Analysis of Neolithic pottery technology along the Iranian Zagros foothills

Natalia Petrova [1], Hojjat Darabi [2]
petrovany@iaran.ru
1 Institute of Archaeology, Russian Academy of Science, Moscow, RU
2 Department of Archaeology and Research Center for Art and Architecture, Razi University, Kermanshah, IR;
h.darabi@razi.ac.ir

ABSTRACT – *The article presents the results of a technological analysis of the ceramic samples from Neolithic settlements of Ali Kosh, Mahtaj and Guran (the 7th mill. BC). The use of sheep and goat dung in the paste prevailed. While two-layer slabs were applied as the main construction method across the region, a few samples from Guran show the appearance of coil construction around the middle of the 7th millennium BC. First an overall coating with the same clay and red colouring appeared, and later a new type of red slip emerged – a mixture of clay with red pigment.*

KEY WORDS – *Zagros; Neolithic; pottery technology; paste composition; construction methods; slip*

Analiza tehnologije neolitske lončenine iz predgorja Zagrosa v Iranu

IZVLEČEK – *V članku predstavljamo rezultate tehnološke analize keramičnih vzorcev iz neolitskih naselbin Ali Kosh, Mahtaj in Guran (7. tisočletje pr. n. št). V lončarski masi prevladujejo ovčji in kozji iztrebki. V regiji pri izdelovanju posod prevladuje metoda dvojnih glinenih trakov, vendar se v Guranu sredi 7. tisočletja pr. n. št. uporablja tudi tehnika svaljkov. Posode so bile na začetku v celoti premazane z istim premazom rdeče barve. Kasneje se je pojavila nova vrsta premaza – mešanica gline in rdečega pigmenta.*

KLJUČNE BESEDE – *Zagros; neolitik; lončarska tehnologija; sestava lončarske mase; oblikovanje posod; premaz*

Introduction

The emergence of pottery has long been seen as an important technological innovation in human life. Across west Asia, the overall archaeological evidence suggests that the first unfired clay vessels appeared at the turn of the 9th to 8th millennia BC, as shown by the Ganj Dareh materials (*Darabi* et al. *2019*) while the earliest pottery vessels appeared at around 7000 BC (see *Le Mière 2017; Le Mière, Picon 1998; Nieuwenhuyse, Campbell 2017; Tsuneki 2017*). In the Zagros region, excavations at Ganj Dareh yielded two types of clay vessels, including large storage containers, sometimes attached to the wall of buildings, and samples from much smaller ones. They were mostly found in the burnt deposits known as layer D at the site (*Smith 1974; 1990*). This highlights the fact that Neolithic communities were long dealing with such unfired clay containers during the pre-pottery period as a direct predecessor to the fired pottery vessels in the 7th millennium BC. In addition, this important technological innovation should have been influenced by some other preceding items, such as stone vessels,

DOI: 10.4312/dp.49.11

white ware, and waterproofed mat containers, as well as pyro-technological experiments with making clay objects. In this regard, we also assume a technological correlation between the construction of *cob* walls and subsequent pottery vessels. Along the Zagros foothills and intermountain valleys, the earliest available pottery samples are dated to the turn of the 8th to 7th millennia BC (*Darabi 2018*). However, they were regionally variated, although later inter-regional interactions led to some stylistic similarity or uniformity. When it comes to Neolithic pottery in the Zagros (*Bernbeck 2017; Hole 2018; Matthews, Fazeli Nashli 2022.89*), the majority of scholarship has dealt with stylistic consideration of various types, in particular their form and decorative elements, while the composition of the pottery paste, construction methods, and firing of the early ceramics remain poorly understood. Previously, examinations by Frederick R. Matson (*1960*) and Pamela Vandiver (*1987*) presented some information on the Iraqi and Iranian Zagros, respectively. The Zagros region is formed of high intermountain valleys and plains or foothills at lower altitudes. This spectacular geomorphological feature has always played a major role in human life in the area, enabling the coexistence of local, regional and interregional cultural facts resulting from socio-economic interactions. Frank Hole (*2018*) recently pointed out the 'diversity' and local development of various types of Neolithic ceramics across the Zagros piedmont, in Deh Luran, Susiana, Hulailan, Mahidasht Fars. He thus refers to these internal ceramic trajectories as 'creative centuries'. According to Hole, due to the formidable Zagros heights the nearby lowlands, such as the Deh Luran Plain, and intermountain valleys or plains, such as Hulailan, show distinct ceramic trajectories during the Neolithic period. This claim can be assessed through investigating of a large body of various artefacts, including ceramics.

This article presents a comprehensive analysis of Neolithic pottery technology across the Iranian Zagros, with a focus on the samples recovered from three Neolithic sites of Ali Kosh, Mahtaj and Guran. The first two sites are located in the two corners of the lowlands of southwestern Iran, while the last lies at a small, closed intermountain valley, Hulailan, in the central Zagros. Such distinct natural settings may provide us with a better comparison of the Neolithic ceramics in the light of technological, not stylistic, matters. Moreover, both Ali Kosh and Guran represent the most common Neolithic ceramic types, which are ubiquitous on the lowlands and highlands, respectively (Fig. 1).

Materials and their chronology

As noted above, the pottery assemblages examined and presented here are some selected samples from the Neolithic sites of Ali Kosh and Guran, as well as few sherds from Mahtaj. All three sites contain both pre-pottery and pottery levels, though the last one lacks any *in situ* samples due to anthropogenic destruction (see below).

As a result of the stratigraphic excavation in 2017, a total of 227 pottery sherds were found from the upper levels of Ali Kosh, Deh Luran Plain (32°33' 28.14"N, 47°19'29.82"E, about 6km to the northwest of Mousian town, Ilam Province) (*Darabi 2018; Darabi* et al. *2017*). Following the early 1960s excavations, these levels were previously defined as the Mohammad Ja'far Phase in which three pottery types were recovered: Ja'far Plain, Ja'far Painted, Khazineh Red (*Hole* et al. *1969.113*). Accordingly, these are mostly chaff-tempered and burnished. Judging from the cracking and peeling of surface, the two former types (Ja'far Plain and Ja'far Painted) seem to have been covered with a "*wash of the same clay*" (*Hole* et al. *1969.115,117*). In relation to Khazineh Red, both 'slip' ("*as a fine solution of well-cleaned clay*") and 'self-slip' (formed during wet smoothing of the vessels) were applied. Only Ja'far Painted was decorated in geometric designs, such as chevrons, zig-zags and checkerboard (for further information see *Hole* et al. *1969.113–124*). Technological analysis was carried out on 31 fragments of ceramics (for basic information on the samples see Table 1 – the number and other information of the fragments associated with their figures is given by site in the corresponding tables), including 13 samples of the Ja'far Plain type, 12 samples of the Ja'far Painted type, and six samples of the Khazineh Red type. It's noteworthy that the last is not uniform in appearance, with a variation in the red colour on the outer surface. The Ja'far Plain type has a wall thickness between 0.6–1.2cm, predominantly 1.0–1.1cm. The thickness of the walls of Ja'far Painted and Khazineh Red is mostly less than 1cm (0.7–0.9cm). The diameter of the vessel rims of all types ranges from 15 to 25cm.

Chronologically, Hole (*1987*) attributed the pottery layers of Ali Kosh to 6300–6000 BC and the preceding pre-pottery layers (the Boz Mordeh and Ali Kosh phases) to *c.* 7500–6300 BC. Melinda A. Zeder (*1999; 2008*) dated the entire sequence to *c.* 7500–7000 BC. However, recent determinations placed the site within *c.* 7500–6500 BC, and proposed that the pot-

tery emerged from roughly 7000 BC onwards (*Darabi 2018*).

During the sounding at Tapeh Mahtaj, Behbahan Plain (30°38'7.64"N, 50°12'15.33"E, about 3km to the west of Behbahan city, Khuzestan Province), a few pottery fragments were recovered from the site. However, they were all intrusions from upper, destroyed levels. The site presents traces of some subsequent seasonal occupations spanning from the late 8th to early 7th millennia BC (*Darabi* et al. *2017; 2021*). If the upper levels had not been destroyed, the site could have helped with better understanding of the transition from the pre-pottery to pottery Neolithic in southwestern Iran. However, the two samples that were analysed for this research should be attributed to the early 7th millennium BC. They represent fragments of a vessel base, and provide adequate technological information (for basic information on the samples, see Table 2).

Our third assemblage comes from surface of Tapeh Guran (33°45'23.83"N, 47°05'51.90"E, about 4km to the west/northwest of Tohid town in the Hulailan valley, Ilam Province). Diachronically, the site presented various types of Neolithic pottery in the central Zagros: Greyish-brown ware (level S), Buff ware (levels R-D), Archaic Painted (levels R-F), Standard Painted ware (levels O-D), Sarab Geometric (level L-D)[1], and Red-slipped ware (*Mortensen 1972; 2014; Meldgaard* et al. *1964.116–117*) (Fig. 2).

Greyish-brown ware is the earliest type made of untempered pure clay, but later tiny pieces of chaff and husk appeared as inclusions. It is also wet-smoothed or slightly burnished, with incised lines and crescentic impressions from fingernails or the end of a bone tool. Variated grey and brown surface colours are the result of 'poor firing' (*Mortensen 2014.50*). The occurrence of such pottery is controversial, as it was also reported from Ganj Dareh (see *Smith 1976*), a site that has recently been dated to the pre-pottery Neolithic period (see *Zeder 2008; Meiklejohn* et al. *2017; Darabi* et al. *2019*). As the most common type at the site, Buff ware contains some limestone and sand, as natural inclusions of the clay, and tempered with tiny fragments of chaff in medium or large quantities. Some samples were reported to have contained dung as temper. The surface of the Buff ware is wet smoothed or slipped, often slightly burnished and ranges from buff to orange-buff. Standard Painted ware and Sarab Geometric style are tempered with tiny pieces of chaff, grits of limestone and small particles of sand, sometimes naturally added to the clay. They are also slipped and usually burnished, varying from buff to orange buff to reddish colour. In this regard, the inner layer is buff; the outer surface is slipped (light orange to red in colour) and usually burnished. The decoration is also painted in red ochre; though the Standard Painted has bobbled lines (tadpoles) and Sarab Geometric style is decorated with elements

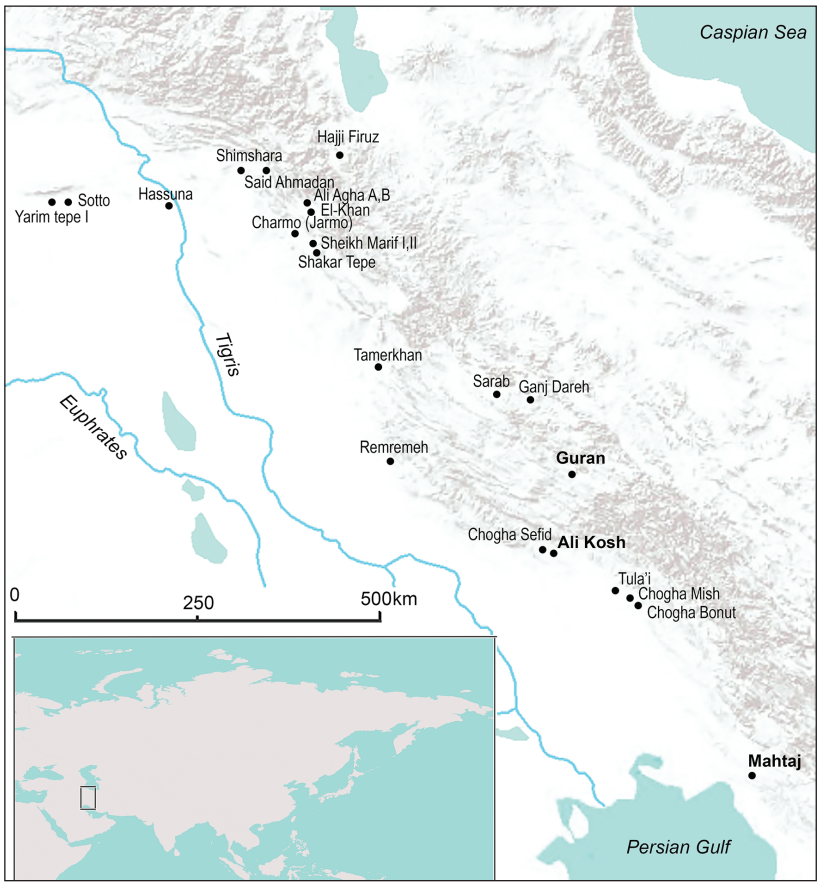

Fig. 1. A map showing the location of Ali Kosh, Mahtaj and Guran among some other key pottery Neolithic sites across Zagros.

