practice. This social process includes, indeed it subsumes, the learning of knowledgeable skills.'[128]

Situated learning

Lave and Wenger defined learning embedded in communities of practice, which continues through legitimate peripheral participation, as 'situated learning'. Even in the stage of situated learning involving theoretical discussion, they also argued for the relational character of this learning in communities of practice. This relational character was influenced by social practice theory, such as Pierre Bourdieu and Anthony Giddens, who '*emphasize the relational interdependency of agent, world, activity, meaning, cognition, learning, and knowing*'.[129] According to Lave and Wenger, the understanding of learning as legitimate peripheral participation in communities of practice enabled them to give situated learning relational character as opposed to a structural character. In other words, participation is constant negotiation and renegotiation of meaning in the world, which also results in changes of communities of practice.

Identity formation and conflict in communities of practice

The above-explained proposals about situated learning, communities of practice, and legitimate peripheral participation were further explored with a description of apprenticeship in five communities of practices: Yucatec Mayan midwives in Mexico, Vai and Gola Tailors in Liberia, U.S. Navy quartermasters, butchers in U.S. supermarkets, and nondrinking alcoholics in Alcoholics Anonymous. A further discussion of several characteristics of legitimate peripheral participation expanded outwards from the five case study analyses. One of these characteristics is that newcomers not only develop their skills but also increase their motivation and form their identities of mastery through legitimate peripheral participation in communities of practice.[130]

Another interesting characteristic of legitimate peripheral participation, especially for archaeology, is that a conflict between newcomers and elders happens in communities of practice. Specifically, the conflict occurs when communities-of-practice members are replaced with newcomers.[131] Newcomers also confront a dilemma in communities of practice: to keep engaging in the existing practice, or to improve the practice, working towards a new practice, which is then sometimes suppressed by elders through the differences of power between the two groups. Lave and Wenger considered that these contradictions caused by legitimate peripheral participation inside communities of practice could be a driving force for transformation. This argument not only provides an explanation as to why communities of practice transformed over time but also allows archaeologists to discuss communities of practice from a long-term perspective.

Summary of communities of practice

In short, the characteristics of Lave and Wenger's communities-of-practice theory can be summarised as follows:

1) learning is not an internalisation of knowledge but a legitimate peripheral participation in

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[127] Lave and Wenger 1991: 49-50.
[128] Lave and Wenger 1991: 29.
[129] Lave and Wenger 1991: 50.
[130] Lave and Wenger 1991: 111.
[131] Lave and Wenger 1991: 114-116.

communities of practice, which is situated learning;
2) communities of practice are not a systemic framework but a network of relations of persons, activities, and materials; and
3) newcomers can form communities-of-practice identity through legitimate peripheral participation, as well as transforming the communities of practice due to the conflict with elders.

Communities of practice and ethnoarchaeology

Many case studies apply the idea of communities of practice to archaeology. Jill Minar, Patricia Crown, and Willeke Wendrich reviewed case studies of the application to archaeology.[132] Ethnoarchaeological studies of craft apprenticeship have given fruitful hints for how to apply this idea to prehistoric communities of practice.[133] Many archaeologists pursuing research into past communities of practice cited these ethnoarchaeological studies, as well as educational psychology,[134] to support their findings about skill and learning on the basis of archaeological evidence. These ethnographies provide archaeologists with the vibrant reality of the craft apprenticeship. They can offer us greater details about craft apprenticeship, for example:

1) From what age did the apprenticeship start and move on to the various steps of learning (e.g., helping, copying, creating, etc.)?
2) How (e.g., through direct instruction/indirect observation, imitation, etc.) and what (e.g., motor skill, abstract knowledge, etc.) did an apprentice learn in the community of practice?
3) What kind of relationships were there between a teacher and an apprentice (e.g., same gender/different gender, same age/different age, kin-related, etc.)?
4) What kind of role did an apprenticeship play in the community, other than learning for making a living (e.g., enculturation, initiation, and identity building)?

In citing these studies, archaeologists attempted to find differences in the archaeological evidence that arose from differences in learning mechanism. In the next paragraph, I will mention one problematic idea that these studies focusing on the past learning mechanisms have in common: the idea of 'open/closed' (informal/formal) learning and the corresponding innovative/conservative material culture.

Open/closed learning strategies

As a result of the research into the learning processes among Cameroon potters in the villages of Dii, Duupa, Doayo, and Fali, Hélène Wallaert-Pêtre classified two types of apprenticeship characteristics. On the one hand, in the villages of Dii, Duupa, and Doayo, their learning strategies put emphasis on the strict reproduction of what the apprentice learned through observation and imitation without questioning.[135] She called these strategies the shaping of 'closed abilities'. In these learning strategies, apprentices' motivations to learning were promoted and limited by 'social goals' such that they mastered the skills that fit in a social structure (e.g., avoiding left-handedness). On the other hand, apprentices in Fali learned potting in trial-and-error training while questioning, as well as through observation and imitation. The abilities to deal with unknown situations and changes trained in Fali were called 'open abilities' by Wallaert-Pêtre. This learning strategy allowed apprentices to not mind errors or left-handedness but rather be innovative. According to Wallaert-Pêtre, apprentices' motivation to learning in Fali was driven by the promise of mastering a potting skill that they found satisfying. She argued for the possibility of finding the archaeological evidence that shows these two learning strategies, although she admitted the preliminary character of the classification.[136] Crown followed this model and discussed the difference in learning mechanisms between the 'open' Mimbres ceramic tradition and the 'closed' Hohokam ceramic tradition.[137]

The insight into learning mechanisms for the purpose of tracing prehistoric material change was remarkable. However, the dualistic classification of learning strategies (open/closed) is preliminary, and there will be more variety among learning strategies. In a recent article, Wallaert-Pêtre changed her mind and argued for the necessity to overcome this dualism.[138] In addition, we should be cautious about assuming a deterministic correlation between learning strategy and archaeological evidence, such as assuming a causal connection between the open learning strategy and innovative material culture change, should be cautious. As Wendrich argued,[139] archaeological materials do not always correlate with learning mechanisms, and we should not assume the correlation between learning mechanisms and material cultures but rather discuss

[132] Minar and Crown 2001; Crown 2014; Wendrich 2013a
[133] Bunzel 1929; Balfet 1965; Friedrich 1970; Nicklin 1971; Hayden and Canon 1984; Herbich 1987; Herbich and Dietler 2008; DeBoer 1990; Hendry 1992; Gosselain 1998, 2008; David and Cramer 2001; Wallaert-Pêtre 2001; Arnold 2008, Wendrich (ed). 2013; Wallaert 2013; Crown 2014.
[134] Crown 2001: 25-27; 2014: 72-73; Wendrich 2013a: 7-9.

[135] Wallaert-Pêtre 2001: 482-483.
[136] Wallaert-Pêtre 2001: 485, 490.
[137] Crown 2001: 465; 2014: 80.
[138] Wallaert 2013: 23, 38.
[139] Wendrich 2013b: 256.

the correlation through analyses of archaeological materials and other contextual data.

Definition and discussion of skill

Above I discussed communities of practice, contexts in which an apprentice improved her/his technical skill and formed an identity through the legitimate peripheral participation. Here my theoretical discussion will move on to the nature of skill that the apprentice acquires and maintains in the community of practice. Before we can approach skill from the archaeological materials in this study, a theoretical discussion about the nature of skill is also required. Below, I will review the recent discussion of skill in anthropology and archaeology, especially anthropological works written by social anthropologist Tim Ingold and a theoretical discussion of skill presented by archaeologist Maikel Kuijpers. Then I will rethink the idea of skill from the current anthropological and archaeological perspectives, which emphasises relationality.

The concept of skill in Tim Ingold's work

In Part III of '*The Perception of the Environment*', Tim Ingold approached skill from an anthropological perspective.[140] Below, I will review two main arguments of Tim Ingold: (1) the transformation of perspectives from skill to the dichotomy between art and technology and (2) the five dimensions of skill.

1) Transformation from skill to the dichotomy between art and technology

At first, before discussing skill in anthropology, Ingold reviewed how perspectives concerning technique or skill developed into the dichotomy between art and technology in modern times. Technique, which derives from *tekhne* in ancient Greek, originally meant a general ability to make things intelligently with a craftsperson's manual skill and perceptual attention.[141] However, as the skilled handling of tools and bodies was gradually replaced with the mechanical operations carried out by machines, techniques were considered to be subdivided into two types of actions: a simple execution of labour using 'technology' ordered from predetermined discursive knowledge and 'art' as a more creative work with human imagination.[142] Ingold argued that the anthropology of technology and art was distorted by this dichotomy between technology and art, and one solution is to dispense with the dichotomy and to return to the original perspective towards technique as a skilled practice. However, Ingold's argument also runs the risk of romanticising the sweaty, laborious, or boring efforts in the actual skilled practices.

2) Five dimensions of skill

Thus, Ingold argued for the importance of the perspective of techniques as skilled practice for anthropology. Second, he introduced five dimensions of skill,[143] which helps to elucidate his uderstanding of skill and his relational perspective between humans, things, and the environment engaging skilled practices. The first point of skill is that there are no categories of user (e.g., shoemaker) and used tools (e.g., shoe-making tools) with predetermined intentionality and functionality in skilled practices; instead, the user, the used tools, and the environment are relationally networked and generate forms in the skilled practice.

The second point casts doubt on the idea that skill is a technique of the body. In other words, Ingold criticised the idea that mechanical, muscular, or physical attributes of humankinds are independent of their mental attributes. Instead, Ingold claimed that not only physical attributes but also mental ones and the environment surrounding the practitioners are indissolubly engaged in skilled practices, while still embodied.

The third dimension is that skilled practice shows a skilled perceptual adjustment, as well as a trained muscular force. The senses, including touch, eyesight, hearing, smell, and taste, require careful attention in a skilled practice. For example, when an apprentice observes how to paint a ceramic vessel, her/his ear hears the rhythm of a master's movement. When she/he conducts the practice, the vessel's surface texture can be felt through the tip of a brush to the fingers of an apprentice. Being attentive is also important for skilled practitioners. In particular I focus on the inseparable character of the two aspects of skilled practices, in Ingold's conception, physical experience and perceptual attention, as exemplified in cello playing.[144] This argument is important when I consider whether the skilled handling and experiential attention can be recognised separately in Section 4-4.

The fourth point questions how the sensory aspects of skilled practice can be trained. Ingold argued that an apprentice could improve her/his perception by participating in the contexts that provide the apprentice with selected opportunities for her/his perception and action. The concept of these contexts is very similar to the conception of communities of practice.

[140] Ingold 2000.
[141] Ingold 2000: 295.
[142] Ingold 2000: 349-351.

[143] Ingold 2000: 352-354. The explanation of skill was also discussed in page 401. In that page, five dimensions of skills were summarised into three points. It is also summarised in Ingold 2018.
[144] Ingold 2000: 414.

Finally, the fifth skill dimension has to do with the forms of objects made by skilled practices. Ingold denied the ieda that prefigured designs of the manufactured objects exist in the brains of skilled practitioners who then outwardly expressed forms. Instead, according to him, it is the excecution of activities that consist of many actors/actants, including skilled craftspersons, tools, and their surroundings, that generate the object forms.

The concept of skill in Maikel Kuijpers' work

Next I will introduce a recent theoretical discussion of skill in archaeology. Maikel Kuijpers delved into skill from an archaeological perspective in his study of metalworking skill in Early Bronze Age Central Europe.[145] Before defining skill from a theoretical point of view, Kuijpers first pointed out several reasons why archaeological studies were reluctant to study skill by pointing out several reasons. First, the value of skill is dependent on the value of the contemporaneous society. Thus, the culturally relative judgement of material skills falls into subjective interpretation. Second, skill (how it was done) was conflated with technique (what was done). The presence of technique (e.g., the complex procedure of metalworking) does not always indicate the presence of skill. We should note that Kuijpers clearly distinguished skill from technique for the application to archaeological analysis, whereas Ingold did not. Third, only more prestigious, unique, and well-preserved materials were previously given attention from an aesthetic perspective when discussing the skilfulness of ancient craftsmanship. This bias in the dataset and the perspective must be solved.

Kuijpers' tripartite concept of skill for archaeology

Kuijpers explained how to demonstrate skill from the archaeological materials using a tripartite concept: (1) technical skill, (2) recognition of skill as expertise and quality, and (3) skill as a social value. Kuijpers defined the first concept, technical skill, as the skill in making an object from a material. He separated this technical skill from the skilfully handling of an object.[146] Technical skill is the first result of skill analysis that can be obtained from the archaeological materials.

Second, a concept of recognition of skill as expertise and quality is introduced for understanding the position of skilled practices within the past communities. According to Kuijpers, (1) understanding the ratio of skilled practitioners to consumers within a community, (2) the idea that skilled practitioners can read the skill of the materials differently from laypersons and consumers, and (3) the purpose of materials (either daily tool or prestige object) are all significant for the reconstruction of how the skill was recognised in the past community.[147] Solely analysing technical skill is not sufficient: the context by which a skilled practice was surrounded is also important for interpreting and discussing the skilled practice. He proposed the 'standard of the time' to assess the skill of archaeological materials within communities of practice.[148] According to Kuijpers, the standard of the time (a standard acceptable in that period) would be close to what is recognised as skilful (or what is generally accepted as well-made) in the past community.

Third, interpreting a skill as a social value refers to researchers' attempts to interpret the value of skills in the sociopolitical contexts based on the assumptions of craft specialisation studies, as reviewed in Section 3-1.[149] For example, archaeologists in craft specialisation studies assumed that a skilled practitioner spent a considerable amount of time making performing the craft. That is why a craftsperson concentrating on her/his work (full-time) was freed from the subsistence economy in the sociopolitical contexts of her/his village. As reviewed earlier, Kuijpers problematised the previous assumption that the skill of a specialist and labour-time (full-time/part-time) are strongly associated or that material specialisation and economic specialisation are strongly connected. However, while exercising caution about these assumptions, he argued that a high level of skilfulness was an attributed value in past communities. The analysis of skill from the archaeological materials is made possible with these three concepts.

Four characteristics of technical skill

Among the three concepts for skill analysis, technical skill pertains to the most important theoretical discussion about the mechanism of how and why skill is generated from a practice. Kuijpers explained four key characteristics of technical skill: (1) engagement with material, (2) senses, (3) body as/and tools, and (4) apperception. I will briefly review these characteristics to compare them with Ingold's concept of skill and to deepen the discussion about the nature of skill.

1) Engagement with materials

Kuijpers first argues that skill is expressed through the producer's engagement with materials. His argument supported Ingold's view that humans, materials, and environment are indissolubly engaged in skilled practices. In addition he also emphasised the passive character of materials in skilled practice. In the skilled

145 Kuijpers 2017.
146 Kuijpers 2017: 41.
147 Kuijpers 2017: 42-44.
148 Kuijpers 2017: 76.
149 Kuijpers 2017: 44-45.

practitioner's attempt to project the 'mental template' onto materials, materials as passive objects are resistant to being shaped. Kuijpers called this projection with material resistance 'approximation'.[150]

2) Senses

Second, Kuijpers also pointed out the importance of senses in skilled practices, as did Ingold. Unlike Ingold, he further regarded senses as a clue to overcoming the Cartesian dualism between the mind (discursive knowledge) and the body (embodied knowledge). He argued that there was no clear boundary between discursive knowledge (e.g., yellow as a scientific categorisation) and non-discursive knowledge (the visual perception of yellow by humans or a poetic expression of yellow, e.g., egg york): the only difference is in the ways of categorisation and choice of metaphors to describe similar material processes and properties. Thus, he proposed the use of 'perceptive categories' to translate the sensory understanding of materials into scientific results and vice versa.

3) Body as/and tools and 4) Apperception

The third characteristic is the use of the whole body for a specific skilled practice. He explained the extension of a skilled practitioner's body to his/her tool using neuroscientific results, specifically pointing out the sensitivity of human fingers. The fourth characteristic, apperception, is the most important of the characteristics of skill in Kuijpers' definition. Apperception means a process in which a new implicit (embodied) experience is transformed through the repetition into an explicit (cognitive/discursive) rule.[151] This process not only helps apprentices narrow down their perceptions with explicit rules as precautions but also allows explicit rules to be formed and transferred to other apprentices. Kuijpers saw the apperceptive process of becoming skilled as 'a hermeneutic spiral'[152], emphasising the recursive and progressive character of skill.

Kuijpers' critique of Ingold's skill: downplaying discursive knowledge

Above, I introduced Kuijpers' definition of skill. Although his definition had commonalities with Ingold's definition of skill in some points (i.e., senses and body as/and tools), he criticised Ingold's definition of skill and pointed out two problems that arise when the concept is deployed in an archaeological analysis of skill. The first problem is the difficulty of applying Ingold's concept to the analysis of archaeological materials due to its philosophical character (especially, its Deleuzian character):

> 'Ingold's writings are perhaps best understood as a philosophy in which forward motion ('flow' or 'flus' in Ingoldian terms) is the modus operandi. In this manner he provides us with a stimulating alternative perspective on craft and skill (and several other topics), but there is problematic lack of a solid methodological framework in which this perspective on material production can be operationalized. He writes the world into existence instead of describing it through (reflective) empirical analysis. In his view skill and craft appear to be devoid of any predetermined form, ideas, or intentions (...). Implicitly, this perspective runs the risk of denying any value in a reflection or abstraction made *after the fact*. Not only is this type of hindsight fundamental for apperception and thus at the core of learning a skill, it is a vital aspect of modern analytical science.'[153]

The second problem is that Ingold focused more on the embodied character of skill rather than cognitive, explicit rules, criticising the example of the weaver bird;

> 'It is tempting to construe skill acquisition purely as repetitive process. This is exactly what Ingold does when he explains skill as an innate part of nature, arguing that there is little difference between the weaving skills of human beings and the nest-building skills of the male weaver bird (Ingold 2000, 34-61). .... Although habit (viz. repetition) is an essential part of becoming skilled, it is the ability to cognize one's own actions that distinguishes human skilled behaviour to that of a weaver bird.'[154]

Discursive knowledge in Ingold's Making

Although I also admit the difficulty of applying Ingold's concept of skill to archaeological analysis (especially to the analysis of the *chaîne opératoire*, discussed in detail in Section 4-4), I argue against Kuijpers' critique that Ingold focused more on the embodied character of skill and undermined the role of discursive (predetermined) knowledge. I will review the ideas of form and discursive knowledge in Ingold's more recent idea in '*Making*'.[155] In fact, Ingold criticised a hylomorphic view in making that discursive knowledge (mental template, intended form) is merely projected onto materials (making as a project).[156] Instead, as argued in *Perception of Environment*, he proposed another view

150 Kuijpers 2017: 48.
151 Kuijpers 2017: 52-56.
152 Kuijpers 2017: Fig. 3.3.
153 Kuijpers 2017: 74.
154 Kuijpers 2017: 53.
155 Ingold 2013.
156 Ingold 2013: 20.

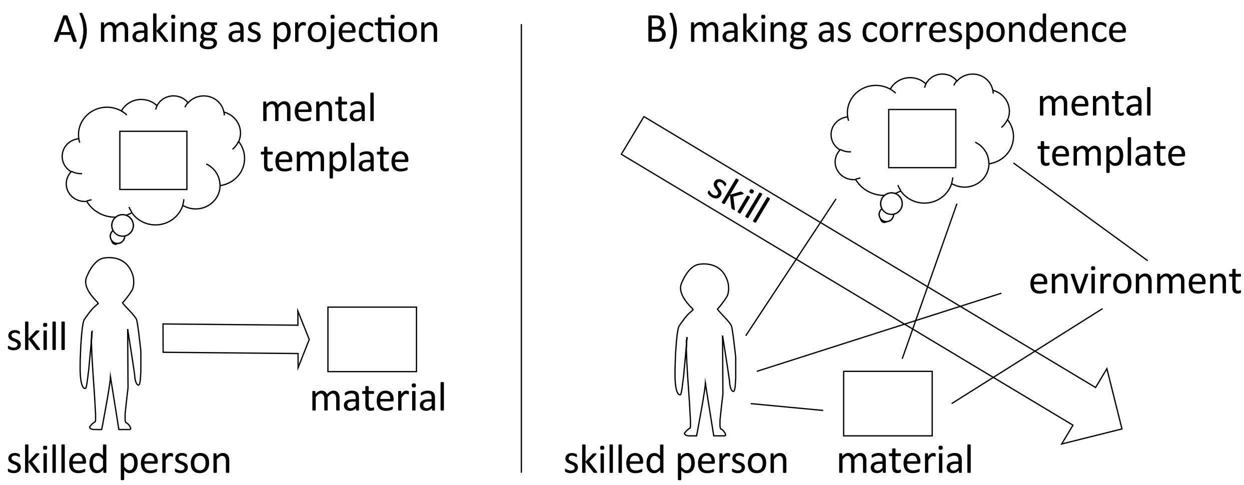

Figure 3.3 Diagrams of making a material and relations between skill, material, skilled person, mental template, and environment. A) making as projection, B) making as correspondence

of making as a process of growth, in which the role of a maker's intention (mental template) is reduced to to one of the participants involved in making things. Whereas making as a project is considered '*interaction*', a motionless and apathetic contact to materials with the prefigured plan, which sets up a clear start and end (the intended form), making as a growth is a process of '*correspondence*', a sentient contact to materials set in motion without start and end.[157]

However, Ingold did not undermine the role of discursive knowledge in skill, as exemplified in the case of the use of geometry by medieval carpenters and masons.[158] The 'practical or *constructive* geometry' was learned on the job for their guidance rather than by reading theoretical books. This discursive knowledge (mental template, or geometry) of medieval masons was placed not only in their minds but also on the process of working with their tools for measurement, such as nails, stakes, ropes, and posts;

> 'His knowledge would have been largely acquired 'on the job', through apprenticeship to a master. It was a matter of learning by doing, rather than acquiring theoretical precepts for subsequent application in practice. The craftsman operated not with theorems but with rules of thumb, valued not for their mathematical correctness or logical consistency but for their guidance in getting the job done.'[159]

To clarify Ingold's argument, I present two diagrams as examples, showing a contrast between making as projection and making as correspondence (Fig. 3.3). On one view, a skilled person who has skill in his/her body and a mental template of a material in his/her mind projects the mental template into the material in a hylomorphic manner, in other words, making as projection (Fig. 3.3: A). On the other view, in making as correspondence (Fig. 3.3: B), the template of a material inheres not just in the mind of the practitioners but also in the action itself — the process of making the materials with which the skilled person, material, and environment relationally correspond. I will adopt Ingold's concept of skill with the caution advised by Kuijpers.

Summary of the definition and discussion of skill

In this section, to consider the nature of skill for the purpose of approaching skill from archaeological materials, I explained the thoughts of Ingold and Kuijpers. Ingold presented the definition of skill from a relational perspective. According to him, skill is generated in the emergent relationship between humans, things, environment, and mental templates. On the other hand, Kuijpers presented a more practical definition of the nature of skill for demonstrating skill from the archaeological materials. The differences of their concepts lie in the passive character of objects and the role of discursive knowledge. After reviewing these concepts proposed by Ingold and Kuijpers, I argue for Ingold's concept of skill, with consideration for Kuijpers' critique. The detailed discussion of the methodology for clarifying skill from archaeological materials in this research will be presented in Section 4-4.

Integrating two theoretical concepts into a relational approach

I have introduced Latour's ANT and Hodder's entanglement theory to explain a relational approach to craft-production organisation (Section 3-2). I then introduced communities of practice as relational to the nature of learning and Tim Ingold's concept of skill as relational to the nature of skill, as well as archaeological

[157] Ingold 2013: 106-107.
[158] Ingold 2013: 50-56.
[159] Ingold 2013: 52.

studies that point out several problems of these concepts. All the above-explained approaches share interests in relationality from different angles and in different degrees. In this section, I will attempt to integrate these concepts in an eclectic way in consideration of the nature of relations (symmetrical or asymmetrical). Below, I will compare (1) communities of practice and Ingold's concept of skill and (2) communities of practice and ANT/entanglement theory. Through this comparison, I will present the theoretical framework for this research.

1) Communities of practice and Ingold's concept of skill

Communities of practice and Ingold's concept of skill have a close relationship. First, Ingold mentioned Lave's idea of 'understanding in practice (same as communities of practice)', mentioning her influence on his thought.[160] Ingold's concept of 'taskscape' also shows a similarity to the concept of a community of practice. Thus it is clear that Ingold's thought was influenced by this concept. Second, I present the relationship between these concepts using the diagrams in Fig. 3.4. A mental template of the material is shared among the members of a community of practice (or environment). On the one end, an apprentice A at the periphery of a community of practice does not correspond well with the material, environment, and the mental template in the process of making, and her/his output results in low-skilled material. On the other hand, a skilled practitioner B at the core of the community corresponds well and creates high-skilled material. The skill of apprentice A will improve over time, as her/his position in the community of practice moves towards the core. In this comparison, asymmetrical relations between apprentices and skilled practitioners are clearer rather than those between humans and things.

2) Communities of practice and ANT/entanglement theory

Neither the idea of communities of practice nor ANT set up a clear boundary between the other entities but rather focus on relations. There are several differences between the two concepts. First, the discourse on communities of practice has not positively discussed the role of things in situated learning. Second, the difference also lies in the nature of the relations among the members. Latour's ANT throws everything into the symmetrical relations of actants, whether humans, things, and social entities. In contrast, as the term 'legitimate peripheral participation' indicates, the concept of communities of practice acknowleges the asymmetrical relationship between skilled practitioners (core) and apprentices (periphery).

[160] Ingold 2000: 416; Lave 1990.

The concept of communities of practice is more similar to Hodder's entanglement theory because, first, core and periphery also exist in an entanglement. Second, when Hodder discussed the problem of evolutionary archaeology, namely, its simple model of cultural transmission, he argued for the necessity of understanding cultural transmission through the notion of fittingness, whereby traits are adopted on the basis of their affordance and coherence in specific contexts.[161] In this point, the situated learning in communities of practice is similar to the idea of fittingness. The notion of communities of practice can provide entanglement theory and its long-term evolutionary perspective with a useful view of a more social anthropological model of cultural transmission. Third, as with Fig. 3.4, I present a diagram showing the relationship between the notion of communities of practice and entanglement theory (Fig. 3.5). Numerous relations between humans and things exist in communities of practices and in entanglement. In this diagram, there are several communities of practices, such as pottery making, lithic reduction, and farming. These communities and entanglement are not clearly separated but are loosely overlapped and related. The configuration of communities of practices expressed in an entanglement can be considered what Wenger called '*constellations of practices*'[162], in other words, '*broader constellations that share historical roots*' [163] than communities of practice. It should be mentioned that, although I have represented humans as 'faceless blobs' in this diagram, they are of course persons with different ages, genders, and backgrounds.

In summary, through the comparison of (1) and (2), I lay the theoretical framework for craft-production organisation for this research (Figs. 3.4-5). Skill is generated in a relational engagement between a practitioner, a material, a mental template of the material, and environment, including communities of practice. Through the acquisition and maintenance of skill for craft production in communities of practice, an asymmetrical relationship between skilled persons and apprentices (legitimate peripheral participation) is generated. Communities of practice and entanglements consist of numerous relations between humans and things. In addition, these have numerous relations with one another. However, I do not propose an answer as to whether relations between humans and things are symmetrical or asymmetrical. Rather, I argue that these relations should not be assumed a priori but rather be discussed through detailed analyses. I will approach reassembling communities of practice and entanglements in the Bakun-period sites using tanglegrams in Chapter 8.

[161] Hodder 2012: 145.
[162] Wenger 1998: 127.
[163] Roddick and Stahl 2016.

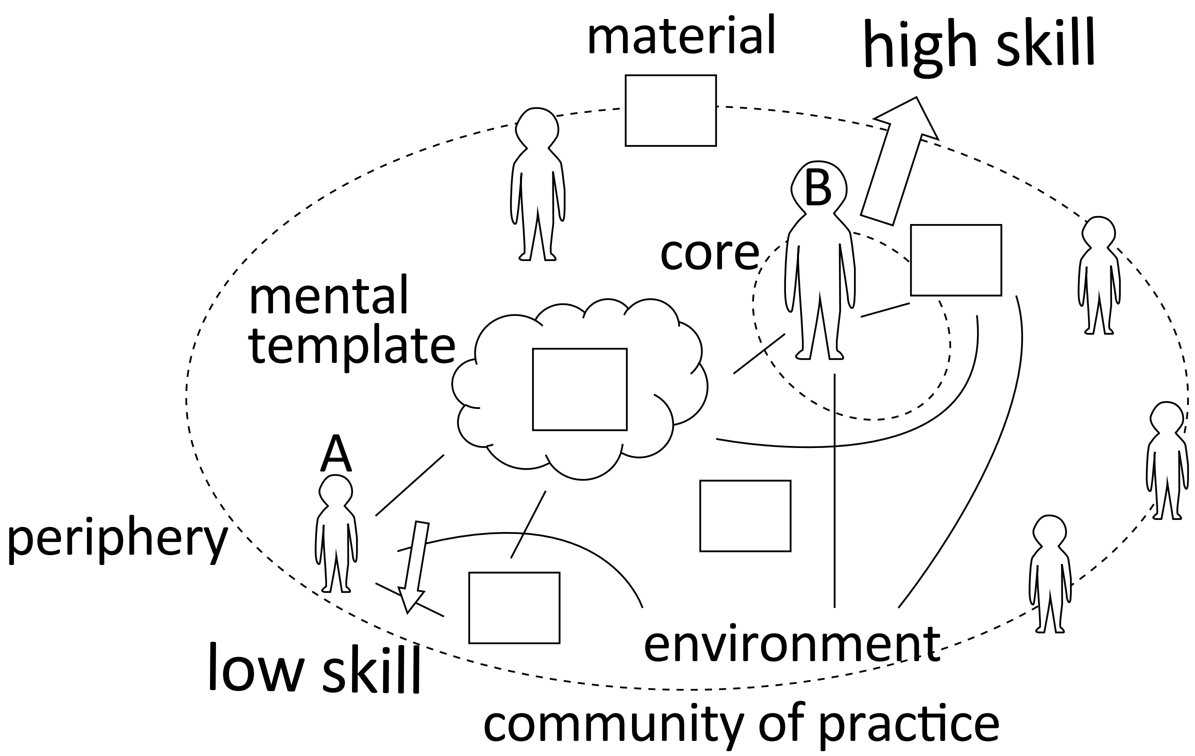

Figure 3.4 Diagram of relationship between community of practice and Ingold's concept of skill

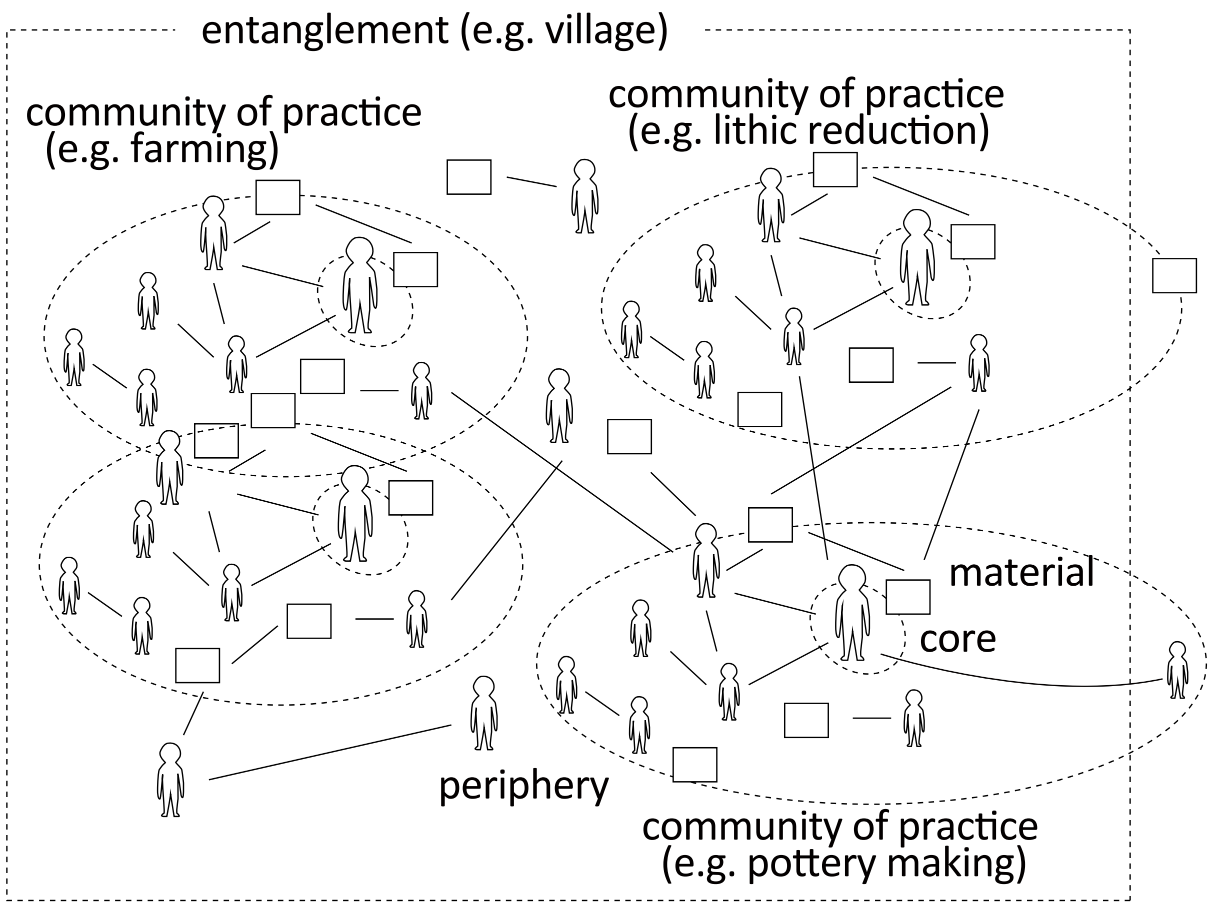

Figure 3.5 Diagram of relationship between community of practice and entanglement

3-4. Summary of Chapter 3

Before moving on to the next chapter on methodology, I summarise the content of this chapter. In the first half, I reviewed previous studies of craft specialisation from the 1950s to the 2010s. The research history showed the orientation towards a systemic framework for craft specialisation to investigates the relationship with sociopolitical complexity (until the 1990s) and the subsequent criticism of the systemic framework with counterexamples (from the late 1990s). The problems of craft-specialisation studies lie in

1) the systemic perspective, which regards the organisation of production as a static structure;
2) the reductionist view that the organisation consists of several separable components;
3) the capitalist interpretation of the value system of the past communities; and
4) the lack of opportunity to invent new aspects/ theories for craft production except for finding counterexamples.

In the second half of this chapter, I proposed an alternative relational approach to the craft-production organisation by introducing Latour's actor–network theory (ANT), Hodder's entanglement theory, and Duistermaat's application to the organisation of pottery production. Furthermore, I updated this approach by integrating Lave and Wenger's idea of communities of practice and Ingold's concept of skill. The discussion of these theoretical concepts provided this thesis a new framework, which focusing on relations in craft production.

1) Latour provided a relational perspective to organisation, which is considered as an association of networks between humans and non-humans. While symmetrical relations between humans and non-humans were emphasised by Latour, Hodder argued for the importance of asymmetrical relations (dependence/dependency) between humans and things in an entanglement. Hodder also brought the long-term point of view into the relational perspective.
2) The idea of communities of practice, as proposed by Lave and Wenger, introduce a situated learning through legitimate peripheral participation into the relations of the members: skilled persons and apprentices. Ethnoarchaeological case studies give us fruitful viewpoints for discussing the apprenticeships from archaeological materials.
3) Ingold explained that skill is generated in the emergent relationship between humans, things, environment, and mental templates. Kuijpers followed his ideas but corrected them for the application to his archaeological analysis.
4) For the discussion of craft-production organisation, a new theoretical framework was presented through the eclectic comparison of three concepts (Figs. 3.4-5). Numerous relations between humans and things engage in the emergence of skill, communities of practice, and entanglement. These relations can be symmetrical and asymmetrical. Hence, detailed analyses are required to consider the relations.

Chapter 4

Methodology

I have clarified problems of previous studies and established the theoretical framework for pottery-production organisation throughout Chapters 2 and 3. Hence, now that I acquired solid goals and foundation, it is time to present the methodology of this research. In Chapter 1, I raised four general research questions about pottery production during the Bakun period. Then, the research questions and the problems were clarified further through more in-depth reviews of previous studies in Chapter 2. One of the research problems regarding archaeological theory (craft specialisation and its alternative) were discussed in Chapter 3.

In this chapter, as the basis for this research, I present the methods that can provide better answers to the above-discovered problems through comparison with the methods of previous studies. I explain analytical methods of wares (Section 4-1), vessel forms (4-2), and painted decoration (4-3), and pottery-making technique (4-4) used in this research. These are solutions to answer research question No. 2: 'When and how black-on-buff ceramics was adopted and developed in the Bakun period?' To analyse pottery-making techniques (4-4), I explain the analytical concept of the chaîne opératoire and its application, then discuss analytical methods of technical skill. I also present the analytical procedures thin-section petrography (4-5) and archaeometric analyses (4-6). Through interdisciplinary research of pottery-making techniques, I provide an answer to research question No. 3, 'How were black-on-buff ceramics and other pottery produced?' Finally, I briefly present a method for discussing pottery-production organisation to answer research question No. 4: 'How was pottery production organised during the Bakun period?' (4-7).

4-1. Ware-type classification

As presented in research question No. 2, the quantitative analysis of wares from the beginning to the end of the Bakun period remains in question. For this analysis, following and integrating former research definitions, I classify the ceramic materials produced during the Bakun period into seven major ware types. The basic criteria of ware-type classification are presence/absence of vegetal temper, presence/absence of coarse sand minerals, fabric colour, and forming technique. The four main ware types are as follows; black-on-buff ware (BOBW) and the two variants, vegetal-tempered black-on-buff ware (VBOBW) and mineral-tempered black-on-buff ware (MBOBW), vegetal-tempered coarse ware (VCW), mineral-tempered coarse ware (MCW), and other types of wares, including red burnished ware and Neolithic ware. The purpose of presenting classification criteria in this section is not to conclude the characteristics of each ware type (especially forming technique, and petrographic fabric), but to set up the basic categories used in ware-type classification for quantitative analysis.

Black-on-buff ware (BOBW)

Previous researchers have referred to BOBW (Fig. 4.1) with a variety of terms, such as 'painted cream-toned pottery', 'buff wares', and 'fine ware'.[1] Many researchers have emphasised its fine-grained fabric and the colour of the fabric. BOBW is a fine painted ware. The surface colour, which was measured using the Munsell Soil Chart, come in a range of colours, including pale yellow (2.5Y 8/3-4, 5Y 8/3-4, 7.5Y 8/3), light grey (2.5Y 8/1-2, 5Y 7/2, 7/4, 8/2, 7.5Y 7/2, 8/20), light yellow (2.5Y 7/3-4, 5Y 7/3), dull yellow orange (10YR 6/4, 7/2-4), light yellow orange (10YR 8/3-4), and dull orange (5YR 6/4, 7.5YR 7/3-4).[2] The pigment of the painted decoration is black, brownish black, olive black, or brown. The fabric is fine and hard, and has no vegetal inclusion, and sometimes calcite particles can be macroscopically observed as inclusion. I present the detailed petrographic description in Chapter 7. Although I will describe the pottery-making technique in more detail in Chapter 7, here, I mention that a coiling method with a low-speed turntable was used when forming BOBW,[3] and that a pottery kiln was usually used for firing. Black painted decoration is applied, on the interior or the exterior, sometimes on both sides. Although I focus mainly on BOBW in this research, unpainted buff pottery did also exist. In this research, I count items as unpainted buff ware only when rim parts of buff ceramics are unpainted. In terms of body parts, it is very difficult to distinguish the unpainted-buff-ware body-sherds from the unpainted part of black-on-buff-ware body-sherds. Therefore, I count unpainted body sherds as unpainted parts of BOBW sherds in this research. BOBW may have been used primarily for serving and consuming food, and sometimes for storage.

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[1] Langsdorff and McCown 1942: 26; Goff 1963: 55; Alizadeh 2006: 68.

[2] These results came from the observation list for the catalogue of Tall-e Gap, my MA thesis written in 2012.

[3] Langsdorff and McCown 1942: 24; Egami and Sono 1962: 37; Egami and Masuda 1962: 11; Petrie 2011: 162.

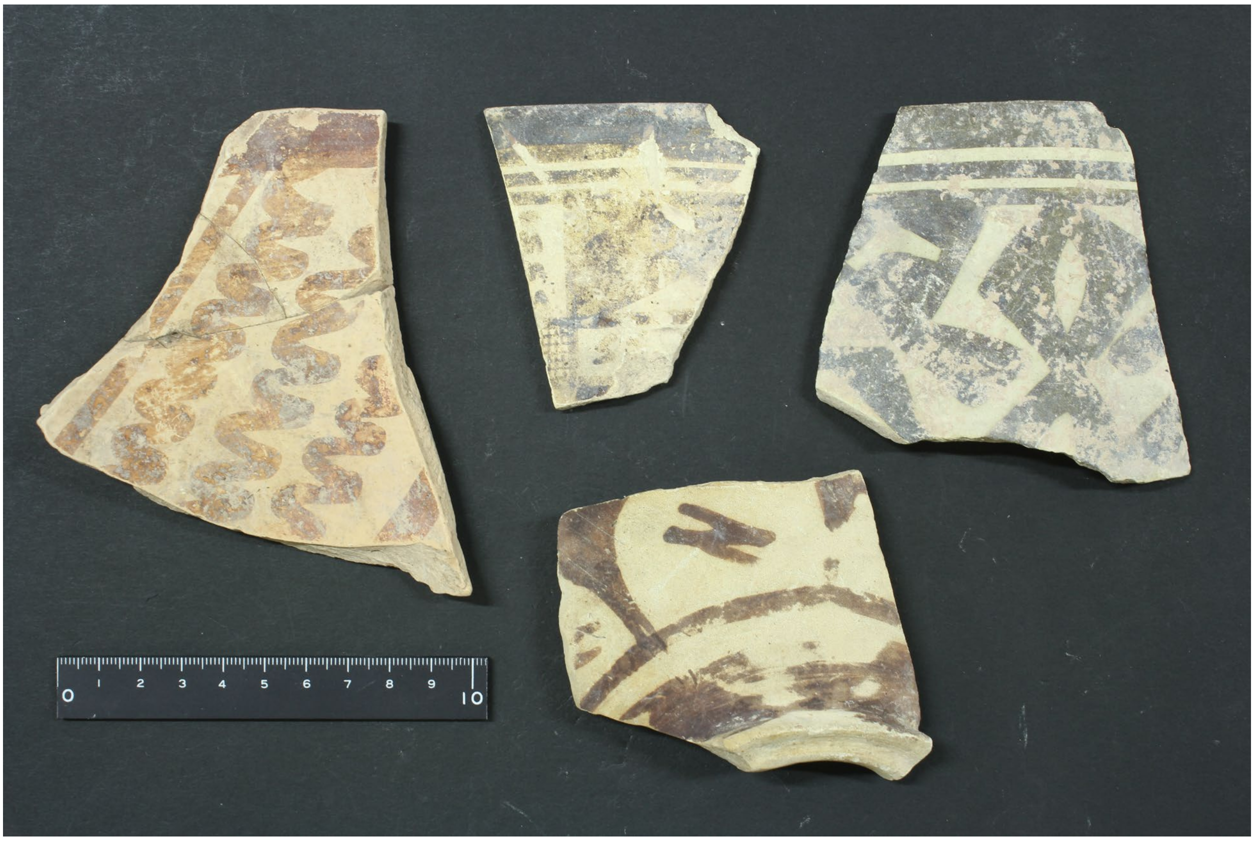

Figure 4.1 Black-on-buff ware (BOBW) collected at Tall-e Bakun A and curated in UMUT (Photo by Miki)

There are two variants of BOBW (Fig. 4.2). Mineral tempered black-on-buff ware (MBOBW) also has black painting and buff colour fabric, but is macroscopically different in rough mineral sand inclusion. This variant has been confirmed only in closed vessels found at Tall-e Bakun A. Vegetal tempered black-on-buff ware (VBOBW) includes frequent vegetal temper, but has painting and fabric colour in common with BOBW.

Vegetal-tempered coarse ware (VCW)

Many researchers have used several terms to refer to vegetal-tempered coarse ware, including 'straw-tempered coarse ware' and 'chaff-tempered Shamsabad ware' (Fig. 4.3).[4] Instead, in this research I use 'vegetal-tempered', as the type of temper was not only chaff. Vegetal-tempered coarse ware is unpainted, vegetal temper included coarse pottery with a thick vessel wall. According to Masuda's measurement, the average thickness of vegetal-tempered coarse ware found at Tall-e Bakun B was 15 mm.[5] In general, the colour of the surface is dull orange (7.5YR 6/4, 7/4), and dull yellow-orange (10YR 6/3, 7/3-4). The fabric colour of the core is similar to the surface, but is sometimes dark because of insufficient firing. As is discernible by naked eye, many vegetal tempers are mixed into the fabric as inclusions, but few mineral inclusions, like calcite particles, can be observed. The forming method of VCW is reported as so-called 'sequential slab construction',[6] in which slabs are piled up. The fabric is very crumbly. It is likely that vegetal-tempered coarse ware was fired at lower temperatures than those of BOBW. The basic vessel form is an open form with a straight or slightly incurved vessel wall. Sometimes, it has a horizontal clay appliqué around the body.[7]

Mineral-tempered coarse ware (MCW)

Earlier researchers have called mineral-tempered coarse ware cooking pots (Fig. 4.4).[8] Mineral-tempered coarse ware is unpainted coarse ware that is partly burnished on its surface, with both vegetal temper and mineral sands visible in its paste. Its core colour is black (5Y 2/1, 7.5YR 1.7/1, 2/1), due to inadequate firing condition. Its surface colour is red brown (5YR 4/4, 4/6, 6/4), dull orange (5YR 6/6), or dull red-brown (5YR4/3). The most common vessel form is a hole-mouth bowl with a pair of knobs in the middle of its body. Vessels

[4] Egami et al. 1977: 1; Voigt and Dyson 1992: 138.
[5] Egami and Masuda 1962.
[6] Vandiver 1987.
[7] Egami et al. 1977: Pl. III-21.
[8] Herzfeld 1932: Tafel XXI; Langsdorff and McCown 1942: 31; Bernbeck et al. 2005: 104.

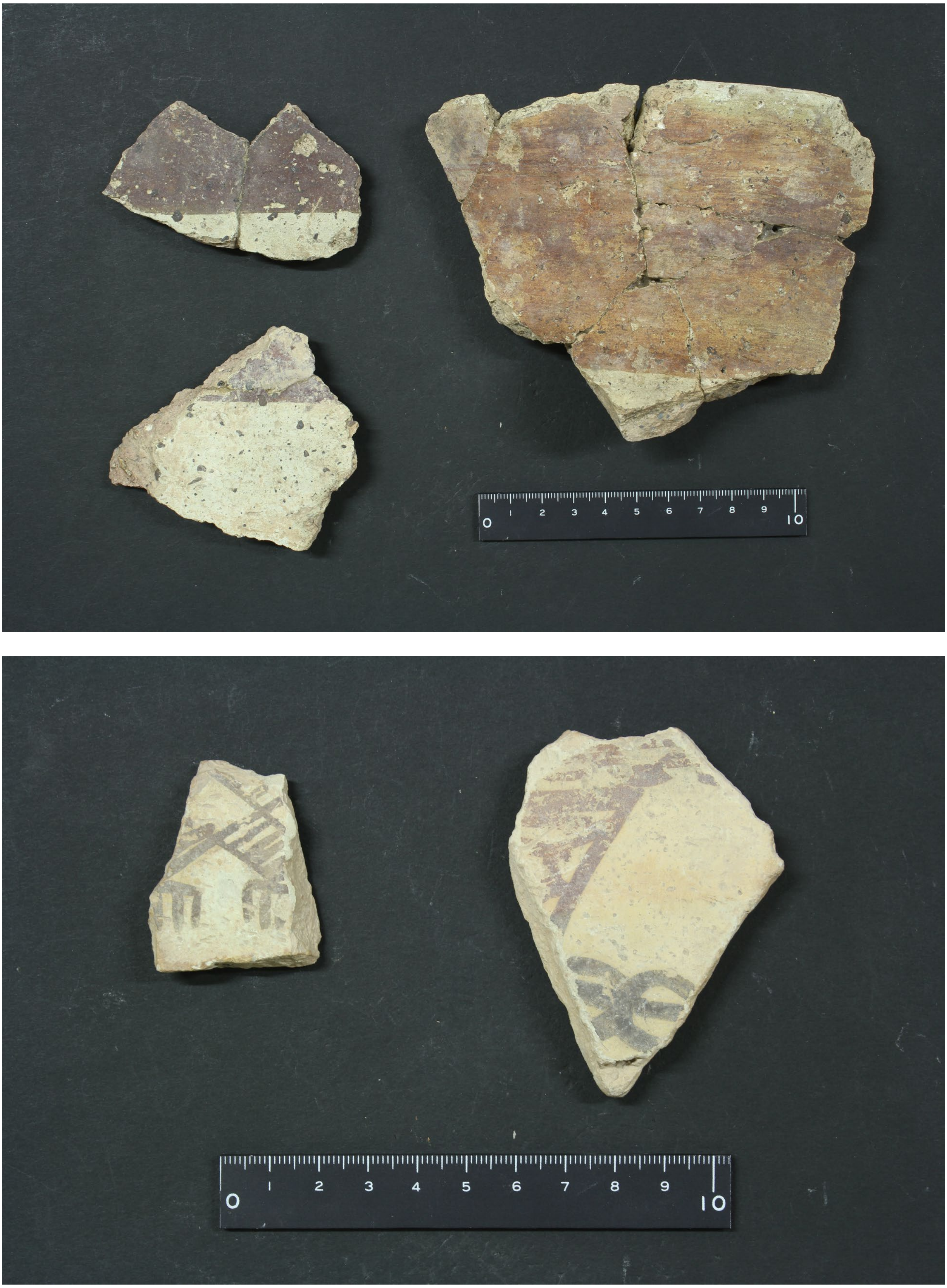

Figure 4.2 Mineral tempered black-on-buff ware (MBOBW) collected at Tall-e Bakun A (top) and vegetal tempered black-on-buff ware (VBOBW) collected at Tall-e Bakun B (bottom), now curated in UMUT (Photo by Miki)

Figure 4.3 Vegetal-tempered coarse ware (VCW) collected at Tall-e Jari A and curated in UMUT (Photo by Miki)

Figure 4.4 Mineral-tempered coarse ware (MCW) collected at Tall-e Bakun A, curated in UMUT (Photo by Miki)

Figure 4.5 Red burnished ware collected at Tall-e Bakun A (left) and the Neolithic ware collected at Tall-e Jari A (right) curated in UMUT (Photo by Miki)

were constructed, by ‘sequential slab construction’ or by coiling methods, followed by clay coating on its surface. It is generally fired at lower temperatures than BOBW, and its fabric is crumbly.

Other types of ware: Red burnished ware and Neolithic ware

Besides the majority of ware types, there are other minor ware types that were found during my collection study. Red burnished ware is confirmed at Tall-e Bakun A, in the layer later than Level IV, and was called Lapui ware by Sumner.[9] Red burnished ware was a typical pottery in the Lapui period, the successor of the Bakun period (Fig. 4.5 upper). There exist two types of fabric, one finer and one coarser. Its fabric colour is red (10R 4/6, 8; 10R 5/6, 8). Open forms and closed forms are typically observed. No decoration is painted on its surface. Instead, both the inside and outside are burnished. In addition to red burnished ware, as a result of the presence of the Neolithic layer below the layer of the Bakun period, tiny pieces of the Neolithic ware (the Bashi or the Jari pottery) appeared at Tall-e Jari A (Fig. 4.5 lower). Its fabric is vegetal tempered and is crumblier than BOBW.

4-2. Classification of BOBW vessel form

No quantitative analysis of vessel forms of the black-on-buff ceramics from the beginning to the end of the Bakun period has ever been conducted. This problem, concerning the diachronic change of vessel forms, must also be solved to answer research question No. 2. The terminology of vessel forms of the black-on-buff ceramics in the Bakun period varied depending on previous researchers, as reviewed in Chapter 2. To approach this research topic, the criteria of complete vessel forms during the Bakun period should be defined from both representative published examples and morphometric characteristics. Then, the methods to estimate complete vessels from potsherds should be improved. Below, I define complete vessel forms with a review of previous classification systems and representative published drawings, objectify this definition through the measurement of morphometric characteristics of complete vessels, and propose ‘exterior-painted open vessel, interior-painted open vessel, and closed vessel’ to interpret the complete vessel forms of badly-preserved potsherds. I also explain rim shape and base shape classification criteria and quantifying method of potsherds.

Criteria of classification of complete vessel form

The simple criterion of complete vessel form classification is presence/absence of neck (open form/closed form). The vessel forms of black-on-buff ceramics during the Bakun period can be further subdivided based on their shapes and sizes. First, I review, compare, and integrate previous researchers’ form classification

[9] Sumner 1972: 41; Sumner 1988.

Table 4.1 Comparison of terminology of vessel forms proposed by former researchers. Left two columns presents the author's classification system of complete vessel forms

Miki		Langsdorff and McCown (1942)	Egami and Sono (1962)	Goff (1964)	Egami and Masuda (1962)	Alizadeh (2006)	Weeks et al. (2006)	Pollock (2012)
Open form	Funnel-shaped vessel					Funnel-shaped vessels		
	Beaker	XI Beakers	XXII Urn XI Tumbler shaped	5. Beakers		Tall Beakers		beakers
	Deep bowl	I Deep bowls XII Cups VI Campani form bowls	IV goblet with ring base V Deep bowl with ring base XIII Cup with ring base VI Deep bowl without ring base VII Deep bowl IX Semi globular cup VIII Cup with sligthtly spreading mouth XIV Bowl	1. Ring-based bowls	Deep bowl Cup	Deep Bowls Straight-sided Bowls	“deep” bowl” (rim diameter < height)	hemispherical bowls
		III Small (Broad) bowls	XVIII Cup-bowl? with ring base	1. Ring-based bowls				deep conical bowls
	Hemispherical bowl	IV Hemispherical bowls		3. Simple bowls with flat or rounded bases?		Hemispherical bowls		hemispherical bowls
	Conical bowl	V Conical Bowls	XII cone base	4. Conical bowls	deep bowl	Conical Bowls	shallow bowl “ (rim diameter > height)	deep conical bowls
	Shallow bowl	XII Cups	XV bowl XVI bowl XIX Shallow bowl XX Ellipse shallow bowl XXI Plate	6. Cups 2. Saucers	shallow bowl			
		II (Big) Broad bowls	XVII bowl with ring base	1. Ring-based bowls		Ring-based Broad Conical Bowls		wide open bowls
	Barrel-shaped bowl					Barrel-shaped bowls		
	Incurved-rim vessel	VII Inverted-rim bowls	III inverted rim		pot (Fig.7 10)		bowl with incurving rims	
	Hole-mouth vessel with holes		X inverted cup					

Closed form	Small jar	VIII Squat pots	I Globular jar/pot	7. Jars?	pot (Fig.7 11-13)		small carinated vessels	squat pots
		IX Globular and Ovoid pots						globular jar, low neck
						Deep Wide-mouth Jars		
	Large jar	X Jars	II elongated jar	7. Jars	jar	Large Jars	large globular vessels	globular jar, high neck
Special form	Miniature vessel					Miniature Jars		
						Miniature Bowls		
		XIII Miniture cones and saucers				Tumblers		
						Miniature Saucers		
	Spouted vessel		XXIV spout					
	Zoomorphic vessel					Zoomorphic Vessels		
	Pot Stand							

systems of vessel forms (Table 4.1). I consider the classification systems proposed by McCown 1942, Sono 1962, Goff 1964, Masuda 1962, Alizadeh 2006, Weeks 2010, and Pollock 2012. I sought the definition of some vessel forms shared among researchers by reading explanations and drawing examples of representative vessel forms. Table 4.1 is the result of comparison and integration of the classification systems. The most detailed classification system is that of McCown, who reported the largest number of complete vessels. Goff and Pollock's classification system basically follows that of McCown. Masuda and Weeks's classification systems are simple in open form (deep bowl, shallow bowl, or cup). Alizadeh introduced a couple of new forms, such as barrel-shaped vessel and funnel-shaped vessel. Here, I define 15 pottery forms, as a result of the comparison and integration (Fig. 4.6; Table 4.1: two columns on the left side). Below, I describe qualitatively the basic characteristics of each complete vessel form, and provide representative examples from earlier published works.

Open form

Beaker and related form

Beaker

A beaker is a tall, elongated open form with a straight wall. Its rim diameter is much smaller than its vessel height. This form has a ring base, a flat base, a conical base, a pointed base, or a rounded base. The representative examples are beakers with ring bases from Tall-e Gap,[10] beakers with rounded bases from Tall-e Nokhodi,[11] beakers with rounded bases,[12] and beakers with ring bases from Tall-e Bakun A.[13] These complete vessels have decoration on their exteriors.

Funnel-shaped vessel

A funnel-shaped vessel was defined by Abbas Alizadeh and it is a rare open form with a long solid or hollow stem on the bottom.[14] This form appeared only in the earlier phase of Tall-e Bakun A, thus Alizadeh argued that this vessel form is likely to be the precursor of a conical bowl.[15]

[10] Egami and Sono 1962 Fig. 12:1,5.
[11] Goff 1964 Fig. 11:1,3.
[12] Langsdorff and McCown 1942 Pl. 27:13.
[13] Alizadeh 2006 Fig. 30:E, 32:D, and 34:E.
[14] Langsdorff and McCown 1942 Pl. 12:1; Alizadeh 2006 Fig. 24:H.
[15] Alizadeh 2006: 70.

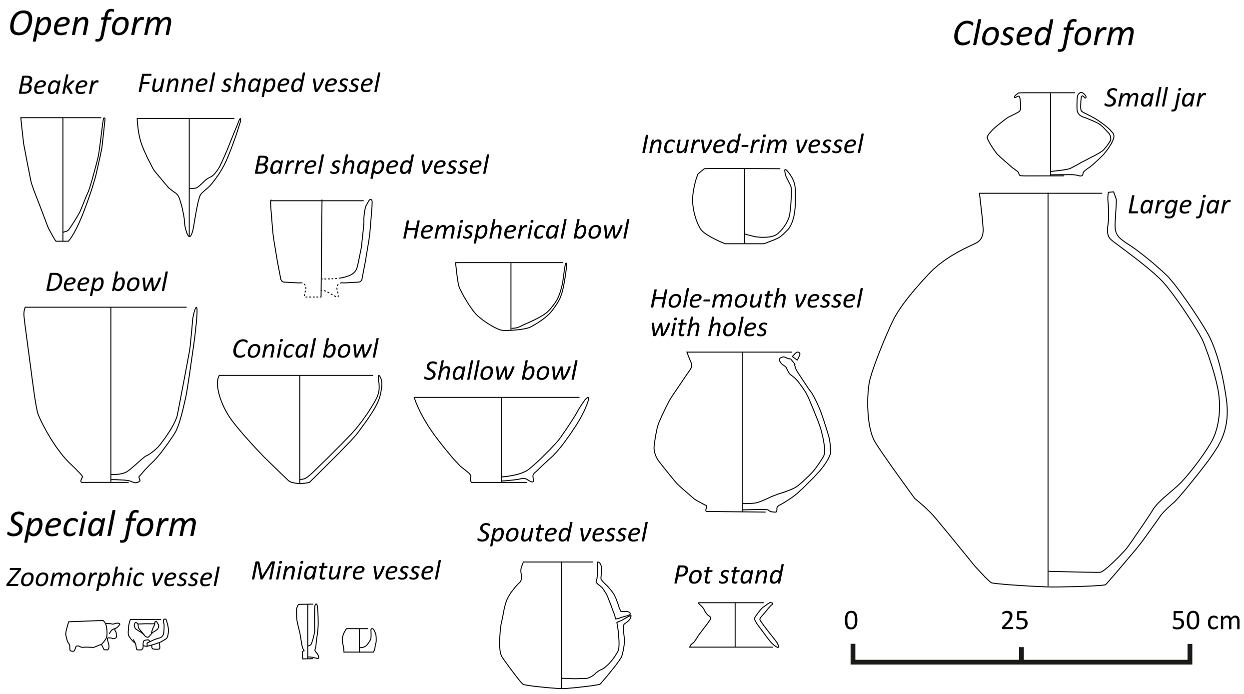

Figure 4.6 Open, closed, and special forms of black-on-buff ceramics (retraced from Langsdorff and McCown 1942: Pl. 9:1; 11:8,14; 12:1,5,10,13; 14:13; 15:6; 16:7; 17:22,25; 18:5; Alizadeh 2006: Figure 37:A; Egami and Sono 1962: Figure 31:4)

Bowls

Deep bowl

A deep bowl is the most popular open form during the Bakun period. It is a tall open form, with a straight wall, a carinated wall, or a curved wall. It is different from a beaker in vessel height; namely, the vessel height of a deep bowl is smaller than that of a beaker when their rim diameters are same. This vessel form has a ring base, a flat base, or a rounded base. A deep bowl with a flat base from Tall-e Gap[16] and deep bowls with ring bases from Tall-e Bakun A represent this vessel form.[17] The painted decoration is drawn on its exterior. Its interior is not usually decorated.[18]

Barrel-shaped vessel

A barrel-shaped bowl was defined by Abbas Alizadeh.[19] This shape is very rare and only one fragment was confirmed in the ceramic materials from Tall-e Bakun A of 1937 season.[20] It has a straight sided wall and a flat base. Another ring base may have been joined to the bottom of the flat base.

Hemispherical bowl

A hemispherical bowl is an open form, mostly with a rounded base. The vessel wall is hemispherical. The rim diameter is about twice as large as the vessel height. The representative instances are samples from Tall-e Gap[21] and from Tall-e Bakun A.[22] Decoration was confirmed either on its inside, on its outside, or on its both sides.

Conical bowl

A conical bowl is an open form with a conical, pointed, or truncated base. The vessel wall is diagonal, with a straight or slightly incurved rim. Alizadeh argued that conical bowls were the most prominent shapes of all thin-walled fine buff ceramics at Tall-e Bakun A.[23] It has decoration either on its outside or on both sides. Conical form is frequently observed in the ceramic materials from Tall-e Bakun A.[24] Alizadeh insisted that conical bowls serve as good index fossils for the 'Late Fars' phase.[25]

16 Egami and Sono 1962 Fig. 16:1, 17:8.
17 Langsdorff and McCown 1942 Pl. 4:3; Alizadeh 2006 Fig. 35:C.
18 Alizadeh 2006: 70.
19 Alizadeh 2006: 70.
20 Alizadeh 2006 Fig. 37:A.
21 Egami and Sono 1962 Fig. 15:8.
22 Langsdorff and McCown 1942 Pl. 11:7,8,9.
23 Alizadeh 2006: 69.
24 Langsdorff and McCown 1942 Pl. 11, 13, 14; Alizadeh 2006 Fig. 24:E, F, G.
25 Alizadeh 2006: 69.

Shallow bowl

A shallow bowl is a short open form with an oblique vessel wall. This vessel form has a ring base or a flat base. The representative complete examples are shallow bowls with ring bases from Tall-e Gap,[26] a shallow bowl with a ring base from Tall-e Bakun B,[27] a shallow bowl with a ring base from Tall-e Jari A,[28] and shallow bowls with ring bases from Tall-e Bakun A.[29] The painted decoration was depicted on its interior, although there were some exceptions, where the decoration was depicted on its exterior or on both of its sides.

Incurved-rim vessel

An incurved-rim vessel is defined as an open form, the rim angle of which is less than 80 degrees. Because the rim angle is difficult to judge, unless its profile was drawn, the judgement of this vessel form from potsherds is difficult. The painted decoration was applied on its exterior surface. Well-preserved vessels were reported at Tall-e Gap[30] and Tall-e Bakun A.[31]

Hole-mouth vessel with holes

Hole-mouth vessels with holes are different from incurved-rim vessels, in that the former have 'suspension' holes near the rim. Some of them also had a short-everted neck on the hole-mouth rim. It has painted decoration on its exterior. Well-preserved examples are found at Tall-e Bakun B[32] and Tall-e Bakun A.[33]

Closed form

Small jar

A small jar is a small closed form with a low or high neck. It has also a squat, globular, or ovoid vessel body wall. The size of a small jar is usually smaller than that of large jar. The representative examples were published in the reports of Tall-e Gap,[34] Tall-e Bakun B,[35] and Tall-e Bakun A.[36] Only its outside is painted.

Large Jar

A large jar is the largest form of all the shapes of the BOBW during the Bakun period. The maximum diameter and vessel height range all the way up to 57 cm.[37] It is a closed form with a low or high neck. It has a globular, concave, or ellipsoidal body wall. It has painting only on its outside. The representative examples are large jars from Tall-e Gap[38] and from Tall-e Bakun A.[39] The vessel function was storage of liquid or grains.

Special form

Miniature vessel

A variety of miniature vessels were identified at Tall-e Bakun A, such as tumblers, saucers, and so on. I refer only to these tumblers and saucers as miniature vessels. Because McCown's 'Cups (XII)' show a morphological similarity to deep bowls and shallow bowls, they are excluded from the category of miniature vessels according to the criteria of this thesis. Miniature cones[40] and miniature saucers[41] from Tall-e Bakun A are well-known examples.

Spouted vessel

There are a few published instances of vessels with a spout. The excavation of Tall-e Gap has reported some parts of spouts.[42] A small jar with a spout on the body has been found at Tall-e Bakun A.[43]

Zoomorphic vessel

The only confirmed report of a small bull-shaped open vessel was at Tall-e Bakun A.[44] A bull head was attached in front, and there were four legs instead of ring base. A painted decoration was observed on the bullhead.

Pot stand

Small pot stands were found only at Tall-e Bakun A.[45] They were used for the support of standing vessels with round or pointed bases. Painting was executed on its exterior.

[26] Egami and Sono 1962: Fig. 31:1,4.
[27] Egami and Masuda 1962 Fig. 17:9.
[28] Egami et al. 1977 Pl. III:1.
[29] Langsdorff and McCown 1942 Pl. 10: 9, 11:2.
[30] Egami and Sono 1962 Fig. 13:7.
[31] Langsdorff and McCown 1942 Pl. 12:5, 17: 8,9; Alizadeh 2006 Fig. 28:E.
[32] Egami and Masuda 1962: Fig. 14-19.
[33] Langsdorff and McCown 1942 Pl. 12:9,10; Alizadeh 2006 Fig. 42:F.
[34] Egami and Sono 1962 Fig. 17:1,4,5.
[35] Egami and Masuda 1962 Fig. 14:17.
[36] Langsdorff and McCown 1942: Pl. 12:13, 13:19.
[37] Langsdorff and McCown 1942: 30.
[38] Egami and Sono 1962 Fig. 11:1, 25:2.
[39] Langsdorff and McCown 1942 Pl. 14:10,11,12,13.
[40] Langsdorff and McCown 1942 Pl. 17:21,22; Alizadeh 2006 Fig. 56:H,J.
[41] Langsdorff and McCown 1942 Pl. 17:25,26; Alizadeh 2006 Fig. 56:D,E,F,G.
[42] Egami and Sono 1962 Pl. 29:8,9,10.
[43] Langsdorff and McCown 1942 Pl. 15:6.
[44] Langsdorff and McCown 1942 Pl. 1:10; Alizadeh 2006 Fig. 57:B, C.
[45] Langsdorff and McCown 1942 Pl. 18:3,5,7; Alizadeh 2006 Fig. 29:A,B,C,D.

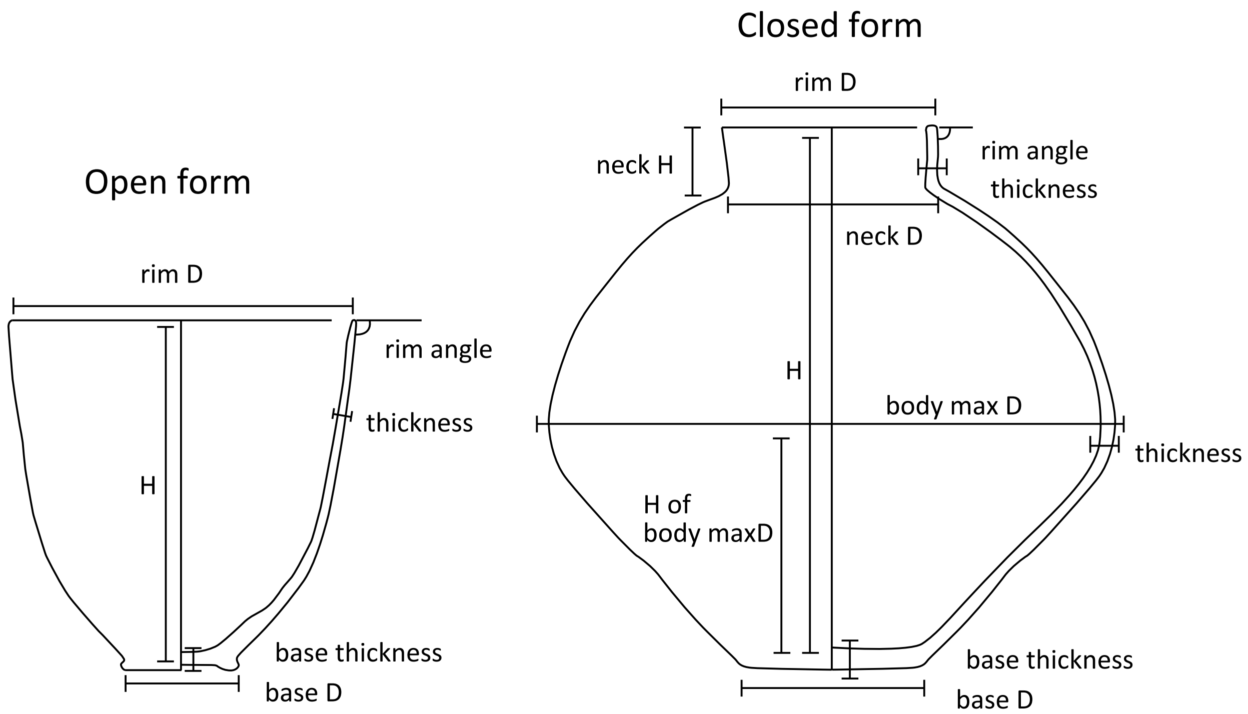

Figure 4.7 Measurement points of open form and closed form. D=Diameter, H= Height

Measurement of published complete vessels

As shown above, I arranged the terminology of vessel forms and briefly summed up the information on each form. This description is qualitative. For the purpose of delimiting the boundary of each vessel form that I qualitatively defined (e.g. the boundaries between deep bowl, hemispherical bowl, conical bowl, and shallow bowl), numerical criteria should also be presented from the already-known pottery data. For that reason, I picked complete vessels from published works, or nearly complete vessels preserved from rim to base. I qualitatively judged their vessel forms and then measured their numerical attributes. I analysed published materials from Tall-e Bakun A (149 samples, 123 open form samples, 26 closed form samples), Tall-e Bakun B (one open form sample), Tall-e Jari A (two open form samples), and Tall-e Gap (62 samples, 58 open form samples, 4 closed form samples). For open forms, I measured rim angle, rim diameter (D), vessel height (H), base diameter, wall thickness (T) 3 cm below the rim, and base thickness. For closed form classification, I measured rim angle, rim diameter, body maximum diameter, vessel height, neck height, neck diameter, base diameter, body max height, wall thickness 3 cm below the rim, wall thickness at the body maximum diameter, and base thickness (Fig. 4.7).

The results of measurements of each open form are listed in Table 4.2, which shows the minimum, median, and maximum, coefficient variance (CV) of rim angles, rim diameters, vessel heights, wall thickness 3 cm below rim, and base thickness, and vessel height/rim diameter ratio, and painted side. The table showed lower CV in rim angle (0.044 – 0.160) and vessel height/rim diameter ratio (0.115 – 0.220) than those in other

Table 4.2 Measurement results of open forms from the published data of four Bakun-period sites

angle (Θ)	beaker	deep bowl	hemi-spherical bowl	conical bowl	funnel-shaped vessel	shallow bowl	incurved-rim vessel	hole-mouth vessel with holes	miniature cones and saucers
maximum	105	119	125	124	118	140	80	51	108
minimum	90	87	94	95	101	96	55	51	87
median	97	100	101.5	113	109	121	69	51	94.5
CV	0.044	0.061	0.070	0.070	0.045	0.070	0.160	N	0.072
Sample N	13	56	24	21	9	32	4	1	10

Table 4.2 continued Measurement results of open forms from the published data of four Bakun-period sites

rim D (cm)	beaker	deep bowl	hemi-spherical bowl	conical bowl	funnel-shaped vessel	shallow bowl	incurved-rim vessel	hole-mouth vessel with holes	miniature cones and saucers
maximum	21	35	34	25	16	36	15	26	8
minimum	10	7	8	10	10	9	9	26	3
median	12.5	15	17.5	17.5	14	15	12.5	26	5.5
CV	0.220	0.406	0.347	0.216	0.154	0.334	0.177	N	0.301
Sample N	14	61	20	22	9	34	4	1	10

H (cm)	beaker	deep bowl	hemi-spherical bowl	conical bowl	funnel-shaped vessel	shallow bowl	incurved-rim vessel	hole-mouth vessel with holes	miniature cones and saucers
maximum	26	40	19	18	24	20	11	24	8
minimum	16	6	5	5	18	4	6	24	3
median	18	13	10	12	20	7	9.5	24	4.5
CV	0.158	0.455	0.340	0.244	0.111	0.442	0.236	N	0.353
Sample N	14	61	20	22	9	34	4	1	10

base D (cm)	beaker	deep bowl	hemi-spherical bowl	conical bowl	funnel-shaped vessel	shallow bowl	incurved-rim vessel	hole-mouth vessel with holes	miniature cones and saucers
maximum	9	12	7	5	2	9	6	10	6
minimum	2	4	2	1	2	3	3	10	0
median	6	6	3	2	2	7	4	10	3
CV	0.405	0.295	0.515	0.559	0.000	0.295	0.256	N	0.668
Sample N	10	40	5	7	1	27	4	1	10

3cm below rim T (mm)	beaker	deep bowl	hemi-spherical bowl	conical bowl	funnel-shaped vessel	shallow bowl	incurved-rim vessel	hole-mouth vessel with holes	miniature cones and saucers
maximum	7	11	8	7	8	25	8	8	10
minimum	2	2	2	3	2	4	5	8	4
median	4.5	5	4	4.5	5	6.5	7.5	8	6
CV	0.314	0.325	0.391	0.315	0.392	0.502	0.175	N	0.325
Sample N	12	50	17	14	9	32	4	1	10

Table 4.2 continued Measurement results of open forms from the published data of four Bakun-period sites

base T (mm)	beaker	deep bowl	hemi-spherical bowl	conical bowl	funnel-shaped vessel	shallow bowl	incurved-rim vessel	hole-mouth vessel with holes	miniature cones and saucers
maximum	20	20	6	20	70	24	19	9	28
minimum	6	2	2	2	4	3	4	9	2
median	9	8	4	8	21	6	8.5	9	8
CV	0.385	0.459	0.326	0.502	0.714	0.566	0.604	N	0.704
Sample N	11	46	13	13	7	31	4	1	10

height/ rimD	beaker	deep bowl	hemi-spherical bowl	conical bowl	funnel-shaped vessel	shallow bowl	incurved-rim vessel	hole-mouth vessel with holes	miniature cones and saucers
maximum	1.800	1.154	0.756	0.923	1.909	0.667	0.917	0.923	2.667
minimum	1.200	0.581	0.368	0.473	1.125	0.250	0.615	0.923	0.429
median	1.427	0.789	0.557	0.667	1.600	0.500	0.700	0.923	0.833
CV	0.115	0.180	0.143	0.162	0.150	0.220	0.155	N	0.644
Sample N	14	64	24	24	9	34	4	1	10

painted side	beaker	deep bowl	hemi-spherical bowl	conical bowl	funnel-shaped vessel	shallow bowl	incurved-rim vessel	hole-mouth vessel with holes	miniature cones and saucers
exterior	14	50	17	24	9	4	4	1	4
interior	0	7	4	0	0	24	0	0	1
bothsides	0	1	0	0	0	3	0	0	0
unpainted	0	4	0	0	0	2	0	0	4
band at rim	0	1	3	0	0	1	0	0	1
Sample N	14	63	24	24	9	34	4	1	10

attributes. Thus, both rim angle and vessel height/rim diameter can serve as better markers for complete vessel form classification. A biplot of rim angle and vessel height/rim diameter ratio is presented in the left side of Fig. 4.8. From these results, the numerical criterion is modelled in the right side of Fig. 4.8, which shows a clear numerical boundary between each form. In this table, it should also be pointed out that several complete vessel forms reflected a preference for specific painted sides. For example, whereas beakers and conical bowls have painted decoration on their exteriors, most of shallow bowls have painted decoration on their interiors. Although this trend is not clearly distinguished vessel form by vessel form, this information is useful when I estimate complete vessel forms from potsherds.

Measurement results of closed form samples are presented in Table 4.3. The numerical attributes that reflect vessel size, such as rim diameter, body maximum diameter, vessel height, neck diameter, base diameter, height at body maximum diameter, and wall thicknesses, show the clear distinction between a small jar and a large jar. For example, whereas the height of a large jar ranged from 19 cm to 63 cm, that of a small jar ranged from 4 cm to 16 cm. Compared with a small jar and other open forms, the wall thickness (3 cm below the rim edge, the point of body maximum diameter, and base) of a large jar was also prominent. The ratio of body maximum diameter to rim diameter indicated that a large jar is more closed than a small jar.

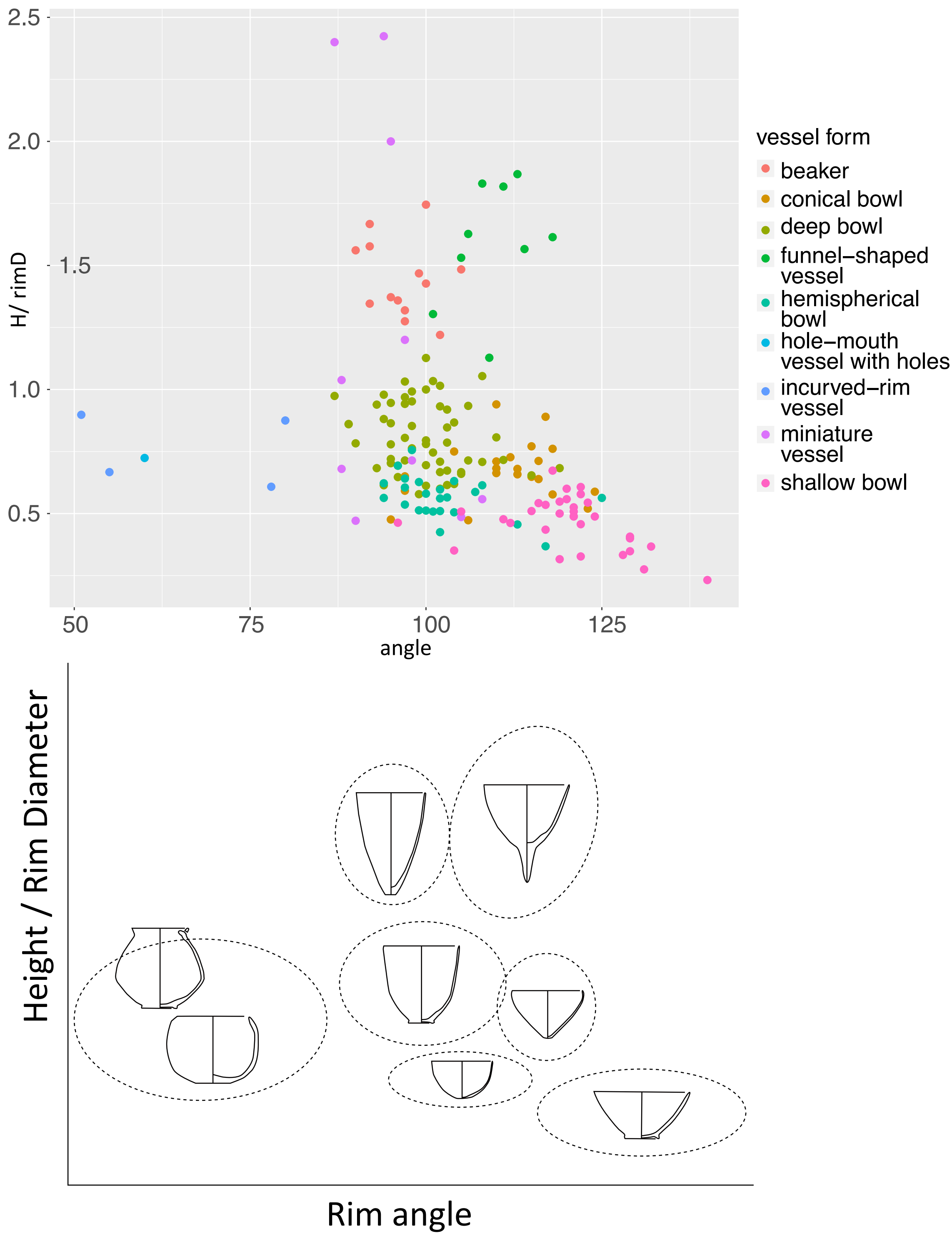

Figure 4.8 Biplot of rim angle and Height/rim diameter of open forms (top) and the distribution of complete vessel forms (bottom)

Estimate of complete open vessel forms from potsherds

Above, I defined the complete vessel-forms of BOBW during the Bakun period based on complete vessels and well-preserved vessels. However, when I identify complete vessel forms from badly preserved potsherds in Chapter 6, there are limits to the exact identification of the above-defined vessel forms, especially complete open vessel forms. In addition, in spite of these limits, the vessel form information is also required when I investigate the correlation between vessel forms and the other attributes (horizontal design structure, ware types, sizes, etc.). Below, I explain:

1) how to estimate complete vessel forms from potsherds, and

Table 4.3 Measurement results of closed forms from the published data of four Bakun-period sites

rim angle (θ)	large jar	small jar
maximum	140	121
minimum	90	91
median	98	106
CV	0.112	0.088
Sample N	16	11

rim D (cm)	large jar	small jar
maximum	25	11
minimum	9	4
median	14	9
CV	0.279	0.256
Sample N	16	11

body max D (cm)	large jar	small jar
maximum	57	19
minimum	18	6
median	30	12
CV	0.326	0.326
Sample N	18	12

H (cm)	large jar	small jar
maximum	63	16
minimum	19	4
median	35	9
CV	0.326	0.423
Sample N	18	12

neck length (cm)	large jar	small jar
maximum	8	9
minimum	1	1
median	4	2
CV	0.399	0.795
Sample N	16	11

neck D (cm)	large jar	small jar
maximum	23	9
minimum	8	3
median	13	8
CV	0.266	0.264
Sample N	16	11

base D (cm)	large jar	small jar
maximum	19	9
minimum	8	0
median	12	6
CV	0.297	0.487
Sample N	13	10

body max H (cm)	large jar	small jar
maximum	30	7
minimum	4	2
median	15	4
CV	0.446	0.406
Sample N	16	11

body maxD/ rimD	large jar	small jar
maximum	3.156	2.043
minimum	1.653	1.145
median	2.200	1.435
CV	0.206	0.164
Sample N	16	11

rim below 3cm T (mm)	large jar	small jar
maximum	19	7
minimum	4	3
median	8	5
CV	0.350	0.244
Sample N	15	11

body max D T (mm)	large jar	small jar
maximum	17	12
minimum	6	4
median	11	6
CV	0.301	0.397
Sample N	15	11

base T (mm)	large jar	small jar
maximum	32	12
minimum	8	2
median	15	6
CV	0.412	0.455
Sample N	15	10

2) how to investigate the correlation between vessel forms and the other attributes.

First, I distinguish open vessels from closed ones (Fig. 4.9). Next, among closed vessels, a small jar is separated from a large jar based on wall thickness. Third, open vessels are subdivided into broad categories based on their painted sides: 'exterior-painted open vessel', 'interior-painted open vessel', 'open vessel painted on its rim', 'unpainted open vessel', and 'open vessel painted on its both sides'. These broad categories are also used to consider the correlation between vessel forms and other information (horizontal design structure and pottery-making technique) from potsherds. Fourth, by considering rim angles, painted sides, and the published complete vessels, I estimate complete vessel forms. This strategy is significant, especially at Tall-e Jari A and Tall-e Bakun B, where the numbers of excavated complete vessels are limited.

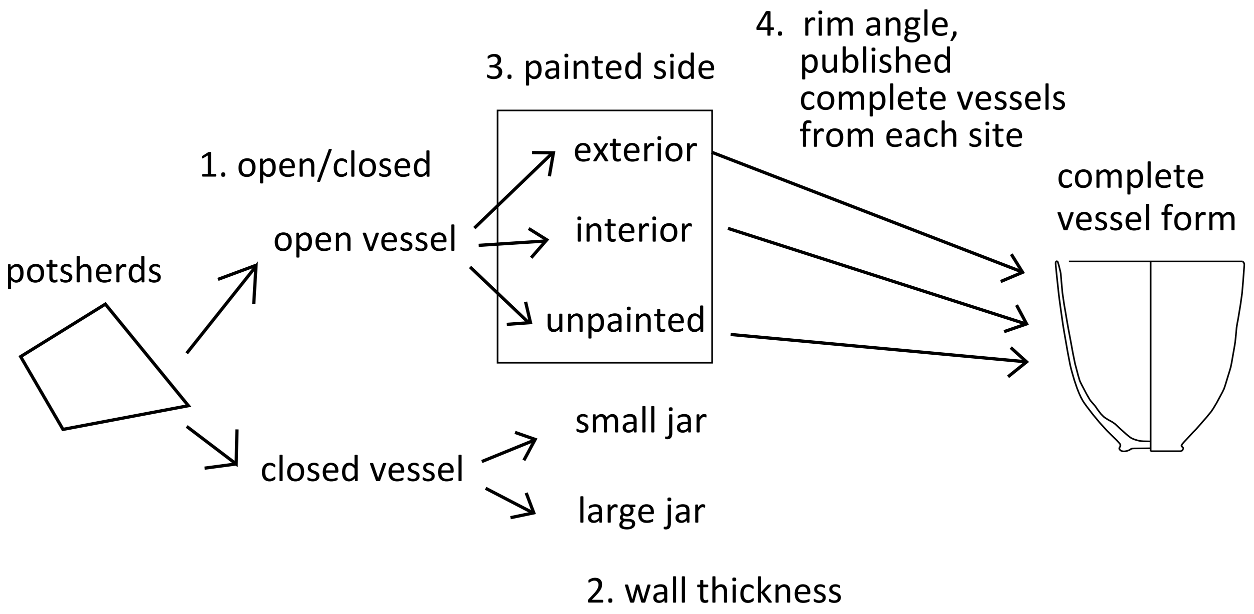

Figure 4.9 Estimate procedure of complete vessel forms from potsherds: 1: judgement of open/closed, 2: judgement of wall thickness, 3: judgement of painted side, 4: judgement of complete vessel form based on rim angle, rim diameter, and published complete vessels from each site

Counting method and rim and base shape classification

After defining the ware types and vessel forms used in this research, I explain the counting method of potsherds. The first procedure is to count potsherds based on ware types. The second procedure is to identify the preserved part of the potsherds. Potsherds of open forms can be subdivided into three parts: rim, body, and base. The criterion of a rim sherd is the presence of the rim edge. The criterion of a base sherd is the presence of the base edge or edge of the ring base. The complete vessels preserving from rim to base, although there are few and they have already been published, were counted separately. Potsherds of closed forms can be subdivided into four parts: rim, neck, body, and base. The criteria of a rim sherd and a base sherd for closed forms are same as those of open forms. The criterion of a neck sherd is the presence of a joint between the neck part and the body part. Rim sherds preserved from rim to neck parts are counted as rim sherds. When potsherds are too tiny to identify their form, I classify them as unknown.

There is some variation in the rim shape and the base shape, on open forms, as well as on closed forms. Except for Bernbeck and his colleagues' report on the Bakun pottery from Tol-e Bashi[46], few researchers have paid attention to the difference of rim shapes. Bernbeck and his colleagues described several rim shapes as 'simple-rounded', 'somewhat pinched on the inside', 'beaded rim', 'flat rim', and 'grooved rim'.[47] Following their classification system, I subdivide the rims of open and closed forms. I evaluate the morphological characteristics from the rim edge to 3-5 cm below the rim. Fig. 4.10 shows the morphological variation of rim shapes of open form (i.e. simple rounded, pinched outside, grooved, beaded, flat, and semi-incurved) and that of closed form (i.e. simple rounded, flat, pinched outside, grooved, horizontal brim, and dropped brim).

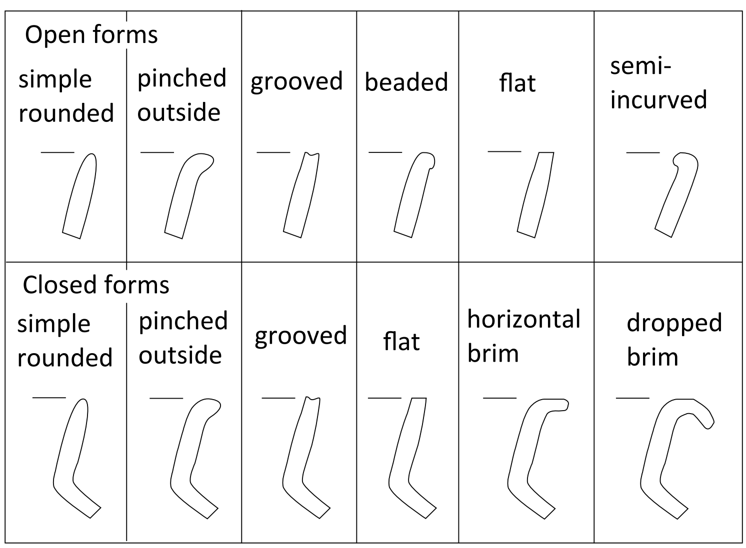

Figure 4.10 Rim-shape subdivision of open forms and closed forms

[46] Bernbeck et al. 2010.

[47] Bernbeck et al. 2010: 156, Table 6.3.

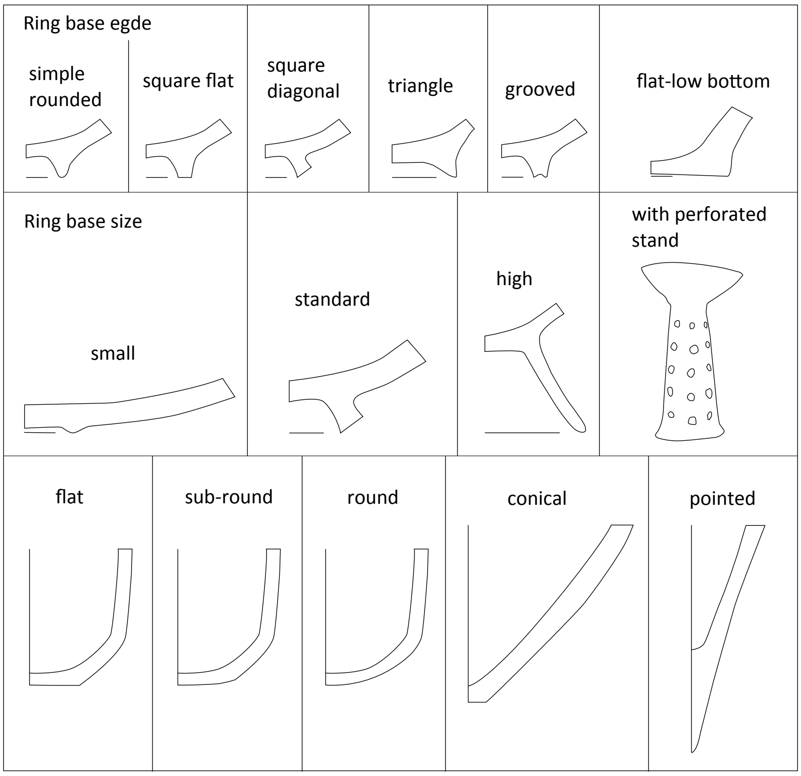

Figure 4.11 Base-shape subdivision of with/without ring bases (retraced from Vanden Berghe 1952: Pl. XLIX)

The previous approach to subdivide base shapes was also conducted by Bernbeck and his colleagues. They indicated some samples with a flat base, a triangular ring base, a rounded ring base, and a square ring base.[48] In this research, following the previous report, I classify base shapes based on the presence of a ring base, the edge form of a ring base, and the relative size of a ring base. First, base shapes of the black-on-buff ceramics can be separated by the presence of a ring base. The bases of ceramic vessels that have no ring base can be classified into five base-shapes: flat, sub-round, round, conical,[49] and pointed (Fig. 4.11). Then, there are two criteria in subdividing ring base shapes. The first criterion is the relative size of a ring base compared to the whole vessel size. I classify the size into four categories – that is, a small, standard, high, and ring base as a perforated stand (Fig. 4.11). The second criterion is the edge form of a ring base. On the basis of Bernbeck and his colleagues' work, I name the edge forms of ring base as simple rounded, square flat, square diagonal, triangle, and grooved, and flat-low bottom. The results of ware-type classification, vessel-form classification, and rim and base shape classification following this classification are explained in Chapter 6.

4-3. Stylistic classification and analysis of painted decoration

As reviewed in Chapter 2, previous studies of the Bakun pottery focused on the classification of painted motifs. I pay attention to painted decoration, both as stylistic patterns and as attributes showing technical skill in painting. Here, I present several ways to approach painted decoration style from the source book written by Prudence Rice, while at the same time defining the terminology. Then, I briefly review former approaches to the Bakun pottery and present the analytical method used in this research.

Stylistic components of painted decoration

First, I define the decoration style used during the Bakun period. I define a decorative style as a manner or mode of expression that is shared in a certain time, place, or context.[50] The painted vessels found from the beginning to the end of the Bakun period shared a set of common stylistic components. All the painted motifs were drawn on a buff surface with black or reddish-brown pigment, in a representational manners (animals and humankind) and in a geometric manner (other decorative patterns). 'The Bakun style' is clearly different, from the Mushki, the Bashi, and the Jari styles, temporally, and from the Late Susiana, the Soghun, the Cheshme Ali styles, spatially.[51]

Next, following Rice, I define the terminology of painted decoration, especially the components. An *element* is the smallest component of a motif.[52] As in the examples of the Bakun painted pottery, it includes a single dot, a single short vertical line, a triangle, a rectangle and a lozenge, and so on (Fig. 4.12). They appear on the surface of pottery either independently or with other elements connected together. Elements do not have to be an irreducible component of the painted decoration. For that definition, the most difficult problem of judging these smallest elements is to distinguish them from the larger unit of painted designs. The boundary between a motif and an element depends on the painted style.

[48] Bernbeck et al. 2010: 157-158, Fig. 6:3.

[49] Although the Base diameter of a conical base is so small and it looks like pointed base, there is a small flat base on the edge.

[50] Rice 1987: 244.

[51] Fukai et al.(eds.) 1973; Pollock et al. 2010; Maeda 1986; Delougaz and Kantor 1996; Alizadeh 2008; Beale 1986; Fazeli Nashli et al. 2004.

[52] Rice 1987: 248.

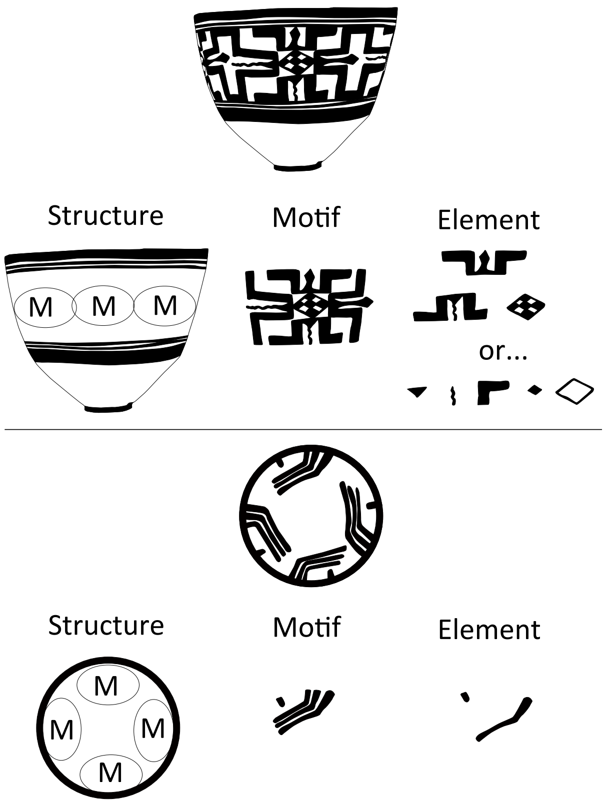

Figure 4.12 Examples of element, motif, and structure of open vessel painted on its exterior (upper) and open vessel painted on its interior (lower). M means motif (retraced from McCown and Langsdorff 1942: Pl. 4:2; Egami and Sono 1962: Figure 30:4)

A *motif* is a specific pattern of element combinations.[53] As a metaphor, the relationship of a motif to an element is similar to that of a molecule to an atom in chemistry. In the Bakun period, a motif is repeatedly configured several times on one vessel (Fig. 4.12). The most important point for identifying one motif is a pattern of the combination of elements rather than its morphological similarity (e.g. length of lines, number of dots, and shape) because those morphological attributes are inconsistent even on one vessel.

Finally, a *structure* is a spatial pattern whose motifs are bounded (e.g. with horizontal bands or with horizontal lines) (Fig. 4.12).[54] As a metaphor, the relationship of a structure to both an element and to a motif is similar to that of a crystal structure to both an atom and a molecule in chemistry. In general, understanding a structure is more difficult than that of an element and a motif due to the scarcity of complete pottery vessels.

Analytical method of painted decoration: design structure analysis

According to the sourcebook written by Rice, analytical methods of painted decoration are subdivided into two types. One method focuses on the element/motif of painted decoration (design element analysis).[55] On the other hand, another one pursues the specific combination patterns of elements, motifs, and structures (design structure analysis).[56] The former analysis is a popular method for approaching the chronological problems in the premise that certain elements/motifs had specific lifespans, thereby becoming good chronological indicators. This analysis was sometimes used for clarifying what kinds of interactions existed between two spatially distant groups with the shared elements/motifs of painted decoration, under the assumption that shared elements/motifs were a result of direct or indirect interaction. The latter was used not only for approaching those problems but also for identifying

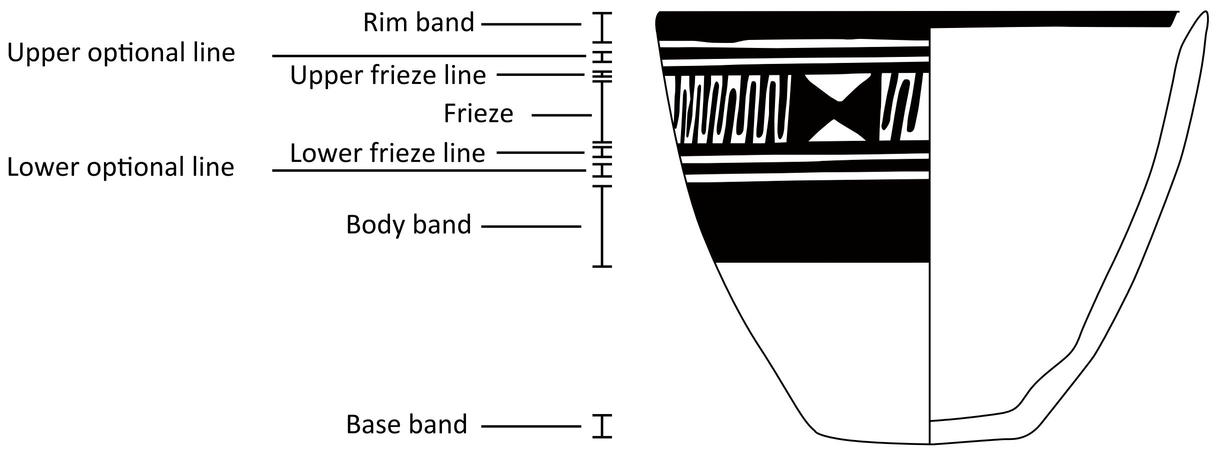

Figure 4.13 Terminology of horizontal design structures of exterior-painted open vessels (1) (retraced from Egami and Sono 1962: Figure24:1)

[53] Rice 1987: 248.

[54] Rice 1987: 249.

[55] Rice 1987: 252.

[56] Rice 1987: 260-266.

explicit rules in painting vessels, thereby contributing to the identification of potter groups.[57]

As I summarised in Section 2-2, the systematic categorisations of the painted decoration during the Bakun period were presented by Herzfeld in 1932, McCown in 1942, Sono in 1962, and Alizadeh in 2006. It is true that these previous classification systems were more oriented towards element/motif analysis than design structure analysis, but they were the mixtures of the two types of analytical methods. Their goals were to solve the problems of chronology and interaction. Other researchers have chosen either to apply the others' classification systems to their own studies[58] or to compare their excavated materials with the similar motifs from the former publications without adopting any classification system.[59] I consider that previous studies have already intensively studied the element/motif analysis for chronology. Hence, in this research, I will not specifically use painted decoration to discuss chronology. Rather, I will approach painted decoration to clarify diachronic changes of the explicit rules or grammars of painting as stylistic patterns towards reassembling communities of practice. Thus, design structure analysis is a more useful method than design element/motif analysis for this book. In addition, previous researchers have not been so concerned with design structure analysis. In this research, I will focus on comprehending design structure patterns rather than classifying design motifs. Below I will restrict the discussion of design structure only to horizontal design structures. Although discussing chronology without painted decoration is problematic in the current situation, considering the limited number of radiocarbon dates and stratigraphic evidence, I am able to avoid discussing diachronic change of specific ceramic materials with a chronological framework based on the same ceramic materials.

Next, I will define the terminology for describing the components of horizontal design structures by referring to six complete ceramic vessels from Tall-e Gap and Tall-e Bakun A (Figs. 4.13-17). Before defining the terminology, I will introduce the previous study of horizontal design structures. Alizadeh has paid attention to the horizontal design structures of the exterior-painted ceramic vessel from Tall-e Bakun A and analysed them.[60] He called horizontal design structures 'banding patterns'. He mentioned the presence of two pairs of a thick band and several thin lines above and below the design panel. He classified the banding arrangements into 19 types. The criterion of the classification was the number of bands above/below the design panel. As a result of the analysis, he discovered the predominant banding pattern in deep bowls and broad bowls (three lines above, three lines below a design panel). In addition, he pointed out the presence of the secondary motifs, such as triangles between a thick topmost band and thin lines. Then he argued that this characteristic is absent both in the predecessor Tall-e Gap and in the Middle Susiana period. He also noticed a common banding pattern on the surface of conical bowls (two lines above, two lines below a design panel) and cups (one band above a design panel). Finally, he reported that the interior-painted bowls have one thick band at the lip and one thick band around the exterior base. Below I will adopt another strategy for horizontal design structures to examine his results, extend potsherds and well-preserved vessels, and expand this analysis to the whole Bakun period.

Fig. 4.13 shows the most typical exterior-painted design structures at Tall-e Gap, which were painted only on its upper part. The design structure consists of a rim band, upper optional line, upper frieze line, frieze, lower frieze line, lower optional line, body band, and base band. A **rim band** is the top horizontal painted line in a ceramic vessel. Even though the term uses 'band', the thickness varies. Sometimes the thickness is as thick as other horizontal lines. An **upper optional line** is one to three horizontal thin lines between the rim band and upper frieze line. This line does not always appear and become an essential part of the horizontal design structure. Thus, the line is called 'optional'. An **upper frieze line** is a line that delimits the upper part of the frieze. A **frieze** is a horizontal design panel where one to two types of motifs are decorated horizontally in a repetitive manner. A **lower frieze line** is a line corresponding to the upper frieze line delimiting the lower part of the frieze. A **lower optional line** is one to three horizontal thin lines between the lower frieze line and body band. A **body band** is a horizontal thick line usually located in the middle or lower-middle part of the body of the ceramic vessel. No design component exists between the body band and base band. The body band can be defined as the lowest component of the main upper horizontal design structure. Finally, a **base band** is a horizontal painted line located either at the edge of the flat base or at the joint between the lower end of the body part and the ring base.

However, when classifying the components of horizontal design structures, sometimes I met the difficult situation of distinguishing between a rim band, upper optional line, and upper frieze line, or between a lower frieze line, lower optional line, and body band. In that case, I created a hierarchical order for the preponderance among the terms to be classified. As for the upper lines above a frieze, the rim band is the first to be classified, and the upper frieze line is the second. An upper optional line can appear in the classification

[57] Rice 1987:264-266, Friedrich 1970, Bernbeck 1999; Bernbeck 2008.
[58] Goff 1964; Voigt and Dyson 1992.
[59] Egami and Masuda 1962; Weeks et al. 2006; Bernbeck et al. 2010.
[60] Alizadeh 2006: 73, Charts 37-42.

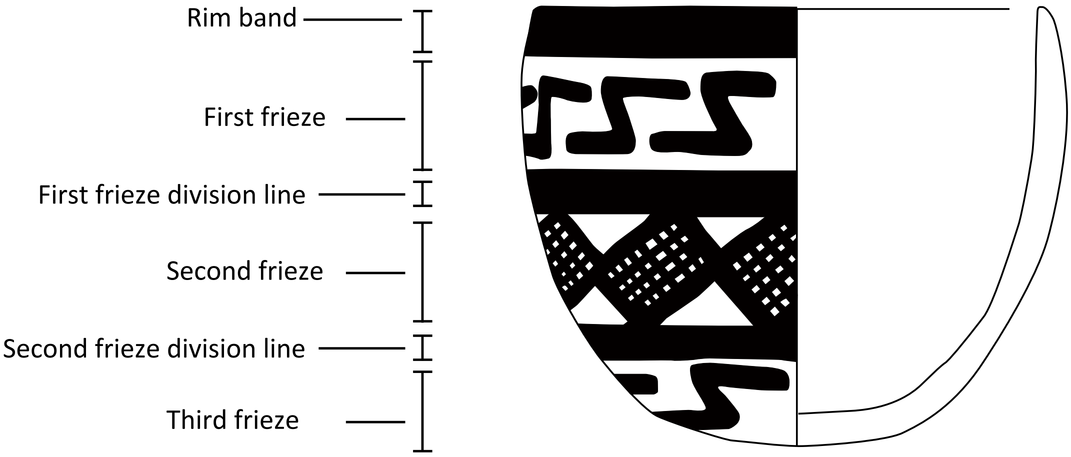

Figure 4.14 Terminology of horizontal design structures of exterior-painted open vessels (2) (retraced from Egami and Masuda 1962: Figure20:5)

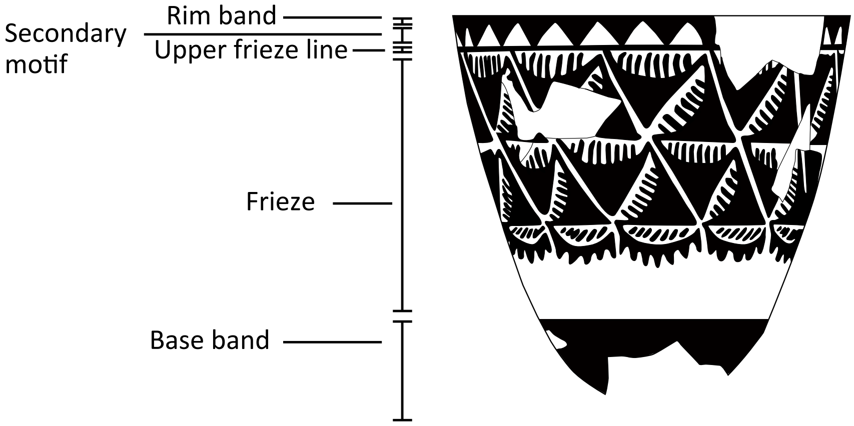

Figure 4.15 Terminology of horizontal design structures of exterior-painted open vessels (3) (retraced from McCown 1942: Pl. 26:8)

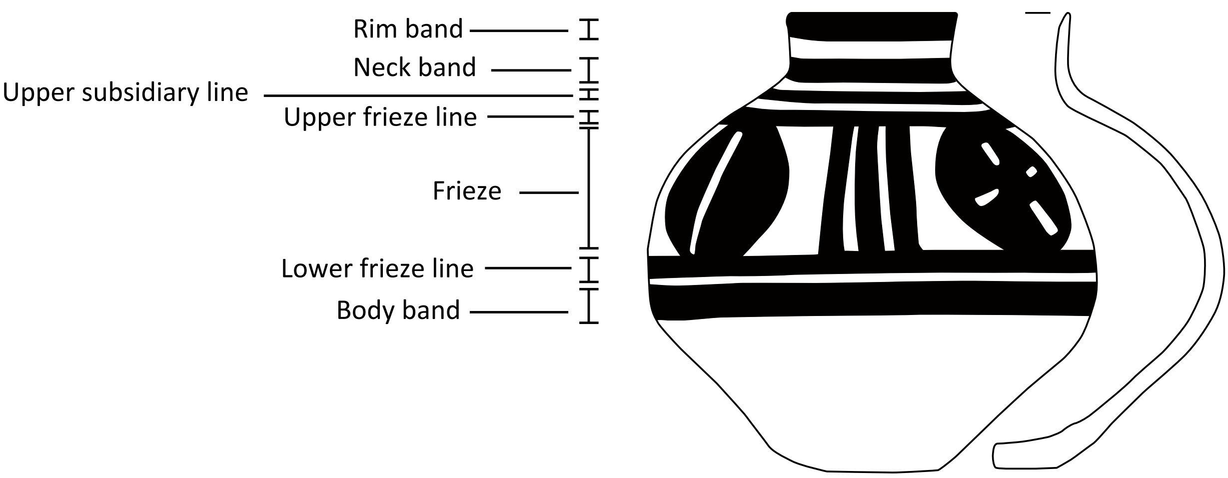

Figure 4.16 Terminology of horizontal design structures of closed vessels (retraced from Alizadeh 2006: Figure 42:C)

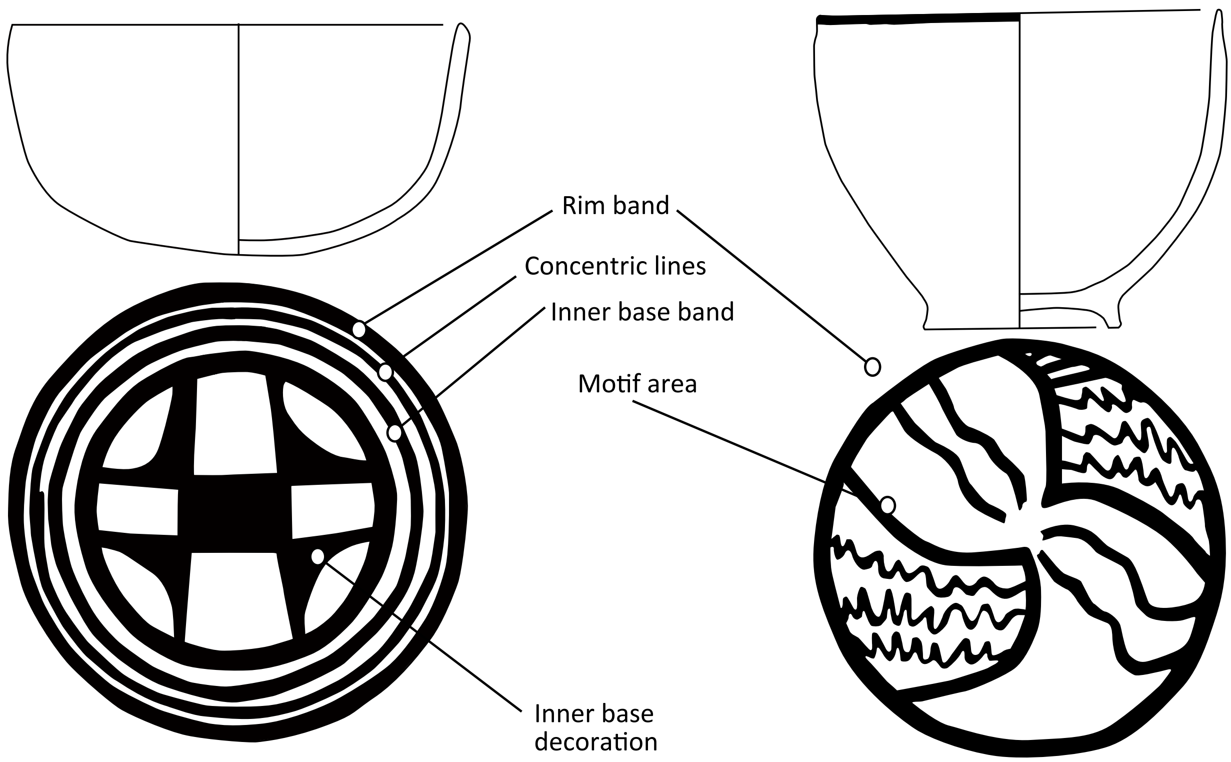

Figure 4.17 Terminology of horizontal design structures of interior-painted open vessels
(retraced from Egami and Sono 1962: Figs. 28:1 and 30:2)

category only if these two predominant lines (rim band and upper frieze line) already exist. Regarding the lower lines below the frieze, the body band is the first and the lower frieze line is the second. A lower optional line can exist only if these two predominant lines are already on the exterior surface.

The second example has three rows of friezes (Fig. 4:14). For the ceramic vessels with more than two friezes, I define a frieze division line. A **frieze division line** is a line sandwiched only between friezes. In this figure, three friezes were observed. As discussed by Alizadeh, small secondary motifs appear on some ceramic vessels from Tall-e Bakun A (Fig. 4.15). This horizontal row of small motifs is located between the rim (body, base) band, upper (lower) optional lines, and upper (lower) frieze line. I call it a **secondary motif**. Closed-form vessels follow this terminology for the design structure painted on their exterior except for the presence of a neck band (Fig. 4.16). This **neck band** is a thick horizontal band painted on the neck joint. It is separated from a rim band.

As for the interior-painted open vessels, a terminology similar to the exterior-painted open vessels was partly adopted. For example, a **rim band** and **base band** are observed also in the interior-painted open vessels (Fig. 4.17). The general structures are subdivided into two types: with an inner base band (Fig. 4.17: left) or without an inner base band (Fig. 4.17: right). An **inner base band** (Fig. 4.17: left) is literally a concentric band located at the bottom of the interior. **Concentric lines** (Fig. 4.17 left) are decorated between a rim band and an inner base band. In the case of vessels without an inner base band, the **motif area** refers to the inside area surrounded by the rim band (Fig. 4.17: right). Motifs are usually hanging down from the rim band in the motif area. Some examples have **friezes** between the rim band, concentric lines, and the inner base band. I will codify horizontal design structures of painted decoration using these terminologies and find stylistic patterns of horizontal design structure in Chapter 7.

4-4. Analysis of pottery-making technique

As the review in Chapter 2 showed, previous researchers have discussed pottery-making techniques to derive a clues about the organisation of pottery production. They seldom examined all the production stages, from clay acquisition to firing. However, as Pollock showed, there was evidence of a poorly painted vessel in the Bakun period, whch implied that archaeological evidence can demonstrate the presence of an apprentice with less technical skills, especially painting activity. I prepared the theoretical foundation for my consideration of technical skills in Chapter 3 by introducing the concept of skill proposed by Tim Ingold. Here, I will separately present methods for understanding pottery-making techniques in two parts: methods for approaching the sequences of technical steps and options (what was done) and methods for discussing the technical skills of pottery-making techniques (how it was done).

The concept of the chaîne opératoire and its problems

I will use the 'chaîne opératoire' concept to reconstruct the manufacturing process of ceramic materials — in other words, how pottery making was done. This concept has its origins in André Leroi-Gourhan's work '*Gesture and Speech*'.[61] Leroi-Gourhan defined and briefly explained the chaîne opératoire as follows:

> 'Techniques involve both gestures and tools, sequentially organised by means of a 'syntax' that imparts both fixity and flexibility to the series of operations involved. This operating syntax is suggested by the memory and comes into being as a product of the brain and the physical environment. If we pursue the parallel with language, we find a similar process taking place'.[62]

This approach has been used by archaeologists studying ancient techniques since the 1990s and builds on the works of Francophone anthropologists.[63] There were also other schools of archaeologists studying ancient techniques in similar ways to the chaîne opératoire in Japan and North America.[64] Peter Bleed combined these methodological concepts and called them 'sequence models'.[65] Although to date lithic analysis has been more suitable than ceramic analysis for the application of the chaîne opératoire, because of the nature of lithic-tool making as a reduction process and of the presence of lots of debitages,[66] more recently archaeological analyses have also applied this methodology to ceramic materials[67] and other materials.[68]

I explain in detail the concept of the chaîne opératoire with the example of pottery-making. First, this concept is a way of describing a technique by separating one whole technical process (pottery making) into several technical steps (e.g. preparing clay, forming, firing, etc.).[69] Researchers can reconstruct and represent the technical process by linking the steps together into a linear sequence (e.g. preparing clay → forming → firing). Second, they can also allow each step within the targeted technique to have several technical options dependent on the different gestures, tools or raw materials used (e.g. forming has several technical options such as coiling, moulding, and wheel-throwing).[70] Third, the universal irreversibility of some technical sequences within the processes (e.g. forming never precedes preparing clay, firing never precedes forming) plays a key role in applying this concept to the reconstruction of the manufacturing techniques used in the creation of archaeological materials from the visible technical traces preserved on them. For the analysis of the sequence of technical steps and options below, I will adopt the chaîne opératoire and define the terminology of the pottery-making process.

Although the chaîne opératoire is quite helpful not only for describing technical processes but also for '*understanding the meaningful links and chains between people and products, between artifice and artefacts, and between gestures and gadgets*',[71] some researchers have identified some problems inherent in the concept of the chaîne opératoire. In their approach to the identification of the apprentice potter from archaeological materials found at Shahr-e Sukhteh, Vidale and his colleagues criticised the linear and normative nature of the chaîne opératoire as reconstructed by archaeologists living in the modern, industrial, and capitalist world, as they take for granted that materials were produced by human labour in a standardised way.[72] They argued that manufacturing in a non-industrial community is much more complicated than the chaîne opératoire reconstructions allow, as indicated by the ethnography into contemporary non-industrial communities recording the fluid and chaotic production flows and the simultaneous commitment of several makers, including apprentices and skilled craftspeople, in their craft production.[73]

I will propose a different method for approaching skill to supplement this drawback of the chaîne opératoire approach below. Although the strength and drawback of the chaîne opératoire approach — that is, that it can describe normative technical sequences, while however disregarding the situational traces of technical activities — are sometimes considered a dichotomy,[74] I do not consider this dichotomy to be compulsory. Rather, dualistic views of pottery-making techniques should be reconsidered. For example, Reinhard Bernbeck applied the chaîne opératoire to find rules hidden in the painted designs decorated in the Neolithic pottery in Iran.[75] He found some explicit rules in the chaîne opératoire of painting, which only the pottery producers could notice and understand in

61 Leroi-Gourhan 1964-65; Leroi-Gourhan 1993; Audouze 1999, 2002.
62 Leroi-Gourhan 1993: 114.
63 Creswell 1976; Creswell 1983; Balfet 1991; Lemmonier 1992; Naji and Douny 2009.
64 Yoshizaki 1961; Schiffer 1975; Bleed 2001.
65 Bleed 2001: 101.
66 Bleed 2001: 118-119; Bar-Yosef and Van Peer 2009; Tostevin 2011
67 Gosselain 1998; Bernbeck 1999; Vidale et al. 2014; Roux 2016.
68 Della Casa et al. 2016; Green 2016; Lopéz-Montalvo et al. 2017.
69 Lemmonier 1992: 26; Bernbeck 1999: 97; Roux 2016: 4.
70 Lemmonier 1992: Fig. 1.
71 Dobres 2010: 107.
72 Vidale et al. 2014: 73-74.
73 Vidale et al. 2014: 73.
74 Bleed 2001; Dobres 2010.
75 Bernbeck 1999.

Table 4.4 Classification of technical steps (vertical) and technical options in each technical step (horizontal) in pottery making techniques during the Bakun period from previous studies. The sequence of technical steps proceeds from the upper of the table to the lower (Abbreviation: H: Herzfeld 1932; L&M: Langsdorff and McCown 1942; E&S: Egami and Sono 1962; E&M: Egami and Masuda 1962; G: Goff 1964; B: Bernbeck et al. 2005; A: Alizadeh 2006; W: Weeks et al. 2010; H&S: Helwing and Seyedin 2010; P: Petrie 2011)

Technical steps		Technical options in BOBW			Technical options in VCW		Technical options in MCW	
1) Obtaining		use of calcareous clay (W: 256: P: 162)						
2) Preparing	removing material from clay	levigation (L&M: 24; E&M: 11; A: 68)						
	adding material to clay	adding chaff (A: 67)	adding sand or grits (A: 67)		adding chaff (E&M: 26)		adding chaff (L&M: 26; E&M: 15)	adding grits and calcite particles (L&M: 26; E&M: 15)
3) forming	technique	coiling (L&M: 24; E&S: 37; E&M: 11)	forming neck, body, base separately by coiling, then joining together (large jar) (L&M: 24; E&S: 37)	hollowing by thin instrument (conical base) (L&M: 25)	coiling (E&M: 26), Sequential Slab Construction (P: 161)	coating clay (E&M: 26)	coiling (L&M: 26, E&M: 15)	covering with cloth, then coating clay (E&M: 15)
	supports and rotational devices	placed on matting or cloth (L&M: 24)	use of turntable, slow wheel, or tournette (E&S: 37; E&M: 11; P: 162; W: 256)					
4) finishing		smearing with extra clay (L&M: 24; A: 69)	smoothing (L&M: 25; E&S: 38; A: 67)	scraping (L&M: 25; E&M: 12; G: 55)	smoothing (E&M: 26)		burnishing (L&M: 26; E&M: 15)	
5) decorating		slipping (E&S: 39; E&M: 12; G: 55; A: 67; W: 256)	painting using brush (L&M: 25; E&S: 40; E&M: 12)		painting (very rare) (E&M: 26)		putting two handles (E&S: 37)	dipping into red wash (A: 69)
6) firing		kiln firng (H; L&M; B; E&S)	firing vessels in stacks (L&M: 24; E&S: 40; A: 69)		lower-temperature firing (E&M: 26)		lower-temperature firing (L&M: 26; E&M: 15; A: 69)	

the village community.[76] He argued that the explicit rules were not explicitly formulated and transmitted to apprentices by verbal communication but were learned by trial and error through the indirect imitation and evaluation by skilled potters.[77] As one example, he presented one poorly painted bowl found from Qaleh Rostam and interpreted it as the result of learning by trial and error. This suggests that explicit rules (a normative aspect) and learning by trial and error (a situational aspect) are not necessarily related in a mutually exclusive relationship.

Technical steps and options of pottery-making techniques in the Bakun period

As many ceramic specialists have discussed, the ethnographic research into pottery-making has helped us to infer the prehistoric pottery-making processes with their several steps.[78] The concept of the chaîne opératoire enabled the discussion of how to reconstruct ancient pottery-making techniques from archaeological ceramic materials. In addition, as I reviewed in Section 2-2, previous studies on pottery production in the Bakun period have found several technical steps and options in the pottery-making techniques. The terminology of pottery-making techniques will be defined below.

Prudence Rice subdivided pottery-manufacturing technology largely into three technical steps: 1) obtaining and preparing resources, 2) forming, finishing, and decorating, and 3) drying and firing.[79] She described technical options within each technical step in detail with a large number of ethnographic examples. As already reviewed in Section 2-2, previous researchers have discussed the pottery-making techniques in the Bakun period. Table 4.4 is a list of previously mentioned technical steps and technical options in pottery-making techniques during the Bakun period. The table shows that, among the archaeologists, there was a partially shared understanding of pottery-making techniques during the Bakun period, particularly those of BOBW. However, we still need more data to confirm these pottery-making techniques. In addition, few studies have described the making techniques of VCW and MCW. Hence, for my study, I will need not only to find traces of new technical steps and options but also to reconfirm the previously mentioned making techniques.

Thus, on the basis of the terminology of pottery-making and the common description of the technical traces by the previous researchers, I classified pottery-making techniques studied in this thesis into seven production steps: 1) obtaining clay, temper, and pigment, 2) preparing clay, 3) forming, 4) surface treatment, 5) applying slip, 6) decorating, and 7) firing. I will explain seven technical steps in the pottery-making techniques and the corresponding research methods. Thin-section petrography is useful not only for identifying the technical steps of obtaining and preparing clay but also for detecting the steps of forming, slipping, and painting. In Section 4-5, I will discuss the procedure of thin-section petrography. I will use ICP-OES (inductively coupled plasma optical emission spectrometer) analysis, which is one of the quantitative geochemical composition analyses, to analyse the technical steps of obtaining clay resources and preparing clay. I will go into more detail about analytical procedures in Section 4-6. X-ray diffraction (XRD), which characterises the minerals inside clay, will contribute to clarifying the steps of obtaining clay and firing temperatures. Then, I will then approach the rest of the technical steps in pottery-making techniques with careful macroscopic observation of ceramic materials. I will observe technical traces of the diagnostic and well-preserved ceramic materials in detail and take pictures.

Analytical method for technical skill in painting

I provided the theoretical background of technical skill in Section 3-2 and pointed out the drawback of the chaîne opératoire in this section. Here, I will review and present the methods of approaching the technical skills that are disregarded by the chaîne opératoire approach, especially the technical step of painting. Generally, technical skills or errors in pottery making are much more difficult to analyse than the general sequence of pottery-making techniques. This is because the plasticity of clay allows potters to correct and modify the mistakes that occurred during the process of forming and surface treatment. The exception is the painted decoration, which is difficult for potters to modify after their mistakes and is the easiest attribute for archaeologists to find with the naked eye. In Chapter 3, I defined skill from a relational view that humans and things, including the environment, are entangled in the skilled handling. Clearly defining the character of skill is very significant in analyses of technical skills because the methodology for archaeological analysis of skill on the basis of materials depends heavily on a discussion of the essence of skill as reviewed below.

Skill score analysis of Crown

Generally, technical skills in making ancient materials were inferred based on their aesthetic quality and the amount of labour consumed in the process. This approach was criticised by Costin, who pointed out that these studies evaluate skill through an assessment of the object's 'quality' and that the assessment is often highly subjective. She asserts the necessity of

[76] Bernbeck 1999: 100-102.
[77] Bernbeck 1999: 103-104.
[78] van der Leeuw and Pritchard (eds.) 1984; Rice 1987; Roux 2016.
[79] Rice 1987.

developing objective measures of skill by observing error or success rates in the execution of techniques, number of gestures, movement control, and use of materials. Patricia Crown also objectively tackled the skill assessment of painted pottery in order to approach learning in the prehispanic American Southwest.[80] In order to find ceramics painted by children, she paid attention to poorly decorated pottery. Crown pointed out seven reasons why the painted pottery was poorly decorated and she assumed it to be product of unskilled potters, perhaps children, considering the historical context in the prehispanic American Southwest.[81]

Crown listed and coded the design attributes by applying the criteria used in education and psychology for assessing the mental and physical development of children.[82] She subdivided these 18 attributes into two types in terms of skill: 1) attributes indicating the cognitive development of children based on educational psychology and 2) attributes indicating motor control in executing designs. She tallied the codes to calculate a total score and then divided that by the highest possible score in order to normalise a total score. I name her method 'skill score analysis'. I will adopt her method in this research. However, I problematize her a priori classification of skill attributes between cognitive maturity and motor control. Although she explained the methodology, drawing on educational psychology and the assumption that the poorly painted pottery was made by unskilled painters, it is dangerous to assume that the dualism between cognitive maturity and motor control is universally present in archaeological materials and applicable to these materials. Rather, cognitive maturity and motor control should be discussed within the archaeological contexts of materials when interpreting skill score analysis results rather than setting them up as framework criteria.

The skill score analysis of Castro Gessner

Gabriela Castro Gessner also adopted a skill score analysis for approaching technical skill of Halaf painted pottery from Fıstıklı Höyük and Tell Sabi Abyad.[83] She classified the attributes of painting into three categories ('likeness', 'care', and 'skill') within the framework proposed by Giddens. This framework subdivided the information about practices into two types of knowledge: on one hand, the embodied knowledge that is routinised and inexplicable (practical knowledge), on the other hand, the knowledge of practices that we prefigure with intention before we do the practices (discursive knowledge). According to her, while likeness and care belong mostly to discursive knowledge, skill belongs to practical knowledge. Below I will review these three attributes proposed by Castro Gessner in more detail.

Castro Gessner's first attribute is likeness, defined as a discursive type of knowledge. This means the degree to which the work attributed to each painter is consistent with that of other painters within his or her community.[84] It is similar to Kuijpers' idea of explicit rules helpful for beginners that I explained in Chapter 3. Castro Gessner measured structural register line width, motif line width, and motif angle size for approaching likeness. The archaeological attributes related to likeness are the most archaeologically available. She also defined care as a discursive type of knowledge and the degree of attentive work towards consistency. Care differs from likeness in being by the degree to which each painter is consistent to her-/himself as an individual within the restraints of the community.[85] Another important point of her definition of care is that it is independent of the painter's performance ability, which is learned from bodily experience. According to her, archaeological attributes such as consistent line width, drips, consistent brushstroke direction, and consistent spacing between design elements relate to care.[86] Finally, Castro-Gessner narrowed down the meaning of the term 'skill' in her analysis, which is different from that of Ingold and Kuijpers (see Chapter 3). Her term 'skill' refers only to practical and embodied knowledge that was acquired only from time-consuming experience. Castro-Gessner argued that skill is recognisable from archaeological traits such as how many times a brush was lifted, whether motif boundaries were respected, line control, and the length of one line.[87]

I also problematise the classification of technical skill proposed by Castro-Gessner as well as Crown. As Castro-Gessner herself admitted, the difference between practical knowledge (skill) and discursive knowledge (likeness and care) is merely conceptual and blurred. Furthermore, they are not practically (or archaeologically) separable,[88] and her division is a mere heuristic solution for her study. Even though they are archaeologically inseparable, why does she subdivide skill and care? One reason is the critique of the previous a priori assumption that skilled practitioners were always careful of doing practices;[89] she assumed instead that '*our embodied ability to do something with dexterity is unrelated to our willingness to do a 'good job,' and therefore our careful attention to a task is affected by the*

80 Crown 1999; 2014: 79.
81 Crown 1999: 30; 2001: 452-456.
82 Crown 1999: 31-35, Table 3.2; Crown 2001: Table 1.
83 Castro Gessner 2008.

84 Castro Gessner 2008: 28.
85 Castro Gessner 2008: 28, 41.
86 Castro Gessner 2008: 47.
87 Castro Gessner 2008: 60.
88 Castro Gessner 2008: 28.
89 Castro Gessner 2008: 48.

conditions in which the activity takes place.'[90] The problem of this approach lies in this assumption. Although her criticism of the previous assumption is correct, it does not justify her assumption that skill and care are archaeologically a priori separable. Skill and care are conceptually separable, but archaeologically they are not. In that point, I propose that setting up several types of attributes for skill analysis before conducting the skill score analysis is problematic even though it is heuristic. Rather, in my relational perspective of technical skill presented in Chapter 3, skill, care, and likeness are relationally located in the skilled practices, which emerge through the entanglement of humans, things, and environment. Without assuming the types of skill a priori, I propose that we should begin by finding clear errors recognisable for prehistoric producers, prehistoric consumers, and archaeologists.

Measurement of highly frequent and lowly variable motifs: Bernbeck

There is another type of objective method of approaching skill: the measurement of lengths and angles of a highly frequent and lowly variable motif. Reinhard Bernbeck illustrated this approach in considering the technical skill at Tol-e Bashi, a Neolithic site in Iran. At first, he cast doubt on the progressive aspects of skill, namely the idea that skilled practitioners maintain skilful handling once they master the skill. Instead, he mentioned the possibility that the craftsperson's skill might decline if she/he takes a longer break from practice. He distinguished skill acquisition or enskilment from the reacquisition of skill (i.e. re-skilment).[91] In addition he defined sloppiness as the lack of attention resulting in the enskilment/re-skilment process, which is similar to the concept of care proposed by Castro Gessner.

Bernbeck approached technical skill by exploring an 'ideal' motif and by finding deviations from that motif. Then, considering the results and the specific context of the pottery production at Tol-e Bashi (i.e. seasonal production and using highly frequent and lowly variable motifs too much), he interpreted the attributes of technical skill (in terms of inconsistency of motif) and sloppiness (in terms of the location of the pin element and the vertical-minus-horizontal line length). It should be noted that unlike Castro Gessner, he did not assume that specific archaeological attributes belong to en-/re-skilment and sloppiness prior to his analysis. Furthermore, by analysing the correlation between inconsistency, pin location, and vertical-minus-horizontal line length, he discussed the re-skilment cycle in more detail. As he showed, an attention to highly frequent and lowly variable motifs is very useful in order to approach the en-/re-skilment process. For that reason, I will also compare the technical skills of complete ceramic vessels with an identical motif in Chapter 8.

Qualitative approaches to skill: Vidale

In the examples above, I introduced quantitative approaches to skill on the basis of archaeological materials either by tallying the error types and brushwork (skill score analysis) or by measuring high-frequency and low-variability motifs. There is also a qualitative method for skill, although it runs the risk of subjective assessment of technical skill. Massimo Vidale and his colleagues selected about 15 badly painted potsherds from a collection of 10,000 potsherds from Shahr-e Sukhteh.[92] By carefully observing errors and brushwork (thickness and direction), they discover the archaeological traces of potting apprenticeship as well as the presence of collaboration with experienced potters. However, this approach pays attention only to finding a lack of technical skills and does not evaluate these poorly skilled materials in relation to moderately or highly skilled materials. Although the qualitative observation of badly painted potsherds has these problems, I will adopt this method with the aim of describing the poorly painted potsherds, which have striking traces that can be qualitatively described.

Summary of the analytical method for technical skill in painting

Above I reviewed previous approaches to technical skills in painting. For the analytical methods in this thesis, I described 1) the objective measurements of technical skill (skill score analysis), 2) the avoidance of a priori classification of skill attributes of archaeological materials (e.g. cognitive maturity and care), and 3) the detailed observation of badly painted potsherds. From my relational point of view, the measurement of errors and brushwork and the subsequent consideration of the character of technical skill as a skill score is the best approach. As Wendrich clearly states, the researcher's distinction of types of knowledge acquired in learning reflects the assumption that certain types of literacy (e.g. discursive knowledge) are primary.[93] However, these knowledge types are thoroughly interwoven. In skill score analyses (Chapter 7), skill scores will be normalised between 0 and 1. I then present distributions of skill scores in each site in the form of histograms. Although I present the theoretical foundations for the method related to technical skill, I do not explain the actual skill score analysis procedure in detail in this chapter, as the procedure depends heavily on the character of specific painted decorations that appear in each case study. The detailed skill score analysis procedure will be described along with the analysis in Chapter 7.

[90] Castro-Gessner 2008: 64.
[91] Bernbeck 2010: 106.
[92] Vidale et al. 2014.
[93] Wendrich 2013: 14.

4-5. Thin-Section Petrography

Previous studies of pottery production during the Bakun period seldom tackled it from the petrographic point of view. As briefly explained in Section 4-4-2, the analytical method of thin section petrography will contribute to clarifying the technical steps of clay acquisition, clay preparation, forming, slipping, and decorating. Below I explain sampling strategy, thin section-making procedure, and methods of description and analysis.

Ceramic sampling strategy

For thin-section petrography and geochemical analysis, the destruction of the ceramic samples was required. I chose 12 undiagnostic sherds each from five sites curated in the University Museum, University of Tokyo (UMUT). For thin-section petrography and ICP-OES analysis, 12 samples from Rahmatabad dated to the Middle Bakun period will be included for comparison. Ceramic samples from Trench H of Rahmatabad were provided by Dr Hossein Azizi-Kharanagi.

Most of the selected sherds were body sherds. The trenches in which sample sherds were found was the same as those where the ceramic materials for quantitative analysis were unearthed. Before cutting and pulverising them for samples, I took precise photographs of the original potsherds. These photographs are presented in the appendix of Chapter 7. Ware-types of sherds varied and were chosen depending on each site. However, the ratio of black-on-buff ceramics and coarse ware (vegetal-tempered coarse ware, mineral-tempered coarse ware, and mineral-tempered BOBW) was 3:1, except for Rahmatabad (6:1).

Thin section-making procedure

The procedure for thin section-making is as follows. First, using a geological rock saw, I sawed the original sherds into three parts – one for thin section analysis, one for chemical analysis, and the rest for additional analysis when required. Ceramics were usually cut perpendicular to rim lines. Then, I filled pores inside the ceramic samples with a transparent two-part epoxy resin under vacuum. When the resin became hard enough, I polished the surface of the ceramic samples using a geological rock-rotating instrument with carborundum abrasive in order to enable the samples to bond with microscope slides. I bonded them together using the two-part epoxy resin. After drying and fixing, I cut off the larger portions of the samples from the slides on a thin sectioning machine. Finally, I ground the ceramic sherd samples on a glass plate to 0.03 mm thickness by hand with abrasion powder and water. I observed the mineral composition in the thin sections using a polarising microscope MT9200 (Meijitechno).

Methods of thin-section description and analysis

Sixty thin-section samples were grouped into several fabric types by eye using the microscope. The characteristics of these fabric types were described using a modification of the Whitbread descriptive system, which Patrick Quinn introduced as a qualitative description system.[94] The description system consists of four sections: inclusions, clay matrix, voids, and comments or fabric summary. Before describing inclusions, clay matrix, and voids in more detail, the relative abundance of these three components were determined by a percentage estimation chart.[95] The frequency, size, shape, and degree of sorting of each inclusion were described. To describe the frequency of minerals in inclusions, semi-quantitative frequency categories were adopted.[96] The frequency labels are as follows: predominant (>70 %), dominant (50-70 %), frequent (30-50 %), common (15-30 %), few (5-15 %), very few (2-5 %), rare (0.5-2 %), very rare (<0.5 %), and absent (0 %). The shape of inclusions including roundness/angularity and degree of sorting were described following the categories for the description of shape in clastic sedimentary grains and a comparison chart for estimating the degree of sorting in clastic sediments and sedimentary rocks.[97] Next, the clay matrix was defined as clay minerals and very small inclusions less than 0.01 mm in diameter. Using the clay matrix, calcareous colour degree and homogeneity were described. Third, not only shapes, but also alignments of the voids were described following the terminology of voids.[98] The sizes of the voids were labelled as follows: mega (>2 mm), macro (0.5-2 mm), meso (0.05-0.5 mm), and micro (<0.05 mm). Finally, in the Comments and Summary sections, discoveries about technical topics and post-depositional phenomena are described. The thin-section petrography results are discussed in Chapter 7.

4-6. Geochemical analysis

As with the thin-section petrography approach, a limited number of previous studies have approached Bakun pottery from a geochemical perspective. Geochemical methods will contribute to clarifying the technical steps of clay acquisition, especially characterising the provenance of clay sources as well as firing temperature. Below I will explain principles, procedures, and analytical methods of ICP-OES (inductively coupled plasma optical emission spectrometer) analysis and XRD (X-ray Diffraction).

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94 Quinn 2013: 80-101.
95 Quinn 2013: Fig. 4.9.
96 Quinn 2013: 89-90.
97 Quinn 2013: Figs. 4.11 and 4.15.
98 Quinn 2013: Fig. 4.25.

ICP-OES analysis

Principle of ICP-OES analysis

ICP-OES is one of the destructive analytical techniques using plasma-ion sources to generate the bulk geochemical compositional data. Liquid samples of pottery are changed into a mist and introduced into a plasma flame (6000 – 10000 °K). As a result, a specific light is radiated from the plasma flame. By measuring the wavelength and the intensity of the light, not only can the presence of geochemical elements be detected, but their composition can also be analysed. The basics of ICP-OES will be introduced, explaining the four components of the instrument: plasma, liquid sample, spectrometer, and detector.

Plasma is a state of matter in which electrically positive and negative particles coexist in an enclosed space and form an electrically neutral situation. ICP-OES generates plasma by ionizing argon gas. In ICP-OES liquid sample introduction, a liquid sample is sent to the plasma chamber using a peristaltic pump. Before the samples reach the plasma chamber, the samples are changed into a mist, and then are sprayed towards the plasma via a nebulizer. When the samples are introduced to the plasma, they become ionised. As a result, the elements or ions of the samples are excited and transition to the ground state, radiating the extra energy as spectral emissions. The light is transmitted to the detector through the spectrometer. The measurement of the spectrum enables the user to measure the geochemical composition. Finally, the results of the spectrums and their intensities radiated from the plasma are converted into the chemical concentration of elements using the calibration curve method.

ICP-OES analysis experimental procedure

Preparation of the liquid samples and measurement were conducted by the author with the support of Japanese archaeometrists Toshiyasu Shinnmen, Tokyo Gakugei University, and Natsuki Murakami, Tokyo University of the Arts. At first, a part of the samples was cut into pieces by cutter to obtain powder. The pieces were washed with purified water and dried to eliminate contaminants. After that, I drilled only the cores of samples using a PROXXON mini router and obtained the powder (50 mg per sample). The powders were dissolved using aqua regia (a mixture of nitric acid and hydrochloric acid in a ratio of 1:3) (0.6 ml) and hydrofluoric acid (3 ml) in a Teflon vessel. The compound was poured into a sealed container made of stainless steel and heated by an electric dryer at 110 degrees Celsius for 80-90 minutes. After heating, the colour of the compound became yellow. The compound was poured into a Teflon beaker with c. 20 ml purified water. It was vaporised to powder again on a hot plate at 150-160 degrees Celsius. After evaporation to dryness, the powder was mixed with hydrofluoric acid (3.5 ml) and purified water and heated on a hot plate for 10-15 minutes. Finally, the compound was mixed with distilled water using a 100-ml volumetric flask and poured into plastic bottles.

I used two ICP-OES measurement instruments, SPS1200A (Seiko Instruments) and 700 Series ICP-OES (Agilent Technologies). Analysis was carried out at the laboratory of Prof Shuji Ninomiya, Tokyo Gakugei University, Japan. Ten elements were measured: titanium, aluminium, iron, manganese, magnesium, calcium, sodium, potassium, strontium, and barium. Because the ratio of calcium was too high in the samples, each 10 ml liquid sample was further diluted tenfold to 100 ml. Three wavelengths were measured per element. I used two standard types of rocks (JB-1a and JG-1a) to quantify the compositional data. With one standard rock as the standard, the samples were measured three times each. The standard was replaced, and then the samples were measured three additional times. The average of six values was used for statistics. When measured elements in geochemical compositions were lower than their detection limits as determined by instruments, elements were regarded as undetectable. I referred to lists of detection limits of the 10 elements in the ICP-OES as reported by Uemoto to examine the detectability of measurement results.[99] Description and statistical discussion of the measurement results are presented in Chapter 7.

X-ray Diffraction (XRD) and Powder XRD

Principles of XRD and Powder XRD

XRD, especially powder XRD, is a method of analysis for characterising minerals inside pottery using their crystalline structures and the powder diffraction files (PDF) database of the International Centre for Diffraction Data (ICDD). Before explaining the XRD experimental procedure, I will briefly introduce the principle of XRD, namely how minerals can be identified from their crystalline structures. When a beam of X-rays with a particular wavelength (λ) is diffracted on the analysis material at a particular angle (θ), the situation fills the Bragg equation:

$$2d \sin\theta = n\lambda$$

where n is a whole number and d is an interplanar spacing of the crystalline structure of the analysis material.[100] The intensity of the diffracted X-rays at a particular angle is measured as a peak d (interplanar spacing), an important clue for characterising the

[99] Uemoto 2011: Tables. 3.2-3.
[100] Rice 1987: 383; Heimann 2016: 330.

mineral. By making the analysis material a fine powder, every possible crystalline orientation of minerals becomes equally represented. The powder is fixed to a sample holder and is put in the measurement circle. The intensity of diffracted X-rays is measured and recorded at every angle. As a result, a diffractogram that records the diffracted X-ray intensity on the vertical axis and glancing angle °2θ on the horizontal axis is generated. The appropriate diffractogram software allows the comparison of the diffractograms with the already known diffraction patterns of minerals in the ICDD database.

XRD and powder XRD experimental procedures

The analytical instrument used for XRD and Powder XRD was a Rigaku MultiFlex. This instrument was connected with a computer with diffractogram analysis software (PDXL) and ICDD. Analysis was carried out at the laboratory of Prof. Shuji Ninomiya, Tokyo Gakugei University, Japan. I measured the Tall-e Gap and Tall-e Bakun A samples using the powder XRD method. The powders were sampled by drilling only the core of the samples as in the ICP-OES analysis sampling method. Then, the powders were ground using a mortar made of agate. For ceramic samples from Tall-e Jari A and Tall-e Bakun B, thin sections were directly measured due to time constraints. Because the ceramic materials from Rahmatabad had already been analysed by powder XRD, this analysis was not conducted.[101] The energy of diffracting X-rays was 40kV/20mA. The range of the measured angles is from 5 °2θ to 90 °2θ. Scanning speed was 2θ/min. Prior to the characterisation of minerals, the original diffractograms were processed through data smoothing, then background processing and Kα2 reduction. The processing was carried out using PDXL diffractogram analysis software (RIGAKU). The peak of the diffractogram was also determined after processing. Results showing the angle and intensity of peaks are presented.

The previous XRD measurement of black-on-buff ceramics at Rahmatabad conducted by Marghussian characterised seven major crystalline phases in the pottery samples: diopside ($CaMg(Si_2)O_6$), diopside aluminian ($Ca(Mg, Fe, Al)(Si,Al)_2O_6$), quartz ($SiO_2$), mullite ($Al_6Si_2O_{13}$), gehlenite ($Ca_2Al_2Si_2O_7$), augite aluminian ($Ca(Mg, Al, Fe)\text{-}Si_2O_6$), and esseneite ($CaFeAlSiO_6$).[102] According to this result, I searched for the presence of diopside, diopside aluminian, gehlenite, quartz, mullite, and syn in the ceramic samples. Marghussian especially pays attention to the presence of diopside, or silicates of calcium-magnesium-iron, in BOBW samples. As a result, she estimates the temperature range of firing temperatures for BOBW between 950–1050 °C.[103]

These minerals function as a clue to the pottery's firing temperature. According to a firing experiment on clay rich in organic matter using a pottery kiln carried out by Lara Maritan and her colleagues,[104] the firing temperature ranges at which specific minerals emerged are as follows: diopside, 820-830 °C; gehlenite, 820-830 °C; quartz, unchanged. Mullite may be formed at firing temperatures higher than 1050 °C.[105] In addition, illite-2MI (MR) ($(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$) and calcite ($CaCO_3$), whose presence indicates firing temperatures, were also searched for. These minerals decompose at temperatures higher than 850 °C.[106] The PDF number of targeted minerals are as follows: illite-2MI (MR) (26-0911), calcite (83-0577), quartz (86-1560), diopside (41-1370), diopside, aluminian (86-0002), mullite, syn (89-2645), and gehlenite (89-5917).

The number of samples for XRD measurement at each site were as follows: 11 samples from Tall-e Jari A (8 BOBW samples, 3 VCW samples), 11 samples from Tall-e Bakun B (8 BOBW samples, 3 VCW samples), 5 samples from Tall-e Gap (3 BOBW samples, 1 MCW sample, 1 VCW sample), and 12 samples from Tall-e Bakun A (8 BOBW samples, 1 MBOBW sample, 1 burnt clay, 2 VCW samples). These samples are the same as those used for ICP-OES analysis. I characterised minerals by comparing the results directly with the peaks of each targeted mineral. I explain the description and discussion of results in Chapter 10.

4-7. The method of reconstructing the pottery-production organisation

Above in this chapter, I have presented methods for analysing specific attributes of ceramic materials. Finally, in this section, I present a relational method for integrating the results obtained from those analyses and for considering (reassembling) pottery-production organisation using a tanglegram (as briefly explained in Chapter 3). As reviewed in Sections 3-2, this method was recently proposed and there are limited numbers of case studies, such as Hodder and Duistermaat's.[107] I updated this relational approach by combining it with communities of practice and Ingold's concept of skill. As schematised in Fig. 3.5, numerous relations between humans and things are involved in the emergence of skill, communities of practice (e.g. pottery making), and entanglement (the village life surrounding pottery

[101] Marghussian et al. 2009.

[102] Marghussian et al. 2009: Table 2.

[103] Marghussian et al. 2009: 744.

[104] Maritan et al. 2006: Fig. 5.

[105] Marghussian et al. 2009: 742.

[106] Maritan et al. 2006: Fig. 5.

[107] Hodder 2012; Duistermaat 2016.

making, other craft productions, and subsistence practices).

A tanglegram is a method visualising relationships between humans and things. The merit of using this tanglegram is that it adds as much heterogeneous information as possible. However, if anything can be freely connected with anything else (materials, humans, concepts) in reassembling entanglements and communities of practice, the choice will be subjective and problems in presenting and comparing results arise. Therefore, the definition of the things/humans to be connected and their connections in tanglegrams of this research require clarification. Below, I review how previous studies defined (1) connected things/humans and (2) connections in tanglegrams. I then propose the relational method for this research.

Things/humans to be connected

In previous studies, what is to be connected has ranged from not only things and humans, but also human activities and material attributes of things. Hodder presented a tanglegram of clay at Çatalhöyük when introducing the tanglegram concept.[108] In that tanglegram, various natural and artificial things (clay, house, etc.) are connected with arrows. Hodder did not connect things with humans in this tanglegram. Instead, as humans are connected to almost everything, he expressed relationships with humans as filled rectangles. Connections are not made only between things and humans in tanglegrams. Hodder also connected the technical steps involved in using clay balls at Çatalhöyük.[109] These sequential relationships between technical steps can also be called the chaîne opératoire (see Section 4-4). Duistermaat followed a similar direction to Hodder's strategy, especially when explaining the tanglegram that connected the technical steps of pottery production.[110] This sequential connection also covers steps of consumption and discard. In addition, Duistermaat connected between raw materials for pottery (clay, water, temper, etc.), their material properties (e.g. plasticity), and their functions (e.g. increasing porosity) in another tanglegram.[111]

Definition of connections

Previous studies have defined connections/relationships between various things/humans in three main ways: (1) dependence, (2) sequentiality, and (3) sharing the same attributes. First, in the abovementioned tanglegram of clay, Hodder connected between things when one thing was dependent on another thing. He raised an example of dogs' dependence on midden for their living space – that is, dogs can be connected with midden in a tanglegram.[112] Second, steps of production, consumption, and discard are connected if they have sequential relationships in the same artefact. In other words, a production step is connected with its previous step and its subsequent step (e.g. a production step of forming pottery can be connected to clay preparation and surface treatment). Third, Hodder also connected houses with the same reliefs and attributes together in Çatalhöyük.[113] Turning to Duistermaat, she also connected material properties and attributes when they appeared in the same pottery type.

The first type of tanglegram: pottery-attribute tanglegram

As reviewed above, there are three types of items to be connected (things/humans, human activities, and material attributes of things) and three kinds of connections (dependence, sequentiality, and sharing the same attribute). I follow Hodder and Duistermaat's connecting methods. After clarifying their definitions, I propose the construction of two types of tanglegrams – the pottery-attribute tanglegram and village tanglegram – for discussing diachronic changes of pottery-making communities and village entanglements. In the pottery-attribute tanglegram, the relations between pottery attributes (what to connect) will be visualised for each site. The main connecting method in the pottery-attribute tanglegram concerns the third connection type, sharing the same attributes. Pottery attributes in this tanglegram are the results of analyses conducted in Chapters 5 to 7, such as shape-related attributes, ware-related attributes, painted decoration, pottery-making techniques, and painting skill.

Because pottery attributes have numerous relations with other pottery attributes, I subjectively picked up several important attributes and put these in the centre of the tanglegrams. The use of specific attributes as centre was inspired by Hodder and Mol's 'ego network', which focuses mainly on one main node (ego) and its neighbours.[114] Here I chose the vessel form (open vessel painted on its exterior, open vessel painted on its interior, or closed vessel; defined in Section 4-2) of BOBW and ware types (VCW or MCW; defined in Section 4-1) as 'main hubs' for presenting relations between the other pottery attributes from the same sites. In addition, I add results obtained from pottery-making techniques and sequences of production steps/options. Thus, the sequential connecting method will be also adopted in this pottery-attribute tanglegram. Furthermore, I

[108] Hodder 2012: Fig. 9.2.
[109] Hodder 2012: Fig. 9.5.
[110] Duistermaat 2016: Fig. 9.2.
[111] Duistermaat 2016: Fig. 9.1.
[112] Hodder 2012: 182.
[113] Hodder 2012: Fig. 9.3.
[114] Hodder and Mol 2015: 1070.

added communities of pottery making, which consist of apprentices and various skilled potters. Pottery is dependent on potters for production, while potters depend on pottery to make a living. Thus, communities of pottery making are connected with pottery by the principle of dependence.

The second type of tanglegram: village entanglement

The second tanglegram is a village entanglement (Figs. 3.5). In this tanglegram, communities of pottery-making and those of other practices including subsistence practices and other craft productions (e.g. lithics, ground stones, copper tools), and materials (clay, pottery kilns, fuel) in a village (an archaeological site) will be connected and discussed. The connecting principle in this tanglegram is (1) dependence. In this method, I will not mainly visualise any persons except for potters, because they are involved with quite a lot of things, as Hodder pointed out. Communities of those other practices will be represented instead of each person. Materials and communities of other practices will be reassembled on the basis of the published evidence from excavation results. It should be noticed that this subjective interpretation of connections is based on archaeologically durable materials, and that not only durable materials but also the unpreserved materials would have generated relations in real entanglement. Before presenting each result, I will not proceed the procedure in more detail. I will discuss more in Chapter 8.

Problem of using tanglegrams: temporality

In reassembling and comparing tanglegrams, one main problem is the temporality of tanglegrams, as pointed out by Pollock and her colleagues.[115] Each site consists of layers of occupations. If I reassemble tanglegrams level by level at each site, the number of actants I can connect within them will be limited. In addition, as I suggest in Chapter 5, each level was occupied for a short period in each site. Hence, I will focus on a site-scale entanglement in this research. However, as for Tall-e Jari A and Tall-e Bakun B, where the Neolithic occupations were confirmed below the levels associated with BOBW, I will essentially not add materials deriving from the Neolithic period to the tanglegrams; exceptions will be mentioned.

Future possibility for visualising and discussing tanglegrams: social network analysis

In this research, defining what to connect and connections themselves is rather subjective. Recent studies focusing on relationships between humans and things are adopting methods derived from social network analysis to visualise and discuss these relations in an objective way.[116] In this research, I will not adopt this social-network-analysis-oriented method. However, in the future, the relational method in this research will be potentially upgraded using such interdisciplinary approaches although at the same time it takes the risk of objectifying relations in the realm of humanities.

4-8. Summary of Chapter 4: Methods for answering four research questions

In this chapter, I presented methods for answering four research questions raised in Chapter 1. These methods were among the better ways of answering problems raised in chapters 2 and 3. The research questions and corresponding methods introduced in this chapter were summarised in Fig. 4.18. The methods for research question No. 2 (diachronic change of the Bakun pottery) are (1) presenting unpublished materials; (2) quantitative analysis of wares, vessel forms, rims, and base shapes; and (3) analysis of horizontal design structure. These analyses appear in Chapter 6. The methods for research question No. 3 (pottery-making technique) are (4) observation of technical steps and options following a model of the chaîne opératoire, (5) skill score analysis and observation of skilfully and badly painted vessels, (6) thin-section petrography, and (7) ICP-OES analysis and XRD. These analyses appear in Chapter 7. The method for answering research question No. 4 (organisation of pottery production) is to integrate results in each chapter site by site using two types of tanglegrams, pottery-attribute tanglegrams and village entanglements. Through these tanglegrams, I visualise and discuss the relationships of humans and things involved in communities of pottery making in each site. The methods for research question No. 1 (chronology) include reconstruction of stratigraphy based on excavation labels and excavation records and assessment of new radiocarbon dating using Oxcal. These are explained in detail in the next chapter.

115 Pollock et al. 2013: 130-132.

116 Knappett 2011; Hodder and Mol 2015; Mills 2017; Peeples 2017; Donnellann ed. 2020.

Analytical methods introduced in Chapter 4

Research Question No. 2:
"When and how were black-on-buff ceramics adopted and developed during the Bakun period?"
Methods:
1) Presenting unpublished materials (results will be presented in Chapter 6)
2) Quantitative approaches of wares, vessel forms, rim and base shapes
(described in sections 4-1., 4-2.)(results will be explained in Chapter 6)
3) Analysis of horizontal design structures (described in section 4-3.) (results will be explained in Chapter 6)

Research Question No. 3:
"How were black-on-buff ceramics and other pottery produced?"
Methods:
4) Chaîne opératoire analysis: observation of traces related to technical steps and options
(described in sections 4-3.)(results will be explained in Chapter 7)
5) Skill score analysis and detailed observation of badly-painted vessels
(described in section 4-4.) (results will be explained in Chapter 7)
6) Thin-section petrography: classification of fabric types and clarifying technical steps of clay acquisition and preparation (described in section 4-5.)(results will be explained in Chapter 7)
7) ICP-OES analysis and XRD: Clarifying changes of clay source and firing temperature
(described in section 4-6.)(results will be explained in Chapter 7)

Research Question No. 4:
"How was pottery production organised during the Bakun period?"
Methods:
9) Visualising communities of practice and entanglement as relations between humans and things using pottery-attribute tanglegram and village entanglement (results will be discussed in Chapter 8)

Analytical methods introduced in other chapters

Research Question No. 1:
"Chronological relations of the Bakun-period sites: Where in the chronological sequence of the Bakun period do Bakun period sites fall?"
Methods:
8) Reconsideration of stratigraphy and radiocarbon dating using Oxcal
(methods and results will be explained in Chapter 5)

Figure 4.18 Summary of analytical methods used in this research for answering four research questions

Part III: Analyses

Chapter 5

Chronological relations of the Bakun-period sites

This chapter describes the stratigraphy and architectural remains of the sites where the analysed pottery vessels were found, namely, Tall-e Jari A, Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A. These sites are located in the southern piedmont of the Kuh-i Rahmat in the Kur River Basin, Fars province. In this chapter, I approach **Research Question 1:** '*Chronological relations of the Bakun-period sites: Where in the chronological sequence of the Bakun period do Bakun period sites fall*?' In Chapter 2, I review the previous studies of the chronological sequence. The current chronological framework, which favours a tripartite subdivision of the Bakun period, is still debated. The first problem lies in the fact that the tripartite subdivision is based on three separate type-sites (Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A), which makes their transitions unclear. The second problem lies in the different ways of dealing with chronological markers (mainly painted decoration on the black-on-buff ceramics) when discussing the chronological relations between these type-sites. In addition, although many researchers have used pottery as one chronological marker to subdivide the Bakun period, I must consider the chronology of the Bakun period from the stratigraphic evidence and limited number of radiocarbon dates as well as pottery. That is because I tackle **Research Question 2**: '*When and how were black-on-buff ceramics adopted and developed during the Bakun period?*' In other words, I tackle the diachronic changes of pottery during the Bakun period.

As one of the solutions of these problems, I will reconsider the stratigraphy and limited number of radiocarbon dates at each site (Sections 5-1, 5-2, 5-3, 5-4). The analysed sites were excavated several times by different expeditions. The comparison of each excavation trench in one site is required toward better understanding of the chronology. I will also briefly explain the architecture found at each level of the four sites. I will also mention the relationship between the architecture and the mobile/immobile remains for pottery production, that is, pottery kiln or kiln-related artefacts, because they are helpful when I examine the location of the pottery production. Then, I will compare trenches of all the seasons in the form of the schematized sections. In the end of this chapter (Section 5-5), I will consider the chronological relationships between analysed sites using Bayesian statistical test and stratigraphic information.

In addition, regarding the excavations conducted by the Japanese expedition at Tall-e Jari A, Tall-e Bakun B, Tall-e Bakun A, where the analysed materials for this book were collected, the stratigraphic information of those materials was not so well-preserved and well-published. For that reason, I will conduct the reconstruction of the stratigraphy from context labels which are curated with excavated materials in wooden boxes.

5-1. Stratigraphy at Tall-e Jari A

Site description and excavation history of Tall-e Jari A

Tall-e Jari A is a circular tell site (52.956648° E, 29.855350° N). The site is the most distant from both the Sivand River and the Kur River of all the analysed sites. There exists an earlier site, Tall-e Jari B, 150 m distant from Tall-e Jari A. This site is 2.5 m in height and about 100 m in diameter (Fig. 5.1).[1] In the 1950s, Vanden Berghe discovered this site and carried out a sounding. As a result, he discovered a tomb with complete vessels.[2] Soon after, Namio Egami and Seiichi Masuda, the University of Tokyo Iraq-Iran Expedition carried out their excavation there in 1959. The first excavation could not reach the lowest level. Later, Masuda excavated there again as a member of the Tokyo University of Education Prehistoric Iran Expedition in 1971, and he was able to find the lowest level, that is, Level III (Fig. 5.2: 1). The first report was published in 1967, and then a summary of two excavations was published in 1977.[3] In 2004, Alizadeh conducted soundings in Tall-e Jari A and took radiocarbon samples. Below, I review the stratigraphy and architectural remains discovered in the past excavation seasons. I also approach the reconstruction of layers of Masuda's excavation trenches, using context labels curated with ceramic materials.

1959 season at Tall-e Jari A

Description of the report published in 1967: grid systems and levels

According to the report published in 1967, Masuda set up seven 'Quarters' (A, B, C, D, E, F, H) on the southeast slope of Tall-e Jari A.[4] He did not mention how large

[1] Egami 1967; Egami et al. 1977: 1. In the earlier report, Egami described its height as about 2.8 m, and about 120 m in diameter (Egami 1967: 2936).

[2] Vanden Berghe 1952.

[3] Egami et al. 1977.

[4] Though Egami reported the excavation, the supervisor of the

each 'Quarter' was. In the report written in 1967, which did not present any plan or section of all the trenches, they subdivided the stratigraphy of all trenches into seven strata (1-7) (Table 5.1).[5] The first paper reported the presence of a huge hole at 'Quarters' A and B. The hole disturbed the architectural remains there. The buildings were observed from Stratum 2 at 'Quarters' B and C, Stratum 3 of 'Quarter' C, and Stratum 5 of 'Quarter' F. The excavation reached virgin soil at 'Quarters' A, E, F, and H. At the lowest Stratum 7 of 'Quarters' F and H, painted ceramics that looked like the Mushki pottery were discovered.[6] The dwelling with a T-shaped plan, discovered at Stratum 5 of 'Quarter' F, the size of which was 6 m x 4 m, was also reported in 1967. The excavator described the square architectural structures made of pisé and mud brick, consisting of large (3 m x 2 m) and small rooms (2 m x 1 m) mixed in an irregular pattern, which were uncovered at Stratum 3 at 'Quarter' C. The excavators described the rooms discovered at Stratum 2 of 'Quarters' B and C as slightly larger than those of Stratum 3. Concerning the important aspect of the stratigraphy, Egami reported that the Shamsabad vegetal-tempered coarse ware (VCW) appeared from Strata 2 to 6, and that black-on-buff ware (BOBW) disappeared below Stratum 4.[7]

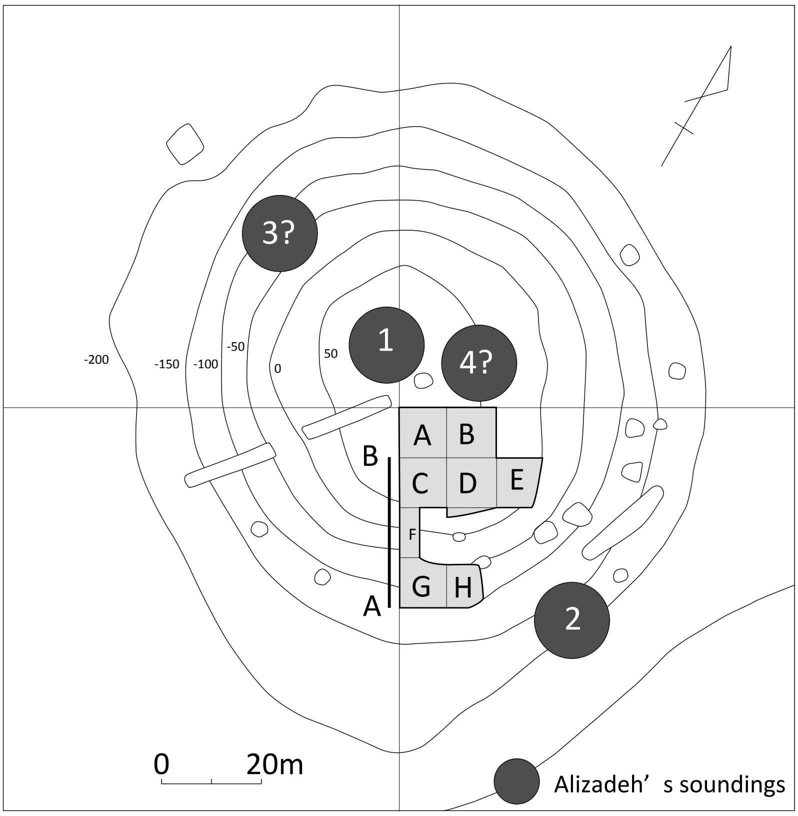

Figure 5.1 Contour map of Tall-e Jari A and estimated locations of Alizadeh's trenches (retraced from Egami et al. 1977: Pl. I.)

Table 5.1 Stratigraphy and 'Quarters' of Tall-e Jari A reported in Egami 1967

<table>
<tr><th colspan="2"></th><th colspan="7">Architectrual remains found in each 'Quarter'</th></tr>
<tr><th>Stratum</th><th>Pottery</th><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>H</th></tr>
<tr><td>1</td><td>BOBW</td><td colspan="2">huge hole, disturbed</td><td></td><td rowspan="7"></td><td rowspan="7"></td><td rowspan="4"></td><td rowspan="6"></td></tr>
<tr><td>2</td><td rowspan="3">BOBW and VCW</td><td rowspan="6"></td><td colspan="2">buildings whose rooms are a little larger than those of stratum 3</td></tr>
<tr><td>3</td><td rowspan="5"></td><td>builidng complexes of smaller (2 m x 1 m) and larger rooms (3 m x 2 m)</td></tr>
<tr><td>4</td><td rowspan="4"></td></tr>
<tr><td>5</td><td rowspan="2">VCW</td><td>T-shaped builidngs (6m x 4 m)</td></tr>
<tr><td>6</td><td></td></tr>
<tr><td>7</td><td>Neolithic ware</td><td colspan="2">'Mushki' pottery discovered</td></tr>
</table>

digging was Masuda. Egami 1967: 2936, Egami et al. 1977: Pl. 1.

[5] Egami 1967: 2936.

[6] Egami 1967: 2936.

[7] Egami 1967: 2937.

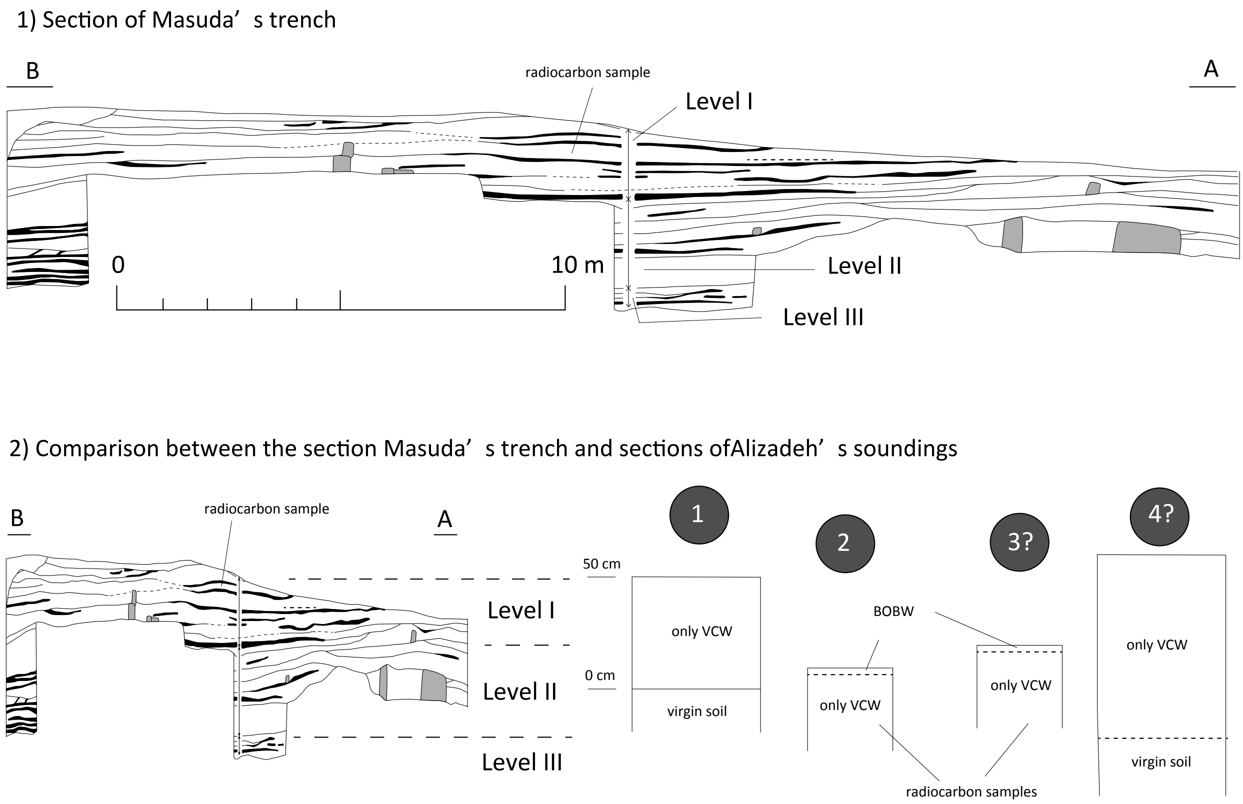

Figure 5.2 Section of Masuda's trench (1) and comparison between the section of Masuda's trench and estimated sections of Alizadeh's trenches (2) (retraced from Egami et al. 1977: Pl. I.)

