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Neolithic obsidian mirrors from Southwest Asia: A reflection on their diffusion and manufacture[☆]

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ABSTRACT

In Anatolia obsidian has been used since the 8th millennium for the production of non-utilitarian artefacts such as ornaments and mirrors. Mirrors are circular objects, slightly convex, with a highly reflective surface. They are rare, as 56 obsidian mirrors were found in the Near East, spread across six sites in Central Anatolia: Tepecik Çiftlik, Çatalhöyük-East, Sırçalıtepe, Güvercinkayası, Domuztepe and Akarçay Tepe occupied between the 8th and the beginning of the 5th millennium. Additionally, one mirror has been found in the Levant at Tel Kabri. Mirrors are found in various contexts, including graves, middens, in the infill of buildings after their abandonment, in caches, or on the surface. To investigate the production and diffusion of these artefacts, an interdisciplinary approach combining typology, technology and use-wear analysis was applied to mirrors and preforms found at Tepecik Çiftlik. This study represents a preliminary step in the analysis, contributing to the identification of a potential mirror manufacturing site and the restitution of the complete *chaîne opératoire*.

1. Introduction

In Anatolia obsidian has been used since the 8th millennium for the production of tools and non-utilitarian artefacts such as ornaments and mirrors (Astruc et al., 2011; Balcı et Altunbilek-Algül, 2017, 2019; Healey, 2007, 2013; Healey et Campbell, 2014). Mirrors, characterized by their circular form and highly reflective surface, are rare. A total of 56 obsidian mirrors have been discovered in the Near East, spread over six sites in Central Anatolia (Fig. 1): Tepecik Çiftlik, Çatalhöyük-East, Sırçalıtepe, Güvercinkayası, Domuztepe and Akarçay Tepe, and one site – Tel Kabri is located in the Levant. The distribution of mirrors is heterogeneous, indeed, Domuztepe accounts for 23 out of the 40 finished mirrors, while at Tepecik Çiftlik, 11 out of the 16 preforms have been discovered.

Tepecik Çiftlik, located on the Melendiz plain in Cappadocia (Türkiye) at 1500 m asl, has been under excavation since 2000 by a team led by Erhan Bıçakçı from Istanbul University. Spanning from the Neolithic to the Early Chalcolithic period, the site witnessed human occupation from the beginning of the 7th millennium to the start of the 6th millennium (Bıçakçı et al., 2012). Situated in close proximity to the main obsidian outcrops of Central Anatolia, the Nenezidağ obsidian outcrops are located approximately 23 km away from the site, while the Göllüdağ sources are about 10–14 km away (Balcı 2019:237). The site's strategic location near these obsidian sources likely played a major role

in the community's decision to settle in this mountainous environment. The majority of the chipped stone industry consist of waste associated with several flake and blade productions, carried out at least partially on site (for details see Guilbeau, 2022; Vinet and Guilbeau, 2018; 2020; 2024).

Mirrors were discovered in various contexts (see Table 1). At Çatalhöyük-East, mirrors were found inside burials serving as funerary offerings in levels dating to the first half of the 7th millennium BC (Carter, 2012; Doyle, 2017; Vedder, 2005). In Sırçalıtepe, mirrors were discovered during a surface collection and near a workshop area, the site was occupied across the mid-8th millennium BC (Balcı et al. 2021; 2022). In Güvercinkayası, a fragmented finished mirror and four preforms were found in layers dating to Middle Chalcolithic. One preform was found in the infill of house M1, and another in a deposit in a walking area. The fragment of the finished mirror was found in a deposit (Balcı and Altunbilek-Algül, 2019). Other discovery contexts are not specified. At Domuztepe, none of the discovery contexts are described. However, two fragments of mirror have been found near beads and knapping workshops (Healey and Campbell, 2014). At Akarçay Tepe, a mirror is said to have been found close to the surface in a trench dating from the transition between the Aceramic Neolithic and Ceramic Neolithic (Balcı and Altunbilek-Algül, 2019). At Tepecik Çiftlik, the mirrors were found in levels dated to the 7th millennium BC, however the available information does not formally identify the discovery contexts. At Tel Kabri, the

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mirror was found on the surface (Gopher et al., 2011; Healey, 2013; Prausnitz, 1969; Thalmann, 2006).

All the mirrors are circular and feature a polished reflective surface. However, three distinct types of mirrors can be distinguished:

- Type 1 comprises mirrors with a diameter between 6 and 9.5 cm, with a flat or domed back, arrises were abraded to facilitate handling (see 1 Fig. 2). They were found at Tepecik Çiftlik, Çatalhöyük-East, Sırçalıtepe and Domuztepe (Carter, 2012; Doyle, 2017; Healey, 2013; Vedder, 2005).
- Type 2 includes mirrors with a handle. They were found at Güvercinkaya and Domuztepe (see 2 Fig. 2). Handles were formed by pitting (Balci et al. (2022)) or by piercing (Healey, 2013).
- Type 3 encompasses several kinds of mirrors displaying one to three circular grooves (see 3 Fig. 2). This type of mirror has been found at Domuztepe and at Tel Kabri.

2. Materials and methods

2.1. Materials

The mirrors described in this paper are extremely scarce: one complete mirror has been identified at Tepecik Çiftlik in the Neolithic levels (Fig. 3, Fig. 12). In addition, eleven preforms were discovered, among them seven were studied and four were identified on the photographic archives¹ (see Table 2). The mirrors are circular or subcircular with a diameter ranging between 29 and 90 mm (average 48 mm) and a thickness ranging between 8 and 40 mm (average 20 mm) (see Plates 1 and 2).

The mirrors are all dated to the Ceramic Neolithic (6850–6000 cal. BC), besides one (see #4 Table 2) which was discovered in a section

during excavations of the Early Chalcolithic level (6100–5900 cal.BC).

The provenance of the obsidian has not been determined by chemical analyses. Nevertheless, the visual characterization (confirmed by chemical analyses) developed by N. Kayacan, T. Carter, and M. Milić was employed (Özbaşaran and Duru, 2014; Carter and Milić, 2013; Milić et al., 2013). Several macroscopic criteria such as color, inclusions, or transparency are used to distinguish obsidians. Preliminary observations indicate that from the Pre-Pottery to the Early Chalcolithic levels, the Göllüdağ outcrop was the main source of obsidian, followed by the Nenezidağ source (Balci, 2016; 2019, Guilbeau 2022; Vinet & Guilbeau 2018, 2020, 2024). It is very likely that the obsidian used to produce the mirrors at Tepecik Çiftlik came from a Cappadocian source.

J. Conolly was the first to attempt the reconstitution of the *chaîne opératoire* of the obsidian mirrors from Çatalhöyük Relying on naked-eye observation of the worked surfaces, he outlined several manufacturing stages (Conolly, 1999; 42-43). Subsequently, J.F. Vedder tested Conolly's model by producing six experimental mirrors (Vedder, 2005). More recently, a tribological study was undertaken on a fragment of polished obsidian bracelet discovered at Aşıklı Höyük, a Pre-Pottery Neolithic site located in Cappadocia. The analysis determined that the bracelet underwent a three-stage production process: pitting, abrading, and polishing (Astruc et al., 2011).

However, a techno-functional study has never been conducted on obsidian mirrors.

2.2. Methods

A techno-functional approach was applied to study the mirrors in order to understand how they were made and use.

