Antiquity 2026 Vol. 100 (412): 904–922
https://doi.org/10.15184/aqy.2026.10371

Research Article

Understanding a first attempt at pottery: early fired containers at Çemka Höyük

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This study examines clay fragments found at Çemka Höyük, a Pre-Pottery Neolithic site in Mardin, Türkiye (tenth millennium BC). Analysis of mineral inclusions in the clay matrix indicates that these fragments may have been deliberately fired, representing an early example of ceramic technology in South-west Asia. The diversity of forms identified and their likely uses suggest, the authors argue, a formative phase in ceramic innovation during which the properties and potential applications of clay were explored by the local community and adopted and adapted within existing social and economic traditions in advance of widespread application in the seventh millennium BC.

Keywords: Türkiye, Mardin, PPNA, container technology, intentionally fired clay, temper

Introduction

Adoption of a new object, style or technology requires its integration within wider cultural, social and temporal spheres (Hodder 1982; Appadurai 1986). Early ceramics were no exception; substantial social changes accompanied the development of ceramics during the Pottery Neolithic in South-west Asia which begins around the turn of the seventh millennium (Craig *et al.* 2013). For a new technology to be widely adopted, there must be widespread demand and ways to integrate it into daily life through new or existing activities, rituals or culinary traditions. This process involves 'embodiment', 'receptivity' and 'affordances' that optimise the technology (Knappett 2004; Bernbeck 2017; Tomkins 2023), but sustained use is what ultimately drives the acceptance of an

Received: 6 March 2025; Revised: 8 January 2026; Accepted: 18 January 2026

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Figure 1. The locations of Çemka Höyük (red dot) and other sites containing Pre-Pottery Neolithic earthenware/clay vessels in South-west Asia (figure by authors).

innovation. Without meeting these criteria, inventions remain isolated and fail to entangle effectively.

Despite its Pre-Pottery Neolithic A (PPNA) date (*c.* 9500 BC), excavations at the site of Çemka Höyük in Mardin Province, Türkiye (Figure 1), have uncovered experimental pottery, showing variability in form and manufacture and intentional firing. Çemka, impacted by bulldozing for roadbuilding as part of the Ilısu Dam Project, has some of the earliest known pottery in South-west Asia, pre-dating the widespread use of ceramics in the seventh millennium BC and enhancing our understanding of early clay container technologies (Çiftçi *et al.* 2020; Kodaş *et al.* 2020). This article examines the contexts of 46 low-fired clay fragments found at the site belonging to nine different vessels. Their technological production illustrates some of the complex social and cultural processes influencing pottery adoption in South-west Asia, including its implementation and social acceptance.

Architecture and stratigraphy

Excavations at Çemka revealed two main levels, dating from the proto-Neolithic/Late Epipalaeolithic (10 800–9600 BC) and the PPNA (9600–8700 BC), with eight distinct building levels (Figure 2). Samples of wood charcoal from building levels 2 and 5 provide radiocarbon dates that place activity at both levels in the middle of the tenth

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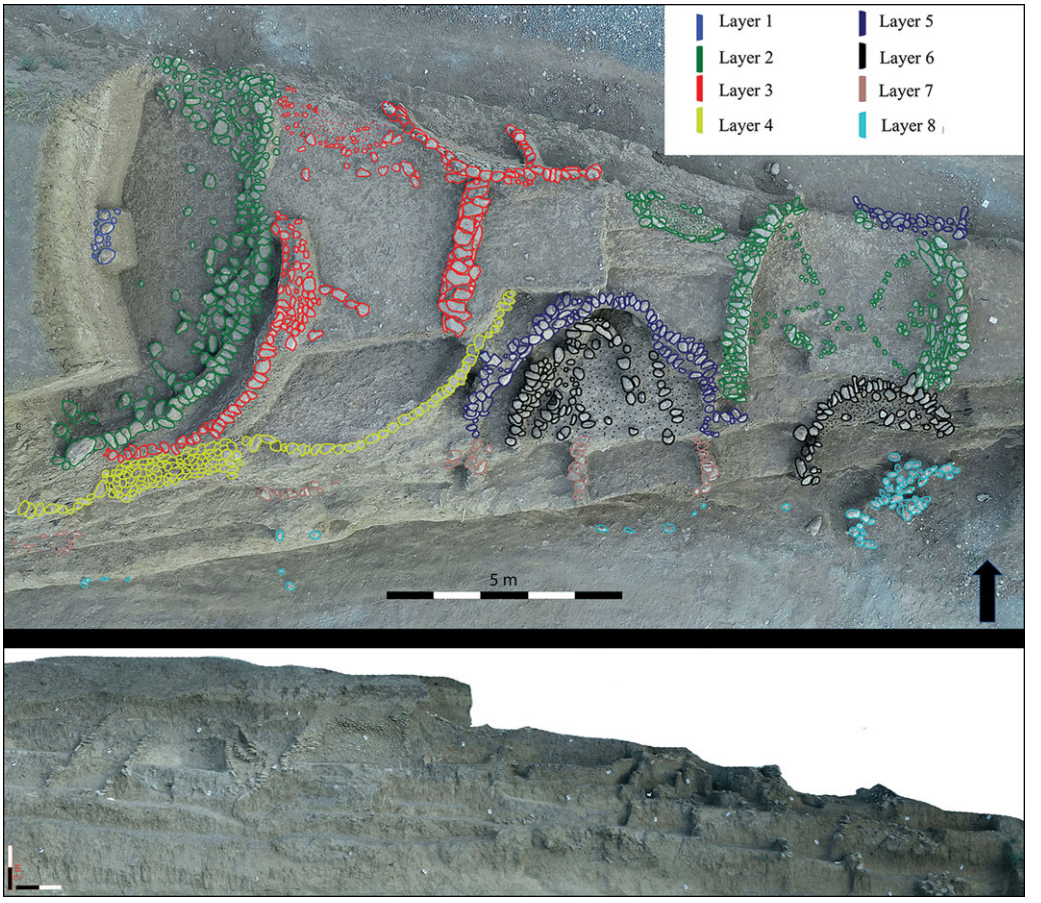


Figure 2. Architectural development at Çemka (figure courtesy of Çemka Project Archive).

