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Beyond loom weights: Contextualising crescent-shaped objects as administrative instruments in Late Bronze Age Konya Karahöyük (south-central Anatolia)

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Abstract

Crescent-shaped objects (CSOs) are common in the Bronze Age archaeological contexts of Anatolia. Particularly for the Middle Bronze Age, these objects were routinely interpreted as loom weights for textile production. While arguments exist for different uses of CSOs, such as identity markers, receipts for goods, fishing net weights or pottery handles, incomplete data from a fully recovered archaeological context prevent further assertions for the Late Bronze Age. This article presents new data from the Late Bronze Age I (ca 16th century BCE) strata of the south-central Anatolian site of Konya Karahöyük, suggesting an alternative use for CSOs. Konya Karahöyük is a major Bronze Age hub in the Konya plain, with numerous examples of CSOs dating to the Old Assyrian Colony (OAC) period uncovered in previous excavations conducted at the site from 1953 to 1992. The new round of excavations, which started in 2022, yielded a significant collection providing an opportunity to reinterpret the functions of these objects. The CSOs found in association with *pithoi* and sealings in a grain and wine storage and preparation context offer evidence of CSOs used as administrative devices. We suggest that CSOs of the 16th-century BCE levels of Konya Karahöyük were utilised as a part of an administrative kit, conceivably accustomed to control time or check the capacity of grain and liquid containers. In the Late Bronze Age, a period marked by the advancement of centralised administrative systems, this new layer of evidence suggests that CSOs may have served a function distinct from their traditionally accepted role as loom weights, which dominates Middle Bronze Age interpretations.

Özet

Hilal biçimli objeler (HBO), Anadolu'nun Tunç Çağı arkeolojik bağlamlarında yaygın olarak karşılaşılan buluntular arasında yer almaktadır. Özellikle Orta Tunç Çağı için bu objeler, genel itibarıyla tekstil üretimine ilişkin tezgâh ağırlıkları olarak yorumlanmıştır. HBO'ların bir nevi kimlik göstergesi, mal makbuzu, balık ağı ağırlığı ya da çömlek kulpu gibi farklı işlevlere sahip olduğuna dair çeşitli görüşler mevcut olsa da, tam olarak açığa çıkarılmış bir arkeolojik bağlamdan elde edilen verilerin yetersizliği, Geç Tunç Çağı için ileri sürülebilecek iddiaları kısıtlamaktadır. Bu makale, Orta Anadolu'nun güneyindeki Konya Karahöyük yerleşiminin Geç Tunç Çağı I (yak. MÖ 16. yüzyıl) tabakalarından elde edilen yeni verileri sunmakta ve HBO'ların alternatif bir kullanımını öne çıkarmaktadır. Konya Karahöyük, Konya Ovası'nın önemli bir Tunç Çağı merkezi olup 1953–1992 yılları arasında yürütülen ilk dönem kazılarında Asur Ticaret Koloni dönemine tarihlenen çok sayıda HBO örneği gün yüzüne çıkarılmıştır. 2022 yılında başlayan yeni kazılar, bu objelerin işlevlerinin yeniden değerlendirilmesine olanak tanıyan kayda değer bir koleksiyon ortaya koymuştur. Küpler ve mühürler ile birlikte tahıl ve şarap depolama ile hazırlama bağlamında ele geçirilen HBO'lar, bu nesnelerin idari araç olarak kullanıldığına ilişkin kanıtlar sunmaktadır. Konya Karahöyük'ün MÖ 16. yüzyıl tabakalarına ait buluntuların, muhtemelen zamanı denetlemek ya da tahıl ve sıvı kaplarının kapasitesini kontrol etmek amacıyla bir idari donanımın parçası olarak kullanıldığı önerilmektedir. Merkezileşmiş idari sistemlerin gelişimiyle karakterize edilen Geç Tunç Çağı'nda bu yeni kanıt katmanı, HBO'ların Orta Tunç Çağı yorumlarına hâkim olan geleneksel tezgâh ağırlığı işlevinden farklı bir rol üstlenmiş olabileceğine işaret etmektedir.

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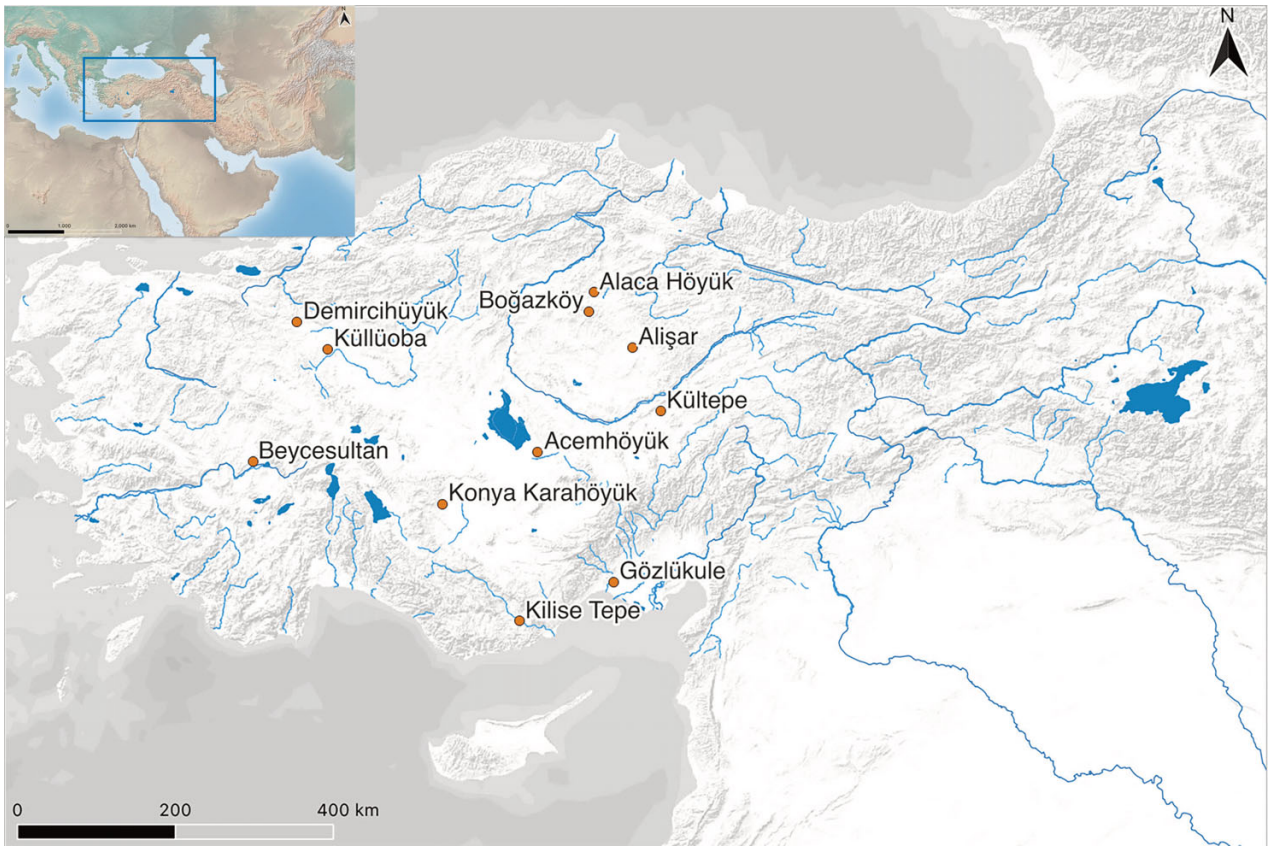

Figure 1. Map showing the archaeological sites yielding crescent-shaped objects frequently referred in the text (by Gülistan Büyükgedik; Konya Karahöyük Excavations archive).

This article discusses crescent-shaped objects (CSOs) as administrative tools by presenting new data from the Late Bronze Age I (ca 16th century BCE) archaeological levels of the south-central Anatolian Bronze Age hub of Konya Karahöyük. Our recent collection was excavated from a dendrochronologically well-dated grain and liquid storage and preparation context, allowing us to suggest and discuss the administrative function of these objects. The new material presented here dates later than the mass of objects known from the Middle Bronze Age, referred to as the Old Assyrian Colony period or Karum period in Anatolia (OAC; ca 1950–1710 BCE).

The Late Bronze Age I period in south-central Anatolia, while meagrely known compared to central Anatolia, represents significant shifts in political, economic and cultural structures (Matessi 2025: 259–88). The Middle Bronze Age to Late Bronze Age transition witnessed the consolidation of centralised authority, particularly the Old Hittite kingdom in north-central Anatolia, which catalysed advancements in administrate systems. We argue that the CSOs found in pairs and triplets from the 16th-century-BCE contexts of Konya Karahöyük, in association with storage vessels and sealings are possibly associated with administrative practices.

Crescent-shaped objects (CSOs) appear across a wide region spanning an area from Syro-Mesopotamia to Europe. They are prevalent in Anatolia (Fig. 1); their occurrence in Syria and Mesopotamia is less common and often inferred through indirect evidence (e.g., Andersson et al. 2010). CSOs were numerous in the OAC strata of Anatolian settlements, while Early Bronze Age examples were also recorded but less common.

