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Halaf and Late Chalcolithic occupations at Shakar Tepe in the Shahrizor Plain, Iraqi Kurdistan: Preliminary report of the 2023 excavations

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ABSTRACT

The Shahrizor Plain is one of the ideal fields for tracking the transition from Neolithic village life in the Fertile Crescent to Urbanisation which occurred in Mesopotamia because of its geographical location connecting the mountainside valleys along the Zagros and the downstream Diyala River that flows into the Tigris. Our field project aims to obtain archaeological materials to unveil this process. Following the first excavations at Shakar Tepe conducted in 2019, we excavated two additional areas at this site in 2023, including one of the three satellite mounds that were newly identified around the main mound. The cultural remains of the Late Halaf settlement uncovered from Operation B at Shakar Tepe II date back to approximately 5600–5400 calBC. On the other hand, Operation C at Shakar Tepe I yielded a thick deposit of the Late Chalcolithic occupations dated to ca. 3800–3600 calBC. The recovered materials fill the time ranges in the late prehistoric chronology of the site and will contribute to our understanding of the historical role of this region in the transition from Neolithisation to Urbanisation.

1. Introduction

The Shahrizor Plain in Sulaymaniyah Governorate, the Kurdistan Region of Iraq, is a geographical crossroads connecting the tectonically-formed valleys along the Zagros Mountains and the downstream Diyala (Sirwan) River, which flows into the Tigris (Fig. 1). This location could be one of the ideal fields for tracking the transition process from Neolithic village life in the Fertile Crescent including the Zagros foothills to Urbanisation which occurred in Mesopotamia between the Tigris and the Euphrates. However, archaeological evidence from the late prehistory of the Shahrizor Plain is scarce. Although the Shahrizor Survey Project (SSP) and subsequent excavations at several sites have revealed rich archaeological records (e.g., Altaweel et al., 2012; Nieuwenhuyse et al., 2016a, 2016b; Odaka et al., 2019; Carter et al., 2020; Matthews et al., 2020), our understanding of such archaeological evidence has just begun and even the basic spatio-temporal framework of material culture is yet to be established.

Therefore, our field project, which commenced in 2019, aims to obtain archaeological materials to establish the late prehistoric chronology covering the transition from the end of Neolithisation to Urbanisation, approximately from the 7th to the 4th millennia calBC (Odaka et al., 2020; Odaka et al., 2023a; Odaka et al., 2023b). Following the excavations at Shakar Tepe in 2019 and Shaikh Marif in 2022, we conducted our second field campaign at Shakar Tepe in 2023.

2. The site

Shakar Tepe is known as a conspicuous archaeological site since the mid-20th century (Mohammed, 2017: p69). The main mound (Shakar Tepe I) has an oval plan comprising a 20-m high, flat-top conical mound in the southwestern half and a lower flat in the northeastern half (Fig. 2). A couple of *wadis* flow by the site into the Darband-i Khan Dam reservoir, whose water often reaches the northern foot-slope of the mound.

Following the surface survey by the SSP team, we visited the site in 2019 and identified late prehistoric artefacts scattering over a limited range at the northwestern skirt of the conical mound. Consequently, we

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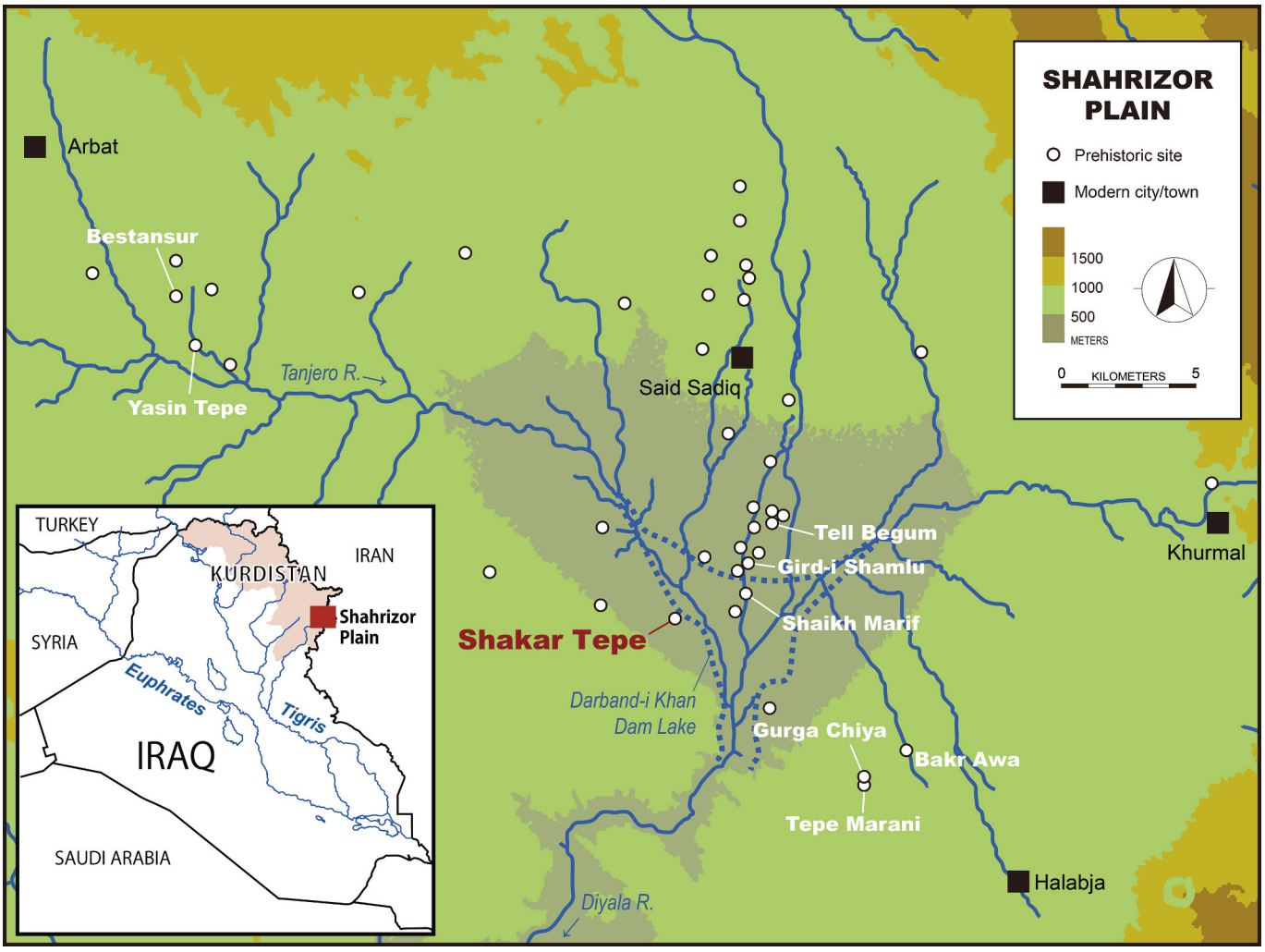


Fig. 1. Location of Shakar Tepe in the Shahrizor Plain.

decided to excavate this area. A step trench (Operation A) measuring 9.5 m long and 2.0 m wide was set on the gentle slope aligned from the bottom of the steep slope of the conical mound towards the northwest (Fig. 3). The excavations successfully recovered the Ubaid materials and stratigraphic sequence of the Late Neolithic period covering ca. 6400–6000 calBC before reaching the natural soil approximately 5 m below the highest surface level of this operation (Odaka et al., 2020; Odaka et al., 2023a).

During the 2019 season, we surveyed the area around the main mound and discovered artefacts on its surface, indicating the presence of other occupational mounds. This was confirmed by the more detailed survey at the beginning of the 2023 season, which identified three low 'satellite' mounds in the west and southwest of the main mound.

Topographic mapping was performed over a wide area, including the satellite mounds, using uncrewed aerial systems (UAS) and structure-from-motion (SfM) multi-view stereo (MVS) photogrammetry. The resultant topographic and orthorectified image maps indicated the precise locations of the satellite mounds, which were numbered from Shakar Tepe II to IV, from northwest to southeast, while the main mound was designated as Shakar Tepe I (Fig. 2).

The second excavation season in 2023 focused on two areas: Operation B at Shakar Tepe II and Operation C at Shakar Tepe I (Fig. 3). Operation B was arranged at the top of Shakar Tepe II to uncover cultural deposits from the Halaf period, because several potsherds, which seemed to be Halaf polychrome-painted ware, were collected on the surface. Operation C was set near Operation A, which was excavated in 2019, to understand the stratigraphic sequence that succeeded the Late Neolithic deposit at Shakar Tepe I. The excavations were conducted between 26 August and 21 September 2023.