Table 1. Radiocarbon dates from Çemka Höyük (using OxCal v.4.4 (Bronk Ramsey 2021) and the IntCal20 calibration curve (Reimer *et al.* 2020)).

ID	Context	Material	BP	$\delta^{13}C$	cal BCE
Tübitak 1156	Sector D17 Level 2	charcoal	9970±38	–27.6±03	9736–9724 (1.1%) 9560–9311 (75.6%) 9668–9572 (18.8%)
Tübitak 1155	Sector D16 Level 5	charcoal	9983±41	–28.0±08	9691–9317 (93.1%) 9740–9721 (2.4%)

As short-lived materials were not available, wood charcoal (unidentified species) was used for dating.

millennium BC (Table 1). The rescue excavations focused especially on areas exposed by heavy disturbance from road construction which split the settlement into a northern and a southern section yielding three exposed profiles reaching depths of 7m in places. In particular the south-facing Profile 2, which cuts through the middle of the mound,

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Figure 3. Clay used as a building material at Çemka: 1) a clay coating on a stone wall; 2) mudbrick (photograph by E. Kodaş).

revealed a deep sequence of architectural remains allowing us to trace repeated building activity and architectural continuity across several phases. The area situated between the two road-cut profiles that falls within the southern sector yielded evidence for buildings that went through phases of renovation and rebuilding. Excavations revealed architectural remains across a 500m^2 area, explored across six 10 × 10m trenches.

The settlement's architectural remains show a development from simple round huts to pit shelters, and finally to surface-level structures. Building level 1 has scattered stone formations hinting at tent-like structures. Level 2 features single-room round shelters, that are both semi- and fully subterranean with radial compartments. Although level 3 was largely destroyed, it has similar single-room pit structures. Level 4 shows round or elliptical subterranean buildings, while levels 5 and 6 include semi-subterranean pit houses, with more substantial masonry and radially divided internal compartments. Levels 7 and 8, from the proto-Neolithic phase, have round structures on red soil, potentially indicating tent-like shelters. The use of clay is identified in construction, both for coating stone walls, which is a practice seen in building levels 2–6 in almost all structures (Figure 3, no. 1) and in the form of a brick from level 2 (Figure 3, no. 2).

Evidence for continuous habitation throughout the Late Epipalaeolithic and PPNA is clear, particularly in the context of microlithic tools, which show a similar techno-typological profile to the chipped stone tools from Epipalaeolithic and PPNA levels at Körtik Tepe, despite some variation in microlith sizes (Kartal *et al.* 2018: 96–98). The characteristics of these lithic assemblages are comparable, including the presence of large-sized microliths and the gradual emergence of macro arrowheads during the PPNA.

Archaeological contexts of low-fired clay fragments

A total of 46 low-fired clay fragments, which likely belong to nine different vessels, were recovered from the building level 2 at Çemka, dated to the first half of the tenth millennium BC (*c.* 9350 cal BC; Kodaş *et al.* 2020). Except for E17-6-A2, found in the common space between buildings ÇH7, ÇH1a and ÇH6, the low-fired clay fragments were

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Figure 4. Plan showing the find locations of the fired clay fragments from Çemka (photograph by E. Kodaş).

dispersed across the *in situ* floor surfaces of structures ÇH5 (G16-3-A4/1, G16-3-A4/3, G16-2-A1, G16-4-A1 and G16-3-A4/2), ÇH1a (E18-21-A1), ÇH8 (E17-6-A1) and ÇH6 (G17-5-A1) (Figure 4). Excavations revealed sherds belonging to a total of nine vessels of which eight (excluding G16-4-A1) are discussed in this article. The buildings ÇH5 and ÇH6 are large, single-roomed and round-planned, with a diameter of approximately 10m; both were constructed in a semi-subterranean pit-shelter style (Kodaş *et al.* 2020). In contrast, ÇH1a has interior partition walls, exhibits an elliptical form, is fully subterranean in a pit-shelter style and was used during building levels 2 and 3 (Çiftçi *et al.* 2020). Contexts from building level 2 contain microlithic tools similar to those from the Körtik Tepe and Hasankeyf Höyük industries (Özkaya & Coşkun 2011; Miyake *et al.* 2012; Kartal *et al.* 2018; Maeda 2018); larger-sized Nemrik and Khiam points begin to appear in building level 3.

Technological aspects of the fired clay items

All samples from building level 2 were examined under an Optica SLX-2 binocular microscope to study their paste composition, construction methods, surface treatment and firing.

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Generally, the pastes consist of clay raw materials containing natural mineral inclusions and, in some cases, added organic inclusions (such as imprints from plant matter). Analysis of inclusions focused on their size, shape and approximate clay concentrations (Bobrinsky 1978; Petrova 2024a). The presence of plant inclusions resulted in a high incidence of irregular channels within the clay matrix, resulting from the plant matter that burns away during firing likely enhancing thermal performance (Aouba *et al.* 2016). Spherulite analysis was also conducted using a petrographic microscope to determine whether animal dung had been used as an inclusion (Biton *et al.* 2014; Amicone *et al.* 2021).

Construction methods were assessed visually through the presence or absence of joints in fragment cross-sections and open surfaces, indicating sequential application of clay element technology (slabs, coils, bands). Additional technological traces are apparent as macropore content, micro-cracks and micro-grooves on the outer surface of the wares, facilitating the identification of processing methods (Bobrinsky 1978; Shepard 1985; Vandiver 1985; Roux 2019).

Firing temperatures and conditions were initially evaluated based on surface and cross-section colouration, with the presence of sharp or gradual transitions between layers indicating varying heating temperatures. These assessments were enhanced through multispectroscopic analyses. Thicker sherds showed more substantial thermal reactions on the surface, forming a distinct black core (Mangueira *et al.* 2011: 95). Fibrous porosity and low compactness of the pastes, along with the colour variation from a black core to red oxidised surfaces, indicate incomplete, short-duration oxidising firing conditions followed by cooling in a reducing atmosphere (600–700°C) (Iordanidis *et al* 2009: 294).

