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A.G. Rybalko, V.N. Zenin, and A.V. Kandyba

Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: rybalko@archaeology.nsc.ru; vzenin@archaeology.nsc.ru;
arhkandyba@gmail.com

Early Middle Paleolithic Industries in Southeastern Dagestan

This study addresses lithic assemblages from the Middle Paleolithic sites Darvagchay-Zaliv-1 and Darvagchay-Zaliv-4, which are highly relevant to the understanding of this stage in Dagestan. We examine paleoclimatic conditions prevailing during the sedimentation at these sites. A detailed description of lithics is provided. Artifacts were discovered in a minimally disturbed paleosol. They represent the Middle Paleolithic, specifically Levallois technique of primary reduction. Judging by the presence of unlined fire-pits and the fact that finds are scattered over a large area, we infer that these sites evidence multiple short-term occupation. The dates of the sites fall within the Riss-Würm (Eemian, Mikulino) interstadial (MIS 5e)—ca 125–110 ka BP. Parallels with coeval sites in Dagestan and elsewhere in the Caucasus are discussed. Whereas no direct parallels with any Caucasian Middle Paleolithic industries can be found, those of Darvagchay-Zaliv-1 and Darvagchay-Zaliv-4 are consistent with the general evolutionary trajectory of the Caucasian Paleolithic.

Keywords: *Caucasus, Dagestan, Middle Paleolithic, Riss-Würm interstadial, primary reduction, lithic assemblage, Levallois.*

Introduction

Until recently, the territory of Dagestan has been one of the insufficiently studied regions in the Caucasus in terms of archaeology. The cultural horizons at the majority of Paleolithic sites discovered in the region have been completely destroyed (Kotovich, 1964). Only in the case of preservation of culture-bearing deposits is it possible to identify the technical-typological features of sites; to establish their cultural and economic system, time, and paleoclimatic conditions; and/or to carry out a comparative analysis of lithic industries. Stratified, multilayered complexes occur extremely rarely in this region. Therefore, it is very important to describe new archaeological materials recovered from clear geological contexts, which makes the obtained data highly reliable and informative.

In the last decade, Paleolithic studies in Dagestan have been noticeably intensified. During the multidisciplinary research in the region, about 20 non-contemporaneous Paleolithic sites were studied (Derevianko et al., 2012: 68–246). Among these, the stratified sites of Darvagchay-Zaliv-1 and Darvagchay-Zaliv-4, located in the Darvagchay geoarchaeological region, are the most informative (Rybalko, Kandyba, 2017, 2019). The present paper provides generalized analytical data obtained during many years of studies (archaeological and scientific), illustrating the Early Middle Paleolithic of Southeastern Dagestan.

Environmental conditions and chronology of the archaeological complexes of Southeastern Dagestan

Stages of human settlement in Southeastern Dagestan should be considered with regard to the environmental settings. At present, the climate of peri-Caspian Dagestan is dry; rivers and other sources of fresh water are scarce; evaporation significantly exceeds atmospheric precipitation. The population of this steppe and semi-desert area lacks fresh water.

To clarify the paleoclimatic situation during the accumulation of the unearthed sediments, 15 samples were taken for palynological analysis from the Darvagchay-Zaliv-1 section (excluding technogenic layer 1). The analysis* revealed an extremely low content of organic matter, which is probably due to post-sedimentation conditions and exposure to the aggressive chemical impact of the enclosing sediments. Miospores noted in the preparations are mostly of poor preservation; this did not allow for more precise definitions. Most plant-remains were identified in layer 3 (paleosol). The identifiable miospores belong to the following taxa: Pinaceae, *Tsuga* sp., *Yuglans* sp., Betulaceae, *Myrica* sp., Poaceae, Asteraceae, *Sphagnum* sp. Some miospores have been identified on the basis of artificial taxonomy: Tricolpollenites sp., and Triletes sp. Samples from layer 3 contain numerous charcoal particles, fragments of charred plant tissues, and phytoliths of arboreal and herbaceous plants. Moreover, indirect signs (abundant rodent burrows, pieces and smears of charcoal) suggest that the Darvagchay-Zaliv-1 area was not prone to droughts; this was most likely a zone of forest-steppe. Judging by the recovered phytoliths and miospores, during the accumulation of the paleosol layer the area was probably vegetated by trees and grasses.

In 2014–2015, the Paleomagnetic Center of the Trofimuk Institute of Petroleum Geology and Geophysics SB RAS carried out the petromagnetic and paleomagnetic analysis of 76 samples from Darvagchay-Zaliv-1 (complex 2) (Kazansky, 2015). The analysis has shown the reverse remanent magnetization of paleosol (Blake polarity episode, 120–100 ka BP) (Karta…, 2013: 21).

Establishing an accurate chronology for Paleolithic objects is one of the most difficult tasks. In the situation of the sheer absence of faunal material, it was only possible to estimate the age of the site with the help of the optically stimulated luminescence method (OSL). The total of 17 samples from Darvagchay-Zaliv-4 was collected for OSL-dating in 2019. Sample-preparation was carried out in the laboratory of Moscow State University; the analysis was performed in the Nordic Laboratory for Luminescence Dating of the Department of Geoscience at Aarhus University (Denmark). The date of 111.9 ± 14.8 ka BP was generated on feldspars for the paleosol layer of the site (layer 1c)*.

For a more complete understanding of the paleoclimatic situation in the area under study, it was necessary to correlate the established chronological period with the phases of the Caspian Sea level fluctuations. According to T.A. Abramova, the analysis of paleobotanical data shows a direct relationship between the climate change, change in vegetation cover, and fluctuations in the level of the Caspian Sea. Comparing the palynological data has revealed a clear pattern: the maximum sea level during a particular transgression is characterized by the most “wooded” types of spectra (Abramova, 1982: 39). The studied interval (MIS 5) refers to the final stage of the Khazar cycle (Late Khazar transgression). This period in the Western Caspian region is characterized by the spread of arboreal vegetation represented by areas of mixed and deciduous forests. The presence of pollen from pine, birch, hazel, and alder is recorded. Meadow herbaceous vegetation covered the coastal plain and foothills (Abramova, 1974). The development of flora associations is inextricably linked with changes in faunal communities. Analysis of the composition of the large mammals indicates an increase in faunal communities typical of the forest-steppe ecozone (Alekseeva, 1990).

Archaeological complexes of Southeastern Dagestan

The site of Darvagchay-Zaliv-1, discovered in 2007, is located on the steep southwestern slope of the ancient Caspian terrace (Fig. 1). Excavations at the site were carried out intermittently from 2010 to 2019. In total, four cultural-chronological complexes were identified and studied; the assemblages are dated to the range from the early to final Middle Paleolithic (Fig. 2). One of these, complex 2, was found on the upper portion of the terrace slope and contained lithic artifacts of the Early Middle Paleolithic. This assemblage was studied in 2012–2014 and in 2019 (Rybalko, Kandyba, Anoikin, 2014; Rybalko, Kandyba, 2019). Excavations were carried out over an area of 87 m^2 and reached a depth of 3.6 m from the daylight surface. The section is described below from top to bottom (Fig. 3):

Layer 1a. Grayish-brown loam. Technogenic layer. Thickness 0.35–0.45 m.

*The study was carried out by E.M. Burkanova, a researcher at the Micropaleontology Laboratory of the Tomsk State University.

*Personal communication by R.N. Kurbanov.

Fig. 1. The site of Darvagchay-Zaliv-1. General view. Location of complex 2 is marked by the arrow.

Layer 1b. Light brown loam, partially disturbed by agricultural activities. Thickness 0.35–0.45 m.

Layer 2. Loess-like light brown loam of aeolian-deluvial origin. Thickness 0.6–0.85 m.

Layer 3. Reddish-brown heavy loam. Thickness 0.65–1.2 m.

Layer 4. Dense yellowish-brown heavy loam of aeolian-deluvial origin. Thickness 0.45–0.6 m.

The underlying layers were traced in the test-pit down to a depth of 8.5 m in the course of collection of samples for paleomagnetic studies (Kazansky, 2015).

This section (excluding the uppermost technogenic portion) is the reference for the Middle Paleolithic studies in the Darvagchay geoarchaeological area. The completeness and thickness of the uncovered loess-soil deposits, with their thorough examination, make it possible to carry out, on a new level, a comparative analysis of the discovered materials with those from other important Middle Paleolithic sites in Dagestan and the Caucasus.

Archaeological remains were embedded in layer 3. The texture of the horizon is not uniform, owing to the presence of numerous rodent burrows and carbonate ties. In the lowermost third part of the layer, numerous isolated pieces of charcoal were recorded, some of them in small clusters. The majority of lithic artifacts were recovered from the bottom part of the layer. Here, several accumulations of artifacts were also noted (their vertical spread does not exceed 10 cm), with some fragments refitting. Judging by the clear pattern of distribution, these portions had not undergone significant deformation. In the lower third part of the paleosol layer, two fireplaces were found; these were represented by the unlined spots of burned soil 2–3 cm thick and 40–45 cm in diameter. In the fireplaces, charred lithic artifacts were found. No mammal fossils were uncovered: owing to the high degree of carbonation, organic materials had rapidly decomposed (Rybalko, Devyatova, 2015).

The lithic collection (443 artifacts) includes: core-like forms (*n*=39), blades and laminar flakes (*n*=15), flakes (*n*=288, including 6 charred specimens), technical spalls (*n*=8), fragments and shatters (*n*=74, including 2 charred specimens), chips (*n*=14), and pebbles (*n*=5). The percentage of the main lithic types in the collection is as follows: core-like forms – 9 %, blades and laminar flakes – 4 %, flakes – 65 %, technical spalls – 1.8 %.

Core-like forms include typologically distinct cores (*n*=25), core shatters (*n*=7), and fragments (*n*=7). The majority of cores (*n*=20) exhibit the Levallois technique of primary reduction (Fig. 4, *7*, *8*; 5, *1–4*). The finds vary in their sizes and degrees of wear. The items are rounded or sub-rectangular; the flaking surfaces

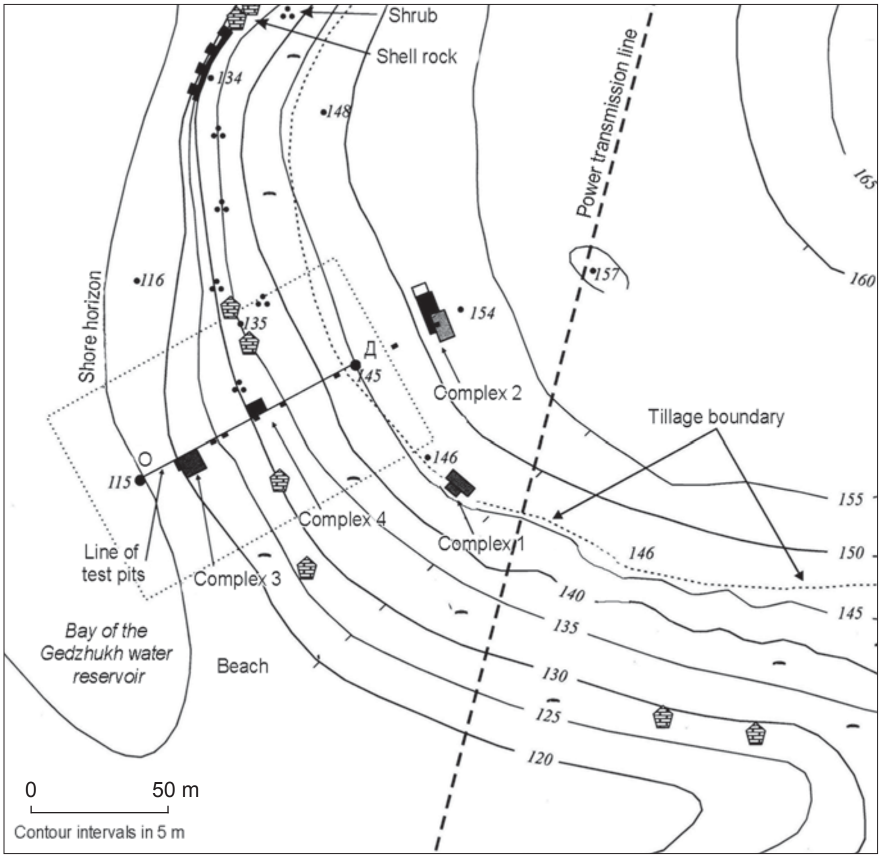

Fig. 2. Darvagchay-Zaliv-1. The topographic map of the area.

are prepared by centripetal detachments; the striking platforms are slightly convex. The cores showing a parallel flaking pattern include single-platform (*n*=3) and double-platform (*n*=2) unifacial varieties. The identifiable residual striking platforms on spalls are mostly plain (62 %) or retain natural cortex (16 %); dihedral (6 %), faceted (12 %) and punctiform (4 %) varieties are less common. Dorsal faceting was sub-parallel unidirectional – 46 %, bidirectional – 10 %, longitudinal-transversal – 15 %, natural – 12 %, radial – 8 %, and irregular – 9 %.

The toolkit (*n*=30; 7 %) comprises 23 artifacts with signs of secondary working; two Levallois flakes, four hammerstones (see Fig. 4, *4*), and one retoucher. The group of the most distinct tools includes two retouched Levallois spalls (see Fig. 4, *1*), four side-scrapers (see Fig. 4, *2*, *5*, *6*), a knife, and an atypical point (see Fig. 5, *6*). The most numerous categories are notches (*n*=5) (see Fig. 5, *5*), retouched spalls, and retouched shatters (*n*=10) (see Fig. 4, *3*; 5, *7*).

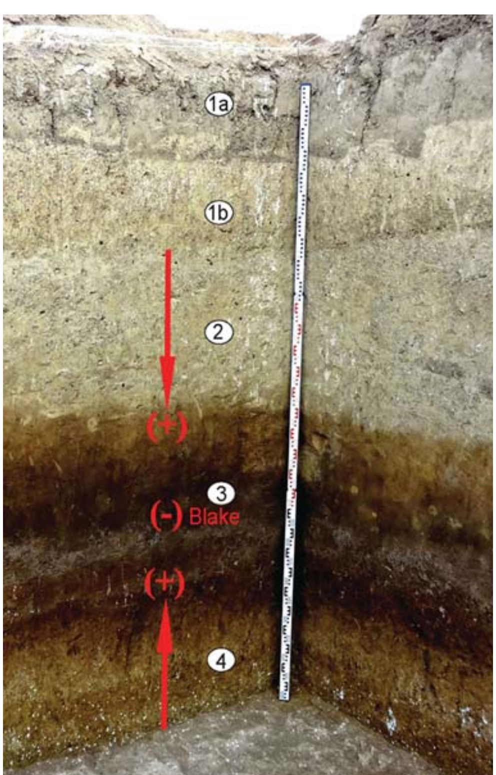

Fig. 3. Northwestern and southwestern profiles at Darvagchay-Zaliv-1 (complex 2). Zones of remanent magnetization are marked.

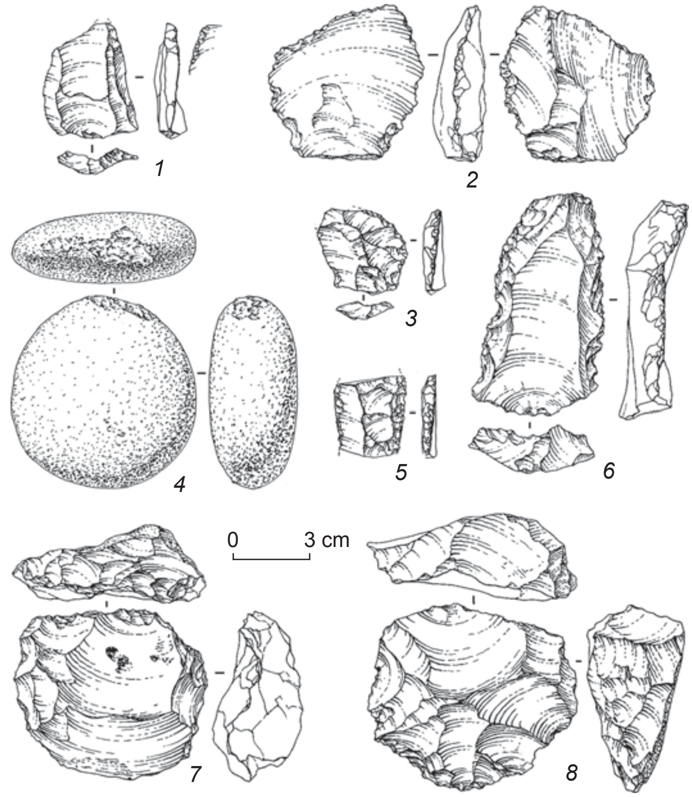

Fig. 4. Lithics from Darvagchay-Zaliv-1 (complex 2). *1* – Levallois flake; *2*, *5*, *6* – side-scrapers; *3* – retouched flake; *4* – hammerstone; *7*, *8* – cores.

The site of Darcagchai-Zaliv-4, discovered in 2010, is located 500 m away from Darvagchay-Zaliv-1, on the slope of the ancient Caspian terrace, at an absolute elevation of 135 m (Fig. 6). During the excavations of 2011 and 2014–2016, the abundant assemblage of Acheulean lithics was collected (Derevianko et al., 2018). In 2017–2019, excavations were executed over an area of 65 m^2. The uppermost portion of the uncovered sediments (layer 1c) yielded artifacts with Middle Paleolithic morphological features. Below is the description of the section from top to bottom (Fig. 7):

Layer 1a. Dark-gray humic loam. Modern soil. Thickness 0.15–0.20 m.

Layer 1b. Light-gray sandy loam. Thickness 0.15–0.35 m.

Layer 1c. Reddish-brown heavy loam. Thickness 0.25–0.45 m.

Layer 2. Loess-like brown loam. Thickness 2.7–3.15 m.

Layer 3. Gravel-pebble deposits. Thickness 1.15–1.6 m.

Layer 4. Light-gray layered sand. Thickness 0.3–0.45 m.

Layer 5. Pebble deposit in sand with admixture of marine mollusk shells. Thickness 0.2–0.45 m.

These artifacts were embedded in the same stratigraphic and planigraphic conditions as the cultural remains in the above-mentioned site, i.e., in small concentrations in the buried soil layer. The essential difference is that the upper portion of the cultural horizon (layer 1c) at Darvagchay-Zaliv-4 had been partially washed out as a result of slope processes.

The lithic collection (*n*=114) includes cores (*n*=14), flakes (*n*=71), blades and laminar spalls (*n*=5), a technical spall, shatters and fragments (*n*=16), and pebbles (*n*=2). The percentage of the main lithic types is as follows: cores – 12 %, blades and laminar spalls – 4 %, flakes – 62 %, and technical spalls – 1 %.

The majority of cores (*n*=11) show the Levallois reduction technique at various stages of core preparation: shaping of the striking platform and convex flaking surface (*n*=3), removal of target flake (*n*=2), and heavily exhausted cores

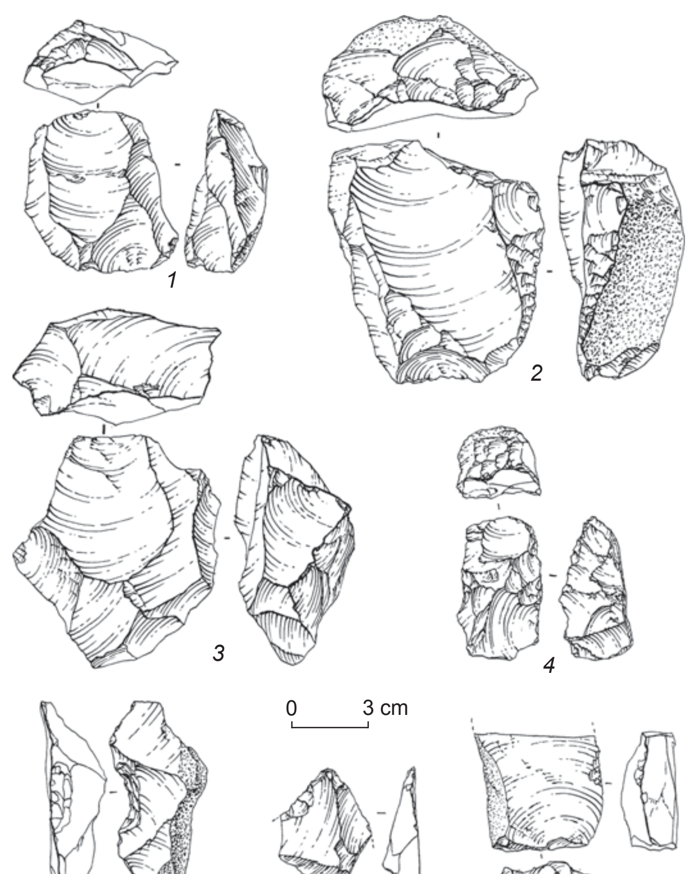

Fig. 5. Lithics from Darvagchay-Zaliv-1 (complex 2). *1–4* – cores; *5* – notched tool; *6* – point; *7* – retouched flake.

Fig. 6. The site of Darvagchay-Zaliv-4. General view. The location of the excavation area is marked by the arrow.

(*n*=6) (Fig. 8, *1*, *2*; 9, *1*, *2*). In addition, two single-platform unifacial cores with natural striking platforms, and one core with the irregular reduction pattern were identified. Among the identifiable striking platforms, the share of plain platforms is 64 %, natural platforms – 18 %, dihedral – 2 %, faceted – 11 %, and punctiform – 5 %. The dorsal faceting of flakes is as follows: subparallel, unidirectonal – 41 %, bidirectional – 14 %, longitudinal-transversal – 14 %, natural – 12 %, radial – 9 %, and irregular – 10 %.

The toolkit consists of 14 artifacts (12 %), including three Levallois flakes (Fig. 9, *3*) and two hammerstones—large ovoid and flat pebbles with wear-traces. The point was fashioned on a shortened sub-triangular Levallois spall with a convex faceted platform; its pointed end was shaped with fine and medium-sized retouch at the distal edge (see Fig. 8, *5*). A single side-scraper with a natural

Fig. 7. Northeastern profile at Darvagchay-Zaliv-4.

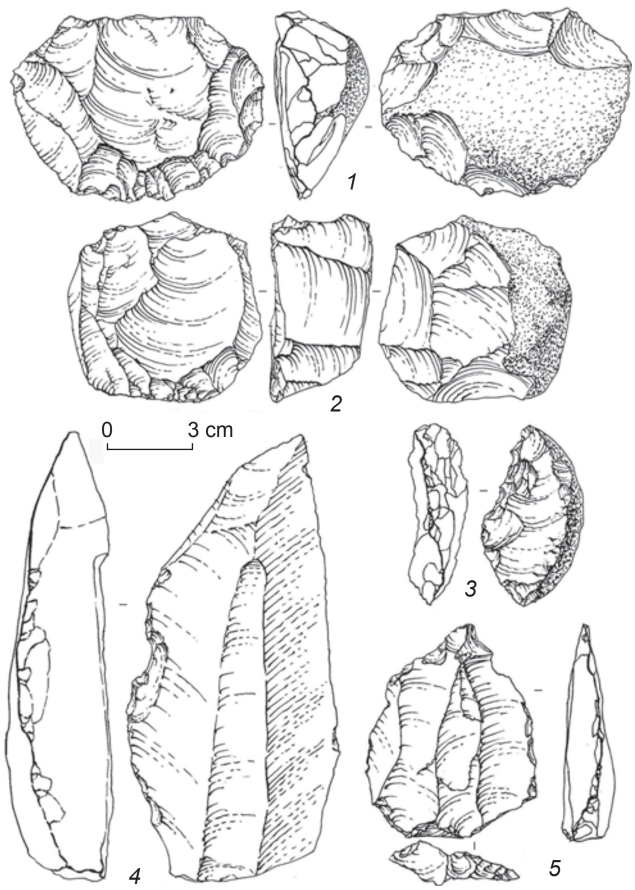

Fig. 8. Lithics from Darvagchay-Zaliv-4 (layer 1c).
1, *2* – cores; *3* – side-scraper; *4* – knife; *5* – point.

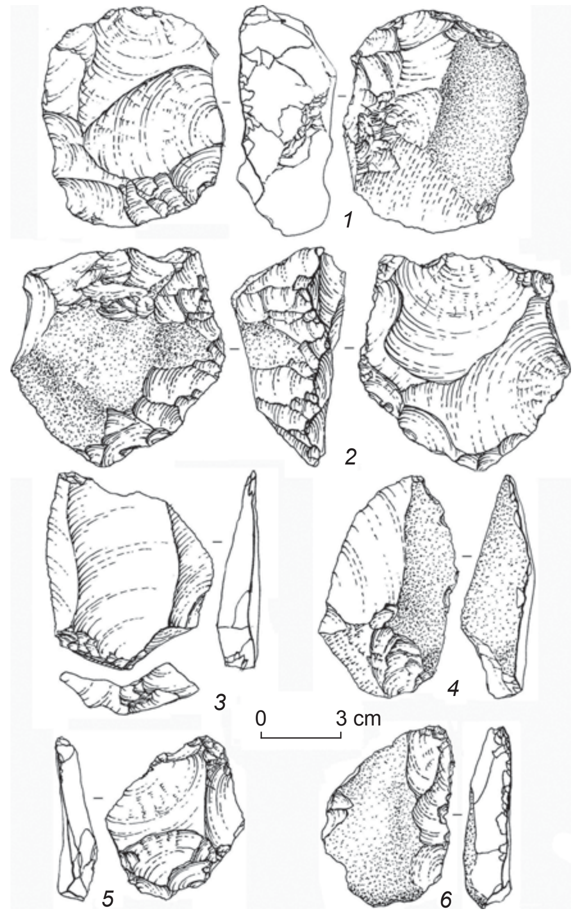

Fig. 9. Lithics from Darvagchay-Zaliv-4 (layer 1c).
1, *2* – cores; *3* – Levallois flake; *4* – knife; *5, 6* – retouched flakes.

back was fashioned on a middle-sized flake; its straight cutting-edge was prepared through semi-abrupt, stepped, scalar, obverse retouch (see Fig. 8, *3*). Three knives were fashioned on a laminar spall with a natural back (see Fig. 9, *4*), a large flake, and a large and thick, subtriangular blade (see Fig. 8, *4*). The long sides of the knives show utilization retouch. A notched tool was manufactured on a large elongated blank. The notch was made through small spall removals and multifaceted retouch. Two medium-sized flakes (see Fig. 9, *5*, *6*) and a large fragment show fine irregular retouch.

Discussion

The Darvagchay-Zaliv -1 and -4 artifacts were recovered only from paleosol layers. The under- and overlying horizons in both cases are archaeologically sterile, which excludes the possibility of the penetration of artifacts from other chronological-cultural groups into these assemblages. Judging by the distribution of the archaeological materials over the layers, the majority of lithics were found *in situ*. Almost all finds, forming small isolated accumulations where the refitting items occurred, were oriented horizontally. An insignificant part of the artifacts were randomly distributed throughout the cultural horizons. This was possibly due to the burrowing animals' activities, and deluvial processes. All the lithic artifacts, regardless of the raw materials, show a similar state of surface preservation (very good). The collections contain all significant categories of stone implements typical of the Middle Paleolithic.

The industry is based on uniform raw materials. The majority of the lithic artifacts were made of silicified limestone (88 %); an insignificant part of the artifacts was made of flint (19 %) and limestone (2 %). Silicified limestone is abundantly available in the form of large and medium-sized pebbles; this is a plastic and hard rock (class 5–6 in Mohs' scale), which is perfectly suited to splitting. Flint occurs mainly in small pieces, with numerous internal defects*. These and other rocks in the

*Identification by N.A. Kulik.

form of pebbles and fragments are widely available in the natural exposures in the central part of the slope and at the terrace's bottom.

The primary reduction of the Darvagchay lithic industry is based on the Levallois technique: it is represented by the tortoise cores aimed at detachment of flakes. The majority of the cores are characterized by their high degree of utilization; the target blanks were large and medium-sized flakes. Blades are few. Non-retouched Levallois primary and secondary points are absent. Identifiable striking platforms are dominated by plain and natural varieties; faceted and specifically dihedral platforms are less common. The majority of the spalls do not retain natural cortex on their dorsal surfaces; this suggests that the rocks were tested and the pre-cores were prepared outside the sites. Such operations were likely performed at the sites of raw material concentration. The toolkit is not numerous; yet, it includes isolated well-fashioned implements: Levallois spalls, side-scrapers, and knives. Side-scrapers are single, double longitudinal, or convergent. The knives with natural backs and those fashioned on the spall's edge were identified. However, the main categories of tools are indistinct notched forms and flakes with discontinuous retouch.

All the above-mentioned features allow us to attribute the Darvagchay-Zaliv-1 and -4 sites to the short-term workshops. Here, knappers used to detach blanks for the subsequent manufacture of tools. The majority of these blanks, as well as all thoroughly prepared implements, were taken away from the sites. This explains the great number of heavily exhausted cores, hammerstones, and retouchers at these sites, and also the small number and the typological homogeneity of tools. This conclusion is supported by the small number of lithic implements in clusters and the fireplaces without any lining. The analyzed collections, despite their specificities relating to the features of the sites, provide the idea of the technical and typological appearance of the lithic industries. According to the analysis of the archaeological materials and the age estimates of the enclosing sediments, these industries belong to the Early Middle Paleolithic.

The results of the interdisciplinary studies at the sites, as well as the available OSL-data, suggest that the cultural horizons and the artifacts embedded therein were accumulated under warm and humid climatic conditions. Such conditions were typical of the recent Riss-Würm (Eemian or Mikulino for the East European Plain) interstadial in the range of 125–110 ka BP (MIS 5e). At that period, the paleoclimatic conditions in the Western Caspian region were favorable for floral and faunal communities, as well as for human dispersal.

The early stage of the Middle Paleolithic in Dagestan and the Caucasus

Currently, in the territory of Dagestan, only one stratified site is known—Rubas-1, which is comparatively close in age to the analyzed sites. Rubas-1 is located in the piedmont zone (Tabasaransky District, Republic of Dagestan). The Middle Paleolithic assemblage was found in association with layer 3 (general stratigraphic column), deposited in the alluvium of the 30 m thick terrace of the Rubas River. The lithic collection consists of artifacts differing in their degree of surface preservation. The archaeological material includes Levallois and parallel cores, Levallois and Mousterian points, and a great number of side-scrapers, as well as a few Upper Paleolithic tools. The composition of the lithic assemblage suggests that the artifacts embedded in the alluvial horizon pertain to various stages of the Middle Paleolithic. The chronological attribution of these finds is determined by paleomagnetic data. In the lower portion of layer 3, the reverse polarity zone was identified. Correspondence of the revealed magnetic zone to the Blake episode appears to be most probable (Anoikin, Rybalko, 2014).

In Dagestan, more than 15 Middle Paleolithic localities with surface occurrence of artifacts have been discovered, most of which are located in the Caspian Depression. The best-known is the site of Chumus-Initz, discovered in 1953 by V.G. Kotovich. The site is located on the right bank of the Darvagchay River, 600–700 m to the north of the Gedzhukh water reservoir's dam. The artifacts were found on the plowed surface on the ancient Caspian terrace. In 2005, this area was revisited by the archaeological team of the Institute of Archaeology and Ethnography SB RAS. In total, 115 lithic implements were found at the site (Kotovich, 1964; Derevianko et al., 2009). According to the data obtained, there are at least two unevenly aged complexes at the site—the Acheulean and Middle Paleolithic. The Middle Paleolithic complex comprises mostly flat parallel cores, with a minor inclusion of Levallois and radial nuclei. The toolkit mainly includes side-scrapers and denticulate tools, as well as solitary Levallois and Mousterian points. Some of these artifacts can be dated to the Early Middle Paleolithic.

The cluster of seven sites of the surface occurrences of artifacts is located in the Manas-ozen River valley (Manas-ozen I–V and Gentorun I, II). The collections from these sites are sparse, and include artifacts of various ages. The majority of finds (*n*=108) were discovered at Manas-ozen IV. In terms of technical-typological features, the lithic industries of these localities were determined by the researcher to be non-faceted and non-Levallois (Amirkhanov, 1986). However, the collection contains solitary core-like implements produced with the Levallois technique. On the basis of these features, Amirkhanov attributed the assemblages to the early stage of the Middle Paleolithic. Some other sites were found in 2003–2005 in the valleys of the Achisu, Kolichi, Rubas, and Darvagchay rivers. The collections from these sites are quite small. Judging by the presence of typologically distinct cores and tools, the sites have been attributed to the Middle Paleolithic, and some of them possibly to its early stage (Amirkhanov, 2015).

Thus, apart from the Darvagchay-Zaliv-1 and -4 complexes, to date no sites that can be reliably attributed to the Early Middle Paleolithic have been found in Dagestan. The other above-mentioned collections consist mainly of the surface collected artifacts and those having conventional stratigraphic associations, i.e. embedded in the alluvial sediments containing redeposited archaeological material. Considering the geomorphological situation in the places of artifact collection, the analyzed complexes may be associated with the Late Khazar or Early Khvalynsk transgressions of the Caspian Sea. The period of existence of these industries ranges from 130 to 60 ka BP (MIS 5-4).

In Eurasia, the Caucasus is the region richest in Middle Paleolithic sites. About 400 sites with Middle Paleolithic implements have been found here. The majority of these sites do not have stratigraphic context, and contain surface, redeposited, and/or mixed archaeological materials.

In the Southern and Central Caucasus, Early Middle Paleolithic complexes (MIS 5) have been found in the cave sites: Kudaro I (layers 4 and 3), Kudaro III (layers 4 and 3), Tsona (layer 5) in the Southern Ossetia; Jruchula in Georgia; Myshtulagty-lagat (layers 14–12) in the Northern Ossetia, Yerevan (layers 7–5A) in Armenia; and Azykh (layer 3) in Azerbaijan. The Middle Paleolithic industries from the cave sites of Kudaro I, Kudaro III, Tsona, and Jruchula are attributed to the Kudaro-Jruchula culture (Lyubin, 1977: 13–96). Materials from these sites show certain parallels with the Middle Paleolithic assemblages of Myshtulagty-lagat (Weasel) Cave in terms of chronology and technology. On the basis of the biostratigraphic data, layers 14–12 of the latter site have been dated to 128–70 ka BP (Hidjrati, 1987; Hidjrati, Kimball, Koetje, 2003). In general, these assemblages have been classified as Levallois, blade-based, with high faceting indexes. Their toolkits are dominated by elongated points and convergent side-scrapers. The specific technique of tool fashioning is additional ventral treatment. The closest parallels to these industries occur in the materials of the Early Middle Paleolithic of the Levant—the Mousterian of Tabun D-type (Lyubin, Belyaeva, 2006: 81).

The Middle Paleolithic industries of Yerevan and Azykh cave sites in the Transcaucasian Highlands show the use of the Levallois technique of primary reduction, high faceting indexes, and a comparatively small number of blades and laminar spalls. The toolkit is dominated by side-scrapers and points; an insignificant number of denticulate, notched, and Upper Paleolithic tools are also reported (Eritsyan, 1970; Guseinov, 2010: 146–168).

In the Northwestern Caucasus, the sites of Matuzka (layer 7) and Ilskaya (lower complex) are the best-studied complexes of the Early Middle Paleolithic; their archaeological materials were deposited in distinct stratigraphic sequences. The age of the industry in the Matuzka lowermost horizon has been established on the basis of the complex natural scientific data (layer 7 yielded the Blake episode of reverse polarity). The collection from this layer comprises 90 artifacts, of which 30 % are limestone pebbles and pebble fragments, and a single-platform unifacial core exhibiting a pattern of parallel flaking. The category of spalls is dominated by large thick flakes with natural and plain striking platforms. The toolkit consists of various side-scrapers and denticulate tools. According to the scholars, the industry belongs to the "archaic Middle Paleolithic" and doesn't have parallels among the known sites in the Northwestern Caucasus (Golovanova et al., 2006: 50–51). The Ilskaya site is one of the first Paleolithic monuments discovered in the Caucasus (1898). The Ilskaya archaeological materials represent two lithic industries of different technical-typological parameters and age (Anisyutkin, 2007). The lower archaeological complex, relating to MIS 5, is classified as non-Levallois and non-blade-based. The toolkit is dominated by convergent side-scrapers and points. Numerous elongated foliate and thick bifaces with plane-convex cross-sections were identified. Given this feature, the complex was formerly related to the East European Micoquien. Researchers who have recently studied the site identify the original Ilskaya industry here (Shchelinsky, 2012).

Conclusions

In Dagestan, archaeological materials dating to the Early Middle Paleolithic (MIS 5) have almost been unknown until recently. It is very difficult to compile their general characteristics and compare the collections to the coeval industries of the Caucasus, because the majority of the materials were collected from surface or from mixed context. The stratified complexes of Darvagchay-Zaliv-1 and -4 don't reveal all industrial parameters, because of the specific feature of the sites (short-term workshops). On the basis of the available data, these industries can be classified as Levallois, non-blade-based, with low faceting-indexes. The Levallois flaking technique, represented by tortoise cores, was aimed at flake production. The toolkit includes side-scrapers of various types, knives, and notched tools. Levallois points and tools on blades occur rarely; artifacts with ventral thinning, bifacially worked tools, and Upper Paleolithic tool types, are absent.

These materials have their closest parallels in the artifacts from layer 3 at Azykh Cave and the lower horizons at Yerevan Cave. However, while the implements associated with primary reduction (Levallois cores for flake production) are quite similar, there is a significant difference in the toolkits. Furthermore, unlike the Southeastern Dagestan lithic industries, the Central Caucasus Middle Paleolithic complexes mostly contain Levallois blade industries, with convergent, significantly elongated forms making up a large proportion of the toolkit. Given the sheer absence of bifacial tools in the analyzed assemblages, it can be inferred that the Eastern Micoquien from the Northwestern Caucasus did not extended its influence over the territory of Dagestan.

Whereas the described Dagestan complexes have no direct parallels in the cultural and chronological scale of the Caucasian Middle Paleolithic, the archaeological materials from Darvagchay-Zaliv-1 and Darvagchay-Zaliv-4 are consistent with the general evolutionary trajectory of the Caucasian Paleolithic. However, they show the features typical of the local variant of the early stage of the Caucasian Middle Paleolithic, which can be explained by the specificity of the sites, paleoclimatic conditions, and the features of raw materials.

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References

Abramova T.A. 1974
Rekonstruktsiya paleogeograficheskikh usloviy epokh chetvertichnykh transgressiy i regressiy Kaspiyskogo morya. Cand. Sc. (Geography) Dissertation. Moscow.

Abramova T.A. 1982
Ritmika sporovo-pyltsevykh spektrov chetvertichnykh otlozheniy zapadnogo poberezhya Kaspiyskogo morya. In *Morskiye berega*. Moscow: Mysl, pp. 32–39. (Voprosy geografii; iss. 119).

Alekseeva L.I. 1990
Teriofauna verkhnego pleistotsena Vostochnoi Evropy (krupnye mlekopitayushchiye). In *Trudy GIN AN SSSR*, iss. 455. Moscow: Nauka.

Amirkhanov K.A. 1986
Manas-ozenskiye mustyerskiye mestonakhozhdeniya v Prikaspiyskom Dagestane. In *Novoye v arkheologii Severnogo Kavkaza*. Moscow: Nauka, pp. 5–26.

Amirkhanov K.A. 2015
Obzor issledovaniy i sostoyaniye izuchennosti srednego paleolita na Severo-Vostochnom Kavkaze. In *Sledy v istorii: K 75-letiyu Vyacheslava Evgenyevicha Shchelinskogo*. Moscow: Izd. IA RAN, pp. 61–69.

Anisyutkin N.K. 2007
O vydelenii dvukh kompleksov Ilskoy musterskoy stoyanki. In *Kavkaz i pervonachalnoye zaseleniye chelovekom Starogo Sveta*. St. Petersburg: Peterburgskoye Vostokovedeniye, pp. 44–59.

Anoikin A.A., Rybalko A.G. 2014
Sredniy paleolit doliny reki Rubas (po materialam sloya 3 pamyatnika Rubas-1, Dagestan). *Vestnik Novosibirskogo gosudarstvennogo universiteta*. Ser.: Istoriya, filologiya, vol. 13. Iss. 3: Arkheologiya i etnografiya: 168–180.

Derevianko A.P., Amirkhanov K.A., Zenin V.N., Anoikin A.A., Rybalko A.G. 2012
Problemy paleolita Dagestana. Novosibirsk: Izd. IAET SO RAN.

Derevianko A.P., Anoikin A.A., Zenin V.N., L eshchinsky S.V. 2009
Ranniy paleolit Yugo-Vostochnogo Dagestana. Novosibirsk: Izd. IAET SO RAN.

Derevianko A.P., Rybalko A.G., Zenin V.N., Yanina T.A. 2018
Excavations at Darvagchay-Zaliv-4: An Early Paleolithic site in Dagestan. *Archeology, Ethnology and Anthropology of Eurasia*, vol. 46 (2): 3–15.

Eritsyan B.G. 1970
Yerevanskaya peshchernaya stoyanka i eye mesto sredi drevneishikh pamyatnikov Kavkaza. Cand. Sc. (History) Dissertation. Moscow.

Golovanova L.V., Doronichev V.B., Levkovskaya G.M., Lozovoy S.P., Nesmeyanov S.A., Pospelova G.A., Romanova G.P., Kharitonov V.M. 2006
Peshchera Matuzka. St. Petersburg: Ostrovityanin.

Guseinov M. 2010
Drevniy paleolit Azerbaidzhana. Baku: TekNur.

Hidjrati N.I. 1987
K probleme interpretatsii nizhnepaleoliticheskikh otlozheniy peshchery Lasok (Myshtulagty lagat) v Severnoy Osetii. In *Problemy interpretatsii arkheologicheskikh istochnikov*. Ordzhonikidze: Izd. Severo-Osetin. Gos. Univ., pp. 141–154.

Hidjrati N.I., Kimball L.R., Koetje T. 2003
Middle and Late Pleistocene investigations of Myshtulagty Lagat (Weasel Cave) North Ossetia, Russia. *Antiquity*, vol. 77, N 298: 1–5.

Karta chetvertichnykh obrazovaniy territorii Rossiyskoy Federatsii. 2013
1:250 000: Poyasnitelnaya zap. St. Petersburg: VSEGEI.

Kazansky A.Y. 2015
Novye dannye po obosnovaniyu vozrasta sredne-paleoliticheskogo kompleksa stoyanki Darvagchay-zaliv-1 (Yugo-Vostochnyi Dagestan). In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territoriy*, vol. XXI. Novosibirsk: Izd. IAET SO RAN, pp. 78–82.

Kotovich V.G. 1964
Kamennyi vek Dagestana. Makhachkala: Dag. filial Inst. istorii, yazyka i literatury AN SSSR.

Lyubin V.P. 1977
Musterskiye kultury Kavkaza. Leningrad: Nauka.

Lyubin V.P., Belyaeva E.V. 2006
Rannyaya preistoriya Kavkaza. St. Petersburg: Peterburgskoye Vostokovedeniye.

Rybalko A.G., Devyatova A.Y. 2015
Korrelatsiya stratigraficheskikh razrezov pamyatnika Darvagchay-Zaliv-1 po geokhimicheskim dannym. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territoriy*, vol. XXI. Novosibirsk: Izd. IAET SO RAN, pp. 148–152.

Rybalko A.G., Kandyba A.V. 2017
Kamennye industrii nachalnogo etapa srednego paleolita Severo-Vostochnogo Kavkaza. *Izvestiya Altaiskogo gosudarstvennogo universiteta*, No. 2 (94): 242–249.

Rybalko A.G., Kandyba A.V. 2019
Issledovaniya srednego paleolita Zapadnogo Prikaspiya (po materialam pamyatnika Darvagchay-zaliv-1). *Gumanitarnye nauki v Sibiri*, vol. 26 (2): 5–10.

Rybalko A.G., Kandyba A.V., Anoikin A.A. 2014
Sredniy paleolit basseyna r. Darvagchay (Primorskiy Dagestan). *Vestnik Dagestanskogo nauchnogo tsentra*, No. 54: 59–66.

Shchelinsky V.E. 2012
Ob Ilskoy musterskoy stoyanke. *Stratum Plus*, No. 1: 69–110.

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K.A. Kolobova[1], A.S. Kolyasnikova[2], V.P. Chabai[3], P.V. Chistyakov[1], M. Baumann[4], S.V. Markin[1], and A.I. Krivoshapkin[1, 5]

[1]Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: kolobovak@yandex.ru; pavelchist@gmail.com; markin@archaeology.nsc.ru; krivoshapkin@mail.ru
[2]Novosibirsk State University, Pirogova 1, Novosibirsk, 630090, Russia
E-mail: kns0471@gmail.com
[3]Institute of Archaeology, National Academy of Sciences of Ukraine, Pr. Geroyiv Stalingrada, 12, Kyiv, 04210, Ukraine
E-mail: v.p.chabai@gmail.com
[4]Bordeaux University, UMR 5199, PACEA laboratory, Bat. B18, Allée Geoffroy St-Hilaire CS 50023, 33615 Pessac cedex, France
E-mail: malvina.baumann@gmail.com
[5]Altai State University, Pr. Lenina 61, Barnaul, 656049, Russia

Middle Paleolithic Bone Retouchers: Size or Proportions

Bone retouchers are the most common tools for processing lithic raw material in the Middle Paleolithic of Eurasia. Typically, they are perceived by Paleolithic researchers as informal, unmodified tools made from bone blanks accidentally obtained during the extraction of marrow. In this article, we introduce new data on a large collection of bone retouchers from Chagyrskaya Cave (in the Altai Mountains). Their dimensions demonstrate a high standardization of blanks, indicating the intentional selectivity of Neanderthals. Selection also concerned animal species and the anatomical positions of bones. We found that morphological characteristics such as the number of active areas and the degree of their modification did not affect the size of the retouchers and attest only to the reorientation of tools during lithic processing. In the course of retouching, cross-sections of diagnostic traces in the active areas underwent significant changes: whereas at the early stages they reveal "furrows" with V-shaped cross-sections, multiple blows against the processed lithic resulted in the deformation of the original form, which eventually resembled an upturned trapeze. The comparison of bone retouchers from several multicultural Middle Paleolithic complexes in Eurasia (Chagyrskaya and Denisova caves in the Altai, Kabazi V site in the Crimea, and Barakayevskaya Cave in the Caucasus) evidences similar proportions but considerable variation in size. Proportions, then, are an inherent functional characteristic of bone retouchers, which does not depend on either the cultural context or the raw material base.

Keywords: *Middle Paleolithic, Neanderthals, Altai, Chagyrskaya Cave, bone retouchers, bone industry.*

Introduction

Along with lithic hammers, bone retouchers were tools used in lithic reduction in the Middle Paleolithic. Bone retouchers started to be mentioned in the scholarly literature already in the late 19th century (Leguay, 1877; Daleau, 1883). Since the 20th century, their description has become an integral part of the analysis of artifacts (Bonch-Osmolovsky, 1934; 1940: 121–122; Zamyatnin, 1934; Gvozdover, Formozov, 1960; Leonardi, 1979; Kolosov, 1986: 183; Valoch, 1988; Kolosov, Stepanchuk, Chabai, 1993: 39, 116, 133, 155; Filippov, Lyubin, 1994; Yevtushenko, 1998; Khlopachev, 2013; Claud et al., 2012; Mallye et al., 2012; Tartar, 2012; Blasco et al., 2013; Neruda, Lázničková-Galetová, 2018; Costamagno et al., 2018; Moigne et al., 2016). Bone retouchers have been widely analyzed in Western European scholarship (Mozota, 2018), and therefore we will focus on key stages in the study of this tool-type in the works of the Eastern European researchers.

After studying the morphology of bone retouchers and retouching on flint tools, as well as conducting experiments, three approaches for using retouchers were proposed: as anvil, pressure tool, and hammer. The term "anvil" (*enclume*) was associated with the use of retouchers as passive tools for applying counter-impact retouching at the La Ferrassie and La Quina sites (Capitan, Peyrony, 1912; Martin, 1906). When analyzing the evidence from the Ilskaya site, S.N. Zamyatnin used the terms "small anvil" and "retoucher" for describing the same bone fragments (1934: 213, pl. III, 15–17).

G.A. Bonch-Osmolovsky reasonably rejected the interpretation of anvil proposed by French scholars, and pointed out that the "asymmetric arrangement of incisions at the ends of double small anvils, and their oblique direction with respect to the axis of bone fragment, testify to the use of the latter as active retouchers, which were pressed against the flint blade" (1934: 134). Somewhat later, comparing retouchers from the collections of the La Quina, Shaitan-Koba, and Kiik-Koba sites, he made a number of important observations that remain relevant today: 1) "incisions are grouped in small zones at one or both" ends of the bone; 2) "zones of incisions are shifted to the left of the midline"; 3) "incisions are directed obliquely, at an angle of 45° relative to the longitudinal axis of the bone"; 4) they were made "with a sharp edge of a flint, which was directed, not perpendicularly, but slightly obliquely to the bone surface", the angle of inclination was "about 30–35°" (Bonch-Osmolovsky, 1940: 120). These observations led Bonch-Osmolovsky to the conclusion that "incisions could only have been made using one technique—active retouching of blades on flint tools. With a bone fragment tightly held in the right hand (I emphasize, in the right hand, which is confirmed by the invariable inclination of the facets from left to right), the artisan pressed on a flint blade, which was held in his left hand and was slightly inclined upward" (Ibid.).

One of the first specialized studies of bone retouchers was carried out by S.A. Semenov in 1957 using the materials from the Eastern European Paleolithic sites of Kiik-Koba and Kostenki. Having compared the data of use-wear analysis of archaeological artifacts and experimental standards, he identified the traces of use on retouchers resulting from pressure retouching at the edge of the lithic tool (Semenov, 1957: 206). In the same study, Semenov confirmed the conclusions of Bonch-Osmolovsky, and interpreted diagonal uniform traces on bone retouchers as evidence of working with the right hand (Ibid: 208).

A.K. Filippov and V.P. Lyubin studied numerous bone retouchers from Barakaevskaya Cave, and subdivided them into five typological groups with different locations of wear-marks (1994). V.N. Stepanchuk analyzed flint-processing tools at the Middle Paleolithic site of Prolom I, and observed that lithic retouchers were made using river pebbles of relatively soft, tuffaceous, and sandstone rocks (1990). A.I. Yevtushenko pointed out the similarities in the morphology of traces (incisions and grooves) on the surfaces of lithic and bone retouchers from Kabazi V (1998). Taking into account specific features of striking platforms on the spalls and these similarities, he concluded that pebble and bone retouchers were used as hammers, and not as pressure tools (Ibid.: 316), which means that the incisions resulted from blows, while the grooves resulted from abrasive processing of tool blades. The evidence from new excavations at Chokurcha I confirmed this observation (Chabai, 2004a: 408–412). V.P. Chabai proposed a classification of bone and pebble retouchers in accordance with the number and location of active areas, and took into consideration their metric features, such as length, width, and thickness. Thus, he established the similarity of many shape-related parameters of bone and pebble retouchers (Ibid.). A.P. Veselsky supplemented Chabai's classification by such features as intensity of use and weight. Studying the collections from Kabazi V, he made a number of important observations: retouchers typically occurred in the layers with the Micoquian artifacts, while they were rare or completely absent in the Levallois-Mousterian layers; the weight of bone retouchers was much less than those made of lithic; intense use of retouchers was manifested not only by the microflaking of active areas, but also by the presence of the second active area (Veselsky, 2008). These observations brought Veselsky to the conclusion about the use of bone retouchers for manufacturing bifacial tools. Moreover, taking into account the weight of retouchers, it was suggested that these were used for manufacturing only distal tool-parts, i.e., points—the thinnest parts, where excessive weight in the retoucher could lead to unintentional damage of the tool (Ibid.). Indeed, in Eastern Europe, retouchers are associated with manufacturing bifaces in the Micoquian technocomplex starting from MIS 5d (Kabazi II, VI/11–14) up to the final stages of MIS 3 (Kiik-Koba, upper layer) (Chabai, 2005: 125; Khlopachev, 2013).

In the Altai Mountains, Middle Paleolithic bone tools were first identified in 2016 in the complexes of Chagyrskaya Cave (Kolobova, Markin, Chabai, 2016; Kolobova, Rendu, Shalagina et al., 2020). The industry of the site was attributed to the Sibiryachikha facies of the Altai Middle Paleolithic, which is the most eastern manifestation of the Micoquian technocomplex widespread in Central and Eastern Europe (Kolobova, Roberts, Chabai et al., 2020). Currently, 1080 bone tools have been identified in the materials from Chagyrskaya Cave, including 1052 retouchers. This is one of the richest collections of bone tools of the Middle Paleolithic of Eurasia. This article presents the results of morphometric analysis of the sample of retouchers from Chagyrskaya Cave. In addition, we will give extensive comparisons with tools of this type from the described Middle Paleolithic assemblages of the Altai, Crimea, and Caucasus, for establishing their functional features.

Materials and methods

After re-examining old artifacts and obtaining new paleozoological collections from Chagyrskaya Cave (2008–2018), complete and fragmented bone tools were identified: weakly modified tools similar to points but with rounded noses, intermediate tools, tools with lateral retouch (Baumann et al., 2020), and retouchers. The retouchers come from layer 6. One hundred bone retouchers were selected for morphometric analysis (Fig. 1). The overwhelming majority of bone retouchers in the collection were fragmented with fractures in the active areas. In the process of sampling, preference was given to complete or slightly fragmented specimens. The probable integrity of the tools was established from the nature and color of postdepositional surfaces of fracture. The sample included most of the presumably

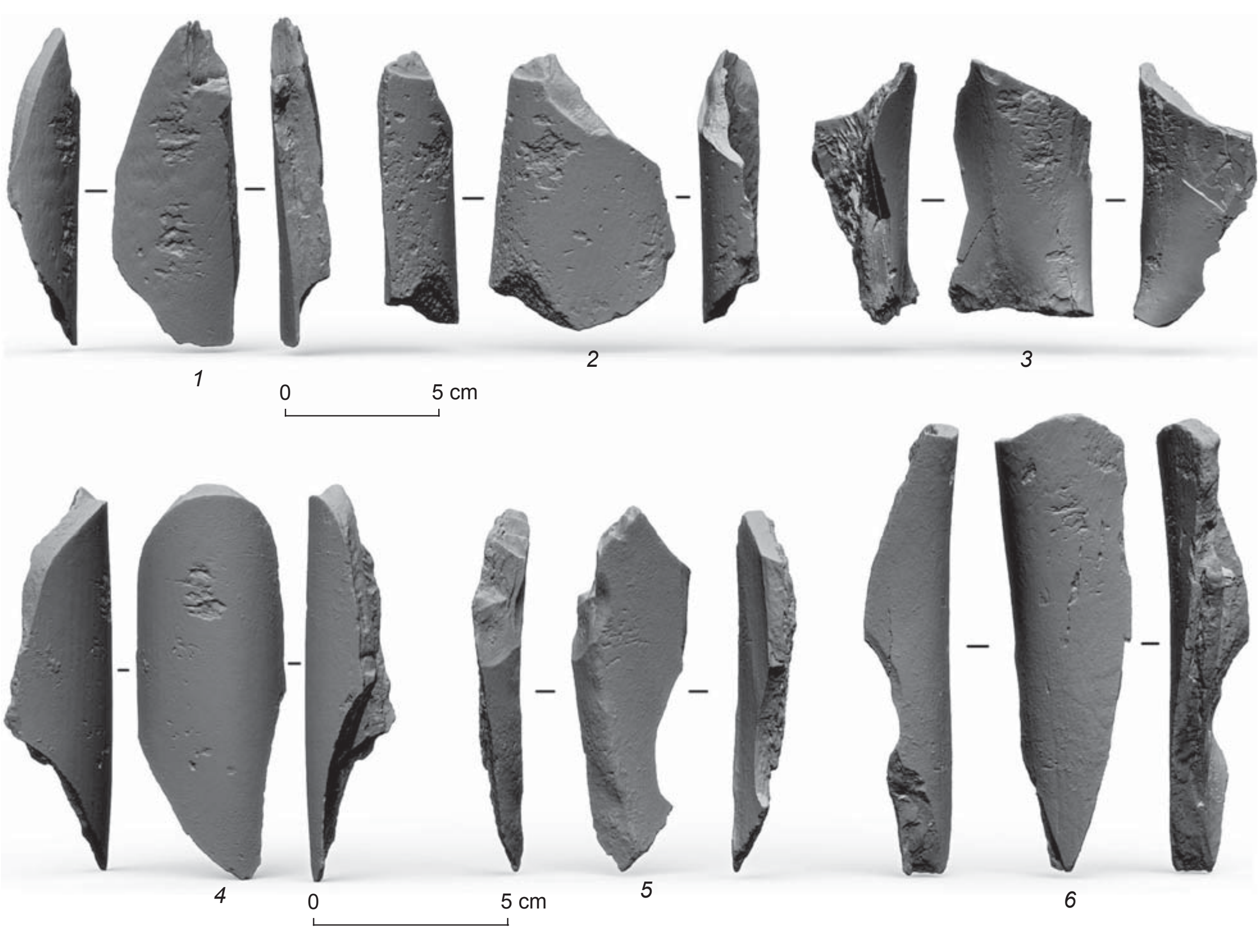

Fig. 1. Bone retouchers from the Middle Paleolithic complexes of Chagyrskaya Cave.

complete bone retouchers; it is representative, and allows for conducting statistical analysis without any restrictions.

Several similar methods based on the classification of morphological features and metric characteristics are applied to the analysis of bone retouchers (Lyubin, 1994; Armand, Delagnes, 1998; Malerba, Giacobini, 1998; Veselsky, 2008; Mallye et al., 2012). We chose the method used by Veselsky (2008) for the following reasons: it was employed in the analysis of the Kabazi V complex, which belongs to the Micoquian, as well as archaeological materials from Chagyrskaya Cave; and a preliminary analysis of retouchers from this cave conducted following this method has shown its exceptional informative significance (Kolobova, Markin, Chabai, 2016). We identified the following features: 1) number of active areas; 2) degree of use/modification on each area; 3) maximum metric parameters: length, width, and thickness, and 4) weight. The measured weight of bone retouchers was undoubtedly different from the original weight of tools made from fresh bones; its decrease resulting from drying and post-depositional mineralization in long bones and ribs of large herbivores could have been differential. Nevertheless, we included this parameter in the study in order to assess its research capacity. The published data on bone retouchers from Kabazi V (Crimea), Barakaevskaya Cave (Caucasus), and Denisova Cave (Altai) were used for establishing variability of studied tools within the single industrial variant (the Micoquian, Kabazi V, Barakaevskaya and Chagyrskaya caves) and differences between different variants (the Micoquian and Denisova variant of the Altai Middle Paleolithic) (Filippov, Lyubin, 1994; Veselsky, 2008; Kozlikin et al., 2019).

During the study, the samples were illuminated by an electric light with changing illumination angle for the qualitative determination of characteristics of surfaces, including both anthropogenic (traces of retouching, removal of the periosteum, cuts, deliberate modification of tools along the edge) and biogenic (fresh breaks, bite marks, traces of roots) modifications. Traces of bone use as a retoucher were the dents in the active area. All tools were oriented along the long axis with obligatory location of the active area in the upper part; if there were two or more active areas, the upper one was considered that with the greatest degree of modifications.

Analysis of the paleontological complexes of Chagyrskaya Cave has shown that the main hunting prey were young and female bisons (*Bison priscus*), and to a much lesser extent Ovodov horses (*Equus* (*Sussemionus*) *ovodovi*) (Kolobova, Rendu, Shalagina et al., 2020). The overwhelming majority of retouchers come from lower layers 6c/1 and 2, which were the least disturbed by post-depositional processes. The data obtained were processed using mathematical statistics methods. All calculations were carried out in the PAST software. The metric parameters of retouchers were compared depending on their distribution across the number of active areas and on the relative degree of modification of the main area. The preliminary stage of data processing included creating descriptive statistical tables and establishing the adequacy of data distribution in the analyzed samples, using the Shapiro-Wilk test. This test has shown that the bulk of the data in the samples was distributed abnormally. Therefore, it was decided to apply the Kruskal-Wallis one-way analysis of variance, which is used for comparing three or more samples (Hammer, Harper, Ryan, 2001). Since it establishes the similarity/difference between several compared samples across one variable, in the case of statistically significant differences, a pairwise comparison was carried out using the Mann-Whitney test with Bonferroni correction to minimize the probability of type I error (Grzhibovsky, 2008).

Visualization of statistical data was carried out by constructing box plots and ternary plots in the PAST software. The ternary plot is the most convenient tool for displaying the relationship between several variables—in our case, metric parameters. For this purpose, a triangular coordinate system on a plane is used, where the relative share of each metric parameter is limited by their sum taken as 1 (100 %), and the vertices of the triangle are the maximum values of length, width, or thickness, also equal to 100 %.

Visualization of retouchers was performed by creating textureless 3D-models: they show a clear advantage in accuracy over schematic drawing, and better display the active areas, as compared to high-quality photography, because of the lack of texture. The models were obtained using a RangeVision PRO 5M structured illumination scanner. After scanning, they were processed using the RangeVision ScanCenter and ScanMerge software (Kolobova, Fedorchenko, Basova et al., 2019). Post-processing of the models, including creation of profiles and elevation maps, was carried out using Autodesk Netfabb, Geomagic Design X, and Geomagic Wrap (trial versions).

Study results

Relatively large fragments of flat bones and diaphyses of long tubular bones were used for manufacturing the retouchers under study. In half of the cases, it was possible to identify the anatomical position of the blank (femur, tibia, radius, less often ribs, various vertebrae, and mandibles) (Kolobova, Chabai, Shalagina et al., 2019). One, two, or three active areas, which resulted from the contact with the processed lithic tools, have been recorded on the retouchers. Most of the areas are located in accordance with the natural relief of the surface of cortical layer of the bone in convex and, less often, flat zones. The diagnostic features of the use of retouchers are closely-spaced deep "furrows" with V-shaped cross-section and "pits" rounded in plan view. Different morphology of traces is associated with the different intensity of operations performed, the morphology of the retouched edge of the tool, and the quality of lithic raw materials. Notably, the V-shaped profile of the depressions was observed on the weakly modified retouchers (Chase, 1990). Using the example of a three-dimensional model of a highly modified retoucher from the complex of Chagyrskaya Cave, we have managed to create longitudinal and transverse cross-sections for the most typical traces within the active areas (Fig. 2). The V-shaped cross-section has not been recorded; the profile of both "pits" and "furrows" rather has a shape of an upturned trapeze. This shape probably resulted from intense use of a retoucher, when there was more than one blow per a unit of the active area, which modified the original V-shaped cross-section. The impact function of retouchers is confirmed by preliminary experiments on modeling bifaces (Shalagina et al., 2019).

The length of the examined tools varies from 38.8 to 156.0 mm; width from 18.7 to 61.3 mm, and thickness from 2.1 to 12.0 mm; the weight of the artifacts ranges from 7 to 107 g. For analyzing metric parameters, bone retouchers were grouped according to their morphological features: with different numbers of active areas on the cortical surfaces (Fig. 3), and with different degrees of modification of active areas (Fig. 4). When more than one active area was observed on the retoucher, this meant that it was reoriented after the primary use and was used secondarily.

The majority of retouchers in the sample under consideration have one (45 %) or two (48 %) active areas; only 7 % of retouchers have three active areas (Table 1). The materials from Chagyrskaya Cave manifest fairly intense retouching of lithic tools. Intensity of retouching can be described as extremely high as compared to the Middle Paleolithic complexes of other industrial variants in Altai (Kara-Bom and Denisova) (Kolobova, 2006; Kolobova, Krivoshapkin, Pavlenok et al., 2012). However, in the context of the Micoquian industries, it corresponds to the mean degree typical of the complexes of the Staroselye facies (Chabai, 2004b: 236–238; Kolobova, Chabai, Shalagina et al., 2019).

We have compared metric parameters of retouchers with different numbers of active areas on cortical surfaces. Judging by the box plot, specimens with three active areas were slightly longer than those with one and two (Fig. 5, *1*). However, the Kruskal-Wallis analysis of variance did not reveal statistically significant differences ($H(\chi^2) = 4.24$; $p = 0.085$). The same applied to the values of width ($H(\chi^2) = 0.59$; $p = 0.744$) and thickness ($H(\chi^2) = 0.093$; $p = 0.95$) (Fig. 5, *2*, *3*). The weight of retouchers with three active areas was slightly larger (Fig. 5, *4*), but the difference was not statistically significant ($H(\chi^2) = 4.63$; $p = 0.098$).

In total, on 100 bone retouchers, 162 active areas have been recorded. Weakly worn areas constitute 52 %; moderately worn 32 %, and highly worn 16 %

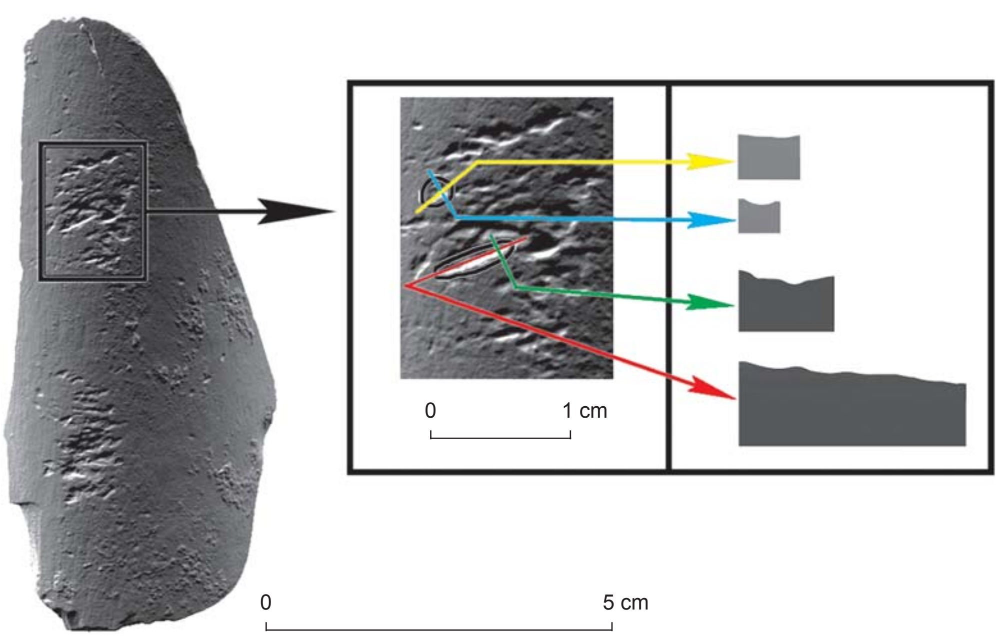

Fig. 2. Cross-sections of a "pit" and a "furrow" on the retoucher.

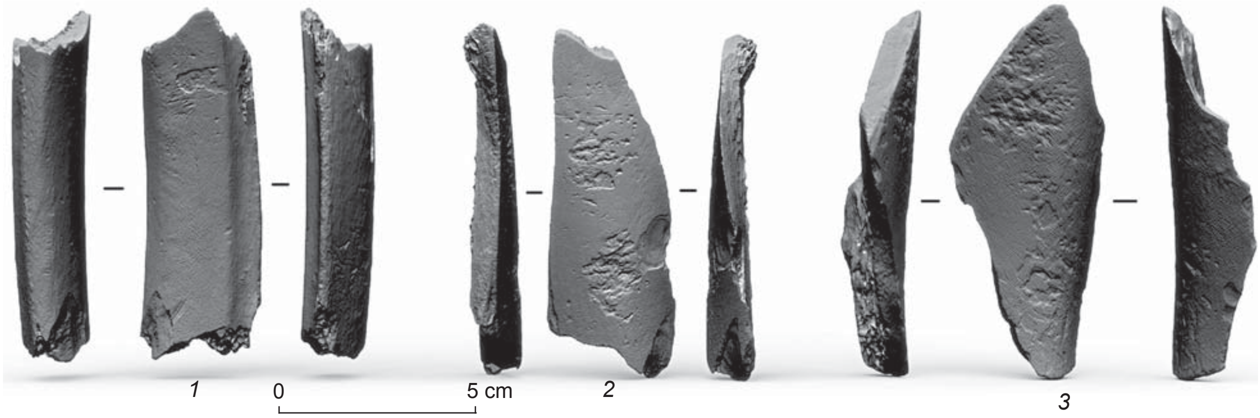

Fig. 3. Bone retouchers with one (*1*), two (*2*), and three (*3*) active areas.

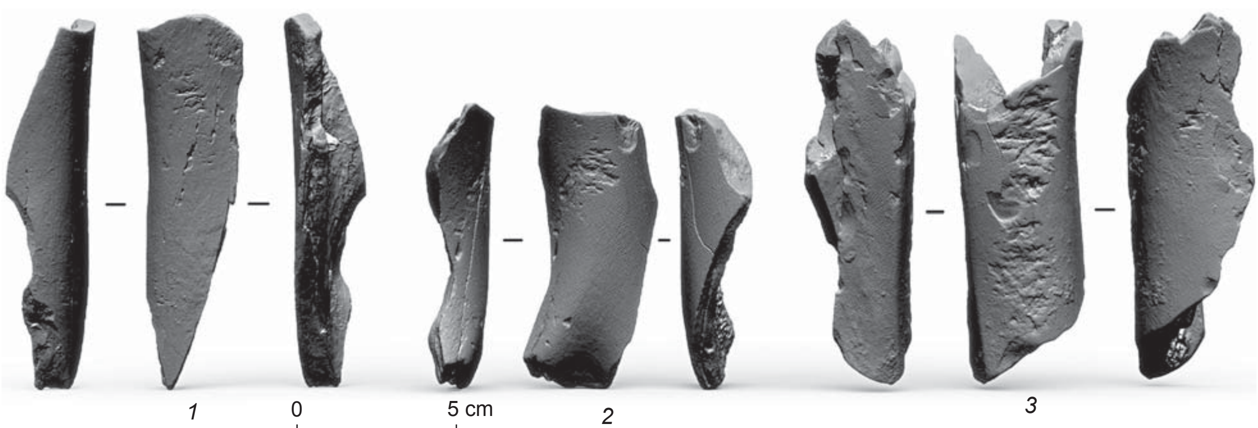

Fig. 4. Weakly (*1*), moderately (*2*), and highly modified (*3*) bone retouchers.

Table 1. **Mean values of metric parameters of bone retouchers from Chagyrskaya Cave, depending on the number of active areas**

Number of active areas	Number of retouchers, %	Length, mm	Width, mm	Thickness, mm	Mass, g
1	45	85.79	36.87	7.61	33.47
2	48	90.36	36.94	7.70	37.04
3	7	102.66	37.90	7.61	48.14

(Table 2). When comparing the length of retouchers with different degrees of utilization, the Kruskal-Wallis test manifested a difference at the limit of statistical significance ($H(\chi^2) = 6.1$; $p = 0.047$) (Fig. 6, *1*). Therefore, the Mann-Whitney test was used. Pairwise comparison has shown that highly and weakly modified retouchers were the most statistically dissimilar (U = 264.5; $p = 0.029$). Since we observed a statistically significant difference between the three samples, it was necessary to apply the Bonferroni correction to exclude type I error. This correction takes into account the critical level of significance for several samples; in our case, p = 0.0253. The level of significance that we have obtained exceeded the critical level, which means that the null hypothesis as to the equality of length of the retouchers could be accepted, and it could be concluded that the groups compared across this parameter did not differ statistically. Significant differences in width ($H(\chi^2) = 1.38$; $p = 0.55$) (Fig. 6, *2*), thickness ($H(\chi^2) = 2.6$; $p = 0.26$) (Fig. 6, *3*), and weight ($H(\chi^2) = 5.58$; $p = 0.06$) (Fig. 6, *4*) have also not been recorded.

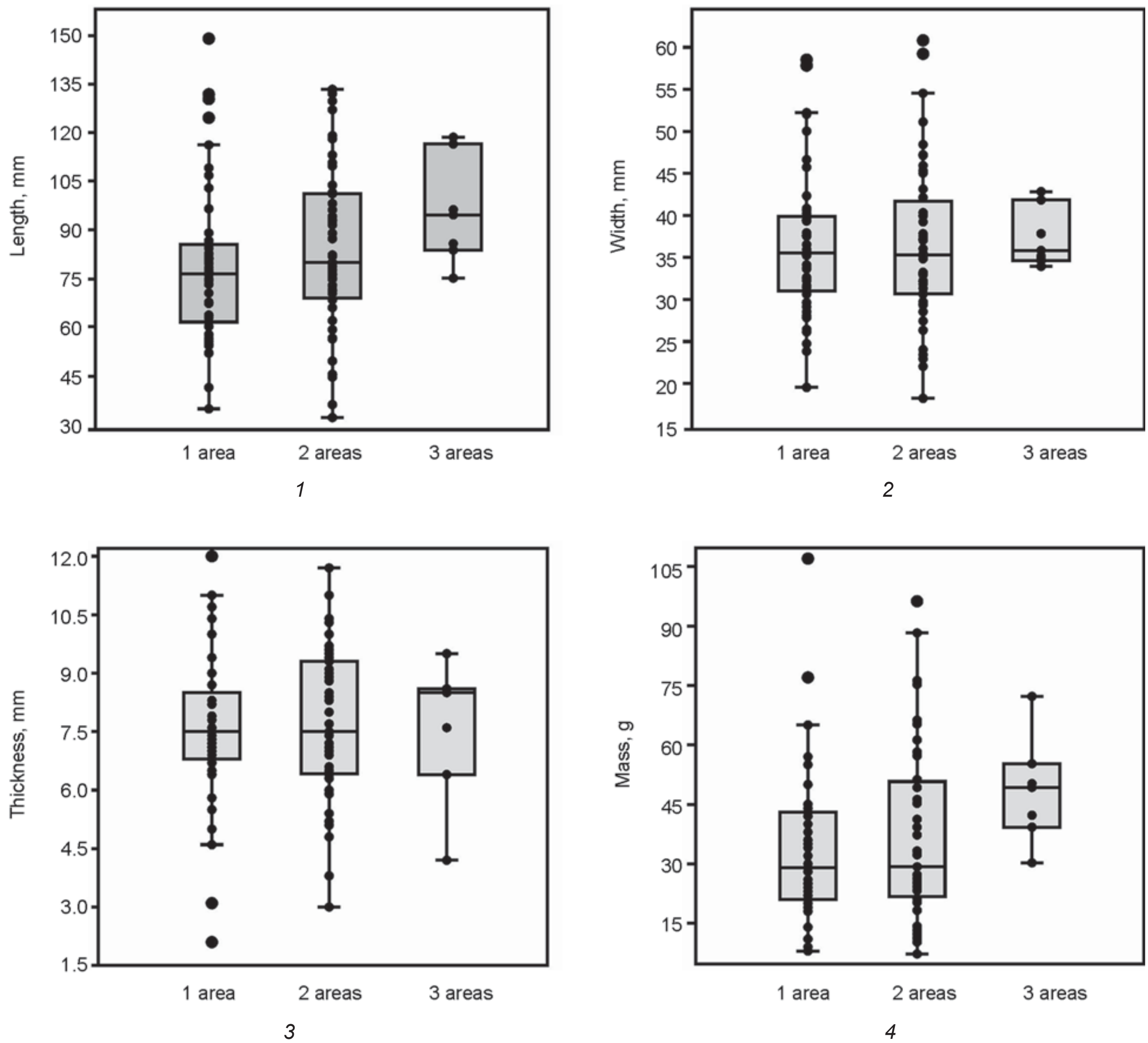

Fig. 5. Box plots of metric parameters of retouchers depending on the number of active areas.

Table 2. **Mean values of metric parameters of bone retouchers from Chagyrskaya Cave, depending on wear degree**

Wear degree	Number of retouchers, %	Length, mm	Width, mm	Thickness, mm	Mass, g
Weak	52	84.43	36.90	7.63	32.79
Medium	32	92.18	35.64	7.38	36.88
High	16	98.51	39.91	8.28	47.88

Discussion

Experimental modeling of manufacturing bifacial tools from Chagyrskaya Cave has demonstrated the use of retouchers at the final stages of shaping lithic bifaces, and obvious advantages of their use as compared to hard mineral hammers and retouchers (Shalagina et al., 2019). These data are in direct agreement with the archaeological assemblage. Evidence for the use of soft hammers—absent or diffuse bulb, combined with pronounced lip —

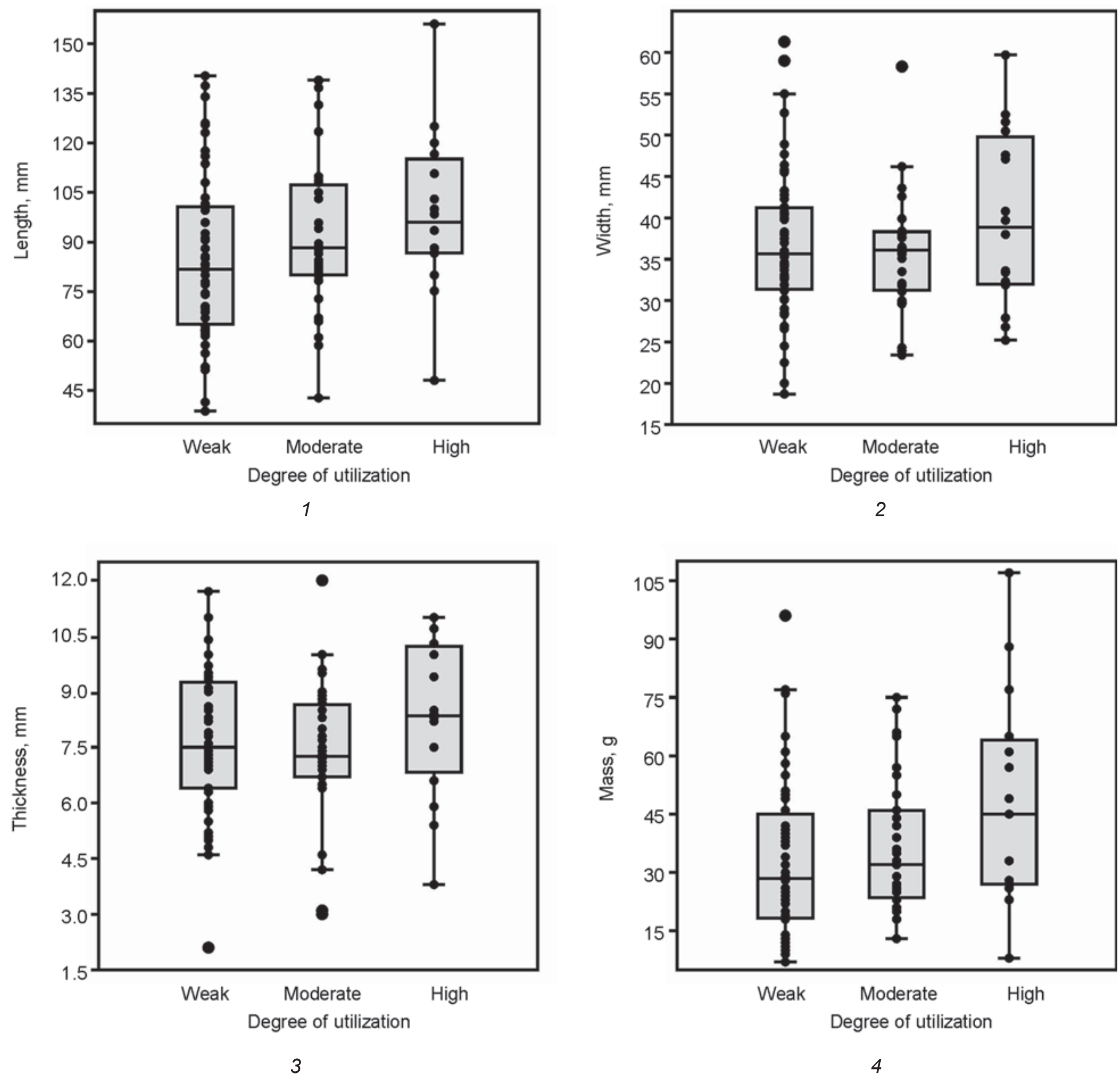

Fig. 6. Box plots of metric parameters of retouchers depending on modification of active areas.

has been found in the proximal zones of all studied bifacial thinning tools (Kolobova, Shalagina, Chabai et al., 2019). A preliminary geometric morphometric analysis of the shape of retouchers from Chagyrskaya Cave has revealed small influence of the anatomical position of blanks on the overall morphological variability of the sample, which most likely indicates deliberate selectivity. At the same time, a sufficiently high degree of uniformity among these tools has been observed (Kolobova, Chabai, Shalagina et al., 2019).

Analysis of morphometric parameters may provide valuable scholarly information about the technological features of the bone industry of Chagyrskaya Cave. In the study of Paleolithic complexes, fragmentation of bone retouchers is an objective obstacle to this kind of research. Analysis of the main metric parameters in one hundred complete or slightly fragmented (still in ancient times) bone retouchers from Chagyrskaya Cave has revealed the high level of their metric standardization. We have not identified any statistically significant differences between retouchers with different numbers of active areas and retouchers with different degrees of their modification. Standardization became apparent after comparing three metric parameters (length, width, and thickness) together. On ternary plots, all retouchers were concentrated in one area, demonstrating the same proportions regardless of their morphological features (Fig. 7).

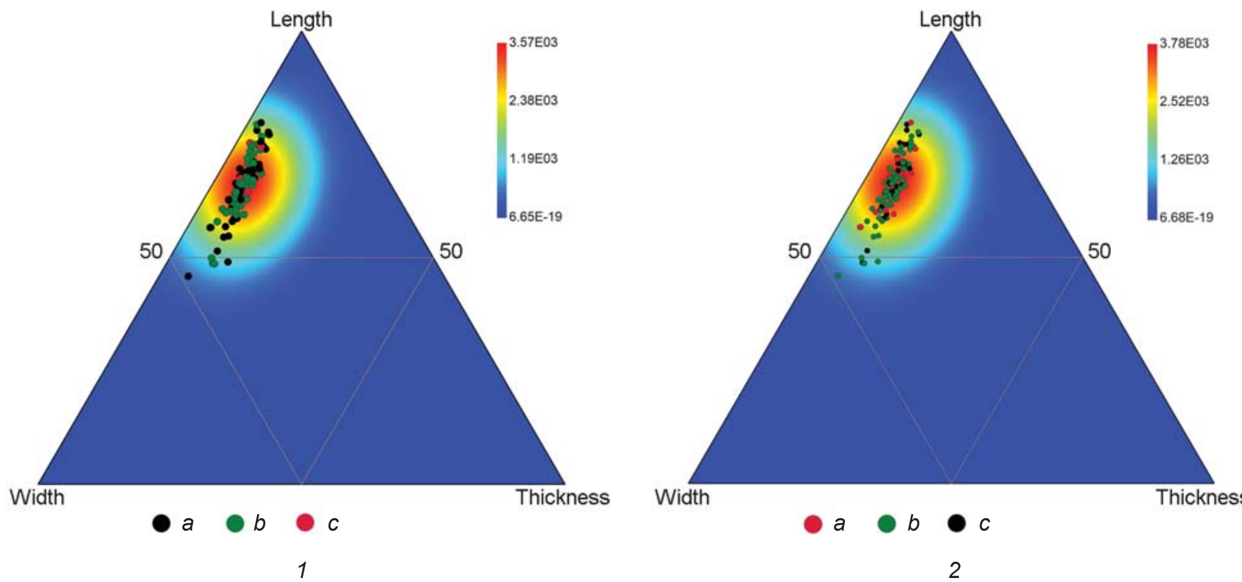

Fig. 7. Ternary plot showing proportions of main metric parameters in bone retouchers from the complex of Chagyrskaya Cave (the point density map, designed using the method of nuclear density estimation, is shown in color).
1 – retouchers with a different number of active areas: *a* – with one area, *b* – with two areas, *c* – with three areas; *2* – retouchers with varying wear degrees: highly (*a*), moderately (*b*), and weakly modified (*c*).