1 This type was later re-classified by the site excavator as a sub-type (group d) of the Standard Painted (see *Mortensen 2014.59*), though they are obviously distinct in terms of their decorative elements.

such as chevrons, zig-zags and bands. Archaic Painted ware is usually burnished and heavily tempered with chaff and decorated with groups of vertical, oblique or horizontal lines. Red-slipped ware is also medium-heavily tempered with chaff and small particles of sand. Both outer and inner surfaces of the ware are slipped and burnished. The outer, and sometimes inner, surface is covered with a medium-dark red to orange-buff slip. In most cases, a grey or black layer is seen inside the fragments, which results from 'insufficient firing' (*Mortensen 2014.50–66*).

Peder Mortensen (*2014.17*) placed the site within *c.* 6700–5500 BC while Zeder (*2008*) suggested a time spanning *c.* 7300–6000 BC. Judging from a regional perspective, the latter seems to be more realistic. With regard to the current research, 22 potsherds were analysed. The available assemblage consisted of various types, with Standard Painted ware including the Charmo (Jarmo) style (one sample) and Guran style (one sample), Sarab Geometric (one sample), Buff ware (four samples) and Red-slipped ware (15 samples), while no samples associated with the Greyish-brown ware and Archaic Painted ware are investigated, as they were stratigraphically limited to the lower levels and hardly found on the surface (for basic information on the samples, see Table 3).

Methods

The ceramic technological analysis included the analysis of ceramics in terms of raw materials, pottery paste, and methods of construction, surface treatment and firing to study the stages of pottery technology. The technique applied is based on a binocular microscopy examination of technological traces on the surfaces and in fresh cross-sections of ceramic fragments,[2] as well as experimental modelling of individual elements of pottery technology to verify issues that arose in the microscopic analysis (*Bobrinsky 1978; 1999*).

Raw materials

In order to reconstruct the knowledge of the potter about the kind of clay to be used for making a desired pottery, the clay ferrugination, qualitative composition of natural inclusions, their dimensions and concentrations were recorded. The clay ferrugination was determined by re-firing samples in a muffle furnace at a standard temperature of 850°C. The concentration of natural inclusions was also measured in comparison with the special tables, previously obtained as a result of the data of numerous experiments (*Bobrinsky 1999.35–40*). Based on the presence of natural sandy inclusions, the used clay can be divided into low sandy, medium sandy and high sandy groups. Low sandy clay contains single grains that are mostly fine (0.1–0.25mm) and sometimes medium-grained sand (0.25–0.5mm) in a concentration of 1:10 (sand:clay). High sandy clay contains very fine (0.05–0.1mm) and fine sand grains (0.1–0.2mm) in a concentration 1:5–1:1 (sand:clay). The larger sand grain inclusions are usually rare (*Lopatina, Kazdym 2010*).

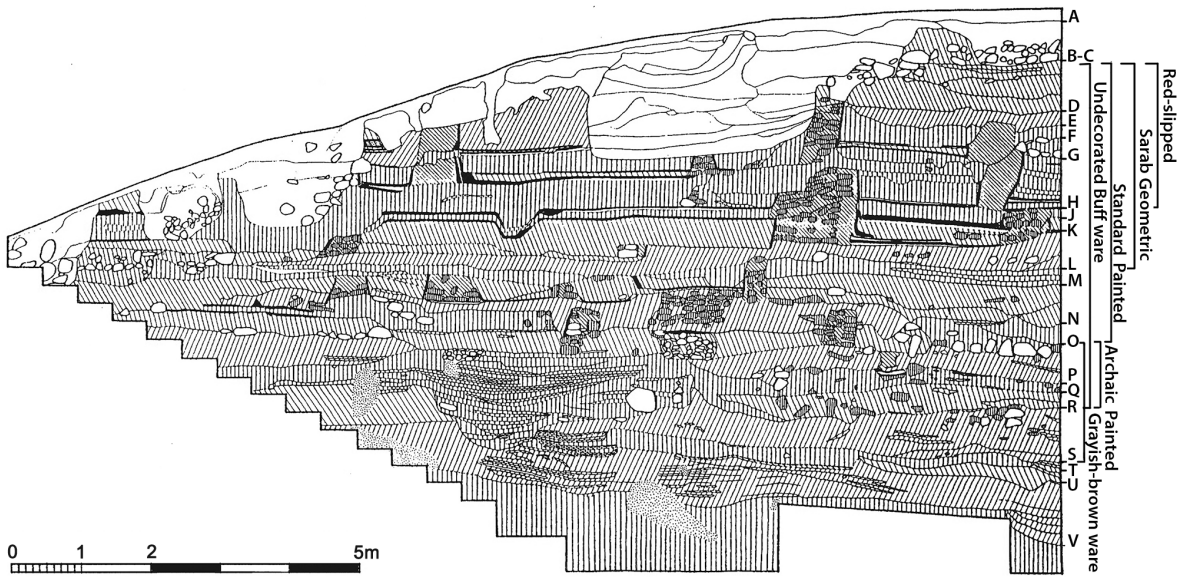

Fig. 2. Archaeological layers at Tapeh Guran showing their related pottery styles (modified by H. Darabi after* Meldgaard *et al.* 1963.109, Fig. 9*).

2 Carl Zeiss 2000-C stereo microscope.

Pottery paste

The qualitative composition of intentionally added inclusions, their dimensions and concentrations were determined. Archaeological samples were compared with experimental samples containing various types of organic inclusions: fresh grass, hay, straw and dung of cattle, sheep and goats (*Bobrinsky 1999.18–19,32–33,41–44,86; London 1981; Rice 1987.82; Tsetlin 2003*). The dung in pottery paste is represented by prints of small plants and sometimes the remaining residues, 0.2–1mm wide and up to several centimetres long, with pointed or rounded tips. In particular, there are a lot of highly degraded particles (0.1–0.2mm wide, less than 1mm long) in the dung of sheep and goats. In case of using fresh dung a strong curvature of small plants is seen in the pottery paste. Experiments show that an admixture of straw, crushed by any type of grinding or by impact, has uneven stepped edges (along the fibres), along with the splitting of the stems along the fibres and the falling of individual plant fibres. Only when cutting is an even cut fixed without splitting into individual fibres. Plant residues (imprints) are not bent and do not break at the bend. The concentration of organic inclusions was examined in comparison with experimental samples (*Petrova 2012.78; 2019; in preparation*).

Construction methods

The construction methods were examined on the basis of studying the vertical and horizontal cross-sections of ceramic fragments, which would attest to the presence of junctures at the places of joints of sequential "*clay building elements*" and the orientation of pores (*Bobrinsky 1978.174–184; Albero Santacreu 2014.78; Roux,Courty 2019.164– 166; Rue 1981; Shepard 1956.184; Vandiver 1987.30–31*). Analysis of the shape, size and direction of the junctures in the sherd allows us to find out from which sequential elements (slabs, coils, bands) the vessel was made. There are two known methods for gluing slabs: unsystematically and along circular horizontal zones. It is possible to assess the construction method by the presence of traces of some action that occured during the forming sequence that were left unsmoothed, changes in the relief and thickness of the vessel walls at the places of joints of sequential elements on the outer and inner surfaces of the ceramic fragments, and the presence of a mould connected with slabs (*Bobrinsky 1978; Rice 1987.125; Vasil'eva, Salugina 2010.72–87*). With regard to the slab construction, the vertical and horizontal cross-section is divided by junctures into many separate parts. The coil construction can be detected by the extended horizontal line of juncture at the horizontal cross-section of the vessel wall. In a vertical cross-section, in the case of coils, the wall is divided into many separate parts by horizontal or oblique junctures (Fig. 3).

Surface treatment

The surface treatment is assessed through analysing the micro-traces left on the surface. To verify the presence of a clay covering, we conducted experiments using different clays to make a basic paste and other types with the addition of various pigments. A full study of all the features of the clay coating is still ongoing. At present, however, it can be noted that at least in the case of applying an additional clay coating (including the slip) before firing, characteristic rounded (micro) cracks and chips appeared on the surface of the vessels, as noted in other studies (*Rue 1981.41,54; Shepard 1956.67*). This resulted from uneven shrinkage of the clay that was used in the basic paste composition and coating.

With regard to the clay covering, we need to clarify the concepts used in our research. We divided the concept of 'slip' into two types: "*coating with the same clay*" – a type of very thin or watery clay similar to the main raw material from which the vessel was made without using additional admixtures; and 'slip' – the application of clay composed of the same or different clay material mixed with a pigment. This is necessary to show the development of idea of the 'slip covering', which will be shown below.

In addition, the traces left by the tools used for smoothing the surface of the vessels were studied and compared with our experimental observations.

Firing

The firing regime, its duration and temperature are determined based on the thickness of the oxidized and un-oxidized layers and the quality type of the transition of margin between them (sharp or gradual) in the cross-section, as well as changes in the form of intentionally added or naturally occurred inclusions (*Bobrinsky 1999.93–95; Rue 1981.118; Volkova, Tsetlin 2016*).

Analyses

Clay raw materials

With regard to the Ali Kosh ceramics, a wet clay with varying degrees of ferrugination was used: medium (19 fragments), high (12 fragments), and low (one fragment). In all the three pottery types recovered

Fig. 3. Experimental samples. **a,b** ***slabs construction (a free modelling on the flat,*** **b** ***construction with using mould);*** **c,d** ***coil construction (experimental samples and photos made by N. Petrova).***

from the site, the clay contained an insignificant concentration of sand (no more than 1:10), which is a natural rounded admixture of sand (with a particle size of 0.2–0.5mm) and a fine admixture of limestone (0.2–0.5mm) in an even lower concentration. The samples of Mahtaj are made of low-ferruginated, low sandy clay (sand particle size 0.2–0.5mm, concentration less than 1:10). At Guran, medium (14 samples) or low ferruginous (eight samples) and low sandy clays are seen. Red-slipped ware, in the overwhelming majority of cases, shows the use of medium ferruginous clay (13 samples), while the Buff ware was only made of low ferruginous clay. In all the samples the clay contains very fine natural sand (0.2–0.5mm) at a concentration of less than 1:10, and there are sporadic larger grains of sand. Limestone was also found in only two fragments in insignificant amounts.

Pottery paste

An examination of the paste of the Ali Kosh ceramics showed different scales of organic prints and residues: very small plants (0.1–0.2mm wide, ≤1mm long) remaining from sheep and goat dung with pointed (needle shape) (Fig. 4.a.23) or rounded ends (Fig. 4.a.2) in wet condition, as evidenced by curved long (Fig. 4.a.15) and very small compressed plant prints (Fig. 4.a.10); coarse plant residues (≤ 0.5mm wide, often ≤1mm long) in a dry state with straight (cut) ends characteristic of mechanical crushing (Fig. 4.b.12). The presence of grain husk residues is also possible (Fig. 4.b.6). It is not clear whether coarse plant admixture was added intentionally or was associated with the dung pellets (like the remnants of undigested fodder, or occurred accidently when the dung was collected or picked up from the ground). However, we may assume that in low concentrations (5–10%) large plant inclusions resulted from dung, while in higher amounts (≥30%) they were added intentionally. The presence of husks can be indicative of adding chaff to the pottery paste, but it is not clear as not enough evidence is available yet.

Ja'far Plain ceramics present the highest concentration of organic admixture – approximately 50% of the volume of the pottery paste – which was recorded in two fragments recovered from the lowest layer of the phase (in one case only coarse plants, and in the other a mixture of dung and larger plants, probably added separately from the dung). A fragment containing only dung was also found in the same layer. Upper layers yielded samples that show only dung or plant inclusions. However, the concentration of organic impurities decreased over time. In terms of Ja'far Painted, except for one fragment with only coarse plant inclusions all the ceramics presented a pure admixture of dung. In general, the concentration of organic admixture in this type of ceramic is less than that in the Ja'far Plain samples. It seems that its amount remained stable, as represented by two values: 10 and 30%. In the Khazineh Red samples the presence of dung is ubiquitous. Both Khazineh Red and Ja'far Painted types show a significant amount – up to 30% – in the lower layers, while only an impurity of dung in a small concentration – up to 10% – is seen in the upper layers. In the remaining two pieces of Khazineh Red, dung forms approximately one-third of the total volume of the pottery paste. In general, we recorded organic admixtures in the ceramics of Ali Kosh which may have resulted from the use of sheep and goats dung and especially crushed, coarse plants (possibly chaff). The highest density of organic impurities (~50%) is seen in the Ja'far Plain samples that were recovered from the lowest layer, where dung was also deployed as temper, whether added to the plant inclusions or specifical-

