A Lower Paleolithic assemblage from western Anatolia: The lithics from Bozyer

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ABSTRACT

In 2005 the Central Lydia Archaeological Survey (CLAS) identified an open-air Lower Paleolithic site called Bozyer near Lake Marmara in the province of Manisa, Turkey. Intensive survey of Bozyer in 2008 resulted in collection of over 300 stone tools. Subsequent systematic analysis attributed 189 of these lithics to a Lower Paleolithic industry. The assemblage is characterized by flakes and retouched flake tools, many of which were produced with the bipolar flaking technique; preferential use of locally available quartz and quartzite over chert; a low proportion of cores, most of which were reused as choppers and chopping tools; and the absence of bifaces and other large cutting tools. With few exceptions, similar assemblages are rare in Anatolia, and comparable industries from Eurasia and the Near East date to the Early Pleistocene period. The lithic industry from Bozyer thus joins other nearby sites in evidencing some of the earliest hominin activities outside Africa, shedding new light on growing understandings of Lower Paleolithic technology, mobility, and activities in Anatolia.

1. Introduction

Anatolia is a key geographical area for understanding the evolution of early hominins. Its critical location between Africa and Eurasia defines it as one of the main dispersal routes. Even so, Paleolithic archaeology in Turkey is poorly developed in comparison to later prehistoric periods (Arsebük, 1998a; Kuhn, 2002). According to the online inventory of archaeological sites in Turkey (Tay Project), only 178 Lower Paleolithic sites have been discovered since the end of nineteenth century (Taşkiran, 2016), a number far from reflecting the actual richness of Lower Paleolithic activities in the country. Furthermore, most Lower Paleolithic sites were discovered in the course of extensive surface surveys and have not been systematically researched (Dincer, 2016). Despite an increasing number of finds resulting from such surveys, Paleolithic research is especially lacking in the western part of Turkey, where no Lower Paleolithic sites had been reported in the province of Manisa until recently. Before 2005, the only confirmed Paleolithic finds from this area were two bifaces discovered by chance near Ural and Narlıdere in İzmir (see Kansu, 1963, 1969). Previous mentions of Paleolithic materials and sites elsewhere in western Anatolia remain unconfirmed (Roosevelt, 2010).

During the first of its ten seasons of diachronic research in 2005, the Central Lydia Archaeological Survey (CLAS) identified a site bearing indications of early prehistoric activities (Roosevelt, 2007). Known locally as Bozyer, the site was revisited in the following years and intensively surveyed in 2008, revealing a history of activity stretching from Paleolithic through later prehistoric times. Chalcolithic and Early Bronze Age remains from Bozyer have now been published (Roosevelt and Luke, 2010; Çilingiroğlu, 2014; Luke et al., 2015), focusing especially on ceramic evidence. The noted density of Paleolithic finds from the site was unpublished until now. Today, Bozyer remains the only intensively surveyed Paleolithic site in the area and one of the few studied open-air Lower Paleolithic sites in all western Turkey (Fig. 1). The Paleolithic assemblage from Bozyer thus represents an important extension of early prehistoric research in a region dominated by fieldwork focusing on later remains. As systematic analysis of the lithic assemblage from the intensive survey and comparison with comparable datasets now shows, the lithic industry of Bozyer is likely one of the earliest assemblages documented from the area, helping define distinctive features of the older phases of the Lower Paleolithic not just for western Anatolia, but for the entire peninsula.

2. Setting

Bozyer is located in western Anatolia, in the vicinity of Karayazı village in Salihli, Manisa, Turkey. The site covers a natural hill and...
surrounding slopes at approximately 88–104 m above current sea level, near the eastern end of a ridge known locally as Bin Tepe, or a “thousand mounds” in Turkish, for its Iron Age burial mounds (Fig. 2). The ridge is the eastern terminus of the Çaldağ High, a horst block residual from Neogene extensional tectonics that resulted also in the fault-dropping of the Gediz Graben. Miocene and Pliocene sedimentary formations of the Çaldağ High include sandstone, marl, and conglomerate intercalations above interfingered conglomerates and lacustrine limestones (Yusufoğlu, 1996; Bozkurt, 2003; Kaya et al., 2004; Çiftçi and Bozkurt, 2009; Oner and Dilek, 2011; Turk, 2014; Altikulac, 2015; Seyitoğlu and Işık, 2015). Active tectonism well into the Pleistocene continued to affect local depositional processes and the course of the Gediz River (Özkaymak et al., 2011; Kent et al., 2017), yet the current topographical constraints of the Gediz Valley around Bozyer were set in place by the end of the Pliocene. The floor of the Gediz Graben, around 2 km south of Bozyer, began to be infilled after the Pliocene, such that Quaternary alluvium defines it today (Figs. 3 and 4). The freshwater lake located around 4 km north of the site, however, appears to have formed only in the Late Pleistocene or early Holocene (Hakyemez et al., 1999, 2013; Bulkan et al., 2018; Vardar, 2018). Local vacillations of Pleistocene and Holocene climate and tectonics undoubtedly had significant effects on local resource availability. By the Early Pleistocene, the broader regional climate was warm and humid with pronounced semi-arid to arid phases allowing the development of an open steppe ecosystem in fluctuating subtropical conditions that appear to have continued into the Middle Pleistocene (Nemec and Kazancı, 1999; Aļıçek et al., 2012; 2017).