In order to establish any cultural or functional preferences in the use of Middle Paleolithic bone retouchers, we employed the published data on several Middle Paleolithic sites in the Crimea, Caucasus, and Altai: Denisova and Barakaevskaya caves, and Kabazi V (Kozlikin et al., 2019; Filippov, Lyubin, 1994; Veselsky, 2008). The complexes from Kabazi V and Barakaevskaya Cave, as well as the complex from Chagyrskaya Cave, are a part of the Eastern Micoquian industries. The assemblages chronologically belonging to the period from the late MIS 4 to the early MIS 3 typically show a combination of flake-based reduction and plano-convex bifacial processing of tools. The toolkits contain bifacial symmetrical and asymmetrical points and side-scrapers, along with simple and convergent side-scrapers and retouched points. The published data include metric parameters of retouchers (Chabai, 2004a; Veselsky, 2008; Filippov, Lyubin, 1994; Kolobova, Roberts, Chabai et al., 2020).

Two hundred and five bone retouchers were found at the Middle Paleolithic site of Kabazi V. Most of these came from two units of horizons III/1 and III/5. These were most likely manufactured from fragments of bones of hydruntines, whose remains prevailed in the paleozoological collection of the site. Such tools are distinguished by only one working surface and one, rarely two, active areas. Fragments of tubular bones and, in sporadic cases, of ribs were used as blanks (Veselsky, 2008). The article by Veselsky provides the mean values of metric parameters of bone tools by layers. We take into account only the published metric parameters of 43 bone retouchers from the layers with individual finds

Table 3. **Mean values of metric parameters of bone retouchers from the complexes of Kabazi V, Chagyrskaya, Barakaevskaya, and Denisova caves**

Site	Number of retouchers	Length, mm	Width, mm	Thickness, mm	Mass, g	Elongation index (length/ width)	Massiveness index (width/ thickness)
Chagyrskaya Cave	100	89.16	36.98	7.90	36.42	2.41	4.68
Kabazi V	43	72.58	26.07	9.40	17.51	2.78	2.77
Barakaevskaya Cave	12	86.28	31.06	10.00	…	2.78	3.10
Denisova Cave	9	115.50	42.80	14.20	74.70	2.69	3.01

(Table 3); therefore, we believe that it is incorrect to use the mean values of the samples.

One hundred and nine retouchers made from fragments of tubular bison bones were identified in the complex from Barakaevskaya Cave. They occurred in four horizons of the Mousterian layer. A significant proportion of bone tools showed traces of deliberate chipping or retouching. According to the published data, we have reconstructed the metric parameters of twelve complete retouchers (Table 3); information on their weight is absent (Filippov, Lyubin, 1994).

In Altai, three Middle Paleolithic industrial variants are known: the Sibiryachikha, the Denisova, and the Kara-Bom. The Sibiryachikha complexes of Chagyrskaya Cave differ technically and typologically from the Denisova and Kara-Bom complexes (Derevianko et al., 2015; Krivoshapkin et al., 2018; Shalagina et al., 2018; Kolobova, Shalagina, Chabai et al., 2019). In Denisova Cave, bone retouchers occur in tool assemblages from the Pleistocene deposits of the Main Chamber and East Chamber. At the present stage of research, 28 specimens have been found. Nine complete retouchers came from layer 12 of South Chambert (MIS 4) (Table 3); these were made from fragments of the diaphyses of tubular bones, probably of horse, bison, rhinoceros, or mammoth. All have morphologically identical wear-traces of varying degrees; one, two, or three active areas have been identified in each retoucher. In some bone artifacts, secondary processing (lateral and/or transverse trimming) has been observed (Kozlikin et al., 2019).

Thus, we have data on complete retouchers from four Middle Paleolithic sites, three of which belong to the Micoquian (Kabazi V, Chagyrskaya and Barakaevskaya caves), and one to the Denisova Levallois-Mousterian variant of the Altai Middle Paleolithic (Denisova Cave). Undoubtedly, our comparisons are rather approximate owing to the small number of samples from Barakaevskaya and Denisova caves. Nevertheless, we can draw some preliminary conclusions.

Taking into account the different species membership of bone materials, the small size of the samples makes it unreasonable to compare metric parameters of bone retouchers. However, a significant difference across the metric parameters can be observed between these complexes. It is also unreasonable to compare retouchers by weight, owing to the different preservation of bones and their different density (Table 3). Comparison of the indices of elongation (ratio of the retoucher's length to its width) and massiveness (ratio of the retoucher's width to its thickness) shows the significant similarity of these parameters in retouchers from all the sites (Table 3). The same picture is demonstrated by all three metric variables in the aggregate (Fig. 8).

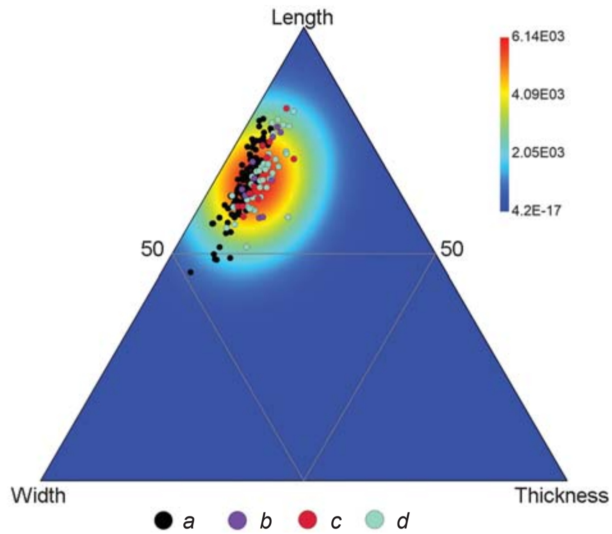

Fig. 8. Ternary plot showing the proportions of the main metric parameters in bone retouchers from the complexes of Chagyrskaya (*a*), Denisova (*b*), and Barakaevskaya (*c*) caves, as well as Kabazi V (*d*).

Conclusions

The available experimental and archaeological data on the Chagyrskaya complex testify to widespread use of bone retouchers for shaping and rejuvenation of lithic tools. The analysis of cross-sections of bone retouchers has shown that their shape depended on the degree of modification of active areas. Multiple blows by the tool against the processed lithic material lead to deformation of the original V-shape, which takes the shape of an upturned trapeze. After comparing the length and width of bone retouchers from Chagyrskaya Cave, it has been found that tools with different number of active areas or degree of modification show small differences. This may indicate the preferences of the Neanderthals in terms of sizes and their selectivity in choosing the blanks. Blanks were also selected by animals' species and the anatomical positions of bones.

Comparison of metric parameters in retouchers from Middle Paleolithic complexes belonging to different cultures (the Micoquian and Denisova industrial variants), which are distant from each other, has demonstrated substantial differences. Moreover, almost the same proportions of tools made from different raw materials have been observed. Thus, we have obtained the functional characteristic of bone retouchers that does not depend on either the cultural context or raw materials. On average, these tools have an elongation index from 2.41 to 2.78, and a massiveness index from 2.7 to 4.7. These proportions were caused by the size and weight of fresh bone, required for successful retouching.

Possibly, such fragments of bones were selected as were the most convenient for holding during work and did not have sharp protrusions along the edges of the part held by the hand. However, the question concerning intentional modification of bone tools still remains: did the Neanderthals take the blanks that were ready for use, or did they modify the blanks until the required shape was achieved. Many scholars mention the selectivity of Neanderthals in choosing bone fragments for retouchers and their special processing before use (see, e.g., (Blasco et al., 2013; Mallye et al., 2012)). The studies of retouchers from Chagyrskaya, Barakaevskaya, and Denisova caves have revealed the traces of additional processing on isolated artifacts (Filippov, Lyubin, 1994; Kozlikin et al., 2019; Kolobova, Chabai, Shalagina et al., 2019). This fact requires a detailed study, since bone blanks were often reshaped into several tools (for example, retoucher and intermediate tool on one blank) (Baumann et al., 2020). Thus, additional processing may not necessarily be a part of shaping the retoucher, but of shaping another tool.

Acknowledgements

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References

Armand D., Delagnes A. 1998
Les retouchoirs en os d'Artenac (couche 6c): Perspectives archéozoologiques, taphonomiques et expérimentales. In *Économie Préhistorique: Les Comportements de Subsistance au Paléolithique: Actes des XVIIIe Rencontre Internationale d'Archéologie et d'Histoire d'Antibes, 23–25 octobre 1997*. Paris: APDCA, Sophia Antipolis, pp. 205–214.

Baumann M., Plisson H., Rendu W., Maury S., Kolobova K., Krivoshapkin A. 2020
Neandertal bone industry at Chagyrskaya Cave (Altai, Russia). *Quaternary International*, vol. 559: 68–88.

Blasco R., Rosell J., Cuartero F., Fernández Peris J., Gopher A., Barkai R. 2013
Using bones to shape stones: MIS 9 bone retouchers at both edges of the Mediterranean Sea. *PLOS ONE*, vol. 8. URL: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0076780.

Bonch-Osmolovsky G.A. 1934
Itogi izucheniya krymskogo paleolita. In *Trudy II Mezhdunarodnoy konferentsii Assotsiatsii po izucheniyu chetvertichnogo perioda Yevropy*, iss. V. Leningrad, Moscow: Gos. nauch.-tekhn. gornogeol.-neft. izd., pp. 114–183.

Bonch-Osmolovsky G.A. 1940
Paleolit Kryma. Iss. 1: Grot Kiik-Koba. Moscow, Leningrad: Izd. AN SSSR.

Capitan L., Peyrony D. 1912
Station préhistorique de La Ferrassie (Dordogne). *Revue anthropologique*, vol. 1: 29–50.

Chabai V.P. 2004a
Chokurcha I Unit IV: Artifacts. In *The Middle Paleolithic and Early Upper Paleolithic of Eastern Crimea*. Liège: Université de Liège, pp. 377–416. (The Paleolithic of Crimea; vol. III). (Etudes et Recherches Archéologigues l'Université de Liège; No. 104).

Chabai V.P. 2004b
Sredniy paleolit Kryma: Stratigrafiya, khronologiya, tipologicheskaya variabelnost, vostochno-yevropeiskiy kontekst. Simferopol: Shlyakh.

Chabai V.P. 2005
Kabazi II, units V and VI: Artifacts. In *Kabazi II: Last Interglacial Occupation, Environment & Subsistence*. Simferopol, Cologne: Shlyakh, pp. 99–132. (Palaeolithic Sites of Crimea; vol. 1).

Chase P.G. 1990
Tool-making tools and Middle Paleolithic behavior. *Current Anthropology*, vol. 31 (4): 443–447.

Claud E., Soressi M., Jaubert J., Hublin J.-J. 2012
Étude tracéologique de l'outillage moustérien de type Quina du bonebed de Chez-Pinaud à Jonzac (Charente-Maritime): Nouveaux éléments en faveur d'un site de boucherie et de traitement des peaux. *Gallia préhistoire*, vol. 54: 3–32.

Costamagno S., Bourguignon L., Soulier M.-C., Meignen L., Beauval C., Rendu W., Mussini C., Mann A., Maureille B. 2018
Bone retouchers and site function in the Quina Mousterian: The case of Les Pradelles (Marillac-LeFrance, France). In *The Origins of Bone Tool Technologies*. Hannover: Propylaeum, pp. 165–195.

Daleau F. 1883
Sur des lesions que présentent certains os de la période paléolithique. In *Congrès de l'Association Française pour l'Avancement des Sciences: 12e session*. Rouen: pp. 600–602.

Derevianko A.P., Markin S.V., Kulik N.A., Kolobova K.A. 2015
Lithic raw material exploitation in the Sibiryachikha facies, the Middle Paleolithic of Altai. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 43 (3): 3–16.

Filippov A.K., Lyubin V.P. 1994
Kostyaniye retushery iz mustyerskogo sloya i prostranstvennoye rasprostraneniye kulturnykh ostatkov. In *Neandertaltsy Guppskogo ushchelya na Severnom Kavkaze*, V.P. Lyubin (ed.). Maikop: Meoty, pp. 142–147.

Grzhibovsky A.M. 2008
Analiz trekh i boleye nezavisimykh grupp kolichestvennykh dannykh. *Ekologiya cheloveka*, No. 3: 50–58.

Gvozdover M.D., Formozov A.A. 1960
Ispolzovaniye kosti na mustyerskoy stoyanke Staroselye v Krymu. *Archeologicke Rozhledy*, vol. XII (3): 390–403.

Hammer Ø., Harper D.A.T., Ryan P.D. 2001
PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica*, vol. 1 (4): 1–9.

Khlopachev G.A. 2013
Bone retouchers from the upper layer of Kiik-Koba Grotto. In *Demidenko Yu.E., Uthmeier T. Kiik-Koba Grotto, Crimea (Ukraine): Re-Analysis of a Key Site of the Crimean Micoquian*. Rahden: Verlag M. Leidorf, pp. 161–163. (Kölner Studien zur Prähistorischen Archäologie; Bd. 3).

Kolobova K.A. 2006
Priyemy oformleniya kamennykh orudiy v paleoliticheskikh industriyakh Gornogo Altaya. Novosibirsk: Izd. IAET SO RAN.

Kolobova K.A., Chabai V.P., Shalagina A.V., Krajcarz M.T., Krajcarz M., Rendu W., Vasiliev S.K., Markin S.V., Krivoshapkin A.I. 2019
Exploitation of the natural environment by Neanderthals from Chagyrskaya Cave (Altai). *Quartar*, vol. 66: 7–31.

Kolobova K.A., Fedorchenko A.Y., Basova N.V., Postnov A.V., Kovalev V.S., Chistyakov P.V., Molodin V.I. 2019
The use of 3D-Modeling for reconstructing the appearance and function of non-utilitarian items (the case of anthropomorphic figurines from Tourist-2). *Archaeology, Ethnology and Anthropology of Eurasia,* vol. 47 (4): 66–76.

Kolobova K.A., Krivoshapkin A.I., Pavlenok K.K., Flas D., Derevianko A.P., Islamov U.N. 2012
The denticulate Mousterian as a supposedly distinct facies in Western Central Asia. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 40 (1): 11–23.

Kolobova K.A., Markin S.V., Chabai V.P. 2016
Kostyaniye retushery v srednepaleoliticheskikh kompleksakh Chagyrskoy peshchery. *Teoriya i praktika arkheologicheskikh issledovaniy*, No. 4: 35–39.

Kolobova K., Rendu W., Shalagina A., Chistyakov P., Kovalev V., Baumann M., Koliasnikova A., Krivoshapkin A. 2020
The application of geometric-morphometric shape analysis to Middle Paleolithic bone retouchers from the Altai Mountains, Russia. *Quaternary International*, vol. 559: 89–96.

Kolobova K., Roberts R., Chabai V., Jacobs Z., Krajcarz M., Shalagina A., Krivoshapkin A., Li B., Uthmeier T., Markin S., Morley M., O'Gorman K., Rudaya N., Talamo S., Viola B., Derevianko A. 2020
Archaeological evidence for two separate dispersals of Neanderthals into southern Siberia. *Proceedings of the National Academy of Sciences*, vol. 117 (6): 2879–2885.

Kolobova K.A., Shalagina A.V., Chabai V.P., Markin S.V., Krivoshapkin A.I. 2019
Signification des technologies bifaciales au Paléolithique moyen des montagnes de l'Altaï. *L'Anthropologie*, vol. 123 (2): 276–288.

Kolosov Y.G. 1986
Akkaiskaya mustyerskaya kultura. Kiev: Nauk. dumka.

Kolosov Y.G., Stepanchuk V.N., Chabai V.P. 1993
Ranniy paleolit Kryma. Kiev: Nauk. dumka.

Kozlikin M.B., Mikhienko V.A., Frantseva E.A., Shunkov M.V. 2019
Kostyaniye retushery iz Denisovoy peshchery: Noviye materialy. *Teoriya i praktika arkheologicheskikh issledovaniy*, No. 4: 7–14.

Krivoshapkin A., Shalagina A., Baumann M., Shnaider S., Kolobova K. 2018
Between Denisovans and Neanderthals: Strashnaya Cave in the Altai Mountains. *Antiquity*, vol. 92 (365): 1–7.

Leguay L. 1877
Les procédés employés pour la gravure et la sculpture des os avec les silex. *Bullet Mémoires de la Société d'Anthropologie de Paris*, vol. 12: 280–296.

Leonardi P. 1979
Una serie di ritoccatoi prevalentemente musteriani del Riparo Tagliente in Valpantena presso Verona. *Preistoria Alpina*, vol. 15: 7–15.

Lyubin V.P. 1994
Itogi kompleksnogo izucheniya Barakayevskoy mustyerskoi stoyanki. In *Neandertaltsy Guppskogo ushcheliya na Severnom Kavkaze*, V.P. Lyubin (ed.). Maikop: Meoty, pp. 151–164.

Malerba G., Giacobini G. 1998
Les retouchoirs sur éclats diaphysaires du Paléolitique moyen et supérieur de trois sites de l'Italie nord orientale (Grotte de San Bernardino, Abri de Fumane et Abri Tagliente). In *Proceedings of the XIII Congress of the International Union of Prehistoric and Protohistoric Sciences (Forlì, 8–14 September 1996)*, vol. 6. Forlì: ABACO, pp. 167–171.

Mallye J.-B., Thiébaut C., Mourre V., Costamagno S. 2012
The Mousterian bone retouchers of Noisetier Cave: Experimentation and identification of marks. *Journal of Archaeological Science*, vol. 39: 1131–1142.

Martin H. 1906
Maillets ou enclumes en os provenant de la couche moustérienne de La Quina, Charente. *Bulletin de la Société préhistorique française*, No. 3: 155–162.

Moigne A., Valensi P., Auguste P., García-Solano J., Tuffreau A., Lamotte A., Barroso C., Moncel M. 2016
Bone retouchers from Lower Palaeolithic sites: Terra Amata, Orgnac 3, Cagny-l'Epinette and Cueva del Angel. *Quaternary International*, vol. 409: 195–212.

Mozota M. 2018
Experimental programmes with retouchers: Where do we stand and where do we go now? In *The Origins of Bone Tool Technologies*. Mainz: Römisch-Germanisches Zentralmuseum, pp. 15–32.

Neruda P., Lázničková-Galetová M. 2018
Retouchers from mammoth tusks in the Middle Palaeolithic: A case study from Kůlna Cave layer 7a1 (Czech Republic). In *The Origins of Bone Tool Technologies: Retouching the Palaeolithic: Becoming Human and the Origins of Bone Tool Technology: Conference at Schloss Herrenhausen in Hannover, Germany, 21–23 October 2015*. Mainz: Römisch-Germanisches Zentralmuseum, pp. 215–234.

Semenov S.A. 1957
Pervobytnaya tekhnika (opyt izucheniya drevneishikh orudiy i izdeliy po sledam raboty). Moscow, Leningrad: Izd. AN SSSR.

Shalagina A.V., Bomann M., Kolobova K.A., Krivoshapkin A.I. 2018
Kostyaniye igly iz verkhnepaleoliticheskikh kompleksov Strashnoy peshchery (Severo-Zapadniy Altai). *Teoriya i praktika arkheologicheskikh issledovaniy*, No. 1: 89–98.

Shalagina A.V., Kharevich V.M., Krivoshapkin A.I., Kolobova K.A. 2019
Eksperimentalnoye modelirovaniye bifasialnogo rasshchepleniya v sibiryachikhinskom variante srednego paleolita Altaya. *Teoriya i praktika arkheologicheskikh issledovaniy*, No. 4: 97–108.

Stepanchuk V.N. 1990

Kriterii podbora instrumentov rasshchepleniya i retushirovaniya v mustye Kryma. In *Kamenniy vek na territorii Ukrainy: Nekotoriye aspekty khozyaistva i etnokulturnykh svyazey*. Kiev: Nauk. dumka, pp. 112–118.

Tartar É. 2012

Réflexion autour de la fonction des retouchoirs en os de l'Aurignacien ancien. *Bulletin de la Société préhistorique française*, vol. 109: 69–83.

Valoch K. 1988

Le Taubachien et le Micoquien de la grotte Kůlna en Moravie (Tchécoslovaquie). In *L'Homme de Néandertal*. Vol. 4: La Technique: Actes du Colloque International de Liège, 4–7 Décembre 1986. Liège: Université de Liège, pp. 205–207.

Veselsky A.P. 2008

Kabazi V: Bone and stone tools used in flint knapping. In *Kabazi V: Interstratification of Micoquian & Levallois-Mousterian Camp Sites*. Simferopol, Cologne: Shlyakh, pp. 427–453.

Yevtushenko A.I. 1998

Kabazi V: Assemblages from selected levels. In *The Paleolithic of Crimea: The Middle Paleolithic of Western Crimea*, vol. 1 (84). Liège: Université de Liège, pp. 287–322.

Zamyatnin S.N. 1934

Itogi poslednikh issledovaniy Ilskogo paleoliticheskogo mestonakhozhdeniya. In *Trudy II Mezhdunarodnoy konferentsii Assotsiatsii po izucheniyu chetvertichnogo perioda Yevropy*, iss. V. Leningrad, Moscow: Gos. nauch.-tekhn. gornogeol. -neft. izd., pp. 207–218.

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A.A. Anoikin[1, 2], G.D. Pavlenok[1], V.M. Kharevich[1], N.A. Kulik[1], and Z.K. Taimagambetov[3]

[1]*Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia*
E-mail: anui1@yandex.ru; lukianovagalina@yandex.ru; mihalich84@mail.ru; kuliknatart@mail.ru
[2]*Novosibirsk State University, Pirogova 1, Novosibirsk, 630090, Russia*
[3]*National Museum of the Republic of Kazakhstan, Pr. Tauelsizdik 54, Nur-Sultan, 010000, Kazakhstan*
E-mail: zhaken.taimagambetov@gmail.com

Shulbinka Paleolithic Site, Eastern Kazakhstan, Revisited

This study revises the cultural and chronological attribution of the Shulbinka site, Eastern Kazakhstan, with reference to recent ideas of the Early Upper Paleolithic in northern Central Asia, including new sites dating to that stage (Tolbor-21, Ushbulak, etc.) and a representative series of absolute dates relevant to the site's chronology. We describe the discovery of the site and principal findings of excavations carried out more than 20 years ago, focusing on the comprehensive analysis of artifacts from Shulbinka, conducted in 2019. We demonstrate that the estimated age and the cultural attribution of the site disagree with earlier interpretations. Earlier claims about the presence of Levallois and Mousterian components in the primary reduction system appear poorly supported. The idea that artifacts from the site resemble those of the Early Upper Paleolithic is subjected to a critical inquiry. As it turns out, the closest parallels to this assemblage are found among the Final Upper Paleolithic industries of southern and central Siberia. Important traits include the combination of large cores for making flakes, blades with edge-faceted and wedge-shaped microcores, and the predominance of end-scrapers and chisel-like tools. Few parallels can be found with industries of different cultural and chronological periods. Based on these analyses, we conclude that the site of Shulbinka dates to the Final Paleolithic. The absence of Final Middle Paleolithic or Early Upper Paleolithic markers makes the site irrelevant to debates around the origin of the Upper Paleolithic in the region.

Keywords: *Central Asia, Kazakhstan, Middle Paleolithic, Upper Paleolithic, lithic industry, chronology.*

Introduction

For a long time, the territory of Kazakhstan (with the exception of its southern piedmont region) remained extremely poor in terms of the presence of stratified Paleolithic sites. The harsh continental and highly arid climate hinders the long-term accumulation of soft sediments in the region, which significantly reduces the likelihood of the preservation of archaeological materials *in situ*. In the southern part of Kazakhstan, several multilayered Late Pleistocene sites have been discovered (Maibulak, Chokan Valikhanov, etc.); although well-stratified sites with Upper Paleolithic assemblages are quite few in the central and northern part of the country (Taimagambetov, Ozhereliev, 2009). As compared to northern Kazakhstan, the Russian Altai contains many more stratified Paleolithic sites, including those dated to the MUP transition period. These provide valuable information on the evolution of lithic industries in the region (Denisova Cave, Kara-Bom, Ust-Karakol-1, etc.) (Derevianko, Petrin, Rybin, 2000; Prirodnaya sreda…, 2003; Shunkov, Kozlikin, Derevianko, 2020). Until recently, Shulbinka—located in the Middle Irtysh—was regarded as the only multilayered site in the eastern Kazakhstan (Petrin, Taimagambetov, 2000). However, since 2015, dozens of sites with Paleolithic artifacts collected from the surface, as well as the stratified Stone Age sites of Ushbulak and Karasai, have also been found in this region (Anoikin et al., 2019). The Ushbulak materials appear to date to various Upper Paleolithic periods, including the initial stage providing new insights into the origins of the Upper Paleolithic industries in this part of Central Asia (Ibid.). Among sites of this region, Shulbinka archaeological materials are of particular interest, because alongside with the Early Upper Paleolithic complex, a Middle Paleolithic component was also identified at the site. Shulbinka is located much further north, and closer to the Russian Altai, than Ushbulak, making it a connecting link between regions with Early Upper Paleolithic industries located at a distance of 600 km from one another. Shulbinka also appears to have been the westernmost point in the dispersal of these industries. Nonetheless, the cultural attribution and chronological estimates for this site have been repeatedly changed since the discovery of the site in 1981. The significance of this site necessitates revisitation of Shulbinka archaeological materials first described 20 years ago, in order to reanalyze these with the aid of modern techniques.

History of study

Shulbinka was discovered in 1981 by the Paleolithic Party of the Shulbinka Archaeological Expedition of the Institute of History, Archaeology and Ethnography of the Academy of Sciences of the Kazakh SSR; the excavations were headed by Z.K. Taimagambetov (1981).

The site was located on an estuarial promontory, on the right-side bank of the Shulbinka River (right tributary of the Irtysh), in the flood zone of the Shulbinka hydroelectric plant, Novoshulbinsky District of the Semipalatinsk Region (currently, Borodulikhinsky District of the Eastern Kazakhstan Region) (Fig. 1). The site was located on a 35–40-meter rocky ledge composed mainly of chert and covered by a 1 m thick layer of soft sediments (Fig. 2). During fieldwork in 1981–1983, the total excavation area reached 1000 m^2 and yielded about 5000 artifacts, including surface finds (Taimagambetov, Ozhereliev, 2009).

The composite stratigraphic column of the site is described as follows (from top to bottom) (Taimagambetov, 1981; Petrin, Taimagambetov, 2000):

1. Humic layer of light loam, with distinguishable sod. Thickness up to 0.6 m. The boundary contact with the underlying layer is uneven; it is established only through color differences.

2. Loose and light yellow loam, with isolated lenses of sand and pebbles. Thickness up to 0.4 m. The contact with the underlying layer is poorly defined.

3. Yellow, coarse-grained sand, with isolated lenses of pebbles. In some portions, the layer consists exclusively of pebbles. Thickness 0.15 m. This layer overlies the bedrock.

The layers stretch sub-horizontally, with the minimal inclination of 1–2° in the eastern and southern direction (towards the Shulbinka and Irtysh riverbeds). Layer 2 wedges out from the northwest to southeast, with the total thickness of the section decreasing in this direction. In the eastern part of the excavation, layer 1 mixes with sediments of layer 2; their total thickness is about 0.1 m.

Excavations were carried out using reference levels, 0.2 m in thickness. The sediments were not washed or sieved. Archaeological materials were recorded in layer 1 (cultural horizon (hereinafter, horizon) 1) and 2 (horizons 2 and 3); artifacts were also collected from all over the surface of the excavation site and beyond it.

In the course of preliminary analysis of the materials, all the artifacts were considered a single archaeological complex attributable to the Final Upper Paleolithic (13–12 ka BP). The age was assessed on the

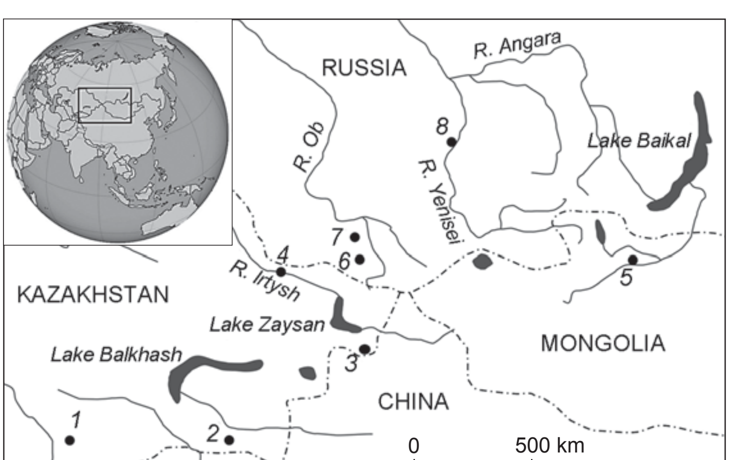

Fig. 1. Sites of the Upper Paleolithic-Mesolithic in Kazakhstan and contiguous regions.
1 – Chokan Valikhanov; *2* – Maybulak; *3* – Ushbulak; *4* – Shulbinka; *5* –Tolbor-4, -21; *6* – Kara-Bom; *7* – Ust-Karakol-1, Anui-2; *8* – Kokorevo-1.

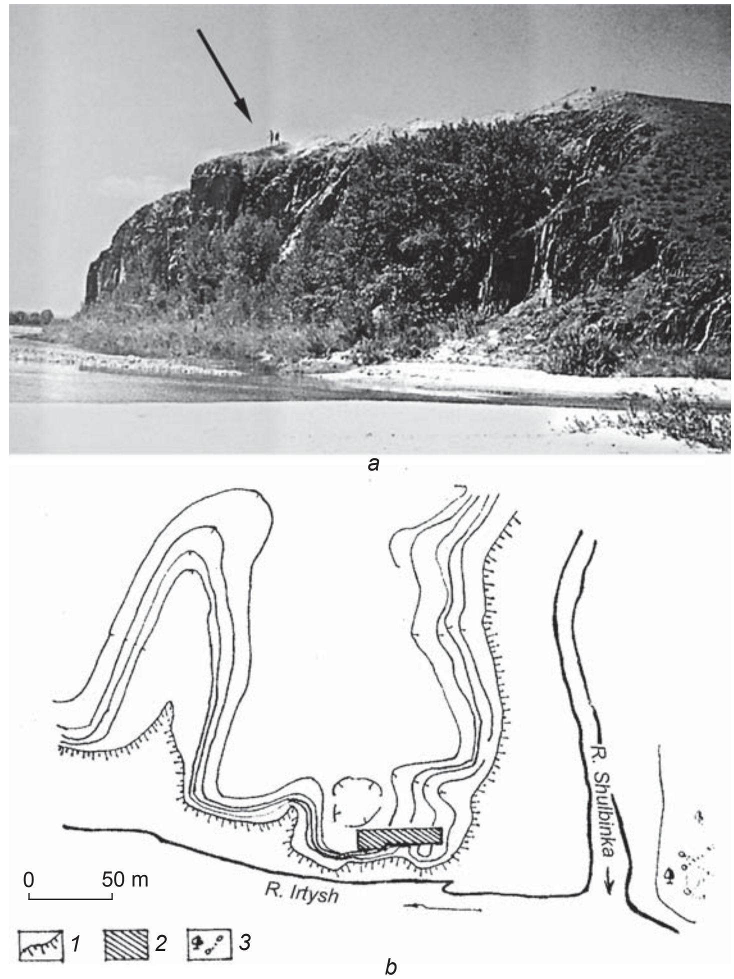

Fig. 2. Eastern view on the site of Shulbinka (*a*), and plan of the site (*b*) (after (Petrin, Taimagambetov, 2000)).
1 – precipice; *2* – excavation area; *3* – wood and bushes.

basis of geomorphological position of the site, its stratigraphy, and the types of tools identified. Possible minor admixture of the Early Holocene (Neolithic) materials was recorded to be associated with layer 1 (upper portion). A burial without grave goods was also located in the sand lens immediately under the sod, at the edge of the rocky ledge (Taimagambetov, 1981).

Later, Taimagambetov, the excavator of the site, hypothesized the presence of two mixed, non-contemporaneous lithic complexes attributable to the initial and terminal Upper Paleolithic, and showing parallels with the materials from contemporaneous sites in southern Siberia (Srostki site, Kokorevo I, and Tolbaga) (Taimagambetov, 1983, 1987).

The most detailed analysis of the Shulbinka lithic industry was provided in the monograph by V.T. Petrin and Z.K. Taimagambetov (2000). The authors argued that Shulbinka served as a repeatedly visited short-term camp-workshop where the entire sequence of operations took place. On the basis of the features of lithic inventory, the scholars identified three intermixed assemblages, dating to the terminal Middle Paleolithic (Mousterian), Early Upper Paleolithic, and Early Holocene. The authors of the monograph noted that the proposed classification of the lithic collection by technical-typological features was "somewhat conventional" (Ibid.: 30). The complexes were distinguished by the presence of core-like shapes and typologically distinct tools. However, the main assemblage of artifacts (flakes and blades, including technical ones; production waste; and "multi-purpose" tool types) was not subjected to analysis.

The Middle Paleolithic complex at Shulbinka included all the cores classified as Levallois (mostly blade cores); along with points, and the majority of side-scrapers made on flakes. Small amount of large and broad blades were also included in this grouping.

The Early Upper Paleolithic complex included parallel blade cores and the tools of the Upper Paleolithic types: end-scrapers, chisel-like tools, and a few burins and borers. Heavily retouched side-scrapers on blades and heavily retouched blades were also included into this group.

Finally, the Early Holocene complex consisted of edge-faceted cores for production of small blades and microblades, microblades and tools made on them, and micro end-scrapers.

The common set of raw materials used in all the established complexes and their industrial continuity were noted (Ibid.).

The proposed interpretation of the Shulbinka archaeological complexes was widely popular in the scientific literature; all the subsequent researchers of the Shulbinka materials adhered to this interpretation (Taimagambetov, Ozhereliev, 2009; Morimoto et al., 2019).

Results of 2019 research

In October 2019, the authors of this paper made an attempt to revise the existing interpretations on the basis of attribute analysis of the entire collection of artifacts from the site. Unfortunately, after filling the Shulbinka reservoir in 1989, the site is today under water. Today, the only available source of information about Shulbinka is the collection of artifacts recovered in 1981–1983 and the field reports on the excavations (Taimagambetov, 1981). Scarce anthropological and faunal remains, together with other organic materials from the initial excavations, are missing. The lithic assemblage is kept at the Paleolithic Museum of Kazakhstan of the Al-Farabi Kazakh National University (Alma-Ata). The collection consists of 3337 items, which is 81 % of the total number of artifacts referred to in the monograph by Petrin and Taimagambetov (2000). During the period of collection storage, some catalogue numbers on artifacts disappeared.

It was impossible to correlate the non-catalogued artifacts with a particular cultural horizon; therefore, all the unidentifiable items, mainly small artifacts (including tools and cores) not exceeding 3 cm, were attributed as likely surface finds. In 2019, the collection was subjected to comprehensive analysis.

Petrographic analysis

About 70 % of the total number of cores and ~35 % of spalls from Shulbinka retain residual pebble cortex. This cortex reveals the alluvial origin of the lithic raw material. The petrographic composition of the pebbles is therefore determined by the composition of alluvium from numerous tributaries joining the Irtysh downstream the city of Ust-Kamenogorsk, forming the drainage system of the vast territory of Rudny Altai, Kalba-Narym, and Chara zones (Geologiya SSSR…, 1967: 213–234).

Despite the great variety of pebble types at the raw material site al-Q_1, the rocks for tool manufacture appear to have been selected according to significant petrographic features, including high hardness (H = 6-6.5-7 in Mohs' scale) and fine-grained or cryptocrystalline structure with massive texture. For stone knapping, mostly siliceous and highly siliceous sedimentary rocks were used: these included siliceous mudstones, cherts, and chalcenolites. Artifacts made of these rocks compose over 70 % of the collection. Porphyritic effusive rocks and quartz varieties, including chalcedony and rock crystal, are less common.

In sum, only local, specially selected raw materials obtained in the Early Quaternary alluvium of the Irtysh and its tributaries were used in artifact production.

Study of archaeological materials

Cultural horizon 3. In 2019, the total archaeological collection from this component contained 752 items (44.5 % of the number indicated in the Petrin's and Taimagambetov's monograph (2000)), including 73 cores and 215 tools (Table 1). The primary reduction assemblage from this layer is dominated by flat-parallel unidirectional flaking (~45 % of the total number of cores) (Fig. 3, *5*). There also cores showing bidirectional knapping, aimed at blade production (Fig. 3, *4*), radial knapping for flake production; small edge-faceted cores for making blades; and microcores for making bladelets and microblades (Fig. 4, *4*; 5). A few orthogonal and sub-prismatic cores were also identified. The collection contains a large number of core-like fragments (Table 2).

The category of spalls is dominated by primary and secondary flakes (over 50 % of the total number of technical spalls), as well as natural cortex removals. Among rejuvenation and modification-related spalls (ridge- and half-ridge flakes, plunging flakes, rejuvenations of platform and flaking arch), the proportion of elongated artifacts is about 50 % (see Table 1).

The spalls assemblage includes blades, bladelets, and flakes (see Table 1). The majority of elongated removals show longitudinal parallel flaking pattern on the dorsal face (Table 3). Evidence for preparation of the flaking surface was recorded on 65 % of laminar spalls, representing both reverse (~60 %) and direct (~30 %) reduction. More than a half of the identifiable striking platforms are smooth; the proportions of the punctiform and dihedral platforms are almost equal (Table 4).

The flakes mostly exhibit longitudinal or longitudinal-transversal faceting and smooth, or, more rarely, natural and dihedral striking platforms (see Table 3, 4). Signs of the flaking surface preparation through direct and reverse reduction were recorded on less than a half of the spalls.

The share of informal tools (blades and flakes with irregular retouch) is about 1/3 of the total number. The category of typologically distinct tools is dominated by end-scrapers (Table 5). These are end-scrapers made on flakes, including thumbnail ones (Fig. 6, *5*) and those with traces of treatment along the perimeter (Fig. 6, *8*). End-scrapers made on blades are few (Fig. 6, *13*). Chisel-like tools and side-scrapers are represented by roughly equal shares. Chisel-like tools are mainly small, flat, and sub-rectangular; with one or two (opposite) cutting edges (see Fig. 6, *3*). Side-scrapers are mostly single-edged longitudinal, more rarely double-edged (see Fig. 5, *4*).

The layer also yielded bifacial tools (see Fig. 5, *2*), pebble tools—side-scrapers (see Fig. 5, *7*), planing tools (see Fig. 5, *6*), as well as similar unifacial tools. Pointed forms are rare; these include retouched convergent lamellar blanks (see Fig. 5, *3*). Burins are also scarce (see Fig. 6, *15*), with all of them being angle varieties. Spurs, notches, and knives (see Fig. 5, *5*) are also not numerous.

Cultural horizon 2. The archaeological collection from this layer contained 681 items when revisited for analysis (85.6 % of the number indicated in the Petrin's and Taimagambetov's monograph (2000)), including 21 cores and 103 tools. The primary reduction strategy appears to have been based on the same techniques as

Table 1. **Composition of Shulbinka lithic industries**

Category/group	Horizon 3		Horizon 2		Horizon 1		Surface collection		Total	
	spec.	%	spec.	%	spec.	%	spec.	%	spec.	%
Pebbles	3	*0.4*	6	*0.9*	–	–	8	*0.5*	17	*0.5*
Split pebbles	53	*7.0*	13	*1.9*	12	*4.9*	25	*1.5*	103	*3.1*
Core-like artifacts:	126	*16.8*	40	*5.9*	24	*9.7*	33	*2.0*	223	*6.7*
cores	73	*9.7*	30	*4.4*	24	*9.7*	19	*1.1*	146	*4.4*
core-like fragments	53	*7.0*	10	*1.5*	–	–	14	*0.8*	77	*2.3*
Technical spalls:	156	*20.7*	154	*22.6*	50	*20.2*	183	*11.0*	543	*16.3*
primary	31	*4.1*	40	*5.9*	6	*2.4*	18	*1.1*	95	*2.8*
secondary	53	*7.0*	72	*10.6*	7	*2.8*	42	*2.5*	174	*5.2*
rejuvenations of the flaking arch	4	*0.5*	2	*0.3*	1	*0.4*	–	–	7	0.2
rejuvenations of the flaking surface	1	*0.1*	4	*0.6*	–	–	–	–	5	*0.1*
ridge	3	*0.4*	–	–	3	*1.2*	6	*0.4*	12	*0.4*
half-ridge	16	*2.1*	8	*1.2*	6	*2.4*	22	*1.3*	52	*1.6*
natural marginal	23	*3.1*	12	*1.8*	18	*7.3*	52	*3.1*	105	*3.1*
marginal	10	*1.3*	11	*1.6*	7	*2.8*	42	*2.5*	70	*2.1*
rejuvenations of the striking platform	13	*1.7*	3	*0.4*	1	*0.4*	1	*0.1*	18	*0.5*
plunging	2	*0.3*	2	*0.3*	1	*0.4*	–	–	5	*0.1*
Blades (width, mm):	81	*10.8*	84	*12.3*	17	*6.9*	71	*4.3*	253	*7.6*
40–59	17	*2.3*	3	*0.4*	–	–	2	*0.1*	22	*0.7*
20–39	51	*6.8*	63	*9.3*	10	*4.0*	32	*1.9*	156	*4.7*
12–19	13	*1.7*	18	*2.6*	7	*2.8*	37	*2.2*	75	*2.2*
Bladelets	1	*0.1*	5	*0.7*	3	*1.2*	28	*1.7*	37	*1.1*
Microblades	–	–	3	*0.4*	–	–	5	*0.3*	8	*0.2*
Laminar flakes (length, mm):	38	*5.1*	28	*4.1*	20	*8.1*	117	*7.1*	203	*6.1*
large (≥ 50)	24	*3.2*	13	*1.9*	5	*2.0*	14	*0.8*	56	*1.7*
medium-sized (30–49)	10	*1.3*	14	*2.1*	10	*4.0*	54	*3.3*	88	*2.6*
small (≤ 29)	4	*0.5*	1	*0.1*	5	*2.0*	49	*3.0*	59	*1.8*
Flakes (mm):	183	*24.3*	192	*28.2*	61	*24.7*	600	*36.2*	1 036	*31.0*
large (≥ 50)	64	*8.5*	38	*5.6*	9	*3.6*	19	*1.1*	130	*3.9*
medium-sized (30–49)	96	*12.8*	103	*15.1*	28	*11.3*	110	*6.6*	337	10.1
small (≤ 29)	23	*3.1*	51	*7.5*	24	*9.7*	471	*28.4*	569	*17.1*
Shatters, fragments	111	*14.8*	150	*22.0*	60	*24.3*	587	*35.4*	908	*27.2*
Chips	–	–	4	*0.6*	–	–	–	–	4	*0.1*
Total	752	100	681	100	247	100	1657	100	3 337	100

those identified in horizon 3 (see Fig. 3, *2*, *3*). The most significant differences are the absence of bipolar cores for making laminar blanks in this component, and the high proportion of edge-faceted cores for making blades and microcores (see Table 2; Fig. 4, *1*).

Types and proportions of technical spalls basically coincide with those established for horizon 3 (see Table 1).

The spall assemblage includes microblades, which are absent in the underlying horizon (see Table 1). Elongated spalls show parallel longitudinal and bidirectional faceting of dorsal surface (see Table 3). In terms of the flaking surface preparation, the collections of the two horizons are similar. The striking platforms are mainly smooth, more rarely dihedral (see Table 4).

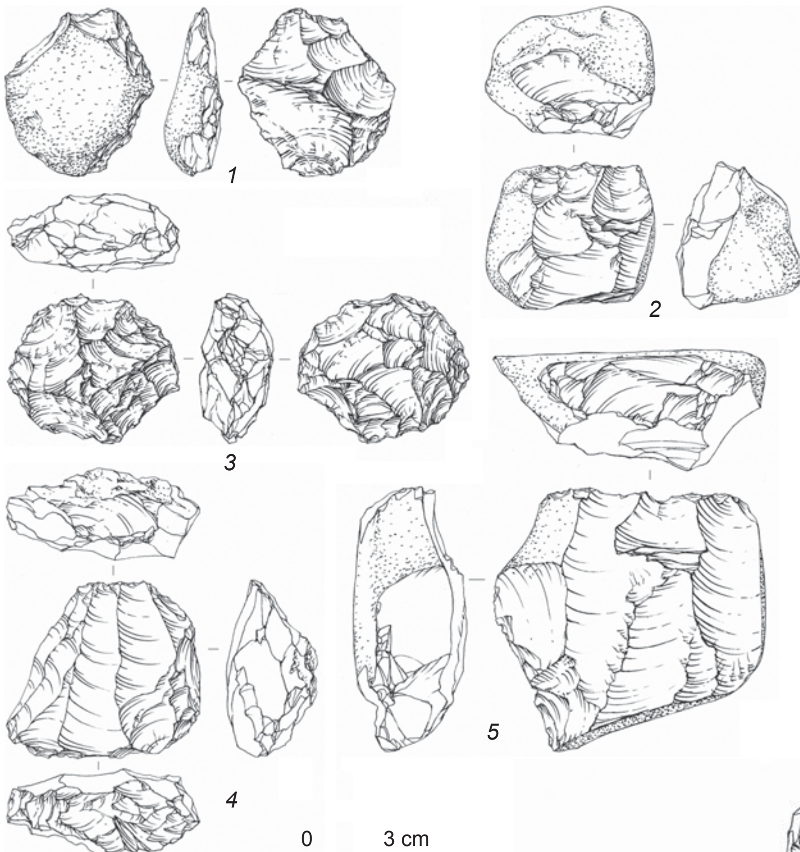

Fig. 3. Cores for making large spalls from Shulbinka cultural horizons 1 (*1*), 2 (*2*, *3*), and 3 (*4*, *5*).

The flakes from this layer show mainly longitudinal or longitudinal-transversal faceting and smooth striking platforms (see Table 3, 4). Flaking surface preparation was executed in the same way as during the accumulation of horizon 3.

The proportion of informal tools in the tool kit is about 1/3. The category of typologically distinct tools is dominated by end-scrapers (see Fig. 6, *6*, *10*), represented by the same types as in the collection from horizon 3 (see Table 5). The proportion of chisel-like tools (see Fig. 6, *12*) and side-scrapers, including two convergent forms, increases in horizon 2. Chisel-like tools in horizon 2 are more diverse than in horizon 3; some tools show four cutting edges in this layer.

The collection includes a small fragment of a biface (see Fig. 6, *1*). Among pebble tools, the portion represented by side-scrapers (see Fig. 5, *1*, *7*, *8*) is higher than in horizon 3. Burins (see Fig. 6, *9*) are diverse but few, similarly to horizon 3. Other forms, such as points (see Fig. 6, *11*), spurs (see Fig. 6, *14*), and notches are quite scarce and similar to the collection from horizon 3.

Cultural horizon 1. The archaeological collection contained 247 items during reanalysis (72.9 % of the number indicated in the Petrin's and Taimagambetov's monograph (2000)), including 23 cores and 48 tools. The primary reduction strategy for this level was based on the same techniques as those identified in horizons 2 and 3 (see Fig. 3, *1*; 4, *2*, *3*). The main difference is that horizon 1 did not yield edge-

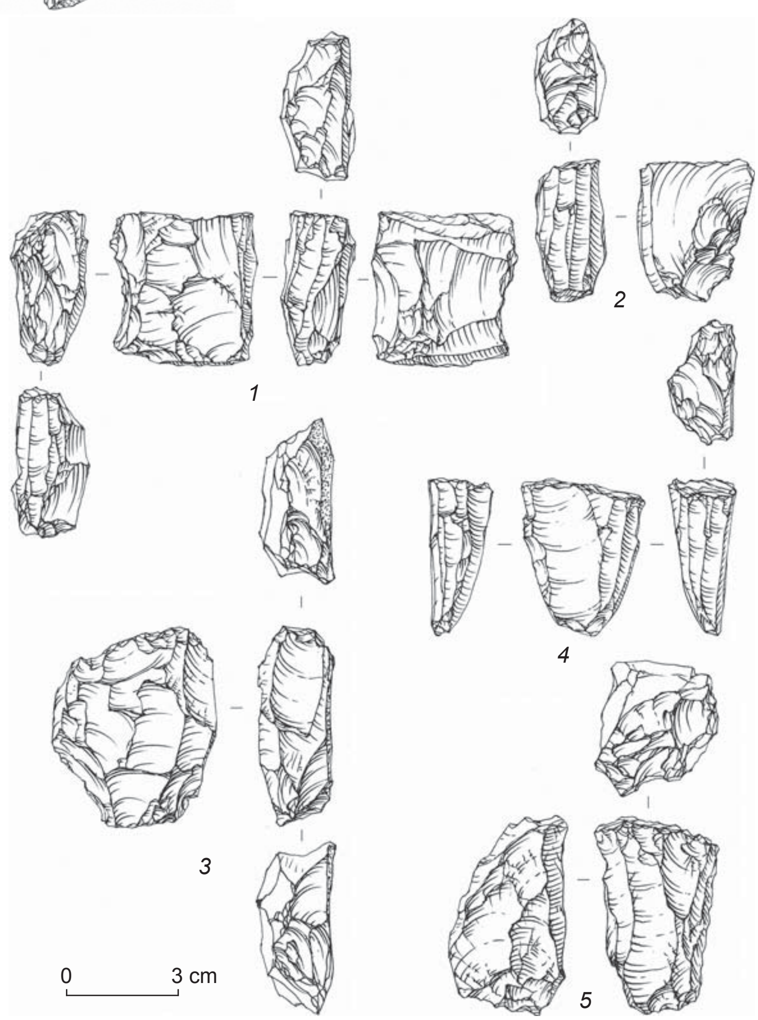

Fig. 4. Cores for making bladelets and microblades from Shulbinka cultural horizons 2 (*1*), 1 (*2*, *3*), and 3 (*4*, *5*).

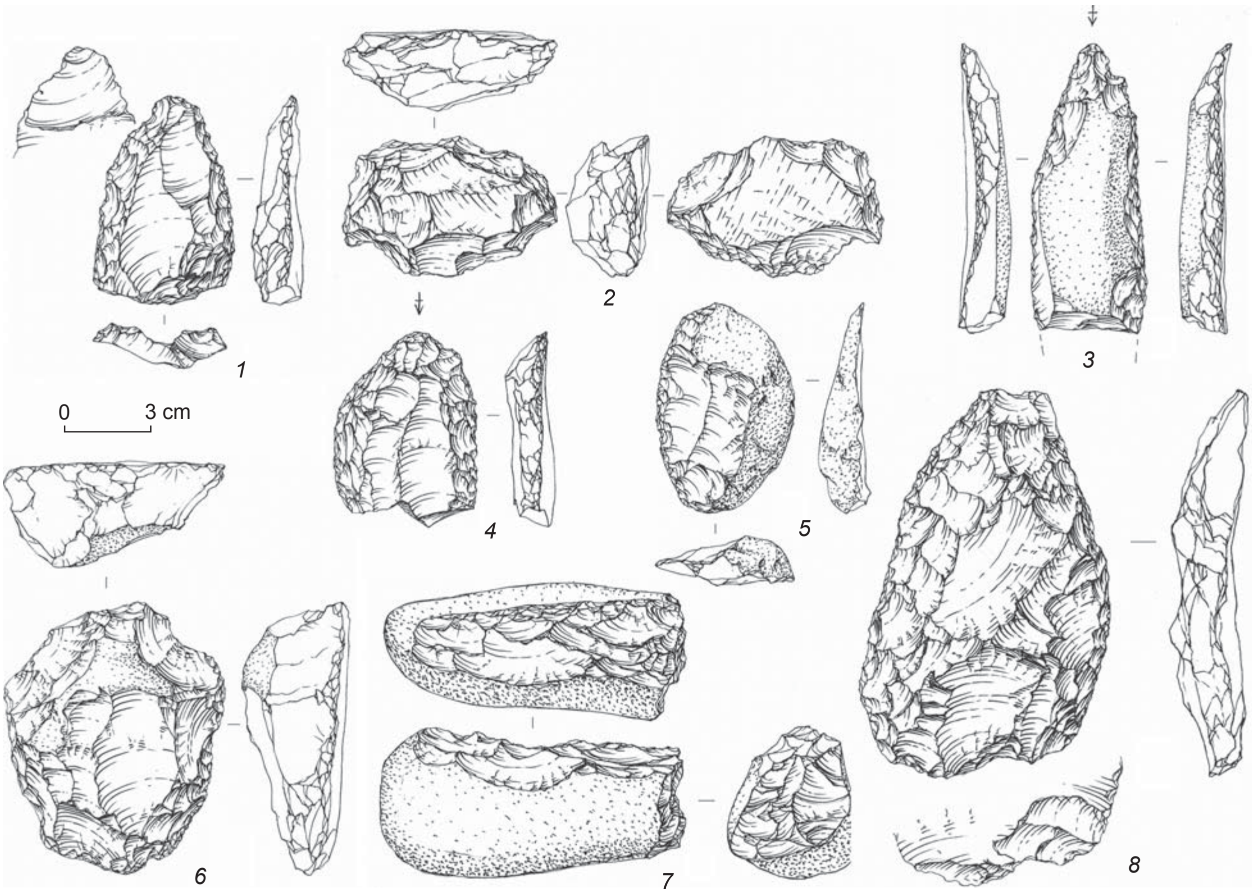

Fig. 5. Tools from Shulbinka cultural horizons 2 (*1*, *7*, *8*) and 3 (*2–6*).

Table 2. **Core-like forms in Shulbinka lithic industries**

Core type	Horizon 3	Horizon 2	Horizon 1	Surface collection	Total	
	spec.	spec.	spec.	spec.	spec.	%
1	2	3	4	5	6	7
Flat-parallel	45	14	12	3	74	57.8
Including:						
Unidirectional:	32	9	10	3	54	42.2
single-platform with one flaking surface for making flakes	15	3	6	3	27	21.1
single-platform with one flaking surface for making blades and flakes	14	2	4	–	20	15.6
single-platform with one flaking surface for making bladelets	–	3	–	–	3	2.3
single-platform with two flaking surfaces for making flakes	2	1	–	–	3	2.3
single-platform with three flaking surfaces for making blades	1	–	–	–	1	0.8
Bidirectional flaking:	9	4	1	–	14	10.9
double-platform with one flaking surface for making flakes	–	2	1	–	3	2.3

Table 2 (end)

1	2	3	4	5	6	7
double-platform with one flaking surface for making blades	8	–	–	–	8	6.3
double-platform with two flaking surfaces for making flakes	–	1	–	–	1	0.8
double-platform with two flaking surfaces for making blades	1	1	–	–	2	1.6
Orthogonal:	4	1	1	–	6	4.7
double-platform with one flaking surface for making flakes	3	–	–	–	3	2.3
double-platform with two flaking surfaces for making flakes	–	1	1	–	2	1.6
triple-platform with one flaking surface for making flakes	1	–	–	–	1	0.8
Radial:	9	4	4	2	19	14.8
single-platform	7	3	2	1	13	10.2
double-platform	2	1	–	–	3	2.3
exhausted	–	–	2	1	3	2.3
Edge-faceted:	3	3	–	5	11	8.6
single-platform with one flaking surface for making blades	2	1	–	1	4	3.1
single-platform with one flaking surface for making bladelets	–	–	–	2	2	1.6
double-platform with one flaking surface for making bladelets	–	2	–	1	3	2.3
combination, single-platform with two flaking surfaces for making bladelets	1	–	–	1	2	1.6
Sub-prismatic:	1	–	–	–	1	0.8
single-platform with one flaking surface for making blades	1	–	–	–	1	0.8
Microcores	7	7	5	4	23	18.0
Including:						
Edge-faceted:	6	7	4	1	18	14.1
single-platform with one flaking surface for making microblades	2	6	3	–	11	8.6
single-platform with two flaking surfaces for making microblades	1	–	1	–	2	1.6
double-platform with one flaking surface for making microblades	2	–	–	–	2	1.6
double-platform with two flaking surfaces for making microblades	–	1	–	1	2	1.6
combination, single-platform with two flaking surfaces for making microblades	1	–	–	–	1	0.8
Prismatic:	–	–	1	–	1	0.8
single-platform with one flaking surface for making microblades	–	–	1	–	1	0.8
Exhausted, for making microblades	1	–	–	3	4	3.1
Amorphous	8	2	3	5	18	–
Core-like fragments	53	10	–	14	77	–
Total	126	40	24	33	223	100

Table 3. **Distribution of blank spalls by patterns of dorsal faceting in Shulbinka lithic industries, spec.**

Faceting pattern	Cultural horizon												Surface collection				Sub-total				Total	
	3				2				1													
	Blades	Laminar flakes	Technical spalls	Flakes	Blades	Laminar flakes	Technical spalls	Flakes	Blades	Laminar flakes	Technical spalls	Flakes	Blades	Laminar flakes	Technical spalls	Flakes	Blades	Laminar flakes	Technical spalls	Flakes	spec.	%
Natural	–	–	41	–	–	–	44	–	1	–	6	–	1	1	18	1	2	1	109	1	*113*	*5,4*
Smooth	–	–	–	12	–	–	2	12	–	–	–	1	–	–	–	8	–	–	2	33	*35*	*1,7*
Parallel and sub-parallel unidirectional	70	31	56	99	73	18	68	95	12	8	25	28	92	85	91	153	247	142	240	375	*1004*	*48,3*
Parallel and sub-parallel bidirectional	10	6	5	9	18	6	3	7	4	4	4	6	9	13	13	18	41	29	25	40	*135*	*6,5*
Longitudinal-transversal	2	1	42	45	1	1	28	53	3	8	10	15	2	6	42	50	8	16	122	163	*309*	*14,9*
Transversal	–	–	9	5	–	–	4	8	–	–	3	3	–	–	10	13	–	–	26	29	*55*	*2,6*
Irregular	–	–	3	13	–	3	5	17	–	–	2	8	–	12	9	357	–	15	19	395	429	20,6
Total	82	38	156	183	92	28	154	192	20	20	50	61	104	117	183	600	298	203	543	1036	*2080*	*100*

Table 4. **Distribution of blank spalls by patterns of striking platforms preparation in Shulbinka lithic industries, spec.**

Preparation pattern	Cultural horizon												Surface collection				Sub-total				Total	
	3				2				1													
	Blades	Laminar flakes	Technical spalls	Flakes	Blades	Laminar flakes	Technical spalls	Flakes	Blades	Laminar flakes	Technical spalls	Flakes	Blades	Laminar flakes	Technical spalls	Flakes	Blades	Laminar flakes	Technical spalls	Flakes	spec.	%
Natural	3	–	19	11	1	–	15	13	–	–	8	4	–	4	10	13	4	4	52	41	*101*	*9.4*
Smooth	24	10	60	61	28	11	53	74	2	6	17	27	12	21	64	101	66	48	194	263	*571*	*53.2*
Dihedral	10	2	9	13	19	1	9	16	1	3	5	8	11	25	36	79	41	31	59	116	*247*	*23.0*
Faceted	–	1	2	1	–	–	2	–	–	–	–	–	–	–	–	–	–	1	4	1	*6*	*0.6*
Linear/punctiform	8	2	6	6	3	4	7	17	2	1	2	2	8	18	22	41	21	25	37	66	*149*	*13.9*
Total	55	17	105	105	70	17	95	136	6	13	37	49	42	93	168	313	173	140	405	603	*1074*	*100*

Table 5. **Tool types in Shulbinka lithic industries**

Tool type	Cultural horizon						Surface collection		Total	
	3		2		1					
	spec.	%	spec.	%	spec.	%	spec.	%	spec.	%
1	2	3	4	5	6	7	8	9	10	11
Side-scrapers:	23	16.7	14	17.9	2	6.1	9	7.6	*48*	*13.1*
single	17	12.3	7	9.0	1	3.0	5	4.2	*30*	*8.2*
transverse	1	0.7	–	–	–	–	–	–	*1*	*0.3*
diagonal	–	–	1	1.3	–	–	–	–	*1*	*0.3*
double	3	2.2	4	5.1	–	–	–	–	*7*	1.9
double longitudinal-transverse	1	0.7	–	–	–	–	–	–	*1*	*0.3*
convergent	–	–	2	2.6	–	–	3	2.5	*5*	*1.4*
triple	–	–	–	–	1	3.0	1	0.8	*2*	*0.5*
retouched along the perimeter	1	0.7	–	–	–	–	–	–	*1*	*0.3*
End-scrapers:	58	42.0	23	29.5	11	33.3	57	48.3	*149*	*40.6*
end-scrapers on blades	2	1.4	1	1.3	–	–	1	0.8	*4*	*1.1*
end-scrapers on laminar flakes	7	5.1	1	1.3	1	3.0	13	11.0	*22*	*6.0*
end-scrapers on flakes	42	30.4	16	20.5	5	15.2	20	16.9	*83*	*22.6*
end-scrapers on laminar flakes with retouched long sides	–	–	–	–	–	–	9	7.6	*9*	*2.5*
end-scrapers on flakes with retouched long sides	–	–	–	–	–	–	2	1.7	*2*	*0.5*
thumbnail	4	2.9	–	–	–	–	–	–	4	1.1
flake scrapers on laminar flakes	2	1.4	–	–	–	–	1	0.8	*3*	*0.8*
flake scrapers on flakes	–	–	3	3.8	2	6.1	2	1.7	*7*	*1.9*
double end-scrapers on laminar flakes	–	–	–	–	–	–	2	1.7	*2*	*0.5*
double flake scrapers on flakes	–	–	1	1.3	–	–	–	–	*1*	*0.3*
angle on flakes	–	–	–	–	3	9.1	–	–	*3*	*0.8*
retouched along 3/4 of the perimeter, on laminar flakes	–	–	–	–	–	–	2	1.7	*2*	*0.5*
retouched along 3/4 of the perimeter, on flakes	–	–	1	1.3	–	–	3	2.5	*4*	*1.1*
retouched along the perimeter	1	0.7	–	–	–	–	2	1.7	*3*	*0.8*
Points:	2	1.4	1	1.3	1	3.0	2	1.6	*6*	1.6
retouched along the perimeter	1	0.7	1	1.3	1	3.0	1	0.8	*4*	*1.1*
with alternate retouch	1	0.7	–	–	–	–	1	0.8	*2*	*0.5*
Pointed blades with heavy retouch	2	1.4	–	–	–	–	–	–	*2*	*0.5*
Blades with heavy retouch	3	2.2	4	5.1	1	3.0	2	1.7	*10*	*2.7*
Laminar flakes with heavy retouch	–	–	–	–	–	–	4	3.4	*4*	*1.1*
Burins:	4	2.9	4	5.1	2	6.1	–	–	*10*	*2.7*
angle	4	2.9	2	2.6	1	3.0	–	–	*7*	*1.9*
dihedral	–	–	1	1.3	1	3.0	–	–	*2*	*0.5*
flat	–	–	1	1.3	–	–	–	–	*1*	*0.3*
Chisel-like tools:	26	18.8	16	20.5	10	30.3	28	23.7	*80*	*21.8*
single-edged	20	14.5	8	10.3	7	21.2	8	6.8	43	11.7
double-edged	6	4.3	6	7.7	3	9.1	19	16.1	*34*	*9.3*
triple-edged	–	–	1	1.3	–	–	1	0.8	*2*	*0.5*
four-edged	–	–	1	1.3	–	–	–	–	*1*	*0.3*

Table 5 (end)

1	2	3	4	5	6	7	8	9	10	11
Knives with retouched cutting edge	5	3.6	3	3.8	1	3.0	7	5.9	*16*	*4.4*
Bifacial artifacts:	3	2.2	2	2.6	1	3.0	1	0.8	*7*	*1.9*
bifaces	–	–	1	1.3	–	–	–	–	*1*	*0.3*
biface blanks	–	–	–	–	–	–	1	0.8	*1*	*0.3*
with bifacial treatment	3	2.2	1	1.3	1	3.0	–	–	*5*	*1.4*
Unifaces	2	1.4	–	–	1	3.0	–	–	*3*	0.8
Spurs	3	2.2	4	5.1	1	3.0	–	–	*8*	*2.2*
Notches with retouched encoche	1	0.7	–	–	–	–	4	3.4	*5*	*1.4*
Combination tools:	2	1.4	–	–	1	3.0	4	3.4	*7*	*1.9*
end-scraper + side-scraper	2	1.4	–	–	–	–	1	0.8	*3*	*0.8*
end-scraper + chisel-like tool	–	–	–	–	1	3.0	3	2.5	*4*	*1.1*
Pebble tools:	4	2.9	7	9.0	1	3.0	–	–	*12*	*3.3*
side-scrapers	2	1.5	3	3.8	–	–	–	–	*5*	*1.4*
scraper-like tools	1	0.7	2	2.6	–	–	–	-	*3*	*0.8*
planing tools	1	0.7	2	2.6	1	3.0	–	–	*4*	*1.1*
Retouched spalls:	76	–	22	–	12	–	41	–	*151*	–
pointed blades with retouch	–	–	1	–	–	–	1	–	*2*	–
blades with retouch	18	–	7	–	–	–	1	–	*26*	–
laminar flakes with retouch	7	–	1	–	1	–	2	–	*11*	–
flakes with retouch	18	–	4	–	1	–	1	–	*24*	–
shatters and fragments with retouch	4	–	–	–	–	–	2	–	*6*	–
blades with irregular retouch	18	–	6	–	1	–	4	–	*29*	–
laminar flakes with irregular retouch	–	–	–	–	–	–	8	–	*8*	–
flakes with irregular retouch	11	–	3	–	5	–	11	–	*30*	–
shatters and fragments with irregular retouch	–	–	–	–	4	–	11	–	*15*	–
Tool fragments	–	–	3	–	2	–	13	–	*18*	–
Hammerstones	1	–	–	–	–	–	3	–	*4*	–
Total	215	100 (from 138)*	103	100 (from 78)*	47	100 (from 33)*	175	100 (from 118)*	*540*	100 (from 367)*

* In parentheses, the number of tools without unidentifiable forms (retouched shatters and tool fragments) assumed as 100 % is provided.

faceted cores for making blades and core-like fragments (see Table 2).

The types and composition of technical spalls are similar to those in the collection of horizon 2 (see Table 1).

The pattern of dorsal faceting, techniques of ledge rejuvenation, and the frequency of their use in lamellar spall working in horizon 1 coincides neatly with those observed in the underlying horizons (see Table 3). The number of identifiable striking platforms does not constitute a representative sample, however.

The materials from horizon 1 are similar to those from horizon 3 in terms of the pattern of dorsal faceting and striking platform preparation, and to those from horizon 2 in terms of flaking surface preparation (see Table 3, 4).

The proportion of informal tools in the tool kit is ~30 %. The typologically distinct tools from this layer include end-scrapers (see Fig. 6, *2*) and chisel-like tools (see Fig. 6, *4*); these are represented by the same types as in horizons 3 and 2 (see Table 5). As compared to the underlying horizons, horizon 1 yielded far fewer side-scrapers and pebble tools, and far more unifaces. Other forms (burins (see Fig. 6, *7*), spurs, and others), are similar to those from collections of horizons 2 and 3.

Surface finds. The collection of surface finds includes 1657 artifacts (129 % of the number indicated in the Petrin's and Taimagambetov's monograph (2000)), and includes 19 cores and 175 tools (see Table 1). The primary reduction process observed in these artifacts is similar to

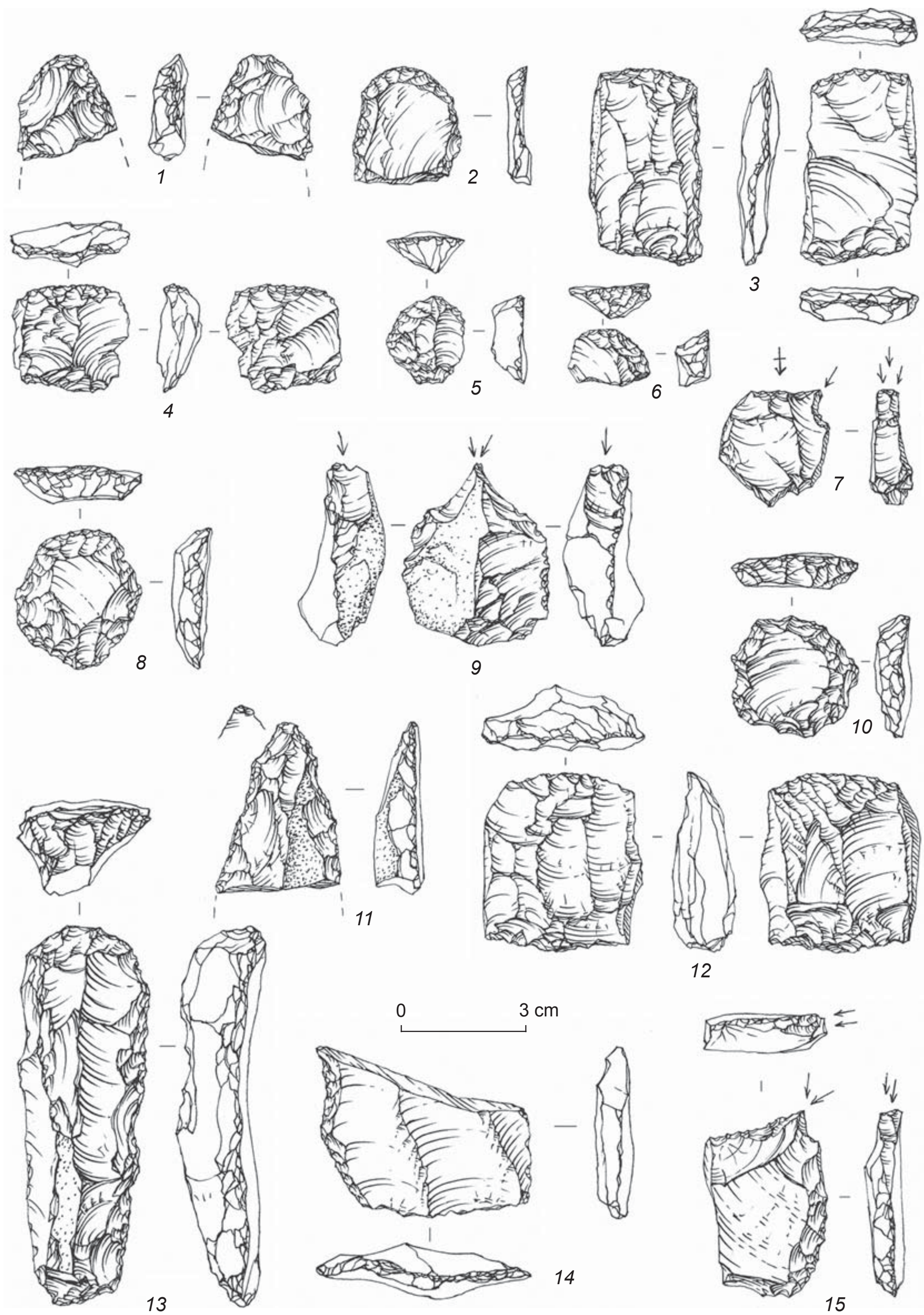

Fig. 6. Tools from Shulbinka cultural horizons 2 (*1*, *6*, *9–12*, *14*), 1 (*2*, *4*, *7*), and 3 (*3*, *5*, *8*, *13*, *15*).

those recovered from the stratified complexes; however, 2/3 of the collection consists of small edge-faceted cores for making blades, and microcores for making bladelets and microblades; while 1/3 of the collection consists of radial and single-platform parallel cores (see Table 2).

Spalls are of the same types as in the collections of horizons 2 and 3, but they are half as frequent in this portion of the assemblage (see Table 1).

The spall assemblage includes blades, bladelets, microblades, and flakes (see Table 1). The dorsal faceting of laminar spalls observed here is the same as in the collection of horizon 3 (see Table 3). The identifiable striking platforms include approximately equal shares of smooth, punctiform, and dihedral platforms (see Table 4). Approximately half of laminar spalls show signs of preparation of flaking surfaces through direct and reverse reduction.

The flakes show mainly longitudinal or longitudinal-transversal faceting and smooth, dihedral, or punctiform striking platforms (see Table 3, 4). Flaking surface preparation, observed on more than half of the flakes, was carried out mostly through direct reduction.

The proportion of informal tools in the tool kit is ~30 %. The typologically distinct tool category is dominated by end-scrapers of the same types as in the collections of other horizons, and by chisel-like tools with two cutting edges (see Table 5). The number of side-scrapers in the assemblage is small: those that we did identify are mostly longitudinal single-edged and convergent. Knives with retouched edges are represented by a small series of artifacts.

Analysis of the obtained results

The main discrepancies between the results of studies conducted in 2019 and earlier work pertain to the analysis of cores. In this category, we have identified numerous radial cores, but no Levallois cores (cf.: (Petrin, Taimagambetov, 2000: Fig. 7, *2*; 10, *2*, *3*)) (see Fig. 3, *1–3*). In earlier analysis, a large number of Levallois cores for blades production were identified in the assemblage, probably owing to the broad interpretation of the term “Levallois” (which attributed all flat cores with signs of preparation, made for serial production of blanks of a special type and shape, to this technique). Our reanalysis shows that such cores were in fact subjected to minor preparation, specifically during the shaping of striking platforms and flaking surfaces. Cores of this type were often used for obtaining blanks of various sizes. The collection does not contain spalls that can be interpreted as final or technical products of the Levallois technique. One noteworthy feature of the assemblage is the small proportion of sophisticated striking platforms, among which faceted platforms are rare. Radial cores show centripetal faceting of working surfaces and can be regarded as the flake Levallois forms (see Fig. 3, *1–3*). However, the central convexity of their flaking surfaces is not high and does not suggest that they were used for removing a single target spall. Circular flaking on these artifacts was not preparatory, but systematic, resulting in series of large target spalls. The collection includes some cores with two flaking faces (see Fig. 3, *4*), which were utilized in the same way. This would be impossible if the Levallois technique was used, because the Levallois technique implies flaking of only one surface to get the target blanks.

The technical-typological analysis of the collection has shown almost complete uniformity between artifacts from all the horizons, and those from the surface. Comparison of metrical features of core-like artifacts (n=349) from various horizons also fails to show significant distinctions. A particularly indicative consideration is the even distribution over the horizons of products differing in width (Fig. 7). The homogeneity of the archaeological materials from all horizons is further supported by the distribution of spalls of different types over horizons (n=1210, without technical spalls and debitage) (Fig. 8). The parameters of various spall types across the four assemblages are very close, often identical.

A significant proportion of artifacts with missing catalogue numbers most likely originated within horizon 3, because the number of the available artifacts in this group during reanalysis was considerably smaller than in the 2000 records (Petrin, Taimagambetov, 2000). With this in mind, and taking into account that catalogue numbers usually didn’t survive on the smallest items, the collection of horizon 3 may include more microcores, small tools, small spalls, and microblades than originally calculated. In this case, the proportions of these categories in the collections of all the discussed horizons would be almost identical. In our viewpoint, the Shulbinka site should be understood as a single culture-chronological Upper Paleolithic complex, possibly with minor inclusions of the Early Holocene (Neolithic) artifacts coming from the roof of the humic layer, or from areas of Pleistocene deposits; for instance, in the burial zone (see (Taimagambetov, 1981)).

Analysis of stratigraphy and planigraphy of the site also provides nothing to contradict this interpretation (Ibid.; Petrin, Taimagambetov, 2000). The general description of the site profile suggests that most of archaeological finds attributed to layer 1 were deposited near the bottom or in the lenses of light yellow loam corresponding to the sediments of layer 2 (“there is a small interlayer of yellow loam (in layer 1), where lithic artifacts are concentrated in grid Д-К/32-41” (Petrin, Taimagambetov, 2000: 5)). This absence of a clear boundary between layers 1 and 2 and analysis of spatial distribution of the artifacts over the horizons supports the idea of a single cultural horizon. Indeed, when plans of the horizons are superimposed, it can be seen that the accumulations of finds at one level correspond to gaps at the other; in particular, the artifacts are concentrated in the household zone around the hearth in horizon 2. The only place where the artifacts of horizon 3 overlap those in other horizons, is the central zone of western section of the excavation area, which is characterized by the greatest thickness of culture-bearing deposits (Fig. 9).

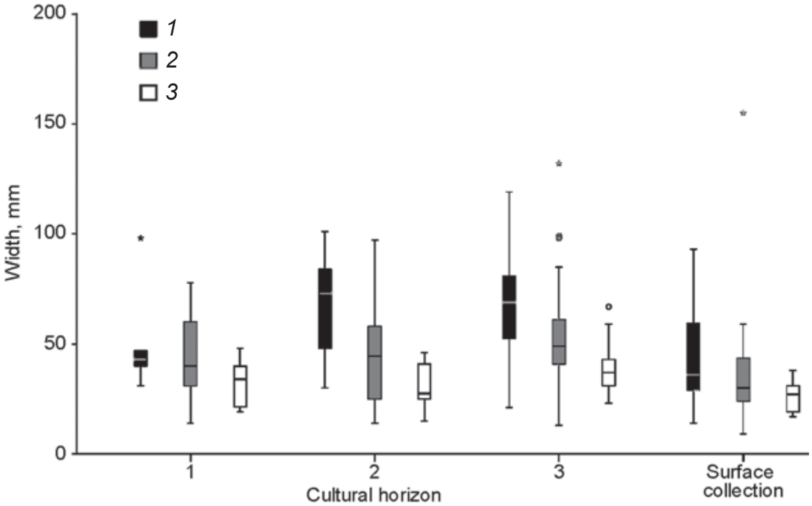

Fig. 7. Width distribution of the core-like artifacts from various horizons and surface collection at Shulbinka.
1 – split pebble; *2* – core; *3* – core-like fragment.

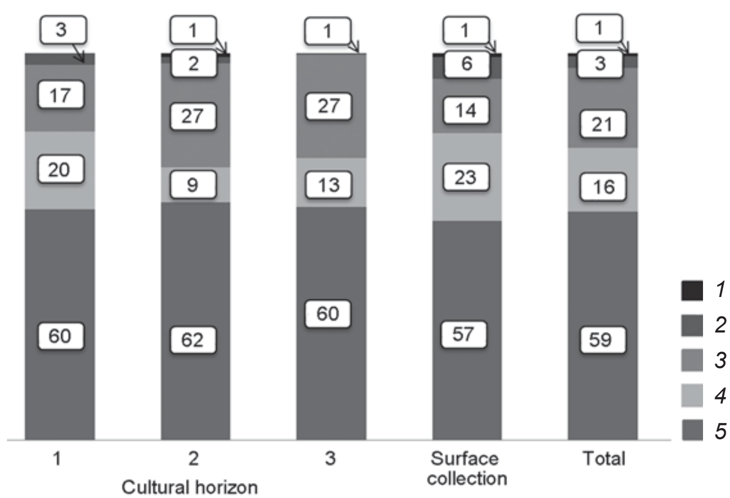

Fig. 8. Percentages of blank spalls from various horizons and surface collection at Shulbinka.
1 – microblade; *2* – bladelet; *3* – blade; *4* – laminar flake; *5* – flake.

Arguments for an early age for some portion of the Shulbinka collection were also based on the geological features of the site. For example, Petrin and Taimagambetov (2000) argued that layer 3 was formed along with the sediments of the Irtysh terrace III, while the yellow loam (layer 2) was accumulated during the Ror Formation of the late MIS 4. Correlation of the sediments of layer 2 to the Novoshulbinka formation (MIS 3) was regarded as less likely, mainly because of the high position of the site over the Irtysh water level; since "the Novoshulbinka formation is associated with the second terrace above the flood plain" (Ibid.: 5). This argumentation raises a number of questions, however. First, the site was discovered on the rock ledge rather than on the terrace; the height of this ledge was not determined by the activity of the river, and cannot be directly related to its terrace levels. Second, in the Irtysh valley near the site, the deposits of the Ror Formation, which are represented by meters of thick strata, were revealed only to the east of the Shulbinka riverbed (Matsuy et al., 1973). At Shulbinka, local geology was formed by the sediments of another genesis—pebble-loamy-sandy of the Tentek Formation in some areas (MIS 2), and young aeolian sands QIII–IV (over vast areas) (Ibid.).

Thus, the assignment of Shulbinka's archaeological materials to MIS 2 does not contradict the local geological situation. Palynological data also provide evidence of the severity of the climate close to LGM during the period of site formation. According to the published data, the ecological conditions during the accumulation of layer 2 corresponded to modern steppe vegetation, but in a poorer form (Taimagambetov, 1987).

The issue of the mixed character of the assemblage, which was argued in early publications, is debatable. In our viewpoint, the archaeological materials represent a homogenous complex, which does not contain any items belonging to other culture-chronological periods. Though the artifacts may had undergone post-depositional displacement; still they relate a single, possibly prolonged, period of occupation. The artifacts' surfaces are undamaged and show no features of deflation, which can be regarded as an indirect proof that the artifacts were not redeposited. The presence of features of anthropogenic origin at the site, such as burials, pavements, fire places, and household pits (Taimagambetov, 1981, 1983, 1987), also indicates that the sediments were not fundamentally altered.

Discussion

The absence of a clear Middle Paleolithic component in the materials of the site under consideration makes it necessary to search for its parallels in Upper Paleolithic industries. The multilayered and well-stratified Upper Paleolithic site of Ushbulak is the nearest site to Shulbinka (Anoikin et al., 2019). However, direct comparison of the industries of these sites can hardly be considered reliable, since they differ both functionally, and in terms of raw materials; though, the used raw materials shows similar "consumer" characteristics (hardness, toughness, etc.). At Shulbinka, tools on river pebbles were produced and utilized. The artifacts from Ushbulak layers 6 and 7—attributable to the Early Upper Paleolithic—suggest that the site was a workshop where blades were detached from large stones (Ibid.). Both archaeological assemblages were focused on production and use of blades as tool blanks. However, the proportion of artifacts typical for laminar reduction in the Ushbulak lithic industry is very high (about 80 % of tools were fashioned on blanks and laminar spalls). In contrast, the relevant proportion at Shulbinka does not exceed 40 %. The shares of various types of cores for production of blades and flakes were approximately equal. Ushbulak layers 6 and 7 yielded cores with over 90 % bearing scars of blade detachments, while the proportion of such cores at Shulbinka does not exceed 50 %. There are also a number of technological differences in the materials of these sites. Bidirectional detachment of laminar blanks, a technique that was widespread in the Central Asian Early Upper Paleolithic industries (Derevianko et al., 2007; Anoikin et al., 2019), including at Ushbulak, was performed much less frequently at Shulbinka. Technological differences are also revealed by differences in core typology and spall faceting (Ushbulak layers 6 and 7 yielded ~40 % of blades with a bidirectional flaking pattern, the relevant share at Shulbinka is ~15 %). A key feature of Early Upper Paleolithic blade production, flaking surface preparation through pecking (Slavinsky et al., 2017), is not present in the Shulbinka lithic industry. Tool types found at both sites, such as end-scrapers on blades, heavily retouched blades, burins, etc., occur in many other Upper Paleolithic complexes. Moreover, the Shulbinka collection does not contain implements that are considered markers of the Early Paleolithic of southern Siberia and Central Asia: such tools include those with basal thinning of ventral surfaces, beveled points, core-burins, and others (Rybin, 2014).