CSOs typically have rounded bodies with perforations at each end; this indicates that they were intended to hang by strings. Their sizes may vary from 15–25cm and weigh as much as approximately 450g. Some CSOs were marked with basic surface decorations like points or lines. More complex patterns were also made, with single or multiple stamping in geometric or naturalistic forms. Stamping has been generally done with stamp seals, yet unique examples decorated with cylinder seals are known from Konya Karahöyük (Alp 1994, pl. 143, 440–41).

CSOs from the major OAC settlements, such as Kültepe / Kaneš *kārum* (Kayseri), Acemhöyük (Aksaray) and Konya Karahöyük, were mostly identified as loom weights used in textile production (Lassen 2015; Ahrens 2019). However, the findspots of the objects and associated materials are rarely described in detail. Konya

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Karahöyük provided the major corpus of the CSOs discussed in the literature (Alp 1994), yet there is limited information on their archaeological contexts (see *Legacy Data*). This lack of contextual detail limits our understanding of the specific functions and socio-economic roles these objects may have had within the broader framework of OAC and its subsequent Late Bronze Age I.

Crescent-shaped objects from Bronze Age Anatolia

CSOs were recovered in different archaeological contexts, varying from palaces to domestic areas and graves in the western and central Anatolian Bronze Age settlements (Lassen 2015: 127). This heterogeneous spatial distribution hinders their exact function and use. Limited contextual evidence (e.g., Demircihüyük) paved the way to the identification of CSOs as loom weights, and the present, actually thin line of evidence dominates the literature. Most CSOs from critical archaeological sites (e.g., Acemhöyük) remain understudied regarding their relevance to textiles and weaving. Yet, the rarity of ancient textiles and the lack of identified textile-crafting-related archaeological contexts in Bronze Age Anatolia make it harder to process the material (Dardeniz, Öztan 2020).

The archaeological site of Demircihüyük yielded one of the best examples providing information on the use of CSOs. The site, located in northwestern Anatolia, has several archaeological layers spanning from the Early Bronze Age up to the Middle Bronze Age (Fig. 1). CSOs were found in both strata of Demircihüyük, yet detailed examinations present differences in the typologies and archaeological contexts of the objects.

In the Early Bronze Age contexts of Demircihüyük, 29 loom weights were found clustered together at the east wall of a room of the Early Bronze Age A phase E1 (2850–2830 BCE) (Korfmann 1983: fig. 45, 33–34). Among them, eight were crescent-shaped, and the rest were pyramid-shaped. Ayşe Baykal-Seeher and Julia Obladen-Kauder (1996: 239) posited that these objects were part of a weaving kit around a possible loom, while Manfred Korfmann (1983: 34–35) noted that his initial assumptions of the existence of a complete loom might be challenged by the small amount of remains relative to the large number of weaving weights recovered. Regardless of whether there was a loom or not, the pyramid-shaped objects were categorically loom weights. Therefore, scholars suggest the co-occurrence of CSOs with the pyramid-shaped loom weights as evidence that the CSOs also functioned as loom weights (Rahmstorf 2015: 9).

Close to Demircihüyük from the Early Bronze Age levels of Küllüoba, two CSOs were found (Fig. 1). However, they did not have a clear archaeological stratum as they were found scattered near Early Bronze Age structures. Deniz Sarı (2018: 217–18) noted that the area where the CSOs were found had pits from the upper Middle Bronze Age levels.

The Middle Bronze Age assemblage of Demircihüyük included 76 CSOs, two of which were very fragmentary. Among these 76 objects, only 12 were found, grouped in a room with an apsidal extension (Kull 1988: 10, pl. 43.2–8; 44.1–3.5.6; figs 11–12). Unlike the Early Bronze Age, the Middle Bronze Age assemblage showed no evidence of a loom. The remaining CSOs from this stratum were found individually from different archaeological contexts, including one broken CSO recovered from a stillborn grave (Kull 1988).

In Demircihüyük, CSOs from the Early and Middle Bronze Age were found in diverse archaeological contexts. They also differ in shape, size, production technology and context. Korfmann (1983: 34) noted the difference between the Early Bronze Age and Middle Bronze Age objects, with the former being larger, heavier and clumsier in shape. Baykal-Seeher and Obladen-Kauder (1996: 237–45) referred to the Middle Bronze Age CSOs as 'much more delicate and partly decorated' compared to the eight examples from the Early Bronze Age.

For the second millennium BCE, the function of CSOs was studied experimentally, particularly in the context of OAC-period wool production (Lassen 2008; 2015). Agnete Lassen (2008: 75) accepted the objects by default as the loom weighs and pointed out the weight and thickness as two significant factors in determining the quality levels of the product. Her selective sample set relied on replicas of Konya Karahöyük's material uncovered in the Middle Bronze Age levels (ca 1750 BCE). She selected 42 loom weights – each measuring ca 3.2cm wide, with 9cm between the perforations and weighing 250g – to weave textiles (Lassen 2008: 85). Lassen's experiment confirmed the use of CSOs as weights for warp-weighed looms to produce specific fabrics known as tabby and twill. Following her experiment, she related the consumption of fabrics with similar designs to the iconography of textiles depicted in the Old Assyrian sealing designs (Lassen 2015). However, one should note that neither the group that Lassen based her experimental kit on nor the comprehensive assemblage of CSOs from Konya Karahöyük bear a standard measure, shape or weight. Additionally, they were not found in piles, which could indicate the presence of an associated warp. While the archaeological contexts of the material from the 1953–1992 excavations were unclear (see *Supplement 1*), recent excavations yielded over 200 CSOs, mostly single or in groups of two or three (see *Legacy Data and New Excavations*). Thus, it is not clear how such diverse sizes and weights could be used on warp-weighed looms (Weingarten 1990: 65 fn. 11).

Beycesultan, located in inner western Anatolia, yielded CSOs dated from the 18th–16th century BCE (Fig. 1).

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Recent research about spindle whorls and loom weights from the site accepts these objects, by default, as the most common form of loom weights (Ergün 2020). At Beycesultan, these artefacts have varying lengths between 13 and 19cm, and weigh from 170–408g. Among different types of loom weights (e.g., pyramid-shaped), 95% of items found in layer 5b (1700–1595 BCE) and 90% of those excavated in layer 5a (1600–1500 BCE) are crescent-shaped. Regarding their archaeological contexts, they were recovered in storage rooms, living rooms or courtyards in groups (Ergün 2020). Yet, the connection of such functionally diverse areas and objects to textile production remains unclear.

While the dominant argument relates CSOs to weaving and textile production, there are other opinions. Erich F. Schmidt (1932: 122) proposed that CSOs were container handles to aid transportation of goods (mainly pottery). Correspondingly, he linked the CSOs decorated with seal impressions to trade. Hetty Goldman (1956: 319, fig. 441, 11) uncovered 26 CSOs from the Late Bronze Age I layers of Tarsus Gözlükule, which she identified as fishing-net weights. However, her proposal has not garnered significant scholarly support.

At Kilise Tepe, Dominique Collon and Dorit Symington (2007) defined CSOs as 'clay crescents' due to uncertainties over their use in weaving. Five or six of these objects were recovered from the destruction debris of a probable courtyard or open area (Room H20) at the site possibly incorporated them with material packing in that layer or part of a below layer (Level III a-c, below is Level IVb, ca 1500) (Postgate, Thomas 2007: 820, fig. 473). Two of them (object nos 1634 and 1636) with designs and impressions similar to Konya Karahöyük (Alp 1994) were already noted by the specialists. Additionally, Collon and Symington (2007: 464) suggested that the way CSOs were used transformed over time, referencing Alp's argument that CSOs may have been used as receipts.

Nicholas Postgate (1996: 421–22, fig. 11) pointed to Beycesultan in the west and Alaca Höyük in the north as parallels to the Kilise Tepe examples, yet a functional argument related to weaving has not been proposed. He briefly mentioned a potentially administrative function but did not develop this idea due a limited number of objects recovered at the site. Recent excavations at Konya Karahöyük yielded new evidence (e.g., pottery, CSOs) to tighten connections between Kilise Tepe and Konya Karahöyük (Dardeniz 2024b), which were already pointed out via the typologies of CSOs (Collon, Symington 2007: 464). The objects subjected to this study support Collon, Symington and Postgate's suspicion that the objects were used for administrative purposes, and that their usage transformed over time.

Gillian Vogelsang-Eastwood (1990: 104), a specialist in ancient textiles, also approached CSOs' relation to textile production with scepticism. She rejected the idea that they were loom weights on technical grounds, and further noted that there is no evidence for them even being part of cloth production.

The presence of CSOs from the central Anatolian sites of Alaca Höyük and Alişar are significant; however, their archaeological context is particularly problematic (Fig. 1). At Alaca Höyük, 78 CSOs were listed systematically in publications as 'Hittite hangers/handles' (*Hitit askısı*), and that they were remnants of the Hittite period (stratum II). Forty-six of them were catalogued in the 1940–1948 excavations' monograph, whereas the rest were listed as part of the 1963–1967 excavations. While details of the typologies were provided with images of the objects, their archaeological contexts were described vaguely (Koşay 1966: 44–45, pl. 20; 1973: 28–30, pls XLVIII–XLIX).