From the vantage point of Bozyer, early hominins would have benefited from the gathering potential of the alluvial plain and locally available resources (e.g., abundant quartz and quartzite, and some chert) to produce technologies of a mobile forager subsistence strategy. In addition, the lush river plain would have provided ideal conditions for attracting wild game, and thus also excellent grounds for hunting (Luke and Roosevelt, 2009). Large mammalian paleofauna are now evidenced by teeth and jaw bones from Cervus elaphus and Bos primigenius, if not also Equus and other species, recovered from nearby late Early Pleistocene formations of approximately 800 ka (Şahinci, 1976; Sarica, 2000; Hakyemmez et al., 2013; Kent et al., 2016). These faunal assemblages match better known Early and early Middle Pleistocene mammal populations documented over a broader area in western Turkey (Kahlke et al., 2011; Güngör et al., 2018). The site is heavily used today for cultivation of wheat and other field crops as well as fig and olive orchards. Frequent and deep plowing of the site has contributed to the mixing of its archaeological...
assemblages and bringing them to the surface. This is clearly indicated by traces of iron plows in rust lines on the exterior surfaces of some finds, while the unpatinated scars of others show their fresh fracturing. Recent activities, thus, have contributed to the erosion of the site and the exposure of cultural materials found in heavy concentrations across its surface. In turn, natural weathering processes, especially heavy rains, have further altered the exact find locations of material remains.

3. Field and laboratory methods

Paleolithic materials at Bozyer were first identified between 2005 and 2007, when 35 lithic samples were collected and catalogued in the course of regional survey and grab sampling (Roosevelt and Luke, 2009). Based on promising preliminary analyses, intensive survey was planned and implemented in 2008. Following previously established CLAS protocols (e.g., Roosevelt and Luke, 2009, 2010), the extent of Bozyer was defined using a combination of on-site observation, QuickBird satellite imagery, and detailed microtopographic survey (Figs. 5 and 6), which together suggested a total site area of roughly 14 ha. A systematic approach to terrain coverage and sampling strategies was then developed, providing for intensive sampling of 10.3 ha of the site.

The intensive sampling strategy included an array of 20 m² circular survey units arranged on a 20 × 20 m grid superimposed over the site. For each survey unit, team members worked on hands and knees to cover the area, collecting all cultural/archaeological materials discovered. After quantifying and recording the total numbers of finds in each survey unit, a lithics expert sorted geofacts from artifacts and
selected blades, flakes, cores, and other artifacts from the latter for further cleaning and documentation in a laboratory setting. Long-term curation of the collection continues to be managed by the regional museum authority (Manisa Museum of Ethnography and Archaeology). Proceeding in this fashion over two and a half weeks, material was collected from a total of 248 survey units, totaling 4960 m² in area, or roughly 3.5% of the estimated total 14 ha of the site. A total of 1562 artifacts were identified in the field, from which 331 artifacts were selected for further laboratory analysis owing to restrictions on collections (see challenges below; Fig. 7).

Laboratory analysis included cataloguing of lithic artifact types identified according to a formal typology based on the production techniques and reduction strategies (chaîne opératoire) used to reduce pebbles and chunks into cores then to blanks and finally tools. Data collected for each lithic tool included designation as flake, blade, or core, material type, material color, presence of patina and cortex, observations on retouch, measurements of thickness, length, and width, and chronological attribution (where possible), among other metrics and front and back photographs.

Challenges to field and laboratory methods employed at Bozyer include restrictions of areal coverage as well as sample retention. Reduction of ground visibility resulting from weed growth within survey units impeded the intended 100% collection within each unit. Owing to the planting of one field in wheat, furthermore, at least 23 survey units were unsurveyed altogether, reducing the intended total coverage of the site. Equally critically, limitations imposed by in-country regulations, such as the limited museum storage space allocated for this work, required the selection of representative samples in the field described above and further culls of material subsequently. Limited retention of samples for storage reduced the number of artifacts available for repeated analysis. Despite these challenges, the intensive survey of Bozyer produced a rigorous dataset, valuable for understanding its particular history as well as broader developments in the region.

