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Evolution of the Lithic Industry in Central Dagestan During the Early Pleistocene: The Rising Occurrence of Flake Blanks

Archaeological data from stratified Early Pleistocene sites in Central Dagestan are arranged in a direct stratigraphic sequence, making it possible to reconstruct the changes in lithic industry over a span of 1.2 mln years, from ~2.0 to 0.8 Ma BP, and to separate the principal stages in the Early Paleolithic culture of the Caucasus. This study examines blanks found at sites of the Ainikab-Mukhkay group, such as Ainikab-1, and Mukhkay-1, -2, and -2a. Occurrences of large flake blanks (>10 cm) at the Oldowan and the Oldowan to Acheulean transitional stage are provided. Such blanks appear at the beginning of the Jaramillo paleomagnetic episode (~1.07 Ma BP). By the end of the Early Pleistocene, their share attains 25.77 % of the total number of blanks for morphologically distinct tools. They are absent in Oldowan deposits (~2 Ma BP). The totality of statistical data justifies the separation of the transitional Oldowan to Acheulean stage in the region, dating to 1.0–0.8 Ma BP.

Keywords: *Northeastern Caucasus, Early Pleistocene, lithic industry, evolution, flake blanks, statistics.*

Introduction

The issue of manifestations of the evolution of the Central Dagestan Paleolithic industry during the Matuyama chron was previously discussed elsewhere (Amirkhanov, 2016; Amirkhanov, Taimazov, 2019). The papers introducing archaeological materials from particular sites provided mainly descriptions of finds. The general inference following from such a consideration was the identification, in the periodization of the Early Paleolithic of this region, of a separate stage when the lithic industry was transformed from the Oldowan to the Acheulean. This stage corresponds to the *Early Pleistocene large flake industry*. We accepted the appearance of large flakes (> 10 cm) as blanks for tools as one of the main indicators of significant changes in the industry. The onset of this stage on the generalized stratigraphic column corresponds to one of the intervals of the Jaramillo Subchron.

In characterizing the evolution of the industry, we have previously relied mainly on value judgments. This study is an attempt to consider the issue in more detail, with an emphasis on statistical and chronostratigraphic aspects. For this, we carried out a comparative analysis of quantitative data of the collections from cultural layers at the Ainikab-1, Mukhkay-1, -2, and -2a sites. The artifacts for research were selected according to the following criteria: the cultural layers from which they originated were excavated over a fairly large area; the materials were located *in situ*, or at least in a stratigraphically clear position; in quantitative terms, the collections were statistically significant; the layers of the sites under

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consideration correlated with each other, had at least a generalized date, and were separated from one another in a vertical direction and, accordingly, in time.

Study materials

Over the past 15 years, the North Caucasian Paleolithic Expedition of the Institute of Archaeology RAS, with the participation of colleagues from the Institute of History, Archaeology and Ethnography of the Dagestan Federal Scientific Center RAS, has been excavating a group of Early Pleistocene sites in the central (mid-mountain) part of Dagestan (Fig. 1). Eight multilayered stratified sites were studied to varying degrees (Amirkhanov, 2007, 2016; Derevianko et al., 2012). Of these, excavations over a relatively large area were carried out at the sites of Ainikab-1, Mukhay-1, -2, -2a. Therefore, the following conclusions will be based on the data from these particular sites.

The profiles at the sites of the Ainikab-Mukhay group are unusually thick for archaeological sites of the Eurasian Early Pleistocene. The Mukhay-1 profile extends to a depth of 65.5 m; it represents 39 cultural layers, containing accumulations of flint items. At Mukhay-2, the profile is 73 m thick and includes 34 Early Paleolithic cultural layers. The profile at Ainikab-1 is slightly more than 13 m and contains 21 cultural layers.

In terms of lithology, these sections are comparable to each other, which makes it possible to correlate the corresponding archaeological materials. Correlation between the lithic collections from Mukhay-1 and Mukhay-2, located relatively close to each other (at a distance slightly less than 100 m), is sometimes possible at the level of small lithological units. Both sites are located in the marginal part of the ancient basin at the foot of the limestone mountains; the mountain slopes were the source of coarse material in this intermountain depression. In contrast, Ainikab-1 is closer to the central part of the basin. In this area, the alluvial and deluvial removal of clastic material was always more intense than in the areas adjacent to the mountains. Therefore, it is difficult to compare the sections in the compared zones of the basin at the level of small lithological units, although correlation at the level of large lithological units is possible.