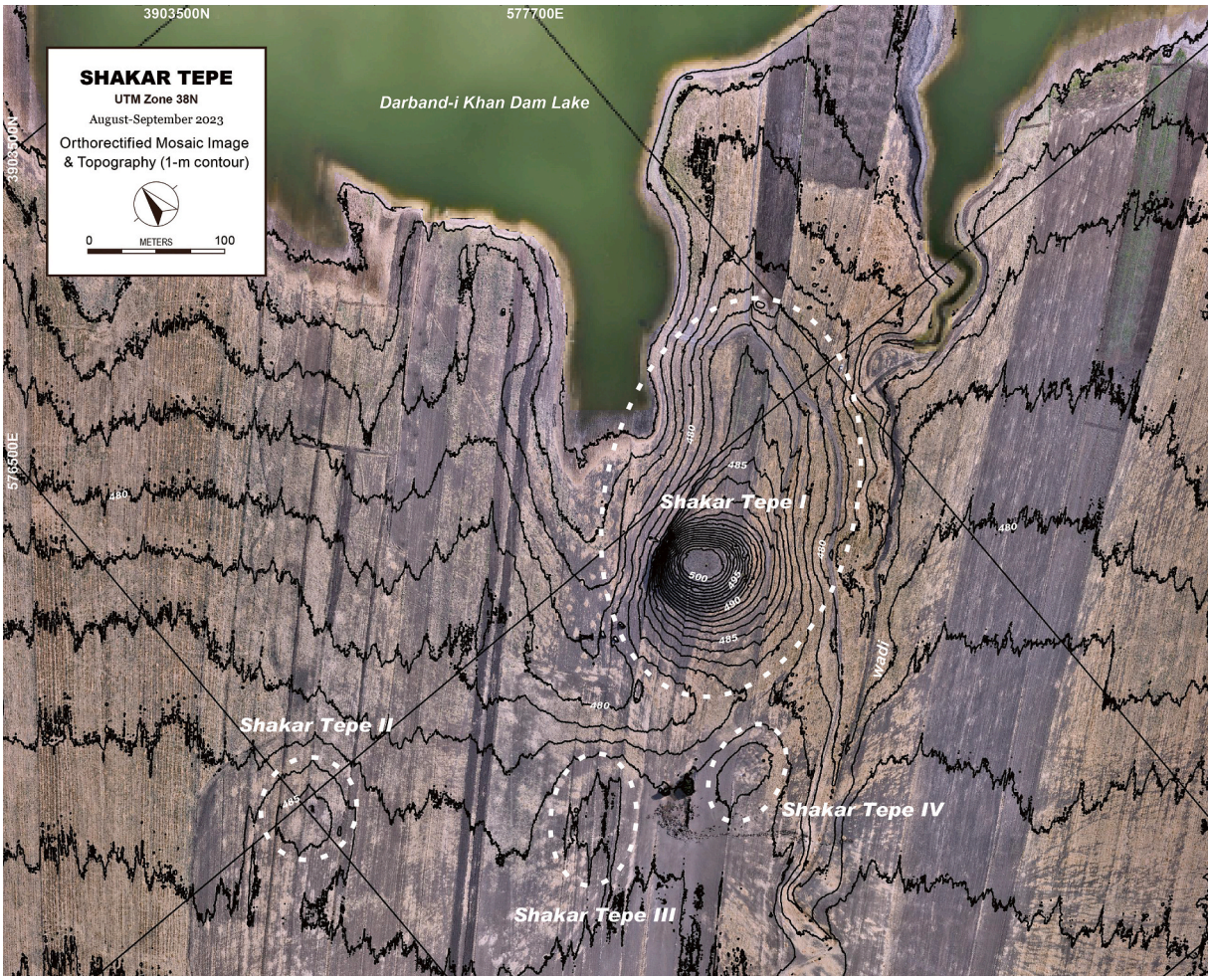


Fig. 2. Orthorectified mosaic image and topography (1-m contour) around Shakar Tepe.

Fig. 3. Operation setting at Shakar Tepe (orthorectified image).

3. Excavation of Operation B (Shakar Tepe II)

3.1. Stratigraphy and structures of Operation B

Shakar Tepe II is a low raised mound and Operation B was set at the central part of the mound, where a 4 m × 4 m square was excavated from the highest point of the mound down to the natural soil. Cultural deposits about 2.3 m thick date back to the Late Halaf period, ranging within 200 years as indicated by the four out of five radiocarbon dates (one was dead carbon) measured by the University Museum, The

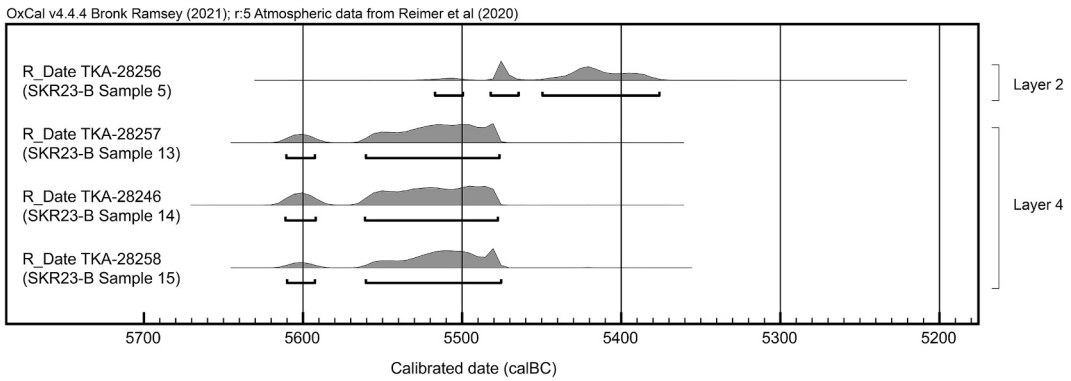


Fig. 4. Radiocarbon dates from Operation B. Calibration was conducted in OxCal 4.4.4 (Bronk Ramsey, 2021) using IntCal20 curve (Reimer et al., 2020). All the samples are wood charcoal and were prepared by the AAA method.

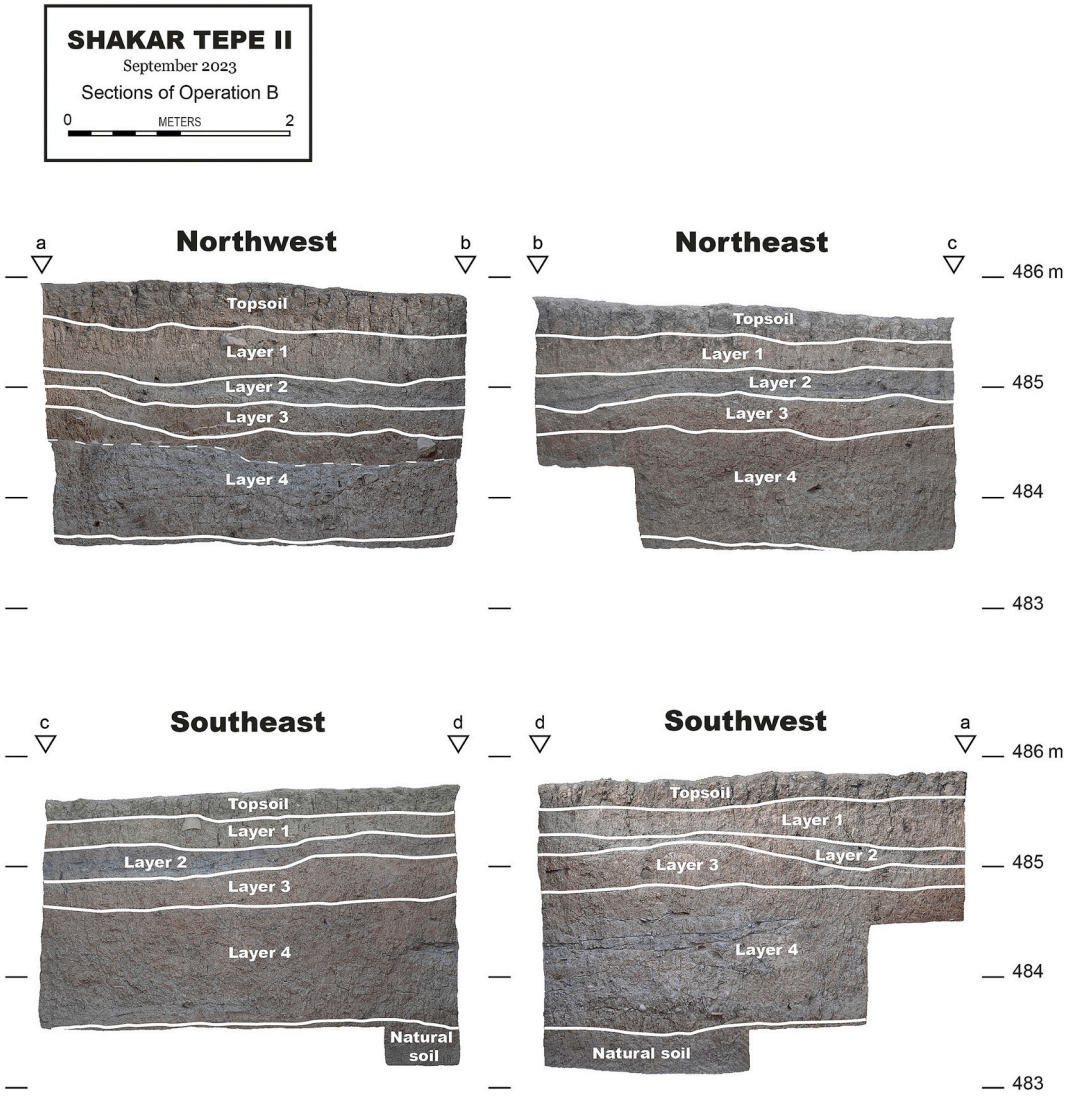


Fig. 5. Section profiles of Operation B (orthorectified image).

University of Tokyo (Fig. 4, Table S1). Although only a few solid architectural remains were discovered owing to the small excavation area, the stratigraphic sequence of Operation B was divided into four layers (Fig. 5) according to the differences in soil types and the number of artefacts recovered.

Layer 1 is a hard and crumbly reddish-brown soil below a ploughed topsoil and contains many pottery sherds and chipped stone artefacts. Within this layer, two structures that were dug from the upper level were discovered. One is an amorphous pit, probably dated to a later age, and the other is a child burial, which has skeletal remains in an extended position with its face towards the southwest, probably from the Islamic period. Other than these, the only structure from the Halaf period is a

Fig. 6. Str. 104, a pit filled with stones.

simple pit (Str. 104), which was dug downward from this layer. It is approximately 80 cm in diameter and at least 60 cm in depth and was filled with burnt soil and a cluster of stones measuring approximately 10 to 20 cm (Fig. 6). Because the wall of the pit was not burnt, and the stones were not regularly placed within the pit, it seems likely that it was a pit into which the burnt soil and the stones were discarded as rubbish rather than one that functioned as a roasting pit or alike.

Layer 2 is a lens of grey ashy deposit, about 10 to 30 cm thick, which accumulated unevenly across the excavated area. Numerous pottery sherds and lithics were recovered but no architectural remains were revealed. One charcoal sample from Layer 2 was dated to 5480–5390 calBC at one-sigma probability (TKA-28256). Layer 3, again devoid of any structure, is composed of hard and compact reddish-brown soil with patches of white lime inclusions and contains fewer artefacts.

Layer 4 is also a hard and compact reddish-brown soil almost identical to that of Layer 3 but yielded more pottery sherds including several collections of large coarse ware (Fig. 7). At the lowest level of this layer, a white plastered floor of a rectangular plan (Str. 103) was uncovered (Fig. 8). The floor surface was flat and hardened with well-preserved plaster with a thickness of a few millimetres. The edges of the floor sloped upwards to the interior face of the upright wall, which remained only up to a height of 2 to 10 cm. Unfortunately, the trace of the wall was unclear, and its exterior face could not be identified. However, the plan and size of the rectangular building were clearly represented by the floor, which is approximately 2.4 m along the NE-SW axis and at least 2.5 m along the NW-SE axis, although the southeastern part of the building is still embedded in an unexcavated area. The floor was re-

Fig. 7. Pottery recovered in Layer 4 of Operation B.