Three potential functional groups are identified for the analysed clay items: fragments of clay coating for organic objects, a fragment of a clay additive intended to be attached to a vessel made of another material, and fragments of clay vessels.

Fragments of clay coating

Fragments from two clay-coated, oval objects are identified (Figure 5), each about 70mm in diameter with a protrusion on the outer part. Sample E17-6-A1 consists of eight thin, curved sherds, and Sample E17-6-A2 consists of 10 fragments with thin walls. Both samples show high crack porosity due to coarse-grained mineral inclusions (Daghmehchi *et al.* 2023). No deliberately added impurities are observed in the paste, and plant imprints are minimal (Figure 5, no. 2c). Observation of fragment cross-sections reveals no sequential clay application. The outer surfaces were intentionally flattened but not smoothed, while the inner surfaces remained uneven (Figure 5, nos. 1b, 1c, 2b). The firing process, which must not have exceeded 750°C, was gradual and oxidative, resulting in an unburnt interior and heavily fired exterior.

X-ray diffraction (XRD) analysis of sherds from all samples analysed and of two unfired clay-based materials found within domestic contexts reveals a consistent paste composition. The unfired clay-based materials are characterised by crystallised calcite and illite structures with no evidence of hematite formation and/or thermal alteration of

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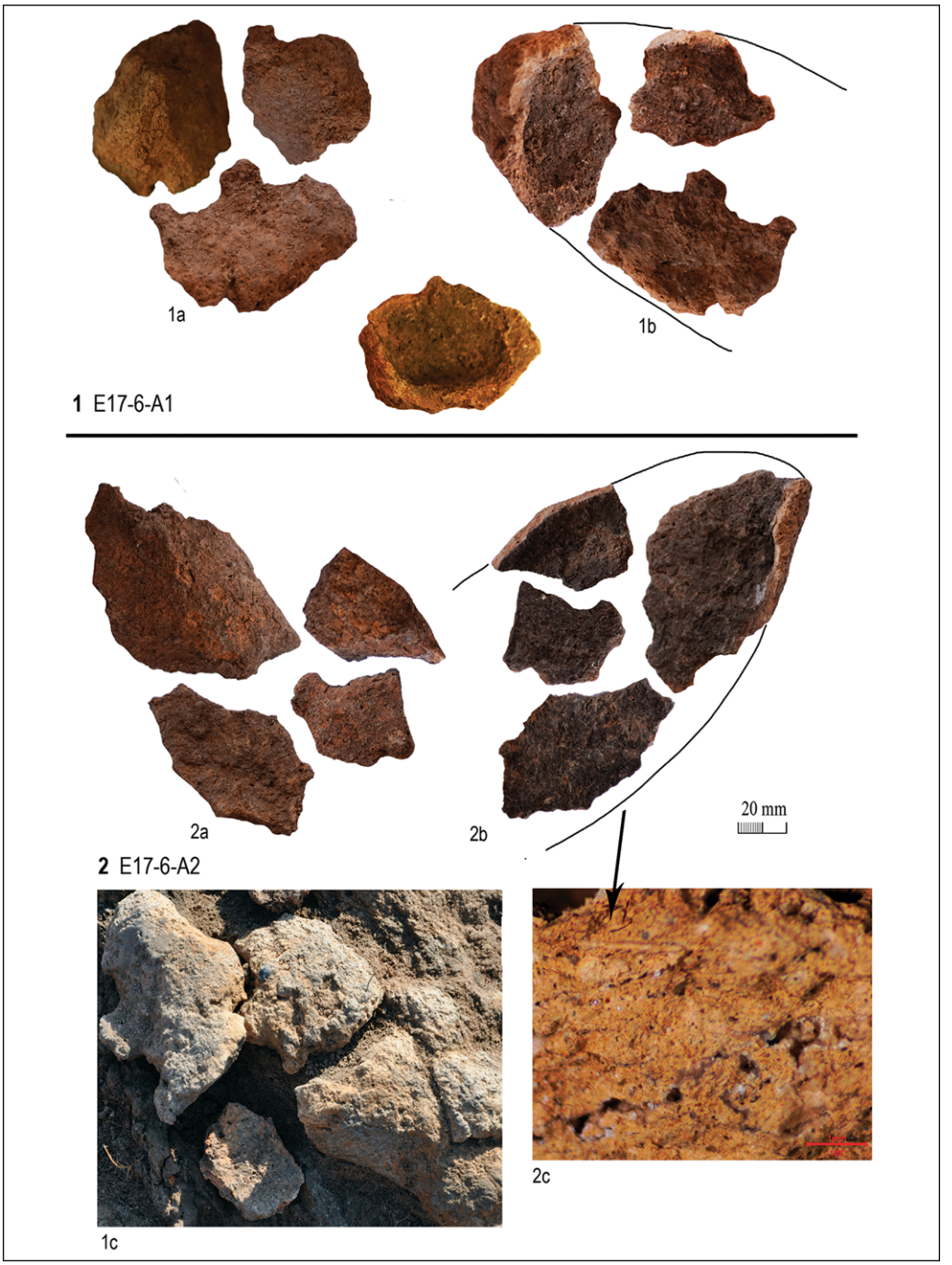


Figure 5. Fragments of clay coating that probably once covered organic objects (photographs and drawings by N. Petrova; photograph 1c by E. Kodaş).

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minerals. In contrast, the fired material shows a reduction in the intensity of calcite and clay mineral (illite) reflections and a weak reflection of hematite nucleation, indicating a firing temperature insufficient for intense decarbonation but likely somewhere between 600 and 700°C under controlled bonfire conditions. According to a recent definition (Spataro *et al.* 2017: 428), the fired samples from Çemka meet the criteria for consideration as ceramics due to their irreversible thermal transformation. The progressive reduction in the intensity of calcite and illite reflections across the low-fired samples further indicates an intentional and consistent firing process, rather than accidental exposure to heat.