The sequence of cultural layers at each of the sites under consideration covers the period from 1.95 to 0.8 Ma BP (Amirkhanov, 2016; Amirkhanov et al., 2012; Tesakov, Ozhereliev, 2017; Chepalyga et al., 2012). The profiles of the sites, as noted above, are comparable to each other, and their upper portions are attributed to the Jaramillo Subchron. Such clear chronological determinations and the possibility of direct stratigraphic observations lend validity to the conclusions following from the diachronic analysis of the archaeological material. The inferences concern typological, technological, and statistical alterations of stone tools in cultural layers of the named sites.

Discussion

The cultural layers of the studied sites in Central Dagestan, in aggregate, represent almost the entire Early Pleistocene, which makes it possible to raise the question of the place, in the Paleolithic periodization of the region, of the Oldowan and Early Acheulean periods and the corresponding industries. The noted similarity of the profiles under consideration suggests the transition from one cultural-chronological stage (period) of the Early Paleolithic to another throughout the phase represented by the geological sections of these sites. The results of comparative typological and technological analyzes of the lithic collections from different layers of these sites cannot have different interpretations, since they are based on obvious stratigraphic data, which have as yet been recorded neither in the Caucasus nor in Eurasia as a whole.

The material that we use for analysis is limited to flake blanks for tools (Fig. 2). This category of artifacts, of course, does not reflect all the changes associated with evolution of the Oldowan during almost 1 mln years in the range of 2–1 Ma BP. However, as noted above, it is a marker of a technological milestone, from which the transformation of the Oldowan industry into the Acheulean begins. Therefore, in the corresponding statistical calculations, all products of this kind have been taken into account, without dividing them into tools or simply blanks (see *Table*). We operate only with those items in the assemblage that have been converted

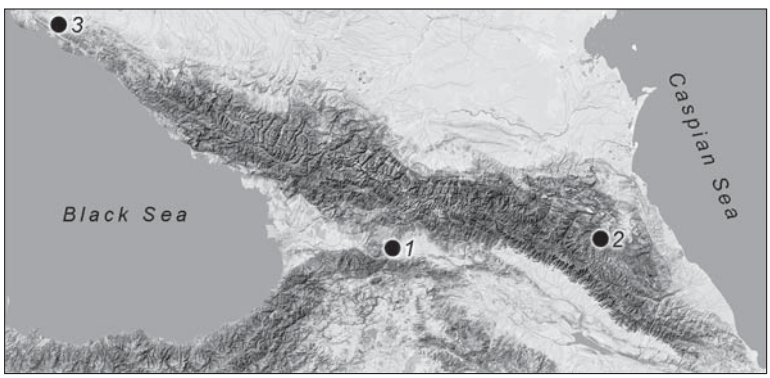

Fig. 1. Locations of the mentioned sites.
1 – Dmanisi; *2* – group of sites Ainikab-1, Mukhay-1, Mukhay-2; *3* – Kermek.

into tools. It seems that such approach makes it possible to reveal both the functional and technological significance of the considered group of blanks in a particular collection.

The comparative analysis is based on data relating to the sites of the Ainikab-Mukhay group (see *Table*). The four oldest sites are Ainikab-1, layer 21; Mukhay-2, layer 74; Mukhay-2, layer 80; Mukhay-2a, layer 2013 (1–3); these sites are united by the fact that their cultural layers lie below the level corresponding to the Olduvai paleomagnetic episode: i.e., these were formed before ~1.95 Ma BP. One site (Mukhay-1, layer 32) is dated within the range from ~1.21 to ~1.07 Ma BP. The remaining five are Mukhay-1, layer 4; Mukhay-1, layer 5b; Mukhay-1, layer 5; Mukhay-1, layer 7c; and Mukhay-1, layer 8. These latter refer to the period from the end of the Jaramillo episode (~0.99 Ma BP) to the turn of the Matuyama- Brunhes epochs (~0.8 Ma BP). For Ainikab-1, there are also two absolute dates obtained using the ESR method (Ahmed et al., 2010; Amirkhanov, Taimazov, 2019), which do not contradict the geological, geomorphological, and paleontological dates of the corresponding levels of the site profile.

It is important that the sites whose materials were subjected to the comparative analysis can be correlated by age not only with each other. Each of them is "embedded" both in the stratigraphic column of a separate multilayered site, and in the detailed general scheme of the cultural stratigraphy of the regional Early Pleistocene. Notably, this scheme is based on the data of direct stratigraphy, confirmed by consistent data from three sites, which were studied throughout the thickness of their profiles.