At Alişar, 40 CSOs were published from the Middle and Late Bronze Age contexts. Among the fragmentary discussion about their scattered archaeological context, some were found in Plot XXV, where a pit and storage vessels were uncovered. Hans H. von der Osten noted that many of the CSOs were found in Stratum II and resembled heavy wooden weights used in certain districts of Anatolia in the 1930s. While Osten at first referred to them as handles, later he defined them as loom weights without discussing any details of a loom or weaving activities (Osten 1937: 273, fig. 300).

CSOs were also documented at the Hittite capital of Boğazköy/Hattuša (Çorum) (Fig. 1). Some examples from Büyükkale and a few from the lower town (K20) were catalogued; however, it is unclear whether they were associated with weaving activities (Fisher 1963: 153, tab. 126, objects 1203, 1207, 1208).

Sedat Alp, the former excavation director of Konya Karahöyük, suggested CSOs as receipts for goods. He argued that stamps/seal impressions on the CSOs were made by the recipients and intentionally fired (Alp 1968: 75). However, this does not explain the use of geometrically impressed and blank CSOs, which were quite common. Alp's hypothesis of CSOs being receipts for goods was challenged by Judith Weingarten (1990: 74), who argued that a single-sided receipt system is far from explanatory in a system of debt acknowledgement.

Disagreeing with Alp, Weingarten (1990) made a detailed study of Konya Karahöyük's CSOs dated to the Middle Bronze Age. She examined a total of 310 CSOs, among which 175 were stamped with seals, 104 were incised with geometric patterns and 31 were blank. She first focused on the function of stamping and demonstrated that CSOs were mainly stamped with geometric designs rather than being naturalistic. Furthermore, CSOs with

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stamping have a wide variety of designs, and every design appears distinct (Weingarten 1990: 68, 73). Her study on CSOs and their designs led her to suggest these objects were identity markers/documents. She argued that CSOs were parts of an accounting system, exchanged when an obligation had been completed or in the presence/absence of an individual. In Weingarten's model, the stamped or incised CSOs were distinctive, and may suggest different levels of individuals and households. For the blank CSOs, she argued for a self-evident task or a different category of individuals (Weingarten 1990: 75). According to her hypothesis, for example, each weaver might have a set of stamped and blank CSOs. The impressions are used to identify the weaving kit of one weaver from that of another. Once the weaver sold their product, they would use one of their own CSOs as a receipt; this would replace the usual container sealing found on other kinds of products. Yet, this does not explain identical CSOs, CSOs with identical stamps and incisions uncovered in recent excavations, nor why a receipt would have string perforations. One also should note that the majority of the CSOs recovered in early excavations do not have clear archaeological contexts confirming or denying such a practice (see *Legacy Data and New Excavations*).

Overall, there is a sporadic consensus on how CSOs were used during the second millennium BCE in Anatolia. In tandem with the cuneiform records referring regularly to textile production and trade in the OAC period (see

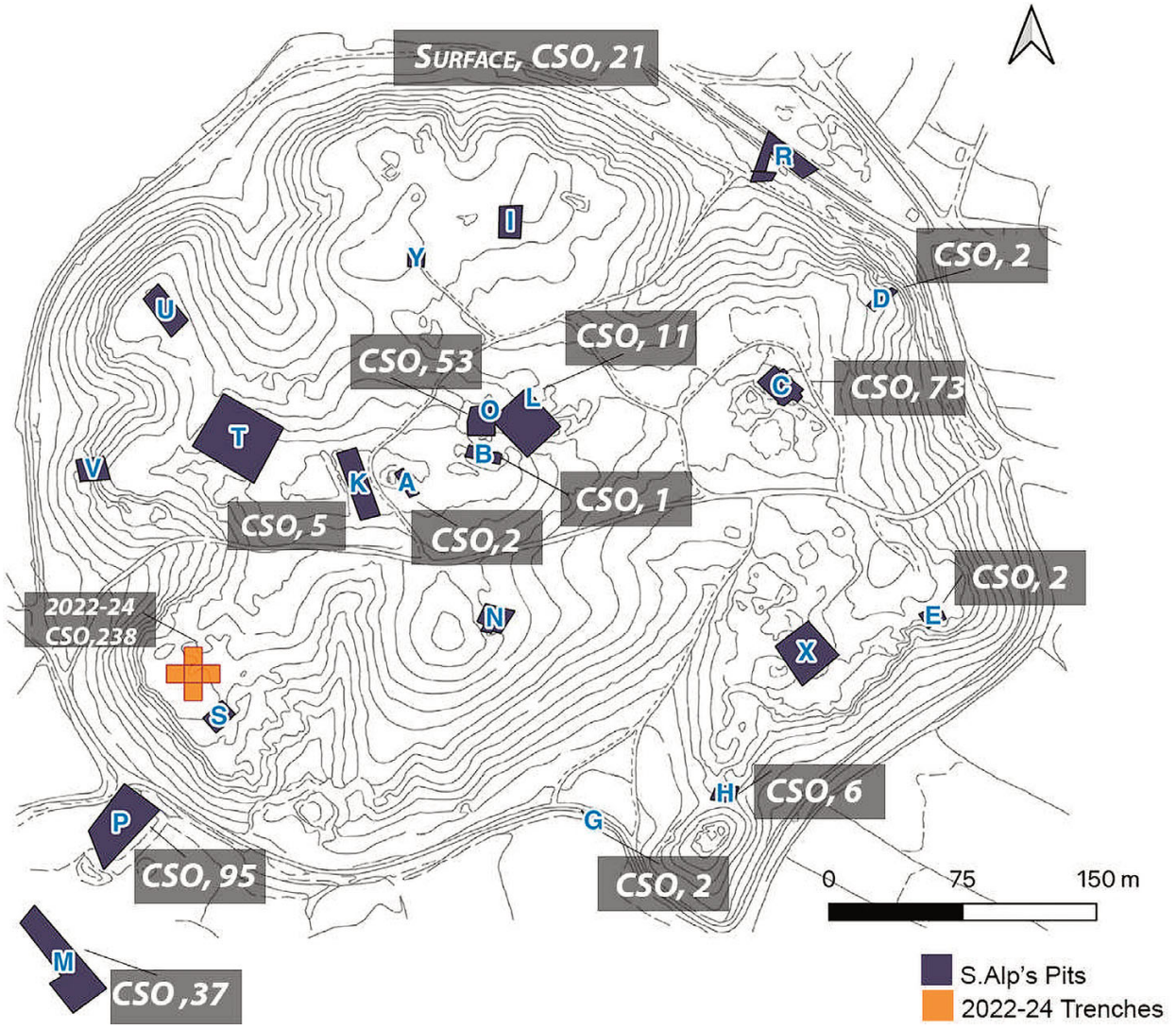

Figure 2. Topographic view of Konya Karahöyük on which Alp's pits from 1953–1992 are located with Geographical Information Systems (GIS) based on the new coordination and mapping (Özdoğru et al. 2023). The map shows the number of CSOs found in Alp's pits. Twenty-one CSOs from Alp's excavations were surface finds. Recent trenches (2022–2024) subjected in detail in this study are highlighted in orange in the southwestern part of the mound (SQs 74.25, 75.16, 75.21, 75.22, 87.01). The details of the data set are provided in Supplement 1.

