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Islamic Pottery from Ancient Termez (Uzbekistan): New Archaeological and Archaeometric Data

Céramique islamique de l'ancienne Termez (Ouzbékistan) : nouvelles données archéologiques et archéométriques

Agnese Fusaro[a], Verónica Martínez Ferreras[a], Josep M. Gurt Esparraguera[a], Andreas Angourakis[a], Shakir R. Pidaev[b] and Larisa Baratova †[b]

Abstract: The study deals with the Islamic pottery from Termez (southern Uzbekistan), with a special focus on the wares dated to the 9th-12th centuries. The city was a major urban settlement, along one of the routes of the Silk Road. Ceramics, both glazed and unglazed, were produced in several workshops located in the lower city (*shahristan*) and its suburbs (*rabad*). Glazed and unglazed wares, including cooking pots, two pottery moulds and two sphero-conical vessels from two excavated areas at Termez are examined by X-ray Fluorescence, X-ray Diffraction, and petrographic thin section analysis. Clayey sediments from different areas of the site are incorporated as a local reference for comparison. The aim is to examine the provenance of the vessels and to determine the production techniques. The results reveal that all the vessels were produced by using calcareous clays and most of them exhibit similar geochemical composition; nevertheless, several chemical groups and petrographic fabrics were identified. XRD points that firing temperatures were generally between 800 and 1,000-1,100°C, being the latter prevalent. The results of this study are remarkable since archaeometric researches on Central Asian pottery are still few.

Résumé : *L'étude concerne la poterie islamique de Termez (sud de l'Ouzbékistan), et particulièrement celle datée du* ix*e au* xii*e siècle. La ville était un important centre urbain, le long de la Route de la Soie, et un centre de production céramique. Plusieurs ateliers ont été localisés dans la ville basse (*shahristan*) et dans ses faubourgs (*rabad*). Des céramiques glaçurées et non glaçurées, des pots, deux moules et deux vases sphéro-coniques ont été examinés par fluorescence de rayons X, diffraction de rayons X et du point de vue pétrographique. Des sédiments argileux provenant de différentes zones du site ont été aussi utilisés comme références locales pour comparaison. Notre objectif est de préciser la provenance des céramiques et de caractériser les techniques de production. Les résultats obtenus montrent que tous les échantillons ont été produits avec des argiles riches en CaO de composition similaire; cependant plusieurs groupes chimiques et pétrographiques ont été identifiés. La DRX indique que les températures de cuisson se situaient généralement entre 800 et 1000-1100 °C, cette dernière fourchette étant majoritaire. Les résultats de cette étude sont remarquables car les recherches archéométriques sur la poterie d'Asie centrale sont encore peu nombreuses.*

Keywords: Central Asia, Islamic pottery, paste characterisation, provenance, technology, Termez

Mots clés : *Asie centrale, caractérisation des pâtes, poterie islamique, provenance, technologie, Termez*

1. Introduction

During the early Islamic period, pottery was widely produced in Central Asia, especially at important urban centres such as Samarqand, Bukhara, Akhsiket and Termez in nowadays Uzbekistan (Shishkina, 1979; Shishkina & Pavchinskaja, 1992; Nekrasova, 1999; Mirzaakhmedov, 2003; Henshaw, 2010; Houal, 2008, 2013), Balkh, Lashkari Bazar, and Ghazni in Afghanistan (Gardin, 1957, 1963;

[a] *Equip de Recerca Arqueològica i Arqueomètrica de la Universitat de Barcelona (ERAAUB), Department of History and Archaeology, University of Barcelona, Barcelona, Spain. (agnese.fusaro@gmail.com), (vmartinez@ub.edu)(jmgurt@ub.edu) (andreas.angourakis@ub.edu)*
[b] *Institute of Fine Arts, Academy of Sciences of Uzbekistan, Tashkent, Uzbekistan. (shakirdjan@mail.ru)*

Fusaro, 2014; Siméon, forthcoming), Hulbuk in Tajikistan (Siméon, 2009, 2012, 2013), and Nishapur in Eastern Iran (Wilkinson, 1973; Rante & Collinet, 2013). In most of these centres, the manufacture of Islamic glazed and unglazed vessels is dated since the 8th-9th centuries.

Archaeometric analyses on Central Asian Islamic pottery are scarce and mainly applied to coatings rather than fabrics. Moreover, in some cases, they are related to museums' collections or pottery collected during surveys. Recent research works have been conducted on ceramics from the sites of Nishapur and Samarqand (Lazzarini *et al.*, 1994; Mason, 2004: 121-155; Rante & Collinet, 2013; Müller-Wiener & Siméon, 2016), Akhsiket (Henshaw, 2010, Henshaw *et al.*, 2006, Wang *et al.*, 2009), and Jam, Afghanistan (Gaiscogne & Bridgman, 2010). Nonetheless, systematic and comprehensive archaeometric studies on Islamic wares from reliable stratigraphic contexts in Central Asia are still few.

Contributing to fill this gap, the authors have recently performed an archaeological and archaeometric study on glazed and unglazed wares collected from stratigraphic excavations at the site of ancient Termez (southern Uzbekistan) and dated between the 9th and the 16th/17th centuries (Martínez *et al.*, 2019a). The city was located on the southern border of the ancient region known as Mawarannahr in the Islamic period. It played a crucial political, economic, and military role in southern Central Asia due to its strategic position at one of the crossing points of the Amu Darya River and one of the intersections of the Silk Road. It was connected with Samarqand and Bukhara in the north and with Balkh in the south, and from there on with the Indian subcontinent through Afghanistan. Many different handicraft productions have been recognised in several quarters of the Islamic city, being the manufacture of pottery one of the most important, at least from the 9th century (Karimov, 2001: 70-72; Lesguer, 2015: 435-436).

The research performed on Islamic vessels from ancient Termez includes their contextualisation, the examination of their morphological and decorative characteristics, and the chemical, mineralogical and petrographic characterisation of selected specimens. The study allowed: 1) to define the reference chemical groups and the petrographic fabrics for the local products; 2) to determine some technological processes involved in the pottery manufacture (clay procurement and processing, modelling, and firing); 3) to recognise imported vessels (Martínez *et al.*, 2019a). Based on this preliminary research, we present herein the complete archaeometric characterisation of the ceramic categories produced and used at the city in the Islamic period (9th-early 13th centuries), including peculiar items such as the sphero-conical vessels.

The macroscopic fabrics were first defined through the examination of the samples under the stereomicroscope. The chemical and petrographic composition was investigated by X-ray fluorescence (XRF-WD) and thin-section optical microscopy respectively, while the mineralogical composition was examined through X-ray Diffraction (XRD). The archaeometric data available on some raw materials collected at different areas of Termez have been used for comparison to determine the provenance of the vessels. Moreover, some technological processes of manufacture have been determined for all the pottery categories, allowing making inferences about their properties and performance characteristics. Besides expanding the study on the Islamic pottery productions at Termez, the final aim of the present study is to contribute to furthering our knowledge on Islamic pottery production and circulation in Central Asia.

2. Ancient Termez

The archaeological site of ancient Termez lies along the Amu Darya river over the Amu Darya-Surkhan Darya floodplain (mean altitude 300 m), which forms part of the Afghan-Tajik depression. The floodplain comprises a Hercynian basement composed of Precambrian-Palaeozoic highly metamorphosed rocks and Permian-Triassic sedimentary and volcanic rocks. This basement is filled mainly by Mesozoic and Cenozoic sediments. The predominant deposits at Termez consist of 1) lower Paleogene layers of carbonate and evaporite rocks (limestone, dolomite, and gypsum), and detrital rocks with carbonate intercalations (claystone, siltstone, sandstone, limestone with shells and marlstone), and 2) upper Miocene rocks and Pliocene sediments including sandstone, siltstone and claystone (Sánchez del Corral & Thum, 2012).

Termez and the whole Mawarannahr were incorporated into the Umayyad caliphate in the early 8th century. During the 9th-10th centuries, under the Samanid dynasty, the city acquired importance as manufacture and trade centre, becoming an important port on the Amu Darya until the early 13th century. The city consisted of a large fortified urban complex comprising three main walled enclosures: the citadel, the lower town (*shahristan*), and the suburbs (*rabad*), where the main economic and manufacturing activities took place (Figure 1). During the conquest of Central Asia by the Mongols of Genghis Khan, the city was sacked and destroyed completely in 1220, although some parts were restored and used until the 16th/17th centuries (Karimov, 2001; Leriche & Pidaev, 2010: 182-184; Leriche, 2013: 155).

As pottery production concerns, four workshops attributed to the Islamic period have been partially excavated by the MAFOuz Uzbek-French team (Lesguer, 2015). Two of them are located north of the *rabad* outside the defensive walls (Figure 1). One is represented by a circular kiln built with

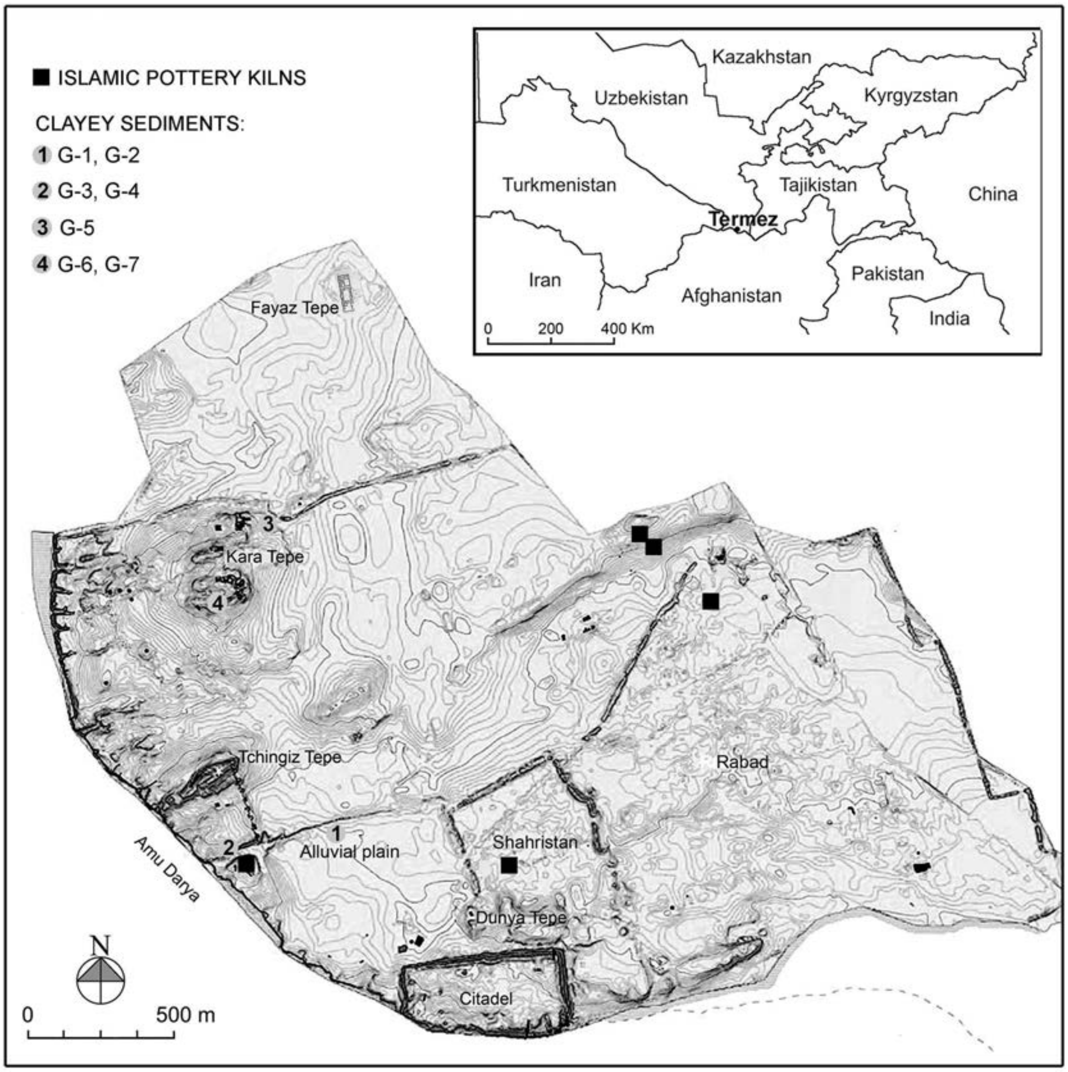

Figure 1: General map of ancient Termez (37°16'2" N, 67°11'24" E) (from Leriche & Pidaev, 2007: 183, Fig. 2; 203, Fig. 20), with the indication of the pottery workshops and the points of sampling of the clayey sediments.
Figure 1 : Carte générale de l'ancienne Termez (37° 16'2" N, 67° 11'24" E) (d'après Leriche et Pidaev, 2007: 183, Fig. 2; 203, Fig. 20), avec l'indication des ateliers de poterie et des lieux d'échantillonnage des sédiments argileux.

