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Late Acheulean Handaxes from Northeastern Caucasus: Morphology and Technology

We describe the variability of morphological and technological features of handaxes from two culturally and chronologically consecutive Acheulean assemblages of Dagestan, Northeastern Caucasus. The early one, dating to MIS 11–10, is represented by three sites: Darvagchay-Zaliv-1 (complex IV, layer 3), Darvagchay-Zaliv-4 (layer 5), and Darvagchay-Zaliv-2. The late complex, dating to MIS 7, includes the sites of Darvagchay-Zaliv-1 (complex IV, layer 2), Darvagchay-Zaliv-4 (layer 3), and Darvagchay-Karier. We examine analogies from other Acheulean sites in the Caucasus. Two-dimensional geometric-morphometric analysis was used to study the shape of tools from Dagestan. The findings suggest that the shape of unifacial tools is the same as that of bifaces. The comparison of tools from two cultural and chronological horizons, including those from contemporaneous sites in the Caucasus, indicates a higher variability in earlier tools. Based on the scar pattern analysis, three chaînes opératoires in manufacturing handaxes were reconstructed. Tools of the later complex had been subjected to a more thorough reduction than those of the early complex. Technological continuity was traced over a considerable timespan (MIS 11–7). It was manifested in the standardization of bifacial shape and the gradual sophistication of chaînes opératoires. Given the high morphological homogeneity of tools from Dargvachay complexes and other contemporaneous industries of the Caucasus, it can be suggested that these technological tendencies are characteristic of the entire Caucasus.

Keywords: *Acheulean, Caucasus, Dagestan, handaxes, geometric-morphometric analysis, scar pattern analysis.*

Introduction

Analysis of the morphological variability of stone tools underlies many Paleolithic studies. Understanding of the required standards of stone tool manufacture is important for the reconstruction of ancient hominin behavior. Bifacial tools, and handaxes in particular, constitute one of the ancient categories of lithic artifacts whose morphological variability has always been a focus of interest for researchers. Many scientific papers address the morphology of handaxes (see, e.g., (O'Brien, 1981; Vaughan, 2001; Beyene et al., 2013)).

There are several hypotheses explaining the significant morphological uniformity of handaxes over a wide area and over a long period of time. One of them is the hypothesis of cultural transmission (social/cultural learning): handaxes and bifaces are considered as cultural markers, the style and manufacturing technology of which were passed down from generation to generation. The hereditary transmission of the tradition of reproducing the tool shape ensured the preservation of its main models in the populations of *Homo erectus* and *Homo heidelbergensis* during the Middle Pleistocene (Foley, 1987). The transfer of technological knowledge was

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most likely dominated by imitative learning or imitation (Mithen, 1999; Shennan, Steele, 1999; Shipton, Petraglia, Paddayya, 2009; Bar-Yosef, 2006).

The cultural transmission theory, which does not allow us to imagine the mechanism of transmission of cultural information during several hundred thousand years, has been developed in the hypothesis of genetic transmission, which explains the transfer of the technology of handaxe production through genetic inheritance (Corbey et al., 2016).

In the study of the Acheulean tools, in addition to the traditional methods (linear measurements and visual evaluation of shape) (Roe, 1968; McPherron, Dibble, 1999), statistical and quantitative methods verifying the derived data began to be used, for determination of the morphology of items (Lycett, Cramon-Taubadel, von, Foley, 2006; Herzlinger, Goren-Inbar, Grosman, 2017; Weiss et al., 2018; Serwatka, 2015; Lycett et al., 2016). The use of various methods allowed researchers not only to identify a significant morphological similarity of the studied items, but also to explain the variability of bifaces and handaxes by their purpose, technological convergence, reduction of tools, quality and availability of lithic raw materials (Vaughan, 2001; McPherron, 2006; Li H., Kuman, Li C.-R., 2014; Lycett et al., 2009; Shipton, Clarkson, 2015).

The purpose of this article is to study the variability of the shape and the technology of handaxes from the Late Acheulean complexes from Southeastern Dagestan (Northeastern Caucasus), using geometric-morphometric and the scar pattern analyses (Rybalko 2017, 2019; Rybalko, Kandyba, 2019, 2020).

Materials and methods

Archaeological assemblages

The Late Acheulean complexes of Southeastern Dagestan include two stratified sites—Darvagchay-Zaliv-1 (complex IV, layers 2 and 3) and Darvagchay-Zaliv-4 (layers 3 and 5), and two localities with the surface exposed artifacts—Darvagchay-Karier and Darvagchay-Zaliv-2. On the basis of the analysis on archaeological materials, as well as the data on the relative and absolute dating, two cultural-chronological complexes have been identified (Rybalko, 2017, 2019; Rybalko, Kandyba, 2020). The early complex II has been recorded at the Darvagchay-Zaliv-1 (layer 3), Darvagchay-Zaliv-4 (layer 5), and Darvagchay-Zaliv-2. The finds occur in similar geochronological condition, their age has been determined to be within MIS 11–10 (380–330 ka BP) (Kurbanov, Rybalko, Yanina, 2021). The late cultural-chronological complex I contains the artifacts from Darvagchay-Zaliv-1 (layer 2), Darvagchay-Zaliv-4 (layer 3), and Darvagchay-Karier, which have been dated to 250–220 ka BP, corresponding to MIS 7 (Ibid.).