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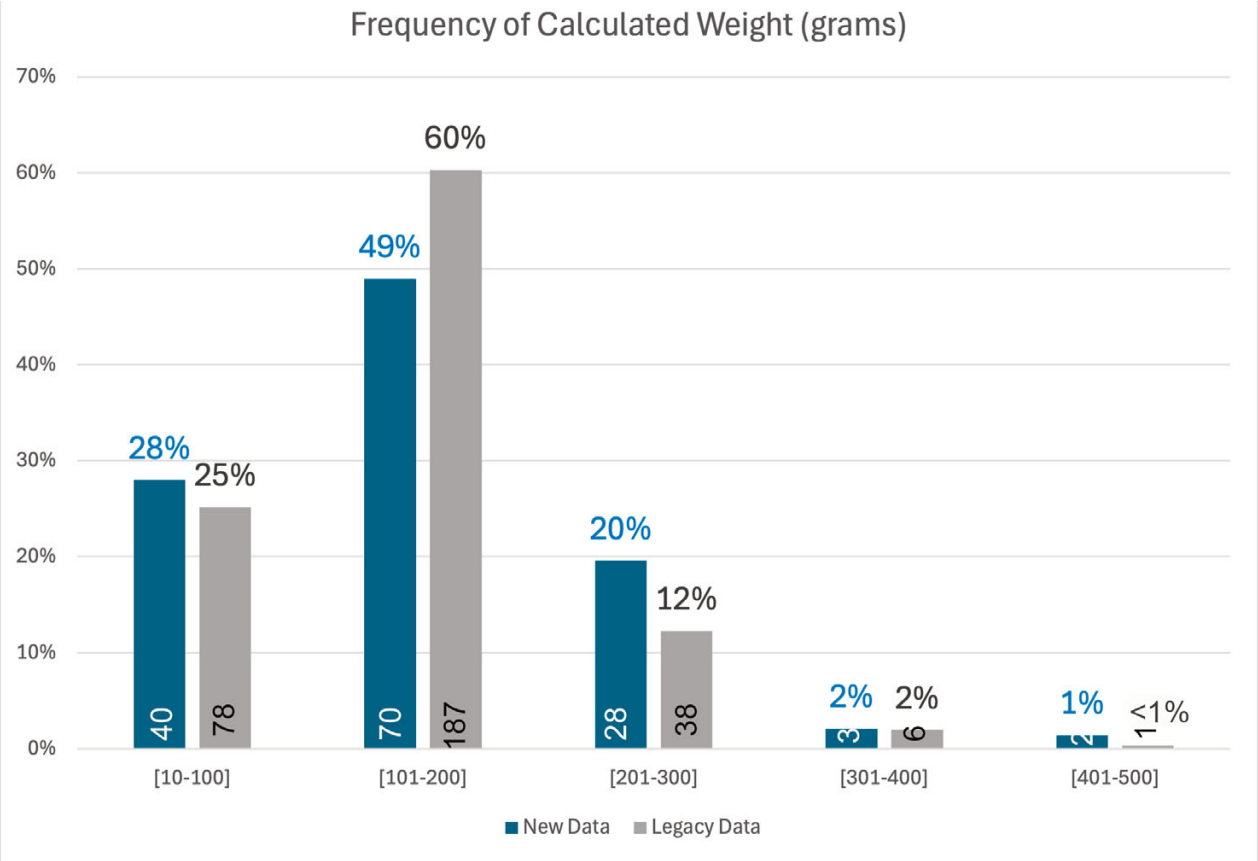

Figure 3. Number of CSOs distributed to weights in grams. The majority of the CSOs weigh between 100 and 200g, which is 20% less in weight than the CSOs used for experimental weaving studies. The grey columns refer to the 1952–1992 excavations. The blue columns reflect the object numbers from the 2022–2024 excavations.

Discussion), the objects were mostly related to weaving and identified with loom weights. While the archaeological material from Alp's excavations at Konya Karahöyük provided the main dataset, less discussion has been made regarding their context without much evidence of weaving. The eminent textile specialist Vogelsang-Eastwood (1990) challenged the loom weight argument on a technical basis. Collon, Symington and Postgate (2007) related CSOs found in Kilise Tepe with administration; however, due to a limited number of objects, they left the discussion open. Alternative interpretations – such as their use as handles, fishing-net weights, or as impressed objects functioning as trade or identity markers for households or individuals – have received little-to-no scholarly acceptance. While further evidence from *in situ* material is needed to sort through this variety of arguments, we propose that CSOs could be multi-functional and/or might experience a shift in their function in the following Late Bronze Age due to a change in administrative practices.

Konya Karahöyük: Legacy data and new excavations

Konya Karahöyük is located 8km southwest of the modern city centre of Konya in Türkiye. The mound expands to 33ha with a lower city, which increases the spatial enlargement of the site to almost 100ha (Dardeniz et al. 2024). The site was excavated between 1953 and 1992 by Sedat Alp, who established a chronology spanning from the Late Chalcolithic / Early Bronze Age to the Middle Bronze Age based on 27 successive layers of occupation.

Konya Karahöyük received the attention of the scholarly community due to its archaeological levels dating to 2000–1750 BCE. The final occupation phase (level I) of the site was dated to ca 1750 BCE, a date already challenged and shifted later (ca 1700–1650 BCE) by several scholars based on seal iconography (Boehmer 1996; Weeden 2018; Öztürk 2023).

Excavations, restarted in 2022 in the southwestern section of Konya Karahöyük, yielded significant evidence for the Late Bronze Age I occupation at the site (16th century BCE, also referred to as the Old Hittite period), which was previously unidentified (Dardeniz 2024a; 2024b; Dardeniz et al. 2024; 2025). The newly uncovered 16th-century BCE layers are also significant due to their uniqueness in the regional archaeological data. While the exact nature of this period (ca 1600–1400 BCE) in the Konya plain is poorly understood, this period marks the

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dissolution of the OAC network in central Anatolia, followed by the formative period of the Hittites at their capital Boğazköy/Hattuša in north-central Anatolia.

Our study combines legacy data with new material evidence. The legacy data is examined with statistical analysis focusing on 310 artefacts published by Alp (1994) and discussed by Weingarten (1990), yet we must note that the contextual information from this data is limited (see *Supplement 1*) with a fluctuating chronology. Nonetheless, the legacy data was chronologically attributed to no later than the 17th century BCE. The 2022–2024 excavations yielded 238 objects of different sizes, impressions and conditions of preservation. Statistical evaluations were also applied to 160 objects from the new set; the rest were excluded from the statistics, as they needed to be returned to the Konya Museum before their measurements were completed in the database. Yet, the 160 CSOs should be considered representative of the complete set. *Supplement 1* presents details of all legacy and 2022–2024 excavation data.

Legacy data

The archaeological material from Alp's excavations at Konya Karahöyük suffers greatly from fragmentary publication. The major publication of the site is Alp's 1968 monograph on seals, seal impressions and CSOs with sealings, which he revised in 1994. However, the majority of the artefacts and their contexts were poorly addressed. Regarding CSOs, only the stamped and impressed examples are presented. Likewise, CSOs decorated with dots, lines, circles, or any other geometric designs are presented with one example, yet the exact number of finds is unknown. Similarly, the number of blank CSOs and their contextual information are rather vague (Fig. 2). Most artefacts without impressions stay muted in the publication, which obscures the general picture.

For this study, all the published CSOs by Alp are digitised in a database that records context, size, preservation and decoration/impression information (*Supplement 1*). Not much information is available on blank CSOs. The digital list includes a total of 310 pieces, among which 232 were stamped and 78 were impressed in geometric shapes.

At Alp's excavations, most of the published CSOs were found individually. The only group-find contains 70 CSOs in pit C, level I, Room 25, distributed along a plastered wall near which a *pithos*, a cup and the neck part of a probable jug/bottle were visible (Alp 1994: pl. 143, 439). Out of 70 CSOs, 42 were blank, 15 carried the same seal impression, two had foot-shaped impressions and the remaining 11 showed diverse impressions. Even though Figure 2 provides contextual distribution by site based on Alp, the details (e.g., type of the building, other finds in the same room/context) were unclear.

Figure 2 shows the distribution of the CSOs in Alp's pits (see also Dardeniz 2024a for a detailed discussion on

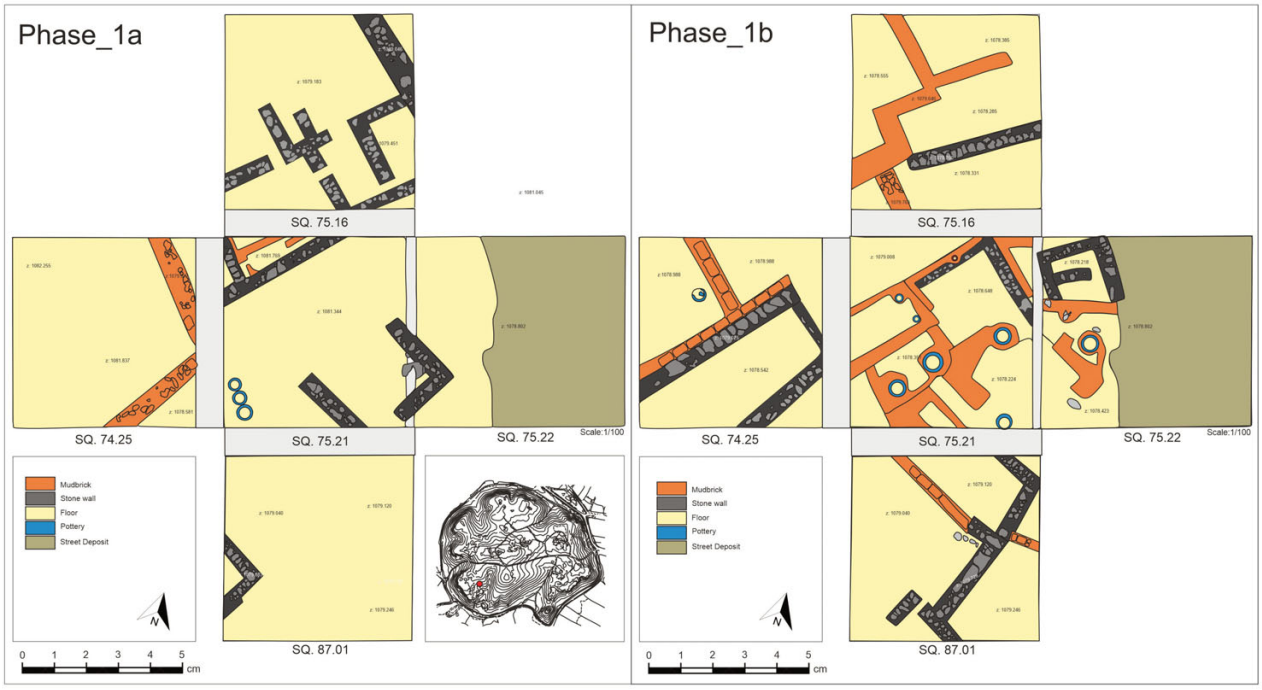

Figure 4. The architectural plans of Phase 1a and Phase 1b of the southwestern sector (drawing by Onur Kaya; Konya Karahöyük Excavations archive).