Technological analysis is based on the identification of knapping scars on cores and products that enables the characterization of the

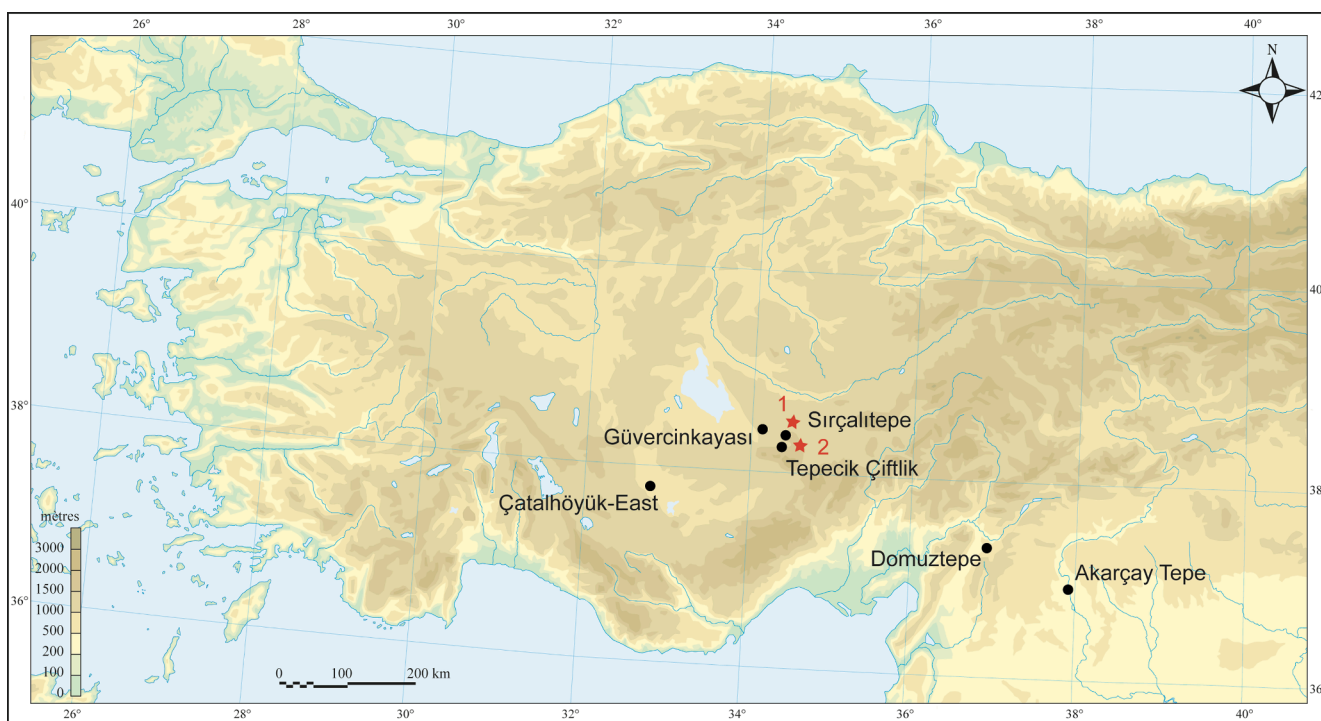


Fig. 1. Map showing the localisation of Anatolian sites where obsidian mirrors were found (black circles) and the Cappadocian obsidian sources (red stars). The numbered sources are: 1 – Nenezidağ and 2 – Göllü Dağ. Credits: A. Vinet.

¹ These mirrors are stored at the Niğde Archaeological Museum and have not been studied.

knapping techniques and the manufacturing processes to reconstitute the *chaîne opératoire* (Inizan et al. 1995).

The use-wear analysis enables the identification of the technical activities in which tools were engaged by examining the traces left on

the tools during use. Use-wear analysis is based on the identification of use-wear traces such as micro-scarring which inform on the tool motion and the hardness of the worked material; edge rounding which informs on the position of the tool and the degree of abrasion of the worked material; striations which inform on the motion of the tool; abrasion which informs on the abrasiveness of the worked material; and polish which informs on the type of worked material (Claud et al. 2019; Keeley 1980; Semenov 1964; Tringham et al. 1974; Vaughan 1985). Mirrors were observed with stereoscopic and metallographic microscopes at various magnification (ranging from 10x to 500x). The interpretation of traces is based on the comparisons of archaeological and experimental traces (i.e. Clemente et al., 2015; Hurcombe, 1992; Kononenko, 2011; Rodriguez Rodriguez, 1998) and enables the recognition of the activities in which the tools were involved. To ensure consistency in the results, several identification criteria were systematically recorded for each type of use-wear trace. For scars, the criteria include position, distribution, orientation, termination, initiation, morphology, size, and quantity. Edge rounding was described using three criteria: symmetry, continuity, and texture. Striations were documented based on their location, quantity, density, orientation, length, width, and morphology. Abrasion was recorded through its position, development (for instance patches, removals, linear bands), extent, and grain size. Polishes were described using position, distribution, extent, orientation, limit, density, texture, and microtopography (for a more detailed methodological description, see Vinet 2022). In this study, the reference collection of the Laboratory of Technological and Functional Analyses of Prehistoric Artefacts (LTFAPA) in Rome, Italy was consulted. This collection, established since 1986, comprises experimental tools made from various raw materials, including flint, quartz, basalt, obsidian, rhyolite, and radiolarite. The tools were used in both exploratory and problem-oriented experiments, conducted under strict control of variables. For this research, 153 tools were selected from the collection and analyzed according to the methodological protocol outlined. This collection provides a diverse and comprehensive framework for identifying and interpreting use-wear traces, offering valuable insights for the comparative analysis of the archaeological corpus.

This study was conducted as part of a doctoral research project completed prior to the COVID-19 pandemic. Initially, there were plans to undertake collaborative experiments. However, the onset of the pandemic disrupted these plans, and the research had to be finalized in its current form to meet the requirements of the doctoral timeline. While experimental investigations remain a valuable avenue for future studies, this paper focuses on the analysis and interpretation of the data available at the time.

The mirrors were studied at a macroscopic scale at Tepecik Çiftlik with a stereomicroscope: the Leica EZ4W (magnifications from 8x up to 35x), and a metallographic microscope: the Nikon Optiphot (magnifications from 50x to 400x). Then, the microscopic data was acquired in the Prehistory Department lab at the Istanbul University with a metallographic microscope: the Nikon LV150 (magnifications from 100x up to

400x).

Based on the thorough examination of artifacts discovered at Tepecik Çiftlik, the following section proposes a production sequence for obsidian mirrors, of which every stage is documented by preforms.

3. Results

At Tepecik Çiftlik, the traces were impacted by post-depositional surface modifications (PDSM). Nearly 70 % of the tools recorded for the Early Chalcolithic assemblage show a heavily damaged surface (Vinet, 2022; Vinet & Guilbeau 2024). The post-depositional surface modifications observed are due to various taphonomic processes and also to storage in very large plastic bags containing too many pieces. The alterations include bright spots, intersecting striations, and micro pitting. The PDSM are easy to recognise as they are clearly distinguishable from use-wear and therefore did not prevent the examination of the mirrors. The main PDSM observed on the mirror assemblage were striations and micro pitting (Fig. 11).

Every step of the *chaîne opératoire* of mirrors was identified at Tepecik Çiftlik and documented, the following graph sums up the production sequence (Fig. 4).

1. Obtaining a subcircular blank

The first step to manufacture a mirror is to obtain a blank with a relatively flat and subcircular surface. These blanks can be exhausted blade or flake cores or can be obtained directly from a raw material nodule. Among the assemblage, the blanks are exhausted blade or blade/flake cores besides one cortical flake (Table 1).

2. Retouch of the blank to modify the shape

The blank is then retouched to improve its circular shape. Small flakes are removed by percussion or pression all around the perimeter of the mirror. This step is evidenced on every preform even though the following production steps have often obliterated the bulbs observable on the removals. The preform #8 is subcircular, irregular negatives of removals are observed on the sides of the preform (Fig. 5). This retouch is located on top of the blades removals and happened after the core was used to obtain blades.

3. Retouch of the surface to level the blank

Once the mirror has its final shape, the next step is to obtain a very flat surface. If the surface exhibits protruding areas, they are level by very shallow removals. This stage is documented with three preforms found at Tepecik Çiftlik: #3, #5 and #6. The figure 6 shows preforms #3 (right) and #5 (left), with shallow removals on the surface (Fig. 6).

4. Retouch of the blank's outline to remove the sharpness

Table 1

Obsidian mirrors discovered across the Near East..