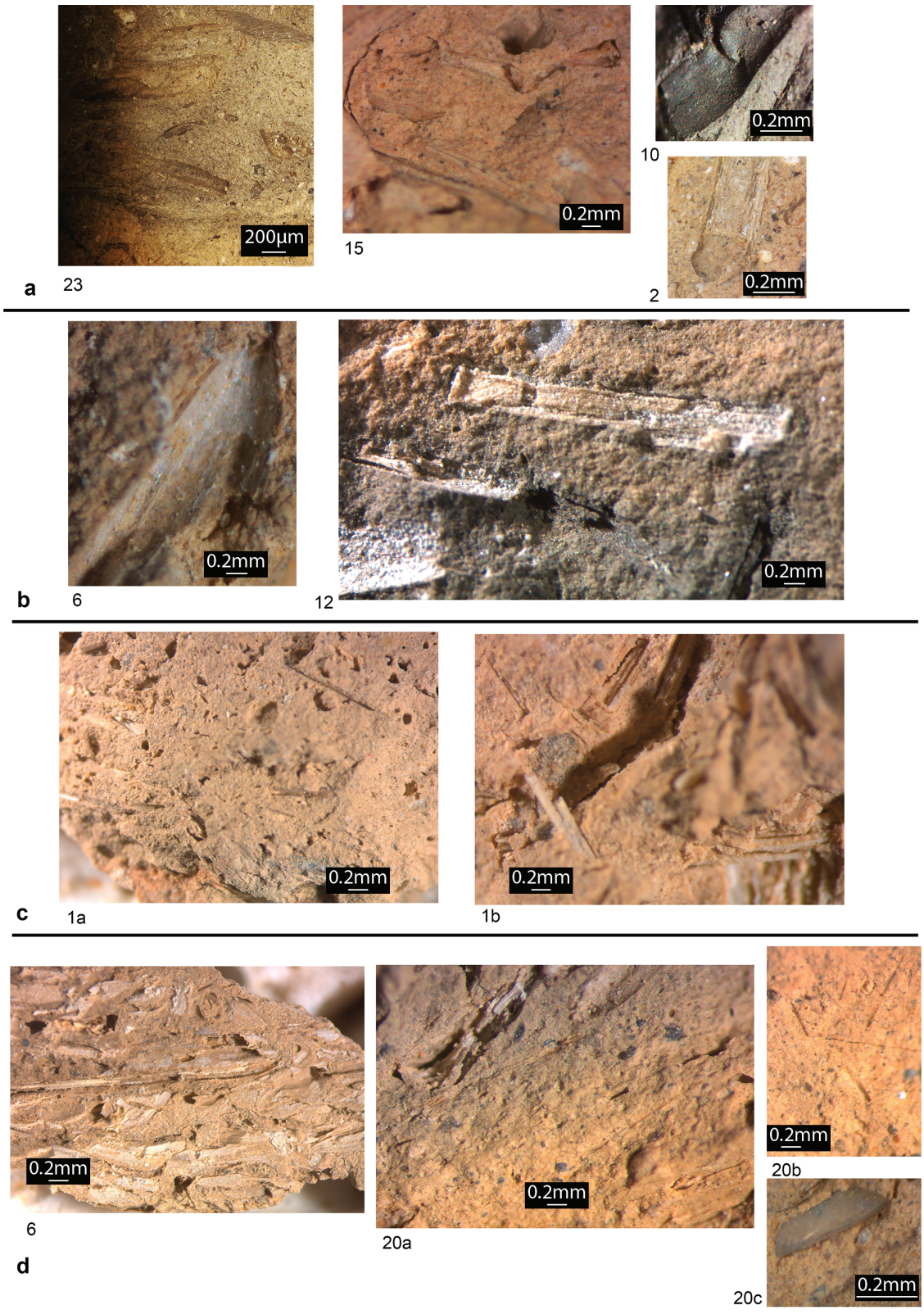

Fig. 4. The composition of pottery paste at Ali Kosh, Mahtaj and Guran (photos made by N. Petrova). **a** ***Ali Kosh, plant prints, dung-related:*** **23** ***general view of dung (pointed ends of prints),*** **15** ***curved plant prints,*** **10** ***compressed plant prints,*** **2** ***rounded end of plant print;*** **b** ***Ali Kosh, plant prints, not related to dung:*** **6** ***probably husk imprint;*** **12** ***straw imprint with straight (cut) ends;*** **c** ***Mahtaj, plant prints, dung-related.*** **1a,b** ***general view;*** **d** ***Guran, plant prints, dung-related.*** **6,20a,b** ***general view,*** **20c** ***shell chip, presumably dung-related. The number of fragments here and below are given by number in the corresponding (by sites) tables (see Tabs. 1–3).***

ly used. In the later layers, ceramic fragments with only dung or large plants or a mixture of both components in the pottery paste are common. The latter two types of admixtures dominated the Ja'far Plain ceramics. There is a general tendency toward decreasing the concentration of organic temper over time: from 30 to 50% in the lower layers to 10–30% in the upper ones.

In the composition of the samples selected from Mahtaj both dung in a wet and dried state and coarse plant imprints and residues were recorded in approximately the same concentrations. In general, the organic admixture to the clay makes up to at least 50% of the total volume of the pottery paste (Fig. 4.c.1a,b).

Regarding Guran, the addition of dung as temper is seen in all the ceramic types (Fig. 4.d.20a,b). The admixture of dung is represented by the predominance of very small (<0.1–0.5mm wide) plant imprints with pointed (needle) ends in the cross-sections (Fig. 4.d.6). In addition, a fragment of a mollusc shell (0.3mm long) was encountered, which is also most likely connected with dung. The shell of the mollusc is highly thinned and transparent. On its surface, there is absolutely no surface pattern typical for the outer layer of the shell, possibly indicating only the inner, pearlescent layer. In this regard, it can be assumed that it had gone through a process of digestion (Fig. 4.d.20c).

The dung was added both in lightly wet (Fig. 4.d. 20a) and dry (Fig. 4.d.6) condition, as shown by the form of plant prints (lightly curved or straight). Sometimes larger plant prints (>1mm wide) are also seen, but in low concentration. Their presence is also most likely connected with dung. In most cases the dung of goats or sheep was added (Fig. 4.d. 20a,b). The concentration of dung varies between 10–50%. In the earlier sub-type of Standard Zagros – Jarmo style – dung consisted of around 50% of the total pottery paste, while in the Guran and Sarab Geometric styles this decreased to about 30%. In the Buff ware, dung mostly presented in a concentration of about 30% (four samples), but in one case it was 10–15%. In the Red-slipped ware it varied much more, from 10 to 50% (Fig. 4).

Forming techniques

The features of the sequential construction of clay building elements were recorded in the cross-section of the Ali Kosh samples. Owing to the very small size of the available fragments, there is not enough information to distinguish the details by ceramic type. In most cases, slab construction was used in making vessels (Fig. 5). The clay slabs were joined sequentially along a horizontal circular path. This can be seen in only one large example of Ja'far Painted type (Fig. 5.a.13a) showing horizontal zones bounded by deepened lines. In the vertical and horizontal cross-sections joints of these zones are visible. They divide this horizontal zone into elements (slabs) (Fig. 5.a.13b,c). Layering of slabs divided horizontal and vertical cross-sections of sherds into two parts, inside of which joins are located at a short distance from each other (Fig. 5.a,b,c). In all cases, the clay slabs were elongated (approx. 2 x 3cm in size) and placed horizontally. In most of the ceramic fragments, there is a two-layer sequential slab construction.

Two-layer slab construction is also visible in the cross-sections of the two bases from Mahtaj in the way that slightly-deformed and elongated slabs are evident (1.2cm height, 3cm wide, 4.2cm long) (Fig. 6).

Sequential slab construction is also present in all the analysed samples from Guran (Fig. 7). The Jarmo style ceramics are made of two-layer slabs and, possibly, the same can be assigned to the fragment of the Guran style vessel (Fig. 7.a.1). In most of the Red-slipped samples two-layer slabs were also used (Fig. 7.a.6,13,14). In the horizontal and vertical cross-sections of the vessel walls, the junctions are located a short distance from each other and at a large angle to the walls of the vessel, creating layering. The slabs have a horizontal elongated shape. However, in two cases we can assume the construction of vessels from coils – in horizontal cross-section – due to the extended horizontal line of juncture, parallel to the vessel walls, in vertical cross-section, and the division into many separate parts by junctures (Fig. 7.b.4,10). Such a construction method is also seen in three fragments of Buff ware (Fig. 7. b.19).

Surface treatment and decoration

With regard to the Ja'far Painted (Fig. 8) and Ja'far Plain (Fig. 9) types at Ali Kosh, the outer and inner surfaces in all cases are covered with an additional dense layer, most likely of the same clay as the main raw material but without any organic temper, as suggested by the smooth surface of most fragments without plant imprints. Almost all ceramics with preserved coating have some loss of the upper layer (for example see Figs. 8.5a,b,6,7b, 8,9; 9.a.16b,18b,20) and cracks (Fig. 9.c.6c), which can be associated

with uneven shrinkage of the coating clay and the basic composition of the pottery paste. However, on some ceramic fragments with a destroyed surface this slightly ferruginous clay is visible in large amounts under a layer of clay covering (Fig. 9.a. 14,15,19). In some cases, over the clay, the surface of the vessels with varying degrees of wetness has been smoothed with a hard tool, probably made of bone or pebble (Figs. 8.a.3b; 9.b.25a).

The geometric designs, presumably painted with red ochre, are seen on the outer surface of all the Ja'far Painted vessels. Hole also mentioned the use of a specular hematite in one case (see *Hole* et al. *1969.117*). Under magnification, the paint showed a grainy texture, and it was applied unevenly (Fig. 8.a.11b).

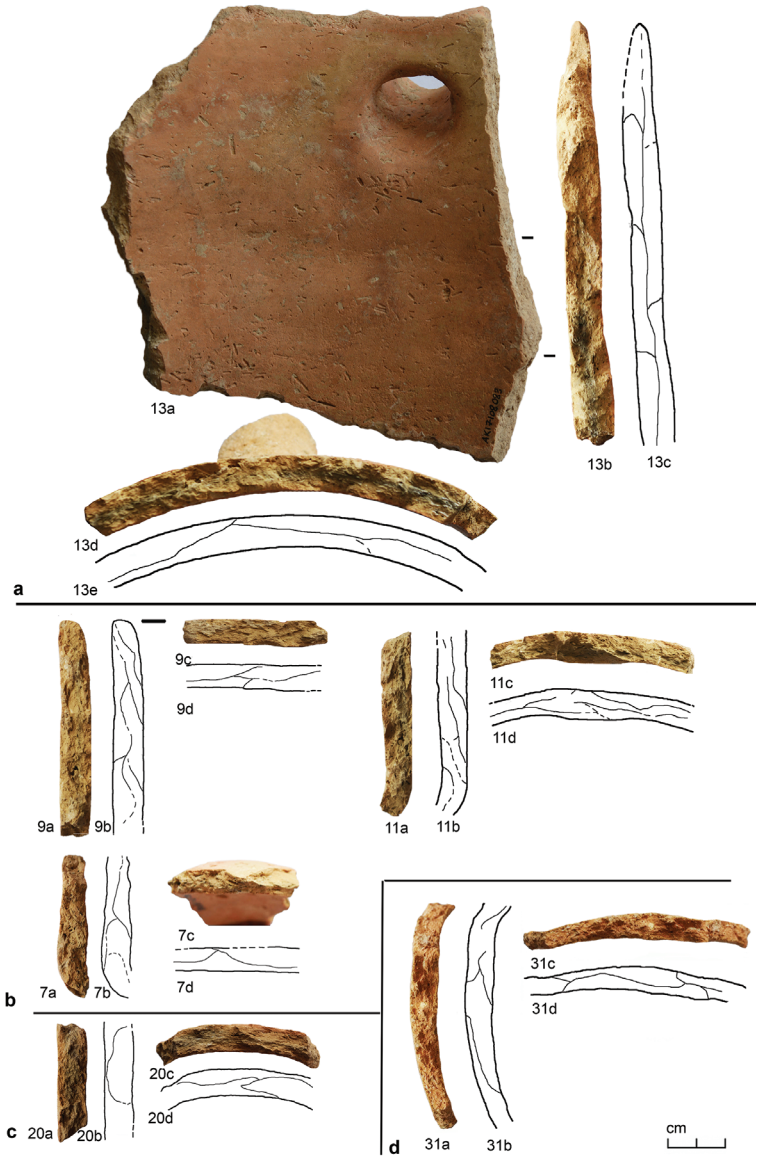

Fig. 5. Ali Kosh. Forming techniques methods: two-layer slabs. **a**,**b** ***Ja'far Paint;*** **c** ***Ja'far Plain;*** **d** ***Khazineh Red (photos and drawings here and further made by N. Petrova).***

Fragments of Ja'far Plain are usually covered with the same slightly ferruginous clay (Fig. 9a), but sometimes with highly ferruginous clay, as evidenced by characteristic cracks on the surface (Fig. 9b,c). This last case is interesting: when smoothing over a well-dried surface and then firing it in an oxidized atmosphere, the effect of a 'reddish colour' appeared. In one case the vessel was polished with a hard tool. As the result, both surfaces of the vessel acquired a bright red colour (Fig. 9.c.26a-d).