Description of the report published in 1977: levels

In 1977, the second brief excavation report was published, which included one section drawing, two plan drawings, material drawings, and photographs (Figs. 5.1-3).[8] This report did not use the subdivision system of the stratigraphy (Strata 1-7) reported in 1967. Instead, Egami and his colleagues classified the stratigraphy into three levels (Levels I – III) (Fig. 5.2 and Table 5.2).[9] The criteria of the classification were based on the difference of pottery. The description of Level III in the second report corresponds to that of Stratum 7 in the first report, although the second report described the painted motif on the pottery not as being the Mushki style, but as being the Jari style.[10] Thus, it is clear that Stratum 7 was re-classified as Level III in the latter report. Masuda reported that the ceramics from Level II consisted mostly of the VCW and that BOBW was very scarce.[11] This statement about Level II is in accordance with the description of Strata 5-6 in the first report. As such, Strata 5-6 can be situated as Level II. The rest of the strata, namely, Strata 1–4, in which the presence of the black-on-buff ceramics was confirmed, share common characteristics with Level I of the latter report. This indicates that Strata 1-4 belong to Level I.

Description of the report published in 1977: grid systems

The account of the grid system of the excavation at Tall-e Jari A also changed in the article published in 1977. The latter report called trenches 'sections' instead of 'quarters'. The size of each 'section' was basically 9 m by 9 m. The plan indicated eight 'sections' in total (A, B, C, D, E, F, G, and H) (Fig. 5.3). Plate II of the second report presented the presence of architectural remains in five 'sections' (C, D, E, G, and H). According to the latter report, the remains at 'Sections' C and D belong to Level I. The remains at 'Sections' G and H dated to Level II, and only remains at 'Section' E dated back to the earliest Level III. The relationship between 'quarter' and 'section' must be revealed through the identification of the buildings. The three main architectures, which were already described in 1967, belonged to Strata 2, 3, and 5, namely Levels I and II. It is implied that:

1) the buildings in 'Quarters' B and C correspond to the remains in 'Section' C;
2) buildings in 'Quarter' C correspond to the remains in 'Section' D; and

[8] Egami et al. 1977. Although the title of this article said that the excavations were carried out in 1961 and 1971, the first excavation was carried out not in 1961 but in 1959.
[9] Egami et al. 1977: 1-3.
[10] Egami et al. 1977: 2-3.
[11] Egami et al. 1977: 2.

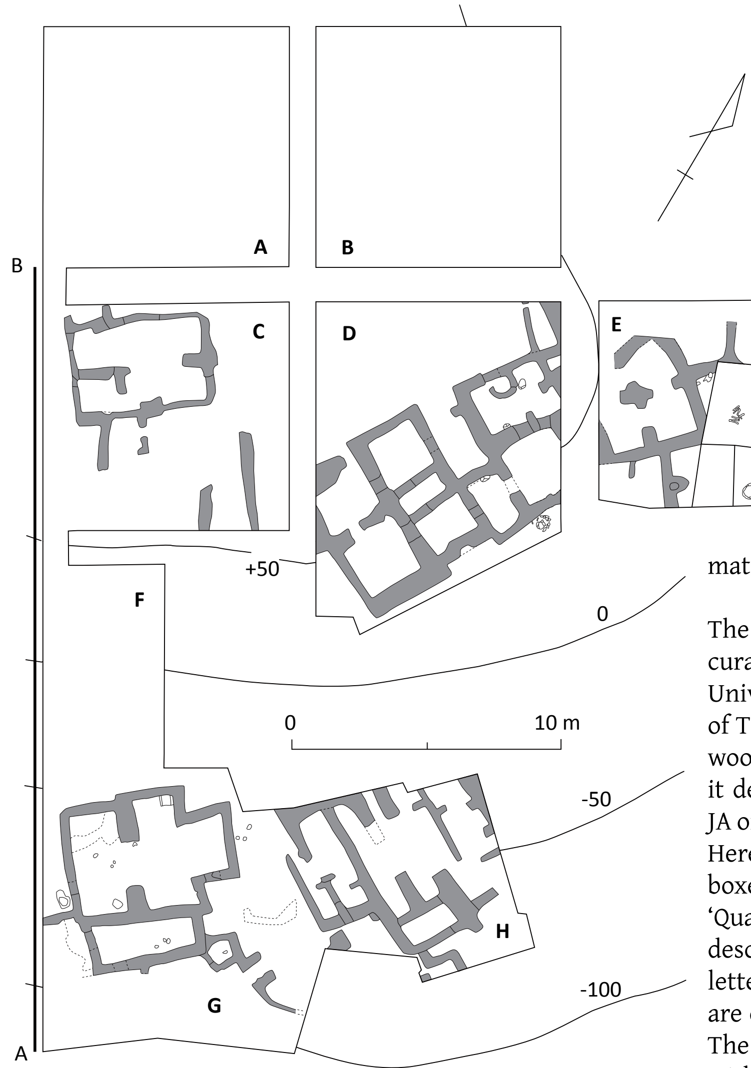

Figure 5.3 Plan of excavated architectures at Tall-e Jari A (retraced from Egami et al. 1977: Pl. II.)

3) the T-shaped dwelling of 'Quarter' F corresponds to the remains at 'Section' G.

It is evident that 'Quarters' designations are not in accordance with 'Sections' letters. At present, there is no record to demonstrate whether this inconsistency was a result of an intentional change of the alphabets or an unintentional mistake. The architectural layout in 'Sections' E and H were newly added in the plan, which implies that these two areas were excavated in the 1971 season.[12] In the final part of the texts, Egami and his colleagues mentioned the excavation of a human remains buried in a flexed position with a complete vessel from Level I.[13] Plate II of the second report also indicated the presence of a human burial at the eastern part of 'Section' E.

Reconstruction of the stratigraphy at Tall-e Jari A from context labels

As indicated above, these descriptions were different regarding stratigraphy and grid systems, and no further excavation report has been published. In addition, the ceramic materials used for this thesis do not have stratigraphic information corresponding to the stratigraphy published in two reports. Thus, to establish the site stratigraphy for the ceramic analysis in this research, I needed to reconstruct the stratigraphy based on context labels, which were stored with the ceramic materials in the sample boxes.

The ceramic materials from Tall-e Jari A are now curated both in the University Museum, the University of Tokyo (UMUT) and at the University of Tsukuba. The ceramic materials are kept in the wooden boxes. Each wooden box has the label and it describes the site name (Jari A, abbreviated to JA or A) and the excavation trenches (A, B, C, D, ...). Here, I call the trench letters written in the wooden boxes 'excavation trench' to avoid confusion with 'Quarters' and 'Sections'. There is no record which describes the meaning of excavation-trench letters. Inside the wooden boxes, the ceramics are curated according to the excavation contexts. The contexts can be judged from the cloth labels with which the excavated ceramics were curated. The labels had an excavation date, an information number (unknown), L number (possibly layer number), R number (Room number), and fl. number (Floor number).

The ceramic materials from 'Sections' C and D belong to Level I, the occupation level of the Bakun period at Tall-e Jari A. Hence, given the assumption that 'Section' corresponds to the excavation trenches written in the wooden boxes, I recorded the information written in the labels inside the wooden boxes of excavation trenches C and D (Appendix Table A2). I presented the information from the excavation trenches C and D. These tables indicate that excavation trench C includes a larger amount of information about rooms than excavation trench D. The presence of as many as 17 rooms (R1 - R17) at excavation trench C implies that excavation trench C may refer to both 'Sections' C and D, which buildings were discovered.

I reconstructed the stratigraphy of excavation trench C based on L number and excavation date. Excavators numbered room numbers in accordance with the order

[12] Egami et al. 1977: Pl. I-II.
[13] Egami et al. 1977: 7, Pl. II; Nishiaki 2003: Pl. 4.2.

Table 5.2 Stratigraphy and 'Sections' of Tall-e Jari A reported in Egami et al. 1977

			Architectural remains found in each 'section'							
Strata of 1969 report	Levels of 1977 report	Pottery	A	B	C	D	E	F	G	H
1	I	BOBW and VCW			at least one room (Quarters B and C?)	building complexes of large and small rooms (Quarter C?)	burial			
2										
3										
4										
5	II	VCW							T-shaped buildings (Quarter F)	building complexes
6										
7	III	Neolithic ware					buildings			

of their excavation. That rule was also useful to arrange the ceramic materials in stratigraphic order. Excavation date, L number, and R number correlated with each other in order, which reinforces the assumption that the L number refers to the layer. As a result, I classified the cultural layers of excavation trench C of Tall-e Jari A Level I into six layer numbers from the surface soil to Layers 1, 2, 3, and 4, including an unknown layer. When layer numbers were not described on the labels, I estimated layer numbers from the relative order of layers available, based on the other information, such as excavation date, room number, and floor number. Unfortunately, these reconstructed layers could not be identified in the section drawing (Fig. 5.2).

2004 season of Tall-e Jari A

In 2004, Alizadeh excavated four soundings at Tall-e Jari A.[14] He selected the highest point at this site for the main trench (No. 1 in Figs. 5.1 and 5.2: 2). In their main 3 m x 6 m stratigraphic trench, his team reached occupation layers that have only VCW below the surface. They continued excavating down to the virgin soil, almost to the same level as the present plain and they did not find the occupation associated with the Jari pottery below the sediment with the VCW.

Alizadeh continued his excavation in three more soundings.[15] He chose the eastern edge of Tall-e Jari A (No. 2 in Figs. 5.1 and 5.2: 2), the northwest part of the site (No. 3), and the northeast slope located at the highest part of Tall-e Jari A (No. 4). In the eastern-edge trench (No. 2) and the northwest trench (No. 3), few black-on-buff ceramic sherds that were not associated with any architecture were discovered close to the surface. Below this top layer, a 50-cm thick layer of greenish-grey deposit appeared, and they observed traces of ovens, burnt surfaces, and stone pavements with VCW. They collected a large number of samples for radiocarbon dating. In the fourth trench, his team found the deposit that consisted of innumerable thin layers with VCW, bones, and stone tools. After excavating another 60 cm, they reached the virgin soil there.

Comparison of sections and radiocarbon dates at Tall-e Jari A

Comparison of sections at Tall-e Jari A

Fig. 5.2: 2 shows the section of the Japanese trench and the estimated sections of Alizadeh's trenches at Tall-e Jari A. I estimated the sections of Alizadeh's trenches based on his description[16] and the contour map of Tall-e Jari A (Fig. 5.1). There are two discrepancies between Egami and Masuda's reports and Alizadeh's report about the stratigraphy. First, whereas Masuda's trenches started from the layer with BOBW (Level I), the main trench (No. 1) and the trench at the northeast slope (No. 4) of Alizadeh's excavation had no sediment with BOBW. As is analysed in Chapter 6, the proportion of BOBW in wares in Masuda's trenches is very low. Two of Alizadeh's trenches are likely to show layers that paralleled Level I of the Japanese expedition, but they lack BOBW, due to the low quantities of BOBW.

Second, in contrast to the former problem, the layers including BOBW at the eastern-edge trench (No. 2) and the northwest trench (No. 3) are slightly deeper than the cultural deposit of Level I of Masuda's trenches. This may suggest the subtle difference of the stratigraphic boundary between the Bakun period and the Shamsabad period in other places at Tall-e Jari A, especially at the edges of the site. Thus, it is difficult to

14 Alizadeh et al. 2004: 99-101; Alizadeh 2006: 41-42.
15 Alizadeh et al. 2004: 100, 2006: 41-42.
16 Alizadeh et al. 2004; Alizadeh 2006.

Table 5.3 Radiocarbon dates from Tall-e Jari A, Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A and their unmodelled and modelled dates

Site	Level	Context	type of sample	sample No.	uncalibrated date (BP)	Unmodelled dates OxCal. v 4.4.2 calibrated date (1σ) (calBCE)	Unmodelled dates OxCal. v 4.4.2 calibrated date (2σ) (calBCE)
Jari A	Shamsabad	Stratigraphic trench, 0.2 m above virgin soil	bone	AA63492	6280±69	5330-5080	5470-5045
Jari A	Shamsabad	Sounding, Feature 13, oven	charred seeds	Beta-207564	6170±40	5210-5050	5220-4995
Jari A	Shamsabad	Sounding, Feature 9, oven	charred seeds	Beta-210982	6010±40	4955-4835	5005-4790
Jari A	layer 3 (Level I)	floor 2, Room 9, trench C	charcoal	Tka-13822	6120±35	5210-4990	5210-4945
Bakun B	Shamsabad, Ash point	Masuda's trench		P-931	6264±70	5320-5205 (47.9%) 5170-5115 (14.3%) 5100-5075 (6.0%)	5465-5450 (0.4%) 5380-5030 (95.1%)
Bakun B	Shamsabad	Stratigraphic trench, 1.40 m above virgin soil	charred seeds	AA63489	6234±72	5305-5065	5360-4995
Bakun B	3m below surface	Masuda's trench	charcoal	P-438	5990±81	4995-4790	5205-5170 (2.2%) 5110-5105 (0.1%) 5070-4690 (93.1%)
Bakun B	Early Bakun	Stratigraphic trench, 1.90 m above virgin soil	charred seeds	Beta-210985	6160±40	5210-5040	5220-4990
Gap	17	Trench GAT-1	charcoal	GAK-197	5870±160	4935-4540	5210-5160 (2.0%) 5120-5095 (0.9%) 5080-4435 (90.1%) 4430-4365 (2.5%)
Gap	17	Trench GAT, soil sample	charcoal	IAAA-110031	5810±30	4720-4610	4775-4545
Gap	6	Trench GAI-5	charcoal	GAK-198	5440±120	4445-4420 (3.8%) 4395-4385 (0.8%) 4370-4220 (41.5%) 4205-4160 (8.4%) 4135-4055 (13.7%)	4535-4525 (0.3%) 4505-3985 (95.2%)
Gap	5b	Trench GAI-8, Ash sample	charcoal	IAAA-110030	5670±30	4540-4455	4605-4400
Bakun A	4	Sq. BB27, Trash Deposit	charred seeds	Beta-210983	5570±40	4445-4355	4495-4340
Bakun A	3	Sq. BB27, Trash Heap near oven	charred seeds	Beta-207562	5560±40	4445-4350	4490-4335
Bakun A	III (2)	Sq. BB27, Trash Heap near oven/ Kiln	bone	AA63491	5612±63	4495-4360	4600-4340

Modelled dates Bayesian analysis calibrated date (1σ) (calBCE)	Modelled dates Bayesian analysis calibrated date (2σ) (calBCE)	agreement of Bayesian analysis	Reference
5245-5205 (11.2) 5170-5035 (57.0%)	5315-5000	71.1%	Alizadeh 2006
5210-5195 (3.0%) 5185-5175 (2.7%) 5140-5025 (62.6%)	5215-5000	98.8%	Alizadeh 2006
5200-5190 (2.2%) 5045-4965 (66.0%)	5210-5175 (10.1%) 5070-4915 (85.4%)	34.5% (poor agreement)	Alizadeh 2006
5030-4945	5200-5165 (3.3%) 5075-4895 (90.5%) 4870-4850 (1.7%)	80.1%	
			Stuckenrath Jr et al. 1966 :350
5295-5250 (15.3%) 5230-5200 (14.1%) 5185-5085 (38.9%)	5325-5040	106.3	Alizadeh 2006
			Stuckenrath Jr 1963: 90
5210-5195 (2.8%) 5190-5160 (10.1%) 5145-5035 (55.4%)	5215-5000	101.3	Alizadeh 2006
			Egami and Sono 1962, Kigoshi and Endo 5: 115
4715-4605	4725-4545	93.4	
			Egami and Sono 1962, Kigoshi and Endo 5: 115
4545-4485 (54.6%) 4480-4455 (13.6%)	4610-4445	96	
4450-4390	4490-4475 (2.3%) 4465-4355 (93.1%)	103.1	Alizadeh 2006
4440-4375	4450-4355	107.5	Alizadeh 2006
4415-4355	4445-4340	111.1	Alizadeh 2006

distinguish between Levels I (the Bakun) and II (the Shamsabad) based only on the presence of BOBW. The absolute heights of layers at which the radiocarbon dating samples were collected by Alizadeh correspond to Level II of Masuda's trenches.

Radiocarbon dating and Bayesian test at Tall-e Jari A

I was able to get one radiocarbon date from a charcoal found from the room fill on Floor 2 of Layer 3, Level I, excavation trench C of Tall-e Jari A, which is also curated in UMUT. The radiocarbon date was measured by accelerator mass spectrometry (AMS) in the Laboratory of Radiocarbon dating, the University of Tokyo.[17] The calibrated radiocarbon date is rounded to 5 years. The radiocarbon date ranges between 5210 and 4945 BCE (2σ) (Table 5.3). There are three published radiocarbon dates from Tall-e Jari A. All three samples were collected at the levels associated with VCW. I calibrated the published and newly analysed radiocarbon dates using Intcal20.[18] I then conducted a Bayesian statistical test of these samples using OxCal 4.4.2 (Fig. 5.14).[19] After the Bayesian analysis, except for one sample with poor agreement, the radiocarbon dates of the sediments with only VCW at Tall-e Jari A fell in the range between approximately 5300 BCE and 5000 BCE (2σ). In addition, the range of the radiocarbon date from Level I was limited between 5075 BCE and 4895 BCE (90.5%).

Summary

I tackle the comparison of excavation trenches at Tall-e Jari A and the reconstruction of the stratigraphic information of the curated ceramic materials in this section. As a result, the chronological relationship between the excavation trenches is presented based on the description and contour map of Tall-e Jari A. This helps us to consider not only the radiocarbon dates obtained from Masuda's trenches and Alizadeh's soundings, but also the layers reconstructed from context labels of excavation trench C.

[17] The measurement was a part of results of Japan - France joint project 'Zooarchaeological studies of Neolithization process in Southwest Iran'.
[18] Reimer et al. 2020.
[19] Bronk Ramsey 2009.

5-2. Stratigraphy at Tall-e Bakun B

Site description and excavation history at Tall-e Bakun B

Tall-e Bakun B (52.888343° E, 29.913039° N) is a round-shaped site situated 150 m from Tall-e Bakun A. The site is 140 m in diameter and 5 m in height (Fig. 5.4). Tall-e Bakun B was excavated by Alexander Langsdorff in 1932. Namio Egami and Seiichi Masuda also excavated a small trench in Tall-e Bakun B.[20] As a result of the sounding and the radiocarbon dating by Alizadeh in 2004, it is estimated that the site existed from 5200 to 4800 BCE,[21] which is discussed in detail later.

1932 season at the central trench of Tall-e Bakun B

The excavation report of the 1932 season at Tall-e Bakun B was limited to a brief description in the book of the '*Chronology of Prehistoric Iran*' published by McCown[22] and short texts written by Schmidt[23] until Alizadeh published the layer description, written by Langsdorff, with the plan and section of the excavation in 2006.[24] McCown reported the lower Stratum BI, where only the Shamsabad VCW, lithics, and bone tools occurred, and the upper Stratum BII, where the deposit was less than 1 m thick and had been disturbed by Islamic graves.[25] From Stratum BII, VCW and BOBW were observed. His basis for dividing Strata BI and BII was the presence of BOBW. Schmidt described the difficulty of confirming buildings from the excavation of Tall-e Bakun B.[26]

According to the description published by Alizadeh in 2006, the thickness of Stratum BII was about 1.5 m and no architecture was found in Stratum BII.[27] He also presented a brief note written by Langsdorff, which is now curated in the Archives of the Oriental Institute. The note mentioned the finds from Tall-e Bakun B and Muslim graves.[28] The central trench was subdivided into four 10 m x 10 m squares CE03, CE04, CE13, and CE14.[29] Alizadeh reported that Muslim graves disturbed Stratum BI, which consisted of dark, beaten ashy surfaces with material remains. The excavation could not confirm house remains in Stratum BII. Only a part of a fireplace was discovered at Square CE04 in this level. The stratigraphic boundary between Stratums BII and BI was not mentioned. The digging of all four squares reached to the ash layer at elevation 1.80 m. Then the expedition continued the excavation only at Square CE03, tilling the virgin soil. Although several layers of beaten ash floors were found in the deep trench, no traces of architecture were discovered. The lowest beaten floor with a very hard surface was constructed just above the virgin soil, and a hard, greenish-grey deposit was on this floor. Other than the beaten floor, two wells were found at Square CE03.

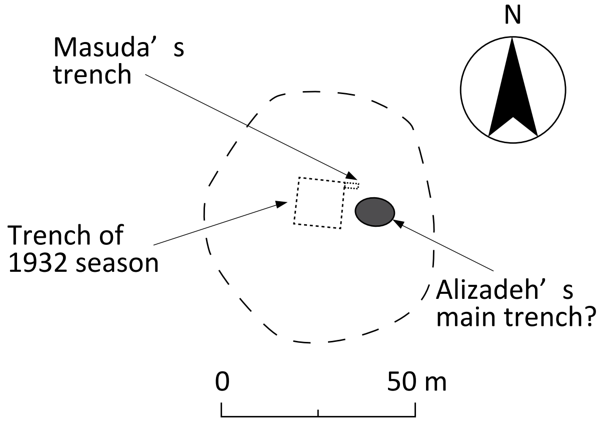

Figure 5.4 Plan of the trench of 1932 season, Masuda's trench, and estimated locations of Alizadeh's main trench at Tall-e Bakun B (retraced from Google Earth)

1956 season at Masuda's trench of Tall-e Bakun B

Description of 1956 season at Tall-e Bakun B

The report of the Japanese expedition at Tall-e Bakun B was briefly written in English, consisting of nine sentences.[30] However, the supplementary information about the excavation was written only in Japanese.[31] Below, I describe the stratigraphy, following this Japanese description. They set up a 2 m x 6 m trench at the northeast edge of the central trench, which had been excavated in 1932 (Fig. 5.4).[32] The duration of the sounding was just one week. They reported that the surface soil continued to an elevation of one meter from the surface and was damaged by Muslim graves. The excavators named the layers, which continued from below the surface soil to an elevation of 2.7 m from surface 'Level I', which corresponds to Stratum BII of McCown's stratigraphy. Although McCown did not set up a layer for the surface soil, Masuda distinguished the surface soil from their 'Level I' (Table 5.4). Then, the deposit under 'Level I' down to the virgin soil was categorised as 'Level II', or Stratum BI of McCown.[33] The criteria for dividing these two levels was also

[20] Egami and Masuda 1962.
[21] Alizadeh et al. 2004; Alizadeh 2006.
[22] McCown 1942: 23.
[23] Schmidt 1939: 124.
[24] Alizadeh 2006: 39-40.
[25] McCown 1942: 23.
[26] Schmidt 1939: 124.
[27] Alizadeh 2006: 39. In this report, the stratum BII was presented as Level 1 and Stratum BI was presented as Level 2. I converted them into Strata BII and BI.
[28] Alizadeh 2006: 39-40. However, if Tall-e Bakun B was excavated in 1937, the note was likely to be written by Schmidt.
[29] Alizadeh 2006: 40, Fig. 11.
[30] Egami and Masuda 1962: 2.
[31] Egami and Masuda 1962: 7-9 in Japanese.
[32] Egami and Masuda 1962: 7 in Japanese.
[33] Egami and Masuda 1962: 8-9 in Japanese.

the presence of BOBW.[34] However, this stratigraphic border corresponded to the thick band of greenish clay deposits.[35] The deposit of Tall-e Bakun B consisted of four types of sediments, that is, clay sediment, ashy sediment, black organic sediment, and greenish clay sediment.[36] These sediments formed a succession of horizontal layers. No mud brick architecture was found except for the trace of pit filled with ashy sediments near the virgin soil.

Reconstruction of the stratigraphy of Tall-e Bakun B from context labels

Like the ceramic materials from Tall-e Jari A, Those from Tall-e Bakun B curated at UMUT lacked stratigraphic information. Below, through the analysis of context labels, I attempt to reconstruct levels at Tall-e Bakun B, in other words, Stratum BII of McCown (with BOBW) or Stratum BI (without BOBW). The ceramic materials excavated by the Japanese expedition were, at first, conveyed to Japan for analysis, and then, only the well-preserved materials were returned to Iran after the analysis. At present, the ceramic materials except for well-preserved ones are curated in UMUT. As with the ceramic materials from Tall-e Jari A, the ceramic materials are curated in wooden boxes. Each wooden box has a label on its side, describing a site name (Bakun B). Inside the wooden boxes, the ceramics are subdivided according to the excavation contexts. The contexts can be judged either from the number and the letter (e.g. B3, B4) written directly on the ceramic sherds or from the context labels with which the excavated ceramics were curated. The labels sometimes have either excavation date, B number (possibly context number), or context information in Japanese.

I present here the list of context labels from wooden boxes with the site name 'Bakun' or 'Bakun B' (Appendix Table A2). Then, I approach the reconstruction of Strata BII and BI of McCown from these labels. According to the description that there existed no BOBW in Stratum BI, I searched for the contexts with which only VCW was curated. As a result, it turned out that the labels with the information of 'B4', 'B6', 'B7', 'B8', '①', '9/10 the lowest (greyish red) layer', '8/10 the lowest clay', '5/10-250-270' indicated the absence of BOBW, namely the contexts of Stratum BI. These context numbers did not overlap with the other contexts, which had both BOBW and VCW. In particular, the label '5/10-250-270' refers both to the excavation date of 5th October, the latter half of the excavation season, and the depth of 250-270 cm from the surface, which corresponds to the stratigraphic border between Strata BI and BII. Furthermore, the ceramics with the information 'B4' and 'B8' include the ceramics, the drawings of which were published as the materials found from Stratum BI.[37] I use this reconstructed stratigraphy for the material studies.

Table 5.4 Comparison of stratigraphy between the trench of 1932 season and Masuda's trench at Tall-e Bakun B

Level of Tall-e Bakun B	Trench of 1932 season	Masuda's trench
BII of McCown	Bakun II (1 m thick: McCown 1942:23) (1.5 m thick: Alizadeh 2006: 39)	surface soil (1 m thick)
		Bakun I (1.7 m thick)
BI of McCown	Bakun I	Bakun II

2004 season of Tall-e Bakun B

In 2004, Alizadeh conducted two test excavations at Tall-e Bakun B, as well as Tall-e Jari A and Tall-e Bakun A.[38] The sounding points have not been reported yet in his articles, but the photograph of the main trench implied that the trench was set up at the slope, which went downwards toward the east.[39] This suggests that Alizadeh's main trench was close to Masuda's trench. In both trenches, Alizadeh discovered a shallow deposit of Stratum BII, totally disturbed by late Sasanian-early Islamic graves, and a much thicker deposit of Stratum BI with only the Shamsabad VCW.[40] He reported the presence of a 50–60 cm thick layer of greenish-grey deposit without any finds between Strata BII and BI, which he interpreted as an indicator of a large temporal gap between these strata.[41] At Stratum BI, he found ovens, fire pits, ashy layers, postholes, stone pavements mixed with sherds, and fragmentary pisé walls, which had not been discovered in the past excavations.[42] That thick layer is likely to be the same one as the boundary layer between Strata BI and BII of Masuda's trench. The description of Alizadeh's stratigraphy is largely congruent with the past excavation results, thereby allowing me to apply the radiocarbon dates collected from Alizadeh's main trench to Masuda's trench for the ceramic analysis.

Comparison of sections and radiocarbon dates at Tall-e Bakun B

Comparison of sections at Tall-e Bakun B

Fig. 5.5 shows sections of the trench of the 1932 season, Masuda's trench, and the estimated section of Alizadeh's

[34] Egami and Masuda 1962: 9 in Japanese.
[35] Egami and Masuda 1962: Fig. 4.
[36] Egami and Masuda 1962: Fig. 4.

[37] Egami and Masuda 1962: Fig. 18: 29, 30, 33.
[38] Alizadeh et al. 2004: 103-104; Alizadeh 2006: 41.
[39] Alizadeh et al. 2004: Fig. 3. The picture was taken from the east.
[40] Alizadeh et al. 2004: 103.
[41] Alizadeh et al. 2004: 104; Alizadeh 2006: 41.
[42] Alizadeh 2006: 41.

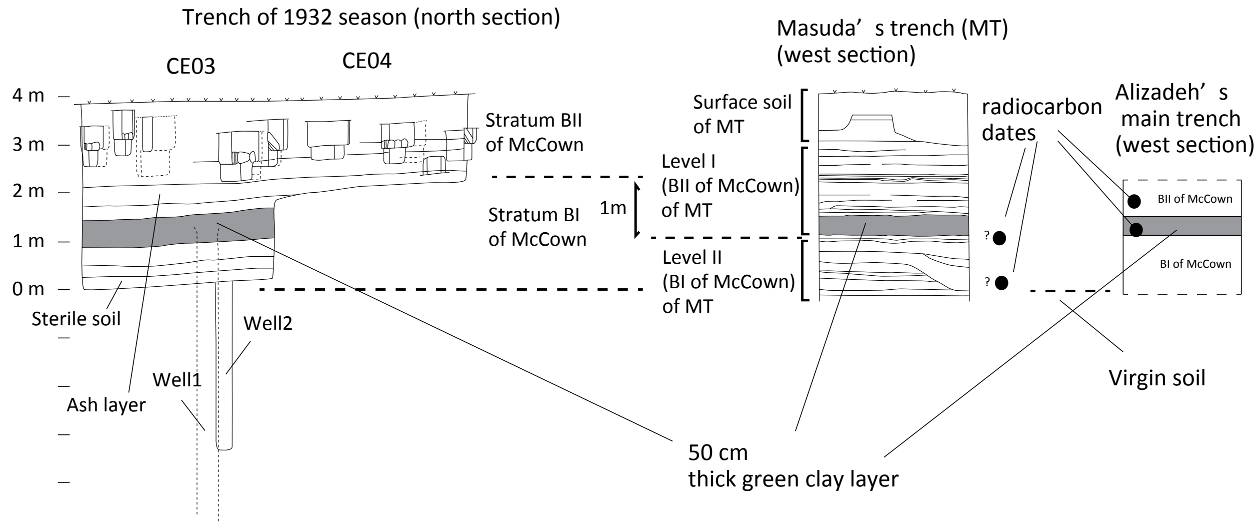

Figure 5.5 Comparison between the trench of 1932 season, Masuda's trench and estimated section of Alizadeh's main trench at Tall-e Bakun B (modified and retraced from Egami and Masuda 1962:Figure 4; Alizadeh 2006: Figure 11)

main trench at Tall-e Bakun B. I estimated the sections of Alizadeh's based on Alizadeh's description.[43] Several important discoveries about the stratigraphy were revealed from the comparison. First, the section of the trench of the 1932 season and that of Masuda's trench should have been similar because these trenches were close to each other, with Masuda's at the northeast edge of the trench of the 1932 season. However, the depth of the stratigraphic boundary between Strata BI and BII was different between those two trenches. The boundary in McCown's trench is about one meter higher than that in Japanese trench. The problem lies in the definition of the culture level. The definition of Strata BI/BII reflects the absence/presence of BOBW. The different depths of the boundaries between absence/presence of BOBW, depending on trenches at Tall-e Bakun B, may reflect the spatial difference in the presence of BOBW at the transitional level.

Second, at Masuda's trench and at Alizadeh's main trench, a 50 cm-thick green clay layer between Strata BI and BII was discovered. The proximity of these trenches supports the identification of the green clay layer. The presence of a hard clay layer that covered the floor of Stratum BI was also found in the central trench. This clay layer is similar to that in the depth of Masuda's trench. Thus, in analysing the ceramic materials from Tall-e Bakun B in this research, I set up the boundary between Strata BI and BII at the bottom of this greenish clay layer, rather than in terms of the presence of BOBW.

[43] Alizadeh et al. 2004; Alizadeh 2006.

Published radiocarbon samples and Bayesian test at Tall-e Bakun B

There are four published radiocarbon dates from Tall-e Bakun B (Table 5.3). The first and second samples were measured by the University of Pennsylvania in 1963 and 1966.[44] In 1958, R.H. Dyson Jr. collected and submitted radiocarbon samples from 3 m below the surface at Masuda's newly-cut trench. Dyson reported that the sample was associated with 'handmade straw-tempered pottery of Tall-e Bakun B'.[45] Given the associated pottery and the depth, the level of the sample was likely to belong to Stratum BI of McCown. However, the calibrated date of this sample (5070–4690 BCE, 93.1%) showed a much later date. In 1964, J. R. Caldwell collected and submitted radiocarbon samples from the ash layer in the section of Masuda's trench. According to the report, the ash layer was associated with VCW.[46] From the evidence of pottery, this ash layer is likely to belong to Stratum BI of the McCown trench. The calibrated date of this sample (5380–5030 BCE, 95.1%) matched the generally acknowledged duration of the Shamsabad period. These two dates were not measured by AMS. Hence, I removed them from the samples for a Bayesian statistical test.

The rest of the four samples were collected by Alizadeh from his trenches in 2004 (Table 5.3).[47] He took two samples from two different cultural levels (Stratum BII and BI of McCown). He reported that the sample belonging to Stratum BII of the McCown trench was taken at 1.9 m above the virgin soil and that the sample

[44] Stuckenrath Jr. 1963; Stuckenrath Jr. et al. 1966.
[45] Stuckenrath Jr. 1963: 90.
[46] Stuckenrath Jr. et al. 1966: 350.
[47] Alizadeh 2006.

of Stratum BI of the McCown trench was collected at 1.4 m above the virgin soil.

From the results of radiocarbon dating and a Bayesian statistical test using only two radiocarbon dates, there turned out to be a slight overlap between a published radiocarbon date from Stratum BII and those from Stratum BI of the McCown trench (Table 5.3). Radiocarbon samples from the cultural sediments with the Shamsabad pottery range from 5325 to 5040 BCE (2σ). On the other hand, the radiocarbon sample from Stratum BII (Early Bakun) was dated to 5215–5000 BCE. From these dates, Alizadeh suggested that the Bakun period started from c. 5200 BCE (2σ). The reason that the radiocarbon dates of Strata BII and BI were partially contemporaneous at Tall-e Bakun B is likely to consist of many factors: sampling point, disturbance by the Muslim graves, and criteria of defining strata (the presence of BOBW).

Summary

In summary, first, I reconstruct levels of the ceramic materials curated in UMUT based on context labels. Second, by comparing sections obtained from three separate trenches at Tall-e Bakun B, it turned out that a thick green layer was widely distributed throughout these trenches. This layer can be a stratigraphic marker to divide Stratum BII of the McCown trench from Stratum BI. Furthermore, the comparison of sections contributed to provide more stratigraphic information.

5-3. Stratigraphy at Tall-e Gap

Site description and excavation history at Tall-e Gap

Tall-e Gap is a mound, approximately 5 m in height and 120 m in diameter (52.942072° E, 29.840160° N).[48] The excavated mound, Tall-e Gap A, is one of seven mounds clustered together (A, B, C, D, E, F, and G).[49] Vanden Berghe discovered this site, dug soundings, and reported in the 1950s.[50] Namio Egami and Toshihiko Sono, the University of Tokyo Iran–Iraq Archaeological Expedition, excavated this site in 1959. Sono managed the excavation as a site supervisor.

1959 season at Tall-e Gap

Grid system and stratigraphy at Tall-e Gap

Five large excavation trenches were set up on top of the site: GAI, GAII, GAEI, GAEII, and GAT (Fig. 5.6). Each trench was further subdivided into 3 m x 3 m excavation squares. Only the GAT trench was excavated deeply, revealing 20 stratigraphic layers from Levels 1

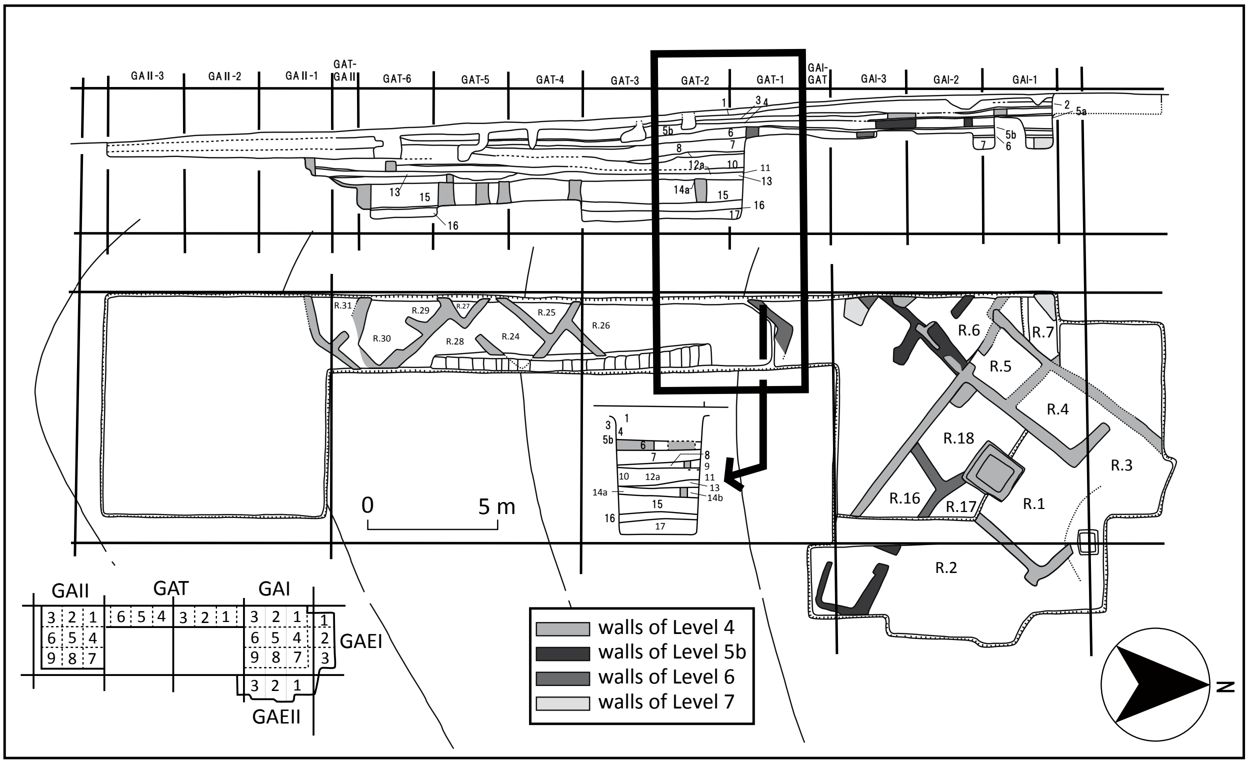

Figure 5.6 Section and plan of the trenches excavated by Sono at Tall-e Gap (retraced from Egami and Sono 1962: Figure 5)

48 Egami and Sono 1962: 1.
49 Egami and Sono 1962: Figs. 3-4.
50 Vanden Berghe 1952.

Table 5.5 Stratigraphy, architectural remains and the presence of the pottery production related materials at Tall-e Gap (retraced from Egami and Sono 1962: 2 in English and modified by Miki)

Phases proposed by Sono (1962)	Level	Architectures and remains	Presence of the pottery production related materials
IIc	1	'vessel stand' (GAT-1)	
	2		
	3		
	4	R1, R2, R3, R4, R5, R6, R7	Perforated disc (GAEII)
IIb	5a		Pottery slags (GAT-1)
	5b	R9, pottery pavement (GAI-3), burial (GAT-2)	Perforated disc (GAI-9)
	6	R8, R16, R17, R18, 'oven for bread' (GAI-3), clay cones and hearths (GAT-1,2), burial (GAT-1)	
	7		
	8		
	9	R10, R11, R12, R13, R14, R15, pavement (GAT-5,6)	Pottery slag (GAT-5,6)
IIa	10		Pottery slag (GAT-5,6)
	11		
	12a	R19	
	12b	Floor of R19, pavement (GAT-5,6)	
?	13		
Ib	14a	R20, R21, R22	Misfired pottery (GAT-6)
	14b		
	15	R23, R24, R25, R26, R27, R28, R29, R30	
Ia	16		Perforated disc (GAT-5,6)
	17		

to 17 (Table 5.5). Egami and Sono first subdivided the stratigraphy of Tall-e Gap into two periods based on the stratigraphic characteristics and building activities of the GAT trench: Period I (Levels 17 to 14a) and Period II (Levels 12b to 1). Egami and Sono reported that no building activity was observed in Level 10 and that no materials were found in Level 11. Then they subdivided the stratigraphy in more detail based on the frequencies of painted motifs: Period Ia (Levels 17 to 16), Period Ib (Levels 15 to 14a), Period IIa (Levels 12b to 10), Period IIb (Levels 9 to 5a), and Period IIc (Levels 4 to 1).[51]

The materials excavated from Tall-e Gap were brought to Japan for analysis; then, the well-preserved ceramics were returned to Iran. The quantitative material studies in Chapter 6 focus on Squares GAT-1 (3 m x 3 m) and GAT-2 (3 m x 3 m) because they are located on the highest point of the mound and contain the deepest deposits at the site. Here, I will not present detailed descriptions of all of the levels at Tall-e Gap. Below, I will introduce the levels associated with intensive dwelling remains, focusing on the cultural deposits at Squares GAT-1 and 2, from the uppermost level to the lowest. I will also report the production-related artefacts discovered from observation of the material collection curated at UMUT. Those findings will support the argument that BOBW was produced at Tall-e Gap, which does not have a confirmed pottery kiln yet.

Architectural remains at Levels 2-10 of Tall-e Gap

At Level 2 of Square GAT-1, a vessel stand was found, although this level was disturbed in some ways.[52] According to the excavator, this stand is made of clay and painted pottery sherds.[53] The floor area is limited and confirmed only in GAT-1. Level 4 was observed in Trenches GAI, GAEI, GAEII, GAT-1, and GAT-2. A building

[51] Egami and Sono 1962: Table 12.

[52] Egami and Sono 1962: Fig. Pl. 17:1.

[53] Egami and Sono 1962: 11 (Japanese).

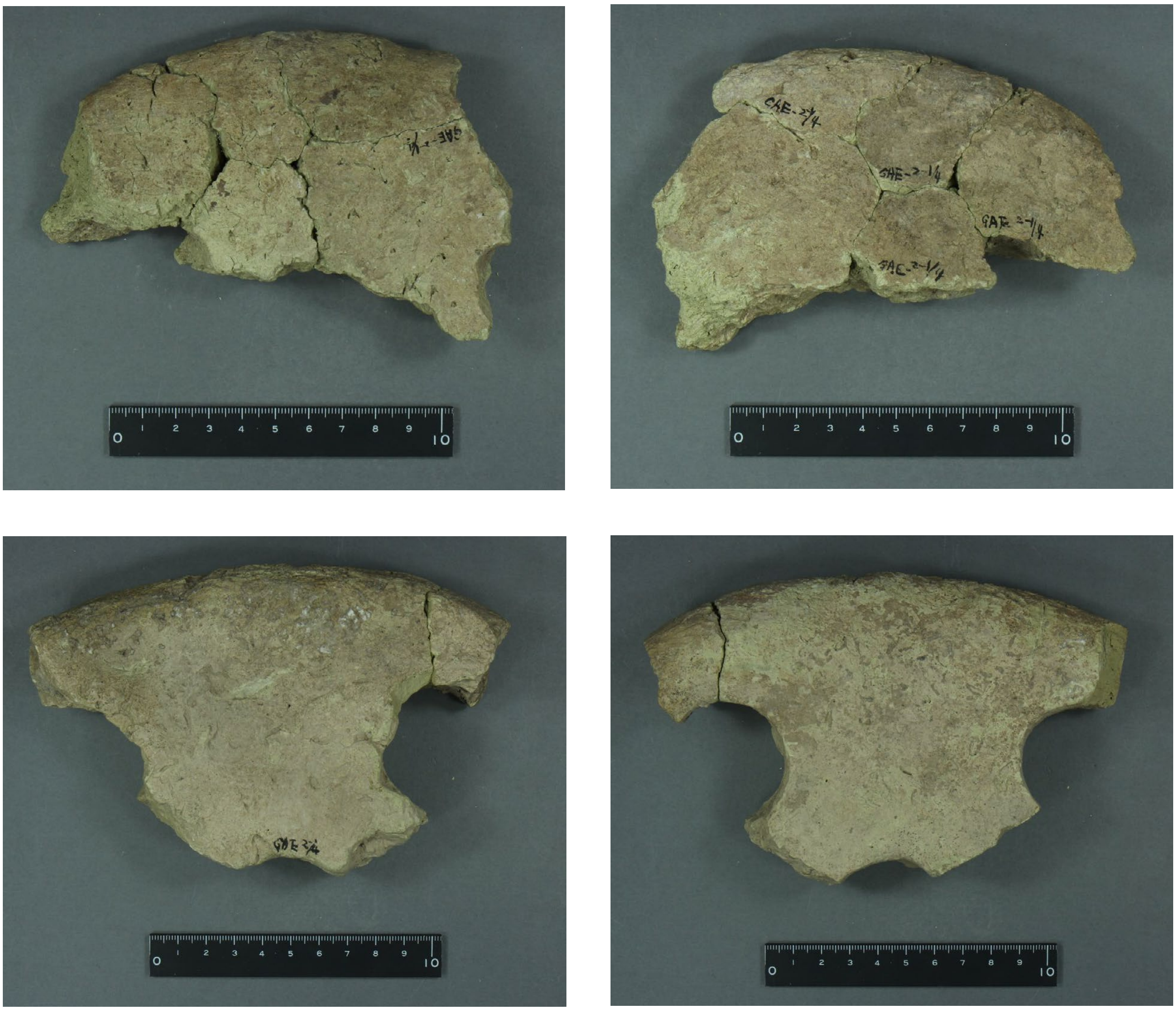

Figure 5.7 Perforated discs found from Trench GAEII of Level 4 at Tall-e Gap (Photo by Miki)

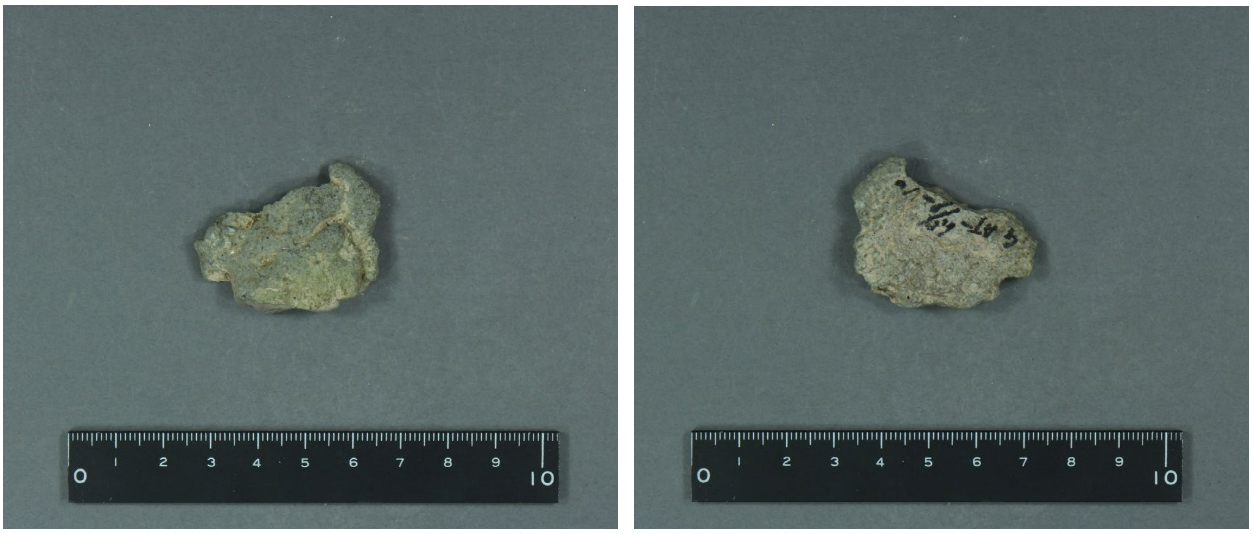

Figure 5.8 Perforated discs found from Trench GAEII of Level 4 at Tall-e Gap (Photo by Miki)

Figure 5.9 Misfired pottery found from Trench GAT-6 of Level 9 at Tall-e Gap (Photo by Miki)

Figure 5.10 Perforated discs found from Trench GAT-5,6 of Level 16 at Tall-e Gap (Photo by Miki)

complex consisting of seven rooms was discovered at this level (Fig. 5.6). Rooms 1, 2, 3, 4, and 5 comprise an 8 m x 10 m rectangular building, and Rooms 6 and 7 extend from Room 5. The central part of this building, Room 1, has a square fireplace.[54] Pieces of perforated pottery discs were found in Square GAEII, possibly inside Room 2, which are similar to the one discovered inside the pottery kiln at Rahmatabad (Fig. 5.7, Table 5.5).[55] These finds imply pottery was produced near the building complex, if the finds were not discarded away from the pottery production loci. The excavation of Squares GAEI and GAEII stopped at this level.

Level 5 is subdivided into Level 5a (upper greenish-grey ash sediment, mainly observed in Trench GAI) and Level 5b (lower sediment of collapsed walls, well preserved in Squares GAT-1, 2, and 3). A pottery pavement was observed at Level 5b of Square GAI-3.[56] Potsherds were paved onto the floor surface and then covered with coating for the floor. The potsherds for the pavement were not refitted together. Four pieces of pottery slag, created by misfiring of pottery, were newly reconfirmed from Level 5a of Square GAT-1 (Table 5.5). One baby burial (Burial No. 10, 1–2 years old), in a flexed position, was also confirmed at Level 5b of Square GAT-2.[57] One perforated pottery disc, which indirectly implies pottery production, was also found at Level 5b of Square GAI-9 (Table 5.5).[58]

Because the excavator decided to preserve the wall of building complex at Level 4 of trench GAI, the excavation area of Level 6 at Trench GAI was limited. A part of house walls was confirmed at Squares GAI-3, GAI-8, and GAT-1, but the excavator could not grasp the entire structure. From Square GAI-3, '*an oven for bread*' was discovered.[59] At Squares GAT-1 and GAT-2, the combination of clay cones and hearths were discovered.[60] In addition, one infant burial in a flexed position (Burial No. 11) was discovered from Square GAT-1.[61] The excavation at Trench GAI stopped at Level 8. Levels under Level 8 were confirmed only in Trench GAT. Level 9 is a well-preserved cultural deposit, and three rooms (R13, R14, R15) were found from Squares GAT-1 and 2,[62] other three rooms (R10, R11, R12) were discovered at Squares GAT-5 and 6 with the potsherds pavement on its floor.[63] Interestingly, the potsherds pavement lay under the house wall. One piece of pottery slag was found on the floor of R11 of Square GAT-6. One other piece of pottery slag was also found at Level 10 of Square GAT-5,6 (Fig. 5.8, Table 5.5).

54 Egami and Sono 1962: 3.
55 Bernbeck et al. 2005.
56 Egami and Sono 1962: Pl. 7:1, Fig. 8:1.
57 Egami and Sono 1962: 30 in Japanese.
58 Egami and Sono 1962: Pl. 17: 4, 42: 7.
59 Egami and Sono 1962: 13 in Japanese.
60 Egami and Sono 1962: 14 in Japanese.
61 Egami and Sono 1962: 31 in Japanese, Pl. 19:2, Fig. 9:3.
62 Egami and Sono 1962: 15 in Japanese, Pl. 5:2
63 Egami and Sono 1962: 15 in Japanese, Pl. 6:1,2, 7:3, Fig. 8:1,2.

Architectural remains at Levels 12-17 of Tall-e Gap

Room 19 was confirmed in Level 12 of Squares GAT 5 and 6. The floor of the building was prepared by paving the potsherds and subsequently coating clay on the pavement. The room's wall was erected on the clay-coated pavement floor.[64] Square GAT-5 and 6 of Level 14a also has several room walls (R20, R21, R22). From this level at Square GAT-6, a new material indicating the presence of pottery production was rediscovered. This misfired ceramic sherd, with a part of the stacked pottery on its exterior, clearly shows that pottery production occurred in Tall-e Gap (Fig. 5.9, Table 5.5).

Below Level 14, the best-preserved building unit (R23, R24, R25, R26, R27, R28, R29, and R30) was discovered in Level 15 of Squares GAT-4, 5, and 6.[65] The direction of the building walls is the same as those found at the upper levels. Just below the floor of the building unit in Level 15 is a sediment of Level 16 without building remains.[66] As with Levels 4 and 6, four pieces of perforated pottery discs were found below Room 28 of Squares GAT-5 and 6 (Fig. 5.10, Table 5.5), and another one was found below Room 31 of Square GAT-6 (Table 5.5).[67] These finds imply the presence of pottery kilns in Level 16. Given the absence of building activity, a place distant from house was likely chosen for firing pottery. The lowest level which Egami and Sono reached was Level 17. They discovered BOBW as well as VCW from Level 17.[68] A small chunk of ash was discovered inside one of the VCW vessels. In addition, an infant burial (No. 13) in a flexed position was also unearthed.[69]

Radiocarbon dates at Tall-e Gap

There are four published radiocarbon dates from Tall-e Gap (Table 5.3). The first two samples were measured by Japanese professors Kunihiko Kigoshi and Kunihiko Endo.[70] The samples were taken from Level 17 of Square GAT-1 and Level 6 of Square GAI-5. The calibrated date of the first sample from Level 17 (GAK-197) ranged from 5080–4435 BCE (90.1 %), showing a broad range due to the old measurement. The second sample from Level 6 was dated from 4505–3985 BCE (95.2 %). These radiocarbon dates obtained from the old measurement were excluded from Bayesian statistical testing. The second two samples were rediscovered by the author while observing the ceramic materials curated in UMUT. These samples were measured by Institute of Accelerator Analysis (IAA). These samples came from the ash samples packed in tin cans. One of the samples originated from the same level and grid as the one measured before (Level 17 of GAT-1). Another sample was taken from Level 5b of Square GAI-8, next to Square GAI-5. As with the samples from Level 17 at Square GAT-1, the two samples from Trench GAI likely were originally found in the same context.

A Bayesian statistical test was conducted using only two radiocarbon dates from Tall-e Gap, which slightly limited the range of the radiocarbon dates from the new measurements. The oldest radiocarbon date in Tall-e Gap was 4725 BCE (2σ), and the radiocarbon date from Level 5b ends at 4445 BCE (2σ), although these dates depend on their ranges. Hence, the absolute dates of the levels later than Level 5b at Tall-e Gap are likely to be younger than 4500 BCE. In addition, the average duration of each building level can be estimated. When the duration from Level 17 to Level 5b (280 years at most) is divided by 12 levels (levels confirmed in the section of Square GAT-1: Levels 17, 16, 15, 14, 13, 12, 10, 9, 8, 7, 6, and 5b), the average duration of one level is 23.3 years.

In this section, instead of discussing chronological relationships between trenches, I describe the architectural remains and pottery-production related materials found at each level at Tall-e Gap as well as newly measured radiocarbon samples. The unpublished misfired potsherd supports pottery production having occurred at Tall-e Gap. New radiocarbon dates can help with examining the chronological relationships with other sites, as discussed in Section 5-5.

5-4. Stratigraphy at Tall-e Bakun A

Site description and excavation history at Tall-e Bakun A

As with the three aforementioned sites, Tall-e Bakun A (52.885680° E, 29.913804° N) is located in the Kur River Basin, Fars Province, in the southern part of the Zagros Mountains. Tall-e Bakun A is approximately 150 m long, 120 m wide, and 5 m high.[71] Tall-e Bakun A was the first excavated site of all the Bakun-period sites and a type site of this period, especially the Late Bakun phase, in the tripartite subdivision system. Herzfeld started the excavation of Tall-e Bakun A in 1928. Langsdorff and McCown conducted large-scale excavations in 1932 and 1937 respectively. At present, a large portion of the finds unearthed by this excavation is curated at the Oriental Institute, University of Chicago. In 1956, Namio Egami and Seiichi Masuda conducted a small-scale sounding at the south-western part of Tall-e Bakun A in the University of Tokyo Iraq–Iran Expedition. In 2004, Alizadeh also performed a small sounding at Tall-e

[64] Egami and Sono 1962: 16 in Japanese, Pl.7:2.
[65] Egami and Sono 1962: 17, 27 in Japanese.
[66] Egami and Sono 1962: 18 in Japanese.
[67] Egami and Sono 1962: Pl. 42:6.
[68] Egami and Sono 1962: 18 in Japanese.
[69] Egami and Sono 1962: 31 in Japanese.
[70] Egami and Sono 1962: 23; Kigoshi and Endo 1963: 115.
[71] Alizadeh 2006: Fig. 6.

Bakun A and collected samples for radiocarbon dating. Below, I will describe the details of these excavations.

1928 season at Tall-e Bakun A

Ernst Herzfeld started the first excavation of Tall-e Bakun A in 1928.[72] The descriptions about the stratigraphy of his trenches are limited. He opened two trenches at the north-west and south-east parts of the mound. He discovered one beehive-shaped kiln at a point 4 m deep from the surface (Table 5.6).[73] The locations of his trenches are indicated in the excavation plan of Tall-e Bakun A reported in 1942.[74]

1932 season at Tall-e Bakun A

Grid system of the 1932 season at Tall-e Bakun A

Langsdorff began the excavation of Tall-e Bakun A under Herzfeld's direction in 1932.[75] He partitioned the whole mound into 5 m squares. First, he opened a long 3-m-wide trench crossing the mound in the east–west direction (Trench I).[76] Below an approximately 2 m layer disturbed by Muslim graves, he found a part of wall remains in Square K26. Then, he pursued traces of walls and extended the trench northwards (Squares J-Q, 26-32).[77] Afterward, he set up a long trench parallel to Trench I to confirm the settlement's presence (Trench II, Squares C-Z17).[78] However, he gave up on excavating the trench below the Muslim graves level.

Levels I and II of the 1932 season at Tall-e Bakun A

Langsdorff divided the stratigraphy of Tall-e Bakun A into four levels based on building levels.[79] The excavation area of the lowest level, Level I, was limited. Hearths, clay cones, and post holes were found in Square H26 of Trench I. In addition, two kilns were unearthed in Squares R30 and L28.[80] The well-preserved one in Square L28 was reported in detail (Table 5.6). The excavator reported that this kiln was used until the end of Level III and was filled with disposals; then, the house was constructed at Level IV. The architectural traces of Level II were very limited and preserved only in the form of wall fragments in Squares K29–30 and N-O31.[81] As Alizadeh pointed out, it is difficult to associate the materials with these wall fragments from Level II, and the materials from Level II are likely to belong to Level III.[82] In fact, the reported materials found from Levels I and II came only from Trench I, Squares K29, M31, N31-32, O31-32, and Q31.

Level III of the 1932 season at Tall-e Bakun A

Building Level III of Tall-e Bakun A has a well-preserved building complex comprising 13 buildings (Buildings I – XIII), with each building linked together. The total number of rooms in the building complex is 51.[83] Each building has about four rooms, on average. Interestingly, the entrances of the dwellings are distant from each other—in other words, the buildings are not connected. Building VIII is the largest building and has niches added to its wall.[84] Painted walls were observed at seven loci in Level III.[85] Some buildings had the smallest rooms, called storerooms, at the most distant location from their entrances.[86] One such room had a complete large jar in situ.[87] As discussed by Alizadeh and Fraser,[88] sealings with well-preserved traces of seal impressions on their surfaces were discovered at Buildings II, III, IV, VII, and XIII. Stirrup-shaped scrapers, which are tools related to pottery making, have been found inside the fills of Room 3 of Building III and Rooms 2 and 3 of Building IV.[89] A heap of yellowish-green clay was confirmed in Room 2 of Building II, which the excavators interpreted as being clay used by a potter.[90] Next to this room, Room 1 of Building II had a hearth inside the room. An oven, possibly for baking bread, was found outdoors between Houses II and III. Finally, the excavator argued that the good preservation of the building complex of Level III was the result of a conflagration with the evidence of ash and reddish burnt clay.[91] In contrast, Alizadeh insisted on not only the absence of the conflagration but also the simple abandonment of Tall-e Bakun A.[92]

[72] Herzfeld 1929, 1932.
[73] Herzfeld 1932: 5. From which trench the kiln was discovered is unknown.
[74] Langsdorff and McCown 1942: Fig.2, 4.
[75] Langsdorff and McCown 1942: 1.
[76] Langsdorff and McCown 1942: Fig. 2 and 3.
[77] Langsdorff and McCown 1942: 4, Fig. 4.
[78] Aerial photograph of Tall-e Bakun A taken in 1932 (Schmidt 1939: Fig. 88; Alizadeh 2006: Pl. 1) indicates that the western part of Trench II (west of the central trench) was actually either unexcavated or not deeply excavated. The fact that Trench II did not penetrate horizontally a whole part of Tall-e Bakun A fits well with the description of the Japanese trench (located on west side Trench II), Alizadeh's reconstruction of location of the Japanese trench (Alizadeh 2006: Fig. 7), and the current preservation situation of Tall-e Bakun A observable from Google Earth.
[79] Langsdorff and McCown 1942: 5.
[80] Langsdorff and McCown 1942: Figs. 5 (L28) and 6 (R30).
[81] Langsdorff and McCown 1942: 7.
[82] Alizadeh 2006: 58.
[83] Langsdorff and McCown 1942: Fig. 4. I follow Alizadeh's argument that Building XIII was assigned to level III, not level IV originally described by Langsdorff and McCown 1942. The grounds are the presence of ash layer on building XIII, which also covered the other buildings in Level III, and the presence of sealings in building XIII.
[84] Alizadeh 2006: 58; Fraser 2008: 12.
[85] Langsdorff and McCown 1942: 8.
[86] Langsdorff and McCown 1942: 10.
[87] Langsdorff and McCown 1942: Figs. 11 and 12.
[88] Alizadeh 1988 Fig. 4; Fraser 2008: 5.
[89] Langsdorff and McCown 1942: 17, Pl. 8: 14; 83:1-2.
[90] Langsdorff and McCown 1942: 12, Fig. 13.
[91] Langsdorff and McCown 1942: 15.
[92] Alizadeh 2006: 64.

Level IV of the 1932 season at Tall-e Bakun A

Building Level IV has five buildings and 17 total rooms (XIV – XVIII). A majority of the buildings are located on the exterior part of the building complex of Level III, except for Building XVI, which lied above Building VIII.[93] Red and yellow wall paintings also existed in Level IV.[94] In Room 2 of Building XVII, a part of the west wall was extended and used as a small pottery kiln, whose insides were reddish due to firing (Table 5.6).[95] A clay slab was found on the floor. The excavator argued that small clay objects were fired in the pottery kiln and that Room 2 of Building XVII was a workshop.[96]

1937 season at Tall-e Bakun A

In 1937, McCown opened one 20 m x 20 m square trench (BB27, BB28, BB37, BB38) in the central part of Tall-e Bakun A and seven 10 m x 10m square trenches (BB60, BB62, BB64, BB86, BB78, and BC70) in the southern part.[97] Square BB 60 only has a sterile layer. The upper layers of Squares BB64, BC70, and CB06 were penetrated by Islamic graves. Under their upper layers was a sterile layer, except for at BB64, which contained pavement made of pebbles and potsherds and a circular fireplace.[98] In addition, he re-excavated the trenches excavated in the 1932 season to confirm the elevation of the virgin soil at these trenches.[99]

Central trench of the 1937 season at Tall-e Bakun A

Five building phases (level 1, 2, 3, 4, and 4a) were uncovered in a 20 m square trench (BB27, BB28, BB37, BB38).[100] Level 1 was largely destroyed by Islamic graves. Below that, in Level 2, one building comprising six rooms was confirmed in Squares BB27 and BB28. One degenerated kiln with a semi-elliptical shape was found between an open space and Room 4 of the building (Table 5.6). One fireplace was set up in Room 1. Another fragment of a fireplace was also confirmed in the open space at Square BB37.

Additionally, one building complex with at least 15 rooms was discovered in Level 3 of Squares BB37 and 38. Room 3 of Square BB38 had stone slab pavement. A fireplace was built inside Room 1 of Square BB38. In the next building level, Level 4, three parts of building complexes were found at the southern part of the large square (BB37, three rooms, and BB38, ten rooms) and in the eastern part (BB28 and BB38, two rooms). In particular, four lines of parallel unplastered mudbrick walls exist beside the eastern building complex. The floors between each wall are sloped, beaten earth. Between Level 4 and the virgin soil, one more building phase, Level 4a, appeared. There was a fragment of floors (Squares BB27 and BB37), two pottery kilns (Squares BB27 and BB37) (Table 5.6), one wall fragment (Square BB38), and two fireplaces (Square BB27) in Level 4a. Kiln 1 was a well-preserved kiln with both the upper chamber and fire chamber remaining.[101] Kiln 2 only had the lower part of its fire chamber remaining.

Other trenches of the 1937 season at Tall-e Bakun A

As with the other trenches, the uppermost layer of Square BB62 was pierced by Islamic graves.[102] However, three degenerated kilns were confirmed in Level 2 of Square BB62 (Table 5.6). Each kiln size and the preserved situation are different, although the presence of the grate, which was erected on the floor of the fire chamber, can be confirmed in each kiln. One more kiln was discovered near one of the three kilns in the lowest layer, Level 3 (Table 5.6). This kiln has a completely preserved lower chamber and a well-preserved upper chamber. There were two clusters of pavements of potsherds in the same layer. Square BB 78 had a building complex consisting of at least eight rooms in Level 3, with the majority continuing from the lower level, Level 4. Finally, one building complex with 10 rooms and a deep well was excavated in Level 4 of Square BB86.

In total, 11 pottery kilns were found during the excavations at Tall-e Bakun A. These kilns are summarised in Table 5.6. Following the classification scheme by Helwing and Seyedin based on results from Darreyeh Bolaghi, the shapes of the kilns from the Bakun period can be classified into three types: single-chambered, keyhole-shaped double-chambered, and circular-shaped double-chambered kilns.[103] Except for the kiln discovered by Herzfeld, two heavily degenerated kilns, and one apse-shaped kiln attached to a house wall, most of the kilns discovered at Tall-e Bakun A are keyhole-shaped double-chambered kilns, including two possible cases. Each keyhole-shaped kiln has a stokehole entering into the subterranean combustion chamber, in which a middle protruding wall connected to the circular outer wall is constructed to support the upper firing chamber. Most of the firing chamber is poorly preserved. The average length of the keyhole-shaped kilns (a stokehole and a combustion chamber) is 2.2 m, and their average width is 1.5 m.

[93] Langsdorff and McCown 1942: 19, Fig. 4.
[94] Langsdorff and McCown 1942: 19.
[95] Langsdorff and McCown 1942: 19-20, Fig. 18.
[96] Langsdorff and McCown 1942: 20.
[97] Alizadeh 2006: 60-63, Fig. 7.
[98] Alizadeh 2006: 62, Fig. 15, 17, 20, 21.
[99] Alizadeh 2006: 63.
[100] Alizadeh 2006: 60-61, Figs. 12-14, Pl. 4: B.
[101] Alizadeh 2006: 61, Fig. 14, Pl. 6: C.
[102] Alizadeh 2006: 62, Fig. 16.
[103] Helwing and Seyedin 2010.

Table 5.6 List of pottery kilns found at Tall-e Bakun A

Trench	Level	Length (m) (preserved length)	Width (m) (preserved width)	Preserved height (m)	Preserved depth (m)	Type	Note	Reference
Herzfeld's trench	4 m deep					'beehive-shaped', double-chambered		Herzfeld 1932: 5
L28	I (-III?)	2.7	2	0.8		keyhole-shaped, double-chambered		Langsdorff & McCown 1942: 6, Fig. 5
R30	I	1.5	1.2			keyhole-shaped, double-chambered		Langsdorff & McCown 1942: 6, Fig. 6
Q29	IV	2	1			apse-shaped attached to wall		Langsdorff & McCown 1942: 19, Fig. 4
BB27-28	2	(0.6)	(1)	0.3		?	degenerated	Alizadeh 2006: Fig. 12
BB27	4a	1.8	1.1		0.5	keyhole-shaped, double-chambered?	Kiln 2	Alizadeh 2006: 61, Fig. 13, Pl. 6C
BB37	4a	2.6	2.1	0.6	1	keyhole-shaped, double-chambered	Kiln 1	Alizadeh 2006: 61, Figs. 13-14, Pl. 6C
BB62	2	(1.8)	(1.7)	(0.5)		keyhole-shaped, double-chambered	degenerated	Alizadeh 2006: 62, Fig. 16
BB62	2	(0.4)	(1)			keyhole-shaped, double-chambered	Kiln 2, degenerated	Alizadeh 2006: 62, Fig. 16
BB62	2	(1.5)	1.7	(0.4)		keyhole-shaped, double-chambered?	Kiln 3	Alizadeh 2006: 62, Fig. 16
BB61-62	3	(1.9)	(1.5)	(0.4)	1.2	?	Kiln 1	Alizadeh 2006: 62, Fig. 16

1956 season at Tall-e Bakun A

Description of the excavation during the 1956 season

A brief summary of the Japanese expedition at Tall-e Bakun A during the 1956 season was published in English,[104] more description about the excavation was written in Japanese[105] as well as the Japanese excavation at Tall-e Bakun B. A 3 m x 10 m trench next to the western edge of Trench II of the 1932 season was excavated.[106] Sounding was conducted from 25 September 1956 to 30 September 1956. The excavator confirmed a 50 cm-thick surface soil sediment, which was penetrated by seven Islamic graves. Although Level I of the Masuda's trench was partly disturbed by Islamic graves, one complete jar and one stamp seal were found from this level.[107] The description of Levels II and III is very scarce, in both English and Japanese, mentioning their soil characteristics (ashy layer of Level II and brownish soil of Level III) and the discovery of abundant amounts of potsherds from Level II. The lowest level, Level IV, contained one mudbrick building formed by at least three rooms. The mudbrick was plastered and then painted red. The floor was a beaten earth. The trench was extended to eastwards to confirm the extent of Room 3.[108] There were one hearth and one cluster of pebbles inside Room 1. Two almost-complete ceramics were discovered from Room 2. This small excavation continued under Level IV; then, the excavator found yellowish-brown virgin soil. Sediment with artefacts was also confirmed under Rooms 1 and 2 of Level IV. Finally, based on the similarity of the red-painted walls, the excavator argued that Level IV of the Japanese trench was equivalent to Level III of the northern large trench, which was excavated by the University of Chicago in 1932.[109]

Reconstruction of the stratigraphy at Tall-e Bakun A from context labels

The ceramic materials from Tall-e Bakun A collected by the Japanese expedition were processed in the same way as those from Tall-e Bakun B were. The ceramic materials

Figure 5.11 Perforated discs found from Masuda's trench at Tall-e Bakun A (Photo by Miki)

Figure 5.12 Misfired pottery found from Masuda's trench at Tall-e Bakun A (Photo by Miki)

are stored at UMUT, except for the excellent ones, which were returned to Iran. The ceramic collection at UMUT is kept in wooden boxes, each with a label containing the site name (Bakun A) on the front side. The ceramics are separated into several paper boxes according to the excavation contexts inside the wooden boxes. The available context information is recorded on the cloth labels curated with the ceramics. The excavator described the excavation date, number (1 or 2, what it actually means is unknown), and context information in Japanese, or just the number (appeared 1 or 2, unclear). Unfortunately, no written records exist at UMUT about the levels (I-IV) mentioned in the excavation report. Hence, I must reconstruct the stratigraphic information of the pottery from the context labels as with those at Tall-e Jari A and Tall-e Bakun B.

Table A2 (in Appendix) provides a list of the labels on the wooden boxes with the site name 'Bakun' or 'Bakun A'. The problem with reconstructing Levels I, II, III, and IV from these labels is the presence of wooden boxes with a large amount of reported ceramics (boxes 2209, 2132, etc.). This means that the diagnostic ceramics were

[104] Egami and Masuda 1962: 1.
[105] Egami and Masuda 1962: 4-6 in Japanese.
[106] Egami and Masuda 1962: 7, Fig. 3; Egami and Masuda 1962: 4 in Japanese. Although the English summary described, 'On Site A trench was dug on the west of the Trench II dug by the University of Chicago at the southwest foot of the Tell,' the description in Japanese said, 'We selected one of the excavated trenches and set up a 3 m x 10 m trench along the eastern (mistake of western?) wall of the trench. Our trench is located on the southwest foot of the Tell, in other words, on the point near the western part of the Trench II.'
[107] Egami and Masuda 1962: Pl. 1:1, 4:1.
[108] Egami and Masuda 1962: Fig. 3.
[109] Egami and Masuda 1962: 1, 6 in Japanese. However, painted wall cannot be a good chronological marker of Level III of northern trench because they are confirmed in various levels in trenches excavated in 1937.

extracted from the original boxes and then moved to several other boxes separately, instead of being returned to the original boxes. Additionally, the excavator did not provide any context information on the ceramic sherds other than 'TB' (Tall-e Bakun). Although it is impossible to date the reported diagnostic ceramics, presenting the relative stratigraphy of undiagnostic sherds using context labels is possible. Many context labels have recorded excavation dates ranging from 25 September to 2 October 1956. Although I cannot determine the original levels from the excavation dates, I can say that the later the excavation date, the deeper the context. There are two labels with excavation dates and context information, such as '30/9 under Room 4' and '2/10 under Room 3', which can be dated to Level IV. Thus, for the quantitative analysis of ceramic materials in the later chapters, I will classify ceramic materials mainly by excavation dates.

During the observation of the curated materials from Masuda's trench at Tall-e Bakun A, pottery-production-related materials also were observed. Perforated discs, possibly a part of a pottery kiln, were confirmed in the collection (Fig. 5.11). Unlike those discovered at Tall-e Gap (Figs. 5.7, 10), the discs have some lines traced with black pigment. This might be caused by putting unfired painted pottery on these discs. There are also two diagnostic pieces of misfired ceramics. Fig. 5.12 shows some misfired rim sherds with green vitrified clay on their edges, which were caused by overfiring. This evidence proves that pottery was produced not only at the north trench, the central trench, and BB62 but also at Masuda's trench.

2004 season at Tall-e Bakun A

Alizadeh excavated three trenches in the central and west-central parts of Tall-e Bakun A, in collaboration with the Iranian Cultural Heritage Organisation (ICHO).[110] He also re-excavated 'the administrative centre at Bakun A' excavated in 1932 for publication as a tourist attraction, but it turned out that the area had already been disturbed by cultivation during the Iranian Revolution.[111] The exact locations of those soundings were not published, except for the north section of BB27-28.[112] Alizadeh sought a transitional layer between the Bakun and Lapui periods from these soundings. However, the sediments 1–1.5 m below the surface were affected by the later graves belonging to the late Sasanian and early Islamic periods, which made his approach impossible. He excavated all three trenches to the depth of virgin soil and obtained lithics, ceramics, other artefacts, faunal samples, botanical samples, and charcoals.

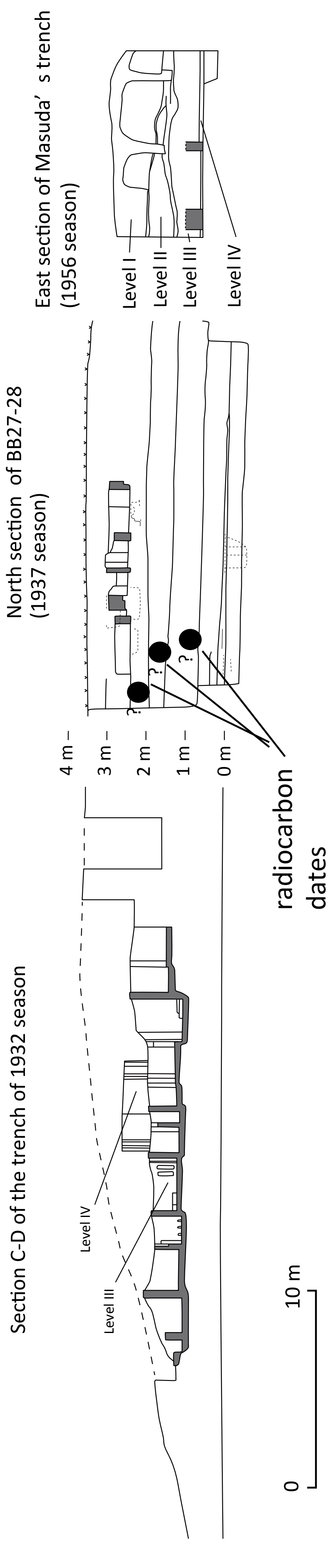

Figure 5.13 Comparison of sections of trenches of 1932, 1937, and 1956 seasons (modified and retraced from McCown and Langsdorff 1942: Figure 4; Alizadeh 2006: Figure 13; Egami and Masuda 1962: Figure 3)

[110] Alizadeh et al. 2004: 98-99; Alizadeh 2006: 41.
[111] Alizadeh et al. 2004: 98.
[112] Alizadeh et al. 2004: Figure 3B.

Table 5.7 Comparison of stratigraphy between trenches of 1932, 1937, and 1956 season at Tall-e Bakun A

trench of 1932 season	BB27-28 of 1937 season	Masuda's trench of 1956 season
	Level 1	
Level IV	Level 2	Level I
Level III	Level 3-4	Level II-III
Level II	Level 4a	Level IV
Level I		

Comparison of sections and radiocarbon dates at Tall-e Bakun A

Comparison of sections at Tall-e Bakun A

Fig. 5.13 shows a comparison of sections of the excavation trenches from the 1932, 1937, and 1956 seasons using a contour map and section descriptions. Following the comparison of the absolute depths, the stratigraphy of these trenches is summarised in Table 5.7. Unlike Tall-e Jari A and Tall-e Bakun B, there were no clear markers of the specific levels at Tall-e Bakun A such as the presence of specific sediments, BOBW, or VCW.

Radiocarbon dates at Tall-e Bakun A

There are three published radiocarbon dates from Tall-e Bakun A (Table 5.3). All three samples were collected during the excavation of Square BB27 conducted by Alizadeh.[113] Two samples were measured at Beta Analytic AMS Laboratory. One charred seed sample was collected at a trash heap near the oven at Level 3. Another charred seed sample came from a trash deposit at Level 4. One more bone sample for radiocarbon dating was sampled from a trash heap near an oven/kiln at Level III. The reason why the level number was indicated as 'III' instead of '2' is not evident. Here, I interpreted this 'Level III' as contemporaneous to Level 2 because of evidence that the kiln remains were discovered from Level 2 of BB27. In addition, the absolute height of the sample-collection point cannot be reconstructed because the report did not mention Levels 1, 2, 3, 4, or 4a in the section drawing. The results of radiocarbon dating with Bayesian statistical testing revealed just a slight difference among the radiocarbon samples between Levels III, 3, and 4, regardless of the depth of the sampling points. The oldest level, Level 4, started from 4465 BCE (93.1%). The latest date from Level III ended at 4340 BCE (2σ). The average duration of one level is 41.7 years, which is slightly longer than that of Tall-e Gap (23.3 years).

[113] Alizadeh 2006: 120-121.

Summary

In this section, I concentrate on describing the well-preserved architectural remains and pottery-production-related remains discovered during past excavations, rather than on the stratigraphy at Tall-e Bakun A. The stratigraphic information of the curated ceramic sherds at UMUT was also reconstructed. The reconsideration of the radiocarbon samples using Bayesian statistical testing was useful for the inter-site comparisons of stratigraphy described in the next section.

5-5. Chronological relations of four Bakun-period sites

I have shown the reconsideration of the stratigraphy of four Bakun period sites (Tall-e Jari A, Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A), the reconstruction of stratigraphic information about the ceramic materials curated at UMUT, the contexts of architectural remains and pottery-production related facilities, and the radiocarbon dates. Finally, instead of a summary of this chapter, I integrate the radiocarbon dates from four sites and discuss the chronological relationships between these sites, independent of the current tripartite subdivision system of the Bakun period's chronology. Fig. 5.14 integrates all of the calibrated radiocarbon dates with the results of Bayesian statistical testing from Tall-e Jari A, Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A. I used 11 radiocarbon samples measured by AMS from these sites. The sequence started from the Shamsabad period of Tall-e Jari A (Level I) and Tall-e Bakun B (Level/Stratum BI), the precursor to the Bakun period. The sequence ended at Level III of Tall-e Bakun A. The Shamsabad phase for both Tall-e Jari A and Tall-e Bakun B lasted from 5300 to 5000 BCE. However, the beginnings of Bakun period at both sites is slightly different. Level (Stratum) BII of Tall-e Bakun B (5215–5000 BCE, 2σ) was earlier than Level I of Tall-e Jari A (5075–4895 BCE, 90.5%), although the radiocarbon dates from Level BII of Tall-e Bakun B overlap the other dates from Level BI. It is implied that this difference in the beginning of the Bakun period at both sites was derived from the definition of the strata, which used the presence of BOBW and sampling contexts. Although radiocarbon dates showed that the Bakun period began at Tall-e Bakun B before it did at Tall-e Jari A, as discussed in the rest of this research, the ceramic evidence shows that the chronological relationship between Level BII of Tall-e Bakun B and Level I of Tall-e Jari A is actually the opposite. I will discuss this problem in the final discussion (Chapter 8) after presenting the ceramic evidence.

Next, there is a 200-year gap (ca. 4900–4700 BCE) between the Bakun levels at Tall-e Jari A and Tall-e Bakun B and the oldest level at Tall-e Gap. I calculated

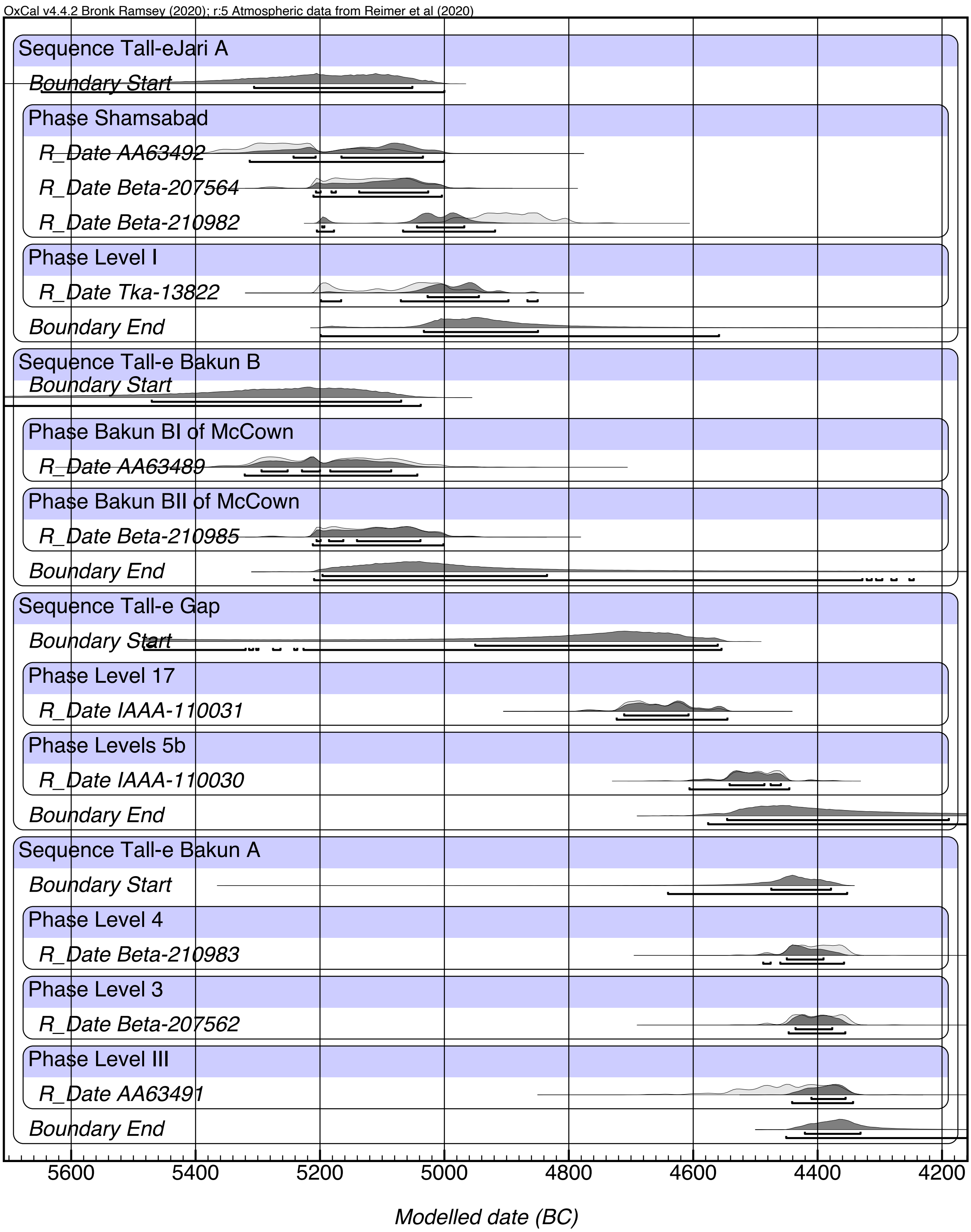

Figure 5.14 Integration of all the calibrated radiocarbon dates from the Bakun-period sites with results of a Bayesian statistical test

the average duration of one level at Tall-e Gap and pointed out its short term (23.3 years). If the calculation is correct, then the end date of Tall-e Gap would have been (4610–4445 BCE, 2σ) minus (23.3 years x 3 levels (Levels 1, 3, and 4 confirmed in the section of GAT-1)) = 4540–4355 BCE (93.1%). If so, the duration of Tall-e Gap slightly overlaps that of Tall-e Bakun A, which lasted from 4465 to 4360 BCE (overlap: 105 years at most). The radiocarbon dating from the latest level at Tall-e Bakun A shows the date ranging from 4445 to 4340 BCE.

Table 5.8 Chronological relations of the Bakun period sites based on the stratigraphy and radiocarbon dates

cal.BCE	Tall-e Jari A	Tall-e Bakun B	Tall-e Gap	Tall-e Bakun A
4000				
4200				
				Level III (Central trench)
4400				Levels 3-4 (Central trench)
			Level 5b	
4600				
			Level 17	
4800				
	Level I			
5000		BII of McCown		
	Level II	BI of McCown		
5200				

The end date of Tall-e Bakun A is not clear due to the disturbance, but the presence of Lapui ware implies that the settlement existed until the end of the 5th millennium BCE.

Following these results, the chronological relationship between the four sites based on their stratigraphy and radiocarbon dates is presented in Table 5.8. In this research, below, the chronological order of four sites is understood as Tall-e Jari A ≒ Tall-e Bakun B > Tall-e Gap ≥ Tall-e Bakun A. This sequence is independent of the former tripartite subdivision system, which classified the Bakun period into the early, middle, and late Bakun phases. Using this sequence, I investigate the diachronic change of the Bakun pottery in the following chapters.

Chapter 6

Materials and analyses of wares, vessel forms, and design structures

In Chapter 5, I re-arranged the Bakun chronology based on the published and unpublished descriptions of the stratigraphy and radiocarbon dates. Thanks to this stratigraphy, I can search for diachronic changes in pottery both within and between each site. The next research question this chapter will tackle is **Research Question No. 2:** 'When and how were black-on-buff ceramics adopted and developed in the Bakun period?' This chapter focuses especially on wares, vessel forms, and design structures. Previous studies did not approach the ware assemblages and vessel forms changes quantitatively from the beginning to the end of the Bakun period. Previous studies of the painted decoration in the Bakun period have focused on its painted motif as a chronological marker rather than its horizontal design structure.

In this chapter, first, I describe both published and unpublished materials used for my analysis at the beginning of each section. I also introduce the unpublished diagnostic ceramics drawings presented in a catalogue at the end of this chapter (192-224). Second, I show the quantitative analyses results of the diachronic changes of wares, vessel forms, and vessel sizes in four sites: Tall-e Jari A (6-1), Tall-e Bakun B (6-2), Tall-e Gap (6-3), and Tall-e Bakun A (6-4). I present in these sections a shorter-term diachronic change of pottery in each site. These sections are also named 'the adoption of black-on-buff ceramics (Sections 6-1 and 6-2)', 'the development of black-on-buff ceramics (Section 6-3)', and 'the final phase of black-on-buff ceramics (6-4)' to express the remarkable characters of pottery changes in each site. In the fifth section (6-5), I conduct a longer-term diachronic comparison of wares and vessel forms between the four sites. In this inter-site comparison, I group together the ceramic assemblages from each level of the four sites.

In the next section (6-6), I move on to the diachronic change of painted decoration, especially horizontal design structures. I analyse the painted decoration's horizontal design structure from the published reports and the unpublished drawings to find the horizontal design structure patterns throughout the Bakun period. The following are the specific research questions in this section: What kind of horizon design structure pattern appeared, continued, and then disappeared during the Bakun period? Were there any predominant patterns?

6-1. The adoption of black-on-buff ceramics 1: Wares and vessel forms from Tall-e Jari A

Ceramic materials from Tall-e Jari A

Published ceramic materials from Tall-e Jari A

In this section, I describe published materials used for my analysis at Tall-e Jari A. First, Vanden Berghe reported two well-preserved ceramic shallow bowls excavated from graves at Tall-e Jari A.[1] One of them had a 'dancing scene' on its interior surface and perforated pedestal. Thirty-four drawings of the ceramics found from Level I appeared in the 1977 Japanese expedition's brief excavation report from Tall-e Jari A (Table 6.1).[2] One complete BOBW (black-on-buff ware) shallow bowl was discovered from a burial.[3] The drawings consist of 11 interior-painted open vessel sherds, nine exterior-painted open vessel sherds, two small jar sherds, and 10 profiles of base sherds. Four VCW (vegetal-tempered coarse ware) sherds were also reported. In a catalogue of the well-preserved pottery curated in the University Museum, the University of Tokyo (UMUT), Nishiaki presented one unpublished BOBW complete vessel painted on its rim with a round base and five complete VCW vessels.[4]

The frequent motifs in published materials are cross-hatched diamonds usually decorated on an exterior surface,[5] cross-hatched triangles usually painted on an interior surface,[6] horizontal or vertical rows of wavy lines only painted on an interior surface,[7] and a horizontal row of filled triangles on the exterior part of the rim.[8] Other motifs appeared just once. There was only one representational motif of a humankind raising his/her hands.[9]

1 Vanden Berghe 1952: Pl. XLIX-L; 1966: Pl. 50, 52.
2 Egami et al. 1977: Pl. II
3 Egami et al. 1977: Plate III: 1
4 Nishiaki 2003: Pl. 33-35.
5 Egami et al. 1977: Plate III: 11, 14, 18, and 19.
6 Egami et al. 1977: Plate III: 2, 6, 13.
7 Egami et al. 1977: Plate III: 7, 8, and 12.
8 Egami et al. 1977: Plate III: 10, 12.
9 Egami et al. 1977: Plate III: 5.

Table 6.1 Number of published vessels and potsherds in wares at each site

Site	Published report	BOBW	VCW	MCW	unpainted red ware	Later period ware	Total
Tall-e Jari A	Vanden Berghe 1952	2	–	–	–	–	2
	Egami et al. 1977	31	4	–	–	–	35
	Nishiaki 2003	1	5	–	–	–	6
	SUM	34	9	–	–	–	43
Tall-e Bakun B	McCown 1941	24	–	–	–	–	24
	Alizadeh 2006	31	-	-	-	–	31
	(Overlap with McCown 1942)	8	–	–	–	–	8
	(Overlap? with McCown 1942)	2	–	–	–	–	2
	Egami and Masuda 1962	76	69	–	–	–	145
	Sono 1969	2	-	-	-	-	2
	SUM	123	69	-	-	–	192
Tall-e Gap	Vanden Berghe 1952	20	–	–	–	–	20
	Egami and Sono 1962	396	1	1	–	–	398
	Nishiaki 2003	13	–	–	–	–	13
	SUM	429	1	1	–	–	431
Tall-e Bakun A	Herzfeld 1932	140	-	1	–	–	141
	Langsdorff and McCown 1942	1062	–	8	34	3	1107
	Alizadeh 2006	144	1	11	1	2	159
	Masuda and Egami 1962	73	–	10	6	3	92
	SUM	1419	1	30	41	8	1499

Unpublished ceramic materials from Tall-e Jari A

Here, I introduce unpublished ceramic materials from excavation trench C of Tall-e Jari A and use these ceramics for a quantitative analysis of wares and vessel forms. Most of the ceramic materials are currently stored at UMUT. All the excavated ceramic materials were shipped to Japan with permission, and then the well-preserved and special materials were returned to Iran after the analysis, following the distribution contract between the archaeological department of Iran and the Tokyo University Iraq–Iran Archaeological Expedition.[10] The UMUT collection had 2,031 sherds from excavation trench C (Table 6.2). Of these, 296 pieces were too small to classify, so I excluded them. Some of the ceramic materials excavated in the 1959 excavation of trench C were brought and stored with the materials of the 1971 season at the University of Tsukuba for the 1977 excavation report. There were 82 sherds in total at Tsukuba University.

I also present unpublished ceramic sherds with diagnostic motifs, both from excavation trench C and from other trenches curated at UMUT. In Cat. 6.1-5, I present 25 unpublished diagnostic drawings from excavation trench C.[11] The frequent motifs in the exterior surface are the same as the published materials, such as cross-hatched diamonds (Cat. 6.1: 1-2, 6.2: 4) and cross-hatched triangles (Cat. 6.1: 3, 6.2: 2). The motifs on interior surfaces often include cross-hatched triangles, as well (Cat. 6.3: 1-3). Interestingly, there were two pieces of painted VCW with exterior painting (Cat. 6.5: 5, 6). One sherd has only a thick vertical line; another sherd has several thick lines. The Neolithic ware, which likely emerge from the lower strata (Cat. 6.5: 7), has a painted motif similar to those of the Bashi period. In addition, I present diagnostic examples from other trenches (Cat. 6.6-9).[12] Other than cross-hatched

[10] Nishiaki 2003.

[11] These drawings include one re-drawn material from 1977 (Fig. 6.4: 2 from Fig. 6.2: 19) because it turned out to be refitted with the other unpublished sherds.

[12] Because I could reconstruct only layers of excavation trench C at Tall-e Jari A, I will not present the layers of the materials from other trenches.

Table 6.2 Total number of potsherds which were used for quantitative analysis and small pieces which were unused for the analysis and their total weight in the selected in each site

Site	Loci of the potsherds for analysis	Total number of sherds (N)	Total number of small pieces (N)	weight (g)
Tall-e Jari A	Excavation trench C (UMUT collection)	2031	296	84637.9
	Excavation trench C (Tsukuba collection)	82	1	981.6
	SUM	2113	297	85619.5
Tall-e Bakun B	Masuda's trench (UMUT collection)	329	10	15981.8
	(unobserved published potsherds (returned or missing))	76	N/A	N/A
Tall-e Gap	Square GAT-1 (UMUT collection)	2438	169	71594
	(published potsherds extracted to the other boxes)	27	-	927
	(published potsherds which were reconstructed or returned)	53	N/A	N/A
	SUM of Square GAT-1	2518	169	72521
	Square GAT-2 (UMUT collection)	1785	311	37969
	(published potsherds extracted to the other boxes)	19	-	547.2
	(published potsherds which were reconstructed or returned)	23	NA	N/A
	SUM of Square GAT-2	1827	311	38516.2
Tall-e Bakun A	Masuda's trench (UMUT collection)	1861	266	55135.9
	(unobserved published potsherds (returned or missing))	37	N/A	N/A

Table 6.3 Count (upper) and proportion (lower) of wares found in each layer at excavation trench C of Tall-e Jari A

	Complete + Rim			Body				Base		
Layer/ Ware	BOBW	VCW	Neolithic ware	BOBW	VCW	Neolithic ware	Burnt clay	BOBW	VCW	Neolithic ware
Surface soil	4	14	-	31	56	1	-	1	2	0
Layer 1	-	16	-	5	100	-	-	1	7	0
Layer 2	11	34	1	31	117	-	2	4	9	0
Layer 3	2	90	3	15	476	21	13	2	38	0
Layer 4	6	65	2	11	427	15	2	1	29	1
Unknown	9	10	1	27	85	1	1	9	6	0
Total	32	229	7	120	1261	38	18	18	91	1

	Complete + Rim			Body				Base		
Layer/ Ware	BOBW	VCW	Neolithic ware	BOBW	VCW	Neolithic ware	Burnt clay	BOBW	VCW	Neolithic ware
Surface soil	22.22	77.78	-	35.23	63.64	1.14	-	33.33	66.67	0
Layer 1	-	100	-	4.76	95.24	-	-	12.50	87.50	0
Layer 2	23.91	73.91	2.17	20.67	78	-	1.33	30.77	69.23	0
Layer 3	2.11	94.74	3.16	2.86	90.67	4	2.48	5.00	95.00	0
Layer 4	8.22	89.04	2.74	2.42	93.85	3.30	0.44	3.23	93.55	3.23
Unknown	45	50	5	23.68	74.56	0.88	0.88	60.00	40.00	0
Ware Total	11.94	85.45	2.61	8.35	87.75	2.64	1.25	16.36	82.73	0.91
Total		100			100				100	

diamonds (Cat. 6.6: 1, 6.7: 1) and triangles (Cat. 6.6: 3, 6.7: 5, 6.9: 4, 6.10: 1-2), there are motif variations such as the x-motif (Cat. 6.7: 3), diamond with dot (Cat. 6.7: 4), horizontal zigzag (Cat. 6.7: 2), horizontal rows of wavy lines (Cat. 6.9: 1-2) and filled diamond (Cat. 6.9: 3).

Counts and weights of wares from Tall-e Jari A

Table 6.3 shows the counts and proportions of wares in each layer of Level I at excavation trench C of Tall-e Jari A. As seen in this Table, VCW accounts for more than approximately 80% in most of layers. The VCW count decreased from Layer 2. The BOBW proportion showed a slight increase over time. However, there were very few BOBW potsherds in Layer 1 in comparison with those from Layer 2 and the surface soil. Table 6.4 presents the weight and proportion of wares in each layer. Similar results to those presented in Table 6.3 are clear; that is, 1) the predominance of VCW, 2) the decrease of VCW's weight from Layer 2, and 3) the slight increase of BOBW. Tables 6.3 and 4 also demonstrate that the average weight of BOBW per sherd (12.6 g) was much lighter than that of VCW (51.0 g). The low proportion of BOBW in all layers, especially layers 1, 3, and 4 might imply the rare frequency of BOBW making, which was unlikely to have changed over time (from Layer 4 to surface soil) at Tall-e Jari A. I present a more detailed discussion of the BOBW-making communities in Section 8-1.

Table 6.4 Weight (upper) and proportion (lower) of wares found in each layer at excavation trench C of Tall-e Jari A

Layer/ Ware	BOBW (g)	VCW (g)	Neolithic ware (g)	burnt clay (g)
Surface soil	597.4	2700.6	8.5	-
Layer 1	91.9	5609.7	-	-
Layer 2	741.8	9026.6	12.6	622.2
Layer 3	179.1	30812.2	240.4	689.5
Layer 4	401.5	26354.3	154.8	85.9
Unknown	877.7	6387.2	8	17.6
Total	2889.4	80856.7	424.3	1449.1
Layer/ Ware	BOBW	VCW	Neolithic ware	burnt clay
Surface soil	18.07	81.68	0.26	-
Layer 1	1.61	98.39	-	-
Layer 2	7.13	86.77	0.12	5.98
Layer 3	0.56	96.53	0.75	2.16
Layer 4	1.49	97.62	0.57	0.32
Unknown	12.04	87.61	0.11	0.24
Ware Total	3.37	94.44	0.50	1.69
Total	100	100	100	100

Vessel forms, rim shapes, base shapes of BOBW from Tall-e Jari A

Vessel forms of BOBW

Table 6.5 shows the counts and proportions of BOBW vessel forms in each layer of Level I in excavation trench C of Tall-e Jari A. Although I defined 15 complete vessel forms in Chapter 4, I do not present the classification results of complete vessel forms at Tall-e Jari A in this section. Instead, as presented in Section 4-2-3, I classify rim sherds into five categories of vessel forms: small jar, open vessel painted on its exterior, open vessel painted on its interior, open vessel painted on its rim, and large jar. I discuss the final estimate and assessment of complete vessel forms in the next section. Layer 1 was eliminated, as BOBW did not appear in that layer. Body sherds are also classified in the same way, but they have another category: unpainted parts of an open vessel.

In complete vessels and rim sherds, open vessels painted on the interior comprised the majority of vessel forms at all layers (approximately 75 %, 55 %, 100%, and 25 % in each layer). However, in body sherds, unpainted parts of open vessels were predominant, followed by exterior-painted open vessels. Painted parts of BOBW in Tall-e Jari A are limited. These unpainted body parts of open vessels possibly were 1) open vessels painted on their rims, 2) open vessels painted on their exteriors, or 3) open vessels painted on their interiors. In addition, while I did not observe a rim sherd of a large jar, body sherds of large jars existed in Tall-e Jari A beginning at Layer 3. About 10% of large jar pieces were in body sherds. Therefore, there are two possibilities: 1) rim sherds of large jars were incidentally not discovered at the excavation trench C, or 2) thick body sherds of exterior-painted open vessels were misunderstood as body sherds of large jars.

Rim and base shape of BOBW

All BOBW open vessels at excavation trench C of Tall-e Jari A (31 samples) had simple rounded rim edges (Table 6.6). Although the number of diagnostic BOBW bases is limited, there were four variables in BOBW base shapes at excavation trench C of Tall-e Jari A (Table 6.7):

1) a ring base of simple rounded rim edge,
2) a ring base of triangle rim edge,
3) a ring base of flat-low bottom, or
4) a flat base.

Exterior-painted open vessels had solely simple rounded rim edges of the ring base. Open vessels painted on their interiors had either simple rounded rim edges or flat-low bottoms of ring bases (eight samples). The

Table 6.5 Count (upper) and proportion (lower) of BOBW vessel forms found in each layer at excavation trench C of Tall-e Jari A

Part	Complete	Rim					Body			
Layer/ Vessel form	open vessel painted on its interior	small jar	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its rim	large jar	open vessel painted on its exterior	open vessel painted on its interior	unpainted part of open vessel	large jar
Surface soil	-	-	1	3	-	-	7	1	20	3
Layer 1	-	-	-	-	-	-	1	-	4	-
Layer 2	-	-	5	6	-	-	13	1	14	3
Layer 3	-	-	-	2	-	-	8	-	5	2
Layer 4	1	1	2	1	1	-	4	3	4	-
Unknown	-	-	2	5	2	-	8	3	10	6
Total	1	1	10	17	3	-	41	8	57	14

Part		Complete + Rim					Body			
Layer/ Vessel form		small jar	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its rim	large jar	open vessel painted on its exterior	open vessel painted on its interior	unpainted part of open vessel	large jar
Surface soil		-	25	75	-	-	22.58	3.23	64.52	9.68
Layer 1		-	-	-	-	-	20	-	80	-
Layer 2		-	45.45	54.55	-	-	41.94	3.23	45.16	9.68
Layer 3		-	-	100	-	-	53.33	-	33.33	13.33
Layer 4		16.67	33.33	33.33	16.67	-	36.36	27.27	36.36	-
Unknown		-	22.22	55.56	22.22	-	29.63	11.11	37.04	22.22
Total		100					100			

flat-low bottom was the most frequent base shape at excavation trench C. There was only one sample of a flat base in Tall-e Jari A, which was an unpainted part of an open vessel.

Table 6.6 Count of BOBW rim shapes found in each layer at excavation trench C of Tall-e Jari A

vessel form	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on rim	small jar
rim shape	simple rounded	simple rounded	simple rounded	simple rounded
Surface soil	1	3	-	-
Layer 1	-	-	-	-
Layer 2	5	6	-	-
Layer 3	-	2	-	-
Layer 4	2	2	1	1
Unknown	2	5	2	-
Total	10	18	3	1

Comparing the base shapes of published drawings at Tall-e Jari A encourages further understanding. First, while several pieces of triangle-edge ring bases were published,[13] just a few of these ring base pieces were confirmed from the UMUT collection. Second, a shallow bowl with a pedestal was found only from a burial[14] and was not confirmed from the UMUT collection. Finally, a complete deep bowl published by Nishiaki had a round base.[15]

Complete vessel forms and vessel sizes from Tall-e Jari A

Estimate of complete vessel forms from potsherds

At the end of the quantitative analyses of ceramic materials from Tall-e Jari A, I present 1) the estimate of complete vessel forms and 2) the vessel sizes using both published and unpublished materials to prepare for the data used in the inter-site comparison of Section 6-5. It is very difficult to infer complete vessel forms (what I presented in Fig. 4.6) from badly preserved

[13] Egami et al. 1977: Pl. III: 27, 31-33.
[14] Vanden Berghe 1952: Pl. XLIX.
[15] Nishiaki 2003: Pl. 33.1.

Table 6.7 Count of BOBW base shapes found in each layer at excavation trench C of Tall-e Jari A

vessel form	open vessel painted on its exterior	open vessel painted on its interior		open vessel painted on its exterior joint				unpainted part of open vessel
base shape	ring base (standard size)	ring base (standard size)		ring base (standard size)				without ring base
layer	simple rounded	simple rounded	flat low bottom	simple rounded	triangle	flat-low bottom	undistinguishable	flat base
Surface soil	-	-	-	-	1	-	-	-
Layer 1	-	-	-	1	-	-	-	-
Layer 2	-	-	-	1	-	2	-	1
Layer 3	1	-	-	1	-	-	-	-
Layer 4	-	-	1	1	-	-	-	-
Unknown	1	2	1	-	-	4	1	-
Total	2	2	2	4	1	6	1	1

potsherds. Thus, by using rim angles and the published drawings of the painted sides of well-preserved vessels from Tall-e Jari A, I analyse which complete vessel form corresponded to the rough vessel form categories (exterior-painted open vessel, interior-painted open vessel, and unpainted open vessel).

First, the published complete open vessels painted on their exteriors from Tall-e Jari A were a deep bowl (Cat. 6.1: 2) and a shallow bowl (Cat. 6.7: 5). The rim angles were 87° and 121° (median: 95°, CV (coefficient of variation): 0.141, N=18). The rim angles of the published open vessels painted on their exteriors at Tall-e Jari A ranged from 63° to 121°. The rim angle of deep bowls from the morphometrical analysis in Chapter 4 ranged from 87° to 119° (median 100°) (Table 4.6). Hence, potsherds of exterior-painted open vessels at Tall-e Jari A were likely to be deep bowls. There were four exceptional cases in which rim angles were below 80 degrees; they were classified as incurved-rim vessels.

Second, the published complete open vessel painted on its interior at Tall-e Jari A was a shallow bowl with a rim angle of 128°.[16] The newly reported complete open vessel painted on its interior (Cat. 6.4: 1) was also a shallow bowl with a rim angle of 118°. The rim angles of the published open vessels painted on their interiors at Tall-e Jari A ranged from 96° to 145° (median: 124°, CV: 0.108, N=21). This suggests that interior-painted open vessel potsherds correlate with shallow bowls (rim angle between 96° and 146°, median 121° Table 4.6). The rim angles of the open vessels painted on its rims at Tall-e Jari A ranged from 114° to 141° (median: 122°, CV: 0.09, N=3), which also fits the rim-angle range of shallow bowls (Table 4.6).

Vessel sizes

The data available for discussing vessel sizes of BOBW and VCW is limited at Tall-e Jari A. There are 23 diagnostic sherds with measurable rim diameters at Tall-e Jari A. The rim diameters of exterior-painted open vessels range from 9–23 cm (median: 14 cm, CV: 0.293, N=10). Ranging from 14–25 cm (median: 17.5 cm, CV: 0.192, N=8), the interior-painted open vessels have larger rim diameters than those painted on their exteriors. The rim diameters of open vessels painted on their rims (size: 7-22 cm, median: 18 cm, CV: 0.310, N=5) are similar to those of interior-painted open vessels. Examples with discernible vessel heights are quite rare at Tall-e Jari A. The vessel heights of the exterior-painted open vessels (size: 7-11 cm, N=2) are taller than those of the interior-painted open vessels (size: 7-8 cm, N=2).

Egami and his colleagues and Nishiaki published 10 complete VCW vessels at Tall-e Jari A in their excavation reports,[17] although all the vessels were found from Level 2—not the Bakun period but the Shamsabad period. VCW rim diameters at Tall-e Jari A ranged from 13–40 cm (Median: 16.5 cm). VCW vessel heights at Tall-e Jari A ranged from 7.5–34.7 cm (Median: 12.5 cm). VCW rim angles at Tall-e Jari A (five samples) ranged from 65° to 110° (Median: 85), and the thickness of vessel walls 3 cm below the rims of VCW at Tall-e Jari A (five samples) ranged from 9–16 mm (Median: 9 mm). Only a simple

[16] Egami et al. 1977: Pl. III: 1.

[17] Egami et al. 1977: Pl. IV: 4, 6, 9, 10, 11. Nishiaki 2003: Pl. 33-35.

rounded rim was confirmed in the rim shapes of VCW. A flat base and a flat-low bottom of ring base were observed in the VCW complete vessels.

At the end of this section, a short summary of diachronic change of pottery at Tall-e Jari A is described;

1) VCW was predominant in wares. The proportion of BOBW slightly increased over time.
2) Interior-painted open vessels were more common than exterior-painted ones. Large jar rim sherds were absent. Only simple rounded rim shapes existed; ring bases were predominant. Interior-painted open vessels had unique base shapes, such as a flat-low bottom ring base or a pedestal ring base.
3) I estimated the presence of a deep bowl, a shallow bowl, and a small jar as complete vessel forms. Interior-painted open vessels had more open rim angles and larger rim diameters than exterior-painted ones.

6-2. The adoption of black-on-buff ceramics 2: wares and vessel forms from Tall-e Bakun B

Ceramic materials from Tall-e Bakun B

Published ceramic materials from Tall-e Bakun B

There was a low number of published ceramic sherds from Tall-e Bakun B (Table 6.1). First, in McCown's report of 24 motifs on ceramic sherds from Tall-e Bakun B, he did not distinguish whether the vessel surface on which the paint decoration was drawn was interior or exterior.[18] However, the painted bands imply that most of the motifs were painted at the exterior surface, except for the motifs without bands.[19] Second, among the 31 potsherds from Tall-e Bakun B which Alizadeh reported and are curated by the National Museum of Iran, 10 appeared in Alizadeh's report and have already been reported by McCown.[20] The comparison helps to identify the original motif of the published drawings. It also turned out that the motif McCown showed included

Table 6.8 Count (upper) and proportion (lower) of wares found in each level at Masuda's trench of Tall-e Bakun B

	Complete	Rim				Neck	Body			
Level	BOBW	BOBW	VBOBW	VCW	Mineral tempered wheel made ware	BOBW	BOBW	VBOBW	VCW	Later period ware than Sasanian
Unknown	-	-	-	1	-	-	-	-	37	-
Surface collection	-	2	-	-	-	2	1	-	-	-
Level BII of McCown	1	57	1	47	-	4	122	3	25	1
Level BI of McCown	-	-	-	29	-	-	-	-	26	-
Total	1	59	1	77	1	6	117	3	88	1
		Complete + Rim					Neck + Body			
Level		BOBW	VBOBW	VCW	Mineral tempered wheel made ware		BOBW	VBOBW	VCW	Later period ware than Sasanian
Unknown		-	-	100	-		-	-	100	-
Surface collection		100	-	-	-		100	-	-	-
Level BII of McCown		54.72	0.94	44.34	-		81.29	1.94	16.13	0.65
Level BI of McCown		-	-	100	-		-	-	100	-
Ware Total		43.17	0.72	55.40	0.72		57.21	1.40	40.93	0.47
Total		100					100			

[18] McCown 1942: Figs. 10-13.
[19] McCown 1942: Figs. 10-13: 47, 55, 72, 109, 110, 111.
[20] Alizadeh 2006: Fig. 23.

Table 6.9 Weight (upper) and proportion (lower) of wares found in each level at Masuda's trench of Tall-e Bakun B

Level/ wares	BOBW (g)	VBOBW (g)	VCW (g)	Mineral tempered wheel made ware (g)	Later period ware than Sasanian (g)
Unknown	-	-	2918.1	-	-
Surface collection	65.7	-	-	-	-
Level BII of McCown	4306.4	327.3	4395	276.1	16.9
Level BI of McCown	-	-	3676.3	-	-
Total	4372.1	327.3	10989.4	276.1	16.9

Level/ wares	BOBW	VBOBW	VCW	Mineral tempered wheel made ware	Later period ware than Sasanian
Unknown	-	-	100	-	-
Surface collection	100	-	-	-	-
Level BII of McCown	46.20	3.51	47.15	2.96	0.18
Level BI of McCown	-	-	100	-	-
Total	27.36	2.05	68.76	1.73	0.11

his speculation.[21] Third, among the 145 potsherds Masuda reported, 76 were BOBW potsherds and 69 were VCW potsherds.[22] Two VCW sherds were reported to have reddish painting.[23]

Unpublished ceramic materials from Tall-e Bakun B

Many of the 329 ceramic materials found in Masuda's trench are included in published materials and curated now in UMUT (Table 6.2). All the excavated ceramic materials were shipped to Japan, as well as those from Tall-e Jari A, and the well-preserved and special materials were returned to Iran.[24] Of these ceramic materials, four unpublished potsherds were presented as drawings in Cat. 6.10. The diagnostic painted potsherds have already been discussed in previous literature. Twelve sherds published in 1962 were not confirmed in the collection, implying that some of the diagnostic materials were returned to Iran after the research.

Counts and weights of wares from Tall-e Bakun B

Table 6.8 shows the counts and proportions of wares in Levels BII and BI of McCown at Masuda's trench of Tall-e Bakun B. I calculated the proportions of complete vessels plus the rim and body sherds, integrating neck and body sherds. As already reported, Level BI of McCown consisted only of VCW. On the other hand, in the ware assemblage at Level BII of McCown, BOBW accounts for 54% (Complete +Rim) and 81% (Body). However, the result will change if ceramic materials from unknown levels are integrated to Levels BI and BII of McCown. Quite a small portion of VBOBW (vegetal tempered black on buff ware) was confirmed in Level BII of McCown.

Table 6.9 presents weights and their proportions of wares in Levels BII and BI of McCown at Masuda's trench of Tall-e Bakun B. The weight proportion of VCW decreased from Level BI (100%) to Level BII of McCown (47%). At Level BII, the proportion of VCW in number (54 % and 81 %) exceeded the proportion of VCW in weight (47 %). This suggests that the weight of one VCW potsherd was much heavier than that of one BOBW potsherd at Tall-e Bakun B.

The above two tables do not show diachronic changes of the ceramic materials' absolute amounts between levels of Tall-e Bakun B because they do not consider the densities of ceramic materials in the trench. To compare the amounts of the ceramic materials in each level of Tall-e Bakun B, I calculated the total number (a sum of the number of rim, neck, body, and base sherds) and the weight of potsherds per 1 m^3 (pottery density. Table 6.10). Prior to the calculation, I estimated the soil volume of each level of Masuda's trench at Tall-e Bakun

Table 6.10 Total number (upper) and weight (lower) of wares per m3 in each level at Masuda's trench of Tall-e Bakun B

Level/ Ware	BOBW	VBOBW	VCW
Level BII of McCown	5.65	0.12	1.36
Level BI of McCown	-	-	2.39

Level/ Ware	BOBW	VBOBW	VCW
Level BII of McCown	132.91	10.10	135.65
Level BI of McCown	-	-	204.24

[21] Especially McCown 1942 Fig. 10: 40 and Alizadeh 2006 Fig. 23: BB.
[22] Egami and Masuda 1962: Figs. 13-17, 19.
[23] Egami and Masuda 1962: Fig. 19: 31, 35.
[24] Nishiaki 2003.

B. The estimate is based on the published data and the Japanese excavation report's section drawing. The soil volume of Level BI of McCown is 6 m x 2 m x 2.7 m = 32.4 m^3. That of Level BII of McCown was 6 m x 2 m x 1.5 m = 18 m^3. As a result, the number and the weight of VCW per 1 m^3 decreased at Level BII of McCown as expected.

Vessel forms, rim shapes, base shapes of BOBW from Tall-e Bakun B

BOBW vessel forms

Table 6.11 designates the counts and their proportions of BOBW vessel forms in Level BII of McCown at Masuda's trench of Tall-e Bakun B. In rim sherds and complete vessels, interior-painted open vessels (41 %) were slightly more found than exterior-painted ones (37 %). Small and large jar rim sherds also appeared in Level BII of McCown. Each closed vessel rim sherd accounts for about less than 10%. A hole-mouth vessel with holes was newly observed at Tall-e Bakun B. Next, in neck and body sherds, exterior-painted open vessels were predominant (42 %) and exceeded the ratio of interior-painted ones and unpainted parts of open vessels (21 %). Large jar body sherds were confirmed and accounted for 14%.

BOBW rim and base shape

The rim shape of BOBW vessels in all forms at Level BII of Tall-e Bakun B was defined by a simple rounded rim shape (Table 6.12). Only one pinched-outside rim shape was found from an open vessel painted on its exterior. One grooved rim shape was found in the open vessel painted on its interior. On the other hand, regarding base shapes, the simple rounded edge of a ring base was predominant at Tall-e Bakun B (Table 6.13). Two flat-low bottom ring bases and one square-flat-edge ring base were also confirmed. There was one pedestal in the open vessel painted on both sides, as published by Masuda.[25] Although ring bases were most common at Tall-e Bakun B, three flat-base sherds were confirmed.

Complete vessel forms and vessel sizes from Tall-e Bakun B

Estimate of complete vessel forms from potsherds

Published drawings of diagnostic vessel forms from Tall-e Bakun B are limited. Only the pottery excavated from Masuda's trench was available to estimate the complete vessel forms.[26] The rim angles of the published exterior-painted open vessels at Tall-e Bakun B showed 106° at the maximum, 90° at the minimum, and 93° at the median (CV: 0.06, N=15). On the other hand, the rim angles of the published interior-painted open vessels at Tall-e Bakun B indicated 138° at the maximum, 105° at the minimum, and 117° at the median (CV: 0.07, N=14). Therefore, the rim angles were clearly separated between exterior-painted open vessels and interior-painted ones. On the basis of the rim angles of complete vessel forms (Table 4.6) and the absence of base shapes that are characteristic of a hemispherical bowl (round base), a conical bowl (conical base), and a funnel-shaped vessel (pointed base) at Tall-e Bakun B, only a deep bowl was estimated as a complete vessel form of the open vessel painted on its exterior and a shallow bowl as that of the open vessel painted on its interior. Based on their diagnostic sherds, hole-mouth vessel with holes, a large jar, and a small jar were estimated to exist.

Vessel sizes

The number of diagnostic samples with rim diameters and vessel heights at Tall-e Bakun B is much less than that at Tall-e Jari A. There is only one published open vessel painted on its exterior with a rim diameter (14 cm).[27] Rim diameters of published open vessels painted on their interiors at Tall-e Bakun B ranged from 24–31 cm (median: 28 cm, CV: 0.103, N=4), showing a different size class from exterior-painted open vessels. The only preserved vessel height of an interior-painted open vessel was 6 cm.[28]

From Masuda's measurement of VCW vessel-wall thickness, thin and thick VCW sherds existed at Level BI of McCown, ranging from 5–29 mm.[29] On the contrary, the proportion of thick VCW vessels increased at Level BII of McCown, which was where BOBW appeared. A simple rounded rim was a major VCW rim shape at Tall-e Bakun B, but a flat rim was also confirmed.[30] A flat and flat-low bottom of ring bases were observed in the VCW base sherd drawings. One solid goblet base sherd of VCW was also discovered on Level BII of McCown.[31]

To summarise, the diachronic change of pottery at Tall-e Bakun B was as follows:

1) The proportion of BOBW increased rapidly at Tall-e Bakun B.
2) Exterior-painted open vessels were as common as interior-painted ones at Tall-e Bakun B. Although ring bases were predominant, flat bases also appeared.
3) The presence of a deep bowl, a shallow bowl, a hole-mouth vessel with holes, a small jar, and a large jar were estimated as complete vessel forms. Rim diameters of interior-painted open vessels were much larger than that of exterior-painted ones.

[25] Egami and Masuda 1962: Fig. 14: 20.
[26] Egami and Masuda 1962: Figs. 13-19.
[27] Egami and Masuda 1962: Fig. 15: 11.
[28] Egami and Masuda 1962: Fig. 17: 9.
[29] Egami and Masuda 1962: 28 in Japanese, Fig. 18: 27.
[30] Egami and Masuda 1962: Fig. 18: 2, 8, 19: 5-6.
[31] Egami and Masuda 1962: Fig. 18: 36.

Table 6.11 Count (upper) and proportion (lower) of BOBW vessel forms in each level at Masuda's trench of Tall-e Bakun B

Ware	BOBW													VBOBW		
Part	Complete	Rim						Neck		Body				rim	body	
Level/ vessel form	open vessel painted on its interior	small jar	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its rim	hole-mouth vessel with holes	large jar	small jar	large jar	open vessel painted on its exterior	open vessel painted on its interior	unpainted part of open vessel	large jar	open vessel painted on its interior	open vessel painted on its interior	large jar
Surface collection	-	1	1	-	-	-	-	2	-	1	-	-	-	-	-	-
BII of McCown	1	2	22	23	5	1	4	2	2	55	24	27	16	1	2	1
Total	1	3	23	23	5	1	4	4	2	56	24	27	16	1	2	1

Ware		BOBW+VBOBW														
Part		Complete + Rim								Neck + Body						
Level/ vessel form		small jar	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its rim	hole-mouth vessel with holes	large jar			open vessel painted on its exterior	open vessel painted on its interior	unpainted part of open vessel	large jar	small jar		
Surface collection		50	50	-	-	-	-			33.33	-	-	-	66.67		
BII of McCown		3.45	37.93	41.38	8.62	1.72	6.90			42.31	18.46	20.77	14.62	1.54		
Total		5.00	38.33	40.00	8.33	1.67	6.67			42.11	18.05	20.30	14.29	1.50		

Table 6.12 Count of BOBW rim shapes in each level at Masuda's trench of Tall-e Bakun B

Wares	BOBW										VBOBW
Vessel form	open vessel painted on its exterior		open vessel painted on its interior			open vessel painted on its rim	small jar		large jar		open vessel painted on its interior
Level/ Rim shape	simple rounded	pinched outside	simple rounded	grooved	undistin-guishable	simple rounded	simple rounded	undistin-guishable	simple rounded	undistin-guishable	undistin-guishable
Surface collection	1	-	-	-	-	-	-	1	-	-	-
Level BII of McCown	11	1	7	1	-	4	1	-	-	1	1
Total	12	1	22	1	1	5	2	1	2	1	1

Table. 6.13 Count of BOBW base shapes in each level at Masuda's trench of Tall-e Bakun B

Vessel form	open vessel painted on its exterior		open vessel painted on its interior				open vessel painted on its both sides	unpainted part of open vessel
Presence of ring base	ring base (standard size)	without ring base	ring base (standard size)			without ring base	with pedestal	ring base (standard size)
Level/ Base shape	simple rounded	flat base	simple rounded	flat low bottom	square flat	flat base		flat low bottom
Level BII of McCown	5	1	2	2	1	1	1	1
Total	5	1	2	2	1	1	1	1

6-3. The development of black-on-buff ceramics: Wares and vessel forms from Tall-e Gap

Ceramic materials from Tall-e Gap

Published ceramic materials from Tall-e Gap

Vanden Berghe reported 20 rim and body potsherds of BOBW from Tall-e Gap in 1952.[32] In 1962, Sono reported 398 BOBW potsherds in the form of pictures and drawings (Table 6.1). Among them, there was only one drawing of VCW and one of mineral-tempered coarse ware (MCW). Finally, Nishiaki published a catalogue of the ceramic materials from Tall-e Gap curated in UMUT.[33] These catalogues show 13 photographs of newly published ceramic materials from Tall-e Gap.

As Sono described and classified in detail, the motif variation of Tall-e Gap increased more than those of Tall-e Jari A and Tall-e Bakun B. On the basis of his criteria, he classified 63 motif types in total (18 main types and their variants Ia1 to XVIII).[34] According to Sono's motif classification, the motif types decorated on the exterior surfaces of the open vessels ranged from simple motifs, such as cross-hatched diamond (Design IV), filled square (Design III), filled triangle (Designs VIII and X), animal (Designs XIV-XV), and dot motifs (Design Ih) to complicated ones such as circles (Design II) and combinations of zigzag lines, filled triangles, filled diamonds, and dots (Designs Ic and Id). Large jars shared some of their motif types with exterior-painted open vessels. Representative motifs on the interior surfaces of open vessels were filled triangles, half circles (Design XIf), short lines (Design XII), and a comb-like motif (Design XIII).

Unpublished ceramic materials from Tall-e Gap

For the quantitative analysis of wares and vessel forms, I analyse ceramic materials from Squares GAT-1 and GAT-2 of Tall-e Gap. Most of the ceramic materials are now stored at UMUT. All the excavated ceramic materials were permitted to be shipped to Japan because there were so many pottery fragments to be refitted and analysed.[35] The total number of sherds from Squares GAT-1 and GAT-2 curated at UMUT were 2,518 and 1,827, respectively (Table 6.2). There were 169 potsherds in Square GAT-1 and 311 potsherds in Square GAT-2 that were too small to classify, so I excluded 480 tiny pieces from the quantitative analysis. The well-preserved ceramics from Tall-e Gap were returned to Iran after the description and drawing. The returned vessels replicas were made and stored in UMUT. The other well-preserved vessels were reconstructed with plaster and curated at UMUT. The weights of these well-preserved ceramics (53 vessels in GAT-1 and 23 vessels in GAT-2) were not measurable due to their plasters.

Cats. 6.11-26 show unpublished diagnostic ceramic vessels from Squares GAT-1 and 2. Concerning exterior-painted open vessels, an open vessel with dotted bands, reversed triangles, and diagonal lines (Cat. 6.11: 1) was an interesting discovery unknown from the Tall-e Gap published pottery. Its parallels were reported in the excavation report at Tall-e Bakun A.[36] A hole-mouth vessel sherd with two holes and wavy decoration (Cat. 6.14: 3) was also an unpublished vessel form from Tall-e Gap.

Cats. 6.19-22 present drawings of interior-painted open vessels from Squares GAT-1 and 2. The motifs consisted of hanged vertical/horizontal lines (Cat. 6.19: 1, 2), wavy lines (Cat. 6.19: 3, 5; 6.20: 1, 2, 4, 5), concentric lines (Cat. 6.19: 4), and geometric motifs (Cat. 6.22: 2-4). The unique motifs were the geometrical motifs painted on its interior, which were usually found from the lower levels. In particular, Cat. 6.22: 3 is an example showing the chain of cross-hatched diamonds. Cat. 6.22: 4 is also an interesting example because a similar motif was observed in Tall-e Jari A.[37] Only a few open vessels painted on both sides (Cat. 6.23) have been reported in Tall-e Gap. Although these are limited, a box with a row of short lines (Cat. 6.23: 1, 2) was preferred as the exterior-painted motif. The interior-painted motif consisted of wavy lines (Cat. 6.23: 1, 4, 5) and partly filled motifs (Cat. 6.23: 2, 3). These samples appeared only in the upper levels (later than Level 5).

I also included unpublished diagnostic vessels from the other trenches at Tall-e Gap (Cat. 6.27-33). These collections include one pair of large open vessels with two rows of diamond motifs on their exteriors (Cat. 6.27:1-2) and ceramic vessels with dot motifs (Cat. 6.27: 3; 6.28: 4-6; 6.29: 1; 6.30: 3; 6.32: 1) and animal motifs (Cat. 6.28: 2; 6.29: 6). There are some motifs that are similar to the pottery found at Tall-e Bakun A. Cat. 6.28: 5 is the same motif as the one presented in Cat. 6.11: 1, which is similar to the pottery reported at Tall-e Bakun A. Cat. 6.28: 6 has a horizontal row of small, filled triangles between its rim band and frieze, which also were confirmed in Tall-e Bakun A.[38] Cat. 6.28: 7 is similar to the one Nishiaki published.[39] A hole-mouth vessel with a hole (Cat. 6.28: 1) and a miniature ring base (Cat. 6.31: 3) were rare examples.

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32 Vanden Berghe 1952.
33 Nishiaki 2003
34 Egami and Sono 1962: 6-10 in English, 41-48 in Japanese, Table 1.
35 Egami and Sono 1962: viii in English.
36 Alizadeh 2006: Figure 32.
37 Egami et al. 1977: Pl. III.
38 Langsdorff and McCown 1942: Pl. 26: 8, 27: 13.
39 Nishiaki 2003: Pl. 66.

Table 6.14 Count (upper) and proportion (lower) of wares found in each level at Square GAT-1 of Tall-e Gap

Part	Complete		Rim			Neck	Body			Spindle whorl	Burnt clay
Level/ Ware	BOBW	VCW	BOBW	MCW	VCW	BOBW	BOBW	MCW	VCW		
1	-	-	13	-	-	5	122	3	-	-	-
2	-	-	8	-	-	1	54	-	-	-	-
4	-	-	8	-	-	-	33	1	-	-	-
5a	4	-	103	7	-	7	415	42	-	-	-
5b	-	-	11	1	-	-	109	11	-	-	-
6	-	-	2	1	-	-	52	-	-	-	-
7	3	-	20	5	-	2	199	43	6	-	-
8	1	-	7	-	-	1	34	-	-	-	-
9	4	-	25	-	-	4	131	-	-	1	-
10	5	-	22	-	1	2	101	2	1	-	-
12a	-	-	-	-	-	-	3	1	-	-	-
12b	-	-	1	-	-	-	21	-	-	-	-
14a	-	-	4	-	-	-	29	-	-	-	1
14b	-	-	3	-	-	-	15	-	13	-	-
15	-	-	12	-	4	1	52	-	23	-	-
16	2	-	8	-	2	2	28	-	19	-	-
17	2	1	55	-	2	5	212	-	49	-	5
Total	21	1	302	14	9	30	1610	103	111	1	6

Part	Complete + Rim			Neck + Body		
Level/ Ware	BOBW	MCW	VCW	BOBW	MCW	VCW
1	-	-	-	97.69	2.31	-
2	-	-	-	100	-	-
4	-	-	-	-	2.94	-
5a	93.86	6.14	-	90.95	9.05	-
5b	-	8.33	-	-	9.17	-
6	-	33.33	-	-	-	-
7	82.14	17.86	-	80.40	17.20	2.40
8	100	-	-	100	-	-
9	100	-	-	100	-	-
10	96.43	-	3.57	97.17	1.89	0.94
12a	-	-	-	-	25	-
12b	-	-	-	-	-	-
14a	-	-	-	-	-	-
14b	-	-	-	-	-	46.43
15	-	-	25	69.74	-	30.26
16	83.33	-	16.667	61.22	-	38.78
17	95	-	5	81.58	-	18.42
Ware Total	93.08	4.03	2.88	88.46	5.56	5.99
Total		100			100	

Table 6.15 Count (upper) and proportion (lower) of wares found in each level at Square GAT-2 of Tall-e Gap

	Complete	Rim			Neck	Body				Burnt clay	Perforated disc
Level/ Ware	BOBW	BOBW	MCW	VCW	BOBW	BOBW	MCW	VCW	Red material included ware		
1	-	6	-	-	1	32	-	-	1	-	-
2	-	2	-	-	-	24	-	-	-	-	1
4	-	1	-	-	-	7	-	-	-	-	-
5a	-	10	1	-	-	23	-	-	-	-	-
5b	1	18	1	-	-	94	3	-	-	-	-
6	1	6	2	-	3	140	5	-	-	3	-
7	-	29	-	-	2	143	-	2	-	1	-
9	-	39	-	1	8	295	-	1	-	-	-
10	1	18	-	1	6	58	-	3	-	-	-
14a	-	4	-	-	1	47	3	5	-	-	1
14b	-	8	-	1	2	21	-	1	-	-	-
15	2	10	-	-	-	22	-	-	-	-	-
16	-	11	-	-	-	65	-	-	-	-	-
17	-	21	-	1	1	228	-	1	-	-	-
Total	5	183	4	4	24	1199	11	13	1	4	2

	Complete + Rim			Neck + Body			
Level/ Ware	BOBW	MCW	VCW	BOBW	MCW	VCW	Red material included ware
1	-	-	-	97.06	-	-	2.941
2	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5a	-	-	-	-	-	-	-
5b	95	5	-	-	3.093	-	-
6	77.78	22.22	-	96.62	3.378	-	-
7	-	-	-	98.64	-	1.36	-
9	-	-	2.50	99.67	-	0.33	-
10	95	-	5	95.52	-	4.48	-
14a	-	-	-	85.71	5.357	8.93	-
14b	-	-	11.11	95.83	-	4.17	-
15	100	-	-	-	-	-	-
16	-	-	-	-	-	-	-
17	-	-	4.55	99.565	-	0.43	-
Ware Total	95.92	2.04	2.04	97.997	0.881	1.042	0.080
Total	100			100			

There are two diagnostic open vessels painted on both sides from the upper levels of Square GAI at Tall-e Gap (Cat. 6.32: 1, 3). Cat. 6.32: 1 is very similar to what Nishiaki published in 2003, as the motifs are quite similar both on their exteriors ('windmill' motif) and interiors (wavy lines).[40] Well-preserved interior-painted open vessels are presented in Cat. 6.32-33. A hanged arc with a line of horizontal short lines (Cat. 6.32: 2) and two units of hanged triangles filled with cross-hatched diamonds (Cat. 6.33: 1) are unpublished interesting samples.

Above I presented drawings of open vessels from Tall-e Gap. I also present unpublished drawings of closed vessels (Cat. 6.24), VCW (Cat. 6.25), and MCW (Cat. 6.26) from Tall-e Gap. These drawings will be used mainly for discussing the vessel sizes in Section 6-3-4.

Counts and weights of wares from Tall-e Gap

Counts of wares at Squares GAT-1 and 2

In analysing the ceramic materials from Tall-e Gap, I selected two excavation squares: GAT-1 and GAT-2. Below, I analyse the ceramic data from these two squares separately to understand the spatial bias of the amount of ceramics in Tall-e Gap. Table 6.14 shows the counts and proportions of wares in each level at Square GAT-1 of Tall-e Gap. In both complete vessels+rim sherds and neck+body parts, the majority of wares were BOBW. In other words, this might mean the more frequent production of BOBW and transmission of knowledge concerning BOBW making. Whereas VCW was observed in complete vessels+rim sherds from Levels 17 to 10, MCW appeared instead of VCW from Level 7. The proportion of MCW in rim sherds ranged from 6% to 33% (Median: 13 %[41]) in each level, while that of VCW ranged from 4% to 25% (Median: 11 %) in each level. On the contrary, in neck+body parts of the potsherds, the process of replacing VCW with MCW is less clear, as the MCW body sherds were observed from Level 12a and those of VCW continued until Level 7.

Table 6.15 presents the counts and proportions of wares in each level at Square GAT-2 of Tall-e Gap. It indicates a slightly different result from Table 6.14. The MCW rim sherds appeared starting on Level 6 and those of VCW disappeared at Level 9. On the other hand, MCW body sherds came along from Level 14a and those of VCW vanished at Level 7. The proportion of MCW rim sherds ranged from 5% to 22% (Median: 9 %), while that of VCW rim sherds ranged from 3% to 11% (Median: 9 %) in each level. The proportions of VCW in lower levels (Levels 14b-17) of Square GAT-1 are higher than those of Square GAT-2. This might indicate a spatial difference in the proportion of the ware weights between Square GAT-1 and Square GAT-2, which is helpful for revealing the function of each square or the post-depositional process. The proportions of the body sherds of MCW and VCW were approximately 5% respectively, in each level. The tables show that 1) BOBW was predominant at Tall-e Gap and that 2) VCW was replaced by MCW at the middle levels of Tall-e Gap.

Weights of wares at Squares GAT-1 and 2

Table 6.16 displays the weight and proportion of wares in each level at Square GAT-1. Take caution when considering the results; the weight of 51 published ceramics, which were either restored with plaster or returned to Iran, was excluded from the measurement. Interestingly, the weight ratio of VCW (0.5 – 84 %, Median: 32 %) exceeded that of BOBW in Levels 16-14b, whereas the count percentage of VCW (Table 6.14) did not. This suggests that the average weight of one VCW sherd was much heavier than that of BOBW during those levels. Meanwhile, the weight percentage of MCW (9 - 35%, Median: 20 %) did not indicate that one MCW sherd is heavier than one BOBW sherd. The proportion pattern of the ware weight at Square GAT-2 (Table 6.17) is similar to that of the ware counts at Square GAT-2 (Table 6.15), although 20 restored or returned vessels were not measured. The assemblage consists almost entirely of BOBW, MCW (3-7 %, Median: 6 %), and VCW (0.4-17 %, Median: 2 %).

Total number and weights of wares per m^3 (density) at Squares GAT-1 and 2

Aiming to compare the density of wares between levels, I calculate the soil volumes of each level of Squares GAT-1 and GAT-2. For that purpose, I reduce the west section and plan drawings to simpler geometric models (Fig. 6.1). Through the works assigning levels recorded in the sections to the levels where the preserved ceramic materials were unearthed, there was no ceramic material at some levels (e.g. Level 3 of GAT-1, etc.). Hence, I eliminate such levels from the analysis. In addition, I integrate the ceramic materials from Levels 5a, 5b, 12a, 12b, 14a, and 14b to Levels 5, 12, and 14 because the drawings of the west section of Squares GAT-1 and GAT-2 show only the presence of Levels 5b, 12a, and 14b.

Table 6.18 contains the total number and weight of wares per m^3 in each level at Square GAT-1 of Tall-e Gap. These tables do not show the increase in the amount of BOBW over time at Tall-e Gap, such as the increase explained in Tall-e Bakun B. Alternatively, they indicate that the levels with more than 100 potsherds per m^3 (or more than 300 g) were Levels 1, 5, 7, 8, 9, and 17, and the others had fewer than 50 potsherds per m^3 (Levels 4, 6, 12, 14, 15, 16). The

40 Nishiaki 2003: Pl. 69.

41 Median was calculated excluding 0 % and 100 %.

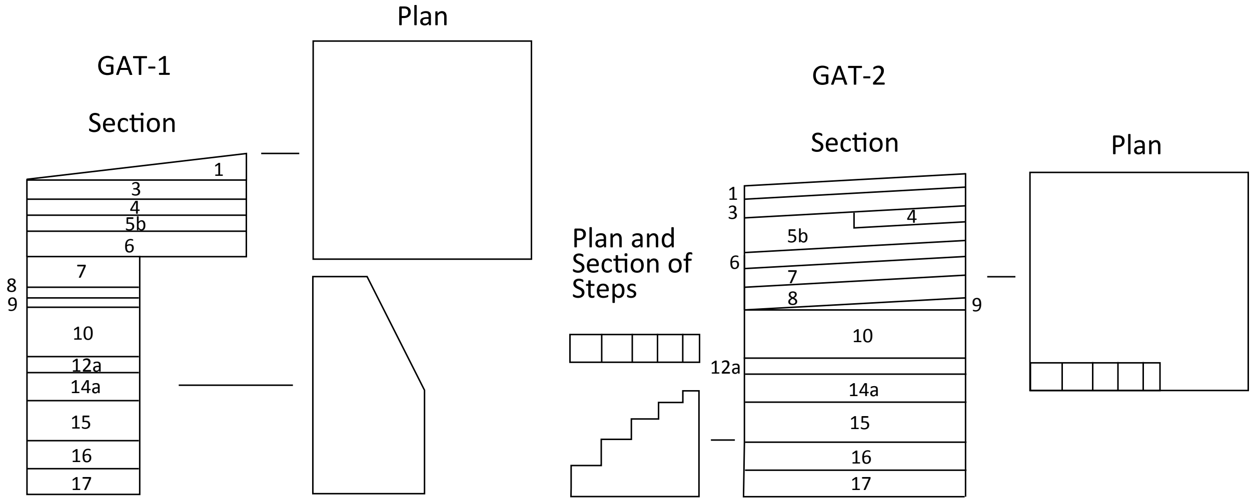


Figure 6.1 Schematic plans and sections for calculating the soil volume of each level at Squares GAT-1 and GAT-2 at Tall-e Gap 147

number of potsherds is especially remarkable at Levels 5, 9, and 17. As stated in Chapter 5, potsherd pavement was unearthed at Level 5b, which possibly contributed to the high BOBW density in this level. In addition, parts of the rooms (R10, R11, R12) were confirmed at Level 9 of this square, possibly thereby proving the existence of many potsherds in that level. There may have been different patterns of use/discards of ceramics in respective levels, presumably as a result of spatial functions of Square GAT-1 transforming over time.

The total number and weight of potsherds per m^3 in each level at Square GAT-2 are represented in Table 6.19. This also indicates differences in the number of potsherds in each level: the intense clusters of the ceramic materials (more than 100 potsherds or 3 kg per m^3) at Levels 9 and 17 and the small scatter of potsherds at the other levels. Furthermore, the potsherd densities were compared between Squares GAT-1 and GAT-2. While high pottery densities at Levels 9 and 17 were shared in both squares, the high density of pottery in Level 5 was confirmed only at Square GAT-1, possibly due to the presence of potsherd pavement. This suggests synchronic differences in spatial functions at Tall-e Gap.

The pottery density in each level at Squares GAT-1 and 2 can be briefly summarised as follows:

1) Levels with high and low densities of pottery existed in Squares GAT-1 and GAT-2, implying a diachronic change of their spatial functions.
2) The comparison of pottery density between Squares GAT-1 and 2 suggests a synchronic difference of spatial functions.

The difference in pottery density in each level and each square will be important in comparing the density at Tall-e Gap in discussion with those at the other sites (Section 6-5).

Vessel forms, rim shapes, base shapes of BOBW at Tall-e Gap

Vessel forms of BOBW at Squares GAT-1 and 2

Table 6.20 displays the counts and their proportions of BOBW vessel forms in each level at Square GAT-1 of Tall-e Gap. Two new vessel-form categories are adopted—unpainted open vessels and open vessels painted on both sides. In complete vessels and rim sherds, exterior-painted open vessels (33-75 %, Median 50%[42]) predominate in most levels. Interior-painted open vessels are the next most common vessel form (8-67 %, Median 36 %), and then large jars follow (4-25 %, Median 12 %). Other vessel forms make up less than 5%. Note that open vessels painted on both sides appear from Level 5a and account for 15% at Level 1. In terms of neck and body sherds, large jar body sherds occupy the majority in every level (27-68 %, Median 47%) because of the largest size of large jars among the existing vessel forms. The body sherds of open vessels painted on their exteriors follow large jars. The proportion of open vessels painted on their interiors (2-26 %, Median 13 %) and the unpainted part of open vessels (7-33 %, Median 13%) are similar.

Counts and proportions of BOBW vessel forms in each level at Square GAT-2 of Tall-e Gap are presented in Table 6.21. In complete vessels and rim sherds, major vessel forms are exterior-painted open vessels (18-86 %, Median 52 %), interior-painted open vessels (16-63%, Median 31 %), and large jars (5-25 %, Median 14 %). Unpainted open vessels account for 36% and 29% in Levels 16–17 due to the discovery of nearly complete unpainted vessels. Open vessels painted on both sides are confirmed in Levels 5b and 2. In body parts and neck parts, large jar sherds (14-79 %, Median 44 %)

[42] I calculated median excluding the values of 0 % and 100 %.

Table 6.16 Weight (upper) and proportion (lower) of wares found in each level at Square GAT-1 of Tall-e Gap. N/A: not available

Level/ Ware	BOBW (g)	MCW (g)	VCW (g)	spindle whorl (g)	burnt clay (g)
1	5239	N/A	-	-	-
2	1916	-	-	-	-
4	1994.6	N/A	-	-	-
5a	13814.2	2024	-	-	-
5b	1305	508	-	-	-
6	795	N/A	-	-	-
7	7738	811	63	-	-
8	1493.6	-	-	-	-
9	5047	-	-	4	-
10	3495	N/A	17	-	-
12a	133.4	71	-	-	-
12b	1201	-	-	-	-
14a	862.7	-	-	-	45
14b	264	-	1405	-	-
15	2215.2	-	1986	-	-
16	1310.1	-	2701	-	-
17	11689.2	-	2204	-	169
Total	60513	3414	8376	4	214
Level/ Ware	BOBW	MCW	VCW	spindle whorl	burnt clay
1	100	N/A	-	-	-
2	100	-	-	-	-
4	100	N/A	-	-	-
5a	87.22	12.78	-	-	-
5b	71.98	28.02	-	-	-
6	100	N/A	-	-	-
7	89.85	9.42	0.73	-	-
8	100	-	-	-	-
9	99.92	-	-	0.079	-
10	99.52	N/A	0.48	-	-
12a	65.26	34.74	-	-	-
12b	100	-	-	-	-
14a	95.04	-	-	-	4.958
14b	15.82	-	84.18	-	-
15	52.73	-	47.27	-	-
16	32.66	-	67.34	-	-
17	83.12	-	15.67	-	1.20
Total	83.44	4.71	11.55	0.01	0.30

Table 6.17 Weight (upper) and proportion (lower) of wares found in each level at Square GAT-2 of Tall-e Gap. N/A: not available

Level/ ware	BOBW (g)	MCW (g)	VCW (g)	burnt clay (g)	perfor-ated disc (g)	red material included ware (g)
1	1209	-	-	-	-	22
2	456	-	-	-	8	-
4	122.1	-	-	-	-	-
5a	509	-	-	-	-	-
5b	2055.6	62	-	-	-	-
6	5511.9	345	-	44	-	-
7	4415.7	-	80	9	-	-
9	7842.2	-	150	-	-	-
10	2357.6	-	308	-	-	-
14a	1142.8	99	261	-	N/A	-
14b	1180.6	-	-	-	-	-
15	503.3	-	-	-	-	-
16	3627.4	-	-	-	-	-
17	7848	-	34	-	-	-
Total	38781.2	506	833	53	8	22
Level/ ware	BOBW	MCW	VCW	burnt clay	perfor-ated disc	red material included ware
1	98.21	-	-	-	-	1.79
2	98.28	-	-	-	1.72	-
4	100	-	-	-	-	-
5a	100	-	-	-	-	-
5b	97.07	2.93	-	-	-	-
6	93.41	5.85	-	0.75	-	-
7	98.02	-	1.78	0.20	-	-
9	98.12	-	1.88	-	-	-
10	88.45	-	11.55	-	-	-
14a	76.04	6.59	17.37	-	N/A	-
14b	100	-	-	-	-	-
15	100	-	-	-	-	-
16	100	-	-	-	-	-
17	99.57	-	0.43	-	-	-
Total	96.46	1.26	2.07	0.13	0.02	0.05

Table 6.18 Total number (left) and weight (right) of potsherds per m³ found in each level at Square GAT-1 of Tall-e Gap. N/A: not available

Level/ Ware	BOBW	MCW	VCW	spindle whorl	burnt clay		Level/ Ware	BOBW (g)	MCW (g)	VCW (g)	spindle whorl (g)	burnt clay (g)
1	108.89	2.22	-	-	-		1	3880.74	N/A	-	-	-
4	24.44	0.56	-	-	-		4	1108.11	N/A	-	-	-
5	304.44	27.56	-	-	-		5	6719.64	1125.33	-	-	-
6	20.37	0.37	-	-	-		6	294.44	N/A	-	-	-
7	89.71	18.02	2.25	-	-		7	2904.65	304.43	23.65	-	-
8	112.61	-	-	-	-		8	3363.96	-	-	-	-
9	255.85	-	-	1.46	-		9	7378.65	-	-	5.85	-
10	71.57	1.00	1.00	-	-		10	1749.25	N/A	8.51	-	-
12	43.54	1.50	-	-	-		12	2003.60	106.61	-	-	-
14	40.54	-	12.01	-	0.75		14	845.87	-	1054.80	-	33.78
15	19.43	-	7.60	-	-		15	623.65	-	559.12	-	-
16	32.28	-	15.77	-	-		16	983.56	-	2027.78	-	-
17	166.67	-	31.53	-	2.82		17	6581.76	-	1240.99	-	95.16

Table 6.19 Total number (left) and weight (right) of potsherds per m³ found in each level at Square GAT-2 of Tall-e Gap. N/A: not available

Level/ Ware	BOBW	MCW	VCW	Red material included ware	Burnt clay	Perfor-ated disc		Level/ Ware	BOBW (g)	MCW (g)	VCW (g)	Red material included ware (g)	Burnt clay (g)	Perfor-ated disc (g)
1	31.11	-	-	0.74	-	-		1	895.56	-	-	16.30	-	-
4	5.56	-	-	-	-	-		4	67.83	-	-	-	-	-
5	68.44	2.22	-	-	-	-		5	1139.82	27.56	-	-	-	-
6	59.63	2.59	-	-	1.11	-		6	2041.44	127.78	-	-	16.30	-
7	68.69	-	0.75	-	0.38	-		7	1657.55	0	30.03	-	3.38	-
9	514.62	-	2.92	-	-	-		9	11465.20	0	219.30	-	-	-
10	43.04	-	2.00	-	-	-		10	1179.98	0	154.15	-	-	-
14	65.32	2.25	5.26	-	-	0.75		14	1744.29	74.32	195.95	-	-	N/A
15	9.85	-	-	-	-	-		15	141.69	0	0	-	-	-
16	59.31	-	-	-	-	-		16	2723.27	0	0	-	-	-
17	143.58	-	1.13	-	-	-		17	4418.92	0	19.14	-	-	-

Table 6.20 Count (upper) and proportion (lower) of BOBW vessel forms found in each level at Square GAT-1 of Tall-e Gap

Part	Complete			Rim							Neck		Body			
Level/ Vessel form	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its rim	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its both sides	incurved-rim vessel	unpainted open vessel	small jar	large jar	small jar	large jar	open vessel painted on its exterior	open vessel painted on its interior	unpainted part of open vessel	large jar
1	-	-	-	8	1	2	-	1	-	1	1	4	37	6	23	56
2	-	-	-	8	-	-	-	-	-	-	-	1	12	1	7	32
4	-	-	-	3	3	-	-	-	-	2	-	-	10	4	-	16
5a	2	2	-	51	38	2	-	3	1	8	-	7	164	54	42	153
5b	-	-	-	5	5	-	-	-	-	1	-	-	31	24	13	42
6	-	-	-	1	1	-	-	-	-	-	-	-	7	7	8	30
7	3	-	-	12	6	-	1	-	-	1	-	2	50	23	30	96
8	-	1	-	6	1	-	-	-	-	-	1	-	12	9	-	12
9	2	2	-	15	5	-	-	-	-	5	-	4	63	18	10	44
10	1	2	2	12	8	-	-	1	-	1	-	2	34	8	9	50
12a	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1
12b	-	-	-	-	-	-	-	-	-	1	-	-	2	3	2	15
14a	-	-	-	2	2	-	-	-	-	-	-	-	7	3	-	19
14b	-	-	-	1	2	-	-	-	-	-	-	-	9	2	-	4
15	-	-	-	8	1	-	-	-	1	2	-	1	12	7	7	26
16	-	2	-	6	-	-	-	-	-	2	-	2	5	5	6	12
17	1	1	-	24	19	-	-	3	1	8	1	4	53	21	47	93
Total	9	10	2	162	92	4	1	8	3	32	3	27	509	195	205	701

Table 6.20 continued Count (upper) and proportion (lower) of BOBW vessel forms found in each level at Square GAT-1 of Tall-e Gap

Part	Complete + Rim								Neck + Body				
Level/ Vessel form	open vessel painted on its rim	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its both sides	incurved-rim vessel	unpainted open vessel	small jar	large jar	small jar	open vessel painted on its exterior	open vessel painted on its interior	unpainted part of open vessel	large jar
1	-	-	-	15.38	-	7.69	-	7.692	0.79	29.13	4.72	18.11	47.24
2	-	-	-	-	-	-	-	-	-	22.64	1.89	13.21	62.26
4	-	-	-	-	-	-	-	25	-	33.33	13.33	-	-
5a	-	49.53	37.38	1.87	-	2.80	0.93	7.477	-	39.05	12.86	10	38.10
5b	-	-	-	-	-	-	-	9.091	-	28.18	21.82	11.82	-
6	-	-	-	-	-	-	-	-	-	13.46	13.46	15.38	-
7	-	65.22	-	-	4.35	-	-	4.348	-	24.88	11.44	14.93	48.76
8	-	-	25	-	-	-	-	-	2.94	35.29	26.47	-	-
9	-	58.62	24.14	-	-	-	-	17.241	-	45.32	12.95	7.19	34.53
10	7.41	48.15	37.04	-	-	3.70	-	3.704	-	33.01	7.77	8.74	50.49
12a	-	-	-	-	-	-	-	-	-	33.33	-	33.33	-
12b	-	-	-	-	-	-	-	100	-	9.09	13.64	9.09	-
14a	-	-	-	-	-	-	-	-	-	24.14	10.34	-	-
14b	-	-	-	-	-	-	-	-	-	60	13.33	-	-
15	-	-	-	-	-	-	8.333	16.667	-	22.64	13.21	13.21	50.94
16	-	-	-	-	-	-	-	20	-	16.67	16.67	20.00	46.67
17	-	43.86	35.09	-	-	5.26	1.754	14.035	0.46	24.20	9.59	21.46	44.29
Vessel form Total	0.62	52.94	31.58	1.24	0.31	2.48	0.929	9.907	0.18	31.04	11.89	12.50	44.39
Total	100								100				

Table 6.21 Count (upper) and proportion (lower) of BOBW vessel forms found in each level at Square GAT-2 of Tall-e Gap

Part	Complete		Rim					Neck		Body				
Level/ Vessel form	small jar	open vessel painted on its exterior	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its both sides	unpainted open vessel	large jar	small jar	large jar	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its both sides	unpainted part of open vessel	large jar
1	-	-	2	3	-	-	1	-	1	6	1	1	8	16
2	-	-	-	1	1	-	-	-	-	6	-	-	7	11
4	-	-	1	-	-	-	-	-	-	6	-	-	-	1
5a	-	-	7	3	-	-	-	-	-	5	7	-	4	7
5b	-	1	11	5	1	-	1	-	-	47	16	-	10	21
6	-	1	5	-	-	-	1	2	1	14	7	-	7	112
7	-	-	14	9	-	-	6	-	2	39	22	-	19	63
9	-	-	21	11	-	2	5	1	7	85	22	2	57	129
10	-	1	15	3	-	-	-	3	3	19	8	-	5	26
14a	-	-	2	1	-	-	1	1	-	22	5	-	3	17
14b	-	-	3	5	-	-	-	-	2	14	4	-	-	3
15	1	1	8	2	-	-	-	-	-	12	4	-	3	3
16	-	-	2	5	-	4	-	-	-	3	7	-	26	29
17	-	-	5	7	-	6	3	-	1	17	11	-	45	155
Total	1	4	96	55	2	12	18	7	17	295	114	3	194	593

Table 6.21 continued Count (upper) and proportion (lower) of BOBW vessel forms found in each level at Square GAT-2 of Tall-e Gap

Part	Complete + Rim							Neck + Body						
Level/ Vessel form	small jar		open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its both sides	unpainted open vessel	large jar	small jar		open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its both sides	unpainted part of open vessel	large jar
1	-		-	50	-	-	16.667	-		18.18	3.03	3.03	24.24	51.52
2	-		-	50	50	-	-	-		25.00	-	-	29.17	-
4	-		-	-	-	-	-	-		85.71	-	-	-	-
5a	-		-	30	-	-	-	-		21.74	30.43	-	17.39	-
5b	-		63.16	26.32	5.26	-	5.263	-		50.00	17.02	-	10.64	-
6	-		85.71	-	-	-	14.286	1.40		9.79	4.90	-	4.90	79.02
7	-		-	31.03	-	-	20.690	-		26.90	15.17	-	13.10	44.83
9	-		-	28.21	-	5.13	12.821	0.33		28.05	7.26	0.66	18.81	44.88
10	-		84.21	15.79	-	-	-	4.69		29.69	12.50	-	7.81	45.31
14a	-		-	25	-	-	25	2.08		45.83	10.42	-	6.25	-
14b	-		-	62.5	-	-	-	-		60.87	17.39	-	-	21.74
15	8.33		75	16.67	-	-	-	-		54.55	18.18	-	13.64	-
16	-		-	45.45	-	36.36	-	-		4.62	10.77	-	40.00	-
17	-		-	33.33	-	28.57	14.286	-		7.42	4.80	-	19.65	68.12
Vessel form Total	0.53		53.19	29.26	1.06	0	9.574	0.572		24.12	9.32	0.25	15.86	49.88
Total	100							100						

Table 6.22 Count of BOBW rim shapes found in published complete vessels at Tall-e Gap

Rim shape/ vessel form	open vessel				closed vessel	
	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its rim	unpainted open vessel	small jar	large jar
simple rounded	26	22	2	1	1	-
pinched outside	5	1	-	-	-	-
semi incurved	-	1	-	-	-	-

comprised the largest part of vessel forms, followed by exterior-painted open vessels (5-86 %, Median 27 %), unpainted parts of open vessels (5-40 %, Median 16 %), and interior-painted open vessels (3-30 %, Median 12 %). The reverse phenomenon of the ratio of large jar sherds between complete vessel-rim sherds (14 %) and neck and body sherds (44 %) implies that a large jar was by far the largest of all the vessel forms at Tall-e Gap.

In a short summary, vessel forms of BOBW at Tall-e Gap can be summarised as follows:

1) Exterior-painted open vessels were predominant in rim sherds at Tall-e Gap.
2) Open vessels painted on both sides newly appeared in the upper levels of Tall-e Gap.
3) The large jar was predominant in body sherds, suggesting its large body size at Tall-e Gap.

Table 6.23 Count of BOBW rim shapes found

Vessel form	open vessel painted on its exterior			open vessel painted on its interior					open vessel painted on its both sides	open vessel painted on its rim
Level/ Rim shape	simple rounded	pinched outside	undistin-guishable	simple rounded	pinched outside	flat	grooved	undistin-guishable	simple rounded	simple rounded
1	7	1	-	1	-	-	-	-	2	-
2	7	1	-	-	-	-	-	-	-	-
4	3	-	-	2	-	-	-	1	-	-
5a	52	-	1	38	-	1	-	1	2	-
5b	5	-	-	5	-	-	-	-	-	-
6	1	-	-	1	-	-	-	-	-	-
7	12	1	1	4	1	-	-	1	-	-
8	5	1	-	2	-	-	-	-	-	-
9	15	2	-	7	-	-	-	-	-	-
10	13	-	-	9	1	-	-	-	-	2
12b	-	-	-	-	-	-	-	-	-	-
14a	2	-	-	1	-	-	-	1	-	-
14b	1	-	-	2	-	-	-	-	-	-
15	8	-	-	1	-	-	-	-	-	-
16	6	-	-	2	-	-	-	-	-	-
17	22	2	1	17	-	-	1	2	-	-
Total	159	8	3	92	2	1	1	6	4	2

Rim shape of BOBW from Squares GAT-1, 2 and published vessels

Here, I describe the classification result of BOBW rim shapes from Square GAT-1 at Tall-e Gap (Table 6.23). A simple rounded rim was predominant in exterior-painted open vessels. This rim type was also preferred in interior-painted open vessels; flat or grooved rim shapes were rarely observed. The rim shapes of large jars were more varied (simple rounded, beaded, grooved, flat) than those of open vessels. The majority of large jars had simple rounded rims or flat rim shapes. Similar rim shapes were observed at Square GAT-2 (Table 6.24). I also analysed the rim shapes of published well-preserved vessels from Tall-e Gap (Table 6.22). In exterior-painted open vessels, five pinched-outside rim sherds were confirmed. In interior-painted open vessels, one semi-incurved rim sherd was found. In summary, regarding the rim shapes of BOBW at Tall-e Gap, 1) a simple rounded rim shape was predominant in open vessels and 2) both a simple rounded rim shape and a flat rim shape existed in large jars.

Base shape of BOBW from Squares GAT-1, 2 and published vessels

I also present the classification result of BOBW base shapes from Square GAT-1 at Tall-e Gap (Table 6.26). Among open vessels, not only ring bases but also flat bases and sub-round bases were popular. A variety of ring base shapes (simple rounded, square flat, square diagonal, grooved, flat-low bottom) was observed. Among the ring bases, a square diagonal edge of the ring base was the most common at Tall-e Gap. A flat-low bottom ring base disappeared at levels above Level 14b. Among large jar bases, flat bases were the most common; the base shapes of BOBW unearthed from Square GAT-2 (Table 6.27) showed similar results. I also analysed the base shapes of published well-preserved vessels at Tall-e Gap (Table 6.25). In exterior-painted open vessels, the number of flat bases exceeded that of ring bases. In interior-painted open vessels, no predominance of flat bases over ring bases was observed. Concerning base shapes of BOBW at Tall-e Gap, 1) flat and ring bases constituted the majority, 2) a flat base was especially predominant in exterior-painted open vessels, and 3) a variety of ring base shapes existed.

in each level at Square GAT-1 of Tall-e Gap

unpainted open vessel				incurved-rim vessel	small jar	large jar				
simple rounded	flat	grooved	undistinguishable	simple rounded	simple rounded	simple rounded	beaded	grooved	flat	undistinguishable
-	-	-	1	-	-	-	-	1	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	2	-
1	1	1	-	-	1	2	1	-	4	1
-	-	-	-	-	-	-	-	-	1	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	-	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	3	-	-	2	-
1	-	-	-	-	-	-	-	-	-	1
-	-	-	-	-	-	-	-	-	1	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	1	-	-	1	-
-	-	-	-	-	-	1	-	-	1	-
3	-	-	-	-	1	5	1	-	1	-
5	1	1	1	1	3	13	2	1	13	2

Table 6.24 Count of BOBW rim shapes found in each level at Square GAT-2 of Tall-e Gap

Vessel form	open vessel painted on its exterior			open vessel painted on its interior			open vessel painted on its both sides	unpainted open vessel	small jar	large jar				
Level/ Rim shape	simple rounded	pinched outside	beaded	simple rounded	flat	undistin-guishable	simple rounded	simple rounded	simple rounded	simple rounded	beaded	grooved	flat	undistin-guishable
1	2	-	-	3	-	-	-	-	-	-	-	-	1	-
2	-	-	-	1	-	-	1	-	-	-	-	-	-	-
4	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5a	7	-	-	3	-	-	-	-	-	-	-	-	-	-
5b	12	-	-	5	-	-	1	-	-	-	-	1	-	-
6	6	-	-	-	-	-	-	-	-	1	-	-	-	-
7	13	1	-	9	-	-	-	-	-	3	1	-	1	1
9	21	-	-	11	-	-	-	2	-	3	-	1	1	-
10	15	-	1	3	-	-	-	-	-	-	-	-	-	-
14a	2	-	-	1	-	-	-	-	-	-	-	-	1	-
14b	3	-	-	4	1	-	-	-	-	-	-	-	-	-
15	9	-	-	2	-	-	-	-	1	-	-	-	-	-
16	2	-	-	4	-	1	-	4	-	-	-	-	-	-
17	5	-	-	5	2	-	-	6	-	2	-	-	-	1
Total	98	1	1	51	3	1	2	12	1	9	1	2	4	2

Table 6.25 Count of BOBW base shapes found in published complete vessels at Tall-e Gap

Base shape/ vessel form		open vessel					closed vessel	
		open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on its rim	open vessel painted on its exterior joint	unpainted part of open vessel	small jar	large jar
standard, with ring base	simple rounded ring base	4	4	-	-	-	-	-
	square diagonal ring base	1	2	-	-	-	-	-
	square flat ring base	-	2	-	-	-	-	-
	grooved ring base	-	-	-	-	-	-	-
	flat-low bottom ring base	-	-	-	-	-	-	-
	undistinguishable	2	2	1	-	-	-	-
without ring base	flat base	15	10	1	-	1	1	1
	sub-rounded base	9	4	-	-	-	1	1

Complete vessel forms and vessel sizes Tall-e Gap

Estimate of complete vessel forms from potsherds

To define BOBW complete vessel forms in Chapter 4, I analysed 58 published complete vessels from Tall-e Gap. Of the 31 complete vessels painted on their exteriors, 25 were categorised as deep bowls and four as beakers. The others were one hemispherical bowl and one shallow bowl. On the other hand, a shallow bowl (18 samples) was the most common complete vessel form of 24 complete open vessels painted on their interiors at Tall-e Gap. However, there were five deep bowls and one hemispherical bowl painted on their interiors. Hence, generally, exterior-painted open vessels at Tall-e Gap were either deep bowls or beakers, and interior-painted open vessels were shallow bowls, although there were some exceptions.

Rim angles and vessel sizes

As is the case with Tall-e Jari A and Tall-e Bakun B (Sections 6-1-4, 6-2-4), rim angles, rim diameters, and as with Tall-e Jari A and Tall-e Bakun B (Sections 6-1-4, 6-2-4), I present the rim angles, rim diameters, and vessel heights of painted-side-based vessel forms at Tall-e Gap (Table 6.28), using published complete vessels and diagnostic rim sherds found at Tall-e Gap for the calculation.[43] The median rim angle and rim diameter of exterior-painted open vessels (96°, 16 cm) were smaller than those of interior-painted ones (120.5°, 20 cm). On the other hand, the median vessel height of exterior-painted open vessels (10 cm) was larger than that of interior-painted ones (8 cm). The median rim angle and rim diameter of open vessels painted on both sides (106.5°, 19 cm) were between those of exterior-painted ones and those of interior-painted ones. Because the practice of painting the interior/exterior surface correlated with the more flared/straighter rim angle of the vessels, I suggest that painting both sides was likely to require a balanced rim angle.

Rim angles and vessel sizes of large and small jars at Tall-e Gap were also analysed using published and unpublished drawings (Cat. 6.24). The rim angles of large jars (87-113°, median: 102°, CV: 0.069, N=12) were more vertical than those of small jars (108-120°, median: 116°, CV: 0.044, N=3). The median rim diameter of a large jar (17 cm, size: 9-24 cm, CV: 0.308) was clearly larger than that of a small jar (10 cm, size: 6-12 cm, CV: 0.267) at Tall-e Gap, although not all large jars had a larger rim diameter than small jars.[44]

Several unpublished diagnostic MCW and VCW sherds from Squares GAT-1 and 2 of Tall-e Gap were presented at Cat. 6.25-26 to deepen the understanding of their rim angles, vessel sizes, and rim and base shapes. One complete basin-shaped VCW vessel was published at Tall-e Gap.[45] Its large rim diameter (39 cm) and thickness (18 mm) is comparable to the vessel in Cat. 6.25: 1 (41 cm). A smaller class of VCW also existed (Cat. 6.25: 2, 23 cm). The rim angles of VCW at Tall-e Gap (three diagnostic samples) were 64°, 81°, and 94° (Median: 81°). The vessel wall thicknesses 3 cm below the rims of VCW at Tall-e Gap (three samples) were 17 mm, 18 mm, and 29 mm (Median: 18 mm). A simple rounded rim and flat rim were confirmed in VCW vessels. A flat base and a flat-low bottom VCW ring base were observed. Six diagnostic MCW sherds were available at Tall-e Gap, including one published rim sherd with a pair of

[43] Egami and Sono 1962.

[44] Egami and Sono 1962: Fig. 11: 1.

[45] Egami and Sono 1962: Fig. 11: 6.

Table 6.26 Count of BOBW base shapes found

Vessel form	open vessel painted on its exterior							open vessel painted			
Presence of ring base	ring base (standard size)					without ring base		ring base (standard size)			
Level/ Base shape	simple rounded	square flat	square diagonal	groo-ved	undistin-guishable	flat base	sub round	simple rounded	square flat	square diagonal	groo-ved
1	-	-	1	-	-	2	-	-	-	-	-
2	-	-	-	-	-	1	1	-	-	-	-
4	-	-	-	-	-	1	-	-	-	1	-
5a	1	1	4	1	-	8	6	-	3	2	-
5b	1	-	-	-	-	-	1	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-
7	1	1	3	-	1	1	1	1	1	1	1
8	-	-	2	-	-	2	-	-	-	-	-
9	-	-	3	-	-	6	2	-	1	-	-
10	1	-	-	-	-	2	3	-	-	-	-
12a	-	-	-	-	-	-	-	-	-	-	-
12b	-	-	-	-	-	1	-	-	-	-	-
14a	-	-	-	-	-	-	-	-	-	-	-
14b	-	-	-	-	-	1	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	1	-
16	-	-	1	-	-	2	-	-	-	1	-
17	1	-	1	-	-	2	2	-	-	1	-
Total	5	2	15	1	1	29	16	1	5	7	1

in each level at Square GAT-1 of Tall-e Gap

on its interior				open vessel painted on its rim	open vessel painted on its exterior joint			unpainted part of open vessel		unpainted part of large jar	
		without ring base		without ring base	ring base (standard size)			without ring base		without ring base	
flat-low bottom	undistin-guishable	flat base	sub round	flat base	simple rounded	square flat	square diagonal	flat base	sub round	flat base	sub round
-	-	-	-	-	-	1	1	-	-	2	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	1	-
-	-	1	2	-	-	-	-	-	1	5	2
-	-	1	-	-	-	-	-	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	1	-	-	4	1
-	1	1	-	-	-	-	-	2	-	-	-
-	-	1	-	-	-	-	-	-	-	2	-
-	1	3	1	1	-	1	-	1	-	4	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	1	-	-	-	1	-
-	-	-	-	-	-	-	-	-	-	1	-
-	-	-	-	-	-	1	-	-	-	-	-
1	-	-	-	-	1	-	-	-	-	1	-
-	-	1	-	-	-	-	-	-	-	-	-
1	-	1	-	-	6	-	1	1	-	7	-
2	2	10	3	1	8	4	3	4	1	28	3

Table 6.27 Count of BOBW base shapes found in each level at Square GAT-2 of Tall-e Gap

Vessel form	open vessel painted on its exterior					open vessel painted on its interior			open vessel painted on its exterior joint					unpainted part of open vessel	unpainted part of large jar
Presence of ring base	ring base (standard size)			without ring base		ring base (standard size)		without ring base	ring base (standard size)					without ring base	without ring base
Level/ Base shape	simple rounded	square diagonal	grooved	flat base	sub round	square diagonal	flat-low bottom	flat base	simple rounded	square flat	square diagonal	grooved	undistin-guishable	flat base	flat base
1	-	-	-	-	2	-	-	-	-	-	-	-	-	1	-
2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
4	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
5a	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
5b	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
6	-	-	-	1	2	-	-	1	-	-	3	-	-	-	1
7	1	-	1	2	-	1	-	-	-	1	-	1	1	1	4
9	-	-	-	3	-	1	-	-	1	-	2	-	-	2	1
10	-	-	-	4	-	1	-	-	1	-	2	-	-	2	1
14a	-	1	-	-	-	2	-	-	-	-	-	-	-	1	-
14b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
17	-	-	-	-	-	-	1	-	-	-	-	-	-	-	4
Total	1	2	1	12	10	5	1	1	2	1	7	1	1	7	14

Table 6.28 BOBW rim angles, rim diameters, and vessel heights of open vessel forms in published and diagnostic ceramics from Tall-e Gap. D: diameter, CV: coefficient of variation

open vessel painted on its exterior	rim angle (°)	rim D (cm)	height (cm)
max	118	29	22
min	62	9	7
median	96	16	10
CV	0.069	0.277	0.322
sample N	111	115	31

open vessel painted on its interior	rim angle (°)	rim D (cm)	height (cm)
max	142	35	29
min	95	8	4
median	120.5	20	8
CV	0.095	0.264	0.633
sample N	58	54	33

open vessel painted on its rim	rim angle (°)	rim D (cm)	height (cm)
max	-	22	14
min	-	13	7
median	-	17.5	10.5
CV	-	0.257	0.333
sample N	-	2	2

open vessel painted on both sides	rim angle (°)	rim D (cm)	height (cm)
max	113	21	-
min	105	13	-
median	106.5	19	-
CV	0.029	0.171	-
sample N	4	4	-

knobs.[46] The rim diameters of MCW at Tall-e Gap ranged from 14 cm to 22 cm (Median: 16 cm). The rim angles of MCW at Tall-e Gap ranged from 53° to 71° (Median: 63°). The wall thickness 3 cm below the rims of MCW at Tall-e Gap ranged from 8 mm to 14 mm (Median: 12.5 mm). Only a simple rounded rim shape was confirmed in MCW at Tall-e Gap.