4. The lithic industry of Bozyer

Of the 331 stone tools collected from Bozyer for analysis, storage, and future reference, 189 were attributed to the Lower Paleolithic period, 75 to prehistoric periods in general, and 16 to the Bronze Age; it was not possible to attribute 51 of the remaining tools to a certain period. The Lower Paleolithic assemblage includes 26 cores, 81 flakes, 60 retouched flakes, 20 chips, and two hammerstones. Most of the assemblage, 152 artifacts or 80.42%, was made from white quartz pebbles. Twenty artifacts, or 10.58% of the assemblage, including two hammer stones, were made from white quartzite pebbles, the second-most common raw material. The availability of quartz and quartzite pebbles in local deposits helps explain its dominance in the assemblage (91%). Sixteen artifacts, or 8.46% of the assemblage, were made from a variety of colored cherts, including examples in brown, cream, grey, pink, purple, translucent, and white (Table 1). Most chert tools were made from rounded pebbles bearing neo-cortex, and these may derive from local deposits also. Two chert scrapers displaying primary cortex must have come from a primary source, the location of which remains unknown.

The preservation of lithics at Bozyer is generally very good. Quartz and quartzite artifacts show no evidence of abrasion or rolling. A few chert artifacts show a medium level of abrasion. A carbonate crust (caliche) on some quartz and quartzite artifacts must have developed after their production and use. Such crusts result from burial and demonstrate that the artifacts remained buried during at least one arid climatological phase following their production and before recent exposure. No other evidence points to the duration of burial. The distribution of all lithics across the site was irregular (Fig. 7), with noted concentrations in areas just southwest, northwest, and southeast of its highest point, matched by a similar distribution of Paleolithic materials, the densest concentrations of which clustered on the slopes of a shallow eroded hollow that defines the western side of the mound (Fig. 8).

Cores and core/tools (n = 26) constitute nearly 14% of the Bozyer assemblage (Figs. 9-12). Raw materials used for cores are consistent with the general distribution of raw materials throughout the assemblage. Among core/tools are four chopping tools and one chopper. Although none are typical core tools, they are assigned to these types based on their technology. The quartzite chopper (S2008.306:1) is large (11.6 × 6.57 × 3.97 cm) and has a very uneven cutting edge created by two large removals from the same face. A chopping tool in chert (S2008.357:10) is a small core or very small micro-chopping tool (2.29 × 3.62 × 3.06 cm) made from a rounded pebble. Removals are partially centripetal and bifacial. Both faces bear cortex, and its base was left unworked. The other three chopping tools are quartz. All three bear fractures on their working edges, providing evidence for their use as tools; however, they represent no clear typology. Removals from these chopping tools could have been used as regular tools. Scars on one (S2008.522:3) are very invasive bifacially and left no cortex on the tool. These three quartz chopping tools thus were probably used first as cores for the production of other tools, and then later as chopping tools, taking advantage of their resultant shape.
Cores from Bozyer fall into three groups: more than half are globular (n = 12); a few are unidirectional with prepared platforms (n = 3); the remainder is more diverse (n = 6) (Figs. 11 and 12). All but one of the globular cores is quartz. The exception was made from a calcareous stone the properties of which obscure signs of flaking; it resembles a polyhedral piece. The average maximal dimension of globular cores is 6.78 cm, with a minimum of 3.89 cm and maximum of 11.20 cm. In their final form, globular cores bear an average of seven removal scars, with the largest core bearing 14 removal scars.

Three unidirectional cores from Bozyer have prepared platforms (n = 3). Two unidirectional cores are quartz, one of them probably made from a thick flake. One unidirectional core is chert. Except for one tested core with four small removals that was likely discarded because of irregularities in the chert, all chert cores and core/tools (n = 2, excluding the tested core) were unidirectionally worked. Raw material appears not to have influenced the reduction systems used for unidirectional cores, but one chert core (S2008.550:8) was further retouched after it had been used for flake production (Figs. 11 and 12, no. 1). This flake core made from a chert pebble saw further removals (retouches) from its edges. Its platform was prepared over 35% of its edge, and marks of this preparation are limited to the platform of the removed flake, with the flake scar measuring 6.50 cm long. The core...
was not reduced very much before the retouch. Another quartz core is a small (max. dimension: 4.66 cm) semi-prismatic core with two re-
movals (S2008.550:4). Three additional quartz cores show minimal pre-
determination of the flake shape. Two show platform preparation over at least 90% percent of their edges. Since these predeterminations are minimal, these should not be taken as prepared cores. No Levallois-
like prepared core technology was identified at Bozyer, contrary to preliminary assessments (Roosevelt and Luke, 2009).

