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Institute of Archaeology and Ethnography

Pr. Akademika Lavrentieva 17,

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Tel.: (383) 330-83-66

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Editors of the original

Russian texts

N.M. Andjievskaya

T.V. Romanenko

Issuing Editor

Y.A. Zhuravleva

Designers

T.A. Klimenkova

A.A. Fursenko

Russian texts translated by

V.A. Baranov

A.A. Evteev

E.Y. Pankeyeva

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N.I. Snytnikova

English texts revised by

L. Baranova

P. Magnussen

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A.P. Derevianko

*Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
Altai State University,
Pr. Lenina 61, Barnaul, 656049, Russia
E-mail: derev@archaeology.nsc.ru*

The Peopling of Mongolia by *Homo sapiens denisovan*

The article continues a series of publications in this journal, addressing the peopling of Iran, Tajikistan, and Uzbekistan by *H. s. denisovan*. Around 400 ka BP, two large populations branched off from the ancestral taxon *H. heidelbergensis* in the Levant. One of them migrated to Europe, where its hybridization with natives gave rise to a new taxon *H. s. neanderthalensis* 200–150 ka BP. The other, having passed through the Iranian Highland, settled in Central Asia, where its mixture with local Central Asiatic *H. erectus*, natural and sexual selection, and adaptation to various environments in the vast Central Asiatic region 200–150 ka BP resulted in the emergence of a morphologically and genetically distinct taxon, whose informal name is *H. s. denisovan*.

Keywords: *H. heidelbergensis*, *H. s. denisovan*, Early, Middle, Upper Paleolithic, Pleistocene, Levallois.

Initial peopling of Mongolia by *Homo erectus*

The topic of the initial peopling of Mongolia arouse the interest of scientists in the early 20th century in connection with the Osborn-Matthew hypothesis on the possible Central Asian center of evolution of animals, including anthropoid apes (Larichev, 1969). The members of the Central Asian Expedition of the American Museum of Natural History under the leadership of R.C. Andrews over a period of five years in the 1920s conducted a large-scale survey and searched for Early Paleolithic sites (Andrews, Osborn, 1926). These surveys covered a significant part of the territory of Gobi and the Gobi Altai. Numerous lithic artifacts were collected from surface in the areas of the Arts-Bogdo and Gurvan-Saikhan ridges and Lake Orog Nuur. In the course of the field work, the researchers collected quite extensive

materials, some of which were described (Fairservis, 1993). I had a chance to view this collection in 1975.

The systematic study of the Stone Age in Mongolia is associated with the activities of the outstanding researcher of the Paleolithic of Central and Northern Asia, Academician A.P. Okladnikov (1981, 1986; Okladnikov, Abramova, 1994). During his first expedition to Mongolia in 1949, along with a number of sites with the surface occurrence of artifacts, he discovered a unique well-stratified Paleolithic site of Moiltyn. In 1960, Okladnikov resumed field work in Mongolia, which continued intermittently until his death in 1981.

Mongolia is an amazing country. My first expedition to Mongolia took place in 1966, and I was fascinated with its endless plains, intermountain basins, and impressive mountains. I participated in twenty expeditions and managed to cover more than fifty thousand kilometers. I travelled through the

same places many times at various seasons of the year, and the landscapes always opened up with new facets and looked new.

Over 1000 Paleolithic sites have been discovered in Mongolia, mostly with a surface cultural layer (Derevianko, 2017). This is due to the specific natural and climatic conditions of this region. In the Pleistocene, owing to strong wind denudation, there were no soil formation and loose sediments were not accumulated; at present, large areas, especially on hill tops, show bedrock surfaces with concentrations of lithic artifacts of various periods.

Each field season lasted for one or two months, and the number of Paleolithic sites discovered varied from year to year. For example, in 1983–1985, in the course of archaeological survey in the Mongolian Altai, 193 sites were recorded (Fig. 1). In addition to localities with the surface occurrence of artifacts, well-stratified sites were revealed in the basins of the Orkhon, Selenga, and Tuin-Gol Rivers and in the Tsagaan Agui and Chikhen caves. The findings

of these expeditions were published in more than 100 papers and 13 monographs (Kamenny vek..., 1990, 2000; Archaeological Studies..., 1996, 1998, 2000; Derevianko, Krivoschapkin, Larichev, Petrin, 2001; Derevianko, Zenin, Olsen et al., 2002; Derevianko, Petrin, 1995; Derevianko, Olsen, Tseveendorj et al., 2000a, b; Derevianko, Kandyba, Petrin, 2010; Derevianko, 2017, 2019; and others).

Owing to insufficient number of well-stratified sites with available geochronological attribution, the period of the initial peopling of Mongolia by *H. erectus* can be determined only by indirect data. The initial migration of *H. erectus* from Africa to the western regions of Central Asia occurred prior to 800 ka BP. At the site of Kuldara in Tajikistan, V.A. Ranov discovered culture-bearing layers in pedocomplexes 11 and 12, overlain by loess and paleosol layers over 100 meters thick (Ranov et al., 1987; Ranov, 1988; etc.). Initially, the site was dated to about 800 ka BP (Ranov, 1992a, b); later, its age was reassessed to 915–950 ka BP (Ranov, Lomov, 2001). In the Altai, 14 km from Denisova

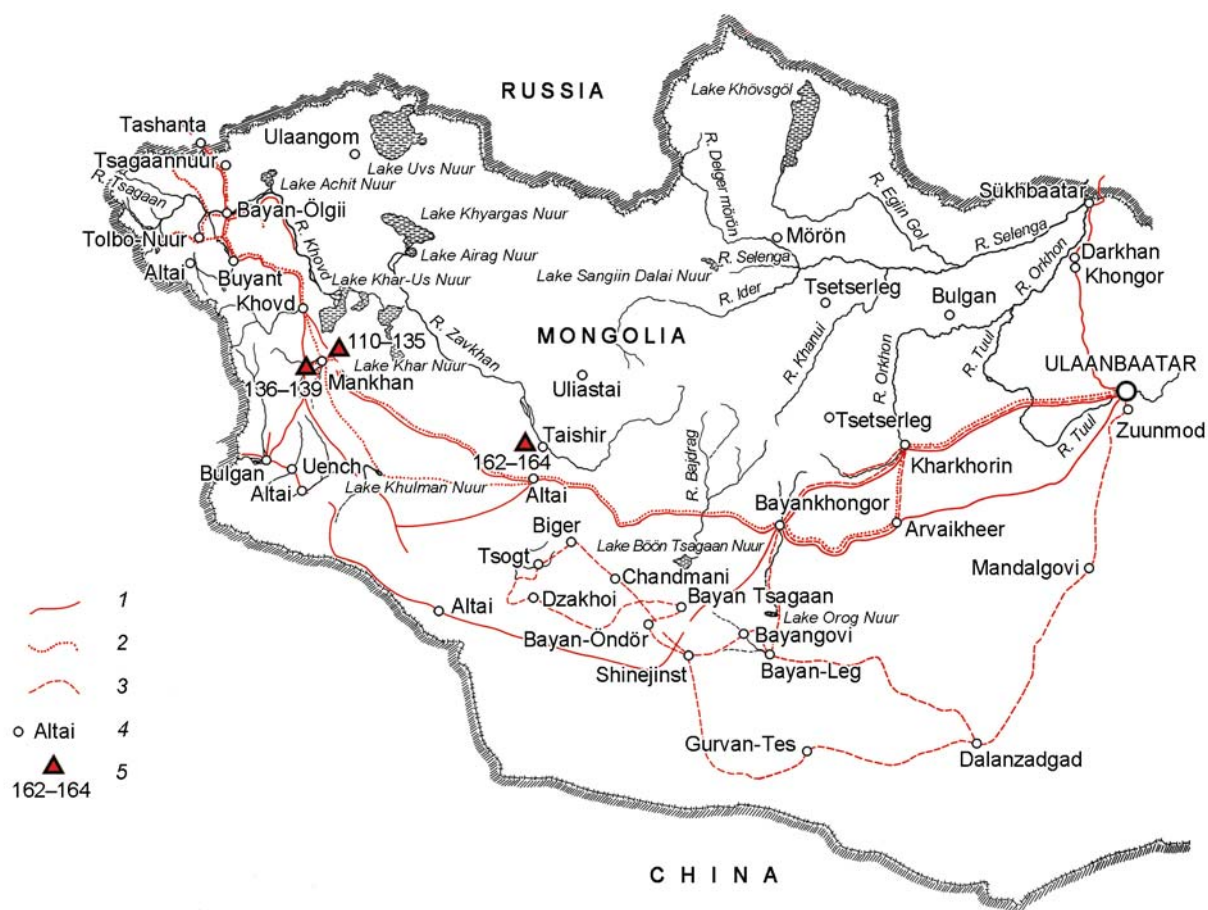


Fig. 1. Survey routes of the Stone Age study team of the Joint Soviet-Mongolian expedition in the territory of the Mongolian Altai in 1983–1985 (after (Kamenny vek..., 1990)).

1 – 1983 route; 2 – 1984 route; 3 – 1985 route; 4 – aimag centers; 5 – archaeological sites.

Cave downstream the Anui River, the site of Karama was discovered; its stratigraphic sequence revealed four culture-bearing layers with pebble-flake industry dating back to 600 (500)–800 ka BP (Derevianko, Shunkov, 2005; Stoyanka..., 2005; Bolikhovskaya, Derevianko, Shunkov, 2006). Mongolia was a transit territory in *H. erectus* migrations; this was the only way for the hominins moving from Tajikistan to the Altai. Hence, colonization of Mongolia by *H. erectus* could have taken place no later than 800 ka BP.

The initial stage of the Denisovans dispersal

The migration of the morphologically and genetically rising Denisovans from the western regions of Central Asia to Mongolia began ca 400–350 ka BP (Derevianko, 2024, 2025). This is evidenced by the findings of excavations in Tsagaan Agui Cave, located in the Bayankhongor aimag, 40 km northeast of the Bayanlig Somon center. The cave site was discovered by the Joint Soviet-Mongolian Historical and Cultural Expedition in 1987. In 1988–1989, cultural deposits of the cave were studied by the Soviet-Mongolian team of researchers of the Stone Age of Mongolia (Derevianko, Petrin, 1995). Since 1995, for four years, Tsagaan Agui Cave has been studied by the Joint Russian-Mongolian-American Archaeological Expedition (Archaeological Studies..., 1996, 1998, 2000; Derevianko, Olsen, Tseveendorj et al., 2000a, b; Derevianko, Devyatkin, Simakova et al., 2000; Kamenny vek..., 2000; Derevianko, Krivoshepkin, Olsen, 2005; Derevianko, 2017; and others).

The cave can be conventionally subdivided into four parts: the Pre-Entry Zone, the Entry Chamber (the narrowest part of the cave), the Great Chamber (the largest cavity in the cave) with a large opening in the ceiling, and the Small Chamber.

On the basis of pollen and other analytical data (see Table), three cycles of sedimentation during the Pleistocene were identified at the site. Cycle 1 is represented by layers 11, 10 in the Pre-Entry zone, layer 6 in the Entry Chamber, and layers 11–13 of the Great Chamber. The results of the pollen analysis indicate that the territory around the cave was forested by mixed- and coniferous-deciduous woods. The samples taken from Pre-Entry layer 11 have revealed the initial stage of the Brunhes chron (Gnibidenko, 1998), corresponding to MIS 18 and 19. The RTL date of 470 ± 117 ka BP (RTL-800) was derived for layer 10 in the Pre-Entry Zone, and the date of 520 ± 130 ka BP (RTL-805) for layer 12 in the Great Chamber.

Cycle 2 of sedimentation (layers 6–11 of the Great Chamber, layer 5 of the Entry Chamber) took place during the relative cooling period as compared to the general fairly warm climate. Lithological horizons composed of sands, sandy loams, and loams with fine and coarse-grained deposits, as well as alluvial pebbles, were accumulated. For layer 11 of the Great Chamber, the date of 450 ± 123 ka BP (RTL-803) was generated, which corresponds to MIS 12.

Cycle 3 of sedimentation (layers 4 and 5 of the Pre-Entry Zone, layers 2–5 of the Great Chamber) took place during the growing aridization and cooling period as compared to the previous stage. Steppe cenoses dominated in the region; severely reduced forested areas consisting mainly of coniferous and small-leaved species still existed in the mountains. The following dates are available for the Great Chamber layers: layer 5 was dated to 227 ± 57 ka BP (RTL-804), the upper part of layer 4 was dated by the ESR method to 44 ± 5 ka BP; layer 3 was dated to the range of 30–33 ka BP according to several radiocarbon determinations.

The resulting geochronological sequence of Tsagaan Agui Cave should be considered preliminary. Apparently, the RTL age of the lower layers was greatly overestimated. This is confirmed by the results of radiocarbon and ESR dating, as well as by the animal bones typical of the Upper Pleistocene found in layer 5 dating back to ca 200 ka BP.

The culture-bearing layers belonging to cycle 1 of sedimentation yielded quite few lithic artifacts: two bifacially worked pieces, a combination tool, several flakes and retouched fragments. One side-scaper-like bifacial tool was fashioned on a robust piece of rock (Fig. 2, 3). It has a triangular cross-section. The base side partially retains the natural cortex—a kind of back. The opposite edge bears discontinuous retouch on both sides. The morphology of the other tool (Fig. 2, 4) suggests its classification as a bifacially processed implement resembling Acheulean handaxes. The artifact shows an elongated oval shape and a lenticular cross-section. Reduction was executed by large and broad detachments. The proximal part is fashioned by large transverse removals; the distal portion shows negative scars of large detachments on one side, and smaller ones on the other; edge of the artifact shows signs of additional retouch. The combination tool (Fig. 2, 2), with working elements of notched and side-scaper-like products, was made on a large and thick flake. The notch was shaped on one of the longitudinal edges of the artifact by a removal, and shows additional rejuvenation by fine marginal

Summary table of the main pollen data, chronological determinations, and paleoclimatic reconstructions for Tsagaan Agui Cave

Pre-Entry Zone				Great Chamber			
Layer	Pollen data	Climate	Dates	Layer	Pollen data	Climate	Dates
0	Semi-desert-steppe landscapes	Modern; precipitation 112–133 mm per year	–	0	Semi-desert-steppe landscapes	Modern; precipitation 112–133 mm per year	–
4 (upper part)	Trees and shrubs – 67 %; significant increase of the share of broad-leaf trees; the share of Betulaceae – up to 54 %; Chenopodiaceae – 36 %; <i>Artemisia</i> – 8 %. Forest-steppe landscapes	Warmer and more humid than the previous and the modern ones	–	1	–	–	931 ± 65 BP (AA-26586)
4 (lower part) 5	Grasses and shrubs – 68–92 %; Chenopodiaceae – up to 75 %; Compositae – up to 21 %; Arbores: <i>Pinus</i> sg. <i>Diploxylon</i> – up to 79 %; solitary broad-leaf trees. Steppe landscapes	Growing aridization; slightly cooler than the previous one	175 ± 44 ka BP (RTL-802)	2–5	Grasses – 75 %; dominant are Gramineae, Compositae, Chenopodiaceae, <i>Ephedra</i> , Polygonaceae; tree-shrub species: <i>Alnus</i> , <i>Fraxinus</i> , <i>Carpinus</i> , <i>Tilia</i> , <i>Picea</i> , <i>Pinus</i> , <i>Betula</i> . Steppe landscapes with rare inclusions of forest associations	Cooler than the previous one, with heavy aridization	Layer 3 32,960 ± 670 BP (AA-23159) 33,497 ± 600 BP (AA-26588) 33,777 ± 585 BP (AA-26587) 30,942 ± 478 BP (AA-26589) 33,840 ± 640 BP (AA-23158) Layer 4 49 ± 6 ka BP (EU) (QT 40 & 41) 57 ± 7 ka BP (LU) (QT 40 & 41) 66 ± 9 ka BP (RU) (QT 40 & 41) Layer 5 227 ± 57 ka BP (RTL-804)
7 8	Grasses – from 72 to 98 %; trees and shrubs: <i>Pinus</i> sg. <i>Diploxylon</i> , <i>Carpinus</i> , <i>Ostryodsis</i> ; solitary broad-leaf species; grass and shrubs: Compositae – up to 85 %; <i>Ephedra</i> – up to 21 %, Chenopodiaceae – 36 %. Steppe landscapes	More humid and warmer than the modern one; precipitation: > 400–500 mm per year	–	6–11	Dominant tree pollen: pine – up to 50 %, spruce – up to 24 %, birch – up to 55 %; broad-leaf trees: elm, hornbeam, maple, oak, lime; Moraceae and <i>Juglans</i> are disappearing; Asteraceae and Polygonaceae predominate among the grasses. Forest and forest-steppe landscapes	Cooler than the previous one, but more humid and warmer than the modern one	450 ± 123 ka BP (RTL-803)
10 11	Trees and shrubs – 67–87 %; <i>Carpinus</i> – up to 39 %; <i>Fraxinus</i> – up to 14 %; <i>Betula</i> sect. <i>Albae</i> – up to 18 %; conifers: <i>Cedrus</i> , <i>Picea</i> , <i>Pinus</i> ; broad-leaf species: elm, hornbeam, maple, oak, lime. Forest and forest-steppe landscapes	"	470 ± 117 ka BP (RTL-800)	12 13	Trees and shrubs – 75–90 %; spruce – 25 %, pine – up to 35 %, Betulaceae – up to 28 %; broad-leaf: <i>Alnus</i> – up to 15 %, <i>Carpinus</i> – up to 10 %, <i>Ulmus</i> – up to 6 %; <i>Corylus</i> – up to 8 %, <i>Tilia</i> – up to 22 %; <i>Juglans</i> , Moraceae. Forest and forest-steppe landscapes	More humid and warmer than the modern one; precipitation: > 400–500 mm per year	520 ± 130 ka BP (RTL-805)

retouch. The fragment of an end-scraper-like tool (Fig. 2, 1) was worked by semi-abrupt dorsal retouch.

The presence of a bifacial tool in the lowermost cultural layer points to the arrival of Denisovans to Mongolia, who had the lithic industry different from the pebble-flake variety of *H. erectus*. Unfortunately, the paucity of finds in the layers of sedimentation cycle 1 and the unreliability of the geochronological attribution do not allow for age estimation of this significant event.

Primary reduction in the lithic industry related to the initial stage of sedimentation cycle 2 is illustrated by various types of cores, preforms, core-like fragments, laminar spalls, flakes, shatters and chunks. The collection of lithic artifacts contains Levallois cores for the production of flakes and elongated spalls. The Levallois flake cores are rounded in shape. Striking platform was prepared by removals on one side, while flakes (including laminar) were detached from the opposite side (Fig. 3, 1). Cores for the production of elongated subtriangular spalls are convex; the flaking and back surfaces were prepared by centripetal removals; a wide striking platform beveled toward the back surface was usually shaped by a single large detachment (Fig. 3, 4). The collection includes a small number of subprismatic single- and double-platform cores (Fig. 3, 6). Their striking platforms were prepared by a single wide removal followed by minor subsequent trimming. Usually, the main reduction was carried out from one of the platforms, while the opposite platform was used to maintain the required convexity of the flaking surface. The number of blanks detached from cores of this type was usually limited to two or three (elongated spalls with subparallel longitudinal edges). The blanks include laminar specimens (Fig. 3, 8, 9). The collection also contains a core modified into a side-scraper (Fig. 3, 5), a fragment of a carinated end-scraper-type tool (Fig. 3, 2), a side-scraper-like tool made on a convergent blank (Fig. 3, 7), and a spall with irregular retouch (Fig. 3, 3).

The choice of the blank production strategy that the Denisovans used at Tsagaan Agui may have been largely due to the poor quality of the available raw materials. Numerous internal voids and crystalline inclusions often resulted in defects. The industry clearly shows the bifacial flaking and Levallois reduction strategies, which characterize the initial stage of the dispersal of Denisovans in Mongolia.

In the second half of the Middle Pleistocene, the Mongolian Paleolithic demonstrates significant variability in lithic industry. This is explained by the fact that representatives of the morphologically and genetically rising Denisovan taxon arriving to this

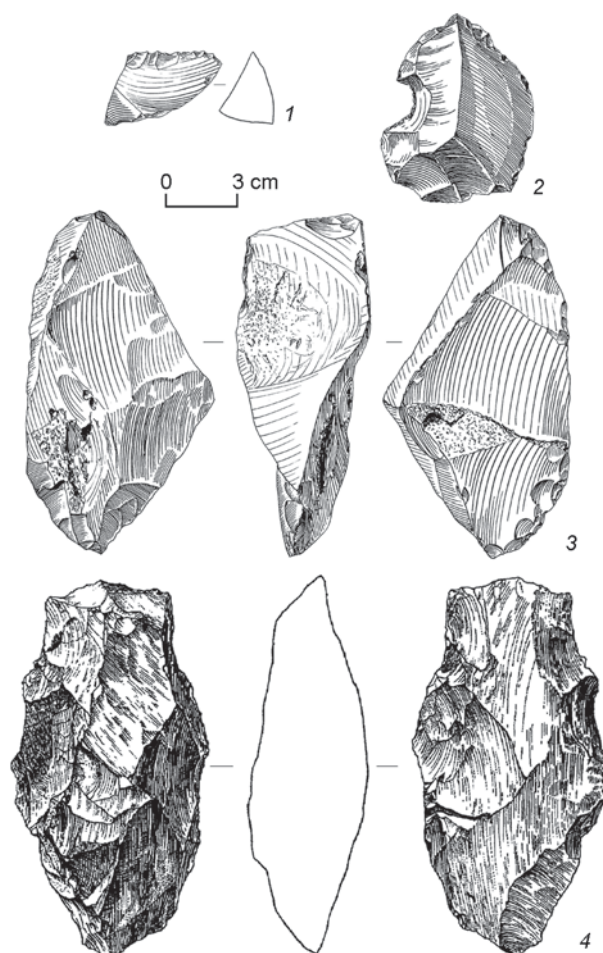


Fig. 2. Lithic artifacts from the layers of sedimentation cycle 1 in Tsagaan Agui Cave (after (Arkheologicheskoye issledovaniya..., 2000)).

1 – end-scraper-like implement; 2 – combination tool; 3 – bifacial tool; 4 – handaxe-like bifacial tool.

region encountered an indigenous population here—Central Asian *H. erectus* with a pebble-flake industry. Over a long period of time, hominins of these two taxa settled in the vicinity to one another, and could have assimilated and passed on innovative stone processing technologies to each other.

In Mongolia, same as in other regions of Central Asia, the Denisovans used bifacial handaxe-type tools only at the initial stage of habitation. The sites with bifacial tools are quite few; while the Levallois primary reduction technique spread across almost the entire region. Currently, handaxe-type tools have been reported from the sites of Otson-Mant, Mandal-Gobi, Mount Yarkh, and Dno Gobi in eastern Mongolia and the southeast of the Gobi Altai (Okladnikov, 1986; Derevianko, 2014, 2019). Seven Paleolithic sites have been discovered in the Otson-Mant area, located east of Mount Sain-Shand. In this area, a vast valley is bordered

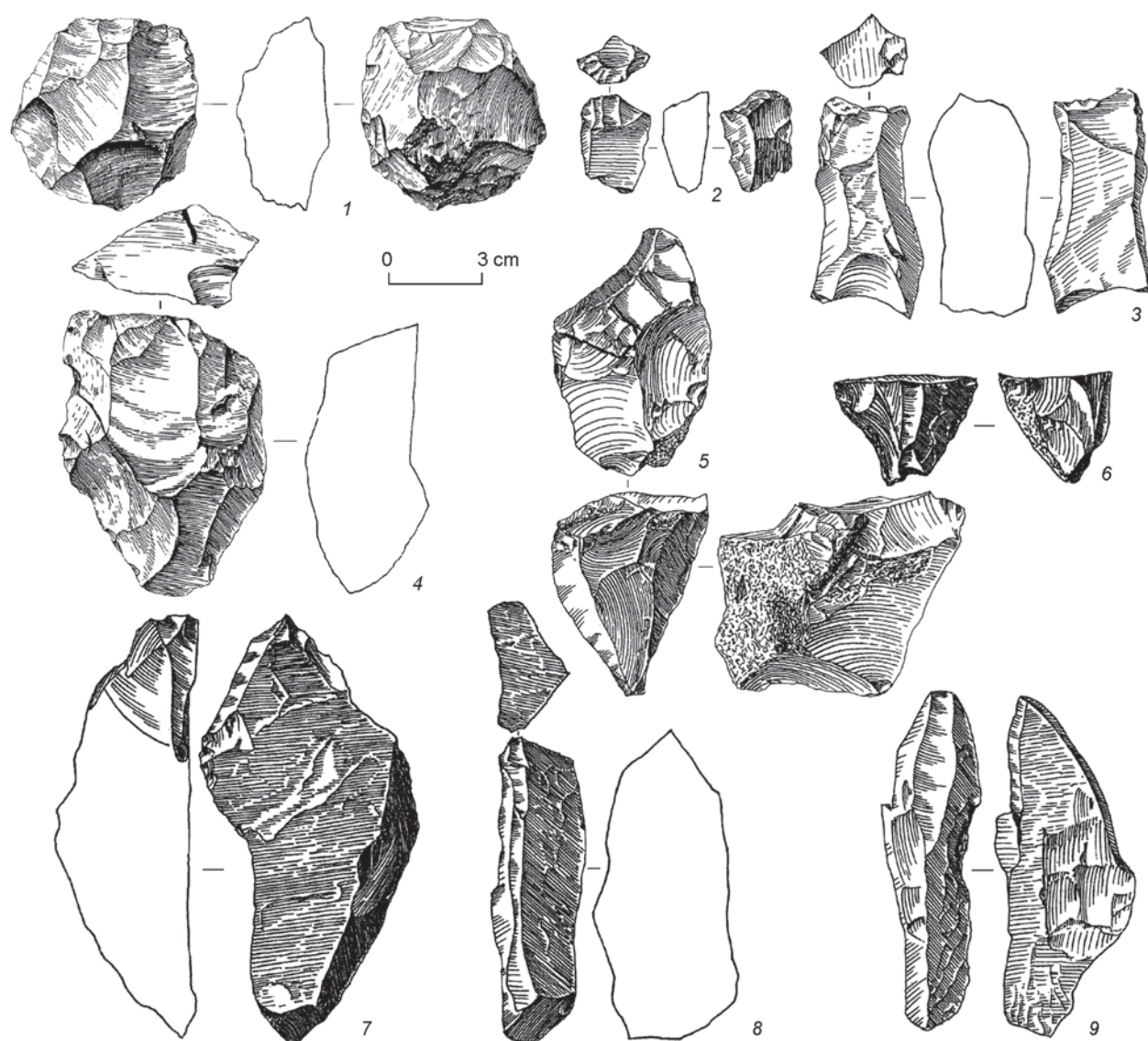


Fig. 3. Lithic artifacts from the layers of sedimentation cycle 2 in Tsagaan Agui Cave (after (Arkheologicheskoye issledovaniya..., 2000)).

1, 4, 6 – cores; 2 – tool fragment; 3 – flake with irregular retouch; 5 – core modified as a side-scraper; 7 – side-scraper-like implement fashioned on a convergent blank; 8, 9 – laminar blanks.

on the east and west by ridges of low hills composed mainly of coarse-grained granites. The granites are covered with chert deposits (Okladnikov, 1986: 12).

Paleolithic sites were located at the foot of granite remnants. The largest number of lithic artifacts was recorded at the site of Otson-Mant-7, where loci A and B were established. The limited area of the site yielded many flakes, various blanks, including laminar flakes and blades. Black chert was used as a raw material. Several bifacial tools were found at locus A. One of them was made of a flat chert pebble, subtriangular in plan view and lenticular in cross section (Fig. 4, 2). Both of its surfaces were treated by flake removals of various

sizes, directed mainly from the edge to the center. The sharp distal part was formed by small longitudinal and transverse removals followed by additional retouch. The proximal oval-shaped part was especially thoroughly treated on both surfaces. This specimen was used as a chopping tool. The other bifacial item was also made on a pebble. Both surfaces were shaped by longitudinal and transverse removals (Fig. 4, 8). The biface was used as a chopping tool; later, several flakes, including laminar ones, were detached from it.

Primary reduction at the sites of Otson-Mant was based on radial and Levallois techniques. One Levallois core from locus 7A was made from a subtriangular

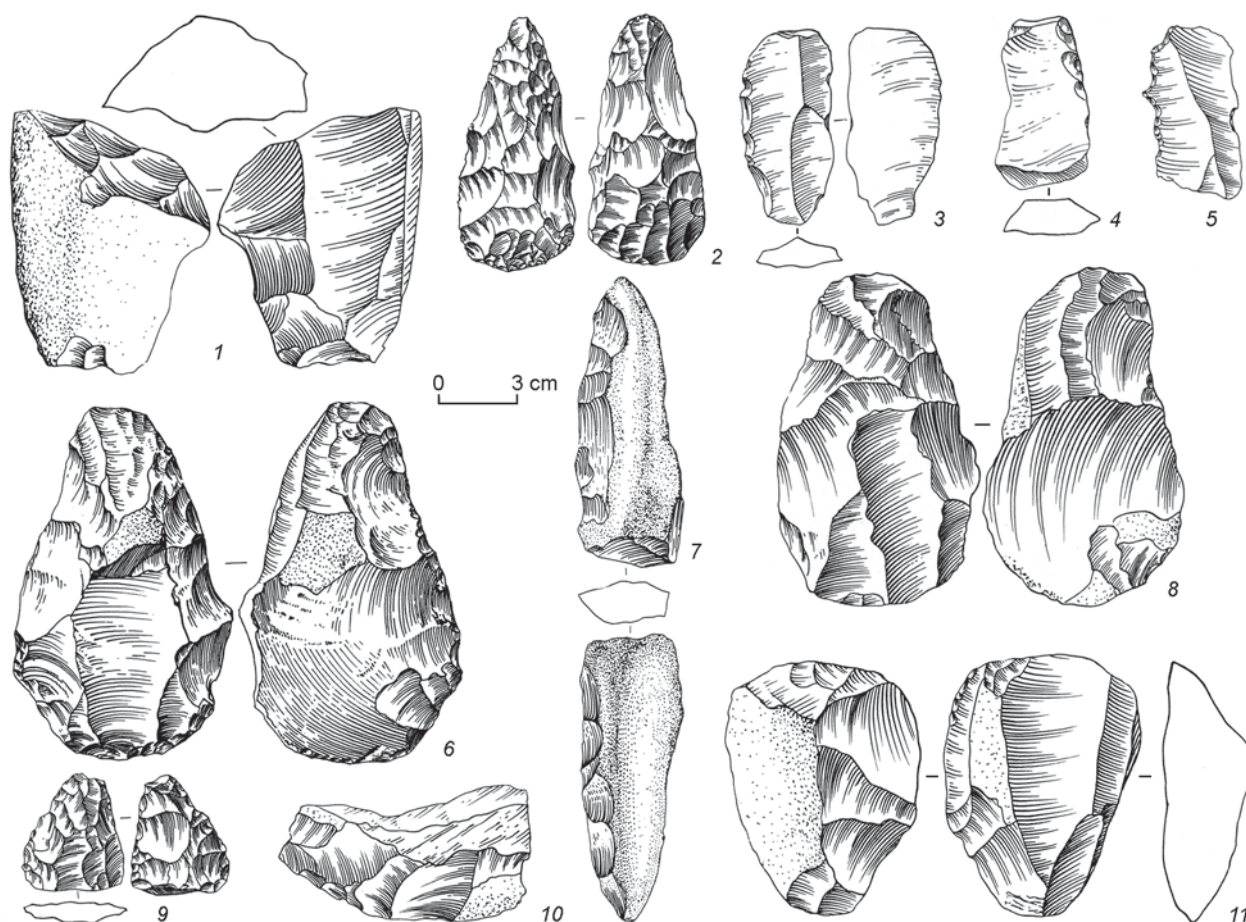


Fig. 4. Lithic artifacts from Otson-Mant (after (Okladnikov, 1986)).

1, 11 – cores; 2, 6, 8, 9 – bifaces; 3, 4 – retouched blades; 5 – denticulate tool; 7 – backed knife (side-scraper); 10 – side-scraper.

pebble (Fig. 4, 11). One of its surfaces bears a striking platform prepared by a series of spall detachments; the striking platform forms an acute angle with the flaking surface for the production of laminar blanks. The tools kit from this locus comprises side-scrappers of several varieties (Fig. 4, 10), denticulate-notched tools, and retouched flakes.

Bifacial tools were also recorded in locus 7B. One such tool was fashioned on a subtriangular pebble (Fig. 4, 6). Both of its surfaces bear negative scars of transverse and longitudinal removals of various sizes. One surface and the lower oval-shaped cutting edge were trimmed by irregular marginal retouch. This bifacial tool, same as the biface from locus 7A, was subsequently used as a nucleus. This locus also yielded discoidal, sub-rectangular, and Levallois cores (Fig. 4, 1). A fragment (upper part) of a small biface (Fig. 4, 9), thoroughly treated by small longitudinal and transverse removals from both surfaces and retouch, is worth noting. Another product was designated by Okladnikov as a biface blank. According to the shape

(pebble flat in plan view) and degree of preparation, this tool should probably be attributed to side-scrappers or naturally-backed knives (Fig. 4, 7). Locus 7B revealed laminar flakes with traces of retouch, including notched-denticulate retouch (Fig. 4, 3–5).

All loci at Otson-Mant presumably belong to the same chronological stage. The surfaces of all artifacts bear a distinct patina and traces of severe corrosion. The edges of negative scars are considerably smoothed. According to Okladnikov, these loci “belong not to the Late, but rather to the Middle Acheulean period” (1986: 13). In my opinion, the Otson-Mant loci and other sites with bifaces should be dated to ca 350–250 ka BP. Occurrences of bifacially processed tools suggest that this industry can be attributed to the Late Acheulean.

The Otson-Mant area attracted Denisovans not only as a source of good quality raw materials for stone tools manufacturing. The topography of the area, intersected by deep channels of now-extinct watercourses, indicates that it provided sufficient water resources in the pluvial periods of the Pleistocene.

In 1968, in the southeastern part of Mongolia, localities with a much larger number of bifacial tools were discovered. One of them was located on the way from Somon Mandakh to Somon Undurshil. The majestic domed peak of Mount Yarkh, revered by Mongolians, is clearly visible from the road. About 4 km to the west of the mount, the slope of a small hill, composed mainly of whitish-gray quartzite, yielded many yellow jasper-like rocks of various sizes scattered over the surface. Among the rocks, thousands of stone artifacts were identified, showing varying degrees of preparation and made from this raw material. This site used to be a workshop. To manufacture tools, the Denisovans used partings or broke out pieces of rock from vein outlets. Many nodules showing the initial stage of processing were observed among the densely scattered lithic artifacts. The rocks were characterized by fissuring, internal cavities, and were covered with porous cortex, which had to be removed before flaking.

Primary reduction was executed through three main techniques: discoid, Levallois, and subprismatic. Discoidal cores were prepared on thick and ovoid pebbles (Fig. 5, 6, 11). Negative scar on one surface was used as a striking platform; on the other surface, the next shortened flake was detached from the edge to the center. Some cores partially retained their pebble cortex in the middle part. Levallois cores were found in small numbers (Fig. 5, 5). These were prepared on thick subtriangular or ovoid pebbles. Striking platform was shaped by transverse removals from one side; the other side was used for the detachment of laminar blanks. All subprismatic cores are single-platform, with one flaking surface. Stone partings and pebbles demonstrate striking platforms prepared by transverse removals on one surface; the striking platform formed an acute angle with the flaking surface, from which laminar flakes and blades were detached.

Tools are dominated by those with bifacial working; they can hardly be classified into a specific type. The most numerous group of bifacially processed tools are side-scrapers. Their only distinguishing feature is additional retouch on one lateral edge. Such artifacts were fashioned on flat blanks. Bifacial side-scrapers are mainly longitudinal (Fig. 5, 2, 4, 8, 12). Several convergent side-scrapers were identified (Fig. 5, 13, 19). One of them was fashioned on a subtriangular flake (Fig. 5, 13). First, the entire dorsal surface was flaked, then, the edges were trimmed by one-stepped large-faceted retouch. Ventral surfaces exhibit traces of fine irregular retouch. There are scraper-like combination tools with points (Fig. 5, 3, 7).

These were prepared mainly on flat pebbles. One or partially two edges of these tools were treated by large-faceted retouch or small removals with discontinuous rejuvenation by fine retouch. A point was fashioned at one of the ends by retouch and chip removals.

Pointed tools were fashioned on bifaces (Fig. 5, 17, 18) and flakes. One of these was made from a subtriangular pebble split lengthwise. One surface shows flake scars from the edges to the center. Pebble cortex was retained only partially (Fig. 5, 18). Two removals were made from the opposite surface. Another unifacial tool made on a pebble split lengthwise shows dorsal surface prepared by spall removals (Fig. 5, 15). A large biface-point was shaped in an original way (Fig. 6, 2). Its pointed part was carefully treated by small longitudinal removals; but two faces bear negative scars of large detachments.

One of the most numerous typological groups consists of bifaces of various sizes (see Fig. 5, 1, 9, 10, 14, 16; 6, 1, 3–6). These tools were manufactured of large flakes and pebbles; in plan view, they are mostly ovoid, more rarely subtriangular and heart-shaped. They were formed mainly by large removals from the edges to the center. The bifaces also bear negative scars of longitudinal removals. The tip of some bifaces was carefully prepared by flaking and additional trimming with retouch. There are bifaces with an oval-shaped distal part, without a distinct tip. Many of them do not show traces of trimming with retouch on lateral edges. Some bifaces have only one face prepared by flaking, while the opposite face is only partially processed. One such item was made of a pebble split lengthwise. The lateral sides of the bifaces are serrated. All the stone tools show heavily abraded surfaces.

The Mount Yarkh lithic industry is characterized by a distinct bifacial processing of not only bifaces, but also scraper- and point-like items. Although the bifaces from this site are somewhat different from the classic Acheulean handaxes, the composition of the tool kit leaves no doubt that this industry belonged to the Late Acheulean.

Westwards of Mount Yarkh, there is one more mountain, rising above the steppe plain, Chin. Abundant Paleolithic artifacts have been found at its foot, on the slopes, and on the summit. In this region of the Middle Gobi, the most informative group of Paleolithic sites in Mongolia was discovered (Okladnikov, 1986: 13–14). The sites are located 53 km north of the town of Mandalgovi, the administrative center of the Middle Gobi aimag (now, the Dundgovi aimag). This area is called the Yorool (Bottom) Gobi. It is a deep depression bordered by steep basalt cliffs

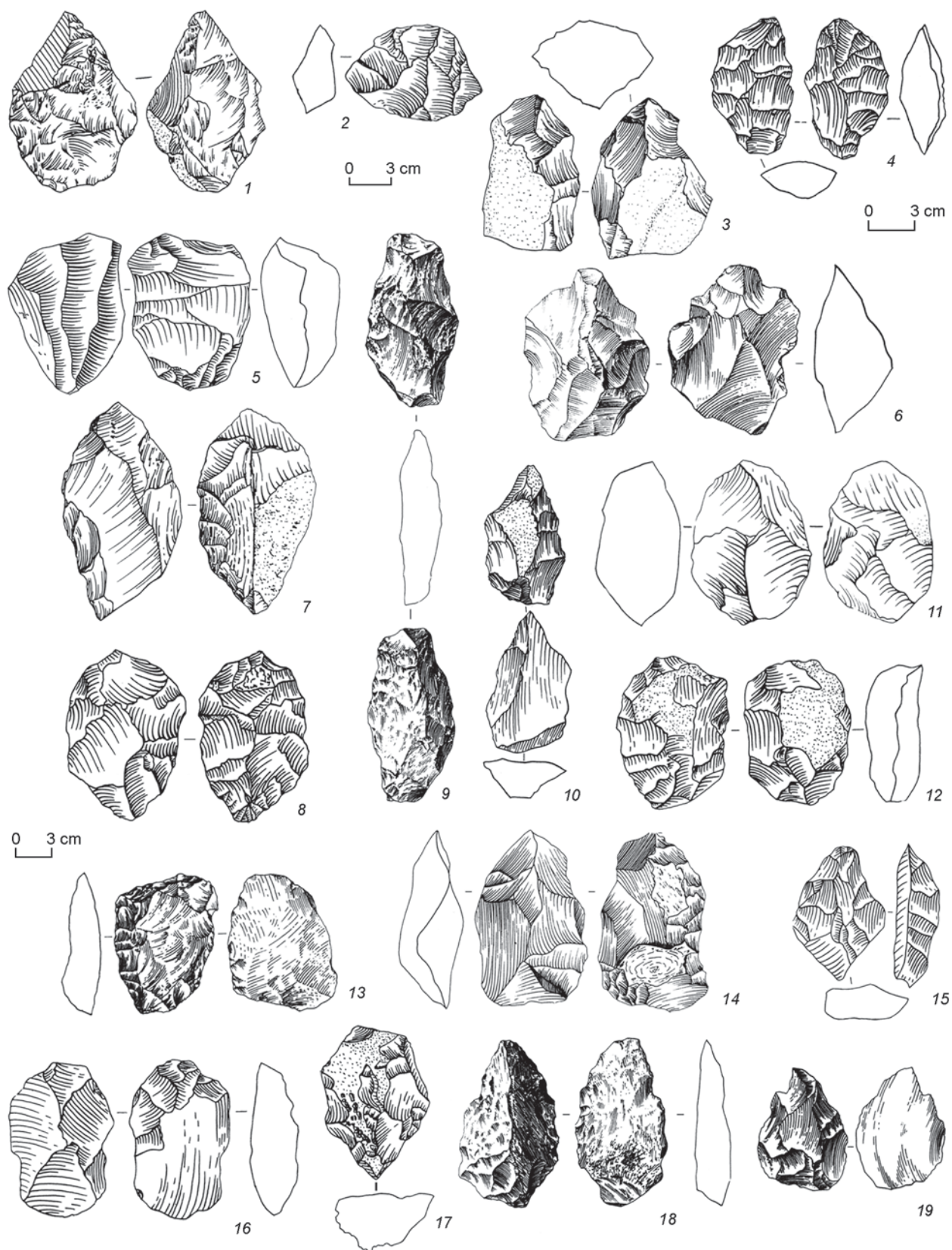


Fig. 5. Lithic artifacts from Mount Yarkh (after (Okladnikov, 1986)).

1, 9, 10, 14, 16 – bifaces; 2, 4, 8, 12 – side-scraper-bifaces; 3, 7 – side-scrapers with points; 5, 6, 11 – cores; 13, 19 – side-scrapers on flakes; 15 – uniface; 17, 18 – pointed tools.

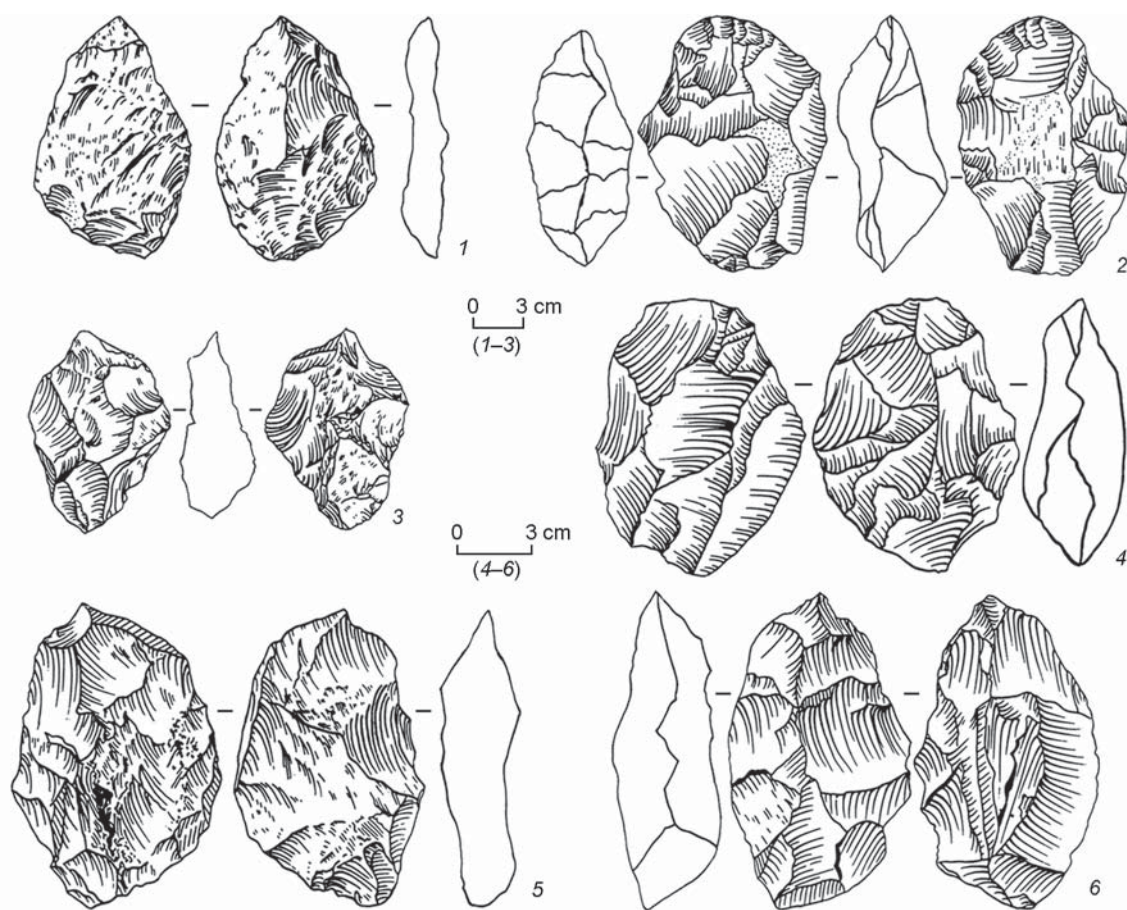


Fig. 6. Bifaces (1, 3–6) and pointed bifacial tool (2) from Mount Yarkh (after (Okladnikov, 1986)).

30–40 m high on the south and north. Along the edges of the cliffs, abundant artifacts attributable to a wide cultural and chronological range (from the Early to the Late Paleolithic) are concentrated.

Some artifacts with heavily abraded surfaces and a layer of patina were noted in the assemblage. This lithic industry contains bifacially processed tools. Primary reduction at the sites under consideration is illustrated primarily by discoidal (Fig. 7, 6; 8, 2), Levallois, and subprismatic single- and double-platform (Fig. 9, 7) cores. The bifaces demonstrate various shapes: ovoid, lenticular, subtriangular, and heart-shaped (see Fig. 7, 1–5, 7, 8; 8, 3–5; 9, 1–3, 5, 6). They were manufactured mainly from pebbles. Isolated bifaces retained pebble cortex. All the bifaces were treated by removals of various sizes directed from the edges to the center. A few bifaces show longitudinal removals. Some of these tools have the well-prepared distal part. Apparently, these were used as multifunctional tools. Chisel-like tools were also noted (see Fig. 8, 1, 6). Some bifacial items could have been used primarily as side-scrappers

(see Fig. 9, 4). In terms of typology, the industry with bifaces from the site of Yorool Gobi can be defined as Late Acheulean.

Sites with isolated bifaces were also found in other areas of Mongolia. However, these artifacts are probably casual; and these sites can only tentatively be classified as the Late Acheulean.

The surface occurrence of cultural layer at the sites with bifaces does not provide grounds for the age estimation. Considering the heavily abraded surface of the negative scars on stone tools, as well as the Late Acheulean appearance of the lithic industry, these sites should be attributed to the initial stage of the dispersal of Denisovans in Mongolia.

One of the most important Paleolithic sites in Mongolia is the Flint Valley, discovered in 1995 by participants of the Joint Russian-Mongolian-American Expedition in the course of surveying the southern face of the Gobi Altai (Derevianko, Zenin, Olsen et al., 2002). This valley borders upon the Arts Bogdo Ridge in the south and reveals the outcrops of light-gray chalk flint of good quality over an area of tens of square

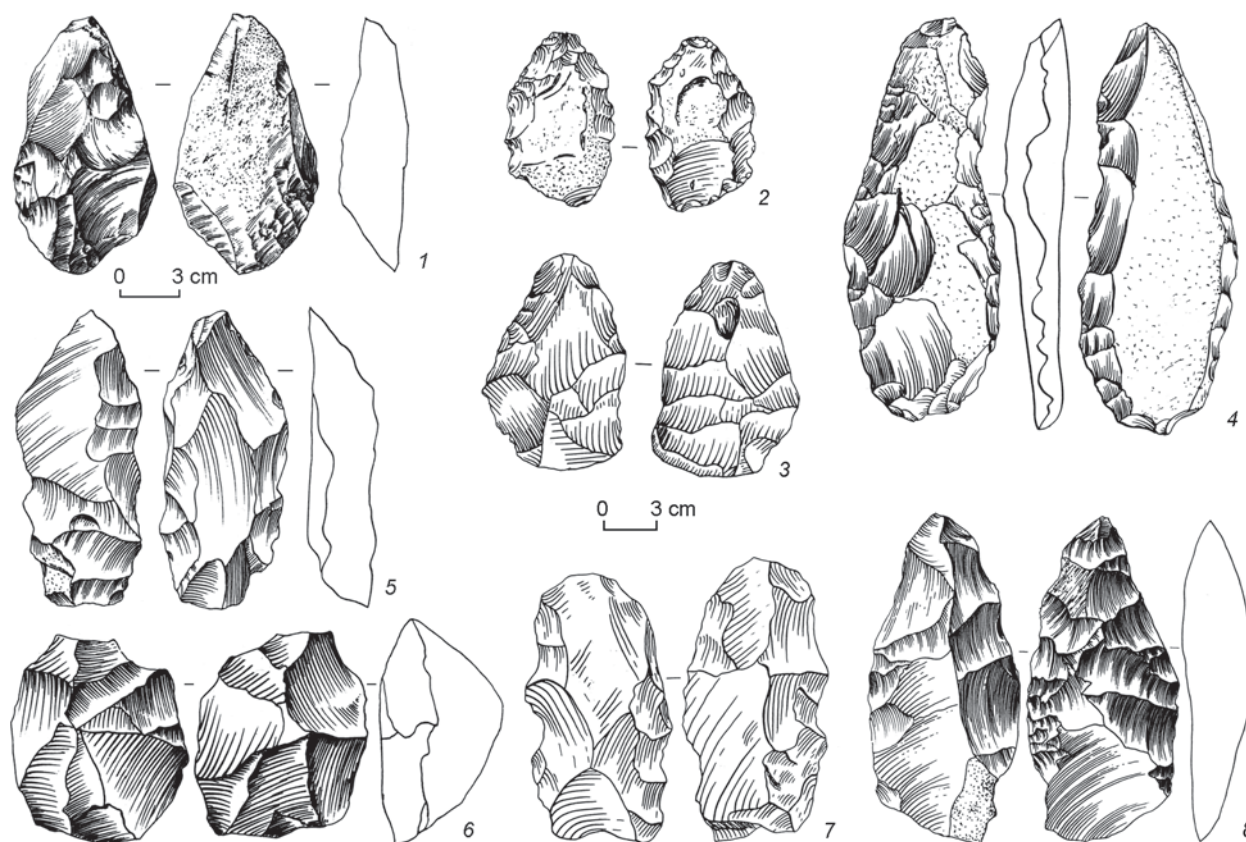


Fig. 7. Bifaces (1–5, 7, 8) and core (6) from Dno Gobi (after (Okladnikov, 1986)).

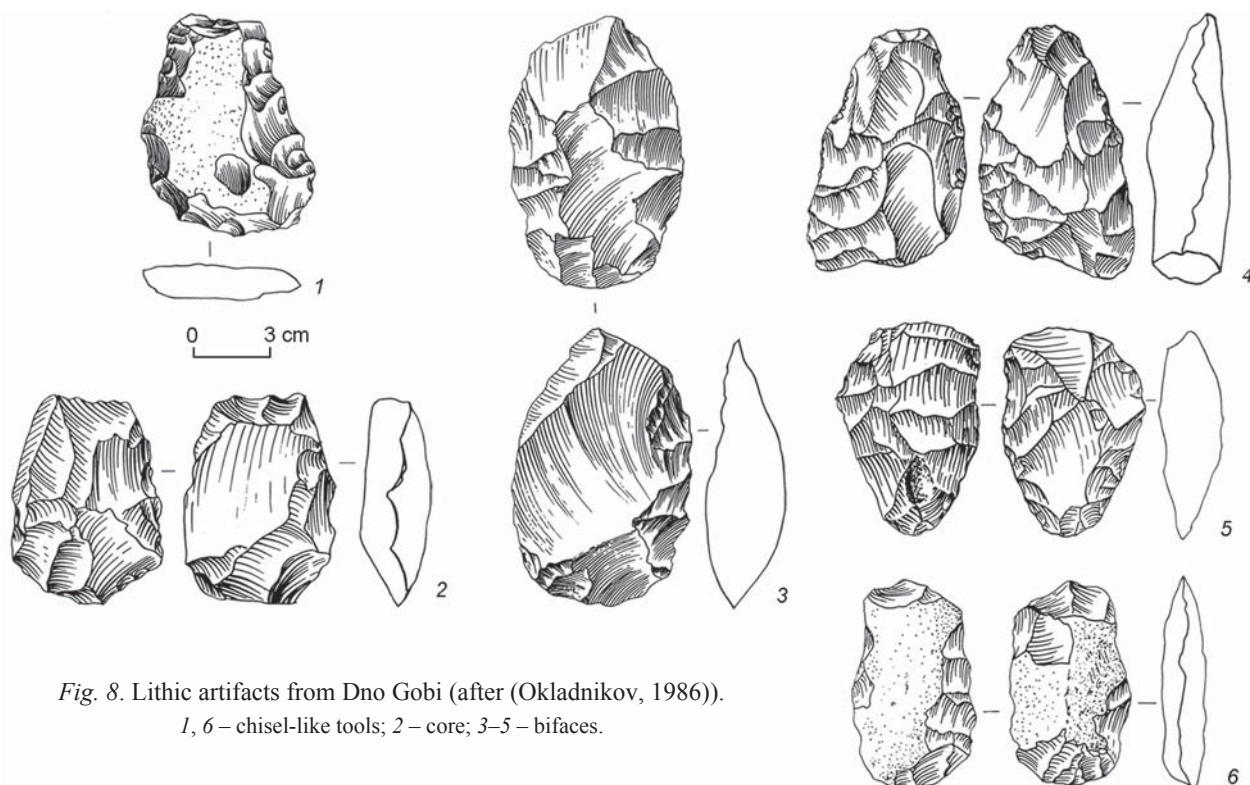


Fig. 8. Lithic artifacts from Dno Gobi (after (Okladnikov, 1986)).

1, 6 – chisel-like tools; 2 – core; 3–5 – bifaces.