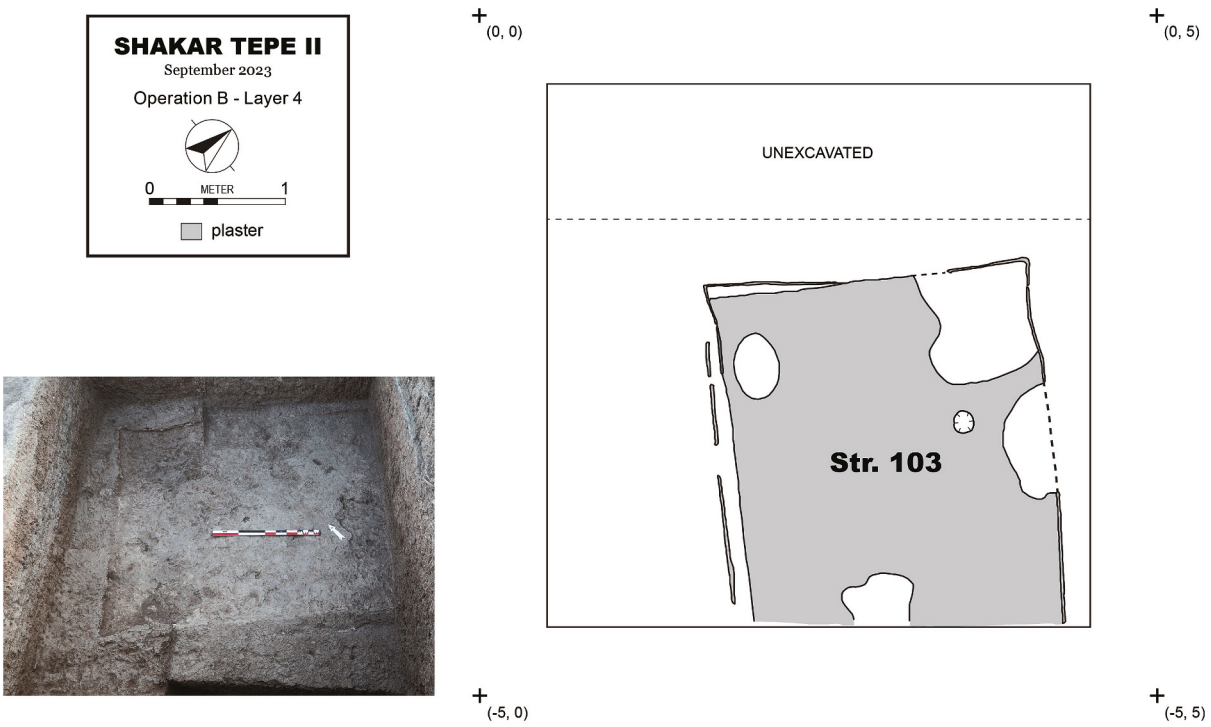


Fig. 8. Str. 103, a plaster-floored building in Layer 4 of Operation B.

plastered in some parts particularly near the wall as evidenced by the two layers of plastered surface. No distinctive features were found inside Str. 103 except for a small pit about 15 cm in diameter and 10 cm deep. It was filled with many small potsherds of about 2–5 cm and could have served as a posthole for bolstering a wooden post with sherds filled around the post. Three charcoal samples from Layer 4, one of which was recovered inside a large coarse ware (Fig. 7, bottom right), were dated to 5535–5480 (TKA-28257), 5550–5480 (TKA-28246) and 5530–5480 (TKA-28258) calBC at one sigma probability (Fig. 4, Table S1), which are all consistent with the slightly later date in Layer 2.

Natural soil was reached a few centimetres below the floor level of Str. 103. It is a homogeneous hard reddish-brown soil devoid of any artefacts. This was confirmed by a 2 m × 0.7 m sub-trench dug into the natural soil to a depth of approximately 50 cm at the southern corner of the trench.

3.2. Pottery from Operation B

The pottery assemblage recovered from Operation B consists of two ware types: Halaf ware (Fig. 9) and Coarse ware (Fig. 10). Although the tentative observations of recovered pottery do not suggest any remarkable differences between the layers, Halaf ware is quantitatively more abundant in Layers 1 and 2 than in the lower two layers (Table 1).

Most of Halaf wares (89 % of the rim-sherds) have painted decorations, often with various polychrome pigments such as black, brown, red, and white. Their motifs comprise geometric designs, such as parallel horizontal lines (Fig. 9: 1, 2, 7, 11–14) and crosshatches, which are sometimes arranged in panels (Fig. 9: 1, 3–5, 15). The surfaces were carefully smoothed or lightly burnished. Although they look relatively finer than Coarse ware, the fabrics usually include sand and sometimes vegetal tempers. Regarding the vessel shapes, shallow open bowls (Fig. 9: 1, 2), bowls with S-shaped profiles (Fig. 9: 4–7), rounded bowls (Fig. 9: 11, 12), sub-hemispherical bowls (Fig. 9: 13, 14), and collared jars (Fig. 9: 15) are remarkable.

Coarse wares have fabrics including sand and, generally, vegetal tempers. The surfaces were treated with smoothing or light burnishing, without decoration. Their vessel shapes include flat-based bowls with everted or vertical walls (Fig. 10: 2–7), cooking pots with handles (Fig. 10: 10), and large jars (Fig. 10: 12, 13). Flat base fragments with grooved interiors were also observed (Fig. 10: 11); at first glance, these look like the so-called "husking trays" but are evidently different vessels.

The total weight of the recovered pottery is 28.116 kg (24 %) for Halaf ware and 87.801 kg (75 %) for Coarse ware. In contrast, there are 238 rim-sherds of Halaf ware and 139 rim-sherds of Coarse ware. This suggests that Halaf wares generally comprise smaller vessels with thinner walls than Coarse wares.

This pottery assemblage resembles that of the Halaf layers at Tell Begum and Tepe Marani in the Shahrizor Plain, which dates back to approximately 5600–5200 calBC (Nieuwenhuyse et al., 2016a; Odaka and Nieuwenhuyse, 2022; Wengrow et al., 2016). From a typological perspective, some attributes of Halaf pottery from these sites show characteristics of the Late Halaf or the so-called "Halaf-Ubaid Transitional" pottery. For example, polychrome paint decorations and bowls with S-shaped walls in vessel shapes frequently occurred. However, some local characteristics of the Late Halaf pottery unique to this plain are also commonly observed; for example, occasional chaff inclusions in the fabric, whereas Halaf ware from other regions usually have only fine minerals or no visible inclusions. Traces of chaff inclusions are visible to the naked eye and appeared to have been intentionally added as tempers. Regarding painted decorations, the white pigment is unique, and the frequent occurrence of monotonous parallel horizontal lines and the lack of figurative motifs are remarkable.

3.3. Chert and obsidian artefacts from Operation B

Although the number of chipped stone artefacts recovered from Operation B is not large (581 pieces), they apparently represent the general characteristics of the lithic assemblage of Shakar Tepe II (Table 2). Almost all the artefacts were hand-collected without using a screen. Still, the loss of tiny pieces is likely minimal, as occasional 5-mm mesh sieving trials on soil from several contexts yielded no significant quantities of lithics.

The main raw material is local chert, which can be collected along the *wadis* near the site. The quality of chert varies, and its knappability is

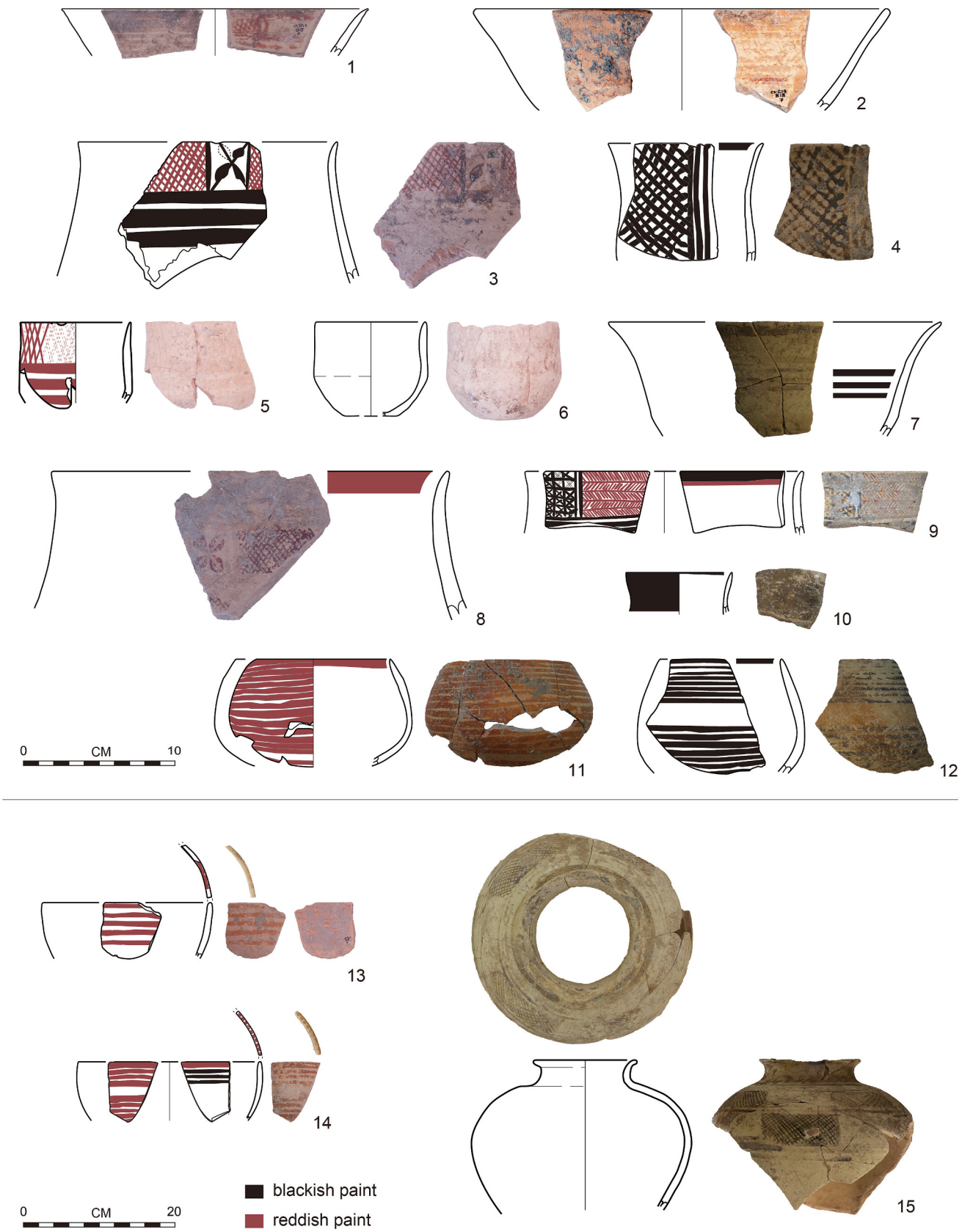


Fig. 9. Halaf wares from Operation B.