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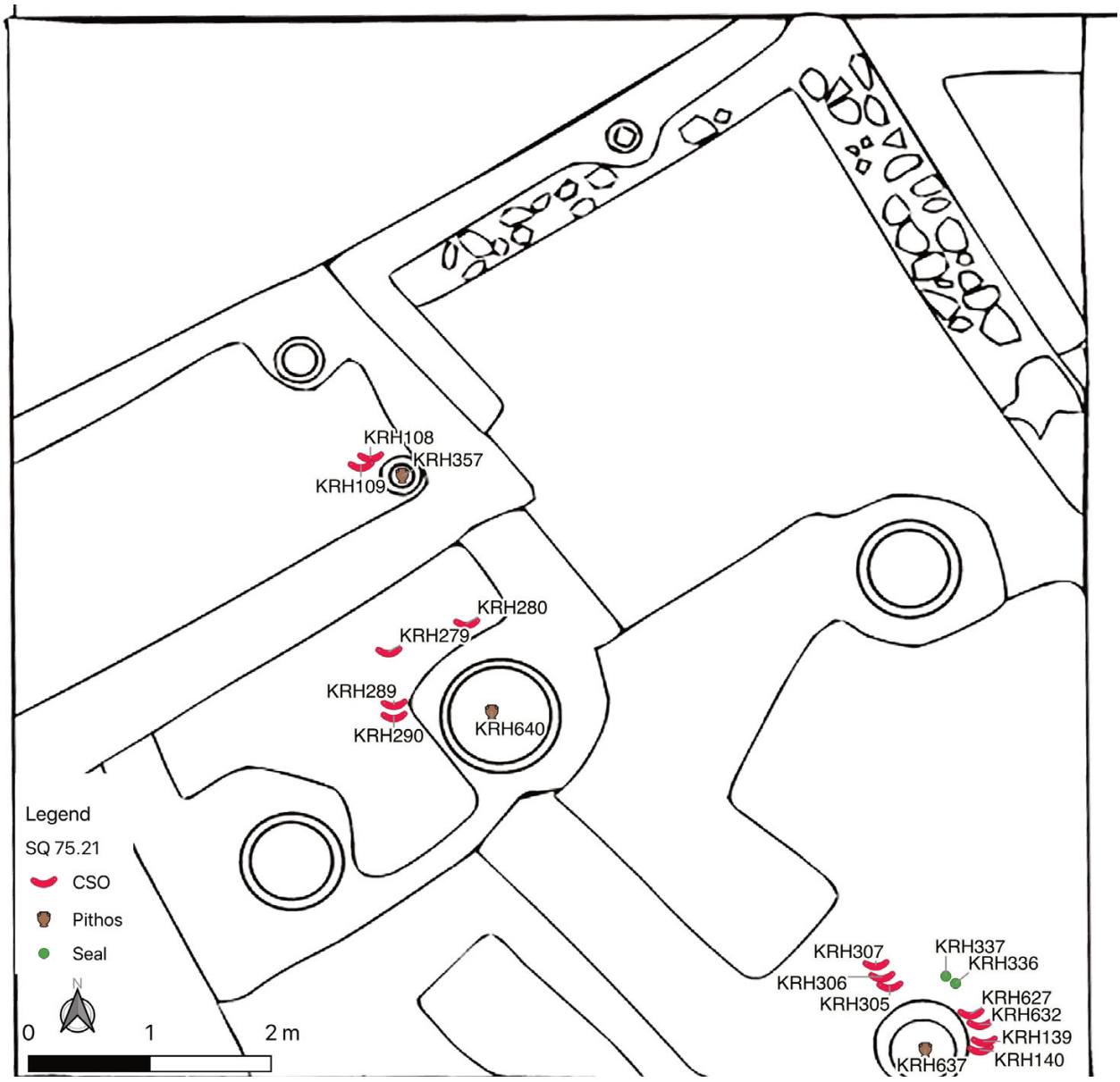

Figure 5. The architectural plan of SQ 75.21 and Konya Karahöyük inventory codes (KRH) of CSOs, seals and pithoi that are discussed in the text (drawing by Onur Kaya and Gülistan Büyükgedik; Konya Karahöyük Excavations archive).

Alp's pits). The highest number of objects was found in pit P, a domestic area in the lower town. This is followed by pit C, where the aforementioned group of 70 CSOs was found. In terms of the total number of CSOs, the artefacts collected from the mound (number of CSOs: 157) and the lower town (number of CSOs: 132) are not very different considering that Alp's team worked at shorter times and limited areas in the lower town (pits R, P and M) (see Dardeniz 2024a for a detailed discussion).

The weight of CSOs appears as an important factor in understanding their function. For example, Lassen (2015) preferred CSOs weighing 250g for her experimental weaving. The statistical analysis of Alp's material shows, however, that a majority of the CSOs are lighter than 250g. Figure 3 demonstrates the frequency of the number of CSOs versus their weights; it shows that most were lighter than 200g, and the highest frequency is observed between 100 and 200g.

New excavations

Excavations that restarted in 2022 in the southwestern sector of Konya Karahöyük exposed a Late Bronze Age I structure with two occupation phases, labelled Phase 1a and Phase 1b (Fig. 4). The first phase (Phase 1a, beneath the top soil) left fragmentary architecture. Its destruction is partially modern and must have occurred when local

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Figure 6. Close-up photo of grains collected from inside the pithos KRH 734 (photo by Elmas Kuru; Konya Karahöyük Excavations archive).

people removed soil in the 1970s. Thus, architectural details could not be recovered fully from this late phase. The archaeological remains of Phase 1a mostly consisted of partially scattered stone walls and crumbled, orange-coloured mudbricks, indicating at the mudbrick walls had collapsed. The colour and texture of the mudbricks exhibited signs of light burning but not heavy fire.

The earlier phase (Phase 1b) reveals evidence of the rapid burial of materials; since the 2025 excavation season we know this was because of a flood (Fig. 4). The evidence of rapid burial was also observed in archaeobotanical remains. Grape skins survived in the *pithoi* of Phase 1b, which would not have been possible in the case of intensive fire. Doğa Karakaya, the archaeobotany specialist of Konya Karahöyük, noted that the carpological remains of Phase 1b indicate carbonisation around 100–200ºC. The archaeobotanical remains (grape skins, pips, stalks, varieties of barley and wheat) in *pithoi* were scorched in Phase 1b. Yet, there are no remains of heavy fire in Phase 1b. The CSOs and archaeological material subjected to this study all belong to Phase 1b, which was sealed due to the collapse of Phase 1a.

In Phase 1 of the southwestern sector, 18 juniper and cedar samples were uncovered, among which 10 timbers were dated securely with dendrochronology. The tree-rings from datable samples from Phase 1b span a period from 1557±4 and 1518±4 BCE, confirming the construction of the partially uncovered structure at the very end of the 16th century BCE (Dardeniz 2024a; 2024b; Dardeniz et al. 2024; *in prep*).

Three adjacent trenches – squares (SQ) 74.25, 75.21 and 75.22 – were opened at the southwestern edge of the site, where over a dozen *pithoi* of different sizes were uncovered *in situ*. The *pithoi* preserve contextual integrity by remaining in positions that reflect their spatial arrangement and functional placement at the time of their last use.

Figure 7. The pithos KRH 637 is used as a liquid (possibly wine) container (Konya Karahöyük Excavations archive).

Most of these vessels contain carbonised grains (30+ kg) and seeds. Preliminary archaeobotanical research confirms the existence of varia of wheat, barley and grape seeds. In 2023, four new trenches (SQs 74.23, 51.20 and 53.24) were opened at different sections of the mound. In 2024, this was followed by SQs 75.16 and 87.01 at the south-western edge (Fig. 4).

Three excavation seasons (2022–2024) yielded a total of 238 CSOs in these eight trenches (see *Supplement 1* for details). Compared to former excavations, the ever-increasing number of CSOs signals Alp's selective, thus limited, recording. While all eight trenches yielded CSOs, this study focuses only on the material evidence collected from Phase 1b of SQs 74.25, 75.21, 75.22 and 87.01, which display undisturbed use and objects in their original position of deposition (Fig. 4).

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Figure 8. The CSOs (KRH 305, 306 and 307) found in association with pithos KRH 637. KRH 307 have a four-leaf-shaped stamp decoration, with a star and dots design visible in the nearly middle of the object (Konya Karahöyük Excavations archive).

