

## HIGH-PLATEAU ADAPTATION AND LATE ACHEULEAN INDUSTRY AT GÜRGÜRBABA HILL (LOCALITIES 018 AND 020), VAN / TÜRKİYE

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### Abstract

Türkiye, with its strategic location between the African and Eurasian continents, has been a key region for Paleolithic dispersals. The province of Van in eastern Türkiye, with its geological and climatic characteristics, represents one of the vital waypoints along these dispersal routes. A field survey at the obsidian deposits of Gürgürbaba Hill, located in the village of Ulupamir, north of Van, was conducted to investigate hominin migration between the three continents during the Pleistocene. Recent studies date these Late Acheulean sites to between approximately 424 kya and 311,000 ± 32 kya years ago, corresponding to the Middle Pleistocene interglacial period known as Marine Isotope Stage 9 (MIS 9). In the most recent survey of the area, a total of 2,832 obsidian lithic remains recovered from localities 018 and 020 were analyzed. Lithic data analysis using ArcGIS was applied to each artifact. The data were evaluated comparatively with both nearby sites and other localities at Gürgürbaba Hill. Locality GBT-018 and GBT-020 are technologically and typologically similar to other localities (GBT-010 and GBT-028) at Gürgürbaba Hill, as evidenced by the data. This finding is also supported by statistical analyses (PCA data). The presence of hand axes, Quina-type scrapers, and evidence of the Levallois technique within the industry suggests that Gürgürbaba served as a key link between the South Caucasus and the Levant. These findings provide further evidence of Middle Pleistocene hominin mobility across regions and their adaptation to high-plateau environments.

**Keywords:** Late Acheulean, Middle Pleistocene, Marine Isotope Stage 9, Gürgürbaba Obsidian, Acheulo-Yabrudian, High-Plateau Adaptation

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## Introduction

Türkiye, a geographically and climatically important transition zone between Africa, Europe and Asia, lies along the migratory routes of the genus *Homo*, which moved northward from Africa during the Pleistocene<sup>1</sup>. Evidence from Dmanisi (Georgia)<sup>2</sup> and Kocabaş (Türkiye-Denizli)<sup>3</sup> provides early traces of the first hominin migrations from Africa. *Homo erectus* fossils and Mode 1 industry at Dmanisi, Georgia, dating to 1.8 million years ago<sup>4</sup>, and stone tools from Karakhach, Armenia, dating to 1.81 million years ago<sup>5</sup> suggest an earlier dispersal from Africa than previously thought. However, the precise route by which early hominins arrived in the Caucasus remains debated. Absolute dating evidence from this period in the Levant is scarce. Human fossils attributed to *Homo erectus*, along with numerous animal fossils and stone tools, have been found in Ubeidiya, Israel, but the earliest layer of Ubeidiya dates to 1.6-1.4 million years ago<sup>6</sup>. Latamne-Syria<sup>7</sup>, Hummal-el Kowm-Syria<sup>8</sup> and Evron-Israeli<sup>9</sup>, which are thought to date to about one million years ago, come immediately after Ubeidiya. More detailed evidence appears later at Gesher Benot Ya'aqov, Israel, dated to 800,000–700,000 BP<sup>10</sup>. While Paleolithic assemblages in Iran – situated at the crossroads of Anatolia and the Caucasus – attest to early hominin occupation, the absence of radiometric dating limits the determination of these routes<sup>11</sup>.

The Eastern Anatolia Region, the focus of this study, serves as a key connection point between the Levantine and Caucasian areas along early hominin migration routes. Systematic surveys since 2014 and excavations between 2017 and 2018 at the GBT site, near Ulupamir Village in the Erciş district, have identified 33 archaeological localities spanning the Lower Palaeolithic, Middle Palaeolithic, and Chalcolithic Periods, with Lower Palaeolithic remains present in 17 of these sites.<sup>12</sup> A total of 33 archaeological localities, dating to the Lower Palaeolithic, Middle Palaeolithic, and Chalcolithic Periods, were identified in the GBT site near Ulupamir Village of the Erciş district, northern Van Province. Notably, Lower Palaeolithic remains were found in 17 of these sites<sup>13</sup>. Technological and typological analyses of the lithic artefacts from these sites indicate strong similarities with the Acheulean-Yabrudian assemblages from the Levant and Late Acheulean assemblages from the Caucasus. This reveals that the GBT was situated along early hominin migration routes, reinforcing the significance of Anatolia

1 Otte et al. 1998; Güleç et al. 1999; Kuhn et al. 2009; Lebatard et al. 2014; Chevalier et al. 2015; Baykara et al. 2022a; Bulut et al. 2022; Özçelik – Karahan 2023; Özer et al. 2018; Özer 2023.

2 de Lumley et al. 2005.

3 Kappelman et al. 2008; Lebatard et al. 2014.

4 de Lumley et al. 2005.

5 Presnyakov et al. 2012.

6 Bar-Yosef – Goren-Inbar 1993; Shea 1999; Tobias 1966; Belmaker et al. 2002.

7 Clark 1966.

8 Le Tensorer et al. 2011.

9 Porat – Ronen 2002.

10 Goren-Inbar et al. 2000.

11 Ariai – Thibault 1975; Bigliari et al. 2004; Bigliari – Shidrang 2006; Davoudi et al. 2015.

12 Baykara et al. 2016; Baykara et al. 2017; Baykara et al. 2018a; Baykara et al. 2018b; Baykara et al. 2022a; Baykara et al. 2022b; Uslu et al. 2019

13 Baykara et al. 2018a; Baykara et al. 2018b.

in human migration and evolution, as well as the importance of Eastern Anatolia in Pleistocene Period research<sup>14</sup>. Fundamentally, this analysis seeks to evaluate the behavioral and adaptive strategies of the hominin groups occupying Eastern Anatolia by precisely examining the GBT 018 and 020 lithic assemblages; this inquiry aims to elucidate the precise mechanisms by which this region facilitated cultural exchange and technological connectivity between the broader Levantine and Caucasian Acheulean traditions.

### Site information and Gürgürbaba Hill (GBT)

The GBT Palaeolithic site is in the Erciş district of Van province in the Eastern Anatolia Region of Türkiye (Fig. 1). It lies within the Lake Van Basin, the second-largest closed basin in Türkiye, which formed approximately 13 million years ago due to compression from the collision of the Eurasian and Arabian plates<sup>15</sup>. Lake Van, a barrier lake, was formed by the closure of a tectonic depression following the eruption of the Nemrut Volcano, situated at an altitude of approximately 1655 m above sea level. Lake Van covers a very large area of 3522 km<sup>2</sup>, making it the world's largest soda lake, with a salinity of 2.6%. In addition, the lake, with a volume of 607 km<sup>3</sup>, has an average depth of 171 m and a maximum depth of 451 m. The lake temperature can reach 20–23 °C at the surface in summer and drop below 0 °C in winter. Unlike the Eastern Anatolia Region in general, the basin has a milder continental climate<sup>16</sup>. Climatic conditions in the basin have varied over time, with cold and dry conditions during glacial periods and warm, humid conditions during interglacial periods. Today, the region's vegetation is primarily composed of steppe and meadow landscapes<sup>17</sup>.

The tectonic regime that began in the Middle Miocene, driven by the collision of the Arabian and Anatolian plates, initiated the Neo-tectonic process, leading to the formation of folds, faults, cracks, and associated volcanic activity<sup>18</sup>. As a result, volcanic topography covers a very large area throughout the region. In this respect, many provinces in Eastern Anatolia and the Eastern Black Sea region (Van, Erzurum, Erzincan, Bingöl, Muş, Kars, Rize, etc.) have volcanic raw material resources preferred by prehistoric communities for chipped stone tool production. In the Lake Van Basin, volcanism primarily resulted from Neogene-Quaternary activity, forming several major volcanic mountains: Nemrut (2935 m), Süphan (4434 m), Tendürek (3533 m and 3291 m), and Meydan (3290 m). These mountains, aligned in a southwest-northeast direction north of Lake Van, contain dacitic-rhyolite lava sequences, andesitic perlite, and blackish-colored obsidian, particularly within and around their calderas<sup>19</sup>. The Meydan Mountain complex and Gürgürbaba parasitic cones developed in three phases: Miocene, Pliocene, and Quaternary. The Gürgürbaba Volcanic Cone (2278 m), the focus of this research, formed as a parasitic cone during the Quaternary, when volcanic activity associated with the Meydan Mountain caldera spread

14 Baykara et al. 2022a; Baykara et al. 2022b.

15 Okuldaş – Üner 2013.

16 Kempe et al. 1978; Yıldız – Deniz 2005; Çağatay et al. 2014.

17 Kwiecien et al. 2014; Litt et al. 2014.

18 Şengör – Yılmaz 1981; Şaroğlu – Güner 1981; Yılmaz et al. 1987; Şaroğlu – Yılmaz 1991.

19 Bigazzi et al. 1997.

extensively across the region<sup>20</sup>. The structure of the volcanic materials of the Gürgürbaba lavas consists of grey-black rhyolite, brown, brown-black obsidian, and grey perlitites<sup>21</sup> (fig. 2). In terms of climatic and geological characteristics, the Lake Van Basin has been a preferred region for settlement since the Middle Pleistocene because of the environmental conditions suitable for prehistoric communities.