The Upper Paleolithic industries are well represented in the contiguous to Eastern Kazakhstan regions of the Russian Altai (Kara-Bom, Ust-Karakol-1, etc.) (Derevianko et al., 1998; Derevianko, Shunkov, 2005; Prirodnaya sreda…, 2003). The Shulbinka artifacts show certain parallels to the Early Upper Paleolithic industry of Kara-Bom (Upper Paleolithic assemblages 1 and 2), as well as to the finds from Ushbulak layers 6 and 7 (Derevianko, Petrin, Rybin, 2000). The parallels have been noted in the tool kits of Shulbinka and Ust-Karakol-1 layers 8–11 (Prirodnaya sreda…, 2003). This similarity can be explained by the similarity of raw materials used at each site, and the focus of their primary reduction systems towards the production of blades. Moreover, Ust-Karakol-1 layer 9 yielded microcores, including wedge-

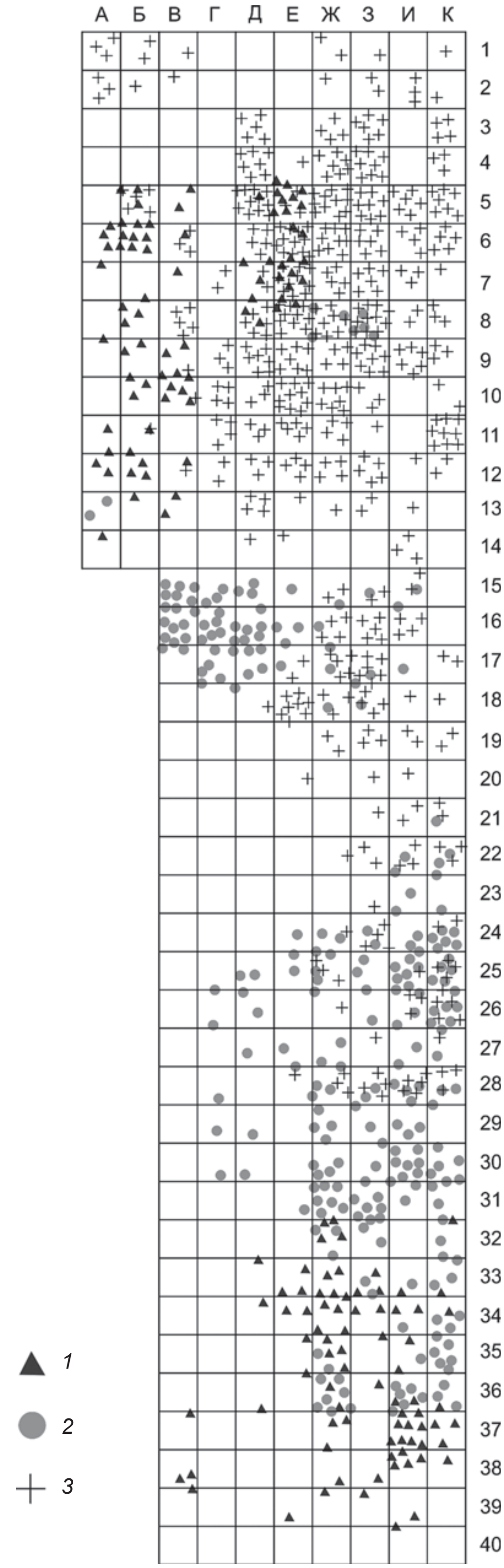

Fig. 9. Spatial distribution of artifacts within Shulbinka cultural horizons 1 (*1*), 2 (*2*), and 3 (*3*).

shaped microcores, that appear archaic when compared to similar Shulbinka artifacts. These microcores show subtriangular flaking surface convex in plan and in profile view, which is typical of the early "keeled" varieties; wedge and crests are weakly expressed or absent; and microblade blanks removed from such cores are often curved in profile view. The Ust-Karakol-1 microcores are quite different from the classic wedge-shaped cores of the Final Paleolithic (Abramova, 1986). In addition, Ust-Karakol-1 layers 8–11 yielded certain artifacts that can be regarded as the typological and technological markers of the Early Upper Paleolithic (Rybin, 2014), which were absent at Shulbinka.

Common culture features are revealed when comparing archaeological materials from Shulbinka with the Middle Upper Paleolithic complexes of the Altai (Anui-2). For instance, primary reduction strategy at Anui-2 and Shulbinka is utilized cores for making large blades and microcores, including wedge-shaped varieties (Prirodnaya sreda…, 2003) At the same time, significant differences can be seen in the proportions of the main core types and in the tool kit compositions of these assemblages. Middle Upper Paleolithic sites of southern and Western Siberia were characterized by the use of small blades as the main blanks in tool production (Lisitsyn, 2000); but this was not the case in the Shulbinka industry.

The Final Paleolithic industries of southern Siberia show the closest parallels to the Shulbinka collection. Use of large cores for making blades, and small cores for making microblades with regular faceting patterns, in the primary reduction system is typical of many lithic industries associated with the Kokorevo archaeological culture, practiced in southern Siberia 14–10 ka BP (Abramova, 1979; Lisitsyn, 2000; Kharevich, Akimova, Vashkov, 2017). In terms of the technique for flaking surface preparation in blades, the Shulbinka collection is also closer to the Kokorevo assemblages than to the Early Upper Paleolithic industries. Considerable similarity between Shulbinka and Kokorevo sites was also evident in the tool kits at each site, which both contain plenty of end-scrapers on flakes and blades, various side-scrapers on flakes, and pebble tools, such as planing tools, choppers, and unifacial side-scrapers. Both complexes also include heavily retouched blades, burins, and points. Apparently, the lithic industries from the classic Kokorevo sites (Kokorevo I, IV, Novoselovo VII) and from Shulbinka are not identical, however. For instance, the Shulbinka microindustry is dominated by edge-faceted cores, while the Kokorevo complexes mostly reveal wedge-shaped microcores and numerous laminar tool-blanks. It can be stated that the similarities between the complexes under consideration are related not to cultural unity, but to their common stage within the Paleolithic sequence, which makes it possible to attribute the Shulbinka materials to the Final Upper Paleolithic.

This conclusion is further supported through comparison of the Shulbinka materials with the younger Early Holocene complexes of Kazakhstan, which formerly were attributed to the Mesolithic (Kungurov, 2008; Merts, 2008; Zaibert, Potemkina, 1981). The specific features of these industries include the small size of artifacts—cores (edge-faceted, wedge-shaped, prismatic, and cone-shaped), target spalls (microblades), and tools made on microblades, including geometric microliths.

The proportion of microlithic artifacts at Shulbinka is comparatively small, perhaps because the excavated soil was not subjected to screening. Cores for production of microblades are most typical artifacts in the microindustry; such cores were recovered in approximately same quantities from all the horizons (see Table 2). The proportion of microblades in the assemblage is very small (see Table 1); tools made on microblades are absent; tools on blades are few (an end-scraper and a chisel-like tool).

In the considered part of Central Asia, as the researchers suggest, there were two types of Mesolithic industries: those with and those without geometric microliths (Shnaider, 2015; Kungurov, 2008; Merts, 2008; Okladnikov, 1966). The former group is larger and includes the sites of the turn of the Pleistocene-Holocene in Western and Central Kazakhstan (Shiderty-3 and others), Turkmenistan (Dam-Dam-Chashme-2 and others), Tajikistan (Tutkaul, Obi-Kiik, Istyk Cave (horizons 3–4), and others), and Mongolia (Chikhen-Agui). Such industries are characterized by well-developed micro-flaking, mainly of the volumetric and edge-faceted cores, and presence of geometric microliths in the tool kit (Alisher kyzy et al., 2020; Merts, 2008; Shnaider et al., 2020; Derevianko et al., 2008: 9–10). The latter group includes the sites of Ubagan, Yavlenkovskaya, Vinogradovskaya, Karasai, and the Telmanovskaya group of sites in Northern and Eastern Kazakhstan (Zaibert, Potemkina, 1981). Their assemblages also show the developed micro-flaking of the prismatic and edge-faceted cores, but the removed spalls were not modified into geometric microliths.

Comparisons with these assemblages suggest that the Shulbinka materials do not match the characteristics of the Mesolithic industries in Central Asia. For instance, microblades, which are the basis of the Mesolithic complexes, are poorly represented on the site under study. Among blank spalls, the percentage of small laminar forms at Shulbinka is small, and the tool kits do not contain tools made on microblades.

Conclusions

Reanalysis of the Shulbinka collections provides new insights into our understanding of this site. The initial arguments linking the site with the Final Paleolithic proposed by Z.K. Taimagambetov seem reasonable today, an assertion supported by both the typological composition of the lithic artifacts and their stratigraphic position. Owing to the absence of components of the Final Middle and Early Upper Paleolithic, the materials of the site appear to be irrelevant to ongoing debates about the origin of the Upper Paleolithic in the region. At present, this question remains open; however, the available data suggest that Upper Paleolithic culture penetrated into the region from the Altai Mountains. The Shulbinka archaeological materials fit well within the regional context of the Final Upper Paleolithic, and expand our understanding of the development of lithic industries in northern Central Asia in the Late Pleistocene.

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References

Abramova Z.A. 1979
Paleolit Yeniseya: Kokorevskaya kultura. Novosibirsk: Nauka.

Abramova Z.A. 1986
Klinovidnye nukleusy v paleolite Severnoi Azii. In *Paleolit i neolit*. Leningrad: Nauka, pp. 11–16.

Alisher kyzy S., Shnaider S.V., Kolobova K.A., Krivoshapkin A.I. 2020
Novye dannye po mezolitu Vostochnogo Prikaspiya: Kamennaya industriya grota Dam-Dam-Cheshme-2 (po materialam raskopok A.P. Okladnikova). *Stratum plus*, No. 1: 257–278.

Anoikin A.A., Pavlenok G.D., Kharevich V.M., Taimagambetov Z.K., Shalagina A.V., Gladyshev S.A., Ulyanov V.A., Duvanbekov R.S., Shunkov M.V. 2019
Ushbulak – a new stratified Upper Paleolithic site in Northeastern Kazakhstan. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 47 (4): 16–29.

Derevianko A.P., Olsen J.W.,Tseveendorj D., Gladyshev S.A., Nokhrina T.I., Tabarev A.V. 2008
New insights into archaeological record at Chikhen Agui Rockshelter (Mongolia). *Archaeology, Ethnology and Anthropology of Eurasia*, No. 2 (34): 2–12.

Derevianko A.P., Petrin V.T., Rybin E.P. 2000
The Kara-Bom site and the characteristics of the Middle-Upper Paleolithic transition in the Altai. *Archaeology, Ethnology and Anthropology of Eurasia*, No. 2: 31–52.

Derevianko A.P., Petrin V.T., Rybin E.P., Chevalkov L.M. 1998
Paleoliticheskiне kompleksy stratifitsirovannoi chasti stoyanki Kara-Bom (mustye – verkhniy paleolit). Novosibirsk: Izd. IAET SO RAN.

Derevianko A.P., Shunkov M.V. 2005
Stanovleniye verkhnepaleoliticheskikh traditsiy na Altae. In *Perekhod ot srednego k pozdnemu paleolitu v Evrazii: Gipotezy i fakty*. Novosibirsk: Izd. IAET SO RAN, pp. 283–311.

Derevianko A.P., Zenin A.N., Rybin E.P., Gladyshev S.A., Tsybankov A.A., Olsen J.W., Tseveendorj D., Gunchinsuren B. 2007
The technology of Early Upper Paleolithic lithic reduction in Northern Mongolia. *Archaeology, Ethnology and Anthropology of Eurasia*, No. 1 (29): 16–38.

Geologiya SSSR. Vostochnyi Kazahstan. 1967
Moscow: Nedra, vol. 41.

Kharevich V.M., Akimova E.V., Vashkov A.A. 2017
K probleme verkhney granitsy kokorevskoy kultury v pozdnem paleolite Yeniseya (po materialam stoyanki Troitskaya). *Vestnik Tomskogo gosudarstvennogo universiteta*, No. 418: 182–190.

Kungurov A.L. 2008
Problemy issledovaniya mezolita Altaya. *Izvestiya Altaiskogo gosudarstvenogo universiteta*, No. 4-2 (60): 121–126.

Lisitsyn N.F. 2000
Pozdniy paleolit Chulymo-Yeniseyskogo mezhdurechya. In *Trudy IIMK RAN*, vol. II. St. Petersburg: Izd. IIMK RAN.

Matsuy V.M., Mukhamedzhanov S.M., Erofeev V.S., Tsekhovsky Y.G. 1973
Pozdniy kaynozoy Kazakhstanskogo Priirtyshya. Alma-Ata: Nauka.

Merts V.K. 2008
Periodizatsiya golotsenovykh kompleksov Severo-Vostochnogo Kazakhstana. *Omsky nauchny vestnik*. Ser.: Istoricheskiye nauki, No. 1 (63): 22–26.

Morimoto S., Kato S., Kunitake S., Shiba K., Kato H., Petrin V.T., Taimagambetov Z.K., Artyukhova O.A., Mamirov T.B., Ospanov E.B. 2019
The Study of Upper Paleolithic Culture in Kazakhstan. Nara: [s.n.]. (In Japanese). (Nara National Research Institute for Cultural Properties Research Report; vol. 22).

Okladnikov A.P. 1966
K voprosu o mezolite i epipaleolite v aziatskoi chasti SSSR. Sibir i Srednyaya Aziya. In *U istokov drevnikh kultur (epokha mezolita)*. Moscow; Leningrad: Nauka, pp. 213–223. (MIA; No. 126).

Petrin V.T., Taimagambetov Z.K. 2000
Kompleksy paleoliticheskoy stoyanki Shulbinka iz Verkhnego Priirtyshya. Almaty: Al-Farabi Kaz. Gos. Nats. Univ.: IAET SO RAN.

Prirodnaya sreda i chelovek v paleolite Gornogo Altaya. 2003
Novosibirsk: Izd. IAET SO RAN.

Rybin E.P. 2014
Tools, beads, and migrations: Specific cultural traits in the Initial Upper Paleolithic of southern Siberia and Central Asia. *Quaternary International*, vol. 347: 39–52.

Shnaider S.V. 2015
Tutkaulskaya liniya razvitiya v mezolite zapadnoi chasti Tsentralnoy Azii. Cand. Sc. (History) Dissertation. Novosibirsk.

Shnaider S., Kolobova K., Filimonova T., Taylor W., Krivoshapkin A. 2020
New insights into the Epipaleolithic of western Central Asia: The Tutkaulian complex. *Quaternary International*, vol. 535: 139–154.

Shunkov M.V., Kozlikin M.B., Derevianko A.P. 2020
Dynamics of the Altai Paleolithic industries in the archaeological record of Denisova Cave. *Quaternary International*. URL: https://doi.org/10.1016/j.quaint.2020.02.017

Slavinsky V.S., Rybin E.P., Belousova N.E., Fedorchenko A.Y., Khatsenovich A.M., Anoikin A.A. 2017
Spetsificheskiy sposob podgotovki zony rasshchepleniya nukleusov v nachalnom verkhnem paleolite Yuzhnoi Sibiri i Tsentralnoi Azii. *Stratum plus*, No. 1: 221–244.

Taimagambetov Z.K. 1981
Otchet ob issledovanii pamyatnikov kamennogo veka v zone stroitelstva Shulbinskoi GES v Vostochnom Kazakhstane letom 1981 goda. In *Arkhiv Instituta istorii, arkheologii i etnografii Komiteta nauki Ministerstva obrazovaniya i nauki Respubliki Kazakhstan*. (Manuscript).

Taimagambetov Z.K. 1983
Shulbinskaya stoyanka. In *Arkheologiya epokhi kamnya i metalla Sibiri*. Novosibirsk: Inst. istorii, filologii i filosofii SO AN SSSR, pp. 161–167.

Taimagambetov Z.K. 1987
Kamennyi vek. In *Arkheologicheskiye pamyatniki v zone zatopleniya Shulbinskoy GES*. Alma-Ata: Nauka, pp. 9–23.

Taimagambetov Z.K., Ozherelyev D.V. 2009
Pozdnepaleoliticheskiye pamyatniki Kazakhstana. Almaty: Kazak universiteti.

Zaibert V.F., Potemkina T.M. 1981
K voprosu o mezolite lesostepnoi chasti Tobolo-Irtyshskogo mezhdurechya. *Sovetskaya arkheologiya*, No. 3: 108–130.

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A.V. Kandyba[1], Nguyen Khac Su[2], S.A. Gladyshev[1], Nguyen Gia Doi[2], A.M. Chekha[1], and A.P. Derevianko[1]

[1]Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: arhkandyba@gmail.com; gladyshev57@gmail.com; chekhandrej@yandex.ru; derev@archaeology.nsc.ru
[2]Institute of Archaeology, Vietnam Academy of Social Sciences, Phan Chu Chin, 61, Hanoi, Vietnam
E-mail: khacsukc@gmail.com; doitrong@hotmail.com

Con Moong Cave: A Stratified Late Pleistocene and Early Holocene Site in Northern Vietnam

Here, we outline the findings of comprehensive archaeological studies in Con Moong Cave, northern Vietnam, carried out by the Russian-Vietnamese Expedition, with the participation of Australian specialists, in 2010–2014. The cave is a stratified site, whose habitation deposits span a period beginning ca 42 ka BP. A detailed description of finds is provided. Diachronic changes in artifact types, use of raw materials, and technology are presented. Lithics from layers K–S represent the Early Upper Paleolithic Sơn Vi culture. Finds from layer K include core-shaped debris, flakes, and a discoidal side-scraper (or sumatralith). Tools were made on quartzite pebbles. Finds from layer L, dating to ca 36 ka BP, attest to substantial changes in the choice of lithic raw material: in addition to quartzite, mostly andesite and, less often, limestone, basalt, and certain sedimentary rocks were employed. Primary reduction was not preceded by preparation of nuclei. Flakes are large and medium-sized. Tools include a sumatralith and an end-scraper. The richest material comes from Con Moong layers Q and S, dating to 26–21 ka BP. Preforms consist of pebble cores with unprepared striking platforms. Nuclei include flat-parallel, radial, and irregular varieties. New tools in the assemblage include choppers, longitudinal and transverse convergent side-scrapers, and discoidal sumatraliths, as well as Hoabinhian axes and a unilateral axe (sumatralith). We conclude that archaeological remains from Con Moong Cave provide evidence of the evolution of the Sơn Vi culture from its emergence to its replacement by the Hoabinhian Technocomplex ~25 ka BP. Lithic industries from layers K and L correlate with one of the earliest stages in the peopling of this region by Homo sapiens.

Keywords: *Northern Vietnam, Con Moong Cave, Sơn Vi lithic industry, Sonvian, Hoabinhian, sumatraliths, paleoecology.*

Introduction

Vietnam is a unique region in Southeast Asia in terms of its peopling, the evolution of culture among its ancient human populations, and the development of humans and their cultures. Owing to the geographical proximity of its northern frontier to southern China, Vietnam likely constituted a transit zone for migrating ancient hominins during the period of Sundaland's existence (Fig. 1). This assumption is supported by the presence of Early Paleolithic sites yielding a bifacial industry, located in the central part of the country. In the vicinity of An Khê town in Gia Lai Province, the joint Russian-Vietnamese Archaeological Expedition has discovered more than 20 Early Paleolithic sites yielding a pebble-flake industry and bifacially flaked tools such as handaxes, which belong to the An Khê industrial complex (Derevianko et al., 2018). These sites include Roc Tung 1 and Go Da, with dates of 806 ± 22 and 782 ± 20 ka BP respectively, based upon $^{40}K/^{38}Ar$ assays of tektites found in the cultural layer associated with bifaces and pebble tools. These dates lead us to conclude that the Early Paleolithic An Khê culture in Vietnam existed simultaneously with the lithic industry found in the Baise Basin in southern China (Xie, Lin, Huang, 2003).

Later Paleolithic sites in Vietnam date to the beginning of the Middle Pleistocene (Davidson, Noble, 1992; Kahlke, 1965, 1973; Kahlke, Nguyen Van Nghia, 1965; Ciochon, Olsen, 1986; Olsen, Ciochon, 1990; Nguyễn Khắc Sử, 2007). Ten *H. erectus* teeth and dental remains of extinct great apes were discovered in Tham Khuyen and Tham Hai caves, in Lạng Sơn Province on Vietnam's Chinese border. The faunal remains found associated with this lithic complex mainly belong to extinct genera, such as *Ailuropoda*, *Stegodon*, *Pongo*, etc. The age of these sites is roughly 475 ± 125 ka BP (Marwick, 2009).

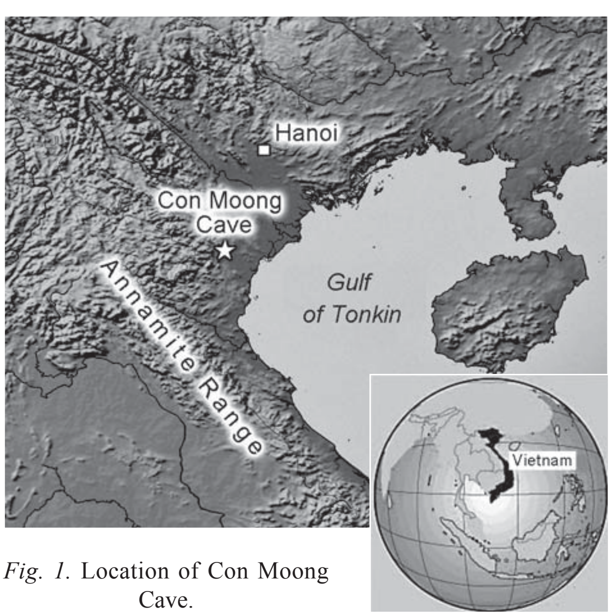

Fig. 1. Location of Con Moong Cave.

Artifacts found in Late Pleistocene sediments in northern Vietnam have been attributed to the Nguom, Sơn Vi, and Hòa Bình Paleolithic industries (ca 40–10 ka BP). Their main technical and typological features correspond with the Early Paleolithic of Vietnam, indicating diachronic continuity among Paleolithic traditions throughout the entire Pleistocene. The most representative industry in terms of chronology and geographical territory was the Sơn Vi lithic industry (Sonvian in Western literature). One of the key sites yielding evidence of Sơn Vi origins is Con Moong Cave. The purpose of this study is to present a detailed description, periodization, and chronology of archaeological evidence derived from that cave.

History of research in Con Moong Cave

Con Moong Cave (Hang Con Moong; 20°40′86.0″ N, 105°65′16.4″ E) is located in Cúc Phương National Park in Thanh Hóa Province, northern Vietnam (Fig. 2). This site, encompassing a total area of 230 m^2, was discovered in 1974 and investigated by Vietnamese archaeologists in 1975–1976 and 2008 (Nguyễn Khắc Sử, 2009).

The cave is located at an altitude of 147 m above sea level and 32 m above an unnamed seasonal watercourse flowing into Thanyen Creek, which subsequently joins the Bai River. The cave is in a limestone massif; the end of a mountain range stretching along the Su River; roughly 100 km west-southwest of Hanoi. This barrel-shaped cave has two connecting ingresses: a western entrance, 5.2 m wide and 6 m high, and a southeastern entrance, 5.2 wide and 6.2 m high.

Vietnamese scholars initially identified three cultural and chronological units in Con Moong Cave: Sơn Vi, Hòa Bình, and Bắc Sơn (Fig. 3) (Nguyễn Khắc Sử, 1977). The earliest deposits enclosing remains of the Sơn Vi culture occur at depths of about 3 m below the surface; their average thickness reaches 0.5 m. These strata are dark brown in color and contain whole snail shells, mainly of the species *Cyclophorus fulguratus*, *Camaena vayssierei*, and *Pollicaria crossei*. The artifact assemblage includes choppers, pebble fragments, retouched flakes, and animal bones with traces of processing. Stone tools of the Sơn Vi culture are dated to the Late Paleolithic (ca 17–14 ka BP).

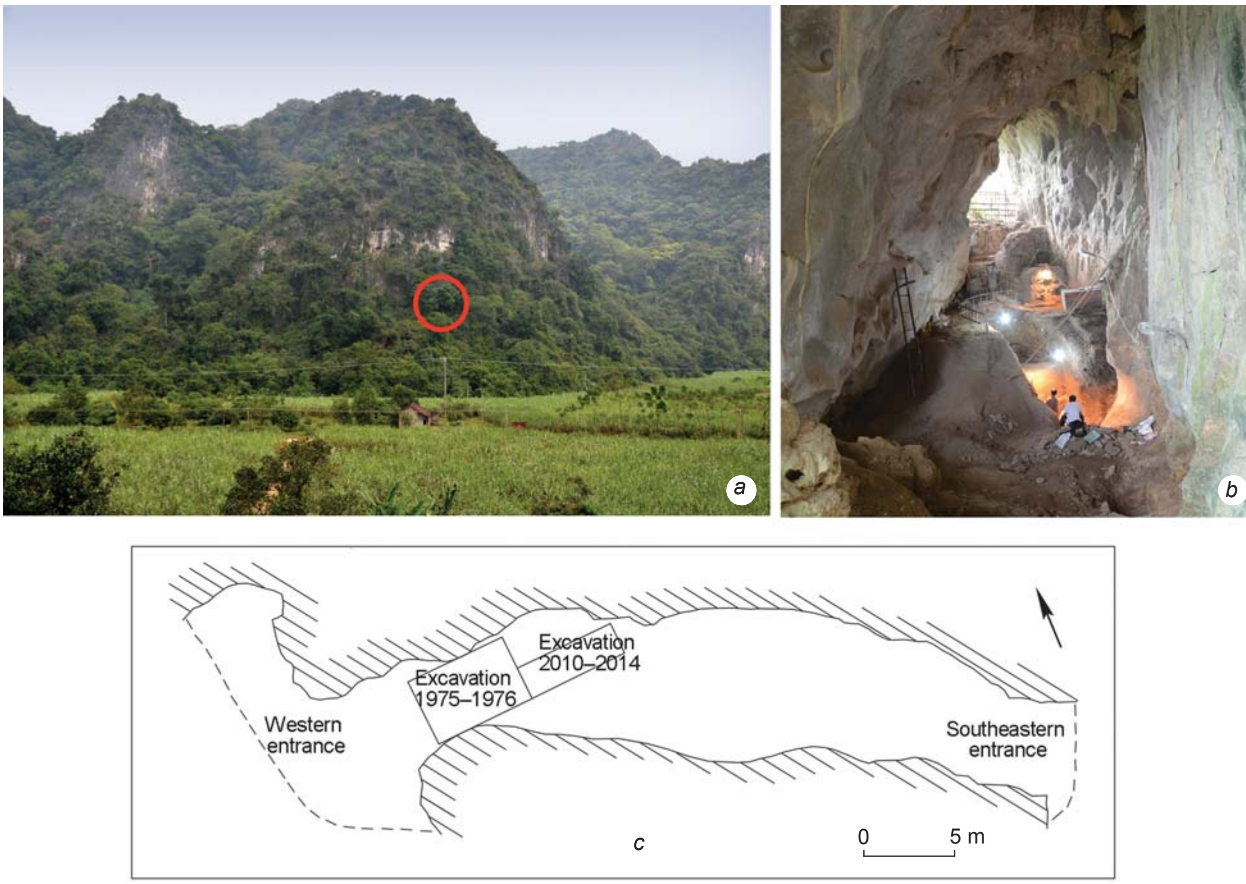

Fig. 2. Con Moong Cave.
a – general view of the massif indicating the location of the cave; *b* – western entrance of the cave; *c* – plan of the cave floor.

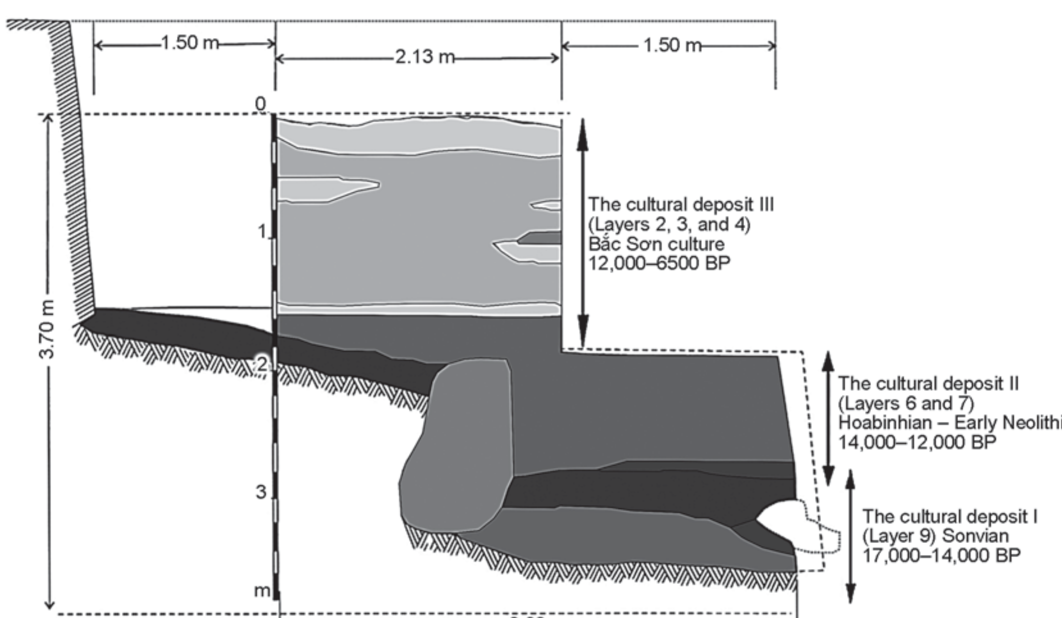

Fig. 3. Stratigraphy of deposits with chronological definitions in Con Moong Cave, based on the results of archaeological work conducted in 1975–1976 (after (Nguyễn Khắc Sử, 2009)).

In 2008, burials of a 25–30 year-old male and 40–50 year-old female were found in the cave. The height of the male was 1.75 m, that of the female 1.61 m; both individuals belonged to the Australo-Melanesian phenotype (Nguyễn Khắc Sử, 2009).

The deposits of the second cultural unit average 1.2 m thick, are blackish-brown in color, and are permeated with fragmentary gastropod shells, mainly of the genus *Cyclophorus*. This unit also contains remains of mollusks identified as *Antimelania swinhoei*, *A. siamensis*, *A. costula*, *Lanceolaria laevis*, *L. gray*, *L. frustorferi*, *Oxynaria diespiter*, *O.* sp. indet., and *Sinohyriopsis cumingii*. The species composition is diverse and includes preferential inhabitants of streams, mountain rivers, and marine environments. The burial of a 50–60 year-old man of Australo-Negroid phenotype was found in these sediments, containing pieces of ocher, stone tools, and oyster shells. The man was buried on his side with flexed legs. In contrast with the first cultural unit, the second contained amygdaloidal and discoidal sumatraliths, short and long axes, bone points, and side-scrapers made of shell. These artifacts are typical of the Hòa Bình culture at the Pleistocene-Holocene boundary (ca 14–9 ka BP) (Ibid.).

The third cultural unit in Con Moong Cave, averaging 1.2 m thick, was formed of limestone clay of various colors, ranging from brown in the lower strata to yellow in the upper layers, containing numerous intact and broken mollusk shells, mainly of the genera *Cyclophorus* and *Antimelania*. Three human burials were also discovered in this unit. The boundaries of the burials were unclear and the bones were very poorly preserved, making it impossible to establish the original position of the interred. All burials contained red ocher, stone tools, and oyster shell side-scrapers. These deposits, unlike the previous layers, contain stone axes with polished blades, sharpened bone points, oyster shell knives, and pottery. This archaeological complex is associated with the Bắc Sơn (or Bacsonian) cultural period (ca 9–7 ka BP) (Ibid.).

Hearths were identified in each cultural unit; their number increasing from bottom to top along the stratigraphic column. At the same time, their size decreased and their location shifted toward the cave entrance.

Unfortunately, the site's initial Vietnamese investigators present osteological evidence without division into cultural and chronological periods. It is clear that the Con Moong faunal complex comprises species typical of the tropical monsoon climate: *Rhinoceros* sp. indet., *Cervus* sp. indet., *Rusa unicolor*, *Muintiacus muntjak*, Bovidae gen. et sp. indet., *Capricornis sumatraensis*, *Macaca mulatta*, Sciuridae gen. et sp. indet., Canidae gen. et sp. indet., *Sus scrofa*, *Paradoxurus hermaphroditus*, *Anser* sp. indet., *Lophuru* sp. indet., and *Rattus* sp. indet. Bones were mostly fragmented and in some cases severely burned.

Research conducted at Con Moong Cave in 2010–2014

Archaeological investigations at Con Moong Cave were continued by the joint Russian-Vietnamese Expedition 2010–2014. An excavation area of 14 m^2 was established in the western entrance of the cave. The total thickness of unearthed sediments was 5.5–6.0 m. A specific feature of these deposits is their loose, sometimes calcified structure. They are composed of red-brown, in some places whitish, dust-like sandy loam, which was divided into 21 lithological layers. Large limestone ébolis occurs in the upper part of the deposits; their concentration decreasing with depth. The color of the deposits changes to gray-yellow directly at the contact of loose sediments and the cave's rocky base.

Joint Russian-Vietnamese investigations yielded 455 lithic and bone artifacts, unevenly distributed throughout the deposits. For the first time, radiocarbon and OSL dating of exposed sedimentary deposits, as well as micromorphological analysis of individual sections in the sedimentary column were conducted, making it possible to establish a chronological framework for sedimentation revealed by the 2010–2014 Con Moong excavations (Fig. 4) (McAdams et al., 2019). A series of chronometric dates obtained by specialists from the University of Wollongong (Australia) under the leadership of R. Roberts covers a range from 70 to 20 ka BP, and the results of micromorphological analysis of the deposits became the basis for reconstructing the evolution of natural and climatic changes during that period.

Assumptions regarding the habitation of Con Moong Cave by early humans during the Late Pleistocene were confirmed by analytical results of faunal remains (n=668) (Derevianko, Kandyba, Chekha, 2019; Derevianko et al., 2014). Osseous remains were found in layers V–H, but were not preserved in the lower layers. The degree of preservation of faunal remains decreased with depth; bones were severely fragmented, which complicated species identification; unidentifiable bones constituted a large proportion of the assemblage. Unfortunately, mineralization, leading

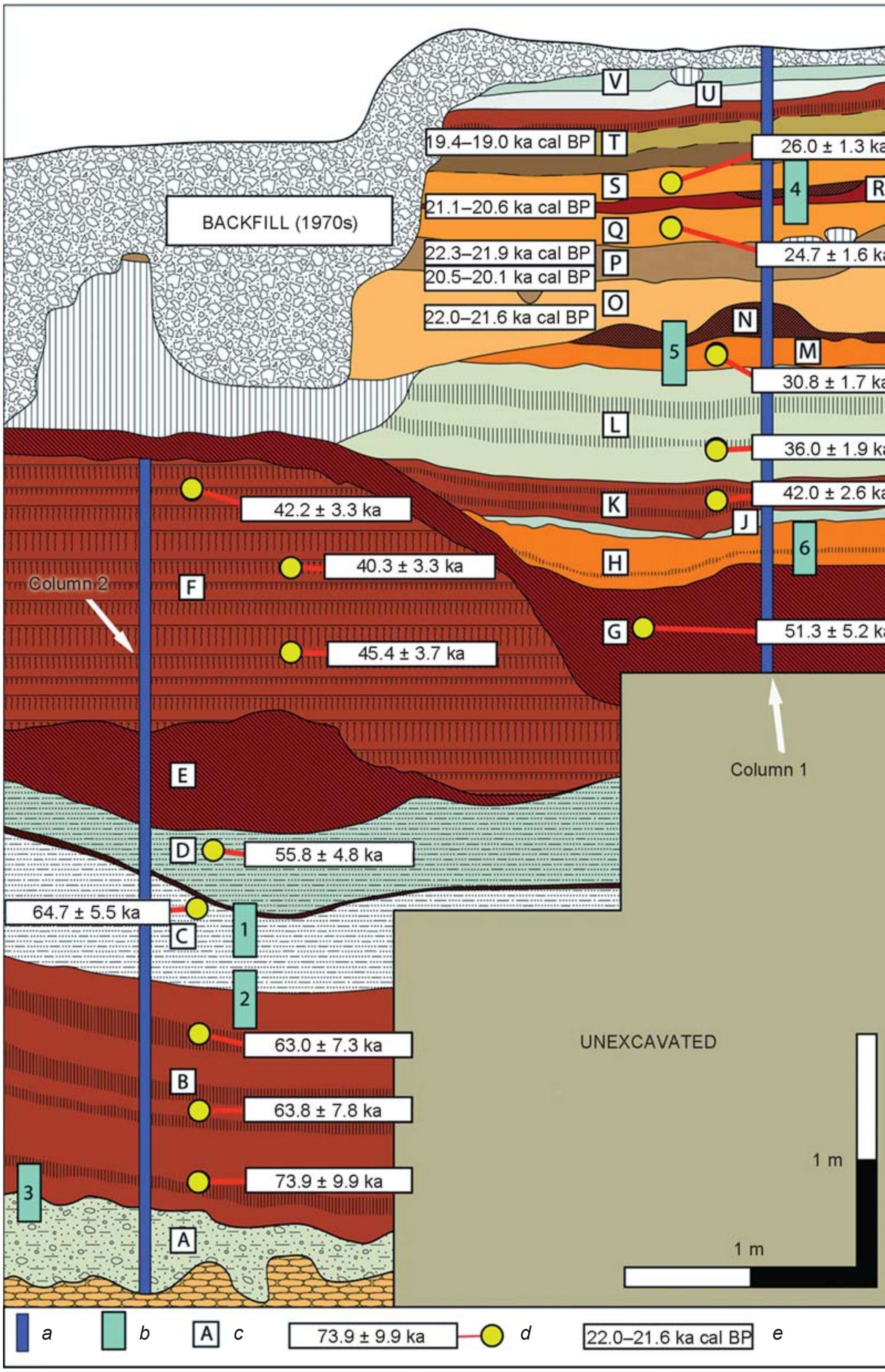

Fig. 4. Stratigraphy of deposits with chronological definitions in Con Moong Cave, based on results of archaeological work conducted in 2010–2014 (after (Nguyễn Khắc Sử, 2019)).
a – bulk sample column; *b* – micromorphology sample; *c* – lithostratigraphic unit; *d* – OSL age and sample position; *e* – ^{14}C age (charcoal and shell).

to decomposition of collagen, rendered osteological remains from layers L–H unsuitable for radiocarbon dating (McAdams et al., 2019).

Human bones (n=14) were found scattered in layers V, U, and T together with remains of large ungulates, carnivores, and primates (*Elephas maximus*, *Rhinoceros* sp. indet., *Ursus thibetanus*, *Rusa* sp. indet., *Muntiacus* sp. indet., *Bos* sp. indet., *Sus* sp. indet., *Hystrix* sp. indet., and *Macaca* sp. indet.). More than half of the recovered faunal remains were bones of artiodactyls (deer and wild boar). Fragments of smaller animals in these layers were significantly fewer than in the underlying layers; mainly bat remains were recovered.

A total of 144 bones were identified from layer S. The main difference between this horizon and the upper layers was the predominance of small mammals (30 %), birds (32 %), and turtles (14 %). Two fragments of human bone were also found here. Two animal bones exhibited traces of human processing. The most interesting find was the metapodial of a medium-sized cervid, from which a borer was fabricated. Several bone fragments, including a piece of elephant tusk, showed traces of fire modification.

The collection of lithic artifacts from layer S totals 253 items. The flake assemblage includes 243 specimens, of which 183 are medium-sized and small flakes. Faceting of dorsal surfaces of the flakes (predominantly parallel unidirectional and natural) is present in equal proportions. The collection contains two laminar flakes. The identifiable faceting of the dorsal surfaces of both artifacts is parallel and unidirectional. The residual striking platforms are natural in almost all flakes. The remaining 60 items in the flake industry are stone fragments, mostly medium-sized and small.

The toolkit comprises nine artifacts, including seven side-scrapers. The most numerous group, transverse convex side-scrapers, consists of five items (Fig. 5, *1*, *2*, *5*). Three of these tools were made on flat pebbles, and two on large, flat stone blocks. The working edge was created using direct percussion and finished by continuous scalar semi-abrupt medium- and small-faceted retouch. Two convergent convex side-scrapers were made on large flat pebbles by direct percussion and were finished by continuous scalar semi-abrupt retouch (Fig. 5, *3*, *6*). Two discoidal side-scrapers (sumatraliths) were made on pebbles (Fig. 5, *4*, *7*), their working edges shaped along the perimeter by continuous marginal retouch in one case, and invasive, scalar, semi-abrupt, medium-faceted retouch in the other. The toolkit also includes two retouched flakes.

Layer R yielded no lithic artifacts. The faunal collection from this stratum is small (n=61), half of which consisted of bird bones. One third of the bones belonged to artiodactyls.

Faunal remains increased sharply in layer Q (n=260), with ungulate bones prevailing (71 %), two-thirds of which derived from deer. A fragment of rhinoceros horn with traces of cuts was also found in this stratum.

The collection of lithic artifacts from layer Q includes 74 items. Primary reduction is represented by 14 cores and six core-shaped fragments. The collection also contains split pebbles and a hammerstone. Cores modified by parallel flaking total seven items (Fig. 6; 7, *1*). Removals were made across the long axis of the blank, which was a flat, massive, and large pebble, from unprepared striking platforms retaining natural cortex. Negative scars of large and medium-sized flakes were observed on the flaking surfaces. Radial cores total five specimens (Fig. 7, *2–4*). Removals were made along the perimeter of large pebbles, without preliminary preparation. In some cases, bifacial flaking was undertaken (Fig. 7, *5*, *6*). Two cuboid nuclei

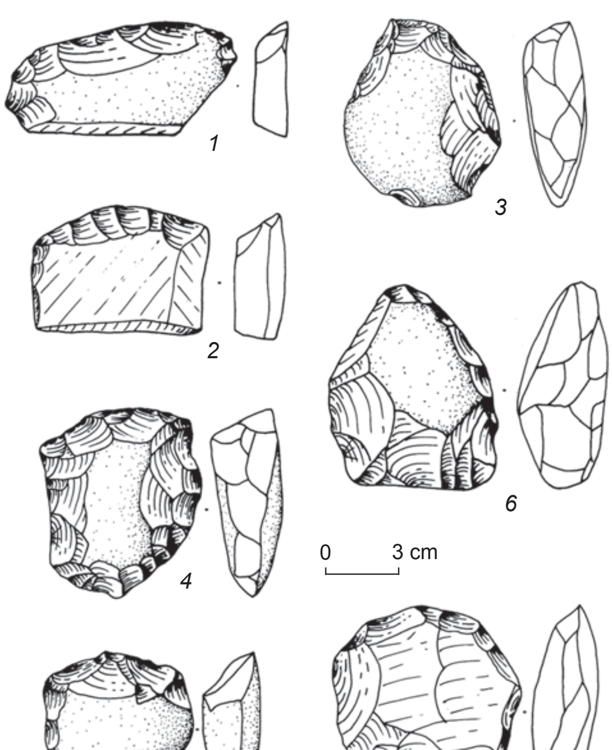

Fig. 5. Stone side-scrapers from layer S in Con Moong Cave.
1, *2*, *5* – transverse-convex; *3*, *6* – convergent-convex; *4*, *7* – discoidal (sumatraliths).

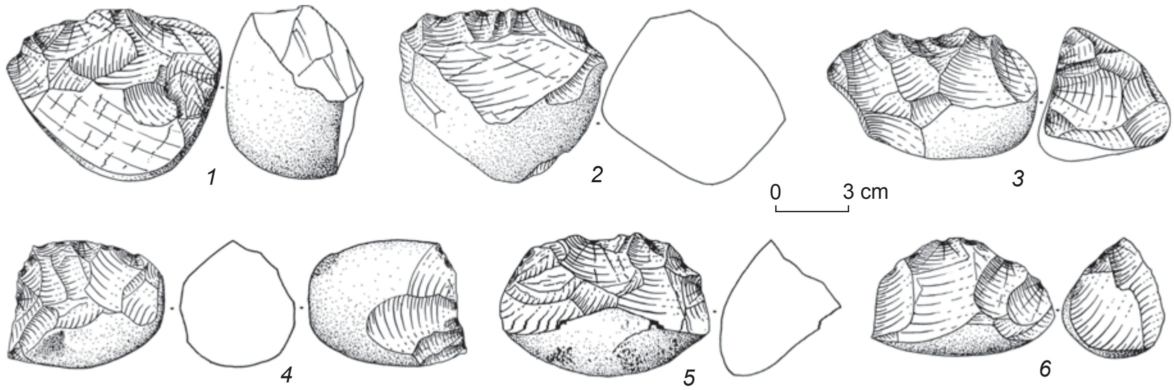

Fig. 6. Parallel reduction cores from layer Q in Con Moong Cave.

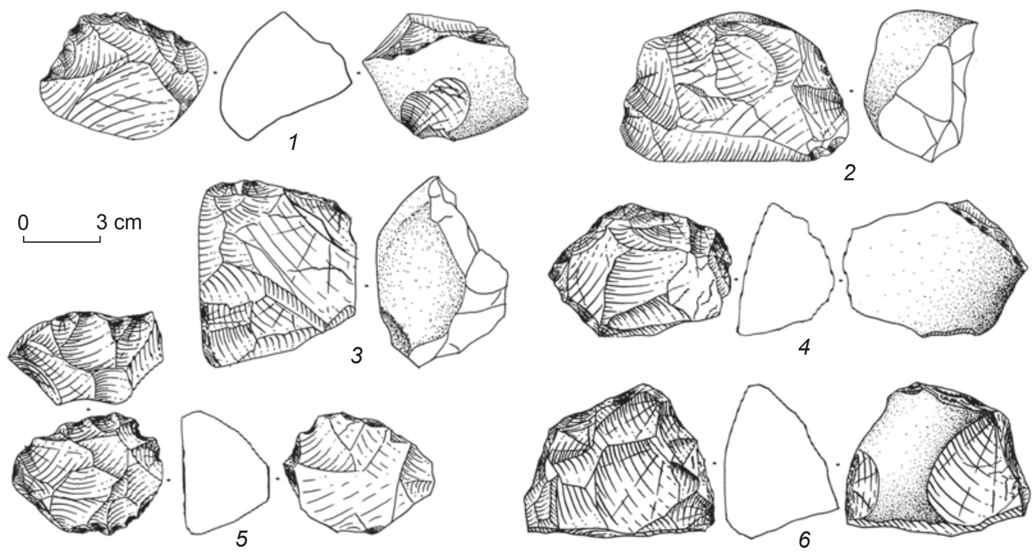

Fig. 7. Cores from layer Q in Con Moong Cave.
1 – parallel reduction; *2–4* – radial; *5*, *6* – radial-bilateral.

exhibiting irregular flaking patterns were discovered with multidirectional negative scars on their surfaces.

The flake assemblage comprises nine items: seven large flakes with natural residual faceting of their dorsal surfaces, and two fragments.

The toolkit (*n*=43) includes 10 choppers (Fig. 8). Large massive pebbles, mostly ovoid, were used in fabricating choppers. All the tools exhibit nearly right angles on their working edges, originally formed by direct percussion and additionally trimmed with scalar large- and medium-faceted retouch. Two chopping-tools were made on massive oblong pebbles, one of which was fragmented. The working edge in both cases was formed by bifacial direct percussion and in one case was trimmed with occasional scalar retouch.

The collection contains five Hoabinhian axes (Fig. 9, *1*, *3*). These tools are rectangular and plano-convex in cross-section. Most of the surfaces of two examples are covered with negative scars of shaping removals; edges were additionally trimmed with a series of small removals. The working edge on the third axe was formed only by small bifacial removals (Fig. 9, *4*). One axe that apparently did not receive its final shape belongs to this same group of tools (Fig. 9, *2*). Its working edge was made along 3/4 of the perimeter of a flat ovoid pebble by applying continuous semicircular, scalar, large-faceted retouch.

The layer Q assemblage includes 18 side-scrapers, among them six discoids or so-called sumatraliths (Fig. 10, *3*, *4*, *5*), three of which are fragmentary (Fig. 10, *1*, *2*). These artifacts were manufactured on large, flat pebbles. The tools achieved their round shape through the application of continuous abrupt, scalar, large-faceted retouch. Most such artifacts retain their natural cortex on the back side. Four transverse convex side-scrapers were found in layer Q

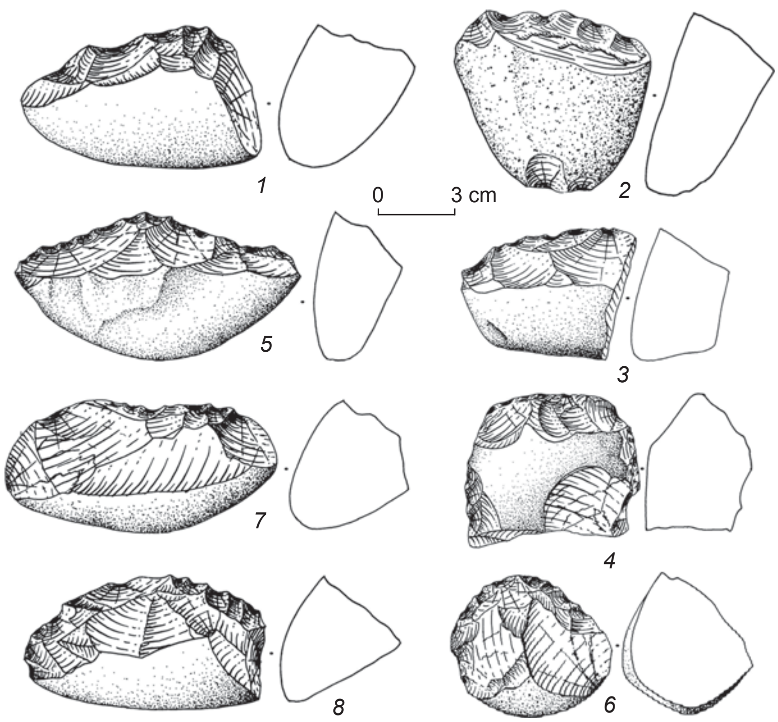

Fig. 8. Choppers from layer Q in Con Moong Cave.

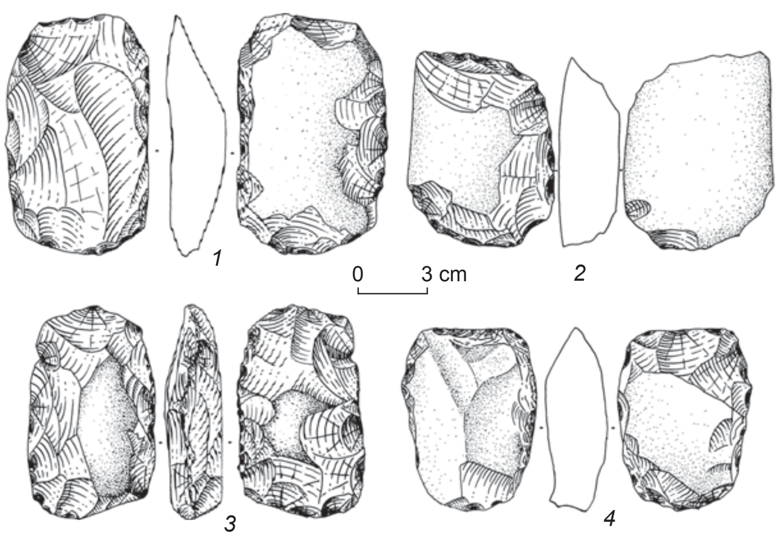

Fig. 9. Hoabinhian axes from layer Q in Con Moong Cave.

(Fig. 10, *6–9*); one of which was fragmentary (Fig. 11, *6*). They are morphologically similar to sumatraliths, but were mostly made on large primary spalls; one was fabricated on a flat pebble. Secondary flaking comprised applying continuous scalar, semi-abrupt retouch with medium-sized facets. Two convergent convex side-scrapers were made on large flakes by applying continuous scalar, semi-abrupt retouch to the ventral surface of the blank (Fig. 11, *8*). One convergent straight side-scraper was made on a massive flake (Fig. 11, *1*); its working edge was formed by continuous heavy, vertical, scalar retouch with medium-sized facets. A longitudinal straight side-scraper was made on a laminar flake; one of its edges was formed by continuous scalar semi-abrupt retouch (Fig. 11, *7*). One longitudinal convex side-scraper with ventral trimming was made on a large flake. The working edge was shaped by occasional scalar, semi-abrupt retouch (Fig. 11, *3*). A canted side-scraper was made on a large secondary spall (Fig. 11, *5*). Continuous scalar, large-faceted, semicircular retouch was applied to the ventral side of the blank. An ovoid pebble was used as a blank for a bifacial side-scraper (Fig. 11, *2*). Its straight working edge was initially prepared by removing a series of numerous small spalls and subsequently trimmed by continuous scalar retouch.

The layer Q lithic collection contains a notched piece made on a large flake, a backed knife fabricated on a medium-sized flake, four large spalls with retouch, and two pestles.

One item can be interpreted as the blank of a bilaterally flaked tool (Fig. 11, *4*). The edges on both sides of this triangular piece were partially treated with a series of small removals.

Seventy-four non-human bones were recovered from layer P, 40 of which belonged to deer and wild boar. No lithic artifacts were found in this stratum.

Layer O was the deepest lithological unit containing osteological evidence—47 specimens. Ten bones of these could not be meaningfully taxonomically identified because of their highly fragmented state. More than half of these osteological remains belong to ungulates. The collection contains the metatarsal bone of a sambar deer (*Rusa* sp. indet.) exhibiting artificial cut-marks.

The assemblage of lithic artifacts from layer O amounts to 42 items, including one pebble. The flake industry is represented by 41 items; 29 of which are intact, mostly of large and medium sizes. Dorsal trimming of flakes was predominantly parallel, unidirectional and parallel, bidirectional. Residual striking platforms generally retained their natural

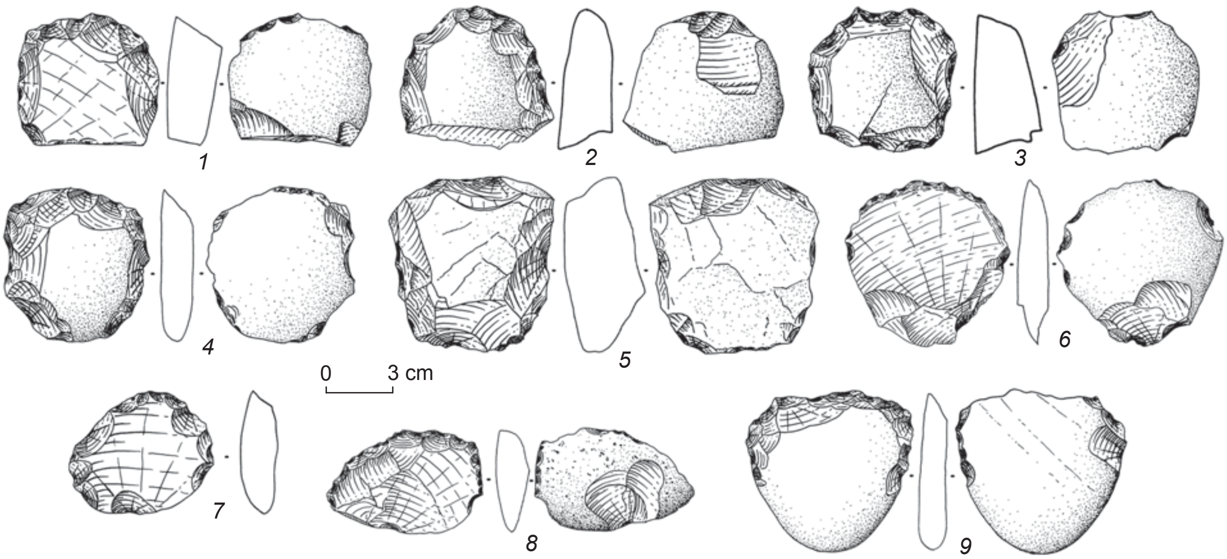

Fig. 10. Side-scrapers from layer Q in Con Moong Cave.
1–5 – discoids (sumatraliths); *6–9* – transverse-convex.

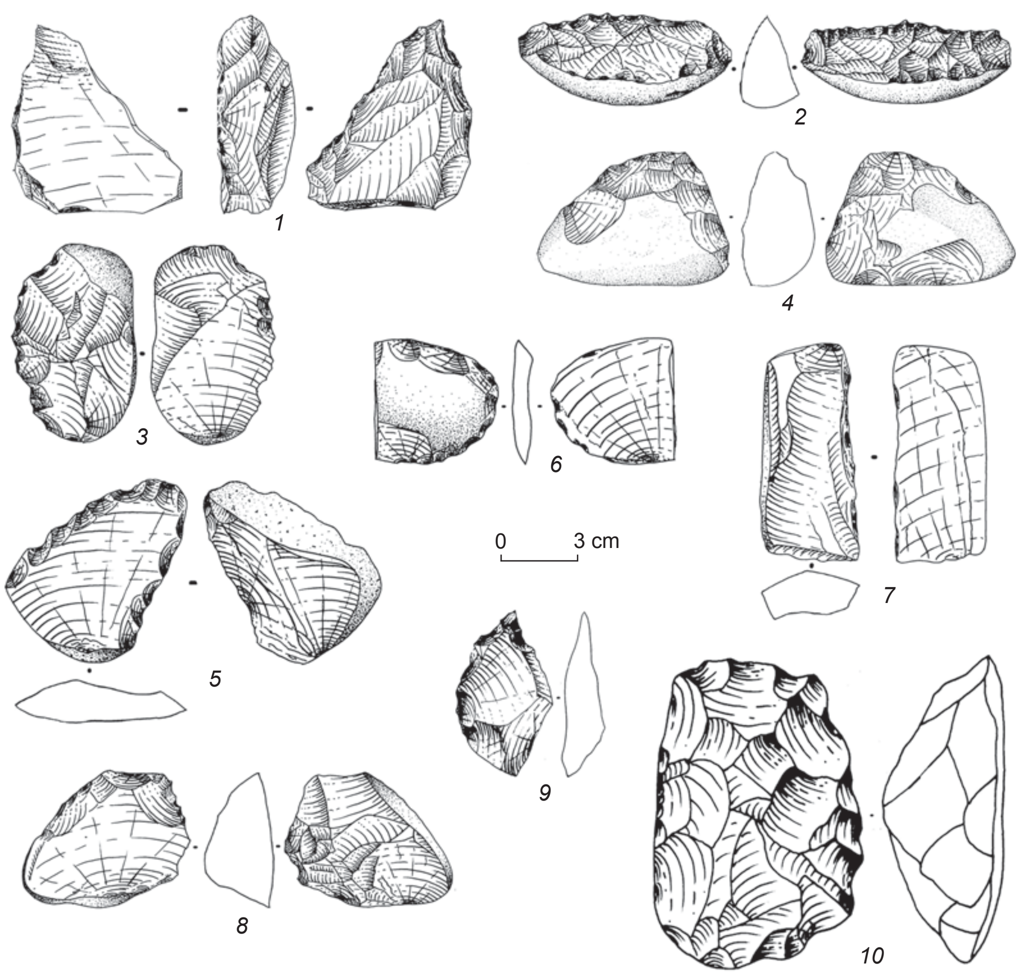

Fig. 11. Lithic artifacts from layers Q and L in Con Moong Cave.
1 – convergent straight side-scraper; *2* – bifacial side-scraper; *3* – longitudinal convex side-scraper; *4* – blank of a bifacially flaked tool; *5* – canted side-scraper; *6* – transverse convex side-scraper; *7* – longitudinal straight side-scraper; *8* – convergent convex side-scraper, *9* – denticulate end-scraper; *10* – sumatralith.

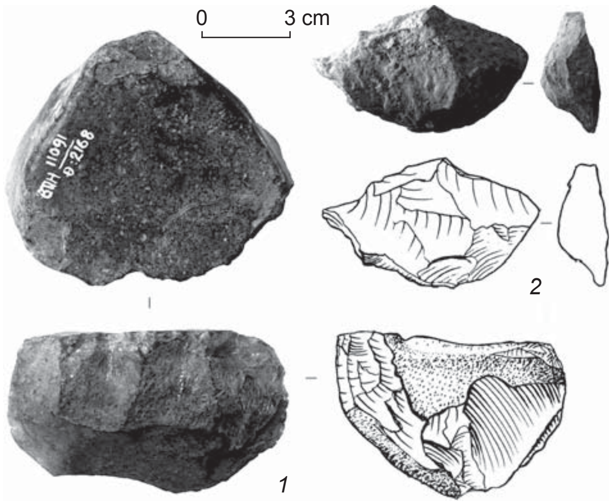

Fig. 12. Parallel reduction core (*1*) and flake (*2*) from layer L in Con Moong Cave.

surfaces. The rest of the items were medium-sized stone fragments.

Layer M yielded no archaeological evidence.

The collection of lithic artifacts from layer L includes 20 items. Primary reduction is represented by one nucleus, a large core-shaped fragment, and split pebbles. A pebble core modified by simple parallel flaking belongs to the initial stage of utilization (Fig. 12, *1*). Removals were made from its unprepared natural cortex surface across the long axis of the blank.

The flake industry is represented by 18 items; 14 of which are large and shortened flakes (Fig. 12, *2*). Dorsal trimming of flakes was predominantly parallel and unidirectional. Almost all residual striking platforms are natural. There are also four stone fragments in this assemblage.

The layer L toolkit consists of three items. One sumatralith was made on a nearly quadrangular pebble (see Fig. 11, *10*). Intense shaping of one plane of this blank was carried out through careful direct percussion and modification of the edge with small removals. A denticulate end-scraper was made on a flake fragment by denticulated retouch. A borer was made on a flake (see Fig. 11, *9*); its tip was created by removing several facets from a natural protrusion on the blank.

The collection of lithic artifacts from layer K includes six items. The process of primary reduction is represented by two core-shaped sub-triangular fragments of quartz bearing traces of removals.

The flake industry includes two artifacts: a medium-sized flake with a smooth striking platform and parallel, unidirectional dorsal faceting, and a medium-sized stone fragment.

The toolkit consists of two items. A discoidal side-scraper (sumatralith) was made on a quartzite pebble; its round shape was produced through continuous steep, scalar, large-faceted retouch. Natural cortex is preserved on the reverse side of this specimen. One end-scraper made on a large triangular quartz fragment exhibits marginal scalar, semicircular retouch.

Conclusions

Research carried out in Con Moong Cave in 2010–2014 has made it possible to establish the basic features its habitation by ancient humans. During the initial stages of deposition of soft sediments (layers A–E) under humid climatic conditions, the cave was inhabited by bats (McAdams et al., 2019). No lithic artifacts were found in layers A–E; thus, it can be concluded that during the period corresponding to the deposition of these deposits (ca 74–51 ka BP), Con Moong Cave was not utilized by ancient humans. Layer G was the first to contain remains of ash, which comprises indirect evidence of the presence of ancient humans in this shelter; all other evidence of human activities, including artifacts, is absent.

The beginning of human habitation in Con Moong Cave is established by evidence from the deposits of layer K, which were formed ca 42 ka BP. Here, quartzite pebbles were used as raw material for lithic reduction. The collection of stone tools is scarce, consisting of core-shaped fragments and debitage and, importantly, including tools such as discoidal side-scrapers (sumatraliths) typical of later periods.

The evidence from layer L, dating to ca 36 ka BP is also scant, but nonetheless reveals significant changes in the selection of lithic raw material. In addition to quartzite, andesite was used, and, slightly less frequently, limestone, basalt, and some sedimentary rocks. Notably, all blocks of raw material used by ancient humans at Con Moong came from alluvial deposits, as evidenced by the natural pebble cortex preserved on many artifacts. Primary reduction was not preceded by preparation of cores. Products of reduction were large and medium-sized flakes. The toolkit contained such types as sumatraliths and bone borers.

Lithic materials from layer O, which comprised only debitage (spalls, stone fragments, and split pebbles), testify to a continuing strategy of using various raw materials with a sharp decrease in the use of quartzite. Split bones of ungulates (deer and wild boar) discovered in layers O and P suggest that the inhabitants of the cave specialized on hunting large mammals over a considerable period of time.

Layers Q and S, whose age has been established in the range of 26–21 ka BP, were the richest in archaeological materials. Techno-typological features appearing in the previous archaeological layers K, L, and O were most clearly manifested in layers Q and S. Andesite was the main raw material exploited in these layers; basalt, limestone, and quartzite were used much more rarely. Pebble cores were used as blanks. Reduction was not preceded by preparation of striking platforms, which is confirmed by the fact that the overwhelming majority of flakes retain their natural surfaces. Along with flat-parallel cores, the layers Q and S lithic collection contained radial and irregular cores. The toolkit became more diverse here; pebble tools such as choppers made their appearance. More types of side-scrapers were also identified. In addition to discoidal side-scrapers (sumatraliths), convergent, longitudinal, and transverse varieties were also found. Notably, the collection of axes included the Hoabinhian type (bifacially flaked) and a unifacial axe (sumatralith). A bone borer and two pestles testify to the beginning of intense visits to the cave by humans and permanent habitation there. Judging by abundant bone remains, the people associated with the material culture from layer Q actively hunted deer. This, most likely, led to the disappearance of deer in the vicinity of the cave, forcing its layer S inhabitants to prey on birds, turtles, and small mammals, including rodents. Among the finds from layers Q and S, noteworthy is a half-digested bone, which is very similar to bone remains regurgitated by hyenas. While hyenas are not represented in the modern fauna of Indochina, remains of *Crocuta* have been found in Late Pleistocene deposits in southern China. Several bones exhibiting traces of burning were split by humans, probably to extract bone marrow. Generally, the Con Moong faunal assemblage corresponds with that of Late Pleistocene Indochina. Human habitation of Con Moong Cave fits well the previously elaborated cultural and chronological sequence of the site; its materials significantly enrich the Late Pleistocene human history of the region.

The Vyunshau and Maze sites in Vĩnh Phúc Province, both yielding evidence of the Sơn Vi industry, are located on prominences covered almost completely with alluvial pebbles which are eroded areas of the third terrace above the flood plain of the Lower Middle Quaternary (Nguyễn Khắc Sử, 1982). According to their age, these hills in the Hanoi Depression occupy an intermediate position between the 25–35 m Lower Middle Quaternary terrace and the 5–8 m Upper Quaternary terrace. Therefore, the age of the surface on these hills can be dated to the QIII period, and these sites can presumably be attributed to the Final Pleistocene.

The results of this study confirm the conclusions of Vietnamese archaeologists (Ha Van Tan, 1971, 1997; Ha Van Tan et al., 1999) who regarded the Sơn Vi culture as a Late Pleistocene phenomenon immediately preceding the Hòa Bình technocomplex seem convincing. The evidence from Con Moong Cave makes it possible to trace the natural history of northern Vietnam over the past 70,000 years, and to establish one of the earliest stages in the emergence of modern human populations in the region.

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References

Ciochon R.L., Olsen J.W. 1986
Paleoanthropological and archaeological research in the Socialist Republic of Vietnam. *Journal of Human Evolution*, vol. 15: 623–631.

Davidson I., Noble W. 1992
Why the first colonization of the Australian region is the earliest evidence of modern human behavior. *Archaeology in Oceania*, vol. 27: 135–142.

Derevianko A.P., Kandyba A.V., Chekha A.M. 2019
Paleoekologiya peshchery Konmong (Severny Vyetnam). *Vestnik Novosibirskogo Gosudarstvennogo Universiteta*. Ser.: Istoriya, filologiya, vol. 18. Iss. 5: Arkheologiya i etnografiya: 64–68.

Derevianko A.P., Kandyba A.V., Nguyen Khac Su, Gladyshev S.A., Nguyen Gia Doi, Lebedev V.A., Chekha A.M., Rybalko A.G., Kharevich V.M., Tsybankov A.A. 2018
The Discovery of a Bifacial Industry in Vietnam. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 46 (3): 3–21.

Derevianko A.P., Nguyen Khac Su, Tikhonov A.N., Tsybankov A.A., Kandyba A.V., Nguyen Gia Doi, Chekha A.M. 2014
Paleoekologiya peshchery Konmong (po rezultatam faunisticheskikh issledovaniy). In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territoriy*, vol XX. Novosibirsk: Izd. IAET SO RAN, pp. 36–38.

Ha Van Tan. 1971
Văn hóa Son Vi. *Khảo cổ học*, Số 11/12: 60–69.

Ha Van Tan. 1997
The Hoabinhian and before. *Bulletin of the Indo-Pacific Prehistory Association*, vol. 16 (3): 35–41.

Ha Van Tan, Nguyễn Khắc Sử, Trình Năng Chung. 1999
Văn hóa Son Vi. Hanoi: Nhà Xuất bản Khoa học xã hội.
Kahlke H.D. 1965
Neue Funde von Urmensche Resten in Ostasien. *Natur und Museum*, Bd. 93 (3): 109–115.
Kahlke H.D. 1973
A review of the Pleistocene history of the Orangutan (Pongo Lacepede 1799). *Asian Perspectives*, vol. 1: 5–14.
Kahlke H.D., Nguyen Van Nghia. 1965
Preliminary report paleontological and anthropological research in North Vietnam 1963–1964. In *Tin Tuc Dong Khoa Hoc*. Hanoi: pp. 15–33.
Marwick B. 2009
Biogeography of Middle Pleistocene hominins in mainland Southeast Asia: A review of current evidence. *Quaternary International*, vol. 202: 51–58.
McAdams C., Morley M.W., Fu X., Kandyba A.V., Derevianko A.P., Nguyen T.D., Nguyen G.D., Roberts R.G. 2019
The Pleistocene geoarchaeology and geochronology of Con Moong Cave, North Vietnam: Site formation processes and hominin activity in the humid tropics. *Geoarchaeology*, vol. 35: 72–97.
Nguyễn Khắc Sử. 1977
Hang Con Mong giới thiệu và nhận xét. *Khảo cổ học*, Số 2: 26–35.
Nguyễn Khắc Sử. 1982
Kultura shonvi i ee mesto v kamennom veke Yugo-Vostochnoi Azii. *Sovetskaya arkheologiya*, No. 3: 5–13.
Nguyễn Khắc Sử. 2007
Stone Age Archaeology in Vietnam. *Vietnam Archaeology*, vol. 2: 53–64.
Nguyễn Khắc Sử. 2009
Con Mong Cave: New data and new perceptions. *Vietnam Archaeology*, vol. 4: 40–52.
Olsen J.W., Ciochon R.L. 1990
A review of evidence for postulated Middle Pleistocene occupations in Vietnam. *Journal of Human Evolution*, vol. 19: 761–788.
Xie G.M., Li Q., Huang Q. 2003
The Baise Paleolithic Industry. Beijing: Wenwu. (In Chinese).

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A.P. Derevianko[1, 2], S.P. Nesterov[1], A.V. Tabarev[1], S.V. Alkin[1], Kazunori Uchida[3], Dai Kunikita[4], Kazuki Morisaki[5], and Hiroyuki Matsuzaki[6]

[1]Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: derev@archaeology.nsc.ru; nesterov@archaeology.nsc.ru; olmec@yandex.ru; alkin-s@yandex.ru
[2]Altai State University, Pr. Lenina 61, Barnaul, 656049, Russia
[3]Hokkaido Government Board of Education, Kita 3-jo, Nishi 6-chome, Chuo-ku, Sapporo, 060-8588, Hokkaido, Japan
E-mail: wtn_uchida@yahoo.co.jp
[4]Graduate School of Humanities and Sociology, University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, 113-0033, Tokyo, Japan
E-mail: dkunikita@yahoo.co.jp
[5]Agency for Cultural Affairs, Government of Japan, 3-2-2, Kasumigaseki, chiyoda-ku, 100-8959, Tokyo, Japan
E-mail: mediocritas@icloud.com
[6]University Museum, University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, 113-0033, Tokyo, Japan
E-mail: hmatsu@um.u-tokyo.ac.jp

Novopetrovka III—an Early Neolithic Site in the Western Amur Basin and Its Chronology

This article discusses the chronology of Novopetrovka III—a Neolithic settlement in the Western Amur basin, evaluated by the radiocarbon analysis of charred remains on pottery. The Novopetrovka culture as a whole, represented by Novopetrovka I–III and Konstantinovka sites, which had been excavated in the early 1960s, was dated to the 5th (possibly 6th) to early 4th millennia BC on the basis of the typology of the blade industry. The overview of data on prismatic blades manufactured by the pressure technique demonstrated that blade industries appeared in a vast territory of Eurasia in the Final Pleistocene to Early Holocene and, in certain regions, survived until the Chalcolithic. Therefore, they are only a rough guide to the relative chronology of the sites. In the 1990s, after the appearance of radiocarbon dates generated from samples of organic remains in temper and charred remains on pottery from Novopetrovka II, the culture was redated to 15.5–10.8 cal BP. A comparative analysis of new radiocarbon dates based on charred remains on pottery suggests that the age of Novopetrovka III is 9.0–9.5 thousand years. Because no changes were traced in the Novopetrovka sites over a long period of time, the chronological assessment of the Novopetrovka culture in toto and of its separate sites is problematic.

Keywords: *Amur Region, Novopetrovka culture, Early Neolithic, AMS-dates, charred remains, pottery, chronology, Novopetrovka III.*

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Introduction

Archaeological sites of the Early Neolithic Novopetrovka culture discovered in the vicinity of the village of Novopertovka, Konstantinovsky District, Amur Region, are located on the 8–9 m high Amur left-side terrace 1, on the left bank of the Dunayka River, 2–3 km from its confluence with the Amur. The wide Dunayka flood plain is a remnant of one of the Amur channels in the branched flow system that existed here in the Early Holocene (Nikolskaya, 1954) (Fig. 1). In the heavy rain of summer season, the water level of the Dunayka is high; during the Amur flood periods, the Dunayka is filled with the Amur water, whose level is as high as the terrace edge (Fig. 2).

In the early 1960s, three settlement sites were excavated within an area of approximately 1 km on the Dunayka promontory coastline (Fig. 3). The site of Novopetrovka I (Krutoi Mys) yielded a dwelling partly destroyed by the modern road (in 1962). The site contained artifacts from the Novopetrovka culture; a test pit was established next to this site (in 1965) (Derevianko, 1970: 14, 32–37). The Novopetrovka II site is located 1.16 km to the southeast of Novopetrovka I. The site contained eight dwellings, two utility buildings, and seven work areas of the Novopetrovka culture (1963, 1964) (Ibid.: 15, 37–109). In 1962, "several more dwellings" were excavated between the above-mentioned sites, and another large dwelling was found in 1964 (Fig. 4). It was named Novopetrovka III (Ibid.: 13–14). The site was located approx. 620 m to the southeast of Novopetrovka I and 530 m to the northwest of Novopetrovka II. However, in 2003–2004, excavations over an area of 434 m^2 have not revealed any other dwellings (Derevianko, Nesterov, Alkin et al., 2004: 102). However, approx. 340 m to the northwest of Novopetrovka II, a new site of this culture was found—Novopetrovka IV: a corner of some construction was traced in the test pit (Nesterov et al., 2008).

The characteristic feature of the Novopetrovka settlements located on the bank of the old channel of the Amur River (including the Konstantinovka site, located 20 km west of the sites, near the village

Fig. 1. View from the north, from Novopetrovka I on the Dunayka flood plain. *Photo by S.P. Nesterov, 2003*.

Fig. 2. Dunayka flood plain during the flood in 2003 (view from the north, from Novopetrovka I). *Photo by S.P. Nesterov*.

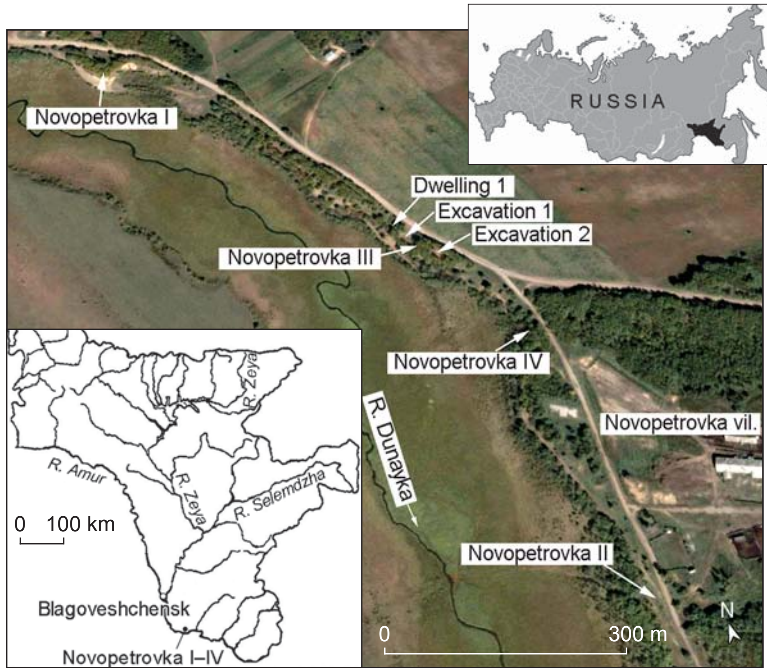

Fig. 3. Location of the sites near the Novopetrovka village.

of Novopetrovka (Derevianko, 1970: 26–17)) is the absence of any depressions on the modern surface in places over the Neolithic dwellings, which is evidenced by their stratigraphic columns (Fig. 4, *b*). Studies carried out on the terrace over an area of ca 95 m long and up to 20–28 m wide, 18 m south of dwelling 1 at Novopetrovka III, have shown that the stratigraphy is basically the same in the southern portion of the terrace and in its northern part close to the mentioned dwelling. The established stratigraphic sequence was similar to the sequence of lithological layers at other Novopetrovka sites. Analysis of stratigraphic sections of the walls and baulks of the excavations provided the generalized scheme of deposits in the given area of the terrace (Fig. 5).

Layer 1. Modern sod from 10 to 20–28 cm thick. This layer can be conventionally subdivided into two horizons, both by color and density. The roof of the layer is dense and black, while the bottom is loose and gets lighter in color. The boundary between layers 1 and 2 is uneven; in several places, frost clefts were noted.

Layer 2. Loose, light brown loam*. The layer lies subhorizontally throughout the excavated area of the terrace. The thickness varies from 30 to 40 cm, and in some portions decreases to 10 cm. The layer yielded artifacts from the Novopetrovka culture. The isolated artifacts occur throughout the thickness, mainly in the bottom part, up to the boundary with layer 3.

*In the 1960s, layer 2 was denoted as the light brown (Novopetrovka II) or grayish-brown (Novopetrovka III) sandy loam (Derevianko, 1970: 38, 110, 190). According to M.I. Dergacheva, it is not easy to distinguish between "loam" and "sandy loam" in the field conditions "by the profile distribution of granulometric fractions in terms of the genesis of modern soil owing to the possible initial heterogeneity of the parent rock…" (1997: 60, 62, tab. 1).

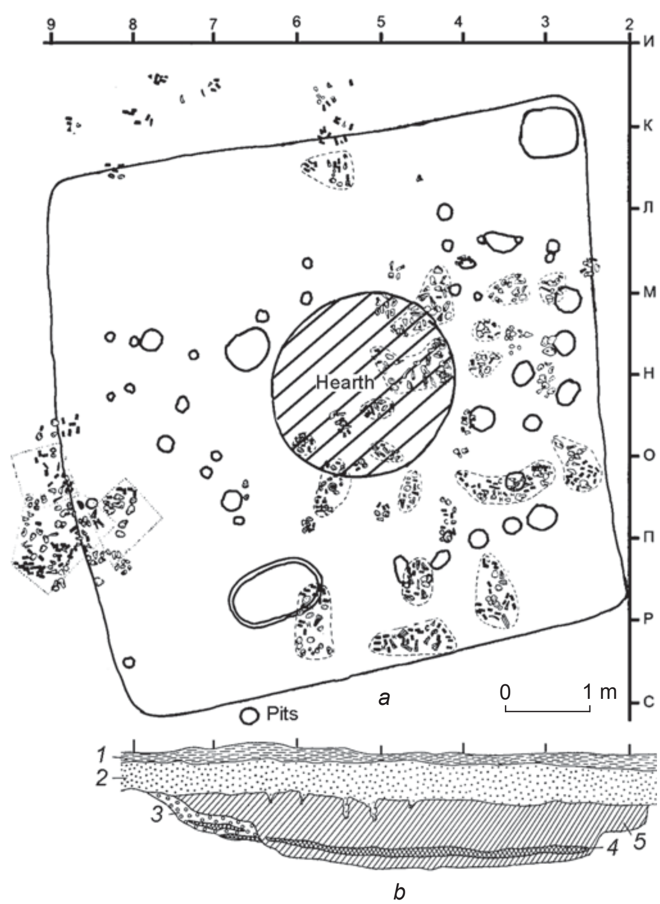

Fig. 4. Map (*a*) and stratigraphic section (*b*) of dwelling 1 (after (Derevianko, 1970: 110, 122)).
1 – sod; *2* – light-grayish-brown sandy loam; *3* – sand; *4* – black sandy loam; *5* – dark humic sandy loam.

Fig. 5. Stratigraphy of the site (2003).
a – excavation 1; *b* – excavation 2.

Layer 3. Dark mixed sandy loam. The mixed structure is caused by numerous brown loam leaks and black humic spots. The layer consists of the buried soil 12–40 cm (20 cm on average) thick; its upper border is blurred both in color and linearly; the lower border is uneven, with numerous depressions into the underlying layer 4 containing alluvial sand. In these depressions, the layer's color becomes black and more homogeneous. Judging by the planigraphic and hypsometric data, in the old times there were pits and old channels, some of which were large, up to 1.6 m deep. Saturation of the filling of these pits with the Novopetrovka artifacts (cores, broken stone tools on blades, debitage, pottery fragments, thermally split pebbles, small calcified bones, charcoal pieces, etc.) suggests that during the settlement's habitation they all were open (probably, in the deepest ones, water accumulated) and were used for household and industrial waste. Apart from the pit fillings, layer 3 does not contain any significant archaeological finds, except for those rarely found in the brown spots and leaks from layer 2. Probably, the Novopetrovka people started developing this area of the terrace from the top of layer 3, whose surface was quite uneven (Derevianko, Nesterov, Alkin et al., 2004: 97–98). Possibly owing to this last-named circumstance, the people did not erect other dwellings here.

In total, the overall collection of artifacts from the excavations of 1964 and the early 2000s (in sum, 534 m^2), and the artifacts collected from the terrace slope and defensive fighting positions of the 1940s, contains 11 thousand lithic artifacts and pottery fragments (Derevianko, 1970: 122; Nesterov, Bolotin, 2003; Derevianko, Nesterov, Alkin et al., 2004: 103). The finds' concentration decreases from north to south, i.e. away from dwelling 1, suggesting that this area, which is currently about 2700 m^2 (undoubtedly, it was larger in antiquity, which is supported by the finds under the disintegrating edge of the terrace and on the tilled field 20 m to the east of the excavations), was a long-term "camp" with one dwelling and adjacent habitation zone. Layer 2 at Novopetrovka III was found to contain lithic artifacts and pottery from the Novopetrovka culture exclusively. Isolated potsherds of the Uril, Talakan, and Mikhailovskoye cultures, as well as Troitsky group of the Mohe culture, point to the absence of any younger continuous cultural horizon of the Early Iron and medieval period at this terrace.