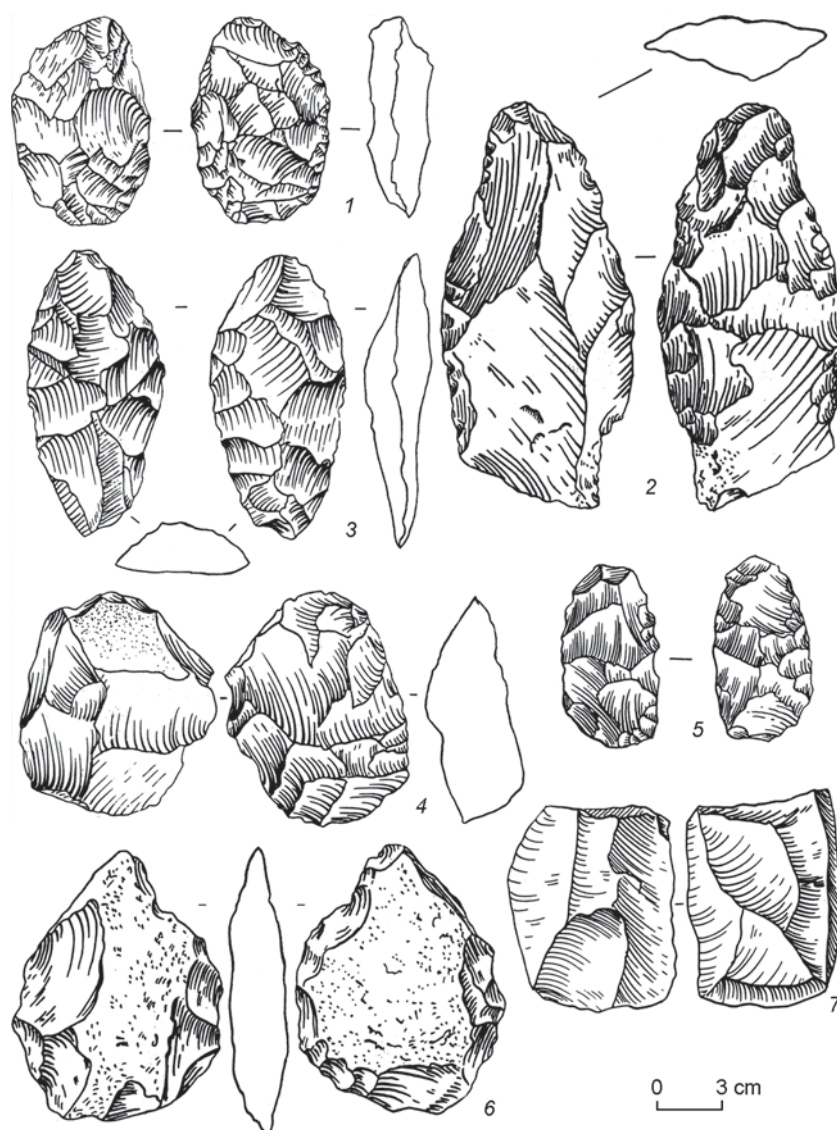


Fig. 9. Lithic artifacts from Dno Gobi (after (Okladnikov, 1986)).

1–3, 5, 6 – bifaces; 4 – bifacially prepared side-scraper; 7 – core.

of tools, core-like products, and the most impressive artifacts illustrating primary reduction and the tool kit. The finds were catalogued and mapped.

As a result of field studies in the Flint Valley, a total of 29,867 stone products was collected from an area of 86 m², resulting in 350 artifacts per 1 m² on average. For the present paper, the heavily abraded assemblage numbering 2320 items is of special interest. As a result of physical and chemical weathering and corrosion, negative scars of flake removals and retouch on the surfaces of many artifacts were hardly traceable; magnifying glass was often used for the identification of finds.

Primary reduction in this assemblage is illustrated by single-platform unifacial cores with longitudinal and transverse orientations of flaking scars (5.22 % of the total number of finds). Preparation of the striking platform beveled toward the back surface was carried out mainly by

kilometers—an inexhaustible source of raw material for the manufacture of stone tools. At present, the climate of this region is arid. During the Pleistocene, in the cool periods, when extremely arid climatic conditions dominated, hominins rarely visited it; however, during pluvial periods, which are evidenced by deep canyons from temporary watercourses, the valley provided favorable conditions for human habitation: outcrops of high-quality lithic raw materials were adjacent to permanent sources of fresh water.

The Flint Valley yielded abundant lithic artifacts scattered on the surface of some hills. One of the hills was carefully explored and revealed more than 1 million stone implements. Two loci of 25 m² and three loci of 12 m² were arbitrarily chosen on the hill, where the researchers of the expedition collected all the available archaeological materials. Spatial distribution of finds in each square was recorded, with indication

a single removal, less often by two removals. In some cases, discontinuous rejuvenation of the flaking arc was noted. Most cores demonstrated flaking surfaces prepared by centripetal removals.

The single-platform unifacial cores for the production of one target blank of given parameters are noteworthy. Such cores were shaped using the techniques typical of the preparation of Levallois cores. Notably, quite few well-prepared Levallois cores were found, but the share of Levallois blanks was significant. Levallois blade cores were also identified (Fig. 10, 2).

The tool kit of the heavily abraded assemblage contains 230 items (9.91 % of all the finds). Single side-scrapers with longitudinal or transverse working edges are most numerous. Few double and convergent side-scrapers were also identified. The tool kit includes items with a pointed working part, denticulate, denticulate-notched, and multifunctional tools (Fig. 10, 3).

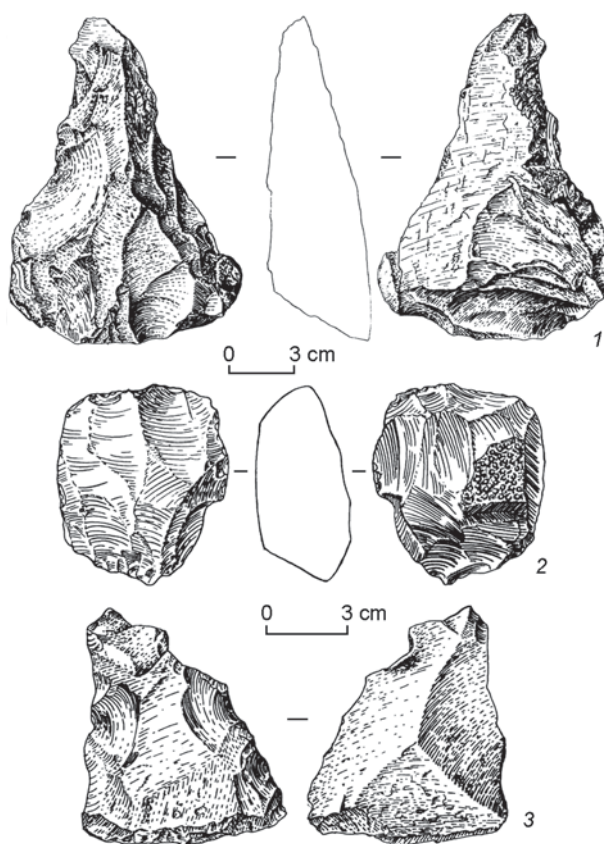
Fig. 10. Lithic artifacts from Flint Valley (after (Derevianko, Zenin, Olsen et al., 2002)).

1 – bifacially prepared tool; 2 – core; 3 – combination tool.

The heavily abraded assemblage is distinguished by the presence of bifacially processed ovoid and sub-triangular artifacts. Large robust bifaces predominate (Fig. 10, 1; 11). Smaller items are also quite robust. All the bifaces are treated by large marginal flake removals; some artifacts demonstrate the unfinished preparation. The shaping of these items indicates the apparent use of bifacial processing. However, many bifaces can hardly be classified as classic Acheulean handaxes. The use of the Levallois technique of primary flaking and the bifacial technology in preparation of some artifacts allows us to attribute this assemblage to a Denisovan variant of the Early Middle Paleolithic.

Despite the lack of any cultural-stratigraphic sequence, which hampers the possibility of dating the heavily, moderately, slightly, and non-abraded assemblages of the Flint Valley, this area is of extreme importance. It shows the dynamics of the development of the Denisovan lithic industry from the initial stage of Denisovan settlement in Mongolia till the terminal Middle Paleolithic. Heavily and moderately abraded assemblages can be roughly dated to the range of 250–150 ka BP, and slightly and non-abraded to 100–60 (50) ka BP.

The initial stage of the Denisovan habitation in Mongolia is illustrated by several dozen sites with a lithic industry featuring the Levallois primary



reduction technique aimed at the production of flakes, blades, and pointed blanks. The groups of sites of Nariyn Gol, Uench, Barlagin Gol, Mankhan, etc. contain hundreds and thousands of lithic artifacts scattered on the surface. These assemblages, dating back to the second half of the Middle Pleistocene, show many parallels with the materials from cultural layers 22.1–19 of the Main Chamber and layers 15 and 14 of the East Chamber of Denisova Cave, which yielded the dates in the range of 280–150 ka BP (Jacobs et al., 2019). The lithic industry of these sites demonstrates bifacial processing of stone implements, but contains no tools of the Acheulean handaxe type.

Bifacial technology is most clearly manifested in the south of Mongolia. It was recorded at a small number of sites. But this does not indicate the smallness

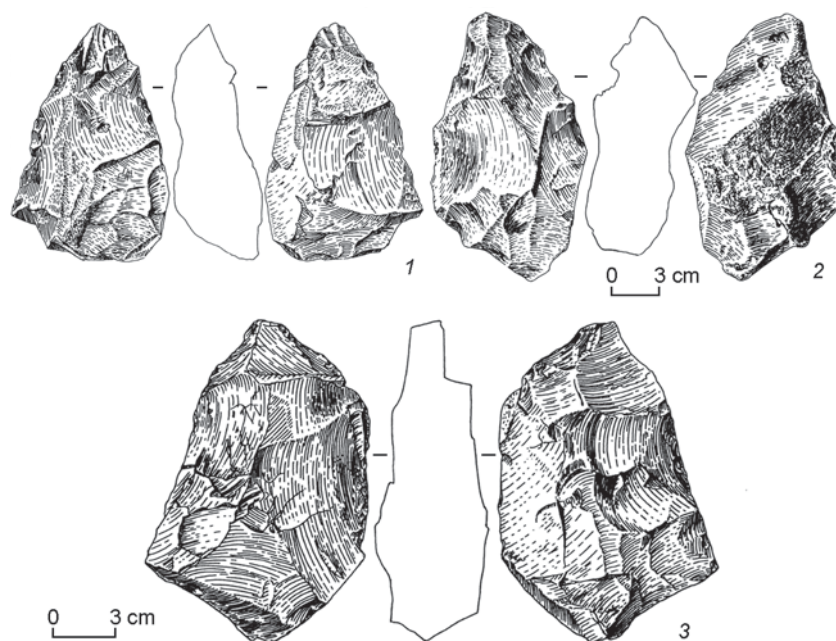


Fig. 11. Bifacially prepared tools from Flint Valley (after (Derevianko, Zenin, Olsen et al., 2002)).

of the Denisovan population in this area. Bifacial processing of stone implements was very widespread, while the manufacture of tools resembling Acheulean handaxes was quite rare.

The overall trend in the development of the hominin lithic industry in Mongolia in the second half of the Middle and the first half of the Upper Pleistocene is the growing role (up to the dominance) of the Levallois flaking technique aimed at the production of certain flakes, pointed and blade blanks. At the terminal stage of the Middle Pleistocene, the share of blade reduction of sub-prismatic and prismatic cores and the frequency of using blades for manufacturing tools of various types began to increase.

The Denisovan lithic industry in the terminal Middle Paleolithic

Over 200 Paleolithic sites in Mongolia can be attributed to the terminal stage of the Middle Paleolithic. About 120 such sites have been established in the Valley of

the Lakes in northwestern Mongolia alone (Derevianko, Petrin, 1987; Derevianko, Nikolaev, Petrin, 1992; Kamenny vek..., 2000). The valley is a large depression stretching from northwest to southeast. It separates the mountain ranges of Khangai and Gobi Altai. The depression is about 400 km long and from 30 to 50 km wide. In the north, the Valley of the Lakes borders upon a low tectonic-denudational bench of the South Khangai Range. The middle part of the valley is plain and contains three large lakes: Bon Tsagaan Nuur, Orog Nuur, and Tatsin Tsagaan Nuur. The lakes are fed by the waters of the Baidarik-Gol, Nariyn-Gol, and Tatsin-Gol rivers, flowing from Khangai in the north. The water level in the lakes is currently unstable and depends on the water level in the feeding rivers. In dry years, it falls by 5–10 m, exposing a wide strip of coastal ledges.

Some sites discovered in the Valley of the Lakes (Fig. 12) can be attributed to the early stage of the Denisovan dispersal in northwestern Mongolia. These sites are located primarily in the valleys of the Nariyn-Gol and Baidarik-Gol rivers (Kamenny vek..., 2000). Based on the main technical and typological features

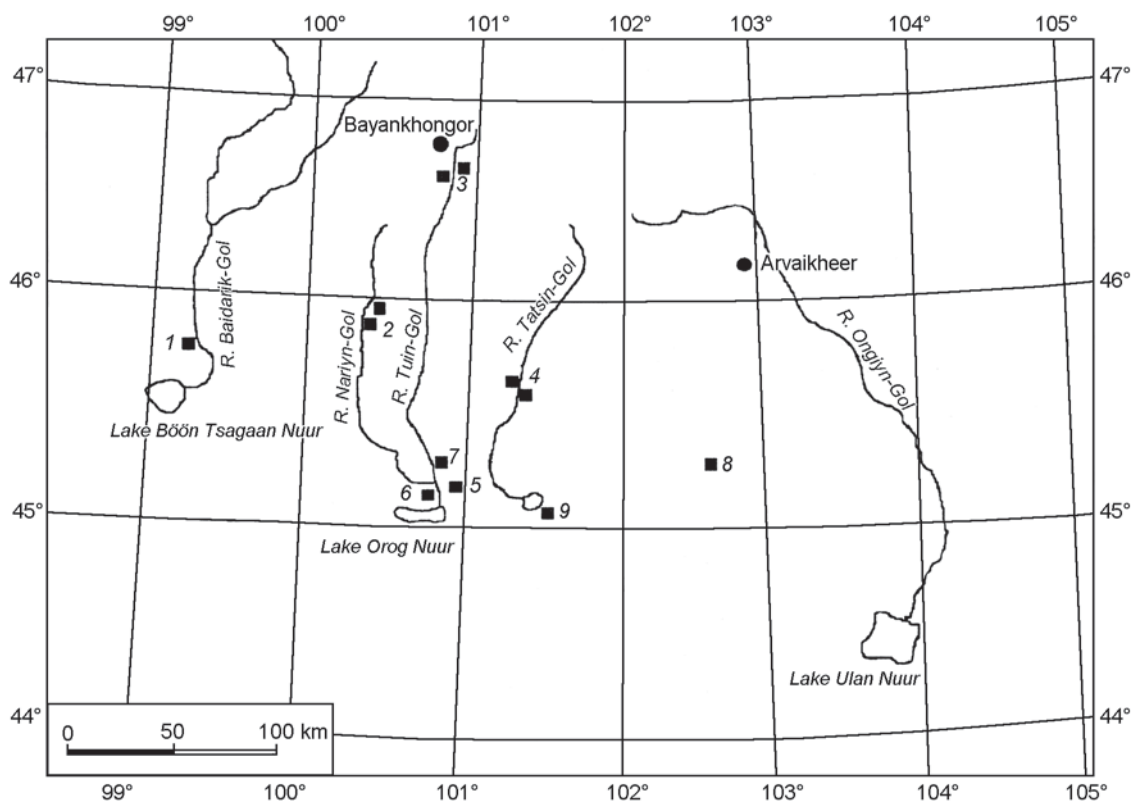


Fig. 12. Map of the northern edge of the Lake Valley showing locations of the terminal Middle Paleolithic sites (after (Kamenny vek..., 2000)).

1 – Baidarik-Gol-1 (12 sites); 2 – Nariyn-Gol-1 (37 sites); 3 – Tuin-Gol-1 (35 sites of the left side and 19 sites on the right side); 4 – Tatsin-Gol-1 (four sites); 5 – Orog-Nuur-1 and -2; 6 – Bogd-1 (three sites) and -5 (seven sites); 7 – Argalant-1 (five sites); 8 – Guchin-Us-1 (seven sites); 9 – Zodokh-Guvshikh-1 (two sites) and Zhinst (one site).

of the lithic industry, the overwhelming majority of the sites in the Valley of the Lakes can be correlated to the terminal stage of the Middle Paleolithic and dated to the range of 90–50 ka BP. Moreover, the lithic assemblages of these sites show many parallels in the primary reduction, typology of stone tools, and manufacture techniques with the terminal Middle Paleolithic industry of Denisova Cave.

The Orog-Nuur-1 and -2 technocomplexes are most typical of the northern coast of the Valley of the Lakes; they have been defined as the Orog-Nuur terminal stage of the Mongolian Middle Paleolithic. Orog-Nuur-1 yielded 273 artifacts, including 40 cores (of them, 15 were Levallois nuclei). The latter can be classified into several varieties, but all of these cores were intended for detaching blanks in the form of flakes,

blades, and pointed forms (Fig. 13, 1, 2, 7–9; 14, 8). In addition, double-platform unifacial (see Fig. 13, 3) and bifacial cores (see Fig. 13, 5), and those showing radial flaking pattern (see Fig. 13, 4; 14, 9) were identified. Analysis of the cores has shown a definite uniformity of the collection in terms of technical and typological features and the degree of abrasion.

The tool kit includes 96 items. Most of them were fashioned on Levallois blanks. Seven Levallois points were identified. Four of them are elongated (see Fig. 14, 1–4), and three are shortened (see Fig. 14, 5–7). At one of the elongated points, the tip is missing, the dorsal side bears subparallel negative scars, and the lateral edges are covered with facets of fine regular retouch (see Fig. 14, 3). Another such point shows a similar dorsal faceting; one of its lateral sides has notches

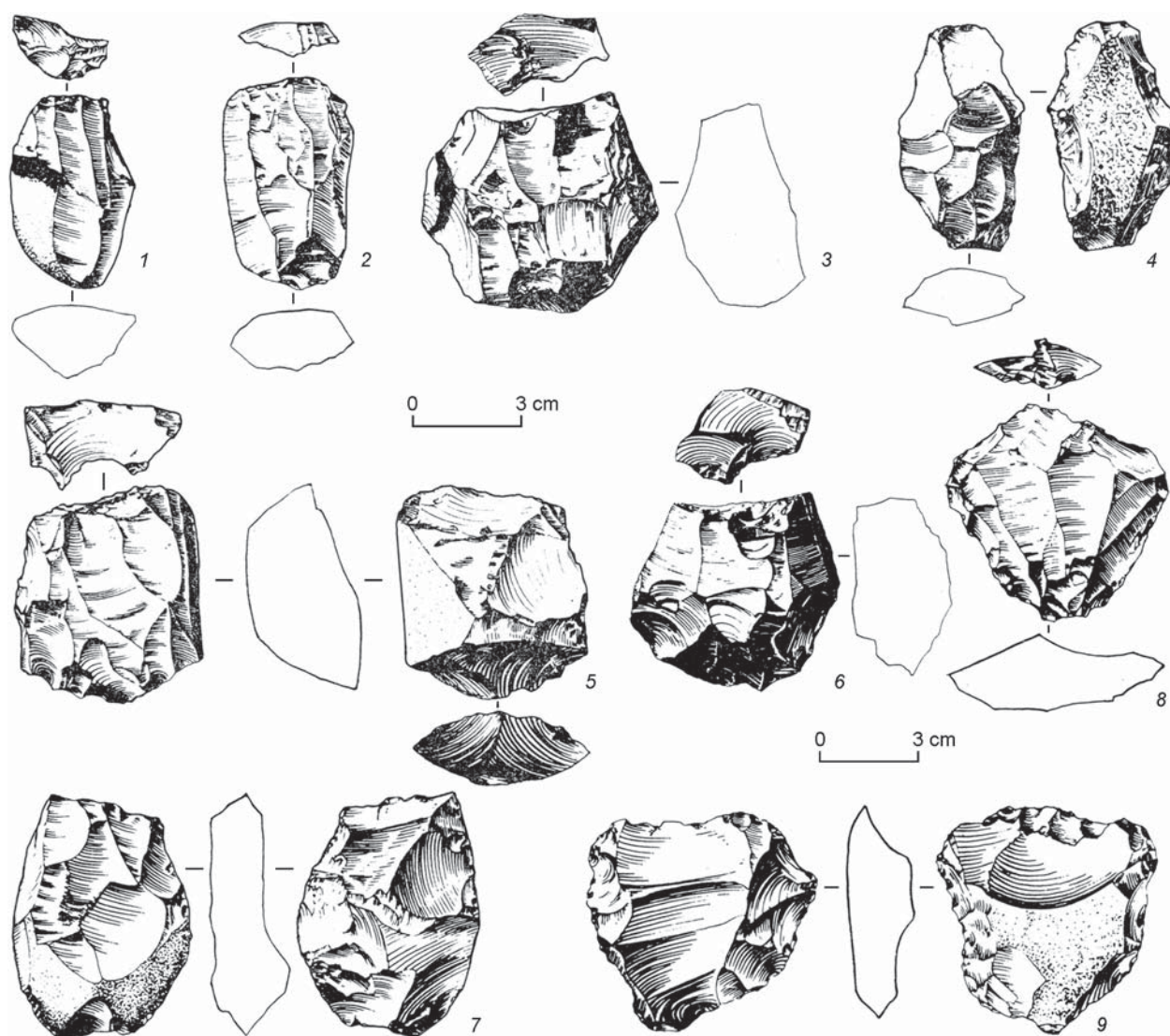


Fig. 13. Cores from Orog-Nuur-1 (after (Derevianko, Petrin, 1990)).

1, 2, 7–9 – Levallois cores; 3, 5, 6 – double-platform cores; 4 – radial core.

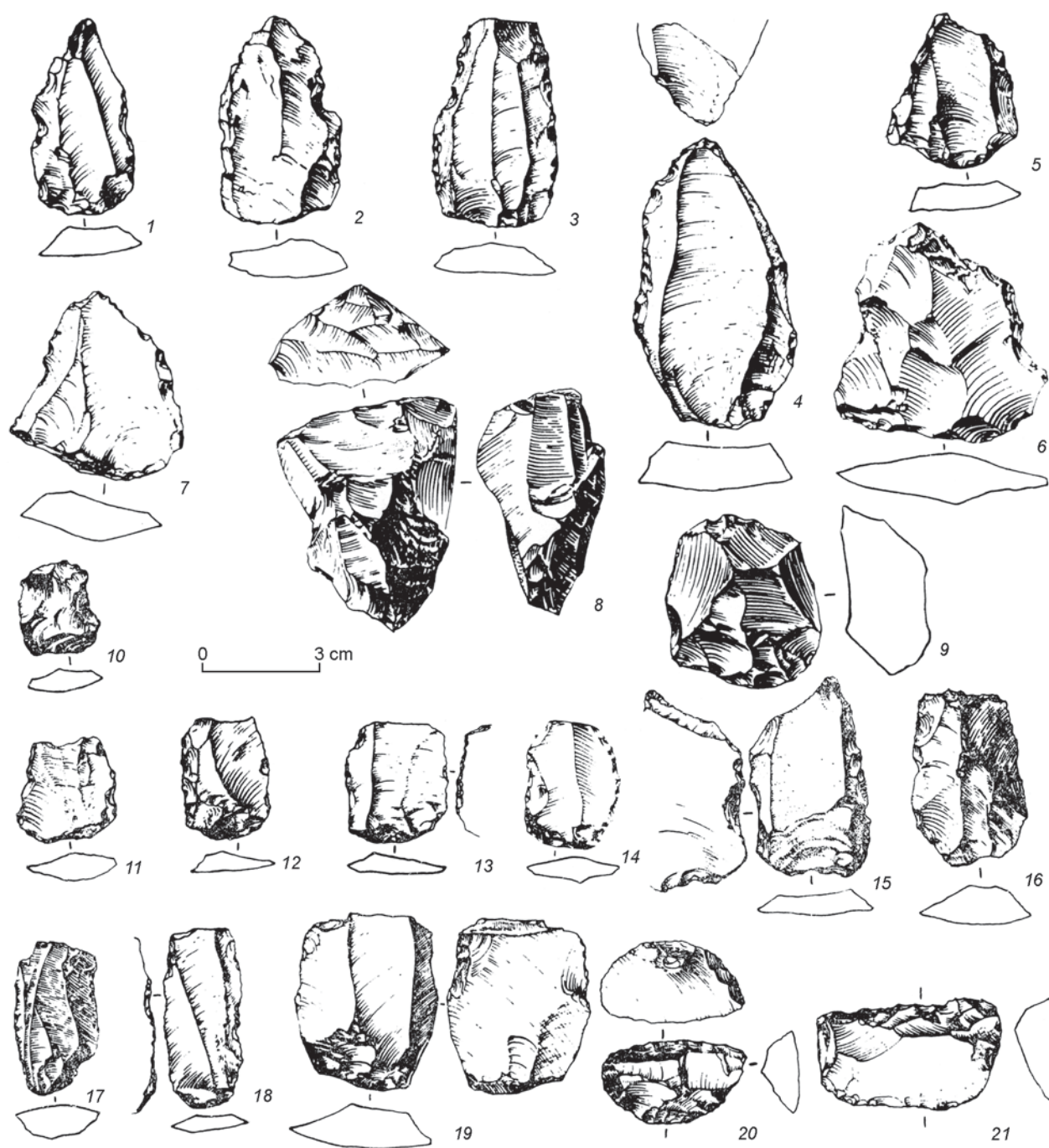


Fig. 14. Lithic artifacts from Orog-Nuur-1 (after (Derevianko, Petrin, 1990)).

1–7 – points; 8, 9 – cores; 10, 11 – flakes; 12–14, 16–19 – blades with irregular retouch; 15, 20, 21 – side-scrapers.

formed by retouch; it also bears a negative longitudinal scar resembling a burin one (see Fig. 14, 1). The third elongated point demonstrates both original “early” retouch and “fresh” (i.e. accidental) one on the edges (see Fig. 14, 4). The shortened points (see Fig. 14, 5–7) show marginal retouch, including very abrupt one.

Retouched Levallois blades are represented by 12 intact and fragmented specimens (see Fig. 14, 12–14,

16–18), nine proximal fragments (see Fig. 14, 19), and two distal ones. Some intact specimens are shortened. Irregular retouch is observed along the edges of the blades. Levallois flakes (see Fig. 14, 10, 11) are relatively small.

The greatest number of the tools falls within the category of side-scrapers. These vary primarily in size and type of secondary working. Three large scrapers

are noteworthy. One of them is made on a pebble; it has a robust back part, the working edge is slightly convex, the clear facets of stepped retouch are visible. The other two side-scrapers are made on large spalls; their working edges are either straight or slightly convex. The fragment of a longitudinal side-scraper was fashioned on a blade (see Fig. 14, 15). Its working edge was treated from the dorsal face and discontinuously trimmed from the ventral face. The other side-scrapers are small. Of these, a semicircular raclette is noteworthy, which shows continuous marginal retouch from the dorsal face (see Fig. 14, 20). The retouch is abrupt and modifying. There is a small area retouched from the ventral face. Notably, the bulb of percussion of the tool was cut off by a series of flattening removals. The side-scraper made of a laminar secondary flake is interesting (see Fig. 14, 21). One of its longitudinal edges was treated by very abrupt two-stepped retouch, and the opposite edge (the back) by finer retouch. Fragments of two side-scrapers were recorded; the working edge of one of them was shaped with flat retouch.

The tool kit also includes denticulate-notched implements, two burins, retouched flakes, and a chisel-like tool. In general, this technocomplex is homogenous in terms of the degree of surface abrasion and technical and typological characteristics.

The site of Orog-Nuur-2 is located 1.5 km from Orog-Nuur-1. The stone tools here were made of the same chert, and show the same degree of the scar surface abrasion. In total, 730 items were found. Of these, 198 artifacts (27.1 %) illustrate primary reduction. Cores from this site are identical to those from Orog-Nuur-1. They are dominated by Levallois, single- and double-platform uniface cores, and double-platform bifacial varieties. Flakes, blade flakes, blades, core trimming elements, and tools found at Orog-Nuur-1 and -2 made up a single technical and typological complex.

The Orog-Nuur-2 toolkit includes 296 items. Here, as at the neighboring site, Denisovans often used Levallois blanks in tool manufacturing. The Orog-Nuur-2 tools were prepared mainly on blades, including pointed ones, and laminar blanks. Point-like implements are particularly noteworthy (Fig. 15, 2, 5–8). Several distal and proximal fragments could also have been used by the hominins as points (Fig. 15, 1, 3, 4, 9, 11, 12). Combination implements were shaped by fine and medium sharpening and semi-abrupt retouch. Judging by their shape and modification pattern, they could have been used as tools with denticulate-notched functions (Fig. 15, 10, 15–17, 20), side-scrapers and end-scrapers (Fig. 15, 18, 19), scraper-burins

(Fig. 15, 13), and side-scrapers with well-prepared distal ends (Fig. 15, 14). In the tool kit, end-scrapers (Fig. 15, 21, 22, 24), burins (Fig. 15, 23, 26), and borers (Fig. 15, 25) are identified. There are blades and flakes with traces of irregular retouch (Fig. 15, 27, 28). Almost all the tools bear signs of dorsal one-stepped, predominantly fine-faceted, abrupt and semi-abrupt sharpening retouch. Additional ventral retouch is observed on some items.

The Orog-Nuur-1 and -2 lithic industry is characterized by the predominance of the Levallois technique in primary reduction. The blanks are dominated by blades from which various tools were made. At the same time, no well-prepared Upper Paleolithic blade cores were found in these technocomplexes, and the number of Upper Paleolithic tools is minor. The lithic industry of these sites, as well as those from other locations in the Valley of the Lakes, should be attributed to the terminal stage of the Middle Paleolithic.

About 100 short-term sites with Middle Paleolithic industry have been discovered in the foothills of the Ikh-Bogdo and Arts-Bogdo ridges (Okladnikov, Larichev, 1963; Okladnikov, 1986; Kamenny vek..., 1990; and others). Lightly abraded and non-abraded lithic artifacts have been discovered here; typologically, these can be attributed to the terminal stage of the Middle and Upper Paleolithic. In the Otson-Mant region, localities with bifaces reminiscent of the Acheulean have been discovered; several sites with the Late Middle and initial (Early) Upper Paleolithic industry have also been identified. These are the sites of Mukhar-Bulag, Ikh-Bulag, and others (Derevianko, Petrin, Krivoshapkin, 1998; Derevianko, Krivoshapkin, Larichev, Petrin, 2001). According to the main technical and typological features of primary reduction, types of stone tools, and manufacturing techniques, assemblages from these localities are close to materials from layers 11 and 12 of Denisova Cave, which belong to the terminal stage of the Middle Paleolithic, the Middle to Upper Paleolithic transition, and the initial Upper Paleolithic. However, “closeness” does not mean “identity”. Certainly, lithic industry of hominins inhabiting various regions in the territory of the Altai and Mongolia has local variations, but these were formed due to different environmental conditions and different quality of lithic raw materials for making tools. These hominins were Denisovans. In the Mousterian industry of Neanderthals, who inhabited the vast territory of Eurasia, researchers distinguish more than 10 local variations (cultures). There is no doubt that in the course of further study

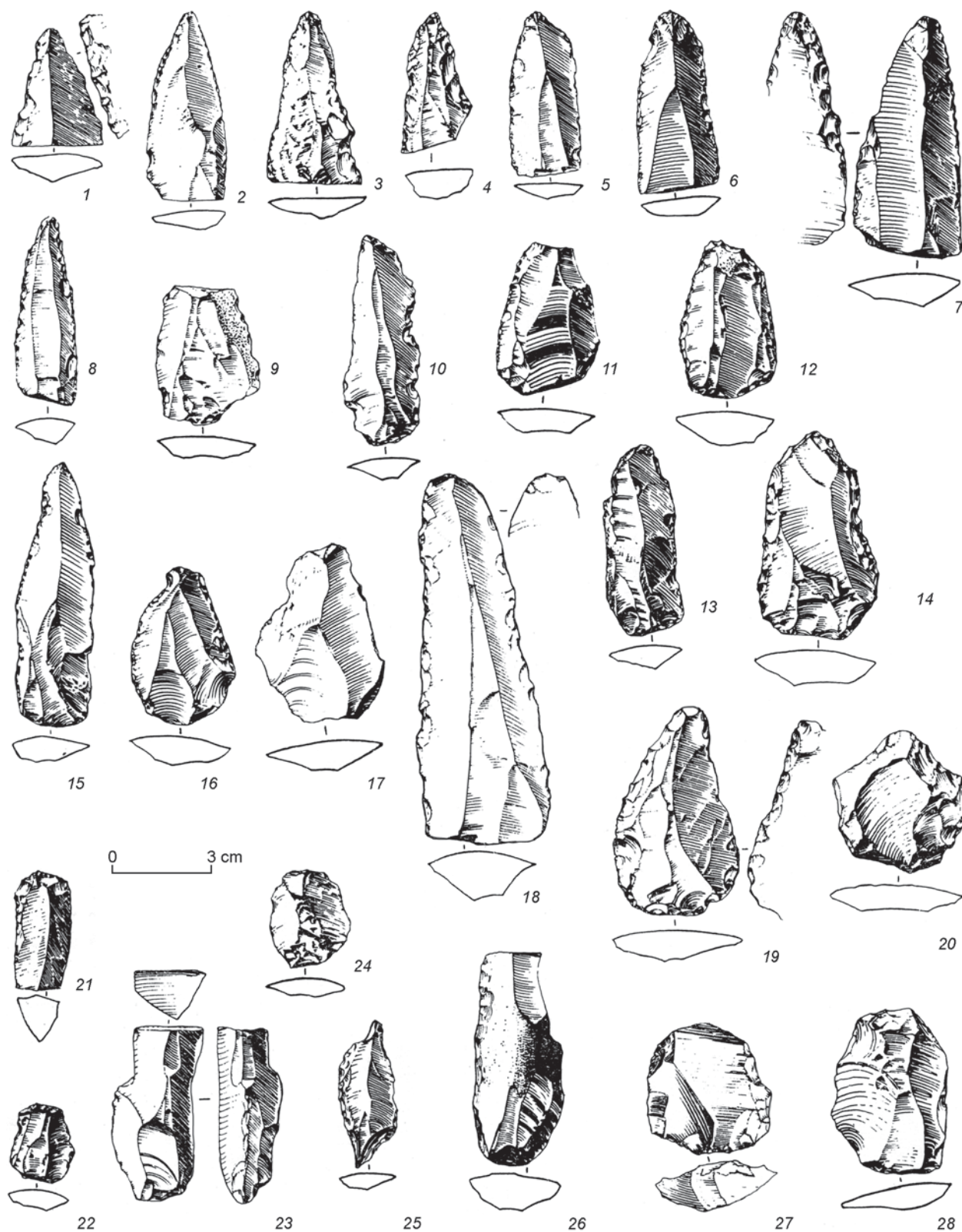


Fig. 15. Lithic artifacts from Orog-Nuur-2 (after (Derevianko, Petrin, 1990)).

1–9, 11, 12 – intact and fragmented points; 10, 15–17, 20 – denticulate-notched tools; 13 – side-scraper-burin; 14 – side-scraper-point; 18, 19 – combinations of side- and end-scrapers; 21, 22, 24 – end-scrapers; 23, 26 – burins; 25 – borer; 27, 28 – flakes with irregular retouch.

of Denisovans and their material culture in Central, East, and Southeast Asia, a significant number of variants of the Denisovan industry will also be identified. In this respect, the sites dating to the terminal stage of the Middle Paleolithic, the Middle to Upper transition, initial and early Upper Paleolithic are of particular interest. Such well-stratified sites have been studied in the valleys of the Orkhon and Selenga rivers in the northern part of Mongolia.

Cultural layers dating to the terminal stage of the Middle Paleolithic were studied in floodplain sediments at the sites of Orkhon-1, -7, and Moiltyn Am. The total of 14,193 stone products were recovered (Derevianko, Kandyba, Petrin, 2010). Primary reduction at these sites was executed mainly using the unidirectional unifacial Levallois and parallel flaking cores, usually with a longitudinal orientation of flaking; radial and orthogonal cores are also present. Among the tools, denticulate-notched items are most numerous. The categories of lateral and angle side-scrapers and retouched spalls are less numerous. Side-scrapers with concave working edges are also present. Solitary combination tools and bifacially prepared artifacts are identified. The lithic industry in the Orkhon Valley looks archaic, due to the poor quality of the raw material, which is characterized by macro-crystallinity and fracturing in the texture, preventing laminar reduction. Radiocarbon and ESR dates in the range of 65–55 ka BP were generated for the site in the floodplain facies of the Orkhon River alluvium. However, A.V. Astashkin and his co-authors argued that sample No. 4 can be dated back to 71 ka BP according to the results of ESR dating (1993: 15).

A specific feature of the sites in the Orkhon Valley is that the lithological layers covering the floodplain sediments contain lithic artifacts of the initial (early) Upper Paleolithic. Thus, at Orkhon-1, -7, and Moiltyn Am, the continuity in the Denisovan industry development can be traced for almost 20 thousand years.

Since the early 2000s, the Joint Russian-American-Mongolian Expedition has carried out large-scale studies of the initial Upper Paleolithic in the Selenga River valley in Northern Mongolia. Two groups of sites—Tolbor and Kharganyn-Gol—are of particular importance. The Tolbor group is located in the Ikh-Tulberiyn-Gol River valley; about 45 sites were discovered here, six of which were partially excavated. The Kharganyn-Gol group includes about 19 sites, two of which were partially studied (oral communication by E.P. Rybin). In addition, within the area of 10 km

around the confluence of the Ikh-Tulberiyn-Gol (Tolbor) and Selenga rivers, five sites with long stratigraphic sequences are being studied: Tobor-4, -15, -16, -21, and Kharganyn-Gol-5 (Khatsenovich, 2018; Rybin, 2020). So far, no cultural layers of the terminal Middle Paleolithic and the Middle to Upper Paleolithic transition have been uncovered at these sites. But in general, the lithic industry shows a clear blade Upper Paleolithic trend. The derived calibrated interval of 48–47 ka BP indicates that the Upper Paleolithic in Mongolia, as in the Altai, is among the earliest in Eurasia.

Conclusions

The initial dispersal of African *H. erectus* in the territory of Mongolia might have occurred earlier than 800 thousand years ago. The arrival of a new population of hominins with a Late Acheulean industry in this area is evidenced by the groups of sites of Flint Valley, Otson-Mant, Dno Gobi, and others, which technocomplexes show a significant role of the Levallois primary reduction strategy, and which tool kits are dominated by bifacially processed tools of the Acheulean handaxe type. The hominins who started peopling Central Asia 400–350 ka BP were morphologically and genetically evolving Denisovans. After the split from Neanderthals in the Levant around 400 ka BP, these early humans with the Late Acheulean industry gradually migrated to the east of Asia.

In Central Asia, the early stage of the Denisovan dispersal can be traced in Tajikistan (Derevianko, 2024) and Uzbekistan (Derevianko, 2025). In Tajikistan, pedocomplex 4 at the Obi-Mazar site dating to 364–420 ka BP reveals clear elements of a different lithic industry in the primary reduction pattern and the tool kit in its cultural layer dating to the terminal stage of the Early Paleolithic Karatau culture (pebble-flake industry of *H. erectus*); this evidences the arrival of representatives of a new taxon, the Denisovans, to this territory. The Denisovans mixed with the indigenous population of late *H. erectus* with a pebble-flake industry. Both Denisovans and *H. erectus* belonged to an open genetic system; interbreeding between these two taxa produced fertile offspring. Assimilation and diffusion of their lithic industries took place. This was the initial stage of the process of morphological and genetic evolution of *H. denisovan*.

In Mongolia, the Denisovans also encountered the indigenous *H. erectus* population with a pebble-flake industry. Subsequently, same as in the western part

of Central Asia, assimilation and diffusion of their industries occurred. The most vivid confirmation of mixing between *H. erectus* and *H. denisovan* is the archaic dental system detected in the latter.

The fragment of a skullcap discovered in the Salkhit Valley in Mongolia provides the evidence of hybridization between representatives of the morphologically and genetically evolving Denisovan taxon and morphologically modern humans. This fossil includes a virtually complete frontal bone, and partially complete parietals and nasals with well-expressed archaic features, which gave D. Tseveendorj and his co-authors grounds to identify a new taxon—*Mongolanthropus* (Tseveendorj, Batbold, Amgalantugs, 2006, 2007). Anthropological analysis established its relationship with Neanderthals and *H. erectus* in some parameters, but overall, in terms of physical morphology, it was a modern human with pronounced ancestral features inherited from *H. erectus* (Coppens et al., 2008). The comparison of the find's dimensions with the skulls of various hominin species using multidimensional scaling analysis showed similarities with Neanderthals, *H. erectus*, and Asian archaic *H. sapiens* (Kaifu, Fujita, 2012), which allowed the researchers to classify the Salkhit hominin as a Late Pleistocene modern human.

A study of three samples of biomaterial from the Salkhit skull showed that the mtDNA lineage of this individual belongs to macrohaplogroup N, which is among the basic ones, common to all non-African modern humans (Devièse et al., 2019). The sequencing of nuclear DNA from the skull fragment showed 18 segments of Denisovan heritage longer than 0.2 cM in the genome of this hominin. Unfortunately, the data concerning the Denisovan phenotype are quite scarce. But its morphology should exhibit mosaic structure. Owing to the small number of *H. erectus*, which probably inhabited not all areas of Central Asia, Denisovans did not mix with the indigenous population in all parts of this vast region. Therefore, not all representatives of this morphologically and genetically evolving taxon were equally likely to exhibit features typical of *H. erectus*. The Salkhit fossil provided limited information; however, the available data suggest certain similarity between this individual and Denisovans (Derevianko, 2024).

In 2006, a geomorphological and stratigraphic research was conducted in the approximate area of discovery of the Salkhit skullcap (Derevianko, Tseveendorj, Gladyshev et al., 2007). The valley is located in the Norovlin sum of the Khentii aimag. Since 2001, the Bayan-Erdes company had been mining

gold there; the workers found the skull and delivered it to the Institute of Archaeology of the Mongolian Academy of Sciences. By 2006, a significant share of the loose deposits had been completely destroyed, up to the granite bedrock.

In the immediate vicinity of the place where the skullcap was found, in the areas undisturbed by gold miners, several excavation trenches were established. The most significant information was collected from the trench on the western edge of the Salkhit Valley. It was 10 m long. Loose sediments were excavated to a depth of 4.25 m, down to the weathering crust. The crust was overlain by a layer of sandy-gravel-rubble sediments, which were rather unstable. The changes could have been caused by climatic fluctuations towards warming (the Karga period), which led to an increase in humidity and water availability in the region contributing to intense erosion-denudation processes underlying the accumulation of absolutely unsorted clastic sediments of deluvial-proluvial genesis. Sufficient amount of free water led to the formation of an alluvial-proluvial deposit at this level, which appears to be a former channel of a small watercourse filled with dipping-layered sandy material.

The next horizon covering the Karga strata is layer 3, characterized by slope genesis. This horizon was apparently formed during the Sartan period, which was characterized by the general cooling. The deposits of layer 4 were accumulated due to the deluvial-proluvial processes in the Holocene. The soil-vegetation horizon covering the profiles was also formed during the Holocene.

Summarizing the data obtained from the analysis of the stratigraphic profile of the Salkhit Valley the conclusion can be made that the lowermost layer of the loose sediments is not older than the Early Karga period (final MIS 3). Initially, the age of the Salkhit skull was determined to be ~23 ka BP, but it turned to be underestimated owing to poor sample preparation, and currently the skull is dated to 34,950–33,900 cal BP (Devièse et al., 2019). In Mongolia, this time is correlated with the Middle Upper Paleolithic, characterized by blade industry recorded at the sites of Chikhen-1 and -2.

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I.V. Schmidt

*Dostoevsky Omsk State University,
Pr. Mira 55a, Omsk, 644077, Russia
E-mail: rebewster@gmail.com*

The Earliest Snake Images in the Middle Irtysh Region

Herpetomorphic images are quite rare in Paleolithic and Mesolithic art. Published bone daggers from Cherny-Ozerye (OMK 9675/702) and Aitkulovo (MAEAAGU OF 93) are the earliest examples of the Middle Irtysh Final Paleolithic or Mesolithic art showing snakes engraved in a stylistically original manner. Both specimens show opposed reptiles striving, as it were, to meet. This plot has so far not been described or geographically localized. An attempt is made to interpret it at least tentatively. It is proposed that people inhabiting southwestern Siberia and the southern Urals in the Final Paleolithic and Mesolithic practiced a snake cult, resulting in amazingly similar works of art. While this region has not been subjected to detailed archaeological studies, examples of early art suggest that it was an ancient cultural province, comparable with that of Malta-Buret, where a search for graphic forms of communication was conducted, special cultural texts were created, and major aspects of worldview were discussed.

Keywords: Southwestern Siberia, Final Paleolithic–Mesolithic, snake images, “opposed snakes striving to meet”, decoration of bone blade items, ancient communicative practices.

Introduction

The earliest snake images in Siberia have been attributed to the Paleolithic. However, their occurrence over the archaeological sites of the region is uneven. The herpetomorphic features of the Malta pictorial collection are beyond doubt (Gerasimov, 1931, 1935; Demeshchenko, 2000, 2022; Lipnina, Medvedev, Oshchepkova, 2001; Lipnina, 2008; Korneva, 2020; and others), as well as the serpentine character of ornamental patterns on some artifacts from the Malta archaeological collections—in particular, on a staff from the Achinskaya site (Larichev, 1987). Snake images have also been recorded on artifacts from the sites distant from Malta—an alunite racer’s head from the site of Firsanova Sopka on the Lefu River (Krupyanko, Tabarev, 1996; Tabarev, 1997; Brodyansky, Garkovik, Krupyanko, 1998). “Malta snakes” are considered stylistic reference images, and the introduction of similar images into the pictorial sources should start through correlation with

them. However, the plot of the Malta plaque with snake images remains a unique and obviously local phenomenon.

The snake is an uncommon creature; it seems useless from a practical point of view, which increases the “supernatural” significance of this image. It is hardly possible to identify whether ophiolatry and the relevant ritual practices existed in the regions under consideration in the Paleolithic (Istoriya..., 1968: 113; Ozols, 1971: 29; Toporov, 1972: 93; Kondratenko, 1983: 74–76; Evers, 1991: 119–120; Frolov, 1992: 107). However, the fascination with this character among the prehistoric people of Siberia is intuitively clear. The snake is a stylized metaphor for the danger that surrounded Paleolithic humans (Efimenko, 1938: 513); it is an object of observation and a polysemantic generalizing symbol. The qualities and features of the reptile were likely assessed in an ambivalent way, and this duality was conveyed to its image and survived throughout millennial traditions (Gordeev, 2002; Sümer, 2016).

The Middle Irtysh region was a suitable habitat for snakes, and was peopled by ancient humans in the Final Paleolithic. However, the symbolic behavior of the Irtysh humans, unlike those in other regions, was not based on the artistic imagery of that period; no engraved representations of mammoths or horses, nor bird figurines, have been recorded here so far. Their “ornamental language”, which was important for the development of the region, included the image of a snake. Unfortunately, the prehistoric art images are rarely discussed, which is obviously because of their insufficient publication. This unfairly excludes the Middle Irtysh region from cultural regions with original pictorial texts, theme reflection, and decoration practices. The present paper focuses on the analysis of style and technique of snake representation, the motif that unites herpetomorphic images, and generalization of the available information on the topic.

Material and methods

Two daggers decorated with stylized images of snakes have been found in the Middle Irtysh region: the Chernozerye dagger (Omsk State Museum of Local History, OMK 9675/702) and Aitkulovo dagger (Museum of Archaeology and Ethnography of the Altai State University, MAEAGU OF 93). The Chernozerye dagger is fairly well known to the scientific community (Petrin, 1971: 19; 1986: 60; Gening, Petrin, 1985: 50; Schmidt, 2005, 2006); the radiocarbon age of the encompassing deposits has been established (cultural horizon 1, $10,561 \pm 48$ cal years BC (GV-03895)). The Aitkulovo dagger is an accidental find dating to the Mesolithic–Neolithic; it is described in two publications (Kungurov, Shemyakina, 1994; Tolpeko et al., 2021). The Chernozerye dagger was fashioned on a fragment of the diaphysis of bone from a large mammal, the Aitkulovo artifact was made from a straightened rib of a large animal. Both are fragmented. Their decorative compositions are based mainly on the principles of geometric symbolism represented by chains of rhombs, zigzags, and straight lines. The original arrangement of these elements suggests that the compositions contain plots where snakes are the main characters.

The engravings on the daggers were analyzed through comparative-morphological and stylistic methods. Inferences on the stylistics of images are based on the theory by G. Semper, who identified the following style-forming factors: function of the

object bearing the image, material of the object, technology of design, and personality of the author (his ideological/cultural ideals) (1970: 223–224). The ideas of V.D. Viktorova on the stylistics of cultural communities and archaeological cultures (2017: 222–237), A.Y. Sher (1980: 25–43), and I.V. Kovtun (2005) on the formation of stylistic invariants obviously influenced the discussions on this issue.

The images’ interpretation and reasoning are based on the text paradigm of culture proposed by Y.M. Lotman, according to which a text is understood as an “expression in a given system of signs (‘fixation’) and its capacity to perform in a certain relationship (in the system of signals functioning in a community) as elementary concept” (2004: 434). “In a preliterate culture, the distinguishing feature of a text was a supplementary, supralinguistic organization on the level of expression” (Ibid.: 435). In our case, the “supralinguistic organization” is the decoration pattern and the engraved images, which can be currently read only at the level of analyzing the algorithms of constructing and connecting signs, technical markers of their creation. Within the framework of this study, Paleolithic and Mesolithic ornament is a “dead language”, but still it is a language and a text accessible to us in its visual component, calling for research (Ananyev, 1982: 24; Kozhin, 1991; Givón, 2002: 19; Privalova, 2013; Korneva, 2017; and others). The perception of a plot arranged by binary opposition is based on the theory of binary structures in semiotic systems by V.V. Ivanov (1972) and many others who have addressed this issue.

The analysis of images involves a specific focus on their graphic features. Registration of plots and symbolic notations and the structure of images are carried out using the literary method proposed by A.-J. Greimas (1966: 18–29, 45–54, 153–158, 167–171, 254–256).

The technical details of the images were recorded by macro photography with a Canon EOS 850D camera (sensor size 22.3×14.9 mm, resolution 24.2 MP) and a Canon EF 100 mm f/2.8 Macro USM macro lens, under oblique external lighting. The resulting images were processed via the stacking method, using the Canon EOS Utility and Helicon Focus.

Results

Both daggers were decorated on both sides. The Chernozerye item shows a combination of conventionally realistic and geometric images, while the Aitkulovo

dagger exhibits geometrically schematic images; both artisans were familiar with the palimpsest technique*. The compositions on the artifacts under consideration are original, no complex parallels to them have been found; but there is a clear similarity in one of the plots, which has not yet been noticed by researchers.

Images of snakes on the Chernozerye dagger. As noted above, the item was manufactured on a fragment of the diaphysis of a large mammal. The thickness of the compact bone was sufficient for fashioning the dagger; however, the proximal and central zones show the trabecular structure of the bone. One of the faces is carefully smoothed; the opposite face does not demonstrate any traces of preparation, no processing seems to have been carried out. The edges were flattened by planing (with subsequent grinding) and then supplemented by relatively deep V-shaped slots for inserting blades. The proximal part of the dagger shows two biconical holes. Both faces bear engraved images (Fig. 1, a).

We can consider three herpetomorphic images on the Chernozerye dagger, but only one of them is beyond doubt. It is located on the face that is perceived as a reverse side, showing the trabecular texture of the bone (Fig. 1, a, b)**. The spongy surface, “blurring” the outline, did not allow the first researchers to clearly identify the image, which they initially interpreted as a zigzag line (Petrin, 1971, 1986: 62). Owing to this “simplicity”, the artifact was always exhibited with its

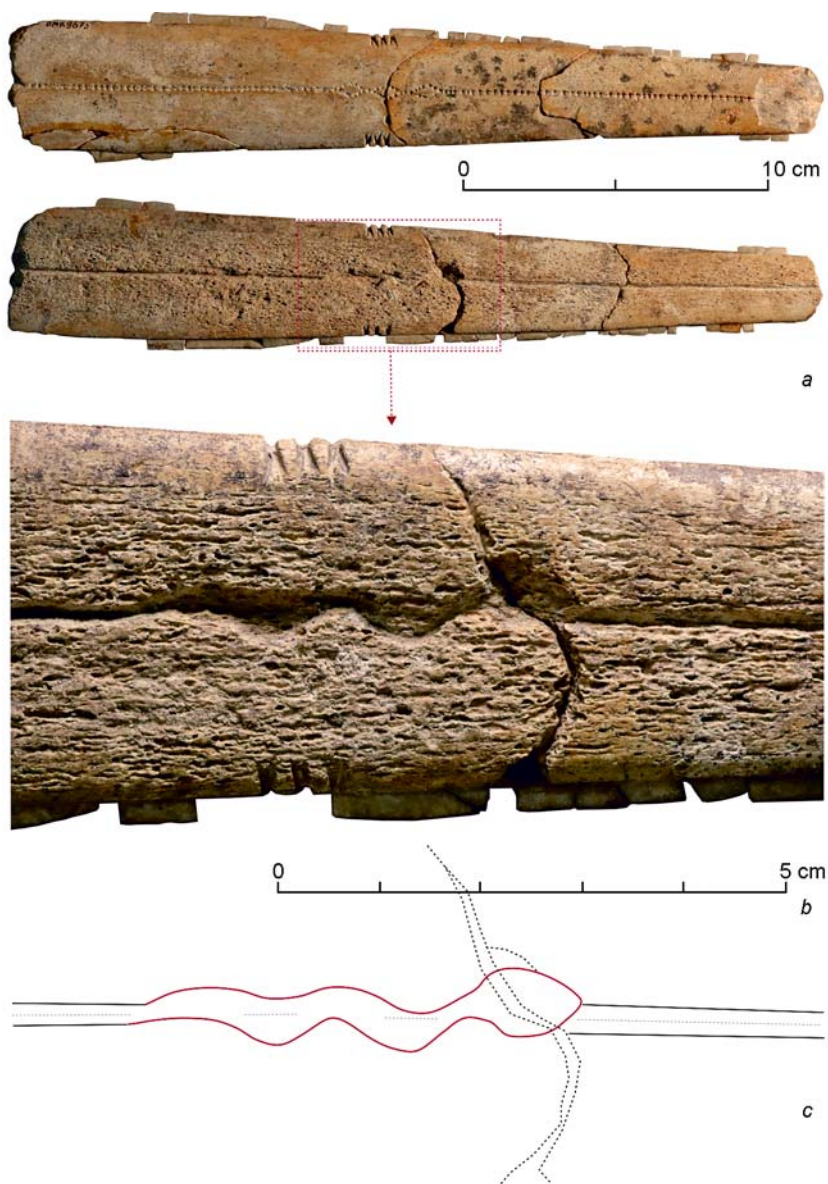


Fig. 1. Chernozerye dagger. From the collection of the Omsk State Museum of History and Local Lore (OMK 9675/702).

a – obverse and reverse faces of the artifact; b – fragment with snake image; c – trace-drawing of the image outline.

“front face”, containing a more complex composition. In 2005, the short zigzag was interpreted as an image of a snake, when an obvious thickening, resembling the reptile’s head, was revealed at one of its ends (Schmidt, 2005: 100).

The image demonstrates the style original for the Siberian region. The writhing snake’s body is engraved using a linear counter-relief technique. The visible length of the image is 45 mm; the width of the main line is 3–5 mm; the head is approx. 7 mm long; the cutting depth is up to 2–3 mm. The outlines of the serpent’s body resemble a short wavy line

*I agree with E.Y. Giryа (oral communication) concerning the impropriety of using the term palimpsest in most cases, since there was no intentional erasure of signs and placement of others at the spare places. But in the compositions under consideration, some signs overlap others.

**The item consists of five fragments, which are now combined into two blocks. The block of three fragments containing the images under study is discussed in the paper.

with rounded tops, i.e. not a zigzag, although such tops were traditionally conveyed by pointed angles. The head area is damaged by a crack and a small negative scar, which precludes an identification of its original upper outline, but the general direction of the line is clear (Fig. 1, c). The image overlapping the engraved straight groove with V-shaped profile suggests the simplest plot—“a coiling snake”. No parallels in the manufacture technique and plot are known within the Siberian region.

The conventional front side of the artifact is decorated with a narrow (1.0–1.5 mm) engraved line, V-shaped in side view, running along the middle part of the face, with rounded and crescent-shaped caverns (mean diameter from 1 to 2 mm) in the slot (Fig. 1, a). This decorative motif is known as a “thread of pearls”, which is characteristic of the Chernozerye ornamental style (it is not recorded in the materials from other sites). In the central area, a chain of three rhombs connected by short cut lines forms a simple composition (Fig. 2). Formerly, it was hypothesized that this scene represented images of snakes with their bodies stretched out in a line; yet, this interpretation was not supported (Schmidt, 2005: 100). However, there are two reasonable grounds in favor of that interpretation. The first is based on the narrative style used in the design of the reverse side of the Malta plaque. Its lateral compositions suggest figurative correlations of stylistically different images of the same character—a snake, rendered in the conditional- realistic and geometric manner. The second ground is the interpretation of a number of absolutely straight Malta rod-pendants as the images of snakes (see (Lbova et al., 2020: 85–86; Demeshchenko, 2022: 37–38)), which suggests the existence of several

iconographic traditions of conveying this image in the figurative practice in ancient Siberia. If the rhomb in the Chernozerye composition is interpreted as the head of a snake, and the adjacent long line as its body, then the abstract “chain of rhombs cutting across the straight groove” (Schmidt, 2005: 100) can be a plot of “opposed/ mirrored snakes in extended positions, separated by a rhomb-shaped figure”. The snake image is known to be conveyed mainly in a state of movement, writhing; therefore, the above-proposed interpretation of the composition on the front face of the dagger remained a working hypothesis for a long time, until a similar plot was noted on the Aitkulovo dagger and the bone arrowhead from Lake Shigir (see more on this below).