The GBT site (fig. 1) is located approximately 6 km southeast of the Meydan Mountain caldera and the Gürgürbaba parasitic cone, approximately 2200 m above sea level. The rhyolite rocks on the eastern and southern slopes of the hill prevented erosion of the cultural deposit on the upper part of the hill. The Miocene Hawaiite bedrock is the oldest geological unit, which was subsequently covered by basalt and rhyolite formations resulting from later volcanic activity. These layers were later overlain by lava flow from the volcanic cone<sup>22</sup> (fig. 2). The geological structures of the GBT-finding areas were generally similar to each other. Excavations conducted in 2017 and 2018 at locality GBT-10 revealed stratigraphic layers with distinct geological characteristics (fig. 3). The stratigraphy was divided into levels A1, A2, and A3. Level A1 constitutes the uppermost part of the soil fill, and the soil is generally soft because of the plant roots. It also contains non-*in situ* remains. At level A2, archaeological material is scarce, and the soil structure is hard and clayey with a loam/mud form. Plant remains are sparse. Level A3 is the preserved Palaeolithic layer. There were a few plants remains and trachy-basalt fragments with a diameter of approximately 5/15 cm in the soil fill. The site contains rhyolite, small trachy-basalt rock fragments, and dense obsidian fragments of varying sizes. Using the cosmogenic nuclide method applied to layer A3, the layer was dated to MIS 9, the interglacial period of the Middle Pleistocene, 311±32 millennia ago<sup>23</sup>. The B1 level, which is characterized by fine-grained, mild-sized and yellow/light-yellow-coloured volcanic fill, constitutes a different geological unit. It contains pyroclastic volcanic deposition, defined as the Gürgürbaba Hill sector D. Gürgürbaba Hill sector D was also dated to 424,000 years ago using the <sup>40</sup>Ar/<sup>39</sup>Ar method<sup>24</sup>. The B2 level is a continuation of level B1. Unlike the B1 level, it was characterized by smaller rock fragments. The grain size is small, and there are vertical, possible plant root cavities that are orange in colour and resemble the fill of the overlying strata<sup>25</sup>.

### Material and Method

In 2021, detailed research was conducted using intensive survey techniques in localities 018 and 020, which were identified during the 2015 surveys. The chipped stones produced from obsidian raw materials GBT-018 and GBT-20 constitute the material used in this study. Locality 018 is northwest of the dirt road leading to the village of Tuğlu, where erosion has left a partial soil fill of approximately 1-2 m in height remains. Locality 020 is northwest of the dirt road

20 Akköprü et al. 2019.

21 Arslan 1994.

22 Baykara et al. 2022a.

23 op.cit.

24 Akköprü et al 2019.

25 Baykara et al. 2023.

leading to the village of Tuğlu and has been partially destroyed by the road opened for the obsidian mine. There is a soil fill approximately 10 m in width between localities 018 and 020. Therefore, the chipped stones found in the study area were evaluated together. To determine the evidence of Palaeolithic human activities and the occupation of the region, the coordinates of all the remains visible on the surface were recorded using CORS GPS. The data of the study were modelled using ArcGIS software, and distribution maps were created (fig. 4).

Due to the moderate slope of the hill and its location within a north-east-flowing stream bed, erosion has partially removed the soil fill, periodically exposing artifacts. The shallow depth of the stream suggests that these sites were only recently exposed. It was observed that the hill generally opened during the discharge of snow water in winter and dried up at the end of May. This seasonal hydrological pattern results in a low stream flow rate, which has helped preserve some in-situ archaeological remains while allowing for the deposition and exposure of artifacts. In addition, because of the low water flow rate in the area, it was possible to detect chipped remains smaller than 2.5 cm. The presence of small-sized herbaceous plants (thyme, sage, etc.) on Gürgürbaba Hill makes the obsidian easily visible in the area. In addition to these features, the preservation status of the finds exposed owing to the current use of the area is quite low. Owing to the widespread herding in the region and the herds passing through the finds, recent fractures can be seen in the remains. Owing to the patinal difference in the remains, recent fractures can be easily detected.

Technological descriptions of the chipped stone remain recovered from GBT-018 and GBT-020 were made according to Inizian et al. (1999) and Kuhn et al. (2009). Levallois (Lev.) findings were classified according to Van Peer (1992), Debénath and Dibble (1994), and Boëda (1995). Bordes' (1961) typology list was used for the typological classification of chipped stone remains and handaxes.

To determine the similarities between the technologically and typologically examined chipped stone remains and those from other localities, we used Principal Component Analysis (PCA) to create a graph. However, the technological classification of the chipped stone artifacts is based on ordered categorical data. The magnitude relationship between numerical values (e.g., the value "1" being smaller than "5") can lead to the attribution of artificial meaning in statistical analysis. This situation can lead to incorrect results, especially in multivariate analyses based on variance and covariance (e.g., PCA or CVA). To eliminate this problem, the variable in issue was transformed into a binary format. During the transformation process, if, for example, the code "5" is not present in the data set and the code '0' is present, this situation is recoded as "1"; thus, artificial statistical effects that could be caused by sequential values are avoided. This approach has ensured more reliable and meaningful results in the analyses. The PCA method combines highly correlated variables to form a cluster called "principal components," which account for the most variation in the data groups. PCA data standardization involves the steps of calculating the covariance matrix, calculating eigenvalues and eigenvectors, classifying eigenvalues, selecting principal components, and creating a new data set. As a result, it displays variance values through identification and classification processes in high-dimensional data. When examined statistically, the data set is defined as a matrix containing  $n$  ob-

servations and p variables. The mean of each variable is calculated, and this mean is subtracted from the relevant variable to center the data. Covariance values are calculated from the X variables representing the data center. The eigenvalues and eigenvectors of the covariance matrix are calculated. Eigenvalues show how much variance in the data each component explains, while eigenvectors explain the direction of movement. Eigenvalues are sorted from largest to smallest, and those with the highest eigenvalues are selected. This indicates the components that explain the most variance in the data<sup>26</sup>.

### Results of Lithic Assemblages

As a result of the 2021 intensive surveys, the chipped stone remains identified at localities GBT-018 and GBT-020 were evaluated together because the areas border each other. During these surveys, 1712 chipped stone remain from GBT-018 and 1120 from GBT-020 were located using CORS GPS, and a density distribution map was created. Among the chipped stone remains distributed in the area, a total of 727 chipped stone remains with typical characteristics were selected for detailed technological and typological analyses. Among these remains, there were 423 blanks, 100 cores, 189 handaxes, and 15 hammers.

Given that the GBT site is situated within the obsidian deposit of the Meydan Mountain volcano, obsidian was the primary raw material used for chipped stone production, with a strong preference for black obsidian. However, other obsidian variants were also utilized, including 19 brown obsidian artifacts (11 blanks, 6 handaxes, 2 cores) and 6 brown-red obsidian artifacts (4 blanks, 1 handaxe, 1 core). In addition to obsidian, basalt (1 blank) and trachy-basalt (1 blank and 2 handaxes), which are also volcanic rock types, were used as raw materials.

Fig. 5 shows the condition of all chipped stone artifacts recovered from localities GBT-018 and GBT-020. The majority of the blanks consisted of broken fragments (n=213), which include proximal, distal, medial, and split fragments. Complete fragments (n=199) were also found in significant quantities. Among the broken fragments, distal fractures (n=104) were the most common, followed by proximal (n=66) and medial (n=37) fractures. Complete fragments (n=88) were predominant in the cores. In addition, small amounts of distal (n=8), proximal (n=2), and medial (n=2) fragments were found. Complete fragments (n=107) were generally observed on the handaxes. Additionally, proximal (n=41), distal (n=22), medial (n=7), and split (n=12) fragments were found, although not intensively. The high frequency of broken fragments in the assemblage is attributed to recent fractures caused by ongoing land use, in addition to older fractures resulting from prehistoric use and knapping activities.

Fig. 6 shows the blank types recovered from localities GBT-018 and GBT-020. When the blank types were analysed, there was an industry dominated by flakes (n=334, 79%). Simple flakes (n=200) were predominant, followed by large flakes (n=59), Levallois flakes (n=44), and cortical flakes (n=18). In addition, kombewa flakes (n=7), natural backed flakes (n=3), atypical Levallois flakes (n=3), and flake fragments (n=13) were also found in small quantities. In addition to

<sup>26</sup> Abdi – Williams 2010.

flake carries, there are also plain blades (n=22), Levallois blades (n=15), cortical blades (n=3), éclat débordant (n=4), and one each of large blades and naturally backed blades.

Fig. 7 shows the metric measurements of plain flakes, plain blades, Levallois flakes, Levallois blades, and large flake residues according to the blank types. Accordingly, it was determined that the average length of the plain flakes was 83 mm, width 74,25 mm, thickness 24,4 mm, platform width 47,7 mm and platform thickness 19,23 mm. The average length, platform width, and platform thickness of the Levallois flakes were 78.33 mm, width 59.26 mm, thickness of 15.51 mm, platform width of 43.17 mm and platform thickness of 15.57 mm. When the measurements of plain blades were analysed, it was determined that the average length was 107.86 mm, width 48.05 mm, thickness 20.77 mm, platform width 33.08 mm and platform thickness 15.17 mm. In Levallois blades, the average length was 98.33 mm, width 46.2 mm, thickness 16.27 mm, platform width 30.08 mm, and platform thickness 12 mm. In large flakes, the average length was 124.44 mm, width 118.97 mm, thickness 43.25 mm, platform width 70.87 mm and platform thickness 33.33 mm. In addition, the metric measurements of the carriages were statistically compared. Plain flakes and Levallois flakes were compared in terms of width (p-value of Mann-Whitney U test: 0,000), thickness (p-value of Mann-Whitney U test: 0,000) and platform thickness (p-value of Mann-Whitney U test: 0,047), while no statistically significant difference was observed for length (p-value of Mann-Whitney U test: 0,271) and platform width (p-value of Mann-Whitney U test: 0,228). In the comparison of the measurements of the plain blade and Levallois blades, an independent-samples t-test was applied because the length, width, and thickness measurements of both types of carriers showed normal distribution. Accordingly, no statistically significant difference was observed between the plain blade and Levallois blades in terms of length (p: 0,441), width (p: 0,739) and thickness (p: 0,144) measurements. Since the platform measurements of these two types of carriers were not normally distributed, the Mann-Whitney U test was applied. Accordingly, no statistically significant difference was observed between the plain blade and Levallois blade in terms of the platform width (p-value of Mann-Whitney U test: 0,414) and platform thickness (p-value of Mann-Whitney U test: 0,119).

The chipped stones recovered from the localities and typologically analysed are shown in Figure 8. Side scrapers were intensively found in the retouched findings. There were different types of side scrapers, such as single straight side scrapers (n= 19), single convex side scrapers (n= 17), convex transverse side scrapers (n= 10), side scrapers on the ventral surface (n= 8), convergent convex side scrapers (n= 6), and double concave/convex side scrapers (n= 4). There were also large retouched tools (n= 25), miscellaneous (n= 6), notch (n= 5), Mousterian point (n= 4), handaxes flake (n= 3), flakes with abrupt and alternating retouch (n= 5), Levallois point (n= 2), retouched natural pieces (n= 11), and retouched chipped stone remains, such as typical and atypical endscrapers, inverse choppers, denticulate, and elongated Mousterian points.