mud bricks and measuring 3.19 m of maximum diameter, to which is attributed the manufacture of large storage jars. 18 channels or pipes placed radiantly along the wall of the firebox connected this space with the firing chamber (2.11 m diameter). The second workshop is located to the north and comprises two kilns, one circular and the other with a trapezoidal shape. The firing chamber of the latter measures 4.9 m long and 3.5 m large, and the grid was supported by arches. These two kilns were specialised in the manufacture of glazed ceramics and sphero-conical vessels. A third workshop, recovered in the *shahristan*, comprises a circular kiln (3.30 m diameter) and a pottery dump. The firebox was connected to the firing chamber through 10 channels. According to the findings, this workshop produced unglazed moulded flasks and jugs with relief decoration and probably fine unglazed vessels. The fourth pottery workshop is located to the south-east of Tchingiz Tepe and comprises a pottery kiln built with mudbricks and dated to the 11th-12th centuries. The firing box measures 2.33 m long, and 2.20 m large, and the grid was supported by four arches. Given the small dimensions of this structure, it probably fired ceramics of rather a small size. This evidence suggests that several pottery workshops, specialised in producing different wares, were active in Termez at least during the 9th-12th centuries.

Recent archaeological surveys and excavations carried out by the Uzbek-Spanish IPAEB team provided new evidence of pottery production in Termez during the Islamic period. Indeed, since 2017 several workshops and kilns both outside the *rabad* and in the *shahristan* are the focus of a new project and several ceramics collected there are currently being analysed.

3. Sampling

Ceramic vessels

The pottery assemblage investigated and presented herein includes 37 glazed and unglazed wares (Table 1, Figure 2). 17 (coded TS) were recovered from the excavations conducted by L. Baratova in 2009 in the area of a pottery workshop in the *shahristan*. According to typological and stylistic criteria, they have been dated to the 9th-early 13th century. Despite the lack of archaeological information regarding the specific finding context of the vessels, it is possible to suggest that they could correspond to several productions of this ceramic workshop. The other 20 vessels (coded TA) were found in several contexts from sector AC2, excavated by the Uzbek-Spanish IPAEB team in 2009 in the alluvial plain. It is one of the westernmost contexts of the Islamic period investigatesd at Termez, and it consists in a refuse deposit formed over an earlier occupation on the ancient canal that connected the Surkhan Darya with the Amu Darya through Termez. The chronology proposed through the typological examination of the vessels suggests a quite long period of use (9th-11th/12th centuries). Apart from the vessels recovered at the *shahristan*, this study does not include any sample from the workshops mentioned above, since these contexts had not been included among the investigated areas of the Uzbek-Spanish team when this research was carried out.

The examination of fresh fractures under the stereomicroscope allowed to describe the macroscopic features and the surface treatment specific for each sherd, as well as to group them according to different macroscopic fabrics. It should be noted that all the vessels recovered are earthenware, while no stonepaste specimens have been found in these excavated areas.

The glazed vessels analysed are 16 bowls and dishes (Figure 2), whose forms and decorations broadly conform to the Central Asian ceramic horizon for the period considered, having stronger similarities with the productions of the southern and eastern areas (e.g., Nishapur, Balkh, Hulbuk), and of the main centres of Mawarannahr, such as Bukhara and Samarqand (Martínez *et al.*, 2019a). They exhibit fine to medium-fine calcareous fabrics, brown-reddish to pale brown (Figure 3).

Most of the slip-painted wares analysed, characterised by a dark brown/black slip-painting over white slip, were found in the lower layers (SU15, SU16, and SU18) of sector AC2, suggesting that their production and distribution were more widespread in the 9th-10th centuries. TA12, which is the only vessel presenting white slip-painting over a dark slip, seems to have been produced slightly later (10th-11th centuries) (Table 1). The underglaze painted ware is represented by six bowls (TA2/3/5/9/10/13) recovered throughout the stratigraphy of AC2 (9th-11th/12th centuries). The splashed *sgraffiato* ware, herein exemplified by samples TA4 and TA7, is abundant in the whole AC2 stratigraphy, even if it seems more widespread in its upper layers. The last group identified is composed of four monochrome glazed specimens from the *shahristan* (TS3/5/6/7) attributed to the 12th-early 13th centuries; TS7 also bears *sgraffiato* decoration.

The unglazed wares analysed comprise 22 items, including three moulded relief decorated pilgrim flasks (TS10, TS11 and TS12; in Figure 2, the flask to the left of these samples, found in *shahristan*, exemplifies their original form) and two pottery moulds used in their manufacture (TS13 and TS14), as well as jugs and jars, lids, a basin, two sphero-conical vessels, and cooking pots (Figure 2). The moulds, the pilgrim flasks with moulded relief decoration and the jar TS9, all from the *shahristan*, consist of medium-coarse fabrics, pale-brown to pale-greyish, with abundant inclusions (Figure 3). Fine tableware is represented by jugs and one lid or flask (TA15/16/15/16/17), some bearing high-quality incised, carved, cut pierced, and applied decoration; they consist of a medium-fine fabric with buff or creamy colour. The two sphero-conical vessels analysed (TS20/21) are made of the same highly vitrified, fine fabric. Among the less refined wares, the basin TA18 and the large flat lid TA14 from sector AC2 have coarse and medium-coarse fabrics respectively, and both show a light colour-whitish surface.

The cooking pots display different shapes, which in turn correspond to different, coarse to very coarse macroscopic fabrics (Figures 2, 3). TA20 has a light brown matrix and predominance of rock fragments of ca. 1 mm grain size, and some dark grains. The paste of TA21 has a light red matrix, which contains similar inclusions, although dark grains are prevalent. TA21 macroscopically resembles the pot TS19, although the latter presents coarser inclusions and more abundant dark, angular grains. The pot TA22 is a coarse fabric with a heterogeneous matrix. The core of the body wall is greyish, while the surfaces are reddish, which indicates that it was fired in reducing conditions and cooled in an oxidising atmosphere. The handle TA19 consists of a very coarse red fabric tempered with large dark inclusions, and it probably belongs to a cooking pot or a large storage jar. The same applies for TS18, which consists of medium-coarse red fabric with similar inclusions to those found in TA19, though smaller.

Sample	Archaeological Context	Chronology	DESCRIPTION
TA2	AC2-SU11-4	9th-11th c.	Wheel-thrown, underglaze painted ware; hemispherical bowl; white slip, transparent colourless glaze, and underglaze painted red and brown decoration; fine fabric.
TA3	AC2-SU11-1	10th-11th c.	Wheel-thrown, slip-painted ware; hemispherical bowl with disc base; white slip, transparent colourless glaze, and underglaze slip-painted dark brown and light brown arabesque pattern; fine fabric.
TA4	AC2-SU11-2	10th-11th c.	Wheel-thrown, splashed *sgraffiato* ware; hemispherical bowl; white slip, transparent colourless glaze, with *sgraffiato* geometric and arabesque patterns and green-mustard-brown splashes; fine fabric.
TA5	AC2-SU12-2	9th-10th c.	Wheel-thrown, underglaze painted ware; hemispherical bowl; white slip, transparent colourless glaze, and underglaze painted brown, yellow and green decoration; fine fabric.
TA7	AC2-SU14-2	10th-11th c.	Wheel-thrown, splashed *sgraffiato* ware; bowl; white slip, transparent colourless glaze,with *sgraffiato* geometric decoration with grid pattern and green-mustard splashes; fine fabric.
TA8	AC2-SU15-2	9th-10th c.	Wheel-thrown, slip-painted ware; conical bowl; white slip, transparent colourless glaze, and underglaze slip-painted black pseudo-epigraphic band; fine fabric.
TA9	AC2-SU15-1	9th-11th c.	Wheel-thrown, underglaze painted ware; bowl; white slip, transparent colourless glaze, and underglaze painted red and black intertwined pattern; fine fabric.
TA10	AC2-SU16-1	9th-10th c.	Wheel-thrown, underglaze painted ware; hemispherical bowl; white slip, whitish glaze, and underglaze painted brown and green dotted pattern; fine fabric.
TA11	AC2-SU16-3	9th-10th c.	Wheel-thrown, slip-painted ware; conical bowl; white slip, transparent colourless glaze, and underglaze slip-painted black epigraphic band; fine fabric.
TA12	AC2-SU18-2	10th c.	Wheel-thrown, slip-painted ware; Conical shallow dish; dark brown slip, transparent colourless glaze, and underglaze slip-painted white dotted rosettes; fine fabric.
TA13	AC2-SU18	9th-11th c.	Wheel-thrown, underglaze painted ware; small fragment of bowl; white slip, transparent colourless glaze, and underglaze painted red and dark brown intertwined pattern; fine fabric. [no photo]
TA14	AC2-SU11-5	11th-12th c.	Unglazed large flat lid with finger impressed decoration on the rim; medium-fine yellowish fabric.
TA15	AC2-SU11-6	10th-12th c.	Unglazed wheel-thrown narrow-necked jug with vertical handle; medium-fine, yellowish fabric.
TA16	AC2-SU12-1	10th-12th c.	Unglazed wheel-thrown handled jug with carved horizontal lines and applied button-shaped elements on the neck; medium-fine, yellowish fabric.
TA17	AC2-SU16-2	9th-10th c.	Unglazed wheel-thrown carinated lid or pilgrim flask (?), with engraved and incised floral and geometric decoration; medium-fine, pale yellowish fabric.
TA18	AC2-SU15-3	11th-12th c.	Unglazed wheel-thrown conical basin with carved lines and carved notches on the rim; coarse, brownish fabric.
TA19	AC2-SU11-7	10th-12th c.	Unglazed hand-made(?) storage jar or cooking pot; finger impressions below the handle, black slip covering the outer surface; very coarse red fabric.
TA20	AC2-SU11-8	10th-12th c.	Unglazed hand-made(?) cooking pot, short cylindrical neck, everted rim, with soot traces on the outer surface; coarse light brown fabric.
TA21	AC2-SU14-1	10th-11th c.	Unglazed wheel-thrown cooking pot, with triangle-shape everted rim, twisted loop handle(s), and soot traces on the outer surface; coarse, light red fabric.
TA22	AC2-SU18-16	9th-11th c.	Unglazed hand-made(?) cooking pot, very short neck, simple rounded rim; small fragment; coarse fabric, with grey core and red surfaces. [no photo]
TS3	Shahristan	(11th-)12th c.	Wheel-thrown, green monochrome ware; carinated bowl; transparent green glaze; medium-coarse, pale-brown fabric.
TS5	Shahristan	12th-early 13th c.	Wheel-thrown, turquoise monochrome ware; small conical bowl; white slip and transparent turquoise glaze; medium-fine, pink-brownish fabric.
TS6	Shahristan	12th-early 13th c.	Wheel-thrown, turquoise monochrome ware; dish; white slip, transparent turquoise glaze, and underglaze carved polylobed decoration; medium-fine, yellowish fabric.
TS7	Shahristan	12th-early 13th c.	Wheel-thrown, turquoise monochrome *sgraffiato* ware; open form; white slip, transparent turquoise glaze, and underglaze *sgraffiato* decoration; medium-fine, pale brown fabric.