Nearly one third of the Bozyer lithic industry consisted of retouched flake tools (n = 60). This abundance might have resulted from the collection methods explained above. The retouched flakes do not reflect the ideal tool types published in well-defined typologies (e.g., Bordes, 1981): they are somewhat atypical. Technologically, more than half of the retouched flakes are scrapers (n = 35), dominated by single scrapers (n = 25) (Figs. 13 and 14). Other retouched tools are denticulates (n = 9), notches (n = 7), atypical end scrapers (n = 2), perçoirs (n = 1), utilized flakes bearing use fractures (n = 2), and retouched pieces (n = 4) (Figs. 15 and 16, nos. 1–5). Reduction of retouched tools is generally minimal. Quartz and quartzite retouched tools, especially, are reduced very rarely; original flake sizes and shapes are changed only minimally as a result of retouch removals. Chert tools are reduced and retouched more frequently. In sum, the chert component of the assemblage is clearly differentiated from the quartz and quartzite components in that half the chert artifacts are retouched tools.

A prevalence of chert reduction is evident also in the dorsal scars and cortex percentages of the flakes. While flakes made on locally available quartz and quartzite have averages of 2.07 and 2.14 scars on their dorsal faces, respectively, chert flakes have an average of 3.5 scars. Cortical flakes represent slightly more than 50% of all raw material types; no chert flake bears more than 90% of cortex on its dorsal surface, while cortex is fully preserved on 10% of quartz and quartzite flakes. The average length of chert flakes is also 0.12 cm shorter than that of quartz flakes. The abundance of chert relative to quartz and quartzite reduction may point also to the relative scarcity of chert re-
sources.

The most distinctive feature of the Bozyer assemblage is the pre-

Table 1
Distribution of tool types at Bozyer. “Other cores” include multidirectional and tested cores. “Other retouched” includes perçoir, end scraper, and utilized flakes.

<table>
<thead>
<tr>
<th>Type/Raw material</th>
<th>Quartz</th>
<th>Chert</th>
<th>Quartzite</th>
<th>Other</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core/chopper</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>0.53</td>
</tr>
<tr>
<td>Core/chopping tool</td>
<td>3</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>4</td>
<td>2.12</td>
</tr>
<tr>
<td>Globular core</td>
<td>11</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>12</td>
<td>6.35</td>
</tr>
<tr>
<td>Unidirectional core</td>
<td>2</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>3</td>
<td>1.59</td>
</tr>
<tr>
<td>Other cores</td>
<td>5</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>6</td>
<td>3.17</td>
</tr>
<tr>
<td>Flakes</td>
<td>32</td>
<td>5</td>
<td>8</td>
<td>–</td>
<td>45</td>
<td>23.81</td>
</tr>
<tr>
<td>Bipolar flakes</td>
<td>34</td>
<td>–</td>
<td>2</td>
<td>–</td>
<td>36</td>
<td>19.05</td>
</tr>
<tr>
<td>Single scraper</td>
<td>17</td>
<td>3</td>
<td>5</td>
<td>–</td>
<td>25</td>
<td>13.23</td>
</tr>
<tr>
<td>Double scraper</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>–</td>
<td>10</td>
<td>5.29</td>
</tr>
<tr>
<td>Denticulate</td>
<td>9</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>9</td>
<td>4.76</td>
</tr>
<tr>
<td>Notch</td>
<td>6</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>7</td>
<td>3.70</td>
</tr>
<tr>
<td>Other retouched</td>
<td>4</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>5</td>
<td>2.65</td>
</tr>
<tr>
<td>Retouched pieces</td>
<td>3</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>4</td>
<td>2.12</td>
</tr>
<tr>
<td>Chips</td>
<td>20</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>20</td>
<td>10.58</td>
</tr>
<tr>
<td>Hammerstone</td>
<td>–</td>
<td>–</td>
<td>2</td>
<td>–</td>
<td>2</td>
<td>1.06</td>
</tr>
<tr>
<td>Total</td>
<td>152</td>
<td>16</td>
<td>20</td>
<td>1</td>
<td>189</td>
<td>100</td>
</tr>
<tr>
<td>%</td>
<td>80.42</td>
<td>8.47</td>
<td>10.58</td>
<td>0.53</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 7. Plan of Bozyer showing the distribution and quantities of all lithic materials found at the site. (© Gygaia Projects).
bipolar flake products constitute more than 30% of all flakes (43 of 137) in the assemblage. In some industries, the use of the bipolar technique on quartz creates smaller flakes with broken platforms (Güleç et al., 2009); this is not the situation at Bozyer, however. Broken platforms are more common in direct percussion than bipolar flakes. The average dimensions of bipolar flakes at Bozyer is slightly larger than other flakes, reaching 5.07 × 4.20 × 1.67 cm (Table 2). This might be the result of the dimensions and homogeneous structure of the raw quartz available at Bozyer. Because quartz is a hard raw material and requires more force to be knapped than chert, bipolar flaking is more advantageous than the free-hand technique allowing the knapper to obtain useable flakes from large cores with the advantage of predetermination of flake thickness (Mourre, 1993–1994).