As shown in fig. 9, flat platforms (n = 180) were the most common among the lithic remains. A significant number of broken platforms (n = 139) were also identified, likely due to the high frequency of broken distal fragments.

Other observed platform types included faceted ( $n = 67$ ), cortical ( $n = 24$ ), and dihedral with two facets ( $n = 1$ ).

Fig. 10 shows the orientation and origins of the dorsal scars of the lithic assemblages. The majority of the scars were multidirectional/orthogonal ( $n = 200$ ), followed by a substantial number of parallel scars ( $n = 149$ ). Less frequent but still notable orientations included convergent asymmetric scars ( $n = 21$ ) and convergent symmetric scars ( $n = 6$ ). Regarding the origins of the dorsal scars, the most common patterns were proximal scars ( $n = 153$ ) and centripetal scars ( $n = 141$ ), observed in a nearly linear proportion. Additionally, a significant number of orthogonal dorsal scars ( $n = 58$ ) were recorded.

Fig. 11 shows the types, number of platforms, and number of faults in the core remains recovered from GBT-018 and 020. Among the core types, non-Levallois cores ( $n = 68$ ) were more abundant than Levallois cores ( $n = 32$ ). When the core types are analysed, the unifacial form ( $n = 43$ ) is the most common core type. In addition, Levallois was unidirectional ( $n = 21$ ), tested ( $n = 10$ ), Levallois point core-broad ( $n = 5$ ), Levallois bidirectional ( $n = 5$ ), core on flake ( $n = 4$ ), prismatic blade core ( $n = 3$ ), bifacial, centripetal Levallois, single/double platform (protoprismatic), and polyhedron core types. In addition, 5 cores with unidentified forms were identified. When the number of platforms is analysed, it can be seen that there are mostly single platforms ( $n = 55$ ). In addition, cores with two platforms ( $n = 33$ ) were observed in close proportions. There were a few cores with three or more platforms ( $n = 8$ ). When the flaws occurring on the cores due to production or raw materials are analysed, heavy step fracturing ( $n = 70$ ) is found in large amounts.

Fig. 12 shows the platform orientations of the Levallois and non-Levallois cores. In both core types, only one platform was observed in terms of platform orientations. In addition, opposing faces ( $n = 11$ ) and opposing faces ( $n = 7$ ) were also common in the non-Levallois cores. In Levallois cores ( $n = 31$ ), opposite faces ( $n = 4$ ) and orthogonal faces ( $n = 3$ ) were frequently observed.

Fig. 13 shows the general distribution of the technological characteristics of the handaxes. Accordingly, flakes ( $n = 114$ ) were the most common type of blank, followed by tabular pieces ( $n = 36$ ) and angular chunks ( $n = 23$ ). The majority of the handaxes had plano-convex ( $n = 93$ ) and biconvex ( $n = 84$ ) sections. The edge profiles are predominantly straight ( $n = 106$ ). The proximal part of the handaxes was roundish ( $n = 55$ ), with a high number of straight ( $n = 48$ ) and round ( $n = 43$ ) handaxes. The distal part of the handaxes was point-shaped ( $n = 100$ ). Hard-hammer ( $n = 87$ ) was used predominantly during the chipping of the handaxes, but soft hammer ( $n = 52$ ) and hard hammer + soft hammer shaping of the edge ( $n = 47$ ) were also used in close proportions. When we examined the amount of patina in terms of its embedment in the area, there was intense patination on both the dorsal and ventral surfaces. In terms of the cortex ratios, the amount was quite low on both the dorsal and ventral surfaces. Generally, there is no cortex on the handaxes.

The typological characteristics of the handaxes were established according to Bordes (1961) methodology. When the typology of the handaxes was analysed according to the metric measurements, it was observed that the number of flat ( $n = 53$ ) and thick ( $n = 50$ ) handaxes were close to each other (fig. 14-18). Flat

mutations were predominantly observed in the other GBT findings. Among the flat handaxes, the cordiform handaxes (n= 42) were predominantly used (fig. 14.1-5; fig.16.1-8). Triangular (n= 8) (fig.16.9-10), ovate (n= 2), and limande (n= 1) were also observed in this group. In the thick group, the amygdaloids (n= 42) (fig.14.6-9; fig.15) were the most common. In addition, there was lanceolate (n=3), Micoquien (narrow long) (fig. 17.1) (n= 3), and one Micoquien/Halbkeile (n= 1). This typology also includes eight cleavers, one chopping tool, and a chopper. Cleavers are generally made of coarse flakes and exhibit dense stepped trimming (fig. 17.2-3). A Quina-type retouch was found in four of them, with the ventral surfaces heavily smoothed and patinated. Most cleavers did not show any cortex, with only two specimens having small amounts. These cleavers were primarily chipped with a hard hammer, although one specimen also exhibited hard hammer and soft hammer shaping of the edge. The chopping tool and chopper were both made from different types of blanks. The chopping tool was fashioned from an angular chunk, while the chopper was created from a flake blank. Both tools showed significant patination and lacked cortex, suggesting they were heavily used.

### Discussion

Technological and typological analyses of the chipped stone remains recovered from localities GBT-018 and GBT-020 were conducted and compared with findings from other sites in the area and nearby settlements. A total of 727 chipped stone remains were identified, including 423 blanks, 100 cores, 189 handaxes, and 15 hammers. The lithic assemblages from GBT-018 and GBT-020 are primarily composed of complete fragments. However, owing to the proximity of the finds to the surface, a significant number of broken pieces were also recorded, especially among the blank. The chipped stones exhibited intense patination, further indicating their prolonged exposure to surface conditions. The industry consisted of plain flakes (n= 200). In addition, large flakes (n=59) (Fig.17.4-5) were found in large quantities. There are also various types of blank remains, such as Levallois flakes, plain blades, Levallois blades, and core edges. In addition, cortical flakes and kombewa flakes were also found in very high quantities. Among the platform types of blanks, flat platforms are the most common. In addition, the high number of broken platforms, in direct proportion to the state of preservation, suggests that the proportion of platform types may vary. Faceted platform types are mainly associated with Levallois remains. When the dorsal scar types were analysed, it was determined that the industry was predominantly multidirectional (n= 200) and parallel (n= 149). In addition, the measurements of the plain flake/blade and Levallois flake/blade were compared. Plain flakes were found to be longer, thicker, and wider than Levallois flakes, and a statistically significant difference was observed between the two carriage types in terms of width, thickness, and platform thickness. In the case of blades, although the measurements of plain blades were higher than Levallois blades, no statistically significant difference was observed between the two carriage types.

Among the 100 cores identified in both areas, the unifacial (n= 43) and Levallois unidirectional (n= 21) cores were the most prevalent. In addition, various other core forms were present, including tested cores, Levallois point

core-broad, Levallois bidirectional, and prismatic blade cores. Analysing the dorsal scar ratios in the cores revealed that parallel and orthogonal scars were relatively scarce. The parallel production in the cores compared to the similar ratios of parallel and centripetal scars in the blank types indicates that the core morphology changed in the formation of the end products.

In terms of retouched tools, a variety of side scraper types were identified, including single straight side scrapers, single convex side scrapers, convex transverse side scrapers, and side scrapers on the ventral surface. In addition, other tools with distinct typological characteristics, such as large retouched tools, notches, miscellaneous, Mousterian points, and Levallois points, were present. When side scrapers were analysed in terms of the morphology of the retouch, fine marginal, abrupt, and simple scalar retouch types were commonly observed. Notably, Quina-type retouch appeared in most side scrapers with a simple scalar retouch. A total of 22 side scrapers were used, including convex side scraper (n=7), single convex side scraper (n=4), convergent convex side scraper (n=3), double convex side scraper (n=2), single straight side scraper (n=2), déjeté convex side scraper (n=1), double straight/convex side scraper (n=1), side scraper on the ventral surface (n=1), and double convex side scraper (n=1). Two large retouched tools and one thick flake also exhibited a Quina-type retouch. Compared with other studies, a Quina-type retouch is more common. Only one concave transverse side scraper at GBT-10, two large retouched tools, and two double convex side scrapers at GBT-028 displayed a Quina-type retouch.

Among the handaxes that constitute another chipped stone group within the retouched group, flakes were preferred as the blank type. The handaxes were mainly symmetrical and small. Although the hard hammer technique is generally used in the production of handaxes, soft hammers, and hard and soft hammer-shaping techniques were also observed. The handaxes featured plano-convex and biconvex sections, while the edge profiles were generally flat. The proximal parts exhibited roundish, straight, and round in close proportions, whereas the distal parts were mostly pointed in shape. The dense patination on the dorsal and ventral surfaces of the handaxes indicated that the handaxes were highly visible on the surface and exposed to external factors. Flat and thick handaxes were found in close proportions in the handaxes. In addition, thick forms-amygdaloid and flat forms-cordiform were almost equal in number and were preferred more than the other types. In addition, handaxes with different typological characteristics, such as triangular, limande, and ovate within flat forms and lanceolate, micoquien, and micoquien/halbkeile within thick forms, were also identified in the area. Unlike GBT-010 and GBT-028, chopping tools, choppers, and cleavers were also found among bifacial chipped stones. While no cleavers were found in GBT-028, three pieces were found in GBT-010, distinguishing this assemblage from the other localities.