To summarise the rim angles and vessel sizes of pottery at Tall-e Gap, the comparison of rim angles and vessel sizes will be presented:

1) BOBW showed variability in rim angles and vessel sizes depending on vessel form (open/closed) and painted side (exterior/interior).
2) The rim diameter and vessel thickness of VCW were larger than those of BOBW and MCW.
3) The rim angle of MCW was more incurved than that of BOBW and VCW.

At the end of this section, I summarise diachronic changes in wares, vessel forms, and vessel sizes at Tall-e Gap. This pottery change can be called 'the development of BOBW':

1) BOBW was predominant at Tall-e Gap, and VCW was replaced by MCW at the middle levels. This might give clues for the more frequent transmission of knowledge concerning BOBW making. There was a difference in pottery density in space and time at Tall-e Gap, implying a difference in spatial function.
2) Exterior-painted open vessels became the predominant vessel forms. Open vessels painted on both sides newly appeared at the upper levels. The body of large jars became larger.
3) Deep bowls, beakers, shallow bowls, and hemispherical bowls were determined as complete vessel forms at Tall-e Gap. Vessel sizes and rim angles of pottery at Tall-e Gap differed among vessel forms and wares.

6-4. The final phase of black-on-buff ceramics: Wares and vessel forms from Tall-e Bakun A

Ceramic materials from Tall-e Bakun A

Published ceramic materials at Tall-e Bakun A

In total, there are 1499 published ceramic vessels from Tall-e Bakun A (Table 6.1). First, Herzfeld reported 140 well-preserved BOBW vessels and one large MCW vessel in 1932.[47] Then, Langsdorff and McCown published a large volume of excavation reports from Tall-e Bakun A with 1107 ceramic drawings and photographs (1062 BOBW vessels, eight MCW vessels, 34 red burnished ware sherds, and three sherds from the later period).[48] Egami and Masuda presented 92 pottery drawings and pictures in the report of their small excavation at Tall-e Bakun A, including 10 MCW potsherds, six red ware

[46] Egami and Sono 1962: Fig. 11: 3.

[47] Herzfeld 1932.

[48] Langsdorff and McCown 1942.

Table 6.29 Count (upper) and proportion (lower) of wares

Level/ Part	Complete		Rim							
Level/ Ware	BOBW	Medium - Coarse red burnished ware (Coarse Lapui?)	BOBW	MBOBW	MCW	VCW	Fine red burnished ware (Fine Lapui)	Medium - Coarse red burnished ware (Coarse Lapui?)	Mineral tempered wheel made ware	Later period ware: Kaftari Period?
surface collection	-	-	-	-	-	-	-	-	-	-
surface soil	-	-	-	-	-	-	2	-	-	-
9/25.	-	-	2	-	1	-	-	-	-	-
9/26.	-	-	25	-	1	1	-	1	2	-
9/27.	-	-	5	-	1	-	-	-	-	-
9/28.	-	-	20	-	-	-	-	-	-	-
9/29.	-	-	19	-	1	-	-	-	-	-
Level I	1	1	-	-	-	-	-	2	-	-
Levels I-III.	-	-	-	-	8	-	-	-	-	-
Levels I-IV.	1	-	52	1	1	-	-	-	-	4
Level IV	1	-	6	-	-	-	-	-	-	-
unknown	-	-	18	1	-	3	-	-	1	10
Total	3	1	147	2	13	4	2	3	3	14

Level/ Part	Complete + Rim							
Level/ Ware	BOBW	MBOBW	MCW	VCW	Fine red burnished ware (Fine Lapui)	Medium - Coarse red burnished ware (Coarse Lapui?)	Mineral tempered wheel made ware	Later period ware: Kaftari Period?
surface collection	-	-	-	-	-	-	-	-
surface soil	-	-	-	-	100	-	-	-
9/25.	66.67	-	33.33	-	-	-	-	-
9/26.	83.33	-	3.33	3.33	-	3.33	6.67	-
9/27.	83.33	-	16.67	-	-	-	-	-
9/28.	100	-	-	-	-	-	-	-
9/29.	95	-	5	-	-	-	-	-
Level I	25	-	-	-	-	75	-	-
Levels I-III.	-	-	100	-	-	-	-	-
Levels I-IV.	88.33	1.67	1.67	-	-	-	-	6.67
Level IV	100	-	-	-	-	-	-	-
unknown	54.55	3.030	-	9.09	-	-	3.03	30.30
Ware Total	77.72	1.04	6.74	2.07	1.04	2.07	1.55	7.25
Total	100							

found in each context at Masuda's trench at Tall-e Bakun A

	Neck			Body								
Late period ware: after Sasanid Period?	BOBW	MBOBW	Later period ware: Kaftari Period?	BOBW	MBOBW	MCW	VCW	Fine red burnished ware (Fine Lapui)	Mineral tempered wheel made ware	Later period ware: Kaftari Period?	Late period ware: after Sasanid Period?	Neolithic ware
-	-	-	-	6	-	-	-	5	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	1	-	-	52	-	1	2	4	-	-	-	-
-	-	-	-	222	1	17	1	8	1	-	1	-
-	-	-	-	110	3	3	-	1	-	-	-	-
-	-	-	-	152	1	-	-	-	-	-	-	-
-	1	-	-	297	-	6	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	11	-	-	-	-	-	-
1	1	2	-	75	1	5	-	-	-	-	-	3
-	1	-	-	42	-	-	-	-	-	-	-	-
-	3	-	1	188	43	8	10	6	11	7	-	-
1	7	2	1	1144	50	51	13	24	12	7	1	3

		Neck + Body								
Late period ware: after Sasanid Period?		BOBW	MBOBW	MCW	VCW	Fine red burnished ware (Fine Lapui)	Mineral tempered wheel made ware	Later period ware: Kaftari Period?	Late period ware: after Sasanid Period?	Neolithic ware
-		54.55	-	-	-	45.45	-	-	-	-
-		-	-	-	-	-	-	-	-	-
-		88.33	-	1.667	3.333	6.67	-	-	-	-
-		88.45	0.40	6.773	0.398	3.19	0.40	-	0.40	-
-		94.02	2.56	2.564	-	0.85	-	-	-	-
-		99.35	0.65	-	-	-	-	-	-	-
-		98.03	-	1.974	-	-	-	-	-	-
-		-	-	-	-	-	-	-	-	-
-		-	8.33	91.667	-	-	-	-	-	-
1.67		87.356	3.45	5.747	-	-	-	-	-	3.45
-		100	-	-	-	-	-	-	-	-
-		68.953	15.52	2.89	3.610	2.17	3.97	2.89	-	-
0.52		87.529	3.95	3.878	0.989	1.83	0.91	0.61	0.08	0.23
						100				

Table 6.30 Weight (upper) and proportion (lower) of wares found in each context at Masuda's trench at Tall-e Bakun A

Level/ Weight	BOBW(g)	MBOBW(g)	MCW(g)	VCW(g)	Red burnished ware (Lapui) (g)	Mineral tempered wheel made ware	Later period ware: Kaftari Period?	Late period ware: after Sasanid Period? (g)	Neolithic ware (g)	Vegetal tempered burnt clay (g)	Perforated disc(g)	Fire dog (g)
surface collection	88	-	-	-	105	-	-	-	-	-	1	-
9/25.	2889	-	27	75	17	-	-	-	-	-	1	-
9/26.	7350	112	528	201	258	1087	-	10	-	-	4	-
9/27.	4688	139	550	-	14	-	-	-	-	-	6	-
9/28.	1704	92	-	-	-	-	-	-	-	-	2	-
9/29.	9777	-	67	-	-	-	-	-	-	-	3	-
Levels I-III.	-	789	2608	-	-	-	-	-	-	-	1	-
Levels I-IV.	5380	445	115	221	-	-	101	2	35	290	8	271
Level IV	2481	-	177	-	-	-	-	-	-	-	2	-
unknown	7178	2286	434	810	509	789	380	-	-	24	10	-
Total	41533	3862	4506	1308	902	1876	480	12	35	314	38	271

Level/ Weight	BOBW	MBOBW	MCW	VCW	Red burnished ware (Lapui)	Mineral tempered wheel made ware	Later period ware: Kaftari Period?	Late period ware: after Sasanid Period?	Neolithic ware	Vegetal tempered burnt clay	Perforated disc	Fire dog
surface collection	45.35	-	-	-	54.14	-	-	-	-	-	0.52	-
9/25.	96.01	-	0.90	2.50	0.56	-	-	-	-	-	0.03	-
9/26.	76.97	1.17	5.53	2.10	2.70	11.38	-	0.11	-	-	0.04	-
9/27.	86.86	2.57	10.19	-	0	-	-	-	-	-	0.11	-
9/28.	94.75	5.13	-	-	-	-	-	-	-	-	0.11	-
9/29.	99.29	-	0.68	-	-	-	-	-	-	-	0.03	-
Levels I-III.	-	23.22	76.75	-	-	-	-	-	-	-	0.03	-
Levels I-IV.	78.35	6	1.67	3.22	-	-	1.46	0.02	0.51	4.22	0.12	3.94
Level IV	93.29	-	6.64	-	-	-	-	-	-	-	0.08	-
unknown	57.79	18.41	3.50	6.52	4.10	6.35	3.06	-	-	0	0.08	-
Ware Total	75.33	7.00	8.17	2.37	1.64	3.40	0.87	0.02	0.06	0.57	0.07	0.49
Total						100						

potsherds, and three potsherds belonging to the later period.[49] Finally, Alizadeh reported an unpublished ceramic collection curated at the Oriental Institute of the University of Chicago, which was found in the 1937 season of excavation at Tall-e Bakun A.[50] His report showed 144 diagnostic BOBW ceramic vessels, one VCW vessel, 10 MCW vessels, one red ware vessel, and three potsherds from the later periods.

Unpublished ceramic materials from Tall-e Bakun A

I analysed ceramic materials from Masuda's trench at Tall-e Bakun A for a quantitative analysis of wares and vessel forms. The ceramic materials are now stored at UMUT. All the collected ceramic materials were shipped to Japan with permission for further analysis.[51] The total count of potsherds from Masuda's trench curated at UMUT amounts to 1861 potsherds (55 kg including 266 tiny pieces. Table 6.2). The well-preserved ceramics were returned to Iran after the analysis and publication. The other well-preserved vessels were preserved at UMUT after reconstruction with plaster. The weights of the well-preserved ceramics that were either returned or reconstructed (37 vessels) could not be measured.

Counts and weights of wares from Tall-e Bakun A

In Chapter 5, I could not reconstruct the stratigraphy of the materials from Tall-e Bakun A curated at UMUT following the excavator's stratigraphy (Level I-IV). Hence, I reconstructed the stratigraphy of Masuda's trench at Tall-e Bakun A based on excavation date (from September 25 to September 29). Table 6.29 illustrates the counts and proportions of wares found at each excavation date at Masuda's trench of Tall-e Bakun A. The complete vessels and rim sherds at Tall-e Bakun A consisted mostly of BOBW (67-96 %, Median: 89 %). The proportion of MCW increased over time (2-33 %, Median: 11 %). In complete vessels and rim sherds, red burnished Lapui ware was confirmed only on 9/26. In neck and body parts, BOBW was the most predominant. The proportion of the red burnished ware increased slightly over time (0.9-7 % Median: 3 %). MBOBW (mineral-tempered Black-on-Buff Ware) appeared on 9/27. The weight and proportion of wares found at each excavation date at Masuda's trench at Tall-e Bakun A are presented in Table 6.30. The proportion of weight in wares shows a similar pattern to the count proportion of neck and body sherds in the table.

[49] Egami and Masuda 1962.
[50] Alizadeh 2006.
[51] Nishiaki 2003.

Vessel forms, rim shapes, base shapes of BOBW from Tall-e Bakun A

Vessel forms of BOBW

Table 6.31 shows counts and the proportions of BOBW vessel forms found at each excavation date at the Japanese trench of Tall-e Bakun A. For the dates on which more than 15 complete vessels and rim sherds were found (9/26, 9/28, 9/29), the proportions of exterior-painted open vessels (47-60 %, Median: 48 %), interior-painted vessels (30-42 %, Median: 36 %), and large jars (8 - 11 %, Median: 8 %) are predominant. An interesting point is that open vessels painted on both sides account for 8–20% (Median: 14 %) in some contexts (9/26, 9/27). Furthermore, for neck and body sherds (Table 6.31), the proportions of exterior-painted open vessels (9/26: 32 % and 9/29: 27 %), interior-painted open vessels (10 and 7 %), open vessels with both sides painted (2 and 1 %), unpainted parts of open vessels (31 and 31 %), and large jars (25 and 34 %) are similar between the 9/26 and 9/29 excavation dates, which include more than 200 potsherds. The predominance of large jar body sherds was also confirmed at Tall-e Bakun A and Tall-e Gap. This also implies the large body size of a large jar at Tall-e Bakun A.

Rim shape of BOBW from Masuda's trench and published vessels

Below, I compare 1) the rim shapes of BOBW from Masuda's trench curated at UMUT with 2) the rim shapes of published complete vessels. Whereas the exterior-painted open vessels have only a simple rounded rim shape (Table 6.32), interior-painted open vessels have a flat rim shape as well as a simple rounded rim shape. A semi-incurved rim shape was observed in vessels painted on both sides. Large jars have three types of rim shapes: simple rounded, grooved, and flat. The simple rounded rim shape is the majority in large jars.

Furthermore, I present the rim shape classification result of 142 published complete vessels (Table 6.33). There are 33 undistinguished vessels for which the rim shape information is absent. The simple rounded rim shape is the most common. A semi-incurved rim shape was also clearly confirmed at Tall-e Bakun A. Table 6.33 shows the relationship between rim shapes and the complete closed vessel forms that have been published before. A simple rounded rim was preferred in large jars. Alongside the simple rounded rim shape, a flat rim shape was also applied to large jars. Although a rim shape with a brim was not confirmed in the UMUT collection, it was reported in published small jars.

Table 6.31 Count (upper) and proportion (lower) of BOBW vessel

Ware	BOBW									
Part	Complete		Rim						Neck	
Level/ Vessel form	unpainted open vessel	large jar	small jar	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on both sides	incurved-rim open vessel	large jar	small jar	large jar
surface collection	-	-	-	-	-	-	-	-	-	-
9/25.	-	-	-	2	-	-	-	-	-	1
9/26.	-	-	-	12	9	2	-	2	-	-
9/27.	-	-	-	2	1	1	-	1	-	-
9/28.	-	-	1	12	6	-	-	1	-	-
9/29.	-	-	-	9	8	-	-	2	1	-
Level I	-	1	-	-	-	-	-	-	-	-
Levels I-III.	-	-	-	-	-	-	-	-	-	-
Levels I-IV.	1	-	3	26	16	-	2	5	-	1
Level IV	-	1	-	2	2	1	-	1	-	1
unknown	-	-	-	9	9	-	-	-	-	3
Total	1	2	4	74	51	4	2	12	1	6

Ware	BOBW + MBOBW									
Part	Complete + Rim									
Level/ Vessel form	unpainted open vessel		small jar	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on both sides	incurved-rim open vessel	large jar	small jar	large jar
surface collection	-		-	-	-	-	-	-	-	16.67
9/25.	-		-	100	-	-	-	-	-	58.49
9/26.	-		-	48	36	8	-	8	-	25.45
9/27.	-		-	40	20	20	-	20	-	56.88
9/28.	-		5	60	30	-	-	5	-	9.87
9/29.	-		-	47.37	42.11	-	-	10.53	0.34	34.01
Level I	-		-	-	-	-	-	100	-	-
Levels I-III.	-		-	-	-	-	-	-	-	100
Levels I-IV.	1.852		5.556	48.15	29.63	-	3.70	11.111	-	15.79
Level IV	-		-	28.57	28.57	14.29	-	28.57	-	40.48
unknown	-		-	47.37	47.37	-	-	5.26	-	53.85
Vessel form Total	-		2.63	48.68	33.55	2.63	1.32	7.89	0.084	35.47
Total	100									

forms found in each context at Masuda's trench at Tall-e Bakun A

Body					Others			MBOBW		
								Rim	Neck	Body
open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on both sides	unpainted part of open vessel	large jar	plate	box	misfired object	large jar	large jar	large jar
4	1	-	-	1	-	-	-	-	-	-
13	7	2	-	30	-	-	-	-	-	-
70	21	4	69	55	-	1	2	-	-	1
28	6	3	10	59	-	-	4	-	-	3
62	18	8	49	14	-	-	1	-	-	1
78	22	2	91	100	-	-	4	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	1
54	2	5	3	8	1	-	2	1	2	1
14	4	1	6	16	-	-	1	-	-	-
53	14	1	40	80	-	-	-	1	-	43
376	95	26	268	363	1	1	14	2	2	50

Neck + Body			
open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on both sides	unpainted part of open vessel
66.67	16.67	-	-
24.53	13.21	3.77	-
31.82	9.55	1.82	31.36
25.69	5.50	2.75	9.17
40.79	11.84	5.26	32.24
26.53	7.48	0.68	30.95
-	-	-	-
-	-	-	-
71.05	2.63	6.58	3.95
33.33	9.52	2.38	14.29
22.65	5.98	0.43	17.09
31.68	8.00	2.19	22.58
100			

Table 6.32 Count of BOBW rim shapes found in each context at Masuda's trench at Tall-e Bakun A

Vessel form	open vessel painted on its exterior	open vessel painted on its interior		open vessel painted on both sides		unpainted open vessel	incurved-rim vessel	small jar	large jar			
Level/ rim shape	simple rounded	simple rounded	flat	simple rounded	semi-incurved	simple rounded	simple rounded	simple rounded	simple rounded	grooved	flat	undistin-guishable
9/25.	2	-	-	-	-	-	-	-	-	-	-	-
9/26.	11	4	4	2	-	-	-	-	2	-	-	-
9/27.	2	1	-	-	1	-	-	-	-	-	1	-
9/28.	12	6	-	-	-	-	-	1	1	-	-	-
9/29.	10	7	-	-	-	-	-	-	1	-	-	1
Level I	-	-	-	-	-	-	-	-	-	-	1	-
Levels I-IV.	26	9	7	-	-	1	2	3	2	2	1	1
Level IV	2	1	1	1	-	-	-	-	1	-	1	-
unknown	9	6	3	-	-	-	-	-	-	-	1	-
Total	74	34	15	3	1	1	2	4	7	2	5	2

Base shape of BOBW from Masuda's trench and published vessels

The count of BOBW base shapes at Masuda's trench of Tall-e Bakun A is displayed in Table 6.34. Exterior-painted open vessels have few variations in their ring bases, either simple rounded or square flat. A new type of ring base, a high ring base, appeared in exterior-painted open vessels. The count of flat bases exceeds that of ring bases in exterior-painted open vessels. In addition, a conical base and a pointed base appeared at Tall-e Bakun A. This major change in the base shape was not confirmed in interior-painted open vessels. Ring bases, including simple rounded, square flat, and grooved ring base shapes, are more predominant than flat bases or sub-round bases in interior-painted open vessels. Open vessels painted on both sides have only grooved-edge ring bases. Open vessels whose painted side is unclear have more ring bases than flat bases. Following a simple rounded ring base, a grooved ring base is the second most common of these samples. Large jars have only flat bases.

The base shapes of the published complete vessels more clearly show the diversity of base shapes at Tall-e Bakun A (Table 6.35). In exterior-painted open vessels, vessels without ring bases outnumber those with ring bases. A simple rounded ring base was preferred. Ring bases vary not only in their edge shape but also in their length. In vessels without ring bases, a flat base, a round base, a conical base, and a pointed base are common. Bases of large jars are usually flat, but one ring base and two round bases of large jars were also found. A ring base became popular in small jars at Tall-e Bakun A.

Complete vessel forms and vessel sizes from Tall-e Bakun A

Estimate of complete vessel forms from potsherds

The procedure of identifying complete vessel forms from potsherds using the publication report was the same as that used for Tall-e Gap (Sections 4-2 or 6-3). As analysed in Chapter 4, there were 123 complete vessels or vessels well preserved from the rim to the base at Tall-e Bakun A. Tall-e Bakun A also has the largest variety of complete vessel forms. Table 6.36 indicates the correlation between complete vessel forms and painted sides in the published drawings of the ceramics from Tall-e Bakun A. Exterior-painted decoration was applied to all existing complete vessel forms, mainly to deep bowls (25 examples), conical bowls (24 examples), hemispherical bowls (15 examples), beakers (10 examples), funnel-shaped vessels (nine examples), and incurved rim vessels (five examples). These complete vessel forms can be distinguished by their base shapes (conical base →

Table 6.33 Count of BOBW rim shapes found in published complete vessels at Tall-e Bakun A

Rim shape/ Vessel form	Open vessel					Closed vessel	
	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on both sides	open vessel painted on its rim	unpainted open vessel	small jar	large jar
simple rounded	53	7	1	3	9	-	6
flat	-	-	-	-	-	-	5
pinched outside	1	1	-	-	-	-	1
beaded	-	-	-	1	-	-	-
semi-incurved	9	3	2	-	-	-	-
horizontal brim	-	-	-	-	-	3	1
droped brim	-	-	-	-	-	1	-
undistinguishable	32	-	1	-	-	-	2

conical bowl, round base → hemispherical bowl). On the other hand, a shallow bowl was correlated with interior-painted decoration (four samples), decoration painted on both sides (three samples), and exterior-painted decoration (three samples). These results suggest the difficulty of estimating original vessel forms of potsherds using rim angles and painted sides at Tall-e Bakun A.

Rim angles and vessel sizes at Tall-e Bakun A

The rim angles and vessel sizes of each vessel form using the published data at Tall-e Bakun A were already presented in Chapter 4 to define complete vessel forms. In addition, Pollock carried out the volume analysis of the published ceramic materials from Tall-e Bakun A.[52] Here, I present only the correlation between rim angles, rim diameters, vessel heights, and vessel forms (Table 6.37). First, the median rim angle of the exterior-painted open vessels (102.5°) does not show a distinct difference from that of interior-painted open vessels (110°) as seen at Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap. The median rim angle of open vessels painted on both sides (120.5°) is also larger than that of interior-painted vessels. The rim angles of both large jars (90-140°, median: 97°, CV: 0.115, N=15) and small jars (91-121°, median: 100°, CV: 0.091, N=9) are oriented to upright.

Second, the median rim diameter and vessel height of exterior-painted open vessels (17 cm, 14 cm) became larger than that of interior-painted open vessels (13.5 cm, 11 cm), indicating a change in relationship between exterior-painted ones and interior-painted ones. The median rim diameter of large jars (14 cm, size: 9 – 25 cm, CV: 0.264) is clearly different from that of small jars (9 cm, size: 4 – 11 cm, CV: 0.257).

[52] Pollock 2012.

I also describe the vessel sizes of other wares at Tall-e Bakun A. Four complete MCW vessels were published in the excavation reports by Langsdorff and McCown and Alizadeh.[53] Only one complete vessel had a pair of knobs on its body. The rim diameters of MCW at Tall-e Bakun A were 8 cm, 14 cm, 18 cm, and 36 cm (Median: 16 cm). The rim angles of MCW at Tall-e Bakun A were 67°, 73°, 85°, and 85° (Median: 79°). The wall thicknesses 3 cm below the rim of MCW at Tall-e Bakun A were 7 mm, 10 mm, 12 mm, and 14 mm (Median: 11 mm). Both a simple rounded rim and a flat angular rim were confirmed in the MCW. A round base and a flat base were observed in the published complete MCW vessels. A square flat ring base and a flat-low bottom ring base of MCW were also confirmed at the excavation of Masuda's trench.[54]

Here, the diachronic changes of wares, vessel forms, and vessel sizes at Tall-e Bakun A are recapitulated:

1) BOBW was still predominant at Tall-e Bakun A. A small portion of MBOBW, MCW, and red burnished ware were confirmed.
2) Exterior-painted open vessels were still predominant in vessel forms. In addition, new base shapes such as a conical base and a pointed base appeared in the exterior-painted open vessels.
3) The largest variety of complete vessel forms was confirmed at Tall-e Bakun A. The difference between the rim angles and vessel sizes of exterior-painted open vessels and interior-painted ones became smaller.

[53] Langsdorff and McCown 1942: Pl. 17:1, 18: 1, 4; Alizadeh 2006: Fig. 53:1.

[54] Egami and Masuda 1962: Fig. 12: 8-10.

Table 6.34 Count of BOBW base shapes found in

Vessel form	open vessel painted on its exterior							open vessel painted on its interior		
Presence of ring base	ring base (standard size)		ring base (high)	without ring base				ring base (standard size)		
Level/ Base shape	simple rounded	square flat	simple rounded	flat base	conical	conical or pointed	pointed	simple rounded	square flat	grooved
9/25.	-	-	1	-	-	-	-	-	-	-
9/26.	-	-	-	2	-	-	-	1	1	-
9/27.	-	-	-	-	-	1	1	-	-	1
9/28.	-	-	-	3	-	-	-	1	1	-
9/29.	-	-	-	-	-	-	-	-	-	-
Level I	-	-	-	-	-	-	-	-	-	-
Levels I-IV	2	-	-	2	3	-	-	1	-	1
Level IV	-	-	-	-	-	-	-	-	-	-
unknown	-	1	-	-	-	-	-	-	-	1
Total	2	1	1	7	3	1	1	3	2	3

Table 6.35 Count of BOBW base shapes found in published complete vessels at Tall-e Bakun A

Base shape/ Vessel form			Open vessel					Closed vessel	
			open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on both sides	open vessel painted on its exterior joint	unpainted open vessel	small jar	large jar
with ring base	standard	simple rounded ring base	11	4	3	-	-	4	1
		angular ring base	2	1	-	-	-	-	-
		flat ring base	2	-	-	-	-	1	-
		grooved ring base?	1	-	-	-	-	-	-
		flat bottom ring base	1	-	-	-	-	-	-
		ring base	5	-	-	-	-	-	-
	small	simple rounded ring base	1	-	-	-	-	-	-
	high	simple rounded ring base	-	2	-	-	-	-	-
		ring base	2	-	-	-	-	-	-
without ring base		flat base	15	3	-	2	6	3	11
		sub-round base	0	-	-	-	1	-	-
		round base	18	1	-	2	1	2	2
		conical base	14	-	-	-	-	-	-
		conical/pointed base	1	-	-	-	-	-	-
		pointed base	22	-	-	-	-	-	-
undistinguishable			1	-	1	-	-	1	1

each context at Masuda's trench at Tall-e Bakun A

		open vessel painted on both sides	open vessel painted on its exterior joint					unpainted part of open vessel			unpainted part of large jar
without ring base		ring base (standard size)	ring base (standard size)					without ring base			without ring base
flat base	sub round	grooved	simple rounded	square flat	square diagonal	grooved	undistinguishable	flat base	sub round	conical	flat base
-	-	-	1	-	-	-	-	-	-	-	1
-	-	1	2	1	-	3	-	-	-	-	3
-	-	-	-	1	-	-	-	-	-	-	-
2	-	-	1	-	-	2	-	-	-	-	-
-	-	-	-	1	-	1	-	1	1	-	-
-	-	-	-	-	-	-	-	-	-	-	1
-	-	1	-	-	-	1	4	-	1	1	-
-	-	-	-	-	-	1	-	-	-	-	1
-	1	-	7	-	1	-	1	-	-	-	2
2	1	2	11	3	1	8	5	1	2	1	8

Table 6.36 The correlation between published complete open vessels of BOBW and their painted sides in Tall-e Bakun A

Complete vessel form/ painted sides of open vessels	open vessel painted on its exterior	open vessel painted on its interior	open vessel painted on both sides	open vessel painted on its rim	unpainted open vessel
beaker	10	-	-	-	-
funnel-shaped vessel	9	-	-	-	-
deep bowl	25	2	1	-	3
hemispherical bowl	15	4	-	3	-
conical bowl	24	-	-	-	-
shallow bowl	3	4	3	-	2
incurved rim vessel	5	-	-	-	-
miniature vessel	4	1	-	1	4
Total	95	11	4	4	9

6-5. Discussion: diachronic change of wares and vessel forms between sites

Above, I presented the diachronic changes of wares and vessel forms at each site using a quantitative approach. To understand the longer-term diachronic changes, an inter-site comparison of ceramic assemblages is required. In this section, I group the ceramic materials from the whole context within one site together, except for surface collection and Level BI of McCown at Tall-e Bakun B. Then, I compare wares and vessel forms between each site.

Table 6.37 BOBW rim angles, rim diameters, and vessel heights of vessel forms in published complete vessels from Tall-e Bakun A. D: diameter, CV: coefficient of variation

open vessel painted on its exterior	rim angle (°)	rim D (cm)	Height (cm)
max	128	36	29
min	60	3	4
median	102.5	17	14
CV	0.106	0.397	0.410
Sample N	90	81	81

open vessel painted on its interior	rim angle (°)	rim D (cm)	Height (cm)
max	126	34	19
min	102	7	4
median	110	13.5	8.5
CV	0.057	0.459	0.477
Sample N	11	11	11

open vessel painted on its rim	rim angle (°)	rim D (cm)	Height (cm)
max	108	13	8
min	98	6	4
median	103	10	5.5
CV	0.035	0.293	0.257
Sample N	4	4	4

open vessel painted on both sides	rim angle (°)	rim D (cm)	Height (cm)
max	122	25	15
min	115	20	12
median	120.5	24	13
CV	0.023	0.095	0.088
Sample N	4	5	5

unpainted open vessel	rim angle (°)	rim D (cm)	Height (cm)
max	135	18	7
min	88	5	3
median	96	7	6
CV	0.142	0.458	0.275
Sample N	11	11	11

Diachronic change of wares

Counts and weights of wares

Fig. 6.2 illustrates the counts and proportions of wares found at four Bakun-period sites. Only Tall-e Gap had two analytical units to consider the spatial bias. As a general trend, the proportion of BOBW increased over time and reached its peak at Tall-e Gap. In contrast, the percentage of VCW decreased, and MCW alternatively appeared at Tall-e Gap. In contrast to the rapid decrease of VCW, there were fewer changes in the proportion of MCW between Tall-e Gap and Tall-e Bakun A. It is also possible that this continuity between Tall-e Gap and Tall-e Bakun A is due to the slight chronological overlap. MBOBW and red burnished ware were observed only at Tall-e Bakun A.

Although the chronological relationship between Level I of Tall-e Jari A and Level BII of Tall-e Bakun B is more or less contemporaneous from the viewpoint of radiocarbon dates, as explained in Chapter 5, the proportion of BOBW at Tall-e Bakun B was higher than at Tall-e Jari A. There are two hypotheses to explain the difference in the proportion of BOBW between Level I of Tall-e Jari A and Level BII of Tall-e Bakun B:

1) If it is true that the percentage of BOBW increased over time, then Tall-e Jari A is older than Level BII of Tall-e Bakun B. There was a problem with radiocarbon dating.
2) Tall-e Bakun B lacked clear evidence of buildings. Thus, the low proportion of VCW in ceramic materials from Level BII of Tall-e Bakun B was a result of the more mobile way of life, which involved less VCW. Radiocarbon dating was correct.

As it stands, I cannot confirm which hypothesis is correct. The weight of wares at each site is compared in Fig. 6.3. The proportion of BOBW weights increased over time, as well as that of BOBW counts.

Total number and weight of wares per m^3 (density)

I also calculated the amount of excavated ceramic material per 1 m^3 by dividing the amount by the soil volume of each excavated trench (Fig. 6.5). The soil volumes were calculated following the schematized

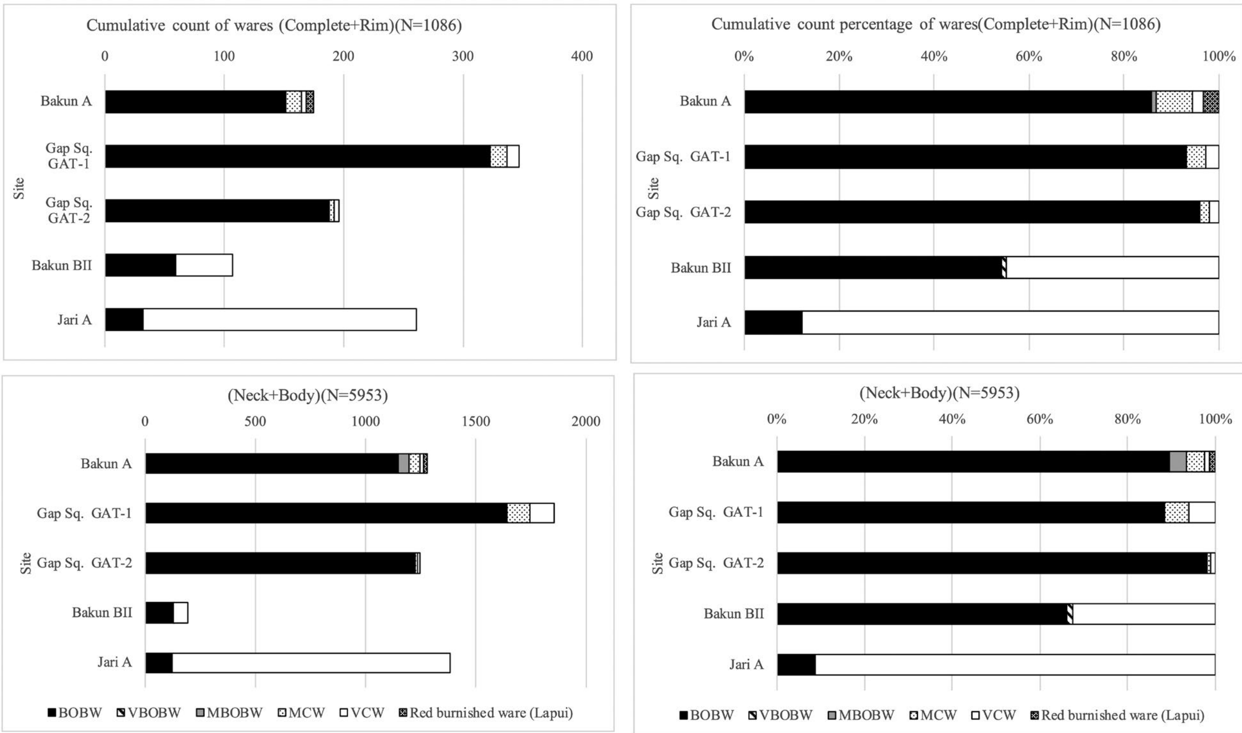


Figure 6.2 Count (left) and count percentage (right) of wares found in each site. Upper two graphs show counts of complete vessels and rim sherds. Lower two graphs show counts of neck and body sherds

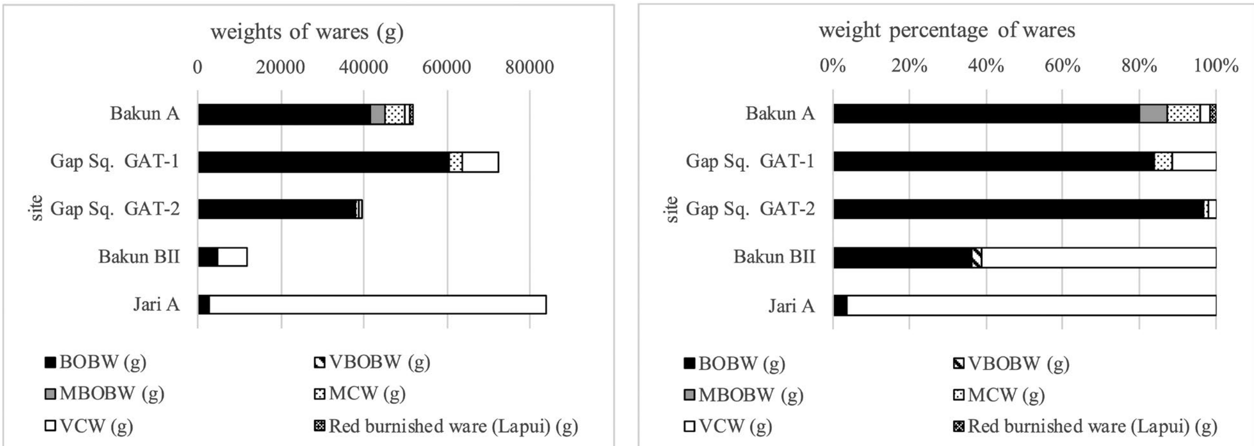


Figure 6.3 Weight (left) and weight percentage (right) of wares found in each site

sections and plans of excavated trenches (Fig. 6.4). As for Tall-e Jari A, I calculated the soil volumes of three excavation trenches: Section C, Section D, and Sections C and D. That is because it is unclear whether the excavation-trench alphabets written on the wooden boxes of the ceramic materials from Tall-e Jari A correspond to the 'Section' alphabet as explained in Section 5-1. The estimated soil volumes at each trench are as follows: 'Section C' of Tall-e Jari A: 84.24 m^3; 'Section D' of Tall-e Jari A: 104.05 m^3; 'Sections C and D' of Tall-e Jari A: 188.29 m^3; Level BII of the Japanese trench at Tall-e Bakun B: 32.4 m^3; Square GAT-1 of Tall-e Gap: 24.56 m^3; Square GAT-2 of Tall-e Gap: 36.08 m^3, and the Japanese trench at Tall-e Bakun A: 68.97 m^3.

In total number and weight, the pottery density at Level BII of Bakun B and the integration of Sections C and D of Tall-e Jari A were the lowest, and that at Square GAT-1 of Tall-e Gap was the highest (Fig. 6.5). First, the pottery density in Square GAT-1 of Tall-e Gap (85 potsherds/m^3 and 2944 g/m^3) was twice as high as that in Square GAT-2 (42 potsherds / m^3 and 1094 g/m^3). This shows a vivid spatial bias within the same site (Tall-e Gap). Second, it is clear that the density of BOBW increased exponentially over time and then declined. This suggests the increase and subsequent decrease of the amount of BOBW production. In contrast, the densities of VCW and MCW did not show such rapid changes over time. This suggests that BOBW increased not relatively to VCW but regardless of VCW.

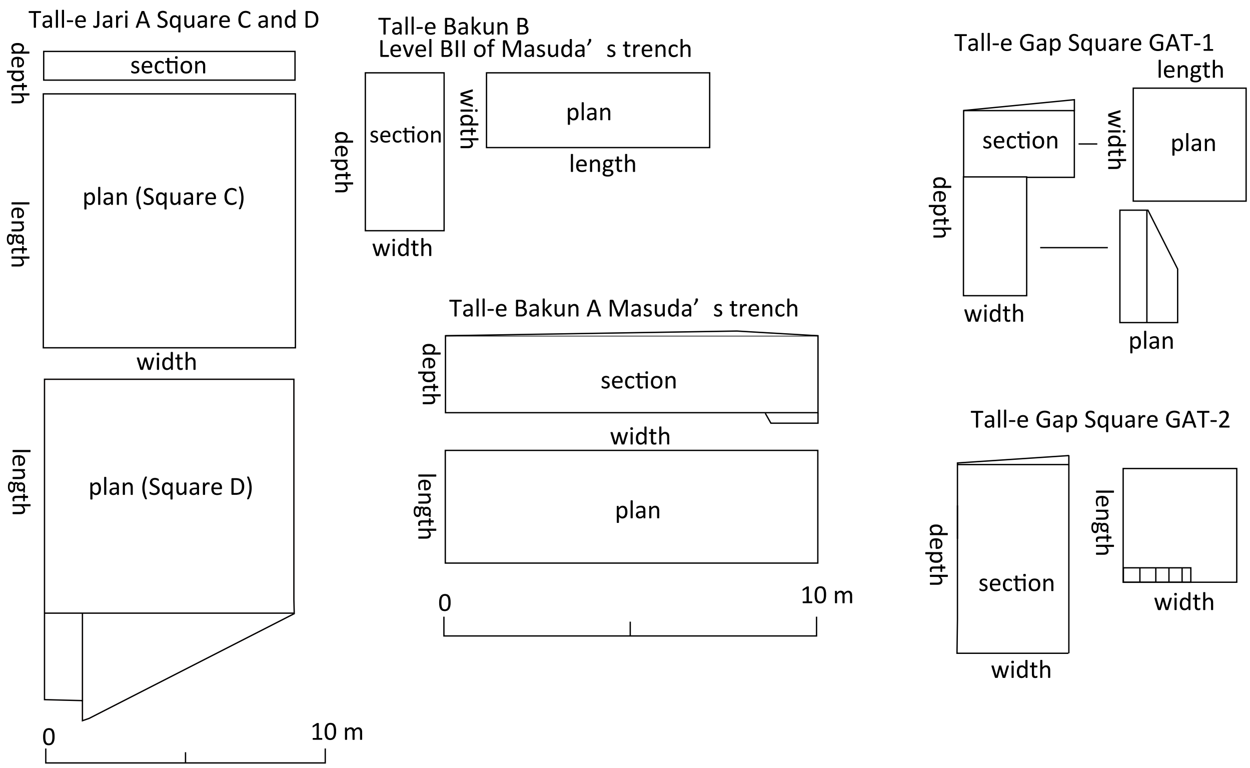


Figure 6.4 Schematic plans and sections for calculating the soil volume of each site

Diachronic change of vessel forms, rim shapes, base shapes of BOBW

Vessel forms of BOBW

Fig. 6.6 shows the inter-site comparison of BOBW vessel forms. In complete vessels and rim sherds, the proportion of interior-painted open vessels at Tall-e Jari A (56 %) decreased gradually until Tall-e Gap (29%, 32%), and the proportion remained unchanged at Tall-e Bakun A. Contrary to interior-painted open vessels, the numbers of exterior-painted open vessels increased from Tall-e Jari A (31%) to Tall-e Gap (53%, 53%), and the increase stopped at Tall-e Bakun A (49 %). Large jar rim sherds were confirmed from Level BII of Tall-e Bakun B. The rates of large jar sherds were stable from Tall-e Bakun B to Tall-e Bakun A (from Bakun BII to Bakun A: 6%, 10%, 10%, 9%). Small jars consisted of approximately 2% of the assemblage from Tall-e Jari A to Tall-e Bakun A (3%, 5%, 0.5%, 0.9%, 2%). A similar case was true for hole-mouth vessels with holes. Open vessels painted on both sides appeared at Tall-e Gap and increased gradually. Unpainted open vessels were present at Tall-e Gap but were the minority.

In necks and body sherds, the rates of exterior-painted open vessels (from Jari A to Bakun A: 34%, 43%, 24%, 31%, 33%) were higher than those of interior-painted open vessels (from Jari A to Bakun A: 7%, 19%, 9%, 12%, 8%). That is perhaps because of the high proportion of unpainted parts of open vessels, some of which possibly belonged to interior-painted open vessels. The rates of large jar body and neck sherds at Tall-e Jari A and Tall-e Bakun B were 12% and 14%, respectively. However, from Tall-e Gap, the rates increased to 30–50% (from Gap to Bakun A: 50 %, 44 %, 32 %). This suggests that large jars became common and larger in vessel size for storage.

Rim and base shape of BOBW

The inter-site comparison of the rim shape of BOBW is displayed in Fig. 6.7. A simple rounded rim shape was predominant in exterior-painted open vessels at all the sites (Fig. 6.7: A). Rim shapes of BOBW did not show major diachronic changes. However, several changes were observed. At Tall-e Bakun A, especially in the interior-painted open vessels, the rate of a flat rim increased (12 %) (Fig. 6.7: B). In large jar rim shapes (Fig. 6.7: C-D), only a simple rounded rim edge was present at Tall-e Bakun B. This rim shape was still preferred in Tall-e Gap and Bakun A. On the other hand, a flat rim shape was present from Tall-e Gap, as well as a simple rounded rim shape and a grooved rim shape.

Fig. 6.8 presents the inter-site comparison of BOBW base shapes. Base shapes show clear diachronic changes in contrast to rim shapes. First, in exterior-painted open vessels (Fig. 6.8: A), the proportion of ring bases decreased over time. Instead, flat bases, sub-round bases, and conical/pointed bases occupied the majority of base shapes during the later phase of the Bakun period. Second, this replacement of the ring base by

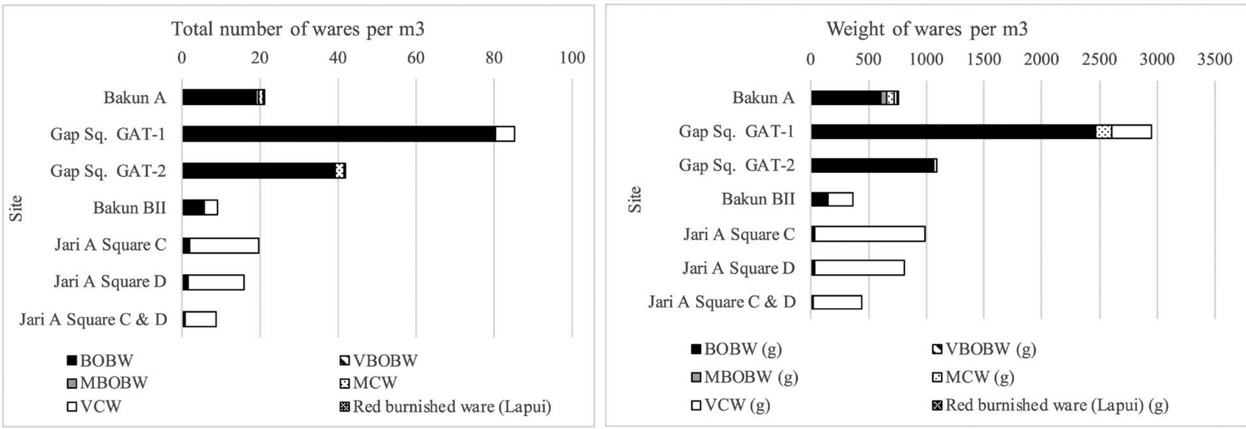


Figure 6.5 Total number (left) and weight (right) of wares per m3 found in each site

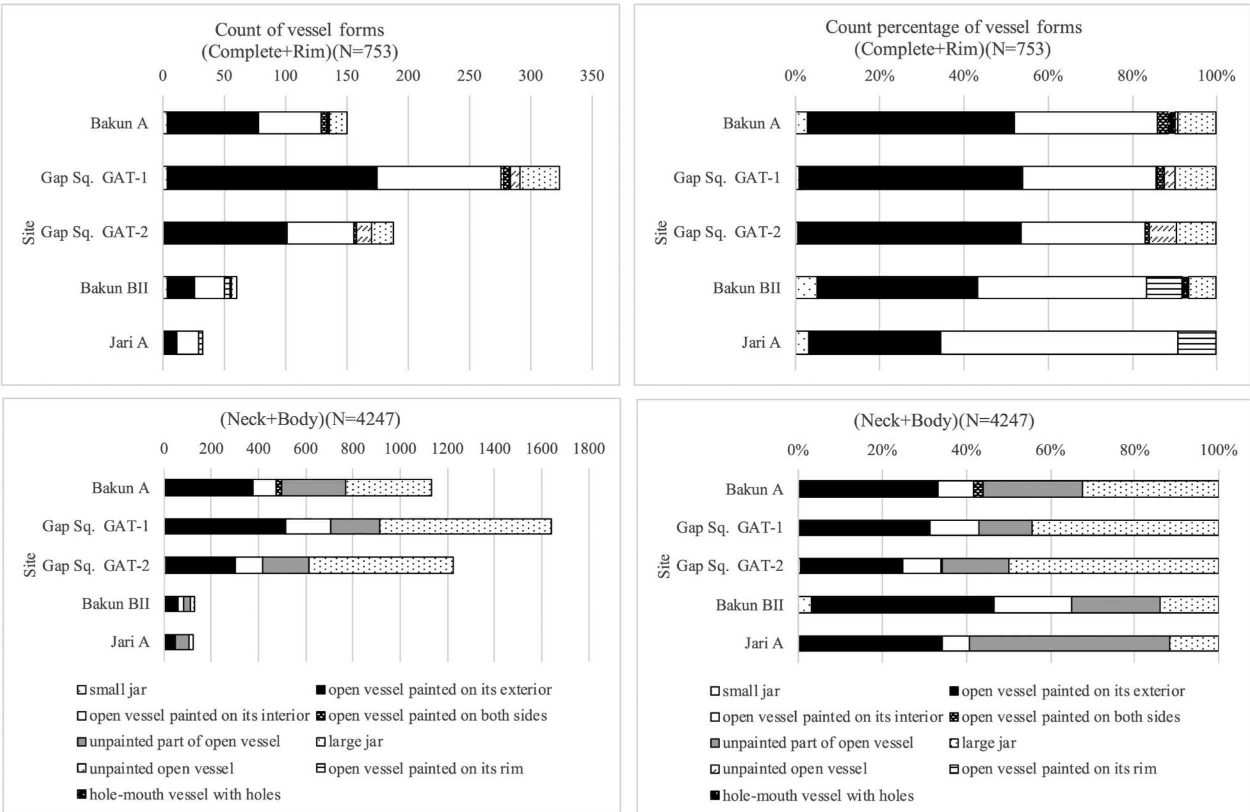


Figure 6.6 Count (left) and count percentage (right) of BOBW vessel forms found in each site. Upper two graphs show counts of complete vessels and rim sherds. Lower two graphs show counts of neck and body sherds

the flat base was not as clear in interior-painted open vessels (Fig. 6.8: B), and ring bases continued to be used for those vessels. Third, ring base shapes of exterior-painted open vessels were further subdivided (Fig. 6.8: C). A simple rounded ring base predominated, except for a square diagonal ring base at Tall-e Gap. Fourth, in interior-painted open vessels (Fig. 6.8: D), a flat-low bottom ring base was observed in the earlier phase Bakun-period sites, such as Tall-e Jari A and Tall-e Bakun B. These base shapes can be good chronological markers for future studies.

Diachronic change of vessel sizes and rim angles

In this section, I compare the rim angles and vessel sizes of exterior-painted open vessels and interior-painted open vessels at each site. The data used for this comparison derive from those used in Sections 6-1, 6-2, 6-3, and 6-4. Fig. 6.9 presents the inter-site comparison of rim angles (A, B), rim diameters (C, D), and vessel heights (E, F) of open vessels using boxplots. First, the rim angles of exterior-painted open vessels increased over time, whereas those of interior-painted

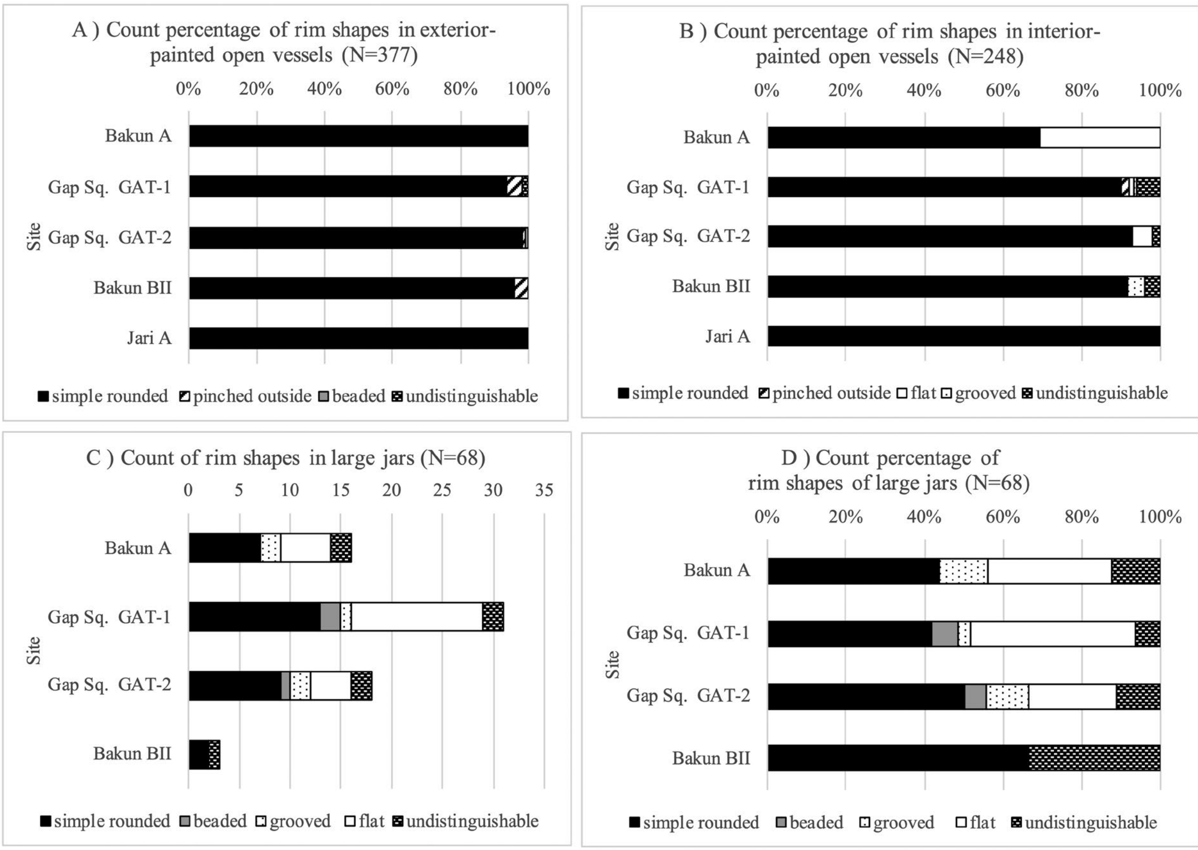


Figure 6.7 Count (C) and count percentage (A, B, D) of BOBW rim shapes of open and closed vessels found in each site

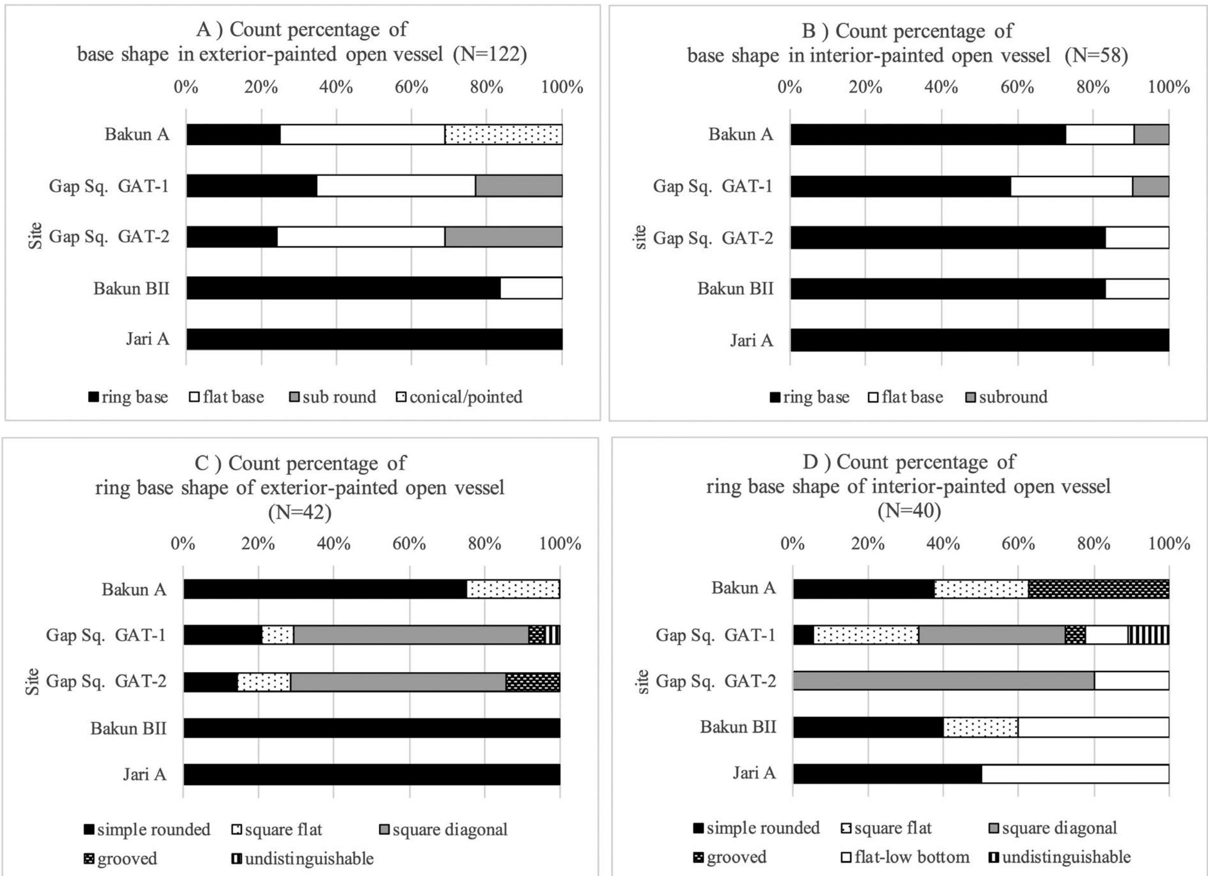


Figure 6.8 Count percentage of BOBW base shapes of open vessels found in each site

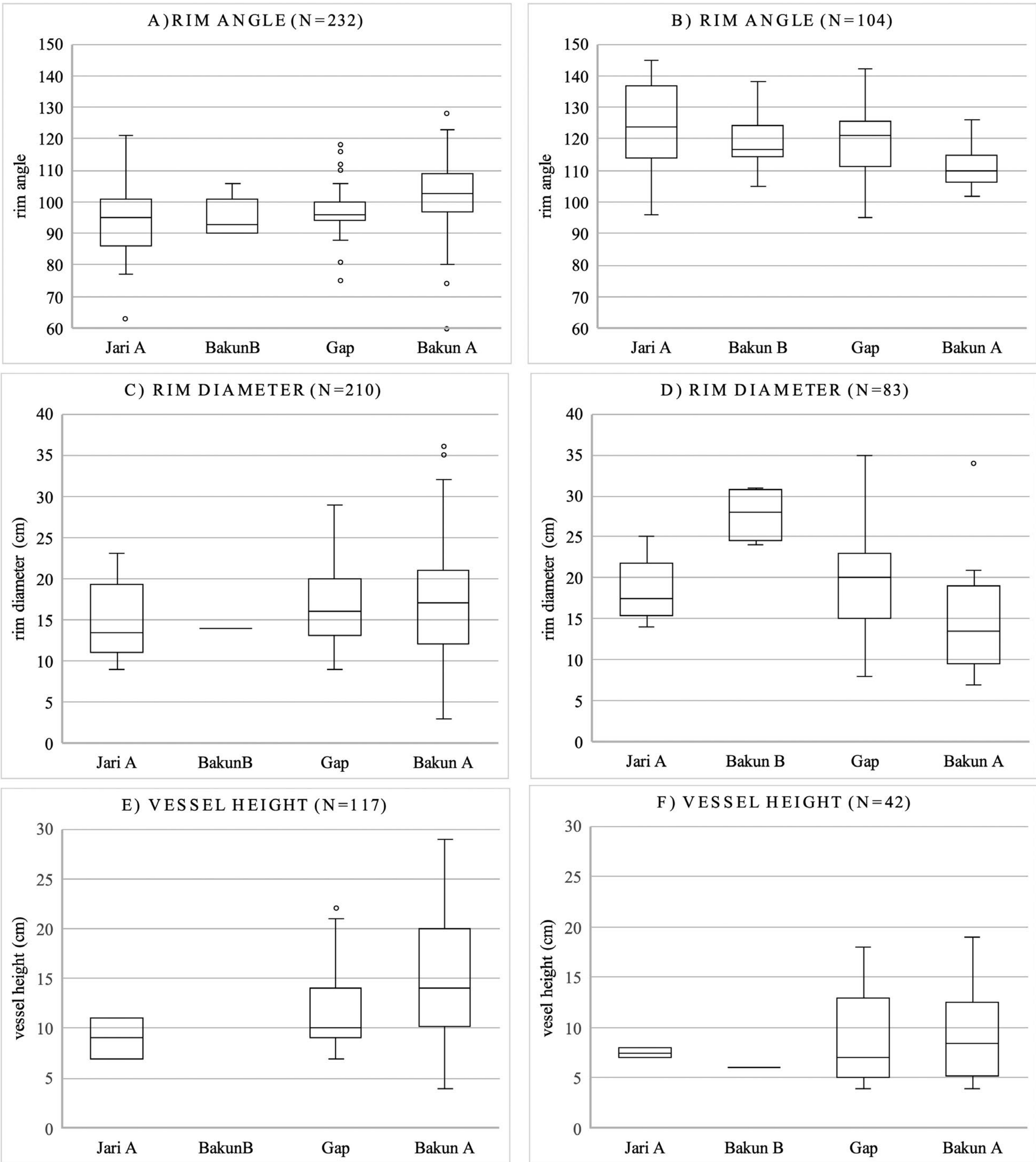


Figure 6.9 Box plots of BOBW rim angles, rim diameters, and vessel heights of exterior-painted open vessels (A, C, E) and interior-painted open vessels (B, D, F) in each site

open vessels decreased (Fig. 6.9: A-B). This suggests that the separation of rim angles between exterior-painted open vessels and interior-painted ones became less clear. This suggestion is supported by the presence of pottery painted on both sides during the later phase of the Bakun period. Second, regarding the rim diameters of exterior-painted open vessels (Fig. 6.9: C), the median rim diameter did not show a clear change, whereas the range of rim diameters became wider over time, implying the increase of vessel size classes from small-sized miniature vessels to large-sized vessels. Exceptionally large exterior-painted open vessels with rim diameters of more than 30 cm existed only at Tall-e Bakun A. In contrast, rim diameters of interior-painted vessels showed a different pattern (Fig. 6.9: D). The median rim diameter was the largest at Tall-e Bakun B and then decreased. Third, as for the vessel heights of exterior- and interior-painted open vessels (Fig. 6.9: E-F), exterior-painted ones presented an increase in their median and range, as with their rim diameters. The vessel heights of interior-painted open vessels did not show a significant change.

Summary of wares and vessel forms

In these five sections above, I presented the materials used for this thesis and tackled **Research Question No. 2:** 'When and how were black-on-buff ceramics adopted and developed in the Bakun period?' I analyse wares, vessel forms, rim and base shapes, rim angles, and vessel sizes of ceramic materials found at four sites belonging to different phases of the Bakun period to answer this question. Shorter-term diachronic changes within the stratigraphy of each site were explained in the first four sections (Sections 6-1, 6-2, 6-3, and 6-4). In the final section (6-5), longer-term diachronic changes were discussed through inter-site comparisons. Here, I summarise these longer-term diachronic changes:

1) The proportion and amount of BOBW increased over time, peaking at Tall-e Gap, whereas VCW decreased. MCW appeared at Tall-e Gap.
2) Concerning BOBW vessel forms, interior-painted open vessels decreased gradually, whereas those painted on the exterior became the majority from Tall-e Gap. The percentage of large jars remained stable, but the vessel size became larger from Tall-e Gap. Although rim shapes did not show major changes, base shape shifted from a ring base to a flat base and a conical base. The estimated complete vessel forms varied over time.
3) The difference in rim angles between exterior-painted open vessels and interior-painted ones became less clear. The median diameter of exterior-painted open vessels was relatively stable over time, whereas that of interior-painted open vessels decreased.

These results showed the diachronic changes in the preferences and demands of potters and consumers of the Bakun period. The next section will turn attention to diachronic changes of painted decorations of BOBW, especially horizontal design structures.

6-6. Horizontal design structures

In this section, I begin with the analysis of horizontal design structures at Tall-e Gap, as there are ample complete examples to analyse them at this site. I classify horizontal design structures of exterior-painted open vessels, interior-painted ones, and closed vessels based on the presence/absence of structural components, such as a body band and upper/lower optional lines, as explained in Section 4-3. Each classified pattern is described with the representative drawings, followed by analyses of those from Tall-e Jari A and Tall-e Bakun B, where samples are limited. Next, I analyse the most variable horizontal design structures at Tall-e Bakun A. Finally, I compare and discuss the results diachronically. In this section, I do not discuss vertical division of the design structures; this topic will be analysed in Chapter 8, which deals with complete vessels with whole circumferences rather than pottery drawings presenting only one side of vessels.

Horizontal design structures at Tall-e Gap

Horizontal structural patterns of exterior-painted open vessels at Tall-e Gap

The sequence model of painting horizontal design structures

To classify the horizontal design structures of exterior-painted open vessels, I developed a sequence model of painting the structural components, from (1) rim band to (2) base band, (3) body band, (4) upper optional line, (5) lower optional line, (6) upper frieze line, (7) lower frieze line, (8) frieze division line, (9) first frieze, (10) second and third friezes, and (11) secondary motifs (Fig. 6.10). I based this model on the assumption that the order of drawing lines moved from thicker lines to thinner lines and from the outskirt (rim, base) to the middle of the body. Unless the existence of the superimposition of the structure lines could be confirmed, it was difficult to confirm the actual painting sequence.

Classification of horizontal design structure patterns

I made a list of published well-preserved exterior-painted open vessels at Tall-e Gap based on horizontal design structures (Appendix Table A4.1). This list includes 31 published and unpublished complete vessels and 41 well-preserved potsherds. I recorded the presence (O), absence (X), or lack of data (N) of the structural components from rim band (1) to secondary motifs (11). Fig. 6.11 shows the presence or absence of each structural component of open vessels painted on their exteriors from Tall-e Gap. This figure shows that almost all well-preserved vessels had (1) rim bands, (2) base bands, (6) upper frieze lines, and (9) first friezes. In contrast, (11) secondary motifs were rarely observed, and ceramic vessels with (8) frieze division lines were the minority. In addition, the presence/absence of some components, such as (3) body bands and (4-5) upper/lower optional lines, were clearly separated. Hence, I classified horizontal structure patterns at Tall-e Gap, focusing especially on these minor structural components and clearly separated ones. As a result, there were seven horizontal structure patterns for exterior-painted open vessels at Tall-e Gap: GE (**Gap exterior**) 1) with body bands and upper/lower optional lines, GE2) with body bands and without upper/lower optional lines, GE3) without body bands and with upper/lower optional lines, GE4) with neither body bands nor upper/lower optional lines, GE5) with neither body bands nor upper/lower frieze lines, GE6) with multiple friezes, and GE7) with secondary motifs.

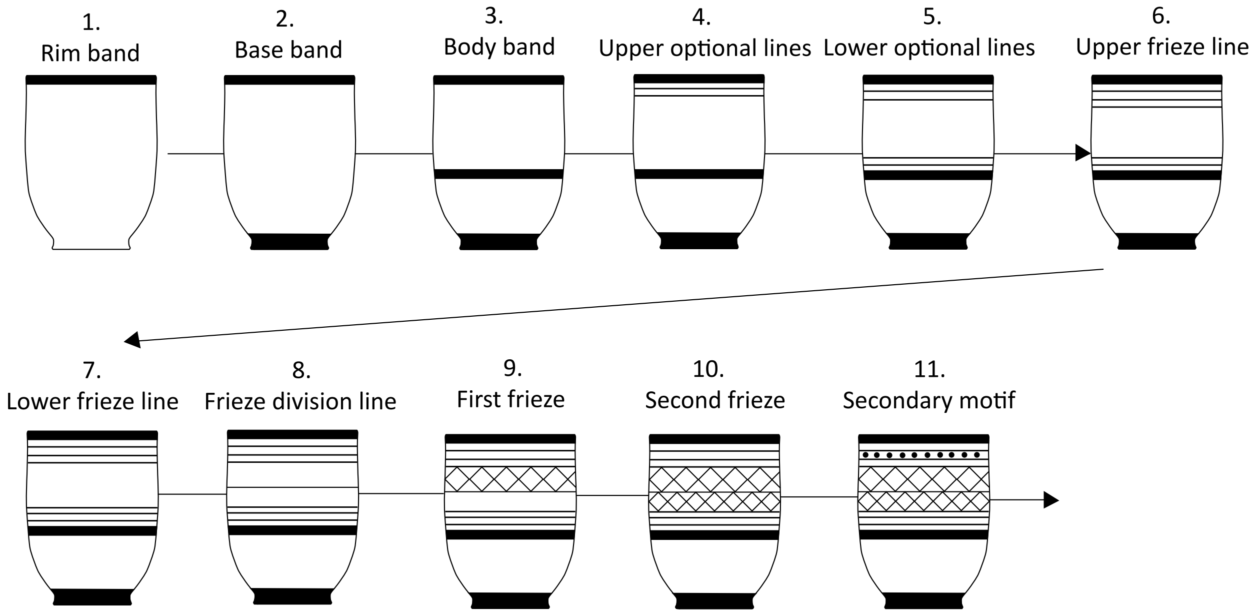


Figure 6.10 Sequence model of drawing elements of the horizontal design structure of an exterior-painted open vessel

Among these patterns, GE6 and 7 can occur with other patterns.

GE1) with body bands with upper/lower optional lines

This first structure pattern was the most frequent in open vessels painted on their exteriors at Tall-e Gap. The group consists of 39 samples and one exceptional one, which had only bands and optional lines.[55] This structure pattern was observed from Levels 17 to 4 at Tall-e Gap. The main motifs inside the friezes were geometric motifs, such as filled boxes and white boxes with vertical short lines,[56] cross-hatched boxes,[57] and >>> motifs.[58] The location of body bands had two patterns, either the upper-middle[59] or the lower part of the body.[60] The latter type was a minority and mostly appeared on small vessels. The latter type was not observed at levels higher than 10.

Table 6.38 shows an analysis of the combination of the numbers of upper/lower optional lines. Combinations of two upper optional lines and two lower optional lines (17 samples) were common at Tall-e Gap, as well as the combination of one upper optional line and one lower optional line (13 samples). It was common to draw the same number of upper/lower optional lines at Tall-e Gap; this may have been an explicit rule. On the other hand, the rest of the samples (9 samples) did not show an equal number of upper/lower optional lines. Some samples had only lower optional lines,[61] while others had only upper optional lines.[62] It is uncertain whether the rule of the same number of upper/lower optional lines was intentionally violated.

GE2) with body bands and without upper/lower optional lines

The second pattern of horizontal design structure was a minority in comparison with GE1. Nine complete and well-preserved examples were observed. This type was confirmed both in upper and lower levels at Tall-e Gap. The motif elements include cross-hatched diamonds[63] and triangles.[64] Although the majority of these samples had both upper and lower frieze lines, there were several irregular samples without lower frieze lines.[65]

GE3) without body bands and with upper/lower optional lines

This minority structure pattern had only three examples at Tall-e Gap. Because the body band was absent, the frieze extended to the whole body. This pattern was confirmed both in upper and lower levels. The motif element includes either cross-hatched diamonds[66] or zigzags and boxes with vertical short lines.[67] The same number of upper/lower optional lines was confirmed in these samples.

55 Egami and Sono 1962 Fig. 12:1.
56 Egami and Sono 1962 Fig. 13:6.
57 Egami and Sono 1962 Fig. 19:4.
58 Egami and Sono 1962 Fig. 24:3.
59 Egami and Sono 1962 Figs. 12:1; 13:6; 19:4.
60 Egami and Sono 1962 Figs. 19:2; 24:3.
61 Egami and Sono 1962 Figs. 18:6; 19:6.
62 Egami and Sono 1962 Fig. 20:12.
63 Egami and Sono 1962 Figs. 20:1, 7.
64 Egami and Sono 1962 Figs. 19:1; 21:2.
65 Egami and Sono 1962 Figs. 21:6; 24:5.
66 Egami and Sono 1962 Fig. 22:7.
67 Egami and Sono 1962 Figs. 16:1-2.

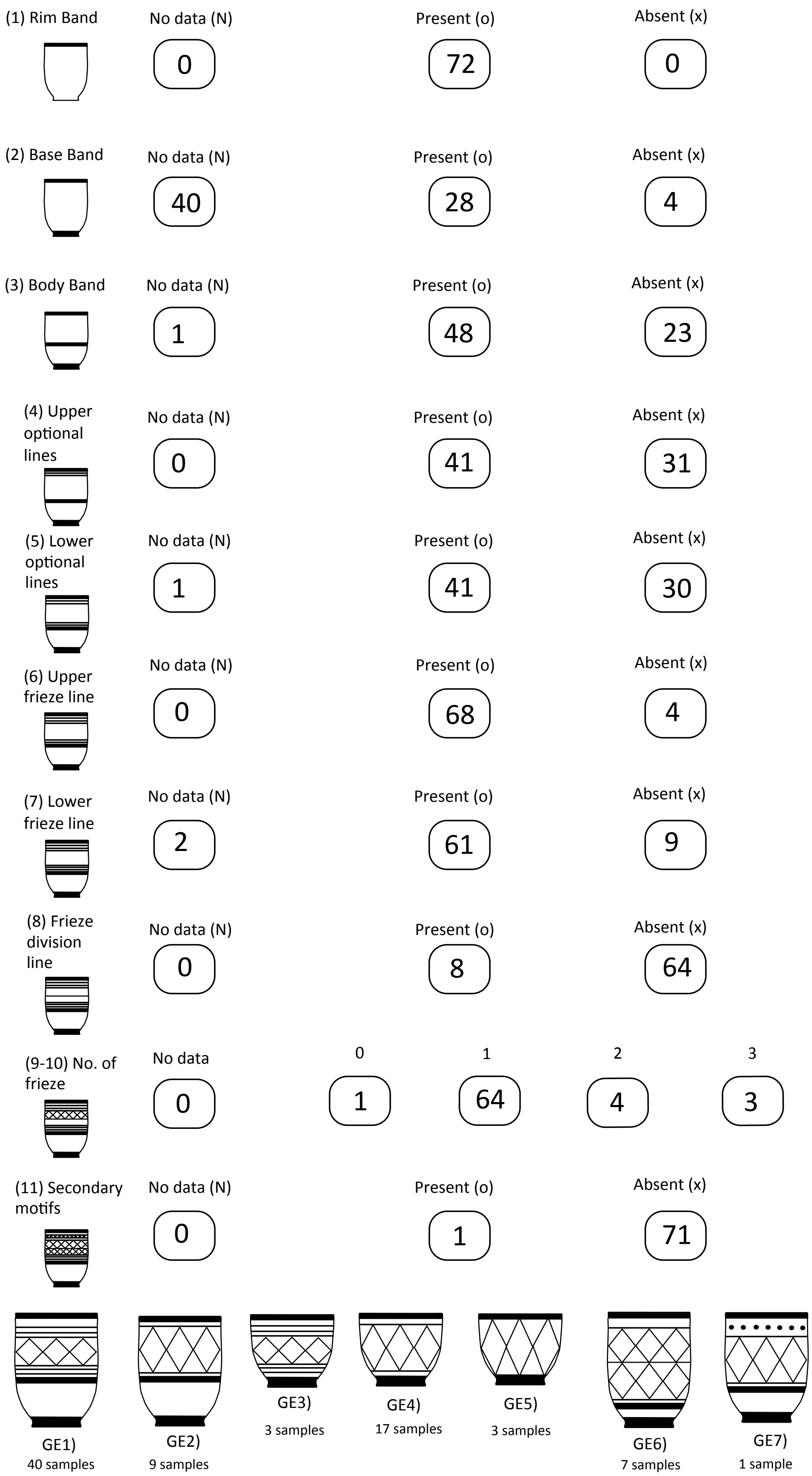


Figure 6.11 Result of the presence/absence of each structural component of open vessels painted on their exteriors at Tall-e Gap

Table 6.38 The number and proportion of upper/lower subsidiary lines of vessels with GE1 at Tall-e Gap

(No. of upper optional lines) and (No. of lower optional lines) of GE1	Total	%
0 and 1	1	2.5
0 and 2	1	2.5
1 and 0	1	2.5
1 and 1	13	32.5
1 and 2	2	5
1 and unknown	1	2.5
2 and 1	3	7.5
2 and 2	17	42.5
4 and 4	1	2.5
Total	40	100

GE4) with neither body bands nor upper/lower optional lines

Seventeen samples had this pattern of horizontal design structure, which was more common than GE3 when the body band is absent at Tall-e Gap. In addition, this pattern of horizontal design structure was more common at the upper levels at Tall-e Gap. Motifs in this pattern include zigzags and boxes,[68] dotted motifs,[69] and diamonds.[70] Several samples of this structure pattern did not have upper or lower frieze lines.[71]

GE5) with neither body bands nor upper/lower frieze lines

Three samples belong to a minor structure pattern without body bands or upper/lower frieze lines at Tall-e Gap.[72] One sample lacks even a base band.[73]

GE6) with multiple friezes

The diagnostic vessels with multiple friezes comprise seven samples at Tall-e Gap (also in Cat. 6.18: 1-2; 6.19: 1). The motifs inside the multiple friezes include diamonds[74] and wavy lines.[75] Those with two rows of friezes (four samples) were slightly more popular than those with three rows (three samples). The number of frieze division lines ranged from one to three (Cat. 6.18: 1-2; 6.19: 1).

GE7) with secondary motifs

Only one example with secondary motifs between a rim band and upper/lower frieze line was confirmed.[76] The secondary motif was short horizontal lines.

Horizontal structural patterns of interior-painted open vessels at Tall-e Gap

The sequence model of painting horizontal design structures

Like open vessels painted on their exteriors, I adopt a similar method for analysing the design structure of interior-painted open vessels—that is, modelling the sequence of drawing the elements of the horizontal design structure painted on an interior (Fig. 6.12). This model begins with the (1) interior rim band, (2) exterior base band, (3) interior base band, (4) interior concentric lines, (5) interior motif area/frieze, and (6) interior base decoration.

Classification of horizontal design structure patterns

In total, 26 published complete vessels and 35 well-preserved potsherds were recorded for the classification of the horizontal design structures of interior-painted open vessels at Tall-e Gap. I recorded the presence (O), absence (X), or lack of data (N) of the structural components. Fig. 6.13 presents the presence/absence of each structural component of open vessels painted on their interiors from Tall-e Gap. The result indicates that most of the samples had (1) interior rim bands and (5) motif areas/friezes. The presence/absence of both (3) interior base bands and (4) interior concentric lines is a good indicator to categorise the structure pattern of the interior-painted open vessels. The presence of (2) exterior base bands is also important but not suitable for the category marker because many of the published samples do not have preserved exterior base parts. Thus, I categorised two design structure patterns: GI (**Gap Interior**) 1) with neither interior base bands nor concentric lines and GI2) with interior base bands. In addition, I set up GI3) without interior rim bands, since few vessels without interior rim bands were reported.

GI1) with neither interior base bands nor concentric lines

The design structure without an interior base band or concentric lines is the most frequent pattern at Tall-e Gap. In total, 52 samples were observed from the published datasets. In this structure pattern, the interior-painted open vessels with ring bases[77] and those with flat bases[78] are slightly different in the

[68] Egami and Sono 1962 Fig. 16:3.
[69] Egami and Sono 1962 Figs. 17: 8, 10.
[70] Egami and Sono 1962 Figs. 13: 3-4.
[71] Egami and Sono 1962 Fig. 12:5.
[72] Egami and Sono 1962: Fig. 15:11.
[73] Egami and Sono 1962: Fig. 20:5.
[74] Egami and Sono 1962: Figs. 20:2, 5-6.
[75] Egami and Sono 1962: Fig. 18:1.
[76] Egami and Sono 1962: Fig. 15:10.
[77] Egami and Sono 1962 Figs. 26:1,6; 28:1,4; ;31:4,6.
[78] Egami and Sono 1962 Figs. 26:11; 30:1,3,4,6.

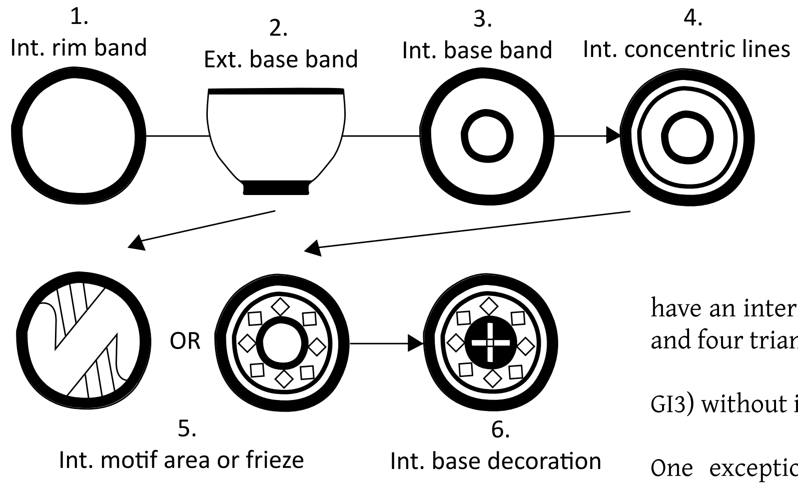


Figure 6.12 Sequence model of drawing elements of the horizontal design structure of an interior-painted open vessel

presence of an exterior base band. The ceramic vessels with ring bases usually had exterior base bands at their joints between their ring bases and body parts.[79] In contrast, none of the 15 samples with flat bases had exterior base bands.

This difference between the vessels with ring bases and those with flat bases also correlated with the difference of the motif elements in motif areas. The motifs of the interior-painted open vessels with ring bases include geometric motifs, such as cross-hatched diamonds (Cat. 6.22: 3; 6.33: 1) and comb-like figures[80] at the lower levels, wavy lines,[81] and hanged vertical lines[82] at the upper levels of Tall-e Gap. The motifs of the interior-painted open vessels with flat bases consist of simpler motif elements, such as hanged vertical lines,[83] short horizontal lines,[84] and hanged leaf shapes.[85]

GI2) with interior base bands

Open vessels with interior base bands were a minority among the interior-painted open vessels at Tall-e Gap. This structure pattern amounts to eight examples. This pattern could be further subdivided by frieze-oriented subtypes and concentric lines-oriented subtypes. Three samples belonged to the former subtype, motifs being depicted in friezes between concentric lines.[86] The friezes were painted in the same way as the exterior-painted open vessels. The motifs inside the friezes include an X motif, horizontal zigzag line, and bird. These samples were observed only at the lower levels at Tall-e Gap. On the other hand, the latter subtype has only concentric lines on its interior body part.[87] Three samples have only concentric lines, while two samples have an interior base decoration consisting of one box and four triangles.[88]

GI3) without interior rim bands

One exceptional case of the interior-painted open vessel with a ring base is one without an interior rim band.[89]

Horizontal structural patterns of closed vessels at Tall-e Gap

Classification of horizontal design structures

Finally, for the analysis of the structural rules of the closed vessels at Tall-e Gap, I modelled the sequence of painting structural components and recorded a list of structural components of closed vessels in almost the same way as the open vessels painted on their exteriors, except for the presence of (2) neck bands (Fig. 6.14). While a rim band was usually applied from the rim to the neck of a closed vessel, some of the rim bands ended at the middle part of the rim, and a neck band was separately drawn on the neck. The total number of the published diagnostic closed vessels was 13. Fig. 6.14 reveals that no closed vessel had a base band. Unlike the exterior-painted open vessels, the presence of a body band, upper/lower optional lines, and upper/lower frieze line were not good markers for categorisation due to the lack of preservation. On the other hand, in (10) number of friezes, the samples without friezes were clearly separated from those with friezes (six samples), so the marker of the classification is the presence of a frieze: **Gap closed vessel** (GC) 1 with frieze and GC2) without frieze as well as GC3) with a neck band.

GC1) with frieze

The frieze drawn on the surface of a closed vessel was the same as the frieze drawn on an exterior-painted open vessel. None of the five examples were complete, being composed of partly preserved sherds. These vessels were large jars. Fig. 18:5 of Egami and Sono 1962 is only one example in which upper/lower optional lines and upper/lower frieze line were preserved

[79] Sono did not express the exterior base band in the drawing (Fig. 7.13). However, when observing the photographs published by Nishiaki in 2003, it turned out that some vessels (e.g. Fig. 7.13: 2-3) had actually an Exterior base band.
[80] Egami and Sono 1962 Fig. 31:4.
[81] Egami and Sono 1962 Figs. 28:1,4.
[82] Egami and Sono 1962 Figs. 26:1,4.
[83] Egami and Sono 1962 Figs. 26:11; 30:4.
[84] Egami and Sono 1962 Fig. 30:1, 4.
[85] Egami and Sono 1962 Figs. 30:1, 3.
[86] Egami and Sono 1962 Figs. 29:5; 31:2; 36:2.
[87] Egami and Sono 1962 Figs. 12:4; 30:2.
[88] Egami and Sono 1962 Figs. 30:2,5.
[89] Egami and Sono 1962 Fig. 31:6.

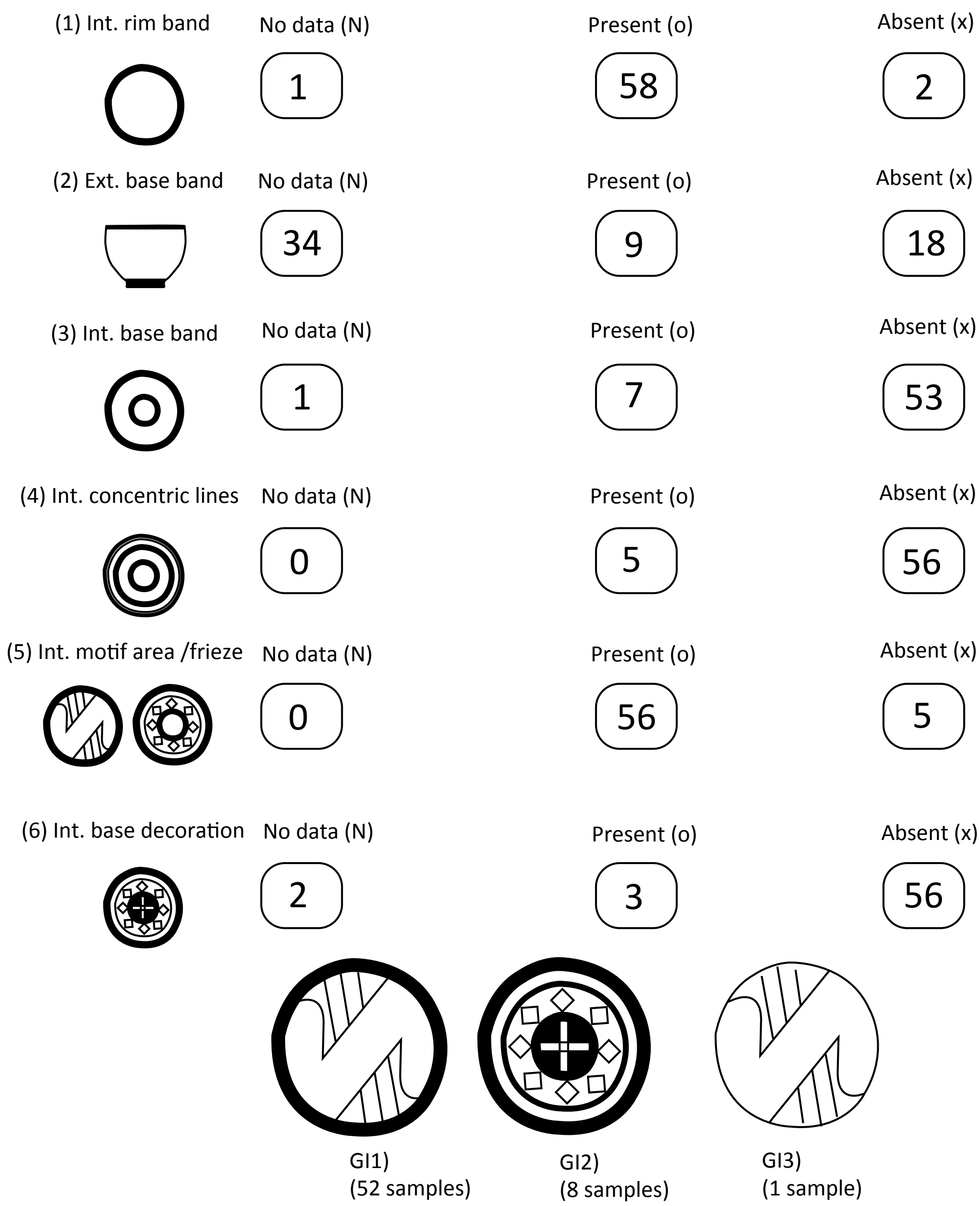


Figure 6.13 Result of the presence/absence of each structural component of open vessels painted on their interiors at Tall-e Gap

on the upper to middle parts of the body. The other three examples, except for Egami and Sono 1962: Fig. 25: 1 (with concentric bands and a neck band), have two upper optional lines. The motifs in the panel are wavy lines,[90] circles,[91] diamonds,[92] vertical zigzags, and animals.[93]

GC2) without frieze

This simple pattern of horizontal design structure has only a thick rim band ranging from the rim to the neck. Eight published samples were reported from Tall-e Gap; vessel forms include both large jars[94] and small jars.[95] There were two samples with motifs in their body parts, such as a succession of X motifs[96] and dog motifs.[97]

GC3) with a neck band

[90] Egami and Sono 1962 Figs. 18:5, 7.
[91] Egami and Sono 1962 Fig. 18:7.
[92] Egami and Sono 1962 Fig. 22:2.
[93] Egami and Sono 1962 Fig. 25:3.
[94] Egami and Sono 1962 Figs. 11:4; 25:2.
[95] Egami and Sono 1962 Figs. 17:1-2, 4.
[96] Egami and Sono 1962 Fig. 17:2.
[97] Egami and Sono 1962 Fig. 25:2.

	No data (N)	Present (o)	Absent (x)
(1) Rim band	0	13	0
(2) Neck band	0	1	12
(3) Base band	5	0	8
(4) Body band	6	1	5
(5) Upper optional lines	0	4	9
(6) Lower optional lines	3	1	9
(7) Upper frieze line	0	4	9
(8) Lower frieze line	2	2	9
(9) Frieze division line	0	1	12

	No data	0	1	2	3
(10) No. of frieze	0	7	6	0	0

	No data (N)	Present (o)	Absent (x)
(11) Secondary motifs	0	0	13

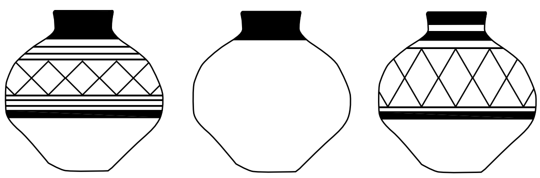


Figure 6.14 Result of the presence/absence of each structural component of closed vessels at Tall-e Gap

Only one sample with a neck band was confirmed.[98] The design element of this example consists only of a horizontal band.

I summarise the analysis of horizontal design structure pattern at Tall-e Gap below.

1) There were seven patterns in the exterior-painted open vessels, including multiple friezes and secondary motifs. GE1 (with a body band and with upper/lower optional lines) was the most predominant. The painted motifs in each pattern were slightly different.
2) Three patterns were confirmed in the interior-painted open vessels. The majority were GI1 (without an interior base band and concentric lines).
3) Closed vessels had three patterns of horizontal design structures; they were predominantly simple patterns with rim bands (GC2).

Horizontal design structures at Tall-e Jari A

Horizontal structural patterns of exterior-painted open vessels at Tall-e Jari A

Classification of horizontal design structures

The classification of horizontal design structures in exterior-painted open vessels was based on 15 diagnostic vessels from Tall-e Jari A, the majority derived from the unpublished materials at UMUT (Fig. 6.15). The majority of the exterior-painted open vessels have body bands, except for one example. In addition, the upper optional lines were absent in most of the samples from Tall-e Jari A. Thus, the presence of upper/lower optional lines and upper/lower frieze lines are good subdivision markers for classification at Tall-e Jari A. Below, I describe JE (**Jari A exterior**) 1) with body bands and upper/lower optional lines, JE2) with body bands and without upper/lower optional lines, JE3) with body bands and without upper/lower frieze lines, and JE4) with neither body bands nor rim bands. Although rare, JE5) multiple friezes and JE6) secondary motifs were also discovered.

JE1) with body bands and with (upper)/lower optional lines

Six samples belong to this structure pattern. Except for Cat. 6.6: 1 which had both one upper and one lower optional line, the other five examples have only lower optional lines. The decoration was applied only on the upper part of the body. As for the motifs in the frieze, a connected row of cross-hatched diamonds was common (Cat. 6.1: 1; 6.6: 1; 6.8: 4).

[98] Egami and Sono 1962 Fig. 25:1.

JE2) with body bands and without upper/lower optional lines

Four examples of this structural pattern were confirmed from Tall-e Jari A. The representative motif is a connected row of cross-hatched motifs (Cat. 6.1: 2; 6.7: 1), similarly to JE1.

JE3) with body bands and without upper/lower frieze line

Four examples followed this structural pattern. Though all the poorly preserved pieces have limited information, the motif elements in this structural pattern were triangles (Cat. 6.1: 3; 6.6:3), horizontal zigzags (Cat. 6.7: 2), and x motifs (Cat. 6.7: 3).

JE4) with neither body bands nor rim bands

Cat. 6.7: 5 was the only example showing this pattern. This sample also has a complete vessel form (shallow bowl) that is atypical among the exterior-painted open vessels at Tall-e Jari A.

JE5) multiple friezes

There were three examples with multiple friezes at Tall-e Jari A (Cat. 6.2: 4, 6.7: 3).

JE6) secondary motifs

Only Egami et al. 1977 Pl. III: 11 showed secondary motifs (small dots) between the rim band and the frieze at Tall-e Jari A.

Horizontal structural patterns of interior-painted open vessels at Tall-e Jari A

Classification of horizontal design structures

Fig. 6.16 shows the presence/absence of the structural components of interior-painted open vessels; the presence of (1) interior rim bands, (3) interior base bands, and (4) interior concentric lines subdivides the diagnostic examples painted on their interiors at Tall-e Jari A. I set up three categories following the interior-painted open vessels at Tall-e Gap: JI (**Jari A interior**) 1) with neither interior base bands nor interior concentric lines, JI2) with interior base bands and interior concentric lines, and JI3) without rim bands.

JI1) with neither interior base bands nor interior concentric lines

Only three examples followed this pattern. Many of the undiagnostic samples that were not used for the analysis of horizontal design structures possibly belong to this pattern. Egami et al. 1977: Pl. III: 1 is the most preserved example, showing four motifs consisting of

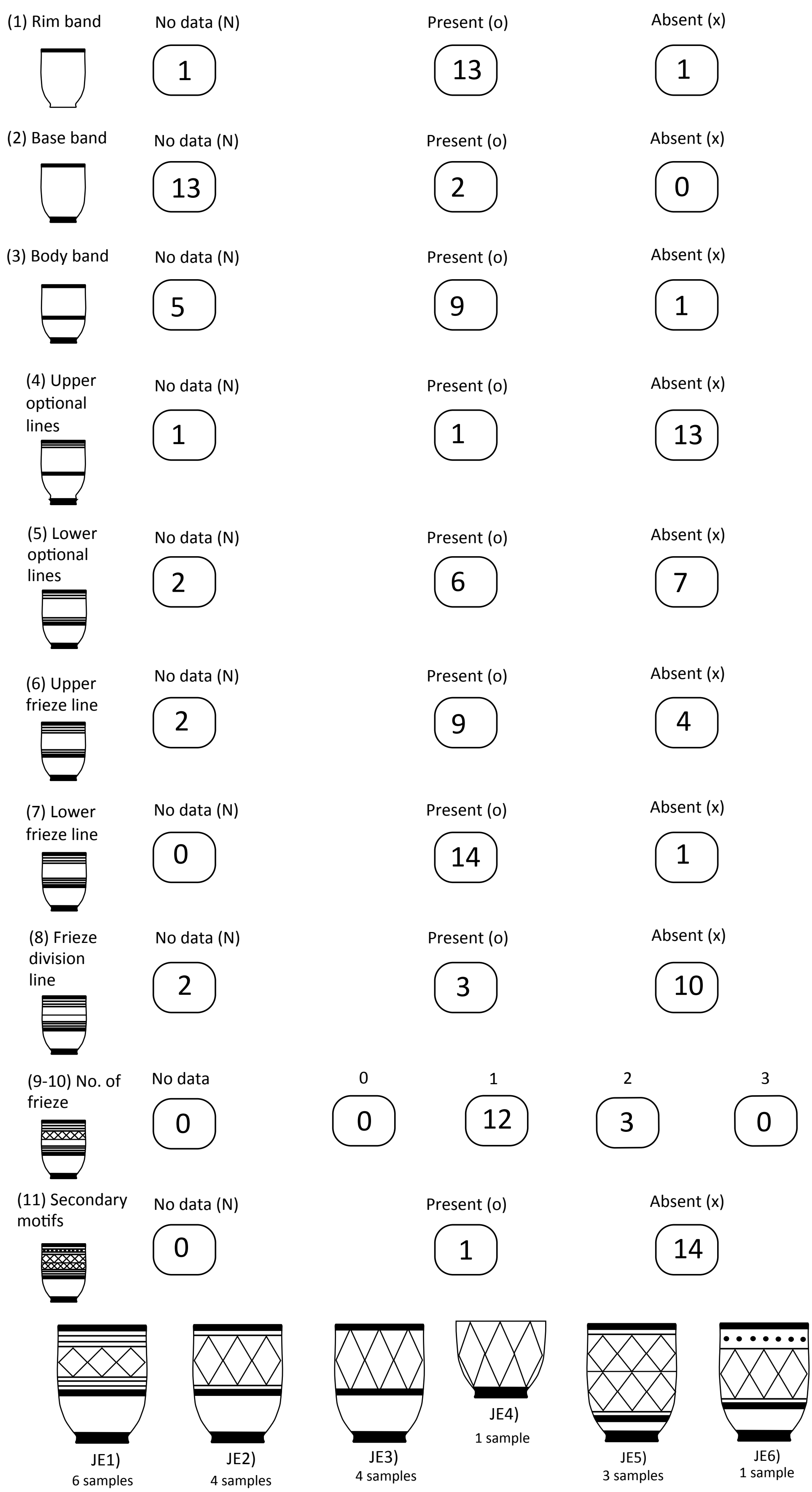


Figure 6.15 Result of the presence/absence of each structural component of open vessels painted on their exteriors at Tall-e Jari A.

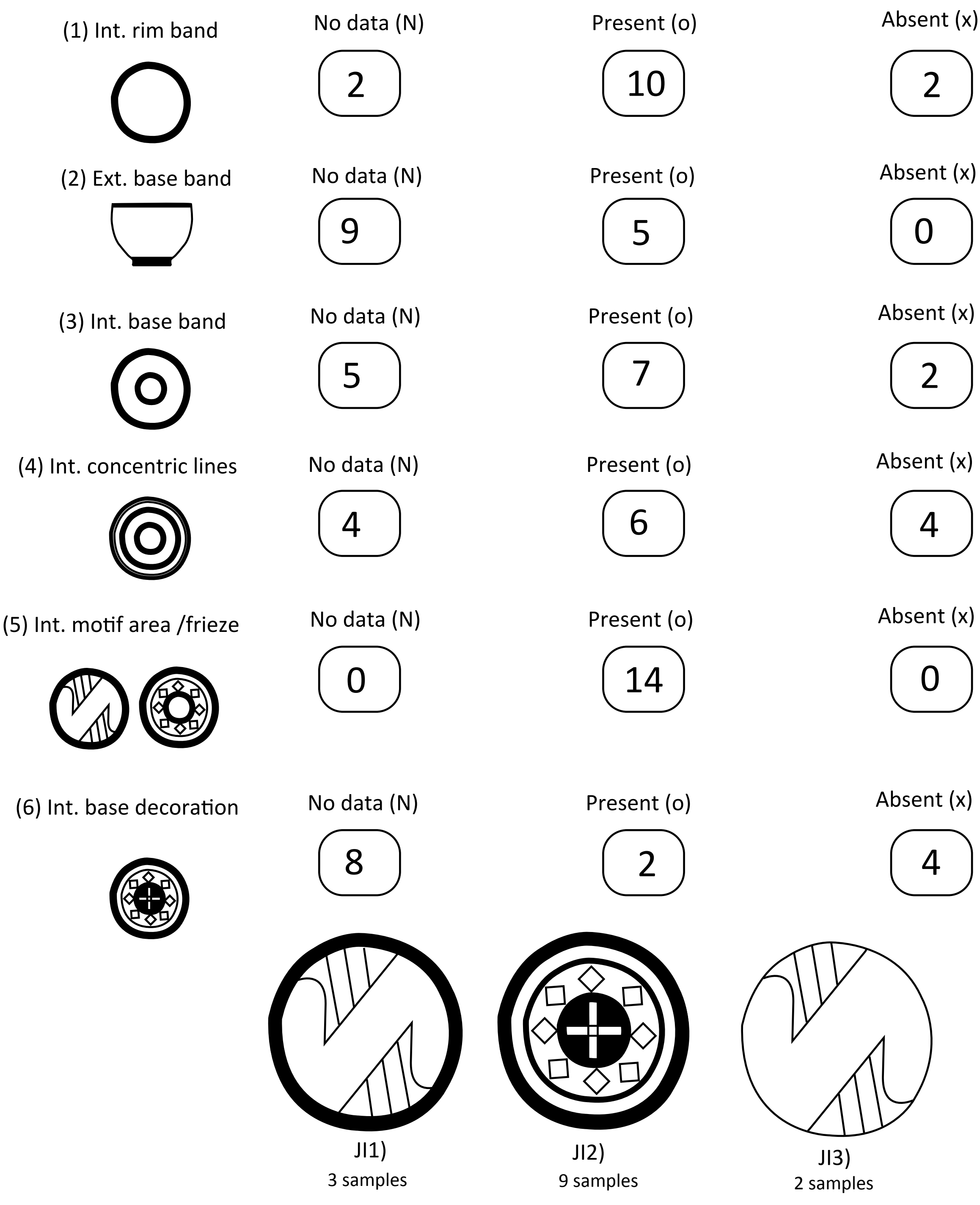


Figure 6.16 Result of the presence/absence of each structural component of open vessels painted on their interiors at Tall-e Jari A

triangles and zigzags. Other vessels show wavy lines (Cat. 6.4: 1) and filled diamonds (Cat. 6.9: 3).

JI2) with interior base bands and interior concentric lines

Nine examples showed the presence of an interior base band or interior concentric lines at Tall-e Jari A. These include an exceptional one with a pedestal and human motifs.[99] Another human motif also appeared on a vessel belonging to this pattern.[100] Other motifs include horizontal wavy lines (Cat. 6.9: 1).

[99] Vanden Berghe 1952 Pl. XLIX.
[100] Egami et al. 1977 Pl. III: 5.

JI3) without rim bands

Two cases had no rim bands. This pattern was correlated with hanged cross-hatched triangles (Cat. 6.3: 2-3). It is also possible that the rim bands vanished in the post-depositional process.

Although the total samples used for those analyses were limited, I summarise the results from Tall-e Jari A below.

1) Six structural patterns were observed in exterior-painted open vessels. Most of the samples had body bands (JE1-JE3).
2) In interior-painted open vessels, those with base bands or concentric lines on their interiors (JI2) were predominant.

Horizontal design structures at Tall-e Bakun B

Horizontal structural patterns of exterior-painted open vessels at Tall-e Bakun B

Classification of horizontal design structures

The structural components of the open vessels painted on their exteriors at Tall-e Bakun B were recorded using the sequence model of painting and the limited numbers of published examples (32 samples) (Fig. 6.17). Although a 'No data' designation accounts for the majority in terms of (2) base bands (31 cases), (3) body bands (16 cases), and (5) lower optional lines (16 cases), the presence of body bands can be inferred because the painted decoration was applied on the upper body parts in many cases at Tall-e Bakun B. I followed the classification at Tall-e Gap and Tall-e Jari A with modifications: BE (**Bakun B Exterior**) 1) with possible body bands and upper/lower optional lines, BE2) with possible body bands and without upper/lower optional lines, BE3) without body bands and with upper/lower optional lines, and BE4) multiple friezes.

BE1) with possible body bands and upper/lower optional lines

Twenty examples, including 11 estimated samples of this pattern, existed in Tall-e Bakun B. Cross-hatched triangles,[101] cross-hatched squares,[102] and wavy lines[103] are seen on the surface of the vessels with this structural pattern. The limited information prevents me from analysing whether upper/lower optional lines appeared in the same numbers. At least five samples had equal numbers of upper/lower optional line. Three samples lacked either upper optional lines or lower optional lines.[104]

BE2) with possible body bands and without upper/lower optional lines

Eleven examples of this type were discovered, including seven estimated samples. Goats,[105] horizontal wavy lines,[106] horizontal zigzag lines,[107] cross-hatched diamonds, and triangles[108] were confirmed in combination with this horizontal design structure. One example lacked an upper frieze line.[109]

BE3) without body bands and with optional lines

There was only one clear example of a flat base[110] following this structural pattern at Tall-e Bakun B. There was a combination of triangle motifs in its frieze.

BE4) multiple friezes

Six examples had multiple friezes. Usually, these friezes are combinations of the simple motifs, such as small vertical lines and wavy lines.[111] The frieze division lines numbered two or three lines.[112]

Horizontal structural patterns of interior-painted open vessels at Tall-e Bakun B

Classification of horizontal design structures

Only 11 diagnostic cases of open vessels painted on their interiors were published from Tall-e Bakun B. The analysis of design structural elements in sequential order (Fig. 6.18) showed that the presence of (3) interior base bands and (4) interior concentric lines was clearly separated among the published sherds. This result fit well with the classification proposed in previous sections. Below, I describe three categories of interior-painted horizontal design structure patterns—BI (**Bakun B Interior**) 1) with neither interior base bands nor interior concentric lines, BI2) with interior base bands and interior concentric lines, and BI3) without rim bands.

BI1) with neither interior base bands nor concentric lines

[101] Egami and Masuda 1962 Fig. 15:7.
[102] Egami and Masuda 1962 Figs. 15:5, 15.
[103] Egami and Masuda 1962 Fig. 14:7; Alizadeh 2006 Fig. 23: O, X.
[104] Egami and Masuda 1962 Fig. 14:1; Alizadeh 2006 Fig. 23: J, W.
[105] Alizadeh 2006 Fig. 23: B.
[106] Egami and Masuda 1962 Fig. 14: 5; Alizadeh 2006 Fig. 23: S.
[107] Egami and Masuda 1962 Fig. 14:11.
[108] Egami and Masuda 1962 Fig. 15:2, 11.
[109] Egami and Masuda 1962 Fig. 15:11.
[110] Egami and Masuda 1962 Fig. 14:21.
[111] Egami and Masuda 1962 Fig. 14:5.
[112] Egami and Masuda 1962 Fig. 15:13.

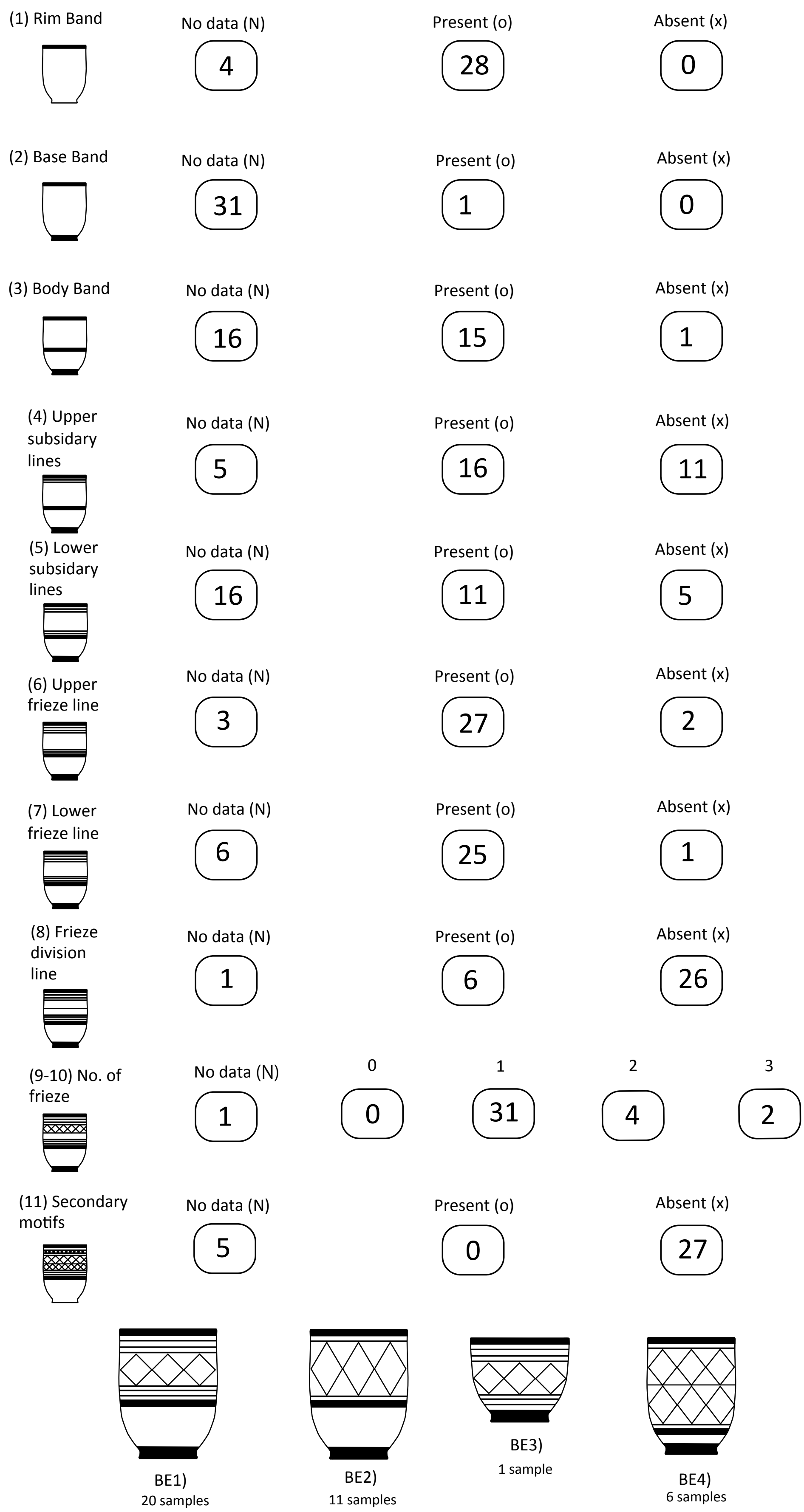


Figure 6.17 Result of the presence/absence of each structural component of open vessels painted on their exteriors at Tall-e Bakun B

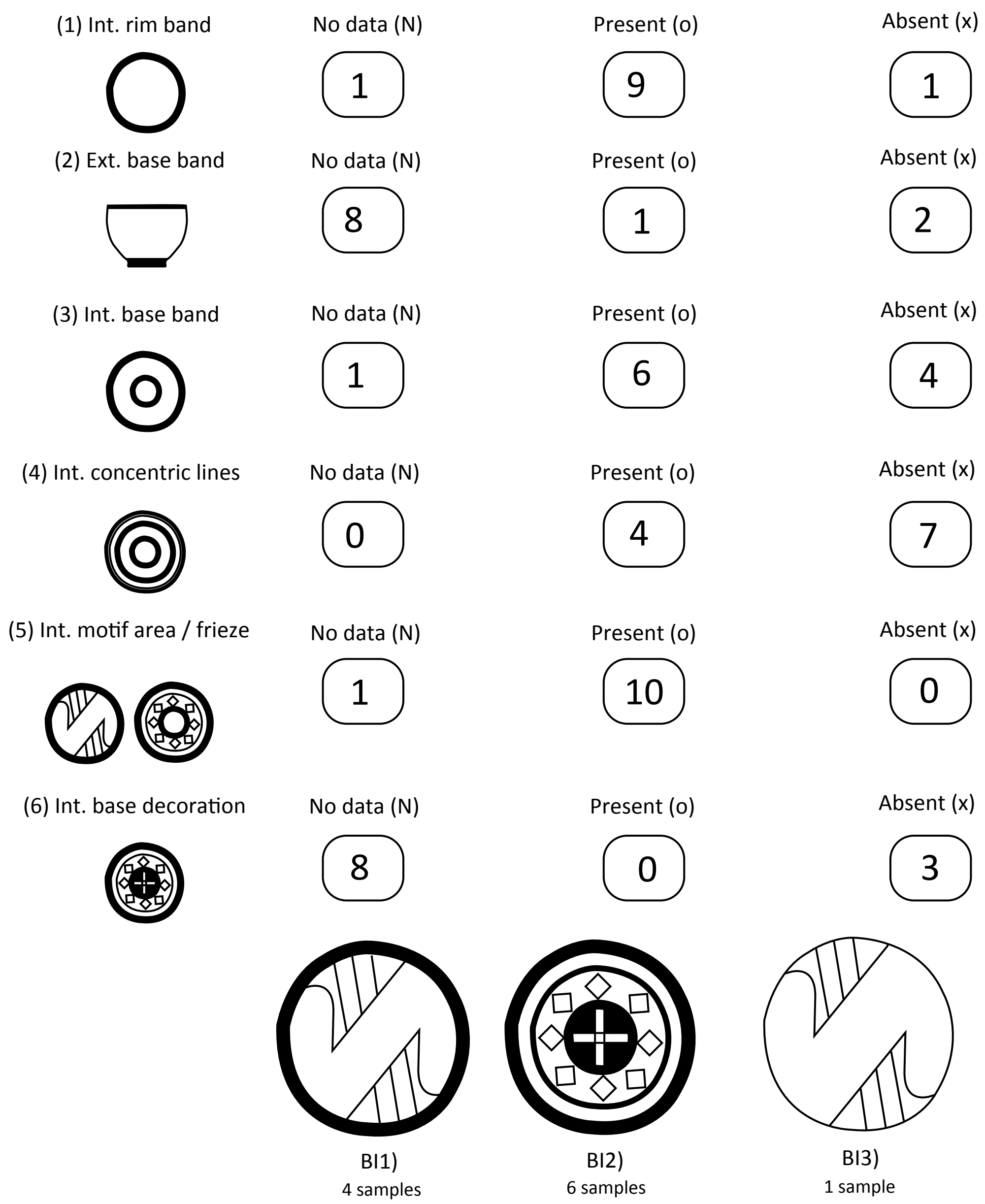


Figure 6.18 Result of the presence/absence of each structural component of open vessels painted on their interiors at Tall-e Bakun B

Four examples had this structure pattern; zigzag lines[113] and diamond-like motifs[114] were confirmed. The majority of the poorly preserved vessels are likely to follow this pattern, considering the locations and parts of the motif elements on the inner surfaces.

BI2) with interior base bands and concentric lines

This structure pattern was observed in six samples. Vertical lines,[115] triangles,[116] and a horizontal zigzag[117] were confirmed from the published examples.

BI3) without rim bands

One strange example without a rim band and with vertical lines starting from the rim existed at Tall-e Bakun B.[118]

Horizontal structural patterns of closed vessels at Tall-e Bakun B

Only five diagnostic sherds belonging to closed vessels have been published to date, consisting of two small and three large jars. All the large jars have upper/lower optional lines,[119] although the presence of body bands

[113] Egami and Masuda 1962 Fig. 17:9.
[114] Egami and Masuda 1962 Fig. 17:3.
[115] Egami and Masuda 1962 Fig. 16: 10, 12.
[116] Egami and Masuda 1962 Fig. 17:2.
[117] Egami and Masuda 1962 Fig. 17:8.
[118] Egami and Masuda 1962 Fig. 16:11.
[119] Egami and Masuda 1962 Fig. 13:1, 5, 6.

was unclear in the observed samples. As for small jars, one had an upper optional line[120] and another had just a rim band and hanged vertical lines.[121]

The limited published drawings at Tall-e Bakun B provided the following results concerning the horizontal design structures.

1) Four structural patterns were observed on the exterior surface of open vessels. Each pattern shared motif elements.
2) Among three patterns observed in the interior-painted open vessels, the structural pattern with interior horizontal lines/bands (BI2) was preferred. There might be differences in motif elements between BI1 and BI2.

Horizontal design structures at Tall-e Bakun A

Horizontal structural patterns of exterior-painted open vessels at Tall-e Bakun A

Classification of horizontal design structures

I used 76 published complete vessels and 129 published well-preserved potsherds (total: 205 vessels) for the analysis of horizontal design structures of exterior-painted open vessels at Tall-e Bakun A. Fig. 6.19 shows presence/absence of each structural component of ceramic vessels painted on their exteriors from Tall-e Bakun A. The difference between this graph and those of the other sites is a new category, 'thin rim band', in (1) rim band. A thin rim band with a thickness of less than 5 mm was categorised separately from thick rim bands. This graph clearly delineates the presence/absence of (3) body bands, (4–5) upper/lower optional lines, and (6–7) upper/lower frieze lines. I categorized seven horizontal design structure patterns, drawing attention to the presence/absence of these structural elements: AE (**Bakun A Exterior**) 1) with body bands and upper/lower optional lines, AE2) with body bands and without upper/lower optional lines, AE3) with body bands and without upper/lower frieze lines, AE4) without body bands and with upper/lower optional lines, AE5) with neither body bands nor upper/lower optional lines, AE6) with neither body bands nor upper/lower frieze lines, and AE7) with neither body bands nor rim bands. Furthermore, three additional types independent of the above seven types were classified; AE8) multiple friezes, AE9) secondary motifs, and AE10) thin rim bands.

AE1) with body bands and with upper/lower optional lines

This structural pattern was the most famous among the exterior-painted open vessels (91 published examples including five possible examples) at Tall-e Bakun A. Below the relationship between this structure pattern and A) motifs, B) complete vessel forms, and C) the number of upper/lower optional lines will be explained.

A) Representative motifs drawn inside the frieze of this design structural pattern were windmills,[122] white leaves,[123] triangles,[124] structured human motifs,[125] geometrically complex black lines,[126] and other elaborate motifs.[127] In particular, the first two motifs occurred frequently.
B) Table 6.39: left shows the complete vessel forms with this pattern at Tall-e Bakun A. This design structural pattern was frequently found in deep bowls/ possibly deep bowls (11/63 samples). This pattern was also observed in the other six complete vessel forms, barrel-shaped vessel, beaker, hemispherical bowl, incurved-rim vessel, and shallow bowl, though they were small sample sizes (1-3 samples confirmed in each complete vessel form).
C) The most frequent number of upper/lower optional lines (Table 6.39: right) was one upper optional line and one lower optional line (66 samples). The other combination patterns of the number of upper/lower optional lines[128] were small in observed sample sizes (less than six samples in each pattern), suggesting strict restrictions on the number of upper/lower optional lines (one line) in this structural pattern.

AE2) with body bands and without upper/lower optional lines

Eleven samples belonging to this structure pattern were confirmed. These include two samples of funnel-shaped vessels with zigzags and boxes[129] and one sample with secondary dot motifs.[130]

AE3) with body bands and without upper/lower frieze line

There were only five vessel samples with neither upper/lower optional lines nor upper/lower frieze line

[120] Alizadeh 2006 Fig. 23: BB.
[121] Egami and Masuda 1962 Fig. 14:17.
[122] Herzfeld Tafel II:1.
[123] Herzfeld Tafel III:3.
[124] Alizadeh 2006 Fig. 38:C.
[125] Langsdorff and McCown 1942 Pl. 4:3.
[126] Langsdorff and McCown 1942 Pl. 53:1.
[127] Herzfeld Tafel XI:1.
[128] Herzfeld 1932 Tafel X:5, XIII:2, XVI:5; Langsdorff and McCown 1942 Pl. 60:2, 61:9.
[129] Langsdorff and McCown 1942 Pl. 36:14.
[130] Alizadeh 2006: Fig. 35:E.

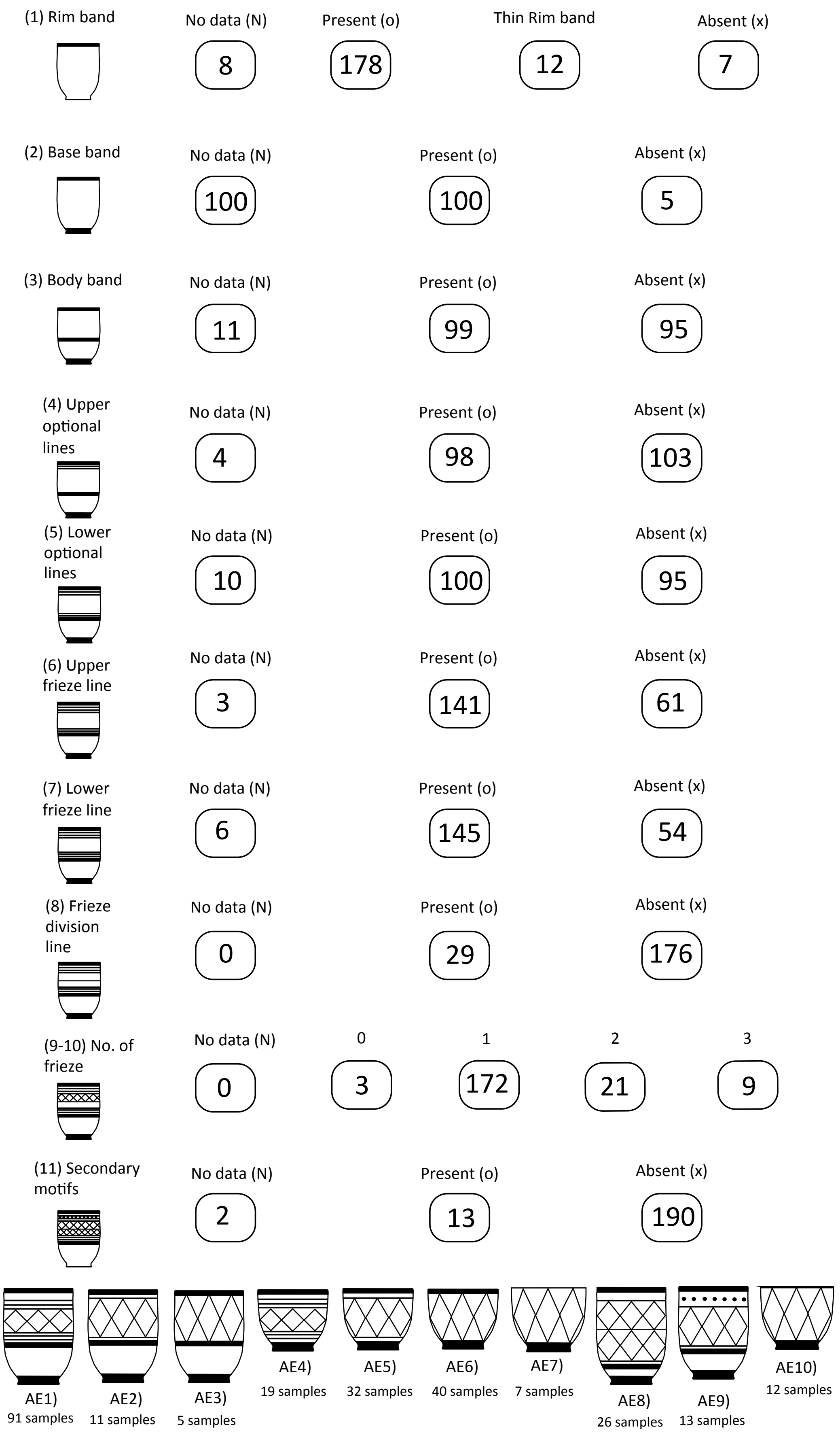


Figure 6.19 Result of the presence/absence of each structural component of open vessels painted on their exteriors at Tall-e Bakun A

Table 6.39 Correlation between complete vessel forms and AE1 (left) and the number of upper/lower optional lines of vessels with AE1 (right) at Tall-e Bakun A

Complete vessel form of AE1	Total	%
barrel-shaped vessel	1	1.10
beaker	2	2.20
possibly beaker	2	2.20
conical bowl	1	1.10
deep bowl	11	12.09
possibly deep bowl	63	69.23
hemispherical bowl	3	3.30
possibly hemispherical bowl	1	1.10
incurved-rim vessel	2	2.20
possibly incurved-rim vessel	2	2.20
shallow bowl	1	1.10
possibly shallow bowl	2	2.20
Total	91	100

(No. of upper optional lines) and (No. of lower optional lines) of AE1	Total	%
0 and 1	6	6.59
0 and 1<	1	1.10
1 and 0	2	2.20
1 and 1	66	72.53
1 and 1<	2	2.20
1 and unknown	1	1.10
2 and 1	3	3.30
2 and 2	5	5.49
2 and 2<	1	1.10
2 and unknown	1	1.10
3 and 1	1	1.10
unknown and 1	1	1.10
unknown and 2	1	1.10
Total	91	100

Table 6.40 Correlation between complete vessel forms and AE4 (left) and the number of upper/lower optional lines of vessels with AE4 (right) at Tall-e Bakun A

Complete vessel form of AE4	Total	%
beaker	4	21.05
possibly beaker	1	5.26
conical bowl	4	21.05
possibly conical bowl	1	5.26
deep bowl	3	15.79
possibly deep bowl	1	5.26
funnel-shaped vessel	2	10.53
possibly hemispherical bowl	1	5.26
incurved-rim vessel	1	5.26
shallow bowl	1	5.26
Total	19	100

(No. of upper optional lines) and (No. of lower optional lines) of AE4	Total	%
0 and 1	3	15.79
1 and 0	3	15.79
2 and 0	2	10.53
1 and 1	6	31.58
1 and 2	1	5.26
1 and unknown	1	5.26
2 and 2	2	10.53
unknown and 2	1	5.26
Total	19	100

when they had body bands. Animal motif[131] and cross-hatched box motif was confirmed with this pattern.

AE4) without body bands and with upper/lower optional lines

The patterns of horizontal design structures described below (AE4, AE5, AE6, and AE7) do not have a body band. There were 19 examples which have no body band but upper/lower optional lines. Below the relationship with A) motifs, B) complete vessel form, and C) the number of upper/lower optional lines will be taken a closer look.

A) Although the well-known motifs such as 'white leaf'[132] and 'windmills'[133] were observed, they are not predominant, and varieties of motifs existed.
B) As for complete vessel forms (Table 6.40: left), conical bowls/possibly conical bowls (five

[131] Langsdorff and McCown 1942 Pl. 74:3.

[132] Langsdorff and McCown 1942 Pl. 62:2.

[133] Alizadeh 2006: Fig. 31:D.

samples), beakers (four samples), and funnel-shaped vessels (two samples) were as frequently associated with this pattern as deep bowls/possibly deep bowls (four samples), showing more variability in complete vessel forms than AE1.

C) The number of upper/lower optional lines (Table 6.40: right) converged on one upper optional line and one lower optional line (6 samples).[134] The other samples sometimes lack part of the upper/lower optional lines.[135]

AE5) with neither body bands nor upper/lower optional lines

The vessels categorised into this pattern amount to 32 samples, including eight estimated samples. This pattern is the third most frequent pattern in the exterior-painted open vessels at Tall-e Bakun A. Of 32 published diagnostic vessels, 19 samples were conical bowls. In particular, two types of motifs were dominant in conical bowls with this structural pattern: white leaves[136] and goats with two big spiral horns.[137] Samples with only upper frieze line[138] or lower frieze line[139] were rare.

AE6) with neither body bands nor upper/lower frieze line

AE6, which had neither body bands, upper/lower optional lines, nor upper/lower frieze lines, was the second most popular pattern in Tall-e Bakun A (40 samples). The long frieze zone delimited only by a rim band and base band enabled the painter to draw more elaborate and complex motifs than the other designs' structural patterns. I will explain A) representative motifs and B) complete vessel forms in this pattern.

A) Frequent motifs seen on the surface of this type were complex geometrical combinations of thick black lines (nine samples),[140] Z-shaped white lines with dots in the upper part, >>> or <<< lines in the lower part (five samples),[141] white Ms penetrated by a vertical white line (two samples),[142] and semi-circle lines both on upper and lower (three samples).[143] Please note that there were neither big goat motifs with spiral horns nor white leaf motifs in this horizontal design structural pattern.

B) More than half of the vessels with this pattern were estimated to be hemispherical bowls (19 examples), followed by complete vessel forms of beakers (10 samples) and deep bowls (9 samples).

AE7) without rim bands

The ceramic vessels on which painters did not draw rim bands for special decoration were classified into this pattern. This pattern is difficult to distinguish from cases in which the thin rim bands vanished in the use or post-depositional processes. Seven samples were confirmed. The motifs conforming to this pattern did not follow the frequent motifs explained above, being composed of / \[144], x boxes[145], and white trees.[146]

AE8) multiple friezes

In this category, I will explain structure patterns independent of the above classifications; 26 samples with multiple friezes were confirmed from 205 well-preserved and diagnostic vessels. Examples with double friezes[147] (18 samples) number more than those with triple friezes (eight samples).[148] This design structure needs a long frieze. Hence, the vessels with multiple friezes also belong to AE6 (nine samples) and AE5 (eight samples). Furthermore, deep bowls (ten samples) and beakers (eight samples) were preferred as complete vessel forms with multiple friezes. An interesting motif is a combination of double/triple rows of cross-hatched diamonds on the exterior and wavy lines on the interior (five samples).[149] As already stated in AE6, Z white lines with dots in the upper part, and >>> or <<< lines in the lower are also categorised with the double frieze motif.[150]

AE9) secondary motifs

The horizontal design structure—placing a horizontal row of secondary motifs between a rim band and a frieze—was a minority among 205 published examples (13 examples). Among 13 examples, nine also showed AE1 (with body bands and with upper/lower optional lines). Most of the vessels with this pattern were deep bowls. The secondary motifs consist of solid triangles,[151] dots,[152] and stylized small goats.[153]

134 Langsdorff and McCown 1942 Pl. 1:11, 62:2.
135 Langsdorff and McCown 1942 Pl. 27:13, 69:18; Alizadeh 2006: 36:C.
136 Alizadeh 2006: Fig. 24:G.
137 Langsdorff and McCown 1942 Pl. 71:15; Alizadeh 2006: 25:C,D.
138 Langsdorff and McCown 1942 Pl. 54:13.
139 Langsdorff and McCown 1942 Pl. 71:15.
140 Herzfeld 1932 Tafel VI:2.
141 Alizadeh 2006: Fig. 32:D.
142 Herzfeld 1932 Tafel XII:4.
143 Langsdorff and McCown 1942 Pl. 22:19.
144 Langsdorff and McCown 1942 Pl. 60:13.
145 Langsdorff and McCown 1942 Pl. 46:1.
146 Langsdorff and McCown 1942 Pl. 24:1.
147 Herzfeld 1932 Tafel IX:3; Langsdorff and McCown 1942 Pl. 52:12; Alizadeh 2006: Fig. 33:C.
148 Herzfeld 1932 Tafel XIII:1; Langsdorff and McCown 1942 Pl. 67:13; Alizadeh 2006: Fig. 36:A.
149 Alizadeh 2006: Figs. 35:D, 36:A.
150 Alizadeh 2006: Fig. 33:C.
151 Herzfeld 1932 Tafel V:4; Langsdorff and McCown 1942 Pl. 34:1.
152 Alizadeh 2006: Fig. 35:E.
153 Herzfeld 1932 Tafel XVI:4.

AE10) thin rim bands

Finally, there were 12 samples of structure patterns with thin rim bands (less than 5 mm) at Tall-e Bakun A.[154] Thin rim bands had close relationships with AE6 (10 examples) and hemispherical bowls (10 examples), implying the explicit rule to combine AE6 and hemispherical bowls with a thin rim band. Frequent motifs were those explained in AE6 and AE7.

Horizontal structural patterns of interior-painted open vessels at Tall-e Bakun A

Classification of horizontal design structures

The chaîne opératoire of drawing interior-painted design structures is presented in Fig. 6.20, representing a search for the presence/absence of structural components of interior-painted open vessels at Tall-e Bakun A. The number of samples for the analysis (53 samples) was much smaller than that of the exterior-painted open vessels. The presence/absence of (4) interior concentric lines meets the criterion of the subdivision of structural patterns. I categorised two design structure patterns of interior-painted open vessels as well as those in the other sites: AI (**Bakun A Interior**) 1) without interior base bands or interior concentric lines and AI2) with interior concentric lines.

AI1) with neither interior base bands nor interior concentric lines

The majority of the interior-painted open vessels followed this pattern in Tall-e Bakun A. More than half of the vessels were categorised as shallow bowls (24 samples). The most frequent motif in this pattern was wavy lines hanging from a rim band.[155] Other motifs include complex combinations of triangles[156] and diamonds.[157] Although the data are minimal, vessels without an exterior base band or with a flat base are rare in Tall-e Bakun A.[158]

AI2) with interior concentric lines

Eighteen samples belonged to this structural pattern, the minority among the interior-painted open vessels at Tall-e Bakun A. This pattern can be subdivided into two variants: frieze-oriented[159] and motif-oriented.[160] The former variant had a similar horizontal design structure to the exterior-painted decoration. The latter variant looks like AE1, except for the presence of one concentric line just below its rim band. Geometric motifs were preferred in the frieze. Some open vessels painted on their interiors also had secondary triangle motifs between their rim bands and friezes.[161]

Horizontal structural patterns of closed vessel at Tall-e Bakun A

Classification of horizontal design structures

I decided on subdivision criteria of the horizontal design structure of the closed vessels at Tall-e Bakun A based on the presence/absence of the design structure attributes of 45 well-preserved vessels (20 complete vessels and 25 diagnostic vessels). The estimated drawing procedures show the clearly separated presence/absence of (2) neck bands, (3) body bands, (4–5) upper/lower optional lines, and upper/lower frieze lines (Fig. 6.21). In addition, (10) the presence of friezes can be a good marker, as shown in Tall-e Gap (GC2). Therefore, six structural patterns were set up: AC (**Bakun A closed vessel**) 1) with body bands and upper/lower optional lines, AC2) with body bands and without optional lines, AC3) without body bands and with upper/lower optional lines, AC4) without body bands and with friezes, AC5) with neither body bands nor friezes, and AC6) with neck bands.

AC1) with body bands and upper/lower optional lines

Fourteen samples with both body bands and upper/lower optional lines were confirmed. As for complete vessel forms, both large jars (nine samples) and small jars (five samples) showed this pattern. In the friezes of large jars, the combination of separate circle and cross motifs, vertical wavy lines,[162] and a horizontal succession of bird-like motifs[163] were popular. Complex geometric motifs were preferred in the friezes of small jars.[164] The most frequent number of upper/lower optional lines was one upper optional line and one lower optional line (five samples).[165] Vessels without either upper or lower optional lines were also included.

AC2) with body bands and without upper/lower optional lines

I observed 20 examples of this structural pattern; large jars were popular (15 samples). Representative motifs in the friezes of large jars were circle and cross motifs[166] and coffee bean motifs.[167] On the other hand, complex

[154] Herzfeld 1932 Tafel IV:6, VI:2, XII:4.
[155] Langsdorff and McCown 1942 Pl. 28:12, 29:2; Alizadeh 2006 Fig. 24:C.
[156] Langsdorff and McCown 1942 Pl. 26:2.
[157] Langsdorff and McCown 1942 Pl. 43:12.
[158] Alizadeh 2006 Fig. 55:F.
[159] Langsdorff and McCown 1942 Pl. 34:10, 43:15, 44:6, 53:10.
[160] Alizadeh 2006 Fig. 27:D, 28:C.
[161] Langsdorff and McCown 1942 Pl. 43:15, 44:6.
[162] Langsdorff and McCown 1942 Pl. 31:2.
[163] Alizadeh 2006 Fig. 41:D.
[164] Langsdorff and McCown 1942 Pl. 53:8, 54:6.
[165] Langsdorff and McCown 1942 Pl. 54:6; Alizadeh 2006 Fig. 41:D.
[166] Langsdorff and McCown 1942 Pl. 31:1; Egami and Masuda 1962 Fig. 6:1; Alizadeh 2006 Fig. 41:E.
[167] Langsdorff and McCown 1942 Pl. 31:1.

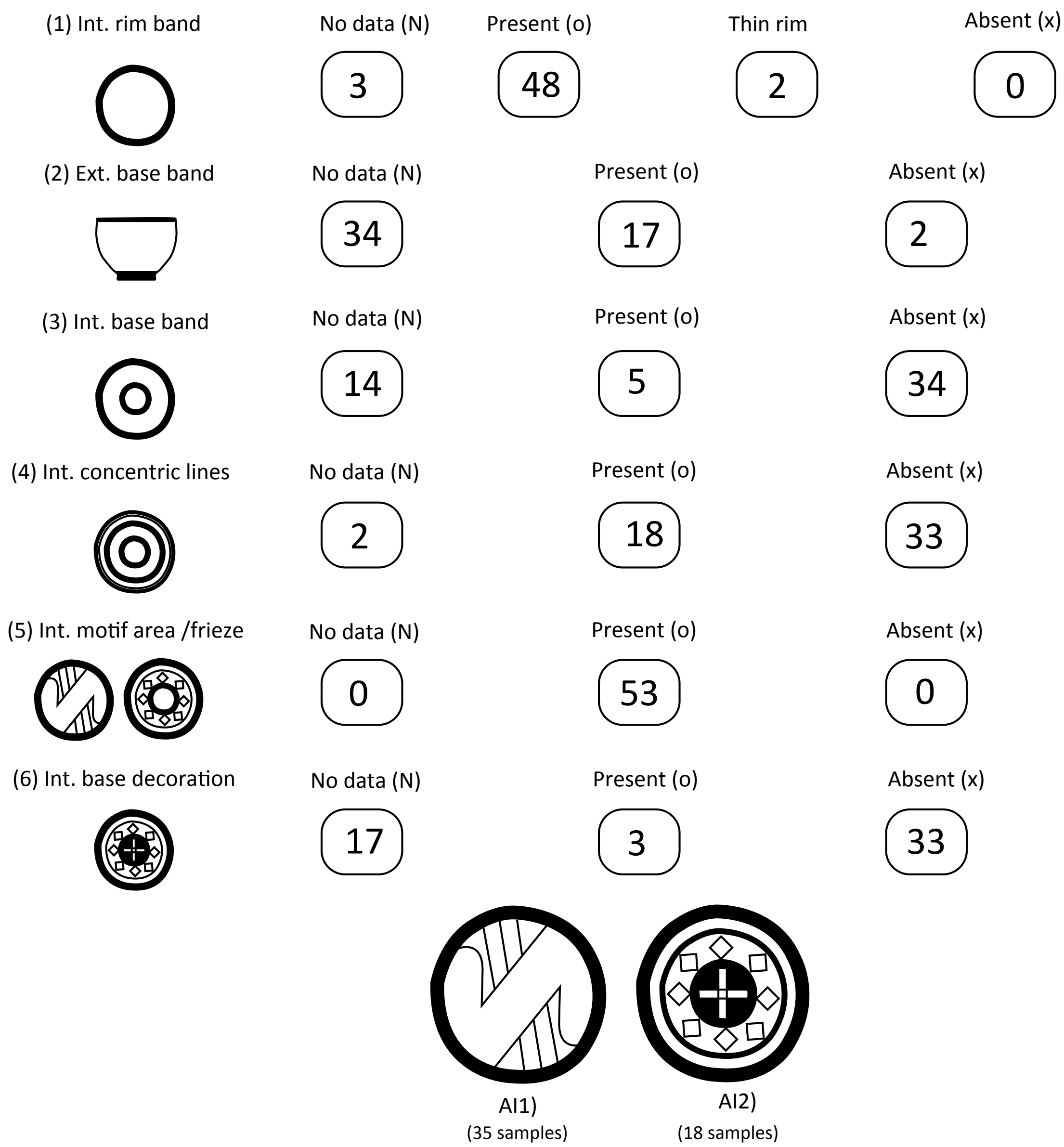


Figure 6.20 Result of the presence/absence of each structural component of open vessels painted on their interiors at Tall-e Bakun A

geometric motifs were painted in the friezes of small jars, as well as those of AC1.[168] Secondary motifs were drawn between the friezes and the rim/base bands.[169]

AC3) without body bands and with upper/lower optional lines

Two small jar samples had base bands instead of body bands to delimit their friezes (Fig. 6.21: AC3).[170] This structural pattern is similar to the AE4 of exterior-painted open vessels. This pattern was unlikely to appear on large jars, since the painters had to fill in large areas of these jars.

AC4) without body bands and with friezes

Five samples of small jars belong to this simple pattern. Two small jars have upper optional lines and horizontal wavy lines.[171] Two samples of small jars were covered by black paint, preserving white horizontal wavy lines.[172]

AC5) with neither body bands nor friezes

This structure pattern corresponds to GC2 (without frieze) at Tall-e Gap. Two large jars and two small jars had only rim bands.[173]

[168] Langsdorff and McCown 1942 Pl. 58:2, 11; Alizadeh 2006 Fig. 39:D.
[169] Alizadeh 2006 Fig. 39:D; 41:C.
[170] Langsdorff and McCown 1942 Pl. 4:7, 13:3.
[171] Langsdorff and McCown 1942 Pl. 22:12; Alizadeh 2006 Fig. 43:A.
[172] Langsdorff and McCown 1942 Pl. 61:12.
[173] Langsdorff and McCown 1942: Pl. 13:7; 14:9-10; 15:4.

	No data (N)	Present (o)	Thin rim	Absent (x)
(1) Rim band	1	43	1	0
(2) Neck band	0	10		35
(3) Base band	20	6		19
(4) Body band	0	33		12
(5) Upper optional lines	0	18		27
(6) Lower optional lines	0	35		10
(7) Upper frieze line	0	34		11
(8) Lower frieze line	0	30		15
(9) Frieze division line	0	6		39

	No data	0	1	2	3
(10) No. of frieze	0	5	40	3	0

	No data (N)	Present (o)	Absent (x)
(11) Secondary motifs	0	4	41

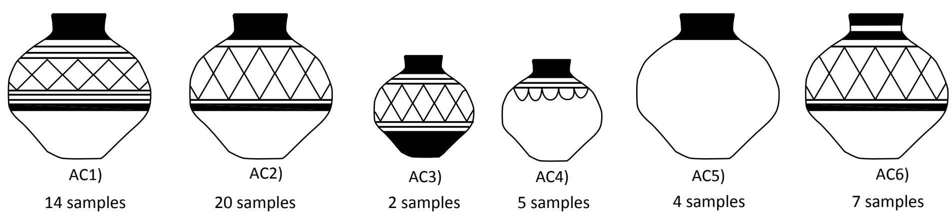


Figure 6.21 Result of the presence/absence of each structural component of closed vessels at Tall-e Bakun A

AC6) with neck bands

Finally, as a horizontal design structure pattern independent of the above five patterns, I describe the structural pattern with a neck band. This pattern was recognised both in large jars (5 samples) and small jars (4 samples). There was no correlation with any structural pattern or motif.

Finally, as a horizontal design structure pattern independent of the above five patterns, I describe the structural pattern with a neck band. This pattern was recognised both in large jars (5 samples) and small jars (4 samples). There was no correlation with any structural pattern or motif.

The analysis of abundant published vessels with horizontal design structures at Tall-e Bakun A (205 exterior-painted open vessels, 53 interior-painted ones, and 45 closed vessels) resulted in the following.

1) As many as 10 structural patterns were discovered on the surface of exterior-painted open vessels. Among them, AE1 (with body bands and with upper/lower optional lines) and AE6 (with neither body bands nor upper/lower frieze line) were popular at Tall-e Bakun A. While some structural patterns were commonly combined with specific motifs and complete vessel forms (e.g. AE10), others were not.
2) Vessels with (AI1) and without inner concentric lines (AI2) existed.
3) Six horizontal design structures were confirmed on closed vessels. In comparison with the complex geometric motifs, which were drawn on the surface of small jars, the decoration of large jars looked simpler.

Discussion: The diachronic change of horizontal design structures during the Bakun period

In the final part of this section, I integrate the results concerning horizontal design structures from four sites and compare them to clarify their diachronic changes. While the diachronic changes of motif elements over the course of the elaboration of patterns at Tall-e Bakun A (a final phase) were well-studied before, those of horizontal design structures have received less attention. Open vessels painted on their exteriors, interior-painted ones, and closed vessels will be separately compared.

The diachronic change of horizontal structural patterns of exterior-painted open vessels

Inter-site integration of horizontal design structure patterns

Above, I classified and described the horizontal design structure patterns of open vessels painted on their exteriors at each site, ranging from four (Tall-e Bakun B) to 10 patterns (Tall-e Bakun A). Table 6.41 contains a list of the structure patterns in each site for inter-site comparison. As a result, I set up 10 design structure patterns of exterior-painted open vessels (**DE**) corresponding to the classifications at Tall-e Bakun A based on the presence of rim bands, body bands, upper/lower optional lines, upper/lower frieze lines, frieze division lines, and secondary motifs (Fig. 6.22). DE8, DE9, and DE10 were characterised independently of the other seven patterns. The confirmed counts of DE patterns in each site are presented in Table 6.42. Below, I discuss the details of diachronic changes by focusing on the A) presence of body bands, B) absence of body bands, C) number of upper/lower optional lines, and D) multiple friezes, secondary motifs, and thin rim bands.

Table 6.41 Comparison of horizontal design structure patterns of open vessels painted on their exteriors between four sites and DE (design structure exterior)

Tall-e Jari A	Tall-e Bakun B	Tall-e Gap	Tall-e Bakun A	DE (Design structure Exterior)
JE1	BE1	GE1	AE1) with body bands and upper/ lower optional lines	DE1
JE2	BE2	GE2	AE2) with body bands and without upper/ lower optional lines	DE2
JE3			AE3) with body bands and without upper/ lower frieze lines	DE3
	BE3	GE3	AE4) without body bands and with upper/ lower optional lines	DE4
		GE4	AE5) with neither body bands nor upper/ lower optional lines	DE5
		GE5	AE6) with neither body bands nor upper/ lower frieze lines	DE6
JE4			AE7) with neither body bands nor rim bands	DE7
JE5	BE4	GE6	AE8) multiple Friezes	DE8
JE6		GE7	AE9) secondaryl motifs	DE9
			AE10) thin rim bands	DE10

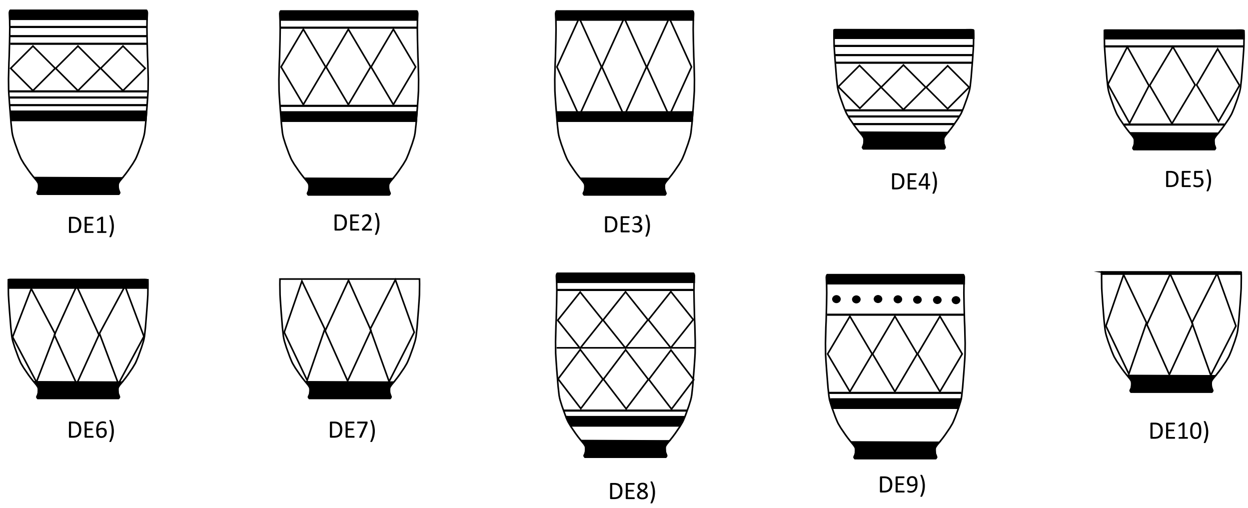


Figure 6.22 Schematic examples of horizontal design structure patterns of open vessels painted on their exteriors (DE)

Table 6.42 Confirmed number (left) and percentage (right) of horizontal design structure patterns of open vessels painted on their exteriors (DE) in each site

Horizontal design structure patterns	Jari A	Bakun B	Gap	Bakun A
DE1	6	20	40	91
DE2	4	11	9	11
DE3	4	-	-	5
DE4	-	1	3	19
DE5	-	-	17	32
DE6	-	-	3	40
DE7	1	-	-	7
Total of DE1-DE7	15	32	72	205
DE8	3	6	7	26
DE9	-	-	1	13
DE10	-	-	-	12

Horizontal design structure patterns	Jari A	Bakun B	Gap	Bakun A
DE1	40.00	62.50	55.56	44.39
DE2	26.67	34.38	12.50	5.37
DE3	26.67	-	-	2.44
DE4	-	3.13	4.17	9.27
DE5	-	-	23.61	15.61
DE6	-	-	4.17	19.51
DE7	6.67	-	-	3.41
Total of DE1-DE7	100	100	100	100
DE8	20.00	18.75	9.72	12.68
DE9	-	-	1.39	6.34
DE10	-	-	-	5.85

A) Diachronic changes regarding the presence of body bands:
At first, I discussed structure patterns in terms of body bands. Table 6.41 indicates that most vessels had body bands (DE1, DE2, DE3) at Tall-e Jari A and Tall-e Bakun B, and that there were more structural patterns without body bands (DE4, DE5, DE6, DE7) at Tall-e Gap. This increase of vessels without body bands suggests that painters came to use wider spaces for decoration over time. In addition, a closer look at the samples with body bands (DE1, DE2, DE3) in this table shows that the relative count and proportion of DE2 and DE3 (without upper/lower optional lines) decreased and the number of open vessels with upper/lower optional lines (DE1) increased over time.

B) Diachronic changes regarding the absence of body bands:
On the other hand, in the case of exterior-painted open vessels without body bands (DE4, DE5, DE6, DE7), the significant difference between Tall-e Gap and Tall-e Bakun A is the number of the exterior-painted open vessels without upper/lower frieze lines (DE6). Furthermore,

Table 6.43 Confirmed number and proportion of upper/lower-optional-lines patterns of DE1 and DE4 in each site

(No. of upper optional lines) and (No. of lower optional lines) / Site / Structure type	Jari A	Bakun B		Gap		Bakun A	
	DE1	DE1	DE4	DE1	DE4	DE1	DE4
0 and 1	3	1	-	1	-	6	3
0 and 1<	1	1	-	-	-	1	-
0 and 2	1	-	-	1	-	-	-
1 and 0	-	1	-	1	-	2	3
2 and 0	-	-	-	-	-	-	2
1 and 1	1	5	-	13	2	66	6
1 and 1<	-	-	-	-	-	2	-
1 and 2	-	-	-	2	-	-	1
2 and 1	-	-	-	3	-	3	-
2 and 2	-	-	-	17	1	5	2
2 and 2<	-	1	-	-	-	1	-
3 and 1	-	-	-	-	-	1	-
4 and 4	-	-	-	1	-	-	-
1 and unknown	-	8	-	1	-	1	1
2 and unknown	-	1	-	-	-	1	-
unknown and 1	-	1	-	-	-	1	-
unknown and 2	-	1	1	-	-	1	1
Total	6	20	1	40	3	91	19

(No. of upper optional lines) and (No. of lower optional lines) / Site / Structure type	Jari A	Bakun B		Gap		Bakun A	
	DE1	DE1	DE4	DE1	DE4	DE1	DE4
0 and 1	50.00	5	-	2.50	-	6.59	15.79
0 and 1<	16.67	5	-	-	-	1.10	-
0 and 2	16.67	-	-	2.50	-	-	-
1 and 0	-	5	-	2.50	-	2.20	15.79
2 and 0	-	-	-	-	-	-	10.53
1 and 1	16.67	25	-	32.50	66.67	72.53	31.58
1 and 1<	-	-	-	-	-	2.20	-
1 and 2	-	-	-	5.00	-	-	5.26
2 and 1	-	-	-	7.50	-	3.30	-
2 and 2	-	-	-	42.50	33.33	5.49	10.53
2 and 2<	-	5	-	-	-	1.10	-
3 and 1	-	-	-	-	-	1.10	-
4 and 4	-	-	-	2.50	-	-	-
1 and unknown	-	40	-	2.50	-	1.10	5.26
2 and unknown	-	5	-	-	-	1.10	-
unknown and 1	-	5	-	-	-	1.10	-
unknown and 2	-	5	100	-	-	1.10	5.26
Total	100	100	100	100	100	100	100

Table 6.44 Comparison of horizontal design structure patterns of open vessels painted on their interiors between four sites and DI (design structure interior)

Jari A	Bakun B	Gap	Bakun A	DI (Design structure Interior)
JI1	BI1	GI1) with neither interior base bands nor concentric lines	AI1	DI1
JI2	BI2	GI2) with interior base bands	AI2	DI2
JI3	BI3	GI3) without rim bands		DI3

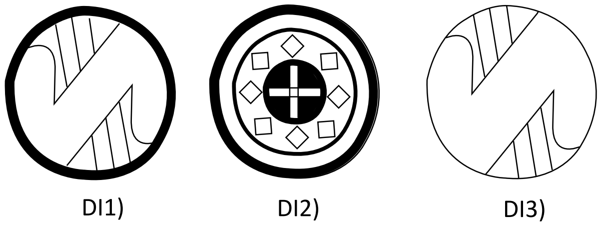


Figure 6.23 Schematic examples of horizontal design structure patterns of open vessels painted on their interiors (DI)

Table 6.45 Confirmed number (left) and proportion (right) of horizontal design structure patterns of open vessels painted on their interiors (DI) in each site

Horizontal design tructure patterns	Jari A	Bakun B	Gap	Bakun A
DI1) with neither interior base bands nor concentric lines	3	4	52	35
DI2) with interior base bands and concentric lines	9	6	8	18
DI3) without rim bands	2	1	1	0
Total	14	11	61	53

Horizontal design tructure patterns	Jari A	Bakun B	Gap	Bakun A
DI1) with neither interior base bands nor concentric lines	21.43	36.36	85.25	66.04
DI2) with interior base bands and concentric lines	64.29	54.55	13.11	33.96
DI3) without rim bands	14.29	9.09	1.64	-
Total	100	100	100	100

Table 6.46 Comparison of horizontal design structure patterns of closed vessels between two sites and DC (design structure closed)

Gap	Bakun A	DE (Design structure Closed vessel)
GC1	AC1) with body bands with upper/ lower optional lines	DC1
GC1	AC2) with body bands and without optional lines	DC2
	AC3) without body bands and with Upper/ Lower optional lines	DC3
	AC4) without body bands and with Frieze	DC4
GC2	AC5) with neither body bands nor friezes	DC5
GC3	AC6) with neck bands	DC6

the relative proportion of vessels with upper/ lower optional lines (DE4) at Tall-e Gap and Tall-e Bakun A was lower than those without upper/lower optional lines (DE5). This suggests that, generally, when a body band was absent, no upper/lower optional lines were drawn.

C) Diachronic change regarding the number of upper/ lower optional lines:

Finally, I used the confirmed number of vessels with upper/lower optional lines (DE 1 and DE4) to investigate the preferred number of upper/ lower optional lines (Table 6.43). While one upper optional line and one lower optional line were predominant at Tall-e Bakun A and Tall-e Bakun B, two upper optional lines and two lower optional lines were dominant at Tall-e Gap. In these sites, equal numbers of upper/ lower optional lines were preferred. On the other hand, at Tall-e Jari A, this pattern was not predominant. A lack of upper optional lines and one lower optional line was frequently observed at Tall-e Jari A. It is likely that the equal number of upper/lower optional lines became the explicit rule after Tall-e Bakun B; this rule might indicate stability of communities of pottery painting.

D) multiple friezes, secondary motifs, and thin rim bands during the Bakun period:

Regarding additional elements such as DE8) multiple friezes, DE9) secondary motifs, and DE10) thin rim bands (Table 6.41), although DE8) multiple friezes and DE9) secondary motifs

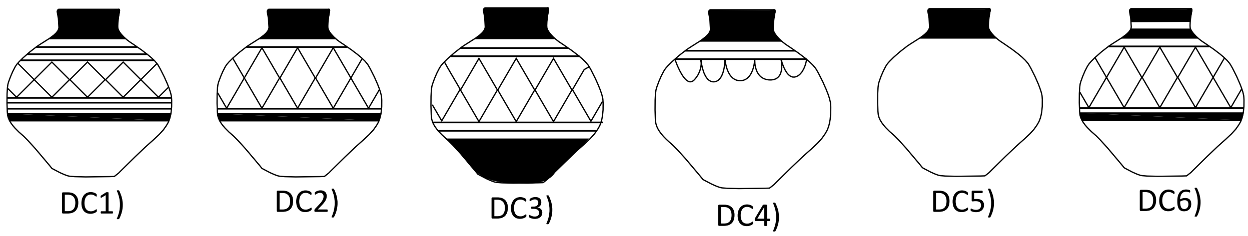


Figure 6.24 Schematic examples of horizontal design structure patterns of closed vessels (DC)

Table 6.47 Confirmed number (left)and proportion (right) of horizontal design structure patterns of closed vessels (DC) in each site

Horizontal design structure patterns	Gap	Bakun A
DC1) with body bands and with upper/ lower optional lines	4	14
DC2) with body bands and without optional lines	1	20
DC3) without body bands and with upper/ lower optional lines	-	2
DC4) without body bands and with friezes	-	5
DC5) with neither body bands nor friezes	8	4
Total of DC1-DC5	13	45
DC6) with neck bands	1	7

Horizontal design structure patterns	Gap	Bakun A
DC1) with body band with upper/ lower optional lines	30.77	31.11
DC2) with Body band without optional lines	7.69	44.44
DC3) without Body band and with upper/ lower optional lines	-	4.44
DC4) without body band and with frieze	-	11.11
DC5) without body band and without frieze	61.54	8.89
Total of DC1-DC5	100	100
DC6) with neck band	7.69	15.56

existed as early as Tall-e Jari A, their number and proportion increased at Tall-e Bakun A, especially secondary motifs. Thin rim bands were observed only at Tall-e Bakun A.

The diachronic change of horizontal structural patterns of interior-painted open vessels

As a result of the comparison of the categories in each site (Table 6.44), I set up three design structure patterns of interior-painted open vessels (**DI**) for the inter-site comparison: DI1) with neither interior base bands nor concentric lines, DI2) with interior base bands and concentric lines, and DI3) without rim bands (Fig. 6.23). Table 6.45 presents the confirmed number of horizontal design structures of interior-painted open vessels in each site. The majority of horizontal design structures shifted from DI2 (Tall-e Jari A, Tall-e Bakun B) to DI1 (Tall-e Gap, Tall-e Bakun A) over time, implying that painters came to use motifs on interior-painted vessels more freely. The absence of rim bands (DI3) was scarcely observed in Tall-e Jari A and Tall-e Bakun B, but this structure pattern became rarer during the later phase of the Bakun period, regardless of the fact that the absence of rim bands was observed in exterior-painted open vessels in the later phase (DE7).

The diachronic change of horizontal structural patterns of closed vessels

Because there are few diagnostic cases showing the design structural patterns of closed vessels at Tall-e Jari A and Tall-e Bakun B, I compare only those from Tall-e Gap (GC) and Tall-e Bakun A (AC). I followed the criteria of horizontal design structure patterns of closed vessels at Tall-e Bakun A (AC1-AC6), setting up six patterns for horizontal design structure patterns for closed vessels (**DC**) (Table 6.46, Fig. 6.24); DC1) with body bands and upper/lower optional lines, DC2) with body bands and without optional lines, DC3) without body bands and with upper/lower optional lines, DC4) without body bands and with friezes, DC5) with neither body bands nor friezes, and DC6) with neck bands.

A comparison of design structure patterns of the closed vessels between Tall-e Gap and Bakun A is presented in Table 6.47. At first, DC1 was confirmed at both sites as well as Tall-e Bakun B,[174] showing long-term continuity. Second, while DC5 (only one rim band) was preferred over DC1 at Tall-e Gap, DC1 and DC2 (with a body band and frieze) were predominant at Tall-e Bakun A. The

[174] Egami and Masuda 1962 Fig. 13:1-3.

preference of friezes and body bands at Tall-e Bakun A coincided with the appearance of elaborate motifs on the surfaces of closed vessels. Thirdly, the separation of neck bands (DC7) from rim bands increased at Tall-e Bakun A.

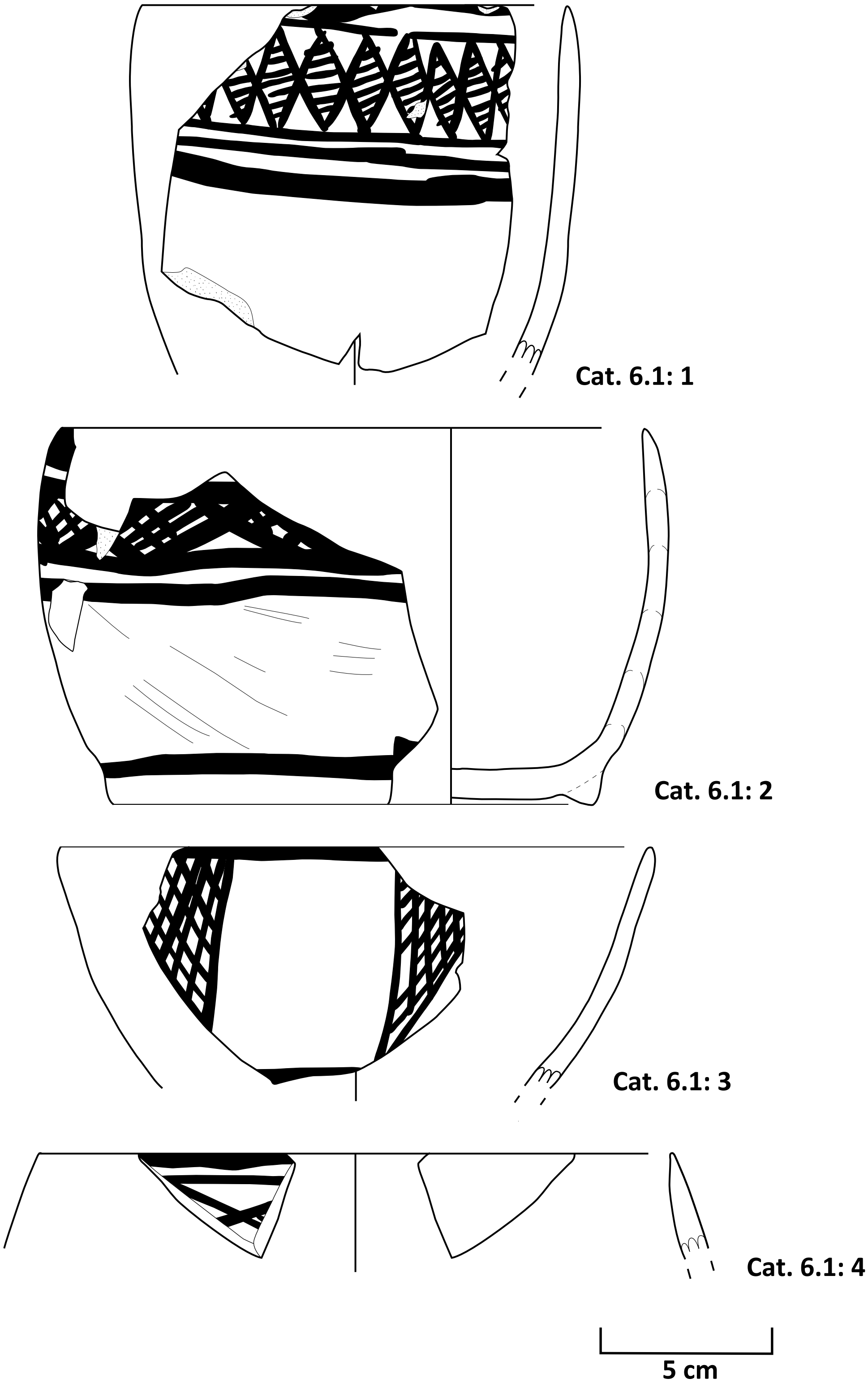
Summary of horizontal design structures

In this section, I discuss diachronic changes of Bakun pottery in terms of horizontal design structures of black-on-buff pottery, pursuing **Research Question No. 2:** 'When and how were black-on-buff ceramics adopted and developed in the Bakun period?' In this chapter, I lean toward a viewpoint of painted decoration different from those of previous studies, which emphasise design motifs. I categorise and aggregate horizontal design structure patterns in each site with brief explanations of painted motifs corresponding to the patterns. In the final section, I discuss longer-term diachronic changes inter-site comparisons. As a result of the horizontal design-structure analysis, I was able to establish the following longer-term diachronic changes.

1) I confirmed 10 design structural patterns of exterior-painted open vessels, three patterns for interior-painted open vessels, and six patterns for closed vessels throughout the Bakun period.
2) The number of exterior-painted open vessels with body bands and without upper/lower optional lines increased over time, allowing more space for painting.
3) As for open vessels painted on their interiors, the proportion of the vessels with interior base bands decreased over time.
4) Regarding closed vessels, the number of design structure patterns increased over time, coinciding with the elaboration of painted motifs.

In the next chapters, I approach pottery-making techniques and their diachronic changes.

(from next page) Catalogue (Chapter 6) (Abbreviations: JA: Tall-e Jari A, BB: Tall-e Bakun B, GP: Tall-e Gap, Ext: exterior, Int: interior, Surface: Surface treatment



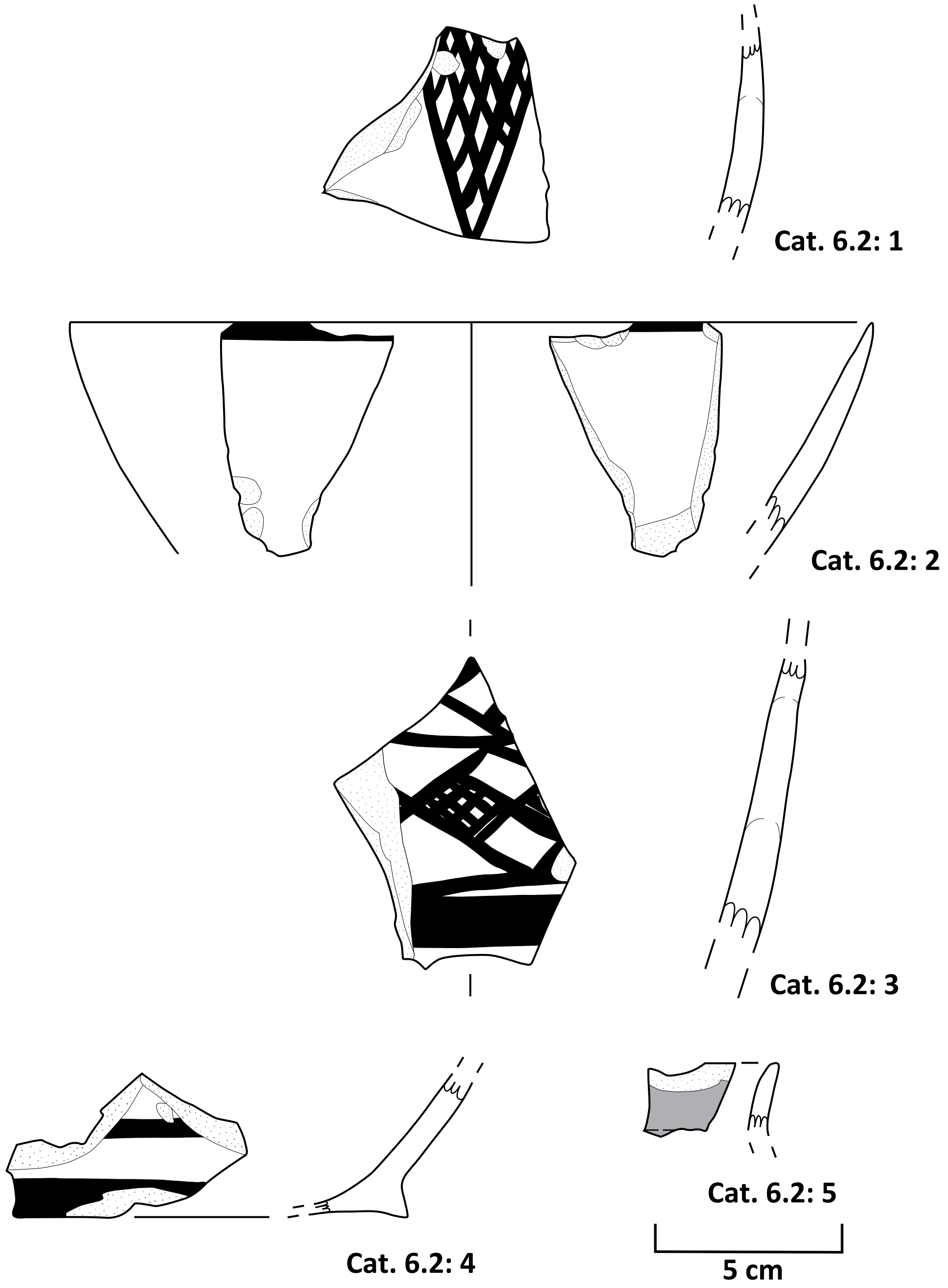
Pottery from Tall-e Jari A, Trench C, open vessels

Cat. 6.1: 1. JA. Surface soil. BOBW. Colour Ext, Int, Paint: 7.5YXR, 7.5YXR, 7.5YXR. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.1: 2. JA. Layer 1. BOBW. Colour Ext, Int, Paint: 7.5YXR, 7.5YXR, 7.5YXR. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.1: 3. JA. Layer 1. BOBW. Colour Ext, Int, Paint: 7.5YXR, 7.5YXR, 7.5YXR. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.1: 4. JA. Layer 2. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 7.5YR 4/6. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally-vertically smoothed, slipped



Pottery from Tall-e Jari A, Trench C, open and closed vessels.