The flakes from Bozyer do not differ very much in terms of knapping strategy, except for their slightly different sizes. Plain platforms (n = 67) and parallel/sub-parallel dorsal scars (n = 64) are the most common platform types and scar orientations on all kinds of flakes, including retouched flakes (Table 3). Clactonian or wide and open-angled platforms are naturally missing in bipolar flakes and are represented by only six other flakes from Bozyer. One quartz single scraper represents the only faceted platform. Completing the assemblage, 20 small flakes of less than 3 cm length were defined as chips. All were quartz and demonstrate that flaking took place on site. It is important to note, however, that the survey methods used undoubtedly minimized the representation of such flaking chips.

In summary, the Bozyer lithic assemblage reflects a flake-based industry dominated by quartz and quartzite and characterized by distinctive features including the use of the bipolar technique, the absence of bifaces, and a low proportion of cores and core tools. The presence of cores, nonetheless – among flaking waste products (chips) and hammerstones – demonstrates that local quartz and quartzite tools were produced on site. The high percentage of retouched flake tools suggests further that tools were not only produced but were also used on site. The relative availabilities of raw materials – quartz, quartzite, and various cherts – are apparent on the ground as well as in differential rates of reduction, whereby chert tools from non-local sources were correspondingly more reduced.

5. Comparable Paleolithic sites in Anatolia and the Aegean

To contextualize the Lower Paleolithic industry at Bozyer, we review here the available evidence for Lower Paleolithic activities in central and western Anatolia and the eastern Aegean. The oldest proposed Lower Paleolithic artifact in Anatolia was found just 70 km east of Bozyer. It is a single quartz flake found in an old terrace of the Gediz River on the Burgaz Plateau, around 16 km northeast of Kula. The fluvial gravel layer from which it comes has been dated to between 1.17 and 1.24 Ma according to $^{40}$Ar/$^{39}$Ar dating and paleomagnetism. The artifact is described as a hard-hammer flake that bears two flake scars on its dorsal face (Maddy et al., 2015). Although the object is claimed to be the oldest ever recorded human-made object in Turkey, it was a singleton find and returned to its context after discovery and documentation. For this reason, neither the find itself nor an associated assemblage remain available for exploring the technological properties of possibly the earliest find in Turkey. Nonetheless, it is likely that a Homo erectus produced this type of flake as well as others of the earliest artifacts in Anatolia.

The fossil record supports this probability. A cranium fragment belonging to a Homo erectus was discovered in 2002 at Kocabas near Denizli in western Turkey (Kappelman et al., 2008). The cosmogenic nuclide concentration and paleomagnetism dating of the travertine related to this Homo erectus fossil revealed a date range between 1.0 and 1.6 Ma (Lebatard et al., 2014a; Vialet et al., 2018), with the most recent consensus date of the fossil itself of 1.1–1.3 Ma (Lebatard et al., 2014b). According to its morphological and metric properties, this specimen is closer to African and Asian Homo erectus than to either the geographically closer Homo georgicus, known from Dmanisi, Georgia and dating 1.8 Ma, or Homo heidelbergensis (Vialet et al., 2014).

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Fig. 8. Plan of Bozyer showing the distribution and quantities of Paleolithic finds. (© Gyaiga Projects).
The single Burgaz Plateau quartz flake (Maddy et al., 2015) and the Kocabas fossil (Lebatard et al., 2014a, 2014b) constitute the earliest known evidence of hominin presence in the entire Anatolian peninsula. Both are chronometrically dated by separate research teams to before 1 Ma, and both are located in the same general region as Bozyer, within 150 km as the crow flies. Furthermore, these finds are now joined by chert bifaces, choppers, and chopping tools recently discovered at multiple Lower Paleolithic sites in Denizli, near Kocabaş (Özçelik et al., 2016). While the tools from the Denizli area reflect technical properties different from those evidenced at Bozyer, the Burgaz Plateau flake at least shows the same preference for quartz.

Additional evidence for the Lower Paleolithic in Anatolia and the eastern Aegean consists of both surface materials and stratified remains. Surface materials discovered during archaeological surveys are usually characterized by the presence of the most recognizable types, especially bifaces (or handaxes), among other tools. Two isolated bifaces were found near Izmir (Kansu, 1963, 1969), roughly 150 km west of Bozyer. More recently, more than 50 Paleolithic tools were recovered in surface...
Fig. 10. Drawings of core tools from Bozyer. 1: chopping tool; 2: chopping core (used); 3: chopping core; 4: chopper; 5: chopping tool. Scale in cm. (Illustrations D. Turan; © Gygaia Projects).
survey at Kömür Burnu, an open-air site near Karaburun in İzmir; the assemblage is dominated by flakes, but includes also cores, retouched flakes, blades, scrapers, two bifaces, and a chopper and hammerstone, all but two pieces made from local basalt (Çilingiroğlu et al., 2016, 2018a; 2018b).