In case of Khazineh Red (Fig. 10), two sub-types of surface treatment can be distinguished. First, the surface was covered with an additional clay coating from the same clay on both surfaces of the vessel. This is usually accompanied with chips of the upper layer (Fig. 10.a.27b,29) and characteristic cracks (Fig. 10.a.30). In two cases, burnishing with a hard tool is recorded on a not completely dried surface (the so-called 'leather-hard' condition, when barely visible grooves left by the smoothing tool remain on the surface) (Fig. 10.a.29, 30). In general, this tradition of surface treatment is also characteristic of the Ja'far Plain and Ja'far Painted types. Regarding Khazineh Red specifically, however, the outer surface of fragments is completely red or sometimes plum coloured (Fig. 10. a.30). Second, the vessel has a layer of red slip (clay mixed with some red pigment) on both surfaces. The slip is indicated both by cracks on the outer surface (Fig. 10.b.31b) and by a layer, 0.1mm thick (Fig. 10.b. 31c), that is easily distinguishable under a microscope in the cross-section. Interestingly, in one case while the outer surface of the fragment was only covered with red slip, the inner red-slipped surface was overlaid with plum colouring (Fig. 10.b.31a,d,c), but the outer surface only had a layer of coating with the same clay (Fig. 10.b.31d,e).

In the case of the samples from Mahtaj, an additional coating with the same clay is distinguishable on the outer and inner surfaces of the vessels. Cracks are also visible on both sides.

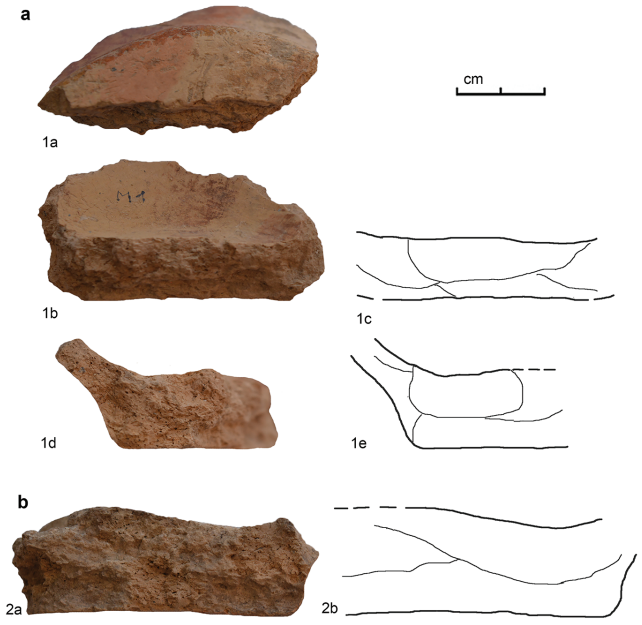

Fig. 6. Mahtaj.* a,b *two-layer slabs in the bases of different vessels.

At Guran, the Standard Painted ceramics, including Charmo (Fig. 11.a.1) and Guran styles (Fig. 11.a.2), Sarab Geometric (Fig. 11.b) and buff wares (Fig. 11.c) were slipped with a clay similar to their paste before firing, as evidenced by characteristic cracks on the surface (Fig. 11. b.3c,19c) and delamination of the coating layer, under which the surface is visible with a high density of organic inclusions (Fig. 11.c.22). The buff ware was also burnished in all cases. The ceramics types of the Charmo style, Guran style and Sarab Geometric were decorated with geometric designs painted in red ochre. Here, Red-slipped ware can also be divided into two sub-types.

In most of the available samples, both outer and inner surfaces (or sometimes just the outer) of the Red-slipped ware (Fig. 12), based on the colour uncharacteristic of natural clay, are covered with a mixture of clay and red pigment before firing (Fig. 12.a). In addition, a variation of brown slip is found (Fig. 12.a.14). The thickness of the slip layer varies (for a comparison see Fig. 12.a.5d – 0.15mm, and Fig. 12.c.17c – 0.05mm) and in all cases it is applied to the unfired surface, as evidenced by characteristic cracks (Fig. 12.a.6c) and by surface losses – *i.e.* rounded chips inside these cracks (Fig. 12.a.5a,b,c,6a, 8b). The slipped surface is usually slightly or highly burnished. From time to time, one can find prints of textile indicating its application either in smoothing or slipping with a textile (Fig. 12.a.11c).

In three cases the surface of vessels was covered with the same clay and then fully overlaid by colouring (Fig. 12.b,c,d). Two samples represent a reddish-brown colouring just on the outer surface (Fig. 12.b.15a,16a). In another case, brown colouring was applied to the outer surface (Fig. 7.d.17a,c,d), while the inner surface contains red colouring (Fig. 12.d. 17b,e). In one interesting case, brown paint covered a layer of red slip applied to the outer surface of the vessel (Fig. 12.c.18a,c,d), but the inner

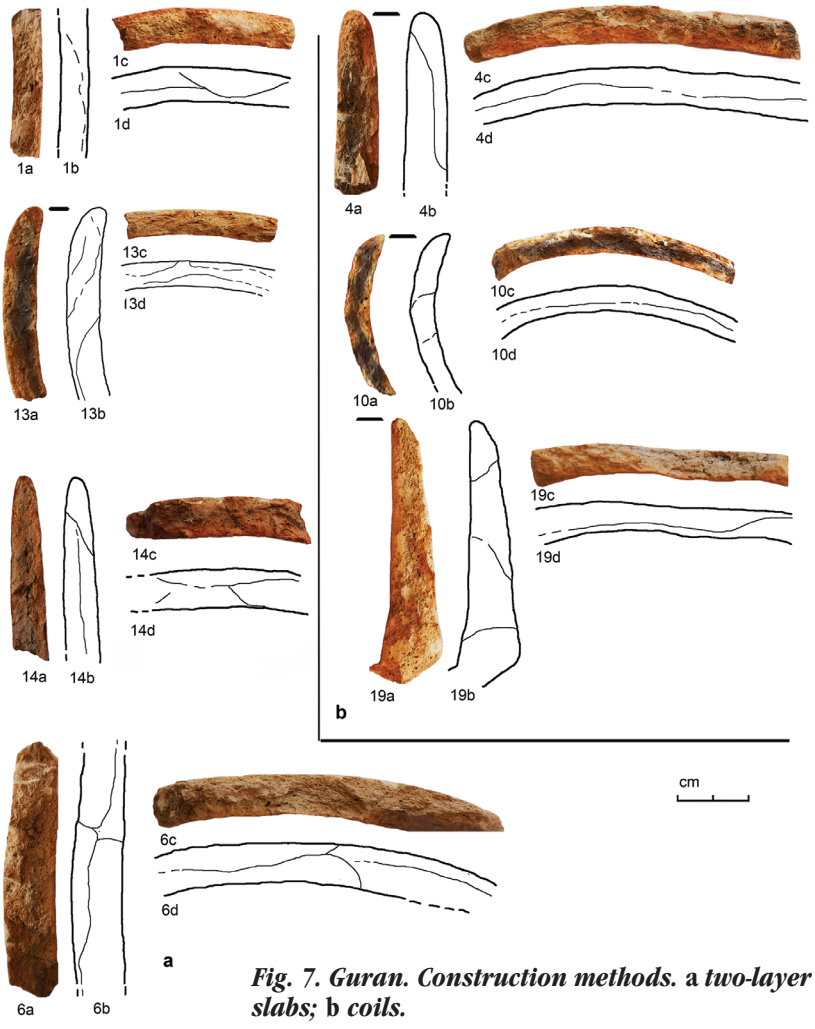

Fig. 7. Guran. Construction methods.* a *two-layer slabs;* b *coils.

surface was covered by red slip only. Different variants of brown colour can be reached by using iron oxide pigments with firing at higher temperatures (*Hole* et al. *1969.113*), for example magnetite, hematite and limonite in a different oxidative and reduction firing atmosphere (*Nieuwehuyse* et al. *200.158–160*).

Firing

All the Ali Kosh vessels were fired using an oxidizing atmosphere. Two fragments of Khazineh Red pottery are fully oxidized (Fig. 5.d). Others have a dark or light grey core. In half of the cases, the margin of the transitional layer between the outer orange layer and dark core is sharp (this mainly refers to the Ja'far Plain ceramics (Fig. 5.c.9a, 16c, 19b,20b), which indicates that the vessel did not cool down in the firing device and was abruptly removed after a short exposure to high temperatures. In other cases – mostly Ja'far Painted – the margin of the dark core is gradual and the oxidized layer is much thicker, which may indicate a longer stay in the firing device (Fig. 5.a,b). Judging from the thickness of the oxidized layers and the presence of calcined organic residues in some fragments, the ceramic vessels of Ali Kosh seem to have been fired at a temperature of about 650–700°C (*cf. Bobrinsky 1999.99; Rue 1981.118*). Our analysis showed that the bases recovered from Mahtaj are completely oxidized (see Fig. 6). All the Guran samples were also fired in an oxidizing environment at a temperature not lower than 700–750°C, and the lack of organic inclusions suggests their long exposure to the heat. Thin-walled fragments of Jarmo, Guran and Sarab Geometric styles are all oxidized (Fig. 7.a.1), while just half of other types had the same feature (Fig. 7.a.6,b19), and the rest have a light grey core with gradient margins, although complete oxidation is also recorded in different parts of the fragment (Fig. 6.a.13,14, b4,10). Of the analysed samples only one piece of Red-slipped ware contains a very thin oxidized layer, with a dark grey core and a sharp margin between oxidized and core layers of its cross-section.

Fig. 8. Ali Kosh. Ja'far Painted ceramic type – covering with the same clay + paint.

Discussion: development of Neolithic pottery technology in Zagros

The ceramic assemblages analysed for this research were sampled from Neolithic sites that are located in both the highlands and lowlands. At the same time, they, and specifically Ali Kosh and Guran, represent the most common Neolithic ceramic types in the region. This inspired us to deploy a deductive approach in order to reach some 'generalization', though local criteria should also be given attention. In the light of available evidence and based on the current research, however, we may discuss the development of early pottery technology of the Zagros region with regard to the analyses outlined above.

Addressing the emergence of pottery technology, it is necessary to draw on Vandiver's assumption highlighting its connection with building technologies (*Vandiver 1987*). In this regard, general clay architectural remains from the pre-pottery Neolithic, and specifically those from Ganj Dareh, indicated the presence of a large plant admixture added during the

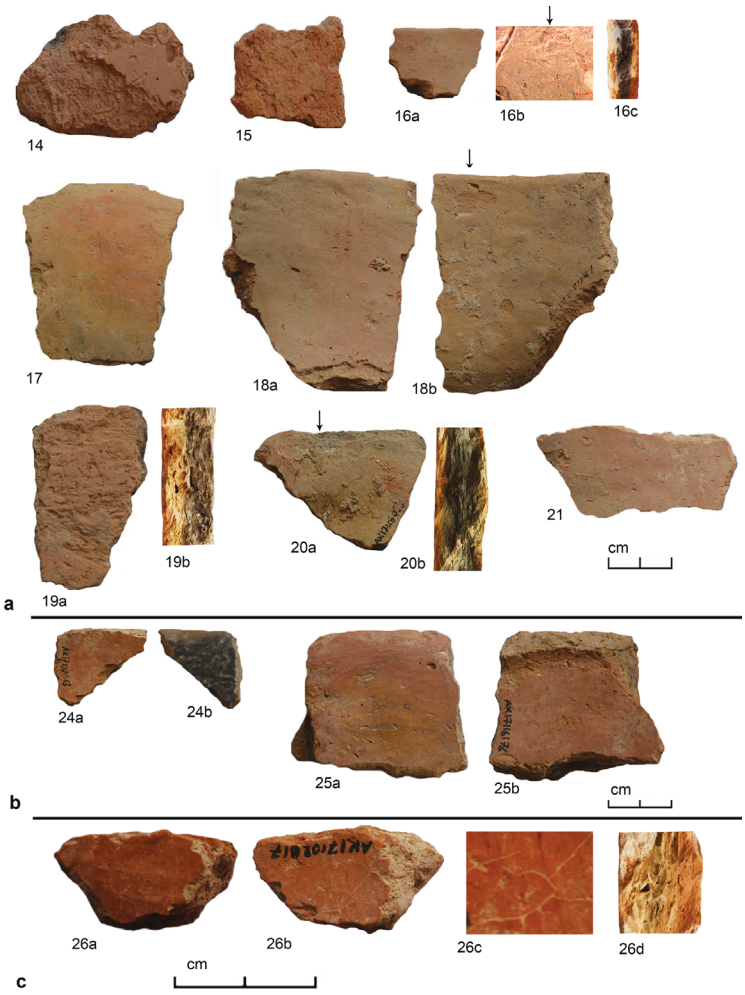

Fig. 9. Ali Kosh. Ja'far Plain ceramic type.* a *coated with the same slightly ferruginous clay;* b *coated with the same highly ferruginous clay + burnishing;* c *high burnishing over the highly ferruginous clay creates the effect of a 'red surface', in the cross-section a calcined highly ferruginous layer of clay can be seen (*26.d*).

construction of adobe buildings. At Ganj Dareh, the clay building construction elements are found in two types: chineh (strips) and mud bricks (*Smith 1990. 328–332*). It is noteworthy that such features were omnipresent at early Neolithic sites such as Ali Kosh, Sheikhi Abad, Mahtaj and Abdul Hosein. Along with the production of clay vessels, stone vessels, baskets and white ware, as well as clay objects, such pise walls reveal both long experimentation and knowledge before the appearance of true pottery. From an architectural perspective, pise building and plastering or coating walls either with clay or red ochre merits specific attention as a key precursor to pottery-making and decorating. The small and large clay containers from Ganj Dareh evidently support this idea. Here, large unbaked storage vessels were in some cases fixed to the floor or attached to the wall. These were large, round, up to one meter in height, storage vessels, and semicircular storage compartments that had one common wall with the dwelling (*Smith 1990. 332*). Vandiver (*1987.25*) noted that montmorillonite clays are mainly used in the settlements of the region. Our observations of earlier ceramics of Ali Kosh, Mahtaj and Guran demonstrated the careful and intentional selection of raw materials, and that the clay was used without large mineral impurities, including limestone seen in an insignificant concentration and small size. This shows differences compared to Ganj Dareh, where some vessels were made of clay with a large mineral admixture (*cf. Smith 1990.332*).