Blade industry as a technological phenomenon of the Final Pleistocene-Early Holocene

The lithic assemblage from Novopetrovka III was classified by typological features into eight groups of cores for production of knife-like blades, core blanks, four groups of arrowheads, massive points, two groups of knives and inserts for knives, six groups of end-scrapers, knife-like blades, burins (side, straight dihedral, and end-burins), three groups of borers, combination tools, adzes, and hoes, as well as items intended for production of stone tools (hammerstones, pressures, and grinding stones) (Derevianko, 1970: 124–154).

The collection obtained from excavations of 2003–2004 is well correlated to the above classification by the most important parameters (Derevianko, Nesterov, Alkin et al., 2004: 98–101). Most cores were imported in the form of pre-tested blanks and knapped at the site. The cores at the initial stage of flaking include specimens with one or two flaking surfaces, with partial or complete preparation of platform through fine faceting (Fig. 6). Scars of laminar detachments and preparation of platforms suggest that pressure technique was predominantly used. As long as the artisan was able to keep the necessary angle (under 90°) between the flaking surface and the platform, the core seemed to have been fixed in a special clamp. As the core became exhausted and owing to various technical faults (fractures, chipping of the flaking arch, etc.), manual fixation was used, and flaking was executed by pressure and percussion with or without intermediate tools. The main target product was tri- and tetrahedral blade blanks from 3–5 to 12–15 cm long. The blades were modified into various tools (arrow and dart-heads, points, borers, burins, knives, end-scrapers, inserts, etc.) through multidirectional burin spall removals, as well as dorsal and ventral marginal retouch (Fig. 7).

In domestic archaeology, the first systematic description of knapping techniques and methods of production of prismatic blades in the Paleolithic, Prehistoric Egypt, and in the cultures of the Mesoamerican and North American Indians was given by S.A. Semenov (1957: 61–72). He formulated the very important features of the pressure technique: "The technique of detachment of prismatic blades is based on the use of a short impulse. Obviously, these blades cannot have been produced by the direct blow of a hammerstone, as some researchers believe. This inference is supported by the striking platform on the narrow face of such blades: it is very small, sometimes barely traceable. The signs of percussion on the core platforms are never visible by optical observation of their surfaces. But the thorough preparation of the platform prior to blade-flaking is obvious. The preparation primarily consists of reduction of protrusions on the platform's margins, the so-called 'platform fringe' resulted from detachment of previous blades…" (Ibid.: 62).

Notably, experimental studies in the field of reduction techniques in foreign archaeology have been carried out since the 1940s. The authors proposed various devices for fixing cone-shaped cores and producing blades with the aid of a hammerstone or pressure tool (Barnes, 1947; Crabtree, 1968; Quintero, Wilke, 1995; Sheets, Muto, 1972; Sollberger, Patterson, 1976). Many researchers pointed to the effectiveness of the long pressure tool (lever) and imparting a considerable impulse to it (Inizan, Roche, Tixier, 1992: 64). Domestic specialists, in the 1980–1990s, also studied the advantages of the lever structure. A series of experiments led to the predominant opinion that large and standard blades could be produced

1

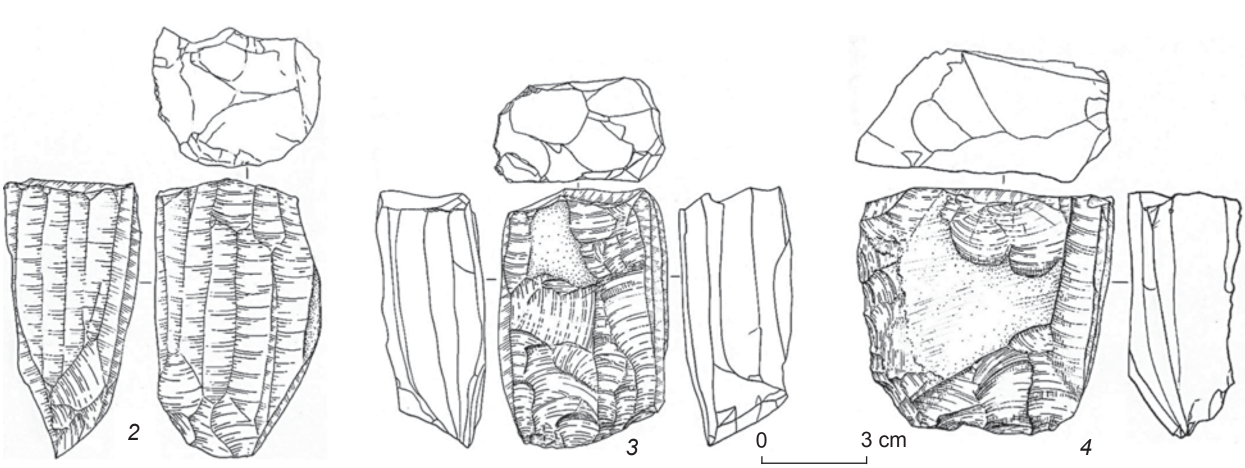

Fig. 6. Locations of cores in the cultural layer (*1*); trace-drawing of cores (*2–4*).

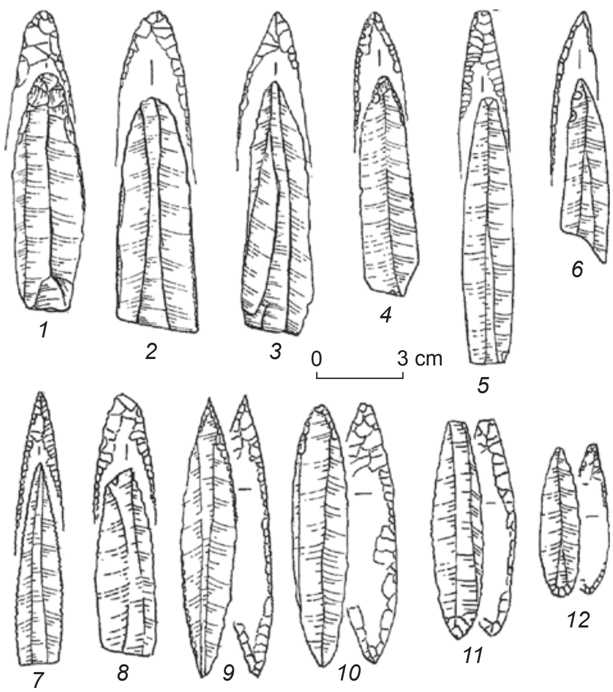

Fig. 7. Points on prismatic blades.
1–8 – with dorsal-ventral retouch on the distal end; *9–12* – with alternating dorsal-ventral retouch.

exclusively through "increased pressure" in the complex auxiliary structures (Volkov, Girya, 1990; Girya, Nekhoroshev, 1993).

During the last 15–20 years, interest in the technology of production of prismatic blades increased greatly, along with a significant increase in studies aimed at description, analysis, and replication of the techniques of particular lithic industries all over the world—in Western and Northern Europe, Near and Middle East, India, Central Asia (Gobi), Central and Mesoamerica (Pelegrin, 2002; Gladyshev, Tabarev, 2012; Borrell, Khalaily, 2016; Chabot, 2017; and others). Noteworthy is the collective monograph on the origins of pressure technique for production of micro- and macro-blades, providing the general picture of experiments with various raw materials (The Emergence…, 2012). With respect to the lithic industry of the Novopetrovka culture, these developments allow us to highlight two important points.

First, mass production of prismatic blades required comprehensive knowledge of raw materials, special devices and instruments, plus practical skills in core preparation and exploitation, along with a sufficient amount of raw materials in the form of blanks. Such stockpiles (hoards) of core blanks were found during excavations of the Novopetrovka sites (Derevianko, 1970: 42–43; Derevianko, Nesterov, Alkin et al., 2004: 51, 60) (see Fig. 6, *1*). If all these ingredients were available, the skilled artisan could have produced several hundreds of high-quality blades.

Second, despite the external unwieldiness of the lever devices, their use did not affect the mobility of the ancient hunter-fisher-gatherers. This inference is supported, for example, by the analysis of bone and horn artifacts from rich collections of the Early Holocene sites in Northern Europe. The scholars have identified four tool categories (two types of pressure tools, striking tool, and lever-heads) that were used in blade production through pressure technique (David, Sorensen, 2016: 140). Experimental observations add this series to fragments of uneven-grained abraders and pieces of skin for shock absorption when fixing a core in the device. This "kit" has 1.5–2 kg weight on average and can be easily carried in a shoulder- or waist-bag.

Chronologically, blade industries based on the pressure technique of blade detachment emerged in the vast territory of Eurasia in the Final Pleistocene to Early Holocene, documenting the transition from the Paleolithic to Neolithic. However, in some regions, these survived until the Chalcolithic, demonstrating their effectiveness in the cultures of both appropriating and producing economies.

Chronology of the Novopetrovka culture and radiocarbon dates of the Novopetrovka III settlement

In the first monographic publication describing the Novopetrovka materials, the culture was dated to the 5th (possibly 6th) to early 4th millennia BC by its tool types and working techniques (radiocarbon dates were not available at that time) (Derevianko, 1970: 190–191). The first radiocarbon dates were generated for Novopetrovka II in the late 1990s to early 2000s. Three dates were obtained on the organic temper (grass) in the paste, one date on the charred remains on a potsherd (Table 1) (Derevianko, Kuzmin, Burr et al., 2004). The only place where a vessel with grass in the paste was found was dwelling 8. In its northern part, on the floor near the wall, pottery fragments lay "as a continuous mass in several layers. These were the remains of a single vessel made of poorly tempered clay with organic temper. The firing of the vessel was poor. The color of the fragments was light gray" (Derevianko, 1970: 98). Pottery from other dwellings (2, 3, 5–7) showed sand or rock-debris as temper*. Potsherds with rock debris in the paste were found in the filling of dwelling 8 (Ibid.: 94). The origin of the sample for which the radiocarbon date of 9740 ± 60 BP (AA-38109) was obtained has not been established (Kuzmin, 2006).

*In square 17-O in dwelling 3, a large fragment of an unornamented ceramic vessel, grayish-yellow, poorly fired, tempered with crushed shell was noted (Derevianko, 1970: 59).

Table 1. **Radiocarbon dates of the Novopetrovka sites in the Western Amur basin***

Site	Material	Radiocarbon age, BP	Index	Calibrated date (±2σ), BP
Novopetrovka II**	Organic temper (grass) in ceramics	10,400 ± 70	AA-20938	12,630–12,050
"	"	9765 ± 70	AA-20937	11,320–10,800
"	Charred remains	9740 ± 60	AA-38109	11,260–10,810
Novopetrovka III	Charcoal	8040 ± 90	MTC-05943	9240–8610
Novopetrovka IV	"	7890 ± 50	IAAA-32079	8980–8590

*After (Kuzmin, Nesterov, 2010).

**The date of 12,720 ± 130 BP (AA-38103, ±2σ 15,430–14,320 cal BP) obtained on the organic temper (grass) in the paste is not included, because in all publications this date is associated with the Gromatukha culture (Derevianko, Kuzmin, Burr et al., 2004; Derevianko A.P., Derevianko E.I., Nesterov et al., 2017).

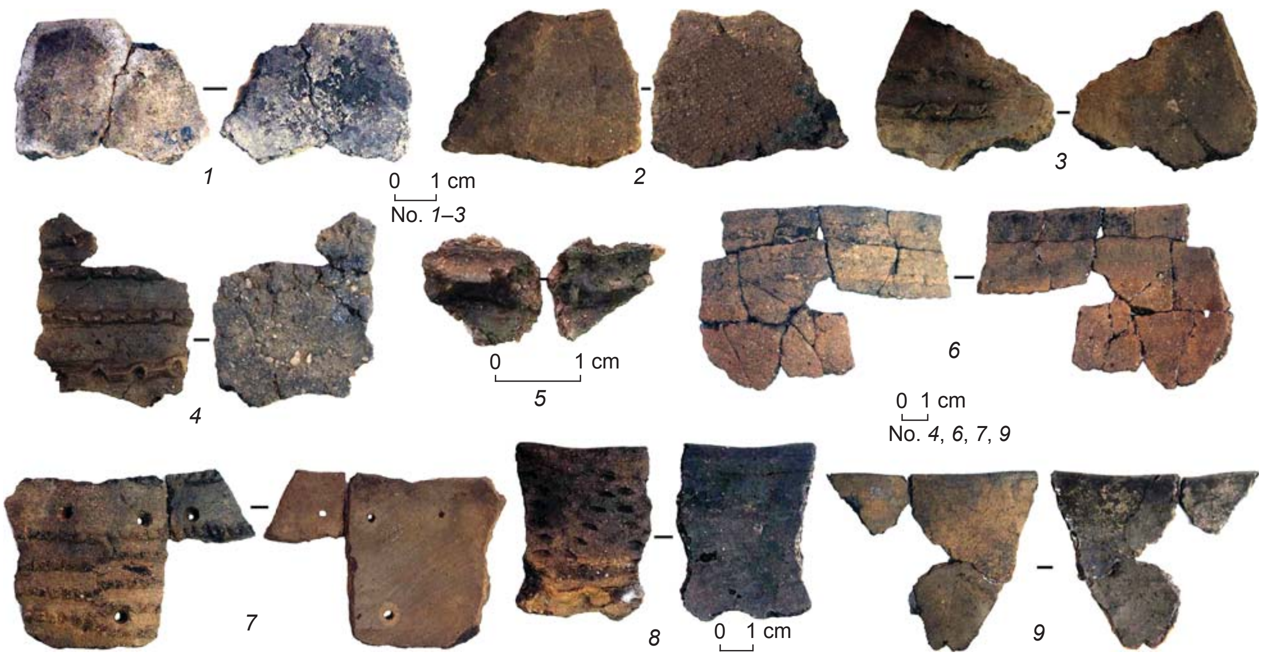

Fig. 8. Potsherds with charred remains on surfaces subjected to the radiocarbon dating (see Table 2).

For the site of Novopetrovka III, despite the availability of 16 charcoal pieces collected in 2003, only one radiocarbon date of 8040 ± 90 BP (MTC-05943), cal 9240–8610 BP (Table 1) was obtained (Kuzmin, Nesterov, 2010). In 2015, in the University of Tokyo, radiocarbon AMS-dating of ten samples of charred remains on Novopetrovka III pottery fragments (materials of 2003–2004) was carried out (Fig. 8, Table 2).

Synchronization of the calibrated dates obtained from charred remains on pottery and one date on charcoal produced two chronological ranges: the early period of 9522–9411 BP (8425 ± 30 BP, 8485 ± 35, 8535 ± 35 BP) and late period of 9030–9249 BP (8155 ± 35 BP, 8085 ± 35, 8200 ± 35, 8155 ± 35 BP; the charcoal date is 8040 ± 90 BP) (Fig. 9). The minimal gap between the end of the early period (9411 BP) and the start of the late period (9249 BP) is ca 170 years. Each interval, in its turn, consists of two periods, with a minor differences between them: 24 and 31 years. However, the limits of the three calibrated dates of the two charred potsherds (8315 ± 35 BP, 8290 ± 35 BP, and 8335 ± 40 BP) fall within both early and late chronological group. Thus, these dates can be attributed to either the early, or the late, or even the intermediate group. The first two dates were obtained on the charred remains on the interior (NOV-08i) and exterior (NOV-08o) surfaces of the fragment of a vessel rim, refitted of two pieces (see Fig. 8, *7*). They are almost identical (Table 2).

Table 2. **Radiocarbon dates obtained from the charred remains on pottery from Novopetrovka III**

Lab Code	Catalogue number of a potcherd; location in trench*	Location of the charred remains on vessel	Image number on Fig. 8	Radiocarbon date, BP	Index	Calibrated date (±2σ), BP**	δ ^{13}C, ‰
NOV-02i	169 Dwelling 1, excavation 1964	Interior surface of the rim	*1*	8425 ± 30	TKA-19750	9522–9411 (100 %)	–25.2
NOV-03i	6552 Excavation 1, sq. Ж-11, –80 cm, filling of pit 1	Interior surface of the body	*2*	8155 ± 35	TKA-19751	9142–9009 (85 %) 9249–9171 (15 %)	–24
NOV-04o	286 Excavation 1, sq. A-10, filling of pit 1	Exterior surface of the body	*3*	8085 ± 35	TKA-19752	8827–8794 (3 %) 8881–8868 (1 %) 8907–8901 (1 %) 9126–8976 (95 %)	–30.3
NOV-05o	3760 Excavation 1, sq. Л-11, horizon 4, layer 2	"	*4*	8200 ± 35	TKA-19753	9270–9030 (100 %)	–24.1
NOV-06o	No number Excavation 1, horizon 3, layer 2	Exterior surface	*5*	8155 ± 35	TKA-19754	9142–9009 (85 %) 9249–9171 (15 %)	–26.6
NOV-07i	2000 Excavation 1, sq. И-13, horizon 2, layer 2	Interior surface of the rim	*6*	8485 ± 35	TKA-19755	9537–9460 (100 %)	–25.6
NOV-08i	9713, 9714 Excavation 2, sq. И-12, –147 cm, filling of pit III	"	*7*	8315 ± 35	TKA-19756	9173–9146 (3 %) 9450–9243 (97 %)	–27.8
NOV-08o	"	Exterior surface of the rim	*7*	8290 ± 35	TKA-19757	9180–9138 (10 %) 9426–9198 (90 %)	–26
NOV-09o	8169 Excavation 2, sq. E-11, –185 cm, filling of pit III	"	*8*	8335 ± 40	TKA-19758	9161–9157 (0,4 %) 9469–9254 (99,6 %)	–27.4
NOV-011i	5931 Excavation 1, sq. В/Г-12/13, –130 cm, filling of pit 1	Interior surface of the rim	*9*	8535 ± 35	TKA-19760	9545–9484 (100 %)	–28.3

*After (Derevianko, Nesterov, Alkin et al., 2004: Fig. 26, 37, 73, 76].

**Calibrated values were calculated using Calib radiocarbon calibration program (Calib 611) (Stuiver, Reimer, 1993).

Conclusions and future prospects

Judging by the analysis of radiocarbon dates obtained from the samples of charcoal, organic temper (grass) in the paste, and charred remains on pottery from the Neolithic site of Gromatukha, Amur Region, the calibrated dates on charred remains produce the largest chronological interval (Derevianko A.P., Derevianko E.I., Nesterov et al., 2017: 12). However, in the case of ^{14}C date of charcoal sample from Novopertovka III (8040 ± 90 BP, MTC-05943), despite of its closeness to the result obtained from charred remains (8085 ± 35 BP, TKA-19752), the calibrated date of the charred remains shows the smaller time range owing to the difference in the standard deviation.

The ten calibrated ^{14}C dates on the charred remains on pottery and one date on the charcoal sample from

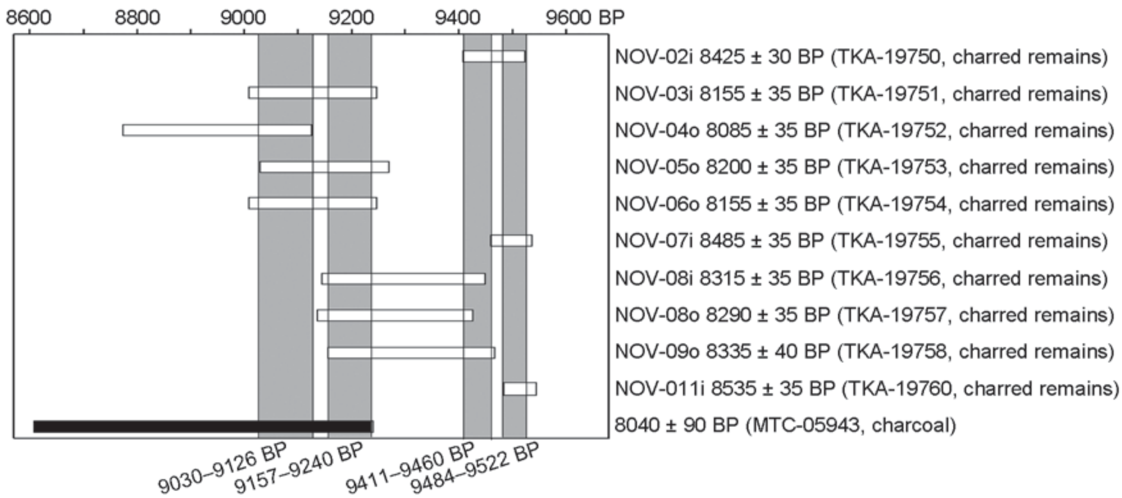

Fig. 9. Ranges of the radiocarbon dates of Novopetrovka III.

Novopertovka III make it possible to assess the age of the site as 9.5–9.0 ka BP. Despite the two chronological intervals (during the 500-year period) when artifacts were accumulated in the layer, there seem to have been no changes in archaeological materials represented by blade industry, polished tools, and pottery. At the present stage, we have not got enough data to say whether these sediments are associated with the residents of the "camp", or other inhabitants who arrived here 170 years later and whose housing-construction either did not survive or has not been uncovered yet. In addition, the potentials of the radiocarbon dating should be also taken into account.

The established chronological interval suggests that Novopetrovka III is younger than Novopetrovka II and older than Novopetrovka IV (±2σ 8980–8590 cal BP) (see Table 1). The stone blade pieces from all three sites are quite similar. On the other hand, the pottery shows certain distinctions from site to site; this is due to the presence at Novopetrovka II of isolated vessels with crushed shell and organic temper (grass) in the paste. Three calibrated (±2σ) dates for ceramics from this site fall within the range from 12.6 to 10.8 ka BP (see Table 1). The issue of the presence in one dwelling at Novopetrovka II of ceramics with both organic and sand temper requires further study, as does the art of pottery in the Novopetrovka culture in general. However, at this stage of knowledge, the available data and radiocarbon dates of the ceramics suggest attribution of this site to the range of complexes with the early ceramics in the Western (Gromatukha culture) and Eastern (Osipovka culture) Amur region, as well as in the Far Eastern region abroad.

The available radiocarbon assessments attest to the younger age of Novopetrovka III as compared to Novopetrovka II, despite the typological similarity of the artifacts.

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References

Barnes A.S. 1947
The production of long blades in Neolithic times. *American Anthropology*, vol. 49: 625–630.

Borrell F., Khalaily H. 2016
Reconstructing the last stages of bidirectional blade technology in the Levant: North and south (dis)connections. *Paléorient*, vol. 42 (2): 73–95.

Chabot J. 2017
Industrie néolithique de longues lames en obsidienne, l'exemple d'Aknashen-Khatunarkh (Arménie, début du VIe millénaire): Sur la piste des premiers débitages par pression. *Journal of Lithic Studies*, vol. 4 (2): 1–16.

Crabtree D.E. 1968
Mesoamerican polyhedral cores and prismatic blades. *American Antiquity*, vol. 33: 446–478.

David É., Sorensen M. 2016
First insights into the identification of bone and antler tools used in the indirect percussion and pressure techniques during the early postglacial. *Quaternary International*, vol. 423: 123–142.

Derevianko A.P. 1970
Novopetrovskaya kultura Srednego Amura. Novosibirsk: Nauka.

Derevianko A.P., Derevianko E.I., Nesterov S.P., Tabarev A.V., Kadzunori Uchida, Dai Kunikita, Kazuki Morisaki, Hiroyuki Matsuzaki. 2017
New data on the chronology of the initial Neolithic Gromatukha culture, Western Amur region. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 45 (4): 3–12.

Derevianko A.P., Kuzmin Y.V., Burr G.S., Jull A.J.T., Kim J.C. 2004
AMS ^{14}C age of the earliest pottery from the Russian Far East: 1996–2002 results. *Nuclear Instruments and Methods in Physics Research.* Section B: Beam Interactions with Materials and Atoms, vol. 223/224: 735–739.

Derevianko A.P., Nesterov S.P., Alkin S.V., Petrov V.G., Volkov P.V., Kang Chan Hwa, Lee Heong Jong, Kim Kyoung Ju, Oh Youn Suk, Lee Won Jun, Yang Na Re, Lee Hye Yeon. 2004
Ob arkheologicheskikh raskopkakh pamyatnika Novopetrovka III v Amurskoy oblasti v 2003 g. (Materialy arkheologicheskogo izucheniya pamyatnika Novopetrovka III na Amure v 2003 godu). Novosibirsk, Jeju-si: Izd. Fonda kultury i iskusstva Jejudo.

Dergacheva M.I. 1997
Arkheologicheskoye pochvovedeniye. Novosibirsk: Izd. SO RAN.

Girya E.Y., Nekhoroshev P.E. 1993
Nekotoriye tekhnologicheskiye kriterii arkheologicheskoy periodizatsii kamennykh orudiy. *Rossiyskaya arkheologiya*, No. 4: 5–24.

Gladyshev S.A., Tabarev A.V. 2012
Rannegolotsenoviye mikroplastinchatiye industrii Tsentralnoy Azii (po materialam kitaysko-shvedskoy ekspeditsii S. Khedina, Muzey Vostochnykh Drevnostey, Stokgolm, Shvetsiya). *Vestnik Novosibirskogo Gosudarstvennogo Universiteta*. Ser.: Istoriya, filosofiya, vol. 11. Iss. 3: Arkheologiya i etnografiya: 222–232.

Inizan M.-L., Roche H., Tixier J. 1992
Technology of Knapped Stone. Meudon: Centre national de la recherche scientifique. (Prehistoire de la Pierre Taillee; t. 3).

Kuzmin Y.V. 2006
Palaeoenvironment and chronology. In *Archaeology of the Russian Far East: Essays in Stone Age Prehistory*. Oxford: Archaeopress, pp. 13–40. (BAR Intern. Ser.; No. 1540).

Kuzmin Y.V., Nesterov S.P. 2010
Khronologiya neoliticheskikh kultur Zapadnogo Priamurya. In *Traditsionnaya kultura vostoka Azii*, iss. 6. Blagoveshchensk: Izd. Amur. Gos. Univ., pp. 103–110.

Nesterov S.P., Bolotin D.P. 2003
Pamyatnik Novopetrovka III (perspektivy issledovaniya). In *Arkheologiya i sotsiokulturnaya antropologiya Dalnego Vostoka i sopredelnykh territoriy*. Blagoveshchensk: Izd. Blagoveshch. Gos. Ped. Univ., pp. 71–77.

Nesterov S.P., Naumchenko B.V., Kuzmin Y.V., Kang Chan Hwa, Oh Youn Suk, Mineo Imamura, Minoru Sakamoto. 2008
Novopetrovka IV – noviy pamyatnik novopetrovskoy kultury na Amure. In *Traditsionnaya kultura vostoka Azii*, iss. 5. Blagoveshchensk: Izd. Amur. Gos. Univ., pp. 54–61.

Nikolskaya V.V. 1954
Paleogeograficheskiye materialy iz Novopokrovskoy stoyanki na Amure. *Izvestiya AN SSSR*. Seriya geograficheskaya, No. 5: 73–77.

Pelegrin J. 2002
La production des grandes lames de silex du Grand-Pressigny. In *Matériaux, production et circulation du Néolithique à l'Âge du bronze*, J. Guilane (ed.). Paris: Édition Errance, pp. 131–148.

Quintero L., Wilke P.J. 1995
Evolution and economic significance of naviform core–and–blade technology in the Southern Levant. *Paléorient*, vol. 21: 17–33.

Semenov S.A. 1957
Pervobytnaya tekhnika (opyt izucheniya drevneishikh orudiy i izdeliy po sledam raboty). Moscow, Leningrad: Izd. AN SSSR. (MIA; No. 54).

Sheets P.D., Muto G. 1972
Pressure blades and total cutting edge: An experiment in lithic technology. *Science*, No. 175: 632–634.

Sollberger J.B., Patterson L.W. 1976
Prismatic blade replication. *American Antiquity*, vol. 41: 517–531.

Stuiver M., Reimer P.J. 1993
Extended ^{14}C data base and revised CALIB 3.0 ^{14}C age calibration program. *Radiocarbon*, vol. 35 (1): 215–230.

The Emergence of Pressure Blade Making. 2012
P.M. Desrosiers (ed.). New York: Springer.

Volkov P.V., Girya E.Y. 1990
Opyt issledovaniya tekhniki skola. In *Problemy tekhnologii drevnikh proizvodstv*. Novosibirsk: Poligraf, pp. 38–56.

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V.V. Olenchenko[1, 2], L.V. Tsibizov[1–3], P.S. Osipova[1, 2], T.T. Chargynov[4], B.T. Viola[5], K.A. Kolobova[6], and A.I. Krivoshapkin[1, 6]

[1]Novosibirsk State University,
Pirogova 1, Novosibirsk, 630090, Russia
E-mail: olenchenkovv@ipgg.sbras.ru; tsibizovlv@gmail.com; osipovaps@ipgg.sbras.ru; krivoshapkin@mail.ru
[2]Trofimuk Institute of Petroleum Geology and Geophysics,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia
[3]Geophysical Center, Russian Academy of Sciences,
Molodezhnaya 3, Moscow, 119296, Russia
[4]Jusup Balasagyn Kyrgyz National University,
Frunze 547, Bishkek, 720033, Kyrgyzstan
E-mail: chargynov@mail.ru
[5]University of Toronto,
27 King's College Circle Toronto, Ontario M5S 1A1, Canada
E-mail: bence.viola@utoronto.ca
[6]Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: kolobovak@yandex.ru

Peculiarities of Using 2D Electrical Resistivity Tomography in Caves

The efficiency of archaeological studies inside caves could be greatly enhanced by geophysical methods because of their potential for examining deposit structure and features. Application of those methods in caves entails a number of problems caused by limited space for measurements and the complexity of the surrounding medium's structure as compared to above-ground measurements. In 2017, Selungur Cave in the Fergana Valley, Kyrgyzstan, was examined using electrical resistivity tomography. Because of the above concerns, in the course of the work the question of the reliability of the results arose. To clarify the issue, a numerical experiment was performed to assess the effect of the three-dimensional cave geometry on the results of a two-dimensional inversion. It was found that variations of cave geometry parameters result in unexpected false anomalies, and considerable errors in bedrock location and resistivity can occur. In the case of downward diverging cave walls, an accurate resistivity section can be obtained by using the inversion based on a two-dimensional model. Therefore, electrical resistivity tomography in caves with similar geometry can yield reliable results concerning the shape of bedrock surface, the thickness of sedimentary layers, and size and position of inclusions such as fallen fragments of roof therein.

Keywords: *Archaeogeophysics, geophysical studies, inversion, numerical modeling, geoelectrics, Selungur Cave.*

Introduction

Geophysical methods are widely used in archaeological studies (Campana, Piro, 2008; Witten, 2017; El-Qady, Metwaly, Drahor, 2019). One of the important questions that could be answered with geophysics is: how deep is a bedrock. Precise information about bedrock's form and deepness can bring a vast improvement to excavation planning. Electrical resistivity tomography (ERT) is an effective method for such studies. Bedrock and sediments are often quite different in their electrical resistivity; therefore, the bedrock's surface can be registered as a high-contrast border in an electrical resistivity section. In the case of irregular surface of bedrock, three-dimensional ERT is required to build a correct model of it. The situation inside a cave is more complex: long and narrow space gives no opportunities to implement a 3D survey. Beyond that, the electrical current can flow through the cave ceiling and make an unexpected contribution to measured data. We have found two articles where ERT studies inside closed space are considered: in a pyramide (Tejero-Andrade et al., 2018) and in a church (Tsokas et al., 2008). Most often, geophysical studies are carried out above caves, on the daylight surface, for establishing the location of passages or the stability of the cave's roof (Leucci, De Giorgi, 2005; Cardarelli et al., 2010; Martinez-Moreno et al., 2013). An ERT application for determining of sedimentary layer thickness and morphology was described, whose functions included prospecting sites of archaeological interest. Depth of electrical resistivity sections did not exceed 4 meters, whereas archaeological excavation showed 12-meter thickness of sediments (Obradovic et al., 2015).

The problem turned up for the authors during multidisciplinary research at Selungur Cave, in the southern part of the Fergana Valley, in Kyrgyzstan (Fig. 1). This cave is one of the largest karst cavities in Central Asia. The site was excavated in the 1980s, when it was described as an Early Paleolithic item. New study in 2014 has proved that stone complexes from Selungur Cave have Middle Paleolithic characteristics (Kolobova et al., 2018; Krivoshapkin et al., 2018). The scientific significance of the site, due to the uniqueness of its anthropological and archaeological finds, requires further research into it.

Fig. 1. Location of Selungur Cave.

Methods

Geophysical methods, including ERT (Tsibizov et al., 2017), were used there in order to choose the most promising areas to excavate. Electrical resistivity tomography was performed using the "Skala-48" equipment along 6 parallel profiles located at a distance of 1 m from each other along the main gallery of the cave (Fig. 2, *a*). A pole-dipole array was used for measurements (Fig. 3). It is more sensitive to local inhomogeneities, as compared to the Wenner-Schlumberger array, and the data obtained are less noisy as compared to the dipole-dipole array. The number of electrodes was 48, the distance between the electrodes varied from 1 to 5 m, and the *n* factor varied from 1 to 6. The maximum *na* distance was 30 m. The maximum depth of research was 11 m. In order to decrease grounding resistance, points of contacts were watered with brine.

Data processing was carried out using the two-dimensional and three-dimensional inversion programs Res2DInv and Res3DInv (Loke, 2002, 2007). A robust inversion with a standard threshold coefficient of 0.05 was used. This limitation tends to give a model with contrasting boundaries between areas with different resistance values, but within each area these values are almost constant. This is acceptable for solving such a geological problem as the boundary between loose and bedrock rocks, which corresponds to our case.

Results

In the lower part of the geoelectric section in profile 4, the estimated boundary of the top of the bedrock with a specific electrical resistivity of 600–2000 Ohm·m was identified (see Fig. 2, *b*), overlaid with loose deposits (200–500 Ohm·m). Sediments with a resistivity of less than 100 Ohm·m in the interval 25–30 and 35–40 m are represented by moist cave loess. Large fragments of the roof buried in loose rocks are distinguished by high-resistivity anomalies.

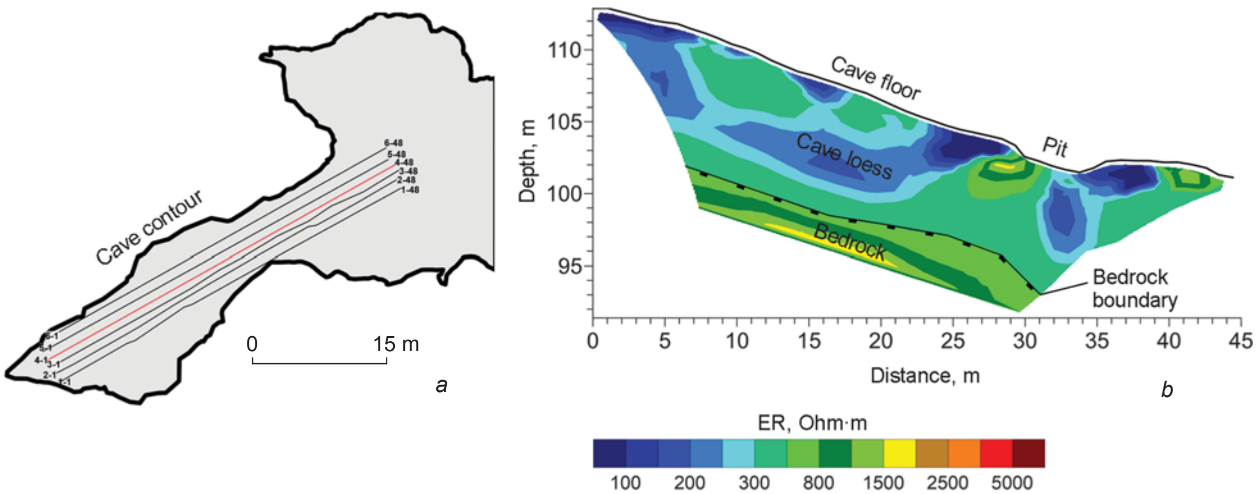

Fig. 2. Location of profiles inside Selungur Cave (*a*), and resistivity section along profile 4 (*b*).

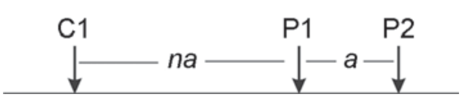

Fig. 3. The scheme of pole-dipole array: C1– current electrode; P1, P2 – potential electrodes.

An area of a collapse appears on the section as a local anomaly of high resistivity in the interval of 41–43 m. Starting from 30 m, the bedrocks subside abruptly. This is explained by a fault zone that cuts the cave across the main gallery prolongation. The results of electrotomography have been confirmed during excavations: the depth of the sediments in the largest gallery of Selungur Cave reaches 6–9 meters.

The obtained results seem quite informative; nevertheless, it is not clear how trustworthy they are. In order to clear up this question, we conducted numerical modeling of ERT surveys in caves with different geometrical parameters. Synthetic results were analyzed and compared to field data.

Numerical modeling was done with Comsol Multiphysics software. The cave was approximated by a 3D-medium (150 × 100 × 100 m) with a cavity partially filled with sediments (Fig. 4). The length, width, and height of the cavity's free space were equivalent to 70, 10, and 5 m respectively. The thickness of the sediments varied between 2.5, 5, and 10 m. The electrical resistivity of the medium was estimated during the field studies (Tsibizov et al., 2017) and equivalent to 1000 Ohm·m for the bedrock and 200 Ohm·m for the loose deposits. In order to estimate the influence of the ceiling (which could conduct a part of the current), all numerical experiments were carried out in models both with ceiling and without it (half-space models). A pole-dipole array was modeled (according to the field measurements). The model was enclosed by "infinite elements" (to model the infinite electrode) with "ground" conditions ($U = 0$) on their external boundaries. On the basis of the modeled data, two-dimensional inversion was done with RES2DInv software. The number of data points for each profile in 2D-modeling was 916. In Fig. 5–7, inversion results in six considered cases are provided.

With the sedimentary layer 2.5 m thick (Fig. 5), the thickness of the sediments is determined quite adequately. In the first case (without a roof), a false low-resistivity anomaly (up to 300 Ohm·m) appears starting from a depth of 12 meters. Inversion yields a bedrock resistivity bigger by a factor of 2–5 than in the forward model. In the second case (with a roof), similar results are obtained, but the low-resistivity anomaly reaches 150 Ohm·m and starts from a depth of 9 m.

With the sedimentary layer 5 m thick (Fig. 6), the thickness of sediments in these both cases is underestimated (3.5 m), and bedrock resistivity is twice as big as in the model. Low-resistivity anomaly (up to 550 Ohm·m) is recorded only in the second case (with roof).

With the loose deposits 10 m thick, the surface of bedrock cannot be determined if the cave's wall is 5 m from the profile (Fig. 7). The wall creates a false "border" in the section at a depth of 5 m. Bedrock resistivity is restored quite well (1200 Ohm·m) in the model with a roof; and in the restored half-space model without roof, it rises up to 4200 Ohm·m with depth, which is not in agreement with the true model.

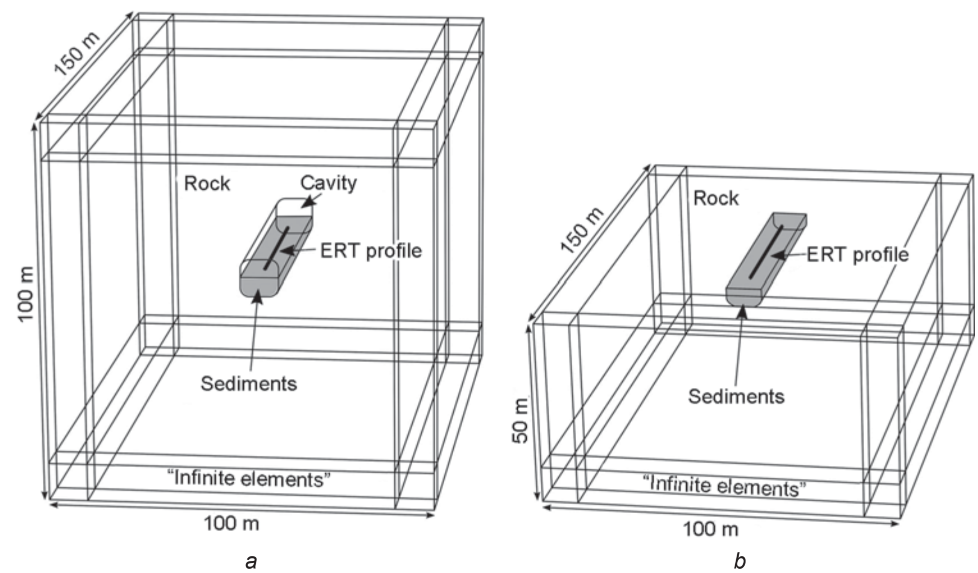

Fig. 4. General view of the considered finite-element models.
a – cavity with low-resistive (200 Ohm·m) sediments inside conductive (1000 Ohm·m) space; *b* – conductive half-space with sediments.

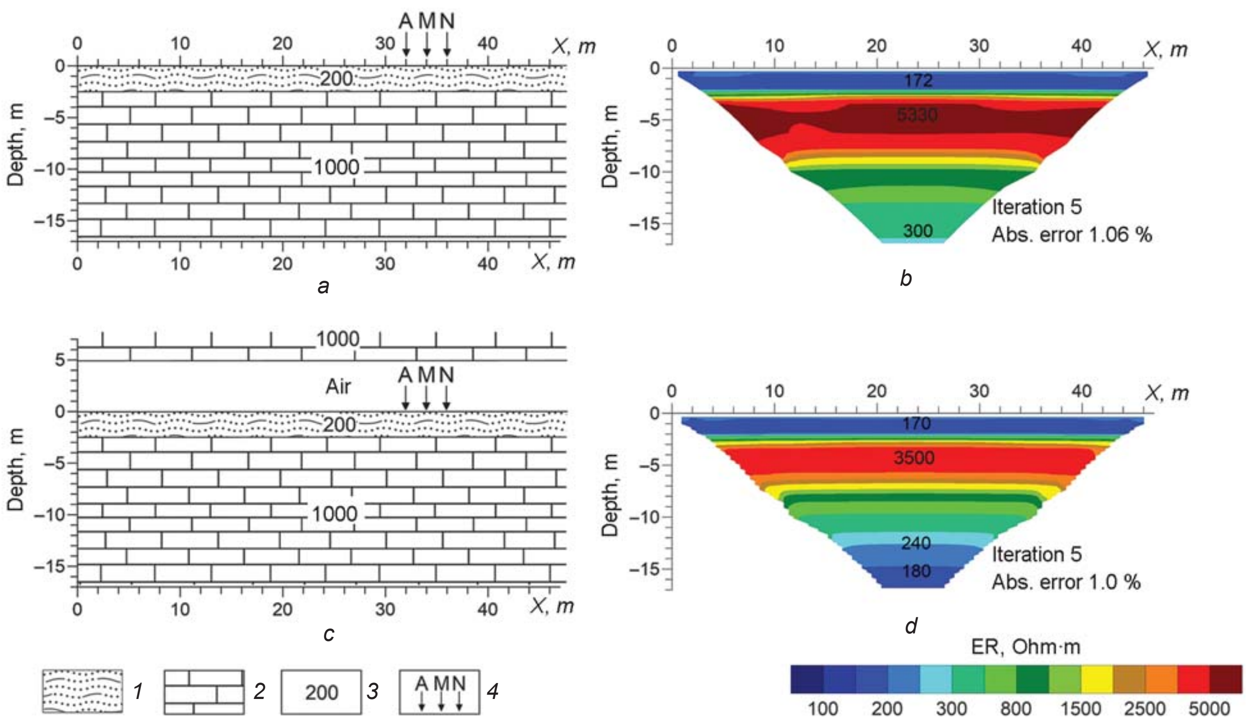

Fig. 5. Geoelectrical models of cave without roof (*a*) and with roof (*c*), and the respective 2D inverse model resistivity sections (*b*, *d*) of forward modeling data. Thickness of sedimentary layer is 2.5 m.
1 – cave loess; *2* – limestone; *3* – resistivity; *4* – pole-dipole array.

Discussion

Numerical modeling showed that 2D automatic inversion that uses a forward problem for half-space cannot be applied for processing of data obtained from the cave in the general case. The sedimentary layer's thickness will not be determined if it exceeds the distance to the cave's wall. The electrical resistivity of sediments and bedrock will be determined incorrectly.

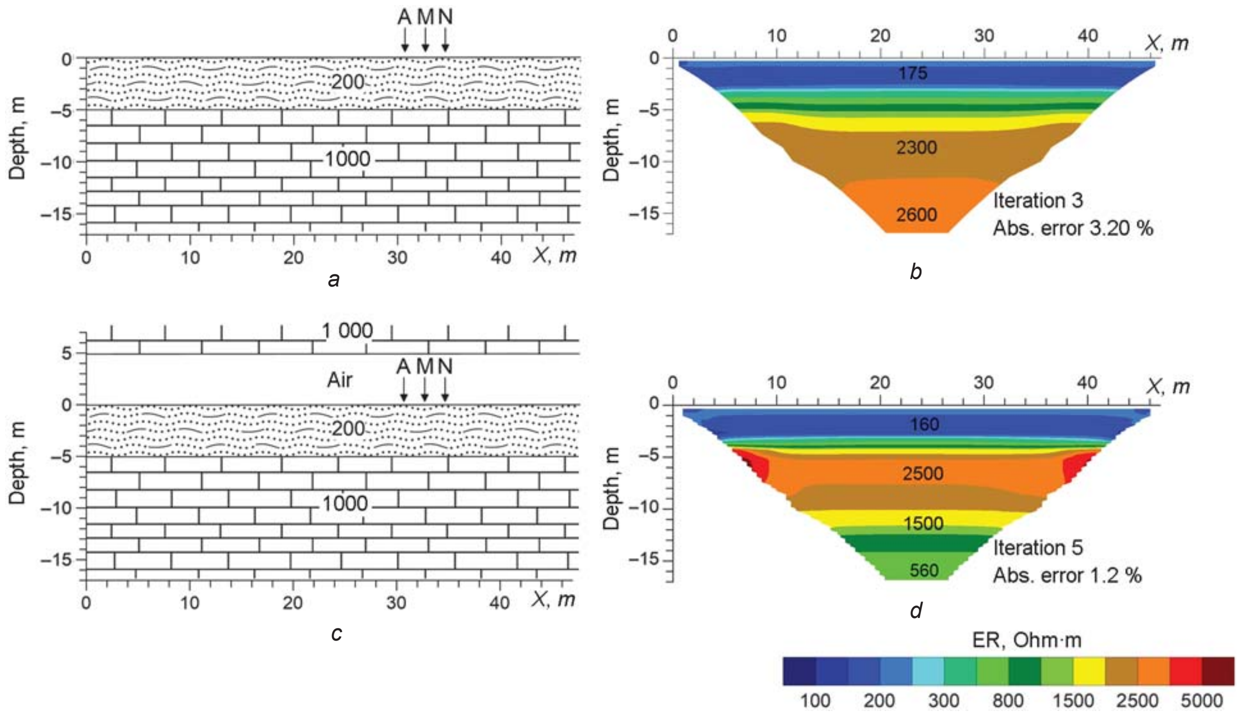

Fig. 6. Geoelectrical models of cave without roof (*a*) and with roof (*c*), and the respective 2D inverse model resistivity sections (*b*, *d*) of forward modeling data. The thickness of sedimentary layer is 5 m.
See Fig. 5 for conventions.

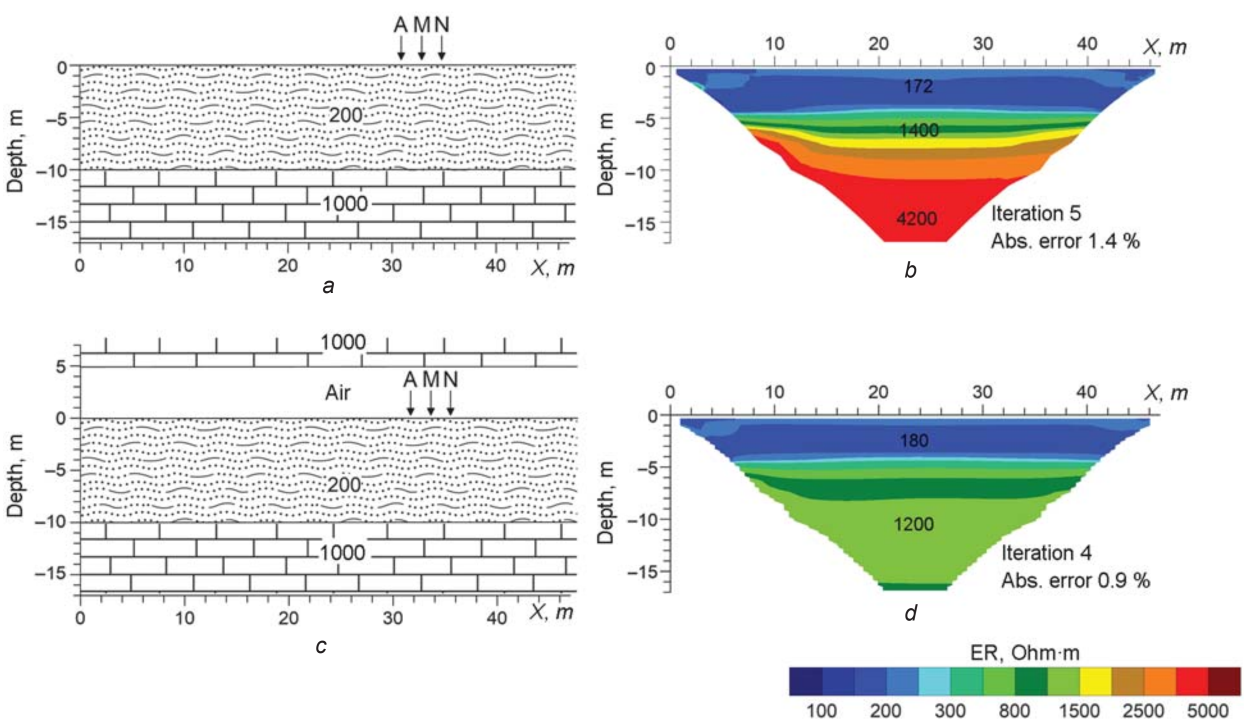

Fig. 7. Geoelectrical models of cave without roof (*a*) and with roof (*c*), and the respective 2D inverse model resistivity sections (*b*, *d*) of forward modeling data. Thickness of sedimentary layer is 10 m.
See Fig. 5 for conventions.

Additionally, a three-dimensional survey was modeled in order to estimate how such a setting could improve the results. Seven parallel 2D survey lines were combined into a 3D set (Fig. 8). Data from profiles 2, 3, 4 were used twice—for these and for symmetric profiles (which are not shown in the Figure). For the subsequent inversion, Res3DInv software was used. Outer profiles were set on the cave wall. The total number of measurement points in 3D modeling was 6412.

In the case of low (2.5 m) thickness of sediments (Fig. 9, *a*), the bedrock-sedimentary border is determined confidently; but the resistivity of sediments (120–130 Ohm·m) and bedrock (up to 2250 Ohm·m) is under- and overestimated, respectively, as compared to the true model. In the case that the sedimentary layer's thickness exceeds half of the cave's width (Fig. 9, b), neither bedrock depth nor resistivity of the layers can be restored. The depth of the border between low- and high-resistivity layers (sediments and bedrock) was higher than in the geoelectrical model of the cave. As can be seen from the above, even three-dimensional inversion does not restore the geoelectrical model of the cave in examined cases.

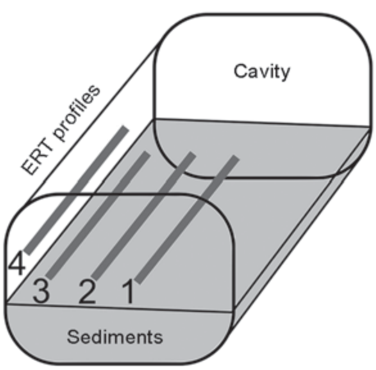

Fig. 8. Scheme of ERT profiles in three-dimensional modeling.

Do the results mean that for each cave wrong geoelectrical sections would be obtained? The field data reject this. The section does not contain any low-resistivity anomalies in its lower part (see Fig. 2), but the sedimentary layer's thickness (8 m) is bigger than half of the cave's width (5 m). Why do the modeling results contradict the field data? We supposed that the complex geometry of the cave was not taken into account, and built another model (Fig. 10, *a*): cave walls were extrapolated downwards (in accordance with the observed slope angle of 70° in their exposed part), and a rough form of the roof was also included in the model. The sedimentary layer's thickness was assumed to be 8 m, its resistivity 200 Ohm·m, and bedrock resistivity 1000 Ohm·m (according to field data). The line was situated along the cave, equidistantly from its walls.

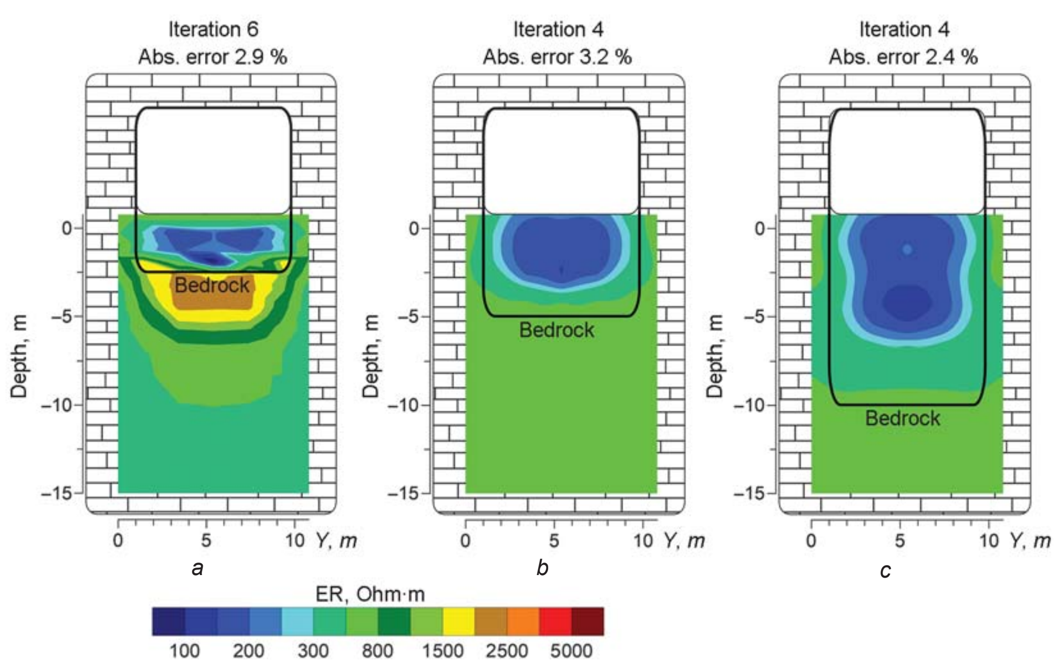

Fig. 9. 3D restored model resistivity sections with thickness of sediments 2.5 m (*a*), 5.0 m (*b*), and 10 m (*c*).

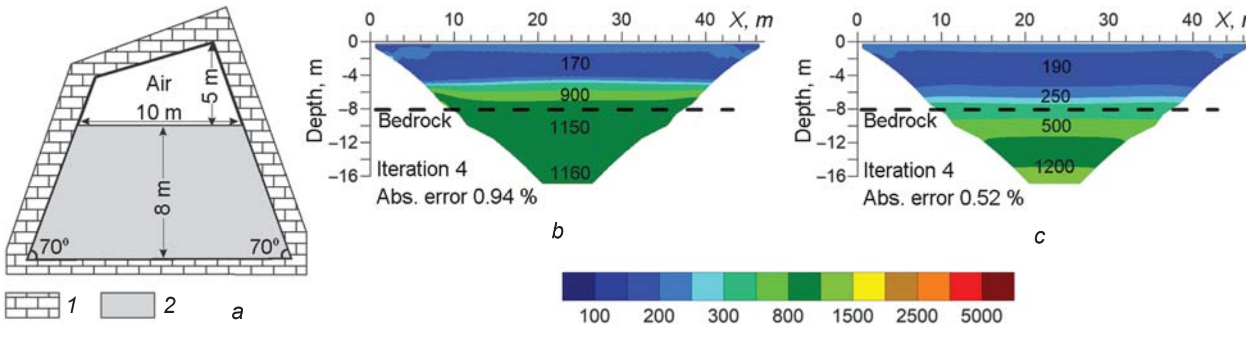

Fig. 10. Model of Selungur Cave with sloping walls (*a*), and inversion results for this model (*b*) and for simple two-layered model (*c*).
1 – bedrock; *2* – sediments.

The three-dimensional forward problem was solved for the model, and then, on the basis of the obtained data, two-dimensional automatic inversion (developed for half-space) was done. In this case, the inversion yielded a good-fitting result: resistivity and border are restored (Fig. 10, *b*). We compared the obtained data with the inversion result for a two-layered model with similar parameters (ρ_1 = 200 Ohm·m, h_1 = 8 m, ρ_2 = 1000 Ohm·m, $h_2 = \infty$). The resistivity of the upper layer is quite close to "real", but the border is diffused (Fig. 10, *c*). We have assured that in the case of diverged walls their influence on the current distribution was smoothed over, and two-dimensional inversion for half-space yielded a credible result.

Conclusions

ERT with the use of 2D inversion generally cannot be applied to study inside a cave whose half-width is smaller than the thickness of sediments. Use of the method under adverse conditions can lead to the production of false low-resistivity anomalies in the lower part of the section, error in locating of borders of rocks, and incorrect estimation of their electrical resistivity. Three-dimensional survey and inversion do not essentially improve the quality of results. Nevertheless, in some cases (as was shown from the abovementioned field study), two-dimensional ERT gives a good-fitting model of cave structure. This becomes possible when cave walls diverge, with the depth and current distributed approximately as in 2D medium. The use of other geophysical techniques, such as ground-penetrating radar, in complex with ERT seems efficient, but can be complicated by reflections from caves' roofs and walls.

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References

Campana S., Piro S. 2008
Seeing the Unseen: Geophysics and Landscape Archaeology. London: CRC Press.

Cardarelli E., Cercato M., Cerreto A., Di Filippo G. 2010
Electrical resistivity and seismic refraction tomography to detect buried cavities. *Geophysical Prospecting*, vol. 58: 685–695.

El-Qady G., Metwaly M., Drahor M.G. 2019
Geophysical techniques applied in archaeology. In *Archaeogeophysics: State of the Art and Case Studies*. Cham: Springer, pp. 1–25.

Kolobova K.A., Flas D., Krivoshapkin A.I., Pavlenok K.K., Vandenberghe D., De Dapper M. 2018
Reassessment of the Lower Paleolithic (Acheulean) presence in the western Tien Shan. *Archaeological and Anthropological Sciences*, vol. 10: 615–630.

Krivoshapkin A., Viola B., Chargynov T., Krajcarz M.T., Krajcarz M., Fedorowicz S., Shnaider S., Kolobova K. 2018
Middle Paleolithic variability in Central Asia: Lithic assemblage of Sel'ungur Cave. *Quaternary International*, vol. 535: 88–103.

Leucci G., De Giorgi L. 2005
Integrated geophysical surveys to assess the structural conditions of a karstic cave of archaeological importance. *Natural Hazards and Earth System Science*, vol. 5: 17–22.

Loke M.H. 2002
RES2DINV ver. 3.50. Rapid 2-D resistivity and IP inversion using the least-squares method. URL: https://moodle.polymtl.ca/pluginfile.php/419838/mod_resource/content/0/MANUELRES2Dinv.pdf

Loke M.H. 2007
Res3Dinv Software, Version 2.14. Geoelectrical imaging 2D&3D, Pinang. URL: http://personales.upv.es/jpadin/coursenotes.pdf

Martinez-Moreno F.J., Pedrera A., Ruano P., Galindo-Zaldivar J., Martos-Rosillo S., Gonzalez-Castillo L., Sanchez-Ubeda J.P., Marin-Lechado C. 2013
Combined microgravity, electrical resistivity tomography and induced polarization to detect deeply buried caves: Algaidilla Cave (southern Spain). *Engineering Geology*, vol. 162: 67–78.

Obradovic M., Zeid N.A., Bignardi S., Bolognesi M., Peresani M., Russo P., Santarato G. 2015
High resolution geophysical and topographical surveys for the characterisation of Fumane Cave prehistoric site, Italy. *Near Surface Geoscience 2015. 21st European Meeting of Environmental and Engineering Geophysics*, vol. 1: 1–5.

Tejero-Andrade A., Argote-Espino D.L., Cifuentes-Nava G., Hernández-Quintero E., Chávez R.E., García-Serrano A. 2018
'Illuminating' the interior of Kukulkan's Pyramid, Chichén Itzá, Mexico, by means of a non-conventional ERT geophysical survey. *Journal of Archaeological Science*, vol. 90: 1–11.

Tsibizov L.V., Krivoshapkin A.I., Osipova P.S., Olenchenko V.V., Grigorevskaya A.V., Viola B., Chargynov T., Kolobova K.A., Shnaider S.V. 2017
Aprobatsiya kompleksa geofizicheskikh metodov v peshchere Selungur (Kyrgyzstan). *Teoriya i praktika arkheologicheskikh issledovaniy*, No. 4: 169–177.

Tsokas G.N., Tsourlos P.I., Vargemezis G., Novack M. 2008
Non-destructive electrical resistivity tomography for indoor investigation: The case of Kapnikarea Church in Athens. *Archaeological Prospection*, vol. 15: 47–61.

Witten A. 2017
Handbook of Geophysics and Archaeology. New York: Routledge.

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L.V. Zotkina, N.V. Basova, A.V. Postnov, and K.A. Kolobova
Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: lidiazotkina@gmail.com; bass15@yandex.ru;
postnov@yandex.ru; kolobovak@yandex.ru

An Elk Figurine from Tourist-2, Novosibirsk: Technological and Stylistic Features

Most figurines from the Bronze Age cemetery Tourist-2 in Novosibirsk are anthropomorphic, and follow one and the same iconographic style, termed "Krokhalevka". Two fragments, however, refer to a zoomorphic image—that of an elk. As they cannot be refitted, a special analysis was carried out. Computer-aided measurements and statistical comparisons suggest that they belong to a single specimen. This is important for further study, the search for parallels, and interpretation. Stylistic comparison with other items of portable art from Tourist-2 is difficult, since these are anthropomorphic. Nonetheless, the analysis suggests that the elk figurine is a perfect match with the homogeneous and stable technological complex revealed by other specimens. In terms of technology and style, the elk figurine parallels those of the Late Angara figurative tradition. Because the Tourist-2 burial had not been dated, a preliminary AMS-date of 4601 ± 61 BP (3511–3127 cal BC) was generated. Given this date and the archaeological context of the elk figurine, it can provide a reference point for the cultural and chronological attribution of other stylistically and technically similar images.

Keywords: *Stone figurines, technology, style, Bronze Age, Krokhalevka culture, rock art.*

Introduction

Among the items of portable art from Tourist-2, representing mainly anthropomorphic images, a figurine of an elk made of shale was discovered. It is especially interesting in its similarity to other items of portable art from this site, which belong to a very specific motif-stylistic complex of the so-called Karakol-Okunev circle (Basova et al., 2017; Kolobova et al., 2019: 73; Basova et al., 2019). The context of this find was quite peculiar. While the rest of the items of portable art were found directly in graves, the fragments of the elk figurine were located outside the burial complexes. The shale at the place of fractures has crumbled, and the two pieces do not fit with each other.

The settlement of Tourist-2 is located on the above-floodplain terrace of the right bank of the Ob River, 1.3 km north of the modern mouth of the Inya River, in the central part of Novosibirsk. The site was studied by excavations in 1990, and even then a long-term technogenic impact on the territory of the site of cultural heritage was noted (Molodin et al., 1993: 6–7). During the 2017 rescue fieldworks, carried out in connection with the development of the embankment, an Early Bronze Age burial ground was discovered, which included 21 flat graves. All the deceased were laid in an extended position on their backs (Basova et al., 2017: 510). Some of the graves contained Krokhalevka ceramics, which made it possible to attribute the entire complex of portable art to this culture (Basova et al., 2019: 54; Molodin, 1977:

Pl. LXIV, 1; LXVI, 3, 4; Bobrov, Marochkin, 2016; Polosmak, 1978, 1979). The site has been completely excavated. The uncovered area was 6040 m^2, the collection of artifacts recorded in 2017 totals 10,394 items. The overwhelming majority of items identified in the settlement assemblage belong to the Krokhalevka culture. The stylistic and iconographic unity of the items of portable art against the background of a clear cultural and chronological context of the finds made it possible to identify the figurative style as "Krokhalevka" (Basova et al., 2019).

Two fragments of presumably the same figurine of an elk (Fig. 1, *1*) were found together, lying one on top of the other, on the territory of the burial ground, outside the grave (excavation area, sq. 101/364). They are identical in terms of raw material, texture, and color; and both show very similar processing techniques. These considerations made it possible to assume that they constituted one item—a two-sided flat figurine of an elk. The length of the item, taking into account the missing fragment, was about 22 cm, width (along the body) 2.9 cm, thickness about 0.4 cm (Basova et al., 2019: 59, fig. 8). The items were found while exposing the baulk. Stratigraphically, their occurrence was traced at the very top of the cultural layer, at the point of contact with the technogenically altered lithological formations. Since this area of the site has undergone intense man-made interventions, it can be assumed that the fragments of an elk figurine were in the grave, like other items of portable art; but the burial was destroyed by the equipment, and the fragments of the figurine remained in the depression. Their arrangement one on top of the other may indicate that these items were not re-deposited as a result of earthworks, since such an intervention would undoubtedly separate them. As the excavations showed, part of the burial ground was destroyed. Fragments of human bones that were located not in anatomical order (along with randomly scattered artifacts lying in the same layer with modern debris) were recorded in these technogenically altered layers.

It can be assumed that the fragments of the elk figurine belonged to the settlement of the Krokhalevka culture, but this is unlikely, since below them there were no archaeological finds of this settlement, and the fragments lay at the same level as the grave goods. In addition, their location (one on top of the other in the same orientation) barely corresponds to the spatial distribution of finds in a settlement with a characteristic scattering of fragments of one item. However, one cannot completely rule out the possibility that fragments of the elk figurine constituted a treasure, as well as the likelihood of their belonging not to one, but to different sculptures. This issue requires special study.

The assemblage of items of portable art from the Tourist-2 burial ground is one of the pivotal examples

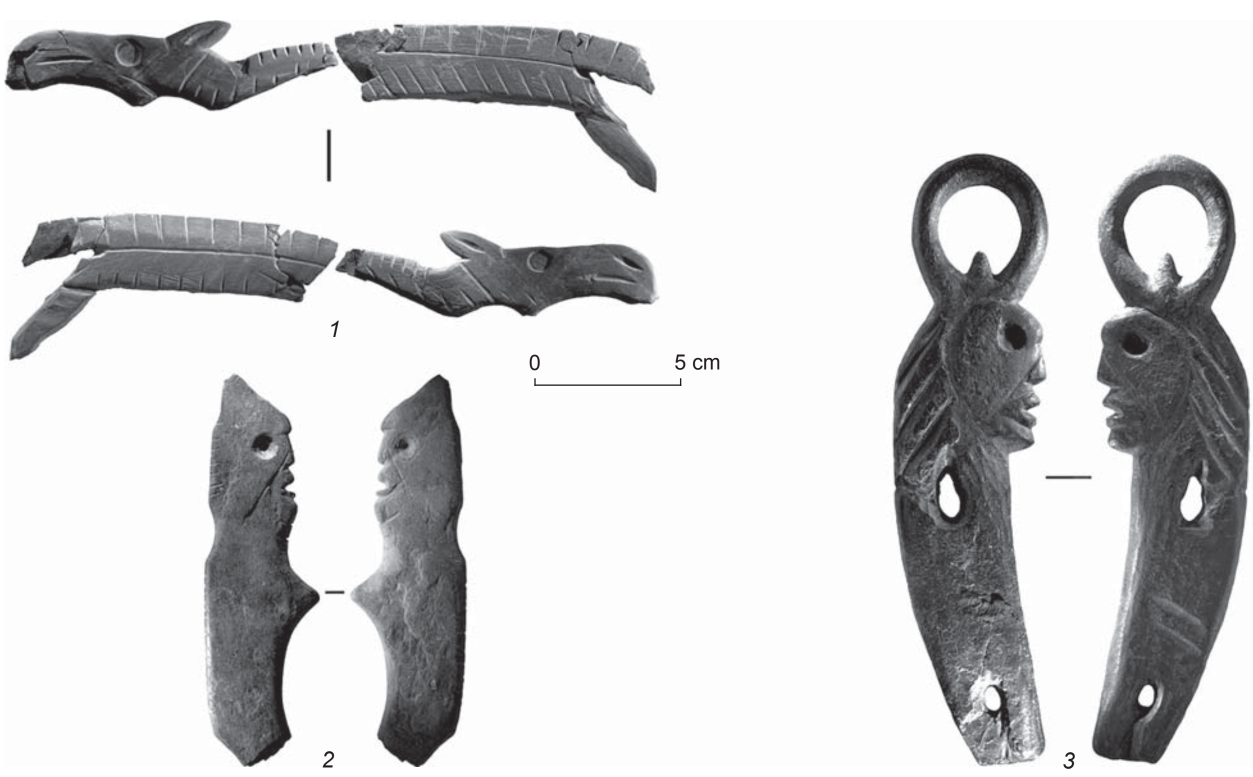

Fig. 1. Items of portable art from the Tourist-2 site.
1 – figurine of elk made of shale; *2* – anthropomorphic image made of shale (burial 6); *3* – anthropomorphic buckle made of burl (burial 5).

for the comparative-stylistic and stylistic-technological analysis of samples of the visual art of the Early Bronze Age in Siberia (Ibid.: 53–65). If all other figurines from this site come from graves that can be dated by radiocarbon method, then the sculpture was found outside the grave. Thus, the context of the find demands an answer to the question of whether it belongs to a portable art complex from the Tourist-2 cemetery, which is quite homogeneous in terms of style and technology, as well as its comparison with other items of portable art with a reliable dating context (in graves).

It is necessary to determine the place of the considered elk figurine in the general picture of development of the ancient art style in the region. Earlier, a brief stylistic description of this image was provided, and several analogs were proposed; as a result, it was noted that the figurine has features of the Angara figurative tradition (Ibid.: 62). However, in order to answer the question posed above and to clarify the place of this sculpture within the Angara style, it is necessary to consider in more detail both the artistic and technological techniques of its creation.

To obtain reliable information about the age of the Tourist-2 site, a series of dates is needed. However, items of portable art found in a dated archaeological context are extremely rare in Siberia. Therefore, even one radiocarbon date is of great importance for obtaining an idea about the age of the considered figurine. An animal bone from burial 6 at Tourist-2 produced the first preliminary radiocarbon date of 4601 ± 61 BP (NSKA-2423). Its calibration in the OxCal 4.3 software (Bronk Ramsey, 2009), using the IntCal13 calibration curve (Reimer et al., 2013), gave the intervals of 3511–3127 (1σ – 68.2 %) and 3622–3101 (2σ – 95.4 %) years BC. This date can be regarded as an important chronological reference, and makes the artifact in question one of the reference examples of the Early Bronze Age portable art in Siberia.

Methods

The study of the elk figurine from Tourist-2 was performed in two directions: a technological analysis and a search for stylistic parallels were carried out. To characterize the design techniques, the figurine was examined using an Olympus SZ2-ET binocular stereoscopic microscope (×8–56). Based on the data obtained, a technical drawing of all the identified traces of the artifact was made. The macro-photographs were remotely stacked using the indicated microscope and Nikon D750 camera, glued using Helicon Focus software. Notably, not only was the elk figurine analyzed, but also all the items of portable art from Tourist-2. This made it possible to speak about the degree of homogeneity of technological and figurative techniques of execution and about the place of the figurine under consideration in the assemblage.

To search for parallels, published materials on portable and rock art in the region were used. The study of technological and stylistic characteristics of items of ancient fine art as signs of the "plan of expression" (Sher, 1980: 25) is a very promising area. This approach allows us to identify important combinations of them, which are difficult to detect by examining only one of these aspects (see, e.g., (Molodin et al., 2019)).

In order to find out whether the two fragments (head and body) were parts of the same figurine, we used the method of determining the belonging of unrefitted fragments to one artifact. This method implies the study of scaled three-dimensional models on which high-precision measurements of the most stable metric parameter (in this case, thickness) are carried out. The samples are then compared using parametric (Student's t-test) and non-parametric (Mann-Whitney U test) tests. If the fragments belong to the same artifact, the null hypothesis will be confirmed, asserting the homogeneity of the statistical samples. This method allows us to derive an unambiguous answer (Kolobova et al., in press).

Technological features

To find out whether the elk figurine found outside the graves at the Tourist-2 cemetery is contemporaneous with the rest items of portable art found in the graves, a comparative analysis of their technological features was carried out. Similar techniques of drilling, shaping the contours of figurines, and decorating with grooves by sawing, as well as intense abrasive processing (Fig. 2), occur precisely in this combination on almost all items of portable art from this site. A detailed examination of each item allows a conclusion to be drawn about the technological unity of the entire series. The closest items to the elk figurine are two anthropomorphic images made of shale and burl (see Fig. 1, *2*, *3*). In these items, the technological similarity is especially pronounced. In this article, we will not give a detailed description of their technological characteristics; we only note that identical methods of contour design are recorded on the anthropomorphic sculptures (for example, an elk earring and the body/arms of an anthropomorphic stone figurine); all deep lines on the artifacts' surfaces are made by sawing, the eyes of the characters are emphasized by specific drilling techniques (including circular or tubular), and the leveling and smoothing of the surface is carried out by intense abrasive processing. The elk figurine made of soft shale shows the following technological features (Fig. 3). The blank was modified using a combination of techniques: abrasion to render the general shape, and sawing grooves to shape the contour details (for

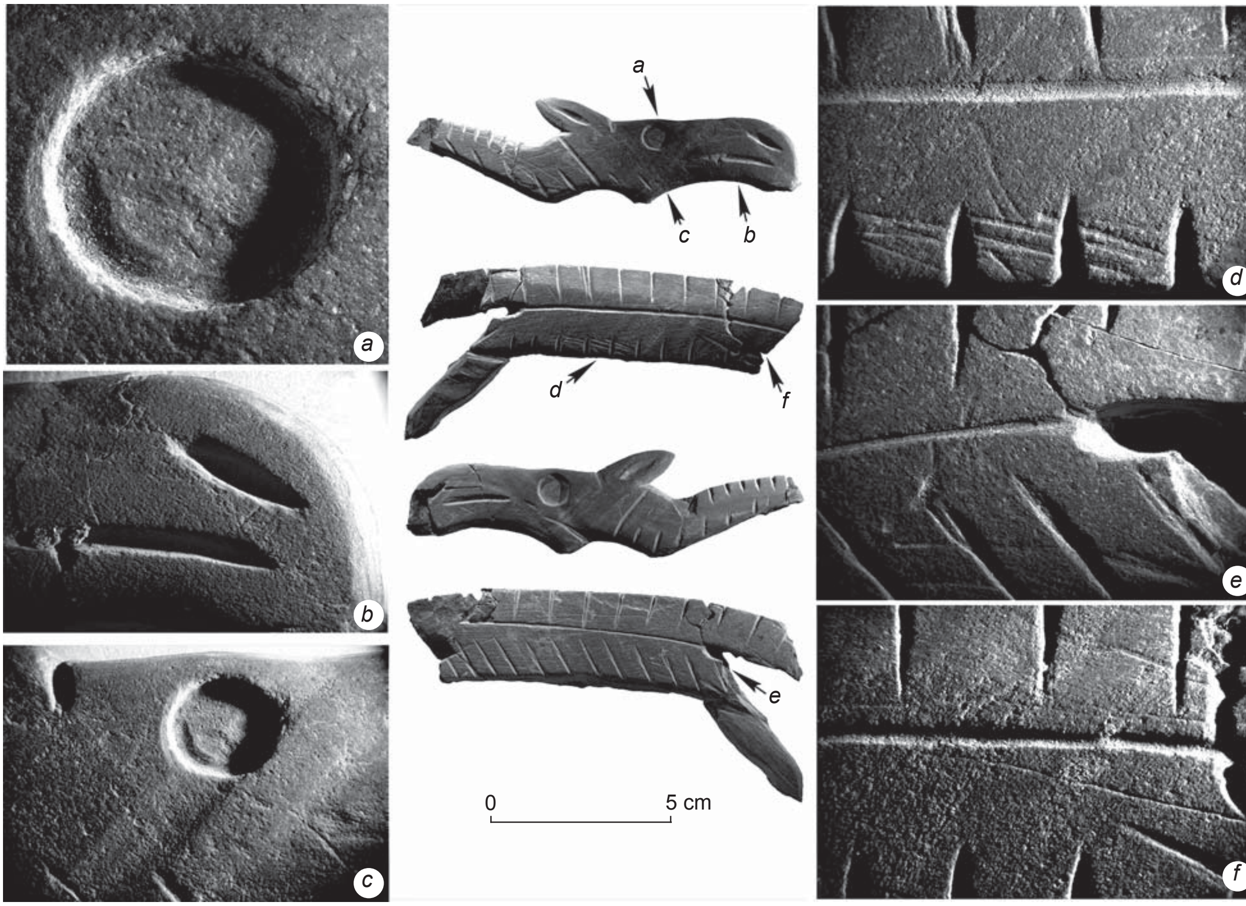

Fig. 2. Macrophotographs of details of the elk figurine.
a, *e*, *f* – magnification ×12.5; *b*–*d* – magnification ×8.

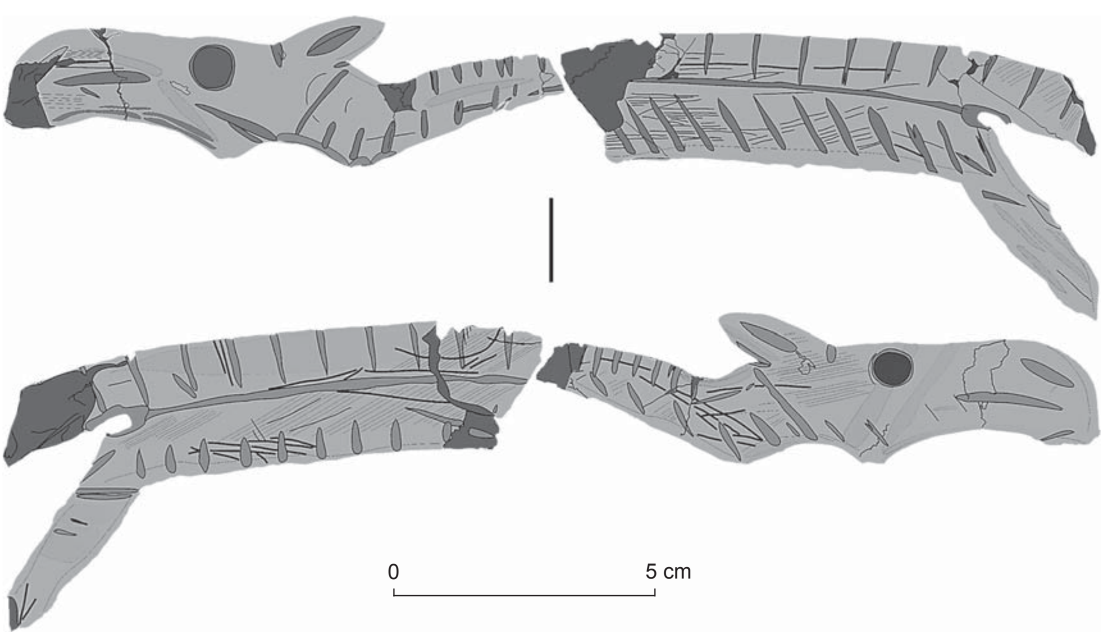

Fig. 3. Technical tracing of features of manufacturing the sculptural image of an elk.

example, at the base of the ear, the ends of grooves are clearly visible, which served to bulge this area). The same technique was applied for decoration in the form of deep notches made on both sides of the item. The grooves for shaping the contours of the figurine, in contrast to the decorative ones, could be rounded in plan view, and not only straight.

Sanding and grinding was used to flatten the surface and give a smoother shape to the already shaped areas. The entire surface shows thin linear parallel traces, mostly unidirectional (kinematics of the movements was reciprocating, not circular). There are areas where the grinding angle is slightly changed. This technique allowed the artisan to shape the facets, and thus to even "play" with volume on a flat figurine (as, for example, in the neck of the elk). There are also shallow, but relatively wide, grooves (for example, in the area of the elk's eye, there are two parallel grooves without sharp boundaries), which were made by grinding rather than sawing. In this case, a tool with a narrow working surface was used. Additional abrasive processing of the figurine was carried out after shaping the contours of the elk image, as evidenced by long linear grinding marks on both sides, passing through the entire artifact, parallel to its edges.

The main decorative element is a deep groove, which was made using the sawing technique. In most cases, its central part is deeper and wider than the ends. This is due to the fact that during sawing, the working part is not the point, but the blade of the tool, which better works through the central part of the formed groove.

Both fragments show engraving. On one (head), there are two thin connecting lines; on the other fragment (body and hind leg), there are several lines, parallel to some grooves. This technique possibly served to mark future deeper lines. However, there is also an engraving that is not associated with grooves. These thin lines, including the curved ones, can be either part of the sketches of figurative elements, or just random ones, which is difficult to judge owing to the incomplete integrity of the item.

The elaboration of the figurine's eyes deserves special attention. Considering the relatively large diameter, the same depth, and the flat bottom of the holes and the walls perpendicular to it, it can be concluded that these dimples could not have been simply cut with a sharpened tool. A more complex technique had to be used here, for example, circular drilling. Judging by the small irregularities at the bottom of the depression, after the formation of the rounded contour, the space inside it was scraped out.

No signs of wear were found that would allow establishing the functional purpose (or method of use) of the elk figurine. There is a slight smoothness along the contours, especially in the area of the head and muzzle of the animal, but this may be due to the final stage of the sculpture's fashioning by smoothing the surface with a soft abrader.

The results of numerous measurements of the thickness of three-dimensional models and their subsequent comparison using the nonparametric Mann-Whitney test ($U = 19$; $p = 0.325$) unambiguously indicate that the fragments were part of the same figurшге (Kolobova et al., in press). The same raw materials and similar techniques used for decoration in both fragments also support this conclusion.

As the study of the entire series of portable art from Tourist-2 demonstrates, the main feature of making figurines (regardless of the material being processed) is the active use of two techniques: abrasion and sawing deep grooves. Of particular interest is the specific drilling method used to shape the eyes. It can be considered that the elk figurine is part of a complex of small figurines from the Tourist-2 cemetery that is completely homogeneous in terms of technological methods.