Documented Lower Paleolithic sites east and north of Bozyer are scarcer and bear atypical bifaces among other tools. Lower Paleolithic tools were reported from travertine beds at Sürmeck, near Banaz, Uşak (Polat, 2018), yet subsequent analyses showed them to be Middle Paleolithic (Söyler et al., 2018). A few Lower Paleolithic bifaces were reported from near Domaniç and Taşanlı in Kütahya (Efe, 1990), yet recent surveys in this area, too, revealed mainly Middle Paleolithic rather than Lower Paleolithic sites (Dinçer et al., 2014; Dinçer, 2015). Further north at Belen Tepe in the Kocasu Basin of Bursa, two unfinished Lower Paleolithic chert bifaces were found along with a large chopping tool, many Clactonian flakes, and various cores (Dinçer, 2014, 2016). Further east, two chopping tools and possible Clactonian flakes in quartz, quartzite, and other materials were recovered from Kuzfındık in Eskişehir (Dinçer and Türkcan, 2011), and a single chert biface was found at Meneke Kayalar in Afyon; it was produced by soft hammer percussion and dates typologically to the Upper Acheulean (Taşkran and Taşkran, 2011).

Even further from Bozyer, Lower Paleolithic finds are well known from the Istanbul area and Turkish Thrace (Runnels and Özdoğan, 2001; Dinçer and Slimak, 2007; Aydingün, 2013). Bifacial artifacts have been found east of the Bosphorus (Jelinek, 1980), while surveys in western parts of Turkish Thrace revealed Lower Paleolithic assemblages dominated by choppers and chopping tools in quartz and quartzite (Dinçer and Slimak, 2007). Recent surveys of several sites in Çanakkale and Sakarya have reported Lower Paleolithic finds, as well, yet these

Fig. 11. Photographs of a selection of cores from Bozyer. 1: chert flake core retouched after reducton; 2–5: cores. Scale in cm. (Photos B. Dinçer; © Gygaia Projects).
await fuller publication (Özdoğan, 1990; Özer et al., 2017, 2018; Kartal et al., 2018).

All such material from survey sites were dated to the Lower Paleolithic sensu lato based on the presence of identifiable tool types and their percentages in the assemblages. None were dated using chronometrical methods. It remains possible that some of these atypical biface assemblages now attributed to the western Anatolian Lower Paleolithic might actually reflect relatively later periods, later than the beginning of the Middle Pleistocene (ca. 780 ka).

For comparative Paleolithic materials from excavated contexts, one must look further afield. A post-780 ka date for the surface assemblages described above is suggested further by the site of Rodafnidia on the island of Lesbos (Galanidou, 2013; Galanidou et al., 2013). Paleogeographic reconstruction of Aegean sea levels and shores during the last 400 ka shows that, like many other islands of the eastern Aegean, Lesbos was then connected to Anatolia (Lykousis, 2009; Tourloukis, 2010; Tourloukis and Karkanas, 2012), enabling the arrival of early hominins without the need of seafaring (but see Howitt-Marshal and Runnels, 2016; Runnels et al., 2014). Among excavated Lower Paleolithic sites, Rodafnidia is the closest to Bozyer, approximately 170 km to its northwest as the crow flies. Using both survey and excavation methods at the site, 705 artifacts have been recovered. All artifacts were made of chert, and unretouched flakes constitute more than half the assemblage. Cores are the second largest group in the assemblage, represented by 213 pieces. The use of prepared core (Levallois) technology is minimal, represented by only four cores and two flakes. The distinctive feature of the Rodafnidia assemblage is its large cutting tools. Although 25 large cutting tools were discovered during survey of the site, only five were found during excavation. Of these, 20 are described as handaxes and four as cleavers. Trihedrals, unifaces, and roughouts occur as well. Four samples were taken from three geological units for post-infrared stimulated luminescence (pIRIR). Results range
between 164 ± 33 (MIS 6) and 476 ± 62 ka (MIS 13), and the artifacts are argued to have been deposited prior to the deposition of MIS 13 (before 476 ± 62 ka) and later incorporated within that geological unit as it formed (Galanidou et al., 2016). Rodafnidia thus might date to either the late Lower Paleolithic or the second half of the Middle Pleistocene. It remains the only site with absolute dating that can be compared to Acheulean assemblages of western Anatolia or the eastern Aegean.