Macro-tools, including choppers, picks, core-like scrapers, and handaxes, are a characteristic feature of the lithic assemblages of the both complexes. Researchers of the Darvagchay archaeological district assigned to the category of handaxes not only classic bifacial tools, but also partial handaxes and unifacial handaxes (Rybalko, 2019, 2020; Rybalko, Kandyba, 2020). We included artifacts of this category into our study materials in order to expand the number of technological observations and enlarge the sample.

The collection of handaxes from the early complex II comprises 12 items (Fig. 1, *5–9*). In this set, there are 2 unifacial tools; the other tools are partial (9 spec.) or complete (1 spec.) bifaces.

The collection of handaxes from the late complex I includes 16 specimens (Fig. 1, *1–4*). As compared to earlier industries, the share of bifacial handaxes (5 spec.) is greater here, the main part again consists of partial handaxes (9 spec.), and unifacial tools are few (2 spec.).

Geometric-morphometric analysis

The standard procedure of geometric-morphometric analysis, which has been repeatedly described in the research literature (Costa, 2010; Serwatka, 2014, 2015; García-Medrano et al., 2020; Shalagina et al., 2020), was applied to study the handaxe morphology. The method is aimed at the study of the artifact shape through a multidimensional analysis of the coordinates of landmarks established on its surface at a given distance from one another (Herzlinger, Goren-Inbar, Grosman, 2017). In the course of the study, a two-dimensional geometric-morphometric analysis of the items outlines was used.

The XY-coordinates of the outlines of artifacts were taken in the TPS program (Rohlf, 2006). The contours of items were recorded through the graphic images of handaxes from the Acheulean sites of Darvagchay (25 spec.) and the Acheulean sites of the Caucasus region (25 spec.), described in the monographs by V.P. Lyubin (1998: 43, fig. 19, *1*; p. 103, fig. 53) and V.P. Lyubin, E.V. Belyaeva (2004: 105, fig. 47; p. 107, fig. 49, *2*; p. 149, fig. 70; p. 176, fig. 83). Bifacial tools were oriented along the longest axis of symmetry, in accordance with the technique proposed by S. McPherron and H. Dibble (1999).

The XY-coordinates of the items contours were taken automatically in the TPSdig program, using 60 landmarks, starting from the distal end in a clockwise direction. Under landmarks, as proposed by other researchers (Herzlinger, Grosman, 2018; Serwatka, 2014, 2015; Costa, 2010), we understand both types of marks, including semi-landmarks, which are established evenly