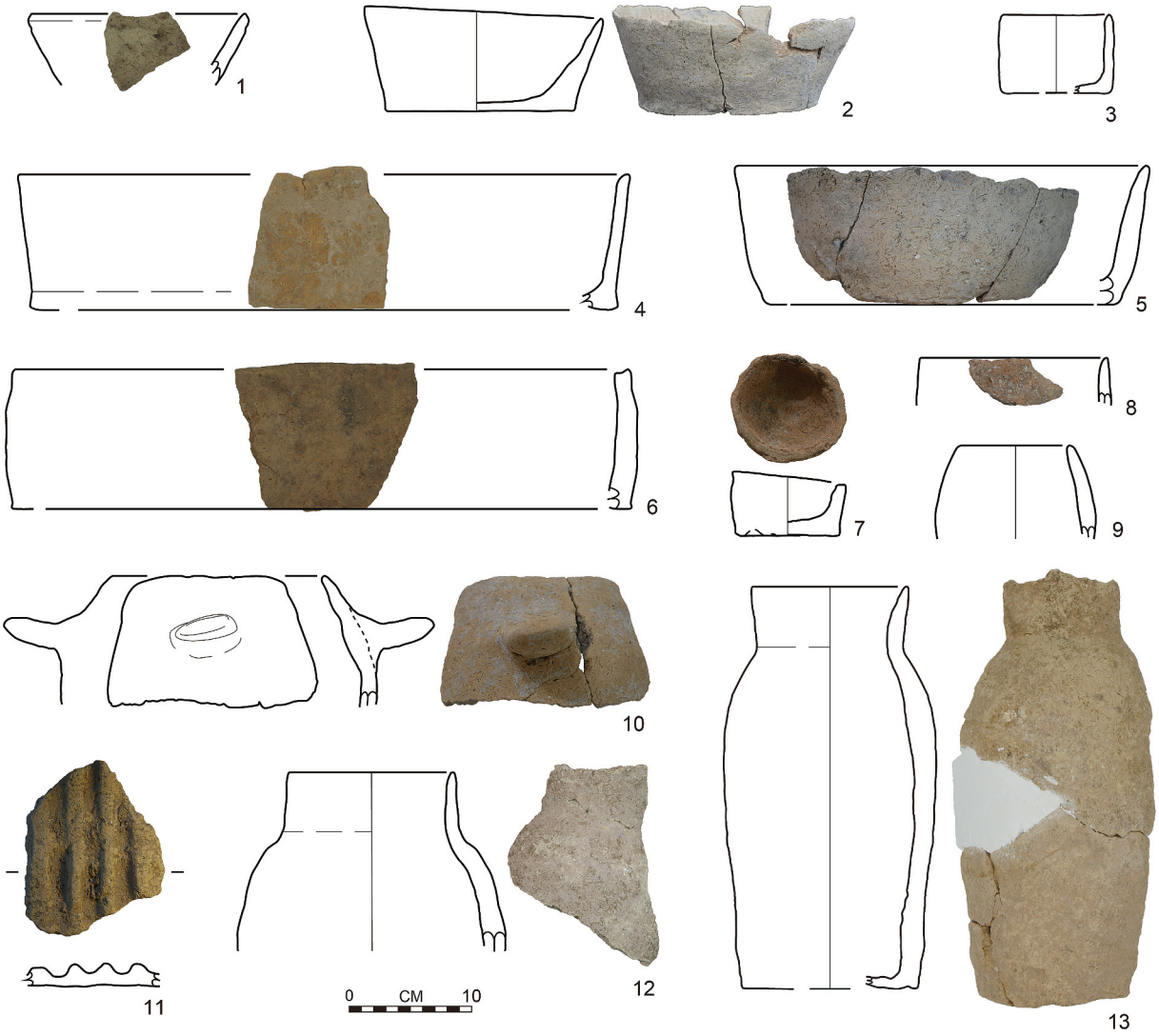


Fig. 10. Coarse wares from Operation B.

Table 1
Pottery assemblages by layer from Operation B.

Layer	Weight (kg)				Number of rim-sherd			
	Halaf ware	Coarse ware	Others/Uniden.	Total	Halaf ware	Coarse ware	Others/Uniden.	Total
1	7.828 (39.45 %)	11.460 (57.75 %)	0.556 (2.80 %)	19.844	79 (71.82 %)	30 (27.27 %)	1 (0.91 %)	110
2	6.399 (40.25 %)	9.417 (59.23 %)	0.082 (0.52 %)	15.898	60 (70.59 %)	24 (28.24 %)	1 (1.18 %)	85
3	2.301 (28.93 %)	5.652 (71.07 %)	0.000 (0.00 %)	7.953	14 (51.85 %)	13 (48.15 %)	0 (0.00 %)	27
4	9.078 (14.04 %)	55.582 (85.96 %)	0.000 (0.00 %)	64.660	66 (53.23 %)	58 (46.77 %)	0 (0.00 %)	124

not particularly high; however, many cherts are still sufficient quality for the production of regular blades. Its colour ranges from grey to brown, and those with a greyish-purple hue and grey with small black flecks are characteristic. Chert (or radiolarite) of reddish-brown and of green colours is also present. Obsidian is rare, and only eight pieces (about 1.4 % of all of the chipped stones) were recovered. This ratio is much lower than that of the Late Neolithic assemblage at Operation A and similar to that of the Late Halaf assemblage at Tepe Marani about 9 km to the southeast (Wengrow et al., 2016). Geochemical obsidian sourcing was carried out by the Manchester Obsidian Laboratory using pXRF and all were attributed to the southeastern Anatolian sources: three Nemrut Dağ, one Bingöl A or Nemrut Dağ and four Meydan Dağ obsidians. This fits the general pattern of obsidian distribution in the Fertile Crescent, which demonstrates an increase of Meydan Dağ obsidian in the Halaf period (Chataigner et al., 1998).

The production of chert artefacts is represented by two methods: the production of regular blades and irregular blade-like flakes (elongated flakes). Although evidence of the local production of these blades and flakes is minimal, a few blade cores, including one regular pressure-detached blade core found in the topsoil (Fig. 11: 1), suggest that

Table 2
Break down of the chipped stone artefacts recovered from Operation B.

Type	Chert	Obsidian
Blade cores	3	
Flake cores	7	
Crested blades	1	
Crested blade-like flakes	2	
Overshot blades	2	
Overshot blade-like flakes	1	
Flakes	381	
Blades (central)	107	7
Blades (lateral)	8	
Blade-like flakes (central)	38	
Blade-like flakes (lateral)	10	
Sickle blades	9	
Retouched tools	4	
Corner-thinned blades		1
Total	573	8

many blades and flakes were produced on-site. A crested blade (Fig. 11: 4) and a couple of fine lateral blades (Fig. 11: 2–3) also imply local blade production. The most regular blades are blade segments (Fig. 12: 1–11) with dorsal ridges parallel to their lateral edges. Their platform remnants are usually small and flat, and the platform perimeters are well prepared, indicating that many were detached using the pressure-flaking technique.

Blade-like flakes are less numerous and were produced using the same type of local chert as the regular blades (Fig. 12: 15–18). They are usually larger than the regular blades and have thick and uneven profiles. They were obviously flaked in a less sophisticated manner by direct percussion, as represented by the large and flat platform which shows no or few preparations on their perimeter.

The retouched tools are extremely rare. Tile knives, which are typical of the Halaf period, are absent. Only a few irregular borers (Fig. 12: 19) and retouched flakes (Fig. 12: 21) were used. A majority of regular blades and blade-like flakes were used without modification, except for a few examples of retouched blades (Fig. 12: 20). Use-wear is often observed on their working edges but is usually not very intensive. Of particular note are the nine sickle blades made on a short segment of the pressure-flaked blades (Fig. 11: 5–12). The gloss and traces of the fixative, probably bitumen, remain either parallel (Fig. 11: 11, 12) or oblique (Fig. 11: 5–10) to their lateral edges. This suggests that two different types of sickles, for which the blades were inserted into a haft either parallelly or obliquely, were used. The use of simple blade segments for sickle blades is typical of the Zagros foothill regions from the 8th to 6th millennia calBC (Maeda et al., 2016) but oblique hafting is unusual in this region.

The seven obsidian artefacts are small pressure-flaked blades (Fig. 12: 22–26), apparently imported from elsewhere. The other obsidian artefact, made of Nemrut Dağ obsidian, is a corner-thinned blade, which has thinning retouch at all four corners on the ventral face of the proximal segment of the blade (Fig. 11: 13). Both ends of the blade were truncated by retouch before the corner-thinning was applied. Corner-thinned blades are frequently found in Late Neolithic contexts in north Mesopotamia and are usually made of southeast Anatolian obsidian (Nishiaki, 2000). The one from Operation B is the first example recovered from the Halaf period.

To summarise, the Halaf lithic assemblage recovered from Operation B demonstrates clear differences from the Late Neolithic lithic assemblages from Operation A of Shakar Tepe I, and also Shaikh Marif II excavated in 2022 (Odaka et al., 2023). The local production of pressure-flaked blades observed at Operation B is a characteristic technological feature not identified at Operation A and Shaikh Marif II, where regular blades were not produced on-site. In contrast, large robust blades, which are characteristic at Operation A and Shaikh Marif II, are absent at Operation B. This suggests a gap in the lithic tradition between the Late Neolithic and Halaf at these sites, as demonstrated by the more than 400-year difference in radiocarbon dates.