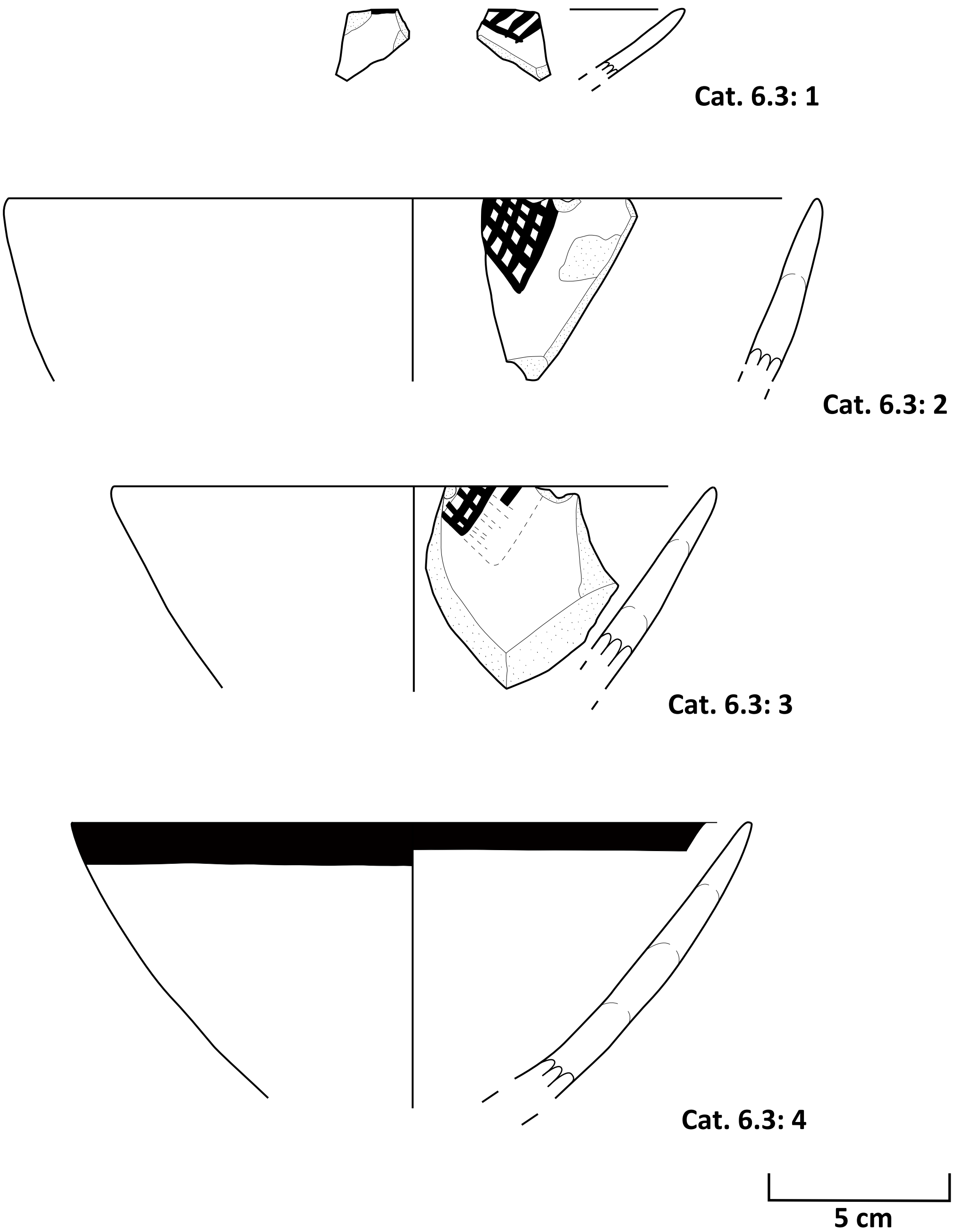
Cat. 6.2: 1. JA. Layer 2. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 7.5YR 4/6. Surface Ext, Int: Roughly smoothed, slipped. Roughly smoothed, slipped.

Cat. 6.2: 2. JA. Layer 2. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10Y 3/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally-vertically smoothed, slipped.

Cat. 6.2: 3. JA. Layer 2. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 7.5YR 4/6. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.2: 4. JA. Layer 3. BOBW. Colour Ext, Int, Paint: 7.5Y 8/1, 7.5Y 8/2, 5YR 5/8. Surface Ext, Int: Roughly horizontally smoothed, slipped. Roughly smoothed.

Cat. 6.2: 5. JA. Layer 4. BOBW. Colour Ext, Int, Paint: 2.5Y 8/3, 2.5Y 8/3, 10R 6/8. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.



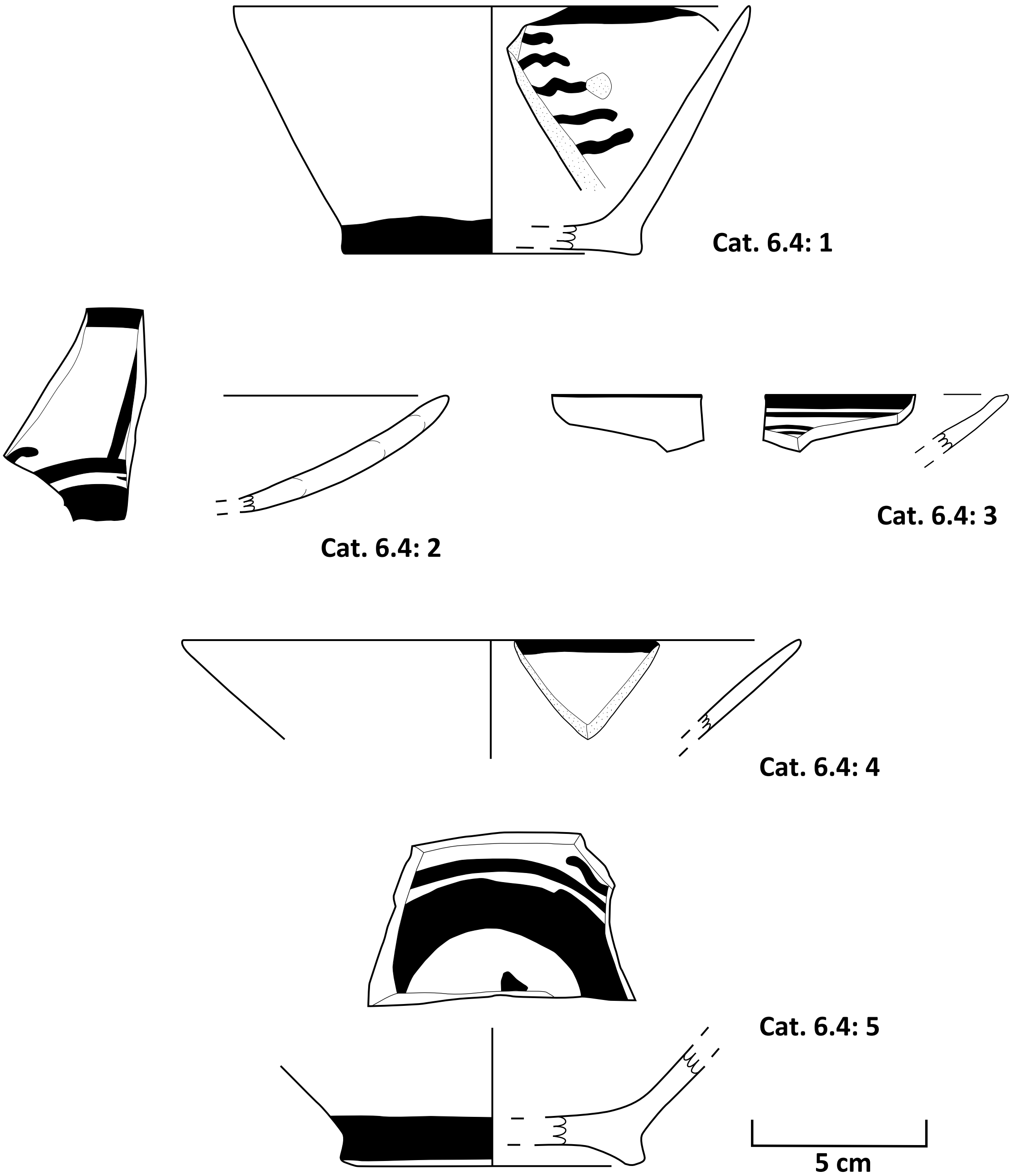
Pottery from Tall-e Jari A, Trench C, open vessels

Cat. 6.3: 1. JA. Layer 1. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10Y 2/1. Surface Ext, Int: Smoothed, slipped. Smoothed, slipped.

Cat. 6.3: 2. JA. Layer 1. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 7.5YR 5/6. Surface Ext, Int: Horizontally smoothed, slipped. Roughly horizontally smoothed, slipped.

Cat. 6.3: 3. JA. Layer 2. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 7.5YR 5/8. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.3: 4. JA. Layer 4. BOBW. Colour Ext, Int, Paint: 2.5Y 8/4, 2.5Y 8/3, 5YR 5/8. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.



Pottery from Tall-e Jari A, Trench C, open vessels

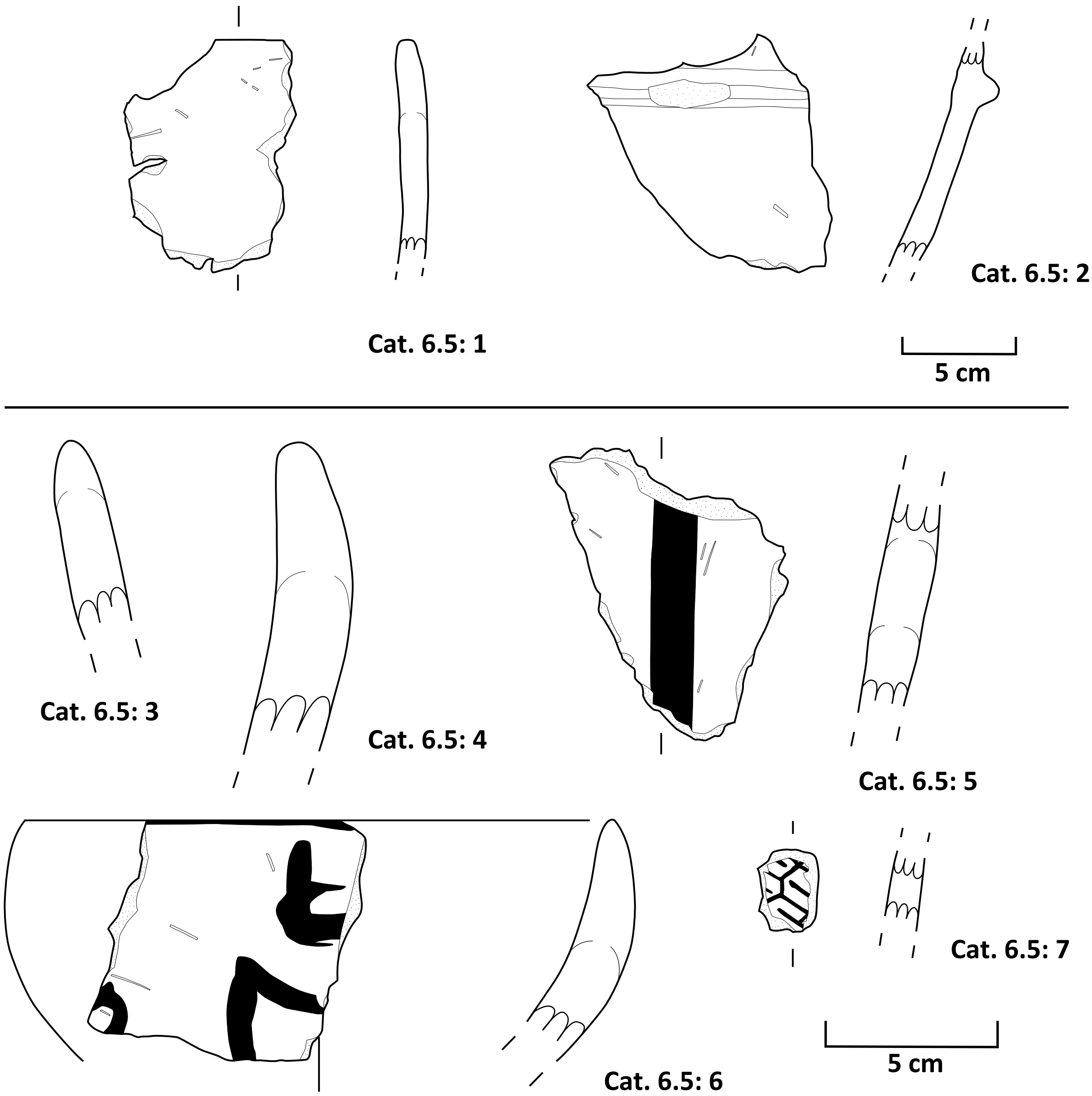
Cat. 6.4: 1. JA. Layer 4. BOBW. Colour Ext, Int, Paint: 7.5Y 8/1, 7.5Y 8/2, 5YR 4/6. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.4: 2. JA. Layer 4. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.4: 3. JA. Unknown layer BOBW. Colour Ext, Int, Paint: 10Y 6/2. 10Y 6/2, 10Y 2/1. Surface Ext, Int: Roughly horizontally smoothed. Roughly horizontally smoothed.

Cat. 6.4: 4. JA. Unknown layer BOBW. Colour Ext, Int, Paint: 2.5Y 8/3, 2.5Y 8/3, 7.5YR 5/6. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.4: 5. JA. Unknown layer BOBW. Colour Ext, Int, Paint: 10Y 8/1. 10Y 8/1. 7.5YR 4/6. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed, slipped.



Pottery from Tall-e Jari A, Trench C, VCW, Neolithic ware

Cat. 6.5: 1. JA. Layer 1. VCW. Colour Ext, Int: 7.5YR 8/4, 7.5YR 8/4. Surface Ext, Int: Horizontally smoothed. Horizontally smoothed.

Cat. 6.5: 2. JA. Layer 1. VCW. Colour Ext, Int: 7.5YR 8/4, 7.5YR 8/4. Surface Ext, Int: Horizontally smoothed. Smoothed.

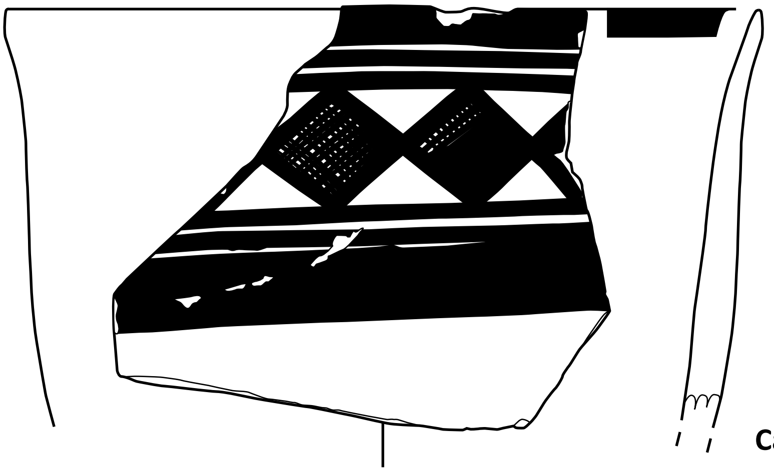
Cat. 6.5: 3. JA. Layer 2. VCW. Colour Ext, Int: 2.5Y 8/2, 7.5YR 8/4. Surface Ext, Int: Smoothed. Smoothed.

Cat. 6.5: 4. JA. Layer 3. VCW. Colour Ext, Int: 7.5YR 8/4, 7.5YR 8/4. Surface Ext, Int: Smoothed. Smoothed.

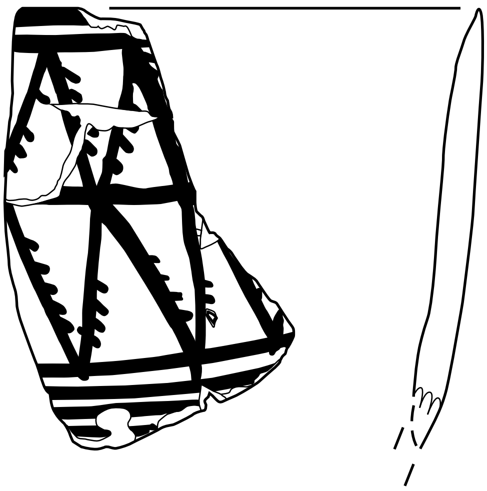
Cat. 6.5: 5. JA. Layer 2. VCW. Colour Ext, Int, Paint: 2.5Y 8/4, 2.5Y 8/3, 5YR 3/6. Surface Ext, Int: Smoothed. Smoothed.

Cat. 6.5: 6. JA. Layer 3. VCW. Colour Ext, Int, Paint: 2.5Y 7/6, 2.5Y 8/3, 5YR 4/6. Surface Ext, Int: Roughly vertically smoothed. Horizontally-vertically smoothed.

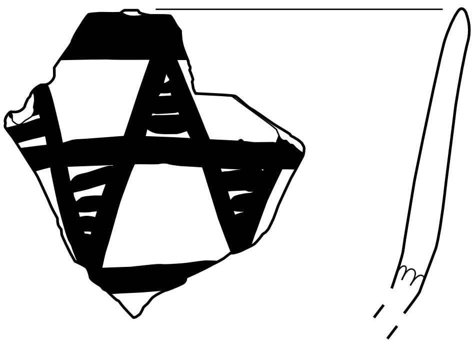
Cat. 6.5: 7. JA. Layer 3. Neolithic ware. Colour Ext, Int, Paint: 7.5YR 8/4, 7.5YR 8/4, 5Y 2/1. Surface Ext, Int: Smoothed. Smoothed



Cat. 6.6: 1



Cat. 6.6: 2



Cat. 6.6: 3

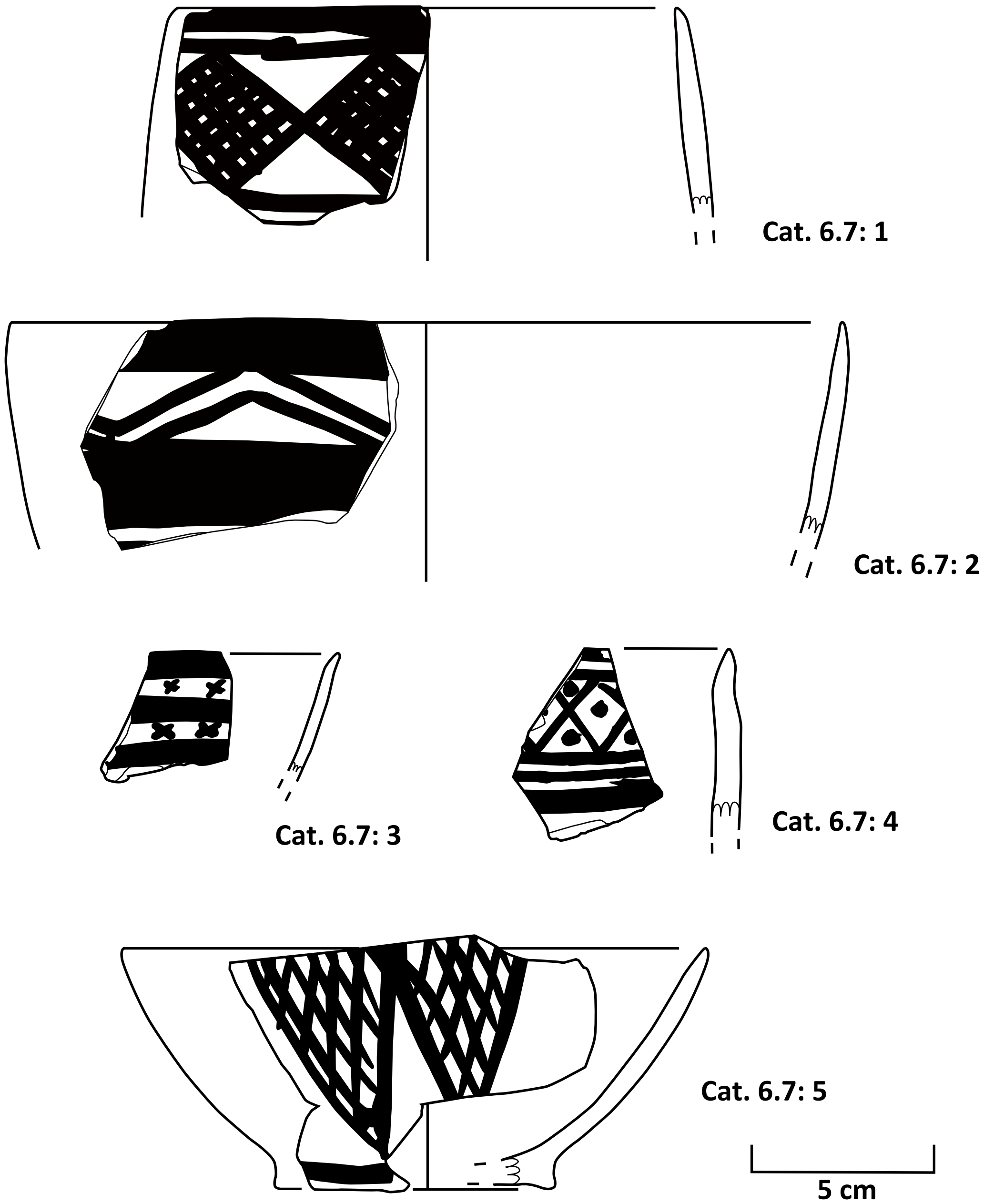
5 cm

Pottery from Tall-e Jari A, other trenches, open vessels.

Cat. 6.6: 1. JA. Trench G. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10Y 3/2. Surface Ext, Int: Horizontally-diagonally smoothed, slipped. Horizontally-diagonally smoothed, slipped.

Cat. 6.6: 2. JA. L2? BOBW. Colour Ext, Int, Paint: 5Y 8/3, 5Y 8/3, 5Y 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed.

Cat. 6.6: 3. JA. Trench G. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 5YR 4/8. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed, slipped.



Pottery from Tall-e Jari A, other trenches, open vessels

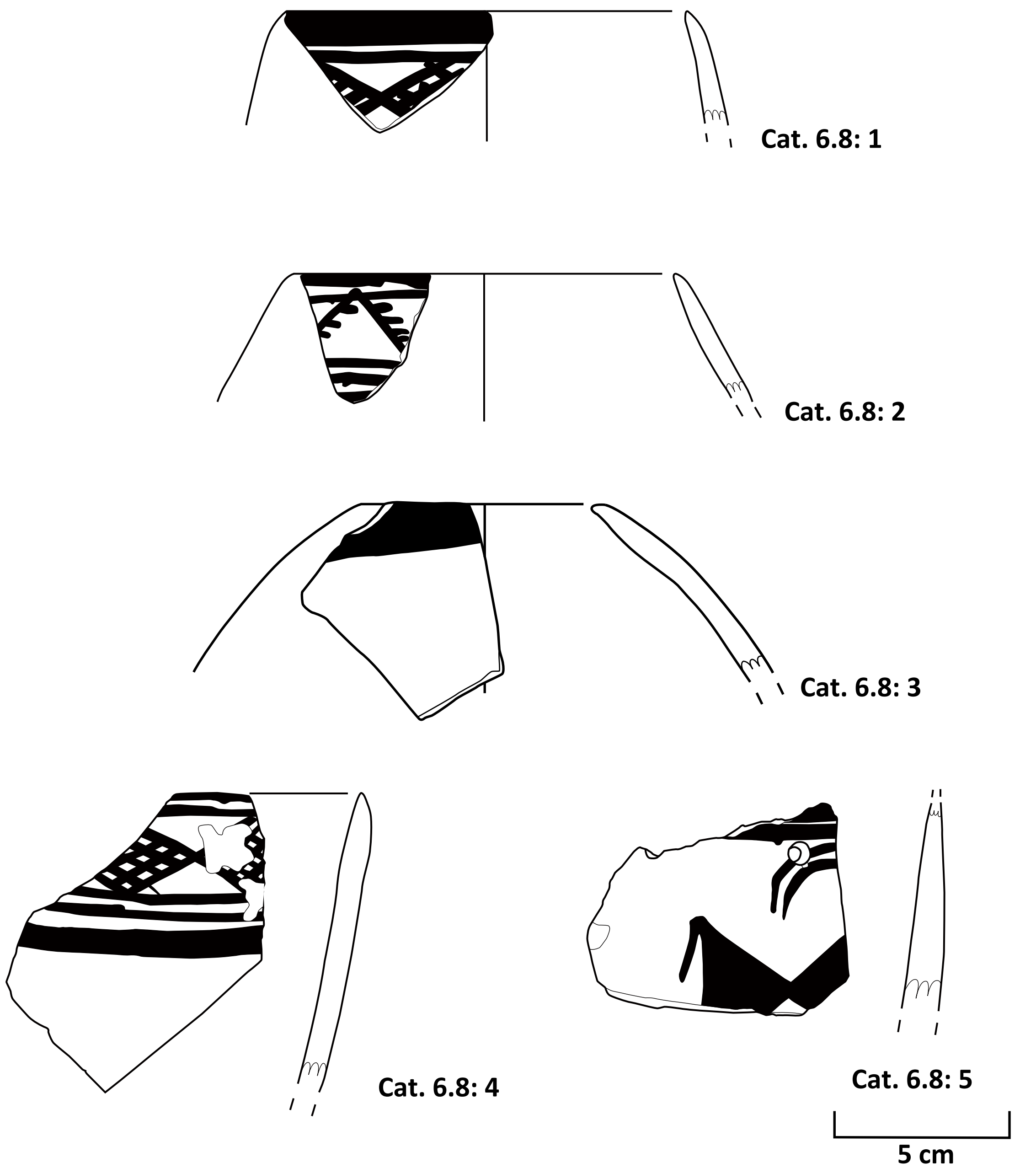
Cat. 6.7: 1. JA. Trench G. BOBW. Colour Ext, Int, Paint: 7.5Y 8/1, 7.5Y 8/1, 7.5Y 3/1. Surface Ext, Int: Vertically smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.7: 2. JA. Trench B. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 5YR 4/8. Surface Ext, Int: Horizontally smoothed, slipped. Covered by calcium

Cat. 6.7: 3. JA. Trench G. BOBW. Colour Ext, Int, Paint: 5Y 8/3, 5Y 8/3, 5Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.7: 4. JA. Trench D. BOBW. Colour Ext, Int, Paint: 7.5Y 8/1, 7.5Y 8/1, 7.5Y 2/2. Surface Ext, Int: Horizontally smoothed. Horizontally smoothed.

Cat. 6.7: 5. JA. Trench D. BOBW. Colour Ext, Int, Paint: 10YR 8/6, 5Y 8/3, 10YR 2/3. Surface Ext, Int: Horizontally-diagonally smoothed. Horizontally smoothed.



Pottery from Tall-e Jari A, other trenches, open vessels

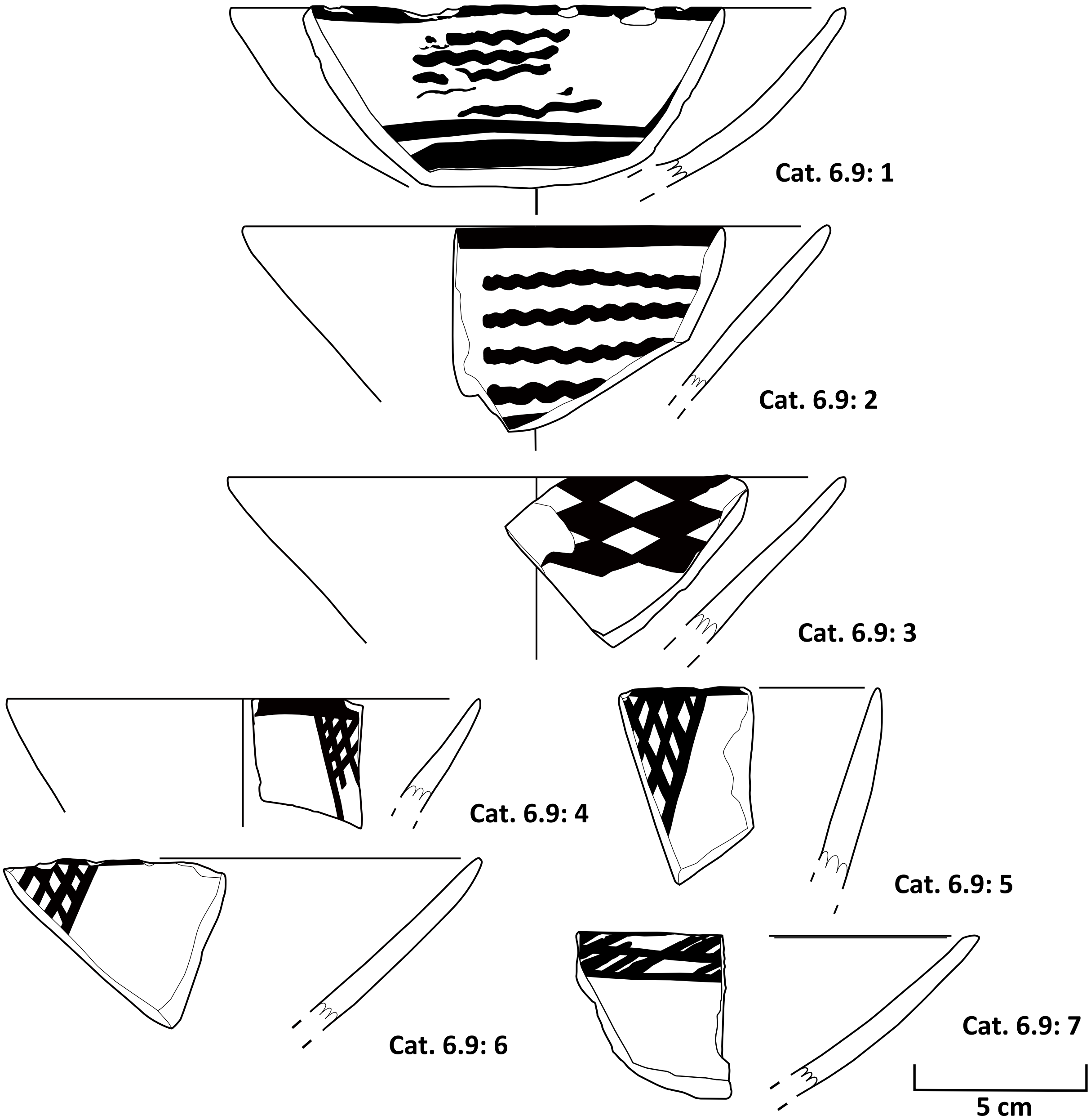
Cat. 6.8: 1. JA. Trench G. BOBW. Colour Ext, Int, Paint: 7.5Y 8/1, 7.5Y 8/1, 7.5Y 3/1. Surface Ext, Int: Vertically smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.8: 2. JA. Trench B. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 5YR 4/8. Surface Ext, Int: Horizontally smoothed, slipped. Covered by calcium

Cat. 6.8: 3. JA. Trench G. BOBW. Colour Ext, Int, Paint: 5Y 8/3, 5Y 8/3, 5Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.8: 4. JA. Trench D. BOBW. Colour Ext, Int, Paint: 7.5Y 8/1, 7.5Y 8/1, 7.5Y 2/2. Surface Ext, Int: Horizontally smoothed. Horizontally smoothed.

Cat. 6.8: 5. JA. Trench D. BOBW. Colour Ext, Int, Paint: 10YR 8/6, 5Y 8/3, 10YR 2/3. Surface Ext, Int: Horizontally-diagonally smoothed. Horizontally smoothed.



Pottery from Tall-e Jari A, other trenches, open vessels

Cat. 6.9: 1. JA. Trench E. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10Y 2/1. Surface Ext, Int: Covered by calcium. Slipped.

Cat. 6.9: 2. JA. Trench D. BOBW. Colour Ext, Int, Paint: 2.5Y 8/4, 2.5Y 8/4, 5YR 2/4. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

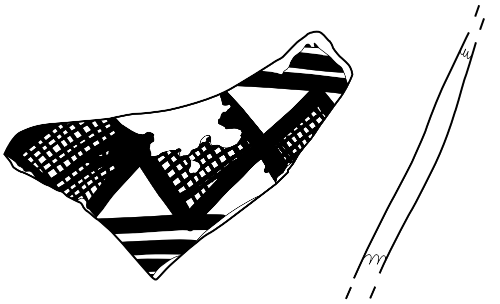
Cat. 6.9: 3. JA. Trench B. BOBW. Colour Ext, Int, Paint: 5Y 8/4, 2.5Y 8/4, 7.5YR 3/4. Surface Ext, Int: Smoothed. Horizontally smoothed.

Cat. 6.9: 4. JA. Trench D. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10YR 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

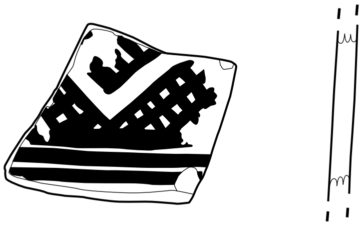
Cat. 6.9: 5. JA. Trench A. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10Y 4/2. Surface Ext, Int: Smoothed. Smoothed.

Cat. 6.9: 6. JA. Trench D. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 2.5Y 3/3. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed, slipped.

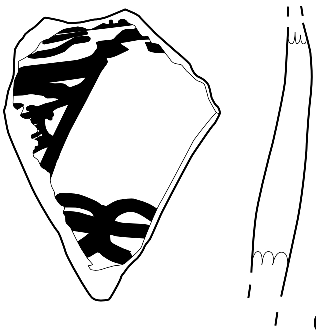
Cat. 6.9: 7. JA. Trench D. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 7.5Y 2/1. Surface Ext, Int: Horizontally-diagonally smoothed, slipped. Diagonally smoothed, slipped.



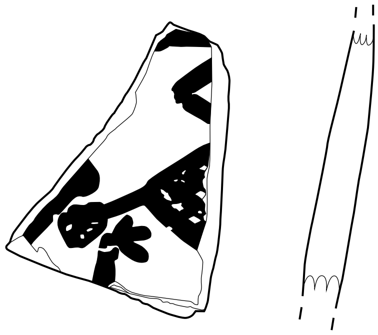
Cat. 6.10: 1



Cat. 6.10: 2



Cat. 6.10: 3



Cat. 6.10: 4

5 cm

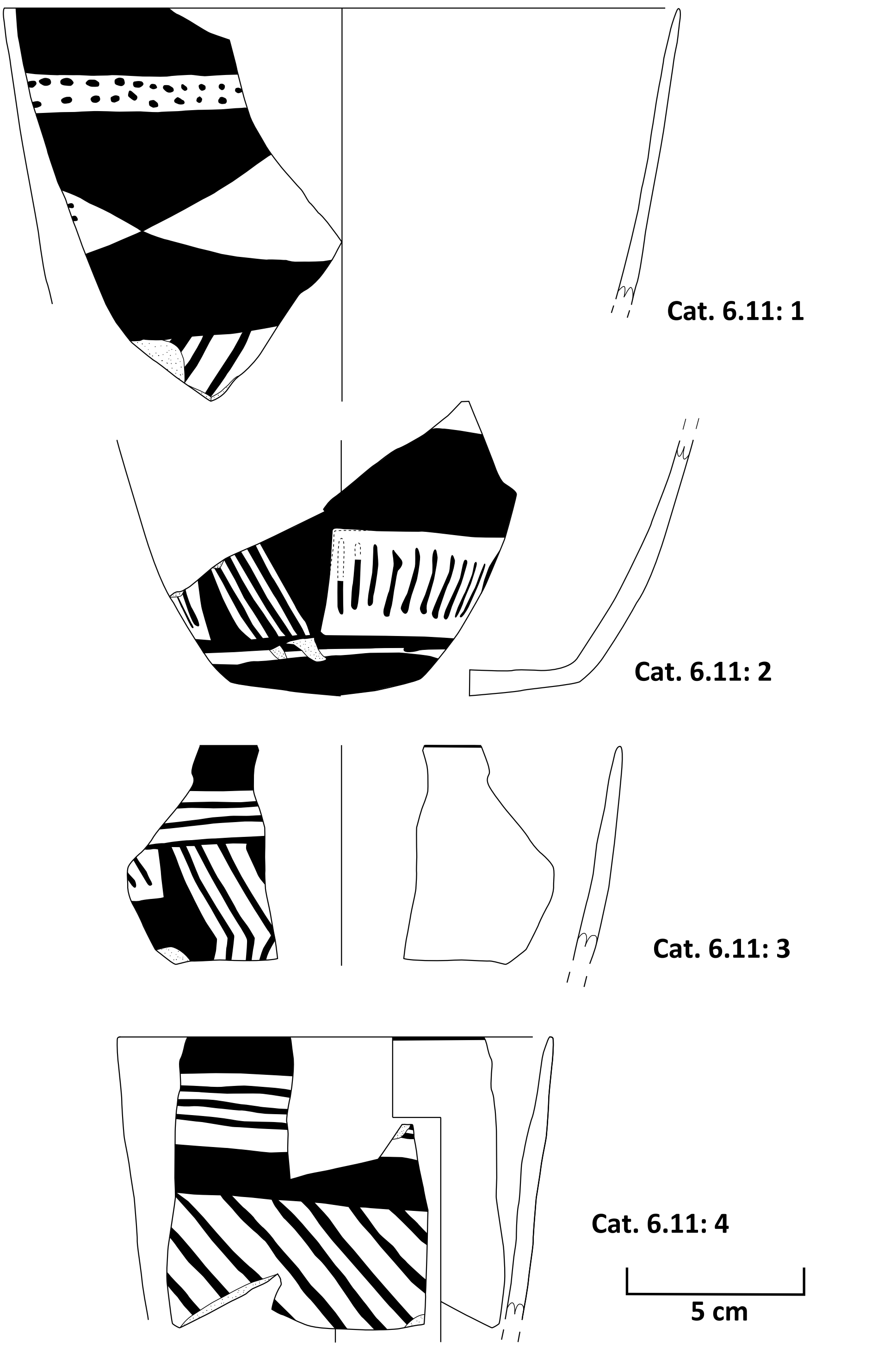
Pottery from Tall-e Bakun B, BOBW and VBOBW open vessels

Cat. 6.10: 1. BB. Surface soil. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 7/2, 10Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Abraded.

Cat. 6.10: 2. BB. B11. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 2.5Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Smoothed.

Cat. 6.10: 3. BB. Surface soil. VBOBW. Colour Ext, Int, Paint: 7.5Y 7/2, 7.5Y 7/2, 5YR 2/3. Surface Ext, Int: Diagonally smoothed. Smoothed, slipped.

Cat. 6.10: 4. BB. Surface soil. VBOBW. Colour Ext, Int, Paint: 7.5Y 7/2, 7.5Y 7/2, 10Y 2/1. Surface Ext, Int: Horizontally smoothed. Smoothed, slipped.



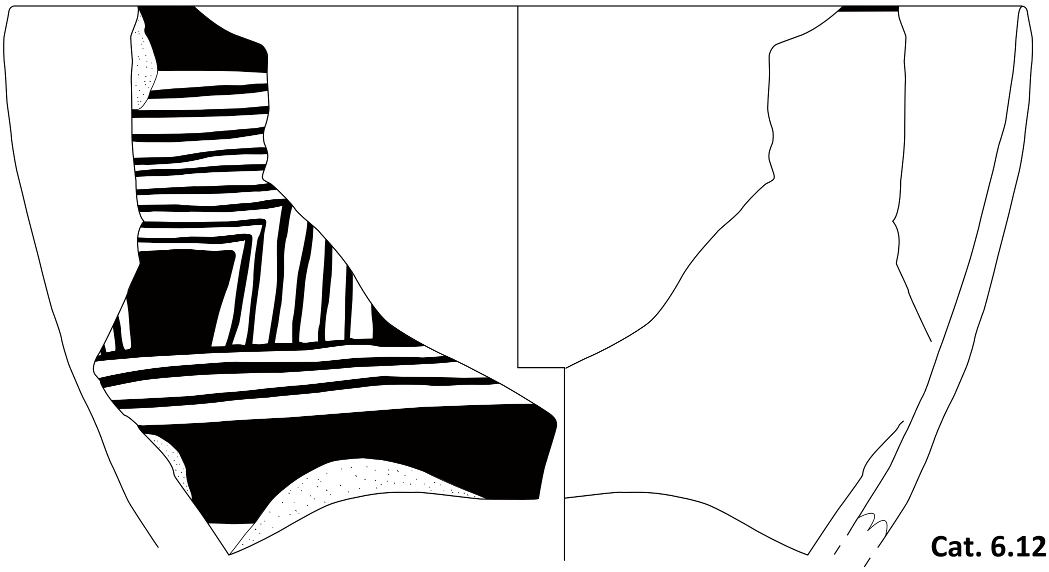
Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

Cat. 6.11: 1. GP. GAT-1, Level 1 BOBW. Colour Ext, Paint: 2.5Y 8/4, 2.5Y 3/3. Surface Ext, Int: Vertically smoothed, slipped Horizontally smoothed, slipped.

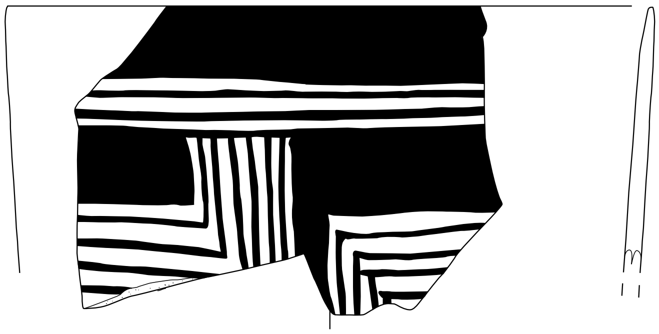
Cat. 6.11: 2. GP. GAT-1, Level 2. BOBW. Colour Ext, Paint: 10YR 8/4, 10YR 2/1. Surface Ext, Int: Diagonally scraped, slipped. Smoothed.

Cat. 6.11: 3. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 2.5Y 8/3, 2.5Y 3/2. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed, slipped.

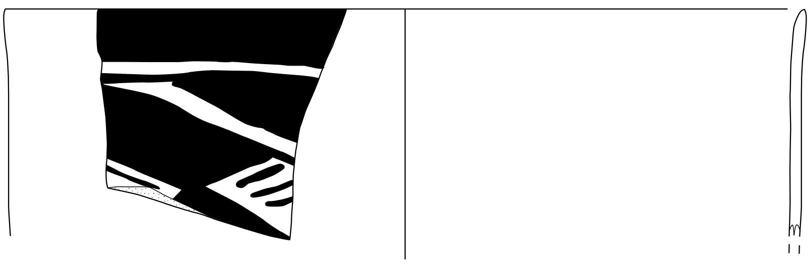
Cat. 6.11: 4. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 5Y 8/2, 5Y 2/1. Surface Ext, Int: Smoothed, slipped. Smoothed, slipped.



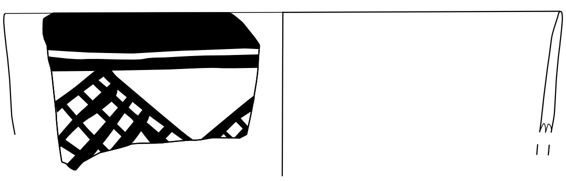
Cat. 6.12: 1



Cat. 6.12: 2



Cat. 6.12: 3



Cat. 6.12: 4

5 cm

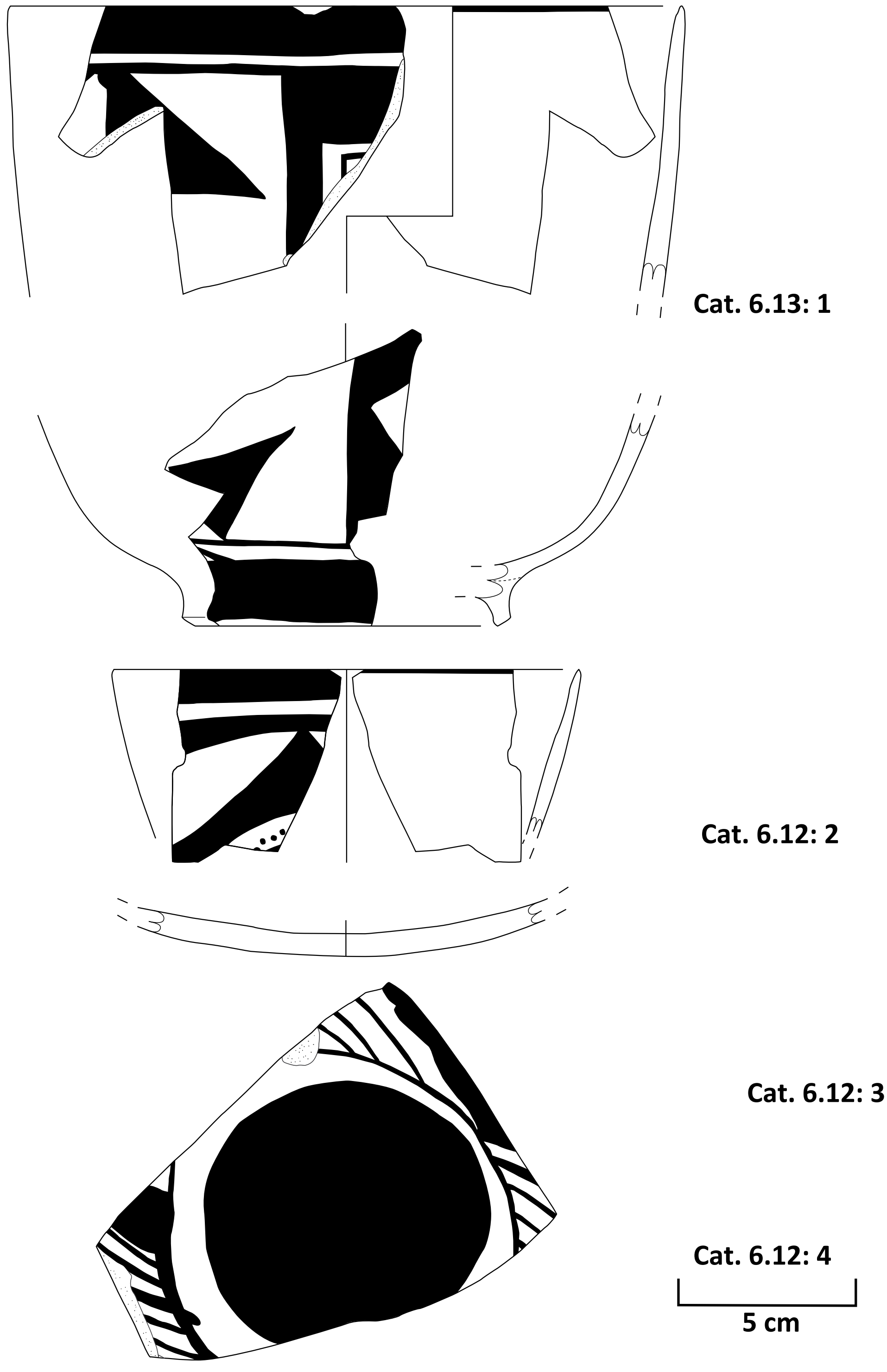
Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

Cat. 6.12: 1. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 5Y 8/3, 5Y 2/1. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.12: 2. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 5Y 7/3, 5Y 2/1. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.12: 3. GP. GAT-2, Level 5a. BOBW. Colour Ext, Paint: 2.5Y 7/3, 2.5Y 2/1. Surface Ext, Int: Diagonally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.12: 4. GP. GAT-2, Level 5a. BOBW. Colour Ext, Paint: 2.5Y 7/3, 2.5Y 2/1. Surface Ext, Int: Horizontally-diagonally smoothed, slipped. Horizontally smoothed, slipped.



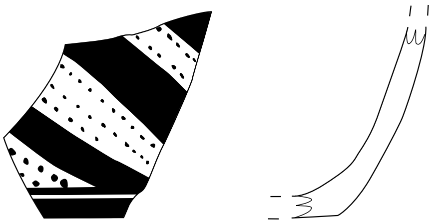
Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

Cat. 6.13: 1. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 2.5Y 8/4, 10YR 2/2. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed, slipped.

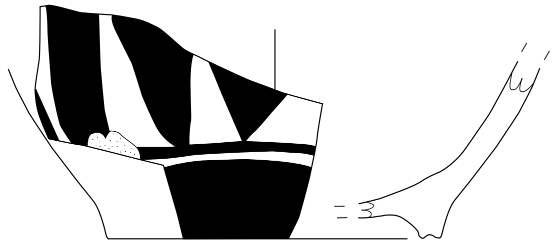
Cat. 6.13: 2. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 5Y 8/3, 10YR 1.7/1. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.13: 3. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 7.5YR 7/4, 7.5YR 3/2 Surface Ext, Int: Horizontally smoothed, slipped. Smoothed, slipped.

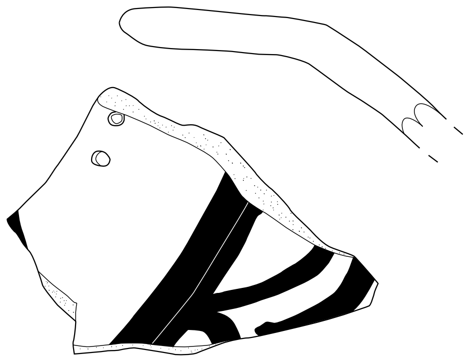
Cat. 6.13: 4. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 2.5Y 8/3, 2.5Y 3/1. Surface Ext, Int: Smoothed.



Cat. 6.14: 1



Cat. 6.14: 2



Cat. 6.14: 3

Cat. 6.14: 4

5 cm

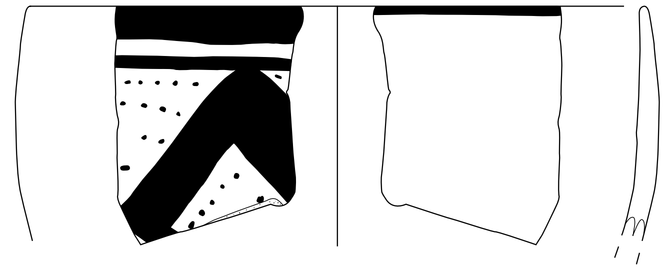
Pottery from Tall-e Gap, Trenches GAT-1, 2

Cat. 6.14: 1. GP. GAT-2, Level 5b. BOBW. Colour Ext, Paint: 2.5Y 8/4, 2.5Y 3/1. Surface Ext, Int: Smoothed, slipped. Smoothed, slipped.

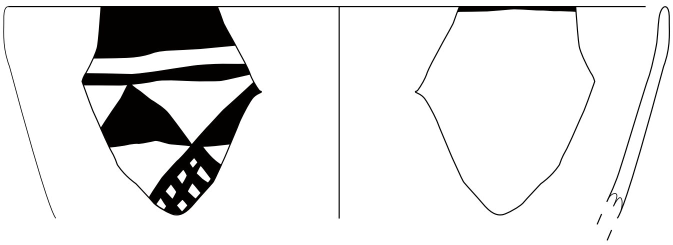
Cat. 6.14: 2. GP. GAT-2, Level 6. BOBW. Colour Ext, Paint: 5Y 7/3, 5Y 2/1. Surface Ext, Int: Slipped. Smoothed, slipped.

Cat. 6.14: 3. GP. GAT-1, Level 7 BOBW. Colour Ext, Paint: 5Y 8/2, 5Y 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

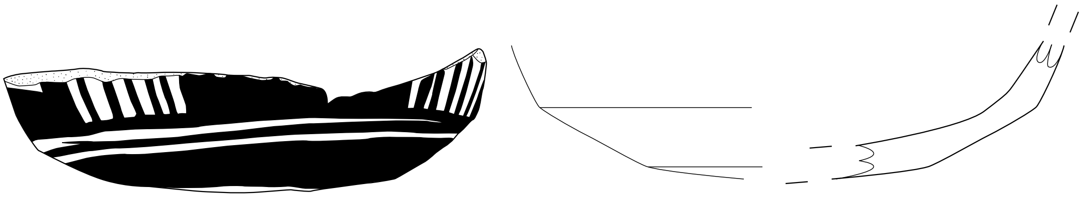
Cat. 6.14: 4. GP. GAT-1, Level 7. BOBW. Colour Ext, Paint: 2.5Y 8/2, 2.5Y 3/2. Surface Ext, Int: Horizontally-diagonally smoothed, slipped. Horizontally smoothed, slipped.



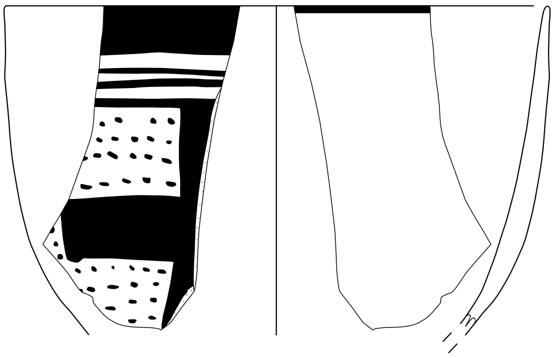
Cat. 6.15: 1



Cat. 6.15: 2



Cat. 6.15: 3



Cat. 6.15: 4

5 cm

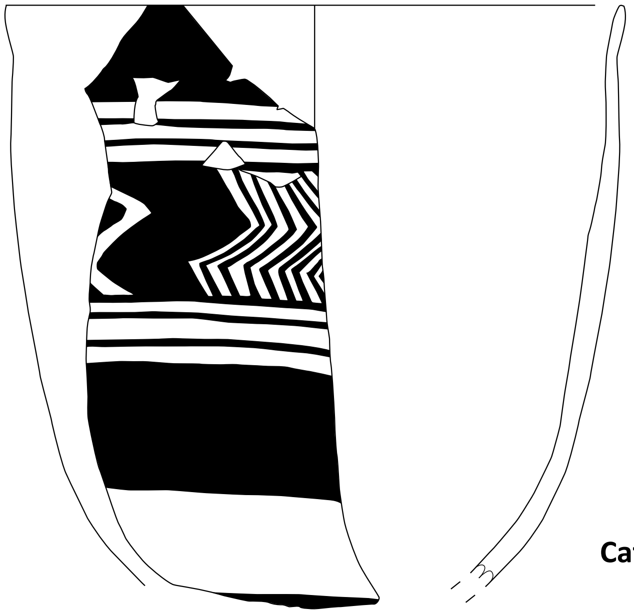
Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

Cat. 6.15: 1. GP. GAT-1, Level 7. BOBW. Colour Ext, Paint: 2.5Y 8/3, 2.5Y 3/3. Surface Ext, Int: Horizontally smoothed, slipped. Roughly smoothed, slipped.

Cat. 6.15: 2. GP. GAT-2, Level 7. BOBW. Colour Ext, Paint: 5Y 7/2, 5Y 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally-diagonally smoothed, slipped.

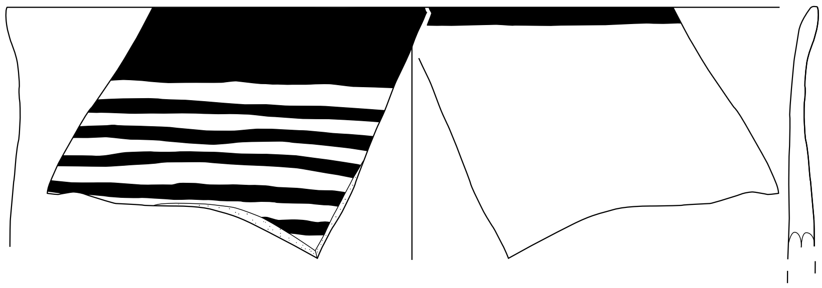
Cat. 6.15: 3. GP. GAT-2, Level 7. BOBW. Colour Ext, Paint: 2.5Y 8/4, 2.5Y 3/1. Surface Ext, Int: Scraped, slipped. Horizontally smoothed, scraped, slipped.

Cat. 6.15: 4. GP. GAT-1, Level 8. BOBW. Colour Ext, Paint: 5Y 8/2, 5Y 3/2. Surface Ext, Int: Horizontally-diagonally smoothed, slipped. Horizontally smoothed, slipped.

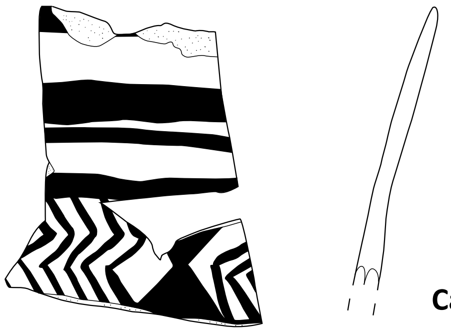


Cat. 6.16: 1

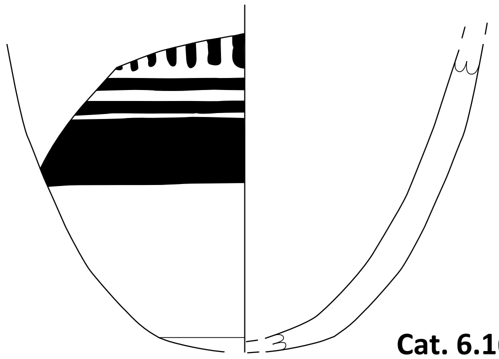
5 cm



Cat. 6.16: 2



Cat. 6.16: 3



Cat. 6.16: 4

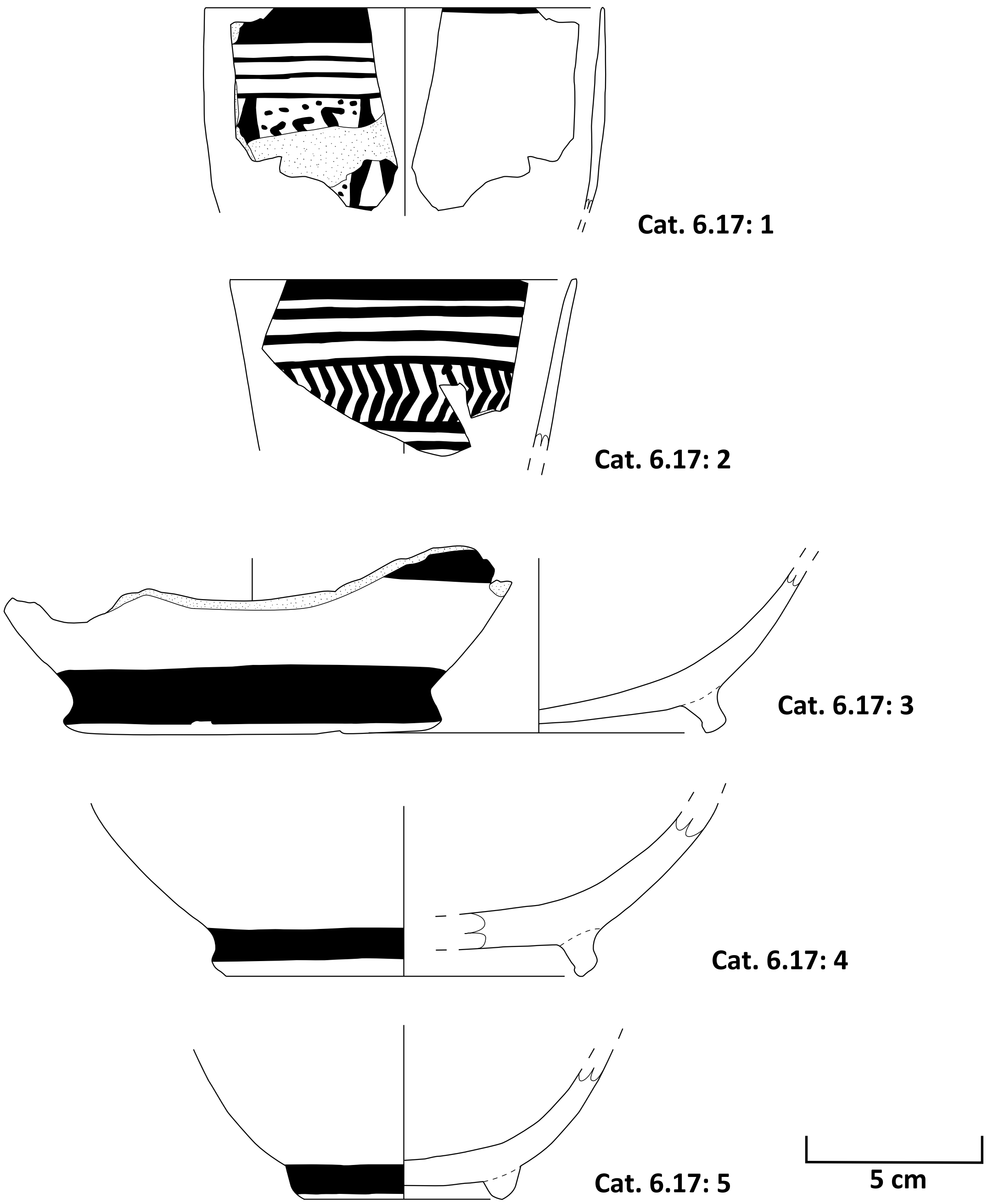
Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

Cat. 6.16: 1. GP. GAT-1, Level 9 BOBW. Colour Ext, Paint: 5Y 6/2, 5Y 3/2. Surface Ext, Int: Horizontally-diagonally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.16: 2. GP. GAT-1, Level 9 BOBW. Colour Ext, Paint: 5Y 8/2, 10YR 1.7/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.16: 3. GP. GAT-1, Level 9 BOBW. Colour Ext, Paint: 5Y 7/3, 7.5YR 2/1. Surface Ext, Int: Roughly horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.16: 4. GP. GAT-1, Level 9 BOBW. Colour Ext, Paint: 10YR 7/3, 5YR 3/1. Surface Ext, Int: Horizontally smoothed. Diagonally smoothed, scraped, slipped.



Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

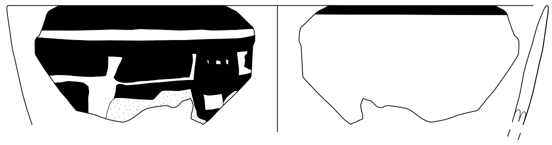
Cat. 6.17: 1. GP. GAT-1, Level 10. BOBW. Colour Ext, Paint: 2.5Y 8/3, 2.5Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.17: 2. GP. GAT-1, Level 10. BOBW. Colour Ext, Paint: 2.5Y 8/3, 7.5YR 2/3. Surface Ext, Int: Horizontally smoothed, slipped. Roughly horizontally smoothed, slipped.

Cat. 6.17: 3. GP. GAT-1, Level 9 BOBW. Colour Ext, Paint: 5Y 7/2, 5Y 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Smoothed.

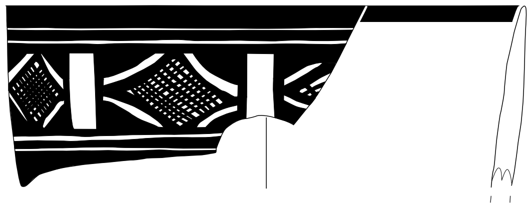
Cat. 6.17: 4. GP. GAT-1, Level 16. BOBW. Colour Ext, Paint: 5Y 7/3, 2.5Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Smoothed.

Cat. 6.17: 5. GP. GAT-1, Level 17. BOBW. Colour Ext, Paint: 5Y 7/2, 10YR 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Smoothed, slipped, red pigment.

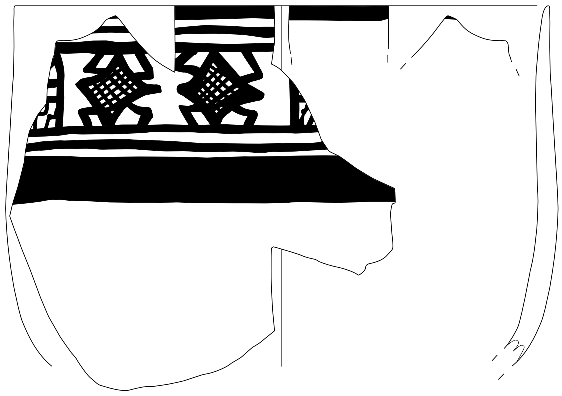


Cat. 6.18: 1

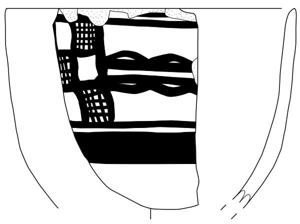
Cat. 6.18: 2



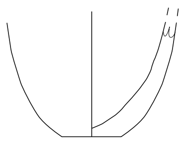
Cat. 6.18: 3



Cat. 6.18: 4



Cat. 6.18: 5



Cat. 6.18: 6

5 cm

Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

Cat. 6.18: 1. GP. GAT-1, Level 17. BOBW. Colour Ext, Paint: 5Y 7/2, 5Y 2/1. Surface Ext, Int: Horizontally smoothed. Horizontally smoothed, slipped.

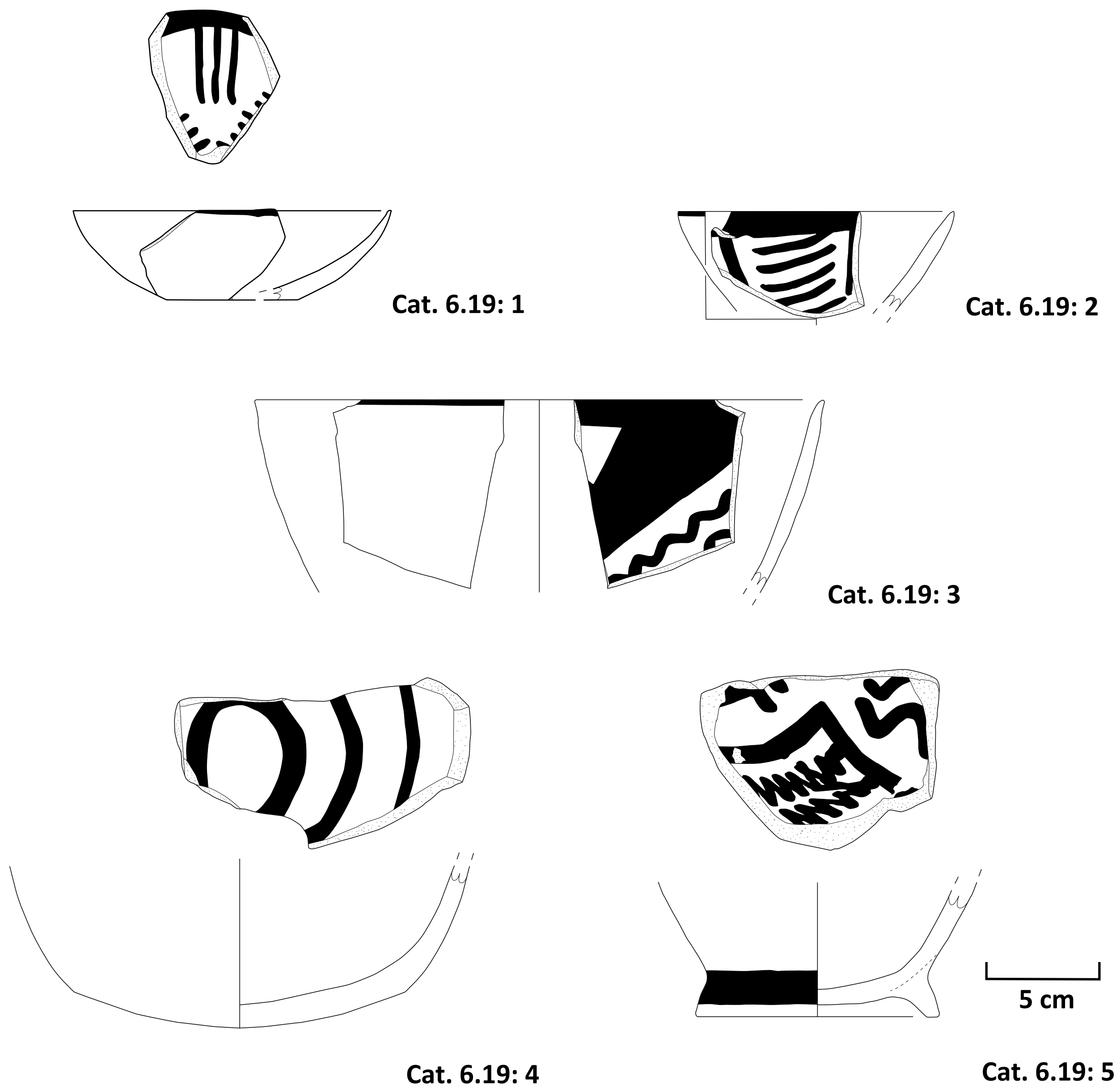
Cat. 6.18: 2. GP. GAT-1, Level 17 BOBW. Colour Ext, Paint: 2.5Y 8/3, 7.5YR 4/4. Surface Ext, Int: Horizontally smoothed, slipped. Roughly horizontally smoothed, slipped.

Cat. 6.18: 3. GP. GAT-2, Level 17 BOBW. Colour Ext, Paint: 5Y 8/2, 7.5YR 3/3 Surface Ext, Int: Horizontally-diagonally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.18: 4. GP. GAT-2, Level 17 BOBW. Colour Ext, Paint: 5Y 7/3, 7.5YR 1.7/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.18: 5. GP. GAT-1, Level 17 BOBW. Colour Ext, Paint: 7.5YR 6/3, 7.5YR 6/6. Surface Ext, Int: Horizontally smoothed, slipped. Roughly horizontally smoothed, slipped.

Cat. 6.18: 6. GP. GAT-1,3, Level 17. BOBW. Colour Ext, Paint: 2.5Y 7/3, Surface Ext, Int: Diagonally smoothed. Roughly smoothed.



Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

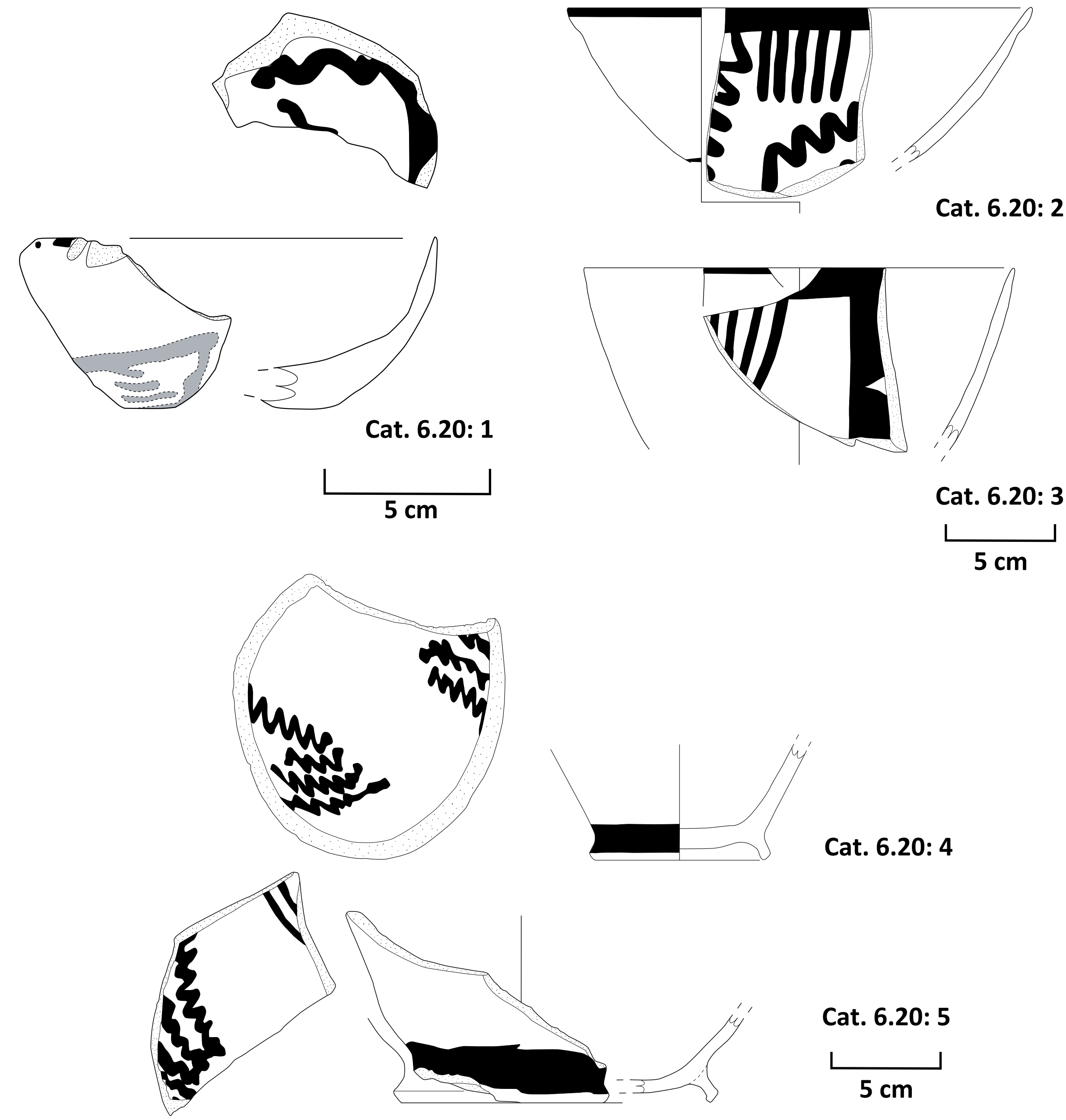
Cat. 6.19: 1. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 5Y 8/3, 2.5Y 2/1. Surface Ext, Int: Smoothed, slipped. Smoothed, slipped.

Cat. 6.19: 2. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 2.5Y 8/3, 10YR 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.19: 3. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 2.5Y 8/3, 10YR 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally-diagonally smoothed, slipped.

Cat. 6.19: 4. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 10YR 7/4, 10YR 3/4. Surface Ext, Int: Horizontally smoothed. Smoothed.

Cat. 6.19: 5. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 2.5Y 8/3, 10YR 2/1. Surface Ext, Int: Smoothed, slipped. Smoothed.



Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

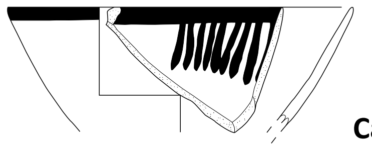
Cat. 6.20: 1. GP. GAT-2, Level 7. BOBW. Colour Ext, Paint: 2.5Y 7/3, 2.5Y 3/1. Surface Ext, Int: Smoothed, slipped. Smoothed, slipped.

Cat. 6.20: 2. GP. GAT-1, Level 10. BOBW. Colour Ext, Paint: 2.5Y 8/3, 7.5YR 3/4. Surface Ext, Int: Horizontally-diagonally smoothed, slipped. Horizontally-diagonally smoothed, slipped.

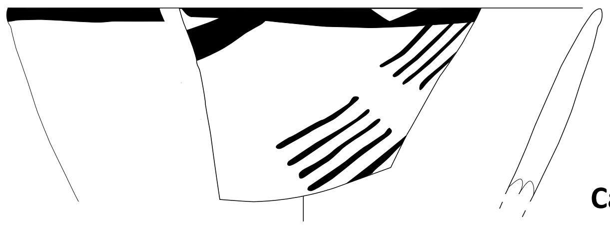
Cat. 6.20: 3. GP. GAT-1, Level 9 BOBW. Colour Ext, Paint: 2.5Y 8/3, 2.5Y 3/2. Surface Ext, Int: Horizontally-diagonally smoothed, paddled, slipped. Horizontally smoothed, slipped.

Cat. 6.20: 4. GP. GAT-2, Level 6. BOBW. Colour Ext, Paint: 2.5Y 8/4, 10YR 2/3. Surface Ext, Int: Horizontally smoothed, slipped. Smoothed, slipped.

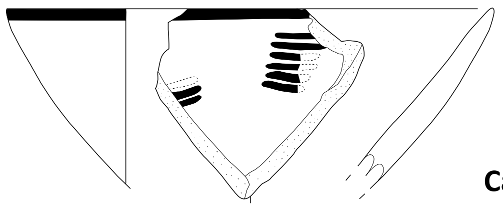
Cat. 6.20: 5. GP. GAT-1, Level 7 BOBW. Colour Ext, Paint: 5Y 7/3, 5Y 3/2. Surface Ext, Int: Horizontally smoothed, slipped. Smoothed, slipped.



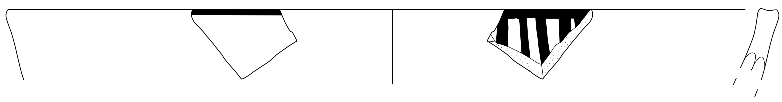
Cat. 6.21: 1



Cat. 6.21: 2

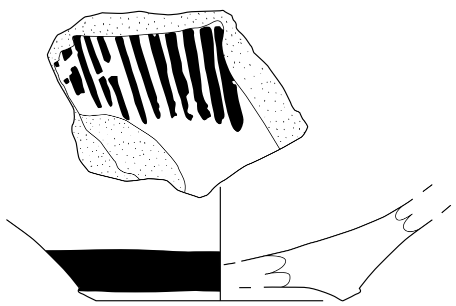


Cat. 6.21: 3



Cat. 6.21: 4

5 cm



Cat. 6.21: 5

5 cm

Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

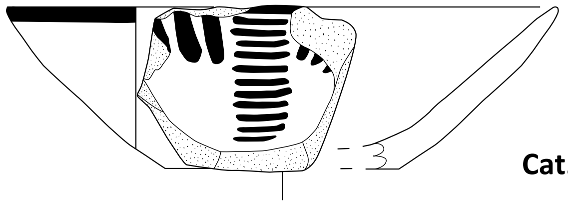
Cat. 6.21: 1. GP. GAT-1, Level 10. BOBW. Colour Ext, Paint: 2.5Y 8/3, 2.5Y 3/3. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.21: 2. GP. GAT-2, Level 14. BOBW. Colour Ext, Paint: 2.5Y 8/3, 7.5YR 3/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

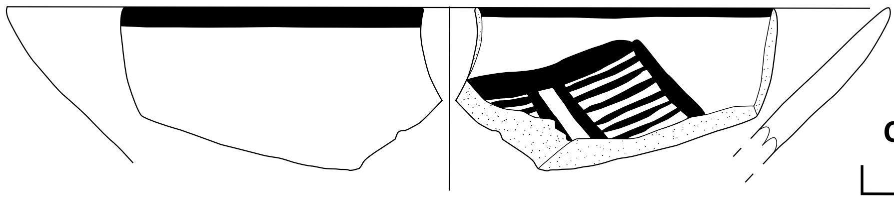
Cat. 6.21: 3. GP. GAT-1, Level 17. BOBW. Colour Ext, Paint: 2.5Y 8/2, 2.5Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.21: 4. GP. GAT-1, Level 17. BOBW. Colour Ext, Paint: 5Y 8/2, 7.5YR 1.7/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

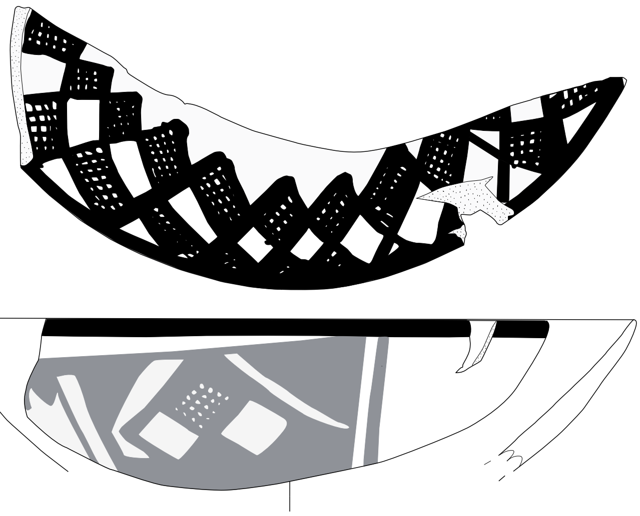
Cat. 6.21: 5. GP. GAT-1, Level 15. BOBW. Colour Ext, Paint: 5Y 7/2, 5Y 3/2. Surface Ext, Int: Horizontally smoothed, slipped.



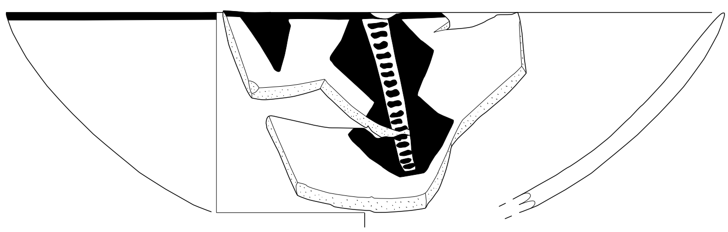
Cat. 6.22: 1



Cat. 6.22: 2



Cat. 6.22: 3



Cat. 6.22: 4

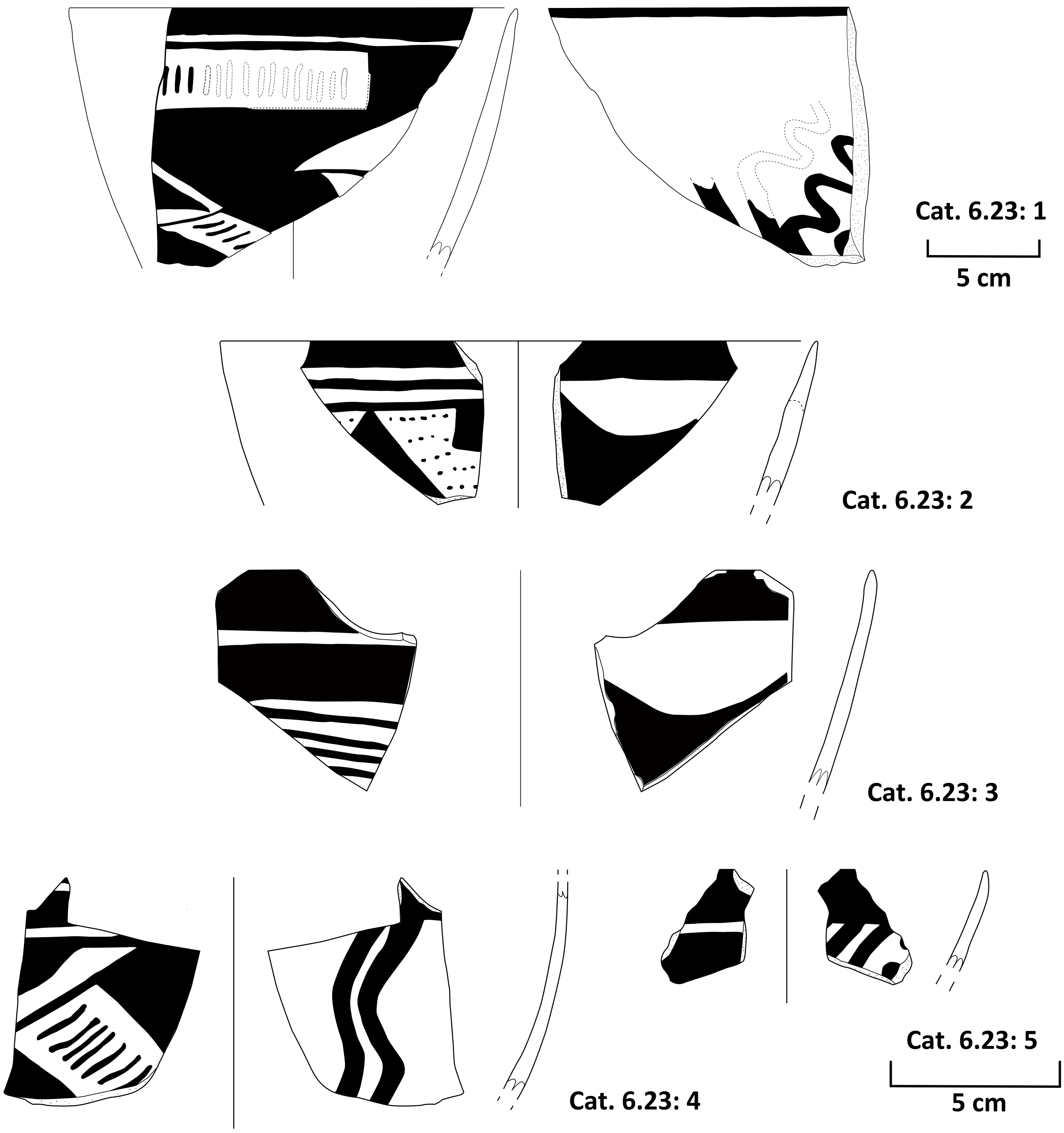
Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

Cat. 6.22: 1. GP. GAT-1, Level 17 BOBW. Colour Ext, Paint: 2.5Y 8/3, 5Y 3/6. Surface Ext, Int: Horizontally-diagonally smoothed, slipped. Horizontally smoothed.

Cat. 6.22: 2. GP. GAT-1, Level 17. BOBW. Colour Ext, Paint: 2.5Y 8/3, 2.5Y 3/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.22: 3. GP. GAT-2, Level 17. BOBW. Colour Ext, Paint: 5Y 8/3, 5Y 2/1. Surface Ext, Int: Horizontally smoothed, diagonally scraped, slipped. Horizontally smoothed, slipped.

Cat. 6.22: 4. GP. GAT-1, Level 17. BOBW. Colour Ext, Paint: 5Y 7/3, 5Y 3/1. Surface Ext, Int: Roughly horizontally smoothed, slipped. Horizontally smoothed, slipped.



Pottery from Tall-e Gap, Trenches GAT-1, 2, open vessels

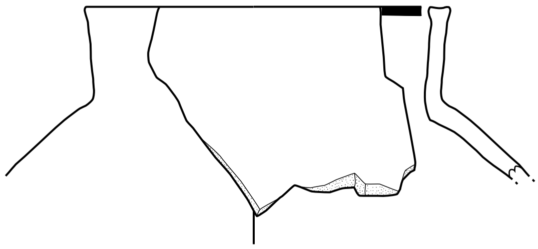
Cat. 6.23: 1. GP. GAT-1, Level 1 BOBW. Colour Ext, Paint: 2.5Y 8/3, 10Y 3/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.23: 2. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 5Y 8/3, 5Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

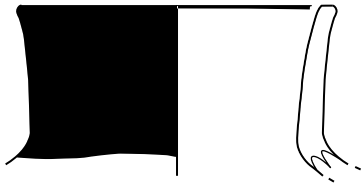
Cat. 6.23: 3. GP. GAT-2, Level 5b. BOBW. Colour Ext, Paint: 5Y 7/3, 2.5Y 3/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.23: 4. GP. GAT-1, Level 2. BOBW. Colour Ext, Paint: 2.5Y 8/2, 2.5Y 3/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

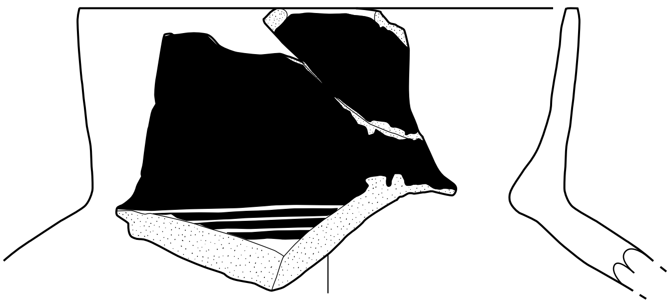
Cat. 6.23: 5. GP. GAT-1, Level 5a. BOBW. Colour Ext, Paint: 5Y 8/2, 5Y 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.



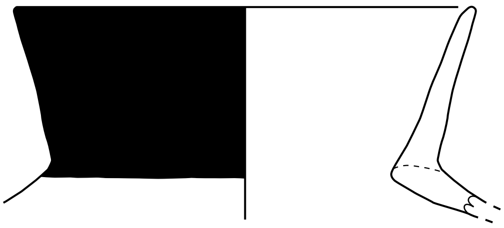
Cat. 6.24: 1



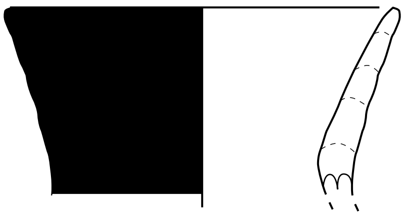
Cat. 6.24: 2



Cat. 6.24: 3



Cat. 6.24: 4



Cat. 6.24: 5

5 cm

Pottery from Tall-e Gap, Trenches GAT-1, 2, closed vessels

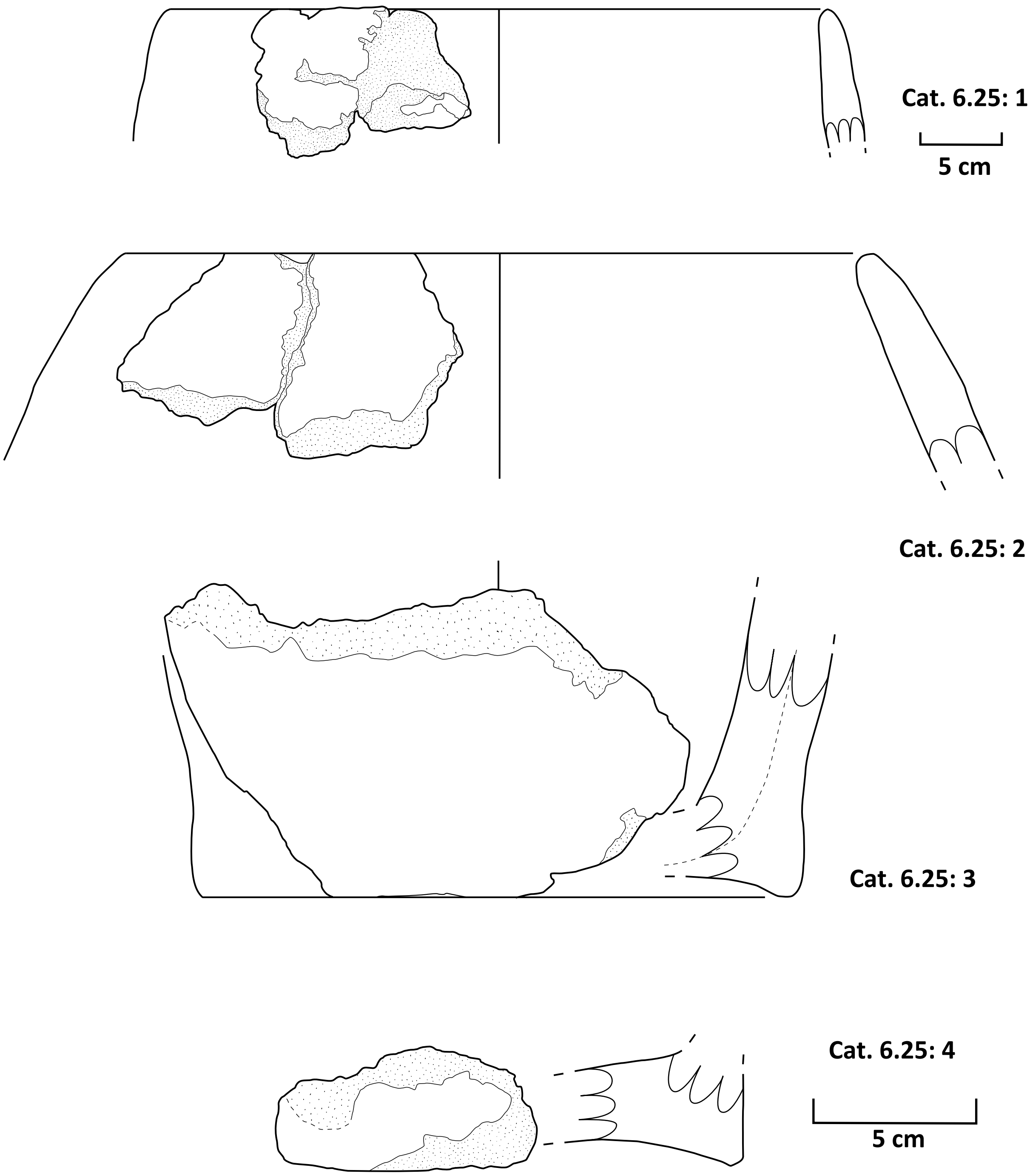
Cat. 6.24: 1. GP. GAT-1, Level 1. BOBW. Colour Ext, Paint: 10YR 8/3, Surface Ext, Int: Abraded. Horizontally smoothed, slipped.

Cat. 6.24: 2. GP. GAT-2, Level 9. BOBW. Colour Ext, Paint: 5Y 7/3, 2.5Y 3/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.24: 3. GP. GAT-1, Level 12b. BOBW. Colour Ext, Paint: 2.5Y 8/3, 10YR 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.24: 4. GP. GAT-1, Level 17. BOBW. Colour Ext, Paint: 10YR 7/4, 10YR 2/3. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.24: 5. GP. GAT-1, Level 17. BOBW. Colour Ext, Paint: 2.5Y 7/3, 10YR 4/4. Surface Ext, Int: Roughly horizontally smoothed, slipped. Horizontally smoothed, slipped.



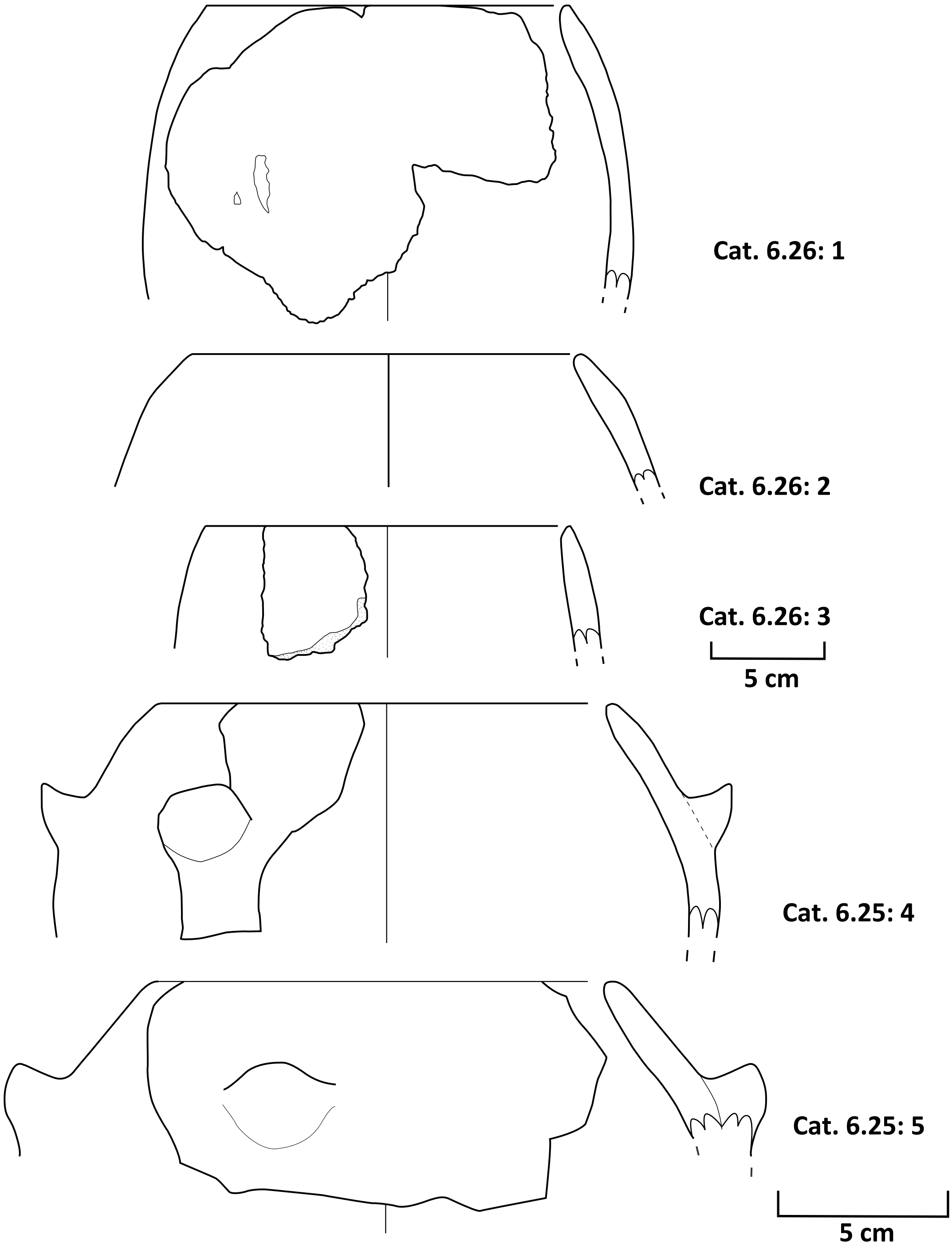
Pottery from Tall-e Gap, Trenches GAT-1, 2, VCW

Cat. 6.25: 1. GP. GAT-1, Level 15. VCW. Colour Ext, Int: 7.5YR 7/3, 7.5YR 7/4, Surface Ext, Int: Horizontally smoothed. Horizontally smoothed.

Cat. 6.25: 2. GP. GAT-1, Level 16. VCW. Colour Ext, Int: 10YR 7/3, 7.5YR 7/4, Surface Ext, Int: Horizontally smoothed. Horizontally smoothed.

Cat. 6.25: 3. GP. GAT-1, Level 14b. VCW. Colour Ext, Int: 10YR 8/3, 7.5YR 7/4, Surface Ext, Int: Smoothed. Smoothed.

Cat. 6.25: 4. GP. GAT-1, Level 14b. VCW. Colour Ext, Int: 10YR 8/3, 7.5YR 7/4, Surface Ext, Int: Horizontally smoothed. Smoothed.



Pottery from Tall-e Gap, Trenches GAT-1, 2, MCW

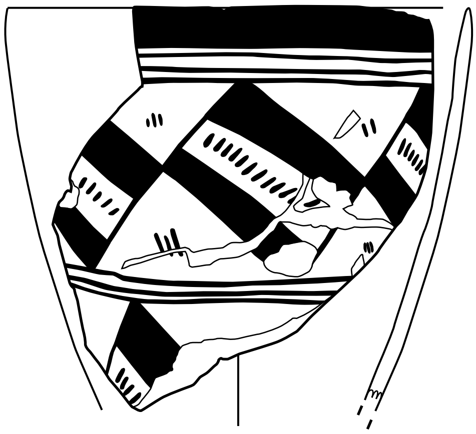
Cat. 6.26: 1. GP. GAT-1, Level 5a. MCW. Colour Ext, Core: 7.5YR 5/8, 7.5YR 3/1. Surface Ext, Int: Burnished.

Cat. 6.26: 2. GP. GAT-1, Level 5a. MCW. Colour Ext, Core: 5YR 4/4, 5YR 3/1. Surface Ext, Int: Horizontally burnished. Horizontally burnished.

Cat. 6.26: 3. GP. GAT-1, Level 6. MCW. Colour Ext, Core: 5YR 4/6, 5YR 3/1. Surface Ext, Int: Burnished. Burnished.

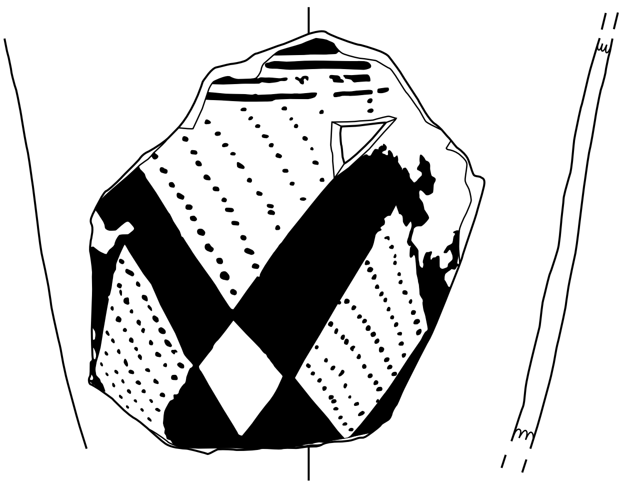
Cat. 6.26: 4. GP. GAT-1, Level 6. MCW. Colour Ext, Core: 5YR 4/3, 2.5Y 7/2. Surface Ext, Int: Burnished. Burnished.

Cat. 6.26: 5. GP. GAT-2, Level 6. MCW. Colour Ext, Core: 5YR 6/4, 7.5YR 1.7/1. Surface Ext, Int: Burnished. Burnished.



Cat. 6.27: 1

Cat. 6.27: 2



Cat. 6.27: 3

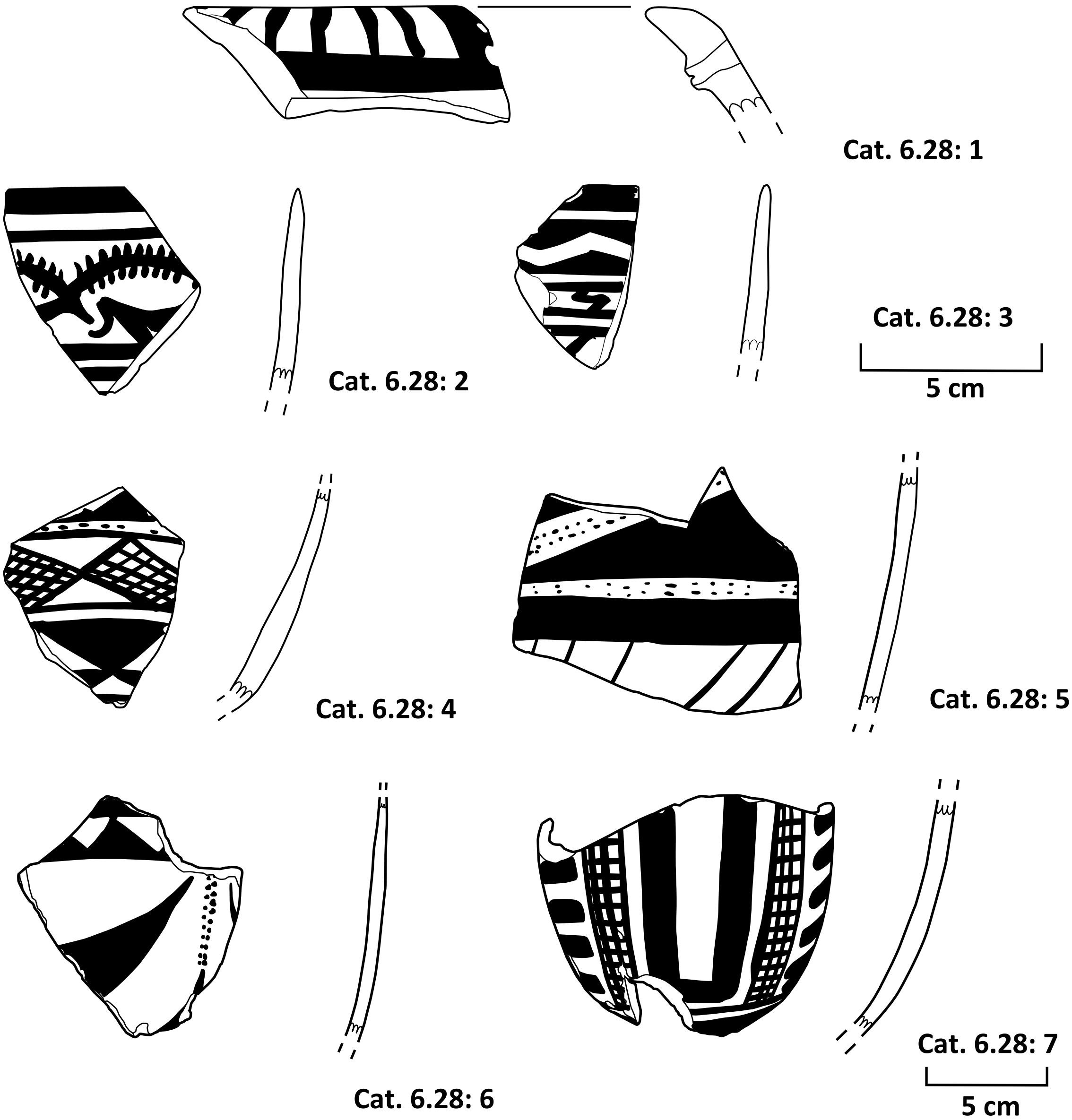
5 cm

Pottery from Tall-e Gap, Trenches GAI and GAEI, open vessels

Cat. 6.27: 1. GP. GAI-4, Level 2. BOBW. Colour Ext, Int, Paint: 5Y 8/3, 5Y 8/2, 5YR 5/6. Surface Ext, Int: Vertically smoothed, slipped. Horizontally smoothed (Upper), roughly smoothed (Lower).

Cat. 6.27: 2. GP. GAEI, Level 4. BOBW. Colour Ext, Int, Paint: 5Y 8/2, 5Y 8/2, 5YR 2/2. Surface Ext, Int: Horizontally smoothed (Upper), diagonally scraped (Lower), slipped. Diagonally smoothed (Upper), horizontally smoothed (Middle), vertically smoothed (Lower).

Cat. 6.27: 3. GP. GAI-1, Level 1. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10YR 1.7/1. Surface Ext, Int: Vertically smoothed, slipped. Horizontally smoothed, slipped.



Pottery from Tall-e Gap, Trenches GAI and GAEI, open vessels

Cat. 6.28: 1. GP. GAI-1, Level 2. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 2.5Y 2/1. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed.

Cat. 6.28: 2. GP. GAI-7, Level 3. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 5Y 2/1. Surface Ext, Int: Smoothed, slipped. Horizontally-diagonally smoothed, slipped.

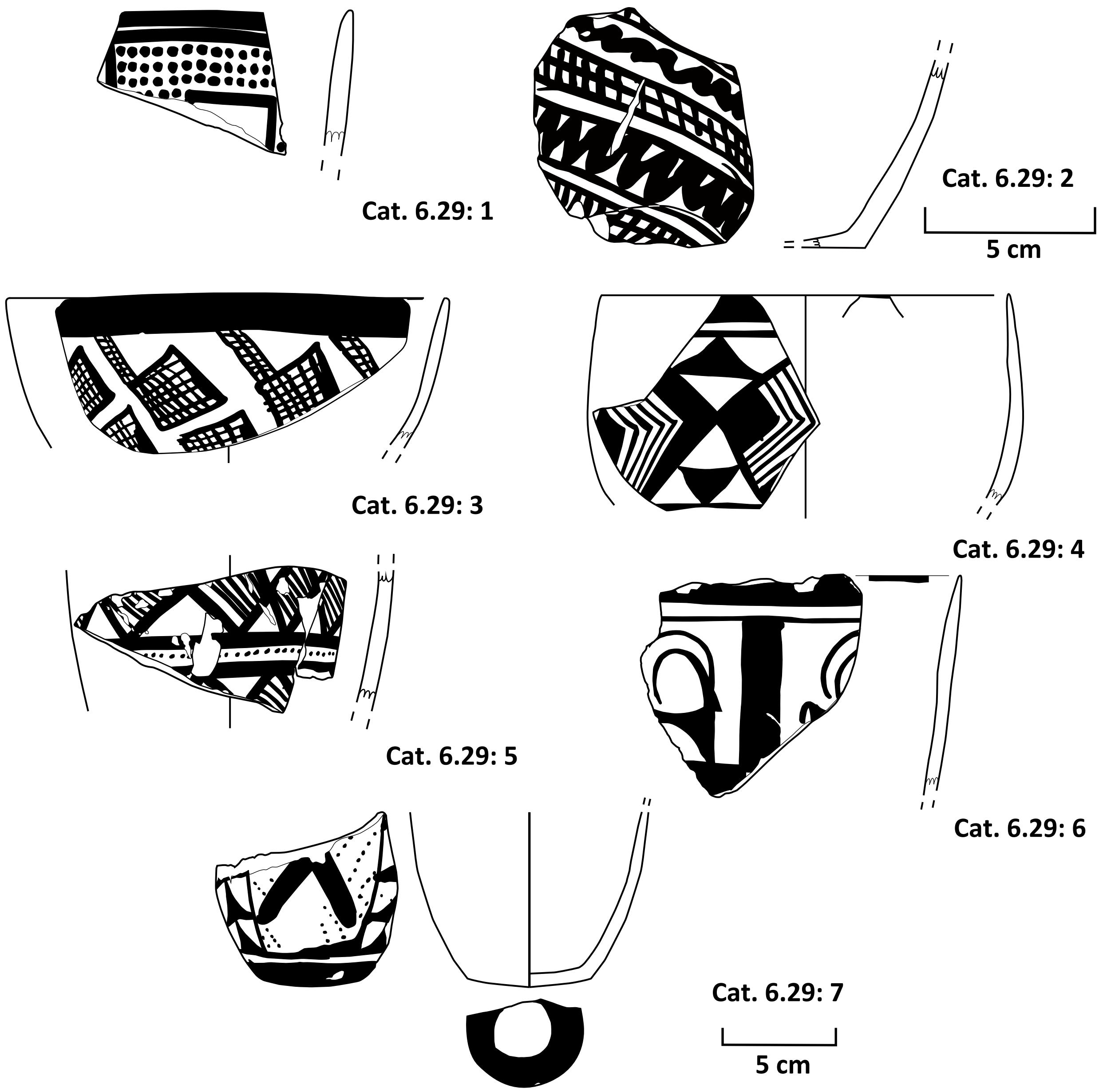
Cat. 6.28: 3. GP. GAI-3, Level 3. BOBW. Colour Ext, Int, Paint: 5Y 8/3, 5Y 8/3, 5Y 3/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.28: 4. GP. GAI-1, Level 3. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 7/2, 7.5Y 2/1. Surface Ext, Int: Diagonally smoothed, slipped. Horizontally smoothed.

Cat. 6.28: 5. GP. GAI-5, Level 3. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 2.5Y 2/1. Surface Ext, Int: Smoothed, slipped. Smoothed, slipped.

Cat. 6.28: 6. GP. GAI-1, Level 4. BOBW. Colour Ext, Int, Paint: 10Y 8/1. 10Y 7/2. 10Y 2/1. Surface Ext, Int: Smoothed. Horizontally smoothed.

Cat. 6.28: 7. GP. GAEI, Level 4. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 6/2, 2.5Y 2/1. Surface Ext, Int: Vertically smoothed, slipped. Horizontally smoothed, slipped.



Pottery from Tall-e Gap, Trench GAI, open vessels

Cat. 6.29: 1. GP. GAI-5, 7, Level 5a. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 2.5Y 3/3. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.29: 2. GP. GAI-6, Level 5b-6. BOBW. Colour Ext, Int, Paint: 7.5Y 7/2, 7.5Y 7/3, 7.5Y 2/2. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed.

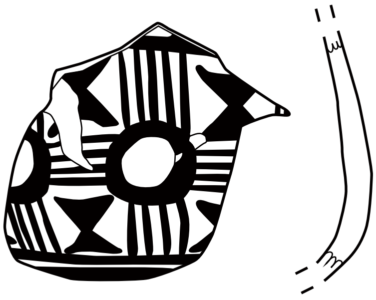
Cat. 6.29: 3. GP. GAI-4, Level 5. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10Y 2/1. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.29: 4. GP. GAI-6, Level 5b-6. BOBW. Colour Ext, Int, Paint: 5Y 8/3, 5Y 8/3, 2.5Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.29: 5. GP. GAI-9, Level 5a. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10YR 2/3. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed.

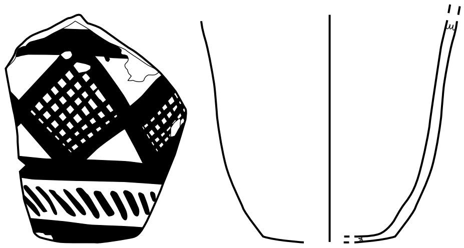
Cat. 6.29: 6. GP. GAI-8,9, Level 5b. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 5Y 2/1. Surface Ext, Int: Diagonally smoothed, slipped. Horizontally smoothed.

Cat. 6.29: 7. GP. GAI-6, Level 4. BOBW. Colour Ext, Int, Paint: 5Y 8/3, 5Y 8/2, 10YR 1.7/1. Surface Ext, Int: Horizontally smoothed. Horizontally smoothed.



Cat. 6.30: 1

5 cm



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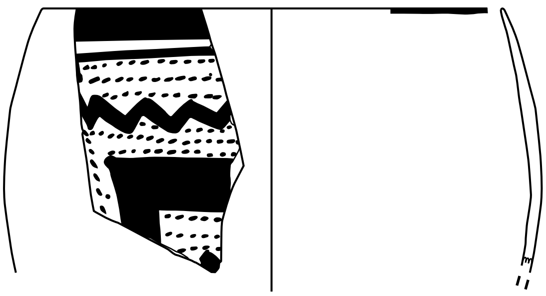

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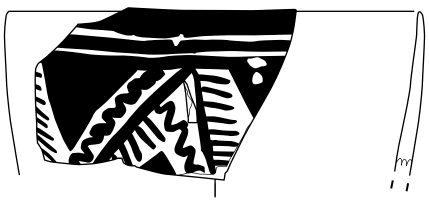
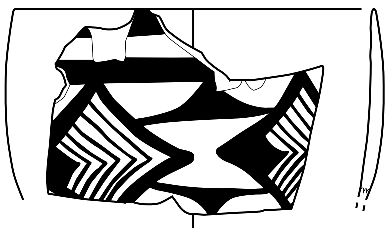


Cat. 6.30: 4



Cat. 6.30: 5

5 cm

Pottery from Tall-e Gap, Trench GAI, open vessels

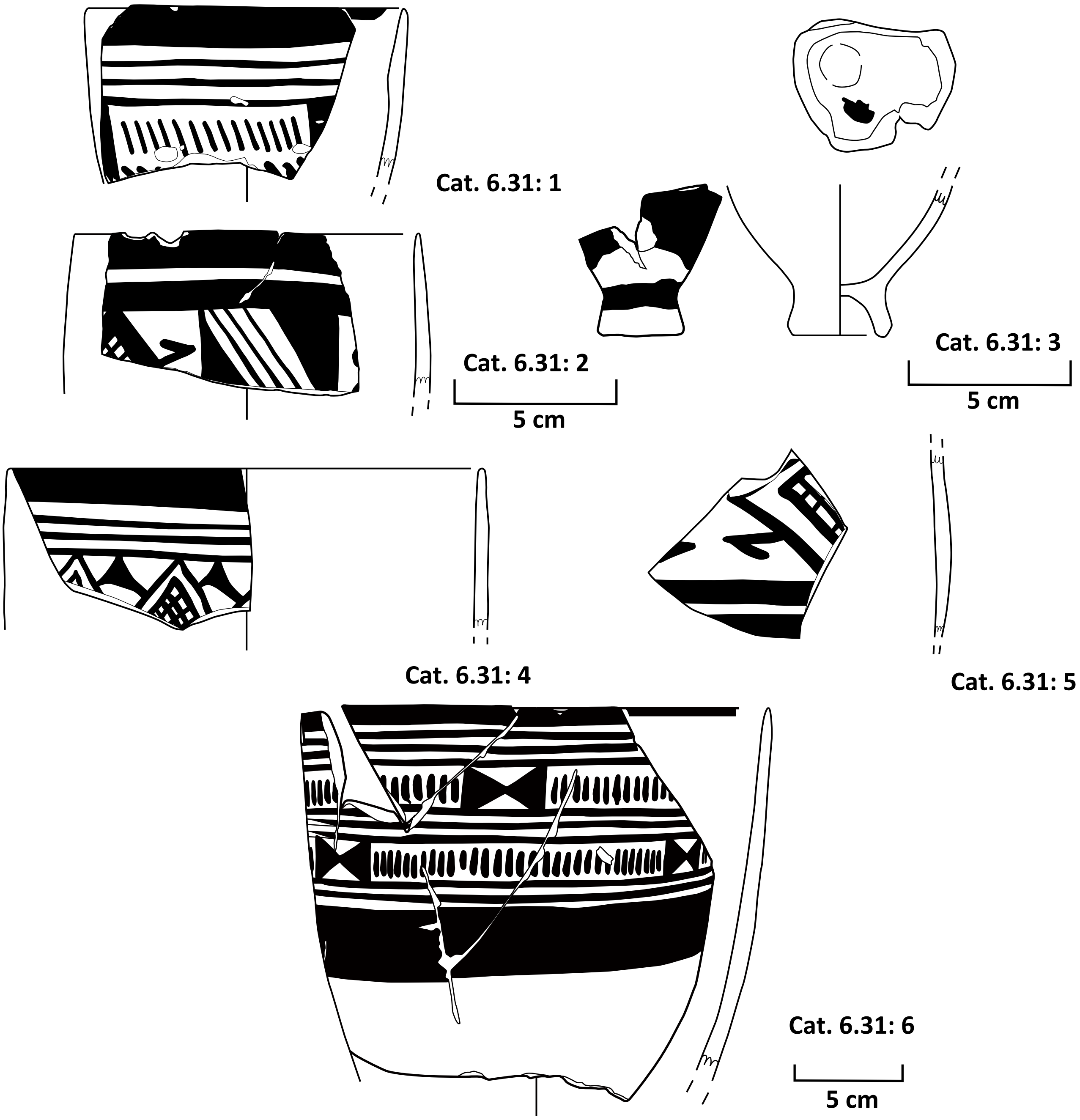
Cat. 6.30: 1. GP. GAI-6, 9, Level 6. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 6/3, 10Y 2/1. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed.

Cat. 6.30: 2. GP. GAI-2, Level 6. BOBW. Colour Ext, Int, Paint: 2.5Y 8/4, 2.5Y 8/4, 2.5Y 2/1. Surface Ext, Int: Vertically scraped, slipped. Horizontally smoothed.

Cat. 6.30: 3. GP. GAI-6, 9, Level 6. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10Y 2/1. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.30: 4. GP. GAI-2, Level 6. BOBW. Colour Ext, Int, Paint: 5Y 8/4, 5Y 8/4, 5Y 2/1. Surface Ext, Int: Diagonally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.30: 5. GP. GAI-5, 8, Level 6b. BOBW. Colour Ext, Int, Paint: 2.5Y 8/3, 2.5Y 8/3, 2.5Y 3/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.



Pottery from Tall-e Gap, Trenches GAI, GAT-5,6, open vessels

Cat. 6.31: 1. GP. GAI-3, Level 7. BOBW. Colour Ext, Int, Paint: 5Y 8/3, 5Y 8/3, 5Y 2/2. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed.

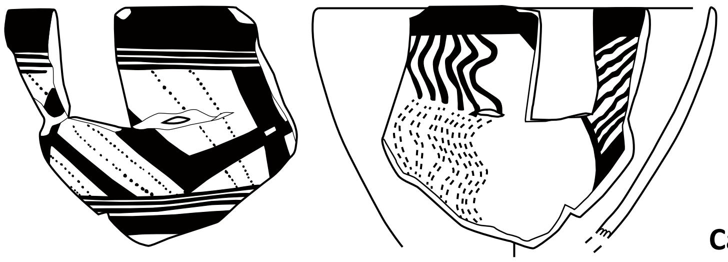
Cat. 6.31: 2. GP. GAI-3, Level 7. BOBW. Colour Ext, Int, Paint: 5Y 8/3, 5Y 7/4, 5Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed.

Cat. 6.31: 3. GP. GAT-5, 6 Level 15. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 7/2, 7.5Y 2/1. Surface Ext, Int: Smoothed, slipped. Smoothed, slipped.

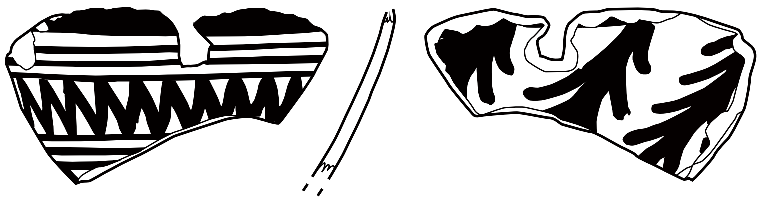
Cat. 6.31: 4. GP. GAI-3, Level 7. BOBW. Colour Ext, Int, Paint: 5Y 8/4, 5Y 8/4, 2.5Y 2/1. Surface Ext, Int: Horizontally smoothed, slipped.

Cat. 6.31: 5. GP. GAI-2,3, Level 7. BOBW. Colour Ext, Int, Paint: 7.5YR 8/8, 7.5YR 8/8, 7.5YR 2/1. Surface Ext, Int: Vertically smoothed, slipped.

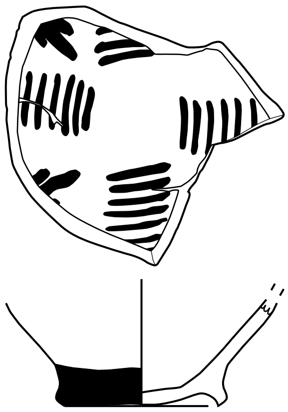
Cat. 6.31: 6. GP. GAT-6, Level 15. BOBW. Colour Ext, Int, Paint: 7.5Y 7/3, 7.5Y 7/3, 2.5YR 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.



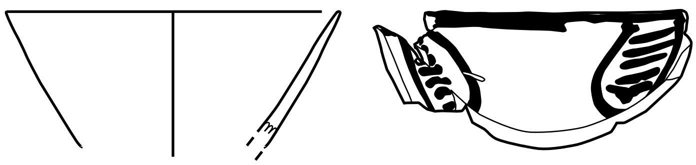
Cat. 6.32: 1



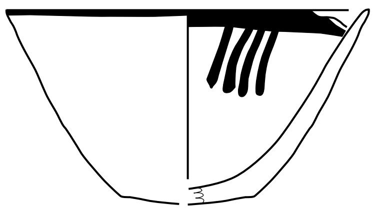
Cat. 6.32: 3



Cat. 6.32: 2



Cat. 6.32: 4



Cat. 6.32: 5

5 cm

Pottery from Tall-e Gap, Trenches GAI, GAT-2,3,6, open vessels

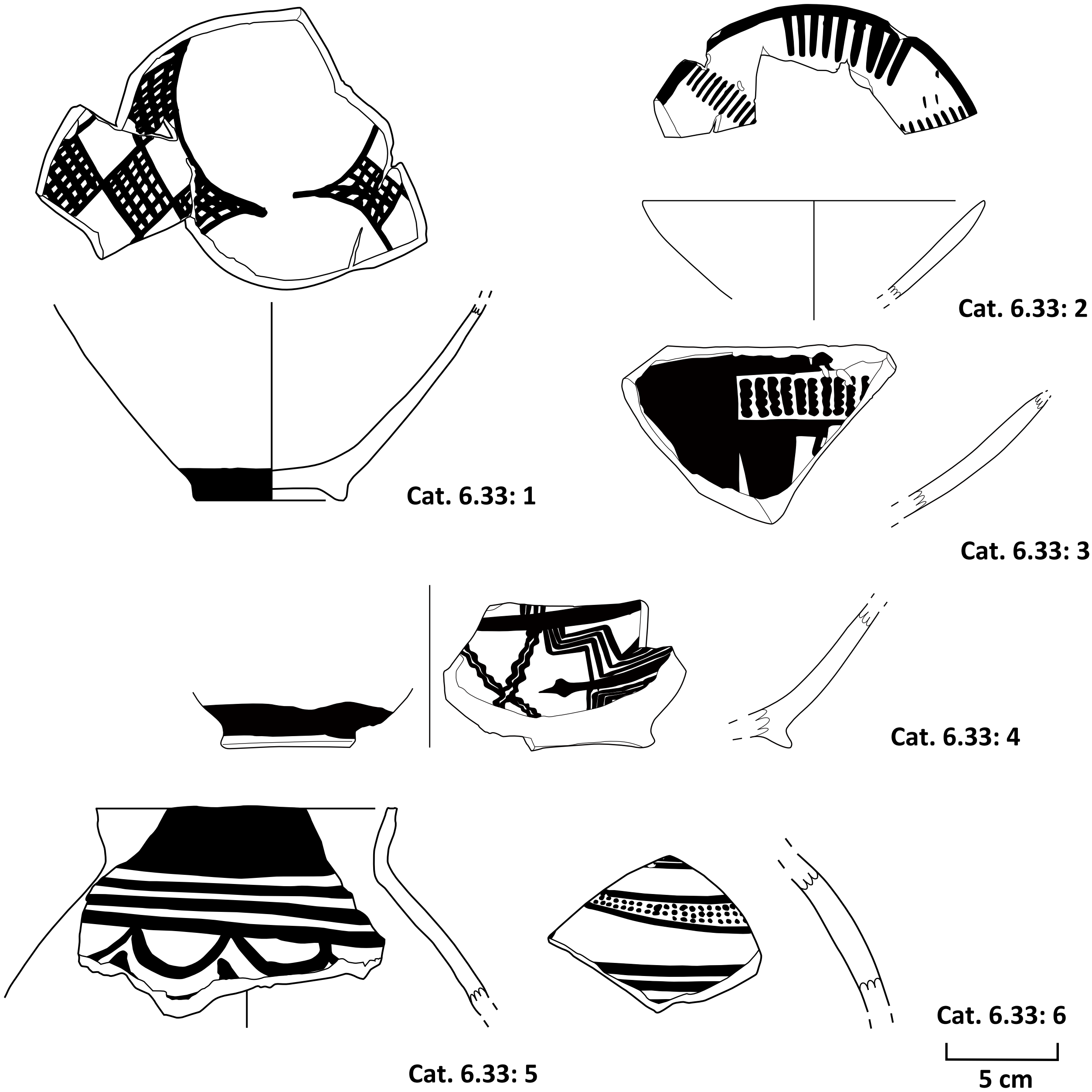
Cat. 6.32: 1. GP. GAI-7, Level 3. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10Y 2/1. Surface Ext, Int: Smoothed, slipped. Smoothed, slipped.

Cat. 6.32: 2. GP. GAI-6, Level 3. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 5Y 8/4, 7.5YR 3/4. Surface Ext, Int: Horizontally smoothed, red pigment. Horizontally smoothed, slipped, red pigment.

Cat. 6.32: 3. GP. GAI-2, Level 6. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/3, 7.5Y 2/1. Surface Ext, Int: Diagonally smoothed, slipped. Diagonally smoothed, slipped.

Cat. 6.32: 4. GP. GAT-6, Level 7. BOBW. Colour Ext, Int, Paint: 2.5Y 8/3, 2.5Y 8/3, 7.5YR 2/2. Surface Ext, Int: Horizontally smoothed, slipped.

Cat. 6.32: 5. GP. GAT-3, GAT-2, Level 10. BOBW. Colour Ext, Int, Paint: 5Y 8/2, 2.5Y 8/2, 10YR 2/3. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.



Pottery from Tall-e Gap, Trenches GAI, GAT, open and closed vessels

Cat. 6.33: 1. GP. GAT-3. Level 15. BOBW. Colour Ext, Int, Paint: 7.5Y 8/3, 7.5Y 8/3, 10YR 3/2. Surface Ext, Int: Diagonally smoothed. Horizontally smoothed, slipped.

Cat. 6.33: 2. GP. GAT-4, 5. Level 16. BOBW. Colour Ext, Int, Paint: 2.5Y 8/3, 2.5Y 8/2, 10YR 2/1. Surface Ext, Int: Horizontally smoothed, slipped. Horizontally smoothed, slipped.

Cat. 6.33: 3. GP. GAT-1,3 Level 17. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 10Y 2/1. Surface Ext, Int: Diagonally scraped. Horizontally smoothed, slipped.

Cat. 6.33: 4. GP. GAT-1,3 Level 17. BOBW. Colour Ext, Int, Paint: 7.5Y 7/3, 7.5Y 7/3, 7.5Y 2/2. Surface Ext, Int: Horizontally smoothed, slipped. Smoothed, slipped.

Cat. 6.33: 5. GP. GAI-5, Level 5a. BOBW. Colour Ext, Int, Paint: 2.5Y 8/6, 2.5Y 8/6, 5YR 3/6. Surface Ext, Int: Horizontally-diagonally smoothed, scraped, slipped. Roughly horizontally smoothed.

Cat. 6.33: 6. GP. GAT-3, Level 14a. BOBW. Colour Ext, Int, Paint: 7.5Y 8/2, 7.5Y 8/2, 7.5YR 3/4. Surface Ext, Int: Smoothed, slipped. Horizontally smoothed.

Chapter 7

Analysis of pottery-making techniques

In Chapter 7, I will analyse pottery-making techniques, the research topic for the **Research Question No. 3**: How were black-on-buff ceramics and other pottery produced? As explained in Chapter 4, this question is subdivided into two types of specific research questions:

1) How many technical steps were there in pottery production? What kinds of technical options were available in each technical step of pottery making? These two questions are related to the chaîne opératoire of pottery-making technique.
2) With what degree of quality and dexterity were black-on-buff ceramics produced? Can we find errors or differences of skill in making pottery from archaeological materials? These two questions are concerned with skill as discussed in Chapter 3.

These two research questions are also related to the questions about diachronic change: How did pottery-making techniques change over time?

I will begin with the observation of well-preserved materials from the Tall-e Bakun site's mound A curated in the Oriental Institute of Chicago (OIC) (Section 7-1). Then I will move to the observation of potsherds from Tall-e Jari A, Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A curated in the University Museum, the University of Tokyo (UMUT) (Section 7-2). In these analyses of ceramic materials from four sites, I will separate the description of pottery-making technique as a sequence of technical steps: chaîne opératoire analysis from that as technical skill, especially in painting: skill score analysis and qualitative observation of technical skill. As for the latter, I will also present the comparison of technical skill using six complete vessels with an identical motif from Tall-e Bakun A. Then I will discuss the diachronic changes of pottery-making techniques in Section 7-3, then summarise the content of this chapter.

In Sections 7-4 and 7-5, I will shift analytical methods from the direct observation of pottery to thin-section petrography and geochemical analysis. In Section 7-4, I will approach pottery pastes using thin-section petrography to clarify the technical step of obtaining and preparing clay. In Section 7-5, I will approach the technical steps of obtaining clay and firing by means of geochemical analysis, such as ICP-OES (inductivity coupled plasma optical emission spectrometer) and XRD (X-ray diffraction).

7-1. Pottery-making techniques of ceramic materials from Tall-e Bakun A curated in OIC

At first, in order to approach the pottery-making techniques of the best-preserved materials of the four sites, I will set out the analysis of ceramic materials from Tall-e Bakun A now curated in the Oriental Institute of Chicago (OIC). That is because these are the best-preserved vessels and most complete vessels among the excavated Bakun period sites. In total, I observed 4171 pottery sherds and complete vessels curated in this institute. Among them, there were 3607 black-on-buff ware (BOBW) vessel sherds. Among these, 178 pottery sherds were refitted with other sherds, and 99 pottery sherds were unclassifiable because of their tiny sizes. The collection contains 1115 rim parts, 2432 body parts, 269 bottom parts, and 78 other parts. 74 complete vessels are preserved from the rim to the base (which was included in rim parts). I chose 70 well-preserved vessels (mainly complete vessels) for the description of the ceramic production techniques (Appendix Table A5.1).

Analysis of the chaîne opératoire at Tall-e Bakun A

In Chapter 4, the sequence of technical steps (the chaîne opératoire: forming, surface treatment, applying slip, decorating, and firing) in the pottery-making process during the Bakun period was presented based on the previous research. In order to find the variability of technical options in each step of the chaîne opératoire, I will observe the technical traces preserved in the ceramic materials from Tall-e Bakun A. The technical traces to which I will draw attention in each step are as follows:

1) Forming: surface traces, joints between body parts, necks, and ring bases
2) Surface treatment: direction of smoothing, scraping, and burnishing, a remarkable trace called "grooves", tools used for surface treatment
3) Applying slip: presence of slip
4) Decorating: vertically divided number of motif-units
5) Firing: a remarkable trace caused by the vaporisation of pigments called an "imprint".

1) Forming

Forming of BOBW

At first, as a result of detailed observation, the majority of BOBW vessels (open vessels: 51 vessels) did not show visible traces of the forming techniques such as coiling or throwing using a potter's wheel. On the basis of the absence of the horizontally striating marks, or riling (the indirect evidence of the throwing techniques),[1] it is inferred that these vessels were fashioned using the coiling technique without a potter's wheel. On the other hand, the rest of the well-preserved BOBW vessels (closed vessels: 14 examples) showed traces of deleting the joints between the coils on their interior surfaces. Horizontal cracks showing the joints between the body and the neck were remarkable in the greater portion of large jars (12 vessels). This suggests that the neck parts were added after drying the body parts of large jars. Second, the intermittent forming process of one large jar was suggested from the discovery of horizontal cracks on its body (Fig. 7.1). There are horizontal cracks both inside and outside the large jar shown in Fig. 7.1. It is suggested that these traces were caused by a drying process used to make the vessel harder before piling up more clay on the large jar body part (Fig. 7.1). This also implies that it takes more time to form large jars than other vessel forms because of the several interruptions for drying vessels.

Figure 7.1 The evidence of BOBW forming technique: a horizontal crack preserved on the exterior surface of a large jar, suggesting intermittent forming process (A20281) at Tall-e Bakun A (Photo by Miki. Courtesy of the Oriental Institute of the University of Chicago)

Above I gave observations of well-preserved vessels. Eleven pieces of the badly-preserved vessels also showed diagnostic traces of the forming techniques. They present traces of a) coiling, b) forming the base of funnel-shaped vessels, and c) vegetal mats used in forming. At first, two pieces showed traces of a coiling technique (A39758, A397620).[2] The first piece is the body part of a large jar showing the incised coil.[3] The second piece is a fragment of a ring base which presented a finger-pressed pattern on the broken surface.[4] It is suggested that these incisions and impressions were applied on the coils to strengthen the joints. Second, six base sherds of funnel-shaped vessels and conical bowls (A37365, A37374, A37464, A38004, A38159 and A38162, Fig. 7.2) showed the other traces of forming: penetrating the insides of the cones using stick-like tools. Three well-preserved funnel-shaped vessels also showed this trace (A20102, A20118, A20290, see below). From the observation, it is suggested that cones were joined to the body parts and then penetrated. Third, two examples with traces of vegetal coiled matting on the flat bottoms were observed (A39783, A39785).[5] These rare examples give an additional clue regarding the forming techniques of BOBW.

Forming of MCW

As for MCW (mineral-tempered coarse ware), the traces showing a) forming techniques, b) clay- and cloth-coating techniques, and c) attaching a pair of knobs will be explained. Four well-preserved MCW vessels were curated in OIC. Although McCown and Masuda described the forming techniques as coiling,[6] it is likely that the "sequential slab construction technique" was used for the three diagnostic vessels rather than coiling (Fig. 7.3). These vessels showed several remarkable

[1] Rice 1987: Fig. 5.8.
[2] These numbers are material registration numbers in the Oriental Institute of Chicago.
[3] Langsdorff and McCown 1942: Pl. 1: 4.
[4] Langsdorff and McCown 1942: Pl. 1: 6.
[5] Langsdorff and McCown 1942: Pl. 1: 3.
[6] Langsdorff and McCown 1942: 24, 26.

Figure 7.2 The evidence of BOBW forming technique: traces of penetrating the insides of the cones of funnel-shaped vessels using stick-like tools (A37365) at Tall-e Bakun A (Photo by Miki. Courtesy of the Oriental Institute of the University of Chicago)

horizontal cracks. It is suggested that these cracks showed the original units of slabs. Next, as Masuda noted, subsequent clay coatings were also confirmed in all the well-preserved vessels. In addition, one sample with traces of cloth on its interior surface was observed (Fig. 7.4). It is suggested that the thick additional clay covered only the interior surface of MCW. Third, both MCW vessels with pairs of knobs and ones without knobs exist in the collection. The knobs were attached after forming the body.

2) Surface treatment

Smoothing and scraping of BOBW

In describing the technical step of surface treatment, I focused on the direction and roughness of smoothing and scraping. Table 7.1 shows the direction and roughness of smoothing and scraping on interior surfaces (upper) and exterior surfaces (lower) of the well-preserved BOBW vessels (64 samples in total). To find the relationships of surface treatments with vessel forms and vessel sizes, I classified vessel forms into four variations: open vessel, closed vessel (with small and large jar subtypes), and special vessels (pot stands and zoomorphic vessels). The variations of smoothing on interior surfaces (six variations) were much less than those on exterior surfaces (20 variations). On interior surfaces, horizontal smoothing was the most frequent pattern (60 samples). There were only two samples whose smoothing direction was different in the upper part and the lower part of the interior surfaces

Figure 7.3 The evidence of MCW forming technique: traces of the horizontal cracks showing the sequential slab construction (A20280) at Tall-e Bakun A (Photo by Miki. Courtesy of the Oriental Institute of the University of Chicago)

Figure 7.4 The evidence of MCW forming technique: the cloth impression which was covered by the clay coating (A36965) at Tall-e Bakun A (Photo by Miki. Courtesy of the Oriental Institute of the University of Chicago)

(horizontal and diagonal). Rough smoothing was usually observed on interior surfaces of closed vessels (ten samples).

As for exterior surfaces of BOBW, horizontal smoothing was the most common. (41 samples). Horizontal smoothing might be indirect evidence of smoothing on a turntable. Diagonal and vertical smoothing appeared only in combination with horizontal smoothing (ten samples) on exterior surfaces. Rough smoothing was less common on exterior surfaces (three samples) than interior surfaces and appeared only in a closed vessel. While traces of scraping were absent in the interior surfaces of BOBW vessels, scraping appeared

Table 7.1 Directions and types of smoothing and scraping on the interior surfaces (upper) and exterior surfaces (lower) of the well-preserved BOBW vessels at Tall-e Bakun A

Direction of smoothing on interior surfaces	open vessel	small jar	large jar	special vessel	Total
horizontally smoothed	38	6	5	2	51
smoothed?	1	-	-	-	1
Upper: diagonally smoothed, Lower: horizontally smoothed	1	-	-	-	1
Upper: horizontally smoothed, Middle: diagonally smoothed	1	-	-	-	1
roughly horizontally smoothed	-	1	8	-	9
roughly smoothed	-	-	1	-	1
Total	41	7	14	2	64

Direction of smoothing & scraping on exterior surfaces	open vessel	small jar	large jar	special vessel	Total
horizontally scraped	1	-	-	-	1
horizontally smoothed	24	5	5	2	36
horizontally smoothed by a tool	-	-	1	-	1
horizontally smoothed, Bottom: scraped	-	-	1	-	1
horizontally smoothed, vertically scraped	1	-	-	-	1
vertically, horizontally smoothed	1	-	-	-	1
roughly horizontally smoothed	-	-	1	-	1
roughly smoothed by a tool	-	-	1	-	1
roughly smoothed	-	-	1	-	1
smoothed/smoothed?	1	-	2	-	2
smoothed by a tool	-	-	1	-	1
Upper: horizontally smoothed, Lower: diagonally scraped	1	-	-	-	1
Upper: horizontally smoothed, Lower: diagonally smoothed or scraped	-	1	-	-	1
Upper: horizontally smoothed, Lower: horizontally scraped	-	1	-	-	1
Upper: horizontally smoothed, Lower: horizontally-vertically scraped	1	-	-	-	1
Upper: horizontally smoothed, Lower: vertically burnished-scraped	1	-	-	-	1
Upper: horizontally smoothed, Lower: vertically scraped	2	-	-	-	2
Upper: horizontally smoothed, Lower: vertically smoothed	8	-	-	-	8
Upper: horizontally smoothed, Middle: diagonally scraped & diagonally smoothed, Lower: horizontally smoothed	-	-	1	-	1
Middle: horizontally smoothed by a tool, Lower: vertically smoothed by a tool	-	-	1	-	1
Total	41	7	14	2	64

on exterior surfaces with smoothing traces (eleven samples). In scraping technique, vertical directions (four samples) and diagonal directions (three samples) were preferred as well as horizontal directions (three samples).

Grooves on exterior surfaces of BOBW

Other than smoothing and scraping traces, the rows of grooves were preserved on exterior surfaces of BOBW (Figs. 7.5-6). Of the 70 well-preserved vessels, 11 vessels had such traces. The vessel forms with the grooves consisted of six large jars, two small jars, two funnel-shaped vessels, and one beaker. Other than the well-preserved vessels, 16 examples with grooves on their exterior surfaces were found. Not only body sherds of closed vessels (nine samples), but also body sherds of open vessels painted on their exteriors (four samples), one conical bowl, one funnel-shaped vessel, and one shallow bowl were confirmed using the diagnostic sherds.

Below I will describe the length and intervals of grooves and the directions of rows and grooves for the purpose of characterising the original technique. The average length of one groove was about 2 cm. There were intervals of approximately 3 mm between the grooves. These grooves were observed mainly on the bodies of the vessels. Usually both open and closed vessels had horizontal rows of diagonal or vertical grooves (Figs. 7.5-6). As it stands, there are two hypotheses about the original techniques. One possibility is that these patterns are result of scraping using some special tools as argued by McCown.[7] The other possibility is the application of paddling to enhance the hardness of vessel walls.

Tools used for surface treatment

Other than the direct traces of surface treatment techniques stated above, there was indirect evidence of surface treatment technique: tools used for surface treatment techniques. Of course, it is possible that surface treatment was mostly carried out using the human hands and organic materials such as wooden tools and cloths. Of these tools used for surface treatment, archaeologically durable tools in the collection include a reworked pottery scraper and a clay scraper. Below I will describe the details (number, location of edge, source, length of edge, and shape of edge) of reworked pottery scrapers and clay scrapers. At first, from OIC, 37 reworked pottery scrapers were confirmed . Among them, at least five reworked pottery scrapers published by Herzfeld in 1932 were rediscovered.[8] Second, the majority of the scrapers made their rim parts the edges of the scrapers (23 samples). As for the rest of the scrapers, the broken edges of the body parts were reworked into the edges of the scrapers (14 samples). Third, the exterior-painted open vessels were preferred as the materials for the reworked pottery scrapers (31 examples). Interior-painted open vessels (two samples) and large jars reworked as scrapers were in the minority (four samples). Fourth, the lengths of the scrapers' edges range from 15 cm at the maximum – a large-jar body sherd – to 3.5 cm at the minimum. The median length of the edges was 6 cm. Fifth, the shapes of scrapers' edges conformed to convex shapes after reworking (31 samples). Considering the sizes and shapes of scrapers' edges, the reworked pottery scrapers seemed to be suitable for the smoothing insides of open vessels.

Next, as stated by Alizadeh and McCown,[9] the clay instruments with the straight edges, which connect perpendicularly to the handles were confirmed and interpreted as the tools related to the surface treatment

Figure 7.5 The evidence of BOBW surface treatment technique: horizontal rows of vertical grooves on a large jar (A38235) at Tall-e Bakun A (Photo by Miki. Courtesy of the Oriental Institute of the University of Chicago)

Figure 7.6 The evidence of BOBW surface treatment technique: horizontal rows of vertical grooves on a small jar (A20120) at Tall-e Bakun A (Photo by Miki. Courtesy of the Oriental Institute of the University of Chicago)

7 Langsdorff and McCown 1942: 25.

8 Herzfeld 1932: Tafel XXVI, XXVII.

9 Langsdorff and McCown 1942: 71; Alizadeh 2006: 79.

technique. Two pieces of such scrapers were confirmed from the collection.[10] The character of the clay scraper is different from that of the reworked pottery scraper. Considering the length of the blade (about 10 cm), it seems unsuitable for interior smoothing. Rather, using this tool for exterior rough smoothing or scraping for large jars seems more likely.

Smoothing and light burnishing of MCW and red-burnished ware

Five examples of well-preserved MCW vessels showed rough smoothing in their interior surfaces and a combination of smoothing and light burnishing in their exterior surfaces. The direction of the MCW's burnishing was not identified. Red-burnished ware shows a clearer trace of horizontal and diagonal burnishing on its exterior body surface.

3) Applying slip

Covering with slip is a widely observed technical step in making the surface of BOBW. By covering a vessel with slip, the surface becomes less porous and smoother. Most of the well-preserved BOBW vessels have slip both on their interiors (46 of 53 samples) and on their exteriors (59 of 64 samples). However, some interior surfaces of large jars were not covered by slip (6 of 14 samples). The absence of slip is possibly due to difficulty applying it due to closed vessel form and the visibility of the surface. On the other hand, MCW vessels showed slight traces of a reddish-brown wash. Red-burnished ware shows the red slip.

4) Decorating

Vertically dividing the motif-units of BOBW from Tall-e Bakun A

Other than horizontal design structures, which were analysed in Chapter 6, the way in which design panels were subdivided vertically by motif-units was also an important attribute in the technical step of decorating BOBW. This attribute shows the repetition of a technical step of decorating motif-units. There are 44 well-preserved vessels whose number of motif-units was identifiable in OIC. In addition, 17 diagnostic sherds, such as conical base sherds, and 31 published drawings were included. As a result of the counting, at first, it turned out that the most common number of motif-units was three in open vessels and large jars at Tall-e Bakun A (47 samples). Second, the number of motif-units ranged from two to 13 (Table 7.2: Upper). In particular, open vessels painted on their exteriors showed the most variable motif-units of all vessel forms (from 2 to 13) (Table 7.2: upper). Hence, this category was further subdivided into complete vessel forms and the relationship with the number of motif-units was considered (Table 7.2: lower). Among these complete vessel forms, three was the most common number of motif-units except for in conical bowls, for which the most frequent number was two. In addition, motif-units numbering more than nine appeared only in a deep bowl and a beaker.

There were correlations between motif type, number of motif-units, and vessel forms. This is due to the fact that the required size of each specific motif was shared among the potters. For example, the vessels with two motif-units have the goat motifs and the complete vessel form of a conical bowl (nine examples). The vessels with more than four motif-units had diamond motifs (five samples). The representative motifs among the three motif-units on the exterior-painted open vessels were "white leaves" (seven samples),[11] "zigzags and boxes" (six samples, Fig. 7.9),[12] "windmills" (two cases), and the others.

5) Firing

Imprints on the surface of BOBW from Tall-e Bakun A

Almost all of the BOBW vessels were well-fired using a pottery kiln. Here an unexpected discovery about the firing process of the black-on-buff ceramics will be reported. 57 examples with "imprints" were confirmed. Imprints occurred when the painted pottery pieces were piled on each other in the kiln and were then fired (Figs. 7.7). Of the 57 examples, eight examples were discovered from the well-preserved vessels, and the other 49 samples were confirmed in the diagnostic potsherds collection. Imprinting accounts for just 1.6 % of all the observed BOBW materials of the Chicago collection (57 of 3607 BOBW samples), but for 12.5% of all the well-preserved BOBW ceramic vessels (8 of 64 well-preserved vessels). It is suggested that the better-preserved a vessel was, the more the traces of imprints were discovered. Considering the observed number, the phenomenon is likely to be a coincidence. This phenomenon was already recognised by previous researchers. McCown reported that

> "Bowls, particularly the smaller ones, frequently were fired in nests, and the paint often vaporized from one bowl onto the interior of the next, leaving a faint pattern there."[13]

In the excavation report of Tall-e Gap, Sono also recognised the imprint and regarded it as an "*interesting*

[10] Langsdorff and McCown 1942: Plate 8:14.

[11] Herzfeld 1932 Tafel II:1.

[12] Herzfeld 1932 Tafel III:3.

[13] Langsdorff and McCown 1942: 24.

Table 7.2 The cross-tabulations between number of motif-units and vessel forms (upper) and between complete vessel forms of open vessel painted on its exterior and number of motif-units (lower) at Tall-e Bakun A

Vessel form/ No. of motif-units	2 motif units	3 motif units	4 motif units	5 motif units	6 motif units	7 motif units	8 motif units	9 motif units	10 motif units	11 motif units	13 motif units	Total
open vessel painted on its exterior	22	27	1	3	-	1	1	1	1	2	1	60
open vessel painted on its interior	4	12	1	-	1	-	-	-	-	-	-	18
open vessel painted on both sides	1 (int.)	1 (int.)	-	-	-	1 (ext.)	-	-	-	-	1 (ext.)	4
small jar (painted on its exterior)	-	-	1	-	1	-	-	1	-	-	-	3
large jar (painted on its exterior)	-	7	-	-	-	1	-	-	-	-	-	8
Total	27	47	3	3	2	3	1	2	1	2	2	93

Complete vessel form/ No. of motif-units	2 motif units	3 motif units	4 motif units	5 motif units	6 motif units	7 motif units	8 motif units	9 motif units	10 motif units	11 motif units	13 motif units	Total
beaker/ possibly beaker	3	4	-	-	-	-	-	1	1	1	1	8
conical bowl/ possibly conical bowl	17	10	1	1	-	-	-	-	-	-	-	24
deep bowl	1	5	-	2	-	1	1	-	-	1	1	12
funnel-shaped vessel	-	5	-	-	-	-	-	-	-	-	-	5
incurved rim vessel	1	1	-	-	-	-	-	-	-	-	-	2
shallow bowl	-	2	-	-	-	1	-	-	-	-	-	3
Total	22	27	1	3	-	2	1	1	1	2	2	62

phenomenon".[14] Thus, although the existence of imprinting was already well-known among researchers, no one approached it in detail.

The details of the confirmed examples with traces of imprints were recorded. The recorded items were as follows: (A) the vessel form; (B) the surface on which the imprints were observed (inner/outer); (C) the location at which the imprints were observed, such as rim, body, or bottom; (D) the stylistic components of the imprints based on the stylistic classification of painting, such as a motif and a design structure (see Section 4-3-1); and (E) the relationship between the original paintings and the imprints on the same vessel (same, similar, different, insufficient data to judge the relationship). Below I will explain the classification results of imprints following these orders.

A) As for vessel forms, most of the vessel forms whose imprints were confirmed at Tall-e Bakun A were exterior-painted open vessels (54 samples) or both-sides-painted open vessels (one sample) (Table 7.3: A and B). This implies that the interior-painted open vessels were not piled up together when they were fired in the pottery kiln.

B) Regarding preserved surfaces of imprints, the ratio of imprints preserved on the inner surface versus imprints on the outer surface was about 8:1 (51 samples: 6 samples) (Table 7.3: A and B). This suggests that the majority of imprints occurred on the inner surfaces of the ceramics when the potters piled up the exterior-painted open vessels of approximately the same size and fired them. In few cases, it occurred on the outer surface of the pottery either when they stacked vessels on the interior-painted open vessels, or when the exterior surfaces of the exterior-painted open vessels touched one another in the pottery kiln. The closed vessels, which were impossible to stack, had the latter imprints on their bodies.

C) Next, regarding the location of imprints, the imprints were frequently confirmed in the body part of the ceramic vessels (35 examples) (Table 7.3: C). Eight

[14] Egami and Sono 1962: 40 in Japanese.

Figure 7.7 The evidence of BOBW firing technique: imprints on the inner surfaces of open vessels (1: A20089, 2: A20116, and 3: A39436) at Tall-e Bakun A (Photo by OIC and Miki. Courtesy of the Oriental Institute of the University of Chicago)

samples with the traces of the base bands on the inner bottoms were confirmed. These results suggest that the upper vessels which were piled up reached their bases to either the body parts or even the interior bottoms of the lower vessels. Imprinting is the indirect evidence of the stacking same-sized vessels and vessels with the same forms. In contrast, the vessels with the imprints only on the inner rim parts (four samples) might not have fitted the upper vessels for some reasons. There were two complete conical bowl samples which showed the wide areas with traces of imprints from the rim to the bottom, or from the body to the bottom (Fig. 7.7: 1-2), indicating that the upper vessels were same-sized.

D) Although the preserved parts of imprints were scarce, the stylistic components of imprints were classified into three types: motif + design structure, design structure (horizontal lines and bands), and motif (Table 7.3: D). Motif (28 examples) was the most frequent component in preserved imprints. The samples in which both motif

Table 7.3 Vessel forms (A), preserved surfaces (B), location (C), stylistic component (D), and stylistic relationship with original motifs(E) of imprints at Tall-e Bakun A

A, B) Vessel form/ preserved surface of imprint	outer surface	inner surface	Total
open vessel painted on its exterior	4	50	54
open vessel painted on both sides	1	-	1
open vessel painted on its rim	-	1	1
large jar (painted on its exterior)	1	-	1
Total	6	51	57

C) Location of imprint	Total
rim - bottom	1
rim and bottom	1
rim - body	6
rim	4
body - bottom	1
boy and bottom	1
body	35
bottom	8
Total	57

D) Stylistic omponent of imprint	Total
motif, horizontal design structure	13
horizontal design structure	11
motif	28
possibly motif	2
unknown	3
Total	57

E) Motif-imprint stylistic relationship	Total
a) same motif, horizontal design structure	3
b) same motif	2
c) similar motif, horizontal design structure	6
d) similar motif	6
e) different motif, horizontal design structure	5
f) different motif	17
g) insufficient data	18
Total	57

and horizontal design structure were preserved as imprints amount to 13 examples.

E) Furthermore, the correlation of the relationships between original motifs of the imprinted pottery and imprinted motifs was analysed (Table 7.3: E). There are 18 samples whose original painting was unclear (counted as insufficient data). The characters of the relationships between original motifs and imprints were classified into seven categories:

a) same motif, horizontal design structure, b) same motif, c) similar motif, horizontal design structure, d) similar motif, e) different motif, horizontal design structure, f) different motif/ motif? and g) insufficient data. An interesting point is that except for those with insufficient data, about half of the samples had the same or similar imprints to the original decoration (a, b, c, d: 17 samples). The outstanding examples were the two conical bowls with identical imprints as the original decoration (Fig. 7.7: 1-2). It is likely that the painters of the original motif (a goat motif with two big horns or the “white leaf” motif) and the same imprint motif were the same person. Another possibility is that the painter of the original motif and the painter of the imprint motif were different persons, and the former potter ordered the latter potter to paint the same motif. It is further speculated that the painters with high-level skill could make several ceramics with the same motifs.

Reddish part on the exterior surface

Besides traces of imprints, another trace of firing technique was observed on the well-preserved large jars: a reddish part on the exterior surface (three samples: Fig. 7.8). These reddish spots appear on one side of the body. The size of the spots varies. It is inferred that the difference of the fabric colour (pinkish brown) from the other part of the exterior surface (buff) was due to the arrangement of the vessels in a pottery kiln. The reddish part was likely to be less fired than the other parts because (1) this part touched the floor of a pottery kiln or (2) this part contacted other vessels in a pottery kiln. If hypothesis (1) was correct, large jar vessels were fired with the vessels laid down in a narrow pottery kiln. Considering the fact that large jars rarely had imprints of the beautiful exterior-painted open vessel, it is possible that large jars were fired either alone or only with other large jars themselves in a pottery kiln.

The observation of technical traces for the analysis of the chaîne opératoire of OIC collection is summarised as follows:

Figure 7.8 The evidence of BOBW firing technique: reddish parts on the exterior surfaces of large jars (A20271) at Tall-e Bakun A (Photo by Miki. Courtesy of the Oriental Institute of the University of Chicago)

1) It is suggested that BOBW was formed using the coiling method. Traces of the joints seen in neck, body, and base suggest the drying period before attaching those parts. MCW was formed using sequential slab construction. MCW was then covered with cloth and coated with additional clay.
2) BOBW was usually smoothed horizontally on exterior and interior surfaces. It was possibly smoothed on a turntable. The presence of grooves on the exterior surfaces of BOBW, especially large jars, suggests either the use of a special instrument or the technical option of paddling. Both reworked pottery scrapers and clay scrapers used for surface treatment were discovered. MCW was lightly burnished.
3) In many cases, the design panels of BOBW were vertically subdivided into three motif-units at Tall-e Bakun A. Then the same motif was painted on each motif-unit. However, conical bowls were vertically subdivided into two motif-units in many cases.
4) Finally, the traces of imprints helped discussing the piling of vessels in a pottery kiln. The same imprints as the original motifs suggest that the skilled potters painted the same motifs in a short period.

These results were schematized as diagrams of the chaîne opératoire in Figs. 7.34 and 7.36.

Analysis of painting skill at Tall-e Bakun A

Following Ingold's discussion regarding skill in Chapter 3, skill in craft-making has a relational nature; that is, skill is emergent in a growing process of craft-making whose relationships among humans, things, and environment are entangled. While the template of materials made by skilled practitioners inheres not just in the minds of the practitioners but in the process of making the materials which humans, things, and environment relationally correspond to, the templates of materials made in the minds of apprentices were directly projected to the passive materials without any correspondence with the materials or environment. In other words, relationships between humans, things, and environment in craft-making are not well-established. This mechanism of technical skill causes a skill difference between an apprentice and a skilled practitioner.

After establishing the theoretical framework of technical skill in Chapter 3, in Chapter 4 I reviewed analytical methods of technical skills in previous studies – namely, skill score analysis, microstylistic analysis of high-frequency and low-variable motifs, and qualitative observation of technical skills. Although skill score analysis assumes the nature of a skill or error *a priori*, it is useful when I avoid this assumption. In this section,

1) skill score analysis of complete vessels with identical motifs,
2) skill score analysis of published drawings, and
3) qualitative observation of technical skills of ceramics, especially badly painted vessels and skilfully painted ones, will be adopted.

Skill score analysis of complete vessels with an identical motif: the analysis of well-preserved vessels with the motif "zigzags and boxes"

Introduction

The difficulty of a painting technique depends on the types of motifs drawn (from simple motifs to complex motifs). Hence, the comparison of technical skills between ceramic vessels with different motifs is difficult. In this section, I will approach demonstrating the difference of painting skill through the comparison of complete vessels with an identical motif using skill

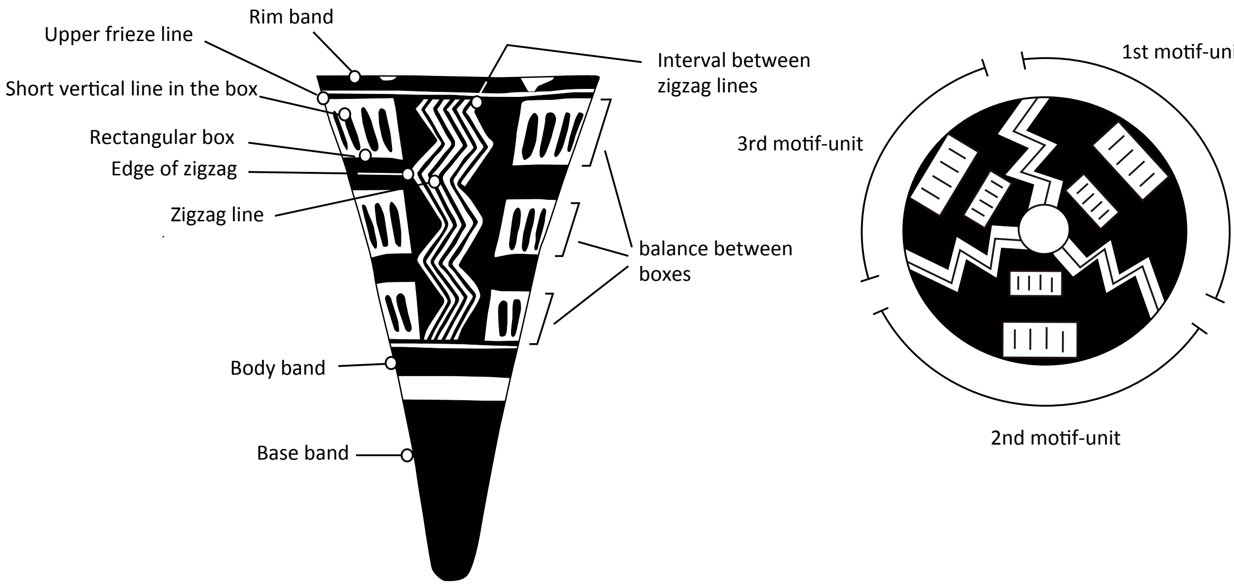


Figure 7.9 Terminology for the microstylistic analysis of a motif 'zigzag and boxes' (drawing directly traced from Langsdorff and McCown 1942: Pl. 36:14)

score analysis. This comparison using vessels with the same motif makes it easier to find any error caused by poor handling. The most suitable motif for the skill score analysis in the OIC collection was the "zigzags and boxes" motif, VIIIA in McCown's classification (Fig. 7.9).[15] In total, seven well-preserved vessels with this motif were confirmed from the collection (Table 7.4). This motif is the most frequent among the well-preserved vessels curated in the Institute (seven vessels out of 70 well-preserved vessels curated in this institute). This motif was also reported as Design type Ic1 by Sono in the excavation report of Tall-e Gap. It originated from Level 10 of Tall-e Gap.[16] These vessels are either funnel-shaped vessels (A20118 and A20290) or beakers (A20096, A20097, A20099, A20289, and A38321). All the vessels were complete except for A38321, which was eliminated from detailed analysis.

Eighteen variables for microstylistic analysis

For the purpose of comparing the microstylistic attributes of the "zigzags and boxes" motif, the terminology for the variables will be defined and described (Fig. 7.9). The motif complex consists of two types of motifs: rectangular boxes and zigzag lines. One zigzag lines motif and one row of rectangular boxes motif comprise one motif-unit. The rest of the frieze was filled with black paint after drawing rectangular boxes and zigzags. A first motif component, a vertical row of two or three box motifs, composes one motif. Each box has a horizontal line of short vertical lines inside it. On the other hand, the second motif component, the zigzag lines motif, consists of a horizontal line of one to five vertical zigzag lines except for two outer delimiting lines. For the microstylistic analysis of the "zigzags and boxes motif", 18 variables (V) related to errors are set up as follows:

V1) number of motif-unit (Fig. 7.11: V1),
V2) number of boxes in one motif-unit (Fig. 7.11: V2),
V3) overlap of horizontal lines/band with the other horizontal ones (Fig. 7.11: V3),
V4) inconsistency of departure and terminal of horizontal lines /band (Fig. 7.11: V4),
V5) number of short lines in each box (Fig. 7.12: V5),
V6) evenness of the heights of boxes (Fig. 7.12: V6),
V7) overlap of box motif lines (Fig. 7.12: V7),
V8) number of motif line overflow across horizontal lines/band (Fig. 7.12: V8),
V9) starting point and direction of zigzag lines (rightward or leftward) (Fig. 7.13: V9, 10, 11),
V10) number of zigzag lines departing/reaching the upper/lower frieze lines (Fig. 7.13: V9, 10, 11),
V11) difference of P10 between that of departing lines and that of reaching lines (Fig. 7.13: V9, 10, 11),
V12) number of edges of the zigzag lines (Fig. 7.13: V12),
V13) reaching-point of zigzag lines (lower frieze line or sideline of the box) (Fig. 7.13: V13),
V14) evenness of intervals between zigzag lines (Fig. 7.13: V14),
V15) overlap of zigzag lines (Fig. 7.14: V15),
V16) number of zigzag lines overflow across the motif (Fig. 7.14: V16),
V17) number of zigzag lines overflow across horizontal lines/band (Fig. 7.14: V17), and
V18) number of paint drops (Fig. 7.14: V18).

[15] Langsdorff and McCown 1942: 41. McCown named it "Vertical zones of zigzags joined by horizontal bands."
[16] Egami and Sono 1962: 7 in English, Table 14.

Table 7.4 List of seven well-preserved vessels with an identical motif 'zigzags and boxes' curated in OIC. Reg No. means material registration number in OIC. OIP means the plate number in the publication of Langsdorff and McCown 1942

Reg No.	Field Reg. No.	Locus	Level	Part	OIP	Vessel Form	Note
A20096	PPA 2064	Bldg.III.Room 2	III	rim - base	Pl.36:13	beaker	discovered inside 38321 with another small beaker
A20097	PPA 2065	Bldg.XVII.Room 2	IV	rim - base	Pl.12:A	beaker	
A20099	PPA 2070	Bldg.V.Room 6	III	rim - base	Pl.16.8	beaker	
A20118	PPA 2103	Unknown	III	rim - base	Pl.16:6	funnel-shaped vessel	
A20289	PPA 3576	Bldg.III.Room 2	III	rim - base	not published	beaker	same imprint inside
A20290	PPA 3579	Bldg.XVII.Room 2	IV	rim - base	not published	funnel-shaped vessel	
A38321	PPA 3574	Bldg.III.Room 2	III	rim - base	not published	beaker	

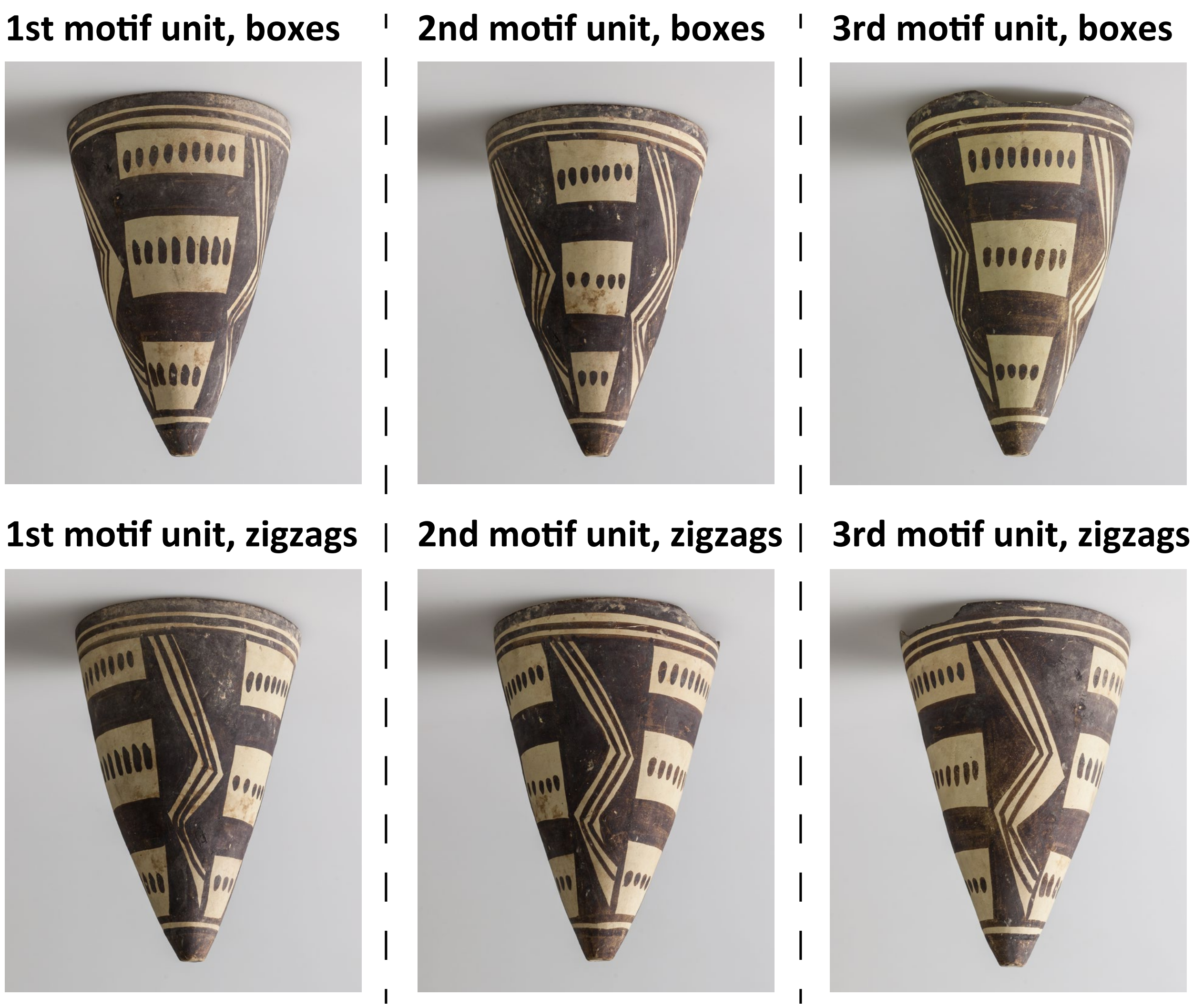


Figure 7.10 Example A20096 (Photo by OIC and Miki. Courtesy of the Oriental Institute of the University of Chicago)

Ceramic example showing 18 variables: A20096

I will take a closer look at these variables by giving an example (A20096) (Fig. 7.10). A20096 had three motif-units (V1). The motif-units each had rows of three boxes (V2). The horizontal lines/bands were not overlapped with the other horizontal lines (V3). The starting and terminal points of the horizontal lines were connected well (V4). Then, the parameters related to the rectangular box motif will be described. The numbers of vertical short lines inside the boxes in the first motif-unit were 9 (upper row), 8 (middle row), and 5 (lower row). Those in the second motif-unit were 7, 5, and 3; those in the third motif-unit were 9, 7, and 4 (V5). The height of each rectangular box within each motif-unit was uneven in all the motif-units (V6). The box lines did not overlap with the interior vertical short lines (V7). No line overflow of the box lines existed (V8).

This description will move to variables for the zigzag lines motif in A20096. Zigzag lines started from the left edge (V9). The number of zigzag lines was two, except for the first motif-unit (V10). While the number of zigzag lines departing from the upper frieze line and the number of zigzag lines reaching the lower frieze line equalled at the second and third motif-units, these numbers were different at the first motif-unit (V11). There were two edges of zigzag lines in all the motif-units of A20096 (V12). The terminal point of the zigzag lines in all the motif-units was not the lower frieze line, but the left side of the lowest box due to narrower space (V13). The intervals between zigzag lines were uneven in all the motif-units, especially in the third motif-unit (V14). The zigzag lines in all the motif-units overlapped with the next zigzag lines (V15). While the overflow of zigzag lines beyond the zigzag motif itself was not confirmed (V16), the overflow of zigzag lines beyond the lowest box was observed at the first and third motif-units (V17). Finally, in total, 10 paint drops were found on the exterior surface of A20096 (V18).

Results of microstylistic analysis of 18 variables

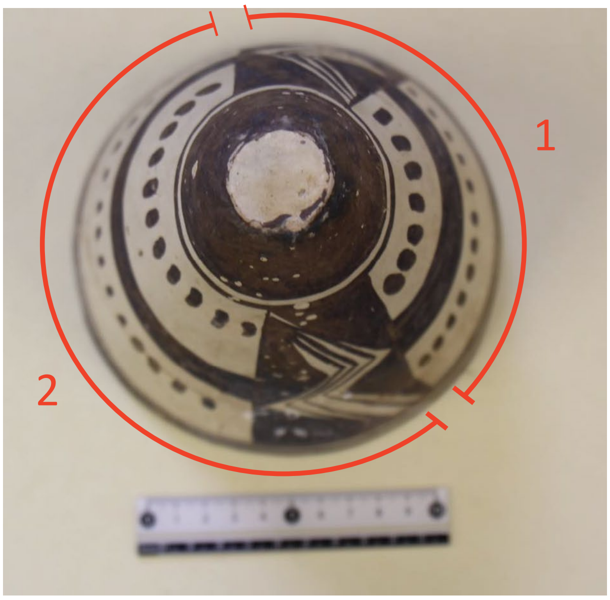
The results of the microstylistic analysis of the abovementioned attributes are summarised in Table 7.5. Below, results of these parameters among six complete vessels will be described in more detail in order to search for a character of each parameter and its relationship to technical skill. The number of the motif-units on most of the vessels (V1) was three except for on A 20097 (Fig. 7.11: V1, Table 7.5). It is suggested that A20097 deviated from the rules of the number of the motif-unit. The standard of V1 was likely to be three units. The number of boxes in one motif-unit (V2) was subdivided into two types: two boxes in one motif-unit (A20097, A20099, A20289), and three boxes in one motif-unit (the others) (Fig. 7.11: V2). There was no fluctuation in the number of boxes between motif-units within one vessel. The overlap of horizontal lines/bands (V3) was observed only in A20097 (Fig. 7.11: V3). The absence of overlap (V3) was typical. Inconsistency of departure points and terminal points of horizontal lines/bands (V4) was confirmed only in A20099 (Fig. 7.11: V4) and A20118. The inconsistency of horizontal lines/bands (V4) was a minority among the analysed materials.

