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CONTENTS

PALEOENVIRONMENT. THE STONE AGE

THE METAL AGES AND MEDIEVAL PERIOD

ETHNOLOGY

PERSONALIA

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The Peopling of Tajikistan by *Homo sapiens denisovan*

The study published in the previous issue of this journal addressed the dispersal and early morphological and genetic evolution of H. s. denisovan in Iran, following the split of the ancestral taxon H. heidelbergensis into two taxa, Neanderthals and Denisovans, in the Levant ~400 ka BP. The latter taxon was first described owing to the sequencing of DNA extracted from the fragment of the fifth finger phalanx from layer 11.2 of Denisova Cave, Altai. Having left the Levant 400–350 ka BP, Denisovans began to spread via Iran to Central Asia and eventually to the Altai. Humans appeared in Denisova Cave ~300 ka BP, having crossed vast territories of Central Asia different in terms of environment, climate, landscape, flora and fauna, and partly populated by aborigines—the late populations of H. erectus. Adapting to changing environments, assimilating native humans, and undergoing natural selection, H. s. denisovan evolved both genetically and morphologically. Here, the spread of Denisovans in Tajikistan will be discussed.

Keywords: *H. erectus, H. s. denisovan, H. s. neanderthalensis, Early (Lower) Paleolithic, Middle Paleolithic, Upper Paleolithic, Acheulean industry.*

Introduction

The Paleolithic in Tajikistan is a key topic in the prehistoric studies of the Central Asia. V.A. Ranov and his colleagues executed a tremendous amount of archaeological studies in the loess-paleosol deposits in Southern Tajikistan, and managed to discover the most ancient Early Paleolithic site, Kuldara. The culture-bearing layers of the site in the soils of pedocomplexes 11 and 12 are overlain by a more than 100-meter thick stratum of loess and paleosols (Ranov et al., 1987; Ranov, 1988; and others). Initially, the site was dated to about 800 ka BP (Ranov, 1992a, b), later, a date of 915–950 ka BP was proposed (Ranov, Lomov, 2001). The excavations of the site yielded only 40 distinct lithic artifacts, representing an unusual small-sized pebble-flake industry. But this was an outstanding discovery: Kuldara is the only site of such an old age in Central Asia. Pedocomplexes 10–7, overlying the Early Paleolithic cultural layers, contained only few artifacts, which did not provide reliable grounds to assert that *H. erectus* still inhabited Tajikistan at a later period. They could have died out due to the small number of population, or migrated to the regions with more favorable environment.

Consequently, there was a long break (200–300 thousand years) in the peopling of Tajikistan. In pedocomplexes 6–4, an Early Paleolithic industry was discovered, which Ranov designated as the Karatau (Ranov, 1977; Lazarenko, Ranov, 1977). Researchers attribute six sites to this culture. Five sites (Karatau-1, Lakhuti-1, Obi-Mazar-4 and -6, and Khonako-3) were explored in the 20th century, Lakhuti-4 was found in

2021 (Anoikin et al., 2021, 2023; and others). At the Karatau sites, deposits were exposed over an area of about 800 m^2; >2000 diagnostic artifacts were discovered.

The development of the Karatau Lower Paleolithic industries is divided into the early and the final stage. The early stage is associated with cultural layers traced in pedocomplex 6, dated to 650–600 ka BP, and pedocomplex 5, 520–480 ka BP. Lithic artifacts of the final stage have been identified in pedocomplex 4, dated to 425–364 ka BP.

The assemblages of artifacts attributed to the early stage of the Lower Paleolithic are dominated by flakes, shatters, chips, manuports, and poorly preserved unidentifiable animal bones (Ranov, 1980a, b; 1988; Ranov, Karimova, 2005; Khudjageldiev, 2007; and others). Primary reduction is characterized mainly by cores of the pebble type, poorly shaped, with striking platforms retaining pebble cortex; some cores bear few traces of trimming. Flakes were detached usually in an irregular manner; however, negative scar of the previous removal was often used as a striking platform. Many flakes are of amorphous shapes. Ranov argued that the presence of "citron slices" or simple crescents (which are blanks removed from pebbles, usually curved and retaining pebble cortex on the dorsal side) points to the pebble technique. There are numerous wedges—varieties of citrons; these were probably unintentionally produced during pebble flaking (crushing technique) (Ranov, 1986, 1988, 2005; and others). The platforms of the flakes are plain or retain natural cortex. Manuports and waste products make up a significant share (up to 70 %) of the assemblage. Laminar flakes and blades are rare.

The tool kit does not show any specialization of lithic products. The identified types include tools often shaped on different blanks. Retouch is usually marginal, not extending to the ventral and dorsal planes, one-stepped, often denticulate. Products with regular and extensive retouch are rare. Choppers, which were possibly used as chopping tools and cores, as well as side-scrapers, scraper-like products, and atypical end-scrapers, predominate in the collection. Denticulate and notched tools are also present. Flakes often exhibit signs of irregular retouch and negative scars, which suggests their use without additional preparation for performing various tasks.

The industry of the Final Karatau culture was identified in pedocomplex 4 of the sites of Obi-Mazar-4, Khonako-3, and Lakhuti-4 (Ranov, 2005; Ranov, Schäfer, 2000; Ranov, Khudjageldiev, Schäfer, 2004; Khudjageldiev et al., 2023; Anoikin et al., 2023; Rybalko et al., 2023; and others).

Pedocomplex 4 was associated with the period corresponding to MIS 11; it was formed in the chronological range of 425–364 ka BP. Obi-Mazar-4 yielded the most abundant and informative finds. In this regard, noteworthy are the inferences made by V.A. Ranov and J. Schäfer (2000) concerning the industry of this technocomplex. When characterizing the primary reduction, the researchers noted small-sized cores as a feature distinguishing this industry from all the others (discovered in pedocomplexes 6 and 5). These cores demonstrate various shapes: cuboid, ovoid, discoidal, sub-prismatic, triangular, and pyramidal. But most importantly, all the cores show prepared surfaces. The researchers argued that such cores might well be found at Mousterian sites. Thus, certain technical features observed in the Obi-Mazar-4 industry bring it closer to the industries of the Middle Paleolithic, despite the fact that in general it demonstrates Lower Paleolithic characteristics and undoubtedly belongs to the Karatau culture (Ibid.: 29).

The emergence of new Middle Paleolithic elements in the hominin lithic industry in pedocomplex 4, dating back to 425–364 ka BP, can only be explained by the appearance on the territory of Tajikistan of a new taxon—Denisovans, with a different industry.

Initial peopling of Tajikistan by the Denisovans

DNA sequencing of ancient hominins has revealed that the Denisovans and Neanderthals diverged 430–380 ka BP in the Levant (Reich et al., 2010; Meyer et al., 2012; Prüfer et al., 2014). The essence of this phenomenon was that the single ancestral taxon *H. heidelbergensis* split into two taxa. The population of one taxon settled in Europe, where the genetic and morphological evolution of *H. s. neanderthalensis* took place in the process of assimilation of the indigenous population and adaptation to the changing environment 200–150 ka BP (Derevianko, 2022, 2024a). Another part of the *H. heidelbergensis* population moved through the Iranian Plateau and settled in Central Asia and Altai; here, in Denisova Cave, a new taxon was identified—Denisovans (Derevianko, 2019, 2022, 2024b). The genetic and morphological development of the Denisovans, same as Neanderthals, occurred in the process of assimilation of the late forms of *H. erectus*, natural selection, and adaptation to changing environmental conditions.

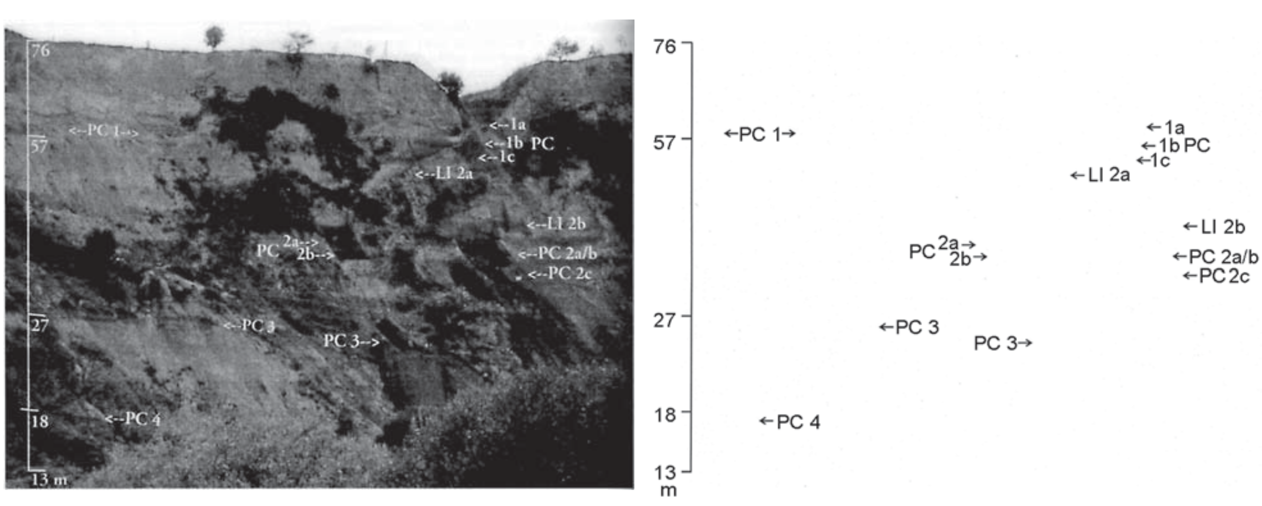
The dispersal of the emerging Denisovan taxon in Asia began around 400 ka BP; the lithic industry of the sites in Southern Tajikistan, discovered in pedocomplex 4, evidences the beginning of dispersal of the emerging Denisovan taxon over this area.

In the territory of Tajikistan, representatives of the genetically and morphologically evolving Denisovan taxon contacted with *H. erectus* population, carriers of the pebble-flake Lower Paleolithic industry. Since both the indigenous population and the newcomers had an open genetic system (Derevianko, 2019, 2022), they were able to interbreed and produce fertile offspring. Furthermore, there occurred a diffusion of industries, which was reflected in the technocomplex of the Final Karatau.

Pedocomplex 3 of Tajikistan loess-paleosol deposits have produced quite few artifacts as of yet. Generally, no Paleolithic sites dating to 350–240 ka BP have been found in this region. Therefore, currently there are no reliable grounds to evaluate the development of the industrial complex in the Early Middle Paleolithic. Hopefully, the Joint Russia-Tajikistan Expedition, which has been studying the loess-paleosol deposits of Southern Tajikistan since 2019, will discover new sites that will fill the existing hiatus in the Paleolithic records of this territory.

A well-developed Middle Paleolithic industry was uncovered from pedocomplex 2 at Khonako-3 (Ranov et al., 2003; Schäfer, Ranov, Sosin, 1998). Cultural layers were located at a depth of 30 m below the daylight surface. The first lithic products were discovered by Ranov at the bottom of the excavation area (Ranov, 1980a). In 1984, J. Schäfer and A. Paster were the first to find lithic artifacts in pedocomplex 2. In 1995–1997, excavations of pedocomplexes 1 and 2 were carried out at this site. The most extensive studies were organized in 1997: the excavation area reached 43 m^2; in total, 283 lithic artifacts were uncovered (6.6 artifacts per 1 m^2). Excavations at the Khonako-3 site were carried out over five seasons; an area of approximately 80 m^2 was excavated, and more than 600 lithic artifacts were collected (Ranov, Karimova, 2005).

Since the site was excavated over several years, difficulties arose in correlating the profiles and the finds from different excavation areas (Ranov et al., 2003: 25–30). Publications of the archaeological materials from Khonako-3 provide somewhat different information on the occurrence of finds in pedocomplexes 2 and 1. Taking this into account, I refer to the paper by J. Schäfer and his co-authors, since it presents data on the geochronology of the finds (Schäfer, Ranov, Sosin, 1998). The article contains a map of the excavation area (Ibid.: Fig. 7), but unfortunately it is illegible, so the diagram of the stratigraphic sequence is provided (Fig. 1). The site contains: pedocomplex 4 with materials of the Final Karatau culture, pedocomplex 3 with solitary finds, pedocomplex 2 comprising three paleosols 2a–2c; pedocomplex 1 with three paleosols 1c, 1b, and 1a, and loesses LI 2a and LI 2b lying between the latter two pedocomplexes.



a *b*

Fig. 1. Khonako-3 stratigraphic profile (after (Schäfer, Ranov, Sosin, 1998)).
a – photo; *b* – diagram.

The researchers note that lithic artifacts occurred throughout pedocomplex 2 (MIS 7; 242–186 ka BP) and in loess-paleosol and loess deposits separating pedocomplexes 2 and 1 (MIS 6; 186–127 ka BP); pedocomplex 1 (MIS 5; 127–71 ka BP) yielded stone tools dating back to the Middle Paleolithic.

According to the description given by Schäfer and his colleagues, the lithic artifacts were deposited more or less horizontally in the sediments of pedocomplex 2, which was formed during the climatic optimum of MIS 7. The oldest finds (ca 230 ka BP) were attributed by the researchers to paleosol 2b. In the western part of the excavation area, many lithic artifacts were deposited within and between the paleosol sediments during the middle and late stages of MIS 7 (220–200 ka BP) (the sediment complex between paleosols 2b and 2a). Notably, the lithic collection from paleosols 2b and 2a contains a significant number of complete and broken blades, as well as a few Levallois flakes and shatters. Cores are rare and heavily exhausted. The scholars provide drawings of four tools—three longitudinal side-scrapers on convergent blades detached from Levallois cores (Fig. 2, *2–4*) (Ibid.: Fig. 9), and a fragment of a Levallois point (Fig. 2, *1*). Noteworthy are the signs of thorough shaping of these items. Lithic artifacts from loess LI 2a attract special attention. This collection includes blades (33 %), flakes (40 %), and shatters (15 %). Of particular interest are three pyramidal (conical) cores (Fig. 3) (Ibid.: Fig. 10) found in the 180 thousand years old deposits. Their typological characteristics points to the Upper Paleolithic. Given their old age, we can ascertain the high level of primary reduction technique used by the Denisovans in the Late Middle Pleistocene.

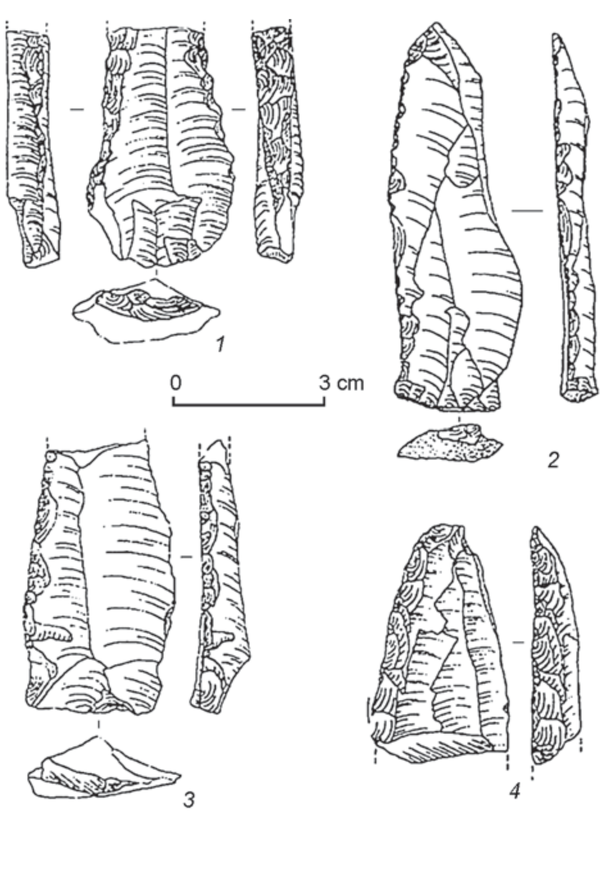


Fig. 2. Lithic artifacts from paleosol layers 2b–2a in Khonako-3 pedocomplex 2 (after (Schäfer, Ranov, Sosin, 1998)).
1 – fragment of Levallois point; *2–4* – longitudinal side-scrapers on blades.

The archaeological materials of excavations of pedocomplex 2 unfortunately have not yet been published in full. Ranov and Schäfer (2000) listed 530 finds recovered during all the years of field studies of pedocomplex 2.

The materials of 1997 excavations were described in most detail (Ranov et al., 2003). The researchers assumed that lithic artifacts were distributed throughout the entire soil stratum of the climatic optimum, since humans inhabited this site despite the microclimatic fluctuations during the soil accumulation. In contrast, the loess sediments that were formed in cold and arid climatic conditions yielded practically no finds.

At Khonako-3 pedocomplex 2, lithic artifacts were dispersed vertically; and since the excavations were carried out by different research teams in different years, with and without the participation of soil scientists, later there arose difficulties in the attribution of the artifacts positions to specific units of the multi-layered pedocomplex.

The excavations of 1997 produced 283 finds, including: cores (*n*=3; 1.1 %), blades (*n*=28; 9.9 %), blade fragments (*n*=29; 10.2 %), laminar flakes (*n*=4; 1.4 %), flakes (*n*=70; 24.7 %), shatters (*n*=83; 29 %), pebbles (*n*=11; 3.9 %), and bones (*n*=55; 19.8 %). Raw materials used by hominins for the tool manufacture were felsite-porphyry, metamorphic silicified rocks, fine-grained quartzite, silicified shales, and limestone. Pebbles were collected at the talus slopes of disintegrating Pliocene conglomerates underlying the soil-loess sequence. All the artifacts uncovered in 1997 in the rudimentary soil and the climatic optimum soil at a level of 47.60–52.64 m, i.e. in a 5-meter thick stratum, are considered by the researchers as a single complex.

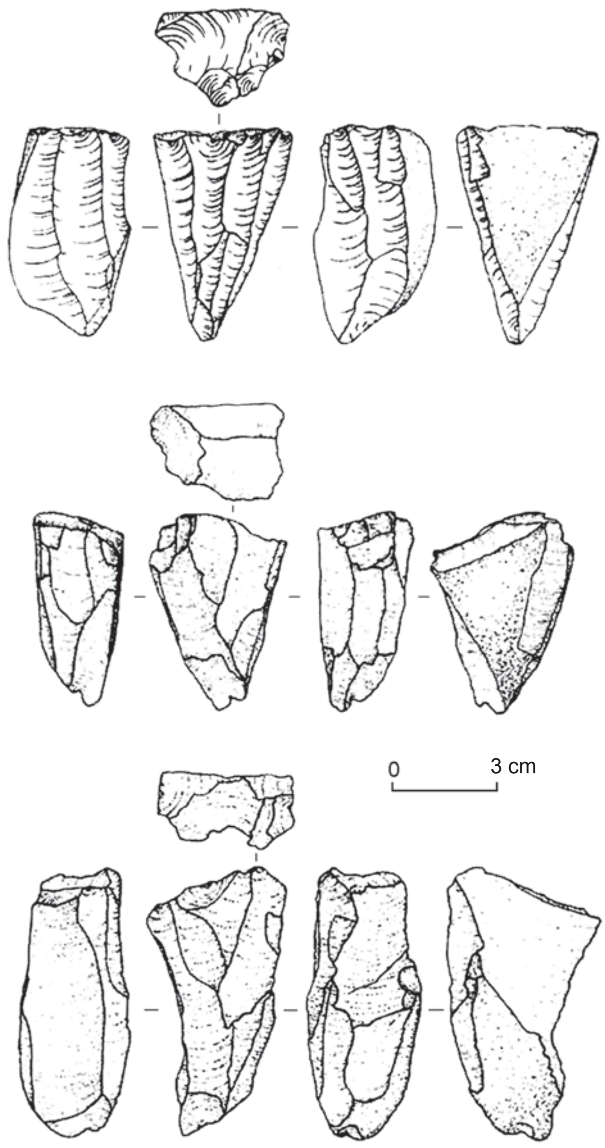


Fig. 3. Cores from layer LI 2a in Khonako-3 pedocomplex 2 (after (Schäfer, Ranov, Sosin, 1998)).

During the excavations, three cores were found. One of the cores was recovered from the rudimentary soil layer, and was classified by the researchers as a "well-prepared prismatic core" (Fig. 4, *1*). The core is large, 13.4 × 11.7 × 6.9 cm. Its striking platform is wide and bears rejuvenation scars along the edge. The second core is oval in plan view, bears traces of radial removal of shortened flakes (Fig. 4, *2*). It was deposited in the climatic optimum soil layer, less than 1 m below the prismatic core. The researchers note that similar cores were found at the Final Middle Paleolithic site of Khudji, and in paleosol 4 at Obi-Mazar-4, which contained Final Karatau artifacts. The back of the second core shows different-sized negative scars, which can be classified as the preparation of the striking platform; large flakes are blanks. One more core was classified as a preform.

In total, 26 tools were identified. One half of them, according to the researchers, were recovered from the rudimentary soil, another from the paleosol of the climatic optimum. The most numerous group consists of side-scrapers made on blades and blade fragments (*n*=9), and on flakes (*n*=4). Two scrapers are classified as bifaces prepared on blades. One of them was considerably damaged (Fig. 5, *7*). It was fashioned on a blade with a triangular cross-section and a thick proximal part. One of the edges shows traces of dorsal and stepped retouch; the opposite edge, fine and abrupt retouch. The other side-scraper (knife?) was partially destructed (Fig. 5, *3*). It was manufactured on a large blade of a regular shape, triangular in cross-section. One of the edges demonstrates traces of one-stepped large-faceted retouch, while the other edge, fine and abrupt retouch. There are two fragmented bifacial side-scrapers. One of them was made on a large thick blade, triangular in cross-section (Fig. 6, *1*). One edge shows abrupt, almost vertical denticulate retouch on the dorsal face, with the working edge rejuvenated by fine retouch. The opposite edge is partially treated with abrupt retouch. The second side-scraper, represented by only a small medial part (Fig. 6, *2*), was made on a blade with a trapezoidal cross-section. The edges are shaped with abrupt retouch on the dorsal face.

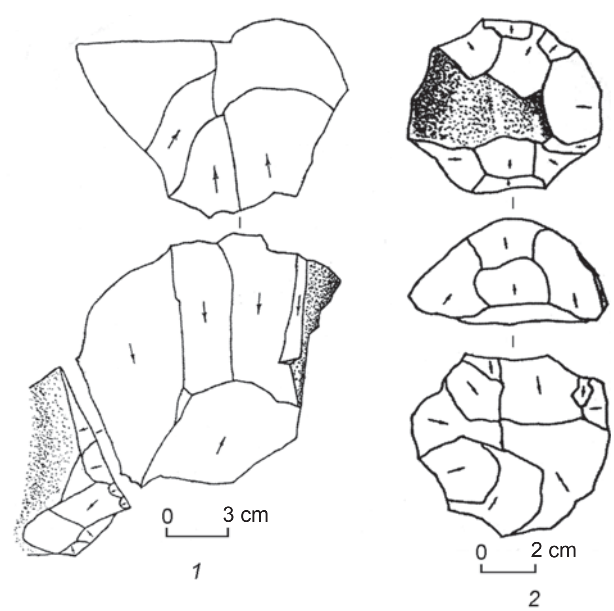


Fig. 4. Cores from Khonako-3 pedocomplex 2 (after (Ranov et al., 2003)).

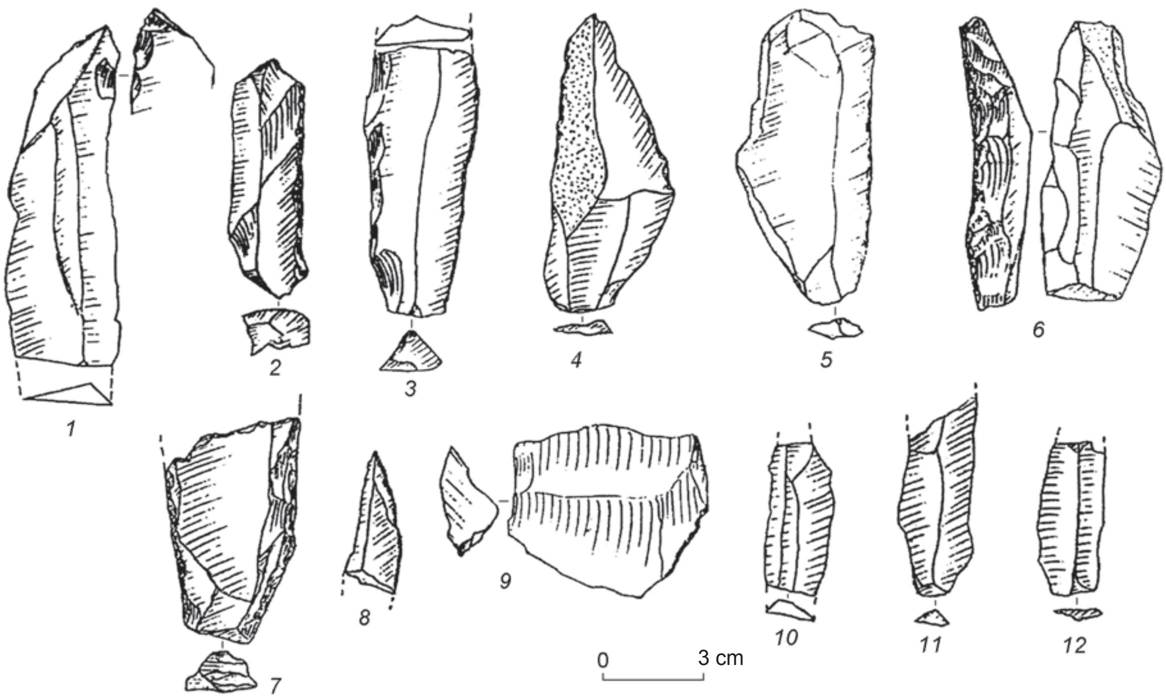


Fig. 5. Retouched lithic artifacts from Khonako-3 paleosol layer 2 (after (Ranov et al., 2003)).
1, *2*, *5*, *6* – unifacial side-scrapers; *3*, *7* – bifacial side-scrapers; *4* – knife; *8* – beveled bladelet; *9* – end-scraper; *10–12* – blades.

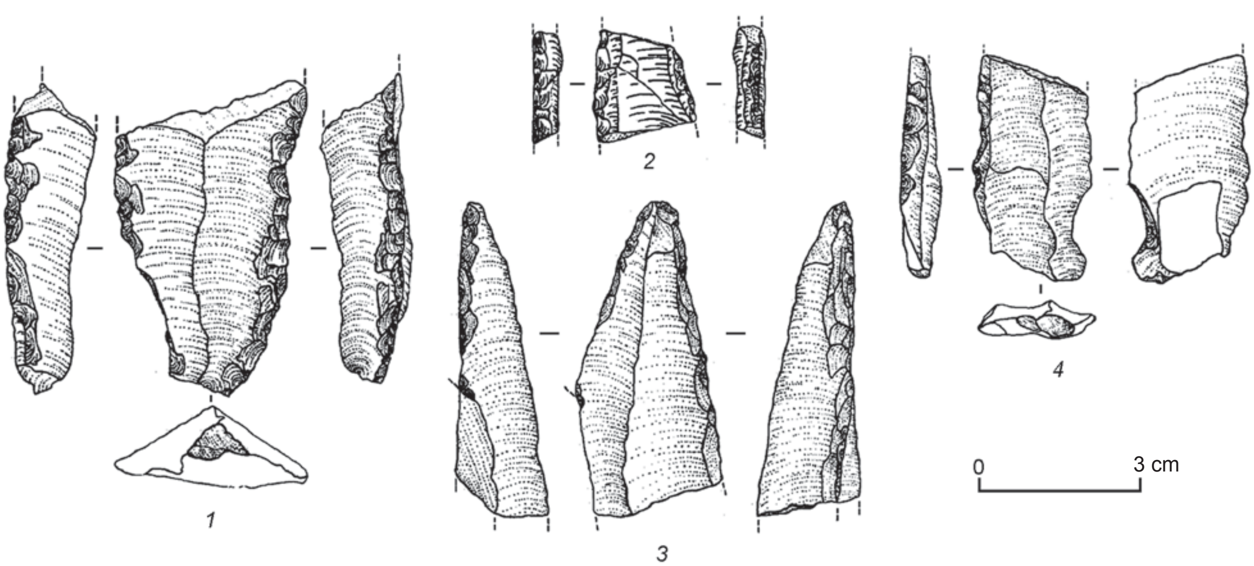


Fig. 6. Lithic artifacts from Khonako-3 paleosol layer 2 (after (Ranov, Schäfer, 2000)).
1, *2* – fragments of bifacial side-scrapers; *3* – combination tool end-scraper–side-scraper; *4* – combination tool (notched side-scraper).

Four longitudinal unifacial side-scrapers on blades were identified. One of them shows a slightly curved profile (see Fig. 5, *6*). Its distal end is sharpened by two spall removals from the ventral surface. One edge was first prepared by different-sized removals; after that, fine sharpening retouch was applied to the proximal part. A side-scraper on a blade of trapezoidal cross-section (see Fig. 5, *1*) is trimmed at the distal end on the ventral face. One flattening spall was detached from the dorsal face. The researchers determine this part of the tool as the working area resembling the edge of a carinated scraper. Another unifacial side-scraper is fashioned on a small blade with a heavily thickened proximal part (see Fig. 5, *2*). Its platform is partially removed by two wide detachments. One edge is prepared by fine abrupt stepped retouch. On the ventral surface, the researchers have identified two small areas with traces of retouch or use-wear.

Side-scrapers on flakes exhibited a more rough working as compared to those made on blades. A side-scraper (knife?) on a sub-triangular flake (see Fig. 5, *4*). Its longitudinal edge, partially retaining natural cortex, bears traces of fine abrupt retouch. The opposite edge also shows irregular retouch. Another side-scraper is made on a flake partially retaining pebble cortex (Fig. 7, *7*). One edge is partially treated with abrupt retouch. There is a notch in the distal part. The researchers argue that two spurs formed by the notch were used to perform certain operations. In their opinion, the poorly shaped side-scraper on a flake resembles Quina-type scrapers. The retouch is marginal and one-stepped. The surface of the tool is heavily weathered, the retouch is poorly visible (Ranov et al., 2003) (Fig. 7, *8*).

Two combination tools. One tool shows a combination of an end-scraper and a side-scraper made on a thick fragmented trihedral blade (see Fig. 6, *3*). One edge is prepared through abrupt one- and two-stepped retouch along the entire length; the opposite edge demonstrates partial retouch. The distal part bears abrupt, blunting retouch, which suggests that this tool was also used as an end-scraper. One trihedral blade was modified into a side-scraper by treating its edge with fine abrupt retouch (see Fig. 6, *4*). In the proximal part of the opposite edge, a deep notch was made, with traces of partial fine retouch.

Other types of tools are represented in the form of isolated specimens. A point with a broken tip is made on a very thin laminar flake (see Fig. 7, *1*). Both edges forming the tip are faceted through fine vague retouch, which is described by the researchers as “ephemeral”. The retouch is light, one-stepped, barely affecting the tool’s edges. The knife is made on a large laminar flake (see Fig. 7, 5). The retouch is fine, barely visible, and can be traced along the edge of the item. The proximal end of the item is missing, and the researchers believe that it was broken intentionally; the break could have served as a finger rest. One more knife with casual, very fine marginal retouch was fashioned on a blade with a missing proximal end. A small notch is noted there, too. An end-scraper on a robust flake, whose working edge covers the distal part and the adjoining right area (see Fig. 5, *9*). The retouch is fine, parallel, and one-stepped. The researchers also distinguish a pseudo-Levalloise point with irregular retouch, and blades with fine abrupt or sharpening abrupt, but not denticulate, retouch, covering some portion or the entire length of one edge (see Fig. 5, *8*, *10–12*; 7, *3*, *4*, *6*, *9*).

Ranov notes that the proportions of blades in the two paleosols of pedocomplex 2 are 25 and 44 %, respectively. These are well-faceted blades of more or less regular shapes; some of the blades and flakes can be attributed to Levallois artifacts (2000: 34). The researcher mentions the fact that at Khonako-3, a significant number of finds were deposited not

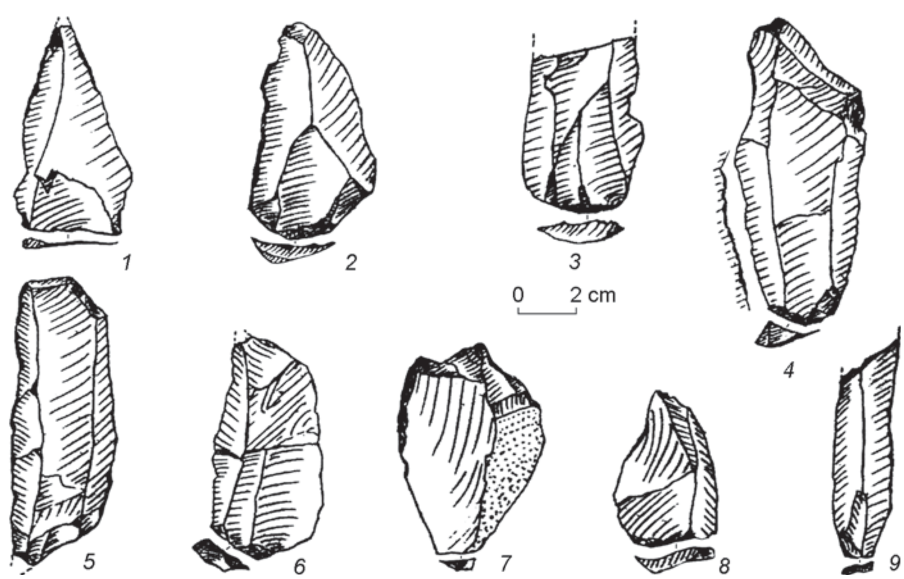


Fig. 7. Lithic artifacts from Khonako-3 paleosol layer 2 (after (Ranov et al., 2003)).
1 – point; *2* – unifacial side-scraper; *3*, *6* – blades; *4* – blade with ventral fine retouch; *5* – knife; *7* – side-scraper with large-faceted retouch; *8* – side-scraper with small-faceted retouch; *9* – prismatic blade.

in the soil of the climatic optimum, but partly in the rudimentary soil. Among other known loessic Paleolithic sites, this site was the first where four spots of burnt soil (their basal parts) were discovered, which fact suggests that the hominins used hearths.

Ranov and his co-authors compared the lithic artifacts discovered in 1997 with the materials from previous excavations, and came to the conclusion that these finds constituted a single whole and represent a lithic industry different from the Karatau. The latter can be attributed to the Levallois-Mousterian facies of the Central Asian Mousterian in its blade version, with a predominance of tools on blades reaching 12 cm in length, and very rare tools with regular retouch (2003).

Excavations of pedocomplex 1 yielded significantly fewer archaeological materials than pedocomplex 2 (Ranov, 2000). The industry of pedocomplex 1 is also defined as blade-based, but the amount of blades is much smaller here than that in the collection of pedocomplex 2. The shares of blades in two paleosols of pedocomplex 2 are 25 and 44 %, while those in pedocomplex 1 are considerably fewer. Ranov notes that the industries of these two pedocomplexes differ primarily in the lithic raw materials used. The artifacts (flakes and a small number of blades) from pedocomplex 1 are made mainly of less ductile quartzite-like dark gray sandstone. These two pedocomplexes are separated by a significant chronological gap—about 60 thousand years. Pedocomplex 2 is dated to 242–186 ka BP and corresponds to MIS 7, and pedocomplex 1 is dated to 127–71 ka BP and belongs to MIS 5.

The results of excavations of Khonako-3 pedocomplexes 2 and 1, carried out in the late 20th century, turned out to be completely unexpected for researchers. Ranov considered the occurrence of Upper Paleolithic tools in the interstadial soil layer lying 2 m above pedocomplex 2 and dating to ca 180 ka BP as an unusual phenomenon. The specific feature of this lithic industry is the presence of prismatic cores, from which narrow blades of the Upper Paleolithic type were detached (Ibid.: 35). The scientist noted that the emergence of the industry of pedocomplex 2 could be reliably associated with the migration of hominins from the Near East, while the emergence of the Khonako-3 pedocomplex 1 industry remained unclear (Ranov, 1990a, 2000).

The inferences made in the late 20th century can be considered quite correct. However, the discovery of a new taxon (Denisovans, who diverged from Neanderthals and migrated through Central Asia to the Altai 400–350 ka BP) requires a revision of the previous conclusions. Furthermore, pedocomplex 4 at Obi-Mazar-4, Lakhuti-4, and Khonako-3, displays changes in the technocomplex of stone tools, which are clearly visible at the final stage of the Karatau culture and are associated with the emergence of well-prepared cores in the primary reduction and the Middle Paleolithic artifacts among the tools. These changes can be correlated with the onset of dispersal over the territory of Tajikistan of the new taxon, Denisovans. The lack of local sites falling within the chronological range of 370 (350)–240 ka BP precludes the reconstruction of the complex process of interaction between the indigenous *H. erectus* population and the migrants—early Denisovans.

The lithic industry from Khonako-3 pedocomplex 2, dated to the range of 240–180 ka BP, belongs to the well-developed Middle Paleolithic, rather than to its early stages. Only two cores were found—a prismatic core and a discoidal one with traces of radial flaking. But given that tools were fashioned mainly on blades and laminar flakes, this industry can be conventionally attributed to the middle stage of the Middle Paleolithic.

The site of Khonako-3 is located approximately half-way the transit route of the early Denisovans from the starting point in the Levant to the destination point in the Altai. Notably, the comparisons of the Middle Paleolithic industries of the relevant period from Denisova Cave, Khonako-3, and the Levant have shown their similarity, but not identity. This is understandable: the industries are separated by vast territories; moreover, the Denisovans of Denisova Cave and Khonako-3 lived in different environmental and climatic conditions and, consequently, used different subsistence strategies. The chronological period of 240–180 ka BP in the Levant corresponds to the final stage of the Qesem industrial complex and the initial stage of the Misliya technocomplex; in Tajikistan, the industry from Khonako-3 pedocomplex 2; and in Denisova Cave, the industry of the final Early to the beginning of the middle stage of the Middle Paleolithic. All the above industries, despite the sparsity of finds in Khonako-3, demonstrate many parallels. I have no doubt that the industry from Khonako-3 pedocomplex 4 marks the initial stage of the Denisovan dispersal over Tajikistan, where they assimilated with the Karatau people, *H. erectus*. The industry from Khonako-3 pedocomplex 2 illustrates the developed stage of the Middle Paleolithic; it belonged to the Denisovans.

In 2022–2023, the teams of the Joint Russian-Tajik Georchaeological Expedition of the Institute of

Archaeology and Ethnography of the Siberian Branch of the Russian Academy of Sciences and the Donish Institute of History, Archaeology and Ethnography of the Tajik Academy of Sciences carried out small-scale excavations at Khonako-3 (Kurbanov et al., 2022; Khudjageldiev et al., 2023). The excavations have revealed very few, but important new materials: in pedocomplex 2, Upper Paleolithic tools were deposited, and pedocomplex 1 contained quite a lot of laminar blanks, including pointed ones.

Dispersal of *H. s. denisovan* over the territory of Tajikistan in the Late Pleistocene

R.N. Kurbanov and co-authors analyzed the industries from Khonako-3 pedocomplexes 1 and 2, and came to the conclusion that the emergence of blade industry in pedocomplex 2 was possibly the result of the initial peopling of this region by early *H. sapiens*, which did not stay long here and were subsequently replaced by Neanderthals (Kurbanov et al., 2022: 160).

Hypothesis as to the possible emergence of modern humans on the territory of Tajikistan ca 240 ka BP is not proven. Even if we accept that the fossils from Misliya belonged to modern humans, then, given their age <200 thousand years (Hershkovitz et al., 2018) and the lack of sites with Misliya-type blade industry in the transit zone from the Levant to Tajikistan, the conclusion made by Kurbanov and his colleagues cannot be considered valid. The small artifact collection from Khonako-3 pedocomplex 1 does not include any diagnostic items that could be attributed to the European Mousterian.

By 1971, Ranov had identified 21 sites in Tajikistan, which he classified as the Mousterian (1971). The researcher noted that only one of these sites was subjected to large-scale excavations, four other sites were partially excavated, and the rest 16 localities yielded few lithic artifacts (Ibid.). All these sites chronologically fall within the Upper Pleistocene. In total, about 11 thousand artifacts were discovered; 7747 artifacts were collected at Kara-Bura, and all the other sites produced a small number of lithics.

Over the past 50 years, new sites were discovered and studied in Tajikistan: those with long stratigraphic sequences and those with surface occurrence of artifacts. The sites yielded abundant artifact collections, including diagnostic implements. However, the lack of geochronological data complicates the construction of a reliable chronological classification of the sites, and does not provide grounds to trace the evolution of the Middle Paleolithic industry identified. To solve these issues, it is important to know whether one or several human taxa inhabited the territory of Tajikistan. As was mentioned in the first part of this paper, *H. erectus* tribes with pebble-flake industry were the first settlers in this region; 400–350 ka BP, the evolving Denisovans began to disperse here. A part of the indigenous population was assimilated by the migrants, others likely died out gradually. No Paleolithic sites dating back to the chronological period of 350–240 ka BP have been found in Tajikistan. Culture-bearing layers in Khonako-3 pedocomplex 2 contain the Middle Paleolithic blade industry of the Denisovans. The comparatively small, but informative, collection includes pyramidal cores, a Levallois point, and end-scrapers on blades dating back to ca 180 ka BP (see Fig. 3, 4). This collection suggests that the Denisovans with the Middle Paleolithic industry close to the Denisovan type continued to disperse over Tajikistan in the Late Middle Pleistocene. Notably, the Denisovan industry of the Altai and Tajikistan, in terms of the primary reduction strategy and tool kits, reveal both similarities and distinguishing features, which are likely due to the significant distance between the regions and differences in environmental settings.

In Tajikistan, no Paleolithic sites dating back to the Late Middle Pleistocene have been found; the few and uninformative lithic artifacts from Khonako-3 pedocomplex 1 dating back to MIS 5, do not provide any evidence on the continuity of these two technocomplexes. The hiatus in the Middle Paleolithic industry from pedocomplexes 1 and 2 will likely be filled by materials from further studies on the Khargushon Plateau in Southern Tajikistan. Earlier, on this plateau, excavations were carried out at the Dusti site (Ranov, Khudjageldiev, Schäfer, 2001; Ranov, Amosova, 1993).

At Dusti, during two short field campaigns, 229 lithic artifacts were uncovered from pedocomplex 1. These artifacts are characterized as rough, well-prepared both technically and typologically as compared to similar products from Khonako-3. The researchers believe that this is due to the site type: Dusti is clearly a hunting camp. It is quite possible that hominins took the best implements away, and the site served as a short-term occupation camp (Ranov, Khudjageldiev, Schäfer, 2001: 207).

Notably, the hominins used poor-quality lithic raw materials to manufacture tools; this added to the peculiarity of the Dusti lithic industry. An attempt to determine the age of the cultural layer at Dusti using the RTL-technique turned out to be useless: the date of 71.5 ± 15.6 ka BP was derived from a sample of loess lying 1 m above the top of the pedocomplex containing cultural remains, and the date of 26.8 ± ± 2.9 ka BP was generated on a sample of loess deposited 6.5 m lower than the above-mentioned sample. But this sample was taken from a test pit located 5.5 m to the south of the excavation area (Laukhin et al., 2004).

Researchers argue that the excavations on the Khargushon Plateau, where surface finds have been recorded at 20 more localities, should be continued, because owing to the special geological conditions that led to the strong erosion of pedocomplex 1, the artifacts were spread over dozens of square kilometers.

Ranov distinguished three main trends of development in the Middle Paleolithic of Central Asia and Kazakhstan, in terms of technology and typology, the relevant local groups being: the Levallois-Mousterian (including the Levallois and Levallois-Mousterian facies); Mousterian (Mountain Mousterian); and Mousterian-Soan (1971). He divided the Central Asian Middle Paleolithic industries into four varieties: the Levallois—Khodzhakent, Dzhar-Kutan, and Obi-Rakhmat (?); the Levallois-Mousterian—Kayrak-Kum, Kapchigay, and Tossor (?); the Mousterian (Mountain Mousterian)—Teshik-Tash and Semiganch (?); and the Mousterian-Soan (or Mousterian of Soan tradition)—Kara-Bura and Ak-Dzhar (?) (Ranov, 1988).

Scholars of the Central Asian Paleolithic express also other opinions about the periodization and identification of local industry varieties in the Middle Paleolithic of this region, but they all proceed from the fact that this vast region was inhabited by Neanderthals with the Mousterian. With the discovery of the new taxon, it is necessary to consider all the local Middle Paleolithic varieties of Central Asia from the Late Middle to the first half of the Upper Pleistocene within the framework of single Denisovan industry associated with *H. s. denisovan*. Judging by the results of genetic studies, the Denisovans dispersed over the vast territory of Central, East and Southeast Asia (Meyer et al., 2012; Prüfer et al., 2014), and in the future, plenty of local varieties of Middle Paleolithic industries are to be identified.

One of the well-studied sites of the initial stage of the Upper Pleistocene is Ogzi-Kichik cave. The cave is located at an altitude of 1200 m above sea level. Five excavation trenches with slightly different stratigraphic sequences were established in the cave (Ranov, 1975, 1977, 1980b; Ranov, Amosova, 1983; and others). The total area of excavation was about 200 m^2 (Ranov, 1988).

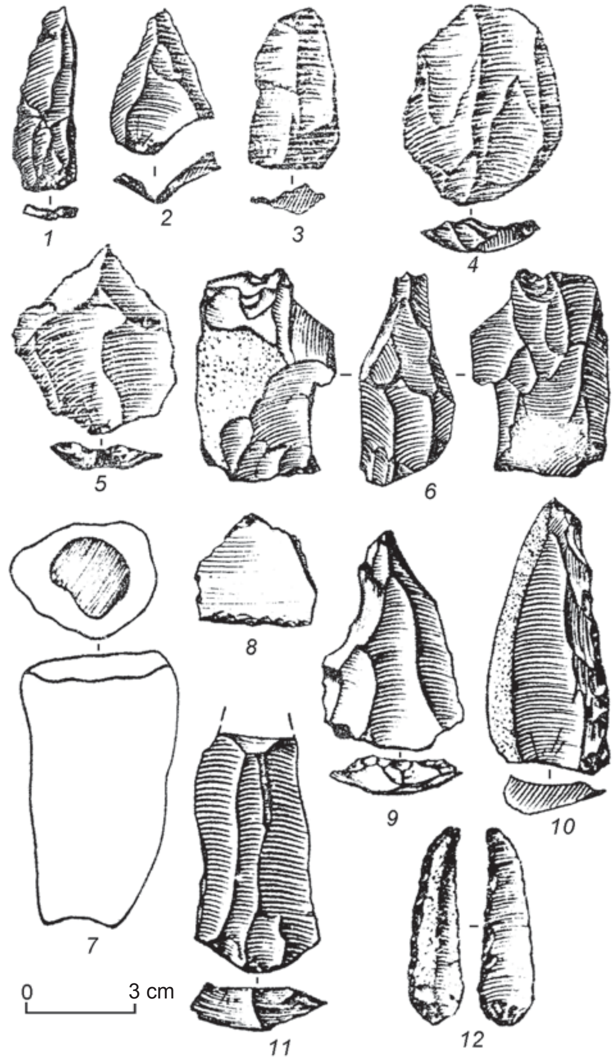
The greatest amount of finds was discovered in 1977 in excavation 5. The researchers noted that stone products and animal bones were mainly in a "suspended" state, and did not form any clearly distinguishable levels that could be identified as the remains of habitation horizons (Ranov, Amosova, 1983).

Lithic artifacts from excavation 5 did not differ in their technical and typological features from those found in other excavation trenches. Hominins used mainly flint rocks for the production of tools; according to the researchers, the features of primary and secondary flaking depended on the quality of raw material. Few cores were found in excavation 5 (n=4) (as generally in the cave); all the cores were heavily exhausted. One of the well-preserved subprismatic cores was used for the detachment of small blades and flakes (Fig. 8, *6*). The collection contains 308 fragments and shatters, including flint – 175 spec., non-flint – 52 spec.; 125 flakes, including flint – 73 spec. and non-flint – 52 spec. Among the flakes noteworthy are Levallois-type laminar blanks with rejuvenated and faceted striking platforms (Fig. 8, *2–5*), and pseudo-Levallois pointed blanks (Fig. 8, *9*, *11*). Judging by the available blanks, hominins inhabiting the cave used Levallois, subprismatic, and discoidal cores.

Ranov identified 12 tools in the lithic collection from excavation 5, seven of which were made on flakes, and the rest on blades and laminar flakes. The tools are dominated by longitudinal side-scrapers: double – 3 spec., notched backed – 2 spec. (Fig. 8, *1*, *10*), and transverse – 3 spec. Noteworthy are a side-scraper with abrupt alternate retouch (Fig. 8, *12*) and an end-scraper.

Ranov notes that the Ogzi-Kichik lithic industry as a whole does not demonstrate any technical and typological differences between the artifacts depending on their position in the stratigraphic sequence. He considered the assembled artifacts as a single collection (Ranov, 1988). The proportion of tools is very high – 27 %, the Levallois index is 32.7 %. Among blanks, there are numerous blades and laminar flakes. Noteworthy is the large number

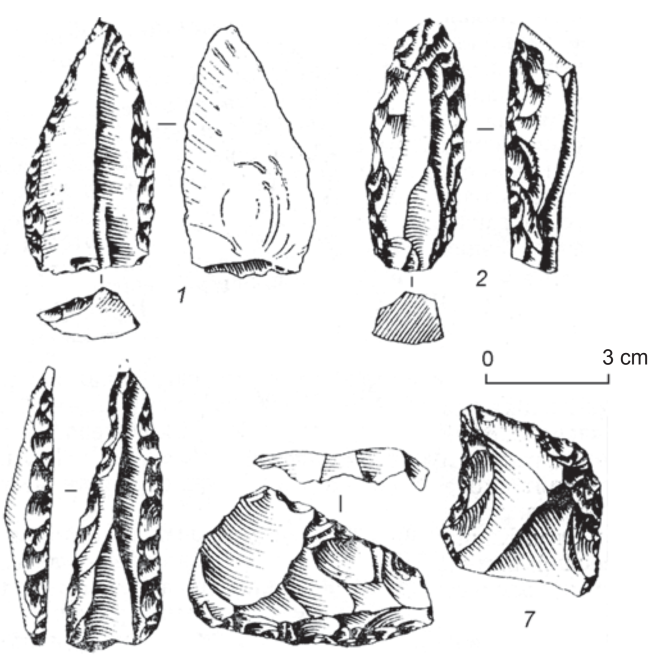
Fig. 8. Lithic artifacts from Ogzi-Kichik excavation 5 (after (Ranov, Amosova, 1983)).
1, *10* – side-scrapers; *2–5* – flakes and blades with faceted striking platforms; *6* – sub-prismatic core; *7* – a calcareous encased flint geode; *8* – side-scraper (raclette) with straight edge; *9*, *11* – pseudo-Levallois points; *12* – side-scraper with abrupt alternate marginal retouch.



of side-scrapers (Fig. 9, *2*, *4*, *6*, *7*) and points (Fig. 9, *1*, *5*); Ranov classified them into 21 and 5 subtypes, respectively. These artifacts are thoroughly retouched, mainly on the dorsal face. Other tools, few in numbers, include points, end-scrapers, limaces, carinated end-scrapers, burins, knives (Fig. 9, *3*), and denticulate-notched tools. Flakes with irregular retouch are rather numerous.

The Ogzi-Kichik Middle Paleolithic industry, in terms of technology and typology, can be attributed to the developed Middle Paleolithic. The primary reduction strategy was based mainly on the Levallois and blade technique. The most typical tools are points and side-scrapers of various types. The retouch is dorsal, multifaceted, and heavy. Ventral scaly retouch was used quite rarely. In general, this industry has much in common with the materials of the developed stage of the Denisovan Middle Paleolithic industry. The proportion of the Upper Paleolithic tools at the site is only 1.89 % (Ibid.).

Age estimation of the site of Ogzi-Kichik is problematic. Several radiocarbon dates were derived (from profile top to bottom): 24,780 ± 380 BP (GrA-10968), 25,530 ± 370 BP (GrA-10966),



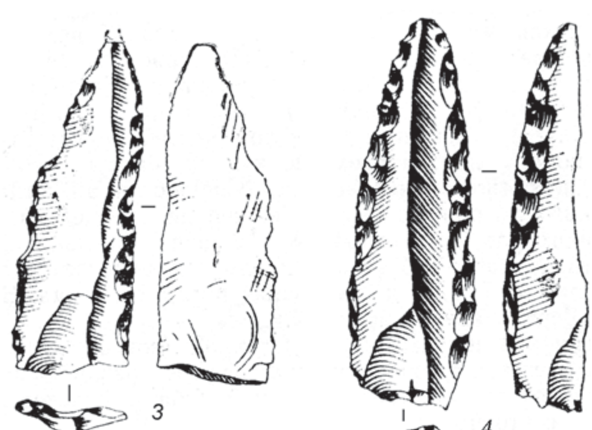


Fig. 9. Lithic artifacts from the Ogzi-Kichik site (after (Ranov, Nesmeyanov, 1973: Fig. 33)).
1, *5* – points; *2*, *4* – convergent side-scrapers; *3* – knife; *6* – side-scraper; *7* – canted scraper.

13,050 ± 230 BP (GrA-10969). The date for the GrA-10967 sample is 38,360 ± 390/380 BP (Ranov, Laukhin, Van der Plicht, 2002). The date for the lowermost deposits proved to be the youngest—about 13 ka BP. The age of samples from the upper part of the deposits is 15–16 ka BP; between them, there are layers producing the dates of 24, 25, and 38 ka BP. The researchers concluded that radiocarbon dating of the Ogzi-Kichik stratigraphic sequence isn't possible because of the dusty structure of the analyzed deposits and the small amount of organic matter in the samples (Ibid.).

Later, the thermoluminescence method was used to determine the age of this complex. In 1997, five dates were obtained for the samples from different levels of the stratigraphic sequence: two dates for the upper layers – 104 ± 26 ka BP (RTL-914) and 138 ± 35 ka BP (RTL-909); two dates for the middle layers – 110 ± 26 ka BP (RTL-910) and 126 ± ± 31 ka BP (RTL-907); and one date for the lowermost layer – 178 ± 44 ka BP (RTL-902) (Volgina et al., 2017). Based on the dates for the upper and middle parts of the profile, the age of the site was estimated as not younger than 87 thousand years, but unlikely older than 160 thousand years.

A large amount of faunal remains was discovered at the site: over 20 thousand animal bones, most of which were split by humans. The total of 26 species of mammals, 2 species of reptiles and birds were identified (Sharapov, 1998). The fauna is represented mainly by modern species, although several species exotic for this area were also identified, for example, the Late Pleistocene Merck's rhinoceros (Ranov, Karimova, 2005). Taking into account the technical and typological features of the industry, as well as the faunal composition dominated by modern species, the site of Ogzi-Kichik should be attributed to the first half of the Upper Pleistocene and dated to ca 70–80 ka BP.

The majority of the known Middle Paleolithic sites in Tajikistan are those with a destroyed cultural layer or surface scatters of artifacts. Non-contemporaneity of lithics in these complexes and the lack of established chronological sequences often make it impossible to conduct an objective analysis of the materials collected. Researches rely on their experience, knowledge, and intuition, i.e. the influence of a subjective factor is quite possible. Particularly difficult is the analysis of workshops and sites with the surface occurrence of artifacts attributed to various stages of the Paleolithic.

An example of sites with surface scatters of archaeological materials are localities in the Kairak-Kum region, in the south of Tajikistan. These were discovered by A.P. Okladnikov in 1954. The greatest number of finds was accumulated on terraces 2 and 3 of the Syr Darya River (Litvinsky, Okladnikov, Ranov, 1962). The initial location of archaeological material was identified. The researchers argued that hominins settled mainly on Middle Pleistocene terrace 4 of the Syr Darya, near the mouths of its tributaries. Over time, the lithics were redeposited to the newly forming lower terraces of the river.

The researchers subdivided the stone tools into two main groups: Khodzhi-Yagoninskaya (7 loci) and Naukatskaya (24 loci). In total, 1040 artifacts were collected at 31 loci (Ibid.).

Primary reduction was based mainly on radial and Levallois strategies. Many pointed and laminar blanks bear faceted striking platforms. According to the calculations made by Ranov, the Kairak-Kum finds contain 69 porphyrite cores: 23 discoidal (Fig. 10, *1*, *5*) and typologically close, 21 Levallois (Fig. 10, *3*, *12*), 13 elongated, 8 cuboid, 3 subprismatic (Fig. 10, *11*), and 1 subtriangular core. 25 cores were manufactured from siliceous rocks, including 10 discoidal and typologically close cores, 8 Levallois, 3 cuboid, 2 elongated, 1 subrectangular, and 1 conical (subprismatic) core. Many cores were used for the removal of blades and laminar blanks. The cores are mostly exhausted; some of them retain significant size: from 5 to 10 cm. Most of the cores show trimmed platforms, including faceted varieties (Ranov, 1965).

The proportion of blades in the Kairak-Kum collection is rather large. It makes up 20 % of the total number of finds, which is significantly higher than at other Paleolithic sites in the Central Asian region. Among the products of this category, blades with a triangular shape in plan view are the most numerous (38 %); rectangular-elongated blades make up 32 %. The cross-section of these blades is predominantly triangular, more rarely trapezoidal. Blades and laminar flakes were mainly used in tool manufacturing.

Two types of tools predominate: side-scrapers – 34 spec. (Fig. 10, *6*, *7*, *10*, *13*, *15–17*, *19*, *20*, *24*) and pointed tools – 43 spec. (Fig. 10, *2*, *8*, *9*, *14*, *18*, *21*). Other tools (11 spec. in total) include retouched blades (Fig. 10, *22*), a chisel-like tool, burins (Fig. 10, *4*), and points ((Fig. 10, *21*, *23*).

Many points are fashioned on thick blades. Ranov notes that this collection includes no light thin tools,

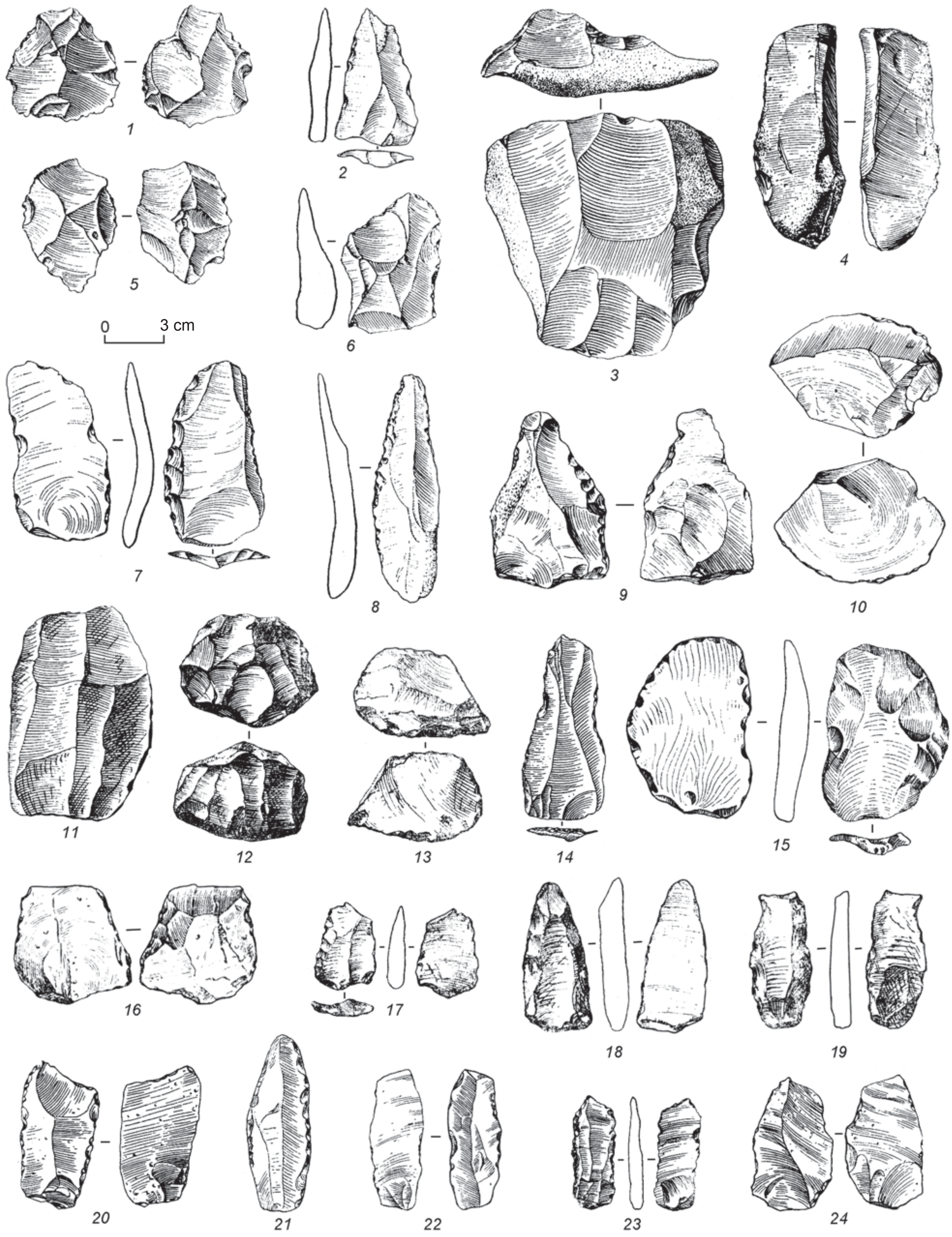


Fig. 10. Lithic artifacts from the Kairak-Kum localities (after (Litvinsky, Okladnikov, Ranov, 1962)).
1, *3*, *5*, *11*, *12* – cores; *2*, *8*, *9*, *14*, *18* – points; *4* – burin-like implement; *6*, *7*, *10*, *13*, *15–17*, *19*, *20*, *24* – side-scrapers; *21*, *23* – points; *22* – retouched blade.

typical of many Late Mousterian sites in Europe. The researcher emphasizes that the Kairak-Kum localities contain quite homogenous points (in contrast to some European and Crimean Mousterian sites), and this feature brings them close to the less diverse points from the Levallois-Mousterian layers of Palestinian caves (Skhul and Tabun) (Ibid.).

At the sites under consideration, unifacial side-scrapers prevail over bifacial varieties. The vast majority of side-scrapers show longitudinal working edges. The edge is usually straight and rarely has any convexities, which is determined by its natural shape and not by intentional modification. Few side-scrapers bear slightly marked notches. Most of the tools are retouched on the dorsal face.

At the Kairak-Kum localities, all artifacts were collected from the surface, which made it very difficult to date the sites. Ranov, following Okladnikov, attributes these materials to the Acheulean-Mousterian period or to the Late Acheulean, which he considers the lower chronological boundary; and the upper boundary, in his opinion, should be not younger than the Early Mousterian (Ibid.: 29).

According to the main technical and typological features, the Kairak-Kum lithic artifacts correspond to neither the Acheulean nor the Mousterian. The Kairak-Kum industry shows the prevalence of radial, Levallois, and blade reduction; the tool kit is dominated by side-scrapers and points. Ranov believes that the Acheulean-Mousterian sites in Northern Tajikistan belong to the group of Lower Paleolithic sites without handaxes (Ibid.). But such an old age estimation raises doubts not only by the absence of handaxes. At the Kairak-Kum localities, only a small amount of lithics show slightly patinated surfaces. The main feature of the Kairak-Kum industry is a significant proportion of blade-based products. Consequently, we can classify it as a variety of the Denisovan Middle Paleolithic, and tentatively date it to a wide chronological range of 100–60 ka BP. The Kairak-Kum industry also differs from those of the European Mousterian and Teshik-Tash.

In northern Tajikistan, Ranov explored a site near the village of Dzhar-Kutan on the left bank of the eponymous river on the southern edge of the Shakhristan Basin (Ibid.; Nesmeyanov, Ranov, 1962; Ranov, Krivoshapkin, Shalagina, 2015). According to the researcher, Mousterian artifacts were collected mainly at the level of the Middle Pleistocene terrace complex. In order to determine the deposition features of the finds, a test pit and two trenches were dug out at the upper level, and two pits and two trenches, with a total area of 22 m^2, at the lower terrace level. Lithic artifacts were discovered at different depths both on the upper and lower ledges. Ranov argues that the artifacts were redeposited and, regardless of where they were discovered—within a layer or on the surface, the collection constitutes a single synchronous complex, which is confirmed by "completely similar raw materials, identical techniques of stone working, typology of artifacts, and the same degree of patination" (1965: 31).

The Dzhar-Kutan collection comprises 670 lithic artifacts. Ranov identifies 93 blades, 76 flakes, 25 cores, 18 side-scrapers, 14 points, 2 notched tools, 9 retouched blades and flakes, 46 core-like products, and 387 fragments and shatters.

Ranov distinguishes discoidal (unifacial) cores – 4 spec., double-platform cores – 13 spec., and single-platform cores – 8 spec. At the same time, describing the lithic reduction strategy, he notes that the specificity of the laminar blanks suggests the widespread use of "Levallois cores, while the flakes removed from discoidal cores usually bore percussion bulb beveled with regard to the long axis" (Ibid.: 40). Judging by the available drawings, hominins inhabiting the Dzhar-Kutan site used three main types of cores: Levallois, discoidal, and prismatic. Most likely, at the initial stage of reduction, the cores were quite large, as evidenced by the sizes of laminar blanks.

A.I. Krivoshapkin and A.V. Shalagina re-examined the Dzhar-Kutan collections (Ranov, Krivoshapkin, Shalagina, 2015). Based on the study of cores and flakes, they came to the conclusion as to the unreasonably exaggerated role of Levallois technique in the primary reduction. In the Dzhar-Kutan assemblage, this technique was of secondary importance.

The researchers classify Dzhar-Kutan as a workshop site, since there is a lot of primary flakes (the evidence of rocks testing), and a few tools, including isolated well-shaped artifacts. Most of the tools show use-wear but not intentional retouch, which precludes their classification by types. Burin-cores are identified, which were used for the detachment of small blades and bladelets. The researchers reasonably correlate the Dzhar-Kutan technocomplex with the Late Obi-Rakhmat cultural tradition (Ibid.), which, in turn, is a version of the Denisovan Middle Paleolithic industry (Derevianko, 2001, 2022).

The site of Semiganch, excavated by Ranov 30 km eastwards from Dushanbe, the republic's capital city, contains a lithic industry similar to Dzhar-Kutan in terms of technology and typology (Ranov, 1972).

In total, 316 lithic artifacts were collected at this site. Among them, blade and flake cores (laminar and discoidal forms) are distinguished. Tools (*n*=14) are represented mainly by side-scrapers and scraper-like products.

The site of Kara-Bura occupies a special place among the Middle Paleolithic sites in Tajikistan (Ranov, 1965, 1973; and others). It is located on the left bank of the Vakhsh River, 5 km northeast of the village of Jilikul and 37 km southwest of the city of Kurgan-Tyube. This area contains several hills separated by basins. Three trenches were established at the site, which yielded finds at different levels; most of the lithics were located in the middle part of the profile, at a depth of approximately 40 to 100 cm. In terms of degree of preservation and patination, the finds recovered from trenches at various depths do not differ significantly from each other. The researchers express different viewpoints on the conditions of the culture-bearing horizon's development at Kara-Bura. According to Ranov, the materials of the site were redeposited; they shifted from higher terraces, "the eluvial-proluvial accumulation of Kara-Bura pebbles (and, consequently, burial of the tools) occurred in the Middle Quaternary, Ilyak period, most likely in its second half" (1965: 54). Judging by the occurrence of artifacts and the inclination of pebble layers at the Late Ilyak level, S.A. Nesmeyanov assumed that initially the artifacts were located on the higher, now eroded, terraces to the north of the modern hill (Ranov, Nesmeyanov, 1973: 74).

The raw materials mainly included porphyrite of various colors. The large number of cores and flakes, including primary ones, suggests attribution of this site to the workshop type.

Ranov identifies the following types of cores at Kara-Bura: discoidal unifacial (*n*=160) and bifacial (*n*=17), single-platform (*n*=51) and double-platform (*n*=16), micro-cores (*n*=40), nuclei of a "special shape" (*n*=17), semi-prismatic (*n*=8), nuclei at the initial stage of preparation (*n*=41). No Levallois cores were found at Kara-Bura; yet, Levallois-type blanks were noted.

Unifacial discoidal core, most often of irregular shape, is the leading form of Kara-Bura cores (Fig. 11, *23*, *30*, *39*, *41*); this feature distinguishes Kara-Bura from other Levallois-Mousterian sites. Less common are double-platform cores demonstrating significant differences in the flaking strategy (Fig. 11, *31*, *40*, *42*); bifacial discoidal cores are very rare (Fig. 11, *27*). There are blanks (represented mainly by flakes) – 1244 spec., blades – 15 spec., and laminar flakes – 90 spec.