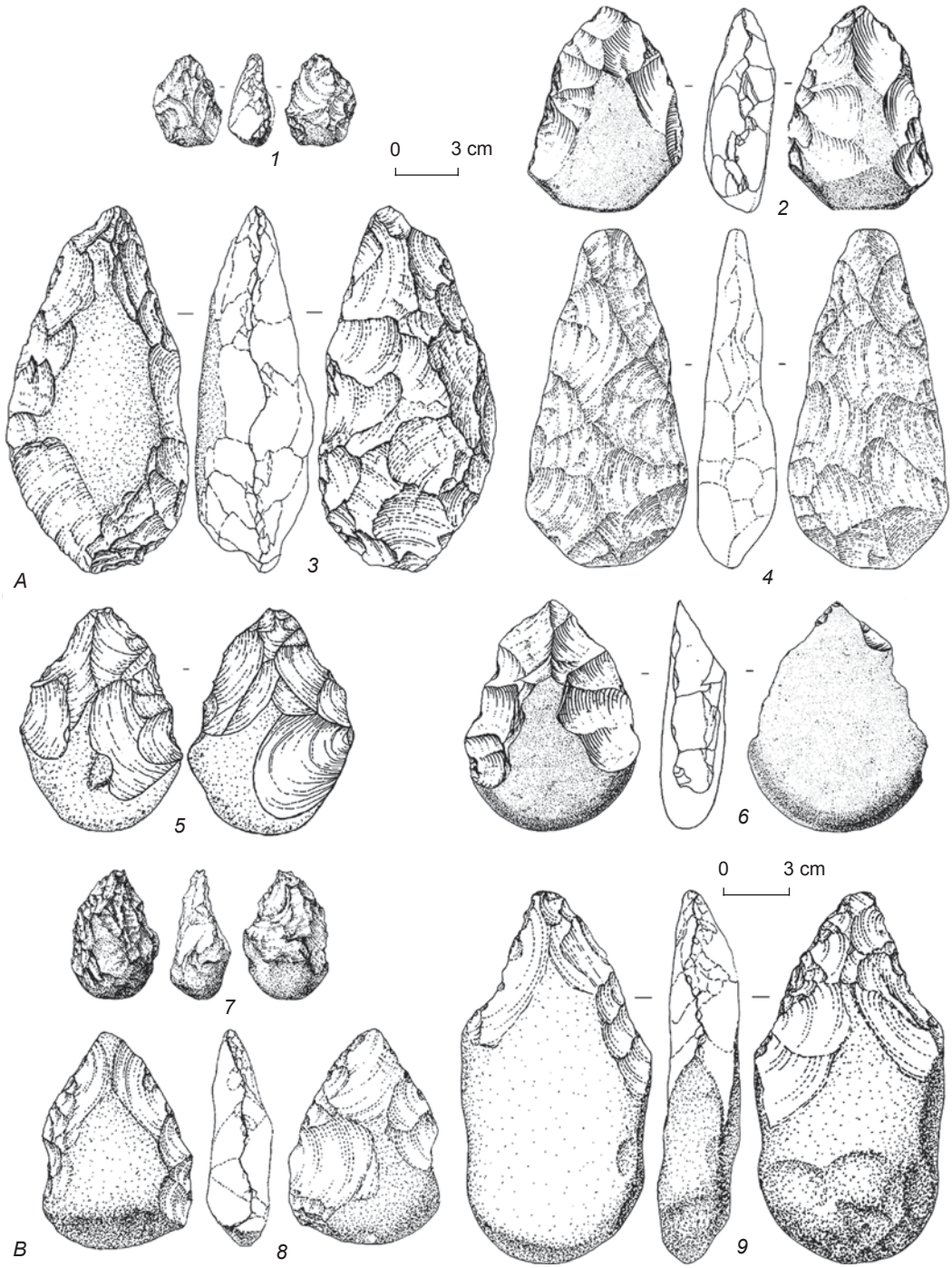

Fig. 1. Handaxes from the Acheulean complexes of Southeastern Dagestan.
A – cultural-chronological complex I: *1* – Darvagchay-Zaliv-1 (layer 2), *2* – Darvagchay-Zaliv-4 (layer 3), *3* – Darvagchay-Zaliv-1 (layer 2), *4* – Darvagchay-Zaliv-4 (layer 3); *B* – cultural-chronological complex II: *5*, *6* – Darvagchay-Zaliv-4 (layer 5), *7* – Darvagchay-Zaliv-2, *8*, *9* – Darvagchay-Zaliv-1 (layer 3).

at a given distance on the surface or along the contour of an item (Serwatka, 2014; Shalagina et al., 2020). The number of landmarks used in studies can vary from 28 (García-Medrano et al., 2020) to 75 (Costa, 2010) and 100 marks (Serwatka, 2014, 2015). The number of marks and choice of their location are determined by the researcher. Analyzes of Lower and Middle Paleolithic bifacial tools show that 60 landmarks are enough to record the handaxe contour (García-Medrano et al., 2020; Iovita, 2009).

The XY-coordinates of items contours were converted into a single system using Procrustean analysis in the PAST (PAleontological STatistics) program

(Hammer, Harper, Ryan, 2001). The same program was used to subject the transformed data to the principal component analysis.

Scar pattern analysis

Scar pattern analysis was carried out in order to reconstruct the technique of shaping the bifacial tools from the Acheulean complexes of the Darvagchay archaeological district. This method is based on a thorough study of all negative scars on the surface of a lithic artifact (Pastoors, 2000; Kot, 2014; Shalagina, Kolobova, Krivoshapkin, 2019). For each product, a flowchart was made reconstructing the succession of tool shaping operations. Each block in the chart corresponds to a group of negative scars similar in morphological characteristics (flakes from the same striking platform, in the same direction, etc.) and aimed at one technological stage. This article provides an analysis of the sets of flowcharts constructed on the basis of graphic images of the most typical tools. The scar pattern analysis was carried out for 18 items: Darvagchay-Karier – 2 spec., Darvagchay-Zaliv-1 – 4 spec., Darvagchay-Zaliv-2 – 1 spec., and Darvagchay-Zaliv-4 – 11 spec., of which 7 specimens belong to complex II, and 11 specimens to complex I.

Results

The two-dimensional geometric-morphometric analysis was carried out for 25 handaxes from the Darvagchay sites. In order to ensure the statistical representativeness of the sample and the possibility of comparing the Darvagchay complexes with other Acheulean industries of the Caucasus, our sample was supplemented by bifacial tools (25 spec.) from other Acheulean sites of the region that correspond to archaeological complexes of Southeastern Dagestan in terms of culture and chronology. These include the tools from the stratified sites of Koudaro I (11 spec.), Azykh, layer 5 (2 spec.), Tsona Cave (2 spec.) and from the surface collections of Satani-Dar (6 spec.), Kheivani (1 spec.), and Yashtukh (3 spec.).