Out of 238 CSOs, 100 are from the Late Bronze Age I storage and process context of southwestern trenches, among which SQ75.21 presents the best-preserved contexts. The architectural plan of the area shows the arrangement of the *pithoi* buried partially in mudbrick stages (Figs 4, 5). Some *pithoi* were full of grains (Fig. 6). In two *pithoi*, ceramic sherds of cups, bowls, pitchers and jugs were collected. Some sherd fragments found at the bottom of *pithoi* join to form whole/near whole pots, which suggests that they must have been dropped into the vessels while taking liquid and could not be retrieved. In the storage area, most of the *pithoi* have CSOs in association with their lids or necks in groups of two or three. These pairs of different sizes when measured tip-to-tip. When groups of two were found they were of similar size; groups of three included one small, one medium and one large CSO. If the CSO bundle is composed of three objects, only the medium-sized one is stamped.

To support our argument, we present three representative examples. The *pithoi* KRH 637, excavated at the southeastern corner of SQ 75.21, appears as a container for liquid, most probably wine rather than grain (Fig. 7). A significant number of ceramic sherds were collected from inside the vessel, most of which were jugs and cup fragments relevant to liquid consumption. Grape seeds and skins were identified in the archaeobotanical research. Details of these analyses will be published elsewhere (Dardeniz et al., *in prep.*), macro- and micro-remains strongly suggest wine preparation and storage.

On the western side of KRH 637, three CSOs of different sizes were found (Fig. 8). KRH 305, the small CSO, is 10.6cm in length and weighs 120g. The big one, KRH 306, is 15.5cm and weighs 473g. The medium-sized CSO (KRH 307) is 13.8cm and weighs 33.2g, which is quite light compared to the other pieces. The clay of KRH 307 is also different due to its heavy clay temper, and also is impressed with a stamp seal in a four-leaf shape. The four-leaf shape has a six-ray star in it, and the triangular spaces between the rays are decorated with dots (Fig. 8). Two complete stamp seals, one made of steatite (KRH 336) and the other made of metal (KRH 337), were also found just in front of the pithos. The presence of the seals proves administrative activities and control in this context (Fig. 5). The shape and the iconography of these stamp seals reflect the Old Hittite (Late Bronze Age I) sealing practices (Dardeniz et al., *in prep*). Most significantly, the

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Figure 9a. The pithos KRH 357 is probably a liquid container.(Konya Karahöyük Excavations archive).

Figure 9b. The CSOs KRH 108 and KRH 109, found in association with the storage vessel (Konya Karahöyük Excavations archive).

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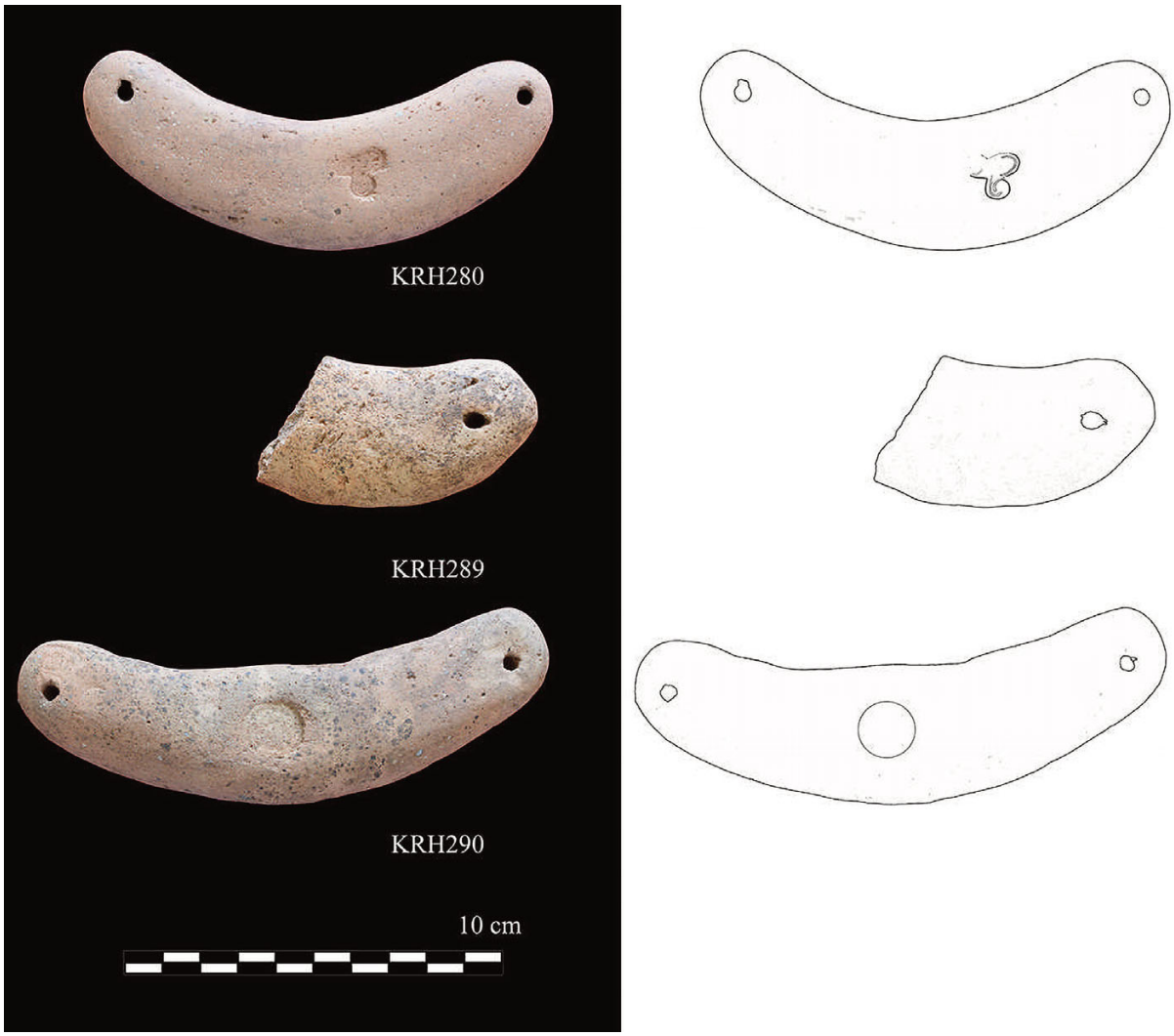

Figure 10. CSOs (KRH 280, 289, 290) found near the pithos KRH 734. KRH 280 was stamped with a triskele design (Konya Karahöyük Excavations archive).

seals were found on a floor level, together with an *in situ* wooden beam (KRH 621) sticking out of the wall connecting the rooms. The wood was identified as a juniper, and the rings cover 1642–1557 BCE, dendrochronologically dating the context after 1557±4 BCE.

The second example is from the same archaeological storage context (Fig. 5). The pithos (KRH 357) signals liquid storage but is smaller in size compared to KRH 647 (Fig. 9a). Two CSOs were found in association with KRH 357. The smaller one (KRH 108) is 12.1cm in length and weighs 159.3g. This faintly bears a crescent shape (Fig. 9b). The bigger one (KRH 109) is 13.6cm in length and weighs 109.8g. KRH 108 has a rounded impression with no decoration. A fragmentary CSO was found in the loose soil above KRH 357, which is probably related to this pithos, making the CSOs a set of three.

KRH 734 is another *pithos* from the same context, full of barley (Fig. 6). Three CSOs (KRHs 280, 289, 290) were uncovered around KRH 734 (Fig. 5), which might also be in association with the grain *pithos* at the west. KRH 280 and 290 are found intact, whereas KRH 289 is half-preserved (Fig. 10). KRH 280 is stamped with a triskele design (Fig. 10). This distribution confirms that CSOs were also used in association with grain containers.

While CSOs were mostly found outside the *pithoi*, some examples were found in the vessels rather than around them. In 2024, a partially survived (KRH 1204) grain *pithos* with one CSO was recovered in SQ 87.01. Regarding our model detailed below, the CSO used for time or capacity control must have fallen inside and gotten stuck there (Fig. 11).

Archaeological material uncovered at the recent excavations at Konya Karahöyük highlights a storage and preparation area for grains and liquids. Yet, one would wonder about any textile-related activity in such CSO-loaded contexts. If one considers spindle whorls as undis-

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Figure 11. The pithos (KRH 1202) with the CSO (KRH 1204) (Konya Karahöyük Excavations archive).

puted pieces of textile production, only five of them were found in the last three excavation seasons. Compared to over 200 CSOs, such a small number of spindle whorls puts the relation of these contexts in doubt with textile production. Additionally, none of the spindle whorls were found in association with CSOs. Finally, any other items which might relate to textile production (e.g., pyramid-shaped loom weights, fragments of a weaving loom, needles, etc.) were not uncovered in these contexts.

It could be argued that various stages of specialised textile production were spatially segregated, with only the weaving stage evidenced on the central mound. However, if this was the case, one would expect clear indications of textile production in the lower town. At Konya Karahöyük, however, such evidence is lacking in Alp's excavations, which have been the basis of previous arguments. Notably, the characteristic pyramid-shaped loom weights – widely associated with textile production (see Demircihüyük) – have not been found in the area subjected to this study. While Lassen (2015) proposed that CSOs may have been used to produce specific textile patterns such as twill, the prevailing consensus identifies pyramid-shaped objects as typical loom weights. Suggesting that pyramid-shaped loom weights were not employed at Konya Karahöyük is therefore problematic (see *Crescent-shaped Objects from Bronze Age Anatolia*). Furthermore, conducting weaving activities in a zone dedicated to wine production, processing, or other liquid-related tasks would be impractical, given the damp conditions such activities would have generated.