Discussion

The item of portable art from Tourist-2 is an image of an elk, stylistically close to the Angara figurative tradition in the rock art of Siberia (Basova et al., 2019: 62). Despite the fact that the figurine is not complete, and it is difficult to judge the position of the animal's body and legs, there are still reasons to attribute it to this tradition. First of all, the realism of the image of the head is noteworthy. On both sides of the figurine, the nostrils and mouth are conveyed by grooves, an earring is highlighted, and an ear is worked out in detail. The eyes are shown with even, rounded indentations. The animal's muzzle is formed with a characteristic rounded contour (Ibid.). The image looks very realistic, detailed, but at the same time, the stylization inherent in the entire series of portable art from Tourist-2 is well traced (Fig. 4, *1*). The unity of technological and stylistic methods of rendering the image of an elk and anthropomorphic figures makes it possible to speak of a certain pictorial canon, generally typical of the Early Bronze Age cultures in Siberia (Basova et al., 2017; Kolobova et al., 2019: 73). At the same time, the head of the figurine under consideration is exaggerated as compared to the neck and body. Notably, the figure is intact in the neck area; it is broken off only at the base. Consequently, the neck was deliberately shaped this way. The body is decorated in the so-called skeletal manner, which often occurs among the rock carvings on the territory of Siberia (Fig. 4, *1*).

When looking for stylistic analogs, one should primarily compare artifacts of the same category and images that are identical or as close as possible in content. In this case, the image of an elk in portable art is considered. Comparison with bone items of portable art from a settlement near the village of Bazaikha (Raport…, 2013: 12, ill.), on the basis of which the

Fig. 4. Analogs among the items of portable and rock art (without scale).
1 – elk figurine from Tourist-2; *2*, *3* – bone sculptures of elk from the settlement near the village of Bazaikha (after (Raport…, 2013)); *4* – rock carving of the elk's head at the Shalabolino rock art site; 5 – composition of two elk figures at the Tom rock art site (photo by E.A. Miklashevich); *6* – image of a bull made in a skeletal manner, Chernovaya VIII (after (Esin, 2009)); *7* – "skinny bull", Razliv X (after (Kyzlasov, 1991)); *8*–*10* – images of elk: *8* – Verkhniy Askiz I, mound 1 (after (Savinov, 2006)), *9* – Ulus Sartygoi (after (Leontiev, Kapelko, Esin, 2006)), *10* – Tom rock art site (after (Okladnikov, Martynov, 1972)); *11* – fragment of an anthropomorphic mask on a stele from the Okunev mound Chernovaya XI (Martyanov Regional Museum of Local History in Minusinsk, exposition, No. A 12912; photo by L.V. Zotkina); *12* – anthropomorphic "two-beam" mask on a slab from the Tas-Khazaa mound (Kyzlasov Khakass National Museum of Local History, No. КП А ОФ 304/5; photo by L.V. Zotkina).

Angara style was distinguished (Okladnikov, 1966: 124–125; Podolsky, 1973), allows the following conclusions to be drawn. The Bazaikha elk figurines (Fig. 4, *2*, *3*) are distinguished not only by their realistic performance, but also by their smooth, streamlined forms. There are no sharp lines of decoration, such as grooves. The main specificity of sculptures from Bazaikha is working with the volume of material. These features are not typical of either the flat elk figurine or most of the items of portable art from Tourist-2. Thus, in spite of the general content (the elk image), it is difficult to recognize the methods of manufacturing the figurines from these sites as similar in terms of methods of implementation (Fig. 4, *1–3*). Comparison with small bone figurines of the Kitoi culture (classic specimens from the Shamanka II and Lokomotiv cemeteries) (Studzitskaya, 2011: Fig. 1, *2–9*), where one of the predominant subjects is the head of an elk, allows us to draw approximately the same conclusions: streamlined, rounded shapes and a specific minimalist, naturalistic manner of execution (Ibid.: 39) are alien to the figurine in question. Of course, the difference between materials (shale and bone) should be taken into account. But among the items of portable art from Tourist-2, there are also specimens made of bone (horn, mammoth tusk); however, the methods of their processing and rendering of images are still close to a single standard, and do not radically change within the site. Nevertheless, in terms of visual characteristics, noteworthy is the design of the animal's head: a deliberately outlined earring, a shaped nostril, and a specific rounded shape of the ear, with a depression inside, are all signs that bring the Bazaikha sculptures closer to the considered elk figurine. This similarity is due to belonging to the Angara tradition* in general, but in this case it is hardly appropriate to speak of an absolute stylistic coincidence. It is rather about different variations on the topic of the Angara motif-stylistic tradition.

Considering that the Angara style is best represented in rock art, let us turn to petroglyphs. Quite often, in the Angara images of elk, one can find a rounded eye rendered by *contrerelief* (Fig. 4, *4*). Technologically, this variant differs from the smooth rounded depression on the figurine from Tourist-2. However, both methods visually emphasize the eye, which looks different as compared to the background (Fig. 4, *1*, *4*). In general, all the details of the head and muzzle of the elk image are quite typical of the Angara tradition in a broad sense (Podolsky, 1973: 267; Sher, 1980: Fig. 101).

On the petroglyphs of the Tom rock art site, abrasion above pecking and sawing deep grooves along the contour were quite often used; such a combination of techniques was specifically popular in shaping the head and neck of elk (Fig. 4, *10*). In some cases, grinding and sawing of grooves were used to fashion the entire image (Fig. 4, *5*). It was these techniques that were chosen by the artisan for making the elk figurine from the Tourist-2 site. The eye in the form of a flat round depression resembles numerous items of the Okunev's art, which show flat rounded dimples of the most varied outlines, used as elements for decorating steles (Fig. 4, *11*, *12*). And in general, grinding and sawing deep grooves are frequent techniques in the Okunev art tradition. The specific way of eye rendering finds parallels among the items from the Bronze Age burials of the Odino culture (for example, burial 542 at Sopka-2/4A) (Molodin, 2012: 167, fig. 230, *4*).

In addition, the skeletal manner of depicting the animal's body deserves special attention (Kovtun, 2001: Pl. 30a). This variant is found on the rocks of the Lower Tom region (images of elk) (Fig. 4, *10*), as well as in the Okunev figurative tradition (images of elk, bull) (Fig. 4, *6–9*).

Another characteristic feature is a deep line separating the head from the body on the elk sculpture from Tourist-2. This technique is found in some Okunev zoomorphic images and figurines of elk on the petroglyphs of the Lower Tom region (Fig. 4, *6*, *8–10*). Such a feature of the Tourist-2 sculpture as an exaggerated head is characteristic of the Okunev art and of the petroglyphs of the Tom region (Ponomareva, 2016: 76).

All the above stylistic and technological characteristics allow us to believe that the elk figurine from the Tourist-2 settlement tends not so much to the classic Angara figurative tradition, but to its variations with increased geometrization. As has been noted more than once, the continuation of this Neolithic tradition is quite typical of the later pictorial strata, and a somewhat modified (or even strongly transformed) Angara style is used in both the Karakol and Okunev art of the Early Bronze Age (Podolsky, 1973: Fig. 8, p. 273; Savinov, 1997: 205; 2006: 160–161). Most researchers attribute elk images among the petroglyphs of the Lower Tom region to the Bronze Age, and the Angara style is considered an integral element of a kind of local geometrized stylistics: the Tom group of the "Angara" figurative tradition (after (Kovtun, 2001: 48)) or the independent Tom style (after (Ponomareva, 2016: 78)). In general, the elk figurine under consideration, from the portable art complex from the Tourist-2 site, found in a dated archaeological context, can serve as one of the reference artifacts for studying the development of the Angara style as an epochal phenomenon in Siberia, as well as the integration of Angara pictorial techniques into subsequent iconographic traditions.

Conclusions

The study has shown that two separate fragments of a small stone figurine found outside the graves of the Tourist-2 cemetery should be considered the parts of one item. The technological analysis carried out not only for the elk figurine made of shale, but also for the entire

*By the Angara tradition, we mean an epochal phenomenon, a special stylistic manner (primarily typical of the elk images), which was widespread in Western and Eastern Siberia from the Neolithic to the Bronze Age, undergoing various transformations. In this case, the style is viewed as a global phenomenon, not exclusively associated with one archaeological culture or group of ancient population.

series of portable art from this site, allows us to speak about the unity of technological characteristics of the artifacts' assemblage. Comparison of the image of elk from Tourist-2 with well-known examples of portable and rock art in Siberia leads to the conclusion that this figurine belongs to the Angara style in a broad sense, but the techniques of execution are closer to the Tom and Okunev pictorial style. This is quite consistent with the preliminary date obtained for the Tourist-2 cemetery, which makes it possible to attribute it to the Early Bronze Age. However, it should be emphasized that it does not give a complete idea of the age of the site. It requires a series of dates to refine it.

Thus, the sculptural image of elk from Tourist-2 can be considered one of the reference artifacts that chronologically and stylistically mark the development of the Angara tradition. It is especially important that this figurine was not only found in a dated archaeological context, presumably in a destroyed burial, but is also a component of a whole series of portable art, homogeneous in terms of iconography and technological methods of execution, characteristic of the Karakol-Okunev art or, more precisely, "Krokhalevka" style.

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References

Basova N.V., Postnov A.V., Nesterkina A.L., Akhmetov V.V., Morozov A.A. 2017
Rezultaty okhranno-spasatelnykh raskopok na poselenii Turist-2 v Novosibirske v 2017 godu. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territoriy*, vol. XXIII. Novosibirsk: Izd. IAET SO RAN, pp. 509–512.

Basova N.V., Postnov A.V., Zaika A.L., Molodin V.I. 2019
Objects of portable art from a Bronze Age cemetery at Tourist-2. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 47 (4): 53–65.

Bobrov V.V., Marochkin A.G. 2016
Krokhalevskaya kultura ranney bronzy na territorii Kuznetskoy kotloviny (spetsifika materialnogo kompleksa i khronologiya). *Vestnik Tomskogo gosudarstvennogo universiteta*, vol. 42. Iss. 4: Istoriya: 108–112.

Bronk Ramsey C. 2009
Bayesian analysis of radiocarbon dates. *Radiocarbon*, vol. 51 (1): 337–460.

Esin Y.N. 2009
Drevneye iskusstvo Sibiri: Samusskaya kultura. Tomsk: Izd. Tom. Gos. Univ. (Trudy Muzeya arkheologii i etnografii Sibiri Tomskogo gosudarstvennogo universiteta; vol. II).

Kolobova K.A., Chistyakov P.V., Basova N.V., Postnov A.V., Zotkina L.V. (in press)
Metod opredeleniya prinadlezhnosti neapplifitsiruyemykh fragmentov k odnomu artefaktu na primere ploskikh skulptur bronzovogo veka. *Archaeology, Ethnology and Anthropology of Eurasia*.

Kolobova K.A., Fedorchenko A.Y., Basova N.V., Postnov A.V., Kovalev V.S., Chistyakov P.V., Molodin V.I. 2019
The use of 3D-modeling for reconstructing the appearance and function of non-utilitarian items (the case of anthropomorphic figurines from Tourist-2). *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 47 (4): 66–76.

Kovtun I.V. 2001
Izobrazitelniye traditsii epokhi bronzy Tsentralnoy i Severo-Zapadnoy Azii: Problemy genezisa i khronologii ikonograficheskikh kompleksov severo-zapadnogo Sayano-Altaya. Novosibirsk: Izd. IAET SO RAN.

Kyzlasov L.R. 1991
Drevnyaya i srednevekovaya istoriya Yuzhnoy Sibiri (v kratkom izlozhenii). Abakan: Khakas. otd. Krasnoyar. kn. izd.

Leontiev N.V., Kapelko V.F., Esin Y.N. 2006
Izvayaniya i stely okunevskoy kultury. Abakan: Khakas. kn. izd.

Molodin V.I. 1977
Epokha neolita i bronzy lesostepnogo Ob-Irtyshya. Novosibirsk: Nauka.

Molodin V.I. 2012
Pamyatnik Sopka-2 na reke Omi: Kulturno-khronologicheskiy analiz pogrebalnykh kompleksov odinovskoy kultury, vol. 3. Novosibirsk: Izd. IAET SO RAN.

Molodin V.I., Geneste Z.-M., Zotkina L.V., Cheremisin D.V., Creten K. 2019
The "Kalgutinsky" style in the rock art of Central Asia. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 47 (3): 12–26.

Molodin V.I., Novikov A.V., Roslyakov S.G., Novikova O.I., Kolontsov S.V. 1993
Arkheologicheskiye pamyatniki goroda Novosibirska. Novosibirsk: Nauka. (Materialy "Svoda pamyatnikov istorii i kultury Rossii"; iss. 1).

Okladnikov A.P. 1966
Petroglify Angary. Novosibirsk: Nauka.

Okladnikov A.P., Martynov A.I. 1972
Sokrovishcha Tomskikh pisanits: Naskalniye risunki epokhi neolita i bronzy. Moscow: Iskusstvo.

Podolsky M.L. 1973
O printsipakh datirovki naskalnykh izobrazheniy: Po povodu knigi A.A. Formozova "Ocherki po pervobytnomu iskusstvu: Naskalniye izobrazheniya i kamenniye izvayaniya epokhi kamnya i bronzy na territorii SSSR". *Sovetskaya arkheologiya*, No. 3: 265–275.

Polosmak N.V. 1978
Keramicheskiy kompleks poseleniya Krokhalevka-4. In *Drevniye kultury Altaya i Zapadnoy Sibiri*. Novosibirsk: Nauka, pp. 39–46.

Polosmak N.V. 1979
Krokhalevka-17 – noviy pamyatnik krokhalevskogo tipa. In *Sibir v drevnosti*. Novosibirsk: Nauka, pp. 45–49.

Ponomareva I.A. 2016
On the Angara petroglyphic style. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 44 (2): 69–80.

Raport Zhozefa de Baya o doklade I.T. Savenkova na XI mezhdunarodnom antropologicheskom kongresse v Moskve "O drevnikh pamyatnikakh izobrazitelnogo iskusstva na Yeniseye". 2013
Krasnoyarsk: Trend.
Reimer P., Bard E., Bayliss A., Beck J.W., Blackwell P.G., Bronk Ramsey C., Buck C.E., Cheng H., Edwards R.L., Friedrich M., Grootes P.M., Guilderson T.P., Hafidason H., Hajdas I., Hatté C., Hea-ton T.J., Hoffmann D.L., Hogg A.G., Hughen K.A., Kaiser K.F., Kromer B., McCormac F.G., Man-ning S.W., Niu M., Reimer R.W., Richards D.A., Scott E.M., Southon J.R., Staff R.A., Turney C.S.M., Plicht J., van der. 2013
IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. *Radiocarbon*, vol. 55 (4): 1869–1887.
Savinov D.G. 1997
K voprosu o formirovanii okunevskoy izobrazitelnoy traditsii. In *Okunevskiy sbornik: Kultura. Iskusstvo. Antropologiya*. St. Petersburg: Petro-RIF, pp. 202–212.
Savinov D.G. 2006
O vydelenii stiley i ikonograficheskikh grupp izobrazheniy okunevskogo iskusstva. In *Okunevskiy sbornik-2: Kultura i eyo okruzheniye*. St. Petersburg: Eleksis Print, pp. 157–190.
Sher Y.A. 1980
Petroglify Sredney i Tsentralnoy Azii. Moscow: Nauka.
Studzitskaya S.V. 2011
Drevneye iskusstvo v zerkale arkheologii: K 70-letiyu D.G. Savinova. Kemerovo: Kuzbassvuzizdat, pp. 37–50. (Trudy Sibirskoy assotsiatsii issledovateley pervobytnogo iskusstva; iss. VII).

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I.A. Durakov[1] and L.N. Mylnikova[2]
[1]Novosibirsk State Pedagogical University,
Vilyuiskaya 28, Novosibirsk, 630126, Russia
E-mail: idurakov@yandex.ru
[2]Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: L.Mylnikova@yandex.ru

Foundries at Stary Tartas-5—an Early Bronze Age Site in the Baraba Forest-Steppe

This study focuses on areas evidencing bronze casting at the Odino culture site, Stary Tartas-5, in the Baraba forest-steppe. One such area is within dwelling 1 and has a smelting hearth and pits situated nearby; the other, outside the dwelling, has a smelting kiln. We provide characteristics of these areas and their archaeological context. Each artifact from the foundries is described in detail, parallels are listed, and results of binocular microscopy of the molding compound are outlined. Based on findings of thermogravimetric studies, we assess the functions of technical pottery represented by fragments, and the number of times various items of the casting set could have been used. Previously, crucibles shaped as straight-walled jars have not been found at Odino sites, with the exception of a single intact specimen from burial 286 at the Tartas-1 cemetery. Dwelling 1 at Tartas-5 and the workshop associated with it were apparently parts of a single household. The Odino bronze casting tradition was retained by the Krotovo population, who supplemented it with innovations, such as the use of oval cups with thicker bottoms adapted to their own casting practices. The Odino sites in the Baraba forest-steppe date to the first half of the third millennium BC. It is concluded that the evidence of the bronze casting industry found at Stary Tartas-5 is the earliest in that region, and that its level in the Odino culture was high.

Keywords: *Odino culture, Baraba forest-steppe, Stary Tartas-5, bronze casting areas, crucibles, nozzles, molds.*

Introduction

The Early Bronze Age brought several innovations to human society. Some scholars consider this period to be extremely important (Hansen, 2019: 28), or momentous (Tsivilizatsionnye tsentry…, 2013: 3), or the time of radical changes and transformations (Hansen, 2011), which played a crucial role in ancient history. Such innovations included production of copper and bronze. In the Baraba forest-steppe, the Odino culture is considered the earliest culture with proven bronze casting. Yet, until recently, it was unclear what level of metalworking was reached among the carriers of that culture. In the course of many years of field work by the team of V.I. Molodin at the sites of the Odino culture in the region (Markovo-2 (Molodin, 1981), Sopka-2 (Molodin, Grishin, 2019), Tartas-1 (Molodin, Mylnikova, Novikova et al., 2011), Stary Tartas-5 (Molodin, Nesterova, Mylnikova, 2014)), smelting furnaces, tool sets, and various kinds of complexes have been identified, which can be described as economic complexes associated with bronze casting. However, information about them has not yet been summarized. The sources accumulated to date make it possible to do this. The purpose of this article is to present the features of bronze casting areas of the Odino culture based on the analysis of the evidence from the settlement of Stary Tartas-5.

This site is located 1 km south of the village of Stary Tartas, in Vengerovsky District of Novosibirsk Region (Fig. 1). It was discovered by V.I. Molodin in 1994 (Molodin, Novikov, 1998: 57) and appears as eleven visually noticeable depressions remaining from dwellings and located in two parallel rows (Molodin, Nesterova, Mylnikova, 2014: 111, fig. 1). During the excavations at the site carried out by the expedition from the Institute of Archaeology and Ethnography of the SB RAS in 2012–2013, deposits were unearthed over an area of 307 m^2, and four housing structures were examined (Molodin, Mylnikova, Nesterova et al., 2013: 283). Pottery with the features of mostly classical Odino culture was found at the settlement (Molodin, Nesterova, Mylnikova, 2014: 118–121, fig. 10, 11). Foundry waste in the form of small fragments of molds, crucibles, and slagged clay occurred over the entire territory. Taking into account these finds, scholars suggested that the settlement had smelting furnaces associated with bronze casting, and specialized production areas (Molodin, Nesterova, Mylnikova, 2014: 114, 116). The results of our analysis of the smelting furnaces and utility pits, as well as correlation with the above-mentioned finds make it possible to identify two bronze casting areas on the territory of the excavated zone of the settlement.

Fig. 1. Location of the Stary Tartas-5 settlement and other sites with the objects of the Odino culture.
1 – Stary Tartas-5; *2* – Tartas-1; *3* – Sopka-2; *4* – Ust-Tartas-2; *5* – Markovo-2.

Description of the specialized bronze casting areas

One production area was identified at the floor level of the pit remaining from dwelling 1 (Fig. 2), which was a subrectangular semi-dugout, oriented with its corners to the cardinal points. The size of the pit was 7.7 × 7.1 m; its area was 54.67 m^2. The walls were steep. The depth in the center of the dwelling was 0.33–0.34 m; the depth at the walls was 0.12–0.2 m. The bottom was uneven, sloping from the walls towards the center of the dwelling, where a horizontal platform around the hearth was located. Absence of posts suggests that the structure was made of logs. The production area in the dwelling had a smelting hearth and three pits.

Hearth. The hearth was located in the center of the dwelling pit (Molodin, Nesterova, Mylnikova, 2014: 114, fig. 4), and was a rectangle pit with its long side oriented along the NE-SW line, with strongly smoothed corners (Fig. 3). The pit was 1.32 m long and 0.35–0.45 m wide. The walls were sloping; the bottom was uneven with its depth reaching 12 cm in the southeastern part, 10 cm in the northeastern part, and 5 cm in the central part.

Two rows of vertically set large fragments of pottery (parts of a single vessel) were found along the western wall of the hearth (Fig. 3). Fragments of the vessel's bottom and the part adjacent to it were in the middle of the hearth. Remains of an inner lining made of pottery fragments survived also in the southwestern corner of the hearth depression. All fragments were inserted into a shallow groove (3–5 cm deep) in order to keep them in a vertical position.

The northeastern part of the hearth was a saturated carbonaceous area of dark gray, sandy loam (Fig. 3, *2*). In its filling, the fragment of a ceramic nozzle and a clay ball with a barely noticeable groove were found. Fragments of casting molds were discovered near the southern and northern walls (Fig. 4, *1*, *2*, *8–11*).

Taking into account the technical characteristics (the walls were covered with fragments of vessels), as well as waste from bronze casting (fragments of molds, crucibles, and a clay nozzle), which was found in the filling and on the adjacent territory (see Fig. 2), this object should be considered a smelting furnace. Note that subsequently such smelting structures were a part of foundry production in Western Siberia for a long time. For example, smelting kilns with inner walls lined with fragments of vessels have been found at the sites of the Krotovo culture. At the settlement of Vengerovo-2 (Baraba forest-steppe), in dwelling 10, three hearths were discovered. One of the hearths had a similar lining on its southern wall (Molodin, Mylnikova, Nesterova et al., 2017: 371). Three types of smelting furnaces were found

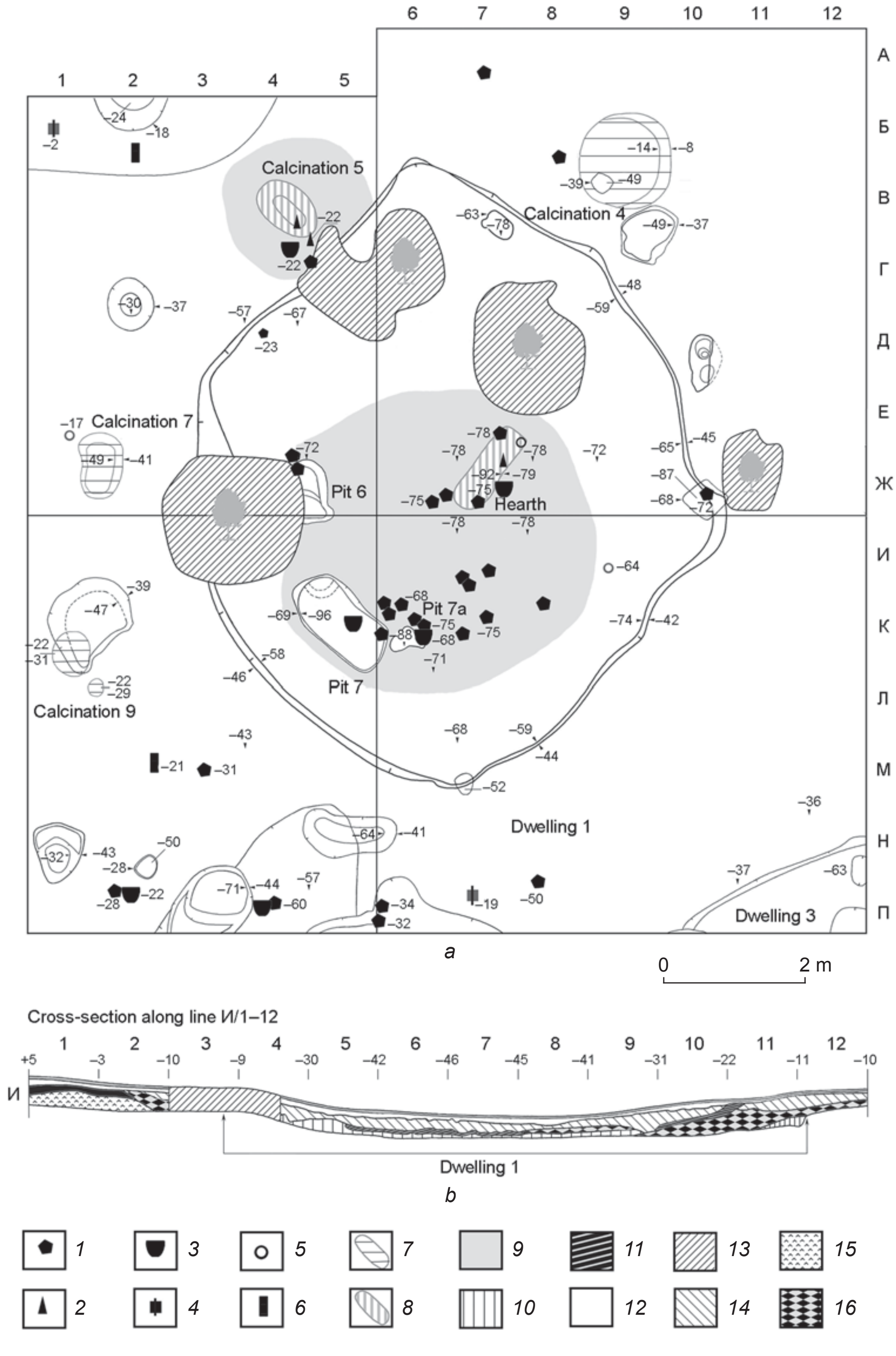

Fig. 2. Ground plan of bronze casting areas with objects and technical pottery (*a*), and cross-section (*b*) of dwelling 1 at Stary Tartas-5.

1 – fragment of a casting mold; *2* – fragment of a nozzle; *3* – fragment of a crucible; *4* – item made on a ceramic fragment; *5* – ceramic ball; *6* – fragment of a bronze product (fragment of a knife?); *7* – calcination; *8* – smelting kiln; *9* – territory of bronze casting area; *10* – dense, mixed, gray-brown sandy loam with inclusion of carbonaceous lenses; *11* – black, carbonaceous, humic sandy loam; *12* – gray, humic sandy loam; *13* – areas occupied by trees; *14* – whitish-gray, fine sandy loam; *15* – mixed black-brown, lumpy sandy loam; *16* – gray sandy loam with ferruginous inclusions.

in dwelling 7 at the same site. One of these furnaces had its inner walls covered with pottery fragments (Molodin, Durakov, Mylnikova et al., 2018: 54–55, fig. 9). The same smelting furnace was discovered in dwelling 3 (hearth 8) at the settlement of Stary Tartas-5 (Molodin, Nesterova, Mylnikova, 2014: Fig. 1).

Utility pits were associated with the smelting furnace in dwelling 1.

Pit 7 was located 2 m to the northwest of the smelting kiln. It was of subrectangular shape, had rounded corners, and was oriented along the NW-SE line (Fig. 5, *1*). The size of the pit was 1.6 × 0.81 m. Its northern wall was 8–12 cm lower than the southern wall. The maximum depth from the floor of the dwelling reached 0.32 m. The bottom and walls were covered with a layer of carbonaceous soil of rich black color (up to 0.12 m thick) (Fig. 5, *2*). Inclusions of ash and lumps of fired clay occurred in the filling, which also contained the fragment of a crucible.

Pit 7a was located 0.45 m to the east of pit 7. It had the shape of an irregular triangle with strongly rounded corners (Fig. 6, *1*). The size of the pit was 0.72 × × 0.78 m; the depth from the floor of the dwelling was 0.11–0.12 m. The filling of the pit in its western part was a lens of reddish-brown soil. The central part and bottom of the pit were covered with mixed reddish-brown and black soil; the eastern part was filled with deep black carbonaceous soil (Fig. 6, *2*).

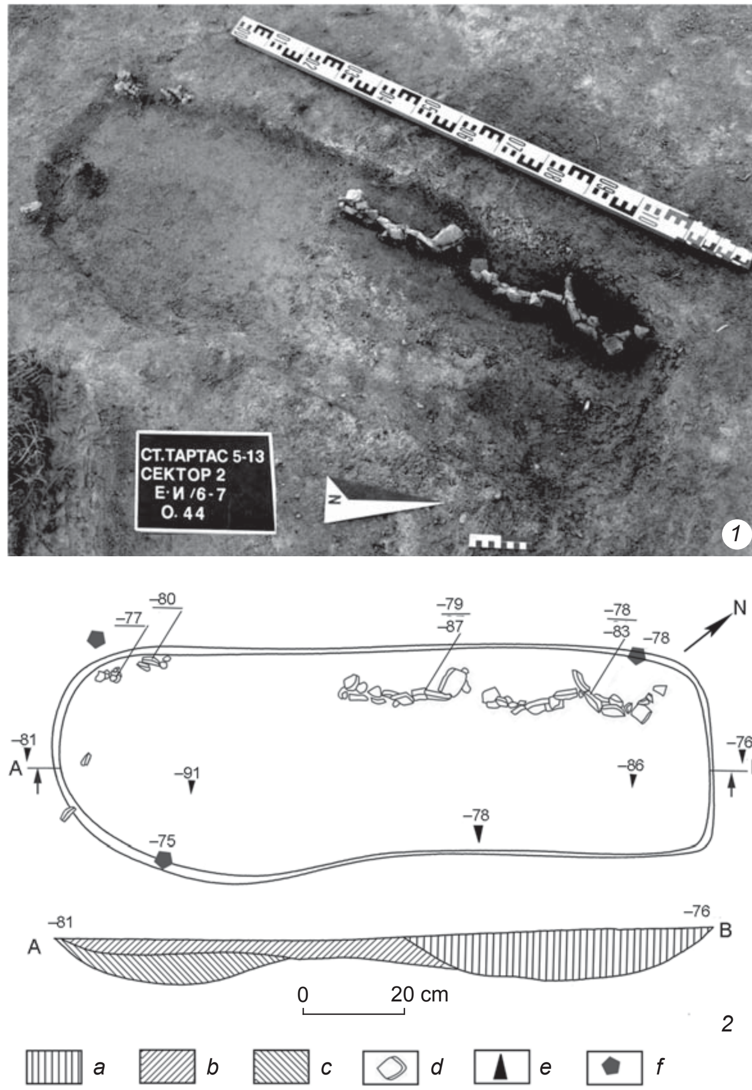

Fig. 3. Smelting hearth in dwelling 1.
1 – photo after removal of the filling; *2* – ground plan and cross-section.
a – dense carbonaceous soil of rich black color; *b* – calcined reddish-brown soil; *c* – calcined red soil; *d* – pottery fragments; *e* – fragment of a nozzle; *f* – fragment of a casting mold.

Pit 6 was located 2 m to the north of pit 7 and was a depression in the form of a rectangle elongated along the N-S line, with strongly rounded corners. The western part of the pit was under a tree. The size of the excavated part was 1.0 × 0.4–0.8 m; the depth was 0.1 m. The walls were inclined; the bottom was stepped. The pit was filled with mixed black-brown soil.

Thus, the production complex of dwelling 1 consisted of four objects located in a small area in the central and southwestern part of the pit (see Fig. 2). A hearth was in the center of the area; a large number of small fragments of baked clay were found on the southern side of the hearth in addition to waste of bronze casting. The filling of the pits (ashy soil) and finds in the pits indicate their use as collectors of waste after cleaning the hearth.

The second bronze casting area of the settlement was located in the space between the dwellings, near the northwestern wall of dwelling 1 (see Fig. 2). The place for the main production activities was the area around a smelting hearth (calcination 5). Fragments of technical pottery, including fragments of two nozzles, a crucible, and casting mold (Fig. 7), were found there.

The hearth consisted of an oval depression oriented with its long axis along the NW-SE line (Fig. 7, *1*), measuring 0.98 × 0.61 m, with a depth of 0.1 m. The walls were inclined; the bottom was even. In accordance with the topography, the eastern edge of the pit was 0.09 m lower than the western edge. Over a depression in the northwestern part of the hearth, the remains of a vault in the form of a lens of lumpy, orange, baked clay were found. The size of the preserved part of the

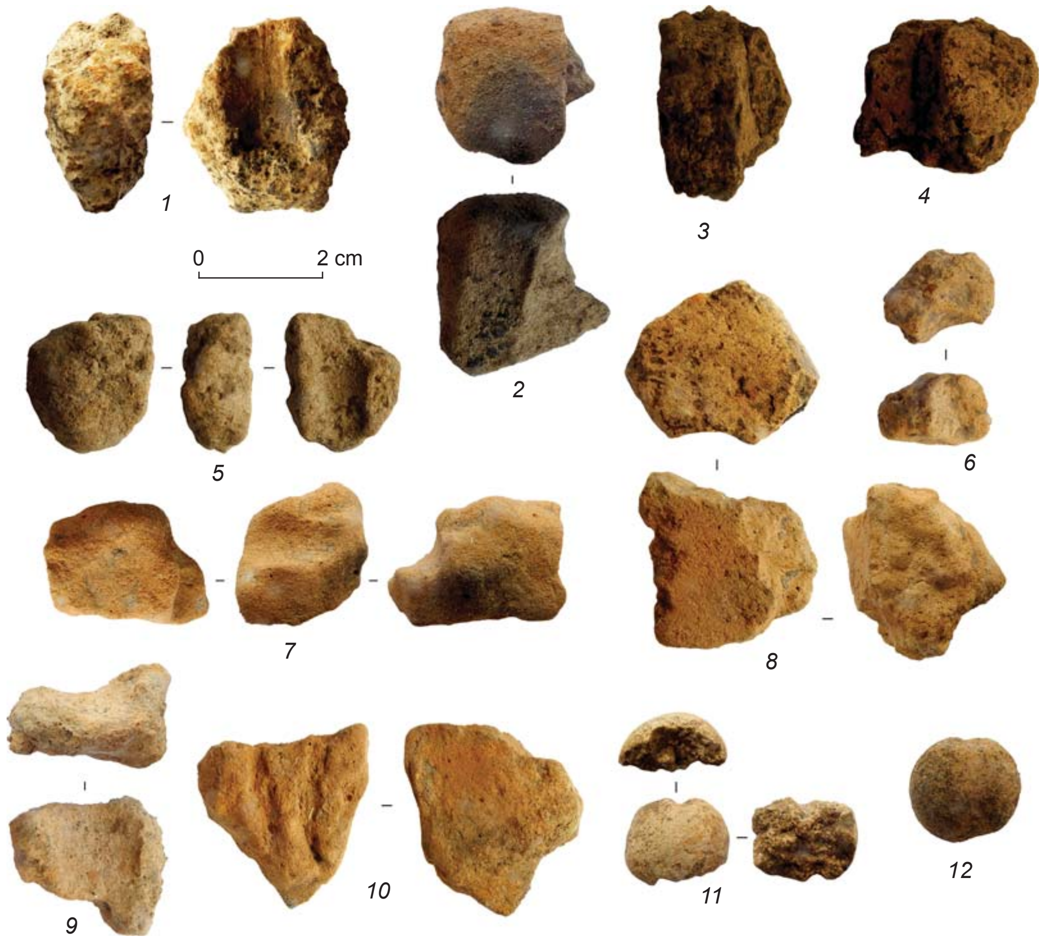

Fig 4. Fragments of casting molds (*1*, *3–10*), a casting core (*2*), and ball (*11*, *12*).
1 – sq. Ж/18; *2* – sq. П/2; *3* – production area 2, sq. Г/5; *4* – sq. Б/14; *5* – sq. С/8; *6* – sq. Д/13; *7* – sq. Ж/16; *8*, *9* – production area 1, sq. К/6; *10* – sq. И/15; *11* – sq. Е/1; *12* – filling of the kiln in dwelling 1, sq. Е/7.

vault was 0.28 × 0.31 m; the thickness was at least 5 cm. The vault was made of ferruginous clay with the addition of sand.

The pit was filled with rich, calcined orange and brick-red soil. The underlying layer was mixed gray-brown, sandy loam interspersed with calcined soil (Fig. 7, *2*). Fragments of two ceramic nozzles (see Fig. 7, *3*, *4*) and the fragment of a casting mold were found near the southern wall, which makes it possible to link this object with the bronze casting industry.

Analysis of technical pottery

The investigated territory of the settlement revealed some items related to the foundry collection of production

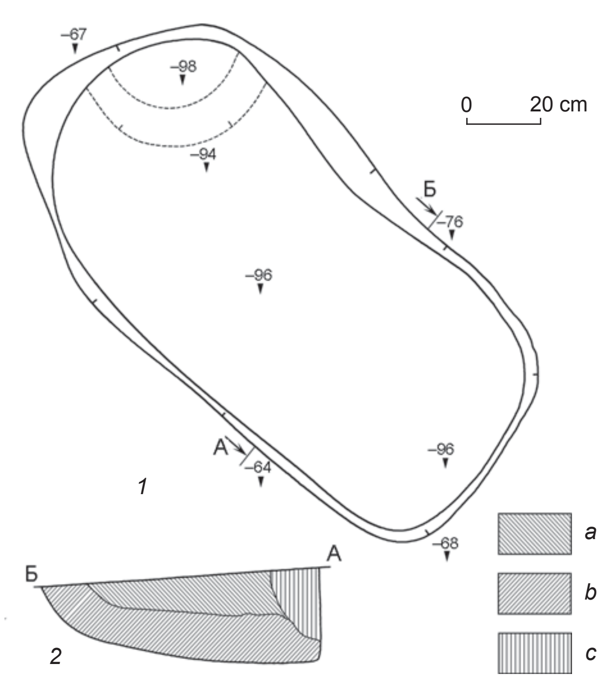

Fig. 5. Ground plan (*1*) and cross-section (*2*) of utility pit 7.
a – gray-black, mixed, ashy sandy loam; *b* – black, carbonaceous sandy loam; *c* – ferruginous, reddish-brown loam.

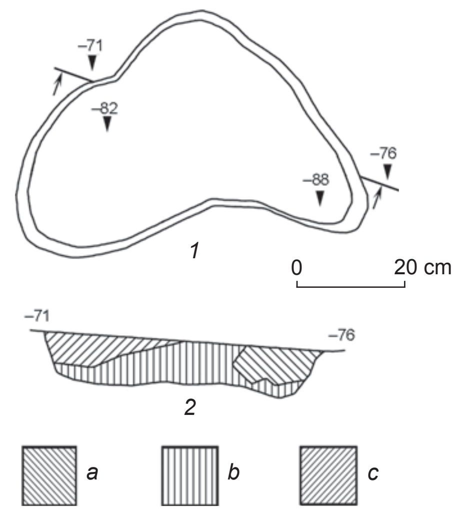

Fig. 6. Ground plan (*1*) and cross-section (*2*) of utility pit 7a.
a – carbonaceous soil of rich black color; *b* – mixed reddish-brown and black soil; *c* – reddish-brown soil.

equipment, including nozzles, fragments of casting molds and crucibles.

Casting molds. Forty four fragments have been studied, of which 32 were discovered in the immediate vicinity of the above-mentioned bronze casting areas, and 12 were scattered over the rest of the settlement. The remains of the working chambers were preserved in nine fragments (see Fig. 4, *1*, *3–10*). Due to the fragmented nature of the finds, it is not possible to completely reconstruct the cast items. Some of the molds might have been intended for casting strips having lenticular or trapezoidal cross-section (see Fig. 4, *5*, *9*). The width of the items did not exceed 1.0–1.5 cm. Molds for casting such items widely appear among the materials of the Early Bronze Age in Western Siberia (Molodin, 1977: Pl. XLIX, *5*; LXI, *1*, *2*; LXII, *2*; Molodin, Durakov, Mylnikova et al., 2012: 115–117, fig. 13, 14). According to scholars, the artifacts cast in such molds were later forged into strips, rods, staples, etc. (Molodin, Polosmak, 1978: 24–25). For example, an oval-shaped rod was cast in the mold shown in Fig. 4, *1*. This mold was one-piece and disposable; most likely, it was damaged when the casting was being removed. The imprint of a wood structure inside the working chamber suggests that a whittled stick served as a model.

Two molds (see Fig. 4, *3*, *4*) were intended for casting strips having wedge-shaped cross-section (knife blades?), with thickness of the butt reaching at least 0.2–0.3 cm. The same series includes the mold for casting an object in the form of a subtriangular strip at least 2.5 cm wide, with two convex ridges on the surface. It is impossible to reconstruct the complete shape of the cast product; a distant parallel with distinctive ridges along the blade, which could have resulted from casting in such molds, might have been the fragment of a knife from the settlement of Berezovaya Luka (Kiryushin, Maloletko, Tishkin, 2005: 129, fig. 69, *2*).

Three molds were used for casting rods or tubes, round in cross-section, with diameter of 1.5 to 3.0 cm (see Fig. 4, *6–8*). Fragments of two casting rods (see Fig. 4, *2*) were also found at the settlement, which suggests manufacturing hollow castings.

Thus, judging by the working chambers in the molds, it can be concluded that mostly simple products such

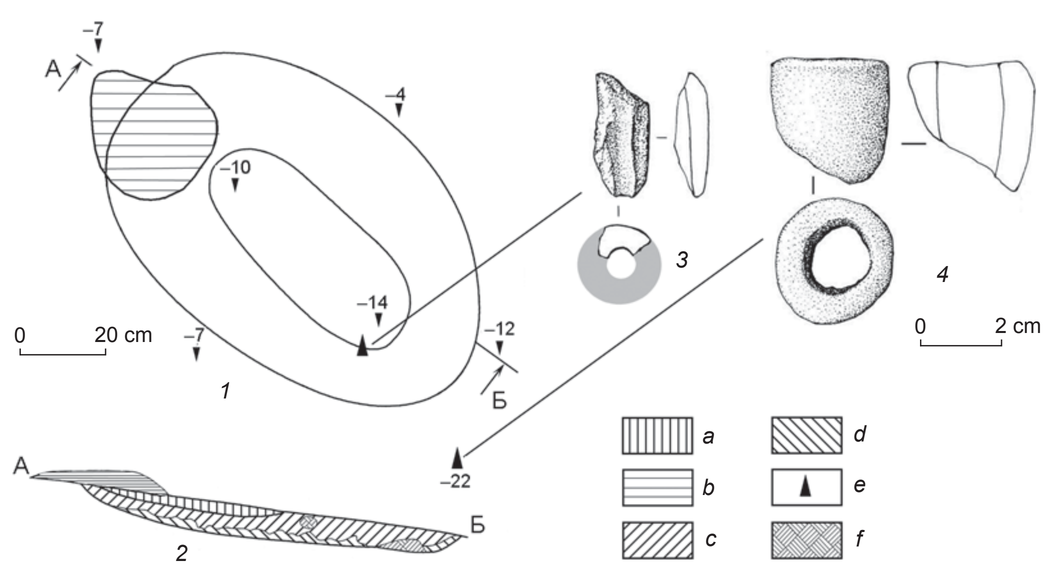

Fig. 7. Ground plan (*1*) and cross-section (*2*) of the smelting hearth (calcination 5), fragments of nozzles from its filling (*3*, *4*).
a – lumpy, orange burnt soil; *b* – red-orange, baked clay (coating); *c* – saturated brick-orange, calcined sandy loam; *d* – mixed gray and reddish-brown sandy loam; *e* – fragment of a nozzle; *f* – tree roots.

as rods and strips were cast at the settlement of Stary Tartas-5. The molds were made of compounds consisting of ferruginous clay and uncalibrated river sand, with the addition of a small amount of organic matter (dry grass?) (Fig. 8, *1*, *2*). All molds underwent reduction firing. Undoubtedly, some of them were disposable, one-piece molds.

Thermogravimetric studies of the main body of the molds and surfaces of the working chambers have revealed insignificant differences in weight loss (see *Table*) and consequently, in the thermal impact on these objects (Fig. 9). Usually, such a ratio of indicators corresponds to short-term use of the mold: due to short-term impact of metal on the working chamber, a difference in weight loss would accumulate only as a result of multiple repetitions of the pouring cycle (Molodin, Mylnikova, Shtertser et al., 2019: 121–122).

Nozzles. These consisted of a series of four fragments. The best-preserved item was found at the edge of the hearth (calcination 5) in production area 2 (sq. Г/5) (see Fig. 2). It was the end part of a conical ceramic tube (Fig. 10, *1*). The length of the surviving part was 3.4 cm; the thickness of the walls was 0.6–0.8 cm. The diameter of the tube along the outer edge was 3.0–3.3 cm. The diameter of the air duct was 1.8 cm along the outer edge and 1.3 cm along the inner edge. The object was made of a clay band rolled into a spiral. The compound consisted of clay with additions of sand, organic matter (dry grass), and a small amount of dry clay (Fig. 10, *2*).

The second nozzle was also associated with the smelting hearth (calcination 5) in production area 2, found in the filling of the hearth (see Fig. 7, *3*). A fragment of the wall with the air duct survived. Its length was over 3.0 cm; its wall thickness was 0.6–0.65 cm. The diameter along the outer edge was at least 2.0 cm. The diameter of the tube channel hole was 0.7–0.8 cm.

The third nozzle was represented only by a wall fragment (Fig. 10, *3*). Its length was 3.1 cm; the thickness of the walls was 0.3–0.5 cm. The reconstructed outer diameter was 2.3 cm; the diameter of the air duct was 0.6 cm.

The fourth nozzle survived fragmentarily (Fig. 10, *4*); it was found in the filling of the smelting kiln in production area 1 (sq. Ж/7) (see Fig. 2). The length of the fragment was 2.1 cm; its wall thickness was 0.6 cm. The reconstructed diameter was 2.8 cm, and diameter of the air duct was 1.3 cm.

These nozzles were the earliest among similar items discovered in Western Siberia. According to H.H. Coghlan, bellows were invented in the third millennium BC (1951: 65–66). Almost at the same time they appeared in Siberia; this can be explained either by the rapid spread of this innovation over the vast expanses of Eurasia, or by simultaneous creation of these devices in different regions. The penetration of nozzles to the north, to the Upper Ob region, is probably associated with the Odino production tradition. The earliest nozzles in this region go back to the period when pottery of the Odino-Krokhalevka type emerged (Koksharov, 2014).

Crucibles. Fragments of four items were found. One of them was a fragment of a large, thick-walled (1.6–1.5 cm), apparently oval, cup (Fig. 11, *1*). The height of its walls was at least 2.4 cm. The crucible was made of a compound consisting of clay with artificial addition of river sand and organic matter, which could be seen from traces of grass and burnt grains 2.0–2.5 mm in size (Fig. 11, *2*). Comparative thermogravimetric studies revealed a small loss of mass on both surfaces of samples 5 and 6. Rather good firing indicates the repeated use of the item (see Fig. 9, *Table*).

Crucibles in the form of oval cups were typical of the Odino culture and have been found in casting areas of the Markovo-2 and Tartas-1 sites (Baraba forest-steppe). This type of Odino crucible was later adopted by bronze casting artisans of the Krotovo culture (Kondratiev, 1974: Fig. 1, 2; Molodin, Grishin, 2016: Fig. 403–404). They,

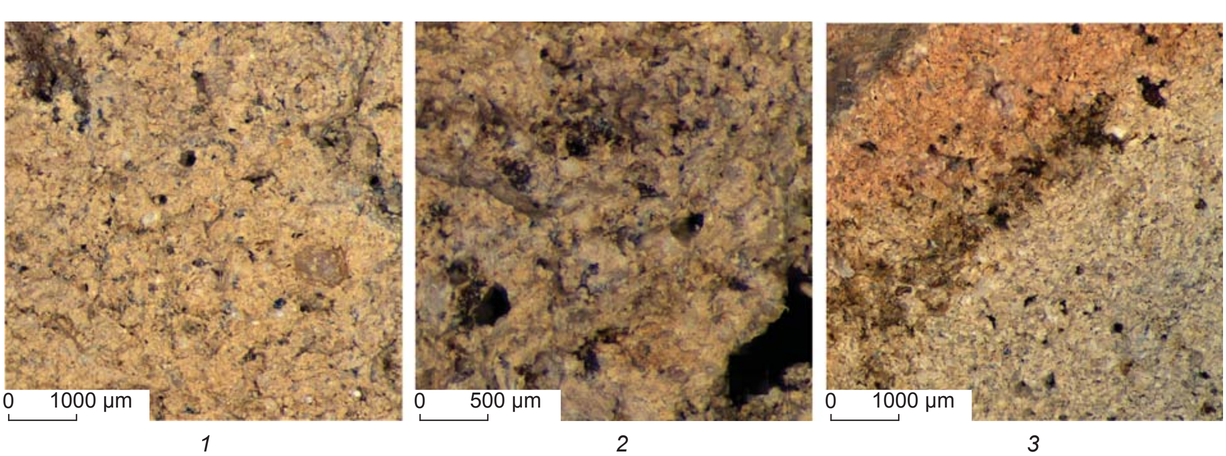

Fig. 8. Microphotographs of parts of the clay compound on casting molds.
1, *2* – sq. Б/8; *3* – sq. П/2.

Weight loss in the samples of technical pottery at different temperatures, %

Sample No.	Place of discovery	Item	Place of sampling	Temperature, °C			
				30–350	350–600	600–850	30–850
1	Sq. Г/15	Nozzle	Rim	2.92	1.13	0.61	4.66
2			Inner surface	3.09	1.41	0.57	5.07
3	Sq. Ж/16, dwelling 2	Fragment of casting mold	Body	3.69	1.73	0.75	6.17
4			Working chamber	3.12	1.34	0.60	5.06
5	Sq. П/2	Fragment of crucible	Outer surface	4.36	2.00	1.23	7.59
6			Inner surface	4.65	2.23	1.2	8.08
7	Sq. К/6	"	Outer surface	6.57	1.26	0.55	8.38
8			Inner surface	9.07	1.36	0.52	10.95
9	Sq. К/6	Fragment of casting mold	Body	6.96	1.58	0.64	9.18
10			Working chamber	6.90	1.41	0.55	8.86

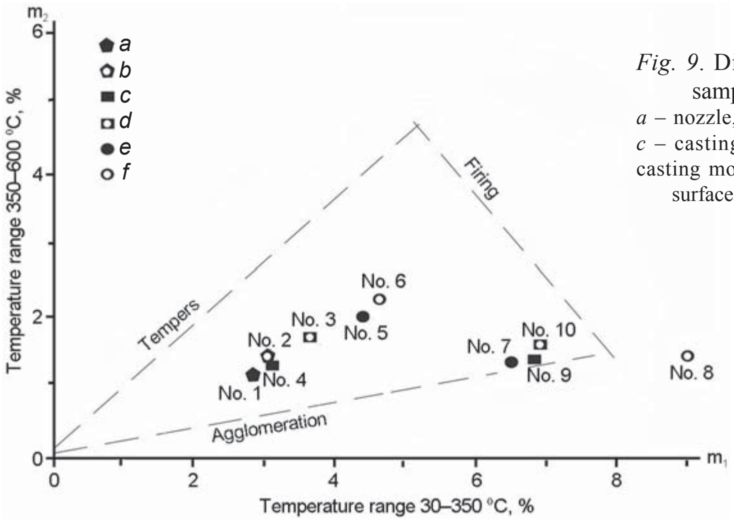

Fig. 9. Diagram of weight loss in the samples of technical pottery.
a – nozzle, rim; *b* – nozzle, inner surface; *c* – casting mold, working chamber; *d* – casting mold, body; *e* – crucible, exterior surface; *f* – crucible, interior surface.

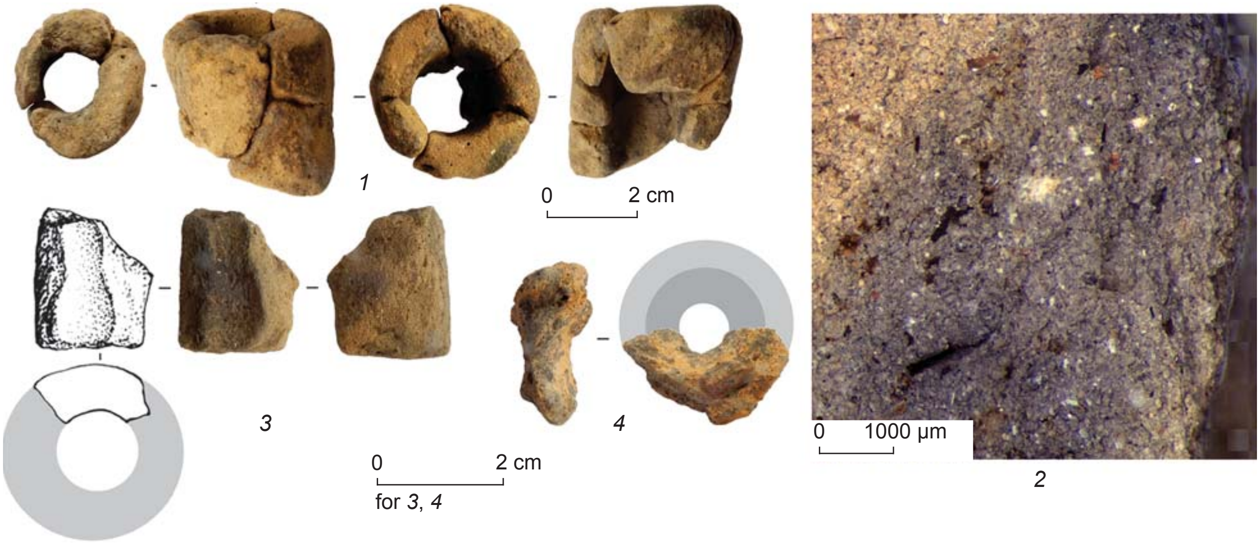

Fig. 10. Clay nozzles (*1*, *3*, *4*), microphotograph of clay compound on the nozzle (*2*).
1 – filling of kiln (calcination 5) in production area 2, sq. Г/5; *2* – sq. Г/5; *3* – sq. Ж/16; *4* – hearth of dwelling 1, sq. Ж/7.

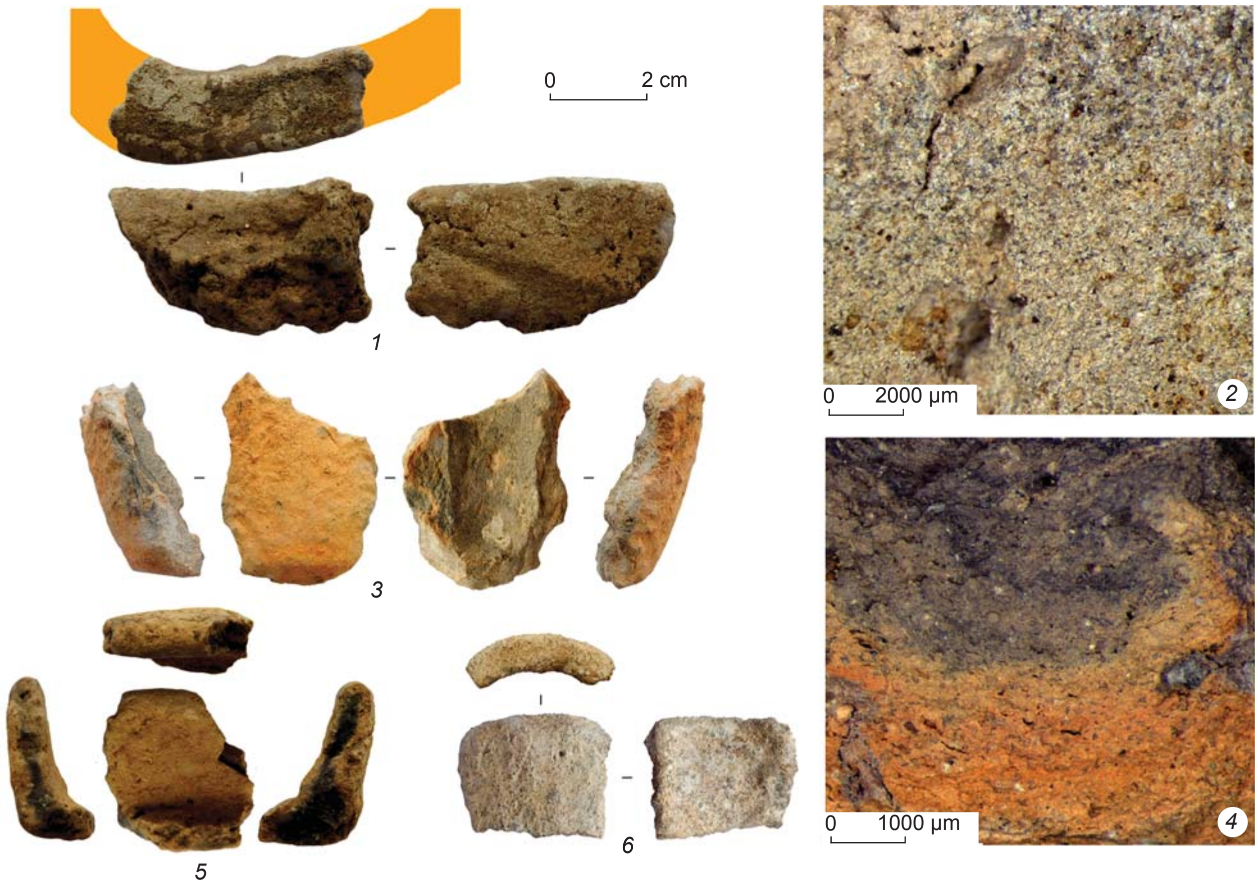

Fig. 11. Fragments of ceramic crucibles (*1*, *3*, *5*, *6*) and microphotographs of part of the clay compound (*2*, *4*).
1, *2* – sq. П/2; *3*, *4* – dwelling 1, sq. К/6; *5* – production area 2, sq. Г/5; *6* – dwelling 1, sq. Ж/7.

however, made the bottom of this type of crucible much thicker, since their production involved much greater thermal impact on that area than was the case with the carriers of the Odino culture. Crucibles with thickened bottoms occur among the materials of the Krotovo culture (Stefanova, 1998: 66, fig. 6, *4*; Durakov, Kobeleva, 2017).

Three fragments of crucibles indicate that they were flat-bottomed, miniature jars. A part of the wall and bottom in one of them survived (Fig. 11, *3*). The height of the surviving part was 3.6 cm; the wall thickness was 0.6 cm; the diameter along the upper edge was 4 cm. The reconstructed volume was at least 20–25 cm^3. The smelting chamber was made of ferruginous sandy clay with addition of organic matter (dry, fine grass) (Fig. 11, *4*). The diagram clearly shows large differences in weight loss in the inner and outer surfaces of the product (samples 7 and 8) (see Fig. 9). It can be concluded that there was a very large temperature impact on the outer surface of the crucible, which might have led to damage to the object (loss of mass by the inner surface indicates poor-quality firing) (see Fig. 9, *Table*). A particularly large thermal impact on the bottom part caused the sand to melt in this place over the entire thickness of the crucible wall.

The third crucible had cylindrical shape (Fig. 11, *5*); its height was 2.3 cm; its wall thickness was 0.5 cm; the reconstructed volume was 27–30 cm^3.

The fourth crucible, represented by a part of the wall with the rim, can be partially reconstructed (Fig. 11, *6*). It was found near the hearth in dwelling 1 (sq. Ж/7) (see Fig. 2). Its diameter along the outer edge was 4.5–5.0 cm; its height was not less than 2.5 cm, and its walls were 0.9 cm thick. Crucibles in the form of straight-walled jars have not previously been found in the complexes of the Odino settlements; they are known only from one intact item from burial 286 at the Tartas-1 cemetery.

Notably, a bronze item (sq. М/2)—a forged rectangular strip (fragment of a knife blade?) 2.7 cm long and 1.7–1.9 cm wide—was discovered for the first time in a layer of the dwelling complex of the Odino culture at Stary Tartas-5.

Conclusions

The settlement of Stary Tartas-5 is undoubtedly one of the sites of Odino culture with signs of bronze casting. Traces of intensive casting activities have been found only in one researched dwelling (No. 1) at the settlement. The same concentration of clear production features has been also discovered at other sites of the Odino culture. For example, at Markovo-2, only one of the three excavated structures revealed the remains of casting production (Molodin, 1981: 70). This can be explained by specialization of production and its specific organization as an individual family occupation (when production required involvement of only two or three people, a group was organized based on an individual family (members of a single household) from among the population of the village (community)). An indirect sign of such specialization is the presence of burials with foundry implements, which have been found at Tartas-1 (burial 286) (Molodin, 2012) and Ust-Tartas-2 (burial 32).

The analysis of different types of smelting furnaces found at the site and such items as nozzles, crucibles, and casting molds, which were a part of the foundry equipment, makes it possible to conclude that there was a high level of specialization in bronze casting among the carriers of the Odino culture. The presence of artifacts of the Seima-Turbino appearance (celts and spears) at the sites of this culture is reliably confirmed by finds from closed complexes (Molodin, 2013: 310–313, fig. 3, 4). The transition to manufacturing sophisticated thin-walled items of the Seima-Turbino type necessitated an increase in the pouring temperature and in the fluidity of the metal. The difficulties that arose in searching for a solution to this problem are manifested by a high share of casting defects in the Seima-Turbino casting. For example, at the Rostovka cemetery (the Irtysh region), 12 objects (4 celts, 8 spears; 54.5 %), out of 22 hollow objects (10 celts, 12 spears) found, had traces of casting defects. At the Turbino-1 cemetery, 28 objects (22 celts, 6 spears; 49.12 %), out of 57 objects (44 celts, 13 spears) found, had blowholes, short runs, and seams (Molodin, Durakov, 2019: 49). The artifacts from the Seima cemetery also had casting defects (Bader, 1970: Fig. 24, 26, 27, 29). The desire of the Odino artisans to resolve this was manifested in covering the inner walls of heating devices with pottery fragments, creation of nozzles, and using devices for artificial inflation of air into the smelting structures, which is evidenced by the production areas at Stary Tartas-5.

Currently, taking into account the calibrated radiocarbon dates (Molodin, Marchenko, Orlova et al., 2012: 238, pl. 1), the Odino complexes of the Baraba forest-steppe can be dated to the first half of the third millennium BC. Accordingly, the traces of metalworking found at Stary Tartas-5 can be considered the earliest in that region.

Acknowledgments

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References

Bader O.N. 1970
Bassein Oki v epokhu bronzy. Moscow: Nauka.

Coghlan H.H. 1951
Notes on the Prehistoric Metallurgy of Copper and Bronze in the Old World, No. 4. Oxford: Oxford Univ. Press.

Durakov I.A., Kobeleva L.S. 2017
Tekhnicheskaya keramika krotovskoy kultury. *Vestnik Tomskogo Gosudarstvennogo Universiteta*, No. 49: 23–25.

Hansen S. 2011
Technische und soziale Innovationen in der zweiten Hälfte des 4. Jahrtausends v. Chr., S. Hansen, J. Müller (eds.). In *Sozialarchäologische Perspektiven: Gesellschaftlicher Wandel 5000–1500 v. Chr.: ZwischenAtlantik und Kaukasus*. Mainz: Verlag Ph. Von Zabern, pp. 153–191. (Archäologie in Eurasien; No. 24).

Hansen S. 2019
Technical and social innovations: A new field of research. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 47 (3): 27–37.

Kiryushin Y.F., Maloletko A.M., Tishkin A.A. 2005
Berezovaya Luka – poseleniye epokhi bronzy v Aleiskoy stepi, vol. 1. Barnaul: Izd. Alt. Gos. Univ.

Koksharov S.F. 2014
Sopla bronzovogo veka s severa Zapadnoy Sibiri. *Vestnik Novosibirskogo Gosudarstvennogo Universiteta*. Ser.: Istoriya, filologiya, vol. 13. Iss. 3: Arkheologiya i etnografiya: 78–87.

Kondratiev O.M. 1974
Raskopki poseleniya epokhi ranney bronzy Chernoozerye VI v 1970 g. In *Iz istorii Sibiri*, iss. 15. Tomsk: Tom. Gos. Univ., pp. 17–19.

Molodin V.I. 1977
Epokha neolita i bronzy lesostepnogo Ob-Irtyshya. Novosibirsk: Nauka.

Molodin V.I. 1981
Pamyatniki odinovskogo tipa v Barabinskoy lesostepi. In *Problemy zapadnosibirskoy arkheologii. Epokha kamnya i bronzy*. Novosibirsk: Nauka, pp. 63–75.

Molodin V.I. 2012
Pamyatnik Sopka-2 na reke Omi: Kulturno-khronologicheskiy analiz pogrebalnykh kompleksov odinovskoy kultury, vol. 3. Novosibirsk: Izd. IAET SO RAN.

Molodin V.I. 2013
Seiminsko-turbinskiye bronzy v “zakrytykh” kompleksakh odinovskoy kultury (Barabinskaya lesostep). In *Fundamentalniye problemy arkheologii, antropologii i etnografii*. Novosibirsk: Izd. IAET SO RAN, pp. 309–324.

Molodin V.I., Durakov I.A. 2019
Metod litiya “na proliv” v seiminsko-turbinskoy metalloobrabatyvayushchey traditsii (po materialam krotovskoy kultury). *Uralskiy istoricheskiy vestnik*, No. 1: 48–54.

Molodin V.I., Durakov I.A., Mylnikova L.N., Nesterova M.S. 2012
Proizvodstvenniy kompleks krotovskoy kultury na poselenii Vengerovo-2 (Barabinskaya lesostep). *Vestnik Novosibirskogo Gosudarstvennogo Universiteta*. Ser.: Istoriya, filologiya, vol. 11. Iss. 5: Arkheologiya i etnografiya: 104–119.

Molodin V.I., Durakov I.A., Mylnikova L.N., Nesterova M.S. 2018
The adaptation of the Seima-Turbino tradition to the Bronze Age cultures in the south of the West Siberian plain.

Archaeology, Ethnology and Anthropology of Eurasia, vol. 46 (3): 49–58.

Molodin V.I., Grishin A.E. 2016

Pamyatnik Sopka-2 na reke Omi. Vol. 4: Kulturno-khronologicheskiy analiz pogrebalnykh kompleksov krotovskoy kultury. Novosibirsk: Izd. IAET SO RAN.

Molodin V.I., Grishin A.E. 2019

Pamyatnik Sopka-2 na reke Omi. Vol. 5: Kulturno-khronologicheskiy analiz pogrebalnykh kompleksov pozdnekrotovskoy (chernoozerskoy), andronovskoy (fedorovskoy), irmenskoy i pakhomovskoy kultur. Novosibirsk: Izd. IAET SO RAN.

Molodin V.I., Marchenko Z.V., Orlova L.A., Grishin A.E. 2012

Khronologiya pogrebalnykh kompleksov odinovskoy kultury pamyatnika Sopka 2/4a (lesostepnaya polosa Ob-Irtyshskogo mezhdurechya). In *Kultury stepnoy Yevrazii i ikh vzaimodeistviye s drevnimi tsivilizatsiyami*, bk. 2. St. Petersburg: IIMK RAN, Periferiya, pp. 237–242.

Molodin V.I., Mylnikova L.N., Nesterova M.S., Borzykh K.A., Borilo B.S. 2017

Vengerovo-2: Noviye danniye po krotovskoy kulture. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territoriy*, vol. XXIII. Novosibirsk: IAET SO RAN, pp. 368–372.

Molodin V.I., Mylnikova L.N., Nesterova M.S., Nenakhov D.A. 2013

Poseleniye odinovskoy kultury Stariy Tartas-5. In *Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territoriy*, vol. XIX. Novosibirsk: IAET SO RAN, pp. 282–287.

Molodin V.I., Mylnikova L.N., Novikova O.I., Durakov I.A., Kobeleva L.S., Efremova N.S., Soloviev A.I. 2011

Periodization of Bronze Age cultures in the Ob-Irtysh forest-steppe: The stratigraphic position of Early and Middle Bronze Age burials at Tartas-1. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 39 (3): 40–56.

Molodin V.I., Mylnikova L.N., Shtertser N.V., Durakov I.A., Drebushchak V.A. 2019

Termogravimetriya v issledovanii drevney tekhnicheskoy keramiki. *Khimiya v interesakh ustoychivogo razvitiya*, No. 1: 115–122.

Molodin V.I., Nesterova M.S., Mylnikova L.N. 2014

Osobennosti poseleniya odinovskoy kultury Stariy Tartas-5 v Barabinskoy lesostepi. *Vestnik Novosibirskogo Gosudarstvennogo Universiteta*. Ser.: Istoriya, filologiya, vol. 13. Iss. 3: Arkheologiya i etnografiya: 110–125.

Molodin V.I., Novikov A.V. 1998

Arkheologicheskiye pamyatniki Vengerovskogo rayona Novosibirskoy oblasti. Novosibirsk: NPC po sokhraneniyu istoriko-kulturnogo naslediya. (Materialy “Svoda pamyatnikov istorii i kultury narodov Rossii”; iss. 3).

Molodin V.I., Polosmak N.V. 1978

Vengerovo-2 – poseleniye krotovskoy kultury. In *Etnokulturniye yavleniya v Zapadnoy Sibiri*. Tomsk: Izd. Tom. Gos. Univ., pp. 17–29.

Stefanova N.K. 1998

Krotovskaya kultura v Srednem Priirtyshye. In *Materialnaya kultura drevnego naseleniya Urala i Zapadnoy Sibiri.* Yekaterinburg: Ural. Gos. Univ., pp. 53–75. (Voprosy arkheologii Urala; iss. 19).

Tsivilizatsionnye tsentry i pervobytnaya periferiya v epokhu rannego metalla: Modeli vzaimodeystviya. 2013

Moscow: Yazyki slavyanskoy kultury. (KSIA; iss. 230).

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A.V. Epimakhov[1], S.E. Panteleeva[2], and L.N. Koryakova[2]

[1]South Ural State University,
Pr. Lenina 76, Chelyabinsk, 454080, Russia
E-mail: epimakhovav@susu.ru
[2]Institute of History and Archaeology,
Ural Branch, Russian Academy of Sciences,
S. Kovalevskoi 16, Yekaterinburg, 620108, Russia
E-mail: spanteleyeva@mail.ru; lunikkor@mail.ru

Wells as a Source of Cultural and Chronological Information: The Case of Kamennyi Ambar, Southern Trans-Urals

This article presents 44 radiocarbon dates from 18 water wells of different Bronze Age periods at Kamennyi Ambar settlement, in the southern Trans-Urals. At the preliminary stage, statistical outliers were identified, which enhanced the reliability of the conclusions. Potsherds from the filling of the wells, contextual analysis of dating samples, and ^{14}C dates allowed us to carry out the cultural attribution of nearly all wells (31 out of 34). The analyzed wells were subdivided into four chronostratigraphic groups corresponding to various settlement phases. Their duration and chronological limits were estimated. Most wells were found to belong to the Sintashta-Petrovka period (densely spaced linearly arranged blocks of structures inside fortified areas). This period comprised three construction phases, the latest of which correlates with the Petrovka ceramics. The second period, marked by randomly arranged structures, is associated with the Srubnaya-Alakul artifacts, and is represented by only four wells. The simulation results suggest that the site existed for less than one and a half centuries, including a short chronological gap between the two periods. The Sintashta (phases 1 and 2) and Petrovka (phase 3) were two consecutive traditions, which may have overlapped during the late period. In the Srubnaya-Alakul period (phase 4), a transformation of the architectural tradition took place, and the layout and construction of the wells changed too.

Keywords: *Bronze Age, Trans-Urals, wells, radiocarbon dating, simulation.*

Introduction

An ancient settlement appears to be an open complex. In this regard, the determination of its chronological position can hardly be considered a trivial task, even if we are talking about monocultural objects of study. Ceramics of different cultures having been discovered within the framework of one site is typical of the Bronze Age of the Trans-Urals. There are also frequent traces of repairs and reconstructions, which, given the small thickness of the cultural layer and unclear stratigraphy, do not have a singular cultural and chronological attribution. Some of these problems can be solved with a comprehensive study of wells (Alaeva, 2002; Epimakhov, Berseneva, 2012; Rühl et al., 2016; Koryakova, Panteleeva, 2019; Chemyakin, 2020; and others), but, unfortunately, large series of well-documented results are rare.

The fortified settlement of Kamennyi Ambar is a fortunate exception (Koryakova et al., 2011;

Multidisciplinary Investigations…, 2013: 68–85; Culture…, 2020; and others). The purpose of this study is to identify and culturally attribute groups of wells corresponding to different phases of settlement development by comparing radiocarbon dating data and the spatial distribution of ceramic material. The conclusions should become the foundation of the cultural-chronological scheme of a particular site and the reconstruction of the model of its functioning.

Characteristics of the site

As a result of the research, two periods of the settlement's functioning were identified. The early one (Sintashta-Petrovka) is represented by densely situated regular buildings within the boundaries of the fortification line. The late period (Srubnaya-Alakul) is marked by separately standing dwellings, during the construction of which the previous cultural layer was often destroyed.

The structure of the main elements of the settlement was reliably established by geophysical methods. In some cases, the location of the wells is well diagnosed. As in other synchronous settlements, the well was an indispensable attribute of every building. However, in our case, the excavations showed a very complex history of the functioning of the buildings and a large number of wells. They were studied at two sites in the northeastern and northern parts of the site (total area 1840 m^2). A total of 34 wells were discovered within the boundaries of the excavations. Twenty-five of these wells have been fully archaeologically studied, and nine have been examined only in the upper filling. Selected wells were subjected to low invasive drilling in order to obtain samples for archaeobotanical studies and radiocarbon dating, as well as to identify the sequence of filling layers.

Some objects were completely filled with clay a long time ago, in antiquity; others stood open for a long time, and others were reused. The last category is the most numerous. Despite the complexity of interpretation, it is of particular interest for chronological conclusions. Detailed stratigraphic observations made it possible to establish that a significant part of the wells was filled only partially, which created the so-called lock (shut away) above the level of the aquifer, and then in the remaining depressions, pits-furnaces, less often utility pits, were built. The furnace pits were filled with calcined and carbonaceous layers, and often contained evidence of small-scale metal production. These structures could presumably be used for the recycling of metallurgical waste. Some wells bear traces of repeated reuse. For example, first, a utility pit was built in an abandoned well, and then a furnace pit was built on top.

The wells in the Kamennyi Ambar settlement are not simultaneous even within the boundaries of individual buildings. It is enough to look at the plans of some of them or to correlate their number with the investigated area. This conclusion is in solid agreement with the numerous traces of redevelopments and repairs of dwellings, as well as differences in the complex of material culture, primarily ceramics. Most of the wells contained remnants of wooden formwork (timbering) parts of various designs and preservation.

In the filling of the structures, 870 fragments of ceramic dishes were found. The identifiable part is subdivided into three typological groups: Sintashta (84 spec.), Petrovka (53 spec.) and Srubnaya-Alakul (355 spec.). Analysis of the conditions of occurrence of various types of ceramics provides additional opportunities for studying the cultural-chronological relationship of wells. The greatest interest is the material from the middle and bottom filling of the wells (the period of construction and use for its intended purpose), as well as the material associated with well-identifiable structures of secondary use.

An attempt to differentiate objects by cultural affiliation and the corresponding construction phases met with some difficulties: some of the wells did not contain identifiable ceramics, some did not have radiocarbon dates, or the obtained dating results formed rather wide calibrated intervals. Only the latest structures were confidently diagnosed, primarily due to stratigraphic observations, structural features, and the predominance of the Srubnaya-Alakul ceramics in the filling.

Methods of analysis

A total of 18 wells were dated, eight of which were provided with an only single analysis. The sampling strategy was adjusted during the work on the site. As a result, a series began to form. The largest samples in terms of volume are associated either with the study of botanical spectra or with the obvious stratigraphic heterogeneity of individual objects. Among undated wells, some were examined only in the upper filling or with a drill use. The latter greatly reduced the chances of finding not only culturally diagnosed materials, but also organic residues in sufficient quantities for analysis. A total of 44 samples were obtained

Table 1. **Results of radiocarbon dating of the wells***

Lab code	Age, BP	Location	Material	Source
1	2	3	4	5
MAMS-11649	3989 ± 67	Building 4, well 4/1, upper filling	Coal	(Rühl et al., 2016)
MAMS-11654	3976 ± 53	Building 2, well 2/8	Wood	(Multidisciplinary Investigations…, 2013)
UGAMS-16777	3760 ± 25	Building 5b, well 5/10, lower filling	"	(Culture…, 2020)
Hd-28408	3644 ± 31	Building 2, well 2/1a, lower filling	Wood, outer ring 5	(Multidisciplinary Investigations…, 2013)
Hd-28458	3636 ± 26	Building 2, well 2/4, lower filling	"	(Ibid.)
Hd-28431	3618 ± 31	Building 2, well 2/1, lower filling	Wood, inner ring 10	"
Hd-28430	3617 ± 31	Building 2, well 2/1a, lower filling	Wood, inner ring 4	"
MAMS-11651	3601 ± 38	Building 2, well 2/7	Coal	"
Hd-28432	3594 ± 31	Building 2, well 2/1, lower filling	Wood, outer ring 5	"
MAMS-15087	3592 ± 30	Building 5b, well 5/1, lower filling	Seeds of plants	(Koryakova, Kuzmina, 2017)
MAMS-11660	3577 ± 21	Building 2, well 2/9, lower filling	Wood, outer ring 2	(Multidisciplinary Investigations…, 2013)
Hd-29289	3572 ± 23	Building 4, well 4/1	Coal	(Chechushkov, Molchanova, Epimakhov, 2020)
MAMS-19904	3570 ± 30	Building 5b, well 5/9, lower filling	Buds of plants	(Koryakova, Kuzmina, 2017)
MAMS-15084	3564 ± 23	Building 4, well 4/1, middle filling	Coal + seeds of plants	(Rühl et al., 2016)
MAMS-19903	3561 ± 27	Building 5b, well 5/9, lower filling	Wood	(Koryakova, Kuzmina, 2017)
Hd-28457	3559 ± 26	Building 2, well 2/4, lower filling	Wood, outer ring 5	(Multidisciplinary Investigations…, 2013)
MAMS-21412	3559 ± 23	Building 5c, well 5/4, lower filling	Charred seeds of plants	(Koryakova, Kuzmina, 2017)
MAMS-15083	3558 ± 28	Building 6, well 6/1, lower filling	Seeds of plants	(Rühl et al., 2016)
MAMS-15086	3551 ± 28	Building 5b, well 5/1, middle filling	"	Not published
MAMS-11652	3550 ± 24	Building 7, well 7/1, lower filling	Coal	(Multidisciplinary Investigations…, 2013)
MAMS-11661	3548 ± 25	Building 2, well 2/4	Pinecone	(Ibid.)
MAMS-11656	3540 ± 27	Building 2, well 2/9	Wood	"
MAMS-11659	3539 ± 22	Building 2, well 2/9, lower filling	Wood, inner ring 1	"
MAMS-19902	3537 ± 29	Building 5b, well 5/9, lower filling	Seeds of plants	Not published
MAMS-15085	3537 ± 22	Building 4, well 4/1, lower filling	Wood	(Rühl et al., 2016)
MAMS-27513	3534 ± 31	Building 6, well 6/1, верхнее заполнение	Coal + seeds of plants	(Culture…, 2020)
MAMS-11655	3531 ± 24	Building 3, well 3/1, middle filling	Coal	(Multidisciplinary Investigations…, 2013)
UGAMS-16778	3530 ± 20	Building 5b, well 5/3, lower filling	Wood	(Culture…, 2020)
MAMS-19901	3530 ± 27	Building 5b, well 5/9, pit-furnace	Charred seeds of plants	Not published
MAMS- 11658	3526 ± 24	Building 5b, well 5/2	Coal	(Chechushkov, Molchanova, Epimakhov, 2020)
MAMS-19907	3518 ± 26	Building 5b, well 5/7, lower filling	Seeds of plants	(Koryakova, Kuzmina, 2017)
MAMS-19906	3508 ± 22	Building 5b, well 5/7, middle filling	Charred seeds of plants	Not published
MAMS-27516	3505 ± 24	Building 4, well 4/1, lower filling	Seeds of plants	(Culture…, 2020)

Table 1 (end)

1	2	3	4	5
MAMS-27518	3505 ± 29	Building 5b, well 5/10, lower filling	"	(Koryakova, Kuzmina, 2017)
MAMS-19908	3502 ± 32	Building 5b, well 5/7, lower filling	"	(Ibid.)
Hd-29412	3482 ± 45	Building 6, well 6/1	Coal	(Chechushkov, Molchanova, Epimakhov, 2020)
MAMS-10885	3478 ± 27	Building 4, well 4/1	"	Not published
MAMS-27515	3474 ± 25	Building 6, well 6/1, lower filling	Seeds of plants	(Culture…, 2020)
MAMS-11653	3471 ± 25	Building 2, well 2/5, middle filling	Coal	(Multidisciplinary Investigations…, 2013)
MAMS-15082	3462 ± 22	Building 6, well 6/1, lower filling	Seeds of plants	(Rühl et al., 2016)
Hd-29225	3442 ± 33	Building 6, well 6/1	Coal	(Chechushkov, Molchanova, Epimakhov, 2020)
MAMS-27514	3433 ± 25	Building 6, well 6/1, lower filling	Charred seeds of plants	(Culture…, 2020)
MAMS-11650	3433 ± 25	Building 6, well 6/1, middle filling	Wood	(Chechushkov, Molchanova, Epimakhov, 2020)
UBA-26188	3348 ± 36	Building 6, well 6/1, upper filling	Charred seeds of plants	(Rühl et al., 2016)

*Statistical outliers are marked in italics.

(Table 1)*. The dating was carried out using accelerator technology in four laboratories. Calibration of individual values and modeling were carried out in the OxCal 4.3.2 program using the IntCal13 calibration curve (Bronk Ramsey, 2017; Reimer et al., 2013).

The dating materials were mainly coal, branches, and wooden stakes for casing the watered part of the wells (in some cases, it was possible to date their outer layers), seeds, and fruits of plants. These are optimal for obtaining "narrow" time intervals due to their short life cycle. The greatest uncertainty is usually associated with coal, for which the old wood effect cannot be ruled out**. However, in our case, both examples of a sharp difference from the entire series (3976 ± 53 BP (MAMS-11654), well 2/8; 3760 ± ± 25 BP (UGAMS-16777), well 5/10) related to the analysis of a tree***.

Serial dating of the same objects (including analysis in different laboratories) and the distribution of samples by depth and context (phases of the well shaft use and the presence of culturally diagnosed ceramics) were critical for assessing the reliability of the results. In addition, in some cases, the stratigraphic position of objects relative to each other was established, which made it possible to express these differences in numbers.

At the stage of preliminary assessment of the available calibrated dates, we noted the chronological heterogeneity of the sample outside the Srubnaya-Alakul part. The resulting intervals on the timeline form three blocks: the end of the 21st century to the second half of the 20th century BC, the second half of the 20th century to the 19th century, and the early 19th century to the first half of the 18th century BC. The latter, at first glance, almost coincides with the operation time of the Srubnaya-Alakul objects. These groups of dates have been assigned to specific wells.

Further work included carrying out a statistical analysis of radiocarbon dating results to check the correctness of identifying chronological groups and clarifying their boundaries, as well as studying the archaeological context. The first step was to check the consistency of the results for individual objects ("Combine" procedure) and to explain the deviations. The list of analytical procedures also included the analysis of samples for the presence of statistical outliers (plotting a range diagram* and "Outlier" procedure in the OxCal program); statistical check of

*Of this number, five results are published for the first time.

**It is hardly a stretch to assume that the old structures were used as fuel during the renovation of buildings, not to mention the long-lived pine trees—the main building material of the settlement.

***Unfortunately, in the first case it was a single date, in the second, the result was duplicated by the dating of plant seeds, and the data obtained completely coincided with the expectations and the general summation.