Fragment of clay additive

Sample E18-21-A1 is a preserved segment of an object that may have originally been oval and of a substantial size, with an estimated maximum diameter of 370mm and an approximate height of 100–120mm measured from rim to pedestal. The object was constructed without a flat base and consists of two main elements: a concave pedestal underneath a body that flares upwards and outwards in a bulbous fashion (Figure 6). It is plausible that this clay component was integrated into a larger container, likely fashioned from stone, as excavations revealed numerous shallow stone containers of comparable dimensions (Figure 6, nos. 2a, 2b). These clay additions likely aimed to expand the capacity of the stone containers.

The fragment features two intentionally pierced holes, each approximately 15mm in diameter, produced at an angle and made prior to firing. Only one of these holes is fully preserved (Figure 6, nos. 1b–1f). The outer clay layer is damaged, with a remaining thickness of 32–42mm, making it unclear whether the holes originally penetrated the full thickness of the wall.

The material of the fragment has few natural mineral inclusions and no added impurities. Accidental plant imprints are visible on the outer surface. The object appears to have been constructed from uneven oval slabs arranged in at least three layers. The outer layer is lumpy with a rough clay coating, which has cracked and fallen off in places, revealing the inner second layer (Figure 6, nos. 1c, 1e). The high density of irregular channels within the matrix results from the burning of organic matter in the paste, indicating that the firing temperature was above 400–500°C (Daghmehchi *et al.* 2023).

Fragments of vessels

Fragments from five possible containers showing varying amounts of organic inclusions are identified (Figure 7). A fragment from a large, thick-walled (15mm) vessel with a 270mm rim diameter (Sample G16-3-A4/1; Figure 7, no. 1) and two smaller fragments, display prominent inclusions. Some parts of Sample G16-3-A4/1 were found at the base of a pit surrounded by small rows of stones, while others were scattered around it (Figure 7, no. 1g). Made from two-layer slabs without a mould (Figure 7, nos. 1b, 1d), this vessel has few mineral impurities (Figure 7, no. 1c) but contains up to 30 per cent dry, crushed plant residues (Figure 7, no. 1f). An additional cracked clay coating covers

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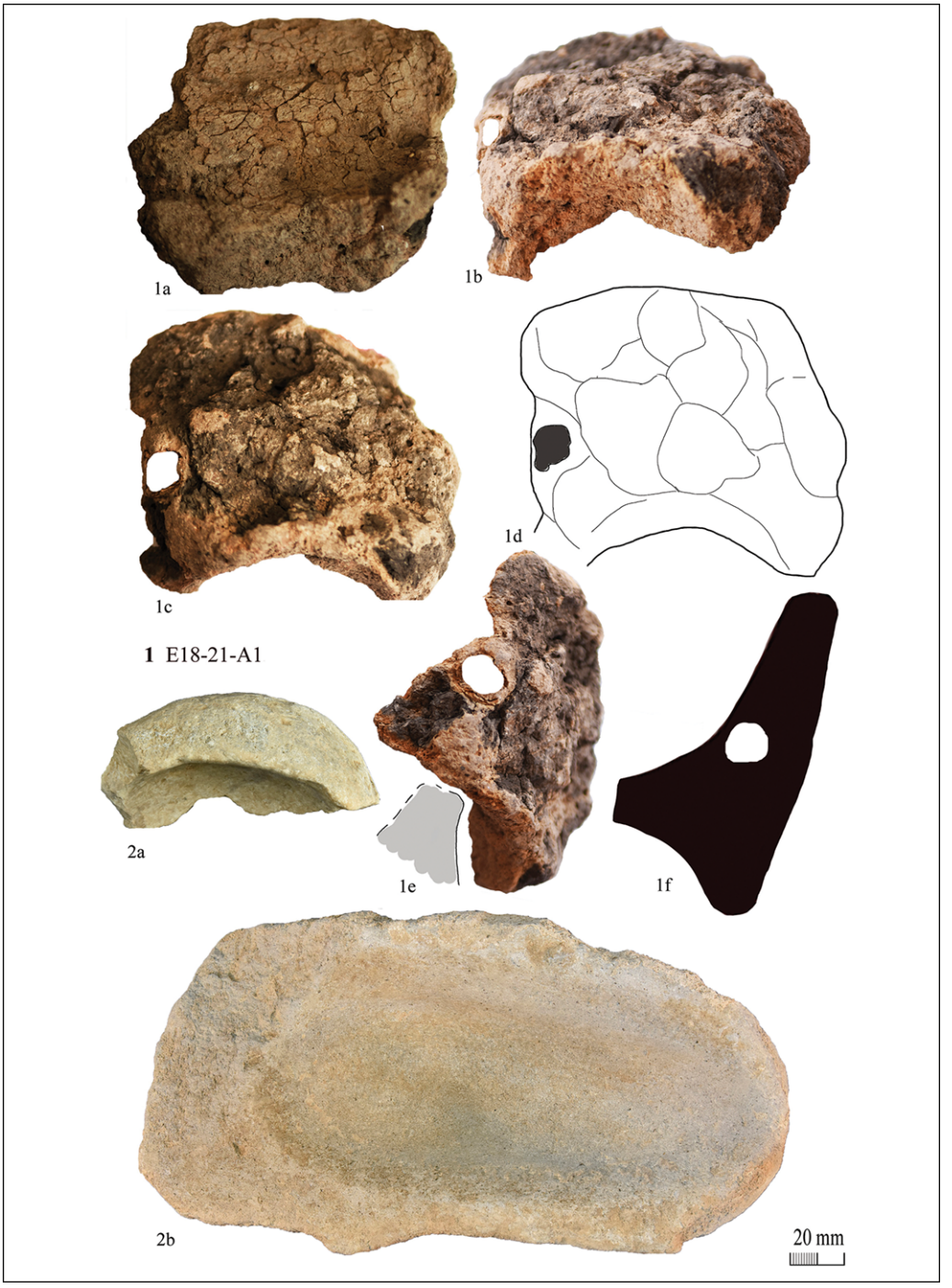


Figure 6. 1a–f) Fragment of clay additive; 2a–b) limestone vessels with similar shapes and dimensions (1a–f: photographs and drawings by N. Petrova; 2a–b: photographs by E. Kodaş).