The parameters of the “images” can hardly be determined, since the composition is damaged (one fragment of the reconstructed dagger is missing). The available fragment of the dagger shows that the total length of the “proximal snake” is 120 mm, that of the rhomb-shaped head is 11 mm, and its width is 5 mm. The algorithm for constructing the rhomb: ZE (zigzag elbow) + iZE (inverse zigzag elbow). The length of the “distal snake’s” body is 114 mm (its end is damaged by a break). The dimensions of the rhomb-shaped head and the algorithm for constructing the rhomb are identical to those of the first image (Fig. 2).

The plot has not been interpreted in full; the possible meaning of the rhomb-shaped figure, dividing the images opposed to each other, is unclear. The algorithm for the rhomb’s construction and its dimensions do not differ from those described above.

The rhomb is an ancient and capacious symbol; it is rather rarely found in Paleolithic and Mesolithic engravings (Lozovskaya, 2023). This image does not belong to the Malta set of figurative symbols,

but it was used to decorate items in the Middle Irtysh region and the Urals. This fact suggests the graphic and, possibly, substantive similarity of the figurative practices of the populations inhabiting these regions and their potential “kinship” (Schmidt, 2022: 357).

Snake-like images on the Aitkulovo dagger. The dagger is

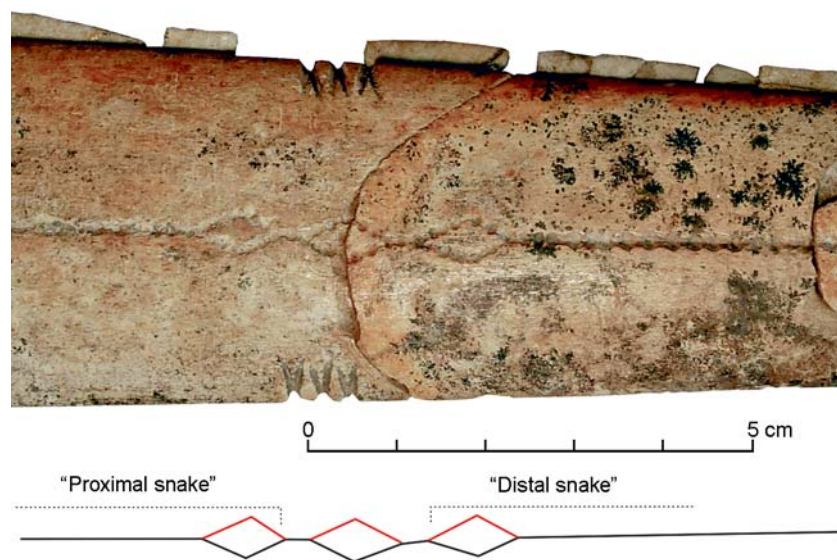


Fig. 2. Fragment of the Chernozerye dagger (obverse face of the artifact), bearing the composition of “chain of rhombs/opposed snakes striving to meet”. From the collection of the Omsk State Museum of History and Local Lore (OMK 9675/702).

made from a straightened rib of a large animal. Some signs of damage (peeling) of the bone compact are noticeable. The conventional front face, bearing the serpentine images, is well preserved. The surface of the artifact reveals the following technological traces: planing zones (areas with micro-ribbed surfaces), preparation of slots for inserts (similar to the Chernozerye algorithm), preparation of the working area and marking the slot for the second insert-blade (on the opposite edge of the item). In the proximal part of the artifact, there is a hole with traces of heavy, diagonally oriented wear (for more details, see (Schmidt, 2024)).

Both faces of the dagger are decorated with engravings; the snake-like images are located only on the conventional obverse face. The composition consists of two tiers: one with four cross-shaped figures, the other with the plot “snakes crawling towards each other/opposed snakes separated by two rhombs”. Previously, the latter composition was interpreted as stylized fish images (Kungurov, Shemyakina, 1994: 35), but the interpretation was not substantiated.

The snake images (“proximal” and “distal”) were made using a technique of deep contour engraving; then, thin carved lines covered the grooves and the space between them. The physical condition of the engraved and carved lines suggests the Mesolithic age of the compositions and a gap in the artistic development of the images; two phases in the manufacturing sequence have been established (this issue is addressed in a separate study (Schmidt, 2024)).

The “proximal snake”, located in the area adjacent to the dagger’s handle, is 87 mm long, the body

width is 3–4 mm. The width of the lines contouring the body is 1.6–1.8 mm. The writhing body is depicted by a zigzag consisting of four elbows with unsmoothed tops. The head is represented by a rhomb 19 mm long, 8 mm wide; this feature, like the adjacent rhomb figure, was designed according to the “Cherno-Ozerye algorithm”: KE + iKE (Fig. 3, b; 4).

The total length of the “distal snake” is 55 mm, the body width is 3–4 mm. The head is rendered as a rhomb-shaped figure 13 mm long and 7.5 mm wide. But the algorithm of its construction (like that of the adjacent rhomb) differs from the technological sequence described above. The rhombs are constructed by the interweaving of two proportionally large and elongated zigzag lines, the tops of which are inversely opposed to each other: KE + OiKE (the overlapping inverse elbow of the zigzag). It took

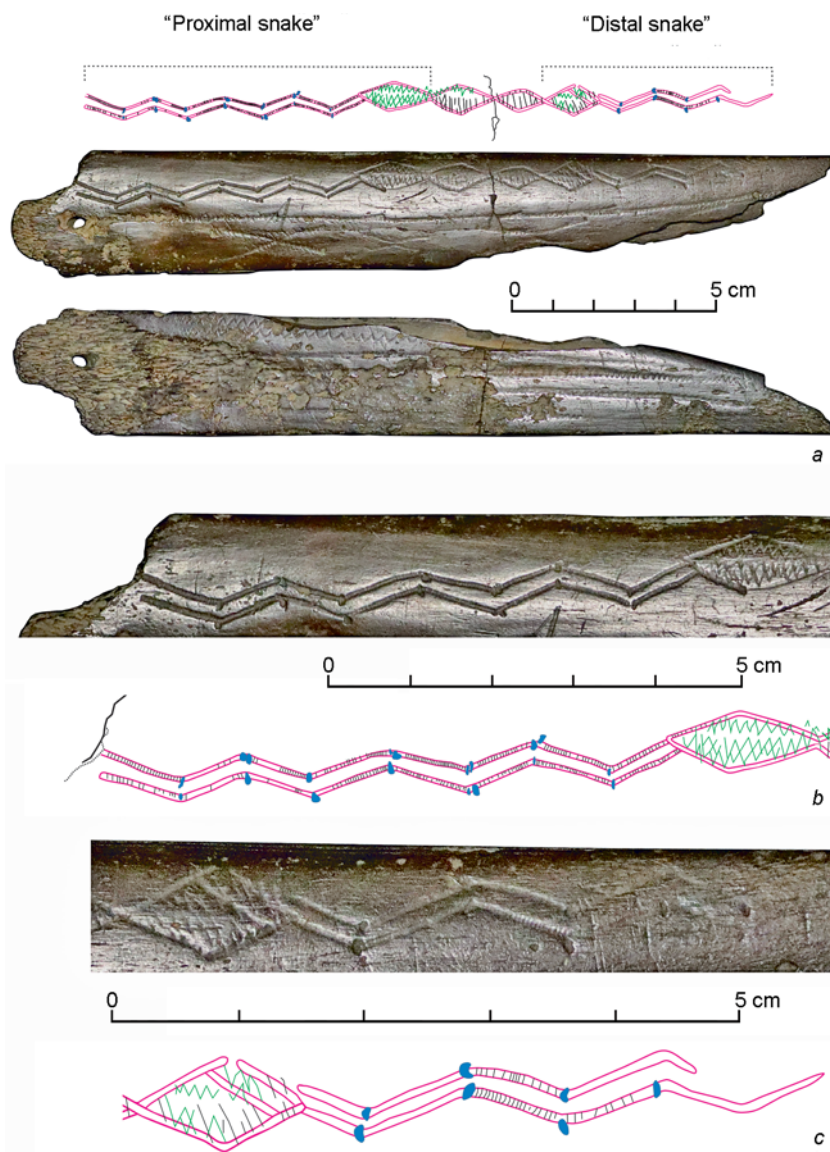


Fig. 3. Aitkulovo dagger. From the collection of the Museum of Altai Archaeology and Ethnography of the Altai State University (MAEAGU OF 93).

a – obverse and reverse faces of the artifact, trace-drawing of the composition; b – “proximal snake”, trace-drawing of the image; c – “distal snake”, trace-drawing of the image.

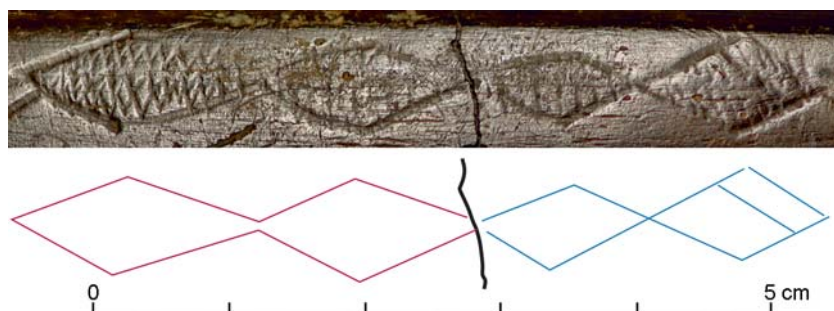


Fig. 4. Fragment of the Aitkulovo dagger, showing a chain of rhombs; layout of rhombs. From the collection of the Museum of Altai Archaeology and Ethnography of the Altai State University (MAEAAGU OF 93).

the artisan a few tries to join these lines harmoniously in the “back of the snake’s head” (see Fig. 3, c; 4).

As noted above, the composition underwent several phases of development. After the stage of “free/simple image” mode, it was supplemented. The grooves outlining the contours of the snakes’ bodies were unevenly covered with thin carving transversely oriented notches (see Fig. 3). This creates the effect of a vibrating line, enhancing the dynamism of the images. The rhombs within the contour are covered with rows of zigzag and straight, diagonally oriented signs (see Fig. 4). The areas of the zigzag elbows are marked with small caverns. Their shapes are oval/lenticular and irregular. In certain bends of the “proximal snake’s” body, one can notice the doubling of the caverns (see Fig. 3, b). The shape of these additional signs and their placement show parallels with the Mesolithic artifacts from the Ural zone (Savchenko, 2020: Fig. 6, 15, 22, 28, 25); something similar can be found in the Mesolithic materials of the Volga-Oka interfluvium (Lozovskaya, 2020: Fig. 1, a).

The plot, as in the case of the Chernozerye composition, cannot be interpreted in full: the images of snakes opposed to each other are separated by two rhomb-shaped figures, whose meaning remains unclear.

Discussion

Three indisputable images of herpetomorphs and two probable snake images are represented on the surfaces of the two daggers. The images are different in terms of style and technology, probably because the artisans belonged to different population groups. However, the similarity in the plots suggests common ideas, in which the main image was the snake. Apart from the items under discussion, no Paleolithic or Mesolithic artifacts containing compositions with

images have been reported from the Middle Irtysh region; thus, it is hardly the time to speculate about compositional and figurative tendencies in the pictorial practices of the region’s inhabitants (the region lacks profound studies). This fact is surprising and increases the interest in the engravings under consideration.

The difference in manufacturing techniques (fine engraving/carving, counter-relief, and wide-grooved engraving covered with thin-line carvings) and in designs of reptile representation (from conventionally realistic to extremely stylized) definitely emphasizes the importance of the characters chosen for the compositions—the snake was of interest to the ancient inhabitants of the Middle Irtysh region. It was depicted in various styles, using various carving techniques, in pairs or alone, twice in the context of a specific plot (dissimilar to the Malta one). The revealed plot is rare, but occurs at the sites located further west (see (Viktorova, 2017: Fig. 90, b)), for example, on a bone single-edged side-bladed spearhead from Lake Shigir (Fig. 5). One of its faces is decorated with an original composition including the plot of “snakes crawling towards each other/opposed to each other”. It was made using the technique of fine carving and dates back to the Mesolithic period. The snakes’ bodies are smoothly curving; the heads are shown by various figures: one is rhomb-shaped, the other is difficult to describe briefly. The snakes are not separated by any signs or figures, they rather merge with each other (Fig. 5, d).

The discovery of a plot similar to the Aitkulovo one in the Ural collections adds credibility to the proposed interpretation of the imagery on the front face of the Chernozerye dagger. This assumption can be considered highly probable. The dagger comes from the region where the important/obligatory plot of “snakes striving to meet/opposed to each other” could have had morphological and stylistic variations, but still remained quite recognizable.

Noteworthy are not only the variability of the plot, its territorial locality and the chronological range of its existence, but also its connection to functionally important items. It was recorded three times—always in the design of blade items (a single- and a double-edged dagger, and a bone arrowhead with a side blade). These tools are related to wounding/murder in one way or another. We don’t know the types of snakes rendered in

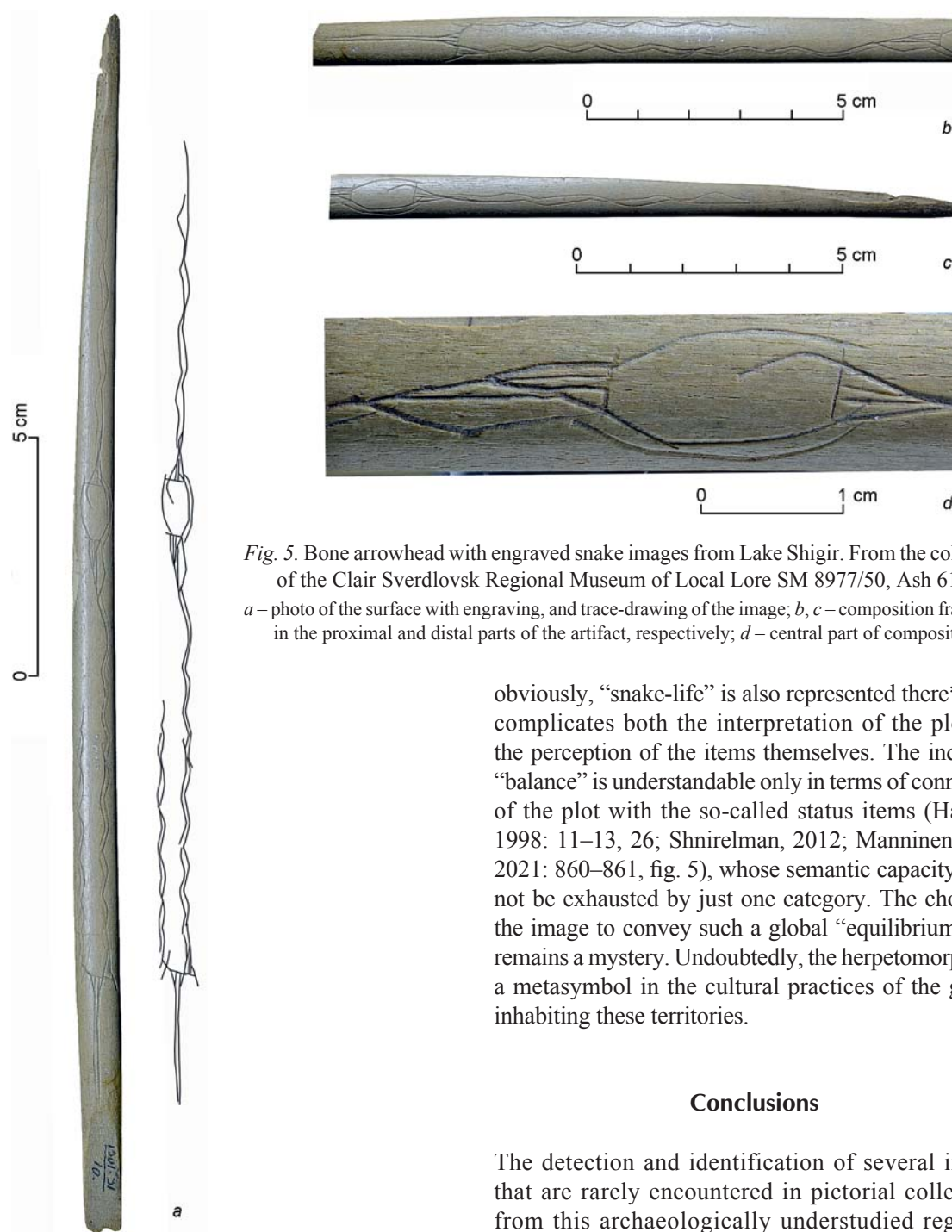


Fig. 5. Bone arrowhead with engraved snake images from Lake Shigir. From the collection of the Clair Sverdlovsk Regional Museum of Local Lore SM 8977/50, Ash 611).

a – photo of the surface with engraving, and trace-drawing of the image; *b*, *c* – composition fragments in the proximal and distal parts of the artifact, respectively; *d* – central part of composition.

obviously, “snake-life” is also represented there*. This complicates both the interpretation of the plot and the perception of the items themselves. The indicated “balance” is understandable only in terms of connection of the plot with the so-called status items (Hayden, 1998: 11–13, 26; Shnirelman, 2012; Manninen et al., 2021: 860–861, fig. 5), whose semantic capacity could not be exhausted by just one category. The choice of the image to convey such a global “equilibrium” idea remains a mystery. Undoubtedly, the herpetomorph was a metasympol in the cultural practices of the groups inhabiting these territories.

Conclusions

The detection and identification of several images that are rarely encountered in pictorial collections from this archaeologically understudied region is a significant event. Neither the mammoth, nor the horse, nor the bison were as important for the inhabitants of the Middle Irtysh region as the snakes depicted in various styles and techniques, in a stable (with minimal variations) plot. A convincing interpretation of pictorial texts with snakes is a matter for future studies; for

the plots or the semantics of these images, but only one of the images is associated with “death”. The difference in their modalities is intuitively grasped: different are the directions of movement of the snakes (in the three cases under discussion), as well as the algorithms for constructing their heads in the Aitkulovo composition and on the bone arrowhead from Lake Shigir. The plot seems to convey some ideas of duality. If it contains, for instance, the category of “snake-death”, then,

*Binary opposition does not necessarily operate with the named maxims; it can also be an opposition of male-female, good-evil, etc.

now, we can only analyze individual aspects of the origin of the images, rely on our own intuition, and wait for the emergence of new materials confirming our assumptions. Yet, we have achieved certain results.

The snake image was known and certainly of interest to the Paleolithic and Mesolithic hunter-gatherer communities of the Middle Irtysh region. This interest was probably due to the “common Siberian” traditions. But in the region under consideration, the snake image had a certain semantic load, unknown further east, where its semantic content was obviously controlled by the traditions of Malta.

Obviously, noteworthy is the association of the snake image with blade items, which imply a “global” transformative activity (whole-part, single-divided, living-dead). The accompanying pictorial “texts” emphasized the essence of what was happening through semantically capacious figurative combinations. The former ignoring of this meaningful image is explained by the scattered locations of the items and the stylistic originality of the compositions, which hampered focusing on the plot’s unity. This publication pointed to the occurrence of herpetomorphs in the Paleolithic-Mesolithic pictorial tradition of the southwestern Siberia, which makes it possible to include this region in the list of the cultural landscapes (comparable with the Malta-Buret zone), where search for graphic forms of communication was conducted, and the process of creating “texts” developing global worldview categories was under way.

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THE METAL AGES AND MEDIEVAL PERIOD

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V.I. Molodin

*Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: molodin@archaeology.nsc.ru*

The Ukok Plateau, an Archaeological Gem of the Altai: 35 Years Later

The article brings together the most important results of work carried out by archaeologists from the Institute of Archaeology and Ethnography SB RAS on the Ukok Plateau in the southwestern part of the Altai Republic, Russia, over the past thirty years since the first excavations by Natalia Polosmak. Over this period, a series of fundamental discoveries was made on the plateau, and the findings were published in a number of monographs and articles. Regrettably, these publications have received little attention from experts and lay public amenable to scientific boom and to myths spread by hedge journalists, by the public craving for brouhaha, and sometimes even by professional archaeologists. This study highlights major excavation findings, their scholarly interpretation and museumization of the Early Iron Age Pazyryk mounds, including rare ones with permafrost. These were interpreted with regard to the specific area of Central Asia, and to the entire timespan from its initial peopling in the Late Pleistocene to the recent centuries. The archaeologists' role in the detection and description of over 400 sites on the plateau is assessed. Rock art galleries, especially the key site at Kalgutinsky Rudnik with the earliest petroglyphs among those known in the Russian and Mongolian Altai, are described. Protective measures regarding cultural legacy of the Ukok Plateau, its coverage by the media, and prevention of ecological harm by tourists are proposed to municipal authorities in the Republic of Altai.

Keywords: Ukok Plateau, Pazyryk culture, classification, chronology, rock art, media coverage, scholarly tourism.

Introduction

The Ukok Plateau is situated in the Russian part of the Altai Mountains. The plateau occupies a considerably large territory in the southwestern part of the Altai Republic, Russia, bordering Mongolia, China, and Kazakhstan (Fig. 1). The plateau elevation is 2000–2500 m above sea level. It fully justifies its name—“mountain with a flat top” (Molchanova, 1979: 324), framed by high and hard-to-reach cliffs. However, passable routes connect Ukok with the expanses of Central Asia in the south, with the Russian Altai in the north and east, and with the steppe regions of Kazakhstan in the west (Fig. 2). These passes are largely facilitated by the Bukhtarma and Ak-Alakha river systems, which originate on the plateau and connect it with the northern

and western areas of the region (Sapozhnikov, 1949: 113–136; 283–296; 409–415) (Fig. 3).

The plateau is a typical high-mountain tundra environment with a harsh climate and fairly low temperatures even in summer. At the same time, owing to the vast pastures freed from snow by constant winds, the plateau provides favorable conditions for winter keeping and grazing of cattle. In addition, the abundance of wild animals in tundra and fish in the rivers and lakes has always attracted people to that area. Ukok was also actively used for roaming by migrating inhabitants of this Asian region at least until the late 20th century.

Owing to the above environmental conditions, people inhabited the plateau starting from the first human migration from the south in the Late Pleistocene up to the present time, as was established by the recent paleogeographical research (Deline et al., 2023). Such



Fig. 1. Map of the southwestern Altai Mountains and the Ukok Plateau.

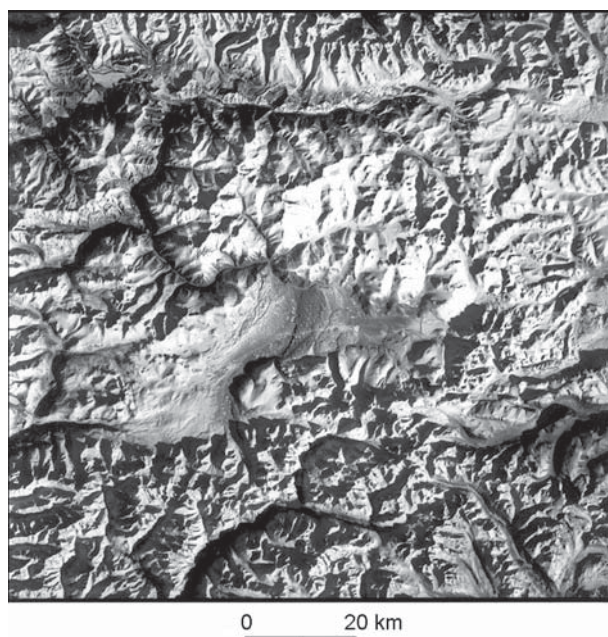


Fig. 2. View from space of the Ukok Plateau and surrounding mountains.

a long period of human habitation resulted in the emergence of various archaeological objects—rock art sites, stone steles, mound and flat-grave burial grounds, sanctuaries, megalithic constructions, and settlements.

Results of research on the Ukok Plateau

The first archaeological surveys on the plateau were carried out in the 1970s by V.D. Kubarev, a researcher at the Institute of History, Philology and Philosophy of the Siberian Branch of the USSR Academy of Sciences; he recorded several burial mound groups



Fig. 3. The Ukok Plateau. View of the Ak-Alakha River Valley.

and rock art sites on the Ukok (Kubarev, 1980). It was he who advised N.V. Polosmak to conduct excavations of Early Iron Age burial mounds on the plateau aimed at discovering “frozen” archaeological complexes therein.

Thirty-five years ago, an archaeological team led by Natalia Polosmak, PhD in history at that time*, carried out the first large-scale excavations on the Ukok Plateau, which yielded excellent scientific results (Polosmak, 1991). This was the first frozen tomb of Ak-Alakha-1 of the Pazyryk culture. A unique set of grave goods made of various perishable organic materials dating to the 5th–4th centuries BC was recovered. This discovery launched archaeological research on the Ukok Plateau, which was carried out till the end of the 20th century and continues sporadically nowadays.

The main work was performed by two archaeological teams headed by N.V. Polosmak and V.I. Molodin**. By the present paper, I would like to recall the main scientific achievements gained on the Ukok Plateau. At present, this seems especially important to me, since after the discovery by Natalia

*Currently, N.V. Polosmak is a Doctor of Historical Sciences, Corresponding Member of the Russian Academy of Sciences, and Chief Researcher at the Institute of Archaeology and Ethnography of the Siberian Branch of the Russian Academy of Sciences.

**Editor’s note: On June 6, 2005, by the Decree of the President of the Russian Federation, Novosibirsk archaeologists Academician of the Russian Academy of Sciences V.I. Molodin and Doctor of Historical Sciences N.V. Polosmak were awarded the 2004 State Prize in Science and Technology for the discovery and study of unique complexes of the Pazyryk culture of the 6th–3rd centuries BC in the Altai Mountains.



Fig. 4. Process of melting ice in the burial chamber of mound 1 at Ak-Alakha-3. N.V. Polosmak and E.V. Shumakova in the burial chamber.

Polosmak of the burial of a woman from the middle class of the Pazyryk society in a frozen tomb filled with ice (mound 1 at Ak-Alakha-3) (Polosmak, 1994a) (Fig. 4), followed by the multidisciplinary studies and several fundamental publications (Polosmak, 1996, 2000a, b), reporters of the yellow press and makers of modern myths put it on the map and floated an idea that this woman was the Altai princess, the progenitor of the Altai people, etc. In the wake of this nonsense, the real scientific achievements gained on Ukok were overshadowed. Unfortunately, this concerns not only an average person who is eager to get in touch with the myth and even participate in it, but also some members of the scientific community who, voluntarily or involuntarily, fuel the unhealthy focus in their ill-considered publications.

So, 35 years have passed since the start of excavations at Ukok. What are the main scientific data that have been derived from the artifacts collected in the course of the sophisticated field research?

Among the main tasks that were set for the two archaeological teams—and first of all for the

team of Polosmak—was the study of burial sites of the Pazyryk culture dating to the Early Iron Age (6th–3rd centuries BC). Some of the tombs were frozen owing to the harsh climate, which provided a unique opportunity to study the whole ethnographic complexes, since the ice preserved the most sophisticated elements of burial practices, unique artifacts, often highly artistic (Fig. 5), made of wood (Fig. 6, 7), fabrics (Fig. 8, 9), leather, felt (Fig. 10, 11), horn (Fig. 12), and skins, as well as the remains of animal corpses (horses) and buried people. The involvement of specialists in the field of natural sciences, armed with modern equipment and methods, in the research made it possible to derive representative scientific information concerning both humans (e.g., paleogenetic data) and numerous items of material and spiritual culture, as well as the most complex methods of mummification (Fig. 13), embalming, tattooing (Fig. 14, 15) of deceased Pazyryk people.

Team 2 of the expedition was also engaged in the study of the Pazyryk records, and contributed a lot to the study of burial complexes on the Ukok Plateau (Molodin, 1997, 2000b; Polosmak, Molodin, 2000). In total, the two teams excavated 22 burial mounds of the Pazyryk culture, including six frozen burials. The large size and the specifics of funerary rite suggest that N.V. Polosmak excavated two



Fig. 5. Wooden decorations of horse harness. Mound 1, Ak-Alakha-3.



Fig. 6. Wooden vessel with a carved handle (1), and artistically decorated mirror base (2). Mound 1, Ak-Alakha-3.



Fig. 7. Wooden neck torque. Mound 3, Verkh-Kaldzhin II.



Fig. 8. Fabric trousers. Mound 3, Verkh-Kaldzhin II.



Fig. 9. Silk shirt (1) and wool skirt (2). Mound 1, Ak-Alakha-3.



elite complexes (regrettably, these were not frozen and were heavily disturbed by looters). The findings were introduced in a number of publications, including summarizing monographic works (Polosmak, 1994b, 1997, 1999, 2001; Fenomen..., 2000; Naseleniye..., 2003; Tekstil..., 2006; Molodin, 2000a, c; Polosmak, Molodin, 2000, 2019; Polosmak, Barkova, 2005). In addition, the attempts were made to develop the methodology for studying “frozen” burial complexes

(Polosmak, Molodin, 2000; Molodin, 1996, 2000b; Fenomen..., 2000: 50–56).

Notably, the Siberian Branch of the Russian Academy of Sciences granted considerable financial support to scientific analyses of materials from the Pazyryk sites on the Ukok Plateau; the unique level of participation of various specialists in the multidisciplinary study still has no equal not only in Siberia but also in the Russian Federation as

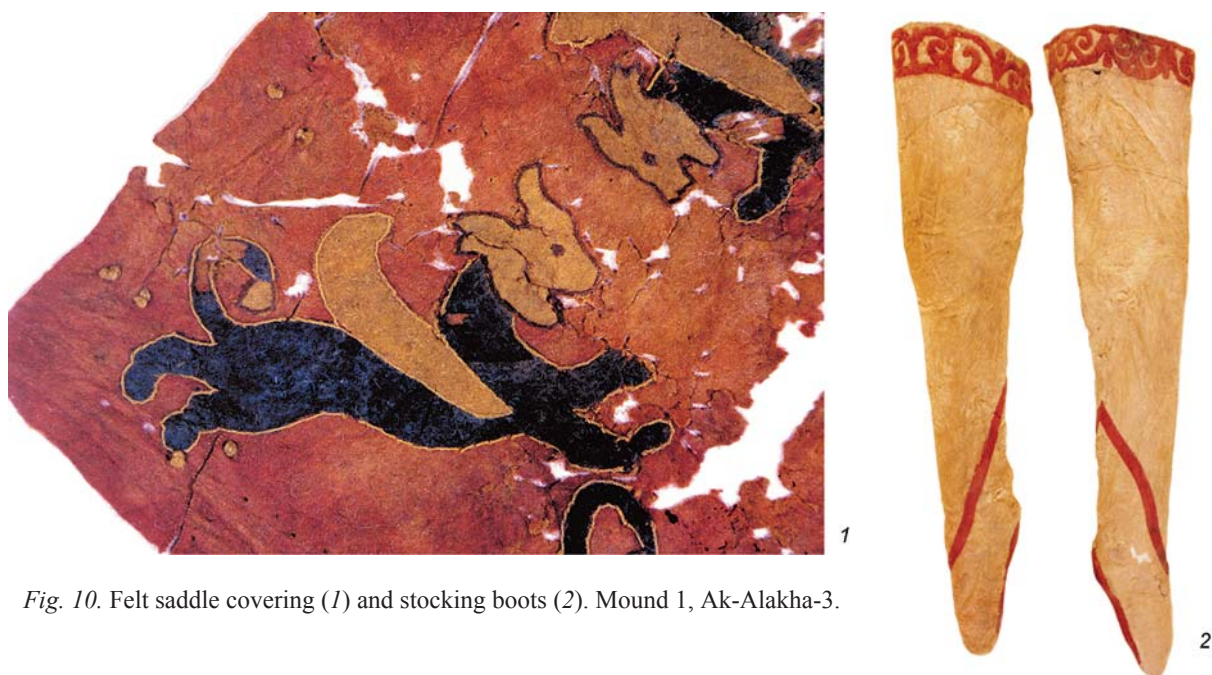


Fig. 10. Felt saddle covering (1) and stocking boots (2). Mound 1, Ak-Alakha-3.



Fig. 11. Felt headdress with wooden decorations. Mound 3, Verkh-Kaldzhin II.



Fig. 12. Vessel made of horn. Mound 1, Ak-Alakha-3.

a whole (see (Polosmak et al., 1997; Fenomen..., 2000; Naseleniye..., 2003; Tekstil..., 2006)). The Ukok findings served as the basis for establishing the dendrochronological classification of the Early Iron Age cultures of Southern Siberia (Sljusarenko, 2000); the issues of ancient techniques of wood processing in that period were considered (Myl'nikov, 1999). In addition, for the first time, a comparative analysis

of the Ukok and Xinjiang artifacts was carried out (Polosmak, 1998).

Currently, the derived data are well known by the scientific community; the information was presented in the summary publications listed above, as well as in the latest version of the "History of Siberia" (Polosmak, Molodin, 2019). The information is also available to the general public interested in the history of the Fatherland (see, e.g., (Molodin, 2000d)). Apparently, it is these works that should be the primary source for any historical and cultural constructions.

The second major line of scientific research on the Ukok Plateau became the issues of chronostratigraphic classification of ancient cultures in the Altai Mountains from the early peopling of the region until the late medieval period. This implied the search for new and insufficiently studied sites from various chronological periods in this region. The Ukok Plateau provided

broad, essentially unique opportunities in this regard. Over several years (apart from the Early Iron Age complexes discussed above), sites aged to the terminal Upper Paleolithic, the Early and Middle Bronze Age, the Early Scythian and Xiongnu-Sarmatian periods, the Old Turkic and Mongolian epochs, and the recent centuries (ethnographically modern period) were discovered and studied in the plateau. Notably,



Fig. 13. Mummy of a man. Mound 3, Verkh-Kaldzhin II.



Fig. 14. Tattoo on the shoulder of a female mummy. Mound 1, Ak-Alakha-3.

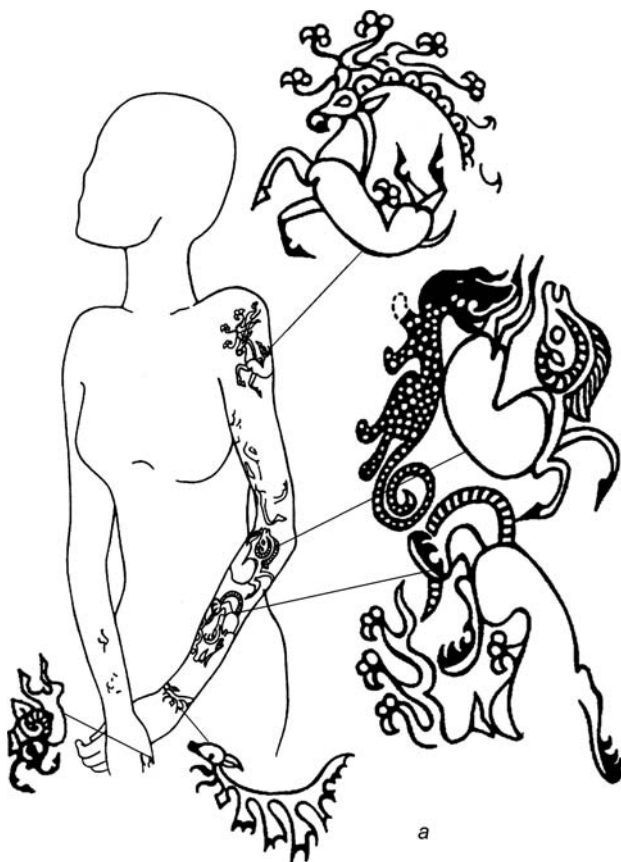


Fig. 15. Copies of tattoos of the mummies from mound 1 at Ak-Alakha-3 (a) and mound 3 at Verkh-Kaldzhin II (b).

many discovered sites are still unique for the Altai Mountains and adjacent areas of Central Asia.

A significant amount of derived data was accumulated and promptly introduced into scientific circulation (see (Drevniye kultury..., 1994; Polosmak, 1993, 2007; Molodin, Cheremisin, Novikov,

2004)); a chronological scheme of historical and cultural development in the region was developed (Molodin, 1995; Arkheologicheskiye pamyatniki..., 2004: 223), and it is in use today (Fig. 16). This periodization has not been disputed by anyone from the scientific community, and it should serve the

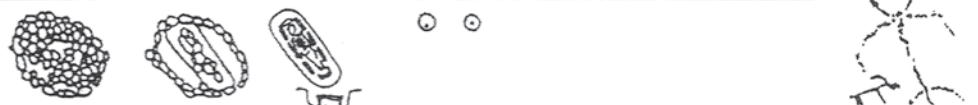
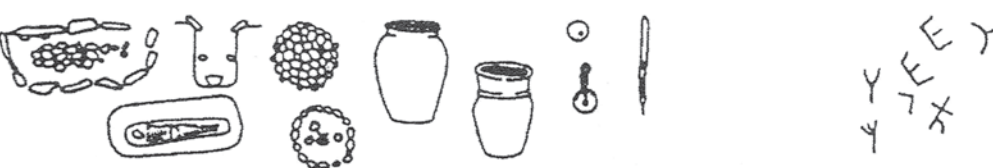
Middle Ages	17th–18th centuries AD	
	15th–16th centuries AD	
	Mongolian period, 12th–14th centuries AD	
	Old Turkic period, 6th–11th centuries AD	
	Xiongnu-Sarmatian period, 2nd century BC to 5th century AD	
	Pazyryk culture / Kara-Koba culture, 6th–2nd centuries BC	
Early Iron Age	Early Scythian period, 8th–7th centuries BC	
	Late Bronze Age, late 2nd to early 1st millennia BC	
	Middle Bronze Age, 2nd millennium BC	
Bronze Age	Afanasyevo culture, late 4th to early 2nd millennia BC	
	Paleolithic	

Fig. 16. Scheme of historical and cultural development of populations on the Ukok Plateau.

basis of any historical and cultural reconstructions.

In 1996, the government of the Altai Republic imposed a moratorium on archaeological excavations in the Kosh-Agachsky District and declared the Ukok Plateau a “Quiet Zone”; large-scale excavations were stopped and limited to geophysical projects at some burial complexes and studies of rock art sites. However, even during that period, several magnificent discoveries have been made at Ukok. This were primarily several burial grounds of the Pazyryk culture, probably containing frozen tombs, found using geophysical monitoring technique.

At the same time, the revealed scientific significance of the cultural heritage from the Ukok Plateau required accumulation of all currently available data on archaeological sites, with their description, spatial structure, and reference to a coordinate system. In the late 20th century, a project of construction of a highway and gas pipeline connecting Russia and China across the plateau was proposed; its implementation included rescue archaeological surveys. Hence, a team led by Natalia Polosmak executed a survey and mapped the discovered archaeological sites in the zone of highway and gas pipeline construction (owing to the lack of proper coordination, similar work was carried out by a group of archaeologists from the Gorno-Altai State University, headed by V.I. Soenov, who re-documented these sites (Soenov, 2001)). Particularly important were the surveys carried out in 2001 by the teams led by E.S. Bogdanov and D.V. Cheremisin, who determined the exact coordinates and got more accurate data on the spatial structure of most archaeological sites discovered on the plateau (Fig. 17).

The most important result of all the works was the collective monograph “Archaeological Sites of the Ukok Plateau (the Altai Mountains)” (2004), which included a comprehensive description of



Fig. 17. Mound cemeteries (1) and deer stones (2) on the Ukok Plateau.

405 archaeological sites, a historical and cultural essay presenting the materials found, as well as an exhaustive (for that period) list of references concerning the archaeology of Ukok. Of course, this does not mean that all sites have been uncovered on the plateau; new targeted studies of the region will certainly yield new findings, but even today the amount of sites and information discovered is impressive.

Another important result of archaeological research on the Ukok Plateau was the discovery and cataloguing (with subsequent interpretation) of rock art sites. Careful survey conducted by a special group headed by D.V. Cheremisin revealed dozens of clusters of boulders bearing rock images, as well as stone statues (Molodin, Cheremisin, Novikov, 2004) (Fig. 17, 2). In addition, several particularly significant petroglyph

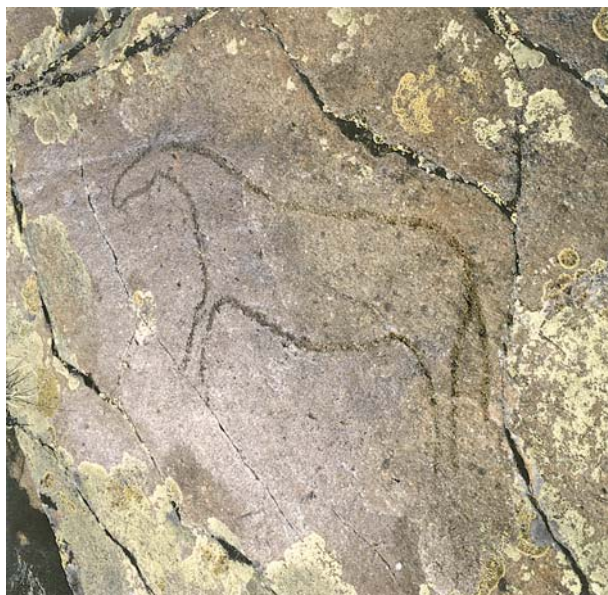


Fig. 18. The earliest “Kalgutinsky” image from the Ukok Plateau.

sites were discovered and subjected to special studies. This concerns the so-called Bertek rock art site of the Early Iron Age (Cheremisin, Slyusarenko, 1994), a remarkable boulder bearing a palimpsest of images discovered on the shore of Lake Muzdy-Bulak (Molodin, Cheremisin, 2002), and other sites. However, the most impressive site is Kalgutinsky Rudnik, where a set of images attributable to the earliest rock art period in this part of the Altai Mountains was recorded, analyzed, and published (Molodin, Cheremisin, 1999) (Fig. 18). Without a doubt, this discovery is one of the most important on the Ukok Plateau to date. Special studies of this remarkable site were continued by the Russian-French expedition; consequently, the “Kalgutinsky” style of rock images—the oldest one in this region of Central Asia today—was established after targeted research in the adjacent territory of the Mongolian Altai (Molodin et al., 2021). The rock art of the Ukok Plateau was described in a special article (Molodin, Cheremisin, 2007) (Fig. 19). Currently, a periodization of the petroglyphs of the Altai Mountains has been developed (Molodin et al., 2023).

These are the main scientific results of 35 years of archaeological research on the Ukok Plateau. The Ukok archaeology has been described in quite a large number of publications, but unfortunately it is not

much in demand by a wide range of readers, especially non-professionals, which contributes to the flourishing of the myth-making of particular type.

Conclusions

Studies of archaeological materials from the Ukok Plateau continue today. For instance, recently, a tomographic study of the female mummy from the frozen tomb at the Ak-Alakha-3 burial ground has been carried out and provided new data on the woman’s ante-mortem diseases that probably caused her death (Letyagin et al., 2018).

The above review clearly shows that the Ukok Plateau is truly an archaeological gem of the Altai Mountains. However, excavations can be resumed here exclusively based on a balanced and thoughtful approach by both professionals and the authorities protecting the historical and cultural heritage of the Altai Republic. Obviously, only highly qualified specialists skilled in the latest multidisciplinary research techniques can be admitted to works on the Ukok Plateau. Furthermore, this approach implies the need in a set of equipment for conservation and restoration of invaluable artifacts, which with a high probability can be found in almost any archaeological site. At the same time, it is clear that the field and laboratory studies should be carried out by highly qualified specialists, and, unfortunately, there are not so many of them in our country today.

In addition, governmental authorities for the protection of historical and cultural heritage of the Altai Republic should take a thoughtful approach

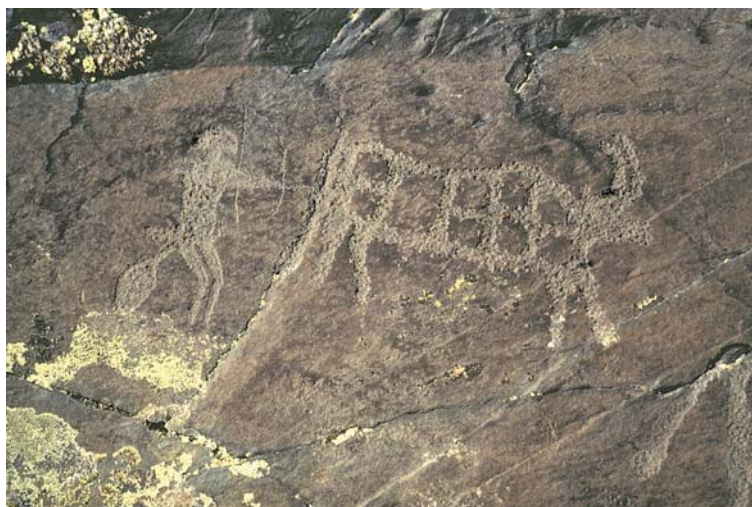


Fig. 19. Rock image at Kara-Chad X.

to embarking on tourism on the plateau, and prevent the admittance of private groups of people who do not have sufficient qualification (in all respects) and cause significant harm to both cultural sites and the environment of the plateau as a whole.

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R.I. Bravina¹ and V.M. Dyakonov^{1, 2}¹*Institute for Humanities Research and Indigenous Studies of the North, Siberian Branch, Russian Academy of Sciences, Petrovskogo 1, Yakutsk, 677027, Russia
E-mail: bravinari@bk.ru; arkh_muz@mail.ru*²*Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia*

An Unusual Bronze Figurine from the Samartai Museum, Yakutia: The “Thing-in-Itself” and Semantic Content

This article presents a rare bronze idol—a winged bear with an anthropomorphic mask and a bear head on the chest. The artifact was found in the Khangalas Ulus (district) of Yakutia and is kept in the Samartai Museum in the village of Kerdem. The search for parallels led to a wide range of Early Iron Age and medieval cultures of the Western Urals and Western Siberia. Similar composite images are common among cast ritual items relating to the Pechora, Perm, and Western Siberian animal styles. Chemical analysis showed that the sculpture was made of tin bronze with the addition of iron. This bronze idol could have been brought to Yakutia by tradesmen or Cossacks. While being quite unusual for Yakutia, it could have been used to represent a patron spirit or aid in shamanic or domestic rituals, being consonant with Yakut religious, specifically totemic beliefs, as evidenced by numerous ethnographic sources.

Keywords: Samartai Museum, cast ritual items, winged bear, bird with mask on the chest, Western Siberian animal style, shamans.

Introduction

The collection of the Zakharov Historical and Ethnographic Museum of Samartai in the village of Kerdem, Zhemkonsky 2nd Nasleg, Khangalas Ulus, the Republic of Sakha (Yakutia), contains an ancient bronze sculpture of a winged bear with images of both an anthropomorphic mask and a bear head in the center. It was discovered in the summer of 1992 near the ruins of an ancient dwelling in the Ulakhan Kuosagas area, Malzhagarsky 2nd Nasleg, Khangalas Ulus, by a fifth-grader, V.S. Alekseev*, who donated the find to the museum.

*Vasily Stepanovich Alekseev, born in 1985, from the village of Ulakhan An, Ordzhonikidzevsky District of the Yakut Autonomous Soviet Socialist Republic (ASSR). Recorded by R.I. Bravina on November 11, 2023, Yakutsk.

The exhibit (inv. No. 20) is noteworthy not only in its unique iconography, but also in its obvious non-local provenance. In the museum records, it is designated as a “shaman chest amulet—*oiuun ymyy kyyla*”. There is no object with such a name in the literature on Yakut shamanism. Apparently, the museum staff relied on the presence of loops/holes on the item, which were clearly intended for fastening it, for example, to clothing. According to the well-known regional historian of the Republic, member of the Russian Geographical Society P.R. Nogovitsyn*, the exhibit could be designated as

*Prokopyy Nogovitsyn, born in 1955, from the village of Nemyugyuntsy, Ordzhonikidzevsky District of the Yakut ASSR. Recorded by R.I. Bravina on December 23, 2023, the village of Nemyugyuntsy, Khangalas Ulus, Republic of Sakha (Yakutia).

a *kyotyor emeget** (Yakut ‘bird-idol’), considering the ancestral legends of the Khangalas people about a totem bird *khotoi-tangara* (‘eagle-deity’). Judging by the condition of the artifact and its Yakut names, it could have been used as a cult object in the ritual practices of the local population for a long period of time.

Similar examples of cast ritual items were widespread over a vast territory from the watershed of the Ob and Yenisei rivers in the east to the Kama River in the west. There is quite extensive literature on the role, significance, and functions of ancient bronze items in the late ritual practices of the Ob Ugrians. A historiographical overview of these studies is available in the monograph by A.V. Baulo (2004: 3–10).

In the past, using the example of ritual paraphernalia of Chinese origin, the current authors examined the problem of cultural borrowings by the Yakuts in accordance with their own mythological and ritual traditions. Due to their unusualness and rarity, such items often ended up among the elite, including those who serve in the cult, and were gradually filled with new religious and mythological content. In this regard, the Yakut culture exhibits high adaptive capacity (Bravina et al., 2016).

This study intends to attribute the artifact, establish the place and time of its manufacturing (“thing-in-itself”), as well as possible routes by which it reached Yakutia, clarify the semantics of the image in accordance with the traditional worldview and beliefs, and identify the function of the item in the ritual practices of the Yakuts.

“Thing-in-itself”: Description and study method

The bronze cast theriomorphic item under discussion is a syncretic image, which combines bear and bird features complemented by representations located on the chest of the main character, that of a human mask and beneath it, an inverted bear’s head.

The item is not intact. There is a crack in the middle; the tips of the muzzle of the bear in relief as well as the wings have been broken off and lost. The weight of the item is 119 g. Its height is 12.8 cm and the maximum width is 13.25 cm. The sculpture was cast in a bivalve mold made using a model. The secondary

processing included removing the sprue and splashes along the seams, with subsequent polishing of the front surface. The reverse side has no ornamentation, loops, or traces of secondary processing.

The theriomorphic figurine with bird wings, which are spread and point downwards, is crowned with the full-faced head of a bear of conical shape with short ears and a wide powerful neck, made in relief. The eyes are marked by incised ovals. The maximum width of the neck is 4.3 cm; the height of the head with the ears is 3.8 cm; the length of the surviving part of the muzzle is 2.6 cm (Fig. 1).

Two bands on both sides of a row of “pearls” of round or oval shape are located at the top edge of the wings. Pairs of straight bands (in the middle of each wing there is a single band) alternate with single rows of pearls descending down the wings from the lower line of relief. They denote stylized wing feathers of the bird. Holes for sewing or tying the figurine were made at the ends of both wings. Three intact holes filled with metal putty and two half-broken holes have survived on the right wing, and one hole also filled with putty has been preserved on the left wing. Loops for tying the item, located on the upper edges of the wings, have been worn down on the top and resemble small claws pointing towards each other. Additional rounded holes were drilled below them.

The tail, similar to a bird’s tail, is oblong and has a rounded end. Its entire surface is covered with the same ornamentation as the wings, only it is half-worn away. Three oval holes for sewing or tying the item were made at the end of the tail; the middle hole is broken. Sub-triangular protrusions edged with a band extend to each side at the beginning of the tail. A row of three “pearls” is in the middle of each protrusion. The width of the tail is 2.7–3.2 cm and 4.4 cm with the sub-triangular protrusions.

An anthropomorphic mask in relief with a “hairstyle” of wavy lines (“braids”) diverging to the sides parallel to the ornamental lines on the wings lies between the wings in the very center of the item. The ends of the “braids” end at signs, which resemble stylized figures of curled-up animals or insect larvae with one front limb. The outline of the anthropomorphic mask is oval; the eyes are marked by convex circles with a bulging dot in the middle. Other physiognomic details, such as the nose and mouth were either missing or worn away during the use of the object. The length of the oval of the anthropomorphic mask is 1.9 cm; the width is 1.2 cm. The ears are marked by arcs on both sides at the level of the “cheeks”; two “pearls” are located near the ears (below and on the side).

**Emeget*—“wooden, birch-bark and other figures representing spirits that Yakuts worshipped in past times” (Bolshoy tolkoviyy slovar..., 2018, vol. 15: 224–225).

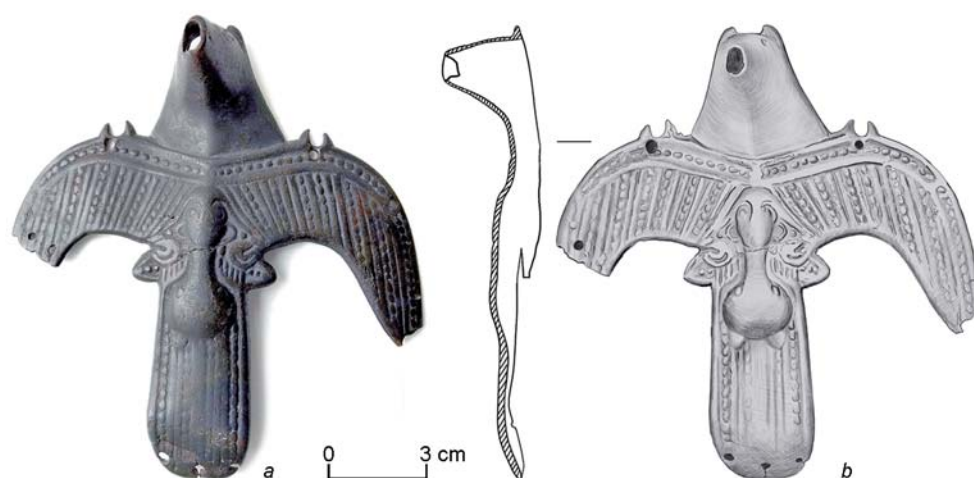


Fig. 1. Bird-like idol. From the collection of the Historical and Ethnographic Museum of Samartai, Russia.

a – photograph; *b* – drawing.

Below the anthropomorphic mask there is a heraldic symbol common to the Ob-Irtysh cultural and historical community—a stylized bear head with its nose touching the mask. The ears are marked by semicircular worn-out protrusions; the eyes are represented by small drawn circles. The length of the head is 2.6 cm; the width is 2.2 cm. Its paws with imitations of claws look like the continuation of the decorative edging of the bird's tail, made with bands. If we count the claws by the ridges, including the outline of the edge of the bird's tail, there are five of them. If we count the grooves between the bands, there are four claws, which is consistent with other similar ritual representations of four-toed bears associated with the image of the deceased “great” shaman who became the spirit assistant of another shaman, and tied with the idea of the thumb as a receptacle for the soul and the shaman's power (Gemuev, 1985: 140–143; Troitskaya, 2000: 45).

The metal of this item was analyzed using a portable MetExpert X-ray fluorescence analyzer from the research equipment of the Center for Collective Use at the Federal Research Center “Yakut Scientific Center of the SB RAS”. For this purpose, a small area on the back was mechanically cleaned of oxides. The item was established to have been made of bronze containing 60.843 % copper, 29.132 % tin, and 10.025 % iron. Analysis of the metal putty in the holes on the wings has revealed the presence of iron, copper, and aluminum: 60.773, 38.172, and 1.055 %, respectively, in one place, and 64.089, 34.687, and 1.224 % in another place.

The search for parallels to such a sophisticated polymorphic image, which previously has not been found in Yakutia, led to the circle of archaeological cultures of Western Siberia, where ritual artistic bronze

casting was widespread. This bronze casting is embodied by the so-called Western Siberian or Ob animal style, which in turn has parallels with the Perm and Pechora animal styles (Muratbakieva, 2021). Both of these share the bird motif, including birds with anthropomorphic masks on their chest (Belavin, Ignatieva, 2010: 75). V.A. Mogilnikov noted that according to the beliefs of the Ob Ugrians, a bird accompanied the soul of the deceased to the afterlife, and the mask on the chest of a bird-like creature could have symbolized the soul of the deceased (1987: 190). According to M.F. Kosarev, ancient bronze syncretic bird-like idols, which also combined zoomorphic and anthropomorphic features, could have been totemic (1984: 188). In this regard, the image of the winged bear Shelab, a powerful spirit of the Ob expanses, is noteworthy. Figurines of bird-animals with masks on their chests, similar to the Selkup winged bear Shelab, have been found over a vast territory from the Ob and Yenisei watershed in the east to the Kama River in the west (Pelikh, 1992: 89).