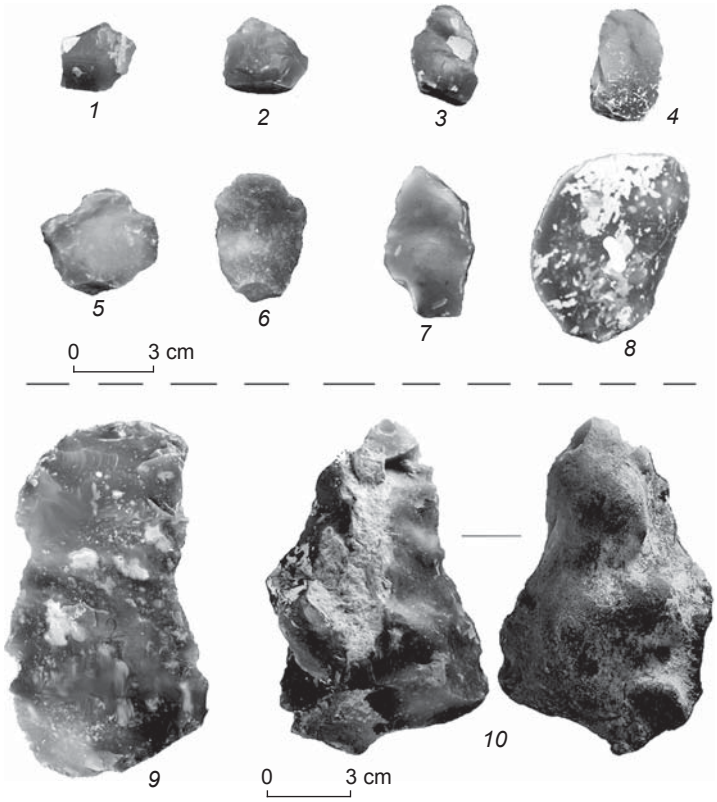

Fig. 2. Flake blanks of the classic Oldowan (*1–8*) and of the Early Pleistocene transitional large flake industry (*9*, *10*) in Central Dagestan. *1–8* – Ainikab-1, profile bottom; *9*, *10* – Mukhay-1, profile top.

Let us consider specific indicators of changes in the frequency of the use of large flakes as blanks for the manufacture of tools in the Early Pleistocene industries of Central Dagestan. First of all, noteworthy is the total absence of items of this type in the inventory of layers dating back to the time before the Cobb Mountain

Large flake tools in the collections of the Early Pleistocene sites in Central Dagestan

Site	Layer	Date, Ma BP*	Number of lithics, spec.		Percentage of large flake tools, %
			total	tools	
Mukhay-1	4	~0.8 – ~0.85	235	97	25.77
	5b	~0.8 – ~0.85	339	101	19.81
	5	~0.85 – ~0.99	465	101	14.85
	7c	~0.95 – ~0.99	186	43	6.98
	8	~0.95 – ~0.99	933	98	2.04
	32	~1.21 – ~1.07	586	111	3.6
Mukhay-2	74	> 1.95	370	128	0
	80	> 1.95	1079	99	0
Mukhay-2a	2013 (1–3)	> 1.95	738	56	0
Ainikab-1	21	> 1.95	166	44	0

*The dates of cultural strata are based on the paleomagnetic studies, as well as on the data of the paleontological and palynological identifications, geological-geomorphological characteristics, and solitary ESR-dates of the sites whose materials are considered here (see (Amirkhanov, 2016; Derevianko et al., 2012; Chepalyga et al., 2012; Tesakov, Ozhereliev, 2017)).

paleomagnetic episode (~1.21 Ma BP). This was mentioned in earlier publications. It has been noted that typical blanks in the local industry of the first half of the Early Pleistocene were small (3–5 cm on average) flakes and corresponding cores (Amirkhanov, 2016; Ozhereliev, 2014). The sizes of cores from layer 21 of Ainikab-1 are indicative: height 4.7 cm, width 5.9 cm, thickness 5.5 cm. The cores found in this layer (Fig. 3) are not large; their sizes were not predetermined by the shape and mass of the raw material units. In this case, the sizes of the cores cannot be explained by the sizes of the available pebbles. None of the varieties of raw materials found at the site are pebbles in their origin. All cores are made of mostly tablet-nodules, and originate from the horizons lying between limestone beds.