	Dates	Finished objects	Preform	Context	Production on site	References
Tepecik Çiftlik	6850–5900 BCE	1	11	Unknown	yes	/
Çatalhöyük-East	7100–5950 BCE	12	1	Burial	no	Carter 2012; Doyle 2017; Vedder 2005
Sırçaltepe	mid-8 th millennium BCE	2	0	Surface	no	Balci et al. 2021; 2022
Güvercinkayası	5200–4750 BCE	1	4	Building infill, caches, and unknown	yes	Gülçur & Fırat 2005; Balci & Altınbilek-Algül 2019
Domuztepe	6800–5450 BCE	23	0	Unknown	no	Healey 2007 & 2013
Akarçay Tepe	7800–6000 BCE	1	0	Unknown	no	Balci & Altınbilek-Algül 2019
Tel Kabri	6400–4500 BCE	1	0	Surface	no	Gopher et al. 2011; Healey 2013; Prausnitz 1969
<i>Total</i>		<i>40</i>	<i>16</i>			

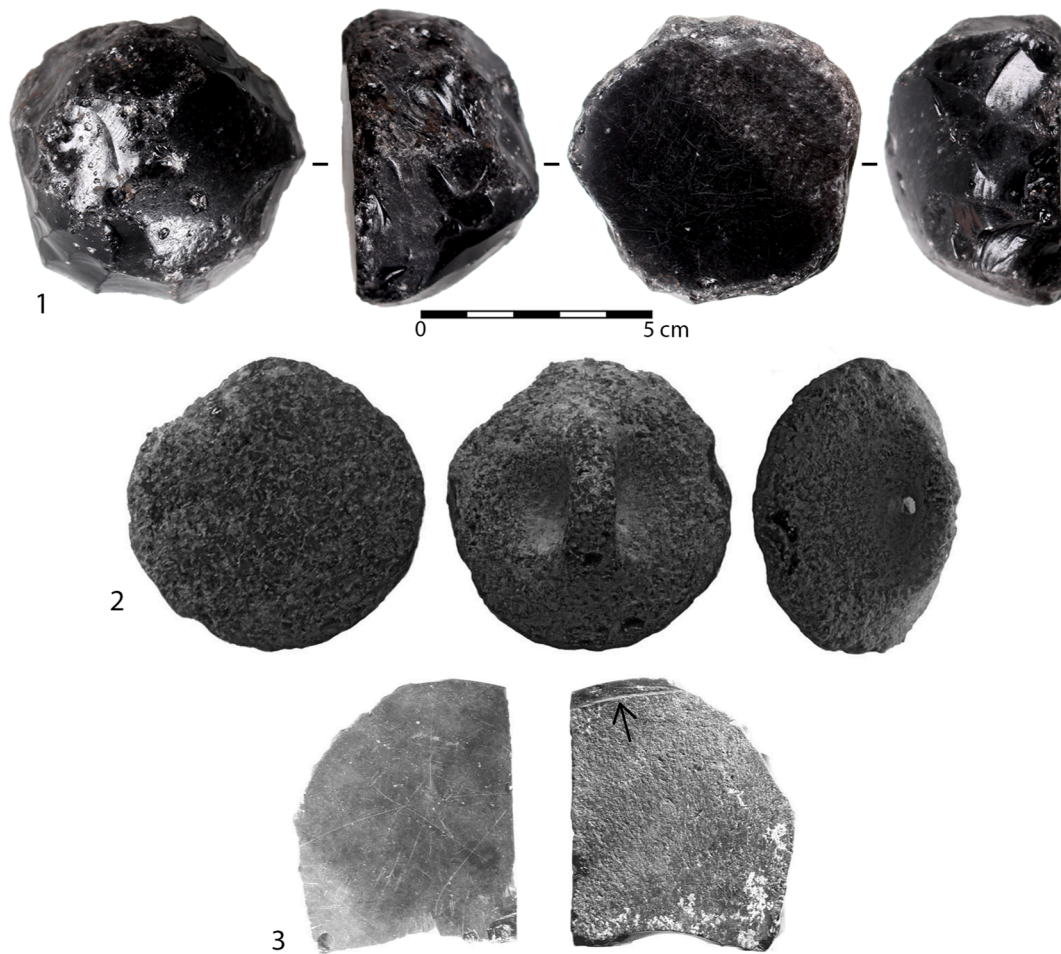


Fig. 2. The three types of mirrors. 1: type 1; 2: type 2; 3: type 3, the arrow indicates the groove. Credits: (1) A. Vinet; (2) Balci & Altunbilek-Algül, 2019; (3) Healey, 2013.



Fig. 3. The finished mirror discovered at Tepecik Çiftlik in 2012 in a Ceramic Neolithic level with a highly reflective surface. Credits: A. Vinet.

When the surface is sufficiently flat and no further retouching is needed, the outline of the mirror is chipped by direct percussion with a soft stone. The goal is to facilitate handling of the preform by removing the sharpness from the edge. This stage is observable in preforms #4 and #2. Partial evidence of edge chipping is discernible on other preforms as well, but the subsequent manufacturing steps have partially or

Table 2

Inventary of complete mirrors and preforms of mirrors found in Tepecik Çiftlik with the manufacture information.

#	Diameter in mm	Width in mm	Manufacture	Analysis	Blank Type
1	57	36	Finished mirror	Studied	Blade core
2	39	13	Preform, step 7 uncompleted	Studied	Blade/flake core
3	47	14	Preform, step 3 completed	Studied	Flake core
4	28	9	Preform, step 5 completed	Studied	Blade core
5	87	41	Preform, step 3 completed	Studied	Blade core
6	41	12	Preform, step 3 uncompleted	Studied	Cortical flake
7	42	20	Preform, step 6 uncompleted	Studied	Blade/flake core
8	40	17	Preform, step 2 uncompleted	Studied	Blade core
9	ca70	/	Preform, unknown step	Not studied	Blade core
10	ca50	/	Preform, step 4 completed?	Not studied	N/a
11	ca80	/	Finished mirror?	Not studied	Blade core
12	ca40	/	Preform, step 7 completed?	Not studied	N/a

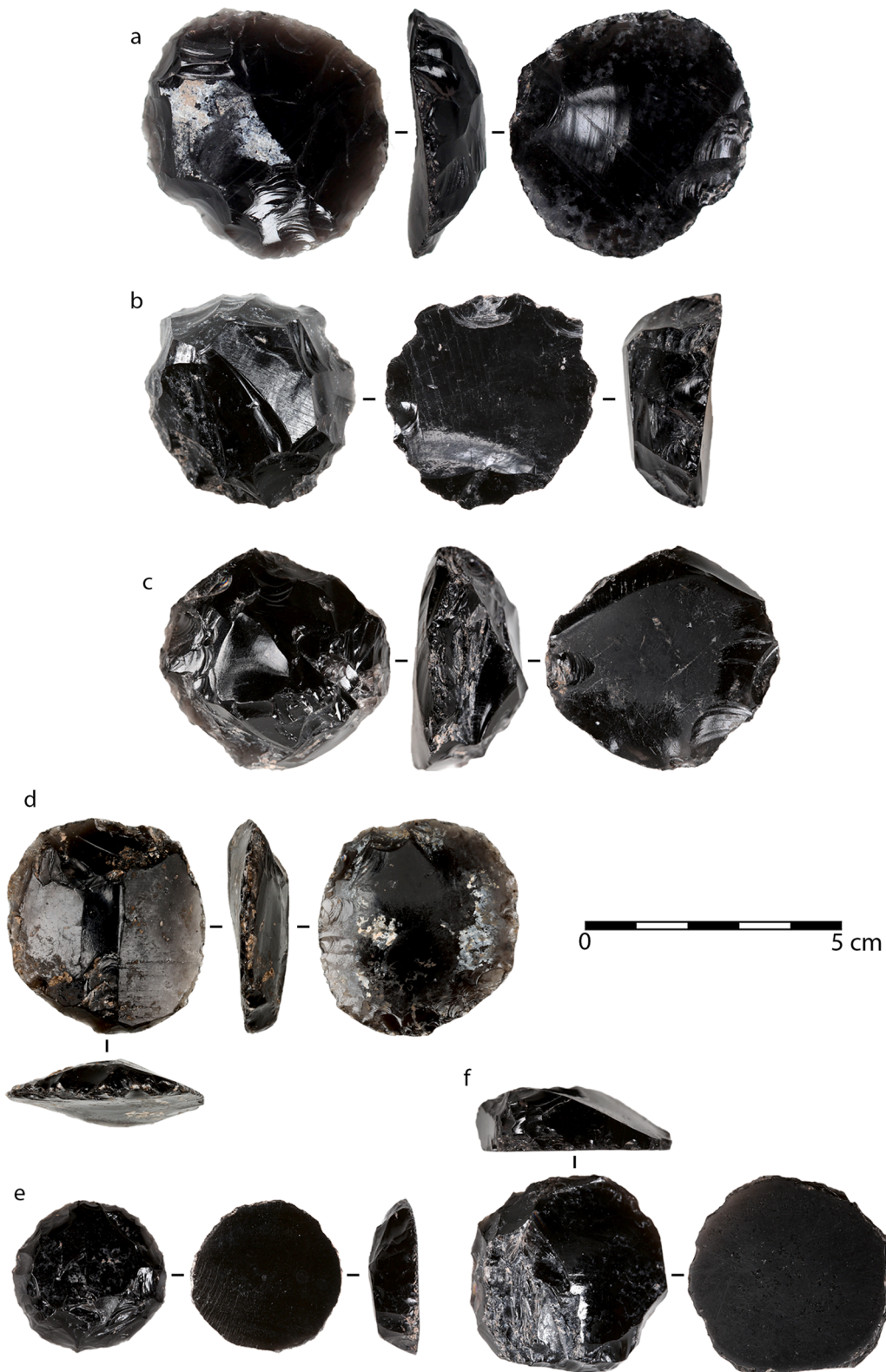


Plate 1. Mirrors from Tepecik Çiftlik. (a) to (f) were studied. (a) preform #3, (b) preform #8, (c) preform #7, (d) preform #6, (e) preform #4, (f) preform #2. Credits: A. Vinet.

completely masked this stage (Fig. 7).