The tool collection of the site is dominated by side-scrapers and scraper-like tools (Fig. 11, *1–6*, *8–10*, *15*, *25*, *26*, *28*, *29*, *32–38*). The side-scrapers are prepared primarily on flakes. This category of tools includes transverse (Fig. 11, *1*, *3*, *5*, *6*, *10*), longitudinal unifacial (Fig. 11, *9*, *17*), longitudinal bifacial (Fig. 11, *4*, *15*) varieties, those with a convex edge (Fig. 11, *18*, *19*), and those shaped by flaking and retouching all over the margins (Fig. 11, *2*, *8*). The side-scrapers are retouched primarily on the dorsal surfaces. The retouch is mainly one-stepped, abrupt, fine- and large-scaly, occasionally denticulate with conchoidal fractures. Scraper-like tools are also made on flakes, but their retouch is irregular and partly covers the working edges. The scraper-like tools show various forms in plan view (Fig. 11, *25*, *26*, *32–37*).

The proportion of tools in the Kara-Bura collection is only 2 %, apart from scraper-like tools, choppers, and chopping tools. With scraper-like tools, the tool assemblage will make up 6.8 % of the total number of finds; and with choppers and chopping tools, 13.7 %.

Points are especially noteworthy in the tool kit (Fig. 11, *12–14*, *20*). There are only eight of them. Four points are fashioned on blades, and one point on a laminar flake. Three other points are manufactured on Levallois blanks. The retouch is abrupt, one-stepped, mostly fine-faceted. The tip are shaped with extra care. Two points demonstrate retouched bases. The Kara-Bura points are distinguished by their shape and thorough preparation.

The Kara-Bura lithic industry differs from the Levallois-Mousterian of Tajikistan not only in the peculiarities of primary reduction, but also in the presence of rough cutting tools such as choppers and chopping tools – 143 spec. (Fig. 11, *7*, *11*, *21*, *22*, *24*). Ranov designates some of these items as "pebble handaxes". Some of them were possibly used as flake cores, but they all were shaped as typical chopping tools. Rough cutting tools (choppers and chopping tools) are specific to the Kara-Bura industry.

The comparison of the industry with those from the sites of the adjacent regions, including European, has shown that is the availability of pebble tools that gives grounds for the attribution of a site to the Soanian tradition. At the same time, the researcher points to the peculiarity of this industry as a part of the Soanian culture. The researcher describes the Kara-Bura industry as an intermediate link between the classic Mousterian of West Asia and the contemporaneous industries of India and Southeast Asia. On this basis, Ranov proposed to estimate the Kara-Bura age (in the

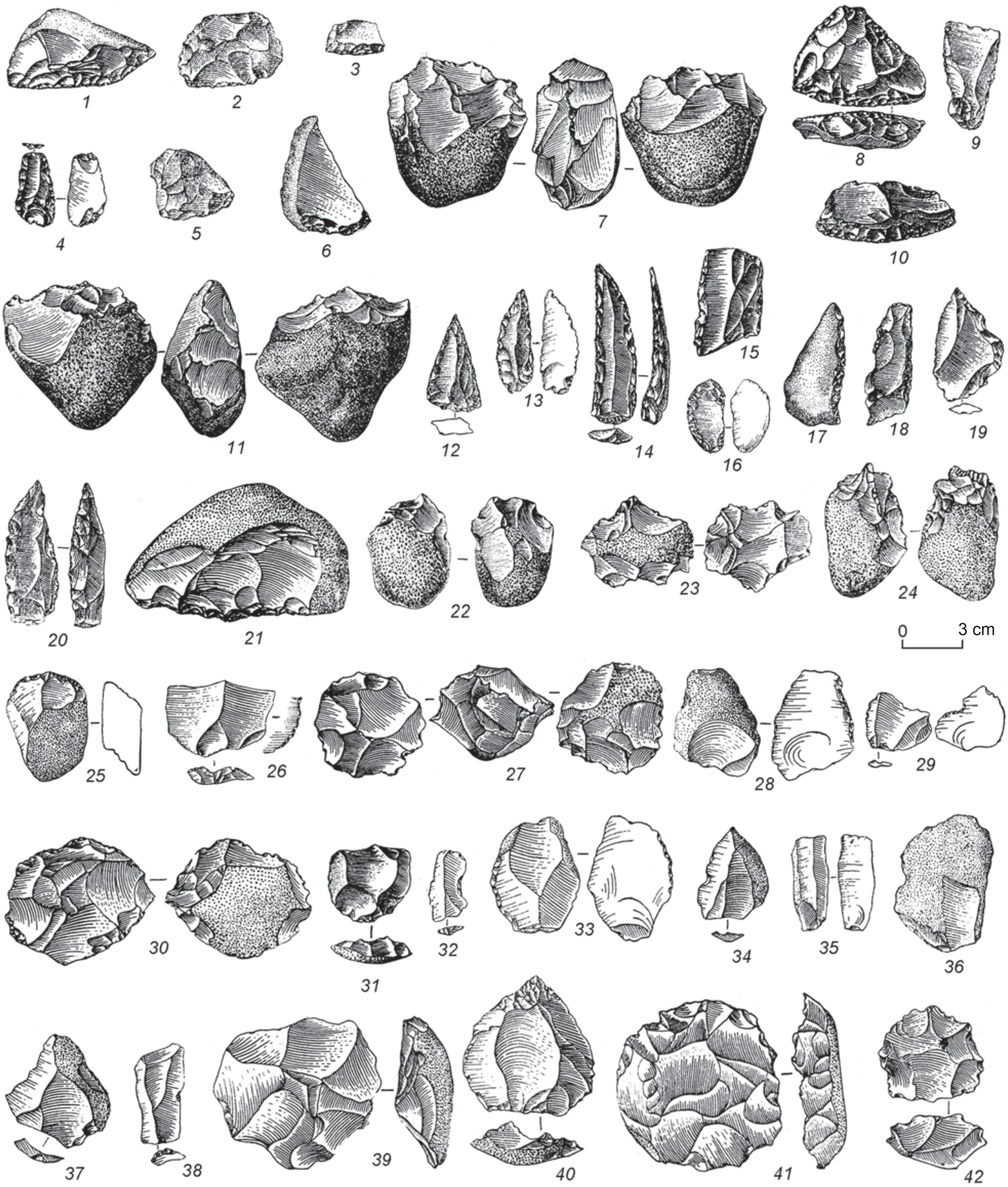


Fig. 11. Stone tools from the Kara-Bura site (after (Ranov, 1965)).
1–6, *8–10*, *15–19*, *25*, *26*, *28*, *29*, *32–38* – side-scrapers and scraper-like tools; *7*, *11*, *22*, *24* – chopping tools; *12–14*, *20* – points; *21* – chopper; *23*, *27*, *30*, *31*, *39–42* – cores.

European scale) as the Late, but not Final, Mousterian (Ranov, 1965: 80).

For that time, Ranov's conclusions as to the Kara-Bura industry affiliation can be considered quite correct. But in the light of present-day knowledge, with the discovery of the new taxon *H. s. denisovan*, which dispersed in Central Asia in the Late Middle to Upper Pleistocene, a different approach to the interpretation of this industry is required. Apparently, the Kara-Bura industry exhibits a clear regional specificity. However, having compared this industry with the technocomplexes of other Central Asian sites (Kairak-Kum, Teshik-Tash, Khodzhakent, Dzhar-Kutan), Ranov identified certain similarities and differences between them. The main distinguishing feature of this site from the Levallois-Mousterian localities, as he correctly considered, was the absence of Levallois reduction manifestations and the presence of obvious pebble tradition elements in the industry.

This industry should be interpreted with the consideration of data about what taxon could have dispersed in Tajikistan at that time. Any migration of populations with the Soanian industry can be excluded, because the only similarity between the Kara-Bura industry and the Soanian is the presence of pebble tools of chopper/chopping type. However, there are certain distinctions in that point, too: the Soanian industry is dominated by choppers, while the Kara-Bura by chopping tools.

The Kara-Bura industry differs from those of all the above-mentioned sites dated to the first half of the Upper Pleistocene in a large percentage of pebble products, the lack of the Levallois reduction, and a very small proportion of laminar blanks used for tool shaping. This does not make it possible to attribute this technocomplex with the Denisovans and the Denisovan Middle Paleolithic industry.

The lithic collection from Teshik-Tash Cave is an example of the Neanderthal industry in Central Asia. The primary reduction here is also dominated by radial flaking of discoidal cores; however, the proportion of laminar blanks in Teshik-Tash is considerably higher than that in the Kara-Bura assemblage, while pebble chopping tools are rare. Unfortunately, there are no absolute dates for the Kara-Bura site. If we assume that the Kara-Bura age is 50–60 thousand years, then, it was probably inhabited by the Neanderthals with an industry somewhat different from that of Teshik-Tash. But this assumption cannot be considered a definitive solution to the problem of the origins of this industry and its attribution to the Neanderthal taxon.

The site of Khudji is classified by Ranov as the Middle Paleolithic. In 1997, Ranov and his team excavated an area of over 40.2 m^2 at this site, and uncovered most of the finds in the lowermost layer of loess-like deposits with traces of amorphous soil (Laukhin, Ranov, Khudjageldiev, 1999). Another horizon, containing a small number of lithic artifacts, animal bones, and hearth spots, was recorded ca 2 m higher up the profile, between sandy-loamy-grus lenses. In two test pits, isolated lithic artifacts were found below the layer containing the main concentration of finds. A series of radiocarbon dates was generated on charcoal pieces: from 35,930 + + 710/–650 years (GrA-13306) to 42,110 + 2440/ –1870 years (GrN-23686) (Ranov, Laukhin, Van der Plicht, 2002).

The lithic industry obtained at Khudji during the 1978 excavations was studied in more detail by a group of researchers after the death of V.A. Ranov; almost the entire collection of finds (n=8178) was analyzed (Ranov et al., 2015). The lithic collection included the following types: production waste (chunks, chips, shatters) – 1247 spec. (27.4 %), cores – 185 spec. (3.1 %, excluding production waste), core-like fragments – 146 spec. (2.5 %), core-trimming elements – 230 spec. (3.9 %), blank spalls – 5222 spec. (88.0 %), tools – 148 spec. (2.5 %).

Eight main types of cores were identified: those exhibiting simple parallel flaking pattern, broad-faced – 32 spec.; longitudinal-convergent flaking pattern, broad-faced – 32 spec.; bidirectional flaking pattern, broad-faced – 17 spec., truncated-faceted – 29 spec.; narrow-faced – 28 spec.; centripetal flaking pattern – 16 spec.; Levallois – 8 spec.; longitudinal-transverse flaking pattern – 14 spec. (Fig. 12). Each type was subdivided into several subtypes.

The most numerous are cores exhibiting parallel flaking pattern, with a wide flaking surface (81 spec.). Such cores were used mainly for the manufacture of rectangular (Fig. 12, *1*) and pointed (Fig. 12, *2–4*) laminar blanks. There are flattened and volumetric varieties. Flattened cores are mainly those aimed at detachment of rectangular blades. Truncated-faceted cores on flakes are quite numerous (Fig. 12, *5–7*). They were used to detach small flakes and blades. In terms of chaîne opératoire and shaping technique, these cores find close parallels with lithic artifacts of the Obi-Rakhmat industry (Krivoshapkin, 2012).

Researchers pay special attention to the narrow-faced cores, which are subdivided into narrow-faced, narrow-faced wedge-shaped, longitudinal burin-cores, and bidirectional burin-cores (Fig. 12, *8–10*). These are mainly small in size (from 40 to 70 mm long). Flaking surface of such a core is located on the narrow side face of the blank, and has a pointed lower part. Cores of this type were made both on small blanks and on thick flakes. A small group of combination cores is also identified, whose flaking surface is located both on the wide and narrow face (Fig. 12, *14*).

The Khudji collection contains few burin-cores. They are made on medium and large (5–12 cm long)

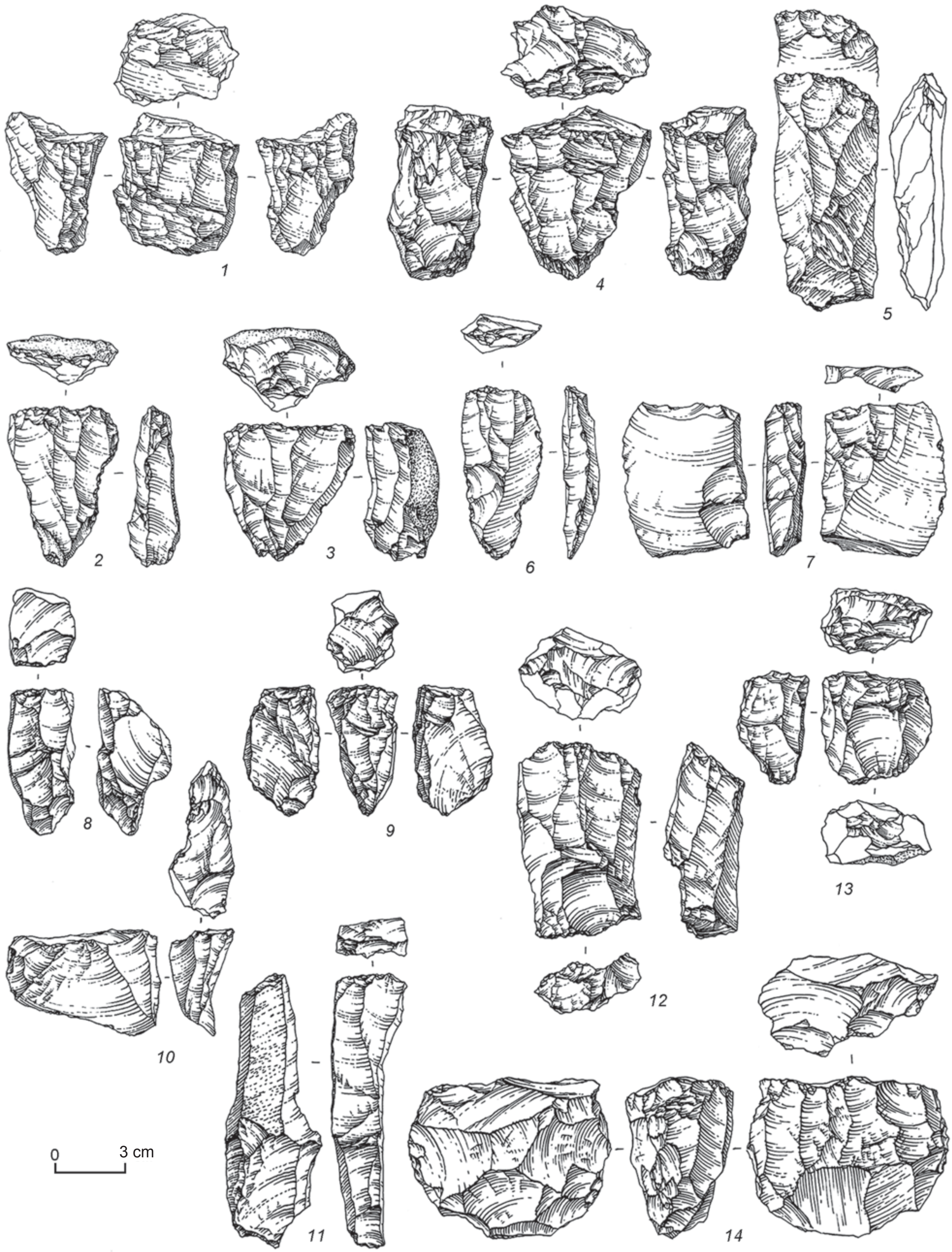


Fig. 12. Core types from the Khudji site (after (Ranov et al., 2015)).
1 – with simple parallel flaking pattern; *2–4* – with longitudinal-convergent flaking pattern; *5–7* – truncated-faceted; *8* – narrow-faced; *9*, *10* – narrow-faced wedge-shaped; *11* – bidirectional burin-core; *12*, *13* – with bidirectional flaking pattern; *14* – combination core.

blades and laminar spalls (Fig. 12, *11*). Flaking surface is located on one of the long margins. Platforms are either prepared by several removals or natural. Researchers believe that cores of this variety were intended for short-term use and produced one or two blades. The groups of cores with bidirectional flaking pattern (Fig. 12, *12*, *13*), Levallois, radial, and multidirectional cores contain few artifacts each. The cores were subjected to unifacial flaking; bifacial reduction was less common.

The Khudji lithic industry does not contain any microcores; however, a small number of bladelets are identified. Such blanks were probably obtained during the reduction of cores of other types, for example, narrow-faced cores. Based on the analysis of the Khudji primary reduction technique, researchers identified two separate flaking strategies used at the site: simple parallel and longitudinal-convergent flaking. The occurrence of pointed blanks at the site indicates the use of a special technique of core preparation and its subsequent rejuvenation during flaking process rather than the frequent use of the Levallois strategy (Ranov et al., 2015: 115–116).

The Khudji collection of tools discovered during 1978 excavation season is dominated by side-scrapers (Fig. 13, *3–8*, *11*), which V.A. Ranov and A.G. Amosova classified into simple (Fig. 13, *3*, *5–8*) (straight, convex, concave) – 48 spec., double (straight, straight-concave, biconvex (Fig. 13, *11*), convex-concave) – 7 spec., convergent – 3 spec., transverse (straight, convex) – 3 spec., and those with alternate retouch – 1 spec. In addition, the following tool types were identified: typical and atypical end-scrapers – 10 spec., typical and atypical burins – 10 spec., a knife with a back formed by a longitudinal flake removal; points (Fig. 13, *1*, *2*, *9*, *14*), truncated points – 6 spec. (Fig. 13, *10*, *12*, *13*), tranchet – 2 spec., notched-denticulate tools – 24 spec., cutters (thick flakes with ventral trimming) – 4 spec., choppers – 2 spec., a combination tool (Fig. 13, *4*), spalls and flakes with traces of regular and irregular retouch. The most common stone working technique is marginal one-stepped and extensive retouch. "Heavy" Quina retouch and stepped retouch with conchoidal fractures are rarely noted (Ranov, Amosova, 1984: 29–31).

The Khudji site produced the dates in the chronological range of 42–37 ka BP. Initially, Ranov attributed the Khudji industry to the Late Mousterian and, possibly, to the transitional stage from the Middle to the Upper Paleolithic. He noted: "…From the point of view of archaeology, the Khudji industry contains many elements that suggest association of this site with the Mousterian to the Upper Paleolithic transition period; therefore, it can be assumed that its age should be somewhere between 40 and 50 thousand years" (Ranov, 1998: 71).

The Khudji industry is usually attributed to the Middle to the Upper Paleolithic transition period.

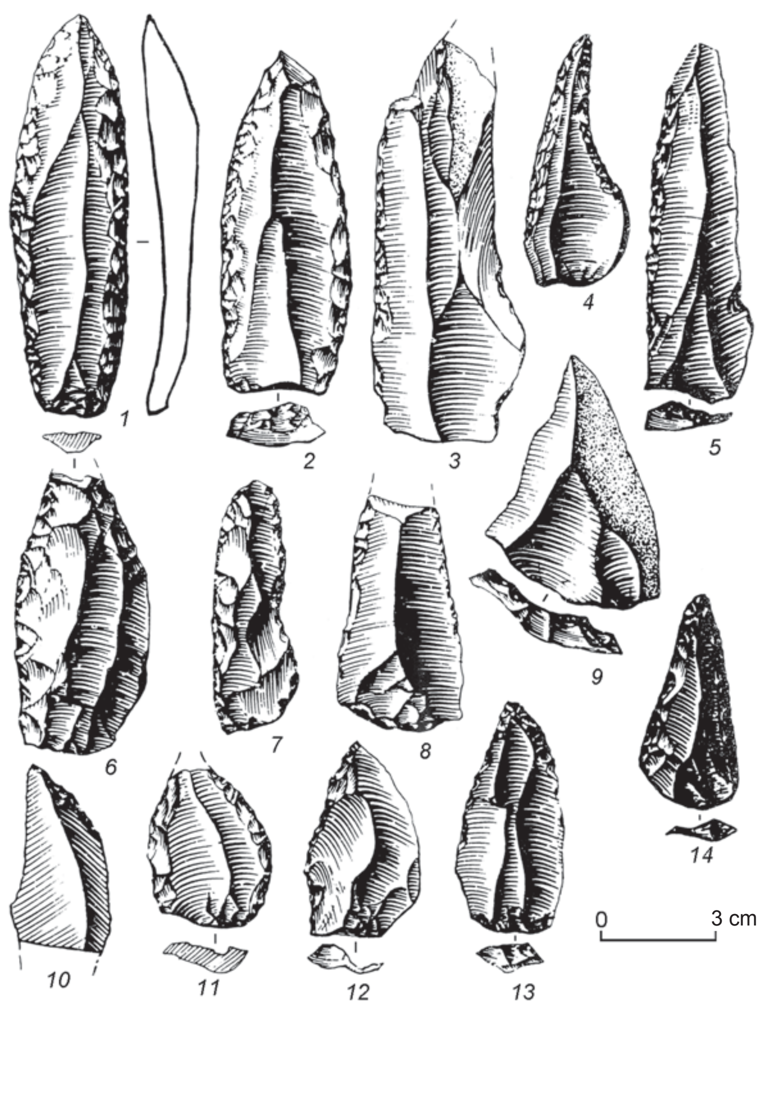


Fig. 13. Tools from the Khudji site (after (Ranov, Amosova, 1984)).
1 – elongated point; *2* – point or convergent side-scraper; *3*, *5*, *8* – simple straight side-scrapers; *4* – combination tool – straight-concave side-scraper-borer; *6*, *7* – simple convex side-scrapers; *9* – pseudo-Levallois point; *10*, *12*, *13* – truncated points; *11* – double biconvex side-scraper; *14* – point on Levallois spall.

Primary reduction was primarily aimed at producing blades and laminar blanks. The typical tools are: side-scrapers of various modifications and pointed tools, as well as typical Upper Paleolithic products: burins, end-scrapers, truncated points, etc. The tool kit reflects regional specificity of the subsistence strategy of hominins (Denisovans?) inhabiting the site. However, in the strict sense, the site cannot be attributed to the transition period, because currently, no sites of the Final Middle Paleolithic have yet been discovered in Tajikistan, whose technocomplex would clearly illustrate the continuity with the Khudji industry.

Discussion

According to the results of the nuclear genome studies, the split between Denisovans and Neanderthals occurred ca 400 ka BP. This event meant that one part of the *H. heidelbergensis* population—the ancestral basis of Denisovans and Neanderthals—began to disperse in Europe, where *H. s. neanderthalensis* evolved 200–150 ka BP, and the other part of *H. heidelbergensis* population migrated through the Iranian Plateau to Central Asia, where *H. s. denisovan* evolved. The process of genetic and morphological evolution of each of these taxa took a long time; Denisovans assimilated the indigenous population of *H. erectus* and adapted to the changing environment (Derevianko, 2019, 2022, 2024). In the process of evolution, representatives of the Denisovan taxon disseminated over the territory of Tajikistan 400–350 ka BP (MIS 11). This is confirmed by the emergence of Middle Paleolithic elements in the assemblage of the Final Karatau culture from pedocomplex 4 at Obi-Mazar-4, Khonako-3, and Lakhuti-4.

The Obi-Mazar-4 excavations produced the most convincing evidence. The lithic industry from pedocomplex 4 differs from those found in pedocomplexes 6 and 5 primarily in the presence of small-sized cores. But most importantly, almost all the cores show surface preparations (Ranov, Schäfer, 2000). Researchers argue that such cores have parallels in Mousterian collections. Particularly noteworthy is a bifacial tool of the handaxe type, as well as artifacts of the Middle Paleolithic appearance identified in the tool kit.

The noted changes can only be explained by the arrival in the territory of Tajikistan of a new taxon (Denisovans) with a different industry. During the dissemination over transit regions, tribes of future Denisovans encountered the indigenous population (late *H. erectus*) with pebble-flake industry. Since these two taxa were genetically open systems (Derevianko, 2019, 2022), they could assimilate; as a result of interbreeding, fertile offspring were born and a diffusion of lithic industries occurred. This process marked the initial stage of the morphological and genetic evolution of *H. s. denisovan*.

A completely different technical and typological complex of lithic artifacts, as compared to the Final Karatau industry, is presented in pedocomplex 2 at Khonako-3 (Ranov, 2000: 34). The Final Karatau industry from pedocomplex 4 (427–364 ka BP) and the technical and typological complex of lithic artifacts from pedocomplex 2 (242–186 ka BP) of this site do not demonstrate any continuity. Nevertheless, pedocomplex 3 yielded isolated archaeological materials that could have belonged to the transitional industry. But the sparsity of finds does not allow us to reconstruct its specific features. Thus, based on the results of the Tajikistan Paleolithic studies, it can be concluded that ca 400–350 ka BP this territory began to be populated by a new, morphologically and genetically developing taxon—Denisovans. In the future, we may be able to discover sites that will allow us to trace in detail the regional development of the Denisovan-type lithic industry in the territory of Tajikistan.

Ranov carried out excavations at Khonako-3 in the late 20th century, and on the basis of analysis of the materials from pedocomplex 2 hypothesized that the change from the Lower Paleolithic to the Middle Paleolithic culture was the result of migration of hominins from the west, most likely from the Near East.

The finds from pedocomplexes 2 and 1 are separated by a time gap of almost 60 thousand years. We can agree with Ranov that the available materials provide no possibility to trace the continuity between the industries from these two pedocomplexes (Ranov, 1990b, 2000). Although the 2022 excavations of Khonako-3 pedocomplex 1 uncovered a larger number of blades than before (Kurbanov et al., 2022), the issue of continuity between the industries of pedocomplexes 2 and 1 at Khonako-3 still remains unclear. In this regard, the Ranov's assumption as to the association of the industry from Khonako-3 pedocomplex 1 with the Neanderthals needs to be considered.

In Central Asia, a small amount of anthropological remains has been discovered as yet. The earliest finds came from Selungur Cave in Kyrgyzstan. Layer 2 of excavation 8 of the cave yielded a fragment of the occipital bone of the skull and scattered human teeth

(Islamov, Krakhmal, 1995), and layer 3, a fragment of the humerus (Islamov, 1990). The teeth and fragments of the humerus were studied by various researchers (Islamov, Zubov, Kharitonov, 1988; Islamov, Krakhmal, 1995; Zubov, Khodzhayov, 1997; Zubov, 2009).

On the basis of this relatively small amount of uninformative remains (heavily worn incisors and premolars), anthropologists tried to determine the taxonomic affiliation of the Selungur individual. Comparative analysis of the premolars morphology provided a more reliable taxonomic affiliation of this fossil hominin. The constructed sequence illustrating the position of the Selungur hominins in the evolutionary continuity of *Homo habilis*, *H. erectus*, *H. s. neanderthalensis*, and *H. s. sapiens* shows that this individual occupies a position between paleoanthropes and archanthropes. At the same time, this individual deviates significantly from the general evolutionary lineage owing to the exceptionally large buccolingual diameter of the crown (Islamov, Zubov, Kharitonov, 1988; Zubov, Khodzhayov, 1997), which brings these finds closer to the Denisovans.

Selungur cave also provided the low half of the diaphysis and the lower epiphysis of the humerus of a fossil human. Based on the fusion of the block with the diaphysis, V.M. Kharitonov estimated the age of the individual as close to 10 years old by modern standards (Islamov, Zubov, Kharitonov, 1988). Hence, this hominin was close in age to the Teshik-Tash boy. Comparison of the Selungur humerus with that from Teshik-Tash revealed the greater robusticity of the former. The index reflecting the ratio of the minimum thickness of the medullary cavity to the diameter of the diaphysis (on the radiograph) is 28 % for the Teshik-Tash individual, 28 % for the Sinanthrop, and 15 % for the Selungur individual, which suggests the older age and archaic morphology of the finds from Selungur (Islamov, Krakhmal, 1995: 94).

After the emergence of new anthropological materials in the late 20th to early 21st century and owing to doubts of some researchers about the attribution of the dental finds to the genus *Homo*, A.A. Zubov thoroughly reexamined the Selungur teeth (2009). As a result of his study, Zubov inferred that according to the main traits (robusticity and thickness of the premolar roots, arcuate curvature of their vestibular contour, which is unusual for modern humans, talonid expansion and mesial shift of metaconid, subrectangular shape of the premolar crowns, marked curvature of the root of the upper lateral incisor) the Selungur samples have parallels among the teeth of fossil Pleistocene humans, especially Asian *Homo erectus* (Ibid.: 143). In the paper addressing these findings, he cites the opinion of A.B. Savinetsky, the Head of the Laboratory for Biogeocenology, Historical Ecology, and Evolution of the Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, which opinion is based on the study of Selungur teeth: the hypothesis as to their attribution to deer or bears is untenable (Ibid.).

According to an alternative point of view, the morphological characteristics of the teeth suggest their attribution to deer and cave bears rather than humans; the humerus corresponds to the variability of the parameters of Neanderthals (Viola, Krivoshapkin, 2014). In my view, this conclusion, made by anthropologist B. Viola, is not reliable, because it is not supported by convincing arguments. Zubov is a recognized dental anthropologist in Russia and worldwide of the second half of the 20th to early 21st century. He is the author of a large number of fundamental works, and I am sure he was able to distinguish human teeth from those of bears or deer.

Unfortunately, at the modern stage of research, it is not possible to determine the absolute date of human habitation in Selungur Cave. Taking into account that hominins inhabited the cave for a long time, it seems reasonable to estimate the time of initial occupation of the cave by humans as the Late Middle Pleistocene (MIS 6). The presence of osteological remains of small mammals in the layers is very important for dating the site. A. Markova found out that there were no bones of Early Pleistocene rodents in Selungur Cave (2013). The remains of archaic *Microtus (Neodon)* ex gr. *juldaschi*, which became extinct in the Late Pleistocene, are indicators of the possible age (Velichko et al., 1990). Bone remains of this species of vole were recovered from cultural horizons 3–5, but did not occur in horizon 2. The date of 126 ± 5 ka BP was generated on a piece of travertine from the layer overlying cultural horizon 1 (Ibid.).

In their morphological features, the dental fossils from Selungur Cave differ from those of the Neanderthal, and show similarities with the dentition of Asian *H. erectus*. This inference confirms my hypothesis as to the assimilation of the evolving Denisovans with *H. erectus* in the course of Denisovan dispersal over the territory of Tajikistan. As a result of interbreeding between migrants and locals, the born offspring gained a dentition close to that of Asian *H. erectus* (Derevianko, 2022).

The fact that Denisovans inherited their dental morphology from Asian *H. erectus* is also evidenced by anthropological finds from Obi-Rakhmat Grotto in Uzbekistan (Grot Obi-Rakhmat, 2004). Obi-Rakhmat Grotto is a unique site with a lithic industry obviously based on blade reduction technique and showing similarities with the Denisovan industry of the Final Middle Paleolithic in technical and typological features (Derevianko, 2001, 2022). In layer 16 of the Grotto, anthropological remains were uncovered in association with a 50–60 thousand years old lithic industry of the Middle to Upper Paleolithic transition period. Anthropological finds (OR-1) included six isolated permanent teeth from the maxilla and about 150 small fragments of the skull (Glantz, Viola, Chikisheva, 2004; Viola, Seidler, Nadden, 2004; Glantz et al., 2008; Bailey et al., 2008).

Anthropologists attributed all the dental finds to a single individual, and determined his age as ca 9–12 years old. They noted the archaic morphology of OR-1, expressed in larger bucco-lingual sizes of the dentition. Such sizes are typical of Early Pleistocene hominins, including *H. erectus* (Glantz et al., 2008). Anthropologists have not come to a definitive conclusion about the taxonomic affiliation of the anthropological finds from Obi-Rakhmat. They write: "Given current models of late Pleistocene hominin systematics… we are left with either identifying OR-1 as a Neandertal or a modern human" (Ibid.: 235). Anthropologists note that the ear labyrinth morphology of the OR-1 individual was close to the Neanderthal type. But in this case, this similarity is not a proof, because the Neanderthal morphology of the bony ear labyrinth is also observed in some Upper Paleolithic humans, for example, in Sungir (Razhev et al., 2024). The Neanderthal dentition is completely different from that of OR-1, closer to the Denisovans; hence, it should be identified as a Denisovan. The OR-1 fossil cannot be classified as a Neanderthal also because Teshik-Tash Cave contains the Mousterian industry, while Obi-Rakhmat Grotto demonstrates the typical Denisovan Middle Paleolithic industry—starting from the lower cultural layer and up to layer 16 containing anthropological finds. Thus, we have every reason to assert that Obi-Rakhmat Cave, from the very start of its occupation by humans ca 80 ka BP, was inhabited by genetically and morphologically mature Denisovans (Derevianko, 2022).

In the Late Middle to the first half of the Upper Pleistocene, the evolving Denisovan taxon settled not only in Central Asia, but also in adjacent regions. This assumption is confirmed by the Xiahe hominin mandible, ca 160 thousand years old, from Baishiya Cave in the Chinese Province of Gansu, northeastern Tibet; the fossil was identified as Denisovan based on morphological and genetic traits (Chen et al., 2019; Zhang et al., 2020).

Baishiya Cave is located at the northeastern edge of the Tibetan Plateau, at an altitude of 3280 m above sea level. Denisovan DNA was extracted from several lithological layers of the site; hence, it was established that these hominins lived in the cave in the chronological range of at least 100–60 ka BP. Denisovan mtDNA is also present in lithological layers dating back to 30–50 ka BP, but given the character of sedimentation, researchers are not sure whether the Denisovans survived in the cave until the arrival of modern humans 40–30 ka BP (Zhang et al., 2020). In my opinion, Denisovans could have lived in Baishiya Cave, as in Denisova Cave, up to 40 ka BP.

Notably, Denisovans shared not only morphological characteristics with hominins inhabiting Tibet in the Pleistocene, but also genetic traits with modern population. A particular feature of the genetic code of the indigenous population of Tibet is a specific variation in the EPAS1 gene, which is responsible for human adaptation to high-altitude hypoxia. Comparison of the DNA of Tibetans and Denisovans has shown that the Tibet people are genetically much closer to Denisovans than other modern people, and the mechanism of adaptation to high-altitude environment was launched thanks to the genes inherited from Denisovans (Huerta-Sánchez et al., 2014).

Sequencing of DNA extracted from the Xiahe fossil and from modern Tibetans has confirmed the conclusion that during their dispersal over Central Asia and adjacent regions, including highlands, the early Denisovans gained some archaic morphological features as a result of assimilating the indigenous population (*H. erectus*); and the adaptation to living at high altitudes resulted in the development of a gene providing them with the ability to withstand hypoxia.

Neanderthals migrated from the Middle East to Central Asia ca 60 ka BP. In Central Asia, Neanderthal remains and the Mousterian industry were recorded only at Teshik-Tash Cave. In the territory of Tajikistan, no undoubted Neanderthal remains have been found.

At the site of Khudji, in 1997, the crown of a lower right deciduous tooth with a part of root was discovered, which belonged to a 3–5 (max. 7) years old child. The crown is heavily worn; its dimensions correspond to the average size of Neanderthal teeth. It differs from many Neanderthal teeth in the extremely weak development of the marginal ridges and lingual cusp (Trinkaus, Ranov, Laukhin, 2000). E. Trinkaus attributed this anthropological find to Neanderthals, and A.A. Zubov and N.I. Khaldeeva (1989; Zubov, 2004), to archaic *H. sapiens*. The taxonomic affiliation of this uninformative find is disputable, because the above-mentioned chronological stage was associated with only two taxa—modern humans and Neanderthals. Furthermore, the Khudji industry differs from the Teshik-Tash and the Mousterian of European Neanderthals. The question as to the taxonomic affiliation of the Khudji fossil remains open. Hopefully, in the future, fossil remains of modern humans and Neanderthals will be discovered in the territory of Tajikistan, which will provide the opportunity to distinguish between the sites dated to the second half of the Upper Pleistocene in this region on the basis of taxonomic affiliations of their inhabitants.

Unfortunately, in Tajikistan, the sparsity of sites with reliable and continuous chronology corresponding to the second half of the Middle and Upper Pleistocene makes it impossible to trace the development of the Middle Paleolithic industry. However, from my point of view, the available material suggests that 400–350 ka BP, this territory was inhabited by some part of the *H. heidelbergensis* population that migrated through the Iranian Plateau to Central Asia; as a result of the assimilation with indigenous population (*H. erectus*), natural selection, and adaptation to changing environment, a new taxon was formed—*H. s. denisovan*.

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Raptorial Birds as Taphonomic Agents for Small Mammal Remains in Pleistocene Deposits at Tsagaan Agui Cave, Mongolia

The study assesses the role of raptorial birds in the formation of small mammal taphocoenosis at Tsagaan Agui Cave in the Gobi Altai region of Mongolia and reconstructs paleoclimatic conditions there through the composition of small mammalian remains in layers 4 and 5.1–5.3 of the cave's Main Chamber. Concentrations of small mammal bones were revealed in these layers in excavation pit 2 during our 2022 and 2023 field seasons. We hypothesize that these concentrations are correlated with nests of large raptorial birds in the ceiling of the cave. We employed mathematical statistics, the R software environment, and generated graphs to reveal the boundaries of these concentrations and explain differences in the patterns of their accumulation between lithological layers. Sedimentation in excavation pit 2 was disturbed by water inflowing from a chimney in the cave ceiling, which was the source of red sediments from the surface of the surrounding limestone massif. Our results indicate that raptorial birds played a pivotal role in the accumulation of small mammal remains in layers 4 and 5.1–5.3. These concentrations, located in only one area, suggest that they are the remains of prey species rather than resulting from the activity of these animals inside the cave. The taxonomic composition of the small mammals recovered from Tsagaan Agui layers 4 and 5.1–5.3 indicates stable climatic conditions during their accumulation despite a considerable hiatus in the sedimentation cycle. Most species in these concentrations are inhabitants of open stony semi-desert landscapes or dry steppes with exposed cliffs.

Keywords: *Mongolia, taphocoenosis, cave, small mammals, spatial distribution, kernel density estimation.*

Introduction

The taphocoenosis of Tsagaan Agui Cave is a unique source of paleontological data for the reconstruction of animal and human behavior, the evolution of vertebrate species, and changes within the faunal complex of the Gobi Altai during the Pleistocene. The cave has 13 layers in the Entrance Grotto, and 14 layers in the Main Chamber and the Entrance Terrace. The sediments in the Main Chamber contain archaeological material dating to the Upper (layers 2.1–3) and Middle (layers 4–14) Paleolithic. The remains of small mammals from this site have not previously been the subject of detailed study. This paper examines the concentrations of rodent and lagomorph bones associated with the activities of raptorial birds, revealed through analysis of spatial distribution and the application of statistical methods. Such phenomena are rare in cave records owing to the specificity of sediment accumulation, so avian predators have rarely been studied as the agents of cave taphocoenoses, that is, the animals that influence the accumulation, preservation, and integrity of taphonomic remains (Lyman, 2002; Wolverton, Nagaoka, 2018). The most easily identifiable eagle-owl niches (Ovodov, Martynovich, Nadakhovsky, 1998) are found around Tsagaan Agui Cave in modern times (Martynovich, 2002). Eagle-owls inhabit mostly small rock shelters and grottoes, but in Austria *Bubo Bubo* and representatives of the eagle family were the agents of Pleistocene taphocoenoses in several caves (Fladerer et al., 2023). The accumulation of the remains of hares and pikas is associated with their activities. In Portugal, bearded vulture (*Gypaetus barbatus*) coprolites were found in the sediments of Lagar Velho rock shelter, which is interpreted as a breeding site of this raptor ca. 29,000 cal BP (Sanz et al., 2023). The bones from their pellets and coprolites point to the consumption of small to medium-sized ungulates.

In most cases, the study of birds in caves is limited to their taxonomy, without reconstructing their influence on the formation of taphocoenoses. The latter is important for understanding the role of various agents—raptorial birds, mammalian predators (e.g., hyenas, wolves, foxes, sables, and felids), and humans—in the accumulation of bones and their possible modification at cave sites. Another important aspect is the reconstruction of the composition of small mammal faunas in the microregion studied, since avian predators were collectors of fauna from quite extensive areas around caves.

We assume that raptorial birds had nests in the chimney in the ceiling of Tsagaan Agui Cave. These nests began functioning at the time of accumulation of layers 4–5.1 in excavation pit 2 in the Main Chamber. The principal accumulation of the remains of small mammals in these stratigraphic units is a consequence of the pellets they left behind. During the formation of layer 3, the inflow of water and sedimentary material from the chimney intensified, which is demonstrated by the thickness of the associated sediments. Obviously, for that reason, no more nests were built there. The area below the chimney is identified in sedimentary layers as a compact concentration of bones of mainly hares and rodents, including those from the gastrointestinal tract (hereinafter, GIT), without any coprolites. Such a diet is characteristic of raptorial birds smaller than vultures—large scavengers, whose menu includes medium-sized ungulates (Ibid.). The hare remains in the cave are probably also associated with the activities of foxes and humans. Here, we demonstrate the presence of avian nests in the chimney at Tsagaan Agui Cave by explaining the specificity of the accumulation of faunal remains using analysis of spatial distribution and mathematical statistics. The taxonomic identification of small mammals and amphibians has made it possible to create a preliminary reconstruction of paleogeographic conditions that prevailed in the vicinity of the cave.

Material and methods

Tsagaan Agui Cave is located in Bayankhongor *aimag*, 42 km northeast of the Bayanlig *sum* center (44°42′53.3″ N, 101°10′13.4″ E), in the Tsagaan Tsakhir limestone massif, which is a part of the Gobi Altai mountain system, southwest of the Baga Bogd Uul range (Fig. 1). This area in southern Mongolia borders northwest China. It is currently inhabited by desert and semi-desert faunas and is characterized by severe changes in the diurnal-nocturnal temperature regime. The cave was initially studied in 1987–1989 and 1995–2000 (Derevianko, Petrin, 1995; Derevianko et al., 2000). In 2021–2023, we investigated the sedimentary sequence in excavation pit 2 of the cave's Main Chamber over an area of 4 m^2 (sq. A′18, B′18, A′19, B′19), which yielded the principal material analyzed here. Judging by the profile of the adjacent longitudinal section of the cave, the stratigraphy of the excavation pit includes 13 layers and sublayers, but the sediments have been excavated only down to layer 8 thus far. An important factor influencing the formation of the taphocoenosis in this part of the cave was the chimney in the ceiling of the cave, extending to the surface of the limestone massif (Fig. 2). The formation of such features is attributed to various karstic processes (Ford, Williams, 2007: 41; James, Banner, Hardt, 2014; Lavrova, 2020). We identified traces of presumed avian nesting behavior in Middle Paleolithic layers 4 and 5.1–5.3, which incorporate a considerable hiatus in the sedimentation cycle. The fourth layer is the lowest in the aeolian stack of layers 2.1–4.

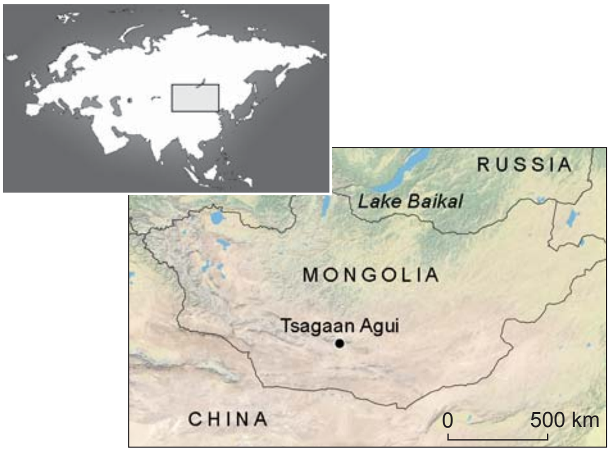

Fig. 1. Location of Tsagaan Agui Cave, Mongolia.

It was buried very quickly, as is evidenced by the bones of an equid found in correct anatomical position, as well as by the pattern of lithic artifact deposition. In sq. A′18 and B′18, the period of accumulation of layers 2.1–4 was a time of active water and sediment influx through the chimney. The sediments are bright orange in color because of the high content of incoming limestone erosion products, densely cemented, include large carbonate concretions, and are devoid of archaeological and paleontological remains. The boundary of these sediments with the undisturbed layers is marked by a manganese lens that can be traced both horizontally and vertically.

During the 2022 and 2023 field seasons, layer 5 in excavation pit 2 was divided into three separate lithologic structures—5.1, 5.2, and 5.3. The uppermost layer in this sedimentary unit was subjected to erosion unrelated to the chimney. The opening in the cave's ceiling already existed during the formation of layers 5.1–5.3; however, the inflow through it was insignificant, and *terra rossa* from the weathered surface of the massif is absent. The boundary between layers 4 and 5.1 is indistinct despite their different genesis: there are lenses visible in plan view, but they are not apparent in vertical profiles. They may indicate the erosion of later sediments prior to the accumulation of layer 4.

In the undisturbed layers of excavation pit 2 in Tsagaan Agui Cave, in addition to skeletal remains, there are hyena coprolites and bones processed in the GITs of hyenas and raptorial birds. The paleontological analysis of bones from GITs, as well as the type of erosion noted on the surfaces of the bone fragments, allowed us to categorize them into those digested by the hyenas, and those by raptorial birds. The diet of hyenas consisted of large and, less often, medium-sized ungulates. The bones of horses, mountain goats, woolly rhinoceros, and an undetermined bovid have been identified. Large raptorial birds also inhabited the cave and its vicinity. The rostrum of a presumed member of the Accipitridae was recovered in layer 3. At present, accipitrids do not permanently inhabit the cave, but some small birds nest in the chimney, and the remains of their life activities fall on sq. B′19 and are scattered to neighboring areas. To track the modern Tsagaan Agui fauna, we installed a camera trap. It recorded visits to the cave by a kestrel (a small falconiform raptor), Strigidae (owl), tolai hare, and pika (Fig. 3).

To test our hypothesis as to the existence of bird nests in the chimney above sq. B′19, we studied the small mammalian fauna from our 2021 and 2022 excavations of sq. B′18 (layer 4) and sq. A′19 and B′19 (layers 5.1–5.3). To recover faunal remains, all the excavated sediment was first dry-sieved, then washed

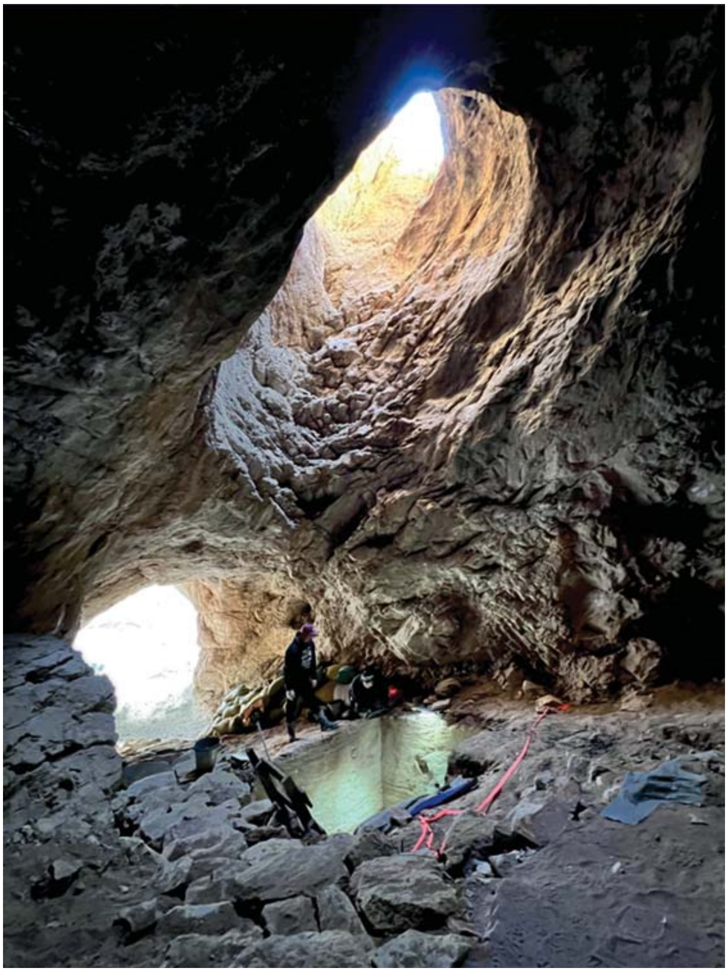

Fig. 2. East-west view of excavation pit 2 and the chimney above it in the Main Chamber of Tsagaan Agui Cave.

Fig. 3. Images taken between 2022 and 2023 by a camera trap installed in the cave's Entrance Terrace.
1 – tolai hare *Lepus tolai*; *2* – female kestrel *Falco* sp. *(F. tinnunculus?);* 3 – Strigidae (owl).

through screens with a 1.4 mm mesh, and dried. The resulting concentrate was sorted in the field using a Nikon binocular microscope. Additionally, rodent teeth were cleaned in the laboratory in a PSB-Gals ultrasonic bath. Further taphonomic and morphologic studies of faunal materials were carried out using a Leica MZ16 stereomicroscope (with coupled AxioCam ERc 5s digital camera). The taxonomic affiliation of 368 specimens, mostly teeth and jaws of small mammals and frogs, was identified to three orders—Anura, Lagomorpha, and Rodentia (see *Table*). The fossil bone assemblage was highly fragmented and consisted mainly of isolated teeth. Therefore, special attention was paid to the recording of postmortem changes of the bone and dental surfaces (Andrews, 1990: 1–22, 45–88; Fernández-Jalvo, Andrews, 1992; López, Chiavazza, 2019; Royer et al., 2019).

Postcranial bones of hares, pikas, jerboas, and hamsters from sq. B′19 and A′19 were identified and counted separately as part of the zooarchaeological analysis of all mammalian remains from Tsagaan Agui Cave. These are absent from the accompanying table but are included in the database for the construction of artifact density maps. Some hare bones were excavated individually, but most were recovered from sediment sieving operations. In the upper part of the section (layers 1–3), these finds were individual finds. Most of the identified hare bones were recovered from layers 4 (n=933) and 5.1–5.3 (n=612). In the underlying layers 6 and 7 such remains were an order of magnitude scarcer (n=66 and 21, respectively). The concentration of bones in sq. B′19 was located at the boundary of layers 4 and 5.1, resting on limestone cobbles whose coordinates were recorded during excavation, allowing us to trace their outlines on both plan and profile views (Fig. 4, *a*, *b*).

To study the pattern of distribution of hare bones in the cave sediments, we plotted all coordinates of the sieved soil where hare bones had been identified on the profile (Fig. 4, *a*) and plan (Fig. 4, *b*) views. We also plotted the points where hare bones were recovered separately. This enabled us to obtain a general idea of the distribution of these finds. Each excavated square meter was divided into four sub-squares, each having received an additional distinct numerical designation (Fig. 4, *b*). Thus, the soil subjected to sieving was collected from an area of 0.25 m^2.

The distribution of hare bones in layers 4 and 5.1–5.3 was plotted by constructing bone density maps and by using kernel density estimation statistics (Beardah, Baxter, 1996; Larionova, 2019: 49; Spagnolo et al., 2020). Since most hare bones derived from soil sieving operations, estimating their number per unit area (0.5 × 0.5 m subsquare) was deemed a valid approach. The coordinates of finds within each sub-square were set randomly by the Excel function RANDBETWEEN. Based on this dataset, density maps were constructed and kernel density calculated with a scale of 0.25 m^2. These calculations were carried out in the R software environment, using the spatstat package (R Core Team, 2023; Baddeley, Turner, 2005).

Species composition of small mammals and amphibians, based on dentition recovered from Layers 4 and 5.1–5.3 at Tsagaan Agui Cave

Taxonomy	Layer 4			Layers 5.1–5.3	
	Sq. B′18	Sq. A′19	Sq. B′19	Sq. A′19	Sq. B′19
Ranidae – true frogs	–	1	–	–	2
Lepus sp. L. – hares	–	–	–	–	2
Lepus cf. *tolai* Pall. – tolai hare	–	–	–	–	3
Ochotona sp. Link – pikas	–	3	16	2	55
Ochotona cf. *daurica* Pall. – Daurian pika	–	–	–	5	2
Ochotona daurica Pall. – Daurian pika	–	–	–	–	8
Spermophilus sp. F. Cuv. – ground squirrels	–	–	–	–	5
Dipodidae – jerboas	–	–	–	–	13
Allactaga sp. F. Cuv – five-toed jerboas	–	2	10	–	15
Allactaga cf. *sibirica* Forst. – Mongolian five-toed jerboa	–	–	4	–	7
Allactaga cf. *bullata* Allen – Gobi jerboa	–	1	2	–	18
Dipodinae – three-toed jerboas	–	1	–	–	–
Dipus sp. Gmel. – northern three-toed jerboas	–	1	4	–	19
Dipus sagitta Pall.– northern three-toed jerboa	–	–	13	–	–
Cricetidae – hamsters, voles, lemmings, etc.	–	–	2	–	9
Cricetulus sp. Milne-Edw. – grey dwarf hamsters	3	1	15	–	39
Cricetulus cf. *migratorius* Pall. – grey dwarf hamster	–	–	–	–	5
Allocricetulus sp. Argyr. – hamsters	–	1	–	–	–
Ellobius cf. *tancrei* Pall. – northern mole vole	–	–	–	–	1
Meriones sp. Ill. – gerbils	–	–	–	–	1
Alticola sp. Blanf. – mountain voles	–	3	3	1	16
Alticola cf. *argentatus* Severtz. – silver mountain vole	–	–	–	–	3
Alticola cf. *barakshin* Bannikov – Gobi Altai mountain vole	–	–	–	–	1
Eolagurus sp. Argyr – yellow steppe lemmings	–	1	1	–	16
Eolagurus luteus Eversm. – yellow steppe lemming	–	3	7	–	9
Eolagurus przewalskii Büchner – Przewalski's steppe lemming	–	–	–	–	6
Eolagurus cf. *simplicidens* – fossil steppe lemmings	–	–	–	–	2
Microtus sp. Schrank – common field voles	–	–	–	1	6
Total	3	18	77	9	263

Results

Layer 4, that presumably includes avian pellets from nests, dates to ca. 45,000 cal BP. The chronology of the accumulation of the underlying layer 5 remains unclear but, most likely, it is much older. Studies undertaken in 1995–2000 yielded a date of 227 ± 57 ka BP for this layer through the application of an experimental radiothermoluminescence (RTL) method (Derevianko et al., 2000). The archaeological assemblages found in these layers are also heterochronous. The lithic materials from layer 4 belong to the Final Middle Paleolithic, whereas the underlying assemblages exhibit a more archaic appearance, including bipolar flaking and early forms of the Levallois reduction technique (Khatsenovich et al., 2022).

The bones from the studied sediments are highly fragmented. Some teeth of hares and rodents of the jerboa and hamster families have remained in place in fragmentary mandibles. The rest occurred as isolates. No complete skulls were recovered. The color of the bones is heterogeneous, ranging from yellow-brown to ash-brown. Some bones exhibit mineral formations in the form of black spots. The taxonomic identification of small mammals to species, and the differentiation of Upper and Middle Pleistocene forms, are still difficult because of

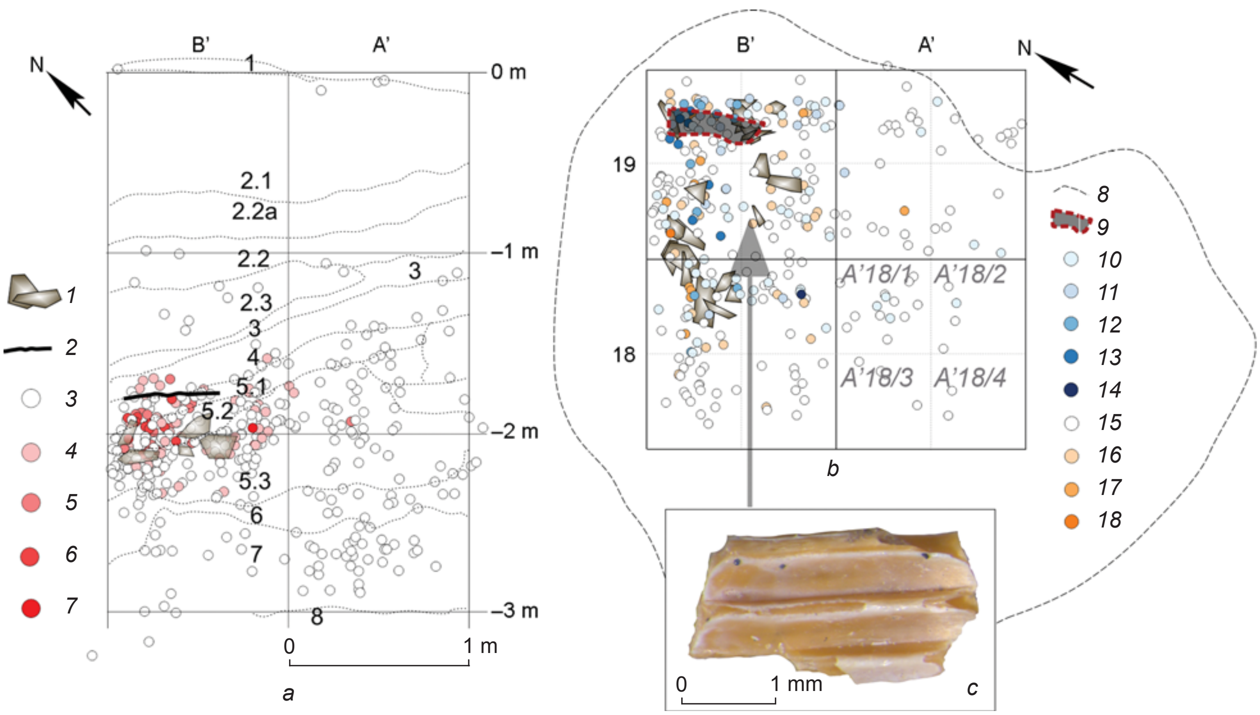

Fig. 4. Stratigraphic profile of the eastern wall (*a*), and plan (*b*) of excavation pit 2, with a projection of captured points of sieved soil and an indication of the number of hare bones; small mammal tooth with traces of digestive enzymes on the enamel (*c*).

1 – large stones; *2* – upper contour of the concentration of pellets in the profile; *3–7* – number of hare bones in the sieved soil: *3* – 1–4, *4* – 5–15, *5* – 16–32, *6* – 33–68, *7* – 69–117; *8* – projection of the opening of the chimney; *9* – upper contour of the concentration of pellets on the plan; *10–14* – number of hare bones, layer 4: *10* – 1–4, *11* – 5–11, *12* – 12–32, *13* – 33–52, *14* – 53–117; *15–18* – number of hare bones, layers 5.1–5.3: *15* – 1–4, *16* – 5–13; *17* – 14–40, *18* – 41–68.

the small sample size and limitations of the comparative osteological collection currently available.

Importantly, most teeth demonstrate changes in their enamel surfaces because of stomach acid of carnivorous mammals or raptorial birds (Fig. 4, *c*). These specimens exhibit partially dissolved enamel, rough surfaces, and partially rounded morphologies. This indicates that the fossil remains of rodents in sq. A′19 and B′19 accumulated as the result of predator activity.

The vertebrate remains are unevenly distributed throughout the excavations. The largest number was recovered from layers 5.1–5.3 in sq. B′19. A significant number of jerboas and pikas were identified from this square: 27 % and 24 % of the faunal assemblages, respectively. These species likely comprised a significant component of the diet of both avian and quadrupedal predators. The large amount of jerboa and pika remains also attests to the abundance of these mammals.

The distribution of hare bones in layers 4 and 5.1–5.3 differs considerably, despite the common genesis of these fossil remains, associated with the pellets of raptorial birds. Their concentration is highest in layer 4, and an absolute majority of them was recorded in Subsquare B′19/1 (Fig. 5, *a*, *b*). In layers 5.1–5.3, the hare concentration remains present, but the center of its distribution is shifted to the west (sq. B′19/3), and it contains almost three times fewer bones than the center of the concentration in layer 4 (see Fig. 5, *a* and *c*, *b* and *d*). Furthermore, in layers 5.1–5.3, these remains occur throughout almost the entire excavation area (Fig. 5, *c*).

Judging by the results obtained, the concentration of avian pellets in layer 4 is the best preserved. The opening of the chimney led to the bedding of "empty" red sediments in sq. B′18, which probably explains its shape (Fig. 5, *a*, *b*). In layers 5.1–5.3, which were formed under aquatic conditions, the moist environment accelerated the erosion of the concentration of small mammal remains and their areal distribution. The presence of large stones at the base of the concentration prevented its complete destruction, but a small number of hare bones fell outside the accumulation (sq. B′18/2–4, A′19, A′18/1, and A′18/3), probably owing to the shifting of sediments.

Discussion

Comparison of the highest concentrations of hare bones and the accumulation of stones in layers 5.1–5.3

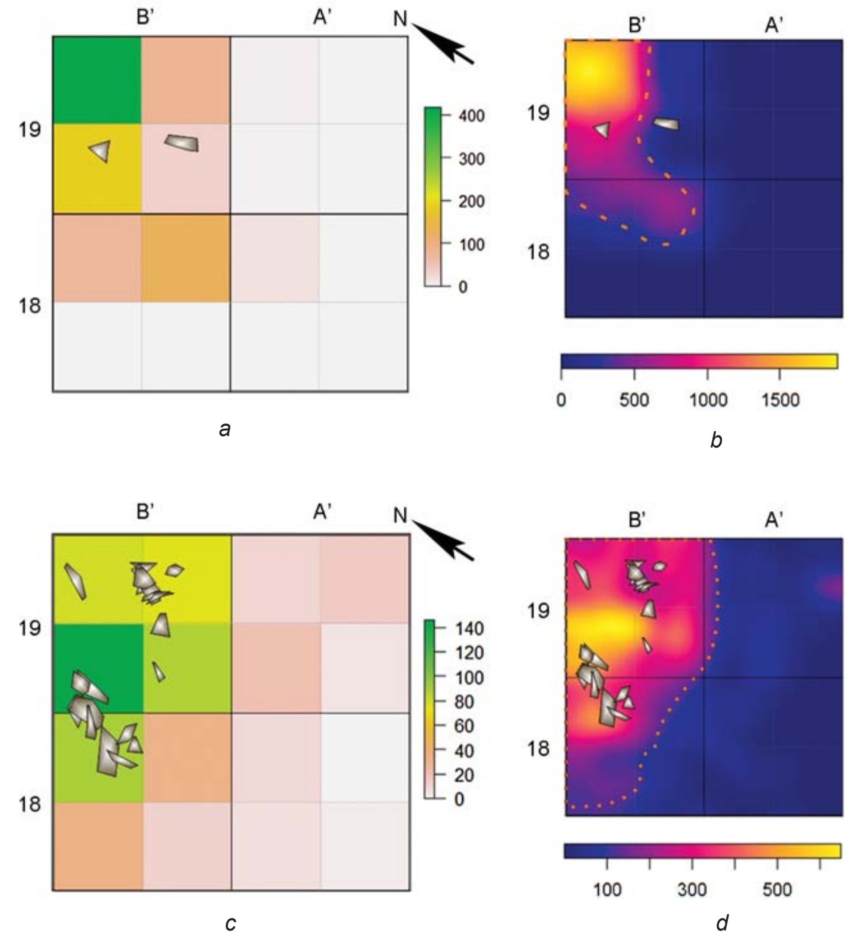

Fig. 5. Results of the analysis of density distribution of hare bones in layers 4 (*a*, *b*) and 5.1–5.3 (*c*, *d*).
a, *c* – density maps for 0.5 × 0.5 m subsquares; *b*, *d* – kernel density estimation.

allows us to propose the following reconstruction (Fig. 6, *a*). Most avian nests were located above the B′19/1 and B′19/3 subsquares, where most of the bones of small animals were concentrated. The clearest boundary of the zone of their concentration was recorded during excavations on the southeastern side of the units (sq. B′19/1 and B′19/3) where a concentration of stones remained. The southwestern part of this zone in layer 4 appeared to be cut off, apparently related to inflow from the chimney that introduced cemented bright orange sediments in sq. B′18 (Fig. 6, *a*). The contents of the lower part of the concentration of pellets, extending into the moister layers 5.1–5.3, were dispersed over a larger area. This possibly explains the relatively low proportion of hare bones in the concentration and

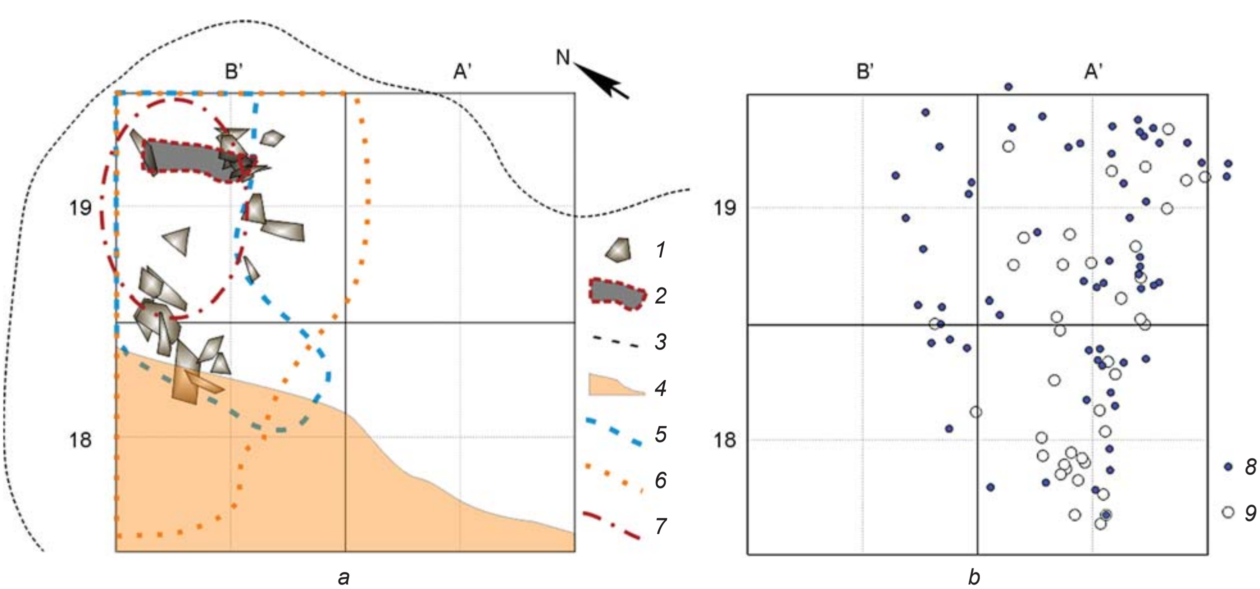

Fig. 6. Reconstruction of the locations of nests above excavation pit 2 and concentrations of small mammal remains in layers 4 and 5.1–5.3 (*a*); plan of distribution of hare bones in layer 6 (*b*).
1 – large stones; *2* – upper contour of the concentration of pellets; *3* – projection of the opening of the chimney; *4* – sediments delivered through the chimney into layer 4; *5*, *6* – boundaries of concentrations in layers 4 and 5.1–5.3, respectively; *7* – reconstruction of the location of avian nests above excavation pit 2; *8* – lithic artifacts in layer 6; *9* – hare bones in sieved soil (1–4 spec.).

beyond. Based upon the slope of the sediments, erosion of pellet contents may have occurred both towards the cave entrance and the cave walls. Another factor in the dispersion of bone concentrations across the area of excavation pit 2 may have been the activity of foxes, whose remains increased in layers 5.1–5.3.

Our analysis suggests several explanations for the formation of the studied accumulation of small mammal remains in Tsagaan Agui. Most likely, their accumulation may be correlated with the presence of raptorial bird nests during the accumulation of layers 4 and 5.1–5.3. Thus, the concentrations of hare bones in layers 4 and 5.1–5.3 are the result of the same mechanism and the differences in their distribution are associated with post-depositional changes that affected layer 4 to a lesser extent.

Perhaps the large concentration of stones in layers 5.1–5.3 combined with moister conditions led to the deformation of underlying sandy layer 6, which is recorded not only in the stratigraphic profile but also in the distribution of finds. All these materials, including hare bones, are displaced towards the central axis of the cave, leaving the line of the B′ squares nearly empty (Fig. 6, *b*). Notably, one hare bone bears possible traces of anthropogenic butchering.

Our analysis of small mammal remains has yielded preliminary paleogeographic reconstructions for the time of accumulation of layers 4 and 5.1–5.3. As we know, rodents and hares, owing to their biological and ecological features (especially their relatively short life-cycle, ability to reach high population sizes, and respond to environmental changes), provide convincing material to characterize their living conditions (Erbaeva, 1970: 27–28).

The general appearance of the fossil rodent and hare fauna in the vicinity of Tsagaan Agui Cave is similar to the modern one. The ratio of small mammalian species suggests that in the Middle to Upper Pleistocene in central Mongolia, most species were preferential inhabitants of open semi-desert landscapes or dry steppes with exposed rock formations.