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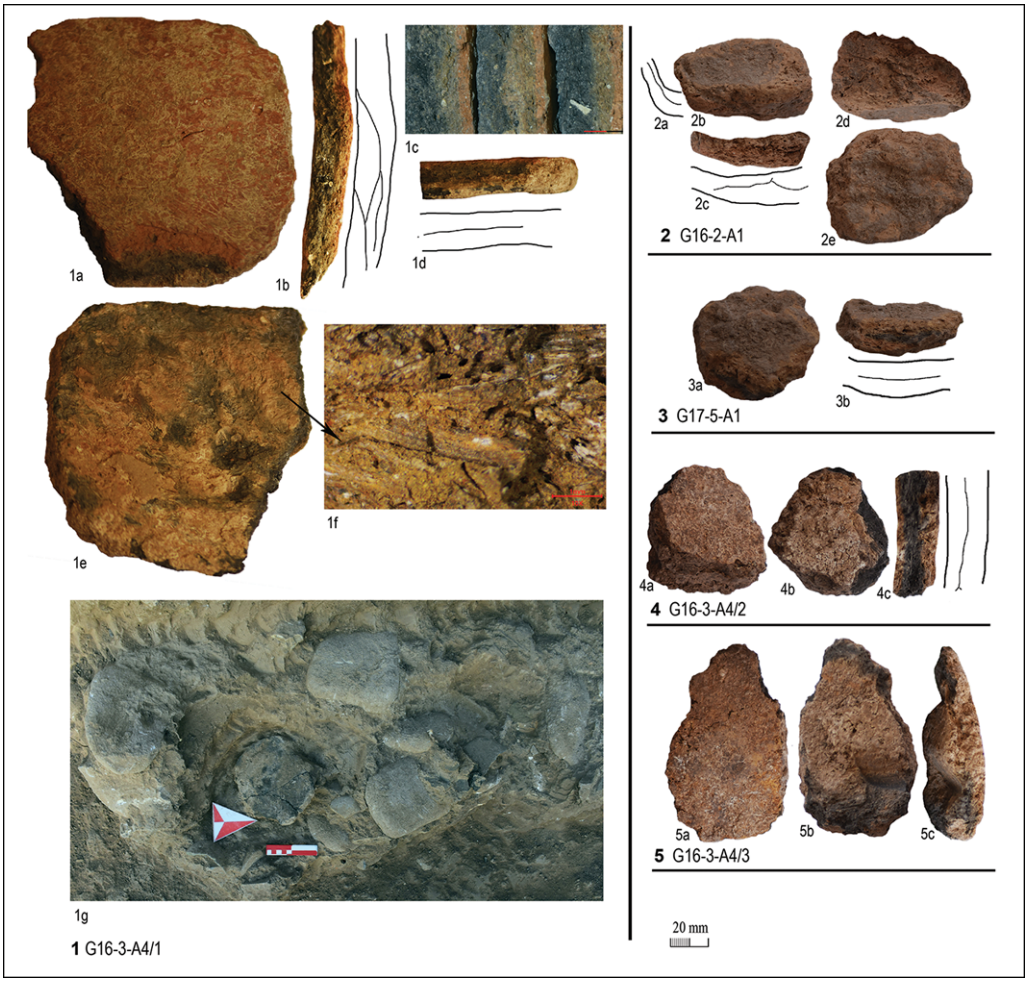


Figure 7. Fragments of clay vessels (photographs and drawings by N. Petrova; photographs 1g & 6 by E. Kodaş).

its outer surface. The inner surface shows recent damage (Figure 7, no. 1e), with only small areas of the original smoothing still observable, making it difficult to determine the surface treatments employed in the production of this vessel.

Four additional thick-walled vessel fragments (G16-2-A1, G17-5-A1, G16-3-A4/2, G16-3-A4/3; Figure 7, nos. 2–5) could come from vessels with a large diameter or that were possibly rectangular in shape. Crushed plant materials are observable in varying concentrations in these fragments.

Sample G16-2-A1 (Figure 7, no. 2) is a part of a vessel base, 10–20mm thick and 70mm in diameter, with an uncertain overall shape. Its composition is 15–20 per cent crushed plants and it was constructed with two-layer slabs (Figure 7, nos. 2a–2c); the inner surface was smoothed by finger and the outer surface has two horizontal grooves likely from manufacturing. The vessel was fired slowly under low oxidising conditions.

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Sample G17-5-A1 (Figure 7, no. 3) also has high plant-temper density (up to 30%), creating fibrous porosity. Evidence for slab building is visible as cross-section joints (Figure 7, no. 3b). This vessel has a black core and pale brown surfaces, indicating incomplete oxidising firing, around 600–650°C, confirmed by XRD analysis (Iordanidis *et al.* 2009).

G16-3-A4/2 and G16-3-A4/3 contain less plant matter than other vessels and lack surface coatings. G16-3-A4/2 (Figure 7, no. 4) shows porosity between mineral particles, leading to substantial biological and chemical alteration (Molina *et al.* 2001: 110; Santos *et al.* 2012). Cross-sections of fragments from this vessel reveal sequential application of clay elements (Figure 7, no. 4c). Although the piece is only partially preserved and does not show the full form, it likely had a slightly flaring shape with a straight, sharp rim. The colour variation from a black core to buff surfaces suggests a low firing temperature under incomplete oxidising conditions (Maritan *et al.* 2006: 13; De Bonis *et al.* 2014).

Part of the vessel wall in Sample G16-3-A4/3 (Figure 7, no. 5), with a heavily materialised matrix, has been destroyed, making it hard to determine the exact thickness. The 10 fragments of this vessel suggest a slightly inward curved body that was made using sequential clay application. The interior is slightly burnt, while the exterior is heavily fired.

Spherulite analysis of organic inclusions detected dung spherulites in samples G16-3-A4/1 and G16-2-A1 (Figure 8).