The early medieval images of bird-like creatures with masks on their chests had roots in the Early Iron Age cultures from the taiga zone of the West Siberian Plain, in particular the Kulaika culture from which the Relka, Potchevash, Upper Ob, and other cultures originated (Chindina, 1991: 3). According to the mapping made by A.M. Belavin, V.A. Ivanov, and N.B. Krylasova (2009: 246–249, fig. 72–74), such images were widespread over a vast territory from the Upper Ob region in the east to the Vetluga-Vyatka interfluvium in the west, but their greatest concentration was observed in the Perm Cis-Urals, in the area of the Lomovatovka culture. They have also been frequently discovered in the Ob and Irtysh regions; individual



Fig. 2. Bird-like idol of the Potchevash culture from the Okunevo III burial ground in the Omsk Irtysh region (scale unspecified).

a – photograph (Istoriya Sibiri, 2019: Fig. 122, 60); *b* – drawing (Mogilnikov, 1987: Pl. XXVIII, 33).

finds are known from the Komi, Udmurtia, Tatarstan, and Mari El Republics (Ibid.: 214–215).

The winged idol iconographically most similar to the Samartai figurine was found in the Omsk Irtysh region at the Okunevo III burial ground of the late 7th–8th centuries AD of the Potchevash culture from the Early Middle Ages (Mogilnikov, 1987: Pl. XXVIII, 33). This idol consisted of a bird figure

with anthropomorphic mask and bear head in the center (Fig. 2). The heraldic composition on a bird-like idol of not only an anthropomorphic mask, but also a bear head, is a rare phenomenon, although representation of bear heads in a “sacrificial” pose is a very common motif over the entire territory from the Kama region to Western Siberia (Troitskaya, 2000: 45). In addition to the general iconographic type, the Samartai idol is similar to the Okunevo idol in the presence of loops for tying it, and in the distinctive design of the wings with rows of pearls. However, as opposed to the Samartai item, the Potchevash figurine represents an actual bird with the head of a long-eared owl, which means that these are different sacred characters.

The question of when and how the Samartai winged bear with the mask on its chest came to a region so remote from the main area of such idols remains open. This could have resulted from various interethnic contacts between ancient tribes. A find from layer IV at the Ulakhan-Segelennyakh site on the Tokko River in the Lower Olekma River basin, dating back to the Early Iron Age, is indicative in this regard. It consists of the fragment of a slightly curved plate made of reindeer antler (Fig. 3, 1), decorated with double longitudinal and diagonal carved lines. Scholars find parallels to such plates in their metal version in the traditional outfit of the Nganasans (Stepanov, Kirillin, 2003: 91–92).

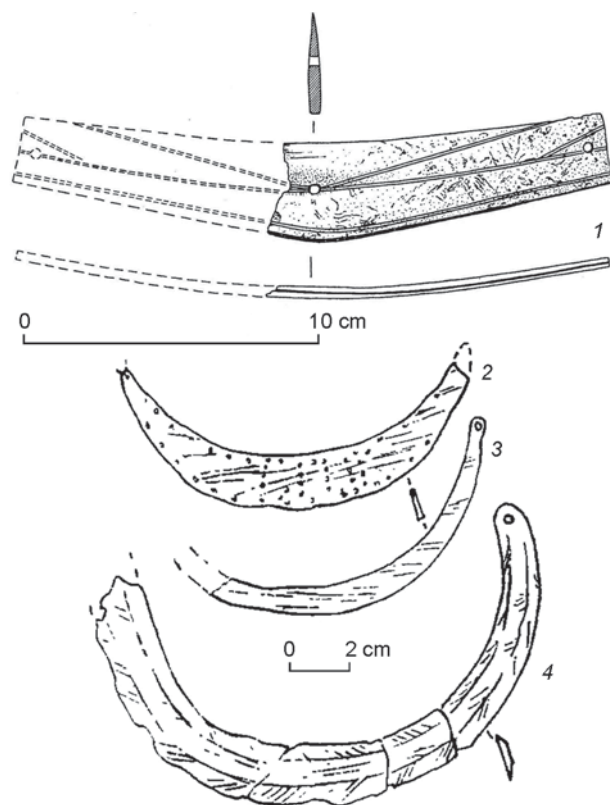


Fig. 3. Sewn-on curved plates.

1 – bone plate from the Ulakhan-Segelennyakh site in Yakutia (after (Stepanov, Kirillin, 2003: 91)); *2–4* – metal plates of the Relka culture from the Middle Ob region (after (Chindina, 1991: Fig. 32, 38, 39, 41)).

Sickle-shaped bronze plates of similar shape are a part of the material complex of the Relka culture (6th–9th centuries) in the Tom-Naryn Ob region (Chindina, 1991: 172, fig. 32, 38, 39, 41) (Fig. 3, 2–4). According to scholars, the Relka culture had a number of features similar to the Kulaika culture, but also had similarities with the ethnographic evidence of the modern Ugrians and Samoyeds of Western Siberia. The discovery of a bone sewn-on plate in the Olekma River basin, which was similar in appearance to the *badyamuo* plates of the traditional Nganasan outfit, as well as the presence of a large Samoyedic layer in the toponymy of Yakutia, indicate that the Uralic-speaking tribes of the Ugro-Samoyed origin could have widely settled there in the Early Iron Age along with the Yukaghirs (Stepanov, 2004, 2005; Bravina, Petrov, 2018).

Due to intensification of migration processes, contacts between Western and Eastern Siberia became even more active in the Middle Ages, as evidenced by numerous parallels in the cultures of the Yakuts and the “Saamai” (Yakut ‘Samoyed’) tribes (Bravina, Petrov, 2018). V.A. Tugolukov suggested that the autochthonous pre-Yakut population of the Vilyui River could have been the ancestors of ancient tribes belonging to the Uralic (Finno-Ugric and Samoyed) language family (1985: 216). In this context, a unique folklore text, “The Bear Song”, recorded by S.I. Bolo in 1938 among the Vilyui Yakuts, is of particular interest, since it shows parallels with bear songs of the Finno-Ugric and Samoyed peoples (Mukhopleva, 2022: 107–108).

And finally, the “winged bear” could have been brought from Western Siberia by Russian explorers to be exchanged, for furs or arrived there at a later time with traders and hunters.

The only thing which is certain is that the sculpture is not of local origin. It is too recognizable and belongs to the Ugric peoples; this is clearly a ritual attribute that is not native to Central Yakutia.

Semantic content: Ethnographic interpretations

Upon studying the religious and ritualistic practices of the Ob Ugrians, who used items of ancient bronze casting as ritual paraphernalia, A.V. Baulo concluded that cultural borrowing consisted of three stages: recognition, use, and influence (2004: 36–44). Recognition occurs primarily at the semantic level. It is worth noting the eagle, the totem of the Khangalas clan in whose territory the sculpture was discovered.

According to their myth, it became a deity for the Khangalas people after striking down a goose for their ancestor who was dying of hunger (Predaniya..., 1995: 178–179). The Yakuts were afraid of naming the eagle out loud, using substitute names instead of the word *khotoy* (‘eagle’): *ulakhan kyył* (‘huge animal’), *toyon kyył* (‘lord-animal’), or *kynattaakh kyył* (‘animal with wings’) (Skryabin, 2017: 180), which confirmed worship of the power and grandeur of the bird. The name “animal with wings” is especially noteworthy, since it is highly consistent with the iconography of the sculpture under discussion, which is reminiscent of the image of the “winged devil” Shelab in the guise of a seven-winged bear among the Selkups (Pelikh, 1992: 77, fig. II, 1).

According to N.A. Alekseev, the mythological development of the totemistic views on the eagle resulted in beliefs about the good deity (*aiyy*) Khomporuun Khotoy (Hump-Nosed Eagle)—the progenitor of people and eagles (1975: 58, 190–191). He was believed to cruelly punish any person who killed an eagle, sending the spirits of diseases to him. “At the request of the guilty person, the shaman begins the shamanic ritual after making representation of the animal from rotten wood (*emekh mas*). If it was an eagle, the shaman turns through the best (front) window (*bastyng* (= *bastyky*) *tyunnygyunen*), to the southwest. In this case, a horse having large dark spots on the shoulders (*khara dyagyl sylgy*) [about a horse’s coat color – R.B., V.D.] is sacrificed. The shaman paints the prepared representation with the blood from the heart of the sacrificed animal (draws eyes, etc.), then, during the ritual, he promises on behalf of the owners to honor the eagle (if an eagle was killed) as a “patron spirit” (*tangara*), appointed by Urung Ar-om [the supreme ruler of the heavenly deity-creators of the *aiyy*. – R.B., V.D.]. The representation made by the shaman, in which the soul (*syur*) of the killed eagle is implanted, is placed in the front corner of the house. After the ritual is finished, the representation is taken out into the forest. Another record of mine shows that it was hung in the front corner (*basyk usukka*)...” (Ionov, 1915: 53–54). According to folklore, the wooden figure of an eagle with outstretched wings was called an eagle idol (*khotoi emegete*) (Bolshoy tolkoviy slovar..., 2005: Vol. 2, p. 106).

As V.M. Ionov wrote, in some cases, childless women asked the eagle-ancestor to grant them children (1913: 7–8). From this point of view, the Yakuts could have been attracted by the motif of a bird-like creature with an anthropomorphic mask on its chest in a representation that was unusual for them and could

have been interpreted as the image of a deity-ancestor bringing the *kut* soul of the requested child on its chest. All of the above suggests the possibility that the bronze bird-like bear could have served for the Yakuts as an image of a totem-ancestor—an “animal with wings”, occupying an honorable corner of the house.

The most archaic myths about totemic deities are legends about the totem-bear, dating back to the most ancient Eurasian-American layer of the bear cult. B.A. Vasiliev, the author of a study on the bear festival, came to the conclusion that this cult stems from extremely early times, belongs to the “pre-shamanic” period of the history of religious beliefs, and was brought by the colonization flow from Siberia to North America in the Final Paleolithic, which testifies to the antiquity of the cult (1948: 103).

The Yakuts believed that a bear could hear when a person spoke badly about it, and could punish him for it. That is why the Yakuts replaced the word *ese* (‘bear’) with euphemisms *tyataagy* (‘the forest one’), *khara* (‘the black one’), *kharanga tyuyuleekh* (‘the dark-haired one’), *kyrdyagas* (‘the old one’), *adyrga kyyl*, *siemekh kyyl* (‘huge, bloodthirsty beast’), *arbagastaakh* (‘the one who has a fur coat’), *maamyktaakh* (‘the one who has an official position’)*, *tya kineese* (‘prince of the forest’), *uluu kyyl* (‘great beast’), *toyon* (‘lord’), etc. (Skryabina, 2017: 179).

V.M. Ionov continued: “The bear was once a woman, and this can be easily verified if you remove its skin and place it on its back (itteneri uurdakhkha): it then has the appearance of a woman (dakhtar dakhtarynan). In addition, women’s adornments (simekh) are visible on its body. The adornments that this woman once wore left traces on the outside as well, since the fur is worn out (simege bysyta siebite – syrgannaakh) in the places where these adornments are usually worn—on the neck from a ring (kyldyy), on the chest from front adornments (ilin kebiser), in the groin from lower adornments (kyabakka simege). This woman, soon after arriving at her husband’s house... began to avoid people, hide, and finally went into the forest, where she turned into a bear” (Ionov, 1915: 51).

The Yakuts from the Uryuney clan in the north, which was of Evenki origin, revered the bear as an ancestor. However, some traces of totemic beliefs about the bear have also been preserved among the central Yakut clans. It is known from the ethnographic evidence that the Tunguses roamed the vast territory of the modern

Khangalas Ulus (Ushnitsky, 2018: 15–16). On the basis of one legend, the ancestor of the Nyomyugyun clan of the Khangalas people was the grandson of the legendary Tygyn—Bas Kharynny/Kharanna (Ksenofontov, 1977: 87). According to clan legends of the Nyomyugyun people, the name of their ancestor is translated as “the head of a bear” (*bas* (Yakut) ‘head’, *khara*—euphemism for the word ‘bear’ (Yakut) + *nya*—the suffix conveying color (Evenki)). Indeed, in the area of the Nasleg, in the dense taiga, one can find trees with bear skulls, which were believed to be amulets against evil spirits, still hanging on the branches. Notably, the son of Kharynna, named Khapyral, later became the prince of the Nyomyugyun Nasleg and received a dagger* (Istoricheskiye predaniya..., 1960: 137–138). Thus, it is quite possible that the Nyomyugyun people identified themselves with the descendants of a very noble taiga ancestor who occupied a high position among the animal world of the taiga.

The eagle and bear were believed to be the patron spirits of the shamans. According to Ionov, the Yakuts considered “those handed over by the eagle” (*khotoyton tuttarbyt*), that is, shamans sent by the eagle (1913: 8) to be the most powerful. According to the Khangalas Yakuts, “each shaman has a so-called mother-beast (‘ije-kyyla’), which supposedly looks like a large bird with a beak resembling an iron icebreaker, with hooked tenacious claws, and a tail three *makhovaya sazhen** long. <...> The mother-beast, after descending to the lower land with the soul (‘kutun-syuryun’) of the one who was to be a shaman, brings him up there on the branch of a spruce tree. The soul of a great shaman is raised on the ninth row of branches (counting from below)” (Ksenofontov, 1992: 44–45).

The pendants of the shaman’s outfit among the peoples of Siberia often included figurines of various birds (spirit-helpers), which were cut out of sheet metal and were not cast. Unlike profile figures of other birds, eagles were depicted full-face, “about a *chetvert*** long”, with widely spread wings and a fan-shaped tail (Popov, 2006: 60).

V.N. Vasiliev described a unique disc-shaped *kyusenge* pendant with eagle images. The plate was quite massive, measuring 17 cm in diameter. The outer slightly convex side was smooth: “in addition to numerous hammer marks, there are three barely

*Daggers were given to the Nasleg leaders (*knazets*) as a symbol of their title starting in 1766.

**A *makhovaya sazhen* is an old Russian unit of length—a distance between the tips of the middle fingers of outstretched arms, usually 1.76 m.

**Maamyk* is an old title for an official before the use of the title *knyazets* (‘petty prince’) (Bolshoy tolkoviy slovar..., 2009: Vol. 6, p. 179).

noticeable figures on the concave side. One of them represents a bird with the spread wings and tail; its head is turned towards the left wing. A pair of legs is visible near the tail on each side. The tail, designated by radially diverging lines, has the form of a fan. The head, wings, and body are outlined with thin contour lines; short and elongated strokes indicate the feathers of the body and wings. The second figure also represents a bird with spread wings, only apparently double-headed (only the base of the neck is noticeable with the second head). Like the first bird, it has a tail and legs. The head, body, and wings are outlined with thin contour lines; crude strokes are supposed to indicate feathers. In addition, both birds have the hint of a mouth. The second figure possibly depicts the fairy-tale shamanic *yoksyokyu* bird*, usually represented with two or three heads...” (Vasiliev V.N., 1910: 18–19, fig. 18) (Fig. 4). The body of an animal was depicted on the same plate above the birds. “The line of the back is continued horizontally and forms an elongated tail. The head, reminiscent of a horse’s head, is drawn at the front, narrow end of the body... <...> Two short lines, which stick up, apparently indicating ears, are on the head. Two pairs of legs ending in three toes like those of birds are marked with 4 lines below” (Ibid.: 19–20). According to the author, the *kyusenge* depicted the shaman’s cloud-seat (*oyuun ologo*) on which he ascends to the upper worlds or descends to the lower worlds during the shamanic ritual.

In the item under discussion, the images of the birds and animal—a horse, as V.N. Vasiliev suggested, were made with a sharp object. Horses were not included in the circle of helping spirits, but were used as a sacrificial animal during the shamanic rituals. The plot of the drawing may represent a sacrificial ritual when the horse’s soul (*syur*) goes to the world of spirits accompanied by the shaman’s patron spirits.

According to some sources, the most powerful shamans had the bear as their mother animal. E.D. Prokofieva wrote that the shaman’s outfit among the Dolgans, Selkups, and Yakuts represented a bear (1971: 8): “...Old Yakut shamans had a caftan sewn of a whole bear skin and skin pulled from the bear’s head and put

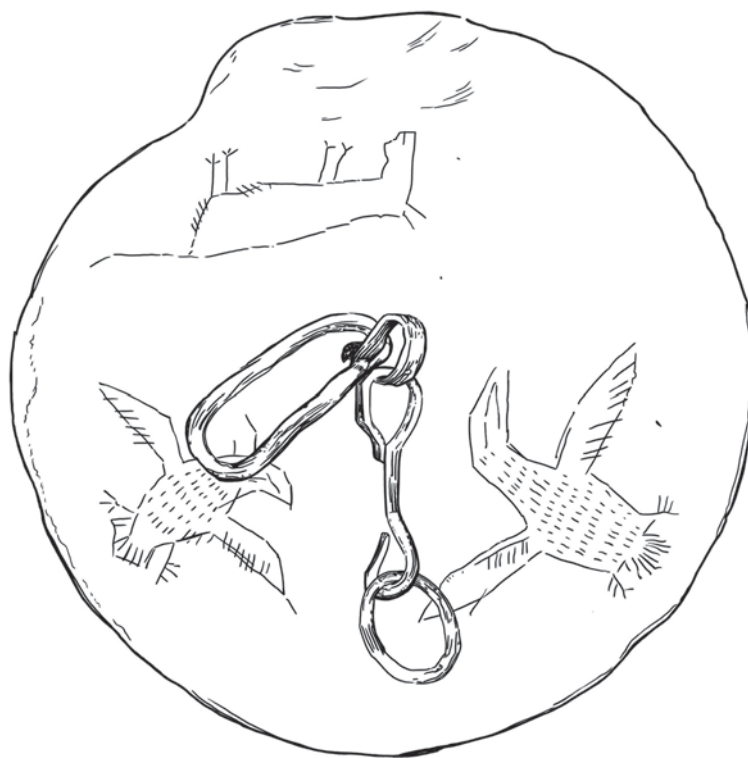


Fig. 4. Shaman’s pendant (*kyusenge*) (after (Vasiliev V.N., 1910: Fig. 18)).

on like a cap as a headdress. The entire outfit represented the animal...” (Ibid.: 42–43). Unfortunately, the author did not indicate her source. We are not aware of any other similar information in the literature on shamanism.

There are several references to the bear figure on the cloak of a Yakut shaman. According to A.A. Popov, “the image of a bear ‘*khaannaakh tangalaidaakh, alta khaardaakh, dengkelekh khardang ese*’ (having a bloody palate, six-years-old, a light-red bear), about 2 *vershoks** long is sewn below the ribs on the left side” (2006: 61, fig. 1, d-2) on the shaman’s cloak. According to G.N. Potanin, on the back of the outfit brought by R.K. Maak, “two iron plates carved as four-legged animals are suspended in the eighth row; one figure resembles a bear judging by the absence of a tail and lowered head; the other has a long tail...” (1883: 684). Unfortunately, it is not indicated where this outfit was from. The work by E.K. Pekarsky and V.N. Vasiliev on the shaman’s attributes has a drawing of a “cast copper image of an animal” suspended from an iron ring (1910: 17, fig. 15).

*The *yoksyokyu* is a shamanic bird usually represented with two or three heads; it is the king of the winged creatures, an eagle, *khotoy, yoksyoku kyl* (Pekarsky, 1959: Vol. 2, col. 1924).

*A *chetvert* is an old Russian unit of length equal to one fourth of an *arshin* (approximately 18.0 cm).

According to the observation of S.V. Ivanov, the bear figures that were cut of iron and used on shaman's outfits among the peoples of Siberia are profile representations, mostly static; they vary in length from 6 to 13 cm. They are distinguished by the line of the lowered head, thick neck, protruding shoulder blades, and lowered back of the body. These figures were placed either on the back of the outfit between the shoulder blades, or on the right and left sides, or on the iron imitations of ribs in order to strengthen them. The bear was considered an assistant of the "black" shamans; one could descend to the lower world on it (Ivanov, 1970: 208–209, fig. 189).

Thus, the evidence described above indicates that the Samartai bronze idol supported the existing totemic images and traditions, as well as the system of the use of objects in the religious and ritual complex, and took its rightful place in it.

Conclusions

This research shows that the objects of art of non-local ethnic origin, which were discovered in Yakutia, were in most cases used for ritual practices. At the same time, the inclusion of the item into the ritual realm was determined by the nature of the transmitted image. Due to their unusualness and rarity, such objects more often fell into the hands of the elite, including shamans, and through their mediation (interpretation), they were gradually filled with local religious and mythological content. In this context, the bronze figurine of the winged bear could have been perceived through the lens of totemic beliefs about ancestor-patrons—the eagle and the bear. During the shamanic ritual dedicated to the Hump-Nosed Eagle (*aiyy*), the figurine could have been used instead of a wooden image of the eagle idol (*khotoi emegete*), and in this capacity it could have been placed in the revered corner of the house. The bronze sculpture could have also played the role of a talisman (*ymyy*), like a bear's paw which was often hung over the cradle. The anthropomorphic mask on the chest of the bird-like figure was possibly associated with beliefs about the soul of children (*kut*), sought for by childless women from the ancestor-eagle (*ayyyysyt*). Finally, the bronze sculpture could have served as an attribute of the shaman's outfit, which was often filled with unusual items emphasizing the sacredness of the world of spirits, closed by the shroud of mystical secrets for unchosen persons.

Such items, revealing the influence of other cultures, probably include a round engraved plate (*kyusenge*) with images of eagles and a horse. According to

N.V. Fedorova, the custom of making drawings on metal items (bronze plaques, mirrors, imported silverware) with a sharp object is known only in Western Siberia and in some parts of the Upper Kama region, more precisely, in the Northern Cis-Urals. This custom, in turn, was based on the ancient "Ural" pictorial manner (Fedorova, 2003: 146). The subject matter of the drawing on the *kyusenge* with the double-headed eagle (*yoksyokyu*) resembles metal dishes with images of three- and seven-headed animals of the Ust-Polui period. Three-headed figures often occur in the Kama region and Western Siberia. The image of the three-headed bird became the most widespread in the Ob region in the Early Iron Age (Muratbakieva, 2021: 288).

The analysis of the bronze idol from the Samartai Museum once again demonstrates that the traditional culture of the Yakuts was not a simple consumer of imported objects; it filled them with its own ideological content and created new forms of cultic paraphernalia in accordance with the Yakuts' own religious and mythological beliefs.

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R.V. Davydov, Y.S. Gubar, and L.V. Zotkina

*Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: puer-viro@mail.ru; julfoxzzz@gmail.com;
lidiazotkina@gmail.com*

Raman Spectroscopy Analysis of Pigments from the Boyary I Rock Art Site, Khakassia

This article describes previously unknown paintings at the Boyary I rock art site, Republic of Khakassia. They are especially important because they were situated in the part of the panel where a missing ledge could have been located. The petroglyphs could indicate the time of its disappearance. Based on stylistic features, it is possible that they date to the Karasuk period (late 2nd to early 1st millennium BC). The article presents the results of Raman spectroscopy analysis of pigments detected in the paintings. The method involved their context assessment with regard to the rock surface and the white paint of recent inscriptions, the composition of ancient pigments, and searching for organic binder residue. The study covered panel 7 and the adjacent panels 8 and 9. The results are based on 103 spectra of various compositions. All three surfaces mainly consist of sandstone, the predominant constituents being albite, quartzite, and anatase, with occasional natural ferruginization. Modern white paint of two types—chalk (panel 7) and styrene acrylic (panel 9)—were detected. The red pigment used for the paintings in the right part of panel 7 consists of hematite. Calcium oxalate (whewellite) was found only where residues of pigments were located, suggesting that it resulted from the decomposition of the organic binder of the ancient paint.

Keywords: Rock art, paintings, pigments, binders, Raman spectroscopy, Minusinsk Basin.

Introduction

The chronology of the earliest rock art of the Minusinsk Basin has yet to be established. None of the three main hypotheses, i.e. the Late Upper Paleolithic, Neolithic, or Early Bronze Age, has yet been proven (Zotkina, Sutugin, 2023: 60).

Panel 7 at the Boyary I site is one of the largest surfaces with earliest petroglyphs in a multilayered composition (Fig. 1, 1, 2). Over sixty images on the panel include zoomorphic representations (mainly bulls) made in the archaic manner typical of the earliest rock art. Some of them are covered by later petroglyphs, for example, by the figures of the Okunev

bull-“izykhs” and Tagar anthropomorphic characters (Fig. 1, 3). Such a stratigraphic context is very promising for making the relative dating of the earliest representations (Zotkina et al., 2021).

The geological context of panel 7 is just as significant. There is a slab (Fig. 1, 2) directly below the panel, lower on the slope, which, judging by the orientation of the rock layers and current location, used to be part of the ledge above panel 7. The slab was probably situated on the right side of the rock art surface, where a relatively thick calcite film was observed. This probably suggests that some images were made after the ledge was lost. This article focuses on the right side of panel 7.

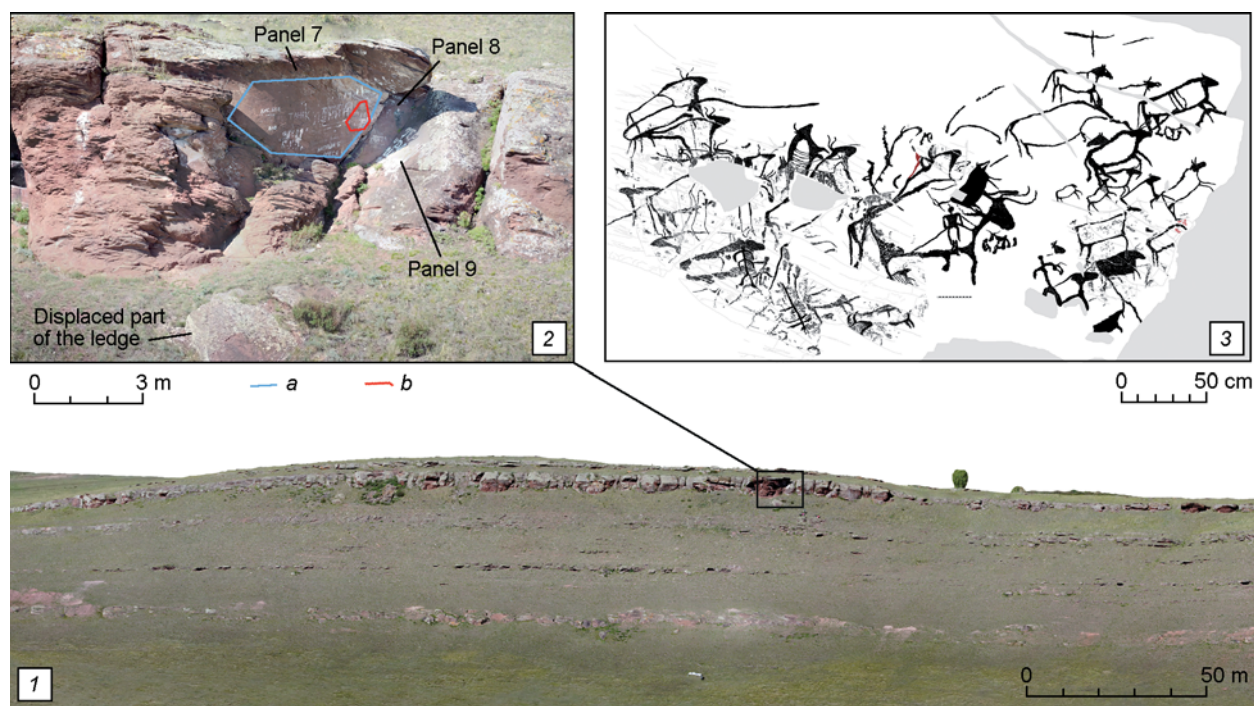


Fig. 1. The Boyary I site.

1 – general view from the southwest; 2 – central section with panels 7–9; 3 – trace-drawing of relief images on panel 7 (author I.D. Rusakova).
a – palimpsest boundary; b – boundary of the ancient paint distribution.

During fieldwork on this section of the panel, very faint, almost imperceptible spots of red mineral pigment were discovered. Photographs of the rock surface were processed and made it possible to see the outlines of the images. This article provides Raman spectroscopy analysis of the paint of these images.

Material and methods

The Boyary I site, or the Troitskaya rock art site, is located just 500 meters from the northwestern outskirts of the village of Troitskoye, in the Bogradsky District of the Republic of Khakassia, on a rock outcrop. The site is part of the Boyary–Abakano–Perevoz rock art complex located on the spurs of the Boyary Range (between the villages of Troitskoye and Abakano–Perevoz) (Fig. 1, 1). It was discovered in 1983 by N.V. Leontiev and N.A. Bokovenko, and received the name of Boyary I. In 1999, it was explored by I.D. Rusakova (2001: 18–20). The site yielded petroglyphs of different periods, from the earliest to the Early Iron Age images. Starting in 2021, the Minusinsk Rock Art Research Team from the Institute of Archaeology and Ethnography of the

SB RAS began studying the Boyary I site (Zotkina et al., 2021).

In 2023, the central section of the site—panels 7–9, with the most abundant images (Fig. 1, 1, 2)—was studied. The largest rock art surface of the site is panel 7 (4.5 × 3.4 m). It is lenticular, convex, exposed to the southeast, protected by a small rocky ledge, and is heavily damaged by geological processes and modern anthropogenic impact (covered with visitors' inscriptions). Over sixty petroglyphs of various periods are known on panel 7. Some of them intersect, forming a sophisticated palimpsest (Fig. 1, 3). The adjacent panels 8 and 9 contain carved zoomorphic representations, also damaged by visitors' inscriptions. These surfaces were analyzed to gain a general understanding of the context (substrate, modern paints).

Special attention has been recently paid to the stratigraphy of images on panel 7 (Ibid.: Fig. 2, 3). Residues of ancient red paint were found on its right part. Two non-figurative signs in the form of a cross and four stylized zoomorphic images made in a manner reminiscent of the Karasuk style (Fig. 2, B) were discovered in the course of processing photographs from this area by DStrech color filtering. Before cleansing the surface of visitors' inscriptions and making



Fig. 2. Location of spectral data collection points, with indication of the identified substances.

A – location of all spectral data collection points on panels 7–9; B – spectral data collection points on the section of panel 7 where painted images were detected (a series of photographs processed in the DStretch plugin). 1–8 – Raman spectral data collection points shown in Fig. 3. a–c – panels 7–9, respectively; d – ancient paint distribution boundaries; e – rock; f – ferruginization; g – calcite; h – chalk paint; i – acrylic-styrene paint; j – calcium oxalate; k – hematite; l – boundaries of identifiable painted images.

a complete record of the paintings, it was decided to make an analysis of the chemical composition of the ancient pigments in their intact condition.

Raman spectroscopy with a RaPort M532 portable rapid analyzer was used for this study. Measurements were made with a laser wavelength of 532 nm (radiation power 30 mW), focal length of 50–75 mm, entrance slit of 20 μm , and spectral range of wavenumber readings 140–4000 cm^{-1} . The device was controlled and spectra were analyzed by means of the EnSpectr Professional software. The spectra acquisition time was 53–120 sec, depending on the nature of the surface under study (usually 60 sec).

The study method involved making several series of analyses in different zones of panels 7–9 (Fig. 2, A). Spectra beyond the ancient paint distribution were collected to establish the geochemical context and identify various contaminants. First, the current authors analyzed the zones without residues of paint, then the visitors' inscriptions made with modern white paint, and finally, the right side of panel 7 with residues of ancient red pigment, partially intersecting with the carved images and modern inscriptions. The zone of ancient paint along the panel was localized using the DStretch plugin for processing color raster images (Gunn, Douglas, Whear, 2014).

Twenty-two zones up to 5×5 cm in size were studied in total, including 15 zones on panel 7, two on panel 8, and five on panel 9. The analysis was carried out at 3–10 points on each of them, depending on the complexity of the chemical composition. In the case of high luminescence or other interference, if the spectra were uninformative, up to three analyses were done at the same point with different device settings (changing laser exposure and spectra collection time) to obtain more accurate readings.

In total, 103 spectra of various rock surface zones were obtained, including those without residues of paint, with visitors' inscriptions, and with residues of ancient pigment. The spectra were decoded by identifying specific peaks based on the published analyses of archaeological evidence using Raman spectroscopy.

The location of analysis points on the panels and distribution of identified evidence were recorded on a 3D model of the area with panels 7–9 (Fig. 2, A). The model was generated with photogrammetry, using Agisoft Metashape software. Photographs were taken with the camera of the DJI Mavic Mini 2 drone (1/2.3-inch CMOS matrix, 12 MP, 35 mm lens, image size 4000×3000 pixels). Eighty-two images were used for the 8×5 m area.

Results

The spectra obtained were classified into three categories, reflecting the composition of the materials detected: substrate, modern paint, and ancient paint.

Substrate. The rock on which the panels with images were composed was found to be quite homogeneous. It contained albite, marked in the spectra by peaks at 188–193, 250, 287–290, 390–394, 478, and 508–510 cm^{-1} , and quartz, marked by peaks at 202–208 and 460–463 cm^{-1} (Fig. 3, 1–4) (Freeman et al., 2008: Fig. 3; Pakhunov et al., 2014: 12; Berlanga et al., 2019: Fig. 3, 4). In addition, titanium dioxide in the anatase modification was detected, which is regularly found in the substrate of rocks. Its presence was established by peaks at 140 and 640 cm^{-1} (Freeman et al., 2008: Pl. 4, fig. 4; Pakhunov et al., 2014: 12; Wojcieszak, Wadley, 2019). Some spectra of the rock showed smooth elevations at 1310 and 1620 cm^{-1} , marking individual inclusions of solid carbon compounds (Silaev et al., 2013).

Natural ferruginization in the form of inclusions of hematite (Fe_2O_3) was expressed in the spectra by individual peaks at 250, 412, 480, and 1310 cm^{-1} in the absence of a peak at 1620 cm^{-1} (Fig. 3, 3–4) (Froment, Tournie, Colomban, 2008: Fig. 2; Wojcieszak, Wadley, 2019: Fig. 3). As opposed to the Raman spectra of zones with ancient paint, the spectra of natural ferruginization included hematite peaks partially suppressed by luminescence or hidden by brighter peaks of rock-forming minerals (quartz, albite).

Calcium oxalate was detected only in two sections in the area of red paint distribution. Peaks at 1460 and 1480 cm^{-1} in the spectra indicated the monohydrate whewellite (Hernanz, Gavira-Vallejo, Ruiz-López, 2006: Fig. 7, 1059–1060).

Modern paint. Two types of white paint with very different compositions were discovered. The main component of one type of paint was calcium carbonate in the calcite phase (CaCO_3), i.e. chalk (Fig. 3, 5). Its presence was revealed by peaks at 154, 278, 710, and 1084 cm^{-1} (Fido, Bell, 2006; Bonneau, Pearce, Pollard, 2012; Donnely et al., 2017). The other paint had a greater number of components (Fig. 3, 6). It was based on a styrene/acrylic copolymer (marked by peaks at 833, 1297, 1583, 2397, and 2911 cm^{-1}) (Fremont, Verboven, Saverwyns, 2014: Fig. 3; Wiesinger et al., 2018). The main coloring agent was titanium dioxide in its crystalline modification, i.e. rutile (peaks at 236, 439, and 608 cm^{-1}) (Noda,

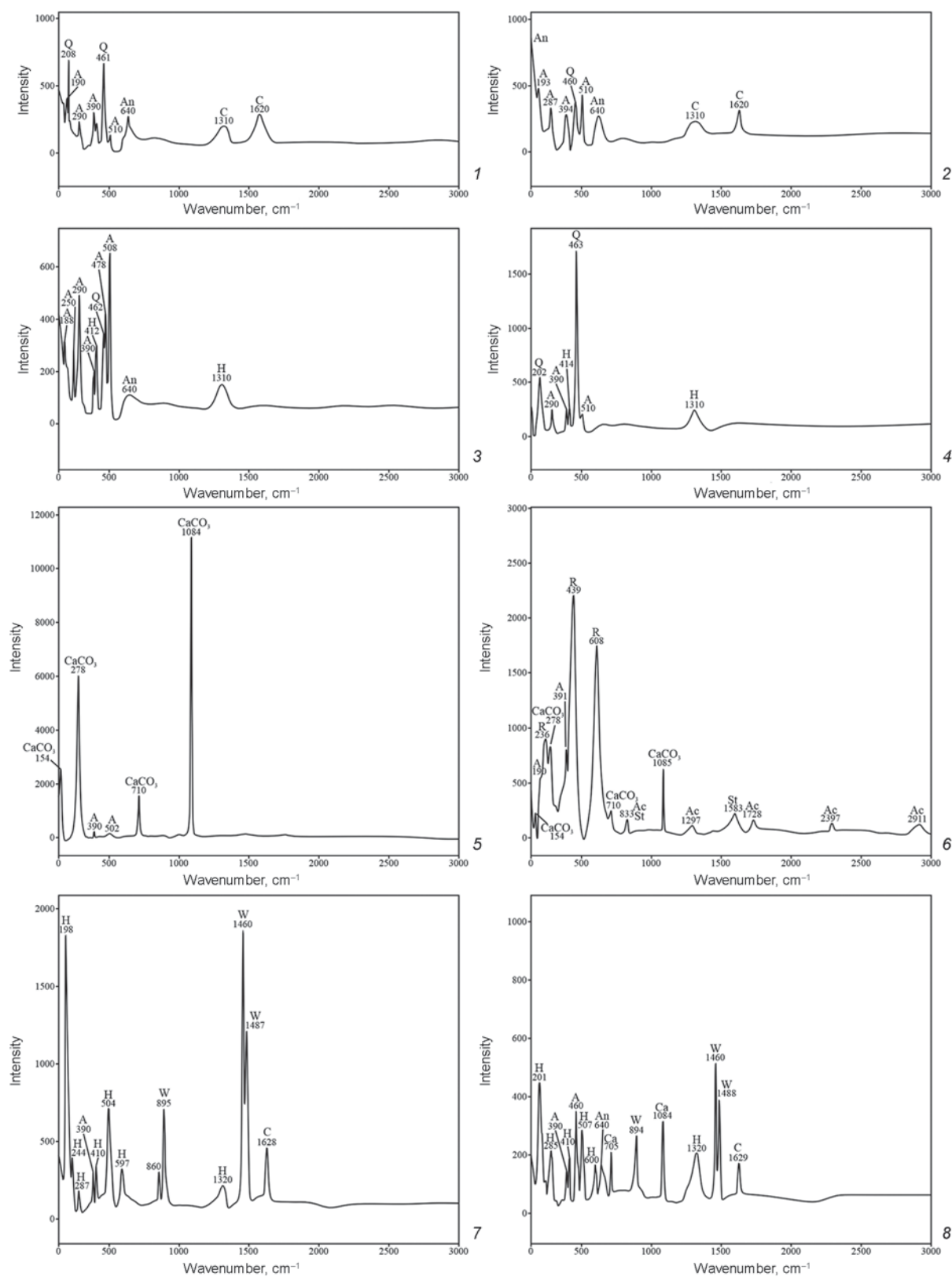


Fig. 3. Typical Raman spectra of different sections of the rock surface.

1–4 – rock without residues of pigments; 5, 6 – visitors' inscriptions; 7, 8 – ancient paint.

A – albite, Q – quartz, An – anatase, C – carbon compounds, CaCO₃ – calcium carbonate, R – rutile, Ac – acrylic, St – styrene, H – hematite, W – whewellite, Ca – calcite.

Sala, 2000: Fig. 2; Fido, Bell, 2006). An additional ingredient was calcium carbonate in the calcite phase (probably indicating the presence of chalk, marked by peaks at 154, 278, 710, and 1085 cm^{-1}) (Bonneau, Pearce, Pollard, 2012; Donnelly et al., 2017).

Red paint. Spectra reflecting the presence of pigment were obtained from the right side of panel 7. In most cases, the results showed a mixed composition including hematite and calcium oxalate in the form of whewellite (Fig. 3, 7). Hematite is a mineral pigment (Fe_2O_3) marked by peaks at 198, 244, 287, 410, 504, 600, and 1320 cm^{-1} (Pakhunov et al., 2014: 11–12; Froment, Tournie, Colomban, 2008: Fig. 2; Smith, Bouchard, Lorblanchet, 1999: Fig. 5; Wojcieszak, Wadley, 2019: Fig. 2). The presence of calcium oxalate in the form of whewellite was indicated by peaks at 1460 and 1487 cm^{-1} (Hernanz, Gavira-Vallejo, Ruiz-López, 2006: Fig 7, 1059–1060). A peak at 1628 cm^{-1} was also identified, which is probably associated with solid carbon compounds (Silaev et al., 2013). It was established that the main area of panel 7 under study was partially covered with calcite film. This was indicated by distinctive calcite peaks at 705 and 1084 cm^{-1} in the spectra (Fig. 3, 8) (Donnelly et al., 2017).

Localization of the identified substances on the rock surface. The results of Raman spectroscopy were compared with locations of the spectral data points marked on the 3D model of the site section (see Fig. 2, A). Data obtained from photographs processed in the DStretch plugin were also used, showing that the remains of ancient red paint were located on the right part of panel 7 (see Fig. 2, B).

Spectra showing signs of calcium oxalate in the form of whewellite without admixture of hematite were obtained only in the immediate vicinity of residues of the ancient pigment. Mixed composition including hematite and calcium oxalate in the form of whewellite was detected only in the area of distribution of ancient red paint used for making the paintings. Residues of hematite and calcium oxalates were found under the calcite layer in the lower part of this image cluster.

The recent inscription in the lower right part of panel 7 (“ЖМА”, the time of its occurrence is unknown) was established to have been made with modern chalk-based paint. Paint of different composition, which contained titanium oxide and a styrene/acrylic copolymer, was discovered during the study of the inscription of 2009 on panel 9.

Discussion

After studying 22 sections of panels 7–9 at the Boyary I site and analyzing 103 spectra, data were obtained on various substances within the substrate and on its surface. The rock included feldspars (albite), quartz, titanium dioxide (anatase), inclusions of natural ferruginization, and individual particles of carbon compounds. This is typical of red-colored Devonian sandstone consisting of albite, quartz, micas, and containing iron oxides (Morozov et al., 2019; Wojcieszak, Wadley, 2019).

Two variants in the composition of the modern white paint of the visitors’ inscriptions were identified. One of them, based on chalk (its presence was marked by calcium carbonate in the calcite phase), is typical of chalk paint used in the 20th century. Another composition included titanium dioxide (rutile), calcium carbonate in the calcite phase (likely, chalk), and a styrene/acrylic polymer as a binder. These components demonstrate that a modern acrylic-styrene paint was used for making the inscription on panel 9, which was dated to 2009. The data on the composition of modern white paints contaminating the panels can be used in further restoration for selecting the best means for their removal from the rock surface.

Information on the composition of the substrate and modern paint made it possible to establish the context for further identification of pigments used for creating the rock paintings on panel 7. Stylized zoomorphic images and cross-shaped symbols were found in the right part of the rock art surface; however, the pigment was also detected in the form of different-sized spots outside these paintings.

Two animal figures can be clearly recognized, located one above the other and oriented with their heads to the right, with ears rendered in detail. They resemble Karasuk-style images typical of the Late Bronze Age (late 2nd to early 1st millennium BC) (Kovtun, 2001: 73–76, pl. 48, 49; Kovaleva, 2011: 32–36, fig. 12, 13). Recent inscriptions covering the paintings need be removed for complete recording and determination of exact boundaries of the latter, which is planned in the future. Analysis has revealed the presence of hematite in the ancient paint.

In the rock and portable art of the Minusinsk Basin, pigments were used in the Early Bronze Age and Final Early Iron Age. Most examples are known from the sites of the Okunev culture, where red and black pigments have been found (Sher, 1980: 122, 132; Esin

et al., 2014). Burial materials of this culture show the use of red pigment (presumably ocher) for painting the walls of stone cists, outer surfaces of pottery, and faces of buried persons; black and red paints were also found on astragals (Polyakov, 2022: 95, 123, 174). The Kavkazskaya rock art site on the Tuba River is a good example of paintings from the late 1st millennium BC (Leontiev, Bokovenko, 1985). Numerous evidence of the use of red and black pigments appears in the materials of the Tashtyk culture, including burial masks and portable art (Gryaznov, 1971: 103–104; Vadetskaya, 1986: 133–134). However, painted images were not known in the Late Bronze Age rock art of the Minusinsk Basin (Kovaleva, 2011: 18). The paintings on panel 7 of the Boyary I site represent the first example of such images.

Red paint of the Early Bronze Age and the Final Early Iron Age has been traditionally interpreted as ocher (Vadetskaya, 1980: 55, 59; Leontiev, Bokovenko, 1985: 87). N.V. Leontiev suggested that dry pigment or pigment diluted in water or serosanguinous fluid could have been used for the Okunev paintings (Leontiev, Kapelko, Esin, 2006: 14). G.A. Maksimenkov also suggested the use of fat as a binder (1980: 25). X-ray fluorescence analysis, conducted by a team of scholars headed by Y.N. Esin on individual samples of red and black paint from the Okunev sculptures, revealed that hematite or red ocher was used for the red pigment and charcoal for the black pigment (Esin et al., 2014: 87). Thus, the composition of red paint based on hematite was quite typical for different periods in the history of the Minusinsk Basin. However, there are few direct parallels, due to the small number of studies on the chemical composition of ancient pigments.

The current analysis revealed the presence of calcium oxalate in the ancient paint mainly in the form of monohydrate (whewellite). In the context of rock art studies, this substance is usually interpreted as a metabolic product of microorganisms living in the upper layers of the substrate (Iriarte et al., 2013: 1557, 1561; Hernanz, 2015: 15). Petroglyphs can be dated by calcium oxalate using the UMS method (Ruiz et al., 2012; Zotkina, Sutugin, 2023: 61–62). Bacterial activity results in a readily visible, fairly thick crust of calcium oxalate, typically gray-blue or black, on the rock surface (Hernanz, Gavira-Vallejo, Ruiz-López, 2006: 1058, 1062). However, if this substance is found exclusively in the area of ancient pigment distribution and does not form a thick crust, it can be interpreted as a decomposition product of the organic component of the ancient paint (Lofrumento et al.,

2012: 814–815; Rousaki et al., 2017). The available data, unfortunately, lack details concerning the type of binder.

No oxalate crust of the required thickness for radiocarbon dating of the images was found on panels 7–9 at Boyary I. Whewellite was discovered almost exclusively in the compositions mixed with hematite. Occasionally it was present on the surface without hematite, but only in the areas of ancient pigment distribution. Based on these data, it can be concluded that the paint used for making paintings on the right part of panel 7 included hematite and an unknown organic binder.

The work at the Boyary I site not only identified various substances in the composition of ancient and modern paints, but also tested the Raman spectroscopy methodology for studying painted images at open sites in the Minusinsk Basin. Given the specific characteristics of these sites, this methodology consists of the contextual study of the substrate, modern pollutants (paint), and mapping to ensure accurate interpretation of the origin of identified substances.

Conclusions

Panel 7 at the Boyary I site contains presumably Karasuk-style paintings. Their occurrence may mark the time when the ledge on the right side of the site was lost, which may justify revising the age of the carved images in the area.

Raman spectroscopy analysis of the paint composition has revealed the presence of hematite and decomposition products from an organic binder. The methodology tested during this study can be applied in future research of painted images at open rock art sites in the Minusinsk Basin and other regions.

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D.A. Sevostyanov¹ and A.I. Pankina²¹*Novosibirsk State Medical University,
Krasny pr. 52, Novosibirsk, 630091, Russia
E-mail: dmitry.sevostyanov1964@yandex.ru*²*Institute of History, Archaeology and Ethnography
of the Peoples of the Far East,
Far Eastern Branch, Russian Academy of Sciences,
Pushkinskaya 89, Vladivostok, 690001, Russia
E-mail: pankina1995b@mail.ru*

On the Identification of Anonymous Artists in Rock Art

This article addresses the assessment of anonymous artistry in rock art—something basically different from the attribution of later paintings, where extra-artistic information may help to attribute the work to a specific artist. No such information is normally available in the case of rock art. The most one can expect in that case is to reveal pictures by one and the same creator, or by his imitators. In this study, we used the method of Giovanni Morelli, who proposed to assess artistry on the basis of secondary details reproduced unconsciously. Two examples of such details are discussed in detail. One concerns structural elements such as fossa, fossula, foveola, insecta, and fissura, detected by traceological analysis of petroglyphs associated with the Tagar culture of Khakassia. Their occurrence and orientation provide clues as to individual motility and thereby to their creators, albeit anonymous. The second example concerns diagnostic features of the large marine mammals depicted in the petroglyphs of the Ulsan group, South Korea (Bangudae and Cheonjeon-ri). Animals represented in those petroglyphs can be diagnosed at the species level, and the way they are represented enables us to decide whether the artist himself observed them or whether he merely imitated someone else's mannerisms.

Keywords: Petroglyphs, anonymous attribution, traceological method, structural elements of rock art, Tagar culture, Bangudae rock art.

Introduction

Attribution of artworks is the most important aspect of their study. It involves establishing where and when the artwork was created, its correlation with a specific artistic movement, trend, style, and school, and finally, with the specific creator. In art criticism, issues of attribution emerge when an authentic work by a famous artist should be distinguished from an imitation or fake. In cultural attribution, a work of art whose creator cannot be reliably established is identified with a specific (described and studied) cultural period.

Attribution of an artwork is possible under one indispensable condition: there must be some informa-

tion about the supposed or actual artist, which expands beyond the artwork. The artist as an independent subject must already be known in one way or another; art historians usually know his name (or nickname), as well as the years of his life, place of residence and artistic school to which he belonged, and have other similar information of a biographical and historical-cultural nature. Unfortunately, this is not always the case.

When studying such extremely important cultural records as petroglyphs, it is quite common to know nothing at all about the genesis of a particular painting. One should proceed from the fact that an image that has become the object of research is the only available imprint of the personality of its creator. We know

nothing else about him or her. In this regard, this image must be considered exclusively as a “document of the period”, and its provenance is not discussed at all.

The question is whether it is possible to make an undoubted (or at least highly probable) attribution of several petroglyphs to the same artist about whom we still essentially know nothing. In this case, the crucial issue of the anonymous attribution of a work of fine art should be raised. First, the identified relationship of a number of images, supported by the data on their anonymous attribution, is of significant help in interpreting the content of these images. In this case, they no longer look isolated (each one in its own), but also cannot be arbitrarily combined into a single composition if they were not originally, provably one. Second, it is known that the phenomenon of “co-creatorship” sometimes can be revealed during the study of petroglyphs, when an image created by one person was subsequently completed by another person. A petroglyph belonging to one culture might later be significantly “updated” by the carriers of another, later culture. The term “co-creatorship” here must be used in quotation marks, since we indeed know absolutely nothing about either the former or the latter artist who participated in creation of this image, and the only thing that can be done is to make a dual cultural attribution.

Problem of petroglyph “creatorship” in archaeology

Even though it cannot be claimed that anonymous attribution of images has become widespread, when studying petroglyphs, some scholars still raise the question of possible attribution of geographically distant paintings to the same artist. Here is an example: “In this case, the question is about the hypothetical possibility of determining the ‘hand of the master’ who worked not only at Oglakhty, possibly at Kuna, but also carried out an ‘order’ at Tepsey (or moved around these places and pecked out his favorite subjects on the surfaces he liked). This similarity is manifested not only in the manner of ‘filling’ the body, but also in drawing the outline of the figure as a whole” (Sovetova, Shishkina, 2021: 295). However, such interpretations and assessments require a common methodological approach, and among other things, they require traceological analysis when any image is considered as a set of traces of certain movements intentionally left by the painting subject (or several subjects) on the pictorial surface. This approach has been used in a number of studies. For example, L.V. Zotkina

and E.A. Miklashevich have demonstrated that “the ‘artworks’ of the Minusinsk style reveal especially well the dexterity of their creators at a specific set of painting techniques. Thoughtful changes in the direction of percussion strokes, variations in the shape, frequency, and depth of dents, reworking of contour lines—all this undoubtedly adds volume, realism, expressiveness, and beauty to animal figures, making the petroglyphs of the Minusinsk style recognizable” (2016: 32).

Although traceological analysis in rock art research, as has already been said, is not new, many studies have traditionally followed a different approach when only the outline of the figure, being the subject of perception and identification, was recorded, while its interior was simply painted over completely in black on the copies of the image. There are many examples of such works (publications and illustrations in them), and some of these are now considered classics of rock art research (Okladnikov, 1966). As a result of this approach, the entire internal structure of the image, initially accessible to observation and copying, was actually lost and excluded from the scope of further research. Although the outline of the figure has indeed its own unconditional significance, such loss of information in relation to petroglyphs about whose artists we know catastrophically little, cannot be considered justified.

Traceological analysis as a method for petroglyph attribution

We should provide an example showing how traceological analysis can be applied practically. Evidence for the analysis included several rock images discovered in Northern Khakassia (Ordzhonikidzevsky District) on rock friezes from two neighboring residual mountains, Mounts Fourth and Fifth Sunduk. In the study by V.E. Larichev (2005), this group of petroglyphs was attributed to the Tagar culture. The images were arranged into a composition, and taken together could be viewed as the exposition of a heroic epic. The following structural pictorial elements were identified therein and assigned the corresponding special terms:

fossa (from Latin ‘ditch’; also an oblong depression on the bone in anatomical nomenclature)—an oblong elliptical dent, 4×2 to 6×3 mm; the shape of these elements demonstrates consistency within a single image; their orientation on the plane can be different; *fossula* (from Latin ‘small ditch’; also a small oblong depression on the bone in anatomical

nomenclature)—a dent of the same shape, but measuring about 1×2 mm; can also have different orientations;

fovea (from Latin ‘pit’)—a rounded dimple with a diameter of about 6 mm; a depression of a hemispherical or conical shape;

foveola (from Latin ‘small pit’)—the same dimple, but with a diameter of 3–4 mm;

insecta (from Latin ‘notch’; also refers to insects as “covered with notches”)—a trace of a strike with a pointed tool; looks like a triangular notch; the upper edge is steep; the lower one is more gentle; the size ranges from 6.0×2.5 to 3.0×1.5 mm; can be oriented differently, with right or left inclination;

fissura (from Latin ‘crevice’)—an extended linear trace of a scraping motion; its width ranges from 1 to 3–4 mm; the length significantly exceeds the width; may have bends and various orientations on the plane (Sevostyanov, 2000: 77).

This set of elements is inherent in the Tagar petroglyphs (Fig. 1). If paintings are made in a different technique and belong to a different culture, the set of structural elements therein may also differ.

The size and depth of the above components largely depend on the preservation of the image. As rock weathers, they decrease; with deep weathering, previously fused elements in some cases become separated and subsequently disappear altogether.