5. Abrasion of the sharp edges and arrises to make them dull

The next step consists of abrading the sharp edges and arrises to

make them dull and, once again, to facilitate handling of the mirror. The abrasion is likely formed by friction between the preform and a coarse-grained stone with a back-and-forth motion. This stage is visible on the finished mirror to the naked eye where the arrises are flattened and appear light gray due to abrasion (Fig. 8). At a macroscale the abrasion

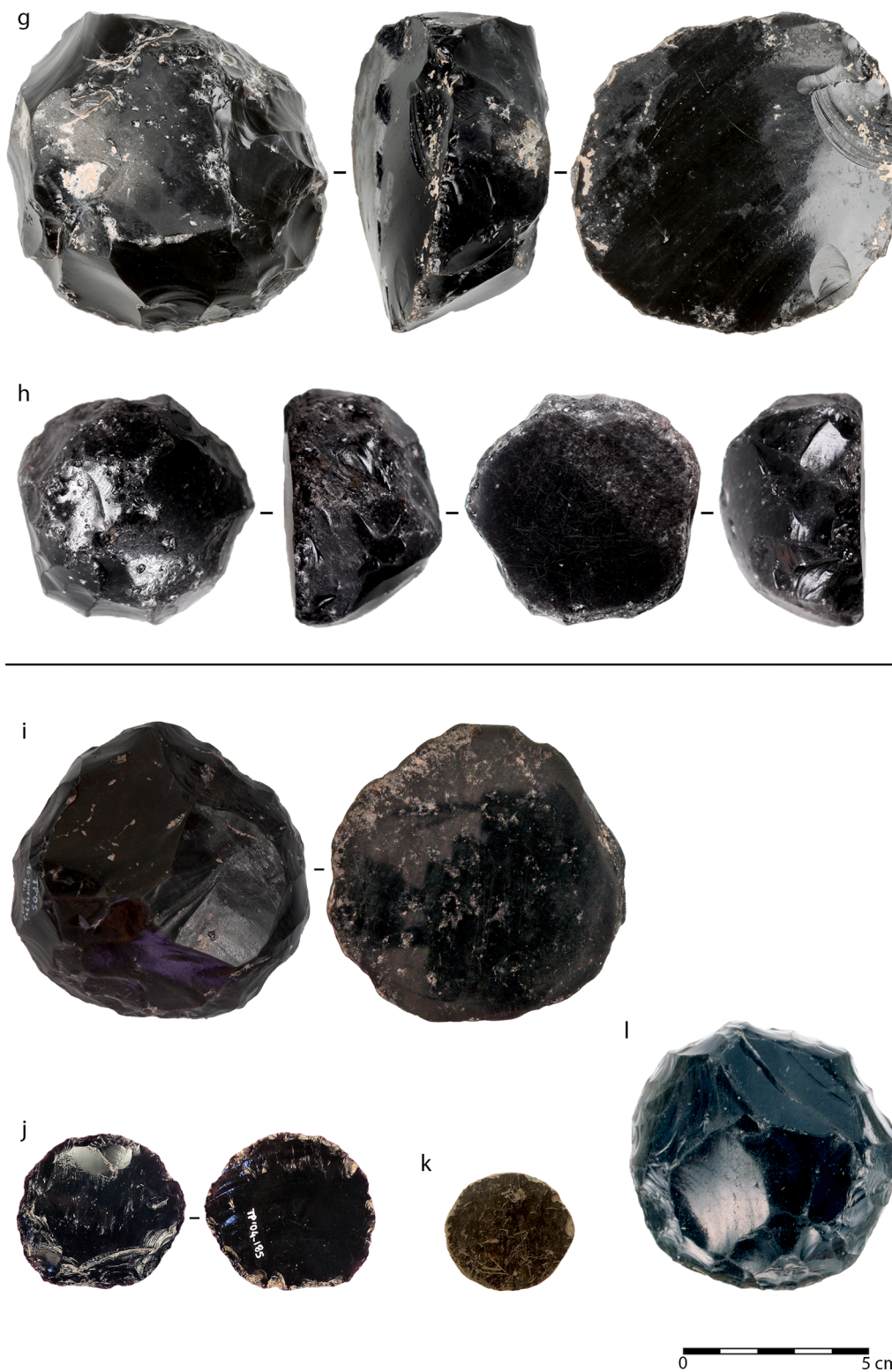


Plate 2. Mirrors from Tepecik Çiftlik. (g) and (h) were studied, mirrors (i) to (l) were not studied.. (g) preform #5, (h) mirror #1, (i) preform #11, (j) preform #10, (k) preform #12, (l) preform #9. Credits: (g) and (h) A. Vinet; (h) to (l) Tepecik Çiftlik team.

appears extensive in the form of large areas, and bands oblique and perpendicular to the top of the mirror. Some bands of abrasion start at the top of the pictures on Fig. 8 and end at the bottom, while others follow the opposite direction. The bands of abrasion are also distributed from the left to the right and vice versa. They are clearly indicating bidirectional left/right and up/down back-and-forth motions. The

significant extension of this abrasion indicates the contact of a very abrasive material.

On preform #4, moderate abrasion is observed on the upper face of the mirror, in the form of a continuous band around the entire periphery of the preform visible to the naked eye (Fig. 9). At a macro scale, the abrasion appears as a large area oblique to the edge, with a coarse

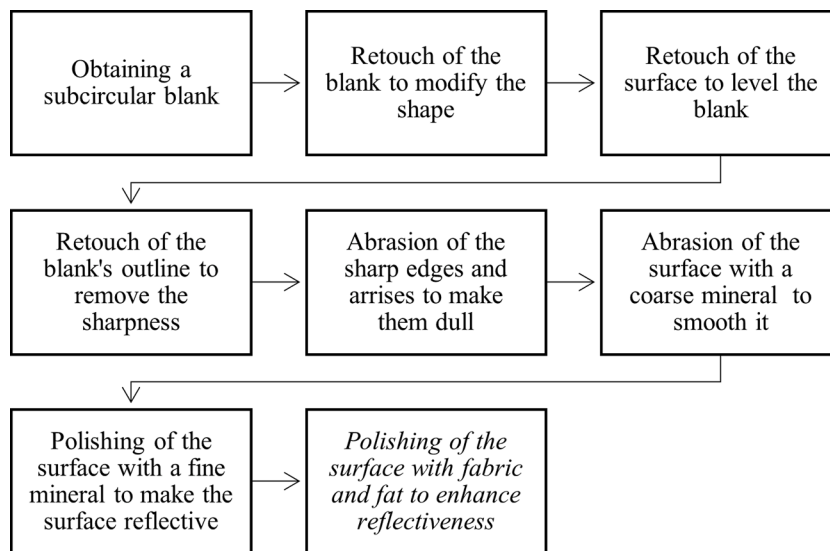


Fig. 4. Production sequence of type 1 mirrors. The eighth step, though not formally identified in the Tepecik assemblage, is suggested as a potential final stage.



Fig. 5. Preform #8. Irregular negatives of removals are observed on the sides of the preform to improve the circular shape. Credits: A. Vinet.

texture. The abrasion gradually decreases towards the center of the mirror, and dotted bands of abrasion can be seen oriented in various directions, indicating a back-and-forth movement. A light and shiny polish partially covers the abrasion, it is visible on the protruding points, and oriented in the direction of the abrasion. It is likely produced by

friction with a coarse-grained stone.