The evidence of blade cores and regular blades from Operation B indicates the use of a sophisticated pressure-flaking technique, as in the case of the Mlefatian lithic tradition known along the Zagros foothills. However, at Operation B, the assemblage does not involve any bullet-shaped cores, the blade sizes are generally large, and no microliths were used. This differs significantly from the characteristics of the Mlefatian lithic industry and more likely represents a Halaf lithic tradition newly introduced during this period. Although the evidence of Halaf chipped stone assemblages in the Shahrizor Plain is scant, that from Tepe Marani, which has been reported as a blade-oriented industry (Wengrow et al., 2016), can be a comparable example.

3.4. Other finds from Operation B

The number and variation of small finds recovered from Operation B is very limited. Two fragments of bone awls with pointed tips were found in Layers 2 and 4. A rim fragment of a stone vessel made of grey stone was recovered from the topsoil and a spout fragment of a stone bowl made of blueish grey stone was recovered from Layer 4. Ground stone artefacts involve a large quern made of fine-grained sandy stone (Fig. 13: 1) and flat mortar (Fig. 13: 2). The mortar has a deep depression in the middle of one face, which is perforated into one of the two shallower depressions on the other face probably owing to its intensive use.

4. Excavation of Operation C (Shakar Tepe I)

4.1. Stratigraphy and structures of Operation C

We set up a steep step trench (Operation C) along the northwestern slope of Shakar Tepe I. This location was promising for exploring a long sequence of this mound because the section of the slope cut by modern activities was confirmed, allowing us to collect pottery fragments indicative of the Late Chalcolithic (LC) at an altitude of approximately 486 m. The slope is very steep and devoid of topsoil, with the brown cultural deposit exposed. The trench, measuring 3 m × 3 m, was set approximately 24 m southeast of Operation A, where the Ubaid and Neolithic artefacts were uncovered in 2019. Before the excavation, the collapsed sediment covering the lower part of the steep slope was removed.

We divided the cultural deposits from Operation C into eight layers: topsoil and Layers 1–7 (Fig. 14). Layers 1–5 contained LC pottery, whereas Layer 6 contained both LC and Neolithic pottery fragments. The pottery from the lowest layer (Layer 7) comprises Late Neolithic pottery. All layers had a limited number of black-on-buff ware from the Late Ubaid period and were probably derived from the Ubaid occupational layer in a nearby area.

The topsoil, which extended to an area of approximately 0.6 m × 3 m at its bottom level, was composed of dark brown soft sediment. Below this was Layer 1, which consisted of brown soil. Layer 2 was a brown to dark-brown compact deposit covering an area of 1 m × 3 m. One jar burial (Str. 201) comprising a nearly complete band-rim jar, commonly used after LC3 (ca. 3800–3600 cal BC), was recovered from the southern part of the trench (Fig. 15). It is likely that it originally stood upright or leaned slightly but collapsed over time after deposition. Inside the jar, the skeletal remains of a possible infant with its head oriented eastward were found (Fig. 16). Although the bones were not well-preserved, it is likely that the body was interred in an articulated position.

Layer 3 composed brown to light brown, slightly soft sediment with mudbrick fragments. The excavation area was expanded at the bottom of Layer 3 to approximately 1.5 m × 3 m. At this level (approximately 484.2 m), a small step was set up, which resulted in the decrease in the excavation area (1 m × 3 m). Layer 4 contained greyish brown to light brown sediment and more mudbrick fragments than Layer 3. At the bottom of Layer 4, the excavation area was expanded again to approximately 1.4 m × 3 m.

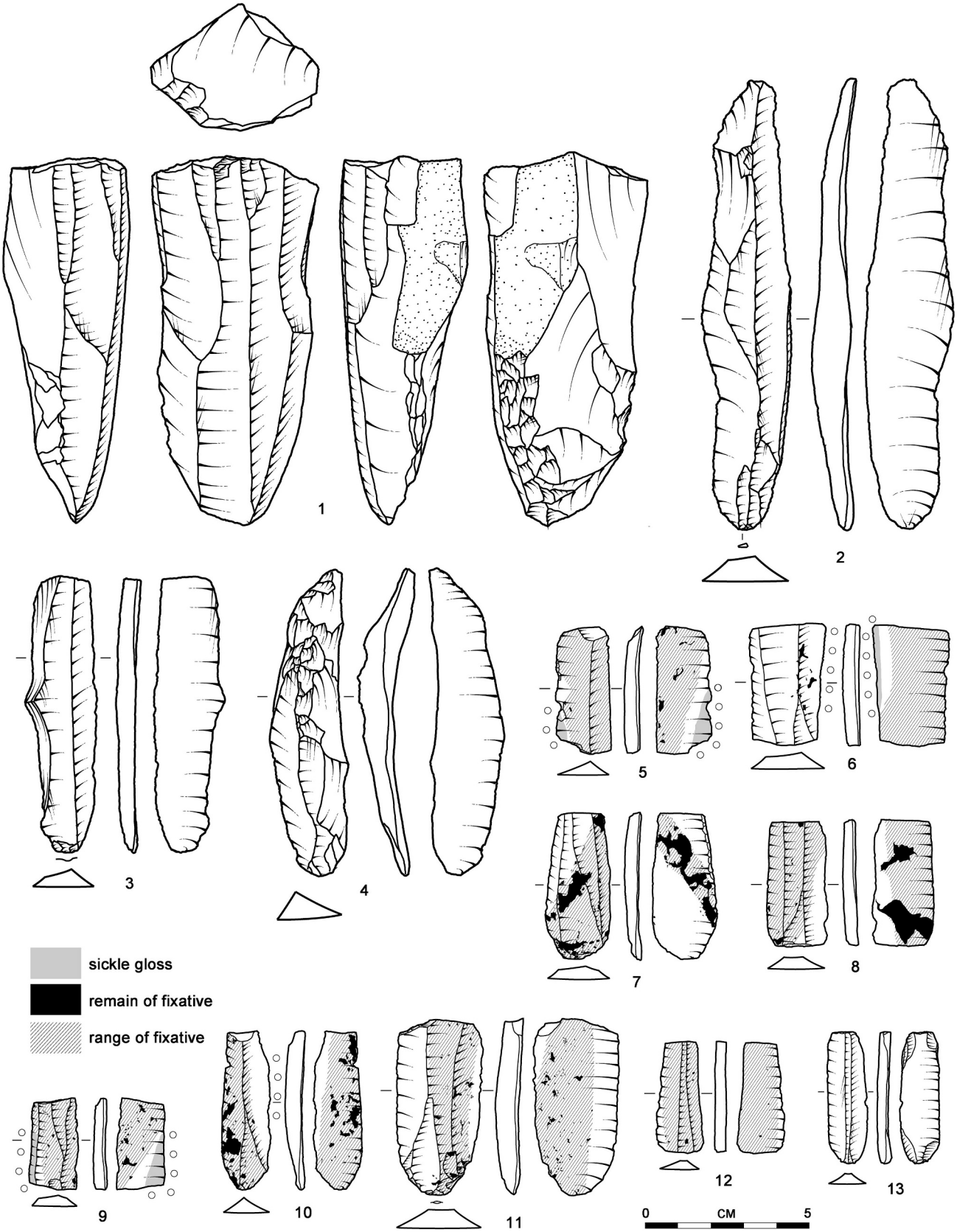


Fig. 11. Chert and obsidian artefacts from Operation B. 1–12: chert, 13: obsidian. 1: pressure-flaking blade core, 2–3: lateral blades, 4: crested blades, 5–12: sickle blades, 13: corner-thinned blades.

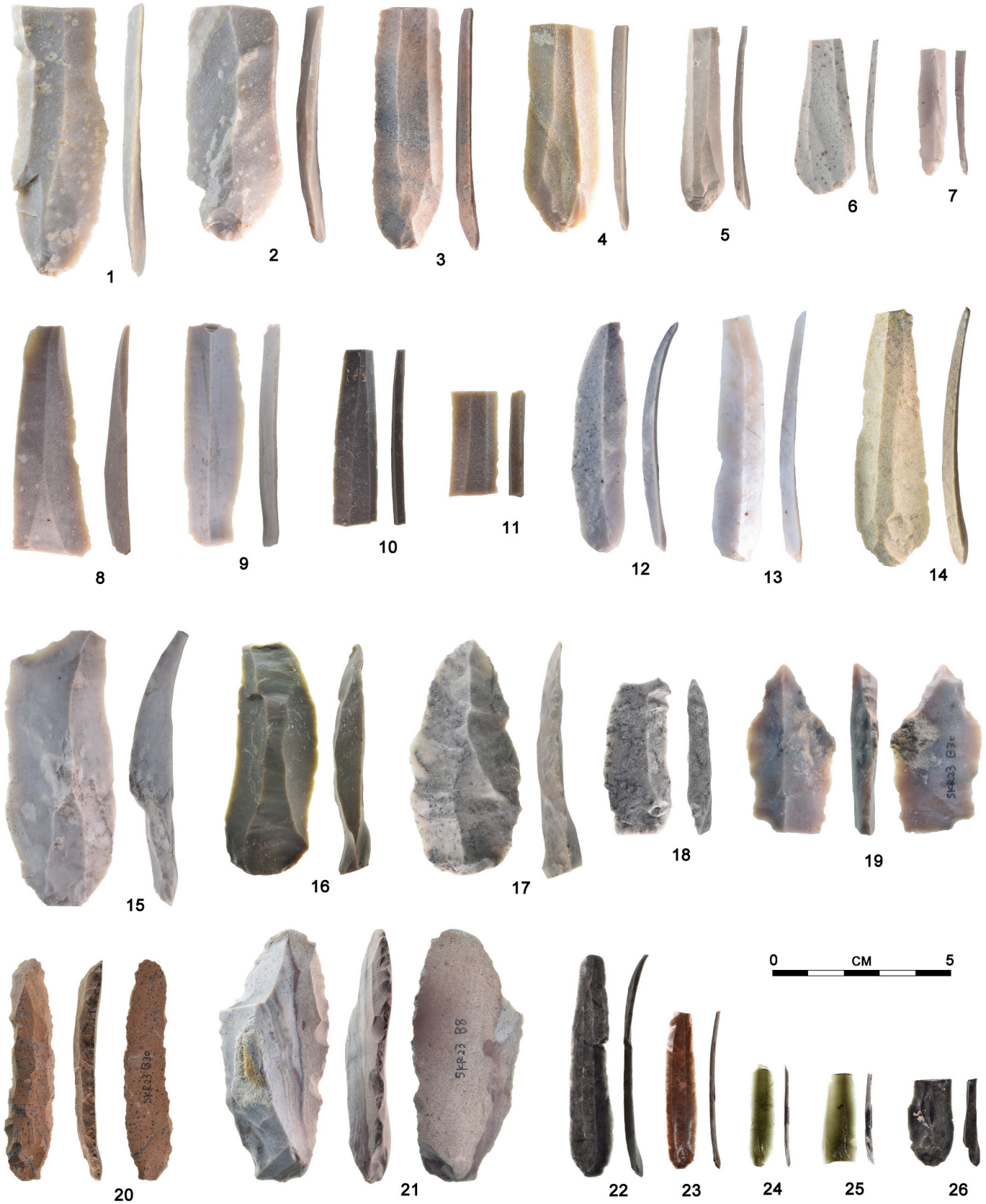


Fig. 12. Chert and obsidian artefacts from Operation B. 1–14: pressure-flaked blades, 15–18: blade-like flakes, 19: borer, 20: retouched blade, 21 retouched flake, 22–26: pressure-flaked obsidian blades.