Geometric-morphometric analysis of the tools outlines revealed a high morphological homogeneity of the sample: 74.92 % of the variability in the shape of handaxes are covered by the first two components—53.79 and 21.13 %, respectively. The first component describes a variety of tool shapes from wide and short to elongated, the second component deals with the range from symmetric leaf-shaped to asymmetric trapezoid (Fig. 2). The Darvagchay tools, as well as the artifacts from other Acheulean industries of the Caucasus, follow common morphological trends. On the plot, the tools from all the sites are distributed evenly, in accordance with the values of the two first principle components (Fig. 2).

The same method was used to compare the morphologies of unifaces and bifacial handaxes. Geometric and morphometric analysis has shown that the outline indexes of unifacial tools fully correspond to the range of variability of bifacial handaxes. On the plot of tools distribution by the values of the two principal components, the unifacial tools gravitate towards the center of the plot and show greater shape uniformity than bifacial tools (Fig. 3). That is, the artisans intentionally produced a convergent shape in unifaces, similar to the

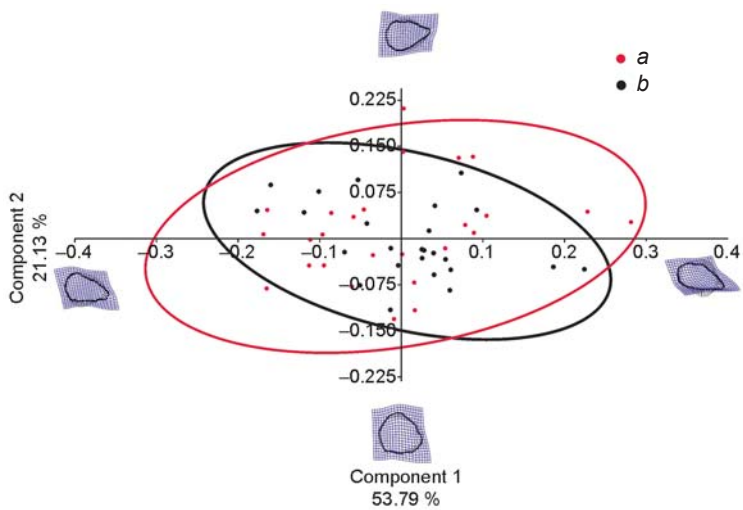

Fig. 2. Plot of distribution of handaxes from the Acheulean complexes of the Caucasus, according to the values of the first two principal components. 95 % variability ellipses include the groups of tools from Darvagchay complexes and those from other Acheulean industries of the Caucasus. N=50. *a* – Acheulean complexes from the Darvagchay archaeological district; *b* – Acheulean complexes from the Caucasus.

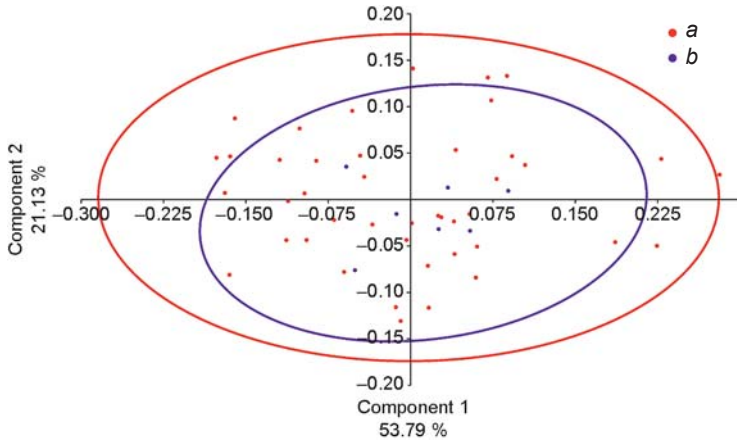

Fig. 3. Plot of distribution of handaxes according to the values of the first two principal components. The tools are grouped by the presence of signs of bifacial or unifacial working. N=50.
A – bifacially worked tools; *b* – unifacially worked tools.

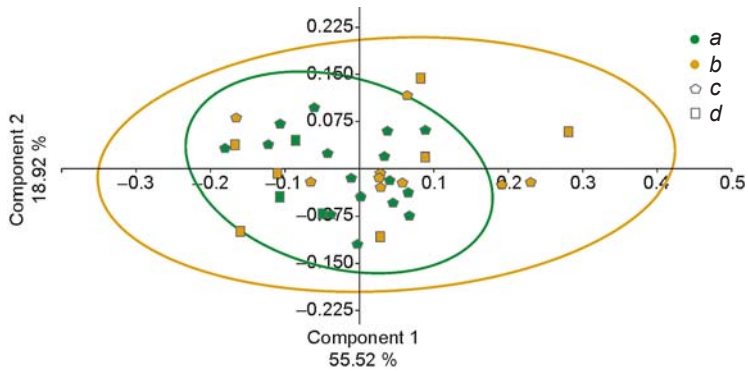

Fig. 4. Plot of distribution of handaxes according to the values of the first two principal components. The tools are grouped by their cultural-chronological affiliation. N=35.
a – cultural-chronological complex I and contemporaneous Acheulean complexes of the Caucasus (MIS 7); *b* – cultural-chronological complex II and contemporaneous Acheulean complexes of the Caucasus (MIS 10–11); *c* – handaxes from Darvagchay complexes (Darvagchay-Zaliv-1, -4); *d* – handaxes from Acheulean complexes of the Caucasus (Koudaro I, Azykh, Tsona Cave).