Fissura obviously provides the greatest opportunity for anonymous attribution of petroglyphs out of all the elements of rock art mentioned above. *Fissura* alone is continuous, while the other elements in the context of the painting are discrete. The curves of the *fissurae*, like similar properties of lines in modern paintings, most clearly display specific features of an artist’s graphomotorics, and make it possible to speak about the individual affiliation of a particular image. The individual manner of these elements is akin to handwriting. In addition, *fissura* forms the outline of the image whose configuration largely determines its aesthetic properties. That is important, since this specific configuration not only makes the image

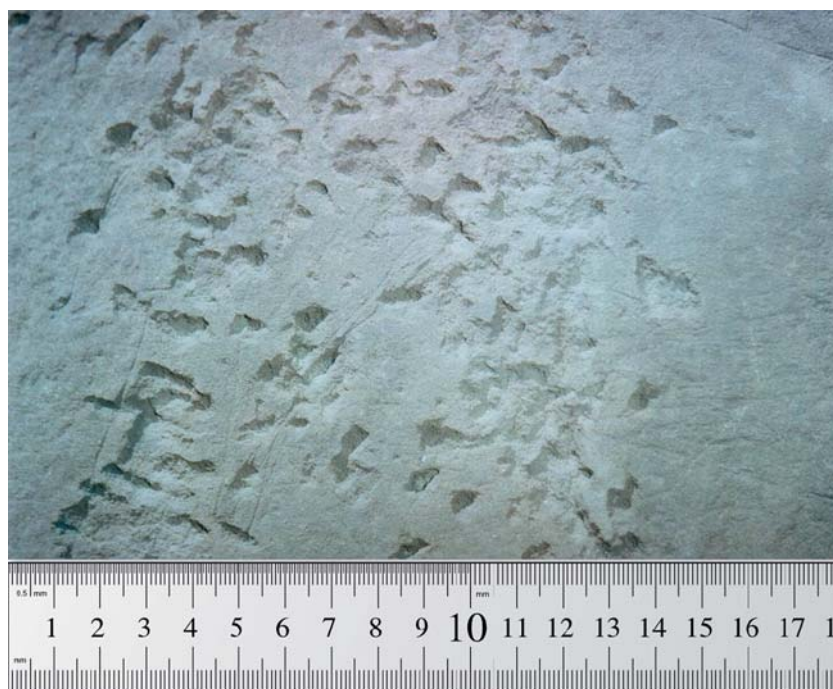


Fig. 1. Fragment of anthropomorphic figure (lower part, image of legs; structural elements—*fossa*, *fovea*, *insecta*—are visible; outline is shown by *fissura*). The size of the selected fragment is 13×18 cm. Photo by D.A. Sevostyanov.

recognizable, but also conveys the impression of an accomplished and captured motor act, which in itself has the capacity to convey an emotional message from the artist to the viewer, even if centuries and millennia lie between these two subjects.

However, *fissurae* rarely occur in the images of the culture in question, rather as an exception. Therefore, anonymous attribution of rock images requires relying on discrete elements, which resulted mostly from striking or striking-drilling impact on the pictorial (rock) surface. Among these, we can distinguish the elements that have orientation on the plane (*fossa*, *fossulae*, *insecta*) and those that do not (*fovea*, *foveolae*). Both the share of these two types of elements and the presence (and predominance) of a certain orientation play their role in the individual structure of the image. Among the varieties, vertical and horizontal elements (although they constitute a minority), ascending elements (from left to right, from bottom to top), and descending elements (from left to right, from top to bottom) may be distinguished. Thus, several numerical indicators can be distinguished for each specific image made in that technique: ratio of elements with orientation to elements without it, ascending to descending elements ratio, and also more specific indicators, for example, *foveolae* to *fossulae* ratio. The prevalence of ascending or descending elements

can be used for making a conclusion about the right-handedness or left-handedness of the images' creator. This method of anonymous attribution makes it possible to identify, with a fairly high degree of probability, the paintings made by the same person or, on the contrary, by different persons within a single pictorial composition or several groups of images placed next to each other.

As an example, we can give two images associated with the Tagar culture and located on different (adjacent) mountains. The ratio of structural elements makes it highly likely that these were made by the same person, and he was obviously left-handed. Both

images were identified as belonging to the “kingdom of the dead”. These are male anthropomorphic figures with huge phalluses, discovered on Mounts Fourth Sunduk (Fig. 2) and Fifth Sunduk (Fig. 3). In addition to the common subject matter, these images have similar properties according to the following parameters: 1) ratio of elements with orientation to elements without it (1.98 for the first figure and 1.76 for the second figure, while this parameter varies greatly—from 1.1 to 4.74—for other images on the same rock friezes); 2) ratio of ascending to descending elements (0.38 and 0.32; for other images this indicator ranges from 0.23 to 2.74), and 3) *foveolae* to *fossulae* ratio (0.99 and 1.11; for other images it ranges from 0.27 to 2.12).

This approach to attribution goes back to the method elaborated by Giovanni Morelli. The method consists in identifying the creator of the image by the manner of execution of secondary, insignificant details, which are much more likely to show consistency in each specific artist (Khaziev, 2021). The method is applied to paintings and is based on the constancy of such image details as, for example, hands, shape of the ears in a human figure, or some typical elements of landscape. Notably, it does not affect the basic structure of the compositional solution of the artwork or the manner of rendering the main characters. These aspects are the most noticeable and are often targeted for imitation, which naturally complicates reliable attribution of the works of art and even directly hinders it. Usually, secondary details not only escape the attention of possible imitators, but also escape the actual consciousness of the artist and manifest themselves mainly beyond his will.

Technical differences in creating petroglyphs and paintings (in the modern sense) are certainly very great. Accordingly, the application of Morelli's method (in such extended interpretation)



Fig. 2. Image taken on Mount Fourth Sunduk (to the right of the center). The size of the figure is 33 × 16 cm. Photo by D.A. Sevostyanov.

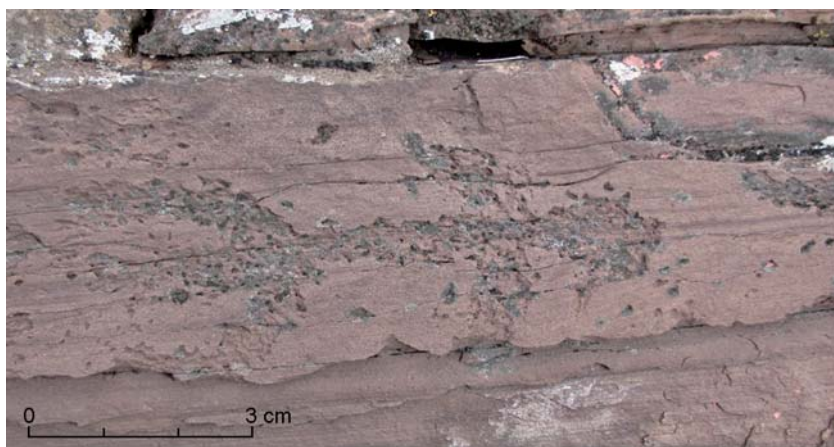


Fig. 3. Image taken on Mount Fifth Sunduk. The size of the figure is 8 × 4 cm. Photo by D.A. Sevostyanov.

in both cases may be significantly different. Nevertheless, this method is undeniably relevant. We do not know exactly the role that imitation of the images of predecessors played in creation of petroglyphs. However, their predominant, distinctive forms indicate that the example of other petroglyphs was much more important for creators of rock art than following nature. Imitation concerned the general outlines of the figures, which were the main considerations in archaeological research for many years. Yet the internal structures of the images depended on individual aspects of the motor skills of their creator, and they are precisely what should constitute the basis for anonymous attribution of rock images by traceological analysis.

Analysis of taxonomic features and natural context for establishing “creatorship” and “imitation” in rock art

Analysis of the environmental conditions in which petroglyphs were created, and biological classification of the images rendered in them, can be another method for establishing a probable “creatorship” and “imitation” in rock art, based on Morelli’s methodology. Some secondary elements of images may indicate the taxonomic affiliation of a particular animal, marking specific environmental conditions, as well as the economic and cultural type of lifestyle, oriented toward direct interaction with such animals. An “imitation” created from the memory of the “original” painting, while preserving the general outline of the figures, would miss these elements, especially if the creator did not deal with these animals in his everyday life.

A remarkable example is the petroglyphs of the Ulsan group—Bangudae and Cheonjeon-ri in South Korea. These sites are located on rocky outcrops on the banks of the Taehwa River and its tributary Taegokcheon River, quite close to each other (2 km). However, the petroglyphs have slightly different styles and techniques. At Bangudae, images

of animals and people are realistic; they were created using knockout technique (outlined, silhouette representation in a “skeletal” style), while at Cheonjeon-ri they are stylized, made by percussion followed by grinding and engraving (Chzhan, 1999: 82–84).

Animal figures at both sites include images of large marine mammals of the order of cetaceans. At Bangudae, this is a large group of about 46 figures constituting 25 % of all images. A biological classification method based on the criteria for determining cetacean species in marine biology made it possible to distinguish gray whales, Japanese whales, humpback whales, killer whales, pilot whales, and dolphins. Identification was based on the following taxonomic features: body shape, presence and shape of the dorsal fin, size of the pelvic fin and shape of the caudal fin, jaw curvature, and the presence and shape of spouting (single-jet or double-jet) (Fig. 4, 1–6) (Chzhan, 2015: 206; Lee, Robineau, 2004: 145; Melnikov, 2006: 12, 14–16). There are only a few rather conventional and stylized images of cetaceans at the Cheonjeon-ri site, with large oval bodies, long caudal peduncles,

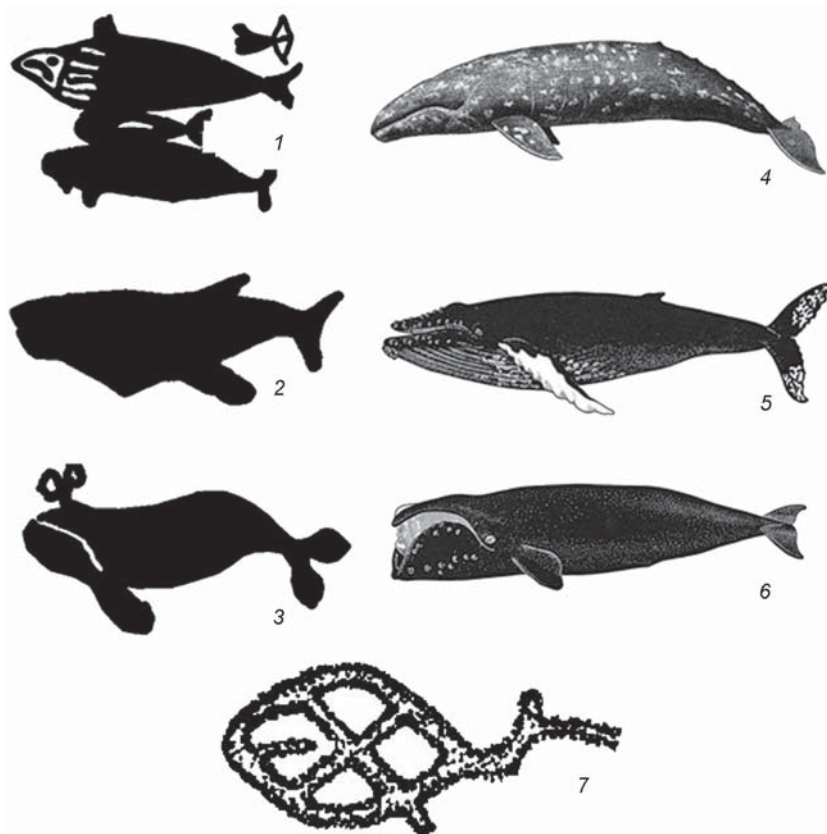


Fig. 4. Images of cetaceans on the petroglyphs from South Korea.

1–3 – Bangudae (after (Songji et al., 2011)); 4–6 – animals corresponding to the images: 4 – gray whale (*Eschrichtius robustus*), 5 – humpback whale (*Megaptera novaeangliae*), 6 – right whale (*Eubalaena*) (after (Melnikov, 2006)); 7 – Cheonjeon-ri (after (Rakov, 1998)).

and large forked caudal fins. The available details do not allow identification of the biological species of the depicted animals (Fig. 4, 7) (Rakov, 1998: 73, 75).

Thus, despite the common outline of the figures (massive oval body, long tail peduncle, forked tail fin), images of cetaceans at both sites demonstrate complete difference in additional details, i.e. the taxonomic features. Notably, according to the discussions about their chronology, Bangudae and Cheonjeon-ri date back to different periods. Rock images at Bangudae were created in the Neolithic, most likely during the Atlantic transgression, when Ulsan Bay and the bed of the Taehwa River constituted the large Kousan paleo-Bay where cetaceans could have lived and could have been hunted. The petroglyphs of Cheonjeon-ri date back to the Bronze Age and Early Iron Age. At that time, the paleo-bay had already ceased to exist, and was covered by the sediments of the Taehwa River; therefore, the population of the adjacent areas could not have engaged in whaling (Hwang, Yun, 2000: 72–76, 80–81, 90; Kang, 2020: 498).

The environmental situation in the area where the creators of images with cetaceans at the chronologically later Cheonjeon-ri site lived did not support the economic activities associated with whaling. These petroglyphs are probably imitations of petroglyphs at Bangudae, which despite their much earlier origin were undoubtedly a part of the ethnic and cultural landscape for the local population. Since the sites are located at a short distance from each other, and are a part of the economic zone (2–3 km for agricultural crops, up to 10 km for hunter-gatherers), rock images at Bangudae could not have been unknown to the creators of petroglyphs at Cheonjeon-ri. In this case, we can rely on the concept of ethnic and cultural projection, elaborated in ethnographic research, which is understood as the process of transferring the properties of an external object (including petroglyphs) to the mentality of the people living nearby. The ethnic and cultural landscape of any indigenous people includes specific features of the terrain and biological diversity, as well as the cultural and historical heritage of the population that left a mark on the culture of this region (including archaeological artifacts and sites) (Bereznitsky, 2021: 24; Latushko, Pankina, 2024: 123).

Conclusions

Despite little attention in the literature, the problem of anonymous attribution of rock art is a key issue, along with the chronology, stylistic variations, and

techniques of petroglyphs. Establishing the “artists”, “co-artists”, and “imitators” of paintings can provide insights into many controversial issues, such as population migrations and the spread of certain cultural traditions, as well as the dating of some problematic sites.

The method of anonymous attribution of rock art proposed in this study is based on the art criticism principle of Giovanni Morelli and is purposely adapted to specific aspects of our archaeological sources. It provides archaeologists with the opportunity to analyze individual features of the motor skills that the creator of the paintings possessed. As a result of applying this method to the study of the petroglyphs of the Tagar culture in Northern Khakassia (Ordzhonikidzevsky District), structural elements of the images—*fossa*, *fossula*, *fovea*, *foveola*, *insecta*, and *fissure*—were identified through traceological analysis. Their number and combination indicate the individual creator of certain paintings.

Another effective way to establish “creators” and “imitators” in the rock art is to apply biological classification to the images of animals, and analyze the broad cultural and natural context in which the petroglyphs were created. Such study was carried out using the evidence from the Bangudae and Cheonjeon-ri sites in South Korea with distinctive images of large marine mammals (cetaceans). The analysis of animals’ features appearing in these images has revealed that the creators of the Bangudae petroglyphs had real information about cetaceans, while the artists of the Cheonjeon-ri paintings most likely “imitated” the images known to them from the Bangudae site and did not have sufficient knowledge of such animals. This is confirmed by the data on the relative chronology of the sites and reconstruction of the environmental conditions during creation of the petroglyphs.

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P.I. Shulga, Y.N. Garkusha, A.E. Grishin, and Z.V. Marchenko

*Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: shulgapi55@yandex.ru; garkusha_y@list.ru;
artem-grishin@mail.ru; afrika_77@mail.ru*

Cremation Burials at Ust-Zelinda-2, the Northern Angara Region: Typology and Chronology of Artifacts

We describe artifacts found in cremation burials at Ust-Zelinda-2 in the Northern Angara region. Such sites have been traditionally attributed to the Early Iron Age, specifically to the second stage of the Tsepan culture (8th–2nd centuries BC), first described by V.I. Privalikhin. Six cremation burials were found at the cemetery. We focus on the most informative burial 16, while other burials are described in brief. The bodies were cremated outside the graves; most artifacts also reveal traces of fire. Cremated remains are those of adults. Accompanying finds are rather abundant, including stone, bone, and bronze arrowheads, horn sockets for attaching them, horn overlays for bows, and bronze ornaments. A specific type of butterfly-shaped belt plaques was common in Scythian-type cultures of northeastern Eurasia from Ordos to the Upper Ob region. Those from Ust-Zelinda-2 are the most numerous in the Angara area and the taiga zone from the Tomsk stretch of the Ob to the Upper Lena. Bronze butterfly-shaped belt plaques used in eastern North Eurasia were examined. On the Angara, they appeared in the 5th century BC and continued to be in use until the 3rd century BC, i.e., longer than on the Upper Ob or in Tuva. The attribution of culture that existed in the Northern Angara region is an open question.

Keywords: Cremation, burial, butterfly-shaped bronze belt plaques, Ust-Zelinda-2, Early Iron Age, Northern Angara region.

Introduction

The search for Early Iron Age sites in the taiga zone of Siberia is hampered by numerous difficulties. However, by 2000, about 40 settlements and burial grounds dating to the 8th–2nd centuries BC had been discovered in the Northern Angara region. On the basis of these materials, V.I. Privalikhin (1993, 2011) identified the Tsepan culture, though burial complexes remained rare. Large-scaled rescue excavations conducted by the Boguchany Archaeological Expedition of the Institute of Archaeology and Ethnography SB RAS in 2007–2012 contributed a lot to replenishment of the source base. According to the interim report compiled

by P.V. Mandryka, over 50 Early Iron Age burials had been recorded by 2014. These included inhumations with skeletons in anatomical order or incomplete; and more than ten secondary cremations with burned remains placed either in the grave or on the old ground surface (Mandryka, 2014: 207–208). At the burial ground of Ust-Zelinda-2, six cremation burials (out of over ten known in the Angara region) were found in small pits (group 2 after (Marchenko et al., 2012: 454–457)). Such burial complexes are of particular interest due to their paucity and deficiency of knowledge. Interest to them is also caused by specifics of the second stage of the Tsepan culture (4th–2nd centuries BC) (Privalikhin, 1993: 21). Privalikhin believes that

“at the second stage... the type of burial and the funerary rite changed: inhumation burials gave way to secondary cremation. Pyres were probably arranged on special platforms; then cremated remains with accompanying goods were placed in small pits” (2011: 170). This supposition requires additional justification based on specific materials.

In this publication, we introduce information about this kind of Early Iron Age burials at Ust-Zelinda-2. This cemetery differs from others in the Angara region by a larger number of burials and more numerous accompanying artifacts, including many bronze belt plaques. Such plaques are common in accurately dated burials associated with Scythian type cultures from the Upper Ob to Ordos, which enables us to specify the chronology of such sites on the Northern Angara region even without scientific dating techniques, the use of which is limited by several factors in this case.

Materials

Ust-Zelinda-2 is located in the Ust-Ilimsky District of the Irkutsk Region, 6 km north-east of Keul village, on the right bank of the Angara, in the estuary of the Zelinda River, on a promontory-like ledge of a terrace framed by these rivers and a deep gorge (Fig. 1, A, B). This heterochronous cemetery comprised 25 Neolithic to Middle Ages graves, including six cremation burials in small pits attributable to the Early Iron Age (group 2 composed of burials 4, 8, 9, 11, 16, and 25 (Marchenko et al., 2012: 454–457)).

Burials of group 2 were arranged in three pairs in an area approximately 50 m long. The distance between the pairs was 2, 3, and 4.5 m (Fig 1, C). Burials of this group are nearly of the same type. Most pits are oval or round in plan view, measuring from 0.25×0.3 m to 0.55×0.64 m. Their depth is 0.1–0.2 m from the reference level and 0.24–0.90 m from the modern ground surface. Human bones are fragmented and badly burned (calcined). They were probably inhumed in some unpreserved containers. Cremated remains are those of adults. The bodies were cremated outside the grave. Traces of fire are visible on all bone artifacts and on some bronze items. Grave goods are rather abundant (see below). Three complexes (burials 9, 11, and 16) are considered to be reliably undisturbed. The most informative burial 16 can be described as an example. The burial was located in a pit measuring $30 \times 25 \times 9$ cm. Its depth was 5 cm from the modern ground surface (Fig. 1, C; 2). The sediment filling the pit contained a compact, 5–7 cm thick, accumulation

of calcined bones and grave goods. The burial was undisturbed. The bones were highly fragmented (fragments of long, metacarpal, vertebral, cranial, and other bones). Most probably, these were the remains of an adult (*Adultus-Maturus*) man.

This accumulation of archaeological remains contained numerous grave goods, including weapon and belt accessories: bronze stemless three-winged arrowheads 4.6 to 8.6 cm long (7 spec., Fig. 3, 18–24), a flat iron “point” 6 cm long, and a fragment of another one (Fig. 3, 13, 14), two complete bone arrowheads 11.0 and 6.4 cm long (Fig. 3, 31, 39) and a fragment of the third one (Fig. 3, 38), five stone arrowheads with a concave base 5–6 cm long (Fig. 3, 27–30), three fragments of bone end overlays for bows 0.5–0.6 cm thick and 0.8–0.9 cm wide (Fig. 3, 16, 17), fragments of two bone points (Fig. 3, 36, 37), four horn sockets for arrowheads, with missing parts (Fig. 3, 32–35), two two-ringed units with missing parts (Fig. 3, 25, 26), a fragment of a bronze artifact (Fig. 3, 12). The butterfly-shaped belt plaques (8 spec.) are represented by five complete specimens 4.8 cm long and 2.8 cm wide (Fig. 3, 1–5), one plaque with a partially missing blade (Fig. 3, 6), and two blades with missing parts, possibly from different specimens (Fig. 3, 8, 9). In addition, there were found a fused half of a plaque with paired representations of griffon heads (Fig. 3, 10), and three fragments of heavily deformed fused plaques (Fig. 3, 7, 11). Other fragments suggest the presence of one or two similar artifacts. In the eastern part of the pit, in the upper layer of the accumulated finds, an iron rectangular blade measuring 9.0×1.2 cm (Fig. 3, 15) was unearthed. It lay horizontally, near a bone arrowhead, 6 cm from the iron “point” and 3 cm above the butterfly-shaped belt plaque. Almost all the bronze arrowheads (6 spec.) lay compactly. The plaques formed a strip in the central part of the accumulation. The two-ringed units were found close to each other, too. Lithic artifacts were concentrated on the southern periphery of the complex, while iron items in its western fringe. In addition, the accumulation contained small fragments of deformed bronze, iron, and bone artifacts that can be tentatively correlated with the mentioned bronze plaques and bone, stone or iron arrowheads. The goods accompanying the cremation were obviously much more numerous. Fragments of narrow (no wider than 1 cm), rectangular (both straight and slightly bent) bone blades are also noteworthy. These could have belonged to lateral overlays for bows. Among the bones, there were also six small ceramic fragments from the cultural layer of an earlier site.

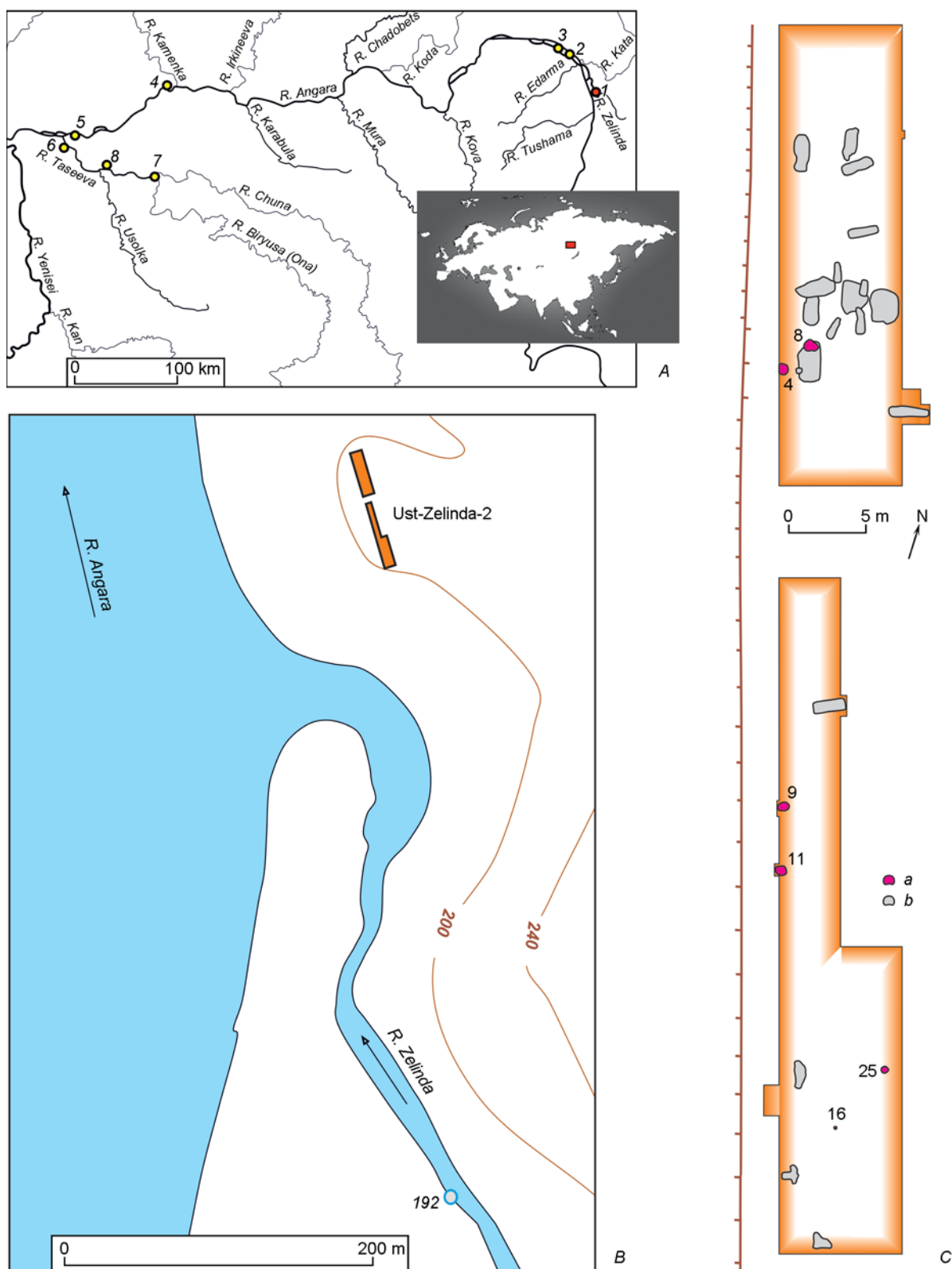


Fig. 1. Location of the mentioned sites in the Northern Angara region (A), excavation of 2012 at the Ust-Zelinda-2 burial ground (B), and burials therein (C).

1 – Ust-Zelinda-2; 2 – Vzvoz; 3 – Sergushkin-3; 4 – Kamenka-1; 5 – Skorodumny Byk; 6 – Ust-Taseyevsky ritual complex; 7 – Mys Arban; 8 – Cave “Grafskaya”.

a – burials of group 2; b – other graves.



Fig. 2. Burial 16 at Ust-Zelinda-2.

A – general view from the west; B – bronze artifacts in the eastern part of the accumulation of calcined bones (eastern view).

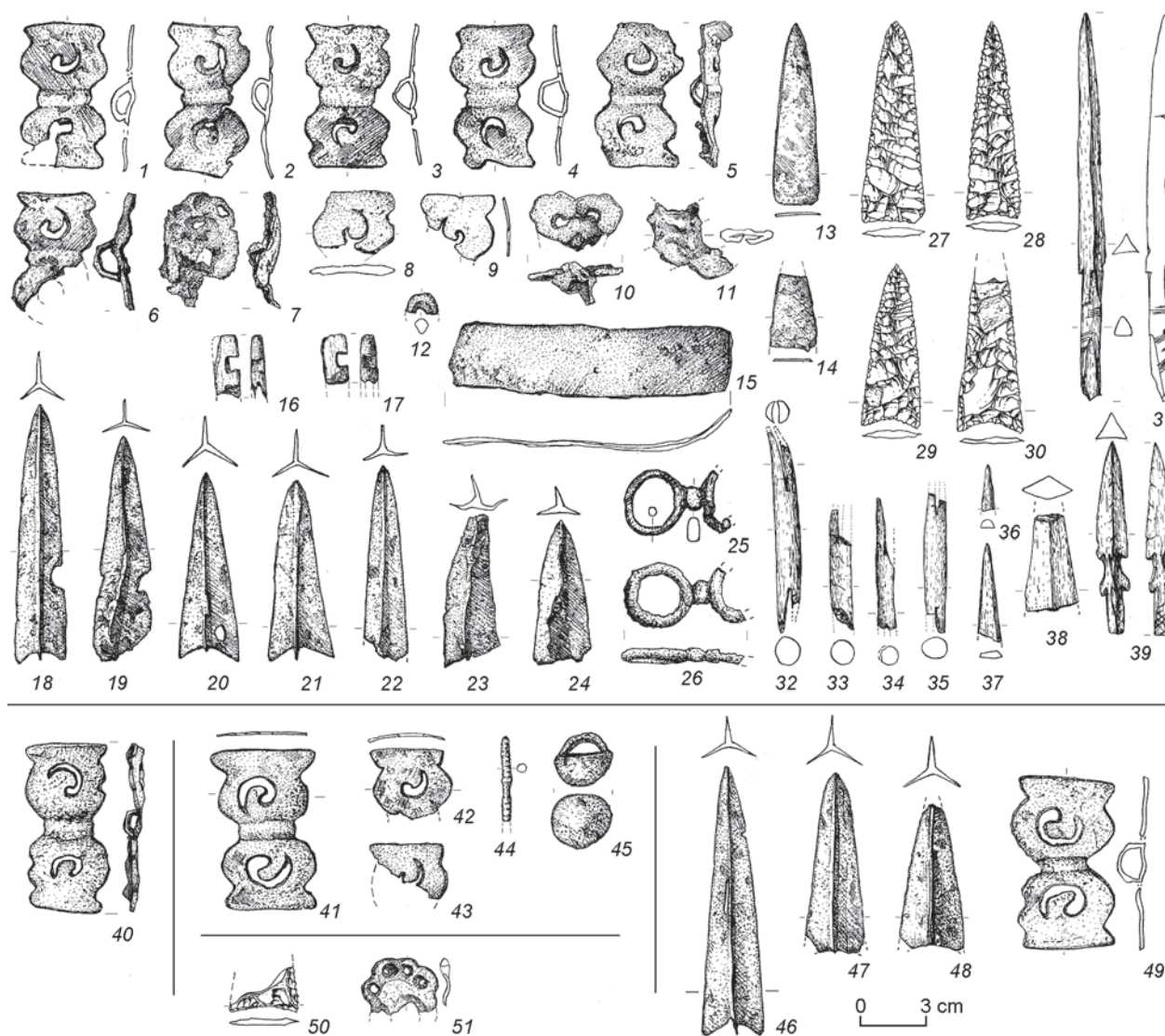


Fig. 3. Finds from burials of group 2.

1–39 – burial 16; 40 – burial 4; 41–45 – burial 9; 46–49 – burial 11; 50–51 – burial 25.

1–11, 40–43, 49, 51 – bronze belt plaques and their fragments; 12 – fragment of a bronze bead (?); 13, 14 – iron “points”; 15 – iron plate; 16, 17 – fragments of bone end overlays for bows; 18–24, 46–48 – bronze arrowheads; 25, 26 – bronze two-ringed units; 27–30, 50 – stone arrowheads and their fragments; 31, 38, 39 – bone arrowheads and their fragments; 32–35 – horn sockets for arrowheads; 36, 37 – fragments of bone points; 44 – bone rod; 45 – bronze button-like plaque.

The bone artifacts are burned and have a typical light gray color; some of them are archaeologically intact. Small sizes of the end overlays are noteworthy; they point whether to the votive character of the artifacts or to the significant decrease in their volume caused by intense fire. Some metal artifacts lack distinct traces of thermal treatment. They were found in different places within the accumulation. Assumedly, during the process of cremation, they lay out of the zone of intense fire.

The summarized description of finds from all six complexes of group 2 looks as follows (Fig. 3) (Shulga et al., 2025).

Grave goods were found in five burials: 4, 9, 11, 16, and 25. Bronze artifacts consist of 13 butterfly-shaped plaques (2.7–3.5 cm wide and 4.6–5.8 cm long) with a pot-like contour of the blades (Fig. 4, 17–27, 29, 30), a fragment of the plaque with representation

of a griffon mane (see Fig. 3, 51), a fragment of the plaque with paired representations of griffon heads (see Fig. 3, 10), ten three-winged arrowheads (including those with missing parts) 4.6–9.0 cm long, two two-ringed units, and unidentifiable fragments of fused items. Iron artifacts were found in burial 16: a blade, a flat “point”, and fragments of unidentifiable objects. Stone arrowheads with concave bases are represented by six specimens from burials 16 and 25. Bone artifacts were found in four burials (9, 11, 16, and 25): two complete arrowheads and fragments, a rod with a crosspiece, three end overlays for bows, sockets for arrowheads, fragments of points, and some other pieces from burial 16. Ceramic fragments and lithic debitage were found in five burials (4, 9, 11, 16, and 25) and possibly came from various layers of the site.

Notably, only one half of a butterfly-shaped plaque was found outside the complexes of group 2

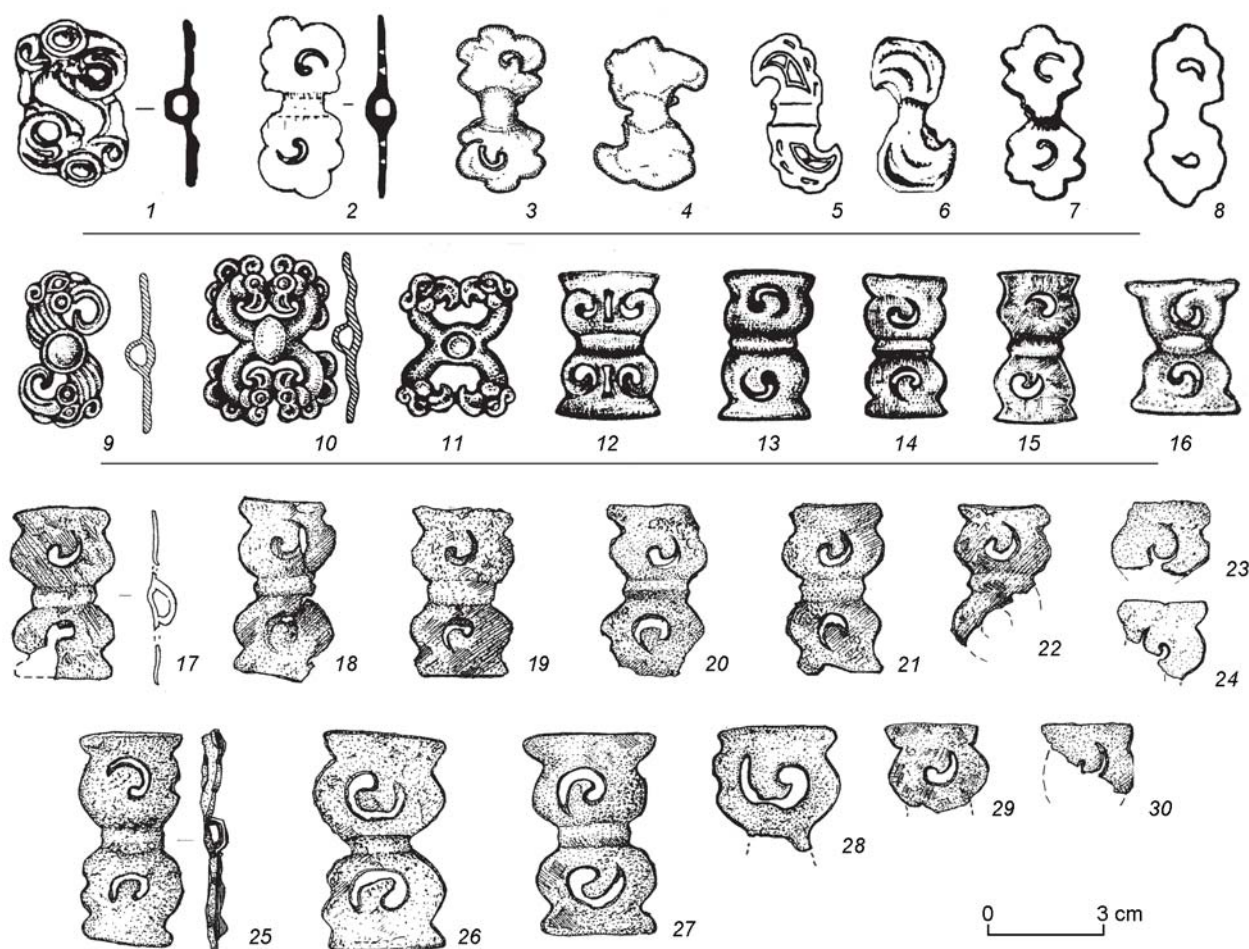


Fig. 4. Typical bronze belt plaques of the 5th–3rd centuries BC from Tuva (1–8), Ust-Taseyevsky ritual complex (9–16), and butterfly-shaped bronze plaques from burials of group 2 at Ust-Zelinda-2 (17–30).

1–8 – after (Kilunovskaya, Frolov, 2020: Fig. 1, 1, 5, 18, 25; Semenov, 2000: Fig. 2, 18; Semenov, Kilunovskaya, 2014: Fig. 9, 9, 11; Chugunov, 1999: Pl. 4, 24); 9–16 – after (Grevtsov, 2013: Fig. 7, 10, 11; 13, 3; 15, 3; 16, 9, 10; 17, 8; Mandryka, Yurieva, 2023: Fig. 3, 5).

(7 m north of burial 8) (see Fig. 4, 28). Bronze arrowheads were not discovered outside the graves. As to the flat iron “points” (5 spec.), these were encountered within a rather small area and most likely belonged to burials of “Iron Age group 3” (Marchenko et al., 2012), which remain unpublished (Shulga et al., 2025).

Dating of the finds and cultural characteristics of the burials

To date, no detailed studies addressing the classification and chronology of most bronze, iron, and bone artifacts similar to those from Ust-Zelinda-2 have been conducted. The time when the three-winged stemless bronze arrowheads were manufactured has also not been determined, though V.I. Privalikhin supposed that they were used in the Angara region approximately in the 4th–2nd centuries BC (2013: 88). In his view, hilts of sickle-shaped daggers and stems of arrowheads gradually disappeared because the early inhabitants of the Angara area strove to save bronze. This idea, however, is not supported by facts. On the contrary, materials from the Ust-Taseyevsky ritual complex and other sites of this kind in the region, as well as from Ust-Zelinda-2, demonstrate “irrational” expenditure of numerous bronze artifacts while performing different rites at burial and ritual sites. If the parsimony principle were the main reason, one could expect a progressive reduction of the mass and size of locally manufactured belt plaques. However, this was not the case. Some specimens are even larger (up to 5.8 cm in length) than in pastoral cultures of Southern Siberia during the Scythian period (ca 4.5 cm long). The group of later celts of smaller mass and size cannot be singled out either. Apparently, the peculiar form of sickle-shaped knives and stemless arrowheads at Angara cannot be ascribed to parsimony; rather, it was caused by cultural idiosyncrasy. We should take in consideration the assumption made by P.V. Mandryka (2008: 129–130) that local sources of metal could have been used, which might indicate that there was no shortage of raw materials. Stemless arrowheads do not point to any specific date of the burials in question in the 8th–2nd centuries BC interval. The chronology of stone and bone arrowheads is even less clear. Ceramic artifacts reliably associated with the complexes of group 2 that might shed a light on the cultural and chronological position of this horizon at the site are also absent.

A morphological and stylistic classification of a sample of bronze and iron items with decorative

elements, proposed by P.V. Mandryka and V.V. Yurieva and partly used by them for assessing their chronology, is noteworthy (2023: 76). These authors attribute the appearance of flat artifacts depicting both highly stylized heads of birds of prey (including the butterfly-shaped plaques) and more realistic figures (including the plaques with representations of the “maned” griffon) in the Krasnoyarsk forest-steppe to the 6th century BC. There is a radiocarbon date that places burial 13 of the Sergushkin-3 cemetery with a butterfly-shaped plaque within the period between the 6th and 1st centuries BC.

Broad intervals of chronological estimates for Early Iron Age artifacts from the Angara region are mostly due to the scarcity of finds and the absence of reliable chronological references for the small sample dating to the 1st millennium BC. In the taiga zone of Siberia, on the other hand, many assemblages with “Scythian-type artifacts dating to the 6th and 5th centuries BC” are known (Frolov, 2008: 163). Such artifacts were traditionally viewed as articles imported from the steppes. They could have penetrated into taiga with a delay and continued to be in use for a long time. From this point of view, such artifacts cannot be regarded as diagnostic. However, in the opinion of Y.V. Frolov, there is a reason to believe that similar bronze artifacts in the steppes and taiga zone are chronologically close. The presence of burial complexes with similar items, including belt plaques, in the taiga zone also points to this (Ibid.: 163–165). Burials of Ust-Zelinda-2 can be attributed to such complexes.

In the burials of group 2, impressive bronze artifacts with more definite chronological position were found for the first time in the closed complexes and in large numbers. These are butterfly-shaped overlay plaques accompanied by a hemispheric button-like plaque with a loop on the reverse (see Fig. 3, 45) and two-ringed units (see Fig. 3, 25, 26). Similar artifacts can be encountered in belt sets of the Scythian age pastoral cultures in Southern Siberia. Counterparts of the two-ringed units are known only from earlier collections of the Upper Ob (Shulga, Umansky, Mogilnikov, 2009: Fig. 29, 1) and Northern Altai (Kireyev, 1992: 41, fig. 4).

The butterfly-shaped belt plaques are especially important for dating the graves of group 2. In the Altai-Sayan region, they can be regarded as chronological markers of the 5th–4th centuries BC (Semenov, 2000: 179). Indeed, in the Upper Ob region and in Tuva, such plaques appeared in the second half/end of the 6th century BC and nearly completely disappeared

in the 4th century BC (Kilunovskaya, Frolov, 2020: 128–130). As recent studies have demonstrated, outside the Altai-Sayan region, they could survive for a short while*. In North China, butterfly- and S-shaped belt plaques were still in use in the 3rd century BC (the Yanglang culture of eastern Gansu and the Ningxia-Hui Autonomous Region) and, possibly, in the early 2nd century BC (high-ranking burials at the Majiayuan cemetery) (Shulga, 2023: 35–37). Iron butterfly-shaped plaques found in the Northern Angara region (Ust-Taseyevsky ritual site (Grevtsov, 2013: 99), Mys Arban (Tarasov, 1997), Kamenka-1 (Zaika, Ovodov, Orlova, 2013), Vzvoz (German, Leontiev, Savelieva, 2015)) and on the northeastern coast of Lake Baikal (Kharinsky, 2004: Fig. 2, 4; 2017: Fig. 1) may indicate that they were in use starting from the mid-4th century BC**. Currently, there is no suggestion that in that region such artifacts existed in the 2nd–1st centuries BC.

All butterfly-shaped plaques from Ust-Zelinda-2 belong to the same type, which can be termed the Angara variety, after the place where most such items were found (see Fig. 4, 12–30). They differ from the majority of butterfly and S-shaped plaques by the shape of blades arranged in a mirror-like symmetrical fashion***. The greatest diversity of such plaques, including sophisticated (see Fig. 4, 10, 11) and simple (see Fig. 4, 12–16) forms, is represented at the Ust-Taseyevsky ritual complex. In simple ones, blade butts are square with the long axis and protrude symmetrically. A transverse roll (“false socket” after (Mandryka, Yurieva, 2023: 74)) divides the blade in the center. Its reverse side bears a small longitudinal loop. Each blade is decorated with an incised “comma”, same as on many similar plaques from other regions. However, there is no traditional stylized representation of a griffin head. The origin of this decoration is not yet clear. At Ust-Taseyevsky ritual site, even complex plaques with double griffins, having no parallels elsewhere, have pot-like blades.

*For Southern Siberia, V.I.A. Semenov initially attributed the butterfly-shaped plaques to the period between the 5th and 3rd centuries BC (1997: 19).

**Previously, the lower chronological boundary of burials 1 and 8 of Baikalskoye-31, based on the ^{14}C -dates of 2130 ± 50 BP (SOAN-4100) and 2025 ± 75 BP (SOAN-4878), was erroneously referred to the mid-3rd century BC (German, Leontiev, Savelieva, 2015: 83); however, according to the results of calibration (OxCal 4.4, IntCal 20), the lower range of both dates is the mid-4th century BC.

***Almost all butterfly- and S-shaped plaques from Southern Siberia and North China were fashioned on the principle of central symmetry (see Fig. 4, 1–9).

In decorative terms, such a shape could have resulted from the evolution of the Chinese caudate griffin in a foreign tradition, as evidenced by a small unilateral protrusion at each blade and the position of the “comma” (see Fig. 4, 18, 19, 22), whose tail may correspond to the protrusion, as in Yanglang plaques (Shulga, 2023: Fig. 3, 16–20; 8, 13–24). If we proceed from this evolutionary line, then the Angara plaques should be considered comparatively late. However, the fact that in the Upper Ob region such artifacts occur in rather old complexes contradicts the given assumption.

Either way, the large quantity and great variety of belt plaques with pot-like contours of blades at Ust-Taseyevsky (see Fig. 4, 12–16) indicate the local production of these belt accessories in the Angara region (Grevtsov, 2013: 99). The nearest and so far the only examined Early Iron Age bronze foundry is known at the Vzvoz site, located on Sergushkin Island, 67 km from Ust-Zelinda downstream the Angara (German, Leontiev, Savelieva, 2015).

The Ust-Taseyevsky collection also contains parallels to the fused plaque with paired representations of griffin heads from burial 16 (see Fig. 3, 10; 4, 11) and to the fragment of a plaque with representation of griffin mane from burial 25 (see Fig. 3, 51) (Grevtsov, 2013: Fig. 7, 6; 9, 1). Regarding bronze items in toto, we believe that group 2 burials at Ust-Zelinda-2 fall within the 5th–3rd centuries BC interval. Results of the analysis of finds from burials of group 3 at this site partially supports this age (Shulga et al., 2025).

Morphologically, the Angara butterfly-shaped plaques are quite variable. Complete or partially preserved 8 butterfly-shaped plaques from burial 16 at Ust-Zelinda-2 are noteworthy. Despite the deformation, they all are distinctly similar in morphology and shaping, and correspond to the Angara variety of plaques with pot-like contours of blades. They measure 4.8×2.8 cm (see Fig. 3, 1–6, 8, 9). The “comma’s” tail on the blade is directed from the center. Probably, two partially preserved plaques from burial 9 were similar (see Fig. 3, 42, 43). Other four specimens, including a half of the plaque found north of burial 8, differ from them and from each other. These are markedly longer (5.5–5.8 cm) and wider (3.0–3.5 cm). The plaque from burial 4 (see Fig. 3, 40) and the broken blade found in the northern part of the excavation (see Fig. 4, 28) have rather similar profiles. One of their edges bears three “waves” reminding a griffin mane. However, the tails of “commas” are oppositely directed, and the broken blade is nearly 5 mm wider. One large plaque (5.8×3.2 cm) from burial 11 (see Fig. 3, 49) has a wavy edge with three oval protrusions at its blade. Similar

edges were recorded on seven published plaques from Ust-Taseyevsky, though these specimens differ from one another (Grevtsov, 2013: Fig. 7, 1; 17, 5). The complete plaque from burial 9 is morphologically close to those found nearby and in burial 16, but it is much larger measuring 5.5×3.5 cm (see Fig. 3, 41). As we can see, all the described butterfly-shaped plaques, with the exclusion of those found in burial 16, differ in shaping or size, although belong to the same Angara variety.

The cultural attribution of pits with secondary cremations at Ust-Zelinda-2 is problematic. Many researchers attribute “Early Iron Age” burials on the Angara to the Tsepan culture by default. This culture was first described by Privalikhin (1993, 2011) on the basis of rather scarce finds. Formally, the described burials of group 2 can be attributed to the second stage of the Tsepan culture (4th–2nd centuries BC), which, according to Privalikhin, is characterized by burials in pits with secondary cremation (2011: 170). The problem is that the Early Iron Age materials found in the Angara region are represented by rather uninformative variegated burial, ritual or dwelling complexes, only partially described. Accordingly, views of researchers on the chronology of sites and ethnic and cultural processes in the Early Iron Age differ significantly (Fokin, 2013: 185; German, Leontiev, 2022: 109). Significantly, Mandryka eventually suggested to regard the area of Tsepan sites within the taiga zone from the Yenisei to Lena rivers as a cultural and historical province uniting “variants of the culture in the ‘Yenisei’, ‘Lower Angara’, ‘Northern Angara’, and ‘Upper Lena’ groups of sites” (2021: 43).

Archaeological materials from Ust-Zelinda-2 do not clarify the problem as well. Judging by the accompanying goods, the two identified groups of burials (1 – inhumation, and 2 – secondary cremation) appeared approximately in the 5th–3rd (2nd) centuries BC (Marchenko et al., 2012). At the same time, the grave goods have their own specifics, though without distinct chronological markers. Significant differences in the burial practice can be explained on the basis of Privalikhin’s assumption that inhumation was practiced earlier than cremation (2011: 170). Yet there is no denying the possible ethnic, cultural or other differences that resulted in the mentioned specifics of the ritual practices (see, e.g., (German, Leontiev, 2022: 108, 109)).

At the same time, the analysis of butterfly-shaped plaques of the Angara variety clearly points to the high degree of homogeneity of material culture existing in the Angara region in the Early Iron Age. This

assumption is supported by the presence of double-bladed curved knives and stemless arrowheads (see Fig. 3, 18–24, 46–48) of definitely local production. Horn sockets for stone arrowheads can also be regarded as local traits (see Fig. 3, 32–35). These observations suggest that a large part of bronze artifacts (for instance, from the Ust-Taseyevsky ritual complex) were not imported but rather made in situ, same as the belt plaques. Without dwelling on this problem, we will touch upon certain aspects of secondary cremation. This rite has been discussed in detail on the basis of abundant materials from Prospikhinskaya Shivera IV and other medieval cemeteries on the Angara (Mandryka, Senotrusova, 2022: 267, 268, 293–327). Following Privalikhin, the authors of the monograph attribute this ritual to the Early Iron Age and note that it was practiced during the second stage of the Tsepan culture*.

It is evident that a similar in-depth study of the practice when cremation was conducted outside the grave is also required for the Early Iron Age in the Angara region. Attention should be paid to the clear similarity among burials of groups 2 and 3 at Ust-Zelinda-2 and graves at Ust-Taseyevsky (Grevtsov, 2013), Mys Arban (Tarasov, 1997), and Kamenka-1 (Zaika, Ovodov, Orlova, 2013). Traces of bonfire or fire, numerous bones, burnt and fused artifacts including butterfly-shaped plaques were found at these sites. Regrettably, only finds from Kamenka-1 were described in detail. The authors of the publication rightfully pointed out the parallels with other ritual sites in the Lower Angara region: Mys Arban, Ust-Taseyevsky, Cave “Grafskaya”, and others (Ibid.: 126). At Ust-Zelinda-2, the same artifacts are present, including butterfly-shaped plaques, but there are no traces of bonfire or animal bones. Instead, there are human remains cremated elsewhere and mixed with artifacts. Evidently, there is some connection between all those ritual and funerary sites, but its details have yet to be specified.

Conclusions

The analysis of butterfly-shaped plaques from group 2 burials at Ust-Zelinda-2 confirms that they were manufactured locally. Indeed, although this site is

*According to some data, secondary cremation in the Angara basin was practiced earlier. For instance, a burial at the Skorodumny Byk site not without reason is dated to the 6th century BC (Fokin, 2013: 185).

more than 500 km away from the Ust-Taseyevsky complex, nearly all the plaques are of local Angara variety with pot-like blades. Most of them are quite different in details, suggesting that several artisans followed the same local tradition. Eight identical plaques can apparently be regarded as the first instance of a rich belt set, which could have included two-ringed units and other plaques. The presence of such a set in burial 16 with cremated remains of an adult can indirectly uphold the Y.A. Grevtsov's idea that belts were used as ritual offerings, and points to the similarity of the rites practiced in places where the Taseyeva and Zelinda rivers flow into the Angara.

Based on the totality of bronze items, burials of group 2 at Ust-Zelinda-2 date to the 5th–3rd centuries BC, but this estimate is tentative. The cultural attribution of people buried in those graves is likewise an open question.

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D.V. Selin¹, A.A. Maksimova², and A.V. Gusev³¹*Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: selin@epage.ru*²*Novosibirsk State University,
Pirogova 1, Novosibirsk, 630090, Russia
E-mail: rock.nastaya64@gmail.com*³*Shemanovsky Yamal-Nenets District Museum and Exhibition Complex,
Chubynina 38, Salekhard, 629008, Russia
E-mail: gusev_av2004@mail.ru*

Early Iron Age Ceramics from the Ust-Polui Ritual and Production Center: Aspects of Technology

This article outlines the findings of a multidisciplinary analysis of pottery from the Early Iron Age ritual and production complex at Ust-Polui, in northwestern Siberia. The raw material used in pottery manufacture was aleurite-type silty ferruginous clay with a small amount of sand. Six recipes for paste preparation are described, the most common of which was adding grus to clay. Both materials were mined nearby. Two types of modeling are identified: base and base-and-body. Both the hollow form and the base were modeled by the coil method. Surface treatment was variable. Eighteen combinations of tools are identified. Two peculiar techniques were employed: shaping the rim by an additional coil, and smoothing with a denticulate tool on the inner surface of the shoulder-body junction. Three pots were painted with ocher. Ceramics were used in foundry as crucibles and possibly ladles for molten metal. Comparison of Ust-Polui ceramic technology with that of Kulaika culture revealed both similarities and differences. Basically, the Ust-Polui ceramics belong to the Kulaika tradition. Their specificity, however, supports the idea of the Ust-Polui variant, which is not synonymous with the Ust-Polui culture sensu V.N. Chernetsov. People associated with this variant were not isolated; they maintained ties with people living upstream on the Ob as far south as Barsova Gora, resulting in a blend of technological traditions differing from those of the Lower and Surgut stretches of the Ob.

Keywords: Early Iron Age, Lower Ob, Kulaika culture, ceramics, technology, multidisciplinary approach.

Introduction

The Ust-Polui ritual and production complex is located in the Yamal-Nenets Autonomous Okrug of the Tyumen Region (Western Siberia, Russia). The site occupies a part of the right-side terrace of the Polui River, ca 2 km from its confluence with the Ob River. It was discovered in 1932; V.S. Adrianov excavated the site for the first time in 1935–1936. In 1938, a small-scale excavation was carried out by A.F. Palashenkov. In subsequent years, exploration

works were conducted by V.N. Chernetsov, V.I. Moshinskaya, S.G. Parkhimovich, and V.M. Morozov. Large-scale excavations were carried out in 1993–1995 and continued in 2006–2015. A detailed description of the site, history of the research, findings, and chronology have been described in a series of summary works (see, e.g., (Arkheologiya Arktiki, 2012, 2017)). We will focus on the most common finds at this site—pottery fragments. Despite the large size of the collection, ceramics remain the insufficiently studied category of artifacts from Ust-Polui, which fact

has been repeatedly mentioned by researchers (Ibid.).

Moshinskaya carried out the first analysis of the Ust-Polui ceramic complex and identified three types of vessels based on their ornamentation and shape. She also provided a brief description of the technology. The vessels were modeled through coil technique; the rim in some cases was shaped by folding the edge inward or adding an extra coil.

Traces of surface paddling with a spatula were noted. The addition of grus and crushed mica schist to the paste was recorded (Moshinskaya, 1953: 112).

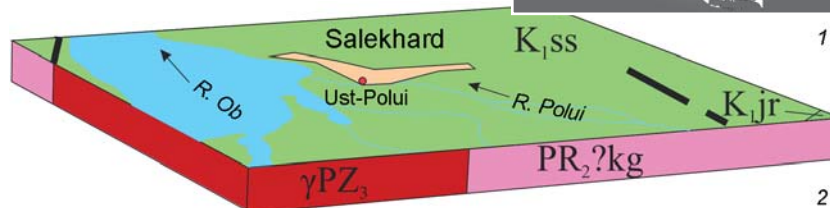
One more research was focused on quantitative and spatial distribution analysis of Ust-Polui ceramics from excavations of different years (Novikova, Rybina, Novikov, 2014). The analysis showed that rims accounted for 45.5 % of the total number of fragments. According to the researchers' estimates, the total number of vessels at the site was approximately 7000 items. At present, this estimate seems somewhat overstated, since the authors did not take into account that one fragment was not equal to a whole vessel; the rim of one item could be crushed into several pieces; and the fragments could be scattered across the area of the site, as evidenced by experimental results (Glushkov, 1996: 89–91).