I will move to the description of variables related to box motifs. The number of short lines in the rectangular boxes in each row of each motif-unit (V5) tends to be the same or similar between motif-units. In the best example (A20118), the amounts of short lines in each motif-unit were 4 (upper box), 3 (middle box), and 2 (lower box) (Fig. 7.12: V5). However, except for this, there was either more or less fluctuation in the number of lines in each motif-unit. The most fluctuated one was A20097 (first motif-unit: 17 [upper box] and 11 [lower box]; second motif-unit: 12 [upper box] and 7 [lower box]). Since the number of short lines in one box is proportional to the length of the rectangular box, it is suggested that the more fluctuated these numbers are, the more unbalanced (inconsistent) the lengths of the rectangular boxes (or proportion of each motif-unit) are. In short, the variability of V5 in one vessel can be a marker of evenness of horizontal lengths of each motif-unit. The median standard deviation of V5 between each row of motif-unit was 0.82 (Table 7.6). In addition, there are varieties in the short lines. A20099 had horizontal short lines. The short lines of A20290 were connected together. The amount of vessels whose box heights in one motif-unit were even (V6) was minor (A20118 and A20290) (Fig. 7.12: V6). Box line-overlap (V7) was observed only in A20099 (Fig. 7.12: V7). The overflow of the box lines to the horizontal lines/bands (V8) appeared only in A20118 (Fig. 7.12: V8).

The description of variables will now turn to those related to zigzag motifs. Zigzag lines departed from the left corner of upper frieze line and box and then went down rightward (Fig. 7.13: V9, 10, 11) except for A20118 (V9). Beginning with the left corner in every motif-unit is the standard, and the cases of A20118 and A38321 can thus be judged as irregular. The number of zigzag lines departing the upper frieze line in each motif-unit (V10) ranges from 2 to 5 (Fig. 7.13: V9, 10, 11). The mode of V10 is 4, and it shows less fluctuation than the number of the short lines inside boxes (V5). The condition in which the number of zigzag lines departing the upper frieze line equals that reaching the lower frieze line in a motif-unit (11 cases) occurred more than those not (7 cases) (Fig. 7.13: V9, 10, 11) (V11). V11 was due to the narrower space for painting on the lower part of the body. In V11, one of the zigzag lines usually overlapped with the other zigzag lines. That also indicates that the

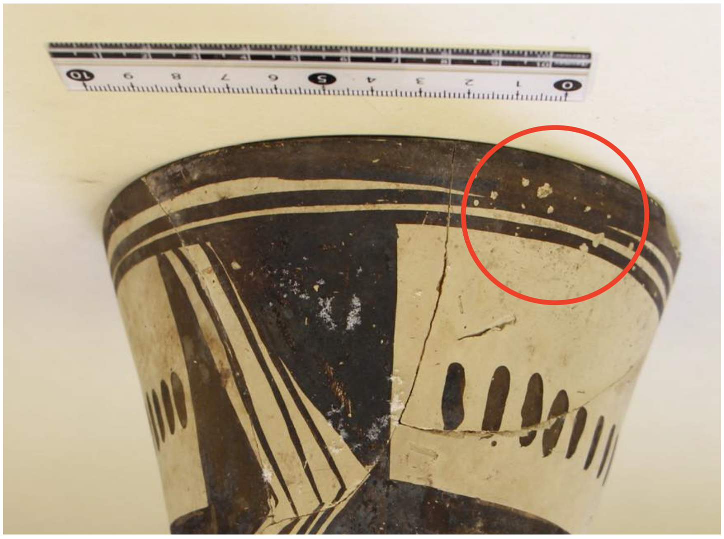
Table 7.5 Results of the microstylistic analysis of 'zigzag and boxes' motif (V1-V18) on six vessels

Reg. no	V1	V2	V3	V4	motif order	rectangular box motif						zigzag lines motif										V18	Skill score
						V5			V6	V7	V8	V9	V10		V11	V12	V13	V14	V15	V16	V17		
						Upper	Middle	Lower					Upper	Lower									
A20096	3	3	no	no	1st unit	9	8	5	uneven	no	-	left	2	1	yes	2	box	uneven	yes	-	2	4	0.51
					2nd unit	7	5	3	uneven	no	-	left	2	2	no	2	box	uneven	yes	-	-	3	
					3rd unit	9	7	4	uneven	no	-	left	2	2	no	2	box	uneven	yes	-	1	3	
A20097	2	2	yes	no	1st unit	17	11		uneven	no	-	left	3	3	no	2	box	uneven	yes	3	-	6	0.36
					2nd unit	12	7		uneven	no	-	left	2	3	yes	2	box	uneven	yes	1	-	7	
A20099	3	2	no	yes	1st uit	7	4		even	yes	-	left	4	4	no	1	frieze line	uneven	no	-	1	1	0.50
					2nd unit	5	5		uneven	yes	-	left	4	4	no	1	frieze line	even	no	2	-	-	
					3rd unit	4	4		uneven	yes	-	left	4	4	no	1	frieze line	even	no	3	3	1	
A20118	3	3	no	yes	1st unit	4	3	2	even	no	1	right	4	3	yes	5	frieze line	even	yes	-	-	1	0.67
					2nd unit	4	3	2	even	no	1	right	3	3	no	5	frieze line	even	no	-	-	2	
					3rd unit	4	3	2	even	no	1	left	3	3	no	4	frieze line	even	no	-	1	2	
A20289	3	2	no	no	1st unit	15	10		uneven	no	-	left	4	3	yes	2	frieze line	uneven	yes	-	-	-	0.79
					2nd unit	11	7		uneven	no	-	left	4	3	yes	2	frieze line	a bit even	yes	-	-	-	
					3rd unit	11	7		uneven	no	-	left	5	4	yes	2	frieze line	a bit even	yes	-	-	-	
A20290	3	3	no	no	1st unit	6	5	4	even	no	-	left	4	4	no	2	frieze line	even	no	-	-	-	0.94
					2nd unit	5	5	4	even	no	-	left	4	4	no	2	frieze line	even	no	-	-	3	
					3rd unit	6	5	4	even	no	-	left	4	4	no	2	frieze line	even	no	-	-	1	



V1) number of motif unit (A20097)

V2) number of boxes in one motif unit (A20096)



V3) overlap of the horizontal lines/ band with the other horizontal ones (A20097)

V4) inconsistency of departure and terminal of Horizontal lines /band (A20099)

Figure 7.11 Diagnostic examples of variables V1-V4 of 'zigzag and boxes' motif at Tall-e Bakun A (Photo by OIC and Miki. Courtesy of the Oriental Institute of the University of Chicago)

V5) number of the short lines in each box (A20118)

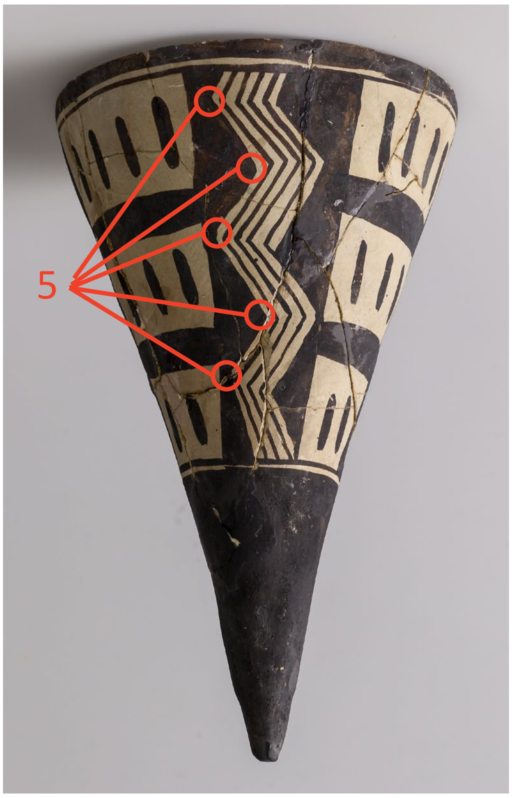
V6) evenness of the heights of boxes (A20099)

V7) overlap of box motif lines (A20099)

V8) number of motif line overflow across Horizontal lines/ band (A20118)

Figure 7.12 Diagnostic examples of variables V5-V8 of 'zigzag and boxes' motif at Tall-e Bakun A (Photo by OIC and Miki. Courtesy of the Oriental Institute of the University of Chicago)

V9, 10, 11) direction and number of the zigzag lines departing/reaching the Upper/Lower frieze lines (A20096)



V12) number of the edges of the zigzag lines (A20290)

V13) reaching point of the zigzag lines (Lower frieze line or sideline of the box) (A20097)

V14) evenness of the intervals between the zigzag lines (A20097)

Figure 7.13 Diagnostic examples of variables V9-V14 of 'zigzag and boxes' motif at Tall-e Bakun A (Photo by OIC and Miki. Courtesy of the Oriental Institute of the University of Chicago)

V15) overlap of zigzag lines (A20096)

V16) number of zigzag lines overflow across the motif (A20097)

V17) number of zigzag lines overflow across Horizontal lines/ band (A20099)

V18) number of paint drops (A20118)

Figure 7.14 Diagnostic examples of variables V15-V18 of 'zigzag and boxes' motif at Tall-e Bakun A (Photo by OIC and Miki. Courtesy of the Oriental Institute of the University of Chicago)

Table 7.6 Standard deviation (S.D.) of number of short lines between motif-units in each row (V5)

Reg no.	Rectangular box motif		
	V5) difference of No. of short lines between units		
	S.D. of short lines in the first row	S.D. of short lines in the second row	S.D. of short lines in the third row
A20096	0.94	1.25	0.82
A20097	2.5	2	
A20099	1.25	0.47	
A20118	0	0	0
A20289	1.89	1.41	
A20290	0.47	0	0
Median of S.D.		0.82	

painters drew the zigzag lines from the top (upper frieze line) to bottom (lower frieze line), since the number of zigzag lines departing the upper frieze line is more than that reaching the lower frieze line. The number of edges of zigzag lines (V12) ranges from 1 (A20099) to 5 (A20118) (Fig. 7.13: V12). Surprisingly, there was no fluctuation of the number of zigzag edges between motif-units in one vessel except for the third motif-unit of A20118.

As a result of the reduced space on the lower frieze line, the zigzag lines sometimes finished not on the lower frieze line, but on the left side of the lower box motif (V13) (A20096 and A20097) (Fig. 7.13: V13), while zigzag lines of the other examples finished on lower frieze lines. Intervals between zigzag lines (V14) was uneven in many examples (Fig. 7.13: V14). The unstable intervals between zigzag lines in the narrow space led to the overlap of the zigzag lines (V15) in a half of the samples (A20289, A20096, and A20097) (Fig. 7.14: V15). Overflow of zigzag lines across the zigzags (V16) was confirmed in two examples (A20099 and A20097) (Fig. 7.14: V16). Another type of overflow, the overflow of zigzag lines across horizontal lines/ band (V17) was more frequent than the former overflow (A20118, A20099, and A20096) (Fig. 7.14: V17). Finally, as a result of close observation, traces of paint drops (V18) were confirmed on most of the examples (Fig. 7.14: V18) except for A20289, whose painting had faded.

Tallying skill score from 11 variables of errors

As reviewed in Chapter 4, I pointed out the problem of classifying the character of skill *a priori* (skill, care, alertness, sloppiness, etc.) before analysis. In this case, for example, was a line-overlap an indicator of an apprentice's poor-skilled handling? Was a line overflow a marker of sloppiness in an experienced potter? These attributes cannot be *a priori* classified into a specific character of technical skill. Only after microstylistic analysis, is the interpretation of the relationship between the character of skill and variables possible. Without classifying the nature of technical skill, I tallied the variables which as a modern archaeologist I judged errors in order to calculate skill scores. As a result of a detailed description of 18 variables (V1-V18) seen in six complete vessels, 11 variables indicating inconsistency, unbalanced proportion, overlap, overflow, and drop (V3, V4, V5, V6, V7, V8, V14, V15, V16, V17, and V18) were interpreted to indicate just an error due only to either lack of experienced skill or lack of careful attention.

Eleven variables concerning errors in each vessel were converted to a skill score using the method proposed by Castro Gessner.[17] The variables were converted into yes-or-no questions. variables V3, V4, and V15 (overlap and inconsistency) are already in the form of yes or no. As for quantitative variables (overflow and drops: V8, V16, V17, and V18), "yes" means that the sum of the mistakes in one vessel is more than one while "no" means zero. As for V5, a standard deviation in each row of more than 0.82 (median of standard deviation of V5) means yes. As for V6 and V13 (balance between boxes and zigzag line interval), uneven means yes. The converted results are presented in Table 7.7. "Yes" answers yielded zero point and "no" answers yielded one point. The skill point total refers to the total number of "no" answers for each vessel. In these questions, the more "no" the vessel has, the higher skill total point the vessel is given. When "yes" and "no" answers for one variable (V5-V18) are mixed in one vessel across multiple motif-units,[18] the score was subdivided by the number of motif-units. Skill total-points were divided by the number of questions, and the results were called skill scores. Each score ranges from zero at the minimum to one at the maximum. Skill total-points and skill scores are presented in Table 7.8.

Interpreting characters of painting skill from skill score

The relationship between skill score and variables related to errors will be considered in order to interpret characters of the parameters by considering skill scores. The vessel with the highest skill score was A20290 (0.94), and the lowest was A20097 (0.36). The median skill score was 0.59. I separated the vessels with scores greater than 0.59 (A20118, A20289, and A20290) from those less than 0.59 (A20096, A20097, A20099). V3 (horizontal line overlap), V5 (uneven motif-unit proportion), V7

[17] Castro Gessner 2008: 427-428.

[18] For example, P6 of A20099 has two yes and one no. So, the score point (one point, number of no) was subdivided by thee (number of motif-unit A20099).

Table 7.7 Conversion of variables (Table 7.5) related to errors to yes/no answers

Reg. no	V3	V4	Rectangular box motif						Zigzag lines motif				V18
			V5			V6	V7	V8	V14	V15	V16	V17	
			upper	middle	lower								
						yes	no	no	yes	yes	no	yes	yes
A20096	no	no	yes	yes	no	yes	no	no	yes	yes	no	no	yes
						yes	no	no	yes	yes	no	yes	yes
A20097	yes	no	yes	yes		yes	no	no	yes	yes	yes	no	yes
						yes	no	no	yes	yes	yes	no	yes
						no	yes	no	yes	no	no	yes	yes
A20099	no	yes	yes	no		yes	yes	no	no	no	yes	no	no
						yes	yes	no	no	no	yes	yes	yes
						no	no	yes	no	yes	no	no	yes
A20118	no	yes	no	no	no	no	no	yes	no	no	no	no	yes
						no	no	yes	no	no	no	yes	yes
						yes	no	no	yes	yes	no	no	no
A20289	no	no	no	no		yes	no	no	no	yes	no	no	no
						yes	no	no	no	yes	no	no	no
						no	no	no	no	no	no	no	no
A20290	no	no	no	no	no	no	no	no	no	no	no	no	yes
						no	no	no	no	no	no	no	yes

(box line overlap), and V16 (zigzag line overflow across motif) appeared only in the vessels with low skill scores. V6 (unevenness of box height) and V14 (zigzag lines interval) also appeared more frequently in samples with low skill scores. These parameters related to errors were interpreted as markers of lack of experiential skill. On the other hand, parameters V4 (inconsistency of horizontal lines), V8 (box line overflow across horizontal lines), V15 (zigzag line overlap), and V18 (paint drop) happened regardless of skill score. These variables were likely to be markers of lack of attention.

Next is the relationship between skill scores and seven variables (1, 2, 9, 10, 11, 12, and 13), which were not used for tallying skill scores (Table 7.5). Three patterns emerged. First, zigzag lines reaching a box (V13) only existed in vessels with low skill scores (A20096 and A20097). This is likely to be as a result of unplanned alignment of box motifs due to a lack of experienced planning. Second, two motif-units (V1) only appeared in the lowest skill score sample (A20097). Two motif-units might be the result of a lack of an explicit rule concerning the number of motif-units. Third, although A20118 has a higher-than-average skill score (0.67), it has the exceptional characteristic of V9 (irregular direction of zigzag lines) and V12 (inconsistent number of zigzag edges), which the others do not have. Two zigzag lines start from the right side (V9), and V12 is different between motif-units in A20118. These outliers seen in A20118 are interpreted either as lack of careful attention or as intentional deviations.

Correlation between skill scores and other technical steps

Below, the correlation between skill scores and horizontal design structures and pottery-making techniques will be discussed to find the relationships with the dexterity in the other technical steps. First, as discussed in Chapter 7, the horizontal design structure patterns of these vessels were compared (Table 7.9). The most frequent design structure pattern is DE4: without body bands and with upper/lower optional lines. The other is DE1: with body bands and upper/lower optional lines (A20290). The vessel with DE1 (A20290) had the highest skill score (0.94). This structural component gives the painters the broader space on the lower frieze line by locating the line on the middle part of the body. This suggests the presence of an explicit rule concerning the strategy for painting the motifs neatly.

The correlation between painting skill and vessel form, size, and other technical steps, such as forming, smoothing, slipping, and firing, will also be addressed. The vessels with high skill scores were funnel-shaped vessels (A20118 and A20290), whereas the others were beakers (Table 7.9). Unlike beaker, funnel-shaped vessels require one more technical step to form, drilling the interior of the bottom using a stick-like tool. Rim diameters of the beakers ranged from 11 to 15 cm, and their heights ranged from 16 to 18 cm. The rim diameters of the funnel-shaped vessels were between 11 and 13 cm, and their heights were between 18 and 22 cm. The correlation between size difference and skill

Table 7.8 Tallying skill total points and skill scores from variables (Tables 7.5, 7) related to errors

Reg. no	V3	V4	Rectangular box motif				Zigzag lines motif				V18	Skill total point	Skill score
			V5	V6	V7	V8	V14	V15	V16	V17			
A20096	1	1	0.33	0	0	0	1	1	0	0.33	1	5.66	0.51
A20097	0	1	0	0	1	1	0	0	0	1	0	4	0.36
A20099	1	0	0.5	0.33	0	1	0.66	1	0.33	0.33	0.33	5.48	0.50
A20118	1	0	1	1	1	0	1	0.66	1	0.66	0	7.32	0.67
A20289	1	1	1	0	1	1	0.66	0	1	1	1	8.66	0.79
A20290	1	1	1	1	1	1	1	1	1	1	0.33	10.33	0.94

Table 7.9 The correlation between skill scores, horizontal design structure patterns, and pottery-making techniques of the vessels with the 'zigzags and boxes' motif.

Reg. no.	Horizontal design structure pattern	Vessel form	Rim diameter (cm)	Height (cm)	Forming	Slipping	Skill score
A20096	without a body band	beaker	11	16	coiling? without potter's wheel	yes	0.51
A20097	without a body band	beaker	15	18	coiling? without potter's wheel	yes	0.36
A20099	without a body band	beaker	15	16	coiling? without potter's wheel	yes	0.50
A20118	without a body band	funnel-shaped vessel	12	19	coiling? without potter's wheel	yes	0.67
A20289	without a body band	beaker	11	approx. 16-18	coiling? without potter's wheel	yes	0.79
A20290	with a body band	funnel-shaped vessel	13	approx. 21-22	coiling? without potter's wheel	yes	0.94

difference among beakers was unclear. There was no diagnostic difference in the techniques of smoothing or slipping. What is the implication of the lesser correlation between the technical step of painting and other technical steps of pottery making? One hypothesis is that the vessels were formed by skilled practitioners and an apprentice only attempted painting. Another hypothesis is that an apprentice at first mastered other techniques and then moved on to painting.

As another discovery of pottery-making techniques, especially firing, A20289 had the same imprint as the "zigzags and boxes" motif on its inner surface (Fig. 7.15). Although the information is limited, it indicates that the vessel which gave A20289 its imprint had three motif-units and zigzag lines consisting of four lines. It also demonstrates that vessels of the same size with the same motif (zigzags and boxes) were fired in the same pottery kiln.

Handedness

To supplement, if one assumes that the painter draws a horizontal line with a brush using her/his dominant hand and rotates the vessel using her/his other hand at the same time, the dominant hand of the painter can be identified from the direction of the painting. A20099 shows a right-to-left direction of the lower frieze line (Fig. 7.11: V4), which indicates that the painter used her/his left hand to rotate the vessel, meaning, the painter was right-handed. The painters of A20096 and A20097 were also right-handed.

Excavated contexts of analysed ceramics

In summary, the presence of skill differences in the same motif was demonstrated through this analysis. This result becomes much more interesting when integrated with the excavated loci of the vessels. A20289, A20096,

Figure 7.15 Imprint of 'zigzag and boxes' motif preserved on the interior surface of a beaker with 'zigzag and boxes' motif (A20289) at Tall-e Bakun A (Photo by Miki. Courtesy of the Oriental Institute of the University of Chicago)

and A38321 (badly-preserved poor-skilled vessel with zigzags and boxes motif) were found together in Room 2 of Building III at Level III, next to a pottery kiln. In addition, when these vessels were discovered, A20096 was inside A38321 with another small beaker, the information of which is unpublished. The imprint of zigzag lines preserved on the interior of A20289 did not match those of A20096 and A38321, implying the presence of another vessel with "zigzags and boxes". A20290 and A20097 (the highest-skilled and the lowest-skilled ones) were also found in one locus, Room 2 of Building XVII at Level IV, where a small pottery kiln was located. Whether these vessels were produced and used in the excavated loci or were just brought from the other production loci to the excavated loci is unclear. If the former is true, it is likely that "zigzags and boxes" was the motif which an apprentice had to learn at some stage of his or her apprenticeship. If the latter is true, however, why did the dwellers of these buildings collect the pottery with the identical motif?

Application of skill score analysis to the published drawings

Tallying the skill scores of published drawings from six variables of errors

After presenting the skill score analysis of complete vessels with the same motif, I will move on to that of published vessels with different motifs. I will extend this skill score analysis to the drawings of vessels published by Herzfeld, McCown, Masuda, and Alizadeh. For the following analyses, six error-related variables were extracted from 18 variables in the former section for tallying skill scores and renamed VD1 (variable for drawing) to VD6:

- VD1 (from V3): overlap of the horizontal lines/band with the other horizontal ones,
- VD2 (from V7 and 15): overlap of motif lines within the motif,
- VD3 (from V4): inconsistency of departure and terminal of horizontal lines/band,
- VD4 (from V8 and 17): presence of motif lines overflow across horizontal lines/band,
- VD5 (from V16): presence of motif lines overflow across the motif, and
- VD6 (from V18): presence of paint drops.

The published materials for the analysis are the same as those I used for the horizontal design structure analysis of vessels at Tall-e Bakun A in Chapter 7 (205 exterior-painted open vessels, 53 interior-painted open vessels, and 45 closed vessels. Appendix Tables A5. 8-10). Table 7.10 lists the total number of samples, number of unmeasurable samples, ratio of unmeasurable samples, and error ratio of the measured samples for each VD of each vessel form from Tall-e Bakun A. A high ratio of unmeasurable samples for each VD parameter of each vessel form reflects a limit in using the parameter for tallying skill scores. This ratio is high for VD5 in all vessel forms (motif line overflow: 46.34 %, 66.04 %, and 77.78 %) and VD1 and 2 of open vessels painted on their interiors. The error ratio of each parameter can be a clue in discussing the character of the parameter (e.g. experiential skill, sloppiness). However, unlike in the previous section, due to the scarcity of variables (only six variables), the interpretation of the VD's character is difficult. VD2 (motif line overlap) shows a higher error ratio than the other parameters (23.30 % and 33.33 %). Considering the numerous complex motifs painted on these vessels, it is suggested that motif overlap is related to a lack of attention. The error ratio of VD3 (horizontal line inconsistency) is also high in interior-painted open vessels (35.06 %) and closed vessels (37.14 %). Considering the large size of closed vessels, especially large jars, this high error ratio is likely to be due to lack of attention while painting.

Results of skill score analysis using published drawings from Tall-e Bakun A

I tallied skill scores ranging from 0.0 to 1.0 using six VDs. Fig. 7.16 presents the histograms of the skill scores of published ceramics in each vessel form from Tall-e Bakun A. A skill score 1.0 was the most predominant for each vessel form from Tall-e Bakun A (exterior-painted open vessels: 79.10 % of total samples; interior-painted open vessels: 60.78 %; closed vessels: 59.52 %). In these histograms, the number of samples in a skill score range decreases as the skill score becomes lower. The analysis was further limited to vessels with the specific motif

Table 7.10 Number of published drawings used for skill score analysis, number of unmeasurable samples, ratio of unmeasurable samples, and error ratio of the measured samples for each variable in each vessel form at Tall-e Bakun A

Vessel form		VD1) horizontal lines overlap	VD2) motif overlap	VD3) horizontal lines inconsistency	VD4) motif to horizontal lines overflow	VD5) motif overflow	VD6) paint drops
open vessel painted on its exterior	total number of samples (N)	205	205	205	205	205	205
	number of unmeasurable samples (N)	54	29	27	52	95	4
	ratio of unmeasurable samples (%)	26.34	14.15	13.17	25.37	46.34	1.95
	error ratio among the measured samples (%)	9.93	23.30	3.37	9.15	11.82	5.47
open vessel painted on its interior	total number of samples (N)	53	53	53	53	53	53
	number of unmeasurable samples (N)	37	41	8	13	35	3
	ratio of unmeasurable samples (%)	69.81	77.36	15.09	24.53	66.04	5.66
	error ratio among the measured samples (%)	6.25	33.33	35.56	5.00	11.11	8.00
closed vessel	total number of samples (N)	45	45	45	45	45	45
	number of unmeasurable samples (N)	15	12	10	6	35	4
	ratio of unmeasurable samples (%)	33.33	26.67	22.22	13.33	77.78	8.89
	error ratio among the measured samples (%)	10.00	12.12	37.14	7.69	0.00	17.07

in which overlaps and overflows frequently occurred: cross-hatches and zigzags (Fig. 7.16). The histogram of the open vessels with cross-hatches on their exteriors indicates a similar pattern to the histograms in Fig. 7.17. On the other hand, regarding the vessels with the zigzag motif, there were more examples with lower skill scores (0.0 – 0.6) (6 samples, 24% of the vessels with the zigzag motif). That is, the samples described in the previous section ("zigzags and boxes") were located in the low-medium skill score range of the total samples and thus belong to the minority among the published vessels from Tall-e Bakun A.

Limits of skill score analysis using published drawings

It should be mentioned that there are some limits to the skill score analysis of published drawings.

1) The published drawings include incomplete vessels. In addition, the published complete vessels present only one motif-unit.
2) Some vessels have specific motifs which cannot overlap and overflow,[19] influencing skill score.
3) Skill scores cannot consider the degree of design complexity (e.g. the size, the number of total strokes, the length of one stroke, the pattern of lines).[20] One solution is to recalculate the skill score of the vessels with a similar motif (e.g. cross-hatched, zigzag, as shown in Fig. 7.18).
4) Skill scores vary depending on the number of answered variables. For example, among the six complete vessels with "zigzags and boxes" observed in the former section, four vessels were also published. When only the six VDs were applied to the four vessels, the skill scores were different from the results obtained using 18 parameters (A20096: 0.51→0.5, A20097: 0.36→0.33; A20099: 0.5→0.17; and A20118: skill score 0.67→0.5).

[19] Herzfeld 1932 Tafel. IV:5, XII:1; Alizadeh 2006: Fig. 24:F.
[20] Herzfeld 1932 Tafel. XII:1.

Observation of badly and skilfully painted pottery

Work of an apprentice at Tall-e Bakun A

Above, I presented the skill score analyses of painted pottery. These quantitative approaches sometimes miss qualitative aspects related to technical skill. For that reason, here, I will qualitatively describe the badly and skilfully painted vessels which worthy of mention. One of the poorest-skilled examples in the collection is A24869, published as Alizadeh 2006: Fig. 55: F (Fig. 7.18). It is a miniature vessel painted on its interior (rim diameter: 7 cm) and has 14 short vertical lines stretching from the interior rim band. According to the skill analysis using six variables, the skill score was 0.0. The 14 vertical lines did not form any motif-unit, which indicates a violation concerning the motif-unit (see decorating in Section 8-1). One of the lines crossed another. Although slip was observed on the interior surface, it was not preserved on the exterior surface. The exterior surface also had a trace of rough smoothing and scraping. This pottery was found in Square CB06, the southern area of Tall-e Bakun A.

Works of exceptionally skilful potters at Tall-e Bakun A

I will also describe two examples which show outstanding painting skills. The first example is A20089, as already introduced in Fig. 7.8: 1 as a diagnostic example which had two motif-units of "goat with two big horns" and the identical imprint in its interior. This vessel was found in Building XI, a "*storeroom*" containing 17 well-preserved vessels, including three cooking pots (MCW). The identical imprint in its interior (even the "cross-circle" motif and "cross-hatched triangle" motif) indicates the presence of an identical vessel in size and painting. Although several samples with the similar motifs (goat with two big horns) have been published,[21] the same combination with the "cross-circle" motif and "cross-hatched triangle" motif have not been discovered or published yet. It is clear that the painter used more than two types of brushes of different thickness. The balance between the motif-units is stable. The motif-units are quite similar in size, except for the length of the goat's tail. Although the original painting did not show any mistakes, the imprinted painting indicates line overflow to the upper frieze line.

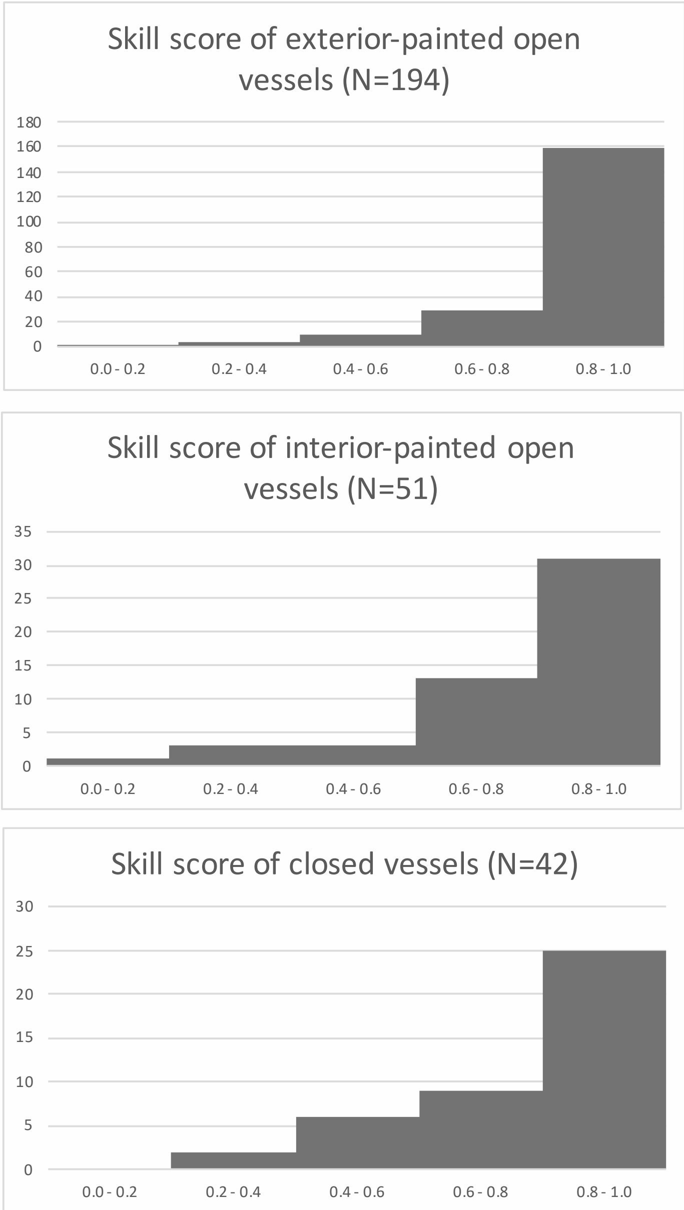


Figure 7.16 Histograms of skill scores of the published drawings in each vessel form at Tall-e Bakun A

The second example (A20116) was also mentioned in Fig. 7.7: 2 as a sample with the identical imprint of the "white-leaf" motif. This small vessel (rim diameter: 10 cm, vessel height: 5 cm) was found in Room 2 of Building III with the bottom sunken to the floor, where two beakers with "zigzag and boxes" motifs were also discovered. Vessels with the same vessel form and the same motifs have been reported.[22] There were two variations in the direction of the "white leaf" motif, clockwise and anti-clockwise. In addition, whereas the "white vertical bar" of A20116 connected to "white leaf" at the lower right side of the bottom, that of A20173 did not. In that point, the

[21] Herzfeld 1932, Tafel XV: 3; Langsdorff and McCown 1942: Pl. 4: 10; 71: 1, 3, 5, 7, 12, 15; 72: 7-10, 12; Alizadeh 2006: Fig. 25: A, D, E; 26: B, C.

[22] Fig. 8.24: A20173; Herzfeld 1932: Tafel XV: 2; Langsdorff and McCown 1942: Pl. 62: 1-2, 7; Alizadeh 2006: Fig. 24: E, G.

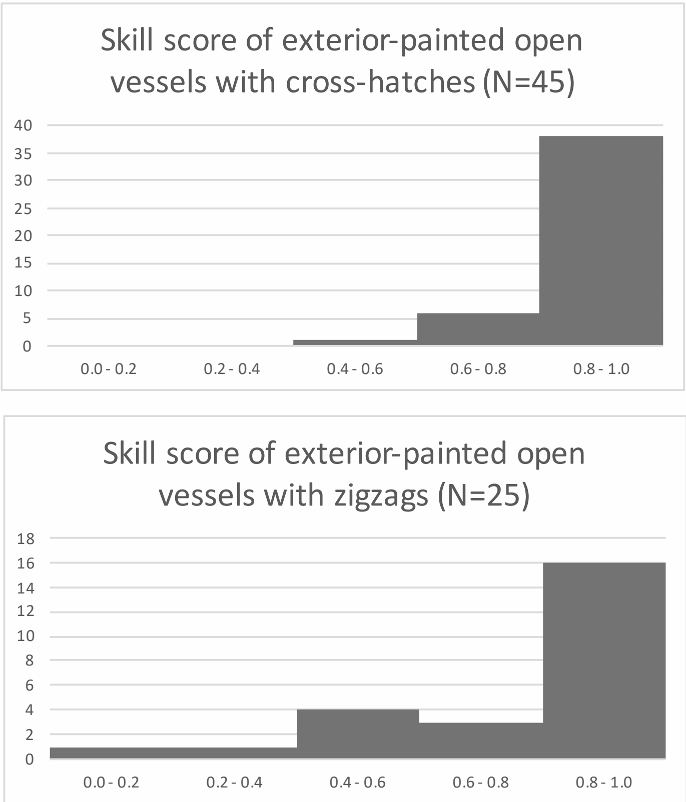


Figure 7.17 Histograms of skill scores of the published drawings with cross-hatches motifs (upper) and zigzags motifs (lower) at Tall-e Bakun A

most similar one among the published examples is Tafel XV: 2 in the work of Herzfeld (1932), although the pattern of dots on the white leaf is different. As these observations show, the qualitative description supplements the quantitative skill score analysis.

In summary, the analyses of technical skill at Tall-e Bakun A clarified three points:

1) The skill score analysis of complete vessels with an identical motif (zigzags and boxes motif) demonstrated the skill difference in the community of pottery-making. Furthermore, the nature of error (lack of experience, lack of attention) can be discussed by taking a closer look.
2) According to the skill score analysis of published drawings from Tall-e Bakun A, the majority of vessels were painted skilfully at this site.
3) The presence of badly painted small pottery suggests forming and painting by an apprentice. The comparison of skilfully made vessels with identical motifs contributes to understanding the painting practice.

7-2. Pottery-making techniques of ceramic materials curated at UMUT

The frameworks for the analysis of technical traces were established in the previous section as examples of well-preserved ceramics and diagnostic sherds from Tall-e Bakun A. In this section, the application of these frameworks will be extended to the more limited ceramic collection curated at the University Museum, the University of Tokyo (UMUT). Although it is impossible for the pottery-making techniques of each collection to be approached to the same extent

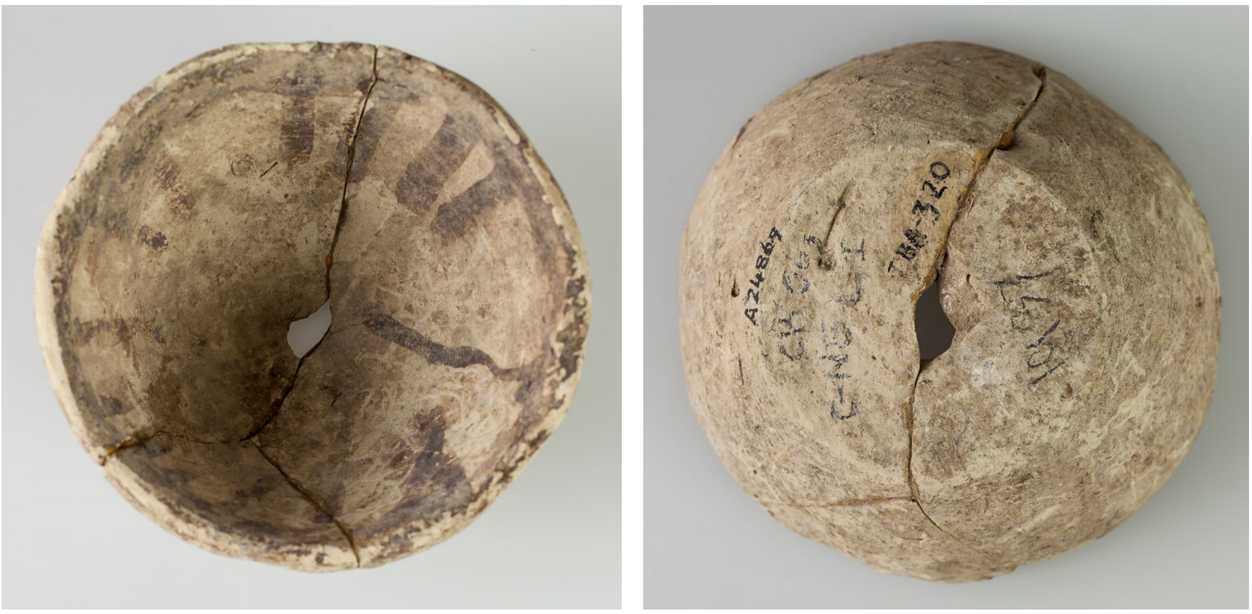


Figure 7.18 A possible work of an apprentice (A24869) found at Tall-e Bakun A (Photo by OIC. Courtesy of the Oriental Institute of the University of Chicago)

Figure 7.19 The evidence of VCW smoothing technique and clay coating: a VCW vessel (Cat. 6.5: 6) at Tall-e Jari A (Photo by Miki)

as in the previous section, below, I will mainly discuss the diagnostic sherds showing technical traces. In a chronological order, I will start by explaining pottery-making techniques at Tall-e Jari A and proceed to those at Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A.

Pottery-making techniques at Tall-e Jari A

I observed the same number of potsherds for the technical traces at Tall-e Jari A as the materials used in Chapter 6 (2031 sherds) (Appendix Tables A5.2-6). In addition, 20 diagnostic sherds from the other trenches presented in Chapter 6 were added. Among them, 13 vessels were examined as well-preserved diagnostic vessels for which all technical steps were described.

Analysis of the chaîne opératoire at Tall-e Jari A

1) Forming

Forming of BOBW at Tall-e Jari A

Well-preserved BOBW vessels from Tall-e Jari A showed the coiling technique (Cats. 6.1: 2). One exceptional example showed the joining of a shallow bowl and a perforated pedestal.[23] Two technical options existed for the technical step to joining the vessel and the pedestal:

1) form the pedestal, pile up the coils of clay, and then form the shallow bowl, or
2) form the pedestal and the vessel separately, then join them together.

[23] Vanden Berghe 1952: Pl. XLIX.

In the latter case, the potter must have been careful to make base the same size as the top of the pedestal.

Forming of VCW at Tall-e Jari A

The majority of well-preserved vegetal-tempered coarse ware (VCW) vessels from Tall-e Jari A were found on Level II (the Shamsabad period). Although they did not actually belong to the Bakun period, I will explain their forming techniques. One large VCW vessel drawing presents a clear example of "sequential slab construction",[24] whereas two VCW potsherds show the coiling technique.[25] To determine the forming technique of VCW, nine diagnostic sherds were picked up from the publication. One was a rectangular vase,[26] and two show the technique of attaching knob appliqués and vertical wavy line appliqués.[27] One example had a horizontal band appliqué (Cat. 6.5: 2). Four examples were published as the vessels with a basket impression on their interiors,[28] suggesting that the forming activities were supported by baskets.

2) Surface treatment, applying slip, and decorating

Surface treatment and applying slip at Tall-e Jari A

Here, I will focus on the surface treatment technique and applying slip application of the well-preserved vessels. First, the interior surfaces of well-preserved BOBW vessels were dominated by horizontal smoothing.

[24] Egami et al. 1977 Pl. IV:11.
[25] Egami et al. 1977 Pl. IV:12-13.
[26] Egami et al. 1977 Pl. IV:1.
[27] Egami et al. 1977 Pl. IV:1-2.
[28] Egami et al. 1977 Pl. IV:5-8.

The exterior surfaces had more variables, not only horizontal smoothing (majority) but also diagonal and vertical smoothing and scraping. Second, one BOBW example showed the trace of vertical rows of horizontal grooves on the exterior surface of the interior-painted open vessel. The grooves were partly erased by the diagonal smoothing. The interval between grooves was very small (1 mm). The length of a groove would be more than 2.5 cm. Third, there is only one example of a reworked pottery scraper from Tall-e Jari A (Cat. 6.6: 2). The lower broken section was made the edge by reducing the interior surface of the edge. The edge (6.4 cm) was shorter than the handle. Fourth, the presence of slip was observed on all BOBW vessels. Fifth, VCW showed horizontal and diagonal smoothing on both surfaces (Fig. 7.19). As a surface finishing technique of VCW, clay coating using finer clay with less vegetal temper was also applied (Fig. 7.19).

Decorating: Vertically dividing the motif-units at Tall-e Jari A

Due to the lower number of well-preserved vessels with whole circumferences, it is very difficult to determine the number of motif-units at Tall-e Jari A. There are one vessel whose motif-units can be directly measured from the illustrations. The complete vessel in Egami et al. 1977 Pl. III:1 had four motif-units in its interior.

Concerning potsherds or published drawings that present one side of the ceramic materials, I estimated the number of motif-units in the following way. I first measured the angle of the arc that one motif unit occupied within the circumference (Fig. 7.20). Subsequently, I divided 360° (the angle of the whole circumference) by this angle, to calculate the estimated number of motif units. Please note that this estimate is a very rough method that assumes that the width of each motif unit is the same in the vessel and that the vessel's circumference is circular.

As a result, most of the estimated numbers of exterior-painted vessels at Tall-e Jari A had more than 12 motif units (12, 14, 20, and 42 motif units) and the motif-units were usually cross-hatched diamonds. As for the estimated number of motif units on the interior-painted vessels, more than seven motif units (8, 12, 15 motif units) were common at Tall-e Jari A, as represented by Vanden Berghe 1952: Pl. LIX-L showing possibly 15 male figures in its interior.

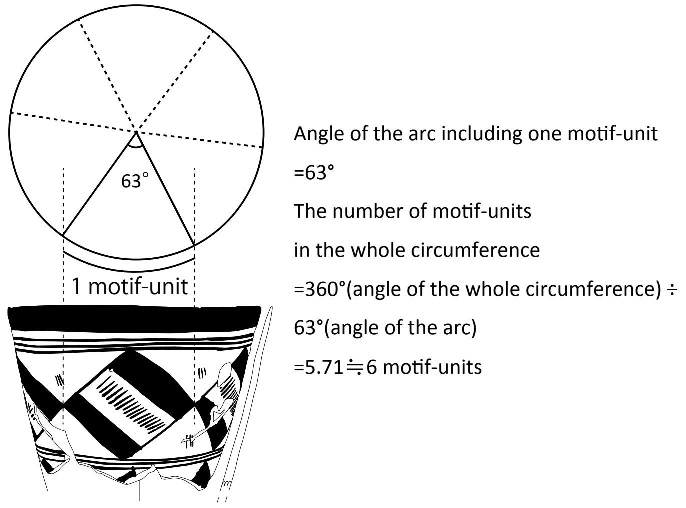


Figure 7.20 The method of estimating the number of motif units

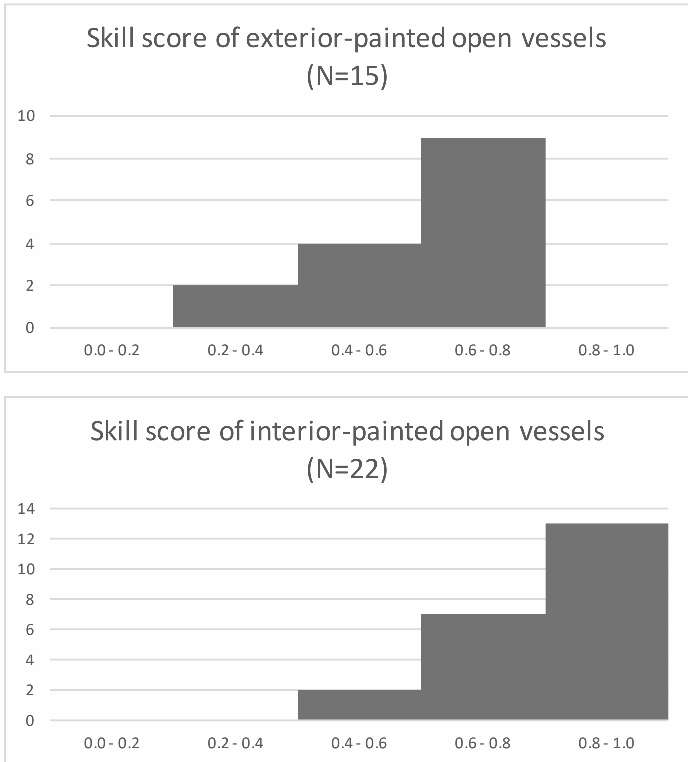


Figure 7.21 Histograms of skill scores of the published drawings in each vessel form at Tall-e Jari A

Skill score analysis and detailed observation

Skill score analysis at Tall-e Jari A

The ceramic materials from Tall-e Jari A used in Chapter 7 for the analysis of horizontal design structures were analysed again for the skill scores (15 exterior-painted open vessels and 22 interior-painted open vessels). I will present the table showing ratios of error samples and unmeasurable samples (Table 7.11) and the histogram of skill scores in each vessel form (Fig. 7.21).

Table 7.11 Number of published drawings used for skill score analysis, number of unmeasurable samples, ratio of unmeasurable samples, and error ratio of the measured samples for each variable in each vessel form at Tall-e Jari A

Vessel form		VD1) horizontal lines overlap	VD2) motif overlap	VD3) horizontal lines inconsistency	VD4) motif to horizontal lines overflow	VD5) motif overflow	VD6) paint drops
open vessel painted on its exterior	total number of samples (N)	15	15	15	15	15	15
	number of unmeasurable samples (N)	5	1	1	4	2	-
	ratio of unmeasurable samples (%)	33.33	6.67	6.67	26.67	13.33	-
	error ratio among the measured samples (%)	70.00	64.29	42.86	27.27	53.85	-
open vessel painted on its interior	total number of samples (N)	22	22	22	22	22	22
	number of unmeasurable samples (N)	15	2	4	18	10	-
	ratio of unmeasurable samples (%)	68.18	9.09	18.18	81.82	45.45	-
	error ratio among the measured samples (%)	0.00	20.00	22.22	50.00	8.33	-

Among the six VDs of exterior-painted open vessels, horizontal line/band overlap (VD1) showed a high ratio of unmeasurable samples (33%) (Table 7.11). Among the six skill attributes of the interior-painted open vessels, motif overflow to horizontal lines (VD4) (81.82 %), horizontal overlap (VD1)(68.18 %), and motif overflow (VD5) showed a high frequency of unmeasurable materials, which prevented the assessment of skill scores. As for the ratio of the presence of errors in the confirmed samples, horizontal line overlap (VD1) (70 %), motif line overlap (VD2) (64.29 %), motif line overflow (VD5) (53.85 %), and horizontal line inconsistency (VD4) (42.86 %) showed high frequency. In the histograms of skill scores (Fig. 7.21), the majority of skill scores of exterior-painted open vessels were in the range of 0.6 to 0.8, followed by 0.4 and 0.6. The distribution of skill scores of interior-painted open vessels showed a different pattern, in which 1.0 was predominant (13 samples: 59 % of the samples).

Detailed observation of the skilfully painted pottery

As indicated above, the high error rate was remarkable in the painting skills at Tall-e Jari A, especially for open vessels painted on the exterior. Here, I will present two exceptionally skilfully painted ceramic vessels found from burials, which were already introduced in Chapters 6.[29] These vessels did not show horizontal lines overlap. Surprisingly, at least 13 male figures drawn in Vanden Berghe 1952: Pl. XLIX show very slight fluctuation in their shapes. As explained above, one additional step was used in forming this vessel, implying the exceptional labour investment for this special vessel used as a burial good.

As a result of the macroscopic observation of ceramic materials from Tall-e Jari A, the chaîne opératoire and technical skills of pottery making at Tall-e Jari A were determined:

1) BOBW was formed using the coiling technique. One exception shows the joining of a pedestal to a shallow bowl. VCW was formed by coiling and sequential slab construction.
2) BOBW was basically horizontally smoothed and then covered with slip. Other evidence of surface treatment of BOBW was scarce. VCW was covered with finer clay and then smoothed. In the painting step, subdividing the design panel of BOBW into many motif-units was common.
3) Low-middle skill scores were predominant in exterior-painted open vessels. However, exceptionally skilful vessels found in burial contexts also existed.

Pottery-making techniques at Tall-e Bakun B

The number of potsherds I observed for the technical traces at Tall-e Bakun B was equals to that of the materials for the analysis of wares and vessel forms (329 sherds, Appendix Tables A5.3-7). In addition to the small sample size, there were few ceramic materials showing diagnostic traces of the pottery

[29] Vanden Berghe 1952: Pl. XLIX-L.

production techniques at Tall-e Bakun B. In this section, I will describe the diagnostic potsherds showing the technical steps of forming, surface treatment, and firing.

Analysis of the chaîne opératoire at Tall-e Bakun B

1) Forming and surface treatment

Forming of BOBW and VCW at Tall-e Bakun B

Although the direct evidence of the use of the coiling method for BOBW was not discovered, the coiling method was likely used at Tall-e Bakun B, as reported by Masuda.[30] One large jar neck sherd shows a succession of diagonal incision lines on the joint between its body part and its neck.[31] Masuda argued that these lines were incised in a leather-hard state to strengthen the joint. This trace is useful for determining the direct knowledge transfer of the forming step because no one can observe this trace except for the participants in the pottery making. Next, as suggested by the published drawings, VCW was formed using coiling and sequential slab construction at Tall-e Bakun B.[32] One of the flat base sherds of VCW at Tall-e Bakun B showed a line of horizontal incision at the joint between the body and base for the purpose of strengthening the joint.[33] Another sherd had a basket impression on its interior bottom, which the reporters described as "four concentric depressions".[34] These traces preserved in VCW show a different forming technique from that of BOBW.

Surface treatment of BOBW: grooves and reworked pottery scrapers

The surface treatment of BOBW vessels at Tall-e Bakun B was poorly known due to their badly preserved surfaces (because of erosion and secondary calcite). Only one tiny sherd with grooves on its exterior surface was discovered. Horizontal rows of diagonal and vertical grooves were confirmed. The intervals between the grooves were short (1-2 mm). The average length of one groove is 1-1.5 cm. In addition, three reworked pottery scrapers were found at Tall-e Bakun B: these were already published in 1962.[35] All the scrapers were made from the rim edge of the interior-painted open vessels. The length of the tip ranged from 4 to 7 cm (median: 4cm). The shape of the tip was convex (two samples) or straight (one sample).

2) Decorating

Vertically dividing the motif-units of BOBW at Tall-e Bakun B

The number of motif-units could barely be estimated at Tall-e Bakun B for only one vessel using the method that I proposed in 7-2-1-1. The vessel in Egami and Masuda 1962: Fig. 15: 1, with cross-hatched diamonds on its exterior surface, was estimated to have 15 motif-units.

3) Firing

Imprints on the surface of BOBW from Tall-e Bakun B

In spite of the small sample size of BOBW potsherds (188 potsherds curated in UMUT) from Tall-e Bakun B, eight diagnostic potsherds with imprints on either their inner or outer surfaces were discovered. Masuda also noticed the imprints and expressed them in the pottery drawing.[36] However, the rest of the imprints were misunderstood as the painting.[37] Furthermore, he thought that the imprints were a result not of the vaporization, but of erasing the painted lines before firing.[38]

Four imprints appeared on the inner surface of the exterior-painted open vessels.[39] The other three imprints were found on the outer surfaces of the interior-painted open vessels[40] and the last one was preserved on the inner surface of an interior-painted open vessel.[41] The inner-preserved and outer-preserved imprints were concentrated on the vessel bodies. One example was located on the interior bottom.[42] Large portions of the imprints indicated different motifs from those of the original paintings.[43] Two examples with the same/similar motif imprints as the original paintings were interior-painted open vessels.[44] The imprints from Tall-e Bakun B that were studied suggest the activity of piling up ceramic vessels inside a pottery kiln.

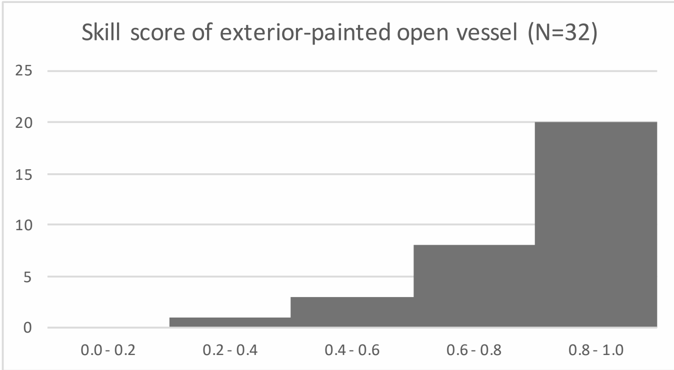
Skill score analysis

Thirty-two exterior-painted open vessel sherds and 11 interior-painted ones from Tall-e Bakun B were analysed for skill score analysis (Appendix Tables A5.8-10). The ratio of unmeasurable samples in each attribute of exterior-painted open vessels did not show high frequency, except for VD5 (motif line overflow) (40.63

[30] Egami and Masuda 1962: 24 in Japanese.
[31] Egami and Masuda 1962: Fig. 13:5, Pl.II:23.
[32] Egami and Masuda 1962: Fig. 19: 2 (coiling); Fig. 18: 8, 19: 6. (sequential slab construction).
[33] Egami and Masuda 1962: 28 in Japanese, Fig. 18: 29.
[34] Egami and Masuda 1962: Fig. 18: 32.
[35] Egami and Masuda 1962: Fig. 17: 4, 6, 8.
[36] Egami and Masuda 1962: 24-25 in Japanese, Fig. 15:11, 17:4.
[37] Egami and Masuda 1962: Fig. 16:14, 17:10.
[38] Egami and Masuda 1962: 24-25 in Japanese.
[39] Egami and Masuda 1962: Fig. 16:16.
[40] Egami and Masuda 1962: Fig. 17:4, 6.
[41] Egami and Masuda 1962: Fig. 17:10.
[42] Egami and Masuda 1962: Fig. 17:10.
[43] Egami and Masuda 1962: Fig. 17:10.
[44] Egami and Masuda 1962: Fig. 17:4, 6.

Table 7.12 Number of published drawings used for skill score analysis, number of unmeasurable samples, ratio of unmeasurable samples, and error ratio of the measured samples for each variable in each vessel form at Tall-e Bakun B

Vessel form		VD1) horizontal lines overlap	VD2) motif overlap	VD3) horizontal lines inconsistency	VD4) motif to horizontal lines overflow	VD5) motif overflow	VD6) paint drops
open vessel painted on its exterior	total number of samples (N)	32	32	32	32	32	32
	number of unmeasurable samples (N)	2	5	1	8	13	-
	ratio of unmeasurable samples (%)	6.25	15.63	3.13	25.00	40.63	-
	error ratio among the measured samples (%)	6.67	29.63	9.68	12.50	21.05	3.13
open vessel painted on its interior	total number of samples (N)	11	11	11	11	11	11
	number of unmeasurable samples (N)	7	5	3	8	6	-
	ratio of unmeasurable samples (%)	63.64	45.45	27.27	72.73	54.55	-
	error ratio among the measured samples (%)	0.00	66.67	0.00	0.00	20.00	-



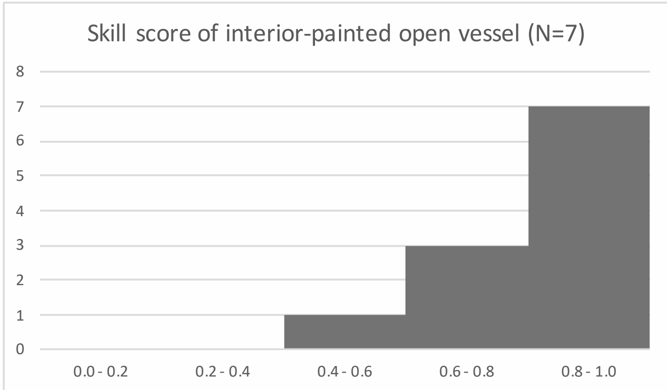


Figure 7.22 Histograms of skill scores of the published drawings in each vessel form at Tall-e Bakun B

%) (Table 7.12). The error ratio was remarkable in motif line overlap (VD2) (29.63%) and motif line overflow (VD5) (21.05 %). Interior-painted open vessels had more limits: only 11 samples could be measured for skill score analysis. Errors were observed in VD2 (66.67 %) and VD5 (20 %) in interior-painted open vessels. The histograms of tallied skill scores (Fig. 7.22) show a high ratio of 0.8-1.0 both in both exterior-painted open vessels (20 samples: 62.5 % of the total samples) and interior-painted open vessels (seven samples: 63.64 %), suggesting the predominance of highly skilled potters in the community of pottery making.

In summary, only a few diagnostic potsherds from Tall-e Bakun B showed the discoveries:

1) BOBW was possibly formed using the coiling technique. The incision on the neck joint of BOBW was an interesting discovery for the discussion of the community of pottery making. VCW was formed by coiling and sequential slab construction, incised to strengthen the joint, and supported by a basket.
2) In decorating, the exterior design panel of BOBW was subdivided into more than four motif-units. As many as eight imprint examples were discovered, despite the small sample size, providing indirect evidence of the activity of piling up ceramic vessels inside a pottery kiln.
3) The majority of both exterior- and interior-painted open vessels had high skill scores.

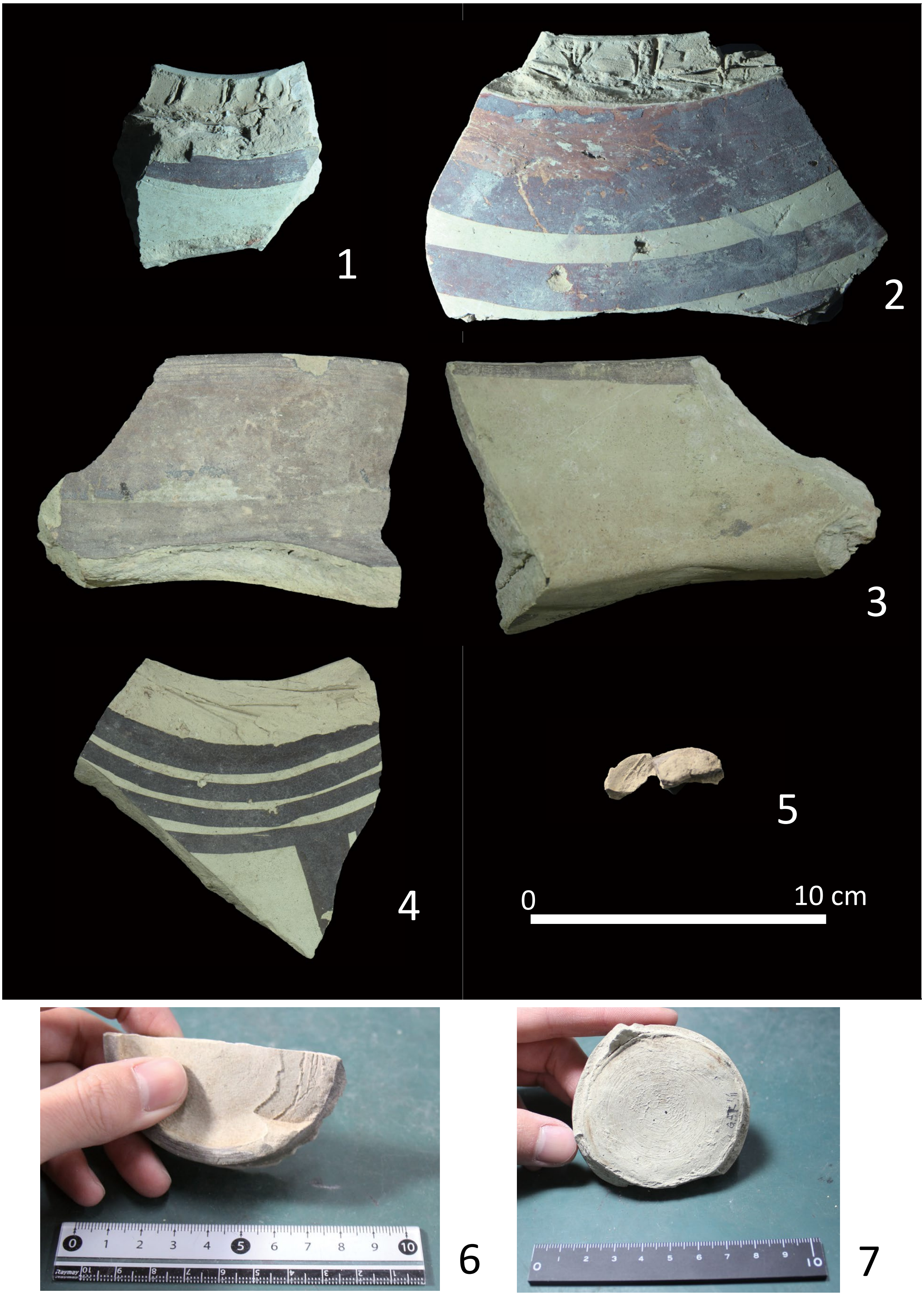


Figure 7.23 The evidence of BOBW forming technique: large jars showing traces of incision on their neck joints (1-5) and open vessels showing traces incision on their base joints (6-7) at Tall-e Gap (Photo by Miki)

Pottery-making techniques at Tall-e Gap

As Nishiaki published in 2003, there are still plenty of well-preserved vessels at UMUT.[45] However, these vessels were mainly restored with plaster and the original parts of these vessels were limited. Although 52 well-preserved vessels which preserved from their rims to their bases were published in the excavation report of Tall-e Gap, for a large portion of these materials, less than half of their circumferences was preserved. Few complete vessels were preserved 100%. The better-preserved published vessels were returned to Iran after the publication, and their replicas are now at UMUT. Hence, the well-preserved vessels at Tall-e Gap for the observation of technical traces are limited. For this observation, I chose 15 well-preserved materials from Squares GAT-1 and GAT-2 which were also used in Chapter 6 (4,269 potsherds) (Appendix Tables A5.2-7). In addition, I included 16 well-preserved materials from the other trenches. Diagnostic potsherds showing one distinctive trace of the pottery-making technique were also picked up from the other trenches.

Analysis of the chaîne opératoire at Tall-e Gap

1) Forming

Forming of BOBW at Tall-e Gap

Thirty-one well-preserved BOBW vessels were made using the coiling technique without a potter's wheel. Regarding forming techniques, incisions were preserved on the joints between the neck and body (Fig. 7.23: 1-4). Their purpose was possibly to strengthen the joints. As Fig. 7.23: 4 shows, the exterior top surface of the body was incised. In total, 11 large-jar joint examples were observed from the collection.[46] These diagnostic examples were found on the lower levels (Levels 17-12a). There were at least four types of incision patterns. The first type is shown in Fig. 7.23: 1 and 2 (combination of a horizontal-diagonal incision and short vertical incisions). The second type is a line of diagonal incisions (Fig. 7.23: 3). The third is the combination of a horizontal line and a line of diagonal incisions.

On the other hand, seven diagnostic base joint examples of BOBW (2 examples from Squares GAT-1, 2) were confirmed (Fig. 7.23: 5-7). The base joint examples were incised on their body sides. The incision pattern of base joints was simpler than that of large jar joint incisions, either one horizontal line (Fig. 7.23: 6) or a series of diagonal lines (Fig. 7.23: 5). Two examples had

Figure 7.24 The evidence of BOBW forming technique: a snake applique on the exterior-surface of a vessel at Tall-e Gap (Photo by Miki)

no trace of incision at the joint. Finally, one example showed that a disc-shaped clay was attached to the bottom and then the ring base was joined (Fig. 7.23: 7). There was one interesting example of a snake appliqué decoration found on Level 5b of Square GAI-5, 8 (Fig. 7.24). The snake was decorated with dots. The vessel to which the snake was attached had painted decoration on its interior. It might have been a variant of the ring base. These joint examples of necks, ring bases, and a snake provide a better understanding of BOBW forming techniques at Tall-e Gap.

Forming of VCW and MCW

As for VCW and MCW, clear evidence of sequential slab construction was not observed at Tall-e Gap. Both MCW and VCW showed evidence of clay coating (Fig. 7.25). Although the clay coating of VCW had the same fabric as the core, that of MCW were finer than the core fabric due to the absence of mineral temper. These samples were covered by clay on both surfaces. Like MCW potsherds at Tall-e Bakun A, two MCW examples with a cloth impression on their interiors were confirmed (Fig. 7.26). The example in Fig. 7.26: 1 had a trace of additional clay covering the cloth impression. The presence of coating clay implies that the interior surface of the core fabric was covered by cloth before coating clay was applied. This trace can also contribute to the analysis of the weaving technique of the cloths.

3) Surface treatment

Smoothing of BOBW, VCW, and MCW from Tall-e Gap

The observation results of the smoothing of 31 well-preserved vessels are presented in Table 7.13. The exterior surface had more variation than the interior surface in terms of the direction, the combination of directions, and the presence of scraping. Although there is only one large jar example, the surface of the large

[45] Nishiaki 2003.

[46] Among them, a group of four examples and another pair of two examples possibly derived from the same vessels according to the context and the painted decoration. if so, seven distinctive examples in total.

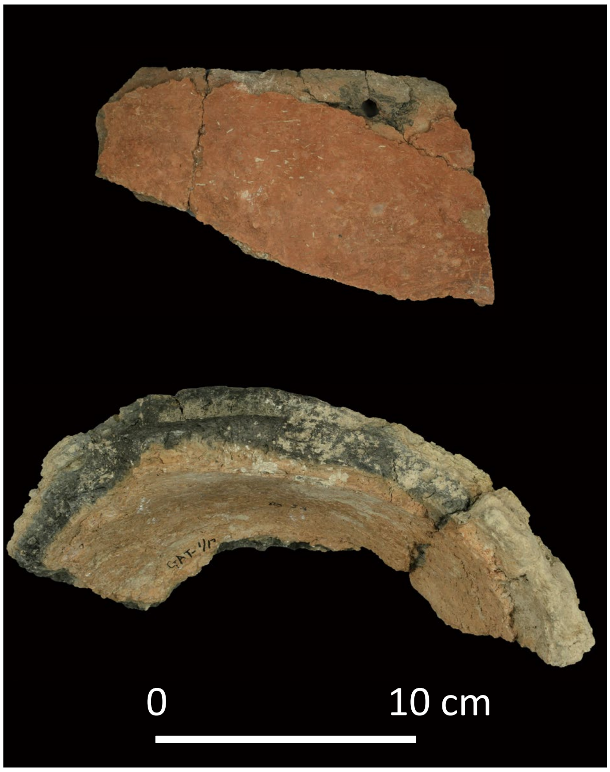


Figure 7.25 The evidence of the forming technique of MCW (upper) and VCW (lower): clay coating on their interior and exterior surfaces at Tall-e Gap (Photo by Miki)

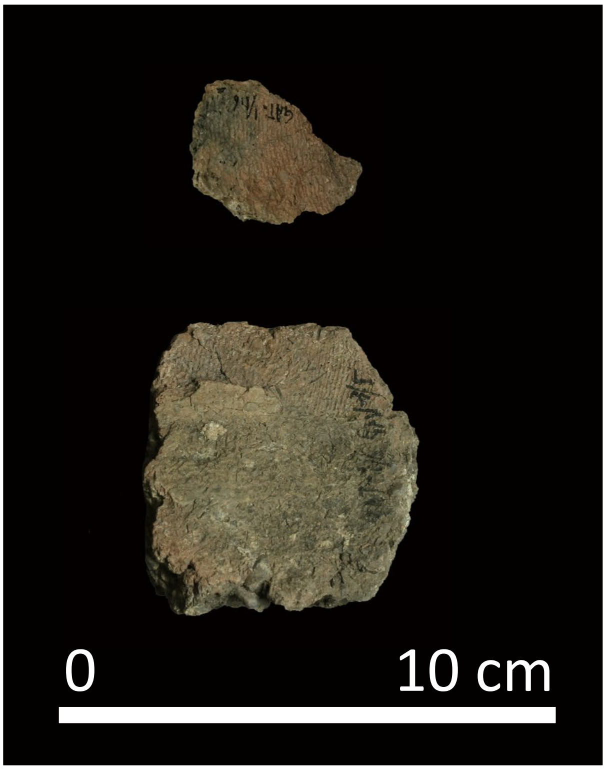


Figure 7.26 The evidence of MCW forming technique: the cloth impression on the interior surfaces of MCW potsherds at Tall-e Gap (Photo by Miki)

jar was more roughly smoothed than that of the open vessels. Four diagnostic large jar sherds showed clear traces of rough smoothing using tools on their interior surfaces, which were difficult to smooth neatly (Fig. 7.27). The surface treatment of MCW was smoothing or light burnishing (Fig. 7.25: upper). The surface of VCW was basically smoothed after clay coating.

Grooves on exterior surfaces

Fifteen cases (two pieces in Squares GAT-1 and 2) with traces of grooves were found at Tall-e Gap (Fig. 7.28). Large parts of the examples were confirmed on the surfaces of large jars (11 pieces). The rest were on open vessels painted on their interiors (four pieces). Most of the samples were confirmed on the levels above Level 12a. The grooves preserved on the surfaces of large jars were either horizontal rows of vertical grooves (seven pieces), diagonal rows of diagonal grooves (two pieces, Fig. 7.28: upper), or vertical rows of horizontal grooves (two). The length of grooves ranged from 1 to 5 cm (2.5 cm in median), and the intervals were between 2 and 6 mm (3 mm in median). On the other hand, horizontal rows of diagonal (two pieces) and vertical grooves (one piece, Fig. 7.28: lower) and diagonal rows of diagonal grooves (one piece) were confirmed on the exterior surfaces of the interior-painted open vessels. The lengths of grooves were between 1 and 4 cm (1.75 cm in median), and the intervals were between 2 and 4 mm (2.25 mm in median). Horizontal rows of vertical and diagonal grooves were preferred at Tall-e Gap. The length and interval of grooves on the large jars were larger than those on the interior-painted open vessels. It is likely that this size difference was due to the use of different types of tools. The examples in Fig. 7.28 also show that the grooves were superimposed by smoothing and scraping, implying that adding grooves to the surfaces preceded the technical steps of smoothing and scraping.

Reworked pottery scrapers from Tall-e Gap

Reworked pottery scrapers, indirect markers of the surface treatment, were observed on all levels of Tall-e Gap (in total 24 samples, nine samples from Squares GAT-1 and 2) (Fig. 7.29). The scraper blades were usually formed from rim parts (17 samples) or broken body parts (seven samples). Below Level 10, the makers of reworked pottery scrapers chose the rim parts as the blades. Broken body parts as scraper blades were predominant on the upper levels. The lengths of the blade ranged from 4 to 11 cm. The median was 7 cm. Both straight (ten samples) and convex blade shapes (14 samples) existed at Tall-e Gap. Finally, the interior-painted open vessels were preferred as the source for the reworked pottery scrapers at Tall-e Gap (18 samples). Exterior-painted open vessels and large jars (three samples each) were the minority.

Table 7.13 Directions and types of smoothing and scraping on exterior surfaces (upper) and interior surfaces (lower) of the well-preserved BOBW vessels at Tall-e Gap

direction of smoothing on interior surfaces	open vessel	large jar	Total
horizontally smoothed	19	-	19
horizontally smoothed or scraped	1	-	1
roughly horizontally smoothed	3	-	3
smoothed	3	-	3
finely smoothed	1	-	1
Upper: diagonally smoothed, Middle: horizontally smoothed, Lower: vertically smoothed	1	-	1
Upper: horizontally smoothed, Lower: roughly smoothed	1	1	2
covered by calcium	1	-	1
Total	30	1	31

direction of smoothing on exterior surfaces	open vessel	large jar	Total
horizontally smoothed	6	-	6
horizontally and diagonally smoothed	1	-	1
horizontally and vertically smoothed	1	-	1
finely horizontally smoothed	1	-	1
horizontally smoothed or scraped	1	-	1
roughly horizontally smoothed or scraped	1	-	1
diagonally smoothed	1	-	1
vertically smoothed	3	-	3
smoothed	6	-	6
Upper-Middle: diagonally smoothed, Lower: horizontally smoothed	1	-	1
Upper: horizontally smoothed, Lower: diagonally scraped	3	-	3
Upper: horizontally smoothed, Middle: diagonally scraped	1	-	1
Upper: horizontally smoothed, Middle: diagonally smoothed	3	-	3
Upper: horizontally smoothed, Lower: diagonally smoothed or scraped	1	-	1
Neck: horizontally smoothed, Body: roughly diagonally smoothed and scraped	-	1	1
Total	30	1	31

4) Applying slip to BOBW

Although the macroscopic recognition of the presence of slipping was difficult, analysis of 31 well-preserved vessels indicated that most of the observed vessels were covered with slip on both their interior and exterior surfaces. Three exceptional cases without slip were found: the interior surface of an exterior-painted open vessel, a large jar, and the exterior surface of an interior-painted open vessel. This implies that unpainted surfaces were sometimes not covered by slip.

5) Decorating

Vertically dividing motif-units at Tall-e Gap

Only 13 vessels were sufficiently well-preserved to identify the number of motif-units (Table 7.14: upper, all interior-painted open vessels). For that reason, the estimate of the number of motif-units was based on 46 partially preserved vessels. The procedure of estimation from published drawings was the same as those at Tall-e Jari A and Tall-e Bakun B.

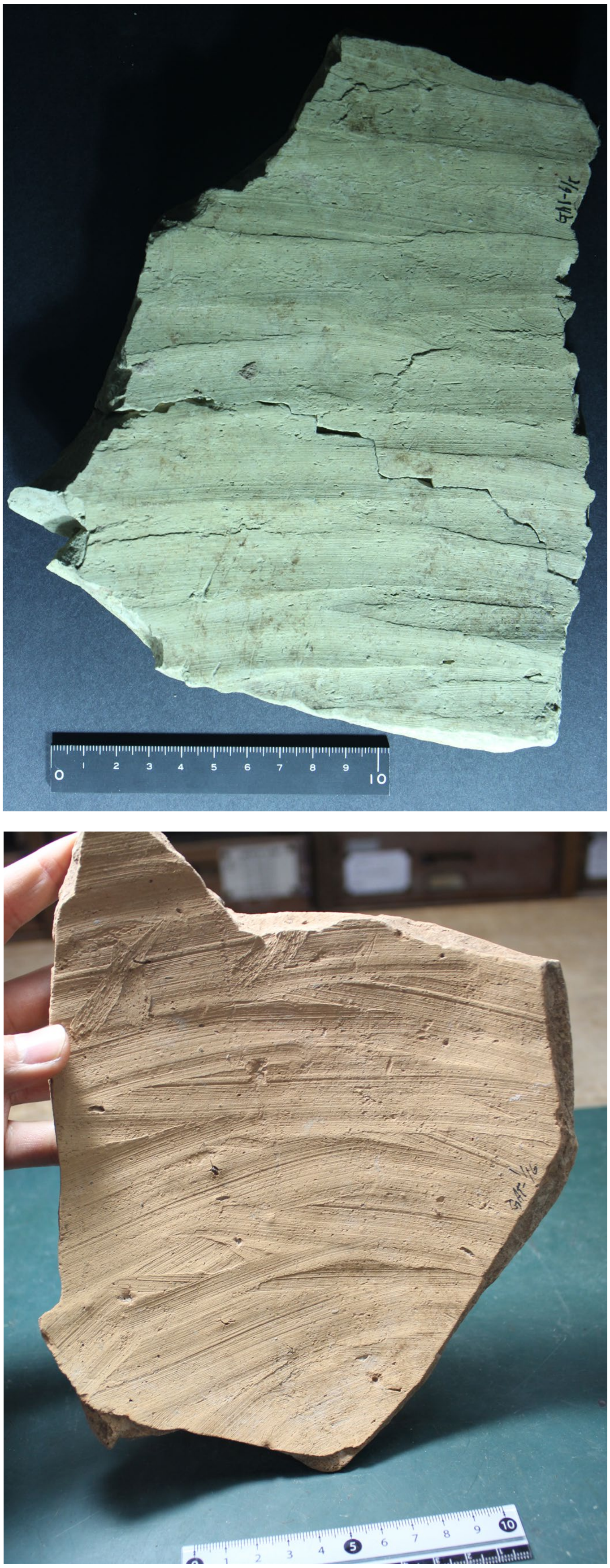


Figure 7.27 The evidence of BOBW surface treatment technique: rough smoothing using tools on the interior surfaces of large jars at Tall-e Gap (Photo by Miki)

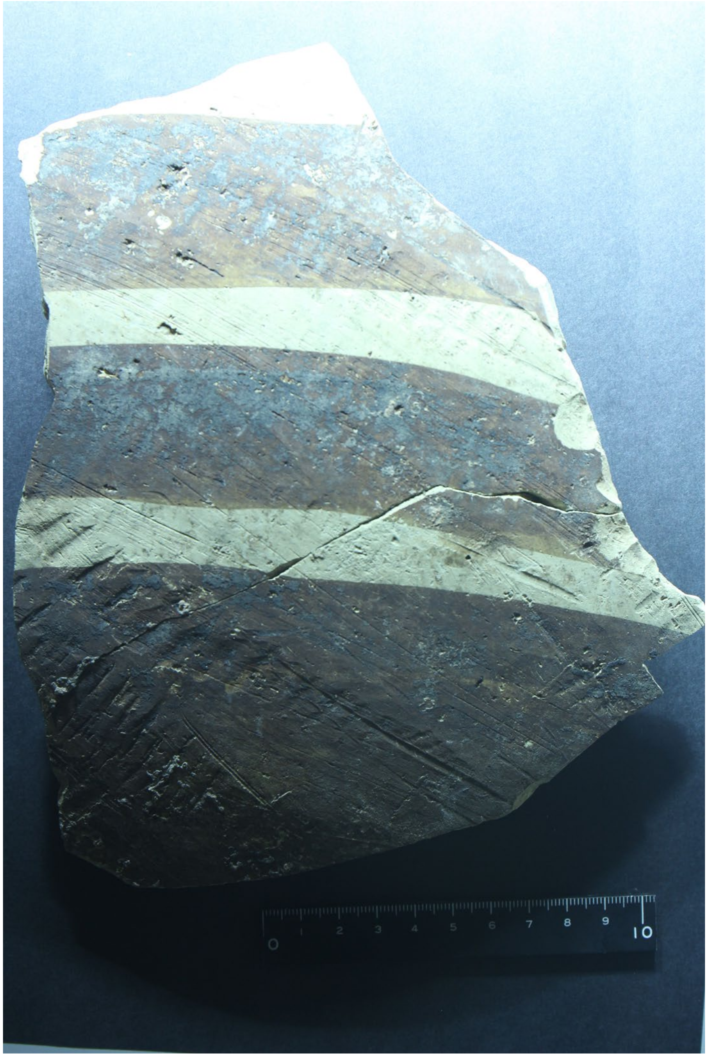


Figure 7.28 The evidence of BOBW surface treatment technique: diagonal rows of diagonal grooves on an large jar (upper) and horizontal rows of vertical grooves on an open vessel (lower) at Tall-e Gap. Red circles show the superimposition of smoothing and scraping on the grooves (Photo by Miki)

Table 7.14 The cross-tabulations between confirmed and estimated numbers of motif-units and vessel forms at Tall-e Gap

Number of motif units counted from well-preserved vessels	2 motif units	3 motif units	4 motif units
open vessel painted on its interior	6	1	6

Number of motif units estimated from drawings	2 motif units	3 motif units	4 motif units	5 motif units	6 motif units	7 motif units	8 motif units	9 motif units	10 motif units	11 motif units	12 motif units	13 motif units	more than 13 motif units
open vessel painted on its exterior	1	4	6	1	4	6	10	1	3	2	3	-	3
open vessel painted on its interior	-	1	3	1	1	-	-	-	-	-	-	-	-

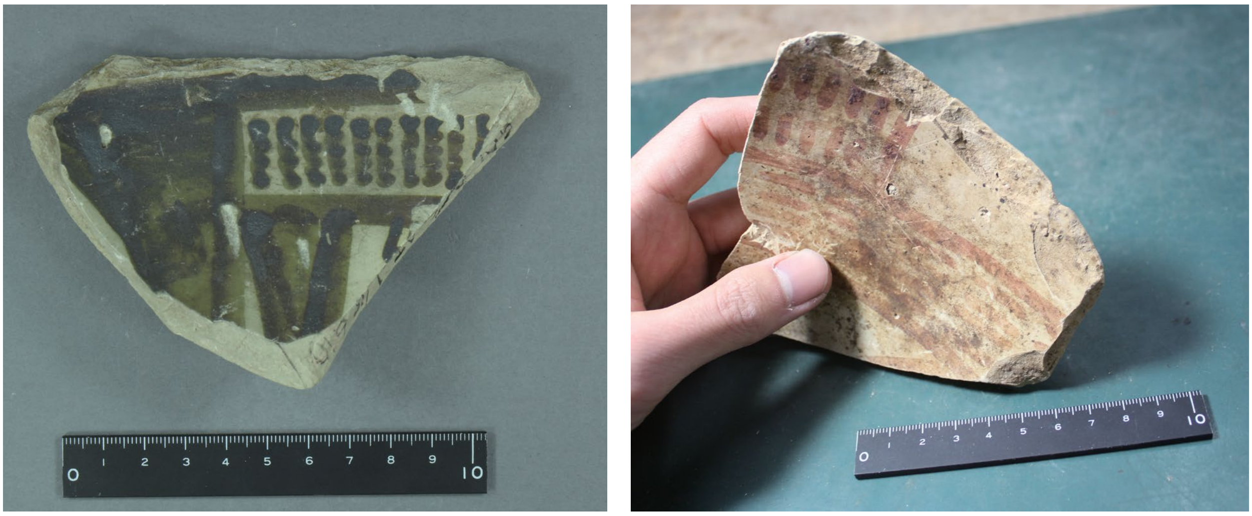


Figure 7.29 The evidence of BOBW surface treatment technique: reworked pottery scrapers at Tall-e Gap (Photo by Miki)

Table 7.15 Vessel forms (A), preserved surfaces (B), location (C), stylistic component (D), and stylistic relationship with original motifs (E) of imprints at Tall-e Gap.

A, B) Vessel form/ preserved surface of imprint	outer surface	inner surface	Total
open vessel painted on its exterior	-	49	49
open vessel painted on its interior	29	6	35
open vessel painted on its both sides	-	1	1
unpainted part of open vessel	1	3	4
large jar	1	-	1
Total	31	59	90

C) Location of imprint	Total
rim	8
rim - body	2
body	59
body, ring base	1
bottom	13
flat base	2
ring base	5
Total	90

D) Stylistic omponent of imprint	Total
motif, horizontal design structure	15
horizontal design structure	22
motif	53
Total	90

E) Decoration-Imprint stylistic relationship	Total
a) same motif, horizontal design structure	1
b) same motif	2
c) similar motif, horizontal design structure	3
d) similar motif	4
e) different motif, horizontal design structure	9
f) different motif	31
g) different horizontal design structure	1
h) insufficient data	39
Total	90

The frequent estimated numbers of motif-units on the exterior-painted open vessels were eight (ten cases), four, seven (six cases), three, and six (four cases) (Table 7.14: lower). Although more than ten motif-units were observed on some vessels (eight samples), they were the minority. The exterior-painted motifs on the vessels with more than four motif units were generally cross-hatched diamonds, rectangles, and triangles. The frequent motifs of the vessels with three motif-units were "zigzags and boxes" (four cases).

On the other hand, the most frequent counted number of motif-units on the interior-painted open vessels was two and four (six samples, Table 7.14: upper). The most frequent estimated number of motif-units on the interior-painted open vessels was four (three samples, Table 7.14: lower), followed by three, five, and six (one sample). While the hanged vertical lines and horizontal lines (Cat. 6.19: 1, 2)

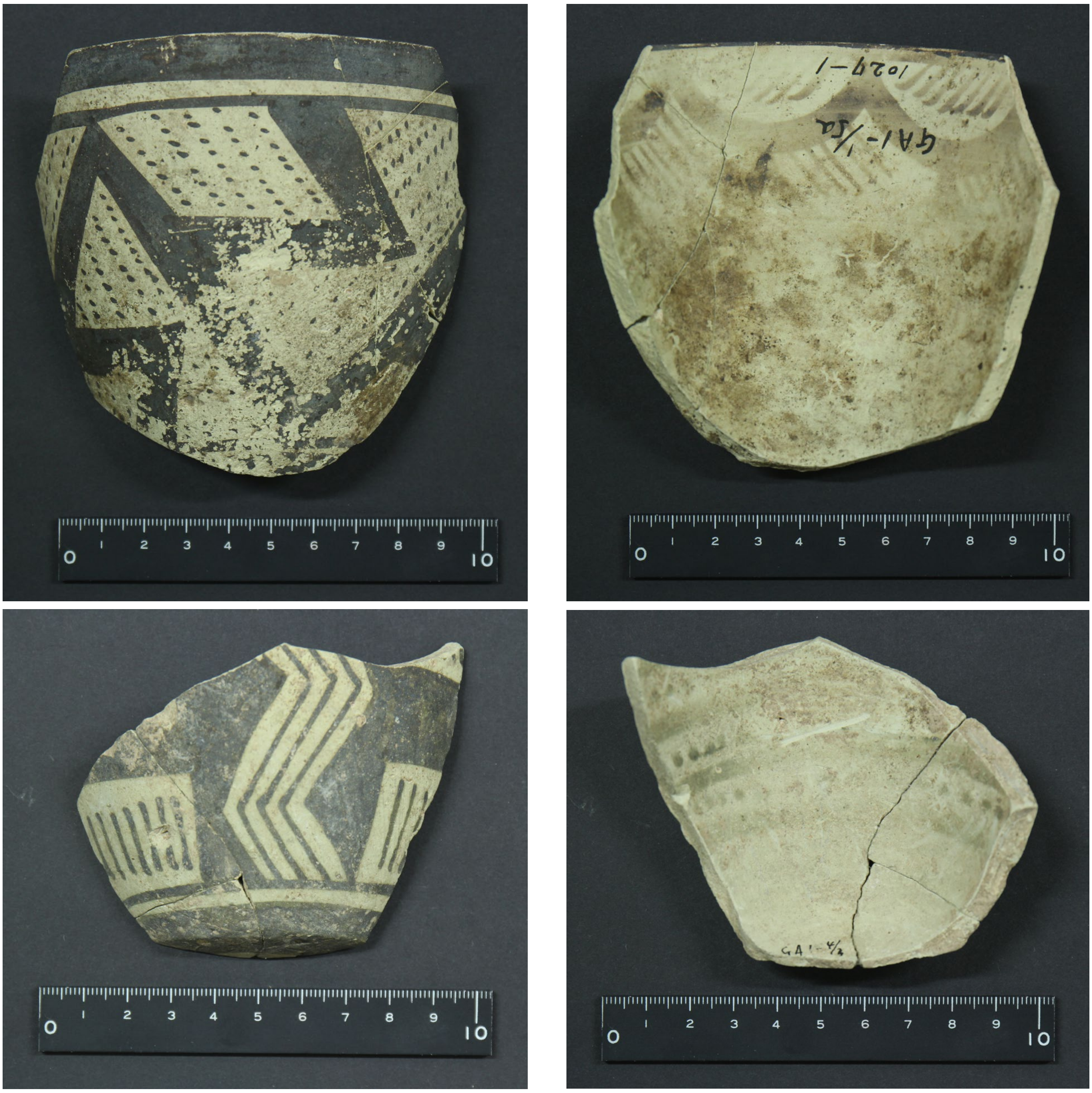


Figure 7.30 The evidence of BOBW firing technique: imprints on the inner surfaces of vessels at Tall-e Gap (Photo by Miki)

constituted the majority of interior-painted motifs, with three and four motif-units, there were generally two motif-units of a combination of wavy lines and triangles. In terms of the specific number of motif-units at Tall-e Gap, two and four was preferred, implying the regulation of the number of motif-units.

6) Firing

Imprints from Tall-e Gap

In total, 90 pieces of potsherds with imprints (10 samples from Squares GAT-1 and 11 samples from GAT-2) were discovered at Tall-e Gap (Figs. 7.30). These samples account for only 0.4 % of the ceramic materials at Square GAT-1 and for 0.7 % of those at GAT-2. Below, as was the case with Tall-e Bakun A, I will explain A) vessel form, B) preserved surface, C) location, D) stylistic component, and E) relationship with the original motifs.

A and B) As for vessel forms, 49 exterior-painted open vessels and 35 interior-painted open vessels with imprints were discovered (Table 7.15: A and B). Regarding preserved surface of the imprints, the imprints preserved on the inner surfaces belonged to exterior-painted open vessels and those preserved on the outer surfaces usually belonged to interior-painted ones (29 samples). This suggests that it was common to pile up the open vessels painted on the same side together. However, six inner-preserved imprints were also discovered on the interior-painted open vessels. The opposite situation (outer-preserved imprints on the exterior-painted open vessels) never happened.

C) Concerning the location of the imprints, both the inner-preserved and the outer-preserved imprints were generally preserved on the bodies (Table 7.15: C). Ten imprints were located near the rims (Fig. 7.30), suggesting that the imprinted vessels were stacked on the smaller vessels or that the larger vessels were stacked on the imprinted vessels. On the other hand, 13 base-band imprints preserved on the interior bottoms, which indicates that the same-size or smaller vessels which could reach the bottom were stacked on the imprinted vessels. Finally, the presence of the imprints on the exterior surface of a large jar base means that the large jar was not fired in the upright position in a pottery kiln (Fig. 7.30: bottom).

D) Motif (53 examples) was predominant in the stylistic components of imprints at Tall-e Gap (Table 7.15: D). Imprints with both motif and horizontal design structure (15 examples) were observed.

E) After the stylistic components of imprints were compared with the original decoration (Table 7.15: E), nearly half of the samples (39 samples) were classified as having h) insufficient data. The rest of the examples in many cases had e) different motifs + horizontal design structure (nine samples) and f) different motifs (31 samples). Imprints with the same motif/motif + horizontal design structure as the original decoration (a,b) (three samples) were as rare as the imprints similar to the original motif/motif + design structure (c, d) (seven samples).

The observation of technical traces preserved on the pottery from Tall-e Gap is summarised below:

1) Aside from the traces showing the coiling technique of BOBW, joints with incisions were observed. Although the forming technique of MCW and VCW (SSC or coiling?) was not clear, covering with cloth and then coating clay was confirmed.
2) Grooves, traces of scraping with tools, and paddling were preferentially confirmed on the surfaces of large jars. Interior-painted reworked pottery scraper was preferred.
3) In subdividing the design panels of BOBW, a specific number, especially, two, three, and four, was preferred.
4) Detailed observation of 90 samples with imprints suggested that the open vessels which were painted on the same side and had different motifs were piled up together.

Skill score analysis and detailed observation at Tall-e Gap

Skill score analysis at Tall-e Gap

The ceramic materials from Tall-e Gap used in Chapter 7 (75 exterior-painted open vessels, 61 interior-painted open vessels, Appendix Tables A5.8-10) were also used for the evaluation of skill scores (Table 7.16). The ratio of unmeasurable samples was high only for VD5 of exterior-painted open vessels (41.33 %). The error ratio was remarkable for VD2 (23.19 %) and VD4 (20.45 %) but generally low. In contrast, the skill parameters of interior-painted open vessels (VD1, VD4, VD5) had a very high ratio of unmeasurable samples due to the characteristics of motifs and the absence of horizontal design structures. Although there was such a bias, the error ratio was high for VD1, VD2, and VD5 (33.33, 21.43, and 14.29 %).

Regarding the distribution of skill scores for the exterior-painted open vessels (Fig. 7.31: upper), a score of 0.8-1.0 accounted for about 75% and lower scores were the minority. The skill distribution pattern of the interior-painted open vessels showed a similar pattern to that of the exterior-painted ones (Fig. 7.31: lower). The ceramic vessels with specific motifs were extracted and analysed again (Fig. 7.32). The histogram of the skill scores of the open vessels with zigzags showed a higher

Table 7.16 Number of published drawings used for skill score analysis, number of unmeasurable samples, ratio of unmeasurable samples, and error ratio of the measured samples for each variable in each vessel form at Tall-e Gap

Vessel form		VD1) horizontal lines overlap	VD2) motif overlap	VD3) horizontal lines inconsistency	VD4) motif to horizontal lines overflow	VD5) motif overflow	VD6) paint drops
open vessel painted on its exterior	total number of samples (N)	75	75	75	75	75	75
	number of unmeasurable samples (N)	5	6	4	11	31	1
	ratio of unmeasurable samples (%)	6.67	8.00	5.33	14.67	41.33	1.33
	error ratio among the measured samples (%)	4.29	23.19	2.82	14.06	20.45	5.41
open vessel painted on its interior	total number of samples (N)	61	61	61	61	61	61
	number of unmeasurable samples (N)	58	5	2	57	54	0
	ratio of unmeasurable samples (%)	95.08	8.20	3.28	93.44	88.52	0.00
	error ratio among the measured samples (%)	33.33	21.43	3.39	0.00	14.29	3.28

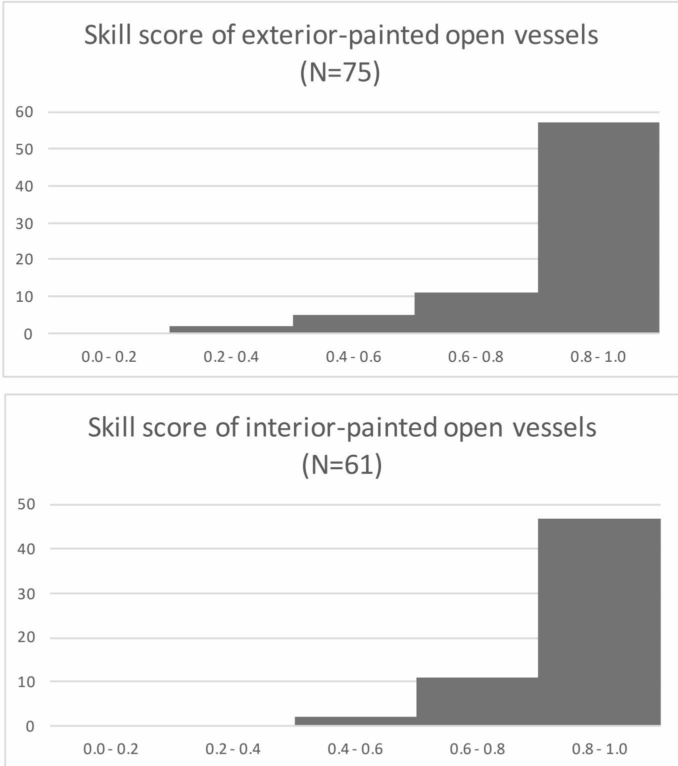


Figure 7.31 Histograms of skill scores of the published drawings in each vessel form at Tall-e Gap (Photo by Miki)

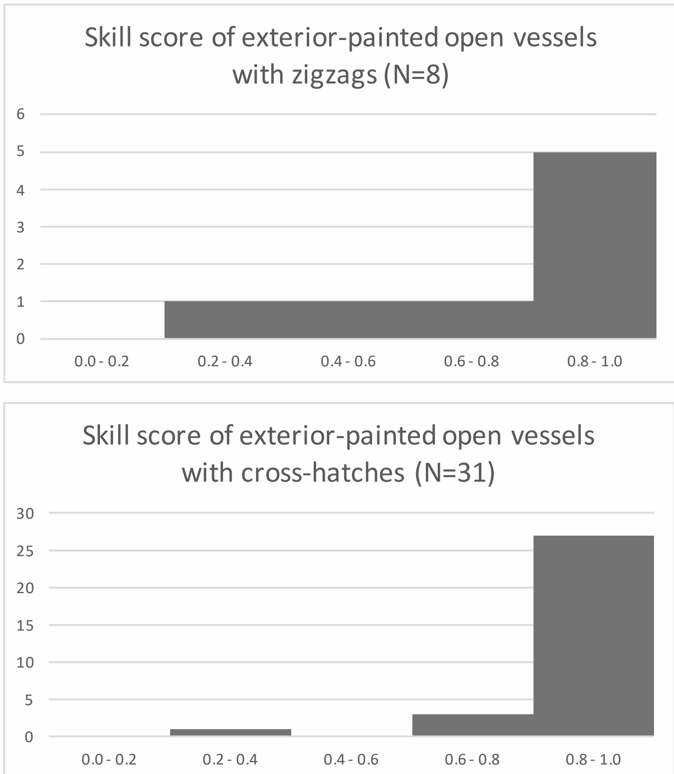


Figure 7.32 Histograms of skill scores of the published drawings with zigzags motifs (upper) and cross-hatches motifs (lower) at Tall-e Gap

Figure 7.33 A possible work of an apprentice (Cat. 6.20: 1) found at Tall-e Gap (Photo by Miki)

proportion of lower scores (0.2-0.8, four samples: 44.44 % of the samples with zigzags) (Fig. 7.32 upper). On the other hand, the histogram of the skill scores of the open vessels with cross-hatches on the exterior was similar to that of the total of all analysed vessels (Fig. 7.32: lower). Thus, a high skill score was predominant at Tall-e Gap except for the samples with zigzags.

Detailed observation of badly painted pottery from Tall-e Gap

I will also describe qualitatively diagnostic examples of the painters' skills. First, there was one small vessel which was formed, smoothed, and painted in an unskilled way (Cat. 6.20: 1; Fig. 7.33). The bottom was much thicker than the body. The interior surface was smoothed and slipped. However, the exterior surface was roughly smoothed by fingers and not slipped. At least two vertical wavy lines were drawn from the rim band to the bottom in its inner surface. Finally, an imprint was preserved on the lower part of the exterior surface. The vessel's appearance is different from that of the other small shallow bowls (Cat. 6.19: 1,2), which have vertical-horizontal straight painted lines.[47] This vessel was likely to be an apprentice's work, like the work from Rahmatabad.

Second, there were a few better-preserved examples with identical complex motifs, which can contribute to the study of skill difference (Cat. 6.27:1-2). Both horizontal design structures consist of one rim band, two upper optional lines, and three frieze division lines. In addition, the diamonds and three small diagonal lines between the diamonds were the same. The painting skill of the lower one's motif (Cat. 6.27: 2) was superior to that of the upper one (Cat. 6.27: 1) in symmetricity and short line strokes. The techniques of forming (the stable thickness of the vessel wall), surface treatment (absence of rough smoothing), and slipping (evenly applied) of the lower vessel were also better than those of the upper one, coinciding with the painting skill. The upper one was found at Level 2 of Square GAI-4 and the lower one was from Level 4 of Square GAEI, which is next to GAI-4. The spatial and temporal (a bit older, though) proximity of the two vessels is remarkable. The lower one's being older than the upper one suggests either that 1) the identical painter could make the vessels better when he or she was young, but his or her skill had declined when the painter tried the identical motif again, or 2) a master painter made the better one, and later an apprentice of the painter attempted to make an identical one.

Another pair of the vessels with the identical motifs were already published by Sono.[48] These are interior-painted shallow bowls with flat bases: one is complete, and another is half-preserved. The motif featured concentric lines on the inner body and a central design consisting of four triangles and one rectangle on the inner bottom. At first, these vessels showed a clear difference in size. The smaller one was inferior to the larger one in forming and surface treatment. While the larger one had two inner concentric lines, the smaller one had no concentric lines. The poor painting skill of the smaller one was clear in the motif's off-centring on the bottom. Furthermore, on the smaller one's interior, the base band overlapped the rim band. Interestingly, while the skilled example was unearthed from Level 10 of Square GAT-1, the poor-skilled one was discovered in Level 4 of Square GAI-1, spatially and temporally distant. When the calculation of the average duration of one level (22.5 years) was applied, the temporal interval between the two vessels was more than 100 years. Using this reasoning suggests that the motif continued to be transmitted within the pottery-making communities during that period, although other well-preserved vessels with an identical motif have not been discovered yet between Level 10 and Level 4.

[47] Egami and Sono 1962: Fig. 26.

[48] Egami and Sono 1962: Pl. 28: 2; Fig. 30: 2, 5; Nishiaki 2003: Pls. 50, 78.

The analysis concerning painting skill at Tall-e Gap indicates the following results:

1) The histogram of skill scores at Tall-e Gap shows predominance of high scores (0.8-1.0).
2) The work of a possible apprentice was observed at Tall-e Gap.
3) The ceramic vessels with identical motifs demonstrate a clear difference in painting skill and the transmission process of the motif.

7-3. Discussion: diachronic change of the pottery-making techniques

Above I described the steps of the chaîne opératoire and technical skill of the pottery-making techniques at each site (Tall-e Bakun A, Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap) separately. In this discussion, I will conduct an inter-site comparison of the pottery-making techniques. In the first part, the chaîne opératoires of 1) forming, 2) surface treatment, 3) applying slip, 4) decorating, and 5) firing will be compared between sites. In the second part, the proportion of skilfully painted pottery or works of apprentices within the ceramic assemblages will be compared between sites using the results from the skill score analysis and qualitative observation.

Diachronic change of the chaînes opératoires

1) Forming

Forming of BOBW

Coiling without a potter's wheel and attaching a ring base and a neck continue to be used as a basic forming technique from the beginning to the end of the Bakun period. The forming technique of BOBW remained stable over time. However, when specific vessels were formed, minor technical steps were added into the basic forming step, such as joining a vessel to a pedestal at Tall-e Jari A and intermittent coiling for forming a large jar and joining a funnel-shaped base to a vessel at Tall-e Bakun A.

Forming of VCW

Forming techniques of VCW consisted of coiling or sequential slab construction and a subsequent clay coating at all the sties. The confirmed presence of a basket impressions on the interior of pieces at Tall-e Jari A and Tall-e Bakun B suggests that VCW was shaped using a basket as argued by Alizadeh.[49] The basket impression was not observed at Tall-e Gap or Tall-e Bakun A, possibly because of potters' ceasing to use a basket at those sites. The attachment of several types of appliqués on the exterior surface of VCW (horizontal ridges, dots, wavy lines) was observed only at Tall-e Jari A. These changes in VCW's forming steps corresponded to the decrease of VCW in ware proportions. This suggests that the basic forming technique of VCW was stable over time, although the use of a basket for shaping and the application of appliqués disappeared over the decreasing course of VCW.

Forming of MCW

Coiling and sequential slab construction were principal forming methods for MCW, a new ware type at Tall-e Gap and Tall-e Bakun A. Furthermore, the technical steps of clay coating, attaching a pair of knobs, and impressing cloth intentionally were also shared between the two sites, showing a strong continuity of the forming technique of MCW.

2) Surface treatment

Smoothing, scraping, and burnishing of BOBW, VCW, and MCW

Few diachronic changes occurred in smoothing and scraping among BOBW, VCW, and MCW. Although the examples from Tall-e Bakun B could not be compared due to their poor surface preservation, the pattern of smoothing and scraping of BOBW was shared between Tall-e Jari A, Tall-e Gap, and Tall-e Bakun A. Horizontal smoothing on the interior surface of BOBW was predominant at all these sites. The combination of the directions of smoothing on the exterior surface of BOBW became more varied (including diagonal and vertical smoothing) than on the interior surface at all of the sites. The preferred direction of exterior surface smoothing was horizontal smoothing on the upper part and diagonal smoothing on the lower part. Scraping traces appeared mainly on the exterior surface of an open vessel. VCW had horizontal smoothing on both surfaces. Smoothing and light burnishing was observed on both surfaces of MCW, especially on the exterior surface.

Grooves on exterior surfaces of BOBW

The evidence of grooves was confirmed on the exterior surfaces of the vessels from the beginning to the end of the Bakun period. Through the comparison of grooves at each site, the diachronic changes of the technical steps behind the traces of grooves can be considered. While at Tall-e Jari A and Tall-e Bakun B, grooves with short intervals (1mm) were preserved on open vessels, at Tall-e Gap and Tall-e Bakun A, not only were there grooves on open vessels, but horizontal rows of vertical grooves with long intervals (3 mm) were also confirmed as preserved on large jars. As I argued before, two hypotheses exist concerning the original techniques

[49] Alizadeh et al. 2004: 101.

which generated grooves: scraping or paddling. Although I require a further experiment to reconstruct the techniques, I argue that the grooves with long intervals preserved on large jars were likely to be caused by paddling. Hence, I suggested that paddling was newly added to the chaîne opératoire of making large jars from Tall-e Gap.

Tools used for surface treatment

Reworked pottery scrapers, one of the inorganic candidates for smoothing and scraping tools, were confirmed at all of the sites. Comparing the length and shape of the scraper's edges from each site allows the diachronic change of scraping activity to be examined. First, the median length of the scrapers' edges at each site ranged from 4 cm to 8 cm, not showing a drastic change over time. Second, as for the shape of the scraper's edges, the reworked pottery scrapers from Tall-e Bakun A showed a higher frequency of having a convex shape (convex: straight = 31: 6) than those from Tall-e Bakun B (convex: straight = 2: 1) and Tall-e Gap (convex: straight = 14: 10). The convex shape of scraper's edge was more suitable for scraping the inner surface of pottery. The diachronic change of the shape of the scraper's edge toward a convex shape might imply the more frequent use of a reworked pottery scraper within the potter's community at Tall-e Bakun A. This change was in tandem with the appearance of a stirrup-shaped clay instrument for scraping at Tall-e Bakun A.

3) Applying slip

The results of the well-preserved vessels from Tall-e Jari A, Tall-e Gap, and Tall-e Bakun A showed that both the exterior and interior surfaces of the vessels were applied with slip except for several large jar vessels, the inner surfaces of which were not slipped. This indicates the strong continuity of this technical step. Macroscopic observation was limited in its ability to precisely identify the presence of slip. The presence of slip will also be tackled in Chapter 9 using thin-section petrography.

4) Decorating

Vertically dividing motif-units of BOBW

Regarding the technical step of decorating, I focused on how many times one painted motif-unit was repeated on the surface of BOBW at each site. Table 7.17 summarises the observed/estimated number of motif-units painted on the exterior (left) and interior (right) of open vessels at each site. The limited samples from Tall-e Jari A and Tall-e Bakun B showed larger numbers of motif-units on exterior-painted open vessels (more than 12 motif-units). On the other hand, the numbers of motif-units became gradually smaller at Tall-e Gap (three, four, six, seven, and eight motif-units). Finally, at Tall-e Bakun A, the numbers of motif-units continued to decrease, and two and three motif-unit decorations were preferred, suggesting that both 1) the size of one motif-unit became larger over time, and 2) the repetition of drawing the same motif-unit in one vessel was gradually avoided. When painters just repeated drawing small motif-units (e.g. cross-hatched diamonds at Tall-e Jari A), the number of motif-units would have not been a matter of concern for painters. I have inferred that in the process of reducing the number of motif-units and generating larger-sized elaborate motifs, the obedience to a specific number of motif-units for a specific motif (such as two motif-units for "goat with big horn (Fig. 7.7: 1)" came to be shared among the communities of potters.

When compared diachronically, the numbers of motif-units of the interior-painted open vessels followed the same tendency as that of the exterior-painted open vessels, namely avoiding repetition. The preferred numbers of motif-units for the interior-painted open vessels differed between Tall-e Gap (two and four motif-units) and Tall-e Bakun A (two and three motif-units).

Though very rare, several VCW sherds with painted decoration were found at both Tall-e Jari A and Tall-e Bakun B. This technical step in the manufacturing process of VCW vanished at Tall-e Gap. MCW was never painted possibly due to the reddish dark fabric colour.

5) Firing

Imprints

The diachronic comparison of imprints reveals change over time in the way ceramic vessels were piled in pottery kilns. Below, 1) the occurrence ratio, 2) the preserved surface, and 3) the relationship between imprints and original decorations will be compared site by site.

1) When the proportions of the confirmed number of imprints in the observed BOBW collection at each site were compared, the highest ratio of imprints was confirmed at Tall-e Bakun B (4.25 %). Tall-e Bakun A (1.6 %) followed with the second highest ratio, and Tall-e Gap had the lowest ratio: 0.6%. Although it is supposed that the imprints occurred contingently in a pottery kiln, some of the factors that possibly affected the increase or decrease of the imprints' occurrence are the patterns of piled-up vessels, the firing temperature, the vessel-form assemblage in the pottery kiln, the size of the kiln, and the amount of fired pottery in the kiln.

2) Regarding preserved surfaces of imprints, basically exterior-painted open vessels had imprints on their inner surfaces, and interior-painted open vessels on

Table 7.17 The confirmed and estimated number of motif-units of exterior-painted vessels (upper) and interior-painted vessels (lower) at each site

vessel painted on its exterior													
Number of motif units	2 motif units	3 motif units	4 motif units	5 motif units	6 motif units	7 motif units	8 motif units	9 motif units	10 motif units	11 motif units	12 motif units	13 motif units	more than 13 motif units
Tall-e Bakun A (N=73)	22	34	2	3	1	3	1	2	1	2	-	2	-
Tall-e Gap (N=44)	1	4	6	1	4	6	10	1	3	2	3	-	3
Tall-e Bakun B (N=1)	-	-	-	-	-	-	-	-	-	-	-	-	1
Tall-e Jari A (N=4)	-	-	-	-	-	-	-	-	-	-	1	-	3

vessel painted on its interior													
Number of motif units	2 motif units	3 motif units	4 motif units	5 motif units	6 motif units	7 motif units	8 motif units	9 motif units	10 motif units	11 motif units	12 motif units	13 motif units	more than 13 motif units
Tall-e Bakun A (N=20)	5	13	1	-	1	-	-	-	-	-	-	-	-
Tall-e Gap (N=19)	6	2	9	1	1	-	-	-	-	-	-	-	-
Tall-e Jari A (N=4)	-	-	1	-	-	-	1	-	-	-	1	-	1

their outer surfaces at all of the sites. At Tall-e Bakun B and Tall-e Gap, imprints were found on both inner and outer surfaces (Tall-e Bakun B inner: outer = 4:3; Tall-e Gap inner: outer = 49: 29). On the other hand, at Tall-e Bakun A, imprints were in many cases on the inner surfaces (inner: outer = 50: 1), reflecting the fact that exterior-painted open vessels were especially preferred and fired together in a pottery kiln in the last phase of the Bakun period.

3) Finally, the relationship between imprints and original decorations of the potsherds were compared diachronically (Table 7.18). At Tall-e Bakun B, one same motif-imprint (a) and one similar motif-imprint (d) were found. The majority of imprints were different from the original motifs at Tall-e Bakun B. The number of same/similar motifs and horizontal design structures (a, b, c, d) increased at Tall-e Gap (10 out of 90 samples) and Tall-e Bakun A (17 out of 57 samples). The increase of same/similar motif-imprints might suggest the presence of a painter who decorated the same motifs on several vessels in a short term of one firing lot.

Summary: Diachronic change of the chaînes opératoires

The above-explained results of the chaînes opératoires of BOBW, VCW, and MCW (from the technical step of forming to firing) during the Bakun period were summarised as schematic diagrams (Figs. 7.34-36). Although diachronic changes of the chaînes opératoires were not so clear, the summary of diachronic changes of the chaînes opératoires is stated below:

1) The forming technique of BOBW (coiling without a potter's wheel) was stable over time except for joining additional parts, such as pedestal, neck, and funnel-shaped vessels. The forming techniques of VCW and MCW did not show major changes.

2) Regarding surface treatment, evidence suggests that a paddling technique for large jars appeared from Tall-e Gap and that reworked pottery scrapers with convex edges were preferred at Tall-e Bakun A.
3) The number of times the same motif-units were painted on the surfaces of vessels decreased over time as the painted motifs became larger and more elaborate.
4) In the technical step of firing, especially in regard to piling up vessels in a pottery kiln, piling up vessels with similar/same motifs increased slightly over time.

Diachronic change of painting skill

In the above sections of the analysis of painting skill at each site, the main target was to find the differences painting skill within the sites. In this discussion of the diachronic changes, I will not compare painting skills themselves between sites. As for painting, it is clear that the amount of time taken for painting at Tall-e Bakun A was much more than that at Tall-e Jari A (see Section 6-6) in terms of the total area painted, the varieties of motif types, and the elaboration of the motifs. However, that fact does not mean that the painter at Tall-e Bakun A was superior to the painter at Tall-e Jari A. That is because the physical surroundings, tolerance of mistakes, and the communities of pottery making around them were different in each site. Thus, skill difference, in other words, how skilled and poorly made works were distributed at each site should be compared between sites.

Diachronic change of skill scores

Henceforth, I did not conduct a comparison of painting skills between sites, but rather a comparison of distribution patterns of skill scores (Figs. 7.37). The skill distribution pattern of the exterior-painted open vessels changed drastically between Tall-e Jari A and Tall-e Bakun B (Fig. 7.37: left). The striking difference was in the location of the peak of the skill score in the exterior-painted open vessel, either 0.6-0.8 (Tall-e Jari A) or 1.0 (Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A). The diachronic change of skill score pattern might suggest the improvement of painting skills over time, implying also the establishment of apprenticeships for painting pottery. On the other hand, regarding the interior-painted open vessels, while skill scores lower than 0.4 did not exist at Tall-e Jari A, Tall-e Bakun B, or Tall-e Gap, the skill scores at Tall-e Bakun A ranged from 0.0 to 1.0 (Fig. 7.37: right). The lower skill scores at Tall-e Bakun A were observed in small, shallow bowls, which were interpreted as apprentices' work (Fig. 7.37). This wide pattern of skill score distribution implies that apprentices were allowed to paint the interior surfaces of the pottery.

Diachronic change of badly/skilfully painted pottery

I will discuss not only skill score analysis but also the observation of badly and skilfully painted pottery over time. First, at Tall-e Jari A, the painted pottery consists of a small number of "masterpieces" with idiosyncratic forms (e.g. a vessel with a pedestal)[50] which were found only in the burial sites, and the poorly painted pottery was found in the dwelling context, presenting great skill difference. Whether these masterpieces were painted by the dwellers of Tall-e Jari A remains unclear. Second, the presence of masterpieces distinguished from other works such as those at Tall-e Jari A became obscure at Tall-e Gap. In addition, a small roughly formed and painted vessel was confirmed at the upper level of Tall-e Gap. As Bernbeck and Pollock pointed out, this craftwork was likely the hand of an apprentice who was permitted to use finer clay for BOBW. The appearance of an apprentice's work could be a hallmark showing the establishment of apprenticeships for BOBW making. Finally, masterpieces represented by the vessel "big-goat" motif which had the same imprint in its interior were created by a skilled potter at Tall-e Bakun A. While masterpieces reappeared at the last phase of the Bakun period, works of apprentices appeared during the middle phase of the Bakun period.

Summary: diachronic change in painting skill

To sum up, diachronic changes of skill-score patterns and badly and skilfully painted pottery indicate the improvement of painting skills within each site over time and the movement toward the establishment of apprenticeships for BOBW making, as shown by the works of apprentices and the masterpieces.

Table 7.18 Stylistic relationships between original motifs and imprints at each site

Motif-imprint stylistic relationship / Site	Bakun B	Gap	Bakun A
a) same motif, horizontal design structure	-	1	3
b) same motif	1	2	2
c) similar motif, horizontal design structure	-	3	6
d) similar motif	1	4	6
e) different motif, horizontal design structure	2	9	5
f) different motif	3	31	17
g) different horizontal design structure	-	1	-
g) insufficient data	1	39	18
Total	8	90	57

[50] Vanden Berghe 1952: Pl. XLIX.

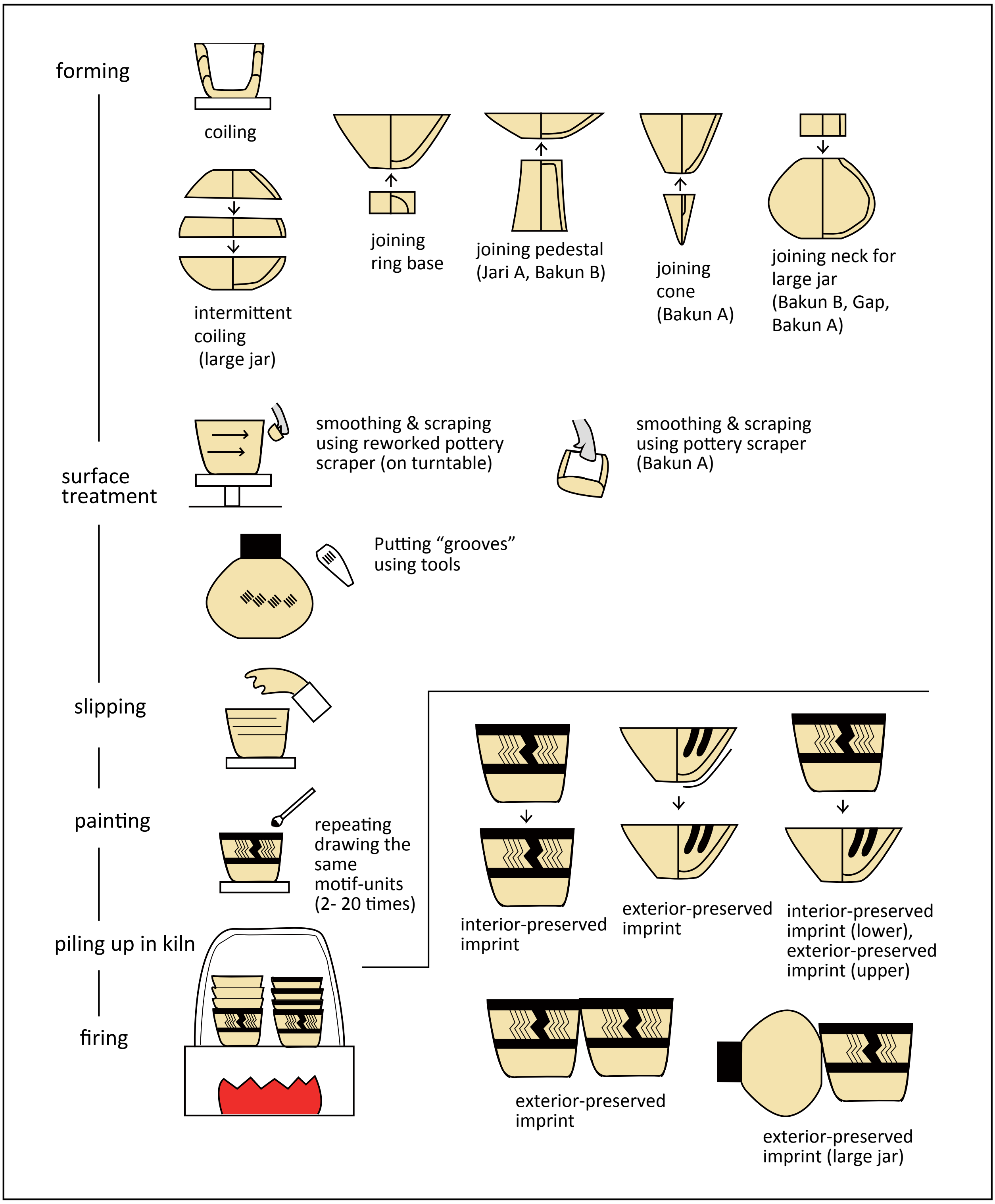


Figure 7.34 Diagram of the chaîne opératoire of BOBW making

Summary of Pottery-making techniques

At the beginning of this chapter, **Research Question No. 3:** "How were black-on-buff ceramics and other pottery produced?" – was subdivided into two components: 1) the chaîne opératoire of pottery-making techniques and 2) technical skill in pottery-making techniques. Starting with the analyses of well-preserved ceramic materials at Tall-e Bakun A curated at the OIC (Section 7-1), I proceeded to the analyses of potsherds from Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap curated at UMUT (Section 7-2). The diachronic change in pottery-making techniques was discussed through the comparison of pottery-making techniques between sites (Section 7-3).

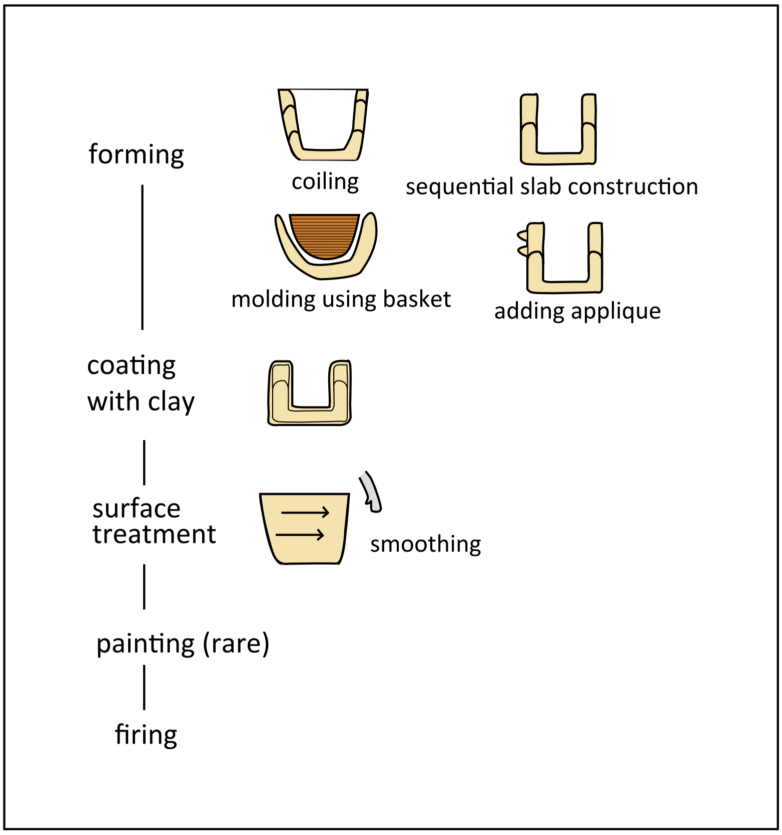


Figure 7.35 Diagram of the chaîne opératoire of VCW making

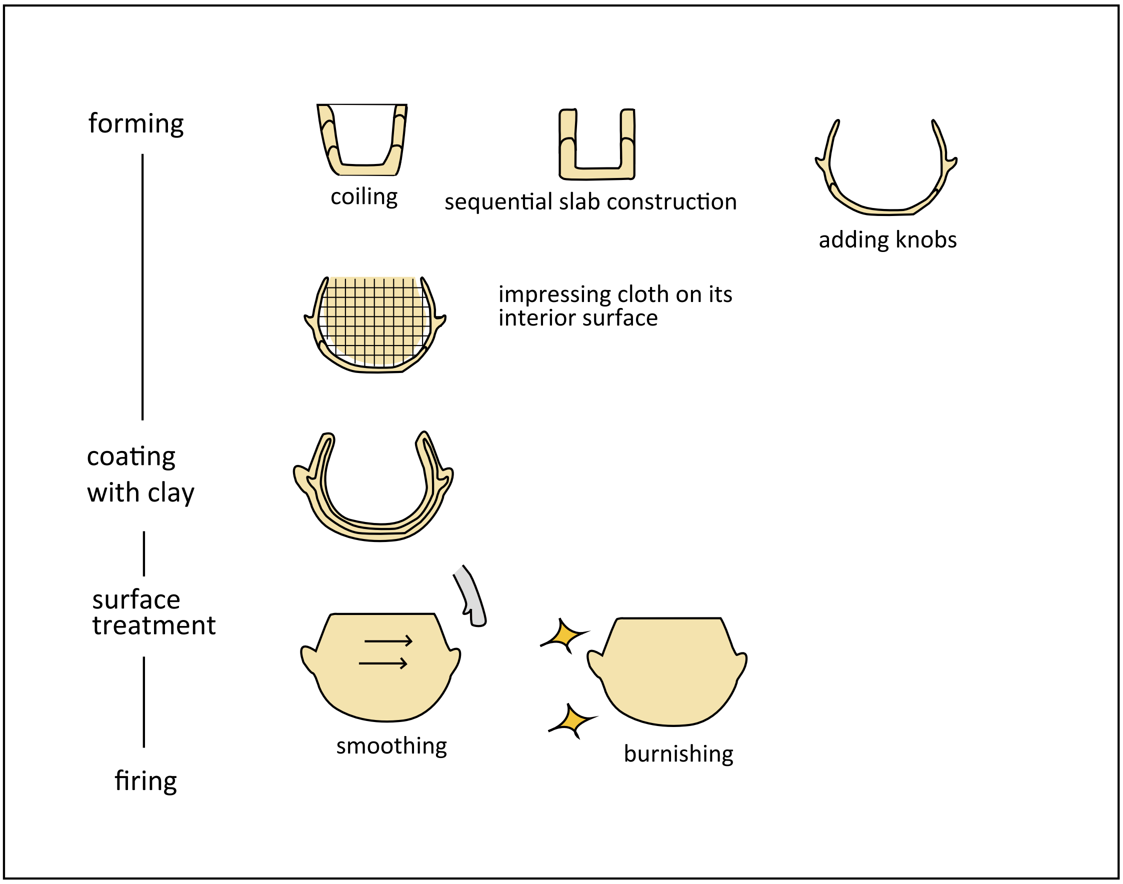


Figure 7.36 Diagram of the chaîne opératoire of MCW making

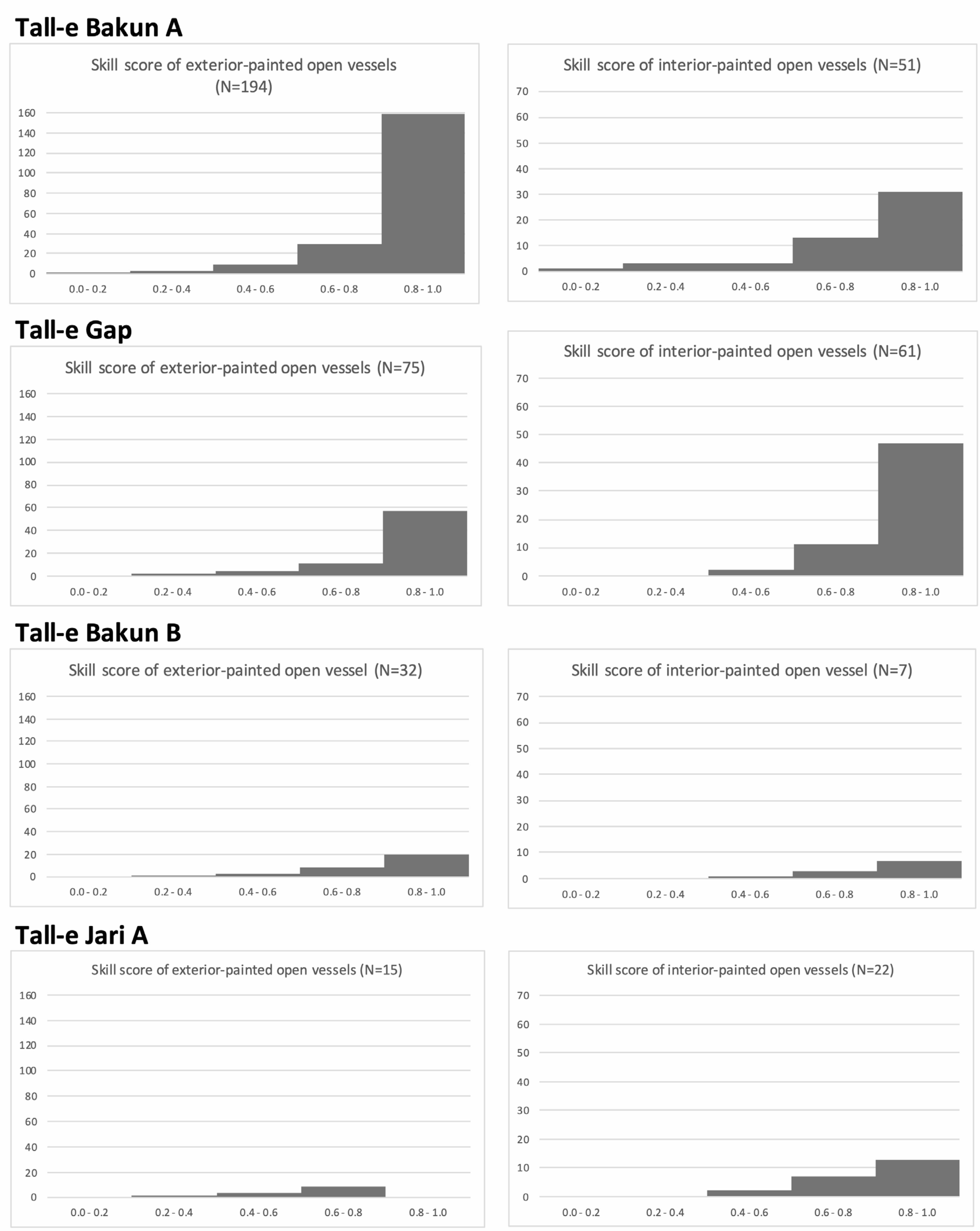


Figure 7.37 Inter-site comparison of histograms of skill scores from the published drawings

To conclude, several remarkable points about the pottery-production technique in the Bakun period emerged:

1) The technical steps and options in the chaînes opératoires of pottery-making, such as forming, surface treatment, and slipping, showed relatively fewer diachronic changes excluding joining additional parts, paddling, and decreasing the frequency of painting motif-units.
2) Imprint, a by-product of firing the pottery by stacking pieces in the pottery kiln, showed a diachronic change in its frequency, preserved

surface, and relationship to the original painted motif. The increase of same/similar motif-imprints suggests the presence of a painter who decorated the vessels with identical motifs in the short term in one firing lot.

3) As for painting skill of the pottery-making technique, skill-score patterns and badly and skilfully painted pottery at each site present the improvement of painting skills within each site over time and the movement toward the establishment of apprenticeships for BOBW making, as indicated by the works of apprentices and the masterpieces.

These three sections analysed macroscopic traces preserved on vessel surfaces to investigate pottery-making techniques. Succeeding sections will approach clay acquisition and clay preparation in pottery-making techniques from a microscopic perspective – that is, thin-section petrography.

7-4. Thin-section Petrography

In this section, I will approach pottery pastes using thin-section petrography. As reviewed in Chapter 2, pottery fabric has not been analysed for the Bakun period pottery. As explained in Chapter 4, this analytical method can approach the technical steps of acquiring and preparing clay and temper from archaeological materials. The detailed analysis of pottery fabric using thin-section petrography also enabled me to tackle not only the technical steps of forming and slipping but also the post-depositional process of pottery through the observation of secondary calcites inside the voids, as presented below. What I will present in this chapter is a part of the answers to Research Question No. 3 (pottery-making technique). I raise four specific questions:

1) What kinds of fabric can be identified at each site?
2) What kinds of technical steps and options can be characterised from petrographic information?
3) Is there any diachronic change in fabric types?
4) Can I find the provenance of mineral inclusions in pottery fabric?

In the first part of this section, classification results of petrography of 60 samples will be described by each fabric type, from fabric type A to fabric type H to answer the first question. Next, on the basis of the descriptions, I will discuss the technical steps and options in pottery-making techniques. Then the petrographic assemblages will be compared between sites belonging to different time-phases in regard to discussing diachronic changes of petrographic types in Bakun pottery. Finally, through comparison of the geological map, I will discuss the provenances of the clay and their inclusions to answer the fourth question.

Classification results of petrography of 60 potsherds

Sixty ceramic samples from five different sites (Appendix Table A6.1) were classified into eight fabric types based on grain size (fine/medium/coarse) and inclusions (mineral/vegetal). Below, each fabric type from the five sites will be described.

Fabric type A: fine-fabric black-on-buff ware

Fine-fabric BOBW is the most popular fabric type among 60 samples (36 samples) (Figs. 7.38-39). This fabric type dominated the types of BOBW at Tall-e Bakun B, Rahmatabad, and Tall-e Bakun A. It is also the most predominant among the fabric types of BOBW at the other sites. A more detailed description of the fabric

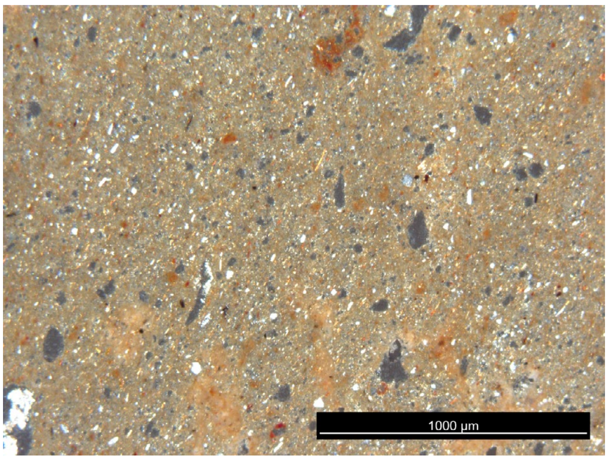


Figure 7.38 Fabric type A: fine-fabric black-on-buff ware in XP (RF006) (Photo by Miki)

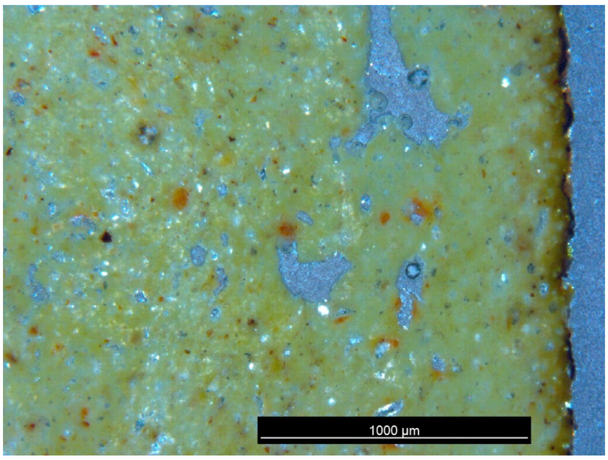


Figure 7.39 The presence of tiny red particles in Fabric type A in XP (GF007) (Photo by Miki)

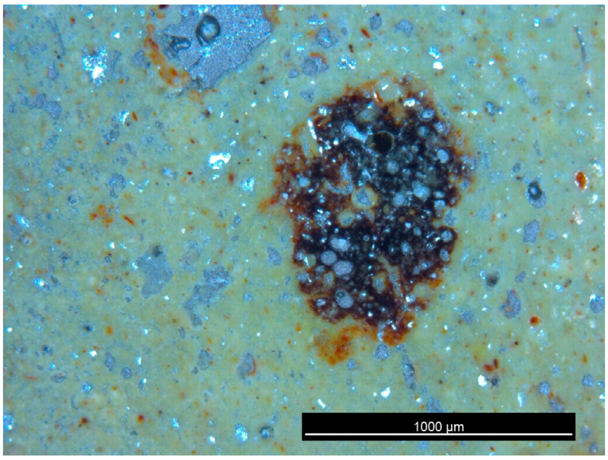


Figure 7.40 The presence of a black equant material filled with round vesicles in Fabric type A in XP (GF007) (Photo by Miki)

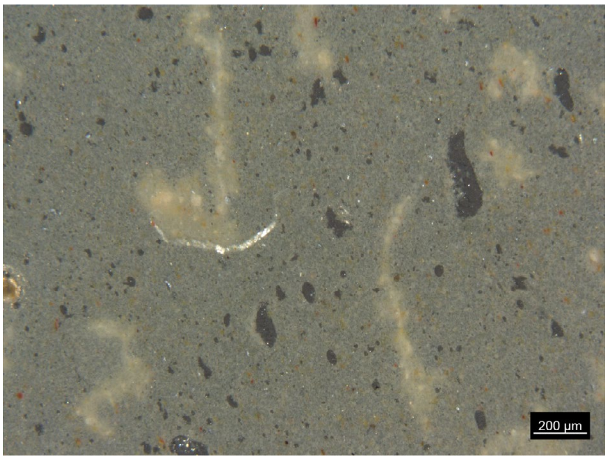


Figure 7.41 The presence of a hair-like material in Fabric type A in XP (JF001) (Photo by Miki)

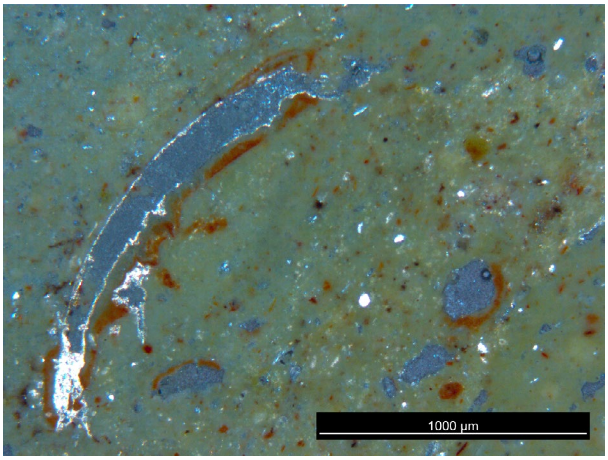


Figure 7.42 Trace of a vegetal material in Fabric type A in XP (GF007) (Photo by Miki)

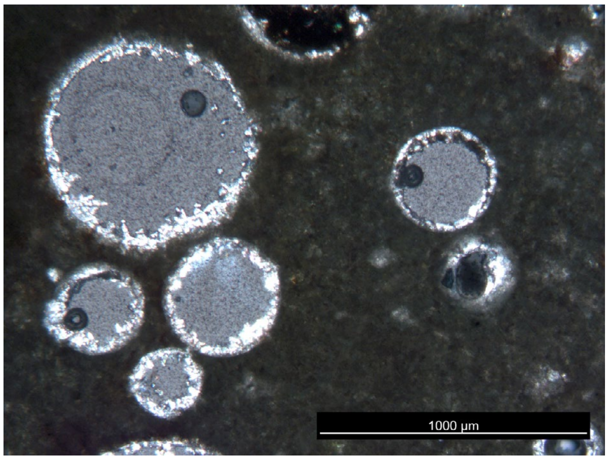


Figure 7.43 Round voids generated by the high firing temperature in Fabric type A in XP (AF008) (Photo by Miki)

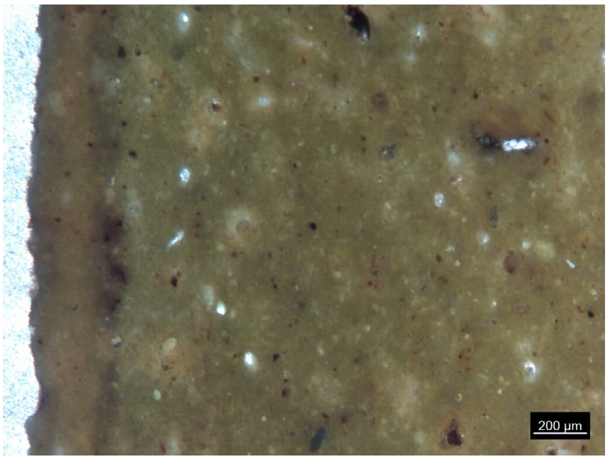


Figure 7.44 Trace of slip on the left surface in Fabric type A in XP (AF006) (Photo by Miki)

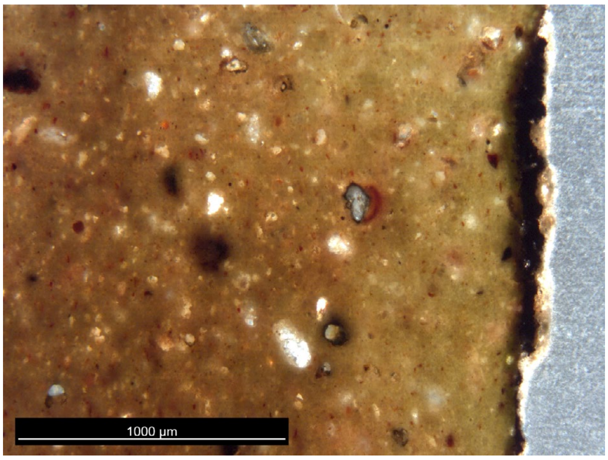


Figure 7.45 Trace of painting on the right surface in Fabric type A in XP (RF003) (Photo by Miki)

types at each site and sample photographs from the microscope in crossed polar (XP) and plain polarized light (PPL) and the original sample are attached as an appendix.

The inclusions account for 3 % of particles, indicating its very fine fabric. The shape of the most inclusions is equant sub-angular or equant sub-rounded. The size is less than 0.2 mm and the mode of the size is 0.1 mm.

Most all of the inclusions were possibly weathered. The intervals between the inclusions were open spaced. The inclusions showed unimodal, well-sorted grain size distribution. Among the mineral inclusions, quartz and biotite were observed in this fabric type at all sites. The inclusion of quartz and biotite is less likely to be intentional as temper. Muscovite in the fine-fabric BOBW was observed at Tall-e Bakun B and Tall-e Bakun A. JF005 (an unpainted part of a bowl sherd) has a weathered brown inclusion (equant-elongate, subangular-subrounded, <0.2 mm, mode=0.1 mm). This inclusion was interpreted as oxidized biotite which turned brown. GF007 (a large jar sherd) has red inclusions (elongate, subangular-subrounded, <0.2 mm, mode=0.1 mm. sharp boundaries, high optical density, discordant). This inclusion was interpreted as weathered red siltstone. Calcite (subangular-subrounded. <0.5 mm, mode=0.15 mm) was observed in AF005 (a large jar sherd).

The calcareous matrix accounts for 92% of particles. The matrix colour is light pale green in PPL and dark pale green in XP (x40). The matrix shows homogeneity. Tiny red, brown, or black particles or "stains" were confirmed in the matrix (Figs. 7.39-40). Although what these materials are is still unclear, they were possibly generated by high-temperature firing. The clay matrix of BF005 shows the heterogeneity in the fabric colour. While the colour of the right surface is light pale green in PPL, the core is dark pale green in PPL, suggesting that the heterogeneity resulted from mixing of different types of clay. BF003, GF007, and AF001 contain 0.5 – 0.6 mm black equant sub-rounded materials filled with tiny rounded and clustered vesicles (Fig. 7.40). These materials are concordant with the matrix as if they were "stains". On the basis of the vesicles, the materials are interpreted as being generated by high firing temperature.

Voids comprise 5% of the ceramic paste of the fine-fabric BOBW. The shapes of the voids were meso-elongate vughs and meso-equant vughs. Traces of organic materials were confirmed in the form of voids on rare occasions. These traces were confirmed in JF001, JF002, JF010, BF002, BF007, GF007, RF007, AF004, and AF006. JF001 contains hair-like materials (0.5 mm x 0.02 mm) (Fig. 7.41). GF007 has one large trace of vegetal temper (1.6 mm) (Fig. 7.42). Considering the low amounts of vegetal temper, they were likely to be unintentional inclusions or might also be contamination during the making of the thin sections. As for the voids, AF008, the sample of the overfired potsherd shows a unique pattern (Fig. 7.43). The voids account for 15% in the paste of AF008. The shape of voids is meso-round, and the voids indicate unimodal, well-sorted void-size distribution. This sample clearly shows the effect of high-temperature firing and has the black materials with vesicles (Fig. 7.40) in common with BF003, GF007, and AF001 in terms of voids.

Besides the petrographic perspective consisting of inclusions, matrices, and voids, evidence showing the traces of the pottery-making techniques was also observed. Traces of slipping were difficult to distinguish from the matrix using the polarized microscope due to the same paste colour in many cases. Eleven samples of this fabric type had traces of slipping on their surfaces (Fig. 7.44). The thickness of the slip ranged from 0.2 mm (BF004, GF001, GF007, GF008, RF008) to 1 mm (BF005). The median slip thickness of this fabric type was 0.3 mm. The number of samples with slips visible was not enough to compare the thickness between sites. How a piece was slipped (either via pouring slip into the vessel or dipping the vessel into a bucket full of slip) might decide slip thickness.

Traces of paint pigments are more distinguishable than those of slipping (Fig. 7.45). Data about paint thickness could be collected from 18 samples of this fabric type. The ceramic sherds with painting from Tall-e Jari A were not chosen due to their small sample sizes. The thickness of the paint ranged from 0.007 mm (RF006) to 0.39 mm (RF004). The median thickness of the painting was 0.04 mm. The thickness showed much more variation than the slip did. Paint thickness might indicate the number of strokes used to draw one line. Of course, it is possible that painting traces became faded during either use of the vessel or the post-depositional process. The thickness of painting traces was also likely to vary depending on how the piece was painted.

Finally, as a result of the post-depositional geological environment being calcium-rich, the traces of secondarily formed calcite appeared both in the voids and on the surfaces (Fig. 7.46). Seventeen examples of this fabric type had the diagnostic traces of secondary calcite. On the basis of this observation result, one should be cautious in interpreting the geochemical results of calcium element in the next chapter.

Fabric type B: red siltstone included medium-fabric of black-on-buff ware

Below, I will describe four variants of fabric type A, a fine fabric of BOBW, ranging from fabric type B to fabric type E. As for these variants, only one or two samples belong to each fabric type. I will describe these petrographic features, drawing attention to the differences from fabric type A.

Red siltstone included medium-fabric BOBW is confirmed only at Tall-e Gap (GF009) (Fig. 7.47). The most diagnostic point is the presence of red siltstone. The inclusions occupy 10% of the paste. The most predominant inclusion is red siltstone (equant, subangular-subrounded, <0.3 mm, mode=0.15 mm). The other mineral inclusions are quartz (elongate, subangular-subrounded, <0.4 mm, mode=0.2 mm),

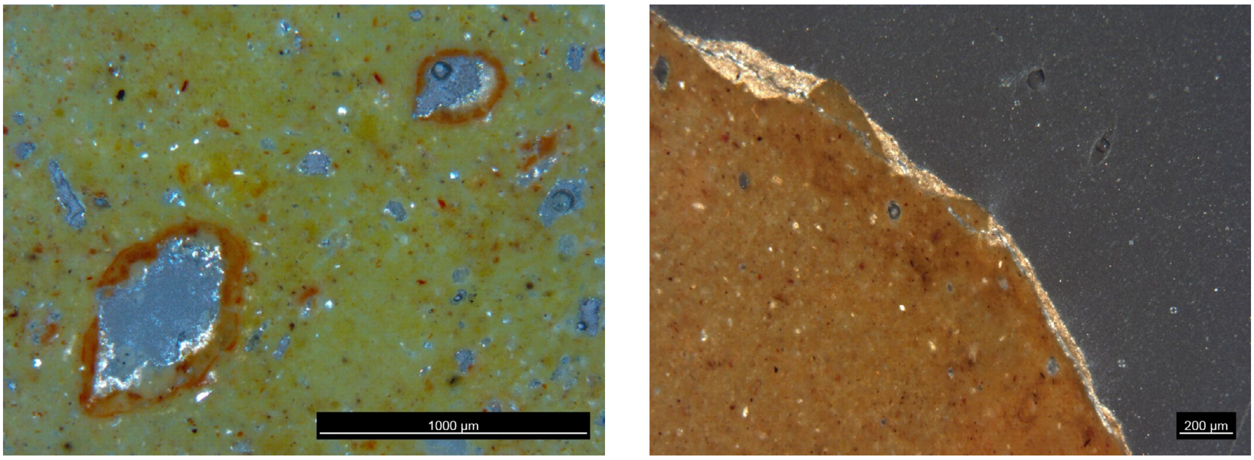


Figure 7.46 Traces of secondary calcite in the voids (GF007) (left) and on the surface (JF002) (right) in Fabric type A in XP (Photo by Miki)

muscovite (elongated, subangular-subrounded, <0.4 mm, mode=0.2 mm), and plagioclase (elongated, subangular-subrounded, <0.4 mm, mode=0.2 mm). These inclusions are open spaced and unimodal. They also show well-sorted grain size distribution. The calcareous matrix (brown in PPL, dark brown in XP (x40) accounts for 82% of the paste and is homogeneous. The shape of the voids (8%) is meso-elongate and meso-equant vughs. The thickness of the slip was 0.5 mm, although it was difficult to distinguish.

Fabric type C: medium-fabric black-on-buff ware

Medium-fabric of BOBW (GF010, Fig. 7.48) was observed only at Tall-e Gap. Its inclusion of the paste (8%) is more than fine-fabric BOBW (3%). The differing point from Fabric type B is that quartz (elongate, subangular-subrounded, <0.2 mm, mode=0.1 mm) is as dominant as red siltstone (equant, subangular-subrounded, <0.3 mm, mode=0.15 mm) in this fabric type. The distribution of these inclusions is open-spaced, and the grain size is well-sorted. Its matrix (84%, Calcareous, pale green in PPL, dark pale green in XP (x40)) is homogeneous. This sample has also a black equant sub-rounded material similar to those confirmed in Fabric type A, indirect evidence of a high firing temperature. The shapes of voids consist mainly of meso-elongate and meso-equant vughs. The observable paint thickness was 0.03 mm. Traces of secondary calcite existed surrounding the voids.

Fabric type D: calcite included medium-fabric black-on-buff ware

The only example of calcite-included medium-fabric BOBW (JF004, Fig. 7.49) exists in Tall-e Jari A. The inclusion occupies 15% of the paste. The most predominant inclusion is calcite (elongate, subangular-subrounded, <0.2 mm, mode=0.1 mm). The other inclusions are quartz, muscovite, and biotite. These minerals are open spaced and show unimodal, well-sorted grain size distribution. The colour of its matrix (89%, calcareous and homogeneous) is warmer than the other fabric types of BOBW: that is, reddish brown in the core and yellowish brown in the right side and slip in PPL and dark brown in XP (x40). The voids show a similar pattern to the other BOBW fabric types. Preserved slip thickness was 0.5 mm.

Fabric type E: organic material included fine-fabric black-on-buff ware

Organic material included fine-fabric BOBW (JF007, JF011, Fig. 7.50) was observed only at Tall-e Jari A, as was Fabric type D. Fabric type D's inclusion (3% of the paste) were similar to the other fabric types of BOBW. Calcite, quartz, muscovite, and biotite were confirmed. While the matrix of JF007 (92%) is homogeneous and shares similar characteristics with other fabric types, that of JF001 (86%) is heterogeneous and shows warmer colour (Yellowish brown in PPL, Dark brown in XP, and Dark brown in PPL in the lower part). The presence of dark clay material inside the matrix (Fig. 7.51) especially implies bad clay mixing. Voids account for 5%, and not only were meso-elongate and meso-equant vughs frequently confirmed, but also hair-like voids of organic materials (length: 0.5 mm, thickness: 0.01 mm), in particular, JF011, were also observed (Fig. 7.51). The preserved slip thickness of JF011 is 0.3 mm.

Fabric type F: greyish material included coarse-fabric mineral-tempered black-on-buff ware

Greyish material-included coarse-fabric mineral-tempered BOBW (AC009, Fig. 7.52) is a fabric type of mineral-tempered BOBW (MBOBW) found only in a large-jar vessel at Tall-e Bakun A. The mineral inclusion was macroscopically observable. Its inclusion accounts

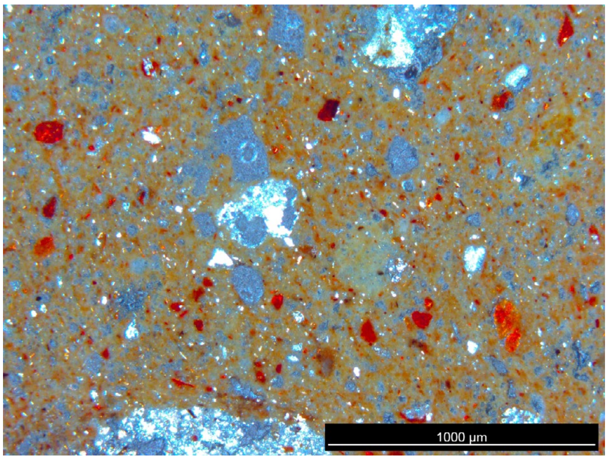


Figure 7.47 Fabric type B: red siltstone included medium-fabric of black-on-buff ware in XP (GF009) (Photo by Miki)

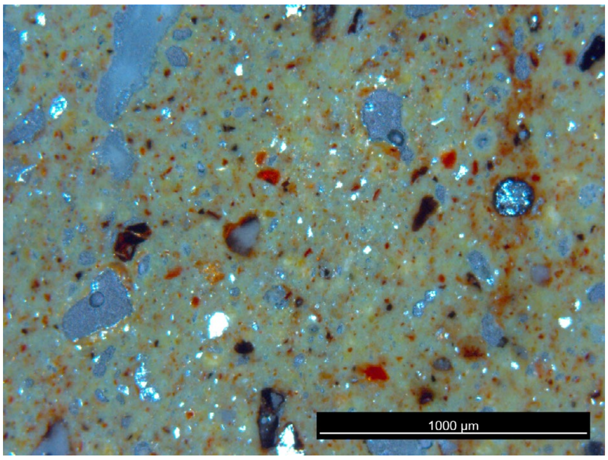


Figure 7.48 Fabric type C: medium-fabric black-on-buff ware in XP (Photo by Miki)

for 10% in the paste (equant & elongate, angular-subrounded, <4.0 mm.). The distribution of the inclusion is open spaced, but shows a bimodal grain size pattern. Coarse fraction accounts for 90% of the inclusions. The size ranges from 0.3 mm to 4.0 mm. The predominant inclusion is greyish material (equant & elongate, angular-subrounded, mode=1.5 mm) (Fig. 7.53). Because the horizontal striation can be confirmed in its interior, it is likely to be red siltstone which was fired at a high firing temperature. This material was clearly included as mineral temper. A few calcite particles (equant, subangular-subrounded, <1.5 mm, mode=1.5 mm) which were also possibly overfired exist in the paste (Fig. 7.53). Fine fraction accounts for 10% and the size is less than 0.3 mm. Fine fraction consists of quartz (equant, subangular-subrounded, <0.3 mm, mode=0.2 mm) and muscovite (equant, subangular-subrounded, <0.2 mm, mode=0.1 mm). The calcareous matrix of this fabric type also shows an interesting feature. It is heterogeneous and shows a mottled mixture of reddish brown and whitish grey in PPL and dark brown and grey in XP, which might also be a result of a high firing temperature. Its slip thickness is 0.3 mm, and its paint thickness is 0.05 mm. Traces of secondary calcite were observed around the voids.

Fabric type G: red siltstone and calcite included coarse-fabric of mineral tempered coarse ware

Red siltstone and calcite included coarse-fabric of mineral-tempered coarse ware is the only one fabric type of mineral-tempered coarse ware (MCW) found at the upper Levels of Tall-e Gap and Tall-e Bakun A (GC005, GC011, and AC012, Fig. 7.54). This fabric type is quite different from those of BOBW in the inclusions, matrix, and voids, as it is macroscopically evident. The inclusion occupies 25% of the paste. The inclusions are either single spaced or double spaced. They show bimodal, poorly sorted grain size distribution. The examples from Tall-e Gap indicate vertically aligned inclusions. The size of coarse fractions (60-80 %) ranges from 0.3 mm to 2.5 mm. Two major inclusions are red siltstone (elongate, angular-subrounded, <2.0 mm, mode=1.0 mm) and calcite (elongate, angular-subrounded, <2.5 mm, mode=1.0 mm) (Fig. 7.55). The red siltstone has clear horizontal striations which were formed as a result of the geologic depositional process. One calcite fragment (Fig. 7.55: right) is angular and not weathered, indicating the intentional breaking of calcite rock to get temper. Fine fraction (20-40%, 0.3-0.01 mm) consists of red siltstone, calcite, biotite, and muscovite.

One interesting feature of this fabric type is the presence of calcite fossils (Figs. 7.56). Their shapes are usually elongated, and their structures are like those of sponges. According to a paper published by geologists who conducted fieldwork near Persepolis,[51] the fossils were identified as orbitolinid foraminifera, which inhabited in the Lower Cretaceous period. The calcareous matrix (69% of the paste) of this fabric type is heterogeneous. The colours of the samples from Tall-e Gap were reddish brown in PPL and brown, reddish brown, and dark reddish brown in XP. The colours of a sample at Tall-e Bakun A (AC012) were reddish brown (inside) and dark brown (outside) in PPL, and dark reddish brown (inside) and dark brown (outside) in XP (x40) (Fig. 7.55). The matrix colour of AC012 change at XP, showing birefringence, a trace of low firing temperature (Fig. 7.55: left).[52] Voids account for 6% of the paste. Meso-elongate and meso-equant vughs and traces of organic tempers (>3.0 mm, mode=1.0 mm) are visible. Two examples from Tall-e Gap have thin traces of red washing (Fig. 7.57). The thickness of the washings were 0.03 mm (GC005) and 0.04 mm (GC011) each.

[51] Shirazi and Abedi 2013.
[52] Quin 2013: 190-191.

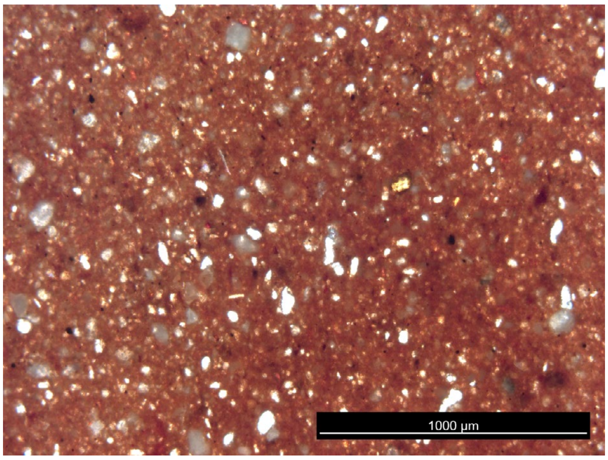


Figure 7.49 Fabric type D: calcite included medium-fabric black-on-buff ware in XP (JF004) (Photo by Miki)

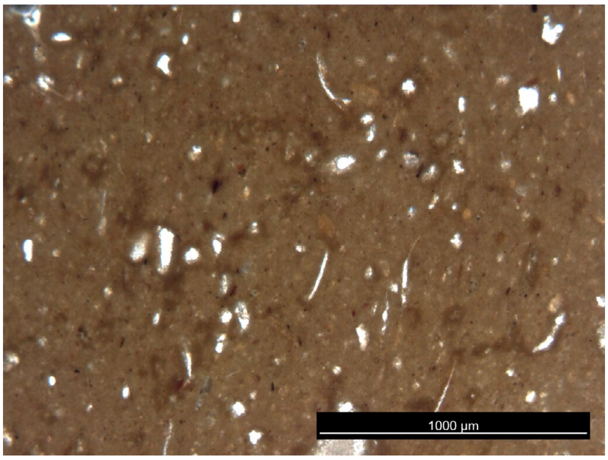


Figure 7.50 Fabric type E: organic material included fine-fabric black-on-buff ware in XP (JF011) (Photo by Miki)

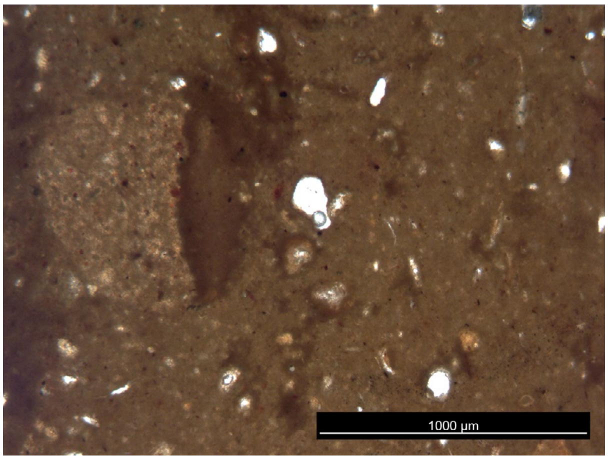


Figure 7.51 A dark clay material possibly due to poor clay mixing in Fabric type E in XP (JF011) (Photo by Miki)

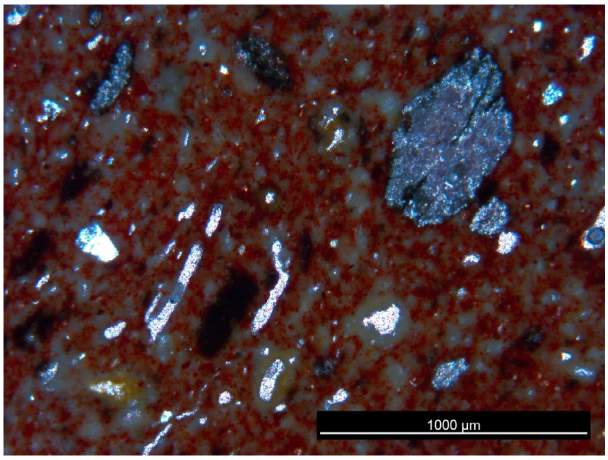


Figure 7.52 Fabric type F: greyish material included coarse-fabric black-on-buff ware in XP (AC009) (Photo by Miki)

Fabric type H: vegetal temper included coarse-fabric of vegetal-tempered coarse ware

Vegetal temper included coarse-fabric is the only fabric type of vegetal-tempered coarse ware, or VCW (Fig. 7.58). One burnt-clay sample (AC010) also belongs to this fabric type. All of the sites have this fabric type and Fabric type A. The ratio of inclusions of the paste in this fabric type is a bit higher than those in Fabric type A (3-4%). The distribution of inclusions is open spaced and unimodal and shows well-sorted grain size distribution. The inclusions are comprised of quartz (equant, subangular-subrounded, <0.2 mm, mode=0.1 mm, weathered?) and muscovite (equant, angular-subrounded, <0.3 mm, mode=0.1 mm, weathered?). Biotite (elongate, angular-subrounded, <0.2 mm, mode=0.1 mm, weathered?) was observed at all of the sites except Tall-e Bakun A. Calcite (equant, angular-subrounded, <0.3 mm, mode=0.1 mm, weathered?) was confirmed in the samples at Tall-e Jari A.

The proportion of the clay matrix varies from 73% (JC003, JC006, GC004, GC012) (Fig.7.58) to 86% (BC011) depending on the proportion of the voids. The matrices are separated into two types: homogeneous (BC009, BC010, BC011, BC012) or heterogeneous (the others). The colour of the former is yellowish brown in PPL and dark brown in XP (x40). On the other hand, the colour of the latter is a mixture of yellowish brown and dark brown in PPL. This heterogeneity of the matrix colour was likely caused by either clay mixing or by incomplete firing. The heterogeneity of the matrix might imply clay mixing for the purpose of making the firing of the vessels successful. The matrices of GC004 and RC011 (Fig. 7.58) show a birefringent character in XP, indicating a low firing temperature. The proportion of voids ranges from 10% (BC011) to 23% (JC003, JC006, GC004, GC012, RC012).

A large part of the voids in Fabric type H were burnt traces of vegetal temper. The majority of these vegetal tempers

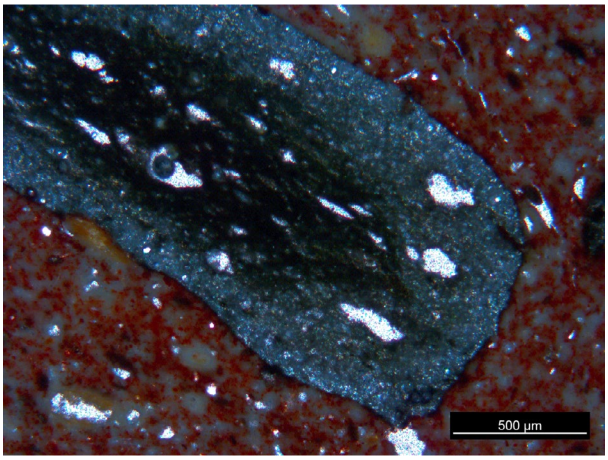


Figure 7.53 The presence of a greyish material in AC009, possibly overfired red siltstone and calcite (Photo by Miki)

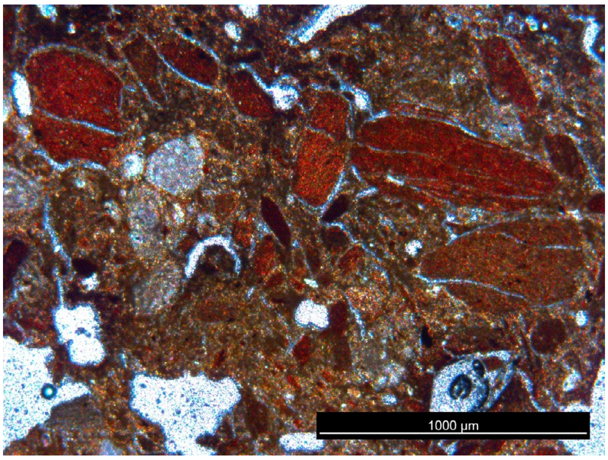


Figure 7.54 Fabric type G: red siltstone and calcite included coarse-fabric of mineral tempered coarse ware in XP (AC012) (Photo by Miki)

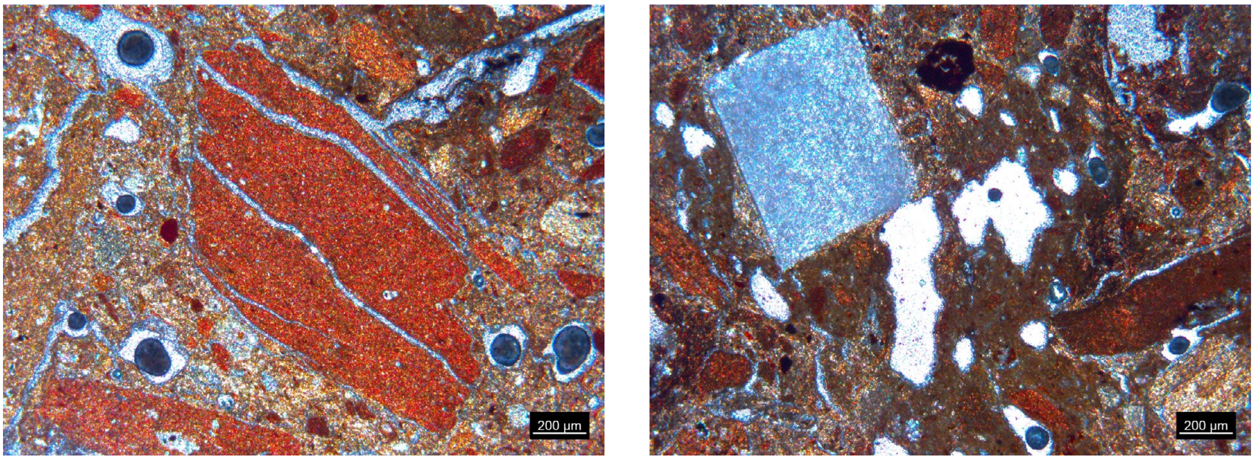


Figure 7.55 The presence of red siltstones (left) and calcite (right) in AC012 in XP (Photo by Miki)

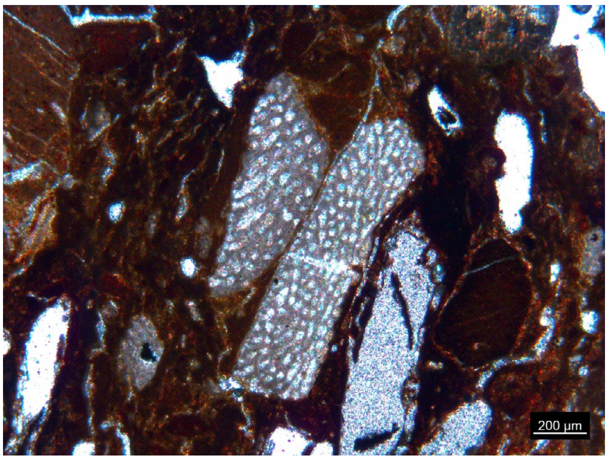


Figure 7.56 The presence of fossils in GC005 (upper) and AC012 (lower) in XP (Photo by Miki)

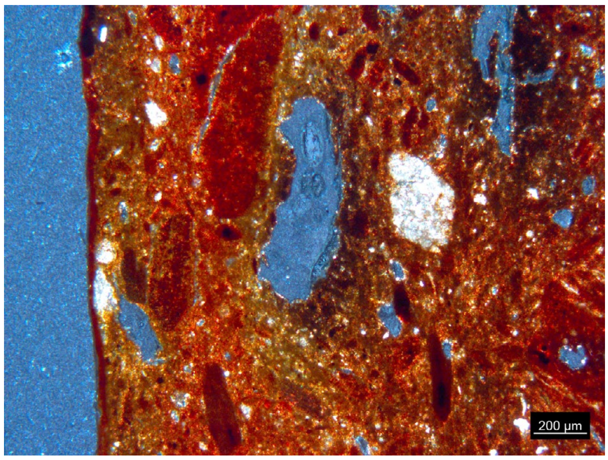


Figure 7.57 Trace of reddish clay coating/washing on the left surface in GC011 in XP (Photo by Miki)

was originally chaff or straw (length: >1 cm, mode: 1mm). The length distribution of vegetal tempers in one sample shows randomness. The voids were sometimes vertically aligned (JC003, JC006, BC009, BC010, GC004, GC012, RC012, and AC011). The presence of secondary calcite around the voids was frequent at Tall-e Jari A and Tall-e Bakun B. Like Fabric type G, two examples from Rahmatabad showed thin traces of red washing on their surfaces (Fig. 7.59). The thickness of the red washing is 0.08 mm (RC011) and 0.07 mm (RC012).