In Mongolia, jerboas inhabit steppes and semi-deserts of various types, avoiding areas with dense grass. In places where semi-desert turns into desert, Siberian jerboas stick to steppe areas and completely disappear in the true desert (Bannikov, 1954: 205) but continue to occur in clay and rubble desert conditions (Mlekopitayushchiye Kazakhstana, 1978: 250–251). The five-toed jerboas also inhabit rocky, saltwort, and shrub deserts, avoiding sandy areas (Bannikov, 1954: 224). The feather-footed jerboas are typical inhabitants of barchan sand dunes. They settle not only in bare barchans but also in shrubby sands (Vinogradov, 1937: 155). The Daurian pika is a typical inhabitant of open semi-desert landscapes. They inhabit a variety of steppe biomes, being most abundant in grassland steppes and in feather-grass and *Artemisia* steppes. The presence of sagebrush in Mongolia determines, to some extent, the relative abundance of Daurian pikas (Bannikov, 1954: 184).

The remains of the yellow steppe lemming are noteworthy, since they were clearly abundant in the vicinity of the cave during the Late Middle Pleistocene. A mandible from the Middle Pleistocene species *Eolagurus* cf. *simplicidens* was recovered in layer 5.3. *E. simplicidens* differs from modern *Eolagurus luteus* by exhibiting widely consolidated triangles in the base of the paraconid of the first molar. At present, the yellow steppe lemming is only sporadically found in sandy areas of the Gobi Desert, north to Lake Uvs Nuur (Ibid.: 296), although in the 20th century this species was common in the Pre-Caspian and Kazakhstan deserts and semi-deserts. In the second half of the 19th century, the yellow steppe lemming became extinct in most parts of Kazakhstan. Today, its main area of distribution is in Xinjiang in northwest China (Gromov, Erbaeva, 1995: 428–429). The yellow steppe lemming is known to be sensitive to climatic changes. Its reproduction and activities depend directly on average annual temperatures and precipitation (An et al., 2023). In northern Xinjiang, the yellow steppe lemming is a key desert-steppe species. Current climatic conditions in Mongolia are not favorable for the distribution of this species.

Mountain voles, whose remains were recovered from Tsagaan Agui Cave, usually inhabit mountains and hummocky terrain, and necessarily with exposed rocky cliffs. They live in rock crevices and rarely dig burrows (Mlekopitayushchiye Kazakhstana, 1978: 209). The recovered remains of true frogs indicate the presence of a body of water nearby the cave. The remaining identified small vertebrate taxa—ground squirrels, hamsters, and hares—provide evidence of the existence of open, dry landscapes.

Conclusions

The materials studied from layers 4 and 5.1–5.3 in sq. A′19 and B′19 in Tsagaan Agui Cave testify to the similarity in composition of small mammalian faunas in the Final Upper Pleistocene and at present. Most of the identified genera and species currently inhabit the vicinity of the cave. The diversity of small mammals attracted various raptorial birds which settled in nearby rocky niches and shelters, as well as in the chimney of the cave itself. These raptorial birds greatly influenced the cave's taphocoenosis.

Our findings indicate that large avian predators played a pivotal role in the accumulation of small mammal remains in layers 4 and 5.1–5.3 of excavation pit 2. Since the bones of various species are concentrated in one area (sq. B′19), we assume that these are not related to the activities of these animals in the cave, but originate mainly from the pellets of large raptorial birds that nested in the chimney above excavation pit 2. Some of the bones recovered from layers 5.1–5.3 may also have been brought in or scattered by foxes, since the number of their remains increases here. Interestingly, the concentration of avian pellets was not disturbed by hyenas or humans that inhabited the cave at about the same time.

The taxonomic composition of the mammals suggests relatively stable paleoclimatic conditions during the accumulation of layers 4 and 5.1–5.3 despite a considerable hiatus in the sedimentation cycle. At that time, dry rubble lithophylous semi-deserts prevailed, with small perennial water bodies capable of supporting frog populations. The current climate in the vicinity of the Tsagaan Tsakhir massif is drier, there are no water bodies present, small mammalian species are less diverse, and amphibians are absent.

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A New Approach to the Study of Flaking Sequence Integrity Based on the Chagyrskaya Cave Assemblage, Northwestern Altai

This paper presents a new approach to assessing the integrity of flaking sequences at Paleolithic sites. It combines experimental modeling with subsequent attribute analysis of the archaeological collection. The method is based on changes in the proportion of various technical spalls at different stages of core and bifacial reduction, as well as changes in the sizes of cortical flakes. This methodology was applied to reconstruct the strategy of the use of lithic raw material by late Neanderthals of the Altai, on the basis of the Chagyrskaya Cave assemblage. The study has shown that the most common method, using the proportion of cortical spalls, is not universal, and has limitations due to the structure of lithic industry and the specificity of raw material. When pebbles and boulders of various sizes are used, as in the assemblage from layer 6c/2 of Chagyrskaya Cave, a high proportion of cortical spalls can result from the production of bifacial tools at the site. The study demonstrates that the first stage in core reduction occurred outside the cave. The high proportion of cortical spalls in the assemblage is due to the fact that bifaces were manufactured in situ, whereas tools on cortical flakes and cortical tool blanks had been transported to the site. The study reveals a connection of various technical spalls with stages in core and biface flaking sequences, and their number is evaluated in the cases of complete versus reduced flaking cycles.

Keywords: *Middle Paleolithic, Micoquian/Keilmessergruppen technocomplex, experimental modeling, technical spalls, core reduction, bifacial technology.*

Introduction

The use of lithic raw materials is among the important aspects of the subsistence strategy of prehistoric humans. This issue is associated with a wide range of features determining the functionality of a site, the specifics of primary reduction strategy, and stone tool manufacture (Chabay, 2004: 205–212; Rybin, Kolobova, 2009; Deschamps, Martín-Lerma, Linares-Matás, 2022; Marchenko et al., 2023). In other words, the strategy of selection and utilization of rocks has a strong effect on the typology of a lithic industry. The use of raw materials is determined by such factors as the availability of rocks, their quality, and the types and sizes of pieces (pebbles, nodules, boulders, tablets, etc.) (Chabay, 2004: 211–212; Khatsenovich et al., 2023; Pavlenok et al., 2024).

The primary topic of any analysis of the strategy of lithic raw material use is the integrity of the flaking sequence observed at a site. Primary attention is usually paid to the proportion of artifacts retaining pebble cortex (Dibble, 1995; Lin, 2014: 106–111; Weiss, Otcherednoy, Wiśniewski, 2017; Delpiano, Heasley, Peresani, 2018).

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It is generally accepted that the proportion of ~50 % of spalls with pebble cortex (Doronicheva et al., 2018; Weiss, Otcherednoy, Wiśniewski, 2017), the location of cortex on dorsal surfaces, and the proportion of primary removals exceeding 10 % (Chabai, 2008) point to the primary stages of flaking in situ. In this case, the original form of the rock (pebble, tablet, flint nodule) and its dimensions (and the dimensions of the cortical spalls accordingly) are not usually taken into account.

In this study, we propose a methodological approach based on establishing the dynamics of changes in the proportion of technical flakes at different stages of core and bifacial reduction, as well as changes in the size of cortical spalls. We will show that the accepted criteria for determining the integrity of the primary flaking sequence are not universal. The proposed approach is used to reconstruct the strategy of lithic raw material use by late Neanderthals of the Altai using the materials from Chagyrskaya Cave.

Material and methods

Chagyrskaya Cave is located on the left bank of the Charysh River in the northwestern Altai (Southern Siberia). During excavations in 2007–2020, an archaeological collection containing more than 120 thousand artifacts was assembled. The Middle Paleolithic artifacts were recovered from several archaeological layers (5–6c/2) and formed a single technocomplex. The most common finds were associated with the subdivisions of layer 6 (6a–c/2). The available absolute dates indicate that this layer was accumulated during the terminal stage of MIS 4 to early MIS 3 (Kolobova et al., 2019). Analysis of archaeological and genetic data has shown that the Chagyrskaya Neanderthals arrived in the Altai from Eastern Europe; the population practiced a material culture that was technologically and morphologically similar to the Micoquian/Keilmessergruppen technocomplex of Central and Eastern Europe (Ibid.; Derevianko et al., 2018: 275).

The industry under study is based on the reduction of radial (Levallois "recurrent centripetal", after (Boëda, Geneste, Meignen, 1990)), and orthogonal cores, as well as on the production of plano-convex bifacial tools, including specific backed knives of the Keilmesser type (Kolobova et al., 2019). The Chagyrskaya Neanderthals used local pebbles (effusive rocks, sandstones, hornfels, jasperoids, and other) (Derevianko et al., 2015). The highest quality jasperoids and chalcedonolites of local origin were used in the production of bifacial and some unifacial retouched tools (Kolobova et al., 2019). In addition to the lithic industry, the site yielded numerous bone tools (Kolobova et al., 2020).

We present the analysis of archaeological materials from an area of 12 m^2 in layer 6c/2 of Chagyrskaya Cave during the excavations of 2008–2017. This layer has been chosen because it is characterized as an *in situ* one, with the smallest post-depositional disturbances of sediments as compared to other layers. The total of 796 flakes exceeding 3 cm in the largest dimension has been analyzed.

The analysis has been carried out through a combination of attribute and experimental methods. The experiments were based on the published results of the flaking sequence analysis and technical-typological data providing the information on the Chagyrskaya reduction techniques (Derevianko et al., 2018: 153–186; Kolobova et al., 2019; Shalagina et al., 2020; Kharevich, 2022: 140–143). The experimental flaking was focused on the creation of reference collections associated with two techniques of blank production (radial and orthogonal), and manufacturing plano-convex bifaces, typical of the Sibiryachikha complexes. Knapping was carried out through direct percussion using hard hammerstones of pebbles and boulders from the Charysh alluvium, as well as bone retouchers for trimming the edges of bifacial tools. Cores were mainly small (up to 40 × 30 × 25 cm) boulders of effusive rocks and chalcedonolites. Small boulders and pebbles of jasperoid and chalcedonolite rocks were used in preference in bifacial tool manufacture.

Cataloguing of the experimental flaking was executed through assigning to every removal a code that recorded the serial number of the removal and the surface (flaking surface or striking platform) from which it was detached. All the spalls detached from cores were subdivided into three equal parts by the order of their removal. The first category included the products of the initial stages of flaking (stage 1), mostly those spalls that were detached during the preparation of striking platforms and core flaking surfaces. The other two categories (stages 2 and 3) included removals associated with the serial production of spalls up to the completion of core utilization (exhaustion or discard). Only complete specimens exceeding 3 cm along one of the axes were taken for the analysis. In accordance with the typology adopted for Eastern European Micoquian complexes (Chabai, Demidenko, 1998), spalls of <3 cm are chips. These were excluded from the analysis. The reconstruction of the Sibiryachikha bifacial technology (Shalagina et al., 2019) suggests several stages identified in the manufacturing of bifacial tools: plane and convex façonage and retouching. However, the analysis sample included only the façonage removals, since there were practically no flakes >3 cm at the retouching stage.

The experimental collection includes 190 spalls (target and technical) from four radial cores, 103 removals from three orthogonal cores, and 76 specimens obtained in the manufacture of nine bifacial tools.

An attribute approach was used to describe the archaeological and experimental collections. This approach was based on the typology of technical spalls, used in the analyses of the Micoquian technocomplex (Derevianko et al., 2018: 151–152; Chabai, Demidenko, 1998), as well as such characteristics as spall sizes and the presence of pebble cortex on their dorsal surfaces.

The Mann-Whitney (U) and Pearson (χ^2) criteria were used in the comparative analysis of the archaeological and experimental collections. The Pearson's test is applied to compare the empirical distributions of one or more features in two or more samples. The non-parametric Mann-Whitney test is used to compare the average values of three or more independent samples with a non-normal distribution of quantitative data. It can be applied to extremely small samples ($N \geq 5$) (Lund R.E., Lund J.R., 1983). All statistical tests were carried out in the PAST 3 program (Hammer, Harper, Ryan, 2001).

Technical spalls have a morphology that suggests their position in the flaking sequence of a core or bifacial tool; these are an important and sometimes dominant part of the industry. A characteristic feature of most technical spalls is a subtriangular cross-section (symmetrical or asymmetrical). In Paleolithic studies, two large groups of technical spalls with asymmetric cross-sections are distinguished: core-edge flakes (éclats débordants) and core-edge flakes with a limited back (éclats débordants à dos limité) (Meignen, 1996; Derevianko et al., 2018: 168–171; Bustos-Pérez et al., 2024).

The core-edge flakes are those with one sharp and one lateral steep edge, with the technological flaking axis coinciding with the long axis of flaking (Fig. 1, *1–3*). The lateral steep edge is the result of removal of the core face, and may bear a cortical surface (cortical core-edge flake; Fig. 1, *4*, *5*), a single negative scar of the previous removal (lateral core-edge flake; Fig. 1, *1–3*), or traces of preparation of the core striking-platform (crested or semi-crested core-edge flake; Fig. 1, *6*, *7*) or of the initial crest.

Core-edge flakes with a limited back are characterized by an obtuse angle between the surface of the striking platform and the lateral steep edge, which retains part of the striking platform (Fig. 1, *8*). The long axis of the flake does not coincide with the technological flaking axis (Meignen, 1996; Derevianko et al., 2018: 163; Bustos-Pérez et al., 2024). Such flakes with cortical surfaces of the lateral steep edge are defined as core-edge flakes with a limited back (Fig. 1, *9*), and the triangular-shaped flakes are defined as pseudo-Levallois points (Fig. 1, *10*, *11*).

A technical flake (Kantenabschläge) has a striking platform that is parallel to the surface of the distal part of the flake (Fig. 1, *12*, *13*) (Richter, 1997: 186–187). Such flakes were usually detached during preparation of striking platform.

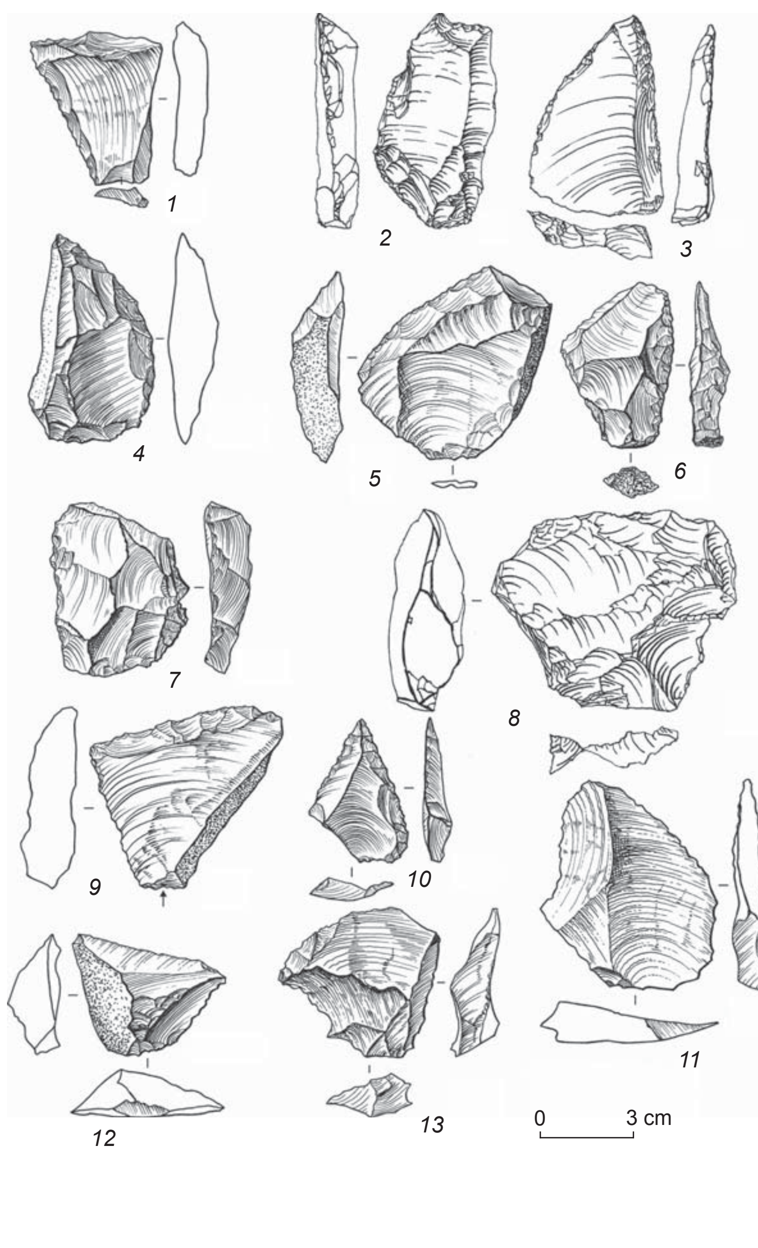

Fig. 1. Technical spalls from layer 6c/2 at Chagyrskaya Cave.
1–3 – lateral core-edge flakes; *4*, *5* – cortical core-edge flakes; *6*, *7* – crested core-edge flakes; *8* – core-edge flake with a limited back; *9* – cortical core-edge flake with a limited back; *10*, *11* – pseudo-Levallois points; *12*, *13* – technical flakes (Kantenabschläge).

Primary spalls retaining pebble cortex over 76–100 % of the overall surface are also classified as technical spalls.

Results of the experimental collection analysis

The general typological composition of the flakes detached through orthogonal, radial, and bifacial reduction is similar to the above (Fig. 2–4). Statistical tests show that the differences existing between them are not significant (see *Table*).

Flakes from radial and orthogonal cores. In the course of the complete flaking sequence, the proportion of flakes (target removals) reaches up to 50 % of the total collection. The category of technical spalls is dominated by primary spalls, core-edge flakes with a limited back, and cortical core-edge flakes (Fig. 2–4).

The main variations in the typological composition of the flakes are linked to the flaking stages; each stage shows a clear pattern. At stage 1, with both the radial and orthogonal methods, primary spalls, flakes, and cortical core-edge flakes predominate; the category of cortical core-edge flakes with a limited back is also significant (see Fig. 2).

At stage 2, with radial flaking, the proportion of flakes increases sharply (by up to 63 %), while the number of various technical spalls retaining pebble cortex (primary spalls, cortical core-edge flakes) decreases. At the same time, there appears a significant number of core-edge flakes with a limited back and lateral core-edge flakes (see Fig. 2). In case of orthogonal flaking, there is no such a sharp increase in the proportion of flakes (44 %), but in general the same trends are noted: the number of primary spalls and cortical core-edge flakes decreases; the numbers of core-edge flakes with a limited back and lateral core-edge flakes are significant. The number of technical flakes (Kantenabschläge) also increases; such flakes are usually the result of striking-platform trimming (see Fig. 3). In the case of radial flaking, the number of technical flakes is minor.

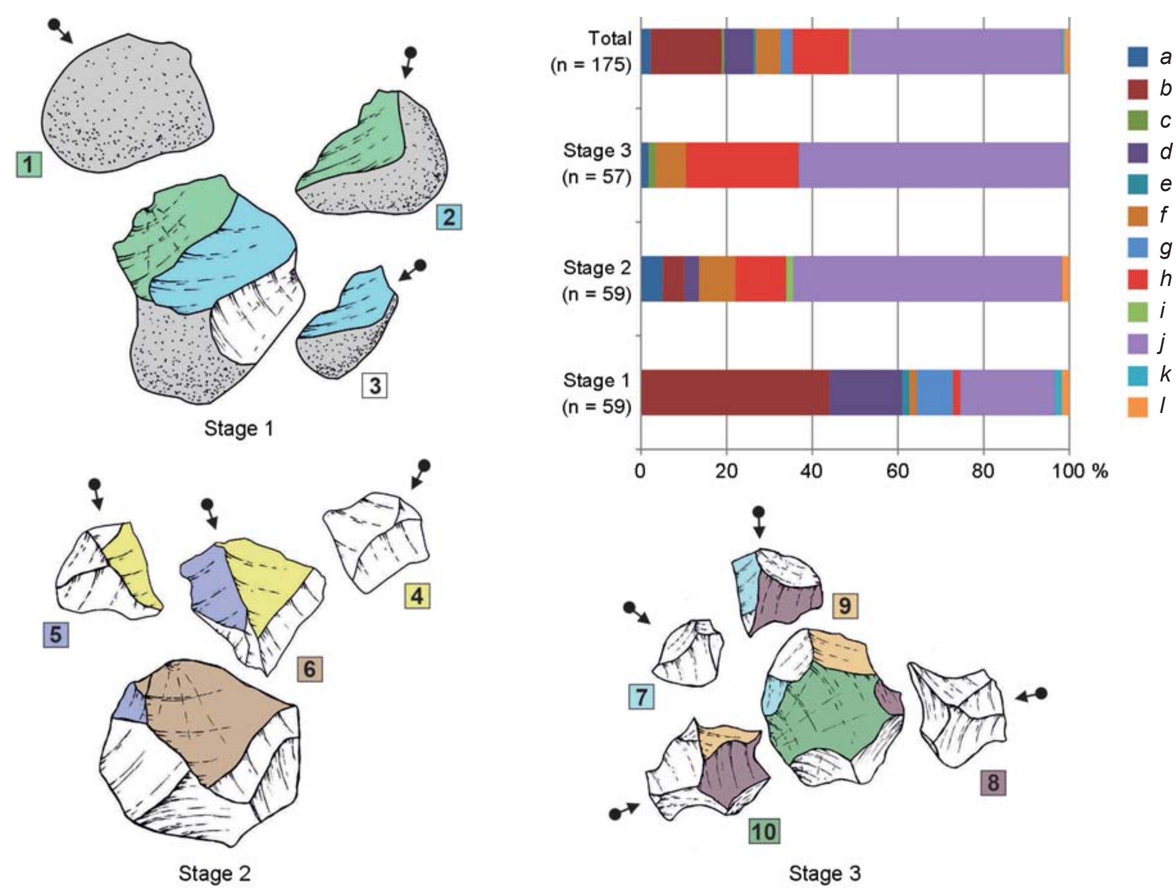

Fig. 2. Reduction pattern for the production of blanks in radial reduction technique, and the typological composition of spalls by stages.
1 – primary spall; 2 – cortical core-edge flake with a limited back; 3 – lateral core-edge flake; 4, 7, 8, 10 – flakes; 5, 9 – core-edge flakes with a limited back; 6 – pseudo-Levallois spall.
a – blades; *b* – primary spalls; *c* – crested spalls; *d* – cortical core-edge flakes; *e* – crested core-edge flakes; *f* – lateral core-edge flakes; *g* – cortical core-edge flakes with a limited back; *h* – core-edge flakes with a limited back; *i* – core-edge flakes with a limited back/technical flakes; *j* – flakes; *k* – pseudo-Levallois spalls; *l* – technical flakes.

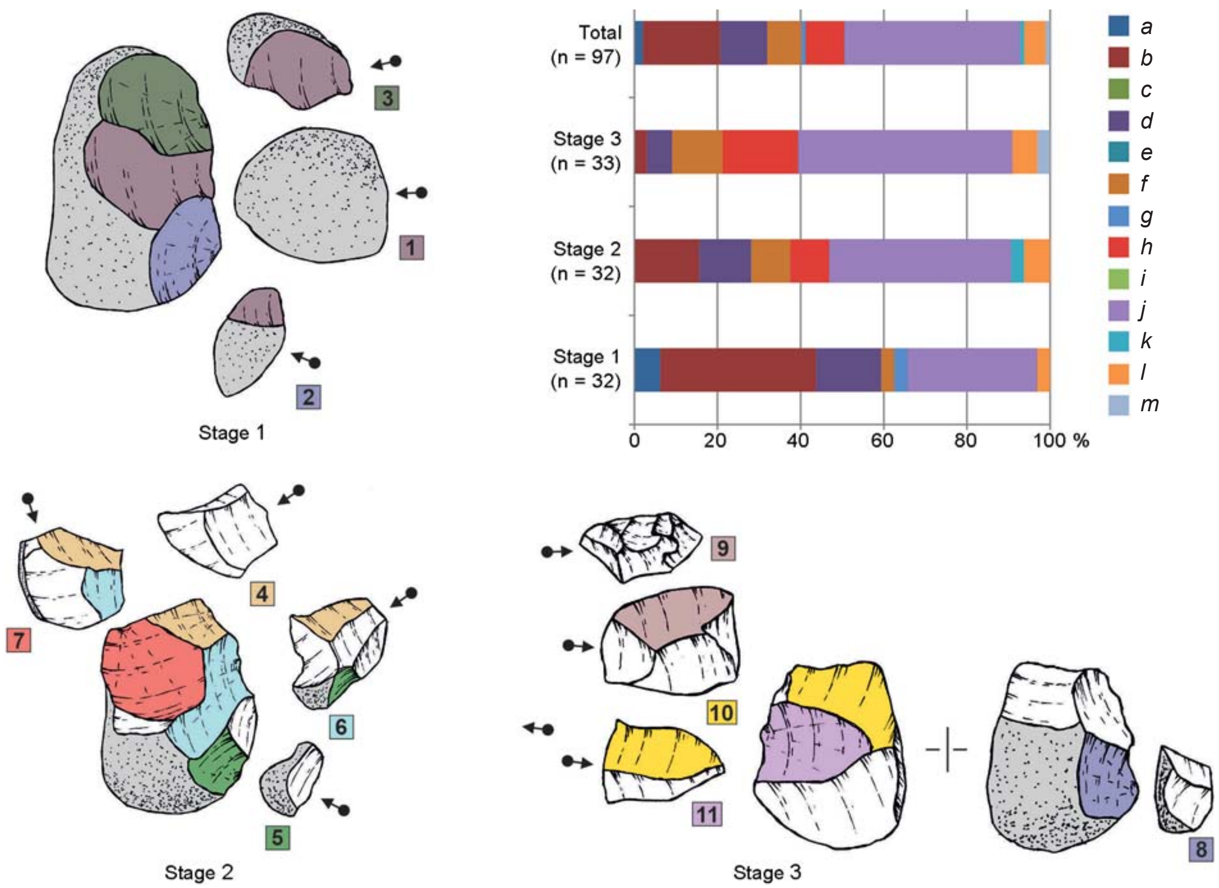

Fig. 3. Reduction pattern for the production of blanks in orthogonal reduction technique, and the typological composition of spalls by stages.
1 – primary spall; 2 – cortical core-edge flake with a limited back; 3, 7 – cortical core-edge flakes; 4–6, 10, 11 – flakes; 8 – technical flake; 9 – semi-crested spall.
a–l – see legend for Fig. 2; *m* – semi-crested spalls.

At stage 3, with radial flaking, the proportion of flakes is stable (63 %), while primary spalls and cortical core-edge flakes disappear completely. Among the technical spalls, core-edge flakes with a limited back predominate, while lateral core-edge flakes are next numerous (see Fig. 2). In the case of orthogonal flaking, there is a tendency towards increasing the number of flakes (52 %), core-edge flakes with a limited back, and lateral core-edge flakes. In contrast to the radial reduction technique, primary spalls and cortical core-edge flakes do not disappear, but their number only decreases. Technical flakes (Kantenabschläge) are also present, and disappear at this stage of radial flaking (see Fig. 3).

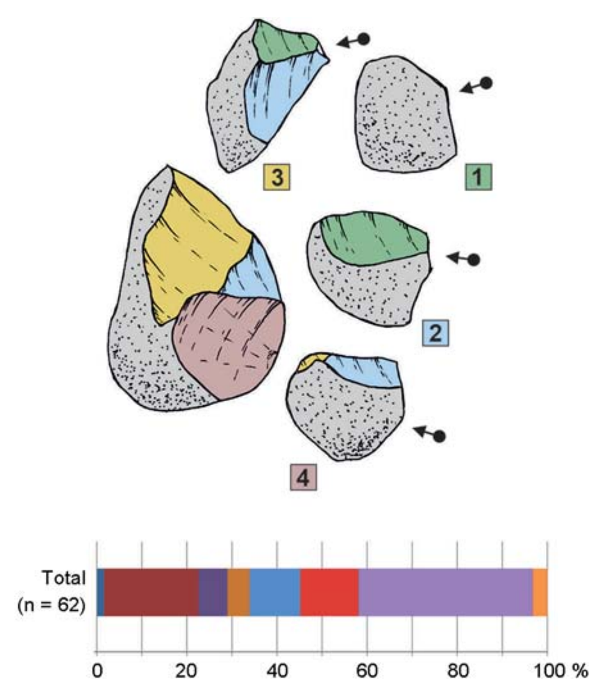

Fig. 4. Reduction pattern for the production of blanks plano-convex processing of bifacial tools, and the typological composition of spalls.
1 – primary spall; 2, 3 – flakes; 4 – cortical core-edge flake with a limited back. Other – see legend for Fig. 2.

Table. **The ratio of the typological composition* of experimental spalls obtained by different reduction methods**

Spalls	Spalls		
	from radial cores	from orthogonal cores	from bifaces
from radial cores	———	$\chi^2 = 12.162$ Df = 12 $p = 0.43279$ Cramer's V = 0.21145	$\chi^2 = 10.773$ Df = 11 $p = 0.4625$ Cramer's V = 0.2132
from orthogonal cores	$\chi^2 = 12.162$ Df = 12 $p = 0.43279$ Cramer's V = 0.21145	———	$\chi^2 = 11.839$ Df = 9 $p = 0.22253$ Cramer's V = 0.27287
from bifaces	$\chi^2 = 10.773$ Df = 11 $p = 0.4625$ Cramer's V = 0.2132	$\chi^2 = 11.839$ Df = 9 $p = 0.22253$ Cramer's V = 0.27287	———

*Blades, primary spalls, crested spalls, cortical core-edge flakes, crested and lateral spalls, core-edge flakes, cortical core-edge and technical spalls from radial cores, flakes, pseudo-Levallois spalls, technical and semi-crested spalls.

Typologically, the flakes detached from flaking surfaces and striking platforms are almost identical. The sizes of spalls from the orthogonal and radial cores are the same. At the same time, their number decreases gradually from the first to the third stage.

Certain patterns have been revealed through the analysis of cortical surfaces on the flakes. In the case of radial flaking, the total of 42 % of flakes retain pebble cortex on their dorsal faces. At stage 1, such flakes amount to 88 %; at stage 2, 27 %; at stage 3, 14 %. Notably, at stage 1, pebble cortex is recorded on the flakes detached from the flaking surfaces and striking platforms; while at stage 2, cortical flakes from the flaking surfaces are quite few; and at stage 3, there are no such flakes.

In the case of orthogonal flaking, the proportion of flakes bearing pebble cortex on their dorsal surfaces is higher than that in radial flaking strategy, that is 66 %. Accordingly, the distribution of such flakes by stages is somewhat different: at stage 1, they make up 94 %; at stage 2, 78 %; and at stage 3, 33 %.

Spalls from bifacial tools. During bifacial reduction, spalls >3 cm were obtained at the stage of plane and convex façonage. The general typological composition of the spalls is similar to that during primary flaking (see Fig. 4). The collection of spalls >3 cm is dominated by flakes (39 %), primary spalls (21 %), lateral core-edge flakes (13 %), and cortical core-edge flakes with a limited back (11 %). Spalls retaining pebble cortex make up 61 %; without it, 39 %. No typological differences were noted between the removals from the plane and convex sides. Also, no significant difference was observed in their attribute features. Spalls from bifaces differ markedly in size from those from cores. The ranges of their metric parameters overlap, but in general, bifacial spalls are smaller than flakes made at the final stages of core reduction (Fig. 5). The same applies to the spalls retaining pebble cortex over some part or entire surface.

The above analysis has proved that the typological composition of spalls obtained through various techniques of lithic reduction (orthogonal, radial, and bifacial) shows no significant variations. However, certain changes in the typological composition of the removals associated with the stages of flaking sequence have still been recorded.

The analysis of the experimental collection has made it possible to establish the origin of certain types of technical spalls, and to determine their position in assessing the flaking sequence integrity at the site. Primary spalls were produced at almost all stages of flaking, except for stage 3 of the radial-flaking technique. Cortical core-edge flakes with a limited back were recorded only at stage 1 in both flaking techniques. The same applies to cortical core-edge flakes in the case of radial flaking. The orthogonal flaking technique produces cortical core-edge flakes at all stages. Core-edge flakes with a limited back, in contrast, have not been recorded at flaking stage 1, and the proportion of these products increases towards stage 3 in both flaking techniques. A similar trend is observed for lateral core-edge flakes; these are few at stage 1, but their number gradually increases towards the third stage. Such a peculiar type as technical flake (Kantenabschläge) is more typical of platform preparation in the orthogonal flaking method, where it is present at all three stages. In the case of radial flaking, such technical flakes are quite few, and are noted at stages 1 and 2. Crested and semi-crested removals are recorded only at stage 3. All the listed types of technical spalls, with the exception of the latter, are also observed in bifacial flaking.

Since bifacial debitage demonstrates a similar typology of spalls, the assessment of the flaking sequence integrity at a site is based on the sizes of removals. As

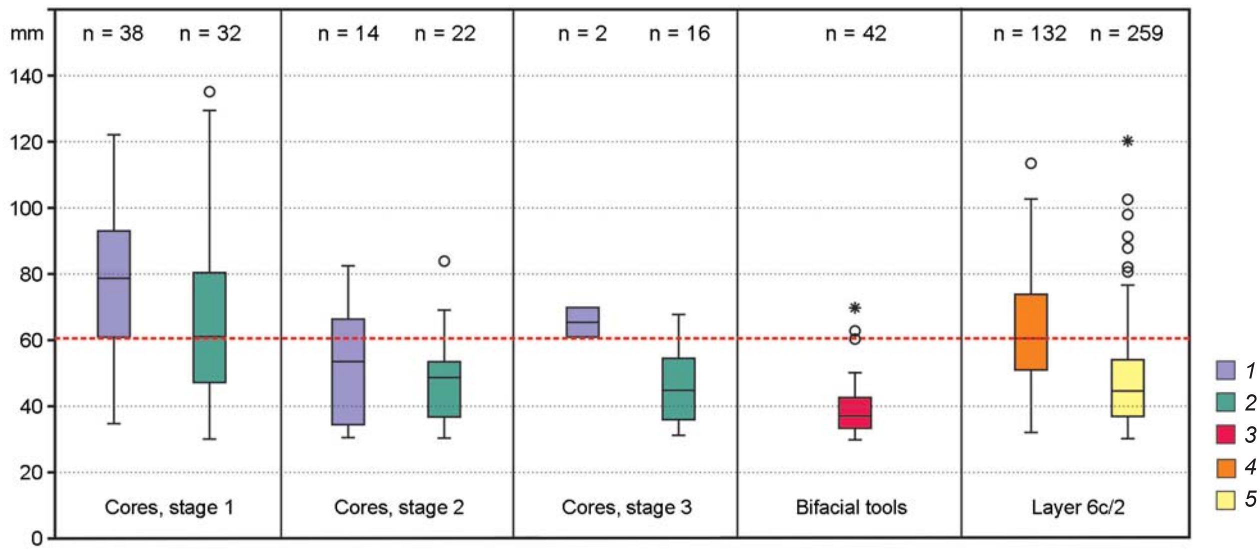

Fig. 5. Comparison of the sizes of archaeological spalls with pebble cortex (tools and spalls without retouch) and experimental ones obtained by bifacial and core reduction.

1 – spalls retaining pebble cortex from flaking surface; *2* – striking platform rejuvenation flakes with pebble cortex; *3* – spalls of plane and convex façonage with pebble cortex; *4* – tools on spalls with pebble cortex; *5* – spalls with pebble cortex without traces of retouch.

already noted, the spalls obtained by bifacial façonage are noticeably smaller than those detached from cores, which is due to the smaller sizes of pebbles used in biface manufacturing. Important patterns were recorded in the change of the sizes of primary spalls and, in general, spalls with cortical surfaces. The largest spalls with pebble cortex were detached at stage 1 and partially at stage 2 of core reduction sequence, and small ones were obtained by bifacial façonage and sometimes by rejuvenation of platforms at the terminal stages of core utilization (Fig. 5).

Discussion

The traditional assessment of the integrity of the flaking sequence at a site based on the presence of core preforms, large primary and secondary removals, the proportion of spalls with pebble cortex, and the ratio of cores to spalls (Inizan et al., 1999: 26–27; Chabai, Uthmeier, 2006; Grace, 2012: 12–15; Roth, Dibble, 1998; Lin, 2014: 106–111; Weiss, Otcherednoy, Wiśniewski, 2017) does not suit the features of the lithic industry of layer 6b/2 at Chagyrskaya Cave. This is due mainly to the fact that there are three main techniques of flaking in this industry: radial and orthogonal core flaking, plus façonage of plano-convex bifacial tools.

Formerly, the analysis of the proportion of spalls with cortical surfaces and the ratio of cores to flakes has led to the conclusion that a complete sequence of lithic reduction was carried out at Chagyrskaya Cave (Derevianko et al., 2018: 166; Kolobova et al., 2019). Layer 6c/2 yielded 386 spalls with pebble cortex on dorsal faces, and 432 spalls without it (47.1/52.9 %). In the experimental collection, containing only the products of core reduction, the relevant ratio was 142/130 specimens (52.6/47.4 %). The Pearson χ^2 criterion shows that there is no significant difference between these samples ($\chi^2 = 2.0577$, Df = 1, $p = 0.15144$). The proportion of spalls with pebble cortex in the experimental sample, which does not include the initial stages of reduction (stage 1), is significantly lower, 60/121 specimens (33.1/66.9 %), which would seem to confirm the conclusion about the flaking sequence integrity. However, a more detailed study of the experimental collection makes it possible to reconsider these results.

The main drawback of this approach to the study of the Chagyrskaya lithic industry is that it does not take into account the proportion of spalls with pebble cortex detached during biface production. Most bifacial tools are made on large pebble spalls and pebble fragments (Kolobova et al., 2019; Shalagina et al., 2020). Moreover, according to experimental data, up to 60 % of production waste (>3 cm) retains pebble cortex on the dorsal surface (Kharevich A.V., Kharevich V.M., Kolobova, 2022). Hence, the presence of traces of bifacial flaking at the site prevents the use of generally accepted indicators of the proportion of spalls with cortex in determining the integrity of production sequence at Chagyrskaya Cave. Fortunately, bifacial removals are significantly smaller in size than core-edge flakes, and it is possible to detect the proportion of such removals with pebble cortex by analyzing metric parameters.

In order to identify a particular stage of a flaking sequence at the site, in addition to the indicators of pebble cortex on flake surfaces, we used the data on metric parameters of flakes at various stages of flaking and on typology of removals in the experimental and archaeological collections. When assessing the role of bifacial reduction, we proceeded from the fact that the previous studies had proven the presence of its complete sequence at Chagyrskaya Cave (Kharevich, 2022: 129).

The analysis of the experimental collection has shown that flakes, primary spalls, cortical core-edge flakes with a limited back, and cortical core-edge flakes are the most representative categories in the identification of the initial stages of core reduction. The comparison of the experimental data with the collection from layer 6c/2 has demonstrated that the ratio of flakes to technical spalls in the industry does not statistically correspond to the complete flaking sequence (Fig. 6). The proportion of flakes in this collection is higher than that of technical spalls. Since the largest number of the latter is associated with the early stages of reduction, it is logical to assume that layer 6c/2 does not contain spalls produced at this stage. The archaeological collection corresponds to the experimental sample that contains no removals of stage 1 of core reduction (there is no statistically significant difference between them) (Fig. 6).

Noteworthy is the small proportion of primary spalls in layer 6c/2 (Fig. 6), which decreases towards the final stage of core reduction (see Fig. 2, 3). Furthermore, in terms of size, the available primary spalls without traces of preparation correspond most closely to bifacial debitage. Also, in layer 6c/2, there are quite few cortical core-edge flakes with a limited back, which are recorded only at stage 1 of core reduction and sometimes during bifacial façonage (see Fig. 2–4).

The comparative analysis of sizes of the long axis of spalls with pebble cortex shows that statistically these sizes are significantly smaller in the archaeological collection than in the experimental sample of the complete flaking sequence (Fig. 7). Considering the clear tendency

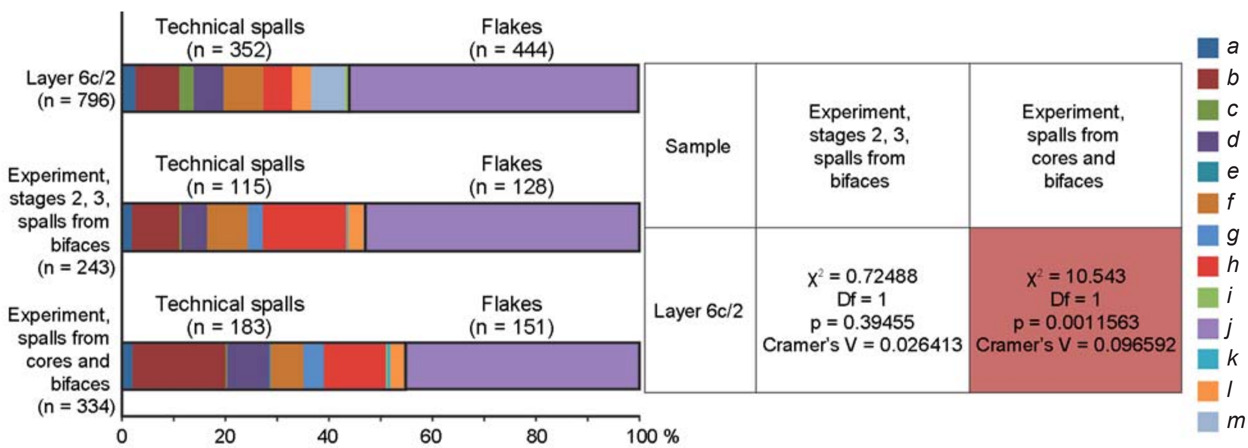

Fig. 6. Comparison of the typological composition of spalls in archaeological and experimental collections.
a–l – see legend for Fig. 2; *m* – bifacial thinning flakes.

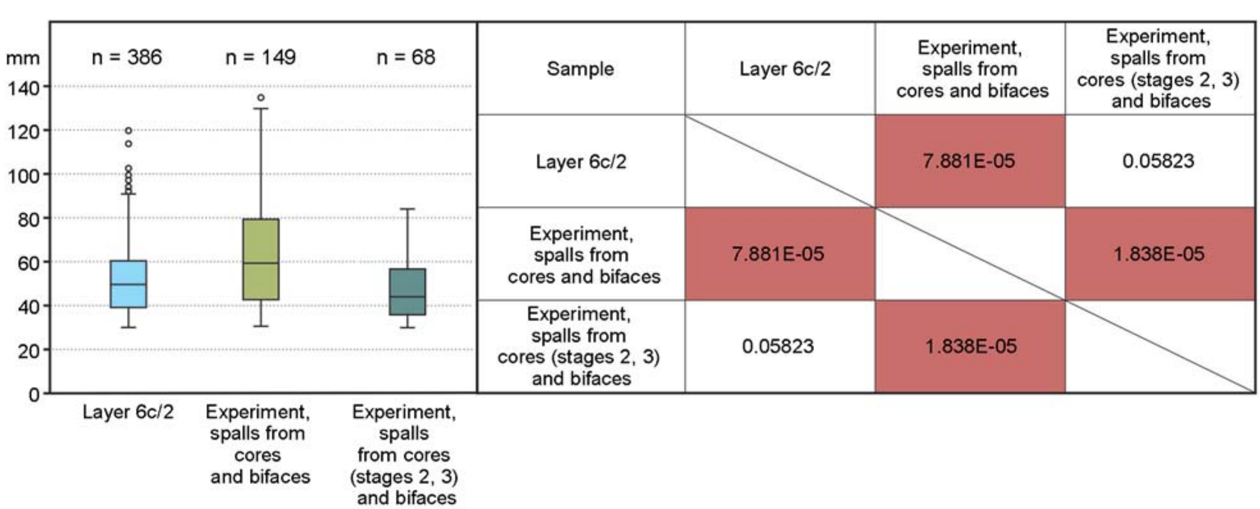

Fig. 7. Comparison of archaeological and general experimental collections by the sizes of spalls retaining cortex.

for the decrease of the spalls' sizes by reduction stages, this can be explained by the fact that the initial stages of core reduction were executed beyond the site. In terms of length, the spalls and tools with pebble cortex from layer 6c/2 correspond most closely to the experimental sample, which includes stages 2 and 3 of primary reduction and bifacial debitage (Fig. 7). The presence in the archaeological collection of solitary large spalls with cortical surfaces, typical of the initial stages of reduction, is explained by the fact that the largest of them (up to 11 cm) are tools; therefore, they could have been brought to the cave as finished tools or tool blanks.

The comparative analysis of tools on spalls with cortical surfaces and removals with cortex without traces of retouch from layer 6c/2 with the experimental items (see Fig. 5) shows that the median length of the tools corresponds to that of the spalls obtained at stage 1. At the same time, spalls not exceeding 8 cm could also be removed from the core flaking surface at stages 2 and 3. Only a small proportion of tool blanks could be detached at stage 1 exclusively. In turn, spalls with cortex without traces of retouch correspond rather to removals from the striking platform at stages 2 and 3 of core reduction or to bifacial debitage. This suggests that such products should be considered as production waste (see Fig. 5).

All the above facts indicate that the initial stages of core reduction were carried out beyond the cave, while the high proportion of cortical spalls in the collection is explained by the production of bifaces at the site (Kharevich, 2022: 129) and the delivery of such spalls to the cave as tools and blanks.

Thus, the study findings have shown that the method most frequently used for the analysis of the flaking sequence's integrity, based on the proportion of spalls with pebble cortex, (Lin, 2014: 144; Weiss, Otcherednoy, Wiśniewski, 2017; Chabai, 2008), is not universal and has limitations due to the structure of lithic industry and the specificity of raw materials. When pebbles and boulders of various sizes are used, a high proportion of spalls retaining cortical surface can be provided by one of the methods of the reduction strategy; in the case of the assemblage of layer 6c/2, by the production of bifacial tools.

Conclusions

The presence and dimensions of the cortical surfaces on flakes are regarded as an important feature in assessing the integrity of flaking sequence at a site in the Paleolithic studies (Dibble, 1995; Weiss, Otcherednoy, Wiśniewski, 2017; Delpiano, Heasley, Peresani, 2018). Researchers often use generally accepted indicators that do not always take into account the characteristics and metric parameters of the original rocks in each particular complex (Roth, Dibble, 1998; Lin, 2014: 144–145). According to the results derived in this study, the proportions and sizes of cortical flakes in primary and bifacial reduction can vary significantly. Hence, such indicators as the proportions of primary removals and spalls with cortex require adjustments related to the size of the raw material and reduction techniques.

Technical spalls are an important source of information not only about the flaking sequence integrity, but also about the shapes of the rocks and blanks that were brought to the site. Experimental modeling of radial, orthogonal, and bifacial flaking suggests the following conclusions.

1. The typological compositions of technical spalls flaked from radial and orthogonal cores are identical.

2. In case of complete core reduction sequence, the proportion of technical spalls (primary and steep-lateral) makes up ca 50 %.

3. Lateral steep technical spalls were obtained not only by preparation of flaking surface, but also by creation and rejuvenation of striking platforms.

4. During core reduction, cortical core-edge flakes with a limited back were detached only at the decortication stage, while core-edge flakes with a limited back were characteristic only of final stages.

5. Crested and semi-crested spalls are recorded only at the last stage of core reduction.

6. All the lateral steep spalls, except for crested and semi-crested ones, are typical of bifacial flaking.

7. Technical flakes (Kantenabschläge) are more common in the case of preparation of the striking platforms of orthogonal cores than those of radial ones.

8. If the stage of core decortication is recorded at a site, the proportion of primary spalls (76–100 % of cortical surface) >3 cm should be ca 16 %. In the production of bifacial tools, the proportion of primary spalls is 21 %.

9. Primary spalls, cortical core-edge flakes with a limited back, and cortical core-edge flakes are most indicative categories for the identification of the initial stages of core reduction.

The application of the new approach has shown that the occurrence of a high proportion of spalls retaining pebble cortex in the industry of layer 6c/2 is explained not by the complete flaking sequence, but by the intense production of bifaces at the site and the delivery of finished tools and spall-blanks to the cave. This model of exploitation of raw material, in which the initial stages of core reduction occurred outside the site, corresponds to the variability of Eastern European Micoquian complexes, and in particular to the materials of the sites located in close proximity to sources of raw material (Chabai, 2004: 239; Chabai, Uthmeier, 2006).

The applied approach has provided for a new insight into the study of the integrity of the flaking sequence at a site, and has shown the importance of such factors as flaking techniques and the type of raw material. This approach and the findings can be used in analysis of non-Levallois lithic industries based on pebble flaking.

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Industry of Okladnikov Cave Layer 3 in the Context of the Sibiryachikha Complexes of the Altai Mountains

This paper presents the results of a comprehensive analysis of lithics from layer 3 of Okladnikov Cave and their relevance to the Sibiryachikha industries of the Altai Mountains. Attribute analysis has shown that the industry of layer 3 demonstrates technological and typological similarities with the Sibiryachikha industries. These include radial flaking with an offset technological axis, a predominance of convergent side-scrapers, and a series of plano-convex bifacial tools. Functionally, the site was a camp where horse and rhinoceros carcasses were butchered and consumed. The analysis of flaking sequence integrity revealed similarity between Okladnikov layer 3 and Chagyrskaya industries in terms of primary and bifacial reduction. The initial stages of core decortication were carried out outside the cave, at the rock outcrops. Subsequent stages of core utilization and all stages of bifacial flaking were carried out in situ. The main difference between Okladnikov layer 3 and Chagyrskaya layer 6c/2 industries concerns only the stage of manufacturing and modifying stone tools. At Okladnikov Cave, these processes were much more intense than at Chagyrskaya, which may indicate transportation of numerous tools and blanks made of high-quality raw material from more distant sources.

Keywords: *Middle Paleolithic, Sibiryachikha variant, Altai Mountains, bifacial technology, model of rock utilization, Neanderthals.*

Introduction

Late European Neanderthals that migrated from Central and Eastern Europe to the Altai inhabited mainly low-mountain areas with available water and hunting resources (Derevianko, 2024; Kolobova et al., 2019). They produced Sibiryachikha complexes of the Middle Paleolithic characterized by the use of radial core flaking and plano-convex bifacial flaking, and the predominance of simple and convergent side-scrapers in tool-kits. These complexes show variability resembling the Micoquian industries: with the increase of distance to raw material sources, the degree of tool modification and bifaces also increased (Chabai, 2004; Derevianko, Markin, Shunkov, 2013). For example, in the assemblages of layers 1 and 2 from Okladnikov Cave, the large number of convergent scrapers, small sizes of tools with two or more working edges, and bifacial tools (Kolobova et al., 2023) suggest a shortage of lithic raw materials. Both Okladnikov and Chagyrskaya caves are located close to raw material outcrops in the Sibiryachikha and Charysh river valleys (Derevianko et al., 2015), which does not imply different attitudes to the economy of resources. However, in Chagyrskaya, in contrast to Okladnikov, a deficit was recorded only in high-quality raw materials. In this situation, it is necessary to apply new research approaches that make it possible to identify the behavioral features of the inhabitants at the sites, and to explain the differences between the assemblages. At present, the reasons for the noted variability are unknown; the stage of *chaîne opératoire* that determined the differences between the industries of these caves is unclear. There is a question as to whether it relates to the core reduction technique, or only to the stages of modification of bifaces and tools. To resolve this issue, we carried out a study of the assemblage of Okladnikov layer 3, using the technical-typological and the attributive methods, and a detailed technological and statistical comparison of this assemblage with that of layer 6c/2 of Chagyrskaya Cave, using experimental data (Kharevich et al., 2024).

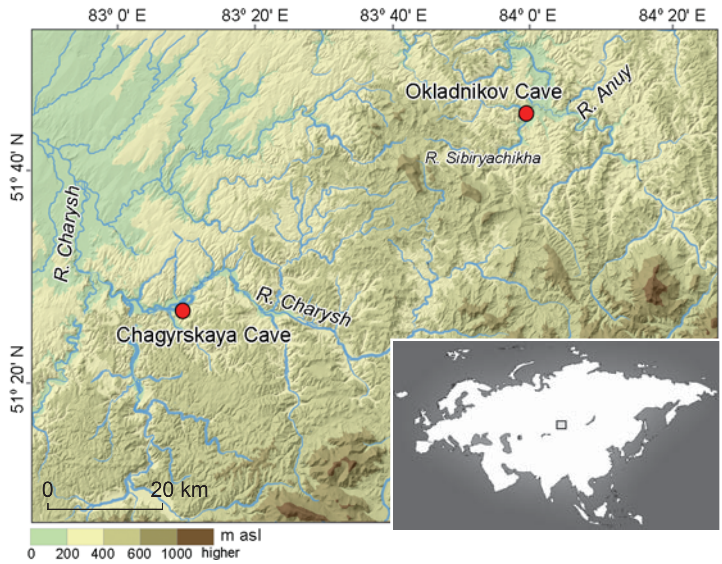


Fig. 1. Location of the Okladnikov and Chagyrskaya caves.

The Okladnikov layer 3 lithic industry is the richest among the assemblages of the site; it is dominated by the elements of primary reduction and retouch: lateral technical spalls, various bifacial thinning flakes, cores and core blanks, and numerous chips. This suggests that layer 3 has undergone the fewest disturbances as compared to overlying layers 1 and 2. Chagyrskaya Cave is a key site of the Middle Paleolithic Sibiryachikha variant; its stratigraphic column contains four cultural layers dating back to 60–49 ka BP. We compare the industry of layer 3 of Okladnikov Cave with the assemblage of undisturbed Chagyrskaya layer 6c/2 (Kolobova et al., 2020).

Okladnikov Cave is located on the left bank of the Sibiryachikha River in the Anuy River valley (Fig. 1). The site was discovered by A.P. Derevianko and V.I. Molodin in 1984 and was studied under the supervision of A.P. Derevianko and S.V. Markin. Nine lithological layers were identified in the stratigraphic sequence. Layers 1–3, 6, and 7 are culture-bearing horizons (Derevianko, Markin, 1992). The cave was inhabited by Neanderthals in the chronological range of >40,000–>44,000 BP (Kolobova et al., 2023).

Material and methods

The study of the collection was carried out by the technical-typological and attributive methods, which takes into account technologically and typologically significant features for each typologically determinable artifact, with the exception of waste products. The main features were established as follows: type of blank and artifact's fragmentation; type of technical flake and its attribution to either core or bifacial flaking sequence; proportion of cortical surface on the dorsal face (0 %, 1–25 %, 26–50 %, 51–75 %, 76–100 %); dorsal scar-pattern; type of residual striking platform; and main metrics. The typological affiliation of the tools was determined through the method proposed by V.N. Gladilin (Gladilin, 1976; Chabai, Demidenko, 1998), which describes the diversity of blank shapes and retouch on side-scrapers, points, and bifacial tools. The published data on lithic assemblages from Chagyrskaya (layer 6c/1) and Okladnikov (layers 1 and 2) caves were used for comparison (Kolobova et al., 2020, 2022, 2023).

The flaking sequence integrity shown by the industry of layer 3 was determined by the features identified during the experimental modeling of primary and bifacial reduction in the Chagyrskaya lithic industries (Kharevich et al., 2024). The sizes of removals retaining pebble cortex and the ratio of the proportion of flakes and technical spalls are the most indicative features in pebble industries.

The following mathematical statistic methods were used in the comparative analysis of the assemblages: the nonparametric Mann-Whitney test, the Kruskal-Wallis

Table 1. **Composition of the Okladnikov layer 3 lithic industry**

Artifact type	Spec.	%	% without waste
Pre-cores	1	0.05	0.1
Cores	10	0.5	1.1
Bifacial tools	9	0.4	1
Spalls:	864	42.6	97.6
blades	9	0.4	1
flakes	326	16.1	36.8
technical spalls	262	12.9	29.6
tools on spalls	267	13.2	30.2
Percussive-abrasive tools	1	0.05	0.1
Shatters	221	10.9	–
Chips	921	45.4	–
Total	2027	100	100

test, and the ternary plot. All calculations were carried out in the Past 3 program (Hammer, Harper, Ryan, 2001). The three-dimensional models were analyzed in the Artifact 3D program (Grosman et al., 2022).

Results

Attribute approach. The lithic collection from Okladnikov Cave layer 3 contains 2027 items. The main part of the collection is made up of spalls, 864 spec. (97.6 % (excluding waste products)): 326 flakes (36.8 % (excluding waste products)), 262 technical spalls (29.6 % (excluding waste products), 9 blades (1.0 %), and 267 tools on flakes (30.2 %) (Table 1).

Waste products total 56.3 % of the collection, most of which are chips (45.4 %). The chips include small spalls detached in the course of fashioning bifacial tools (26.8 % of the identifiable chips) (Table 1).

The collection contains flake cores – 10 spec., radial cores – 3 spec. (including a Levallois centripetal core) (Fig. 2, *1*, *9*), orthogonal cores – 3 spec., flat parallel cores – 2 spec., and bidirectional cores – 2 spec. A pre-core modified into a scraper was also identified.

The set of technical spalls is well correlated with the typology of cores, and includes lateral core-edge flakes (33.7 %*), core-edge flakes with a limited back (29.6 %) (Fig. 2, *10*), primary spalls (20.4 %), bifacial thinning flakes (11.6 %) (Fig. 2, *2–4*), crested and semi-crested flakes (3.3 %), overpassed flakes (0.8 %), citron and semi-citron flakes (0.6 %) (Fig. 2, *5*). Among the bifacial thinning flakes, a tranchet blow was recorded (Fig. 2, *6*) (Frick et al., 2017).

*Hereinafter, percentage of the total number of technical spalls, including tools.

The group of spalls also includes pseudo-Levallois spalls (15 spec.) (Fig. 2, *10*), which were defined by F. Bordes as lateral steep spalls of triangular shape with the technological axis offset (1953). At the initial study of the collection, such technical spalls were described as Levallois, in accordance with the prevailing research paradigm (Derevianko, Markin, 1992: 122, fig. 42, *9*, *10*).

Primary spalls and blades make up 8.6 % of the spalls collection*. Almost 3/4 of the spalls (70.5 %) from layer 3 have not retained cortical surface; only 12.4 % of them bear pebble cortex over more than 50 %.

Most spalls (62.2 % (excluding unidentifiable ones)) from layer 3, show an offset technological axis. The spalls demonstrate predominantly (40.5 %) trapezoid shape. The most numerous spall categories have longitudinal (29.9 %), radial/cross (20.7 %), and orthogonal (18.3 %) faceting.

More than a third of the spalls (37.2 %) show a straight lateral profile. Equal proportions of spalls have lateral twisted (25.5 %) and curved (25.0 %) profiles. Spalls triangular in cross-section predominate (33 %); other spalls are lateral-steep (29.8 %), trapezoid (20.5 %), or convex (10.1 %) in cross-section. Numerous are plain striking platforms (67.5 %), and various forms of faceted (16.8 %) and polihedrial (10.6 %) platforms.

An absent or diffuse bulb is observed in more than a half of the spalls (59.5 %). Almost 1/4 of the spalls show a pronounced lip or semi-lip (24 %). The total of 92.1 % of the spalls with lip (or semi-lip) have a diffuse or absent bulb; the latter may be due to the use of a soft hammer.

The typological structure of the layer 3 tool assemblage is dominated by side-scrapers of various types (82.6 %) and retouched points (10.7 %) (Fig. 3, *7*, *8*); bifacial tools have also been noted (4.0 %) (Table 2).

*One bifacial tool was made on a spall (Fig. 3, *9*).

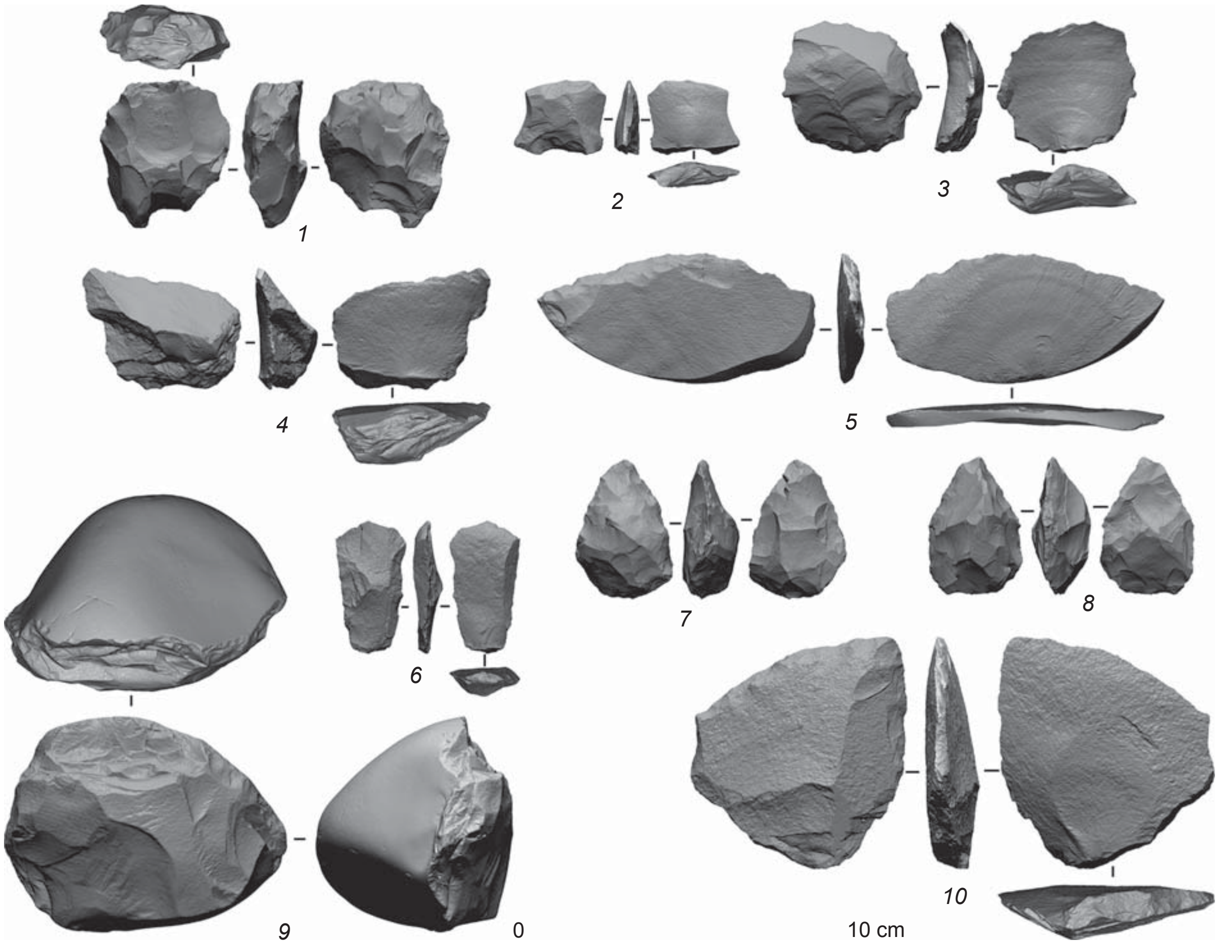


Fig. 2. Artifacts from the assemblage of Okladnikov Cave layer 3.
1, *9* – cores; *2–4*, *6* – bifacial thinning flakes; *5* – tool on semi-citrus slice; *7*, *8* – bifacial tools; *10* – tool on a core-edge flake with a limited back.

Table 2. **Typological composition of the tools in the Okladnikov layer 3 lithic industry**

Tool type	Spec.	%	% without undeterminable pieces
Retouched points	24	8.70	10.71
Side-scrapers:	185	67.03	82.59
simple	49	17.75	21.88
convergent	96	34.78	42.86
undeterminable	40	14.49	17.86
Bifacial tools	9	3.26	4.02
Truncated-faceted tools	3	1.09	1.34
Perforators	3	1.09	1.34
Retouched flakes	45	16.30	–
Retouched blades	2	0.72	–
Undeterminable tool parts	5	1.81	–
Total	276	100	100

The proportion of convergent side-scrapers (42.9 % of the total number of tools) (Fig. 3, *1–6*) is higher than that of the simple ones (21.9 %). After fragmentation, 8.3 % of the tools had been reshaped. Two perforators were fashioned from side-scraper fragments. A total of 3.3 % of the tools was made on bifacial thinning flakes (see Fig. 2, *3*).

The collection of bifacial tools from layer 3 includes 9 items. These are seven complete tools and two fragmentary specimens. The blanks of most of the tools are undeterminable, since they were subjected to intense modification. Four bifacial tools are backed, with three of them being morphologically close to European backed knives of the Keilmesser type (Jöris, 2006). The majority of the items either show continuous retouch or have two working edges (see Fig. 2, *7*, *8*).

Bifacial tools were made through the plano-convex flaking technique typical of the Sibiryachikha industries (Shalagina et al., 2020; Kolobova et al., 2019), which involves the sequential working of plane and convex faces at both the façonage and faceting stages. Most tools show intense flaking. One tool bears traces of reshaping after fragmentation. The category of complete bifaces includes simple (29 %) and convergent (71 %) tools (see Fig. 2, *7*, *8*) (Kharevich, 2022).

The only hammerstone made on a complete pebble of coarse-grained sandstone, corresponding to the middle stage of processing, demonstrates traces of microflaking and edge fractures in its working area (see Fig. 3, *10*).

Assessment of flaking sequence integrity. A comparative analysis on the sizes of cortical spalls determined along their long axes, from the assemblages of Okladnikov layer 3 and Chagyrskaya layer 6c/2, has shown that the parameters coincide, and correspond to those of the removals obtained during reduction of cores (final stages of reduction: serial detachment of blank-spalls and completion of reduction) and bifaces from the experimental sample (Fig. 4, *1*). The experimental sample of the complete core- and bifacial flaking sequence demonstrates the larger sizes of cortical flakes than those of the spalls from the caves' assemblages (Fig. 4, *2*). Such a ratio suggests that the initial core reduction was carried out outside the cave sites.

The comparison between the sizes of cortical spalls/tools and unretouched spalls has revealed a

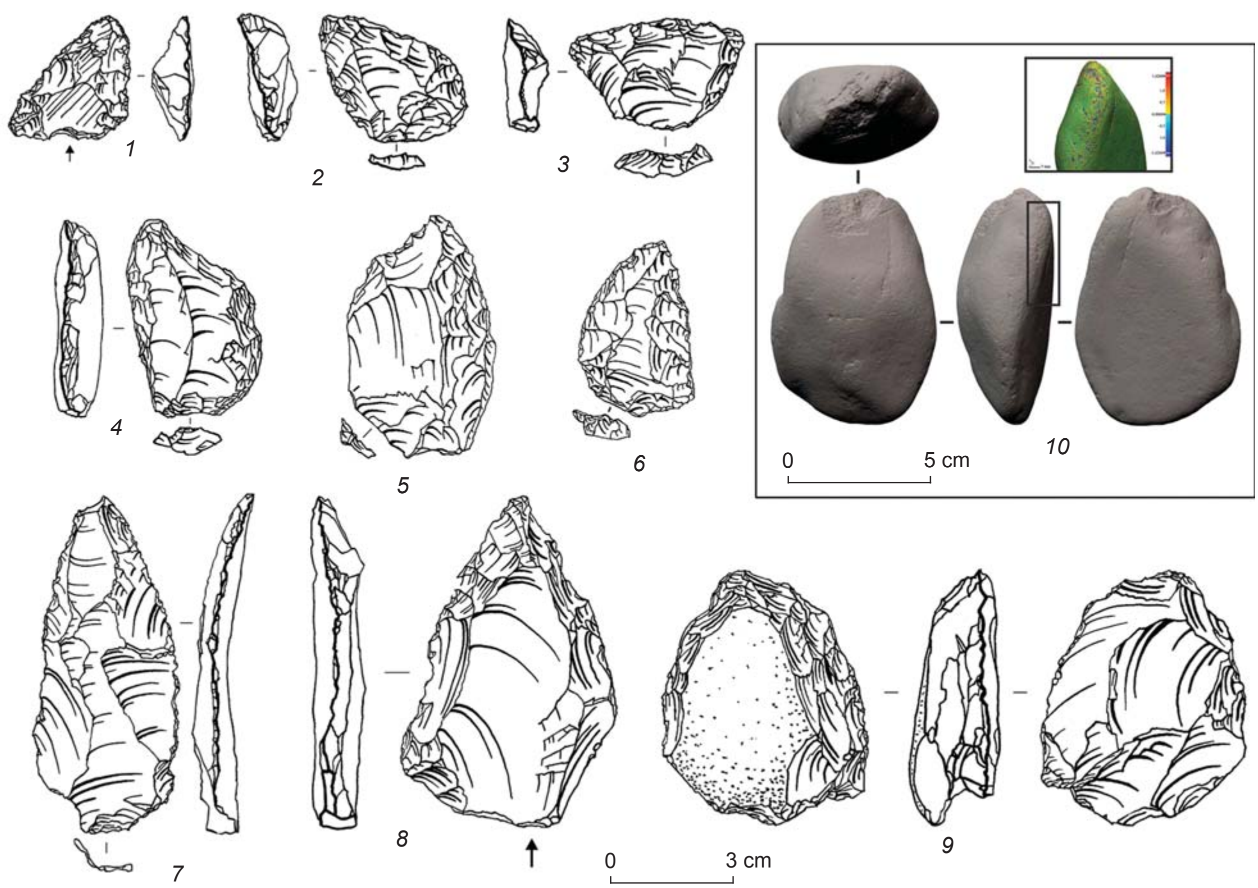
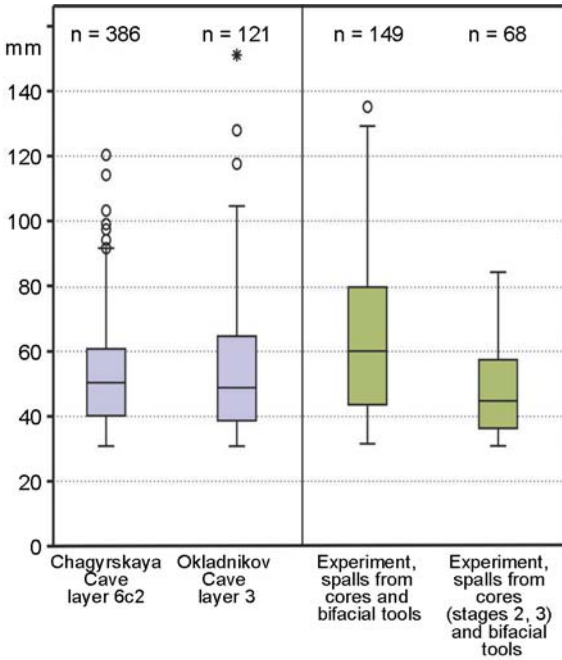


Fig. 3. Tools from Okladnikov Cave.
1 – triangular side-scraper; *2*, *4* – sub-trapezoid side-scrapers; *3* – semi-trapezoid side-scraper; *5* – semi-crescent side-scraper; *6* – sub-crescent side-scraper; *7* – sub-leaf point; *8* – semi-leaf point; *9* – bifacial side-scraper on primary spall; *10* – hammerstone.



