# Ceramic Technology between the Third and Second Millennium BC: New Insights from Southern Mesopotamia

ELOISA CASADEI AND LUCA VOLPI[1]
SAPIENZA UNIVERSITY OF ROME
[1] Corresponding authors E. Casadei: eloisacasadei@gmail.com and L. Volpi: luca.volpi@uniroma1.it

**ABSTRACT:** This paper is the result of a pilot project conducted at the Penn Museum in Philadelphia and based on a selection of pottery vessels from Nippur (area TB) dated at the transition between the late Akkadian and Isin-Larsa period (2350-1763 BC). The continuity in occupation, and the presence of precise chronological markers make area TB a perfect case study for a diachronic analysis of the ceramic repertoire of this period. The aim of the project is a detailed reconstruction of the *chaîne opératoire*, fundamental for understanding the pottery repertoire from a technological point of view. Focusing on the late third millennium BC pottery assemblage, the *chaîne opératoire* approach can be used to discern the organisation and scale of production and the transmission of technical and technological knowledge through time, thus linking pottery production to the economic and social spheres. Macro- and meso-scale observations of pottery allow the identification of manufactural evidences useful for a preliminary reconstruction of the production sequence. Through this approach some aspects of continuity and discontinuity emerged, among which the identification of a new technique (trimming) at the very beginning of the second millennium BC, which can indicate significant technological development in pottery production.[1]

## INTRODUCTION

In southern Mesopotamia (fig. 1), the transition between the third and second millennium BC is characterised by instability of the political entities (from the fall of the Akkadian state to the rise of the Isin-Larsa dynasties), and by differences in the economic organisations.[2]

Pottery is ubiquitous in the archaeological record. When considering pottery production as part of an economic system, it is interesting to detect if its *chaîne opératoire* has changes that can be linked to the aforementioned political and economic instability. In general, the late third millennium BC pottery production has received little attention, being defined as wheel-made, standardised and mass produced (Rice 2015: 19; Simpson 1997: 52).[3] These traits have often been considered as typical of a state-organised society.[4] Nevertheless, recent studies underlined that forming processes employed by potters at the end of the third millennium BC are much more complex, resulting in a combination of methods that differs from just wheel-throwing (Calderbank 2017: 148; Romano and Zingale [illegible] make a first step toward a better definition of the various stages of pottery production at the transition from the third to second millennium BC.



1: This paper is the product of a joint project and the entire work has been conceived by both authors. E. Casadei focuses on phase 1 and 2a; L. Volpi focuses on phase 2b and 3.

2: For a detailed reconstruction of the historical background, see Liverani 2011: 193-244; 266-295. See also Foster 2016; Sallaberger and Schrakamp 2015; Sallaberger and Westenholz 1999.

3: For a theorisation of these concepts, see also Rice 2015: 350-362.

4: For a general overview of pottery craft organisation from textual sources, see Steinkeller 1996.

The autoptic analysis of a sample of 78 pottery vessels from Nippur (Nufar) areas TA and TB, led by the authors in the Middle East Section at the Penn Museum in Philadelphia, was conducted as a pilot project for detecting visible evidences of pottery manufacture. In this paper, 26 ceramic vessels are analysed in detail with the attempt to highlight possible benefits and criticisms of the *chaîne opératoire* approach. Considering the chronological focus of the paper, the 26 vessels are selected from area TB, levels XI-III (c.2350-1800 BC). Preliminary considerations focus on the identification of particular technological traits that could be linked to each pottery phase. These traits may become more evident when a larger number of samples are studied and scientifically analysed in detail.

## THE *CHAÎNE OPÉRATOIRE*

The term *chaîne opératoire* was first coined by Leroi-Gourhan (1964) in the domain of French cultural ethnology and anthropology to refer to particular 'cognitive' human behaviour (Djindjian 2013: 93): "formed as a result of interaction between experience, which conditions the individual by a process of trial and error identical to that of animals, and education [...]" (Leroi-Gourhan 1964: 230). In 1972, with the research group *Techniques et Culture*, the *chaîne opératoire* approach was also applied to the analysis of technological processes involved in the realisation of material cultural assemblages, that is, "...the whole manufacturing process–defined as a series of operations that transform raw material into finished product" (Roux 2017: 101).

In archaeological literature, the term was first applied when describing technical processes related to lithic industries. Regarding pottery, the concept is used for the identification of manufacturing processes of specific morphological types, diachronic changes in the production procedure within social groups. and technological variances between social entities at a macro-regional scale (Bishop et al. 1995: 111; Roux and Courty 2005: 201). Considering that each technological process involves a sequence of behaviours that results from specific technical choices (Schiffer and Skibo 1987: 599) and that these technical choices were made in different spatio-temporal contexts, reconstructing pottery production can help in analysing the social behaviour behind these choices and providing information about the people who produced and used those assemblages.

In Near Eastern archaeology, several studies have utilised the *chaîne opératoire* to reconstruct pottery manufacture. In Levantine archaeology, some of the most recent studies have analysed the *chaîne opératoire* for the Late Chalcolithic and the mid-third millennium BC, aiming to reveal the manufacturing processes of specific pottery types either at site level (Roux and Thalmann 2016; Mouamar 2017) or at a regional scale (e.g. Baldi and Roux 2016; Roux and Courty 2005).

Technological studies were also carried out in other areas of the Near and Middle East. For instance, in the Khuzestan regions of Iran, the *chaîne opératoire* approach has been employed to analyse Late Bronze Age 'beakers' (Mofidi-Nasrabadi 2014). Regarding southern Mesopotamia, a technological approach was adopted by van As and Jacobs (2014: 75-93) to research second millennium BC pottery assemblages. Moreover, analyses on the newly excavated materials from Abu

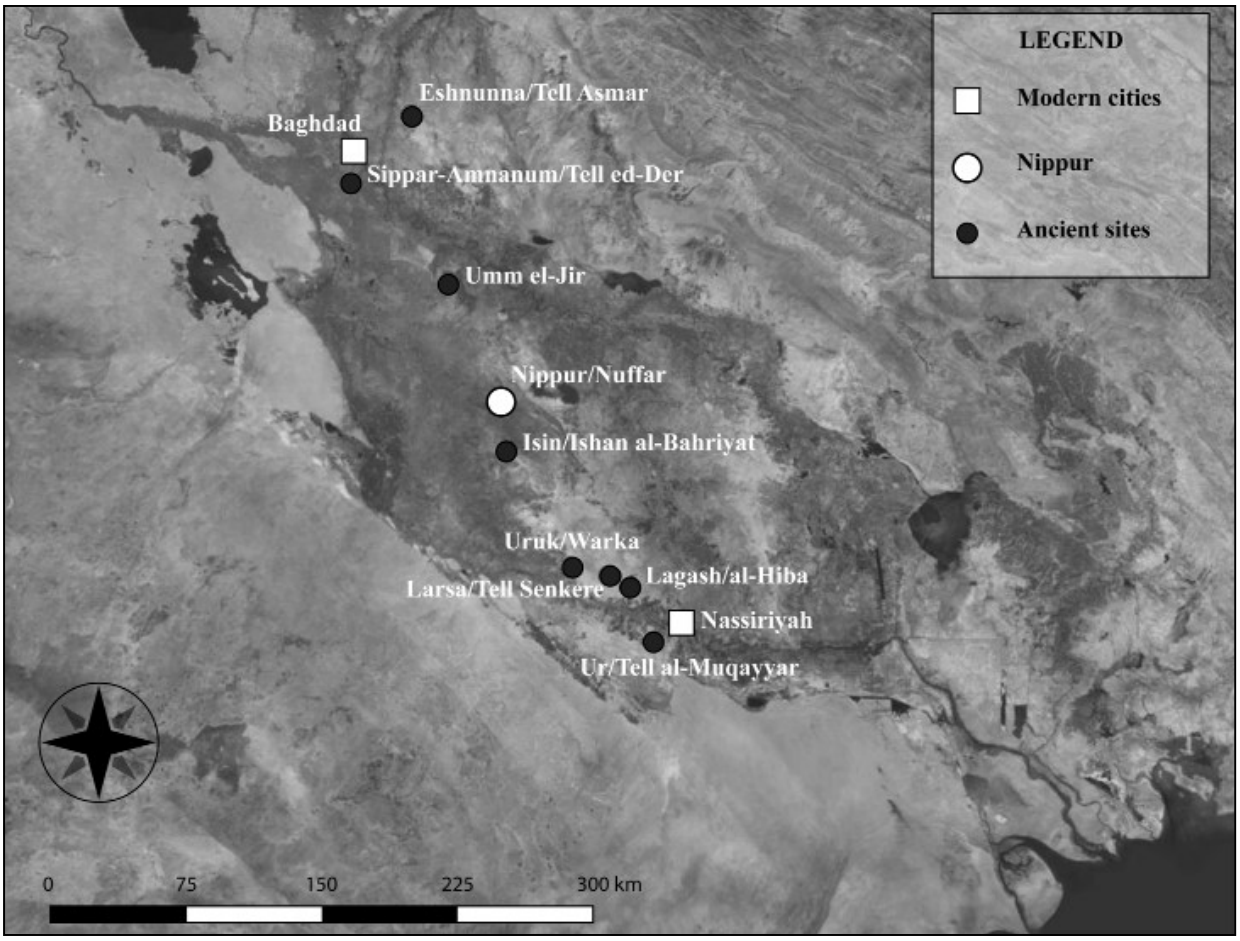


Figure 1: Map of central and southern Mesopotamia and the location of Nippur.

Table 1: Chronological periodisation.

| *Historical period* | *Middle Chronology* | *Armstrong and Gasche 2014* | *McCown and Haines 1967* | *Ceramic Periodisation* |
|---|---|---|---|---|
| Late/Post Akkadian | 2205-2110 BC | ends at 2018 BC | TB XIII-X | Phase 1 |
| Ur III | 2110-2003 BC | 2018-1911 BC | TA XV, TB IX-V | Phase 2a |
| Isin-Larsa | 2019-1792 BC | 1911-1667 BC | TA XIV-XII, TB IV-I | Phase 2b (IV) |
| | | | | Phase 3 (III-I) |

Tbeirah (Romano and Zingale 2019) and Tell Khaiber (Calderbank 2017) are providing new insights on technological aspects related to the pottery production during the mid-third millennium BC and Kassite period.

Starting from these studies, the following analysis applies the *chaîne opératoire* approach to a pottery assemblage from old excavations now housed in a museum collection. The outdated methods of collecting materials, the selection of the repertoire and the limited possibilities of doing destructive analyses partially affect the research. However, preliminary results confirm the suitability of this method to the analysis of previously excavated materials.