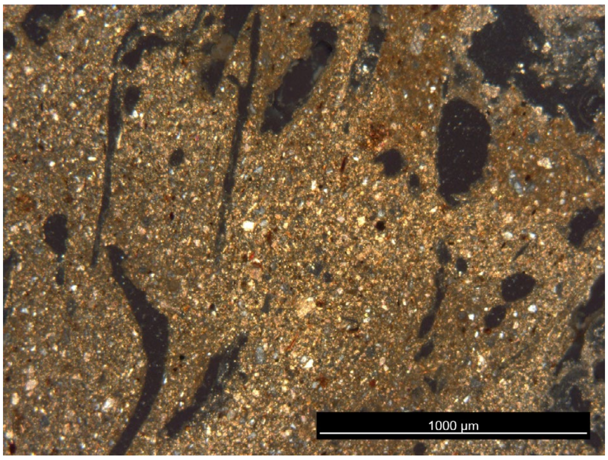


Figure 7.58 Fabric type H: vegetal temper included coarse-fabric vegetal tempered coarse ware in XP (RC011) (Photo by Miki)

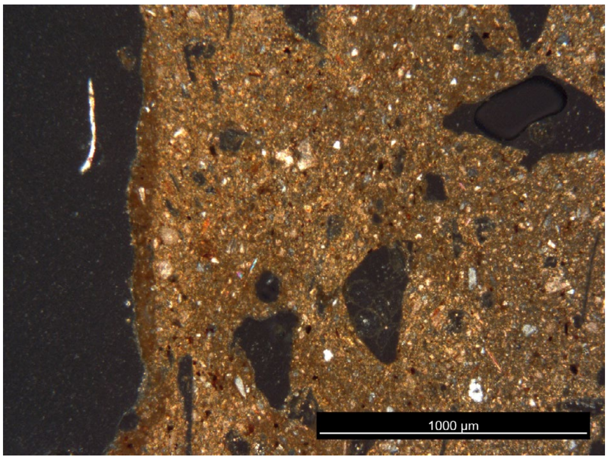


Figure 7.59 Traces of reddish clay coating/washing on the left surface of RC011 in XP (Photo by Miki)

Discussion of thin-section petrography

Technical steps and options in pottery-making techniques

In the previous section, I described the characteristics of fabric types from a petrographic perspective. How did this analysis contribute to the understanding of pottery-making techniques? Below, I will discuss the technical steps and options in the pottery-making techniques of each ware type. First, I begin with the technical steps of obtaining clay and preparing clay for the fabric types of BOBW. Except for several variants within medium fabrics of BOBW (Fabric type B, C, and D), the proportion of inclusion in fabric types belonging to BOBW (Fabric types A and E) was 3% in general, suggesting either a technical step of levigating clay or that of selecting naturally fine clay existed in making this fabric type. On the other hand, a more frequent proportion of minerals such as red siltstone, quartz, and calcite (8-15 %) was confirmed in medium-fabric types of BOBW (Fabric types B, C, D, E). Their size was less than 0.4 mm, and their angularity ranged from sub-angular to sub-rounded.

Here, I introduce fine-medium fabric types made in the same region of the other periods to consider the character of these mineral inclusions. Fine-medium fabric groups are also reported in the petrographic analysis of ceramic materials in the Kur River Basin of the Neolithic and the Bronze Age periods by Possum Pincé and her colleagues.[53] In the Neolithic period, “sedimentary I: melange”, “sedimentary II: sintered”, and “sedimentary III: mica” groups present similar fine-medium fabrics to fabric types B, C, and D.[54] Calcite and mica are confirmed in these groups. The sizes of these minerals are less than 0.3 mm, and the majority of these minerals are sub-rounded.[55] Following the abovementioned evidence, Pincé argues the use of unaltered but fine-grained clay.[56] As for the Bronze Age, “fine-grained A” and “fine-grained B” groups show similarity to fine BOBW fabrics.[57] On the basis of the very low quantities of small sub-angular quartz in these groups (0-5 %, 0.015 – 0.055 mm), Pincé argues that mineral inclusions were not intentionally tempered. She argues that only chaff or straw was intentionally tempered for fine-fabric groups in both periods. In addition, she explains an ethnographic example at ceramic workshops in Shahreza, where local clay is used without adding any temper. After reviewing these results, as it stands, it is less likely that the mineral inclusions in fabric types B, C, and D were intentionally tempered. However, the organic material confirmed in fabric type E might be intentionally tempered.

The other technical steps in pottery-making techniques of BOBW could be confirmed from thin-section petrography. The evidence of the thickness of slip that covered the surface of BOBW implies frequency of slipping and a way of covering slip in the technical step of slipping. The thickness of paint on the surface of BOBW can be a further clue to a technical step of painting, for example, reconstructing a sequence of drawing (beginning, middle, and end) based on the change of paint thickness. The presence of some vesicles with round voids implies the high firing temperature of BOBW.

Next, I will move to the technical steps and options in the pottery-making technique of MCW (Fabric type G). The petrographic analysis gave further evidence about its detail of the technical step of adding temper. The

[53] Pincé et al. 2019a, b.
[54] Pincé et al. 2019a: 1249.
[55] Pincé et al. 2019a: Table 2.
[56] Pincé et al. 2019a: 1253.
[57] Pincé et al. 2019b: 12.

presence of the technical step of adding red siltstone and calcite as temper is clear given the proportion, size, and angularity. The addition of either chaff, straw, or dung as temper was also confirmed from the shape of the voids. A thin layer of red wash suggests the technical step of covering with a red wash. In addition, the birefringent character of the MCW matrix indicates a low firing temperature.

Third, thin-section petrography can provide useful information about the pottery-making technique of VCW (Fabric type H), whose technical steps were difficult to approach due to the fragmentation of the sherds and scarcity of complete vessels. Compared to fine-medium fabric types (A-E), mineral inclusions inside VCW's paste is more remarkable than those fabric types. Hence, it is more likely the technical step of levigating the clay was not carried out in making VCW than in the case of making BOBW. Like MCW, adding either chaff, straw, or dung to the paste of VCW was indicated from the shape of the voids. Clay mixing was also confirmed. Some samples had traces of red washing. Finally, the birefringence of the VCW matrix indicates a low firing temperature.

Above, I confirmed the technical step of adding mineral and vegetal temper from the petrographic perspective. What are the merits and drawbacks of adding these tempers? James Skibo and his colleagues carried out the experiments of analysing the difference of performance characteristics between untempered pottery, organic-tempered pottery, and mineral-tempered pottery.[58] The experiments indicate that organic-tempered pottery could ease forming wet clay, and mineral-tempered pottery showed a superior performance in heating effectiveness. When I applied this study to the above-described petrographic characteristics of BOBW, VCW, and MCW, at first it is suggested that the technical step of forming VCW was easier than BOBW for potters and took less time. Second, MCW was not only easier to form with its organic temper, but also allowed effective heating with its red siltstone and calcite temper. As argued in previous studies, the function of MCW was likely to be a cooking pot.

Comparison of fabric types between sites

In the above section, the description was concerned with each fabric type from each site. In this section, the diachronic change of assemblages of fabric types in each site, the relationships between fabric types and vessel forms, and the comparison of the characters of each fabric type will be discussed.

Table 7.19 shows the number of fabric types in each site. Since Fabric type F (MBOBW), G (MCW), and H (VCW and burnt clay) were able to be macroscopically distinguished at sample selection, they were treated separately. These coarse ware and burnt clay types had only one fabric type for each ware type. They also had less variation, implying a strong continuity of keeping the clay recipes for these ware types. In addition, the fact that VCW and burnt clay at Tall-e Bakun A shared the same clay paste is interesting when considering the relationship between the VCW potter and the user of the burnt clay, who possibly used it for clay sealing or roofing. The petrographic similarity between VCW and burnt clay reinforces the suggestion that the local clay source was used for both. On the other hand, five fabric types were confirmed in the BOBW type. Among them, fabric type A is the most predominant (37 samples; 88% of BOBW samples), and the other fabric types (B, C, D, and E) had only one or two samples. These variants appear only at Tall-e Gap (Fabric types B and C) and Tall-e Jari A (Fabric types D and E). At Tall-e Gap, these variants of the fabric types in BOBW were confirmed only at the lowest level. In contrast, the variants at Tall-e Jari A did not show such a temporal specificity

Table 7.19 Fabric types, ware types, and site of the analyzed petrographic samples

Ware	BOBW					MBOBW	MCW	VCW	Burnt clay
Site / Fabric type	A	B	C	D	E	F	G	H	
Bakun A	8	-	-	-	-	1	1	1	1
Rahmatabad	10	-	-	-	-	-	-	2	-
Gap	6	1	1	-	-	-	2	2	-
Bakun B	8	-	-	-	-	-	-	4	-
Jari A	5	-	-	1	2	-	-	4	-
Total	37	1	1	1	2	1	3	14	1

58 Skibo et al. 1989.

within the four layers. The samples belonging to fabric type E originate from Layers 3 and 4 of Level I at Tall-e Jari A. Fabric type D was confirmed from Layer 2 of Level I at Tall-e Jari A. Considering the paucity of the total number of BOBW sherds at Tall-e Jari A in comparison with the other sites, it is suggested that the clay recipes at Tall-e Jari A were more diverse than those at the other sites.

The median proportions of inclusions, matrices, and voids were compared between fabric types in Table 7.20. The variants of Fabric type A of BOBW and MBOBW indicate more inclusions ranging from 5.5 % to 15 %. Compared to the other fabric types, the highest ratio of inclusions is a characteristic of Fabric type G (25%), and the highest ratio of voids is typical of Fabric type H (20%). These estimations were carried out using a visual percentage estimation chart. In addition, the proportion of homogeneity of clay matrices were different between BOBW-related Fabric types A, B, C, D, and E and Fabric types F, G, and H. While homogeneity of the clay matrix is predominant in the matrices of Fabric types A, B, C, D, and E, the matrix of Fabric type F shows a mottled heterogeneous pattern possibly due to overfiring. Fabric types G (MCW) and H (VCW) are more heterogeneous because of either clay mixing or the difference of firing temperature between the surface and the core. Only VCW samples from Tall-e Bakun B show homogeneity of clay matrices in VCW samples.

Although the samples were selected from the small pieces without diagnostic motifs and vessel forms for the destruction analysis, the relationship between fabric type – especially variants of BOBW and MBOBW (fabric types B, C, D, E, and F) – and vessel form was analysed (Table 7.21). Fabric type A is seen in all the vessel forms. Fabric type B is a large jar sherd. Fabric type C is an open vessel sherd painted on its interior. Fabric types D and E at Tall-e Jari A were unpainted parts of open vessels. Tall-e Jari A originally had fewer BOBW sherds, so it was difficult to select diagnostic pottery with a clear vessel form as a thin-section sample. As already mentioned, Fabric type F is a large jar sherd. Hence, from the examples of Fabric types B and F, it is suggested that clay paste with more mineral inclusions was used for a large jar. The size of a large jar is much bigger than the other vessel forms, and the vessel wall is also thicker. It is possible that the potter of the large jar intentionally prepared a special clay with more mineral inclusions before forming.

Comparison with a geological map

In the last section of this chapter, the provenances of several mineral inclusions will be approached by comparing a geological map of the Fars province (Fig. 7.60). This map was created by combining the geological maps of Shiraz, Sivand, Saatdashtar, and Arsenjan published by the Geological Survey of Iran and tracing them.[59] Nineteen formations and members near the analysed sites were extracted from the map, from the Jurassic to Quaternary periods (Table 7.22). The analysed sites were also dotted in the geological map. All the sites are located on the Quaternary alluvial plain. Tall-e Jari A, Tall-e Gap, and Tall-e Bakun A and B are placed at the southern piedmont of Kuh-i Rahmat, which consisted of formations Kdr (Dariyan formation), Ksv (Sarvak formation), and Kkz (Kazhdumi formation). These sites are apart from the current river locations of the Purvar River and the Kur River. On the other hand, Rahmatabad lies between the Sivand and Purvar Rivers in the valley sandwiched by the mountains of Jsm, Kdr, Kgd, Ksv, and Kfa.

The Kdr or Dariyan formation belongs to the Aptian age of the Cretaceous period. This formation consists of massive, thick-bedded orbitolina limestone, argillaceous limestone, and silicified argillaceous limestone in the lower portions. Other than this formation, limestone is frequently confirmed in the formations near the sites. However, the presence of orbitolina limestone was only confirmed at Kdr in this geological map. As described above, the fossils of orbitolinid foraminifera were discovered in the clay paste of MCW collected at Tall-e Bakun A and Tall-e Gap. The nearest provenance of Kdr to both sites was Kuh-i Rahmat. It is suggested that the MCW potter collected calcite inclusions, including the fossils, from this mountain.

Another diagnostic inclusion of MCW, red siltstone, was also confirmed in only one formation near the site. The Pesa or Sachun formation dated back to the Palaeogene of the Tertiary and has a yellow, greenish-grey, and yellowish-grey marl; marlstone and silt; red siltstone; and cherty conglomerate. This formation is located in the mountains between the city Marv Dasht and Shiraz. The Sachun formation is not associated with the Dariyan formation. In addition, the current river courses of the Purvar River and the Kur River do not pass this formation. From these grounds, it is suggested that red siltstone was brought from the source to the production site as temper. It is also possible that the red siltstone in fabric type B and possibly the greyish material in fabric type F derive from this source.

Summary of Thin-section petrography

To sum up this chapter, eight fabric groups were identified from the analysis of thin-section petrography. As for the preparation technique of the pottery paste, the details of adding temper, such as the temper's size, shape, and proportion, were clarified. Evidence of clay

[59] Geological Survey of Iran 1971.

Table 7.20 Fabric types and the proportion of inclusions, matrices, voids, and the ratio of homogeneity/ heterogeneity of matrix

Ware	Fabric type	inclusions (%)	matrix (%)	voids (%)	homo: hetero
BOBW	A: fine fabric	3	92	5	35 : 2
	B: red siltstone included medium fabric	10	82	8	1 : 0
	C: medium fabric	8	84	8	1 : 0
	D: calcite included medium fabric	15	89	5	1 : 0
	E: organic material included fine fabric	5.5	89	5.5	1 : 1
MBOBW	F: greyish material included coarse Fabric	10	83	5	0 : 1
MCW	G: red siltstone & calcite included coarse fabric	25	69	6	0 : 3
VCW	H: vegetal temper included coarse fabric	4	76	20	4 : 10

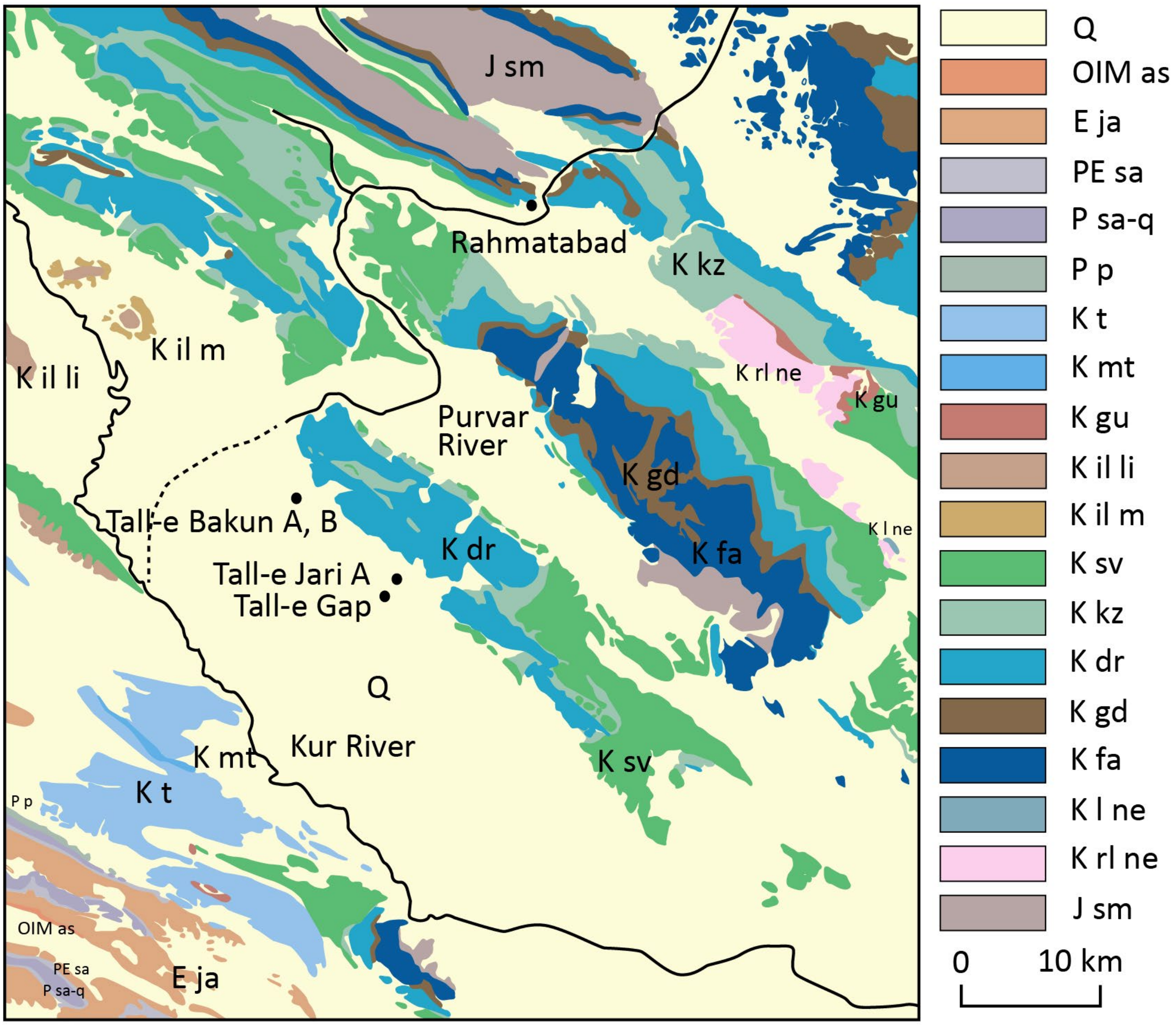


Figure 7.60 Geological map of the Kur River Basin (retraced from Geological survey of Iran)

mixing was also discovered in VCW. Technical steps of slipping, washing, painting, and firing techniques could be approached from the petrographic analysis. Although almost all the clay recipes in each fabric type are stable over time, the diachronic change in the variants of BOBW was observed in Tall-e Jari A and the lowest level of Tall-e Gap. Furthermore, the provenances of two diagnostic minerals, fossil included

Table 7.21 Samples of Fabric types A, B, C, D, E, F and their vessel forms

Ware	BOBW					MBOBW	
Vessel form/ Fabric type	A	B	C	D	E	F	Total
open vessel painted on its exterior	12	-	-	-	-	-	12
open vessel painted on its interior	8	-	1	-	-	-	9
open vessel painted on its rim	1	-	-	-	-	-	1
unpainted part of open vessel	10	-	-	1	2	-	13
large jar	5	1	-	-	-	1	7
misfired object	1	-	-	-	-	-	1
Total	37	1	1	1	2	1	43

calcite and red siltstone, were discussed. In the next chapter, I will examine pottery-making technique from geochemical approaches.

7-5. Geochemical analysis

Although the petrographic analysis using thin-section petrography contributed to understanding the provenance of mineral temper inclusion in mineral-tempered coarse ware (MCW), the technical steps of obtaining clay and firing still remain unsolved, especially black-on-buff fine ceramics (BOBW). The specific research questions in this chapter are as follows:

1) Where did the Bakun potters at the five sites collect clay for BOBW, MCW, and vegetal-tempered coarse ware (VCW)?
2) Did the potters at each site use different sources of clay for BOBW, MCW, and VCW?
3) How high was the firing temperature of each ware type? Did the firing temperature of each ware type change over time?

The first question is especially important at Tall-e Jari A, where BOBW accounted for less than 10%. Was BOBW locally made at this site or imported from the other intermontane valleys? The second question is also important since it can be a clue about whether BOBW, MCW, and VCW were made in the same communities of practice.

In Section 7-5, I will carry out geochemical analyses using ICP-OES (inductivity coupled plasma optical emission spectrometer), XRD (X-ray diffraction), and powder XRD to answer these questions related to the pottery-making techniques. Provenance studies using geochemical approaches are quite unfamiliar in the ceramic studies of the Bakun period. Although the discussion of the firing temperature of BOBW was already reported by Marghussian and her colleagues, the firing temperatures of VCW and MCW were not clarified or compared with that of BOBW. The sampling strategy and measurement instruments were explained in Chapter 4. In the first part of this Section, hierarchal cluster analysis (HCA) will be conducted for the purpose of grouping the geochemical compositions of 60 samples obtained by ICP-OES. The purpose of grouping is to search for geochemical similarities among the 60 samples. Principal component analysis (PCA) will be also conducted to look for similarities in the geochemical compositions of the 60 samples. In the second part of this section, the diagnostic results of XRD of each ware type from each site will be described with a diffractogram from the measurement results. Then, patterns of the geochemical similarities obtained from the HCA and PCA will be compared with the ware types and sites in order to answer the first and second research questions. In addition, the results will be examined with linear discriminant analysis (LDA) to confirm the correlation between ware types, sites, and geochemical compositions. In the third part of this section, I will answer the third question. Through the comparison of the previous studies of XRD at Rahmatabad, the firing temperature will be estimated based on the crystalline phase.

ICP-OES analysis

Hierarchical cluster analysis

The measurement results of the geochemical compositions consisting of ten elements (titanium, aluminium, iron, manganese, magnesium, calcium, sodium, potassium, strontium, and barium) were presented in Table 7.23. All these geochemical compositions were more than the detection limits of these elements in the ICP-OES reported by Uemoto (Appendix Table A6.3).[60] In order to roughly grasp their geochemical similarities and differences, HCA

[60] Uemoto 2011: Tables 3.2-3.

Table 7.22 Geological description of geological map (Figure 7.60) from the geological maps of Shiraz, Sivand, Saatdashtar, and Arsenjan published by Geological survey of Iran

Geological Age		Deposit	Description
Quarternary	Holocene	Q	Silt, sand, and clay, etc.
Tertiary	Oligocene	OIM as	Well bedded to thick bedded cream, brown and gray limestone and marly limestone interbedded with marl (Asmari formation)
	Eocene	Eja	Thick beds of white to cream dolomitic limestone interbedded with marly limestone and marl, dark gray ferrogenous, dolomitic limestone in upper portions (Jahrom formation)
	Paleocene	PE sa	Yellow, greenish gray and yellowish gray marl, marlstone and silt, red siltstone and cherty conglomerate (Sachun fomation)
	Paleocene	P sa-q	Thick bedded limestone and dolomitic limestone; marl, sandy limestone with chert (Ghorban member)
	Paleocene	P p	Purple, red, green and dark shale and marl, sandy marl and shale and conglomerate (Pabdeh formation)
Cretaceous	Marstrich., Companian	K t	Massive, gray to white, feature forming limestone (Tarbur formation)
	Companian	K mt	Yellowish gray marly limestone interbedded with marl (Tarbur member)
	Companian, Santonian	K gu	Yellowish and blueish gray marl, marlstone and marly limestone, dark marl with silicified limestone concreation in upper portions (Gurpi formation)
	Senonian	K il li	Massive, to well bedded, gray to white limestone (Limestone member of Ilam formation)
	Senonian	K il m	Shale, marl, sandstone and conglomerate (Shale member of Ilam formation)
	Cenomanian	K sv	Limestone, argillaceous limestone, marl and shale (Sarvak formation)
	Albian	K kz	Alternating of shale, marl, limestone and argillaceous limestone (Kazhdumi formation)
	Aptian	K dr	Massive to thick bedded, orbitolina limestone, argillaceous limestone and silicified argillaceous limestone in lower portions (Dariyan formation)
	Aptian	K gd	Greenish gray to brown marl and low-weathering, dark gray limestone (Gadvan formation)
	Neocomian	K fa	Massive to thick bedded, dark gray to brown limestone and oolitic limestone in lower portions (Fahliyan formation)
		K l ne	Gray to black detrital limestone with minor cherty radiolaritic beds and silicified limestone
		K rl ne	Alternation of detrital limestone, shale, marl, cherty-radiolaritic, sandy limestone and cherty limestone
Jurassic	Upper	J sm	Massive to thick bedded and feature-forming limestone, dolomitic limestone and argillaceous limestone (Surmeh formation)

Table 7.23 List of geochemical compositions of ceramic samples from five sites rounded by 3

Samples	Ba	Sr	Al2O3	TiO2	MgO	Fe2O3	MnO	K2O	Na2O	CaO
GF001	0.085	0.034	14.304	0.795	6.997	7.502	0.078	1.756	1.976	15.178
GF002	0.068	0.03	13.393	0.801	6.392	6.854	0.11	2.197	2.248	15.993
GF003	0.047	0.04	15.796	0.815	7.266	7.604	0.098	1.113	2.351	16.555
GC004	0.04	0.029	12.791	0.639	4.722	5.874	0.109	3.813	2.421	9.889
GC005	0.029	0.011	18.933	0.97	2.261	7.547	0.111	2.747	1.215	12.66
GF006	0.079	0.062	15.177	0.744	4.988	7.011	0.129	2.733	1.4	17.427
GF007	0.028	0.09	13.711	0.749	5.478	6.919	0.09	1.259	2.248	18.843
GF008	0.06	0.073	13.248	0.636	4.192	6.347	0.104	2.443	1.46	24.303
GF009	0.02	0.046	10.8	0.674	5.677	7.259	0.107	2.194	1.815	14.209
GF010	0.019	0.055	10.195	0.666	6.689	7.446	0.103	1.929	1.264	15.258
GC011	0.009	0.03	17.964	0.893	1.894	7.677	0.114	2.062	0.966	15.039
GC012	0.023	0.045	11.134	0.596	3.619	5.816	0.089	2.683	1.935	21.484
RF001	0.046	0.08	14.67	0.692	5.346	7.063	0.094	1.292	1.437	16.867
RF002	0.026	0.05	15.667	0.738	4.777	7.636	0.111	0.91	1.954	19.023
RF003	0.049	0.056	13.686	0.648	4.305	6.704	0.161	1.951	1.22	20.913
RF004	0.029	0.052	14.613	0.697	4.676	7.063	0.098	1.298	1.787	19.464
RF005	0.026	0.045	15.4	0.671	5.032	7.48	0.114	1.165	1.869	18.545
RF006	0.035	0.05	15.247	0.71	4.12	7.384	0.089	2.27	1.342	14.351
RF007	0.039	0.046	16.147	0.733	4.759	7.557	0.116	2.575	1.337	16.157
RF008	0.029	0.063	15.064	0.708	5.258	7.179	0.097	1.373	1.843	17.33
RF009	0.034	0.05	15.119	0.701	4.832	7.379	0.114	2.097	1.842	16.667
RF010	0.029	0.055	16.43	0.828	0.821	7.726	0.145	1.13	1.973	17.903
RC011	0.028	0.045	12.333	0.602	2.733	5.854	0.12	3.573	1.056	14.463
RC012	0.042	0.051	14.407	0.699	0.816	6.991	0.121	3.603	1.091	16.405
JF001	0.018	0.072	14.068	0.757	5.272	6.906	0.092	0.758	2.065	18.81
JF002	0.066	0.099	12.325	0.697	3.943	6.441	0.119	2.699	0.882	18.525
JC003	0.024	0.1	10.123	0.497	4.062	4.973	0.09	2.501	0.853	27.226
JF004	0.027	0.072	9.404	0.581	3.754	4.914	0.092	1.923	1.429	29.28
JF005	0.03	0.06	12.153	0.732	4.045	6.637	0.122	2.652	1.48	18.253
JC006	0.026	0.123	10.168	0.492	3.399	4.786	0.136	2.601	1.854	27.769
JF007	0.014	0.076	13.451	0.722	4.469	6.49	0.09	1.272	2.383	20.533
JF008	0.016	0.094	11.814	0.714	3.722	5.997	0.112	1.717	2.061	24.261
JC009	0.03	0.079	12.211	0.667	3.48	5.992	0.11	2.938	1.004	21.749
JF010	0.027	0.069	14.069	0.773	3.649	6.574	0.11	1.742	1.731	21.413
JF011	0.031	0.14	12.385	0.636	4.091	5.994	0.102	3.091	0.781	22.827
JC012	0.027	0.08	11.167	0.62	2.962	5.461	0.098	2.821	1.36	21.759
BF001	0.032	0.098	14.77	0.789	4.187	7.272	0.111	2.654	3.902	17.004
BF002	0.05	0.122	12.747	0.672	4.478	5.9	0.092	2.967	1.689	22.028
BF003	0.032	0.123	12.186	0.672	3.893	5.48	0.085	2.487	1.628	24.313
BF004	0.033	0.14	10.429	0.632	5.172	5.559	0.073	2.792	0.758	24.222
BF005	0.02	0.092	11.83	0.681	5.282	5.906	0.096	0.64	2.159	23.832
BF006	0.031	0.057	15.105	0.766	5.185	7.396	0.113	1.348	1.842	17.635
BF007	0.045	0.128	12.368	0.725	4.316	6.82	0.108	2.112	1.128	19.985
BF008	0.1	0.114	14.666	0.757	4.179	7.068	0.119	2.777	1.113	15.932
BC009	0.068	0.144	9.464	0.535	3.205	4.227	0.088	2.699	1.896	31.838

Table 7.23 continued List of geochemical compositions of ceramic samples from five sites rounded by 3

Samples	Ba	Sr	Al2O3	TiO2	MgO	Fe2O3	MnO	K2O	Na2O	CaO
BC010	0.049	0.12	11.684	0.666	3.555	5.063	0.074	2.44	2.023	25.242
BC011	0.066	0.14	9.052	0.544	2.808	3.877	0.073	2.274	1.776	36.034
BC012	0.092	0.158	10.239	0.563	3.22	3.986	0.082	2.766	3.068	32.751
AF001	0.037	0.079	11.77	0.644	3.892	5.416	0.064	2.584	1.641	27.213
AF002	0.031	0.066	14.143	0.732	5.562	6.7	0.109	1.488	2.071	19.423
AF003	0.06	0.098	13.935	0.76	4.505	6.725	0.112	2.331	1.948	18.138
AF004	0.024	0.079	12.846	0.73	4.622	5.999	0.081	0.569	2.291	24.784
AF005	0.031	0.067	12.815	0.676	4.58	6.048	0.09	1.887	1.895	23.359
AF006	0.011	0.086	12.059	0.664	4.142	5.567	0.059	1.019	2.294	28.734
AF007	0.06	0.099	11.806	0.637	3.504	5.586	0.069	2.505	1.541	25.261
AF008	0.028	0.143	11.388	0.679	6.253	5.454	0.104	0.287	2.701	25.944
AC009	0.027	0.044	17.584	0.92	4.704	7.67	0.136	1.546	1.736	15.328
AC010	0.026	0.054	9.424	0.478	3.951	4.328	0.052	2.122	1.165	34.365
AC011	0.023	0.069	9.522	0.505	3.366	4.324	0.048	2.743	1.316	32.856
AC012	0.012	0.03	22.744	1.18	2.437	8.412	0.134	2.608	1.116	9.173

was conducted using statistics software R. Ward method was used to calculate the cluster distances. The compositional data were rounded to three decimal places. Fig. 7.61 shows the result of the HCA of 10 elements. Two large groups (A: 29 samples, B: 31 samples) were separated at the early stage. When the cluster was cut at the height of 20 of the cluster distances, 60 samples could be further subdivided into five clustering group (A1: three samples, A2: 26 samples, B1: five samples, B2: 11 samples, and B3: 15 samples). The number of samples in one cluster group ranged from three (A1) to 26 samples (A2). As demonstrated in Section 7-4, many samples had traces of secondary calcite ($CaCO_3$) in the voids, which were formed in the post-depositional process. In addition, for the purpose of checking the influence from secondary calcite in the geochemical compositions, HCAs of the geochemical compositions without calcium were also carried out (Fig. 7.62). Among two big cluster groups (C: 24 samples, D: 36 samples), there are two (C1: 19 samples, C2: 5 samples) and three (D1: 9 samples, D2: 8 samples, D3: 19 samples) sub-cluster groups. The correlations of geochemical clustering with sites and ware types will be discussed in Section 10-3-1. In Figs. 7.61 and 7.62, samples with dots indicate the presence of secondary calcite in their voids. While the cluster groupings including calcium (Fig. 7.61) shows the densest concentration of these samples in B3 (nine dots of 15 samples; 60%), the cluster groupings without calcium (Fig. 7.62) do not show such dense concentrations (C1: four samples among 19 samples, 21%; D1: four samples among nine samples, 44%; D2: three samples among eight samples, 37%; and D3: seven samples among 19 samples; 36%). It implies that the secondary calcite affected the composition of calcium in ceramic samples, especially cluster B3.

Principal component analysis

PCA was applied to the same compositional data as the previous section using program R in order to 1) examine whether the clustering could be visualised in the form of biplot and 2) identify the relationships between specific chemical elements, shown as red arrows in the biplot, and each ceramic sample. Fig. 7.63 is the biplot of principal component (PC) 1 (contribution ratio: 43.5 %) and PC2 (contribution ratio: 18.4 %) of 10 elements among 60 samples. The distribution of 60 samples could be roughly cut into two groups horizontally at 0.0 to the upper and lower parts. There were several outliers that were distant from the two clusters (AF008, AC012, RC012). In addition, arrows indicate the directions and degrees of influence of 10 elements. Calcium and strontium were directed horizontally to the left. Aluminium, titanium, and iron are directed horizontally to the right. Manganese is directed to the upper right. Magnesium and sodium were directed toward vertically to the lower portion. Finally, potassium and barium are directed to vertically upper portion. From these directions of the elements, it is suggested that PC1 was related to calcium, strontium, aluminium, titanium, and iron and that PC2 was related to magnesium, sodium, and potassium. As with HCA without calcium, PCA of nine elements without calcium was conducted (Fig. 7.64). When compared with Fig. 7.63, the spatial relations between samples looked unchanged. When closely compared, it became clear that the location of GC004 in the biplot moved a bit toward the left. The direction and length of the arrows of elements are similar to those of Fig. 7.63. The samples with secondary calcite in their voids were marked with black frames in Figs. 7.63 and 64. The location of these samples did not

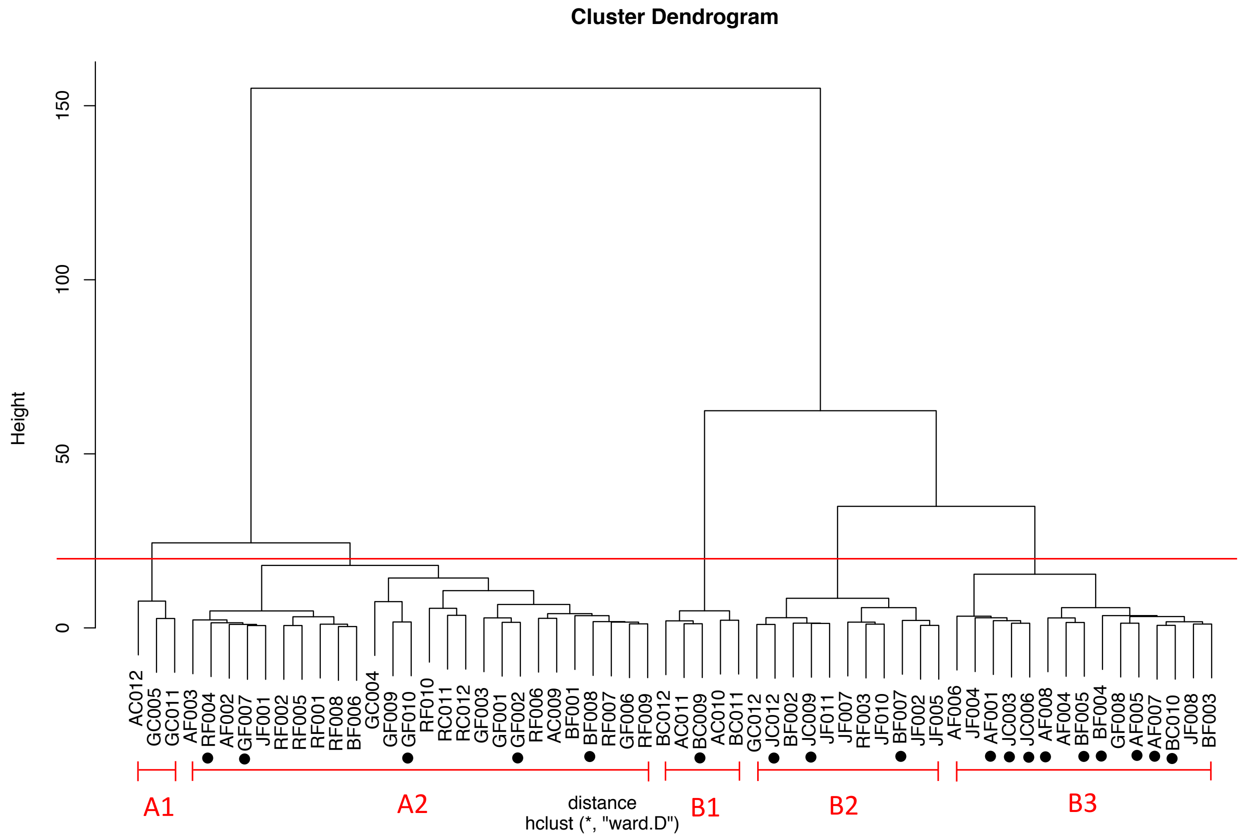


Figure 7.61 Result of HCA of 10 elements. Black dots indicate samples with secondary calcite

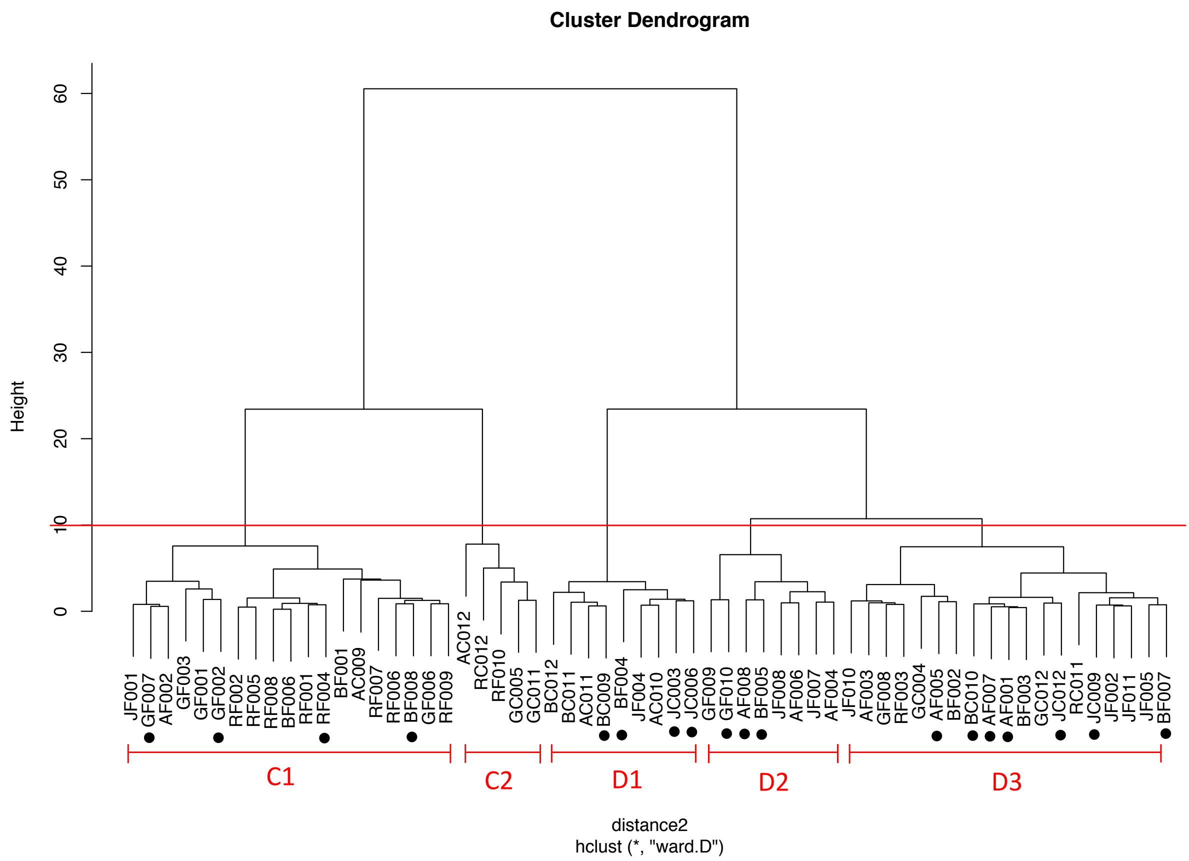


Figure 7.62 Result of HCA of nine elements. Black dots indicate samples with secondary calcite

change very much between the results with calcium and those without calcium, implying the weakness of the influence of secondary calcite, in contrast to the results of HCA.

Discussion of ICP-OES analysis

On the basis of the result descriptions obtained from the geochemical analyses, the discussion includes the technical steps of obtaining clay.

Correlation between HCA and PCA results and sites and ware types

In this section, the correlation between HCA and PCA clustering results of geochemical compositions (Figs. 7.61-64) and sites and ware types will be investigated to approach the geochemical differences and similarities of clay sources by site and ware type. Fig. 7.65 indicates the number of ware-type samples in each HCA clustering group at each site. While bar graphs on the left side show HCA clustering with calcium (Fig. 7.61), those on the right indicate HCA groupings without calcium (Fig. 7.62).

At first, the correlation of HCA clustering including calcium with sites and ware types (Fig. 7.65: left) was considered. At Tall-e Jari A, BOBW belongs to B2, B3, and A2. VCW was confirmed in only B2 and B3, overlapping with the groups of BOBW. BOBW samples from Tall-e Bakun B belong to A2, B2, and B3. One VCW sample belonged to B3 with BOBW. The other three

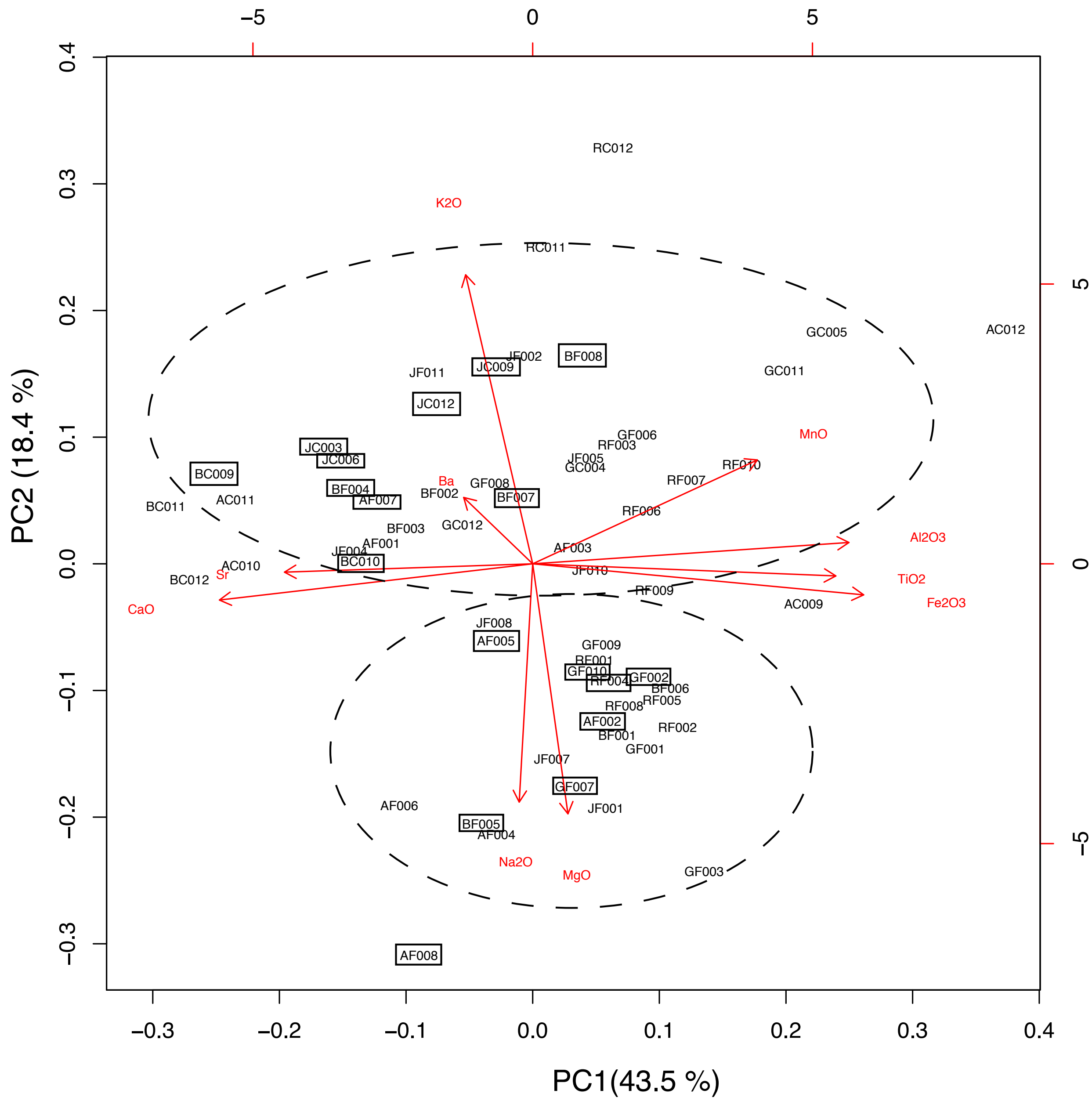


Figure 7.63 Biplot of PCA of 10 elements. Black frames indicate samples with secondary calcite

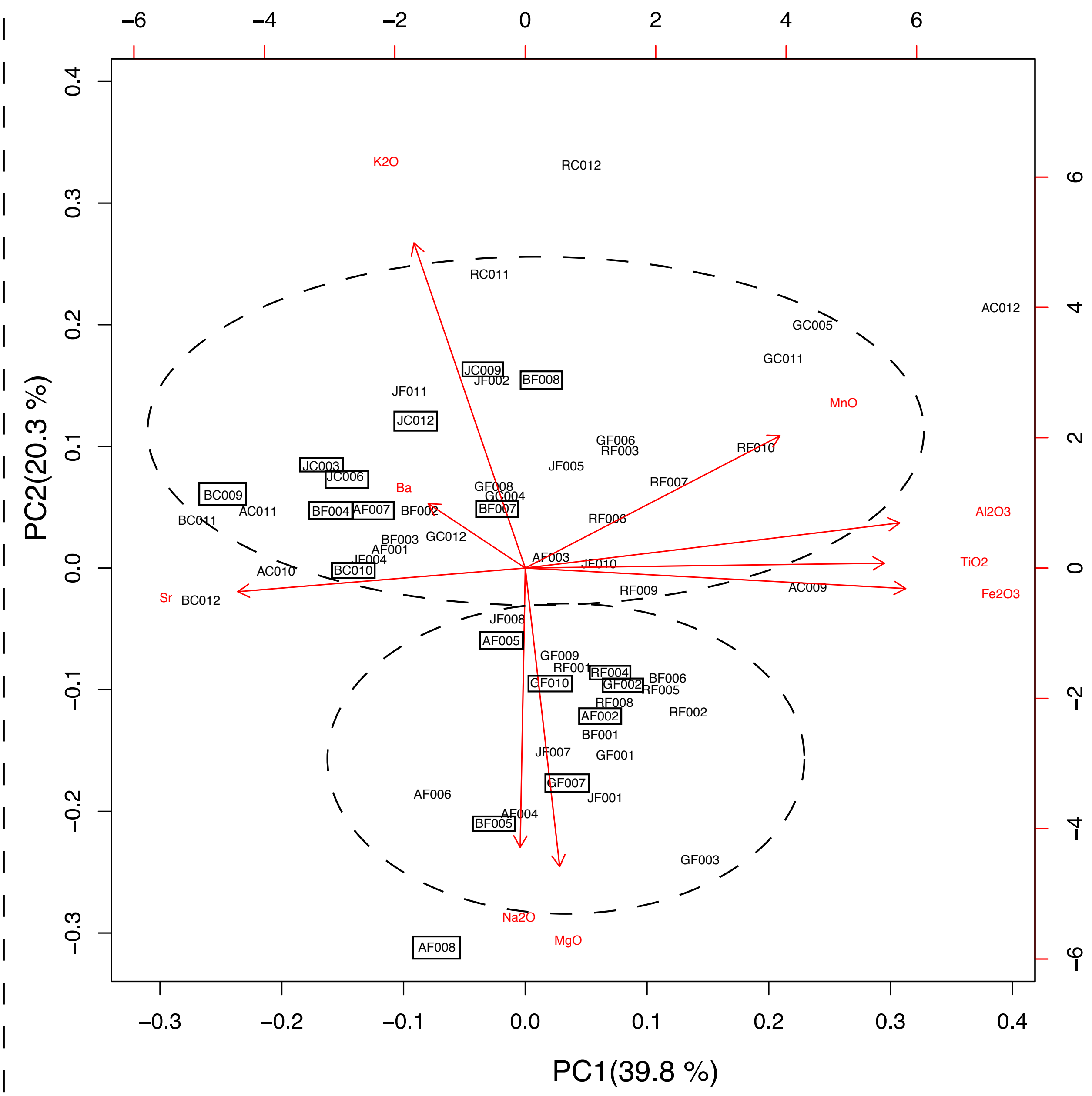


Figure 7.64 Biplot of PCA of nine elements. Black frames indicate samples with secondary calcite

VCW samples concentrated on B1 separately from BOBW. Most BOBW samples from Tall-e Gap were in A2, except for one sample (B3). While a VCW sample was in A2 with the majority of BOBW, another VCW sample was isolated in B2. Two MCW samples were observed exclusively in A1. Rahmatabad shows a similar pattern to Tall-e Gap. Most BOBW samples belonged to A2, except for one in B2 at Tall-e Gap. All the VCW samples were also in B2. Finally, the majority of BOBW samples from Tall-e Bakun A were found in B3. The other BOBW samples were found in A2 with one MBOBW sample. One VCW sample and one burnt clay sample belonged to the same group, B1. One MCW sample existed in A1, the same group as MCW from Tall-e Gap.

Second, the relationship between HCA clustering without calcium and sites and ware types (Fig. 7.65: right) was discussed. At Tall-e Jari A, the majority of BOBW samples fell into D2 and D3, except for one sample each from C1 and D1. VCW overlapped with BOBW at D1 and D3 at Tall-e Jari A. At Tall-e Bakun B, BOBW samples belonged to C1 and D3. The remaining two BOBW samples were found in D1 and D2. Most VCW samples were in D1, except for one sample in D3 at Tall-e Bakun B. At Tall-e Gap, most BOBW samples belonged to C1, which consisted exclusively of BOBW. The remaining BOBW samples were confirmed in D2 and D3. While VCW overlapped with BOBW samples at D3 at Tall-e Gap, MCW belonged only to C2. The pattern at Rahmatabad

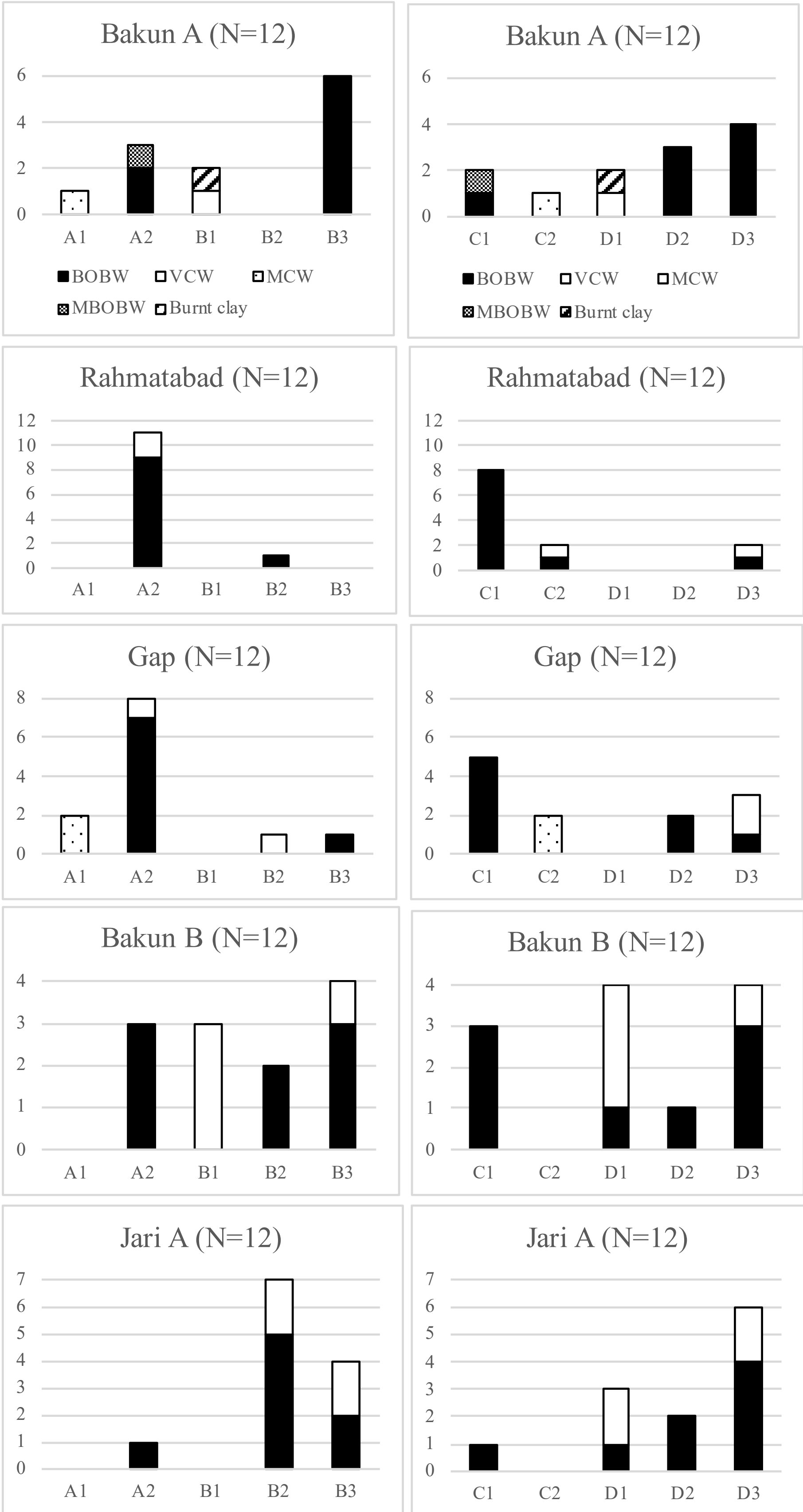


Figure 7.65 Cumulative count of ware-type samples in each HCA clustering group at each site with calcium (left: from Figure 7.61) and without calcium (right: from Figure 7.62)

was similar to that of Tall-e Gap. Most BOBW samples comprised one exclusive group at C1. The rest of the samples were found in C2 and D3, where VCW samples were also confirmed. Finally, at Tall-e Bakun A, all the chemical clustering groups were occupied in C1, C2, D1, D2, and D3. The majority of BOBW samples belonged to D2 or D3. The remaining BOBW samples belonged to C1 with one MBOBW sample. Burnt clay and VCW samples were found together in D1. One MCW sample belonged to C2, as well as those from Tall-e Gap.

There did not exist a clear difference between the geochemical compositions of VCW and those of BOBW at Tall-e Jari A, implying use of the same source of clay as VCW for production of BOBW (see Fig. 7.65). The hypothesis that a small amount of pottery was imported from the other intermontane valleys was rejected. The slight similarity of geochemical composition co-existing in the same clustering between BOBW and VCW was also observed at Tall-e Bakun B, Tall-e Gap, and Rahmatabad. In contrast, MCW independently formed separate clustering groups at Tall-e Gap and Tall-e Bakun A and showed a unique geochemical composition.

The correlations between PCA results (Figs. 7.63-64) and sites and ware types were considered by classifying sites and ware types of ceramic samples in the figures by colour. Fig. 7.66 show the biplot of PCA with calcium that classified sites by colours. The biplot does not show the separation of samples by site. In contrast, the biplot that classified ware types by colour (with calcium: Fig. 7.67) indicate clearer separation of the concentration of ware types than the former biplot by site. A burnt-clay sample was in the concentration of VCW samples. While the concentrations of BOBW samples and VCW samples partially overlapped each other, three MCW samples and one MBOBW sample were distantly distributed from those concentrations.

Considering the directions and degrees of geochemical elements shown in Fig. 7.63-64, specific elements characteristic of each ware type can be identified. The majority of BOBW samples are located in the lower-central part of the biplot. This distribution corresponds with the arrows of Na_2O and MgO. On the other hand, a cluster of VCW samples were observed in the upper-left part of the biplot. This distribution covers the directions of arrows of CaO, Sr, K_2O, and Ba. Finally, MCW is separately clustered in the upper-right part of the biplot. It shows strong influences from MnO, Al_2O_3, TiO_2, and Fe_2O_3. The reddish fabric of MCW might reflect the influence of iron oxides.

Since it is clear that the geochemical compositions of BOBW, VCW, and MCW are different, then the PCA of geochemical compositions of BOBW samples (Fig. 7.68) and that of VCW samples (Fig. 7.69) were conducted and classified by site. PCA results of BOBW samples do not show diagnostic clustering by site. However, PCA results of VCW samples indicate a clear separation of VCW samples at Tall-e Bakun B and Tall-e Bakun A from those at the other sites. Although samples from Rahmatabad and Tall-e Jari A were clustered, those from Tall-e Gap were located between samples from Rahmatabad and those from Tall-e Jari A. Hence, it is suggested that the clay used in making VCW shows more local character than that used for BOBW.

Linear discriminant analysis based on site, ware, and petrography

Considering the correlation between HCA results and sites and ware types, geochemical similarity between VCW and BOBW at Tall-e Jari A and geochemical differences between MCW and other ware types were suggested. From the discussion about the correlation between PCA results and sites and ware types, there is a clearer geochemical difference among ware types than among sites and the geochemical difference of VCW among sites was visualised. To investigate and examine further these four points, linear discriminant analysis (LDA) was also used with the same data as HCA and PCA. The compositional data of 60 samples with archaeologically defined classes (sites and ware types) were used to calculate a discriminant model of these classes using the "lda" function in Package MASS of R. Using another function, "predict", in the same package, the same compositional data were classified again with the discriminant model into groups whose separation of defined classes (sites and ware types) was maximized.

Fig. 7.70 and 7.71 are the biplots of LDA results that were modelled and reclassified based on the discovered sites of the samples. The samples from Rahmatabad were distinguished from the samples from the other sites located in the Kur River Basin. This result fit with the geographical distance between Rahmatabad and the other sites. The samples from Tall-e Gap and Tall-e Bakun B were also distributed separately, though they partially overlapped with the concentration of samples from Tall-e Bakun A and Tall-e Jari A. The samples from Tall-e Bakun A and Tall-e Jari A were mixed in one big concentration. The LDA results that were modelled and reclassified using ware types (Fig. 7.71), as well as the PCA results (Fig. 7.67), show a clear separation of each ware type, reinforcing the argument for the significant difference between geochemical compositions of ware types.

Next, to examine the clustering of BOBW samples based on sites, the compositional data of BOBW samples were extracted, and LDA based on sites was conducted (Fig. 7.72). As a result, three groups of BOBW samples

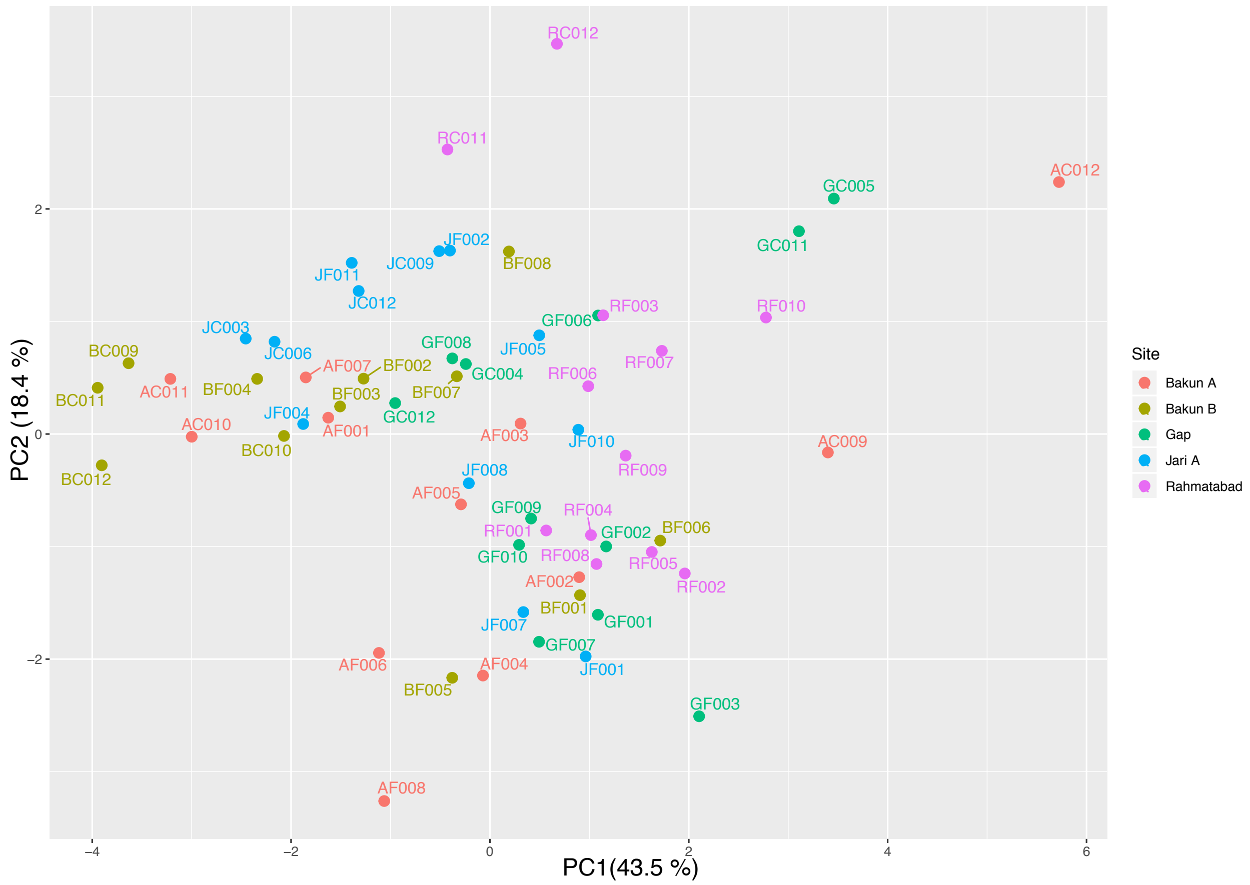


Figure 7.66 Biplot of PCA of 10 elements (same as Figure 7.63)

could be recognised: one cluster that consisted only of samples from Rahmatabad; one cluster that had five samples from Tall-e Gap (GF001, GF002, GF003, GF009, and GF010, each found from Levels 2, 14a, 16, 17, 17 of Tall-e Gap); and one big cluster in which samples from Tall-e Jari A, Tall-e Bakun A, Tall-e Bakun B, and Tall-e Gap were mixed. The ceramic samples from Tall-e Gap that formed the small separate cluster were derived mainly from the lower levels at Tall-e Gap. It is suggested that the clay source of BOBW at Rahmatabad and at the lower levels of Tall-e Gap were different from another main clay source of BOBW at the other sites. The compositional data of VCW samples and one burnt-clay sample were also extracted, and LDA was carried out (with calcium: Fig. 7.73). VCW samples from each site were more clearly separated from each other than the PCA results (Figs. 7.69). This separation suggests that there were separate clay sources near each site and were used for VCW.

The geochemical similarity of BOBW samples within the Kur River Basin even after LDA is possibly due to continuously selecting similar types of naturally fine clay to make BOBW near rivers in the alluvial plain over time. It is inferred that this kind of clay acquisition (looking for naturally fine clay) was distinguished from the local clay acquisition for VCW and another method of clay acquisition for MCW. Whether the activities of collecting clay for each ware type were carried out together or separately (ware type by ware type) still remains a question. Only at Tall-e Jari A, where VCW accounted for about 90% in wares, the sharing of clay for both VCW and BOBW was implied. After Tall-e Jari A, when BOBW became predominant in the ceramic assemblage, it is possible that clay acquisition activity was separated between VCW and BOBW. MCW making was a new tradition from Tall-e Gap, and clay acquisition of MCW might be different from other ware types, as well as acquiring and adding the temper.

XRD analysis

Below, I describe the presence of minerals in each ware type by picking up several diagnostic diffractograms in order to examine the firing temperatures of ceramic materials. I will describe the XRD results of ceramic samples from Tall-e Jari A, and proceed to Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A.

XRD results of ceramic samples at Tall-e Jari A

As it is clear from the diffractograms of samples from Tall-e Jari A, these diffractograms have noises between 20° and 25° 2θ. JF004 is a BOBW sample (Fig. 7.74). As a

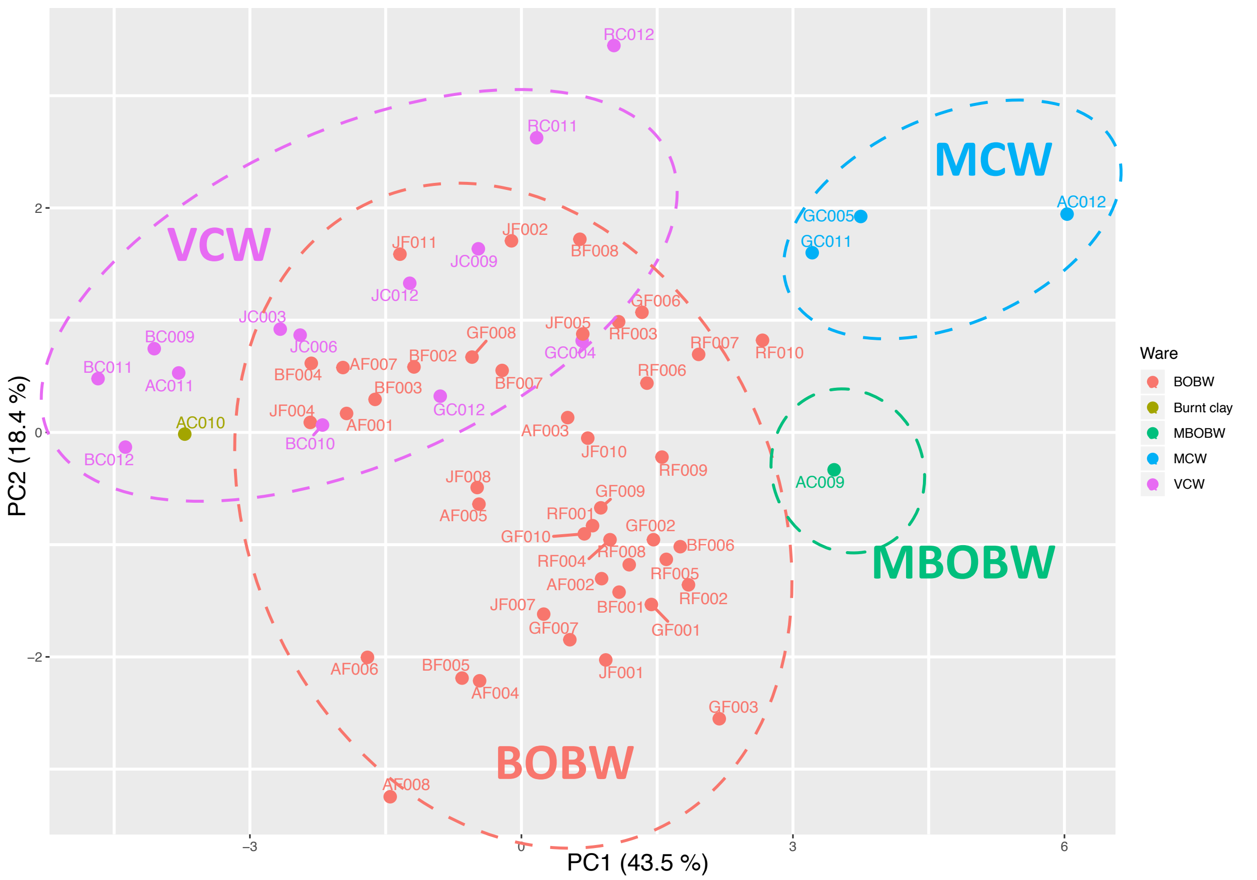


Figure 7.67 Biplot of PCA of 10 elements (same as Figure 7.63)

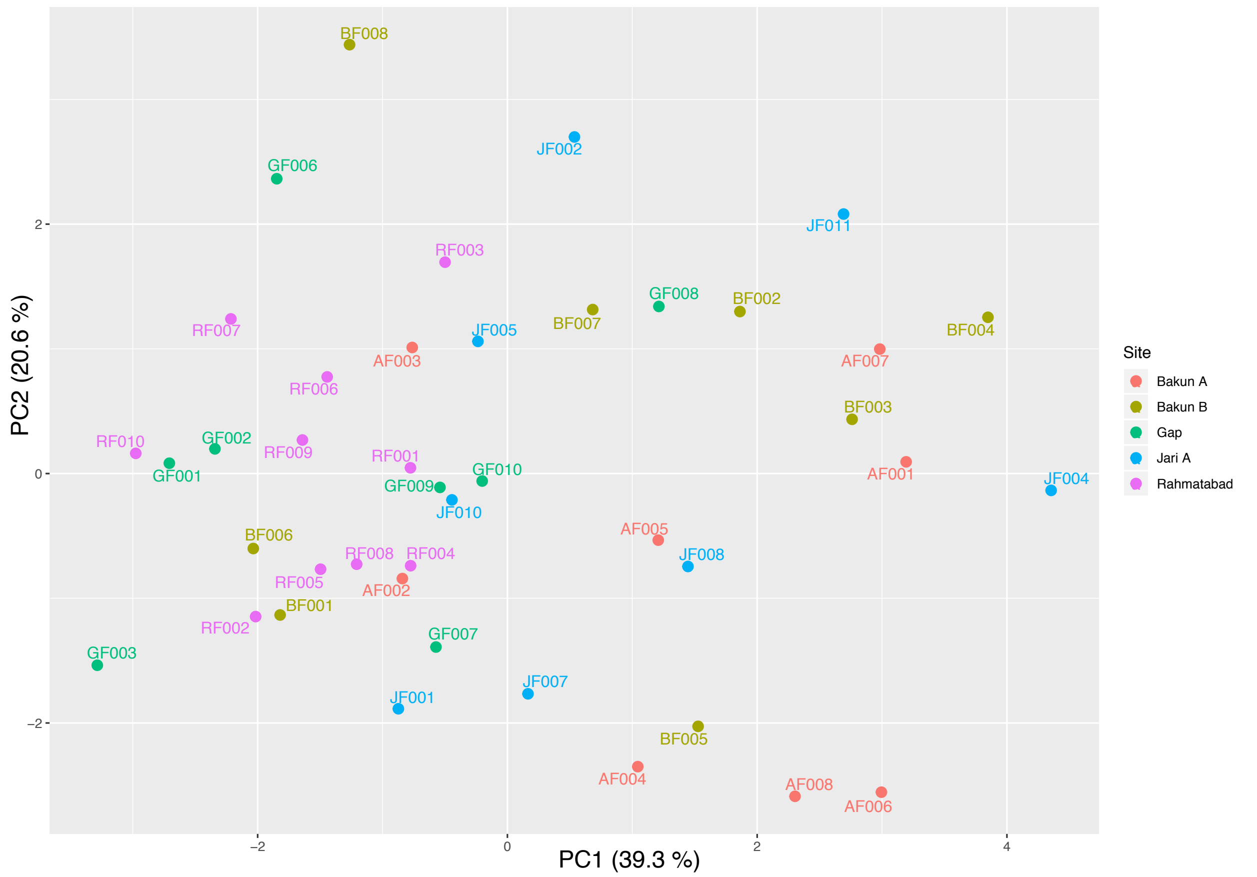


Figure 7.68 PCA biplot of 10 elements of only BOBW samples

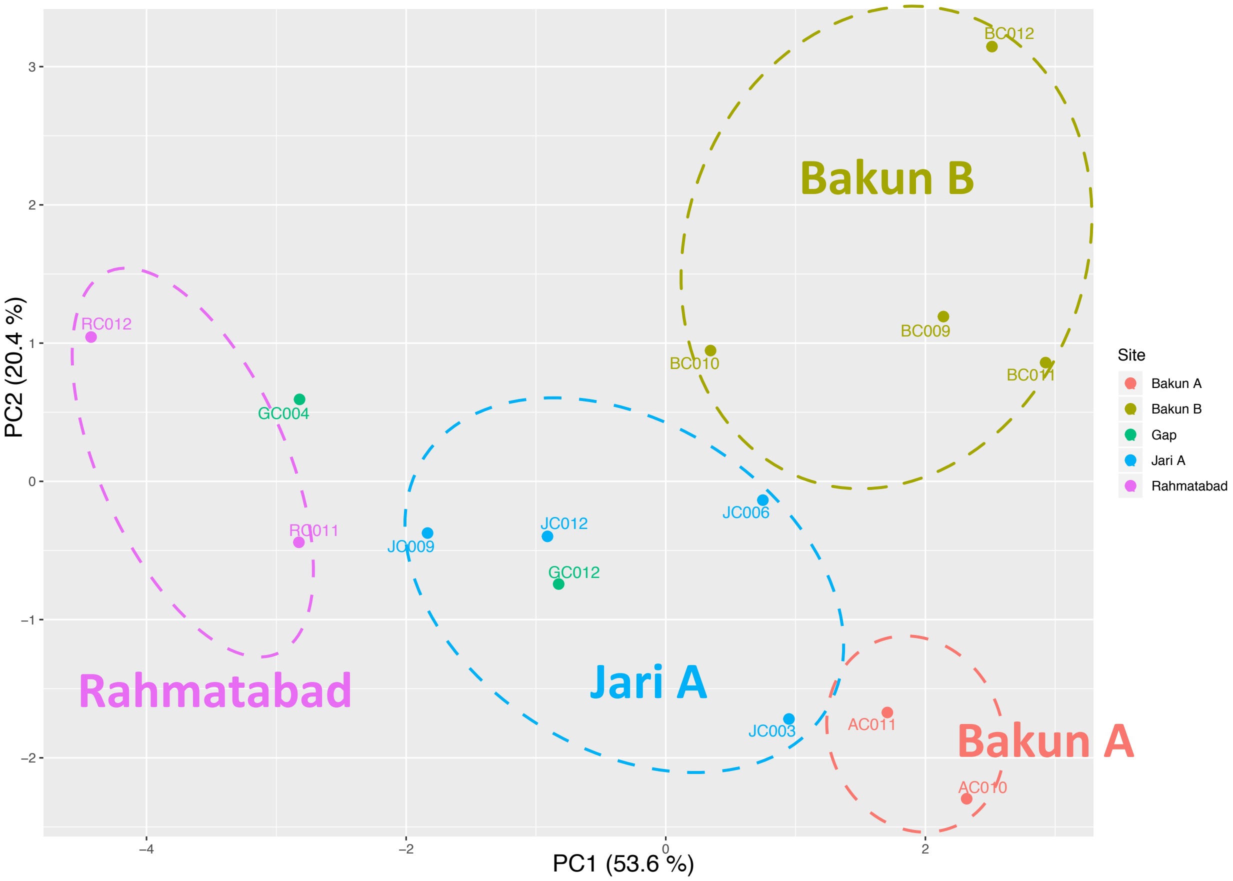


Figure 7.69 PCA biplot of 10 elements of only VCW samples

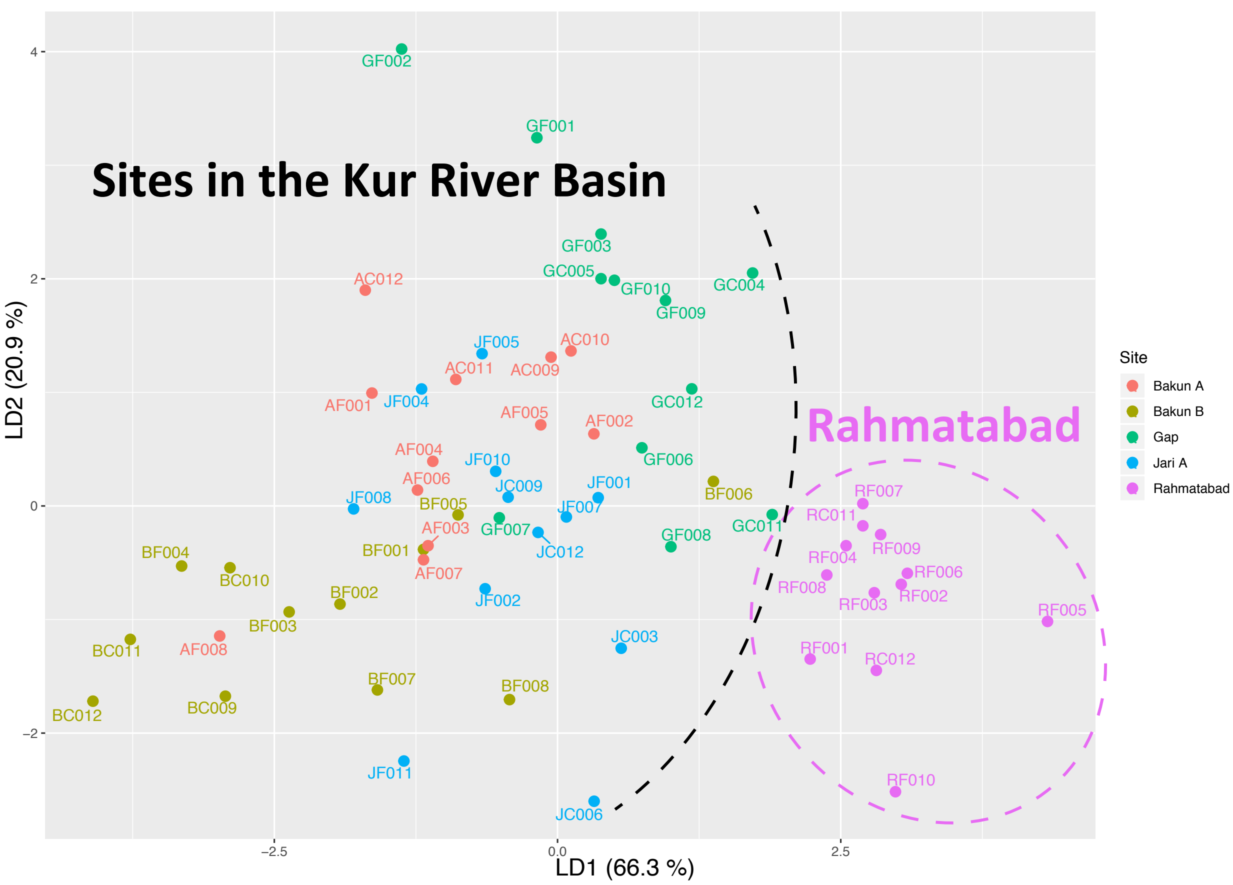


Figure 7.70 Biplot of LDA of 10 elements. Site was used to calculate a discriminant model. Dot colours indicate site difference

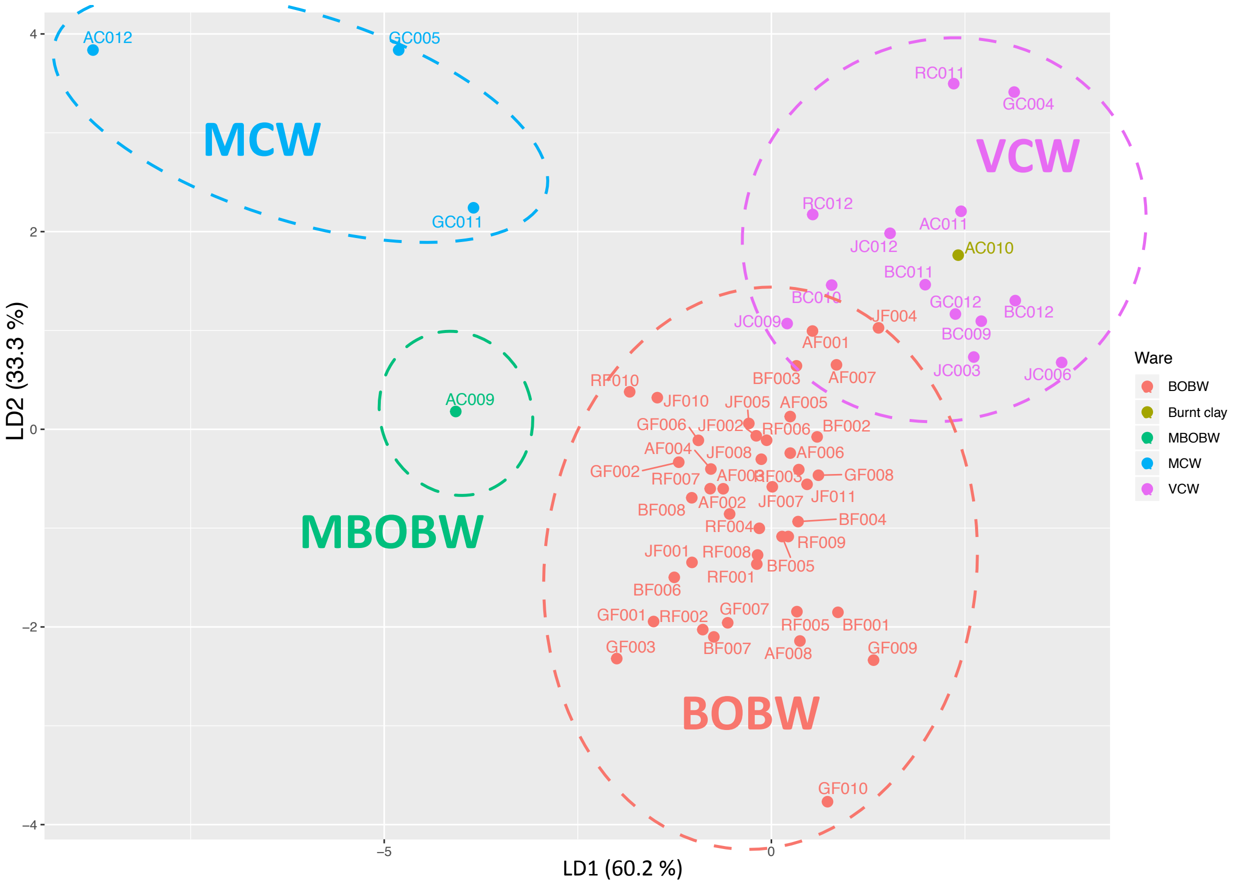


Figure 7.71 Biplot of LDA of 10 elements. Ware was used to calculate a discriminant model. Dot colours indicate ware difference

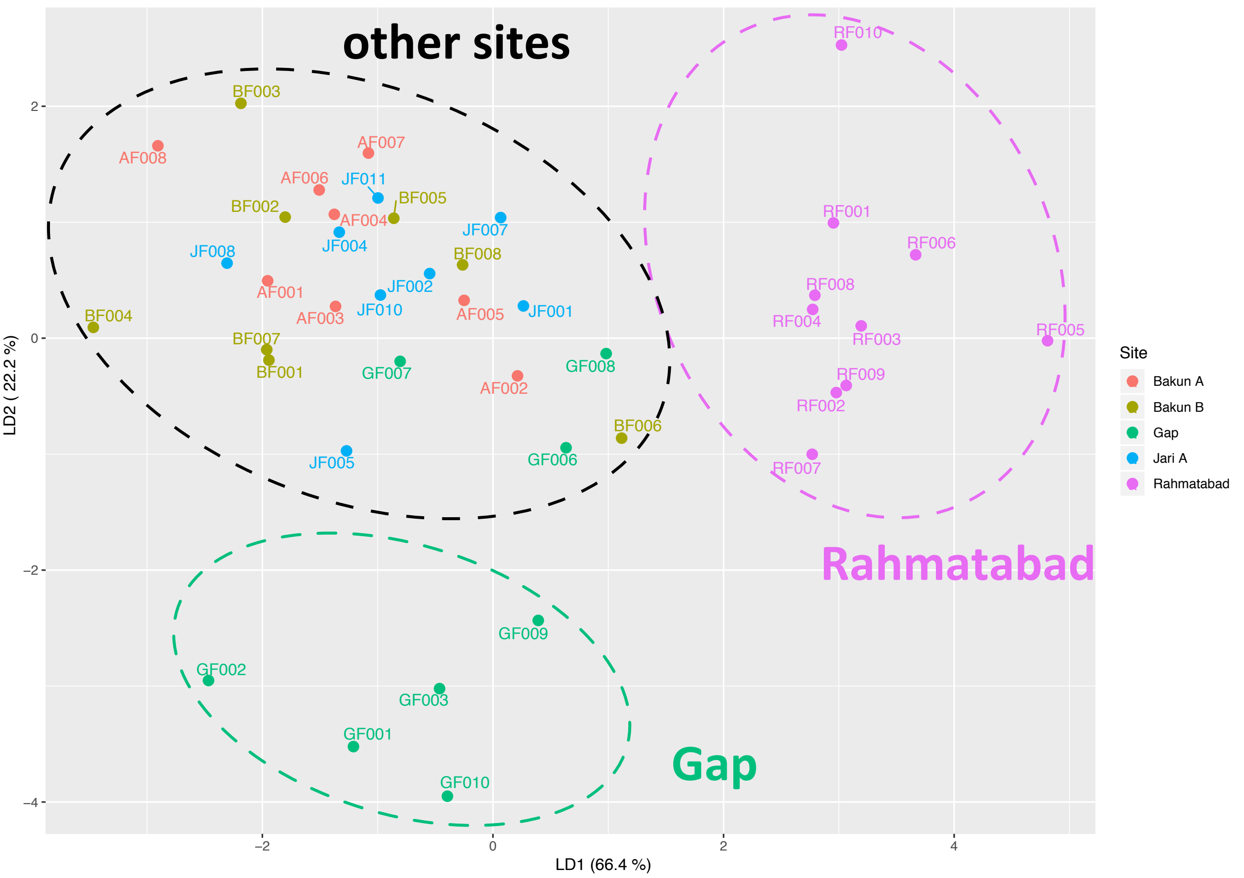


Figure 7.72 LDA biplot of 10 elements of only BOBW samples. Site was used to calculate a discriminant model

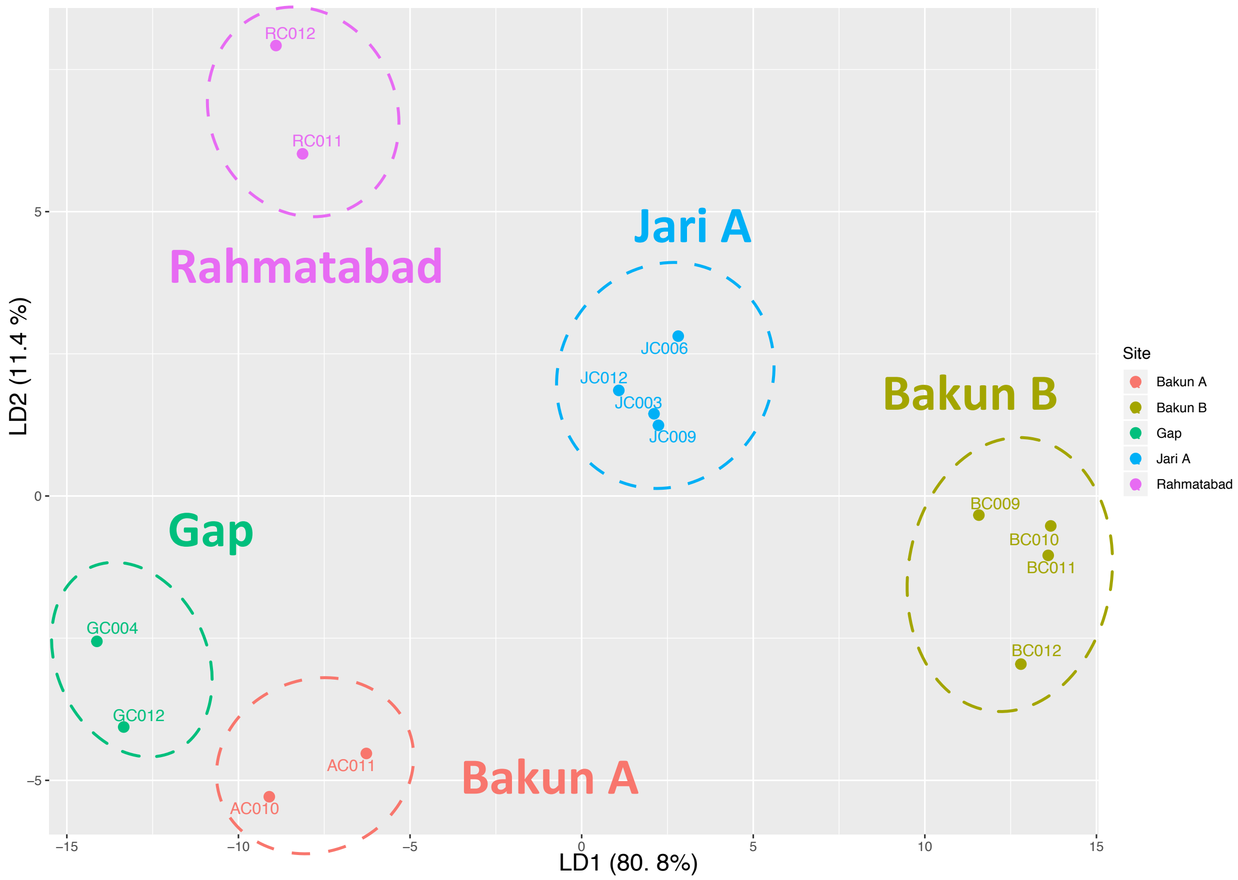


Figure 7.73 LDA biplot of 10 elements of only VCW samples. Site was used to calculate a discriminant model

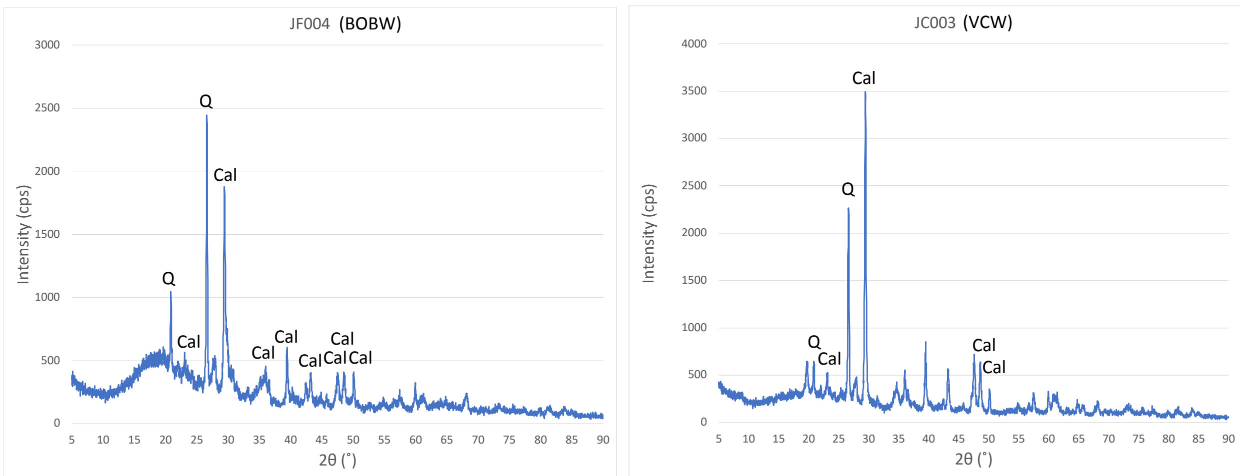


Figure 7.74 XRD diffractograms of samples JF004, JC003, and identified minerals.

result of petrographic analysis, calcite fragments were confirmed in the paste. The diffractogram of JF004 indicates the presence of quartz and calcite, supporting its petrographic result (Fabric type D: calcite-included medium fabric). JF008, an unpainted part of an open BOBW vessel, presents the existence of gehlenite and quartz. On the other hand, not only gehlenite and quartz but also the possible presence of diopside were confirmed in BOBW sample JF010. The other BOBW samples from Tall-e Jari A had either quartz, gehlenite, or diopside (see Table 7.24). Both diopside and gehlenite were confirmed in half of the BOBW samples from Tall-e Jari A. The diffractograms of VCW (JC003) had calcite (Cal) and quartz (Q, Fig. 7.74). In contrast to BOBW, diopside and gehlenite were not observed in the paste of VCW.

XRD results of ceramic samples at Tall-e Bakun B

BF002, an unpainted body part of an open BOBW vessel, showed the presence of quartz and diopside (Di, Fig. 7.75). Although the intensity of the peak was weak, gehlenite (Ge) was also possibly present in BF002. While the presence of quartz and diopside were clearly confirmed in a large portion of BOBW samples at Tall-e Bakun B, gehlenite was less clearly observed. The diffractogram for BC011 (VCW) exhibited the presence of quartz and calcite (Fig. 7.75).

XRD results of ceramic samples at Tall-e Gap

Although Tell-e Gap had fewer XRD samples than the other sites, the measurement results of ceramic materials from Tall-e Gap were obtained from powdered XRD. Thus, the resolution and precision were better than the results of the former two sites. The diffractogram of GF001 (BOBW) had strong peaks of diopside, followed by quartz (Fig. 7.76). In the diffractogram of GF003, an open BOBW vessel painted on its interior, the possible

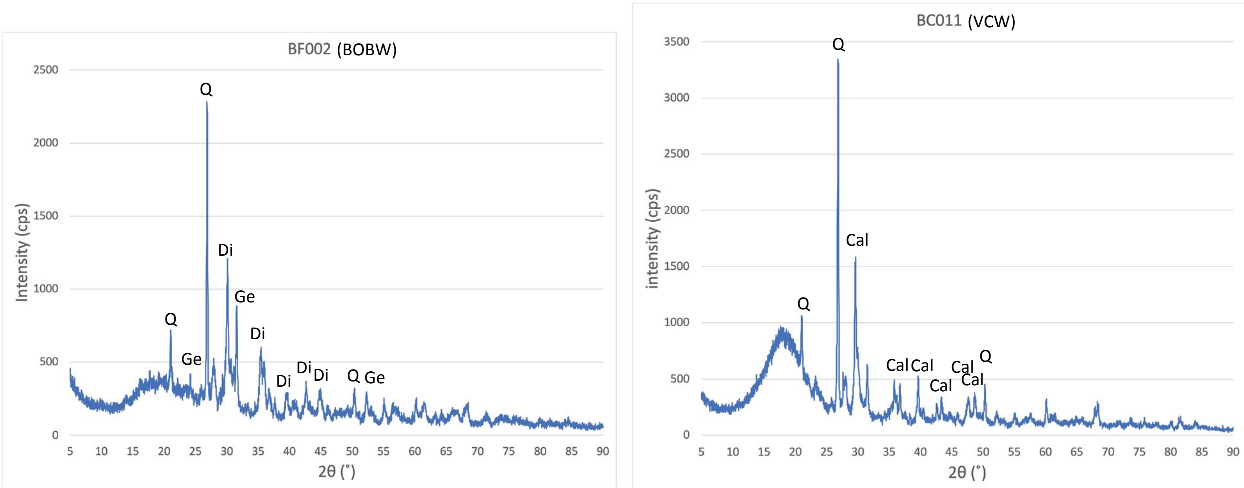


Figure 7.75 XRD diffractograms of samples BF002, BC011, and identified minerals.

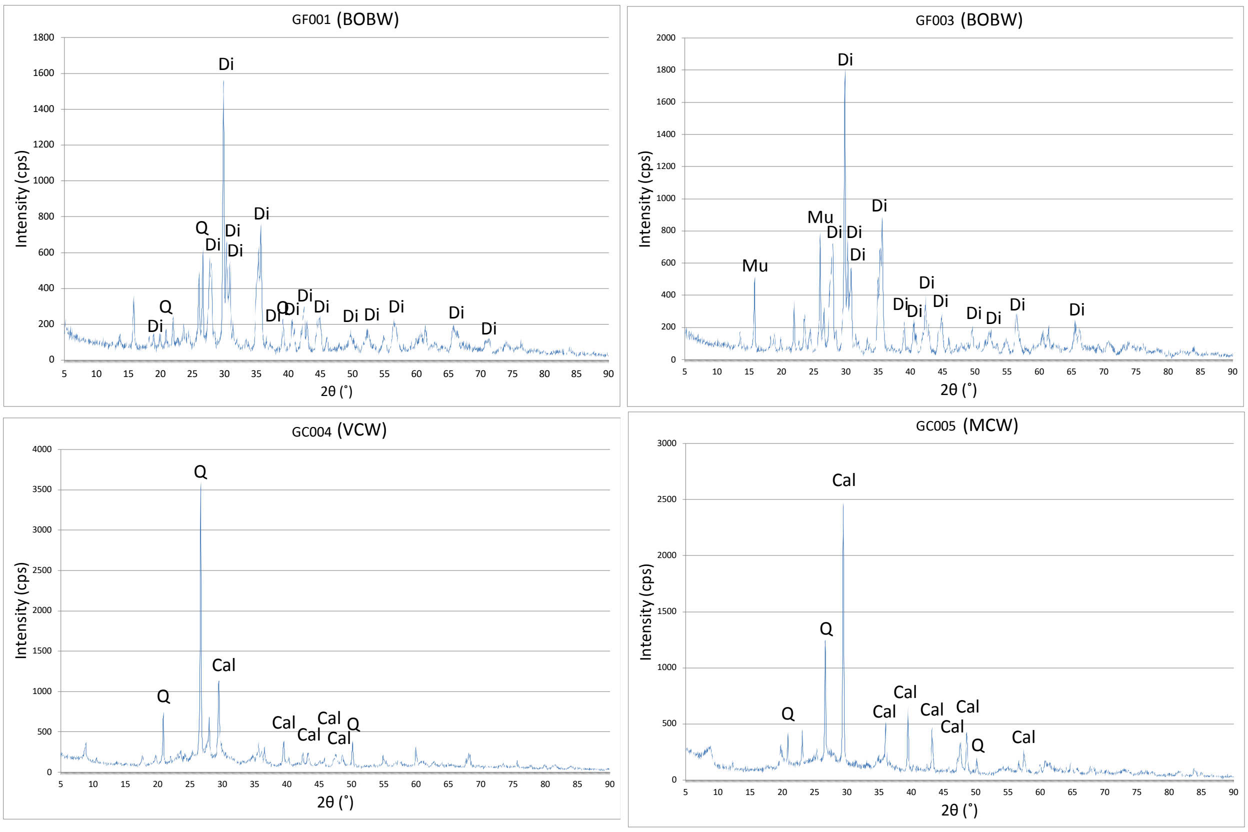


Figure 7.76 XRD diffractograms of samples GF001, GF003, GC004, GC005 and identified minerals.

presence of mullite (Mu) was also observed with the strongest peak of diopside (Fig. 7.76). The other ware types, VCW and MCW, from Tall-e Gap were also measured. VCW sherd GC004 had peaks of quartz and calcite (Fig. 7.76). Though MCW sherd GC005 also had peaks of quartz and calcite, the calcite peak intensity was stronger than that of quartz (Fig. 7.76). The strong peak of calcite was due to the use of calcite as temper.

XRD results of ceramic samples at Tall-e Bakun A

Finally, powder XRD measurements of samples from Tall-e Bakun A include the most diverse ware types of all analysed sites (BOBW, misfired object of BOBW, VCW, MCW, MBOBW, and burnt clay). The diffractogram of each ware type is described below. AF002, a BOBW open vessel painted on its exterior, showed the presence of diopside and quartz (same as BOBW at Tall-e Gap). The presence of diopside aluminian was difficult to distinguish from that of diopside, but the possible presence of diopside aluminian was confirmed in AF002. The diffractogram of AF006, a body part of a large jar of BOBW, exhibited strong peaks of quartz, diopside, and gehlenite (Fig. 7.77). AF008, a misfired object of BOBW, indicated the presence of mullite in addition to the strong peak of diopside (Fig. 7.77). AC009, a body part of a large jar and the only measurement result of MBOBW, showed strong peaks of diopside and quartz (Fig. 7.77). The XRD result of a burnt clay sample, AC010, had the strongest peak of calcite, followed by quartz. The diffractogram of AC012, an MCW sherd, presented calcite and quartz inside the paste. This result fit well with the petrographic observation of MCW of the inclusion of calcite in the paste.

Discussion of comparison of minerals and estimation of firing temperature

Several minerals indicating changes after firing (e.g. calcite, diopside, and gehlenite) were characterised from XRD and powder XRD analyses. Table 7.24 presents the list of identified minerals of 39 ceramic samples. The pattern of identified minerals in each ware type at each site will be considered below in order from Tall-e Jari A, Tall-e Bakun B, Tall-e Gap, to Tall-e Bakun A. First, there were four BOBW samples at Tall-e Jari A in which both diopside and gehlenite were present. One BOBW sample had only diopside (JF001), and one BOBW sample had only gehlenite (JF008). There are two BOBW samples in which both diopside and gehlenite were not observed (JF002 and JF004). Calcite was characterised in JF004. On the basis of the evidence, it is suggested that the majority of BOBW samples at Tall-e Jari A were fired at a temperature greater than 850 °C. In contrast, all VCW samples from Tall-e Jari A have neither diopside nor gehlenite. Instead, the presence of calcite in VCW

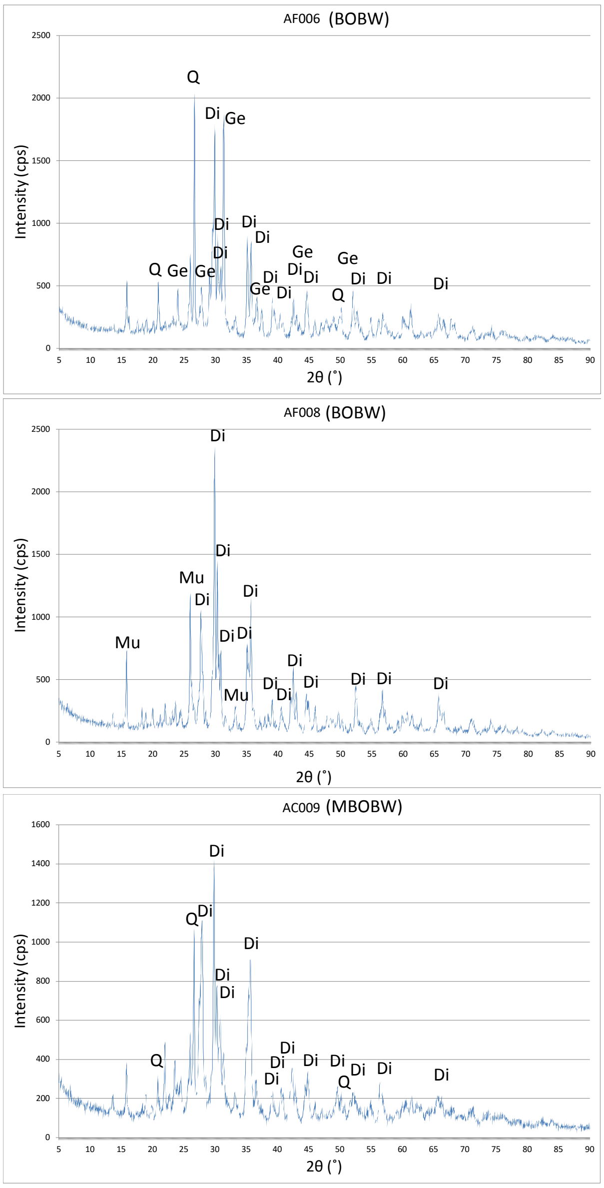


Figure 7.77 XRD diffractogram of samples AF006, AF008, AC009, and identified minerals.

was clear, indicating that the firing temperature was lower than 850 °C.

Second, the presence of quartz was common in BOBW samples from Tall-e Bakun B. Diopside was confirmed in eight BOBW samples, except for BF002. Among them, three BOBW examples indicated the possible presence of diopside aluminian (BF006-008), and three examples showed the possible presence of gehlenite (BF001, BF002, and BF008). The minerals indicating a high firing temperature were not observed in BF004 alone. It is likely that most BOBW samples were fired at a temperature higher than 850 °C. Calcite was confirmed from VCW samples at Tall-e Bakun B, suggesting firing temperatures lower than 850 °C. One exception among the VCW samples is BC010, in which not calcite but gehlenite was identified as a clue of a high firing temperature.

Table 7.24 List of minerals in 39 samples characterised by XRD

Sample	Ware	Illite-2MI(NR) (26-0911)	Calcite (83-0577)	Quartz (86-1560)	Diopside (41-1370)	Diopside, aluminian (86-0002)	Mullite, syn (89-2645)	Gehlenite (89-5917)
JF001	BOBW	X	X	X	O	X	X	X
JF002	BOBW	X	X	O	X	X	X	X
JF004	BOBW	X	O	O	X	X	X	X
JF005	BOBW	X	X	O	O	X	X	O?
JF007	BOBW	X	X	O	O	X	X	O
JF008	BOBW	X	X	O?	X	X	X	O
JF010	BOBW	X	X	O	O	X	X	O
JF011	BOBW	X	X	O	O?	X	X	O
JC003	VCW	X	O	O	X	X	X	X
JC006	VCW	X	O	O	X	X	X	X
JC009	VCW	X	O?	O	X	X	X	X
GF001	BOBW	X	X	O	O	X	X	X
GF002	BOBW	X	X	O	O	X	X	X
GF003	BOBW	X	X	X	O	X	O?	X
GC004	VCW	X	O?	O	X	X	X	X
GC005	MCW	X	O	O	X	X	X	X
BF001	BOBW	X	X	O?	O	X	X	O?
BF002	BOBW	X	X	O	O	X	X	O?
BF003	BOBW	X	X	O	O?	X	X	X
BF004	BOBW	X	X	O	X	X	X	X
BF005	BOBW	X	X	X	O	X	X	X
BF006	BOBW	X	X	X	O	O?	X	X
BF007	BOBW	X	X	O	O	O?	X	X
BF008	BOBW	X	X	O	O	O?	X	O?
BC009	VCW	X	O	O	X	X	X	X
BC010	VCW	X	X	O	X	X	X	O?
BC011	VCW	X	O	O	X	X	X	X
AF001	BOBW	X	X	O	O?	O?	X	X
AF002	BOBW	X	X	O	O	O	X	X
AF003	BOBW	X	X	O	O	O	X	O?
AF004	BOBW	X	X	X	O	X	X	X
AF005	BOBW	X	X	O	O	X	X	X
AF006	BOBW	X	X	O	O	X	X	O
AF007	BOBW	X	X	O	X	X	X	X
AF008	BOBW	X	X	X	O	X	O?	X
AC009	MBOBW	X	X	O	O	O	X	X
AC010	Burnt clay	X	O	O	X	X	X	X
AC011	VCW	X	O	O	O?	O?	X	X
AC012	MCW	X	O	O	X	X	X	X

Third, all three BOBW samples at Tall-e Gap showed the presence of diopside. In particular, GF003 indicated the possible presence of mullite synthetic, which is formed at more than 1050 °C. However, the presence of gehlenite was not confirmed in BOBW samples at Tall-e Gap. It is suggested that the firing temperature of BOBW at Tall-e Gap was higher than 850 °C, possibly reaching as high as 1050 °C. Calcite was present in one VCW sample and one MCW sample at Tall-e Gap. Thus, this evidence supports the idea that VCW and MCW were fired at a temperature lower than 850 °C, as well as VCW samples at the earlier sites.

Finally, diopside and quartz were the common minerals of BOBW at Tall-e Bakun A. Among the BOBW samples with diopside, three examples indicated the presence of diopside aluminian (AF001-003), and two examples showed the presence of gehlenite. Furthermore, mullite was possibly present in AF008, an overfired BOBW waster. It is clear that BOBW samples were still fired at a temperature higher than 850 °C, also showing the possibility of being higher than 1050 °C. Quartz, diopside, and diopside aluminian were present in MBOBW (AC009), implying a similar firing temperature to BOBW. One burnt-clay sample showed the presence of calcite and quartz, which imply a firing temperature lower than 850 °C. On the other hand, one VCW sample (AC011) indicated the possible presence of diopside and diopside aluminian in spite of indicating the presence of calcite. Like the MCW sample at Tall-e Gap, calcite and quartz were present in the MCW sample at Tall-e Bakun A, indicating a firing temperature lower than 850 °C.

Thus, I estimated the firing temperatures of each ware type at each site based on identified minerals. When diachronically viewed, the firing temperature of BOBW continued to be above 850 °C from the beginning of the Bakun period, Tall-e Jari A. From Tall-e Gap and Tall-e Bakun A, the presence of mullite was also suggested, which implies a firing temperature higher than 1050 °C and the improvement of kiln firing. In contrast to BOBW, VCW and MCW samples from all the sites indicated a firing temperature lower than 850 °C, suggesting firing where a pottery kiln was not used. As discussed in Chapters 8 and 9, there were fewer diachronic changes in pottery-making techniques, especially clay preparation, forming, and surface treatment than in wares, vessel forms, and painted decoration (Chapter 6). The firing techniques were also likely to be conservative, as well as the other stable technical steps in pottery-making techniques.

Summary of geochemical analysis

In summary, five discoveries could be determined from the discussion of the statistical analyses of geochemical compositions of 60 ceramic samples via ICP-OES, XRD and powdered XRD:

1) At Tall-e Jari A, the geochemical compositions of BOBW samples were similar to those of local VCW samples. From this discovery, it is suggested that a tiny amount of BOBW found at Tall-e Jari A was not imported from the other intermontane valleys.
2) Except for the above discovery, the geochemical compositions of BOBW samples, VCW samples, and MCW samples were different from each other. Especially, MCW samples showed remarkable geochemical differences from the other ware type samples. This geochemical difference between ware types was more remarkable than that between sites. This difference might suggest the acquisition and use of different types of clay for each ware type. In order to further investigate this point, the chemical influence of temper (e.g. red siltstone, calcite, or vegetal temper) on geochemical compositions of ceramic materials should be clarified by experimental studies.
3) When the geochemical compositions of VCW samples were extracted and compared to one another, they showed differences between sites. As one hypothesis, it is inferred that the clay for VCWs was taken from the clay source near the villages, thereby emphasising a local difference.
4) On the other hand, when the geochemical compositions of BOBW samples were extracted and compared to each other, the presence of three slightly different clusters were suggested: a cluster for BOBW samples from Rahmatabad, a cluster for BOBW samples from the lower levels of Tall-e Gap, and a cluster for BOBW samples from the other sites. The differences of the clusters might reflect the different clay sources, especially the difference between the sites in the Kur River Basin and Rahmatabad. The geochemical similarities of BOBW samples in the Kur River Basin, even after LDA, are possibly due to selecting a similar clay source near rivers in the alluvial plain.
5) The firing temperatures of BOBW and MBOBW (more than 850 °C, fired in a pottery kiln), VCW, and MCW (less than 850 °C, possibly not fired in a pottery kiln) did not show remarkable changes from the beginning to the end of the Bakun period.

This is the last chapter of Part III of this research (analyses). From next chapter, I will proceed to Part IV: discussion and conclusion.

Part IV: Discussion and conclusion

Chapter 8

Discussion: reassembling the organisation of pottery production

Here in Chapter 8, I discuss the final **Research Question No. 4,** "How was pottery production organised during the Bakun period?" As reviewed in Chapters 2 and 3, one of the main problems with previous studies of the organisation of craft production lies in their systemic perspectives, which regard the organisation of production as a static structure, as manifested in craft specialisation studies and social complexity. From the systemic perspective, the organisation of pottery production was categorised as a system with several key variables (context, concentration, scale, and intensity; cf. C. Costin). I have introduced a relational perspective on the organisation of craft production by reviewing actor-network theory, communities of practice, and Tim Ingold's concept of skill. With the help of these concepts, relations in the organisation of pottery making, including those between humans and things, skilled potters and apprentices in communities of practice can be visualised using tanglegrams. This enables me to reassemble the organisation of pottery production as an association of relations.

Integration of the discussed attributes: from components to relations

I have analysed chronology and architectural remains (Chapter 5), the attributes of wares, vessel forms, horizontal design structures (Chapter 6), pottery-making techniques, painting skills, petrography, and geochemical composition (Chapter 7) separately, focusing on the diachronic changes of these individual attributes through four subperiods of what is traditionally called the "Bakun" culture. In Chapters 5-7, I discussed three other research questions separately (chronology, diachronic changes, pottery-making techniques). In this chapter, I integrate these attributes and consider them together, site by site. While from the systemic perspective, these attributes are regarded as direct/indirect evidence of components comprising a pottery production system, from the relational perspective, these attributes are actors/actants that are entangled as communities of pottery making. Thus from the relational perspective, the main concerns are not only these attributes themselves but also the relations that link them.

In this chapter, I integrate the results from Chapters 5-7 using tanglegrams to reassemble and discuss the communities of pottery making and the village entanglement in each site (Sections 8-1, 8-2, 8-3, and 8-4). Next, I discuss diachronic changes in communities of pottery making and village entanglements by comparing tanglegrams of Tall-e Jari A with Tall-e Bakun B, Tall-e Bakun B with Tall-e Gap, and Tall-e Gap with Tall-e Bakun A (Section 8-5). After reconstructing production systems from the systemic perspective in comparison with the relational one, I present a brief summary in Section 8-6.

8-1. Entanglements and communities of practice at Tall-e Jari A

A pottery-attribute tanglegram and village entanglement

Before moving on to the example at Tall-e Jari, A, I briefly summarise the analytical methods in this chapter. As explained in Section 4-7, I set up two sorts of tanglegrams for the purpose of tracing entanglements and communities of pottery making. The first is an entanglement of pottery attributes, or a pottery-attribute tanglegram. In this chapter, I chose the vessel forms (exterior-painted open vessel, interior-painted open vessel, and closed vessel) of BOBW (black-on-buff ware), VCW (vegetal-tempered coarse ware), and MCW (mineral-tempered coarse ware) as the main hubs presenting relations between the other pottery attributes. This choice is somewhat subjective. The pottery attributes that are connected in pottery-attribute tanglegrams are as follows:

1) proportion of wares (Chapter 6),
2) proportion of vessel forms (Chapter 6),
3) rim shapes (Chapter 6),
4) base shapes (Chapter 6),
5) vessel sizes and rim angles (Chapter 6)
6) estimated complete vessel forms (Chapter 6),
7) representative motifs (Chapters 6)
8) horizontal design structures (Chapter 6),
9) the chaînes opératoires (technical steps/options from clay acquisition to firing) (Chapters 7),
10) skill score patterns (Chapter 7), and
11) a community of practice, a skilled potter, and an apprentice.

The second tanglegram is a village entanglement in which relations between the communities of pottery-making, those of other practices (including subsistence practices), and other craft productions, materials, and environments in a village entanglement are considered. The communities of other practices are reassembled based on the published evidence from excavation results obtained from each site. I also mention relations between the sites in the Kur River Basin and contemporaneous sites in the Fars province using the limited evidence from the previous studies.

Example of how to make a tanglegram of pottery attributes at Tall-e Jari A: BOBW

I begin by summarising the analysis of the ceramic materials in the form of a tanglegram by focusing on an open vessel painted on its exterior/interior at Tall-e Jari A (Figs. 8.1-2). Note that the pottery attributes used for the tanglegram are reduced in content and that detailed discussions about the pottery attributes are found in Chapters 6–7. The proportion of BOBW in wares comes from the proportion of BOBW complete vessel + rim sherds in wares (Fig. 6.2). The density of BOBW in excavated trenches is taken from Fig. 6.5. The proportion of exterior/interior-painted open vessels is taken from the proportion of complete vessel + rim sherds of vessel forms at Tall-e Jari A (Fig. 6.6). The base shape variation at Tall-e Jari A is expressed in a pie chart showing the total number of base shapes from the excavation trench (Table 6.7). Vessel sizes and rim angles are from the box plots of rim diameters and angles in Fig. 6.9. Estimated complete vessel forms are based on the discussion in Section 6-1. Representative motifs of open vessels from Tall-e Jari A are picked up from previous publications and Cats. 6.1-9. The pie chart of horizontal design structure is based on the results presented in Tables 6.42-44. The counts of the patterns in the numbers of optional upper/lower optional lines are shown in the pie chart. The results of skill score pattern are taken from Fig. 7.37. The chaîne opératoire is a summary of Sections 7-2, 7-4, and 7-5. At the end of this section, I discuss the community of practice, a skilled potter, and an apprentice at Tall-e Jari A.

The merit of this approach is to allow archaeologists to understand relations between various pottery attributes behind the same vessel form, thereby giving archaeologists an opportunity to note relations that have so far been overlooked. The drawback of this tanglegram is that the pottery attributes of minor vessel forms at Tall-e Jari A, such as open vessels painted on their rims, bases painted on their exterior joints, or small jars, cannot be inserted into these pottery-attribute tanglegrams; these need to be mentioned separately. I picked the pottery attributes and relations in tanglegrams subjectively to visualise major relations. It should be mentioned that there are numerous relations with minor pottery attributes that are not represented in these tanglegrams.

Example of how to reassemble tanglegrams at Tall-e Jari A: VCW

The tanglegram of relations between VCW as wares and other VCW attributes at Tall-e Jari A is also reassembled by centring VCW and connecting its analysed attributes

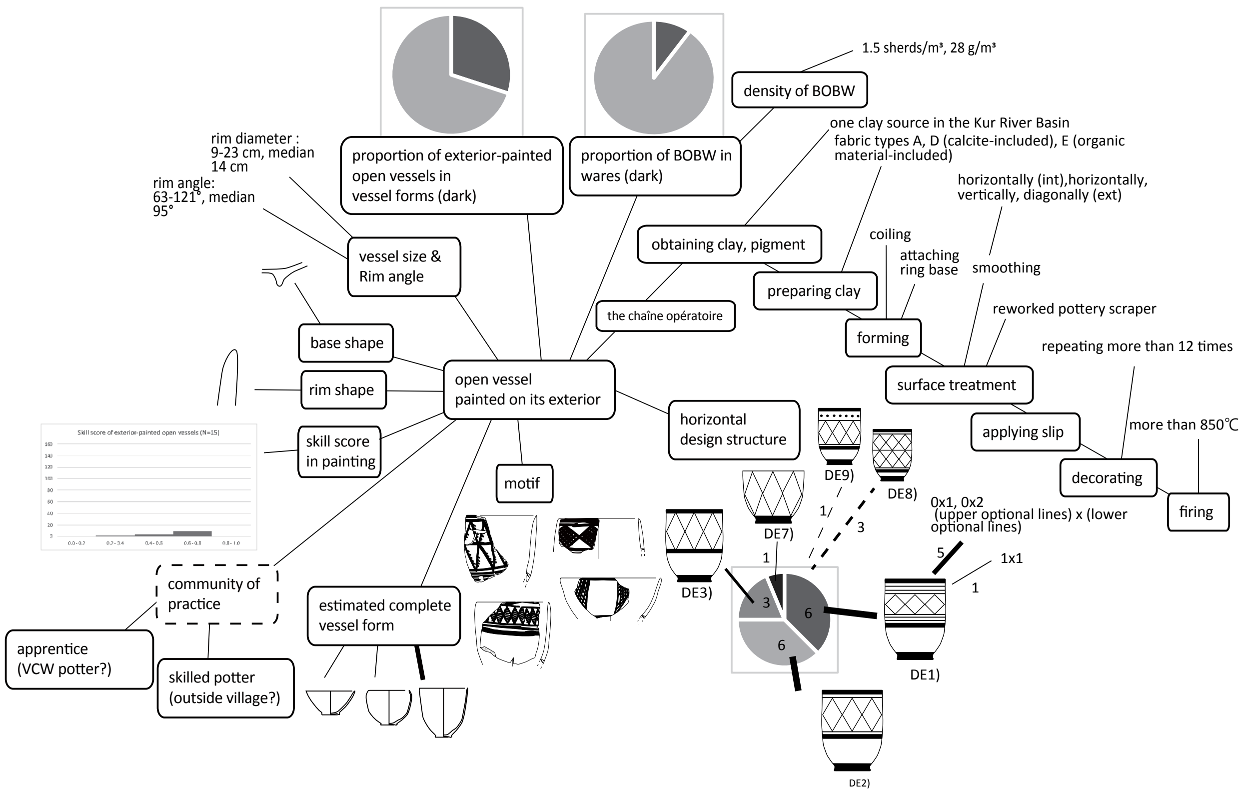


Figure 8.1 Pottery-attribute tanglegram of BOBW exterior-painted open vessels at Level 1 of Tall-e Jari A

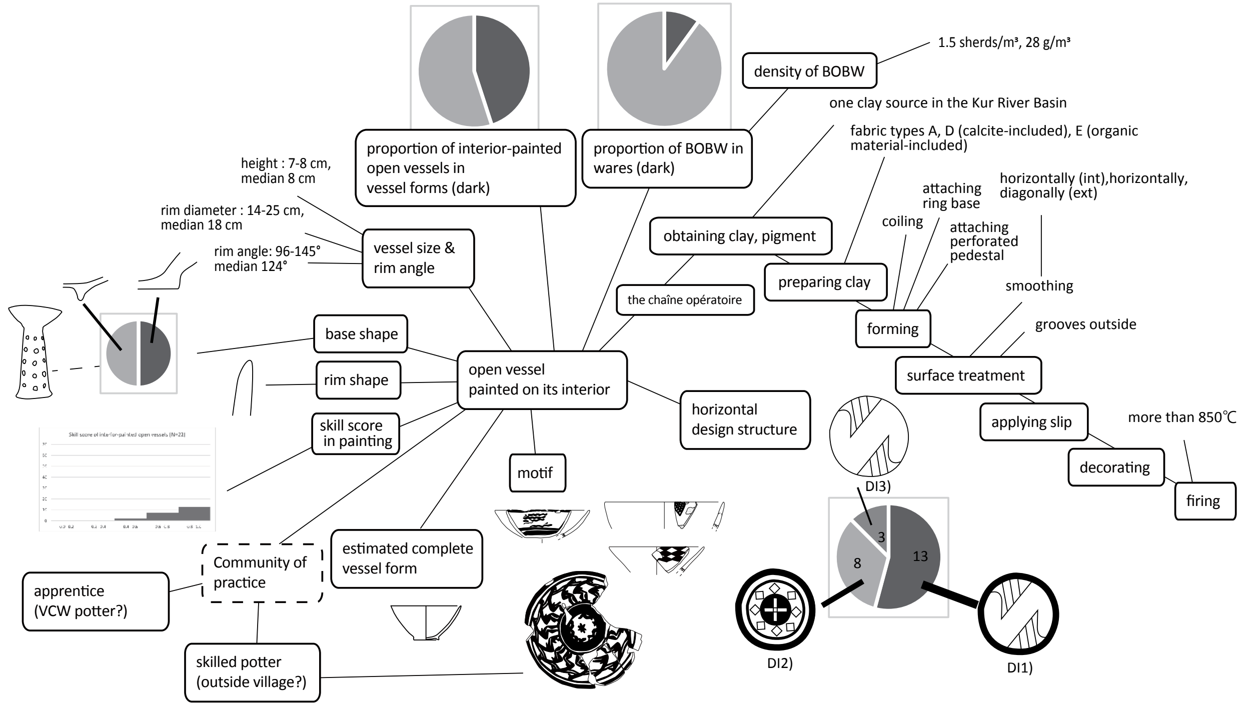


Figure 8.2 Pottery-attribute tanglegram of BOBW interior-painted open vessels at Level I of Tall-e Jari A (motif traced from Vanden Berghe 1952: Pl. XLIX-L)

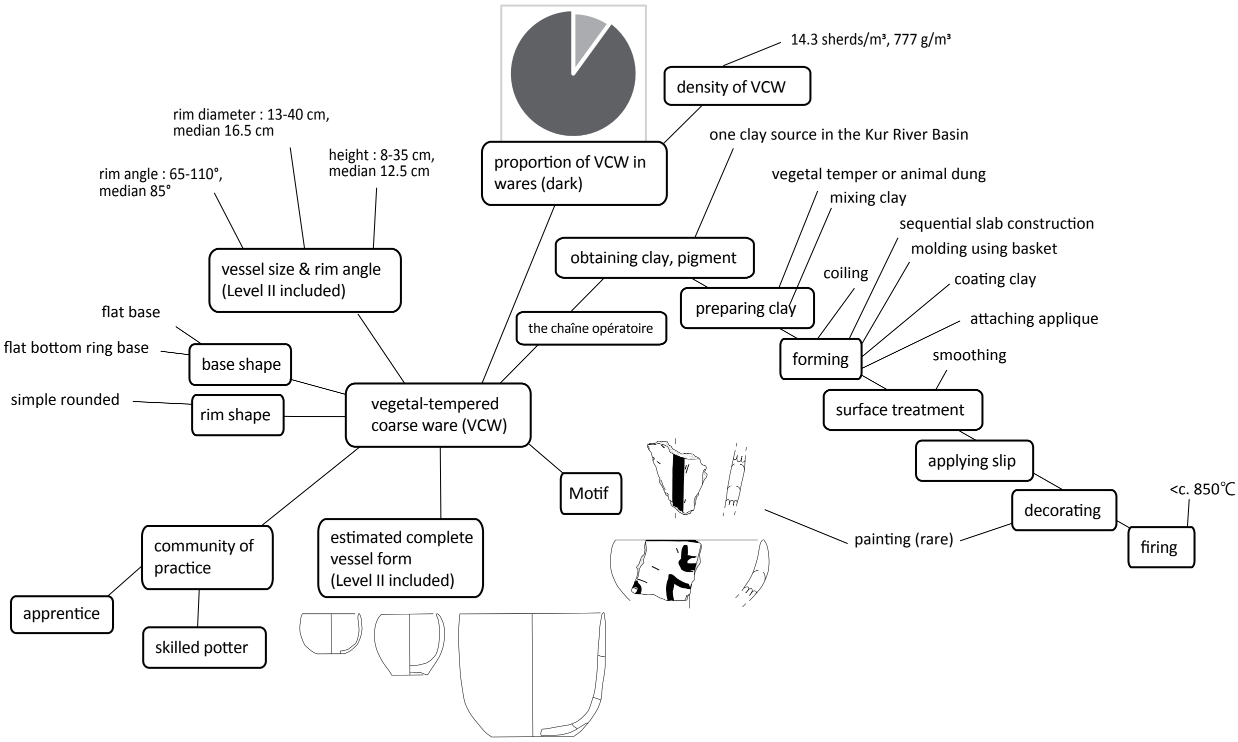


Figure 8.3 Pottery-attribute tanglegram of VCW at Tall-e Jari A (drawings traced from Egami et al. 1977: Pl. IV)

(Fig. 8.3). The proportion of VCW in wares originates from the proportion of the VCW complete vessel + rim sherds (Fig. 6.2). Rim shapes, base shapes, vessel sizes, rim angles, and estimated complete vessel forms are based on data of 10 complete vessels published in 1977 and 2003.[1] Note that these complete vessel forms include those from Level II of Tall-e Jari A. Representative motifs are taken from only two samples with painted

[1] Egami et al. 1977; Nishiaki 2003.

decoration (Cat. 6.5: 3, 5). The chaîne opératoire of VCW was taken from Sections 7-2, 7-4, and 7-5.

Community of BOBW-making at Tall-e Jari A

I describe the ways of tracing entanglements of pottery attributes. The communities of pottery-making — in other words, the ways of transmitting the knowledge of pottery making to the next generation — are also included in these entanglements. Below, by carefully taking the relations between pottery attributes into consideration, I discuss the community of pottery making at Tall-e Jari A. In Section 3-3, I present four viewpoints on communities of practice (or apprenticeship) obtained from ethnographic case studies:

1) From what age did the apprenticeship start and when did she/he move on to various steps of learning?
2) How and what did an apprentice learn in the community of practice?
3) What kind of relationships were there between a teacher and an apprentice?
4) What kind of role did an apprenticeship play in the community, other than learning for making a living?

In reassembling a community of practice, these viewpoints are useful.

First, in discussing communities of BOBW- and VCW-making at Tall-e Jari A, the very low proportion and density of BOBW (about 10 %, 1.5 sherds/ m^3) and the high proportion and density of VCW in wares (90 %, 14.3 sherds/ m^3) are very significant. This may hint toward the frequency of pottery-making — i.e., the frequency of transmitting the knowledge of pottery making. BOBW making was much less commonly made than VCW making, the existing pottery tradition at Tall-e Jari A. As explained in Section 7-5, it is suggested that BOBW was not imported from other intermontane valleys to Tall-e Jari A, indicating that it was produced there in the Kur River Basin. In such a situation, how was the knowledge of BOBW making transmitted at Tall-e Jari A?

Second, the chaîne opératoire of BOBW making had more technical steps than that of VCW, particularly painting and firing pottery at high temperatures. Those steps also required experiential skills, in contrast to VCW-making. In addition, firing pottery at high temperatures required knowledge that has not been observed in the Neolithic levels of Tall-e Jari A. Considering these points, I propose two hypotheses about the community of BOBW making at Tall-e Jari A. The first hypothesis is that BOBW was imported from any sites within the Kur River Basin due to its scarcity and the absence of archaeological remains related to the production of BOBW. Alternatively, the second hypothesis is that a skilled potter who learned BOBW-making elsewhere visited Tall-e Jari A to make BOBW and showed VCW potters how to do it. A small number of BOBW masterpieces showing greater painting skills have been found in burials in Tall-e Jari A, such as a shallow bowl with a perforated pedestal and motifs of male figures;[2] these findings support this hypothesis. It is also possible that both imported BOBW and locally made ones co-existed at Tall-e Jari A.

If the second hypothesis is true, what kind of relationship existed between skilled potters (potters outside Tall-e Jari A) and apprentices (villagers at Tall-e Jari A) in the community of BOBW-making? The skill score patterns of exterior-painted open vessels illustrate poor painting skills, suggesting that apprentices were allowed to paint pottery on the rare occasion of BOBW-making. A few painted VCW potsherds appeared at Tall-e Jari A. Therefore, I argue that apprentices making BOBW were adult VCW potters who already knew basic pottery-making techniques, such as clay acquisition, forming, and surface treatment. In these relations, VCW potters were likely to learn mainly painting and firing from the skilled potters, either through direct instruction or indirect observation.

The community of VCW making at Tall-e Jari A

There is limited information on the community of VCW making. There may have been both skilled VCW potters and apprentices in the community. Although the technical skill of VCW potters is not as clearly recognisable as that of BOBW potters for archaeologists, I maintain that transmitting the knowledge of VCW making would be easier than for BOBW-making; note that this somewhat subjective judgement of ease is based on a modern bias.

Example of how to reassemble tanglegram: village entanglement at Tall-e Jari A

The discussion of communities of practice at Tall-e Jari A extends from pottery making to the other practices at this site; thus, I explain how to assemble the second tanglegram, a village entanglement (Fig. 8.4). The brief excavation reports about Tall-e Jari A indicate the presence of buildings, bone implements, seashell objects, lithics, clay materials, one stone seal, two stone beads, and clay spindle whorls at Level I of Tall-e Jari A.[3] Although the evidence is fragmentary, it is inferred that villagers at Tall-e Jari A cultivated domesticated crops, herded animals, built houses, and made ground

[2] Vanden Berghe 1952: Pl. XLIX.
[3] Egami et al. 1977: 1-2, Pl. II, V, VI, VII.

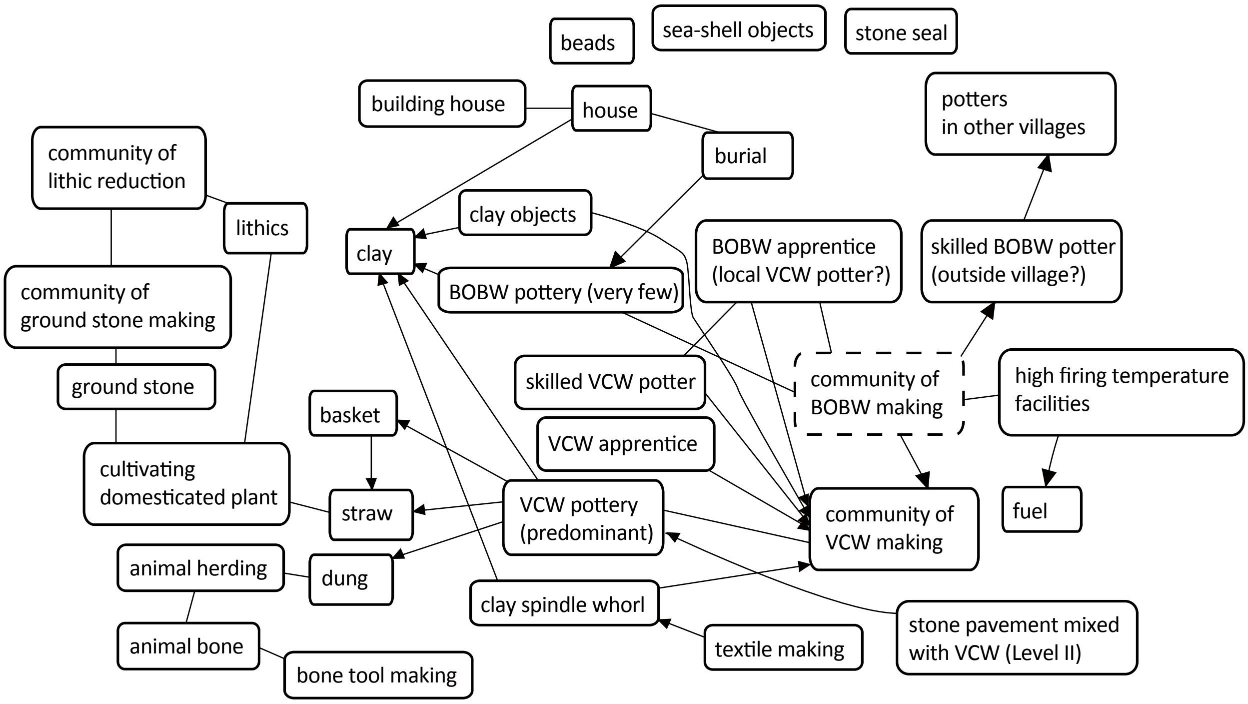


Figure 8.4 The entanglement of village activities at Tall-e Jari A

stone tools, lithics, textiles, and clay spindle whorls.[4] It should be noted that this kind of inference presents the risk of reconstructing social frameworks, which Latour strongly criticised. They likely weaved baskets, as shown by the trace of a basket preserved on the surface of one example of VCW.

Both materials and inferred activities are displayed in the tanglegram (Fig. 8.4). I do not include humans, except for apprentices and skilled potters. The tanglegram of finds and their related activities at Tall-e Jari A are connected with lines when activities and materials are related or dependent. For example, subsistence practices, such as cultivating crops, are related not only to lithics such as sickle blades for harvesting but also to VCW as a source of vegetal temper (such as straw) and with ground stones for processing grains. The dependence and dependency in these relations between materials, humans, and activities are expressed using arrows when the relations are clear. For example, I interpret that clay spindle whorls and clay objects as depending on a VCW-making community, as this community mainly engaged in making clay objects at Tall-e Jari A. As it stands, whether beads, seashell objects, and the stone seal were locally produced or imported is not evident.

Relations between pottery-making and other practices at Tall-e Jari A

Although I did not put communities of these other practices at Tall-e Jari A into the tanglegram of the village entanglement for want of space, all the inferred activities are related to communities of these activities, the skilled persons and apprentices. In addition, as stated in regard to relations between the communities of BOBW-making and that of VCW-making, communities of practice were not always exclusive of one another. Some of the communities of practices possibly overlapped with others. The details of apprenticeships of these village activities are still unknown. However, I surmise that communities of other practices at Tall-e Jari A were similar to the community of VCW-making. As Pollock and Bernbeck argued, the Neolithic world at Tol-e Bashi suppressed material expression in the form of low material variability:

> "Bashi residents had a sense of time that was fundamentally different from ours, less focused on long-term projections and the calculation of potential risks or gains. Their activities were centered on socializing, collective performances, and visits rather than on developing skills in making things, competitions, or hosting a stranger."[5]

It is implied that making VCW, which has much less material variability than BOBW, was well embedded within the entanglement of village activities at Tall-e

[4] The fabric of clay materials and clay spindle whorl is unclear whether it was vegetal tempered or buff fine fabric.

[5] Pollock and Bernbeck 2010: 287.

Jari A and in harmony with communities of other practices, as the relations between VCW pottery and other materials show in Fig. 8.4. In such a harmonious entanglement of the village activities at Tall-e Jari A, BOBW pottery and the community of BOBW-making might look unusual and special for the villagers at Tall-e Jari A. In the village entanglement, burials are related to houses, as they are found near houses (Fig. 5.3). In addition, only rare BOBW vessels were buried with the dead instead of VCW vessels. This contextual evidence of BOBW consumption at Tall-e Jari A suggests a special meaning of BOBW for the villagers. I present the contemporaneous sites in Section 8-5 via an inter-site comparison of tanglegrams.

Summary

Here I summarise Section 8-1 before proceeding to the next section:

1) I illustrate the ways of reassembling tanglegrams of pottery attributes and village entanglements using the examples of Tall-e Jari A. Note that this assembly method starts from the subjective selection of relations and attributes.
2) It has been suggested that no stable BOBW-making community existed at Tall-e Jari A due to the rarity of BOBW. BOBW was possibly imported from other sites in the Kur River Basin or made by potters who lived in Tall-e Jari A with basic knowledge of VCW-making.
3) VCW-making communities and those of other practices, which continued after the Neolithic period, were well-embedded in the village entanglement of Tall-e Jari A. It is likely that BOBW had special meaning to the villagers at Tall-e Jari A because BOBW, not VCW, was used as a burial good.

8-2. Entanglements and communities of practice at Tall-e Bakun B

Tanglegram of pottery attributes at Tall-e Bakun B

I assemble two tanglegrams of pottery attributes at Tall-e Bakun B—BOBW open vessels painted on their exteriors and those painted on their interiors (Figs. A7.1-2 in Appendix). These tanglegrams are reassembled in the same way as those at Tall-e Jari A. Drawings from previous publications; Figs. 6.2, 6.3, 6.9, and 7.37, and Tables 6.42-6.44 are included in these tanglegrams. As in the tanglegrams of BOBW at Tall-e Jari A, here the minor vessel forms at Tall-e Bakun B such as open vessels painted on their rims and closed vessels are not included in tanglegrams due to the scarcity of their occurrence. I also lack enough information about VCW at Tall-e Bakun B to express its relations in a tanglegram. I present a discussion about the relations of pottery attributes and the community of BOBW-making at Tall-e Bakun B in Section 8-5, the inter-site comparison of tanglegrams.

Village entanglement at Tall-e Bakun B

I base the reassembly of the village entanglement at Tall-e Bakun B on two excavation reports published by Egami, Masuda, and Alizadeh (Fig. 8.5).[6] The brief excavation reports of Tall-e Bakun B indicate the presence of bone implements, lithics, ground stone, clay spindle whorls, and wells at Level BII. Although ovens, fire pits, postholes, stone pavement mixed with sherds, and fragmentary pisé walls are present from Level BI (the Shamsabad period) of Tall-Bakun B, these remains are not confirmed at Level BII of Tall-e Bakun B, possibly due to disturbances from Islamic graves. Although these remains likely existed at Level BII of Tall-e Bakun B, I do not express these materials in tanglegrams. My interpretation is that villagers cultivated domesticated plants, herded animals, and made ground stones, lithics, bone tools, and textiles at Tall-e Bakun B. House-building was possibly conducted at Level BII of Tall-e Bakun B. In addition, the clay spindle whorl found at Tall-e Bakun B is made from fine clay, thus suggesting a relation between a clay spindle whorl and a community of BOBW making. I present further discussion and contemporaneous sites in Section 8-5 on the inter-site comparison of tanglegrams.

8-3. Entanglements and communities of practice at Tall-e Gap

A tanglegram of pottery attributes at Tall-e Gap: BOBW

The tanglegrams of open vessels painted on their exterior/interior at Tall-e Gap are reassembled in the same way as those at the other two sites (Figs. 8.6, A7.3). The data used for these tanglegrams are Cat. 6.18 and 6.27, Figs. 6.2, 6.6-9, and 7.37, Tables 6.28:1, 6.42-44, and several published drawings. The ample data on closed vessels enable me to reassemble the tanglegram of closed vessels at Tall-e Gap (Fig. 8.7). The proportions of BOBW, those of large/small jars in vessel forms, horizontal design structures, and pottery-making techniques are taken from previous chapters in the same way for Fig. 8.6. I present the rim shapes of large jars at Tall-e Gap using pie charts showing the total number of rim shapes from trenches GAT-1 and GAT-2 (Figs. 6.7: D). The data on closed vessel sizes are from the discussion in Section 6-3, and I use published drawings to present representative vessel forms and motifs. I would mention that these tanglegrams of BOBW are still reductive and subjective in many ways. For example, the pottery-attribute relationships with

[6] Egami and Masuda 1962; Alizadeh 2006.

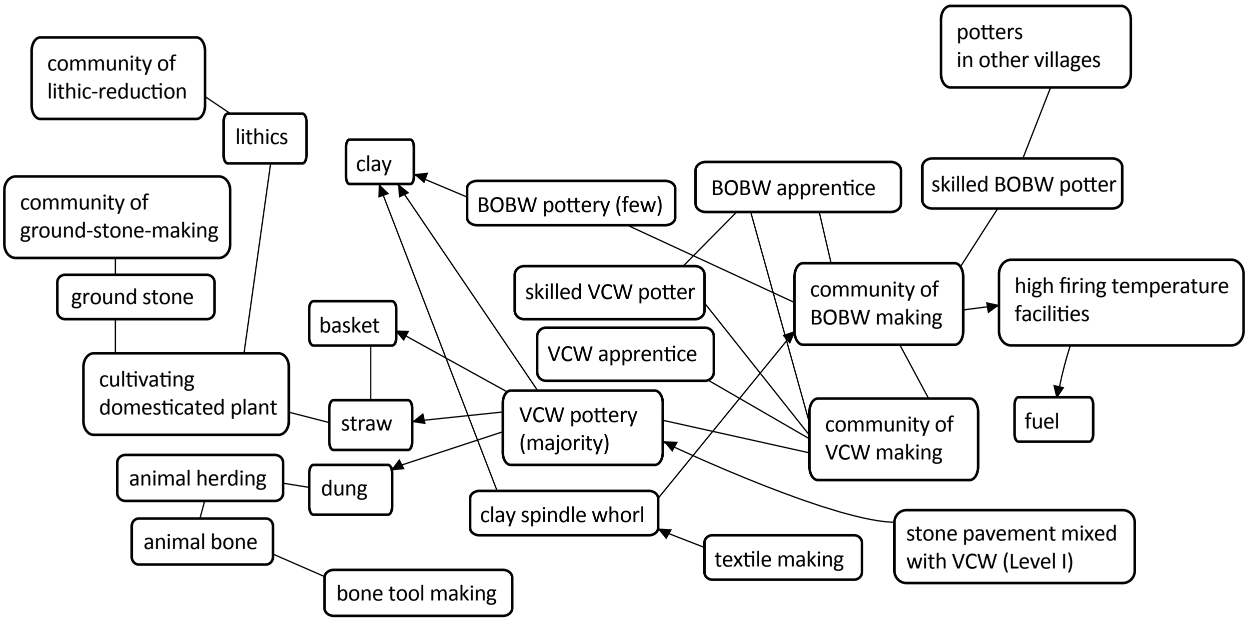


Figure 8.5 The entanglement of village activities at Tall-e Bakun B

the other vessel forms, such as open vessels painted on their rims, open vessels painted on both sides, and unpainted, open vessel bases are not reflected in these tanglegrams.

Community of BOBW-making at Tall-e Gap

Three tanglegrams illuminate the community of BOBW making at Tall-e Gap. First, the high density of BOBW sherds and the proportion of BOBW implies more frequent production at Tall-e Gap than ever before. Second, the discovery of the work of an apprentice (Fig. 7.33) made of fine clay suggests that an apprentice could get access to fine clay. Considering its small size, it is possible that it was made by a child or juvenile, implying the beginning of an apprenticeship. Third, the fact that making large jars was common at Tall-e Gap implies the possibility of collaboration between potters inside the BOBW community in order to make large vessels. Hence, a formal BOBW-making community likely existed at Tall-e Gap to educate potters and build the identities in the community through legitimate peripheral participation.

Tanglegram of pottery attributes at Tall-e Gap: MCW

MCW appears in the middle levels at Tall-e Gap. That also entails a new pottery-attribute tanglegram for MCW (Fig. 8.8). The tanglegram of MCW at Tall-e Gap is also assembled by centring MCW and connecting the analysed attributes of MCW at Tall-e Gap. The procedure of connecting the pottery attributes of MCW is the same as those used for BOBW and VCW. In the tanglegram, I present the data from Figs. 6.2 and 6.5 again; the chaîne opératoire of MCW from adding temper to firing is a brief statement of Chapter 7. From the comparison of pottery-attribute tanglegrams between BOBW and MCW, it is clear that those tanglegrams differ from one another in the chaîne opératoire, clay recipe, geochemical composition, firing temperature, vessel form, and proportion of wares. Although these tanglegrams are clearly different, it is still uncertain whether those communities of practice overlapped—in other words, whether members of BOBW-making communities sometimes also engaged in MCW-making communities. It is also possible that MCW was produced by other communities outside Tall-e Gap and then imported to this site. I do not present a tanglegram of VCW at Tall-e Gap because of insufficient information information. I argue that at Tall-e Jari A, the community of VCW-making, likely overlapped that of BOBW-making. This overlap might continue until Tall-e Gap. The overlap between VCW- and MCW-making at Tall-e Gap is still unclear, although VCW and MCW show similarities in pottery-making techniques, such as vegetal temper and firing temperatures.

Village entanglement at Tall-e Gap

My approach to assembling the village entanglement at Tall-e Gap is based on the excavation report published by Egami and Sono.[7] The excavation report of Tall-e Gap shows the presence of houses, bone implements, lithics, ground stones, clay spindle whorls, animal figurines, and clay objects. Copper pins and a stone vessel were found at the upper levels aof Tall-e Gap. I infer that villagers at Tall-e Gap cultivated domesticated plants, herded animals, built houses, and made ground stone

[7] Egami and Sono 1962.

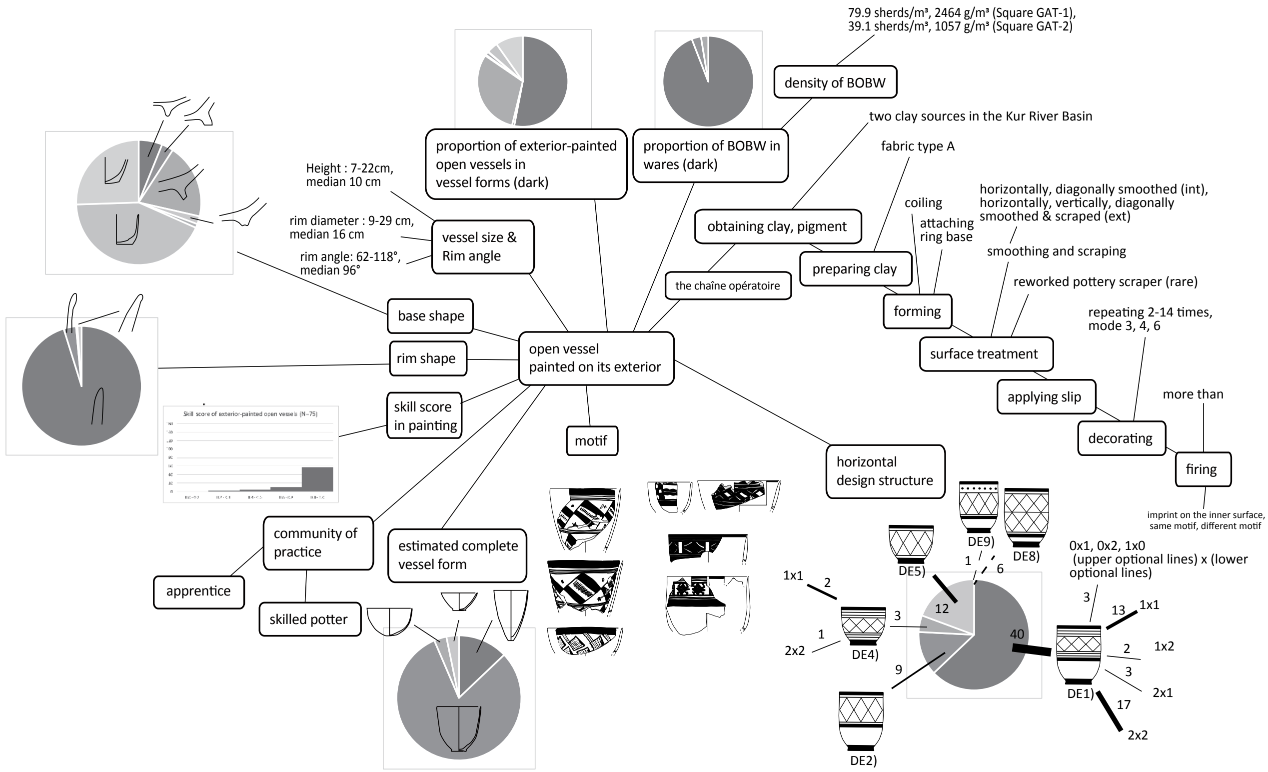


Figure 8.6 Pottery-attribute tanglegram of BOBW exterior-painted open vessels at Tall-e Gap

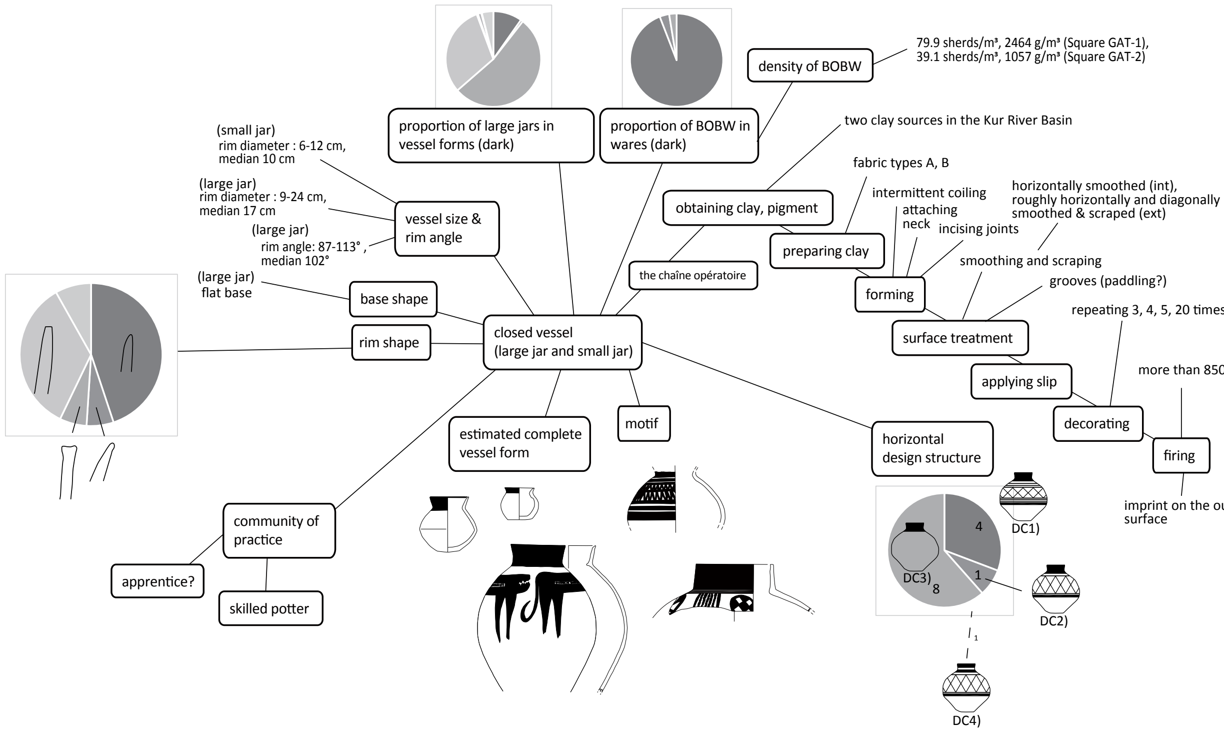


Figure 8.7 Pottery-attribute tanglegram of BOBW closed vessels at Tall-e Gap (motifs traced from Egami and Sono 1962 Figs. 17:1, 5, 18:5,7, and 25: 2)

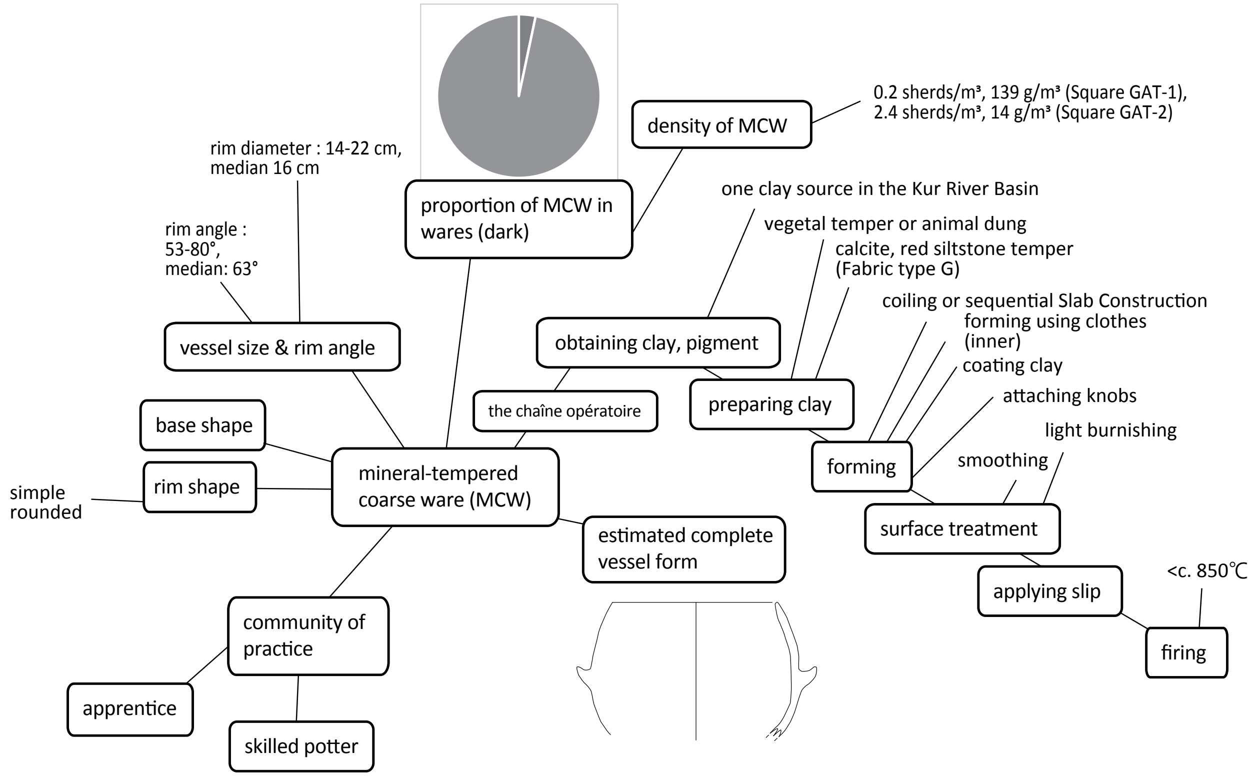


Figure 8.8 Pottery-attribute tanglegram of MCW at Tall-e Gap (vessel forms traced from Egami and Sono 1962: Figure 11:3)

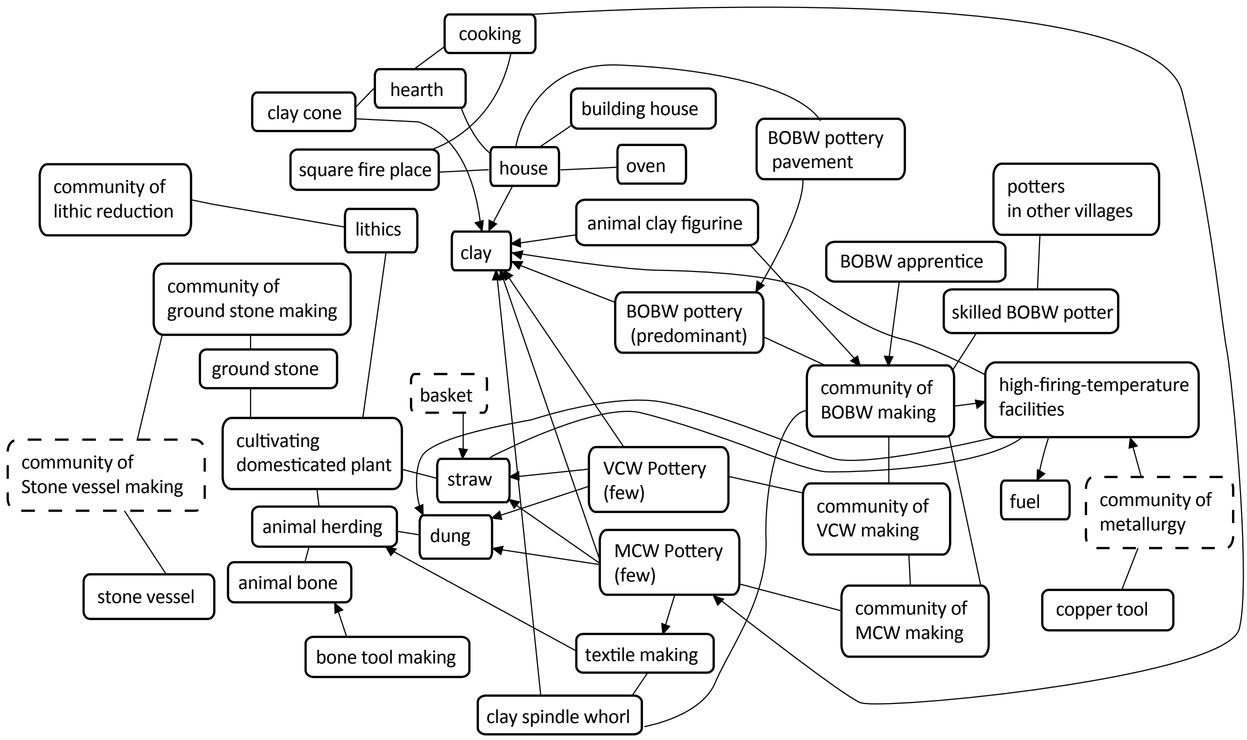


Figure 8.9 The entanglement of village activities at Tall-e Gap

tools, lithics, and textiles (Fig. 8.9). It is not evident where the copper pins and the stone vessel were produced, but their presence at Tall-e Gap is quite interesting. The clay spindle whorl and animal clay figurine are made from fine fabric, thus suggesting a relationship with BOBW-making. At Tall-e Gap, the community of BOBW-making is distinguished from communities of other craft productions in terms of frequency, production amount, required experiences, technical skills, and the clear presence of apprentices.

Contexts of pottery production and consumption at Tall-e Gap

Unlike the excavations at Tall-e Jari A and Tall-e Bakun B, the contexts in which the materials were found at Tall-e Gap may be a good clue to reassembling the village entanglement. First, indirect evidence of pottery production was found at Tall-e Gap, such as pieces of perforated discs in Levels 4, 5b, and 16, and misfired pottery and pottery slags in Levels 5a, 9, 10, and 14a. These materials suggest that pottery production was conducted at Tall-e Gap throughout the whole occupation period. Second, pottery use and the related cooking activities can be inferred from a square fireplace in Room 1 at Level 4, pottery pavement at Levels 5b, 9, and 12b, a bread oven from Square GAI-3, and the combination of clay cones and hearths at Level 6 of Squares GAT-1 and 2. A square fireplace with traces of long-term maintenance was found in the central part of a building. Although the function of this fireplace is still debated, it implies cooking activity inside the house. The combination of clay cones and hearths were found starting on Level 6 with MCW, suggesting that MCW were used in hearths with the support of clay cones for the purpose of cooking and boiling.

Comparison with contemporaneous sites: Rahmatabad

Below I expand the viewpoints of communities of practice to other contemporaneous villages in the Fars province: Rahmatabad, Darrē-ye Bolaghi, and Tol-e Nurabad Phase A16. I begin by describing discoveries at Rahmatabad, located in the Kamin Plain, north of the Kur River Basin.[8] Pottery attributes of BOBW at Rahmatabad are very similar to those at Tall-e Gap. BOBW was the predominant type of pottery at Rahmatabad, and many BOBW potsherds have been discovered there, similar to Tall-e Gap. Motifs, vessel forms, and chaînes opératoires were shared between Tall-e Gap and Rahmatabad, although the geochemical compositions of the wares are different, as discussed in Section 7-5. There is also direct evidence of pottery production, such as an oval pottery kiln and misfired ceramics, and Bernbeck and Pollock pointed out evidence of an apprentice's work.[9] This suggests that a community of BOBW making existed that produced pottery at the same scale as that at Tall-e Gap, and that the community shared BOBW-making knowledge with Tall-e Gap to some degree. VCW and MCW were also present. The repertoires of material cultures in village life at Rahmatabad are also similar to those at Tall-e Gap: for example, animal figurines, painted and unpainted spindle whorls, lithics, ovens, and houses indicating short-term continual changes.

Comparison with contemporaneous sites: the Darrē-ye Bolaghi sites

Here I add information from the excavations at the sites in Darrē-ye Bolaghi, especially Sites 73 and 131, focusing on pottery kilns and burials.[10] First, as many as nine pottery kilns were discovered at Site 73. Although settlement remains were not discovered near the pottery kilns, it is still possible that a settlement existed nearby. These kilns, especially keyhole-shaped ones, are similar to those found at Tall-e Bakun A. The motifs of published pottery drawings of the BOBW vessels found at this kiln show similarity to those in the later levels at Tall-e Gap. Second, a secondary burial of at least eight individuals (Burial 115) was discovered with 13 nearly complete vessels. The assemblage consisted of three large jars with long necks, three small, unpainted beakers inside the large jars, four painted bowls, and one large, deep, unpainted bowl. The frequent occurrence of unpainted vessels and large jars with very long necks in the burial site at Darrē-ye Bolaghi is different from the pottery assemblage at Tall-e Gap. The relation between this burial and settlements is still not clear. Although information about sites in Darrē-ye Bolaghi is limited, this suggests that communities of BOBW-making that produced pottery at a larger scale than at Tall-e Gap were present at Darrē-ye Bolaghi, and that regional differences in pottery attributes existed between the pottery at Tall-e Gap and that at Darre-ye Bolaghi.

Comparison with contemporaneous sites: Phase A16 of Tol-e Nurabad

Tol-e Nurabad is located in the Mamasani Plain, approximately 120 km west of the Kur River Basin. In the deep excavation at Tol-e Nurabad (the Mamasani Plain), excavators estimated Phase A16 to be parallel to the upper levels of Tall-e Gap.[11] One hearth with river cobbles was discovered at this phase. As for pottery attributes of BOBW, two complete deep bowls indicate similar vessel forms, motifs ("zigzags and boxes"), horizontal design structures (without body bands: DE4

[8] Azizi Kharanagi and Khanipoor 2014; Azizi Kharanagi et al. 2014; Bernbeck et al. 2005; Pollock 2015.

[9] Bernbeck et al. 2005: 100; Pollock 2015: 57.

[10] Helwing and Seyedin 2010; Helwing et al. 2012, Karami 2015.

[11] Potts and Roustaei (eds.) 2006.

and DE5), and base shapes (flat base) to those at Tall-e Gap. In spite of this similarity, half of the registered sherds were unpainted at Phase A16 of Tol-e Nurabad, a remarkable difference from Tall-e Gap, where most BOBW vessels were painted.

Comparison with contemporaneous sites: Tappeh Miānroud and Tal-e Mash Karim

Recent excavations revealed further view of sites contemporaneous with Tall-e Gap. First, stratigraphy showing the occupation periods of the Shamsabad period and the Bakun period was obtained from the excavation of Tappeh Miānroud, Kur River Basin.[12] The excavators argue that the Bakun period at this site belongs to the Gap II phase. One oval pottery kiln dated to the Bakun period and one complete painted deep bowl with a flat base and a horizontal design structure (DE1) were reported. More data is required to consider the community of BOBW-making at this site. Second, a recent excavation conducted at Tal-e Mash Karim, near Semirom, about 200 km from the Kur River Basin, uncovered cultural layers with architectural remains dated by radiocarbon to the mid-fifth millennium BCE.[13] According to the preliminary reports, beautiful BOBW sherds, lithics, ground stones, bone tools, clay tokens, rare copper tools, and wall paintings were confirmed at Tal-e Mash Karim.

Extending the perspective of communities of practice to inter-village communities, we should note that the wide distribution of similar decorative styles was acknowledged in the middle phase of the Bakun period in Fars, as argued by Alizadeh and Petrie.[14] However, a closer look at BOBW reveals regional differences between the Kur River Basin and the neighbouring regions, such as long-necked jars and plain vessels. In addition, large-scale pottery production was conducted in these communities. As Sumner's survey results showed, this phase in the Kur River Basin indicated increases of population and pottery-production sites.[15] It is possible that the population increase was partly related to the broader-scale similarity of the decorative styles in the middle phase of the Bakun period.

Summary

Here I summarise the discussion of tracing entanglements and communities of practice at Tall-e Gap as follows:

1) The community of BOBW-making at Tall-e Gap showed a fixed character in terms of the production amount, the presence of apprentices, and the collaborative work of making large jars.
2) MCW appeared in later levels at Tall-e Gap, and the pottery-attribute tanglegram of MCW is different from those of BOBW. Whether the MCW-making community overlapped with that of BOBW-making remains unclear.
3) In the village entanglement at Tall-e Gap, the presence of a few copper pins and a stone vessel at later levels was confirmed, as well as increasing evidence of pottery production and consumption, such as pottery pavement, hearths, and ovens. This helps trace relations between pottery and other materials in the entangled village life.
4) Similar communities of BOBW making were confirmed in the neighbouring region within the Fars province, such as the Rahmatabad and Darre-ye Bolaghi sites as well as Phase A16 of Tol-e Nurabad. This suggests an intimate interaction within the wider region while also showing regional differences.

8-4. Entanglements and communities of practice at Tall-e Bakun A

Tanglegram of pottery attributes at Tall-e Bakun A

The final target of reassembling entanglements is Tall-e Bakun A. I trace the pottery-attribute tanglegrams of exterior-painted open vessels, interior-painted ones, and closed vessels at Tall-e Bakun A (Figs. 8.10, A7.4-5) using the same procedures as those at the other three sites. Again, I use information from previous chapters for the tanglegrams, such as Figs. 6.2, 6.6-7, and 7.37, Tables 6.42-44 and 47, and published drawings. As for rim shapes, base shapes, and complete vessel forms, I use the data from Table 6.32-35. Here, minor vessel forms and wares, such as open vessels painted on their rims, open vessels with both sides painted, VCW, MCW, and red burnished ware (RBW), are not presented. More data would be required for the RBW discovered in the uppermost levels at Tall-e Bakun A, needs more data to allow the reassembly of pottery-attribute tanglegrams.

The community of BOBW-making at Tall-e Bakun A

One of the important aspects of the community of BOBW making at Tall-e Bakun A is the presence of elaborate painted motifs, or indirect evidence of painters with distinguished painting skills. The work of an apprentice was also discovered at Tall-e Bakun A. In addition, the results from the skill score analysis of the complete vessels with identical motifs (zigzags and boxes) provide more information about the community of BOBW making. The skill scores of these vessels

[12] Ebrahimi et al. 2016; Karami et al. 2018.
[13] Sardari and Taheri 2015; Harandi et al. 2015; Nishiaki et al. 2018; Niknami et al. 2018.
[14] Alizadeh 2006: 11.; Petrie 2011: 166.
[15] Sumner 1994.

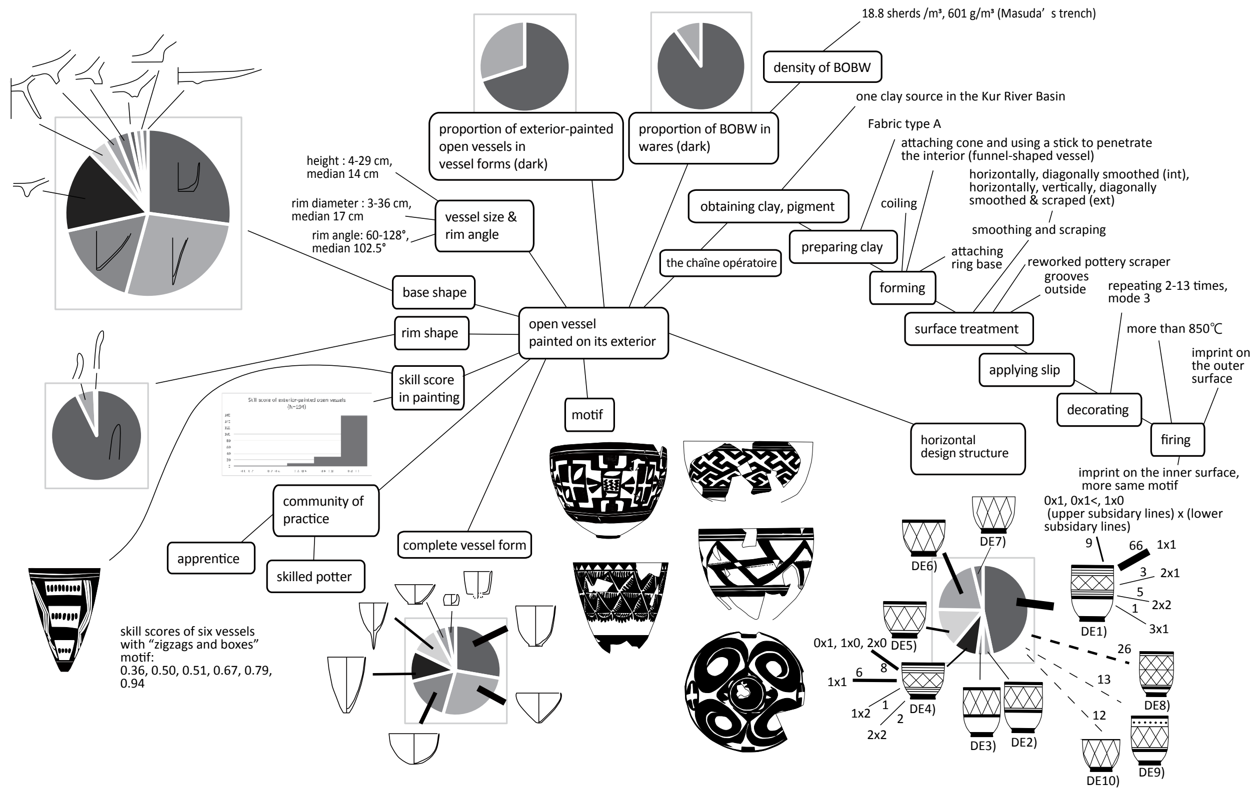


Figure 8.10 Pottery-attribute tanglegram of BOBW exterior-painted open vessels at Tall-e Bakun A (motifs traced from Herzfeld 1932: Taf. II:1; Langsdorff and McCown 1942: Pl. 4:3,10, 26:8, 36:13, 53:1)

ranged from low to high, indicating the presence of painters with various degrees of technical skills.