6. Abrasion of the surface with a coarse mineral to smooth it

The following steps concern only the surface, which will be modified several times until the artefact becomes reflective. Firstly, the surface will be completely abraded through friction with a coarse-grained mineral. The goal is to make the surface of the mirror perfectly

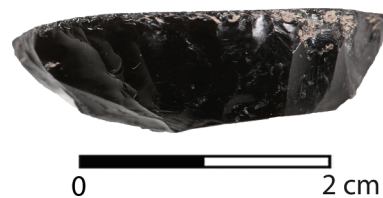


Fig. 7. Preform #4 which was abandoned after step 4 was completed. Chipping of the edge is visible and aims at removing the sharpness and facilitating handling. Credits: A. Vinet.

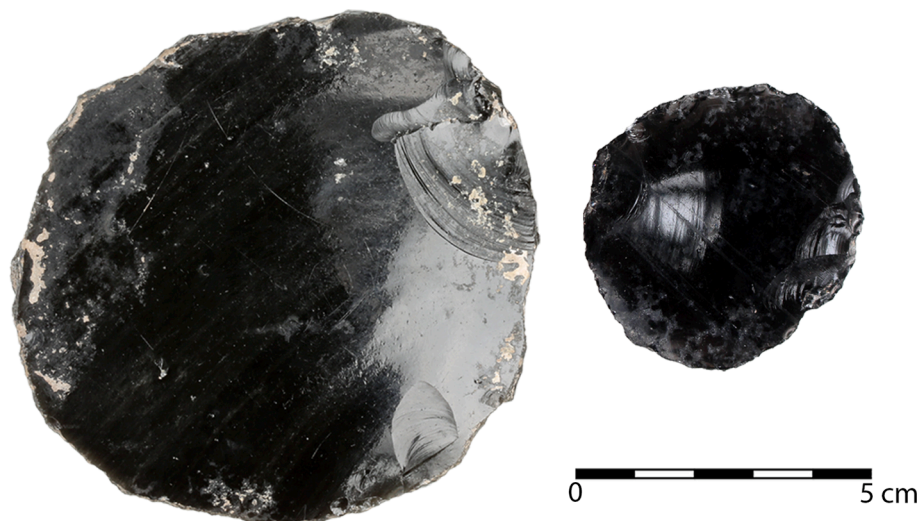


Fig. 6. Preform #5 (left) and preform #3 which was abandoned after step 3 was completed. Shallow removals are observable on the surface to level the surface before abrasion. Credits: A. Vinet.



Fig. 8. Finished mirror #1 showing abraded edges and arrises. Credits: A. Vinet.

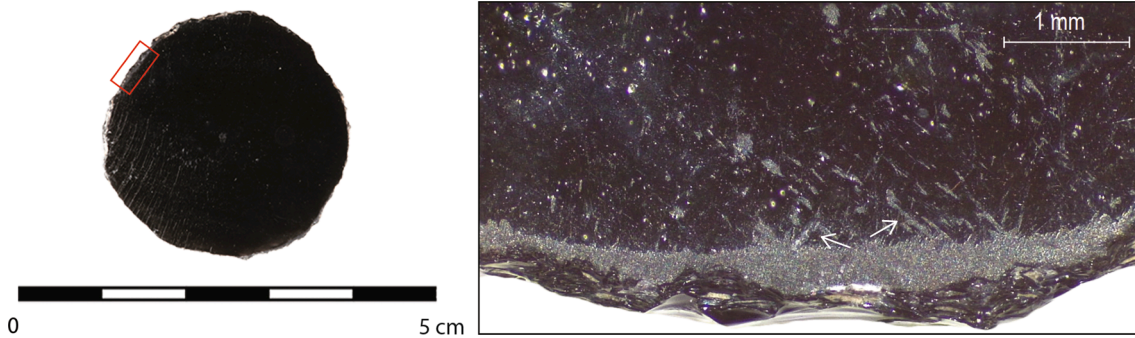


Fig. 9. Preform #4 which was abandoned after step 5 was completed. Moderate abrasion is visible on the upper face of the mirror, in the form of a continuous band around the entire periphery. Arrows indicate dotted bands of oblique abrasion oriented in various directions, indicating a back-and-forth movement. Credits: A. Vinet.

smooth and flat to prepare it for polishing, which occurs afterward. Experiments conducted by J.F. Vedder have demonstrated the necessity of adding water and an abrasive agent such as sand at this stage (Vedder, 2005). In Tepecik Çiftlik, this step is observed on preforms #7 and #2. These were abandoned before the surface was completely smoothed. Fig. 10 shows preform #7, a smooth and abraded surface is visible to the naked eye. At a macro scale, very wide striations are seen, indicating a left/right and up/down back-and-forth movement. The use of a coarse-grained stone is identified through the presence of wide striations on the surface, which are characteristic of abrasion with larger abrasive particles. In contrast, finer abrasives produce narrower striations and a more homogeneous surface. This preform exhibits significant differences in microtopography, likely explaining its abandonment during the

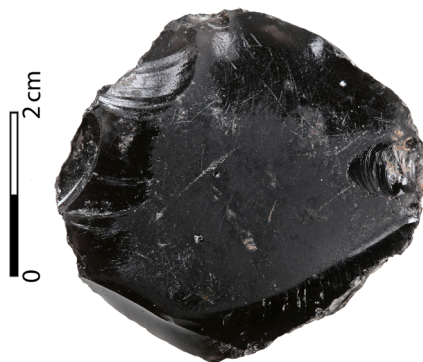


Fig. 10. Preform #7 which was abandoned during step 6. The surface is partially abraded, post-abrasion removals are visible on the surface. Credits: A. Vinet.

manufacturing process, as it would have required extra efforts to finish the mirror.

7. Polishing of the surface with a fine mineral to make the surface reflective

The next step is to polish the surface to make it reflective. The polish is achieved through friction between the mirror surface and a fine-grained stone, adding water and a fine abrasive agent such as clay or sandy ash has been suggested by J.F. Vedder (Vedder, 2005). This step can be observed on preform #2 as it was abandoned during this stage. To the naked eye, the abrasion covers the entire flat surface. The surface is smooth and feels soft to the touch. At low magnification (from x8 to x35), wide abrasive striations are observed, with varying orientations but generally parallel to each other, indicating a non-circular back-and-forth movement (Fig. 11). In contrast to the previous stage, the use of a fine-grained abrasive is indicated by the presence of narrower, more homogeneous striations. This observation is consistent with the tribological analysis of a Neolithic obsidian bracelet, where the surface became more homogeneous with the use of finer abrasives (Astruc et al., 2011). The surface is disrupted by post-depositional pitting. The preform does not exhibit any manufacturing defects that would explain its abandonment during the manufacture. The removals and micro fractures observed on the edge of the preform happened after the abrasion process as they cut the traces.

8. Probable last step: polishing of the surface with leather and fat to enhance reflectiveness

Building upon J. Connolly's suggestion (Connolly, 1999: 43), we propose the hypothesis of a final polishing step intended to make the mirror

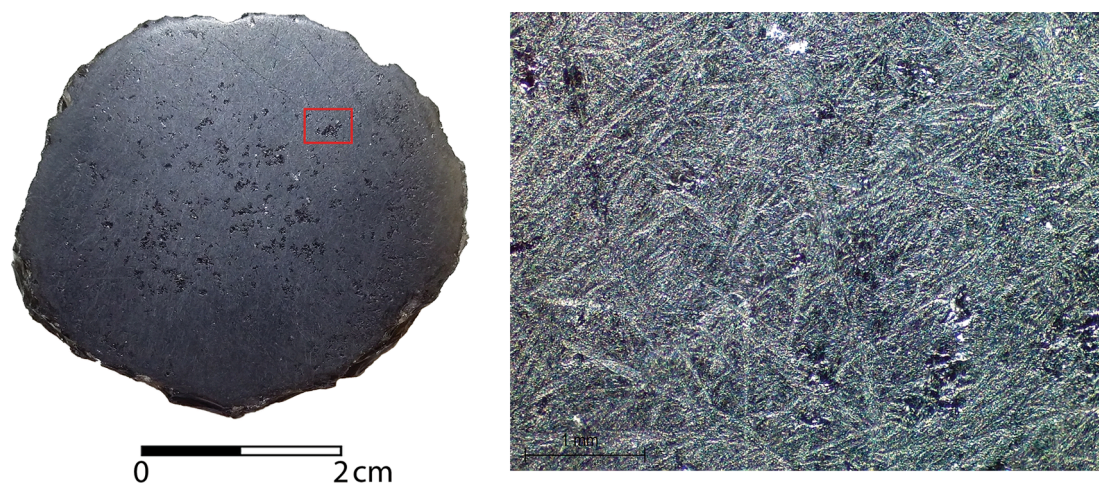


Fig. 11. Preform #2 which was abandoned during step 7. The right picture shows fine-grained abrasion observed under a stereoscopic microscope (x20) and very wide abrasive striations with varying orientations. Traces of post-depositional pitting are visible on the left picture. Credits: A. Vinet.

surface highly reflective. This step was not included in J.F. Vedder experiments, as he considered the level of reflectiveness sufficient. However, finished mirrors recently discovered at Çatalhöyük-East and Tepecik Çiftlik display highly reflective surfaces, which suggests the possibility of an additional polishing step in their manufacture.