## CONTEXTS AND DATA

The excavation of levels XIII-I in area TB at Nippur[5] has revealed an uninterrupted sequence of domestic buildings dated to the Akkadian (c.2350-2200 BC), Ur III (c.2110-2003 BC) and Isin-Larsa (c.2004-1763 BC) periods (see table 1). A small portion of an Akkadian domestic quarter was excavated dating to level XIII to XI (fig. 2a).[6]

In level IX, a large building (House J, fig. 4) was constructed. The find of a re-used stamp-brick with the inscription of Ur-Nammu (c.2110-2093 BC) provides a terminus post quem for the construction of House J (Zettler 1991: 252). Starting from level VI, it was rebuilt and reduced in size. In level V, a new building (House I) was constructed on top of the northwestern portion of the former house (fig. 2b). A clay tablet dated to the reign of Ibbi-Suen (c.2026-2003 BC) was found, helping to date the last rebuilding phase of House J (see also McCown and Haines 1967: 74).

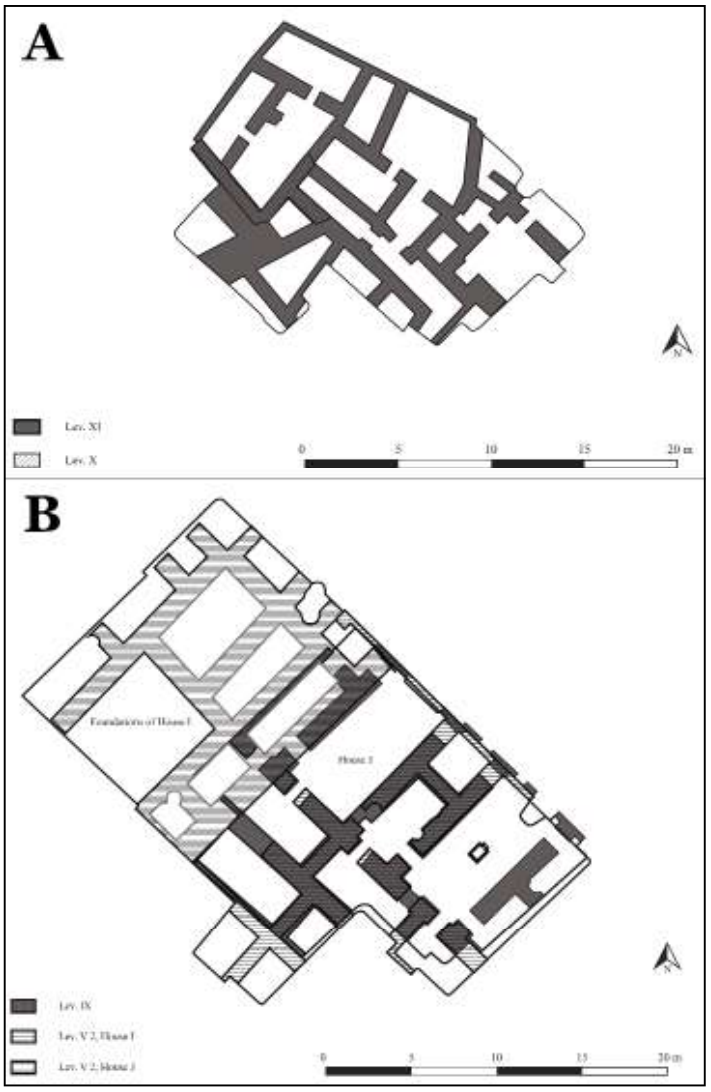


Figure 2: Superimposition of levels XI-X (a) and IX-V.2 (b) (from McCown and Haines 1967: pl. 52C, 55A, 57, redrawn by authors).

Level IV is problematic given that several floors have been grouped together by the excavators and no further subdivision of the material is now possible (fig. 3a). In this level, the presence of a tablet with the name of king Išbi Erra (c.2019-1987 BC) allows it to be dated to the early Isin-Larsa period (Zettler 1991: 253). Levels III to I are also assigned to this phase which is marked by a significant change in the plan of the area; with smaller buildings separated by streets and open spaces (fig. 3b).

Regarding the pottery assemblage, consistency in the repertoire from a morphological point of view is noted. However, because of the re-analysis of the presence/absence of specific pottery types recognised by McCown and Haines (1967: table

5: Carried out between 1951-1953 by a joint expedition of the University Museum of Philadelphia and the Oriental Institute of the University of Chicago.

6: See Zettler 1991 for a detailed re-analysis of the chronology of area TB in relation to the stratigraphy and epigraphic data.

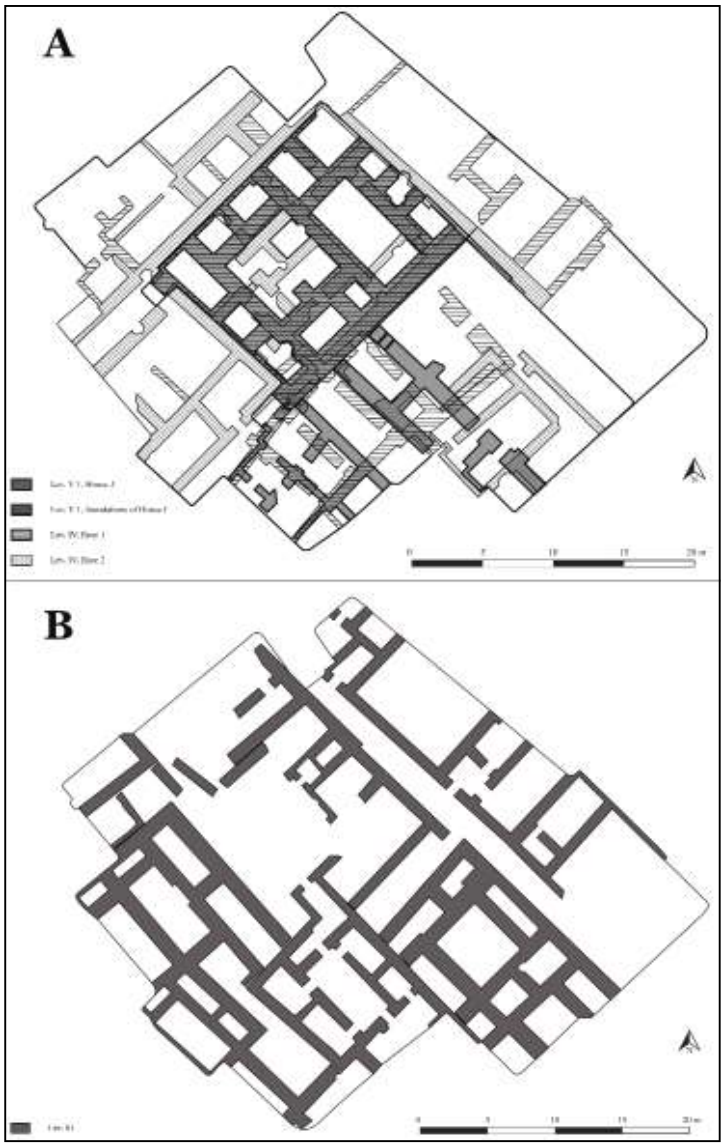


Figure 3: Superimposition of levels V.1-IV (a) and III (b) (from McCown and Haines 1967: pl. 58-60, redrawn by authors).

II), three pottery phases have been identified (see tables 1, 2 and fig. 5).[7]

***PHASE 1***

Two ceramic types (4 and 5) are restricted to levels TB XII-X. In particular, type 5 (fig. 5.3), a heart-shaped vessel with double-ridged rim ('Akkadian beaker'; see also Arrivabeni 2014), featured in levels TB XII-XI. This type is attested in late Akkadian-early Ur III levels at Nippur area WF (level XIIIb-VIII; McMahon 2006: type C-13b, 79), and at Eshnunna (Tell Asmar) in the 'Houses area' (level IVa; Delougaz 1952: pl. 160: B.556.540).

The double carinated bottle (fig. 5.1) was found in TB level XII (McCown and Haines 1967: pl. 81:1). It has comparisons in area WF (levels XIV-VIII; McMahon 2006: type C-19, 73) and at Eshnunna (levels Va-III; Delougaz 1952: pl. 162: B.633.570a-b, B.634.570a-b).

The ovoid bottle (fig. 5.5) was found in TB level XI (McCown and Haines 1967: pl. 81:3) and it is similar to vessels from Eshnunna (level IVb; Delougaz 1952: pl. 164: B.666.540a).

A characteristic long-lasting type of phases 1 and 2a is the medium-sized jar with a carinated, ridged-shoulder (e.g. 'Akkadian jar'; fig. 5.8; see also McMahon 2014) attested from TB level XI to V (McCown and Haines 1967: pl. 81:9). This type is common in the late Akkadian and Ur III periods, as suggested by similar vessels from area WF (levels XIV-VI; McMahon 2006: type C-16b), from Uruk (Warka) Areal P6 (unter Bauschicht 3; van Ess 1993: fig. 14: 174) and from Eshnunna (level IV; Delougaz 1952: pl. 176: C.466.450).

7: The complete description of the ceramic phases is far beyond the scope of this paper, thus only some diagnostic types have been described in full. For a general assessment on the ceramic horizon of the period see: Armstrong and Gasche 2014; Ayoub 1982; Casadei 2020.

Another characteristic type of phases 1-2 (attested in TB level XI-VIII) is the tall, globular jar with a shallow carination between neck and shoulder (fig. 5.7). This is an older version of the so-called 'collared jar', characterised by a globular body.[8] Comparisons are found in area WF (levels XIVa-IX; McMahon 2006: type C-20, 76), at Uruk in the Sinkashid Palace area (level 1; van Ess 1988a: fig. 26: 159) and in Areal P6 (unter Bauschicht 3; van Ess 1993: fig. 16: 186) and at Eshnunna (level IVa; Delougaz 1952: pl. 189: C.777.340).