Village entanglement at Tall-e Bakun A

The approach to reassembling the village entanglement at Tall-e Bakun A is based on the excavation reports published by Langsdorff, McCown, and Alizadeh.[16] Various kinds of excavated materials are present at Tall-e Bakun A. The excavation reports at Tall-e Bakun A show the presence of building complexes, chipped stone tools, ground stones (mace-heads, grooved polishers, rubbing stones, hammers, and palettes), clay spindle whorls, animal figurines of both fine pottery clay and half-baked brown clay, human figurines made of fine clay, and other clay objects (pottery tubes, pottery rings, pottery scrapers, firing tripods, "fire dogs", sling balls, clay horns, roofing materials, and "singletons") in addition to copper objects (knives, hook, pins, needles, chisels, blades, simple rods, a toggle pin, and a dagger), personal ornaments (beads and shell pendants), and stone vessels (open bowls, miniature jars, conical cups, and jars). Bone tools were rarely found at Tall-e Bakun A.[17] Finally, the most noteworthy finds other than pottery at Tall-e Bakun A are stamp seals.

On the basis of these materials, I infer that the residents of Tall-e Bakun A cultivated domesticated crops, herded animals, built houses, made ground stone tools, lithics, textiles, personal ornaments and stone vessels, smelted copper, and carved stamp seals (Fig. 8.11). I point out several relations in this tanglegram below. First, human clay figurines, animal figurines, clay spindle whorls, and other clay objects are possibly related to communities of BOBW-making. The fact that the animal figurines are made of two sorts of clay (fired and unfired) implies that BOBW-making apprentices made unfired animal figurines. Second, the methods of making ground stones, lithics, stone vessels, and carved stamp seals have commonalities in terms of the processing of stones. Third, Alizadeh mentioned the absence of bone tools and the decreased number of lithics, which might be related to the preponderance of copper tools.[18] Fourth, both making BOBW and smelting copper tools require high-temperature firing facilities, such as a pottery kiln or furnace.

Contexts of pottery production and consumption at Tall-e Bakun A

There are plenty of findings showing pottery production near the settlement at Tall-e Bakun A. First, a clay heap, possibly a source of raw material for

[16] Langsdorff and McCown 1942; Alizadeh 2006.
[17] Langsdorff and McCown 1942: 61-80; Alizadeh 2006: 77-81.
[18] Alizadeh 2006: 81.

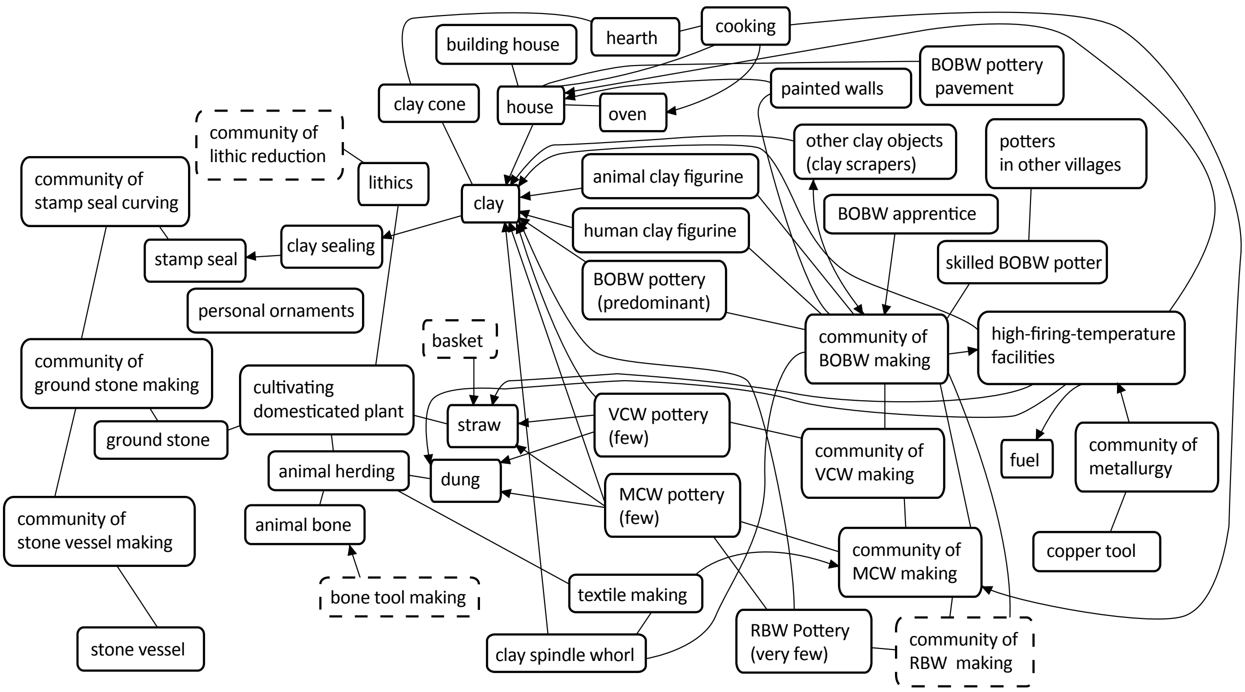


Figure 8.11 The entanglement of village activities at Tall-e Bakun A

pottery, was found in Room 2 of Building II, Level III. Second, possible pottery-making tools, such as stirrup-shaped scrapers, were found in Room 3 of Building III and Rooms 2 and 3 of Building IV at Level III. Third, the excavators argued that small clay objects were fired in the pottery kiln in Room 2 of Building XVII (Level IV) and that the room was a workshop.[19] Fourth, in total, eleven pottery kilns were found at Tall-e Bakun A, four near the northern complex and seven in the central-southern part of Tall-e Bakun A. Here, I draw attention to the long-term use of pottery kilns in the same loci at Tall-e Bakun A. The pottery kiln from Square L28 of the northern complex was used over a long term, from Level I to Level III. There are two pottery kilns at Level 4a of Squares BB27 and BB37, and one more in Level 2 of Square BB27-28. At Squares BB61 and BB62, one pottery kiln was discovered in Level 3, and the other three were in Level 2. This indicates that pottery kilns were maintained and used in the same loci over long periods by the community of BOBW-making.

The contexts in which materials were used at Tall-e Bakun A are well-preserved due to a possible conflagration event. Housing activities were evident in the northern complex and the central quarters and possibly took place everywhere; some of the houses have painted walls. The activities of painting walls and painting pottery might have been related. Storerooms had large jars in situ, evidencing their functions as storage for a longer term than other vessel forms. Beautifully painted open vessels were also stored with storage jars in storerooms. Potsherds pavement was observed in Square BB62. Evidence of indoor cooking was confirmed in Room 1 of Building II and Masuda's trench. An oven was set up in an outer space between Houses II and III.

Comparison with contemporaneous sites: Tall-e Nokhodi

In comparing village activities at the contemporaneous sites of Tall-e Nokhodi, Tappeh Mehr Ali, Tol-e Pir, and Phase A14 of Tol-e Nurabad with those of Tall-e Bakun A to trace interregional relations, I begin with Levels III-IV of Tall-e Nokhodi, located in the Pasargadae plain, north of the Kur River Basin.[20] First, published drawings of BOBW at this site show elaborate painted decorations, triangle secondary motifs, and high ring bases similar to those at Tall-e Bakun A, suggesting that the BOBW-making community included potters with distinguished painting skills.[21] Second, one complete large jar was sunken into the corner of a house in Level IIIb, showing the same use of a large jar as at Tall-e Bakun A. Third, other material characteristics at Tall-e Nokhodi indicate their similarities and differences. The main wall in Level IV was red-plastered. Unbaked and baked animal figurines and baked human figurines were found, as well as other clay objects, such as a spindle whorl, pegs, and circular discs. These materials suggest similar village activities to those at Tall-e Bakun A. On the other hand, differences also existed; as many as seven oval-shaped ovens were found at Levels III and IV.

[19] Langsdorff and McCown 1942: 20.

[20] Goff 1963, 1964.

[21] Goff 1963: Fig. 9:1,2, Fig. 10:8.

Metal objects, such as a copper pin and a copper knife, and a stamp seal made of clay were found in Levels I and II, representing possible transitional periods between the Bakun and the Lapui periods. Worked blades were discovered more often in Levels III and IV than in the upper levels.

Comparison with contemporaneous sites: Tappeh Mehr Ali and other sites

Tappeh Mehr Ali is located in the uppermost part of the Kur River Basin, approximately 100 km northwest of Tall-e Bakun A.[22] Four areas in this site have been excavated and deep stratigraphy revealed, ranging from the Shamsabad to the Lapui periods. The typical pottery attributes seen in Tall-e Bakun A, such as high ring bases and triangle secondary motifs, were confirmed in Phase 8 of Trench J2 and Phases 7-8 of Trench F10. Regarding architectural remains, mud brick alignments were discovered at Phase 8 of Trench F10. Other excavated materials include lithics, cowrie shells, spindle whorls, grinding stones, and misfired potsherds. Although five stamp seals and 15 sealings were found at this site, all of them came from the occupation levels of the Lapui period.

Sir Aurel Stein discovered Tol-e Pir, which is located in the Galedar Valley, approximately 300 km south of the Kur River Basin.[23] Finds collected from the trial excavation at Tol-e Pir show pottery attributes similar to those at Tall-e Bakun A: elaborate motifs, triangle secondary motifs, and conical bases, as well as other materials such as stone stamp seals, grinding stones, and lithics.

Finally, Phase A14 of Tol-e Nurabad has no architectural evidence. The majority of the pottery was discovered from the mixed Phases A13-14 and A14-15. Large portions of the BOBW sherds were unpainted, in contrast to the elaborate motifs at Tall-e Bakun A and its contemporaneous sites, as mentioned above. These descriptions suggest that the entanglements of painted pottery and other materials that required high technical skills (stamp seals and copper tools), as observed at Tall-e Bakun A, are not confirmed at the other contemporaneous sites besides Tol-e Pir.

Summary

In short, three points result from my approach to the entanglements and communities of practice at Tall-e Bakun A:

1) Evidence suggests the presence of potters with distinguished painting skills in the BOBW-making community.
2) Various kinds of artefacts and their related activities suggest complex relations with the BOBW-making community.
3) The discovery of as many as 11 pottery kilns and pottery-related objects inside the site indicates pottery-making inside the village and the importance of kilns for the potters and villagers.
4) Although information about village entanglements and communities of BOBW making in the neighbouring regions is still limited, a wide range of regional interaction from the north to south of the Fars province is suggested.

8-5. Diachronic changes of entanglements and communities of practice during the Bakun period

Through reassembling the communities of pottery-making and village entanglements in each site, I attempt to trace the organisation of pottery production as relations among humans and non-humans in each site. The next step is an inter-site comparison of tanglegrams, focusing especially on the patterns and characteristics of relations among pottery attributes and among activities. Note that the comparison of open-ended tanglegrams in both time and space runs the risk of putting arbitrary constraints/boundaries on the tanglegrams. However, here I do not offer a systematic comparison in quantitative terms. Below, I compare tanglegrams in a diachronic order: Level I of Tall-e Jari A with Level II of Tall-e Bakun B, Level II of Tall-e Bakun B with Tall-e Gap, and Tall-e Gap with Tall-e Bakun A. This comparison enables us to understand the changes in connections and patterns of entanglements. Finally, I compare this diachronic change from a relational perspective to that from a systemic perspective.

The difference of tanglegrams from Tall-e Jari A to Tall-e Bakun B

The chronological relationship between Tall-e Jari A and Tall-e Bakun B

As stated in Chapter 5, Level I of Tall-e Jari A (c. 5000 BCE) and Level BII of Tall-e Bakun B (c. 5000 BCE) are nearly contemporaneous in terms of the stratigraphy and radiocarbon dates. However, the analyses of pottery attributes in Chapters 6-7 reveal their differences. It is still unclear what these differences actually mean, in terms of either functional differences between contemporaneous sites or diachronic differences. Below, I approach these differences from a relational perspective using tanglegrams and a comparison to pottery from Phases A18-19 of Tol-e Nurabad.

[22] Hojabri Nobari et al. 2011; Sardari 2013.
[23] Stein 1937; Askari Chaverdi et al. 2008.

Comparison of pottery-attribute tanglegrams

First, I explain how to compare pottery-attribute tanglegrams between sites using examples of exterior-painted open vessels at Level I of Tall-e Jari A and Level BII of Tall-e Bakun B (Table 8.1). I also compare the pottery attributes and their relations presented in Figs. 8.1 and A8.1. These attributes are roughly subdivided into five categories: ware-related attributes, form-related attributes, pottery-making techniques, painted decoration, and skill score and community of practice. I interpret and express whether pottery attributes and differ between the two sites by colour and sign; the colour difference related to the character of differences (dark grey, red, or <<: major differences, light grey, yellow, or <: minor differences, white, black, or =: stable). Table 8.1 shows major differences in relations of ware-related attributes (BOBW proportions of wares, BOBW density). Other major differences lay in the relations of the proportion of exterior-painted open vessel forms, rim angles, and skill scores. Relations with the other pottery attributes showed minor differences or similarities. Next, I compare pottery-attribute tanglegrams of interior-painted open vessels. Unlike for the exterior-painted open vessels, relations of vessel sizes and the presence of skilled potters who made special burial goods are evidently different. It should also be noted that large jars, which are excluded from these tanglegrams, are present at Tall-e Bakun B, whereas they are not confirmed at Tall-e Jari A.

Comparison of communities of BOBW-making

In the comparisons of pottery-attribute tanglegrams between Level I of Tall-e Jari A and Level BII of Tall-e Bakun B, relations with ware-related attributes, vessel forms (absence/presence of large jars), skill score patterns, and skilled potters (absent or possibly from outside) were clearly different, suggesting differences among BOBW-making communities as well. On the one hand, as interpreted in Section 8-1, the community of BOBW-making at Tall-e Jari A was either absent or not stable, the activity was rarely conducted, and the knowledge was possibly transmitted between VCW potters at Tall-e Jari A and potters with distinguished skills outside the village. On the other hand, skilled potters were not confirmed at Tall-e Bakun B, and the production rate of BOBW and skill scores imply more frequent and stabilised transmission of knowledge.

Comparison of village entanglements

Next, I compare village entanglements at Level I of Tall-e Jari A and Level BII of Tall-e Bakun B (Fig. 8.12). The materials, activities, and relations between them, which are expressed in black, indicate that either they are similar between the two sites or that their differences are still unknown. This is because detailed research on materials other than those used for pottery making has not been conducted yet. In this discussion, I treat other materials in less detail than pottery. If archaeologists specialising in other materials, such as

Table 8.1 Comparison of tanglegrams of BOBW exterior-painted open vessels between Tall-e Jari A and Tall-e Bakun B. <<: major difference, <: minor difference, =: stable

<table>
<tr><th colspan="2"></th><th>Relations with exterior-painted open vessels</th><th>Relations with interior-painted open vessels</th></tr>
<tr><td rowspan="2">Ware-related attributes</td><td>proportion of BOBW in wares</td><td colspan="2"><<</td></tr>
<tr><td>density of BOBW</td><td colspan="2"><<</td></tr>
<tr><td rowspan="6">Form-related attributes</td><td>proportion of ex/interior-painted open vessels in vessel forms</td><td colspan="2"><<</td></tr>
<tr><td>vessel size</td><td>=</td><td><<</td></tr>
<tr><td>rim angle</td><td><<</td><td>=</td></tr>
<tr><td>estimated complete vessel forms</td><td><</td><td>=</td></tr>
<tr><td>rim shape</td><td>=</td><td><</td></tr>
<tr><td>base shape</td><td><</td><td><</td></tr>
<tr><td rowspan="7">Pottery-making techniques (the chaîne opératoire)</td><td>obtaining clay, pigment</td><td colspan="2">=</td></tr>
<tr><td>preparing clay</td><td colspan="2"><</td></tr>
<tr><td>forming</td><td colspan="2">=</td></tr>
<tr><td>surface treatment</td><td colspan="2">=</td></tr>
<tr><td>applying slip</td><td colspan="2">=</td></tr>
<tr><td>decorating</td><td colspan="2">=</td></tr>
<tr><td>firing</td><td colspan="2">=</td></tr>
<tr><td rowspan="2">Painted decoration</td><td>motif</td><td colspan="2"><</td></tr>
<tr><td>horizontal design structure</td><td colspan="2"><</td></tr>
<tr><td rowspan="4">skill score and community of practice</td><td>skill score in painting</td><td><<</td><td><</td></tr>
<tr><td>community of practice</td><td><</td><td><</td></tr>
<tr><td>apprentice</td><td><</td><td><</td></tr>
<tr><td>skilled potter</td><td><</td><td><<</td></tr>
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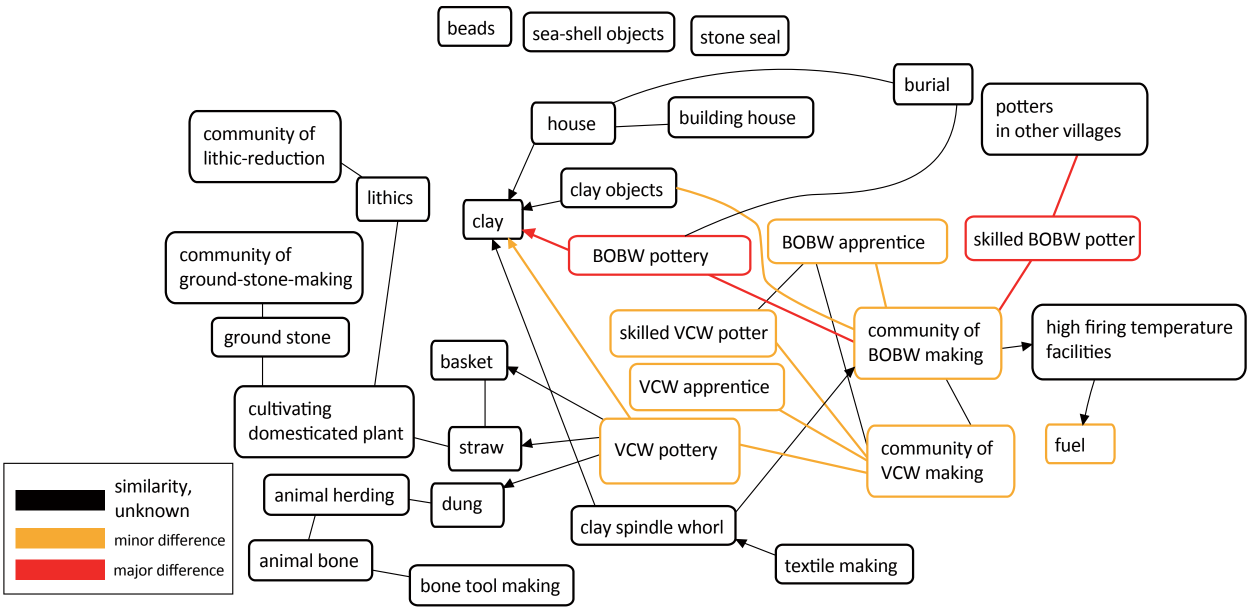

Figure 8.12 Comparison of village entanglements between Tall-e Jari A (c. 5000 BCE) and Tall-e Bakun B (c. 5000 BCE)

lithics or palaeobotany, compile visual tanglegrams in the future, their tanglegrams will be quite different from these pottery-centred ones. As far as I interpret this from excavation reports, relations between materials and activities at both sites are relatively similar, except for the actors related to pottery making. As I argue in reference to the study by Pollock and Bernbeck in Section 8-1, Tall-e Jari A and Tall-e Bakun B have been interpreted as still operating in the material world of the Neolithic period, like Tol-e Bashi.

Comparison with contemporaneous sites: Phases A19 and A18 of Tol-e Nurabad

I add potters in other villages as actors in the village entanglements (Fig. 8.12). Because Tall-e Jari A and Tall-e Bakun B are nearly contemporaneous in terms of radiocarbon dates, both sites could be considered neighbouring villages. Moreover, in order to consider such actors beyond the Kur River Basin, I introduce the pottery and remains excavated from Phases A19 and A18 of Tol-e Nurabad.[24] In Phase A19, chaff-tempered pottery comprised the majority of wares (47 of 58 registered sherds). A small number of BOBW works were confirmed in this phase of Tol-e Nurabad. Unfortunately, the data on painted motifs and vessel forms of BOBW are limited. A hearth with a concentration of burnt river cobbles was discovered in the southwest corner of the trench at Phase A19.

In the next phase, Phase A 18, BOBW became more predominant (87 of 112 sherds). Concerning vessel forms, interior-painted and exterior-painted open vessels with geometric motifs and large jars were confirmed. Animal motifs decorated the surface of large jars. Simple, rounded rims and ring bases were common in open vessels. One complete deep bowl was discovered; its horizontal design structure pattern was DE2 (with body band and without upper/lower optional lines). The data on pottery attributes from Phases A19 and A18 suggest that Phase A19 corresponds to Level I of Tall-e Jari A and that Phase A18 parallels Level BII of Tall-e Bakun B. Hence, I argue that Level I of Tall-e Jari A is likely earlier than Level BII of Tall-e Bakun B.

Summary

In this section, I present the compared tanglegrams between sites using examples of Level I of Tall-e Jari A and Level BII of Tall-e Bakun B. This comparison draws attention to the degrees of relational differences (major difference, minor difference, and similarity) between pottery attributes, materials, and inferred activities. This section can be summarised as follows:

1) Pottery-attribute tanglegrams differ particularly in the amount of BOBW production, suggesting a difference between BOBW-making communities in frequencies and ways of knowledge transmission reflect this difference.
2) Although pottery-attribute tanglegrams are different, village entanglements are similar, implying the material world's continuity of the material world since the Neolithic period.
3) A comparison of Phases A19 and A18 of Tol-e Nurabad suggests diachronic differences between Level I of Tall-e Jari A and Level II of Tall-e Bakun B.

[24] Ebrahimi et al. 2016; Potts and Roustaei (eds.) 2006.

Diachronic changes of tanglegrams from Tall-e Bakun B to Tall-e Gap

Comparison of pottery-attributes tanglegrams

As radiocarbon dates show, Level II of Tall-e Bakun B (c. 5000 BCE) and the earliest level at Tall-e Gap (c. 4700 BCE) are chronologically different. This enables me to investigate the diachronic change in tanglegrams between two sites. However, I would mention that one hurdle for this comparison is a bias in sample sizes between the two sites. The comparison of pottery-attribute tanglegrams of exterior/interior-painted open vessels is visualised in the same way as in the previous section (Table 8.2). First, in exterior-painted open vessels, various kinds of major changes in relations are evident, ranging from ware-related attributes (increase of BOBW) and form-related attributes (preference of exterior-painted open vessels, increasing variations of complete vessel forms and base shapes) to painted decoration. It is likely that pottery attributes influenced each other, thereby leading to such major changes of wide-ranging relations. Second, interior-painted open vessels also show major changes in relation with other pottery attributes as well as exterior-painted ones. However, whereas the relation with vessel sizes changed in interior-painted open vessels, that of exterior-painted ones did not.

Comparing BOBW-making communities

The comparison of pottery-attribute tanglegrams gives us a clue about the diachronic changes in BOBW-making communities from Tall-e Bakun B to Tall-e Gap. In Table 8.2, a community of practice shows a major change in relation with a poorly skilled apprentice, who was allowed to make a vessel using fine clay at Tall-e Gap. As argued in Section 8-3, the increase of BOBW suggests more frequent pottery-making and knowledge transmission through legitimate peripheral participation inside the village. What the apprentices had to learn (painted decoration, vessel forms, etc.) also increased, as seen in the major changes in the tanglegrams. This suggests that apprenticeship at Tall-e Gap became more time-consuming and fixed compared to Tall-e Bakun B. Skill score patterns in painting did not indicate major changes, with only an increase in the number of vessels with high scores. This also implies that a stable mechanism of knowledge transmission was established. Through participating in this stabilised community of BOBW making, apprentices of BOBW making could form identities as members of the BOBW-making community.

Comparison of village entanglements

While the community of BOBW making changed its character towards a longer and fixed apprenticeship, what happened in the village entanglement? To consider the diachronic change of village entanglements, I

Table 8.2 Comparison of tanglegrams of BOBW exterior-painted open vessels between Tall-e Bakun B and Tall-e Gap. <<: major difference, <: minor difference, =: stable, new: newly appeared

<table>
<tr><th></th><th></th><th>Relations with exterior-painted open vessels</th><th>Relations with Interior-painted open vessels</th></tr>
<tr><td rowspan="2">Ware-related attributes</td><td>proportion of BOBW in wares</td><td colspan="2"><<</td></tr>
<tr><td>density of BOBW</td><td colspan="2"><<</td></tr>
<tr><td rowspan="6">Form-related attributes</td><td>proportion of ex/interior-painted open vessels in vessel forms</td><td colspan="2"><<</td></tr>
<tr><td>vessel size</td><td>=</td><td><<</td></tr>
<tr><td>rim angle</td><td><</td><td>=</td></tr>
<tr><td>estimated complete vessel forms</td><td colspan="2"><<</td></tr>
<tr><td>rim shape</td><td>=</td><td><</td></tr>
<tr><td>base shape</td><td><<</td><td><</td></tr>
<tr><td rowspan="7">Pottery-making techniques (the chaîne opératoire)</td><td>obtaining clay, pigment</td><td colspan="2"><</td></tr>
<tr><td>preparing clay</td><td colspan="2"><</td></tr>
<tr><td>forming</td><td colspan="2">=</td></tr>
<tr><td>surface treatment</td><td colspan="2">=</td></tr>
<tr><td>applying slip</td><td colspan="2">=</td></tr>
<tr><td>decorating</td><td colspan="2"><</td></tr>
<tr><td>firing</td><td colspan="2">=</td></tr>
<tr><td rowspan="2">Painted decoration</td><td>motif</td><td colspan="2"><<</td></tr>
<tr><td>horizontal design structure</td><td colspan="2"><<</td></tr>
<tr><td rowspan="5">skill score and community of practice</td><td>skill score in painting</td><td>=</td><td><</td></tr>
<tr><td>community of practice</td><td colspan="2"><<</td></tr>
<tr><td>apprentice</td><td><</td><td><<</td></tr>
<tr><td>work of apprentice</td><td></td><td>New</td></tr>
<tr><td>skilled potter</td><td colspan="2"><</td></tr>
</table>

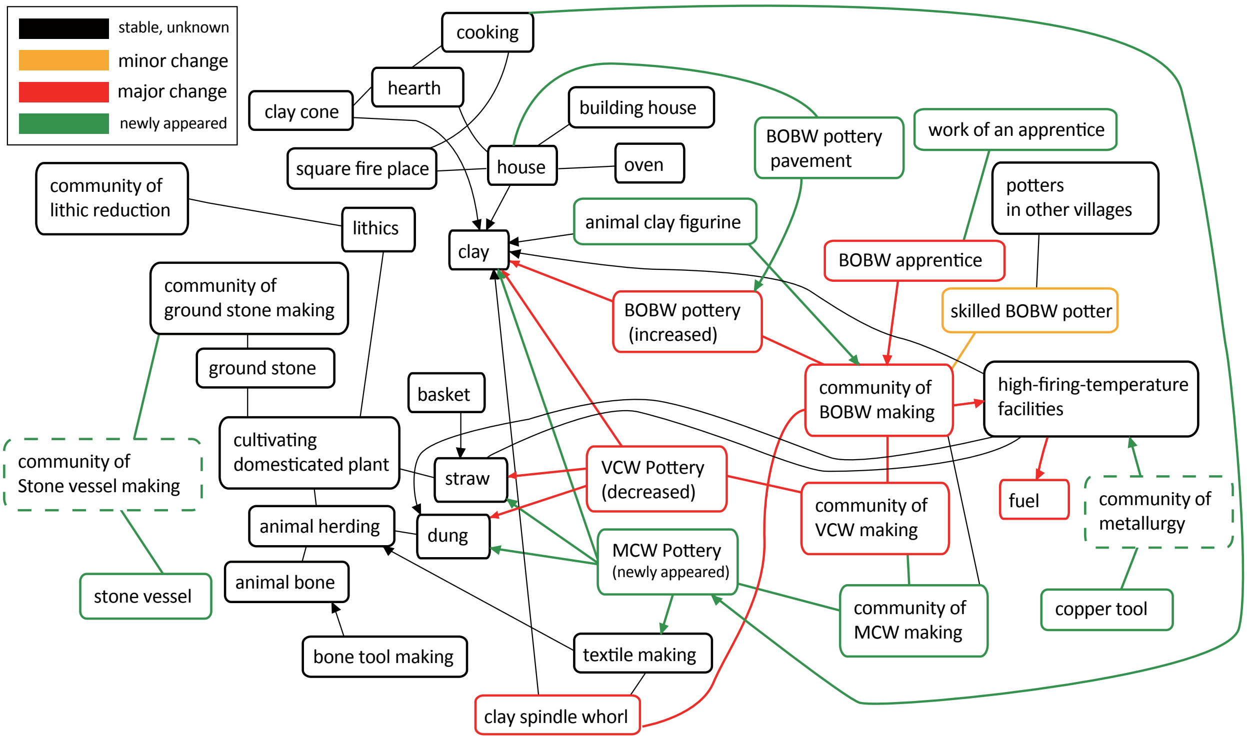

Figure 8.13 Comparison of village entanglements between Tall-e Bakun B (c. 5000 BCE) and Tall-e Gap (c. 4700-4500 BCE)

visually compare village entanglements at Tall-e Bakun B and Tall-e Gap (Fig. 8.13) using the same procedure as in Fig. 8.12. In this comparison, I express actors/actants which newly appeared at Tall-e Gap in green. First, new relations with different actants appeared in the village entanglements, such as MCW, animal clay figurines, copper tools, and stone vessels. The use of MCW as cooking pots was related to hearths and clay cones at Tall-e Gap. According to the analysis and discussion of Çatalhöyük, a cooking pot enabled people to get more nutrients from goat and sheep animal bones by stewing them.[25] Thus, using MCW at Tall-e Gap might have caused changes in food preparation. An analysis of the residue inside MCW is required for further understanding. The number of copper tools and stone vessels at Tall-e Gap was so scarce that it is also possible these were imported from somewhere else. Second, along with the significant change in the community of BOBW-making, the shapes and types of spindle whorls also changed. Not only unpainted biconical spindle whorls were made at Tall-e Gap, but also painted conical ones. The appearance of animal clay figurines might be also related to this change.

The meaning of BOBW

In the process of the transformation of pottery-attribute tanglegrams and village entanglements between Tall-e Bakun B and Tall-e Gap, the meaning of BOBW was also likely to change. The increase of exterior-painted pottery suggests the orientation toward vessel function for display and individual serving rather than collective use. Pollock argued that this change represents an upward trend in the concept of individualisation.[26] Second, several pieces of evidence suggest a breakdown of equality. The increase of large jars implies an increasing importance of storing something, which potentially visualises the differences in property, although it could be shared property among communities. Third, the BOBW-making community developed and produced more vessels than what the Neolithic world had allowed. The material culture BOBW represented became something to be not suppressed (as in the Neolithic period), but to be produced and differentiated. In contrast to the Neolithic lifeworld, the villagers at Tall-e Gap desired increasing variability, and BOBW reflected these desires.

Summary

The following are short summaries of what I have covered before moving on to the next section:

1) BOBW pottery-attribute tanglegrams indicated major changes of relations with various pottery attributes (ware proportion, painted decoration, and vessel shapes). The community of BOBW-making changed, orienting towards more

[25] Hodder 2012.

[26] Pollock 2012.

Table 8.3 Comparison of tanglegrams of BOBW exterior-painted open vessels between Tall-e Gap and Tall-e Bakun A. <<: major difference, <: minor difference, =: stable

<table>
<tr><th colspan="2"></th><th>Relations with exterior-painted open vessels</th><th>Relations with interior-painted open vessels</th><th>Relations with closed vessels</th></tr>
<tr><td rowspan="2">Ware-related attributes</td><td>proportion of BOBW in wares</td><td colspan="3">=</td></tr>
<tr><td>density of BOBW</td><td colspan="3"><<</td></tr>
<tr><td rowspan="7">Form-related attributes</td><td>proportion of ex/interior-painted open vessels/ closed vessels in vessel forms</td><td colspan="3">=</td></tr>
<tr><td>vessel size</td><td colspan="2"><<</td><td>=</td></tr>
<tr><td>rim angle</td><td><</td><td>=</td><td>=</td></tr>
<tr><td>estimated complete vessel forms</td><td><<</td><td>=</td><td><</td></tr>
<tr><td>rim shape</td><td><</td><td>=</td><td><</td></tr>
<tr><td>base shape</td><td><<</td><td colspan="2"><</td></tr>
<tr><td rowspan="7">Pottery-making techniques (the chaîne opératoire)</td><td>obtaining clay, pigment</td><td colspan="3">=</td></tr>
<tr><td>preparing clay</td><td colspan="2">=</td><td><</td></tr>
<tr><td>forming</td><td colspan="3">=</td></tr>
<tr><td>surface treatment</td><td colspan="3">=</td></tr>
<tr><td>applying slip</td><td colspan="3">=</td></tr>
<tr><td>decorating (no. of motif-unit)</td><td><<</td><td colspan="2"><</td></tr>
<tr><td>firing</td><td><</td><td colspan="2">=</td></tr>
<tr><td rowspan="2">Painted decoration</td><td>motif</td><td colspan="3"><<</td></tr>
<tr><td>horizontal design structure</td><td colspan="3"><<</td></tr>
<tr><td rowspan="5">skill score and community of practice</td><td>skill score in painting</td><td colspan="2"><</td><td>=</td></tr>
<tr><td>community of practice</td><td colspan="3"><</td></tr>
<tr><td>apprentice</td><td><</td><td colspan="2">=</td></tr>
<tr><td>work of apprentice</td><td colspan="3">=</td></tr>
<tr><td>skilled potter</td><td colspan="3"><<</td></tr>
</table>

frequent knowledge transmission and longer, fixed apprenticeships.

2) Among the relations of village entanglements, the transformation of the BOBW-making community and new relations with different actants were remarkable, influencing the meaning of BOBW and social equality, which was sustained in the Neolithic period.

Diachronic change of tanglegrams from Tall-e Gap to Tall-e Bakun A

Comparing tanglegrams of pottery attributes: BOBW

Our exploration of the difference in tanglegrams finally turns to the comparison of Tall-e Gap (c. 4700-4500 BCE) and Tall-e Bakun A (c. 4500-4300 BCE), both of which both had appropriate sample sizes. The analysis of stratigraphy and radiocarbon dates in Chapter 5 suggests that the sites were diachronically different, except for the possible slight overlap between the latest levels (upper than Level 5b) at Tall-e Gap and the earliest level at Tall-e Bakun A. First, I compare the tanglegrams of exterior-painted open vessels between Tall-e Gap and Tall-e Bakun A (Table 8.3). The major changes of relations between pottery attributes via exterior-painted open vessels were remarkable in terms of form-related attributes (complete vessel forms, base shapes, vessel sizes) and painted decoration. On the other hand, the proportional attribute of BOBW in wares, which continued to increase until Tall-e Gap, stopped changing at Tall-e Bakun A. Interestingly, the density of BOBW decreased at Tall-e Bakun A.

The next step is to compare the tanglegrams of open vessels painted on their interiors between Tall-e Gap and Tall-e Bakun A (Table 8.3). In contrast to the remarkable change of relations in exterior-painted open vessels, the change in pottery attributes of interior-painted open vessels is not so clear, with the exception of the painted decoration. This suggests that potter's concerns at Tall-e Bakun A shifted from interior-painted open vessels to exterior-painted ones. Although I do not include both-sides-painted open vessels in the above tanglegrams, they showed a slight increase at Tall-e Bakun A, implying a fusion or new relation between interior-painted open vessels and exterior-painted ones. Furthermore, the increase of sample data on closed vessels, especially large jars, allows me to compare pottery-attribute tanglegrams of closed vessels between Tall-e Gap and Tall-e Bakun A in more detail than the previous section (Table 8.3). Major changes are present in painted decoration, such as that of open vessels at Tall-e Bakun A, and minor changes are observed in shape-related attributes (complete vessel forms, rim shapes, base shapes) and clay preparation. The appearance of special vessels (miniature vessels, spout vessels, zoomorphic vessels, and pot stands) should also be noted as major changes in pottery-attribute tanglegrams.

Comparing communities of BOBW-making

The above-mentioned comparison of pottery-attribute tanglegrams between Tall-e Gap and Tall-e Bakun A indicates more emphasis on the variation of painted decoration and vessel forms rather than ware-related attributes at Tall-e Bakun A. How does this emphasis relate to the diachronic change of BOBW-making communities? First, the appearance of quite elaborate motifs indicates skilled potters with distinguished painting skills, as mentioned in Section 8-4. Their presence in the community of BOBW-making at Tall-e Bakun A is a significant difference from that at Tall-e Gap. These skilled potters might have been the "core" of the community of BOBW-making. Their presence was in strong contrast to apprentices as the "periphery" of the community. On the other hand, the long and fixed apprenticeship that was already established at Tall-e Gap was likely stable at Tall-e Bakun A, as shown by the apprentices' works and skill score patterns and the stable pottery-making techniques. This stabilised learning mechanism possibly generated the skilled potters with distinguished painting skills in the first place. The more fixed character of the community of BOBW-making might have contributed to forming the members' identities, at the same time running the risk of conflicts between apprentices and skilled potters. BOBW itself also contributed to fixing the community of BOBW-making. The beautiful BOBW decoration attracted villagers at Tall-e Bakun A; BOBW fostered their desire to produce/use elaborately decorated vessels. This attractive power kept the community of BOBW-making fixed, and it imposed longer apprenticeships on apprentices.

Comparing village entanglements

Expanding my field of view from pottery attributes to village entanglements, I discuss the diachronic change of entanglements between Tall-e Gap and Tall-e Bakun A (Fig. 8.14). Here, I focus on changes in relations with the BOBW community and in relations with stone-processing activities. First, the community of BOBW-making likely occupied itself not only with the production of not only painted pottery, but also that of various kinds of clay objects that newly appeared at Tall-e Bakun A, such as human clay figurines and the other clay objects (clay scrapers, pottery tubes, pottery rings, etc.). Pottery painters might also have done wall paintings. The spindle whorls' decoration not only changed from painting to incising without painting, but also decreased in weight, implying the orientation to finer thread.[27] Because the decoration of spindle whorls changed from painting to incision, it is also possible that another group was engaged in making spindle whorls. These pieces of evidence imply the further expansion of BOBW-making communities within the Tall-e Bakun A village community. This growing community might affect or overlap with the metallurgy community, which shared high-firing temperature facilities, thereby contributing to the increase of copper tools.

Second, I turn my focus to the changes of stone-processing activities. More various categories of ground stones were confirmed at Tall-e Bakun A than Tall-e Gap. More stone vessels were also found at Tall-e Bakun A, suggesting the presence of a stone-vessel carving community. Various stamp seal styles at Tall-e Bakun A were also markers of clear difference from Tall-e Gap.[28] The use of stamp seals implies mistrust among villagers, a new relation, as Pollock argued.[29] Although detailed research on the carving techniques of stamp seals is required, they evidence the same degree of proficiency of carving skills as the painting of elaborate motifs. The relationship between the community of BOBW-making and those of stone-processing activities is still uncertain. It is also possible that the community of stone-processing activities at Tall-e Bakun A came from other regions. However, I argue that the apprenticeship form, which was established by the community of BOBW-making at Tall-e Gap, might have influenced these communities of stone-processing activities at Tall-e Bakun A.

As for subsistence practices, in the longer-term perspective from Tall-e Jari A to Tall-e Bakun A, Mashkour and her colleagues reported a diachronic change in animal exploitation.[30] First, the proportion of

[27] Schoch 2018: 316-320.
[28] Langsdorff and McCown 1942; Alizadeh 1988.
[29] Pollock 2015.
[30] Mashkour et al. 2006.

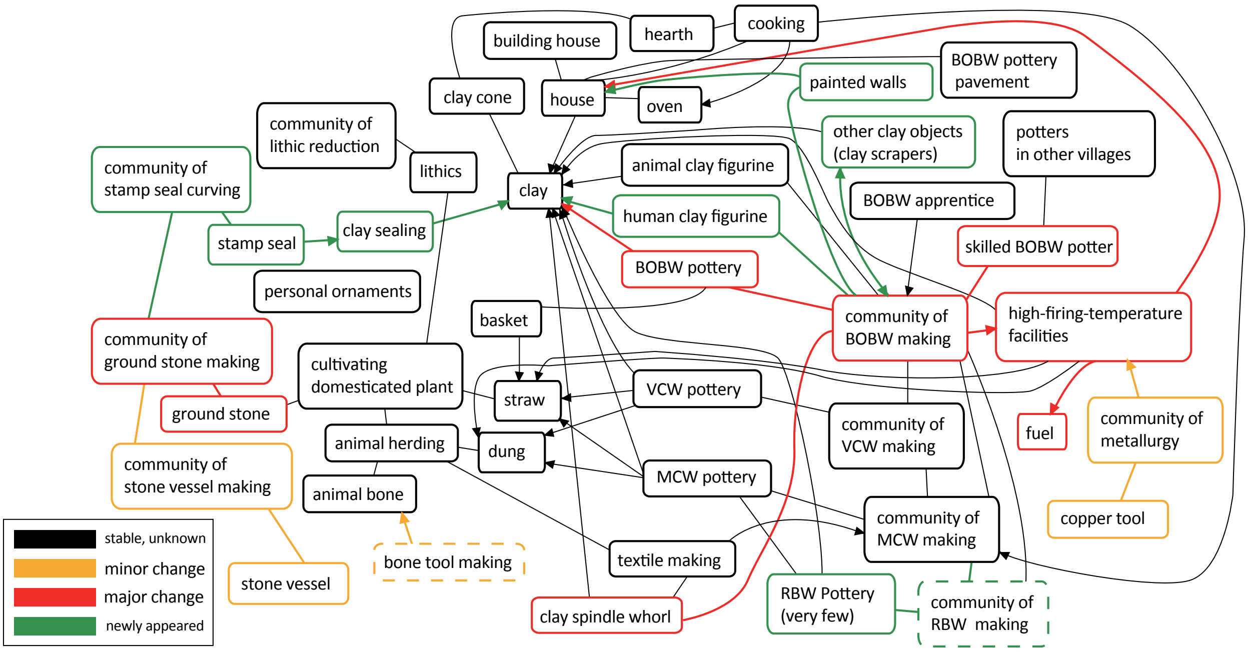

Figure 8.14 Comparison of village entanglements between Tall-e Gap (c. 4700-4500 BCE) and Tall-e Bakun A (c. 4500-4300 BCE)

sheep and goats became predominant at Tall-e Bakun A. They argue that the animals were exploited as food. This change might be related to the use of MCW as cooking pots and new approaches to food preparation (boiling and stewing). Second, the proportion of cattle decreased, implying their purpose as animals of burden and a source of milk. Further research into cattle slaughter patterns is required to examine their argument.

The meaning of BOBW and the pottery kiln

I also consider the diachronic change in the meaning of BOBW for villagers, an invisible actant in entanglements. First, I argue that the villagers at Tall-e Bakun A had taken for granted the presence of BOBW. This might be comparable to how we cannot imagine our modern lives without smartphones. BOBW was used and reused in various occasions, such as reworked pottery scrapers, spindle whorls, or pottery pavement. Second, producing and consuming the more elaborately decorated pottery, which was oriented towards individuality, visualised the differences between those who produced/used it and those who did not. Several of these painted vessels were stored in storerooms with large jars at Tall-e Bakun A, implying that these vessels were not shared between households but kept privately. This helped to stabilise hierarchical relationships between the villagers, thereby accelerating social inequality.

In addition, many pottery kilns at Tall-e Bakun A were not only much closer to the settlement, but also maintained by potters for longer terms in the same places. Although the impact of polluting the air with pottery firing near the settlement needs to be considered, pottery kilns as high-firing temperature facilities might be more functionally (and possibly symbolically) significant for communities of BOBW-making and metallurgy at Tall-e Bakun A than at Tall-e Gap. We should also note another aspect of pottery kilns: Despite many pottery kilns being confirmed at Tall-e Bakun A, the density of BOBW in Masuda's trench at Tall-e Bakun A was less than that at Tall-e Gap. There are two possibilities of the background. One is that BOBW was not used so much at Masuda's trench as in other areas of Tall-e Bakun A. Another possibility is that potters at Tall-e Bakun A produced BOBW than what the villagers consumed themselves and therefore distributed BOBW to other sites.

Summary

Here I summarise the diachronic changes of entanglements between Tall-e Gap and Tall-e Bakun A:

1) The pottery-attribute tanglegrams of BOBW moved towards an elaboration of vessel forms and painted decoration; potters with distinguished painting skills appeared in the BOBW-making community.
2) The community of BOBW-making enlarged its repertoire to other clay objects. At the same time, metallurgy communities and stone-processing activities appeared and generated new relations.
3) BOBW was taken for granted by villagers and at the same time elaborately-painted pottery contributed to visualising the differences between them, encouraging social inequality.

Organisation of pottery production from a systemic perspective

Above I explain the organisation of pottery production from relational perspectives. Here, by briefly reconstructing production systems of Bakun-painted pottery and their changes within the framework of craft specialisation, I illustrate the differences between these two approaches. For the reconstruction, I use Costin's parametrical approach of production systems, consisting of four parameters (context, concentration, scale, and intensity) and types of craft specialisation.[31]

The context of the production system

First, as it stands, the context or degree of élite sponsorship is difficult to assess at four Bakun-period sites because the clear marker of élites was not confirmed yet at all these Bakun period sites. Although Alizadeh argued that the presence of stone stamp seals and sealings at Tall-e Bakun A represented administrative activities carried out by nomadic élites,[32] many researchers cast doubt on his argument.[33] Hence, the pottery production of the Bakun period is not necessarily attached to élites.

The concentration of the production system

The second parameter is concentration, namely whether specialists were evenly distributed or spatially aggregated. At Tall-e Jari A and Tall-e Bakun B, production debris has not yet been discovered and therefore this parameter is unmeasurable. At Tall-e Gap, only a few production debris and several pieces of pottery kilns were discovered near the settlement. Whether the production locale was segregated from the other quarters at Tall-e Gap remains a question. Eleven pottery kilns were discovered at Tall-e Bakun A, and Alizadeh thought that the south-central quarter was a production area. However, the locales of pottery kilns and pottery-making related tools were evenly distributed both in the northern building complex and the south-central areas, as argued by Fraser (see Section 2-4). Although Sumner discussed the number of sites with pottery kilns in the Early, Middle, and Late Bakun sites in the Kur River Basin, he was basing this on survey data and it is possible that the production debris was not discovered by surface surveys alone. The rediscovery of production debris at Tall-e Gap points to the difficulty of discussing the production based only on survey results.

The scale of the production system

As for the third parameter, scale, whether labour for production systems came from kin-based relationship or wage-labour, there is no archaeological clue that directly demonstrates this parameter at the Bakun-period sites. Fraser argues that the labour came from kin-based relationships from the same village as extended households.

The intensity of production system

The final parameter is intensity, the producers' time costs for their craft—full-time on the one extreme and part-time on the other. This parameter is also difficult to approach archaeologically. The density of BOBW from each site is one clue. The number of potsherds from Tall-e Gap exponentially increased. Another indirect clue is the skill score that shows stable acquisition and maintenance of painting skill at all the Bakun-period sites, with the exception of Tall-e Jari A. It implies that the interval between painting activities was not so long. In addition, from Tall-e Bakun A, the amount of time to paint motifs might have rapidly increased as speculated based on the more elaborated painted decoration. These facts might reflect a more full-time-oriented production system at Tall-e Bakun A. However, as Kuijpers pointed out, the assumption of the association between production time and archaeological evidence should be cautiously considered.

Production types of the Bakun pottery-production

The production types during the Bakun period are considered in terms of these four parameters. According to Costin's eight production types and their combination with four parameters, the production types of four Bakun-period sites were classified into individual specialisations. The differences in these production systems lie, to some extent, in concentration and intensity. One might mention that the pottery production systems at the Bakun-period sites were excluded from Costin's classification system because it is impossible to know whether these Bakun-period sites fulfilled her definition of craft specialisation:

> "[I]nstitutionalized production system in which producers depend on extra-household exchange relationships at least in part for their livelihood, and consumers depend on them for acquisition of goods they do not produce themselves".[34]

Clearly, the classification scheme of craft-specialisation studies did not explain archaeological data in the Bakun-period sites very well. These parameters

[31] Costin 1991. See the detail in Section 3-1.

[32] Alizadeh 1988, 2006.

[33] Fraser 2008, Pollock 2015.

[34] Costin 1991: 4.

were quite difficult to examine from archaeological materials, as was criticised in the 2000s. However, this systemic approach is still useful when one compares the Bakun period's production system with those of the Banesh or the subsequent periods in a longer-term view. In addition, each parameter provides helpful viewpoints to discuss organisational aspects that are easily disregarded from archaeological studies sticking only to excavated materials and fieldwork.

8-6. Summary of Chapter 8

In this discussion chapter, I approach **Research Question No. 4**: "How was pottery production organised during the Bakun period?" I avoid explaining the organisation of pottery production from a systemic perspective. Instead, I regard organisation in terms of numerous relations between humans and things from a relational perspective. In tracing these relations and organisation of pottery production, the concepts of communites of practice and entanglement are helpful. I reassemble pottery-attribute tanglegrams and village entanglements at each site in Sections 8-1, 8-2, 8-3, and 8-4, while also mentioning the contemporaneous sites near the Kur River Basin. Then, diachronic changes of entanglements are explained by comparing two sites (Tall-e Jari A with Tall-e Bakun B, Tall-e Bakun B with Tall-e Gap, and Tall-e Gap with Tall-e Bakun A). The details of the diachronic changes are summarised as three steps and compared with production systems from a systemic perspective:

1) When BOBW was adopted at Tall-e Jari A, the community of BOBW-making did not form a stabilised transmission of knowledge. BOBW was either imported from other villages neaby or made on rare occasions by potters who made VCW, with some sort of interaction with skilled potters outside Tall-e Jari A. At Tall-e Bakun B, BOBW-making became slightly more frequent than at Tall-e Jari A. The village entanglements at both sites show continuity since the Neolithic period, that is, suppression of the material variability to prevent social inequality.
2) At the Tall-e Gap stage, tanglegrams showed major relational changes between various pottery attributes, including the amount of production, painted decoration, and vessel forms. In more entangled relations, the community of BOBW-making shifted towards a longer and fixed apprenticeship, which comprised skilled craftspersons and apprentices. The development of BOBW and the appearance of new actants, such as MCW, copper pins, and a stone vessel, generated new relations in the village entanglement, departing from the Neolithic lifeworld in which inhabitants attempted to maintain social equality.
3) Finally, at Tall-e Bakun A, the final phase of the Bakun period, the relations with visually recognisable pottery attributes experienced major changes in terms of elaboration and differentiation. In relation to such a demand for BOBW in the village, potters with distinguished painting skills finally appeared from the community of BOBW-making, which expanded its position inside the village. In addition, the community of BOBW-making and other new communities mutually influenced each other. The meaning of BOBW possibly changed from sharing to private property, also contributing to visualising the differences between villagers, thereby leading to further social inequality.
4) The above-summarised interpretations of the organisation of pottery production based on a relational standpoint were compared with production systems reconstructed from a systemic perspective using Costin's scheme. Ultimately, this systemic scheme had difficulty in discussing the shorter-term change in the organisation of pottery production, such as during the Bakun period.

In the next chapter, the conclusion, I summarise the contents of Chapters 1-7 and present the relevance and limits of this study.

Chapter 9

Conclusion

In this research, I have analysed and discussed the pottery making and village communities of southwestern Iran in the 5th millennium BCE. In this conclusion chapter, I will summarise the previous chapters (Section 9-1) and present the relevance and limits of this study (Section 9-2).

9-1. Summary of each chapter

Below, I will briefly present my answers to the four research questions raised in Chapter 1. For each research question, I will summarise problems with previous studies as clarified in Chapters 2 and 3 and methods I presented in Chapter 4. Subsequently, I will explain the results obtained from Chapters 6-8.

Answers to Research Question No. 1: "*Chronological relations of the Bakun-period sites: when were the sites dated in the chronological sequence of the Bakun period?"*

In previous studies, the chronology of the Bakun period was subdivided into the Early, Middle, and Late Bakun phases. The chronological relations between four main Bakun-period sites (Tall-e Jari A, Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A) varied by researcher because the criteria of chronological markers that they relied on (vessel forms and painted decoration of the Bakun pottery) differed. The absence of one well-excavated site with long stratigraphy ranging from the beginning to the end of the Bakun period made the chronological discussion more difficult. As one of the solutions to these problems, in Chapter 5, I reconsidered the stratigraphy and radiocarbon dates of the four Bakun period sites by reviewing and comparing the descriptions of excavation trenches. A Bayesian statistical test was also conducted to narrow down the time range of radiocarbon dates with the stratigraphic information of four sites.

Following the analyses of the stratigraphy and radiocarbon dates, the chronological relationship between four sites was presented independently of the former tripartite subdivision system, which was based on vessel forms and painted decoration of Bakun pottery. The chronological order of four sites (from earliest to latest) is understood as "Tall-e Jari A ≥ Tall-e Bakun B > Tall-e Gap ≥ Tall-e Bakun A" for the purposes of this research.

Answers to Research Question No. 2: "*When and how were black-on-buff ceramics adopted and developed in the Bakun period?"*

Problems of pottery studies, especially diachronic changes of pottery

The diachronic changes of Bakun pottery have not been well-studied, excluding painted motifs and vessel forms. Hence, I decided to expand attributes to be studied beyond wares, vessel forms, painted motifs, and horizontal design structures (Chapter 6) to pottery-making techniques and petrographic and geochemical characteristics (Chapter 7). There were also few quantitative approaches to pottery changes from the beginning to the end of the Bakun period. In addition, the classification systems of Bakun pottery varied depending on archaeologists.

Quantitative approaches of wares, vessel forms, and vessel sizes (Chapter 6)

For the analysis of wares and vessel forms, I integrated previous classification systems in a quantitative approach to ceramic materials. To supplement data for quantitative analyses, I presented unpublished ceramic materials and drawings from Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap curated in UMUT and University of Tsukuba. I also investigated the diachronic change of wares, vessel forms, and vessel sizes within each site. First, the increase of black-on-buff ware (BOBW), the decrease of vegetal-tempered coarse ware (VCW), and the appearance of mineral-tempered coarse ware (MCW) was revealed. Second, I illustrated the gradual shift from interior-painted open vessels to exterior-painted ones, the increase of large jars, and the diversification of complete vessel forms over time. Third, interior-painted open vessels and exterior-painted ones became similar in rim angles and vessel sizes over time.

Analysis of horizontal design-structure patterns (Section 6-6)

Painted decoration is the second most significant topic in discussing the adoption and development of black-on-buff ceramics. Previous studies drew more attention to the classification of painted motifs depicted on the surface of black-on-buff ceramics than that of horizontal design structures. In terms of painted decoration, I turned from a motif-oriented analysis to a horizontal design-structure-oriented analysis. On the basis of the classification system and terminology I set up in Chapter 4, I classified horizontal design-structure patterns of both the published and unpublished drawings from Tall-e Jari A, Tall-e Bakun B, Tall-e Gap, and Tall-e Bakun A and conducted inter-site comparisons of these patterns in Chapter 6. As a consequence, I was able to describe and explain horizontal design-structure patterns of exterior-painted open vessels (10 patterns), interior-painted ones (3 patterns), and closed vessels (6 patterns). First, in exterior-painted open vessels, structural patterns showing the absence of a body band and upper/lower optional lines became more common over time, coinciding with the elaboration of painted motifs. Second, in interior-painted vessels, patterns with interior base bands decreased through time. Third, structural patterns of closed vessels shifted from simple to complex patterns.

Answers to Research Question No. 3: "*How were black-on-buff ceramics and other pottery produced?*"

Problems of pottery-production studies

Pottery-making techniques have been discussed by previous researchers in attempts to discover more about the organisation of pottery production. As with other pottery attributes, few studies have tackled the whole processs of pottery making from the beginning to the end of the Bakun period. A poorly-painted vessel of the Bakun period has been reported, implying the possibilty that technical skills can be approached via archaeological materials, particularly painting activity. I separated pottery-making techniques into two sections: the explicit sequence of technical steps (what was done: technique) and the degree of technical skills (how it was done: skill).

Methods: the chaîne opératoire

The chaîne opératoire is a useful analytical concept to reconstruct pottery-making techniques as explicit sequences of technical steps. In Section 4-4, I explained the definition and problems of the chaîne opératoire. In the analytical concept of the chaîne opératoire, a pottery-making technique is regarded as a sequence of segmented technical steps/options. Following this understanding, I separated the chaîne opératoire of pottery making into seven general technical steps: clay acquisition, clay preparation, forming, surface treatment, slipping, painting, and firing. I mainly observed the well-preserved vessels from Tall-e Bakun A curated by the OIC (Oriental Institute of Chicago) to find traces of these technical steps. Then, I observed pottery fragments collected at Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap.

Theoretical framework and methods: technical skill

Following Ingold's discussion regarding skill reviewed in Section 3-3, technical skill is defined as emergent in a growing process of craft making in which relationships between humans, objects, mental templates of objects, and environments are entangled. This mechanism causes the skill difference between an apprentice and a skilled practitioner in a community of practice.

I restricted my concern for skill difference only to the technical step of painting. I observed both quantitatively (skill-score analysis) and qualitatively microstylistic traces of painting, indicating errors. I conducted a detailed analysis of complete ceramic vessels with identical motifs ("zigzags and boxes" motif). Then, I extended this analytical method to the published drawings with various painted decorations.

Analysis of pottery-making techniques (Chapter 7)

First, the chaîne opératoire analysis showed that that technical steps/options in the chaînes opératoires of pottery-making indicated few diachronic changes except for minor, rare instances. Second, among these relatively stable technical steps/options, an imprint (a by-product of firing the pottery from stacking pieces in the pottery kiln) suggested a new clue to pottery-firing activity and the presence of a painter who decorated the vessels with identical motifs in the short term, one firing lot at a time. Third, concerning painting skills, skill-score patterns, the works of apprentices, and the masterpieces at each site presented improvements in painting skills over time and movement toward fixed apprenticeships for BOBW making.

Analysis of thin-section petrography (Section 7-4)

In Section 7-4, I turned from the macroscopic observation of pottery-making techniques to microscopic or thin-section petrography. The technical steps of clay acquisition, clay preparation, and other technical steps were approached using thin-section petrography. As a result, eight fabric groups showing various technical options for preparing clay and adding temper were identified from this petrographic analysis. Inter-site comparison of these fabric types suggests that these clay recipes were stable over time. In addition, the provenances of two diagnostic minerals used as temper (fossil-included calcite and red siltstone) were discussed with a geological map.

Geochemical analysis (Section 7-5)

Analyses of pottery-making techniques, especially the technical steps of clay acquisition and firing, were further extended to geochemical analyses using ICP-OES (inductivity coupled plasma optical emission spectrometer), XRD (X-ray diffraction), and powder XRD (Section 7-5). First, as a result of ICP-OES and the subsequent statistical procedures using hierarchical cluster analysis (HCA), principal component analysis (PCA), and linear discriminant analysis (LDA), it is suggested that a tiny amount of BOBW found at Tall-e Jari A was not imported from the other intermontane valleys. Second, BOBW (possibly three clay sources), VCW (possibly five clay sources), and MCW (possibly one clay source) showed different geochemical compositions, implying the acquisition and use of different types of clay for each ware type. Third, the firing temperatures of BOBW (more than 850 °C, fired in a pottery kiln), VCW, and MCW (less than 850 °C, possibly not fired in a pottery kiln) were stable over time.

Answers to Research Question No. 4: "*How was pottery production organised during the Bakun period?*"

Problems with organisation proposed by previous studies

Organisation of pottery production during the Bakun period has been investigated by previous researchers to clarify the degree of craft specialisation and social organisation. They discussed organisation based on the neoevolutionist perspective, searching for chiefdom and social complexity. In Chapter 3, as a result of tracing the history of craft-specialisation studies and the neoevolutionist perspective, four problems of craft-specialisation studies were pointed out: 1) the systemic view, 2) reductionist thinking, 3) capitalist interpretation of the value systems of past communities, and 4) the tendency to reproduce the description of organisation of craft production following existing description systems.

Theoretical framework and methods: relational perspective

After discovering those problems, I proposed an alternative approach, "relational perspective," to craft production through reviewing Lave and Wenger's community of practice, Ingold's concept of skill, Latour's Actor-Network Theory, and Hodder's entanglement theory. I regarded the organisation of pottery production as numerous relations between humans and things from this relational perspective. In tracing these relations and the organisation of pottery production, the concepts of community of practice and entanglement were helpful.

Communities of BOBW making and village entanglement (Chapter 8)

In Chapter 8, I reassembled pottery-attribute tanglegrams and village entanglements at each site. Diachronic changes of entanglements were explained in the form of two-site comparisons. Consequently, the diachronic changes in the organisation of pottery production were presented as follows. First, when BOBW was adopted at Tall-e Jari A (c. 5000 BCE), the community of BOBW making did not form a stabilised transmission of knowledge. Slightly later, at Tall-e Bakun B (c. 5000 BCE), the community of BOBW making became slightly more common than at Tall-e Jari A. The village entanglements at both sites were similar to those of the Neolithic period, suppressing both humans and things by maintaining low variability to prevent social inequality.

Second, at Tall-e Gap (c. 4700 BCE – 4500 BCE), pottery-attribute tanglegrams indicated drastically changing relations between various pottery attributes. In response to such situations, the community of BOBW making also shifted toward a longer, fixed apprenticeship, which consisted of skilled craftspeople and apprentices. As the significance of BOBW increased in the village life, BOBW and new actants such as MCW generated new relations in village entanglement while breaking off the existing Neolithic lifeworld where some sought to maintain social equality.

Finally, at the stage of Tall-e Bakun A (c. 4500 BCE – 4300 BCE), visually attractive pottery attributes such as vessel forms and painted decoration underwent many more changes oriented to elaboration and differentiation than other attributes. Behind such demands for BOBW, skilled potters with distinguished painting skills finally emerged from the community of BOBW making. In addition, the community of BOBW making and other new communities that required experiential skills mutually influenced each other. The properties of BOBW contributed to concretising differences between villagers, thereby leading to further social inequality.

9-2. Relevance and limits of this study, future studies

Relevance and contribution of this study

I summarised the contents of eight chapters in answering four research questions. Below, I will point out four remarkable contributions to the existing literature of pottery and pottery production during the Bakun period: 1) publication of unpublished data, 2) evaluation of changes in pottery, 3) systematic analysis of technique and skill, and 4) relational perspective on the organisation of pottery production.

1) *Publication of unpublished materials, especially those at Tall-e Jari A*
As shown in Chapters 5 and 6, I reconstructed the stratigraphy of the poorly known Bakun level at Tall-e Jari A with a new radiocarbon date and published drawings of the ceramic materials. As it stands, the excavated sites belonging to the beginning of the Bakun period in the Kur River Basin are not well-known except for Tall-e Jari A and Tall-e Bakun B. These data will contribute to developing the discussion of the adoption process of the Bakun black-on-buff pottery.
2) *Presenting diachronic changes of Bakun pottery*
The publication of Tall-e Jari A materials allowed me to discuss changes in pottery (wares, vessel forms, painted decoration, and pottery production techniques) from the beginning to the end of the Bakun period (c. 5000 BCE, c. 4700 BCE – 4300 BCE). The previous studies discussed either pottery in one sub-phase or diachronic change in a few aspects of pottery, such as vessel form and painted decoration. The results of this research overcame previous studies in the time range and number of target aspects. This result will also provide sites to be excavated in the future with useful markers for relative chronology.
3) *Presenting systematic analysis of technique and skill*
Previous studies of pottery-making techniques during the Bakun period have included few discussions about the whole technical process, from clay acquisition to firing. In addition, except for the discovery of poorly painted pottery by Bernbeck and Pollock, errors and mistakes in pottery-making techniques were disregarded: only beautiful, skilful, and elaborate painted pottery was studied and related to the presence of specialist potters. In this research, I analysed the entire technical process in the chaîne opératoire of pottery making and tackled the technical skills of both badly and skilfully painted pottery in Chapter 7. This will give more insight into the ancient craft-making techniques of the Fars province as well as enhancing craft production studies all over the world.
4) *Relational perspective on the organisation of pottery production*
The final contribution to knowledge about pottery production during the Bakun period is establishing an alternative research framework for the organisation of pottery production building upon a relational view. This approach frees craft production study from previous arguments (whether craft specialisation originated in the Bakun period). This alternative perspective also provided a more extensive view of pottery production relationships with other communities of practice in the same village. I have provided a new vision of the diachronic change of organisation of pottery production: numerous relations between humans and things.

Limits of this study

I presented many contributions to academia in the previous section. However, it is true that several constraints exist in this research. First, there is still room for improvement in the chronology of the Bakun period. More radiocarbon dates are required with cautious consideration of the archaeological contexts and excavated materials. Second, there are sample biases between target sites. This problem is also related to the analysis of old collections obtained from the excavation in the 1950s. The published and unpublished materials from Tall-e Jari A and Tall-e Bakun B are scarce in comparison to those from Tall-e Gap and Tall-e Bakun A. This prevents our understanding of the more precise diachronic change of pottery production during the Bakun period.

In addition, the main concern was diachronic change of pottery production rather than synchronic variation of pottery production between contemporaneous sites in the same sub-phase in the Kur River Basin. The perspective on synchronic variability will be indispensable for future studies. Finally, the relational approach is not necessarily superior to the systemic perspective of craft-specialisation studies. Rather, the problems of the relational standpoint became apparent at the cutting edge of the theoretical debate in archaeology. As Oliver T. Harris and Craig N. Cipolla argue, one of the future considerations of the relational perspective is whether things without relations existed[1]. The theoretical debate of approaching craft production does not end, and we should continue to update the theoretical framework.

Future studies

For future studies on pottery production during the Bakun period, these limits should be tackled in the forms of new excavation projects or reconsideration of old excavation materials from the sites in the Kur River Basin. In addition, the discussion should extend to regional comparison inside and outside Fars province. This comparison will contribute to the question of the expansion process of black-on-buff ceramics in southwestern Iran during the 5th millennium BCE. The uniformity and regional variation seen in pottery production is important to the expansion mechanism of pottery production. The understanding of pottery

[1] Harris and Cipolla 2017:187-188.

production on a broader scale is also important to understanding social complexity. The difference in social complexity between Susiana and Fars is clear from settlement size, population, and so on: the interrelation between social complexity and craft production was not likely to be the same between the regions. Future studies should evaluate these points. In addition, this study does not discuss the shift from the community of BOBW making to the community of red-burnished-ware making in the Lapui period. Is this shift a disentanglement of BOBW-centred material world of the Bakun period? Further holistic research of this shift is required.

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Appendix

Table A1.1 List of published complete open vessels used for the measurement of vessel sizes. Abbreviations: L & M 1942: Langsdorff and McCown 1942, E & M 1962: Egami and Masuda 1962, E & S 1962: Egami and Sono 1962, E 1977: Egami et al. 1977, D: diameter, H: height, T: thickness, s.r.: simple rounded, s.-i.: semi-incurved, p.o.: pinched out, b.: beaded, c.b.: conical base, p.b.: pointed base, s.r.r.b.: simple rounded ring base, f.b.: flat base, s.d.r.b: square diagonal ring base, h.r.b.: high ring base, r.b.: round base, g.r.b.: grooved ring base, f.b.r.b.: flat bottom ring base, f.r.b: flat ring base, s.-r.b.: sub-round base, s.f.r.b: square flat ring base

Site	Publication	Fig.	No.	painted side	rim angle (°)	rim D (cm)	H (cm)	base D (cm)	3cm below rim T (mm)	base T (mm)	H/ rimD	original vessel form	complete vessel form	rim shape	base shape
Bakun A	Alizadeh 2006	24	B	exterior	110	22	15	5	7	10	0.682	conical bowl	conical bowl	s.r.	c.b.
Bakun A	Alizadeh 2006	24	E	exterior	115	12	9	2	3	7	0.771	conical bowl	conical bowl	s.r.	c.b.
Bakun A	Alizadeh 2006	24	F	exterior	113	20	13	2	4	10	0.658	conical bowl	conical bowl	s.r.	c.b.
Bakun A	Alizadeh 2006	24	G	exterior	110	13	12	1	3	12	0.940	conical bowl	conical bowl	s.r.	c.b.
Bakun A	Alizadeh 2006	24	H	exterior	113	10	18		8	40	1.868	funnel-shaped vessel	funnel-shaped vessel	s.r.	p.b.
Bakun A	Alizadeh 2006	25	A	exterior	118	14	11		3	9	0.761	conical bowl	conical bowl	s.r.	p.b.
Bakun A	Alizadeh 2006	25	C	exterior	113	15	10		3	2	0.680	conical bowl	conical bowl	s.r.	p.b.
Bakun A	Alizadeh 2006	27	B	exterior	116	18	13		7	13	0.712	conical bowl	conical bowl	s.r.	p.b.
Bakun A	Alizadeh 2006	28	C	interior	123	17	9	3	6	6	0.544	conical bowl	shallow bowl	s.-i.	s.r.r.b.
Bakun A	Alizadeh 2006	28	E	exterior	80	12	11	4	7	19	0.875		incurved bowl	s.r.	f.b.
Bakun A	Alizadeh 2006	28	G	exterior	95	11	11	6	5	5	0.946		deep bowl	s.r.	f.b.
Bakun A	Alizadeh 2006	30	E	exterior	102	15	18	4	6	15	1.220	Tall beaker	beaker	s.r.	s.d.r.b.
Bakun A	Alizadeh 2006	31	A	exterior	92	16	25	6	5	9	1.577	Tall beaker	beaker	s.r.	s.r.r.b.
Bakun A	Alizadeh 2006	32	D	exterior	97	18	24	6	5	10	1.319	Tall beaker	beaker	s.r.	s.d.r.b.
Bakun A	Alizadeh 2006	34	E	exterior	97	21	26	6	6	11	1.275	Tall beaker	beaker	s.r.	s.r.r.b.
Bakun A	Alizadeh 2006	35	B	both sides	122	24	15	7	8	8	0.607	Open bowl	shallow bowl	s.-i.	s.r.r.b.
Bakun A	Alizadeh 2006	35	C	exterior	97	25	26	6	4	11	1.032	Tall beaker	deep bowl	s.r.	s.r.r.b.
Bakun A	Alizadeh 2006	36	C	both sides	121	24	12	7	8	5	0.508	Open bowl	shallow bowl	s.r.	s.r.r.b.
Bakun A	Alizadeh 2006	36	D	both sides	120	20	12	5	5	8	0.600	Open bowl	shallow bowl	s.-i.	s.r.r.b.
Bakun A	Alizadeh 2006	38	C	exterior	102	26	26	8	6	20	1.015	Deep Bowl	deep bowl	s.r.	s.r.r.b.
Bakun A	Alizadeh 2006	54	B	unpainted	100	7	7	5	4	3	1.000		deep bowl	s.r.	f.b.
Bakun A	Alizadeh 2006	54	E	unpainted	90	9	7	6	4	3	0.783		deep bowl	s.r.	f.b.

Site	Publication	Fig.	No.	painted side	rim angle (°)	rim D (cm)	H (cm)	base D (cm)	3cm below rim T (mm)	base T (mm)	H/ rimD	original vessel form	complete vessel form	rim shape	base shape
Bakun A	Alizadeh 2006	54	G	unpainted	112	13	6	8	4	4	0.462		shallow bowl	s.r.	f.b.
Bakun A	Alizadeh 2006	55	E	exterior	108	8	4		10	8	0.558	Special Forms	miniture vessel	s.r.	r.b.
Bakun A	Alizadeh 2006	55	F	interior	105	7	4	6	8	2	0.486	Special Forms	miniture vessel	s.r.	f.b.
Bakun A	Alizadeh 2006	Pl.12	A	exterior	105	12	18	2			1.484	Conical vessels	beaker		c.b.
Bakun A	Alizadeh 2006	Pl.12	B	exterior	117	18	16	1			0.890	Conical vessels	conical bowl		c.b.
Bakun A	Alizadeh 2006	Pl.13	C	exterior	112	20	14	3			0.727	Conical vessels	conical bowl		c.b.
Bakun A	L & M 1942	1	8	exterior	104	15	13		4		0.867	Small Bowl	deep bowl	s.r.	h.r.b.
Bakun A	L & M 1942	2	7	exterior	105	15	23		6		1.531	Beaker	funnel-shaped vessel		p.b.
Bakun A	L & M 1942	2	3	both sides		20	14		6		0.694	Small Bowl	deep bowl		
Bakun A	L & M 1942	3	2	exterior		28	26		8		0.918	Broad Bowl	deep bowl	s.r.	s.r.r.b.
Bakun A	L & M 1942	3	3	exterior	115	25	13		5		0.510	Broad Bowl	shallow bowl		f.b.
Bakun A	L & M 1942	3	4	exterior	102	28	20				0.709	Broad Bowl	deep bowl		f.b.
Bakun A	L & M 1942	4	2	exterior	103	32	25				0.786	Small Bowl	deep bowl		ring base
Bakun A	L & M 1942	4	5	exterior		25	23				0.932	Small Bowl	deep bowl		ring base
Bakun A	L & M 1942	4	9	exterior		17	11		5		0.636	Conical bowl	conical bowl		c.b.
Bakun A	L & M 1942	4	10	exterior		19	12				0.622	Conical bowl	conical bowl		p.b.
Bakun A	L & M 1942	9	1	exterior	98	26	26	8	6	7	0.992	Deep Bowl	deep bowl	s.r.	g.r.b.?
Bakun A	L & M 1942	9	2	exterior	98	23	20	6	4	6	0.853	Deep Bowl	deep bowl	s.r.	f.b.r.b.
Bakun A	L & M 1942	9	3	exterior	98	21	20	5	3	12	0.952	Deep Bowl	deep bowl	s.r.	s.r.r.b.
Bakun A	L & M 1942	9	4	exterior	95	30	22	6	4	13	0.720	Deep Bowl	deep bowl	s.r.	t.r.b.
Bakun A	L & M 1942	9	5	exterior	103	35	29	6	5	8	0.847	Deep Bowl	deep bowl	s.r.	s.r.r.b.
Bakun A	L & M 1942	9	7	exterior	108	32	23	7	6	11	0.708	Deep Bowl	deep bowl	s.r.	s.r.r.b.
Bakun A	L & M 1942	9	9	exterior	105	27	18	6	5	14	0.660	Broad Bowl	deep bowl	s.r.	f.r.b.
Bakun A	L & M 1942	9	10	exterior	99	31	18	8	4	8	0.578	Broad Bowl	deep bowl	s.r.	f.r.b.
Bakun A	L & M 1942	9	12	interior	102	34	19	7	6	6	0.561	Broad Bowl	hemispherical bowl	s.r.	s.r.r.b.
Bakun A	L & M 1942	9	13	exterior	116	36	20	8	4	11	0.542	Broad Bowl	shallow bowl	s.-i.	h.r.b.

Site	Publication	Fig.	No.	painted side	rim angle (°)	rim D (cm)	H (cm)	base D (cm)	3cm below rim T (mm)	base T (mm)	H/ rimD	original vessel form	complete vessel form	rim shape	base shape
Bakun A	L & M 1942	10	7	interior	115	19	13	4	8	16	0.654	Small Broad Bowl	deep bowl	s.-i.	s.d.r.b.
Bakun A	L & M 1942	10	8	exterior	119	21	14	5	4	10	0.683	Small Broad Bowl	deep bowl	s.-i.	s.r.r.b.
Bakun A	L & M 1942	10	9	interior	125	19	11	4	7	5	0.563	Small Broad Bowl	hemispherical bowl	s.-i.	s.r.r.b.
Bakun A	L & M 1942	11	2	interior	119	15	8	8	4	12	0.548	Small Broad Bowl	shallow bowl	s.r.	h.r.b.
Bakun A	L & M 1942	11	3	interior	110	11	9	5	4	8	0.807	Small Broad Bowl	deep bowl	s.r.	h.r.b.
Bakun A	L & M 1942	11	4	interior	105	12	6	5	9	8	0.508	Small Broad Bowl	shallow bowl	p.o.	s.r.r.b.
Bakun A	L & M 1942	11	5	band at rim	108	13	8	2	8	6	0.614	Small Broad Bowl	hemispherical bowl	b.	f.b.
Bakun A	L & M 1942	11	7	exterior	102	21	11		4	3	0.510	Hemispherical Bowl	hemispherical bowl	s.r.	r.b.
Bakun A	L & M 1942	11	8	exterior	99	17	10		2	2	0.627	Hemispherical Bowl	hemispherical bowl	s.r.	r.b.
Bakun A	L & M 1942	11	9	interior	102	12	7		2	2	0.597	Hemispherical Bowl	hemispherical bowl	s.r.	r.b.
Bakun A	L & M 1942	11	10	exterior	98	15	12		2	4	0.763	Hemispherical Bowl	deep bowl	s.r.	r.b.
Bakun A	L & M 1942	11	11	exterior	110	18	12		5	5	0.663	Conical Bowl	conical bowl	s.-i.	c.b.
Bakun A	L & M 1942	11	13	exterior	104	17	13		4	20	0.750	Conical Bowl	conical bowl	s.-i.	p.b.
Bakun A	L & M 1942	11	14	exterior	110	25	18	2	4	6	0.710	Conical Bowl	conical bowl	s.-i.	p.b.
Bakun A	L & M 1942	12	1	exterior	109	16	18		5	70	1.128	Conical Bowl	funnel-shaped vessel	s.r.	p.b.
Bakun A	L & M 1942	12	2	exterior	101	14	18		3	13	1.304	Conical Bowl	funnel-shaped vessel	s.r.	p.b.
Bakun A	L & M 1942	12	4	exterior	106	18	17		3	2	0.934	Campaniform Bowl	deep bowl	s.r.	r.b.
Bakun A	L & M 1942	12	5	exterior	60	15	11	6	8	12	0.724	Inverted rim Bowl	incurved rim bowl	s.r.	f.b.
Bakun A	L & M 1942	12	10	exterior	51	26	24	10	8	9	0.898	Inverted rim Bowl	incurved rim bowl	s.r.	s.r.r.b.
Bakun A	L & M 1942	15	8	exterior	100	10	18		3	20	1.745	Beaker	beaker	s.r.	p.b.
Bakun A	L & M 1942	15	9	exterior	90	11	18		4	8	1.561	Beaker	beaker	s.-i.	r.b.
Bakun A	L & M 1942	16	1	exterior	92	12	20	4	4	8	1.667	Beaker	beaker	s.r.	f.b.
Bakun A	L & M 1942	16	6	exterior	106	12	19		2	29	1.627	Beaker	funnel-shaped vessel	s.r.	p.b.
Bakun A	L & M 1942	16	7	exterior	99	12	18	2	2	12	1.468	Beaker	beaker	s.r.	c.b.
Bakun A	L & M 1942	16	8	exterior	108	15	16		4	9	1.054	Beaker	deep bowl	s.-i.	p.b.
Bakun A	L & M 1942	16	9	exterior	118	14	23		7	21	1.614	Beaker	funnel-shaped vessel	p.o.	p.b.

Site	Publication	Fig.	No.	painted side	rim angle (°)	rim D (cm)	H (cm)	base D (cm)	3cm below rim T (mm)	base T (mm)	H/ rimD	original vessel form	complete vessel form	rim shape	base shape
Bakun A	L & M 1942	16	10	exterior	114	15	24	2	4	4	1.566	Beaker	funnel-shaped vessel	s.-i.	c.b.
Bakun A	L & M 1942	16	11	exterior	111	11	20		5	20	1.818	Beaker	funnel-shaped vessel	s.r.	p.b.
Bakun A	L & M 1942	16	12	band at rim	104	8	5		4	3	0.631	Cup	hemispherical bowl	s.r.	r.b.
Bakun A	L & M 1942	16	13	band at rim	101	12	6		3	4	0.508	Cup	hemispherical bowl	s.r.	r.b.
Bakun A	L & M 1942	16	15	exterior	97	12	7		7	8	0.592	Cup	conical bowl	s.r.	r.b.
Bakun A	L & M 1942	16	17	exterior	97	12	8		5	8	0.650	Cup	conical bowl	s.r.	r.b.
Bakun A	L & M 1942	16	18	exterior	97	11	6		5	4	0.536	Cup	hemispherical bowl	s.r.	f.b.
Bakun A	L & M 1942	17	2	exterior	97	13	8	3	4	4	0.605	Cup	hemispherical bowl	s.r.	f.b.
Bakun A	L & M 1942	17	5	unpainted	96	9	6		4	2	0.693	Cup	deep bowl	s.r.	f.b.
Bakun A	L & M 1942	17	8	exterior	78	13	8	4	8	4	0.608	Cup	incurved bowl	s.r.	f.b.
Bakun A	L & M 1942	17	9	exterior	55	9	6	3	5	5	0.667	Cup	incurved bowl	s.r.	f.b.
Bakun A	L & M 1942	17	11	exterior	96	12	6	9	5	3	0.463	Cup	shallow bowl	s.r.	f.b.
Bakun A	L & M 1942	17	12	exterior	123	10	5		6	4	0.520	Cup	conical bowl	s.r.	p.b.
Bakun A	L & M 1942	17	17	interior	111	9	4	5	8	3	0.477	Cup	shallow bowl	s.r.	f.b.
Bakun A	L & M 1942	17	18	interior	107	9	5	2	4	4	0.587	Cup	hemispherical bowl	s.r.	f.b.
Bakun A	L & M 1942	17	19	exterior	87	4	8		5	14	2.400	Miniature cones & saucers	miniature vessel	s.r.	p.b.
Bakun A	L & M 1942	17	20	unpainted	97	6	7	3	5	4	1.200	Miniature cones & saucers	miniature vessel	s.r.	f.b.
Bakun A	L & M 1942	17	21	exterior	95	3	6	2	6	28	2.000	Miniature cones & saucers	miniature vessel	s.r.	f.b.
Bakun A	L & M 1942	17	22	exterior	94	3	8	2	4	16	2.424	Miniature cones & saucers	miniature vessel	s.r.	s.r.r.b.
Bakun A	L & M 1942	17	23	band at rim	98	6	4	3	4	6	0.714	Miniature cones & saucers	miniature vessel	s.r.	f.b.
Bakun A	L & M 1942	17	24	unpainted	88	5	5	4	6	10	1.038	Miniature cones & saucers	miniature vessel	s.r.	s.-r.b.
Bakun A	L & M 1942	17	25	unpainted	88	5	3	5	7	6	0.680	Miniature cones & saucers	miniature vessel	s.r.	f.b.
Bakun A	L & M 1942	17	26	unpainted	90	7	3	6	10	8	0.471	Miniature cones & saucers	miniature vessel	s.r.	f.b.

Site	Publication	Fig.	No.	painted side	rim angle (°)	rim D (cm)	H (cm)	base D (cm)	3cm below rim T (mm)	base T (mm)	H/ rimD	original vessel form	complete vessel form	rim shape	base shape
Bakun A	L & M 1942	10	9	unpainted	131	18	5		25	24	0.275	shallow bowl	shallow bowl	s.r.	r.b.
Bakun A	L & M 1942	22	19	exterior	104	29	18	5			0.619	Broad Bowl	deep bowl		ring base
Bakun A	L & M 1942	30	6	exterior	113	18	8		3		0.456	Hemispherical Bowl	hemispherical bowl		r.b.
Bakun A	L & M 1942	30	7	exterior	96	17	12				0.693	Hemispherical Bowl	hemispherical bowl		r.b.
Bakun A	L & M 1942	30	8	exterior	104	21	11		7		0.505	Hemispherical Bowl	hemispherical bowl		r.b.
Bakun A	L & M 1942	36	13	exterior	100	11	16		4		1.427	Beaker	beaker		c.b.
Bakun A	L & M 1942	36	14	exterior	108	11	21		3		1.830	Beaker	funnel-shaped vessel		p.b.
Bakun A	L & M 1942	38	5	exterior	96	12	8				0.647	Cup	deep bowl		r.b.
Bakun A	L & M 1942	40	5	exterior	97	16	10				0.641	Hemispherical Bowl	hemispherical bowl		ring base
Bakun A	L & M 1942	43	9	exterior	102	25	11		4		0.425	Hemispherical Bowl	hemispherical bowl		r.b.
Bakun A	L & M 1942	50	15	exterior	118	21	12				0.577	Conical bowl	conical bowl		p.b.
Bakun A	L & M 1942	51	1	exterior	103	18	10		4		0.565	Hemispherical Bowl	hemispherical bowl		r.b.
Bakun A	L & M 1942	62	1	exterior		17	11				0.625	Conical bowl	conical bowl		p.b.
Bakun A	L & M 1942	69	18	exterior	115	21	14				0.648	Conical bowl	conical bowl		p.b.
Bakun A	L & M 1942	71	7	exterior	124	17	10				0.588	Conical bowl	conical bowl		p.b.
Bakun A	L & M 1942	72	9	exterior	116	18	12				0.639	Conical bowl	conical bowl		
Bakun A	L & M 1942	76	19	exterior	117	19	7				0.368	Hemispherical Bowl	hemispherical bowl		r.b.
Bakun A	Herzfeld 1932	IV	3	exterior	100						0.580	Fb	hemispherical bowl	s.r.	r.b.
Bakun A	Herzfeld 1932	VI	2	exterior	94						0.622	Fb	hemispherical bowl	s.r.	r.b.
Bakun A	Herzfeld 1932	VI	5	exterior	100						0.512	F	hemispherical bowl	s.r.	f.b.
Bakun A	Herzfeld 1932	VI	6	exterior	98						0.756	Fc	hemispherical bowl		r.b.
Bakun A	Herzfeld 1932	VIII	2	exterior	97						0.805	Aa	deep bowl		ring base
Bakun A	Herzfeld 1932	X	3	exterior	100						0.795	Fb	deep bowl		f.b.
Bakun A	Herzfeld 1932	XV	1	exterior	106						0.473	Ga	conical bowl		c.b.
Bakun A	Herzfeld 1932	XV	2	exterior	95						0.476	Ga	conical bowl		c.b.
Bakun A	Herzfeld 1932	XVI	2	exterior	100						0.612	B	deep bowl		ring base

Site	Publication	Fig.	No.	painted side	rim angle (°)	rim D (cm)	H (cm)	base D (cm)	3cm below rim T (mm)	base T (mm)	H/ rimD	original vessel form	complete vessel form	rim shape	base shape
Bakun B	E & M 1962	17	9	interior	140	24	6	9	6	4	0.232	shallow bowl	shallow bowl	s.r.	f.r.b.
Gap	E & S 1962	11	5	unpainted	100	35	40	12	11	11	1.127	Big Urn	deep bowl	s.r.	f.b.
Gap	E & S 1962	12	1	exterior	92	15	21	9	6	7	1.346	Tumbler	beaker	s.r.	s.r.r.b.
Gap	E & S 1962	12	3	exterior	118	15	10	5	6	10	0.673	Bowl	shallow bowl	s.r.	s.-r.b.
Gap	E & S 1962	12	5	exterior	96	12	16	7	7	6	1.359	Tumbler	beaker	p.o.	s.d.r.b.
Gap	E & S 1962	13	1	exterior	94	14	14		6		0.979	Bowl	deep bowl	p.o.	s.-r.b.
Gap	E & S 1962	13	3	exterior	95	18	15	9	6	9	0.864	Bowl	deep bowl	p.o.	s.r.r.b.
Gap	E & S 1962	13	4	exterior	94	12	11		8	7	0.881	Bowl	deep bowl	s.-i.	s.-r.b.
Gap	E & S 1962	15	6	exterior	94	24	13		6	4	0.563	Bowl	hemispherical bowl	s.r.	s.-r.b.
Gap	E & S 1962	15	10	exterior	95	13	18	7	3	7	1.372	Tumbler	beaker	s.r.	s.r.r.b.
Gap	E & S 1962	15	11	exterior	89	15	13	8	6	9	0.860	Bowl	deep bowl	s.r.	f.b.
Gap	E & S 1962	16	1	exterior	103	15	10	6	6	8	0.615	Bowl	deep bowl	s.r.	f.b.
Gap	E & S 1962	16	2	exterior	103	15	10	7	6	5	0.673	Bowl	deep bowl	s.r.	f.b.
Gap	E & S 1962	16	3	exterior	102	15	9	6	7	8	0.600	Bowl	deep bowl	s.r.	f.b.
Gap	E & S 1962	17	3	exterior	102	10	7	6	6	7	0.667	Bowl	deep bowl	p.o.	f.b.
Gap	E & S 1962	17	6	exterior	94	13	8	10	4	12	0.614	Bowl	deep bowl	s.r.	f.b.
Gap	E & S 1962	17	8	exterior	101	9	9	4	5	4	1.034	Cup	deep bowl	s.r.	f.b.
Gap	E & S 1962	17	10	exterior	103	11	10	4	3	6	0.919	Bowl	deep bowl	s.r.	f.b.
Gap	E & S 1962	18	3	exterior	81	10	10	3	6	3	0.941	Bowl	deep bowl	s.r.	f.b.
Gap	E & S 1962	19	1	exterior	97	15	15	9	7	7	0.942	Deep bowl	deep bowl	p.o.	s.r.r.b.
Gap	E & S 1962	19	2	exterior	100	12	10	6	6	9	0.780	Bowl	deep bowl	s.r.	s.-r.b.
Gap	E & S 1962	20	3	exterior	97	10	7	5	4	4	0.714	Bowl	deep bowl	s.r.	f.b.
Gap	E & S 1962	20	5	exterior	89	11	9		6	6	0.861	Bowl	deep bowl	s.r.	s.-r.b.
Gap	E & S 1962	20	6	exterior	105	19	12		6	6	0.667	Bowl	deep bowl	s.r.	s.-r.b.
Gap	E & S 1962	21	2	exterior	93	12	8	4	4	5	0.683	Bowl	deep bowl	s.r.	f.b.
Gap	E & S 1962	22	7	exterior	95	19	13	7	6	10	0.703		deep bowl	s.r.	f.b.

Site	Publication	Fig.	No.	painted side	rim angle (°)	rim D (cm)	H (cm)	base D (cm)	3cm below rim T (mm)	base T (mm)	H/ rimD	original vessel form	complete vessel form	rim shape	base shape
Gap	E & S 1962	24	1	exterior	106	15	10	6	6	6	0.714	small jar	deep bowl	s.r.	f.b.
Gap	E & S 1962	24	3	exterior	97	10	9	6	3	6	0.969	Cup	deep bowl	s.r.	f.b.
Gap	E & S 1962	24	4	exterior	93	10	9	4	4	3	0.939	Cup	deep bowl	s.r.	f.b.
Gap	E & S 1962	26	1	interior	121	18	9	7	7	7	0.525	Small bowl	shallow bowl	s.r.	s.r.r.b.
Gap	E & S 1962	26	2	interior	120	13	7	4	6	5	0.558	Small bowl	shallow bowl	s.r.	f.b.
Gap	E & S 1962	26	4	interior	124	13	6	3	6	6	0.488	Small bowl	shallow bowl	s.r.	f.b.
Gap	E & S 1962	26	5	interior	129	16	7		7	7	0.407	Small bowl	shallow bowl	s.r.	s.-r.b.
Gap	E & S 1962	26	6	interior	122	13	8	5	7	10	0.578	Small bowl	shallow bowl	s.-i.	s.r.r.b.
Gap	E & S 1962	26	7	interior	132	15	5		5	5	0.367	Small bowl	shallow bowl	s.r.	s.-r.b.
Gap	E & S 1962	26	8	interior	121	12	6	5	4	6	0.488	Small bowl	shallow bowl	s.r.	f.b.
Gap	E & S 1962	26	9	interior	129	14	5		6	6	0.348	Small bowl	shallow bowl	s.r.	f.b.
Gap	E & S 1962	26	10	interior	122	14	6	5	7	4	0.457	Small bowl	shallow bowl	s.r.	f.b.
Gap	E & S 1962	26	11	interior	119	14	7	5	7	5	0.500	Small bowl	shallow bowl	s.r.	s.-r.b.
Gap	E & S 1962	26	12	interior	129	15	6	6	6	4	0.400	Small bowl	shallow bowl	s.r.	f.b.
Gap	E & S 1962	27	4	interior	100	24	17	10	5	9	0.695	Bowl	deep bowl	p.o.	s.d.r.b.
Gap	E & S 1962	28	1	interior	95	23	18	11	9	9	0.779	Bowl	deep bowl	s.r.	s.f.r.b.
Gap	E & S 1962	28	4	interior	101	19	14	9	3	6	0.746	Bowl	deep bowl	s.r.	s.f.r.b.
Gap	E & S 1962	29	1	interior	111	20	14	8	6	11	0.716	Bowl	deep bowl	s.r.	s.r.r.b.
Gap	E & S 1962	30	1	interior	119	17	5	8	8	9	0.316	Bowl	shallow bowl	s.r.	f.b.
Gap	E & S 1962	30	2	interior	99	23	12		8	6	0.513	Bowl	hemispherical bowl	s.r.	s.-r.b.
Gap	E & S 1962	30	3	interior	122	16	5	9	9	6	0.327	Bowl	shallow bowl	s.r.	f.b.
Gap	E & S 1962	30	4	interior	117	14	6	5	6	4	0.435	Bowl	shallow bowl	s.r.	f.b.
Gap	E & S 1962	30	5	interior	104	11	4	7	8	5	0.351	Bowl	shallow bowl	s.r.	f.b.
Gap	E & S 1962	31	1	interior	117	26	14	9	7	12	0.535	Bowl	shallow bowl	s.r.	s.r.r.b.
Gap	E & S 1962	31	4	interior	121	26	13	9	9	7	0.489	Bowl	shallow bowl	s.r.	s.d.r.b.
Gap	Nishiaki 2003	48		interior		23	10				0.444	Bowl	shallow bowl	s.r.	ring base

Site	Publication	Fig.	No.	painted side	rim angle (°)	rim D (cm)	H (cm)	base D (cm)	3cm below rim T (mm)	base T (mm)	H/ rimD	original vessel form	complete vessel form	rim shape	base shape
Gap	Nishiaki 2003	51		band at rim		13	7				0.542	Bowl	shallow bowl	s.r.	f.b.
Gap	Nishiaki 2003	53	1	band at rim		22	14				0.641	Bowl	deep bowl	s.r.	ring base
Gap	Nishiaki 2003	64	1	exterior		10	9				0.875	Bowl	deep bowl	s.r.	s.-r.b.
Gap	Nishiaki 2003	66		exterior		17	22				1.311	Bowl	beaker	s.r.	ring base
Gap	Nishiaki 2003	70	1	exterior		12	9				0.720	Bowl	deep bowl	s.r.	s.-r.b.
Gap	Nishiaki 2003	73	1	exterior		13	15				1.153	Bowl	deep bowl	s.r.	ring base
Gap	Nishiaki 2003	76	1	interior		22	17				0.764	Bowl	deep bowl	s.r.	ring base
Jari A	E 1977	III	1	interior	128	25	8	9	8	4	0.333	shallow bowl	shallow bowl	s.r.	s.r.r.b.
Jari A	E 1977	III	19	exterior	87	11	11	8	6	8	0.974	deep bowl	deep bowl	s.r.	s.r.r.b.

Table A1.2 List of published complete closed vessels used for the measurement of vessel sizes (Table 4.2). Abbreviations: L & M 1942: Langsdorff and McCown 1942, E & M 1962: Egami and Masuda 1962, E & S 1962: Egami and Sono 1962, D: diameter, H: height, T: thickness, s.r.: simple rounded, p.o.: pinched out, s.r.r.b.: simple rounded ring base, f.b.: flat base, r.b.: round base, f.r.b: flat ring base, s.-r.b.: sub-round base

Site	Publication	Fig.	No.	rim angle (°)	rim D (cm)	body max D (cm)	H (cm)	neck length (cm)	neck D (cm)	base D (cm)	body max H (cm)	rim below 3cm T (mm)	body max D T (mm)	base T (mm)	height/ rimD	body maxD/ rimD	complete vessel form	rim shape	base shape
Gap	E & S 1962	11	1	102	9	28	36	5	8	12	15	19	12	14	4.067	3.133	large jar	flat	s.-r.b.
Gap	E & S 1962	17	1	108	10	15	14	3	8	6	6	6	6	12	1.412	1.471	small jar	s.r.	s.-r.b.
Gap	E & S 1962	17	5	116	6	10	8	1	7	6	4	7	10	9	1.286	1.571	small jar	s.r.	f.b.
Gap	Nishiaki 2003	49				29	37										large jar	s.r.	f.b.
Bakun A	L & M 1942	14	10	106	12	21	21	3	10	8	8	4	8	8	1.845	1.810	large jar	s.r.	f.b.
Bakun A	L & M 1942	14	11	98	16	33	34	4	16	12	15	7	8	16	2.119	2.069	large jar	p.o.	f.b.
Bakun A	L & M 1942	14	13	92	20	54	58	6	20	18	25	8	10	24	2.920	2.680	large jar	flat	f.b.
Bakun A	L & M 1942	15	1	98	13	40	36	3	12	13	12	10	14	15	2.813	3.156	large jar	flat	f.b.
Bakun A	L & M 1942	15	3	102	13	25	26	4	11	8	7	7	8	16	2.048	1.968	large jar	h.b.	s.r.r.b.

Site	Publication	Fig.	No.	rim angle (°)	rim D (cm)	body max D (cm)	H (cm)	neck length (cm)	neck D (cm)	base D (cm)	body max H (cm)	rim below 3cm T (mm)	body max D T (mm)	base T (mm)	height/ rimD	body maxD/ rimD	complete vessel form	rim shape	base shape
Bakun A	L & M 1942	15	4	101	12	21	26	5	12	8	12	9	6	9	2.056	1.653	large jar	flat	f.b.
Bakun A	L & M 1942	15	6	90	9	18	19	2	12	11	4	8	8	16	2.067	2.044	large jar	s.r.	f.b.
Bakun A	L & M 1942	12	13	91	9	19	12	3	9	9	6	6	4	4	1.326	2.043	small jar	d.b.	s.r.r.b.
Bakun A	L & M 1942	13	7	100	6	7	5	9	5	3	2	4	8	2	0.726	1.145	small jar	h.b.	f.b.
Bakun A	L & M 1942	13	9	99	11	16	16	4	9	5	4	7	12	8	1.481	1.519	small jar	h	s.r.r.b.
Bakun A	L & M 1942	13	19	106	10	17	16	2	9	7	7	5	4	7	1.667	1.740	small jar	s.r.	s.r.r.b.
Bakun A	L & M 1942	14	3	99	9	13	14	5	8		6	3	5		1.522	1.435	small jar	s.r.	r.b.
Bakun A	L & M 1942	14	6	121	7	9	6	1	6	3	3	4	4	4	0.833	1.222	small jar	s.r.	f.b.
Bakun A	L & M 1942	14	7	106	9	11	7	1	9	4	3	5	8	5	0.807	1.273	small jar	s.r.	f.b.
Bakun A	L & M 1942	14	8	118	4	6	7	1	3	0	2	4	4	8	1.500	1.364	small jar	s.r.	r.b.
Bakun A	L & M 1942	14	9	95	7	9	9	2	6	6	3	6	8	4	1.368	1.382	small jar	h.b.	f.r.b.
Bakun A	E & M 1962	6	1	97	18	50	63	8	17	16	30	11	11	17	3.455	2.727	large jar	flat	r.b.
Bakun A	E & M 1962	6	2	93	11	32	31	4	11	12	14	7	8	8	2.815	2.889	large jar	flat	f.b.
Bakun A	L & M 1942	24	7			40	33										large jar		
Bakun A	L & M 1942	31	1	99	25	57	52	7	23		19				2.130	2.333	large jar		f.b.
Bakun A	L & M 1942	38	19			12	4										small jar		
Bakun A	Alizadeh 2006	39	D	140	17	29	24	1	15	19	7	10	15	10	1.424	1.727	large jar	s.r.	s.r.r.b.
Bakun A	Alizadeh 2006	41	E	96	12	27	30	3	12	8	14	8	17	10	2.500	2.250	large jar	s.r.	f.b.
Bakun A	Alizadeh 2006	42	C	96	14	38	42	5	14		17	11	14	21	2.800	2.725	large jar	s.r.	f.b.
Bakun A	Alizadeh 2006	42	E	96	14	30	36	4	14	12	15	9	11	14	2.350	2.150	large jar	s.r.	f.b.
Bakun A	Alizadeh 2006	42	G	92	15	28	38	5	14		17	8	16	32	2.632	1.895	large jar	s.r.	r.b.

Table A2 Context-label lists of Tall-e Jari A, Tall-e Bakun B, and Tall-e Bakun A curated in UMUT (the University Museum, the Univerisity of Tokyo) and University of Tsukuba

Site	Trench	Layer/ Level	Context Information: number	Context Information: Room number	Context Information: text	Context Information: date	Box number	Storage
Jari A	JA-C	surface soil	1			4/25.	2298	UMUT
Jari A	JA-C	surface soil	1		表土 (surface soil)	4/29.-4/30.	2126	UMUT
Jari A	JA-C	surface soil	1		表土 (surface soil)	4/29.-4/30.	2126	UMUT
Jari A	JA-C	surface soil	1		表土 (surface soil)	4/29.	2126	UMUT
Jari A	JA-C	1	1		No.2	4/29.-5/1.	1838	UMUT
Jari A	JA-C	1	1		No.1	4/29.-5/1.	1838	UMUT
Jari A	JA-C	1	1			4/30.	1838	UMUT
Jari A	JA-C	1	2	R1	floor 1	5/2.	1808	UMUT
Jari A	JA-C	1		R1	floor 1?	5/2.	1808	UMUT
Jari A	JA-C	1	2	R2	floor 1		1808	UMUT
Jari A	JA-C	1	2	R2	floor 1		1831	UMUT
Jari A	JA-C	1		R2	floor	5/4.	1808	UMUT
Jari A	JA-C	2		R3	floor	5/4.	2115	UMUT
Jari A	JA-C	2		R3	floor		1839	UMUT
Jari A	JA-C	2		R3	floor 1 ②	5/4.	1831	UMUT
Jari A	JA-C	2	2	R3, R6		5/5.	2115	UMUT
Jari A	JA-C	2	1, 2		L2		2299	UMUT
Jari A	JA-C	2	1		L2		2299	UMUT
Jari A	JA-C	2	1		L2		2299	UMUT
Jari A	JA-C	2			L2		2056	UMUT
Jari A	JA-C	2			L2		2056	UMUT
Jari A	JA-C	2	1		L2		1838	UMUT
Jari A	JA-C	3	1		L3		2249	UMUT
Jari A	JA-C	3	2		L3		2249	UMUT
Jari A	JA-C	3	1		L3		2249	UMUT
Jari A	JA-C	3	1		floor 2		2249	UMUT
Jari A	JA-C	3	2			5/6.	2249	UMUT
Jari A	JA-C	3	2		L3		2238	UMUT
Jari A	JA-C	3		R7	L3, floor 4		2292	UMUT
Jari A	JA-C	3		R7	L3, floor 4		2292	UMUT
Jari A	JA-C	3		R7	floor 4		1827	UMUT
Jari A	JA-C	3		R7	floor 2		2055	UMUT
Jari A	JA-C	3	4	R9	L3		2055	UMUT
Jari A	JA-C	3		R9	floor 2		2055	UMUT
Jari A	JA-C	3	4	R8	floor 1		1767	UMUT
Jari A	JA-C	3		R8	floor 2		1767	UMUT

Site	Trench	Layer/ Level	Context Information: number	Context Information: Room number	Context Information: text	Context Information: date	Box number	Storage
Jari A	JA-C	3		R8	L3, floor 4 No. 1		2062	UMUT
Jari A	JA-C	3		R8	L3, floor 4 No. 2		2062	UMUT
Jari A	JA-C	3		R8	L3, floor 4		1831	UMUT
Jari A	JA-C	3	2	R6			2235	UMUT
Jari A	JA-C	3		R9	floor 2		2235	UMUT
Jari A	JA-C	3	1		L3		1838	UMUT
Jari A	JA-C	4	4②	R10	fil	5/7. ?	1803	UMUT
Jari A	JA-C	4	4②	R10		5/7.	1803	UMUT
Jari A	JA-C	4		R10 outside	L4		1856	UMUT
Jari A	JA-C	4		R10	floor 2		1856	UMUT
Jari A	JA-C	4	3	R12	floor 4, fill		1827	UMUT
Jari A	JA-C	4	3	R12	floor 4, fill		1827	UMUT
Jari A	JA-C	4	3	R1	floor 4, fill		1797	UMUT
Jari A	JA-C	4	3	R11	floor 4, fill		1797	UMUT
Jari A	JA-C	4		R13		5/7.	1797	UMUT
Jari A	JA-C	4	3	R13		5/7.	1797	UMUT
Jari A	JA-C	4	3	R13	floor	5/7.	1797	UMUT
Jari A	JA-C	4	4	R13	fil		1806	UMUT
Jari A	JA-C	4	4	R13	fil		1806	UMUT
Jari A	JA-C	4	3	R13	floor		1838	UMUT
Jari A	JA-C	4	2	R15	floor 1	later than 5/7.	2265	UMUT
Jari A	JA-C	4		R15	floor 4	later than 5/7.	2265	UMUT
Jari A	JA-C	4		R15	floor 4	later than 5/7.	2265	UMUT
Jari A	JA-C	4		R15, R10	floor 3, Bの石中床 (stone middle floor of B?)	later than 5/7.	1826	UMUT
Jari A	JA-C	4		R17	fil	later than 5/7.	1826	UMUT
Jari A	JA-C	unknown			拡張 (extension)		1780	UMUT
Jari A	JA-C	unknown			拡張 (extension)		1780	UMUT
Jari A	JA-C	unknown	1		拡張部 (extension) ②		1838	UMUT
Jari A	JA-C	unknown	1		拡張部 (extension)②		4F	UMUT
Jari A	JA-C	unknown	1		floor 1		2298	UMUT
Jari A	JA-C	1		R2 (2)	fl.		3-298	Tsukuba
Jari A	JA-C	2			L2		3-285	Tsukuba
Jari A	JA-C	2	1		L2		3-293	Tsukuba
Jari A	JA-C	2	1		L2		3-299	Tsukuba

Site	Trench	Layer/ Level	Context Information: number	Context Information: Room number	Context Information: text	Context Information: date	Box number	Storage
Jari A	JA-C	2		R3	fl.		3-293	Tsukuba
Jari A	JA-C	2		R3	fl.		3-298	Tsukuba
Jari A	JA-C	2		R3	fl.		3-299	Tsukuba
Jari A	JA-C	3			L3		3-285	Tsukuba
Jari A	JA-C	3		R7	L3, fl. 4		3-285	Tsukuba
Jari A	JA-C	4	4②			5/7.	3-285	Tsukuba
Jari A	JA-C	4	4	R13			3-285	Tsukuba
Jari A	JA-C	unknown	1		fl. 2		3-285	Tsukuba
Jari A	JA-C	unknown	②				3-285	Tsukuba
Jari A	JA-C	unknown	1				3-293	Tsukuba
Jari A	JA-C	unknown	(1)				3-293	Tsukuba
Jari A	JA-C	unknown	1		floor 2		3-293	Tsukuba
Jari A	JA-C	unknown	4				3-293	Tsukuba
Jari A	JA-C	unknown	(1)				3-298	Tsukuba
Jari A	JA-C	unknown	1				3-298	Tsukuba
Jari A	JA-C	unknown	(1)				3-299	Tsukuba
Jari A	JA-C	unknown	1				3-300	Tsukuba
Jari A	JA-C	unknown	①			4/29 - 5/7.	3-304	Tsukuba
Jari A	JA-D		1, 6				1854	UMUT
Jari A	JA-D		6	Room			1773	UMUT
Jari A	JA-D		1, 6				1773	UMUT
Jari A	JA-D		3		a, b, c	4/29?	2236	UMUT
Jari A	JA-D		2	X room 5	X floor	5/.	2236	UMUT
Jari A	JA-D		1				2236	UMUT
Jari A	JA-D		1, 9, 2				2236	UMUT
Jari A	JA-D		4				2236	UMUT
Jari A	JA-D		4			5/15.	2236	UMUT
Jari A	JA-D		3a			5/10.	2236	UMUT
Jari A	JA-D		1				2236	UMUT
Jari A	JA-D		1,4, 7				2124	UMUT
Jari A	JA-D		4, 5				1813	UMUT
Jari A	JA-D		1			4/25.	1813	UMUT
Jari A	JA-D		1, 6				2253	UMUT
Jari A	JA-D		1,4, 6				2253	UMUT
Jari A	JA-D		6				2293	UMUT
Jari A	JA-D		1, 6				2293	UMUT
Jari A	JA-D		1, 6				2293	UMUT
Jari A	JA-D		2			4/27.	2232	UMUT
Jari A	JA-D		2, 3				2232	UMUT
Jari A	JA-D		2,3, 5				1747	UMUT

Site	Trench	Layer/ Level	Context Information: number	Context Information: Room number	Context Information: text	Context Information: date	Box number	Storage
Jari A	JA-D		3a			4/29.	1747	UMUT
Jari A	JA-D		3				1841	UMUT
Jari A	JA-D		3, 3				1841	UMUT
Jari A	JA-D		3		黒灰 (black ash)	4/27.	2289	UMUT
Jari A	JA-D		1, 3			4/29.	2289	UMUT
Jari A	JA-D		3a				2289	UMUT
Jari A	JA-D		3b			5/16.	2289	UMUT
Jari A	JA-D		3c2			5/13.	2247	UMUT
Jari A	JA-D		3c			5/.	2247	UMUT
Jari A	JA-D		3b			5/.	2248	UMUT
Jari A	JA-D		3,3				2248	UMUT
Jari A	JA-D		3c			5/15.	1815	UMUT
Jari A	JA-D		3b			5/8-12.	1815	UMUT
Jari A	JA-D		3a				1815	UMUT
Jari A	JA-D		3c			5/.	1815	UMUT
Jari A	JA-D		4, 2			5/5.	1815	UMUT
Jari A	JA-D		3c1			5/12.	1815	UMUT
Jari A	JA-D		3c2				1815	UMUT
Jari A	JA-D		4			4/29.	1815	UMUT
Jari A	JA-D		4			5/15.	1815	UMUT
Jari A	JA-D		4, 5	R			2255	UMUT
Jari A	JA-D		4			4/29, 5/13.	2288	UMUT
Jari A	JA-D		4, 2				2288	UMUT
Jari A	JA-D		4			4/27.	2288	UMUT
Jari A	JA-D		4				2288	UMUT
Jari A	JA-D		4, 5	R			1831	UMUT
Jari A	JA-D		4下 (lower)	R	fl		1831	UMUT
Jari A	JA-D		5 (4-2 3b)				2290	UMUT
Jari A	JA-A, D		5				2290	UMUT
Jari A	JA-D		51				2220	UMUT
Jari A	JA-D		3, 3				2220	UMUT
Jari A	JA-D		3b			5/16.	2220	UMUT
Jari A	JA-D		51			5/19.	2220	UMUT
Jari A	JA-D		5				2220	UMUT
Jari A	JA-D		6	R	fl		1784	UMUT
Jari A	JA-D		6				1784	UMUT
Jari A	JA-D		6				1784	UMUT
Jari A	JA-D		6	R	fl		1784	UMUT
Jari A	JA-D		6	R			2240	UMUT
Jari A	JA-D		6				2240	UMUT

Site	Trench	Layer/ Level	Context Information: number	Context Information: Room number	Context Information: text	Context Information: date	Box number	Storage
Jari A	JA-D		6				2240	UMUT
Jari A	JA-D		6				1810	UMUT
Jari A	JA-D		6	R			1810	UMUT
Jari A	JA-D		6				2218	UMUT
Bakun B	Masuda	Unknown	①		presence of BOBW in the context: No		2139	UMUT
Bakun B	Masuda	Unknown	①		No		2143	UMUT
Bakun B	Masuda	Unknown	①		No		2158	UMUT
Bakun B	Masuda	Unknown			No		2147	UMUT
Bakun B	Masuda	Surface collection	表面採集 (surface collected)		Yes	30/9.	2142	UMUT
Bakun B	Masuda	BII of McCown	TBBI 表土 (surface soil)		Yes	1/10.	2141	UMUT
Bakun B	Masuda	BII of McCown	B表 (surface soil)		Yes		2129	UMUT
Bakun B	Masuda	BII of McCown	B表 (surface soil)		Yes		2132	UMUT
Bakun B	Masuda	BII of McCown	B表 (surface soil)		Yes		2158	UMUT
Bakun B	Masuda	BII of McCown	B表 (surface soil)		Yes		2209	UMUT
Bakun B	Masuda	BII of McCown	B表 (surface soil)		Yes		4F	UMUT
Bakun B	Masuda	BII of McCown	②		Yes		2158	UMUT
Bakun B	Masuda	BII of McCown	②		Yes		2140	UMUT
Bakun B	Masuda	BII of McCown			Yes		2138	UMUT
Bakun B	Masuda	BII of McCown	B9		Yes		2127	UMUT
Bakun B	Masuda	BII of McCown	B9		Yes		2132	UMUT
Bakun B	Masuda	BII of McCown	B9		Yes		2139	UMUT
Bakun B	Masuda	BII of McCown	B9		Yes		2209	UMUT
Bakun B	Masuda	BII of McCown	B5		Yes		2132	UMUT
Bakun B	Masuda	BII of McCown	B5		Yes		2158	UMUT
Bakun B	Masuda	BII of McCown	B3 (including Egami and Masuda 1962 Fig. 19-8, 11 (BII)		Yes		2158	UMUT
Bakun B	Masuda	BII of McCown	B3		Yes		2161	UMUT
Bakun B	Masuda	BII of McCown	B3		Yes		2209	UMUT
Bakun B	Masuda	BII of McCown	B2		Yes		2127	UMUT
Bakun B	Masuda	BII of McCown	B2		Yes		2132	UMUT
Bakun B	Masuda	BII of McCown	B2		Yes		2158	UMUT

Site	Trench	Layer/ Level	Context Information: number	Context Information: Room number	Context Information: text	Context Information: date	Box number	Storage
Bakun B	Masuda	BII of McCown	B2		presence of BOBW in the context: Yes		2209	UMUT
Bakun B	Masuda	BII of McCown	B11		Yes		2209	UMUT
Bakun B	Masuda	BII of McCown	B11		Yes		4F	UMUT
Bakun B	Masuda	BII of McCown	B10		Yes		2127	UMUT
Bakun B	Masuda	BII of McCown	B10		Yes		2132	UMUT
Bakun B	Masuda	BII of McCown	B10		Yes		2140	UMUT
Bakun B	Masuda	BII of McCown	B10		Yes		2209	UMUT
Bakun B	Masuda	BII of McCown	B10		Yes		4F	UMUT
Bakun B	Masuda	BII of McCown	Egami and Masuda 1962 Fig. 19-36 (BII)		No		2158	UMUT
Bakun B	Masuda	BII of McCown	Egami and Masuda 1962 Fig. 16-13, 20		Yes		4F	UMUT
Bakun B	Masuda	BI of McCown	B8		No		2129	UMUT
Bakun B	Masuda	BI of McCown	B8		No		2139	UMUT
Bakun B	Masuda	BI of McCown	B8 (including Egami and Masuda 1962 Fig. 18-33, 30 (BI))		No		2158	UMUT
Bakun B	Masuda	BI of McCown	B7		No		2158	UMUT
Bakun B	Masuda	BI of McCown	B6		No		2158	UMUT
Bakun B	Masuda	BI of McCown	B4		No		2129	UMUT
Bakun B	Masuda	BI of McCown	B4 (including Egami and Masuda 1962 Fig. 18-29 (BI))		No		2139	UMUT
Bakun B	Masuda	BI of McCown	B4		No		2158	UMUT
Bakun B	Masuda	BI of McCown	250-270		No	5/10.	2138	UMUT
Bakun B	Masuda	BI of McCown	最下（灰赤）層 (the lowest (graysh red) level)		No	9/10.	2137	UMUT
Bakun B	Masuda	BI of McCown	最下粘土 (the lowest clay)		No	8/10.	2131	UMUT
Bakun A	Masuda	surface collection	トレンチ外にて採集 (collected outside the trench)			27 / 9.	2142	UMUT
Bakun A	Masuda	unknown					2127	UMUT
Bakun A	Masuda	unknown					2133	UMUT
Bakun A	Masuda	unknown					2135	UMUT
Bakun A	Masuda	unknown					2137	UMUT
Bakun A	Masuda	unknown					2148	UMUT

Site	Trench	Layer/ Level	Context Information: number	Context Information: Room number	Context Information: text	Context Information: date	Box number	Storage
Bakun A	Masuda	unknown					2160	UMUT
Bakun A	Masuda	unknown					2209	UMUT
Bakun A	Masuda	unknown					2127	UMUT
Bakun A	Masuda	unknown	A① 3-1				4F	UMUT
Bakun A	Masuda	unknown	A①				2142	UMUT
Bakun A	Masuda	Levels I-III					2150	UMUT
Bakun A	Masuda	Levels I-IV	1				2156	UMUT
Bakun A	Masuda	Levels I-IV	2				2156	UMUT
Bakun A	Masuda	Levels I-IV	①				2129	UMUT
Bakun A	Masuda	Levels I-IV	①				2146	UMUT
Bakun A	Masuda	Levels I-IV	②				2129	UMUT
Bakun A	Masuda	Levels I-IV	②				2146	UMUT
Bakun A	Masuda	Levels I-IV					2132	UMUT
Bakun A	Masuda	Levels I-IV					2147	UMUT
Bakun A	Masuda	9/25.				25 / 9.	2155	UMUT
Bakun A	Masuda	9/26.				26 / 9.	2149	UMUT
Bakun A	Masuda	9/26.				26 / 9.	2156	UMUT
Bakun A	Masuda	9/26.				26 / 9.	2157	UMUT
Bakun A	Masuda	9/26.				26 / 9.	2163	UMUT
Bakun A	Masuda	9/27.				27 / 9.	2151	UMUT
Bakun A	Masuda	9/27.				27 / 9.	2161	UMUT
Bakun A	Masuda	9/27.				27 / 9.	2161	UMUT
Bakun A	Masuda	9/27.				27 / 9.	2209	UMUT
Bakun A	Masuda	9/27.	東イ(East "I") 45, 3-2			27/9.	4F	UMUT
Bakun A	Masuda	9/27.				27 / 9.	4F	UMUT
Bakun A	Masuda	9/28.				28 / 9.	2145	UMUT
Bakun A	Masuda	9/28.				28 / 9.	2145	UMUT
Bakun A	Masuda	9/29.				29 / 9.	2136	UMUT
Bakun A	Masuda	9/29.				29 / 9.	2152	UMUT
Bakun A	Masuda	9/29.				29 / 9.	2153	UMUT
Bakun A	Masuda	Level I	Fig. 6-2				4F	UMUT
Bakun A	Masuda	Level IV		4号床下 (under floor of Room 4)		30 / 9.	2134	UMUT
Bakun A	Masuda	Level IV		3号床下 (under floor of Room 3)		2 /10.	2151	UMUT

Table A3 List of diagnostic BOBW samples used for analyses of rim angles and vessel sizes from Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap. Abbreviations: D: diameter, H: height, E 1977: Egami et al. 1977, E & M 1962: Egami and Masuda 1962, E & S 1962: Egami and Sono 1962, o.v.interior: open vessel painted on its interior, o.v.exterior: open vessel painted on its exterior, o.v.rim: open vessel painted on its rim, o.v.both: open vessel painted on both sides

site	publication	Fig.	No.	vessel form	rim angle (°)	rim D (cm)	H (cm)
Jari A	E 1977	III	2	o.v.interior	136		
Jari A	E 1977	III	4	o.v.exterior	95		
Jari A	E 1977	III	5	o.v.interior	124		
Jari A	E 1977	III	6	o.v.interior	96		
Jari A	E 1977	III	7	o.v.interior	105		
Jari A	E 1977	III	8	o.v.interior	115		
Jari A	E 1977	III	9	o.v.exterior	104		
Jari A	E 1977	III	10	o.v.interior	124		
Jari A	E 1977	III	11	o.v.exterior	95		
Jari A	E 1977	III	12	o.v.interior	113		
Jari A	Catalogue	6.1	1	o.v.exterior	90	13	
Jari A	Catalogue	6.1	3	o.v.exterior	110	9	
Jari A	Catalogue	6.1	4	o.v.exterior	79	19	
Jari A	Catalogue	6.2	2	o.v.rim	114	22	
Jari A	Catalogue	6.3	1	o.v.interior	143		
Jari A	Catalogue	6.3	2	o.v.interior	108	23	
Jari A	Catalogue	6.3	3	o.v.interior	122	17	
Jari A	Catalogue	6.3	4	o.v.rim	122	19	
Jari A	Catalogue	6.4	1	o.v.interior	118	15	7
Jari A	Catalogue	6.4	2	o.v.interior	145		
Jari A	Catalogue	6.4	3	o.v.interior	144		
Jari A	Catalogue	6.4	4	o.v.rim	141	18	
Jari A	Catalogue	6.6	1	o.v.exterior	100	20	
Jari A	Catalogue	6.6	2	o.v.exterior	96		
Jari A	Catalogue	6.6	3	o.v.exterior	100		
Jari A	Catalogue	6.7	1	o.v.exterior	83	14	
Jari A	Catalogue	6.7	2	o.v.exterior	87	23	
Jari A	Catalogue	6.7	3	o.v.exterior	109		
Jari A	Catalogue	6.7	4	o.v.exterior	90		
Jari A	Catalogue	6.7	5	o.v.exterior	121	16	7
Jari A	Catalogue	6.8	1	o.v.exterior	77	12	
Jari A	Catalogue	6.8	2	o.v.exterior	63	11	
Jari A	Catalogue	6.8	3	o.v.rim	39	7	
Jari A	Catalogue	6.8	4	o.v.exterior	99		
Jari A	Catalogue	6.9	1	o.v.interior	128	18	
Jari A	Catalogue	6.9	2	o.v.interior	131	17	

site	publication	Fig.	No.	vessel form	rim angle (°)	rim D (cm)	H (cm)
Jari A	Catalogue	6.9	3	o.v.interior	134	18	
Jari A	Catalogue	6.9	4	o.v.interior	122	14	
Jari A	Catalogue	6.9	5	o.v.interior	109		
Jari A	Catalogue	6.9	6	o.v.interior	132		
Jari A	Catalogue	6.9	7	o.v.interior	139		
Bakun B	E & M 1962	14	1	o.v.exterior	101		
Bakun B	E & M 1962	14	2	o.v.exterior	101		
Bakun B	E & M 1962	14	3	o.v.exterior	106		
Bakun B	E & M 1962	14	5	o.v.exterior	90		
Bakun B	E & M 1962	14	6	o.v.exterior	101		
Bakun B	E & M 1962	14	9	o.v.exterior	94		
Bakun B	E & M 1962	14	10	o.v.exterior	94		
Bakun B	E & M 1962	14	11	o.v.exterior	93		
Bakun B	E & M 1962	15	2	o.v.exterior	92		
Bakun B	E & M 1962	15	5	o.v.exterior	90		
Bakun B	E & M 1962	15	6	o.v.exterior	90		
Bakun B	E & M 1962	15	8	o.v.exterior	91		
Bakun B	E & M 1962	15	10	o.v.exterior	90		
Bakun B	E & M 1962	15	11	o.v.exterior	90		
Bakun B	E & M 1962	16	4	o.v.interior	112		
Bakun B	E & M 1962	16	8	o.v.interior	119		
Bakun B	E & M 1962	16	9	o.v.interior	105		
Bakun B	E & M 1962	16	10	o.v.interior	124		
Bakun B	E & M 1962	16	11	o.v.interior	117		
Bakun B	E & M 1962	16	12	o.v.interior	108		
Bakun B	E & M 1962	16	15	o.v.exterior	105		
Bakun B	E & M 1962	17	1	o.v.interior	116		
Bakun B	E & M 1962	17	2	o.v.interior	125		
Bakun B	E & M 1962	17	4	o.v.interior	124		
Bakun B	E & M 1962	17	5	o.v.interior	128		
Bakun B	E & M 1962	17	6	o.v.interior	115		
Bakun B	E & M 1962	17	7	o.v.interior	115		
Bakun B	E & M 1962	17	8	o.v.interior	115		
Gap	E & S 1962	12	2	o.v.interior	120	35	
Gap	E & S 1962	12	4	o.v.interior	95	28	
Gap	E & S 1962	12	6	o.v.exterior	96	12	
Gap	E & S 1962	12	7	o.v.exterior	96	14	
Gap	E & S 1962	12	8	o.v.exterior	94	14	
Gap	E & S 1962	12	10	o.v.exterior	92	18	
Gap	E & S 1962	13	5	o.v.exterior	94	23	
Gap	E & S 1962	13	6	o.v.exterior	94	19	

site	publication	Fig.	No.	vessel form	rim angle (°)	rim D (cm)	H (cm)
Gap	E & S 1962	13	7	o.v.exterior	62	12	
Gap	E & S 1962	13	8	o.v.exterior	95	19	
Gap	E & S 1962	14	1	o.v.exterior	99	22	
Gap	E & S 1962	14	2	o.v.exterior	96	17	
Gap	E & S 1962	14	4	o.v.exterior	99	13	
Gap	E & S 1962	14	5	o.v.exterior	91	22	
Gap	E & S 1962	14	7	o.v.exterior	102	24	
Gap	E & S 1962	14	8	o.v.exterior	99	11	
Gap	E & S 1962	15	2	o.v.exterior	94	16	
Gap	E & S 1962	15	3	o.v.exterior	99	12	
Gap	E & S 1962	15	4	o.v.both	113	13	
Gap	E & S 1962	15	7	o.v.exterior	94	12	
Gap	E & S 1962	15	12	o.v.exterior	90	9	
Gap	E & S 1962	16	4	o.v.exterior	112	22	
Gap	E & S 1962	16	5	o.v.exterior	95	14	
Gap	E & S 1962	16	6	o.v.exterior	92	12	
Gap	E & S 1962	16	7	o.v.exterior	91	27	
Gap	E & S 1962	16	9	o.v.exterior	92	22	
Gap	E & S 1962	16	10	o.v.exterior	92	17	
Gap	E & S 1962	16	11	o.v.exterior	97	15	
Gap	E & S 1962	17	7	o.v.exterior	102	12	
Gap	E & S 1962	17	9	o.v.exterior	97	12	
Gap	E & S 1962	17	11	o.v.exterior	92	13	
Gap	E & S 1962	18	1	o.v.exterior	98	24	
Gap	E & S 1962	18	2	o.v.exterior	98	25	
Gap	E & S 1962	18	6	o.v.exterior	102	24	
Gap	E & S 1962	19	3	o.v.exterior	92	15	
Gap	E & S 1962	19	4	o.v.exterior	91	13	
Gap	E & S 1962	19	5	o.v.exterior	102	18	
Gap	E & S 1962	19	6	o.v.exterior	99	20	
Gap	E & S 1962	19	7	o.v.exterior	96	19	
Gap	E & S 1962	19	8	o.v.exterior	98	16	
Gap	E & S 1962	20	1	o.v.exterior	94	15	
Gap	E & S 1962	20	2	o.v.exterior	97	21	
Gap	E & S 1962	20	4	o.v.exterior	88	18	
Gap	E & S 1962	20	7	o.v.exterior	94	23	
Gap	E & S 1962	20	8	o.v.exterior	100	15	
Gap	E & S 1962	20	9	o.v.exterior	101	23	
Gap	E & S 1962	20	10	o.v.exterior	96	22	
Gap	E & S 1962	20	11	o.v.exterior	98	20	
Gap	E & S 1962	20	12	o.v.exterior	110	18	

site	publication	Fig.	No.	vessel form	rim angle (°)	rim D (cm)	H (cm)
Gap	E & S 1962	21	1	o.v.exterior	94	18	
Gap	E & S 1962	21	3	o.v.exterior	99	12	
Gap	E & S 1962	21	4	o.v.exterior	116	17	
Gap	E & S 1962	21	5	o.v.exterior	106	15	
Gap	E & S 1962	21	6	o.v.exterior	96	15	
Gap	E & S 1962	21	7	o.v.exterior	97	20	
Gap	E & S 1962	21	8	o.v.exterior	101	21	
Gap	E & S 1962	21	9	o.v.exterior	93	12	
Gap	E & S 1962	21	10	o.v.exterior	103	18	
Gap	E & S 1962	21	11	o.v.exterior	93	27	
Gap	E & S 1962	21	12	o.v.exterior	94	23	
Gap	E & S 1962	22	3	o.v.exterior	94	15	
Gap	E & S 1962	22	4	o.v.exterior	104	14	
Gap	E & S 1962	22	5	o.v.exterior	95	20	
Gap	E & S 1962	22	8	o.v.exterior	101	18	
Gap	E & S 1962	22	9	o.v.exterior	106	26	
Gap	E & S 1962	23	1	o.v.exterior	96	23	
Gap	E & S 1962	23	2	o.v.exterior	93	21	
Gap	E & S 1962	23	3	o.v.exterior	96	29	
Gap	E & S 1962	23	4	o.v.exterior	92	25	
Gap	E & S 1962	23	7	o.v.exterior	97	23	
Gap	E & S 1962	23	9	o.v.exterior	132	27	
Gap	E & S 1962	23	10	o.v.exterior	142	18	
Gap	E & S 1962	24	5	o.v.exterior	94	14	
Gap	E & S 1962	24	6	o.v.exterior	105	17	
Gap	E & S 1962	24	7	o.v.exterior	102	13	
Gap	E & S 1962	24	8	o.v.exterior	97	14	
Gap	E & S 1962	24	10	o.v.exterior	92	13	
Gap	E & S 1962	24	11	o.v.exterior	100	15	
Gap	E & S 1962	26	3	o.v.interior	120	15	
Gap	E & S 1962	26	13	o.v.interior	124	18	
Gap	E & S 1962	27	1	o.v.interior	115	23	
Gap	E & S 1962	27	2	o.v.interior	121	26	
Gap	E & S 1962	27	3	o.v.interior	111	21	
Gap	E & S 1962	27	5	o.v.interior	115	25	
Gap	E & S 1962	27	6	o.v.interior	100	17	
Gap	E & S 1962	27	7	o.v.interior	119	22	
Gap	E & S 1962	27	8	o.v.interior	112	22	
Gap	E & S 1962	27	9	o.v.interior	136	24	
Gap	E & S 1962	28	2	o.v.interior	111	21	
Gap	E & S 1962	28	3	o.v.interior	135	22	

site	publication	Fig.	No.	vessel form	rim angle (°)	rim D (cm)	H (cm)
Gap	E & S 1962	28	5	o.v.interior	110	21	
Gap	E & S 1962	28	6	o.v.interior	110	19	
Gap	E & S 1962	29	2	o.v.interior	123	19	
Gap	E & S 1962	29	3	o.v.interior	106	22	
Gap	E & S 1962	29	4	o.v.interior	111	20	
Gap	E & S 1962	29	5	o.v.interior	135	27	
Gap	E & S 1962	29	6	o.v.interior	134	24	
Gap	E & S 1962	31	2	o.v.interior	121	22	
Gap	E & S 1962	31	3	o.v.interior	117	20	
Gap	E & S 1962	31	5	o.v.interior	127	23	
Gap	E & S 1962	31	6	o.v.interior	125	15	
Gap	catalogue	6.29	1	o.v.exterior	100	19	
Gap	catalogue	6.29	3	o.v.exterior	100	16	
Gap	catalogue	6.30.	1	o.v.exterior	95	11	
Gap	catalogue	6.30.	2	o.v.exterior	100	22	
Gap	catalogue	6.30.	3	o.v.exterior	98	22	
Gap	catalogue	6.30.	4	o.v.exterior	95	21	
Gap	catalogue	6.31	1	o.v.interior	125	14	4
Gap	catalogue	6.31	2	o.v.interior	100	8	5
Gap	catalogue	6.31	3	o.v.interior	135	15	4
Gap	catalogue	6.31	4	o.v.interior	125	22	
Gap	catalogue	6.33	1	o.v.interior	130	24	
Gap	catalogue	6.33	2	o.v.interior	125	28	
Gap	catalogue	6.33	3	o.v.interior	126	29	
Gap	catalogue	6.34	1	o.v.both	106	20	
Gap	catalogue	6.34	4	o.v.both	107	18	
Gap	catalogue	6.35	1	o.v.exterior	99	18	
Gap	catalogue	6.35	2	o.v.exterior	106	20	
Gap	catalogue	6.35	3	o.v.exterior	102	20	
Gap	catalogue	6.36	1	o.v.exterior	95	22	
Gap	catalogue	6.37	1	o.v.exterior	75	18	
Gap	catalogue	6.40.	1	o.v.both	105	21	

Table A4.1 List of horizontal structural patterns of exterior-painted open vessels at Tall-e Gap, Tall-e Jari A, Tall-e Bakun B, and Tall-e Bakun A. Abbreviations: L & M 1942: Langsdorff and McCown 1942, E & M 1962: Egami and Masuda 1962, E & S 1962: Egami and Sono 1962, E 1977: Egami et al. 1977, p.: possibly, h.s.p.: horizontal structure pattern, r.b.: rim band, ba.b.: base band, bo.b.: body band, u.o.l.: upper optional line, l.o.l.: lower optional line, u.f.l.: upper frieze line, l.f.l.: lower frieze line, f.d.l, frieze division line, f.f.: first frieze, s.f.: second frieze, t.f.: third frieze, s.m. secondary motifs, *: thin rim band, o: present, x: absent, N: no data

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	ba.b.	bo.b.	u.o.l.	l.o.l	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Gap	E & S 1962	12	1	beaker	GE1	o	o	o	o	o	o	o	o	o	o	o	x	4	4
Gap	E & S 1962	12	3	shallow bowl	GE2	o	o	o	x	x	o	x	o	x	x	x	x	0	0
Gap	E & S 1962	12	5	beaker	GE5	o	o	x	x	x	x	o	x	o	x	x	x	0	0
Gap	E & S 1962	13	1	deep bowl	GE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	13	3	deep bowl	GE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	13	4	deep bowl	GE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	15	6	hemispherical bowl	GE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	15	10	beaker	GE5	o	o	x	x	x	o	o	x	o	x	x	o	0	0
Gap	E & S 1962	15	11	deep bowl	GE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Gap	E & S 1962	16	1	deep bowl	GE4	o	o	x	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	16	2	deep bowl	GE4	o	o	x	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	16	3	deep bowl	GE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	17	3	deep bowl	GE5	o	x	x	x	x	o	x	x	o	x	x	x	0	0
Gap	E & S 1962	17	6	deep bowl	GE5	o	x	x	x	x	o	x	x	o	x	x	x	0	0
Gap	E & S 1962	17	8	deep bowl	GE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	17	10	deep bowl	GE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	18	3	incurved rim vessel	GE5	o	o	x	x	x	o	o	o	o	o	o	x	0	0
Gap	E & S 1962	19	1	deep bowl	GE2	o	o	o	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	19	2	deep bowl	GE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	20	3	deep bowl	GE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	20	5	deep bowl	GE6	o	x	x	x	x	x	x	o	o	o	o	x	0	0
Gap	E & S 1962	20	6	deep bowl	GE5	o	x	x	x	x	o	N	o	o	o	x	x	0	0

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	ba.b.	bo.b.	u.o.l.	l.o.l	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Gap	E & S 1962	21	2	deep bowl	GE2	o	o	o	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	22	7	deep bowl	GE4	o	o	x	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	24	1	deep bowl	GE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	24	3	deep bowl	GE1	o	o	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	24	4	deep bowl	GE1	o	o	o	o	o	o	o	x	o	x	x	x	2	2
Gap	Nishiaki 2003	64	1	deep bowl	GE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Gap	Nishiaki 2003	66		deep bowl	GE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Gap	Nishiaki 2003	70	1	deep bowl	GE5	o	o	x	x	x	o	x	x	o	x	x	x	0	0
Gap	Nishiaki 2003	73	1	deep bowl	GE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Gap	E & S 1962	12	6	p. beaker	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	13	5	p. beaker	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	13	6	p. beaker	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	13	7	p. incurved rim vessel	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	14	4	p. deep bowl	GE2	o	N	o	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	14	5	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	16	7	p. beaker	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	18	6	p. deep bowl	GE1	o	N	o	x	o	o	o	o	o	o	x	x	0	1
Gap	E & S 1962	19	3	p. beaker	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	19	4	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	19	6	p. deep bowl	GE1	o	N	o	x	o	o	o	x	o	x	x	x	0	2
Gap	E & S 1962	19	7	p. beaker	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	1
Gap	E & S 1962	19	8	p. beaker	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	20	1	p. deep bowl	GE2	o	N	o	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	20	2	p. deep bowl	GE1?	o	N	N	o	N	o	N	o	o	o	x	x	1	N
Gap	E & S 1962	20	7	p. deep bowl	GE2	o	N	o	x	x	o	o	x	o	x	x	x	0	0
Gap	E & S 1962	20	8	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	ba.b.	bo.b.	u.o.l.	l.o.l	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Gap	E & S 1962	20	12	p. deep bowl	GE1	o	N	o	o	x	o	o	x	o	x	x	x	1	0
Gap	E & S 1962	21	1	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	21	3	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	21	4	p. shallow bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	21	5	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	2
Gap	E & S 1962	21	6	p. deep bowl	GE2	o	N	o	x	x	o	x	x	o	x	x	x	0	0
Gap	E & S 1962	21	7	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	21	8	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	21	9	p. beaker	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	21	12	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	22	3	p. beaker	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	22	4	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	22	5	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	2
Gap	E & S 1962	23	1	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	24	5	p. deep bowl	GE2	o	N	o	x	x	o	x	x	o	x	x	x	0	0
Gap	E & S 1962	24	6	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Gap	E & S 1962	24	7	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	24	8	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	2	1
Gap	Catalogue	6.16	1	p. deep bowl	GE1	o	o	o	o	o	o	o	x	o	x	x	x	2	2
Gap	Catalogue	6.18	2	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	Catalogue	6.18	5	p. deep bowl	GE2	o	N	o	x	x	o	o	x	o	x	x	x	0	0
Gap	Catalogue	6.18	3	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	Catalogue	6.18	4	p. deep bowl	GE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	Catalogue	6.31	6	p. deep bowl	GE1	o	N	o	o	o	o	o	o	o	o	x	x	2	1
Jari A	E 1977	III	11	p. deep bowl	JE2	o	N	o	x	x	o	o	o	o	o	x	o	0	0
Jari A	Catalogue	6.1	1	p. deep bowl	JE1	o	N	o	x	o	o	o	x	o	x	x	x	0	1
Jari A	Catalogue	6.1	2	p. deep bowl	JE2	o	o	o	x	x	o	o	x	o	x	x	x	0	0

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	ba.b.	bo.b.	u.o.l.	l.o.l	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Jari A	Catalogue	6.1	3	p. deep bowl	JE3?	o	N	N	x	x	N	o	x	o	x	x	x	0	0
Jari A	Catalogue	6.2	3	p. deep bowl	JE2?	N	N	o	N	x	N	o	o	o	o	x	x	N	0
Jari A	Catalogue	6.6	1	p. deep bowl	JE1	o	N	o	o	o	o	o	x	o	N	x	x	1	1
Jari A	Catalogue	6.6	2	p. deep bowl	JE1	o	N	o	x	o	o	o	x	o	N	x	x	0	2<
Jari A	Catalogue	6.6	3	p. deep bowl	JE3?	o	N	N	x	x	x	o	x	o	N	x	x	0	0
Jari A	Catalogue	6.7	1	p. deep bowl	JE2?	o	N	N	x	N	o	o	N	o	N	N	x	0	N
Jari A	Catalogue	6.7	2	p. deep bowl	JE3?	o	N	N	x	N	x	o	N	o	N	N	x	0	N
Jari A	Catalogue	6.7	3	p. deep bowl	JE3?	o	N	N	x	x	x	o	o	o	o	N	x	0	0
Jari A	Catalogue	6.7	4	p. deep bowl	JE1	o	N	o	x	o	o	o	x	o	x	x	x	0	1
Jari A	Catalogue	6.7	5	p. deep bowl	JE7	x	o	x	x	x	x	x	x	o	x	x	x	0	0
Jari A	Catalogue	6.8	2	p. deep bowl	JE1	o	N	o	x	o	o	o	x	o	N	N	x	0	1<
Jari A	Catalogue	6.8	4	p. deep bowl	JE1	o	N	o	x	o	o	o	x	o	x	x	x	0	1
Bakun B	McCown 1942		203	p. deep bowl	BE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun B	Alizadeh 2006	23	B	p. deep bowl	BE2?	o	N	N	x	N	o	N	x	o	x	x	x	0	N
Bakun B	Alizadeh 2006	23	F	p. deep bowl	BE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun B	Alizadeh 2006	23	H	p. deep bowl	BE1?	o	N	N	o	N	o	o	x	o	x	x	x	1	N
Bakun B	Alizadeh 2006	23	J	p. deep bowl	BE1	o	N	o	x	o	o	o	x	o	x	x	x	0	1<
Bakun B	Alizadeh 2006	23	M	p. deep bowl	BE1?	o	N	N	o	N	o	o	x	N	x	x	x	1	N
Bakun B	Alizadeh 2006	23	N	p. deep bowl	BE1?	o	N	N	o	N	o	o	x	o	x	x	x	1	N
Bakun B	Alizadeh 2006	23	O	p. deep bowl	BE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun B	Alizadeh 2006	23	S	p. deep bowl	BE2	o	N	o	x	x	o	o	x	o	x	x	x	0	0
Bakun B	Alizadeh 2006	23	W	p. deep bowl	BE1	o	N	o	x	o	o	o	x	o	x	x	x	0	1
Bakun B	Alizadeh 2006	23	X	p. deep bowl	BE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun B	Alizadeh 2006	23	DD	p. deep bowl	BE1?	o	N	N	o	N	o	o	x	o	x	x	x	1	N
Bakun B	E & M 1962	14	1	p. deep bowl	BE1	o	N	o	o	x	o	o	o	o	o	o	x	1	N
Bakun B	E & M 1962	14	2	p. deep bowl	BE1?	o	N	N	o	N	o	N	o	o	o	x	x	1	N
Bakun B	E & M 1962	14	3	p. deep bowl	BE1	o	N	N	o	o	o	o	o	o	o	x	x	2	2<

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	ba.b.	bo.b.	u.o.l.	l.o.l	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Bakun B	E & M 1962	14	5	p. deep bowl	BE2	o	N	N	x	N	o	o	o	o	o	o	x	0	N
Bakun B	E & M 1962	14	6	p. deep bowl	BE1?	o	N	o	o	N	o	o	x	o	x	x	x	1	N
Bakun B	E & M 1962	14	8	p. deep bowl	BE1?	o	N	N	o	N	o	o	x	o	x	x	x	1	N
Bakun B	E & M 1962	14	9	p. deep bowl	BE2?	o	N	N	x	N	x	N	x	o	x	x	x	0	N
Bakun B	E & M 1962	14	11	p. deep bowl	BE2	o	N	o	x	x	o	o	x	o	x	x	x	0	0
Bakun B	E & M 1962	14	14	p. deep bowl	BE2?	o	N	N	x	N	o	o	o	o	o	x	N	0	N
Bakun B	E & M 1962	14	21	p. deep bowl	BE3?	N	o	x	N	o	N	o	N	o	N	N	N	N	2
Bakun B	E & M 1962	15	1	p. deep bowl	BE2?	N	N	o	N	x	o	x	x	o	x	x	N	0	0
Bakun B	E & M 1962	15	2	p. deep bowl	BE2?	o	N	N	x	N	o	o	x	o	x	x	x	0	N
Bakun B	E & M 1962	15	5	p. deep bowl	BE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun B	E & M 1962	15	7	p. deep bowl	BE1?	N	N	o	N	o	N	o	x	o	x	x	N	N	2
Bakun B	E & M 1962	15	8	p. deep bowl	BE2?	o	N	N	x	N	o	N	x	o	x	x	x	0	N
Bakun B	E & M 1962	15	9	p. deep bowl	BE1?	o	N	N	o	N	o	N	x	o	x	x	x	2	N
Bakun B	E & M 1962	15	10	p. deep bowl	BE1?	o	N	N	o	N	o	N	x	o	x	x	x	1	N
Bakun B	E & M 1962	15	11	p. deep bowl	BE2	o	N	o	x	x	x	o	x	o	x	x	x	0	0
Bakun B	E & M 1962	15	13	p. deep bowl	BE2?	o	N	N	N	N	o	o	o	o	o	x	x	N	N
Bakun B	E & M 1962	15	15	p. deep bowl	BE1?	N	N	o	N	o	N	o	x	o	x	x	N	N	1
Bakun A	Alizadeh 2006	24	B	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	24	E	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	24	F	conical bowl	AE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	24	G	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	24	H	funnel-shaped vessel	AE2	o	o	o	o	x	o	o	x	o	x	x	x	1	0
Bakun A	Alizadeh 2006	25	A	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	25	C	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	27	B	conical bowl	AE4	o	o	x	x	o	o	o	x	o	x	x	x	0	1
Bakun A	Alizadeh 2006	28	E	incurved-rim vessel	AE4	o	x	x	o	x	o	x	x	o	x	x	x	2	0
Bakun A	Alizadeh 2006	28	G	deep bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	ba.b.	bo.b.	u.o.l.	l.o.l	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Bakun A	Alizadeh 2006	30	E	beaker	AE5	o	o	x	x	x	o	o	o	o	o	o	x	0	0
Bakun A	Alizadeh 2006	31	A	beaker	AE2	o	o	o	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	32	D	beaker	AE6	o	o	x	x	x	x	x	o	o	o	x	x	0	0
Bakun A	Alizadeh 2006	34	E	beaker	AE1	o	o	o	o	o	o	o	x	o	x	x	x	2	2
Bakun A	Alizadeh 2006	35	B	shallow bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	35	C	deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Alizadeh 2006	36	C	shallow bowl	AE4	o	o	x	o	x	o	o	x	o	x	x	x	2	0
Bakun A	Alizadeh 2006	38	C	deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Alizadeh 2006	40		incurved-rim vessel	AE1	o	N	o	o	o	x	o	o	x	o	x	x	1	1
Bakun A	Alizadeh 2006	42	F	incurved-rim vessel	AE1	o	N	o	o	o	x	o	o	x	o	x	x	1	1
Bakun A	Alizadeh 2006	Pl.12	A	beaker	AE4	o	o	x	o	x	o	o	x	o	x	x	x	1	0
Bakun A	Alizadeh 2006	Pl.12	B	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	Pl.12	C	conical bowl	AE1	o	o	o	o	x	o	o	x	o	x	x	x	1	0
Bakun A	L & M 1942	1	8	deep bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	2	7	funnel-shaped vessel	AE2	o	o	o	x	x	x	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	2	3	deep bowl	AE4	o	o	x	o	o	o	o	o	o	o	x	x	1	1
Bakun A	L & M 1942	3	2	deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	3	3	shallow bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	3	4	deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	4	2	deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	4	5	deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	4	9	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	4	10	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	9	2	deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	9	4	deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	9	10	deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	9	13	shallow bowl	AE5	o	o	x	x	x	o	x	o	o	o	x	x	0	0

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Bakun A	L & M 1942	11	7	hemispherical bowl	AE6	o*	x	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	11	8	hemispherical bowl	AE6	o*	x	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	11	10	deep bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	11	11	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	11	14	conical bowl	AE4	o	o	x	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	12	1	funnel-shaped vessel	AE4	o	o	x	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	12	2	funnel-shaped vessel	AE4	o	o	x	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	12	4	deep bowl	AE7	x	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	15	8	beaker	AE4	o	o	x	o	x	o	x	x	o	x	x	o	1	0
Bakun A	L & M 1942	15	9	beaker	AE1	o	o	o	x	o	o	o	o	o	o	o	x	0	1
Bakun A	L & M 1942	16	1	beaker	AE4	o	o	x	o	o	o	o	x	o	x	x	x	1	2
Bakun A	L & M 1942	16	6	funnel-shaped vessel	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	16	8	deep bowl	AE4	o	o	x	o	o	o	o	x	o	x	x	x	2	2
Bakun A	L & M 1942	16	10	funnel-shaped vessel	AE6	o	o	x	x	x	x	x	o	x	x	x	x	0	0
Bakun A	L & M 1942	17	12	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	22	19	deep bowl	AE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	30	6	Hemispherical Bowl	AE6	o	o	x	x	x	x	x	o	o	o	x	x	0	0
Bakun A	L & M 1942	30	7	hemispherical bowl	AE6	o	o	x	x	x	x	x	x	o	o	x	x	0	0
Bakun A	L & M 1942	30	8	hemispherical bowl	AE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	36	13	beaker	AE4	o	o	x	o	x	o	o	x	o	x	x	x	1	0
Bakun A	L & M 1942	36	14	funnel-shaped vessel	AE2	o	o	o	x	x	o	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	38	5	deep bowl	AE3	o	x	o	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	40	5	hemispherical bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	43	9	hemispherical bowl	AE6	o*	o	x	x	x	x	x	o	o	o	o	x	0	0
Bakun A	L & M 1942	50	15	conical bowl	AE4	o	o	x	o	o	o	o	x	o	o	o	x	1	1
Bakun A	L & M 1942	51	1	hemispherical bowl	AE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	62	1	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	1	1

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	ba.b.	bo.b.	u.o.l.	l.o.l	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Bakun A	L & M 1942	69	18	conical bowl	AE4	o	o	x	x	o	o	o	x	o	x	x	x	0	1
Bakun A	L & M 1942	71	7	conical bowl	AE5	o	o	x	x	x	x	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	76	19	hemispherical bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	IV	3	hemispherical bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	VI	2	hemispherical bowl	AE6	o*	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	VI	5	hemispherical bowl	AE6	o*	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	VI	6	hemispherical bowl	AE6	o*	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	VIII	2	deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	X	3	deep bowl	AE1	o	x	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	XV	1	conical bowl	AE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	XV	2	conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	XVI	2	deep bowl	AE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	24	A	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Alizadeh 2006	24	C	p. conical bowl	AE5?	o	N	N	x	N	o	o	x	o	x	x	x	0	N
Bakun A	Alizadeh 2006	24	D	p. conical bowl	AE4	o	o	x	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Alizadeh 2006	25	B	p. conical bowl	AE5?	o	N	N	x	N	o	o	o	o	o	o	x	0	N
Bakun A	Alizadeh 2006	25	D	p. conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	27	A	p. conical bowl	AE2?	o	N	x	x	N	o	N	x	o	x	x	x	0	N
Bakun A	Alizadeh 2006	28	D	p. deep bowl	AE3?	o	N	o	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	29	E	p. deep bowl	AE6	o	N	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	30	A	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Alizadeh 2006	30	B	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Alizadeh 2006	30	C	p. deep bowl	AE1	o	N	N	o	o	o	o	x	o	x	x	x	2	2<
Bakun A	Alizadeh 2006	30	D	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Alizadeh 2006	31	D	p. deep bowl	AE4	o	o	x	o	o	o	o	x	o	x	x	x	2	2
Bakun A	Alizadeh 2006	32	A	p. beaker	AE6	o	N	x	x	x	x	x	o	o	o	x	x	0	0
Bakun A	Alizadeh 2006	32	B	p. beaker	AE6	o	N	x	x	x	x	x	o	o	o	x	x	0	0

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Bakun A	Alizadeh 2006	32	C	p. beaker	AE6	o	N	x	x	x	x	x	o	o	o	x	x	0	0
Bakun A	Alizadeh 2006	33	A	p. beaker	AE2	o	N	o	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	33	B	p. beaker	AE1?	o	N	N	o	N	o	N	x	o	x	x	x	2	N
Bakun A	Alizadeh 2006	33	C	p. beaker	AE6	o	N	x	x	x	x	x	o	o	o	x	x	0	0
Bakun A	Alizadeh 2006	33	D	p. beaker	AE2?	o	N	N	x	N	o	N	x	o	x	x	x	0	N
Bakun A	Alizadeh 2006	33	E	p. beaker	AE1?	N	o	o	N	o	x	o	x	o	x	x	x	N	2
Bakun A	Alizadeh 2006	34	B	p. beaker	AE5	o	N	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	34	C	p. deep bowl	AE1?	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Alizadeh 2006	34	D	p. deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Alizadeh 2006	35	A	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Alizadeh 2006	35	D	p. deep bowl	AE5?	o	N	x	x	N	o	N	o	o	o	o	x	0	N
Bakun A	Alizadeh 2006	35	E	p. deep bowl	AE2	o	N	o	x	x	o	o	x	o	x	x	o	0	0
Bakun A	Alizadeh 2006	36	A	p. shallow bowl	AE5?	o	N	x	x	N	o	o	o	o	o	o	x	0	N
Bakun A	Alizadeh 2006	36	B	p. deep bowl	AE5?	N	N	x	x	x	N	o	o	o	o	x	x	0	0
Bakun A	Alizadeh 2006	37	A	barrel-shaped vessel	AE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Bakun A	Alizadeh 2006	38	A	p. deep bowl	AE1	o	o	o	o	o	o	o	x	o	x	x	x	2	2
Bakun A	Alizadeh 2006	39	A	p. beaker	AE6	N	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	13	D	p. hemispherical bowl	AE6	o*	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Alizadeh 2006	13	E	p. hemispherical bowl	AE6	o*	N	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	3	5	p. deep bowl	AE2	o	N	o	x	x	o	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	3	10	p. hemispherical bowl	AE7	x	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	4	8	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	23	3	p. beaker	AE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	24	1	p. beaker	AE7	x	N	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	26	8	p. beaker	AE6	o	o	x	x	x	x	x	x	o	x	x	o	0	0

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Bakun A	L & M 1942	28	2	p. hemispherical bowl	AE6	o	N	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	28	4	p. deep bowl	AE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	32	2	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	32	12	p. shallow bowl	AE3	o	N	o	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	32	13	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	34	1	p. deep bowl	AE1	o*	N	o	o	o	o	o	x	o	x	x	o	1	1
Bakun A	L & M 1942	34	9	p. incurved rim bowl	AE1	o	N	o	x	o	o	o	x	o	x	x	o	0	1
Bakun A	L & M 1942	35	10	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	o	1	1
Bakun A	L & M 1942	38	2	p. deep bowl	AE5?	N	o	x	x	x	o	o	o	o	o	x	N	0	0
Bakun A	L & M 1942	38	3	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	39	4	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	39	6	p. deep bowl	AE6?	N	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	41	14	p. hemispherical bowl	AE4	o	o	x	x	o	o	o	o	o	o	x	x	0	1
Bakun A	L & M 1942	43	1	p. deep bowl	AE1	o	N	o	o	o	o	o	o	o	o	x	x	1	1
Bakun A	L & M 1942	46	1	p. beaker	AE7	x	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	46	6	p. beaker	AE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	50	12	p. deep bowl	AE1	o	N	N	o	o	o	o	o	o	o	x	x	1	1<
Bakun A	L & M 1942	52	12	p. hemispherical bowl	AE6	o	o	x	x	x	x	x	o	o	o	x	x	0	0
Bakun A	L & M 1942	53	1	p. shallow bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	53	14	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	2	1
Bakun A	L & M 1942	54	15	p. beaker	AE4?	N	o	x	N	o	N	o	x	o	x	x	x	N	2
Bakun A	L & M 1942	55	5	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	57	12	p. incurved rim bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	58	5	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	59	10	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	60	1	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	ba.b.	bo.b.	u.o.l.	l.o.l	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Bakun A	L & M 1942	60	2	p. deep bowl	AE1	o	N	o	x	o	o	o	x	o	x	x	o	0	1
Bakun A	L & M 1942	60	13	p. deep bowl	AE7	x	N	x	x	x	x	x	o	o	o	x	o	0	0
Bakun A	L & M 1942	61	1	p. deep bowl	AE1?	N	o	o	N	o	x	o	x	o	x	x	x	N	1
Bakun A	L & M 1942	61	2	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	61	9	p. deep bowl	AE1	o	N	o	x	o	o	o	x	o	x	x	o	0	1
Bakun A	L & M 1942	63	7	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	64	9	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	65	9	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	66	2	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	67	3	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	67	11	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	67	13	p. deep bowl	AE4?	o	N	N	o	N	o	N	o	o	o	o	x	1	N
Bakun A	L & M 1942	68	11	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	71	11	p. hemispherical bowl	AE7	x	o	x	x	x	x	x	o	o	o	x	x	0	0
Bakun A	L & M 1942	71	15	p. conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	L & M 1942	73	17	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	74	3	p. shallow bowl	AE3	o	o	o	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	75	6	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	75	12	p. deep bowl	AE6	o	N	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	L & M 1942	76	16	p. beaker	AE5?	o	N	N	x	N	o	N	o	o	o	o	x	0	N
Bakun A	Herzfeld 1932	I	2	p. deep bowl	AE1?	o	N	N	o	N	o	o	x	o	x	x	x	1	N
Bakun A	Herzfeld 1932	I	3	p. deep bowl	AE2	o	N	o	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	I	4	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	II	1	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	II	2	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	II	3	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	ba.b.	bo.b.	u.o.l.	l.o.l	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Bakun A	Herzfeld 1932	II	4	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	III	1	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	III	2	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	III	3	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	IV	1	p. hemispherical bowl	AE6	o	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	IV	2	p. deep bowl	AE3	o	N	o	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	IV	4	p. shallow bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	IV	5	p. deep bowl	AE6	o	N	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	IV	6	p. deep bowl	AE6	o	N	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	V	2	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	V	3	p. hemispherical bowl	AE1	o	N	N	x	o	x	o	x	o	x	x	x	0	1<
Bakun A	Herzfeld 1932	V	4	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	o	1	1
Bakun A	Herzfeld 1932	VI	1	p. hemispherical bowl	AE7	x	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	VII	5	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	VIII	3	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	IX	2	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	IX	3	p. deep bowl	AE2	o	N	o	x	x	x	o	o	o	o	x	x	0	0
Bakun A	Herzfeld 1932	X	4	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Bakun A	Herzfeld 1932	X	5	p. deep bowl	AE1	o	N	o	x	o	x	o	x	o	x	x	x	0	1
Bakun A	Herzfeld 1932	X	6	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	2	2
Bakun A	Herzfeld 1932	X	8	p. deep bowl	AE1	o	N	N	o	o	o	o	x	o	x	x	x	1	1<
Bakun A	Herzfeld 1932	XI	1	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	o	2	1
Bakun A	Herzfeld 1932	XI	2	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	XI	3	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	o	2	1
Bakun A	Herzfeld 1932	XII	1	p. conical bowl	AE5	o	o	x	x	x	o	o	x	o	x	x	x	0	0

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	ba.b.	bo.b.	u.o.l.	l.o.l	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Bakun A	Herzfeld 1932	XII	2	p. hemispherical bowl	AE6	o	N	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	XII	4	p. hemispherical bowl	AE6	o*	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	XII	5	p. hemispherical bowl	AE6	o*	o	x	x	x	x	x	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	XIII	1	p. deep bowl	AE6	o	o	x	x	x	x	x	o	o	o	x	x	0	0
Bakun A	Herzfeld 1932	XIII	2	p. deep bowl	AE1	o*	N	o	x	o	x	o	x	o	x	x	x	0	1
Bakun A	Herzfeld 1932	XIV	4	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	XIV	5	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Herzfeld 1932	XV	3	p. conical bowl	AE5?	o	o	x	x	x	o	o	x	o	x	x	x	0	0
Bakun A	Herzfeld 1932	XVI	1	p. beaker	AE6?	N	o	x	N	x	N	o	x	o	x	x	N	N	0
Bakun A	Herzfeld 1932	XVI	4	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	o	3	1
Bakun A	Herzfeld 1932	XVI	5	p. deep bowl	AE1	o	N	o	o	x	o	o	x	o	x	x	x	1	0
Bakun A	E & M 1962	8	12	p. deep bowl	AE1	o	N	o	o	o	o	o	x	o	x	x	x	1	1

Table A4.2 List of horizontal structural patterns of interior-painted open vessels at Tall-e Gap, Tall-e Jari A, Tall-e Bakun B, and Tall-e Bakun A. Abbreviations: L & M 1942: Langsdorff and McCown 1942, E & M 1962: Egami and Masuda 1962, E & S 1962: Egami and Sono 1962, E 1977: Egami et al. 1977, V. B. 1952: Vanden Berghe 1952, p.: possibly, *: thin rim band, o: present, x: absent, N: no data

Site	Report	Fig.	No.	Estimated complete vessel form	horizontal structure pattern	interior rim band	exterior base band	interior base band	interior concentric lines	interior motif area/ frieze	interior base decoration
Gap	E & S 1962	26	1	shallow bowl	GI1	o	o	x	x	o	x
Gap	E & S 1962	26	2	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	26	4	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	26	5	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	26	6	shallow bowl	GI1	o	o	x	x	o	x
Gap	E & S 1962	26	7	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	26	8	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	26	9	shallow bowl	GI1	o	x	x	x	o	x

Site	Report	Fig.	No.	Estimated complete vessel form	horizontal structure pattern	interior rim band	exterior base band	interior base band	interior concentric lines	interior motif area/ frieze	interior base decoration
Gap	E & S 1962	26	10	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	26	11	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	26	12	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	27	4	deep bowl	GI1	o	o	x	x	o	x
Gap	E & S 1962	28	1	deep bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	28	4	deep bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	29	1	deep bowl	GI1	o	o	x	x	o	x
Gap	E & S 1962	30	1	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	30	2	hemispherical bowl	GI2	o	x	o	o	x	o
Gap	E & S 1962	30	3	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	30	4	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	30	5	shallow bowl	GI2	o	x	o	x	x	o
Gap	E & S 1962	31	1	shallow bowl	GI1	o	o	x	x	o	x
Gap	E & S 1962	31	4	shallow bowl	GI1	o	o	x	x	o	x
Gap	E & S 1962	31	1	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	31	3	shallow bowl	GI1	o	x	x	x	o	x
Gap	E & S 1962	48	2	shallow bowl	GI1	o	o	x	x	o	x
Gap	E & S 1962	76	1	shallow bowl	GI1	o	o	x	x	o	x
Gap	E & S 1962	12	2	p. shallow bowl	GI2	o	N	o	o	x	N
Gap	E & S 1962	12	4	p. shallow bowl	GI2	o	N	o	o	x	N
Gap	E & S 1962	15	4	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	26	3	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	26	13	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	27	1	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	27	2	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	27	3	p. deep bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	27	5	p. shallow bowl	GI1	o	N	x	x	o	x

Site	Report	Fig.	No.	Estimated complete vessel form	horizontal structure pattern	interior rim band	exterior base band	interior base band	interior concentric lines	interior motif area/ frieze	interior base decoration
Gap	E & S 1962	27	6	p. deep bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	27	7	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	27	8	p. deep bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	27	9	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	28	2	p. deep bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	28	3	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	28	5	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	28	6	p. deep bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	29	2	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	29	3	p. deep bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	29	4	p. hemispherical bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	29	5	p. shallow bowl	GI2	o	N	o	x	o	o
Gap	E & S 1962	29	6	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	31	2	p. shallow bowl	GI2	o	N	o	x	o	x
Gap	E & S 1962	31	3	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	31	5	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	E & S 1962	31	6	p. shallow bowl	GI3	x	N	x	x	o	x
Gap	E & S 1962	36	2	p. shallow bowl	GI2	o	o	o	o	o	x
Gap	Catalogue	6.23	1	p. deep bowl	GI1	o	N	x	x	o	x
Gap	Catalogue	6.19	4	p. shallow bowl	GI2	N	x	o	o	x	x
Gap	Catalogue	6.20	2	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	Catalogue	6.22	2	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	Catalogue	6.22	4	p. shallow bowl	GI1	o	N	x	x	o	x
Gap	Catalogue	6.20	4	p. deep bowl	GI1	N	o	x	x	o	x
Gap	Catalogue	6.20	1	p. shallow bowl	GI1	o	x	x	x	o	x
Gap	Catalogue	6.22	3	p. shallow bowl	GI1	o	N	x	x	o	x

Site	Report	Fig.	No.	Estimated complete vessel form	horizontal structure pattern	interior rim band	exterior base band	interior base band	interior concentric lines	interior motif area/ frieze	interior base decoration
Jari A	V. B. 1952	XLIX-L		shallow bowl	JI2	o	o	o	o	o	o
Jari A	V. B. 1952	XLIX-L		shallow bowl	JI2	o	N	o	o	o	x
Jari A	E 1977	III	1	shallow bowl	JI1	o	o	x	x	o	x
Jari A	E 1977	III	5	p. shallow bowl	JI2	o	N	o	x	o	x
Jari A	Catalogue	6.3	2	p. shallow bowl	JI3	x	N	N	N	o	N
Jari A	Catalogue	6.3	3	p. shallow bowl	JI3	x	N	N	N	o	N
Jari A	Catalogue	6.4	1	shallow bowl	JI1	o	o	x	x	o	x
Jari A	Catalogue	6.4	2	p. shallow bowl	JI2	o	N	o	o	o	N
Jari A	Catalogue	6.4	3	p. shallow bowl	JI2	o	N	N	o	o	N
Jari A	Catalogue	6.4	5	p. shallow bowl	JI2	N	o	o	o	o	o
Jari A	Catalogue	6.9	1	p. shallow bowl	JI2	o	N	o	o	o	N
Jari A	Catalogue	6.9	2	p. shallow bowl	JI2	o	o	o	N	o	N
Jari A	Catalogue	6.9	3	p. shallow bowl	JI1	N	N	N	x	o	N
Jari A	Catalogue	6.9	7	p. shallow bowl	JI2	o	N	N	N	o	N
Bakun B	Alizadeh 2006	23	R	p. shallow bowl	BI2	o	N	o	x	o	N
Bakun B	E & M 1962	16	8	p. shallow bowl	BI1	o	N	N	x	o	N
Bakun B	E & M 1962	16	10	p. shallow bowl	BI2	o	N	o	o	o	N
Bakun B	E & M 1962	16	11	p. shallow bowl	BI3	x	N	x	x	o	N
Bakun B	E & M 1962	16	12	p. shallow bowl	BI2	o	N	o	o	o	N
Bakun B	E & M 1962	17	1	p. shallow bowl	BI1	o	N	x	x	o	x
Bakun B	E & M 1962	17	2	p. shallow bowl	BI2	o	N	o	x	o	N
Bakun B	E & M 1962	17	3	p. shallow bowl	BI1	o	o	x	x	o	x
Bakun B	E & M 1962	17	8	p. shallow bowl	BI2	o	N	o	o	o	N
Bakun B	E & M 1962	17	9	shallow bowl	BI1	o	x	x	x	o	x
Bakun B	E & M 1962	17	10	p. shallow bowl	BI2	N	x	o	o	N	N
Bakun A	Alizadeh 2006	28	C	shallow bowl	AI2	o	o	x	o	o	x
Bakun A	Alizadeh 2006	35	B	shallow bowl	AI1	o	o	x	x	o	x

Site	Report	Fig.	No.	Estimated complete vessel form	horizontal structure pattern	interior rim band	exterior base band	interior base band	interior concentric lines	interior motif area/ frieze	interior base decoration
Bakun A	Alizadeh 2006	36	C	shallow bowl	AI1	o	o	x	x	o	x
Bakun A	Alizadeh 2006	36	D	shallow bowl	AI1	o	o	x	x	o	x
Bakun A	Alizadeh 2006	55	F	miniature vessel	AI1	o	x	x	x	o	x
Bakun A	L & M 1942	2	3	deep bowl	AI1	o	o	x	x	o	x
Bakun A	L & M 1942	10	7	deep bowl	AI1	o	N	x	x	o	x
Bakun A	L & M 1942	10	9	hemispherical bowl	AI1	o	N	x	x	o	x
Bakun A	L & M 1942	11	2	shallow bowl	AI1	o	o	x	x	o	x
Bakun A	L & M 1942	11	3	deep bowl	AI1	o	o	N	N	o	x
Bakun A	L & M 1942	11	4	shallow bowl	AI1	o	o	x	x	o	x
Bakun A	L & M 1942	11	9	hemispherical bowl	AI2	o	o	o	o	o	o
Bakun A	L & M 1942	17	17	shallow bowl	AI1	o	N	x	x	o	x
Bakun A	L & M 1942	17	18	hemispherical bowl	AI2	o	N	x	o	o	x
Bakun A	Alizadeh 2006	24	A	p. deep bowl	AI2	o	N	N	o	o	N
Bakun A	Alizadeh 2006	24	C	p. conical bowl	AI1	o	o	x	o	o	x
Bakun A	Alizadeh 2006	27	D	p. conical bowl	AI2	o	x	x	o	o	o
Bakun A	Alizadeh 2006	35	D	p. deep bowl	AI1	o	o	x	x	o	x
Bakun A	Alizadeh 2006	36	A	p. deep bowl	AI1	o	o	x	x	o	x
Bakun A	Alizadeh 2006	36	B	p. deep bowl	AI1	o	o	x	x	o	x
Bakun A	L & M 1942	2	4	p. shallow bowl	AI1	o	N	x	x	o	x
Bakun A	L & M 1942	2	8	shallow bowl	AI1	o	o	x	x	o	x
Bakun A	L & M 1942	3	1	p. shallow bowl	AI1	o	o	x	x	o	o
Bakun A	L & M 1942	9	12	shallow bowl	AI1	o	o	x	x	o	x
Bakun A	L & M 1942	10	1	p. shallow bowl	AI1	o	o	x	x	o	x
Bakun A	L & M 1942	10	3	p. shallow bowl	AI1	o	N	N	x	o	N
Bakun A	L & M 1942	10	5	p. hemispherical bowl	AI2	o	N	o	o	o	N
Bakun A	L & M 1942	22	20	p. shallow bowl	AI1	o	N	x	x	o	x
Bakun A	L & M 1942	27	15	p. shallow bowl	AI2	o	N	N	o	o	N