TS9	Shahristan	9^{th}-10^{th} c. (?)	Unglazed wheel-thrown biconical jar, with carved horizontal lines and red painted band on the neck; medium-coarse, pale-greyish fabric.
TS10	Shahristan	10^{th}- 12^{th} c.	Unglazed moulded flask with relief decoration (reversed S-shaped motifs); medium-coarse, pale brown-orangish fabric.
TS11	Shahristan	10^{th}-12^{th} c.	Unglazed moulded flask with relief decoration (rosette motifs); medium-coarse, pale brown-yellowish fabric.
TS12	Shahristan	10^{th}-12^{th} c.	Unglazed moulded flask with relief decoration (reversed S-shaped motifs); medium-coarse, beige fabric.
TS13	Shahristan	10^{th}-12^{th} c.	Unglazed wheel-thrown mould for flasks/jugs manufacture, decorated with roundels; medium-coarse, pale-greyish fabric.
TS14	Shahristan	10^{th}-12^{th} c.	Unglazed wheel-thrown mould for flasks/jugs manufacture, decorated with S-shaped motifs, roundels and square medallions with palmette motifs; medium-coarse, pale-greyish fabric.
TS15	Shahristan	10^{th}-12^{th} c.	Unglazed wheel-thrown jug (?), with incised and comb incised decoration; medium-fine, creamy fabric.
TS16	Shahristan	Unknown	Unglazed wheel-thrown jar or jug (unshaped sample); medium-fine, creamy fabric. [no photo]
TS17	Shahristan	11^{th}-12^{th} c.	Unglazed wheel-thrown handled jug, with biconical carinated body, decorated with incised vegetal motifs, comb impressed dots, and cut pierced grid band on the neck; medium-fine, beige-creamy fabric.
TS18	Shahristan	Unknown	Unglazed hand-made (or coil-made?) cooking pot or jar with two ledge handles on the neck, black slip partially covering the outer surface; medium-coarse red fabric.
TS19	Shahristan	Unknown	Unglazed wheel-thrown cooking pot; unshaped fragment; coarse light brown fabric. [no photo]
TS20	Shahristan	9^{th}-14^{th} c.	Unglazed wheel-thrown sphero-conical vessel with carved geometric-vegetal motifs on the shoulder; overfired grey fabric, greenish outer surface.
TS21	Shahristan	9^{th}-14^{th} c.	Unglazed wheel-thrown sphero-conical vessel, with elongated spherical body and pointed base; overfired grey fabric, greenish outer surface.

Table 1: Inventory of the vessels analysed.
Tableau 1 : Inventaire des céramiques analysées.

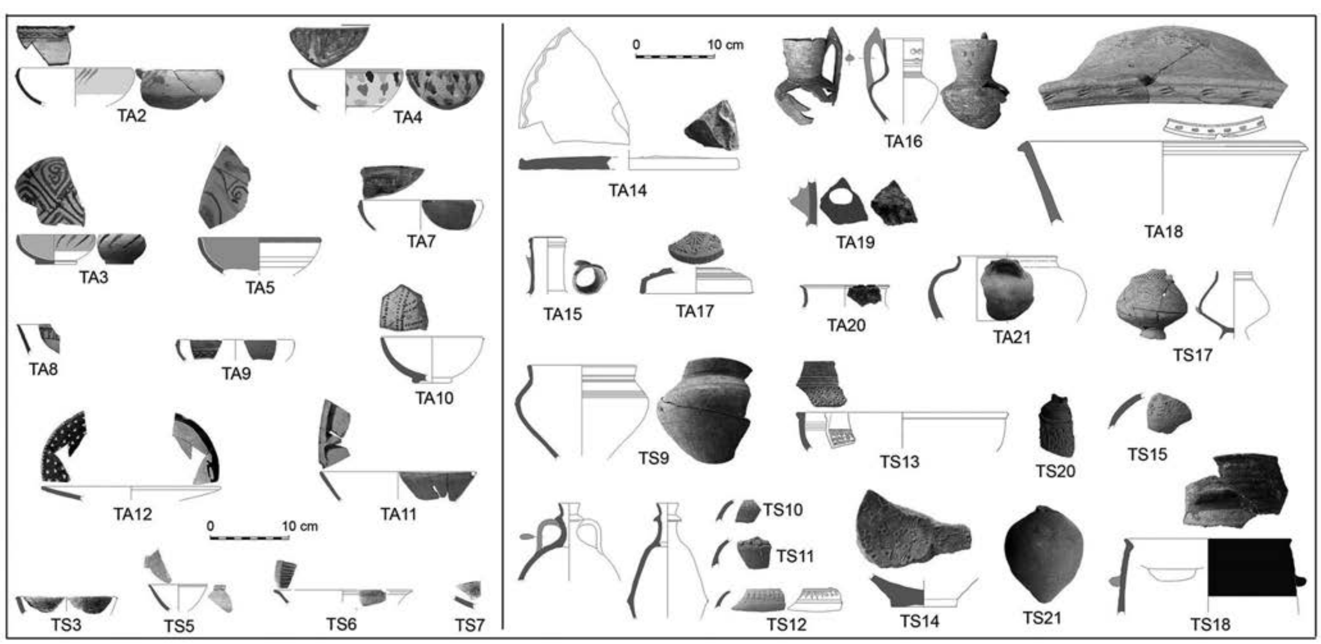

Figure 2: (See colour plate XV) The glazed and unglazed wares analysed.
Figure 2 : (Voir planche couleur XV) Céramiques glaçurées et non glaçurées analysées.

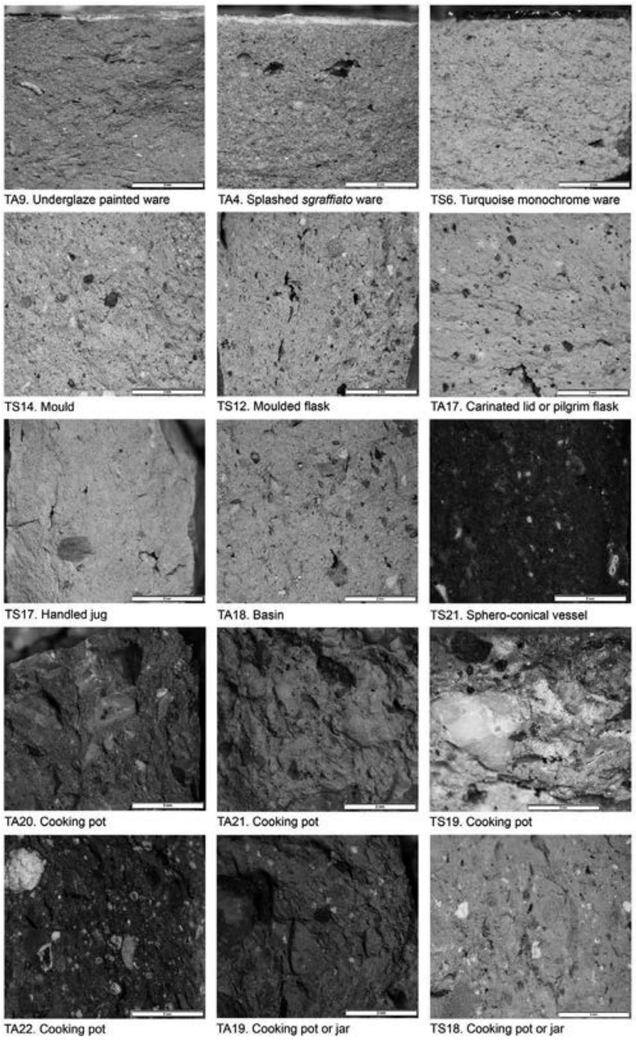

Figure 3: (See colour plate XVI) Microphotographs at 20× of fresh fractures of representative wares of all the macroscopic fabrics identified, through the micro-stereoscope.
Figure 3 : (Voir planche couleur XVI) Microphotographies à 20× de fractures fraîches des productions représentatives de toutes les fabriques macroscopiques identifiés à travers le micro-stéréoscope.

Local raw materials

The raw materials analysed include seven clayey sediments collected at different areas of the site: two at sector AC2 in the alluvial plain (G-1/2), two at the south-western slope of Tchingiz Tepe (G-3/4), and three at the area of Kara Tepe, located on the north-western part of the site (G-5/6/7) (Figure 1). The previous mineralogical investigation by X-rays of oriented aggregates pointed out some differences in the mineral fraction of these raw materials (Martínez *et al.*, 2019a). Muscovite is prevalent in G-1/2/4/6/7, which also contain few kaolinite and chlorite fragments. In G-3, the predominant clay fraction is montmorillonite together with few muscovite and kaolinite. G-5 largely differs from the others, since the clay minerals are scarce and mainly represented by muscovite and kaolinite. Besides the clay fraction, other mineral phases identified by XRD analysis in all the raw materials are (in order of abundance) quartz, calcite, plagioclase, and K-feldspar, while dolomite was only recognised in G-1/5, and hematite in G-2/4.

The petrographic examination also reveals differences in the grain size of the groundmass, being the coarsest that of G-3/5, and the finest that of G-4/7. The frequency and amount of non-plastic inclusions in the coarse fraction also differs among the samples. However, the main constituents identified in all of them are quartz, K-feldspar, plagioclase, micas (biotite and muscovite) and calcite, and are consistent with the principal lithological types already described for the alluvial plain and Tchingiz Tepe. The two samples collected at the southern slope of Tchingiz Tepe consist of silty-sandy sediment (G-3) with a brown-greenish groundmass and common to abundant inclusions up to 0.5 mm, and fine clayey sediment (G-4) with few inclusions including schist and quartzite. Regarding the two sediments from the alluvial plain (sector AC2), G-1 contains a brown-orange groundmass with abundant clay fraction and few to common non-plastic inclusions. Conversely, G-2 is silty sediment composed of a brown-greenish groundmass with abundant fine fraction and common coarse fraction (≤ 0.8 mm grain-sized). Among the raw materials collected in the area of Kara Tepe, G-5 is silty-sandy sediment with abundant fine and coarse inclusions (0.1 to 1.0 mm grain sized) including slate/phyllite and schist, and chlorite. G-6 is texturally similar to G-2, being Ca-rich silty sediment with a light-brown groundmass and a few to common inclusions (≤ 0.5 mm in size). G-7 resembles G-6, but it is finer, being the average of the non-plastic inclusions ca. 0.05 mm, with maximum sizes of 0.1 mm.

4. Methods

Fresh fractures of all the specimens analysed were observed under an Olympus SZ61TR micro-stereoscope, while petrographic thin section analysis was carried out on most of the sherds using an Olympus BX43F polarising microscope. In both cases, photographs, measurements, and evaluations were performed with an Olympus DP73-WDR digital camera and the Stream Basic software.

The chemical and mineralogical analysis by X-ray fluorescence (XRF-WD) and X-ray diffraction, respectively, was applied on all the sherds except the two moulds (TS13/14), the two sphero-conical vessels (TS20/21), and the cooking pot TA22. They were conducted at the CCiT-UB laboratory at the University of Barcelona on powdered samples following the procedures described elsewhere (Martínez *et al.*, 2016). XRF-WD was carried out using a Philips PW 2400 spectrometer with a Rh excitation source. For the XRD analysis, two different diffractometers were used: a Siemens D-500 and a Panalytical X'Pert PRO alpha 1.

5. Results and discussion

Chemical analysis by XRF-WD

The chemical subcomposition of the 32 vessels and the seven raw materials analysed by WD-XRF is displayed in Table 2. According to the CaO values, all the glazed and unglazed vessels exhibit similar CaO values (between 8-14 wt% CaO). These values match with that found in the raw materials (8-16 wt% CaO). In contrast, the cooking pots were produced using low calcareous pastes (between 1.7-3.4 wt% CaO), and their chemical composition significantly differs from the rest of the vessels analysed.

Some slip-painted wares, underglaze painted wares, splashed *sgraffiato* wares (TA2/4/8/10/11/12/13), and the green monochrome bowl (TS3) exhibit very high Pb values. Such values are probably due to the diffusion of the lead glaze into the ceramic matrix or the glaze was not completely removed during the preparation process of the samples. The same applies to the high Cu values observed in the green (TS3) and turquoise (TS6) monochrome glazed specimens, and in the splashed *sgraffiato* ware TA4. Very high P_2O_5 concentrations are also detected in two cooking pots (TS18/19), probably related to alterations produced during their use or occurred during their deposition (Maritan & Mazzoli, 2004). However, it should be noted that two other pots (TA20/21) exhibit the lowest P_2O_5 values.