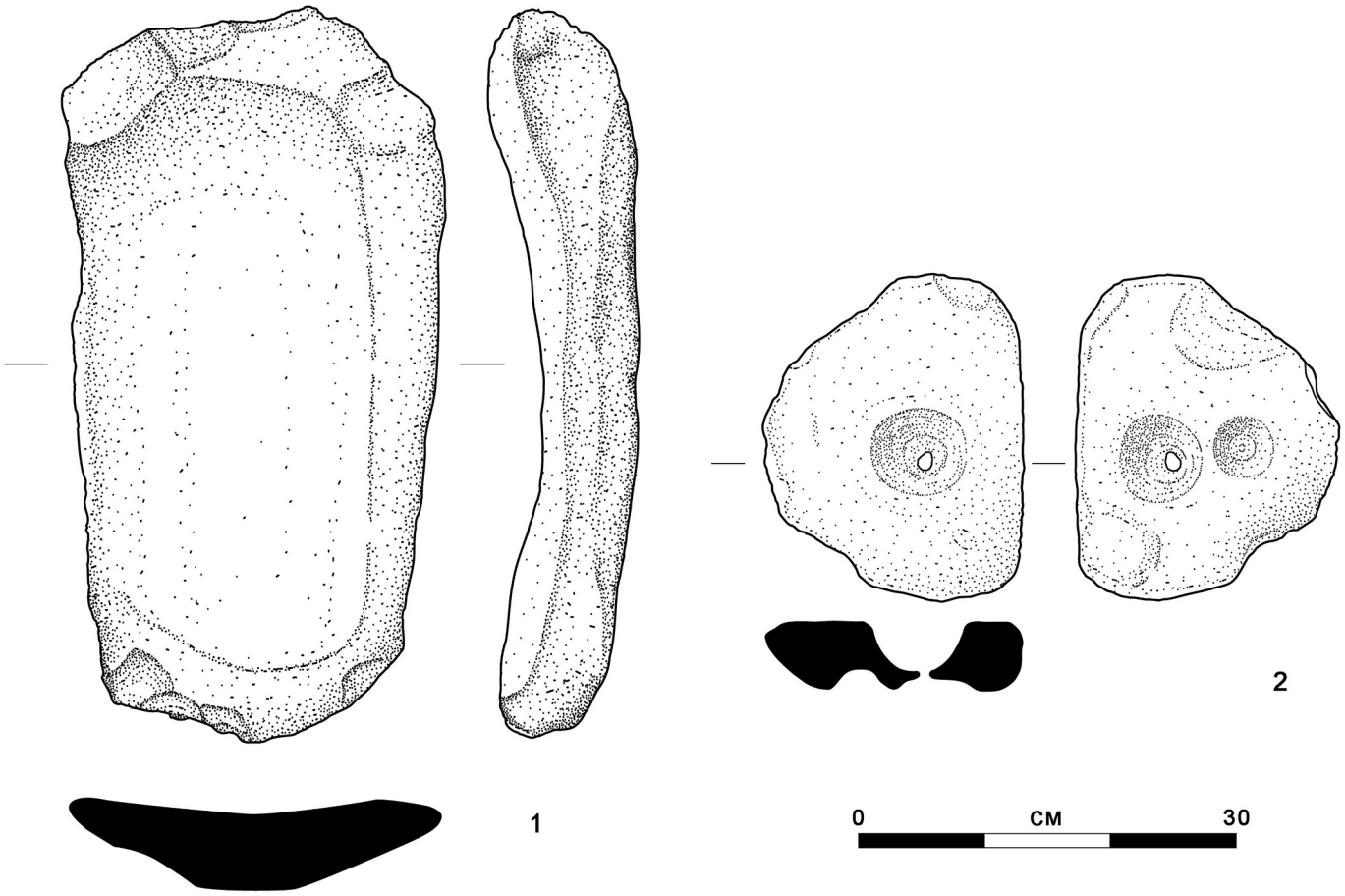


Fig. 13. Ground stone artefacts from Operation B.

Measuring approximately 2 m, Layer 5 was the thickest deposit, and was subdivided into five sub-layers. The sediment, which was greyish brown to light brown, was slightly soft and included more charcoal, pottery sherds, mudbrick fragments, and ashy blocks. Mudbrick fragments and ashy blocks were identified in all of the sub-layers and may represent debris from conflagration events. Another step was set at an altitude of approximately 483.0 m in the middle of Layer 5. At the height of approximately 482.8 m, we reached the top level of the gentle slope at the western skirt of the mound and continued to dig down in an approximately 1.5 m × 3.0 m area.

Layer 6 was the thinnest deposit (approximately 20 cm thick), with brown to light brown soil. The final layer (Layer 7) consisted of a light brown to orange-brown sediment, with some Hassuna incised ware. A clay installation associated with thin black-ashy deposits was unearthed along the eastern wall of the trench. We dug down until the height of approximately 481.0 m and finished the season's excavation after confirming that we had reached the Late Neolithic layer apparently contemporary with the upper Late Neolithic layer at Operation A excavated in 2019.

Fifteen radiocarbon-dating samples collected from Operation C were analysed. Although one sample from Layer 1 was dead carbon, the other charcoal samples from Layers 2 to 7 were dated to relevant periods (Fig. 17, Table S2). The three dates from the Layer 2 samples ranged from 3800 to 3600 calBC. One sample (TKA-28248) from inside the jar burial (Fig. 16) matched the typological dating of the jar itself (a band-rim jar). Four samples from Layers 2 and 3 showed a time range of 3800 to 3650 calBC. Four samples from Layer 5 were dated from 3950 to 3650 calBC. These radiocarbon dates suggest a four-metre-thick deposit of the LC layers in Operation C, mainly belonging to LC3 (ca. 3800–3600 calBC). Two samples from Layer 6 were dated to the end of the 7th millennium calBC. Two radiocarbon samples from Layer 7 were matched to the fourth quarter of the 7th millennium calBC (TKA-28254) and the beginning of the 4th millennium calBC (TKA-28267), with the latter probably originating in the upper LC layers.

Furthermore, we performed Bayesian analyses using OxCal 4.4.4. In OxCal, the stability of A_{model} is measured in terms of the model agreement index. Values above 60 indicate acceptable agreement between the radiocarbon data and prior information on which the model is based (Bronk Ramsey, 1995). After removing one sample from Layer 7, which dated to the 4th millennium BCE, the A_{model} for the radiocarbon stratigraphy of Operation C was 75, which met the criteria (Fig. 18a, b; Table S3). As a result, the Span for Layers 5 to 2 were estimated to be approximately 10 to 30 years. This implies short-term sediment deposition during the Late Chalcolithic at Operation C.

4.2. *Pottery from Operation C*

In the topsoil and Layers 1 to 5, the LC layer ware assemblages primarily consisted of five ware types: chaff-tempered fine/medium ware, chaff-tempered coarse ware, chaff and limestone-tempered medium ware, chaff and limestone-tempered coarse ware, and grey burnished ware (Fig. 19). Chaff-tempered fine/medium ware (Fig. 19: 4) was slightly prevalent in the topsoil and Layer 1, with medium-sized jars and bowls identified. Chaff and limestone-tempered medium ware (Fig. 19: 5, 6) predominated Layers 1–5. It includes carinated bowls (Fig. 19: 5), band-rim jars (Fig. 19: 6), and other LC vessel forms. The complete band-rim jar presented in Fig. 18: 6, which had a hole in its lower body, is a burial jar (Fig. 15). Chaff- and limestone-tempered coarse ware was common especially in Layers 5. This ware type was associated with bevelled-rim bowls (Fig. 19: 1).