In the GBT Palaeolithic Period settlement area, many remains were reached by applying intensive survey methods in localities with high surface visibility and a significant number of chipped stone remains. These techniques facilitated the discovery of numerous lithic artifacts across four primary localities—GBT-010, GBT-018, GBT-020, and GBT-028—alongside other sur-

veyed areas<sup>27</sup>. A comparative technological and typological analysis of the lithic assemblages from GBT-010<sup>28</sup> and GBT-028<sup>29</sup>, which were extensively studied at Gürgürbaba Hill, revealed broad similarities among these sites. There is a flake-oriented industry in localities GBT-018 and 020, as in the others. While plain flakes were found intensively, other blank types such as large flakes, Levallois flakes, Levallois blades, and plain blades were also found in quite significant proportions. The number of non-Levallois cores was high in GBT-018 and 020, as in GBT-028. In GBT-010, the number of Levallois cores was high, unlike in the other localities. Different types of side scrapers, such as single straight, single convex, and double convex, were found intensively in all localities. In terms of the morphology of the retouched tools, Quina-type retouch tools were relatively rare in most sites, but they were prevalent in localities GBT-018 and 020 compared to the others. When the handaxes were analysed, there were almost equal proportions of flat and thick sectioned ones in GBT-018 and 020 as in GBT-010 and GBT-028. Typologically, cordiform and amygdaloid handaxes were found in high proportions in all the localities. Although the proportion of cleavers (n= 8) was lower in GBT-018 and 020, the number of cleavers (n= 8) was higher than in the other localities. The Principal Component Analysis (PCA) was also applied to evaluate the technical characteristics of the chipped stones (fig. 19–21). The analysis of PCA, which includes technological comparisons, revealed a relatively low change in eigenvalue values, indicating significant technological similarities between the localities. When examining the plain flake, plain blade, Levallois flake, and Levallois blade data within the blank type, general similarities were observed across all localities, with differences appearing in only a few instances (fig. 19). The chipped stone remains from GBT-010 exhibited slight differences in buttshape, profile, platform modification, platform type, and dorsal scars in the plain flake. In the case of plain blades, differences were noted in termination among a few specimens. The Levallois flake remained generally similar. There are differences in platform type and buttshape in GBT-010 and the profile in GBT-028 in a few specimens. Although the Levallois blade differed in scars and terminations in a few specimens at GBT-010, it was generally similar in all localities. The technological comparison of cores including unifacial cores, centripetal cores, Levallois unidirectional cores, and Levallois bidirectional cores, also indicated general similarities, with only minor differences observed in a few cases, similar to the blank types (Fig. 20). Notably, since centripetal Levallois cores were absent in GBT-028, their distribution analysis was limited to GBT-010, GBT-018, and GBT-020. The technological characteristics of handaxes also displayed overall consistency across the sites. The edge profile and proximal parts of cordiform handaxes exhibited minor variations in a few specimens from GBT-028, while slight differences in percussion and section were noted in GBT-010. In almond handaxes, differences were observed in the blanks, sections, and left-side edge profiles of a few specimens from GBT-010, but the general characteristics remained similar. Lanceolate were found in

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27 Baykara et al. 2022a; Baykara et al. 2022b; Baykara et al. 2023.

28 Baykara et al. 2022a.

29 Baykara et al. 2022b.

very small quantities in the localities. Owing to the scarcity of data, the *eigenvalue* value was high and the rate of variation in the distributions was high (Fig. 21.A). When analysing the metric measurements of the handaxes, the cordiform, amygdaloid, and triangular types displayed similar measurements, with only minor variations in a few samples. However, the lanceolate type, despite being represented by fewer specimens, exhibited more pronounced differences in terms of measurements (fig. 21.B).

Large Flake Acheulian (LFA) is defined as an industry with technological and typological differences within Acheulian lithic assemblages. This lithic assemblage, which was evaluated in a very large geographical area, is defined as a separate phase of the Acheulian based on various criteria. Sharon (2010) defines this industry as flake-dominated production and states that it is characterized by the presence of a low proportion of oval-shaped handaxes, and a high proportion of cleaver remains. The distal part of the handaxes is generally pointed, broad and oval blades are very rare, and bifaces must be larger than 10 cm in size. Several different methods have been used to shape bifaces. One approach involves minimal shaping of the ventral surface of handaxes made from large flakes, achieved primarily by thinning the striking bulb of the flake. Another method is the intensive retouching of both surfaces of the handaxes, which are usually made on unprocessed flake carriers. The core defined within the LFA industry is large and depending on the know-how in core technology, it has been stated that flakes with the desired shape are obtained with almost no additional correction by predetermining the processed flakes before separation from the core<sup>30</sup>. Within the LFA group, high-quality and fine-grained raw materials (flint, obsidian, etc.) are generally found near settlements, although lower-quality and coarse-grained raw materials (basalt, dolerite, etc.) are preferred for production<sup>31</sup>. However, it has also been reported that some communities used fine-grained, high-quality rocks as an exception to the general pattern<sup>32</sup>. When comparing the LFA with the lithic assemblages from GBT-018 and GBT-020, both similarities and significant differences can be observed between these industries. This is similar to a flake-dominated industry. The number of oval-shaped handaxes was relatively low, and most of the handaxes (n=189) exceeded 10 cm in length, with 134 specimens surpassing this threshold. However, the number of heavily retouched cleavers, which is common in LFA, was quite low (n=8). In terms of bifacial modification, 70 handaxes from GBT-018 and GBT-020 exhibited dense retouch on both their ventral and dorsal surfaces, while 26 lacked any retouching on the ventral surface. More than half (n=56) of the cores recovered from the GBT localities were larger than 10 cm, and 43 of the end-products from these cores contained flakes larger than 10 cm. Additionally, the handaxes from GBT-018 and GBT-020 shared a notable similarity with the LFA industry in that their distal ends were predominantly pointed (n=100). Localities GBT-018 and 020 are on the obsidian raw material source, and other volcanic sources, such as basalt, trachy basalt, and rhyolite, can be easily accessed within the site. However, in the

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30 Sharon 2009.

31 Sharon 2008.

32 Sharon 2010.

GBT assemblages, trachy basalt was preferred in two samples, whereas obsidian was used in the rest of the industry. This choice in the use of raw materials may be because it is one of the exceptional findings mentioned by Sharon (2008). In terms of the general characteristics of the handaxe remains recovered from the sites, there is a proximity to LFA technology, but it cannot be said that it is completely like this industry.

The lithic assemblages recovered from localities GBT-018 and 020 were evaluated in comparison with the other localities identified at Gürgürbaba Hill and the Lower Palaeolithic Late Acheulian sites known from Türkiye, the Caucasus, and the Levantine. Very few sites date to the Late Acheulian Culture in Anatolia. There are settlement areas such as Yarımburgaz Cave, Dursunlu, Karain Cave, and Kaletepe Deresi 3, where detailed data are available from excavations. In addition, there were sites identified by various surveys (fig. 1). The open field settlement of Dursunlu, located within the borders of Konya Province, was dated to approximately 780-990 thousand years ago. It is a flake-dominated industry. Retouched tools, poly-facials, and cores are abundant on the site. However, lithic assemblages generally belong to Mode 1 technology in general<sup>33</sup>. Yarımburgaz Cave, located within the borders of the Istanbul Province, has a flake-dominated industry. While there remain retouched flakes and denticulate tools in the cave, bifacial handaxes and remains belonging to Levallois technology are absent<sup>34</sup>. In Kaletepe Deresi-3, which is located within the volcanic area of Göllüdağ within the borders of Niğde Province, the Lower Palaeolithic levels consist mainly of poly-facial artifacts. In level IV of Kaletepe Deresi-3, large tools produced with a technique close to Levallois technology were found, whereas in Level V, large tools made of basalt and rhyolite and bifaces tools made of obsidian were found. Flat convex, asymmetrical handaxes, and flakes, which are the remains of bifacial tool production, are abundant at levels VI-XII<sup>35</sup>. Another site is Karain Cave, located in the province of Antalya. There is also a flake-based industry. Remains with various typological characteristics, such as retouched flakes, side scrapers, denticulate, and notched tools, have been identified in caves<sup>36</sup>. Localities GBT-018 and 020 have a flake-dominated industry, similar to the Lower Palaeolithic settlements in Anatolia. Although plain flakes are found intensively, blanks such as large flakes, Levallois flakes and blades, plain blades, edges of cores, and cortical flakes are also found intensively. In terms of tool typology, side scrapers of different forms have been extensively found. There are various types of tools, such as Levallois and Mousterian points, handaxes flakes, denticulates, and notches. In terms of core technology, unidirectional forms such as unifacial and Levallois are commonly found. In addition, unlike the other settlements in Anatolia, handaxes with various typological characteristics such as bifacial and unifacial are found in large quantities. For this reason, similar to other localities in Gürgürbaba Hill, where detailed studies were carried out, localities GBT-018 and 020 differ from the Lower Palaeolithic sites in Anatolia in terms of their technological and typological characteristics.

33 Güleç et al. 1999; Güleç et al. 2002; Güleç et al. 2009.

34 Özdoğan 1998; Kuhn et al. 1996; Arsebük 1996; 1998.

35 Slimak et al. 2008; Kuhn et al. 2015.

36 Otte et al. 1998; Yalçınkaya et al. 2003.

The lithic assemblages recovered from the GBT localities were evaluated technologically and typologically by comparing them with the settlements in Levantine, which were dated to the early phases of the Late Acheulean Period. The Late Acheulean culture in Levantine is characterized by a preference for flint and silicium raw materials and the low number of handaxes produced with soft hammers and tools such as choppers and scrapers<sup>37</sup>. In addition, cordiform and ovate handaxes are generally preferred in the Levantine, while lanceolate and triangular handaxes, cleavers, and chipped stones produced with Levallois technology are very rare<sup>38</sup>. Sharon (2016) stated that the sites identified for the early phases of the Late Acheulean Period in the Levantine are generally the result of surveys that do not include a regular chronology. Detailed information on this period in the region was obtained from the Nadaouiyeh excavation in the El-Kowm plain in Syria, dated to approximately 550-325,000 years ago<sup>39</sup>. The Nadaouiyeh site is characterized by the frequent use of retouched tools and handaxes<sup>40</sup>. The Late Acheulean Period of the Levantine, defined as the Acheulo-Yabrudian complex, is characterized by ovate and pointy-shaped handaxes<sup>41</sup> and non-Levallois blades, wide-thick flakes, and Quina-type scrapers<sup>42</sup>. This period preceded the Mousterian period of the Levantine and constituted the last phase of the Lower Palaeolithic<sup>43</sup>. The settlements that technologically and typologically best reflect the chipped stone remains of the period within the Levantine Acheulo-Yabrudian assemblages are Tabun Cave, Revadim Quarry (403-194.000 years ago), and Holon (200.000 years ago) settlements within Israel<sup>44</sup> (fig. 1). The lithic assemblages of the Holon site are characterized by handaxes, flakes, and cores on flakes<sup>45</sup>. Revadim Quarry has a flake-dominated industry. The site is characterized by a lithic assemblage consisting of Quina-type scrapers, core on flakes, choppers, and ovate-type handaxes in general<sup>46</sup>. In addition, a cleaver was also found in this area, although with only one example<sup>47</sup>. When comparing the chipped stone remains identified from GBT-018 and 020 to the Levantine Acheulo-Yabrudian chipped stone remains, similarities emerge in the flake-dominated industry and the use of handaxes. In addition, although not very dense, there were Quina-type chipped stone tools (n= 26) and handaxes (n= 5) among the chipped stone remains. Levallois technology was found in both cores (n= 21) and blanks (n= 64), although not very intensively so. In terms of the use of the preferred hammer in handaxe production, although a hard hammer (n= 87) was preferred intensively in the localities GBT-018 and 020, the use of a soft hammer (n= 52) was also notably high.