Mann-Whitney	Chagyrskaya Cave layer 6c2	Okladnikov Cave layer 3	Experiment, spalls from cores and bifacial tools	Experiment, spalls from cores (stages 2, 3) and bifacial tools
Chagyrskaya Cave layer 6c2		1	0.0001576	0.1165
Okladnikov Cave layer 3	1		0.01104	0.2979
Experiment, spalls from cores and bifacial tools	0.0001576	0.01104		3.677E-05
Experiment, spalls from cores (stages 2, 3) and bifacial tools	0.1165	0.2979	3.677E-05	

1

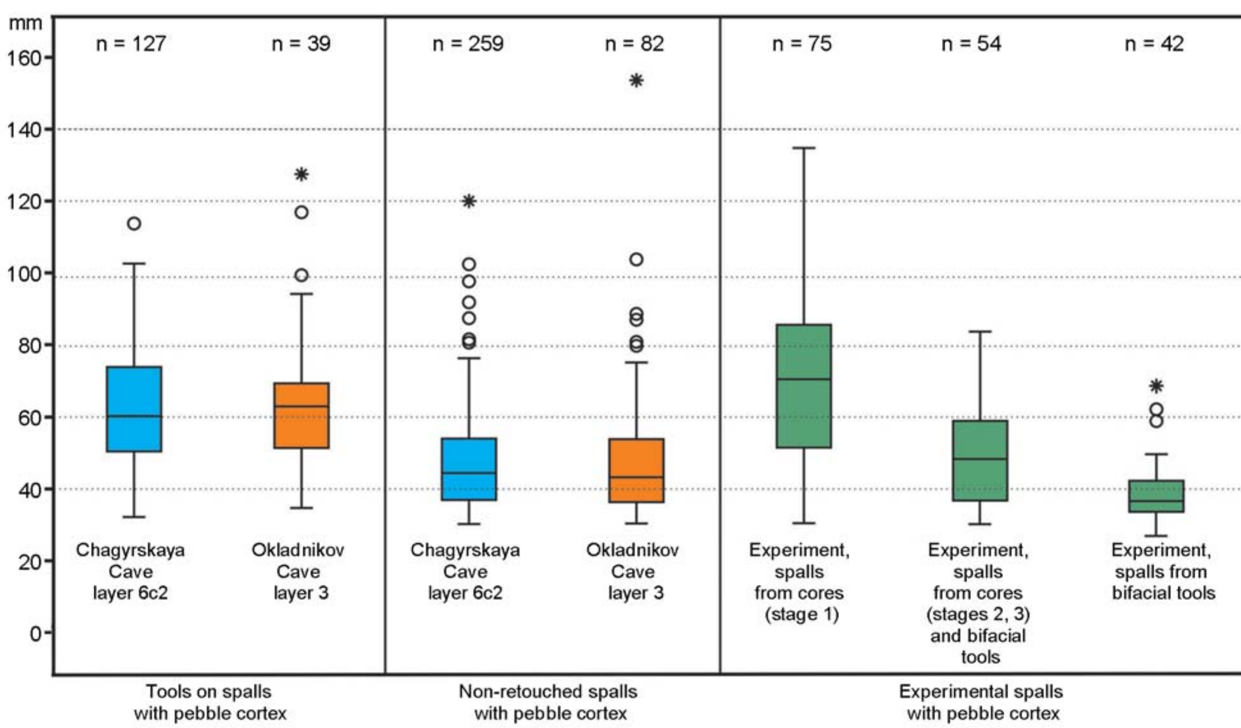


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Fig. 4. Comparison of the sizes of spalls from archaeological (Okladnikov Cave, Chagyrskaya Cave) and experimental collections.

1 – the ratio of the length of spalls and tools with pebble cortex from archaeological and experimental collections; *2* – the ratio of the length of tools with pebble cortex, blank-spalls with pebble cortex, and experimental spalls with pebble cortex.

correspondence in the sizes of tool blanks to the experimental removals obtained during the initial core reduction (Fig. 4, *2*). The cortical flakes without retouch correspond to the removals from the experimental sample illustrating the final stages of core reduction (serial production of blanks and completion of reduction) and bifacial flaking. These data indicate that there were no operations relating to the initial stages of core reduction at Okladnikov Cave, and no intense modifications of bifacial and unifacial tools at Chagyrskaya Cave (Kharevich et al., 2024). This observation is evidenced by numerous bifacial thinning spalls and chips in layer 3.

Discussion

Okladnikov Cave is located in the river valley; because of that, the Neanderthal inhabitants could have hunted primarily horses and bison during their annual migrations (Derevianko et al., 1990). In the faunal collection from layer 3, there are bone remains of at least three horses, one bison, and four rhinoceroses. Traces of anthropogenic impact were noted on fragments of tubular bones belonging to medium-sized ungulates and rhinoceros, which may have been hunted by the cave's inhabitants.

The lithic industry of Okladnikov layer 3 shows almost complete parallels with the collections from layers 1 and 2 in terms of technical and typological features. All assemblages demonstrate the predominantly trapezoidal flake detachment with plain and faceted striking platforms from radial, parallel, and orthogonal cores. The assemblages are characterized by a small proportion of flakes with straight profiles and feathering distal ends, which shape is due to the peculiarities of bifacial flaking that produced spalls with curved profiles and hinge ends. The only difference is the predominance of flakes with offset technological and morphological axes in layer 3 (62.2 %), and flakes with matching axes in layers 1 and 2 (59.2 and 65.6 % respectively). According to the first indicator, the assemblage from Okladnikov layer 3 shows similarity to those from Chagyrskaya layers 6c/1 and 6c/2.

All the layers yielded numerous tool-kits. For example, in layer 3, the proportion of tools in the typologically determinable collection reaches 30.2 %. Assemblages of layers 1–3, in which the majority of tools are convergent side-scrapers (41.8, 48.5, and 42.9 %, respectively), are identical in composition, but in layer 3 the proportion of remodified tools is higher and reaches 8.3 %; the relevant proportion in layer 1 is 3.3 %, and in layer 2, 2.3 %. The comparison of tools from the three layers by length and width did not reveal statistically significant differences by the Kruskal-Wallis criterion (length: $H = 1.87$, $p = 0.39$; width: $H = 3.51$, $p = 0.17$).

The comparison of convergent tools from Okladnikov layer 3 and those from Chagyrskaya layer 6c/2 by the main metrics has revealed a statistically significant difference. Convergent tools from Okladnikov layer 3 are significantly smaller (length: $U = 6433$, $p = 0.001$, width: $U = 5578$, $p = 1.97E$; thickness: $U = 6514$, $p = 0.0007$) than those from Chagyrskaya. This confirms the assumption about a more intense tool re-shaping at Okladnikov Cave, and indicates their heavier reduction.

The study of the typological structure of bifacial tools from Okladnikov layer 3 has shown the prevalence of convergent products with intensely retouched blades all over the margins. Layer 3 contains simple bifacial tools with one blade; in layers 1 and 2, more intensely modified convergent side-scrapers and points predominate among bifacial tools (Kharevich, Markin, Derevianko, 2022). The analysis of the Chagyrskaya bifacial tools has shown that this typological structure reflects intense lithic processing (Kharevich, 2022).

The lithic industry of Okladnikov layer 3 represents a primary reduction strategy identical to that of the assemblage from Chagyrskaya layer 6c/2, and leads us to the conclusion that the initial core reduction was carried out beyond the site limits. Some large flakes with pebble cortex detached at the initial stage of core reduction, along with the prepared cores, were transported to the site as tools and blanks. The sizes of the unretouched flakes with pebble cortex correspond to the stages of serial production of blanks/completion of reduction and bifacial flaking.

However, the ratio of the proportions of flakes and technical spalls from Okladnikov layer 3 differs significantly from that of Chagyrskaya layer 6c/2: 41.8 / 58.2 % and 55.8 / 44.2 %. This difference is due to the greater number of bifacial thinning flakes and core-edge flakes with a limited back in the Okladnikov layer 3 collection—their cumulative share is 26.5 % of the total number of spalls, and in Chagyrskaya Cave it is 12 %. The Okladnikov inhabitants probably reshaped side-scrapers and bifacial tools more intensely, which is confirmed by the data on the sizes of convergent side-scrapers and bifacial tools. Convergent and bifacial tools at the Sibiryachikha sites were made mainly from high-quality raw materials (Derevianko et al., 2015); the heaviest modifications were noted on the artifacts made from Zasurye jasperoids and chalcedonolites. Since the proportion of such raw materials among the pebbles of the Charysh and Sibiryachikha rivers near the caves under study does not exceed 2 %, it can be assumed that the Neanderthals searched for these rocks among other beach pebbles up and down the riverbeds, at a considerable distance from the sites (Kolobova et al., 2019).

Conclusions

The assemblages from the Sibiryachikha variant of the Altai Middle Paleolithic are homogeneous in terms of primary reduction strategy, bifacial flaking, and tool manufacturing. Artifacts found in layer 3 at Okladnikov Cave suggest the existence of a base camp where the prey was butchered and consumed. The number of prey (four horses and one bison) shows that the inhabitants of this cave were inferior hunters to those from Chagyrskaya Cave (in all subdivisions of layer 6c, at least 14 bison carcasses with butchering traces were identified) (Koliasnikova et al., in press). Operations relating to the initial decortication were probably carried out at raw material outcrops. Cores and flakes, including primary ones, were transported to the sites. In both caves, operations were carried out, corresponding to the middle and final stages of core reduction and to the complete bifacial flaking sequence. The main difference between the Okladnikov and Chagyrskaya assemblages is recorded at the stage of stone-tool production and modification. In Okladnikov Cave, these activities were more intense (possibly owing to the transportation of numerous tools and blanks made of high-quality raw materials from more distant sources) than in Chagyrskaya Cave. Undoubtedly, a small number of the jasperoid and chalcedonolite tools were made from local rocks; but at present it is hardly possible to determine the place of raw material origin within the river beds and the share of export in the industry.

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Rocks and Their Sources in the Upper Paleolithic of the Altai: Relevance to Bifacial Technologies

On the basis of the analysis of thin leaf-shaped bifacial points, which are very elaborate and sensitive to the quality of rocks, we reconstruct the adaptive strategies of humans at the early stages of the Upper Paleolithic. Mineral raw materials and their exploitation relating to different resource bases of the central (the Ursul River basin) and northwestern (the Anuy River basin) parts of the Altai region are analyzed. To attribute the rock sources for bifaces, we have compiled a comparative database of petrographic and petrochemical characteristics of artifacts and pebbles from nearby rivers. Chemical criteria were proposed for differentiating rocks, including those that are hard to distinguish, and non-destructive techniques were applied to assess the chemical composition of rocks using a portable XRF spectrometer. Findings suggest that rocks available in the Anuy and Ursul basins met the conditions for biface manufacture. Bifaces from the Ursul valley were made of local fine-grained rocks—felsic volcanic tuff and ignimbrite; those from the Anuy valley were also of local rocks, but of lower quality—hornfels transformed (meta-sedimentary) siltstone and fine-grained sandstone or felsic volcanic rocks. In the Anuy valley, scarcity of quality raw material was compensated for by imported high silica jasper-like rocks. Results suggest that the Early Upper Paleolithic inhabitants of the region, when implementing technical skills, showed stable behavioral and technological stereotypes despite habitat change and deterioration of the resource base.

Keywords: *Thin bifaces, raw material strategies, petrochemistry, X-ray fluorescence analysis (pXRF), portable XRF, scanning electron microscopy (SEM EDS).*

Introduction

Stone raw materials and their sources are extremely important for studying Paleolithic sites in the Altai (Postnov, Anoikin, Kulik, 2000; Kulik, Postnov, 2001; Kulik, Shunkov, Petrin, 2003; Derevianko et al., 2003, 2015; Rybin et al., 2018; Kulik, Kozlikin, Shunkov, 2023). Most of the Stone Age sites discovered in the Altai are located in a single geological macrostructure—the Anuy-Chuya structural-facies zone (Kuznetsov, 1963; Gosudarstvennaya geologicheskaya karta…, 2019), composed of marine sediments and volcanics of the Vendian-Paleozoic age. This zone is distinguished by a variety of raw mineral resources. The prevalence of a specific type of stone material at a certain site, as well as its quality, is determined by the local geology and geomorphology (Derevianko, Kulik, Shunkov, 2000). The main source of rocks for lithic assemblages were pebbles from waterways, while bedrock was used to a lesser extent (Postnov, Anoikin, Kulik, 2000; Belousova, 2018). The absence of universal high-quality material in the region forced people to carefully select raw materials, adapt to local geological occurrences, or import rocks (Postnov, Anoikin, Kulik, 2000; Kulik, Postnov, 2001; Derevianko et al., 2015).

This study aimed to reconstruct raw material use and adaptation strategies of people that settled in the Altai at the early stages of the Upper Paleolithic by analyzing the material of thin leaf-shaped bifaces. The main Upper Paleolithic sites are concentrated in the northwest of the region—in the valley of the upper reaches of the Anuy River (Ust-Karakol-1, Anuy-1 and -3 sites, Denisova Cave) or in the central part of the region—in the Elovskaya depression in the Ursul River basin (Kara-Bom and Tyumechin-4 sites). In the Initial and Early Upper Paleolithic, these areas were inhabited by the same groups of people: ca 45,000–40,000 noncal BP by the creators of the Kara-Bomian cultural tradition, and ca 30,000–35,000 noncal BP by those of the Ust-Karakolian (Belousova, 2018). Natural settings in the Elovskaya depression granted wide access to homogeneous fine-grained high-quality raw materials as opposed to the Anuy valley, where access was limited. The influence that local material resources had on the industries within a single cultural tradition is a fundamental issue. Resolving this issue will not only expand our understanding of cultural dynamics in the Upper Paleolithic, but also shed some light on the background for technological and typological variability of industries. In this study, this issue is addressed by analyzing lithic material that was selected by humans to make thin leaf-shaped bifacial points. These sophisticated artifacts required high quality of rocks. They were manufactured at sites in the Ursul and Anuy valleys; therefore, they can be an important source of information for assessing the lithic resources and the stability of behavioral and production stereotypes among the carriers of bifacial technology.

The materials used for the bifacially processed artifacts and their sources were identified using methods that did not damage the samples and were suitable for working with fine-grained rocks (with individual grain size of 2–15 μm), which were preferred in manufacturing thin bifaces. Identification of such rocks using classic petrographic analysis in transparent thin sections is extremely complicated, since the thickness of the preparation is about 30 μm, which exceeds the size of the single grains. This makes it impossible to measure the optical properties of minerals, and sometimes to determine their shape and nature of intergrowths. In addition, if rocks do not have any specific textural and structural features (layering, flow-banding, spotting, etc.), they cannot be divided into classes and unambiguously identified.

For these reasons, rocks were studied using comprehensive analysis of petrographic and petrochemical features established by non-destructive methods (Vishnevsky et al., 2023). A database of petrographic and petrochemical features of rocks for making bifaces and pebbles from the nearby waterways was created; petrochemical criteria for differential diagnostic assessment of rocks, including hardly-discernible, fine-grained varieties, were elaborated. The research was based on extensive experience in geological and archaeological surveys of recent decades, the data of geological maps, and explanatory notes from them (Gosudarstvennaya geologicheskaya karta…, 2001, 2019), taking into account specific features of the alluvium composition of local waterways and rocks in their original occurrence.

Materials

This study employed archaeological collections from two groups of sites in the Northwestern and Central Altai: the Anuy group in the Anuy River basin and the Ursul group in the Ursul basin, where thin bifacially processed tools of the early stages of the Upper Paleolithic were discovered. In addition to archaeological materials, groups of pebble samples from the Anuy and Ursul rivers were used. These included experimental samples taken from each waterway (encompassing those with high utilitarian features), and petrographic samples from the Anuy, reflecting the diversity of rocks as a whole.

The archaeological collection includes 28 bifacial tools and their blanks (Fig. 1, Table 1), which is about 90 % of the total number of items discovered to date and available for study. The collection comprises artifacts from sites on the Ursul River (Tyumechin-4, *n*=6; Kara-Bom, *n*=5) and Anuy River (Denisova Cave, *n*=9; Ust-Karakol-1, *n*=4), dated to the Initial and Early Upper Paleolithic, as well as items similar in their morphometry to the Upper Paleolithic artifacts, but requiring clarification of their chronological position (Anuy-3, *n*=4). The tools were manufactured

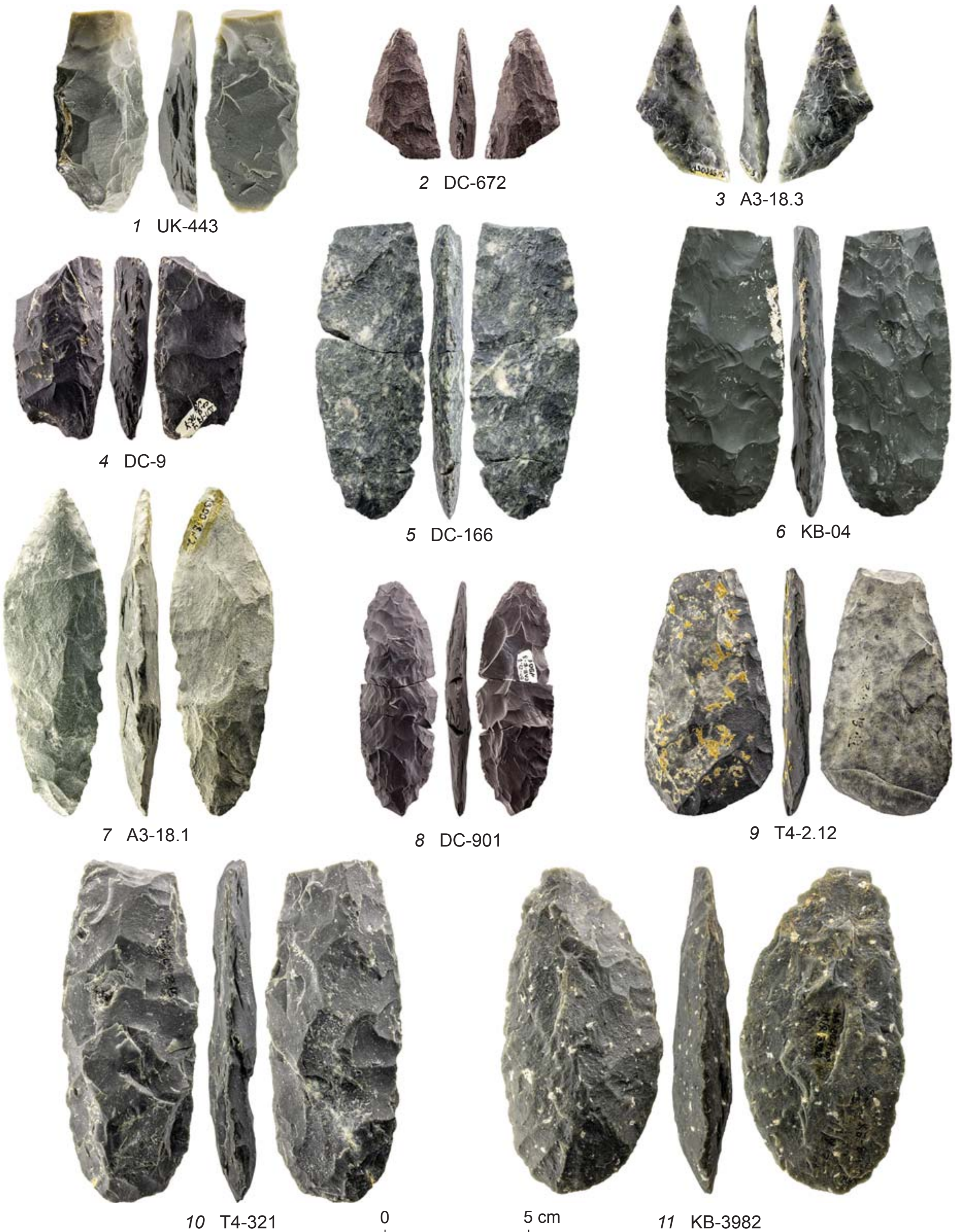

Fig. 1. Leaf-shaped bifaces from the sites of Ust-Karakol-1 (*1*), Denisova Cave (*2*, *4*, *5*, *8*), Anuy-3 (*3*, *7*), Tyumechin-4 (*9*, *10*), and Kara-Bom (*6*, *11*).

1 – felsic volcanic rock of the Anuy type or tuff of the Kara-Bom type; *2*, *5* – felsic volcanic rocks of the Karakol type without phenocrysts; *3* – felsic volcanic rock of the Anuy type; *4*, *8* – highly siliceous rocks; *6*, *10*, *11* – volcanic tuffs and ignimbrites; *7*, *9* – hornfelse (meta-sedimentary) rocks, aleurolite.

Table 1. **Chemical composition of material of the bifaces* from the sites in the Anuy and Ursul river basins, according to pXRF data, wt%**

Sample	Si	Ti	Al	Fe	Mg	Ca	Mn	K	S	Zr**	Nb**
Denisova Cave, Anuy											
DC-944	29.62	0.40	7.88	4.82	1.45	1.42	0.09	2.82	0.03	262	5
DC-65	46.25	0.04	1.51	0.60	0.41	0.19	0.09	0.59	Bdl***	18	Bdl
DC-901	42.64	0.14	2.40	3.59	0.50	0.26	0.23	0.35	0.02	41	"
DC-9	39.52	0.08	2.90	1.63	Bdl	0.24	0.08	0.16	0.04	31	"
DC-277	41.7	0.05	1.26	0.07	0.6	0.32	0.01	0.32	0.13	67	"
DC-919	23.51	0.54	6.49	6.02	1.50	3.05	0.10	1.46	0.07	171	9
DC-87	21.89	0.22	4.40	3.85	Bdl	2.86	0.36	1.49	0.01	47	Bdl
DC-672	30.45	0.17	7.34	3.02	"	0.70	0.03	2.25	Bdl	288	"
DC-166	33.31	0.20	7.46	2.15	"	0.74	0.05	3.42	0.03	330	7
Ust-Karakol-1, Anuy											
UK-622	27.84	0.11	5.55	0.78	Bdl	0.60	0.02	3.93	0.09	161	Bdl
UK-655	36.52	0.10	6.78	0.50	"	0.47	0.01	4.18	0.03	143	"
UK-443	34.56	0.09	6.05	3.58	0.49	0.25	0.09	5.61	Bdl	238	5
UK-369	29.69	0.41	8.43	4.17	1.33	5.73	0.06	2.01	"	181	8
Anuy-3, Anuy											
A3-18.1	31.49	0.06	5.91	1.61	Bdl	0.25	0.04	4.13	0.12	387	8
A3-18.2	30.21	0.41	7.38	4.02	0.91	4.93	0.05	1.58	0.03	163	5
A3-18.3	37.50	0.07	6.00	0.37	Bdl	0.26	0.01	2.72	0.04	168	Bdl
A3-31.1	35.37	0.16	6.89	1.20	"	0.64	0.03	1.27	0.07	346	17
Kara-Bom, Ursul											
KB-04	37.17	0.09	6.55	1.59	0.59	0.31	0.03	4.28	0.02	468	27
KB-20	31.54	0.07	4.45	1.36	Bdl	0.14	0.04	5.04	0.02	494	22
KB-5231	34.05	0.08	6.36	1.42	"	0.31	0.07	3.95	0.07	624	29
KB-3982	36.52	Bdl	6.20	0.62	"	0.45	0.02	3.17	0.02	110	Bdl
KB-92	37.73	0.07	5.99	1.41	"	0.24	0.03	6.40	0.04	369	21
Tyumechin-4, Ursul											
T4-435	33.17	0.07	5.45	1.14	Bdl	0.27	0.02	3.85	0.07	650	28
T4-321	38.19	0.09	6.01	1.53	"	0.21	0.04	4.04	0.03	456	26
T4-2.15	33.87	0.06	5.35	1.56	"	0.24	0.04	3.82	0.06	536	27
T4-2.12	2.13	0.51	8.97	5.71	1.93	6.03	0.11	1.48	0.05	158	8
T4-426	35.50	0.08	6.54	1.60	Bdl	0.29	0.07	4.40	0.08	517	24
T4-419	36.18	0.05	6.11	0.68	"	0.34	0.02	3.29	0.07	106	5

*Data for the surface.
**Content in ppm.
***Bdl – below detection limit of the method.

using the secondary thinning technique—a special bifacial processing that was the most effective for homogeneous fine-grained rocks with isotropy of physical and mechanical properties, fostering the production of thin symmetrical bifaces with maximum preservation of the product's width. The length of the tools reached 15–20 cm. The cultural and chronological context, morphology, and technology of the artifact production has been discussed earlier (Belousova et al., 2019, 2022).

The experimental collection includes 37 samples of rocks with high utilitarian properties, collected in 2020–2022 for the experimental splitting simulation program (Belousova et al., 2022) (Table 2). The sources of the rocks were modern and ancient gravels of the Ursul basin at the mouths of the Altaira and Nizhny Tyumechin rivers (n=28, Ursul group of sites), and the Anuy River basin (n=9, Anuy" group of sites).

Petrographic collection. For expanding the range of rocks from the Anuy River basin available for analysis, a collection (n=152) gathered in 1997 by N.A. Kulik was used. It includes samples of pebbles from the modern alluvium of the Anuy and its upstream tributaries (Karakol, Turata, Muta, etc.), as well as samples of the ancient alluvium of the Anuy and Karakol rivers, exposed during gold mining. Twenty-eight samples of volcanic (effusive) rocks (Table 2) are of particular importance to this study. Rocks of this type, widely used by the inhabitants of the local Paleolithic sites, are not found in the experimental collection.

Samples of individual high-siliceous blocks of rocks, similar to that of which several bifaces were made, are

Table 2. **Typical composition of rock samples from modern gravels of the Anuy and Ursul rivers, according to pXRF data, wt%**

Sample	Si	Ti	Al	Fe	Mg	Ca	Mn	K	S	Zr*	Nb*
Experimental collections											
Volcanogenic-sedimentary rocks from the Ursul River valley											
Exp-3	33.87	0.04	5.81	2.48	0.43	1.39	0.05	4.18	0.15	491	19
Exp-9	39.20	0.07	5.27	0.84	0.32	0.14	0.05	5.01	0.12	454	20
Exp-10	38.40	0.04	6.50	1.28	Bdl**	0.16	0.03	4.65	0.09	469	25
Exp-11	31.61	0.10	6.17	1.55	"	0.34	0.07	5.33	0.57	183	7
Exp-16	37.14	0.06	6.00	1.40	"	0.34	0.03	3.74	0.15	544	36
Exp-19	38.23	0.08	6.31	1.38	"	0.21	0.06	3.79	0.18	527	23
Exp-55	30.80	0.09	4.95	1.41	"	0.25	0.04	2.75	0.05	589	32
Meta-sedimentary rocks from the Anuy River valley (mouth of the Karakol River)											
Exp-14	20.80	0.33	4.87	3.61	0.98	5.12	0.07	3.11	Bdl	145	Bdl
Exp-27	21.60	0.46	7.27	6.91	1.96	5.19	0.10	1.48	0.17	154	7
Exp-29	30.71	0.36	7.05	3.85	1.38	4.96	0.06	1.61	0.03	160	6
Exp-36	27.47	0.44	7.93	4.84	1.58	5.18	0.06	1.07	Bdl	173	6
Exp-45	27.73	0.35	7.21	3.28	1.14	4.91	0.06	3.56	"	190	9
Petrographic collection of N.A. Kulik											
Felsic effusive rocks from the Anuy River valley, Anuy type											
An-127	38.67	0.13	5.84	1.18	Bdl	0.28	0.01	3.33	Bdl	192	Bdl
An-124a	30.88	0.06	4.74	0.20	0.37	0.12	0.01	1.56	"	138	3
An-122a	39.89	0.06	6.13	0.59	Bdl	0.16	0.01	4.52	"	152	Bdl
An-8	36.99	0.07	7.98	1.15	"	0.25	0.01	0.38	"	181	"
An-10	34.64	0.30	6.48	2.95	"	0.66	0.01	3.85	"	238	"
Tu-98a	36.21	0.07	6.69	1.29	"	0.17	0.01	3.66	"	443	10
Felsic effusive rocks from the Anuy River valley, Karakol type											
Kk-40	35.84	0.16	7.53	1.59	Bdl	1.10	0.03	2.80	Bdl	301	9
Kk-50	35.15	0.40	6.79	3.63	0.52	1.96	0.09	2.71	"	241	6
Kk-52	31.42	0.50	8.46	5.20	0.85	2.75	0.09	1.77	0.01	261	5
Kk-88	34.95	0.26	7.53	1.97	Bdl	1.76	0.06	2.85	Bdl	251	6

*Content in ppm.

**Bdl – below detection limit of the method.

not considered in this study, since such material was not found in the river alluvium, slope deposits, or bedrock outcrops of the Anuy and Ursul basins.

Methods

The study followed a set of geological and mineralogical methods aimed at establishing the petrographic features of rocks and their chemical composition. Standard petrographic thin sections for studying in transmitted light, as well as polished preparations from pieces of rock mounted in epoxy resin for working with a scanning electron microscope, were made from the samples of the experimental and petrographic collections. Scanning electron microscopy (SEM) was used for detailed study of the rock structure and identification of minerals with an integrated energy-dispersive spectrometer (EDS) under standard parameters at the Center for Collective Use of Scientific Equipment for Multi-Element and Isotope Research of the Siberian Branch of the Russian Academy of Sciences, using a Tescan Mira 3 system with Oxford X-Max 50 spectrometer.

A portable X-ray fluorescence (pXRF) analyzer Olympus Vanta M, with a 4 W rhodium anode and silicon drift detector in a modification specialized for studying rocks, was used for establishing the chemical composition. It is non-destructive and does not require sample preparation, which is important when studying archaeological artifacts. For the analysis an area with a relatively flat, homogeneous, and clean surface was sufficient. The device does not require a vacuum or short-term calibration. The built-in camera makes it possible to select the area for analysis.

The device does not measure the content of elements lighter than magnesium. This concerns primarily sodium, the typical content range of which for volcanic and sedimentary rocks is 0.3–3.0 wt%. Sodium plays an important role in the composition of many rocks; therefore, in the absence of data on its content, direct use of petrochemical recalculations and many classification diagrams is impossible.

The Olympus Vanta M has proven to be useful in analytical work at geological sites, and has shown stability of results with multiple measurements (Wawryk, Hancock, 2022). Previous studies have revealed that this analyzer was effective in the diagnostics of rocks, and the obtained values could be used for direct comparison of the chemical composition of material from the flaked surfaces of artifacts and that from modern rock outcrops without grinding the artifact (Vishnevsky et al., 2023).

At least two spectra were obtained for each studied sample. The numerical results of spectra calculations were averaged. The diameter of the excitation spot of the surface was ca 3 mm; the voltage was 10/40 kV; the spectra accumulation time was 15 sec (30 sec in total).

Petrography and mineral composition of samples from the experimental and petrographic collections

Sedimentary and meta-sedimentary rocks from the Anuy alluvium. Nine samples were selected from the river spits near the Ust-Karkol-1 site for the experimental collection (Table 2). Most of the rocks are massive and lumpy-banded siltstones with color ranging from gray and dark gray to black (often with a brownish tint), with grains 20–50 μm in size. Some rocks with grains ~100 μm in size can be described as silty sandstones and fine-grained sandstones. The grains are poorly sorted and weakly rounded (Fig. 2, *1*), dominated by fragments of magmatic rocks of intermediate and basic composition, as well as quartz and plagioclase grains.

All of the studied rocks manifest traces of recrystallization under temperature (metamorphic) and/or hydrothermal influence of varying degrees, and consequently are meta-sedimentary. Many samples have poor textural and structural features, such as fine-spotted textures typical of hornfels. Albite and epidote are the most common among the newly formed minerals. Epidote forms both small idiomorphic grains and rather large poikilitic crystals up to 100–150 μm in diameter (Fig. 2, *1*, BSE). The structure of the rock shows embayed boundaries of fused grains, which ensures increased strength and homogeneity of the material. In addition to epidote, sericite and chlorite are observed in the intergranular space of some rocks; their share reaches 20 vol%. Previously, such a wide occurrence of neogenic minerals was attributed to low stages of regional metamorphism of sedimentary rocks in the Anuy basin (Gosudarstvennaya geologicheskaya karta…, 2001; Postnov, Anoikin, Kulik, 2000). However, widespread occurrence of hydrothermally transformed rocks and low-temperature contact-metamorphic aureoles in this region (Gosudarstvennaya geologicheskaya karta…, 2001) suggests a connection between the observed changes and magmatism.

Volcanogenic rocks of the Anuy alluvium. Twenty samples were taken. In the Anuy channel near Denisova Cave, two types of effusive rocks occur: the most common are aphyric rhyolites; less common are rare-porphyritic rhyolites and rhyodacites with massive, spotted-banded, and flow-banded (fluidal) texture, and

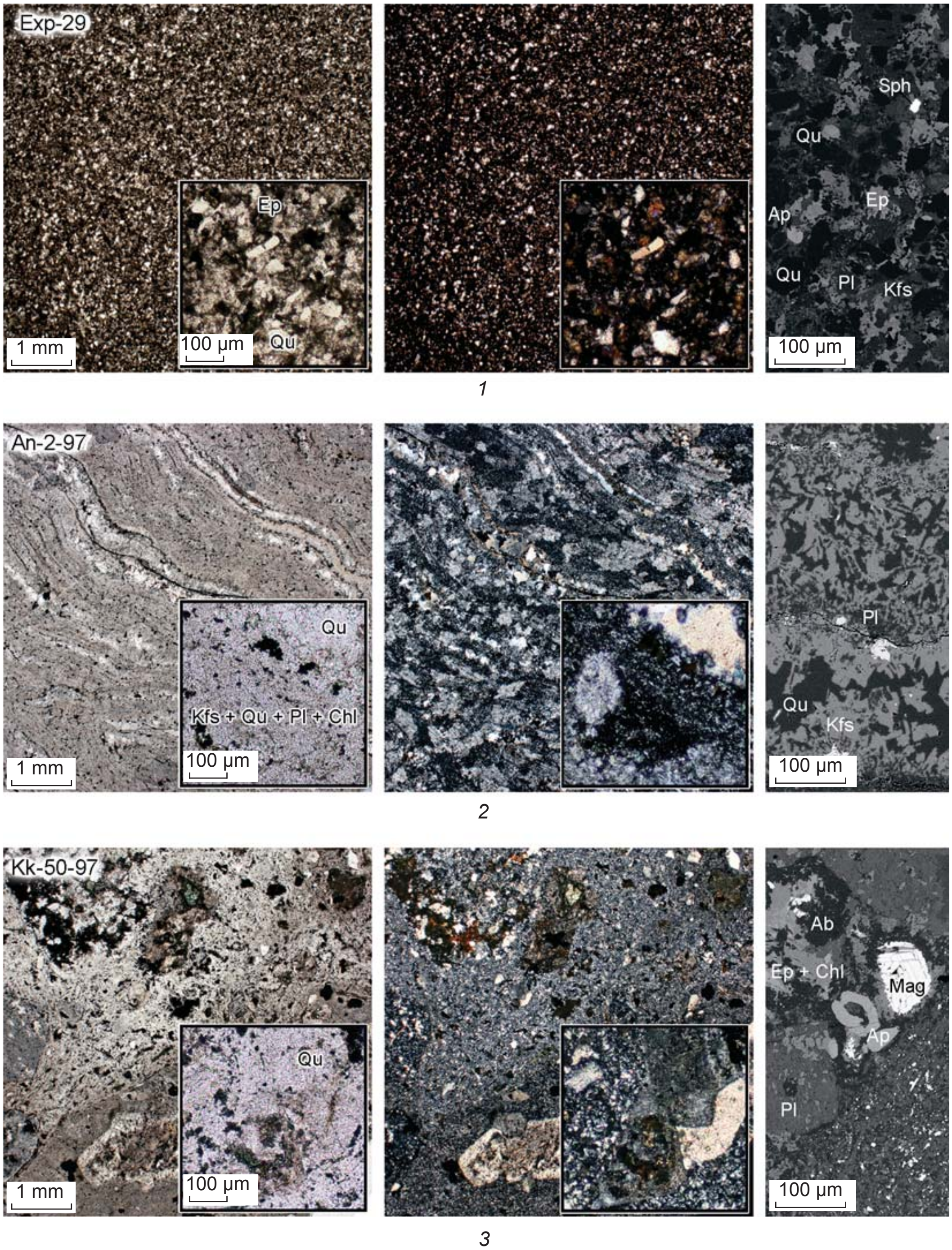

Fig. 2. Petrographic features of meta-sedimentary and volcanic rocks from the Anuy alluvium. The images were taken using an electron microscope: in plane-polarized light (ppl) – left column, in crossed nicols (xpl) – central column, in backscattered electrons (BSE) – right column.

Ap – apatite; Chl – chlorite; Ep – epidote; Kfs – potassium feldspar; Mag – magnetite; Pl – plagioclase; Qu – quartz; Sph – sphalerite. *1* – Exp-29, typical meta-sedimentary rock visually diagnosed as aleurolite. On the left a fine-grained structure with uniform distribution of weakly rounded grains is visible. The BSE-image clearly shows the growth of a newly formed epidote— the development of a hornfels structure; *2* – An-2-97, aphyric rhyolite of the Anuy type with distinctive flow-banding and micropoikilitic texture of the groundmass formed by poikilocrysts of potassium feldspar; *3* – Kk-50-97, porphyritic dacite of the Karakol type with a large number of different-sized phenocrysts of altered feldspars, chloritized grains of dark-colored minerals, magnetite, and apatite.

felsitic, spherulitic, or micropoikilitic groundmass, the so-called felsic volcanic rocks (FVR) of the Anuy type (Fig. 2, *2*). The groundmass of these rocks consists of closely intergrown very fine grains (1–5 μm) of quartz, plagioclase (albite), and potassium feldspar. Accessory minerals are most often magnetite, apatite, zircon, and less often titanite. In some samples, the rock is strongly altered—albitized and chloritized, but its grain size remains extremely fine. These rocks have a light (beige-gray, greenish-gray, yellowish) color, or less often range from a reddish to brown color. Their pebbles are typical of the right tributaries of the Anuy River—the Cherga, Turata, and Khulusta rivers.

Dacites (up to andesites) with porphyritic and glomeroporphyritic texture, usually without pronounced flow-banding—the so-called Karakol type (Fig. 2, *3*)—occur more rarely in the Anuy alluvium. These rocks are dark-colored, gray, greenish-gray or greenish-brown, sometimes with a reddish-violet tint. Phenocrysts include intermediate plagioclase, chloritized dark-colored minerals, such as amphibole or clinopyroxene, as well as magnetite, and ilmenite (Fig. 2, *3*, BSE). Quartz, albite, and potassium feldspar dominate in the main microgranular mass. Accessory minerals (ilmenite, magnetite, apatite, and titanite) are present in much larger quantities than rocks of the Anuy type. Secondary minerals—chlorite and sericite—are widespread. The main supplier of such rocks to the Anuy valley is the Karakol—a large left tributary flowing into the Anuy 2 km upstream from Denisova Cave. However, variability in the composition and textural-structural features of volcanic rocks in this case is rather high: the Anuy pebbles above the confluence of the Karakol also contain porphyritic rocks, and the Karakol alluvium contains rock types almost devoid of phenocrysts.

Volcanogenic-sedimentary rocks of the Ursul basin. For the experimental collection, 28 samples were taken from the alluvium of the Altaira River, 200 m from its mouth, and from the alluvial fan of the Nizhny Tyumechin River, which is eroded by the Ursul in the area of the Tyumechin-1–3 sites (Belousova et al., 2022). These are pyroclastic (volcanogenic-sedimentary) rocks of felsic composition, formed by dispergation of magmatic material during a volcanic eruption and its subsequent deposition, that is, these are compacted fine-grained ash tuffs (Fig. 3, *1*, *2*) and ignimbrites with massive or poorly banded, discontinuous-linear or unevenly spotted texture caused by fiamme relics (Fig. 3, *3*). They are usually completely devitrified and partially recrystallized under the effect of either low-grade regional or contact metamorphism during intrusion of small magmatic bodies that are widespread in this region (Gosudarstvennaya geologicheskaya karta…, 2019). The preserved phenocrysts/fragments of quartz and feldspar grains make it possible to distinguish tuffs as initially vitroclastic (almost free of phenocrysts) (Fig. 3, *1*) and crystal-vitroclastic (Fig. 3, *2*).

Most of the rock (grain size of 5–25 μm) is composed of an aggregate of quartz, potassium feldspar, acid plagioclase, and biotite (sometimes with chlorite), which gives it a gray or greenish color. Larger grains, mainly of potassium feldspar, usually constitute no more than 5 vol% of the rock, rarely up to 20–25 %. The grains usually have an irregular shape, sometimes in the form of an acute angle. Resorption and recrystallization with decrease in granularity are sometimes visible along their boundaries (Fig. 3, *2*). Epidote, allanite, and titanite are widespread, forming close intergrowths and individual metacrystals with a diameter of 50–500 μm, rarely up to 1.5 mm (Fig. 3, *1*, BSE), perceived by the naked eye as white spots. Apatite and zircon are noticeably less common. Some samples demonstrate macroscopically noticeable pyrite, forming anhedral grains and clusters, usually up to 200 μm, but sometimes up to several millimeters; small sphalerite and galena grains are much less common.

Chemical composition of the gravels and bifaces

Analysis of the pXRF-derived data on the chemical composition of pebbles and bifaces has revealed compositional groups and established petrochemical criteria for distinguishing between different types of rocks (Fig. 4). The graphs show compositional fields for the rocks from the experimental and petrographic collections (except for the tuffs of the Elovskaya depression), which are compared with the results of the tools material analysis (Fig. 4).

Experimental and petrographic collections. Variability of the shares of minerals and heterogeneous fragments in meta-sedimentary rocks from the Anuy alluvium is confirmed by data on their chemical composition obtained using pXRF and EDS (area scanning over sections of about 400 × 400 μm). These data show good convergence within 1σ. The contents of all petrogenic elements vary. For example, the silicon content ranges from 20.8 to 30.7 wt%, and titanium content from 0.33 to 0.57 wt% (pXRF data; Fig. 4, *a*, *b*; Table 2). Positions of points of these elements on the classification diagrams of clastic sedimentary rocks, for example, $\log(SiO_2/Al_2O_3)$ to $\log(Fe_2O_3/K_2O)$ (Herron, 1988), make it easy to distinguish them. In this

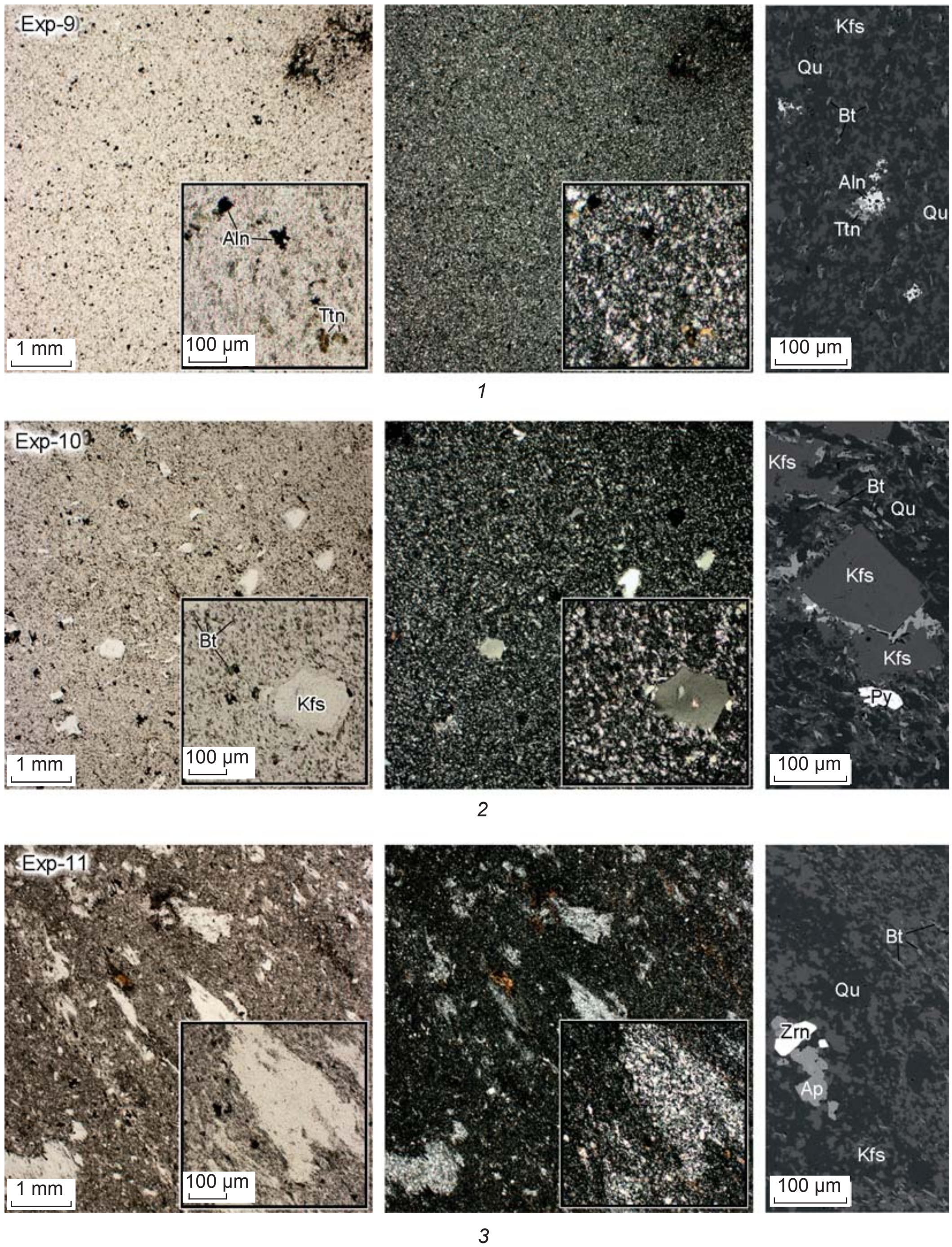

Fig. 3. Petrographic features of volcanogenic and volcanogenic-sedimentary rocks from the Ursul alluvium. The photographs were taken using an electron microscope: in plane-polarized light (ppl) – left column, in crossed nicols (xpl) – central column, in backscattered electrons (BSE) – right column.

Aln – allanite; Ap – apatite; Bt – biotite; Kfs – potassium feldspar; Py – pyrite; Qu – quartz; Ttn – titanite; Zrn – zircon.

1 – Exp-9, fine-grained small-spotted tuff with massive texture, containing no large (porphyry) crystals nor their fragments—vitroclastic tuff. Intergrowths of grains of newly formed titanite and allanite, as well as regular parallel orientation of biotite flakes, are clearly visible; *2* – Exp-10, rock with cement similar to Exp-9, but containing fragments of quartz crystals and potassium feldspar—crystal-vitroclastic tuff. Newly formed xenomorphic pyrite often occurs along with phenocrysts. Phenocrysts of potassium feldspar are partially recrystallized at the edges into granular aggregate; *3* – Exp-11, ignimbrite with distinctive discontinuous-linear texture resembling that of the flow in lavas, which is caused by flame-like segregations (fiamme). Concordant orientation of fiamme and biotite flakes is visible.

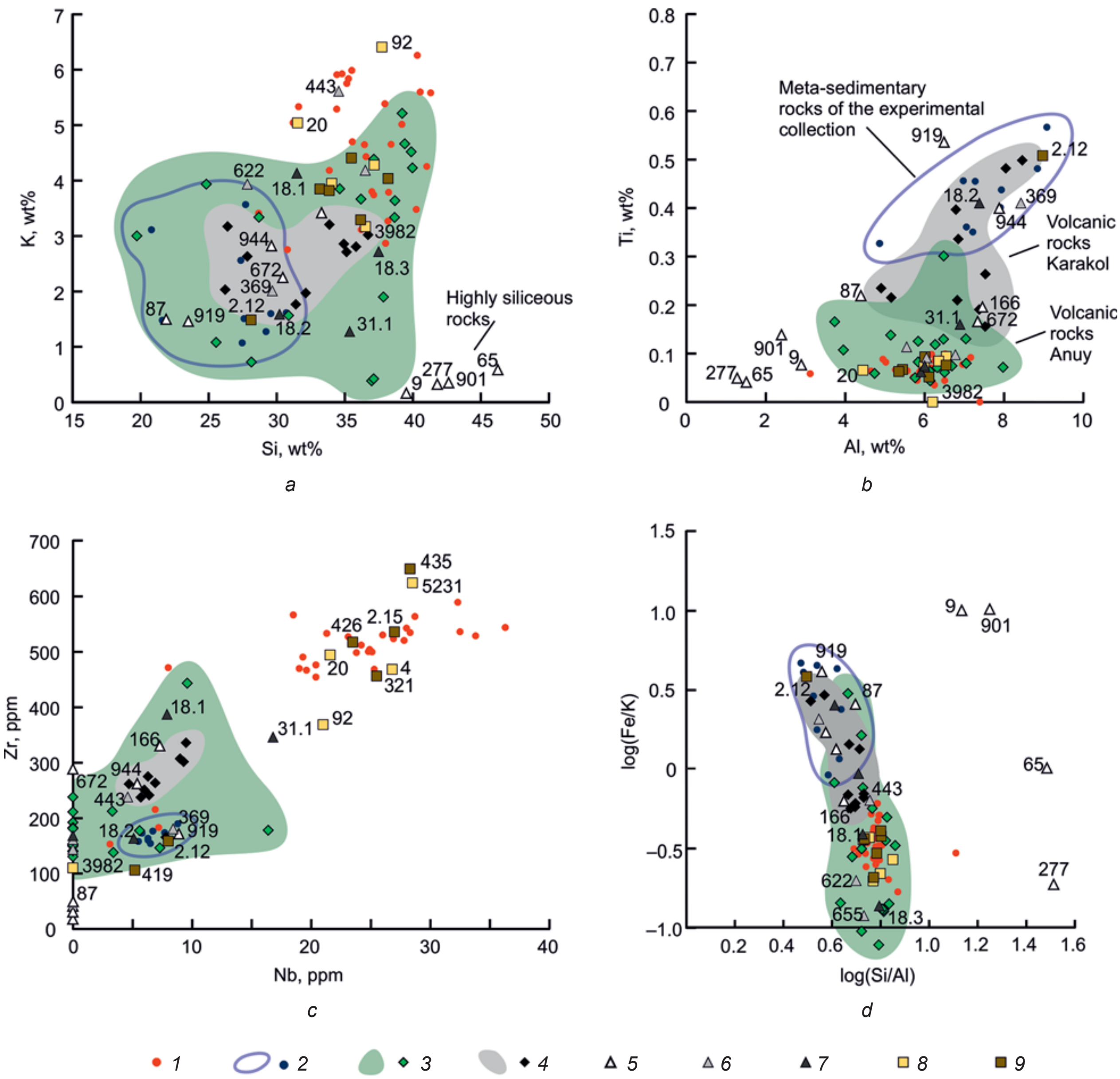

Fig. 4. Chemical composition of materials of the bifaces, meta-sedimentary and effusive rocks from the modern channel alluvium of the Anuy River (at the mouth of the Karakol River), as well as volcanogenic-sedimentary rocks from the Ursul River (at the mouth of the Nizhny Tyumechin River), according to pXRF data. The composition fields of meta-sedimentary and felsic volcanic rocks of the Anuy and Karakol types are highlighted. Numbers indicate the points of surface composition of the material of some bifaces.

1 – tuffs and ignimbrites of the Elovskaya depression (Ursul); *2* – meta-sedimentary rocks (Anuy); *3* – volcanic rocks from the Anuy alluvium; *4* – volcanic rocks from the Karakol alluvium; *5* – Denisova Cave; *6* – Ust-Karakol-1; *7* – Anuy-3; *8* – Kara-Bom; *9* – Tyumechin-4.

study, a modified version of the diagram in log(Si/Al) – log(Fe/K) coordinates was used for illustrating the compositional features of rocks (Fig. 4, *d*). The content of zirconium in meta-sedimentary rocks of the Anuy varies within the narrow range of 150–200 ppm; the niobium content is within 5–10 ppm (Fig. 4, *c*; Table 2).

The content of silicon in the volcanogenic-sedimentary rocks from the alluvium of the Ursul River basin on average is 36.4 wt%, while the potassium is 4.65 wt% (Fig. 4, *a*). No significant regularities in compositional deviations that would correlate with the textural features of rocks (vitroclastic, crystal-vitroclastic tuffs and ignimbrites) are observed in the available sample. As compared to metasediments, the rocks show lower contents of calcium, iron, and titanium (Fig. 4, *b*; Table 2), which corresponds to FVR of the

Anuy type. Some samples demonstrate an increased concentration of sulfur due to pyrite and other sulfides. In the log(Si/Al) to log(Fe/K) diagram, the points form a compact field in the range of values from −0.25 to −0.75 log(Fe/K) and from 0.7 to 0.85 log(Si/Al). Only the composition of sample Exp-25 (Fig. 4, *d*), which has an atypical spotted texture, stands out in the high value of log(Si/Al) > 1. The two groups are clearly distinguished by the zirconium content: the main group (n=24) with concentration values >400 ppm, and a small group (n=3) with concentration values in the range of 150–250 ppm (Fig. 4, *c*). The niobium content generally shows a close connection with zirconium; in most rocks, this indicator is in the range of 20–35 ppm, and in the group with low zirconium contents it is 3–8 ppm (Fig. 4, *c*; see Table 1).

FVR from the Anuy alluvium demonstrate the widest variation in their composition, caused not so much by their original nature, but rather by later secondary processes. Nevertheless, a specific set of features usually distinguishes the composition of these rocks from the felsic tuffs of the Elovskaya depression, in spite of their similarity of appearance. The Anuy-type rocks have low calcium content, up to 0.66 wt% (mean 0.2 wt%), while the average value for the Karakol type is 1.5 wt%. The difference is also manifested in a titanium content of 0.05–0.3 (mean 0.1) wt% for the Anuy and 0.16–0.5 (mean 0.3) wt% for the Karakol type; it results in the appearance of a significant amount of ilmenite, which gives a darker color to the rock. The differences of other components are not particularly significant—the wider composition values for the Anuy type completely encompass the Karakol ones (Fig. 4, *a*, *c*; see Table 1). The log(Fe/K) values vary from 0.47 to −0.25 (mean 0) for the Karakol rocks, and from 0.48 to −1.11 (mean −0.5) for the Anuy rocks.

The sharp drop to 0.3–0.7 wt% as opposed to an average of 3.5 wt% is observed in the potassium content in some samples of the Anuy type FVR. The SEM study has shown that this was caused by albitization—replacement of the original aggregate of albite, quartz, and potassium feldspar by very fine-grained secondary albite. In this case the hardness of the rock and pattern of fracture do not change significantly.

An important criterion for differential diagnostics is the niobium content, which does not exceed 20 ppm in the vulcanics from the Anuy alluvium, and does not fall below this value in the main group of the studied tuffs from the Elovskaya depression (Fig. 4, *c*). The average values of the zirconium content are also indicative. They are 185 ppm for the Anuy rocks, 265 ppm for the Karakol rocks, and 480 ppm for the main group of tuffs. These criteria help to identify the rocks brought to the Anuy River valley with a high degree of reliability.

Rocks used for bifaces. The surfaces of artifacts exposed to groundwater and other exogenous factors for a long time may change in color and chemical composition, since weathering causes uneven destruction of minerals constituting the rock. The processes of oxidation and depositing of minerals from the groundwater have a large effect, resulting in formation of films of iron and manganese oxides, calcite crusts, etc. on the surfaces. Previous analysis of statistical data on the materials from open-air sites has revealed a slight shift in the concentrations of these elements under the influence of external factors (Vishnevsky et al., 2023). In some areas of Denisova Cave, such an important factor was migration of pore solutions through layers enriched by waste products of bats, which caused changes in the surfaces of artifacts and formation of various phosphates (Sokol et al., 2022). Among the items of this study, only one artifact DC-87 bears traces of such changes.

Most of the points in the composition of materials of the bifaces made of rocks macroscopically identified as sedimentary (despite wide variations in the concentrations of petrogenic elements (see Table 1)) are located predominantly in the composition field of meta-sedimentary rocks of the experimental collection selected from the alluvium of the Anuy valley (Fig. 4, *b*). The most typical composition, gravitating toward the central part of the field, is revealed in the material of items from the sites of Anuy-3, Ust-Karakol-1, and Denisova Cave—A3-18.1 (see Fig. 1, *7*), UK-369, and DC-919, respectively (see Fig. 4, *c*), although the latter item shows a slightly increased concentration of titanium. Biface DC-944 has a lower content of calcium and a higher content of aluminum, which is not compensated for by potassium (forming potassium feldspar). This can be explained by the wide albitization process with introduction of sodium, which is not identified by pXRF. Artifact DC-87 from the Anuy valley, made of meta-sedimentary rock, demonstrates distinctive traces of secondary phosphate mineralization and low concentrations of most components except for iron, calcium, and phosphorus. The share of phosphorus exceeds 5 wt%, which is due to the transformation of its surface by phosphorus-rich solutions (Ibid.). Such data are not very suitable for direct comparison, since in the binary diagrams (Fig. 4, *a*–*c*), the composition point of sample DC-87 shifts diagonally to the lower left corner, with values closer to zero. However, in general, the proportions of the components continue to be consistent. In the diagram of logarithmic ratios, the point of the composition of sample DC-87 is in the field of meta-sedimentary rocks. Notably, samples with such pronounced surface changes require not only careful petrographic control, but also a technique for identifying the trend of compositional transformation, which is worth creating.

The compositional field of meta-sedimentary rocks from the experimental collection also includes the material of biface T4-2.12 (see Fig. 1, *9*) from the Tyumechin-4 site—the only one not made of tuff (9.1 %) among the artifacts discovered at the sites of the Ursul group. The upper reaches of the Elo River, as well as tributaries of the Anuy River, including the Karakol, erode complexes of Cambro-Ordovician and Silurian sedimentary rocks; therefore, the use of such rocks from the gravels of the Elo and Ursul rivers is quite possible.

The petrochemical indices in most (63.6 %, *n*=7) of the bifaces from the Ursul River in the diagram are overlapped by the main area of those of rocks from the experimental collection gathered in that valley (tuffs and ignimbrites) in all components, including the samples KB-20, KB-04 (see Fig. 1, *6*), KB-5231, T4-426, T4-321, T4-2.15, and T4-435. The increased utilitarian features of individual rock samples (e.g., KB-04) are determined not by variations in the chemical composition, but by structural features of the mineral aggregate.

The material of the bifaces KB-3982 (see Fig. 1, *11*) and T4-419 has lower zirconium concentration in comparison with other items of that type from the Ursul River. According to this indicator, the material gravitates toward a separate small group of tuff compositions. It also has a lower iron content (two times lower than average) and titanium content (in KB-3982, below the pXRF detection limit). The sample KB-92 occupies an intermediate position in zirconium concentration between the two groups of the experimental collection; furthermore, it corresponds to a maximum potassium content of 6.4 wt%.

Thus, the material of eight out of ten bifaces from Kara-Bom and Tyumechin-4 differs significantly in its petrochemical criteria from FVR the Anuy River basin, which are often quite similar in appearance.

Half of the bifaces discovered at the sites of the Anuy group (50 %, *n*=8) are made of FVR. The material of items UK-622, UK-655, A3-18.3 (see Fig. 1, *3*), and A3-18.1 (see Fig. 1, *7*) in all their characteristics corresponds to typical rhyolites and rhyodacites of the Anuy type. Another subtype of Anuy rocks is represented by tool A3-31.1, distinguished by significant depletion of potassium, which, taking into account the amount of aluminum, can be compensated for by albitization. This is also evidenced by white flake-like inclusions in the rock, which are most often greenish-gray. Noteworthy are the increased concentrations of niobium and zirconium (17 and 367 ppm), which are at the limit of values obtained for the samples of corresponding rocks from the petrographic collection.

The material of bifaces DC-166 (see Fig. 1, *5*) and DC-672 (see Fig. 1, *2*) is unusual in its chemical composition: it demonstrates higher concentrations of iron, aluminum, titanium, and zirconium (see Fig. 4, *b*, *c*) than most of the FVR of the Anuy type; thus, its features are similar to the FVR of the Karakol type, with the exception of a low calcium content. However, in the Karakol rocks, calcium is concentrated mainly in plagioclase phenocrysts, which are absent from DC-166 and DC-672. It can be assumed that the raw material for them was Karakol-type rock without phenocrysts. This is quite likely, considering the variability of structure and composition of rocks of the Kuyagan Formation, which was the source of the material.

The material of biface UK-443 (see Fig. 1, *1*) should be considered questionable, since it shows high potassium content (5.61 wt%), typical of tuffs from the Elovskaya depression, and relatively low concentrations of niobium and zirconium (see Fig. 4, *c*; see Table 1). However, the same raw material is distinguished by a high iron content (4.82 wt%), common to meta-sedimentary rocks and FVR of the Karakol type, and low titanium content, which is uncommon for them. The material has a greenish-gray color and a spotted texture; phenocrysts are absent. Thus, it can either be a metasomatized (ferruginized and K-feldspathized) FVR of the Anuy type or a ferruginized tuff of the Kara-Bom type. Unfortunately, it is not possible to reliably establish this without using destructive methods.

A separate group consists of highly siliceous rocks of bifaces from Denisova Cave—DC-65, DC-901 (see Fig. 1, *8*), DC-9 (see Fig. 1, *4*), and DC-277. These show the highest silicon content, reaching 46.3, 42.6, 39.5, and 41.7 wt%, respectively. These rocks are distinguished by consistently low concentrations of all other elements, in comparison with sedimentary rocks (see Table 1). These features are clearly visible in the diagrams. In particular, the log(Si/Al) values for them are two times higher than for rocks of other types (see Fig. 4, *d*). In addition, a distinctive feature of the high-siliceous rocks is very low zirconium concentrations—18, 41, 31, and 67 ppm, respectively, which is almost an order of magnitude less than that typical of both sedimentary rocks and vulcanites (see Fig. 4, *c*). The ratio of the concentration of chemical elements for such rocks usually gives little information, since the error in determination becomes greater, while the rocks could have undergone significant metasomatic transformation with introduction and (or) removal of various components. Their initial origin can be established only using a comprehensive approach involving destructive methods.

Sources of rocks

The geological structure of the central and northwestern parts of the Russian Altai is based mostly on volcanogenic and volcanogenic-sedimentary rocks of the Devonian period, represented in the areas under study by the Kuyagan (Anuy River basin) and Kurata (Ursul River basin) formations (Gosudarstvennaya geologicheskaya karta…, 2001, 2019). Together with other series of that age, these overlie earlier, mainly sedimentary, rocks that were deposited on the continental slope and later on the shelf of the ancient oceanic basin, where the strata of marl and limestone accumulated (Yolkin et al., 1994). The latter contributed to the formation of many karst caves of the Altai in the Quaternary. All of these sedimentary, volcanogenic-sedimentary, and volcanogenic strata were breached by numerous magmatic intrusions of various ages, including both small vein-like bodies and volcanic feeder channels, and huge granite massifs measuring tens of square kilometers. Such large magma intrusions led to the heating of surrounding sediments, and caused hydrothermal activity and metamorphism, which was expressed in changes in the structure and mineral composition of rocks. As a result of these processes, metamorphic aureoles (Fig. 5) (Gosudarstvennaya geologicheskaya karta…, 2001, 2019), represented by hornfels of various mineral composition and structure, depending on the heating temperature and chemical composition of the original rocks, emerged around many large magmatic bodies.

Most of the bifaces (*n*=10) from the sites of the Ursul group were manufactured from local rocks of the Middle Devonian volcanogenic-sedimentary Kurata Formation, exposed on the western slopes of Mount Aptyrga, and widely present in the alluvium of the Altaira and Nizhny Tyumechin rivers. These rocks include dark greenish-gray to greenish-black dense volcanic tuffs of felsic composition and ignimbrites with massive or discontinuously banded

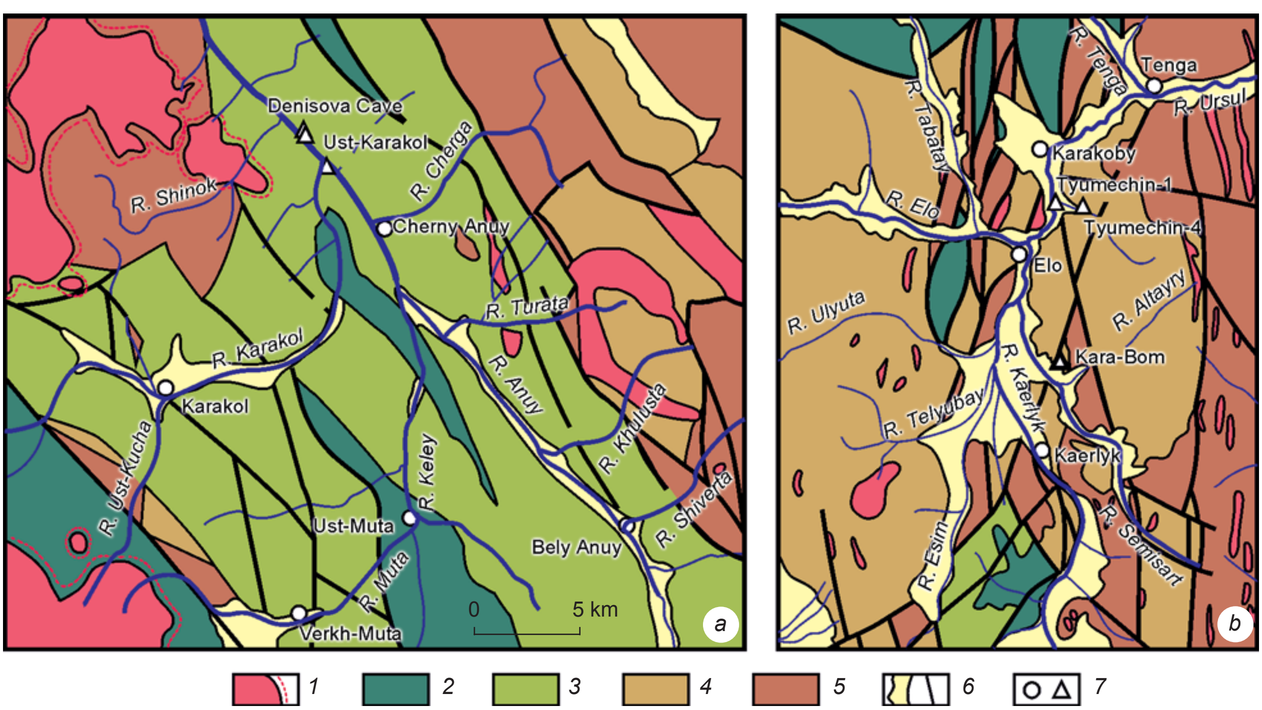

Fig. 5. Geological maps of the areas in the upper part of the Anuy basin (Denisova Cave, Ust-Karakol-1, and Anuy-3) (*a*) and Elovskaya depression in the Ursul valley (Kara-Bom, Tyumechin-4) (*b*). Compiled after (Gosudarstvennaya geologicheskaya karta…, 2001, 2019).