Scientific analysis of the technology of pottery manufacture is extremely important (Bobrinsky, 1978; Tsetlin, 2017; and others). To date, pottery from the Beloyarskaya and Kalinkinskaya cultures and the Kulaika tradition from the Novosibirsk, Tomsk-Narym, and Surgut regions of the Ob has been analyzed through a unified methodology (see, e.g., (Selin, 2021; Selin, Chemyakin, 2022a, b; Stepanova, Pletneva, Rybakov, 2021; and others)). The same algorithm was used for the study of the Ust-Polui ceramics, which makes it possible to compare correctly the techniques of the Early Iron Age pottery manufacture, primarily the Kulaika pottery, from various sites in the Ob region.

Ust-Polui is located on the West Siberian platform; its cover is weakly dislocated and composed of Cretaceous sedimentary rocks, the bedrock consisting of Proterozoic formations of the Ural Fold Belt (Zyleva et al., 2014). It is dominated by rocks of the Severo-Sosvinskaya Formation, which is composed of sands and siltstones with interlayers of silty and carbonaceous clays (Gosudarstvennaya geologicheskaya karta...,

Fig. 1. Ritual and production complex at Ust-Polui on the map of Eurasia (1) and geological map-scheme (2).

K₁ss – Severo-Sosvinskaya Formation; K₁jr – Yaronskaya Formation; PR₂?kg – crystalline schist-gneiss strata.



2013a). The deposits of the Yaronskaya Formation, consisting of clays with interlayers of sandstones, were also noted. The bedrock of the region contains Proterozoic crystalline schist-gneiss strata, which include paragneisses, crystalline schists, quartzites, metasandstones, and granite gneisses. Late Paleozoic granitoids, including granites, granodiorites, and leucogranites, are also found (Gosudarstvennaya geologicheskaya karta..., 2013b) (Fig. 1).

The aim of the study is to reconstruct the techniques used at certain stages of pottery manufacture and the historical and cultural processes among the Ust-Polui population, which are available for study based on archaeological ceramics.

Methods and materials

The ceramics were subjected to multidisciplinary analyses using various scientific techniques. The pottery was studied by the method proposed by A.A. Bobrinsky (1978). The sample under study included fragments of 125 vessels.

Thin sections were examined using an ADF A1 polarizing microscope. In total, twenty items were subjected to petrographic analysis. The smallness of the sample is due to the fact that the Ust-Polui collection is kept in the Shemanovsky Yamal-Nenets District Museum and Exhibition Complex, and the Museum rules do not permit a larger number of samples to be taken.

X-ray fluorescence (XRF) analysis was performed on the MetExpert device. The chemical composition of clays, paint, and metal drops was established. The detection thresholds of particular elements are: Na, Mg, Al, Si – 0.2 wt%; from P to Mo – 0.02 wt%; from Ag to Am – 0.05 wt%.

The Ust-Polui ceramics have been analyzed using this set of methods for the first time.

Ceramics study results

Selection and preparation of the original ductile raw material. Ferruginous clays with different concentrations of sand and other natural impurities were selected. Four clay subtypes have been identified.

Clay 1 ($n=107$) – with a minor admixture of rounded sand (0.1–2.0 mm, up to 7 incl. per 1 cm²). Admixture of brown iron ore was identified in 33 specimens. The size of the inclusions is 0.1–2.0 mm; the concentration is 1–9 incl. per 1 cm². In 19 vessels, only rounded fractions were recorded, in 11 only angular ones, in 3 specimens both varieties. The occurrence of angular inclusions suggests the preliminary crushing of raw material.

Clay 2 ($n=14$) – the amount of sand admixture is similar to the above. Solitary fragments of plant stems and/or leaves (2–5 mm) were noted in twelve vessels, fragments of mollusk shells (0.5–1.0 mm) in one vessel, and bird down (0.5 mm) in one more vessel. This raw material could have been mined in the immediate vicinity of a reservoir or in a floodplain.

Clay 3 ($n=2$) – moderately sandy, with natural inclusions of rounded sand (0.1–1.0 mm; 20 incl. per 1 cm²).

Clay 4 ($n=2$) – with high sand-content, with rounded fine (0.1–0.5 mm) and dusty sand.

The vast majority of vessels ($n=121$) were made of clay with low sand-content, which suggests the stability of skills in selecting highly ductile raw material. The difference is that some of the clay deposits could have been in floodplains or near water bodies, which led to the occurrence of various natural organic impurities, characteristic of clay 2, in the raw material.

Petrographic analysis also showed differences in the mineral composition of the clays used. Two groups have been distinguished. Group 1 (5 samples) is characterized by an inequigranular psammitic

clay texture consisting of 90 % cement and 10 % clastic material. The cement is composed of illite, plagioclases (0.02–0.19 mm), potassium feldspar (0.03–0.19 mm), and amphibole (0.06–0.2 mm). The detrital material consists of unrounded grains of plagioclases (0.24–1.19 mm), granitoids (0.62–2.47 mm); amphiboles (0.26–0.68 mm) and biotites (0.69–1.01 mm) are less common.

Group 2 (15 samples) is characterized by a silty-pelitic clay texture consisting of 70–90 % cement and 10–30 % clastic material. The cement is composed of illite, quartz (0.02–0.07 mm), plagioclases (0.02–0.17 mm), potassium feldspars (0.03–0.25 mm), biotites (0.04–0.35 mm), and amphiboles (0.03–0.23 mm). The detrital material consists of granitoids (0.64–4.41 mm), plagioclases (0.27–2.24 mm), biotites (0.16–1.39 mm), and amphiboles (0.18–1.08 mm).

All the samples were subjected to XRF analysis (Fig. 2). The derived data were compared with the results of petrographic analysis; and two groups were identified. Group 1 shows a high proportion of Mg (average values of 3 wt%). In addition, differences in the contents of Ca, Mn, and Zn were identified: their contents were higher in group 1 (average values of 18.9, 6.1, 1.2 wt%, respectively) than in group 2 (average values of 11.2, 3.2, 0.5 wt%, respectively). The Al content was 2 times higher in group 2. Despite the noted differences in the proportions of chemical elements, the compositions of all the samples are comparable with one another, which suggests a single clay mining region.

Paste preparation. Six recipes were established (Fig. 3, 1–4): 1) clay + grus ($n=97$); 2) clay + grus + organic solution ($n=15$); 3) clay + grus + grog ($n=10$); 4) clay + grus + grog + organic solution ($n=1$); 5) clay + grus + organic matter (manure?) ($n=1$); 6) clay + grus + animal hair ($n=1$).

Grus was found in all the samples under study (Fig. 3, 1–4). The petrographic analysis showed that the grus was obtained from disintegrated granitoid granules consisting mainly of quartz, biotite, plagioclase, and amphibole, suggesting their attribution to leukoplagiogranites and leucogranites; granites are less common. The rocks and clay could have been mined near the site. Furthermore, the Ust-Polui area yielded fired pieces of granitoids, which probably served as raw material for grus production.

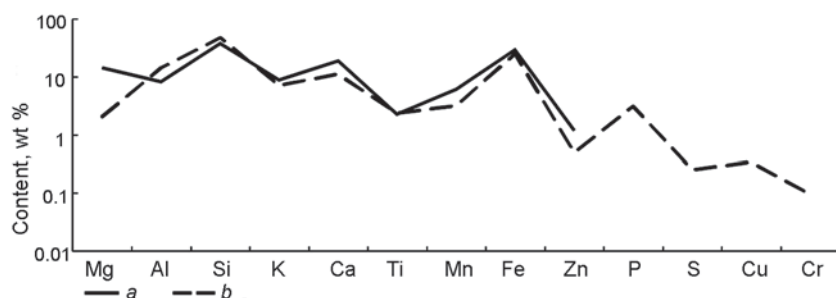


Fig. 2. Contents of chemical elements in ceramic samples.

a – average values for group 1; b – same for group 2.

Grus was not calibrated in the vast majority of cases ($n=117$). The fraction size averages 0.1–4.0 mm; some fragments demonstrated inclusions up to 8 mm. Eight vessels contained grus calibrated by the upper boundary (≤ 2 mm). Two main variations of this impurity concentration were recorded: 1 : 1 to 2 ($n=59$) and 1 : 5 to 6 ($n=46$).

Grog was revealed in eleven vessels, only in combination with grus (Fig. 3, 4). In six cases, it was not calibrated (0.1–4.0 mm); five specimens contained grog calibrated by the upper limit (≤ 2 mm). The main concentrations were 1 : 5 to 6 ($n=3$) and 1 : 6 to 9 ($n=7$). In nine cases, the concentrations of grog and grus in one vessel were the same. One of the samples shows granitoid grus (0.1–0.5 mm) in grog.

The organic solution was recorded in the form of elongated voids (0.5–4.0 mm) with a glossy substance inside and black shiny drips, sometimes with scraps of plants up to 0.3 mm (Fig. 3, 3). In one vessel, fragments of burnt thin plant-stems (1.0–2.5 mm) were identified, presumably the remains of ruminant manure. In one more vessel, an admixture of wool was noted.

A comparative analysis of clay types and paste recipes was made. Four of the six recipes were based on the first two clay types; clay 2 was used in manufacturing 11 % of the total number of vessels, of which 36 % have grog admixture in the paste. The only vessel with wool additive was also made from clay 2. Clay 3 was used in multicomponent recipes with organic solution. In clay 4, only grus was added.

Construction of the bottom, hollow body, and base. The type of modeling was reliably identified in 10 vessels. These were constructed according to two techniques: base ($n=4$) and base-and-body ($n=6$). The hollow body was built up by coil technique, with

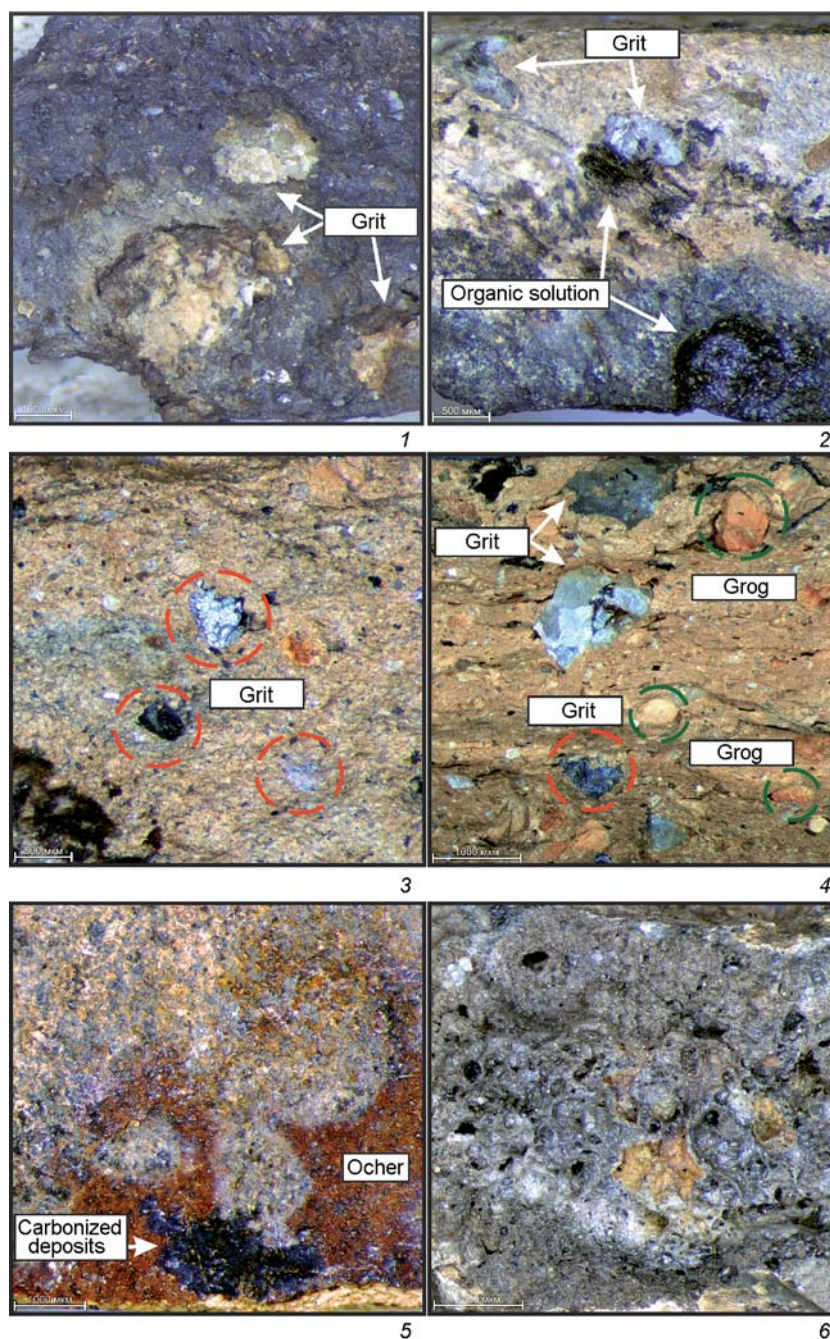


Fig. 3. Microphotographs of ceramic surfaces and fractures.

1, 3 – grus; 2 – grus and organic solution; 4 – grus and grog; 5 – ocher and carbonized deposits covering ocher stains; 6 – overburning on the exterior surface of potsherd.

an overlay from the interior or exterior surface along the coil (Fig. 4, 1–5). The width of the coils varies from 3 to 7 cm; most common width is 4–5 cm. One vessel shows coils applied in double-layer. Traces of paddling the exterior surface with a smooth mallet were noted on two items. In five vessels, the upper edge of the rim was shaped by an additional small coil 0.5–1.8 cm in diameter (Fig. 4, 6). Nine bases were



Fig. 4. Traces of construction of hollow body and base.

1–5 – fractured vessels showing traces of coil method; 6 – shaping the rim from inside with a small coil; 7 – coil-shaped base.

modeled of coils 3–5 cm wide, which were stuck to the lower part of the vessel from the inside or outside in a circle (Fig. 4, 7). One base was made of two coils with lateral overlapping.

Surface treatment. The vessels were smoothed and polished through various techniques in several combinations. The most common was smoothing both surfaces with a plain tool ($n=68$). Several specimens show the exterior surface finished with a plain tool, and the interior surface with fingers ($n=12$). A total of 18 combinations were identified. On three vessels, traces of smoothing of the shoulder-body junction with a denticulate tool were recorded.

Making the ceramics solid and water-resistant. The fractures show a variety of one-, two- and three-layer color schemes (from brick-red to black). Baking took place at a temperature above the clay's incandescence point in the range from 550–650 °C to 900–1100 °C, in a reduction environment.

Surface painting. Three fragments from different vessels were painted (see Fig. 3, 5; 5, 1–7). On two items, the paint unevenly covers both surfaces; on one item it only covers the inner surface. On one vessel, the paint is covered with carbonized deposits (see Fig. 3, 5). XRF analysis was performed on the inner surface of a ceramic fragment (see Fig. 5, 5). It showed that

the substance consisted of Mn (3.649 ± 0.076 wt%), Fe (47.542 ± 0.264 wt%), Mg (13.818 ± 4.640 wt%), Zn (0.417 ± 0.028 wt%) and can be classified as iron oxide golden ocher. The painted vessels do not differ in shape and ornamentation from the bulk of Ust-Polui ceramics.

Use of vessels in household and in production. Carbonized deposits were noted on 99 vessels. Traces of overburning were recorded on the fragments of four items (see Fig. 3, 6), which was associated with their use in foundry. This is also evidenced by metal drops up to 2 mm in diameter, which were found on the inner surface of one fragment (see Fig. 5, 8). XRF analysis was carried out on a drop along a fresh fracture, at the point of its adjoining the shard's surface. The following data were derived: Mn – 4.45 wt%, Fe – 90.66, Zn – 0.42, Ti – 2.83, Co – 0.90, Ni – 0.50, Cu – 0.65 wt%. Most likely, the vessel was used as a crucible.

Discussion

The above-described stages of pottery manufacture show differences in terms of substrate and adaptive skills. Two shaping methods have been identified—base and base-and-body. This stage of manufacture is the most conservative, and its complete change takes the time of working activities of five to six generations of artisans (approx. 150–180 years). Other substrate skills have been recorded in a uniform state. For example, the only discovered method of constructing a hollow body is the coil technique; the shape of vessels was modeled through paddling.

Adaptive skills include selection and processing of raw materials, paste preparation, and surface finishing. These skills change quite quickly, usually during the first few years upon the start of the interaction. Shaping skills occupy an intermediate position; these change during ca 25–30 years (Tsetlin, 2017: 192). The dominant subtype of raw material is clay with low sand-content, possibly pre-crushed. A considerable share of vessels, 86 %, were made from this type of

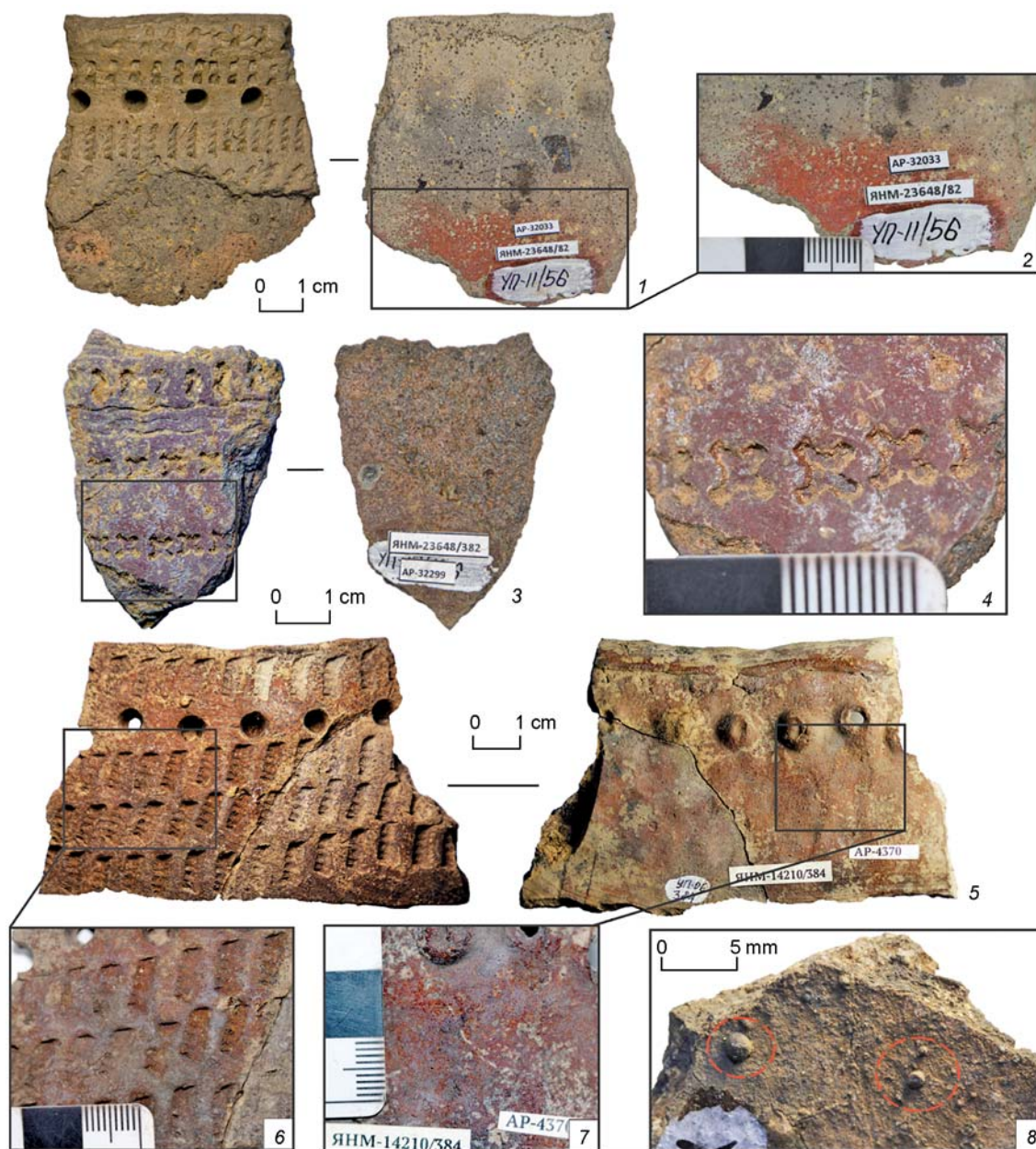


Fig. 5. Vessels painted with ochre, and metal drops on the potsherd interior surface.

1 – vessel 1; 2 – macrophoto of the interior surface of vessel 1; 3 – vessel 2; 4 – macrophoto of the exterior surface of vessel 2; 5 – vessel 3; 6, 7 – macrophoto of the surfaces of vessel 3; 8 – macrophoto of metal (iron) drops on the interior surface of vessel.

clay. The main mineral additive was grus, which was identified in all the vessels. Grog occurs only together with grus, and its concentration does not exceed 1 : 4 to 6, and most often is 1 : 6 to 9, which indicates almost complete assimilation of this tradition. Various techniques of surface treatment are preserved. Two peculiar technological skills have also been recorded: shaping the rim by an additional coil and smoothing the inner surface of the shoulder-body junction with a denticulate tool.

The revealed features suggest the stability of pottery traditions at the level of adaptive and partly substrate skills. On average, no more than 14 % of the total number of vessels was manufactured of clays 2–4 and mixed recipes with grog and organic impurities, which attests to the almost complete cultural homogeneity of the Ust-Polui population. The use of two modeling types suggests two components in the development of Ust-Polui tradition. Since this stage of technology is the most

conservative, this interaction took place at a rather remote time.

Vessels painted with ocher are a unique phenomenon for the Early Iron Age pottery-making in the taiga zone of Western Siberia. Ocher spots were recorded on solitary vessels at Ust-Polui (*Arkheologiya Arktiki*, 2017: Vol. 1, p. 54). The population used ocher at least in strewing it over the soil and in ceramic painting. Pottery painting was not a widespread phenomenon, since painted ceramics account for only 2.4 % of the entire collection. Vessels of this type were dispersed over the site and did not form any separate cluster.

Ceramic vessels could be brought to the site for ritual purposes, but also could be used in foundry as crucibles, as evidenced by the traces of burning and drops of iron found on them. This partly explains such a large number of ceramic shards in the territory of the site.

The comparison of the Ust-Polui ceramics with the Early Iron Age ware (primarily the Kulaika) from other regions of Western Siberia provides very important information. The pottery of the Surgut variant of the Kulaika culture demonstrates the use of ferruginous clays, which were mined within the boundaries of the Surgut volcanic field, but from several deposits. A wide range of artificial admixtures has been identified. The admixtures show various combinations. For example, at Barsov Gorodok (hereinafter Bg) I/5, nine recipes have been established, and at Bg I/4 eight. Most sites at Barsova Gora show the predominant use of the clay + grus composition, but there are sites (Bg I/4, Bg I/30) where grog was the main admixture. Vessel-bottom modeling was executed through base-and-body technique. The vessels were predominantly constructed by patch technique; however, at certain sites (Bg I/4, I/5, I/7, I/8, I/20, III/6, IV/3, Barsova Gora III/2) the coil method was also recorded. Most often, the number of such vessels does not exceed 5–10 %. Surface treatment was variable. At Bg I/4, up to 39 methods of combining various tools were identified. In addition, at all the analyzed sites of Barsova Gora, peculiar technological skills were recorded: additional decoration of the rim with a coil up to 1 cm in diameter, and inner surface smoothing of the shoulder-body junction with a denticulate tool.

The Surgut ware of the Kulaika tradition shows certain similarities with the Ust-Polui ceramics: the use of ferruginous clays, the choice of grus as the main admixture, and the use of the two technological skills mentioned above. At the same time, no cases of the base-shaping method of bottom modeling have

been noted at the sites of the Surgut region of the Ob. Differences were also observed in the techniques of hollow-body construction. At Ust-Polui, the main construction elements were coils, while in the Surgut region of the Ob, patches. However, it is extremely important that at some settlements of Barsova Gora solitary vessels made by coil method have been discovered. This suggests contacts between northern groups having populated the area of modern Salekhard and their southern neighbors. These northern groups penetrated the regions upstream of the Ob River, where they interacted with local population; as a result, production skills atypical of this region, such as coil technique, appeared in the Surgut region of the Ob. Apparently, the tradition of adding grog into the ceramic paste was borrowed by the Ust-Polui people from their southern neighbors.

In the Tomsk-Naryn stretches of the Ob, the Kulaika people used at least two ways of paste preparation: with grus and with sand. The first trend refers to the pottery from several sites on the Tom River studied by a team of researchers (Stepanova, Pletneva, Rybakov, 2021). It was manufactured from ductile clays with low or no ferrous content. The most popular was the recipe of clay + grus + organic matter. The second trend is represented at the Sarov fortified settlement and the settlement of Malget-6 (Selin, Chindina, in press). Those pottery-makers selected mainly ferruginous clays with low sand-content. Eight recipes of the paste were identified, with the main one being clay + sand (72 %). The use of the same two above-mentioned peculiar technological methods was recorded. Bottom modeling was made according to the base-and-body pattern; in almost all cases, a hollow body was built up with patches. Notably, two vessels from the Sarov fortified settlement and one from Malget-6 were made by the coil method, which is atypical of both the Tomsk-Naryn and the Surgut regions of the Ob. However, the existing significant differences in technology do not provide any ground to consider the Ust-Polui ceramics as a variant of the Kulaika (Sarov) tradition and to link the emergence of the Ust-Polui ceramics directly with human migrations from the Middle Ob region, as was suggested by L.A. Chindina (1984: 156–175). At present, we can state that the inhabitants of the Sarov fortified settlement did not produce a significant influence on the pottery technology of the Ust-Polui population, and the tradition of using coil technique could have penetrated the Tomsk-Naryn region of the Ob from Barsova Gora, where this technique is recorded more often than in Kulaika (Sarov). The connections

between the populations of the Tomsk-Narym and Surgut regions of the Ob are evidenced by vessels with an artificial sand admixture recorded in a number of Barsova Gora settlements (Selin, Chemyakin, 2022a, b).

The pottery of the Novosibirsk variant of the Kulaika tradition was made mainly from ferruginous clays with medium sand-content. At the Kamenny Mys burial ground, six recipes of paste were identified, the main one being clay + grus (68 %) (Selin, 2021). A similar trend is also typical for other settlement sites (Dubrovinsky Borok-3, -4, Ordynskoye-9). A hollow body was made by patch technique, and no traces of coil method were recorded.

Conclusions

The Ust-Polui pottery-making tradition is characterized by the use of ferruginous silty clays with low sand-content, possibly after preliminary crushing. Six paste recipes have been identified, of which clay + grus is the dominant one. The granitoid grus was most wide-spread, granite grus was less common. Clay and stone were mined most likely near Ust-Polui. Two types of bottom modeling methods have been established: base and base-and-body. Hollow body and bases were constructed of coils with lateral overlap. Surface treatment is variable. Firing could take place in a reduction or semi-reduction environment. The use of two peculiar technological skills has been recorded: shaping the rim with an additional small coil 0.5–1.8 cm in diameter, and smoothing with a denticulate tool over the inner surface of the shoulder-body junction. Three vessels painted with ocher have been uncovered. Ceramics were used in metalworking as crucibles.

Comparative analysis of the Ust-Polui pottery and the Kulaika ceramics from the Surgut, Tomsk-Narym and Novosibirsk regions of the Ob has shown both common Kulaika pottery traditions and regional specifics. The former include the use of ferruginous clays with low sand-content mined near the sites, the use of base-and-body shaping method, variability in surface treatment, and the use of two peculiar technological skills. These traditions are inherent in the Kulaika pottery throughout the Ob region, including Ust-Polui. At the same time, different regions show specific local features. In the Surgut stretch of the Ob, these are the use of various clay types, a wide range of artificial additives, a variety of paste recipes, and the main method of constructing

vessels by patch application. In the Tomsk-Narym region of the Ob, at least two traditions of paste preparation coexisted: with grus and with sand. The typical features of the Ust-Polui pottery are the use of clays with low sand-content, the clay + grus recipe, the use of base and base-and-body shaping method, and coil technique. Ceramics painted with ocher were found.

The common Kulaika pottery traditions recorded in Ust-Polui suggest attribution of their main ceramic complex to the Kulaika culture. The noted specificity of the pottery manufacture technology provides grounds for identifying a special—Ust-Polui—variant within this culture. The term “Lower Ob variant” seems too general, since the Lower Ob region includes a huge understudied territory stretching from the Irtysh River mouth to the Gulf of Ob. In addition, the Ust-Polui variant of the Kulaika tradition is not equivalent to the Ust-Polui culture in the sense that V.N. Chernetsov (1953) put into it. In our opinion, the Ust-Polui culture is a research construct representing the state of study of the Lower Ob region at the time of its identification. The Ust-Polui variant demonstrates both similarities to the general Kulaika tradition and certain specific characteristics. In general, the regional specificity of pottery technology is not a unique phenomenon; it is characteristic of all areas of the Kulaika culture distribution area. The bearers of the Ust-Polui trend did not exist in isolation, but interacted with southern groups upstream of the Ob, up to Barsova Gora. This led to the exchange in technological skills that were not typical of these territories, such as coil technique in the Barsova Gora collections and the addition of grog in Ust-Polui.

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**R.K. Nepop^{1, 2}, A.R. Agatova^{1, 2}, V.S. Myglan³,
V.V. Barinov³, M.O. Filatova⁴, and A.V. Petrozhitskiy^{5, 6}**

¹*Sobolev Institute of Geology and Mineralogy,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Koptuyuga 3, Novosibirsk, 630090, Russia
E-mail: rnk@igm.nsc.ru; agat@igm.nsc.ru*

²*Yeltsin Ural Federal University,
Mira 19, Yekaterinburg, 620062, Russia*

³*Siberian Federal University,
Pr. Svobodny 79, Krasnoyarsk, 660041, Russia
E-mail: dend_ro@mail.ru; nelisgar@mail.ru*

⁴*Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: mayaphylatova@gmail.com*

⁵*Budker Institute of Nuclear Physics,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 11, Novosibirsk, 630090, Russia
E-mail: petrozhav@gmail.com*

⁶*AMS Golden Valley,
Novosibirsk State University,
Pirogova 2, Novosibirsk, 630090, Russia*

On Dating Archaeological Sites Evidencing Ferrous Metallurgy in the Southeastern Altai, based on Radiocarbon and Dendrochronological Analyses of Charcoal

This study examines the use of charcoal for dating iron-smelting furnaces in the southeastern Altai. Problems with using radiocarbon analysis in this case are connected with the accuracy of assessing the calendar age. Another important reason why the age of furnaces is overestimated is the “old wood” effect. This effect cannot be avoided by making radiocarbon dating of thin tree trunks (branches) from slag or by using the youngest radiocarbon dates of samples from a single archaeological context. In the case of dendrochronological analysis, considering the age trend in individual series is also not a reliable criterion for determining closeness to the bark due to the long lifespan of trees in the southeastern Altai. Currently, the only way to avoid the “old wood” effect is to date samples with preserved bark, which are quite rare. Results of dendrochronological analysis demonstrate that conclusions drawn from the earliest dates for the same furnace are unreliable. Long tree-ring chronologies based on archaeological charcoal are more prospective for dating ferrous metallurgy sites in the region. The use of dendrochronological analysis minimizes the difficulties with interpreting radiocarbon dates.

Keywords: Iron-smelting furnaces, archaeological charcoal, radiocarbon analysis, Bayesian modeling, dendrochronology, southeastern Altai.

Introduction

Time is a key parameter in chronologically oriented scientific and archaeological disciplines. Events that are recorded in sediments, landforms, or artifacts give little information until they are arranged in chronological order. This fully applies to the dating of iron smelting sites in the southeastern part of the Russian Altai. Archaeological data and radiocarbon dating have helped to resolve this issue (Zinyakov, 1988; Agatova, Nepop, Korsakov, 2018; Vodyasov et al., 2020). Recently, the first encouraging results have also been obtained from dendrochronological analysis (Agatova et al., 2023; Myglan et al., 2024).

Concentration of a large number of bloomery furnaces in the region was caused by the availability of ore deposits and ore occurrences, as well as the proximity of necessary forests (Agatova, Nepop, Korsakov, 2018; Agatova et al., 2018, 2023). Fragments of charcoal discovered in the fore-furnace holes and furnace fillings have made it possible to use radiocarbon analysis for chronological attribution of ferrous metallurgy sites (Gutak, Rusanov, 2013; Agatova, Nepop, Korsakov, 2018; Agatova et al., 2023; Murakami et al., 2019; Vodyasov et al., 2020; Zaitseva, Vodyasov, 2023). Currently, over thirty ^{14}C dates have been obtained for the furnaces from the Chuya-Kuraika metallurgical region (see review in (Agatova et al., 2023)). Approaches to their interpretation differ among research groups, which leads to significant differences in establishing the operating time of bloomery furnaces. Some studies (Agatova, Nepop, Korsakov, 2018; Agatova et al., 2023; Murakami et al., 2019) argue that furnaces of the Kosh-Agach type were made in the Old Turkic period (late 6th to the first half of the 10th century), while other works (Gutak, Rusanov, 2013; Vodyasov et al., 2020; Zaitseva, Vodyasov, 2023) suggest the earlier Xiongnu period.

This article introduces seven new radiocarbon AMS dates of charcoal from slags of furnace No. 4 at the Kuektanar site, and presents the results of their calibration using Bayesian statistics. In addition, some specific aspects of interpreting data from charcoal radiocarbon dating will be analyzed, including a discussion of the “old wood” effect, which is the main reason for giving erroneous earlier dates to archaeometallurgical sites. Further, the dendrochronological analysis of charcoal will be presented, demonstrating the vulnerability of conclusions derived from the “earliest” radiocarbon dates for a single furnace.

Study area, material, and methods

The archaeological ferrous metallurgy sites under discussion are located in the Chuya and Kuraika depressions in the southeastern Altai. The Chuya-Kuraika mining and metallurgical region was set off after the areal archaeometallurgical survey in the 1970s (Zinyakov, 1988). Twenty-nine sites were discovered in the depressions. Two types of bloomery furnaces were identified, including the most common box-shaped furnaces of the Kosh-Agach type and less common furnaces with a semicircular back wall (Ibid.: 31–49; Vodyasov, Zaitseva, 2020).

The age of the ferrous metallurgy sites in the Russian Altai is based on the time when the bloomery method of iron production was developed in the region. A number of artifacts similar to finds from archaeological assemblages in other parts of the Altai were discovered during excavations at the Kosh-Agach type furnaces (Gavrilova, 1965: 36–40, 61), which made it possible to attribute them to the Old Turkic period (Zinyakov, 1988: 49–52). Analysis of the typological features of bloomery furnaces revealed the similarity of individual structural elements with sites of the 6th–9th centuries AD in the Khakassia-Minusinsk Depression (Sunchugashev, 1975: 93–100) and furnaces of the Saltov type of the 8th–9th centuries AD (Afanasiev, Nikolaenko, 1982). This indicates that iron-smelting furnaces of the Kosh-Agach type in the southeastern Altai functioned in the Old Turkic period in the 6th–10th centuries AD (Zinyakov, 1988: 51).

For the chronological attribution of bloomery furnaces at the Kuektanar River mouth, charcoal from the slag collected by the current authors after excavations by N.M. Zinyakov and E.V. Vodyasov was analyzed. Two fragments from furnace No. 4, containing 91 and 112 annual rings, were used for radiocarbon AMS dating of rings from the central and peripheral parts of each of them. Individual AMS dates were obtained for three more fragments of charcoal from the same furnace. The samples were prepared at the Institute of Archaeology and Ethnography SB RAS (Novosibirsk) and were dated at the AMS Golden Valley radiocarbon laboratory (Novosibirsk, index GV).

Radiocarbon dating of different fragments of a single sample allowed the researchers to use the Bayesian statistical modeling of calendar age, taking into account the exact number of tree rings separating the dated fragments. Calibration of radiocarbon dates and Bayesian analysis were

carried out in OxCal v.4.4.4 (Bronk Ramsey, 2021), using the IntCal20 calibration curve (Reimer et al., 2020). In addition to radiocarbon dating, the longest available floating 377-year tree-ring chronology based on charcoal (Myglan et al., 2024) was used for chronological attribution of iron smelting sites in the southeastern Altai.

Specific aspects of using charcoal for establishing the operating time of iron smelting furnaces

The most common method for charcoal dating is radiocarbon analysis. The main problem with its application in archaeology is the accuracy of dates, including those obtained by AMS. For example, for iron smelting furnaces at the Kuektanar River mouth, the smallest uncertainty of the calibrated (2σ) age was 130 years (sample Le-11825 (Vodyasov et al., 2020)), while the maximum uncertainty exceeded one thousand years (sample Le-11994 (Ibid.)), which is significantly longer than the archaeological periods under consideration and makes such a date unsuitable for chronological reconstructions (Fig. 1). It has been observed (Hendrickson, Hua, Pryce, 2013) that the use of charcoal extracted from large pieces of metallurgical slag makes it possible to work with organic material that was not exposed to the destructive effects of the external environment and contamination with young carbon. However, even this approach does not ensure acceptable dating accuracy.

The uncertainty of the obtained calendar age depends on the confidence interval which the radiocarbon date is calibrated with. Calibration at 1σ provides a 68 % probability of falling within the calculated time interval, which means that the reliability of age determination is 68 %. Calibration with a confidence interval of 2σ provides 95 % reliability, but gives a wider scatter of calendar dates. Some scholars prefer using calibration results with the confidence interval of 1σ when reconstructing archaeological events, because the range of the obtained calendar age often exceeds the duration of existence of the cultures in the southeastern Altai. For example, in a number of works (Vodyasov et al., 2020; Vodyasov, Zaitseva, 2020; Zaitseva, Vodyasov, 2023), despite the calibration carried out for both options, the narrower ranges of calendar age obtained with the confidence interval of 1σ were used in chronological reconstructions. This approach only

creates the illusion of precision, since the reliability of age determinations in this case is only 68 %.

Another problem in chronological reconstructions based on charcoal (regardless of the dating method) is that the obtained date indicates the lifespan of the tree rather than the age of the event of interest, such as smelting. Moreover, in the case of radiocarbon analysis, it indicates the time of cessation of carbon exchange with the external environment in the cells of a specific dated annual ring or group of rings. The obtained age differs from the date of felling the tree and time of operation of the furnace, representing the *terminus post quem* for the age of the archaeological event.

A fragment of slightly carbonized larch bark was discovered in the filling of the working chamber in iron-smelting furnace No. 2 at the Kuektanar River mouth (Agatova, Nepop, Korsakov, 2018). Its age (radiocarbon AMS date NSKA-00832, Fig. 1) corresponds to the time of the tree felling, and with a high degree of probability, to the last smelting. Using this information to calibrate (2σ) the radiocarbon LSC date SOAN-9091 of charcoal fragments from the same furnace has made it possible to establish the time of the last smelting—between 655 and 765 AD, which is consistent with the Old Turkic period (Ibid.). To date, this is one of the most accurate reconstructions of the age of an archaeometallurgical object using the radiocarbon method. However, even in this case, its precision was 110 years. The use of Bayesian modeling for establishing the age of charcoal from furnace No. 4 insignificantly increased the precision to 101 years (GV-4638, GV-4639). The outer growth ring of the studied charcoal fragment was dated to 332–433 AD, but direct correlation of this interval with the functioning time of furnace No. 4 is hampered by another important circumstance—the “old wood” effect, or, as it was first designated by L.V. Firsov (1976: 41–44), the intrinsic age of the tree.

As has been repeatedly observed, it is the “old wood” effect that significantly affects the correctness of chronological reconstructions using wood and charcoal (Ibid.: 41–44; Schiffer, 1986; Agatova, Nepop, Korsakov, 2018; Kim et al., 2019; Zaitseva, Vodyasov, 2023; and others). Regardless of the dating method used, the number of peripheral rings that were lost during charcoal burning and smelting remains unknown. Generally, fragments of the oldest parts of the wood become concentrated in slags during metal production. Accordingly, there are fewer ^{14}C dates of the younger outer rings

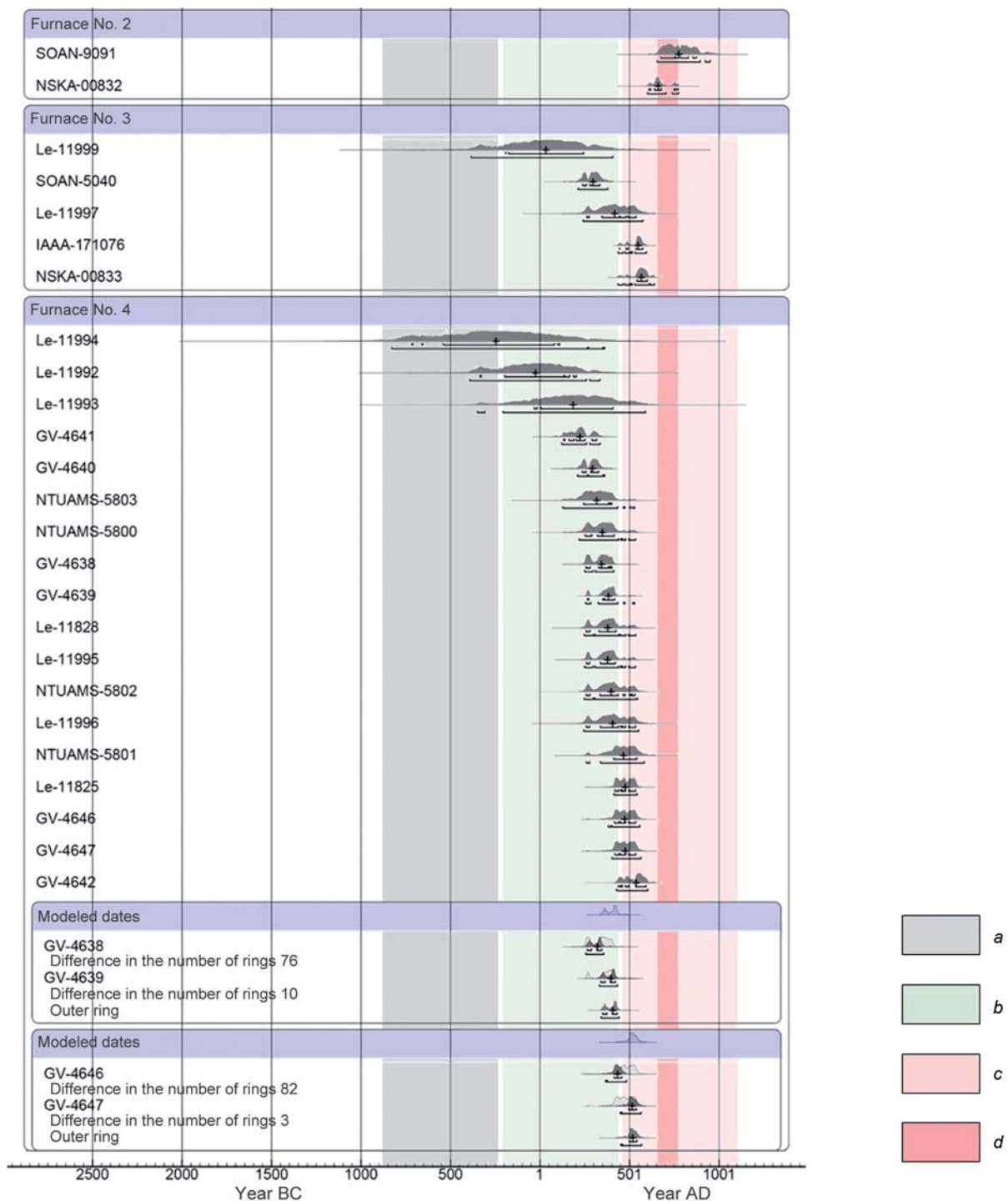


Fig. 1. Radiocarbon dates of archaeological charcoal from bloomery furnaces at the Kuektanar River mouth.

a – Scythian period (late 9th–3rd century BC); *b* – Xiongnu-Xianbei-Rouran period (2nd century BC–first half of the 5th century AD); *c* – Old Turkic period (late 5th–11th centuries AD); *d* – time of the last smelting for iron furnace No. 2, established by radiocarbon dating of a fragment of preserved bark (Agatova, Nepop, Korsakov, 2018).

in the sampling, but these are closer to the operation time of the furnaces. In the southeastern Altai and the adjacent areas of Tuva, the average age of living larches ranges from 325 to 500 years (Myglan et al., 2012; Bocharov, Savchuk, Dirks, 2014), which emphasizes the need to take the “old wood” effect into consideration.

Currently, several approaches to resolving this issue have been suggested in the scholarly literature. Some studies proposed obtaining a series of at least three ^{14}C dates for the same object, the “youngest” of which would most accurately correspond to the true age (Vodyasov, Zaitseva, 2020; Zaitseva, Vodyasov, 2023). In addition, selecting charcoal fragments containing outer rings for dating was recommended, as well as the use of young trees and branches. Despite the obvious validity of this approach (obtaining numerous dates and subsequent consideration of the “youngest” of them in chronological reconstructions), it is difficult to use this in practice, which may be illustrated by the example of the floating tree-ring chronology for charcoal taken from the southeastern Altai bloomeries made by the current authors (Myglan et al., 2024). Its duration is 377 years; it contains 275 individual series (Fig. 2). In this case, 268 samples were selected from furnace No. 4. The last hundred years of this chronology are provided by 39 samples, and the last 77 years by only three samples. Thus, the probability of finding a sample in the entire sampling, which would not be more than one hundred years older than the youngest annual ring in the entire tree-ring chronology is 14 %, and not more than 77 years older is only 1 %.

Regardless of the dating method, the key problem, i.e. establishing the total number of lost peripheral rings, has not been solved. Only charcoal with the surviving ring under the bark makes it possible to eliminate this. Identification of such rings using dendrochronological methods and their selection for radiocarbon dating could have simplified the solution to the “old wood” problem (Agatova et al., 2023; Myglan et al., 2023). However, stabilization of growth of *Larix sibirica* Ledeb. in the modern environment of the Altai and Tuva highlands occurs at about 150 years after the start of tree growth, whereas the survival time of the tree can be over 450 years (Myglan et al., 2012). In addition, in harsh conditions, trees live longer (Büntgen et al., 2019). For example, the age of the oldest larches on the South Chuya Ridge framing the Chuya Depression reaches 700 years (Bocharov, Savchuk, Dirks, 2014). Thus, signs of growth stabilization found in charcoal samples

do not provide reliable evidence for being close to the ring under the bark on their own (Agatova et al., 2023; Myglan et al., 2023).

This analysis allows for several conclusions. First, radiocarbon dating of several pieces of charcoal within a single archaeological context and consideration of the “youngest” dates in fact does not help us in solving the “old wood” problem, since the probability of finding a sample from the last (within the tree-ring chronology) hundred and even more so 70–50 years is negligible. Dating the overwhelming majority of samples would give us an age of wood far from the time of its felling and smelting. Therefore, obtaining a series of radiocarbon dates close in value, which was formed due to predominant preservation of charcoal from the inner part of the trunk, would not reduce the “old wood” effect, as E.V. Vodyasov and O.V. Zaitseva (2020) claimed. Second, the small thickness of the dated trunks/branches (?) cannot guarantee that the “youngest” dates were obtained because of the very significant (up to 500 years or more) lifespan of trees in the region under study. For the same reason, the identification of the rings under the bark using dendrochronological methods is problematic. Third, the precision of radiocarbon dating, comparable to the duration of cultural periods, does not allow for the reliable chronological attribution of iron smelting sites. It is the use of dendrochronological analysis that makes it possible to solve the problem of uncertainty of radiocarbon dates and minimize the “old wood” effect.

Age of the iron smelting furnaces at the Kuektanar River mouth

Let us dwell in more detail on the issue of chronological attribution of bloomery furnaces from the Kuektanar River mouth, where there are currently 25 determinations (see Fig. 1), taking into account seven new radiocarbon AMS dates obtained (see *Table*) and the results of age modeling using Bayesian statistics.

In some studies, the authors reported that they were able to assess the “old wood” effect, use it in chronological reconstructions, and date the time of operation of furnace No. 4 to 244–500 AD, that is, to the Xiongnu period (Vodyasov et al., 2020: 10; Zaitseva, Vodyasov, 2023: 84). Even in addition to the new radiocarbon dates provided herein, the previously obtained 14 calibrated (2σ) dates for furnaces No. 2–4 at the Kuektanar River mouth partially cover the

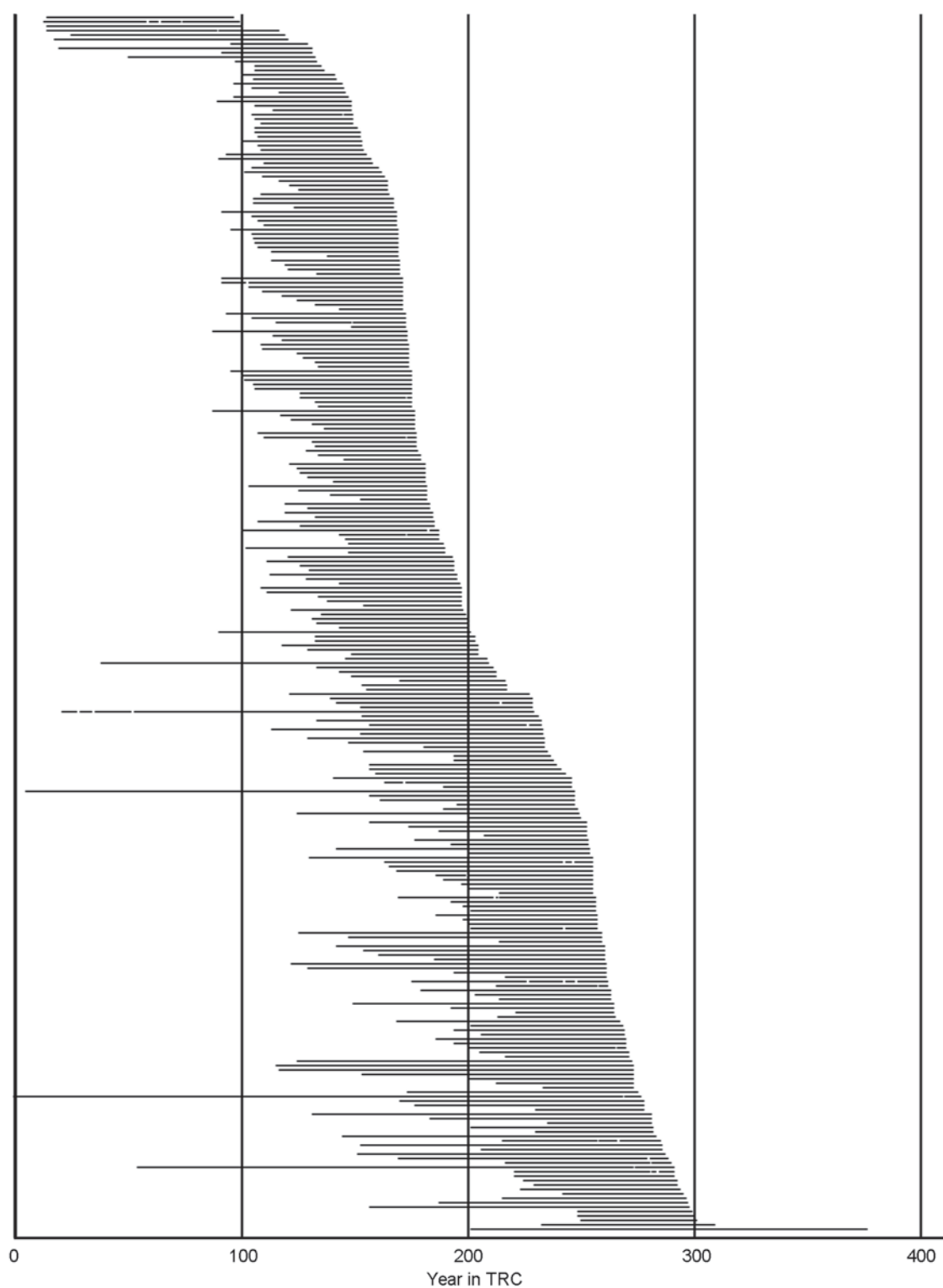


Fig. 2. Sample content of the 377-year-old floating tree-ring chronology (TRC) based on charcoal from iron furnaces.

New radiocarbon dates for charcoal from iron smelting furnace No. 4 at the mouth of the Kuektanar River and the previously published dates for the central and peripheral parts of two charcoal fragments from the same furnace, discussed in this article

Lab code	Description	¹⁴ C-age, years	Calibrated date, years AD		Bayesian modeling (2σ), years AD
			1σ	2σ	
NTUAMS-5800-1*	Heartwood, sample <i>D</i> = 13 cm	1710 ± 60	335 ± 81	378 ± 158	–
NTUAMS-5801-1*	Outer rings, sample <i>D</i> = 13 cm	1614 ± 60	477 ± 64	402 ± 141	–
NTUAMS-5803*	Heartwood, sample <i>D</i> = 5.5 cm	1743 ± 69	324 ± 79	329 ± 201	–
NTUAMS-5802*	Outer rings, sample <i>D</i> = 5.5 cm	1666 ± 62	396 ± 136	397 ± 148	–
GV-4638	Heartwood, rings No. 81–90	1720 ± 31	331 ± 72	331 ± 81	307 ± 51
GV-4639	Outer rings No. 5–14	1677 ± 31	342 ± 76	393 ± 137	383 ± 51
GV-4646	Heartwood, rings No. 80–90	1613 ± 39	476 ± 59	470 ± 88	425 ± 59
GV-4647	Outer rings No. 0–6	1607 ± 39	478 ± 59	484 ± 81	507 ± 59
GV-4641	Charcoal	1825 ± 40	225 ± 93	230 ± 107	–
GV-4640	"	1784 ± 31	283 ± 46	286 ± 76	–
GV-4642	"	1597 ± 39	516 ± 77	516 ± 87	–

*Previously published dates (Vodyasov et al., 2020).

Note. Dates GV-4638 and GV-4639 are for sample No. 1, GV-4646 and GV-4647 are for sample No. 2, and the remaining three dates are for three different samples.

6th century AD (see Fig. 1); this conclusion requires a more detailed analysis.

It would be worthwhile discussing their arguments in some detail. The works of E.V. Vodyasov and his co-authors (Vodyasov et al., 2020; Zaitseva, Vodyasov, 2023) contain the results of radiocarbon AMS dating of two charcoal fragments from furnace No. 4. For each sample, the age of inner and outer growth rings was established as 1710 ± 60 (NTUAMS-5800-1) and 1614 ± 60 (NTUAMS-5801-1) years for the first sample, and 1743 ± 69 (NTUAMS-5803) and 1666 ± 62 (NTUAMS-5802) years for the second sample. The number of growth rings in the fragments was not determined, but was based on the average values of uncalibrated radiocarbon dates. The authors concluded that the difference in age between the inner and outer rings of each sample was 96 (1710 minus 1614) and 77 (1743 minus 1666) years, respectively, indicating the lifespan of the tree. This difference was then added to the calibrated (1σ) age of the central rings of each fragment and the following conclusion was drawn: “Felling (of trees) for smelting most likely occurred before 500 AD and after 244 AD” (Vodyasov et al., 2020: 10; Zaitseva, Vodyasov, 2023: 84).

The incorrectness of such chronological reconstructions can be demonstrated. The conclusion that the lifetime of a tree corresponds to the difference between the average values of uncalibrated ¹⁴C dates with a precision of one year is fundamentally

erroneous. This approach ignores the probabilistic nature of the radiocarbon age determination, which has a precision in this case of 120–138 years. With calibration (2σ), the range of possible values of the calendar age of the central/peripheral groups of rings increases to 281/315 years for the first sample and to 295/403 years for the second sample (see *Table*).

The incorrectness of this approach is also confirmed by the results of the radiocarbon dating made by the current authors of a charcoal fragment from the same furnace No. 4. The difference in the average values of the uncalibrated radiocarbon age of tree rings from the central (1613 ± 39, GV-4646) and peripheral (1607 ± 39, GV-4647) parts of the second sample was six years, while for the calibrated radiocarbon age it was 5 (1σ) and 17 (2σ) years. However, as counting of real tree rings in the sample has shown, their dated groups were separated by an interval of eighty years. Bayesian modeling has made it possible to significantly reduce uncertainty in age estimates: the difference in the average values of the modeled ages was 82 years, and uncertainty (2σ) in the calendar age for each group of rings was 118 years (see the *Table*).