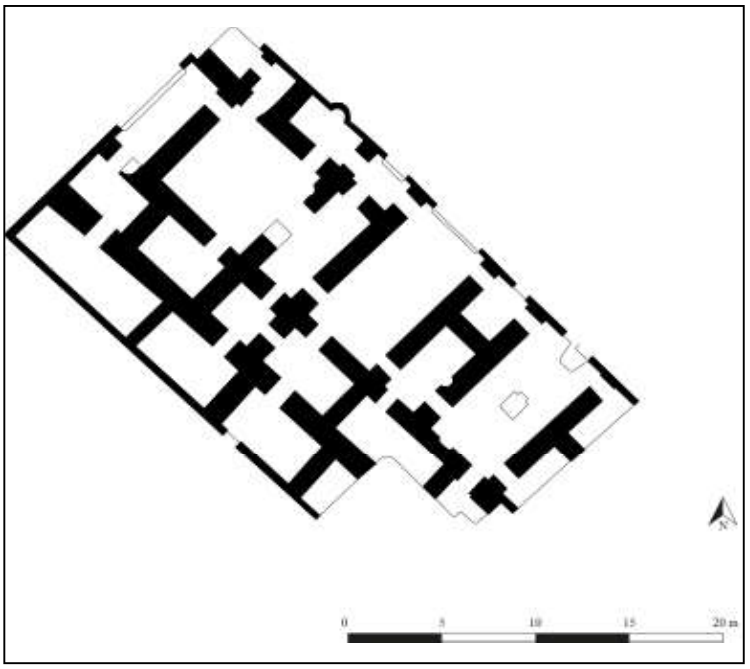

Figure 4: Plan of the administrative building, house J, dated to level VIII, Ur III period (from McCown and Haines 1967: pl. 53 B, redrawn by authors).

### *PHAS 2*

Phase 2 is characterised by pottery types attested from level IX to IV (type 8a, 11, 16 and 17). The most significant type (only attested at Nippur) is the band-rim bowl (fig. 5.9; type 8a), characterised by an overhanging band rim. They appear in level VII to IV, and are also attested in area WF (levels X-VI; McMahon 2006: type O-22, pl. 94: 1-11), area WA (level VI) and area WC-3 (level V b-c; Armstrong and Gasche 2014: type 20D, pl. 33: 1-3, 5-6, 9-10).

Two reasons could suggest a preliminary subdivision of phase 2 into two subphases, 2a (levels IX-V) and 2b (level IV): some types (9, 10) are attested only until level V; types diagnostic of the entire phase 2 (8a, 11, 16 and 17), attested in level IV for the last time, are combined with new types (13, 14b, 18 and 19a) appearing here and continuing into levels III-I.

### *SUB-PHASE 2A*

The large profiled-rim bowls (fig. 5.14; type 9) are attested in TB levels VI-V. Parallels can be found in area WA (level VI) and WC-3 (level VB) and at Sippar-Amnanum (Tell ed-Der) in area A (levels IVb-IIe; Armstrong and Gasche 2014: type 20 K, pl. 39: 1–8).

A medium-sized jar with round shoulders, flaring neck and thickened, outward protruding rim (fig. 5.15) is found in TB level VIII (McCown and Haines 1967: pl. 85: 16). Parallels can be found in area WC-3 (level V) and at Sippar-Amnanum in area A (levels IVb-IIId; Armstrong and Gasche 2014: type 240 C, 65, pl. 109: 3-9).

The large basin with triple-ridged rim and wavy-combed decorations (fig. 5.16) is attested in TB level VII (McCown and Haines 1967: pl. 84: 21). It finds comparisons

8: Although McCown and Haines (1967: type 15) did not divide this type into an older and a later version, Armstrong and Gasche (2014: type 110 B, 43-44) assert it is possible to recognise differences in the body shape.

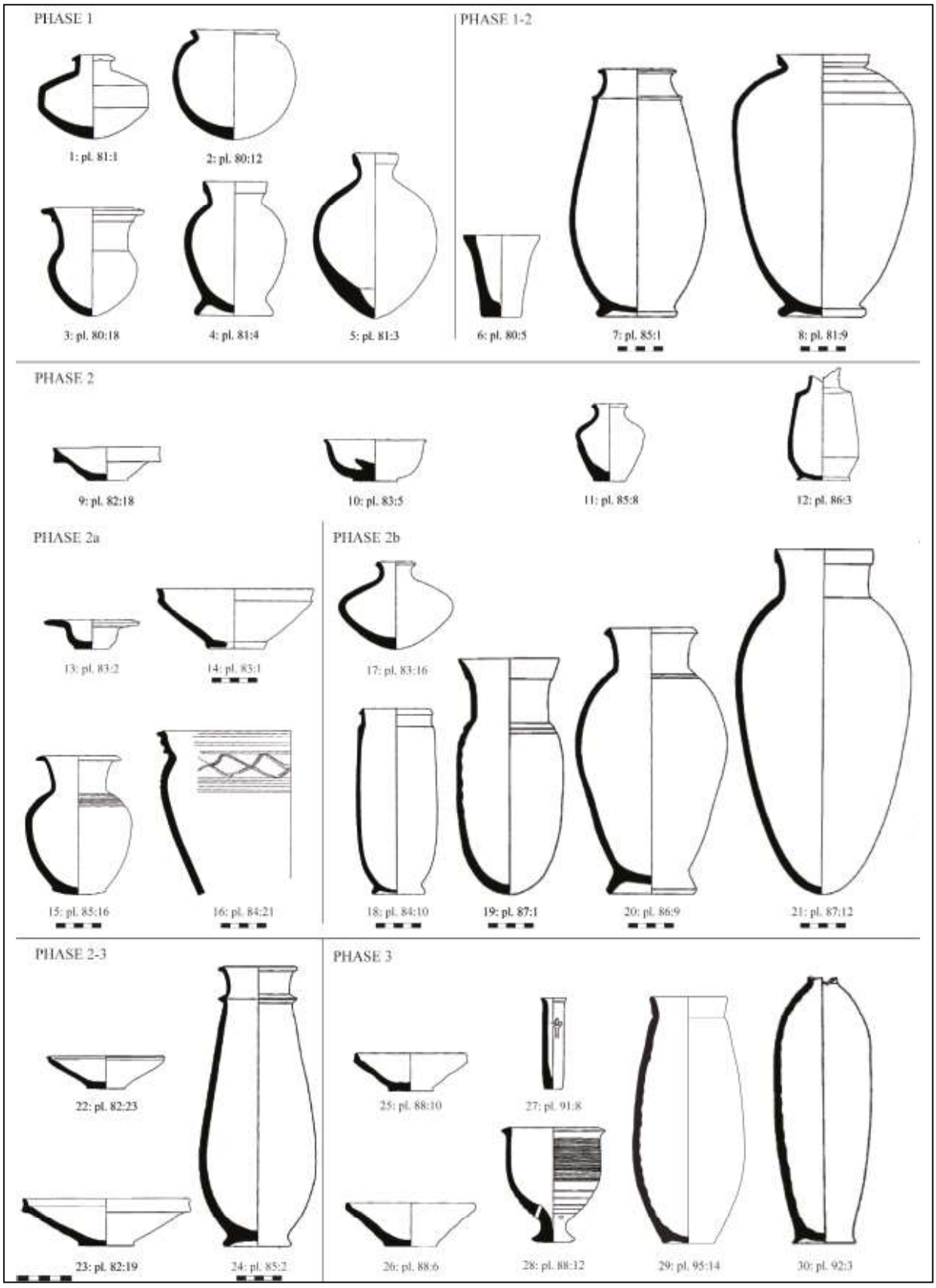


Figure 5: Types used in chronological assessment, based on McCown and Haines 1967: table II (drawings from McCown and Haines 1967: pl. 80-93; n. 29, redrawn from Armstrong and Gasche 2014: pl. 67: 4).

Table 2: Stratigraphic sequences cited in the text (according to Armstrong and Gasche 2014; Delougaz, Hill and Lloyd 1967; McCown and Haines 1967; McMahon 2006; van Ess 1988a, 1988b; Zettler 1991).

<table>
<tr><th colspan="6">Nippur/Nuffar</th><th>Eshnunna/ Tell Asmar</th><th>Sippar-Amnanum/ Tell Ed-Der</th><th colspan="2">Uruk/Warka</th><th>Larsa/Tell Senkere</th></tr>
<tr><th>TB</th><th>WF</th><th>WC-3</th><th>WA</th><th>TA</th><th>WB</th><th>Houses</th><th>A</th><th>Sinkashid</th><th>Areal P 6</th><th>Le quartier nord-est</th></tr>
<tr><td rowspan="2">XIII - X</td><td>XVI - XIV</td><td></td><td></td><td></td><td></td><td rowspan="2">IV a-b</td><td></td><td></td><td></td><td></td></tr>
<tr><td>XIII - IX</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>IX - V</td><td>VIII - VII</td><td>V c-b</td><td></td><td></td><td></td><td>III</td><td>IV a-b - III d</td><td></td><td rowspan="2">Bauschicht 4 – 3</td><td></td></tr>
<tr><td>IV</td><td>VI</td><td rowspan="2">IV</td><td></td><td>XIII - XII</td><td></td><td rowspan="2">II-I</td><td rowspan="2">III b - I e</td><td>1 – 2</td><td></td></tr>
<tr><td>III - I</td><td></td><td>VI - V</td><td>XI - X</td><td>IV</td><td>3 – 5</td><td>Bauschicht 2 – 1</td><td>Bâtiments 27 and 59</td></tr>
</table>

in area WF (level VI; McMahon 2006: type O-25), in area WC-3 (level Vb), and at Sippar-Amnanum (levels IVb-IIId; Armstrong and Gasche 2014: type 265 A, pl. 120: 5-6, 8, 10).[9]

***SUB-PHASE 2B***

Ellipsoidal bottles (fig. 5.17; type 13) are attested in TB level IV (one example is also reported from level I). Comparisons are found in area WC-3 (level V), at Sippar-Amnanum (levels IVb-Ia; Armstrong and Gasche 2014: type 185 A, pl. 88: 2, 4-8), and at Uruk in the Sinkashid Palace area (level 5; van Ess 1988a: fig. 12: 101).

The medium-sized cylindrical jar with narrow shoulder and short neck (fig. 5.18; type 14b) is present in area TB, levels IV-III, and in area TA, level XII. Comparisons are attested at Sippar-Amnanum (levels Ie-Ii; Armstrong and Gasche 2014: type 105 B, pl. 68: 1-2).

Medium to large-sized elongated jars with a ring base and sometimes with combed horizontal decorations on the shoulder (fig. 5.20; type 18) are attested in TB levels IV-III. Parallels are present in area WC-3 (level IV; Armstrong and Gasche 2014: type 250 B, pl. 112: 6). Similar vessels are found at Sippar-Amnanum (levels IIa-Ii; Armstrong and Gasche 2014: type 250 A, pl. 110: 6-11; pl. 111: 1-6).

Type 19b (fig. 5.21) is characterised by a large elongated body with a round base sometime with horizontal combed decorations on the shoulder. This type was found in TB levels IV-II. Comparisons are attested from area WB (level IV 2; Armstrong and Gasche 2014: type 270 C, pl. 128: 11), Uruk in the Sinkashid Palace area (level 3; van Ess 1988a: fig. 25: 155) and Sippar-Amnanum, (levels Ia-e; Armstrong and Gasche 2014: pl. 128: 4-9).