We hypothesize that this final polishing step may have been achieved using a smooth fabric in combination with grease. The friction created between the polished surface and the greasy textile would help diminish dull spots and create a uniform reflective surface.

In the case of the Tepecik Çiftlik assemblage, the identification of this step is particularly challenging. The surface of the finished mirror (#1) is heavily disturbed by numerous post-depositional matte-abraded striations and micro pits likely produced by friction with sediments and other obsidian implements during storage (Fig. 12). These disturbances obscure the original surface treatment and complicate the detailed characterization of the polish. Fig. 12 illustrates the reflective surface of the finished mirror at x35 magnification, showing a polished, white, flat surface interspersed with numerous striations and thin bands of abrasions oriented in multiple directions. These linear traces were produced by friction with different materials. Some are shallow and could have been produced by thin particles, others are very wide and abraded and were produced by a larger abrasive material.

Further study of better-preserved finished mirrors is needed to confirm this hypothesis definitively. Until such evidence is available, the

eighth step remains a plausible but unconfirmed stage of the manufacturing sequence.

Similar challenges are encountered in the study of polished alpine jade axes, as highlighted by Pétrequin et al. (2012, Pétrequin et al. (2017)) in their experimental reconstructions. The « *polissage à glace* » of Alpine jade axes involved gentle, repeated friction under water using an extremely fine-grained siliceous or metamorphic stone, resulting in a reflective surface. A potential explanation for the divergence in techniques between obsidian and jade lies in their differing physical properties. Obsidian, with a Mohs hardness of approximately 5–5.5, is significantly softer than jade, which can reach a hardness of 6–7. The greater toughness and finer grain of jade would necessitate distinct polishing approaches. This distinction highlights the importance of material-specific considerations in understanding ancient manufacturing processes.

4. Discussion

4.1. Production and diffusion

The preforms and the finished mirror uncovered at Tepecik suggests that the inhabitants were manufacturing type 1 mirrors in the village during the 7th millennium BC. Tepecik Çiftlik is the only archaeological site where a complete set of preforms, attesting the local production, has

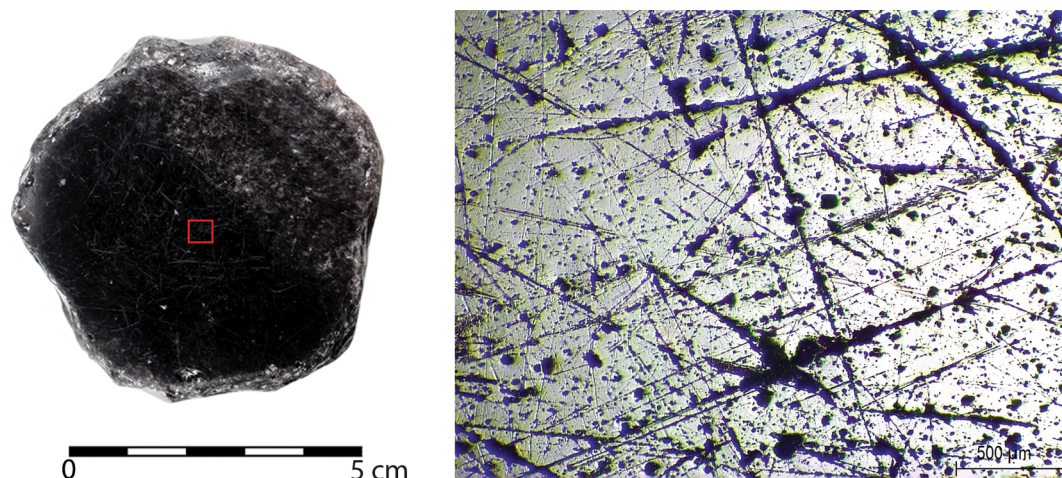


Fig. 12. Left: finished mirror. Right: polished surface observed with a stereoscopic microscope (x35), the striations are post-depositional, the white areas are polished and highly reflective. Credits: A. Vinet.

been found. Interestingly, other locations where type 1 mirrors have been unearthed exhibit no signs of their production. It should be noted that one circular object showing traces of abrasion on its surface has been identified as a preform at Çatalhöyük-East (Vedder, 2005). However, the object, which is broken, lacks the circularity and flatness observed on obsidian mirrors. Its microtopography is irregular and bumpy and the abrasion is visible only on the protruding areas. This suggests that, if it were a preform, the step 6 of the manufacturing process would have occurred before step 3, contradicting the expected production sequence. Consequently, this object appears less like a mirror preform and more like a sub-circular tool with traces of abrasion on its surface. It could, for instance, have been used as a burnisher for pottery or a tool for plastering walls or floors. Furthermore, later publications on obsidian mirrors from Çatalhöyük (Carter 2012; Doyle 2017) never mention this supposed preform, focusing exclusively on finished mirrors. This absence suggests that subsequent researchers did not interpret the object as a preform. Finally, it is the only preform-like artifact found at Çatalhöyük-East since the 1960's, further supporting the hypothesis that the site was not a production hub for obsidian mirrors. These considerations suggest that Çatalhöyük-East likely received mirrors as finished products. This aligns with the site's raw material procurement strategy, where obsidian arrived from Cappadocia either in the form of blades or cores (Carter et al Milic, 2013). The procurement analysis carried out on the two mirrors found in 2012 indicates that the obsidian came from Nenezidağ (Doyle, 2017) suggesting that the production site could be located in Cappadocia near the obsidian sources. Nenezidağ obsidian outcrops are situated 23 km away from Tepecik Çiftlik and were extensively used for raw material procurement by neolithic people.

Mirrors first appeared in Central Anatolia during the 8th millennium BCE. Sırçalıtepe is the nearest archaeological site to the obsidian sources in Cappadocia, dated to the Pre-Pottery Neolithic. While the presence of mirrors and the proximity to raw material sources suggest the possibility that Sırçalıtepe could have been a local production center, this remains a hypothesis that requires further testing. The mere proximity of a site to obsidian sources and the presence of these objects are not sufficient to determine whether the site was a mirror production center. A thorough typo-technological and traceological analysis is necessary to evaluate this hypothesis and provide more conclusive evidence.

The available evidence strongly supports the hypothesis of local production of Type 1 mirrors at Tepecik Çiftlik, spanning from the late

Pre-Pottery Neolithic to the Early Chalcolithic (6850–5900 cal. BCE) with a potential distribution to Çatalhöyük-East (Fig. 13). This production reflects the know-how developed by the site's inhabitants, who were capable of meeting local needs while ensuring regional distribution. Additionally, we suggest the possibility of an extra-regional diffusion to more distant sites, such as Akarçay Tepe where the use of both east Anatolian and Cappadocian obsidian is confirmed (Maeda 2007). While this hypothesis remains to be confirmed, it opens intriguing avenues for understanding the scope and influence of Tepecik's obsidian production within broader exchange networks (Fig. 12).

The production and distribution of type 2 mirrors, found in Güvercinkaya and Domuztepe, remains to be seriously investigated. Güvercinkaya is located near the Cappadocian obsidian sources, providing the inhabitants with unlimited access to raw material. A few preforms and a finished mirrors were found on the settlement, but they have not been studied yet. Domuztepe, on the contrary, is located far from the Cappadocian obsidian sources. However, many polished and non-utilitarian obsidian objects have been found such as beads, pendants, vessels, and mirrors. The inhabitants of the settlement mastered the techniques for creating polished obsidian objects as some small-scale production of certain objects happened locally (Healey and Campbell 2009; 2014). Most of the obsidian used on site came from eastern sources, however provenance studies indicate that obsidian from the Cappadocian sources may have been preferred for the production of non-utilitarian objects (Healey 2013; Healey and Campbell 2014). Investigating the links between Güvercinkaya and Domuztepe seems highly promising for future research.