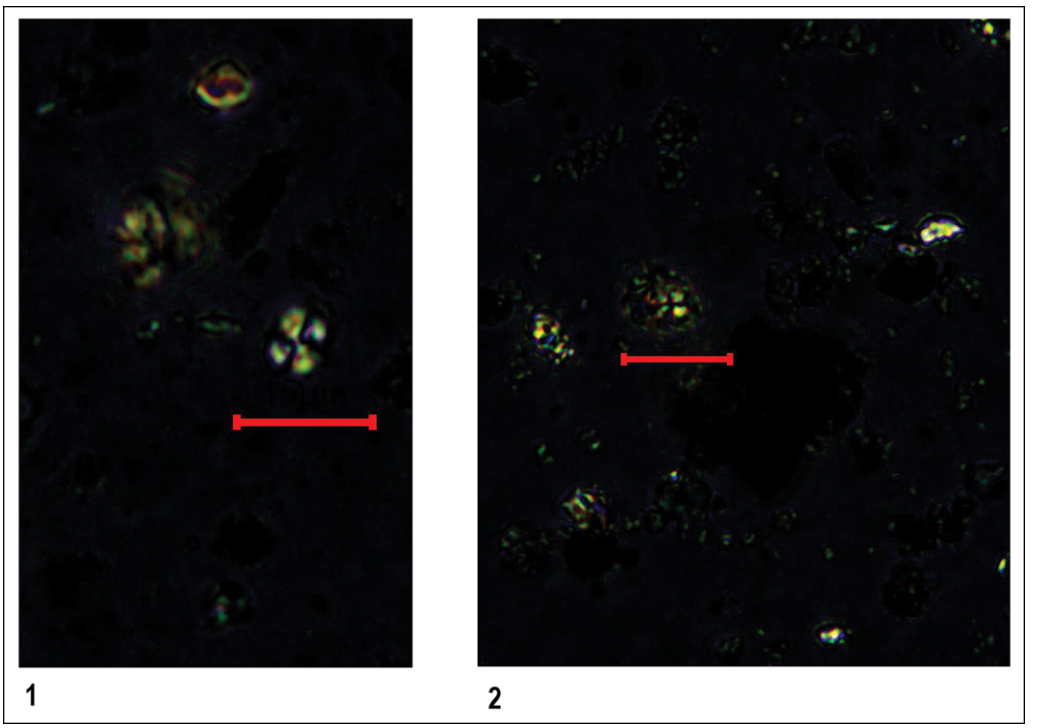


Figure 8. Dung spherulites identified within fragments of clay vessels (samples G16-3-A4/1 and G16-2-A1) under cross-polarised light. Scale bar 15µm (photograph by A. Babenko).

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Analysis and discussion

Samples E17-6-A1 and E17-6-A2 (Figure 5) were likely coatings for an uneven, oval organic object. They lack joints, suggesting the absence of clay slab technology. Although their purpose is unclear, they may relate to culinary practices as their outer surfaces are burnt while the inner surfaces remain unburnt.

The difference in the diameter of the pedestal and rim of Sample E18-21-A1 suggests it was likely added to a vessel made of stone, wood or another organic material to expand its capacity (Figure 6). Similar examples have been found at Ganj Dareh in the Zagros (8200–7600 BC), with stone mortars augmented by clay (Smith 1990: 332; Petrova *et al.* 2025). The perforating holes may have been for threading a cord, perhaps used to tie on a lid. Constructed of multiple clay layers, this object might reflect local traditions.

The remaining analysed pieces display various morphological groupings, including deep, straight and slightly curved vessels with differing wall thicknesses (Figure 7). The ceramic technology involves raw materials with few mineral inclusions and added organic inclusions, including dung, of varying concentrations. Slabs in layers are used as the primary construction technique. Some fragments have an additional layer of clay applied, which might represent a continuation of clay coating found in non-ceramic traditions. The firing process was oxidative with gradual cooling at high-temperature exposure sites. The vessel-making technology differs from non-ceramic products as the pottery paste was intentionally mixed with organic inclusions.

Çemka in context

Evidence of clay and pottery vessels has been identified across various PPN sites in South-west Asia, including Abu Hureyra (Moore 1995), Beidha (Kirkbride 1966), Boncuklu (Spataro *et al.* 2017), Çayönü (Özdoğan & Erim-Özdoğan 1993), Demirköy (Rosenberg 2011), Ganj Dareh (Petrova *et al.* 2025; Smith 1972), Gre Fılla (Ekinbaş Can 2026), Jericho (Kenyon & Holland 1982), Kfar HaHoresh (Biton *et al.* 2014), Mureybet (Cauvin 1974) and Nevali Çori (Morsch 2002) (Figure 9). The introduction of these clay/earthenware vessels can be traced back to the PPNA period (9600–8700 BC), with their production continuing into the PPNB period (8700–7000 BC). Demirköy, in north-west Türkiye, yielded some of the earliest known evidence of fired clay/earthenware vessels, characterised by heavily plant-tempered, light-brown sherds (Figure 9f; see Rosenberg 2011: 82). The presence of burnt interiors and suspension piercings indicates deliberate firing, albeit inconsistently controlled.

Clay/earthen vessels from the Middle PPNB (8200–7500 BC) were found at Mureybet in northern Syria (Cauvin 1974) and Nevali Çori in south-eastern Türkiye (Morsch 2002). Three of the five well-preserved sherds from Mureybet are unfired (Figure 9c; Cauvin 1974: 200), including two thick-walled bowls with flat bottoms, a thick-walled bowl with a curved bottom and a cup. One bowl has horizontal line motifs and symmetrical rope holes; the other is jar-like. These vessels show heavy plant tempering and lack deliberate firing, indicating hand-shaping (Cauvin 1974;