*Used only at the preliminary stage when studying the sample as a whole.

the synchronicity of groups of dates within individual phases; routine calibration of individual dates; a sum of probabilities ("Sum of probabilities") in order to assess the homogeneity of the series for the selected groups; modeling the boundaries of date ranges of objects or phases ("Boundary"). In a number of cases, we have reliable stratigraphic arguments for assessing the synchrony / asynchrony of events. The listed procedures revealed contradictions in some series. In each case, they were explained based on the context of the findings. Critical analysis made it possible to cut off obviously implausible results and increase the reliability of conclusions.

The program that was used provides the simulation of the duration of phases and hiatuses. The values obtained are not absolute and are in direct proportion to the size of the sample, as well as to its quality and the assumptions made, including stratigraphic information and hypotheses about the ratio of events on the timeline.

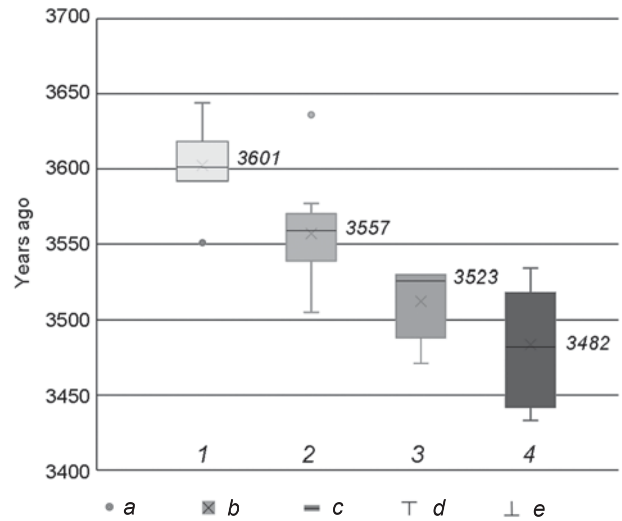

Fig. 1. Plot of uncalibrated values to determine statistical outliers and medians.
1–4 – chronostratigraphic groups.
a – outlier (point of single data); *b* – average; *c* – median; *d* – maximum; *e* – minimum.

Dating results

At the first stage of the analysis (before calibration), the presence of statistical outliers was checked by plotting a range diagram for the series as a whole. Values were used without taking into account the standard deviation. This procedure reduced the number of dates used to 40, mainly due to deliberately older dates (MAMS-11649, 3989 ± 67 BP; MAMS-11654, 3976 ± ± 53 BP; UGAMS-16777, 3760 ± 25 BP; UBA-26188, 3348 ± 36 BP). As a result, one object turned out to be outside the analysis—well 2/8, with a single date*.

Work on identifying statistical outliers ("Outlier") within the groups showed (Fig. 1) that some values that do not have a reliable cultural context do not fit into the main aggregates. Thus, one of the dates of well 6/1 (MAMS-15083, 3558 ± 28 BP) turned out to be much older than the results of dating the layers with the Srubnaya-Alakul ceramics located above and below in the stratigraphic column. It is close to the date of the layer that marks the termination of the functioning of this well (MAMS-27513, 3534 ± 31 BP). The presence of early materials within it is explained by the history of the place—the Srubnaya-Alakul building destroyed the Sintashta one.

Another example, this time later concerning to the expected date (MAMS-10885, 3478 ± 27 BP), is associated with a coal sample from well 4/1*. For this object, there are four more dates obtained from the materials of the layers of debris in the bottom part and above. The batch does not pass the χ^2 consistency test. If this value is rejected, the combined date is successfully formed, i.e. 3545 ± 11 BP, which, according to the results of calibration, provides intervals of 1920–1880 (1σ) and 1940–1780 (2σ) BC**. The reasons for this deviation are not clear.

Checking the consistency of the series within each of the four groups (phases) showed that they also contain outliers—far-distant extreme values: 3551 ± 28 BP (MAMS-15086), 3636 ± 26 BP (Hd-28458), 3471 ± 25 BP (MAMS-11653). With a high degree of probability, it can be assumed that this is not about dating problems, but about inaccuracies in the attribution of the context of the finds. In one case (MAMS-15086, 3551 ± 28 BP), this is well 5/1, for which dates were obtained from the drill samples, and there is a greater value for a stratigraphically earlier sample (MAMS-15087, 3592 ± 30 BP). In another case

*Its location and structure indicate chronological proximity to neighboring wells 2/7 and 2/9, which were probably built sequentially and belonged to the early period of development.

*Unfortunately, the depth was not recorded when taking this sample, as a result, it is not possible to relate it precisely to the stratigraphic column.

**Significant expansion of the interval in the later part with a probability of 2σ yields a segment of the calibration curve with a local plateau section.

Table 2. **Results of the analysis of distribution of dates over chronostratigraphic groups**

Group No.	Number of dates (without outliers)	Medians of uncalibrated values, BP	Summation of probabilities	
			68.2 %	95.4 %
1	6	3601	2025–1920 BC	2130–1880 BC
2	14	3557	1950–1820 BC	1980–1770 BC
3	4	3523	1900–1770 BC	1930–1760 BC
4	11	3482	1890–1740 BC	1920–1680 BC

(Hd-28458, 3636 ± 26 BP), the outer rings of the tree are dated, but the date from a pinecone from the bottom of well 2/4 is much younger (MAMS-11661, 3548 ± ± 25 BP)*. Apparently, the dating of this object should be guided by a later result, and the deviation is associated with the effect of an old tree (unless, of course, the episodes of the construction and abandonment of the well are separated in time by many tens of years).

All other values form groups with distinct areas of overlap of uncalibrated values (taking into account standard error). This situation is repeated (more precisely, it is aggravated) when summing up the probabilities ("Sum probabilities") for each of the groups (Table 2). The complex profile of the plots for some of them is a direct reflection of the nature of the calibration curve and, in part, a small number of statistical observations.

Cultural attribution of chronostratigraphic groups

The identified chronostratigraphic groups were attributed by ceramics from the infill or by overlapping structures clearly correlated with the development phases.

Group 1 includes four objects: three in the northeastern part of the settlement (2/1, 2/1a, 2/7), and one in the northern (5/1). The presence of ceramics of the Sintashta type in the average filling of wells 2/1 and 2/1a makes it possible to attribute this group of structures to the first construction phase associated with the Sintashta people.

Group 2 includes six objects: three in the northeastern part of the settlement (2/4, 2/9, 7/1), and three in the northern part (4/1, 5/4, 5/9). Also related to this period is the date obtained for the average filling of the earlier well 5/1, apparently confirming the time of its filling. Although the wells did not contain identifiable ceramics in their middle and bottom fillings, nevertheless, presumably they can be attributed to the Sintashta construction phase. The reason for this is the archaeological context of well 5/4: it was found under the ruins of the southern wall of building 5b and is associated with an earlier structure—Sintashta building 5c. Ceramics of the Sintashta type were found in the upper filling of this well. Above the shafts of wells 7/1 and 5/9, pits-furnaces were built in a later period. One (above the first object) contained ceramics of the Petrovka type, the other (above the second)—Sintashta and Petrovka (mainly). This circumstance allows us to conclude that the construction of the second group of wells could precede the Petrovka construction phase in time.

Group 3 includes four objects: one in the northeastern part of the settlement (2/5), and three in the northern part (5/2, 5/3, 5/10). In addition, a corresponding date was obtained for the foundation of a kiln pit above an earlier well 5/9. Analysis of the distribution of ceramic material in these structures shows a rather variegated picture. The typological composition of the ceramics collected at different levels of the shaft of well 5/10 allows us to conclude that the construction time of the object and both stages of its secondary use (utility pit and furnace pit) can be correlated with the Sintashta phase of the settlement's functioning. A fragment of the Petrovka vessel was found in the furnace pit above the 5/3 well. Finally, the furnace pit above well 5/9 contained predominantly Petrovka-type ceramics. It can be assumed that the objects under consideration date back to the time when the Sintashta tradition was replaced by the Petrovka one. At least some of these wells may have been built and/or reused during the Petrovka construction phase.

Group 4 includes wells 6/1, 5/7, and 3/1. They were distinguished by their large sizes and were recorded from the uppermost horizons of the cultural layer in the form of deposits of a dark humus layer formed above the mine pits. For the facing of wells 3/1 and 6/1, stone slabs were used along with wood. These objects, apparently, stood open for a long time and gradually collapsed. After well 5/7 was abandoned, the

*The consistency of the calibrated values is only 48.2 %.

Table 3. **Results of the simulation of chronological limits of phases and periods**

Period	Phase	Probability	
		68.2 %	95.4 %
Sintashta-Petrovka	Beginning of phase 1	1959–1922 BC	1976–1901 BC
	Turn of phases 2 and 3	1916–1888 BC	1932–1882 BC
	End of phase 3	1883–1867 BC	1890–1853 BC
Srubnaya-Alakul	Beginning of phase 4	1876–1826 BC	1883–1793 BC
	End of phase 4	1840–1764 BC	1876–1736 BC
General duration of phases 1–4		98–188 years	49–222 years

large furnace was equipped in its depression. In all the structures, at different filling levels, a large number of fragments of Srubnaya-Alakul dishes was found.

Based on stratigraphic observations and the features of occurrence of the ceramic material, eight more objects that do not have radiocarbon dates can be confidently attributed to the Sintashta ceramics (1/1, 1/2, 2/3, 2/6, 2/10, 5/5, 5/6, 5/11). For example, fragments of the Sintashta dishes were found in the lower and middle filling of wells 2/10 and 5/11, as well as in the filling of pits-furnaces above the shafts of wells 1/1, 1/2, and 2/6. The clogged well 2/3, according to the authors of the excavations, chronologically preceded wells 2/1 and 2/1a. Wells 5/5 and 5/6 were reliably connected with the Sintashta building 5c and contained the corresponding ceramic material in their upper filling.

Well 15/1 was examined only in the upper part, where the predominant category of finds was Petrovka-type ceramics. It is possible that this object belongs to the Petrovka construction phase or precedes it. Well 2/2 was built, apparently, during the Petrovka period, the corresponding ceramics were found in the well's middle filling.

Well 5/15, examined only in the upper part, on the basis of its size, nature of its filling, and the level of the first fixation can be confidently attributed as of Srubnaya-Alakul period.

Simulation results

In Russian archaeology, modeling is still rarely used (Schneeweiss et al., 2018; Chechushkov, Molchanova, Epimakhov, 2020), although it opens up new perspectives in evaluating large series of dates. One of the main tasks of the work was the construction of statistical models taking into account the available facts of stratigraphy. The selected groups were considered as successive phases: the first three were combined within the Sintashta-Petrovka period, the fourth was defined as an independent period. The Sintashta phases 1 and 2 were considered as a single line of continuous development, while the Petrovka (phase 3) continued this line. The model does not provide for the presence of chronological gaps between phases and periods.

In the process of defining the boundaries of periods and phases, it was found that some dates do not correspond well with the main series. This applies to both the earliest dates (Hd-28408, 3644 ± 31 BP; Hd-28458, 3636 ± 26 BP) and the latest (MAMS-27514, 3433 ± 25 BP; MAMS-11650, 3433 ± 25 BP). Another date (MAMS-27516, 3505 ± 24 BP) of the second phase was found among the "younger" ones. The calculation option after excluding these values quite adequately reflects the duration of the periods (Table 3): early (Sintashta-Petrovka)—maximum of 85 years (probability 95.4 %), late (Srubnaya-Alakul)—maximum of 61 years. The break between them was 37 years at most. The third (Petrovka) phase is separated from the two preceding Sintashta phases at about the turn of the 20th and 19th centuries BC (1897 (1σ) / 1906 (2σ) BC). Thus, its duration within the framework of the proposed model is approximately 30 years.

Earlier, a similar set of dates was analyzed within the framework of two models, including the assumption of a hiatus between two main periods (without dividing into three phases of the Sintashta-Petrovka period) (Chechushkov, Molchanova, Epimakhov, 2020: 13–14). Discrepancies in the results concern the assessment of the total duration of the settlement's functioning and individual periods (in our case, it is longer), as well as some details, but the overall picture has not undergone significant corrections.

Conclusions

As a result of the study, it was possible to identify groups of wells corresponding to the main phases of the development of the Kamennyi Ambar settlement and to clarify the chronological framework of these phases and periods. The first two phases are associated with the Sintashta materials and, apparently, illustrate the continuous existence of the population within the boundaries of a densely built-up area. Unfortunately, the available data do not allow us to clarify the differences in the chronology of the southern and northern halves of the settlement, although it is obvious that the latter has a longer history (Epimakhov et al., 2016). The third phase is conventionally attributed to the Petrovka period. Although there are almost no "pure" Petrovka objects at our disposal, the appearance of ceramics of this culture correlates well with the stratigraphically late phase of the settlement's functioning within the densely built-up area. Its duration, apparently, was shorter than that of Sintashta, which is confirmed by the smaller number of materials and dates.

Finally, the fourth phase, which completes the history of the settlement, within the framework of the

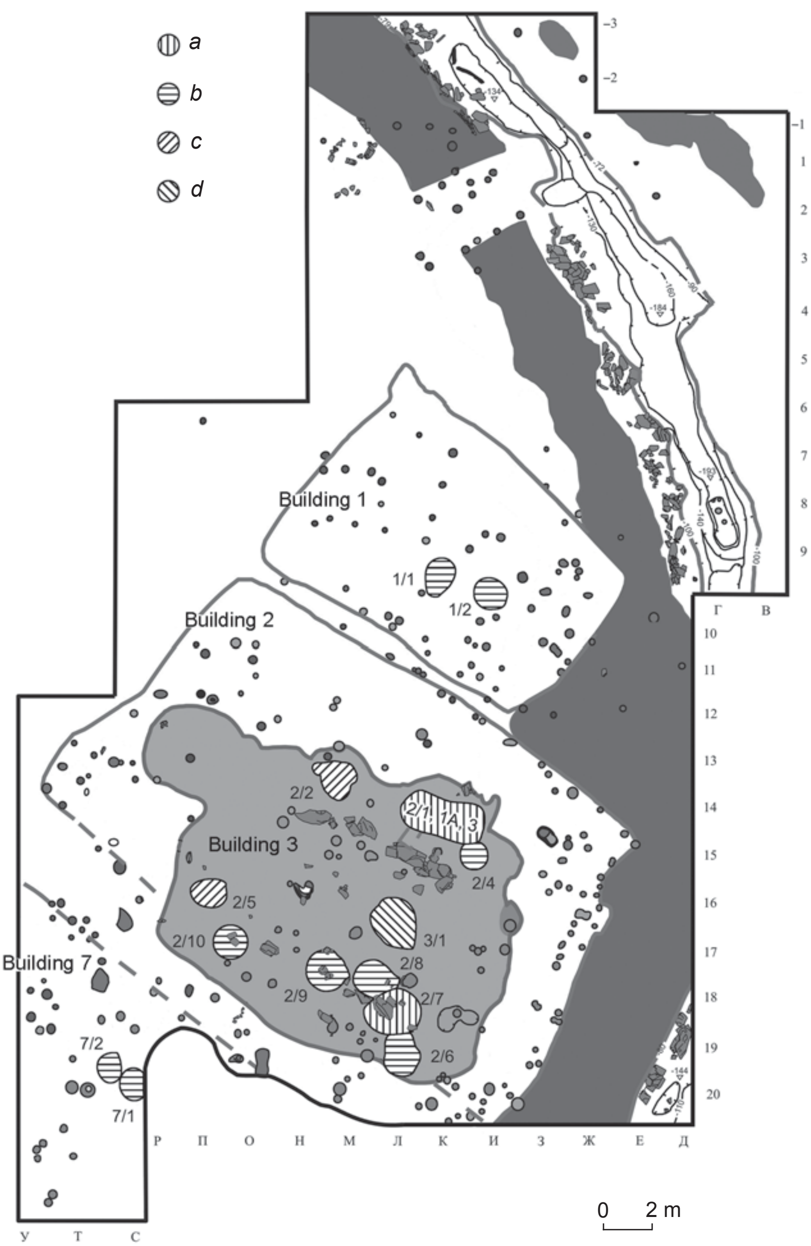

Fig. 2. Localization of wells in excavations 1–5 according to the results of cultural and chronological attribution.
a – group 1; *b* – 1/2 and 2; *c* – at 3; *d* – group 4.

Fig. 3. Localization of wells in excavation 6 based on the results of cultural and chronological attribution.
a–d – see Fig. 2; *e* – the group is not defined.

proposed statistical model, begins after a short break and illustrates the life of the settlement for about half a century. The new dwellings were built as independent objects, but the early pits and the collapse of the outer wall and ditches were taken into account, which were well traced at the time of construction.

At least 18 wells (twenty-one, if the indirect data is taken into account) at the investigated area are associated with the Sintashta construction phase (groups 1 and 2). A significant number of objects confirm that this period in the history of the settlement was the longest. Numerous reconstructions of dwellings, traces of the transfer of walls, reliably recorded during the excavation process, and the richness of the cultural layer testify to this. The predominance of the earliest Sintashta wells in the northeastern part of the site may suggest that an initial populating of the site may not have taken place simultaneously, i.e. development on the investigated area began from the southeastern line*.

The Petrovka phase was very short, and there were only six wells associated with it. Remains of buildings of this time are so inexpressive and difficult to identify that, before excavations in the northern part of the site, the Petrovka phase was not separated from the Sintashta phase at all, although the sequence of cultural deposits was clearly recorded in the filling of the ditches (Panteleeva, 2020).

*This conclusion does not take into account the simultaneous functioning of the northern and southern halves of the settlement in the early period. The latter was abandoned at the time of the general reduction of the building area (Epimakhov et al., 2016). This is partly confirmed by a single early date for the southern part of the settlement (MAMS-22509, 3608 ± 24 BP).

The location of the wells indicates that during the Sintashta-Petrovka period, a uniform cluster development model was maintained, despite traces of redevelopment. The wells were dug sequentially, forming "chains" along the central axis of the buildings, which were often closed by the Petrovka objects. This situation can be seen in the northeastern part of the site, where the earliest wells are located in the rear half of the dwellings, and the later ones (Petrovka) are shifted closer to the entrance (Fig. 2, 3). We also emphasize that we do not see significant differences in the design of the Sintashta and Petrovka wells—the technological tradition was clearly the same.

It is probably the wells that mark the earliest planning scheme that was lost during the reconstruction. Particularly expressive in this sense is the picture in building 2 with two lines of wells, apparently reflecting the existence of two earlier structures. A similar situation was observed in the northern part of the settlement: wells 5/4, 5/5, and 5/6 were found directly on the line of the southern wall of building 5b. An analysis of the excavation materials allowed us to conclude that these objects are associated with an earlier structure (building 5c).

In the final (Srubnaya-Alakul) construction phase, the picture is more variable: wells were built in dwellings, small utility rooms, and in open space outside large buildings. Wells of this period significantly differ from earlier ones in size and design.

In general, it can be concluded that there were no large chronological intervals between the construction phases. On the one hand, this is confirmed by the radiocarbon dates obtained for different objects, which have a significant mutual overlap. On the other hand, the continued use of the original layout of buildings in the Petrovka period (including the localization of wells) indicates that the ruins of the previous structures, at a minimum, were still clearly visible on the surface. The same can be said about the final period of the settlement's functioning. Although in the Srubnaya-Alakul period, the principle of cluster development gave way to chaotic outbuildings, and large residential buildings were often erected in the contours of the previous foundation pits.

The first half of the 19th century BC can be considered as the time of the most intense cultural processes. It was during this period that there was a consistent change in cultural traditions, traces of which were recorded in the materials of the monument. The total duration of the history of the settlement did not exceed one and a half centuries. This conclusion can be adjusted by using all the dates of the site, but, as shown above, even the cultural attribution of specific samples from wells is not always clear; for finds from filling pits or ditches, this problem is even more relevant.

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References

Alaeva I.P. 2002
Kolodtsy poseleniy bronzovogo veka Uralo-Kazakhstanskogo regiona. In *Severnaya Yevraziya v epokhu bronzy: Prostranstvo, vremya, kultura*. Barnaul: Izd. Alt. Gos. Univ., pp. 7–9.

Bronk Ramsey C. 2017
Methods for summarizing radiocarbon datasets. *Radiocarbon*, vol. 59 (6): 1809–1833.

Chechushkov I.V., Molchanova V.V., Epimakhov A.V. 2020
Absolyutnaya khronologiya poseleniy pozdnego bronzovogo veka Kamenniy Ambar i Ustye I v Yuzhnom Zauralye: Vozmozhnosti bayesovskoy statistiki. *Vestnik arkheologii, antropologii i etnografii*, No. 2: 5–19.

Chemyakin Y.P. 2020
Kolodtsy poseleniya epokhi bronzy Korkino I. In *Stepnaya Yevraziya: Bronzoviy mir: Sbornik nauch. tr. k 80-letiyu Gennadiya Borisovicha Zdanovicha*. Chelyabinsk: Izd. Chelyab. Gos. Univ., pp. 184–198.

Culture, Environment and Economy of the Bronze Age in the Karagaily-Ayat Microregion (South Urals, Russia). 2020
Bonn: Verl. Dr. Rudolf Habelt GmbH. (In press).

Epimakhov A.V., Berseneva N.A. 2012
Traditsiya sooruzheniya kolodtsev v aridnoy chasti Severnoy Yevrazii v epokhu bronzy. In *Kultury stepnoy Yevrazii i ikh vzaimodeistviye s drevnimi tsivilizatsiyami*, bk. 2. St. Petersburg: Periferiya, pp. 164–168.

Epimakhov A.V., Berseneva N.A., Fedorova N.V., Noskevich V.V. 2016
Geophysics and archaeology of Bronze Age settlements – a case study from Kamennyi Ambar fortified settlement (South Urals). *Near Surface Geoscience 2016 – 22nd European Meeting of Environmental and Engineering Geophysics, 4–8 Sep. 2016, Barcelona*, vol. 2016. DOI: 10.3997/2214-4609.201602029

Koryakova L.N., Krause R., Epimakhov A.V., Sharapova S.V., Panteleeva S.E., Berseneva N.A., Fornasier J., Kaiser E., Molchanov I.V., Chechushkov I.V. 2011
Archaeological studies of the Kamenny Ambar (Olgino) fortified settlement. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 39 (4): 61–74.

Koryakova L.N., Kuzmina S.A. 2017
Nekotoriye osobennosti arkhitektury ukreplennogo poseleniya Kamenniy Ambar v kontekste obraza zhizni naseleniya Yuzhnogo Zauralya nachala II tys. do n.e. *Uralskiy istoricheskiy vestnik*, No. 1: 92–102.

Koryakova L.N., Panteleeva S.E. 2019
Kolodtsy ukreplennogo poseleniya Kamenniy Ambar. *Uralskiy istoricheskiy vestnik*, No. 1: 17–26.

Multidisciplinary Investigations of the Bronze Age Settlements in the Southern Trans-Urals (Russia). 2013
Bonn: Verl. Dr. Rudolf Habelt GmbH.

Panteleeva S.E. 2020
Prostranstvennoye raspredeleniye keramiki v sloye ukreplennogo poseleniya Kamenniy Ambar: K rekonstruktsii osnovnykh stroitelnykh faz. *Vestnik Yuzhno-Uralskogo gosudarstvennogo universiteta*. Ser.: Sotsialno-gumanitarniye nauki, vol. 20 (3): 38–48.

Reimer P.J., Bard E., Bayliss A., Beck J.W., Blackwell P.G., Bronk-Ramsey C., Buck C.E., Cheng H., Edwards R.L., Friedrich M., Grootes P.M., Guilderson T.P., Haflidason H., Hajdas I., Hatté C., Heaton T.J., Hoffman D.L., Hogg A.G., Hughen K.A., Kaiser K.F., Kromer B., Manning S.W., Niu M., Reimer R.W., Richards D.A., Scott E.M., Southon J.R., Turney C.S.M., Plicht van der J. 2013
IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. *Radiocarbon*, vol. 55 (4): 1869–1887.

Rühl L., Koryakova L.N., Krause R., Stobbe A. 2016
Wells of the fortified Bronze Age settlement Kamennyi Ambar (Chelyabinsk Oblast, Russia). In *Ekologiya drevnikh i traditsionnykh obshchestv*. Tyumen: Izd. Tyum. Gos. Univ., pp. 187–192.

Schneeweiss J., Becker F., Molodin V.I., Parzinger G., Marchenko Z.V., Svyatko S.V. 2018
Radiouglerodnaya khronologiya protsessa zaseleniya pamyatnika Chicha i bayesovskaya statistika dlya otsenki preryvistogo perekhoda ot epokhi pozdney bronzy k rannemu zheleznomu veku (Zapadnaya Sibir). *Geologiya i geofizika*, No. 6: 792–813.

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M.V. Dobrovolskaya, N.A. Makarov, and M.A. Samorodova
Institute of Archaeology, Russian Academy of Sciences,
Dm. Ulyanova 19, Moscow, 117292, Russia
E-mail: mk_pa@mail.ru; MakarovNA@iaran.ru; rita.am@mail.ru

Mobility of the Suzdal Opolye Settlers in 900–1150 AD

The formation of Northeastern Rus in the 10th–11th centuries is usually regarded as a process triggered by intense multicultural interaction and the influx of new settlers from the Dnieper region, Northwestern Rus, and Scandinavia to the Volga-Oka watershed. The dense rural settlement network that existed in 1000–1300, which was recently documented in central Northeastern Rus, and the reconstructed medieval landscapes unambiguously suggest that the prosperity and stability of villages was an important factor in the rise of the region. The level of mobility of the population in Northeastern Rus in the 10th–12th centuries is highly relevant to this issue. This parameter can be assessed using paleodietary data on the isotopic composition of strontium in the dental enamel and bone collagen of individuals buried at medieval cemeteries. The analysis of such samples from a large, rural agglomeration dating to the 10th–early 13th centuries, Shekshovo-9, suggests that this was a culturally diverse and wealthy population, which was part of a trade network. The migration level in this agglomeration was estimated by the results of the mass spectrometric analysis of samples from 24 humans and three animals from the Shekshovo-2 and -9 cemeteries. The reconstructions indicate a high proportion of locals as compared to similar sites in Eastern Europe. No direct relationship was found between the presence of artifacts introduced from other cultures and the isotopic profile of first-generation immigrants. The resulting pattern, indicating a high proportion of native individuals, has no parallels among the 10th–11th century sites in Eastern and Northern Europe represented by comparable data on strontium isotopes.

Keywords: *Medieval mobility, Northeastern Rus, migrations, population continuity, strontium isotopes.*

Introduction

A historical view of Rus in the 10th–12th centuries combines the images of movement and settlement in new territories by large and small groups, and orderly rural life with long succession in space planning and economic development of individual places. According to the common opinion of historians and archaeologists, the emergence of Northeastern Rus in the 10th–11th centuries was associated with the appearance of new colonists in the Volga-Oka region and presupposed high mobility of a part of the population interested in long-distance trade and agricultural development of new lands. Identification of migration indicators, including items of Scandinavian, Baltic, or Southern Russian origin, which could be associated with the presence of migrants from the North and South and cultural elements indicating the original areas of colonization, has traditionally played an important role in studying archaeological evidence from Northeastern Rus of the 10th–11th centuries. The dense network of rural settlements of the 11th–13th centuries identified in the central regions of Northeastern Rus in recent decades, and reconstruction of medieval landscapes clearly indicate that flourishing of the region was largely caused by its agricultural capacity, well-being and the stability of villages, and attachment of the medieval societies to the initial centers of settlement (Makarov, Leontiev, Shpolyansky, 2004; Makarov, 2009).

Archaeology, Ethnology & Anthropology of Eurasia 48/4 (2020) 106–115 E-mail: Eurasia@archaeology.nsc.ru

The issue of the relationship between mobility and "sedentariness" in the society of Northeastern Rus in the 10th–12th centuries and level of mobility of the population living in rural areas is of paramount interest and involves the use of current bioarchaeological approaches to its solution. It is known, however, that most of the cemeteries in the center of the Rostov-Suzdal land were excavated in the mid 19th century. The anthropological remains discovered in these excavations were not transferred to museum collections, and excavation finds of the subsequent period are fragmentary and insufficiently documented. Given this situation, the opportunities for reconstructing the mobility of the medieval population on the basis of the analysis of isotopic composition of skeletal remains are extremely limited.

Cemetery of Shekshovo-9—a necropolis of one of the largest settlement agglomerations of the 10th–13th centuries

One of the few burial sites of the 10th–12th centuries, which is promising in terms of obtaining isotope data on the lifestyle of people who lived in the central regions of Northeastern Rus, is the Shekshovo-9 cemetery in the Suzdal Opolye (Fig. 1). The study of that necropolis was initiated in 1852 by A.S. Uvarov, who explored 244 burial mounds there. The survey of the area in 2011 showed that there were no external signs of burial mounds at that cemetery, but some of the burials, ditches, and areas on which burial mounds were erected have survived and are available for study. Fourteen areas of former burial mounds were partially or completely unearthed; intact and disturbed burials performed according to the funeral rite of cremation and inhumation were explored for a period of seven years of excavations over an area of about 2550 m^2. Nineteen out of 26 inhumation burials were most likely earthen graves not covered with burial mounds. The area with remains of cremation on the surface or in shallow pits was identified from calcified bones and medieval items damaged and deformed by fire outside the areas of the burial mounds. Calcified bones belonged to at least 20 individuals of different sex and age. In total, the remains of at least 46 people were found at the explored site, including 10 males, 10 females, and 14 children and adolescents.

After new excavations, the Shekshovo necropolis appears as a site with flat graves and burial mounds, which formed a sophisticated ensemble. It may be assumed that its original core consisted of flat graves of cremated persons, as well as burial mounds covering burials also performed according to the cremation rite. The replacement of cremation by inhumation should be attributed to the turn of the 10th–11th to the early 11th century, since there is no reliable evidence for the continuing practice of cremation in the 11th century. Changes in the funeral rite in the late 10th–early 11th century were quite radical: burials began appearing at the cemetery in spacious and deep grave pits with few grave goods. They were placed in the area where cremated remains were scattered on the surface not long before. Excavation evidence from Shekshovo reveals the emergence of a powerful center of the Old Russian culture in the early 11th century, where Finnish traditions were clearly expressed in the preceding 10th century (Makarov et al., 2020).

Fig. 1. Medieval cemeteries which skeletal evidence was used to study the strontium isotopic composition.
1 – Birka; *2* – Sigtuna; *3* – Ladoga, necropolis near the Church of St. Clement; *4* – Novgorod; *5* – Poddubye; *6* – Shekshovo-9; *7* – Shekshovo-2; *8* – Bolshoye Davydovskoye-2; *9* – Bodzia; *10* – Ciepłe.

Despite the presence of weaponry and festive male clothing in the burial inventory, which gives the site a special flavor, Shekshovo-9 is a cemetery with standard sex and age distribution of the buried persons with a proportional representation of males, females, and children. The funeral rite, with all variety of its specific forms, was focused on demonstrating the prestige and high wealth of medieval settlers of Shekshovo. Common elements for many sites of the 10th–11th centuries, which are traditionally viewed as testimonies of social prestige and participation in commodity-money relations (including Eastern, Byzantine, and Western European coins, weights and parts of scales for weighing light loads) appear there in an extremely vivid way.

Shekshovo is a necropolis of one of the largest settlement agglomerations of the 10th to the first half of the 13th century in the Suzdal Opolye (complex of settlements of Shekshovo-2–Bolshoye Davydovskoye-2), which at the early stage of its existence (10th–11th centuries) can be described as a large settlement. The total area of sites with cultural layer of the 10th–11th centuries covers at least 15 hectares. Material evidence from excavations and collections characterize this site as a complex with a sophisticated, multicomponent culture, where the Old Russian and Volga-Finnish traditions are clearly expressed and where Scandinavian elements are present, and as a settlement with its own agricultural life supporting system, craftsmanship, and wide trade ties (Fig. 2). The Shekshovo agglomeration was one of the

Fig. 2. Grave goods from burial 12 (first half of the 11th century) at Shekshovo-9.
1 – ring; *2* – knife; *3*, *5–7* – temple rings; *4* – beads; *8* – pendant coin (England, Ethelred II, London, Leofnod coiner, 991–997); *9*, *10* – vessels.*1*, *3*, *5–7* – non-ferrous metal; *2* – iron; *4* – glass; *8* – silver; *9*, *10* – ceramics.

most important centers of the new settlement network that emerged in the center of the Volga-Oka region in the 10th century (Fedorina, Krasnikova, 2015; Makarov, Fedorina, 2015; Makarov, Fedorina, Shpolyansky, 2018). The presence of two other cemeteries in the microregion, corresponding to the earlier stage of its development (Bolshoye Davydovskoye-2, late 3rd–4th centuries) and to the final stage of habitation at the settlement (Shekshovo-2, late 12th–13th centuries), make it possible to use paleoanthropological evidence from other periods for comparative study and to follow bioarchaeological approaches in a diachronic context. The data on the strontium isotopic composition of dental enamel and bone tissue provide the needed means for reconstructing the mobility and migration activity of medieval people living in the Suzdal Opolye.

Methodological aspects of studying the isotopic composition of strontium in material evidence from the medieval sites of the Suzdal Opolye

Data on the isotopic composition of strontium in bone tissue and dental enamel of persons whose remains were found at archaeological sites are successfully and widely used for evaluating population mobility. The share of strontium isotopes in the environment is primarily determined by the geological deposits on which the local flora grows and by the mineral composition of drinking water. This method has been actively used in archaeology for over ten years, but numerous methodological difficulties continue to be discussed (Bentley, 2006; Frei et al., 2015). The first step of research is to clarify the boundaries of the local variability of strontium composition in local biota and water. In the case when individual data are beyond the local values of the $^{87}Sr/^{86}Sr$ ratio, the person, animal, or material of biological origin (leather, wool, textiles made of wool, silk, plants, etc.) should be considered to have been formed or spent the last years of life outside that specific area. The most preferred object of study is dental enamel, because it is least susceptible to the impact of factors that may transform the lifetime isotopic composition in the soil of the burial. Compact bone tissue of good preservation can also be used for analysis.

It is important to keep in mind that dental enamel on each tooth (baby tooth or permanent tooth) is formed over a certain period of time. When, for example, enamel of the first upper incisor is used as a sample, the isotopic composition of strontium will reflect the total characteristics of a person's habitation for about three to four of his first years of life, while his compact bone tissue will reveal the characteristics for the last seven to ten years of life. Thus, when analyzing dental enamel, we can learn about a specific period in the childhood of that person. The data obtained from compact bone tissue inform us about the average parameters of his habitation over the last seven to ten years of life.

Data on the isotopic composition of strontium in the dental enamel of baby teeth require special interpretation. These teeth emerge in the period of intrauterine development, and the composition of the enamel will reflect specific features of both the nutrition of the woman in whose body the child is developing, and the environment (food and drinking water). Analysis of dental enamel, for example, of the central baby incisor of the maxilla will give us an idea on the environment of the mother during her pregnancy and the newborn infant in the first months of life.

The term "mobility" has been widely used in bioarchaeological literature for describing the intensity of a person's movements throughout his life. Most often, scholars use information on the composition of dental enamel; therefore, the conclusion about the level of mobility is usually made from whether the person lived in the given area in his childhood or not. Presence of remains of people who spent their childhood in other lands in the burials can be interpreted as manifestation of mobility. Yet these data may indicate either one resettlement or many movements. Analysis of the isotopic composition of strontium in teeth enamel only partially reveals the history of the person's mobility. When comparing the data obtained from dental enamel and bone tissue, the opportunities for assessing one's mobility increase. Bone tissue undergoes constant restructuring; its composition changes throughout the entire life. Therefore, a detailed description of the type of bone tissue and of a bone fragment makes it possible to determine with greater accuracy which period of a person's life is characterized by the value of the ratio of strontium isotopes obtained.

The possibility of studying cremated remains has been substantiated in a number of studies (Snoeck et al., 2018). Such material evidence is important for assessing migration intensity of the medieval population in the period preceding the spread of Christianity and the rite of inhumation. The isotopic composition of strontium in cremated bones was established by K.M. Frei in collaboration with the National Museum of Denmark. Results were obtained at the Department of Geosciences and Natural Resource Management at the University of Copenhagen. The ratio of strontium isotopes in 29 samples was established at the Center for Isotope Research of the Karpinsky Russian Geological Research Institute (St. Petersburg) by E.S. Bogomolov, and at the Institute of Geology and Geochemistry of the Ural Branch of the Russian Academy of Sciences (Yekaterinburg) by D.V. Kiseleva.

Reconstruction of population mobility in the Suzdal Opolye

The Vladimir-Yuryev Opolye is a unique natural phenomenon, which ensured the successful development of the medieval arable agriculture. Formation of fertile soil was largely fostered by the nature of the upper part of the Quaternary cover, which consisted of an undivided complex of subaerial, loamy deposits on underlying low-carbonate moraine. Therefore, it is possible to identify local residents and migrants based on geochemical features of the territory. To obtain the boundaries of the local variations in $^{87}Sr/^{86}Sr$ values, we used the principle of geomorphological diversity (Dobrovolskaya, Reshetova, 2018). Shells of bivalve mollusks associated with the main source of water were collected, and plant samples were taken in terraced and floodplain areas near the Irmes River next to the cemetery. The boundaries of local variability were confined to the values of 0.71041–0.71575 (Frei et al., 2016).

Most of our samples were dental enamel or tooth root (see *Table*). One sample was organic matter from a humic accumulation of soil in the cultural layer of Shekshovo-9. Only one person was represented by the samples of dental enamel and compact bone tissue. The range of $^{87}Sr/^{86}Sr$ values obtained from the analysis of human skeletal remains was 0.7098–0.7211. Most of the individual values were within the limits of local variability (Fig. 3), and more than two thirds of the values were within the narrower range of 0.710–0.712. The values of the isotope ratio in the dental enamel of animal teeth indicate their local origin. All cremated bone samples show values similar to baseline numbers. The exception was the skeletal remains of the persons buried according to the inhumation rite from the Shekshovo-2 cemetery, and four ground burials from Shekshovo-9 (Fig. 4). We will dwell on them in more detail.

Burial 14 was one of the earliest inhumations at Shekshovo-9, dated to the late 10th to early 11th century. It belonged to a person of 15–19 years of age and a female, judging by the jewelry. The anthropological determination of sex did not contradict this conclusion. The isotopic composition of strontium in the upper incisor enamel is formed in the period from 0.5 to about 4 years of age. The obtained value of $^{87}Sr/^{86}Sr$ (0.70986) indicates the presence of that girl in a different geochemical environment at an early age.

Burials 8 and 11 (excavations of 2014) were children's; both were dated to the 11th century. The age of the child from burial 8 was 3–4 years. The enamel from the germ of the first upper permanent molar was used as a sample. The $^{87}Sr/^{86}Sr$ ratio was 0.716252. Similar values were obtained, for example, from the paleoanthropological evidence from the south of Novgorod Region (Dobrovolskaya, Reshetova, 2018: 14). The crown was formed at the age of 2–3.5. Thus, the child was born and lived in his first years of life in another area, and shortly before his death moved to the Opolye. Obviously, he could have moved there only with his relatives. The child from burial 11 was somewhat older, although poor preservation of his remains did not make it possible to establish his age accurately. The enamel from the germs of the first molars was also used as a sample. The $^{87}Sr/^{86}Sr$ ratio was 0.721159, the highest in the sample. It can be associated, for example, with the territory of Scandinavia (Price, Moiseyev, Grigoreva, 2019: 6098). This person was also born and spent the first two or three years of life outside the Suzdal Opolye, and moved there shortly before the person's death. The presence of such children in the paleopopulation most likely reflects the migration of families or groups of relatives. The small number of cases and the fact that the samples belonged to children do not yet make possible a sound discussion of these facts.

Three burials of individuals identified as "natives born in other territories" were located in the same section of the necropolis and belonged to flat graves of the 10th–11th centuries.

Burial 8 (excavations of 2017) stands out among the majority of burials at Shekshovo-9 by its isolated location, unusual orientation (southern), and position of hands (folded on the chest). Judging by the presence of an oval fire striker with a prong, the burial can be dated to no later than the mid 12th century, most likely to its first half. The $^{87}Sr/^{86}Sr$ ratio in the canine tooth was 0.71194 and corresponded to the local variation range. Based on this indicator, this person could have been born locally. However, the $^{87}Sr/^{86}Sr$ value in the compact bone tissue of his fibula was significantly lower, reaching only 0.70989, beyond the limits of local variability. Thus, the male from burial 8 spent his childhood in the Suzdal Opolye, lived the last years of his life in other lands, and was buried in his homeland. Comparison of isotopic parameters in dental enamel and bone samples makes it possible to evaluate his mobility. It is interesting that the ratio of strontium isotopes characterizing the childhood environment of the girl buried in burial 14, and the last years of life of the male whose remains were found in burial 8, were almost identical. This may indicate the existence of stable links between the Suzdal Opolye and the territory with this geochemical value.

Two burials from Shekshovo-2 belonged to males of 25–35 years of age. They are in a part of the necropolis that emerged at the settlement of the same name in the late 12th century after abandoning the northern section of the settlement previously occupied by residential buildings. The values of the ratio of strontium isotopes in dental enamel of these individuals were close to the values obtained in the analysis of dental enamel of the girl from burial 14 and bone tissue of the male from

The ratio of radiogenic strontium isotopes in the samples from the Sekshovo-2 and -9 cemeteries

Year of excavations	Place of discovery, sex, age	Sample	Comment	$^{87}Sr/^{86}Sr$, ‰
		Shekshovo-2		
2007	Burial 1, adult male	Upper premolar enamel	Inhumation	0.71009
2011	Burial 2, adult male	Upper incisor enamel	"	0.70981
		Shekshovo-9		
2012	Excavation 1, burial 1, male, 30–45 years old	Third upper molar enamel	"	0.71019
2012	Area 1, sq. 579/092в, adult individual	Tubular bone	Cremation	0.71140
2012	Sq. 574/080, plowed soil	Dental enamel	Bovine cattle	0.71222
2013	Excavation 2, brown layer, upper part of the ditch, sq. 584/063, adult individual	Tubular bone	Cremation	0.71169
2013	Excavation 2, sq. 583/068, upper part of the ditch, adult individual	Tubular bone	"	0.71040
2013	Burial 1, female, 30–39 years old	Lower canine enamel	Inhumation	0.71072
2013	Burial 2, male, 40–49 years old	Molars enamel	"	0.71153
2013	Burial 4, child, 6–7 years old	Lower premolar enamel	Tooth germ, inhumation	0.71050
2013	Burial 5, female, 20–29 years old	Lower canine enamel	Inhumation	0.71050
2013	Burial 6, child, 3–4 years old	First molar enamel	Tooth germ, inhumation	0.71133
2014	Burial 7, male, 40–49 years old	Cranial vault	Inhumation	0.71153
2014	Burial 8, child, about 3–4 years old	First molar enamel	Tooth germ, inhumation	0.71625
2014	Burial 11, child, 3–6 years old	Molars enamel	Teeth germs, inhumation	0.72116
2014	Burial 12, female, 30–39 years old	Upper premolar enamel	Inhumation	0.71154
2015	Burial mound 11, western ditch	Dental enamel	Horse, inhumation	0.71208
2015	Burial 14, female, 15–19 years old	Upper incisor enamel	Inhumation	0.70986
2015	Burial 15, child, about 10 years old	Second lower molar enamel	Tooth germ, inhumation	0.71105
2016	Burial mound 12, adult male	Root of lower canine	Cremation	0.71020
2016	Burial mound 8, southwestern ditch, sq. 573/051	Dental enamel	Horse	0.71020
2017	Excavation 1, burial 5, male, 20–29 years old	Upper first premolar enamel	Inhumation	0.71160
2017	Excavation 2, burial 6, female, 20–29 years old	Upper second molar enamel	"	0.71136
2017	Excavation 1, burial 7, child, about 3 years old	Upper canine enamel	Tooth germ, inhumation	0.71286
2017	Excavation 1, burial 8, male, 30–39 years old	Upper canine enamel	Inhumation	0.71194
2017	"	Compact tubular bone (fibula)	"	0.70989
2018	Excavation 4, burial 9, child, about 9 years old	Second molar enamel	Deciduous tooth, inhumation	0.71164
2018	Excavation 4, burial 10, male, 40–49 years old	Upper second molar enamel	Inhumation	0.71022
2013	Sq. 640/089, accumulation 1, black layer	Organic matter in soil	–	0.71204

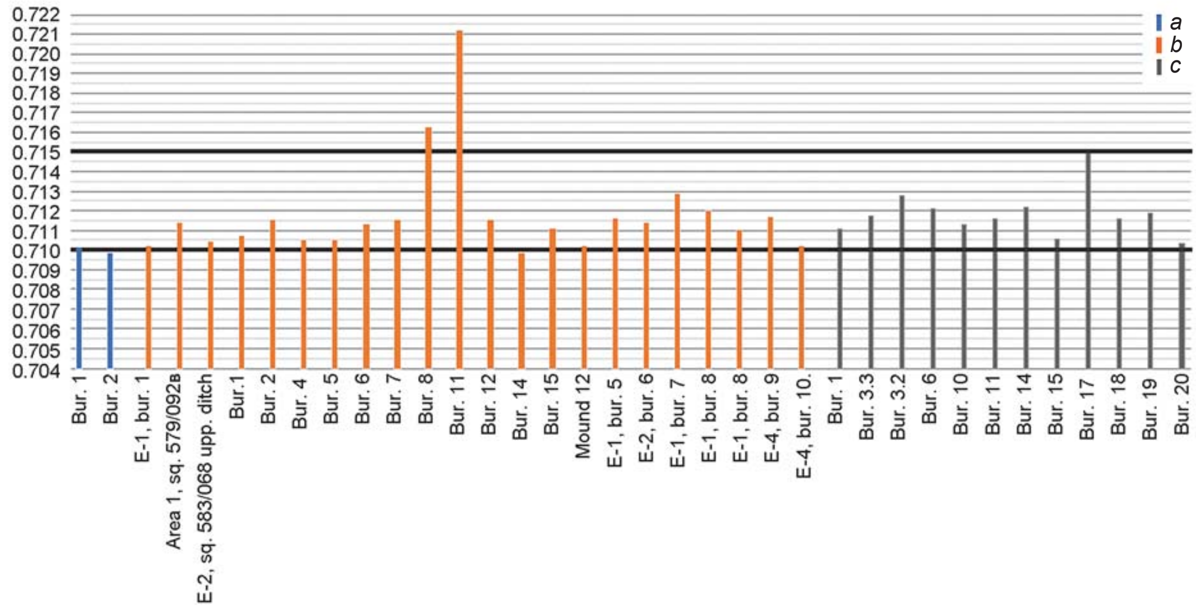
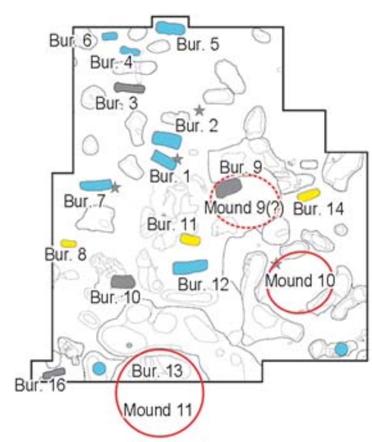


Fig. 3. Ratio of strontium isotopes in dental enamel and bone tissue of people buried at Shekshovo-2 (*a*), -9 (*b*), and Bolshoye Davydovskoye-2 (*c*).



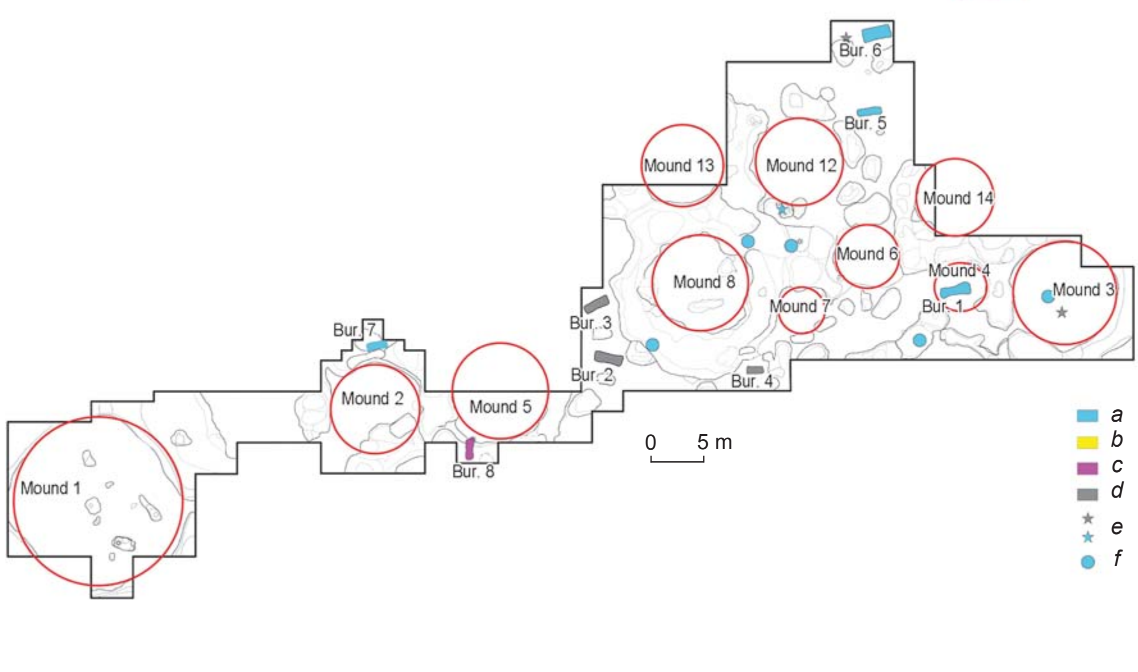


Fig. 4. Ground plan of burials with designation of "born locally" and "migrants", identified by the isotopic composition of strontium, at Shekshovo-9.

a – "born locally"; *b* – "migrants"; *c* – "born locally" but living outside the Suzdal Opolye in the last years of life; *d* – no data on the isotopic composition of strontium; *e* – burials made according to the cremation rite; *f* – cremated remains of unidentified location found outside large clusters.

burial 8 at Shekshovo-9, which confirms the hypothesis on the existence of territories that had stable connections with the Suzdal Opolye.

Discussion

Overall, the results obtained suggest a predominantly local origin of the people buried at the Shekshovo-9 cemetery. The addition of persons born in other areas to this group was small, but can be observed at all stages of the necropolis' functioning. It is important that samples from burials performed according to different rites (cremation and inhumation under a burial mound, or inhumation without a burial mound) provide similar values of strontium isotopes. Notably, burial mound 8 where the complex contained a set of bridle elements, according to I.E. Zaitseva, was associated with the nomadic world (2017). The results of isotope analysis indicate the local origin of two persons whose burials contained coins placed in the graves as "Charon's obol"—whole dirhems and cut pieces of coins (burial 1, excavations of 2012; burial 5, excavations of 2017). Such a custom was rare in Medieval Rus. It is possible that it was spread by mobile tradesmen, but the isotope data do not support this assumption. In terms of $^{87}Sr/^{86}Sr$ values, the persons from several burials of the first half of the 11th century, which were performed according to the inhumation rite, should be recognized as "local" (burial 1, excavations of 2013; burial 12, excavations of 2014; burials 5 and 6, excavations of 2017). Thus, the emergence of this rite, including the custom of burying in large pits, as well as presence of prestigious imported items in material complexes, in particular Western European and Byzantine coins, was not associated with the arrival of migrants to Shekshovo. New forms of funeral rite, reflecting the emergence of Old Russian cultural norms and abandonment of pagan traditions, entered the everyday life of the local population in the first half of the 11th century. The only burial of a newcomer identified by the isotope markers (burial 8, excavations of 2017) is distinguished by an unusual funeral rite.

For comparative assessment of mobility of the people leaving behind the Shekshovo-9 necropolis, we should turn to available data on isotopic composition of strontium in the skeletal remains from Bolshoye Davydovskoye-2 of the Early Iron Age (Makarov, Krasnikova, Zaitseva, 2010). We compared two groups of people who lived on the same territory, but were separated by seven to eight centuries. Samples of bone tissue and dental enamel represented 11 persons of different sex and age from Bolshoye Davydovskoye-2. The range of the values obtained for $^{87}Sr/^{86}Sr$ was 0.710334–0.715177. None of the individual indicators significantly exceeded the boundaries of local variability. The arithmetic average values for the series from Bolshoye Davydovskoye and Shekshovo were identical up to three decimal places (0.7117 and 0.7118, respectively), and the standard deviation for the medieval group was twice as large. This made it possible to assume that persons from Shekshovo-9 could have originated in different parts of some geochemically unified space. The necropolis might have been the burial place for not only one large agglomeration of settlements, but also for its surrounding areas. The lifestyle of the Early Iron Age people leaving behind the Bolshoye Davydovskoye-2 cemetery was also distinguished by moderate mobility. However, is there a risk that the range of local variations in values is too large and does not make it possible to assess the mobility of ancient groups in this region?

The nearest place with known data on variability of the strontium isotopic composition is Yaroslavl, located about 100 km to the north of Shekshovo. Excavations of the medieval layers in Yaroslavl, corresponding to the time of Khan Batu's invasion, have made it possible to collect rich osteological evidence. The data on the isotopic composition of strontium in the skeletons of humans and animals was obtained. There is reason to believe that not only local residents, but also people from other territories were in the town during its capturing, so we cannot rely on individual data of the buried from collective graves. It is more important that the boundaries of local variability were identified on the basis of ancient and modern local fauna. The local values ranged from 0.7119 to 0.7137 (Engovatova et al., 2015: 120). Most of the individuals from Shekshovo, as has been mentioned above, are characterized by a strontium ratio from 0.710 to 0.712, which differ from the values typical of the territory of Yaroslavl. This indicates that the method is effective in distinguishing between the groups of local residents.

Two out of the four persons from Shekshovo-9 who could be called migrants had $^{87}Sr/^{86}Sr$ values below local values (burials 14 and 8). The values of 0.7098 and 0.7099 have been observed in more southern regions of the Russian Plain. The lower values are typical of the Caucasus, where rocks of magmatic or metamorphic origin are present (Shishlina et al., 2016: 35).

Generally, the value of $^{87}Sr/^{86}Sr$ in the samples from Shekshovo-2 and -9 tends to be low within the limits of local variability. Note that earlier examination of woolen fabric from Shekshovo showed a value of 0.70999 (Frei et al., 2016), which is comparable with that of an individual from burial 14, one of the earliest burials.

We should consider the ratios of strontium isotopes in the samples from burial sites that are chronologically close to the Shekshovo cemetery and are also associated with the emergence of power centers (see Fig. 1). Bodzia and Ciepłe are necropolises with burials of the military elite of the late 10th to first half of the 12th century in Poland. Northern Europe is represented by burials from Birka (8th–10th centuries), Sigtuna (10th–12th centuries), and Staraya Ladoga near the Church of St. Clement (11th–12th centuries).

The isotopic composition of strontium in dental enamel of individuals from the Ciepłe cemetery has revealed a high percentage of "non-residents". Individual values (21 individuals) ranged from 0.7096 to 0.7115. The authors of the study suggested that individuals with values below 0.7102 (amounting to about half) were recent migrants. This group included those buried both in burial chambers and in single graves. Presumably, these people were the natives of Denmark, Southwestern Sweden, Western Norway, Rügen Island, and Southeastern Poland (Bełka et al., 2019).

The study of 13 samples from the elite burials of the Bodzia necropolis has shown that only one individual could be recognized as locally born resident (Price, Frei, 2015: 458). This probably indicates an exceptional importance of the settlement that attracted people from other regions. Variability of the indicator among the migrants was not high, ranging within 0.7090–0.7129. The authors observed that such values are typical of many European territories with blanking deposits associated with loess and presence of carbonates.

The scatter of values for the burials of Early Medieval Birka was significant and ranged from 0.71026 to 0.73425 against the baseline of local variations within 0.722–0.732 (Price et al., 2018: 32). The $^{87}Sr/^{86}Sr$ values in the samples from Sigtuna varied from 0.7080 to 0.74215, with a local range of 0.7167–0.7323 (Krzewinska et al., 2018: 2733). Over a half of the 36 individuals were "non-residents". The samples from Staraya Ladoga also showed a wide range of values from 0.7105 to 0.7334. Persons presumably related by their origin in Southeastern Sweden, Finland, and Northwestern Russia were identified. It is difficult to distinguish those born locally because of possible intersection in local isotopic characteristics with those of the Gotland Islands and some other territories. In any case, the group included a significant share of "non-residents" (Price, Moiseyev, Grigoreva, 2019: 6107).

Thus, the resulting picture is diverse. People from different territories were buried at the necropolises of Bodzia, Birka, Sigtuna, and Staraya Ladoga. About half of the persons buried in Ciepłe were first generation migrants. In Shekshovo, only a few buried persons were people from other territories. When comparing the areas where the "migrants" originated, a zone with variations in the isotopic strontium ratio in the approximate range of 0.708–0.710 was distinguished. Scholars who studied the evidence from the Bodzia necropolis suggested that some of the buried originated in the Kiev lands and were associated with the retinue of Svyatopol, who relied on the military support of Boleslav I in the struggle for Kiev, based on some finds from burials and identification of a group of migrants with indicators ranging between 0.709 and 0.710 (Price, Frei, 2015). Some migrants from Shekshovo could have been associated with the southern Russian lands. We should also mention that similar values (0.709–0.710) characterize territories favorable for arable farming. Assessment of mobility of the people leaving behind the cemeteries of Bodzia, Ciepłe, and Shekshovo reveals significant differences in the history of emergence of these population groups.

Conclusions

The study of the strontium isotopic composition in skeletal remains from Shekshovo-9 is one of the first experiments in reconstructing mobility of people in the 10th–11th centuries, associated with the emergence of a new settlement network in the north of the Russian Plain. When archaeologists address this topic, they traditionally focus on the evidence that may reveal movements, migrations, long-distance trade traveling, presence of people from different ethnic backgrounds in medieval groups, and special lifestyle emphasizing the prestige of military and trade pursuits. The first results of studying the isotope markers indicating the mobility of Shekshov settlers do not fully correspond to the expected pattern of high mobility of the medieval population from Northeastern Russia. People buried in the necropolis at one of the largest settlements of the 10th–11th centuries in the Suzdal Opolye, included into the system of princely administration, were mostly born locally. Future studies will show whether these observations reflect specific features of the historical and cultural situation in the Shekshov microregion or more general patterns.

References

Bełka Z., Dopieralska J., Królikiwska-Ciagło S., Ratajczyk Z., Wadyl S. 2019
Pochodzenie w świetle badań skłdu izotopowego strontu biogenicznych fosforanow. In *Chiepłe: Elitarna nekropola wczesnośredniowieczna na Pomorzu Wschodnim*, S. Wadyla (ed.). Gdańsk: Muzeum archeologiczne w Gdańsky, pp. 439–447.

Bentley A.R. 2006
Strontium isotopes from the Earth to the archaeological skeleton: A review. *Journal of Archaeological Method and Theory*, vol. 13: 135–187.

Dobrovolskaya M.V., Reshetova I.K. 2018
O landshaftnom podkhode v izuchenii mobilnosti naseleniya proshlykh epokh na osnovanii dannykh ob izotopnom sostave strontsiya. *KSIA*, iss. 258: 7–14.

Engovatova A.V., Dobrovolskaya M.V., Zaitseva G.I., Antipina E.E., Kleshchenko E.A., Mednikova M.B., Tarasova A.A., Yavorskaya L.V. 2015
Yestestvennonauchniye metody v rekonstruktsii sistemy pitaniya i sotsialnoy stratifikatsii naseleniya srednevekovogo yevropeiskogo goroda. In *Yestestvennonauchniye metody*

issledovaniy i paradigma sovremennoy arkheologii: Materialy vseros. nauch. konf. Moscow: IA RAN, pp. 117–126.

Fedorina A.N., Krasnikova A.M. 2015
Srednevekovoye rasseleniye v Shekshovskom mikroregione. In *Arkheologiya Vladimiro-Suzdalskoy Zemli: Materialy nauch. seminara*, iss. 5. Moscow: IA RAN, pp. 147–158.

Frei K.M., Makarov N., Nosch M.L., Skals I., Berghe I.V., Zaitseva I. 2016
An 11th-century wool 2/2 twill from a burial in Shekshovo, Russia. *Archaeological Textiles Review*, No. 19: 34–42.

Frei K., Mannering U., Kristiansen K., Allentoft M.E., Wilson A.S., Skals I., Tridico S., Nosch M.L., Willerslev E., Clarc L., Frei R. 2015
Tracing the dynamic life story of a Bronze Age female. *Scientific Reports*, vol. 5. URL: https://doi.org/10.1038/srep10431.

Krzewinska A., Kjellström A., Günther T., Hedenstierna-Jonson Ch., Zacyrisson T., Omrak A., Yaka R., Kilinç G.M., Somel M., Sobrado V., Evans J., Knipper C., Jakobsson M., Storå J., Götherström A. 2018
Genomic and strontium isotope variation reveal immigration patterns in a Viking Age town. *Current Biology*, vol. 28 (17): 2730–2738.

Makarov N.A. 2009
Arkheologicheskoye izucheniye Severo-Vostochnoy Rusi: Kolonizatsiya i kulturniye traditsii. *Vestnik RAN*, iss. 12: 1068–1079.

Makarov N.A., Fedorina A.N. 2015
Fenomen "bolshikh poseleniy" Severo-Vostochnoy Rusi X–XI vv. *KSIA*, iss. 238: 115–131.

Makarov N.A., Fedorina A.N., Shpolyansky S.V. 2018
Bolshiye poseleniya X–XI vv. i struktury rasseleniya XII–XIII vv. v Suzdalskom Opolye: Problemy preyemstvennosti. In *Arkheologiya Vladimiro-Suzdalskoy Zemli: Materialy nauch. seminara*, iss. 8. Moscow: pp. 7–25.

Makarov N.A., Krasnikova A.M., Zaitseva I.E. 2010
Mogilnik Bolshoye Davydovskoye-2 – pogrebalniy pamyatnik pervoy poloviny I tysyacheletiya n.e. v Suzdalskom Opolye. *Rossiyskaya arkheologiya*, No. 1: 41–52.

Makarov N.A., Krasnikova A.M., Zaitseva I.E., Dobrovolskaya M.V. 2020
Srednevekoviy mogilnik Shekshovo: "Vladimirskiye kurgany" v svete novykh polevykh issledovaniy. *Rossiyskaya arkheologiya*, No. 4. (In press).

Makarov N.A., Leontiev A.E., Shpolyansky S.V. 2004
Srednevekovoye rasseleniye v Suzdalskom Opolye. *Rossiyskaya arkheologiya*, No. 1: 19–34.

Price T.D., Arcini C., Gustin I., Drenzel L., Kalmring S. 2018
Isotopes and human burials at Viking Age Birka and the Mälaren region, east central Sweden. *Journal of Anthropological Archaeology*, vol. 49: 19–38.

Price T.D., Frei K. 2015
Isotopic proveniencing of the Bodzia burials. In *Bodzia: A Late Viking-Age Elite Cemetery in Central Poland*, A. Buko (ed.). Leiden, Boston: Brill, pp. 445–462.

Price T.D., Moiseyev V., Grigoreva N. 2019
Vikings in Russia: Origins of the medieval inhabitants of Staraya Ladoga. *Archaeological and Anthropological Sciences*, vol. 11: 6093–6109.

Shishlina N.I., Larionova Y.O., Idrisov I.A., Azarov E.S. 2016
Variatsii izotopnogo sostava strontsiya v obraztsakh sovremennykh ulitok vostochnoy chasti Kavkaza. *Aridniye ekosistemy*, vol. 2, No. 2 (67): 32–40.

Snoeck C., Pouncett J., Claeys P., Goderis S., Parker Pearson M., Willis C., Zazzo A., Lee-Thorp J., Schulting R.J. 2018
Strontium isotope analysis on cremated human remains from Stonehenge support links with west Wales. *Scientific Reports*, vol. 8. URL: https://doi.org/10.1038/s41598-018-28969-8.

Zaitseva I.E. 2017
Uzdechniy nabor X v. iz Shekshova v Suzdalskom Opolye. *KSIA*, iss. 246: 306–322.

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B.Z. Nanzatov
Kalmyk Research Center,
Russian Academy of Sciences,
I.K. Ilishkina 8, Elista, 358000, Russia
E-mail: nanzatov@yandex.ru

Descendants of Eleudei: The Problem of Oirat-Buryat Ethnic Contacts

Eleuths (Ölöts) played an important part in the ethnic history of the Mongol peoples of Inner Asia, in particular of the Oirats, being the dominant group of the Oirat union at the early stages of its history. In this study, an attempt was made to fill in one of the gaps in the ethnic history of the Turko-Mongol peoples, using the ethnonym "Ölöt". The major limitation in studying the Oirat ethnic history is the insufficiency of sources. Much can be gained from using Buryat and Sakha (Yakut) folklore, specifically epics, genealogical legends, and tales. The reason is that the Ölöts, according to one of the hypotheses, took part in the formation of those peoples. This idea is supported by the reconstruction of protoforms of certain Buryat and Yakut ethnonyms and eponyms. Their comparative and historical analysis indicates ethnic ties between the Buryats and the Yakuts, and their participation in the ethnic history of the Mongolian stratum. These facts open up a wider perspective on Turko-Mongol ties. The Ölöt ethnic history shows them to have been distributed across vast territories of Inner Asia and Siberia, eventually becoming a component of various Turkic and Mongolian groups, while preserving their identity and featuring prominently in ethnogonic legends not only of Dörben-Oirats, but of the Buryats and Yakuts as well. The findings of this study attest to the complexity of ethnic processes among the Mongolian and Turkic speaking nomads of Eurasia. Also, they contribute to the understanding of the ethnic composition of Mongolia, Buryatia, and Yakutia, thus widening the scope of studies on the Altai.

Keywords: *Inner Asia, Turko-Mongol peoples, ethnogenesis, phonetic reconstruction, ethnonyms.*

Introduction

In-depth studies into ethnic names of the Turkic and Mongol peoples expand our knowledge on the ethnic history of the Eurasian steppe belt. Using the example of the ethnonym *oliot*/*eliot*/*eliut*/*ölöd*/*ööld*/*öölöd*/*ögeled*/*ügeled*/*ögälät*/*öliyed*, this study attempts to establish participation of one of the branches of the Oirat community (the Ölöts and, in a wider sense, Oirats) in ethnogenesis of the Yakuts and Buryats. The Ölöts played an important role in the ethnic history of the Oirats, especially in the early stages of the development of the Oirat community, since according to the generally accepted opinion of scholars, after the collapse of the Mongol Empire, they became the dominant group among the Oirats. Changes in the status of the ethnic names "Ölöt" and "Oirat" have been observed in different periods: at one time "Ölöt" was expanded to all Oirats, while at another time the Ölöts became a part of the Oirats. Such dynamics in the hierarchy of ethnic communities makes it necessary to clarify the events that led to these changes. Partial evidence is provided by written sources, although their information is inconsistent. In the studies of ethnogenesis and ethnic history, written sources are not always the key testimonies. This does not exclude their use with a certain degree of caution.

The history of the Oirats is covered in sufficient detail in the surviving chronicles. Unfortunately, the information of chronicles concerning the Ölöts is rather scanty, since most of the authors (Batur-Ubashi Tümen, Gaban Sharab, etc.) belonged to other branches of the Oirats. In Á. Birtalan's article (2002) on the ethnogenesis of the Ölöts, only two written sources are indicated, while evidence from oral folklore (genealogical traditions, legends) is almost completely absent from that study. Therefore, the source base needs to be expanded. This study will focus on the ethnic history of the Ölöts and geography of their settlement, in order to reconstruct the ethnic map of Inner Asia in various periods. The identity of the Ölöts is of particular interest.

Methodologically, this study is supported by historical-comparative and historical-linguistic methods used in research on ethnogenesis and in the study of ethnonyms and eponyms. The long period from the fall of the Yuan dynasty in the history of Northern Mongolia (including the Baikal region, Tuva, Khakassia, and Western Mongolia) is known as "dark", because of the lack of written sources. The texts of the 18th–19th centuries, which have survived to this day, are compilations of non-extant works. The situation is aggravated by the loss of written traditions among the Western Buryats and Yakuts, who also incorporated the Ölöts. Despite the presence of the appropriate terminology, no books of that time have been found in their possession. To a certain extent, this gap can be filled by the rich oral folk tradition, which includes a wide range of epic works, as well as genealogical legends and narrations. The proposed hypothesis is based on the evidence recorded in the first half of the 18th century by Y.I. Lindenau (1983: 18) among the Vilyui Yakuts and in the late 19th century by M.N. Khangalov (1960: 107–108) among the Qudai (Kuda) Buryats. The term "Ölöt" is mentioned in the Oirat chronicles.

Complex ethnic processes occurred in the history of the Oirats in the late period of the Yuan dynasty, the Ming period, and the times of the Manchu domination: voluntary and forced migrations, and mixing and division of the Oirat community. All this triggered the emergence of a multi-level system of the Oirat identity. At different stages of the development of the Oirat community, the ethnonym "Ölöt" united most of the Oirats and lost its relevance (for more details, see (Terentiev, 2017)). This justifies the interest in the ethnic history of the Ölöts. An important task is to study their role in the ethnogenesis of the Buryats, who inhabited the northern periphery of the Mongolian world.

Dispersed settlement of the Ölöts (along the Ili, Qarashar, Alashan, Kobdo, and Hailar Rivers) was due to a number of reasons: conflicts with other peoples, strife among the nobility, and forced migration in the Qing period. According to G. Lijee (2008: 12–14), they were one of the groups of the Mongolian population of Xinjiang, and amounted to twenty-one *sum* units. At the present, we know groups of the Ölöts such as the Kobdo (Erdenebüren *sum*) and Arkhangai (Khotont and Ölziit *sums*) in Mongolia (Disan, 2012: 107); the Mongol-khure, Emel, Khutagtyn-khure, and Khara-us (Xinjiang) (Lijee, 2008: 12–14), as well as Hulunbuir (Hulunbuir Aimag of the Inner Mongolia Autonomous Region) in China (Tsybenov, 2017); and the Sart-Kalmaks in Kyrgyzstan (see (Nanzatov, Sodnompilova, 2012)). In addition, small groups of Ölöts widely appear almost throughout the entire territory of Mongolia (for more details, see (Ochir, Disan, 1999: 11–13)); and they are present among the Tuvinians, including the Oyunnars and Khomushku (Dulov, 1956: 130, 134). Among the Darkhats, they were noted by G.D. Sanzheev (1930: 12). Among the Western Buryats, the Ölöts, also known as Segenuts, along with the Bulagats and Ekhirits, comprise one of the oldest tribal associations. They include such units as the Ikinat and Zungar (Khangalov, 1890a: 88; 1960: 107–108).

Written sources

According to a version of the ethnic history of the Oirats, the Ölöts are the ancestors of the Choros on their maternal side. Oolinda Budun-Tayishi, the daughter of the Ölöt Boo-Khan, married a Khoyd prince and originated the Choros clan (Okada Hidehiro, 1987: 210). According to the written sources, the ethnonym "Ölöt" became known only at the turn of the 15th–16th centuries. For example, one of the sources narrates of the separation of the subjects of Khamag-Taishi (grandson of Esen-Khan) from the community of the Choros (*čoros*), which was larger at the time; they had the ethnonym *ügeled*/*ööld* (Oyirad teüke-yin…, 1992: 9). The "Tale on the Dörben Oyirad" says that "three hundred eighty-two years have passed since the time when the Kalmyks wearing a red thread on their hats (*ulan zalatu xalimaq*) received the nickname 'Oyirads-Elyots' (*oyirad öyilöd*) until this year of the 'earth-hare'" (Pozdneev, 1907: 24; Skazaniye…, 1969: 17–18; Sanchirov, 2016: 21). According to the calculations of V.P. Sanchirov, this event occurred in 1438, when the Oirat ruler Togon-Taishi from the noble family of Choros (Tsoros) utterly defeated the Eastern Mongolian Supreme Khan Adai and became the head of the first union of the Dörben-Oirats (Pismenniye pamyatniki…, 2016: 21).

The text of Batur-Ubashi Tümen (2003: 127) informs us about migration of the Ölöts to the Kizilbash; migration beyond the Mankhan River is mentioned in the "History of Khoo-Orlug" (Pismenniye pamyatniki…, 2016: 31). B.U. Kitinov (2017) researched the migration of the Ölöts to the west in the context of the religious situation among the Oirats in the 15th–early 16th centuries. In his opinion, the reason for desintegration of the Ölöt community was the marriage of Ash-Temur (Amasanj-Tayishi) and the daughter of the ruler of Moghulistan; its main condition was the adoption of Islam by their children. Subsequently, a conflict started between father and his sons Ibrahim

((亦卜剌因 Yìboláyīn) and Ilyas (亦剌思 Yìlásī)* caused by their religious differences. Owing to the conflict, first Amasanj-Tayishi went to Moghulistan (but subsequently returned), and later his sons did. According to "Tarikh-i Rashidi", all this occurred from 1469 to 1504–1505 (Serruys, 1977: 375; Khaidar, 1996: 115), and according to V.V. Bartold, in 1472 (1898: 81–82). Kitinov (2017: 378) believes that the events following the marriage of Ash-Temur (Amasanj-Taishi, Esmet-Darkhan-Noyon) led to the destruction of the majority of the Ölöts and their ruling clan Choros.

In the first half of the 18th century, most of the Ölöts settled in the Dzungar Khanate. After its fall in 1757–1758, important changes occurred (for more details, see (Ochirov, 2010)). At the final stage of the history of the Dzungar Khanate, the notion of the "Dzungars (*jūnγar*/*züüngar*)" included the entire Oirat population. This is confirmed by the presence among the Kalmyk Zyungars of large independent units such as the Torguts, Khoyds, Uryankhuses, and Telengits (Mitirov, 1998: 142; Shantaev, 2009: 142; Bakaeva, 2016: 87). However, after the fall of Dzungaria, the ethnonym "Dzungar (*dsungar*/*jüünγar*/*züüngar*)" was officially banned, and the ethnonym "ölöt (*eleuths*/*öölöd*)" became the official name for most of its Oirat-Mongol population (Fang Chao Ying, 1943: 11). Thus, in the Qing period, the Züngars began to be called "Ölöts", as before. At the same time, Torguts, Khoshuts, Derbets, Chakhars, Uriankhai, and Zakhchins were officially recorded in Xinjiang (Dzungaria and Eastern Turkestan) (Lijee, 2008: 8–18). Consequently, the population there of the Ölöt *khoshun* and *sum* units was composed of closely related Ölöts and Zungars, while other groups of Oirats lived separately. The fact that the Ölöts began to be called the Dzungars from 1437 is mentioned in the essay "The History of Kho-Urlyuk": "*…γool dumda ni Qošud čerig, ǰegün bey-e-dü Ögeled-ün čerig-i ǰegün γar-un čerig geǰü nereyidbei… Tegün-eče ekileged, Ögeled-tü J̌egünγar gedeg nere šinggebei, Torγud-tu baraγun γar gedeg ner-e qadaγdabai gedeg*" (Pismenniye pamyatniki…, 2016: 27), which translates as "…the army of the Khoshuts was in the center; the army of the Ölöts, which was called *züüngaryn tsereg* ('the army of the left wing'), was on the left flank (*züün biide*)… They say that since that time the name 'dzungars' (*züün γar*) has been attached to the Ölöts, and the name of *baruun γar* ('right flank') – to the Torguts" (Ibid.: 33–34). Another example of how the ethnonyms "Oirat" and "Ölöt" were related, is the Oirat written source "Iletkhel Shastir", where these names are interchangeable (Sanchirov, 1990: 45–46).

The history of the Ölöts, who remained in Outer Mongolia, is described in detail by O. Oyunzhargal (2009, 2015) in a monograph that was later published in Russian translation. After analyzing the events leading to the emergence of the Ölöt Chuulgan (League) on the basis of the "Iletkhel Shastir" and archival sources, Oyunzhargal (2009: 53–74; 2015: 63–83) came to the conclusion that the Ölöt Chuulgan (League) included six *khoshuns* ('banners'), including those of the Ölöts, Khoyds, and Khoshuts. However, there is another opinion on the issue of the ethnic composition of the Ölöt League. Instead of the Khoshut *khoshun*, Ts.B. Natsagdorj (2015a: 183; 2015b) indicated the Torgut Mergen Tsorji. In any case, the Ölöts, whose name was given to the Chuulgan, were the most numerous.

The evidence from the written sources presented above, which reflects the stages in the development of the early Ölöt community, is still controversial. Notably, considering the objectives of the present study, the problem of the relationship between the Choros and Ölöts is not crucial. Studying the complex settlement of several enclaves of the divided Ölöt community is of interest in terms of participation of one of its branches in the consolidation of the Bargu-Buryats.

Evidence and discussion

Ethnonym. As Okada Hidehiro observed, the Manchus used *Ȫlöd*, transcribed in Manchurian as *Ūlet*, as a synonym for *Oyirad*. The term *Ȫlöd* was chineseized as *E-lu-t'e*, from which the European version of *Eleuths* is derived (Okada Hidehiro, 1987: 197). Notably, the Manchu called the Oirats "Urūt" (Crossley, 2006: 80).

The presence of the Ölöt League in the Qing Empire before the conquest of Dzungaria makes it possible to solve the problem of correlating the terms *oirat*/*oyirad* and *oliot*/*ȫlöd* in the Qing period. In our opinion, the latter term replaced the concept of "oirat" in the eyes of the Manchu administration in connection with the formation of the first Oirat Chuulgan within the Empire. The League, named after the largest Oirat unit, became the starting point for identification of the entire Western Mongolian population.

One of the first European written sources about the Oirats was the book by I. Bichurin, published in 1834, indicating the discrepancy in the ethnonym: "Prince *Eliutei* was so famous in Mongolia that the name Elyut was given by his name to his entire generation. According to the Chinese pronunciation, the word *Eliutei* is *Olotai*; according to the Mongolian pronunciation, one should write *Eliutei*, and from this Eliut, the name of the generation" (Bichurin, 1834: N. 20). It is possible that this statement was based on a phrase from the manuscript by V.M. Bakunin (1995: 20), published much later: "But this is certain that in the 16th century, the Kalmyk people were called 'oirot' in their language and 'oiliot' in the Mongolian language". As an official and translator from the Kalmyk language, Bakunin (1700–1766) accompanied

*On Ibrahim and Ilyas, see (Serruys, 1977: 375).

the Chinese embassy to the Kalmyks in 1731. Precisely this event could have influenced the perception of the exoethnonym *Oyirad* as *Ȫlöd*. For a long time, there was no unambiguous position on this issue in Mongolian Studies, and some scholars believed that the Chinese 厄鲁特 (*O-lu-te*/*Èlǔtè*) is a distorted *oirot/Oyirad* (Uspensky, 1880: 127; Bretschneider, 1888: 168).

The seeming phonetic affinity of the ethnonyms 卫拉特 (Wèilātè) – 'oirat', and 厄鲁特 (Èlǔtè) – 'olot' in the Chinese language of the Qing period seems to be a difficult problem. The presence of hieroglyphic terms denoting the Oirats (斡 亦 剌 惕 (Wòyìlátì) in the Yuan period (Yuan-chao…, 1936: 58) and 瓦剌 (Wǎlà) (Míngshǐ (s.a.); Pokotilov, 1893: 32; Hambis, 1969: 93; Pelliot, 1960: 6) / 衛拉特 (卫 拉) (Wèilāte) in the Ming period (Míngshǐ (sì kù quánshū běn), (s.a.); Pelliot, 1960: 8)) on the one hand, and absence of such hieroglyphic terms for the concept of "olot" on the other hand, makes it possible to assume that Chinese historiographers transmitted the latter concept at that time by the term *oirot*/*oyirad*, the spelling of which was changed in the course of phonetical development of the Chinese language. We agree with the opinion of P.K. Crossley (2006: 80–81) that it is impossible to consider *olot*/*ölöt* as a reverse construction of the Chinese *elete*/*weilete*.

The question on the etymology of the ethnonym *Öölöd* remains important for our discussion. There is a hypothesis of the Chinese scholar Altanorgil (1987: 145) about its origin from *ööliy* ('large, powerful'). A. Ochir believed that this ethnonym went back to the root öge, citing the examples of names from "The Secret History of the Mongols": öge-lün (eke), öge-lei (čerbi), öge-dei (qaγan) (Kuribayashi, Choijinjab, 2001: § 13, 55, 93, 191, 214, 226, 255, 270). Further, he proposed to connect the development of *ögeled* in *elēd* with the meaning "ikh, uugan, naszhuu" ('big, senior, tall, elderly'), allowing for a possibility of *öleged* > *eleged* (Ochir, 2008: 150–151; 2016: 148). However, this contradicts the hypothesis on the root öge, since the transition VgVlV > VlVgV has not been observed. G.O. Avlyaev connected the ethnonym "Ölöt" with the verb *ogulekü* (*ööleχü*) – 'to be offended, to be dissatisfied with something'. Accordingly, he believed that the ethnonym had the meaning of 'offended', 'aggrieved', or 'dissatisfied' (Avlyaev, 2002: 55, 192, 194).

In our opinion, the most reliable hypothesis was proposed by Japanese scholars, who suggested that the ethnonym *Öölöd* originated from *ögelen* with the meaning 'maternal brother, but from another father' (Haneda Akira, 1971: 561–565; Okada Hidehiro, 1987: 210). In the Mongol-French Dictionary by A. de Smedt and A. Mostaert, Haneda Akira discovered the combinations *ögelen köbegün* – "fils d'un autre lit" ('stepson'), *ōlön aχa dū* / *ula aǤa diū* – "frères nés de la même mère, mais de pères différents" ('brothers born of one mother, but from different fathers, half-brothers'), *ula k'adzi diü* – "soeurs nées de la même mère, mais de différents pères" ('sisters born of the same mother, but from different fathers, half-sisters') (Smedt, Mostaert, 1933: 469; Haneda Akira, 1971: 562). Okada Hidehiro expanded the argumentation and used another work by A. Mostaert, where several phrases with ögelen/ȫlö were mentioned: *ȫlȫ k'ū̄* – "fils d'un autre lit" (= *dag̯awu̯rk'ū̄*) / *ögelen köü* – 'stepson', *ȫlȫ k'ū̄'*^{k}*χet* – "enfants d'un autre lit" (=*dag̯awu̯rk'ū̄'*^{k}*χet*) / *ögelen keüked* – 'stepchildren', *ȫlön e'tš'ige* – "le second mari de la mere" ('the second husband of the mother') / *ögelen ečige* or *qoyitu ögele* – 'stepfather' (Mostaert, 1942: 531; Okada Hidehiro, 1987: 210). In addition, he suggested understanding the term *ögele(n)+d* as kinship of the Khoyds and Baatuts with the Choroses. One of the confirmations of the hypothesis proposed by Japanese scholars is the text "Oyirad teüke-yin durasqal-ud", which directly says that the three princes, great-grandsons of the Oirat Esen-Taishi, the sons of his grandson Khamag-Taishi, were called the Ölöts: "…the second son of Esen is Ongotsa; his son is Khamag-Taishi. Out of the three sons of Khamag-Taishi, the eldest is Ragnanchinsang; the second is Nuskhanai, and the third is Onggoi (Ongui). These three princes are called Elots. Taking charge of the Oirats, they migrated away at the instigation of Shara Shulma…" (1992: 9; Pismenniye pamyatniki…, 2016: 195–196). The problem of the relationship of the root stem *ögele(n)* in Mongolian languages with *ög*, *oq*, or another stem in Turkic or other languages has not yet been resolved and is the subject of a separate study.