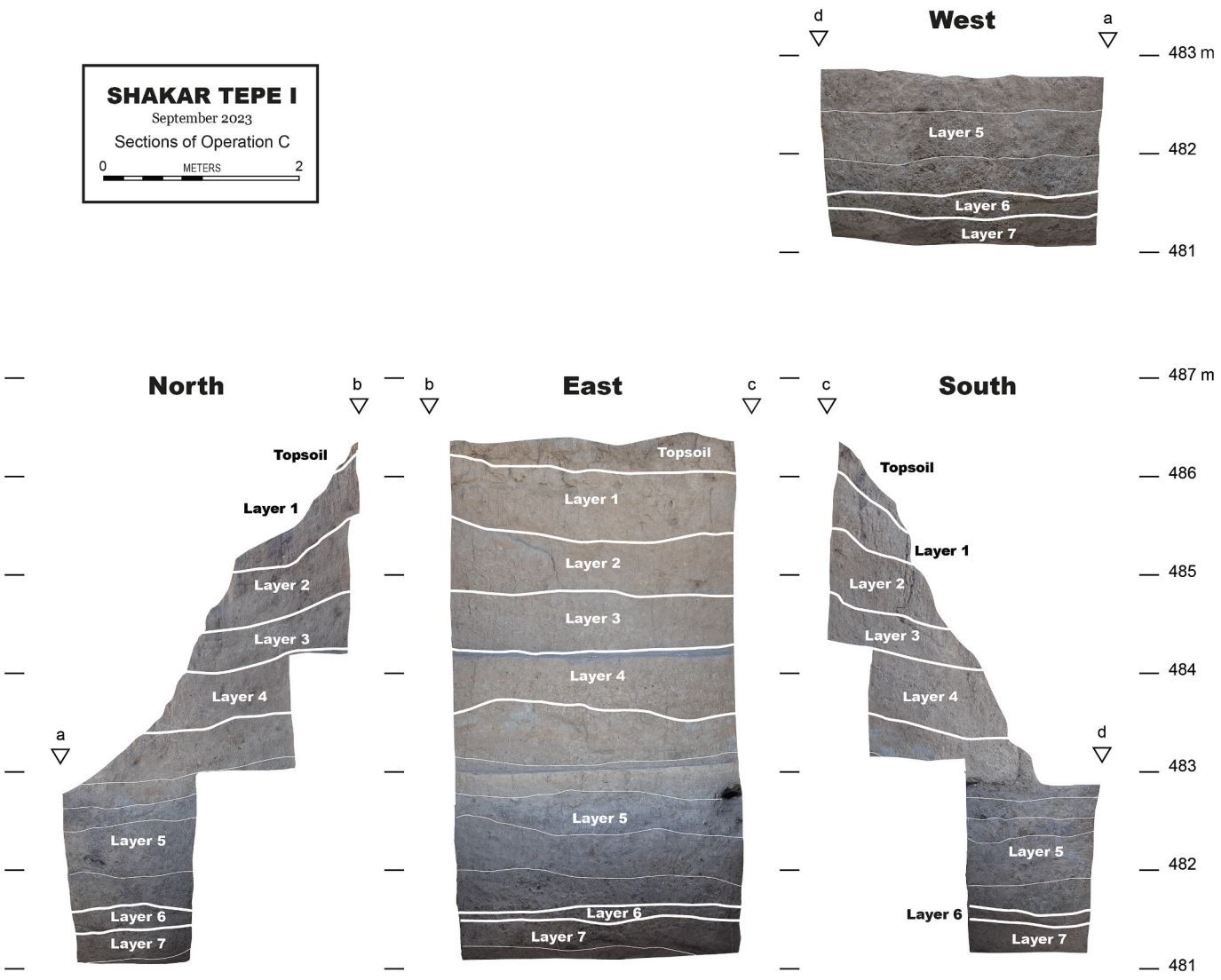


Fig. 14. Section profiles of Operation C (orthorectified image).

Fig. 15. Str. 201, a jar burial recovered in Layer 2 of Operation C.

Fig. 16. The inside of Str. 201.

Grey burnished ware (Fig. 19: 2) was in the minority, and its ratio within the ware assemblages was slightly higher in the topsoil and Layer 1. Mineral-tempered coarse ware (Fig. 19: 3), which includes angular calcite coarse sands, was also a minor ware type but was present throughout the LC layers at Shakar Tepe I. This type of ware was used as the cooking pot. From a typological perspective, we suggest that Layers 1–5 belong to LC3 (ca. 3800–3600 calBC), which was consistent with the radiocarbon dating. Additionally, limestone-tempered medium ware

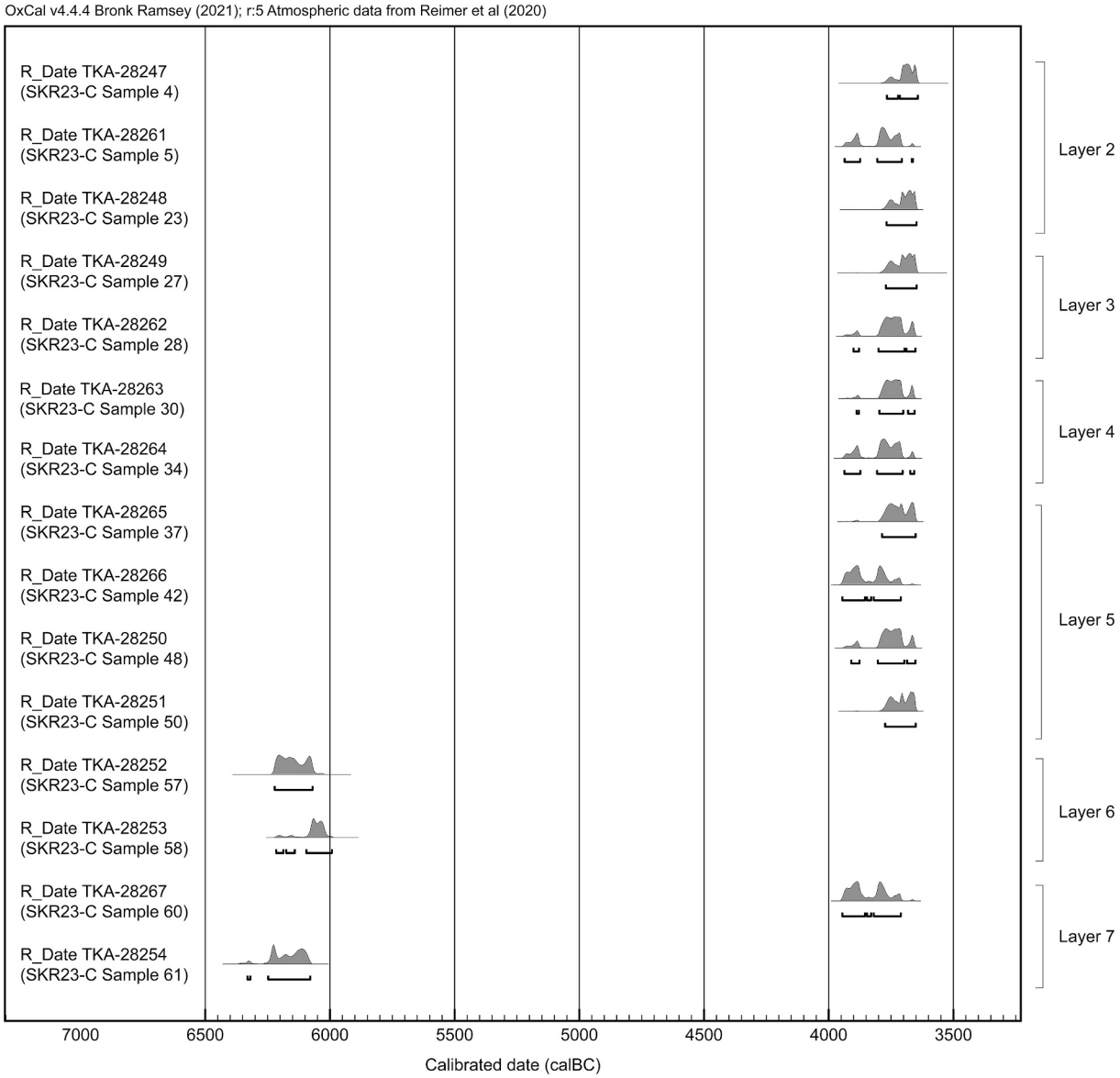
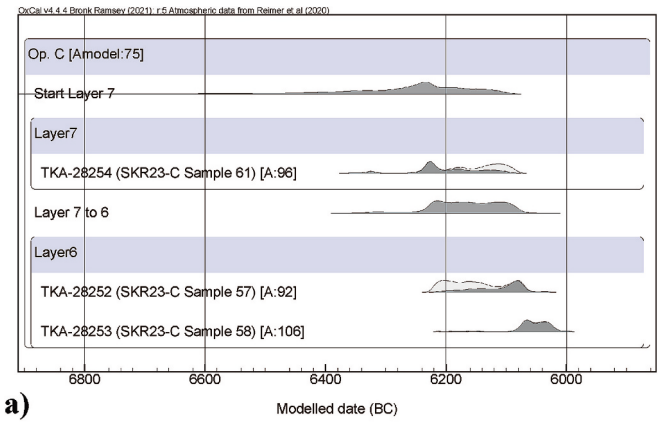


Fig. 17. Radiocarbon dates from Operation C. Calibration was conducted in OxCal 4.4.4 (Bronk Ramsey, 2021) using IntCal20 curve (Reimer et al., 2020). All the samples are wood charcoal and were prepared by the AAA method.



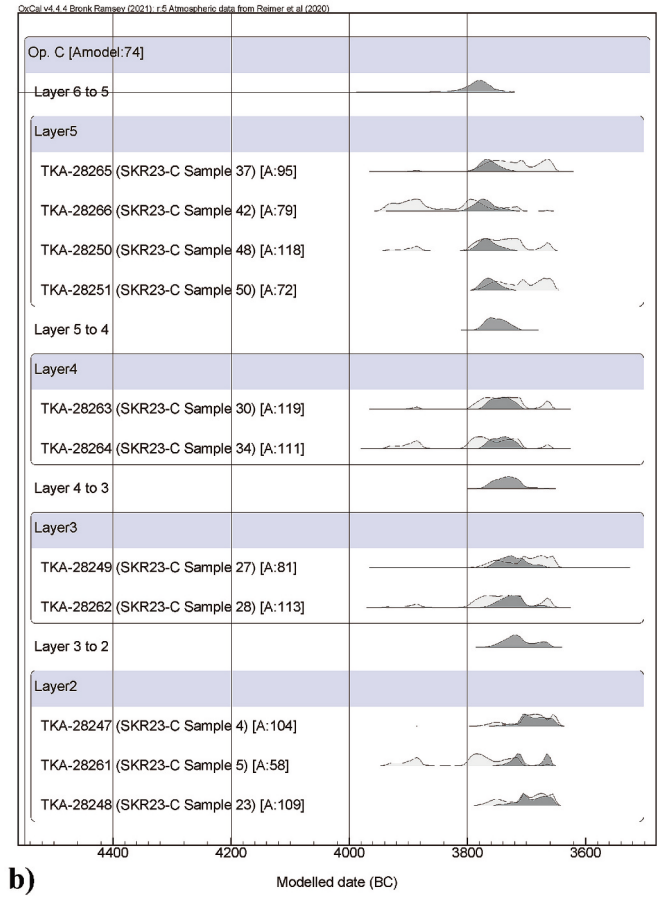


Fig. 18. Bayesian modeled dates for Operation C of Shakar Tepe I for Layers 7 and 6 (a) and Layers 5 to 2 (b). Boundary indicates the period at the start and end of each layer.

with diagonal incision lines (Hassuna pottery) and plant-tempered coarse ware with limestone inclusions were present in Layers 6 and 7 (Late Neolithic). A small amount of Ubaid black-on-buff ware was also observed in all of the layers, indicating a disturbance from nearby Ubaid occupations.