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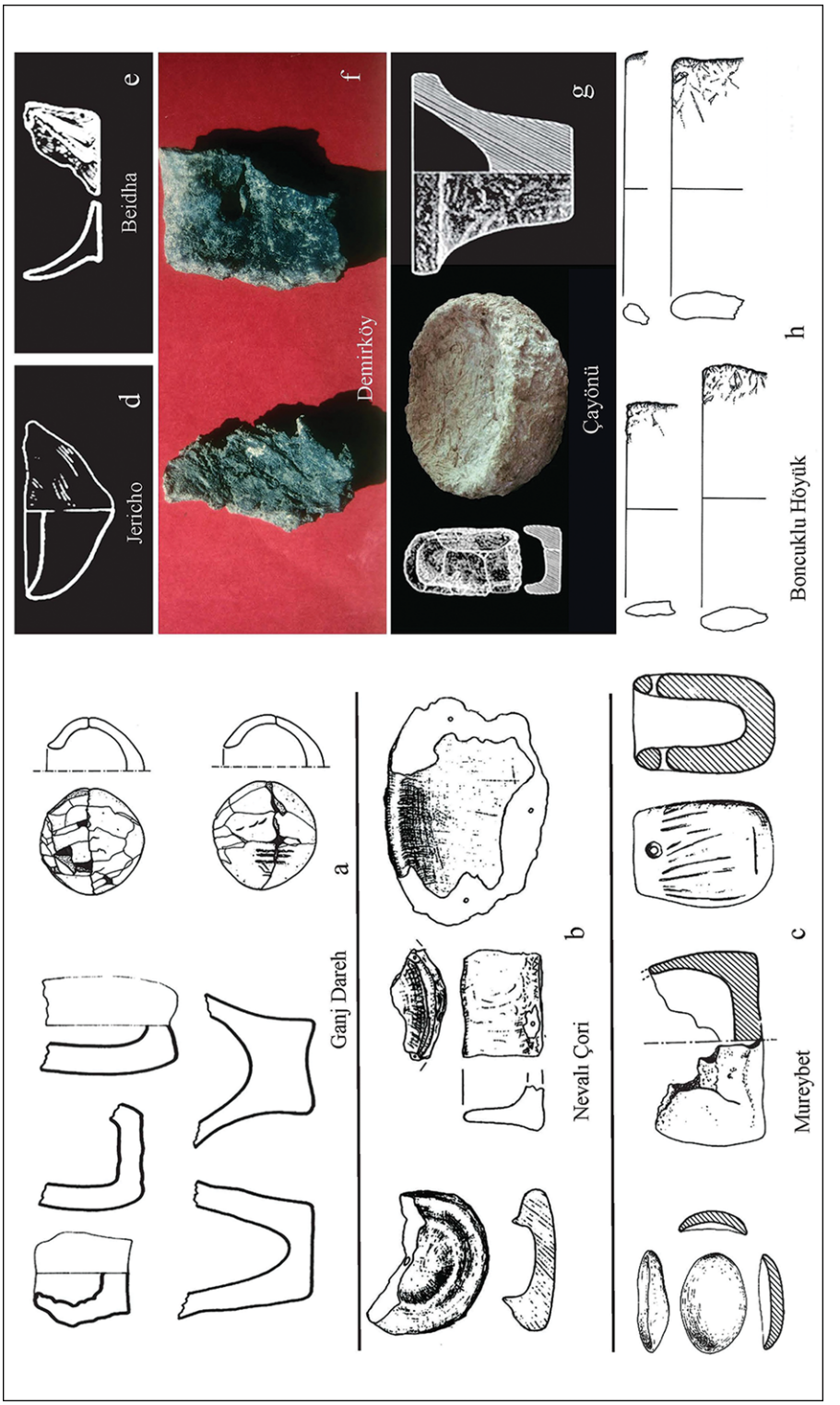


Figure 9. Examples of Pre Pottery Neolithic fired or dried earthenware/clay vessels from other sites in South-west Asia. Images are not to scale (a: Smith 1972; b: Morsch 2002; c: Cauvin 1974; d: Kenyon & Holland 1982; e: Kirkbride 1966; f: Rosenberg 2011 and personal comm. 2025; g: Erim-Özdoğan & Yalman 2004; Erim-Özdoğan 2011 and personal comm. 2025; h: Spataro et al. *2017).*

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Le Mière & Picon 1998). The Nevali Çori samples are less well preserved (Morsch 2002: 150) but indicate flat bottoms and oval bodies (Figure 9b). Some have geometric motifs (Morsch 2002: 150). All the Nevali Çori samples are small (20–80mm) and some show firing.

Boncuklu Höyük in Central Anatolia produced numerous clay/earthenware sherds, likely representing small-sized bowls and jars (Figure 9h). This pottery appears to have been moulded intentionally and shows a variety of paste compositions, with smoothed inner and outer surfaces (Spataro *et al.* 2017).

Gre Fılla, also in south-eastern Türkiye, yielded a small, oval-shaped baked vessel with natural mineral inclusions dating to the Early PPNB (8700-8200 BC) (Ekinbaş Can 2026: 293; Ekinbaş Can *pers. comm.* 2026). Sherds from Middle PPNB Tell Abu Hureyra (northern Syria) (Moore 1995; Le Mière & Picon 1998) and a recent discovery from the PPNB levels of Karahan Tepe (south-eastern Türkiye) may show some evidence of firing (N. Karul *pers. comm.* 2024). The only sherd from the Late PPNB (7500–7000 BC) level at Jericho was part of a deep, pointed-bottom bowl, likely exposed to fire (Figure 9d; Kenyon & Holland 1982; Le Mière & Picon 1998). Similarly, the single sherd from Beidha, Jordan, is from a thick-walled, flat-bottomed bowl with heavy chaff tempering, which seems to have undergone some firing (Figure 9e; Kirkbride 1966).

An important group of clay containers found at Çayönü in south-eastern Türkiye are plant-tempered and show no conscious firing (Figure 9g; Özdoğan 2009). Despite finding many sherds, six of them were sufficiently diagnostic to determine the vessel form. These mould-made containers are shallow and round or rectangular with rounded corners. Some display woven impressions suggesting they were made inside baskets (Erim-Özdoğan & Yalman 2004: 71). The vessel pastes are mineral or plant tempered and generally box-shaped, though one is a deep, thick-walled bowl. They were produced using moulds in various forms and sizes (Erim-Özdoğan 2011: 224).