The Na_2O concentrations also vary from 0.7 to 2.1% among the pottery sherds, and from 0.8 to 2.4% among the raw clayey samples. The highest Na_2O values in specific wares and clays could be related to the occurrence of weathering processes (crystallisation of salts) linked to the presence of evaporites in this semi-arid/arid environment. This phenomenon was attested in previous studies concerning earlier ceramics from Termez and other sites in the Surkhan Darya valley (Martínez *et al.*, 2016; Tsantini *et al.*, 2016). Since they consist of soluble substances, they are dissolved and transferred to the pottery by meteoric water and groundwater and re-precipitated in the pores and over the surface (Amit & Yaalon, 1996). Therefore, Pb, Cu, P_2O_5, and Na_2O were excluded from the statistical treatment to avoid distortions caused by contamination and weathering processes.

Aiming to calculate the chemical variation in the dataset, the compositional variation matrix (CVM) was calculated over the rest of the subcomposition according to J. Buxeda (1999). The total variation provided (tv = 1.046) is high and characteristic of a heterogeneous assemblage (Buxeda & Kilikoglou, 2003). The sum of variances calculated for each element (τ.i values) indicates that the element most contributing to the total variation is CaO, followed by Ga and MgO.

To visualise the distribution of the samples according to the (dis)similarity of the compositional data, we applied hierarchical agglomerative cluster analysis to the same subcomposition, using the centroid method on squared Euclidean distances. The data was previously transformed into additive log-ratios using the component with the lowest τ.i value (Fe_2O_3) as the divisor (Buxeda, 1999). The resulting dendrogram sharply separates the cooking pots from the rest of specimens analysed due to the lower CaO content of the former (Figure 4). Moreover, within the category of cooking pots, minor differences in other components determine two groups (TA20/21 and TS19, on the one hand, and TA19 and TS18, on the other).

Most of the glazed and unglazed wares join the main group, to which are also linked five clayey sediments, especially G-1 from the alluvial plain. Several underglaze painted and slip-painted vessels (TA2/8/12/13), and the splashed *sgraffiato* bowl TA4 match in a second group. They differ from the rest of tableware and common wares because they present higher Ga content.

Thin section analysis

The vessels were classified in different petrographic fabrics according to the characteristics of the matrix (groundmass), the microstructure (micromass), the frequency and shape of the voids, and the frequency, size, shape, distribution, and type of the aplastic inclusions in the fine (< 0.125 mm) and coarse (> 0.125 mm) fractions.

The glazed and unglazed samples examined consist of different medium-coarse, medium-fine, fine and very fine fabrics (Figure 5). They all have a Ca-rich groundmass, although the colour and optical activity vary depending on the amount of carbonates and the firing temperature reached in each case. It is generally homogeneous, brown-orangish to pale brown-greenish, the latter being characteristic of the more calcareous and higher fired ceramics. Voids (usually micro- and meso- vughs and vesicles) are common to abundant. The frequency and size of the inclusions slightly differ among the sherds. The basin TA18 represents the coarsest fabric. The two moulds (TS13/14), the three pilgrim flasks (TS10/11/12), the jar (TS9), and the green monochrome glazed vessel TS3 consist of medium-coarse fabrics with abundant non-plastic materials (generally ≤ 0.5 mm grain-sized, rarely ≤ 0.7 mm). Inclusions are common in the two turquoise monochrome specimens (TS6/7) and some other glazed samples (TA3/4/5/7/8/10/11/12/13). The finest fabrics, with few inclusions, usually ≤ 0.5 mm grain-sized, include glazed (TS5 and TA2/9) and unglazed items (TA15 and TS15/16/17), as well as the two sphero-conical vessels (TS20/21). The fine fraction is mainly constituted by small crystals (quartz and probably feldspars) and phyllosilicates, together with carbonates totally or partially decomposed. The coarse fraction is moderately to well-sorted and oriented rather parallel to the vessel margins. The inclusions usually appear well distributed except in the flasks, in which they are more concentrated in the margins of the vessels, indicating that they were produced with moulds. The coarse fraction mainly comprises sub-angular to sub-rounded crystals of monocrystalline quartz, K-feldspar and plagioclase. The presence of mica flakes and metamorphic and igneous rock-fragments varies from frequent to common, depending on the sample. The amount of Ca-microfossils and nodules of Cal-micrite (usually partially or totally decomposed) also diverges from frequent to common; they are more abundant in the three monochrome specimens (TS5/6/7) and several unglazed vessels (TA14/15/16/17 and TS15/16/17), while they are scarcer in TA4/8/12/13. Opaque minerals and amphibole appear common to few, while crystals of pyroxene and epidote are few to rare. Most of the glazed wares from sector AC2 (TA2/3/5/7/9/10/11) also contain few fragments of chert and rare garnet; in contrast, TA4/8/12/13 have more opaque minerals, while metamorphic rock fragments are absent. Fragments of granitoids and sandstone are more abundant in the basin TA18. All the inclusions identified are analogous to those detected in earlier local pottery productions from Termez (Tsantini *et al.*, 2016; Martínez *et al.*, 2019b), and are consistent with the geological environment in and around Termez (Sánchez del Corral & Thum, 2012; Martínez *et al.*, 2019b).

The cooking pots are represented by at least two main Fe-rich, very coarse fabrics, which match with the macroscopic fabrics previously defined for this category (Figure 5). Thus, TA21 and TS19 share the same very coarse fabric, characterised by ubiquitous rounded fragments of fine-grained reddish to dark siltstone, large fragments (≤ 2 mm) of igneous rocks and crystals derived from these rocks, together with common ferruginous nodules and few nodules of micritic calcite. The second petrographic group is represented by TA19/22 and TS18, made of a very coarse fabric with a brown-reddish matrix. Voids are abundant and mainly consist of meso- and macro-vughs. The inclusions are abundant, poorly-sorted and moderately-well distributed. The fine fraction is common in TS18 and TA19, and abundant in TA22. It mainly comprises small crystals, together with few carbonates and phyllosilicates. The coarse fraction is very abundant, and it is constituted by two types of inclusions. The largest ones (≤ 3 mm) are elongated and rounded fragments of fine-grained, Fe-rich sedimentary rocks (probably claystone and siltstone), although some of them resemble grog fragments. This fabric composition includes very abundant, sub-angular to sub-rounded inclusions (≤ 0.4 mm), and match the non-plastic grains found in the glazed and unglazed vessels.

Mineralogical analysis by XRD

Since all the glazed and unglazed vessels consist of Ca-rich pastes, the mineralogical changes developed during firing are mostly due to the decomposition of calcium carbonates. Between 600thC and 800°C, carbon dioxide gas (CO_2) is released, and free-lime (CaO) is formed. At 800/850°C, the CaO reacts with Si to produce new Ca-silicates such as gehlenite and diopside. The maximum stability of gehlenite is around 850-950°C, and above 900-950°C it reacts again, being completely decomposed around 1050-1100°C (Cultrone *et al.*, 2001; Trindade *et al.*, 2009). Moreover, phyllosilicates decrease at high temperatures and normally disappear in the range between 1000-1100ºC. The iron oxides also react with both the primary and firing phases, as well as the decomposed organic material transformed in carbon (Nodari *et al.*, 2007; Maggetti *et al.*, 2011). In

Table 2: (Next page) a) XRF normalised data of the pottery and clayey sediments analysed by WD-XRF on the subcomposition Fe_2O_3, Al_2O_3, P_2O_5, TiO_2, MgO, CaO, Na_2O, K_2O, SiO_2 (in %), Ba, Rb, Th, Nb, Pb, Zr, Y, Sr, Ce, Ga, V, Zn, Cu, Ni, Cr (in ppm) and the loss on ignition (LOI) (in %), GW (glazed ware), UW (unglazed ware), CK (cooking pot), C (clayey sediment); (b) Summary of the Compositional Variation Matrix of the vessels and the 7 clayey sediments analysed.

Tableau 2 : (Page suivante) (a) Données chimiques normalisées des céramiques et des sédiments argileux analysés par FRX sur la sous-composition Fe_2O_3, Al_2O_3, P_2O_5, TiO_2, MgO, CaO, Na2O, K2O, SiO_2 (en%), Ba, Rb, Th, Nb, Pb, Zr, Y, Sr, Ce, Ga, V, Zn, Cu, Ni, Cr (en ppm) et la perte au feu (en %), GW (échantillons glaçurés), UW (échantillons non glaçurés), CK (pots), C (sédiment argileux); (b) Résumé de la matrice de variation compositionnelle des céramiques et des sept sédiments argileux analysé.

a)

		Fe_2O_3	Al_2O_3	MnO	P_2O_5	TiO_2	MgO	CaO	Na_2O	K_2O	SiO_2	Ba	Rb	Nb	Pb	Zr	Y	Sr	Ce	Ga	V	Zn	Cu	Ni	Cr	LOI
GW	TA2	5.9	15.0	0.10	0.27	0.68	3.1	9.6	1.4	3.0	56.7	454	104	17	3241	168	35	366	47	41	89	105	71	45	74	4.19
GW	TA3	6.0	15.2	0.10	0.26	0.67	3.4	9.6	1.4	3.1	57.3	511	130	18	1305	161	31	356	59	27	93	106	60	47	76	2.83
GW	TA4	5.9	15.1	0.10	0.20	0.68	3.4	9.9	1.4	3.0	57.3	456	97	17	6518	172	41	331	43	64	97	101	345	52	75	2.13
GW	TA5	5.7	14.6	0.09	0.23	0.64	3.2	10.9	1.3	3.0	55.1	493	125	17	1329	163	31	411	59	27	86	101	82	45	100	5.0
GW	TA7	6.2	15.6	0.10	0.25	0.68	3.5	9.7	1.4	3.1	56.2	528	134	18	1439	160	31	366	60	30	89	107	88	50	78	2.79
GW	TA8	6.3	15.7	0.11	0.26	0.69	3.5	9.7	1.3	3.3	55.3	482	110	18	5176	164	40	407	56	56	100	112	48	57	76	3.0
GW	TA9	5.5	13.9	0.10	0.24	0.62	3.2	11.9	1.2	2.8	52.5	475	126	17	283	153	27	511	45	20	83	98	42	43	65	6.89
GW	TA10	5.7	14.2	0.10	0.22	0.66	3.1	10.7	1.3	2.9	54.6	465	122	17	1492	159	31	455	50	28	84	98	65	43	67	6.22
GW	TA11	6.9	17.3	0.12	0.20	0.74	3.5	7.8	1.4	3.6	56.1	536	155	19	1404	166	37	294	71	32	111	118	53	56	83	1.3
GW	TA12	5.8	15.0	0.10	0.22	0.67	3.4	10.2	1.5	2.8	57.8	462	85	18	7114	177	42	334	65	69	97	105	56	54	75	1.17
UW	TA13	6.0	15.3	0.10	0.24	0.66	3.7	11.7	1.6	2.6	54.9	487	80	19	5480	162	42	397	59	58	98	116	63	56	72	1.46
UW	TA14	5.1	13.9	0.09	0.16	0.58	3.0	11.7	1.6	2.7	57.4	541	120	16	16	151	25	371	61	18	86	86	36	43	72	3.57
UW	TA15	6.4	15.4	0.12	0.17	0.66	3.5	13.4	1.9	2.4	54.6	587	95	18	13	150	28	317	47	21	98	103	32	55	79	1.57
UW	TA16	6.0	14.9	0.10	0.17	0.65	3.3	12.9	1.6	2.8	55.3	557	123	18	32	163	27	345	55	20	91	83	32	52	75	2.33
UW	TA17	6.0	15.0	0.10	0.17	0.66	3.5	11.9	2.0	2.8	56.7	513	113	18	13	163	28	322	63	20	90	89	26	51	71	0.8
UW	TA18	6.3	16.0	0.09	0.23	0.68	3.2	8.1	1.3	3.3	58.0	618	147	18	31	154	28	377	67	21	105	116	44	52	78	2.57
CK	TA19	6.7	17.9	0.06	0.17	0.83	2.2	1.7	1.9	3.3	64.0	370	152	17	23	190	32	183	67	22	148	104	35	39	97	1.95
CK	TA20	4.3	18.1	0.06	0.09	0.64	1.3	3.4	1.1	3.6	64.3	590	179	19	19	201	33	220	73	22	104	49	25	34	80	3.03
CK	TA21	3.3	20.3	0.03	0.10	0.88	0.7	2.7	0.7	3.6	65.4	293	171	21	13	222	33	207	84	23	108	23	32	32	80	2.03
GW	TS3	5.8	14.9	0.12	0.21	0.67	3.0	9.7	1.9	3.0	59.0	527	111	13	5314	168	38	277	95	22	129	80	615	50	95	1.60
GW	TS5	5.4	13.7	0.10	0.29	0.62	3.2	12.3	1.8	3.3	54.1	468	102	13	39	152	25	424	56	17	108	92	84	40	74	6.80
GW	TS6	5.6	14.7	0.09	0.20	0.67	3.2	11.1	1.8	2.5	59.5	427	61	13	30	169	26	272	62	18	97	81	405	41	78	0.97
GW	TS7	5.2	13.9	0.09	0.19	0.64	2.8	10.8	1.8	3.0	58.7	475	104	13	21	176	26	330	62	17	89	81	37	38	71	4.03
UW	TS9	5.7	14.7	0.09	0.27	0.63	3.7	10.8	1.4	3.4	56.1	496	117	14	31	150	26	338	63	18	119	102	37	45	84	4.53
UW	TS10	6.0	15.3	0.09	0.32	0.65	4.0	10.4	1.4	3.4	56.2	502	117	14	35	151	25	359	68	19	122	108	40	49	91	3.43
UW	TS11	5.4	14.2	0.09	0.33	0.61	3.4	9.4	1.5	3.5	57.5	460	108	13	39	152	24	391	52	17	110	94	33	43	83	5.46
UW	TS12	5.7	14.8	0.09	0.28	0.61	3.4	10.5	1.3	3.3	56.3	468	117	14	40	149	25	292	56	18	127	101	35	46	87	4.89
UW	TS15	6.5	15.8	0.11	0.18	0.71	3.5	12.5	1.7	2.5	56.4	587	86	15	14	160	29	318	69	19	137	96	25	50	94	0.93
UW	TS16	6.5	15.7	0.12	0.17	0.68	3.4	12.6	2.1	2.8	56.3	634	84	15	21	157	28	284	60	20	113	89	13	53	91	0.93
UW	TS17	6.4	15.5	0.11	0.16	0.67	3.2	13.7	1.8	2.8	53.9	703	106	14	28	146	27	353	63	19	139	95	41	53	84	3.33