1 – magmatic intrusive bodies and contact metamorphic (hornfels) aureoles around them; *2* – Cambrian-Ordovician sedimentary formations; *3* – Ordovician-Silurian sedimentary formations, including those with carbonate rocks; *4* – Devonian Kuyagan and Kurata formations, including felsic volcanic and volcanogenic-sedimentary rocks; *5* – other Devonian sedimentary and volcanogenic-sedimentary formations; *6* – Quaternary alluvial deposits and major tectonic faults; *7* – settlements and Paleolithic sites.

texture, which were previously considered hornfels (Derevianko et al., 1998), felsic effusive rocks (Kulik, Shunkov, Petrin, 2003), or silicites (Rybin et al., 2018). According to the type of material, tools KB-92, KB-3982 (see Fig. 1, *11*), and T4-419 correspond to the range of variations in the composition of Kurata rocks (Gosudarstvennaya geologicheskaya karta…, 2019). Notably, the material of some bifaces from the Kara-Bom site, for example, KB-04 (see Fig. 1, *6*), which was initially identified as silicified siltstone (Belousova et al., 2019), upon closer examination turned out to be tuff. One of the artifacts from Tyumechin-4 (see Fig. 1, *9*) was made of local Ursul siltstone, whose composition is also typical of the alluvium from the Anuy River valley.

Thin leaf-shaped bifaces discovered at the sites in the Anuy valley were made of three types of raw materials: meta-sedimentary rocks (*n*=5, including sample DC-87), felsic volcanic rocks (*n*=8), and highly siliceous rocks (*n*=4). All of the rocks, except for the highly siliceous ones, can be found in local gravels of modern waterways. Post-sedimentation metamorphism of the rocks and hornfels aureoles have been described in detail during mapping works (Gosudarstvennaya geologicheskaya karta…, 2001). Traces of metamorphic or hydrothermal alteration in all samples that were included in our experimental collection suggest that many rocks of this type used for manufacturing Paleolithic tools were metasomatites or hornfelses of varying degrees of heating. Rivers ensure natural "enrichment" of rocks: less durable varieties in the form of large pebbles, unaffected by these processes, are practically absent from the alluvium, since mineral grains in them do not grow together into a common framework and the rocks are softer and anisotropic in their physical properties.

Volcanic rocks in the Anuy alluvium are represented by two types. The first type, lighter in color, is low-calcium and low-ferrous (the Anuy type), originating from the Kuyagan Formation—a formational equivalent of the Kurata Formation, exposed in the upper reaches of the right tributaries of the river. The second type is darker, with more high-calcium and titanium rocks of the Karakol type, coming to the surface in the upper reaches of the left tributaries of the Karakol and Muta rivers. Despite the relationship and sometimes visual similarity to the material of the Kara-Bom industry, these rocks differ in the ratio of most chemical elements.

It can be assumed that some of the artifacts from the Paleolithic sites of the Northwestern Altai, the material of which was previously identified as aphyric acid/felsic effusive/volcanic rock or even as porphyritic rock, were made of tuffs and ignimbrites. In this case, their fine grain size and, accordingly, good utilitarian features may be explained not by rapid solidification of the erupted rocks, but by formation of ash particles from this melt, which was accompanied by crushing of phenocrysts and partial differentiation of particles according to size during stratification. This suggests the presence of other sources of such rocks for the Paleolithic industry.

Conclusions

The non-destructive method of research using modern portable X-ray fluorescence spectrometers, designed for rock analysis, does not require special sample preparation. It has proven to be a highly productive tool, together with macro- and microscopic study of the surface, which has made it possible to reliably typify fine-grained raw materials of Paleolithic industries. As a result of study using pXRF analyzers, out of 24 initial petrographic definitions of bifaces, the following were confirmed: completely – 16, clarified – 3, and transferred to another group of raw materials (from sedimentary to volcanogenic-sedimentary) – 5, of which 4 were initially questionable.

It was established that thin leaf-shaped tools from the sites in the Elovskaya depression were made of local rocks mainly of volcanogenic origin, which widely occur in the alluvium of the tributaries of the Ursul—the Altaira and Nizhniy Tyumechin. These are dark greenish volcanic tuffs and ignimbrites of felsic composition; previously, scholars considered them hornfels, silicites, or felsic volcanic rocks. Bifaces from the sites in the Anuy valley were made of other material mainly of local origin, with lower utilitarian features than the tools from the sites in the Elovskaya depression. Most of the tools were made of FVR, and some were produced of meta-sedimentary, possibly hornfelsed, rocks. The sites on the upper reaches of the Anuy River also yielded isolated relatively small and often asymmetric bifacial tools made of high-quality, highly siliceous material—jasper-like rocks and microquartzites, which are absent from the alluvium and bedrock deposits. Indirect signs give reason to suggest that such rocks belonged to siliceous formations of the Zasurye (Marcheta) Formation, expanding to the west of this region, in the basin of the Charysh River, or the Kaim, Kayancha, and Eskongo formations, or the Peschanaya Series, which come to the surface to the east of the Anuy River valley, along the tributaries of the Peschanaya River, in the basins of the Sarasa, Sema, and Katun rivers.

Our findings show that thin and symmetrical bilaterally processed tools both in the central and northwestern parts of the Altai were manufactured mainly from local pebbles collected in the immediate vicinity of the sites. Mineral resources of the Anuy or Ursul were probably sufficient to satisfy the basic peoples' need for raw materials suitable for manufacturing high-quality artifacts. The collection of bifaces suggests that in the Ursul and Anuy river valleys Paleolithic humans, using local rocks, were able to reproduce points of the needed shape, proportions, and sizes (Belousova et al., 2022). However, in the Anuy river valley, where homogeneous fine-grained individual blocks were extremely rare (and ones like those in the Ursul valley were completely absent), it was necessary to engage in labor-intensive selection of rocks to make bifaces, and sometimes imported material was used. In solving sophisticated technological problems in new areas of habitation with resources of inferior quality as compared to previously inhabited territories, the early Upper Paleolithic inhabitants of the region demonstrated high stability of behavioral and manufacturing stereotypes. The data obtained suggest that raw materials most likely did not make a significant impact on the typological appearance of lithic industries, but undoubtedly determined their structure.

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The Afontova Gora IV (Ovrazhnaya) Site: An Analysis of a Complex with "Ocher" in the Structure of the Paleolithic Layer

We analyze a part of the Paleolithic layer of Afontova Gora IV (Ovrazhnaya) in Krasnoyarsk, evidencing intentional exploitation of outcrops of red sandstone and other local rocks. We describe archaeological finds and faunal remains, identify species important for subsistence. Based on the results of the intrasite spatial analysis, we separate an area of domestic activities centered on an open hearth. Scar-patterns and raw material links were analyzed. The preservation of the cultural context was demonstrated. The area likely functioned within a single activity episode. Types of activity are reconstructed. Primary reduction techniques applied to oval-flat pebbles to get first or second order blades were the same as those used to obtain ready wedge-shaped microcores transported to the site. To test the idea that red rocks were used as sources for mineral pigment, rock samples and archaeological artifacts were examined. In samples from Afontova Gora IV, no minerals that could be used to obtain the red pigment of the "ocher" type were found. Pieces of red rock brought to the site must have been used differently. The ^{14}C-date of the complex with cultural remains is ca 18 ka cal BP.

Keywords: Yenisei Paleolithic, Afontova Gora, utilitarian complex, intrasite spatial analysis, ocher, X-ray diffraction analysis.

Introduction

Afontova Gora IV as a separate archaeological site within the group of Paleolithic localities of Krasnoyarsk city has been known since the 1920s due to the studies carried out by V.I. Gromov, G.P. Sosnovsky, and N.K Auerbach (Sosnovsky, 1934: 257; Abramova et al., 1991: 100), although I.T. Savenkov collected the first archaeological objects in this area as early as 1884. Till the end of the 20th century, the site was regarded as a locality with scarce archaeological remains; studies were limited to observations; and the site area was occupied by private houses.

The full-scale study of the site began at the turn of the 20th–21st centuries owing to the construction of the fourth bridge across the Yenisei and development of Nikolaevsky Avenue. Prospecting works carried out in 2011–2019 have revealed the exact location and limits of the site in the modern landscape forms (Meshcherin, 2020), and a new locus—Afontova Gora IV (Ovrazhnaya) in its western part (Fig. 1, *A*, *B*).

In 2020–2022, the team headed by V.M. Novoseltseva, A.V. Barkov, E.V. Artemiev, and A.V. Vezhenko conducted rescue excavations at that locus, in an area exceeding 14,000 m^2. The scope of the work ensured the adequate reconstruction of the spatial arrangement of cultural remains. The most informative materials were discovered in the cultural layer located in the roof of the Final Pleistocene sediments (Novoseltseva, Stasyuk, Akimova et al., 2020; Novoseltseva, Akimova, Stasyuk et al., 2020; Akimova, Novoseltseva, Stasyuk, 2021: 106). One of the findings was the identification within the Paleolithic deposits of complexes evidencing hunting specialization (Akimova et al., 2021), residential and utility zones (Razgildeeva et al., 2022).

The feature distinguishing the area under study from other zones of the site is the presence of fragments of red rocks among archaeological remains. In archaeology, finds of this sort are traditionally termed as "ocher" and regarded as evidence of natural pigments use (Popelka-Filcoff et al., 2007; Pakhunov et al., 2014; Yanshina, Lev, Belousov, 2017). To prove the assumption that ancient inhabitants of Afontova Gora used red rocks as sources for mineral pigments, local rock samples and archaeological artifacts were examined. Findings did not reveal the presence at Afontova Gora IV of minerals that could be used for making the red pigment. Pieces of red rock brought to the site must have been used for different purposes.

Geomorphology, stratigraphy, and taphonomy

Afontova Gora IV (Ovrazhnaya) is located on the left bank of the Yenisei River, on a plateau-like surface near the top of Mount Afontova, at a level of 220–236 m according to Baltic Height System, within accumulative terrain. The western part of the site is associated with cover deposits of a high (85–101 m) terrace gradually merging with a gentle, southeast-facing slope. The system of ravines influenced significantly the character of exogenous processes and the structure of Quaternary deposits. The original landscape underwent irreversible changes; therefore, the streets of Nikolaevskaya Sloboda – Ovrazhnaya and 1st Baikitskaya were chosen as conventional landmarks. These streets actually run along ancient ravines.

The accumulation of cultural remains in question was located on a platform, ~250 m^2 in size, hypsometrically dominant within the upper tier of the southeastern slope, flattened by denudation, and gently declining

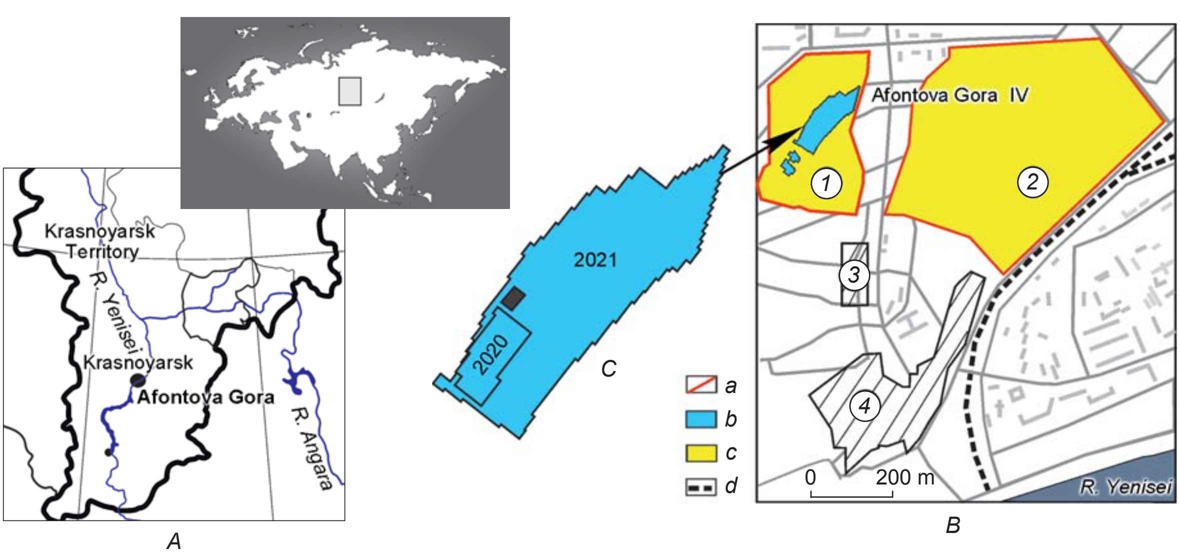

Fig. 1. Location of Afontova Gora IV (Ovrazhnaya).
A – scheme of the study area; *B* – situational plan: *1* – new locus of the Afontova Gora IV (Ovrazhnaya) site, *2* – territory of the Afontova Gora IV site in the 1920s, *3* – the Krutaya site, *4* – the Afontova Gora II site; *a* – boundaries of the archaeological heritage object, *b* – excavated areas, *c* – total area of the Afontova Gora IV site, *d* – railway; *C* – scheme of the excavated area of locus II, with the complex under study (marked).

toward the Yenisei River (Fig. 1, *A*, *B*). Archaeological remains were found at a depth of 0.2 m from the daylight surface, in the lower portion of light-brown sandy loam (lithological stratum 3, hereinafter LS 3). In the geological section, the upper part of the Holocene deposits of the Yenisei terrace proper, including the LS 3 roof, was obliterated by technogenic impact and replaced.

The geological sections of the area under study (excavation 5, loci 7 and 14) include:

LS 0 – modern technogenic deposits: mixed humified loam with domestic waste and mixed loams covering LS 0.1. The lower boundary is broken. Thickness is 0.02–0.17 m.

LS 0.1 – arable horizon of the modern soil complex: mixed chernozem soils. The lower boundary is even and distinct. Thickness is 0.15–0.22 m.

LS 3 – pale-yellow-brown, yellowish-gray loess-like sandy loams; light, porous, homogeneous, non-carbonaceous, non-laminated with lightly humified inclusions along the top. The boundaries are washed out, uneven, and indistinct. Thickness is 0.1–0.3 m.

LS 4 – light-gray loess-like sandy loams; porous, non-laminated. The whole stratum is impregnated with carbonates forming stains and flows. Visible thickness is up to 1.2 m.

The culture-bearing layer within the study area is partially destroyed by the road bed. The zone containing hearth is cut by technogenic pits on three sides (Fig. 2, *A*). The northwestern part of the hearth is covered by a lens of reddish-brown soil up to 4 cm thick, which was formed around the roots of a modern maple above the hearth spot (Fig. *B*; *C*, *4*). Outside the technogenic pits, in the area measuring ~50 m^2, culture-bearing deposits have been preserved *in situ*, with remains of manufacturing activities arranged mostly horizontally.

Methods

Archaeological research at the site was carried out using traditional methods of field studies. Stadia surveying of all the finds recorded *in situ* (including those of the micro category) was conducted. To understand the spatial organization of the site, methods of quantitative analysis, refitting, and identification of raw material units were employed. The reconstruction of activities was based on technical-typological and morphological analysis of artifacts. Pigments of the "ocher" type in rocks and soil were studied by X-ray powder diffraction. Some artifacts were examined by the petrographic method. Species composition of the fauna was identified to characterize the subsistence base.

Intrasite spatial organization

The main element of the habitation area—the hearth—is represented by a rounded spot of colored soil (3–4 cm) measuring 60 × 55 cm, encircled by archaeological remains. The cross-section of the black infill lens has a cup-shaped form (Fig. 2, *B*; *C*, *2*, *4*).

Near the hearth, there lay two slightly rounded sandstone cobbles with their long axes oriented towards the hearth's center. A subrectangular stone (18 × 8 × 8 cm) lay on its sharp edge in the southern part of the spot. A fissured stone fragment subtriangular in cross-section (24 × 10 × 12 cm) adjoined the spot from the east (Fig. 2, *B*; *C*, *5*). The base of the fragment lay on light sandy loam, which suggests that this stone had been present here since the early stages of the hearth use. Facets of the stones demonstrate reddish stains.

East of the boulders, there is a washed out spot of gray-black soil, fragments of split bones, including charred ones, and small debitage pieces (Fig. 2, *B*; *C*, *4*, *5*). Excavations between the stones revealed a pit (3 cm in diameter and 8 cm deep) filled with substance of intense black color. Closer to the stone subtriangular in cross-section, there was a fragment of a siliceous sandstone cobble of gray and mossy green color (12.8 × 7.8 × 6.8 cm). The cobble was knapped from narrow ends, and the detached flakes were embedded in the stratum. Five centimeters west of the hearth, in an area measuring 10 × 12 cm, a fragment of reindeer phalanx, unidentifiable split bones, flakes, and fragments of gray-pink sandstone tablets were found (Fig. 2, *C*, *1*). Short fragments of the bones lay horizontally. Another minute accumulation of bones including a longitudinal fragment split from a large bone, fragmented ribs and vertebrae of Equidae gen., and unidentifiable osteal fragments was recorded 15–20 cm south of the hearth spot. Some bones were found in vertical position, probably in a small pit (~10 cm in diameter, and ~15 cm in height). Ten centimeters south of this accumulation, the layer was disrupted by a technogenic pit.

Sediments outside the hearth zone were indistinct in terms of coloration: slightly brownish sandy loam was recorded near the bone accumulations, and reddish, in the areas with red rocks (Fig. 2, *C*, *3*, *6*).

A statistically significant cluster of debitage and fragmented rocks and bones was recorded in an area measuring ~5 m^2, 2 m southeast of the hearth. The periphery of the habitation area was marked by bone splinters. Fragments of reindeer antlers and those of a tibia were identified. Long fragments were arranged irregularly, while location of some pieces followed the microrelief.

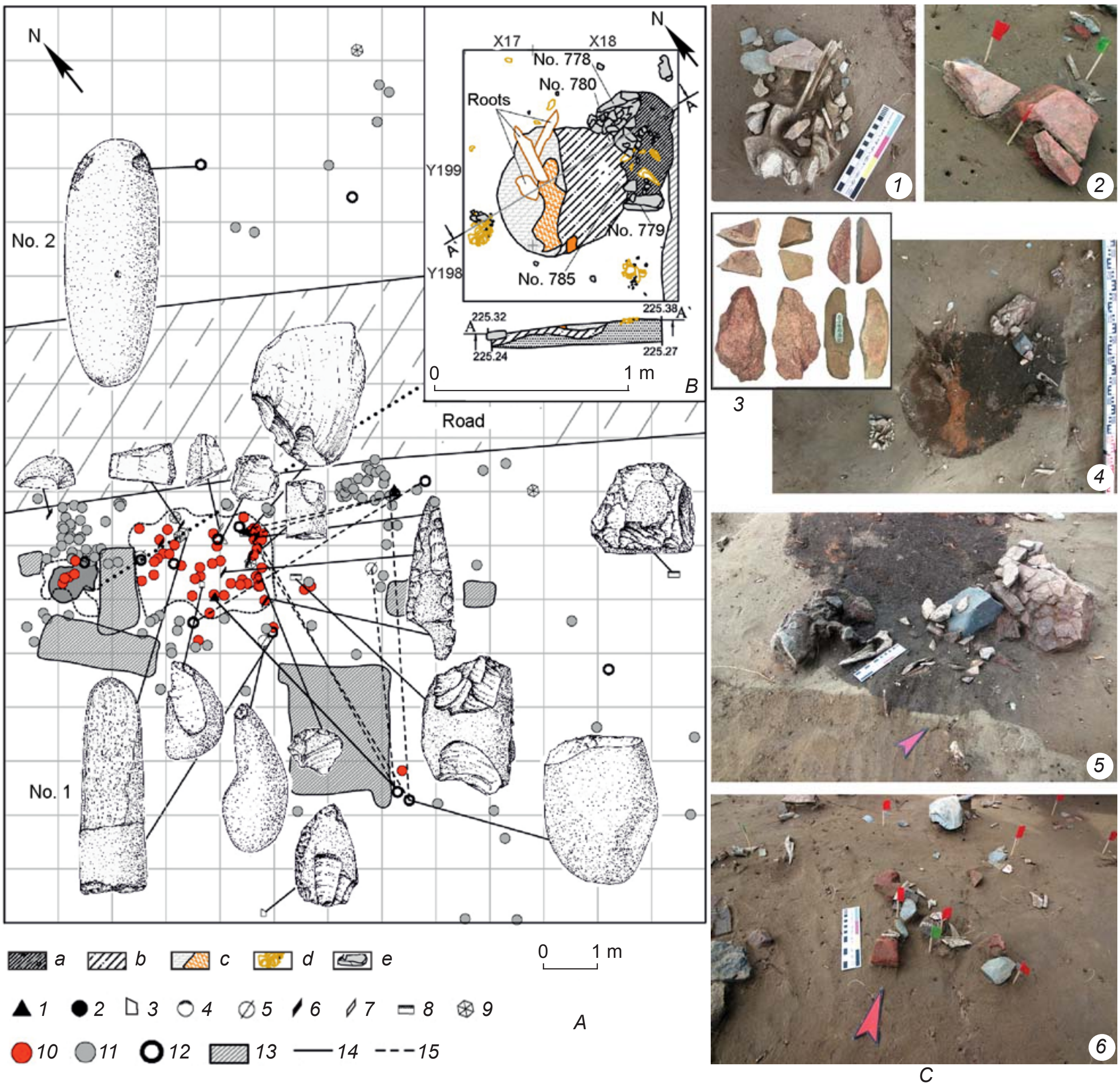

Fig. 2. Part of the Paleolithic layer of Afontova Gora IV.
A – plan of the complex with the scheme showing location of lithic artifacts: *1*, *2* – debitage, *3* – burin, *4* – end-scraper, *5* – tool fragment, *6* – blade, *7* – microblade, *8* – retouched implement, *9* – core, *10* – "ocher", *11* – bone, *12* – fragment of a pebble, *13* – technogenic pits, *14* – projection of artifact point, *15* – refitting links; *B* – plan and profile of the hearth: *a* – charcoal spot, *b* – charred sediment, *c* – soil lens with a root, *d* – bone fragments, *e* – stones near the hearth; *C* – components of the cultural layer: *1* – cluster of archaeological remains west of the hearth, *2* – piece of "ocher", *3* – rock fragments, *4* – hearth with the lens around the root, *5*, *6* – clusters of finds.

In the area north-northeast of the hearth, the culture-bearing layer was destroyed by the earth road. On its side, 4.5 m of the hearth, a cluster of bone splinters and lithics, including fragments of sandstone, was found. A large pebble core (9.6 × 8.1 × 5.4 cm) was discovered 9 m northeast of the hearth (Fig. 3, *11*; 4). Fragments of blades detached from the core were identified in the cluster located 2.5–3.0 m of the hearth. A wedge-shaped core (see Fig. 3, *3*), located behind the road, 11 m of the hearth, marked the limit of the habitation area. Microcore rejuvenation flakes were found among debitage in the central cluster (see Fig. 4).

Lithics and fauna remains

The artifact assemblage consists mostly of small and medium debitage pieces (60 %) (see *Table*). The informative material is scarce (~30 spec.). Primary reduction is shown by a single-platform unifacial core

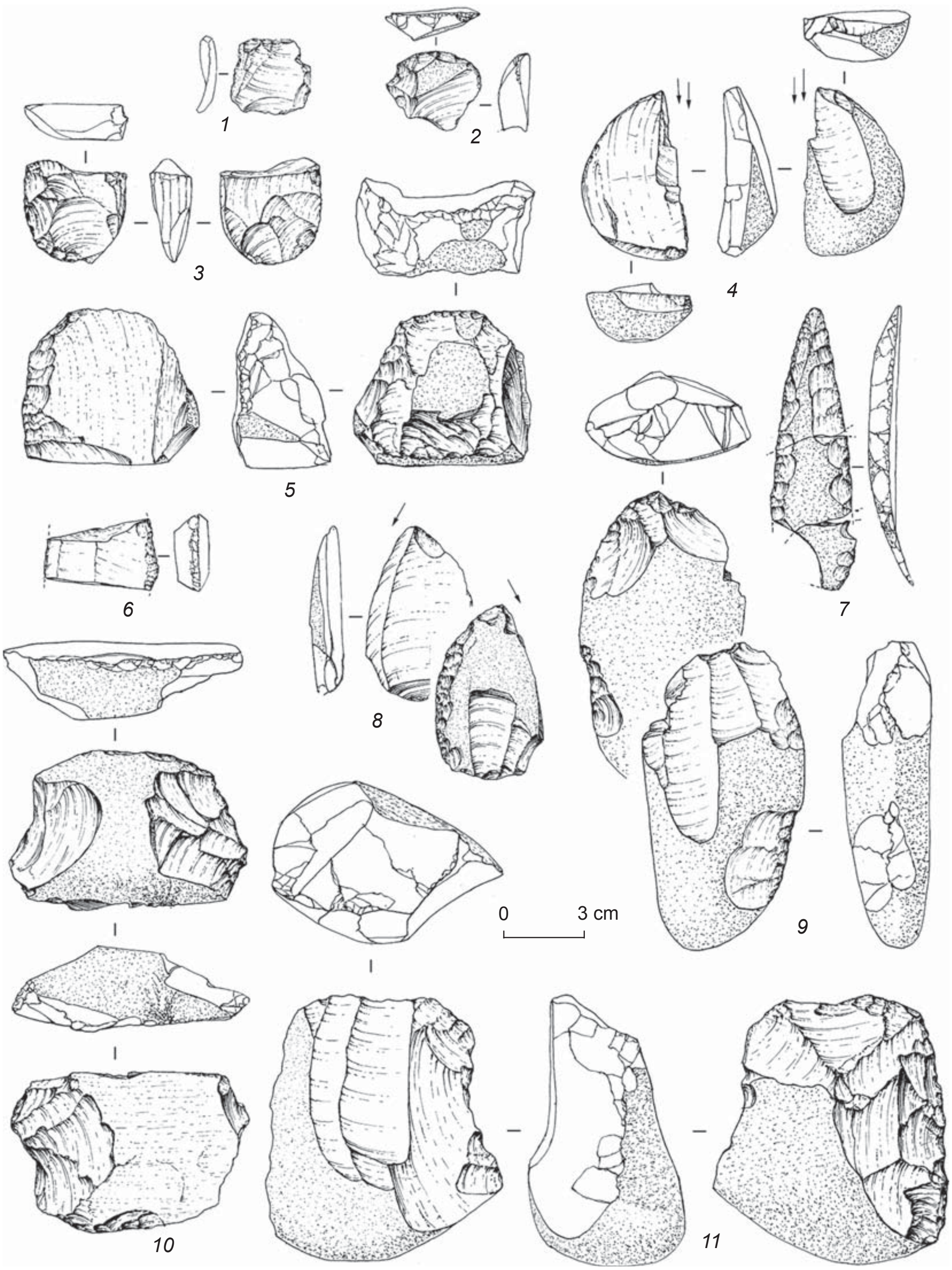

Fig. 3. Lithic artifacts.
1 – retouched flake; *2* – end-scraper; *3* – wedge-shaped microcore; *4*, *8* – burins; *5* – scraper-like (?) tool; *6* – fragment of a retouched blade; *7* – point; *9*, *11* – cores; *10* – chisel-like (?) tool.

on a large pebble (see Fig. 3, *11*), a core on an elongate pebble with traces of rejuvenation and a series of blades detached from it (see Fig. 3, *9*), a wedge-shaped microcore (see Fig. 3, *3*), and rejuvenation flakes (8 spec.). A nodule of green siliceous sandstone with an inner defect exhibits a failed attempt of flaking.

The tool kit comprises two burins (see Fig. 3, *4*, *8*), an end-scraper on a flake (see Fig. 3, *2*), a point composed of three fragments (see Fig. 3, *7*), a chisel-like (see Fig. 3, *10*) and a scraper-like (see Fig. 3, *5*) implements, a large hammerstone, a retoucher on a small pebble, a large retouched flake, two fragments of blades,

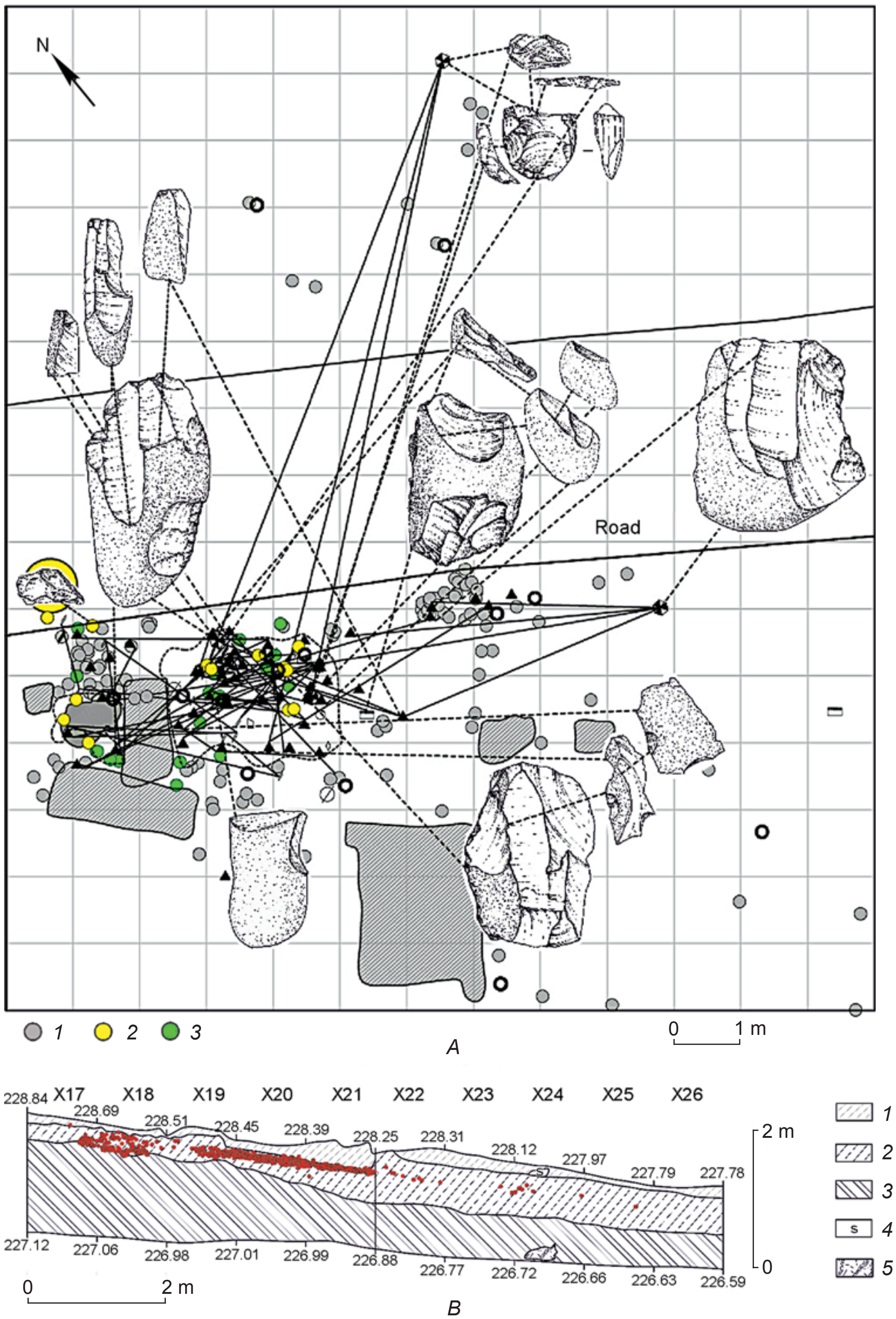

Fig. 4. Refitting links between cores and groups of raw material units (*A*): *1* – bone, *2*, *3* – groups of elements of raw material units; stratigraphic transect with the projection of artifacts (*B*): *1* – lithological stratum 0, *2* – lithological stratum 2, *3* – lithological stratum 4, *4* – stone, *5* – technogenic pits. Red points stand for the location of finds.

two retouched flakes, and two elongate sandstone pebbles with heavily worn surfaces. At least seven pebble tools are represented by fragments.

The culture-bearing layer within the habitation area was marked by tabular fragments resembling blocks of "ocher" by their reddish color (see Fig. 2, *C*, *3*, *5*). Near the hearth and in the cluster located northeast of it, over 220 fragments of this sort, including nodules in the form of broken bars and pencil-shaped pieces with smoothed facets, were found. The petrographic

Composition of the complex with "ocher" at Afontova Gora IV, excavation 5, number of specimens

Category	Loci				Subtotal
	7	8	13	14, 19	
Cores	1	–	–	2	3
Flakes from microcores	8	–	–	–	8
Blade fragments	5	–	–	–	5
Microblade fragments	48	–	–	–	48
Flakes (cortical)	191 (83)	2	8 (3)	4	291
Chips	22	–	–	–	22
Chunks (unidentifiable)	215	–	–	4	219
Broken pebbles	4	–	–	–	4
Fragments of red-colored rocks	194	–	26	9	229
Tools:					
points	1	–	–	–	1
end-scrapers	1	–	–	–	1
side-scrapers	–	–	–	1	1
retouched flakes and blades	1	–	1	–	2
chisel-like tool	–	–	1	–	1
burins	2	–	–	–	2
pebble tools	2	1	3	1	7
Total	778	3	42	21	844

analysis has shown that these are fragments of igneous and sedimentary rocks of geological complexes located in the site area (see Fig. 1, *B*). There are rocks such as quartz sandstones, granites, and trachytes, containing a small amount of iron ore minerals in the form of hematite and magnetite (less than 3–5 %). The color of the rocks, varying from pink to red, resulted from secondary alternations; some specimens are covered with a crust of secondary carbonate and iron oxides and hydroxides. The soil is bright red loess-like sandy loam with pieces of whitish-gray incompact concretions composed of redeposited secondary calcium carbonate from the parental rocks. The soil itself consists of quartz (~35–45 %), fieldspars (~35–40 %), clay minerals (~8–13 %), secondary calcium carbonate (~5–15 %), and accessory minerals (hematite less than 5 %).

Faunal remains (800 spec.) are dominated by fragments of split long bones and small splinters. Identifiable remains include bones of hooves (21.8 %), elbow (8.7 %) and ankle (4.4 %) joints, incisors and tooth fragments (56.3 %), fragments of reindeer (*Rangifer tarandus*) antlers (4.4 %), and fragments of chest (24 spec.) belonging to a juvenile individual of an unspecified equine (Equidae gen.). Near the hearth, fragments of mammoth bones, including one rather large specimen measuring 12.2 × 1.9 × 1.6 cm, were discovered.

Discussion

Quantitative analysis of finds upheld the presumption that domestic activity zones concentrated near the hearth and northeast of it. The periphery of the habitation area is marked by isolated artifacts lying at a distance not exceeding 11–12 m from the hearth (see Fig. 2, *A*; 4). As to the location of the pebble core (see Fig. 3, *11*; 4), it could probably have been moved down the slope by some natural processes. The wedge-shaped microcore, owing to the absence of slope in the microrelief, could not have been moved in that manner, so chances are that it had been transported by humans (see Fig. 3, *3*; 4).

The composition of the lithic assemblage points to the purposeful selection of raw materials. Large flakes and tools were made of fine grained sandstones and argillites. Microdebitage indicates the predominant use of siliceous rocks similar to jasper and flint. Refitting makes it possible to reconstruct the primary reduction stage of oval-flat pebbles (up to 13 cm long): removal of cortical flakes, including those of blade variety. Judging by fragments of prismatic microblades (34 spec. found around the hearth, and 14 spec. in the eastern cluster) and rejuvenation flakes, not only the wedge-shaped core (see Fig. 3, *3*), but also microcores made of light brown flint and light green jasper (see Fig. 4, yellow and green points) were flaked. The width of the bladelets (up to 1 cm) and microblades (3–5 mm) suggests that they were obtained intentionally. The assemblage includes the distal part of a thin rectangular pebble (6.7 × 3.7 × 2.4 cm) with a facet of blade removal on the ridge, and implements on cortical blades detached from pebbles of the same shape (see Fig. 3, *7*).

Tools of the complex demonstrate the spheres of domestic and stone reduction activities. Ten implements are associated with the former. This category includes an end-scraper (see Fig. 3, *2*), a retouched cortical blade (typologically a point) (see Fig. 3, *7*), and a double burin (see Fig. 3, *4*). A pebble flake (see Fig. 3, *10*) with alternate retouch along the convex edge could have been used as a scraper, a cutting or chisel-like tool. There is a series of cortical flakes refittable with this implement. Two artifacts—the distal part of a semicortical blade and the medial fragment of a retouched trihedral blade (see Fig. 3, *6*)—are represented by fragments. Informal tools include a flake with use retouch (see Fig. 3, *1*) and a robust pebble flake of siliceous sandstone (9.0 × 6.4 × × 2.5 cm). The latter, judging by polished surface of the thin convex edge, could have been used as a knife. Two other implements—a scraper-like pebble fragment (5.9 × 6.3 × 3.4 cm) and a cortical flake with burin spalls (6.3 × 3.9 × 1.0 cm) made of green flint—are patinated (see Fig. 3, *5*, *8*). Given the appearance of these finds and their location in the periphery, apart from other artifacts, it may be suggested that they were destined for other purposes.

Other tools lay compactly in the area of the main cluster within 1.5 m from the hearth (see Fig. 2, *A*; 4). Almost all the artifacts with use-wear signs are represented by fragments. They have working edges typical of cutting and scraping tools.

Refitting links (13 blocks) and groups of raw material units (fine- and coarse-grained variously colored siliceous sandstones) were identified within an area of ~250 m^2, which, in our view, indicates a single habitation episode (see Fig. 4). Stone knapping served multiple purposes and resulted in both large primary blades and microblades. The debitage also reflects the process of tool-making and utilization. To replenish the toolkit, the transported supply of raw material was used: preforms of cores and siliceous rocks selected by size and shape, with a view of receiving subprismatic and wedge-shaped cores.

The industry reveals a focus on local outcrops of red sandstone and other rocks resembling "ocher" (see Fig. 2, *C*, *2*, *3*, *6*). Pieces of rocks are laminated tabular concretions of coarse-grained or powder texture, pink, light crimson, bright red or orange in color.

The artifact assemblage comprises a series of transversally broken elongate pebbles of "heavy" effusive rocks. Use-wear signs and character of fragmentation suggest that they could be used as pestles/grinders for rocks. Together with the pebble-retoucher (9.3 × 4.0 × × 1.9 cm) (see Fig. 2, *A*), discovered in the southern portion of the debitage accumulation, these finds are attributed to the group of tools used for stone reduction.

Traces of paint can be observed not only on the fragments of red concretions, but also on two implements. One of them is an oblong and flat sandstone pebble, partly composed of two fragments. Intense use-wear on opposing sides of its distal and medial parts suggests that the pebble was first fragmented, and then the fragments were utilized from different planes. On another pebble of ellipsoid shape, three areas damaged by pecking are visible along the lateral surface in the thick part. Its thin end displays signs of flattening. The fact that the fragments of the former tool were remote from each other can be explained either by movements of one and the same individual during work or by more than one person being engaged in the fragments' use (see Fig. 2, *A*, *No. 1*). The second tool was found behind the road, not far from the microcore (see Fig. 2, *A*, *No. 2*). The area with the typical pecking erosion suggests that the pebble could have been used as a support during flaking.

Some pebbles of coarse-grained rocks (andesites, basalts) were probably used for crushing stone slabs. If large backed fragments and refittable ones are included, then eight specimens can be regarded as hammerstones. The pebbles are large and heavy, with flaked narrow sides or fragmented. As refitting has shown, transversal flakes and their fragments were located near red rock pieces. Backed fragments were associated with the periphery of the platform.

A distinctive feature of this part of the Afontova Gora IV (Ovrazhnaya) site is that its cultural layer is partially red, which is usually due to the erosion of Riphean, Ordovician, and Devonian red-colored sedimentary and igneous rocks. In this case, the red rocks are of interest as a potential raw material for the "ocher". This specific geological feature of the region has not been previously studied in the context of finding sources of the "ocher" and their use by ancient inhabitants of Afontova Gora. Therefore, while examining the artifacts and culture-bearing sediments, we paid special attention to the presence of the coloring mineral.

In archaeology, "ocher" belongs to the group of pigments varying in color from yellow to bright red. Yellowish-red coloration of rocks is associated mostly with the presence of the iron-group (Fe) minerals, less often with the manganese (Mn) group. The most common mineral that ancient people used as the red pigment was hematite (Fe_2O_3). Observations show that even a small amount of hematite adds color to rocks and culture-bearing sediments (Tetenkin et al., 2020: 16, fig. 3 *d*, *i–l*). At Afontova Gora IV, no hematite-rich rocks or ocher pieces that could be used for practical purposes have been found. However, exposures of hematite ores occur ~70 km east and ~50 km south of the site (the right side of the Krasnoyarsk Reservoir) (Gosudarstvennaya geologicheskaya karta…, 2009). The farthest potential geological sources are located more than 200 km north and northeast of the site. Whether people of Afontova Gora IV used red-colored rocks from the nearby outcrops as raw material for producing pigment (ocher) remains an open question.

Conclusions

The findings of the study of part of the Afontova Gora IV (Ovrazhnaya) site have enabled us to reconstruct some of the ways humans processed the red rocks. While hypsometrically the habitation area dominates the slope, the culture-bearing layer in the geological transect occupies a stable position at the bottom of lithological stratum 3. The age of the archaeological remains is determined by the radiocarbon dates of 15,431 ± 71 (GV-4209) and 15,153 ± 75 (GV-4196) uncal BP, generated on a reindeer tooth fragment and an epiphysis of a vertebra of a young (?) horse, respectively.

The analysis of spatial arrangement of the finds evidences a loose concentration of cultural remains in the open space around the hearth. The hearth is small (~0.6 m in diameter); stone lining is absent, though stones lying near the hearth could possibly bear relation to its construction. The artifact assemblage comprises debitage of qualitatively different raw materials. Primary reduction is represented by pebble cores. Technological analysis suggests that relatively large cortical flakes were detached unintentionally. Microblades are represented solely by fragments up to 5 mm long. We have revealed traces of processing the microcores that are absent in the collection. Refitting links indicate the use of artifacts from the raw material units in various activity cycles in the study area of Afontova Gora IV, while the implements form a small set that could be easily transported. The diet can be characterized by the remains of fauna, which include the identified bones of a reindeer and a young individual of Equidae gen. The season of death of the animals could not be determined.

The accumulation of fragments of red rocks indicates that they were brought to the site intentionally. Judging by the presence of open outcrops of those rocks near Krasnoyarsk Akademgorodok, these were easily available for the site inhabitants. Because of a very low content of coloring minerals, the rocks were not specially used to obtain pigments. Still, people could have used them for utilitarian or ritual purposes.

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Human Remains from a Neolithic Burial at Krokhalevka-5 on the Upper Ob: Physical Type and Origin

We describe the skeletal remains of a male, aged 25–30, from the Neolithic burial 33 at Krokhalevka-5 in the Upper Ob basin, 21 km northwest of Novosibirsk, dating to the mid-5th millennium BC. Craniometric, dental metric, and nonmetric traits are analyzed. Cranial measurements are evaluated in the context of their variation in 58 individuals representing 11 local populations of the Paleolithic and Neolithic of Northern Eurasia. Data were processed using the principal component analysis in the STATISTICA 10 software. The first PC differentiates crania in terms of general size. The structure of loadings on PC2 indicates the presence of western and eastern trait combinations. The position of individuals on PC1 and PC2 reveals heterogeneity apparently caused by the conservatism of the underlying substratal populations. The Krokhalevka-5 individual is closest to those from Firsovo XI (Barnaul stretch of the Ob) and Zarechnoye-1 (Salair region). They are rather similar to the Volosovo individual from Sakhtysh-2A in Central Russia and a Kitoy individual from Fofanovo in the Trans-Baikal area. These findings point to a complex origin of the Upper Ob population on the basis of one of the evolutionarily conservative Mesolithic or Neolithic substratal components, possibly admixed with more consolidated eastern and western ones introduced by migration. Neolithic crania from Baraba contrast with those from the Upper Ob, suggesting that different substrates were involved in the population history of those regions.

Keywords: *Neolithic, burial, Upper Ob region, anthropological composition, non-consolidated morphological complex, individual variation, principal component analysis.*

Introduction

The quantity of qualitative archaeological and, primarily, anthropological sources pertaining to the Mesolithic-Neolithic period is relatively small. Furthermore, the distribution of these sources across Northern Eurasia is uneven. On the one hand, their regional specificity reflects the processes of accumulation of people within the most favorable landscape areas in the post-glacial period. On the other hand, the discovery of new Mesolithic-Neolithic materials has consistently demonstrated their uniqueness and peculiarity, which have precluded their classification as complexes of recent periods. Moreover, the study of the anthropological population dynamics is complicated by the paucity of radiocarbon dates for Mesolithic and

Archaeology, Ethnology & Anthropology of Eurasia 52/4 (2024) 85–97 E-mail: Eurasia@archaeology.nsc.ru

Neolithic burials, which is still a relatively minor area of investigation. As demonstrated by recent practice of the Neolithic dating, burials initially perceived as contemporaneous have yielded materials from different epochs (Kiryushin et al., 2021: 26). Indeed, in some instances, burials belonging to the Mesolithic and Bronze Ages have been unearthed within the boundaries of known Neolithic settlements. In light of this, a comparative analysis of the paleoanthropological sources should be undertaken at an individual rather than intergroup level, with due consideration given to the radiocarbon dating.

The study and generalization of cranial material of the Neolithic and Bronze Age from the southern territories of Western Siberia and the Altai-Sayan highlands have provided for the identification of two main anthropological superstrata for the central regions of Northern Eurasia—the Northern and Southern Eurasian formations (Chikisheva, 2012: 180). The former geographically occupies the north of the Russian Plain and the whole West Siberian Plain, and the latter occupies the mountain-steppe territories of the southern regions of North Asia. These large anthropological groups have differences, but racially they are characterized by a protomorphic complex of traits. So, the study of the genesis of these superstrata and the reconstruction of the dynamics of the population mechanisms of their formation seem important. The territory of the Upper Ob basin is a contact zone for members of both formations, which entails a certain mosaic pattern in many anthropological and archaeological features. Nevertheless, each new well-attributed and dated complex from this region is of great importance for understanding both the time and circumstances of the formation of genetic structure of the population, and the development of specific aspects of material and spiritual culture.

Archaeological context

The individual under study was interred in burial No. 33 of the Krokhalevka-5 cemetery, located 21 km to the northwest of Novosibirsk (Kochenevsky District, Novosibirsk Region). This site is located on the first terrace above the flood plain on the right bank of the Chik-Chaus river-lake system (the territory of the Kudryashov pine wood), which is an ancient arm of the Ob River on its left bank. The burial is individual, disturbed, made in a deep pit (1.5 m from the ancient surface level). The man was buried in an extended supine position, with his head to the north (downstream of the Ob and the nearest channel). Only the bones of the feet and (probably) the skull were found *in situ*. Most of the bones of the postcranial skeleton were compact, unarticulated, and haphazardly laid in the lower horizons of the northern part of the pit. The completeness analysis showed that almost all the bones, with the exception of both femurs, were present in the burial. The grave presumably contained part of a wooden boat in which a human body was placed, judging by the morphology of the lower part of the pit near the head and by the presence of wood decay on the floor in the northern half of the chamber. A unique fact, recorded mainly on the basis of late ethnographic evidence of the funerary practices of the ancient West Siberian peoples, is the use of a boat as a symbolic means of transport for the transition to the other world in Neolithic funerary rites. In the Middle Neolithic (contemporaneous to the Krokhalevka burial), similar mythological representations connected with the boat are found in the materials from the Lower Ob basin, in the form of specific miniature boat-shaped clay vessels (Oshibkina et al., 1996: 262).

The grave goods comprise only lithic artifacts (adze, arrowheads, biface). The items with these morphological and metric characteristics are typical of the Upper Ob culture of the Middle Neolithic (Molodin, 1977: 10–25). The radiocarbon date (6122 ± 42 BP, UBA-39724) obtained from human bones places the calibrated age of the complex within the last quarter of the 4th millennium BC. However, the freshwater reservoir effect on the anthropological material can be assumed with great probability; thus the burial most likely belongs to the middle of the 5th millennium BC*.

Material and methods

The materials for the palaeoanthropological study are the remains of a man who died at the age of 25–30 years. Cranial, nonmetric, and postcranial measurements were performed. The craniometric data of the deceased were evaluated in the context of the individual variability of these traits in the Mesolithic and Neolithic people of Northern Eurasia**. To

*A more detailed description and analysis of the archaeological material, funerary rite, radiocarbon dates and corrections will be published separately (Marchenko et al., in press).

**The skull from burial 1, mound 2 at Zarechnoye-1 was initially included in the analysis, defined as male by V.A. Dremov (1997: 199–204), but genetic investigation (Zakh, 2023) showed that the skull belonged to a female.

include the maximum possible composition of the sample considered as a general population, we excluded from the trait's set the nasal bridge characteristics at the level of dacryon, the simotic chord, and the forehead profile angle, because these are unknown for the majority of individuals. The study was carried out using the principal component analysis (PCA) in STATISTICA v.10.

We distributed a large amount of comparative data from Siberia, the East European Plain, and Central Asia into regions on the basis of previous anthropological studies, which state that in the Neolithic the main space of population relations for Western Siberia is located within their boundaries (Chikisheva, 2012: 59–60; Chikisheva, Pozdnyakov, 2021). The allocation of regions according to geographical distribution is rather conditional, since we rely on the data about modern landscape and climatic conditions and understand that in the Neolithic the boundaries of natural zones could have been shifted. However, the pattern of spatial distribution of paleoanthropological material is as important as the cultural and chronological ones, for understanding the peculiarities of the interrelations and interactions of populations. Thus, the statistical analysis includes the characteristics of 58 individuals, which we assigned to 11 local groups (Table 1): Upper Ob (comprises burials from the Upper Ob basin), Altai-Sayan (Altai Mountains, Krasnoyarsk-Kansk forest-steppe, and Kuznetsk Basin), West Siberian forest-steppe (Baraba forest-steppe, Middle and Pavlodar stretches of the Irtysh), Ural (Cis-Urals and Trans-Urals), Volga-Ural (Volga-Ural interfluve), East European (comprises burials in the central part of the East European Plain with pit-comb ware and the Volosovo culture), Mesolithic from the northwestern part of the East European Plain, Trans-Baikal, Cis-Baikal, Yakut, and Central Asian.

Morphological features of paleoanthropological material

The male remains have been well preserved, thus enabling the full range of characteristics to be ascertained, as is necessary to assess the anthropological status and determine the male's place in the general population of individuals of the Meso-Neolithic in Northern Eurasia (Tables 2, 3).

Morphology of the skull. The cranium is generally characterized by small (sometimes bordering on average) values of length, breadth, and height, and mesomorphic proportions. With the smooth contours of the vault in the vertical and lateral norm (sphenoid and ellipsoid, respectively), the occipital contour is intermediate between roof-like and vault-like. The mastoid processes are well-developed and face forward. The nuchal lines are moderately pronounced. The occipital protuberance is poorly defined. The intercilium is moderately robust, the brow-ridge is high but not long and does not extend beyond the middle of the orbit. The cranial base and vault components show average parameters. The frontal bone is the largest segment of the sagittal arch. The frontal bone is narrow, of short length, weakly convex and inclined, which, combined with the high intercilium and weakly expressed tubercles, gives the impression of a sloping forehead. The smallest component of the sagittal arch is the parietal, which is much smaller than the occipital, with an occipito-parietal index (OPI) greater than 100. The curvature of the occipital bone is marked, but the back of the head does not seem to be protruding.

The facial cranium demonstrates average values of the main diameters, a strong horizontal flattening in a homoplatyprosoptic form, an alveolar prognathism of the vertical profile, with a general mesognathism. Orbits are wide and moderately high, mesoconchal. The nasal aperture is narrow, moderately high, leptorrhine, with a sharp lower edge and a pronounced anterior nasal spine. The nose bridge is narrow and high, the nasal dorsum has a very small simotic height and breadth, but an average value of their ratio, the nose is moderately prominent. The alveolar arch is of great length and average width; the palate is small, its ratio given by its leptostaphyline (palatal) index. The canine fossa is moderately deep. The mandible is characterized by large overall dimensions (length from angles and from condyles; condylar, angular, and anterior width) and a slightly inclined ramus. As for the body, the large height at the level of the symphysis and the mental foramen goes hand in hand with the small thickness, giving the impression of overall slenderness of the mandibular bone.

The craniological traits observed in the Krokhalevka individual, when considered in the context of the morphological complexes of Northern Eurasia, exhibit a certain correlation with the dominant features of ancient and modern groups in the East Siberian population. These features include homoplatyprosopy of facial part; moderate nasal protrusion; size, shape, and slope of the frontal bone; and relative elongation of the occipital component of the sagittal arch. Conversely, some features are more

Table 1. **Individual craniological materials involved in the comparative analysis**

No.	Geographic region	Locality	Dating	Data source
1	2	3	4	5
1	Upper Ob region	Krokhalevka-5, burial 33	Mid 5th millennium BC	Authors' data
2	"	Ordynskoye-1, burial 1	Neolithic	(Alekseev, 1961)
3	"	Inya-4	"	(Shpakova, Mylnikova, 1998)
4	"	Firsovo XI, burial 9	"	(Solodovnikov, Tur, 2017)
5	"	Firsovo XI, burial 14, vault 1	"	(Ibid.)
6	Altai-Sayan region	Ust-Isha, burial 4	4th millennium BC	(Dremov, 1986)
7	"	Ust-Isha, burial 8	4th millennium BC	(Ibid.)
8	"	Solontsy, burial 4	Mid 4th millennium BC	(Kungurova, Chikisheva, 2002)
9	"	Solontsy, burial 3	Mid 4th millennium BC	(Ibid.)
10	"	Bazaikha, burial 1	3rd millennium BC	(Alekseev, 1961)
11	"	Bazaikha, burial 2	3rd millennium BC	(Ibid.)
12	"	Dolgoye Ozero, No. 4	Neolithic	(Gerasimova, 1964)
13	"	Perevoznoye, burial 1	3rd millennium BC	(Alekseev, 1961)
14	"	Vaskovo-4, burial 3	Neolithic	(Chikisheva, 2012)
15	"	Zarechnoye-1, kurgan 4, burial 6	"	(Dremov, 1997)
16	West Siberian forest-steppe	Protoka, burial 4B	5th millennium BC	(Polosmak, Chikisheva, Balueva, 1989)
17	"	Sopka-2, burial 61F	6th millennium BC	(Chikisheva, 2012)
18	"	Vengerovo-2A, complex 2, burial 1, vault 17	Late 6th millennium BC	(Chikisheva, Pozdnyakov, Zubova, 2015)
19	"	Same, burial 2, ditch	Late 6th millennium BC	(Ibid.)
20	"	Omskaya site, burial 3	Neolithic	(Bagashev, 2003)
21	"	Shiderty-3	Second half of 4th millennium BC	(Yablonsky, 2002)
22	Trans-Baikal	Pad Tokuy	Mid 6th millennium BC	(Vasiliev et al, 2018).
23	"	Fofanovo, burial 6	Mid 6th millennium BC	(Gerasimova, 1992)
24	"	Fofanovo, burial 15	Late 4th – late 3rd millennium BC	(Ibid.)
25	"	Fofanovo, burial 41	Late 4th – late 3rd millennium BC	"
26	"	Fofanovo, burial 2	Late 4th – late 3rd millennium BC	"
27	"	Fofanovo, burial 18	Late 4th – late 3rd millennium BC	"
28	"	Fofanovo, burial 5	Late 4th – late 3rd millennium BC	"
29	"	Shilka	Neolithic	(Levin, 1953)
30	Ural region	Shigir peat bog, No.1-841	Early Neolithic	(Bagashev, 2003)
31	"	Same, No.162	"	(Debets, 1953)
32	"	Buranovskaya Cave	"	(Ibid.)
33	"	Davlekanovo	Neolithic–Chalcolithic	(Shevchenko, 1986)
34	Volga-Ural interfluve	Lebyazhinka-4	7th millennium BC	(Khokhlov, 2017)
35	"	Mellyatamak III, burial 1	Mesolithic–Neolithic	(Yablonsky, 1992)
36	"	Mellyatamak III, burial 6	"	(Ibid.)
37	"	Mellyatamak III, burial 11	"	"

Table 1 (end)

1	2	3	4	5
38	Central part of the East European Plain	Berendeevo swamp	First half of the 3rd millennium BC	(Mamonova, 1969)
39	"	Lovetskoye Ozero	4th–3rd millennium BC	(Neolit…, 1997)
40	"	Sakhtysh-2, burial 19	4th–3rd millennium BC	(Ibid.)
41	"	Sakhtysh-2A, burial 22	4th–3rd millennium BC	"
42	"	Sakhtysh-2A, burial 42	4th–3rd millennium BC	"
43	"	Volodary, burial 1	Neolithic	(Akimova, 1953)
44	"	Sakhtysh-2, burial 12, vault A	3rd millennium BC	(Neolit…, 1997)
45	"	Sakhtysh-2A, burial 9	3rd millennium BC	(Ibid.)
46	"	Sakhtysh-2A, burial 15	3rd millennium BC	"
47	"	Sakhtysh-2A, burial 35	3rd millennium BC	"
48	Northwestern part of the East European Plain	Yuzhny Oleniy Ostrov, No. 5773-13	Mesolithic	(Yakimov, 1960; Alekseev, Gokhman, 1984)
49	"	Same, No. 5773-74	"	(Yakimov, 1960; Alekseev, Gokhman, 1984)
50	"	Peschanitsa	"	(Gerasimova, Pezhemsky, 2005)
51	Cis-Baikal	Verkholenskiy cemetery, burial 10	Neolithic	(Levin, 1956)
52	"	Same, burial 16/2	"	(Ibid.)
53	"	Same, burial 22D	"	"
54	"	Same, burial 24A	"	"
55	"	Same, burial 29	"	"
56	Yakutia	Tuoy-Khaya	3rd millennium BC	(Debets, 1956)
57	Southeastern Aral Sea region	Tumek-Kichidzhik, burial 29	4th–3rd millennium BC	(Vinogradov, Itina, Yablonsky, 1986)

prevalent in the groups from Western Siberia and the European regions of Northern Eurasia: the average absolute sizes of the main diameters of the cranium and the facial part, as well as their general mesomorphic proportions; a very narrow piriform aperture with a sharp lower edge and a long anterior nasal spine. The Neolithic age of the burial suggests that the individual's anthropological identification belongs to the non-consolidated (protomorphic) component of the polymorphic morphological space of Northern Eurasia, as reflected in the modern typology. The existence of this autochthonous substrate and its role in subsequent epochs is demonstrated in numerous studies from the past decade.

Dental traits. Hypodontia is absent, and all the teeth are present in their entirety. The degree of dental attrition is low (grade 3 for the central (medial) incisors, first premolars and first molars, and 1–2 for the other teeth). The occlusion pattern is psalidontic. Incisors, molars, and upper premolars display small antemortem enamel chippings. Caries is present on the occlusal surfaces of both upper third molars, with a high prevalence of dental calculus across all teeth.

Maxilla. The presence of lingual shoveling has been observed on lateral incisors (grade 2) and canines (grade 1). Vestibular shoveling is absent. The incisors show weakly developed lingual cusps (grade 1), no accessory ridges; lingual fossae are observed on the laterals. On the canines, the lingual cusps are well-developed (grade 2) and distal ridges are clearly visible (grade 1–2). In the case of the first premolars, the dimensions of the buccal and distal cusps are comparable (type 2). However, in the second premolars, the ratio of these cusps is indeterminate because of significant attrition. Distal reduction is not observed in the first molars, whereas in the second molars it is a notable phenomenon, affecting both the hypoconus (3+) and the metaconus (3). Enamel extension (grade 6) was observed on the second molar. All the molars are three-rooted. Owing to enamel wear on the key teeth, specific archaic features or odontoglyphic patterns could not be recorded.

Table 2. **Craniometric traits of a man from Krokhalevka-5, burial 33**

Trait*	Value	Trait	Value
1. Cranial length	178.00	Frontal subtense (FS)	14.80
8. Cranial breadth	139.00	77. Nasomalar angle	145.80
8 : 1. Cranial index	78.09	Zygomaxillary breadth (ZB)	101.30
17. Cranial height	132.00	Subtense from subspinale to the zygomaxillary breadth (SS)	17.20
5. Cranial base length	102.00		
9. Minimal frontal breadth	88.00	Zm. Zygomaxillary angle	142.60
Sub. 9. Transverse frontal curvature subtense	14.40	DS. Dacrial subtense	12.00
10. Maximal frontal breadth	112.00	DC. Dacrial chord	20.60
29. Frontal chord	109.00	SS. Simotic subtense	1.90
26. Frontal arch	122.00	SC. Simotic chord	5.40
27. Parietal arch	116.00	FC. Canine fossa depth	3.20
30. Parietal chord	106.00	32. Frontal profile angle from nasion	77.00
12. Occipital breadth	108.00	GM\FH. Frontal profile angle from glabella	69.00
28. Occipital arch	120.00	72. General facial angle	81.00
Sub. NB. Frontal curvature subtense	20.00	73. Mid-facial angle	85.00
31. Occipital chord	97.00	74. Alveolar angle	67.00
Sub. 31. Occipital curvature height (OCH)	27.00	75. Nasal bones inclination index	59.00
25. Sagittal arch	358.00	75 (1). Nasal protrusion angle	22.00
26 : 25. Fronto-sagittal index	34.10	Cranial shape (superior view)	Sphenoid
27 : 25. Parieto-sagittal index	32.40	Cranial shape in the lateral norm	Ellipse
28 : 25. Occipito-sagittal index	33.50	Cranial shape in occipital norm	Roof-vaulted
Occipital-parietal index	103.40	Intercilium	4
40. Facial base length	106.00	Browridges	2
45. Bizygomatic breadth	134.00	External occipital tuber	1
48. Upper facial height	70.00	Mastoid process	3
43. Upper facial breadth	103.50	Inferior margin of the piriform aperture (IMPA)	Anthr.
46. Midfacial breadth	101.00	Anterior nasal spine	4
60. Alveolar length	57.00	*Mandible*	
61. Alveolar breadth	62.00	68 (1). Mandibular length from condyles	105.00
62. Palate length	47.40	79. Mandibular ramus angle	113.00
63. Palate breadth	37.30	68. Mandibular length from angles	81.00
63 : 62. Palatal index	78.69	70. Ramus height	61.00
51. Orbital breadth from mf.	43.20	71a. Minimum ramus breadth	39.00
51a. Orbital breadth from d.	39.30	65. Condylar width	113.00
52. Orbital height	33.50	66. Angular width	98.00
52 : 51. Orbital index	77.55	67. Anterior width	49.00
54. Nasal breadth	22.90	69. Symphyseal height	34.00
55. Nasal height	51.40	69 (1). Corpus height	31.00
54 : 55. Nasal index	44.55	69 (3). Corpus breadth	11.00
43 (1). Frontal chord (FC)	95.90	Mental protrusion angle	79.00

*The table includes only those traits that the preservation of the skull allowed us to measure.

Table 3. **Postcranial anthropometric parameters of a man from Krokhalevka-5, burial 33**

Trait*	Right	Left
Humerus		
1. Maximum length	319	319
2. Total length	325	325
3. Upper epiphysis breadth	49	49
4. Lower epiphysis breadth	61	62
5. Maximum midshaft diameter	21	21
6. Minimum midshaft diameter	16	17
7. Minimum shaft circumference	55	57
7a. Circumference of midshaft (MSC)	58	60
6 : 5. Cross sectional index	76.2	81.0
7 : 1. Robusticity index	17.2	17.9
Radius		
1. Maximum length	258	258
2. Physiological length	246	246
4. Transverse diameter	14	14
5. Sagittal diameter	9	9
3. Minimum shaft circumference	34	33
5 : 4. Cross sectional index	64.3	64.3
3 : 2. Thickness index	13.8	13.8
Ulna		
1. Maximum length	277	…
2. Physiological length	248	…
11. Sagittal diameter	14	…
12. Transverse diameter	14	…
13. Upper transverse diameter	18	…
14. Upper sagittal diameter	22	…
3. Minimum shaft circumference	33	…
3 : 2. Robusticity index	13.3	…
11 : 12. Cross sectional index	100	…
13 : 14. Platoleny index	81.8	…
Clavicula		
1. Maximum length	143	143
6. Circumference at midshaft	36	36
6 : 1. Robusticity index	25.2	25.2
Scapula		
1. Scapular breadth	155	155
2. Scapular length	99	99
2 : 1. Scapular index	63.9	63.9
Sacrum		
1. Auricular surface length	137	
2. Anterior height	126	
5. Anterior breadth	97	

Trait	Right	Left
Pelvis		
1. Height (total pelvic height)	213	210
9. Ilium height	139	137
10. Alar height	103	100
15. Ischium height	77	76
17. Pubic length	76	77
12. Ilium width	147	147
8. Ischial spines width	88	
23. Sagittal diameter	112	
24. Transverse diameter	118	
2. Width (pelvic width)	242	
7. Joint width	116	
1 : 2. TPH/PW	88.0	86.8
23 : 24. Lesser pelvic inlet index	94.9	
Tibia		
1. Total length	365	367
2. Condylo-talar length – 355	346	350
1a. Maximum length	369	370
5. Upper epiphysis width	75	76
6. Lower epiphysis breadth	49	48
8. Sagittal diameter at midshaft	29	28
8a. Sagittal diameter at nutrient foramen	33	33
9. Transverse diameter at midshaft	16	17
9a. Transverse diameter at nutrient foramen	19	17
10. Midshaft circumference	73	73
10b. Smallest circumference	65	65
9a: 8a. Cross sectional index	57.6	51.5
10b : 1. Robusticity index	17.8	17.7
Fibula		
1. Maximal length	360	362
Body length		
L. Manouvrier	166.8	
K. Pearson and A. Lee	168.8	
A. Telkka	169.3	
C. Dupertuis and J. Hadden	170.7	
Average	168.9	

*The table includes only those traits that the preservation of the postcranial skeleton allowed us to measure.

Mandible. No evidence of shoveling is apparent on the incisors, while it is only moderately present on the canines (grade 1). The right canine exhibits a distal ridge (grade 1). The morphology of the first premolar is consistent with type 1, while that of the second premolar aligns with type 4. In addition to their 5Y shape and protostylid fossa, both first molars exhibit an additional *tami* cusp. The morphology of the second molars exhibits the shape 4X. No enamel extension is observed. It was not possible to establish the odontoglyphic pattern and archaic complex signs of the molars, owing to the dental wear.

Thus, in the extant system of dental differentiation with a west-east gradient, the observed morphological features can be attributed to the western vector. The dental status of the individual displays no specific Eastern stock markers, which, according to A.A. Zubov (Zubov, Khaldeeva, 1993: 162–164) permits the referral of such complexes to the Western dental stock. However, it is challenging to ascertain the taxonomic status of the Krokhalevka male, given the lack of specific diagnostic features observable in the dentition.

Postcranial morphology. The preservation is excellent, although the specimen is incomplete. The femurs and left ulna were lost, which complicated the reconstruction of the individual's body length using regression formulas*. We estimated the dimensions of the postcranial skeleton relying on the tables of postcranial metrics for males by D.V. Pezhemsky (2011: 314–318). Noteworthy is the almost perfect symmetry of the bones on both the left and right sides. The dimensions of the long bones and the indices of the midshafts of their diaphyses attest to their gracile structure. Judging by the ratios of the longitudinal dimensions of the upper limb's segments, its length was determined by the distal type of growth. The humerus bones had average length, while the radius and ulna bones were large. This is reflected in the corresponding indices (radio-humeral – R1 : H1 – 80.9; ulna-humeral – U1 : H1 – 86.8). The tibia bones exhibit average longitudinal dimensions, and the radio-tibial index (R1 : T1) is greater (70.7), which attests to either a proximal type of growth of the lower limb, or its shortening relative to the upper limb. The body length was calculated using various formulae, namely those proposed by K. Pearson and A. Lee, A. Telkkä, C. Dupertuis and J. Hadden, and L. Manouvrier (Alekseev, 1966: 225, 226, 228, 230, 231); the obtained values ranged from 170.7 to 166.8 cm, with 168.9 cm on average. The aforementioned parameters characterize the individual's stature as average or above average.

Comparison of the postcranial morphology of the Krokhalevka male with other members of the Neolithic population of Western Siberia (Chikisheva, Pozdnyakov, 2016: 134–135, Table 8) reveals its distinctive skeletal characteristics: a gracile skeleton, a distal growth pattern of the upper limbs, and a body length above average. In general, individuals from the West Siberian Neolithic population are characterized by a medium robust skeleton, average height, and mesomorphic proportions of limb segments. Individuals from Vengerovo-2A display both the above-average stature and elongated forearms. However, they also show the relative tibia elongation, while the Krokhalevka male (taking into account the longitudinal dimensions of his tibiae) suggests different proportions of the lower-limb segments, either mesomorphic or brachymorphic.

Statistical analysis of craniometrics

The first two principal components (PC) describe 41 % of the total variability. The highest loadings for component PC1 (26.33 %) are observed in values of cranial length and breadth, minimal frontal breadth, bizygomatic breadth, upper facial height, orbital breadth and height, and nasal breadth and height (Table 4). Thus, this component differentiates between skulls with large total dimensions, large orbits, and broad and high nasal apertures (negative area) and skulls with the opposite characteristics (positive area). The distribution of individuals along the PC1 axis does not generally correlate with the territorial grouping of the material; both the negative and positive areas encompass representatives of almost all groups (see *Figure*). Single skulls from Yakutia and southeastern Aral Sea region are located in the negative area, demonstrating the robust morphology. In contrast, skull No. 162 from the Shigir peat-bog in the Middle Trans-Urals (positive area, minimum dimensions) and a skull from Perevoznoe burial 1 in the Krasnoyarsk-Kansk forest-steppe (negative area, maximum dimensions) occupy disparate positions within the PC1 coordinates.