The Ganj Dareh specimens (western Iran) feature PPNB large, clay silo vessels, small unfired clay jars, likely made from two moulds (Figure 9a; Smith 1972; Vandiver 1985), and medium-sized, thick-walled vessels made from dung and plant paste using slab technology (Petrova *et al.* 2025). In addition to Ganj Dareh, many PPNB sites, including Ain Ghazal, Jericho, Tell Magzaliyah, Basta and Tell el-Kerkh, have silo-like, earthen/clay vessels, which are densely plant- or dung-tempered, were likely used for food storage and show little evidence for deliberate firing (Smith 1990; Rollefson 1992; Bader 1993; Tsuneki 2017; Nieuwenhuyse *et al.* 2023; Odaka 2023).

Sherds from Kfar HaHoresh, Israel, dating to the PPNB period, were likely tempered with burned dung (Biton *et al.* 2014). They were fired at around 500°C, which does not fully sinter or fuse the clay, leaving partially burned organic materials in the matrix.

Thus, intentional firing of pottery is sometimes evident in South-west Asia during the PPN, such as at Boncuklu and Demirköy, but often remains uncertain. The appearance of 'incipient pottery' in the Middle PPNB and 'practical pottery' in the Late PPNB suggests a gradual technological transition (Gibbs & Jordan 2016; Tsuneki 2017). Some nearby south-east Anatolian sites like Demirköy and Gre Fılla may have had fired vessels

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from the PPNA and PPNB period and Çemka Höyük contributes to a growing picture of this technology in the greater region.

Discussion

The fragments of early fired-clay containers found at Çemka Höyük offer important insights into the origins of ceramic technology in South-west Asia. Dating to the tenth millennium BC, they represent an experimental phase in which clay was intentionally tempered with organic materials and fired at low oxidising temperatures to create functional containers. A similar date is suggested for the appearance of pottery technologies in Africa (Huysecom *et al.* 2009; Lizuka & Terry 2022), but the earliest pottery identified to date is found in East Asia and dates to the sixteenth millennium BC (Kuzmin 2017; Wang & Sebillaud 2019).

Falling within the earliest known examples from South-west Asia, the Çemka samples may suggest that controlled ceramic technologies emerged in this region much earlier than previously assumed. This new evidence points to an early implementation and demonstrates that ceramic innovation emerged before widespread production and adoption, developing regionally and progressively rather than through a single invention event. Our analysis of the fired clay items from Çemka shows that the inhabitants of the site experimented with pottery production by selectively using organic temper, low-temperature firing technologies and slab-construction techniques.

The Çemka assemblage includes clay vessels and other clay-based products, including various forms of fired and unfired clay coatings applied to stone dwellings and organic objects, at least one fragment of a clay 'brick' and clay augmentation for containers made of other materials. This diversity suggests that the manipulation of clay was already embedded in daily life and local practices nearly 12 000 years ago.

In contrast to the Zagros region where the development of pottery is associated with building techniques (Petrova *et al.* 2025), the use of clay for construction is uncommon in the Taurus foothills. The fired-clay vessels from Çemka are compositionally consistent, and they differ from other unfired clay objects found at the site due to mineral degradation that occurs during the firing process. Their shape and size (diameter, thickness) also distinguish them from other clay items but show similarities with later Pottery Neolithic clay vessel fragments. Their construction techniques may be related to the practice of layering clay coatings on utility structures such as building walls, observed occasionally in the Taurus foothills (Petrova 2024b) highlighting the complex technological and sociocultural processes involved in the gradual adoption of pottery, implementation of novel technologies, social acceptance and interaction with existing materials and practices. The use of clay for coating organic materials and as enhancements to non-clay vessels suggests a transitional phase where communities experimented with the material properties of clay before developing fully independent ceramic traditions. Changes in culinary traditions, storage needs or cooking demands likely drove the increased use of clay containers, paving the way for the full adoption of pottery in later periods.

Technological innovations require both functional advantages and social acceptance to become widespread. The Çemka ceramics illustrate how early communities navigated

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https://doi.org/10.15184/aqy.2026.10371 Published online by Cambridge University Press

this process, integrating clay technologies into daily life while interacting with existing material traditions. The clay coatings on organic items or walls and clay enhancements to non-clay vessels likely inspired the creation of clay vessels using slab technology. For new technology to spread widely, it must meet a demand and be integrated into daily activities and rituals; otherwise, inventions may remain isolated (Bernbeck 2017: 97). The evidence from Çemka underscores the entanglement of technological factors as well as social factors such as community preferences in the emergence of pottery. The communities at this site were not yet reliant on ceramics for storage or cooking, but their incipient application reflects a growing awareness of clay's affordances and potential. Future research that incorporates microstructural analysis and other experimental archaeological techniques will further elucidate the technological decisions made by these early potters and their broader implications for Neolithic societies.

Conclusion

By situating Çemka within the broader context of the Pre-Pottery and early Pottery Neolithic of South-west Asia, this study enables insights into the diverse pathways through which ceramic technology must have emerged. The Çemka finds reveal a pivotal stage in South-west Asian innovation: the translation of constructional knowledge into container production, contributing to our understanding of early pottery development as neither uniform nor linear but rather regionally variable and dynamic. Thus, early pottery can be seen as a mosaic of regional experiments, each negotiating functional demands and social acceptance. At present, Çemka stands as a key example of how early Neolithic communities explored the possibilities of clay, setting the stage for the fully developed ceramic traditions of the seventh millennium BC.

Acknowledgements

We express our sincere gratitude to Anna Babenko for conducting spherulite analysis and to Halil Tekin and Evren Çubukçu for providing access to the Domuztepe expedition and the Hacettepe University binocular and petrographic microscopes used in this study. We are grateful to the staff of KUYTAM (Koç University Surface Science and Technology Center) and the Archaeology Lab at Koç University for their instrumental and facility support. We extend thanks to Adria Breu and two anonymous reviewers for valuable feedback on an earlier draft of this manuscript. Thanks also go to Aslı Erim and Michael Rosenberg for providing photograph images for Figure 8 and giving us permission to include them here.

Funding statement

This research was funded by the Institute of Archaeology of the Russian Academy of Science (state assignment no. 126011315527-2), the Turkish Ministry of Culture and Tourism, the Directorate General for State Hydraulic Works DSİ District 16, and Koç University's Graduate School of Social Sciences and Humanities.

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https://doi.org/10.15184/aqy.2026.10371 Published online by Cambridge University Press

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