Carinated bowls (type 8b) are a long-lasting type of phases 2 and 3, attested from the Ur III to the Isin-Larsa period. This type includes two variants, one older with

9: These are the most accurate parallels for the TB specimen, although according to Armstrong and Gasche type 265 A is attested until 13th century BC (Armstrong and Gasche 2014: pl. 120-124).

high carination and vertical, concave rim (fig. 5.23; see also Armstrong and Gasche 2014: type 20 E; Schmidt 2014) and one with high carination and very small rim (fig. 5.22; Armstrong and Gasche 2014: type 20 B).[10]

The first variant is attested from TB level VIII to III (only scattered sherds are attested from level II to level E). Comparisons exist in area WA (level VI), area WC-3 (levels V-IV; Armstrong and Gasche 2014: type 20 E, pls 33: 9-10; 34: 7-9, 11-15, 17-19, 27-34) and area WF (levels XI-VI; McMahon 2006: type O-17 and O-22, 80). At Uruk parallels are found in the Sinkashid Palace area (levels 1-2a; van Ess 1988a: pl. 3: 37-43), Areal P6 (Bauschicht 3; van Ess 1993: fig. 8: 129; fig. 14: 170-172), at Eshnunna in levels IVa-I (Delougaz 1952: pl. 150: B.151.210, unpublished) and at Sippar-Amnanum in levels IVb-Ii (Armstrong and Gasche 2014: pl. 33: 11-43). The second variant is attested at Nippur in area WA (level V), and at Sippar-Amnanum (levels IIc-Ii; Armstrong and Gasche 2014: pl. 31: 7-9, 11-13).

Another long-lasting type characteristic of phases 2 and 3 is the tall, cylindrical jar with horizontal ridge on the neck (fig. 5.24), that corresponds to the later variant of the 'collared jar' (McCown and Haines 1967: type 15, pl. 85: 5-6; see Armstrong and Gasche 2014: type 110 A, 43; McMahon 2006: type C-20, 76 note 115). This type is attested in area TB, level V-III, and area WC-3 (level Vb; Armstrong and Gasche 2014: pl. 69: 4), at Uruk in the Sinkashid Palace area (level 2; van Ess 1988a: fig. 40: 231–232, 234) and at Sippar-Amnanum (level IIId; Armstrong and Gasche 2014: pl. 69: 1).

***PHASE 3***

Our phase 3 is characterised by some new types (21, 22, 23, 27 and 39a) attested for the first time in TB level III, continuing throughout levels II and I.[11] Slightly carinated bowls with upright rims and more or less pronounced groove inside (fig. 5.26; type 21) are found from TB, levels III to D and in area TA level X. Comparisons come from area WA (levels VIA-V; Armstrong and Gasche 2014: type 20 C, pl. 32: 10-13), area WB (level IV; Armstrong and Gasche 2014: type 20 C, pl. 32: 6-9), at Larsa (Tell Senkere) in quartier nord-est, Bâtiment 59 (Calvet 2003: fig. 66: 59.150) and at Sippar-Amnanum (level Ig-I; Armstrong and Gasche 2014: type 20 C, pl. 32: 3-4).

Medium-sized jars with a tall, flaring neck (fig. 5.29; type 39a) are attested in area TB, from level III to E, and area TA, levels XII-X. Comparisons are found in area WB (level IV; Armstrong and Gasche 2014: type 105 A, pl. 67: 7-8). The tall elongated bottle with ring base (fig. 5.30) comes from level III (McCown and Haines 1967: pl. 92:3; c.f. Armstrong and Gasche 2014: type 225 A). This specimen is comparable with vessels from Uruk, Sinkashid Palace area (level 5; van Ess 1988a: fig. 33: 189, 194).

10: McCown and Haines (1967: type 8b) did not divide this type into variants. According to Armstrong and Gasche the variant with high carination and very small rim (fig. 5.22; Armstrong and Gasche 2014: type 20 B) seems to be attested in slightly later contexts respect to type 20 E.

11: Due to the focus of the paper, the authors have decided to omit the detailed morphological description of those vessels that start from levels II-I (area TB), all assigned to the late Isin-Larsa period.

## ANALYSIS OF THE REPERTOIRE

Although the pottery production at the second half of the third millennium BC has been considered generally as wheel-made,[12] recent studies suggested that various modelling processes, with and without the use of the wheel, have been employed by the potters (Calderbank 2017 and Romano and Zingale 2019). Therefore, a detailed analysis of each step of the *chaîne opératoire* is fundamental for the comprehension of the specific methods employed.

The pottery manufacturing process has been divided into four stages: preparation of raw materials; primary *forming*; secondary *finishing*; and firing.[13] At a macroscopic level, the most clearly visible traces of manufacturing are linked to vessel *forming* and *finishing*, including fissures, over-thicknesses, bumps, compression folds, undulating profiles, preferential fractures, crevices and surface striations (for a detailed description see Roux 2019: 141-154, 158-191). In the present paper, the selection of 26 vessels from levels XII to III of area TB is viewed as a case study for analysing the manufacturing traces visible at both macro- and meso-scale levels.[14]

Following the subdivision by phases, a short description of raw materials and the type of firing employed, a detailed description of the forming and finishing diagnostic traces for each vessel will be given (table 3). Except where highlighted, the entire repertoire is characterised by regular undulating profiles and by parallel concentric striations, generally fine and regular.

### *PHASE 1*

Vessel fabric is pinkish (5YR 7/3) or yellowish (7.5YR 6/4)[15] in colour, with a low frequency (7-15%) of very small to small, round minerals (orange, black, brown and white in colour) and a low frequency of vegetal inclusions (2-5%). The surface colour indicates oxidising firing conditions.

The heart-shaped Akkadian beaker (fig. 6.1) presents some preferential fractures on its rim that has a bevelled profile.[16] This feature, together with the meso-scale traces, indicates a join on the external part of the triangular rim.

The small globular jar (fig. 6.2) is characterised by an irregular profile, with bumps[17] on both inner and outer surfaces and variable body thickness. The rim is

12: There are two variants. The wheel-coiling technique, e.g. forming the roughout through separate coils, and using the wheel for joining and thinning the coils only; and the wheel-throwing technique, e.g. shaping the vessel directly from a mass of clay. Although these techniques leave similar macroscopic traces, they can be considered consistently different because they required different potters' expertise. See Roux 2019: 72-75; 84-87.

13: For the identification of manufacturing traces, see f.e. Gibson and Woods 1990; Hamer and Hamer 1991; Roux 2019; Rye 1981; van As 1989.

14: Meso-scale pictures have been taken with © Celestron Digital Microscope PRO.

15: Fabric colours and frequency of inclusions are given according to the Munsell© Soil-Color Chart.

16: This type of fracture provides information on the fashioning techniques and joining procedure used. The joining of the various elements of a vessel creates fragile zones favouring the development of preferential fractures (see Hamer and Hamer 1991: 79-86; Rye 1981: 60-61, 66-83).

17: Irregular impressions can occur on the profile of the vessel due to the digital manipulation of clay during shaping processes. In this case, they can characterise the joins between coils (Gibson and Woods 1990: 36-37) or the forming of a specific part of the vessel. See Roux 2019: fig. 3.9d.

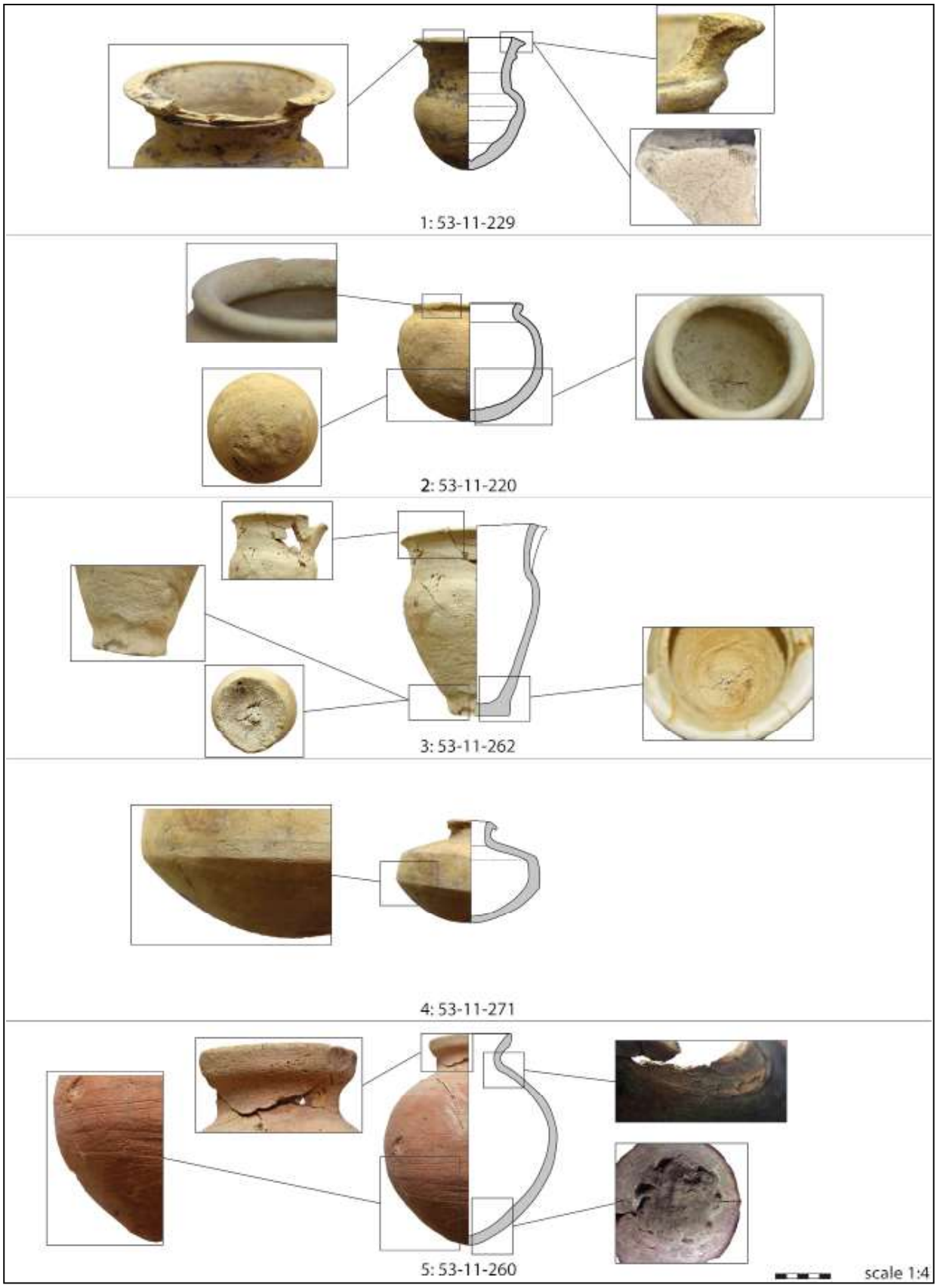


Figure 6: Selected vessels from phase 1 (courtesy of the Penn Museum of Philadelphia, drawings and photographs by authors).