As for intentionally added impurities, the earliest clay vessels of Ganj Dareh are of two types: small samples without any visible, specially added temper, and oversized items (larger pottery, storage vessels, and basins) where plant impurities are recorded (*Vandiver 1987.17; 1985.194–195*). When it comes to the pottery paste, the putative organic temper is considered for the Neolithic assemblages though various terms like 'vegetal', 'straw' or 'chaff' are also applied. However, the presence of dung was already reported from some sites, such as Charmo, Gird Ali Agha and Tell el-Khan (*Adams 1983; Matson 1960. 68*), Shimshara (*Tauber 1970.143*) and Guran (*Mortensen 2014.50*; also see above). With regard to the samples from Ali Kosh and Mahtaj, the organic temper from the very beginning has a different and multicomponent composition: dung and crushed coarse plant inclusions, both separately and in combination. It can be assumed that the tradition of adding the dung of sheep and goats to the pottery paste spread during the 7th millennium BC. It is noteworthy that dung had also been used as fuel resource in the Zagros region during the pre-pottery Neolithic, as evidenced by micro-morphological analysis (*Matthews* et al. *2013; 2016; 2020; Fatui Dilanchi* et al. *2020*). We assume that dung along with crushed plant admixtures was used by local potters, though a full understanding of the organic material (threshing waste, chaff or some other type of crushed straw) requires further consideration. The technological characteristics of the later stage at Guran (from level O onwards) showed the

predominance of dung added to the pottery paste.

The Neolithic ceramics in the studied region were mostly produced using clay slabs (Fig. 13). Even their precursor, namely clay containers from Ganj Dareh, had a similar method of production (*Vandiver 1987.18*). Slab construction in the Zagros region has been reported from a number of sites, such as Sarab (*Vandiver 1987.18*), Chogha Sefid (in layers of later Neolithic – Sefid and Surkh phase) (*Hole, Tonokie 2021*), Sabz (*Hole* et al. *1969.111–112*), Chogha Mish (*Delougaz, Kantor 1984.228*), Hajji Firuz (*Vandiver 1987.18–19; Voigt 1983.149–152*) and in Northern Mesopotamia – Yarim Tepe I, Sotto, Umm Dabaghiya of Proto-Hassuna and Hassuna periods (both Archaic and Standard) (*Petrova 2019; 2021*). Based on our analysis, the ceramics were built up in two-layer slabs in Ali Kosh and Mahtaj. This method is also attributable to the later Guran ceramics from level O onwards, specifically in the cases of tadpole (Charmo and Guran styles) and Red-slipped wares.

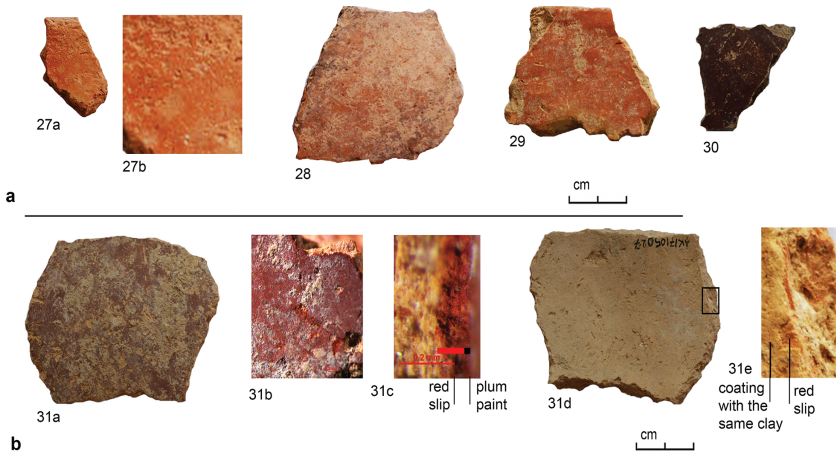

Fig. 10. Ali Kosh. Khazineh Red ceramic type.* a *coating with the same clay + full pigment colouring;* b *coating with red slip (clay mixed with red pigment). Outer surface – red slip + plum colouring (*31.a,b,c*). Inner surface – red slip + coating with the same clay (*31.d,e*).

In connection with the use of sequential slab construction, the question of using the mould to which these slabs were stuck arises. On the one hand, the connection with building technologies suggests free modelling, and that the first storage vessels were most likely built in this way. On the other hand, some of the vessels made of two-layer slab construction are small and thin-walled, which is difficult to do without using a mould and paddling. It is noteworthy that sticking clay slabs onto a base mould is still being used by some women who produce pottery vessels in Baneh, Iranian Kurdistan (*Sedighian, Mahjour 2010.83*). According to archaeological materials, the use of a mould was previously supposed for the vessels from Ganj Dareh (*Smith, Crepeau 1983. 56–58*). The prints of weaving, which possibly remained from a liner that covered the mould (to help separate the future vessel from mould), were found on the ceramics of the later site of Hajji Firuz, northwestern Iran, where they are seen inside the bases of the vessels and on the outer surface under a layer of coating (see *Voigt 1983.149, Pl. 25*). In addition, some samples from Chogha Mish showed the appli-

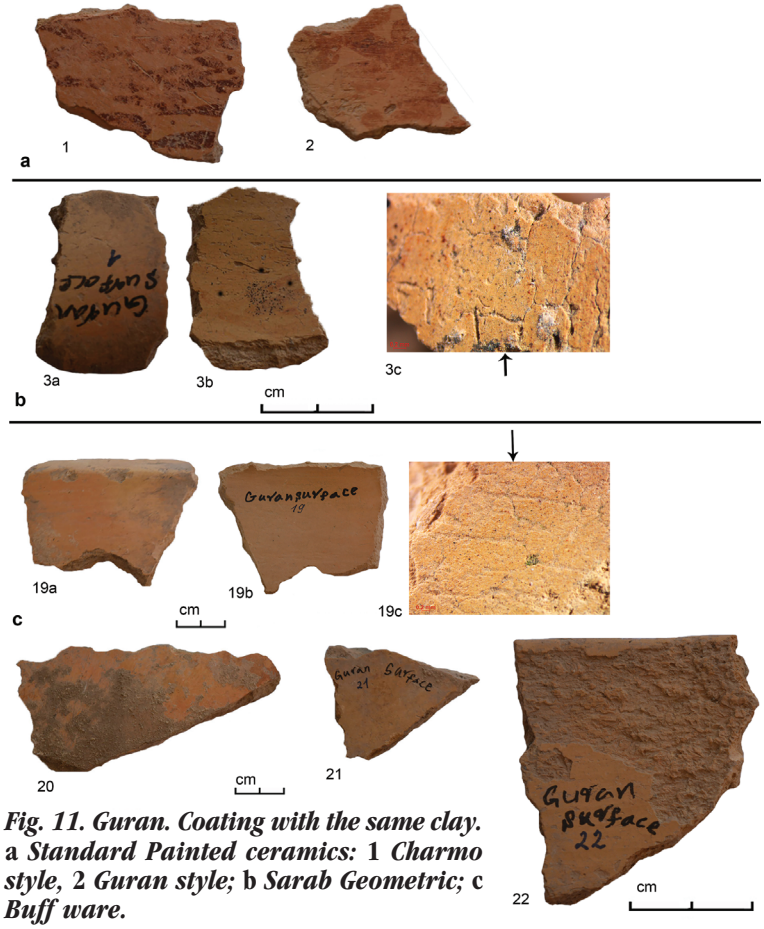

Fig. 11. Guran. Coating with the same clay.* a *Standard Painted ceramics:* 1 *Charmo style,* 2 *Guran style;* b *Sarab Geometric;* c *Buff ware.

cation of the same method on their inner sides (*Delougaz, Kantor 1996.228*). The use of a mould in making pottery vessels has not yet been reported from other Neolithic sites in Zagros. Hole *et al.* (*1969.111*) noted the absence of features of paddling in Ali Kosh, and although such features are also seen in our assemblage from the site, they are comparatively smaller in size. However, as indicated by some fragments from Hajji Firuz, a mould or link might have been applied during the Neolithic, though their prints were hidden by subsequent clay coating.

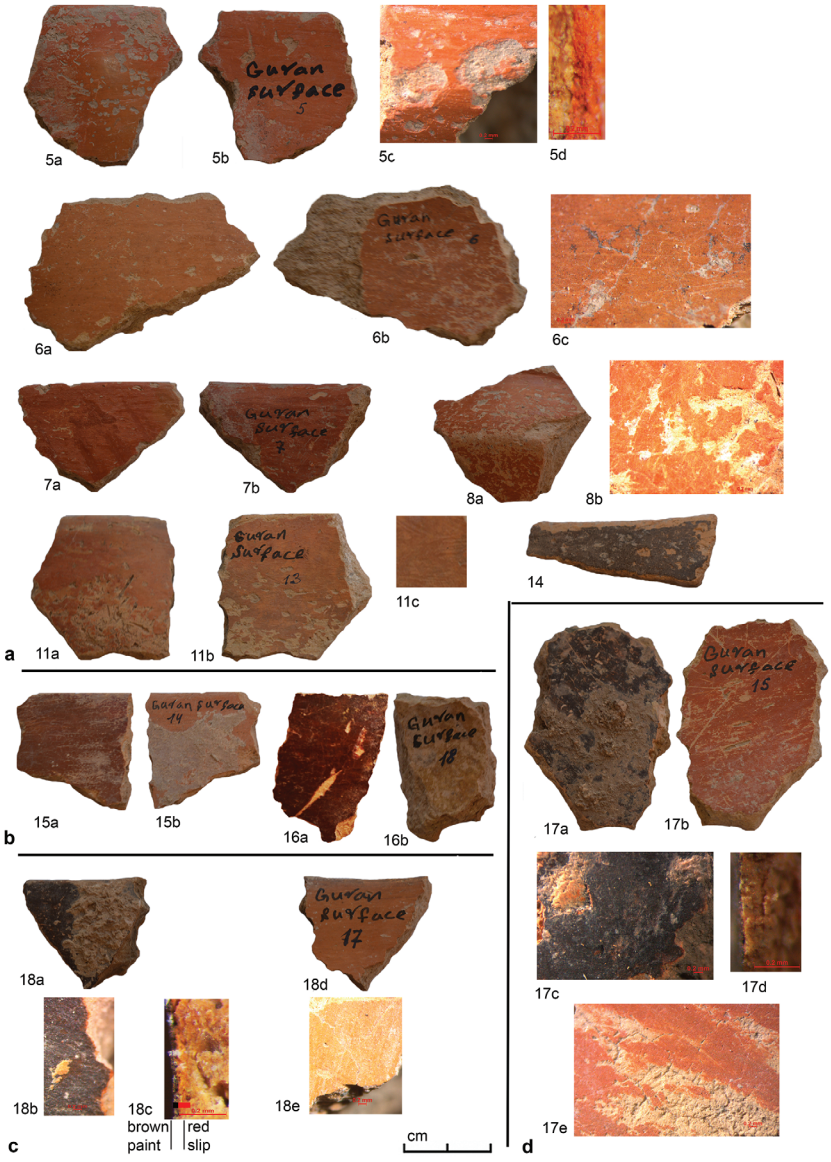

Fig. 12. Guran. Red-slipped ware.* a *both surfaces covered with red slip (clay mixed with red pigment);* b *outer surface coated with the same clay + red-brown paint, inner surface – coating with the same clay;* c *outer surface coated with red slip + brown paint (*18.a,c,d*), inner surface – red slip (*18.b,e*);* d *outer surface coated with the same clay + brown paint (*17.a,c,d*), inner surface – coating with the same clay + red paint (*17.b,e*).

At Guran, some samples of Buff and Red-slipped wares were produced using coil construction. However, it is difficult at present to conclude whether this method was used from the beginning of ceramic levels of the site, or it was a later tradition that had been brought from outside. This issue requires further data. The use of coils was previously recorded from the sites of Hajji Firuz and Ali Agha, both dated to the late 7th and early 6th millennia BC, in northern and northwestern/western Zagros, respectively (*Voigt 1983.149–152*) and in Northern Mesopotamia – Yarim Tepe I, Sotto, Umm Dabaghiya of Proto-Hassuna and Archaic Hassuna periods (*Petrova 2019; 2021*).