In central Anatolia Acheulean technologies are more dominant among Lower Paleolithic assemblages. The only systematically excavated in situ Acheulean site in Turkey is Kaletepe Deresi 3 (KD3), near Niğde. The site is located on the slopes of the Göllü Dağ obsidian source, more than 500 km east of Bozyer. More than 5000 Lower Paleolithic chipped stones have been recovered from this site. Basal Acheulean layers include high percentages of chopper and chopping tools as well as polyhedral pieces mostly produced in andesite and rhyolite, while obsidian seems to have been restricted to the production of bifacial tools like handaxes (Slimak and Dincer, 2007; Slimak et al.,

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**Fig. 13.** Photographs of a selection of scrapers from Bozyer. 1–7: atypical side scrapers; 8: thick end scraper. Scale in cm. (Photos B. Dincer; © Gygaia Projects).
It is worth noting that, in contrast to excavated KD3 assemblages, one third of the Lower Paleolithic large cutting tools recovered from surface survey in the region are made from basalts, while neither andesite nor rhyolite choppers were found (Kuhn et al., 2015). Applied tephrachronological dating methods provided no certain date for the Lower Paleolithic layers of the site (Tryon et al., 2009), yet its sequence is bracketed between bedrock below, dated to 1.1 ± 0.02 Ma, and a 160 ka tephra layer, above (Mouralis, 2003). Most of the Lower Paleolithic sequence, then, is likely Middle Pleistocene in date, while its earliest layers might date to late in the Early Pleistocene.

In western central Anatolia, around 320 km from Bozyer, Lower Paleolithic tools and faunal remains were found 10–12 m below the modern surface in a lignite quarry in Dursunlu, Konya. Excavators recovered an assemblage of 135 lithics, 95% of which is quartz. Because quartz is not local to the site, all recovered quartz fragments were considered to indicate hominin activity at the site (Güleç et al., 1999; 2009). The Dursunlu industry is flake based, with only seven cores and 12 modified pieces. Nearly 10% of the flakes show crushed platforms that demonstrate use of the bipolar technique. The assemblage consists...
of relatively small pieces: the average size of unbroken flakes is 2.85 cm (Güleç et al., 1999; 2009), while the average maximal dimension of all flakes is 2.62 cm (min.: 0.90 cm; max.: 5.45 cm; standard deviation: 1.07 cm; n = 41) and that of bipolar flakes is 3.04 cm (min.: 1.75 cm; max.: 5.50 cm; standard deviation: 0.97 cm; n = 12). When chips and chunks, which constitute almost half the assemblage, are included, the average maximal dimension drops to 2.15 cm (data provided by S. L. Kuhn). The Paleolithic stratum is dated to 0.78–0.99 Ma by paleomagnetism and to 0.85–0.90 Ma by microfauna, placing it at the end of the Early Pleistocene.

Only two other Lower Paleolithic sites in western Turkey have been excavated using modern scientific standards and both are caves and nearly 300 km from Bozyer: Karain and Yarimburgaz. Data are more plentiful from these caves than from open-air sites because of their good preservation of archaeological, faunal, and anthropological remains. Lower Paleolithic strata in both caves have been dated roughly to the Middle Pleistocene, with both probably in use after 500 ka. At Karain, where all stages of the Paleolithic period are represented, the Lower Paleolithic assemblage is characterized by notched and denticulated Clactonian flakes. Common raw materials are locally available radiolarites, cherts, and calcareous stones (Otte et al., 1998). The age of Karain Lower Paleolithic materials is given by their association with local geological unit V.1, dated by correlation with oxygen isotope stages to 370–400 ka (Otte et al., 1998). The only biface from the site

**Fig. 15.** Photographs of a selection of retouched tools and flakes from Bozyer: 1–3: denticulates; 4: a notch; 5: retouched flake; 6–8: flakes; 9–10: bipolar flakes. Scale in cm. (Photos B. Dinçer; © Gygaia Projects).
was found among other tools just below this, in unit V.2, and may date to before 400 ka (Yalçınkaya et al., 2009).

The Lower Paleolithic of Yarımburgaz is characterized by a high percentage of retouched flakes and the selection of different raw materials for the production of different kinds of tools. Chert dominates the assemblage and is used for most retouched flakes. Quartzite is not a very frequent raw material, yet nearly 75% of core tools (e.g., choppers and chopping tools) are quartzite. Such tools are very few in number, constituting only 4% of the total assemblage (Kuhn et al., 1996; Kuhn, 2010). The bipolar flaking technique is evident and was used more frequently on quartz than on chert. Nearly 20% of the retouched flakes are made of quartz as well (Arsebüük, 1998b). Electron spin resonance and $^{230}$Th/$^{234}$Th methods date the Lower Paleolithic assemblage of Yarımburgaz to between 220 ± 20 and 390 ± 40 ka in the middle of the Middle Pleistocene (Arsebüük and Özbasar, 1999), during what micromammal remains shows was a relatively cold period (Santel and Koenigswald, 1998; Koenigswald et al., 2010).