Table 3: Catalogue of the selected vessels analysed in the paper.

| Fig. | No. Penn | Level (area TB) | Locus | McCown and Haines 1967 | forming | | | | | | | | | | | | | | finishing | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | undul. relief | bumps | irregular profile | fissure | Y-sh. fissure | overthickness | scraping | crevices | compression folds | trimming | string-cut base | pref. fracture | U-sh. fracture | bev. fracture | multidir. striations | fluidified | compact | shaving | |
| 6.1 | 53-11-229 | X | 284 | type 5 | x | | | | | | | | | | | x | | x | | | x | | Phase 1 |
| 6.2 | 53-11-220 | X | 292 | type 4 | x | x | x | | x | | | | | | | | | | x | | x | | |
| 6.3 | 53-11-262 | X | 297 | pl. 80: 14 | x | x | x | | | | | | x | | | x | | x | x | x | | | |
| 6.4 | 53-11-271 | XI | 299 | pl. 81: 1 | | | | | | x | | | | | | | | | | | | x | |
| 6.5 | 53-11-260 | X | 291 | pl. 81: 3 | | x | x | | | x | x | | | | | x | | x | x | | x | | |
| 7.1 | 53-11-190 | VIII | 280 | type 8b | x | | | | | | | x | | | x | | | | x | x | | | Subphase 2a |
| 7.2 | 53-11-191 | VI | 240 | type 8b | x | | | x | | x | | x | | | x | | | | x | x | | | |
| 7.3 | 53-11-192 | V.1 | | type 8a | x | | | x | | x | | x | | | x | | | | x | x | | | |
| 7.4 | 53-11-193 | V.1 | | type 8a | x | | | | | | | x | | | x | | | | x | x | | | |
| 7.5 | 53-11-253 | | 273 | type 15 | x | | | | | x | | | | | | x | | x | x | | x | | |
| 7.6 | 53-11-372A | V.2 | 256 | pl. 85: 6 type 15 | x | | | x | | | | | | | | x | | | x | | x | | |
| 7.7 | 53-11-248 | V.1 | 241 | type 14b | x | | x | x | | | | | | | | | | | x | x | x | | |
| 8.1 | 53-11-238 | V.1 | | type 16 | x | | x | x | | | | | x | | x | | | | | | x | | |
| 8.2 | 53-11-237 | VIII | | pl. 92: 3 | x | | x | x | | | | | | | x | | | | x | | x | | |
| 8.3 | 53-11-274 | V.1 | 231 | | x | | | x | | | | | | | | x | | | | x | x | | |
| 8.4 | 53-11-251 | VI | 248 | pl. 86: 12 | | x | x | x | | x | x | | | | | x | | | | x | x | | |
| 9.1 | 51-6-25 | IV | 230 | type 8b | x | | | | | | | x | | x | x | | | | x | x | | | Subphase 2b |
| 9.2 | 51-6-27 | IV | 201 | type 8b | x | | | x | | | | x | | | x | x | | | x | x | | | |
| 9.3 | 53-11-255 | IV.1 | 3B26 | | x | x | x | | | | x | | | | | x | | x | | | x | | |
| 9.4 | 51-6-77 | IV | 228 | pl. 87: 7 type 19b | x | x | | x | | | | | | | | x | | x | | x | x | | |
| 9.5 | 51-6-78 | IV | 213 | | x | | x | | | | | | | x | | x | | x | x | x | x | | |
| 9.6 | 51-6-72 | IV | 213 | pl. 84: 13 type 14b | x | x | x | | | | | | | x | | | | | | x | x | | |
| 10.1 | 51-6-24 | III | 167 | type 8b | x | | | | | | | | | x | x | | | | | x | | | Phase 3 |
| 10.2 | 51-6-21 | III | | type 8b | | | | x | | | | | | | x | x | x | | x | x | | | |
| 10.3 | 51-6-70 | III | 183 | pl. 88: 12 type 23 | x | | | | | x | | | x | | | | | | | x | | | |
| 10.4 | 51-6-71 | III | 162 | type 14b | x | x | x | | | | | | | x | | | | | x | x | x | | |

characterised by a Y-shaped fissure,[18] indicating that the upper part of the vessel could be coil-built. The exterior surface is characterised by markedly irregular and multi-directional striations near the base.

The jug (fig. 6.3) has an irregular profile, with changes in thickness and in profile orientation between the neck and the shoulder. The preferential orientation of the fractures and their bevelled profile on the upper part of the vessel could suggest the use of coils. The interior surface of the base features compression folds,[19] the

18: Fissures are considered "deep incisions situated at the limit of juxtaposed elements" (Roux 2019: 145, fig. 3.9c). The Y-shaped fissures are generally left at the joined ends of two coils.

19: Traces created by the compression of part of the vessel, especially bases and necks, with or without RKE (Hamer and Hamer 1991: 329–330; Roux 2019: fig. 3.11:b; 3.35:d; Rye 1981: 75).

outer base has bumps, and the bottom is flat with no evidence of string cut base, suggesting the absence of RKE for primary forming processes of the lower part. The striations on the lower part of the vessel are irregular and multi-directional. The surface is smooth with a 'fluidified' film and some crests.[20]

The double-carinated bottle (fig. 6.4) features outer horizontal striations at the lower carination. They could be the result of the removal of clay by scraping/shaving for realising the carinated profile (Colas 2005: fig. 6; Roux 2019: 64-68; fig. 2.22). A small over-thickness is present on the inner surface in correspondence with the upper carination.

Finally, the ovoid bottle (fig. 6.5) has an irregular profile with no visible undulations. The interior base has some bumps, while the exterior surface exhibits traces of scraping.[21] The upper part is characterised by bevelled preferential fractures, and by an over-thickness of the inner surface between the body and the neck that suggest the join of the neck.

***Sub-phase 2a***

Fabric colour is pinkish (5YR 4/6 to 10YR 8/4). The mineral inclusions are very small to small (fig. 7.5 also medium-sized), round and sub-angular and orange, black, brown and white in colour. They occur in low frequency, (10-15%; except for fig. 7.3, 7%; fig. 7.5, 20%). Vegetal inclusions occur in low frequency (1-5%). They were baked in oxidising firing conditions (fig. 8.3 has a not completely oxidised core).

Of the two carinated-rim bowls (fig. 7.1, 7.2), vessel 53-11-191 (fig. 7.2) is characterised by a fissure visible on the inner surface at the joining between the rim and the body. Both vessels present an over-thickness on the outer surfaces between the rim and the body, and some crevices at the same point on the inner surfaces (Roux 2019: fig. 3.9:b; 3.10:b). In this case, crevices could suggest the use of the wheel-throwing method for the body, while the rim might have been added in a second step. The surface is smooth with a fluidified film, with slightly accentuated striations on the outer surface on the rim and between the rim and the body.

The two band rim bowls (fig. 7.3, 7.4) have an over-thickness between the exterior rim and the body. Crevices are found on the inner surfaces of both vessels (Roux 2019: fig. 3.43:c), suggesting that the bodies were manufactured via the wheel-throwing method, with the band rim added at a later stage. There are striations on the outer surface of the rim.

Of the two collared jars (fig. 7.5, 7.6), vessel 53-11-372A (fig. 7.6) shows a fissure visible on the outer surface between the rim and the neck. The preferential fracture at the body is horizontal and spirally oriented, following the undulating profile of the vessel. The ring base of 53-11-253 (fig. 7.5) has been separately attached to the body, as indicated by the over-thickness at the bottom of the vessel, and a horizontal fracture with straight profile between the ring base and the body. The

20: According to Roux (2019: fig. 3.16:a; 3.52; 3.53), this indicates the smoothing of a wet paste with added water.
21: Scraping would have removed the excess clay in order to shape the base, as suggested by marked, irregular and multi-directional striations in the lower part of the body.

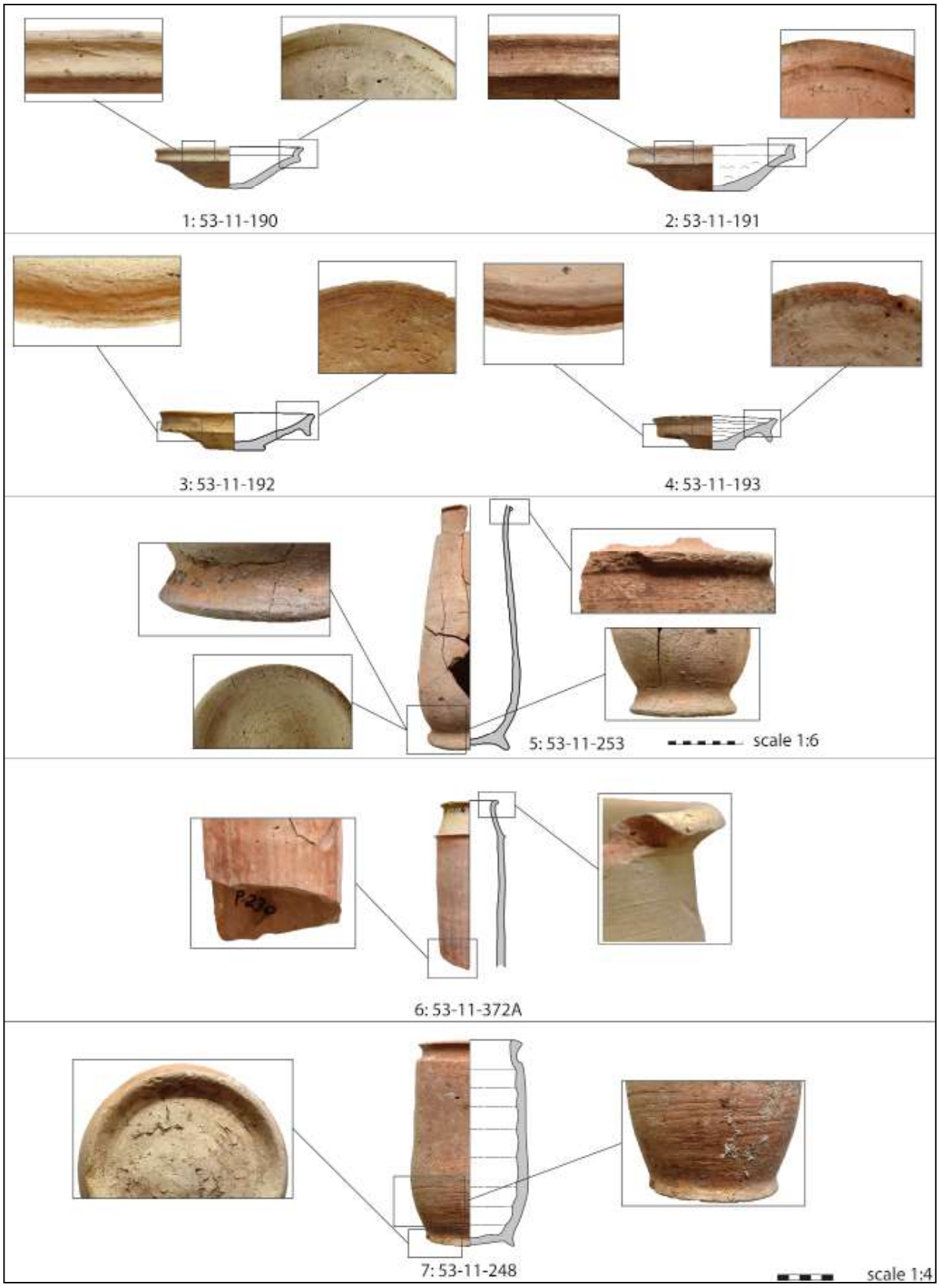


Figure 7: Selected vessels from phase 2a (courtesy of the Penn Museum of Philadelphia, drawings and photographs by authors).