Type 3 mirrors were uncovered in Domuztepe and Tel Kabri. The one finished mirror from Tel Kabri has not been studied yet, the provenance of the obsidian is unknown. The location of the site far from the sources might suggest an importation from a foreign site, which remained to be identified.

4.2. Functions

Understanding the functions of mirrors in prehistoric societies involve unraveling their role beyond mere reflective surfaces. The distribution of type 1 mirrors prompt an exploration into the significance these objects held within their cultural and socio-economic contexts.

The finished mirrors are sufficiently reflective to actually be used as

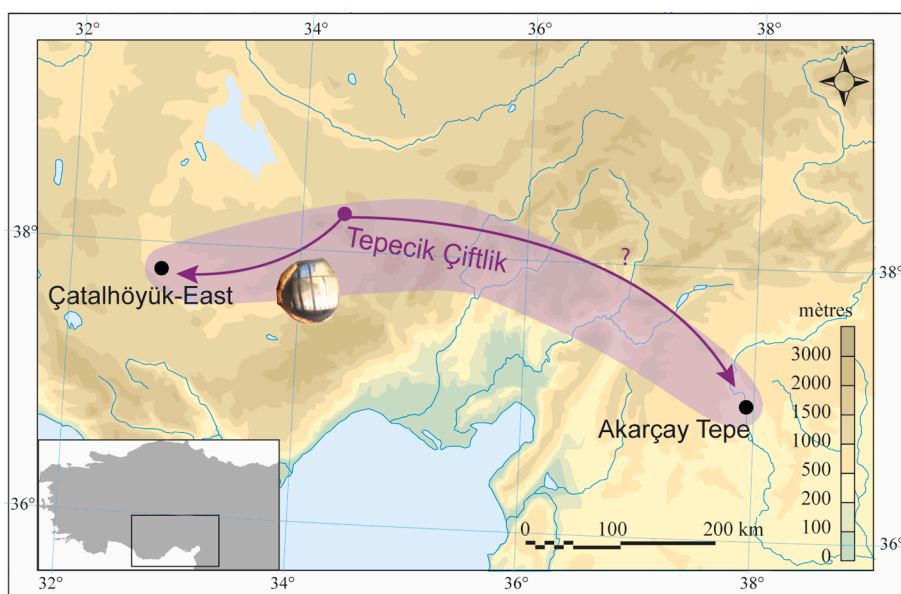


Fig. 13. Map showing the potential distribution of mirrors during the 7th millennium BC in Central Anatolia. The distribution area of mirrors is represented in light purple, the arrow in dark purple indicates the production center (Tepecik Çiftlik) and the likely receiving sites of mirrors (Çatalhöyük-East, and Akarçay Tepe). Credits: A. Vinet.

mirror to see oneself. According to J. Conolly, the reflective surface is the functional property of mirrors (Conolly, 1999; 43). Other suggested uses include redirecting light or signalling (Healey, 2013). The reflective surface may not be the sole functional property of mirrors. I. Franz, for instance, suggests that they may have served as tools for burnishing ceramics, with the tool's surface gradually becoming reflective during use (Franz, 2010). However, the *chaîne opératoire* detailed in the previous section emphasizes that obtaining a reflective surface was the main objective of the production and not the result of another technical activity.

Mirrors are also portable and mobile objects, designed to be hand-held rather than mounted on walls. At Çatalhöyük-East, at least one mirror is plastered everywhere except on the reflective surface, a feature seen by J. Conolly as evidence of their portable nature (Conolly, 1999; 43). The plaster is believed to enhance grip and prevent injuries from scars that may detach from the mirror, potentially damaging the object as well.

Three mirrors recently discovered in Çatalhöyük-East burials were associated with pigments. Blue and green pigments were found near two mirrors in a multiple burial in 2012 (Tung, 2012; 15), while red and yellow pigments were associated with a mirror in an individual burial in 2017 (Haddow et al., 2017; 106). This suggests that the backs of these mirrors might have been painted, either entirely or partially.

In the context of Çatalhöyük-East, mirrors are exclusively found in burials, indicating their role as funerary offerings accompanying the dead. However, on other sites, contextual information does not provide insight into their significance.

5. Conclusion

Mirrors are exceedingly rare objects in the Near East, with fewer than 60 known to date following a comprehensive inventory. The recent discovery of eleven preforms and one finished mirror at Tepecik Çiftlik presents an extraordinary opportunity to trace the manufacturing, diffusion, and functions of type 1 mirrors. The results reveal that their production involved eight steps. The site might have played a pivotal role as a production hub, manufacturing and distributing mirrors across Anatolia during the 7th millennium BC.

Understanding the functions of prehistoric mirrors extends into their cultural and socio-economic significance. Carefully designed to be handled, mirrors may have been painted and served various functions, including self-observation. Some mirrors, discovered in burials at Çatalhöyük-East, suggest a funerary role, while their significance on other sites remains unclear.

This study represents a preliminary step in the analysis of obsidian mirror production and use. While significant progress has been made in identifying a potential manufacturing site and reconstructing the *chaîne opératoire*, further experimental work and detailed analyses, including high-resolution imagery, are planned for future research. These advancements will refine our understanding of the gestures, techniques, and levels of specialization involved in crafting these unique artefacts.

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CRediT authorship contribution statement

Alice Vinet: Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Conceptualization.

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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Data availability

Data will be made available on request.