37 Gilead 1970; Bar-Yosef 1998; Doronichev 2008.

38 Sharon 2014.

39 Le Tensorer et al. 2007; Jagher 2016.

40 Jagher 2011; 2016; Moncel et al. 2018.

41 McPherron 2003; Zaidner et al. 2006; Gisis – Ronen 2006.

42 Adler et al. 2014; Sharon 2014; Malinsky-Buller 2014; Shimelmitz et al. 2016.

43 Jelinek 1982.

44 Marder et al. 1999; 2006; Malinsky-Buller 2014; Malinsky-Buller 2016; Agam et al. 2014; Shilmelmitz et al. 2016; Agam – Barkai 2018.

45 Malinsky-Buller 2014; Malinsky-Buller 2016.

46 Marder et al. 1999; Marder et al. 2006; Agam – Barkai 2018.

47 Marder et al. 2006.

The Caucasus is geographically close to the GBT locality, yet the Lower Palaeolithic remains from the North Caucasus (south of Russia) are very limited. Among the best-described sites is Treugolnaya Cave. The Lower Palaeolithic cave is dated to the Middle Pleistocene Period (OIS 15-11) approximately 600-350 thousand years ago. Analysis of the lithic assemblages from this cave reveals that the settlement, associated with the Tayacian culture, primarily contains large tools, such as side scrapers with heavy trimming, denticulate tools, and choppers<sup>48</sup>. In contrast, the lithic assemblages from the GBT localities (GBT-018 and GBT-020) exhibit a significant presence of handaxes in various forms and Levallois technology. This distinction highlights key differences, as the Tayacian industry of the North Caucasus predominantly consists of choppers and retouched tools made on small flakes.

In the South Caucasus (South Georgia, Azerbaijan, and Armenia), Late Acheulean finds are more abundant, showing notable similarities to the findings of Gürgürbaba Hill. Hatis-1, one of the sites identified as a result of research carried out in the volcanic areas of the Hrazdan Valley of Armenia<sup>49</sup> was dated to 700–480 thousand years ago by K-Ar dating. The Hatis-1 site has an industry consisting of large flakes produced from flake-shaped cores and tools produced from them and is defined as the LFA industry<sup>50</sup>. Although the sizes of the cores were generally larger than 10 cm and angular chunk cores (n= 51) were dense in GBT-018 and 020, flakes (n= 34) were not very dense. Single-striking plane cores and Levallois single-striking plane cores were abundant. It is stated that the handaxes found at Hatis-1 are closer to Types III and IV of Bordes' typology, among which the cordiform and amygdaloid-shaped ones in group III and the ovate-shaped ones in group IV predominate. While cordiform and amygdaloid-shaped handaxes are abundant at GBT-018 and 020, ovate-shaped handaxes are rare. The cleaver was not found among the chipped stone remains at Hatis-1, but GBT-018 and 020 contain a small number of cleavers (n= 8). Although the forms of the handaxes are similar, there are slight differences with the Hatis-1 industry owing to the presence of a cleaver. Another site is the Nor Geghi 1 open-field settlement dated to the last phase of the Late Acheulean Period. This site was dated between 197-441 thousand years using the <sup>40</sup>Ar/<sup>39</sup>Ar method. Nor Geghi 1 Late Acheulean lithic assemblages are defined as a combination of handaxes and the Levallois industry, where the production of Quina-type retouched tools and blades began<sup>51</sup>. The industry in the area where obsidian is used as raw material is represented by single striking plane cores and Levallois cores. The dorsal traces of the Levallois cores were characterized by parallel and centripetal extractions. Levallois flakes and blades contained flat and faceted heels, and their dorsal traces were parallel. Side scrapers were found in the retouched chipped stone group<sup>52</sup>. The handaxes found in the settlement area were morphologically similar to those in the Late Acheulean Period. Localities GBT-018 and 020 are like Nor Geghi 1

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48 Doronichev 2008; Doronichev – Golovanova 2010.

49 Adler et al. 2014; Gasparyan 2010; Belyaeva 2020; Frahm et al. 2020; Frahm et al. 2021; Gill et al. 2021; Golovanova et al. 2022.

50 Gill et al. 2021.

51 Adler et al. 2014.

52 op.cit.

because of the combination of handaxes and Levallois technology, the abundance of side scrapers, and the retouching of tools with Quina-type retouch, albeit at low rates. Like GBT-010 and GBT-028, localities GBT-018 and 020 are technologically and typologically similar to the Late Acheulean sites of the South Caucasus.

### **Conclusion**

Through the technological and typological analysis of the GBT-018 and GBT-020 lithic assemblages, this study emphasizes the critical role of Eastern Anatolia in Pleistocene archaeology. These Late Acheulean localities, situated at approximately 2200 m above sea level within the Meydan Volcanic Mountain complex — a key source of obsidian raw material — were examined jointly due to their close spatial relationship, as established during the intensive survey phase of the Van Province Pleistocene Period Survey in 2021. The data confirm that the GBT-018 and GBT-020 sites align structurally with other sites at Gürgürbaba Hill (such as GBT-010 and GBT-028). This finding is further substantiated by supplementary statistical analyses (PCA data). The diagnostic features of these assemblages, particularly the technological coexistence of handaxes and sophisticated Levallois production, reveal clear parallels with regional traditions such as the Levantine Acheulo-Yabrudian and the Late Acheulean settlements of the South Caucasus (e.g. the Hrazdan Valley). This technological convergence is more than just a shared artefact type; it represents a notable record of hominin behavioral connectivity and adaptive exchange. These dual affinities suggest that eastern Anatolia was not a peripheral zone, but rather a dynamic intersection point and cultural basin where ideas and populations from the Levant and the Caucasus overlapped and interacted. This highlights the region's significant potential for future Pleistocene research, particularly in clarifying the complex relationship between Paleolithic human mobility, technological transfer and the exploitation of localized resources in high-altitude environments.

**Öz****Gurgurbaba Tepesi'nde (018 ve 020 Numaralı Alanlar) Yüksek Plato Adaptasyonu ve Geç Aşölyen Endüstrisi, Van / Türkiye**

Türkiye, Afrika ve Avrasya kıtaları arasındaki stratejik konumuyla Paleolitik Dönem yayılımları için anahtar bir bölge olmuştur. Türkiye'nin doğusunda bulunan Van ili ise jeolojik ve iklimsel özellikleriyle bu yayılım rotalarının önemli duraklarından birini oluşturmaktadır. Pleistosen dönemde üç kıta arasındaki hominin göçünü araştırmak amacıyla Van'ın kuzeyinde, Ulupamir köyünde bulunan Gurgurbaba Tepesi'ndeki obsidiyen yataklarında yüzey araştırması gerçekleştirilmiştir. Son araştırmalarla bu Geç Aşölyen buluntu alanlarının yaklaşık olarak 424 bin ile 311 bin  $\pm 32$  yıl öncesine, Deniz İzotop Seviye 9 (Marine Isotope Stage 9 / MIS9) olarak bilinen Orta Pleistosen buzularası dönemine ait olduğu belirlenmiştir. Bölgede gerçekleştirilen en son yüzey araştırması çalışmalarında, 018 ve 020 numaralı buluntu alanlarından toplam 2.832 adet obsidiyen yontmataş kalıntı tespit edilmiştir. ArcGIS kullanılarak her bir eser üzerinde yontmataş veri analizi yapılmıştır. Veriler hem yakın bölgelerdeki hem de Gurgurbaba Tepesi'ndeki diğer buluntu alanlarıyla (GBT-010 and GBT-028) karşılaştırmalı olarak değerlendirilmiştir. GBT-018 ve GBT-020 buluntu alanları, verilerle kanıtlandığı üzere, Gurgurbaba Tepesi'ndeki diğer buluntu alanlarıyla teknolojik ve tipolojik olarak benzerdir. Bu bulgu, istatistiksel analizler (PCA verileri) tarafından da desteklenmektedir. El baltaları, Quina tip kazıyıcılar ve Levallois tekniğinin kullanıldığına dair kanıtların bulunması, Gurgurbaba'nın Güney Kafkasya ile Levant arasında önemli bir bağlantı noktası olduğunu göstermektedir. Bu bulgular, Orta Pleistosen döneminde homininlerin bölgeler arasında hareketliliğine ve yüksek plato ortamlarına adaptasyonuna dair kanıtlar sunmaktadır.