Comparisons of the corresponding contemporaneous materials from the Caucasus and the Azov Sea region produce a similar picture. Differentiated analysis of the Dmanisi inventory by the type of raw material has shown that the smallest cores are of flint (3.6 × 2.1 × 2.3 cm), and the largest of rhyolite or basalt (7.9 × 6,9 × 4 cm) (Lumley et al., 2005: 78). However, neither is included in the category of large flake cores.

Materials from the Azov Sea region dating to not later than the middle of the Early Pleistocene (Kermek site) also indicate the use of cores for the manufacture of medium and small flakes (Shchelinsky, 2013). Blanks exceeding 5 cm in length are not numerous at Kermek; very few significantly exceed this size. The length of negative scars even on the largest Kermek cores are 5 cm on average. Even if in some classifications flakes of this size are assigned to large, these are not those large flakes of the Early Acheulean and the "developed Oldowan" from the Olduvai Gorge, which were deliberately chopped off as blanks for bifaces, including hand-axes.

Thus, the materials from the Caucasus and the Azov Sea region, which represent primary reduction and belong to at least the first half of the Early Pleistocene, reflect the standards for core sizes and, consequently, the main features of the classic Oldowan blanks.

According to our observations, noticeable changes in the industry occurred approximately at the initial stage of the Jaramillo episode (1.07 Ma BP). At the very beginning of this period, the proportion of tools on large flakes in the collections from the sites in Central Dagestan was only 3.6 %, and at its end 6.98 %. In the period from 1.95 to about 1.1 Ma BP, in the northeastern Caucasus, features suggesting the use of large flake technology have not been noted.

The tendency towards the use of large flakes is more noticeable in the range from the final Jaramillo episode to the Late Early Pleistocene (0.85 Ma BP). Finally, the peak in the use of this type of blank falls on the boundary of the Early and Middle Pleistocene. During this period, more than a quarter of the tools on flakes (25.77 %) were associated with blanks of the type under consideration. At this stage also, other signs of the onset of a new era in the development of the lithic industry were noted—the Acheulean. For example, large flakes were regularly used for the manufacture of massive implements—picks and choppers. In the Oldowan strata, such tools were manufactured on nodules and fragments. Knives made on large flakes became common. In the upper layers of at least two sites (Ainikab-1 and Mukhay-1), solitary artifacts with bifacial trimming have been found. Another characteristic feature of this stage is the relative abundance of transverse two-edged choppers in the upper layers (Mukhay-1).