To sum up, almost all the *pithoi* at this storage and food preparation area revealed complete or fragmentary CSOs, signalling a relation between the containers and the CSOs. Based on the present evidence, we suggest that CSOs of this grain and liquid storage and preparation context should serve as administrative devices rather than being related to weaving in the Late Bronze Age I.

Discussion

The majority of excavations define CSOs by default as part of the toolkit for textile production, preferring a utilitarian explanation without in-depth analysis of their archaeological contexts. The limited remains of ancient textiles, as well as textile-related craft quarters, lead scholars to examine second-millennium BCE Anatolian textile production via cuneiform tablets, seals, seal impressions

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and the presentation of textiles in ancient art (Lassen 2008: 7). The multi-layered information gathered from textual and iconographic records was extrapolated to broader Anatolia, assigning function(s) to these problematic objects. CSOs were hypothesised to have been used in the production of wool and plant-based fibres mostly based on experimental studies framed in textile crafting, yet other plausible uses remain understudied (see also Vogelsang-Eastwood 1990). Although sites such as Kilise Tepe have yielded potential evidence suggesting that CSOs may have served administrative functions during the Late Bronze Age, the limited number of finds and their fragmentary contexts have prevented the excavators from further arguing for an administrative use (Postgate 1996; Collon, Symington 2007).

A good portion of research on textile production benefits from cuneiform archives of Assyrian merchants, who traded tin and textiles from Aššur (modern northern Iraq) to an extended Anatolian network, among which Kültepe / Kaneš *kārum* was the major hub. Over 23,000 cuneiform tablets uncovered at Kültepe / Kaneš reveal the details of this broad trade network spanning the region from northern Iraq to west-central Anatolia (Fig. 1). This extensive commerce had its heyday in the first quarter of the second millennium BCE, an era widely recognised as the OAC period (Larsen 2015). Aside from Kültepe / Kaneš, sites like Konya Karahöyük and Acemhöyük also reveal contemporaneous archaeological strata, the former assumed to be less active in this specific network driven by Assyrian merchants and controlled by Anatolian rulers (Barjamovic et al. 2019). While no cuneiform tablets, textile remains or crafting areas have been unearthed so far from Konya Karahöyük, the site yielded one of the richest CSO collections of Anatolia, dating to the OAC period. This collection became one of the pillars of arguments relating CSOs to weaving (e.g., Lassen 2015; Ergün 2020). The new CSO collection, dating to the Late Bronze Age I, provides evidence for an administrative function which could represent a shift in usage following the transformation from the Middle to the Late Bronze Age.

Against the backdrop of the textual records of the OAC period, state-administered textile production emerged as one of the major aspects of Anatolian economies. While the contextual projection (e.g., pit C, level I, Room 25) of centrally controlled textile production at Konya Karahöyük is promising, the lack of archaeological data from Alp's excavations prevents further attestations. One should note, however, that 70 CSOs found in pit C, level I, Room 25 were distributed along a plastered wall near which a *pithos*, a cup and the neck part of a probable jug/bottle were visible (Alp 1994, pl. 143, 439). Out of 70 CSOs, 42 were blank and the rest were impressed. Their typologies appeared very diverse. While there is no supportive evidence that they were part of weaving kit or a loom, it is hard to argue otherwise due to a lack of data. However, the existence of a *pithos*, a cup and a jug/bottle is reminiscent of storage vessels and CSOs in SQ 75.21.

New excavations support central administration; however, rather than textile production, there seems to be control over agricultural products in storage, where CSOs were used. Considering the long-term agricultural capacity of the Konya plain, from Neolithic Çatalhöyük to the modern day, the site's link to agricultural products, especially grapes, is not a revelation.

Konya Karahöyük has OAC levels that are contemporary with Kültepe / Kaneš *kārum*, where CSOs were sometimes found in caches of 20–30 and referred to as loom weights. Some of them were impressed with stamp seals (Lassen 2008: 92). While the exact number of objects at Kültepe / Kaneš *kārum* is unclear, the majority of the CSOs from the site have been waiting for publication. Contemporary to Kültepe / Kaneš *kārum* and Konya Karahöyük, Acemhöyük also yielded CSOs from different archaeological contexts dated to the OAC period, which are yet to be published. It is important to note that both at Kültepe / Kaneš *kārum* and Acemhöyük, the objects are mostly 'U'-shaped and standardised. This standardisation and 'U' shapes are not observed in the Late Bronze Age I contexts of Konya Karahöyük. Some of them even barely show a crescent shape (e.g., KRH 108, Fig. 9b). Additionally, if Konya Karahöyük was assumed to be less active in the OAC network, driven by the Assyrian merchants and controlled by the Anatolian rulers (Barjamovic et al. 2019), the locals might well give other functions to CSOs than weaving.

While Lassen (2008; 2015) favours the interpretation of CSOs as loom weights for textile production, she also disagrees with Weingarten's (1990) suggestion that stamped and incised CSOs were indicators of different levels of individuals or households. Lassen suggests that the owners of CSOs impressed with toggle pins, fingernails or other simple designs had not owned a seal and rather used these objects as identity markers. Lassen (2008: 96) states that the CSOs' owners were not directly connected to the centralised administration but had responsibilities toward the centralised administration. She suggested that the stamps and impressions on CSOs reflect the marks of craftspeople employed by the central authority. Accordingly, Lassen argues that the group of 70 CSOs in pit C, level I, Room 25 of Konya Karahöyük is a possible workshop (Lassen 2008: 100), but there is no other evidence for a workshop other than CSOs. Other than this assemblage, no other groups with, for example, more than 5–10 CSOs together were recorded at the site (see *Supplement 1*). The Late Bronze Age I levels do not yield a group of more than three. Lassen also did not

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explain how CSOs of diverse sizes and weights could be used in weaving.

We propose CSOs as administrative tools used at storage and/or food preparation facilities during the Late Bronze Age I period rather than serving as loom weights for textile production. This is supported by the fact that SQs 74.25, 75.16, 75.21, 75.22 and 87.01 did not yield any remains associating the area with textile production or indicating a textile-related workshop. Only five spindle whorls have been found so far at these trenches, two of them (KRH 20; KRH 27) at SQ 75.21, one (KRH 210) from SQ 74.25, and the other two from SQ 74.22, which is a semi-open area connected to the street uncovered nearby (Fig. 4).

The wear-mark analysis also disagrees with possible loom weight usage. An indication that CSOs were used as loom weights is wear marks near the perforated edges or surfaces of the objects (Lassen 2015: 135–36). The edges of loom weights show marks, fissures or fractures on their surface, as they collide with each other during weaving. Additionally, their surfaces do not bear marks/cracks of collusion. Our macroscopic and microscopic examinations of CSOs in 2024 do not show weaving-related or any other wear marks (Figs 8, 9, 10).

Another reason that the idea of CSOs as weaving tools falls short for the 16th-century BCE Konya Karahöyük context is the non-standardised sizes and weights of the artefacts. For weaving textiles, the size and weight of the loom weights should be homogeneous in order to hold the fibres with the same tension and thereby ensure the quality of the weaving, but our assemblage is diverse and not standardised (see *Supplement 1*). Vogelsang-Eastwood (1990) also highlighted and explained in detail why such heterogeneously sized objects could not be used for cloth production.

Our proposal for the function of CSOs as administrative tools does not entirely refute the usage of these objects in textile production in other archaeological contexts or earlier periods, particularly in the Middle Bronze Age. Yet recent evidence represented with a significant number of CSOs from Konya Karahöyük did not yield any weaving-related area. The ceramic assemblage of the area is composed of mostly *pithoi*, pots, varia of plates, jugs and funnels. The pottery suggests storage other than that in the food and beverage preparation area (Fig. 12). The preliminary archaeobotanical research confirms extremely well-cleaned two-rowed barley (*Hordeum vulgare ssp. distichum*), confirming the storage function of the area. Two- and one-grained einkorn (*Triticum monoccoccum*), naked barley (*Hordeum nudum*-type) and bitter vetch (*Vicia ervilia*) are also detected in the vessels (Dardeniz et al., *in prep.*). Additionally, SQs 74.25 and 75.21 yielded significant amounts of grape pips (*Vitis vinifera*), skins and stalks indicative of the winemaking process (Dardeniz et al. 2025; *in prep.*).

The presence of CSOs at the Late Bronze Age I levels of Konya Karahöyük raises compelling questions regarding their functional role within the storage and administrative systems, and requires an explanation for how they have been utilised. While previous scholarship has proposed textile-related uses, the spatial and contextual association uncovered recently support a novel interpretive framework grounded in administrative practice, specifically, the control of time and storage capacity related to commodities, such as liquids like wine.

The CSOs were found in groups of two or three, varying in size and weight. Notably, impressions, where present, tend to occur on medium-sized objects rather than the smallest or largest examples. This pattern suggests differentiated roles within the set, probably linked to function or timing. Their consistent recovery in association with large storage vessels strongly implies intentional placement, likely suspended with cords, and not accidental deposition.