Eponym. The solution to the problem of the origin of the Ölöts in Mongolian historiography is usually limited to a search among forest tribes and indicating their being mentioned among the Dörben-Oirats, for example, in Batur-Ubashi Tümen and Gaban Sharab (Skazaniye…, 1969: 19; Batur-Ubashi Tümen, 2003: 127; Gaban Sharab, 2003: 84). Unfortunately, neither "The Secret History of the Mongols" (Mongγol-un niγuča tobčiyan), nor the Collection of Chronicles by Rashid ad-Din (Jāmī al-Tawārīkh), mention the ethnonym *Ȫlöd*/*Öyilöd*/*Ögeled*. The absence of the term in such important written sources makes it possible to admit that the Ölöts might have settled together with the Dörben-Oirats within the Sekiz-Mören and Barqujin-töküm, known from the same sources (Kozin, 1941; Pelliot, 1949; Rashid ad-Din, 1952; The Secret History…, 2004).

Unfortunately, scholars have overlooked one of the most important sources of ethnogenesis—oral ethnogonic legends and traditions. The legendary ethnic genealogy of the Buryats is associated with the history of Barqujin-töküm. In the 19th century, Khangalov (1890b) recorded and published the legend about Bargu Bator. The fragment about his eldest son is quite remarkable: "According to the Qudai legend, the ancestor of the Buryats was Barga-batur, who lived near Tobolsk and had three sons; the eldest had the name Iliuder-Turgen; the middle son was

Gur-Buryat, and the youngest son was Khoredoi-mergen. Subsequently, Barga-batur and his two sons Gur-Buryat and Khoredoi-mergen moved to the east from Tobolsk, and left his eldest son, Iliuder-Turgen, in Tobolsk, telling him, 'You will be the king of these lands! Your happiness is in the old place!' So Iliuder-Turgen remained in the old place. The present-day Kalmyks living in the Astrakhan, Stavropol, and Saratov governorates originated from him. The Buryat tradition does not know how the descendants of Iliuder-Turgen moved from Tobolsk to the west. Apparently, some descendants of Iliuder-Turgen later came to the east; at least the Buryat Zungar and Ikinat clans from the Balaganskoye Vedomstvo are considered to be from the Kalmyk tribe, in Buryat: ölöd or segenut" (Khangalov, 1960: 107–108). The manuscript "Bodonguudyn ügiin bichig" ("Genealogy of the Bodonguts"—the Agin Buryats who migrated to Mongolia), published by Sumyabaatar (1966: 179), mentioned Ölidei, the son of Bargu-bator (Barγu baγatur), the older brother of Buriyadai and Qorudai. This form is the closest to the Yakut Eldei, which will be discussed below.

Notably, the image of Prince Eleutei, first mentioned in the work of I. Bichurin, probably did not come out of nowhere. According to V.P. Sanchirov, the author of the foreword to the edition of 1991, a mistake was made in transcribing the name of Arugtai (Bichurin, 1991: 17). The legitimacy of this opinion is confirmed by H. Serruys (1959: 217; 1977: 358), who thoroughly investigated the history of the Mongols of the Ming period and managed to find a real historical person, a representative of the Mongol nobility with the name Aruγtai (阿魯台 A-lu-t'ai). We believe that the cause of Bichurin's mistake could have been the genealogical legends known to him, according to which some of the Ölöts were taken by the "yellow shulmus" to the south, and the other part went north, leaving the lands of Northern Mongolia, and settled in the Cis-Baikal region. Perhaps, the image is associated with the latter group. This image entered the Buryat oral tradition and by the 19th century underwent some phonetic changes: Öölödei> Elüdei> Ilüder(–Türgen). This word could only have come from the Ölöts who happened to be among the ancestors of the Buryats. The list of the *otok* administrative units of the Dzungar Khanate indirectly testifies to the possibility that the ethnonym might have existed in the form of not only *Ōlöd*, but also *Ōlödöi*, since the ethnonym in the list is indicated as *Öölödei* (Atwood, 2006: 627). Another possible proof of the movement of the Ölöts to the north is the eponym "Ellei" among the Yakuts (Istoricheskiye predaniya…, 1960: 57–86), more precisely, its archaic form recorded in the 18th century by Y.I. Lindenau: "When she grew up, a refugee named Ersogotorh, or, as they also call him, Elei, or Eldei-Bator, came to them. Omogon gave him his adopted daughter, and they had eight sons and four daughters: Antantüik, Barkutai, Kordoi, Kogosuk, Bolotoi, Katamaldai, Tscheriktei, Artbudai. <…> They use the word Elei, or Eldei-bator for denoting a warlike man and legislator (Gesetzgeber). Names are given to people according to their qualities. These sons of Eldeei-bator eventually became the ancestors of various widely branched clans" (1983: 18).

In our opinion, there is a parallel with the Buryat eponym Oboγon in the case of the eponym Omogon in Lindenau and Omoγoi in oral traditions (a Buryat who came to the Tuimaada Valley in the Middle Lena region) (Ibid.; Ksenofontov, 1977: 29). According to the legend, the Bulagat group of tribes known as the Obogoni Olon, which descended from an ancestor with the same name, indeed settled in the valley of the Angara and its tributaries, the Osa, Obusa, and Unga Rivers. This means that in the case of Omogon, a real tribal group can be identified (Nanzatov, 2017a, b). By the same token, it is very likely that the tribe Ōlöd, represented by the eponym Eldei/Eldeei, the phonetic form of which corresponds to one of the stages of development Öölödei > Elüdei > Ilüder(-Türgen), participated in the ethnogenesis of the Yakuts. The form Ellei, used by the majority of the Yakuts, reflects the widespread process ll < ld (for more details, see (Grammatika…, 1982: 67)).

The phonetic transformation of the ethnonym *ügeled*/*öölöd* into Öölödei > Elüdei > Eldei (Yakutian) or Öölödei > Elüdei > Ilüder(-Türgen) in the Buryat environment remains an open question. Ochir proposed a version of development öleged > eleged and touched upon the topic of transformation of the ethnonym into the eponym known among the Buryats and Yakuts. In our opinion, this transformation could have occurred under the influence of phonetically close, but semantically different root stems. The word *eləəde* (*eleede*) with the meanings 'significant, large; more than sufficient, abundant; senior', recorded by B.K. Todaeva (2001: 471) could well have been the basis of the eponym representing the *eldest* son of Bargu-bator, the elder brother of Gur-Buryat and Khoredoi. It is also possible to assume the influence of another phonetically close word *ilden* (written Mongolian, *ildeng*, Chinese 伊尔登 *yī ěr dēng*, cf. Mongolian *ilde*, 'without occupation, without official position') (Kowalewski, 1844–1849: 306), which in the 15th–18th centuries was an epithet in titles (Urangua, 2000: 55), for example Dorji-ildeng-noyan (Daičing ulus-un…, 2013: 34), and was also widely used in personal names.

For the replacement of the initial sound ö > e > i, one can refer to the work of B.Y. Vladimirtsov (1929: 185–190), who established the following parallels: e : ö = i : o ~ u = i : ö ~ ü. The eponym is formed as follows: the ethnonym Ōlöd and the noun-forming gender affix -tai (for more details on -tai, see (Kempf, 2006)). As for the suffix -dar/-der, a suggestion concerning its use in the Buryat-Mongolian ethnonymy as a derivational formant, most often denoting the color of horse has already been suggested (Nanzatov, Sundueva, 2017). The epithet Turgen ("fast") is paired with Iluder. According to our suggestion, the transformation –dei > -der in the name, that is, (ö/e)l(i/e/ü)dei > (e/i)lüder, together with the emergence of this epithet, may indicate the transformation of a character into a horse in the Buryat worldview. The preservation of the Yakut form Eldei > Ellei indicates that the eponym came to the ancestors of the Yakuts even before the change in the Buryat Ölidei. A detailed justification of the transformation into Ilüder and Eldei requires a separate historical and phonetic study.

The closeness of the Yakut Eldei (Ellei) to the eponyms that have clear parallels with the Buryat ethnonyms indicates Buryat-Yakut ethnogenetic ties and participation of the Mongolian stratum in the ethnogenesis of the Yakuts, including the Barga-Buryat (cf. Barkutai < Barqutai < Barqu/Barγu, Kordoi < Qoridoi < Qori, Bolotoi < Bolot) and Oirat (Katamaldai < Qatāmal) elements. The ethnonyms "Bargu" and "Khori" are widely known in the Mongolian world; they are mentioned in "The Secret History of the Mongols" and in Rashid-ad-din (The Secret History…, 2004: 136; Rashiduddin…, 1998: 57). Bolot (Bolotoi) is an eponym in relation to the ancestor of a group of the Bulagat tribes (Olzoi, Murui, and Khulmeenge) (Khangalov, 1958: 102; Baldaev, 1970: 161, 163). The clan Khataamal exists among the Kobdos Khoshuts (Dorj, 2012: 13; Bakaeva, 2017: 97). The term "čerik" is widespread in the Turko-Mongol environment. The ethnonym "Kogosuk", later appearing as Khordokoosuk/Kordoi-Khogosuun (Ksenofontov, 1977: 37), and possibly related to qo'a~γo'a~qoha or quba~qou-a~quu-a~uquv-a~qu-a (for more details, see (Rybatzky, 2006: 47, 448)) > uwas/qoas among the Merkits (The Secret History…, 2004: 39), and qoasai/quasai among the Buryats (Rumyantsev, 1962: 241–242).

Segenuts. The Oirat stratum in the ethnogenesis of the Buryats, which is also based on the Ölöts, is of particular interest in the light of the Ölöts' ethnic history. The Segenut, or Ölöd, is the first in the list of the Buryat tribes, compiled by Khangalov (1890a: 88; 1960: 101). He attributed the Zungar and Ikinat administrative clans to this tribe (Khangalov, 1960: 107–108). The Buryat folklorist and ethnographer S.P. Baldaev, who collected genealogical legends and traditions of the Buryats throughout his entire life, significantly expanded the list of the Segenut (Ölöt) units. For example, according to the legends, such Buryat tribes as Ikinat (Ikhinad), Zungar (Züüngar), Bukot (Bukhed), Durlai, Tugut, Khaital, Torgout, Noiot (Noyod), Mankholyut (Mankhalyuud), and Barungar (Baruungar) were related to the Segenuts by the kinship ties. Through marriage, the Segenuts are related to the Kurumchi (Khurumshi) and Tolodoi (Tolöödöy), while the Ikinats are related to the Narat (Naratai/Narad) (for more details, see (Baldaev, 1970: 333)). Here one may notice such Oirat-Buryat parallels as the names of large Oirat associations Züüngar/Zungar, Torguud/Torgout, as well as small tribes: Noyon among the Kobdos Ölöts and Noyot (Noyod) among the Buryats, and Bukhunut (Bükünüt, Bükhnüüd, Bügünüd) as a part of the Ölöts, Derbets, and Zakhchins (Mongol Ulsyn…, 2012: 46, 109, 430; Pelliot, 1960: 124), and Bukot (Bukhed) among the Buryats.

An interesting Buryat term is *ikinat*, which was the name of the largest unit of the Ölöt-Segenuts. The analysis of the Khakass ethnonym ïγï (the Igins) has shown that its probable development was *ïq- > *ïqï > ïγï ~ aγï. Parallel development of the initial ethnonym in the Khakass and Buryat environment: *-qï-> *-ki-> -iχÏi-> iχÏi + nA + d (Nanzatov, Tishin, 2019: 124) is quite possible. Be that as it may, the ancestors of both groups could have been the indigenous population of the Vosmirechye, from which the ethnonym came to the Khakasses and Buryats.

Regarding Ölöt-Buryat relations, we can mention such parallels as *boroldoi* (Nanzatov, 2018: 38, 135, 143), *khar barga*, and *tolton barga* (Ochir, Disan, 1999: 81) among the Kobdos Ölöts and Buryats. The ethnonyms *chonos*/*shono*, *avgas*/*abaganad*, *darkhad*/*darkhat*, *küökü*i/*χüüχet* (*küüked*), which are widespread among the Mongols, also occur among the Kobdos Ölöts and Buryats (see (Ochir, Disan, 1999: 34, 43, 56, 61; Nanzatov, 2018: 29, 39, 43)). The presence of a common motif (feeding a baby by an owl) in the legends about the origin of the Oirat Choros and the Buryat ethnic group of the Uliaaba (Avlyaev, 1981: 64) may also be evidence of Oirat-Buryat ties.

The origin of the ethnonym *segenut* (Buryat *Segeenüüd*/*segeened*) from *segeen* 'light blue, light' has been suggested (Nanzatov, 2005: 55) (cf.: Oirat *cegen*, Khalkh. *cegeen*, Buryat *segeen*, Ordos *čigên*, Kalmyk *cegεːn* 'light, bright, transparent, white'. Mongolian > Yakutian (Kałużynski, 1995: 258–259)). D.V. Tsybikdorzhiev connects it with the ethnonyms "cingnüt (čingnüt)" and "chike", mentioned in the Khori chronicle of the 19th century by S.-N. Khobituev and "Altan Tobchi" by Mergen Gegen (Buryaadai…, 1992: 95; Baldanzhapov, 1970: 141; Tsybikdorzhiev, 2012: 140–143), respectively.

Conclusions

The discovered parallels between the Buryat Ölöt-Segenuts and the Oirats, Mongolian Ölöts, and Buryats testify to deep Oirat-Buryat ties. The main conclusion of our research is that the Oirats took an active part in the ethnogenesis of the Buryats. The Oirat stratum, reflected in Buryat ethnogonic legends, represents the older branch of the early Bargu-Buryat community. A group which had a significant impact on ethnogenesis of the Yakuts separated from it. The Oirats who left for the north, have lost their ethnic name, but retained the eponym thus leaving a trace of their presence. Thus, the traditional theory on the southern origin (Cis-Baikal region) of the ancestors of the Sakha (Yakuts), discussed in detail by G.V. Ksenofontov (1937; 1977), who took the first steps in discovering Buryat-Yakut parallels, and supported by A.P. Okladnikov (1955), has received new confirmation.

Participation of the Oirats in the ethnogenesis of the Buryats and Yakuts expands our view on the problem of interaction between the Turkic and Mongolian peoples. The revealed evidence can be used for compiling maps of the ethnic composition of Mongolia, Buryatia, and Yakutia. The ethnic history of the Ölöts, who were divided, became a part of other peoples, yet retained their identity and took key positions in the ethnogonic legends of not only the Dörben-Oirats, but also the Buryats and Yakuts, reflects complex ethnic processes among the Mongolian and Turkic nomads of Eurasia.

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References

Altanorgil. 1987
Todo üsüg degere jokiyaγdaγsan Mongγol teüke-yin surbulji bičigüd-ün tanilčaγulγa. In *Öbör Mongγol-un bayši-yin yeke surγaγuli-yin erdem šinǰilgen-ü sedgül*. Nemelte sedgül: pp. 137–176.

Atwood C. 2006
Titles, appanages, marriages, and officials: A comparison of political forms in the Zünghar and thirteenth-century Mongol empires. In *Imperial Statecraft: Political Forms and Techniques of Governance in Inner Asia, 6th–20th Centuries*, D. Sneath (ed.). Washington, D.C.: Western Washington Univ., Center for East Asian Studies, pp. 610–634.

Avlyaev G.O. 1981
Etnonimy-totemy v etnicheskom sostave kalmykov i ikh paralleli u tyurkskikh narodov. In *Etnografiya i folklor mongolskikh narodov*. Elista: Kalm. kn. izd., pp. 62–71.

Avlyaev G.O. 2002
Proiskhozhdeniye kalmytskogo naroda. [2nd edition]. Elista: Kalm. kn. izd.

Bakaeva E.P. 2016
O sostave olyotov Mongolii i kalmykov-zyungarov. In *Transgranichnaya kultura: Ocherki sravnitelno-sopostavitelnogo issledovaniya traditsii zapadnykh mongolov i kalmykov*. Elista: KalmNC RAN, pp. 84–91.

Bakaeva E.P. 2017
Khoshuty Kalmykii i Mongolii: Istoriko-etnograficheskiy ocherk. *Noviye issledovaniya Tuvy*, No. 1: 83–101.

Bakunin V.M. 1995
Opisaniye kalmytskikh narodov, a osoblivo iz nikh torgoutskogo, i postupkov ikh khanov i vladeltsev: Sochineniye 1761 goda, M.M. Batmaev (intro.). Elista: Kalm. kn. izd.

Baldaev S.P. 1970
Rodoslovniye predaniya i legendy buryat. Pt. 1: Bulagaty i ekhirity. Ulan-Ude: Buryat. kn. izd.

Baldanzhapov P.B. 1970
Altan Tobci: Mongolskaya letopis XVIII veka. Ulan-Ude: Buryat. kn. izd.

Bartold V.V. 1898
Ocherk istorii Semirechya. Verniy: [Tip. Semirech. obl. pravleniya]. (Pamyatnaya knizhka Semirechenskoy oblasti na 1898 g.; vol. 2).

Batur-Ubashi Tümen. 2003
Skazaniye o derben-oiratakh. In *Lunniy svet: Kalmytskiye istoriko-literaturniye pamyatniki*, A. Badmaev (ed.). Elista: Kalm. kn. izd., pp. 125−155.

Bichurin I. 1834
Istoricheskoye obozreniye oiratov ili kalmykov s XV stoletiya do nastoyashchego vremeni. St. Petersburg: [Tip. med. departamenta Min-va vnutr. del].

Bichurin I. 1991
Istoricheskoye obozreniye oiratov ili kalmykov s XV stoletiya do nastoyashchego vremeni, V.P. Sanchirov (intro.). Elista: Kalm. kn. izd.

Birtalan Á. 2002
An Oirat ethnogenetic myth in written and oral traditions (a case of Oirat legitimacy). *Acta Orientalia Academiae Scientiarum Hungaricae*, vol. 55 (1–3): 69–88.

Bretschneider E. 1888
Medieval Researches from Eastern Asiatic Sources, vol. 2. London: Trubner and Co.

Buryaadai tüükhe beshegüüd. 1992
Ulaan-Üde: Buryaadai nomoi kheblel.

Crossley P.K. 2006
Making Mongols. In *Empire at the Margins: Culture, Ethnicity, and Frontier in Early Modern China*, P.K. Crossley, H.F. Siu, D.S. Sutton (eds.). Berkeley, Los Angeles: Univ. of California Press, pp. 58–82.

Daičing ulus-un mongγul-un maγad qauli: Nigedüger emkitgel. 2013
Köke-qota: Ebür mongγul-un surγal kümüǰil-ün keblel-ün qoriy-a.

Disan T. 2012
Ööld. In *Mongol ulsyn ugsaatny züi*, vol. 2. Ulaanbaatar: Admon, pp. 107–166.

Dorj E. 2012
Khovdyn khoshuud naryn urgiin khelkhees. Ulaanbaatar: Khökh mongol printing XXK.

Dulov V.I. 1956
Sotsialno-ekonomicheskaya istoriya Tuvy (XIX – nachalo XX v.). Moscow: Izd. AN SSSR.

Fang Chao Ying. 1943
Amursana. Eminent Chinese of Ch'ing Period (1644–1912), vol. 1. A.W. Hummer (ed.). Washington: United States Government Printing Office.

Gaban Sharab. 2003
Skazaniye o derben-oiratakh. In *Lunniy svet: Kalmytskiye istoriko-literaturniye pamyatniki*, A. Badmaev (ed.). Elista: Kalm. kn. izd., pp. 84–110.

Grammatika sovremennogo literaturnogo yakutskogo yazyka. 1982
E.I. Ubryatova (ed.). Vol. 1: Fonetika i morfologiya. Moscow: Nauka.
Hambis L. 1969
Documents sur l'histoire des Mongols à l'époque des Ming. Paris: Presses Universitaires de France. (Bibliothèque de l'Institut des Hautes Études Chinoises; vol. XXI).
Haneda Akira. 1971
Futatabi Elyute ni tsuite: Dzyungaru okoku bokko-si no itisokumen. *Sirin = The Shirin or the Journal of History*, vol. 54 (4): 544–565.
Istoricheskiye predaniya i rasskazy yakutov. 1960
G.U. Ergis (comp.), A.A. Popov (ed.). Moscow, Leningrad: Izd. AN SSSR. Pt. 1.
Kałużynski S. 1995
Iacutica: Prace jakutoznawcze. Warschawa: Wydawnictwo Akademickie, Dialog.
Kempf B. 2006
On the origin of two Mongolic gender suffixes. *Ural-Altaischer Jätbucher*. Neue Folge, Bd. 20: 199–207.
Khaidar Mirza-Mukhammad. 1996
Tarikh-i Rashidi, A. Urunbaev, R.P. Dzhalilova (trans.). Tashkent: Fan.
Khangalov M.N. 1890a
Plemena buryat. In *Skazaniya buryat, zapisanniye raznymi sobiratelyami*. Irkutsk: [Tip. K.I. Vitkovskoy], pp. 88−89. (Zapiski VSORGO po etnografii; vol. 1, iss. 2).
Khangalov M.N. 1890b
Barga-batur. In *Skazaniya buryat, zapisanniye raznymi sobiratelyami*. Irkutsk: [Tip. K.I. Vitkovskoy], pp. 112−113. (Zapiski VSORGO po etnografii; vol. 1, iss. 2).
Khangalov M.N. 1958
Sobraniye sochineniy, vol. 1. Ulan-Ude: Buryat. kn. izd.
Khangalov M.N. 1960
Sobraniye sochineniy, vol. 3. Ulan-Ude: Buryat. kn. izd.
Kitinov B.U. 2017
"Oiraty-ogeledy… peresekli reku Mankan": Etno-religioznaya situatsiya u oiratov v seredine XV – nachale XVI vv. *Vestnik RUDN*. Ser.: Vseobshchaya istoriya, vol. 9 (4): 370–382.
Kowalewski J.E. 1844–1849
Dictionnaire mongol-russe-français. Vol. I–III. Kazan: Imprimerie de l'Université.
Kozin S.M. 1941
Sokrovennoye skazaniye: Mongolskaya khronika 1240 g. pod nazvaniem Mongol-un Niguča Tobčiyan. Yuan chao bi shi: Mongolskiy obydenniy sbornik. Vol. I: Vvedeniye v izucheniye pamyatnika: Perevody, teksty, glossarii. Moscow, Leningrad: Izd. AN SSSR.
Ksenofontov G.V. 1937
Uraangkhai-sakhalar: Ocherki po drevney istorii yakutov, vol. 1. Irkutsk: Vost.-Sib. obl. izd.
Ksenofontov G.V. 1977
Elleiada: Materialy po mifologii i legendarnoy istorii yakutov. Moscow: Nauka.
Kuribayashi H., Choijinjab. 2001
Word- and Suffix-Index to the Secret History of the Mongols, Based on the Romanized Transcription of L. Ligeti. Sendai: Tohoku University. (The Center for Northeast Asian Studies. Monograph Series 4).
Lijee G. 2008
Shinzhaany oiraduud: Tüükh sudlal. Ulaanbaatar: Soyombo printing. (Ser. Bibliotheca Oiratica; VI).
Lindenau Y.I. 1983
Opisaniye narodov Sibiri (pervaya polovina XVIII veka): Istoriko-etnograficheskiye materialy o narodakh Sibiri i Severo-Vostoka, Z.D. Titova (trans., comm., and intro.), I.S. Vdovin (ed.). Magadan: Kn. izd.
Míngshǐ, juǎn 328. (s.a.)
[Istoriya dinastii Min]. URL: https://zh.wikisource.org/zh-hant/%E6%98%8E%E5%8F%B2/%E5%8D%B7328
Míngshǐ (sì kù quánshū běn), juǎn 328. (s.a.)
[Istoriya dinastii Min]. URL: https://zh.wikisource.org/wiki/%E6%98%8E%E5%8F%B2_(%E5%9B%9B%E5%BA%AB%E5%85%A8%E6%9B%B8%E6%9C%AC)/%E5%8D%B7328
Mitirov A.G. 1998
Oiraty – kalmyki: Veka i pokoleniya. Elista: Kalm. kn. izd.
Mongol Ulsyn ugsaatny züi. 2012
S. Badamkhatan, G. Tserenkhand (eds.). Vol. II: Oiradyn ugsaatny züi (XIX–XX zaag üe). Ulaanbaatar: Admon.
Mostaert A. 1942
Dictionnaire Ordos, vol. II. Peking: Fu Jen Catholic University Press, pp. 391–768.
Nanzatov B.Z. 2005
Etnogenez zapadnykh buryat (VI–XIX vv.). Irkutsk: Radian.
Nanzatov B.Z. 2017a
Idinskiye buryaty v XIX veke: Etnicheskiy sostav i rasseleniye. *Izvestiya Irkutskogo Gosudarstvennogo Universiteta*. Ser.: Geoarkheologiya. Etnologiya. Antropologiya, vol. 20: 136–156.
Nanzatov B.Z. 2017b
Obogoni olon i buryatsko-yakutskiye svyazi (na primere eponima Obogon/Omogoi). In *Aktualniye voprosy arkheologii i etnologii Tsentralnoy Azii: Materialy II Mezhdunar. nauch. konf. (g. Ulan-Ude, 4–6 dek. 2017 g.)*. Ulan-Ude: pp. 298–302.
Nanzatov B.Z. 2018
Irkutskiye buryaty v XIX v.: Etnicheskiy sostav i rasseleniye. Ulan-Ude: Izd. BNC SO RAN.
Nanzatov B.Z., Sodnompilova M.M. 2012
Sart-kalmaki v sovremennom Kyrgyzstane. In *Kulturnoye naslediye narodov Tsentralnoy Azii*, iss. 3. Ulan-Ude: Izd. BNC SO RAN, pp. 28–49.
Nanzatov B.Z., Sundueva E.V. 2017
Status suffiksa -dar v buryat-mongolskikh i tyurkskikh etnonimakh. *Vestnik Buryatskogo Gosudarstvennogo Universiteta*, No. 10: 73–78.
Nanzatov B.Z. Tishin V.V. 2019
Korennoye tyurkskoye naseleniye Achinskogo okruga v XIX veke: Etnicheskiy sostav i rasseleniye. *Vestnik Buryatskogo Nauchnogo tsentra SO RAN*, No. 4: 108–131.
Natsagdorj Ts.B. 2015a
Kalmytskiy khoshun v Khalkhe v nachale pravleniya Yunchzhena (1728–1731 gg.). In *Transgranichniye migratsii v prostranstve mongolskogo mira*, iss. 3. Ulan-Ude: Izd. BNC SO RAN, pp. 152–195.
Natsagdorj Ts.B. 2015b
On the Torgud (Kalmyks of the Volga Region) Banner in Western Qalqa during the Middle Years of the Yongzheng Reign (1728–1731). *Saksaha*, vol. 13: 1–24.
Ochir A. 2008
Mongolchuudyn garal, nershil. Ulaanbaatar: Nüüdliin soel irgenshliig sudlakh olon ulsyn khüreelen.

Ochir A. 2016
Mongolskiye etnonimy: Voprosy proiskhozhdeniya i etnicheskogo sostava mongolskikh narodov. Elista: KIGI RAN.
Ochir A., Disan T. 1999
Mongol ulsyn ööldüüd. Ulaanbaatar: Sogoo nuur.
Ochirov U.B. 2010
Oiraty Zapadnoy Mongolii i Severo-Zapadnogo Kitaya: Voprosy etnicheskoy istorii, demografii i geografii rasseleniya vo vtoroy polovine XVIII veka. *Vestnik KIGI RAN*, No. 2: 9–15.
Okada Hidehiro. 1987
Origins of the Dörben Oyirad. *Ural-Altaische Jahrbücher*. Neue Folge, Bd. 7: 181–211.
Okladnikov A.P. 1955
Istoriya Yakutskoy ASSR. Vol. I: Yakutiya do prisoyedineniya k russkomu gosudarstvu. Moscow, Leningrad: Izd. AN SSSR.
Oyirad teüke-yin durasqal-ud. 1992
Urumchi: Šinǰiyang-un arad-un keblel-ün qoriya.
Oyunzhargal O. 2009
Manzh Chin ulsaas mongolchuudyg zakhirsan bodlogo: Oiraduudyn zhisheen deer. Ulaanbaatar: Arvin Sudar.
Oyunzhargal O. 2015
Oiraty v politike manchzhurskoy dinastii Tsin. Ulan-Ude: Izd. BNC SO RAN.
Pelliot P. 1949
Histoire secrète des Mongols: Restitution du texte mongol et traduction française des chapitres I à VI. Paris: Adrienne Maisinneuve.
Pelliot P. 1960
Notes critiques d'histoire kalmouke. Vol. I: Texte. Paris: Librairie d'Amérique et d'Orient, Adrien-Maisonneuve.
Pismenniye pamyatniki po istorii oiratov XVII–XVIII vekov. 2016
V.P. Sanchirov (comp. trans., and comm.). Elista: KIGI RAN.
Pokotilov D.D. 1893
Istoriya vostochnykh mongolov v period dinastii Min. 1368–1634. St. Petersburg: [Tip. Imp. Akademii nauk].
Rashid ad-Din. 1952
Sbornik letopisey. Vol. 1, bk. 2. Moscow, Leningrad: Izd. AN SSSR.
Rashiduddin Fazlullah's Jami u't-tawarikh: Compendium of Chronicles. 1998
W.M. Thackston (trans. and annotation). Pt. 1: A History of the Mongols. Cambridge: Harvard Univ. (Sources of Oriental Languages and Literatures; vol. 45; Central Asian Sources; vol. IV).
Rumyantsev G.N. 1962
Proiskhozhdeniye khorinskikh buryat. Ulan-Ude: Buryat. kn. izd.
Rybatzky V. 2006
Die Personennamen und Titel der Mittelmongolischen Dokumente: Eine lexikalische Untersuchung. Helsinki: Yliopistopaino Oy.
Sanchirov V.P. 1990
"Iletkhel-shastir" kak istochnik po istorii oiratov. Moscow: Nauka.
Sanchirov V.P. 2016
Noviy oiratskiy istochnik o proiskhozhdenii dzhungarskikh knyazey. *Mongolovedeniye (Mongol sudlal)*, No. 8: 13–22.
Sanzheev G.D. 1930
Darkhaty: Etnograficheskiy otchet o poyezdke v Mongoliyu v 1927 godu. Leningrad: Izd. AN SSSR.
Serruys H. 1959
Mongols ennobled during the Early Ming. *Harvard Journal of Asiatic Studies*, vol. 22: 209–260.
Serruys H. 1977
The office of Tayisi in Mongolia in the fifteenth century. *Harvard Journal of Asiatic Studies*, vol. 37 (2): 353–380.
Shantaev B.A. 2009
O strukture rodov kalmykov-zyungarov. In *Problemy etnicheskoy istorii i kultury tyurko-mongolskikh narodov*, iss. 1. Elista: KIGI RAN, pp. 140–145.
Skazaniye o derben-oiratakh, sostavlennoye noionom Batur-Ubushi Tyumenem. 1969
Y. Lytkin (trans.). In *Kalmytskiye istoriko-literaturnyye pamyatniki v russkom perevode*. Elista: [s.n.], pp. 13–50.
Smedt A., de, Mostaert A. 1933
Le dialecte monguor parlé par les Mongols du Kansou occidental. Pt. III: Dictionnaire monguor-français. Peking: Imprimerie de l'Universitè Catholique.
Sumyabaatar. 1966
Buriadyn ügiin bichees. Ulaanbaatar: Shinzhlekh Ukhaany Akademiyn khevlel. (Ser.: Studia Ethnographica Instituti Historiae Academaiae Scientarum Republicae Populi Mongoli; vol. III, fasc. 2).
Terentiev V.I. 2017
Voprosy sootnosheniya srednevekovykh oiratov i sovremennykh zapadnykh mongolov: Versii issledovateley. *Vostok (Oriens)*, No. 3: 81–93.
The Secret History of the Mongols. Mongolian Epic Chronicle of the Thirteenth Century. 2004
Igor de Rachewiltz (Trans. with the historical and philological comm.). Vol. I.
Todaeva B.K. 2001
Slovar yazyka oiratov Sintszyana. Elista: Kalm. kn. izd.
Tsybenov B.D. 2017
Olety Khulun-Buira: Migratsii i rodovoy sostav. In *Transgranichniye migratsii v prostranstve Mongolskogo mira: Istoriya i sovremennost*, iss. 4. Ulan-Ude: Izd. BNC SO RAN, pp. 143–156.
Tsybikdorzhiev D.V. 2012
Oiraty do i posle 1207 g. In *Kulturnoye naslediye narodov Tsentralnoy Azii*. Ulan-Ude: Izd. BNC SO RAN, pp. 120–148.
Urangua Z. 2000
Khergem, zereg tsol örgömzhlökhüi (XVII–XX zuuny ekhen). Ulaanbaatar: Naranbulag printing.
Uspensky V. 1880
Strana Kuke-Nor, ili Tsin-Khai, s pribavleniyem kratkoy istorii oiratov i mongolov, po izgnanii poslednikh iz Kitaya, v svyazi s istoriyei Kuke-Nora (preimushchestvenno po kitaiskim istochnikam). *Zapiski IRGO*, vol. 6 (II): 57–196.
Vladimirtsov B.Y. 1929
Sravnitelnaya grammatika mongolskogo pismennogo yazyka i khalkhaskogo narechiya: Vvedeniye i fonetika. Leningrad: Leningr. Gos. Univ.
Yuan-chao mi-shi (The Secret History of the Mongols). 1936
Wang Yunwu (ed.). Shanghai: Shang Wu Yin Shu Guan.

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E.F. Fursova[1] and M.V. Vasekha[2]
*[1]Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: mf11@mail.ru
[2]Institute of Ethnology and Anthropology,
Russian Academy of Sciences,
Leninsky pr. 32A, Moscow, 119334, Russia
E-mail: maria.vasekha@gmail.com*

Floral Designs on Sacrificial Towels from an Old Believers' Prayer House

We reconstruct the semantics of floral compositions on commemorative towels, embroidered by women, members of the Old Believers Bespopovtsy (priestless worship community rejecting marriage) in Novosibirsk. The original vine motif, associated with the funerary cult, was transformed by replacing vines with more familiar motifs, such as flowers, berries, buds, etc. Certain designs resemble those found in late 19th to early 20th century embroidery manuals and on wrappers of cheap soap manufactured by Rallet, Brocard, etc. In most cases, however, there are no exact parallels. Some floral compositions are original: for instance, those showing vases with scrolls reminiscent of Jesus Christ's monogram, and "vases" turned into letters on Our Savior's icons. The results of the technological and stylistic analyses suggest that most sacrificial towels were made in the late 1800s and early 1900s, some in the 1940s and 1950s, and some may have been manufactured in places of the Old Believers' former residence in northern and central Russia. Designs arranged in friezes or central figures, such as crosses, cruciate motifs, "vases", or "vaults", allude to the Old Believers' fundamental values. Ritual towels evidence motifs on commercial embroideries creatively transformed by Old Believers according to their beliefs and traditions.

Keywords: *Floral design, sacrificial towels, Russian Old Believers, Priestless Old Belief, Western Siberia.*

Introduction

Studies of modern material culture, including its manifestations in the form of relics, make it possible to expand our understanding of the inner immaterial life of people. Insofar as culture sustains "deeply intimate, innate connection" with spiritual life, i.e. with the whole complex of religious, moral, and aesthetic experiences, it is alive and it has a "soul". According to O. Spengler, "the soul of culture" is something immaterial, yet captured in specific features of painting, music, architecture, poetry, and scientific reasoning (1993: 262). The attitude to the past, death, the world, and idea of person's place in the world is manifested in every culture, including its material aspect (Kazakov, 2014: 137). In our opinion, ornamental decoration of towels and other hand-made objects can be considered as self-expression of the "soul" of people, which use fine arts and handiwork to translate symbols and signs understandable to them. Numerous studies on art history and ethnography showed that ornamental motifs combine traditions from various periods. Revealing their content may provide further insight into foundations of the worldview of their carriers (see, e.g., (Voronov, 1972: 36; Maslova, 1978: 31)).

We believe that even seemingly simple and common ornamental patterns should be analyzed carefully and with regard to their ethnic and cultural context. The principle of variability in folk culture is widely manifested by the publication of ethnographic and other types of atlases. This principle can be successfully used in studying popular designs (Vasiliev, 2017: 124). It makes it possible to analyze various aspects of general and specific features of the traditional ornamental patterns of Russian peasants living in Siberia in the late 19th to early 20th centuries, without focusing only on general aspects (which is common among the supporters of the mythological school) or exclusively on specific local aspects (which is common in local history studies).

The Old Believers had a great influence on the pictorial tradition of Russians, filling it with religious meaning, by manifesting the worldview in which "single ritual meaning was expressed in a variety of forms—from manuscripts to embroidery and prayer", corresponding to the principles of complementarity and interchangeability of the "subject-oriented, verbal, and actional cultural codes" (Survo, 2014: 194).

During the years of "militant atheism", the Old Believer community (the Fedoseevtsy denomination) of Novosibirsk was a kind of "integral microcosm" with a secret religious life for its members, an island of "true faith". Unfortunately, this community was studied by the authors of this article only in the last three years of its existence. A few words should be told about its history. The Old Pomorian denomination was one of the communities of priestless Old Believers, who did not accept marriage. It emerged in the late 17th century, in the Pskov and Novgorod Governorates, and was named "Fedoseevsky" after its founder Feodosy Vasiliev, who had also preached among those Old Believers who fled to Poland (Kharakteristika ucheniya…, 1902: 552; Kozhurin, 2014: 158–163). In the early 20th century, the Old Believers, who were scattered in the villages of the Tomsk Governorate and other settlements of Western Siberia, began to resettle to Novonikolaevsk (Novosibirsk since 1926). In the 1970s–1990s, the leader of the Fedoseevsky community was spiritual father F.V. Gubarev (born 1908), whose family moved to Novosibirsk in the 1930s from the village of Korovka of the Sapozhkovsky District, Ryazan Region, which was a well-known center of hand-made pattern-weaving and embroidery (Pankova, Sakharova, 2011: 67). According to the recollections of Gubarev, the community included people from various parts of Central Russia, including Ryazan, Tula, and Lipetsk regions (for information about the history of the community, see: (Fursova, Golomyanov, Fursova (Vasekha), 2003: 27)). In 1996–1998, during the time of our communication with these Old Believers, no more than five-six women over 80 years old participated in the services on Saturdays and Sundays; two of them lived permanently in the prayer house. On feast days and days of commemoration of the dead, up to 15–20 people attended the service, including middle-aged people; as "living in fornication" (i.e., in marriage), they stood behind the group of worshipers (Field Materials of E.F. Fursova (hereafter, FMA), 1996). The commemoration practices included not only a service, with the reading of prayers and recitation the names of the dead ("commemoration of relatives"), but also a joint dinner with the brought food, distribution of cookies and sweets for "commemoration of the soul", and donation of towels to the prayer house. Towels were donated not only by the community members, but also by the children of the deceased members: they brought towels that were hand-made by their grandmothers and mothers. As Elena Ivanovna Rybina and Klavdiya Andreevna Boldyreva mentioned*, this was customary from time immemorial; towels were always given as alms pleasing to God (it was believed that "in the other world" this could ease the destiny of the deceased's soul). Until now, at funerals, it is customary for Old Believers to tie towels to crosses and distribute them among those present "for commemoration" (FMA, 1996, observation at the funeral of F.V. Gubarev in 1998). This study was based on the analysis of home-made sacrificial towels (37 items in total) that were kept in the prayer house of the Novosibirsk Fedoseevsky Old Believers (some items had previously been used for elaborating the typology of the Baraba towels (Fursova, 2006)). The collection was formed in the pre- and post-War years, up to the late 1990s (Ibid.). Materials from museum collections were also used as sources (unfortunately, the documentation on these items of handicraft usually indicates only the place of collection and the name of supplier or artisan). Towels from the field collections of the authors, which are kept in the Museum of History and Culture of the Peoples of Siberia and the Far East of the Institute of Archaeology and Ethnography of SB RAS, as well as photos of family collections of needlework of the population of Western Siberia, were used for analysis. Field evidence collected in 1980–2010 by the Eastern Slavic Ethnological Expedition of the Institute of Archaeology and Ethnography of SB RAS was an important source of information. This study aims at reconstructing the semantic content of ornamental compositions of commemorative (sacrificial) towels from the collection of the community of Novosibirsk Old Believers.

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*E.I. Rybina (maiden name Borodina) was born in 1913 in the village of Tychkino in Vengerovsky District of Novosibirsk Region; she died in 2003 in Novosibirsk. K.A. Boldyreva was born in 1925 in the village of Zayachye in Chanovsky District of Novosibirsk Region; died in 2005 in Novosibirsk.

Floral designs of "vine"

Most traditional Russian patterns are based on relatively few images and compositions. Russian scholars have usually focused on geometric ornamentation, as well as zoo-, anthropo-, and ornithomorphic motifs (Maslova, 1978; Rusakova, 1985; Fursova, 2005, 2006; Gribanova, 2013; Survo, 2014; and others). "Grass" designs have been analyzed less frequently, although these often occur in the Old Russian applied art and architecture of the 10th–13th centuries and in the initials of the manuscripts of the 12th–14th centuries (Maslova, 1978: 95). Floral patterns appear on over 90 % of sacrificial towels of the Old Believer community of Novosibirsk. A similar situation is observed in the evidence from large museum collections of the Altai (Gribanova, 2013: 167) and the Russian North (Survo, 2014: 71).

The vine motif is reasonably used in decorating the towels intended for commemorating the souls of deceased Christians. The image of grapes and vine in the Bible symbolizes spiritual fruit blessed by God (for example, Lk. 22:18) and the Garden of Eden, and is associated with the funerary cult. The first symbolic meaning of vine was related to Christ and his disciples, and second meaning was associated with the Christian Church (Uvarov, 1908: 173). Many examples of interpretation of this symbol appear in the Bible. For instance, the book of the Prophet Isaiah says: "Now will I sing to my wellbeloved a song of my beloved touching his vineyard. My wellbeloved hath a vineyard in a very fruitful hill. And he fenced it, and gathered out the stones thereof, and planted it with the choicest vine" (Is. 5:1–2) and "As the new wine is found in the cluster, and one saith, destroy it not; for a blessing is in it" (Is. 65:8).

Bunches of grapes, which sometimes resemble berries, in the patterns on the Old Believers' towels under consideration alternate with leaves or flowers in the form of rosettes, etc. (Fig. 1). In terms of color palette, they correspond to the general Russian tradition based on the combination of white linen, and red and black threads in the pattern. Polychrome variants also occur. Embroidery on sacrificial towels was done mainly with cross-stitching. Notably, among other ethnic and cultural groups of Russian peasants in Siberia, this motif was rendered using customary techniques. For example, the Chaldon old residents performed it with a traditional buttonhole stitch (tambour stitch) (Fig. 2). The Chaldon embroidery looks like a two-colored (red and white) graphic pattern, with intricately twisting lines and without spaces within. Bunches of grapes and leaves in the frieze pattern are shown in a stylized manner; vines are rendered by small loops. In the central part of the embroidery, in the crown of winding lines, one can see a flattened anthropomorphic figure (Fig. 3). Syncretism (a combination of phyto- and anthropomorphic images) is generally a phenomenon typical of archaic imagery (Maslova, 1978: 94; Rusakova, 1985: 133).

The Russian archaeologist and corresponding member of the St. Petersburg Academy of Sciences A.S. Uvarov noted that Christians used the images of pagan monuments that were "consecrated" through the interpretations of Church Fathers of the first two or three centuries AD (1908: 103). When choosing symbolic images, Christians relied on the works of Clement of Alexandria and other writers of his time. The acceptable symbols included the symbols of "dove", "fish", "lyre", and "anchor". Over time, symbols borrowed from Holy Scripture and works of other Church Fathers were added to them (Ibid.: 104). The antiquity of the image of a vine is confirmed by its occurrence in ornamentation of clothing of votive statues from the Hellenized East of the 2nd century AD (Parthian art, Ashur and Hatra) (Schlumberger, 1985: 124). Village craftswomen could see this image in the decoration of iconostases, icons, and books. They probably knew about grapes as a real plant from the stories of pilgrims returning from Palestine (Belyaev, Chekhanovets, 2020: 98). In the process of creative assimilation, the craftswomen filled the image of a vine with the relevant content, and embodied it in new forms: for example, replacing grapes with more familiar items from surrounding nature (Fig. 4, 5). Certain designs show similarities with those found in late 19th to early 20th century embroidery manuals and on wrappers for cheap soap manufactured by Rallet and Brocard; these are known in the literature as "Brokarovsky" (Maslova, 1978: 54). However, most of the ornamental patterns embroidered by rural craftswomen do not find direct parallels in printed examples. This indicates that the pictorial ornamental language introduced into the peasant culture from without corresponded to the traditional imagery and to the entire set of basic values of the Old Believers. Thus, the predominance in the collection of sacrificial towels with a design in the form of a curling shoot with flowers as a typical and widespread motif is not accidental (Zhilina, 2018: 33). "Flower vine" often occurs in the ornamentation of old icons, books, and more mundane things, such as men's traditional *kosovorotka* shirts for festivities and weddings (Charyshsky District, Altai Territory) (FMA, 1988).

Here is the description of some towels with such a design from the Novosibirsk prayer house (25 spec.). The embroidery often depicts two vines: the upper vine is shown in a decorative and geometric style, in the form of alternating rosette flowers and twigs; the lower vine appears with realistically rendered leaves and flowers (see Fig. 4). In the design of one towel, a wavy line, uniting flowers and leaves, is rhythmically interrupted; nevertheless, it is perceived as a grapevine, although it is not entwined around a tree. "Flower vines" were

Fig. 1. Ends of a towel embroidered using the cross-stitch technique, from the collection of the prayer house of the Old Believers in Novosibirsk. *Photo by S.I. Zelensky.*

Fig. 2. Ends of a towel made in the tambour ("loop") technique, late 19th century, Novosibirsk Region. Museum of History and Culture of the Peoples of Siberia and the Far East of the IAET SB RAS.

Fig. 3. Ends of a towel made in the tambour ("loop") technique, late 19th century, Novosibirsk Region. Museum of History and Culture of the Peoples of Siberia and the Far East of the IAET SB RAS.

Fig. 4. Ends of a towel embroidered using the cross-stitch technique, from the collection of the prayer house of the Old Believers in Novosibirsk. *Photo by S.I. Zelensky.*

Fig. 5. Ends of a towel embroidered using the cross-stitch technique. The Charysh Museum of Local History, the Altai Territory. *Photo by E.F. Fursova.*

often enriched with buds, flowers, and leaves of various sizes, and the ornament looked rich and "branchy". The collection under study contains a towel with a clearly legible vine of the "Brokarovsky" type; it has acorns, which alternate with leaves, and entwines around a stem (tree trunk?) (Fig. 6). The design on another towel combines representations of vine and two large squares below, with the inscribed eight-petal rosettes and crosses (Fig. 7). Taking into account Siberian evidence, geometric zigzags with surrounding flowers or bunches of grapes can be attributed to the flower vine design. Wavy vine in this case is replaced by a broken line (Fig. 8). Compositions made with cross-stitching (on three specimens) in the 1940s–1950s include sophisticated asymmetrical realistic images of specific flowers (red lilies, roses, etc.) and can be attributed to the "Brokarovsky" type.

The designs described above have much in common with patterns on towels from the rural population of the Russian North. However, the motif of a flower vine among the northerners was usually combined with geometric ornaments made via loom weaving technique (FMA, 2010; Fig. 9). Such an ornament became widespread in Eastern Europe; it appears on hand-made items of the 19th to early 20th centuries created by Polish, Romanian, and other rural craftswomen.

Fig. 6. Ends of a towel embroidered using the cross-stitch technique, from the collection of the prayer house of the Old Believers in Novosibirsk. *Photo by S.I. Zelensky.*

Floral designs with "vases"/"houses"

According to Uvarov, the image of a chalice was closely related to the image of a grapevine (1908: 104). Floral patterns combined with a chalice/vase (vases) occur on about 10 % of compositions on the towels from the Old Believers' prayer house. They were made using counted techniques: cross-stitch, satin-stitch, and white thread embroidery (on sparse fabric).

Vases in embroidery are not always shown realistically. For example, on two towels from the collection under consideration, the vase is represented as curled letter "X" (Greek "chi") (Fig. 10). In this case, the inflorescence between the scrolls can be associated with letter "I" ("iota") of the Greek alphabet. Such monograms with the crossed interposition of initial letters of the name of Jesus Christ have been found on gravestones from the first centuries of Christianity

Fig. 7. Ends of a towel embroidered using the counted satin-stitch technique, from the collection of the prayer house of the Old Believers in Novosibirsk. *Photo by S.I. Zelensky.*

Fig. 8. Ends of a towel embroidered using the cross-stitch technique. The Chistoozerka Museum of Local History, Novosibirsk Region. *Photo by E.F. Fursova.*

Fig. 9. Ends of a towel embroidered using the cross-stitch technique, the town of Totma, Vologda Region. *Photo by E.F. Fursova.*

and on the vaults of the Archbishop's Chapel of the 5th century in Ravenna (Kak vybrat…, 2003: 23). On one towel, vase is depicted with scrolls facing inward like the Greek letter "Ω" ("omega") (Fig. 11). Icon painters depicted the letters of the Greek alphabet on the icons of Christ. For example, on the icons of the Savior Not Made-by-Hands (the Holy Mandylion), one can see letter "Ѿ" (Russkiye ikony, 2004: 65, 67).

In embroidery, the image of a "vase" was rendered as small house, from which a large plant stretched upward; the branches at the middle level were directed upward and downward (emanating from the corners of the square in the center of the plant), and at the top level they were directed only upward. It is clear that the lower and upper branches are separated horizontally (Fig. 12). The top of the plant is a trefoil framed by small V-shaped figures (birds?). Similar embroidery on towels has been found occasionally in different regions of the Novosibirsk region of the Ob, Vasyugan Plain, and Northern Altai. For example, a composition of floral patterns, vases, and houses with "sprouted" roofs occurs on towels from the collection of the Ordynskoye Museum of Local History, and on embroideries found during the expedition to the village of Yarki in the Cherepanovsky District, Novosibirsk Region (Fig. 13, 14) (FMA, 1993). A towel with an ornamental pattern of a spreading tree with raised branches and numerous inclusions of phyto-anthropomorphic figures, crosses, house-vases from Yarki shows similarities with the Ukrainian embroidered shirts from Podolia (Dintses, 1941: 31). A towel with figures that can be regarded as a typologically early prototype of the image of plant with vase has survived among the Russian Old Believers of the Vasyugan Plain—the descendants of migrants from Glubokovsky Uyezd of the Vilna Governorate of the early 20th century (Fig. 15). The ornament was made using the counted technique; therefore, the vases, from which the trees with upturned branches grow, look stylized. The phytomorphic images end with diamond-shaped figures, which are a continuation of three crosses emanating from the plant's trunk. Large and spreading trees are embroidered on the sides of a less spreading tree or a bush in the center. Tripartite compositions with plants of various types demonstrate a connection between green, fruit-bearing trees and dry, fruitless trees; similar images occur on Early Christian monuments (Uvarov, 1908: 193). Some scholars suggest that these compositions with floral and anthropomorphic symbols were intended to indicate the purpose of the embroidered items and to emphasize their connection with female space, with periods of girls' full age, wedding, and youth (Bernshtam, 1992: 237; Survo, 2014: 73). Such an explanation appears to be more suitable for the semantic content of compositions on the needlework produced by the followers of the official

Fig. 10. Ends of a towel embroidered using the *counted satin-stitch* technique, from the collection of the prayer house of the Old Believers in Novosibirsk. *Photo by S.I. Zelensky.*

Fig. 11. Ends of a towel embroidered using the counted satin-stitch technique, from the collection of the prayer house of the Old Believers in Novosibirsk. *Photo by S.I. Zelensky.*

Church or those Old Believers who accepted marriage. There is an opinion that the embroideries of the Great Mother ruling over all the worlds were executed in a typologically similar iconography (Rusakova, 1985: 133–134). It is impossible to decipher such compositions convincingly, and it is unlikely that this

Fig. 12. Ends of a towel embroidered using the cross-stitch technique, from the collection of the prayer house of the Old Believers in Novosibirsk. *Photo by S.I. Zelensky.*

Fig. 13. Ends of a towel embroidered using the cross-stitch technique. The Ordynskoye Museum of Local History, Novosibirsk Region. *Photo by E.F. Fursova.*

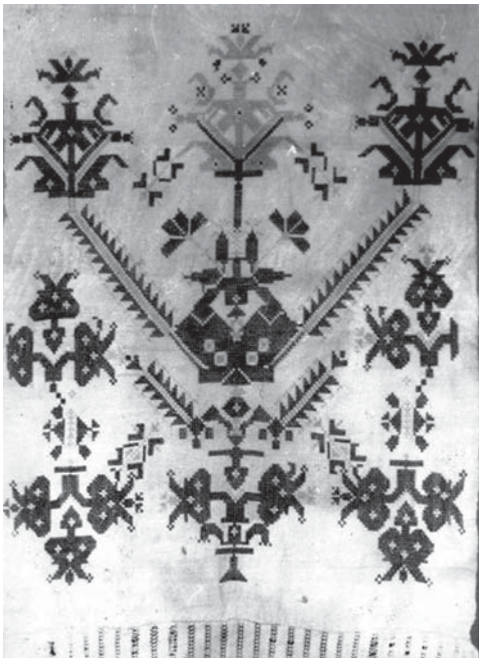

Fig. 14. Ends of a towel embroidered using the cross-stitch technique, the village of Yarki, Cherepanovsky District, Novosibirsk Region. *Photo by E.F. Fursova.*

Fig. 15. Ends of a towel embroidered using the counted thread technique, the village of Bergul, Severnyi District, Novosibirsk Region. *Photo by E.F. Fursova.*

will become possible in the future. There will be no carriers of this artistic tradition, which has been long gone from the lives of many generations of Russians, and Slavic peoples in general.

The symbolism of such images must be viewed using extensive material evidence, especially because the parallels can be found not so much in the common Russian, but in the Indo-European repertoire. Christians also borrowed the symbol of the flow of life (house) from the ancients; in particular, from the Greeks and Romans (Uvarov, 1908: 170). Early Christians interpreted it as a vault or a church. It is logical to interpret houses as vaults in the ornamental patterns with houses from which mythical plants grow. It is possible that in the old days the embroiderers tried to convey the meaning of "everlasting life", eternity of being, and connection between the past and present in their works. In the designs of towels of the Ukrainian settlers in Siberia (the "Krolevets" settlers from the town of Krolevets, Sumy Region), houses with tops in the form of crosses, usually separated by bands from floral and other patterns, symbolize religious buildings (churches). The outlines of houses or vases cannot be discerned in the ornately curved lines of the Chaldon hand-made items.

Conclusions

Floral motifs typical of the Russian tradition of needlework as a whole, and specific to the group of Fedoseevsky Old Believers under study, have been identified in the collection of sacrificial (commemorative) towels of the Old Believers' prayer house in Novosibirsk. This collection was based on the desire of the community members to do a godly deed—to donate a cherished thing left from the ancestors on the female side (grandmother, mother, mother-in-law) to the prayer house. The God-pleasing nature of ornamented towels as a commemorative sacrifice is reflected in funeral and commemorative customs that have survived among the Orthodox population, including the Old Believer groups of Siberia: towels were used for tying stretcher poles, supporting icons while carrying out the deceased; towels were given to grave-diggers, were tied to the cross, etc. (Fursova, 2014: 287–288).

An important result of working with the materials (the collection of towels from the Old Believers' prayer house) is the conclusion about the transformation of the Old Christian image of a "vine": while rendering it in their embroidery, Orthodox craftswomen replaced grapes with flowers, leaves, buds, etc., which were more familiar to them. Replacement of a grapevine with flower, oak, or berry vines has also been observed in the ornamentation of towels of the Orthodox population in the countries where Orthodoxy is the dominant religion (e.g., Romania) or where the Russian Old Believers live (e.g., Poland). Original compositions with a "vase" in the form of monograms combining the initial letters of the name of Jesus Christ have been identified. The collection contains a towel with the image of a "house" from which a large plant is directed upwards. This motif may represent the so-called World Tree traditionally known from the art of the peoples of Eastern Europe (Maslova, 1978: 95), but without figures of animals, birds, or riders on the sides, and without the anthropomorphic features typical of this motif.

Being embedded in the hierarchy of ethnic and cultural identity, and more precisely of its form as denominational identity, floral patterns in "their true essence" contributed to the consolidation of the Old Believers into a single community. Only the members of the community passed towels to each other; selection of ornamental motifs probably occurred at the same level.

Variants of the motifs in the embroidery on the towels from the collection of the Old Believers' prayer house in Novosibirsk could result from adapting the well-known Christian Byzantine images to expressing the "festive feeling of peace", which appeared in Russia at the turn of the first and second millennia. According to M.A. Nekrasova, "with the adoption of the Orthodox faith, Christian elements merged into the traditional popular system, finding a basis in the community of more ancient traditions", which testifies to creative capacity of Russian peasant women and their "spiritual giftedness" (2006: 13).

The pattern with grape clusters and leaves, both realistic and stylized, appears in the material culture of almost all Eastern Slavic groups of Siberia—Russian Old Believers, Chaldons, Ukrainians, etc. Ornamentation in the form of a spreading tree with branches raised up and numerous inclusions of phyto-anthropomorphic figures, crosses, house-vases occurs much less frequently. In our opinion, it shows parallels with Western Russian traditions.

Analysis of the manufacturing technique and the style of patterns suggests that most of the sacrificial towels from the collection of the Novosibirsk prayer house were made in the late 19th to early 20th centuries; a smaller part was made in the 1940s–1950s, and some were probably brought from other places of the initial location of the Old Believers (Russian North, Central Russia).

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References

Belyaev L.A., Chekhanovets Y. 2020
The ethnoarchaeology of Russians in the Syro-Palestinian region (18th–19th Centuries). *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 48 (2): 97–105.

Bernshtam T.A. 1992
Sovershennoletiye devushki v metaforakh igrovogo folklora (traditsionnyi aspekt russkoi kultury). In *Etnicheskiye stereotipy muzhskogo i zhenskogo povedeniya*. St. Petersburg: Nauka, pp. 234–257.

Dintses L.A. 1941
Istoricheskaya obshchnost russkogo i ukrainskogo narodnogo iskusstva. *Sovetskaya etnografiya*, [Iss.] V: 21–58.

Fursova E.F. 2005
Traditions of ornamentation patterns employed in feminine handicrafts reflecting intercultural links in the Baraba and the Vasiugan basin. *Archaeology, Ethnology and Anthropology of Eurasia*, No. 1 (21): 128–140.

Fursova E.F. 2006
Ornithomorphic symbols in the traditional peasant culture of the Ob basin, Baraba and Kulunda steppes, and the Altai (late 19th-early 20th centuries). *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 26 (2): 126–136.

Fursova E.F. 2014
Pokhoronno-pominalnaya obrjadnost staroobryadtsev-pereselentsev iz Belorussii kak etnograficheskiy istochnik (po materialam XX – nachala XXI veka). *Vestnik Novosibirskogo gosudarstvennogo universiteta*. Ser.: Istoriya, filologiya, vol. 13. Iss. 5: Arkheologiya i etnografiya: 284–296.

Fursova E.F., Golomyanov A.I., Fursova (Vasekha) M.V. 2003
Staroobryadtsy Vasyuganya: Opyt issledovaniya mezhkulturnykh vzaimodeistviy konfessionalno-etnograficheskoy gruppy. Novosibirsk: AGRO-SIBIR.

Gribanova N.S. 2013
Polotentse v kulture russkogo selskogo naseleniya Altaya v kontse XIX – nachale XXI veka. Barnaul: Alt. Gos. Ped. Akad.

Kak vybrat natelnyi krest. 2003
Moscow: Kovcheg.

Kazakov E.F. 2014
"Dusha" russkoi kultury. In *Aktualnye voprosy gumanitarnykh nauk: Materialy Vseros. nauch.-praktich. konf.* Kemerovo: pp. 137–145.

Kharakteristika ucheniya raskolnicheskikh tolkov ili soglasiy. 1902
In *Missionerskiy sputnik*. St. Petersburg: [Tip. E.L. Porokhovshchikovoy], pp. 530–553.

Kozhurin K.Y. 2014
Povsednevnaya zhizn staroobryadtsev. Moscow: Mol. gvardiya.

Maslova G.S. 1978
Ornament russkoi narodnoi vyshivki. Moscow: Nauka.

Nekrasova M.A. 2006
Narodnoye iskusstvo i pravoslaviye. Tselokupnost obraza mira. Metodologiya issledovaniya. *Traditsii i sovremennost*, No. 5: 3–15.

Pankova T.M., Sakharova O.M. 2011
"Po obychayu dedovu": putevoditel po ekspozitsii Pevcheskogo korpusa Ryazanskogo kremlya. Moscow: Severnyi palomnik.

Rusakova L.M. 1985
Arkhaicheskiy motiv romba s kryuchkami v uzorakh polotenets sibirskikh krestyanok. In *Kulturno-bytovye protsessy u russkikh Sibiri. XVIII – nachalo XX v*. Novosibirsk: Nauka, pp. 121–138.

Russkiye ikony. 2004
Moscow: OLMA-PRESS.

Schlumberger D. 1985
Ellinizirovannyi Vostok. Grecheskoye iskusstvo i ego nasledniki v nesredizemnomorskoi Azii. Moscow: Iskusstvo.

Spengler O. 1993
Zakat Evropy. Novosibirsk: Nauka.

Survo V. 2014
Obrazy vyshivki i obryadovaya semantika tekstilya v traditsiyakh Karelii. Helsinki: Unigrafia.

Uvarov A.S. 1908
Khristianskaya simvolika. Pt. 1: Simvolika drevne-khristianskogo perioda. Moscow: [Tip. G. Lissnera].

Vasiliev M.I. 2017
The variation of Russian festive ritualism in Russian ethnography. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 45 (2): 123–131.

Voronov V.S. 1972
O krestyanskom iskusstve. Moscow: Sov. khudozhnik.

Zhilina N.V. 2018
Ranniye formy vizantiyskogo ornamenta i ikh rol v khristianskom iskusstve. In *III Svyato-Vladimirskiye chteniya: Materialy mezhdunar. nauch. konf., posvyashch. 1030-letiyu Kreshcheniya Rusi*. Sevastopol: pp. 32–35.

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A.G. Kozintsev
Peter the Great Museum of Anthropology and Ethnography (Kunstkamera),
Russian Academy of Sciences,
Universitetskaya nab. 3, St. Petersburg, 199034, Russia
E-mail: agkozintsev@gmail.com

The Origin of the Okunev Population, Southern Siberia: The Evidence of Physical Anthropology and Genetics

To test the competing hypotheses as to the origin of the Okunev culture, four male cranial series from Okunev cemeteries in the Minusinsk Basin were compared with 23 other pre-Andronovo series from southern Siberia, and 45 Early and Middle Bronze Age groups from Eastern Europe (24 Yamnaya and 21 Catacomb), using multivariate statistical analysis. While the Afanasyevo admixture in the Okunev population is possible, the hypothesis that the Okunev culture of the Minusinsk Basin originated from the second migration from the Eastern European steppes to southern Siberia in the Early Bronze Age is not supported. It could, however, be applied to people associated with the Okunev-type (Chaa-Khol) culture in Tuva, although these may as well have descended from the Afanasyevans. As concerns the Minusinsk Basin and other regions of southern Siberia except Tuva, the findings agree with the idea of a marked evolutionary conservatism peculiar to the autochthonous populations of that territory, as evidenced by the fact that each of the three Early Bronze Age population clusters—on the Yenisei, in the Altai, and in Baraba—has its own Neolithic ancestors in the same area (this does not concern the Chaa-Khol, the Yelunino, and apparently the Samus populations). The immediate ancestors of the Okunev people can be identified with the Neolithic population of the Krasnoyarsk-Kansk area, and more distant ones with the Upper Paleolithic southern Siberian common ancestors of the Okunev people and the Native Americans. These ancestors are evidenced by both cranial data (indirectly) and genetic data (directly). The latter suggest that among these common ancestors were the Malta boy and the Afontova Gora II male. The Okunev population, then, is a relic, offering us a unique opportunity to see what the Upper Paleolithic ancestors of the Native Americans may have looked like in their southern Siberian homeland.

Keywords: *Southern Siberia, Okunev culture, Yamnaya culture, Catacomb culture, Afanasyevo culture, Native Americans.*

Introduction

The origin of the Okunev culture is a highly contentious matter. According to the traditional view, this culture had local Neolithic roots and was "inherently Siberian" (Maksimenkov, 1975: 36–37; Vadetskaya, Leontyev, Maksimenkov, 1980: 26; Sokolova, 2009). As a counter to that, a hypothesis that Okunev origins had been related to a migration of one of the Yamnaya-Catacomb groups from European Russia to southern Siberia was proposed (Lazaretov, 1997; Lazaretov et al., 2012)*. According to absolute dates, in the view of A.V. Polyakov (2017), the immigrants displaced or exterminated their predecessors (Afanasyevans) in less than 100 years. Cultural markers

*The first to have paid attention to the Yamnaya-Catacomb component in the Okunev culture was A.A. Formozov (1969: 203).

of the migration, such as burials in catacombs, graves with ledges, placement of bodies on the right side, etc., are found only at the early, Uibat, stage of the Okunev culture, whereas later, at the Chernovaya stage, they disappear (Polyakov, 2020a, b).

The key role in the discussion is played by cranial data, but they are ambiguous. A.V. Gromov, who has authored the most detailed study of Okunev craniology, believed that "Okunev population was a mixture of groups differing in origin" (1997: 308). One of these he associated with the Neolithic population of the Krasnoyarsk-Kansk forest-steppe, which is the closest to Okunev group as a whole; the other with the Yamnaya and Yamnaya-Catacomb groups of Kalmykia. "A certain resemblance between Okunev crania and those of the Yamnaya and Catacomb people of Kalmykia does not provide direct evidence of a genetic affinity between them. However, to all appearances, precisely that physical type was peculiar to a population that was the source of the Caucasoid component in Okunev origins. Obviously, this Caucasoid group was outnumbered by the autochthonous component and gradually dissolved in it, having, however, left its trace, as seen by the Caucasoid tendency of both the Okunev population *in toto* and its separate groups as compared to contemporaneous autochthonous groups" (Ibid.: 315–316). Trying to elaborate his hypothesis, Gromov paid special attention to brachycranic Yamnaya and Yamnaya-Catacomb groups of Kalmykia, because the earliest of the then available Okunev groups, Tas-Khazaa, deviates from others precisely in that direction. Some heterogeneity is found at the within-group level as well: specifically, three female crania from Chernovaya VIII, and Uibat III and V stand out from others by their Mongoloid appearance.

These conclusions are generally rather vague. Those concerning the between-group level are formulated very cautiously and with an eye on the claims made by archaeologists. At the within-group level, the presence of three Mongoloid females does not support the idea of migration. On the contrary, those having an aberrant appearance should be the few Caucasoid males—the presumed immigrants, which is not the case. The results of the multivariate analysis provide, at best, weak indications of heterogeneity. Also, Gromov's conclusions are quite discordant with the migrationist theories of archaeologists. Attempting to find a compromise, one arrives at a bizarre scenario: immigrants, who had been numerous enough to banish or destroy the Afanasyevans, eventually dissolved in the autochthonous population, which, therefore, should have been even more numerous. Where and how could that have happened? G.A. Maksimenkov's idea (1975: 36–37) about the "Bronze Age Reconquista"—the return of Okunevans to their former habitat—is much more understandable, as it requires only two components rather than three.

Nonetheless, in the words of I.P. Lazaretov and A.V. Polyakov (2018: 60), "at present, few people doubt that the Okunev phenomenon resulted from intense migratory processes. A direct indication thereof is provided by physical anthropology. The Caucasoid component in the Okunev population differs from others by marked brachycrany and an unusual occipito-parietal deformation. The same features are found in the Late Yamnaya and Yamnaya-Catacomb population of the northwestern Caspian area" (the claim is supported by references to A.V. Gromov and A.A. Kazarnitsky). Now, stating that all this is what "few people doubt" is definitely misleading. For one, this point of view is disputed by a leading expert in the population history of southern Siberia—T.A. Chikisheva. Noting that Gromov was unable to reveal the tentative Caucasoid component in the Okunev population, she writes: "The Altai-Sayan highlands, at least from the Neolithic onward, can be regarded as the distribution area (or part of it) of an evolutionarily conservative substrate representing the Southern Eurasian formation. It is logical to associate the physical type characterized by a wide face and brachycrany, common among the Late Bronze Age people of southern Siberia, with that formation. It can be suggested that the populations of the Sayan piedmont and of the mountain-steppe basins originated from that substrate (people associated with the Neolithic traditions and the Okunev tribes)" (Chikisheva, 2012: 88, 123). She continues: "The Southern Eurasian formation was a substrate for all the autochthonous populations of the Altai-Sayan region known to date… In this context it has become evident that the impact of migratory impulses on the origin of physical types of the Altai-Sayan population was somewhat overstated" (Ibid.: 180).

Our findings are similar. First, the craniometric analysis has demonstrated that among the southern Siberian Bronze Age groups precisely the Okunev group, unlike others such as Afanasyevo, Andronovo, Karasuk, and Tagar, can be considered ancestral to all or most modern populations of southern and western Siberia. This supports the hypothesis about the stability of the autochthonous substrate represented by the Okunev people and their relatives (Kozintsev, 1976). In his dissertation, Gromov attempted to downplay this conclusion, referring to what he viewed as the Mongoloid admixture in Okunevans, which opposes them to other southern Siberian Bronze Age groups (2002: 16–17). Later, however, it was shown that Okunevans cannot be regarded as Caucasoids with a Mongoloid admixture, and Gromov appears to have agreed with this. Indeed, the integration of data on two independent trait systems (craniometry and cranial nonmetrics) has allowed us to conclude that the role of admixture in western and southern Siberia was relatively minor as compared to a considerable evolutionary conservatism of the autochthonous component. Specifically, the trait combination displayed by Okunevans and the Sopka-2 people was, shown to be markedly plesiomorphic (Kozintsev, Gromov, Moiseyev, 2003; Kozintsev, 2004)*.

In addition, an amazing fact was discovered: the combination of metric and nonmetric cranial traits links Okunevans to Native Americans. This discovery, initially outlined as a summary of a conference paper (Kozintsev, Gromov, Moiseyev, 1995), evoked such skepticism among archaeologists that the editors of both *Okunev Collections* did not venture to invite us to elaborate on our findings. Such an elaboration, based on a more advanced multivariate approach, was presented in an article published in the USA (Kozintsev, Gromov, Moiseyev, 1999), and was later repeated in Russian using new cranial samples (Kozintsev, Gromov, Moiseyev, 2003; Kozintsev, 2004; Vasilyev et al., 2015: 323–325). Obviously, Okunevans played no part in the peopling of the New World, but they and the Native Americans may have had common Upper Paleolithic ancestors in Siberia.

Okunevans display not only biological but also cultural similarities to certain groups of Native Americans. The parallels between Okunev art and that of Na-Dene Indians, noted by A.N. Lipsky (1969), can be supplemented by a rare type of cranial deformation (the obelionic flattening) evidently caused by cradle-boarding practices. Its similarity to the deformation type seen in Yamnaya and Catacomb crania from Kalmykia was studied in detail (Gromov, 1998), but it has never been noticed that an identical type is found in the New World, specifically in crania of the Pueblo Indians of southwestern USA (Nelson, Madimenos, 2010).

Our conclusions has been fully supported by three independently working teams of geneticists—Danish, headed by E. Willerslev (Allentoft et al., 2015); French, headed by K. Keiser (Hollard et al., 2018); and American, headed by D. Reich (Kim et al., 2018). The effect that this rediscovery, which we had awaited for twenty years, produced in the West was described by O.P. Balanovsky: "Overall, the totality of results described, especially the peculiar status of the Okunev group, is quite consonant with earlier findings by physical anthropologists. This is not only my opinion: in his talk at the 2015 Jena Conference *Linguistics, Archaeology, and Genetics*, Morten Allentoft quoted a reviewer of his article in *Nature*. The meaning of the passage was that many conclusions about the genetic relationships outlined in that article had been preceded by those found in Russian publications on physical anthropology—and who could imagine that Russian anthropologists were so shrewd? This appears to be a clear indication that geneticists should carry out such studies in collaboration with colleagues representing older and more experienced disciplines" (Balanovsky, 2015: 312). Maybe, but the reaction of our Russian colleagues—physical anthropologists and archaeologists—is stunned silence, as before.

Okunev genomes are specially examined in a master thesis by Allentoft's student, the Danish geneticist C.G. Zacho, based on the analysis of DNA in samples taken from 18 Okunev individuals (Zacho, 2016). This study needs to be dealt with in some detail here, the more so because it is not mentioned in the recent Russian summary (Polyakov, 2019). First of all, our conclusion about the affinities between Okunevans and modern Siberian groups has been fully supported: "Okunevo is the ancient group currently known with the closest genomic affinity to present day Siberian populations" (Zacho, 2016: 40). The distinctness of Okunevans on the Siberian background, manifested in their ties with Native Americans, is upheld as well: "The observed combination of ancestry proportions appeared unique. The only individuals that had the same components present, albeit in very different proportions, were the Paleoindians" (Ibid.: 38). Our hypothesis was based on the assumption about common ancestors of Okunevans and Native Americans in Upper Paleolithic Siberia. This assumption has now become a fact. Specifically, genetic ties with Okunevans were detected in a boy who had lived at the Upper Paleolithic site Malta near Irkutsk some 24 ka BP, and in a male from the Upper Paleolithic site Afontova Gora II in Krasnoyarsk, dating to 17 ka BP. Both of them, like Okunevans, reveal affinities with Native Americans (Raghavan et al., 2014; Allentoft et al., 2015).

The idea that the Okunev skeletal sample is a heterogeneous mixture (incidentally, finding little support even in cranial studies) is disproved by genetic analysis. "Both the nuclear PCA and ADMIXTURE analyses indicated a very homogenous gene pool in the Okunevo Culture, in correspondence with the previous genetic study of the Okunevo by Allentoft et al. (2015)" (Zacho, 2016: 38). However, the presence of several genetic components in the Okunev gene pool, indicating past admixture, as in the vast majority of known human groups, is apparent (see (Ibid.: App. 6)): apart from the "Native American" autosomal component proper, whose share is estimated at 4.8 %, there is a Western Eurasian component, as Zacho calls it (61.8 %), and a Siberian component (32.6 %). The proportion of both the latter components is high in Native Americans, in the Malta boy (in his genome, the former component predominates), and in the Ust-Ishim male, dating to ~45 ka BP (in whose genetic makeup both components are nearly equally represented) (Fu et al., 2014). The smallest component of the Okunev gene pool (0.8 %) is typical of Southeast Asians, making one recall the Far Eastern complex that L.A. Sokolova identifies in the Okunev culture (2009: 24).

*At that time, all Early Bronze Age crania from Sopka-2 were pooled. Later, the group was subdivided into several subgroups, which are quite similar (see below).

Therefore, although the component termed Western Eurasian is predominant in the Okunev gene pool, there is no need whatsoever to believe that it was introduced by a Bronze Age migration from Eastern Europe. The sharp difference between the Okunev gene pool and that of the Yamnaya-Afanasyevo population, on the one hand, and the genetic affinities between Okunevans and the Upper Paleolithic Siberians (see above), on the other, suggests that the admixture of various components may have begun many millennia before the formation of the Okunev culture*. The genetic homogeneity of the Okunev sample points in the same direction. "It seems most likely that the Western Eurasian component is from a source that shared ancestry with the Malta individual, which had a substantial West Eurasian ancestry, and that the East Asian ancestry arrived from another source" (Zacho, 2016: 39). Such a source, in Zacho's view, was the population to which the Ust-Ishim individual belonged.

In later studies, these findings were interpreted in a different way. Recent genetic discoveries call into question the unilinear west vs. east dichotomy (Caucasoid vs. Mongoloid in traditional terms). The actual pattern of differentiation in Eurasia and America proved much more complex. According to a new interpretation, the autosomal gene pool of Okunevans as well as the Botai people, the Yamnaya people of northeastern Kazakhstan, and certain groups of the Baikal area is a mixture of two components—the larger Ancient North Eurasian (ANE) and the smaller Ancient East Asian (AEA) (Damgaard et al., 2018).

The former component, which was recently discovered, is present in the Malta boy, who is genetically close to the Afontova Gora II male (Raghavan et al., 2014), whereas among modern groups, those closest to the Upper Paleolithic individuals are Native Americans, Chukchi, Koryaks, Kets, and Selkups (Flegontov et al., 2016). The proportion of ANE in Native Americans amounts to 30–40 %. Kets could have inherited it from Okunevans in their Altai-Sayan homeland (Ibid.). Cranially, the Okunev (or "Americanoid") tendency is the most distinct in Khakassians of the Sagay clan, who live in the same territory where Okunevans had lived before them (Kozintsev, 2004). Likewise high (about 50 %) is the proportion of ANE in Caucasoids, including the Yamnaya people, who inherited it from their ancestors—the so-called Eastern Hunter-Gatherers. These are represented by two bone samples dating to the mid-sixth millennium BC—one from the Mesolithic cemetery on the Yuzhny Oleny Island in Karelia, the other from a sub-Neolithic site Lebyazhinka IV in the Middle Volga basin, associated with the Elshanka culture (Haak et al., 2015).

As the geography and chronology of the ANE component show, it is misleading to describe it as Western Eurasian and associate it solely with ancient Caucasoids. To all appearances, it emerged before the Caucasoid-Mongoloid split. It was absent in Central and Western Europe before the Yamnaya expansion (Flegontov et al., 2016). The observed pattern likely suggests that the remote ancestors of the Yamnaya people had migrated from the east, whereas the Yamnaya-Afanasyevo migrations to the east occurred later. The second largest component of the Okunev gene pool—AEA (it can be described as Mongoloid in traditional terms)—was associated with Early Neolithic (Kitoy) population of the Baikal area.

As to the male genetic legacy of Okunevans, in 14 cases out of 16 (87.5 %) the Y-chromosome subclades belong to the eastern haplogroups Q1 and NO1. The former haplogroup, like the autosomal part of the gene pool, links Okunevans with Native Americans. In two instances (12.5 %) subclades of the western haplogroup R1b were found, possibly indicating Yamnaya and/or Afanasyevo affinities, but present also in their likely ancestor—the Elshanka individual from Lebyazhinka IV (Haak et al., 2015; Damgaard et al., 2018; Hollard et al., 2018). The variant detected in the Malta boy is close to the basal type of the R haplogroup (Raghavan et al., 2014). If the Yamnaya-Afanasyevo admixture (those populations are indistinguishable both genetically and cranially) is present in Okunevans, it can be estimated at ~16 %. This signal is not traceable on the X-chromosome, suggesting that the presumed admixture was male-derived (Damgaard et al., 2018). It could have been received from the Afanasyevans, whose cultural effect on the Okunev culture is beyond doubt (Ibid., Suppl.: 21). We had long ago described Okunevans as "Americanoids" with some Caucasoid admixture (Kozintsev, Gromov, Moiseyev, 1995: 77).

Neither craniometry nor genetics, then, gives any reason to think that the Okunev population emerged owing to a second migration from the Eastern European steppes in the Early Bronze Age. If the Afanasyevo admixture is indeed present, this hypothesis is redundant. However, there is a fact that the migrationists for some reason ignore: a small cranial series from the Chaa-Khol (i.e., Okunev-like) burials at the Aimyrlyg cemetery in Tuva, being strikingly different from the Okunev series of the Minusinsk Basin, is morphologically identical to certain Yamnaya and Catacomb series from Ukraine. We pointed to this fact in several publications (Kozintsev, 2008, 2009), including one specially addressing this issue (Kozintsev, Selezneva, 2015). But archaeologists are apparently as skeptical about these conclusions as about those regarding the affinities between the Minusinsk Okunevans and the Native Americans. All this prompts us to revisit the Okunev problem, the more so because the comparative database has been enlarged manifold over the recent years.

*The gene pool of the Catacomb people has so far been studied only in its least informative mitochondrial part.

Material and methods

Measurements of four male Okunev series were taken from Gromov's publication (1997). Neither the composition nor the names of these groups conform to the modern classification. In particular, the name "Uibat group" is used in the geographic sense, since this group includes all Okunev crania from the Uibat River valley, not only those dating to the early (Uibat) stage. In Gromov's dissertation (2002), the name "Uibat group" is used in the chronological sense, with regard to crania formerly included in the Tas-Khazaa group. However, Lazaretov (2019) recently separated the Tas-Khazaa stage from the Uibat stage, which he now believes to have been even earlier and which, so far, is not represented by craniometric data*. To avoid confusion, I will use the groups and the names that were used in Gromov's publication (1997).

The comparative database includes craniometric data on male series representing populations culturally related to Okunevans—Karakol, Chaa-Khol, Yelunino, Samus, Ust-Tartas, Odino, Krotovo; the Neolithic group from the Krasnoyarsk-Kansk forest-steppe, the Upper Ob (Ust-Isha and Itkul), and the Baraba forest-steppe, as well as measurements of 24 Yamnaya, 21 Catacomb, and 9 Afanasyevo series. Data on the Baraba groups were taken from T.A. Chikisheva's book (2012: 36–43, 69–72, 98–101) and her publication co-authored with D.V. Pozdnyakov (Chikisheva, Pozdnyakov, 2019). Sources of information about most other groups are indicated in my previous publication (Kozintsev, 2009). I used corrected data on Afanasyevo series (Solodovnikov, 2009). Measurements of crania from Yamnaya and Catacomb burials in the Stavropol area were taken from the publication by G.P. Romanova (1991); those relating to the Azov-Caspian steppes, from A.A. Kazarnitsky's monograph (2012: 38, 42–43, 47, 49–50, 58, 69, 77, 81, 91, 103); those relating to the Volgograd Region, from the article by M.A. Balabanova (2016); those relating to the Volga-Ural region, from the book by A.A. Khokhlov (2017: 241–242, 246–253, 267–268); and those relating to Ukraine, from the book by S.I. Kruts (2017: 64–66).

Data on 14 principal craniometric traits were elaborated using the multiple discriminant (canonical) analysis, and the Mahalanobis D^2 distances corrected for sample size were computed. The distance matrix was subjected to nonmetric multidimensional scaling and cluster analysis. The minimum spanning tree was computed, showing the shortest path between the points in the multivariate space. The software included B.A. Kozintsev's statistical package and Ø. Hammer's PAST package (Hammer, 2012)*.

Results

On the plane generated by two axes of nonmetric multidimensional scaling, two large clusters, tentatively called eastern and western, are visible (Fig. 1). The eastern cluster is subdivided into three subclusters: (1) Yeniseian, including the Okunev groups and the Neolithic group from the Krasnoyarsk-Kansk forest-steppe; (2) Altaian, including the Neolithic series from the Upper Ob (Ust-Isha and Itkul), and Karakol; (3) Barabian, including the Neolithic group from the Baraba forest-steppe and seven Bronze Age (mostly pre-Andronovo) series from the same region. The structure of the Yeniseian and Barabian subclusters is rather indistinct. Within the Yeniseian cluster, the Neolithic group is not opposed to Okunev groups, but joins one of them—Verkh-Askiz. Within the Barabian cluster, the Neolithic group is opposed to others, but these are arranged without visible correspondence to cultures or stages. The western cluster consists of two subclusters, one including only two groups—Chaa-Khol and Yelunino, the other comprising 54 Yamnaya, Afanasyevo, and Catacomb groups arranged in a random order, indicating close relationship between those three populations.