**Anahtar Kelimeler:** Geç Aşölyen, Orta Pleistosen, Deniz İzotop Seviye 9, Gurgurbaba Obsidiyeni, Acheulo-Yabrudian, Yüksek Plato Adaptasyonu

## Bibliography and Abbreviations

Gürgürbaba Hill: GBT

Large Flake Acheulian: LFA

Lev.: Levallois

Principal Component Analysis: PCA

MIS: Marine Isotope Stage

op.cit.: Opere Citato

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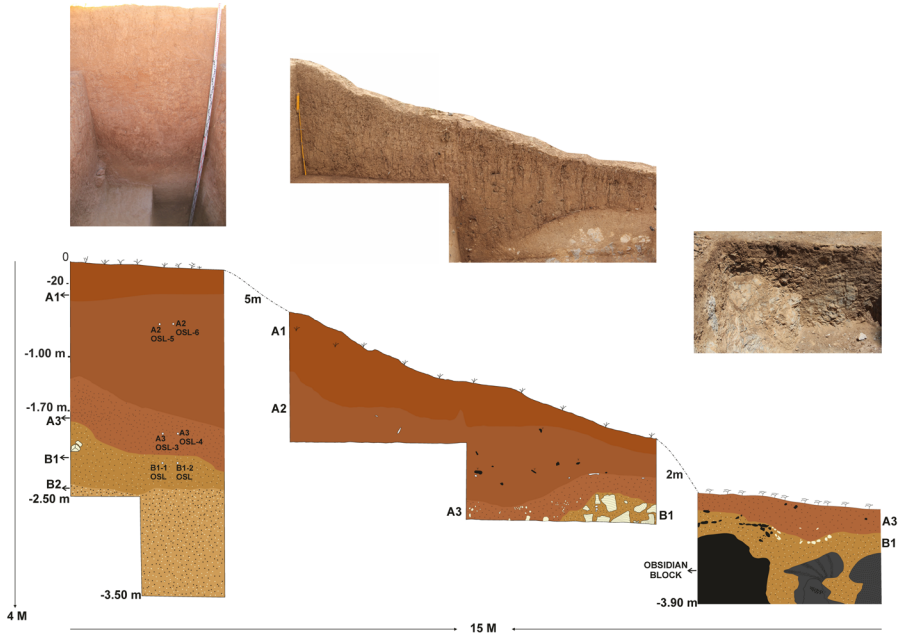


Fig. 3. Stratigraphy of the test trench excavated in 2017 and 2018 at Locality 10

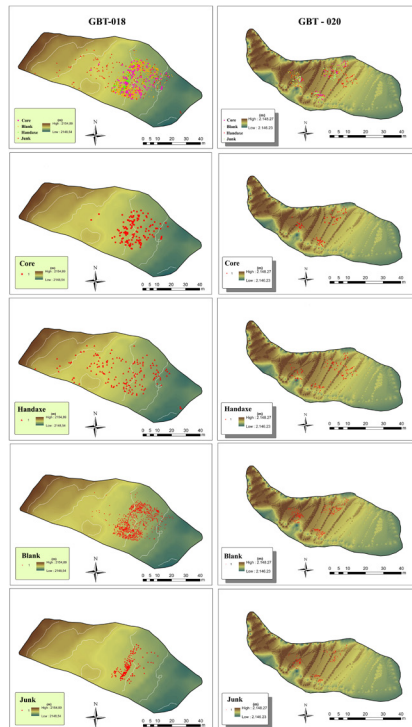


Fig. 4. Distribution of the artifacts found at locality GBT-018 and GBT-020

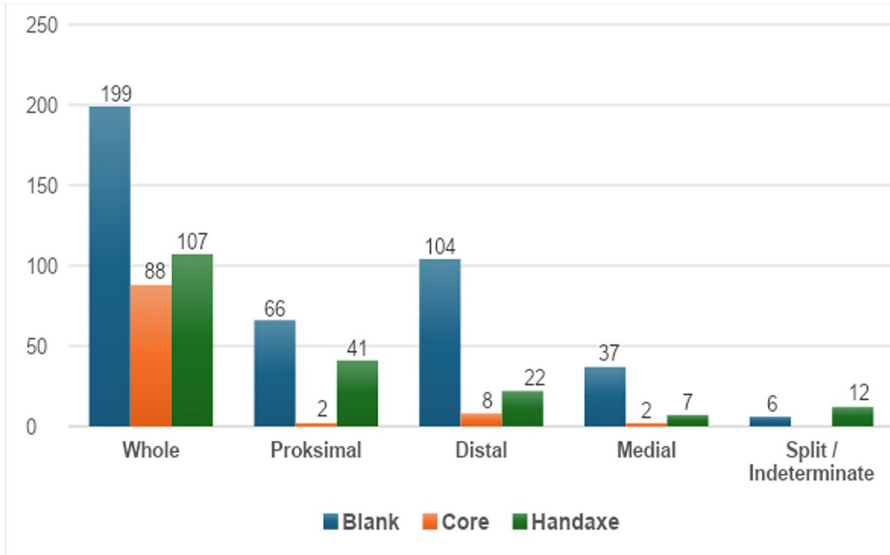


Fig. 5. Blank, Core and Handaxe Condition

	Blank Types	N	%
Flakes n: 334 (%79)	Cortical Flake	18	4.3
	Natural Backed Flake	3	0.7
	Flake	200	47.3
	Atypical Levallois Flake	3	0.7
	Levallois Flake	44	10.4
	Large Flake	59	0.2
	Kombewa Flake	7	1.7
Blades n: 42 (%10)	Cortical Blade	3	0.7
	Natural Backed Blade	1	0.2
	Blade	22	5.2
	Levallois Blade	15	3.5
	Large Blade	1	0.2
Technological Residuals n: 48 (%11)	Eclat Débordant	4	0.9
	Edge of Core	19	4.5
	Flake Fragments	13	3.1
	Debris	11	2.6
	<b>Total</b>	<b>423</b>	<b>100</b>

Fig. 6. Blank Types

		Minimum (mm)	Maximum (mm)	Mean (mm)	Std. Deviation
<b>Plain Flake</b> N=200	Length	37	153	83,02	24,644
	Width	31	160	74,25	23,476
	Thickness	6	54	24,40	8,980
	Platform width	14	101	47,70	19,066
	Platform thickness	7	52	19,23	8,965
<b>Palin Blade</b> N=22	Length	42	207	107,86	42,366
	Width	20	81	48,05	16,308
	Thickness	8	40	20,77	8,646
	Platform width	9	58	33,08	12,161
	Platform thickness	7	38	15,17	8,055
<b>Levallois Flake</b> N=43	Length	41	140	78,33	21,083
	Width	31	110	59,26	15,188
	Thickness	8	29	15,51	5,320
	Platform width	10	68	43,17	13,550
<b>Levallois Blade</b> N=15	Platform thickness	9	26	15,57	5,425
	Length	55	142	98,33	25,461
	Width	23	70	46,20	16,614
	Thickness	7	48	16,27	9,535
	Platform width	15	63	30,08	13,388
<b>Large Flake</b> N=59	Platform thickness	7	30	12,00	6,014
	Length	57	173	124,44	26,555
	Width	57	230	118,97	36,238
	Thickness	22	78	43,25	12,182
	Platform width	14	240	70,87	37,048
	Platform thickness	12	73	33,33	14,953

Fig. 7. Measurements of Blanks

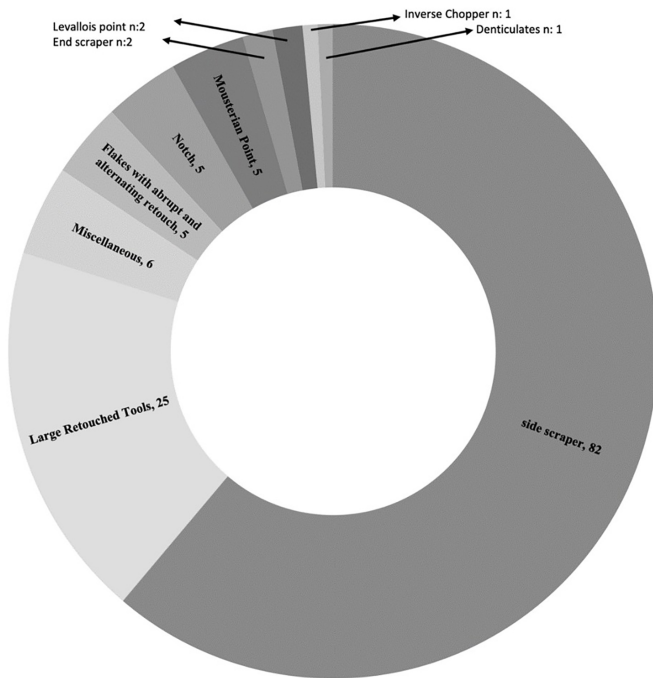


Fig. 8. Retouched tool types

	Platform Types											
	Missing		Cortical		Plain		Dihedral 2 Facets		Faceted		Indeterminate	
	N	%	N	%	N	%	N	%	N	%	N	%
<b>Blank Types</b>												
Cortical Flake	6	1.4	0	0	9	2.1	0	0	3	0.7	0	0
Cortical Blade	1	0.2	1	0.2	1	0.2	0	0	0	0	0	0
Natural Backed Flake	3	0.7	0	0	0	0	0	0	0	0	0	0
Natural Backed Blade	0	0	0	0	1	0.2	0	0	0	0	0	0
Flake	67	15.8	16	3.8	99	23.4	0	0	17	4.0	1	0.2
Blade	9	2.1	0	0	10	2.4	0	0	3	0.7	0	0
Atypical Levallois Flake	0	0	0	0	1	0.2	0	0	2	0.5	0	0
Levallois Flake	13	3.1	1	0.2	10	2.4	1	0.2	19	4.5	0	0
Levallois Blade	2	0.5	0	0	6	1.4	0	0	7	1.7	0	0
Eclat Débordant	1	0.2	0	0	0	0	0	0	3	0.7	0	0
Edge of Core	7	1.7	0	0	11	2.6	0	0	1	0.2	0	0
Kombewa Flake	3	0.7	1	0.2	1	0.2	0	0	2	0.5	0	0
Large Flake	14	3.3	4	0.9	31	7.3	0	0	10	2.4	0	0
Large Blade	0	0	1	0.2	0	0	0	0	0	0	0	0
Flake Fragments	13	3.1	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	<b>139</b>	<b>32.9</b>	<b>24</b>	<b>5.7</b>	<b>180</b>	<b>42.6</b>	<b>1</b>	<b>0.2</b>	<b>67</b>	<b>15.8</b>	<b>1</b>	<b>0.2</b>