According to ethnographic data, different technological stages react differently to innovations (*Bobrinsky 1978; Schiffer, Skibo 1987; Stark 1999*). At all stages of pottery technology, it is very important to distinguish the construction methods deployed for making the vessels. This technological stage is least susceptible to outside influence, and may indicate not only cultural interactions but also the composition of the population and its changes, in contrast to the methods of making the pottery paste and surface treatment (*Bobrinsky 1978.244; Fowler 2017.14; Gosselain 1992.582; 2000.192*).

The surface of the ceramics from our three sites share a feature, the presence of an additional clay coating (covering by the same clay or a slip). This is also reminiscent of an earlier building construction technique when the walls of the houses were covered with additional clay coating in pre-pottery Neolithic settlements. Clay coatings are noted on the ceramics recovered from various sites such as Ali Kosh (*Hole* et al. *1969.110*), Guran (*Mortensen*

2014.50–66), Chogha Bonut (*Alizadeh 2003.46, 56*), Chogha Mish (*Delougaz, Kanto 1984.227*), Chogha Sefid (*Hole 1977*), and Sarab (*McDonald 1979*). In most cases, the coating is similar to the texture of the vessels.

Smoothing and burnishing of the surface is ubiquitous during the Neolithic period. We identified various methods of surface treatment in association with Ali Kosh and Guran: smoothing the surface having varying degrees of dryness with a hard tool (seen in all ceramic types of Ali Kosh) up to the appearance of the effect of slightly burnishing (in Ja'far Plain) and full burnishing (characteristic of Buff ware and Red-slipped ware at Guran). In addition, the surface was also smoothed with textile at Guran.

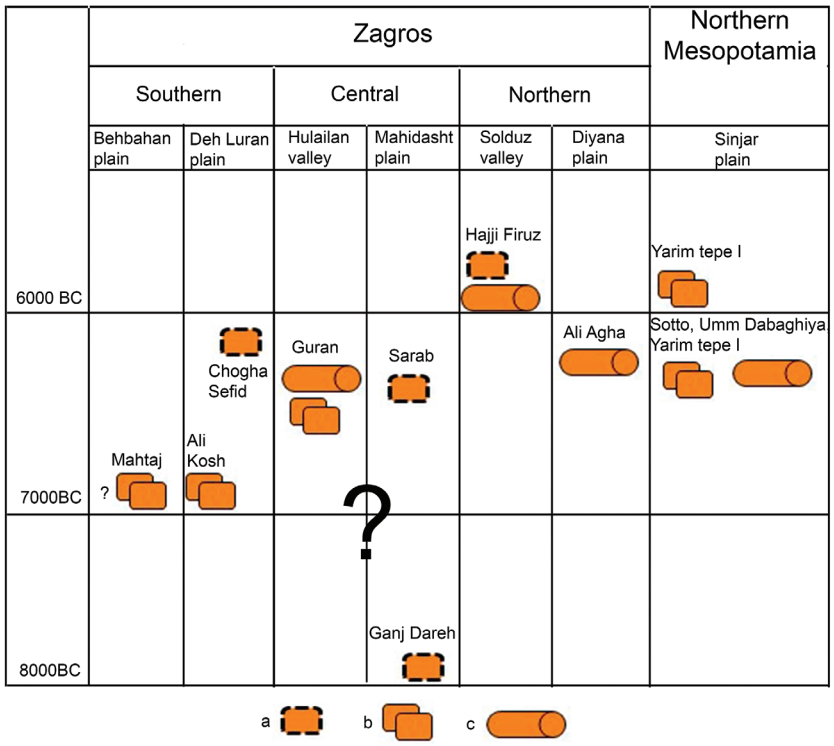

Fig. 13. Pottery construction methods seen in Neolithic Zagros:* a *slab construction (shape and number of layers unknown);* b *two-layers slab construction;* c *coil construction.

Stamped and carved ornaments, specifically punctate impressions like carved lines and crescent notches produced by a fingernail or the end part of a bone, are seen on the earliest ceramics of Guran and also those from the earlier site of Ganj Dareh (*Mortensen 2014.50; Smith 1974.207*). The nature of such early decorated samples is still ambiguous, as they are documented as vessels made of untempered clay and it is still arguable to what extent they can be taken as the incipient clay/pottery containers. However, this type of ornament was then replaced by the paint decoration in the region. Soon after, the surface decoration is associated exclusively with the use of pigments such as red ochre, which were either applied for making geometric designs or completely covered the surface. As mentioned above, at Ali Kosh and Guran such pigment was applied over a surface previously covered with a red slip. This suggests an attitude by the early potters to treat slip as a way of covering, but not decorating, the surface. Our analysis showed various methods of achieving the 'red surface' of Khazineh Red and Red-slipped ware at both sites. This can be divided and diachronically traced. Firstly, a full coverage of the surface with only a colouring pigment such as ochre on a covering of the same clay was common. Secondly, it seems that during the process of treatment a red-slipped surface appeared when the covering with the same clay was mixed with red pigment. This method came about over time, as seen from uppermost levels at Ali Kosh, where fully coverage of the outer surface with of plum-coloured paint is synchronously seen.

All the fragments we studied were fired using an oxidative firing. The vessels from Ali Kosh show the existence of various heat treatments: short or long exposure in the heating zone, depending on the type of ceramics. In this regard, the Ja'far Plain samples were usually fired for a relatively short time, while the Ja'far Painted and Khazineh red ones underwent longer exposure. However, we have some fragments from Ali Kosh of different ceramic types that are fully calcined. At Guran an increase in firing duration for all types is seen over time: in half of the cases the items they are fully calcined; in some other cases (Red-slipped ware and Buff ware) the vessels were fired with long exposure to the heat zone. In general, this may indicate possible improvements in the process of ceramic firing.

According to some researchers, dung was an outstanding fuel resource in western Asia from the early Neolithic onwards (see *Hesse 1984; Matthews*

et al. *2020; Miller 1984; Miller, Marston 2012.97; Spengler 2019*). However, in ethnographic research it is cattle dung that has been mostly given attention (*Mahjour* et al. *2014.25; Matson 1974.345; Petrova 2011.135; Salimi 2014.589*), while the earliest evidence for cattle domestication is attributed to the early 6th millennium BC in Zagros (see *Arbuckle* et al. *2016*). Thus, the use of animal dung at the earlier settlements such as Ali Kosh and Guran would have been restricted to that of goats and sheep. According to Wendy Matthews (*2016.116–117*) the type of fuel used varied depending on local conditions, and dung was widely used as a fuel. In this regard, woods (and specifically oak trees) were more often burned in the highlands (in particular the landscape surrounding Ganj Dareh), while in the foothill-steppe region and on the plains, in particular the Deh Luran Plain where the settlement of Ali Kosh is located, grasses and reeds were used for this purpose (*Helbaek 1969.387; Miller 1996.521–525*). However, the presence of dung in the pottery assemblage from Ali Kosh suggests the multi-purpose usage of dung. As mentioned before, micromorphological analysis has also shown presence of animal dung, most likely goat, at the pre-pottery sites of Sheikhi Abad (*Matthews* et al. *2013*) and Mahtaj (*Fotuhi Dilanchi* et al. *2020*) prior to its use in association with early pottery production, whether as temper or fuel. Our knowledge about firing devices still remains at the level of assumption: firing was carried out either in bonfires, or in hearths coated with clay and built up with mud bricks, or in ovens (*Schmandt-Besserat 1974.15; Hole* et al. *1969.40, 42*). However, excavations at Yarim Tepe I (level 10) have shown the remains of a two-stage pottery kiln dated to the Archaic Hassuna period in Northern Mesopotamia) (*Munchaev, Merpert 1981.75*). The presence of such a developed device at the end of the 7th millennium BC allows us to assume the existence of simpler devices at an earlier time, coinciding with the emergence of pottery in the Iranian Zagros foothills.

Concluding remarks

The technological analysis conducted on the ceramic assemblages from the three Neolithic sites shed new light on the nature of early developments of pottery production along the Iranian Zagros. To conclude the current research, we may highlight both similarities and differences in terms of construction methods, paste, raw materials, firing and surface treatments that were applied by the early potters across highlands and lowlands. Of the samples from Ali Kosh, the Ja'far Plain type is somewhat different from the other two types with regard to the technology. The walls are thicker and firing time was shorter. Sometimes it contained an abundant admixture of coarse plant residues in the pottery paste, occasionally combined with dung. It was previously believed that Ja'far Plain was identical to Ja'far Painted unless the latter was decorated (*cf. Hole* et al. *1969.117*). However, our analysis indicated that the Ja'far Painted type shared some similarities with Khazineh Red, as they both show the predominant use of dung as a temper and a longer firing. The Khazineh Red type represents three variants: the earlier indicated by the samples bearing a red paint fully overlaid with clay slip, and the later represented by red-slipped vessels showing a mixture of clay slip and reddish pigments. However, the third group includes some different cases showing red slip on the outer surface overlaid with full colouring, and on the inner surface with a layer of the same clay covering. We assume that the technology of the Ali Kosh ceramics had definitely passed some stages of development when it emerged at the site (*cf. Hole* et al. *1969. 352*). However, its predecessor still remains a controversial issue. The clay was specially selected without any large natural mineral inclusions. The pottery paste also has a different and multicomponent composition: crushed plants (possibly, threshing waste – chaff) and the dung of sheep and goats. In the construction stage, two-layer elongated slabs were built up along a circular horizontal path. During surface treatment, there is always a clay coating on the vessels. Various smoothing techniques were applied at the site using a hard tool, with varying degrees of dryness on the surface to be slightly or fully burnished. With regard to firing, there are various approaches: short or long exposure in the high temperature zone, depending on the type of vessel being made.

The main technological characteristics of a few pottery fragments from Mahtaj are close to those of Ali Kosh in the way that a combination of dung and coarser plant impurities are seen in the paste. Moreover, the sequential two-layer slab construction of vessels and coating the surfaces with wash are also notable.

Although various ceramic types are present at Guran, they share some technological characteristics: selection of clay without any large amount of natural mineral inclusions, intentional adding of dung into the pottery paste, two-layer slab construction, an intentional covering layer on the vessel (wash or

slip) and the presence of significant amount of completely calcined sherds during firing. In addition to the ubiquitous method of slab construction, clay coils were attested for some Red-slipped and Buff ware fragments. However, the emergence of the coil construction method at Guran is as yet unknown either as a locally developed or an imported tradition. To better understand this a study of stratified early materials from the site seems important.

As in case of Ali Kosh, at Guran three variants of 'red surface' can also be determined in Red-slipped ware: first, a fully red painted surface overlaid with a layer of clay similar to the paste; second, red slipped (clay mixed with pigment) surface, which is present in the majority of cases. The third case is represented by two very interesting ceramic fragments recovered from Ali Kosh and Guran. The pigment was applied over a surface previously coated with a red slip. The presence of similar items in both settlements could synchronize the upper layer(s) of the Ali Kosh settlement and the corresponding layer(s) at Guran, if the ceramics came from stratified excavations. However, the existence of this unusual treatment at both sites may indicate cultural interactions between highlands and lowlands. Such close interactions are mirrored in a majority of comparable archaeological finds, from lithic types to architectural layouts and to pottery style sand construction methods, as well as in the spread of obsidian across Zagros. This may undermine the idea that in the Neolithic period contacts between the foothills of the Zagros (Ali Kosh) and its central regions (Ganj Dareh, Guran) were unlikely, because they were separated by the 'formidable' Kabir Kuh – the longest of the Zagros Mountain ranges (*Hole 2018.178*). Although such natural barriers could have affected the path and rate of interactions, the role played by the transhumant people who were tracking a vertical movement and river valleys, such as Seimarreh, should not be overlooked.

In case of Ali Kosh, the emergence of pottery seems to have happened abruptly at the site, an issue suggesting that some earlier steps may have been taken somewhere else. In this regard, Abbas Alizadeh (*2003*) assumed that the so-called phase of 'Susiana Formation' at Chogha Bonut was a precursor of the Mohammad Ja'far phase at Ali Kosh. However, this hypothesis is still open, as both sites experienced different pottery styles. Therefore, one may see the pottery Neolithic (*c.* 7000–6000 BC) as a millennium which saw a combination of local creativity and inter-connectedness with surrounding areas.

With regard to the initial construction methods, we suppose both free construction of vessels and making them on a mould. The former is seemingly connected with building technologies, while the latter suggests another experience, possibly influenced by coating pits with clay. However, the early ceramics were commonly produced using a slab construction method, though clay coils were sometimes also applied. The origin of the coil construction method in the Zagros region is not yet known. Nevertheless, one may see it as one of the variants in the development of building techniques or elongated slabs. This idea, of course, requires further investigation.

In this study we have brought to light some general information about the technology of the earliest ceramics along the Iranian Zagros. However, placing such analyses within a larger region will allow us to better understand the Early Neolithic pottery technology in the Eastern Fertile Crescent.