Thus, each pair of dates—NTUAMS-5800-1 and NTUAMS-5801-1, NTUAMS-58003 and NTUAMS-5802—is statistically indistinguishable and unsuitable for determining the “old wood” effect,

especially with the year resolution. In addition, the conclusion about tree felling in the range of 244–500 AD, that is, no later than the 5th century AD (Vodyasov et al., 2020: 10; Zaitseva, Vodyasov, 2023: 84), contradicts, among other things, the calibrated dates of the group of outer rings of these same charcoal fragments given by the same authors: 413–541 (1 σ) and 261–542 (2 σ) AD. In both cases, they end up being in the 6th century AD.

Analysis of all radiocarbon dates obtained for archaeometallurgical sites at the Kuektanar River mouth (see Fig. 1) provides an idea of the time when these bloomery furnaces were in operation. The dating of a unique find, i.e. a slightly carbonized piece of larch bark, and fragments of charcoal from the filling of the working chamber in furnace No. 2 revealed (with a confidence interval of 2 σ) the time of the last smelting as being between 655 and 765 AD, corresponding to the Old Turkic period. Three “young” dates (out of five) obtained from charcoal fragments from furnace No. 3, when calibrated (2 σ), confidently encompass the 6th century AD. Taking into account the “old wood” effect, this furnace could have functioned later. Even without taking into account the “old wood” effect, the analysis of all twenty dates for furnace No. 4, where a maximal amount of age determinations were obtained, does not exclude the 6th century AD from consideration of the time of its operation. Notably, 18 out of 25 radiocarbon dates for the sites at the Kuektanar River mouth, when calibrated with the confidence interval of 2 σ , cover the Old Turkic period (see Fig. 1). Apparently, the furnaces of the Kosh-Agach type were built and repeatedly used precisely during this period (Agatova, Nepop, Korsakov, 2018; Agatova et al., 2018, 2023; Myglan et al., 2023, 2024).

Conclusions

The presence of numerous charcoal inclusions in metallurgical slag made it possible to use it for chronological attribution of ancient iron smelting furnaces. The most effective methods for this purpose were radiocarbon dating (primarily using the AMS technique) and dendrochronological analysis.

The main problem in using the radiocarbon method is low accuracy of the calibrated dates, while the “old wood” effect remains a fundamental problem with any dating method. The predominance of charcoal with central (earlier) trunk fragments in metallurgical

slags impedes solving this problem through choosing the “youngest” of several radiocarbon dates in a single archaeological context. The analysis of the floating 377-year-old tree-ring chronology that was developed by the current authors has shown that the probability of encountering a young sample in the range of the last 100 and 77 years was 14 % and 1 %, respectively. Thus, radiocarbon dating of the most archaeological charcoals provides a deliberately earlier age, far from the time of felling of the trees and operation of the bloomery furnaces.

The significant (up to 400–450 years) lifespan of trees in the region hampers the use of dendrochronological methods for identifying rings under the bark in charcoal fragments, as well as relying on ^{14}C dates of charred fragments of thin trunks. Both of these strategies cannot ensure obtaining the “youngest” dates and do not make it possible to take into account the “old wood” effect.

Accuracy of age determinations obtained by calibrating the radiocarbon dates is at best comparable to the duration of cultural periods, which obscures reliable attribution of archaeological sites of iron smelting production in the southeastern Altai. The use of ^{14}C dates calibrated with a confidence interval of 1 σ creates an illusion of more accurate reconstructions, yet providing only a 68 % probability of determination of the age (as compared to 95 % in the case of calibration with the interval of 2 σ).

The provided radiocarbon dates of charcoals from the furnaces of the Kosh-Agach type at the Kuektanar River mouth indicate that they most likely functioned in the Old Turkic period. Dating bark and growth rings under the bark is the only reliable way to avoid the impact of the “old wood” effect. Such a find from the filling of the working chamber in furnace No. 2 dates the last smelting in the furnace to the Old Turkic period. Even without considering the “old wood” effect, this period is confidently covered by three (out of five) calibrated (2 σ) radiocarbon dates for furnace No. 3. All currently available dates of charcoal from that furnace do not exclude the 6th century AD from the probable operation time of furnace No. 4.

The construction of long tree-ring chronologies based on charcoal fragments is a more effective tool for chronological attribution of iron smelting sites. Dendrochronological analysis facilitates solving the problem of radiocarbon dating precision. Due to their length and inclusion of a large number of individual growth series, constructed tree-ring chronologies reduce the impact of the “old wood” effect.

The floating tree-ring chronologies developed by the current authors are currently among the longest tree-ring chronologies for charcoal worldwide. Further prospects for chronological attribution of ferrous metallurgy sites can be associated with continuing work on dendrochronological dating of archaeological charcoal from bloomeries and linking developed long tree-ring chronologies to the calendar time scale using wiggle matching.

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N.Y. Petrova^{1, 2}, N.A. Dubova³, and S.Z. Rakhimzhanova²¹*Institute of Archaeology,
Russian Academy of Sciences,
Dm. Ulyanova 19, Moscow, 117292, Russia
E-mail: petrovanatalya7@mail.ru*²*Margulan Institute of Archaeology,
Pr. Dostyk 44, Almaty, 050000, Kazakhstan
E-mail: saule-rahim@inbox.ru*³*Miklukho-Maklai Institute of Ethnology and Anthropology,
Russian Academy of Sciences,
Leninsky pr. 32a, Moscow, 119334, Russia
E-mail: dubova_n@mail.ru*

The Relationship Between Archaic Construction Methods in Pottery and Architecture in Central Asia

This study explores the connection between archaic construction methods in pottery in Central Asian, mostly that of tandoors (tonurs), and present-day building technologies associated with the use of unbaked clay (“pakhsa”, “kuloh”, “adobe bricks”). Ethnographic fieldwork was done in several areas of Central Asia, including the Sughd Region of Tajikistan, the Turkestan Region of Kazakhstan, the Fergana and Samarkand regions of Uzbekistan, and the Batkent Region of Kyrgyzstan. Traditions of constructing tandoors were examined; materials relating to various building technologies using clay were collected and systematized. Two main methods of pakhsa construction were identified—lining up undried clay lumps in layers, or backfilling clay into a mold (“packed techniques”). The first was developed in construction technology using kuloh—dried lumps of clay joined with mortar. The technique of building tandoors from two layers of slabs, with subsequent transformation into a band, and coils connected pairwise during drying, resembles that of pakhsa construction by placing clay lumps in several rows across the width of the wall in strips (“kurses”) laid along the entire length of it. This confirms the common origin of the most archaic construction methods in pottery and construction from clay in architecture.

Keywords: Tandoors, ceramics construction methods, slabs, coils, construction from clay, pakhsa, kuloh.

Introduction

Studying archaic construction methods in modern pottery—such as various molding techniques—enables their identification in archaeological ceramics, while comparison with other clay-working skills offers additional insights into the origins of pottery-making technology. The connection between pottery and techniques of building construction from clay has been mentioned in the analysis of the earliest evidence from the Near East (Vandiver, 1987). This

study attempts to clarify the relationship between construction methods in pottery manufacture and the most archaic techniques of clay building. The southern part of Central Asia, owing to the coexistence of ancient centers of civilization and numerous mountain systems that isolated the communities, was in the 20th century still a unique region providing the opportunity to study pottery from its most archaic forms to the use of modern advanced techniques. Today, home manufacture of vessels using archaic construction methods has not survived. However, it is still possible to study these

methods by the tandoor (Kazakhstan, Uzbekistan, Kyrgyzstan) or tanurs/tonurs (Tajikistan) technology containing all stages of pottery production except for intentional firing (only occasional drying with fire in winter and firing of the inner surface before installation), and storage vessels (*khums*), sometimes made in the same workshops. Techniques of clay building also remain a relevant source of such information.

Material and methods

The main area of our study in 2023 included the Fergana Valley, bounded by the Tien Shan mountain range in the north and the Hissaro-Alay mountain range in the south. The area included the Sughd Region of Tajikistan, the Fergana Region of Uzbekistan, and the adjacent areas of Kyrgyzstan. Its isolation contributed to favorable conditions for human life, due to which the valley was densely populated since ancient times (Artykbaev, 2014; Ershov, 1960: 5–6). We further studied the adjacent areas of Southern Kazakhstan (Turkestan Region) and Uzbekistan (Samarkand Region).

Tandoor production was observed in the workshops located in the Asht, Isfara, and Penjikent Districts of Sughd Region, Tajikistan. The majority of potters in this region originate from Uzbekistan (in the east, they were migrants from the city of Kokand in Fergana Region; in the west, their roots are associated with the city of Bukhara). In Uzbekistan, the pottery workshops in Rishtan and Samarkand cities were studied. In Kazakhstan, the information on the tandoor production was collected in the Sauran District of Turkestan Region.

The evidence related to archaic building techniques was mainly obtained in the settlements of Asht District, Isfara District, Bobojon-Ghafurov District, and Penjikent District, and in the city of Istravshan in Sughd Region, Tajikistan. These were studied in Turkestan Region of Kazakhstan, Fergana Region of Uzbekistan, and Batken Region of Kyrgyzstan, in less detail.

The main study methods involved questionnaire survey, and photo and video recording.

Construction methods for tandoor production

In Central Asia, since the late 18th century until the present day, ceramic production, which also includes the tandoor production, has been traditionally

divided into a more advanced male production and archaic female production (Dodkhudoeva, 2021: 273), not intended for selling. Women made hand-molded vessels at home without a potter's wheel. Interest in archaic female pottery arose in the 1920s. The main studies were carried out in the first half of the 20th century in the western part of the Karategin, Zeravshan, and Gissar ranges of Tajikistan (Peshchereva, 1929, 1959: 3–4; 1976) and in the Khuf Valley in the Pamir region, where vessels made of clay and sheep dung were studied (Andreev, 1966, 2020; Grigoriev, 1931; Peshchereva, 1959: 45, 76). The vessels were constructed as follows: the female potter placed a lump of clay on a stone and shaped the bottom and lower part of the wall from it. She rolled the clay into a thin coil from the next lump on another stone, stuck the coil to the edge of the workpiece, and flattened it into a band. Coils were applied in a spiral or in a circle (Peshchereva, 1929, 1959: 25–38; Andreev, 2020: 349). The methods of tandoor production did not attract much attention from scholars; only the method of using them for baking flatbreads and heating rooms was studied (Pisarchik, 1982; Gur-Arieh et al., 2013). Currently, this surviving source is of particular interest (Petrova, 2024; Rakhimzhanova, Akkoshkarova, in press).

In the course of the research, we identified several methods of tandoor construction using clay slabs and bands.

Construction of tandoor from clay slabs in a pit was recorded in Turkestan Region of the Republic of Kazakhstan (villages of Teke, Stary Ikan, Zhuinek, Shornak, and Asha). Two straps of coarse fabric are placed crosswise in a round-shaped pit from the bottom to the daylight surface (Fig. 1, 1). Then the artisan descends into the pit. The tandoor is made upside down: the rim is formed around a plastic or iron ring placed in the middle of the pit bottom. Clay construction elements are flat slabs 4–5 cm thick, amorphous or oval in shape (15 × 20 cm). First, the artisan secures the position of the straps by placing one clay slab on each side; the slabs are then laid in rows in a ring with overlapping (Fig. 1, 2). The lower part of the tandoor, protruding beyond the pit, is made of a coil 7–8 cm wide and 5–6 cm thick (Fig. 1, 3). The finished item is pulled to the surface after drying (a week under fabric or without it), using straps. Both men and women use this method for making tandoors. Importantly, potters received their knowledge from female potters. Previously, such tandoors were made only by women for the family; men helped them with lifting, but when making



Fig. 1. Making a tandoor in a pit by molding of clay slabs. Artisan Shauket Isaev, village of Zhuinek (Kazakhstan).
Photo by S. Rakhimzhanova.

tandoors for sale started, men began to participate in their construction.

Construction of tandoor from two-layer clay slabs was recorded in Penjikent District of Sughd Region of Tajikistan, as well as in Samarkand and Bukhara Regions of Uzbekistan among male potters. After mixing clay paste, it is divided with a shovel into separate portions—lumps with the size of a shovel (Fig. 2, 1). These are left to dry under a cloth, then under plastic wrap for a day (Fig. 2, 2). After that, six to seven lumps of clay on the platform are combined into one two-layer band (Fig. 2, 3) and flattened with feet (Fig. 2, 4). This band is used for creating the lower

part of the tandoor. For raising it to a vertical position, it is wound onto a large wooden spool (Fig. 2, 5). The upper, narrower part of the tandoor is made of pieces cut from a large band, which are joined together during addition to the lower band. Then the tandoor undergoes long ramming. A small coil is made by hands to create the neck.

Construction of tandoor from small-diameter clay coils was noted in the village of Ibata (Novy Ikan) in Turkestan Region of Kazakhstan. Coils up to 0.5 m long and 7–8 cm in diameter were wound by a female potter along a ring-shaped trajectory on a cloth lying on the ground (Fig. 3, 1). The rings were laid end

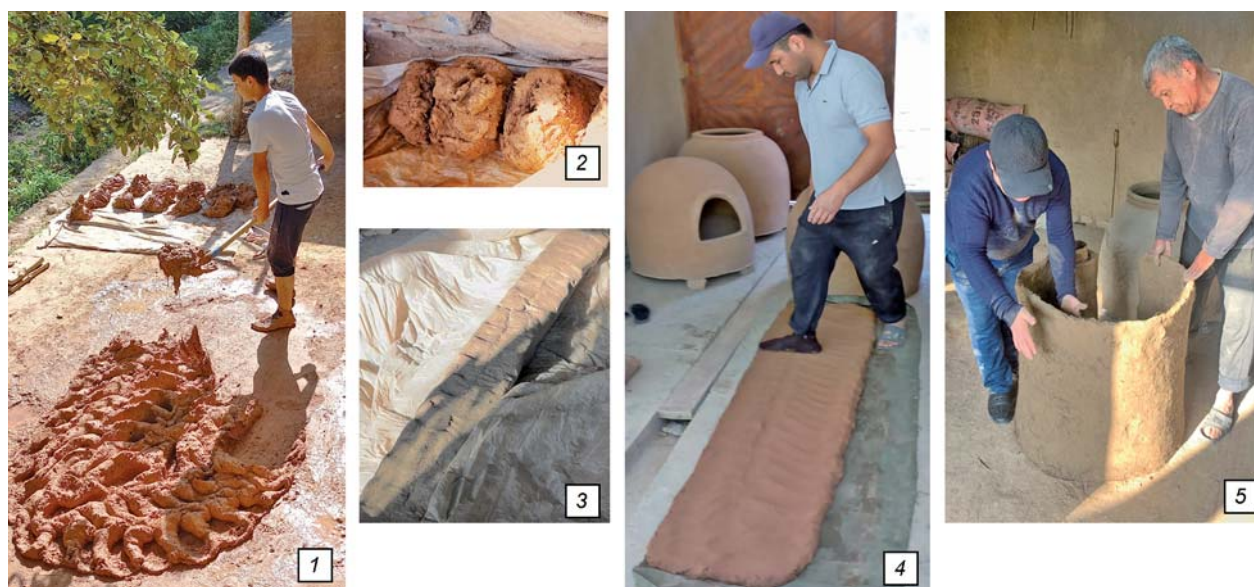


Fig. 2. Making a tandoor by two-layer slab molding. Photo by N. Petrova, Z. Akkoshkarova.

1, 2, 4 – artisan Imamagdi Ashurov, village of Devashtich (Tajikistan); 3, 5 – artisan Samariddin Isakov, city of Samarkand (Uzbekistan).

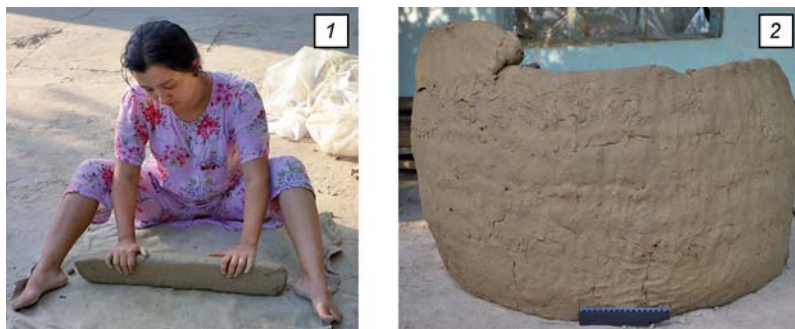


Fig. 3. Making a tandoor using small-diameter coils. Artisan Ulgay Dadakhanova, village of Ibata. Photo by S. Rakhimzhanova, Z. Akkoshkarova.

to end. After every two rows of coils, the potter gave them some time to dry a little, and then began to stick on the next two rows. The tandoor consisted of 16 rings of coils connected in pairs (Fig. 3, 2).

Construction of tandoor from large-diameter clay coils is the most common method. It was recorded in Asht District (village of Uzbek-Okjar) and Isfara District (city of Isfara, village of Vorukh) of Sughd Region, Tajikistan, in the cities of Rishtan and Kokand in Fergana Region of Uzbekistan, and in the city of Turkestan in Kazakhstan. Notably, these workshops were able to make *khums* using the same technology. In the construction process, a large lump of clay paste is rolled out on a table into a coil with a diameter of 15 cm; its length is determined by the size of the table (Fig. 4, 1). It is then moved to the place of further work using a board separated from the table. The coil is placed onto a prepared area (sometimes there were outlined templates on the floor) where it is shaped by feet into a straight or curved band

for the lower and upper parts of the tandoor, respectively. First, the middle part is flattened, and then the edges (Fig. 4, 2). The width of the band is 15 to 30 cm. The thickness of the lower band decreases towards the future upper edge from 3 to 2 cm, while in the middle band, it is the same (2 cm). After some drying, the body of the tandoor is formed from these bands. Several people set up the body vertically and ram it out. The upper band is attached end-to-end to the lower part and also rammed

(Fig. 4, 3), about two hours later. The rim is made from an additional coil (Fig. 4, 4).

Methods of constructing from clay in archaic building technologies

Traditional building technologies involving clay (*pakhsha*, *kuloh*, as well as straw bricks or adobe bricks) attracted scholarly attention in the second half of the 20th century. We have studied all these archaic methods of constructing buildings and fences from the above materials.

Pakhsha. Scholars usually describe this as rammed clay used mainly for building fences (Voronina, 1975: 138; 1982; Davydov, 1973: 11; Ershov, 1960: 12; Zhilina, 1968: 83; 1982: 157). For Tajikistan, it has been mentioned that *pakhsha* is laid in thick (about 1 m high) layers, divided into blocks. The upper row is connected to the previous one in such a way that

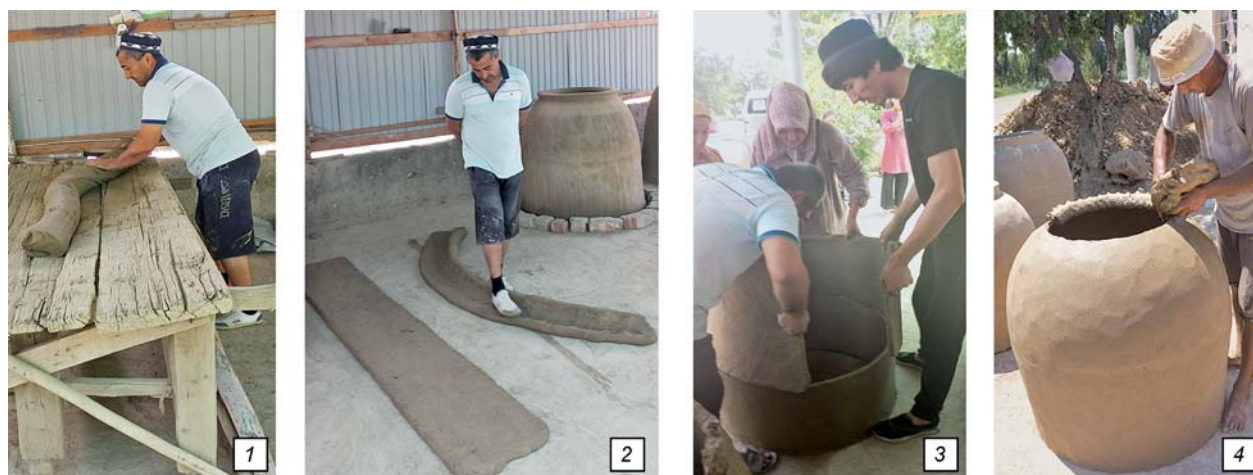


Fig. 4. Making tandoors using large-diameter coils. Photo by N. Petrova.

1–3 – artisan Inomjon Mansurov, city of Isfara (Tajikistan); 4 – artisan Mirzokhid Akhmadaliev, village of Uzbek-Okjar (Uzbekistan).

seams between the blocks do not coincide (Giyasov, Barotov, Naimov, 2019). In Southern Tajikistan, walls 35–60 cm thick are built from *pakhsa* with a slight slope of the outer surfaces. Clay-adobe plaster is common inside and on the front façade. Reed and rush serve as a roof; they are sufficiently waterproof and often are not coated with clay (Voronina, 1975: 138). In Turkmenistan, walls are erected at a slight slope and have a thickness of 90 cm at the base and 40 cm at the upper edge. The number of *pakhsa* layers at a height of 70 cm in the walls of one-story houses is limited to four–six; in two-story houses, to seven–eight (Demidov, 2016: 234).

Unfortunately, the clay-laying process is not entirely clear from the above descriptions, prompting us to examine the issue more closely. Probably, this technology is not currently in use, and all existing structures are several decades old. We observed them in the city of Isfara, and the villages of Vorukh and Devashtich. The collected data indicate that the technique included many variants united by the use of undried clay for making the elements used to construct the walls. Such lumps were laid either on a prepared stone foundation or directly on the ground. There were two types of them: elongated subrectangular in shape, and cubic as blocks. In total, three methods of laying *pakhsa* were identified.

According to the first method, elongated clay lumps with their size determined by the capacity to hold the material in both hands (height of the lumps varied from 10 to 15 cm), were laid out one after

another horizontally up to four rows along the width of the wall. Thus, a line (“kurs”) was obtained along its entire length. The higher the wall, the smaller the number of lumps along the width of the wall was (Fig. 5, 1, 2).

According to the second method, blocks of clay lumps with their size determined by the volume fitting in a special small shovel, measuring 30 to 100 cm in height (depending on the area) and up to 50 cm in length, were stacked in two or more layers forming one horizontal “kurs” with the length of the entire wall. Such “kurses” were laid for about one to two days depending on the size of the structure. They were then smoothed by hand (with finger marks often still visible on the surface) and leveled with a shovel to remove excess clay, followed by drying for a day. Then builders began to lay the next, slightly narrower “kurs”, etc. The number of horizontal rows decreased upwards up to two rows, which was visible in the vertical cross-section of the wall: its width was approximately 60 cm at the bottom, and 30–40 cm at the top. Subsequently, such a wall could become divided by horizontal cracks between the “kurses” and vertical cracks between the blocks. The connection between the lumps is stronger vertically than horizontally, since they are connected while being wet, whereas “kurses” are laid on top of each other after some drying. This creates a false impression of blocks made in a mold. However, in the cross-section of the wall, it is clear that it consists of layers of lumps. In addition, vertical cracks between the blocks

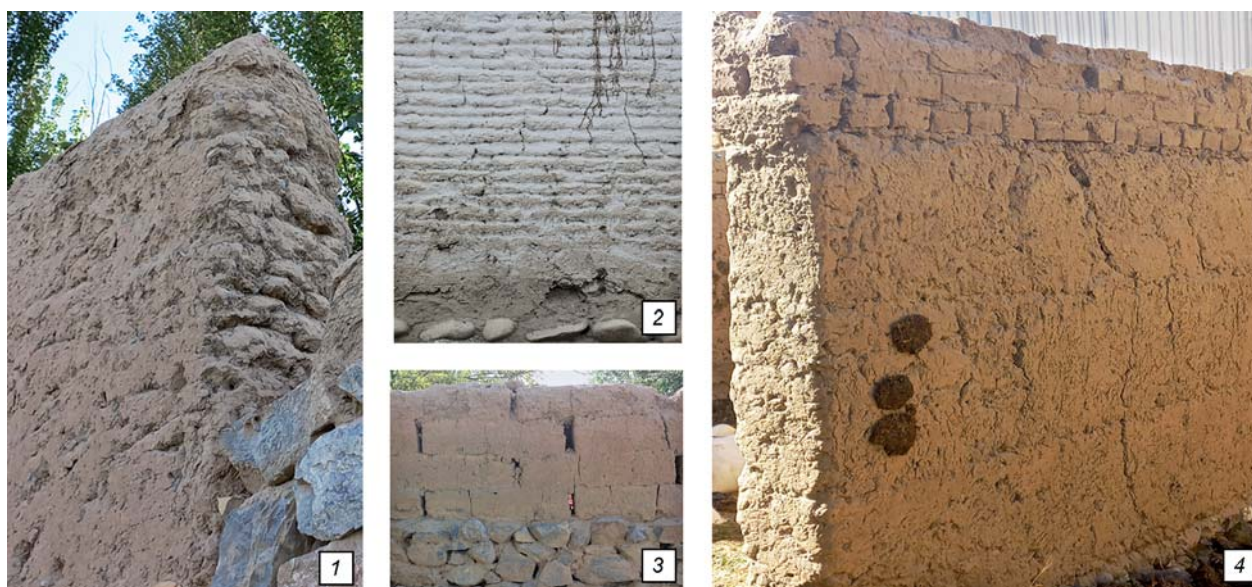


Fig. 5. Walls made of *pakhsa*, erected in different ways. Tajikistan. Photo by N. Petrova.

1, 3, 4 – village of Devashtich, 2 – city of Isfara.

consisting of lumps will not even be on the outer surface of the wall (Fig. 5, 4).

The third method is the production of clay blocks from wet clay by placing it in wooden molds of various sizes. In this case, a homogeneous structure without division into elements is observed in the cross-section of the wall. The outer surfaces of the blocks and the cracks between them are smooth (Fig. 5, 3).

Kuloh. The term “kuloh” (or “kulyukh”, “kulyula”, “guvalya”, “guala”) implies the following technique: lumps of oblong-round shapes are formed by hand from thick clay solution and are subsequently dried in the sun. In Uzbekistan, the lumps are made smaller and more oval (Davydov, 1973: 11; Ershov, 1960: 12).

We encountered the earliest evidence of using the *kuloh* building material in the fortress of the city of Khujand, judging by the pottery fragments found nearby, in the layers from the 18th–19th centuries (Fig. 6, 6), although the technique of building from *kuloh* certainly existed there before. In modern buildings (dwellings and fences), it appears in many villages of Northern Tajikistan, Fergana Region of Uzbekistan (city of Rishtan), and in the village of Khadzhai-Aalo of Batkent Region of Kyrgyzstan. This technique is probably much more widespread

and is still used. In the village of Vorukh, there were numerous *kuloh* blanks (Fig. 6, 4), which are made by the whole family and therefore are of different sizes. The lumps dry for about a week. They are fastened with clay mortar in the wall. Houses made of *kuloh* serve over a hundred years, but they are constantly coated with clay, often mixed with straw. Coating is renewed every three to four years. We saw houses, fences, stoves, and chimneys made using this technique (Fig. 6, 5). It is possible to make a wall in two ways. In the first variant, the *kuloh* is laid in a long row in two layers, most often on a stone foundation. The width of the wall is ca 40–50 cm, slightly wider at the bottom (Fig. 6, 1, 2). In the second variant, wide wooden beams separate the floors and also are installed vertically, with thinner boards additionally nailed inside at an angle. The space between them is filled with *kuloh* in one layer (Fig. 6, 3).

Adobe bricks. Widespread use of this building material in the region under study dates back to the mid-19th century (Davydov, 1973: 9), but it was known earlier, at least since the Bronze Age (that is, since the late 3rd millennium BC) (Zhilina, 1968: 83; 1982: 157; Razzokov, 2016: 101–104; Giyasov, Barotov, Naimov, 2019). Adobe bricks occur everywhere in the

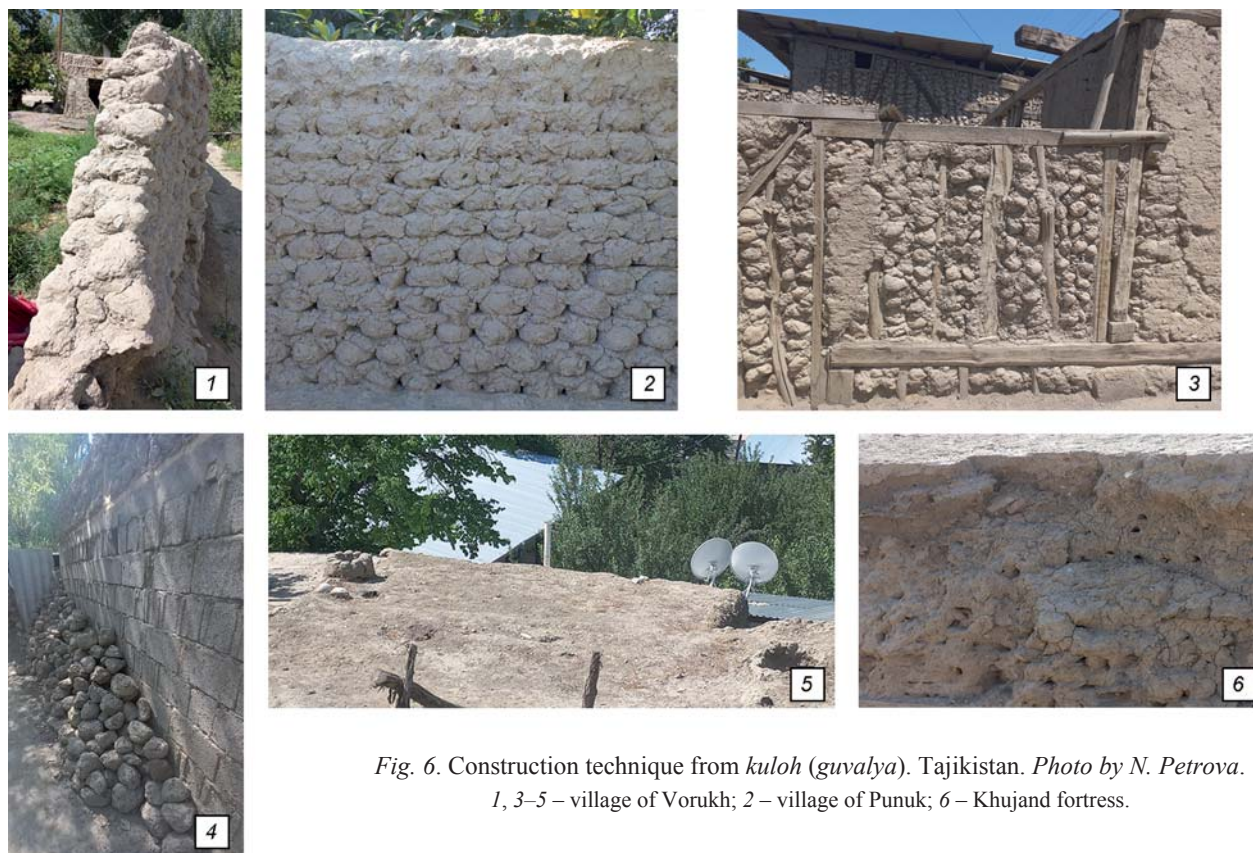


Fig. 6. Construction technique from *kuloh* (*guvalya*). Tajikistan. Photo by N. Petrova.
1, 3–5 – village of Vorukh; 2 – village of Punuk; 6 – Khujand fortress.



Fig. 7. Construction from adobe bricks. Tajikistan. Photo by N. Petrova.
1 – city of Khujand; 2 – village of Punuk; 3 – fortified settlement of ancient Penjikent.

area of our survey, including the historical walls of the Khujand fortress, fortified settlements of ancient Penjikent (6th to mid-8th century; Fig. 7, 3), Jankent (6th to early 11th century), Otrar (first centuries AD to 18th century), etc. It also appears in many other regions: in Southern Tajikistan (e.g., in Baljuvan District) and across Turkmenistan (personal observations by N.A. Dubova) and Uzbekistan (materials of the authors). Brick size varied in different periods of time and in different territories.

We observed the production of adobe bricks in the city of Khujand and in the village of Teke. In the former case, portions of fairly liquid clay were placed with a shovel into special molds in the form of frames measuring 20×20 cm and were leveled by hand. Then, the form was removed and the product dried (Fig. 7, 1). When creating a wall, adobe bricks were attached to each other with clay mortar. In the village of Teke, a wooden mold with a metal bottom, consisting of three compartments, is used for making adobe bricks. Its size is $30 \times 15 \times 12$ cm. Similarly to *kuloh*, adobe can be found between wooden beams (Fig. 7, 2).

Discussion

Our research has revealed four methods of tandoor construction based on the use of clay slabs and coils. The first (the most archaic) method is laying slabs in a pit; sometimes they are combined with coils. Both men and women make tandoors this way. The second method is forming a clay layer from two rows of lumps, followed by flattening and making a band by male potters. The third method is making a tandoor by a female potter sequentially from coils of relatively small diameter. Notably, this method is the rarest and

is similar to that of shaping vessels in female pottery recorded in this area in the first half of the 20th century. The fourth method (the most common) is making a coil of large diameter and forming a band from it by male potters. Apparently, this method was derived from the previous one: typically, two coils were used to form the body, while the third element used for the rim was always made from a coil of a smaller diameter.

The identified archaic construction technologies show a consistent transition from undried lumps of clay to unbaked adobe bricks. According to the degree of “archaism”, these can be distributed as follows: the first method of construction from *pakhsa* (laying elongated undried lumps in a long row in several layers); second variant of this technique (laying elongated undried lumps in blocks in two or more layers); laying *kuloh* dried lumps in one or two layers. The method of backfilling clay into a mold and construction from adobe bricks is the last stage in the development of building elements from unbaked clay.

Conclusions

The technology of building from *pakhsa* must have been very ancient, preserving common roots with multilayered slab construction in pottery. This connection is especially clear when compared to the technology of making tandoors from clay slabs patched together in two layers and turned into a band (similarly to a part of the vessel), which resembles a “kurs” (a row of clay elements) in construction of dwellings or fences. The method of making tandoors using small-diameter coils combined in two layers by height with drying before adding the next two layers also contains the idea of “kurses” in building from

pakhsa. Interestingly, in a number of cases, the three elements (two bands for the body and rim) that make up a tandoor made of bands were called by the potters the first, second, and third floors, which is the obvious reference to building-construction technologies.

In the adjacent territories with a similar climate, tandoors are made using clay slabs by women. This has been observed in Southeastern Turkey (Tekin, 2022: Fig. 47; Şen, Karagel, 2017), Syria (Tsetlin, 1997), Jordan (Ali, 2009), and India (Kholoshin, Sharma, 2021). Coil molding used in tandoor making in Central Asia varies in size, which is probably associated with male or female pottery production. The predominant method in the Fergana Valley is to mold together very large coils that cannot be lifted by one person (the male version). The production of tandoors from coils of smaller diameter clearly goes back to the female pottery of this region and is rare there. However, this method has also been observed in the adjacent areas both in female pottery (in Southeastern Turkey (Petrova, in press)) and in male pottery, for example, in Iran (Wulff, 1966: Fig. 221, 222).

The archaic construction technologies we studied, in some variations, are common for various regions of southern Central and Western Asia, the Caucasus, the Balkans, and Africa. A technique similar to that used in *pakhsa* construction is known in various versions as “tauf” in Arabic (Ivanova, 1981; Prehistoric Archaeology..., 1983: Fig. 86) or “chineh” in Iranian languages (Watson, 1979: 119; Wulff, 1966: Fig. 161).

Thus, a conclusion can be reached that approximately the same archaic technologies for making vessels (and tandoors) and constructing buildings from clay have been widespread since ancient times in similar conditions of dry southern climate of the Middle East and Central Asia. If we consider this topic more broadly and study additives to clay pastes, as well as other details of pottery technology, we will be able to identify even greater similarities. On the basis of the above, we can conclude the relationship between the methods of constructing vessels and dwellings of clay. However, as pottery technology evolves and new methods appear in building construction, this connection becomes increasingly less obvious.

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**K. Wiradnyana¹, A. Sebayang², D. Parhusip²,
D. Hidayati¹, and M.I. Mahmud¹**

¹Research Center for Prehistoric and Historical Archaeology,
National Research and Innovation Agency of Indonesia,
Jend. Gatot Subroto rd. No.10,

Sasana Widya Sarwono building, Fl. 8, Kuningan Barat,
Mampang Prapatan, Jakarta Selatan, Jakarta 12710, Indonesia

E-mail: Ketut_wiradnyana@yahoo.com; terangdamaringrat@gmail.com; mirf001@brin.go.id

²Research Organization for Agriculture and Food,
National Research and Innovation Agency of Indonesia,
Kawasan Sains dan Teknologi (KST) Soekarno,

Jl. Raya Jakarta-Bogor KM 46, Cibinong, West Java 16911, Indonesia

E-mail: amelia.sebayang@gmail.com; dork001@brin.go.id

The *Siungkap-Ungkapon* Ritual in the Batak Toba Community: Archaeological and Agricultural Aspects

In Indonesia, agricultural rituals are consistently performed before, after, and even during specific periods, with variations in form across regions and ethnicities. We outline the results of our study of the *siungkap-ungkapon* ritual and its role in agricultural practices of the Batak Toba community. We examine the ecological context and archaeological data relevant to rice farming. Our study includes interviews with community members and observation of rites involving the *siungkap-ungkapon* stone. We discuss intertwined aspects of the rite—religious, social, ecological, and technological. The rite itself has been practiced at least since the Late Neolithic with a view to receive the ancestors' blessings and instructions as to which rice variety should be cultivated during a specific season. The ritual reveals the peasants' knowledge of agricultural practices, rice types, and the environment, all of which, taken together, ensure the highest yield. How the choice of the rice variety depends on the presence of ants under the stone is not immediately apparent. We conclude that the *siungkap-ungkapon* ritual, which involves practical knowledge, strengthens social unity and is supposed to optimize agricultural labor.

Keywords: Archaeological objects, agricultural rituals, Batak Toba, culture, insect behavior, megaliths.

Introduction

The Batak Toba ethnic group initially inhabited the Samosir Island and the area around Lake Toba before dispersing to various regions within North Sumatra and other provinces. Archaeological studies indicate that the ancestors of this group migrated from Taiwan, traversing southward through the Philippines, Sulawesi, and eventually reaching Sumatra (Bellwood, 2000: 238–241; Wiradnyana and Setiawan, 2013: 7). The migrants brought along megalithic cultural elements, including the use of burial containers of various types accompanied by ancestor worship

(Soejono, 2008: 5). These containers, typically crafted from stone, such as sarcophagi, jars, and coffins, served as secondary burial receptacles. Following the initial burial, the deceased were later exhumed, and then the bones were reinterred within these stone containers. This ritual, known as *mangokal holi* within the Batak Toba ethnic community and *nurun nurun* within the Karo ethnic community, is still observed in North Sumatra nowadays.

The migrants also introduced the traditions associated with agricultural activities. In the Batak Toba community, each phase of these activities, including seed preparation, planting, maintenance,

and harvesting, is marked by accompanying rituals (Nainggolan, 2012: 124; Wiradnyana, Yance, Dalimunthe, 2020: 204). The reverence for food's importance entails meticulous treatment, while challenges such as pest management require specific arrangements. The community's ideologies find expression through rituals involving ancestral burial containers, thereby legitimizing these concepts. Consequently, the meanings embedded in agricultural rituals become shared agreements embodying communal wisdom.

Megalithic culture, characterized by the cult of ancestors, is consistently manifested in ceremonial processes. Consequently, it is unsurprising that agricultural rituals incorporate ancestor-worship concepts. The belief in reciprocation with ancestors constitutes a fundamental aspect of past religions, with the conviction that honoring ancestors would elicit their benevolence towards descendants being a recurrent motif in their lives.

This paper will focus in depth on the *siungkap-ungkapon*, a ritual in agricultural activities to request blessings from ancestors, in terms of archaeology, agriculture, and insectology.

Siungkap-ungkapon

Batu siungkap-ungkapon, categorized as a lid for a stone burial jar, is associated with agricultural processes within the Batak Toba community residing in Tipang, Baktiraja District, Humbang Hasundutan Regency, North Sumatra Province (Wiradnyana, 2014: 19) (Fig. 1). Such jars, widespread across Samosir Island, served as burial receptacles and symbolized the presence of ancestors (Wiradnyana, 2018: 152; Wiradnyana, Setiawan, 2013: 48). Rituals associated with them are acts of reverence bestowed upon ancestors. The rituals conducted with burial containers necessitate specific means imbued with particular significance.

The *siungkap-ungkapon* ritual constitutes an agricultural ceremony, featuring offerings such as betel leaves and nuts and sacrificial animals. Its object is to solicit guidance from ancestors regarding the ideal type of rice to cultivate during the forthcoming planting season. The ceremony is typically overseen by traditional community leaders known as *raja parjolo* or *raja bius*, depending on the ceremony's scale (Wiradnyana, 2014: 19). Within

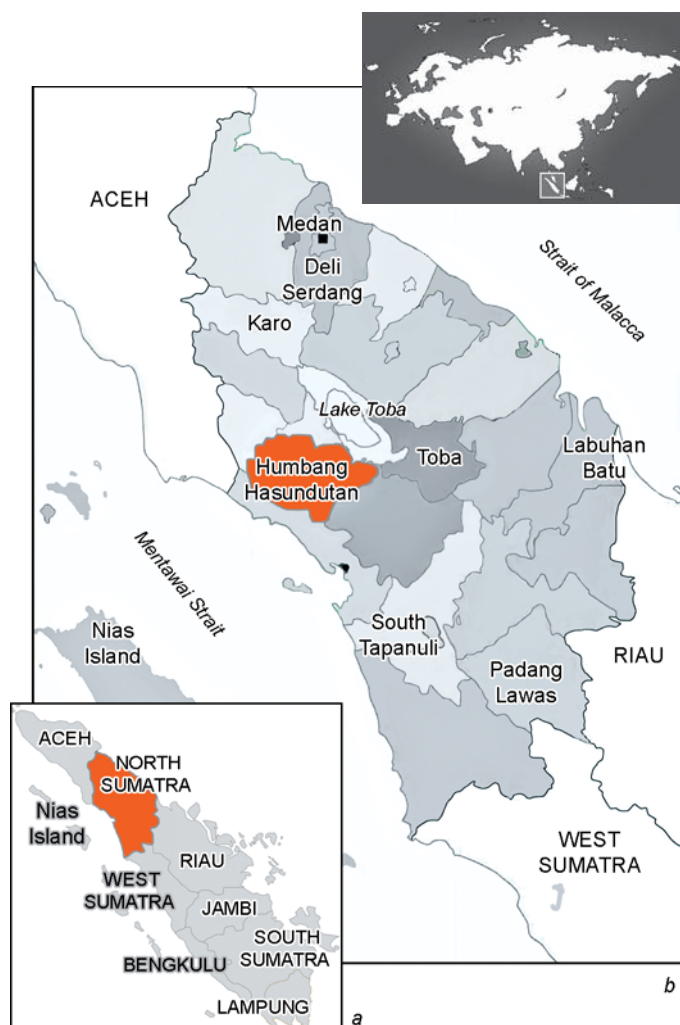


Fig. 1. Location of the North Sumatra Province (a) and Humbang Hasundutan Regency in this province (b).

this context, the religious dimensions intertwined with agriculture, representing local wisdom within the Batak Toba community, are elucidated. This opens avenues for comprehending the Batak Toba community's knowledge regarding rice varieties and planting practices, as well as the challenges entailed if uniformity in rice types and planting seasons is not observed.

The *siungkap-ungkapon* ritual epitomizes the knowledge underpinning the agricultural paradigm of the Batak Toba community, believed to be a product of social power (Jones, 2009: 212). However, it is perceived as a relic of bygone eras. Consequently, the Batak Toba community may no longer adhere to this knowledge paradigm, resulting in a lack of uniformity in rice types and planting seasons. Such changes may stem from cultural shifts.



Fig. 2. Batu siungkap-ungkapon. Photographed by K. Wiradnyana.

Batu siungkap-ungkapon, as a part of a burial container, and the associated ritual, embody religious, socioeconomic, and environmental aspects of the Batak Toba community's life (Geertz, 1992: 102; Abdullah, 2006: 144). Comprehending the significance of

a cultural artifact necessitates comprehensive insights into the artifact and its processes. This requires a qualitative discourse, incorporating archaeological and ethnographic elements, followed by analysis and interpretation contextualized within religion and agriculture as overarching domains, grounded in a continuous conceptual framework (Denzin, Lincoln, 2011: 547–580).

Batu siungkap-ungkapon is situated in the Hutasoit clan fields in the Baktiraja District, Humbang Hasundutan Regency, North Sumatra Province. This stone is positioned within a designated ceremonial area considered sacred (*toguan*). In the Batak Toba language, *siungkap-ungkapon* means “to be opened”. The stone is a sandstone archaeological object resembling a conical lid of a stone jar. It is placed in the middle of the stone structure (Fig. 2). Inside, there is a square-shaped hollow, which is a gathering place for ants in the *siungkap-ungkapon* ritual (Wiradnyana, 2014: 6).

During the farming season, the *Raja Bius* (ceremony leaders from a lineage, also known as *Horja*) (Vergouwen, 2004: 43; Simanjuntak, 2006: 178–188) and their descendants convene to perform the ritual. The *Raja Bius* invokes the ancestors for guidance concerning the rice-planting season. A few days later, he opens the stone lid to observe the color of the ant eggs: if these are white, white rice seeds are to be planted; if red, red rice seeds are chosen for planting (Wiradnyana, 2014: 6). In the Bakkara village, in the same district as the Tipang, the *siungkap-ungkapon* ritual is also practiced (Fig. 3). However, there it



Fig. 3. Agriculture view in the Bakkara (a) and Tipang (b) valleys. Photographed by J. Siahaan, 2024.

is more elaborate, with the symbolic object being the ants themselves, rather than their eggs. In Bakkara, as in Tipang, at the ritual's conclusion, the *batu siungkap-ungkapon* is opened. The presence of red ants beneath the stone dictates the community's planting of red rice seeds, while black ants signify the planting of white rice seeds (Hutauruk et al., 2023).

***Siungkap-ungkapon* ritual: archaeological aspect**

The fertile land of the valleys of Samosir Island were ideal for agriculture, thus establishing the Batak Toba people as farmers. Archaeological studies indicate that the initial migration to the area around Lake Toba occurred in the Late Neolithic (early AD). Local folklore mentions that the progenitor of the Batak people Si Raja Batak resided in the Sianjur Mula Mula valley, an ideal area for agriculture. Farming, which was the main source of livelihood, was closely intertwined with all aspects of the ceremonies performed by the Batak Toba community. Mountains, hills, elevated places, water bodies, animals, and other environmental components related to agriculture became focal points of their religious practices (Nainggolan, 2012: 124; Wiradnyana, 2014: 19).

First, land ownership in the Batak Toba community was individual. The genealogical clan of the individual who initially cleared the land would pass it down to their male descendants, and this clan would become the primary (royal) clan. It held rights to all the land cleared by the ancestors. Over time, as the number of genealogies in the royal clan increased, the land would be divided, resulting in narrower plots. Then, the land became communal and there arose the need for proper management of agricultural activities. One method of management was collective farming, with the *siungkap-ungkapon* ritual representing one of its forms. The awareness of land ownership as ancestral property and the belief in the relationship between spirits and the living made this ritual indispensable.

The modern Batak Toba community, now predominantly Christian or Catholic, has experienced a gradual loss of

traditional elements, although some aspects persist (Nainggolan, 2012: 6–7). This transformation is largely due to the adoption of new, more rational religious concepts that have altered the community's behavior and understanding of rituals (Subagya, 1981: 213). As a result, the significance of the *siungkap-ungkapon* ritual has diminished, even though it still embodies relevant agricultural knowledge today.

The Batak Toba community holds that spirits govern specific territories, with each significant place being under the authority of a particular spirit, either genealogical or natural (Wiradnyana, Dalimunthe, Elyanta, 2021: 164). However, in ancestral land, the authority is vested in the ancestors. Burial containers are symbols of ancestral authority and serve as a means of communication with the ancestors. Consequently, ceremonies often include the presence of symbolic objects, such as the *batu siungkap-ungkapon*. The Batak Toba people believe in a reciprocal relationship between ancestral spirits and their descendants, where treating ancestors with respect is thought to elicit favorable treatment from them. In this context, the *siungkap-ungkapon* ritual is a form of supplication intended to seek ancestral protection for agricultural endeavors, ensuring defense against pests and promising a bountiful harvest (Fig. 4).

The relationship between spirits and the living embodies the concept of harmony in the Batak Toba community. The belief in the existence of structure and function in another world, which must also be visualized in the inhabited world, constitutes a form of harmony. This also reflects the aspect of orderliness,



Fig. 4. Praying to ancestors for agricultural process and best harvest in the Batak Toba community. Photographed by S.J. Simarmata.

including the ritual practice. The *siungkap-ungkapon* ritual must be carried out in an orderly manner, ensuring that all aspects of agriculture, including planting seasons and types of rice seeds to be planted, adhere to a sense of orderliness (Prager, 2008; Nainggolan, 2012: 129–130).

The Austronesian society that migrated from Southern China to Taiwan and the Northern Philippines continued into the Malay Archipelago. These immigrants had an economy based on fishing and agriculture. They cultivated rice and millet. Initially, around 2000 BC, rice was grown in swamps or alluvial marshes. As the population grew, cultivation expanded to dry land. In Sumatra, forest clearing began around 2000 BC (Bellwood, 2000: 242), indicating that agriculture was practiced after this period. This is based on the discovery of rice grains in South Sulawesi around 1500 BP (Glover, 1985) and in Bali around 2660 BP (Simanjuntak, 2020: 221).

The Austronesian immigrants gradually brought religious practices associated with megalithic culture, which is evidenced by megaliths at Sulawesi and North Sumatra (Bellwood, 2000: 161–174; Berita..., 2016: 91). Archaeological studies show that the megalithic traditions were very intensive around 1000 BP (Berita..., 2016: 99). This is based on radiocarbon analysis of materials found in Waruga graves in North Sulawesi, including sites such as Woloan, Tomohon, and Tatelu, which date to 1540 ± 140 BP (140–770 AD), 1260 ± 80 BP (644–954 AD), and 2070 ± 140 BP (400 BC to 230 AD). Some finds date to the 11–13th and 19th centuries AD (Umar, 2006: 45). Additional support for the Megalithic traditions in Sumatra is based on burials in urns, which became widespread after the 1st millennium AD. These urn burials, found at Lolo Gedang, Kerinci District, Jambi, and surrounding sites, date to 11–14th centuries AD (Budisantosa, 2011).

The *siungkap-ungkapon* ritual: agricultural aspect

The *siungkap-ungkapon* ritual encompasses several agricultural aspects, such as the life cycle and biology of ants, the diversity of local rice varieties, and abiotic factors (air temperature, rainfall, and humidity). In the past, there weren't many options for rice types or varieties that could be planted, especially in dryland areas of medium to high altitude. Two colors of upland rice varieties thrive around Lake Toba, red and white. In this region, its biological cycle is approximately six

months, with one planting season per year. Hence, the *siungkap-ungkapon* ritual is performed once a year to select the variety of rice to be sown.

Upland rice is susceptible to lack of moisture. When rainfall is low, periodic watering of crops is necessary. Rice is susceptible to pyriculariosis. The prevalence of this disease in rainfed paddy-fields can vary between planting seasons and regions (Asibi, Qiang Chai, Coulter, 2019: 2–3). The communal agricultural system involves simultaneous collective planting of rice, and of the variety determined through the *siungkap-ungkapon* ritual. Maintaining crop rotation (alternating crops or varieties) and planting at the optimal time reduce the risk of pest and disease infestations (Yulianto, 2017: 51–52). One of the preventive techniques against the development of rice blast disease is to avoid dense planting, as this weakens light and gas regimes and increases plant competition. Both red and white upland rice varieties essentially have the same resistance to pests and diseases, but the main goal of the ritual is the simultaneous planting of the same rice type. The cult of ants as an object used in the ritual is also a form of local knowledge in understanding the intended animal.

Ants (Hymenoptera: Formicidae) act as natural enemies, preying on insect pests, scavenging, and actively foraging. Ants prey on various types of insects, plant nectar, and secretions from Homoptera and Lepidoptera sticking to plants (Bhagat, Ganguli, Gauraha, 2020: 1397–1399; Abdullah et al., 2021: 2). Ants are social insects, which live in colonies, consisting of worker ants, soldier ants, and queens. Worker ants search for prey, while soldier ants immobilize and attract prey to be taken to their nest (Mizuno et al., 2021: 19; Parker, Kronauer, 2021: 1209–1210). Research by Abdullah et al. (2021: 3–5) states that ant diversity varies by location. The population of certain ant species in specific habitats shows an increase and significance based on favorable conditions for ants in nesting, feeding, and foraging.

In the *siungkap-ungkapon* ritual of the Batak Toba community, two types of ants determine rice planting, namely black and red ants. Based on classification, the latter belong to the Hymenoptera order, genus *Solenopsis* (fire ants). Research by (Abdullah et al., 2021: 3) on several vegetations with an abundance of *Solenopsis* sp. shows that red ants choose locations with high soil moisture, where they are more attracted to food than other ant species such as *Pheidolegeiton diversus*, *Anoplolepis gracilipes*, and *Dolichoderus thoracicus*. The presence of red ants in the *siungkap-ungkapon* ritual is related to sacrifices. Sacrificial

animals attract ants as a food source. Additionally, the moist environmental conditions are suitable for red ants' development.

Black ants (*Dolichoderus* sp.) are biological agents commonly found in plantation vegetation such as coconut and cocoa trees. They are known to control several major pests in coconut trees, such as *Brontispa longissima* (coconut leaf beetle) and *Helopeltis theivora* (tea mosquito bug), by preying on their larvae, pupae, and adults, reducing up to 80 % of the pest population (Anuar et al., 2017: 9–10). Furthermore, the increase in *Dolichoderus* sp. populations in coconut plantations decreases the incidence of fruit-rot disease. According to studies (Muhammad, Rizali, Rahardjo, 2022: 3321–3325), black ants prefer locations with high humidity, the presence of wide canopies, and proximity to food sources. They need nutrients such as proteins and carbohydrates. Foods that can attract ant colonies are fresh fish heads and honey. High protein content aids in faster growth of egg, larvae, pupae, and adult stages, while rich carbohydrate food provides ants with extra energy for movement (Wesley, MacGregor-Fors, 2021: 2–3). The presence of black ants in the *siungkap-ungkapon* ritual, as well as red ants, is related to the availability of sacrificial animals. Their connection to the selection of rice types to be planted is not explicitly explained.

So, ants function as tools to monitor environmental quality, track the trends among endangered or threatened species, evaluate land management actions and long-term ecosystem changes, as well as detectors for the presence of invasive species (Underwood, Fisher, 2006: 168–177). The characteristics of ants (especially red) align with local community knowledge about ants themselves about environmental conditions associated with pests and diseases that may occur during the rice planting season. Therefore, the *siungkap-ungkapon* ritual is a form of local wisdom of the Batak Toba community.

Conclusions

Batu siungkap-ungkapon has the appearance of a conical lid of a burial vessel, which is characteristic of the ancestral burial tradition of the Batak Toba community in Tipang, Humbang Hasundutan Regency. The ritual is also observed by the Bakkara community in the same regency. This points to the historical role of *batu siungkap-ungkapon*, which symbolizes the enduring presence of ancestors in every agricultural endeavor. The ritual conducted with the stone

represents a manifestation of communal wisdom, honoring ancestors while managing agricultural land and coordinating planting seasons to address pest and disease challenges in rice cultivation. Additionally, the ritual underscores the deep understanding of the role of ants in agriculture. The *siungkap-ungkapon* ritual serves as a poignant illustration of the Batak Toba community's agricultural livelihood, emphasizing their unity in rice cultivation.