Fig. 9. Platform Types

	Orientation of Dorsal Scars										Origins of Dorsal Scars														
	Parallel		Convergent, Symmetric		Convergent, Asymmetric		Multi-directional / Orthogonal		Indeterminate		Proximal only		Proximal + distal trimming		Proximal and distal		Proximal + one side (Orthogonal)		Centripetal		Lateral		Indeterminate		
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N
<b>Blank Types</b>																									
Cortical Flake	6	1.4	0	0	0	0	0	0	3	0.7	5	1.2	0	0	0	0	1	0.2	0	0	0	0	3	0.7	
Cortical Blade	3	0.7	0	0	0	0	0	0	0	0	3	0.7	0	0	0	0	0	0	0	0	0	0	0	0	
Natural Backed Flake	1	0.2	0	0	0	0	2	0.5	0	0	1	0.2	0	0	0	0	0	0	2	0.5	0	0	0	0	
Natural Backed Blade	1	0.2	0	0	0	0	0	0	0	0	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0	
Flake	70	16.5	1	0.2	9	2.1	114	27	6	1.4	70	16.5	6	1.4	2	0.5	33	7.8	79	18.7	4	0.9	6	1.4	
Blade	15	3.5	0	0	2	0.5	5	1.2	0	0	14	3.3	3	0.7	0	0	2	0.5	3	0.7	0	0	0	0	
Atypical Levallois Flake	1	0.2	0	0	1	0.2	1	0.2	0	0	2	0.5	0	0	0	0	0	0	1	0.2	0	0	0	0	
Levallois Flake	17	4	2	0.5	3	0.7	18	4.3	2	0.5	21	5	1	0.2	1	0.2	2	0.5	16	3.8	0	0	2	0.5	
Levallois Blade	9	2.1	3	0.7	0	0	3	0.7	0	0	10	2.4	1	0.2	1	0.2	1	0.2	2	0.5	0	0	0	0	
Eclat Débordant	2	0.5	0	0	0	0	2	0.5	0	0	2	0.5	0	0	0	0	2	0.5	0	0	0	0	0	0	
Edge of Core	6	1.4	0	0	0	0	13	3.1	0	0	6	1.4	0	0	0	0	4	0.9	9	2.1	0	0	0	0	
Kombewa Flake	2	0.5	0	0	0	0	3	0.7	0	0	2	0.5	0	0	0	0	1	0.2	1	0.2	1	0.2	0	0	
Large Flake	13	3.1	0	0	6	1.4	35	8.3	2	0.5	14	3.3	1	0.2	1	0.2	12	2.8	24	5.7	2	0.5	2	0.5	
Large Blade	1	0.2	0	0	0	0	0	0	0	0	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0	
Flake Fragments	2	0.5	0	0	0	0	4	0.9	6	1.4	1	0.2	1	0.2	0	0	0	0	4	0.9	0	0	6	1.4	
<b>Total</b>	<b>149</b>	<b>35.2</b>	<b>6</b>	<b>1.4</b>	<b>21</b>	<b>5</b>	<b>200</b>	<b>47.3</b>	<b>19</b>	<b>4.5</b>	<b>153</b>	<b>36.2</b>	<b>13</b>	<b>3.1</b>	<b>5</b>	<b>1.2</b>	<b>58</b>	<b>13.7</b>	<b>141</b>	<b>33.3</b>	<b>7</b>	<b>1.7</b>	<b>19</b>	<b>4.5</b>	

Fig. 10. Dorsal Scars

	Core Form	N	Number of Platform				Flaws and Errors					
			1	2	3+>	Indeterminate	No obvious problems	Light-Moderate Step Fracturing	Heavy Step Fracturing	Overpassed	Too Small for Further Use	Flat Removal Face
Non-Levallois	Tested	10	9	1			1		8			1
	Unifacial	43	18	20	5		8		34		1	
	Bifacial	1			1		1					
	Single/Double Platform (Protoprismatic)	1	1						1			
	Prismatic Blade Core	3	3				2					1
	Polyhedron	1		1					1			
	Core on Flake	4	2	2					4			
	Indeterminate	5	1			4	1	1	3			
Levallois	Centripetal Levallois	1		1					1			
	Levallois Point Core-Broad	5	5						3			2
	Levallois Unidirectional	21	16	4	1		1	2	13	2		4
	Levallois Bidirectional	5		4	1		1		2			2
	<b>Total</b>	<b>100</b>	<b>55</b>	<b>33</b>	<b>8</b>	<b>4</b>	<b>15</b>	<b>3</b>	<b>70</b>	<b>2</b>	<b>1</b>	<b>2</b>

Fig. 11. Core forms, number of platforms and flaws and errors of cores

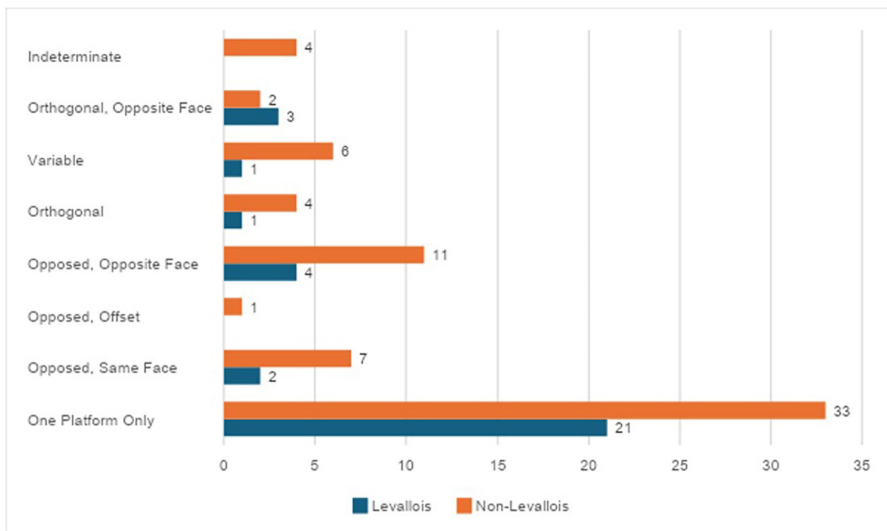


Fig. 12. Distribution of platform orientations of core types

		N	%
Blank	Cobble / Nodule	6	3.4
	Tabular Piece	36	20.1
	Flake	114	63.7
	Angular Chunk	23	12.8
Section	Biconvex	84	46.9
	Plano-Convex	93	52.0
	Indeterminate	2	1.1
Edge of Profile (Left)	Straight	106	59.2
	"S" Shape	11	6.1
	Zigzag	20	11.2
	Alternating	16	8.9
	Indeterminate	26	14.5
Edge of Shape (Left)	Flat	25	14.0
	Less Convex	60	33.5
	Convex	69	38.5
	Concave	3	1.7
	Missing	22	12.3
Hammer Type	Hard Hammer Only	87	48.6
	Hard Hammer with Soft Hammer Shaping of Edge	47	26.3
	Soft Hammer Only	52	29.1
	Indeterminate	3	1.7
Proximal	Straight	48	26.8
	Roundish	55	30.7
	Round	43	24.0
	Pointy	15	8.4
	Missing	28	15.6
Distal	Straight	12	6.7
	Roundish	20	11.2
	Round	16	8.9
	Pointy	100	55.9
	Missing	41	22.9
Patina Dorsal	No Patina	3	1.7
	Less >25	16	8.9
	Middle >50	158	88.3
	Much >90	2	1.1
Patina Ventral	No Patina	3	1.7
	Less >25	65	36.3
	Middle >50	105	58.7
	Much >90	6	3.4
Cortex Dorsal	No Cortex	154	86.0
	0 - 25	14	7.8
	25 - 50	6	3.4
	50 - 90	4	2.2
Cortex Ventral	90 <	0	0.0
	No Cortex	165	92.2
	0 - 25	4	2.2
	25 - 50	1	0.6
	50 - 90	4	2.2
	90 <	4	2.2