ACKNOWLEDGEMENTS

This research benefited from helps and comments of a number of people. In this regard, we wish to express out thanks to Dr. Yuriy Tsetlin, Dr. Sajjad Alibaigi, Prof. Frank Hole, Hafez Ghaderi, Minoo Salimi, Elham Fatuhi, Dr. Shokouh Khusravi, Fereshteh Sharifi and Dr. Hossein Sedighian. Hafez Ghaderi was very helpful with the photography of some samples. We also thank Razi University, Kermanshah, and State Historical Museum, Moscow for their collaboration and support for this research.

References

Adams R. Mc. C. 1983. The Jarmo stone and pottery vessel industries. In L. S. Braidwood, R. J. Braidwood, B. Howe, Ch. A. Reed, and P. J. Watson (eds.), *Prehistoric archaeology along the Zagros flanks*. Oriental Institute Publications. Vol 105. University od Chicago Press. Chicago: 209–232.

Albero Santacreu D. 2014. *Materiality, Techniques and Society in Pottery Production: The Technological Study of Archaeological Ceramics through Paste Analysis*. De Gruyter Open Poland. Warsaw. https://doi.org/10.2478/9783110410204

Alizadeh A. 2003. *Excavations at the prehistoric mound of Chogha Bonut, Khuzestan, Iran. Seasons 1976/77, 1977/78, and 1996*. Oriental Institute Publications. Volume 120. Oriental Institute of the University of Chicago. Chicago.

Arbuckle B. S., Price M. D., Hongo H., and Oksüz B. 2016. Documenting the initial appearance of domestic cattle in the Eastern Fertile Crescent (northern Iraq and western Iran). *Journal of Archaeological Science 72: 1–9*. https://doi.org/10.1016/j.jas.2016.05.008

Bernbeck R. 2017. Merging clay and fire: earliest evidence from the Zagros mountains. In A. Tsuneki, O. Nieuwenhuyse, and S. Campbel (eds.), *The Emergence of pottery in West Asia*. Oxbow Books. Oxford: 97–118.

Bobrinsky A. A. 1978. *Pottery of Eastern Europe. Sources and methods of studying*. Nauka. Moscow. (in Russian)

1999. Pottery technology as an object of historical-and-cultural study. In A. A. Bobrinsky (eds.), *Actual problems of ancient pottery investigation*. Nauchnaya biblioteka Samgpu. Samara: 5–109. (in Russian)

Darabi H. 2018. Revisiting stratigraphy of Ali Kosh. Pazhuhesh-hay-e Bastanshenasi Iran. *Archaeological Research of Iran 16: 27–42*. (in Farsi)

Darabi H., Aghajari M., Nikzad M., and Bahramiyan S. 2017a. In search of Neolithic Appearance along the Northern Shorelines of the Persian Gulf: a report on the excavation at the pre-pottery Neolithic site of tapeh Mahtaj, Behbahan plain. *International Journal of the Society of Iranian Archaeologists 3(5): 13–22*.

Darabi H., Bahramiyan S., Mostafapour S., and Khademi Bami M. 2017b. Re-excavation at tapeh Ali Kosh, Deh Luran plain, Iran. *Neo-Lithics. 2: 15–18*.

Darabi H., Bansgaard P., Arranz-Otaegui A., Ahadi G., and Olsen J. 2021. Investigating early Neolithic occupation of the lowlands in southwestern Iran: New Evidence from Tapeh Mahtaj. *Antiquity 95(379): 27–44*. https://doi.org/10.15184/aqy.2020.215

Darabi H., Richter T., and Mortensen P. 2019. Neolithization process in the central Zagros: Asiab and Ganj Dareh revisited. *Documenta Praehistorica 46: 44–56*. https://doi.org/10.4312/dp.46.3

Delougaz P., Kantor H. J. 1996. *Chogha Mish. Volume I. The first five seasons of excavations 1961–1971*. Oriental Institute Publications 101. The Oriental Institute. Chicago.

Fotuhi Dilanchi E., Darabi H., and Heydari Guran S. 2020. A micromorphological analysis of the Neolithic site of Mahtaj, Behbahan Plain. *Journal of Research on Archaeometry 6(1): 81–96*. (in Farsi) http://jra-tabriziau.ir/article-1-218-en.html

Fowler K. 2017. Ethnography. In A. Hunt (ed.), *Oxford Handbook of Archaeological Ceramic Analysis*. Oxford University Press. Oxford: 469–486. https://doi.org/10.1093/oxfordhb/9780199681532.002.0003

Gosselain O. 1992. Technology and Style: Potters and Pottery among Bafia of Cameroon. *Man (N.S.) 27: 559– 586*.

2000. Materializing identities: an African perspective. *Journal of Archaeological Method and Theory 7: 187–217*. https://doi.org/10.1023/A:1026558503986

Helbaek H. 1969. Plant collecting, dry-farming and irrigation in prehistoric Deh Luran. In F. Hole, K. V. Flannery, and J. A. Neeley (eds.), *Prehistory and Human Ecology of the Deh Luran Plain. An Early Village Sequence from Khuzistan, Iran*. Memoirs 1. Museum of Anthropology at the University of Michigan. University of Michigan Press. Ann Arbor: 383–426.

Hesse B. 1984. These are our goats: The origin of herding in West Central Iran. In B. J. Clutton, C. Grigson (eds.), *Animals and Archaeology 3: Early Herders and Their Flocks*. BAR International Series 202. British Archaeological Reports. Oxford: 243–264.

Hole F. 1977. *Studies in the archeological history of the Deh Luran plain. The Excavations of Chagha Sefid*. Memoirs 9. Museum of Anthropology at the University of Michigan. University of Michigan Press. Ann Arbor.

1987. *The Archaeology of Western Iran. Settlement and Society from Prehistory to the Islamic Conquest*. Smithsonian series in Archaeological Inquiry. Smithsonian Institution Press. Washington.

2018. The creative centuries: diversity and innovation in Iranian Neolithic ceramics. In A. Gomez-Bach, J. Becker, and M. Molist. (eds.), *II Workshop on Late Neolithic ceramics in Ancient Mesopotamia: pottery in context*. Museu d'Arqueologia de Catalunya. Barcelona: 173–184.

Hole F., Flannery K. V. and Neely J. A. 1969. *Prehistory and human ecology of the Deh Luran plain. An early village sequence Khuzistan, Iran*. Memoirs 1. Museum of Anthropology at the University of Michigan. University of Michigan Press. Ann Arbor.

Hole F., Tonokie Yu. 2021. Preforms for Sequential Slab Manufacture? In R. Özbal, M. Erdalkiran, and Y. Tonoike (eds.), *Neolithic pottery from the Near East. Production, Distribution and Use*. Third International Workshop on Ceramics from the Late Neolithic Near East, 7–9 March, 2019 – Antalya: proceedings. Koç University press. Antalya: 69–76.

Le Mière M. 2017. The earliest pottery of West Asia: questions concerning causes and consequences. In A. Tsuneki, O. Nieuwenhuyse, and S. Campbel (eds.), *The Emergence of pottery in West Asia*. Oxbow Books. Oxford: 9–16.

Le Mière M., Picon M. 1998. Les dèbuts de la cèramique, *Palèorient 24(2): 5–26*.

London G. 1981. Dung-tempered clay. *Journal of Field Archaeology 8(2): 189–195*. https://doi.org/10.1179/009346981791505049

Lopatina O. A., Kazdym A. A. 2010. The natural sand inclusions in ancient ceramics (the discussion of the issue). In Yu. B. Tsetlin, N. P. Salugina, and I. N. Vasil'eva (eds.), *Ancient pottery production: results and prospects of investigation*. Institute of archaeology of Russian Academy of Science. Moscow: 46–57.

Mahjour F., Ebrahiminia M., and Sedighian H. 2014. Comparative of Homemade pottery production technology at Bikash and Showy villages, Baneh, Kurdistan. *Zagros Research Quarterly 2–3: 18–28*. (in Farsi)

Matson F. R. 1960. Specialized ceramic studies and radioactive-carbon techniques. In R. J. Braidwood, B. Howe (eds.), *Prehistoric investigations in Iraqi Kurdistan*. Studies in Oriental Civilizations 31. The Oriental Institute of the University of Chicago. The University of Chicago Press. Chicago: 63–70.

Matthews W. 2016. Humans and fire: changing relations in early agricultural and built environment in the Zagros, Iran, Iraq. *The Anthropocene Review 3(2): 107–139*. https://doi.org/10.1177/2053019616636134

Matthews R., Matthews W., and Mahammadifar Y. 2013. *The Earliest Neolithic of Iran. 2008 Excavations at Tapper Sheikh-e Abad and Tappeh Jani: Central Zagros Archaeological Project*. Oxbow Books. Oxford.

Matthews R., Matthews W., Rasheed R. K., and Richardson A. 2020. *The Early Neolithic of the Eastern Fertile Crescent: Excavations at Bestansur and Shimshara, Iraqi Kurdistan*. Oxbow Books. Oxford.

Matthews R., Fazeli Nashli H. 2022. *The archaeology of Iran from the Paleolithic to the Achaemenid Empire*. Routledge World Archaeology. New York.

McDonald M. M. A. 1979. *An examination of mid-Holocene settlement patterns in the Central Zagros region of western Iran*. Unpublished PhD thesis. Department of Anthropology. University of Toronto. Toronto.

Meiklejohn C., Merrett D. C., Reich D., and Pinhasi R. 2017. Direct dating of human skeletal material from Ganj Dareh, Early Neolithic of the Iranian Zagros. *Journal of Archaeological Science. Reports 12: 165–172*. https://doi.org/10.1016/j.jasrep.2017.01.036

Meldgaard J., Mortensen P., and Thrane H. 1964. Excavations at tepe Guran. Preliminary report of the Danish archaeological expedition to Iran, 1963. *Acta Archaeologica 34: 97–133*.

Miller N. F. 1984. The use of dung as fuel: an ethnographic example and an archaeological application. *Paleorient 10(2): 71–78*.

1996. Seed eaters of the Ancient Near East: human or herbivore. *Current Anthropology 37(3): 521–528*. https://doi.org/10.1086/204514

Miller N. F., Marston J. M. 2012. Archaeological fuel remains as indicators of ancient west Asian agropastoral and land-use system. *Journal of arid environments 86: 97–103*. https://doi.org/10.1016/j.jaridenv.2011.11.021

Mortensen P. 1972. Seasonal Camps and Early Villages in the Zagros. In P. J. Ucko, R. Tringham, and G. W. Dimbleby (eds.), *Man, Settlement and Urbanism*. Gerald Duckworth & CO LTD. London: 293–297.

2014. *Excavations at Tepe Guran. The Neolithic period*. Peeters. Leuven-Paris-Walpole.

Munchaev R. M., Merpert N. Ya. 1981. *The Early Agricultural Settlements of Northern Mesopotamia*. Nauka. Moscow. (in Russian)

Nieuwenhuyse O. P., Campbell S. 2017. Synthesis: The emergence of pottery in West Asia. In A. Tsuneki, O. Nieu-

wenhuyse, and S. Campbel (eds.), *The Emergence of pottery in West Asia*. Oxbow Books. Oxford: 167–192.

Petrova N. Yu. 2011. Pottery making in the village of Balhar, Dagestan. *Archeology, ethnography and anthropology of Eurasia 4(48): 130–135*. https://doi.org/10.1016/j.aeae.2012.02.015

2012. A technological study of Hassuna culture ceramics (Yarim Tepe I settlement). *Documenta Praehistorica 39: 75–81*. https://doi.org/10.4312/dp.39.5

2019. The development of Neolithic pottery technology in Eastern Jazira and the Zagros Mountains. *Documenta Praehistorica. 46: 128–136*. https://doi.org/10.4312/dp.46.8

Petrova N. 2021. Neolithic pottery technology of Sinjar Valley, Northern Iraq (Proto-Hassuna and Archaic Hassuna periods). In R. Özbal, M. Erdalkiran, and Y. Tonoike (eds.), *Neolithic pottery from the Near East. Production, Distribution and Use. Third International Workshop on Ceramics from the Late Neolithic Near East, 7–9 March, 2019 – Antalya: proceedings*. Koç University press. Antalya: 213–228.

In preparation. *The Dung among others temper in Zagros and Mesopotamia Neolithic pottery*.

Rice P. M. 1987. *Pottery Analysis. A sourcebook*. University of Chicago press. Chicago and London.

Roux V., Courty M. A. 2019. *Ceramics and Society. A technological approach to archaeological assemblages*. Sprigler. Cham.

Rue O. S. 1981. *Pottery technology. Principles and reconstruction*. Australian National University. Washington, Taraxacum.

Salimi M. 2014. Huh Vorgar. Ethno-archaeological Study on Female Potters at Kurdistan. *International Congress of Young Archaeologist*. University of Tehran. Tehran: 587–596.