Thus, a transitional stage from Oldowan to Acheulean is identified

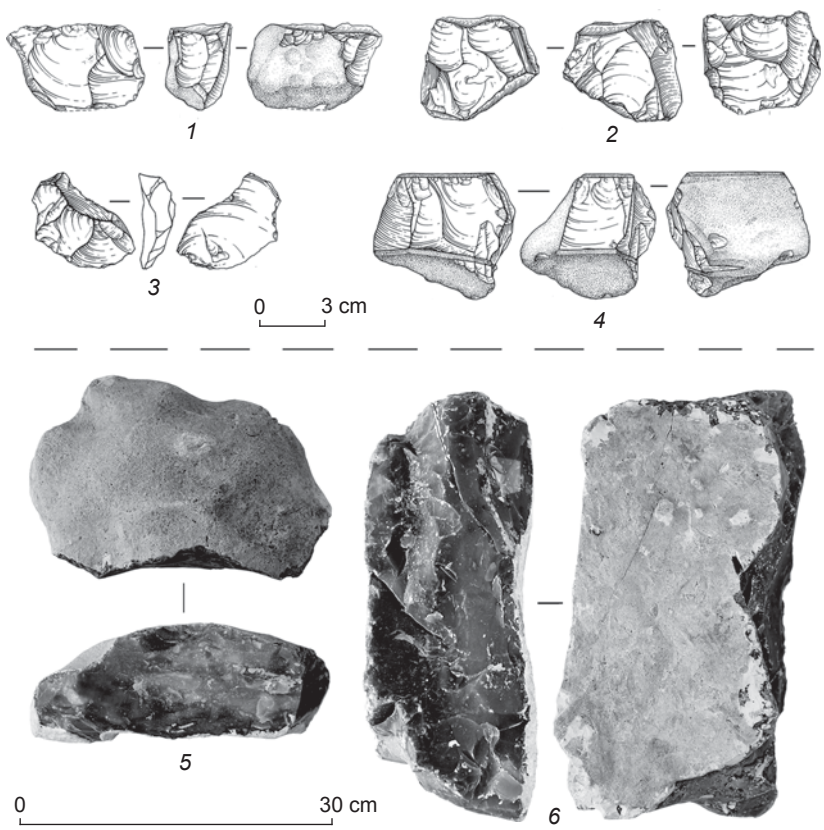

Fig. 3. Cores of the classic Oldowan (*1–4*) and of the Early Pleistocene transitional large flake industry (*5*, *6*) in Central Dagestan.
1–4 – Ainikab-1, layer 21; *5*, *6* – Mukhay-1, layer 7c.

in the development of the Early Paleolithic culture in the Caucasus, during which stage the lithic industry is still dominated by the typological set of the leading Oldowan forms without hand-axes; but at the same time, significant changes occur in the technology of processing stone raw materials. Such manifestations are recorded in different regions and at different times. Technological changes are the essence of this specific stage, which reveals itself in the Early Paleolithic oecumene at different times (and, perhaps, in various forms), but is inevitable in transition to the final stage of the Oldowan industry development. As follows from the presented analysis, in the northeastern Caucasus, the beginning of the Oldowan to Acheulean transition falls at a time of ca 1 Ma BP. The transition itself was not an instantaneous act, but took about 200 thousand years (Amirkhanov, 2016).

It is important to touch upon a question about the reasons for the turning-point in the development of the Oldowan industry, which determined the transition to the Acheulean era in the Caucasus. This issue in relation to the northeastern Caucasus requires correlation of this process with climatic, or, more broadly, paleogeographic, changes in the Late Early Pleistocene. Transformations in the lithic industry associated with the systematic use of large flakes coincided with a sharp and unidirectional change in the features of lithological deposits, as well as changes in palynological spectra in certain sections of the sites. For example, the part of the Mukhay-2 profile (depth 5.15–8.60 m) which corresponds to the Jaramillo paleomagnetic episode produced the distinctly specific palynological characteristics of the samples, making it possible to distinguish two palynological zones. This suggests an increase in the pollen of dark coniferous species (spruce, fir, hemlock). "There appears Serbian spruce (Picea omorica). Pine pollen is constantly present. Broad-leaf species are represented by hornbeam, linden, maple, pterocarya, and celtis. Small-leaf species include birch and alder. In the group of herbaceous species, pollen of Asteraceae and Chenopodiaceae is identified, which most often form rock-and-talus phytocenoses, as well as Astragalus and Leadenidae, which are mountain xerophytes, and wormwood. Spores of the Filicales fern are rare" (Shilova, 2013: 3; 2014: 2). The accumulation of sediments containing this set of pollen and spores should have occurred with a relative cooling and humidification of climate. The layers directly underlying this unit contrast considerably with the abovementioned palynological characteristics. The differences observed in the layers that formed earlier than the Jaramillo episode suggest a warmer and less humid climate.

The mentioned natural changes were followed by a significant change in the vegetation cover and fauna composition during the Jaramillo paleomagnetic episode. Judging by the data of the sites under study, glaciation did not form a continuous cover in the zone of the middle mountains, and even less so in the low mountains of the northeastern Caucasus, and did not lead to depopulation of this area. But the natural conditions most likely served as an impetus for a significant transformation of the culture—to the onset of the Oldowan to Acheulean transition. So far, we do not have sufficient information to describe this process in detail, but we are able to make assumptions concerning its time and duration, as well as the nature and significance of the technical and typological changes that occurred in the industry during the environmental fluctuations.

Conclusions

According to diachronic statistical indicators, during the Early Pleistocene, evolution of flake blanks for the manufacture of tools took place in the lithic industry of Central Dagestan. In the inventory of cultural layers dating back to the Olduvai paleomagnetic episode and earlier, blanks in the form of large flakes (>10 cm) are completely absent. The appearance of the large flakes in the area under study took place in the period immediately before the onset of the Jaramillo episode (from ~1.21 to ~1.07 Ma BP). The number of large flakes gradually increased, and reached its maximum by the Final Early Pleistocene (0.8 Ma BP). It is quite indicative that this corresponds to the time of the origin of the Acheulean elements in the studied region. The recorded phenomena reflect changes in the technological paradigm of primary reduction towards expanding the target settings and technical capabilities in the process of producing flake blanks.

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