design of bifaces. This makes it possible to consider unifaces, partially worked handaxes, and classic bifaces within a single category in studies of the Darvagchay handaxe manufacturing technique.

The morphological variability of handaxes from two cultural-chronological complexes was assessed through the geometric-morphometric analysis. We analyzed the sample of tools (35 spec.) including the Darvagchay tools and the artifacts from Caucasian assemblages with a clear chronological attribution (10 spec.). It concerns the sites contemporaneous to the cultural-chronological complex I (MIS 7): Koudaro I, lenses X – 2 spec., and Tsona Cave – 2 spec.; and to the cultural-chronological complex II (MIS 10–11): Koudaro I, layer 5a/5b – 3 spec., Koudaro I, layer 5c – 1 spec., Azykh, layer V – 2 spec.

The plot of tools distribution by the values of the first two components shows that 95 % of the variability ellipse of the tools from complex I (MIS 7) falls within 95 % of the variability ellipse of the tools from complex II (MIS 10–11) (Fig. 4). In other words, the older the tools are, the more variable they are in shape. Tools from the later complex, showing uniformity, tend towards the center of the plot, i.e., to the unified shape (Fig. 4).

Four unifaces, four partial and three classic bifacial handaxes from complex I were studied using the *scar pattern analysis*. The selected artifacts show leaf-shaped, ovoid, or triangular shape. All the items have two working edges, with several of them showing continuous marginal retouch. The partial bifacial handaxes retain pebble crust covering up to 70 % of each face. Distal ends of the uni- and bifacial tools are metrically similar. Unifacial items of the sample show a distal end angle 115–140° in plan view and 50–60° in side view. Among the bifacial artifacts, this value varies from 80 to 140° in plan view, and 45–83° in side view. The angle of working edges for both unifaces and bifaces reaches from 60 to 85°.

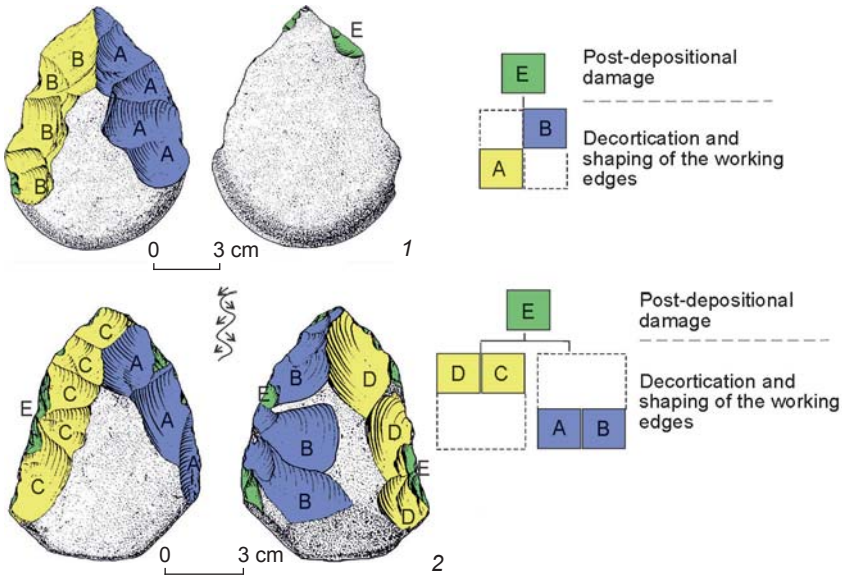

Fig. 5. Diagrams of shaping the handaxes from Darvagchay-Zaliv-4 corresponding to chaîne opératoire 1.
1 – unifacial tool from layer 5; *2* – bifacial tool from layer 3.

Two unifaces and five partial bifaces from the early complex II have been analyzed in detail. These are leaf-shaped and sub-trapezoid artifacts. All the items of the sample show two working edges with a length reaching 3/4 of the length of the product. There are no tools with marginal retouch in this complex. In partial bifaces, the share of pebble crust on each side reaches 50 %. In bifacial products, the angle of the distal end is 80–110° in plan view, 40–68° in side view; in unifaces, 80–90° and 35–50° respectively. The angle of the working edges is 48–70°.

Scar pattern analysis made it possible to identify several main trends in the shaping of handaxes from complexes I and II. In general, all the identified trends are typical of both unifacial and bifacial tools from the Darvagchay sites.