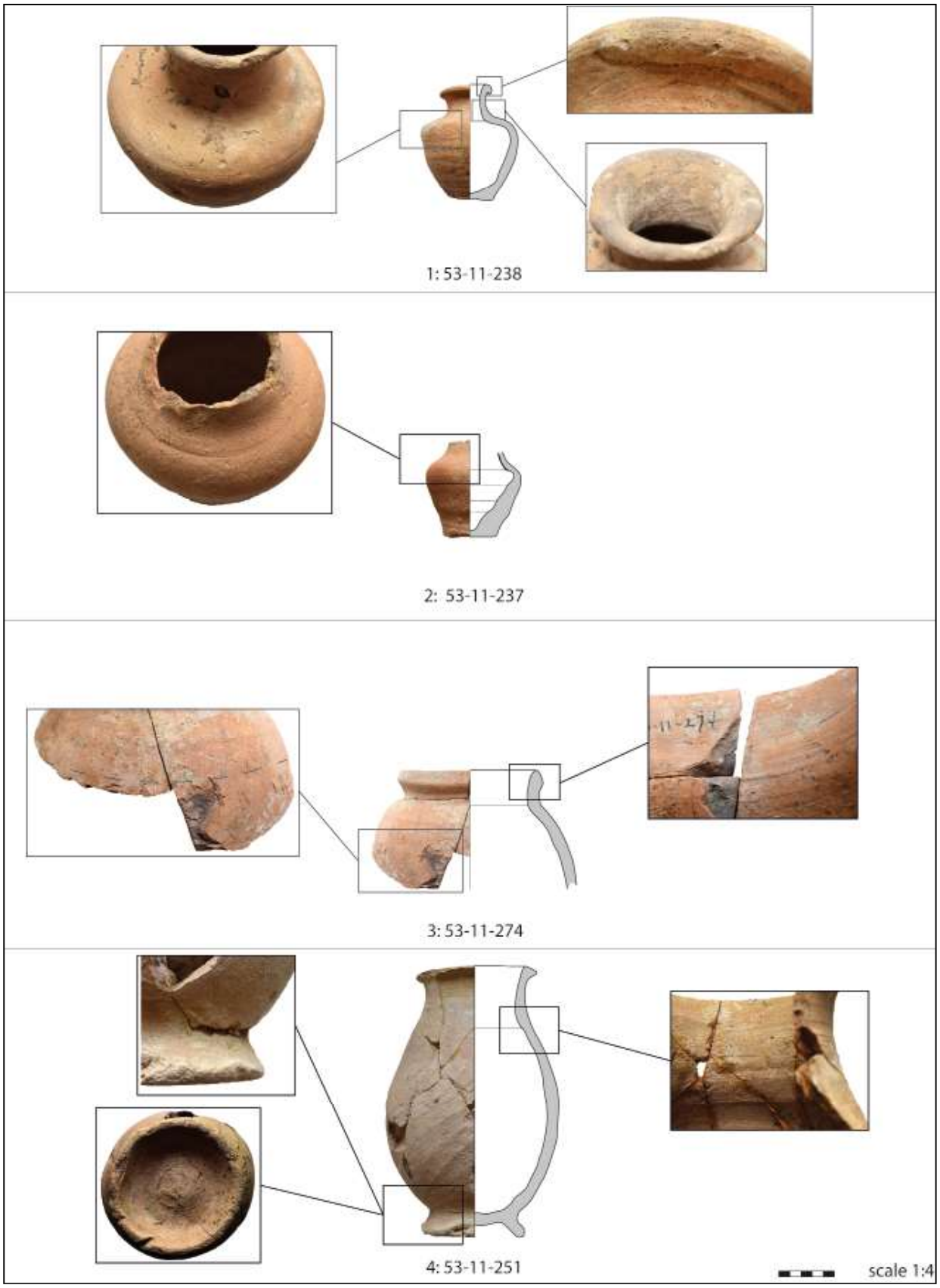


Figure 8: Selected vessels from Phase 2a (courtesy of the Penn Museum of Philadelphia, drawings and photographs by authors).

ridge on the neck is characterised by an over-thickness on its lower part and a preferential bevelled fracture, suggesting the attachment of the ridge as a separate element. The exterior lower surface of the vessel features coarse, multi-directional and irregular striations.

The small cylindrical jar (fig. 7.7) exhibits two changes in profile: at the centre of the body, and between the neck and body. The interior surface of the base has an irregular profile, and a fissure is present at the bottom of the vessel, possibly indicating the join for the ring base. The lower part of the vessel is characterised by irregular, multi-directional striations.

The small folded-rim jar (fig. 8.1) and the small jar (fig. 8.2) have irregular profiles. The rim of vessel 53-11-238 (fig. 8.1) shows traces of an irregular folding. On the inner surface of the neck compression folds are found. It is possible that the shoulders and the bodies of both vessels were made separately and then joined together, as suggested by a parallel fissure that runs between the shoulder and body. Vessel 53-11-237 (fig. 8.2) shows a fissure on the shoulder, and a change in profile on its outer surface between the base and the lower body. Irregular striations are marked on the lower part of the exterior surface.

The globular pot (fig. 8.3) is characterised by a preferential fracture below the rim, and by a fissure at the centre of the body, possibly indicating assembled elements. The surface is smooth with a fluidified film on the inner surface, while the outer surface is smooth and compact.

Finally, 53-11-251 (fig. 8.4) is an S-shaped jar with a tall ring base, and no visible profile undulations. The upper part of the interior surface is characterised by a marked change in profile between the neck and the body. The neck has two fissures that could indicate the use of coils. The lower part of the vessel is characterised by bumps. The ring base is attached, as shown by the preferential horizontal fracture between the ring base and the body, and by an over-thickness at the bottom of the base. The lower part of the body features diagonal scrapings.

***SUB-PHASE 2B***

Fabric colour ranges from pinkish (2.5YR 6/4-7.5YR 6/6) to yellowish (2.5Y 7/3-5Y 7/4), with very small to small mineral inclusions (fig. 9.5 also has medium-sized grains) with a frequency of c.10-15%. Their shape is generally round. Vessel 51-6-78 (fig. 9.5) also has white sub-angular mineral inclusions. Vegetal inclusions are present at c.1-5% (fig. 9.3, 10% at ring base). The yellowish fabrics have mineral inclusions, the majority of which are orange, black and white in colour, while the pinkish fabrics are also characterised by reddish-brown and greyish mineral inclusions. Regarding the firing processes, the pale surface colours suggests firing in oxidising conditions.

Of the two profiled-rim bowls (fig. 9.1, 9.2), vessel 51-6-27 (fig. 9.2) has some crevices on the upper part of its interior surface, suggesting the use of the wheel throwing method, and a visible fissure at the contact point between the inner rim and the body. The presence of a preferential horizontal fracture might indicate the join of the rim in a second step. In contrast, vessel 51-6-25 (fig. 9.1) has a very short-profiled rim, with no traces of fissures or fractures between the rim and the