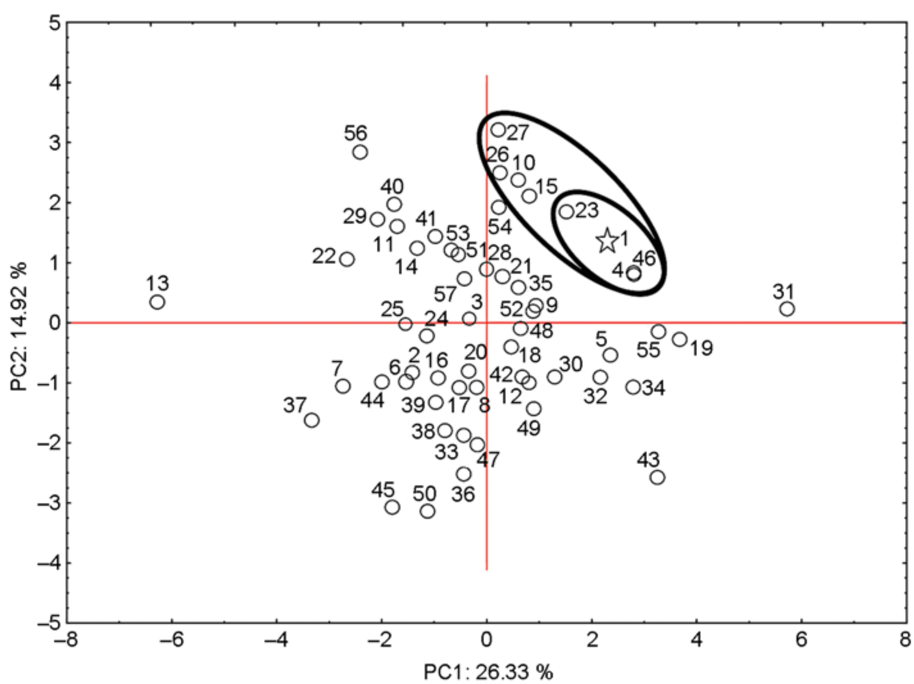
In PC2 (14.92 %), the highest loadings fall to the values of cranial height, simotic subtense, nasal

*Among the segments of postcranial skeleton, the lower limb makes the greatest contribution to the body length, and a more accurate reconstruction is therefore possible using the femur parameters.

Table 4. **Loadings on the first two principal components**

Trait	PC1	PC2
1. Cranial length	**–0.75**	–0.09
8. Cranial breadth	**–0.60**	0.43
17. Cranial height	–0.10	**–0.51**
9. Minimal frontal breadth	**–0.63**	–0.08
45. Bizygomatic breadth	**–0.63**	0.27
48. Upper facial height	**–0.56**	–0.25
51. Orbital breadth from mf.	**–0.69**	–0.14
52. Orbital height	**–0.44**	0.14
54. Nasal breadth	**–0.69**	0.18
55. Nasal height	**–0.67**	–0.29
SS. Simotic subtense	–0.28	**–0.56**
77. Nasomalar angle	0.07	**0.69**
Zm. Zygomaxillary angle	–0.29	**0.71**
72. General facial angle	–0.40	0.05
75 (1). Nasal protrusion angle	–0.05	**–0.44**

Note. Maximum load values are marked in bold.



Scatter plot of the first two principal components for Mesolithic and Neolithic populations of Northern Eurasia (numbers refer to Table 1).

protrusion angle (negative area), and nasomalar and zygomaxillary angles (positive area). Thus, PC2 discriminates between crania with high vault, prominent nose, and face protruding in the horizontal norm, and those with lower vault, less prominent nose, and flattened face. We may assume that PC2 is a means of differentiation between Mongoloid and Caucasoid craniometric complexes. The vast majority of its groups exhibit a complex and intricate composition. However, noteworthy is a distinct series from the Baraba forest-steppe, situated in the negative area of PC2. A contrasting position is occupied by an individual from burial 18 of the Fofanovo cemetery (positive area) and individuals from burial 9 of the Sakhtysh-2A site and from Peschanitsa (negative area).

Thus, the graphical distribution of the sample of Meso-Neolithic individuals from the territory of Northern Eurasia demonstrates primarily a great polymorphism in its anthropological composition. The polymorphism is determined not by the territorial differentiation of groups, but by a number of other factors, the most significant being the initial non-consolidation of morphological substrate. At the same time, evidence suggests the formation of Caucasoid and Mongoloid morphological complexes, as indicated by the structure of loadings on the PC2.

The individual from Krokhalevka, located in the positive areas of PC1 and PC2, exhibits the closest proximity to the people from Upper Ob region (Firsovo XI, burial 9), associated with the East European Volosovo culture (Sakhtysh-2A, burial 15) and the Trans-Baikalian Kitoy culture (Fofanovo, burial 6). Notably, the Krokhalevka skull is situated between the samples from Eastern Siberia on the one hand, and from the southern regions of Western Siberia and the East European Plain on the other. The plot represents a set of objects grouped along the "ray", or vector (marked by a large oval in the figure). This set includes skulls from Zarechnoye-1 (15), Bazaikha (10), and Fofanovo (26, 27).

The combination of craniometric features in the material included in this cluster indicates an eastern ("Mongoloid") tendency. In anthropological terms, the population groups from which these individuals originate are multi-component. This is the reasonable conclusion of specialists who have studied the corresponding craniological collections. The material from Firsovo XI includes the skulls displaying Caucasoid, Mongoloid, and intermediate protomorphic Caucasoid-Mongoloid morphology (Solodovnikov, Tur, 2017: 68). A comparable complexity of anthropological composition, albeit with a more pronounced Caucasoid component, is observed in the Volosovo series from Sakhtysh, ascending to the local Mesolithic population (Alekseeva et al., 1997: 27). The craniological material from the Middle Yenisei basin, to which the skull from Bazaikha belongs, shows a Mongoloid-European intermediacy of the most important diagnostic features (Alekseev, 1961: 112). The Kitoy people from the Trans-Baikal area demonstrated archaic, evolutionarily conservative traits (Gerasimova, 1992: 110), and in the Glazkovo period they displayed enhanced Mongoloid features (Ibid.: 111). The Kitoy cranium from Fofanovo burial 6 (23) is the closest to the Krokhalevka one, and was described by M.M. Gerasimova as Mongoloid "with structural characteristics of the archaic type" (Ibid.: 99).

Thus, the results of the principal component analysis suggest the origin of the specific skull morphology of the Krokhalevka individual in terms of two theoretical approaches. The conservative approach posits that the population history in the Neolithic in Northern Eurasia was dominated by the transformation of archaic morphological complexes. In contrast, the admixture approach allows the existence of consolidated complexes—Mongoloid and Caucasoid—at the Neolithic stage; these were confined to specific areas and were subject to mixing during migration processes. In any case, among the evidence from the West Siberian forest-steppe, the closest parallels to the Krokhalevka individual are those from neighboring territories—Firsovo XI (Barnaul stretch of the Ob) and Zarechnoye-1 (Salair region).

Our analysis has shown that the materials from the Baraba forest-steppe and Irtysh basin (Protoka, Sopka-2, Omskaya site) are closely grouped in the part of the plot that is opposite to the Krokhalevka skull. At first sight, these results appear to deviate from the archaeological analogies established for the Krokhalevka burial, which indicate a westward (Baraba forest-steppe and Irtysh basin) and northward (Lower Ob) trajectory (Marchenko et al., in press). However, given the location of the Firsovo XI and Krokhalevka-5 sites in close proximity to the Ob waterway, which flows northwards, it can be postulated that some elements of spiritual culture were common to the Lower and Upper Ob Neolithic populations (mytho-ritual conception of boat). Unfortunately, at present, there are no available qualitative paleoanthropological materials to be used to form an idea of the craniological type of the Neolithic populations of the Lower Ob and Lower Irtysh regions. However, the extensive archaeological material from these areas, including evidence of burial practices, allows us to conclude that northwestern Siberia was not isolated and was rather intensely developed during the Mesolithic and all stages of the Neolithic (Klementieva, Pogodin, 2020). To date, the only anthropological data from this region are dental materials from Neolithic burials, which indicate their Eastern origin (Ibid.: 136). Furthermore, the results of our analysis demonstrate that in one individual, cranial and dental features may exhibit different vector orientations: Eastern in cranial pattern and Western in dental pattern. This suggests their potential non-consolidation in terms of the modern typology of morphological complexes, and a general diversity of evolutionarily conservative anthropological substrates in the Neolithic in Western Siberia.

With regard to the interaction between the Neolithic populations of Baraba and the Upper Ob basin, our analysis of craniometric data has revealed no evidence of such a phenomenon. The relative anthropological isolation of the Upper Ob and Baraba populations can be attributed to the peculiar character of the two regions, which resulted in distinct trajectories of population evolution. It seems reasonable to suggest that the genetic development processes in the Upper Ob basin and Baraba were relatively independent from each other, and were based on different substrates.

Conclusions

The current possibilities for anthropological study of the Neolithic population of the West Siberian forest-steppe, including the increased amount of available material since the 1990s, innovations in instrumental and comparative statistical analysis, and the formation of new theoretical approaches, allow for the extraction of significant insights even from single finds, thereby considerably clarifying the evolutionary aspect of cultural and genetic processes in the region. Our study of the anthropological features of the individual from burial 33 at the cemetery of Krokhalevka-5 has provided insights not only into the local area (Upper Ob basin), but also extended beyond it.

The combination of cranial traits of this individual, in the context of anthropological differentiation of the Neolithic population of Northern Eurasia, displays a certain trend towards the complexes prevailing in ancient and modern Eastern Siberian groups. This morphology includes homoplatyprosopy of the facial section, moderate nasal protrusion, a narrow sloping frontal bone, and relative elongation of the occipital component of the sagittal arch of the skull. The mesomorphic proportions of the cranium and facial section, in conjunction with the very narrow piriform aperture with a sharp lower edge, are more common in the groups of Western Siberia and the European part of Northern Eurasia. The Neolithic age of the burial suggests that the anthropological identification of the individual is associated with a non-consolidated (protomorphic) component in terms of modern typology. The combination of morphological features of his dentition tends towards the Western dental stock. The Krokhalevka individual differs from representatives of the contemporaneous Neolithic Baraba population (with medium robust skeleton, average stature, and mesomorphic proportions of limb segments) by his postcranial morphology—gracile skeleton, distal type of upper limb growth, and above-average body length.

Statistical principal component analysis carried out for the continuum of individual craniometric data of the North Eurasian population has allowed us to draw conclusions on the general trends of population history in the Eurasian region in the Neolithic, and on the local features of development of the anthropological composition of the Neolithic populations of the Upper Ob basin. We have identified a significant polymorphism in the population of northern Eurasia in general, caused by the initial non-consolidation of morphological substrate. At the same time, the formation of the Caucasoid and Mongolian morphological complexes is outlined.

The specific morphology of the Krokhalevka skull can be interpreted not only as a result of the transformation of one of the archaic morphological types that lived in Northern Eurasia in the Neolithic. The existence of consolidated complexes (Mongoloid and Caucasoid), having their own geographic areas, in the Neolithic suggests their admixture during the migration processes. Irrespective of the chosen hypothesis, important is the fact that among the West Siberian Neolithic groups, the individual from Krokhalevka exhibits the greatest cranial similarity to those buried at Firsovo XI (Barnaul stretch of the Ob) and Zarechnoye-1 (Salair region). Conversely, the paleoanthropological materials from the Neolithic burials of Baraba show certain discrepancies with the above specimens. This suggests that different substrates were involved in the population history of the Upper Ob basin and Baraba.

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Excavations of a Neolithic Dwelling at Pod Lipami, Primorye, in 1976

Long-term archaeological excavations have been carried out at a large group of Late Neolithic (Zaisanovka culture) settlements on the left bank of the lower Partizanskaya River in southern Primorye, mostly dating to early 2nd millennium BC and somewhat earlier. Remains of half-dugout dwellings were unearthed. Many sites, including Sopka Bulochka, Sopka Bolshaya, and Pereval, have been previously published. The only exception is Pod Lipami, a site consisting of a single dwelling, on which this study focuses. Its sub-rectangular foundation, ~46 m^2 in area, had been dug into the slope of the hill, forming a terrace-like platform. The wattle dwelling had a hearth in the center. Numerous stone agricultural tools were found—hoes, querns, grinders, pestles, etc. Other lithics are adzes, scraping, cutting, and grinding tools, including those made of obsidian. Ceramics are represented by shards and larger fragments of crushed handmade flat-bottomed and pot- and vase-like vessels, mostly decorated with carved vertical zigzags, curvilinear figures, and spirals, which are more common in the Neolithic of the Lower Amur. Small as it is, the site with its radiocarbon dates extends our knowledge of the Zaisanovka culture and of its creators, sedentary farmers.

Keywords: *Primorye, Neolithic settlements, Pod Lipami, dwellings, Zaisanovka culture, farming, stone tools, ceramics.*

Introduction

The search for and excavations of the prehistoric sites were carried out discontinuously over ten field seasons of varying lengths by the teams of the Institute of History, Philology and Philosophy of the Siberian Branch of the USSR Academy of Sciences, and later of the Institute of Archaeology and Ethnography SB RAS in southern Primorye, during the period from the mid-1960s up to the early 2000s. The greatest attention was paid to elevated areas in the valley of the Lower Partizanskaya (formerly Suchan) River, 3–8 km from the village of Vladimiro-Aleksandrovskoye in the Partizansky District, mainly in the direction to the city of Nakhodka. A total of six archaeological sites were discovered, at four of which large-scale excavations were carried out.

A settlement site on the Pereval hill, near the village of Vladimiro-Aleksandrovskoye, was studied first. A total of six dwellings attributed to the Zaisanovka Neolithic culture and dated to the second half of the 3rd to early 2nd millennium BC were studied (three of them, only partially). The remains of half-dugout dwellings located on the site of a previously destroyed settlement apparently belonged to the same culture. It was determined that some part of the Pereval hill was earlier inhabited by the bearers of the Rudnya Middle Neolithic culture, with ceramics ornamented with the “Amur plait” motif. The even earlier assemblages of artifacts were abandoned here on the turn of the Pleistocene and Holocene, which is supported by two radiocarbon dates—11,150 ± 100 (LE-1565) and 10,100 ± 100 (LE-1566) BP.

The excavated dwellings contained typical ledges along the walls, a kind of "beds", common in the Neolithic residential structures in the southern part of the Russian Far East, and a hearth in the center. There were large collections of ceramics (including intact pot-like vessels) and various lithic tools: querns, grinders, hoes, pestles, polished adzes, retouched and polished arrowheads, knives-bifaces, borers, fishing sinkers, and others. Particularly noteworthy are the series of tools associated with the initial stage of agriculture in Primorye (Okladnikov, Medvedev, 1995; Medvedev, 2000; Medvedev, Kononenko, 2002).

The second multi-layered site was located on the Bulochka hill, 7 km northwest of Vladimiro-Aleksandrovskoye. This is the most well-studied site in the region, containing the remains of various periods and cultures. A total of 24 dwellings was unearthed here, 21 of which dated back to the Early Iron Age (the Krounovka culture and Poltse cultural community), and three other dwellings to the Late Neolithic Zaisanovka culture. Some groups of artifacts indicate that prior to Zaisanovka people Bulochka was inhabited by those of the Boisman Middle Neolithic culture; though, no traces of Boisman dwelling structures were found. The Zaisanovka people were the first to construct artificial terraces and build dwellings on the Bulochka hill. Sopka Bulochka is one of the key ancient sites in Primorye; it was described in many publications (see, e.g., (Okladnikov, Glinsky, Medvedev, 1972; Derevianko et al., 2005; Derevianko, Medvedev, 2008; Medvedev, Filatova, 2011; and others)).

The third settlement belonging to the Zaisanovka culture was discovered on the dome-shaped summit of a hill we called Sopka Bolshaya (Medvezhya), near the Lebyazhya lagoon close to the Bulochka hill, approximately 7 km southwest of Vladimiro-Aleksandrovskoye. The settlement consisted of no more than six dwellings; the remains of the dwellings in the form of round, very vague depressions 3–8 m in diameter were visible on the surface prior to excavations; these were located compactly at a distance of 0.5–2.0 m from one another. Research at the site was conducted over three field seasons (1970, 1971, and 1976); four dwellings were excavated over a total area of 243 m^2. All of them were rectangular in plan view (with rounded corners), with shallow foundation pits showing no traces of post holes nor hearths. The most numerous were stone tools associated with agriculture: hoes, grinders, querns, and pestles. Adzes, end-scrapers, arrowheads, and other tools were also found. Pottery was represented by solitary sherds, as well as pot-like and vase-like vessels crushed by soil; the vessels were decorated with applique cordons close to the rim edge and a pattern of oblique lines and vertical zigzag over the body and shoulders. The settlement was defined as a seasonal, short-term camp of farmers. It could have been inhabited in the early 2nd millennium BC (Medvedev, 2015).

The other settlement sites of U Dorogi and Vosmoi Kilometr were significantly destroyed and were only partially explored through cleaning and trial excavation. The former was located at the foot of the southeastern slope of the Bolshaya hill, on a low terrace-like platform facing the nearby Lebyazhya lagoon. Remains of two dwellings of the Zaisanovka people were uncovered. One of these dwellings yielded ceramics decorated with various vertical zigzags, and two ceramic spindle whorls of biconical and disc-like shapes; another dwelling, ceramics with carved patterns, a vessel fragment bearing a spiral pattern, hoes made of chert, and obsidian and flint flakes. The Vosmoi Kilometr settlement was located on the top of a 10–15-meter high hill next to the road, 8 km from Vladimiro-Aleksandrovskoye in the direction of Vrangel Bay. The site was attributed to the Neolithic, mainly to its middle and late stages.

The above brief review of the archaeological sites shows that during the Neolithic small groups of people established several long-term settlements on a relatively small area of the fertile valley of the Partizanskaya River, not far from its estuary. The main or one of the main occupations of the population was agriculture. The archaeological materials from almost all the above sites have been published. However, the results of the excavations of the Pod Lipami site-dwelling were not described, although the site is often mentioned in the literature. This paper aims to fill the gap in the corpus of the Primorye antiquities.

Results of the Pod Lipami excavation campaign

The site under study, representing an isolated dwelling, a sort of ancient farmstead, was located in the vicinity to the Lebyazhya lagoon in the Partizansky District, Primorye, and excavated in October 1976*. The vast lagoon is located between the widely known Brat and Sestra hills, 6–7 km southwest of Vladimiro-Aleksandrovskoye. The Manankina River flows into the lagoon; the Bulochka hill rises to the northwest of the lagoon, and the Bolshaya (Medvezhya) hill stands further upstream. An unnamed hill, which we called

*The excavation team included A.P. Okladnikov (Chief of the North Asian Joint Expedition); V.E. Medvedev (Chief of the Amur-Ussuri Team); Senior Laboratory Assistants A.K. Konopatsky, O.A. Kuysali, and V.P. Mylnikov (Institute of History, Philology and Philosophy of the Siberian Branch of the USSR Academy of Sciences), and three students from the Khabarovsk State Pedagogical Institute.

Fig. 1. Location of the Pod Lipami hill (indicated by the arrow; the Bulochka hill and the adjacent Lebyazhya lagoon are to the right).

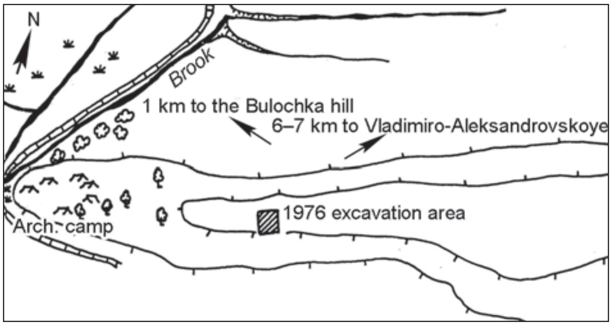

Fig. 2. Map of the Pod Lipami hill and its surroundings (after (Okladnikov, 1976) in a modern edition).

Pod Lipami, is situated 0.5 km from the Bolshaya (Medvezhya), over a small stream in a fairly wide valley. The data provided herein have been collected by V.E. Medvedev in the course of analysis of the Pod Lipami artifact assemblage deposited at the Institute of Archaeology and Ethnography SB RAS and cited from the A.P. Okladnikov's field report (1976) and his diary.

The dwelling was located at an altitude of about 35 m on the southern slope of a long promontory at the fork of the Manankina River and an unnamed stream (Fig. 1, 2). This slope is steep (about 60°), densely overgrown with hazel and small oak trees; the opposite side of the valley is more gentle (about 30°). Among the small oak trees, two very old linden trees survived (hence the name of the hill). A shallow depression, about 5–6 m in diameter and not exceeding 30–35 cm deep from the surface of the hill, was noted on the soil covering the dwelling remains. The excavation trench of 9 × 7 m with two mutually perpendicular edges oriented to the cardinal points (Fig. 3, *a*) was established. The edges remained intact until the end of the work, and served as reference profiles. The stratigraphic sequence was the same all over the edges (Fig. 3, *b, c*). On top there was a thin layer of dark to intensely black turf not exceeding 15 cm thick. Upon removing this layer in sq. Д3, Д4, a small hearth of irregularly rounded shape, 30 cm in diameter, was found. The hearth contained an ash mass at the bottom, overlain with a black carbonaceous mass. A fairly large unprocessed stone was uncovered at a depth of 20 cm from the soil surface. The total area of the dwelling pit was about 46 m^2. The filling consisted of yellow-brown loam with an admixture of coarse small rubble. The thickness of foundation pit sediments in the center reached 40 cm. The underlying virgin land was lighter colored loam saturated with abundant rubble of the above type.

The general shape of the dwelling is rectangular with rounded corners in plan view. In the southern part of the pit, adjacent to the highest part of the hill, there is a steep ledge of the dwelling wall. Its maximum height is 85–90 cm (without additional 10–15 cm of the turf layer). The heights of the pit walls gradually decrease to the northern part of the dwelling. The contours of the dwelling pit in the northern part are hardly traceable, as if the walls tailed. It seems that the pit digging went deeper into the hill in the southern part (upland), and only leveled the surface of the hill in the northern part. The floor of the dwelling is generally horizontal, but not even, with small depressions.

A large, flat, elongated ovoid axe made of dark-gray chert, broken crosswise into four parts, was found on the border between sq. Д1 and Д2, at a depth of 20 cm (Fig. 4, *2*). Also, small fragments of a clay vessel

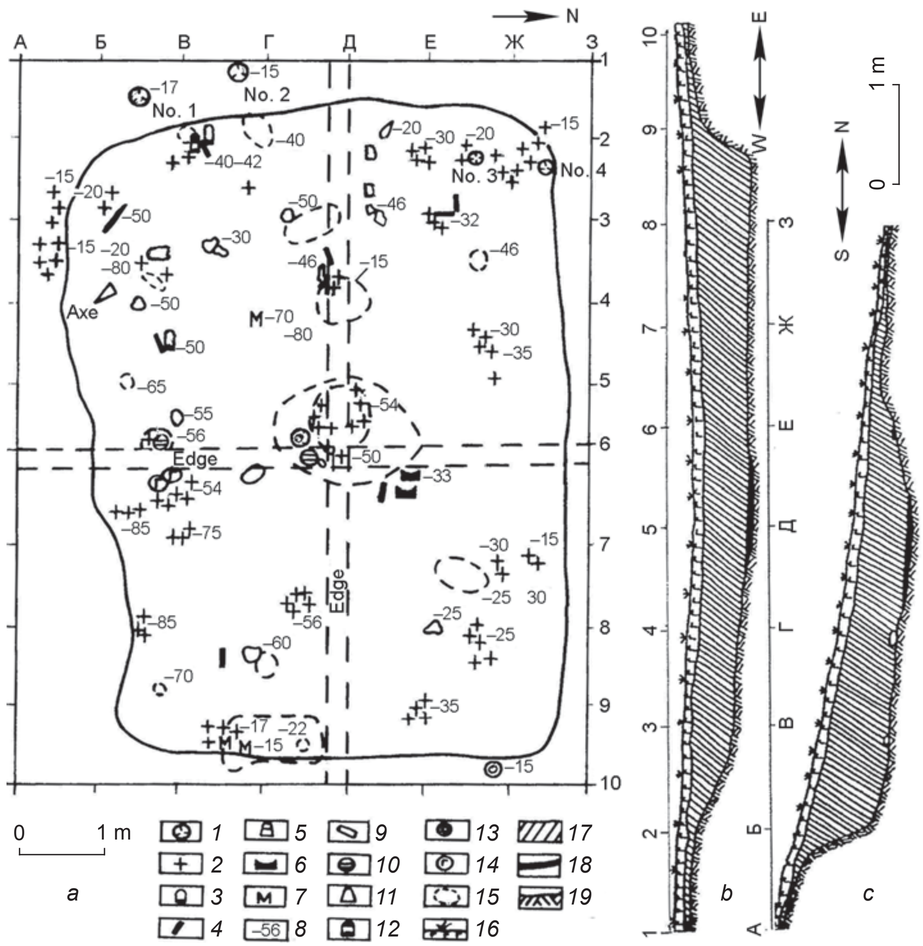

Fig. 3. Map of the dwelling (*a*) and profiles along the lines Д (*b*) and 6 (*c*).
1 – pit; *2* – ceramics; *3* – end-scraper; *4* – flake; *5* – adze blank; *6* – quern; *7* – hoe; *8* – depth of the find occurrence; *9* – stone; *10* – grinding tool; *11* – adze; *12* – obsidian end-scraper; *13* – pressure tool; *14* – grinding pebble; *15* – carbon stain; *16* – topsoil; *17* – yellowish-brown loam; *18* – carbonaceous layer; *19* – virgin land.

with a carved linear ornament were recovered here. In sq. Д2, at a depth of 30 cm, two fragments of rock were discovered close to one another; originally, these were likely located on the roof of the dwelling or at its edge. In the same square, the bottom of a clay container was found. At a distance of 20 cm from it, a 15-cm-high crushed thin-walled clay vase-like vessel with a flat bottom lay on its side. In neighboring squares E2, 3, fragments of a large thick-walled vessel ornamented with a carved vertical zigzag were found. Remains of another crushed vessel were recovered from a layer of 15–20 to 30 cm deep in squares Д1, 2–Ж1, 2.

A black obsidian flake retouched over one of the edges, which apparently served as a cutting tool, and a fragment of the thick bottom of a clay vessel were found at a depth of about 40–42 cm in sq. B2. These items were recovered from a dark carbonaceous layer near the western wall of the dwelling. The layer also contained small pieces of charcoal and burnt bark of black birch in the form of thin charred pieces.

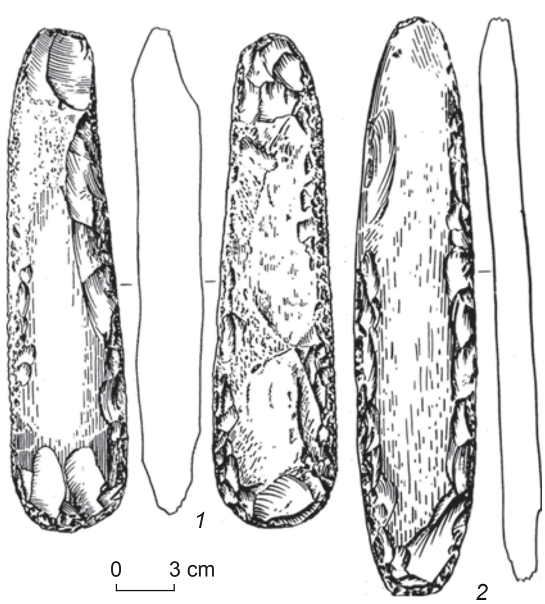

Fig. 4. Stone axes.

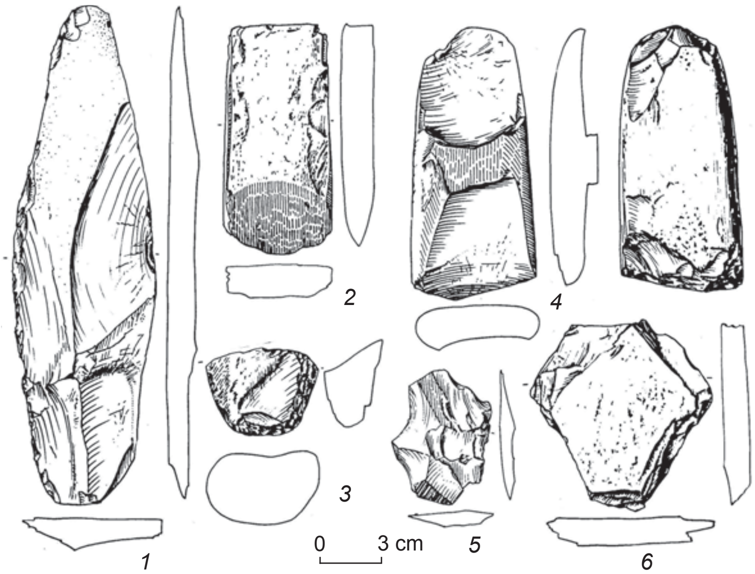

Fig. 5. Stone tools.
1 – tool blank; *2*, *4* – adzes; *3* – chipped pebble; *5* – flake; *6* – tablet.

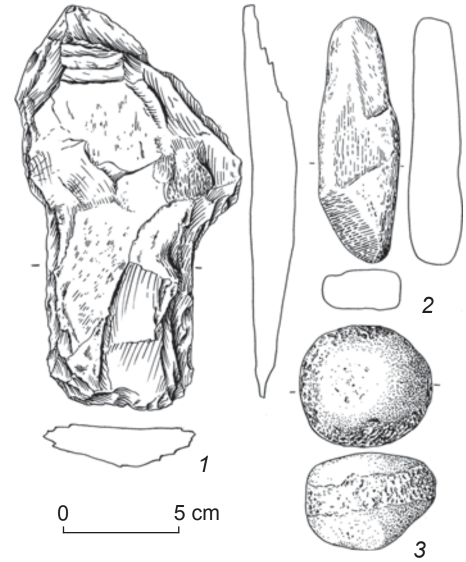

Fig. 6. Hoe blank (*1*), polishing pebble (*2*), and pressure tool (*3*).

At a depth of 50 cm, in sq. В3, a large coarse fragment of chert was found; two more of the same kind were recorded nearby. These stones were likely located on the edge of the pit, from which they rolled down. In the same square, at a depth of 80 cm, a robust polished axe, 26 cm long, oval in cross-section, with traces of microflaking on the working edge (Fig. 4, *1*) was found lying in a horizontal position. It was located in a small depression in the dwelling's wall. At the border between squares Б2 and Б3, there was a rough lamellar blank of a knife or blade made of dark chert, 24.5 cm long and 7.2 cm wide (Fig. 5, *1*); in square В4, a blank of a shouldered hoe made of the same rock (Fig. 6, *1*). These artifacts were located at a depth of 70–80 cm.

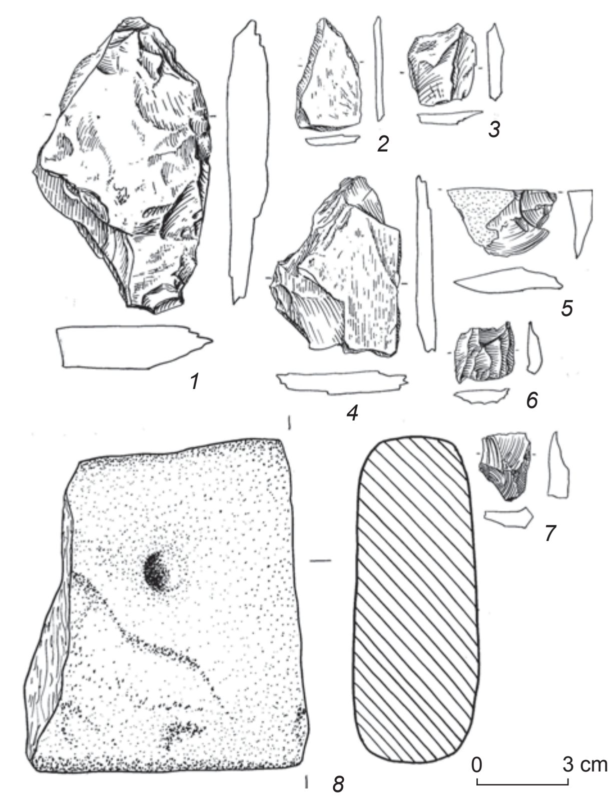

Fig. 7. Spalls from tools and flakes (*1*–*7*), fragment of quern with a hole (*8*).

On the border between squares В1 and В2, small obsidian flakes and a jet-black point lay close to one another on the floor of the dwelling. In sq. Ж1, 2, Е2, 3, fragments of crushed clay vessels with cornice-shaped rims and an ornament of carved vertical zigzags were discovered.

In the center of the dwelling (sq. Г4, 5–Д4, 5), at a depth of 50 cm, there was a hearth. It was located at the intersection of the reference profile walls; originally, it was the deepest point in the depression traced on the surface before the excavations. The rounded hearth pit was 1.4 m in diameter and 15 cm deep from the dwelling floor level. Red-burnt stone fragments were found at the pit bottom, partially overlain with a thin carbonaceous layer of intensely black color. Fragments of a vessel ornamented with carved curve lines were recovered from this layer in three small clusters. One of the fragments had four holes that obviously had been used for fastening the broken vessel. The hearth area yielded a broken adze (oval in cross-section), two large chert flakes, and two well-rounded small pebbles.

In sq. Д6, two fragments of a quern were found, which could also have been used as a "fire stone", judging by the typical holes (Fig. 7, *8*). A large fragment of a vessel with a cornice-shaped rim ornamented with vertical zigzag was found on the rocky floor of the dwelling in sq. E7; fragments of another such vessel were noted in sq. Ж7. Fragments of vessels ornamented with curve lines (Fig. 8, *6*, *7*; 9, *3*, *5*, *7*, *8*) and pricked rows (Fig. 9, *6*) were discovered in squares E7, 8. Ceramics were also found in sq. Г4, 5 (depth 50 cm), Г7 (depth 56 cm), and in other squares. In particular, in sq. A2, 3, Б6, 7, and B9, fragments of vessels with rim-cornices, ornamented with vertical zigzags, were discovered after the final cleaning of the dwelling's floor and walls (see Fig. 8, *1–5*; 9, *2*). A shard with a "pearl" (punched node) pattern was also found (see Fig. 9, *4*).

In addition to the above-listed lithic artifacts, the dwelling (on the floor and in the filling) contained adzes in sq. Г5 and Г3 (see Fig. 5, *2*, *4*), chipped pebbles in sq. Б6 and Б8 (see Fig. *5*, *3*), spalls from tools and flakes in sq. Д5 and Д6 (see Fig. 7, *1–7*), and a pressure tool (see Fig. 6, *3*). In sq. B9, there was a well-rounded pebble with depressions in the middle. A relatively large fragment of rock lay on the horizontal floor at the border between sq. Д7, 8 and E7, 8.

The holes from posts supporting the roof were not clearly visible and survived only in the western part of the excavation area. Two such holes were in sq. Б1 and B1 near the dwelling; and two more, inside the dwelling, in its northwestern corner, at a distance of 1 m from one another. All the holes were round in plan view, 10–15 cm in diameter, 15 cm deep, and were filled with loose humic soil.

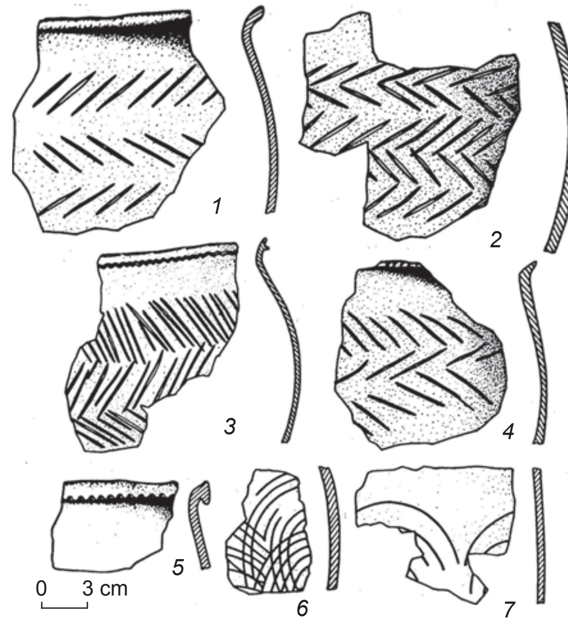

Fig. 8. Pottery.

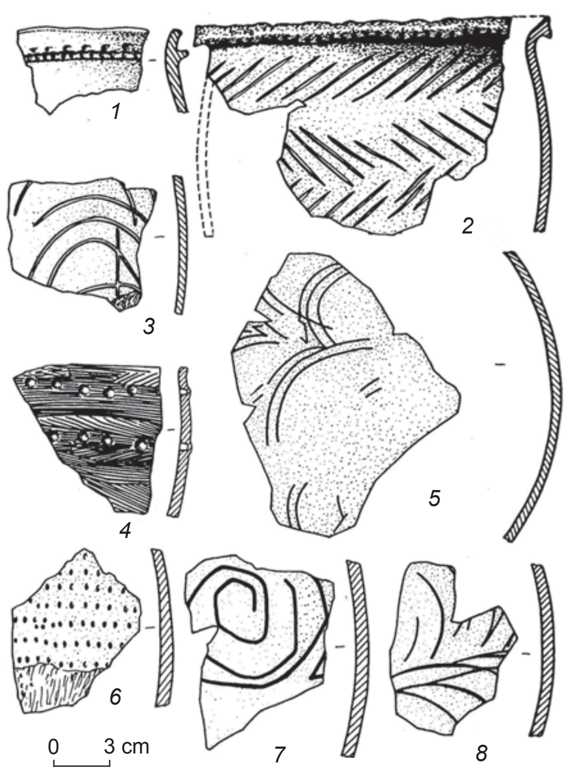

Fig. 9. Pottery.

Discussion

The Pod Lipami dwelling is an unusual settlement site with a single residential construction on the hill. At first glance, the site may seem unremarkable and insufficiently informative. However, the excavation findings are quite useful for expanding our knowledge on the economic activities of the inhabitants of southern Primorye in the Late Neolithic. The formerly derived data on their occupation of the tops of small hills surrounding the flat fertile valleys near the Razdolnaya River and other rivers and streams have been confirmed.

On the hills of Bulochka, Bolshaya, Pereval, and others, Zaisanovka people constructed their dwellings on the foundations deepened into the ground (in some places, sandstone rocky sediments). They arranged small pits or terrace-like platforms of a sub-rectangular shape on the slopes of the hills, with well-defined walls on the upland sides and the vague or absent walls on the foothill sides. Notably, not all the studied Zaisanovka sites in southern Primorye were long-term, i.e. with year-round habitation of people. The observed features suggested that the sites were used only during the periods of agricultural activities. This explains the simple design of the dwellings. The foundation pits were quite shallow; no holes from posts supporting the roofs were identified. Residential structures appear to have been in the form of chums based on a wooden frame made of poles covered with birch bark, animal skins, and other materials. Another fundamentally important feature was the absence of any hearths therein. As for the Pod Lipami dwelling, it contained elements characteristic of a long-term residential structure: a deep underground foundation, traces of post holes, and a hearth established in a specially prepared pit.

The noted characteristics of the Pod Lipami dwelling suggest that agriculture played a significant role in the subsistence activities of its inhabitants; a large portion of their food products were most likely cereal seeds. Although no seed remains were found during the excavations, the set of tools associated with preparing the land for sowing, harvesting, and processing the crop (hoes, blade knives, querns, grinders, and pestles) points to agriculture as the main economic activity. Notably, all the above types of tools, including robust polished axes (see Fig. 4) used for uprooting and clearing land for sowing, show numerous dents and flake scars, i.e. use-wear traces.

Scraping and cutting tools, grinding pebbles and tablets, and a pressure tool found all over the residential complex suggest stone working activities. Chert, granitoids, flint, obsidian, and fine-grained sandstone were the main raw materials used for the manufacture of tools. Woodworking tools include axes and well-prepared polished adzes, rectangular or ovoid in cross-section, with traces of repeated use in construction works, mostly outside the dwelling in the warm season.

The pottery recovered at the site is traditionally important for making more or less balanced judgments on the cultural affiliation of the residential complex attributed to the Zaisanovka culture. The available ceramics include parts of crushed vessels and clusters of scattered shards. In general, the excavations revealed a well-balanced set of stone and ceramic products that had accumulated over the time of the site habitation. In terms of quantity, the assemblage is not as great as is usually observed in the Neolithic dugout and half-dugout dwellings of the south of the Far East, especially Lower Amur. On the other hand, the site is remarkable for the absence of foreign cultural artifacts.

The recovered pottery remains are, almost exclusively, low pot-like, slightly narrowed at the bottom and widened at the top vessels, often with an appliquéd rim in the form of a cornice. The pottery is hand-made, with rough or smoothed surfaces; the paste is tempered with fine sand and grog. The Pod Lipami vessels are characterized by the main technological, morphological, and stylistic features typical for the Zaisanovka ceramics.

Most of the ornamented ceramics recovered from site bear various vertical and horizontal zigzag motifs made by incised lines or combing. Another ornamental motif—carved curvilinear figures and spirals—does not belong to the "typical" Zaisanovka ornamentation pattern, it is mostly characteristic of the Voznesenovskoye culture of the Lower Amur, and supports the hypothesis of the priority of contacts between these two fairly contemporaneous cultures.

In recent decades, the Zaisanovka culture, representing the terminal stage of the Neolithic in Primorye, has attracted considerable interest among archaeologists. New sites have been discovered; the origin, development, chronology of this culture, as well as the material and spiritual perceptions of its carriers, have been discussed. The data derived in the course of the Pod Lipami excavations provide significant additional information on the Zaisanovka culture. The radiocarbon analysis of charcoal pieces from the dwelling provided the following dates: 3915 ± 50 BP (SOAN-1530) and 3635 ± 30 BP (SOAN-1532), suggesting its attribution to the first half of the 2nd millennium BC. It is still unclear why this dwelling remained single and isolated, and whether it was built voluntarily or forced by situation. This issue is unlikely to be easily resolved.

Conclusions

The isolated Neolithic dwelling was excavated during the archaeological works on the Pod Lipami hill. This site represents a kind of a New Stone Age farm. It is probably the only one of its kind in the southern part of the Russian Far East.

The relatively few artifacts found in this Late Neolithic single-layer archaeological site of the Zaisanovka culture include shouldered hoes, querns, and vessels decorated with patterns of carved lines. Some vessels bear the motifs of characteristic zigzag lines, others curved lines, spirals, and arcs. The curvilinear pattern was a relatively new element in the Zaisanovka culture. In this regard, the ceramics with punched node "pearl" ornament, rare for Primorye, are noteworthy. The category of small tools includes obsidian items typical of the Neolithic of Primorye.

The site was defined as a farmer settlement, which conclusion was based on the recovered hoes, querns, and grinders. Furthermore, the dwelling belonged to a sedentary population, living permanently in one place. These people constructed houses with foundations deepened into the ground; and they manufactured clay flat-bottomed vessels. The derived radiocarbon dates provide the important information that extends our knowledge of the complicated issues of chronology of the Primorye Neolithic.

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Clay-Plaster "Masks" from Mound-Vault Skalnaya 5, Khakassia

Findings of excavations at the burial mound-vault Skalnaya 5 of the Tes stage in Khakassia are presented. The article focuses on ritual aspects of clay-plaster coatings of human crania and their semantics. The coating was applied to cervical vertebrae and trepanned skulls. It consisted of a single type of local clay; sculptural portraits were modeled of plaster (with two main layers and a finishing layer), and pigments were made of ocher with various shades, cinnabar, and charcoal. The masks, apparently made by various artisans, represented unique faces with ethnic features. Female masks had more elaborate paintings (one or several trefoils) than male ones which were uniformly red. Wooden structures, certain details of the funerary rite, and the technology of clay-plaster coatings reveal high similarity among the burial mounds at Skalnaya 5, Noviye Mochagi near Kaly, and Lisiy near Sabinka, possibly because they were contemporaneous (first to third centuries AD). Trefoil designs are paralleled by those on two female masks from Kamenka III burials, suggesting that these women belonged to a single ethnic group. Nomadic pastoralists of Southern Siberia did not make sculptural representations of painted plaster, suggesting that the tradition was introduced from the west. But conceptual resemblance is found only among Egyptian plaster funerary masks of the Roman Age.

Keywords: *Tes period, mound-vault, funerary shelves, clay-plaster coating, sculptural portrait, colored painting.*

Introduction

The study of burial "masks" began in 1883, when A.V. Adrianov excavated a Tashtyk vault near the town of Minusinsk (Tagarsky Island) (1902–1924: 2). A number of works by E.B. Vadetskaya (1986a, b; 2004a, b; 2006; 2007a, b; 2009; Vadetskaya, Gavrilenko, 2002, 2006; Vadetskaya, Protasov, 2003) are distinguished among the dozens of different publications on this cultural phenomenon. Vadetskaya's opinion changed with the accumulation of new data, resulting in the conclusion that the custom of making mummies wrapped in grass and/or covered with birch bark, with sticks for attaching the bones, and with trepanation of the skull (in the 2nd–1st centuries BC) appeared initially in the Late Tagar burial tradition. Clay and plaster were not used in the rituals. "The remains of such mummies were discovered both in single burial mounds and in enclosures containing two or three collective graves… Presumably, some birch bark mummies were painted red, especially the face, since traces of paint sometimes survived on the bridge of the nose and in the eye sockets, or on the back of the head or upper jaw" (Vadetskaya, 2006: 344–345). In the 1st–2nd centuries, there appeared burial mound-vaults with collective secondary burials, where the skulls of the deceased ("imitations" of people) were coated with clay, and plaster facial coverings were painted (Ibid.: 345). These developments were found in the Tes burial tradition. Later, starting in the 3rd century, "masks of burial dolls" as a part of inhumation or cremation rituals were made in the Tashtyk culture*. However, it must be admitted that today there is no clear concept regarding the reasons for the emergence or the mechanism of development of various burial rituals with the imitation of people (their parts or only the heads of the deceased) with clay-plaster painted "masks", which existed for a long period of time among the nomadic pastoralists living in the Khakass-Minusinsk steppe. The primary obstacle is the small number of studied Tes collective burials, their large-scale looting (destruction) in ancient times, as well as difficulties in excavating and recording the evidence. Thus, the results of studying mound-vault Skalnaya 5 in the Askizsky District of the Republic of Khakassia in 2021 (Bogdanov, Timoshchenko, Ivanova, 2021: 883–885), where clay-plaster "masks" were discovered, are of extreme importance.

Description of the complex

The Skalnaya 5 burial mound was located on a huge burial field to the northwest of Mount Uytag, and had an unusual architectural structure. The carriers of the Tes culture decided to make a collective vault inside the enclosure (19.5 × 20.5 m) of a large Saragashen burial mound (Fig. 1, *1*, *2*)**. They built a log structure with a multilayered wooden ceiling at the level of the top of the earlier earthen "mound" on the place of the previous burial. In addition, the Tes builders set up several massive slabs vertically at each wall of the enclosure, wedging them with large stones (Fig. 1, *3*). The earthen "mound" was increased in height by five or six layers of clay-sod blocks throughout the entire inner area. The whole structure might have been originally pyramidal in shape. To prevent it from spreading, the mound builders made additional walls of slabs laid horizontally in several layers around the perimeter (Fig. 1, *2*).

The burial structure has survived despite two large-scale robber's invasions and burning of the chamber from the inside (Fig. 2)***. The ten-layered structure of logs joined with a saddle notch was covered with a heavy log ceiling along the west–east line (Fig. 2, *4*). Thinner logs were laid on top of it in a lattice of four layers (Fig. 2, *2*). There were no traces of birch bark coverings. On the eastern side, an opening (under the ceiling) at least 1 m wide was made for the entrance. A passage of two steps lined with stone tiles led down to the entrance. According to stratigraphic observations, the passage remained open for quite a long time.

Fig. 1. Mound-vault Skalnaya 5.
1 – view of the enclosure from the northwest; *2* – stonework of the western wall and entrance to the enclosure; *3* – view of the steles in the center of the wall, set up by the Tes people in the earthen "mound" of a Saragashen burial mound.

Three support logs were set parallel to each other along the western wall on the inside, at a distance of 0.4–0.5 m from each other, at the level of the fourth layer of logs (counting from the bottom) (Fig. 2, *3*). The functional purpose of this structure is difficult to determine. It might have been a "utility area", since it contained an iron bit with mouthpieces, fragments of clay pottery, and remains of heavily burnt felt coverings on the floor under the support logs along the wall. However, the dead could probably have been placed on the logs to prepare them for further stages of the burial rite. Air permeability of

*The objectives of this publication do not include discussion of the entire range of problems of the Tes (mound-vaults, layered burials in stone cists, flat-grave burial grounds) and Tashtyk cultural traditions, nor analysis of the scholarly opinions on these problems. All these were described in detail in the above-mentioned works by E.B. Vadetskaya and the monograph of N.Y. Kuzmin (2011).

**All photographs herein were taken by E.S. Bogdanov; drawings and reconstructions were made by A.A. Paizerova.

***A special publication on the reconstruction of the burial mound-vault with a more detailed description of its features is in preparation.

Fig. 2. Remains of wooden structure in mound-vault Skalnaya 5.
1 – view of the wooden structure from the northwest at the level of the cover destroyed by robbers; *2* – fragment of four-layered cover made of logs; *3* – support logs along the western wall of the cribwork; *4* – southern wall of the cribwork; *5* – ceiling beams; *6* – remains of funerary shelves in the southwestern corner; *7* – remains of planks along the southern wall of the cribwork (traces of the robbers' entrance are in the center).

the room (the entrance to the tomb remained open) could have contributed to transformation of the corpse into skeletal remains in a natural way. Plank funerary shelves (45–60 cm wide and 3–5 cm thick) were made along the northern and southern walls at the level of one layer of logs below the structure described above (Fig. 2, *6*, *7*). The floor in the vault was made of tightly laid rough logs, oriented along the west–east line.

Specific features of the burial rite and goods

The vault was obviously used for quite a long time. At first, the dead ("imitations") were laid quite close to each other directly on the floor along the transverse walls, leaving a free passage in the center. After some time, wide funerary shelves were built on both sides of the passage for newly buried persons. The final action of the ritual was setting fire to the vault from the inside and closing the entrance. The wooden vault and its contents did not completely burn because of the lack of oxygen. Unfortunately, many aspects of the burial rites and their sequence cannot be established. At some point (for ritual purposes? during robbery?), people entered the tomb and dragged all the dead from the shelves into the center of the chamber, breaking most of the clay-plaster coverings of the skulls. Several centuries later, robbers broke into the vault twice. The log ceiling might have collapsed after the first robbery, destroying the interior of the vault. Subsequently, robbers seriously damaged the entire central part of the burial chamber: most of the human bones were found in a fragmented state at different depths of grave filling and in discharged soil. *In situ*, the original situation survived only in three corners of the log structure under the fallen planks of the funerary shelves. The finds in these three corners allow us to partially reconstruct the burial rite, which changed over the time that the vault functioned.

The remains of over 40 adults survived on the floor under the shelves, including one anatomically complete skeleton. The rest of the remains were represented only

Fig. 3. Human remains in mound-vault Skalnaya 5.
1 – view of the accumulation of skeletons in the southwestern corner of the cribwork (traces of the robbers' pit are in the center); *2* – skeleton with burial goods near the southern wall of the cribwork; *3* – fragment of the skeletal remains of a person with a "mask" on the skull; *4* – fragment of accumulation of bone remains in the southeastern corner of the cribwork (a skull with clay coating and fallen plaster coating is in the foreground); *5* – plaster coating fallen off the clay coating of a female skull (No. 21) *in situ*; *6* – skulls (No. 1–3) and burial goods *in situ* in the northwestern corner of the vault.

by parts of skeletons joined together (Fig. 3). These were mainly fragments of the spine with the skull or part of the chest, sometimes only leg bones joined with the pelvis (Fig. 3, *1–4*). Almost all of them were discovered in the chamber in a disorderly arrangement, packed one on top of the other. A layer consisting of a mass of burnt brown grass survived in several places under some long bones and beside them. Burnt thin sticks of various lengths were found along with human remains in the northeastern corner of the cribwork (Fig. 3, *6*). All of the skulls (except for two children's skulls) were trepanned in the temporal part, filled with a mixture of grass, and had painted clay-plaster portrait "masks" (Fig. 3, *5*, *6*; 4–6). During the functioning of the vault (transferring the dead onto the floor) and subsequent destruction, most of the masks crumbled and were unable to be restored.

The burial goods included votive items standard for the Tes culture (bronze mirror-disks, belt buckles and rings), spoon-shaped pendants and tubular beads, fragments of iron items, paste beads, jar-shaped pottery, as well as wooden and birch bark utensils.

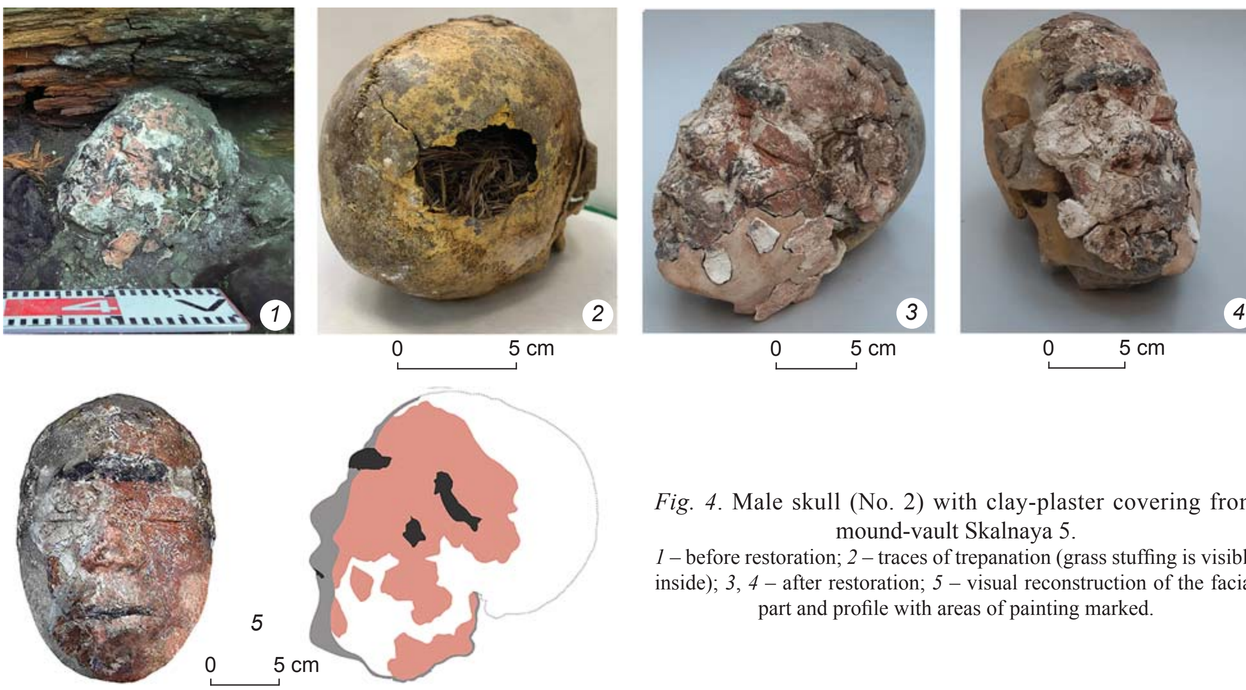

Fig. 4. Male skull (No. 2) with clay-plaster covering from mound-vault Skalnaya 5.
1 – before restoration; *2* – traces of trepanation (grass stuffing is visible inside); *3*, *4* – after restoration; *5* – visual reconstruction of the facial part and profile with areas of painting marked.

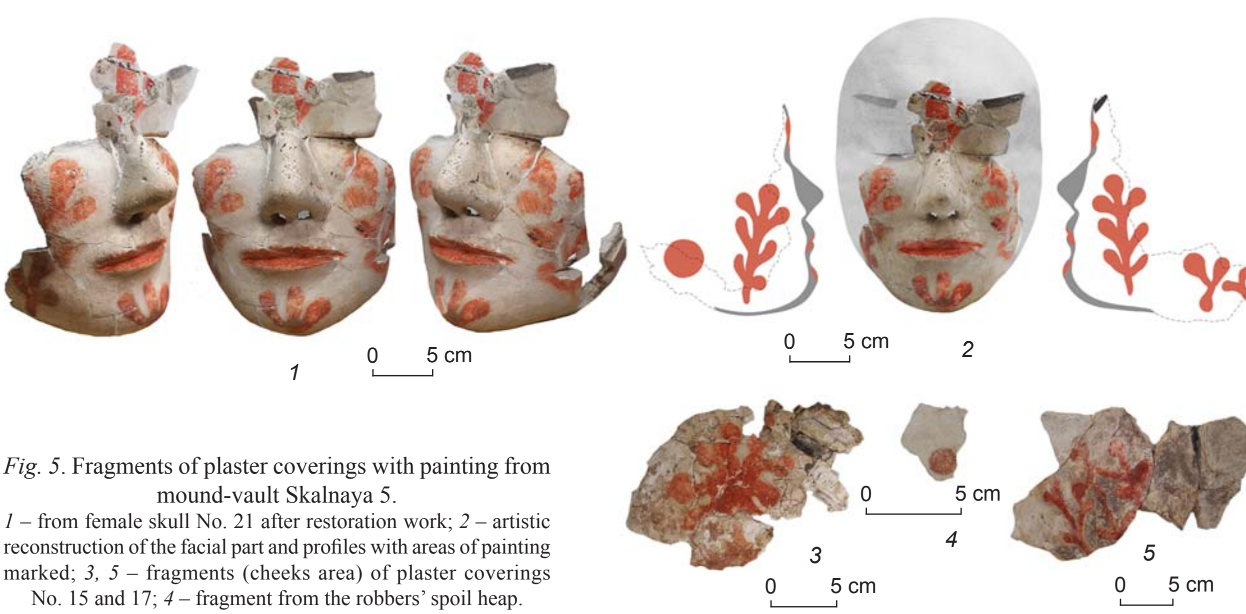

Fig. 5. Fragments of plaster coverings with painting from mound-vault Skalnaya 5.
1 – from female skull No. 21 after restoration work; *2* – artistic reconstruction of the facial part and profiles with areas of painting marked; *3, 5* – fragments (cheeks area) of plaster coverings No. 15 and 17; *4* – fragment from the robbers' spoil heap.

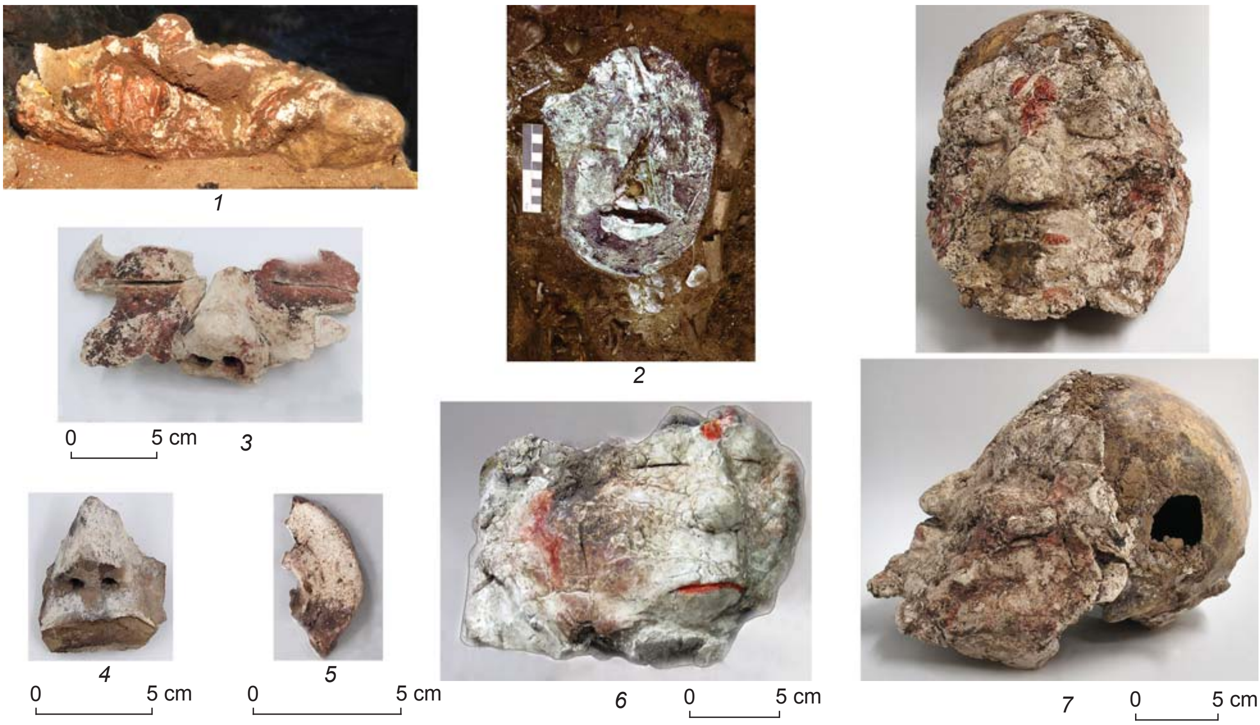

Fig. 6. Clay-plaster coverings from mound-vault Skalnaya 5.
1 – remains of flattened covering from skull No. 11; *2* – remains of burnt plaster covering from skull No. 1; *3–5* – fragments (from the robbers' pit); *6* – fragment of plaster covering from skull No. 12; *7* – trepanned skull (No. 7) with fragments of clay and plaster.

Problems of interpretation of ritual activities and definitions

Analysis of the evidence shows that in the Skalnaya 5 burial mound-vault, remains of people were buried with traces of manipulation to their corpses. The presence of trepanation holes and grass stuffing of the skulls (see Fig. 4, *2*; 6, *7*) suggest the first stage of preparing the deceased for the burial. Following other scholars (K. Goroshchenko, A.M. Talgren, S.V. Kiselev), Vadetskaya believed that "the corpse was temporarily and shallowly buried somewhere for a certain period of time unknown to us (but not less than a year)" (Vadetskaya, Protasov, 2003: 45–46) and "by the time the mask was made, it was already a partially naturally dried skeleton; the clay coating was already made on the bare skull" (Vadetskaya, 2004b: 309). According to M.N. Pshenitsyna and N.Y. Kuzmin, special people carried out all manipulations with the deceased (trepanation of the skull, removal of soft tissues, and coating with clay) immediately after death explicitly for the burial (Pshenitsyna, 1975: 47; Kuzmin, Varlamov, 1988: 148–154; Kuzmin, 2011: 172–179).

Only imprints of skull bones, teeth, and cervical vertebrae, and not a single imprint of skin, hair, gums, or eyes were present on the inner surface of the clay coatings in our evidence. Therefore, it is difficult to say for certain whether the bodies of the deceased were mummified when they were placed into Skalnaya 5. We can only state with certainty that imitations of the deceased were made from skeletal remains of varying degrees of preservation and completeness. In one case, it could have been an almost complete corpse of the deceased (but not a skeleton freed from muscles and tendons); in other cases (in the presence of wooden sticks and layers of a mass of burnt grass along the long bones of legs and arms), only individual bones of the skeleton. Twigs of coniferous trees for attaching the heads, threaded through only the last three or four cervical vertebrae, were a distinctive feature. Judging by the imprints on the clay, the stick was wrapped with a rag secured with a hair rope in its upper part for firm attachment to the skull. According to Vadetskaya, the facts indicate that "the mummies had to sit somewhere, be put on display for viewing, before being placed in the grave" (1986a: 96). Kuzmin believed that "the mannequins in the burial could have been set up vertically, placed in a sitting position (additional support was needed for that) or laid lying on their backs" (2011: 179). However, there may be another explanation, which will be presented below.

To work with the evidence more appropriately, we should first discuss the definitions. It seems not entirely correct to use the terms "mummy", "doll", "doll-mannequin", or "mummy-mannequin" regarding the Tes material evidence. It is more appropriate to speak

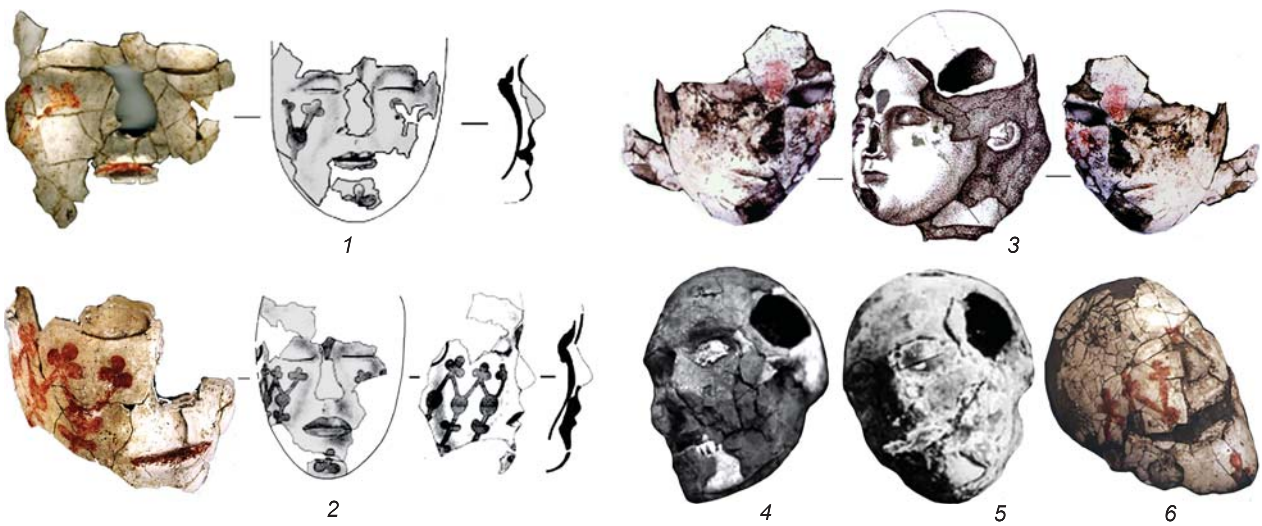

Fig. 7. Photographs and drawings of female "masks" (*1*, *2*), skulls with clay/plaster coverings (*3–6*) (after (Vadetskaya, Protasov, 2003: Fig. 6, 78, 79; Vadetskaya, Gavrilenko, 2006: Fig. 4; Vadetskaya 2009: Fig. 24)).
1–5 – the Noviye Mochagi burial mound; *6* – grave 71B at the Kamenka III burial ground.

about production of an imitation of a deceased person for the funerary rite, giving it individual features. This individuality was clearly reflected in the sculptural image of a human face, which has been called a "mask" in the historical literature since the 19th century (Goroshchenko, 1899) up to the present day (Vadetskaya, 2009). This term is commonly used and is understandable to a wide circle of scholars. However, if this term is to be applied, it should be done with a certain degree of conventionality (using quotation marks). In terms of the semantics and manufacturing technique, clay-plaster sculptural images of human faces do not correspond to either the ethnographic or modern cultural definition of "mask".

The manufacturing technology of clay-plaster coatings from Skalnaya 5

Two critical points should be made immediately. Currently, extremely few complete "masks" that would give a complete idea of the object of study are known to have survived in the Tes mound-vaults (Fig. 7). For example, Vadetskaya noted that "only parts of clay-coated skulls or fragments can usually be extracted from the grave" (Vadetskaya, Protasov, 2003: 36). Unfortunately, this type of finds from burial mounds near the village of Tes, Lake Kyzyl-Kul, the town of Chernogorsk, and burial mounds of Tepsei XVI, Barsuchikha I, and Lisiy near the villages of Sabinka, Noviye Mochagi, Tas-Khyl, and Togr-Tag (Pshenitsyna, 1975: 45; 1979: 83; Vadetskaya, 1986a: 86; 2004b: 308; Pavlov P.G., 1987; Kuzmin, 2011: 52) is supported by rather scant field photographic evidence (in publications), while professional drawings of the "portraits" are absent. The problem is aggravated by "depassportization of evidence", which occurred over time, and destruction of the skulls with "masks" (Kuzmin, 2011: 172).

The second important point is that in our case all conclusions are supported by both field observations and the data of natural sciences, and the opinions of professional restorers*.