The analyzed tools show the signs of use of biconvex and plano-convex shaping techniques. The choice of technique depended on the shape of the blank. In the Darvagchay complexes, handaxes were mainly fashioned on pebbles of various morphologies, some of which had clearly plano-convex shapes. The plano-convex technique was usually used in shaping the plano-convex pebbles. In all other cases, biconvex technique was used; flaking was executed from two surfaces alternately.

Uni- and bifacial tools of complexes I and II show several chaînes opératoires, regardless of the technique used.

Chain 1 is the shortest; it corresponds to the technique of working the convergent-shaped tools with the help of consecutive centripetal spalls from one or two sides (Fig. 5). The working was minor, and no additional shaping was needed. Large spalls, which were also decortication spalls, ensured the convergent shape of the tool and formed two working edges. Among the tools analyzed, there are five items that were manufactured using this chaîne opératoire. The number of spalls from each of the flaking surfaces varies from 4 to 11. Judging by the size of the latest negative scars, the tools were shaped by the largest flakes (Fig. 6). This chaîne opératoire is typical for complexes I and II.

Chain 2 is longer; it consists of two main stages of shaping. The first stage was decortication, which simultaneously served as initial shaping; the second stage was additional working of edges with small detachments (Fig. 7). In some cases, minor basal or distal working was carried out. This chaîne opératoire was identified on nine artifacts. The number of negative scars on each of the prepared surfaces of the tools varies from 6 to 23. The dimensions of the negative scars are generally smaller than those of chain 1 (see Fig. 6). The signs of use of chaîne opératoire 2 have been recorded in both complexes.

Chain 3, the longest, is connected to the careful preparation of the faces. This chain included decortication, shaping of the working edges, shaping of the distal end, and sometimes also basal working (Fig. 8). The convergent shape was given to the tool mainly at

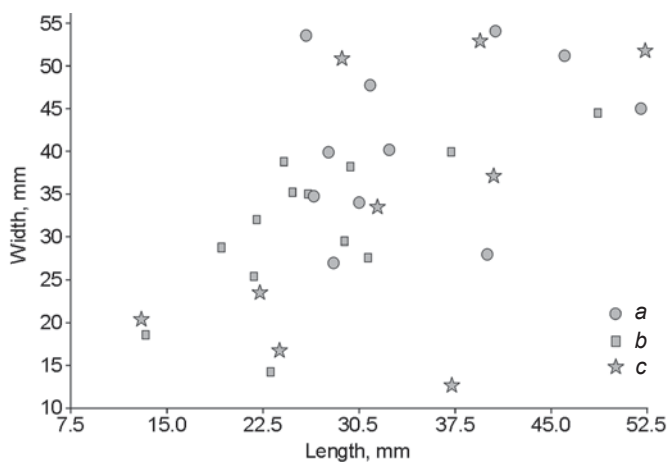

Fig. 6. Sizes of negative scars on the surface of handaxes from the Darvagchay complexes. The two latest and largest negative scars on the surface of the tools were taken into account.
a – chain 1; *b* – chain 2; *c* – chain 3.

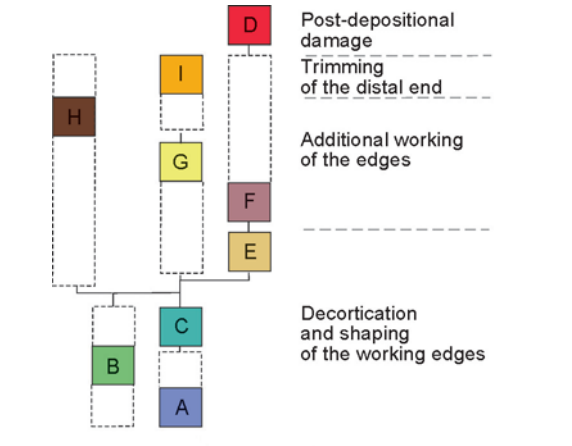

Fig. 7. Diagram of shaping the handaxe from layer 5 at Darvagchay-Zaliv-4, corresponding to chaîne opératoire 2.