The LC3 pottery from Layers 1–5 of Operation C has parallels with those from other LC sites in Iraqi Kurdistan, such as Kani Shaie (Renette et al., 2021); Gurga Chiya and Gird-i Shamlu (Lewis, 2022); Bab, Kur, and Gird-i Gulak (Skuldbøl and Colantoni, 2021); Helawa (Peyronel et al., 2019; Vacca and Peyronel, 2022); Logardan and Gird-i Qala (Vallet et al., 2017; Baldi, 2022). Further analysis of our LC3 data will contribute to our understanding of social interactions in Late Chalcolithic northern Mesopotamia in the future (Baldi et al., 2022). The pottery from Layers 6 and 7 of Operation C was similar to that found in Operation A (Odaka et al., 2020, 2023).

4.3. Chert and obsidian artefacts from Operation C

A total of 719 chipped stone artefacts were recovered from Operation C, of which about 78 % are from the Late Chalcolithic layers (Layers 1 to 5). The majority are irregular flakes of local chert and the rest includes exhausted flake cores (Fig. 20: 1, 2), blade-like flakes (Fig. 20: 3, 4), regular blades (Fig. 20: 5, 6) and, to a lesser extent, retouched pieces. Nine obsidian artefacts, four small blades, three small flakes and two side-blow blade-flakes, were also recovered, and eight were identified as Nemrut Dağ obsidian and one as Bingöl A by geochemical analysis at Manchester. The type of local chert and the techno-morphological features of blade-like flakes and regular blades are similar to those from Operation B of Shakar Tepe II, while there is no evidence of local production of blades in the assemblage from Operation C. Tools involves only retouched blades and flakes (Fig. 20: 8) and no formal tools were recovered. Canaanean blades, typical of the Late Chalcolithic lithic assemblage, are absent. Probably due to the small sample sizes, the lithic artefacts from the Late Neolithic contexts (Layers 6 and 7) do not show any marked differences from those in the Late Chalcolithic layers. One of the two obsidian side-blow blade-flakes recovered from Layer 7 is equivalent to examples from the Neolithic context of Operation A. The other was recovered from the Late Chalcolithic layer (Layer 2) but is probably an intrusion from the Neolithic context.

4.4. Small finds from Operation C

We found small finds mostly from the LC layers of Operation C, with baked-clay cylindrical beads being the most remarkable discovery (Fig. 21). The clay was a medium-to-coarse paste with mineral inclusions and a slight vegetal temper. When the clay was wet, holes were formed using cylindrical rods. The clay beads had two size classes: one with approximately 2 cm in length and 1 cm in width and the other with approximately 4 cm in length and 2 cm in width. The average weight of smaller ones was 2.98 g, while that of larger ones was 21.18 g, ranging between 18.43 g and 22.87 g. Four pieces of larger beads were found together in Layer 3. The function of these beads remains uncertain, as they could have been either ornaments or fishing net weights.

A cylindrical bead made of white stone (Fig. 22: 1) was discovered in Layer 3, with a size similar to that of the small clay beads. A broken piece of a conical clay cone was also found from Layer 3 (Fig. 22: 2), a clay sling ball with a teardrop shape in Layer 5 (Fig. 22: 3), and a broken clay animal figurine (possibly a quadruped) in Layer 5 (Fig. 22: 4). Other unique small finds from the LC layers include a small clay ring (Fig. 22: 5) and a discoidal stone spindle whorl (Fig. 22: 7). A biconical clay

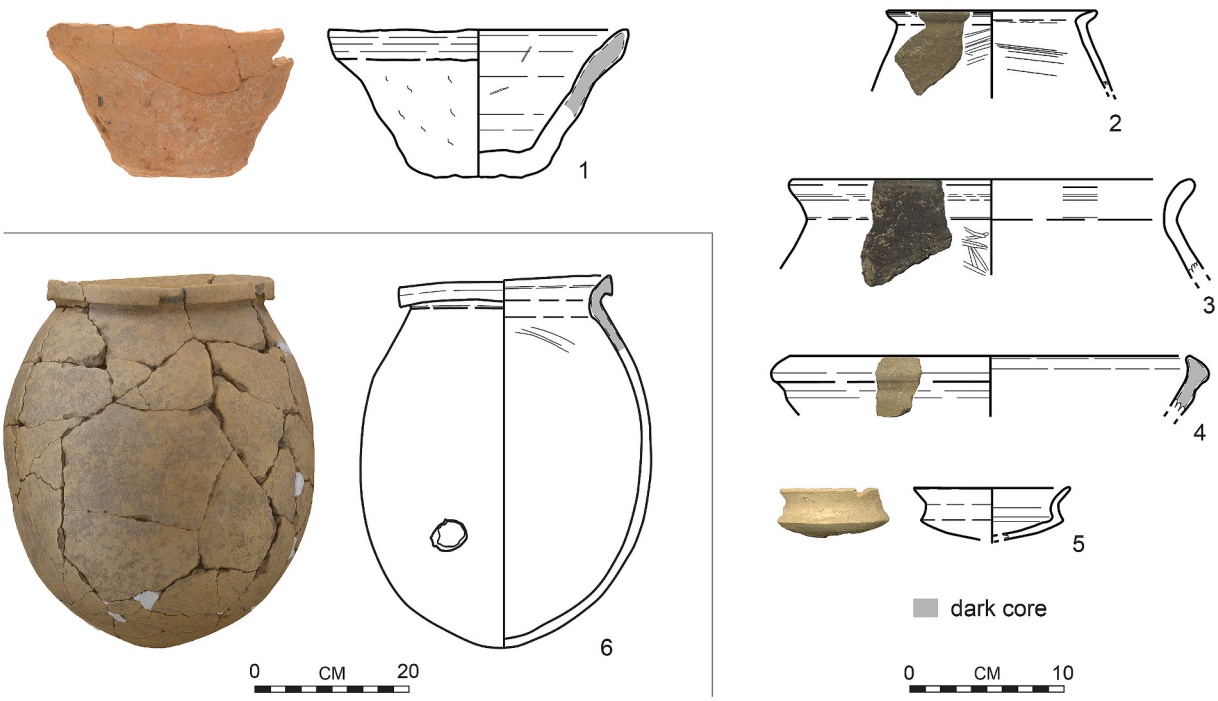


Fig. 19. Late Chalcolithic pottery from Operation C. 1: chaff- and limestone-tempered coarse ware, 2: grey burnished medium ware, 3: mineral-tempered coarse ware; 4: chaff-tempered medium ware, 5–6: chaff- and limestone-tempered medium wares.

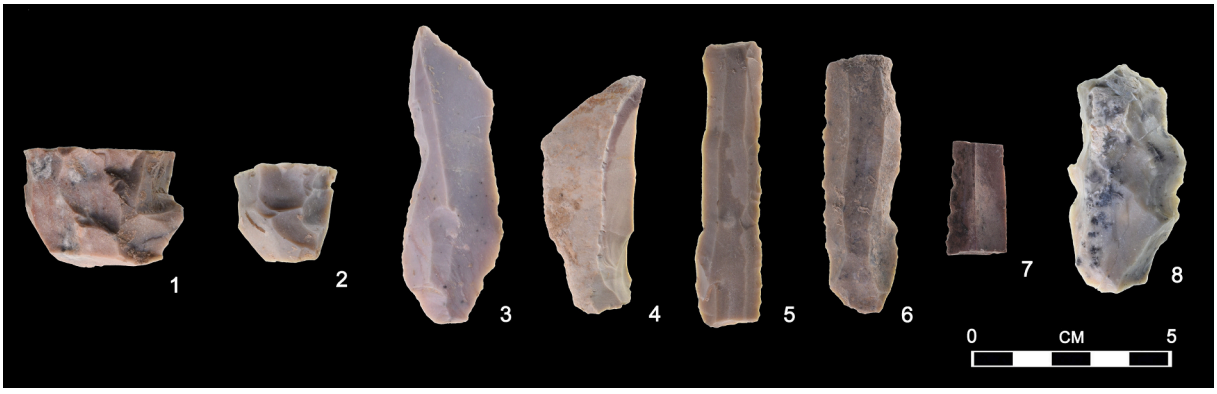


Fig. 20. Chipped stone artefacts from Operation C. All chert, 1–2: flake cores, 3–4: blade-like flakes, 5–7: pressure-flaked blades, 8: retouched flake.

Fig. 21. Clay beads from Layer 3 of Operation C.

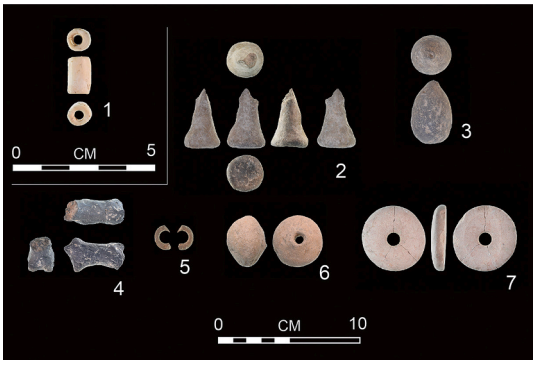


Fig. 22. Small finds from Operation C.

spindle whorl was discovered in Layer 7 (Late Neolithic; Fig. 22: 6).

5. Conclusions

The 2023 excavations conducted at Shakar Tepe provided stimulating discoveries. The three newly identified satellite mounds urge us to consider a more complex history of the site than previously expected. The documented cultural remains of the Late Halaf settlement of Shakar Tepe II, dated to ca. 5600–5400 calBC, and the Late Chalcolithic occupations at Shakar Tepe I, dated to ca. 3800–3600 calBC, fill new time ranges in the late prehistoric chronology of the site. Our findings are comparable to the archaeological evidence available from a few other sites in the Shahrizor Plain, such as Tell Begum, Tepe Marani, and Gurga Chiya. This implies the existence of distinctive material cultures in this region, which have not yet been clarified. However, due to limited materials and insufficient publications, the details and characteristics of these cultures remain poorly understood. Even though they were small-scale excavations, the results of our investigation in this season certainly increased the archaeological evidence to approach these issues, particularly in understanding the historical role of this region in the transition from Neolithisation to Urbanisation.

CRediT authorship contribution statement

Takahiro Odaka: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Osamu Maeda:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Takehiro Miki:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation. **Yuichi S. Hayakawa:** Writing – review & editing, Visualization, Methodology, Investigation, Data curation. **Yu Itahashi:** Writing – review & editing, Methodology, Investigation, Data curation. **Masanori Oda:** Visualization, Formal analysis. **Rawa K. Salih:** Project administration, Investigation. **Hussein Hama Gharib:** Supervision, Resources, Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ara.2025.100592.

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