The frames for clay-plaster sculptural "portraits" from Skalnaya 5 were trepanned human skulls. They were generously coated (except for the occipital part) with layers of gray (local) clay with a small admixture of lime, which was added, according to E.Y. Mednikova, as a binder and to destroy the remaining organic matter (2003a: 257). The modeling process took place in several stages: in some cases, alternation of layers/pieces can be seen on the fractures. As a result, the trepanation hole, sinuses, empty eye sockets, and oral cavity were tightly sealed with hardened mass. At this point, the lower jaw

*Five "masks" on skulls and fragments of clay coatings (see Fig. 4–6) were restored by fine art restorers from the Grabar Art Conservation Center (Moscow), D.E. Kotov and T.A. Pimenova, and a fine art restorer from the Institute of Archaeology and Ethnography of the SB RAS (Novosibirsk), A.A. Paizerova. Clay, plaster, and pigment samples were studied in the Grabar Art Conservation Center using microscopy, microchemistry, and IR-Fourier microspectroscopy. Such restoration work was conducted in Russia for the first time. It was very sophisticated from a methodological point of view, because due to conditions of constant humidity the plaster coating disintegrated: the clay became "diffused" and the plaster (with the exception of one case, see Fig. 5, *1*, *2*) was porous and crumbling. Moreover, during burning of the vault, the remains of the plaster items became covered with soot, and some of them were completely or partially "burned", losing their durability.

was pressed against the upper jaw and was tied with a rope of hair. Judging by distinctive imprints, the cervical vertebrae were also covered with a thick layer of clay on all sides.

After some time, a mass of plaster with sand and plant additives was applied in two layers to the front of the resulting relatively smooth clay "blank" using a direct modeling method without any intermediate layer of fabric or leather. The stages of production are quite visible, since each new layer was applied to a slightly dried previous layer. During hardening of the plaster mass, accompanied by a slight increase in volume, the chin, lips, and brow ridges were modeled and surfaces (eyelids, nose, and lips) were finished to give volume and expressiveness to the resulting image. The closed eyes were shown with thin cut lines. The nose and possibly ears were molded separately (only one specimen made in a stylized manner was found in the grave's filling; see Fig. 6, *5*). The total thickness of the plaster coating was 3–8 mm (thinner on the forehead). After that, the "finishing" layer without additives was applied to the layers of "coarse" plaster. An interesting isolated fact is very careful production, with smoothening and even polishing (with fabric?), of the female facial covering on skull No. 21 (see Fig. 5, *1*).

Painting was done using a brush on a completely dry coating. In the male version, the entire white surface was painted red. A wide band was drawn along the eyebrows with a black-brown brushstroke, and a thin black band was painted along the eyelids. The temporal sections were possibly marked with dots or lines. In female sculptural portraits, the lips were painted bright red. Decoration with plant motifs of a trefoil shoot on a long stem was painted in red on the cheeks, either individually (see Fig. 5, *1–3*) or in rows in a zigzag pattern (see Fig. 5, *5*). "Leaves" and "bases of sprouts" were represented by circles. The chin was decorated with a similar trefoil. The bridge of the nose was marked with a wide, teardrop-shaped spot. In two cases, individual circles appeared on the cheeks (see Fig. 5, *2*, *4*). The pigments were ocher of different shades (red, orange, red-brown, or brown), cinnabar, and charcoal (black). In almost all cases, layers of cinnabar were discovered on top of the layers of ocher.

Discussion

The evidence from the Skalnaya 5 burial mound confirmed some earlier conclusions of other scholars which were based on data in the area of the natural sciences (Kuznetsov, 1906; Tallgren, 1921; Kulkova, 1975; Pshenitsyna, 1975; Egorkov, 2003; Mednikova E.Y., 2003b; Vadetskaya, Gavrilenko, 2006), and have made it possible to identify the main techniques and technologies for producing clay-plaster coverings at the early stages of the Tes burial tradition. However, the Skalnaya 5 evidence, once again, pinpointed issues and unanswered questions concerning the Tes culture.

1. What caused the abrupt, radical changes in beliefs about the afterlife and the "road" leading to another world among the nomadic pastoralists from the Minusinsk Basin? The carriers of the Tagar culture believed that life after death was similar to reality, where meat as food was needed, and full-size household items determined the status of the deceased. In contrast, the Tes collective tombs contained no remains of funeral food; burial goods and the deceased were represented by imitations. The ritual of re-burial after exhibition (?) became significantly more sophisticated.

2. How did skillful sculptors, who masterfully worked with plaster, appear in the nomadic environment, given a lack of tradition in the use of such a material? This should be viewed against the background of the very primitive everyday life of the Tes people (crude handmade dishes, simplified casting of metal products, very stylized and inexpressively pecked petroglyphic compositions).

3. Why were the Tes clay-plaster sculptural portraits produced? What was the semantics of the colored painting on them? Drawing numerous parallels (making masks and dolls as "receptacles of the soul" and/or substitutes for the dead) from ethnography or the ancient history of peoples of the world (Pshenitsyna, 1975: 48; Kuzmin, 2011: 227–229) is a dead end, given specific aspects of the production of the items under discussion.

Herein, we will suggest several ideas with relation to these issues. Most scholars recognize the discrepancy between the "mask" and the real prototype, as well as individuality in conveying portrait features of a man's or woman's face. Yet, the manner of rendering individual features and degree of stylization certainly reflect the skill level of individual sculptors. Given that the clay-plaster coverings were made on a bare skull, the artisan had to hold a certain image in his mind in order to embody it. Moreover, this image was closer to reality than to mythology and abstraction. The person's face was shown as being calm, peaceful, with closed eyes (see Fig. 4–7). In this sense, Kuzmin was absolutely right when he wrote that "the technique of applying layers of clay-plaster with subsequent mechanical modeling is comparable to the method of restoring soft tissues of the skull in reconstructions using the method of M.M. Gerasimov" (2011: 236). Thus, in each specific case, we are dealing with the creative process and cultural phenomenon of the Tes period. We do not know the foreground: whether there were some ethnic and social motives, aesthetic function (aestheticization of death when the dead became attractive in appearance), or "religious and magical" beliefs. The first assumption is supported by the accentuated display of the Caucasoid or Mongoloid features, while the recreated appearance in clay-plaster could have been absolutely opposed to the real face (see (Vadetskaya, 2009: 119) to learn more about this). Further, note that persons both with and without "masks" were buried in almost all studied Tes tombs. This makes it possible to speak about some special group of people in the Tes society, whose representatives were considered important to be buried together, although they died at different times and in different places. The second assumption is supported by the red pigment cover of the lips and black eyelids of female "masks", complete painting of male "masks" with a blood color, and insertion of bluish beads imitating pupils into the eye sockets (about insertions, see (Kuzmin, 2011: 176)).

However, the artisans from the Minusinsk Basin and generally from Southern Siberia of the Scytho-Sarmatian period practiced only artistic casting and masterful woodcarving. Unlike these techniques, clay-plaster modeling is the process of building up a sculptural portrait, which is created gradually from within. Speaking about the first centuries of our era, the artisans who worked with plastic materials lived to the east, south, and west of the region under discussion. S.V. Kiselev was the first to suggest turning to Roman portrait sculpture (busts) and the "ritual of masks" associated with the funerary rite and the cult of ancestors (1949: 252). He found particularly important the surviving written evidence "about plaster and wax portrait masks that covered the face of the deceased person or his burial mannequin in *collocatio* during burial or burning at the stake" (Ibid.). However, noteworthy are more obvious parallels in the evidence of Hellenized Egypt of the Roman Age—sculptural painted plaster portraits made for the funerary rite (Fig. 8). These were individualized, but significantly different from the original faces of the deceased. The famous scholar of Egyptian portrait art V.V. Pavlov believed that from the late 1st to early 2nd century, the mask lying horizontally on the same level with the mummy began to be raised up until it finally took a vertical position, turning into a separate head or portrait bust (1967: 20). If we take this into account, we can imagine why massive clay coating of the neck, as well as the rod inserted through the cervical vertebrae, were needed for those buried in the Tes vault, and how the head with clay-plaster coating was located relative to the "body" (Fig. 8, *5*). Another very interesting feature was the color division of male and female Egyptian plaster portraits (Muravieva, 2008: 17). The former were completely painted red (Fig. 8, *2*), while the latter had the natural white-yellow color of the plaster (Pavlov V.V., 1967: Fig. 13). On Egyptian masks, the eyes were abundantly blue, which was "a symbol of luxury, wealth, and nobility". Likewise, in the Tes "masks" (Noviye Mochagi), the inserts in the eyes were also made of bluish glass. According to the British archaeologist F. Petrie, at the time of Roman Egypt, mummies were not buried immediately after mummification, but were kept for quite a long time, perhaps two or three generations, in the atriums of houses (Ibid.: 21). Thus, we may see a certain conceptual similarity with the Egyptian evidence of the Roman Age. It is not known for certain how such burial practices with the production of plaster portrait images of faces could have reached the Khakass-Minusinsk steppe.

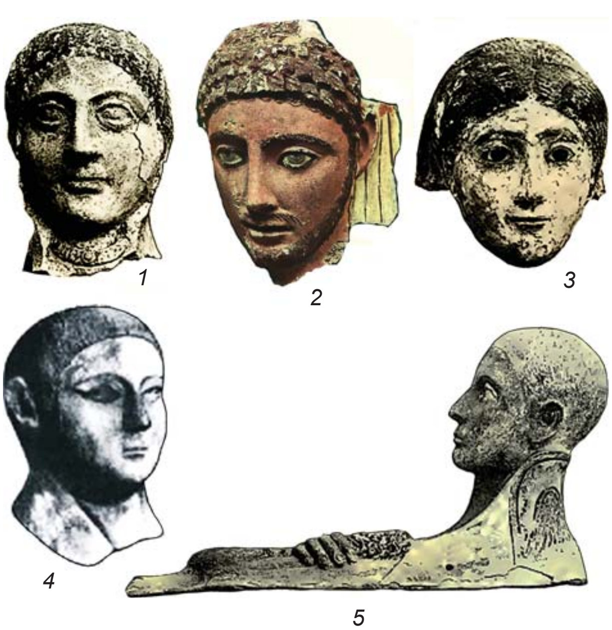

Fig. 8. Egyptian funerary sculptural (plaster) portraits of the Roman Age (after (Muravieva, 2007: Ill. 4, 5; Edgar, 1905: Pl. XXX)).

A separate and absolutely unresolved problem for scholars is the mysterious painting on the female Tes "masks". This painting is fundamentally different from the Tashtyk spiral geometric ornamentation. At present, the "pattern" of trefoils and dots has been found on female plaster coverings from the mound-vaults of Skalnaya 5 (see Fig. 5; 6, *6*, *7*) and Noviye Mochagi (see Fig. 7, *1–3*) (Vadetskaya, Gavrilenko, 2006: 64, fig. 4, 11; Mednikova M.B., 2001: 219) and the Tagar-Tashtyk flat-grave burial ground of Kamenka III (see Fig. 7, *6*) (Pshenitsyna, 1975: 46, fig. 2). Importantly, the distance between the first two sites does not exceed 100 km. N.Y. Kuzmin may be right that the evidence from Noviye Mochagi and Kamenka confirms the contemporaneity of the sites, while "the existence of similar types of coloring makes it possible to raise the question of the ethnic relationship of a group of women" (2011: 183). Most scholars believe that the plant motifs that we see is not of local origin, and represents a tattoo on the face of the deceased (see, e.g., (Kiselev, 1951: 449; Kyzlasov, 1960: 148)). Yet even if the trefoil is a stylized image of the lotus (Kuzmin, 2011: 182), we do not find even remote parallels to it either in the Tagar-Tashtyk materials or in the adjacent territories. Regarding the similarity of cultural stereotypes, one may agree with some points in the concept of Kuzmin "on the Okunev code in the semantics of the Tes-Tashtyk coloring" (Ibid.: 181–187). Indeed, the image of the "third eye" as a teardrop-shaped spot, emphasis on the chin, and eyebrow line on the Tes "portraits" are reminiscent of the decoration of "faces" on the Okunev sculptures. It is especially important that the comparison concerns sculptural works. However, in the Bronze Age, it was pecked on stone, while in the Tes period, it was molded from clay/plaster. Yet, in both cases, we are dealing with attributes of material and spiritual culture, acting, figuratively speaking, as intermediaries between living people and the other world (the world of the spirits). Marking the "third eye" in the center of the forehead, the "sign of the ajna chakra" (Machinsky, 1997: 273), clearly gave the deceased person the ability to reach the world of the dead.

Conclusions

1. Human imitations (apparently, clothed) were made for the secondary burial in mound-vault Skalnaya 5 using bone remains of varying degrees of decomposition and/or skeletal bones of different completeness. Most likely, the "body" was laid horizontally, and the skull with the clay-plaster coating was set up vertically with the front towards the legs.

2. A clay-plaster coating was applied to the cervical vertebrae and bare trepanned skull; fabric (leather) overlays were not used. A single type of local clay with addition of a natural preservative (lime) was used. Sculptural portraits were created only from plaster (two main layers and one finishing layer) and were of two types: male portraits were completely red, and female portraits were white with red plant motifs. Pigments included ocher of various shades, cinnabar, and charcoal. No traces of ancient restoration of coatings or renewal of old painting have been observed on the samples studied from Skalnaya 5.

3. Clay-plaster sculptural portraits from mound-vault Skalnaya 5 were created by different artisans, but with a common desire to convey a unique, specific image with ethnic components in each case. It is not clear why female portraits had more sophisticated coloring (plant motifs) than the male portraits. All known Tes "masks" have a conceptual similarity with the Egyptian evidence of the Roman Age—painted plaster portrait sculptures made for the funerary rite.

4. Great similarity in the coloring of clay-plaster coatings was found among the evidence from the burial mounds of Skalnaya 5, Noviye Mochagi, and burials 71B and 92 at the Kamenka III flat-grave burial ground. Apparently, this similarity resulted either from contemporaneity of the complexes within the 1st–3rd centuries, or from kin relationships.

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The First Results of Remote Sensing Studies of Mounds with "Mustaches" in Northern Kulunda, Southwestern Siberia

In 2019, a group of previously unknown mounds with "mustaches" was discovered in the north of the Kulunda steppe. They are quite unusual: all of the mounds are ground and located on floodplains. In 2023, a set of remote sensing methods (aerial photography, electromagnetic profiling, and electrical resistivity tomography) was used at Karasuk-1 and Troitskoye-1 to assess the design of the mounds and see if additional features were present on their periphery. For this type of structure, geophysical methods were employed for the first time. Maps based on aerial photography data have made it possible to record the relief features of objects in high detail. Troitskoye-1 consists of five rather than four mounds. Using the electrical tomography method, the composition of the mound platforms was shown to be homogeneous. On geoelectric sections, they correspond to conductive areas ca 0.5 m thick. At both sites, the central mounds do not have "walls" on the eastern side. Apparently, no removal of soil was carried out on that side, in order to provide access to the ritual areas from the space enclosed by the "mustaches". According to the results of aerial photography, at Karasuk-1 cup-shaped depressions were discovered on the surface of the western ends of the "mustaches". They can be tentatively associated with the design of the mounds. The northern "mustache" is markedly broken. No additional features were identified inside or near the mounds. The results suggest that both complexes were built at the same time and are autonomous.

Keywords: *Mounds with "mustaches", Northern Kulunda, archaeological and geophysical research, aerial photography, electromagnetic profiling, electrical resistivity tomography.*

Introduction

Mounds with "mustaches" are large complexes of ancient structures common on the Eurasian steppes. Currently, over six hundred such complexes have been discovered on the steppe belt from the Southern Trans-Urals to the Irtysh River. The number of mounds with "mustaches" and the size of their distribution area indicate that these sites reflect a powerful constant in the ritual practices of nomads over the centuries.

In general terms, mounds with "mustaches" constitute a complex of one or more stone mounds ("kurgans"), from which two arched stone (less often earthen) ridges ("mustaches") extend mainly in the eastern direction (Grudochko, 2020: 47; Beisenov, 2017: 32). The length of these ridges varies greatly (from 10 to 280 m) and may differ even within a single site. The ends of the "mustaches" were shaped in a special way: with mounds, stone circles, etc. The amounts of central mounds and variants in their relative positions have been provided in several typologies by Soviet, Kazakh, and Russian scholars (Margulan et al., 1966: 309; Beisenov, 2017: 32, 33; Lyubchansky, 2006: 386–390; Botalov et al., 2006: 91; Grudochko, 2020: 47, 48).

The sites have been divided into several large territorial groups (Grudochko, 2020: 38, 46; Beisenov, 1996; Botalov, Tairov, Lyubchansky, 2006: 10). In 2019–2023 a new group of such structures was discovered in the north of the Kulunda steppe in the valleys of the Karasuk, Baganenok, and Bagan rivers (Grishin, Marchenko, 2022). This group is very isolated, since the distance to the nearest known mounds with "mustaches" in Northern Kazakhstan is over 300 km. Twenty sites have been currently discovered. Exploration surveys continue to investigate them and search for new sites (Marchenko, Grishin, 2023).

The Northern Kulunda group of mounds with "mustaches" is very distinctive: the overwhelming majority of the structures are located on floodplains. Therefore, they are not classified as kurgan burial grounds, in that they are associated with elevated landforms. Another specific feature of the Northern Kulunda group is the exclusively ground nature of the structures. Previously, similar complexes were known only in the Southern Trans-Urals; but there, only the "mustaches" were made of soil, while the central mounds were made of stone (Grudochko, 2020: 77, 78).

Fig. 1. Location of the Karasuk-1 and Troitskoye-1 sites.

Currently, the Northern Kulunda group of mounds with "mustaches" is the easternmost in the area of distribution of such sites, and clearly deserves detailed study. Unfortunately, this is difficult; owing to the significant size of most mounds with "mustaches" their full-scale archaeological examination is very expensive. Therefore, it is important to assess the prospects for studying these sites using geophysical methods. To the best of our knowledge, such work has not been done as of yet. Thus, this study was aimed to test a set of remote sensing methods for establishing the structural features of mounds with "mustaches" and detecting associated sites on their periphery. The set of methods included aerial photography, electromagnetic profiling, and electrical resistivity tomography. The Karasuk-1 and Troitskoye-1 sites, located in the Karasuksky District of the Novosibirsk Region (Fig. 1), were chosen as objects for the research.

Description of the objects for research

The Karasuk-1 site is located on the left bank of the Karasuk River, 3.4 km southeast of the city of Karasuk. It consists of a rounded flat mound (17 m in diameter and 0.3 m high), from which two arched ridges extend to the east. Their length along the crest is 108–114 m; their height reaches 0.2 m, and their width in different sections ranges from 4 to 9 m. The ends of both ridges pass smoothly on to rounded platforms with a diameter of 7–12 m and height of 0.14–0.30 m. All of the mounds have flat surfaces and are loosely covered with sod. Amorphous hollows—places of soil extraction—were found near the central structure and along the perimeter of the ridges. As a whole, the complex is almost symmetrical along the longitudinal axis. Its total length is 117 m with a maximum width of 102 m.

The Troitskoye-1 site is located on the right bank of the Karasuk River, 1 km north of the village of Troitskoye (Marchenko, Grishin, 2023: Fig. 1). The complex consists of a chain of four rounded mounds oriented along the SW–NE axis. Their diameter is 10–13 m and height is 0.24–0.28 m. Two curved ridges 4.5–7.0 m wide and up to 0.15 m high extend from the outermost mounds. Their ends have rounded and teardrop-shaped structures with a diameter of 6.5–7.0 m and height reaching 0.15 m. All mounds of the complex have flattened surfaces and are loosely covered with sod. Hollows of uneven depth (places of soil extraction) are observed around them.

The entire structure is oriented with the longitudinal axis along the WNW–ESE line. The total length is 137 m with a width of 129 m.

Study methods

Aerial photography. Advances in fixed-wing and multirotor aircrafts, as well as reduced sizes of cameras and other additional equipment, ensure high effectiveness and widespread use of aerial photography in archaeological surveys. Detailed orthophotoplans, digital elevation models, and multispectral survey data provide valuable information about archaeological sites. They are used to interpret the results of comprehensive remote sensing studies and to plan geophysical works (Zhurbin et al., 2022). Aerial photographs were taken using a small-sized DJI Mavic Air quadcopter (Balkov et al., 2020). The data were processed using Metashape and Surfer software.

Electromagnetic profiling. This is an effective, non-contact method for quick assessment of specific electrical resistivity of the upper part of a section (Balkov et al., 2023; Batanina, Kupriyanova, Muraviev, 2023). Measurements were taken using Geoviser equipment (Karin et al., 2018) at a frequency of 100 kHz, with data referencing to GNSS receivers with centimeter-level accuracy. The entire area of the sites was profiled using a device towed behind a tracked carrier (Balkov et al., 2023). The distance between the survey pegs was 0.5–1.0 m, and between profiles the distance was 2–3 m. To increase the level of detail, surveys on foot were carried out in some sections, with a distance of 0.3–0.5 m between the survey pegs and no more than 1 m between profiles.

Electrical resistivity tomography. This method has proven to be very successful and has been widely used for detailed study of the geoelectric structure of archaeological sites. It is more resource-intensive than electromagnetic profiling, but has a better capacity for 2D and 3D interpretation (Modin et al., 2023). In this study, the method of electrical resistivity tomography was used both in the form of profile survey and in the pseudo-3D electrical tomography version. Measurements were taken using a Schlumberger unit along a series of parallel profiles. The distance between profiles was 1 and 2 m, with distance within the profile of 0.5 m. Skala-32k4 equipment with thirty-two electrodes and four-channels was employed (Balkov et al., 2023). Data inversion was carried out using Res2DInv and Res3DInv software.

Study results

Karasuk-1. A map of relative heights (Fig. 2, *a*), which displays local depressions and elevations without taking into account the regional relief, was constructed after processing the data of aerial photography (Balkov et al., 2020). The relief features of the site were clearly visible, including the central mound and two symmetrical "mustaches" with rounded extensions at the ends. Hollows ("ditches") for soil extraction were found along the ridges and near the mound. On the surface, the transition from the ridge to the hollows was manifested by a sharp change in vegetation, which is well reflected on the orthophotoplan (Fig. 2, *c*). A noteworthy feature is the bowl-shaped surface on the western ends of the "mustaches". It was most clearly seen on the southern ridge through which profile 1 of electrical resistivity tomography was laid (Fig. 2, *a*). As can be seen in the graph of the digital relief along this profile (Fig. 2, *b*) where the height of the mound is 0.25 m or less, the depth of the depression in its center reached 0.15 m. The eastern ends of the ridges had flattened surfaces, which is clearly demonstrated in the graph of the digital relief along profile 2 (Fig. 2, *a*, *b*).

Upon detailed examination of the central mound, it was discovered to have an asymmetrical C-shaped form with a central depression. It did not have a "wall" on the eastern side. Its size was about 12 × 15 m, the depth was about 0.5 m. The arc at the beginning of the northern "mustache" was uneven, which is most clearly seen from the data of electromagnetic profiling (Fig. 2, *d*). In addition, there was a large cross-shaped area (ca 50 × × 50 m) in the center of the structure, showing altered vegetation (Fig. 2, *c*) and increased resistivity (Fig. 2, *d*), but not visible in the relief (Fig. 2, *a*).

Soils at the site had low resistivity (up to 10 Ohm·m). Relative to the reference environment, the mound areas showed reduced values (1–2 Ohm·m), while the hollow zones surrounding them showed increased values (5–50 Ohm·m). According to the profile of electrical resistivity tomography laid through the central mound, the thickness of the zone of reduced resistivity was ca 0.5 m.

Based on the geoelectric section passing through the western end of the southern "mustache" (Fig. 2, *a*; 3, *c*), the initial depth of the hollows was 0.5–0.6 m from the daylight surface. The conductive area corresponding to the mound at that end extended to a depth of about 1 m and was fairly uniform. A detailed study was carried out at the eastern end of the southern "mustache" along a number of parallel profiles using electrical resistivity tomography (see Fig. 2, *a*). According to its results, especially in the horizontal section, at a depth of 0.1 m, the end of the southern "mustache" was a conductive area without significant local inclusions. The zones corresponding to the "ditches" had a higher electrical resistivity (see Fig. 3, *a*, *b*).

Troitskoye-1. The map of relative heights (Fig. 4, *a*) clearly shows that this complex, unlike the previous one, was not symmetrical relative to the central axis. Places

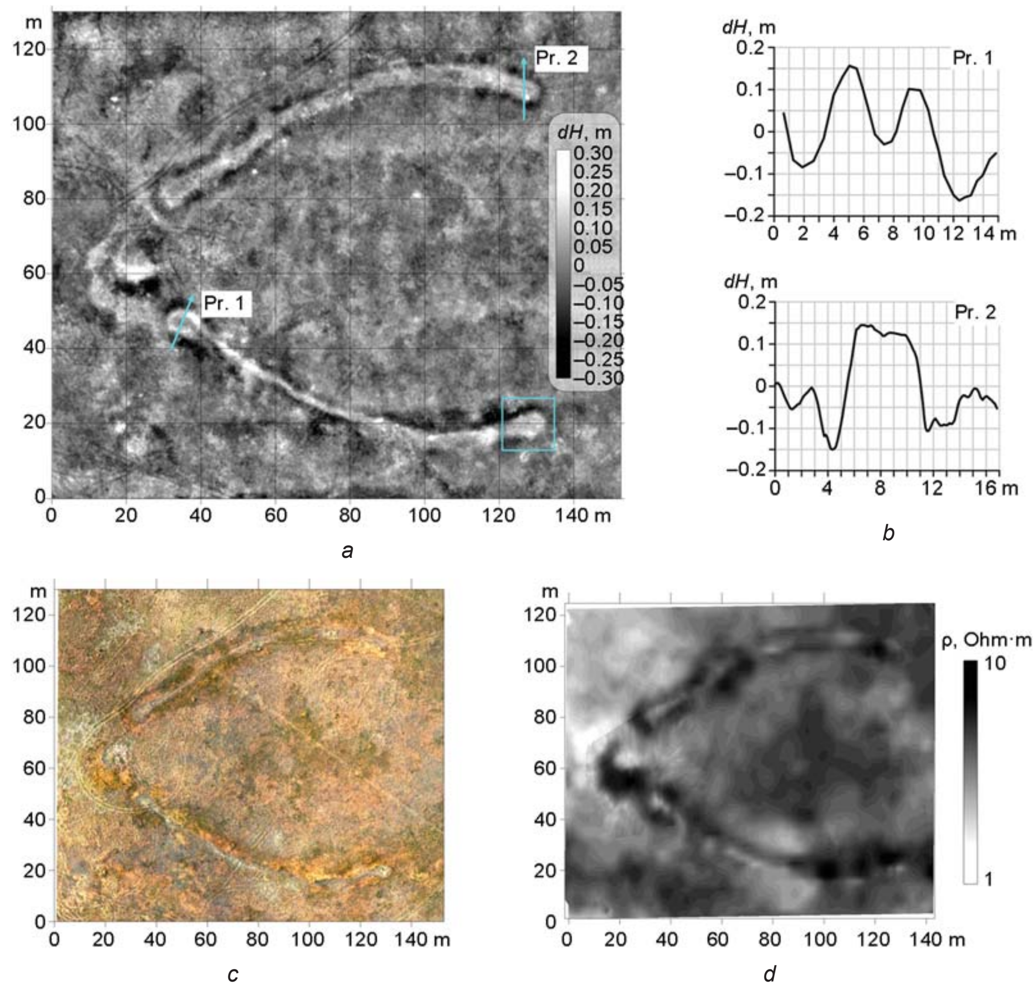

Fig. 2. Results of geophysical studies at Karasuk-1.
a – map of relative heights; *b* – profiles constructed from the data of the altitude map; *c* – orthophotomap; *d* – map of the apparent resistivity distribution created using measurements by *Geoviser* equipment.

of soil extraction, which emphasize and additionally highlight the raised sections of the structure, were clearly seen. As with Karasuk-1, the change in relief was accompanied by marked changes in vegetation (Fig. 4, *a*, *c*).

The research revealed that five rounded mounds constituted the basis of the Troitskoye-1 complex. One of them (the northernmost), measuring about 10 × 12 m and 0.15 m high, was the least expressed in relief, and was not initially identified at the time when the site was discovered. Its presence was confirmed by the profile of relative heights laid through all the central mounds (Fig. 4, *b*), as well as by the orthophotoplan and data of electromagnetic profiling (Fig. 4, *c*, *d*). In addition, the following feature was clearly seen in all the mounds of this complex: their relief manifestations on the interior (eastern) side were minimal or absent. The depression on the surface of the western end of the southern "mustache", observed during archaeological survey, was not visible on the created maps.

On the southernmost mound in the chain of central mounds at Troitskoye-1 (Fig. 4, *a*), measurements were taken along a number of parallel profiles using electrical resistivity tomography, which made it possible to construct a three-dimensional geoelectric model. The contour of the area of reduced electrical resistivity values (1–2 Ohm·m), corresponding to the mound, was visible on the section at a depth of 0.27 m (Fig. 5, *a*). According to the geoelectric section along profile 1 (Fig. 5, *b*), its thickness did not exceed 0.5 m. As with Karasuk-1, no local non-uniformities were found in the structure of the mound.

Discussion

The studies have shown that both sites were very similar and were obviously constructed following a common standard. In both cases, the central mounds were flattened platforms of rounded shape, with a diameter of 10–13 m

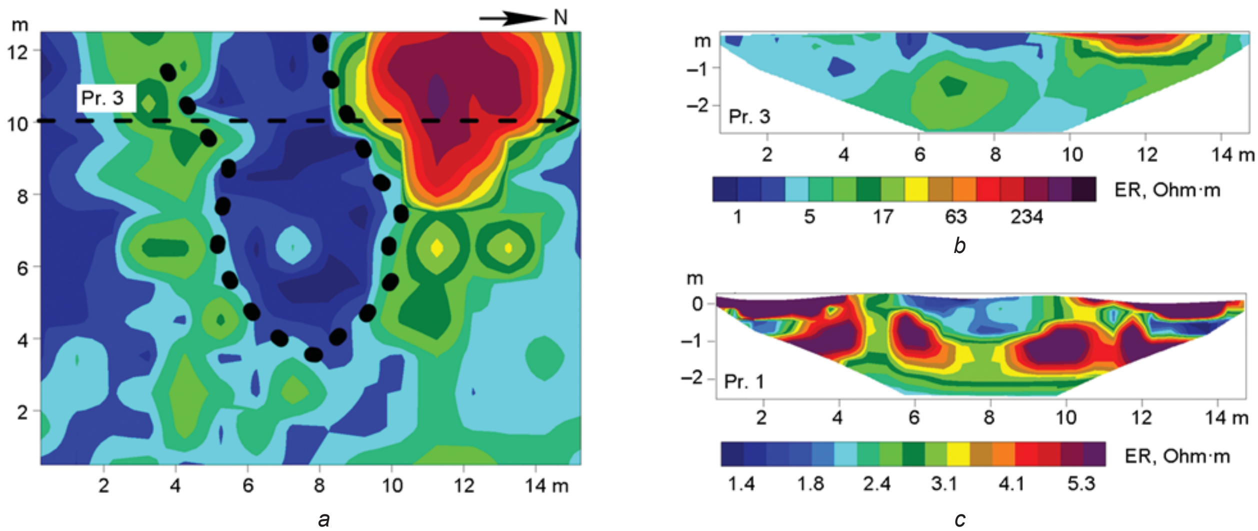

Fig. 3. Results of electrical resistivity tomography of the ends of the southern "mustache" at Karasuk-1.
a – resistivity map at a depth of 0.1 m (eastern end); *b*, *c* – geoelectric sections of the eastern and western ends, respectively.

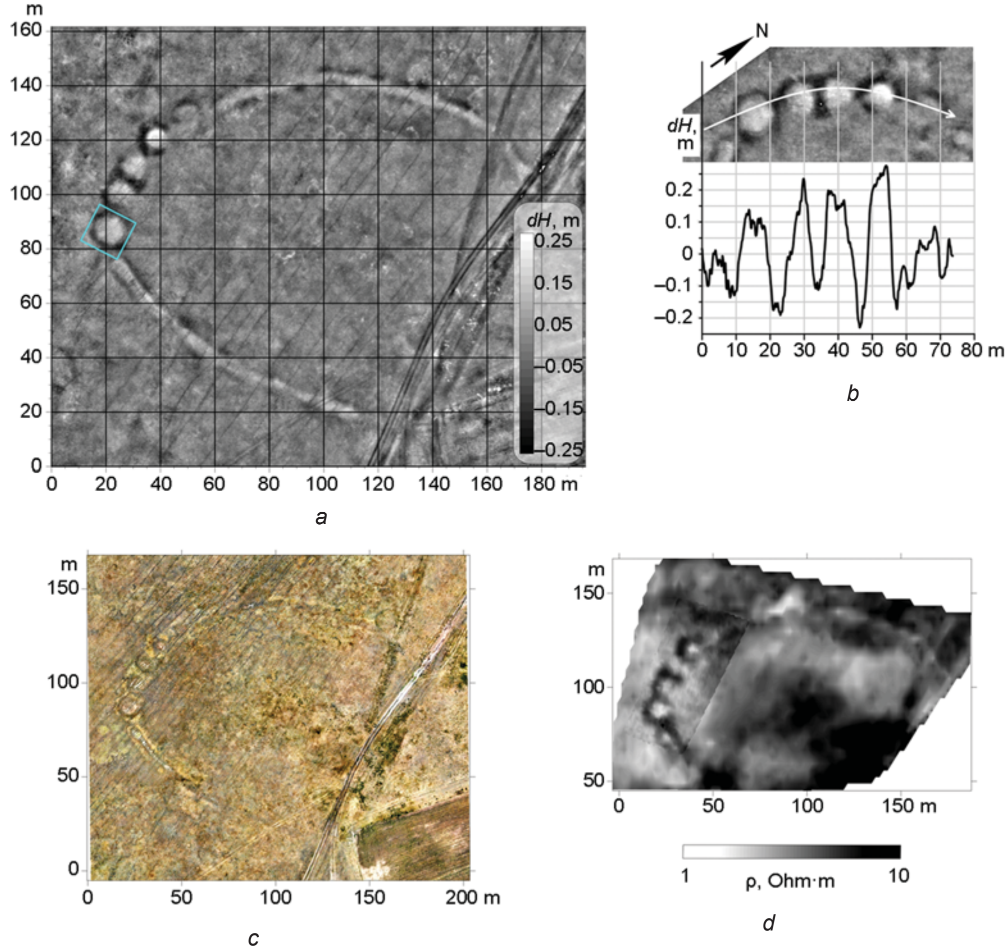

Fig. 4. Results of geophysical studies at Troitskoye-1.
a – map of relative heights; *b* – altitude profile through the central mounds; *c* – orthophotomap; *d* – map of apparent resistivity.

(Troitskoye-1) and 17 m (Karasuk-1). According to the data of terrain survey by electromagnetic profiling and electrical resistivity tomography, the mounds stood out against the surrounding environment and were distinguished by reduced values of electrical resistivity (1–2 Ohm·m) (Fig. 5, *a*). Analysis of the geoelectric sections did not reveal any non-uniformities in their internal structure (Fig. 5, *b*). No conductivity anomalies, which could be correlated with pits or calcinations, were detected.

An interesting feature of the central mounds of both sites, which was revealed by aerial photography and electromagnetic profiling, was the absence of the eastern "wall" (see Fig. 2, 4). Apparently, soil for constructing the mounds was not extracted on the eastern side, in order to provide access to the mounds. Extensive (ca 1500 m^2) zones with increased electric resistivity, which also differed in vegetation, were present at both complexes. They were confined to the center of the area limited by the "mustaches", which can be seen especially clearly at Karasuk-1. These areas could have been associated with some ritual activities, and similar zones may be identified at other complexes in the course of further studies.

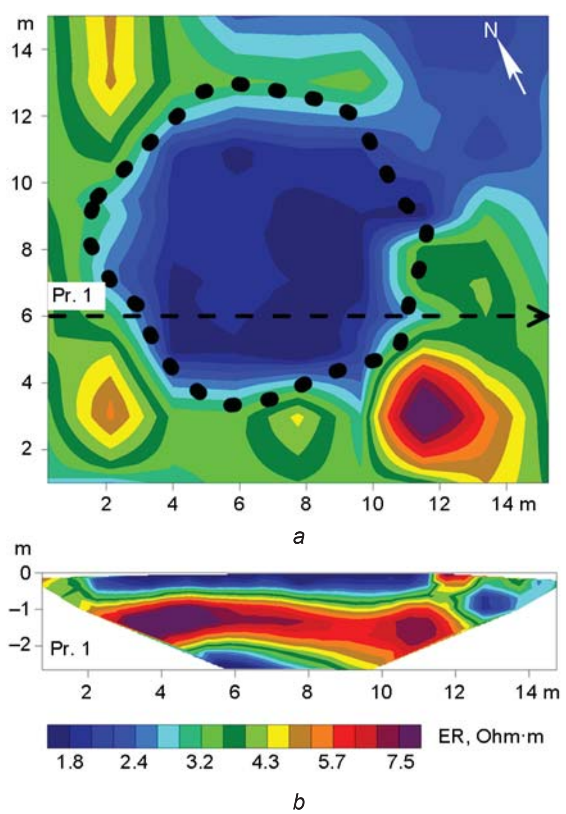

Fig. 5. Results of electrical resistivity tomography at Troitskoye-1.
a – resistivity map at a depth of 0.27 m; *b* – geoelectric section along profile 1.

The ends of the "mustaches" were studied only at Karasuk-1. Judging by the electrical resistivity tomography data, their geoelectric features were similar to those established for the central mounds (see Fig. 3, 5). According to aerial photography, in the center of the western ends of both halves of the "mustaches", there were cup-shaped depressions, which had not been previously (visually) identified. Similar depressions have been discovered at other sites of the Northern Kulunda group of mounds with "mustaches". For example, depressions in the center of the ends of the "mustaches" were found at the Melkoye-13 site and on one of the two central mounds at the Gramotino-1 complex (Grishin, Marchenko, 2022: 482, 483). Based on the elevation data, a similar depression may also be near the central mound of Karasuk-1 (see Fig. 2, *a*). In the main area of distribution of mounds "with mustaches", depressions in the centers of the mounds have been identified many times, for example, at the complexes of Sultantemirovsky I and Sarbulat-1 (Grudochko, 2020: 62, 67). These have been attributed mainly to the consequences of robbery or structural features of the complexes.

The "mustaches" on the created maps were clearly visible according to all types of data. Electrical resistivity tomography and electromagnetic profiling revealed that the "mustaches" had the same geoelectric features as other mounds (see Fig. 2, *a*; 3, *a*). Since there is still insufficient data, it is difficult to say whether the ridges were formed on the ancient surface as was the case at the majority of the sites, or were made in a shallow pit, as, for example, at Solonchanka I (Ibid.: 78).

The "ditches", remaining after soil extraction, were also well recorded by aerial photography (modified vegetation), electromagnetic profiling, and electrical resistivity tomography (areas of high resistivity). The maps showed that the "ditches" additionally emphasized and accentuated the raised parts of the structures (see Fig. 2, 4). Similar finds were previously discovered at the sites in the Southern Trans-Urals where the "mustaches" were made of soil (Solonchanka I, Krutaya Gora, Rymniksky) (Ibid.: Fig. 46, *1*; 100). Interesting observations were made during the excavations at the Solonchanka I complex, where the "ditches" did not reach the sterile soil. This suggested that the ridges were sod structures (Ibid.: 78). As far as the Northern Kulunda group of mounds with "mustaches" is concerned, there are no sufficient data for such conclusions, and this issue requires further archaeological and geophysical studies.

Remote sensing methods have made it possible to detect the brokenness of the northern "mustache" at Karasuk-1, most clearly manifested on the electromagnetic profiling map (see Fig. 2, *d*). In the main distribution area of mounds with "mustaches" such cases are not uncommon, and brokenness of the arc is often typical of the northern "mustache". The examples include the Sukhodol, Novokondurovsky I, Novoaktyubinsky, Medes, and Sarbulat-1 sites (Ibid.: 72–74; fig. 45, *1*; 48, *1*; 52, *1*; 53, *1*; 89, *1*). According to I.V. Grudochko, the curvature of the ridges may reflect some specific aspects of the "engineering" works. After constructing one ridge, the builders had to give the other one a symmetrical shape. However, this was not always possible, and the direction of the second half of the "mustache" had to be corrected. Thus, the place of the sharp turn can be considered the final stage in the ridge formation (Ibid.: 79).

The studies did not reveal any additional objects inside the structures or near them. Further use of other geophysical methods (magnetic surveying, ground penetrating radar) may provide additional information.

Conclusions

Geophysical research of mounds with "mustaches"—specific ritual complexes of ancient nomads—was carried out for the first time. The objects of study (Karasuk-1 and Troitskoye-1) are part of a compact group of sites recently discovered in the Ob-Irtysh interfluve. Since no dating evidence has been found for these sites so far, they may be attributed to a wide chronological range proposed for mounds with "mustaches" by different scholars (mid-1st millennium BC to 1st millennium AD).

The set of remote methods, including aerial photography, electromagnetic profiling, and electrical resistivity tomography, demonstrated a high level of effectiveness and efficiency. Orthophotoplans and maps of relative heights, created from the data of aerial photography, enabled recording the current state of archaeological structures in high detail. Electromagnetic profiling in a mechanized version have made it possible to completely map the territory of the sites with areas ranging from 8000 (Karasuk-1) to 13,000 m^2 (Troitskoye-1) in one working day. The data obtained fostered the prompt identification of sites for detailed studies using the electrical resistivity tomography method and the evaluation of the internal geoelectric properties of archaeological objects. Given the large scale of mounds with "mustaches", the results of this work indicate that further study of such sites using various geophysical methods is undoubtedly promising.

The comprehensive studies have given a large amount of diverse information that requires evaluation in the context of further archaeological works: the structure of the mounds, differences in the structural features of the ends of the "mustaches", sequence of construction of the ridges, absence of traces of soil extraction from the eastern side of the central mounds, as well as traces of burials or pits under them. Notably, no accompanying archaeological items were found on the periphery of the sites nor inside the space limited by the "mustaches". This finding is essential for establishing the functions of these complexes. The results suggest that these were ritual structures built simultaneously and autonomously. Apparently, the sacrificial actions, as in most cases, were performed on the ground. The significant degree of similarity of the studied mounds with "mustaches", established by the research, undoubtedly indicates the presence of common canons associated with the construction of sites of this type among the population that left them.

Acknowledgments

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An Old Mongolian Inscription near the Second (Small) Sulfate Lake in Northern Khakassia as Evidence of Cultural Contacts in the Region in the Middle Ages and Early Modern Age

We describe a rare Old Mongolian inscription carved on an outcrop of Devonian sandstone near the Second (Small) Sulfate Lake in northern Khakassia. Tentative translation, dating, and cultural attribution are provided. The condition of the inscription and adjacent representations of humans, animals, and tamgas are described. Three groups of signs of which the Old Mongolian inscription consists are identified. Variants of translation to modern Mongolian and Russian are proposed. One group of signs renders the text: "In the Year of the Snake, the second winter month, the 21st day…" Other graphemes, translated from Mongolian, mean: master, elapsed, horseman, give, herd, steppe (talo). Certain words are indistinct and illegible. The lower and upper chronological limits of the inscription are 1204 to early 1720s. Horsemen figures are carved in the same technique. Old Buryat parallels suggest a rather recent date. Pre-Mongolian tamgas are pecked rather than carved. The script belongs to the latest instances of Old Mongolian epigraphy in the region.

Keywords: *Northern Khakassia, Second (Small) Sulfate Lake, rock outcrop, petroglyphs, old Mongolian inscription, reading, dating.*

Introduction

The written history of Southern Siberia in the Early and High Middle Ages is represented by numerous runic texts on rocks, burial mound slabs, steles, etc., and that of the Late Middle Ages–Early Modern Age by a very small number of epigraphic records on rock, in the Mongolian script. In the south of the Middle Yenisei, despite the recurrent inclusion of this region into various Mongolian states—those of Genghis Khan, Altyn Khan, Esen Khan, Dzungaria, and the Buryat princes—only few sites are known: the fragmentarily preserved Abakan Mongolian petroglyphs (written in black paint), dated by N.I. Popov to the 16th–17th centuries, as well as lines in Mongolian script at the Shalabolino (in red paint) and Tes (in black paint) rock art sites (Popov, 1874). Information on these inscriptions, provided by Popov, was cited by E.R. Rygdylon (1951). The inscriptions of the Shalabolino

Fig. 1. General view of location of the inscription and images at the break in the rock outcrop at the Second (Small) Sulfate Lake.
a – lower frieze; *b* – upper frieze.

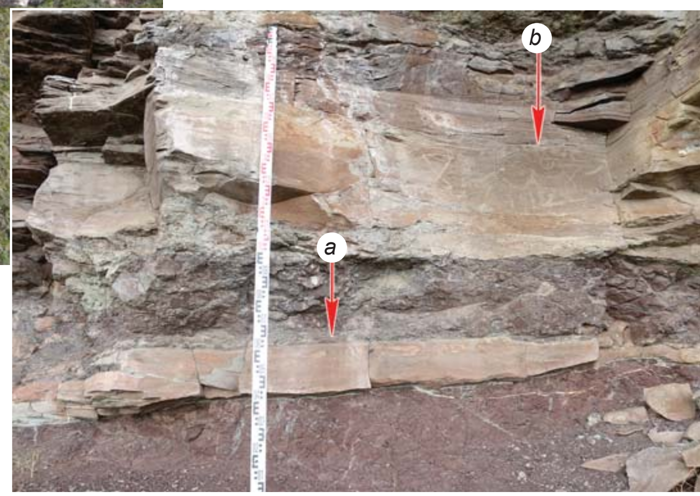

Fig. 2. Location of the images and inscription.
a – lower frieze; *b* – upper frieze.

rock art site have already been examined by D.D. Vasiliev. Interestingly, this site contains several Chinese characters, in addition to the Mongolian text.

Generally, Mongolian inscriptions occur very rarely on rock surfaces in Southern Siberia and Mongolia, and those made by pecking or stone-carving technique have been unknown until now. This fact hampers the analysis of intercultural contacts during the emergence and development of societies in Southern Siberia in the Middle Ages and the Modern Age. Therefore, every newly discovered site of that kind is important. This article provides information about a site with a presumably Old Mongolian inscription carved on a rock outcrop in northern Khakassia. This study intends to describe the spatial context of the inscription, evaluate its condition, read it, give a historical and cultural interpretation, provide details on the accompanying images of people and animals, and establish the chronology of written and imagery records at that rare monument of regional history.

Spatial context of the inscription

The authors of this article examined the surface of a massive outcrop of Devonian sandstone of typical reddish color, located on the steep eastern slope (or rather, on a precipice) of the mountain range, stretching to the north, from the southern end of Mount Sulek to northern shore of Lake Uchum, near the Second (Small) Sulfate Lake. At the suggestion of N.V. Leontiev, they also examined a rock inscription (a text presumably made in the Old Mongolian script) and petroglyphs of various periods.

The site is located 800 m from the southwestern edge of the shore of the Second Sulfate Lake in the Ordzhonikidzevsky District of the Republic of Khakassia, in the places of residence of the modern Kyzyl people. One may reach the site by moving from Mount Sulek down the country road along the edge of the field that is bordered on the right by the First Sulfate and Second Sulfate lakes and on the left by a mountain range. At a quick glance from below, the surface of the rock outcrop at the Second Sulfate Lake seems so badly destroyed that there cannot be any petroglyphs on it. However, upon closer examination, small vertical panels (friezes) of different sizes can be found there. Two of the panels contain an inscription and other petroglyphs (Fig. 1). In front of this panel, there is a platform about 1.8 m wide, convenient for working with rock representations. At a height of about 3 m above the platform, there is a small rock overhang, under which, two east-facing panels with several rock compositions are located (Fig. 2).

State of the inscription

The text and some other images are located at a height of about 0.3 m above the said platform, on the lower vertical surface of a layer of Devonian sandstone with a noticeable sun (desert) patina. The frieze, with a total length of about 2.2 m and a width reaching 0.24 m, consists of five sections divided by vertical cracks (Fig. 3). Its surface texture is not the same in the different sections. It is rather coarse and harder in the left part, and soft and smooth in the right part. Layers of crumbled Devonian sandstone, unsuitable for creating petroglyphs, are below and above that layer.

The text consists of characters that form at least 14 vertically arranged rows, up to 18 cm high. In the Old Mongolian script, lines are written from top to bottom, then from left to right. The placement of characters in the inscription corresponds to this type of script. The characters, like the other images present, are made with carved lines using the technique of fine engraving and scratching. The width and depth of their lines are on average slightly more than 1 mm. Some lines are black, since they were covered with a coloring substance (paint) on the inside, while other lines remain in their original light form. The state of preservation of the characters in the inscription varies, depending on the depth and thickness of the lines. Considering the morphology of the frieze and features of its execution, the characters of the inscription can be divided into three groups (parts).

Group 1 consists of four quite clearly visible rows of characters, separated from the rest of the inscription by a vertical crack (Fig. 4). This group is located in the right part of panel 3, third from the left. Group 2 consists of several vertical rows of characters made with very thin and shallow, and therefore poorly visible, lines. Two rows are somewhat more legible than the others (Fig. 5, *a*). This group is located to the right of group 1, in the left part of panel 4. Group 3 consists of the rightmost seven rows of characters, clearly forming a separate group, since they are located a few centimeters away from the right part of group 2 and are carved with slightly deeper and wider lines (Fig. 5, *b*).

Parts of the inscription demonstrate different states of preservation. The left part, consisting of four vertical rows of characters, looks as if it was freshly made, almost without desert patina. The central and upper half of the right part of the inscription are very dark and barely legible; only in the lower zone of this part do the characters look as fresh as in the left zone. The two rightmost rows of characters in the right part of the inscription are shorter than the other five rows. In some areas of the surface, the characters of the inscription are hardly distinguishable from weak grooves of natural origin.

State of human and animal representations and tamgas

On the lower frieze, along with the inscription, there are images of riders (two of which have disproportionately

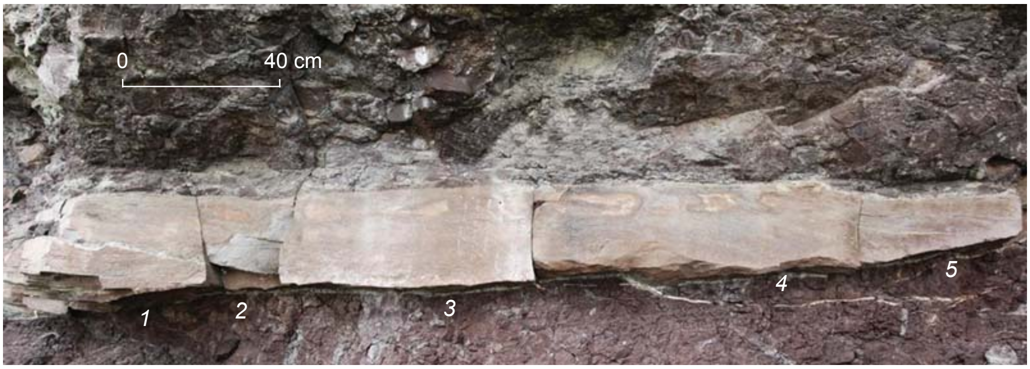

Fig. 3. Panels of the lower frieze.

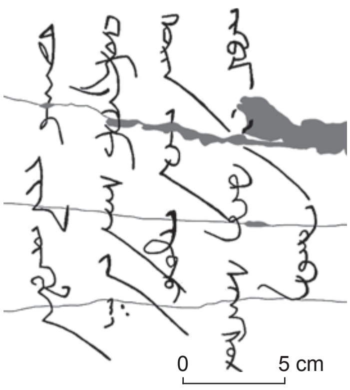

Fig. 4. Trace-drawing of the leftmost four lines of the inscription on the right side of the third panel from the left.

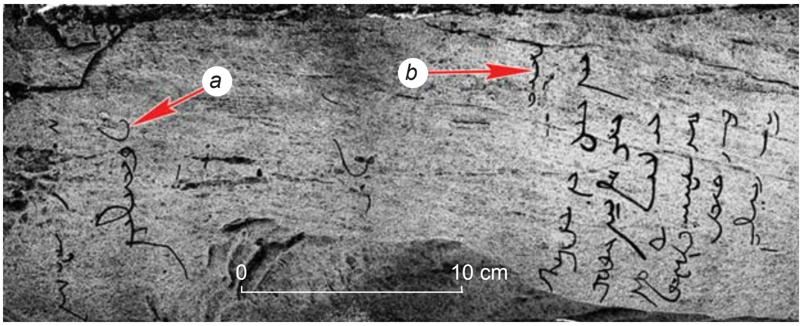

Fig. 5. Trace-drawing of individual lines of the inscription to the right from the characters of group 1 on the left side of panel 4 (*a*) and seven rightmost lines of the inscription (*b*).

large round heads), horses, and a camel. The figures were made with carving technique by thin, shallow lines. The composition of a man with a camel was probably not carved, but lightly scratched with a sharp item.

The largest number of images of people and animals are present on panel 3, to the left of the inscription (Fig. 6). A rider, mounted on a horse in a regular position, probably with a quiver shown near his waist, and presumably wearing a helmet on his head, is depicted in the upper part of the composition. The horse, with an unnaturally elongated body and protruding ears, has a loose tail (Fig. 6, *1*). A figure of another rider, wearing a headdress resembling an inverted mushroom-cap, is slightly lower. The ears of this horse, with a loose tail, are emphasized (Fig. 6, *2*). A head and part of human body are depicted below the horse of the upper rider (Fig. 6, *3*). The image of a third horse, with a disproportionately long body, emphasized ears, and a saddle, is shown below this (Fig. 6, *4*). In the right part of the composition, also below, a fourth horse, with a loose tail and emphasized ears is depicted (Fig. 6, *5*).

A composition of a rider wearing a helmet, with a bow at his belt, leading what seems to be a camel with two disproportionately small (but clearly marked) humps by the reins, is shown on panel 1 (Fig. 7). A figure of a double circle is depicted with thin carved lines; it is not yet possible to interpret this. Thin carved lines are above the characters of group 2 of the inscription. These are probably close in time to these figurative images, although they do not form a unified composition with them.

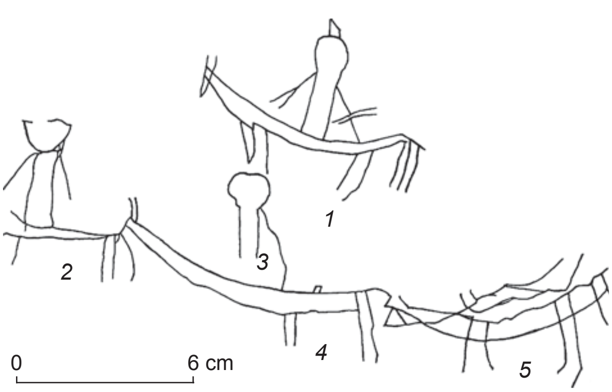

Fig. 6. Trace-drawings of images of people and horses on the lower frieze.
1 – rider wearing a helmet, with a quiver; *2* – rider wearing a headdress in the form of inverted mushroom cap; *3* – human head and part of body; *4* – image of a horse; *5* – shapeless and illegible composition.

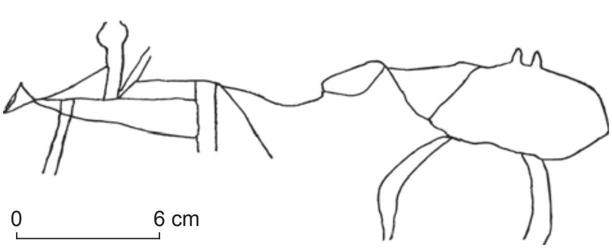

Fig. 7. Trace-drawing of a separate image of rider leading a two-humped camel by the reins.

Images of people and animals almost do not overlap the inscription; they possibly illustrate its content. Only the lines of the heads of three people and body of one of the horses were emphasized with black paint.

The images on the lower frieze demonstrate intersections of straight (or close to straight) lines at right angles, which points to a geometric style, widely known from the petroglyphs of the Baikal region (Melnikova, Nikolaev, 2006: 276–277, fig. 9, 10). Thus, a similar pictorial style is now also known from Khakassia.

On the upper frieze, three signs are pecked, which might have been tamgas—two in the form of the number 8 (or an hourglass, but with pointed corners) and one of a circle with a small vertical tongue inside. An unidentifiable image is below the tamgas. These drawings seem to be ancient. However, the leftmost tamga looks lighter and fresher, and its lines are shallow. Such tamgas have no parallels among those discovered in the region and related to the Middle Ages and Modern Age (Kyzlasov, Leontiev, 1980: 22, 27), but are known from the Altai Mountains (Yamaeva, 1999). No paint was used to create the petroglyphs on the upper frieze of the site.

Reading and interpretation of the inscription

D.D. Vasiliev, the Head of the History Department at the Institute of Oriental Studies of the Russian Academy of Sciences, proposed two variants of a translation of the inscription from Old Mongolian into modern Mongolian for this article. The first variant for the initial part of the inscription (group 1) is as follows: *Mogoy zhiliyn ovliyn dund sarin khorin negniy odor*… The second variant is: *Ezhinu zhili ungurle moritonu saryn khorin negniy edur*. Both variants have an identical meaning: *In the year of the Snake* (in another variant, *in the year of the Dog*), *the second winter month, the 21st day*… The remaining graphemes can only hypothetically refer to individual words, which in translation from Mongolian mean: *master*, *elapsed*, *rider*, *give*, *herd*, *steppe* (*talo*). Some words cannot be read because of the poor legibility of their characters. The author's name cannot be discerned either. The work on clarifying the text is complicated by the fact that in the Mongolian script, including the Oirat *todo bićig* ('clear writing'), many graphemes have three variants, depending on their position in the word (initial, middle, or final).

The first part of the inscription* can be read quickly, and is definitely Old Mongolian. Reading the second and

*The parts correspond to the groups described in the section "State of the inscription".

third parts caused difficulties in determining the language. Some words could be identified, but they were most likely written in the Uyghur-Mongolian script. A specific feature of the inscription was using the verb stem *biti* ('write'), common in the Early Medieval Turkic written records, and the derivative noun *bitig* ('writing'): "inscription" in the phonetic form *bići-*, *bićig-* (Tugusheva, Klyashtorny, Kubarev, 2014: 81). The word *bitidim* could be clearly read in the middle part of the inscription under study, which indicated that the text could have been Turkic, but written in a different script. Something similar has been found in the Mongolian inscriptions on the rocks of the Altai Mountains, where a Turkic (Altaian) text was written on a stele in the Mongolian script. It was possible to identify individual Turkic words and lexical blocks therein (Vasiliev, Kara, 2001; Tugusheva, Klyashtorny, Kubarev, 2014). Since the graphical representation somewhat changes the appearance of the word and does not convey some letters that do not correspond to Mongolian orthography, it is necessary to look for similarly sounding foreign words, primarily in the Turkic linguistic environment. Despite the lack of full translation of all parts of the inscription, the available evidence is sufficient to conclude that we are dealing, not with the Oirat *todo bićig* ('clear script'), but with some other, yet definitely Old Mongolian, script.

Chronology of the inscription and the images

The relative chronology of the inscription and other images can be established from their mutual arrangement on rock surfaces, differences in their execution technique, and their degree of preservation. Judging by their execution technique, the pecked images of tamgas and the unidentifiable figure on the upper frieze could have been the earliest. Much later, the inscriptions were carved on the lower frieze (possibly, three separate texts; they were created in several stages, but with a short break). The carved figures of riders and animals were the last to be made on free spaces of the panels in the lower frieze; in terms of time, these could have been close to the inscription. The images of riders, horses, and camel do not overlap the inscription, but rather complement and illustrate its content. The same degree of "aging" of lines in the inscription and images, as well as the technique of executing the images, suggest that the characters of the inscription and the carved figures were made at the same time.

The inscription could have been made at any period of use of the Uyghur-Mongolian script, beginning with the reign of Genghis Khan. At that time, the Uyghurs, who voluntarily submitted to him, passed the Old Uyghur script to the Mongols. After significant modification, it became the Old Mongolian script. The Mongols often call it "Uyghur" (Mongolian *uyghurzhin bichig*) to distinguish it from other Mongolian scripts, and they still use it today (Kara, 1972). The lower boundary of the period when the inscription was made can be determined with an accuracy of several years. According to a legend, the Uyghur-Mongolian script was created by the order of Genghis Khan no earlier than 1204 by the Uyghur scribe Tatatunga (Kychanov, 1995: 139–140). The upper boundary can be considered the beginning of the 1720s, when the presence of the author of the inscription in the Khakass-Minusinsk Basin, after the establishment of the permanent Russian-Qing border, was unlikely. The scribe could have been either a subject of any of the Mongolian states that subjugated the population of the basin from the 13th to the early 18th century, or an indigenous resident who used this script. As is known, at that time, there were people who "knew how to write and read in Mughal" even among the simple "ulus men" (Istoriya Khakasii…, 1993: 166–167).

The assumption on the creation of the images of riders, horses, and a camel on the inscription near the Second Sulfate Lake in the Late Middle Ages or in the Early Modern Age is confirmed by the Buryat (ethnographic) images of the 16th–19th centuries, known from the Baikal region and similar in technique, manner of execution, and subject (Nikolaev, Melnikova, 2002; Melnikova, Nikolaev, 2006). Importantly, the latter are distinguished by sub-rectangular outlines. This rare feature in the rock art was also recorded in the petroglyphs near the Second Sulfate Lake. A.P. Okladnikov considered petroglyphs made with thin engraved lines, graffiti, to be a special variety of late drawings in the Baikal region (1959: 161). At the site under discussion, these include the images of rider with the led camel. Also, note that a Uighur inscription made exclusively in black paint (without carving or scratching) was discovered in the Urkosh area in the Chuya River valley, in the Altai Mountains. The lines of the characters of that inscription are somewhat wider than those in the inscription at the site under discussion in northern Khakassia (Tugusheva, Klyashtorny, Kubarev, 2014: 79), but stylistically both of them are a part of the same phenomenon in the written history of Southern Siberia.

Conclusions

The presence of Mongolian inscriptions in the non-Mongol territory may have a number of explanations—from the capture of a Mongolian ruler by the troops (which happened more than once) to the penetration of settlers from Tuva and Mongolia, who brought this script into northern Khakassia (for example, the Beltyr ethnic group of the Khakass people was based on direct descendants of marriages between the local population and migrants from the south). In addition, the Old Mongolian script was used as the main means of interethnic and interstate communication in Southern Siberia, from the Late Middle Ages to the Early Modern Age. It was replaced in this capacity by the Russian language. Noteworthy are the figures of horses and riders, made in a distinctive rectangular pictorial style. Full translation of the text and individual words of the inscription should be the focus of further research aimed at identifying the facts of ethnic and cultural contacts at that time between different groups of population in the region.

Generally, all parts of the inscription and accompanying images of people and animals, made with thin carved lines on the lower frieze at the Second Sulfate Lake, are one of the latest works of epigraphic and fine art known in the region. In terms of their form and execution technique (pecking), tamgas at that lake might have belonged to an earlier time than the written evidence of this site, that is, to the pre-Mongol period.

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The World of Migrants from Ryazan in the Post-Reform Period: Methods of Studying Migration and Local Adaptation in the Altai

The study describes a new method of integrating field and archival sources relevant to the migration of peasant families from the Ryazan Governorate to the Altai in the 1880s. Late 19th to early 20th century documents from the archives of the Ryazan and Tomsk regions were used. A new comparative method was applied to analyze the findings of ethnographic surveys in places of the original (Ryazan) and subsequent (Shubinka Volost, Biysk Uyezd, Altai) residence of migrants. Based on interviews with their descendants, adaptation to the new areas of residence was explored. Both before and after the 1917 Revolution, the migrants retained their two basic distinctions—Orthodoxy and the Southern Russian dialect. Adaptation processes included development of the new habitat and marriages not only with members of their group but also with Siberian old residents. These adaptive strategies opposed migrants from Ryazan to those from other Southern Russian Governorates such as Kursk, Voronezh, etc., who maintained ties mostly with migrants from Poltava, Chernigov, and other southern regions.

Keywords: *Ryazan settlers of Siberia, integration of archival and ethnographic sources, comparative field method, adaptation strategies, ethno-cultural memory, 20th century.*

Introduction

Resettlement and adaptation of newcomers to new places were discussed in several works, including some studies using Siberian evidence, yet not all problems have been completely resolved. These are particularly relevant in our days of rapid changes in social and ethnic aspects not only in Russia, but also in the entire world. The historical experience of adapting by the Eastern Slavic peasant settlers from European Russia to Siberia in the second half of the 19th to early 20th centuries and their interaction with the local Russian old-resident population have attracted and continue to attract attention of historians and ethnologists. N.M. Lebedeva considered “successful adaptation” as the adjustment to new conditions according to the model of integration or adopting the skills of an unfamiliar culture until achieving complete social adequacy in it; she called adaptation “unsuccessful” in case of the model of psychological defense or even isolation (1993: 34). The opinion that the host community should also adapt to newcomers in order to restore the balance of security disrupted by their appearance, has been repeatedly voiced in historical literature (Sibirskiye pereseleniya, 2006: 8). In terms of interpersonal relations, the ideas about preferential rights of the first settlers prevailed. This was precisely the situation encountered by the migrants from Ryazan Governorate in the late 19th to early 20th centuries in Siberia.

Sustainability of any historical and cultural entities is known to depend on the degree of their adequacy to new living conditions (Ibid.). If traditional “life forms” correspond to new realities, regional colonization will seamlessly evolve in line with preservation of traditions in economic and spatial aspects. On the contrary, contradictions between old, proven experience and new living conditions result in some changes in traditional economic systems and material culture, manners, beliefs, and ideas, affecting the realm of spiritual culture.

In this study, we used interviewing as ethnographic method of gathering information in the form of formal and (to a greater extent) informal interviews, the so-called "life stories". We followed the method of mutual complementation of archival and ethnographic data, which can be called the method of *integration of archival and ethnographic sources*. This made it possible to supplement the observed ethnographic facts and information obtained during interviewing, with historical and archival evidence, as well as statistical data. The method of integration of archival and ethnographic sources has made it possible to confirm the informants' reports about the places where their ancestors came from, in our case, areas in the Ryazan Governorate.

The author's method of *comparative field research*, which can be considered a variety of comparative historical method, was used in the study. A specific aspect of this methodology is that ethnographic evidence is gathered not only in the places where representatives of ethnographic/ethnic and cultural groups currently live, but also in the presumed or reliable ancestral homeland of their great-grandfathers at the level of one time slice. In our case, field evidence was not compared to archival or published data, but to field evidence gathered in the places from where the settlers departed.

This study attempts to identify specific aspects of the resettlement and adaptation strategies among one of the many migrant groups from the Ryazan Governorate to analyze the ethnic and cultural structure of the Eastern Slavic population of Siberia in the 20th century at a new conceptual level.

Reasons for resettling: Need or urge for changing place?

When studying the Russian experience of settling in new territories, new historical approaches should be followed. For example, B.N. Mironov pointed out that resettlements were induced by the shortage of available lands in the presence of lands suitable for arable farming, and noted the emergence of migration paradigm in the mass consciousness of the Russian peasantry of the 18th–19th centuries, which made agriculturalists psychologically prepared for resettlement (2003: 27–28). In A.V. Golovnev's "anthropology of movement", colonization is viewed a mechanism for appropriating space and social interactions: what is important in it, are not so much the results of appropriating new territories, but the origins of movement—situational impulses that triggered the motive, and then the technology and tradition of colonization (2015: 9). Golovnev was also interested in analyzing the processes and practices of "recoding" the culture of "wanderers" in the Siberian "frontier".

Resettlement to Siberia was thoroughly and comprehensively studied by the statistician and publicist V.N. Grigoriev, who used the evidence from the Ryazan Governorate in the 1880s*. Analysis of the interviews that were taken using the technique of "ethnography of a neighbor", as well as Grigoriev's own observations and letters, allowed him to conclude that the desire to change the place of residence was expressed by former state peasants**, although they were in a more advantageous economic position than landowner peasants, since they owned larger land plots (1885: 5–6, 10, 41). Thus, according to Grigoriev, the situation was not limited to resettlement of mainly land-poor families. The resettlement movement of former landowner peasants began immediately after their liberation from serfdom. Grigoriev was surprised by the low participation of peasants from the northern uyezds of the Ryazan Governorate, although their conditions for farming were significantly worse than those of the peasants from the southern black earth uyezds (Ibid.: 5, 12, 41). Note that such situation was possibly typical of the 1870–1880s, while it changed in a later period of late 19th to early 20th century. There are documents on the movement of peasants from the northern Kasimov and Pronsk Uyezds of the Ryazan Governorate to the Tomsk Governorate (1900) (State Archive of the Ryazan Region (hereafter, GARO). F. 129, Inv. 386, No. 367, Fl. 17; No. 402, Fl. 19; No. 421, Fl. 20).

Grigoriev believed that the main reasons for the movement were the supposed "migration urge" and "restlessness" inherent in Russian peasants (Ibid.: 42). The residents of the Ryazan Governorate who sought to migrate were called "samara", and the process of migration was called "to go to samara"***. The envoys sent by communities to search for places of settlement were called "ssadchiki" (Ibid.: 3, 16). Since the late 1880s, when resettlements to the east became predominant, the designation "samaras" or "samarians" was replaced by "tomenians"—this was how those

*That study was highly praised by the experts, and its author was awarded the Samarin Prize by the decision of the Imperial Moscow University.

**State peasants were special non-serf rural population ("odnodvortsy", "chernososhniye", etc.) of the Russian Empire in the 18th–19th centuries. Unlike the landowners' peasants, they were considered free.