CK	TS18	6.4	17.7	0.08	0.86	0.81	2.2	2.2	1.8	3.2	63.5	412	133	14	23	186	30	255	61	22	147	113	33	39	91	2.30
CK	TS19	4.0	19.7	0.05	0.51	0.72	1.1	2.9	1.0	3.7	64.8	484	187	17	14	216	34	173	85	25	117	38	23	32	69	1.90
C	G-1	5.3	13.2	0.09	0.19	0.56	3.6	12.4	0.8	2.7	46.8	408	117	18	13	126	22	250	40	18	103	98	33	43	61	-
C	G-2	4.7	11.2	0.12	0.15	0.57	2.3	13.0	0.9	2.4	50.1	256	105	19	15	163	20	184	36	16	81	81	32	36	52	-
C	G-3	3.6	9.7	0.11	0.12	0.43	1.8	16.4	1.4	2.1	48.7	353	78	11	10	127	17	220	36	14	63	57	18	26	45	-
C	G-4	6.7	14.4	0.13	0.12	0.61	3.3	11.3	1.2	3.1	45.2	296	115	13	47	126	22	215	55	20	119	115	43	50	60	-
C	G-5	4.3	12.2	0.07	0.17	0.62	2.3	6.6	2.4	2.4	61.2	495	84	12	21	222	27	188	65	15	84	60	16	22	72	-
C	G-6	5.3	13.1	0.10	0.16	0.64	2.7	9.0	2.1	2.8	50.6	254	104	15	16	147	21	188	40	19	94	95	31	36	52	-
C	G-7	6.2	14.5	0.10	0.16	0.66	2.8	8.2	1.5	3.1	51.0	283	121	15	17	145	22	149	48	21	111	110	41	43	60	-

b)

	Fe_2O_3	Al_2O_3	MnO	TiO_2	MgO	CaO	K_2O	SiO_2	Ba	Rb	Nb	Zr	Y	Sr	Ce	Ga	V	Zn	Ni	Cr
τ_i	1.269	1.426	2.216	1.371	2.724	6.351	1.478	1.385	1.787	2.377	1.537	1.692	1.590	2.203	1.984	3.431	1.705	2.515	1.368	1.450
vt/τ_i	0.825	0.734	0.472	0.763	0.384	0.165	0.708	0.755	0.586	0.440	0.681	0.619	0.658	0.475	0.527	0.305	0.614	0.416	0.765	0.722
$r_{v,\tau}$	0.945	0.945	0.227	0.957	0.099	-0.076	0.948	0.950	0.961	0.943	0.944	0.925	0.919	0.767	0.935	0.937	0.969	0.482	0.937	0.975
vt	1.046																			

oxidising atmospheres, oxygen penetrates into the ceramic bodies, carbon oxidises to CO_2 and the iron oxide developed is hematite. In reducing atmospheres carbon is rather stable, and the iron oxides that crystallise are Fe-rich spinels, such as magnetite or hercynite, which confer dark colours to the ceramic bodies. Spinel also appears to be the main firing phase developed in Fe-rich, low calcareous pastes. Based on the stability of such mineral phases, the equivalent firing temperature (EFT) was estimated for all the sherds analysed through the examination of the XRD spectra (Figure 6) (Maniatis *et al.*, 1983).

The diffractograms of two flasks (TS11/12) and four underglaze painted vessels (TA2/5/9/10) present quartz, plagioclase, K-feldspar and muscovite as primary phases, while the firing phases (hematite, gehlenite and diopside) appear more or less developed. The coexistence of these primary and firing mineral phases suggests an EFT higher than 800ºC and lower than 900°C. The same mineral phases are observed in two unglazed vessels (TS9, TA18) and five glazed specimens (TA3/7/8/11, TS5), although the firing phases are increased while calcite and phyllosilicates appear decreased. Therefore, the EFT has been estimated between 900-1000°C

The rest of the unglazed (TA14/1/16/17, TS10/15/16/TS17) and glazed (TA4/12/13/, TS3/6/7) wares are characterised by the absence of calcite and phyllosilicates, suggesting higher EFT (≥ 1,000°C). Moreover, gehlenite is decreased while diopside is much more developed. A still higher firing temperature has been estimated for the two sphero-conical vessels (TS20/21) since diopside appears as the main mineralogical phase together with plagioclase and K-feldspar. Also quartz is decreased, and calcite, phyllosilicates, and hematite are absent.

Regarding the cooking pots, TA20 only presents primary phases (quartz, plagioclase, K-feldspar, muscovite and few hematite fragments) and the EFT has been estimated below 800°C. TA21 and TS18 exhibit the same mineralogical phases but muscovite is decreased, and hematite appears increased as firing phase, suggesting an EFT around 800-900°C. In samples TA19/22 and TS19, phyllosilicates are absent while hematite and spinel appear more developed, thus pointing to an EFT above 1,000°C. Even if the pot TA22 has a greyish core and reddish surfaces, indicative of firing in reducing atmosphere and a post-firing in oxidising conditions, no magnetite has been properly identified, but hematite. Nonetheless, it should be noted that magnetite is difficult to recognise in the diffractograms, due to its low intensity.

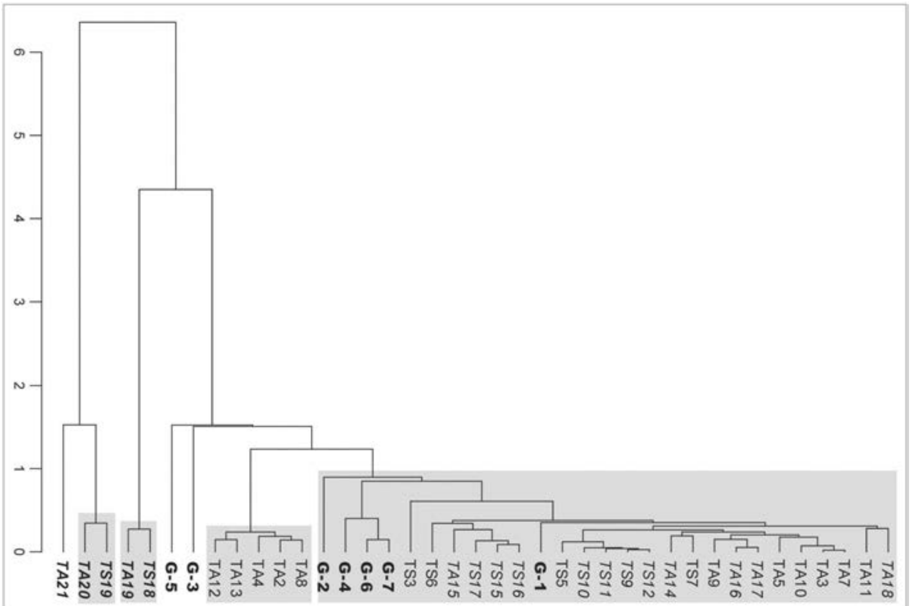

Figure 4: Dendrogram resulting from the cluster analysis of the chemical composition of both ceramics and raw materials.
Figure 4 : Dendrogramme résultant de l'analyse de grappes de la composition chimique des céramiques et des matières premières.

6. Discussion and conclusions

The results of this study highly contribute to the better understanding of the pottery production at Termez from the Samanid period to the Mongol conquest. The chemical and petrographic analysis allowed ascribing the whole assemblage of unglazed wares, as well as the two sphero-conical vessels, to local manufacture at Termez. Most of the glazed vessels are also locally produced: three underglaze painted wares (TA5/9/10), two slip-painted wares (TA3/11), and a splashed *sgraffiato* ware (TA7) from sector AC2 (9th-11th centuries), as well as the four monochrome glazed wares (TS3/5/6/7) from *shahristan* (11th-early 13th centuries). Their attribution to Termez is supported by the compositional similarity between them and most of the clayey sediments analysed, especially the raw material G-1 from the alluvial plain, which consists of the finest sediments among the raw materials examined, containing muscovite as the main clay mineral. From a petrographic point of view, the local products have calcareous, fine-, medium-, to medium-coarse fabrics. The main non-plastic inclusions identified are consistent with the local geological environment (Cenozoic sediments covering the Hercynian basement). However, several fabrics corresponding to different pottery productions have been identified among these wares, thus suggesting that numerous pottery workshops were active during specific periods. Indeed, according to the archaeological data, the glazed wares were manufactured at least in one of the workshops located on the outskirts north of the *rabad*, together with other items such as the sphero-conical vessels. Large storage jars appear to have also been produced in this area, at least during the 11th-12th centuries, while unglazed vessels and moulded pilgrim flasks were manufactured since the 9th-10th centuries.

Besides the local production, a small group of glazed vessels with slightly different chemical and petrographic composition was recognised. It includes two underglaze painted wares (TA2/13), a slip-painted bowl with epigraphic decoration (TA8), a slip-painted vessel with black slip (TA12), and a splashed *sgraffiato* specimen (TA4), all of them attributed to the 9th-11th centuries. These samples mainly differ because they present higher Ga values, although their petrographic composition notably resembles that of the local products and matches with the geological composition of the environment in and around Termez. In the current state of research, it is difficult to precise whether they correspond to a different pottery production within the Termez area, manufactured using different raw materials or, more plausible, they were produced in another nearby site in the region. An unequivocal regional attribution for this production is still not possible, given that most of the coeval glazed productions from other Central Asian centres have not yet been characterised.