Site	Report	Fig.	No.	Estimated complete vessel form	horizontal structure pattern	interior rim band	exterior base band	interior base band	interior concentric lines	interior motif area/ frieze	interior base decoration
Bakun A	L & M 1942	28	9	p. shallow bowl	AI1	o	N	x	x	o	x
Bakun A	L & M 1942	28	11	p. shallow bowl	AI2	o	N	x	o	o	x
Bakun A	L & M 1942	28	12	p. shallow bowl	AI1	o	N	x	x	o	x
Bakun A	L & M 1942	29	1	p. shallow bowl	AI1	o	N	x	x	o	x
Bakun A	L & M 1942	29	2	p. shallow bowl	AI1	o	N	x	x	o	x
Bakun A	L & M 1942	29	6	p. shallow bowl	AI1	o	N	x	x	o	x
Bakun A	L & M 1942	34	7	p. shallow bowl	AI2	o	N	N	o	o	x
Bakun A	L & M 1942	34	10	p. shallow bowl	AI2	o	N	o	o	o	N
Bakun A	L & M 1942	35	5	p. shallow bowl	AI2	o	N	N	o	o	N
Bakun A	L & M 1942	36	10	p. shallow bowl	AI2	o	N	N	o	o	N
Bakun A	L & M 1942	43	12	p. shallow bowl	AI1	o	N	N	x	o	N
Bakun A	L & M 1942	43	15	p. shallow bowl	AI2	o	N	N	o	o	N
Bakun A	L & M 1942	44	2	p. shallow bowl	AI1	o	N	N	N	o	N
Bakun A	L & M 1942	44	5	p. shallow bowl	AI1	N	N	x	x	o	x
Bakun A	L & M 1942	44	6	p. deep bowl	AI2	o*	N	N	o	o	N
Bakun A	L & M 1942	46	15	p. shallow bowl	AI1	o	N	N	x	o	N
Bakun A	L & M 1942	47	5	p. shallow bowl	AI2	o	N	N	o	o	N
Bakun A	L & M 1942	47	14	p. deep bowl	AI2	o*	N	o	o	o	N
Bakun A	L & M 1942	53	10	p. shallow bowl	AI2	o	N	N	o	o	N
Bakun A	E & M 1962	10	1	p. deep bowl	AI1	N	N	x	x	o	x
Bakun A	E & M 1962	10	2	p. deep bowl	AI1	N	N	x	x	o	x
Bakun A	E & M 1962	11	2	p. shallow bowl	AI2	o	N	o	x	o	N
Bakun A	E & M 1962	11	3	p. shallow bowl	AI1	o	N	x	x	o	x
Bakun A	E & M 1962	11	7	p. shallow bowl	AI1	o	N	x	x	o	N

Table A4.3 List of horizontal structural patterns of closed vessels at Tall-e Gap and Tall-e Bakun A. Abbreviations: L & M 1942: Langsdorff and McCown 1942, E & M 1962: Egami and Masuda 1962, E & S 1962: Egami and Sono 1962, p.: possibly, h.s.p.: horizontal structure pattern, r.b.: rim band, n.b.: neck band, ba.b.: base band, bo.b.: body band, u.o.l.: upper optional line, l.o.l.: lower optional line, u.f.l.: upper frieze line, l.f.l.: lower frieze line, f.d.l, frieze division line, f.f.: first frieze, s.f.: second frieze, t.f.: third frieze, s.m. secondary motifs, *: thin rim band, o: present, x: absent, N: no data

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	n.b.	ba.b.	bo.b.	u.o.l.	l.o.l.	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Gap	E & S 1962	17	1	small jar	GC2	o	x	x	x	x	x	x	x	x	x	x	x	x		
Gap	E & S 1962	17	2	small jar	GC2	o	x	x	x	x	x	x	x	x	o	x	x	x		
Gap	E & S 1962	17	5	small jar	GC2	o	x	x	x	x	x	x	x	x	x	x	x	x		
Gap	Nishiaki 2003	49	1	large jar	GC2	o	x	x	x	x	x	x	x	x	x	x	x	x		
Gap	E & S 1962	11	2	large jar	GC2	o	x	x	N	x	x	x	x	x	x	x	x	x		
Gap	E & S 1962	11	4	large jar	GC2	o	x	x	N	x	x	x	x	x	x	x	x	x		
Gap	E & S 1962	11	7	large jar	GC2	o	x	x	N	x	x	x	x	x	x	x	x	x		
Gap	E & S 1962	18	5	large jar	GC1	o	x?	N	o	o	o	o	o	x	o	x	x	x	1	1
Gap	E & S 1962	18	7	large jar	GC1	o	x	N	N	o	N	o	N	x	o	x	x	x	2	N
Gap	E & S 1962	22	2	large jar	GC1	o	x?	N	N	o	N	o	N	x	o	x	x	x	2	N
Gap	E & S 1962	25	1	large jar	GC1	o	o	N	o?	x	x	x	x	o?	x	x	x	x	0	0
Gap	E & S 1962	25	2	large jar	GC2	o	x	x	x	x	x	x	x	x	o	x	x	x		
Gap	E & S 1962	25	3	large jar	GC1	o	x	N	N	o	N	o	o	x	o	x	x	x	2	1<
Bakun A	Alizadeh 2006	39	D	small jar	AC2	o	x	o	o	x	x	o	o	x	o	x	x	o		
Bakun A	Alizadeh 2006	41	E	large jar	AC2	o	o	x	o	x	x	o	o	x	o	x	x	x		
Bakun A	Alizadeh 2006	42	C	large jar	AC1	o	o	x	o	o	x	o	o	x	o	x	x	x	1	0
Bakun A	Alizadeh 2006	42	E	large jar	AC2	o	x	x	o	x	x	x	x	o	o	o	x	x		
Bakun A	Alizadeh 2006	42	G	large jar	AC2	o	o	x	o	x	x	o	x	x	x	x	x	x		
Bakun A	L & M 1942	14	10	large jar	AC5	o	x	x	x	x	x	x	x	x	x	x	x	x		
Bakun A	L & M 1942	14	11	large jar	AC1	o	x	x	o	o	x	o	o	x	o	x	x	x	1	0
Bakun A	L & M 1942	14	13	large jar	AC2	o	x	x	o	x	x	o	o	x	o	x	x	x		
Bakun A	L & M 1942	15	1	large jar	AC2	o	o	x	o	x	x	x	x	x	o	x	x	x		

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	n.b.	ba.b.	bo.b.	u.o.l.	l.o.l.	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Bakun A	L & M 1942	15	3	large jar	AC1	o	x	o	x	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	15	4	large jar	AC5	o	x	x	x	x	x	x	x	x	x	x	x	x		
Bakun A	L & M 1942	12	13	small jar	AC1	o	o	o	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	13	7	small jar	AC5	o	x	x	x	x	x	x	x	x	o	x	x	x		
Bakun A	L & M 1942	13	19	small jar	AC1	o	x	o	o	o	o	o	o	x	o	x	x	x	2	2
Bakun A	L & M 1942	14	6	small jar	AC4	o	x	x	x	o	x	o	x	o	o	x	x	x	2	0
Bakun A	L & M 1942	14	7	small jar	AC4	o	x	x	x	x	x	x	x	o	o	o	x	x		
Bakun A	L & M 1942	14	9	small jar	AC5	o	x	x	x	x	x	x	x	x	x	x	x	x		
Bakun A	E & M 1962	6	1	large jar	AC2	o	x	x	o	x	x	o	o	x	o	x	x	x		
Bakun A	E & M 1962	6	2	large jar	AC2	o	x	x	o	x	x	o	x	o?	x	x	x	x		
Bakun A	L & M 1942	31	1	large jar	AC2	o	x	x	o	x	x	o	o	x	o	x	x	x		
Bakun A	Alizadeh 2006	39	C	large jar	AC1	o	x	N	o	o	o	o	o	x	o	x	x	x	2	2
Bakun A	Alizadeh 2006	39	E	large jar	AC2	o	x	N	o	x	x	o	o	x	o	x	x	o		
Bakun A	Alizadeh 2006	39	F	large jar	AC1	o	x	N	o	o	x	o	o	x	o	x	x	o	2	0
Bakun A	Alizadeh 2006	41	A	large jar	AC2	o	o	N	o	x	x	o	o	x	o	x	x	x		
Bakun A	Alizadeh 2006	41	C	large jar	AC2	o	x	N	o	x	x	o	o	x	o	x	x	o		
Bakun A	Alizadeh 2006	41	D	large jar	AC1	o	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	Alizadeh 2006	42	D	small jar	AC2	o	x	N	o	x	x	o	o	x	o	x	x	x		
Bakun A	Alizadeh 2006	43	A	small jar	AC4	o	x	N	x	o	x	o	x	x	o	x	x	x	1	
Bakun A	Alizadeh 2006	43	B	small jar	AC2	o	x	N	o	x	x	x	o	o	o	o	x	x		
Bakun A	L & M 1942	3	9	large jar	AC2	o	x	N	o	x	x	o	o	x	o	x	x	x		
Bakun A	L & M 1942	4	1	large jar	AC1	o	x	N	o	o	x	o	o	x	o	x	x	x	1	0
Bakun A	L & M 1942	4	7	small jar	AC3	o	x	o	x	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	5	1	large jar	AC2	o	x	N	o	x	x	x	x	o	o	x	x	x		
Bakun A	L & M 1942	5	2	small jar	AC1	o	o	N	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	13	3	small jar	AC3	o	x	o	x	o	o	o	o	x	o	x	x	x	1	1

Site	Report	Fig.	No.	Estimated complete vessel form	h.s.p.	r.b.	n.b.	ba.b.	bo.b.	u.o.l.	l.o.l.	u.f.l.	l.f.l.	f.d.l.	f.f.	s.f.	t.f.	s.m.	No. of u.o.l.	No. of l.o.l.
Bakun A	L & M 1942	22	12	small jar	AC4	o	x	N	x	o	x	o	x	x	o	x	x	x	2	0
Bakun A	L & M 1942	24	12	large jar	AC2	o	x	N	o	x	x	o	o	x	o	x	x	x		
Bakun A	L & M 1942	31	2	large jar	AC1	o	x	N	o	o	x	o	o	x	o	x	x	x	1	0
Bakun A	L & M 1942	31	5	large jar	AC1	o	x	N	o	o	x	o	o	x	o	x	x	x	1	0
Bakun A	L & M 1942	53	8	small jar	AC1	o	x	N	o	x	o	o	o	x	o	x	x	x	0	1
Bakun A	L & M 1942	54	6	small jar	AC1	o	x	x	o	o	o	o	o	x	o	x	x	x	1	1
Bakun A	L & M 1942	58	2	small jar	AC2	o	x	N	o	x	x	o	o	x	o	x	x	x		
Bakun A	L & M 1942	58	4	small jar	AC2	N	o	x	o	x	x	o	o	x	o	x	x	x		
Bakun A	L & M 1942	58	11	small jar	AC2	o*	o	N	o	x	x	x	x	x	o	x	x	x		
Bakun A	L & M 1942	61	12	small jar	AC4	o	x	x	x	x	x	x	x	x	o	x	x	x		

Table A5.1 List of well-preserved vessels from Tall-e Bakun A curated in OIC used for observation of technical traces

Reg No.	Publication (L&M 1942)	part	ware	vessel form	painted side	forming	surfac treatment (interior surface)	surface treatment (exterior surface)	slip (interior surface)	slip (exterior surface)	painting (No. of motif-unit)	firing
A20087	Pl.3:2	rim - base	BOBW	deep bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	8	
A20089	unpublished	rim - base	BOBW	conical bowl	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: vertically smoothed	Yes	Yes	2	same imprint
A20096	Pl.36:13	rim - base	BOBW	beaker	exterior	coiling? without wheel	Upper: diagonally smoothed, Lower: horizontally smoothed	horizontally smoothed	Yes	Yes	3	
A20097	unpublished	rim - base	BOBW	beaker	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	2	
A20098	Pl.14:10	rim - base	BOBW	large jar	exterior	coiling, adding neck	horizontally smoothed	horizontally smoothed, diagonal traces of grooves, Bottom: scraped	Yes (Upper?)	Yes		
A20099	unpublished	rim - base	BOBW	beaker	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: vertically scraped	Yes	Yes	3	

Reg No.	Publication (L&M 1942)	part	ware	vessel form	painted side	forming	surfac treatment (interior surface)	surface treatment (exterior surface)	slip (interior surface)	slip (exterior surface)	painting (No. of motif-unit)	firing
A20102	Pl.16:10	rim - base	BOBW	funnel-shaped vessel	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed, diagonal traces of grooves	Yes	Yes		
A20104	Pl.18:5	rim - base	BOBW	pot-stand	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes		
A20105	Pl.18:17	rim - base	BOBW	zoomorphic vessel	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes		
A20114	Pl.2:3	rim - base	BOBW	deep bowl	both sides	coiling? without wheel, deformed	horizontally smoothed	horizontally smoothed	Yes	Yes	Int: 2, Ext: 13(U), 11 (L)	
A20115	Pl.1:8	rim - base	BOBW	deep bowl	exterior	coiling? without wheel, thin wall	horizontally smoothed	horizontally smoothed	Yes	Yes	3	
A20116	Pl.17:12	rim - base	BOBW	conical bowl	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: vertically smoothed	Yes	Yes	3	same imprint
A20117	Pl.4:9	rim - base	BOBW	conical bowl	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: vertically burnished-scraped	Yes	Yes	3	
A20118	Pl.16:6	rim - base	BOBW	funnel-shaped vessel	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed, diagonal traces of grooves	Yes	Yes	3	
A20119	Pl.12:1, 62:2	rim - body	BOBW	funnel-shaped vessel	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	3	
A20120	Pl.13:17,61:12	rim - body	BOBW	small jar	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed, horizontal rows of vertical traces of grooves	Yes	Yes	6	
A20121	Pl.46:6	rim - base	BOBW	deep bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	3	
A20125	Pl.74:3	rim - body	BOBW	shallow bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	3	
A20128	Pl.11:2	rim - body	BOBW	shallow bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes		

Reg No.	Publication (L&M 1942)	part	ware	vessel form	painted side	forming	surfac treatment (interior surface)	surface treatment (exterior surface)	slip (interior surface)	slip (exterior surface)	painting (No. of motif-unit)	firing
A20136	Pl.4:3, 9:4	rim - base	BOBW	deep bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	5	imprint inside
A20137	Pl.3:1, 3:3	rim - base	BOBW	shallow bowl	both sides	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	int: 3, ext: 7 another motif in space	
A20164	Pl.2:7	rim - base	BOBW	funnel-shaped vessel	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	3	
A20173	unpublished	rim - base	BOBW	conical bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	3	
A20217	Pl.4:4, 9:10	rim - base	BOBW	deep bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	2	similar imprint
A20218	Pl.9:2	rim - base	BOBW	deep bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	3	
A20219	Pl.74:1	rim - body	BOBW	deep bowl	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: vertically smoothed	Yes	Yes	7	
A20283	Pl.9:5	rim - base	BOBW	deep bowl	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: vertically smoothed	Yes	Yes	5	
A20285	unpublished	rim - base	BOBW	beaker	exterior	coiling? without wheel, deformed	horizontally smoothed	Upper: horizontally smoothed, Lower: diagonally scraped	Yes	Yes		
A20287	unpublished	rim - base	BOBW	beaker	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: vertically smoothed	Yes	Yes		
A20289	unpublished	rim - base	BOBW	beaker	exterior	coiling? without wheel	horizontally smoothed	vertically, horizontally smoothed	Yes	Yes	3	
A20290	unpublished	rim - base	BOBW	funnel-shaped vessel	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: vertically smoothed	Yes	Yes	3	
A20318	unpublished	rim - base	BOBW	deep bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes?	Yes	3	

Reg No.	Publication (L&M 1942)	part	ware	vessel form	painted side	forming	surfac treatment (interior surface)	surface treatment (exterior surface)	slip (interior surface)	slip (exterior surface)	painting (No. of motif-unit)	firing
A21024	Pl.12:13, 53:4	rim - base	BOBW	small jar	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: horizontally scraped	Yes	Yes		
A24917	Alizadeh 2006 Fig.25A	rim - base	BOBW	conical bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed, vertically scraped	Yes	Yes	2	
A38235	Pl.24:12	rim - body	BOBW	large jar	exterior	coiling	horizontally smoothed, smearing extra clay	horizontally smoothed, horizontal rows of vertical traces of grooves	No	Yes	3	
A20085	Pl.2:6, 10:9	rim - base	BOBW	hemispherical bowl	interior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes		
A20095	unpublished	rim - base	BOBW	beaker	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: vertically scraped	Yes	Yes		imprint
A20100	unpublished	rim - base	BOBW	small jar	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	9	
A20108	Pl.15:9	rim - base	BOBW	beaker	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed, diagonal traces of grooves	Yes	Yes	Upper: 10, Middle: 11, Lower: 13	
A20133	Pl.24:1	rim - body	BOBW	deep bowl	exterior	coiling? without wheel, thin wall	horizontally smoothed	horizontally smoothed	Yes	Yes		
A20205	unpublished	rim - base	BOBW	deep bowl	painted on its rim	coiling? without wheel	horizontally smoothed	horizontally scraped	Yes	Yes		
A20214	unpublished	rim - base	BOBW	shallow bowl	painted on its rim	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes		imprint inside
A20222	Pl.9:13, 54:10	rim - base	BOBW	shallow bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	3	
A20223	unpublished	rim - base	BOBW	incurved-rim vessel	unpainted	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: horizontally-vertically scraped	Yes	Yes		
A20229	Pl.5:2, 13:6	rim - body	BOBW	small jar	exterior	coiling? without wheel, adding neck	horizontally smoothed	horizontally smoothed	Yes	Yes		

Reg No.	Publication (L&M 1942)	part	ware	vessel form	painted side	forming	surfac treatment (interior surface)	surface treatment (exterior surface)	slip (interior surface)	slip (exterior surface)	painting (No. of motif-unit)	firing
A20231	Pl.5:1, 15:2	rim - body	BOBW	large jar	exterior	coiling, adding neck	horizontally smoothed	horizontally smoothed	Yes?	Yes	3	
A20289	unpublished	rim - base	BOBW	beaker	exterior	coiling? without wheel	Upper: horizontally smoothed, Middle: diagonally smoothed	Upper: horizontally smoothed, Lower: vertically smoothed	Yes	Yes	3	same imprint inside
A24911	Alizadeh 2006 Figure.42E	rim - base	BOBW	large jar	exterior	coiling	horizontally smoothed	Upper: horizontally smoothed, Middle: diagonally scraped & diagonally smoothed, Lower: horizontally smoothed	Yes?	Yes		
A24921	unpublished	rim - base	BOBW	deep bowl	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes		
A20122	Pl.13:3	body - base	BOBW	small jar	exterior	coiling? without wheel	horizontally smoothed	horizontally smoothed, vertical traces of grooves at the bottom	No?	Yes		
A20123	unpublished	rim - base	BOBW	small jar	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: diagonally smoothed or scraped	No?	Yes (Upper)		
A20204	Pl.13:7	rim - base	BOBW	small jar	exterior	coiling? without wheel	roughly horizontally smoothed	horizontally smoothed	Yes?	Yes	4	
A20270	Pl.31:2	rim - body	BOBW	large jar	exterior	coiling, adding neck	roughly horizontally smoothed, smearing extra clay	horizontally smoothed by a tool	Yes?	Yes	3	
A20271	Pl.31:5	rim - body	BOBW	large jar	exterior	coiling, adding neck	roughly horizontally smoothed	smoothed by a tool, random diagonal traces of grooves	Yes?	Yes	3	red part
A20272	unpublished	rim - base	BOBW	large jar	exterior	coiling, adding neck	roughly smoothed	roughly smoothed by a tool	No?	Yes		red part
A20273	unpublished	rim - base	BOBW	large jar	exterior	coiling, adding neck	roughly horizontally smoothed	roughly horizontally smoothed	No?	Yes	3	
A20275	unpublished	rim - body	BOBW	large jar	exterior	coiling, adding neck	roughly horizontally smoothed	smoothed, random diagonal traces of grooves	No?	Yes	3	red part

Reg No.	Publication (L&M 1942)	part	ware	vessel form	painted side	forming	surfac treatment (interior surface)	surface treatment (exterior surface)	slip (interior surface)	slip (exterior surface)	painting (No. of motif-unit)	firing
A20277	Pl.31:3	body - base	BOBW	large jar	exterior	coiling, adding neck	roughly horizontally smoothed	horizontally smoothed, vertical traces of grooves on its middle	No?	Yes		
A20278	unpublished	rim - base	BOBW	large jar	exterior	coiling, adding neck	roughly horizontally smoothed	Middle: horizontally smoothed by a tool, Lower: vertically smoothed by a tool	No?	Yes (Upper)		imprint outside
A20281	Pl.31:1	rim - base	BOBW	large jar	exterior	coiling, adding neck	roughly horizontally smoothed	roughly smoothed, random diagonal traces of grooves	No?	Yes (Upper)	3	
A25887	unpublished	rim - base	BOBW	large jar	exterior	coiling, adding neck	roughly horizontally smoothed	horizontally smoothed	No?	Yes (Upper)		
A37496	unpublished	rim - body	BOBW	large jar	exterior	coiling, adding neck	horizontally smoothed	horizontally smoothed	Yes	Yes		
A38321	unpublished	rim - base	BOBW	beaker	exterior	coiling? without wheel	horizontally smoothed	Upper: horizontally smoothed, Lower: vertically smoothed	Yes	Yes	2	
A24869	Alizadeh 2006 Fig.55F	rim - base	BOBW	shallow bowl	interior	coiling? without wheel	smoothed?	smoothed?	Yes?	Yes?		
A20090	unpublished	rim - body	MCW	incurved-rim vessel		sequential slab construction	roughly smoothed	lightly burnished, clay coating?	No	No		
A20280	unpublished	rim - base	MCW	incurved-rim vessel		sequential slab construction	smoothed, clay coating	lightly burnished, clay coating	No	No		
A20082	unpublished	rim	MCW	deep bowl		sequential slab construction	degenerated	horizontally smoothed, lightly burnished, clay coating	No	No		
A20091	unpublished	rim - base	MCW	incurved-rim vessel		sequential slab construction, adding knob	roughly smoothed	lightly burnished, clay coating	No	No		
A39733	unpublished	body - base	MCW	incurved-rim vessel		coiling? without wheel	roughly smoothed, clay coating	smoothed, partly burnished, clay coating	No	No		
A24904	Alizadeh 2006 Fig.53C	rim - base	Red burnished ware	incurved-rim vessel		coiling? without wheel	horizontally smoothed	diagonally, horizontally burnished	Yes	Yes		

Table A5.2 List of well-preserved vessels from Tall-e Jari A and Tall-e Gap used for observation of technical traces. Abbreviations: E 1977: Egami et al. 1977, p.: possibly

Site	Reference	Fig.	No.	part	ware	vessel form	painted side	forming	surfac treatment (interior surface)	surface treatment (exterior surface)	slip (interior surface)	slip (exterior surface)	painting (No. of motif-unit)	firing
Jari A	E 1977	IIII	1	rim - base	BOBW	shallow bowl	exterior	coiling? without wheel	horizontally smoothed	horizonally and diagonolaly smoothed and scraped	Yes	Yes	4	
Jari A	Catalogue	6.1	1	rim - body	BOBW	deep bowl	exterior	coiling? without wheel	horizontally smoothed	diagonally smoothed and scraped	Yes	Yes		
Jari A	Catalogue	6.1	2	rim - base	BOBW	deep bowl	exterior	coiling	covered by calcium	vertically and diagonally smoothed and scraped	Yes	Yes		
Jari A	Catalogue	6.1	3	rim - body	BOBW	deep bowl	exterior	coiling	horizontally smoothed	horizonally smoothed	Yes	Yes		
Jari A	Catalogue	6.4	1	rim - base	BOBW	shallow bowl	interior	coiling? without wheel	smoothed	smoothed	Yes	Yes		
Jari A	Catalogue	6.3	4	rim - body	BOBW	p. shallow bowl	painted on its rim	coiling	horizontally smoothed	horizonally smoothed	Yes	Yes		
Jari A	Catalogue	6.6	1	rim - body	BOBW	p. deep bowl	exterior	coiling? without wheel	horizontally smoothed (Upper), diagonally smoothed (Lower)	horizontally smoothed (Upper), diagonally smoothed (Lower)	Yes	Yes		
Jari A	Catalogue	6.6	2	rim - body	BOBW	p. deep bowl	exterior	coiling? without wheel	horizontally smoothed	horizonally smoothed (Upper), smoothed (Lower)	Yes	Yes		
Jari A	Catalogue	6.7	5	rim - base	BOBW	shallow bowl	exterior	coiling? without wheel	horizontally smoothed	horizonally and diagonolaly smoothed and scraped	Yes	Yes		
Jari A	Catalogue	6.8	4	rim - body	BOBW	deep bowl	exterior	coiling? without wheel	horizontally smoothed	vertically smoothed	Yes	Yes		
Jari A	Catalogue	6.5	1	rim - body	VCW	p. deep bowl		sequential slab construction?	horizontally smoothed	horizonally smoothed	No (clay coating)	No (clay coating)		
Jari A	Catalogue	6.5	2	body	VCW	p. deep bowl		sequential slab construction? + applique	eroded	horizonally smoothed	eroded	No (clay coating)		
Jari A	Catalogue	6.5	6	rim - body	VCW	p. shallow bowl	exterior	sequential slab construction?	horizontally smoothed (Upper), diagonally smoothed (Lower)	diagonally smoothed	No (clay coating)	No (clay coating)		
Gap	Catalogue	6.11	1	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	horizontally smoothed	horizontally and vertically smoothed	Yes	Yes		

Site	Reference	Fig.	No.	part	ware	vessel form	painted side	forming	surfac treatment (interior surface)	surface treatment (exterior surface)	slip (interior surface)	slip (exterior surface)	painting (No. of motif-unit)	firing
Gap	Catalogue	6.16	1	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	roughly horizontally smoothed	horizontally smoothed (Upper), diagonally smoothed (Middle)	Yes	Yes		
Gap	Catalogue	6.18	5	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	roughly horizontally smoothed	horizontally smoothed	Yes	Yes		
Gap	Catalogue	6.18	2	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	roughly horizontally smoothed	horizontally smoothed	Yes	Yes		
Gap	Catalogue	6.18	3	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	horizontally smoothed	horizontally smoothed (Upper), diagonally smoothed (Middle)	Yes	Yes		
Gap	Catalogue	6.18	4	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	horizontally smoothed	finely horizontally smoothed	Yes	Yes		
Gap	Catalogue	6.19	1	rim - base	BOBW	shallow bowl	interior	coiling ? without wheel	smoothed	smoothed	Yes	Yes	3	
Gap	Catalogue	6.19	4	body - base	BOBW	shallow bowl	interior	coiling ? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes		
Gap	Catalogue	6.20	1	rim - base	BOBW	shallow bowl	interior	coiling ? without wheel	finely smoothed	smoothed	Yes	Yes		
Gap	Catalogue	6.20	2	rim - body	BOBW	shallow bowl	interior	coiling ? without wheel	horizontally smoothed	horizontally smoothed (Upper), diagonally smoothed (Middle)	Yes	Yes		
Gap	Catalogue	6.20	5	body - base	BOBW	shallow bowl	interior	coiling ? without wheel	smoothed	horizontally smoothed	Yes	Yes	2	
Gap	Catalogue	6.22	1	rim - base	BOBW	shallow bowl	interior	coiling ? without wheel	horizontally smoothed	horizontally smoothed (Upper), diagonally smoothed or scraped (Lower)	Yes	Yes		
Gap	Catalogue	6.22	3	rim - body	BOBW	shallow bowl?	interior	coiling ? without wheel	horizontally smoothed	horizontally smoothed (Upper), diagonally scraped (Middle)	Yes	Yes		
Gap	Catalogue	6.22	4	rim - body	BOBW	p. shallow bowl	interior	coiling ? without wheel	horizontally smoothed	roughly horizontally smoothed or scraped	Yes	Yes		
Gap	Catalogue	6.23	1	rim - body	BOBW	p. shallow bowl	interior	coiling ? without wheel	horizontally smoothed or scraped	horizontally smoothed or scraped	Yes	Yes		
Gap	Catalogue	6.27	1	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	horizontally smoothed (Upper), roughly smoothed (Lower)	vertically smoothed	Yes	Yes		

Site	Reference	Fig.	No.	part	ware	vessel form	painted side	forming	surfac treatment (interior surface)	surface treatment (exterior surface)	slip (interior surface)	slip (exterior surface)	painting (No. of motif-unit)	firing
Gap	Catalogue	6.27	2	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	diagonally smoothed (Upper), horizontally smoothed (Middle), vertically smoothed (Lower)	horizontally smoothed (Upper), diagonally scraped (Lower)	Yes	Yes		
Gap	Catalogue	6.27	3	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	horizontally smoothed	vertically smoothed	Yes	Yes		
Gap	Catalogue	6.28	5	body	BOBW	p. deep bowl	exterior	coiling ? without wheel	smoothed	smoothed	Yes	Yes		
Gap	Catalogue	6.28	6	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	horizontally smoothed	smoothed	Yes	Yes		
Gap	Catalogue	6.28	7	body	BOBW	p. deep bowl	exterior	coiling ? without wheel	horizontally smoothed	vertically smoothed	Yes	Yes		
Gap	Catalogue	6.29	3	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	horizontally smoothed	smoothed	Yes	Yes		
Gap	Catalogue	6.29	6	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	horizontally smoothed	diagonally smoothed	Yes	Yes		
Gap	Catalogue	6.30	3	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	horizontally smoothed	smoothed	Yes	Yes		
Gap	Catalogue	6.31	6	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes		
Gap	Catalogue	6.32	1	rim - body	BOBW	p. deep bowl	exterior	coiling ? without wheel	covered by calcium	horizontally and diagonally smoothed	Yes	Yes		
Gap	Catalogue	6.32	2	body - base	BOBW	shallow bowl	interior	coiling ? without wheel	horizontally smoothed	horizontally smoothed	Yes	Yes	4	
Gap	Catalogue	6.32	4	rim - body	BOBW	p. shallow bowl	interior	coiling ? without wheel	horizontally smoothed	horizontally smoothed (Upper), diagonally scraped (Lower)	Yes	Yes		
Gap	Catalogue	6.33	1	body - base	BOBW	shallow bowl	interior	coiling ? without wheel	horizontally smoothed	diagonally smoothed (Middle), horizontally smoothed (Lower)	Yes	Yes	2	imprint on both sides
Gap	unpublished			rim - base	BOBW	shallow bowl	interior	coiling ? without wheel	horizontally smoothed	horizontally smoothed (Upper), diagonally scraped (Lower)	Yes	no	3?	
Gap	Catalogue	6.33	5	rim - body	BOBW	large jar	exterior	coiling ? without wheel	horizontally smoothed (Upper), roughly smoothed (Lower)	horizontally smoothed (neck), roughly diagonally smoothed and scraped (body)	no	Yes		

Table A5.3 List of diagnostic potsherds showing forming and surface treatment techniques at Tall-e Bakun A, Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap. Abbreviations: L & M 1942: Langsdorff and McCown 1942, E & M 1962: Egami and Masuda 1962, E 1977: Egami et al. 1977, p.: possibly

Site	Reference	Reg. No. (Bakun A), Fig. No. (Bakun A, Jari A, Bakun B), Box, Context No. (Gap)		part	ware	estimated vessel form	traces of forming and surface treatment techniques
Bakun A	L & M 1942	Pl. 1: 4	A39758	body	BOBW	large jar	incision on the surface of a coil in order to strengthen the joins
Bakun A		A37365		base	BOBW	funnel-shaped vessel	a trace of rounded stick for the purpose of penetrating the cone base
Bakun A		A37374		base	BOBW	funnel-shaped vessel	a trace of rounded stick for the purpose of penetrating the cone base
Bakun A		A37464		base	BOBW	funnel-shaped vessel	a trace of rounded stick for the purpose of penetrating the cone base
Bakun A		A38004		base	BOBW	funnel-shaped vessel	a trace of rounded stick for the purpose of penetrating the cone base
Bakun A		A38159		base	BOBW	conical bowl	a trace of rounded stick for the purpose of penetrating the cone base
Bakun A		A38162		base	BOBW	conical bowl	a trace of rounded stick for the purpose of penetrating the cone base
Bakun A		A39783		rim - base	BOBW	unpainted part of open vessel	mat impressession on bottom
Bakun A	L & M 1942	Pl. 1: 3	A39785	base	BOBW	unpainted part of open vessel	mat impressession on bottom
Bakun A	L & M 1942	Pl. 1: 6	A39762	ring base	BOBW	p. open vessel	finger-impression on the surface of a coil in order to strengthen the joins (not on body but on ring base)
Bakun A		A36965		body	MCW	p. open vessel	clothes impression
Jari A	E 1977	IV	1	rim - base	VCW	rectangular vase	three knob appliques
Jari A	E 1977	IV	2	body	VCW	bowl?	two wavy line appliques
Jari A	E 1977	IV	5	base	VCW	shallow bowl?	basket impression on its interior
Jari A	E 1977	IV	6	rim - base	VCW	deep bowl	basket impression on its interior
Jari A	E 1977	IV	7	rim	VCW	p. deep bowl	basket impression on its interior
Jari A	E 1977	IV	8	rim	VCW	p. shallow bowl	basket impression on its interior
Jari A	E 1977	IV	11	rim - base	VCW	deep bowl	sequential slab construction
Jari A	E 1977	IV	12	rim - body	VCW	p. deep bowl	coiling
Jari A	E 1977	IV	13	rim - body	VCW	p. deep bowl	coiling
Gap	E & M1962	13	5	body	BOBW	large jar	incision on the joint (also Pl. 2:23)
Gap	E & M1962	18	8	rim	VCW	p. bowl	sequential slab construction
Gap	E & M1962	19	2	rim	VCW	p. bowl	coiling
Gap	E & M1962	19	6	rim	VCW	p. bowl	sequential slab construction
Gap	E & M1962	18	29	base	VCW	p. bowl	incision on the joint (also Pl. 2:23)
Gap	E & M1962	18	32	base	VCW	p. bowl	basket impression
Gap	unpublished	2646	393	body	BOBW	large jar	incision on a neck joint (combination of horizontal-diagonal incision and short vertical incisions)

Site	Reference	Reg. No. (Bakun A), Fig. No. (Bakun A, Jari A, Bakun B), Box, Context No. (Gap)		part	ware	estimated vessel form	traces of forming and surface treatment techniques
Gap	Ch. 7, Fig. 7.23: 2	2622	412	neck	BOBW	large jar	incision on a neck joint (combination of horizontal-diagonal incision and short vertical incisions)
Gap	unpublished	2622	412	rim	BOBW	large jar	incision on a neck joint (combination of horizontal-diagonal incision and short vertical incisions)
Gap	unpublished	2623	413	rim	BOBW	large jar	incision on a neck joint (combination of diagonal incision and short vertical incisions?)
Gap	Ch. 7, Fig. 7.23:1	2643	376	body	BOBW	large jar	incision on a neck joint (combination of horizontal incision and short vertical incisions)
Gap	Ch. 7, Fig. 7.23:4	2834	487	body	BOBW	large jar	incision on a neck joint (diagonal incision)
Gap	unpublished	2530	192	rim	BOBW	large jar	incision on a neck joint (combination of a diagonal incision and horizontal incisions?)
Gap	Ch. 7, Fig. 7.23:3	2655	327	rim	BOBW	large jar	incision on a neck joint (vertical incision?)
Gap	unpublished	2579	94	body	BOBW	large jar	incision on a neck joint (horizontal incision?)
Gap	unpublished	2558	106	body	BOBW	large jar	incision on a neck joint (diagonal incision?)
Gap	unpublished	2558	117	rim	BOBW	large jar	incision on a neck joint (combination of diagonal incision and horizontal incisions?)
Gap	unpublished	2642	371	base	BOBW	open vessel	incision on a base joint (horizontal incision)
Gap	unpublished	3690	1062	base	BOBW	open vessel	base joint (no incision)
Gap	Ch. 7, Fig. 7.23:5	3751	1384	base	BOBW	open vessel	incision on a base joint (horizontal incision)
Gap	unpublished	3753		base	BOBW	open vessel	base joint (no incision)
Gap	Ch. 7, Fig. 7.23:6	2574		base	BOBW	open vessel	base joint (no incision)
Gap	unpublished	3838		base	BOBW	open vessel	incision on a base joint (horizontal incision)
Gap	Ch. 7, Fig. 7.23:7	2582		base	BOBW	open vessel	incision on a base joint (diagonal incision)
Gap	Ch. 7, Fig. 7.26	2615		body	MCW	unknown	cloth impression
Gap	Ch. 7, Fig. 7.26	2591		body	MCW	unknown	cloth impression
Gap	Ch. 7, Fig. 7.25	2592		rim	MCW	p. incurved rim vessel	clay coating
Gap	Ch. 7, Fig. 7.25	2577		boy - base	VCW	p. bowl	clay coating
Gap	Ch. 7, Fig. 7.24	3805	1307	body	BOBW	unknown	snake attached to avessel
Gap	Ch. 7, Fig. 7.27: Upper	3788		body	BOBW	large jar	rough smoothing using tools on the interior surfaces
Gap	Ch. 7, Fig. 7.27: Lower	2529		body	BOBW	large jar	rough smoothing using tools on the interior surfaces

Table A5.4 List of diagnostic potsherds showing grooves at Tall-e Bakun A, Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap

Site	Reg No. (Bakun A), Box, Context No. (Jari A, Bakun B, Gap)	Part	Vessel form	direction of row	direction of grooves	length of grooves (cm)	interval between grooves (mm)
Bakun A	A38062	body	open vessel painted on its exterior	horizontal	diagonal	2.5	1.5
Bakun A	A38222	upper body	open vessel painted on its exterior	horizontal	vertical	9	4
Bakun A	A38238	upper body	open vessel painted on its exterior	diagonal	diagonal	2	1
Bakun A	A38859	body	open vessel painted on its exterior	horizontal	vertical		2
Bakun A	A20230	lower body	conical bowl	horizontal	vertical	1	2
Bakun A	A20093	cone	funnel shaped vessel	vertical	horizontal	1	1
Bakun A	A35906	body	p. shallow bowl	diagonal	diagonal	0.5	1
Bakun A	A36361	body	large jar	diagonal	diagonal		
Bakun A	A37005	body	p. large jar	horizontal	vertical	3.5	5
Bakun A	A37090	body	p. large jar	horizontal	vertical	2.5	4
Bakun A	A37542	body	large jar	horizontal	vertical		3
Bakun A	A39300	body	p. large jar	vertical	horizontal		3
Bakun A	A39875	body	p. large jar	vertical	diagonal	2.5	2
Bakun A	A19827	body	open vessel painted on its exterior	horizontal	vertical	0.5	1
Bakun A	A36815	body	large jar	horizontal	vertical		4
Jari A	1825	body	open vessel painted on its interior	horizontal	vertical	>2.5	1
Bakun B	2141	body	open vessel painted on its exterior	diagonal	vertical	1.3	1.5
Gap	2784, 30 (Ch. 7 Fig. 8.55: 2)	body	p. shallow bowl	horizontal	vertical	0.8	2
Gap	2624, 419	body	large jar	horizontal	diagonal	1.2	2
Gap	3788, 1346 (Ch. 7 Fig. 8.55: 1)	body	large jar	diagonal	diagonal	2.5	5
Gap	3689, 1056	body	large jar	vertical	horizontal	4.5	3
Gap	3773	body	large jar	horizontal	vertical	3	4
Gap	3775	body	large jar	horizontal	vertical	1.7	3
Gap	3818	body	large jar	horizontal	vertical	3.2	5
Gap	3804, 1303	body	large jar	horizontal	vertical	>2.1	2
Gap	3802	body	large jar	horizontal	vertical	2	2
Gap	3819	body	large jar	diagonal	diagonal	3	2
Gap	3820	body	large jar	horizontal	vertical	1	3
Gap	2647, 465	body	p. shallow bowl	horizontal	diagonal	4.2	2
Gap	2663, 351	boy	large jar	vertical	horizontal	3.3	2
Gap	2598, 552	rim	p. shallow bowl	diagonal	diagonal	3.2	2
Gap	2640	base	p. shallow bowl	horizontal	diagonal	2.5	2

Table A5.5 List of diagnostic reworked pottery scrapers at Tall-e Bakun A, B, Tall-e Gap, and Tall-e Jari A curated in OIC and UMUT. Abbreviations: E & M 1962: Egami and Masuda 1962

Site	Reg No. (Bakun A), Reference (Jari A, Bakun B), Box, Context No. (Gap)	Part of edge	Vessel form	Length of the blade (cm)	Shape of the blade
Bakun A	A24844	rim	open vessel painted on its exterior	3.5	straight
Bakun A	A25894	rim	open vessel painted on its exterior	6.6	convex
Bakun A	A25895	broken body edge	open vessel painted on its exterior	8.7	convex
Bakun A	A25897	broken body edge	open vessel painted on its exterior	7.4	convex
Bakun A	A25898	rim	open vessel painted on its exterior	4.6	convex
Bakun A	A25899	rim	open vessel painted on its exterior	5.5	straight
Bakun A	A25904	broken body edge	open vessel painted on its exterior	5.4	convex
Bakun A	A36538	broken body edge	open vessel painted on its interior	7.5	convex
Bakun A	A36569	rim	open vessel painted on its exterior	7.4	convex
Bakun A	A36673	rim	open vessel painted on its exterior	5	convex
Bakun A	A36739	rim	open vessel painted on its exterior	4	straight
Bakun A	A36779	rim	open vessel painted on its exterior	8.2	convex
Bakun A	A36943	rim	open vessel painted on its exterior	6	convex
Bakun A	A37118	rim	open vessel painted on its interior	5.6	straight
Bakun A	A37666	broken body edge	open vessel painted on its exterior	5.6	straight
Bakun A	A38044	rim	open vessel painted on its exterior	4.1	convex
Bakun A	A38892	broken body edge	large jar	5.7	convex
Bakun A	A39051	rim	open vessel painted on its exterior	7	convex
Bakun A	A39161	broken body edge	open vessel painted on its exterior	5.6	convex
Bakun A	A39165	broken body edge	large jar	16.1	convex
Bakun A	A39181	rim	open vessel painted on its exterior	5.9	convex
Bakun A	A39241	broken body edge	open vessel painted on its exterior	6.2	convex
Bakun A	A39343	rim	open vessel painted on its exterior	8.7	convex
Bakun A	A39345	rim	open vessel painted on its exterior	7.1	convex
Bakun A	A39352	rim	open vessel painted on its exterior	8.3	straight
Bakun A	A39393	rim	open vessel painted on its exterior	10.5	convex
Bakun A	A39403	rim	open vessel painted on its exterior	5.8	convex
Bakun A	A39405	rim	open vessel painted on its exterior	4.1	convex
Bakun A	A39492	broken body edge	large jar?	8.1	convex
Bakun A	A39519	rim	open vessel painted on its exterior	10.4	convex
Bakun A	A39595	broken body edge	open vessel painted on its exterior	5.5	convex
Bakun A	A39600	broken body edge	open vessel painted on its exterior	5.3	convex
Bakun A	A39629	broken body edge	open vessel painted on its exterior	8.1	convex
Bakun A	A39660	rim	open vessel painted on its exterior	4.3	convex
Bakun A	A39780	broken body edge	large jar?	5.7	convex
Bakun A	A39842	rim	open vessel painted on its exterior	6.2	convex
Bakun A	A102438	rim	open vessel painted on its exterior	4.6	convex

Site	Reg No. (Bakun A), Reference (Jari A, Bakun B), Box, Context No. (Gap)	Part of edge	Vessel form	Length of the blade (cm)	Shape of the blade
Bakun A	A39760	clay scraper			
Bakun A	A39761	clay scraper			
Jari A	Cat. 6.6: 2	broken body edge	open vessel painted on its exterior	6.4	convex
Bakun B	E & M 1962: Fig. 17: 6	broken body edge	open vessel painted on its interior	3.9	straight
Bakun B	E & M 1962: Fig. 17: 8	broken body edge	open vessel painted on its interior	4.2	convex
Gap	2642, 402	rim	open vessel painted on its interiror	9.8	convex
Gap	2625, 431	rim	open vessel painted on its interiror	8	convex
Gap	2628, 454	rim	open vessel painted on its interiror	7.3	convex
Gap	3768, 1360	broken body edge	open vessel painted on its interiror	8	convex
Gap	3674	rim	open vessel painted on its interiror	10.8	straight
Gap	3680, 1124	broken body edge	open vessel painted on its interiror	11.3	convex
Gap	2612, 25	broken body edge	open vessel painted on its interiror	8.2	convex
Gap	3751, 1382	rim	open vessel painted on its exterior	5	convex
Gap	3751, 1387	rim	open vessel painted on its interiror	10.7	straight
Gap	2590, 42	broken body edge	large jar	5.2	convex
Gap	2591	broken body edge	large jar?	8.2	convex
Gap	2578 (Ch. 7, Fig. 7.29: left)	rim	open vessel painted on its interiror	12	straight
Gap	2859, 1554	rim	open vessel painted on its interiror	8.9	straight
Gap	2559, 407	rim	open vessel painted on its exterior	6	straight
Gap	2547, 143	broken body edge	open vessel painted on its interiror	5	straight
Gap	2548	broken body edge	large jar?	5.3	convex
Gap	2530, 193	rim	open vessel painted on its interiror	6.5	convex
Gap	2530, 561	rim	open vessel painted on its exterior	5.2	straight
Gap	2527, 176	rim	open vessel painted on its interiror	8.7	convex
Gap	2678, 301	rim	open vessel painted on its interiror	5.3	straight
Gap	2678, 301	rim	open vessel painted on its interiror	4.1	straight
Gap	2678, 301	rim	open vessel painted on its interiror	4.6	convex
Gap	2627	rim	open vessel painted on its interiror	5	convex
Gap	2852 (Ch. 7, Fig. 7.29: right)	rim	open vessel painted on its interiror	12.2	straight

Table A5.6 List of diagnostic potsherds at Tall-e Bakun A showing observed number of motif-units curated in OIC and published vessels showing observed and estimated number of motif-units at Tall-e Bakun A, Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap. Abbreviations: L & M 1942: Langsdorff and McCown 1942, E & M 1962: Egami and Masuda 1962, U: Upper, L: Lower.

Site	Reg No. (OIC collection of Bakun A), Publication	Fig.	No.	vessel form	painted side	observed No. of motif-unit	estimated No. of motif-unit
Bakun A	A20126			p. beaker	exterior	9	
Bakun A	A20159			p. beaker	exterior	2	
Bakun A	A20163			conical bowl	exterior	2	
Bakun A	A20175			funnel-shaped vessel	exterior	3	
Bakun A	A20207			holemouth vessel with holes	exterior	3 (rim line)	
Bakun A	A35998			conical bowl	exterior	2	
Bakun A	A36449			conical bowl	exterior	2	
Bakun A	A36729			conical bowl	exterior	3	
Bakun A	A37765			conical bowl	exterior	3	
Bakun A	A37824			conical bowl	exterior	2	
Bakun A	A38017			p. beaker	exterior	3	
Bakun A	A38069			large jar	exterior	7	
Bakun A	A38162			conical bowl	exterior	3	
Bakun A	A38320			conical bowl	exterior	2	
Bakun A	A38322			shallow bowl	interior	3	
Bakun A	A38323			conical bowl	exterior	2	
Bakun A	A39323			conical bowl	exterior	2	
Bakun A	Alizadeh 2006	24	B	conical bowl	exterior	3	
Bakun A	Alizadeh 2006	24	F (U)	conical bowl	exterior	5	
Bakun A	Alizadeh 2006	24	F (L)	conical bowl	exterior	3	
Bakun A	Alizadeh 2006	25	A	conical bowl	exterior	2	
Bakun A	Alizadeh 2006	25	D	p. conical bowl	exterior	2	
Bakun A	Alizadeh 2006	25	E	conical bowl	exterior	2	
Bakun A	Alizadeh 2006	26	A	p. conical bowl	exterior	2	
Bakun A	Alizadeh 2006	26	B	p. conical bowl	exterior	2	
Bakun A	Alizadeh 2006	26	C	p. conical bowl	exterior	2	
Bakun A	Alizadeh 2006	26	D	p. conical bowl	exterior	2	
Bakun A	Alizadeh 2006	27	C	conical bowl	exterior	4	
Bakun A	Alizadeh 2006	40	1	incurved rim vessel	exterior	2	
Bakun A	Alizadeh 2006	35	B	shallow bowl	interior	2	
Bakun A	Alizadeh 2006	36	C	shallow bowl	interior	2	
Bakun A	Alizadeh 2006	36	D	shallow bowl	interior	2	
Bakun A	L & M 1942	2	3	deep bowl	interior	2	
Bakun A	L & M 1942	4	10	conical bowl	exterior	2	
Bakun A	L & M 1942	10	7	deep bowl	interior	3	

Site	Reg No. (OIC collection of Bakun A), Publication	Fig.	No.	vessel form	painted side	observed No. of motif-unit	estimated No. of motif-unit
Bakun A	Alizadeh 2006	27	D	p. conical bowl	interior	6	
Bakun A	L & M 1942	2	8	shallow bowl	interior	3	
Bakun A	L & M 1942	28	9	p. shallow bowl	interior	3	
Bakun A	L & M 1942	28	12	p. shallow bowl	interior	3	
Bakun A	L & M 1942	29	2	p. shallow bowl	interior	3	
Bakun A	L & M 1942	29	6	p. shallow bowl	interior	3	
Bakun A	L & M 1942	44	5	p. shallow bowl	interior	3	
Bakun A	L & M 1942	46	15	p. shallow bowl	interior	4	
Bakun A	E & M 1962	10	1	p. deep bowl	interior	3	
Bakun A	E & M 1962	10	2	p. deep bowl	interior	3	
Bakun A	Herzfeld 1932	XV	1	conical bowl	exterior	2	
Bakun A	Herzfeld 1932	XV	2	conical bowl	exterior	3	
Bakun A	Herzfeld 1932	XV	3	conical bowl	exterior	3	
Bakun A	Herzfeld 1932	XVI	2	deep bowl	exterior	3	
Bakun A	L & M 1942	34	10	p. shallow bowl	interior		9
Bakun A	L & M 1942	2	1	large jar	exterior		3
Bakun A	L & M 1942	2	2	large jar	exterior		2
Bakun A	L & M 1942	3	4		exterior		7
Bakun A	L & M 1942	3	8	large jar	exterior		3
Bakun A	L & M 1942	3	9	large jar	exterior		3
Bakun A	L & M 1942	4	1	large jar	exterior		3
Bakun A	L & M 1942	4	6	funnel-shaped vessel	exterior		2
Bakun A	L & M 1942	4	7	small jar?	exterior		3
Bakun A	L & M 1942	24	1	deep bowl	exterior		5
Bakun A	L & M 1942	26	8	deep bowl	exterior		12
Bakun A	L & M 1942	27	13	deep bowl	exterior		9
Bakun A	L & M 1942	28	5	hemispherical bowl	exterior		3
Bakun A	L & M 1942	32	2	deep bowl	exterior		6
Bakun A	L & M 1942	32	13	deep bowl	exterior		8
Bakun A	L & M 1942	34	1	deep bowl	exterior		7
Bakun A	L & M 1942	36	14	funnel-shaped vessel	exterior		3
Bakun A	L & M 1942	40	5	deep bowl	exterior		6
Bakun A	L & M 1942	40	6	beaker	exterior		4
Bakun A	L & M 1942	41	14	hemispherical bowl	exterior		7
Bakun A	L & M 1942	45	5	hemispherical bowl	exterior		4
Bakun A	L & M 1942	48	7	beaker	exterior		13
Bakun A	L & M 1942	50	12a	deep bowl	exterior		6
Bakun A	L & M 1942	50	12b	deep bowl	exterior		6
Bakun A	L & M 1942	52	3	p. small jar	exterior		14
Bakun A	L & M 1942	60	1	deep bowl	exterior		8

Site	Reg No. (OIC collection of Bakun A), Publication	Fig.	No.	vessel form	painted side	observed No. of motif-unit	estimated No. of motif-unit
Bakun A	L & M 1942	60	2	deep bowl	exterior		9
Bakun A	L & M 1942	61	1	deep bowl	exterior		8
Bakun A	L & M 1942	67	11	deep bowl	exterior		7
Bakun A	L & M 1942	67	13	deep bowl	exterior		4
Bakun A	L & M 1942	68	11	deep bowl	exterior		8
Bakun A	Alizadeh 2006	69	18	conical bowl	exterior		4
Bakun A	Alizadeh 2006	24	C	conical bowl	exterior		10
Bakun A	Alizadeh 2006	24	H	funnel-shaped vessel	exterior		3
Bakun A	Alizadeh 2006	27	B	conical bowl	exterior		4
Bakun A	Alizadeh 2006	30	A	deep bowl	exterior		15
Bakun A	Alizadeh 2006	30	B	deep bowl	exterior		3
Bakun A	Alizadeh 2006	30	D	deep bowl	exterior		30
Bakun A	Alizadeh 2006	30	Ea	deep bowl	exterior		10
Bakun A	Alizadeh 2006	30	Eb	deep bowl	exterior		7
Bakun A	Alizadeh 2006	30	Ea	deep bowl	exterior		6
Bakun A	Alizadeh 2006	31	C	deep bowl	exterior		8
Bakun A	Alizadeh 2006	35	B	deep bowl	exterior		6
Bakun A	Alizadeh 2006	35	C	deep bowl	exterior		4
Bakun A	Alizadeh 2006	35	Da	beaker	exterior		8
Bakun A	Alizadeh 2006	35	Db	beaker	exterior		6
Bakun A	Alizadeh 2006	35	Dc	beaker	exterior		9
Bakun A	Alizadeh 2006	35	E	deep bowl	exterior		4
Bakun A	Alizadeh 2006	36	Aa	p. shallow bowl	exterior		20
Bakun A	Alizadeh 2006	36	Ab	p. shallow bowl	exterior		12
Bakun A	Alizadeh 2006	37	A	barrel-shaped vessel	exterior		8
Bakun A	Alizadeh 2006	38	A	deep bowl	exterior		10
Bakun A	Alizadeh 2006	38	C	deep bowl	exterior		12
Bakun A	Alizadeh 2006	39	A	beaker	exterior		4
Bakun A	Alizadeh 2006	39	C	large jar	exterior		21
Bakun A	Alizadeh 2006	39	D	p. small jar	exterior		5
Bakun A	Alizadeh 2006	39	E	large jar	exterior		8
Bakun A	Alizadeh 2006	39	F	large jar	exterior		6
Bakun A	Alizadeh 2006	41	A	large jar	exterior		3
Bakun A	Alizadeh 2006	41	C	large jar	exterior		8
Bakun A	Alizadeh 2006	41	D	large jar	exterior		26
Bakun A	Alizadeh 2006	41	E	large jar	exterior		3
Bakun A	Alizadeh 2006	42	D	p. small jar	exterior		11
Bakun A	Alizadeh 2006	42	C	large jar	exterior		4
Bakun A	Alizadeh 2006	Pl13	B	p. deep bowl	exterior		4
Bakun A	Herzfeld 1932	I	2	deep bowl	exterior		7

Site	Reg No. (OIC collection of Bakun A), Publication	Fig.	No.	vessel form	painted side	observed No. of motif-unit	estimated No. of motif-unit
Bakun A	Herzfeld 1932	I	4	deep bowl	exterior		12
Bakun A	Herzfeld 1932	II	1	deep bowl	exterior		4
Bakun A	Herzfeld 1932	III	2	deep bowl	exterior		4
Bakun A	Herzfeld 1932	IV	2	deep bowl	exterior		7
Bakun A	Herzfeld 1932	IV	5	deep bowl	exterior		12
Bakun A	Herzfeld 1932	VIII	2	deep bowl	exterior		10
Bakun A	Herzfeld 1932	IX	3	deep bowl	exterior		7
Bakun A	Herzfeld 1932	X	3	deep bowl	exterior		12
Bakun A	Herzfeld 1932	XI	2	deep bowl	exterior		3
Bakun A	Herzfeld 1932	XI	3	p. deep bowl	exterior		9
Bakun A	Herzfeld 1932	XII	1	p. deep bowl	exterior		4
Bakun A	Herzfeld 1932	XII	2	hemispherical bowl	exterior		6
Bakun A	Herzfeld 1932	XIII	1a	deep bowl	exterior		6
Bakun A	Herzfeld 1932	XIII	1b	deep bowl	exterior		6
Bakun A	Herzfeld 1932	XVI	4	deep bowl	exterior		4
Jari A	Vanden Berghe 1952	XLIX-L		shallow bowl with pedestal	interior		15
Jari A	Vanden Berghe 1952	XLIX-L		shallow bowl	interior		12 (Upper), 8 (Lower)
Jari A	Egami et al. 1977	1	1	shallow bowl	interior	4	
Jari A	Catalogue	6.1	1	p. deep bowl	exterior		42
Jari A	Catalogue	6.1	2	deep bowl	exterior		12
Jari A	Catalogue	6.6	1	p. deep bowl	exterior		20
Jari A	Catalogue	6.7	1	p. deep bowl	exterior		14
Bakun B	E & M 1962	15	1	p. deep bowl	exterior		15
Gap	E & S 1962	27	4	shallow bowl	Interior	2	
Gap	E & S 1962	28	1	deep bowl	Interior	2	
Gap	E & S 1962	28	4	shallow bowl	Interior	2	
Gap	E & S 1962	30	1	shallow bowl	Interior	4	
Gap	E & S 1962	30	2	shallow bowl	Interior	4	
Gap	E & S 1962	30	4	shallow bowl	Interior	4	
Gap	E & S 1962	30	5	shallow bowl	Interior	4	
Gap	E & S 1962	31	4	shallow bowl	Interior	4	
Gap	Nishiaki 2003	76	1	shallow bowl	Interior	2	
Gap	Catalogue	6.19	1	shallow bowl	Interior	3	
Gap	Catalogue	6.20	4	shallow bowl	Interior	2	
Gap	Catalogue	6.33	1	p. shallow bowl	Interior	2	
Gap	Catalogue	6.32	2	p. shallow bowl	Interior	4	
Gap	E & S 1962	12	6	p. deep bowl	exterior		3
Gap	E & S 1962	13	1	p. deep bowl	exterior		4
Gap	E & S 1962	13	3	p. deep bowl	exterior		2

Site	Reg No. (OIC collection of Bakun A), Publication	Fig.	No.	vessel form	painted side	observed No. of motif-unit	estimated No. of motif-unit
Gap	E & S 1962	13	4	p. deep bowl	exterior		8
Gap	E & S 1962	15	11	p. deep bowl	exterior		4
Gap	E & S 1962	16	1	p. deep bowl	exterior		3
Gap	E & S 1962	16	2	p. deep bowl	exterior		4
Gap	E & S 1962	16	3	p. deep bowl	exterior		3
Gap	E & S 1962	16	4	p. deep bowl	exterior		4
Gap	E & S 1962	16	7	p. deep bowl	exterior		4
Gap	E & S 1962	17	8	p. deep bowl	exterior		5
Gap	E & S 1962	18	7	large jar	exterior		8
Gap	E & S 1962	19	1	deep bowl	exterior		8
Gap	E & S 1962	19	4	p. deep bowl	exterior		7
Gap	E & S 1962	20	1	p. deep bowl	exterior		6
Gap	E & S 1962	20	2	p. deep bowl	exterior		10 (upper), 8 (lower)
Gap	E & S 1962	20	3	deep bowl	exterior		11
Gap	E & S 1962	20	12	p. deep bowl	exterior		8
Gap	E & S 1962	20	5	deep bowl	exterior		11 (upper), 10 (middle), 7 (lower)
Gap	E & S 1962	20	6	deep bowl	exterior		8
Gap	E & S 1962	20	7	p. deep bowl	exterior		9
Gap	E & S 1962	20	8	p. deep bowl	exterior		4
Gap	E & S 1962	21	1	p. deep bowl	exterior		12
Gap	E & S 1962	21	2	deep bowl	exterior		7
Gap	E & S 1962	21	3	p. deep bowl	exterior		7
Gap	E & S 1962	21	5	p. deep bowl	exterior		12
Gap	E & S 1962	21	6	p. deep bowl	exterior		8
Gap	E & S 1962	21	7	p. deep bowl	exterior		16
Gap	E & S 1962	21	8	p. deep bowl	exterior		8
Gap	E & S 1962	21	9	p. deep bowl	exterior		6
Gap	E & S 1962	21	11	p. deep bowl	exterior		12
Gap	E & S 1962	21	12	p. deep bowl	exterior		10
Gap	E & S 1962	22	1	large jar	exterior		23
Gap	E & S 1962	22	4	p. deep bowl	exterior		15
Gap	E & S 1962	22	7	deep bowl	exterior		8
Gap	E & S 1962	25	2	large jar	exterior		3
Gap	E & S 1962	25	3	large jar	exterior		6
Gap	E & S 1962	26	6	shallow bowl	interior		5
Gap	E & S 1962	26	7	shallow bowl	interior		6
Gap	E & S 1962	26	10	shallow bowl	interior		4
Gap	E & S 1962	26	11	shallow bowl	interior		4

Site	Reg No. (OIC collection of Bakun A), Publication	Fig.	No.	vessel form	painted side	observed No. of motif-unit	estimated No. of motif-unit
Gap	E & S 1962	30	3	shallow bowl	interior		4
Gap	E & S 1962	31	1	shallow bowl	interior		3
Gap	Catalogue	6.18	3	p. deep bowl	exterior		8
Gap	Catalogue	6.27	1	p. deep bowl	exterior		7
Gap	Catalogue	6.27	2	p. deep bowl	exterior		6
Gap	Catalogue	6.18	4	p. deep bowl	exterior		7

Table A5.7 List of diagnostic potsherds showing imprints at Tall-e Bakun A, Tall-e Bakun B, and Tall-e Gap. Abbreviations: E & M 1962: Egami and Masuda 1962, E & S 1962: Egami and Sono 1962, p.: possibly

Site	Reg No. (OIC collection of Bakun A), Publication Fig. No. (Bakun B, Gap), Box and context No. (Bakun B, Gap)	part	vessel form	preserved surface of imprint	location of imprint	stylistic component of imprint	motif-imprint relationship
Bakun A	A20129	rim - body	open vessel painted on its exteiror	interior	body	motif?	insufficient data
Bakun A	A20132	rim - body	open vessel painted on its exteiror	interior	body	motif, design structure	similar
Bakun A	A20213	rim - body	open vessel painted on its exteiror	interior	rim	motif	similar
Bakun A	A24907	body - base	open vessel painted on its exteiror	interior	bottom	design structure	insufficient data
Bakun A	A24920	body	open vessel painted on its exteiror	interior	body	motif	different
Bakun A	A36082	body	open vessel painted on its exteiror	exterior	body	motif?	different
Bakun A	A36154	base	open vessel painted on its exteiror	exterior	bottom	unknown	insufficient data
Bakun A	A36296	rim - body	open vessel painted on its exteiror	interior	body	design structure	insufficient data
Bakun A	A36449	base	conical bowl	interior	bottom	motif, design structure	similar
Bakun A	A36503	rim - body	open vessel painted on its exteiror	interior	body	motif, design structure	different
Bakun A	A36535	body	p. conical bowl	interior	body	motif, design structure	same
Bakun A	A36539	body	open vessel painted on its exteiror	exterior	body	motif	different
Bakun A	A37202	body	open vessel painted on both sides	exterior	body	motif	different
Bakun A	A37646	rim - body	open vessel painted on its exteiror	interior	body	motif	different
Bakun A	A37993	rim - body	open vessel painted on its exteiror	interior	body	design structure	insufficient data
Bakun A	A38000	base	open vessel painted on its exteiror	interior	bottom	design structure	similar
Bakun A	A38017	base	open vessel painted on its exteiror	interior	bottom	motif, design structure	similar
Bakun A	A38067	rim - body	open vessel painted on its exteiror	interior	rim	motif	different
Bakun A	A38088	body	open vessel painted on its exteiror	interior	body	motif, design structure	different
Bakun A	A38163	base	open vessel painted on its exteiror	interior	bottom	design structure	insufficient data
Bakun A	A38216	rim - body	open vessel painted on its exteiror	interior	body	motif, design structure	similar
Bakun A	A38277	rim - body	open vessel painted on its exteiror	interior	rim - body	motif	different
Bakun A	A38352	body	open vessel painted on its exteiror	interior	body	motif	different
Bakun A	A38371	rim - body	open vessel painted on its exteiror	interior	rim - body	motif	similar

Site	Reg No. (OIC collection of Bakun A), Publication Fig. No. (Bakun B, Gap), Box and context No. (Bakun B, Gap)	part	vessel form	preserved surface of imprint	location of imprint	stylistic component of imprint	motif-imprint relationship
Bakun A	A38412	rim - body	open vessel painted on its exteiror	interior	rim - body	motif, design structure	different
Bakun A	A38415	body	open vessel painted on its exteiror	interior	body	motif	different
Bakun A	A38852	body	open vessel painted on its exteiror	interior	body	design structure	insufficient data
Bakun A	A39107	base	open vessel painted on its exteiror	interior	bottom	design structure	insufficient data
Bakun A	A39124	body	open vessel painted on its exteiror	interior	body	design structure	insufficient data
Bakun A	A39192	body - base	open vessel painted on its exteiror	interior	body	motif	similar
Bakun A	A39208	body	open vessel painted on its exteiror	interior	body	motif	different
Bakun A	A39253	body	open vessel painted on its exteiror	exterior	body	unknown	different
Bakun A	A39290	body	open vessel painted on its exteiror	interior	body	motif	insufficient data
Bakun A	A39323	rim - body	open vessel painted on its exteiror	interior	body	motif	insufficient data
Bakun A	A39335	rim - body	open vessel painted on its exteiror	interior	body	motif, design structure	different
Bakun A	A39338	rim - body	open vessel painted on its exteiror	interior	body	motif	different
Bakun A	A39386	rim - body	open vessel painted on its exteiror	interior	body	motif	different
Bakun A	A39436	rim - body	open vessel painted on its exteiror	interior	rim - body	motif	different
Bakun A	A39483	body	open vessel painted on its exteiror	interior	body	motif	similar
Bakun A	A39528	body - base	open vessel painted on its exteiror	interior	bottom	design structure	insufficient data
Bakun A	A39544	body	open vessel painted on its exteiror	interior	body	motif	similar
Bakun A	A39548	body	open vessel painted on its exteiror	interior	body	motif	different
Bakun A	A39563	body	open vessel painted on its exteiror	interior	body	motif	similar
Bakun A	A39572	body	open vessel painted on its exteiror	interior	body	motif	different
Bakun A	A39604	body	open vessel painted on its exteiror	interior	body	motif	insufficient data
Bakun A	A39684	rim - body	open vessel painted on its exteiror	interior	body	motif	same
Bakun A	A102387	rim - body	open vessel painted on its exteiror	interior	body	motif	different
Bakun A	A39851A	rim	open vessel painted on its exteiror	interior	rim	motif	different
Bakun A	A39851G	rim	open vessel painted on its exteiror	interior	rim	motif	insufficient data
Bakun B	box No. 2142	rim	open vessel painted on its exterior	interior	rim	motif	different

Site	Reg No. (OIC collection of Bakun A), Publication Fig. No. (Bakun B, Gap), Box and context No. (Bakun B, Gap)			part	vessel form	preserved surface of imprint	location of imprint	stylistic component of imprint	motif-imprint relationship
Bakun B	E & M 1962	16	16	body	open vessel painted on its exterior	interior	body	motif, design structure	different
Bakun B	E & M 1962	15	11	rim - body	open vessel painted on its exterior	interior	rim - body	motif, design structure	different
Bakun B	E & M 1962	14	12	body	open vessel painted on its exterior	interior	body	design structure	unknown
Bakun B	E & M 1962	17	4	rim - body	open vessel painted on its interior	exterior	body	motif	same
Bakun B	E & M 1962	17	6	rim - body	open vessel painted on its interior	exterior	body	motif	similar
Bakun B	E & M 1962	16	8	rim - body	open vessel painted on its interior	exterior	body	motif	different
Bakun B	E & M 1962	17	10	base	open vessel painted on its interior	interior	bottom	motif	different
Gap	Box, context No.	2642		base	unpainted part of open vessel	exterior	ring base	motif	unpainted inside
Gap	Box, context No.	2626	437	body -base	open vessel painted on its interior	exterior	body, ring base	motif	insufficient data
Gap	Box, context No.	3736	523	rim - body	open vessel painted on its interior	exterior	body	motif	insufficient data
Gap	Box, context No.	3742	503	rim - body	open vessel painted on its interior	exterior	body	motif	insufficient data
Gap	Box, context No.	3676		base	open vessel painted on its interior	exterior	ring base	motif	insufficient data
Gap	Box, context No.	2612		base	large jar	exterior	base	motif	different
Gap	Box, context No.	2590	406	body	open vessel painted on its interior	exterior	body	motif	different
Gap	Box, context No.	2703	214	body	open vessel painted on its interior	exterior	body	motif	unpainted inside
Gap	Box, context No.	2598		body	open vessel painted on its interior	exterior	body	motif	insufficient data
Gap	Box, context No.	3806	1313	rim	open vessel painted on its interior	exterior	body	design structure	insufficient data
Gap	Box, context No.	3819	1262	body	open vessel painted on its interior	exterior	body	motif	similar
Gap	Box, context No.	2859	1554	rim - body	open vessel painted on its interior	exterior	body	motif	different
Gap	Box, context No.	2799		rim - body	open vessel painted on its interior	exterior	rim - body	motif, design structure	different
Gap	Box, context No.	2834		rim - body	open vessel painted on its interior	exterior	body	motif	same
Gap	Box, context No.	2816	545	body -base	open vessel painted on its interior	exterior	body	motif	different
Gap	Box, context No.	2816	545	body -base	open vessel painted on its interior	interior	bottom	design structure	insufficient data
Gap	Box, context No.	2784	496	body	open vessel painted on its interior	exterior	body	motif	different
Gap	Box, context No.	2784	304	body	open vessel painted on its interior	exterior	body	motif, design structure	different
Gap	Box, context No.	2784	304	body	open vessel painted on its interior	interior	bottom	design structure	insufficient data

Site	Reg No. (OIC collection of Bakun A), Publication Fig. No. (Bakun B, Gap), Box and context No. (Bakun B, Gap)			part	vessel form	preserved surface of imprint	location of imprint	stylistic component of imprint	motif-imprint relationship
Gap	Box, context No.	2784	304	base	open vessel painted on its interior	exterior	ring base	motif	insufficient data
Gap	Box, context No.	2705	218	body -base	open vessel painted on its interior	exterior	ring base	motif	insufficient data
Gap	Box, context No.	2545	150	body	open vessel painted on its interior	exterior	body	motif	similar
Gap	Box, context No.	2545	150	rim - base	open vessel painted on its interior	exterior	body	motif	different
Gap	Box, context No.	2530		base	open vessel painted on its interior	exterior	base	motif	similar
Gap	Box, context No.	2677	297	rim - body	open vessel painted on its interior	exterior	body	motif	different
Gap	Box, context No.	2688	242	body	open vessel painted on its interior	exterior	body	motif	different
Gap	Box, context No.	4F	275	body	open vessel painted on its interior	exterior	body	motif	different
Gap	Box, context No.	4F	258	body	open vessel painted on its interior	exterior	body	motif	different
Gap	Box, context No.	4F	546	rim - body	open vessel painted on its interior	exterior	ring base	motif	insufficient data
Gap	Box, context No.	4F	504	body -base	open vessel painted on its interior	exterior	body	motif	different
Gap	Box, context No.	2628	456	rim -body	open vessel painted on its exterior	interior	body	design structure	insufficient data
Gap	Box, context No.	3737	561	body	open vessel painted on its exterior	interior	body	motif	insufficient data
Gap	Box, context No.	3741	497	body	open vessel painted on its exterior	interior	body	motif, design structure	only structure outside
Gap	Box, context No.	3741	584	rim -body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	3673	1089	base	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	3679	1117	rim -body	open vessel painted on its exterior	interior	rim	design structure	insufficient data
Gap	Box, context No.	3679	1117	rim -body	open vessel painted on its exterior	interior	body	motif	insufficient data
Gap	Box, context No.	3681	1127	body	open vessel painted on its exterior	interior	body	motif, design structure	similar
Gap	Box, context No.	3692	1071	body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	3692		body	open vessel painted on its exterior	interior	rim	motif	different
Gap	Box, context No.	3692		body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	2606	6	rim -body	open vessel painted on its exterior	interior	rim	design structure	insufficient data
Gap	Fig. 7.30	3710	1027	rim -body	open vessel painted on its exterior	interior	rim	motif	different
Gap	Box, context No.	2613	26	base	open vessel painted on its exterior	interior	bottom	design structure	insufficient data
Gap	Box, context No.	3751	1383	rim	open vessel painted on its exterior	interior	rim	design structure	different

Site	Reg No. (OIC collection of Bakun A), Publication Fig. No. (Bakun B, Gap), Box and context No. (Bakun B, Gap)			part	vessel form	preserved surface of imprint	location of imprint	stylistic component of imprint	motif-imprint relationship
Gap	Box, context No.	3751	1382	rim	open vessel painted on its exterior	interior	body	motif, design structure	different
Gap	Box, context No.	3751	1384	base	unpainted part of open vessel	interior	bottom	design structure	insufficient data
Gap	Box, context No.	3751	1381	body	open vessel painted on its exterior	interior	body	motif	insufficient data
Gap	Box, context No.	2596	63	body	open vessel painted on its exterior	interior	body	motif, design structure	only structure outside
Gap	Box, context No.	2597	67	body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	2597	67	body -base	open vessel painted on its exterior	interior	bottom	design structure	insufficient data
Gap	Box, context No.	3767	1357	base	open vessel painted on its exterior	interior	bottom	design structure	insufficient data
Gap	Box, context No.	3774	1375	body	open vessel painted on its exterior	interior	body	motif	insufficient data
Gap	Box, context No.	3775	1380	body	open vessel painted on its exterior	interior	body	motif	different
Gap	Fig. 7.30	3815	1243	body -base	open vessel painted on its exterior	interior	body	motif, design structure	different
Gap	Box, context No.	3805		body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	3802	1293	body -base	bowl painted on its both sides	interior	bottom	design structure	insufficient data
Gap	Box, context No.	3798	1282	body	open vessel painted on its exterior	interior	body	design structure	insufficient data
Gap	Box, context No.	3834		base	open vessel painted on its exterior	interior	bottom	design structure	insufficient data
Gap	Box, context No.	3832	1182	body	open vessel painted on its exterior	interior	body	motif	insufficient data
Gap	Box, context No.	3830	1161	rim -body	open vessel painted on its exterior	interior	rim	motif	different
Gap	Box, context No.	3664	1151	base	open vessel painted on its exterior	interior	bottom	design structure	insufficient data
Gap	Box, context No.	3838	1221	body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	3838		base	unpainted part of open vessel	interior	bottom	design structure	insufficient data
Gap	Box, context No.	3838		base	unpainted part of open vessel	interior	bottom	design structure	insufficient data
Gap	Box, context No.	3835	1211	rim -body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	3833	1146	body	open vessel painted on its exterior	interior	body	motif	insufficient data
Gap	Box, context No.	2859	1555	rim -body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	2816	R35	rim -body	open vessel painted on its exterior	interior	body	design structure	insufficient data
Gap	Box, context No.	2801		rim -body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	2640		base	open vessel painted on its interior	interior	bottom	design structure	insufficient data

Site	Reg No. (OIC collection of Bakun A), Publication Fig. No. (Bakun B, Gap), Box and context No. (Bakun B, Gap)			part	vessel form	preserved surface of imprint	location of imprint	stylistic component of imprint	motif-imprint relationship
Gap	Box, context No.	2657	319	body -base	open vessel painted on its interior	interior	body	design structure	insufficient data
Gap	Box, context No.	2692	254	rim -body	open vessel painted on its exterior	interior	body	motif, design structure	different
Gap	Box, context No.	2547	142	rim -body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	2549	156	rim -body	open vessel painted on its exterior	interior	rim	motif	different
Gap	Box, context No.	2551	168	body	open vessel painted on its exterior	interior	body	design structure	insufficient data
Gap	Box, context No.	2528	183	body	open vessel painted on its exterior	interior	body	motif, design structure	different
Gap	Box, context No.	2670	264	rim - body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	2678	301	rim	open vessel painted on its exterior	exterior	rim	design structure	insufficient data
Gap	Box, context No.	2566	136	body	open vessel painted on its exterior	interior	body	motif, design structure	similar
Gap	Box, context No.	2544	147	body	open vessel painted on its exterior	interior	body	motif	different
Gap	Box, context No.	4F	59	rim	open vessel painted on its exterior	interior	body	motif, design structure	different
Gap	Box, context No.	4F	311	rim - body	open vessel painted on its exterior	interior	body	motif, design structure	different
Gap	Box, context No.	3675	1093	body	open vessel painted on its exterior	interior	body	motif	similar
Gap	Box, context No.	3726	526	body - base	open vessel painted on its exterior	interior	body	motif, design structure	same
Gap	Box, context No.	2852	No. 45	base	open vessel painted on its exterior	interior	bottom	motif, design structure	similar
Gap	Box, context No.	2566	136	body	open vessel painted on its exterior	interior	body	motif	same
Gap	E & S 1962	28	2	rim - base	open vessel painted on its exterior	exterior	body	motif	different
Gap	E & S 1962	29	4	rim - body	open vessel painted on its exterior	interior	rim - body	motif, design structure	different
Gap	Nishiaki 2003	60		rim - base	open vessel painted on its exterior	exterior	body	motif	different

Table A5.8 List of published data used for skill score analysis of exterior-painted open vessels at Tall-e Bakun A, Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap. Abbreviations: p.:possibly, L & M 1942: Langsdorff and McCown 1942, E & M 1962: Egami and Masuda 1962, E 1977: Egami et al. 1977, o: present, x: absent, N: no data

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	Alizadeh 2006	24	B	conical bowl	cross-hatched	x	o	x	x	x	o	4	0	0.667
Bakun A	Alizadeh 2006	24	E	conical bowl	“white leaf”	x	x	x	x	x	x	6	0	1
Bakun A	Alizadeh 2006	24	F	conical bowl		N	N	x	N	N	x	2	4	1
Bakun A	Alizadeh 2006	24	G	conical bowl	“white leaf”	x	o	x	x	x	x	5	0	0.833
Bakun A	Alizadeh 2006	24	H	funnel-shaped vessel	“zigzags and boxes”	x	x	o	o	x	o	3	0	0.5
Bakun A	Alizadeh 2006	25	A	conical bowl	“big goat”, cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	Alizadeh 2006	25	C	conical bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	Alizadeh 2006	27	B	conical bowl	“big goat”	x	x	x	x	x	x	6	0	1
Bakun A	Alizadeh 2006	28	E	incurved bowl		x	o	x	x	x	x	5	0	0.833
Bakun A	Alizadeh 2006	28	G	deep bowl		o	N	x	x	x	x	4	1	0.8
Bakun A	Alizadeh 2006	30	E	beaker	cross-hatched	x	o	x	x	x	x	5	0	0.833
Bakun A	Alizadeh 2006	31	A	beaker	cross-hatched	x	o	x	x	x	x	5	0	0.833
Bakun A	Alizadeh 2006	32	D	beaker	“zigzags and zs”	x	x	x	N	N	x	4	2	1
Bakun A	Alizadeh 2006	34	E	beaker	“windmill”	x	x	x	x	N	o	4	1	0.8
Bakun A	Alizadeh 2006	35	B	shallow bowl		x	x	x	x	x	x	6	0	1
Bakun A	Alizadeh 2006	35	C	deep bowl		x	x	x	x	N	x	5	1	1
Bakun A	Alizadeh 2006	36	C	shallow bowl	“zigzags and boxes”	x	o	x	x	x	x	5	0	0.833
Bakun A	Alizadeh 2006	38	C	deep bowl		x	x	x	x	N	x	5	1	1
Bakun A	Alizadeh 2006	Pl.12	A	beaker	“zigzags and boxes”	o	o	x	x	o	o	2	0	0.333
Bakun A	Alizadeh 2006	Pl.12	B	conical bowl	“white leaf”	x	x	x	x	x	x	6	0	1
Bakun A	Alizadeh 2006	Pl.12	C	conical bowl		x	N	x	x	N	x	4	2	1
Bakun A	L & M 1942	1	8	deep bowl		x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	2	7	funnel-shaped vessel		x	N	x	x	N	x	4	2	1
Bakun A	L & M 1942	2	3	deep bowl	cross-hatched	x	x	x	x	o	x	5	0	0.833

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	L & M 1942	3	2	deep bowl		x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	3	3	shallow bowl		x	x	x	x	o	x	5	0	0.833
Bakun A	L & M 1942	3	4	deep bowl		x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	4	2	deep bowl		o	x	x	x	x	o	4	0	0.667
Bakun A	L & M 1942	4	5	deep bowl	“checkerboard”	o	x	x	x	x	o	4	0	0.667
Bakun A	L & M 1942	4	9	conical bowl	“big goat”	x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	4	10	conical bowl	“big goat”	N	x	N	x	N	x	3	3	1
Bakun A	L & M 1942	9	2	deep bowl	“windmill”	x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	9	4	deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	9	10	deep bowl	“windmill”	x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	9	13	shallow bowl	“windmill”	x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	11	7	hemispherical bowl		N	x	x	N	N	x	3	3	1
Bakun A	L & M 1942	11	8	hemispherical bowl		N	x	x	N	x	x	4	2	1
Bakun A	L & M 1942	11	10	deep bowl		x	o	x	x	x	x	5	0	0.833
Bakun A	L & M 1942	11	11	conical bowl	“big goat”, cross-hatched	x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	11	14	conical bowl	cross-hatched	x	o	x	x	x	x	5	0	0.833
Bakun A	L & M 1942	12	1	funnel-shaped vessel	“windmill”	x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	12	2	funnel-shaped vessel		x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	12	4	deep bowl		N	x	N	N	N	x	2	4	1
Bakun A	L & M 1942	15	8	beaker		x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	15	9	beaker	cross-hatched	x	x	o	x	o	o	3	0	0.5
Bakun A	L & M 1942	16	1	beaker	cross-hatched, “checker board”	x	o	o	x	x	x	4	0	0.667
Bakun A	L & M 1942	16	6	funnel-shaped vessel	“zigzags and boxes”	x	x	o	o	x	o	3	0	0.5
Bakun A	L & M 1942	16	8	deep bowl	“zigzags and boxes”	x	o	o	o	o	o	1	0	0.167
Bakun A	L & M 1942	16	10	funnel-shaped vessel		N	N	x	N	N	x	2	4	1
Bakun A	L & M 1942	17	12	conical bowl	“white leaf”	x	x	x	x	x	x	6	0	1

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	L & M 1942	22	19	deep bowl		N	N	x	N	N	x	2	4	1
Bakun A	L & M 1942	30	6	Hemispherical Bowl		N	x	x	N	N	x	3	3	1
Bakun A	L & M 1942	30	7	hemispherical bowl		N	x	x	N	N	x	3	3	1
Bakun A	L & M 1942	30	8	hemispherical bowl		N	x	N	N	N	x	2	4	1
Bakun A	L & M 1942	36	13	beaker	"zigzags and boxes"	x	o	x	o	x	o	3	0	0.5
Bakun A	L & M 1942	36	14	funnel-shaped vessel	"zigzags and boxes"	x	o	x	x	x	x	5	0	0.833
Bakun A	L & M 1942	38	5	deep bowl		N	x	x	x	N	x	4	2	1
Bakun A	L & M 1942	40	5	hemispherical bowl	cross-hatched	x	o	N	x	x	x	4	1	0.8
Bakun A	L & M 1942	43	9	hemispherical bowl		N	x	x	x	N	x	4	2	1
Bakun A	L & M 1942	50	15	conical bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	51	1	hemispherical bowl	zigzags	N	x	x	x	x	x	5	1	1
Bakun A	L & M 1942	62	1	conical bowl	"white leaf"	o	x	x	x	N	x	4	1	0.8
Bakun A	L & M 1942	69	18	conical bowl	"big goat", cross-hatched	x	o	x	x	x	x	5	0	0.833
Bakun A	L & M 1942	71	7	conical bowl	"big goat"	x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	76	19	hemispherical bowl		x	x	x	x	N	x	5	1	1
Bakun A	Herzfeld 1932	IV	3	hemispherical bowl	"windmill"	x	x	x	x	N	x	5	1	1
Bakun A	Herzfeld 1932	VI	2	hemispherical bowl		N	x	x	N	x	x	4	2	1
Bakun A	Herzfeld 1932	VI	5	hemispherical bowl		N	x	x	N	x	x	4	2	1
Bakun A	Herzfeld 1932	VI	6	hemispherical bowl		N	x	N	N	x	x	3	3	1
Bakun A	Herzfeld 1932	VIII	2	deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	Herzfeld 1932	X	3	deep bowl		x	x	x	x	N	x	5	1	1
Bakun A	Herzfeld 1932	XV	1	conical bowl		N	x	x	N	N	x	3	3	1
Bakun A	Herzfeld 1932	XV	2	conical bowl	"white leaf"	x	x	x	x	N	x	5	1	1
Bakun A	Herzfeld 1932	XVI	2	deep bowl		N	x	x	o	N	x	3	2	0.75
Bakun A	Alizadeh 2006	24	A	p. deep bowl		x	o	x	o	N	x	3	1	0.6
Bakun A	Alizadeh 2006	24	C	p. conical bowl	cross-hatched	x	o	x	x	x	x	5	0	0.833
Bakun A	Alizadeh 2006	24	D	p. conical bowl	"zigzags and boxes"	x	x	x	x	x	x	6	0	1

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	Alizadeh 2006	25	B	p. conical bowl	cross-hatched	×	×	×	N	×	×	5	1	1
Bakun A	Alizadeh 2006	25	D	p. conical bowl	"big goat"	×	×	×	×	×	×	6	0	1
Bakun A	Alizadeh 2006	27	A	p. conical bowl	"big goat"	×	×	×	o	N	×	4	1	0.8
Bakun A	Alizadeh 2006	28	D	p. deep bowl		×	o	×	N	N	×	3	2	0.75
Bakun A	Alizadeh 2006	29	E	p. deep bowl		N	N	×	N	×	×	3	3	1
Bakun A	Alizadeh 2006	30	A	p. deep bowl	cross-hatched	×	×	×	×	×	×	6	0	1
Bakun A	Alizadeh 2006	30	B	p. deep bowl		×	×	×	×	×	×	6	0	1
Bakun A	Alizadeh 2006	30	C	p. deep bowl	"zigzags and boxes"	o	o	×	o	×	×	3	0	0.5
Bakun A	Alizadeh 2006	30	D	p. deep bowl		×	N	×	×	N	×	4	2	1
Bakun A	Alizadeh 2006	31	D	p. deep bowl	"windmill"	×	×	×	×	N	×	5	1	1
Bakun A	Alizadeh 2006	32	A	p. beaker	"zigzags and zs"	N	×	N	N	N	×	2	4	1
Bakun A	Alizadeh 2006	32	B	p. beaker	"zigzags and zs"	N	×	N	N	N	×	2	4	1
Bakun A	Alizadeh 2006	32	C	p. beaker	"zigzags and zs"	N	×	N	N	N	×	2	4	1
Bakun A	Alizadeh 2006	33	A	p. beaker		o	o	×	N	N	×	2	2	0.5
Bakun A	Alizadeh 2006	33	B	p. beaker		×	×	×	N	N	×	4	2	1
Bakun A	Alizadeh 2006	33	C	p. beaker	"zigzags and zs"	N	×	N	N	N	×	2	4	1
Bakun A	Alizadeh 2006	33	D	p. beaker		×	×	×	N	N	×	4	2	1
Bakun A	Alizadeh 2006	33	E	p. beaker		o	×	×	×	×	×	5	0	0.833
Bakun A	Alizadeh 2006	34	B	p. beaker		×	×	×	×	N	×	5	1	1
Bakun A	Alizadeh 2006	34	C	p. deep bowl	cross-hatched	×	o	×	×	×	×	5	0	0.833
Bakun A	Alizadeh 2006	34	D	p. deep bowl	"windmill"	×	o	×	×	N	×	4	1	0.8
Bakun A	Alizadeh 2006	35	A	p. deep bowl	"windmill"	o	×	×	×	N	×	4	1	0.8
Bakun A	Alizadeh 2006	35	D	p. deep bowl	cross-hatched	×	×	×	×	×	×	6	0	1
Bakun A	Alizadeh 2006	35	E	p. deep bowl	zigzags	N	o	×	×	×	×	4	1	0.8
Bakun A	Alizadeh 2006	36	A	p. shallow bowl	cross-hatched	×	o	×	×	×	×	5	0	0.833
Bakun A	Alizadeh 2006	36	B	p. deep bowl	cross-hatched	N	o	×	×	×	×	4	1	0.8
Bakun A	Alizadeh 2006	37	A	barre-shaped vessel		×	×	×	×	×	×	6	0	1

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	Alizadeh 2006	38	A	p. deep bowl		x	x	x	N	N	x	4	2	1
Bakun A	Alizadeh 2006	39	A	p. beaker		N	N	N	N	N	x	1	5	1
Bakun A	Alizadeh 2006	40		p. incurved rim bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	Alizadeh 2006	42	F	p. incurved rim bowl		x	x	x	x	N	x	5	1	1
Bakun A	Alizadeh 2006	Pl.13	D	hemispherical bowl		N	x	x	N	x	x	4	2	1
Bakun A	Alizadeh 2006	Pl.13	E	p. hemispherical bowl		N	x	x	N	x	x	4	2	1
Bakun A	L & M 1942	3	5	p. deep bowl		x	x	N	N	N	x	3	3	1
Bakun A	L & M 1942	3	10	p. hemispherical bowl		N	x	N	N	N	x	2	4	1
Bakun A	L & M 1942	4	8	p. deep bowl		x	N	x	x	x	x	5	1	1
Bakun A	L & M 1942	23	3	p. beaker		N	o	N	o	N	x	1	3	0.333
Bakun A	L & M 1942	24	1	p. beaker		N	x	N	N	N	x	2	4	1
Bakun A	L & M 1942	26	8	p. beaker		N	o	x	x	x	x	4	1	0.8
Bakun A	L & M 1942	28	2	p. hemispherical bowl		N	x	x	x	N	x	4	2	1
Bakun A	L & M 1942	28	4	p. deep bowl		N	N	N	N	N	N	0	6	
Bakun A	L & M 1942	32	2	p. deep bowl	zigzags	o	x	x	x	x	x	5	0	0.833
Bakun A	L & M 1942	32	12	p. shallow bowl		N	x	x	o	x	x	4	1	0.8
Bakun A	L & M 1942	32	13	p. deep bowl		x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	34	1	p. deep bowl		x	o	x	x	x	x	5	0	0.833
Bakun A	L & M 1942	34	9	p. incurved rim bowl	zigzags	x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	35	10	p. deep bowl		x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	38	2	p. deep bowl		N	x	N	x	x	x	4	2	1
Bakun A	L & M 1942	38	3	p. deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.833
Bakun A	L & M 1942	39	4	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	39	6	p. deep bowl	zigzags	N	o	x	N	x	x	3	2	0.75
Bakun A	L & M 1942	41	14	p. hemispherical bowl		x	x	x	x	N	x	5	1	1

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	L & M 1942	43	1	p. deep bowl		x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	46	1	beaker?		N	x	x	N	x	x	4	2	1
Bakun A	L & M 1942	46	6	beaker?		N	o	x	x	N	x	3	2	0.75
Bakun A	L & M 1942	50	12	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	52	12	p. hemispherical bowl	zigzags	N	o	N	N	x	x	2	3	0.667
Bakun A	L & M 1942	53	1	p. shallow bowl		x	N	x	x	N	x	4	2	1
Bakun A	L & M 1942	53	14	p. deep bowl	"checker board"	x	N	x	x	N	x	4	2	1
Bakun A	L & M 1942	54	15	p. beaker	"windmill"	x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	55	5	p. deep bowl		x	x	x	N	N	x	4	2	1
Bakun A	L & M 1942	57	12	p. incurved rim bowl		x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	58	5	p. deep bowl		x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	59	10	p. deep bowl		x	N	x	x	N	x	4	2	1
Bakun A	L & M 1942	60	1	p. deep bowl		x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	60	2	p. deep bowl		o	x	x	x	N	x	4	1	0.8
Bakun A	L & M 1942	60	13	p. deep bowl	cross-hatched	N	x	N	N	o	x	2	3	0.667
Bakun A	L & M 1942	61	1	p. deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.833
Bakun A	L & M 1942	61	2	p. deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.833
Bakun A	L & M 1942	61	9	p. deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.833
Bakun A	L & M 1942	63	7	p. deep bowl	"white leaf"	x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	64	9	p. deep bowl	"white leaf"	o	x	x	x	o	x	4	0	0.667
Bakun A	L & M 1942	65	9	p. deep bowl	"white leaf"	x	x	x	x	N	x	5	1	1
Bakun A	L & M 1942	66	2	p. deep bowl		o	x	o	x	x	x	4	0	0.667
Bakun A	L & M 1942	67	3	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	67	11	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	67	13	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	68	11	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	L & M 1942	71	11	p. hemispherical bowl		N	x	x	x	x	x	5	1	1
Bakun A	L & M 1942	71	15	p. conical bowl	"big goat"	x	x	x	N	N	x	4	2	1
Bakun A	L & M 1942	73	17	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	L & M 1942	74	3	p. shallow bowl		N	o	x	N	N	x	2	3	0.667
Bakun A	L & M 1942	75	6	p. deep bowl		x	o	x	x	N	x	4	1	0.8
Bakun A	L & M 1942	75	12	p. deep bowl		N	N	N	N	N	N	0	6	
Bakun A	L & M 1942	76	16	p. beaker	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	Herzfeld 1932	I	2	p. deep bowl	"checkerboard"	x	x	x	x	o	x	5	0	0.833
Bakun A	Herzfeld 1932	I	3	p. deep bowl	"checkerboard"	o	N	x	o	x	x	3	1	0.6
Bakun A	Herzfeld 1932	I	4	p. deep bowl	"checkerboard"	x	N	x	x	x	o	4	1	0.8
Bakun A	Herzfeld 1932	II	1	p. deep bowl	"windmill"	x	N	x	x	N	x	4	2	1
Bakun A	Herzfeld 1932	II	2	p. deep bowl	"windmill"	x	N	x	x	N	x	4	2	1
Bakun A	Herzfeld 1932	II	3	p. deep bowl	"windmill"	x	N	x	x	N	x	4	2	1
Bakun A	Herzfeld 1932	II	4	p. deep bowl	"white leaf"	x	N	x	N	N	x	3	3	1
Bakun A	Herzfeld 1932	III	1	p. deep bowl	"white leaf"	x	N	x	x	N	x	4	2	1
Bakun A	Herzfeld 1932	III	2	p. deep bowl	"white leaf"	x	N	x	x	N	x	4	2	1
Bakun A	Herzfeld 1932	III	3	p. deep bowl	"white leaf"	x	N	x	x	N	x	4	2	1
Bakun A	Herzfeld 1932	IV	1	p. hemispherical bowl		N	N	N	N	N	N	0	6	
Bakun A	Herzfeld 1932	IV	2	p. deep bowl	cross-hatched	N	x	x	N	x	x	4	2	1
Bakun A	Herzfeld 1932	IV	4	p. shallow bowl	"windmill"	x	N	x	x	N	x	4	2	1
Bakun A	Herzfeld 1932	IV	5	p. deep bowl		N	x	N	N	N	x	2	4	1
Bakun A	Herzfeld 1932	IV	6	p. deep bowl		N	x	N	N	N	x	2	4	1
Bakun A	Herzfeld 1932	V	2	p. deep bowl		x	x	x	x	N	x	5	1	1
Bakun A	Herzfeld 1932	V	3	p. hemispherical bowl		x	N	x	x	N	x	4	2	1
Bakun A	Herzfeld 1932	V	4	p. deep bowl		x	x	x	x	o	x	5	0	0.833
Bakun A	Herzfeld 1932	VI	1	p. hemispherical bowl		N	N	N	N	N	N	0	6	

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	Herzfeld 1932	VII	5	p. deep bowl		x	x	x	x	N	x	5	1	1
Bakun A	Herzfeld 1932	VIII	3	p. deep bowl		x	x	x	x	N	x	5	1	1
Bakun A	Herzfeld 1932	IX	2	p. deep bowl		x	x	x	o	o	x	4	0	0.667
Bakun A	Herzfeld 1932	IX	3	p. deep bowl	zigzags	x	x	x	x	x	x	6	0	1
Bakun A	Herzfeld 1932	X	4	p. deep bowl	zigzags	x	x	x	x	x	x	6	0	1
Bakun A	Herzfeld 1932	X	5	p. deep bowl	zigzags	x	x	x	x	o	x	5	0	0.833
Bakun A	Herzfeld 1932	X	6	p. deep bowl	zigzags	x	x	x	x	x	x	6	0	1
Bakun A	Herzfeld 1932	X	8	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	Herzfeld 1932	XI	1	p. deep bowl	cross-hatched, "checker board"	x	x	x	o	o	x	4	0	0.667
Bakun A	Herzfeld 1932	XI	2	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	Herzfeld 1932	XI	3	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	Herzfeld 1932	XII	1	p. conical bowl	cross-hatched	x	o	x	x	x	x	5	0	0.833
Bakun A	Herzfeld 1932	XII	2	p. hemispherical bowl		N	x	N	N	x	x	3	3	1
Bakun A	Herzfeld 1932	XII	4	p. hemispherical bowl		N	x	N	N	N	x	2	4	1
Bakun A	Herzfeld 1932	XII	5	p. hemispherical bowl		N	x	N	N	N	x	2	4	1
Bakun A	Herzfeld 1932	XIII	1	p. deep bowl		N	x	x	N	x	x	4	2	1
Bakun A	Herzfeld 1932	XIII	2	p. deep bowl		x	N	x	N	N	x	3	3	1
Bakun A	Herzfeld 1932	XIV	4	p. deep bowl		o	o	x	o	N	x	2	1	0.4
Bakun A	Herzfeld 1932	XIV	5	p. deep bowl		x	x	x	x	o	x	5	0	0.833
Bakun A	Herzfeld 1932	XV	3	p. conical bowl	"big goat", cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	Herzfeld 1932	XVI	1	p. beaker		N	o	N	N	N	x	1	4	0.5
Bakun A	Herzfeld 1932	XVI	4	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1
Bakun A	Herzfeld 1932	XVI	5	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	Herzfeld 1932	8	12	p. deep bowl	“zigzags and boxes”	x	o	x	x	x	x	5	0	0.833
Jari A	E 1977	III	11	p. deep bowl	cross-hatched	o	o	x	x	o	x	3	0	0.50
Jari A	Catalogue	6.1	1	p. deep bowl		o	x	o	x	o	x	3	0	0.50
Jari A	Catalogue	6.1	2	deep bowl	cross-hatched	x	o	o	x	x	x	4	0	0.67
Jari A	Catalogue	6.1	3	p. deep bowl	cross-hatched	N	o	x	N	x	x	3	2	0.75
Jari A	Catalogue	6.1	4	p. deep bowl		o	o	x	x	x	x	4	0	0.67
Jari A	Catalogue	6.6	1	p. deep bowl	cross-hatched	o	o	x	x	x	x	4	0	0.67
Jari A	Catalogue	6.6	2	p. deep bowl		x	x	x	o	o	x	4	0	0.67
Jari A	Catalogue	6.6	3	p. deep bowl		N	o	x	N	x	x	3	2	0.75
Jari A	Catalogue	6.7	1	p. deep bowl	cross-hatched	o	o	o	x	o	x	2	0	0.33
Jari A	Catalogue	6.7	2	p. deep bowl		N	x	N	N	o	x	2	3	0.67
Jari A	Catalogue	6.7	3	p. deep bowl		N	N	x	o	N	x	2	3	0.67
Jari A	Catalogue	6.7	4	p. deep bowl		o	o	o	x	N	x	2	1	0.40
Jari A	Catalogue	6.7	5	shallow bowl	cross-hatched	N	o	x	N	o	x	2	2	0.50
Jari A	Catalogue	6.8	2	p. deep bowl	cross-hatched	o	x	o	o	x	x	3	0	0.50
Jari A	Catalogue	6.8	4	p. deep bowl	cross-hatched	x	x	o	x	o	x	4	0	0.67
Bakun B	McCown 1942	13	203	p. deep bowl	cross-hatched	x	o	o	x	o	x	3	0	0.50
Bakun B	Alizadeh 2006	23	B	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Bakun B	Alizadeh 2006	23	F	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Bakun B	Alizadeh 2006	23	H	p. deep bowl		x	N	N	N	N	o	1	4	0.50
Bakun B	Alizadeh 2006	23	J	p. deep bowl		x	N	o	o	N	x	2	2	0.50
Bakun B	Alizadeh 2006	23	M	p. deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.83
Bakun B	Alizadeh 2006	23	N	p. deep bowl		x	o	x	o	x	x	4	0	0.67
Bakun B	Alizadeh 2006	23	O	p. deep bowl		x	N	x	N	N	x	3	3	1.00
Bakun B	Alizadeh 2006	23	S	p. deep bowl		x	N	x	x	N	x	4	2	1.00
Bakun B	Alizadeh 2006	23	W	p. deep bowl		o	o	o	N	x	x	2	1	0.40
Bakun B	Alizadeh 2006	23	X	p. deep bowl		x	x	x	o	N	x	4	1	0.80

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun B	Alizadeh 2006	23	DD	p. deep bowl		x	o	x	N	N	x	3	2	0.75
Bakun B	E & M 1962	14	1	p. deep bowl		x	x	x	x	N	x	5	1	1.00
Bakun B	E & M 1962	14	2	p. deep bowl		x	x	x	x	x	x	6	0	1.00
Bakun B	E & M 1962	14	3	p. deep bowl		x	o	x	x	N	x	4	1	0.80
Bakun B	E & M 1962	14	5	p. deep bowl		x	x	x	x	N	x	5	1	1.00
Bakun B	E & M 1962	14	6	p. deep bowl		x	x	x	x	x	x	6	0	1.00
Bakun B	E & M 1962	14	8	p. deep bowl		x	x	x	x	N	x	5	1	1.00
Bakun B	E & M 1962	14	9	p. deep bowl	cross-hatched	N	x	x	N	x	x	4	2	1.00
Bakun B	E & M 1962	14	11	p. deep bowl		x	N	x	x	o	x	4	1	0.80
Bakun B	E & M 1962	14	14	p. deep bowl		x	x	x	x	N	x	5	1	1.00
Bakun B	E & M 1962	14	21	p. deep bowl		x	x	x	x	N	x	5	1	1.00
Bakun B	E & M 1962	15	1	p. deep bowl		N	x	x	N	o	x	3	2	0.75
Bakun B	E & M 1962	15	2	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Bakun B	E & M 1962	15	5	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Bakun B	E & M 1962	15	7	p. deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.83
Bakun B	E & M 1962	15	8	p. deep bowl		x	x	x	N	x	x	5	1	1.00
Bakun B	E & M 1962	15	9	p. deep bowl		x	x	x	x	N	x	5	1	1.00
Bakun B	E & M 1962	15	10	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Bakun B	E & M 1962	15	11	p. deep bowl	cross-hatched	x	o	x	x	o	x	4	0	0.67
Bakun B	E & M 1962	15	13	p. deep bowl		x	x	x	x	x	x	6	0	1.00
Bakun B	E & M 1962	15	15	p. deep bowl	cross-hatched	o	x	x	N	x	x	4	1	0.80
Gap	E & S 1962	12	1	beaker		x	N	x	N	N	x	3	3	1.00
Gap	E & S 1962	12	3	shallow bowl		x	N	x	N	N	x	3	3	1.00
Gap	E & S 1962	12	5	beaker	zigzag	x	x	x	x	o	o	4	0	0.67
Gap	E & S 1962	13	1	deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	13	3	deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	13	4	deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.83

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Gap	E & S 1962	15	6	hemispherical bowl	zigzag	x	x	x	o	o	o	3	0	0.50
Gap	E & S 1962	15	10	beaker		N	o	x	x	x	x	4	1	0.80
Gap	E & S 1962	15	11	deep bowl		N	o	x	x	N	x	3	2	0.75
Gap	E & S 1962	16	1	deep bowl	zigzag	x	o	x	x	x	x	5	0	0.83
Gap	E & S 1962	16	2	deep bowl	zigzag	x	o	x	x	x	x	5	0	0.83
Gap	E & S 1962	16	3	deep bowl	zigzag	x	o	N	o	x	o	2	1	0.40
Gap	E & S 1962	17	3	deep bowl		o	x	x	x	N	x	4	1	0.80
Gap	E & S 1962	17	6	deep bowl		x	x	x	N	N	x	4	2	1.00
Gap	E & S 1962	17	8	deep bowl		x	x	x	x	N	x	5	1	1.00
Gap	E & S 1962	17	10	deep bowl		x	o	x	x	N	x	4	1	0.80
Gap	E & S 1962	18	3	incurved rim bowl		x	x	x	o	N	x	4	1	0.80
Gap	E & S 1962	19	1	deep bowl		x	x	x	N	x	x	5	1	1.00
Gap	E & S 1962	19	2	deep bowl		x	N	x	x	N	x	4	2	1.00
Gap	E & S 1962	20	3	deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	20	5	deep bowl	cross-hatched	N	x	x	N	x	x	4	2	1.00
Gap	E & S 1962	20	6	deep bowl	cross-hatched	x	x	x	N	x	x	5	1	1.00
Gap	E & S 1962	21	2	deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.83
Gap	E & S 1962	22	7	deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	24	1	deep bowl		x	x	x	x	N	x	5	1	1.00
Gap	E & S 1962	24	3	deep bowl		x	x	x	x	N	x	5	1	1.00
Gap	E & S 1962	24	4	deep bowl		x	x	x	x	N	x	5	1	1.00
Gap	E & S 1962	12	6	p. beaker	zigzag	x	x	x	x	N	x	5	1	1.00
Gap	E & S 1962	13	5	p. beaker		x	x	x	x	N	x	5	1	1.00
Gap	E & S 1962	13	6	p. beaker		x	x	x	o	N	o	3	1	0.60
Gap	E & S 1962	13	7	p. incurved rim bowl		x	x	x	o	N	x	4	1	0.80
Gap	E & S 1962	14	4	p. deep bowl		x	N	x	N	N	x	3	3	1.00
Gap	E & S 1962	14	5	p. deep bowl		x	N	x	x	N	x	4	2	1.00

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Gap	E & S 1962	16	7	p. beaker	zigzag	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	18	6	p. deep bowl		x	N	x	N	N	x	3	3	1.00
Gap	E & S 1962	19	3	p. beaker		x	o	x	o	N	x	3	1	0.60
Gap	E & S 1962	19	4	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	19	6	p. deep bowl		x	x	x	x	N	x	5	1	1.00
Gap	E & S 1962	19	7	p. beaker		x	x	x	x	N	x	5	1	1.00
Gap	E & S 1962	19	8	p. beaker		x	x	x	x	N	x	5	1	1.00
Gap	E & S 1962	20	1	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	20	2	p. deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.83
Gap	E & S 1962	20	7	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	20	8	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	20	12	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	21	1	p. deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.83
Gap	E & S 1962	21	3	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	21	4	p. shallow bowl	cross-hatched	x	x	N	x	o	x	4	1	0.80
Gap	E & S 1962	21	5	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	21	6	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	21	7	p. deep bowl	cross-hatched	x	x	x	x	o	x	5	0	0.83
Gap	E & S 1962	21	8	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	E & S 1962	21	9	p. beaker	cross-hatched	x	o	x	N	x	x	4	1	0.80
Gap	E & S 1962	21	12	p. deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.83
Gap	E & S 1962	22	3	p. beaker		x	o	x	x	x	x	5	0	0.83
Gap	E & S 1962	22	4	p. deep bowl		o	x	x	o	N	x	3	1	0.60
Gap	E & S 1962	22	5	p. deep bowl		x	x	x	x	o	x	5	0	0.83
Gap	E & S 1962	23	1	p. deep bowl		o	x	x	x	x	x	5	0	0.83
Gap	E & S 1962	24	5	p. deep bowl		x	x	x	x	N	x	5	1	1.00
Gap	E & S 1962	24	6	p. deep bowl		x	x	x	x	N	x	5	1	1.00

Site	Publication	Fig.	No.	complete vessel form	diagnostic motif	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Gap	E & S 1962	24	7	p. deep bowl		x	x	x	x	N	x	5	1	1.00
Gap	E & S 1962	24	8	p. deep bowl		x	x	x	o	N	x	4	1	0.80
Gap	Catalogue	29	3	p. deep bowl	zigzag	x	x	x	x	x	x	6	0	1.00
Gap	Catalogue	6.18	2	p. deep bowl	cross-hatched	x	x	o	x	o	x	4	0	0.67
Gap	Catalogue	6.18	5	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	Catalogue	6.18	3	p. deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	Catalogue	6.18	4	p. deep bowl	cross-hatched	x	o	x	x	x	x	5	0	0.83
Gap	Catalogue	6.27	1	p. deep bowl		x	x	x	x	N	x	5	1	1.00
Gap	Catalogue	6.27	2	p. deep bowl		x	x	o	o	o	x	3	0	0.50
Gap	Catalogue	6.28	3	p. deep bowl	cross-hatched	N	o	N	N	o	x	1	3	0.33
Gap	Catalogue	6.31	6	p. deep bowl		x	x	x	x	N	x	5	1	1.00
Gap	Nishiaki 2003	64	1	deep bowl	cross-hatched	x	x	x	x	o	x	5	0	0.83
Gap	Nishiaki 2003	66		deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	Nishiaki 2003	70	1	deep bowl	cross-hatched	x	x	x	x	x	x	6	0	1.00
Gap	Nishiaki 2003	73	1	deep bowl		N	x	N	N	N	N	1	5	1.00

Table A5.9 List of published data used for skill score analysis of interior-painted open vessels at Tall-e Bakun A, Tall-e Jari A, Tall-e Bakun B, and Tall-e Gap. Abbreviations: p.:possibly, L & M 1942: Langsdorff and McCown 1942, E & M 1962: Egami and Masuda 1962, E 1977: Egami et al. 1977, V. B. 1952: Vanden Berghe 1952, o: present, x: absent, N: no data

Site	Publication	Fig.	No.	complete vessel form	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	Alizadeh 2006	28	C	shallow bowl	x	N	x	x	x	x	5	1	1.00
Bakun A	Alizadeh 2006	35	B	shallow bowl	N	x	x	N	x	x	4	2	1.00
Bakun A	Alizadeh 2006	36	C	shallow bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	Alizadeh 2006	36	D	shallow bowl	N	o	x	N	x	x	3	2	0.75
Bakun A	Alizadeh 2006	55	F	miniature vessel	N	o	o	N	N	o	0	3	0.00
Bakun A	L & M 1942	2	3	deep bowl	N	x	x	N	x	x	4	2	1.00
Bakun A	L & M 1942	10	7	deep bowl	N	N	x	N	N	x	2	4	1.00
Bakun A	L & M 1942	10	9	hemispherical bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	L & M 1942	11	2	shallow bowl	N	o	x	N	N	o	1	3	0.33
Bakun A	L & M 1942	11	3	deep bowl	N	N	N	N	N	x	1	5	1.00
Bakun A	L & M 1942	11	4	shallow bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	L & M 1942	11	9	hemispherical bowl	x	o	N	N	N	x	2	3	0.67
Bakun A	L & M 1942	17	17	shallow bowl	N	o	o	N	N	x	1	3	0.33
Bakun A	L & M 1942	17	18	hemispherical bowl	x	o	N	o	N	N	1	3	0.33
Bakun A	Alizadeh 2006	24	A	p. deep bowl	x	x	x	N	N	x	4	2	1.00
Bakun A	Alizadeh 2006	24	C	p. conical bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	Alizadeh 2006	27	D	p. conical bowl	x	o	x	N	N	x	3	2	0.75
Bakun A	Alizadeh 2006	35	D	p. deep bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	Alizadeh 2006	36	A	p. deep bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	Alizadeh 2006	36	B	p. deep bowl	N	x	N	N	x	x	3	3	1.00
Bakun A	L & M 1942	2	4	p. shallow bowl	N	x	x	N	x	x	4	2	1.00
Bakun A	L & M 1942	2	8	shallow bowl	N	x	x	N	x	x	4	2	1.00
Bakun A	L & M 1942	3	1	p. shallow bowl	N	x	x	N	N	o	2	3	0.67

Site	Publication	Fig.	No.	complete vessel form	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	L & M 1942	9	12	shallow bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	L & M 1942	10	1	p. shallow bowl	N	N	N	N	N	N	0	6	unmeasurable
Bakun A	L & M 1942	10	3	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	L & M 1942	10	5	p. hemispherical bowl	x	N	x	o	N	o	2	2	0.50
Bakun A	L & M 1942	22	20	p. hemispherical bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	L & M 1942	27	15	p. hemispherical bowl	N	x	N	x	x	x	4	2	1.00
Bakun A	L & M 1942	28	9	p. hemispherical bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	L & M 1942	28	11	p. hemispherical bowl	x	x	x	x	x	x	6	0	1.00
Bakun A	L & M 1942	28	12	p. hemispherical bowl	N	o	x	N	x	x	3	2	0.75
Bakun A	L & M 1942	29	1	p. hemispherical bowl	N	N	N	N	N	N	0	6	unmeasurable
Bakun A	L & M 1942	29	2	p. hemispherical bowl	N	o	x	N	N	x	2	3	0.67
Bakun A	L & M 1942	29	6	p. hemispherical bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	L & M 1942	34	7	p. hemispherical bowl	x	x	N	N	x	x	4	2	1.00
Bakun A	L & M 1942	34	10	p. hemispherical bowl	x	x	x	x	o	x	5	0	0.83
Bakun A	L & M 1942	35	5	p. hemispherical bowl	x	o	N	x	x	x	4	1	0.80
Bakun A	L & M 1942	36	10	p. hemispherical bowl	x	x	x	x	x	x	6	0	1.00
Bakun A	L & M 1942	43	12	p. hemispherical bowl	N	o	x	N	N	x	2	3	0.67
Bakun A	L & M 1942	43	15	p. hemispherical bowl	x	x	N	x	N	x	4	2	1.00
Bakun A	L & M 1942	44	2	p. hemispherical bowl	N	o	x	N	N	x	2	3	0.67
Bakun A	L & M 1942	44	5	p. hemispherical bowl	N	x	N	N	N	x	2	4	1.00
Bakun A	L & M 1942	44	6	p. deep bowl	x	o	x	o	N	x	3	1	0.60
Bakun A	L & M 1942	46	15	p. shallow bowl	N	o	x	N	N	x	2	3	0.67
Bakun A	L & M 1942	47	5	p. shallow bowl	x	N	x	x	x	x	5	1	1.00
Bakun A	L & M 1942	47	14	p. deep bowl	x	o	x	N	x	x	4	1	0.80
Bakun A	L & M 1942	53	10	p. shallow bowl	o	x	x	o	x	x	4	0	0.67
Bakun A	E & M 1962	10	1	p. deep bowl	N	o	N	N	N	x	1	4	0.50
Bakun A	E & M 1962	10	2	p. deep bowl	N	x	N	N	o	x	2	3	0.67

Site	Publication	Fig.	No.	complete vessel form	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	E & M 1962	11	2	p. shallow bowl	N	N	x	N	N	x	2	4	1.00
Bakun A	E & M 1962	11	3	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Bakun A	E & M 1962	11	7	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Jari A	V. B. 1952	XLIX-L		shallow bowl with pedestal	x	x	x	x	x	x	6	0	1.00
Jari A	V. B. 1952	XLIX-L		shallow bowl	x	x	x	x	N	x	5	1	1.00
Jari A	E 1977	III	1	shallow bowl	N	x	x	N	x	x	4	2	1.00
Jari A	E 1977	III	2	p. shallow bowl	N	o	x	N	x	x	3	2	0.75
Jari A	E 1977	III	5	p. shallow bowl	N	x	o	o	x	x	3	1	0.60
Jari A	E 1977	III	7	p. shallow bowl	N	x	x	N	x	x	4	2	1.00
Jari A	E 1977	III	8	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Jari A	E 1977	III	12	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Jari A	Catalogue	6.3	1	p. shallow bowl	N	x	N	N	o	x	2	3	0.67
Jari A	Catalogue	6.3	2	p. shallow bowl	N	x	N	N	x	x	3	3	1.00
Jari A	Catalogue	6.3	3	p. shallow bowl	N	x	N	N	x	x	3	3	1.00
Jari A	Catalogue	6.4	1	p. shallow bowl	N	x	o	N	N	x	2	3	0.67
Jari A	Catalogue	6.4	2	p. shallow bowl	x	x	o	N	N	x	3	2	0.75
Jari A	Catalogue	6.4	3	p. shallow bowl	x	N	x	N	N	x	3	3	1.00
Jari A	Catalogue	6.4	5	p. shallow bowl	x	N	o	N	N	x	2	3	0.67
Jari A	Catalogue	6.9	1	p. shallow bowl	x	x	x	N	N	x	4	2	1.00
Jari A	Catalogue	6.9	2	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Jari A	Catalogue	6.9	3	p. shallow bowl	N	x	N	N	x	x	3	3	1.00
Jari A	Catalogue	6.9	4	p. shallow bowl	N	x	x	N	x	x	4	2	1.00
Jari A	Catalogue	6.9	5	p. shallow bowl	N	o	x	N	x	x	3	2	0.75
Jari A	Catalogue	6.9	6	p. shallow bowl	N	o	x	N	x	x	3	2	0.75
Jari A	Catalogue	6.9	7	p. shallow bowl	x	o	x	o	N	x	3	1	0.60
Bakun B	Alizadeh 2006	23	R	p. shallow bowl	N	N	x	x	N	x	3	3	1.00
Bakun B	E & M 1962	16	8	p. shallow bowl	N	o	x	N	N	x	2	3	0.67

Site	Publication	Fig.	No.	complete vessel form	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun B	E & M 1962	16	10	p. shallow bowl	x	o	x	x	N	x	4	1	0.80
Bakun B	E & M 1962	16	11	p. shallow bowl	N	N	N	N	N	x	1	5	1.00
Bakun B	E & M 1962	16	12	p. shallow bowl	x	x	x	N	x	x	5	1	1.00
Bakun B	E & M 1962	17	1	p. shallow bowl	N	o	x	N	o	x	2	2	0.50
Bakun B	E & M 1962	17	2	p. shallow bowl	N	N	x	N	N	x	2	4	1.00
Bakun B	E & M 1962	17	3	shallow bowl	N	N	N	N	x	x	2	4	1.00
Bakun B	E & M 1962	17	8	p. shallow bowl	x	x	x	x	x	x	6	0	1.00
Bakun B	E & M 1962	17	9	p. shallow bowl	N	o	N	N	x	x	2	3	0.67
Bakun B	E & M 1962	17	10	shallow bowl	x	N	x	N	N	x	3	3	1.00
Gap	E & S 1962	26	1	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	26	2	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	26	4	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	26	5	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	26	6	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	26	7	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	26	8	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	26	9	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	26	10	shallow bowl	N	x	x	N	N	o	2	3	0.67
Gap	E & S 1962	26	11	shallow bowl	N	o	x	N	N	x	2	3	0.67
Gap	E & S 1962	26	12	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	27	4	deep bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	28	1	deep bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	28	4	deep bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	29	1	deep bowl	N	o	x	N	N	x	2	3	0.67
Gap	E & S 1962	30	1	shallow bowl	N	o	x	N	N	x	2	3	0.67
Gap	E & S 1962	30	2	hemispherical bowl	x	x	o	x	N	x	4	1	0.80
Gap	E & S 1962	30	3	shallow bowl	N	o	x	N	N	x	2	3	0.67

Site	Publication	Fig.	No.	complete vessel form	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Gap	E & S 1962	30	4	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	30	5	shallow bowl	o	o	N	x	N	x	2	2	0.50
Gap	E & S 1962	31	1	shallow bowl	N	o	x	N	x	x	3	2	0.75
Gap	E & S 1962	31	4	shallow bowl	N	o	x	N	x	x	3	2	0.75
Gap	Catalogue	6.19	1	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	Catalogue	6.22	1	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	Nishiaki 2003	48	2	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	Nishiaki 2003	76	1	shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	12	2	p. shallow bowl	N	N	x	N	N	x	2	4	1.00
Gap	E & S 1962	12	4	p. shallow bowl	N	N	o	N	N	o	0	4	0.00
Gap	E & S 1962	15	4	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	26	3	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	26	13	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	27	1	p. shallow bowl	N	o	x	N	N	x	2	3	0.67
Gap	E & S 1962	27	2	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	27	3	p. deep bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	27	5	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	27	6	p. deep bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	27	7	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	27	8	p. deep bowl	N	x	N	N	N	x	2	4	1.00
Gap	E & S 1962	27	9	p. shallow bowl	N	N	x	N	x	x	3	3	1.00
Gap	E & S 1962	28	2	p. deep bowl	N	o	x	N	N	x	2	3	0.67
Gap	E & S 1962	28	3	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	28	5	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	28	6	p. deep bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	29	2	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	29	3	p. deep bowl	N	x	x	N	x	x	4	2	1.00

Site	Publication	Fig.	No.	complete vessel form	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Gap	E & S 1962	29	4	p. hemispherical bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	29	5	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	29	6	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	31	2	p. shallow bowl	x	o	x	x	x	x	5	0	0.83
Gap	E & S 1962	31	3	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	31	5	p. shallow bowl	N	o	x	N	N	x	2	3	0.67
Gap	E & S 1962	31	6	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	E & S 1962	36B	2	p. shallow bowl	N	x	x	x	N	x	4	2	1.00
Gap	Catalogue	6.23	1	p. deep bowl	N	N	x	N	N	x	2	4	1.00
Gap	Catalogue	6.19	4	p. shallow bowl	N	N	x	N	N	x	2	4	1.00
Gap	Catalogue	6.20	2	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	Catalogue	6.22	2	p. shallow bowl	N	x	x	N	x	x	4	2	1.00
Gap	Catalogue	6.22	4	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	Catalogue	6.20	4	p. deep bowl	N	x	x	N	N	x	3	3	1.00
Gap	Catalogue	6.20	1	p. shallow bowl	N	x	x	N	N	x	3	3	1.00
Gap	Catalogue	6.22	3	p. shallow bowl	N	o	x	N	o	x	2	2	0.50

Table A5.10 List of published data used for skill score analysis of closed vessels at Tall-e Bakun A. Abbreviations: L & M 1942: Langsdorff and McCown 1942, p.: possibly, o: present, x: absent, N: no data

Site	Publication	Fig.	No.	complete vessel form	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	Alizadeh 2006	39	D	small jar	N	x	x	x	x	x	5	1	1.00
Bakun A	Alizadeh 2006	41	E	large jar	x	x	x	x	x	x	6	0	1.00
Bakun A	Alizadeh 2006	42	C	large jar	x	x	x	x	x	x	6	0	1.00
Bakun A	Alizadeh 2006	42	E	large jar	N	x	x	x	N	o	3	2	0.75
Bakun A	Alizadeh 2006	42	G	large jar	N	N	N	N	N	x	1	5	1.00
Bakun A	L & M 1942	14	10	large jar	N	N	N	N	N	N	0	6	unmeasurable
Bakun A	L & M 1942	14	11	large jar	x	x	x	x	x	o	5	0	0.83
Bakun A	L & M 1942	14	13	large jar	x	o	x	o	N	x	3	1	0.60
Bakun A	L & M 1942	15	1	large jar	N	x	x	N	N	x	3	3	1.00
Bakun A	L & M 1942	15	3	large jar	x	x	x	x	N	x	5	1	1.00
Bakun A	L & M 1942	15	4	large jar	N	N	N	N	N	N	0	6	unmeasurable
Bakun A	L & M 1942	12	13	small jar	x	x	x	x	x	x	6	0	1.00
Bakun A	L & M 1942	13	7	small jar	N	x	N	N	N	x	2	4	1.00
Bakun A	L & M 1942	13	19	small jar	x	o	x	x	x	x	5	0	0.83
Bakun A	L & M 1942	14	6	small jar	x	x	x	x	N	x	5	1	1.00
Bakun A	L & M 1942	14	7	small jar	N	N	x	N	N	x	2	4	1.00
Bakun A	L & M 1942	14	9	small jar	N	N	N	N	N	N	0	6	unmeasurable
Bakun A	E & M 1962	6	1	large jar	x	N	x	N	N	x	3	3	1.00
Bakun A	E & M 1962	6	2	large jar	N	N	x	N	N	o	1	4	0.50
Bakun A	L & M 1942	31	1	large jar	x	x	x	N	x	o	4	1	0.80
Bakun A	Alizadeh 2006	39	C	p. large jar	x	o	x	o	x	o	3	0	0.50
Bakun A	Alizadeh 2006	39	E	p. large jar	N	x	x	x	N	x	4	2	1.00
Bakun A	Alizadeh 2006	39	F	p. large jar	x	x	x	x	N	x	5	1	1.00
Bakun A	Alizadeh 2006	41	A	p. large jar	x	o	x	x	N	x	4	1	0.80
Bakun A	Alizadeh 2006	41	C	p. large jar	N	o	x	x	N	x	3	2	0.75
Bakun A	Alizadeh 2006	41	D	p. large jar	x	o	x	x	N	x	4	1	0.80
Bakun A	Alizadeh 2006	42	D	p. small jar	x	x	x	x	x	x	6	0	1.00
Bakun A	Alizadeh 2006	43	A	p. small jar	x	x	x	x	N	x	5	1	1.00
Bakun A	Alizadeh 2006	43	B	p. small jar	x	x	x	x	N	x	5	1	1.00
Bakun A	L & M 1942	3	9	p. large jar	x	o	x	x	N	x	4	1	0.80
Bakun A	L & M 1942	4	1	p. large jar	x	x	x	x	N	o	4	1	0.80
Bakun A	L & M 1942	4	7	p. small jar	x	x	x	x	N	x	5	1	1.00
Bakun A	L & M 1942	5	1	large jar	N	x	x	x	N	x	4	2	1.00
Bakun A	L & M 1942	5	2	small jar	x	o	x	o	N	x	3	1	0.60
Bakun A	L & M 1942	13	3	small jar	o	o	o	o	N	x	1	1	0.20
Bakun A	L & M 1942	22	12	p. small jar	x	N	x	x	N	x	4	2	1.00
Bakun A	L & M 1942	24	12	large jar	x	o	o	x	N	o	2	1	0.40
Bakun A	L & M 1942	31	2	large jar	x	x	x	x	N	x	5	1	1.00

Site	Publication	Fig.	No.	complete vessel form	VD1	VD2	VD3	VD4	VD5	VD6	Skill point	Number of N	Skill score
Bakun A	L & M 1942	31	5	large jar	x	N	o	x	N	x	3	2	0.75
Bakun A	L & M 1942	53	8	p. small jar	x	o	x	x	x	x	5	0	0.83
Bakun A	L & M 1942	54	6	small jar	o	o	x	x	N	x	3	1	0.60
Bakun A	L & M 1942	58	2	p. small jar	x	x	x	x	N	x	5	1	1.00
Bakun A	L & M 1942	58	4	small jar	o	N	N	x	N	N	1	4	0.50
Bakun A	L & M 1942	58	11	p. small jar	N	o	x	N	N	x	2	3	0.67
Bakun A	L & M 1942	61	12	small jar	N	x	x	N	N	x	3	3	1.00

Table A6.1 List of samples for thin-section petrography and geochemical analysis

Sample No.	site	trench	stratigraphy	ware	part	vessel form	weight (g)
GF001	Tall-e Gap	GAT-1	Level 2	BOBW	rim	open vessel painted on its exterior	2.7
GF002	Tall-e Gap	GAT-1	Level 14a	BOBW	body	unpainted part of open vessel	8.3
GF003	Tall-e Gap	GAT-1	Level 16	BOBW	body	open vessel painted on its interior	4.1
GC004	Tall-e Gap	GAT-1	Level 16	VCW	body	unknown	15.4
GC005	Tall-e Gap	GAT-1	Level 7	MCW	body	unknown	24.9
GF006	Tall-e Gap	GAT-1	Level 1	BOBW	body	open vessel painted on its interior	2.36
GF007	Tall-e Gap	GAT-1	Level 4	BOBW	body	large jar	16.94
GF008	Tall-e Gap	GAT-1	Level 6	BOBW	body	open vessel painted on its interior	8.92
GF009	Tall-e Gap	GAT-1	Level 17	BOBW	body	large jar	29.58
GF010	Tall-e Gap	GAT-1	Level 17	BOBW	body	open vessel painted on its interior	14.89
GC011	Tall-e Gap	GAT-1	Level 5a	MCW	body	unknown	13.22
GC012	Tall-e Gap	GAT-1	Level 14b	VCW	body	unknown	37.93
RF001	Rahmatabad	Trench H	8001	BOBW	body	open vessel painted on its exterior	9.31
RF002	Rahmatabad	Trench H	8007	BOBW	body	open vessel painted on its exterior	15.3
RF003	Rahmatabad	Trench H	8006	BOBW	body	open vessel painted on its interior	12.31
RF004	Rahmatabad	Trench H	8016	BOBW	body	open vessel painted on its exterior	12.04
RF005	Rahmatabad	Trench H	8017	BOBW	body	open vessel painted on its exterior	23.94
RF006	Rahmatabad	Trench H	8015	BOBW	body	open vessel painted on its exterior	16.91
RF007	Rahmatabad	Trench H	8019	BOBW	rim	open vessel painted on its rim	3.93
RF008	Rahmatabad	Trench H	8023	BOBW	body	open vessel painted on its exterior	6.92
RF009	Rahmatabad	Trench H	8028	BOBW	body	open vessel painted on its interior	12.57
RF010	Rahmatabad	Trench H	8032	BOBW	body	open vessel painted on its interior	13.86
RC011	Rahmatabad	Trench H	8019	VCW	body	unknown	16.36
RC012	Rahmatabad	Trench H	8023	VCW	body	unknown	73.19
JF001	Tall-e Jari A	excavation trench C	Layer 1	BOBW	body	open vessel painted on its exterior	11.08
JF002	Tall-e Jari A	excavation trench C	Layer 1	BOBW	body	unpainted part of open vessel	6.4
JC003	Tall-e Jari A	excavation trench C	Layer 1	VCW	body	unknown	17.19

Sample No.	site	trench	stratigraphy	ware	part	vessel form	weight (g)
JF004	Tall-e Jari A	excavation trench C	Layer 2	BOBW	body	unpainted part of open vessel	8.16
JF005	Tall-e Jari A	excavation trench C	Layer 2	BOBW	base	unpainted part of open vessel	24.26
JC006	Tall-e Jari A	excavation trench C	Layer 2	VCW	body	unknown	21.4
JF007	Tall-e Jari A	excavation trench C	Layer 3	BOBW	body	unpainted part of open vessel	6.19
JF008	Tall-e Jari A	excavation trench C	Layer 3	BOBW	body	unpainted part of open vessel	9.67
JC009	Tall-e Jari A	excavation trench C	Layer 3	VCW	body	unknown	16.54
JF010	Tall-e Jari A	excavation trench C	Layer 4	BOBW	body	unpainted part of open vessel	10.2
JF011	Tall-e Jari A	excavation trench C	Layer 4	BOBW	body	unpainted part of open vessel	10.02
JC012	Tall-e Jari A	excavation trench C	Layer 4	VCW	rim	open vessel	33.91
BF001	Tall-e Bakun B	Masuda's trench	BII of McCown	BOBW	body	open vessel painted on its interior	16.15
BF002	Tall-e Bakun B	Masuda's trench	BII of McCown	BOBW	body	unpainted part of open vessel	18.18
BF003	Tall-e Bakun B	Masuda's trench	BII of McCown	BOBW	body	unpainted part of open vessel	14.15
BF004	Tall-e Bakun B	Masuda's trench	BII of McCown	BOBW	body	unpainted part of open vessel	20.19
BF005	Tall-e Bakun B	Masuda's trench	BII of McCown	BOBW	body	large jar	43.79
BF006	Tall-e Bakun B	Masuda's trench	BII of McCown	BOBW	body	unpainted part of open vessel	19.13
BF007	Tall-e Bakun B	Masuda's trench	BII of McCown	BOBW	body	unpainted part of open vessel	18.61
BF008	Tall-e Bakun B	Masuda's trench	BII of McCown	BOBW	rim	open vessel painted on its interior	12.11
BC009	Tall-e Bakun B	Masuda's trench	BII of McCown	VCW	body	unknown	24.48
BC010	Tall-e Bakun B	Masuda's trench	BII of McCown	VCW	body	unknown	33.42
BC011	Tall-e Bakun B	Masuda's trench	BI of McCown	VCW	body	unknown	27.31
BC012	Tall-e Bakun B	Masuda's trench	Unknown	VCW	body	unknown	27.29
AF001	Tall-e Bakun A	Masuda's trench	9/26.	BOBW	body	large jar	26.97
AF002	Tall-e Bakun A	Masuda's trench	9/26.	BOBW	body	open vessel painted on its exterior	32.87
AF003	Tall-e Bakun A	Masuda's trench	9/29.	BOBW	body	open vessel painted on its exterior	10.11
AF004	Tall-e Bakun A	Masuda's trench	9/26.	BOBW	body	open vessel painted on its exterior	18.01
AF005	Tall-e Bakun A	Masuda's trench	9/29.	BOBW	body	large jar	23.86
AF006	Tall-e Bakun A	Masuda's trench	unknown	BOBW	body	large jar	19.63
AF007	Tall-e Bakun A	Masuda's trench	Levels I-IV	BOBW	body	open vessel painted on its exterior	26.05

Sample No.	site	trench	stratigraphy	ware	part	vessel form	weight (g)
AF008	Tall-e Bakun A	Masuda's trench	9/29.	BOBW	body	misfired object	20.66
AC009	Tall-e Bakun A	Masuda's trench	unknown	MBOBW	body	large jar	42.09
AC010	Tall-e Bakun A	Masuda's trench	Levels I-IV	Burnt clay		unknown	20.01
AC011	Tall-e Bakun A	Masuda's trench	9/26.	VCW	body	unknown	25.37
AC012	Tall-e Bakun A	Masuda's trench	Levels I-III	MCW	body	unknown	44.63

Appendix A6.2: Petrographic descriptions of fabric types confirmed at five sites.

Fabric types confirmed at Tall-e Jari A

Fabric type A: fine-fabric of Black-on-buff ware
(Sample JF001, JF002, JF005, JF008, JF010)

Inclusions
3%. eq. sa.-sr. <0.2 mm. Open-spaced. Unimodal, well-sorted grain size distribution
Predominant: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Predominant: biotite, eq.-el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered? (only JF005). (turned brown possibly because of oxidization)

Matrix
92%. Calcareous. Homogeneous.
JF001, JF008: Light pale green in PPL, dark pale green in XP (x40).
JF002, JF005, JF010: Yellowish brown in PPL, dark brown in XP (x40) tiny black dots exist.

Voids
5%. Consisting mainly of Meso-elongate and Meso- equant Vugh.
JF001: 0.5 mm x 0.02 mm hair-like materials are present.
JF002: 0.5 mm x 0.01 mm vegetal temper can be seen (Rare).
JF010: Tiny chaff voids (0.4 x 0.02 mm) was confirmed.

Comments
This fabric is characterised by the fine calcareous matrix.
JF002: secondary calcite on the surface.

Fabric type D: Calcite included Medium Fabric of Black-on-buff ware
(Sample JF004)

Inclusions
15%? eq. sa.-sr. <0.2 mm. Open-spaced. Unimodal, well-sorted grain size distribution
Predominant: calcite; el. sa.-sr. <0.2 mm, mode=0.1 mm. sharp boundaries, high optical density, discordant
Predominant: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Frequent: muscovite; el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
few: biotite; el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?

Matrix
89%. Calcareous. Reddish brown (central) & yellowish brown (right & slip) in PPL, dark brown in XP (x40). Homogenous. Possible slip was observed.

Voids
5%. Consisting mainly of Meso-elongate and Meso- equant Vughs.

Comments
This fabric is characterised by the fine calcareous matrix with frequent inclusion of calcite.
Slip thickness: 0.5 mm.
No trace of secondary calcite surrounding voids.

Fabric type E: Organic material included Fine Fabric of Black-on-buff ware
(Sample JF007, JF011)

Inclusions
3% eq. sa.-sr. <0.5 mm. Open-spaced. Unimodal, well-sorted grain size distribution
Dominant: calcite; eq. sa.-sr. <0.5 mm, mode=0.2 mm (JF011).
Frequent: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Frequent: muscovite; el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered? (JF007)
Few: biotite; el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered? (JF011)

Matrix
Calcareous.
JF007: 92%. Light pale green in PPL, dark pale green in XP (JF007)(x40). Homogeneous. Tiny red particles exist. 0.6 mm Black Equant sub-rounded material filled with tiny rounded & clustered vesicles exists. It was likely to be caused from high temperature firing.
JF011: 86%. Yellowish brown in PPL, Dark brown in XP, and Dark brown in PPL in the lower part (x40). Heterogeneous. The dark material inside the clay was likely to be due to bad clay mixing.

Voids
5-6%. Consisting mainly of Meso-elongate and Meso- equant Vughs. 0.5 mm (mode) x 0.01 mm hair-like organic materials exist.

Comments
This fabric is characterised by the fine calcareous matrix with frequent organic inclusion. It is possible that hair-like organic materials were intentionally included.
Slip thickness: JF011: 0.3 mm.

H: Vegetal temper included Coarse Fabric of Vegetal tempered coarse ware
(Sample JC003, JC006, JC009, JC012)

Inclusions
4% eq. & el. a.-sr. <0.3 mm. Open-spaced. Unimodal, well-sorted grain size distribution.
Predominant: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Few: biotite; el. a.-sr. <0.2 mm, mode=0.1 mm. weathered?
few: calcite; eq. a.-sr. <0.3 mm, mode=0.1 mm. weathered?
Very few: muscovite; eq. a.-sr. <0.3 mm, mode=0.1 mm. weathered?

Matrix
73% (JC003, JC006), 76% (JC009, JC012). Calcareous. Yellowish brown in PPL, Dark brown in XP (x40). Heterogenous.
JC003, JC006, JC009: Yellowish brown (major) & Dark brown (minor) in PPL
JC012: Light brown (outside), Black (core) & Dark brown (core) in PPL.
Clay coating was invisible because of the same fabric as the main matrix.

Voids
23% (JC003, JC006), 20% (JC009, JC012).
JC003, JC006: Consisting mainly of Mega-Meso-elongate Channels – Vesicles <3.0 mm. mode= 1.0-1.5 mm.
JC009: Consisting mainly of Meso-elongate Channels – Vesicles <2.0 mm. mode= 1.0 mm. JC012: Consisting mainly of Meso-elongate Channels – Vesicles <5.0 mm. mode= 1.5 mm.

Comments
This fabric is characterised by coarse matrix with frequent vegetal temper.
JC003: secondary calcite in the voids. JC006: secondary calcite in the voids. JC009: secondary calcite in the voids. JC012: secondary calcite in the voids.

Fabric types confirmed at Tall-e Bakun B

A: Fine Fabric of Black-on-buff ware
(Sample BF001, BF002, BF003, BF004, BF005, BF006, BF007, BF008)

Inclusions
3%. eq. sa.-sr. <0.2 mm. Open-spaced. Unimodal, well-sorted grain size distribution
Predominant: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Frequent: biotite; el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Frequent: muscovite; el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?

Matrix
92%. Calcareous. Light pale green in PPL, dark pale green in XP (x40). Homogenous.
BF004: Heterogeneous as a result of clay mixing. Light pale green (right surface), dark pale green (core) in PPL Dark pale green in XP.
BF003: Tiny red particles exist. 0.6 mm Black Equant sub-rounded material filled with tiny rounded & clustered vesicles exists. It was likely to be caused from high temperature firing.

Voids
3~6%. Consisting mainly of Meso-elongate and Meso- equant Vugh. Trace of secondary calcite surrounding voids can sometimes be seen.
BF002: hair-like material exists.
BF007: tiny vegetal temper exists.

Comments
This fabric is characterised by the fine calcareous matrix.
Slip thickness BF004: 0.2 mm, BF005: 1 mm.
Paint thickness BF001: 0.25 mm, BF008: 0.02 mm.
BF002: secondary calcite on the surface, BF004: secondary calcite in the voids, BF005: secondary calcite in the voids, BF007: secondary calcite on the surface and in the voids, BF008: secondary calcite in the voids.

H: Vegetal temper included Coarse Fabric of Vegetal tempered coarse ware
(Sample BC009, BC010, BC011, BC012)

Inclusions
4% eq. & el. a.-sr. <0.3 mm. Open-spaced. Unimodal, well-sorted grain size distribution.
Predominant: muscovite; eq. a.-sr. <0.3 mm, mode=0.1 mm. weathered?
Few: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Few: biotite; el. a.-sr. <0.2 mm, mode=0.1 mm. weathered?

Matrix
75% (BC009), 76% (BC010), 86% (BC011), 84% (BC012). Calcareous. Yellowish brown in PPL, Dark brown in XP (x40). Homogenous. Clay coating was invisible because of the same fabric as the main matrix.

Voids
BC009: 21%. Consisting mainly of Mega-Meso-elongate Channels – Vesicles <3.0 mm. mode= 1.0~1.5 mm, thickness 0.1 mm. Vertically aligned.
BC010: 20%. Consisting mainly of Meso-elongate Channels – Vesicles <5.0 mm. mode= 1.0~1.5 mm, thickness 0.05 mm. Vertically aligned.
BC011: 10%. Consisting mainly of Mega-elongate Channels – Vesicles <10.0 mm. mode= 2.0 ~3.0 mm.
BC012: 12%. Consisting mainly of Meso—Mega elongate Channels – Vesicles <6.0 mm. mode= 1.0 ~1.5 mm. Thick one (0.5 mm) & thin one (0.1 mm).

Comments
This fabric is characterised by coarse matrix with frequent vegetal temper. The matrix does not show heterogeneity unlike the same fabric from the other sites.
BC009: secondary calcite in the voids. BC010: secondary calcite in the voids and on the surface.

Fabric types confirmed at Tall-e Gap

A: Fine Fabric of Black-on-buff ware
(Sample GF002, GF003, GF008, GF001, GF007)

Inclusions
3%. eq. sa.-sr. <0.2 mm. Open-spaced. Unimodal, well-sorted grain size distribution
Predominant: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Dominant: biotite; el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Common: red inclusions; el. sa.-sr. <0.2 mm, mode=0.1 mm. sharp boundaries, high optical density, discordant. Possibly weathered red siltstone.(GF007)

Matrix
92%. Calcareous. Light pale green in PPL, dark pale green in XP (x40). Homogenous. Tiny red particles exist.
GF007: Black Equant sub-rounded material filled with tiny rounded & clustered vesicles exists. It was likely to be caused from high temperature firing.

Voids
5%. Consisting mainly of Meso-elongate and Meso- equant Vugh.
GF007: 1.6 mm vegetal temper-derived voids & 0.02 mm tiny hair like voids.

Comments
This fabric is characterised by the fine calcareous matrix.
Slip thickness: GF001: 0.2 mm, GF002: 0.2 mm, GF007: 0.5 mm, GF008: 0.2 mm.
Paint thickness: GF001: 0.01 mm, GF007: 0.04 mm, GF008: 0.015 mm.
GF002: secondary calcite in the voids, GF007: secondary calcite in the voids, GF008: secondary calcite on the surface.

B: Red siltstone included Medium Fabric of Black-on-buff ware
(Sample GF009)

Inclusions
10% eq. sa.-sr. <0.3 mm. Open-spaced. Unimodal, well-sorted grain size distribution
Predominant: red siltstone al; eq. sa.-sr. <0.3 mm, mode=0.15 mm.
Frequent: quartz; el. sa.-sr. <0.4 mm, mode=0.2 mm. weathered?
Few: muscovite; el. sa.-sr. <0.4 mm, mode=0.2 mm. weathered?
Few: plagioclase; el. sa.-sr. <0.4 mm, mode=0.2 mm. weathered?

Matrix
82%. Calcareous. Brown in PPL, Dark brown in XP (x40). Homogenous. Possible slip (0.5 mm) is difficult to see because of same type as matrix.

Voids
8%. Consisting mainly of Meso-elongate and Meso- equant Vughs. No trace of secondary calcite surrounding voids.

Comments
This fabric is characterised by the fine calcareous matrix with frequent red siltstone.

C: Medium Fabric of Black-on-buff ware
(Sample GF010)

Inclusions
8% eq. sa.-sr. <0.2 mm. Open-spaced. Unimodal, well-sorted grain size distribution
Dominant: red siltstone; eq. sa.-sr. <0.3 mm, mode=0.15 mm.
Dominant: quartz; el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?

Matrix
84%. Calcareous. Pale green in PPL, Dark pale green in XP (x40). Homogenous. Slip is undistinguishable because of same type as matrix. Black Equant sub-rounded material filled with tiny rounded & clustered vesicles exists. It was likely to be caused from high temperature firing.

Voids
8%. Consisting mainly of Meso-elongate and Meso- equant Vughs. Rarely tiny hair like voids appear.

Comments
This fabric is characterised by the medium calcareous matrix.
Trace of secondary calcite surrounding voids was observed.
Paint thickness: 0.03 mm

G: Red siltstone & calcite included Coarse Fabric of Mineral tempered coarse ware
(Sample GC005, GC011)

Inclusions
25% eq. & el. sa.-sr. <2.5 mm. Single-double-spaced. Bimodal, poor-sorted grain size distribution. Vertically aligned
Coarse Fraction
60%. 2.5-0.3 mm
Predominant: red siltstone; el. a.-sr. <2.0 mm, mode=1.0 mm. Parallel crack were visible inside the siltstone.
Frequent: calcite; el. a.-sr. <2.5 mm, mode=1.0 mm. el. sr. Fossil was also included.
Fine Fraction
40% 0.3-0.01 mm
Dominant: red siltstone
Dominant: calcite
Few-Very Few: biotite
Very Few: muscovite

Matrix
69%. Calcareous. Reddish brown in PPL, Brown, reddish brown, and dark reddish brown in XP (x40). Heterogenous.

Voids
6%. Consisting mainly of Meso-elongate and Meso- equant Vughs. El. Chaff-shaped voids (>3.0 mm, mode=1.0 mm) exist.

Comments
This fabric is characterised by coarse calcareous matrix with frequent inclusions of red siltstone and calcite. It is likely that the inclusions were intentionally included because of the bimodal pattern of inclusions.
Thickness of slip or trace of burnishing: GC005: 0.03 mm. GC011: 0.04 mm.
No trace of secondary calcite surrounding voids.

H: Vegetal temper included Coarse Fabric of Vegetal tempered coarse ware
(Sample GC004, GC012)

Inclusions (GC004)
4% eq. & el. a.-sr. <0.3 mm. Open-spaced. Unimodal, well-sorted grain size distribution.
Predominant: muscovite; eq. a.-sr. <0.3 mm, mode=0.1 mm. weathered?
Few: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Few: biotite; el. a.-sr. <0.2 mm, mode=0.1 mm. weathered?

Matrix
73%. Calcareous. Yellowish brown in PPL, Dark brown in XP (x40). Heterogenous.
GC004: Yellowish brown (major) & Dark brown (minor) in PPL. Color change in XP due to low firing temperature.
GC012: Light brown (outside), Black (core) & Dark brown (in-between) in PPL.
Clay coating was invisible because of the same fabric as the main matrix.

Voids
23%.
GC004: Consisting mainly of Mega-Meso-elongate Channels – Vesicles <5.0 mm. mode= 2.0 mm. Vertically aligned.
GC012: Consisting mainly of Meso-elongate Channels – Vesicles <3.0 mm. mode= 1.0 mm. Vertically aligned.

Comments
This fabric is characterised by coarse matrix with frequent vegetal temper. The proportion of inclusions is a higher than fine fabric of black on buff ware. The change of the matrix color in XP indicates firing in a low firing temperature.

Fabric types confirmed at Rahmatabad

A: Fine Fabric of Black-on-buff ware
(Sample RF001, RF002, RF003, RF004, RF005, RF006, RF007, RF008, RF009, RF010)

Inclusions
3%. eq. sa.-sr. <0.2 mm. Open-spaced. Unimodal, well-sorted grain size distribution
Predominant: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Dominant: biotite; el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?

Matrix
92%. Calcareous. Light pale green in PPL, dark pale green in XP (x40). Homogenous. Slip and painting distinguishable from main matrix. Tiny red particles exist.

Voids
5%. Consisting mainly of Meso-elongate and Meso- equant Vugh. No trace of secondary calcite surrounding voids.
RF007: hair like material exists.

Comments
This fabric is characterised by the fine calcareous matrix.
Slip thickness RF008: 0.2 mm.
Paint thickness RF001: 0.04 mm, RF002: 0.07 mm, RF003: 0.12 mm, RF004: 0.39 mm, RF005: 0.08 mm, RF006: 0.007 mm, RF008: 0.03 mm, RF009: 0.01 mm
RF004: secondary calcite in the voids.

H: Vegetal temper included Coarse Fabric of Vegetal tempered coarse ware
(Sample RC011, RC012)

Inclusions
4% eq. & el. a.-sr. <0.3 mm. Open-spaced. Unimodal, well-sorted grain size distribution.
Predominant: Muscovite; eq. a.-sr. <0.3 mm, mode=0.1 mm. weathered?
Few: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Few: biotite; el. a.-sr. <0.2 mm, mode=0.1 mm. weathered?

Matrix
Calcareous. Reddish brown in PPL, Dark brown in XP (x40). Heterogenous.
RC011: 73%. Yellowish brown (major) & Dark brown (minor) in PPL. Color change in XP due to low firing temperature.
RC012: 84%. Reddish brown (major) & Grayish brown (minor) in PPL.

Voids
RC011: 23%. Consisting mainly of Mega-Meso-elongate Channels – Vesicles >5.0 mm. mode= 1.5 mm. Vertically aligned.
RC012: 12%. Consisting mainly of Meso-elongate Channels – Vesicles >12.0 mm. mode= 1.5 mm.

Comments
This fabric is characterised by coarse matrix with frequent vegetal temper. The proportion of inclusions is a higher than fine fabric of black on buff ware. The change of the matrix color in XP indicates firing in a low firing temperature.
Thickness of clay coating: RC011: 0.08 mm, RC012: 0.07 mm.

Fabric types confirmed at Tall-e Bakun A

A: Fine Fabric of Black-on-buff ware
(Sample AF001, AF002, AF003, AF004, AF005, AF006, AF007, AF008)

Inclusions
3%. eq. sa.-sr. <0.2 mm. Open-spaced. Unimodal, well-sorted grain size distribution
Predominant: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?
Dominant: calcite; eq. sa.-sr. <0.5 mm, mode=0.15 mm. (AF001)
Dominant: muscovite; el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered? (especially AF002 and AF005)
Few: biotite; el. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?

Matrix
92%. Calcareous. Light pale green in PPL, dark pale green in XP (x40). Homogenous. Slip distinguishable from the main matrix. Tiny black and red particles exist.
AF001: 0.5 mm Black Equant sub-rounded material filled with tiny rounded & clustered vesicles exists. It was likely to be caused from high temperature firing.

Voids
5%. Consisting mainly of Meso-elongate and Meso- equant Vugh.
AF004 and AF006: tiny hair-like material was observed.
AF008: 15%. Unimodal, well-sorted void size distribution. Meso-round.

Comments
This fabric is characterised by the fine calcareous matrix.
Slip thickness: AF001: 0.5 mm, AF003: 0.4 mm, AF005: 0.5 mm, AF006: 0.5 mm.
Paint thickness: AF001: 0.04 mm, AF002: 0.1 mm, AF005: 0.1 mm, AF006: 0.05 mm, AF007: 0.05 mm.
AF001: secondary calcite on the surface and in the voids, AF002: secondary calcite on the surface, AF003: secondary calcite on the surface, AF005: secondary calcite in the voids, AF006: secondary calcite on the surface, AF007: secondary calcite in the voids, AF008: secondary calcite in the voids.

F: Greyish material included Coarse Fabric of mineral tempered Black-on-buff ware
(Sample AC009)

Inclusions
10% eq. & el. a.-sr. <4.0 mm. Open-spaced. Bimodal grain size distribution
Coarse fraction
90%. 4.0-0.3 mm
Predominant: greyish material (possibly high fired red siltstone); eq. & el. a.-sr. <4.0 mm, mode=1.5 mm. Horizontal striations inside.
Very Few: calcite; eq. sa.-sr. <1.5 mm, mode=1.5 mm
Fine fraction
10%. 0.3-0.05 mm
Dominant: quartz; eq. sa.-sr. <0.3 mm, mode=0.2 mm. weathered?
Very Few; muscovite; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?

Matrix
85%. Calcareous. Reddish brown and Whitish gray in PPL possibly due to high firing temperature. Dark brown and Grey in XP (x40). Slip is Whitish gray in PPL. Heterogenous.

Voids
5%. Consisting mainly of Meso-elongate and Meso- equant Vughs.

Comments
This fabric is characterised by the coarse calcareous matrix with frequent greyish materials. The heterogeneity of the matrix shows the evidence of the higher firing temperature than those of the other fabric types.
Slip thickness: 0.3 mm.
Paint thickness: 0.05 mm.
Trace of secondary calcite surrounding voids exists.

G: Red siltstone & calcite included Coarse Fabric of Mineral tempered coarse ware
(Sample AC012)

Inclusions
25% eq. & el. sa.-sr. <3 mm. Single-spaced. Bimodal, poor-sorted grain size distribution. Vertically aligned.
Coarse Fraction
80%. 2.5-0.3 mm
Predominant: red siltstone; el. a.-sr. <2.5 mm, mode=1.5-2.5 mm. parallel crack visible.
Frequent: calcite; el. a.-sr. <2.5 mm, mode=1.0 mm. el. sr. fossil included
Fine Fraction
20% 0.3-0.01 mm
Dominant: red siltstone
Dominant: calcite
Very Few: biotite
Very Few: muscovite

Matrix
69%. Calcareous. Reddish brown (inside) & dark brown (outside) in PPL, Dark reddish brown (inside) & dark brown (outside) in XP (x40). Heterogenous.

Voids
6%. Consisting mainly of Meso-elongate and Meso- equant Vughs. El. Chaff-shaped voids (>2.0 mm, mode=1.0 mm) exist.

Comments
This fabric is characterised by coarse calcareous matrix with frequent inclusions of red siltstone and calcite. It is likely that the inclusions were intentionally included because of the bimodal pattern of inclusions.
Trace of secondary calcite surrounding voids exist.

H: Vegetal temper included Coarse Fabric of Vegetal tempered coarse ware or Burnt clay
(Sample AC010, AC011)

Inclusions
3% eq. & el. a.-sr. <0.3 mm. Open-spaced. Unimodal, well-sorted grain size distribution.
Predominant: muscovite; eq. a.-sr. <0.3 mm, mode=0.1 mm. weathered?
Few: quartz; eq. sa.-sr. <0.2 mm, mode=0.1 mm. weathered?

Matrix
82%. Calcareous. Yellowish brown & Dark brown in PPL, Dark brown in XP (x40).
AC010: Heterogenous, Yellowish brown (outside) & black (inside) in PPL.
AC011: Heterogeneous.
Clay coating was invisible because of the same fabric as the main matrix.

Voids
15%.
AC010: Consisting mainly of Mega-Meso-elongate Channels – Vesicles <4.0 mm. mode= 1.0 mm.
AC011: Consisting mainly of Meso-elongate Channels – Vesicles <3.0 mm. mode= 1.0 mm. Vertically aligned.

Comments
This fabric is characterised by coarse matrix with frequent vegetal temper. Heterogeneity of matrix might imply the clay mixing for the purpose of making the firing of the vessels successful. It is interesting that the burn clay possibly used for clay sealing and VCW shows the similar fabric, implying the same source.

Table A6.3 Detection limits of 10 elements measured by ICP-OES analysis. (taken from Uemoto 2011 Table 3.2)

element	wave length	ng/mL (axis)	ng/mL (side)	ppm (axis)	ppm(side)
Al	I 396.153	1.5	3	0.002	0.003
Ba	II 455.404	0.05	0.09	0.000	0.000
Ca	II 393.367	0.04	0.1	0.000	0.000
Fe	II 259.940	0.5	0.3	0.001	0.000
K	I 766.491	9	40	0.009	0.04
Mg	II 279.553	0.06	0.02	0.000	0.000
Mn	II 257.610	0.1	0.09	0.000	0.000
Na	I 589.592	0.8	2	0.001	0.002
Sr	II 407.771	0.03	0.05	0.000	0.000
Ti	II 334.941	0.3	0.3	0.000	0.000

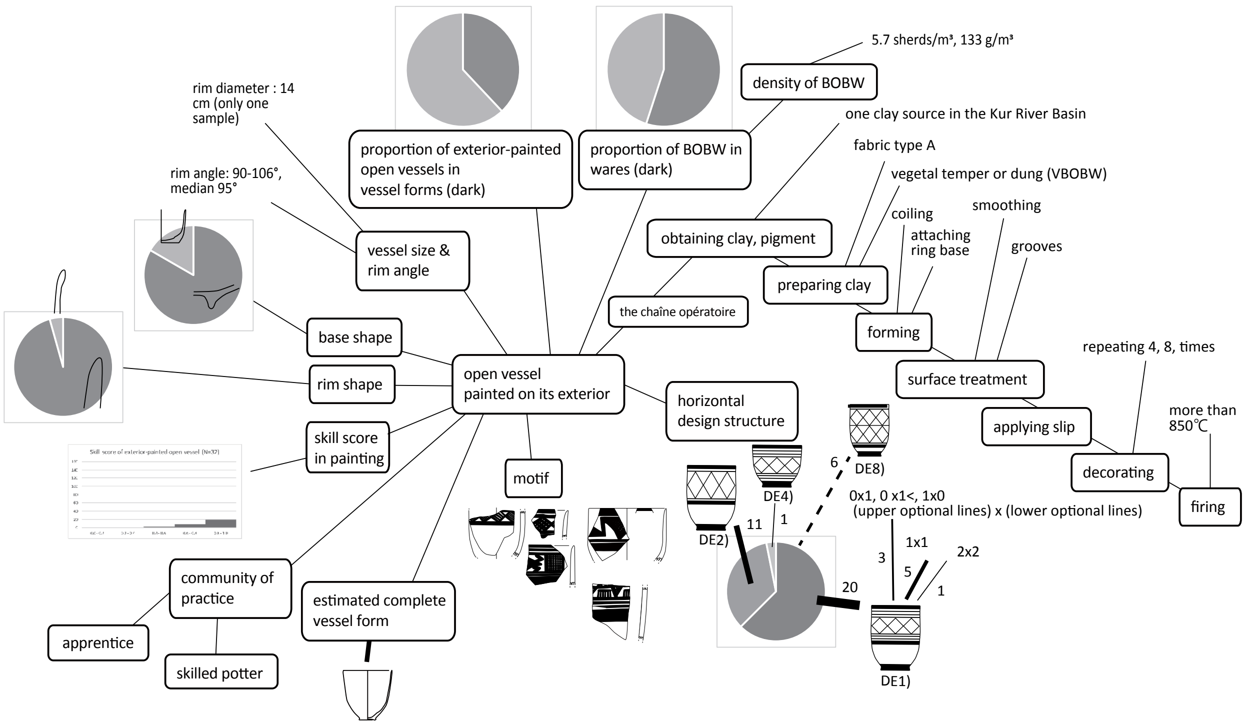

Figure A7.1 Pottery-attribute tanglegram of BOBW exterior-painted open vessels at Tall-e Bakun B (motif traced from Egami and Masuda 1962 Fig. 15: 1, 2, 7, 11)

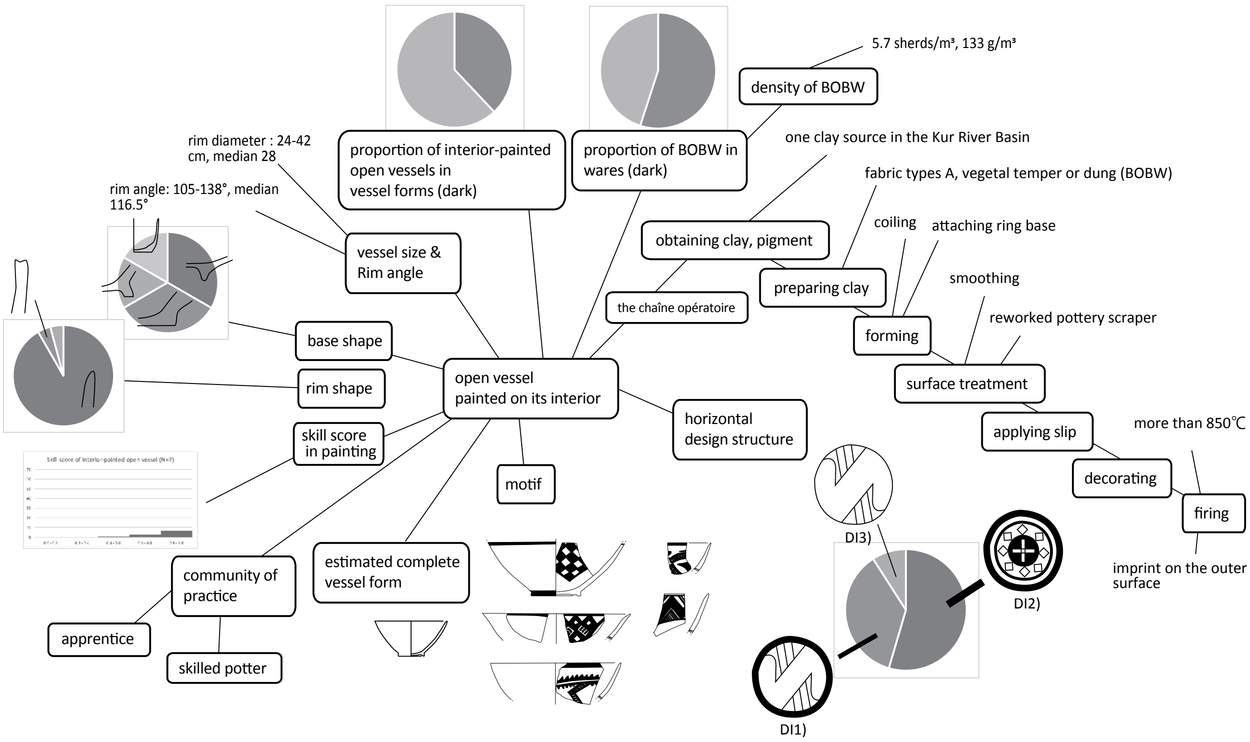

Figure A7.2 Pottery-attribute tanglegram of BOBW interior-painted open vessels at Tall-e Bakun B (motif traced from Egami and Masuda 1962 Fig. 17: 3, 5, 6, 7)

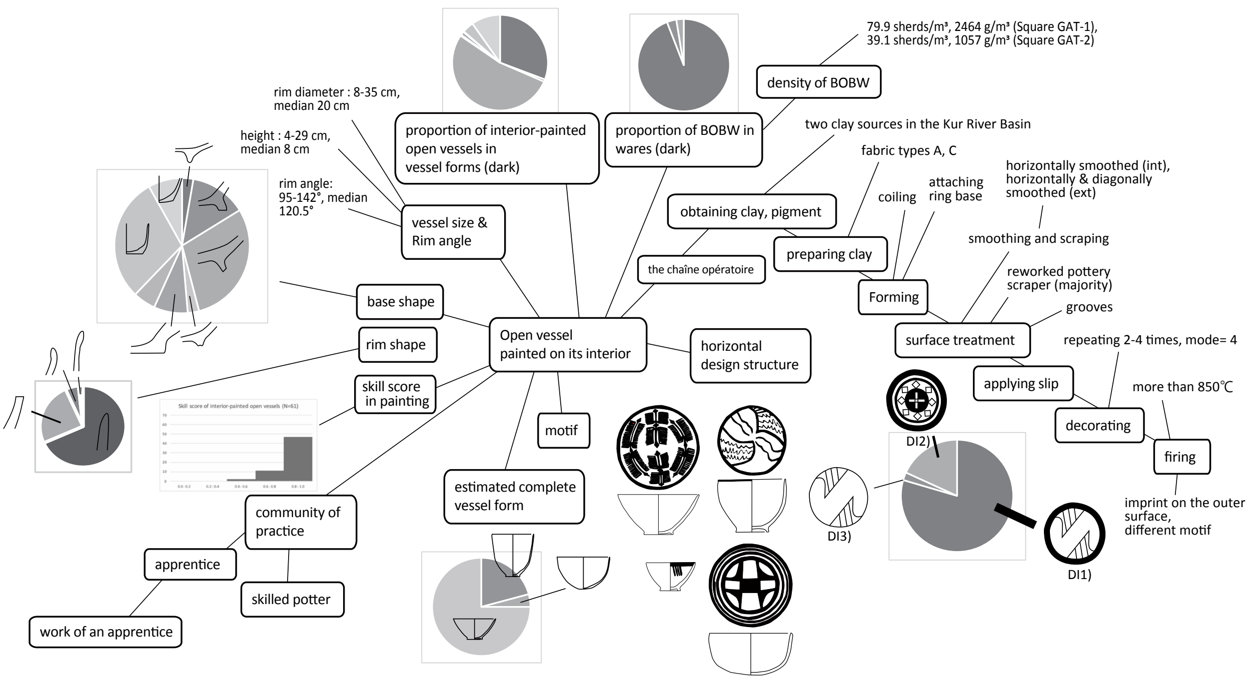

Figure A7.3 Pottery-attribute tanglegram of BOBW exterior-painted open vessels at Tall-e Gap (motif traced from Egami and Sono 1962 Fig. 26:1, 28:1, 30:2, 31:4)

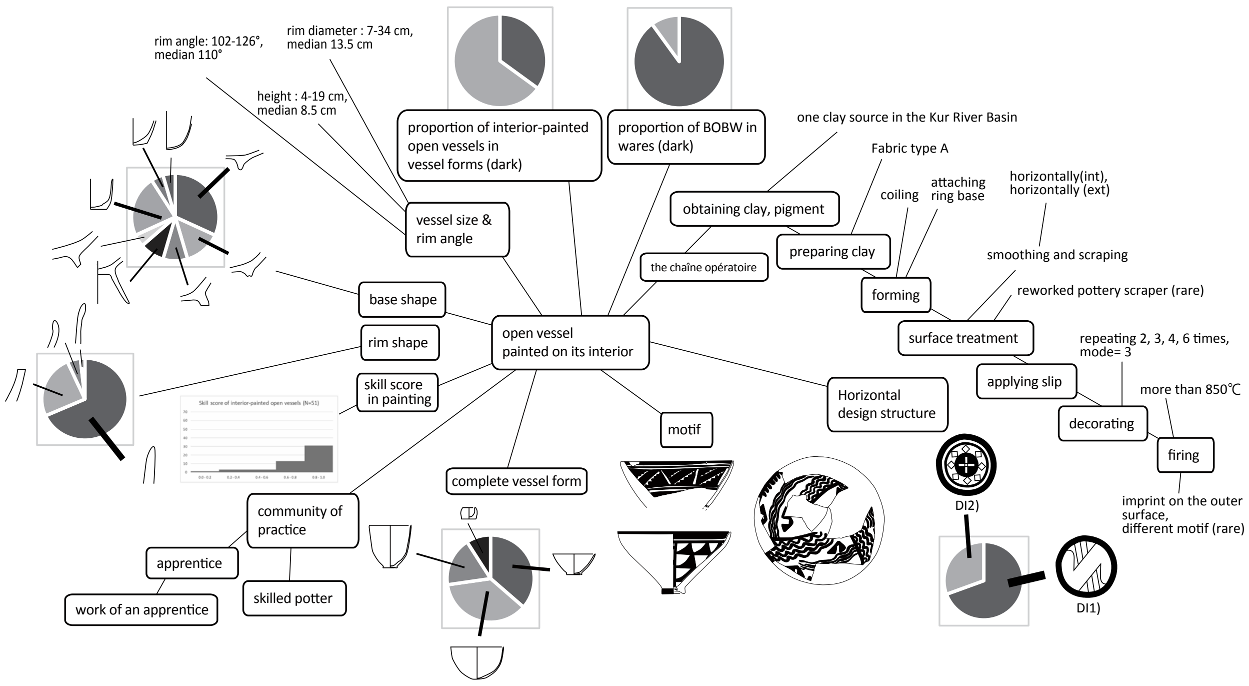

Figure A7.4 Pottery-attribute tanglegram of BOBW interior-painted open vessels at Tall-e Bakun A (motif traced from Langsdorff and McCown 1942 Pl. 28:12, 34:10; Alizadeh 2006 Fig. 28:C)

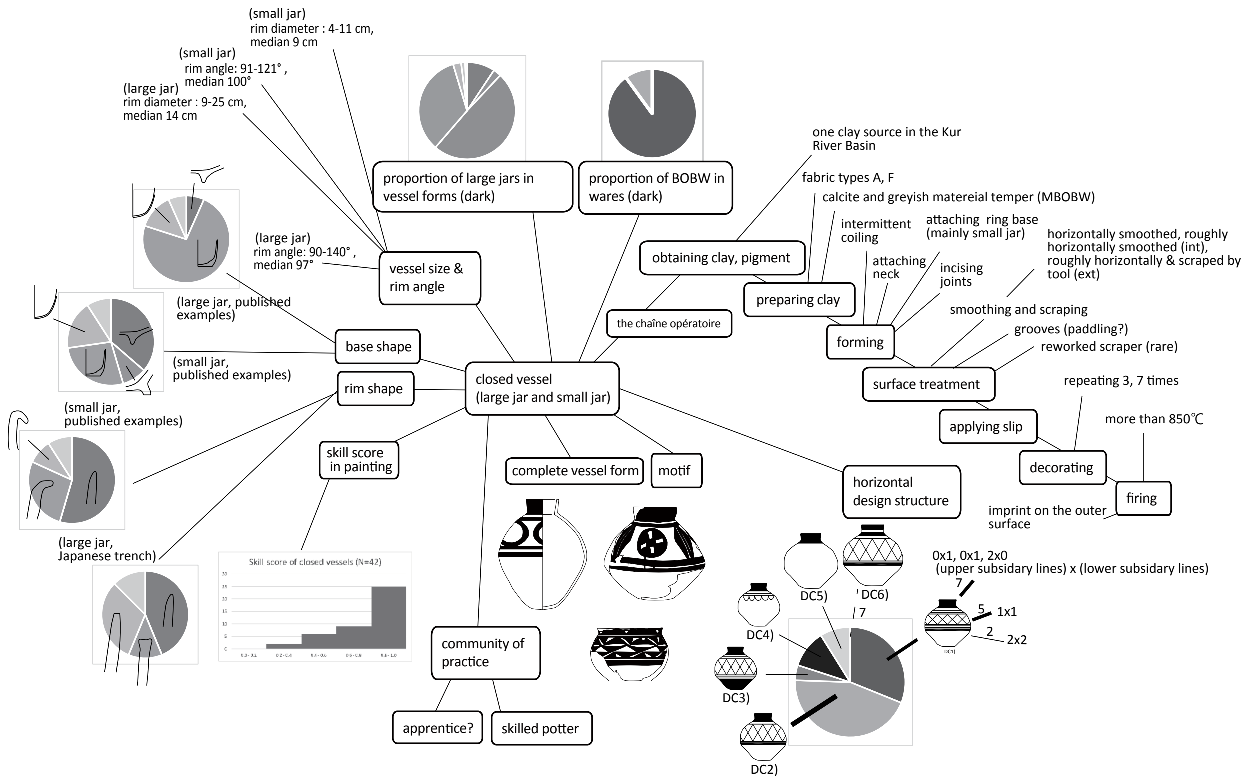

Figure A7.5 Pottery-attribute tanglegram of BOBW closed vessels at Tall-e Bakun A (motif traced from Langsdorff and McCown 1942 Pl. 31:1, 58:2; Egami and Masuda 1962 Fig. 6:1)