***Grigoriev believed that designation of the settlers as "samara" was associated with earlier migrations to free lands in the Samara Governorate. From the interview recorded by the author it followed that "samara" was the name generally given to lands that were free and suitable for agriculture and satisfying life.

leaving for the Tomsk Governorate were called (Ibid.: 38). Interviews of peasant settlers or their neighbors allowed Grigoriev to draw a conclusion about the reasons for the move: "…Poverty in its various manifestations drives peasants to distant but spacious lands. Either there is an inconvenient location of the plot, or rent on difficult terms, or lack of fuel…" (Ibid.: 41–43). Indeed, as the information from the State Archive of the Ryazan Region showed, in the Ryazan villages, even in the presence of forests, houses were often heated with brushwood and deadwood. For example, the "Community Forms" of the Ryazan Governorate's Statistical Committee for 1886–1893 regarding the village of Ryazanovo in Kasimov Uyezd, state: "…The residents have little timber, which is why they mostly have to buy it" (GARO. F. 7, Inv. 1, No. 145, fol. 88). A statistics worker thus wrote about the fuel situation in the village of Argamakova in Spassk Uyezd: "People heat with purchased brushwood. Firewood is relatively inexpensive: on average, it costs about 8 rubles per house… <…> There is almost no forest for fuel nearby. For firewood, peasants go to the left side of the Oka River, to Meshchera, 20 or 30 versts away. They heat with shvyrkoviye ['unchopped' – *E.F.*] firewood and branches" (GARO. F. 7, Inv. 1, No. 145, fols. 59–130). "In the village of Zykovo in Kasimov Uyezd, village of Ivanokovo in Spassk Uyezd, and some other villages, although they had their own small forest, it was not enough for fuel, so they had to buy firewood in the state forest" (GARO. F. 7, Inv. 1, No. 145, fol. 83). Hoping for better life ("it won't get worse"), poor people went to Siberia, for example, a peasant from the village of Podkidyshevo to Biysk Okrug, or a family from the village of Topil of Skopino Uyezd, who in their home village "in winter would spend nights in the stove with their children" due to the lack of fuel (Ibid.: 44).

The "Community Forms" for 1886 reflect the assessments of land quality, given by residents of the villages of Eraltur, Shostie, Zykovo, Ryazanovo, Gavrino, Davydovo, Rubetskoye, Sharanino, etc. in Kasimov Uyezd, and Argamakovo (Rudneva), Ivanokovo, Degtyany, Stary Kistrus, Golovskoye, etc. in Spassk Uyezd (GARO. F. 7, Inv. 1, No. 145, fols. 20, 34–35v, 38–40, 43–46v, 124, 234v, etc.). Many records indicate low or poor land quality (GARO. F. 7, Inv. 1, No. 145, fol. 196). The peasants from the village of Zykovo in Kasimov Uyezd reported: "…The land is almost all sandy loam, and some is clay loam. Hayfields are low-lying, partly even in water; grass in the hayfields is feather grass, partly moss" (GARO. F. 7, Inv. 1, No. 145, fol. 83). It was thus reported about the lands of the village of Ryazanovo in Kasimov Uyezd: "The land belonging to peasant settlements is not distinguished by good quality; overall, in the words of a villager, it is bad. The soil is sandy loam. Arable lands, hayfields, and pastures are not convenient owing to their distance from the village" (GARO. F. 7, Inv. 1, No. 145, fol. 88). There were also comments that "the soil is of mediocre quality, loamy" (GARO. F. 7, Inv. 1, No. 145, fol. 59). To grain crops to grow well on such soil, it was necessary to use a large amount of fertilizer (GARO. F. 7, Inv. 1, No. 145, fol. 88).

Large number of people and "lack of lands" was another important reason for peasant migration. Although it was not as critical as in the black earth regions of the Russian Empire (cf.: (Churkin, 2006: 4; Fursova, 2022: 123)), this also forced people to move intensely to the east. The number of households in almost all villages of the Ryazan Governorate of the post-reform period at the time of compilation of information (1861–1886) grew rapidly, often doubling and tripling (GARO. F. 7, Inv. 1, No. 145, fols. 196v, 202v, 216v, 227v). According to the Statistical Committee of the Ryazan Governorate (report for the Chancellery of the Ryazan Governor for 1883), in all uyezds, especially in Ryazan, Egorievsk, Spassk, Kasimov, Skopin, and Mikhailov, there was an increase in the population (GARO. F. 7, Inv. 1, No. 72, fols. 2v–3).

The reason for resettlement, for example, of the Ryazan Governorate residents who usually had many children was their concern that "the children would not have enough land". Grigoriev cited the following information obtained during interviews with peasants: "A peasant from the village of Bukhovoye is leaving for the Tomsk Governorate. His family consists of 10 people. They took 500 rubles with them. People say about him: 'He is a creditworthy man, but he only has enough land for one person, so he is leaving'" (1885: 42); "A family with three working members is going to samara. Their land is two dessiatines and a quarter; they explain the reason for departure that there is not enough land; the guys run wild on the side (that is, have occasional jobs outside of their home). This is why they are leaving" (Ibid.: 43). There were settlers who responded to invitations of relatives who left for Siberia, to unite and have a good life. For instance, a peasant who moved to the village of Shubinka in Biysk Uyezd, calling on relatives, wrote: "…I eat wheat, but back home I did not have enough rye". Poor peasants from the agricultural areas of the Ryazan Governorate, who were forced to do seasonal work, strove to leave in order to become "real land owner-tillers" in a new place (Ibid.).

Information on migration from the Ryazan Governorate according to the data from the State Archive of the Ryazan Region and expedition to the Meshchery Region

"The Cases of the Ryazan Treasury Chamber" reveal that in 1873–1913, peasants from Dankov, Ranenburg, Sapozhok, and Kasimov uyezds, and other places, actively submitted petitions for resettlement to Siberia (GARO. F. 129, Inv. 386, No. 241, 242, etc.). Local peasants planned to resettle to Yenisei and Tomsk governorates, and the city of Vladivostok (GARO. F. 129, Inv. 386, No. 333, 337, 339, 359, 367, 402, 416, 421, etc.).

In 1899, large families of peasants from the village of Berezovka in Eropkino Volost of Dankov Uyezd moved to the old-resident village of Prokudskoye in Krivoshchekovo Volost of Tomsk Uyezd*, which, judging by the ethnographic evidence, was notorious for brigandry of the local Chaldons, and became registered there. Several families from the village of Nikolskoye from Dolgoye Volost in Dankov Uyezd were registered in the village of Srostkinskoye in Srostinskaya Volost of Biysk Uyezd**, and peasants from the villages of Izbishche and Arkhangelskoye in Dankov Uyezd became registered in the village of Kosikhinskoye in Kosikhinskaya Volost of Barnaul Okrug (GARO. F. 129, Inv. 386, No. 242, fols. 2–35). Peasants from the village of Dubrovka in Kochury Volost of Dankov Uyezd, who had previously belonged to a Georgian princess, moved to Kosikhinskaya Volost in 1899 (GARO. F. 129, Inv. 386, No. 242, fol. 2). The Ryazan migrants from the village of Yagodnoye in Yagodnoye Volost of Dankov Uyezd, became registered in the village of Khairuzovskoye in Biysk Volost of Biysk Uyezd*** (GARO. F. 129, Inv. 386, No. 241, Fl. 10, fols. 1, 2, etc.). Documents from 1899 mention "the transfer with discharge certificates" of peasants from Dankov Uyezd of the Ryazan Governorate to become "the peasants of Kaily Volost of Tomsk Uyezd and Governorate[4*], Smolenskoye Volost of Biysk Uyezd[5*]" (GARO. F. 129, Inv. 386, No. 242, fols. 1–35). There are only few documents on returning of peasants to their homeland. For example, Mikhail Ivanov Kuznetsov—the head of the Kuznetsov family from the village of Kazansky in Kazatkul Volost of Kainsk Okrug—explained his decision that "he does not belong to schismatic sects" (GARO. F. 129, Inv. 386, No. 242, fol. 35). Apparently, the migrants did not want to live next to the followers of other religious currents, possibly Old Believers or Baptists.

A request from the Tomsk Treasury Chamber to the Ryazan Treasury Chamber mentions the persons "who moved without proper permission[6*]" to the community of landless peasants of Novo-Chemrovka in Shubinka Volost of Biysk Uyezd*. The list included the families of Ivan Afanasyev Budaev, widow Matrona Vladimirova Tretyakova with two young children from the village of Malinok in Kudryavshchino Volost of Dankov Uyezd; Fedor Kozmin Koshelev from the village of Lovpunovka (?) in Zenkino Volost of Ranenburg Uyezd; Vasily Sidorov Toropchev (Toropchiy) from the village of Bukovoye in Baevo Volost of Ranenburg Uyezd; Login Nikitin Basmanov from the village of Demkino in Putyatino Volost of Ranenburg Uyezd; Ivan Petrov Panfilov from the village of Ryazhskoye in Troitse-Lesunovo Volost and Uyezd from state peasants (GARO. F. 129, Inv. 386, No. 241, Fl. 10, fols. 1–2v). In 1899–1901, seven families (the Ionovs, Markovs, Stignyaevs, Vasilievs, Akimkins, Fedosovs, and Demins) from Dankov and Ranenburg Uyezds also moved to Shubinka Volost (GARO. F. 129, Inv. 386, No. 242, fols. 1–35).

Unlike settlers from the Russian Black Earth Region, who formed large groups, residents of the Ryazan Governorate more often united in small groups, which included several families. The State Archive of the Ryazan Region has little information about such groups. One of them included 13 families of peasants ready to be transferred to the Tomsk Governorate in 1899 from Dankov, Ranenburg, and Sapozhok Uyezds (GARO. F. 129, Inv. 386, No. 241, Fl. 10, fols. 2–4). This group of 13 families united several related families of brothers, probably the sons of the widow Varvara Andreeva** Gorodentseva (58 years of age at the time of resettlement)***. Varvara from the village of Malinki in Kudryavshchino Volost of the Ryazan Governorate with her two children, stepson Vasily, his wife and five children, was transferred to the Tomsk Governorate (GARO. F. 129, Inv. 386, No. 241, Fl. 10, fols. 2–4). From the same village, the list also included two families of the Gorodentsevs ("Trofim Vladimirov, 42 years of age" and "Nikita Vladimirov, 32 years of age") with the same patronymic names of the householders of the corresponding age, presumably three brothers. One of these families was fraternal: Trofim and his wife united with his younger brother Petr (37 years of age) and his wife; their two young sons (four years of age each) were also listed. Apparently, Nikita was the middle brother in the family and was included in the resettlement group only with his family consisting of parents and two young children. The list included four undivided

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*Now, the village of Prokudskoye in the Kochenevsky District of Novosibirsk Region.

**Now, the village of Srostki in the Biysky District of the Altai Territory (the birthplace of famous writer and actor Vasily Shukshin).

***Now, the village of Khairuzovka in the Troitsky District of the Altai Territory.

4*Now, the Moshkovsky District of Novosibirsk Region.

5*Now, the Smolensky District of the Altai Territory.

6*They were resettled on the basis of the law from April 27, 1896.

*Now, the village of Novaya Chemrovka in the Zonalny District of the Altai Territory. The village of Chemrovaya also existed in Rybnoye Volost of Ryazan Uyezd in the Ryazan Governorate.

**This is how the patronymic was written.

***The patronymics of females are indicated without the endings of -ovna or -evna.

fraternal families (the Gorodentsevs, Peresypkins, Naidins, and Veselkins), three three-generation families of "grandparents – parents – children/grandchildren", and three two-generation families of "parents – children". In addition to children and parents, the Dymov family from the village of Trebunkovo (Trebunok) in Bigilden Volost of Dankov Uyezd* included husband's mother, as well as male cousins—uncle and his son. Commonly, if the family was headed by a representative of the older generation, this was a widower or widow who, together with children and grandchildren, was ready to move. It seems that elderly couples that lived together did not try to change their place of residence. The statistical worker recorded 93 adults and children in these families, but only 12 "census souls" were mentioned**; 41 non-census persons and 40 females were recorded separately.

Population groups, which had not previously known each other, came into contact and interacted during the development of new territories in the Tomsk Governorate. Notably, the original territories were "geopolitical crossroads" where migration waves rolled in different directions (Golovnev, 2015: 330). Field materials of the author, revealing a mosaic of family records from these areas, also confirm this. When working with documents of the State Archive of the Ryazan Region, the diversity of last names in the lists of peasants for resettlement strikes the eye. Last names of local peasants are almost never the same. There are no family nests, as, for example, in the Kursk Black Earth Region or Western Siberia. The conclusion about significant diversity of last names in the 19th–early 20th centuries is confirmed by the author's observations made during a visit to the Old Cemetery on Kokorin Street in Kasimov (formerly, Gorodets Meshchersky).

During the field work in the Ryazan Region, convincing evidence was collected, which indicates that not only Russians and Cossacks, but also russified Kasimov Tatars, and Meshchera people, the memory of whom has survived in the Ryazan Region only in toponymy, migrated from Ryazan to Western Siberia and the Altai. The core motif of local residents' statements about the ethnic composition of population from the Meshchera area was the following: "The locals are all considered Russian, regardless of whether they used to be Tatars in the past or not" (FMA, 2021).

*A legend about the origin of the village of Trebunok has been preserved among the peasants. In ancient times, "12 Cossack families" came from the lower reaches of the Don River. They seized a lot of land, settled on the riverbank, and founded a Cossack settlement. Over time, feeling "tightness in lands", the Cossacks moved 7 versts further, and founded the village of Trebunok.

**"Census soul" was a unit of accounting for the male population in the Russian Empire in the 18th–19th centuries.

Information about Ryazan settlers in Siberian archives

Siberian archives contain data on Ryazan settlers, who constituted insignificant, or large, or even predominant share of population in the settlements. For example, in 1916, in the village of Skalinskoye in Chaus Volost of Tomsk Uyezd, half of the population was old residents (51 %); settlers from the Tambov Governorate were in the second place (30.6 %), and settlers from the Ryazan, Oryol, Penza, Vyatka governorates and other places were in the third place. The following Ryazan last names appeared in archival documents: Aleshins (1 household), Afonins (1 h/h), and Tarasovs (1 h/h) (State Archive of the Tomsk Region (GATO. F. 239, Inv. 16, D. 131, No. 38, without numbering).

As mentioned above, according to the documents of 1899, "peasants of Dankov Uyezd of the Ryazan Governorate moved to the Kaily Volost of Tomsk Uyezd and Governorate"*. The State Archive of the Tomsk Region has preserved information about resettlement of Ryazan peasants to the village of Kaily in Kaily Volost. In 1916, the Ryazan migrants constituted 25 % of the village population (63 h/h) with the proportion of old residents equal to 16 %, and proportion of Chernigov migrants reaching 19 %. The proportion of the Poltava, Mogilev, Kursk, and Kharkov settlers taken together (28.2 %) was commensurate with that of the "Ryazans"; the remaining settlers (from Kharkov and Nizhny Novgorod governorates) constituted less than 5 % of the population. The last names of migrants who arrived in 1881–1914 from the Ryazan Governorate were the following: Bykov (4 h/h)**, Dmitriev (1 h/h), Dubrovitsky (2 h/h), Evseev (5 h/h)***, Fedosov (8 h/h), Granov (1 h/h), Gromov (1 h/h), Karatay (1 h/h), Kiselev (1 h/h), Kornilov (1 h/h), Kurlay (1 h/h), Kuznetsov (10 h/h), Lobuzanov (2 h/h), Maksimenko (1 h/h), Markov (1 h/h), Onufriev (1 h/h), Pometov (1 h/h), Popetov (1 h/h), Rapapashin (3 h/h), Sevostyanov (2 h/h), Sorokin (7 h/h), Stepanenko (1 h/h), Subbotin (1 h/h), Shchegolikhin (2 h/h), Zelenin (2 h/h), and Zorin (1 h/h) (GATO. F. 239, Inv. 16, D. 131, No. 26, without numbering, 248 households).

Since the 1870s, Shubinka Volost of Biysk Uyezd stood out as a place for settlement of new migrants owing to the abundance of fertile lands and proximity of timber (Fig. 1). This volost differed from a number of other (primarily steppe) volosts of Altai Okrug in that both old residents and migrant population were Russians. According to statistical data, there were only five families

*Now, the Moshkovsky District of the Novosibirsk Region.

**The last name Bykov occurs also among old residents (GATO. F. 239, Inv. 16, D. 129, No. 26, fol. 30).

***The last name Evseev occurs also among old residents (GATO. F. 239, Inv. 16, D. 131, No. 38, fol. 60).

Fig. 1. Siberianized newcomers from the Great Russia. *Photo and caption by M.A. Krukovsky, 1910–1912. Archive of the MAE RAS.*

of migrants from the Little Russian governorates among the residents of Shubinka Volost (Materialy…, 1899: 3, 9). Participation of settlers in the economic development of Shubinka Volost of Biysk Uyezd was very noticeable: according to the data of the household census of 1898, only 33 % were households of local villages. The remaining 67 % of households were recorded as newcomers (Ibid.: 6). Migrants from European Russia dominated among the new settlers in Shubinka Volost; 5/6 of them were natives of agricultural governorates: Ryazan gave the Volost 687 households, Tambov – 332 households, Voronezh – 187 households (Ibid.: 7), as well as Perm and Vyatka governorates – 149 households (Ibid.: 8).

Because of a large number of Ryazan settlers, Shubinka Volost (now, Zonalny District of the Altai Territory) was chosen by the author of this study for ethnographic field research. In the 1980s and 1990s, seven interviews were taken from a representative of the descendants of Ryazan migrants from the former Shubinka Volost. In her childhood, she lived in the village of Shubinka. A record of the family of these settlers has been preserved in the files of the Statistical Committee at the Local Government of the Altai Governorate (State Archive of the Altai Territory/The Altai Territory Archival Fund Storage Center (GAAK/TKAFAK). F. 233, Inv. 1a, No. 854, Fl. 66). The questionnaires of 1917 population census for Shubinka Volost in Biysk Uyezd mention a householder listed as a "peasant of Great Russia" Tolmachev Fedor Agapovich (48 years of age), followed by the male members of the family: sons Gavrila (30 years of age), Vasily (27 years of age), Ivan (25 years of age), grandchildren Andrei (13 years of age), Pavel (12 years of age), Yakov (9 years of age), Dmitry (4 years of age), and Sergei (11 years of age). The female members of the family included the householder's wife Fedora, daughters Anna (17 years of age), Ulyana (16 years of age), Avdotya (13 years of age), Agrafena (12 years of age), three daughters-in-law—Irina (30 years of age), Avdotya (27 years of age), Zinoviya (24 years of age), and granddaughter Agrafena (7 years of age). During interviews with the descendants of the family, in particular with Tatyana Ivanovna Tolmacheva born in 1910 (Shadrina by marriage), it became clear that not all archival data reflected the real situation. For example, daughter-in-law Irina was Ivan's wife*, but, according to the census, she was about the same age as Gavrila and was possibly married to him, while Fedor's granddaughter Agrafena, 7 years of age, listed as such apparently by mistake, was in fact Tatiana, our informant (FMA, 1991). Thus, the data from field research have helped to clarify the information of archival sources.

In the questionnaire, the family of F.A. Tolmachev was listed as migrant, "assigned to the volost, with allotment", moved to the Altai from the Ryazan Governorate in

*During the census, Ivan Fedorovich fought on the fields of the First World War, and died there, leaving his wife Irina a widow with five children.

1881, that is, at the time when the flow from the southern regions prevailed. In 1917, after 36 years of residence in the Altai, the family sowed 15.7 dessiatines of wheat, oats, buckwheat, millet, flax, hemp, and potatoes. Taking into account 8 dessiatines left for fallow, the family had only 23.7 dessiatines of arable land. The peasants had a self-dumping reaper, winnowing machine, and three wooden-wheeled carts as agricultural implements. The census questionnaires mentioned 23 heads of livestock, including 7 horses, 2 cows, calf, 8 sheep, 2 lambs, and 3 pigs. The commercial activities of the housekeeper Fedor Agapovich, who was a carpenter, apparently brought additional monetary income to the family (GAAK/TKAFAK. F. 233, Inv. 1a, No. 854, Fl. 66, fols. 48, 66v).

An older brother of Fedor Agapovich, Vasily Agapovich Tolmachev (52 years of age), whom Tatyana Ivanovna called "uncle", probably lived nearby. The family did not have any allotments per capita, but rented 3 dessiatines of land in the village of Verkh-Shubinka, and a total of 7.3 dessiatines were registered, including the fallow land. The "Population Census Questionnaires" mentioned that Vasily Agapovich kept 19 heads of livestock, including 5 horses, 3 cows, 7 sheep, and 4 pigs. The following persons were listed as male household members: two sons—Alexei (11 years of age) and Nikolai (6 years of age), and a grandson 1.5 years of age. The following persons were listed as female members of the family: wife Akulina (46 years of age), daughter Maria (24 years of age), daughter Maria (17 years of age), and daughter Ksenia (17 years of age). The following children who died in 1917 were also listed—Peter (2.5 years of age) and Anna (10 months of age).

Field materials about the "Ryazanias" from Shubinka Volost of Biysk Uyezd

Our key informant T.I. Tolmacheva (1910–2001) belonged to the second generation born in the village of Shubinka in Shubinka Volost. Her mother Arina Prokhorovna Bogomolova (Tolmacheva by marriage) was born in the same village in 1887, and her grandparents came to Siberia from the Ryazan Governorate in 1880 (information about the uyezd or volost of exit has not survived. FMA, 1988). In the mid-1920s, T.I. Tolmacheva married Shadrin from a family of Ryazan settlers (FMA, 1988, 1991, 1992). The Shadrin families from the village of Shubinka were recorded in the archive as both Ryazan and old residents, which is how the Ryazan residents who had arrived there before the 1880s could have been called.

The informant recalled her childhood, spent in individual peasant household, with joyful warmth, as a "heavenly time" of her life. According to E.A. Yartseva, a representative of the older generation, for those who came from the places with neither forest nor hay, with houses were covered with straw and people washing in stoves, who experienced poverty, the village of Shubinka in Biysk Uyezd seemed a blessed place (FMA, 1992).

Families of that time typically had many children, and children and grandchildren of a similar age lived together. "In our Shubinka family, 45 persons lived. Then they built their own houses for eight sons… There were so many children back then" (FMA, 1990: fol. 59v). The informant Tatyana grew up in Orthodox families of the Bogomolovs (relatives on her mother's side) and Tolmachevs (relatives on her father's side). The older members of the family observed all fasts ("The Lord only keeps us because of fasts", they taught their children since the age of seven or eight) and feastdays, prayed three times a day before eating; on Wednesdays and Fridays, following the prohibition, they did not do dirty, dusty work ("did not spin, did not weave"), read the Bible and "spiritually beneficial" literature. The informant recounted about her relatives as Orthodox people who regularly attended services at the local church of Intercession of the Mother of God. The surviving family recollections mentioned the icons of the Kazan Mother of God brought to Siberia (Fig. 2), as well as pilgrimages on foot to the holy places of the Kiev-Cave Lavra, Solovetsky Monastery, and even to Jerusalem during their stay in European Russia. V.N. Grigoriev also wrote about the popularity of such pilgrimages among the dwellers of the Ryazan Governorate (1885: 10). The men of the Tolmachev family graduated from church parish schools, and were literate. The brother of grandfather Fedor Agapovich, Vasily Agapovich (born around 1867) served in the Tsar's army and later "went over to the Reds".

In Tatyana Ivanovna's speech, one could clearly hear the *akanye* and *yakanye* vowel reduction, and the fricative pronunciation of "g" typical of the southern regions of Russia (Russkiye, 1997: 82). Periodically, softened endings of third-person verbs slipped into her speech ("on sidit', ony vidyat'"). As a witness to the life of a pre-revolutionary Altai village, the informant was familiar with customs and norms of behavior of her contemporaries, spoke in a dialect that was common to her, and knew the terminology of that time and environment.

According to recollections of Tatyana Ivanovna, her relatives and fellow people from the Ryazan Governorate lived not only in the volost old-resident village of Shubinka, but also in the nearby villages of Bezrukova, "Chamrovki" (official name Chemrovka), or in the newly founded villages. They took brides from the "cluster of villages" where people with similar way of life lived, usually from their own people from the Ryazan Governorate. People gathered for the feasts of church's dedication. The informant recalled: "In Shubinka, the church of the Intercession had the dedication feast of the Intercession of the Mother of God. Everyone came to us from Bezrukova, Chamrovka; various relatives and acquaintances came. Aunt Zinoviya

Fig. 2. Family icons of the Kazan Mother of God brought by the settlers Tolmachevs to Siberia in 1881.

was taken to marriage from Chamrovka; nanny Anyutka got married to live in Chamrovka… You see, how many relatives by marriage we have! And when St. Elias' Day approached, our people went there to Chamrovka. It was St. Michael's Day in Bezrukova; everyone went there. Kinship relations were strong".

Tatyana Ivanovna remembered almost all family members listed in the 1917 "Census Questionnaires for Biysk Uyezd, Shubinka Volost, village of Shubinskoye" (GAAK. F. 233, Inv. 1a, No. 854, Fl. 66). The informant called Fedor Agapovich's daughters Avdotya, Anna, Ulyana, and Agrafena *nyanki* ('nannies')* ("nyanka Ulyashka", "nyanka Dunka"), because they played with her. The *nyanki* were brought up in the spirit of love, which was especially evident in relation to children. "I was the only little child, and they played with me. Then the aunts started arguing and fighting over me. When Mom was sheafing or mowing far away, and it was time to run and feed me, I was lying in a cradle—that's how everyone did it then. And the girls were arguing who would carry me to Mom. Then it was decided that they would do this as a duty for a week…".

The state was interested in the quickest possible settlement of the migrants in their new places and provided financial assistance to the families. For this purpose, the Siberian Railway Committee was organized (Sibirskiye pereseleniya, 2006: 30). However, the new settlers were also householdly and handy people. For example, the Bogomolov family was engaged in agriculture and arable farming. In addition, "grandpa Prokhor", according to the informant, did some commercial works—he made bricks, especially in the fall. He usually returned home not only with money, but also with goods: "If he stays there in the city of Biysk for two weeks, he goes home and people stuff a whole bag with goods for him for free. And he has a family of seven. He goes back, happy…". Children ran to meet him, and he brought gifts for everyone, mainly shirts. Generally, they were kind and responsive people, as our informant believed; "town people respected villagers", they liked peasants. "They came to visit us… In Biysk, one old woman Pastukhova came to visit us. Many times, when I was still little, I went to visit her in Biysk. This house has survived not far from the local history museum, it is not far from there".

The Tolmachev family also did commercial works: its head Fedor Agapovich was a carpenter. For the initial time in Siberia, F.A. Tolmachev built a small house. Later, when the family began to grow rapidly, three sons got married, and grandchildren were born, a new house was built. Tatyana Ivanovna thus told about this stage of her life and customs of moving to a new house: "Then a new house was built, and it was time to move in. Moreover, the old house was still standing; later it was sold. We, children, ran into the new house, and the *domovoy*

*According to her recollections, they were the daughters of Fedor Agapovich's second wife Fedora. After becoming a widower, the head of the family, who had three sons and daughter Avdotya from his first marriage, married a woman with three children.

Fig. 3. Lunch during fieldwork. Booth (*balagan*). *Photo and caption by M.A. Krukovsky, 1910–1912. Archive of the MAE RAS.*

started throwing clay, throwing-hurling clay at us, and we wondered and ran away… And there was no one there, and when we went in, he threw it from nobody knows where. Then we told this to grandpa. Grandpa brought him a *badik* ('stick') and a hat, so that he would come to the new house. People said: 'My dear, let's go home'. They left everything for him, and he came. For some reason, whoever was building always said: 'Oh, we need to call the owner'. …They, as spirits, are invisible, live in every house; not people are the owners, but they". The informant also recalled that owing to liking or disliking of the "master", the cattle would multiply or, on the contrary, not multiply. "Whatever cattle he likes, it will live. Some of the locals had horses, which would not multiply, would die when they were little. Then people told them what the master's name was, and they started to have cattle".

When developing new lands and building new houses, the Ryazan migrants had to prove their right to life and interact not only with neighbors, local residents, but also with the inhabitants of the "unearthly world". Among the neighbors, as Tatyana Ivanovna noted, there were people who were unable to live in a newly built house. "They stayed there, went to bed, and closed themselves up [lit. *zakidayut* 'fling the door closed (latch the door) with a hook' – *E.F.*]. In the morning, they got up, and there was clay and stuff. That's what was going on! Then they were taught to hold a prayer service and buy an icon of Archangel Michael. And since then he stopped, because Archangel Michael is the victor, everyone is afraid of him".

The informant remembered a little story from the Shubinka people about meetings at a new place of residence, judging by the story, with the "masters of the area". In one of the gardens* of the Shadrinovs, which was considered very large, "three persons lived". "Many times people saw how they came out wearing all black. Our men went out, searched and searched, but there was no one. And then they saw how three people came out from there, wearing all black. And the same happened also in some other family. Everyone said that these were some kind of masters…".

Unlike other residents, for example, of the Anuy Volost**, the Shubinka dwellers did not have a tradition of building "field huts", where families lived in the field since the beginning of summer (Fig. 3). "They had something like a village there. They brought out poultry and cattle there, and lived there till winter. Take Aksenova, Lugovskaya, Staraya Chemrovka, Novaya Chemrovka—they all had huts. They dug them a little into the ground, and that's how they slept; they didn't close the doors, nothing like that" (FMA, 1990: fol. 54). These settlements were considered old residents' or, as Tatyana Ivanovna said, "Siberians lived" there.

Back in the 1990s, specific hodonyms, that is, street names of populated areas (from Old Greek ὁδός 'path',

*These were front gardens near houses. There grew poplars that were also growing in this place during the expedition in 2013 (FMA, 2013).

**Now, the Smolensky District of the Altai Territory.

'street', 'channel'), associated with the ethnic and cultural affiliation of the population, were recorded in the village of Shubinka. Even today, the names of streets and also individual districts (*kraya*, *okolki*, *kolki*) indicate the residence of local cultural groups. The village of Shubinka was divided into the Sibir and Ryazan districts, where old-resident Siberians and Ryazan settlers lived, and their descendants live until this day.

Conclusions

Expeditions to the places of origin of settlers in different regions of European Russia and further comparison of the information obtained with ethnic and cultural heritage of the descendants of these people in Siberia have proven the usefulness of the modern method of comparative field research in the study of Siberian migrant masses, in our case, from the Ryazan Governorate. The validity of the author's method of integrating ethnographic and archival data was convincingly demonstrated by the example of the Ryazan families of the Tolmachevs – Bogomolovs – Shadrins from Shubinka Volost in Biysk Uyezd of the Tomsk Governorate. A research chain from archival data of the late 19th to early 20th centuries to the field evidence of the late 20th century was made, and specific features of local cultural adaptation of the settlers were identified. Field data suggest that the second generation of settlers born in the Altai before the 1917 Revolution retained the Southern Russian dialect (distinctive *akanye* and *yakanye*, pronunciation of the voiced "kh" (ɣ), soft "t" in the endings of the 3rd person singular and plural, etc.). Both in the places of exit in the Ryazan Governorate and in the Altai, a variety of last names was observed, which distinguished the Ryazan migrants from some other Southern Russian (Kursk) peasants and old residents of Siberia, among whom "decks" of last names have been recorded (Fursova, 2022: 125).

Ryazan settlers—residents of pre-revolutionary villages of Shubinka Volost—retained specific aspects of spiritual and material life even after almost 40 years from the time of settlement in Siberia. The Ryazan peasants, firmly adhering to Orthodox faith and the respective religious traditions, stood out from other southern Russian peasants in the depth of their ethnic and cultural memory both on the personal and collective levels. The Ryazan peasant migrants most often settled in the places where Russian old residents or settlers lived, and in this aspect, they differed, for example, from the Kursk migrants, who often chose to settle near people from Little Russia (Ukrainians). Thus, until the social and economic transformations of the first third of the 20th century, this environment sustained the cultural core as a focus of values and beliefs, which "is not recognized by either members of the group or external observers, but is manifested in a reflexive sense of their difference from everyone else" (Sökefeld, 1999: 417). The adaptation process was associated with appropriation of space and establishment of sacred connections with the local inhabitants of the "other world", and in earthly reality—with marriages not only to the fellow Ryazan people, but also to the Siberian old residents, which was considered prestigious.

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Textiles as Product and Symbol. Ritual Gift Exchange Among the Karakalpaks and its Central Asian Parallels

This article focuses on the structure, content, and symbolic form of gift exchange practices among the Karakalpaks in the 20th and early 21st centuries, drawing on methodologies used by Russian and Western ethnographers. Our approach is based on a comparative analysis of practices and ideology of donating textile products among the Turkic peoples of Central Asia. We used field, archival, and published materials on the ethnography of the Karakalpaks, Kazakhs, Kyrgyz, Altaians, etc. Characteristics of gift exchange traditions are outlined, functions and symbolism of textiles in rituals are described, and tendencies of their transformation in modern society are assessed. Findings suggest that among most Turkic peoples of Central Asia, gift exchange using textiles has traditionally accompanied many social practices. In Karakalpak family rituals, pieces of cloth were regarded as both material and spiritual values, and their exchange ensured the transfer of vital forces and strengthening the clan structure. As the analysis of modern Karakalpak gift exchange practices has shown, textiles are no longer regarded as products, but have retained their symbolic function at the level of social communication. Such an exchange has become a symbolic expression of mutual aid and solidarity at the family, clan, ethnic, and national levels.

Keywords: *Turkic peoples of Central Asia, Karakalpaks, ritual gift exchange, textiles, patchwork techniques, social networks.*

Introduction

Gift exchange practices among the peoples of the world have been a traditional subject of research in ethnology, and social and cultural anthropology. The emergence and conceptual development of the theory of gift exchange is associated with the names of B. Malinowski, M. Mauss, E. Crawley, C. Lévi-Strauss, M. Sahlins, W. Hamilton, K. Gregory, K. Polanyi, M. Godelier, and other scholars. According to historiographers, their studies provided the foundation for understanding utilitarian and post-utilitarian exchange as a main mechanism of cultural dialogue and social integration, which accompanied the development of humans and humanity (Sykes, 2005; Fomashin, 2020).

After the publication of Mauss's work "The Gift: Forms and Functions of Exchange in Archaic Societies" in 1923–1924, in addition to social and economic aspects, anthropologists gained the interest in the worldview attitudes of gift-giving (Mauss, 2011). Modern scholars perceive the phenomenon of the gift (after Mauss) as the cornerstone of social existence, since "it encapsulates the concern with what it means to be human" (Sykes, 2005: 4; Martynova, 2021: 547). In this regard, an important point, made by Mauss, was that in archaic and traditional societies, gift exchange as "a connection through things is a connection of souls, since the thing itself has a soul, comes from the soul. It follows that to give something to someone is to give something from one's self'" (2011: 151–152). This point has prompted many scholars to study the underlying motivations for gift-giving and their symbolic manifestations.

During the 20th century, dozens of works were written on gift exchange in the archaic, traditional, and modern local and ethnic communities of the world. Traditions of gift-giving and mutual assistance among the nomadic Turkic-Mongolian peoples of Central Asia were discussed in the studies of N.L. Zhukovskaya (1986, 2014), A.A. Badmaev (2013), M.M. Sodnompilova (2018), O.B. Naumova (2023), and others. The works by N.Z. Shakhanova (1998), S. Werner (1998, 2000), Z.K. Suraganova (2009), I.V. Oktyabrskaya and Z.K. Suraganova (2010, 2012), S.Z. Tokhtabaeva (2013), L.F. Popova and A.B. Shalmanova (2021), and other scholars focused on systematic study of ideology, pragmatics, social practices, as well as mythological and ritual accompaniment of gift exchange, using the evidence of the Kazakh culture, outlining the development of the topic, and setting vectors for comparative research.

The subject of this analysis is the unfolding transformation of the Karakalpak culture from the past to present. The origin of this ethnic group, like many Turkic peoples of Central Asia, was associated with the Kipchak environment. The Karakalpaks reached the consolidation stage by the 16th century, and by that time, they settled in the lower reaches of the Syr Darya River, which belonged to the Bukhara khans. Throughout history, the most significant ties for the Karakalpaks were those with the Uzbek, Kazakh, Nogai, Turkmen, and Kyrgyz communities, which had a great influence on the formation of social and normative culture of this people. The history of the Karakalpaks in the 16th–18th centuries was a history of migrations, wars, and tribute paying, which interlinked the destinies of the Turkic peoples of the macroregion. In the early 19th century, the Karakalpaks were conquered by the Khiva khans. After annexation of Turkestan by the Russian Empire, they became a part of the Syr Darya Region of the Turkestan Governorate General.

In the late 19th century, the Karakalpaks were an essential part of the Muslim world. They practiced cattle-breeding and agriculture, and were involved in regional production-and-market relations. A significant part of the lands was used by individual tribes, which were divided into clan groups. Although in the 20th century, with the creation of the Karakalpak Autonomous Republic as a part of the Uzbek Soviet Socialist Republic, the importance of clan structures decreased, they have survived until today.

There is a revival of interest in the traditional values in the present-day Republic of Karakalpakstan—a part of Uzbekistan. Their systematic study began in the mid-20th century. The studies of T.A. Zhdanko (1952), A.S. Morozova (1954), A.T. Bekmuratova (1969), K. Esbergenov (1963), K. Esbergenov and T. Atamuratov (1975), A. Allamuratov (1977), and others analyzed various aspects of everyday life and ritual practices, as well as artistic and spiritual values of the Karakalpaks. The problem of gift exchange as an important part of intra-ethnic relations has not been specifically addressed, although starting from the 1980s, this topic has been discussed using the evidence from other Turkic and Mongolian peoples of Central Asia.

A comparative study of practices and ideology of gift exchange among the Karakalpaks and Kipchak Turkic people determined the content of this work. We used the evidence from field research in 2017–2022 in various regions of Karakalpakstan, as well as information collected in the Issyk-Kul Region of Kyrgyzstan, in the Russian Altai, and in East Kazakhstan. The data from the archive at the Karakalpak Research Institute for the Humanities of the Karakalpak Branch of the Academy of Sciences of the Republic of Uzbekistan and a wide range of published ethnographic information were also used. This study introduces the example of ritual exchange of textiles among the Karakalpaks for revealing the nature of gift exchange as the most important tool of social communication in the past and present.

Traditional gift exchange among the Karakalpaks in the comparative research

The studies by ethnologists, anthropologists, and political scientists in the recent decades have been describing the paternalistic relations in traditional societies of the Central Asian Turkic peoples through the lens of exchange. The exchange was used for the development and redistribution of resources, power, and family ties as a form of stabilization and ethical justification of the system based on a natural economy, as well as tribal, clan, and community relations (Suraganova, 2009).

Gift exchange was a form of traditional paternalism, which accompanied many production and social (including guest-oriented) practices and rituals in the life of most Turkic peoples of Central Asia. Among the Karakalpaks, various types of gift exchange were called *alıs–beris* (‘take–give’) and *qatnasyq* (from Karak. *qatnasiw* ‘participation, communication’). The Kazakhs had similar definitions: *qarym–qatynasta bolu* ‘be in a relationship, in connection’; practices of exchanging gifts were designated by the concept of *alys–beris* ‘take–give’ and *aralasu* ‘mix/mingle’ (Ibid.: 25, 175).

Celebrations with obligatory exchange of gifts included Karakalpak family feasts, in structure and content similar to those of the Kazakhs, Nagaibaks, and other related peoples. Such feasts were called *shashıw toy* (cf. Nogai *shashkyshlav*, Kazakh *shashu*) ‘scatter’, since during their celebration, coins, grain, and sweets were scattered among the guests. The birth of a child, his admission to school (*papki toy*), circumcision ceremony (*sunnet toy*), initiation of a boy into manhood (*aydar toy*), graduation from a higher educational institution (*diplom toy*), weddings, as well as funerary and commemorative rites of the Karakalpaks involved a large number of guests. The number of people invited to large family events could have reached 500 persons. In public opinion, the more people came to the house for a joyful or sad occasion, the higher the status of the family was (Esbergenov, Atamuratov, 1975).

In the rituals accompanying family celebrations, the Karakalpaks, like other Turkic peoples of Central Asia, widely used textiles. These were designated by the words *gezleme* (cf. Kazakh and Kyrgyz *kezdeme* ‘fabric/textile) and *tawar*. The word *tawar* goes back to the Old Turkic *tabar* ‘property’, *tavar* ‘assets, wealth, goods’ (with the derivatives of *tavarlïγ* ‘rich’, *tavarluq* ‘treasury’) (Drevnetyurkskiy slovar, 1969: 526, 542). The Karakalpaks also used this word to refer to a ritual gift in the form of a two-meter piece of fabric. *Tawar* was used in life cycle rituals, as well as rites accompanying economic practices, including mutual assistance *kómek*.

One of symbolically marked processes in the traditional culture of the Karakalpaks was providing assistance in the construction of a house *jay kómek*. When builders laid the *sharqırawıq* beams for window and door openings during the construction of the walls, the hosts invited their relatives and friends, and performed the *sharqırawıq káde* ritual. The guests brought pieces of fabric and scarves. The gifts were hung on the beams and then distributed to those who helped. This decoration of a house under construction corresponded to the arrangement of wedding space. The ritual’s designation partly coincided with name of wedding (or farewell to the bride)—*el káde toy*. The word *káde* (Arab. ‘basis, rule, principle, example’) emphasized the obligatory nature of the ceremony. Similar traditions existed among the Kazakhs; their pre-wedding rituals included a regulated exchange of gifts *káde*, which most often consisted of fabrics (Oktyabrskaya, Suraganova, 2012: 400).

Gift exchange was an integral part of a wide range of social practices among the Karakalpaks. One of them, i.e. inclusion of a child into the system of kinship ties, took the form of the *besik toy* ceremony, during which women sat down around the *besik* cradle. Host of the ceremony approached the cradle, threw her leg over it, and imitated riding a horse. She held an improvised bridle in one hand and the child in the other hand. Other participants in the ritual “bought” the baby from her for a symbolic price. After that, they placed the baby in the cradle covered with seven items of clothing and pieces of fabric that they brought. If there was a girl in the cradle, the number of pieces increased. It was believed that the more clothes and fabrics were thrown over the cradle, the greater the ransom would be given for the girl when she becomes the bride (Bekmuratova, 1969: 19). Some of the clothing items and pieces of fabric given on the occasion of child’s first celebration were distributed among close female relatives. Older women (especially those with a good disposition and large families) took the most active part in this gift exchange.

The Karakalpaks also used textiles as gifts during the rite of *tısaw kesiw* ‘cutting the fetters’. The ceremony implied that by cutting the rope on the feet of a child who took his first steps, a successful, light-footed woman opened the path of life for him. In gratitude, she was given *jagalı kiyim* ‘clothes with a collar’ (blouse, jacket, etc.), which was considered the most valuable; but most often she was rewarded with a piece of expensive fabric.

The greatest number of gifts in the form of woven products and pieces of cloth accompanied the Karakalpak wedding ceremonies. They started with the visit of matchmakers to the bride’s house—*qudalıq toy*. The groom’s parents gave gifts to bride’s parents. Their acceptance of the piece of fabric meant the consent to the marriage, and acceptance of gift in return confirmed the agreement with conditions put forward to the groom’s family. The official agreement *quda túsiw* was also sealed with a gift. At the same time, the parties agreed on the amount of the bride price. The bride price and dowry essentially equalized each other, strengthening the kinship ties between the families and expanding their joint resources.

On the day of the bride’s departure, the *el káde toy* farewell party was held in her parents’ house. The main celebration was big *úlken* toy wedding in the groom’s house, which included the ritual of *kórimlik* (from *kóriw* ‘see’). During the *bet ashar* ceremony of uncovering the bride’s face, those who saw the girl for the first time, gave her and her family money and *tawar* pieces of fabric. In some families, a large sum of money and much fabric

Fig. 1. Dowry of a Karakalpak bride: chest and stack of *kirpeshe* (*a*), pieces of *tayar* fabric on a *syryk* string, given as a gift (*b*). *Hereafter, photos by Z.K. Kurbanova*.

were collected during *kórimlik*. The Karakalpak bride's dowry always included a chest, stack of *kórpeshe* (thin cotton mattresses in patchwork covers), and *kórpe-tósek* bedding items. Traditionally, the chest was opened in the presence of close relatives so they could see the *qızdıń dunyası* ('goods/property of the girl') with their own eyes (FMA, 2018–2022*).

At Karakalpak weddings, great attention was paid to textiles. The pieces of fabric presented as a gift were hung for everyone to see at the entrance to the house on a specially stretched *sırıq* rope. The ritual was called *sırıqqa salıw* (from *salıw* 'put'). The more pieces of fabric hung on the *sırıq*, the more influential the family was considered (Fig. 1).

Dissatisfaction of one of the parties with the quality of fabric during the wedding exchange sometimes became a cause of discord. To prevent this, the *tawar bólistiriw* "auditing" was performed. It was led by a woman who was entrusted with recording the received valuables and providing reciprocal gifts. This role was usually assigned to *jeńge*—the wife of the elder brother or any older female relative of the hostess, and in some cases, to *biy apa*—the wife of the head of the community. This woman of great authority knew how to achieve mutual understanding between the parties. Giving of gifts, among which fabrics played an important role, was an obligatory element in the post-wedding cycle during the traditional visits of matchmakers *quda shaqırıspaq*. According to the custom, the bride's father was given a *jaǵalı kiyim*—a suit or *shapan* (traditional robe) and skullcap, and bride's mother was given a piece of expensive fabric and headscarf. Other close relatives, such as bride's sisters and aunts, also received gifts. Similar gifts were given in return to groom's parents and relatives. The exchange of gifts (fabrics) between two families was of a ritual nature (FMA, 2018–2022).

Much textile was used during the funerary and commemorative rites of the Karakalpaks. In the past, the *jırtıs* ritual (from *jırtıw* 'tear') was always performed during a funeral. The family of the deceased gave away his clothes, pieces of fabric, food and money. Clothes were always given to the relatives of the deceased and to those who performed his ablution (Esbergenov, 1963: 35; Kurbanova, 2020: 127). Among the Kazakhs, belongings of the deceased were distributed a year after death. The entire set of his clothes and utensils was called *tul* 'widowed, barren', it was considered a ritual substitute for the person. The distribution of the components of the set among the relatives was accompanied by distribution of *jırtıs* scraps (FMA, 2017–2019*) (Kazakhi, 2021: 219, 543, 778).

Back in the 1970–1980s, during funerals or commemorations, especially if the deceased was of

*Field materials of the authors collected in the villages in Shimbay, Kegeyli, Khodzheili, and Moynaq Districts of Karakalpakstan in 2018–2022.

*Field materials collected in the villages of Kosh-Agachsky District of the Altai Republic of the Russian Federation and in the East Kazakhstan region of the Republic of Kazakhstan in 2017–2019.

advanced age, it was customary for the Karakalpaks to give a similar piece of fabric as a gift to everyone who brought it. Rolls of fabric (velvet, brocade, chintz) were purchased for distribution among the relatives. The pieces were given to those who brought cattle and *jagalı kiyim* 'clothes with a collar' to the ceremony. All those who came with gifts were sure to receive *tawar* (Kurbanova, 2020: 132).

Similar practices were widespread among the Turkic peoples of Central Asia. The *jırtıs* scraps among the Kazakhs, *zhyrtysh*, *zhirtysh*/*yirtych* among the Kyrgyz, and *yirtysh* among the Uzbeks were similar to *tawar* scraps among the Karakalpaks. They were used in the rituals of economic, cultural, funerary, and commemorative nature, as well as rituals of wedding and children's cycles, and were an obligatory part of gift exchange.

The ritual of *teberik* 'offering, sacred, bringing happiness' (cf. Kazakh 'prayer, offering, gift'; cf. Kyrgyz 'sacred, revered, bringing happiness') among the Karakalpaks has similar meaning and form as ritual of *jırtıs*. Until the 1980s, the bodies of the deceased, which were carried out of the house, were sprinkled with small coins, fruits, and cookies, collected by women and children. It was believed that grace of the deceased was transferred into the scattered offerings, especially if he was an old man with many descendants. The Karakalpaks considered *jırtıs* and *teberik* to be division of property and "life force" of the deceased among the members of his family clan (Esbergenov, 1963: 35). In modern funerary rites, personal belongings of the deceased are distributed at the *iyis* ('smell/spirit') ceremony to the persons who took part in the ritual ablution. Its content is determined by the principle: *Iysin taslamay júr* 'carry the smell (spirit) with you'. It is believed that clothes and textiles preserve the life force of the deceased among his descendants (Kurbanova, 2020).

Functions and symbolism of textiles in gift exchange among the Karakalpaks and other Turkic peoples of Central Asia

Traditionally, textiles played an important role in life support system, as well as social and normative world of the Turkic peoples of Central Asia. The emergence and development of weaving accompanied their cultural genesis. Words denoting thread processing technologies and various fabrics appeared in Old Turkic times. They included not only *tawar*, but also *bóz*—coarse cotton fabric, etc. Etymologically, the word *boez* was associated with the Old Turkic *böz/büz* 'fabric, canvas, calico' (with the derivative *bözči* 'weaver') (Drevnetyurkskiy slovar, 1969: 118–119, 135).

The horizontal narrow-beam loom (like the *órmek* among the Karakalpaks and Kazakhs, and *ormok* among the Kyrgyz) was known to many nomads of the macroregion. Fabrics were usually made by women. Setting up the loom and adjusting the tension of threads required the help of female relatives and neighbors. The beginning and end of the process were accompanied by good wishes and had a ritual form (Glushkova, Oktyabrskaya, 2007).

For weaving at home, the Karakalpaks used both the narrow-beam *órmek* looms and improved *qozaq* looms, which were widespread in Central Asia. Fabrics brought from Bukhara, Karshi, Urgench, Kokand, and Namangan, where large textile centers had been formed since the Early Middle Ages, were widely used in their culture (Tomina, 1980, 1989).

Central Asian fabrics were in great demand in the Eurasian markets. In the Turkic world of Central Asia, textiles served as one of the monetary equivalents for a long time—they were used in paying taxes, trade transactions, and other payments. In the traditional Karakalpak gift exchange system, *tawar* pieces were a part of high status *sarpay* gifts, which were intended for older relatives during wedding celebrations. Such gifts could be scarves, open fronted sweaters for women, and suits for men. *Sarpay* was given both to the bride's side and to groom's relatives during mutual visits.

Rituals accompanying circulation of textiles were based on a system of ideas which go back to mythological narratives of nomads, including ideas about vital technologies—clay molding, forging, churning kumis, making felt, weaving, and sewing, with the help of which the world, humans, and culture were created by the will of the supreme creators (Lvova et al., 1988).

According to traditional beliefs, the goddess Umai possessed creative power (her name has been known since the Old Turkic period) among the inhabitants of the upper world. The Great Mother Goddess was in charge of life and death, helped women in labor, protected children, and was the giver of strength and fertility. The image of Umai was known to the Altaians, Khakass, Shors, Bashkirs, Kazakhs, and Kyrgyz. In addition to small bow and arrow, her symbols among the Turkic peoples of Siberia were white scraps of fabric and tinsel threads.

With the spread of Islam in Central Asia, functions and attributes of Umai were redirected to Saint Fatima (the daughter of the Prophet Muhammad)—Pirim Bibi Patma among the Karakalpaks. Assisting in labor at her will and in her name, the midwives of the Kazakhs and Kyrgyz (*kindik sheshe* – literally, 'mother of the umbilical cord') might cut the umbilical cord of a newborn girl by placing a spindle under it. Among the Karakalpaks, the *kindik sheshe* wrapped the umbilical cord into a piece of cloth and hung it from the cradle as a talisman or buried it in a secluded place. Fatima/Pirim Bibi Patma was considered the patroness of births and women's handicrafts including weaving.

In the traditional culture of the Central Asian Turkic peoples, fabrics created under the supervision and with blessing of the deities were perceived as measures of destiny and life. According to the perception of values, adjusted by Islam, the parts of the *akret* (burial shroud) were the symbol of the end. When cutting the shroud, the Karakalpaks used white cotton fabric: for men its length was 9 m; for women it was 12 m, since the female body was considered sinful and required more thorough covering. The shroud (for men consisting of three scraps, for women of five scraps) was a symbol of the transition of the soul to the afterlife (Poleviye materialy…, 1989).

The Kyrgyz considered the basis of the *akret* a strip of fabric that married women wrapped around their heads to create a turban. Depending on the wealth of the owner, "a 20–30 m long piece of fabric could be used… it (the turban) could have a practical use: if a woman was giving birth outside her home, she could untie the turban and swaddle the child in white fabric; it could also serve as a shroud for the deceased during nomadic journey" (Dzhanabaeva, 2019: 48). Fabric torn into pieces marked the turning points in person's life.

The Kazakhs widely used scraps of fabric during funerary and commemorative ceremonies. In accordance with norms of traditional culture, scraps of fabric (scarves/flags) were raised on a peak or pole above the yurt of the deceased: white if the deceased was an old man; black if he was a mature man; and red if he was a young man. These scraps were included in the *tul*, which recreated the image of the deceased, and were left until the end of the mourning. Throughout the year, the widow lamented the death of her husband near them and kept them, like the entire *tul*, during nomadic migration. Disassembling the *tul*, breaking the pike, burning the mourning flag, and distributing the *jırtıs* signified the completion of the farewell to the soul of the deceased to the other world after the end of the year. According to traditions, the *kasiet* grace-filled power of the deceased was transmitted to the living via *jırtıs* and scraps of clothing. Such ideas were primarily associated with clothing of those deceased who had crossed the sixty-year mark (Kazakhi, 2021: 546–550).

Communion with grace of the deceased through receiving pieces of fabric during the funeral was known to many Turkic peoples of Central Asia, and in a reduced form has survived until the present day (Kazakhi…, 1995: 165–166). Scholars consider this tradition in development, viewing the ritual of tearing the clothes of a revered person (ruler, elder) to be the original form of sacrifice (Oktyabrskaya, Suraganova, 2012).

Overcoming posthumous "entropy" was embodied in the collection of scraps. In the rituals of the family cycle among the Kazakhs, Kyrgyz, Karakalpaks, Nogai, and other peoples, scraps of fabric symbolized the happiness of their owners who managed to live to extreme age, marry off their daughter, celebrate the birth of the heir, etc. Even in the early 20th century, some groups of Kyrgyz had "zhirtysh—pieces of fabric that were distributed to all the women present in the kibitka with the deceased while all posthumous rituals and funeral were in progress, if the deceased was an old man. These pieces of fabric were kept for the children so they would live to the same advanced age" (Fielstrup, 2002: 100). Women sewed a dowry for their daughters with wishes of having many children and cattle from such scraps. It was believed that the more scraps there were, the more grace would be passed on from the people who possessed it during their lifetime. The Karakalpaks, Kyrgyz, and Kazakhs made children's clothes using patchwork technique (FMA, 2020–2021*) (Fig. 2).

Among many Turkic peoples, patchwork sewing was called *quraq*. The Kyrgyz use this word to denote scraps, threads, trimmings, as well as time and age. The word *quraq* is derived from the verb *kura* 'make up from separate scraps, collect, accumulate, grow rich', and also 'unite, put in order'. It had the same meanings in the Karakalpak language. In the Kazakh language, the word *quraq* (from *quru*) has the following meanings: 'create, make up, build, die, disappear, be destroyed' (Yudakhin, 1985: 447; Karakalpaksko-russkiy slovar, 1958: 41; Shaigozova, Naurzbaeva, 2023: 237). The combination of opposite meanings in a single concept determines the semantics of patchwork things that mark the boundary states of life and death.

By using scraps of *tawar* and old clothes, the Karakalpaks made various items with the *quraq* technique, primarily cradle equipment and clothes for newborns. Sometimes the first shirt and hat for the baby were sewn from old things of the parents. However, most often these items were made of 40 conventional scraps by the 40th day of birth. From this day on, the child was shown to strangers, was "brought out" into the world of people. It was believed that patchwork items were able to ward off the evil eye and evil powers, and carried the energy of good wishes and capacity for longevity of all relatives who gave clothes and pieces of fabric. Given these beliefs, pieces of clothing of old people who lived a long, happy life were sewn onto patchwork hats of small children (Kurbanova, 2015).

Joining of scraps together marked the emergence not only of new life, but also of new families. Patchwork items and pieces of fabric were important components of decoration at Karakalpak weddings. At the beginning of the ceremony of entering the future husband's house, the bride was behind the *shımıldıq* curtain made of different pieces of fabric. The *chemıldıq/shımıldıq/*

*Field materials collected in the villages of the Issyk-Kul Region of Kyrgyzstan in 2020–2021.

Fig. 2. Children's jacket – *kurte* (*a*) and old hat – *toppy* (*b*), acting as amulets. *Quraq* patchwork technique. From the collection of the Savitsky Art Museum (Nukus, Republic of Karakalpakstan).

Fig. 3. Wedding curtain *shımıldıq*. *Quraq* patchwork technique.

chimıldıq curtain was known among the Kazakhs, Nogais, and Uzbeks. The Kyrgyz and Altai Turkic people called it *koshogo*/*kozhogo*. The patchwork curtain served as a talisman, acted as a symbol of the newlyweds' home, and was intended to promote the increase of the family and property, and fertility of livestock. The number of patches determined the "producing capacity" of the family. Many household items were made using that same technique (FMA, 2018–2022) (Fig. 3, 4).

Thus, at the level of mythological and ritual life scenarios, the *quraq* patchwork technique among the Karakalpaks and other Turkic peoples of Central Asia evoked the creation paradigm that entailed

Fig. 4. Seeing off the bride to groom's house with the *shımıldıq* wedding curtain on the background.

the transmission of divine grace from ancestors to descendants, continuity of the family clan and its integrity (Oktyabrskaya, Suraganova, 2010).

Trends in the transformation of gift exchange among the Karakalpaks, and its modern versions

In the traditional gift exchange of the Karakalpaks, fabrics acted both as material asset and symbol. The inclusion of the Karakalpaks in the system of regional and then imperial Russian social, political, and economic relations initiated the transformation of their social and normative practices. Functions, content, and scale of the ritual use of textiles changed. It became rationalized throughout the 20th century.

Noticeable changes were observed in the structure of dowry and kalym, which balance each other. In the past, the dowry (*kyzdyn zhugi* – the girl's property) included a yurt (house), home furnishings and decoration items, as well as clothing and fabrics. Later, the dowry began to include furniture, dishware, household appliances, carpets, and bride's clothes. The kalym was paid in money or cattle (currently, cattle is used only in rural areas) (FMA, 2018–2022).

By the mid-20th century, the *bes kiyim* ('five costumes') ritual of handing over new things to the bride emerged in Karakalpakstan as a component of the wedding gift exchange. Today this ritual is perceived as a part of traditional normative culture. Clothes have traditionally been a marker of status, but the *bes kiyim* set was an innovation. Its appearance was caused by low standard of living among the population and implied material support for the new family. Since the mid-20th century, Karakalpaks began to use new things in the rituals of the life cycle. Local versions of *bes kiyim* in funerary and commemorative practices were based on the custom of distributing clothes to people who took part in ablation of the deceased, but gradually, specially purchased clothes began to be used for that. Old things were accepted as a gift only from very old people as a blessing for the heirs (Kurbanova, 2020). In the structure of ritual gift exchange in the second half of the 20th century, *tawar* scraps turned into "commodity"; they primarily became indicators of wealth and prestige.

During transformations, the basis for reproduction of gift-exchange traditions among the Karakalpaks was preservation of the *úrıw* clan (exogamous) structures. The main ones were and still remain six large *úrıw* paired together by marriage: *qtai-qypshaq*, *keneges-mangyt*, and *muyten-qonyrat*. It is known that all of them are united into *arys–Qońırat* and *On tórt úrıw*, and, in turn, are divided into *tiyre*, and those into *kóshe* (Davletiyarov, 2022). Preservation of unity is based on the knowledge of the common origin and is reinforced by sophisticated system of gift exchange in family feasts, weddings, and funerals.

Connections determining personal relationships and individual characteristics of the heads of families and their senior members emerge in modern Karakalpak society along with stable forms of traditional interactions. Neighborhood-territorial communities (*qońsılas*), kinship relations (*aǵayın-tuwısqan*), marriage unions (*shıńaraq*), associations of classmates (*gruppalas*), colleagues (*kásiples*), and friends (*joralas*) remain relevant. These structures form a system of social networks of the Karakalpaks, where various types of gifts circulate. Similar phenomena were observed by S. Werner in the modern society of the Kazakhs (1998, 2000).

At present, there are several most common types of gift exchange among the Karakalpaks, including *súyinshi* (Kaz. *suyinshi*, Kyrg. *suyunchu*)—a small reward given to a person who brings good news. This is most often money, but in the past, fabric, cattle or other valuables were used as gifts. *Payǵazı* (Kaz. *baigazy*) is a gift given to relatives or friends on the occasion of purchasing one's own new clothes; usually this is a small amount of money. *Kórimlik* (Kaz. *koerimdik*, Kyrg. *koerumduk*) is a gift received for showing something new (including the bride). A piece of fabric, scarf, or money can be used for this (Fig. 5).

Jetkersin is a gift that is customarily given to a guest during family celebrations. It symbolizes a wish that the recipient may also experience favorable changes in life. A piece of fabric, scarf, or man's shirt can be used as such gift.

In modern gift exchange among the Karakalpaks, pieces of fabric still play an important role. They constitute over 50 % of all gifts and significantly more together with textile products. Previously, pieces of fashionable fabric of good quality were used in rituals, but by the 2000s, the principles of choosing *tawar* changed. Today, the Karakalpaks bring inexpensive pieces of fabric which are, as a rule, subsequently re-gifted, even to important ceremonies. The nominal value of fabric is not of great importance. In the system of clan, family, neighborly, and corporate relations, the exchange of *tawar* scraps is a form of symbolic maintenance of social ties.

Conclusions

The evidence presented above indicates that gift exchange was and still remains one of the most important elements of the Karakalpak culture. As a part of traditional life cycle rituals, the system of gift exchange implied mutual obligations, which today contribute to cohesion of Karakalpak society and ensure stability of social networks. According to field observations, mutual exchange of textiles among Karakalpaks takes on a symbolic nature. In the urban environment, pieces of fabric are sometimes replaced by monetary equivalent. However, generally, the process of gift exchange still imposes interconnected obligations on its participants: to give, to take, and to reciprocate. Deviation from even one of them may entail public sanctioning. These rules, with the universal nature in traditional societies, retain their significance even today (Mauss, 2011: 134–288).

In the modern Republic of Karakalpakstan, which is a part of Uzbekistan, traditions of ritual textile exchange, as in the past, are supported by public opinion. In addition to practical interest in textile exchange, there is a demand for maintaining kinship ties and mutual assistance with its help. Nowadays, the purpose of gift exchange using

Fig. 5. Wedding ritual *bet ashar*—uncovering the bride's face.

textiles is primarily to form the maximum number of connections and the system of mutual obligations. The expediency of mutual exchange is explained by the unity of origin, which is confirmed by genealogy and memory about the common ancestors and patrons.

Thus, exchange of gifts among the Karakalpaks in the early 21st century acts as a social mechanism, which provides regulatory and communicative functions. Analysis of current gift exchange practices proves their effectiveness in structuring and self-preservation of the society with a sophisticated tribal composition including several dozen units at different levels. These practices contribute to sustaining traditions, cultural values, mutual assistance, and solidarity at the ethnic and national levels.

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The Shining Star of Academician Chen
To the 60th Anniversary of Academician Chen Xingcan

Chen Xingcan is a hundred per cent scholar…
Kwang-chih Chang

In China, when choosing a name, people often use various auspicious characters and their combinations. The name Xingcan is made up of the characters *xing* 星 ('star, stars') and *can* 灿 ('shining, fulgent'). Their combination predetermined a brilliant career for the name's owner.

The future academician Chen Xingcan was born on December 12, 1964 in the Changge County, Henan Province. Having graduated from high school, he entered Sun Yat-sen University (Guangzhou), the Department of Anthropology (specialization—archaeology). He graduated from the university in 1985. In 1991, Chen Xingcan defended his doctoral (PhD) thesis, which he prepared under the supervision of a distinguished Chinese archaeologist, Professor An Zhimin, at the Department of Archaeology of the Graduate School of the Chinese Academy of Social Sciences (CASS). At present, Chen Xingcan has returned to the above-mentioned universities as a professor, to help fostering new experts. He is also a full-time professor at the Oriental Archaeology Research Center of Shandong University (Jinan, Qingdao) and a visiting professor at Jilin University (Changchun). He is the head of one of the China's most famous archaeological museums, the Yinxu Museum in Anyang.

In 1991, Chen Xingcan joined the Institute of Archaeology CASS. He worked his way from the Research Assistant to the Director of the Institute (since 2017). In 2018, Chen Xingcan was elected a full member of the Chinese Academy of Social Sciences. His research interests include the study of sites from the Mesolithic to the Late Bronze Age. Since 1983, he has participated in fieldworks in more than a dozen provinces and autonomous regions of China. In the 1990s, Chen Xingcan undertook his internship and was involved in research works at a number of major foreign universities—Harvard University (Boston, USA), La Trobe University (Melbourne, Australia) and Simon Fraser University (Burnaby, Canada). He has also visited Russia for scientific purposes. In particular, he was a guest of the Institute of Archaeology and Ethnography SB RAS, and has published articles in Russian journals (*Archaeology, Ethnography and Anthropology of Eurasia*, *Vestnik NGU. Series: History and Philology*).

Chen Xingcan pays special attention to the evidence of the transition from the Late Neolithic to the Early Metal Age, since it was at that time that the main civilizational centers on the territory of China were formed. The researcher supervises the section "Society and Spiritual Culture" in the national program "Research on the Origin of Chinese Civilization". He led the following major international projects: "Settlement Types and Environmental Changes on the Zhudingyuan Plateau", "Settlement Types and the Origin of Chinese Civilization", and "Control and Use of Natural Resources in the Early Chinese States". The projects were implemented with the involvement of archaeologists from Harvard University and La Trobe University. As part of these projects, stationary excavations of the sites of the specified period were carried out in Henan Province (Beiyangping, Xipo, Huizui, etc.).

Academician Chen Xingcan has published a number of prominent studies devoted to the methodology of archaeological research and historiography. The researcher focuses on the socio-economic and ecological reconstruction of life of ancient societies on the basis of archaeological findings. Many of his works describe the issues of agrarian economy and its development (in particular, the domestication of buffalo as the main draft animal, the initiation and spread of rice farming). Among the best-known publications of the scholar are the following: "Study on History of Prehistoric Archaeology in China (1895–1949)" (1997), "Archaeological Essays" (in three parts, 2002, 2010, 2020), "State Formation in Early China" (2003; co-authored by Prof. Liu Li), "China Before China: Johan Gunnar Andersson, Ding Wenjiang, and the Discovery of China's Prehistory" (2004; co-authored by M. Fiskesjö), "Collection of Articles on the History of Archaeological Research in China in the 20th Century" (2009), "Chinese Classical Archaeology Intensive" (2019; co-authored by Prof. Li Boqian), and others. He also acted as the Editor-in-Chief of the "Complete Collection of Painted Pottery Unearthed in China" in ten volumes (2021).

In 2012, the book "The Archaeology of China: From the Late Paleolithic to the Early Bronze Age" was published. It was co-authored by Chen Xingcan and Liu Li, a Stanford University professor. The book largely replaced a well-known monograph "The Archaeology of Ancient China" by Kwang-chih Chang (Zhang Guangzhi), which had served as a basic source of knowledge on the Chinese archaeology for the Western scholars for several decades. In 2017, an expanded Chinese edition of the book was published in Beijing. The authors received the Shanghai Archaeology Forum Award in the category "Research" in the same year.

Academician Chen has been active in scientific-organizational and social-political work. Since October 2023, he has been the Executive Director of the Archaeological Society of China. He is also a member of the editorial boards of some of the most important archaeological and social academic journals published in China and abroad. In January 2023, Chen Xingcan was elected to the 14th National Committee of the Chinese People's Political Consultative Conference.

We wish Academician Chen Xingcan further success in creative pursuits so that his star will keep shining brightly in the firmament of the archaeological science.

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AN SSSR – USSR Academy of Sciences

DVO RAN – Far Eastern Branch of the Russian Academy of Sciences

ERAUL – Etudes et Recherches Archéologiques de l'Université de Liège

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)

IEA RAN – Institute of Ethnography and Anthropology, Russian Academy of Sciences (Moscow)

IIiA UrO RAN – Institute of History and Archaeology, Ural Branch, Russian Academy of Science (Yekaterinburg)

IIMK RAN – Institute for the History of Material Culture, Russian Academy of Sciences (St. Petersburg)

KhAEE – Chorasmian Archaeological-Ethnographic Expedition

KSIA – Brief Communications of the Institute of Archaeology, Russian Academy of Sciences

KSIE – Brief Communications of the Institute of Ethnography of the USSR Academy of Sciences (Moscow)

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

SMYA – Suomen Muinaismuistoyhdistyksen Aikakauskirja

TIE – Transactions of the Institute of Ethnography

UrO RAN – Ural Branch of the Russian Academy of Sciences

VSEGEI – Karpinsky Russian Geological Research Institute (St. Petersburg)

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