As for the cooking pots, they were manufactured with Fe-rich clays, although different tempers were used. At least two main coarse to very-coarse productions have been identified. TA20/21 and TS19 exhibit abundant fragments of igneous rocks as temper, and their provenance must be loca-

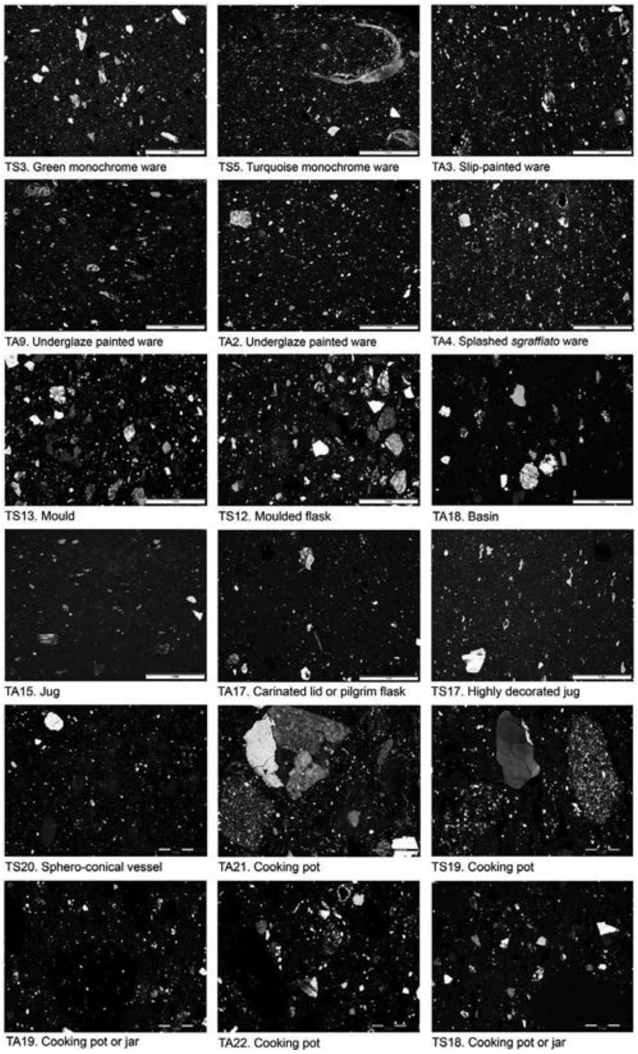

Figure 5: (See colour plate XVII) Thin-section microphotographs at 40× of representative wares of all the petrographic fabrics identified, by using crossed polarized light (XPL).
Figure 5 : (Voir planche couleur XVII) Microphotographies de lames minces à 40× des productions représentatives de toutes les fabriques pétrographiques identifiées, en utilisant la lumière polarisée croisée (XPL).

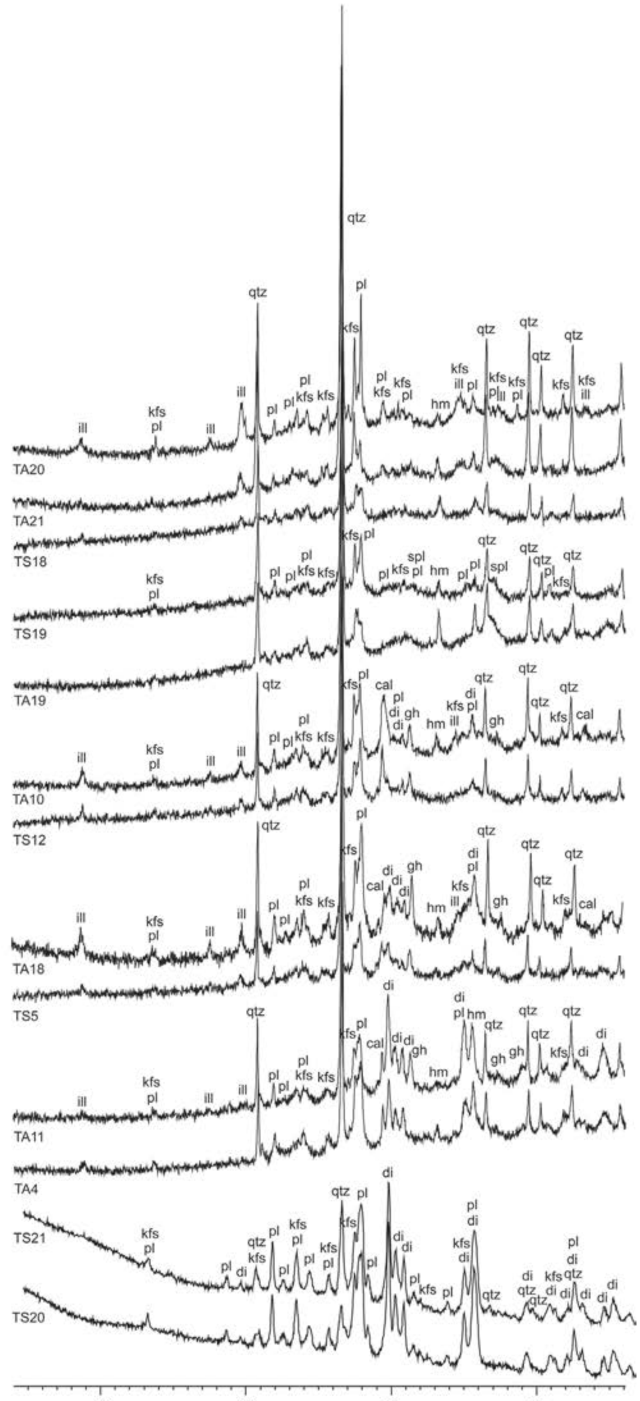

Figure 6: Diffractograms of representative samples related to the different mineralogical categories identified among the glazed and unglazed wares.
Figure 6 : Diffractogrammes des échantillons représentatifs liés aux différentes catégories minéralogiques identifiées parmi les céramiques glaçurées et non glaçurées.

ted outside the Surkhan Darya valley. In contrast, the petrographic composition of the pots TA19, TA22 and TS18 is consistent with the geological formations that define the Amu Darya-Surkhan Darya valleys and, therefore, a local/regional origin has been proposed.

The study also demonstrates the high degree of specialisation that characterises the pottery manufacture in Termez and the advanced technological skills of the potters. They processed local clayey sediments in different ways and applied different technological processes to obtain vessels with specific morphological and decorative features, performance characteristics, and physical and mechanical properties. The firing process principally entailed oxidising conditions and reached temperatures from 800 to above 1000°C.

The archaeological and archaeometric research ultimately reveals that, besides functional wares such as jugs, large basins, and lids, potters from Termez also produced high-quality and finely decorated unglazed items at least during the 9th-12th centuries. In parallel, the potters working at the city developed an important production of glazed wares using a large diversity of materials and techniques. Apart from being a pottery production centre, the research carried out so far reveals that Termez also received traded ceramics produced in other nearby (regional products) and further areas (i.e., Iraqi products, Martínez *et al.*, 2019a). That proves that the city was well integrated into the main Central Asian commercial networks at least since the Samanid period.

Aknowledgements

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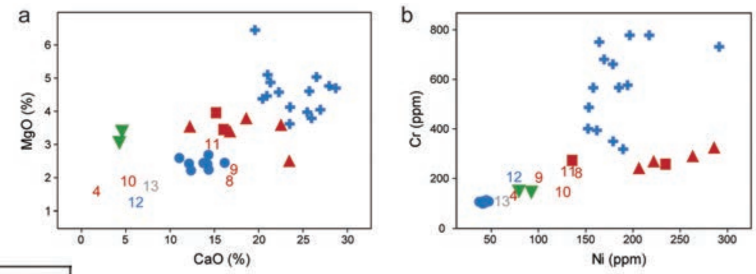
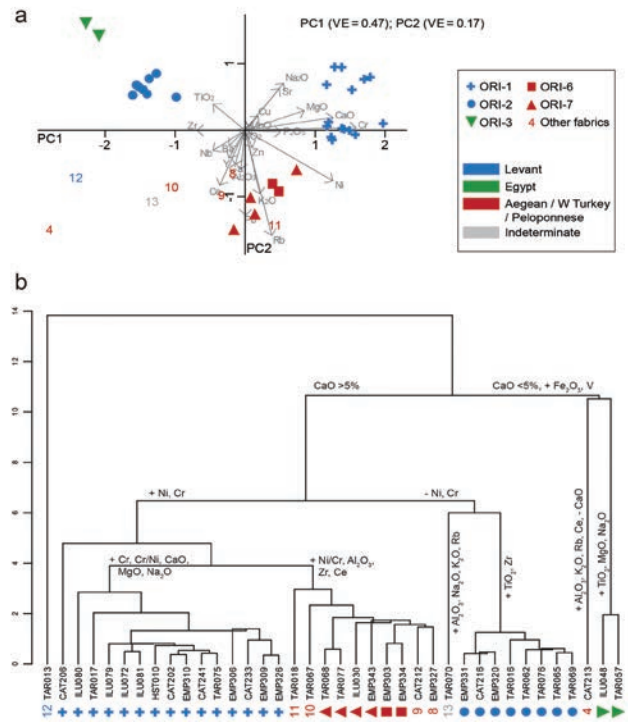
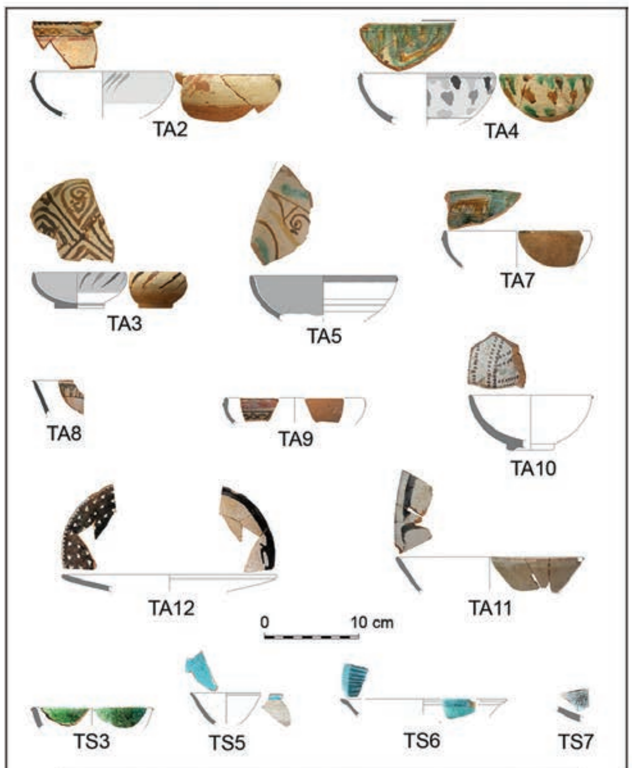
Figures 7, 8 : Leandro Fantuzzi *et al.*, Eastern Mediterranean amphorae from Late Antique Urban Centers…, (p. 237, 240)







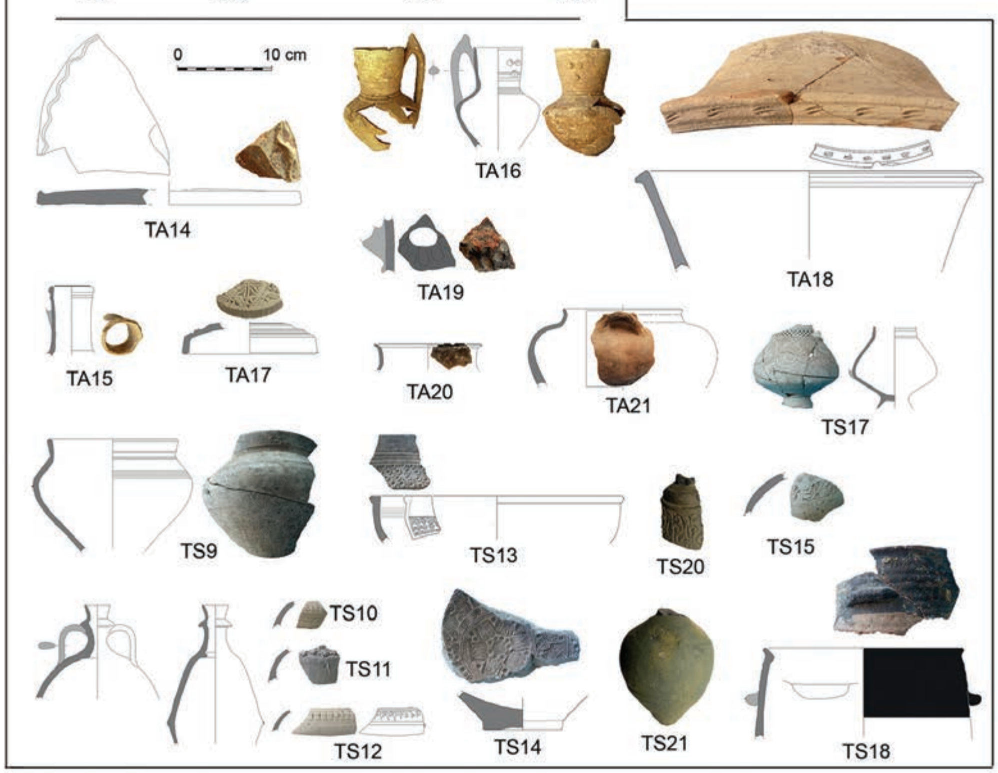
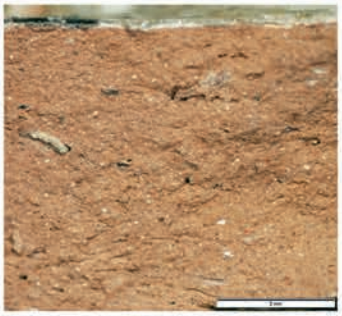
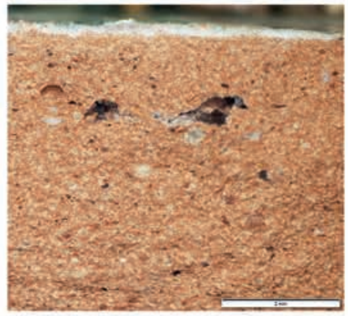
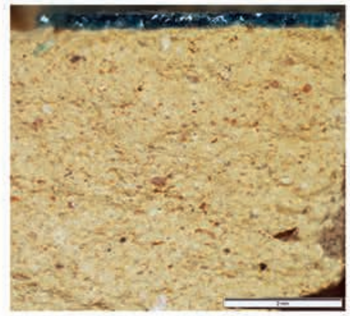
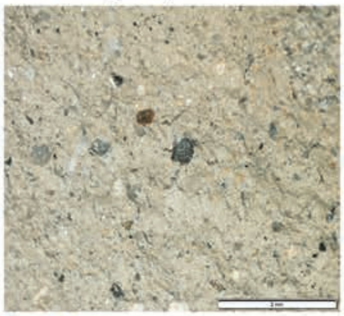