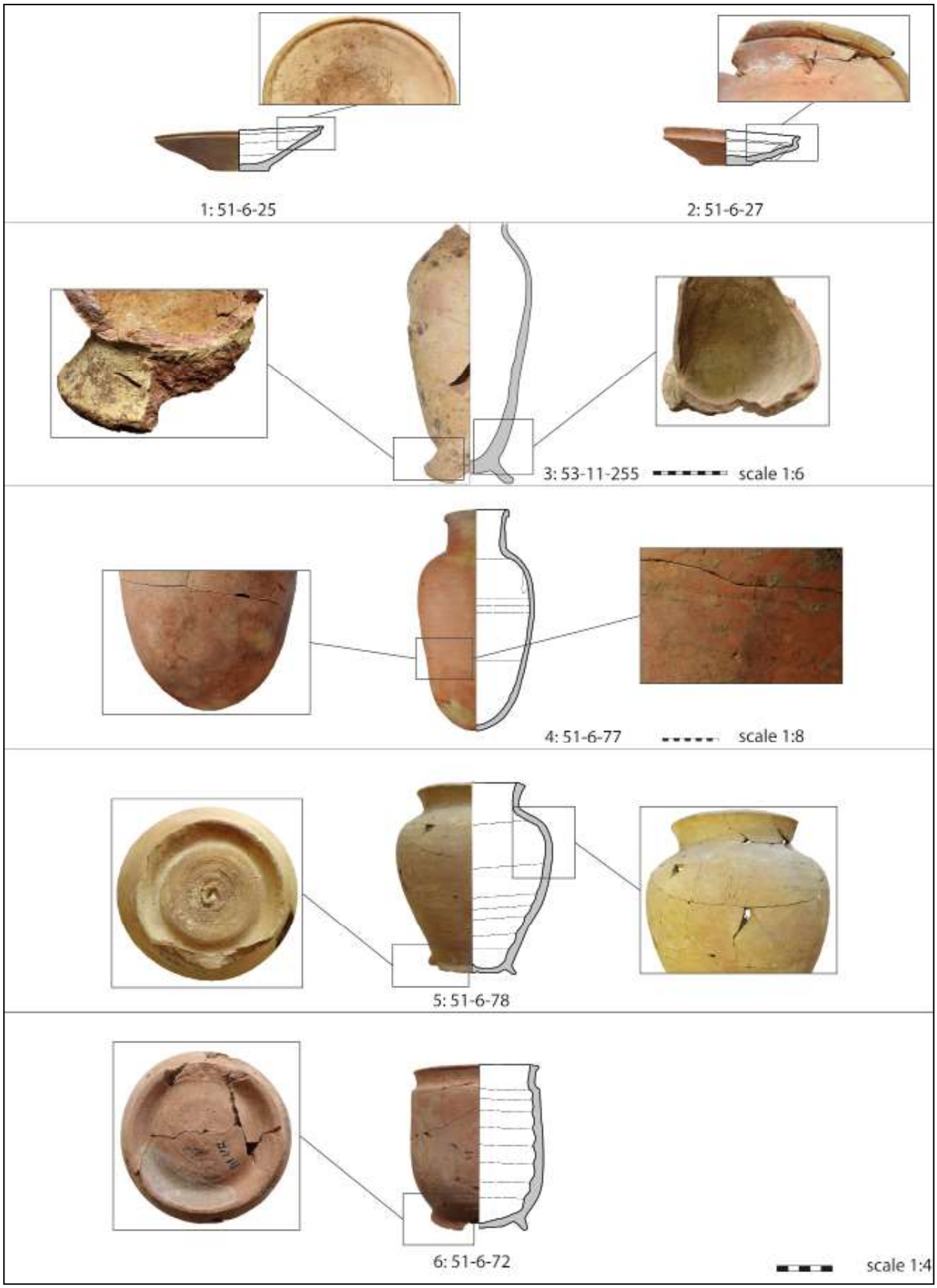


Figure 9: Selected vessels from phase 2b (courtesy of the Penn Museum of Philadelphia, drawings and photographs by authors).

body. Therefore, the body could be realised with the same wheel throwing method as fig. 9.2, while another technique was employed for making the rim (possibly trimming).[22] In both cases, the striations are irregular and multi-directional on the outer surfaces, which appear smooth with a fluidified film.

The high-footed jar (fig. 9.3) has an irregular profile with a changing in thickness in correspondence of the shoulder. The 'footed' base is made using a heavily chaff-tempered clay, and then attached to the body. A preferential, bevelled, horizontal fracture is featured immediately above the base. The lower, inner surface is characterised by some deep, vertical striations, typical of scraping (Roux 2019: 64).

The large elongated jar (fig. 9.4) has a shallow undulating profile, only perceptible at the central part of the body. The lower part is characterised by some bumps on both surfaces, that are attested below a fissure in the central part of the vessel. A preferential, horizontal fracture runs in correspondence to the fissure. All these traces might indicate that the body is realised in two separate parts.

The necked jar (fig. 9.5) features concentric striations at its bottom and no traces of a join between the ring base and the body. This could be the result of trimming operations during the shaping of the base. Preferential fractures (horizontal and bevelled) are present on the upper part of the vessel. The lower part of the outer surface exhibits coarse and multi-directional striations. The inner surface is smooth with a fluidified film, while the outer surface is smooth and compact.

The cylindrical jar (fig. 9.6) is characterised by some bumps at the inner base. The bottom of the vessel is characterised by concentric striations and no traces of join are visible between the ring and the base (similar to vessel 51-6-78, fig. 9.5), indicating the use of trimming. Two changes in profile are evidenced, one at the centre of the body, and one between the neck and body. The outer surface seems to be smooth and compact, while the inner surface is smooth with a fluidified film.

***PHASE 3***

The paste of the vessels is fine, homogeneous and compact. All vessels are pinkish in colour (2.5YR 6/6-7.5YR 7/4). The majority of mineral inclusions are very small to small, round and occur in low frequencies (10-15%) (fig. 10.3 also sub-angular; white, red, black). Vegetal inclusions occur in very low frequencies (2-5%). All vessels are baked in oxidising conditions.

The profiled-rim bowl 51-6-21 (fig. 10.2) exhibits a fissure and a U-shaped preferential fracture between the body and the profiled rim, suggesting a joint of the two elements. Marked striations are attested under the outer rim. By contrast, the profiled bowl 51-6-24 (fig. 10.1) is possibly made with a different technique (similar to 51-6-25, fig. 9.1, from sub-phase 2b), because it does not present any traces of fissures or fractures between the rim and the body.

22: Trimming is a shaving operation where small amounts of clay are removed by using a cutting tool with RKE. This operation gives the vessel its final shape (Roux 2019: fig. 3.49).

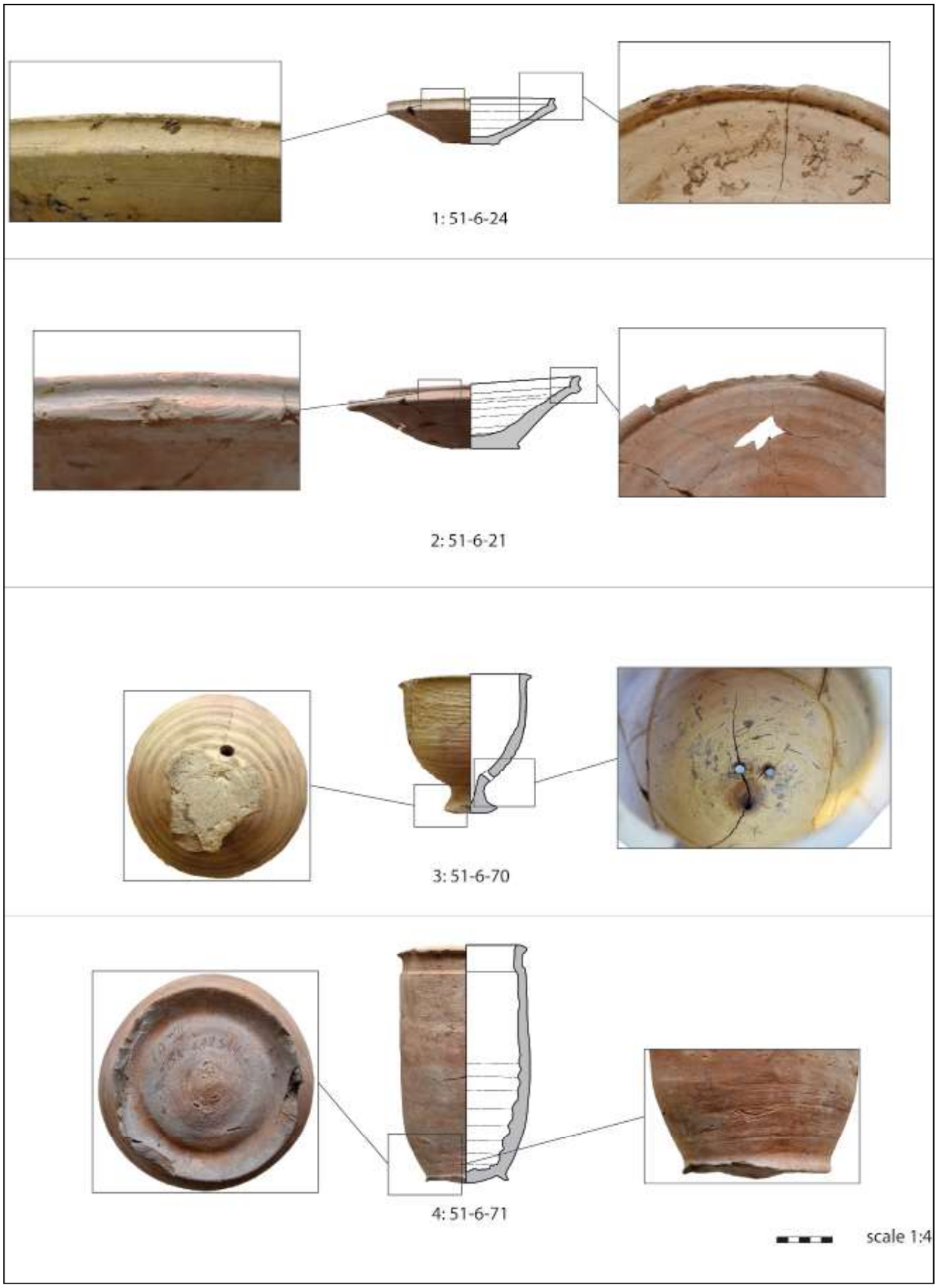


Figure 10: Selected vessels from Phase 3 (courtesy of the Penn Museum of Philadelphia, drawings and photographs by authors).

The interior base of the chalice lid (fig. 10.3)[23] is characterised by compression folds, suggesting a distorted manipulation of the clay. Regarding the outer surface, the bottom of the foot has an over-thickness, suggesting a further addition of clay similar to the so-called 'plugged' bases.[24]

The interior base of the cylindrical jar (fig. 10.4) is characterised by some bumps, while the bottom of the vessel is characterised by fine, concentric striations, possibly related to trimming operations, with no traces of junctions visible between the ring section and the base. In this case, the bottom of the vessel is lower than the ring section itself. Two changes in profile are also present, one in the middle of the body, and one between the neck and body. On the lower part of the outer surface, the striations are marked, irregular, and multi-directional. The outer surface is smooth and compact, while the inner surface is smooth with a fluidified film.

## CONCLUSION

From a technological point of view, the detailed analysis of a small pottery assemblage from the long occupational sequence of area TB at Nippur has enabled to identify characteristic traits of the *chaîne opératoire* during the late Akkadian, Ur III, and Isin-Larsa periods. With this contribution, we provide some insights about the organisation of pottery production and the continuity/changes of technical choices of potters.

Regarding raw materials, autoptic observations suggest a continuity in the preparation of the clay and inclusions. The range of colours from light yellow to pinkish-red suggests the continued use of an oxidising firing atmosphere. We noted some details regarding forming processes, such as joins of the triangular rims (figs 6.1 and 7.6), joins of the rims of the carinated-rim bowls (figs 7.1, 7.2, 9.2 and 10.2), and traces of attached ring bases (e.g. figs 7.5, 7.7, 8.4 and 9.3). These morphological traits are therefore realised through separate elements, and this can be considered an element of continuity between the three chronological phases recognised through the morphological analysis of the repertoire.

From subphase 2b onwards, some traces attesting a different technique for shaping the vessel have been identified, in particular related to the use of trimming. The introduction of this new technique at the very beginning of the second millennium BC could indicate a technological development in pottery production. The ring bases (figs 9.5, 9.6 and 10.4) started to be modelled using trimming, and also the bowls with short-profiled rim (figs 9.1 and 10.1) could have been made using the same technique, differently from the older carinated-rim bowls. Finishing processes, including clay removal by scraping (figs 6.5, 8.4 and 9.3) and multi-directional striations especially localised in the lower part of the vessels, evidence scarce attention to the final aspect of the products.