Edges of the minimum spanning tree, making up a bridge between the eastern and the western cluster, connect the Odino group from Tartas-1 with Samus, and the latter with the Catacomb series from the Stavropol Region. The connection is due to the intermediacy of Samus. Its characteristics, however, are very inaccurate, because it consists of the few male crania, to which female ones have been added after transforming their parameters into male counterparts, using the coefficients of sexual dimorphism. The unreliability of this method is aggravated by the fact that males and females in such cases can represent two different populations—immigrant and native, respectively. Another group, which may be regarded as potentially intermediate, is Yelunino, which falls into the western cluster; in addition, female crania from that group look markedly more Mongoloid than male ones (Solodovnikov, Tur, 2003).

As to Okunev groups, two of them—Uibat (in the geographic sense) and Tas-Khazaa—are very close, and both are somewhat shifted toward the western cluster (this especially concerns the latter group). The same applies

*There are only unpublished nonmetric data, which sharply oppose crania of the Uibat stage not merely from other Okunev groups but also from the Yamnaya and Catacomb series. In the light of these data, the idea of Late Yamnaya and Catacomb migration to Siberia appears implausible (I thank Andrey Gromov for this information).

*Version 2.17 was used because in later versions the path between the points is constructed on the plane rather in the original multivariate space.

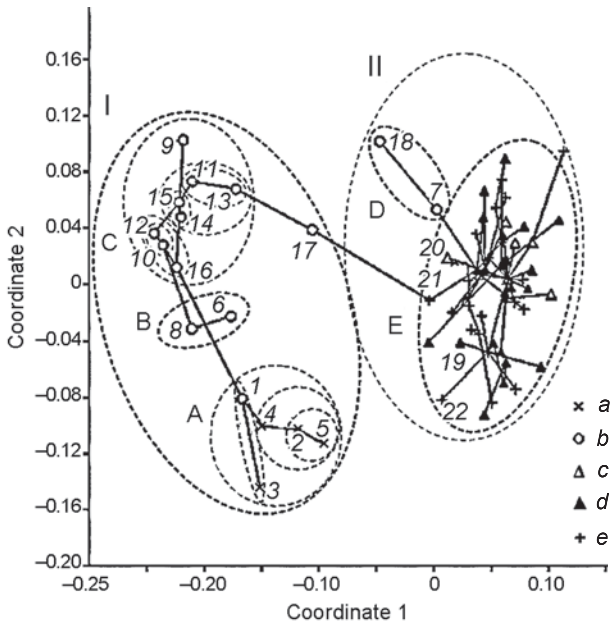

Fig. 1. The position of male cranial series in the space generated by two axes of the nonmetric multidimensional scaling of the corrected Mahalanobis D^2 distance matrix.

Straight lines are edges of the minimum spanning tree showing the shortest path between points in the original multivariate space. Dashed contours delineate clusters (I – eastern, II – western) and subclusters (A – Yeniseian, B – Altaian, C – Barabian, D – Chaa-Khol-Yelunino, E – Yamnaya-Catacomb-Afanasyevo).

a – Okunev series; *b* – other Siberian series except Afanasyevo; *c* – Afanasyevo; *d* – Yamnaya; *e* – Catacomb. *1* – Neolithic group from the Krasnoyarsk-Kansk forest-steppe; *2–5* – Okunev groups: *2* – Uibat (in the geographic sense), *3* – Verkh-Askiz I, *4* – Chernovaya IV, VI, and VIII, *5* – Tas-Khazaa; *6* – Karakol; *7* – Chaa-Khol; *8* – Neolithic of the Upper Ob basin (Ust-Isha and Itkul); *9* – Neolithic of the Baraba forest-steppe; *10*, *11* – Ust-Tartas: *10* – Sopka-2/3, *11* – Sopka-2/3A; *12–14* – Odino: *12* – Sopka-2/4A, *13* – Tartas-1, *14* – Preobrazhenka-6; *15*, *16* – Krotovo: *15* – Sopka-2/4B, C (classic), *16* – Sopka-2/5 (Late Krotovo – Cherno-Ozerye); *17* – Samus; *18* – Yelunino; *19–22* – Yamnaya and Catacomb groups least removed from Okunev and Chaa-Khol: *19* – Yamnaya of the Stavropol Region, *20* – Yamnaya of the Ingulets area, *21* – Catacomb of the Stavropol Region, *22* – Late Catacomb of the Kherson Region.

to the entire Yeniseian subcluster, toward which the Yamnaya-Afanasyevo-Catacomb subcluster, too, shows a slight inclination.

Let us address the ties of separate Okunev groups and of those culturally most related to Okunev. Each of Fig. 2–7 shows ten groups closest to the respective group, ranked in the increasing order of D^2 values. We will speak of closeness, resemblance, or similarity if D^2 is less than 5. All distances between Okunev groups meet this condition.

Uibat (in the geographic sense) (Fig. 2). Apart from Okunev groups, it resembles Neolithic groups from the Krasnoyarsk-Kansk forest-steppe and from the Upper Ob (Ust-Isha and Itkul). Three of the five remaining series belong to the eastern cluster, and two to the western cluster.

Verkh-Askiz (Fig. 3). Its closest parallel is the Neolithic series from the Krasnoyarsk-Kansk forest-steppe. None of the other groups, except those associated with Okunev culture, are similar to it. Five of the remaining six groups fall into the eastern cluster, and one into the western cluster.

Chernovaya (Fig. 4). Apart from Okunev series, it resembles Neolithic groups from the Krasnoyarsk-Kansk forest-steppe and from the Upper Ob. Four of the remaining five groups belong to the eastern cluster, and one to the western cluster.

Tas-Khazaa (Fig. 5). Apart from the Okunev groups, it is close only to the Neolithic group from the Krasnoyarsk-Kansk forest-steppe. Among the remaining six series, two belong to the eastern cluster, and four (two Yamnaya and two Catacomb) to the western cluster.

Karakol (Fig. 6). It is similar only to the Neolithic group from the Upper Ob. Three of the remaining nine series are Okunev, and six others are members of the eastern cluster too.

Chaa-Khol (Fig. 7). What we observe here is radically different from anything that we saw before. All ten most similar groups belong to the western cluster, and all are extremely close to Chaa-Khol. The list can be extended, and the use of the reduced trait battery shows that parallels include Western European groups representing the Funnel Beaker population and those associated with the Globular Amphora culture (Kozintsev, Selezneva, 2015). At the same time, there are no indications of especially strong ties between Chaa-Khol and Afanasyevo: the closest groups represent the Yamnaya and Early Catacomb culture of Ukraine, and generally eight of the ten groups most similar to Chaa-Khol belong to Yamnaya and Catacomb populations (17.8 %), whereas one is Afanasyevo (11.1 %). There are even fewer grounds to speak of affinities between Chaa-Khol and the populations of southwestern Central Asia, contrary to what earlier authors believed.

Does any of the Okunev series display real similarity to Yamnaya, Catacomb, or Afanasyevo groups? The question emerges primarily with regard to the Tas-Khazaa group—the earliest available (see Fig. 1, 5). Apart from its similarity to three other Okunev groups, it is close to one more member of the eastern cluster—the Neolithic series from the Krasnoyarsk-Kansk area. If all the first ten groups are considered, then, apart from Okunev groups, there are three of the 12 "eastern" series (every fourth) against four "western" out of 54 members of the Yamnaya-Catacomb-Afanasyevo subcluster (7.4 %), and taking into consideration only the 45 Yamnaya and Catacomb series, 8.9 %, i.e., every tenth at best. The difference is admittedly insignificant, but its direction is opposite to what one might expect according to the hypothesis that Early Okunev males resemble the

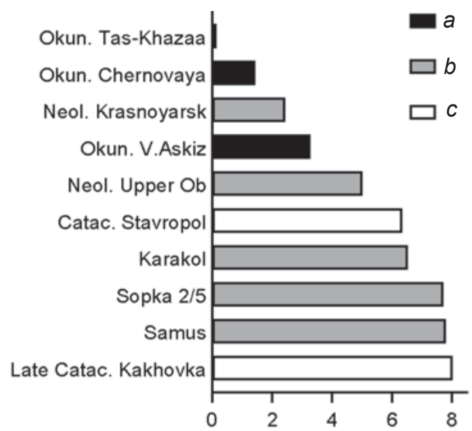

Fig. 2. Groups closest to Uibat (in the geographic sense) (the actual corrected distance from Tas-Khazaa is negative, i.e. the uncorrected distance is less than its error).
a – Okunev groups; *b* – other Siberian groups; *c* – Catacomb groups.

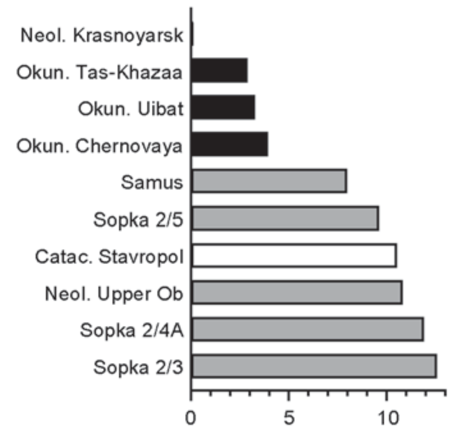

Fig. 3. Groups closest to Verkh-Askiz (the actual corrected distance from the Neolithic group of the Krasnoyarsk-Kansk forest-steppe is negative).
See Fig. 2 for conventions.

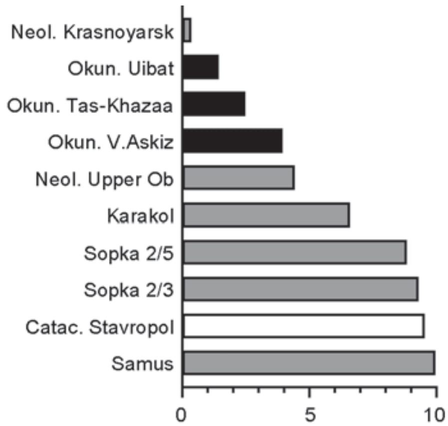

Fig. 4. Groups closest to Chernovaya.
See Fig. 2 for conventions.

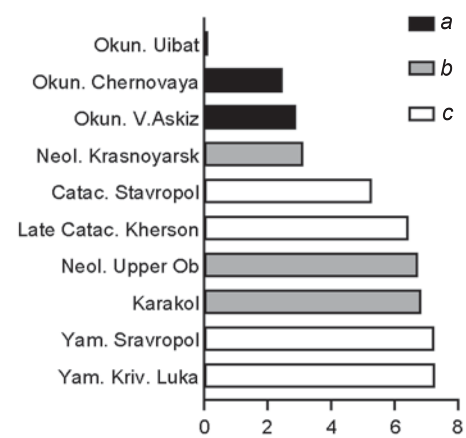

Fig. 5. Groups closest to Tas-Khazaa. See Fig. 2 for conventions.
a – Okunev groups; *b* – other Siberian groups; *c* – Yamnaya and Catacomb groups.

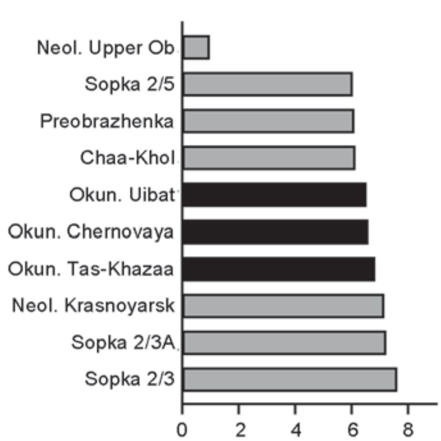

Fig. 6. Groups closest to Karakol.
See Fig. 2 for conventions.

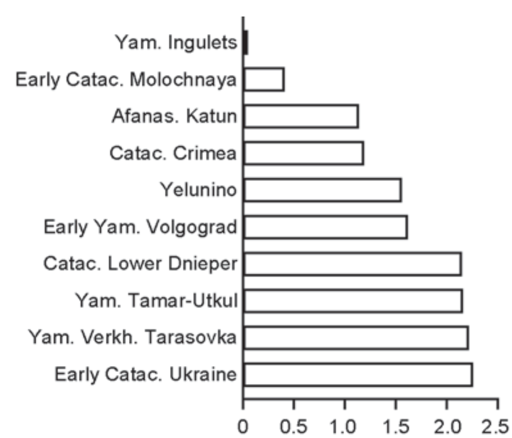

Fig. 7. Groups closest to Chaa-Khol (Aimyrlyg) (the actual corrected distance from the Yamnaya group of the Ingulets area is negative).

Yamnaya and Catacomb people rather than the Neolithic people of Siberia and their descendants—and this despite the fact that Tas-Khazaa is the earliest and the most "western looking" of the available Okunev groups.

The situation with the Uibat group (in the geographic sense), which also displays a slight "western" tendency, is even clearer (see Fig. 1, 2). Apart from the Okunev groups, it resembles two more "eastern" series, and if more distant ones from the first ten are considered, five "eastern" ones (41.7 %), but only two of the Yamnaya-Catacomb-Afanasyevo cluster (3.7 %). According to Fisher's exact test, the likelihood that the difference is incidental equals 0.0015, so it can be stated with certainty that Okunevans of the Uibat River valley were cranially closer to Siberian natives than to actual or presumed migrants from the Eastern European steppes. There is no need to discuss two remaining Okunev series—their autochthonous origin is evident and does not require statistical proof. Given these results, based on the entire combination of traits, references to isolated traits such as brachycrany are unconvincing.

Turning to the western cluster, a somewhat specific position of the Catacomb group from the Stavropol Region should be noted, since it seems to display some "eastern" and, respectively, "Okunev" tendency (see Fig. 1–5). This tendency, however, is slight, and there is no resemblance to Okunev groups in the sense outlined above.

Discussion

The findings of this study lend no support to the belief that admixture played a critical role in the origin of the Okunev population. Instead, they agree with the idea that the autochthonous component was predominant and very ancient in that region (Chikisheva, 2012: 88, 123, 180). The key factor affecting the differentiation of native populations falling into the eastern cluster was geographic. Within each of the three eastern subclusters—Yeniseian, Altaian, and Barabian—the Early Bronze Age populations appear to have been directly descended from their local Neolithic predecessors: Okunevans from the Krasnoyarsk-Kansk people; those associated with the Karakol tradition, from people of Ust-Isha and Itkul; and representatives of all cultures and stages at Sopka and their relatives in Baraba, too, had Neolithic ancestors in the same region. Group differentiation must have been caused mostly by random processes, and the effect of migrations was minimal. The search for "racial components" allegedly introduced from without (see, e.g., (Solodovnikov, 2007)) has proved futile in nearly all instances. There are two exceptions—Samus, known from very inaccurate data (see above), and Yelunino.

Okunevans appear to be full-fledged Siberian autochthons, supporting Gromov's principal conclusion. The Uibat (in the geographic sense) and especially the Tas-Khazaa group display a slight "western" tendency, and the same applies to the whole Yeniseian subcluster as compared to the Altaian and Barabian subclusters. This could well be due to the Yamnaya-Afanasyevo admixture (Damgaard et al., 2018). There are reasons, however, to ascribe this tendency, not so much to the comparatively late (Early Bronze Age) migration from the Eastern European steppes as to much earlier events of the population history.

Indeed, given the affinities of Okunevans with Native Americans (see above), the observed facts are seen in an entirely different light. A number of Native American groups display "quasi-Caucasoid" facial features (Vasilyev et al., 2015: 315–319). Although cranial characteristics of Upper Paleolithic Siberians are unknown, genetic evidence suggests that what we observe in this case is a very ancient legacy. To all appearances, the ANE component, which was abundant in Upper Paleolithic populations of southern Siberia, spread in both directions—eastwards, toward the New World, and westwards, toward Europe. It reached America as early as the Upper Paleolithic, and Eastern Europe no later than the Mesolithic.

The "western" cranial tendency is present in the easternmost of the three eastern subclusters (Yeniseian), whose members, in addition, show an eastern, in fact an "American", shift in their genetic makeup. It can be concluded that the Afanasyevo admixture, even if present, was not the major factor behind the observed pattern, and it is even less likely that the reason was a second pre-Andronovo migration from the Eastern European steppes, although cultural influences from that territory are quite possible.

A marked craniometric similarity between Okunevans and the Neolithic people of the Krasnoyarsk-Kansk forest-steppe is highly relevant to that issue. Everyone who invokes the migratory factor while discussing Okunev origins must adhere to logic and assume the same with regard to this Neolithic group, and such an assumption is arguably wrong. As concerns pre-Andronovo migrations to southern Siberia in the Early Bronze Age, only one of them is beyond doubt—one that gave rise to Afanasyevo. On that scale, Afanasyevans are virtually indistinguishable from Yamnaya or Catacomb people. If, on the other hand, we postulate a second migration, then its most likely representatives would be the Chaa-Khol people of Tuva. However, they could as well be descendants of Afanasyevans. Being very similar to people of Yamnaya, Catacomb, and Afanasyevo cultures, the Chaa-Khol people still cluster not with them, but with the Yelunino people, whose eastern tendency is accentuated by the fact that Yelunino females are markedly more Mongoloid than males.

Conclusions

1. The Okunevans of the Minusinsk Basin should be regarded as southern Siberian autochthons—descendants of the Neolithic and evidently Upper Paleolithic population of that region. Afanasyevo admixture is quite probable, but the hypothesis that the Yamnaya-Catacomb migration had played a considerable role in the origin of the Okunev population is not supported.

2. Cranially, the idea of migration is contradicted by a close similarity between Okunevans and the Neolithic population of the Krasnoyarsk-Kansk forest-steppe and by their specifically "Americanoid" tendency.

3. Genetically, this idea is disproved by the "Americanoid" characteristics of the Okunev gene pool and by the affinities between Okunevans and the Upper Paleolithic people of southern Siberia—the ancestors of Native Americans.

4. If a second pre-Andronovo migration from the Eastern European steppes to southern Siberia took place, then its most likely representatives are people associated with the Okunev-type (Chaa-Khol) culture of Tuva and the Yelunino people.

References

Allentoft M.E., Sikora M., Sjögren K.-G., Rasmussen M., Stenderup J., Damgaard P.B., Schroeder H., Ahlström T., Vinner L., Malaspinas A.-S., Margaryan A., Higham T., Chivall D., Lynnerup N., Harvig L., Baron J., Della Casa P., Dąbrowski P., Duffy P.R., Ebel A.V., Epimakhov A., Frei K., Furmanek M., Gralak T., Gromov A., Gronkiewicz S., Grupe G., Hajdu T., Jarycz R., Khartanovich V., Khokhlov A., Kiss V., Kolář J., Kriiska A., Lasak I., Longhi C., McGlynn G., Merkevicius A., Merkyte I., Metspalu M., Mkrtchyan R., Moiseyev V., Paja L., Pálfi G., Pokutta D., Pospieszny L., Price T.D., Saag L., Sablin M., Shishlina N., Smrčka V., Soenov V., Szeverényi V., Tóth G., Trifanova S.V., Varul L., Vicze M., Yepiskoposyan L., Zhitenev V., Orlando L., Sicheritz-Pontén T., Brunak S., Nielsen R., Kristiansen K., Willerslev E. 2015

Population genomics of Bronze Age Eurasia. *Nature*, vol. 522 (7555): 167–172.

Balabanova M.A. 2016

K antropologii naseleniya eneolita – rannei bronzy (po materialam mogilnikov Volgogradskoi oblasti). *Nizhnevolzhskiy arkheologicheskiy vestnik*, vol. 15 (1): 72–94.

Balanovsky O.P. 2015

Genofond Evropy. Moscow: Tovarishchestvo nauch. izd. KMK.

Chikisheva T.A. 2012

Dinamika antropologicheskoi differentsiatsii naseleniya yuga Zapadnoi Sibiri v epokhi neolita – rannego zheleza. Novosibirsk: Izd. IAET SO RAN.

Chikisheva T.A., Pozdnyakov D.V. 2019

The Physical Anthropology of the Odino People, Western Siberia. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 47 (4): 128–139.

Damgaard P.B., Martiniano R., Kamm J., Moreno-Mayar J.V., Kroonen G., Peyrot M., Barjamovic G., Rasmussen S., Zacho C., Baimukhanov N., Zaibert V., Merz V., Biddanda A., Merz I., Loman V., Evdokimov V., Usmanova E., Hemphill B., Seguin-Orlando A., Eylem Yediay F., Ullah I., Sjögren K.-G., Højholt Iversen K., Choin J., de la Fuente C., Ilardo M., Schroeder H., Moiseyev V., Gromov A., Polyakov A., Omura S., Yücel Senyurt S., Ahmad H., McKenzie C., Margaryan A., Hameed A., Samad A., Gul N., Hassan Khokhar M., Goriunova O.I., Bazaliiskii V.I., Novembre J., Weber A.W., Orlando L., Allentoft M.E., Nielsen R., Kristiansen K., Sikora M., Outram A.K., Durbin R., Willerslev E. 2018

The first horse herders and the impact of Early Bronze Age steppe expansions into Asia. *Science*, vol. 360 (6396). URL: https://science.sciencemag.org/content/360/6396/eaar7711

Flegontov P., Changmai P., Zidkova A., Logacheva M.D., Altinisik N.E., Flegontova O., Gelfand M.S., Gerasimov E.S., Khrameeva E.E., Konovalova O.P., Neretina T., Nikolsky Y.V., Starostin G., Stepanova V.V., Travinsky I.V., Tříska M., Tříska P., Tatarinova T.V. 2016

Genomic study of the Ket: A Paleo-Eskimo-related ethnic group with significant Ancient North Eurasian ancestry. *Scientific Reports*, vol. 6, article No. 20768. URL: https://doi.org.10.1038/srep20768

Formozov A.A. 1969

Ocherki po pervobytnomu iskusstvu. Moscow: Nauka. (MIA; vol. 165).

Fu Q., Li H., Moorjani P., Jay F., Slepchenko S.M., Bondarev A.A., Johnson P.L.F., Aximu-Petri A., Prüfer K., de Filippo C., Meyer M., Zwyns N., Salazar-García D.C., Kuzmin Y.V., Keates S.G., Kosintsev P.A., Razhev D.I., Richards M.P., Peristov N.V., Lachmann M., Douka K., Higham T.F.G., Slatkin M., Hublin J.-J., Reich D., Kelso J., Viola T.B., Pääbo S. 2014

Genome sequence of a 45,000-year-old modern human from Western Siberia. *Nature*, vol. 514 (7523): 445–449.

Gromov A.V. 1997

Proiskhozhdeniye i svyazi naseleniya okunevskoi kultury. In *Okunevskiy sbornik*. St. Petersburg: Petro-RIF, pp. 301–358.

Gromov A.V. 1998

K voprosu ob iskusstvennoi deformatsii cherepov okunevskoi kultury. In *Sibir v panorame tysyacheletiy*, vol. 1. Novosibirsk: Izd. IAET SO RAN, pp. 147–156.

Gromov A.V. 2002

Antropologiya naseleniya okunevskoi kultury (epokha bronzy). Cand. Sc. (History) Dissertation. St. Petersburg.

Haak W., Lazaridis I., Patterson N., Rohland N., Mallick S., Llamas B., Brandt G., Nordenfelt S., Harney E., Stewardson K., Fu Q., Mittnik A., Bánffy E., Economou C., Francken M., Friederich S., Garrido Pena R., Hallgren F., Khartanovich V., Khokhlov A., Kunst M., Kuznetsov P., Meller H.,

Mochalov O., Moiseyev V., Nicklisch N., Pichler S.L., Risch R., Rojo Guerra M.A., Toth C., Széczényi-Nagy A., Wahl J., Meyer M., Krause J., Brown D., Anthony D., Cooper A., Alt K.W., Reich D. 2015
Massive migration from the steppe was a source for Indo-European languages in Europe. *Nature*, vol. 522 (7555): 207–211.

Hammer Ø. 2012
PAST – Paleontological Statistics. Oslo: Univ. of Oslo. URL: https://folk.uio.no/ohammer/past/index_old.html

Hollard C., Zvénigorodsky V., Kovalev A., Kiryushin Y., Tishkin A., Lazaretov I., Crubézy E., Ludes B., Keyser C. 2018
New genetic evidence of affinities and discontinuities between Bronze Age Siberian populations. *American Journal of Physical Anthropology*, vol. 167 (1): 97–107.

Kazarnitsky A.A. 2012
Naseleniye azovo-kaspiyskikh stepei v epokhu bronzy (antropologicheskiy ocherk). St. Petersburg: Nauka.

Khokhlov A.A. 2017
Morfogeneticheskiye protsessy v Volgo-Urale v epokhu rannego golotsena (po kraniologicheskim materialam mezolita – bronzovogo veka). Samara: Izd. Samar. Gos. Sots.-Ped. Univ.

Kim A.M., Kozintsev A.G., Moiseyev V.G., Rohland N., Mallick S., Reich D.E. 2018
Native American relatives in Bronze Age southern Siberia? Okunev Culture and the new dialogue of genome-wide ancient DNA and physical anthropology. *American Journal of Physical Anthropology*, vol. 165, suppl. 66: 139.

Kozintsev A.G. 1976
Naseleniye Minusinskogo kraya epokhi bronzy i ego rol v formirovanii antropologicheskogo sostava narodov Zapadnoi Sibiri. *Voprosy antropologii*, No. 54: 180–189.

Kozintsev A.G. 2004
Kety, uraltsy, "amerikanoidy": Integratsiya kraniometricheskikh i kranioskopicheskikh dannykh. In *Paleoantropologiya, etnicheskaya antropologiya, etnogenez: K 75-letiyu Ilyi Iosifovicha Gokhmana*. St. Petersburg: MAE RAN, pp. 172–185.

Kozintsev A.G. 2008
The "Mediterraneans" of Southern Siberia and Kazakhstan, Indo-European migrations, and the origin of the Scythians: A multivariate craniometric analysis. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 36 (4): 140–144.

Kozintsev A.G. 2009
Craniometric evidence of the Early Caucasoid migrations to Siberia and Eastern Central Asia, with reference to the Indo-European problem. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 37 (4): 125–136.

Kozintsev A.G., Gromov A.V., Moiseyev V.G. 1995
Amerikanoidy na Yenisee? (Antropologicheskiye paralleli odnoi gipoteze). In *Problemy izucheniya okunevskoi kultury: Tezisy dokl. konf.* St. Petersburg: MAE RAN, pp. 74–77.

Kozintsev A.G., Gromov A.V., Moiseyev V.G. 1999
Collateral relatives of American Indians among the Bronze Age populations of Siberia? *American Journal of Physical Anthropology*, vol. 108 (2): 193–204.

Kozintsev A.G., Gromov A.V., Moiseyev V.G. 2003
New evidence on the possible collateral relatives of American Indians in Bronze Age Siberia. *Archaeology, Ethnology and Anthropology of Eurasia*, No. 3 (15): 149–154.

Kozintsev A.G., Selezneva V.I. 2015
Vtoraya volna migratsii evropeoidov v Yuzhnuyu Sibir i Tsentralnuyu Aziyu. In *Radlovskiy sbornik: Nauchnye issledovaniya i muzeinye proekty MAE RAN v 2014 g.* St. Petersburg: MAE RAN, pp. 51–62.

Kruts S.I. 2017
Skify stepei Ukrainy po antropologicheskim dannym. Kiev, Berlin: Izdatel Oleg Filyuk. (Kurgany Ukrainy; vol. 5).

Lazaretov I.P. 1997
Okunevskiye mogilniki v doline r. Uibat. In *Okunevskiy sbornik*. St. Petersburg: Petro-RIF, pp. 19–64.

Lazaretov I.P. 2019
Khronologiya i periodizatsiya okunevskoi kultury: Sovremennoye sostoyaniye i perspektivy. *Teoriya i praktika arkheologicheskikh issledovaniy*, No. 4: 15–50.

Lazaretov I.P., Polyakov A.V. 2018
Issledovaniya mogilnika Uibat-Charkov i novye dannye o rannem etape razvitiya okunevskoi kultury. *Teoriya i praktika arkheologicheskikh issledovaniy*, No. 3: 41–69.

Lazaretov I.P., Polyakov A.V., Esin Y.N., Lazaretova N.I. 2012
Novye dannye po formirovaniyu okunevskogo kulturnogo fenomena. In *Istoriko-kulturnoye naslediye i dukhovnye tsennosti Rossii*. Moscow: ROSSPEN, pp. 130–136.

Lipsky A.N. 1969
Amerikanoidy na Yenisee. In *Proiskhozhdeniye aborigenov Sibiri i ikh yazykov*. Tomsk: Izd. Tom. Gos. Univ., pp. 155–159.

Maksimenkov G.A. 1975
Okunevskaya kultura. D. Sc. (History) Dissertation. Novosibirsk.

Nelson G.C., Madimenos F.C. 2010
Obelionic cranial deformation in the Puebloan Southwest. *American Journal of Physical Anthropology*, vol. 143 (3): 465–472.

Polyakov A.V. 2017
Sovremennaya khronologiya pamyatnikov eneolita i epokhi bronzy Minusinskikh kotlovin. In *Petroglify Tsentralnoi Azii i Severnogo Kitaya*. Ulaanbaatar: Admon print, pp. 187–211.

Polyakov A.V. 2019
Obzor rezultatov nachalnogo etapa paleogeneticheskikh issledovaniy naseleniya epokhi bronzy Minusinskikh kotlovin. *Teoriya i praktika arkheologicheskikh issledovaniy*, No. 2: 91–108.

Polyakov A.V. 2020a
Pogrebeniya katakombnogo tipa v materialakh okunevskoi kultury. *Arkheologicheskiye vesti*, No. 26: 98–110.

Polyakov A.V. 2020b
Problema slozheniya okunevskoi kultury v svete sovremennykh nauchnykh dannykh. *Nauchnoye obozreniye Sayano-Altaya*, No. 1: 3–6.

Raghavan M., Skoglund P., Graf K.E., Metspalu M., Albrechtsen A., Moltke I., Rasmussen S., Stafford T.W., Orlando L., Metspalu E., Karmin M., Tambets K., Rootsi S., Mägi R., Campos P.F., Balanovska E., Balanovsky O.P., Khusnutdinova E., Litvinov S., Osipova L.P., Fedorova S.A., Voevoda M.I., DeGiorgio M., Sicheritz-Ponten T., Brunak S., Demeshchenko S., Kivisild T., Villems R., Nielsen R., Jakobsson M., Willerslev E. 2014
Upper Paleolithic Siberian genome reveals dual ancestry of Native Americans. *Nature*, vol. 505 (7481): 87–91.

Romanova G.P. 1991
Paleoantropologicheskiye materialy iz stepnykh rayonov Stavropolya epokhi rannei i srednei bronzy. *Sovetskaya arkheologiya*, No. 2: 160–170.
Sokolova L.A. 2009
Formirovaniye okunevskogo kulturnogo kompleksa. Cand. Sc. (History) Dissertation. St. Petersburg.
Solodovnikov K.N. 2007
K voprosu o roli evropeoidnogo komponenta v rasogeneze naseleniya Altae-Sayanskogo nagorya epokhi rannei i razvitoi bronzy. In *Altae-Sayanskaya gornaya strana i istoriya osvoeniya ee kochevnikami*. Barnaul: Izd. Alt. Gos. Univ., pp. 145–150.
Solodovnikov K.N. 2009
Antropologicheskiye materialy afanasyevskoi kultury: K probleme proiskhozhdeniya. *Vestnik antropologii*, No. 17: 117–135.
Solodovnikov K.N., Tur S.S. 2003
Kraniologicheskiye materialy eluninskoi kultury epokhi rannei bronzy Verkhnego Priobya. In *Kiryushin Y.F., Grushin S.P., Tishkin A.A. Pogrebalnyi obryad naseleniya epokhi rannei bronzy Verkhnego Priobya (po materialam gruntovogo mogilnika Teleutskiy Vzvoz I)*. Barnaul: Izd. Alt. Gos. Univ., pp. 142–176.
Vadetskaya E.B., Leontyev N.V., Maksimenkov G.A. 1980
Pamyatniki okunevskoi kultury. Leningrad: Nauka.
Vasilyev S.A., Berezkin Y.E., Kozintsev A.G., Peiros I.I., Slobodin S.B., Tabarev A.V. 2015
Zaseleniye chelovekom Novogo Sveta: Opyt kompleksnogo issledovaniya. St. Petersburg: Nestor-Istoriya.
Zacho C.G. 2016
Population Genomics of the Bronze Age Okunevo Culture: Master Thesis. Copenhagen: Univ. of Copenhagen.

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A.S. Pilipenko[1], R.O. Trapezov[1], S.V. Cherdantsev[1], I.V. Pilipenko[1], A.A. Zhuravlev[1], M.S. Pristyazhnyuk[1], and V.I. Molodin[2, 3]

*[1]Institute of Cytology and Genetics,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 10, Novosibirsk, 630090, Russia
E-mail: alexpil@bionet.nsc.ru; Rostislav@bionet.nsc.ru;
stephancherd@gmail.com; pilipenkoiv@bionet.nsc.ru; tos3550@mail.ru; mprist@list.ru
[2]Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: molodin@archaeology.nsc.ru
[3]Novosibirsk State University,
Pirogova 1, Novosibirsk, 630090, Russia*

The Paleogenetic Study of Bertek-33, an Afanasyevo Cemetery on the Ukok Plateau, the Altai Mountains

We present the results of a paleogenetic analysis of bone samples representing seven adult individuals from Bertek-33—an Afanasyevo cemetery on the Ukok plateau, in the Altai Republic, Russia. The findings are interpreted with reference to archaeological and anthropological data. Four systems of genetic markers were analyzed: mitochondrial DNA, polymorphic fragment of the amelogenin gene, autosomal STR-loci, and Y-chromosomal STR-loci. Genetic results indicate the dominance of Western Eurasian mtDNA haplogroups (T, J, U5a, K, H) and the homogeneity of the male gene-pool represented by variants of the Y-chromosomal haplogroup R1b. Data on mtDNA, Y-chromosome, and individual autosomal markers attest to the Western Eurasian affinities of this group. The sample falls within the mtDNA and Y-chromosomal diversity of the Afanasyevo population of southern Siberia. Possible kinship between the individuals buried at Bertek-33 is discussed. Also, we address theoretical issues such as the accuracy of comparisons and the interpretation of genetic data with regard to cultural features.

Keywords: *Paleogenetics, Afanasyevo culture, mitochondrial DNA, Y-chromosome, Altai Mountains, Bronze Age.*

Introduction

The cemetery of Bertek-33 is situated on the left-bank side of the Bertek valley, at the first terrace of the Ak-Alakha River, at the Ukok plateau (the Altai Mountains, Russia) (Fig. 1). Five kurgans were studied at the site by the Western Siberian unit of the North Asian Joint Expedition of the IAET SB RAS. Four of these kurgans had been excavated in 1991 under supervision of D.G. Savinov (1994a, b), while the fifth was studied later by V.I. Molodin. Kurgans 1–3 formed a compact chain, joining one another, and thus were excavated as a single unit (Fig. 2). Kurgan 4 was situated just a few meters from the first three mounds, forming a part of the same chain, while kurgan 5 was also very close to the others. Therefore, all the five objects were further treated as

Fig. 1. Location of the Bertek-33 site.

one burial site, Bertek-33. The grave-goods and burial customs observed in kurgans 1–4 were clearly typical of the Afanasyevo culture (Ibid.). The cultural affiliation of kurgan 5 could not be determined from the same indicators because of the substantial destruction of the complex by the water from the river, but it was tentatively assigned to the same archaeological culture. Thus, the skeletal individuals from kurgans 1–5 of Bertek-33 are considered as a single sample of the people of the Afanasyevo culture from southern Altai (Chikisheva, 1994, 2012: 66).

The remains of 8 adult individuals and an infant (fragmentary) were found in the kurgans. Kurgans 1, 3, and 4 yielded single burials; kurgan 2 contained burials of two adults and an infant; and kurgan 5, a collective burial of three adult individuals (Fig. 3, 4).

This paper outlines the results of a molecular genetic study of seven adult individuals from kurgans 2–5 at Bertek-33 (Table 1). On the basis

Fig. 2. Bertek-33 in the process of excavation.

Fig. 3. Burial in kurgan 3.

Fig. 4. Collective burial in kurgan 2.

Table 1. **Description of the skeletal sample and the results of the analysis of the mtDNA structure**

Number of individual	Location	Age at death*	Haplotype of the mtDNA HVR I region	Haplogroup (subgroup) of mtDNA
1	Kurgan 2, burial 1, skeleton 1	20–25	16126C-16294T-16296T	T
2	Ditto, skeleton 2	25–28	16069T-16126C-16145A-16172C-16222T-16261T	J (J1b1a1)
3	Kurgan 3, burial 1	25–30	16224C-16291T-16311C-16362C	K
4	Kurgan 4, burial 1	Senilis	16362C	H
5	Kurgan 5, burial 1, skeleton 1	25–30	16256T-16270T	U5a
6	Ditto, skeleton 2	40–45	16256T-16270T	U5a
7	Ditto, skeleton 3	50–60	16126C-16163G-16186T-16189C-16294T	T1

*After (Chikisheva, 2012: 209, 213).

of the results obtained, a comparative analysis involving data on other local groups of the Afanasyevo people was carried out. We tested the correctness of assigning kurgan 5 to the Afanasyevo culture, and explored the kinship structure of the sample. It is of note that Bertek-33 is a completely excavated and studied archaeological complex representing a local Afanasyevo population, which was situated between groups of the same culture from the central part of the Altai Mountains (Vadetskaya, Polyakov, Stepanova, 2014) and its southern areas in North-Western Mongolia (Kovalev, Erdenebaatar, 2009).

Materials and methods

Samples for the molecular study were taken from the best-preserved (judging by macroscopic appearance) postcranial elements and teeth of the seven adult individuals from kurgans 2–5.

Preliminary treatment of the skeletal samples and DNA extraction. The methods applied in our previous publications were employed (Pilipenko, Trapezov, Zhuravlev et al., 2015; Pilipenko, Trapezov, Cherdantsev et al., 2018). In order to eliminate possible modern DNA contamination, the external surfaces of the samples were treated with 5 % sodium hypochlorite, and then irradiated with UV. The external bone layer (ca 1–2 mm thick) was mechanically removed, and then the sample was once again treated with UV. Fine bone powder was then drilled out from the cortical layer. The teeth were treated with 5 % sodium hypochlorite, mechanically cleared of external contaminants, irradiated with UV, and ground down using the vibration orbicular grinder Retsch MM200 (Germany).

Before DNA extraction, the bone powder (postcranial samples) was incubated in a 5M guanidine thiocyanate buffer at 65 ºC and constantly mixed during incubation. The teeth specimens were decalcified with 0.5M EDTA solution, followed by lysis with proteinase K. DNA extraction was performed employing a phenol/chloroform protocol, with subsequent sedimentation with isopropanol.

Analysis of genetic markers. Four systems of molecular genetic markers were analyzed: mtDNA (HVR I region), a fragment of an amelogenin gene (sex marker), highly variable autosomal STR-loci (universal markers of the degree of kinship), and STR-loci of the Y-chromosome—phylogenetically and phylogeographically informative markers of the male line of kinship (Pilipenko et al., 2017).

Amplification of the mtDNA HVR I region was performed using two different protocols: four short overlapping fragments using one-cycle PCR (Haak et al., 2005) and one long fragment using two-cycle nested PCR (Pilipenko et al., 2008). DNA sequencing was carried out with an ABI Prism BigDye Terminator Cycle Sequencing Ready Reaction Kit (Applied Biosystems, USA). Sequencing extracts were analyzed with an ABI Prism 3100XL Genetic Analyzer automatic capillary sequencer (Applied Biosystems, USA) at the SB RAS Genomics Core Facility (http://sequest.niboch.nsc.ru). The obtained results were interpreted using phylogenetic and phylogeographic analysis, as described earlier (Pilipenko, Trapezov, Polosmak, 2015).

Profiling of 15 autosomal STR-loci and analysis of the amelogenin gene region polymorphism was performed using the AmpFlSTR® Profiler® Plus PCR Amplification Kit (Applied Biosystems, USA), following the manufacturer's protocol. Profiles of 17 STR-loci of the Y-chromosome were determined using the commercial AmpFlSTR® Y-filer® PCR Amplification Kit (Applied Biosystems, USA), also following the manufacturer's protocol. Haplogroups of the STR-haplotypes of the Y-chromosome were determined using two freeware programs: Haplogroup predictor (http://www.hprg.com/hapest5/) and Vadim Yurasin's YPredictor 1.5.0 (http://predictor.ydna.ru).

Anti-contamination measures and verification of the results. All procedures with the skeletal specimens were carried out in a specially-equipped laboratory for molecular paleogenetics (Institute of Cytology and Genetics of the SB RAS, Novosibirsk, Russia). A description of the anti-contamination measures and verification of the results can be found in our previous publication (Pilipenko et al., 2018).

Results and discussion

Degree of DNA preservation. The climatic conditions of the Altai Mountains, including the Ukok plateau, are favorable for the preservation of ancient DNA in biological specimens from the archaeological sites of various historical periods (Pilipenko, Trapezov, Polosmak, 2015; Pilipenko et al., 2016). Our analysis has shown that the degree of DNA preservation in all the samples is predictably good; thus, a complete study of the structure of mtDNA could be performed. We successfully amplified mtDNA fragments of various lengths: from less than 150 to more than 300 base-pairs. The study of allele profiles of the Y-chromosome STR- and autosomal loci, though more sensitive to the degree of ancient DNA's preservation, was also possible and helped to reconstruct the genetic affinities of the individuals. These markers were best preserved for skeletons 3 and 4 (single burials in kurgans 3 and 4), where complete allele profiles of the 17 STR-loci of the Y-chromosome were obtained. Samples from the same individuals also produced almost complete allele profiles for the autosomal STR-loci: for 14 out of 15, excluding one locus with the longest PCR extract. The skeletons from a double burial in kurgan 2 (skeletons 1 and 2) and a collective burial in kurgan 3 (skeletons 5–7) displayed worse preservation of nuclear DNA, as was clear from the results of the analysis of the autosomal STR-loci allele profile: for only 8–12 out of 15 loci could their status be determined. It is of note that the reaction kit used for determining the Y-chromosome STR-loci profiles appeared to be less sensitive to the degree of DNA preservation as compared to the kit employed for the autosomal markers. Obviously, profiling of autosomal STR-loci alleles is the most objective indicator of the degree of nuclear DNA's preservation in skeletal remains.

Substantial variation in the degree of DNA preservation in skeletons from different complexes of the same site obstructs employing complete archaeological samples for molecular genetic analyses, which decreases the value of such analyses. This variation may occur for several reasons: degradation of remains before inhumation, differences in the construction of burial complexes across the site, and various effects from destructive environmental factors. In the case of Bertek-33, the relatively poor DNA preservation in all the skeletons from kurgan 5 was not unexpected by us, since by the time of excavation the kurgan had been severely damaged owing to repeated destruction of the mound by the river. Infiltration of water has led to the degradation of the remains and, consequently, of the ancient DNA they contained. Thus, only the teeth from the individuals from kurgan 5 were employed in the study, as the bone elements most resistant to the influence of environmental destruction.

Importantly, all the specimens demonstrated the features typical of ancient DNA: better preservation of mtDNA as compared to nuclear markers, and an inverse correlation between the efficiency of amplification and the length of DNA fragments. This additionally verifies the correctness of the results obtained.

Sex determination and verification of the results. Determination of the sex of skeletal individuals by molecular genetic methods is a necessary part of a genetic study irrespective of the presence (or absence) of determination done using macroscopic methods, since this latter approach often produces incorrect results (Sierp, Henneberg, 2015; Gonzalez et al., 2017). Our results have shown that six out of the seven individuals from Bertek-33 were male (Table 2).

The high reliability of the molecular genetic data obtained was confirmed on the basis of the following criteria: concordance between the results of independent analyses of polymorphism of the amelogenin gene and allele profile of the Y-chromosome (both analyses of the presence/absence of Y-chromosome markers were performed for all the skeletons); presence of several structural variants of the Y-chromosome that belong to the same phylogenetic cluster; uniqueness (at the scale of the sample) of the autosomal allele profiles of the individuals; great diversity of mtDNA variants; identity of the results with multiple repetitions of the analysis (for each of the skeletons the analysis was carried out using four DNA extracts obtained at different times during about a two year period); absence of overlap between the structure of the genetic markers of the individuals buried at Bertek-33 and employees of the paleogenetic lab; and the presence of specific features typical of degraded ancient DNA from skeletal remains (see above).

Diversity of individual variants of the Y-chromosome and mtDNA. Reliable data on the structure of mtDNA were obtained for all seven skeletal individuals: the mtDNA HVR I region was sequenced, haplotypes reconstructed, and the phylogenetic position of the variants determined (Table 2). In total, six structural variants of mtDNA were identified, while identical variants were only found in skeletons 5 and 6 from the collective burial in kurgan 5. The variants belong to five haplogroups of mtDNA: T (two variants belonging to different subgroups),

Table 2. **Results of the analysis of autosomal STR-loci, polymorphic fragment of the amelogenin gene and genetically determined sex of the deceased**

Number of individual	D8S1179	D21S11	D7S820	CSF1PO	D3S1358	THO1	D13S317	D16S539	D2S1338	D19S433	vWA	TPOX	D18S51	D5S818	FGA	Amelogenin	Sex
1	10/10	27/30	8/10	N/D	15/16	N/D	8/8*	N/D	N/D	13/13	15/18	N/D	N/D	12/13	N/D	XY	Male
2	12/12	28/28	11/11*	7**/11**	15/19**	7/7*	14/14	9**/12**	″	15/15	15/15	″	″	10/12	″	XY	″
3	10/14	28/31	9/10	11/11*	15/16	9.3/9.3	8/11	9?/13	″	14/14	18/18	9/12	14/14*	11/12	23/23*	XY	″
4	10/10	30/30	8/10	12/13	14/15	8/9**	8/12	13/14	″	13/14**	15/16	8/9	13/14	11/12	18/22	XY	″
5	12/12 (10 ?)	28/30	8/11	N/D (11/11 ?)	14/17	9.3/9.3	8/12	10/11	17/17*	14/19?	16/17	8/8*	N/D	12/14	21/32.2?	XX	Female
6	12/14	28/33.2	8/11?	N/D	15/17	8/9.3	12/15?	10/13	17/17*	14/16	17/18	8/8*	″	9/9*	N/D	XY	Male
7	13/14	31/31*	11/11*	″	16/18	8/9.3	8/8*	N/D	N/D	13/15	15/17	N/D	″	9/10	″	XY	″

*Presence of a longer allele variant, which was not possible to amplify owing to poor DNA preservation, is feasible in this specimen.
**The results for these alleles were not confirmed for all the four extracts.

Table 3. **Results of the analysis of the profile of Y-chromosome STR-loci in the specimens belonging to male individuals**

Number of individual	DYS19	DYS385a/b	DYS389I	DYS389II	DYS390	DYS391	DYS392	DYS393	DYS437	DYS438	DYS439	DYS448	DYS456	DYS458	DYS635	YGATAH4
1	14	11/14	13	29	23	11	13	12	15	N/D	13	19	16	16	23	13
2	14	11/14	13	29	25	11	13	12	15	12	13	19	16	16	23	12
3	14	11/14	13	29	24	11	13	12	15	12	13	19	16	16	23	13
4	14	11/14	13	29	23	11	13	12	15	12	13	19	16	16	23	13
6	14	11/14	13	29	24	11	N/D	12	15	12	13	19	16	16	23	13
7	14	11/14	13	N/D	N/D	11	″	12	15	N/D	N/D	N/D	16	16	N/D	13

J (one variant from the J1b1a1 subgroup), K and H (one variant of each), and U5a (one structural variant in two individuals). Thus, the phylogenetic diversity of mtDNA in the studied sample is substantial. An important result is that all the identified variants belong to the Western Eurasian cluster of mtDNA haplogroups.

Allele profiles of the Y-chromosome STR-loci were determined for the six male (based on molecular genetic data) individuals (Table 3). The number of STR-loci for which reliable data could be obtained varied: a full profile was reconstructed for three individuals (2–4), while for two (1 and 6) only alleles of 16 out of 17 analyzed loci could be determined. For skeleton 7, which yielded poorly preserved DNA, only 10 loci were identified. Despite the difference in the completeness of the allele profiles of the STR-loci, the phylogenetic affiliations of all the Y-chromosome variants could be determined with high probability (from 99.3 to 100 %), using the predictor-software. Unlike the mtDNA sample collection discussed above, the Y-chromosome sample is fairly uniform: all the variants belong to the same phylogenetic cluster—the R1b haplogroup. Moreover, the status of only two loci of the Y-chromosome among all the allele profiles was found to be variable: DYS390 and YGATAH4. The remaining 15 exhibit identical alleles in all the studied specimens (with allowance for the absence of data on some loci for some of the specimens). In five specimens with complete (or almost complete) allele profiles, not less than three different structural variants of the Y-chromosome belonging to the R1b haplogroup were identified: a unique (for this particular sample) variant in skeleton 2, and two variants in pairs of skeletons—1 and 4, 3 and 6.

Clearly, such a small group of individuals cannot be considered representative of the contemporaneous Afanasyevo population of the Altai Mountains (or even of part of it). Nevertheless, some common features are worth pointing out. First, the domination of Western Eurasian variants (though also variable) of mtDNA haplogroups. Second, the phylogenetic and, to a substantial degree, structural uniformity of variants of the Y-chromosome. No "genetically contrast", or outlying, individuals were identified.

Notably, no burial complexes from the Afanasyevo culture have yet been detected in the territory of the Altai Mountains and Mongolia neighboring the Ukok plateau. This fact emphasizes the value of the paleogenetic data obtained in our study for exploring the variation of the genetic structure of local groups from this culture. A comparative analysis involving the samples of the mtDNA and Y-chromosome specimens from Bertek-33 and other Afanasyevo sites from the Altai Mountains and Minusinsk Basin has been carried out. The analysis includes both previously published data (Allentoft et al., 2015; Hollard et al., 2018) and our unpublished results. This analysis has shown the overwhelming prevalence of Western Eurasian mtDNA haplogroups in all the population groups. Moreover, all the mtDNA haplogroups (and even identical mtDNA variants in some cases) detected in the sample from Bertek-33 had been previously found in specimens from other Afanasyevo sites in the Altai Mountains and Minusinsk Basin. It is of note, however, that the mtDNA variants identified in the specimens from Bertek-33, taken separately, are not specific to the Afanasyevo population only, but rather, quite widespread across Western Eurasia.

The similarity between the sample from Bertek-33 and other Afanasyevo sites is even stronger in terms of the composition of variants of the Y-chromosome: almost all of them belong to the R1b haplogroup. Its predominance is a unique feature of the Afanasyevo population of the region, which distinguishes it from other southern Siberian Bronze Age populations, as well as from later groups. Among contemporaneous Bronze Age populations outside southern Siberia whose Y-chromosome gene-pool has been studied to date, such a feature was observed in some local groups from the Yamnaya culture in Eastern Europe (Haak et al., 2015; Allentoft et al., 2015).

The similarity between the individuals from Bertek-33 and other local groups from the Afanasyevo culture is paralleled by observations made by physical anthropologists. According to the results of a craniometric study, the skulls from this burial site display similarity to the Afanasyevo cranial samples from the highlands of the southwestern and central areas of the Altai Mountains, and also to the easternmost Afanasyevo sample from Xinjiang (Chikisheva, 1994: 166). As regards the Y-chromosome and mtDNA data, we did not detect any genetic trace of admixture with the autochthonous population of this region. By "autochthonous" we mean the pre-Afanasyevo populations of Altai and the neighboring areas of southern Siberia and Central Asia, not connected genetically with the western part of Eurasia. Such an influence of the autochthonous groups, connected to the so-called southern Eurasian anthropological formation, on the Afanasyevo population from Bertek-33 had been previously detected in craniometric data (Chikisheva, 2012: 67). Notably, the most evident manifestations of this admixture were observed in the adult individual from kurgan 1, who was not analyzed in the present study.

There are other confirmations of the Western Eurasian vector of genetic connections of the Bertek-33 population, apart from the Y-chromosome and mtDNA data. A high frequency (more than 50 %) of the allele variant 9.3 of the THO1 STR-locus of the tyrosine hydroxylase 1 gene was observed in the sample. Such frequencies of this marker are typical of modern populations of the western part of Eurasia (Europe), while they are much rarer outside Europe (Brinkmann et al., 1996). Interestingly, this allele variant is considered by some scholars to be associated with longevity in European populations (Tan et al., 2002; Wurmb-Schwark et al., 2011). The high frequency of this marker is obviously one more independent piece of evidence supporting the Western Eurasian origin of the studied ancient population.

Thus, the studied sample from the Bertek-33 cemetery fits well into the range of intra-population mtDNA and Y-chromosome genetic variation of the Afanasyevo people in southern Siberia in general, which is in accordance with the findings of physical anthropology and archaeology (Chikisheva, 2012: 66; Molodin, 2001). Kurgan 5 deserves special attention, since owing to the great destruction of this complex it was not possible to describe the details of burial rites and grave goods. Therefore, this kurgan was only tentatively assigned to the Afanasyevo culture. The results of the present study confirm such an attribution of the complex. It is important to keep in mind, however, that genetic markers by themselves cannot be used for confirmation of the cultural affinities of burial complexes, since they are nothing more than specific features of a person as a biological individual. These individual markers can be considered in the light of their compliance (or non-compliance) with the intragroup genetic variation of the ancient population to which the individual potentially belonged. If some specific genetic features were established for a population, the presence of these features in an individual (or individuals) might serve as an important, but inconclusive, argument supporting his/her/their assignment to this particular population. It should be kept in mind that the terms "biological population" and "people of an archaeological culture" are never identical. The presence of carriers of various cultural traditions in a biologically uniform population is quite a typical situation; and vice-versa, a population homogeneous in terms of material culture might well include a number of genetically diverse groups.

Only in some cases can genetic data be used for indirect (!) evaluation of the correctness of a cultural attribution of an archaeological complex. For example, the presence of the Y-chromosome and mtDNA variants typical of the Afanasyevo population of southern Siberia in the skeletons from kurgan 5 at Bertek-33, together with the position of the complex in the chain formed by kurgans 1–4, are an additional indirect evidence for considering all the five kurgans as one cemetery belonging to the Afanasyevo culture. This conclusion is also confirmed by the results of the craniometric study showing that all the skeletal individuals form a single sample (Chikisheva, 2012: 66–67). An important argument in this discussion could be close kinship affiliations between individuals from various complexes of the same site. The presence of identical structural variants of the Y-chromosome and mtDNA can confirm direct kinship between individuals, as well as different types of close relatedness via paternal or maternal lines (respectively).

There are no data available about direct or close maternal kinship between the three individuals from kurgan 5 and other kurgans at Bertek-33. In the whole sample, the only case of a shared mtDNA variant (belonging to the U5a haplogroup) was detected in two individuals from the triple burial (skeletons 5 and 6). But the age at death of these individuals (25–30 year-old female and 40–45year-old male) excludes the possibility of direct "mother-son" relatedness. However, another types of maternal kinship, e.g. "brother-sister", seem more plausible. A large proportion of allele variants of the autosomal STR-loci common between these two individuals additionally supports their kin relationship.

Let us turn to the structure of the Y-chromosome specimens of the five male skeletons from Bertek-33 from the point of view of paternal kinship. As was noted above, three different structural variants of the same R1b haplogroup were detected. Two pairs of the individuals display identical variants: skeletons 1 (kurgan 2) and 4 (kurgan 4); skeletons 3 (kurgan 3) and 6 (kurgan 5). This is an important piece of evidence supporting their patrilineality. In the case of the first pair (1 and 4), the probability of a direct "father-son" relation is fairly high: all the eight successfully genotyped autosomal STR-loci of these two individuals contain at least one common allele variant. The robustness of this conclusion is, however, weakened by the absence of data about the remaining seven loci that were not genotyped because of the poor preservation of the DNA in skeleton 1. The possible patrilineality of the second pair of individuals (3 and 6), exhibiting identical structural variants of the Y-chromosome, was clearly not a direct "father-son" kinship, since a number of the STR-loci display no common allele variant. Neither could they be full siblings, though other types of paternal kinship cannot be excluded, as is suggested by the presence of common alleles for many loci. Thus, both matrilineal and (likely more often) patrilineal kinship was an important factor determining the inhumation of Afanasyevo people at the same cemetery. However, this kinship might be not necessarily direct.

Conclusions

Our molecular genetic study of the individuals from Bertek-33 made a substantial contribution to the existing database of the Y-chromosome and mtDNA gene-pools of the Afanasyevo population of southern Siberia. Previously, genetic data had only been obtained for the population of the central part of the Altai Mountains and Minusinsk Basin. The results of the genetic study were thoroughly explored at different levels: single individual, burial complex, cemetery as a whole, and Afanasyevo populations of various scales. The interpretation of these data in the light of the results of archaeological and anthropological research has helped to resolve partially the long-standing questions of the genetic origin and connections of the Afanasyevo population of the Altai Mountains, its burial rites, and kinship structure. The composition of mtDNA and, particularly, Y-chromosome variants in the skeletal sample from Bertek-33 links this group to the bearers of the Afanasyevo culture from other regions of southern Siberia, and points towards their Western Eurasian origin. The genetic data suggest that kinship was an important factor in determining the inhumation of individuals in the same burial. Further progress in this area of research will require a substantial increase in the representativeness of the genetic databases describing local groups from the Afanasyevo culture, including high coverage whole-genome data for both single individuals and skeletal samples.

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References

Allentoft M.E., Sikora M., Sjogren K.G., Rasmussen S., Rasmussen M., Stenderup J., Damgaard P.B., Schroeder H., Ahlstrom T., Vinner L., Malaspinas A.S., Margaryan A., Higham T., Chivall D., Lynnerup N., Harvig L., Baron J., Della Casa P., Dąbrowski P., Duffy P.R., Ebel A.V., Epimakhov A., Frei K., Furmanek M., Gralak T., Gromov A., Gronkiewicz S., Grupe G., Hajdu T., Jarysz R., Khartanovich V., Khokhlov A., Kiss V., Kolar J., Kriiska A., Lasak I., Longhi C., McGlynn G., Merkevicius A., Merkyte I., Metspalu M., Mkrtchyan R., Moiseyev V., Paja L., Palfi G., Pokutta D., Pospieszny L., Price T.D., Saag L., Sablin M., Shishlina N., Smrcka V., Soenov V.I., Szeverenyi V., Toth G., Trifanova S.V., Varul L., Vicze M., Yepiskoposyan L., Zhitenev V., Orlando L., Sicheritz-Ponten T., Brunak S., Nielsen R., Kristiansen K., Willerslev E. 2015
Population genomics of Bronze Age Eurasia. *Nature*, vol. 522: 167–172.

Brinkmann B., Sajantila A., Goedde H.W., Matsumoto H., Nishi K., Wiegand P. 1996
Population genetic comparisons among eight populations using allele frequency and sequence data from three microsatellite loci. *European Journal of Human Genetics*, vol. 4: 175–182.

Chikisheva T.A. 1994
Kharakteristika paleoantropologicheskogo materiala pamyatnikov Bertekskoy doliny. In *Drevniye kultury Bertekskoy doliny*, V.I. Molodin (ed.). Novosibirsk: Nauka, pp. 157–174.

Chikisheva T.A. 2012
Dinamika antropologicheskoy differentsiatsii naseleniya yuga Zapadnoy Sibiri v epokhi neolita-rannego zheleza. Novosibirsk: Izd. IAET SO RAN.

Gonzalez N.C., Perez J.R., Chamero B., Cambra-Moo O., Martin A.G. 2017
Geometric morphometrics reveals restrictions on the shape of the female os coxae. *Journal of Anatomy*, vol. 230: 66–74.

Haak W., Forster P., Bramanti B., Matsumura S., Brandt G., Tanzer M., Villems R., Renfrew C., Gronenborn D., Werner A.K., Burger J. 2005
Ancient DNA from the first European farmers in 7500-year-old Neolithic sites. *Science*, vol. 305: 1016–1018.

Haak W., Lazaridis I., Patterson N., Rohland N., Mallick S., Llamas B., Brandt G., Nordenfelt S., Harney E., Stewardson K., Fu Q., Mittnik A., Bánffy E., Economou C., Francken M., Friederich S., Pena R.G., Hallgren F., Khartanovich V., Khokhlov A., Kunst M., Kuznetsov P., Meller H., Mochalov O., Moiseyev V., Nicklisch N., Pichler S.L., Risch R., Rojo Guerra M.A., Roth C., Szécsényi-Nagy A., Wahl J., Meyer M., Krause J., Brown D., Anthony D., Cooper A., Alt K.W., Reich D. 2015
Massive migration from the steppe was a source for Indo-European languages in Europe. *Nature*, vol. 522: 207–211.

Hollard C., Zvenigorosky V., Kovalev A., Kiryushin Y., Tishkin A., Lazaretov I., Crubezy E., Ludes B., Keyser C. 2018
New genetic evidence of affinities and discontinuities between Bronze Age Siberian populations. *American Journal of Physical Anthropology*, vol. 167 (1): 97–107.

Kovalev A.A., Erdenebaatar D. 2009
Discovery of new cultures of the Bronze Age in Mongolia according to the data obtained by the International Central Asian Archaeological Expedition. In *Current Archaeological Research in Mongolia: Papers from the First Intern. Conf. on "Archaeological Research in Mongolia". Ulanbaatar, 19th–23rd 2007*. Bonn: pp. 149–170. (Bonn Contributions to Asian Archaeology; vol. 4).

Molodin V.I. 2001
Bronzezeit in Berg Altai. *Eurasia antiqua: Zeitschrift für archäologie Eurasiens*, Bd. 7: 1–51.

Pilipenko A.S., Cherdantsev S.V., Trapezov R.O., Molodin V.I., Kobeleva L.S., Pozdnyakov D.V., Polosmak N.V. 2017
Kinship analysis of human remains from the Sargat mounds, Baraba forest-steppe, Western Siberia. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 45 (4): 132–142.

Pilipenko A.S., Molodin V.I., Trapezov R.O., Cherdantsev S.V., Zhuravlev A.A. 2016
A genetic analysis of human remains from the Bronze Age (2nd millennium BC) cemetery Bertek-56 in the Altai Mountains. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 44 (4): 141–149.

Pilipenko A.S., Romashchenko A.G., Molodin V.I., Kulikov I.V., Kobzev V.F., Pozdnyakov D.V., Novikova O.I. 2008
Infant burials in dwellings at Chicha-1, in the Baraba forest-steppe: Results of DNA analysis. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 34 (2): 57–67.

Pilipenko A.S., Trapezov R.O., Cherdantsev S.V., Babenko V.N., Nesterova M.S., Pozdnyakov D.V., Molodin V.I., Polosmak N.V. 2018
Maternal genetic features of the Iron Age Tagar population from Southern Siberia (1st millennium BC). *PLoS ONE*, vol. 13 (9). DOI: 10.1371/journal.pone.0204062.

Pilipenko A.S., Trapezov R.O., Polosmak N.V. 2015
A paleogenetic study of Pazyryk people buried at Ak-Alakha-1, the Altai Mountains. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 43 (4): 144–150.

Pilipenko A.S., Trapezov R.O., Zhuravlev A.A., Molodin V.I., Romaschenko A.G. 2015
MtDNA haplogroup A10 lineages in Bronze Age samples suggest that ancient autochthonous human groups contributed to the specificity of the indigenous West Siberian population. *PLoS ONE*, vol. 10 (5). URL: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0127182.

Savinov D.G. 1994a
Mogilnik Bertek-33. In *Drevniye kultury Bertekskoy doliny*, V.I. Molodin (ed.). Novosibirsk: Nauka, pp. 39–49.

Savinov D.G. 1994b
Afanasyevskaya kultura. In *Drevniye kultury Bertekskoy doliny*, V.I. Molodin (ed.). Novosibirsk: Nauka, pp. 130–134.

Sierp I., Henneberg M. 2015
The difficulty of sexing skeletons from unknown populations. *Journal of Anthropology*. URL: http://dx.doi.org/10.1155/2015/908535.

Tan Q., Bellizzi D., Rose G., Garasto S., Franceschi C., Kruse T., Vaupel J.W., De Benedictis G., Yashin A.I. 2002
The influences on human longevity by HUMTHO1. STR polymorphism (Tyrosine Hydroxylase gene): A relative risk approach. *Mechanisms of Ageing and Development*, vol. 123 (10): 1403–1410.

Vadetskaya E.B., Polyakov A.V., Stepanova N.F. 2014
Svod pamyatnikov afanasyevskoy kultury. Barnaul: Azbuka.

Wurmb-Schwark N. von, Caliebe A., Schwark T., Kleindorp R., Poetsch M., Schreiber S., Nebel A. 2011
Association of TH01 with human longevity revisited. *European Journal of Human Genetics*, vol. 19 (8): 924–927. DOI: 10.1038/ejhg.2011.43.

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Aleksandr Ivanovich Solovyev: In Honor of his 65th Birthday

Alexandr Ivanovich Solovyev, Doctor of History, a prominent Russian archaeologist, was born in Novosibirsk on the 31st of August 1955. His parents played a huge role in making up his personality; therefore, it appears appropriate to say at least a few words about them. Ivan Petrovich Solovyev was a front-line soldier, who went through the Great Patriotic War as an artillery reconnaissance officer, holder of many orders and medals. After the victory, he received a higher legal education, and throughout his life held high positions in the legal structures of the Novosibirsk Region. Ekaterina Ivanovna Solovyeva was a scholar of history. She worked at the Novosibirsk State Pedagogical Institute, went through all the stages from a teacher to the rector of the institute. She defended her candidate and then doctoral dissertations on the issues relating to the history of a Siberian village in the 19th century. For almost all the authors of this essay, Ekaterina Solovyeva was a teacher and mentor, and we are immensely grateful to her.

Alexandr Solovyev received an excellent education, having graduated from one of the best schools in Novosibirsk (School No. 10, with in-depth study of the English language) and the Humanities Department of the Novosibirsk State University (in 1977). He was interested in many historical disciplines, which contributed to the formation of a well-educated personality with a broad outlook. This feature has always favorably distinguished A.I. Solovyev.

Apparently, everything changed after the archaeological practice in the team that explored the Ilimsky Ostrog. The Spartan conditions, in which the young researchers had to live and work, formed not only Alexandr's character, but also genuine feelings of collectivism and friendship. The unique object of research could not leave him indifferent. So, the choice was made in favor of archaeology, with all its harsh romance; and since that time, Alexandr spent every summer on expeditions.

Of course, a huge role in his choosing a profession was played by the charm of such individuals as Academician A.P. Okladnikov and Professor M.P. Gryaznov. A. Solovyev was fortunate enough to study under them at the university and on the expedition to the Minusinsk Basin. The West Siberian team of the North Asian Joint Expedition became truly dear to him. Even having

become a Doctor of Sciences, Alexandr did not stop working as a part of this team.

From the very beginning of his archaeological career, A. Solovyev was attracted by the issues relating to weapon studies. Apparently, this topic has become one of the most important in his creative life. Weapons were the subject of his Ph.D. thesis, defended in 1984. The work provides a scrupulous analysis of medieval weapons of the West Siberian indigenous populations. Subsequently, the dissertation was published as a monograph entitled "Military Affairs of the Indigenous Population of Western Siberia: The Epoch of the Middle Ages" (Novosibirsk, 1987), which is widely popular among experts in weapon studies even today.

A significant event in the archaeology of Western Siberia was the doctoral dissertation by Alexandr Solovyev, entitled "Burial Monuments of the Pre-Taiga Population of the Ob-Irtysh Region in the Middle Ages (Rite, Myth, Society)", brilliantly defended by him in 2006. This work reveals the specificity of numerous burial complexes in Western Siberia, relating to the ethnicity of the deceased. On the basis of ethnographic data, he made interesting reconstructions associated with the spiritual life of the southern Khanty, Samoyeds, Baraba Tatars, and other ethnic groups that once lived in the region. Excellent knowledge of ethnographic and historical sources allowed the author to carry out a unique research, actually at the intersection of disciplines. This approach became typical of the scientific work of A.I. Solovyev. He published a number of monographic works (including in co-authorship with professional ethnologists), which attract the readers by the depth of analysis and non-standard vision of issues. Noteworthy is the remarkable book of the scholar, entitled "Arms and Armor: Siberian Weapons: From the Stone Age to the Middle Ages" (Novosibirsk, 2003). This work reflects the researcher's favorite topics—weapon studies and the spiritual life of Siberian aborigines. The book contains magnificent graphic reconstructions made by the author himself. He paints beautifully, quite professionally, which skill is extremely important for an archaeologist. This is another of the many talents of A.I. Solovyev. Alexandr has a unique memory. Nature has also endowed him with a gift of storytelling. Any fairy-tale performed by A.I. Solovyev appears to be an event that happened quite recently!

In the last decade, the work of Alexandr Solovyev has been associated with the archaeology of China, Japan, Korea, where the scientist managed not only to travel, but also to actively work with collections and on expeditions. As a result, he carried out a number of original scientific studies, distinguished by a non-standard view on the available data.

A.I. Solovyev has always taken part in landmark projects of the Institute of Archaeology and Ethnography SB RAS. In the 1990s, he took an active part in the implementation of the international program "Pazyryk" on the Ukok plateau, where he led the excavations of a number of archaeological sites of various epochs. Alexandr Solovyev played a great role in writing the first collective monograph "Ancient Cultures of the Bertek Valley (the Altai Mountains, Ukok Plateau)" (Novosibirsk, 1994) based on the materials collected there. A.I. Solovyev is the Executive Secretary of the Editorial Board of Volume II of the fundamental publication entitled "History of Siberia". He has done a tremendous amount of work on the preparation and editing of texts; he is also the author of certain chapters in this book.

Alexandr is an extremely talented science communicator for the public; he writes about complex things in a bright, interesting, and comprehensible way. Among his creative achievements is a textbook on the history of the Novosibirsk Region, for the creation of which A.I. Solovyev, together with a team of authors, was awarded the State Prize of the Novosibirsk Region in 2018.

In total, over the years of creative activity, the scientist has published about ten author and collective monographs and more than 130 articles issued in Russia and other countries. Alexandr Solovyev is a lecturer at the Novosibirsk State University and the Novosibirsk Stage Pedagogical University. It must be said that he enjoys not only great authority and respect, but also a true love of his colleagues and students. For many years, A.I. Solovyev has collaborated with the Russian Foundation for Basic Research in organizing and conducting regional competitions. He himself also participates in the implementation of a number of scientific projects as a leader and a performer.

Alexandr Solovyev inherited remarkable human qualities from his parents. A sense of duty is sacred for him; suffice it to say that after graduating from the university he served in the Soviet army and never considered this time wasted for himself. Alexandr is very kind and sympathetic, tolerant in communication with colleagues; at the same time, he is strict when it comes to scientific creativity. He met his future wife Elena on an expedition to Ukok. And the fact that Elena Anatolyevna has become a specialist in the archaeology of Japan is largely due to Alexandr Ivanovich. They raised a wonderful daughter, who will never let her wonderful parents down.

A lot has been done, but there are still many years of creativity, victories, and achievements ahead. We believe that Alexandr Ivanovich will more than once please us with new books, articles, and discoveries both in the field and at the writing desk!

A.P. Derevianko, V.I. Molodin, N.V. Polosmak, E.I. Derevianko, V.P. Mylnikov, L.N. Mylnikova, V.S. Elagin, V.N. Dobzhansky, A.N. Lipatov, N.Y. Lipatova, S.A. Komissarov

BAR – British Archaeological Reports

BNC SO RAN – Buryat Science Center, Siberian Branch, Russian Academy of Sciences (Ulan-Ude)

GIN AN SSSR – Geological Institute, USSR Academy of Sciences (Moscow)

IA RAN – Institute of Archaeology, Russian Academy of Sciences (Moscow)

IAET SO RAN – Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences (Novosibirsk)

IIMK RAN – Institute for the History of Material Culture, Russian Academy of Sciences (St. Petersburg)

IRGO – Imperial Russian Geographical Society

KIGI RAN – Kalmyk Institute for Humanitarian Studies, Russian Academy of Sciences (Elista)

KSIA – Brief Communications of the Institute of Archaeology, Russian Academy of Sciences

MAE RAN – Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences (St. Petersburg)

MIA – Materials and Investigations on Archaeology in the USSR

VSEGEI – Karpinsky Russian Geological Research Institute (St. Petersburg)

VSORGO – East Siberian Department of the Russian Geographical Society

Alkin S.V., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: alkin-s@yandex.ru; https://orcid.org/0000-0002-6319-6448

Anoikin A.A., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Senior Researcher, Novosibirsk State University, Pirogova 1, Novosibirsk, 630090, Russia. E-mail: anui1@yandex.ru; https://orcid.org/0000-0003-2383-2259

Basova N.V., Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: bass15@yandex.ru; https://orcid.org/0000-0002-6539-5766

Baumann M., Postdoctoral Researcher, Bordeaux University, UMR 5199, PACEA laboratory, Bat. B2, Allée Geoffroy St-Hilaire CS 50023, 33615 Pessac cedex, France. E-mail: malvina.baumann@gmail.com; https://orcid.org/000-0002-7706-3013

Chabai V.P., Director, Institute of Archaeology, National Academy of Sciences of Ukraine, pr. Geroyiv Stalingrada, 12, Kyiv, 04210, Ukraine. E-mail: v.p.chabai@gmail.com; https://orcid.org/0000-0002-1066-3137

Chargynov T.T., Associate Professor, Jusup Balasagyn Kyrgyz National University, Frunze 547, Bishkek, 720033, Kyrgyzstan. E-mail: tima_chargynov@mail.ru; https://orcid.org/0000-0002-6210-9250

Chekha A.M., Junior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: Chekhandrej@yandex.ru; https://orcid.org/0000-0002-2427-7480

Cherdantsev S.V., Doctoral Student, Institute of Cytology and Genetics, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 10, Novosibirsk, 630090, Russia. E-mail: stephancherd@gmail.com; https://orcid.org/0000-0002-4384-3468

Chistyakov P.V., Junior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: pavelchist@gmail.com; https://orcid.org/0000-0001-7036-7092

Dai Kunikita, Associate Professor, Graduate School of Humanities and Sociology, University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, 113-0033, Tokyo, Japan. E-mail: dkunikita@yahoo.co.jp

Derevianko A.P., Scientific Director, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Laboratory Head, Altai State University, pr. Lenina 61, Barnaul, 656049, Russia. E-mail: derev@archaeology.nsc.ru; https://orcid.org/0000-0003-1156-8331

Dobrovolskaya M.V., Leading Researcher, Institute of Archaeology, Russian Academy of Sciences, Dm. Ulyanova 19, Moscow, 117292, Russia. E-mail: mk_pa@mail.ru; https://orcid.org/0000-0001-9695-4199

Durakov I.A., Associate Professor, Novosibirsk State Pedagogical University, Vilyuiskaya 28, Novosibirsk, 630126, Russia. E-mail: idurakov@yandex.ru; https://orcid.org/0000-0002-8526-9257

Epimakhov A.V., Professor, South Ural State University, pr. Lenina 76, Chelyabinsk, 454080, Russia. E-mail: epimakhovav@susu.ru; https://orcid.org/0000-0002-0141-1026

Fursova E.F., Department Head, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: mf11@mail.ru; https://orcid.org/0000-0002-9459-7033

Gladyshev S.A., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: gladyshev57@gmail.com; https://orcid.org/0000-0002-7443-654X

Hiroyuki Matsuzaki, Researcher, University Museum, University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, 113-0033, Tokyo, Japan. E-mail: hmatsu@um.u-tokyo.ac.jp

Kandyba A.V., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: arhkandyba@gmail.com; https://orcid.org/0000-0003-0985-9121

Kazuki Morisaki, Researcher, Agency for Cultural Affairs, Government of Japan, 3-2-2, Kasumigaseki, chiyoda-ku, 100-8959, Tokyo, Japan. E-mail: mediocritas@icloud.com

Kazunori Uchida, Researcher, Hokkaido Government Board of Education, Kita 3-jo, Nishi 6-chome, Chuo-ku, Sapporo, 060-8588, Hokkaido, Japan. E-mail: wtn_uchida@yahoo.co.jp

Kharevich V.M., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: mihalich84@mail.ru; https://orcid.org/0000-0003-2632-6888

Kolobova K.A., Leading Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: kolobovak@yandex.ru; https://orcid.org/0000-0002-5757-3251

Kolyasnikova A.S., Laboratory Assistant, Novosibirsk State University, Pirogova 1, Novosibirsk, 630090, Russia. E-mail: kns0471@gmail.com; https://orcid.org/0000-0002-6356-3738

Koryakova L.N., Chief Researcher, Institute of History and Archaeology, Ural Branch, Russian Academy of Sciences, S. Kovalevskoi 16, Yekaterinburg, 620108, Russia. E-mail: lunikkor@mail.ru; https://orcid.org/0000-0003-4861-344X

Kozintsev A.G., Professor, Chief Researcher, Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya nab. 3, St. Petersburg, 199034, Russia. E-mail: agkozintsev@gmail.com; https://orcid.org/0000-0002-0165-8109

Krivoshapkin A.I., Director, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Department Chair, Novosibirsk State University, Pirogova 1, Novosibirsk, 630090, Russia; Chief Researcher, Altai State University, pr. Lenina 61, Barnaul, 656049, Russia. E-mail: krivoshapkin@mail.ru; https://orcid.org/0000-0002-5327-3438

Kulik N.A., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: kuliknatart@mail.ru; https://orcid.org/0000-0002-2641-5517

Makarov N.A., Director, Institute of Archaeology, Russian Academy of Sciences, Ulyanova 19, Moscow, 117292, Russia. E-mail: MakarovNA@iaran.ru; https://orcid.org/0000-0003-1041-0401

Markin S.V., Leading Researcher, Department Head, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: markin@archaeology.nsc.ru; https://orcid.org/0000-0002-4528-8613

Molodin V.I., Professor, Department Head, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Chief Researcher, Novosibirsk State University, Pirogova 1, Novosibirsk, 630090, Russia. E-mail: molodin@archaeology.nsc.ru. https://orcid.org/0000-0002-3151-8457

Mylnikova L.N., Leading Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Teaching Assistant of the Archaeology and Ethnography Department, Novosibirsk State University, Pirogova 1, Novosibirsk, 630090, Russia. E-mail: L.Mylnikova@yandex.ru; https://orcid.org/0000-0003-0196-5165

Nanzatov B.Z., Researcher, Kalmyk Research Center, Russian Academy of Sciences, I.K. Ilishkina 8, Elista, 358000, Russia. E-mail: nanzatov@yandex.ru; https://orcid.org/0000-0001-8012-2515

Nesterov S.P., Leading Researcher, Department Head, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: nesterov@archaeology.nsc.ru; https://orcid.org/0000-0003-3629-2730

Nguyen Gia Doi, Deputy Director, Institute of Archaeology, Vietnam Academy of Social Sciences, Phan Chu Chin, 61, Hanoi, Vietnam. E-mail: doitrong@hotmail.com

Nguyen Khac Su, Researcher, Institute of Archaeology, Vietnam Academy of Social Sciences, Phan Chu Chin, 61, Hanoi, Vietnam. E-mail: khacsukc@gmail.com

Olenchenko V.V., Associate Professor, Novosibirsk State University, Pirogova 1, Novosibirsk, 630090, Russia; Leading Researcher, Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch, Russian Academy of Sciences, pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia. E-mail: olenchenkovv@ipgg.sbras.ru; https://orcid.org/0000-0002-4386-7064

Osipova P.S., Doctoral Student, Novosibirsk State University, Pirogova 1, Novosibirsk, 630090, Russia; Junior Researcher, Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch, Russian Academy of Sciences, pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia. E-mail: osipovaps@ipgg.sbras.ru; https://orcid.org/0000-0003-0510-6333

Panteleeva S.E., Senior Researcher, Institute of History and Archaeology, Ural Branch, Russian Academy of Sciences, S. Kovalevskoi 16, Yekaterinburg, 620108, Russia. E-mail: spanteleyeva@mail.ru; https://orcid.org/0000-0002-0816-7900

Pavlenok G.D., Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: lukianovagalina@yandex.ru; https://orcid.org/0000-0003-3727-776X

Pilipenko A.S., Head of the Interinstitutional Center, Institute of Cytology and Genetics, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 10, Novosibirsk, 630090, Russia. E-mail: alexpil@boinet.nsc.ru; https://orcid.org/0000-0003-1009-2554

Pilipenko I.V., Junior Researcher, Institute of Cytology and Genetics, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 10, Novosibirsk, 630090, Russia. E-mail: pilipenkoiv@bionet.nsc.ru; https://orcid.org/0000-0002-8325-6719

Postnov A.V., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: postnov@yandex.ru; https://orcid.org/0000-0001-7853-0501

Pristyazhnyuk M.S., Employee, Institute of Cytology and Genetics, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 10, Novosibirsk, 630090, Russia. E-mail: mprist@list.ru; https://orcid.org/0000-0001-9770-6381

Rybalko A.G., Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: rybalko@archaeology.nsc.ru; https://orcid.org/0000-0002-8749-0465

Samorodova M.A., Junior Researcher, Institute of Archaeology, Russian Academy of Sciences, Ulyanova 19, Moscow, 117292, Russia. E-mail: rita.am@mail.ru; https://orcid.org/0000-0002-5506-1228

Tabarev A.V., Leading Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: olmec@yandex.ru; https://orcid.org/0000-0002-6249-8057

Taimagambetov Z.K., Chief Researcher, National Museum of the Republic of Kazakhstan, pr. Tauelsizdik 54, Nur-Sultan, 010000, Kazakhstan. E-mail: zhaken.taimagambetov@gmail.com; https://orcid.org/0000-0003-3541-0600

Trapezov R.O., Researcher, Institute of Cytology and Genetics, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 10, Novosibirsk, 630090, Russia. E-mail: Rostislav@bionet.nsc.ru; https://orcid.org/0000-0002-0483-530X

Tsibizov L.V., Assistant, Novosibirsk State University, Pirogova 1, Novosibirsk, 630090, Russia; Senior Researcher, Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch, Russian Academy of Sciences, pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia; Researcher, Geophysical Center, Russian Academy of Sciences, Molodezhnaya 3, Moscow, 119296, Russia. E-mail: tsibizovlv@gmail.com; https://orcid.org/0000-0002-7395-4679

Vasekha M.V., Researcher, Institute of Ethnology and Anthropology, Russian Academy of Sciences, Leninsky pr. 32A, Moscow, 119334, Russia. E-mail: maria.vasekha@gmail.com; https://orcid.org/0000-0003-4132-4370

Viola B.T., Assistant Professor, University of Toronto, 27 King's College Circle Toronto, Ontario M5S 1A1, Canada. E-mail: bence.viola@utoronto.ca; https://orcid.org/0000-0001-8052-707X

Zenin V.N., Leading Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: vzenin@archaeology.nsc.ru; https://orcid.org/0000-0002-2907-6266

Zhuravlev A.A., Junior Researcher, Institute of Cytology and Genetics, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 10, Novosibirsk, 630090, Russia. E-mail: tos3550@mail.ru; https://orcid.org/0000-0001-6169-0912

Zotkina L.V., Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: lidiazotkina@gmail.com; https://orcid.org/0000-0002-1912-3882