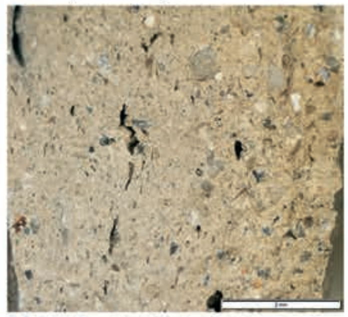
Figure 2 : Agnese Fusaro *et al.*, Islamic Pottery from Ancient Termez (Uzbekistan)… (p. 252)

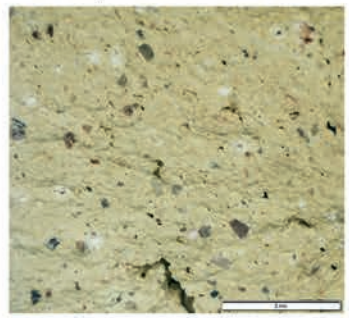

TA9. Underglaze painted ware

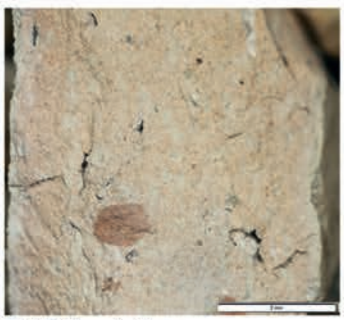

TA4. Splashed *sgraffiato* ware

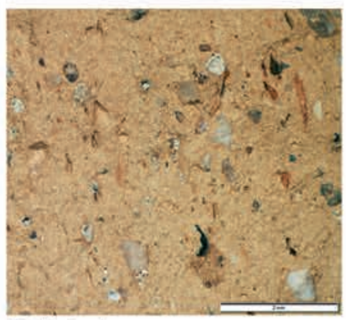

TS6. Turquoise monochrome ware

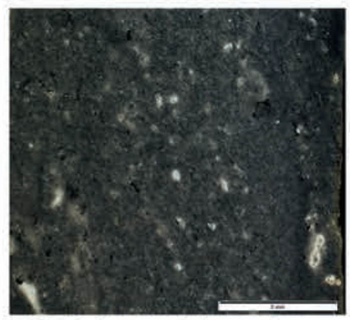

TS14. Mould


TS12. Moulded flask

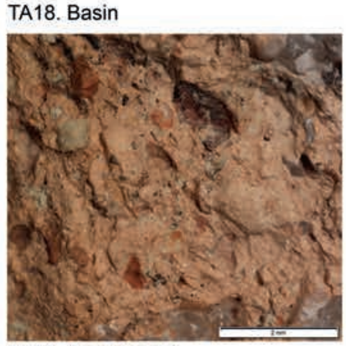

TA17. Carinated lid or pilgrim flask


TS17. Handled jug


TA18. Basin


TS21. Sphero-conical vessel


TA20. Cooking pot


TA21. Cooking pot


TS19. Cooking pot


TA22. Cooking pot


TA19. Cooking pot or jar

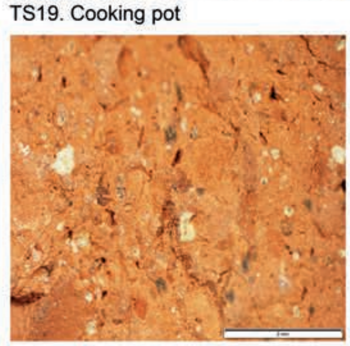
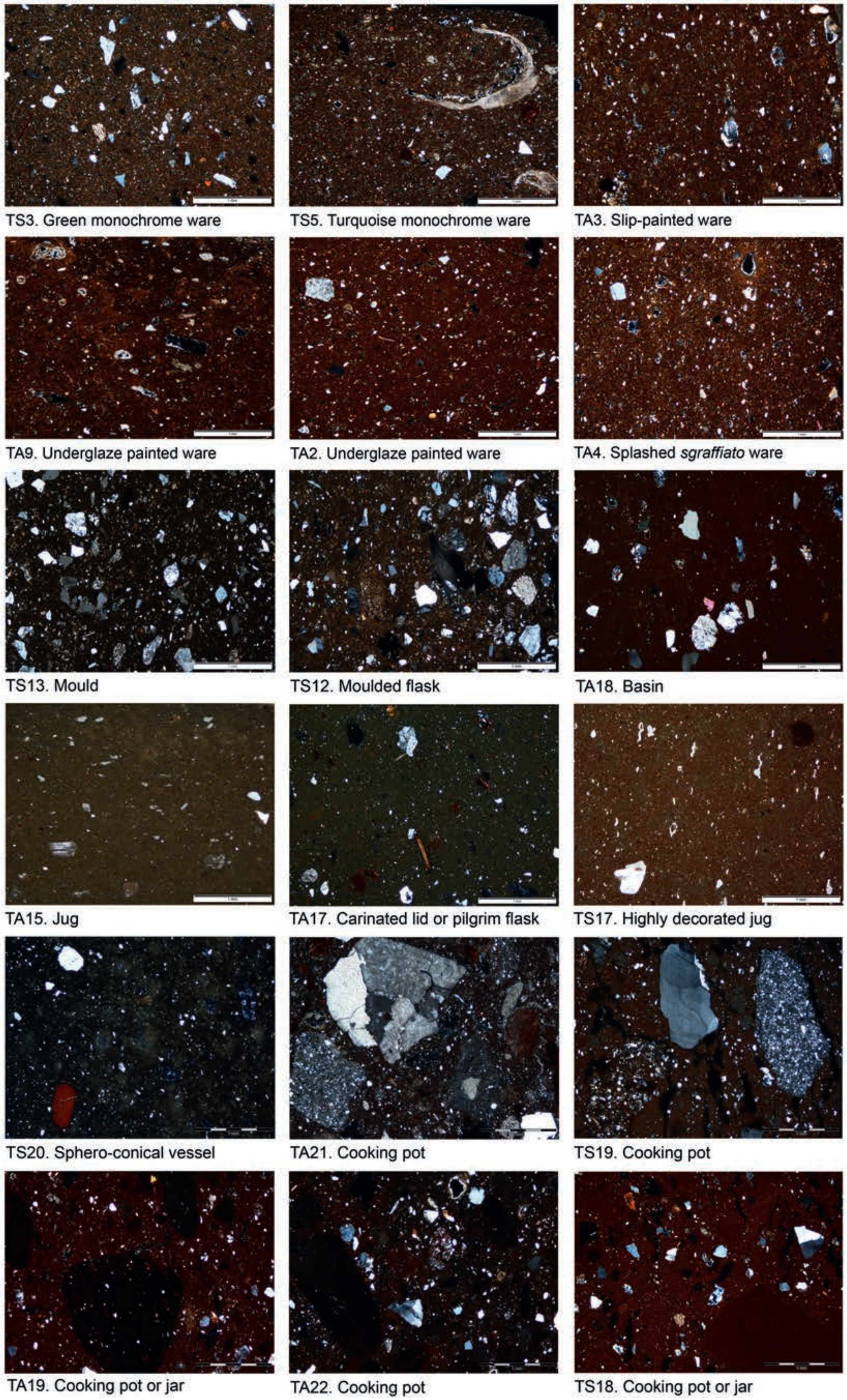

TS18. Cooking pot or jar

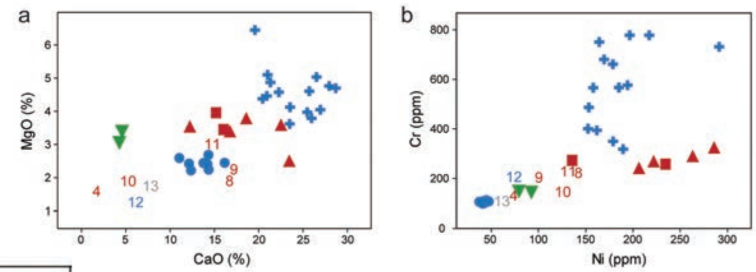
Figure 3 : Agnese Fusaro *et al.*, Islamic Pottery from Ancient Termez (Uzbekistan)… (p. 253)

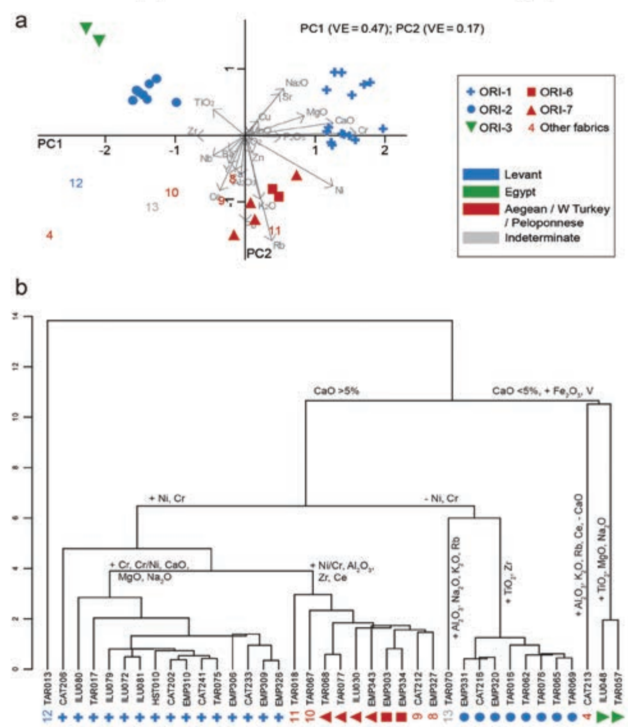


TS3. Green monochrome ware
TS5. Turquoise monochrome ware
TA3. Slip-painted ware
TA9. Underglaze painted ware
TA2. Underglaze painted ware
TA4. Splashed *sgraffiato* ware
TS13. Mould
TS12. Moulded flask
TA18. Basin
TA15. Jug
TA17. Carinated lid or pilgrim flask
TS17. Highly decorated jug
TS20. Sphero-conical vessel
TA21. Cooking pot
TS19. Cooking pot
TA19. Cooking pot or jar
TA22. Cooking pot
TS18. Cooking pot or jar

Figure 5 : Agnese Fusaro *et al.*, Islamic Pottery from Ancient Termez (Uzbekistan)… (p. 259)