References

- Astruc, L., Vargiolu, R., Ben Tkaya, M., Balkan-Atlı, N., Özbaşaran, M., Zahouani, H., 2011. Multi-scale tribological analysis of the technique of manufacture of an obsidian bracelet from Aşkılı Höyük (Aceramic Neolithic, Central Anatolia). *Journal of Archaeological Science* 38, 3415–3424.
- Balci, S., 2016. Tepecik-Çiftlik Höyük'te Obsidiyen Yongalama Alanı. *Anadolu Prehistoriya Araştırmaları Dergisi* 2, 148–159.
- Balci, S., 2019. The obsidian industry of Pre-Pottery Neolithic levels at Tepecik-Çiftlik, central Anatolia, in: Astruc, L., McCartney, C., Briois, F., Kassianidou, V. (Eds.), *Near Eastern Lithic Technologies on the Move: Interactions and Contexts in Neolithic Traditions*. Astrom Editions, Nicosia, Chypre, pp. 235–246.
- Balci, S., Altınbilek-Algül, Ç., 2019. Reflections from Prehistory: Obsidian Mirrors of Güvercinkayası, in: Çaylı, P., Demirtaş, I., Eser, B. (Eds.), *Arkeolojiyle geçen yarım asır: Sevil Gülçür armağanı. Bilgin Kültür Sanat*, Ankara, pp. 553–568.
- Balci, S., Altınbilek-Algül, Ç., 2017. Polished Obsidian Objects: Examples of Prestige Items From Kültepe. *Colloquium Anatolicum* 16, 15–29.
- Balci, S., Altınbilek Algül, Ç., Mouralis, D., Kaycı, O., Büyükkarakaya, A., Açıkgöz, F., 2021. A New Aceramic Neolithic Site Nearby the Obsidian Sources: Preliminary Insights from Sırçalıtepe anar 0, 67–92.
- Balci, S., Altınbilek Algül, Ç., Mouralis, D., 2022. Sırçalıtepe: A New Aceramic Neolithic Site in Volcanic Cappadocia (Central Anatolia), in: Nishiaki, Y., Maeda, O., Arimura, M. (Eds.), *Tracking the Neolithic in the Near East: Lithic Perspectives on Its Origins, Development and Dispersals: Proceedings of the 9th International Conference on the PPN Chipped and Ground Stone Industries of the Near East*, Tokyo, 12th-16th November 2019. Presented at the International Conference on PPN Chipped and Ground Stone Industries of the Near East, Sidestone Press, Leiden, pp. 397–411.
- Bıçakçı, E., Godon, M., Çakan, Y.G., 2012. Tepecik-Çiftlik, in: Özdoğan, M., Başgelen, N., Kuniholm, P.L. (Eds.), *Central Turkey. Archaeology and art publications*, Galatasaray İstanbul, Turquie, pp. 89–134.
- Carter, T., 2012. Chipped Stone from the North and South Areas, Çatalhöyük Archive Report.
- Carter, T., Milic, M., 2013. The Chipped Stone, in: Hodder, I. (Ed.), *Çatalhöyük research project. Substantive Technologies at Çatalhöyük*. British Institute at Ankara, London, Royaume-Uni de Grande-Bretagne et d'Irlande du Nord, Etats-Unis d'Amérique, pp. 417–478.
- Clemente, I., Lazuén Fernandez, T., Astruc, L., Rodríguez Rodríguez, A., 2015. Use-wear analysis of nonflint lithic raw materials: The cases of quartz/quartzite and obsidian, in: Marreiros, J.M., Gibaja Bao, J.F., Bicho, N.F. (Eds.), *Use-Wear and Residue Analysis in Archaeology, Manuals in Archaeological Method, Theory and Technique*. Springer, Heidelberg New York Dordrecht London, pp. 59–81.
- Conolly, J., 1999. The Çatalhöyük flint and obsidian industry: technology and typology in context. *Archaeopress*, Oxford, Royaume-Uni de Grande-Bretagne et d'Irlande du Nord.
- Doyle, S., 2017. Chipped Stone from the North and South Areas, Çatalhöyük Archive Report.
- Gopher, A., Marder, O., Barkai, R., 2011. An Obsidian Industry from Neolithic Hagoshrim, Upper Galilee, in: Healey, E., Campbell, J.S., Maeda, O. (Eds.), *The state of the stone: terminologies, continuities and contexts in Near Eastern lithics*, Studies in Early Near Eastern Production, Subsistence, and Environment. Ex Oriente, Berlin, Allemagne, pp. 395–402.
- Franz, I., 2010. *West Mound Trench 5-7 Pottery, Çatalhöyük Archive. Report*.
- Guilbeau, D., 2022. Tepecik Çiftlik (Turkey) and the exploitation of Cappadocian obsidian during the 7th millennium: preliminary results, in: Nishiaki, Y., Maeda, O., Arimura, M. (Eds.), *Tracking the Neolithic in the Near East. Lithic Perspectives on Its Origins, Development and Dispersals, The Proceedings of the 9th International Conference on the PPN Chipped and Ground Stone Industries of the Near East*, Tokyo, 12th-16th November 2019. Sidestone Press, Leiden, pp. 427–437.
- Gülçür, S., Firat, C., 2005. Spatial analysis of Güvercinkayası, a Middle Chalcolithic hilltop settlement in northwestern Cappadocia : A preliminary report. *Anatolia Antiqua*. Eski Anadolu 13, 41–52. <https://doi.org/10.3406/anata.2005.1036>.

- Haddow, S.D., Milella, M., Tibbetts, M., Schotsmans, E., Knüsel, C.J., Remains, H., Archive, Ç., 2017. Report.
- Healey, E., 2013. Exotic, aesthetic and powerful? The non-tool use of obsidian in the Late Neolithic of the Near East. In: Akkermans, P., Bernbeck, R., Nieuwenhuys, O., Rogasch, J. (Eds.), *Interpreting the Late Neolithic of Upper Mesopotamia*, Papers on Archaeology from the Leiden Museum of Antiquities. Brepols, Turnhout, pp. 251–266.
- Healey, E., 2007. Obsidian as an Indicator of Inter-Regional Contacts and Exchange: Three Case-Studies from the Halaf Period. *Anatolian Studies* 57, 171–189.
- Healey, E. and Campbell, S., 2009. The Challenge of Characterising Large Assemblages of Exotic Materials: A Case Study of the Obsidian from Domuztepe, S.E. Turkey. In *Proceedings of the Implement Petrology Group Conference on Stone Tools*, York, September 2007, edited by Mark Edmonds and Vin Davis. *Internet Archaeology* 26.
- Healey, E., Campbell, S., 2014. Producing adornment: Evidence of different levels of expertise in the production of obsidian items of adornment at two late Neolithic communities in northern Mesopotamia. *JLS* 1, 79–99.
- Hurcombe, L.M., 1992. Use wear analysis and obsidian: theory, experiments and results, Sheffield archaeological monographs. J.R. Collis Publications: Dept. of Archaeology and Prehistory, University of Sheffield, Sheffield.
- Keeley, L.H., 1980. Experimental determination of stone tool uses: a microwear analysis, Prehistoric archeology and ecology. University of Chicago Press, Chicago.
- Kononenko, N., 2011. Experimental and archaeological studies of use-wear and residues on obsidian artefacts from Papua New Guinea, Australian Museum. ed, Technical Reports of the Australian Museum, Online. Sydney Australia).
- Maeda, O., 2007. Meanings of obsidian exchange and obsidian use at Akarçay Tepe, in: Astruc, L., Binder, D., Briois, F. (Eds.), *Systèmes techniques et communautés du Néolithique précéramique au Proche-Orient: actes du 5e colloque international*. Éditions APDCA, 2007, Antibes, France, pp. 245–254.
- Pétrequin, P., Bontemps, C., Buthod-Ruffier, D., Le Maux, N., 2012. Approche expérimentale de la production des haches alpines, in: Pétrequin, P., Cassen, S., Errera, M., Klassen, L., Sheridan, A., Pétrequin, A.-M. (Eds.), *Jade, grandes haches alpines du Néolithique européen: Ve et IVe millénaires av. J.-C.* Presses Universitaires de Franche-Comté, Besançon, France, pp. 258–290.
- Pétrequin, P., Cinquetti, M., Buthod-Ruffier, D., 2017. Le choix des jades alpins, in: Pétrequin, P., Gauthier, E., Pétrequin, A.-M. (Eds.), *JADE: objets-signes et interprétations sociales des jades alpins dans l'Europe néolithique*. Presses universitaires de Franche-Comté, Besançon, France, pp. 47–67.
- Prausnitz, M., 1969. The Excavations at Kabri. *Eretz-Israel: Archaeological, Historical and Geographical Studies* 9, 122–129.
- Rodríguez Rodríguez, A.C., 1998. Traceología de las obsidianas canarias: resultados experimentales. *El Museo Canario* 21–58.
- Semenov, S.A., 1964. Prehistoric technology. ed. Cory, Adams and Mackay, London, UK.
- Thalmann, J.-P., 2006. Obsidian at Tell Arqa, North Lebanon : A stop-over point on a trade route? *Baghdad. Mitt* 37, 575–592.
- Tringham, R., Cooper, G., Odell, G., Voytek, B., Whitman, A., 1974. Experimentation in the Formation of Edge Damage: A New Approach to Lithic Analysis. *Journal of Field Archaeology* 1, 171–196.
- Tung, B., 2012. Excavations in the North Area, 2012, Çatalhöyük Archive Report.
- Vaughan, P.C., 1985. Use-wear analysis of flaked stone tools. University of Arizona Press, Tucson.
- Vedder, J.F., 2005. The Obsidian mirrors of Çatalhöyük. In: Hodder, I. (Ed.), *Changing Materialities at Çatalhöyük: Reports from the 1995-99 Seasons*. British Institute at Ankara, London, pp. 597–613.
- Vinet, A., 2022. Interactions régionales sur le plateau anatolien au Chalcolithique ancien Approche Techno-Fonctionnelle De L'industrie En Obsidienne De Çatalhöyük-Ouest Et Tepecik Çiftlik. Paris 1 Panthéon-Sorbonne, Paris.
- Vinet, A., Guilbeau, D., 2018. A first glimpse of the Late Neolithic and Early Chalcolithic in Cappadocia through the lithic industry of Tepecik-Çiftlik 2017. *Anatolia Antiqua* XXVI 1–12.
- Vinet, A., Guilbeau, D., 2020. Obsidian on the Move: From the Sources to the Tool. The Case of Tepecik-Çiftlik (Turkey) around 6000 BC, in: Otto, A., Herles, M., Kaniuth, K. (Eds.), *Proceedings of the 11th International Congress on the Archaeology of the Ancient Near East*. Harrassowitz Verlag, Wiesbaden, pp. 91–104.
- Vinet, A., Guilbeau, D., 2024. The long blades and their uses: Examples of long laminar flakes from Anatolia. *Journal of Archaeological Science: Reports* 53, 104378.