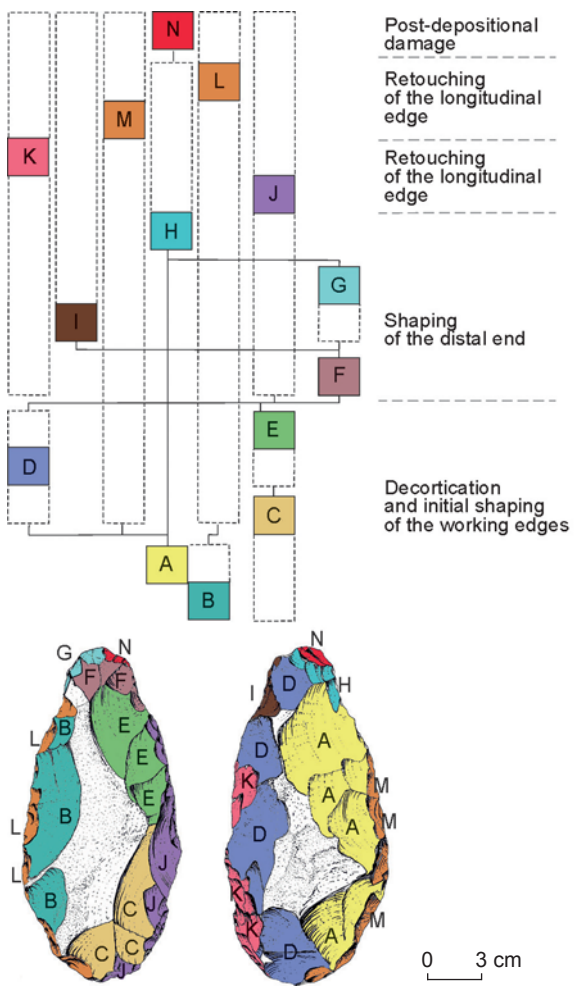

Fig. 8. Diagram of shaping the handaxe from layer 3 at Darvagchay-Zaliv-4, corresponding to chaîne opératoire 3.

the stage of shaping the working edges, and not at the initial stage of decortication. Chaîne opératoire 3 was traced on four artifacts. The number of flakes from each of the treated surfaces of the tools varies from 18 to 41. The dimensions of the negative scars are very diverse; both large and small spalls are recorded (see Fig. 6). The longest chaîne opératoire has been identified only on the tools of the late complex I.

Discussion

The Caucasus is traditionally considered a region where the Acheulean industries are widespread (Lyubin, 1998; Lyubin, Belyaeva, 2004). However, there is an opinion that the classic Acheulean industries with bifaces appeared here no earlier than the second half of the Middle Pleistocene (Doronichev, Golovanova, 2003; Doronichev, 2004), and they were preceded by the lithic industries without classic Acheulean bifaces (Doronichev et al., 2007: 200–250). This assumption is not unfounded: despite the large number of sites with various Acheulean bifaces in this area (Derevianko, 2014: 43–67; Amirkhanov, 2017), most of them are represented by the surface collected artifacts or by the stratified sites whose cultural and chronological affiliation is determined on the basis of relative dates (Lyubin, 1998: 13–96; Kulakov, 2020: 77–84). Accordingly, handaxes, namely their morphology and manufacturing technology, are of fundamental importance for the study of the Acheulean of the Caucasus.

The analysis of the Acheulean technocomplex of the Caucasus is based on assemblages from the stratified sites (Lyubin, 1998: 169–173; Kulakov, 2020: 77–84; Anoikin, 2016). Among the stratified Late Acheulean complexes, the industries of the Koudaro-1, Koudaro-3, Azykh, and Tsona cave sites are best known. According to biostratigraphic data and absolute dates, these sites were formed during the period corresponding to OIS 7–9/10 (Doronichev et al., 2007: 200–250). However, owing to the fact that many of these stratified sites were studied in the first half and middle of the 20th century, using the method of artifact recording, which is now considered outdated, it is not always possible to correlate the materials with the specific geological layer, and, accordingly, to identify the absolute age of the finds.

In this regard, the Late Acheulean industries of Southeastern Dagestan are unique: they were mostly recovered from stratified deposits for which the absolute dates are available. On the basis on these materials, two cultural-chronological complexes of the Late Acheulean have been distinguished. The occurrence of two technocomplexes in a limited area allows us to trace the development of the main methods of processing lithic raw material, including the basic technology of the handaxe manufacture.

The analysis of the scar patterns and morphology of handaxes from the two Late Acheulean complexes of Southeastern Dagestan made it possible to establish the continuity in the tradition of their manufacture. All morphological and technological tendencies that appeared in the late complex I originated in the early complex II. This inference was made on the basis of studying both the morphology of the tools and the pattern of their processing.

The results of the geometric-morphometric analysis has shown that in early industries handaxes were more diverse in shape than in late ones. They were characterized by asymmetric shortened contours and massive bases. The main techniques of shaping the leaf-like or symmetric tools have been recorded in the late complex and originated in the early one. In general, in the late complex, the shape of handaxes becomes more standardized.

The scar pattern analysis has shown that ancient artisans aimed at uniformity of the tools regardless of the number of operations in the chain. In all three chaînes opératoires, the main operations were associated with the shaping of edges, converging in a subtriangular or rounded end. The width and thickness of the distal ends of the tools fashioned using various chaînes opératoires are generally the same. A similar conclusion follows from the analysis of the angles of distal ends in plan and side views (Fig. 9).

The working edges were shaped either by large decortication flakes or were subjected to additional working. The scar pattern analysis shows that the converging edges and convergent shape of tools were formed during the purposeful actions of an artisan, starting from the stage of decortication, but not during utilization.