Fig. 13. General distribution of the technological characteristics of handaxes

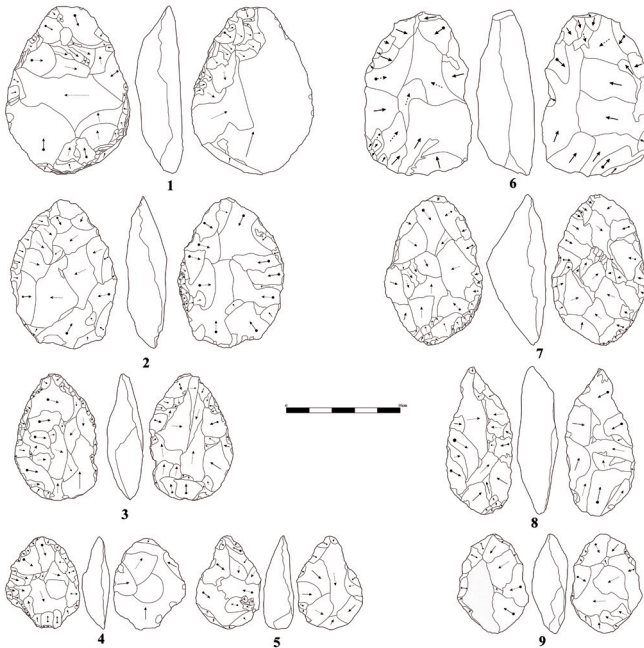


Fig. 14. Cordiform (1-5) and Amygdaloid (6-9) handaxes

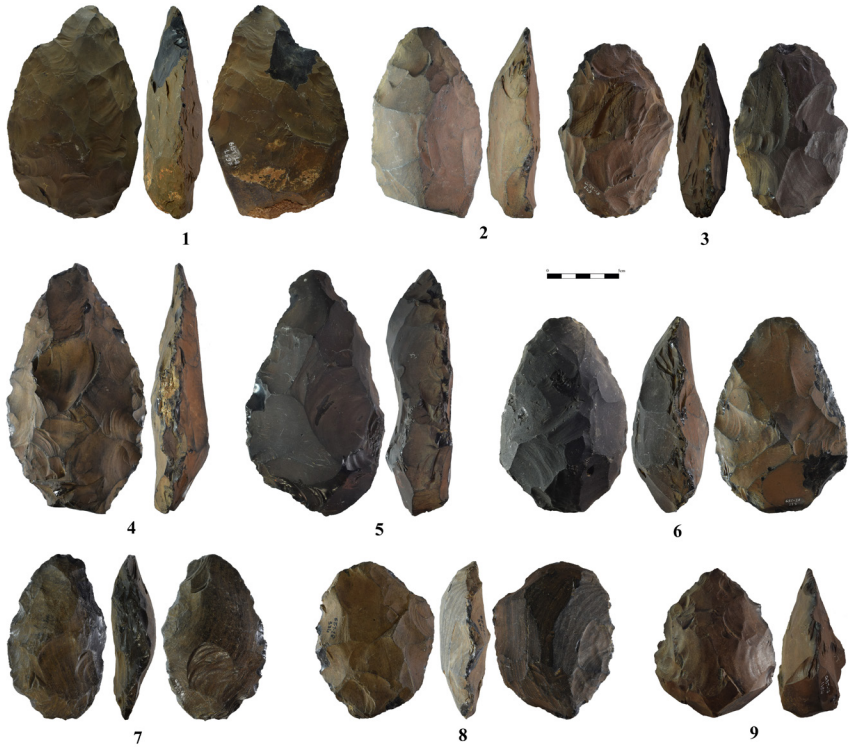


Fig. 15. Almond-shaped handaxes

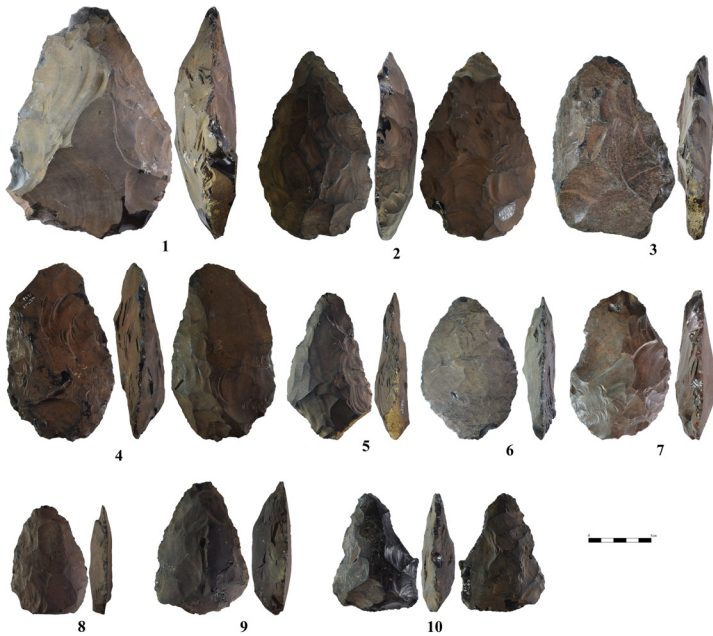


Fig. 16. Cordiform handaxes (1 – 8) and Triangular-shaped handaxes (9 – 10)

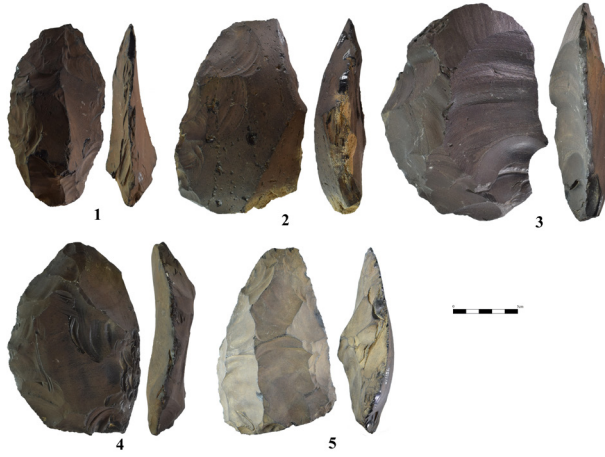


Fig. 17. Micoquien (1), Cleaver (2 – 3) and Retouched Large Flake (4 – 5)

Handaxes Types (Bordes)		Measurements	Minimum (mm)	Maximum (mm)	Average (mm)	Std. Deviation
Flat Forms N=53, 463,5 m/e=2,35	Cordiform N=42, 40,8%	L	69	222	135,24	37,169
		m	54	149	87,5	19,95
		a	23	85	50,74	16,387
		e	18	55	30,81	7,175
		n	51	131	80,51	184,037
		o	38	104	60,69	14,807
	Triangular N=8, 7,4%	L	88	181	129,38	38,9
		m	63	149	96	31,346
		a	18	45	28,75	10,3
		e	25	54	33,62	9,3
		n	52	114	77,5	245,6
		o	39	86	60,75	17,7
	Limande N=1, 0,7%	L	95	95	95,0	-
		m	69	69	69,0	-
		a	57	57	57,0	-
		e	28	28	28,0	-
		n	67	67	67,0	-
		o	58	58	58,0	-
	Ovate N=2, 1,4%	L	78	119	98,5	28,991
		m	73	91	82	12,728
a		54	68	61	9,899	
e		29	38	33,5	6,364	
n		73	90	81,5	120,208	
o		67	81	74	9,899	
Thick Forms N=50, 448,5 m/e=2,35	Amygdaloid N=43, 42,2%	L	84	240	136,88	35,119
		m	49	113	83,53	16,782
		a	26	82	52,74	14,986
		e	22	60	41,56	9,119
		n	46	112	78,547	157,165
		o	34	95	60,86	13,05
	Lanceolate N=3, 2,7%	L	113	151	126	21,656
		m	69	83	78	7,81
		a	21	26	24	2,646
		e	36	42	38	3,464
		n	51	73	63,667	113,725
		o	41	59	50,67	9,074
	Micoquien N=3, 3,9%	L	150	223	179	38,743
		m	77	110	95	16,703
		a	94	105	100,33	5,686
		e	35	54	46,33	10,017
		n	76	106	93,333	155,349
		o	75	86	80	5,568
	Micoquien Halbkeile N=1, 0,9%	L	125	125	125	-
		m	68	68	68	-
a		72	72	72	-	
e		40	40	40	-	
n		68	68	68	-	
o		50	50	50	-	

Fig. 18. Metric measurements according to the typological characteristics of handaxes (L: Length, m: Maximum width, a: Distance from base to maximum width, e: Maximum thickness, n: width at midpoint, o: width at  $\frac{3}{4}$  of length)

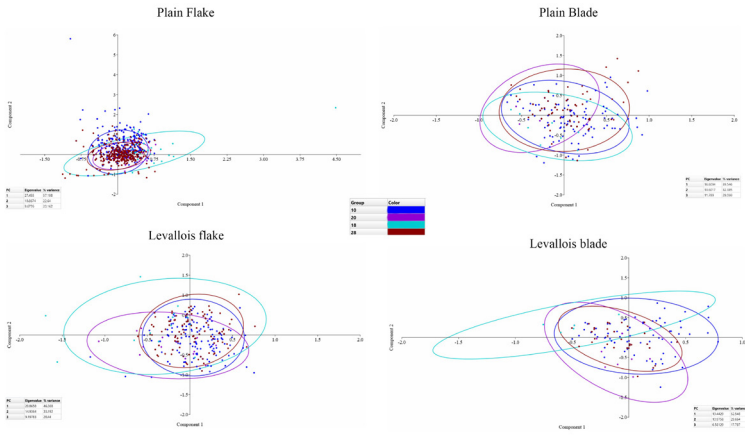


Fig. 19. Technological comparison of plain flakes, plain blades, Levallois flakes and Levallois blades with PCA

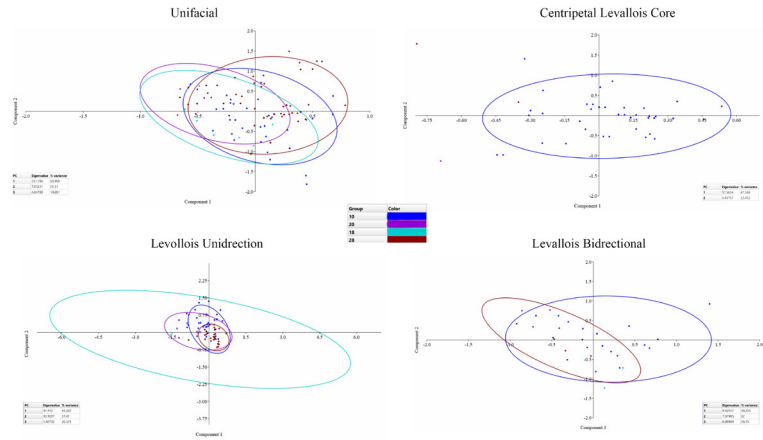


Fig. 20. Technological comparison of unifacial core, centripetal Levallois core, Levallois unidirectional core and Levallois bidirectional core with PCA

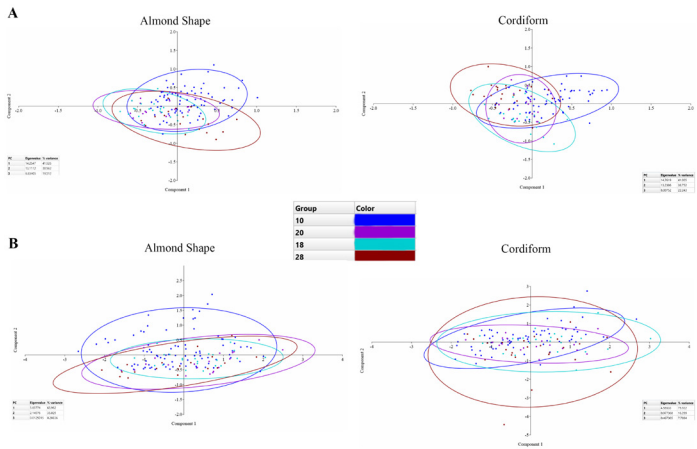


Fig. 21. A. Technological comparison of handaxe types cordiform and almond with PCA analysis (GBT-010,028,018 and 020); B. Comparison of measurements of cordiform and almond with PCA analysis (GBT-010,028,018 and 020)