6. Discussion and conclusion

A growing number of finds from surface surveys is increasingly shedding light on the presence and character of Lower Paleolithic
hominin assemblages in western Anatolia. Bozyer remains the only intensively surveyed Lower Paleolithic site in the area, however. This distinction allows comparison of the characteristics and proportions of tool types and materials resulting from systematic analysis of Bozyer's assemblage with those from comparable excavated sites in Anatolia and the eastern Aegean. Such comparison with radiometrically dated assemblages provides both technological and chronological benchmarks for the site.

As discussed above, the Bozyer industry is characterized by flakes and retouched flake tools, many of which were made with the bipolar technique; preferential representation of locally available quartz and quartzite over chert; only a few cores reused as choppers and chopping tools; and the absence of bifacial handaxes and other large cutting tools. For these reasons the Bozyer assemblage is ill fit to Mode 1 (Oldowan) and Mode 2 (Acheulean) technological complexes. Yet most known Lower Paleolithic sites from Anatolia are characterized by the presence of bifacial tools, and most of these are Acheulean, even if the number of atypical examples increases every year with new discoveries. The perceived abundance of Acheulean tools in Anatolia, and that of bifaces in general, might result from their relatively easily recognizable form and/or their material visibility, most being made in varieties of chert or obsidian that are quickly recognized during field survey. We must also consider the differential preservation and/or exposure of Pleistocene deposits, which may have differentially exposed evidence of Acheulean technologies based on geography, stratigraphic composition, and/or chronology (e.g., Gülteş et al., 2009; see also Tourloukis, 2016). The simplest explanation may be the most apt: hominin population increases in Anatolia after the end of the Early Pleistocene resulted in increasing evidence of their presence (i.e., Acheulean artifacts), and assemblages predating this period are in fact rare. It is in this context that the similarity of Bozyer’s lithic record to earlier assemblages gains importance.

Earlier assemblages in Anatolia are generally scarce. Other than the presence of a few possible Clactonian flakes at Bozyer, its assemblage is different from that of Karain (370–400 ka). The proportions of tool types at Yarburgaz (200–430 ka) and Bozyer are somewhat similar, especially concerning the dominance of flakes, yet distinct differences characterize the assemblages. Raw material choices differ and, while both sites are characterized by a low number of cores and core tools, the cores at Yarburgaz are multidirectional/centripetal, while those at Bozyer are usually globular. The high proportion of retouched flake tools at Yarburgaz, dominated by denticulates (Kuhn, 2010), also differs from that at Bozyer, and this high proportion has even led to consideration of the Yarburgaz assemblage as Middle Paleolithic (Kuhn, 2003). In general, the Bozyer assemblage appears to be more “archaic” compared with the Yarburgaz assemblage, even if both assemblages also evidence the production of quartz flakes using the
bipolar technique. The bipolar technique is one of the most distinctive features of the Bozyer assemblage, and it is seen not only in sparing use at Yarimbargaz, but also in frequent use at Dursunlu (0.78–0.99 Ma). In fact, the use of the bipolar technique and the dominance of quartz as a raw material at Dursunlu make its technology the most similar to the Bozyer assemblage. The association of the bipolar technique with the raw material of quartz seems to be more than random. It may have provided certain advantages compared to direct percussion when producing useable flakes from material with the particular mechanical characteristics of quartz.

In general, and with the exception of the Dursunlu assemblage (Güleç et al., 2009), the distinctive characteristics of the Bozyer assemblage are rarely found together in the relatively few known contemporary sites of Anatolia and the Aegean, and only then in Early Pleistocene assemblages (pre-780 ka). Considering a broader geography, however, Bozyer’s industry can be argued to resemble the temporary sites of Anatolia and the Aegean, and only then in Early (Güleç et al., 2009), the distinctive characteristics of the Bozyer assemblage. The presence of artifactual and skeletal remains dated before 1.1 Ma at some of the oldest hominin sites outside Africa. The close parallels for flake-based Lower Paleolithic industries that have few or no core tools like Bozyer are those from Dmanisi, Georgia (Sirakov et al., 2010) provided certain advantages compared to direct percussion when producing useable flakes from material with the particular mechanical characteristics of quartz.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.quaint.2019.05.016.

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Güleç, M.C., Guadelli et al., 2005. The assemblage of lithic materials analyzed for this article are bipolar in situ Lower Paleolithic contexts, given the nature of the site's exhumation through deep plowing and the finds' coating with carbonate crusts, yet these results demonstrate that even intensive surface survey and systematic analysis can add significantly to understanding the Lower Paleolithic of Turkey, encouraging similar approaches elsewhere.

Data availability

The assemblage of lithic materials analyzed for this article are managed by the Manisa Museum of Ethnography and Archaeology and are available for reanalysis via application through the General Directorate of Cultural Heritage and Museums, Ministry of Culture and Tourism, Republic of Turkey. Central Lydia Archaeological Survey datasets, including Bozyer documents, are currently in preparation for open-access, online sharing.

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