Comparison of the handaxe manufacturing technology of the two different complexes has shown that a more sophisticated tool-shaping technique including the stages of decortication, edge preparation, and trimming of the distal end, was typical for the late complex I. Chaînes opératoires 1 and 2 were recorded in both complexes. Thus, the younger industries testify to the sophistication of handaxe manufacturing technology.

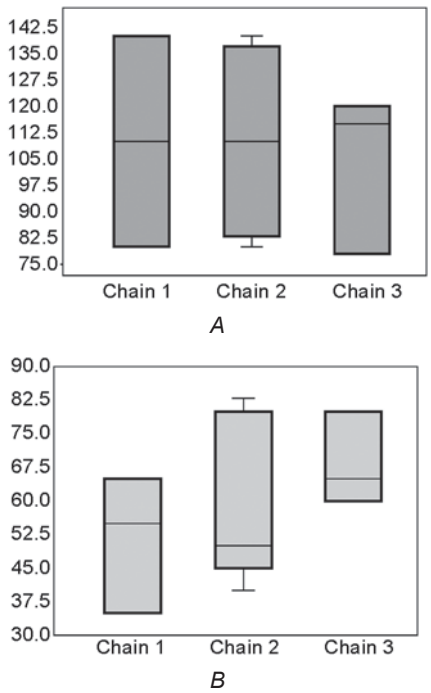

Fig. 9. Values of the angles of distal ends in the handaxes, corresponding to a certain chaîne opératoire. *A* – plan view; *B* – side view.

Conclusions

This study was aimed at deriving the answers to two main questions: whether the succession and development of handaxe manufacturing technology are observable in the Late Acheulean complexes of the Northern Caucasus, and how the technological features of handaxe manufacture in the Darvagchay complexes influence their morphological characteristics.

The findings of the geometric-morphometric analysis revealed the variability in the morphology of handaxes of complexes I and II. In early industries, the shapes of handaxes in plan view are more diverse than in later ones. Among the tools of the early complex, there are relatively symmetrical sub-leaf-shaped specimens, but the majority of handaxes are asymmetric trapezoid items, usually with a squat and massive shape. Handaxes from the late complex I are more uniform in morphology, tending to elongated, symmetrical, and sub-leaf-shaped forms.

Tools from complex I were subjected to more extensive working than tools from complex II. The process of tool manufacture became more and more multi-component. Tools from the late complex, along with short chaînes opératoires aimed at modification of the original shape of the blank, suggest the use of a more complex

sequence, associated with the extensive transformation of the original blank.

Thus, the morphological and technological continuity between the chronologically consecutive Late Acheulean complexes of Southeastern Dagestan is obvious. Both complexes showed the desire of artisans to create morphologically similar handaxes, i.e. elongated, symmetrical, sub-leaf-shaped items. The dynamics in the development of the technology have been recorded: in the late complex, they were focused on the unification of the shape of handaxes, and on the sophistication of the chaîne opératoire.

The issue of the shape and size of handaxes in the Acheulean assemblages is debatable. According to some researchers, the shape of handaxes is a cultural marker over an extremely long period of time. Other specialists argue that the morphological similarity of handaxes from technocomplexes geographically and chronologically distant from one another was the result of numerous remodifications (Iovita, McPherron, 2011). According to the results of the scar pattern analysis, tools of the Darvagchay industries do not bear traces of remodification, i.e. situational changes of shape. Consequently, by the example of Dagestan handaxes, we can observe the tendency towards a certain tool shape in chronologically consecutive complexes.

The quality and shape of lithic raw materials are the factors that could influence the shape of bifaces (White, 1998). Studies of assemblages from Gesher Benot Ya'aqov showed that bifaces made from raw materials of different quality, within the same industry tradition, differ, but not significantly (Herzlinger, Goren-Inbar, Grosman, 2017). These observations are confirmed by the results of a study of bifaces made from raw stone and tusk (Costa, 2010). In the studied assemblages, no stable relationship was noted between the features of the used raw materials and the morphology of the finished tools. In some cases, the shape of the raw material affected the size and intensity of the tool processing (Rybalko, 2021), but not the morphology of the product.

Unfortunately, we cannot discuss the functionality of the handaxes owing to the poor state of preservation of their surfaces.

It can be concluded that the results derived rather support the cultural transmission theory: populations followed a certain pattern of handaxe manufacture over a considerable timespan (from MIS 11 to MIS 7). It is possible that imitation was one of the important ways of transmitting cultural information. The dynamics in the development of handaxe manufacturing technology is manifested in the form of sophistication of technological methods and standardization of the tool shape. Taking into account the significant morphological similarity between the handaxes from Dagestan and the tools from the compared contemporaneous complexes, as well as a high degree of standardization of the shape of tools in the late complexes, which was determined through the geometric-morphological analysis, it is possible to extrapolate the results of this study to other complexes of the Caucasus. However, more ambitious conclusions require further study of the technology.

Acknowledgements

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