Schiffer M. B., Skibo J. M. 1987. Theory and Experiment in the Study of Technological Change. *Current Anthropology 28(5): 595–622*. https://doi.org/10.1086/203601

Schmandt-Besserat D. 1974. The use of clay before pottery in the Zagros. *Expedition 16(2): 11–17*.

Sedighian H., Mahjour. F. 2010. Evolution of domestic pottery production in Bikash village, Baneh, Kurdistan Province. *Iranian Journal of Anthropology 12: 78–95*. (in Farsi)

Shepard A. O. 1956. *Ceramics for the Archaeologist*. Carnegie institution of Washington. Washington.

Smith P. E. L. 1974. Ganj Dareh tepe. *Paleorient 2(1): 207–209*.

1976. Reflection on Four Seasons of Excavations at Tappeh Ganj Dareh. In F. Bagherzadeh (ed.), *Proceedings of the 4th Annual Symposium on Archaeological Research in Iran, 3rd–8th november 1975*. Iranian centre for archaeolgical research. Tehran: 11–22.

1990. Architectural innovation and experimentation at Ganj Dareh, Iran. *Word Archaeology 21(3): 323–335*. https://doi.org/10.1080/00438243.1990.9980111

Smith P., Crepeau R. 1983. Fabrication experimentale de repliques d'un vase neolithique du site de Ganj Dareh, Iran. *Paleorient 9(2): 55–62*.

Spengler R. N. 2019. Dung burning in the archaeobotanical record of West Asia: where we now? *Vegetation History and Archeobotany 28: 215–227*. https://doi.org/10.1007/s00334-018-0669-8

Tauber H. 1970. Radiocarbon dating of potsherds from Tell Shimshara In P. Mortensen (ed.), *Tell Shimshara. The Hassuna period*. Det Kongelige Danske Videnskabernes Selskab Historisk-Filosofiske Skrifter 5, 2. Munksgaard. København: 143–144.

Tsetlin Yu. B. 2003. Organic tempers in ancient ceramics. In S. Di Pierro (ed.), *Proceedings of the 6th European Meeting on Ancient Ceramics, Fribourg, Switzerland, 3–6 October 2001*. Department of Geosciences, Mineralogy and Petrography, University of Fribourg. Friburg: 289–310.

2012. *Ancient pottery. Theory and methods of the historical and cultural approach*. Institute of Archaeology. Russian Academy of Sciences. Moscow. (in Russian)

Tsuneki A. 2017. The significance of research on the emergence of pottery in West Asia. In A. Tsuneki, O. Nieuwenhuyse, and S. Campbel (eds.), *The emergence of pottery in West Asia*. Oxbow Books. Oxford: 2–8.

Vandiver P. 1985. *Sequential slab construction: a Near Eastern pottery production technology, 8000–3000*. The PhD thesis. Massachusetts Institute of Technology. Massachusetts.

1987. Sequential slab construction: a conservative Southwest Asiatic ceramic tradition, ca. 7000–3000 B.C. *Paleorient 13(2): 9–35*.

Vasil'eva I. N., Salugina N. P. 2010. Slab constructions. In Tsetlin Yu. B. (ed.), *Ancient pottery. Results and prospects of study*. Institute of Archaeology. Russian Academy of Sciences. Moscow: 72–87. (in Russian)

Voigt M. M. 1983. *Hajji Firuz Tepe, Iran. The Neolithic settlement*. University of Pennsylvania Museum of Archaeology and Anthropology. Hasanlu Excavations Reports 1. University Museum Monograph 50. Philadelphia.

Volkova E. V., Tsetlin Yu. B. 2016. To the methodology for studying the firing modes of ancient ceramics. In *Traditions and innovations in the study of ancient ceramics. Materials of the International Conference, May, 24–27, 2016, St. Petersburg, Russia*. Institute of History of Material culture of Russian Academy of Science. The State Hermitage Museum. Samara State Academy of Social Sciences and Humanities. UMR 8215 – Trajectoires CNRS-Université Paris 1. St. Petersburg: 76. (in Russian).

Zeder M. A. 2008. Animal domestication in the Zagros. An update and direction for future research. In E. Vila, L. Gourichon, A. M. Choyke, and Buitenhuis H. (eds.), *Archaeozoology of the Near East VIII. Proceedings of the eighth international Symposium on the Archaeozoology of southwestern Asia and adjacent areas. Tome II*. Travau de la Maison De L'orient et de la Méditerranée 49. Archéorient, Maison de l'Orient et de la Méditerranée. Lyon: 243–277.

Appendix

Tab. 1. Technological characteristics of Tapeh Ali Kosh ceramics.

Vessel No.	Type	Context	No.	Part of vessel	D of rim (cm)	Thickness (mm)	Clay ferru-gination	Added inclusions %		Constructi-on method	Surface treatment		Painting		Firing
								Dung	Large plant		Outer	Inner	Outer	Inner	Oxidized
Ja'far Painted (covering with the same clay + paint ornament)															
1		118	180	spout		8-9	high		20		the same clay+ bone/pebble	the same clay +fingers	red ornament		partial, sharp boarders
2	Ja'far Painted	118	181	wall		7	high	30			the same clay+ bone/pebble	the same clay +bone/pebble	red ornament		partial, gradual boarders
3	Ja'far Painted	116	175	wall		10	high	20	10	slabs	the same clay+ bone/pebble	the same clay +bone/pebble	red ornament		partial, gradual boarders
4	Ja'far Painted	115	161	rim		7	medium	10		slabs	the same clay+ bone/pebble	the same clay +bone/pebble	red ornament		partial, gradual boarders
5	Ja'far Painted	115	162	rim	23	7-11	medium	20	10	slabs	the same clay+ bone/pebble	the same clay +bone/pebble	red ornament		partial, gradual boarders
6	Ja'far Painted	115	164	rim		10	medium	10			the same clay+ bone/pebble	the same clay	red ornament		partial, gradual boarders
7	Ja'far Painted	113	138	wall		8-12	high	20	10	slabs	the same clay	the same clay +bone/pebble	red ornament		full
8	Ja'far Painted	112	135	rim		8-10	medium	10		slabs	the same clay+ bone/pebble+ slightly burnishing	the same clay +bone/pebble	red ornament		partial, gradual boarders
9	Ja'far Painted	112	116	wall		10	medium	20	10	slabs	the same clay+ bone/pebble	the same clay +bone/pebble	red ornament		partial, gradual boarders
12	Ja'far Painted	106	049	wall		10	medium	20	10		the same clay	the same clay	red ornament		full
10	Ja'far Painted	111	111	rim	17	7-9	medium	10		slabs	the same clay	the same clay	red ornament		partial, gradual boarders
13	Ja'far Painted	102	024	wall		8-12	low	10	20		the same clay bone/pebble	the same clay	red ornament		full
11	Ja'far	108	083	rim	15	6-13	medium	30	5	slabs	the same clay	the same clay +bone/pebble	red ornament		partial, gradual boarders

Continuation

Ja'far Plain (covering with the same slightly ferruginous clay)															
15		127	198	wall		14	medium		50		the same clay	the same clay			partial, sharp boarders
16	Ja'far Plain	127	196	wall		>11	high	30	30		destroyed surface	destroyed surface			full
14	Ja'far Plain	127	202	rim	25	7	medium	30			the same clay+ bone/pebble + slightly burnishing	the same clay			partial, sharp boarders
18	Ja'far Plain	115	148	wall		11	medium	30	5	slabs	the same clay+ bone/pebble	the same clay +bone/pebble			partial, sharp boarders
17	Ja'far Plain	107	077	rim		10	medium	15	5	slabs	the same clay	the same clay +bone/pebble			full
19	Ja'far Plain	108	102	wall		11	medium		30	slabs	the same clay	destroyed surface			partial, sharp boarders
20	Ja'far Plain	105	028	wall		12	medium	15	5		the same clay	the same clay			partial, sharp boarders
21	Ja'far Plain	108	097	wall		10	medium		30	slabs	the same clay	the same clay			partial, sharp boarders
22	Ja'far Plain	124	190	wall		15	high		30	slabs	the same clay+ bone/pebble	the same clay			partial, sharp boarders
23	Ja'far Plain	117	178	wall		12	high	30			the same clay+ bone/pebble	the same clay			partial, sharp boarders
Ja'far Plain (covering with the same highly ferruginous clay + burnishing)															
24	Ja'far Plain	107	083	wall		12	high	15			the same clay	the same clay +bone/pebble +slightly burnishing			full
25		108	017	wall		13	high	20	10		the same clay+ bone/pebble+ burnishing	the same clay +bone/pebble burnishing			partial, gradual boarders
26	Ja'far Plain	116	176	wall		10-14	high	30	5	slabs	the same clay+ bone/pebble	the same clay +bone/pebble			partial, sharp boarders
Khazineh Red (covered with the same clay + full pigment coloring)															
27	Khazineh Red	116	177	rim		7	medium	30		slabs	the same clay+ bone/pebble	the same clay +bone/pebble	red full coloring		partial, gradual boarders
28	Khazineh Red	116	168	wall		10	medium	10	20	slabs	the same clay	the same clay	red full coloring		partial, gradual boarders
29	Khazineh Red	105	043	rim		10	medium	10		slabs	the same clay+ bone/pebble+ slightly burnishing	the same clay +bone/pebble	red full coloring	red partial coloring	partial, gradual boarders

Continuation

30	Khazineh Red	102	014	wall		8	medium	10			the same clay+ bone/pebble	the same clay	full plum		partial, gradual boarders
Khazineh Red (covered with red slip (pigment + clay))															
31	Khazineh Red	105	027	wall		8-12	medium	30	5	slabs	red slip	red slip+ the same clay		plum full cover	full

Tab. 2. Technological characteristics of Tapeh Mahtaj ceramics.

No.	Part of vessel	Thickness (mm)	Clay ferrugination	Added inclusions %		Contruction method	Outer and inner surface treatment	Firing
				Dung	Large plant			Oxidized
1	base/wall	19/9	medium	20	30	slabs	soft	full
2	base/wall	20	medium	20	30	slabs	soft	full

Tab. 3. Technological characteristics of Tapeh Guran ceramics.

Number	Type	Part of vessel	D of rim (cm)	Thickness (mm)	Clay ferru-gination	Added inclusions %		Constructi-on method	Surface treatment		Painting		Firing
						Dung	Large plant		Outer	Inner	Outer	Inner	
1	Jarmo style	wall		7	medium	30		slabs	the same clay+ slightly burnishing	the same clay	red ornament		full
2	Guran style	wall		5	low	50			the same clay+ textile?	the same clay	red ornament		full
3	Sarab Geometric	rim	20	7	low	20		slabs	the same clay	the same clay		red ornament	full
Red-slipped ware (both surfaces covered with slip)													
4	Red-slipped ware	rim	41	10	medium	20	20	coils	red slip+ burnishing	red slip			partial, gradual boarders
5	Red-slipped ware	rim	28	8	medium	50			red slip+ burnishing	red slip+ burnishing			full
6	Red-slipped ware	wall		10	medium	50		slabs	red slip+ burnishing	red slip+ burnishing			full

Continuation

7	Red-slipped ware	rim	24	9	medium	50			red slip+fingers +burnishing	red slip			full
8	Red-slipped ware	rim+wall		8-11	medium	20-30	5	slabs	red slip+ burnishing	red slip			full
9	Red-slipped ware	rim	27	8	medium	20-30		slabs	red slip+textile +burnishing	red slip			partial, gradual boarders
10	Red-slipped ware	rim	14	5	medium	15		coils	red slip+textile +slightly burnishing	the same clay			partial, gradual boarders
11	Red-slipped ware	rim		6	medium	20-30		slabs	red slip+ burnishing	red slip			partial, gradual boarders
12	Red-slipped ware	rim		8	medium	20-30		slabs	red slip	the same clay +burnishing			partial, sharp boarders
13	Red-slipped ware	rim	10	7	medium	15	5	slabs	red slip+textile	red slip			partial, gradual boarders
14	Red-slipped ware	wall		7	medium	30	5		brown slip	the same clay +fingers			full
Red-slipped ware (different variants)													
15	Red-slipped ware	rim		6	medium	10-15	5	slabs	the same clay+ slightly burnishing	the same clay	red-brown full coloring		partial, gradual boarders
16	Red-slipped ware	wall		7	low	50	5	slabs	the same clay	the same clay	brown full coloring	red full coloring	partial, gradual boarders
17	Red-slipped ware	rim		7	low	10-15			red slip+ slightly burnishing	red slip	brown full coloring		partial, gradual boarders
18	Red-slipped ware	wall		8	medium	30			the same clay+ burnishing	the same clay	red-brown full coloring		full
19	Buff ware	wall		5-9	low	30	5	coils	the same clay+ burnishing	the same clay			full
20	Buff ware	wall		13-15	low	30	5	coils	the same clay+ burnishing	the same clay +burnishing			partial, gradual boarders
21	Buff ware	wall		12	low	10-15			the same clay+ burnishing	the same clay			partial, gradual boarders
22	Buff ware	rim		7	low	30	5	coils	the same clay+ burnishing	the same clay			partial, gradual boarders