Crescent-shaped objects as time-control instruments

The hypothesis advanced here posits that CSOs served as time-regulating devices for stored goods. The nature of the time interval (as seasons or months) is unknown. The presence of multiple CSOs per vessel suggests a system in which each object corresponds to a discrete temporal marker, potentially indicating stages of fermentation, settling periods (influencing quality), or the chronological sequence of storage events such as filling or opening. So far, the best preserved examples were found around *pithoi* related to liquids, possibly wine. The clustering of CSOs around vessels containing liquids further reinforces this view, suggesting a relation to processes requiring time-sensitive monitoring, such as wine fermentation. Although the exact duration indicated by each CSO (or the set) remains unknown, the system may have marked seasonal cycles or shorter-term storage intervals. This explains the presence of more than one CSO in association with a vessel. The existence of pairs of two or three CSOs around a vessel may indicate multiple control times over a period, possibly a harvest season or year.

This interpretative model explains the presence of multiple CSOs on a single jar: rather than redundancy, their multiplicity may reflect successive monitoring events, perhaps tied to agricultural or administrative calendars. This practice would align with broader Late Bronze Age concerns for regulating commodity storage and preserving quality over time. This model also provides a new opportunity to reevaluate the association of large storage vessels with CSOs. The Late Bronze Age levels of Kilise Tepe yielded similar spatial arrangements of storage vessels and CSOs supporting our model. The CSOs in the

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Late Bronze Age storage contexts of Beycesultan might well suit this portrait.

Crescent-shaped objects as capacity indicators

Other than serving as time-control devices, CSOs may have operated as capacity markers – a pragmatic tool within a system of visual communication for managing goods stored in large, deep (ca 1.20m depth) and partially buried *pithoi* often housed in dimly lit storage facilities. It must not have been that easy to inspect their content levels. The CSOs may have served as externally visible indicators of volume/context status; for example, three CSOs might signal a full container, two-thirds full, or conversely, stages of withdrawal. The administrator responsible for the loads might be using CSOs to signal to personnel the quantity of grain or wine put or left in the containers in the storage so that the capacity could be easily noticed by several people using the area. So, the number of CSOs around the containers might be a signal for the personnel to empty/use the containers or refill them. The use of CSOs could thereby facilitate communication between storage personnel and administrators regarding the remaining

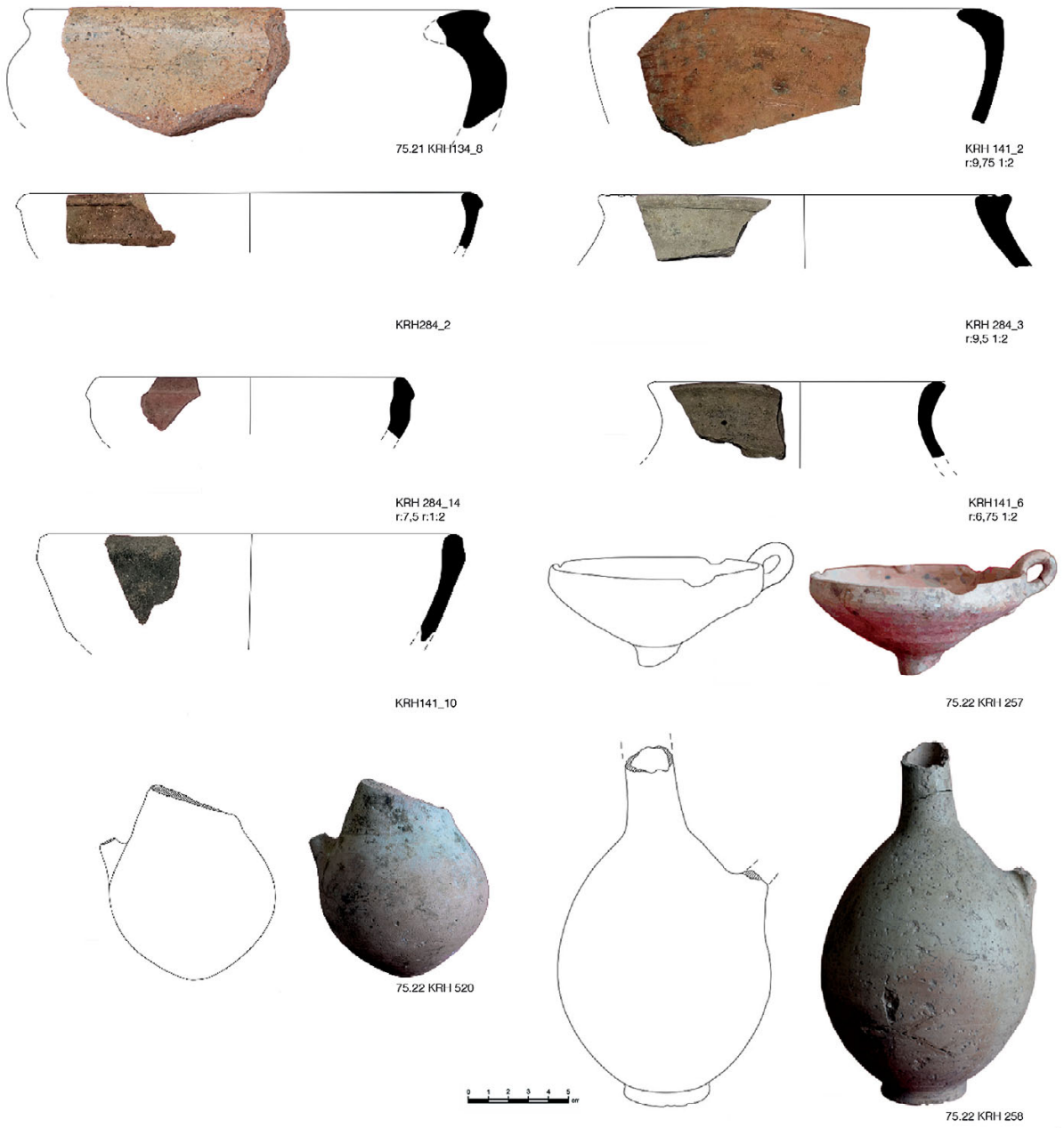

Figure 12. Examples from pots, jugs, plates and funnels uncovered in the storage context of Konya Karahöyük (drawings by Merve Beşel, Şeymanur Özalp; Konya Karahöyük Excavations archive).

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quantity of goods. In a period of increasing centralisation, systems checking available commodities appear mandatory.

The signalling function would have served both inventory management and redistribution logistics, especially in environments where multiple actors accessed storage areas. In such a context, the removal or addition of a CSO could accompany the withdrawal or input of a standard measure of grain or liquid, creating a dynamic tracking system embedded within the storage context itself.

Conclusions

CSOs have been found at various excavations throughout southwest Asia, particularly Anatolia. It has become accepted in the literature that these objects were used as loom weights. Most of the time, their contexts and associated assemblages have not even been taken into consideration. This article presents for the first time CSOs from the Late Bronze Age I contexts of Anatolia, using Konya Karahöyük as a case study. The newly excavated trenches at the site yielded a grain and liquid storage and preparation area with storage vessels, particularly dedicated to grains (wheat, barley) and wine. CSOs documented in association with the *pithoi* indicate that the objects must have been hung on these containers. The objects were collected mostly in groups of three, and it is significant that only the medium-sized ones were stamped.

We argue that the CSOs found in association with storage vessels were used either as time control instruments or capacity indicators. Taken together, the proposed model suggests that CSOs were multifunctional administrative tools used to record and regulate both temporal and quantitative aspects of storage in Konya Karahöyük's Late Bronze Age economy. Detailed investigations in contemporary sites like Kilise Tepe also suit this model. CSOs' contextual relationship with storage jars, variation in size and numerical clustering point to an intentional, codified system likely familiar to those managing and accessing stored goods. This model aligns well with broader southwest-Asian practices of abstract administrative signalling using simple, durable materials – similar in logic, not in form, to earlier token-based systems.

Our model does not underestimtate that CSOs may have been used as loom weights or tools for weaving in other archaeological contexts or periods, particularly in the Middle Bronze Age. Yet, the practice at the Late Bronze Age I Konya Karahöyük adds a significant layer of information about their functions. The function of CSOs might have shifted from textile production to storage control over time, or they could well have been multi-purpose tokens throughout the Bronze Age, utilised differently in diverse contexts or by different groups of people.

We suggest that this new line of evidence leads to a reconsideration of the use of CSOs in spatially and temporally distinct contexts. Further comparative analysis with other sites yielding CSOs, as well as experimental reconstructions of storage and monitoring practices, would help refine this interpretative framework. Nonetheless, the evidence from Konya Karahöyük provides a promising foundation for reconsidering the administrative sophistication embedded in what might otherwise appear to be modest and enigmatic artefacts.

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Supplementary material

Supplementary material may be found online at https://doi.org/10.1017/S0066154625100495 and consists of the following:

Supplement 1
CSO data
Supplement 2
Alp's (1994) data

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