Figures 7, 8 : Leandro Fantuzzi *et al.*, Eastern Mediterranean amphorae from Late Antique Urban Centers…, (p. 237, 240)





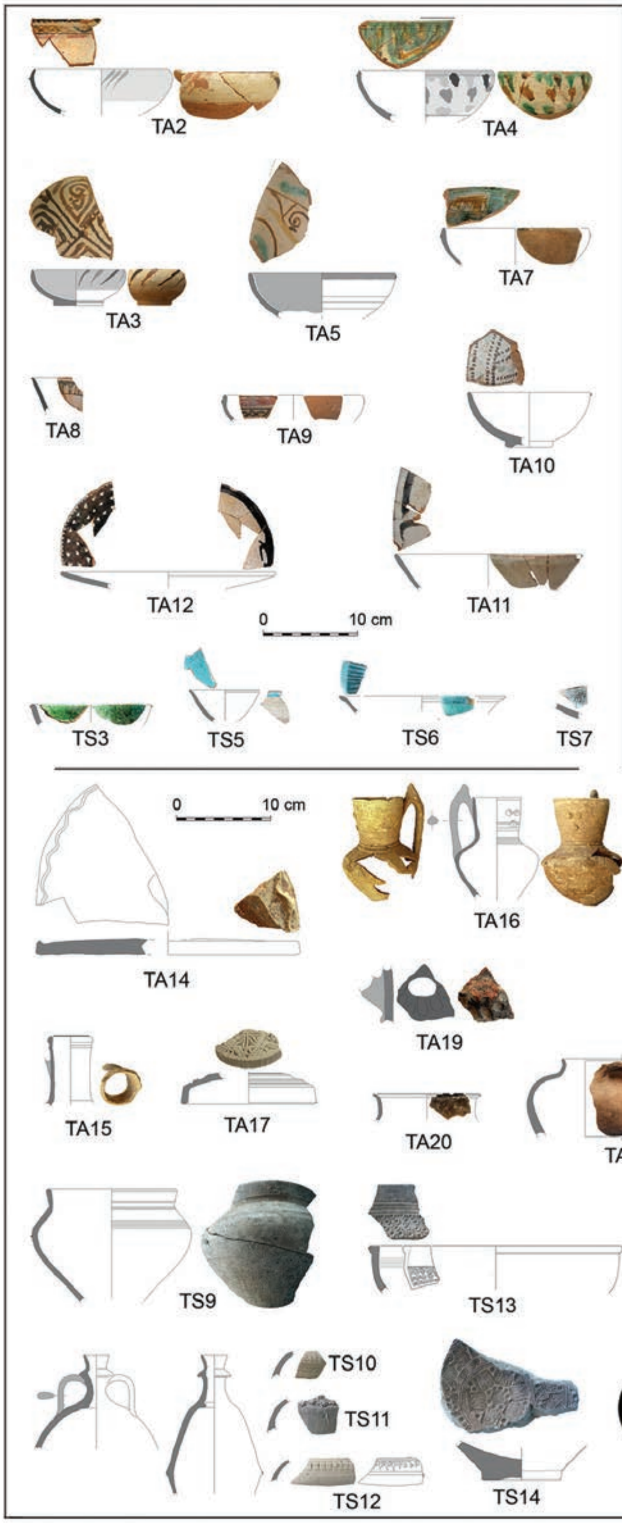
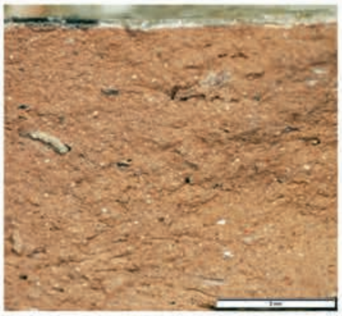
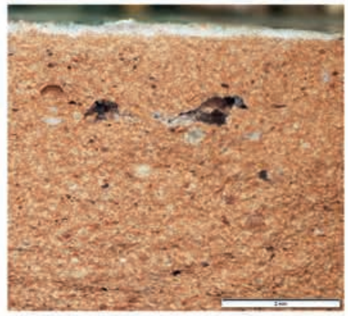
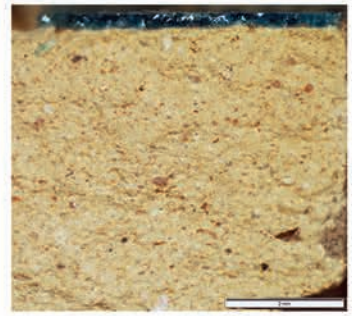
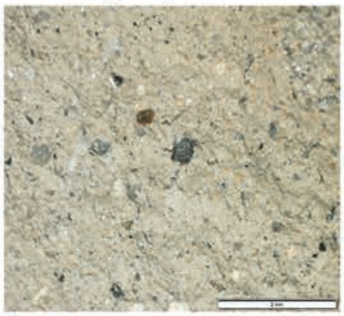


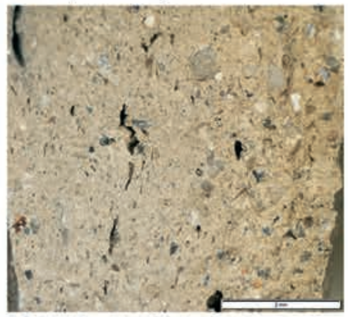

Figure 2 : Agnese Fusaro *et al.*, Islamic Pottery from Ancient Termez (Uzbekistan)… (p. 252)

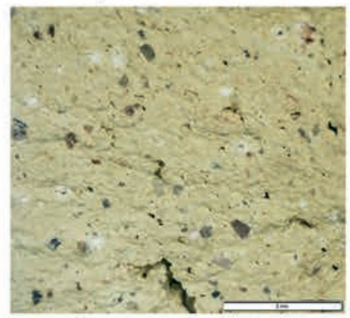

TA9. Underglaze painted ware

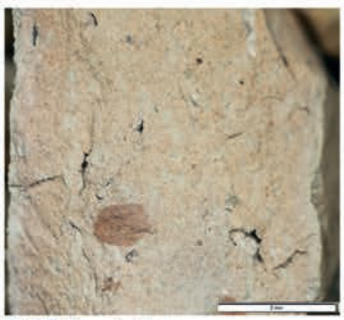

TA4. Splashed *sgraffiato* ware

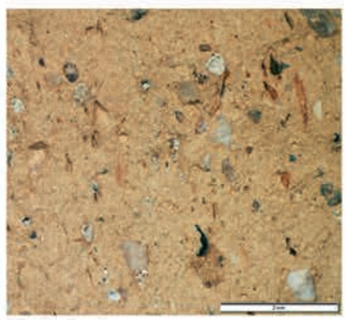

TS6. Turquoise monochrome ware

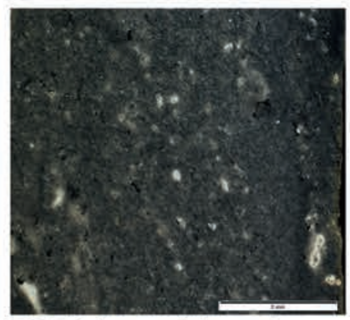

TS14. Mould


TS12. Moulded flask

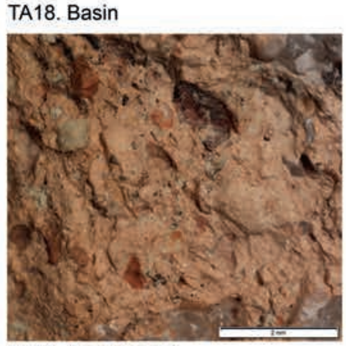

TA17. Carinated lid or pilgrim flask


TS17. Handled jug


TA18. Basin


TS21. Sphero-conical vessel


TA20. Cooking pot


TA21. Cooking pot


TS19. Cooking pot


TA22. Cooking pot


TA19. Cooking pot or jar

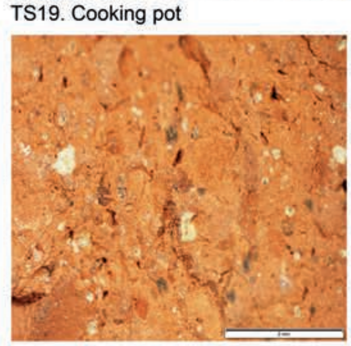

TS18. Cooking pot or jar

Figure 3 : Agnese Fusaro *et al.*, Islamic Pottery from Ancient Termez (Uzbekistan)… (p. 253)

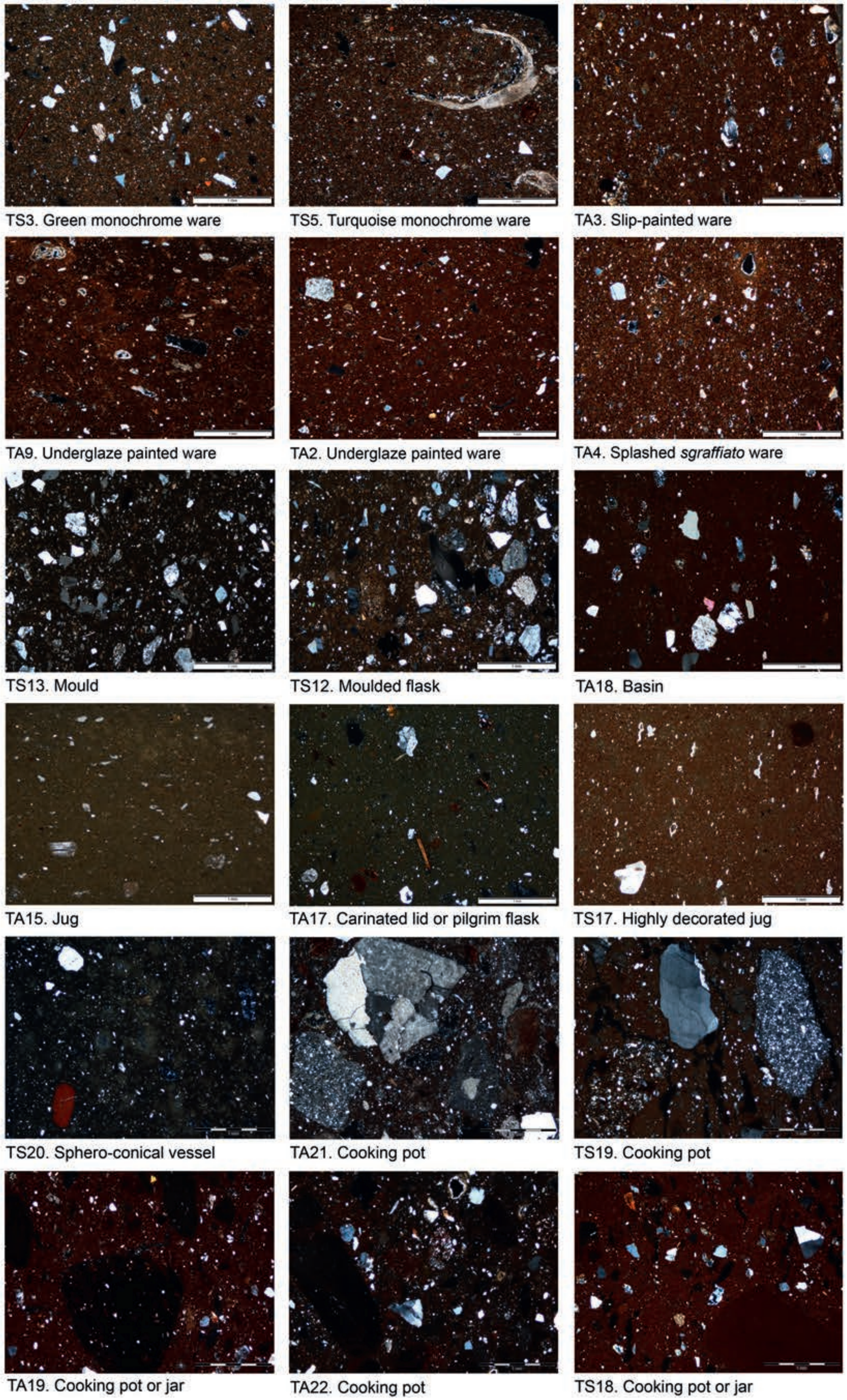


Figure 5 : Agnese Fusaro *et al.*, Islamic Pottery from Ancient Termez (Uzbekistan)… (p. 259)