23: Present in TB and TA, levels III-II and XIII-XII respectively (McCown and Haines 1967: type 23, pl. 88: 12-14). Their functional interpretation as beaker or lid is uncertain. At the moment, no adequate comparisons are attested for these vessels (contra McCown and Haines 1967: pl. 88; Ayoub 1984: Typ 86.1-3, 59, 124). Due to the uncertainties, description and analysis follows the orientation proposed in the original publication.

24: As described by van As and Jacobs (2014: 81, fig. 24).

This pilot project has allowed the potentiality of this approach to be recognised, even from museum collections. The opportunity to increase the sample population with fresh data from new excavations, and with the use of specific scientific analyses, will test the validity of the considerations addressed in this paper and broaden the knowledge of the production processes related to the transition between the third and second millennium BC.

**acknowledgments:** We wish to thank Prof. Pinnock and Prof. Nadali, who supported us in our research over the years. We wish to express our gratitude to the staff of the Penn Museum in Philadelphia, and in particular we wish to thank the Keeper of the Near East Section, Kathrine Blanchard, for her help with the collection and her contribution to our research. Further, we wish to thank Prof. Zettler (Associate Curator-in-Charge of the Near East Section) for allowing us to study the materials from areas TA and TB, Nippur and for his helpful suggestions regarding our research project.

## REFERENCES

Armstrong, J.A. and Gasche, H. 2014. *Mesopotamian Pottery. A Guide to the Babylonian Tradition in the Second Millennium BC*. Chicago and Ghent: Oriental Institute of Chicago.

Arrivabeni, M. 2014. Heart-shaped «Akkadian» beakers and bottles. In Lebeau, M. (ed.). *ARCANE Interregional I: Ceramic*. Turnhout: Brepols Publishers, 237-243.

Ayoub, S. 1982. *Die Keramik in Mesopotamian und in den Nachbargebieten: von der Ur III-Zeit bis zum Ende der kassitischen Periode*. München: Mäander Kunstverlag.

Baldi, J. and Roux, V. 2016. The innovation of the potter's wheel: a comparative perspective between Mesopotamia and the southern Levant. *Levant* 48(3): 253-263.

Bishop, R.L., Canouts, V., Cunningham, R.H. and Reents-Budet, D. 1995. Ceramic technology, composition, and archaeological interpretation: examples from the Americas. In Vincenzini, P. (ed.). *The Ceramics Cultural Heritage. Proceedings of the International Symposium The Ceramic Heritage of the 8th CIMTEC-World Ceramic Congress and Forum on New Materials, Florence, Italy, June 28-July 2, 1994*. Faenza: Techna, 111-122.

Brisch, N. 2013. History and chronology. In Crawford, H. (ed.). *The Sumerian World*. London and New York: Routledge, 111-127.

Calderbank, D. 2017. *Moulding Clay to Model Sealand Society: Pottery Production and Function at Tell Khaiber, Southern Iraq*. Unpublished Ph.D. dissertation submitted to the University of Manchester.

Calvet, Y. 2003. Batiments Paléobabyloniens à Larsa. In Huot, J-L. (ed.). *Larsa. Travaux de 1987 et 1989*. Beyrouth: Institut français d'archéologie du Proche-Orient, 143-298.

Casadei, E. 2020. The pottery repertoire at the end of the 3rd millennium BC as chronological marker between southern Mesopotamian and the neighboring regions. The case-study of the Syrian Jazirah. In Coppini, C. and Simi, F. (eds). *Proceedings of the International Conference Broadening Horizons 5, 5-8 June 2017, University of Udine. Volume III. Civilizations in Contact: Interactions and New Directions in Near Eastern Archaeology (West and East: Rivista della Scuola di Specializzazione in Beni Archeologici)*. Trieste: EUT Edizioni Università di Trieste, 41-57.

Colas, C. 2005. Exemples de reconstitutions des chaîne opératoire des poteries du Néolithique Moyen II dans la Moitié nord de la France. In Livingstone Smith, A., Bosquet, D. and Martineau, R. (eds). *Pottery Manufacturing Processes: Reconstitution and Interpretation* (BAR International Series 1349). Oxford: British Archaeological Reports, 139-146.

Delougaz, P., Hill, H.D. and Lloyd, S. 1967. *Private Houses and Graves in the Diyala Region* (Oriental Institute Publications 88). Chicago: Oriental Institute.

Djindjian, F. 2013. Us et abus du concept de "chaîne opératoire" en archéologie. In Colin, A., Gruel, K., Ralston, I. and Dechezleprêtre, T. (eds). *L'âge du fer en Europe - Mélanges offerts à Olivier Buchsenschutz. Sous la direction de Sophie Krausz* (Collection Mémoires 32). Bordeaux: Éditions Ausonius, 93-107.

Foster, B.R. 2016. *The Age of Agade: Inventing Empire in Ancient Mesopotamia*. New York: Routledge.

Gibson, A. and Woods, A. 1990. *Prehistoric Pottery for the Archaeologist*. London and New York: Leicester University Press.

Hamer, F. and Hamer, J. 1991. *The Potter's Dictionary of Materials and Techniques. III editions*. London and Philadelphia: University of Pennsylvania Press.

Leroi-Gourhan, A. 1964. *Le Geste et le Parole*. Paris: Albin Michel.

Liverani, M. 2011. *Antico Oriente: Storia, Società, Economia*. Roma; Bari: Laterza Editore.

McCown, D.E. and Haines, R.C. 1967. *Nippur I: Temple of Enlil, Scribal Quarter, and Soundings* (Oriental Institute Publications 78). Chicago: The Oriental Institute.

McMahon, A. 2006. *The Early Dynastic to Akkadian Transition. The Area WF Sounding at Nippur* (Oriental Institute Publications 129). Chicago: The Oriental Institute.

McMahon, A. 2014. Carinated, ridged-shoulder "Akkadian" jars. In Lebeau, M. (ed.). *ARCANE Interregional I: Ceramic*. Tutnhout: Brepols Publishers, 245-252.

Mofidi-Nasrabadi, B. 2014. Qualitative veränderungen in der serienmäβigen herstellung des knofbechers in der Spätbronzezeit Elam. In Luciani, M. and Hausleiter, A. (eds). *Recent Trends in the Study of Late Bronze Age Ceramics in Syro-Mesopotamia and Neighbouring Regions. Proceedings of the International Workshop in Berlin, 2-5 November 2006*. Rahden: Verlag Marie Leidorf GmbH, 385-398.

Mouamar, G. 2017. De nouvelles données sur les goblets de Hama: marquers de la chronologie et des échanges de Syrie Centrale pendant la seconde moitié du 3e millénaire avant J.-C. *Paléorient* 43: 69-89.

Romano, L. and Zingale, M. 2019. Area 1 pottery–part 1: a preliminary assessment on typology, technology and use. In Romano, L. and D'Agostino, F. (eds). *Abu Tbeirah Excavations I. Area 1: Last Phase and Building A–Phase 1*. Rome: Sapienza Università Editrice, 323-370.

Roux, V. 2017. Ceramic manufacture: the chaîne opératoire approach. In Hunt, A. (ed.). *The Oxford Handbook of Archaeological Ceramic Analysis*. Oxford: Oxford University Press, 101-113.

Roux, V. 2019. *Ceramics and Society: A Technological Approach to Archaeological Assemblages*. Nanterre: Springer.

Roux, V. and Courty, M.A. 2005. Identifying social entities at a macro-regional level: Chalcolithic ceramics of South Levant as a case study. In Livingstone Smith, A., Bosquet, D. and Martineau, R. (eds). *Pottery Manufacturing Processes: Reconstitution and Interpretation* (BAR International Series 1349). Oxford: British Archaeological Reports, 201-214.

Roux, V. and Thalmann, J.P. 2016. Évolution technologique et morpho-stylistique des assemblages céramiques de Tell Arqa (Liban, 3e millénaire av. J.-C.): stabilité sociologique et changements culturels. *Paléorient* 42(1): 95-121.

Rye, O.S. 1981. *Pottery Technology. Principles and Reconstruction*. Washington: Taraxacum.

Sallaberger, W. and Schrakamp, I. (eds.) 2015. *ARCANE III: History and Philology*. Turnhout: Brepols Publishers.

Sallaberger, W. and Westenholz, A. 1999. *Mesopotamien: Akkad-Zeit und Ur III-Zeit* (Orbis Biblicus et Orientalis 160/3). Freiburg, Schweiz: Univ. Verl.; Göttingen: Vandenhoeck und Ruprecht.

Schiffer, M.B. and Skibo, J.M. 1987. The explanation of artifact variability. *American Antiquity* 62: 27-50.

Schmidt, C. 2014. Late 3rd millennium "Ur III" carinated bowls. In Lebeau, M. (ed.). *ARCANE Interregional I: Ceramic*. Turnhout: Brepols Publishers, 409-415.

Simpson, St J. 1997. Early urban ceramic industries in Mesopotamia. In Freestone, I. and Gaimster, D. (eds.) *Pottery in the Making. World Ceramic Traditions*. London: British Museum Press, 50-55.

Sinopoli, C.M. 1991. *Approaches to Archaeological Ceramics*. New York and London: Plenum Press.

Steinkeller, P. 1996. The organization of crafts in third millennium Babylonia: the case of potters. *Altorientalische Forschungen* 23(2): 232-253.

van As, A. 1989. Some techniques used by the potters of Tell Hadidi during the second millennium B.C. In Bronitsky, G. (ed.). *Pottery Technology. Ideas and Approach. San Francisco*. London: Boulder, 41-79.

van As, A. and Jacobs, L. 2014. The Babylonian potter: environment, clay, and techniques. In Armstrong, J.A. and Gasche, H. (eds). *Mesopotamian Pottery. A Guide to the Babylonian Tradition in the Second Millennium B.C. (Mesopotamian History and Environment II.IV)*. Ghent and Chicago: University of Ghent and Oriental Institute of the University of Chicago, 75-93.

van Ess, M. 1988a. Keramik von der Akkad- bis zum ende der Altbabylonischen zeit aus den planquadraten N XV und XVI und aus dem Sinkašid-Palast in Uruk-Warka. *Baghdader Mitteilungen* 19: 321-442.

van Ess, M. 1988b. Keramik von der Ur III- und Altbabylonischen zeit aus dem suchgraben im planquadrat P XIII in Uruk-Warka. *Baghdader Mitteilungen* 19: 443-463.

Zettler, R. 1991. Nippur under the third dynasty of Ur: Area TB. *Aula Orientalis* 9: 251-281.