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Y.E. Berezkin

*Peter the Great Museum of Anthropology and Ethnography (Kunstkamera),
Russian Academy of Sciences,
Universitetskaya nab. 3, St. Petersburg, 199034, Russia
E-mail: berezkin1@gmail.com*

The Northwest Coast of North America as the Main Route from Beringia to the New World: The Evidence of Mythology

Data on the distribution of folklore and mythological motifs in the New World are analyzed. Their areas agree with the idea that early migrants moved along the Pacific coast of North America. The Columbian Plateau with the adjacent part of the coast could have been a hub whence people dispersed to the south, southeast, and east. The transfer of cultural elements along the Mackenzie Corridor is supported neither by the distribution of mythological episodes and images nor by archaeological evidence (the latter suggests an oppositely directed migration in the Terminal Pleistocene—from the main territory of the U.S. to Alaska). North American and South American narrative episodes and mythological motifs are separated by a huge geographic gap: Many migrant populations seem to have rapidly reached South America, leaving certain groups behind. While in America distribution areas of motifs follow recognizable patterns, in the Old World the same motifs are scattered from Europe to the Pacific, which may attest to the heterogeneity of the Beringian population immediately before the migration to the New World. Besides the main (early) episode of peopling, data on the areal distribution of motifs reveal three or four later episodes.

Keywords: Peopling of America, Beringia, Mackenzie Corridor, Northwest Coast, Columbia Plateau, comparative mythology.

Introduction

By the early 2000s, the author of this article had processed the data reflecting the distribution of folklore and mythological motifs not only in the New World, but also in Eurasia (Berezkin, 2003)*. Thus, it became possible to identify narrative episodes common to the Altai-Sayan area and the Plains. It could be assumed that this was the trace of the people whose ancestral homeland was in the south of Siberia. After reaching Beringia, they moved further along the Yukon and Mackenzie valleys and came to the Plains.

*A motif is an episode or image discovered in two or more traditions; a tradition is a totality of texts occurring within a specific ethnic and linguistic unit or particular territory.

The hypothesis was based on folklore and mythology. There was no archaeological evidence of north to south migration along the Mackenzie Corridor.

Over the next two decades, the scope of the processed evidence tripled, and information on dozens of traditions of Western Eurasia was included in the database. The results of analyzing ancient DNA based on the evidence from the sites in North Asia became available, indicating a boreal cultural continuum from the Atlantic to the Pacific Ocean, the remains of which still survived by the beginning of the peopling of the New World. This continuum began to disintegrate after the Last Glacial Maximum (LGM) and finally disappeared by the Middle Holocene as a result of the displacement of the ancient population of Eastern Siberia by populations from the Transbaikal region

and North China (Berezkin, 2022; Pitulko, 2022: 167). Their genetic lines go back to the people from Tianyuan Cave (ca 40 ka BP) (Wang et al., 2021).

This hypothesis did not address the circumstances for the emergence of Eurasian parallels in the folklore of the Native Americans who lived far from the Bering Sea coast. How exactly did such a set of motifs end up in the depths of the North American continent?

This article introduces some facts favoring the transfer of folklore and mythological motifs deep into the New World along the Pacific coast of North America. For over a quarter of a century of research, we were unable to discover chains of traditions containing identical motifs, which would stretch from the Bering Sea through the Subarctic to the Plains or the Midwest. The lines of communication either go along the Northwest Coast extending to the Plateau*, or begin in the Plateau area and follow therefrom to the south, east, and southeast. The most that can be said about the role of the Mackenzie Corridor is the impossibility of determining, for a number of motifs, whether these were transferred from Beringia to the south along the coast, or through the territories to the east of the Continental Divide. This category includes episodes and images that have not been discovered either in the Subarctic or within the Northwest Coast and Plateau, as well as those that are widespread in North America almost everywhere.

Although the possibility of a coastal route from Beringia after (and, in theory, also before) the LGM is now undisputed (Braje et al., 2017; Steffen, 2024), scholars also keep in mind the alternative route through the Mackenzie Corridor—albeit it was discovered later, which is reflected on the corresponding maps (Becerra-Valdivia, Higham, 2020; Froese et al., 2019; Potter et al., 2018). Only some geneticists point to the coastal route as the only possibility (Willerslev, Meltzer, 2021), while archaeological evidence testifies to an early migration along the Mackenzie and Yukon valleys not from north to south, but only in the opposite direction; that is, to the movement of the carriers of the Clovis tradition of making grooved arrowheads to Alaska (Vasiliev et al., 2015: 171–183).

In addition to the lack of archaeological evidence, there is also an indirect argument against the hypothesis on the significance of migration through the Mackenzie

Corridor for peopling the New World. Although the narrow space between the Laurentide and Cordilleran ice sheets might have become ice-free relatively early, conditions for human habitation there were unfavorable until 13.5–12.7 ka BP (all dates calibrated) (Heintzman et al., 2016; Prates, Politis, Perez, 2020; Steffen, 2024). By that time, the Americas had already been populated. Even if we ignore suggestions about human penetration into the New World before the LGM (Davis, Madsen, 2020; Gruhn, 2023; Hoffecker et al., 2023), several sites in North and South America are definitively dated to between 16 and 14 ka BP (Halligan et al., 2016; Prates, Politis, Perez, 2020; Steffen, 2024; Waters et al., 2018; Williams et al., 2018). Early dates were also obtained for one of the sites of the so-called Western Stemmed tradition in the Plateau (Davis et al., 2022). This tradition is now believed to have appeared earlier than the Clovis tradition, although initially it was attributed at best to the very end of the Pleistocene (Beck, Jones, 2010; Smith et al., 2020).

In recent years, the author of this article operated mainly with average statistical data reflecting the frequency of occurrence of images and episodes in traditions (Berezkin, 2018a, b; 2016). This study will discuss specific motifs*. Currently, distribution patterns of 500 motifs, occurring exclusively in the New World, and another 205 motifs known both in the Old World and in America have been identified. The maps below show the distribution of over twenty motifs whose geographic ranges suggest migration along the Pacific coast. There are almost three times as many of them, but we cannot describe them all in a single article. As far as the remaining American motifs are concerned, these have been either found only in a few traditions or reflect not the migration routes of the Paleo-Indians, but later processes, up to the migration of the Athapaskans to the southwest of the United States, which occurred shortly before the beginning of contacts with Europeans.

*Since this article uses information taken from hundreds of publications, we do not provide a full bibliography, but give references to the Internet resources used. The text catalog (<http://www.ruthenia.ru/folklore/berezkin> or <https://www.areasofmyths.com>) contains summaries of texts with links to the sources. The search should be done by motif codes (A24, K47a, etc.); the use of uppercase or lowercase letters is arbitrary. The catalog is updated once a year in December-January. The site <http://mapsofmyths.com/> (login “customer”, password “aether”) contains English and Russian definitions of motifs and maps of their distribution updated online. Only the names and codes of motifs are given in the text of the article. Their definitions are included in map captions.

*As a historical and cultural region, the Plateau includes the Columbia Plateau along with the adjacent Northwest Coast strip within Southern British Columbia and the states of Washington and Oregon. In historical times, mostly the Salish peoples lived there.

Overview of the evidence

We should start with the pattern confirmed by the largest number of records—the dominance of the coyote as the main folklore trickster south of the Fraser River and the dominance of the raven north of the Columbia River (Fig. 1). Both tricksters appear in the traditions located in the area of contact and overlapping of these large geographic ranges, but more often this role is taken by other characters, such as the mink, blue jay, skunk, raccoon, owl, hawk, and even ice. Such a diversity of tricksters is not observed anywhere else in the world. The figure of the main zoomorphic trickster is a very important element of the tradition (cf. the European fox or hare and spider in Africa). It seems that the contact of two such powerful images within a small and most likely relatively densely populated (owing to fishing opportunities) territory led to a kind of shaking of stereotypes.

The Paleo-Indian trace can be best identified by the motifs that appear both in North and South America. Their distribution zones are most often separated by huge gaps, but precisely this distribution clearly indicates the transfer of plot episodes and mythological images in the early period. The discontinuity of the geographic range can only be explained by displacement of earlier groups of migrants by later groups. In the New World, the trickster-raven is typical exclusively of the north and northwest of North America. In Central and South America, there are no ravens or other vultures among the characters of this type. In the absence of South American parallels, it is difficult to establish the time when such an image appeared in the Bering Sea region—it could have spread both in the Pleistocene and in the Holocene. The same applies to some other motifs, such as “woman and dog: origin of humans” (K47a, Fig. 2). Its geographic range is similar to that of the trickster-raven. In the Old World, the motif of a woman and dog producing humans is typical of East Asia and Southeast Asia. In the American Arctic, it could not have appeared before the third millennium BC, when this territory first became populated. Along the Pacific coast, the distribution area of motif K47a extends far to the south. This motif undoubtedly got there earlier than to the Arctic, although it is impossible to suggest a specific dating.

The situation with the trickster-coyote is different as compared to the raven. Coyotes are not found in South America, but local representatives of the canine family play the same role in folklore in the Andes, Chaco, and Patagonia as the coyote does

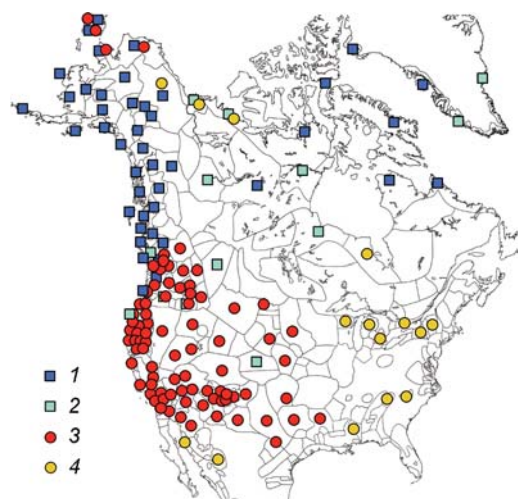


Fig. 1. Areas of two main zoomorphic tricksters in North America.

1 – raven, multiple occurrences; 2 – the same, singular occurrences; 3 – coyote or fox (in the Arctic), multiple occurrences; 4 – the same, singular occurrences.



Fig. 2. Distribution of the motif “woman and dog: origin of humans” (woman becomes intimate with a dog; her children grow as humans and usually become the ancestors of specific ethnic groups).

in North America. The authors of publications call these characters foxes. Significantly, in a number of cases, the corresponding narratives involving a coyote in the north and “fox” in the south include the same episodes (Fig. 3). This is a strong argument in favor of a historical connection between the trickster-coyote of the Native Americans and trickster-fox of Peru, Bolivia, Chile, Argentina, and Paraguay, and hence in favor of the spread of this image in the Paleo-Indian period.

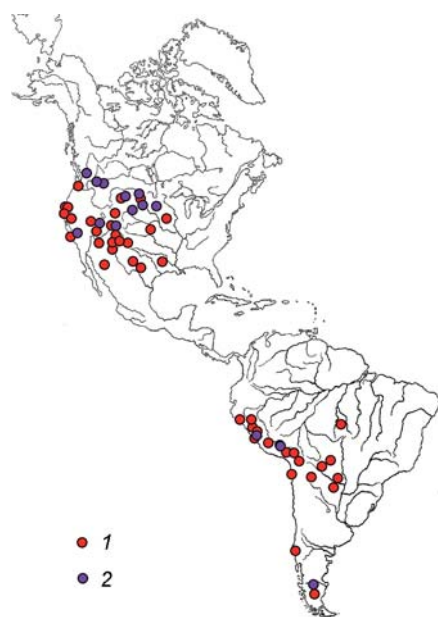


Fig. 3. Distribution of particular trickster episodes involving coyote in North America and “fox” (local representative of the canine family) in South America.

1 – M30, “trickster falls” (person or creature who has no natural wings or can’t fly long distances rises into the air, but falls or, having lost its wings, stays where he can’t return from); 2 – L33b, “trickster provokes a rock” (person or creature invites someone who at first glance is unable to move (stump, boulder, fire) to race; this one begins to move, presses or burns the trickster, or runs away, taking away his property); L33c, “a boulder drowns the trickster” (the trickster and the boulder agree to race down the slope; the boulder is rolling faster and crushing the trickster); L33e, “gift blanket” (the trickster demands back or picks up a blanket belonging to a rock or other character (he usually gave this cape earlier).

Whether the folklore coyote is related to the Eurasian fox cannot be determined. The trickster-fox penetrated into the Western American Arctic (see Fig. 1), but this clearly resulted from the late contacts across the Bering Strait. Among the Paleo-Asians, it competes with the raven, but in America it appears in only a few plots.

The disjointed geographic ranges of motifs (one part in the northwest of North America, and the other part in South America) are typical of the New World. The distinctive examples are “arrow chain” (J58, Fig. 4, 1), “C-section” (F49, Fig. 4, 2), “a bird carries away the antagonist” (J37, Fig. 5, 1), “a bonfire in the bowels of monsters” (L56, Fig. 5, 2), “crying baby” (K86, Fig. 5, 3), and “traveling transformer”

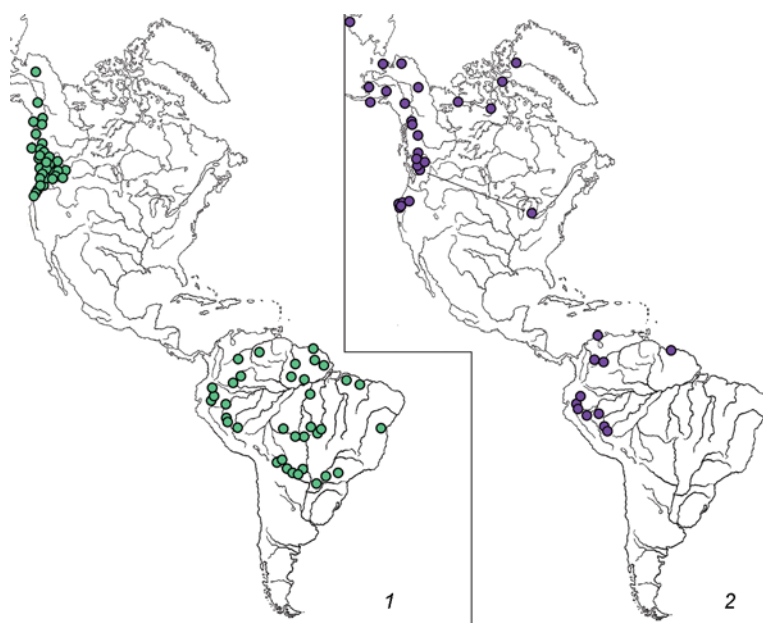


Fig. 4. Areas of occurrence of motifs.

1 – “the arrow chain” (persons shoot arrows (darts) which hit each other’s end forming a chain (rope, ladder); usually, persons climb by this chain the upper world); 2 – “C-section” (the women had their bellies cut to remove the baby; someone explains how to give birth or makes childbirth possible). The arrow indicates the probable transfer of the motif from the Plateau to the Midwest during migration of the ancestors of the Algonquians.

(B28, Fig. 6, 1)*. These motifs occur in Alaska, but are especially typical of the territory of the USA west of the Rocky Mountains, as well as South America. Very often, the North American area of distribution of episodes and images becomes abruptly interrupted in the south, and the boundary passes within the states of Washington, Oregon, or California. Its position was probably determined by where exactly the settling populations managed to gain a foothold so that their cultural heritage would not be subsequently erased by new waves of migrants. As for South America, the territories suitable for colonization were much larger there. Accordingly, the cultural heritage of various groups with greater probability could be preserved until the arrival of Europeans.

The transfer of the “C-section” motif from the geographic range of the Salish traditions to an Algonquian area, which was marked in Fig. 4, means that it most likely came to the Midwest not in the Paleo-Indian period, but much later. There are two

*The image of the transformer as a folklore protagonist of a special type is the distinctive feature of traditions from the New World; in Eurasia, there are only rare and approximate parallels.

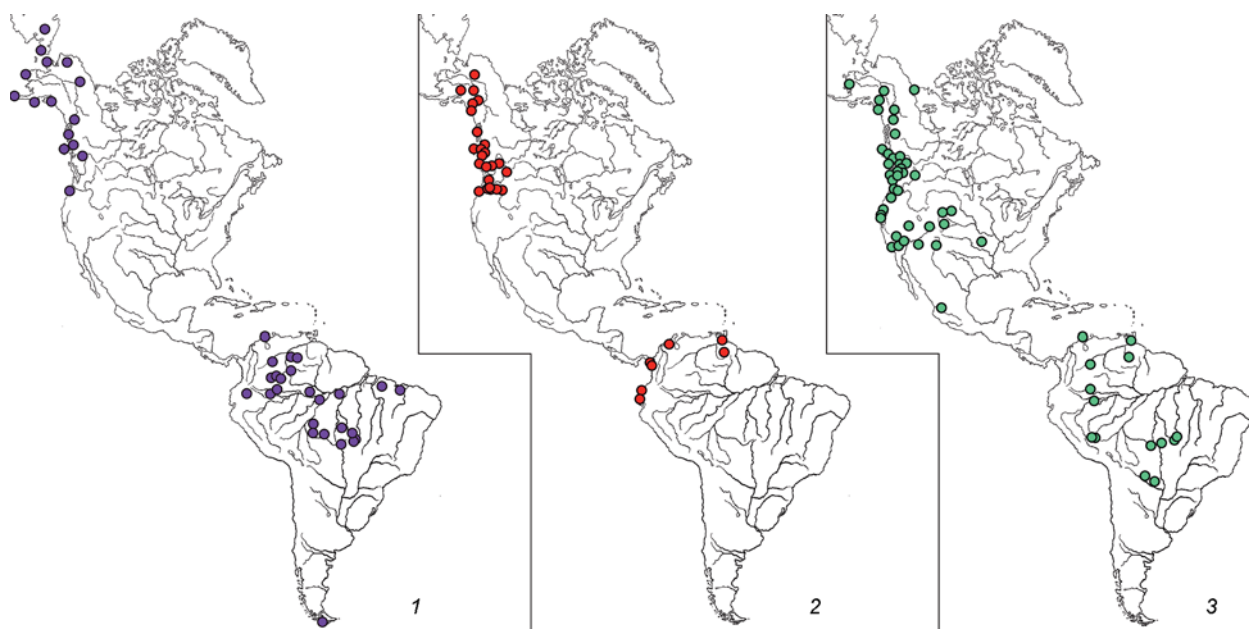


Fig. 5. Areas of occurrence of motifs.

1 – “a bird carries away the antagonist” (having turned into a powerful bird or created one, the hero lifts into the air and carries his opponent away); 2 – “a fire in monster’s belly” (monster or a huge animal dies from a fire in its belly); 3 – “crying baby” (a small (usually capricious) child is ignored, kicked out of the house, thrown on the road, or given to another person for a while. As a result, an animal or spirit takes the baby away).

or three dozen episodes and images that link the traditions of the Salish people of the Northern Plateau and the adjacent coast of British Columbia with the traditions of the Algonquian people of the Great Lakes region and to a lesser extent the Northeast. These episodes and images are absent from the intermediate territories. The Algonquian languages are the main branch of the Algic languages, which also include two languages—Yurok and Wiyot—from the coast of Northern California. The only reasonable scenario is the dispersal of all representatives of the Algic family from the Plateau area. The time of such a migration cannot be precisely established, but archaeological and linguistic data make it possible to assume (cautiously) the late 4th–early 2nd millennium BC (Vasiliev et al., 2015: 401–421; Berezkin, 2010).

There are other variants of the distribution of motifs, reflecting further advance of migrants either west or east of the Continental Divide. The western chain of connections is not always disrupted by the Central American gap. An example of almost continuous distribution is the motif “do not point to a rainbow” (i45b, Fig. 6, 2). In the Old World, a similar prohibition is typical of the Indo-Pacific region of Asia, equatorial Africa, Europe, and its ancient African origin cannot be ruled out. In America, the motif has been found mainly in the Western United States,

Mesoamerica, and Northwest of South America, both in the Andes and in Amazonia.

The American geographic range of the “low sky” motif (B77, Fig. 7, 1) not only includes Mesoamerica, but also extends from Chukotka and Alaska to Brazil and Tierra del Fuego*. In the Old World, the topic of separation of the sky from earth is more widely known than in the New World and is typical of the cosmogonies of various regions. It is especially popular in the mythologies of the Indo-Pacific part of Asia, equatorial Africa, Balkans, Caucasus, and West Asia. In the absence of American data, the motif B77 could be possibly interpreted as an archetype inherent in people’s consciousness. The same applies to the motif “marriage of heaven and earth” (B2d, Fig. 7, 2), which in terms of its plot is related to the previous motif. However, in North America, both these motifs are not widespread or randomly distributed, but clearly gravitate toward the areas west of the Continental Divide, so it is inappropriate to speak about their ubiquity.

*There are almost no data on Native American traditions for Chile, Uruguay, Southwestern Brazil, and almost all of Argentina, so the gap in the records between Chaco and Tierra del Fuego does not necessarily indicate the absence of a motif there.

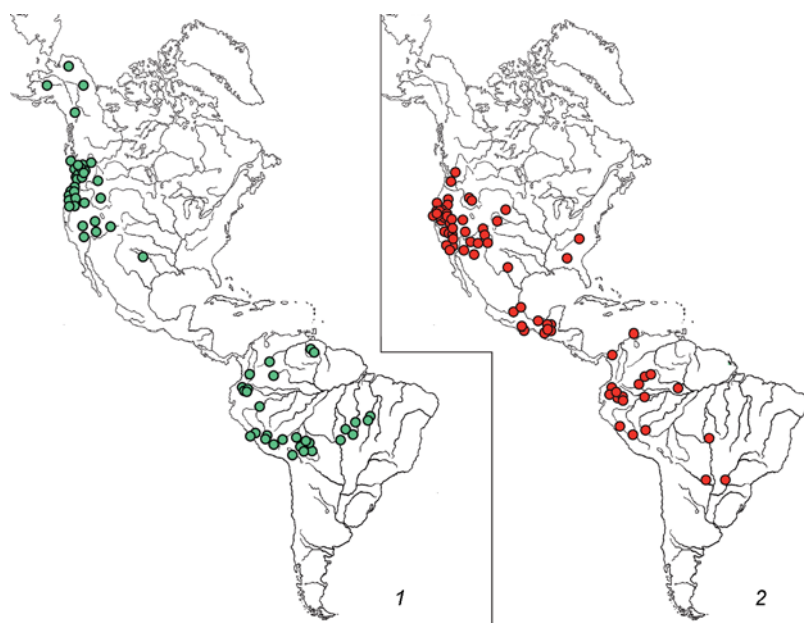


Fig. 6. Areas of occurrence of motifs.

1 – “traveling transformer” (traveling from one area to another, the person consistently turns people into birds and animals, stones, sanctuaries, establishes cultural norms, determines biological features of living beings, peculiarities of the landscapes, etc.); 2 – “do not point to a rainbow” (the person pointing or gazing closely at the rainbow will become ill, or the finger pointing at it will rot or dry out).



Fig. 7. Distribution of motifs.

1 – “low sky” (the sky was near the ground, then it rose); 2 – “marriage of heaven and earth” (Sky is considered a man and marries a woman Earth).

Two more cosmogonic motifs—“first sunrise” (A24) and “one-eyed luminaries” (B11b)—have similar geographic ranges and clearly reflect the movement of people from Beringia to South America through the territories to the west of the Continental Divide (Fig. 8). In the Old World, the former motif is almost unknown, while the latter occurs in Southeast Asia, among the non-Aryan peoples of Central India, and in the Balkans.

If we turn to the motifs that could have been transferred through the territories located not to the west, but to the east of the Continental Divide, a good example is “thunder vs dragon” (K41, Fig. 9, 1). In the Old World, this motif is rare outside of ancient Western Asia and the Aegean Sea region. It is most typical of North and Central America. In North America, the thunderbird usually serves as the embodiment of thunderstorm. In the Bering Sea region, the plot is the fight between such a bird and a whale. Since the motif is unknown in the mainland USA west of the Rocky Mountains, although it is common on the Northwestern Coast, it is logical to assume that upon reaching the south of the Plateau, its carriers continued to migrate not in the southern, but in the eastern direction. In North America, motif J25 (“babies hide and come back”, Fig. 9, 2) demonstrates

the distribution pattern similar to K41. It is more common in South America and is typical of Guiana and the Amazon River basin. In Eurasia, this motif is known from Primorye, Kamchatka, and Taimyr to the Caucasus and Baltic Sea region (Berezkin, 2019). It has no parallels in Eastern Siberia and Alaska, so the Eurasian-American connections must go back to the Paleolithic.

The motif “cranes and pygmies” (K22, Fig. 10, 1) occurs in several areas east of the Continental Divide, and in the American Southwest, but is especially typical of the Northwest Coast, where precisely the local variants are most similar to the Ancient Greek variant (Berezkin, 2007b).

Another motif that spread across the Plains and not through California or the Great Basin is “sharp leg” (L9a, Fig. 10, 2). It has no parallels in Central America and Mexico, although this motif could only have reached South America through these regions, since migration through the Antilles has not been confirmed by archaeological data. Parallels in the Old World are rare, approximate, and geographically remote from America. The motif “the man joins wild animals” (B26) is also almost exclusively American. Its continuous geographical range extends from the Chukchi Peninsula to the Plateau, but the motif



Fig. 8. Distribution of motifs.

1 – “first sunrise” (the primeval ancestors live at dusk. When they are first exposed to the sun, they die, turn into animals, into spirits); 2 – “one-eyed luminaries” (the Sun or Moon is one-eyed; usually the second eye has been knocked out or sucked out, but sometimes the reason is not given; among the Mundurucu people, the Sun of the rainy season has lost both of its eyes).

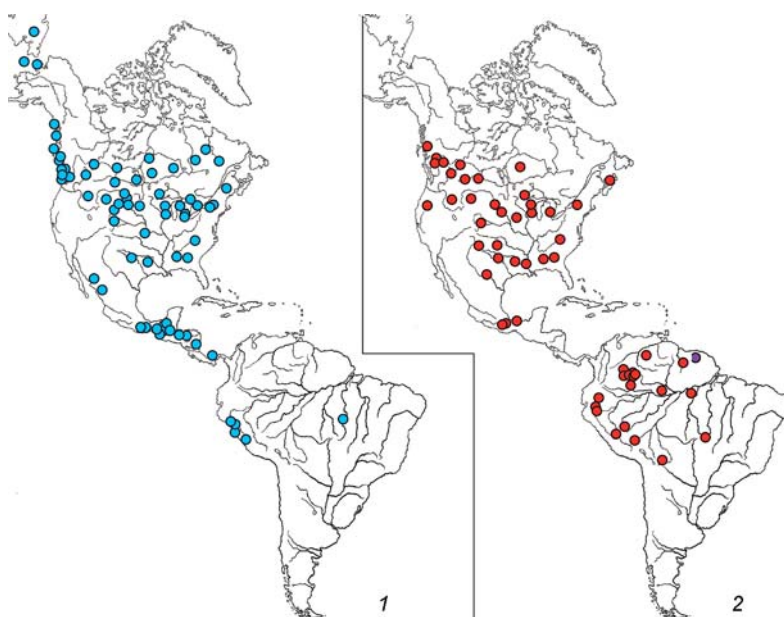


Fig. 9. Areas of occurrence of motifs.

1 – “thunder vs dragon” (thunder or giant bird fights against a reptile, big water animal or other big and strong creature who lives in water or under the earth); 2 – “babies hide and come back” (heroes—one, two, or one out of two—while still babies or embryos, disappear or are thrown out, often into the water. To bring them back to the human world, they are lured or persuaded to come out, or are caught with difficulty).

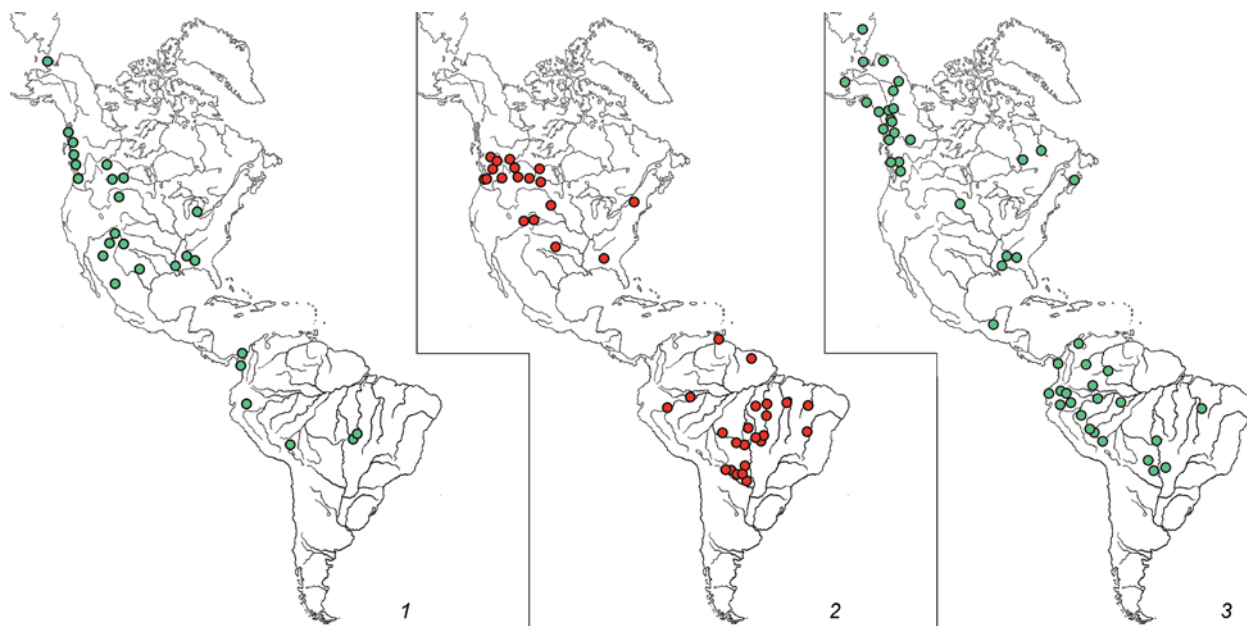


Fig. 10. Distribution of motifs.

1 – “cranes and pygmies” (different from ordinary humans, inhabitants of a faraway country from time to time fight enemies of inhuman nature that attack them); 2 – “the sharp leg” (the person’s leg is maimed – intentionally or accidentally – or initially pointed. He uses sharpened bone as a piercing tool); 3 – “the man joins wild animals” (the person who follows wild animals turns into one of them or becomes their master, or he lives with animals that look like humans to him).

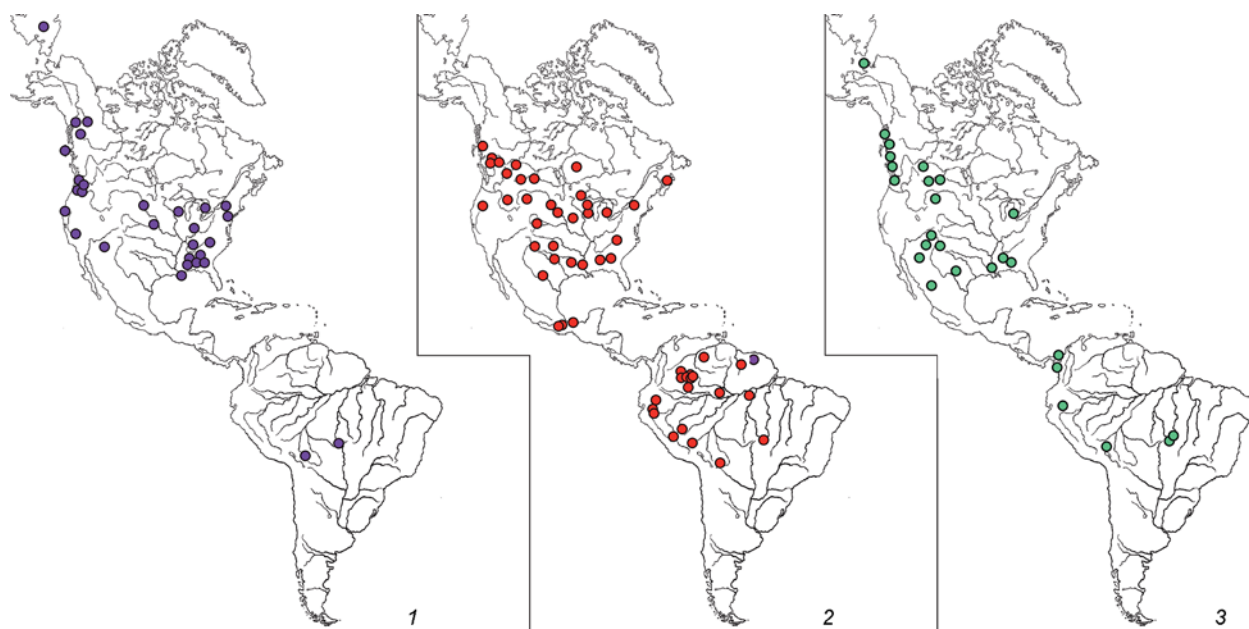


Fig. 11. Areas of occurrence of motifs.

1 – “rising and falling sky” (the vault of heaven constantly hits the ground like the lid of a boiling pot); 2 – “girls in search of the marriage partner” (A girl or two sisters travel, usually in search of a proper marriage partner who lives far away or who has gone away. On their way or after reaching the place of destination, the girls get to some unpleasant suitors); 3 – “whose blood is sweeter” (An insect feeds on human blood or flesh. Dangerous person asks it, where it had sucked blood or whose blood is the most delicious. Usually the insect lies or is unable to answer; thanks to this, the dangerous person attacks certain plants or animals and not people).

has also been found to the east of the Continental Divide, in particular in the northeast and southeast of the United States. It also appeared among the Maya and in South America (Fig. 10, 3).

The motif “rising and falling sky” (i22a, Fig. 11, 1) is a variant of more general motif “objects in permanent movement” (Berezkin, 2024). In the Old World, this variant is typical of Siberia, and is known in the Philippines and Micronesia.

The motif “girls in search of the marriage partner” (J12, Fig. 11, 2) occurs both to the south and to the east of the Plateau, and has not been found in Central America. This is one of the most popular motifs in Native American mythology. In the Old World, it is absent from the Continental Eurasia, but is known from the regions of the Lower Amur–Primorye–Sakhalin–Hokkaido, in the east of Indonesia, in Micronesia, Melanesia, and Australia.

We should also mention the related motifs “whose blood is sweeter” (B50, Fig. 11, 3) and “mosquito and thunder” (B51). In America, the area of their occurrence stretches from Alaska to Oregon. The ancestors of the Algonquins (see the “C-section” motif above) most likely brought these motifs to the Midwest and Northeast. However, the presence of South American variants makes it possible to link their penetration into

the New World not with the Algonquins, but with the Paleo-Indians. In Eurasia, these motifs have been found from France to Manchuria.

Discussion and results

There were several “bottlenecks” in America, through which migrants would pass. These were the arid zone on the border of the American Southwest and Mexico, and also the Isthmuses of Tehuantepec and Panama. The abrupt interruption of the geographical distribution of folklore and mythological motifs in the Plateau area (many ended there, and many began) can also be explained by the natural environment. After migrants to the New World reached this territory, they found themselves beyond the southern border of the glaciers and could subsequently spread in different directions. Accordingly, the Plateau area was a kind of hub for the populations settling in the New World. The natural environment to the south and east of the Plateau was different and more diverse than in the narrow corridor between the ocean and the mountain glaciers. This could not but lead to fairly rapid and multidirectional changes in culture and to ethno-linguistic fragmentation. The appearance

and disappearance of folklore and mythological motifs on the maps of their modern distribution indicate the emergence, movement, and disappearance of human communities.

Although the paleogenetic evidence from North and South America indicates the common origin of all Native Americans and their separation from Siberian populations during the LGM (Potter et al., 2018), the data on the modern groups indicate the complexity of this process. For example, the analysis of the genome of the Blackfoot people (northern Plains, Alberta Province in Canada) indicates that their genetic ancestors separated from other Native American groups 18 ka BP, that is, apparently still in Asia (First Rider et al., 2024). Exclusive links with the Papuans and Andamanese were discovered in the gene pool of the inhabitants of Amazonia and the coast of Peru (Castro e Silva et al., 2021; Skoglund, Mallick, Bortolini, 2015; Vallini, Pagani, 2022: 236). No such genomes have been found in fossil samples, but all samples from South America date back to the Holocene (Willerslev, Meltzer, 2021), while the genomes of many Native American groups have not been analyzed. This suggests that the peopling of the New World should not be conceived as the movement of a homogeneous mass of migrants. Rather, it is more likely that groups of different origins, whose ancestral homelands were located in a vast territory from Central Asia to the Sea of Japan, were colonizing new territories. Contacting and mixing with each other, they reached Beringia, and then populated most of the Western Hemisphere.

The data on the distribution of motifs represented on the maps indicate the movement of carriers of traditions along the Northwest Coast with access to the Plateau. This also concerns the most famous motif of world mythology—“the world diver”, or more precisely, “the acquisition of the earth from the lower world” (C6d). We did not include it in the overview, since the pattern of its distribution in America has already been discussed in another article (Berezkin, 2007a), and in the future, we intend to revisit this topic.

In the cases when the ancestors of the Native Americans continued to move after reaching the Plateau region, they entered South America and settled in different regions. Although both the Northwest Coast and Mexico with Central America were “bottlenecks” on the route of migrants, the distribution patterns of motifs in these territories differed. On the Northwest Coast and Plateau, oral traditions are rich, while in Mexico and Central America

they are poor even as compared to those of Llanos, Guiana, Northwestern Amazonia, Mato Grosso, and Chaco. For comparison, we present the number of motifs registered in our database for the best-studied traditions of these regions.

Northwest Coast and Plateau: Tlingit – 218, Haida – 206, Tsimshian – 171, Kwakiutl – 172, Carrier – 178, Thompson – 211, Shuswap – 202, Puget Sound Salish – 218, Chehalis and Cowlitz – 187, Western Sahaptin – 181, Upper Chinook – 212.

Mexico: Huichol – 75, Aztec – 75, Totonac and Tepehua – 121, Nahua of Puebla – 80, Chinantec and Mazatec – 114.

Central America (from the Isthmus of Tehuantepec to Panama): Tzotzil – 111, Quiche – 93, Paya, Sumu, and Miskito – 59, Bribri and Cabecar – 79, Guna – 104.

Amazonia, Llanos, Guiana, Mato Grosso, Chaco: Sicuani – 188, Warao – 192, Napo and Canelo – 178, Barasana, Taiwano, and Macuna – 160, Paresi – 179, Toba – 152.

The richness of traditions in the American Northwest is also confirmed by the fact that there we can find motifs that have correspondences in almost all other historical and cultural areas of the New World, which is not the case for the traditions of Mexico and Central America. Apparently, after completion of the main, early stage of the New World’s peopling, the influx of new Asian migrants to the Northwest Coast became a rarity, while groups of Native Americans who had already been in North America most likely followed one after another through Central America, erasing the traces of their predecessors.

The described evidence does not categorically exclude the transfer of oral traditions from Beringia along the Mackenzie Corridor. In the monograph (Vasiliev et al., 2015: 388–400), we discussed the corresponding motifs in the entire section, keeping in mind the very distinctive narrative episodes among the Native Americans of the Plains and their Altai-Sayan parallels, which we discovered a quarter of a century ago. Since the movement of migrants along the Mackenzie Corridor was assumed by all scholars at that time, the motifs appearing mainly on the Plains were better suited for the role of those entering America in this way than others. However, already ten years ago it was clear that the Pleistocene complexes of Denali with wedge-shaped cores and microblades, and Nenana complexes with Chindadn points did not penetrate beyond Eastern Beringia, and the later material evidence from Alaska in the south and southeast also has no correspondences (Vasiliev

et al., 2015: 161–171, 558–560). The motifs that connect the Plains with Western Eurasia are absent both from the Subarctic and (except for one case) from the Northwest Coast. This means that it is impossible to make a choice in favor of transferring these motifs along the coast or the Mackenzie Corridor on the basis of folklore and mythology.

Conclusions

Based on the above, the algorithm for peopling America appears sophisticated in details, but overall simple. In the early stages, migrants proceeded along the Pacific coast. The role of the Mackenzie Corridor was at best secondary. The colonization involved groups of different origins, which had gathered in Beringia. If we do not dwell on still mysterious connections between the east of South America and Melanesia, it is not possible to single out one or more areas in the Old World with which significant clusters of motifs recorded among the Native Americans would be exclusively associated. There are somewhat more parallels in the regions near the Pacific Ocean, but they are also scattered throughout continental Eurasia. This can be considered an argument in favor of the relative heterogeneity of the Beringian population before the ancestors of the Native Americans entered the more southern regions of the New World. Geneticists will be able to verify this assumption.

There were also later episodes in the peopling history of the New World, associated with the appearance of ancestors of the Eskimos and Aleuts, the Na-Dene and perhaps the Algonquins (and Iroquois?). However, we will not discuss these topics now.

Acknowledgments

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O.N. Shelegina and G.M. Zaporozhchenko

*Institute of History,
Siberian Branch, Russian Academy of Sciences,
Nikolaeva 8, Novosibirsk, 630090, Russia
E-mail: oshelegina@yandex.ru; galinakoop@yandex.ru*

Ethno-Cultural Aspects of Siberian Regional Identity (Late 20th to the First Decades of the 21st Century)

Using the social constructivist paradigm, we analyze the model of Siberian regional identity, focusing on the ethno-cultural aspects, shaped by sociocultural practices relating to institutes such as museums and theaters and by integrated forms such as cultural projects, festivals, etc., constructing ethnic identity in the late 20th to the first decades of the 21st century. The role of landscape and ethnographic museums, which introduce natural and cultural legacy to the public, in modeling and translating collective and individual identity is highlighted. Theatrical performances in natural languages and ethnographic festivals contribute to the construction of regional identity and strengthen the idea of Siberia as part of the Russian state. We describe symbolic interpretations of Siberian images, enhanced by festivals, tourism, etc. Municipal authorities, regional cultural centers, and theatrical performances shape and propagate the image of “manifold Siberia”.

Keywords: Model of regional identity, social constructivism, Siberia, sociocultural practices, construction of regional identity, ethno-cultural aspect of regional identity.

Introduction

The issues of ethno-cultural identity have now turned into the big challenges of modernity (Mikhailova, 2013). They are faced by states, communities, social groups, and individual citizens, which is evidenced by materials of the International Scientific Conference “Ethno-Cultural Identity of the Peoples of Siberia and the Adjacent Territories” (Etnokulturnaya identichnost..., 2019). To overcome the identity crisis, some new approaches to the study and identification of its features in relation to individual countries and regions are developed. For example, A.V. Golovnev was the first to define “the northernness as a pivotal identity for Russia” (2022: 5), which stimulates further comprehensive study of the proposed concept.

In the Russian science, the issues of the identity formation, which are associated with national self-

consciousness, improvement of civil society, and harmonization of intercultural communications, form an actual interdisciplinary research space. On the cusp of the 20th and 21st centuries, social constructivism became the main trend in this research space. It focuses on “the ability of regional identity to generate/regenerate, to interpret/reinterpret, and to rebirth and rethink in accordance with historical, social, political, and other situations” (Kazakova, 2020: 74).

In the cultural and ideological space of modern Russia, Siberian identity is among the actively growing and leading regional forms. In the political rhetoric, it is considered as a resource for the formation of the all-Russian identity (Golovneva, 2018: 4).

In the Siberian Branch of the Russian Academy of Sciences, the following large-scale projects have been and are being implemented: preservation and study of

historical legacy, ethno-cultural identity of the peoples of Siberia, and analysis of regional institutional processes in the cultural sector (Molodin, 2019; Sibir i sibiriyaki, 2022: 5–26, 109–176; Identichnost..., 2022: 19–48, 72–93, 138–162). The development of the actual and promising trend of “culture – legacy – identity” is of major scientific and applied importance (Zaporozhchenko, Shelegina, 2023), taking into account modern theories of ethno-cultural identity and its systems (Golovneva, 2018: 5–7; Krasovskaya, 2020) in the context of regional sociocultural practices.

In the given scientific and sociocultural circumstances, it seems appropriate to integrate the results of theoretical and applied interdisciplinary studies on the basis of social construction approach. This may help to highlight the ethno-cultural aspect of regional identity in the Siberian region in the late 20th to early 21st centuries. The specificity and novelty of this work consists in the solution of the task using the analysis of a complex of sociocultural practices implemented by basic institutions of culture (museums and theaters) and of the creative forms (projects and festivals) with a high cognitive, adaptive, and emotional potential of the impact at the collective and personal levels related to the ethnic culture. This will contribute to the development and improvement of the approaches to construction of regional identity in the modern culture of the multi-ethnic space of Siberia, one of the macro-regions of Russia.

Methods

It should be emphasized that, despite the active scientific reflection, there are different interpretations of such a complex phenomenon as identity, particularly ethno-cultural identity. The model of regional identity in terms of the philosophy of culture was proposed by E.V. Golovneva (2013; 2018: 14–15), having been based on the materials from Siberia. It provides insights into the following aspects that are significant for our work: the cognitive aspect—historically constructed images of Siberia and the Siberians at the level of everyday consciousness and conceptual development; the value aspect—orientations related to the natural-landscape, toponymical, resettlement, ethno-cultural, historical, and the mental-psychological narratives; the sensual-emotional aspect—a complex system of meanings and senses of the emotional attachment to the place of residence; and the regulatory aspect—specific behavioral strategies and practices

of the Siberians, including the commemorative and performative channels of constructing and implementing of regional identity in the contemporary culture. Notably, the aspect related to ethno-cultural identity is not represented in the model as an independent one. We focus on it and, in solidarity with the position of N.R. Krasovskaya, consider ethno-cultural identity “as the awareness by social groups and individuals of their belonging on the basis of common territory of residence, stable features of culture, and language” (2020: 76). The criteria of ethno-cultural identity distinguished by this author—territorial, cultural, and linguistic—can be correlated with the concept of regional identity and sociocultural practices. In this regard, the logic of the study was developed in the social constructivist paradigm, according to which the sociocultural activity is the construction (formation) of images, concepts, and social practices in the process of social interactions (Kabanov, 2021: 12).

We consider the sociocultural practices correlating with the ethno-cultural identity as “the integrated action forms of culture, aimed at actualizing the social aspect in its cultural diversity, at mastering the historical and cultural legacy, and at transmitting the identity. These forms of culture facilitate the communication and help the population to adapt to the transformation processes of modernity” (Shelegina, Zaporozhchenko, 2021: 91).

The aim of this article is to present the ethno-cultural aspects of regional identity in the Siberian region in the late 20th to early 21st centuries, on the basis of the social constructivist paradigm and modelling. The object of the study is the ethno-cultural Siberian identity. The subject are the traditional and new sociocultural practices associated with ethno-cultural development of the Siberian region. The practices under study are structured on the following grounds: the scale (level)—global, national, and regional; the functions—communicative, commemorative, performative, and educational; the forms of inclusion in the processes of social reality—integration, adaptation, legacy development, and creative industries.

Given the considerable empirical base on the research topic, we focus our attention, in the “case-study” format, on environmental museums and national theaters of Siberia, which are the most related to the ethno-cultural legacy. We also analyze the modern forms (projects and festivals) meeting the main criteria of ethno-cultural identity (territorial, national, cultural, and linguistic).

Role of museums and museum-tourism projects in the development of ethno-cultural legacy and the translation of regional identity

With regard to the modern period, we can point to the interdependence of the Siberian identity and the development of historical and ethno-cultural legacy, the interdependence manifesting itself in the project activities and museumization of the region's territory. Since their appearance in Siberia (the late 18th century) to the present day, museums have played a leading role in the development of legacy, the formation and translation of regional identity, and the implementation of traditional and innovative sociocultural practices (Rol muzeyev..., 2012).

According to our earlier analysis of the history of creation and the current trends in development of environmental museums in Siberia, the traditional historical practices of ethno-cultural legacy assimilation can be correlated with the value aspect of the model of regional identity. The widely known museum-reserves (“Tomskaya Pisanitsa”, “Shushenskoye”, “Valley of the Kings”, “Starina Sibirskaya”), open-air museums (Historical and Architectural Museum of the Institute of Archaeology and Ethnography SB RAS, Ethnographic Museum of the Peoples of Transbaikalia, “Taltsy”, “Torum Maa”, “Cholkoy”, etc.), ethnographic museum-parks of the Khanty-Mansi Autonomous Okrug (KhMAO) – Yugra contribute to the spatial museumization of the territory. They also reflect its multi-ethnicity, being an important means of identification of modern ethnic groups with their cultural traditions and natural environment. The environmental museums have a high adaptive potential, form the image of the region and the people inhabiting it, and translate the regional and local identity into the society (Shelegina, 2019: 156–167, 174–196). Ethnographers believe that the indigenous peoples of Siberia and the Far East tend to rely on their kinship and ethno-local communities, as well as the values of traditional culture, for consolidation and self-preservation (Nikolaev, Oktyabrskaya, 2021: 137). Thus, we can consider the environmental museums created in the territory of their settlement as a mechanism for regeneration of ethno-cultural identity. In the Siberian museums, considerable attention is given to the actualization of intangible cultural legacy (Zolotova, 2021); and the ethnopedagogy is being actively developed (Kuryanova, Zolotareva, Charyshova, 2021). All that is very significant in the context of regulatory aspects of regional identity,

corresponds to the cultural and linguistic criteria of ethno-cultural identity, and plays an important educational role for young people.

We also present two museum and exhibition projects related to ethno-cultural legacy and regional identity. In 2019, the Omsk State Museum of Regional History created a large-scale “Ethnic Panorama of Siberia” (20 ethnic cultures, 700 items) as a result of fruitful cooperation with the Friendship Center and six ethnic cultural associations. The majority of the exhibits belonged to the 19th–early 20th centuries. The exposition displayed complexes characterizing the features of dwellings, traditional economy, national outfit, and spiritual culture of the indigenous peoples of Siberia (Siberian Tatars, Altai peoples, Buryats, Tuvinians, Yakuts, Nenets, Khanty, and Mansi) and new settlers. It reflected the folk architecture, domestic life, ritual practices, religious beliefs, traditional experience of bringing up children, and samples of artistic endeavor of not only large ethnic groups living in the region—Kazakhs, Russians, Ukrainians, Belarusians, and Germans—but also small ethnic groups: Armenians, Moldavians, Romani, and Jewish people. The album-guide to the exhibition, designed for professionals and a wide range of readers who are not indifferent to the legacy of their ancestors (Etnicheskaya panorama..., 2020: 4–16), became a finalist of the All-Russian Contest of Regional and Local Lore Literature “Small Motherland” (2021).

Commemorative turn in the museum practice, aimed at the formation of historical awareness and ethnic self-identification, has led to the use of socio-anthropological approach, technologies of narrating personal, family, and local histories oriented towards the sensual experience, imagination, and critical thinking. In this respect, the experience of the Museum of Local History “Zaeltsovka” (now a department of the Museum of Novosibirsk) is noteworthy, which conducted the regional interdepartmental sociocultural and educational project “We are Fellow Countrymen”. The project included the exhibition “Manifold Zaeltsovka” and was carried out in cooperation with national-cultural associations (Shatova, 2020).

The given examples provide evidence that four main ways of determining ethno-cultural identity are actualized in museums for visitors: linguistic, territorial, national, and cultural (Krasovskaya, 2020: 78).

Two projects can be considered consolidating the historical past and the modernity of the Siberian region and intended for the external representation of its identity, including ethno-cultural identity. These

are the subject construction (based on historical, sociological, and ethno-cultural studies) of the “Museum of Siberia” as an adaptive and creative form of mastering the regional legacy (Shelegina, 2014: 336–355), and the design project of the “Museum of Siberia” (publicly discussed on March 28, 2019)—an imaginative, high-tech permanent exposition of the Slovtsov Tyumen Museum and Educational Association. Its implementation will be a significant event in branding the region in the Russian cultural space.

At the international level, noteworthy is the project “Great Silk Way. The Siberian Road”. It included a tourist route through the territories of the republics of Southern Siberia and the Kuznetsk Basin. The tourist route was developed with due regard for the archaeological and ethno-cultural legacy, as well as modern sites with ethnic specificity. The bronze stirrups became the main symbol of the project—forward movement (Shelegina, 2019: 96–102). The following tourist projects are being created and tested: the ethnographic tour “Cossack Horseshoe of the Altai”, the loop route “Tyumen Circumnavigations” passing through some well-known Siberian cities and towns, Russian and Tatar villages, and a Khanty settlement (Pakhomchik, Shelegina, 2023), the interactive archaeological and ethnographic trail “CheloVechnost” in the tourist attraction of regional importance “Barsova Gora” in the KhMAO–Yugra.

Hence, the sociocultural practices implemented by the museums, together with scientific, educational, and cultural institutions, the museumization of multi-ethnic areas and places of residence of the indigenous population of Siberia, the development of legacy in the form of cultural tourism create a representative ethno-cultural content in the model of constructing the regional identity of the Siberian region.

Role of theaters in the sensual-emotional construction of identity

By 2020, there were 87 professional theaters of different genres in the Siberian Federal District: 31 theaters in million-plus cities, 22 in large cities, 25 in large towns, 6 theaters in medium-sized towns, and 3 theaters in small towns (for the categories of cities and towns by population, see (Goroda..., (s.a.)). Out of the 113 urban settlements, two large towns (Angarsk and Berdsk), six medium-sized towns, and 47 small towns had no theaters (except for a few folk groups). Krasnoyarsk, Omsk, and Novosibirsk

showed themselves to be recognized theatrical capitals. Each of them had more than a dozen different theaters, which reflected the productive nature of “competing localism” (as defined by E.V. Golovneva) manifested in the rivalry for the status of the cultural capital between the Siberian cities.

In the conceptual framework of the performative turn (Antonyan, Sokolova, 2022) as a vector of cultural turn, the theater emerges as a public communicative environment for the identity construction, manifesting its new quality in the conditions of changed social life. Having survived the difficult 1990s and strengthened in the 2000s, it has harmonized a combination of three vectors of development in its activities. The core of the theater sphere was based on the classic legacy of the world and domestic drama, including the plays by two great Siberians—A. Vampilov and V. Rasputin. The innovations have actualized an appeal to the socio-psychological “new drama” with its life-like, intellectual, and analytical character, which was different from the socio-political keenness of the theater productions of the Perestroika period. The “new drama” was also marked by a new expressive language, different from the “Aesopian” language of the Soviet time (Merkulova, 2011). The third component were the sociocultural performative practices with ethno-cultural dominance. Internet resources contain a considerable amount of information about the theater life. We have used it along with the results of the included observation.

The mechanism of qualitative renewal of the theater business was based on a wide exchange of creativity within the festival movement that was launched in 1987 by the Vampilov Irkutsk Theater Festival of the Contemporary Drama. In 1997, it received a high status of the all-Russian festival, and later came to be called “The Baikal Meetings at Vampilov’s”. Since the late 1990s, the leading theaters of Siberia have been regularly nominated for the national theater award “Golden Mask”. The tours, the participation in international theater projects, and the invitation of metropolitan directors and their foreign colleagues to stage productions gave impetus to a profound reform of the theater tradition. Notably, these processes were also active in the musical and dramatic theaters working in natural languages.

In the 2010s, with state support, the Yakut Olonkho Theater, in cooperation with the Olonkho Research Institute at the Ammosov North-Eastern Federal University, created a qualitatively new stage form of Olonkho, for better understanding and presenting the universal nature of the unique Yakut heroic epic.

The institute promotes the activities of the Olonkho Theater by organizing conferences, folklore expeditions to the uluses, and forming a large archive of the Olonkho artifacts. Since 2014, the theater has been holding the Ysyakh Olonkho, the Yakut national holiday, every summer. The Yakut State Theater of the Indigenous Minorities of the North, established in 2014 on the basis of the “Gulun” folk ensemble, stages the folklore-based performances in five languages of the peoples of the North: Even, Evenki, Yukaghir, Dolgan, and Yakut. These examples are a vivid evidence of realization of the positions declared in the Law “On the Strategy for Socio-Economic Development of the Republic of Sakha (Yakutia)...” (Zakon..., 2018) in the area of social construction of ethno-cultural identity.

The Khots Namsaraev Buryat State Academic Drama Theater combines the national, ritualistic, theatrical traditions, and the European drama in performances in the Buryat and Russian languages. For instance, in the play “Maksar. Steppe in Blood”, the archetypal plot of Shakespeare’s Macbeth is transferred to the Buryat-Mongol steppe. The sumptuous national outfits, sword fights, and throat singing accompanied by the authentic folk instruments are framed by the ascetic modern scenography and restrained European direction, which makes the epicism and the unique poetic style of the Shakespeare’s drama especially close and understandable to the Buryat theater and the audience. As part of the State Program “Preservation and Development of the Buryat Language in the Republic of Buryatia” for the year of 2015, the republican festival-competitions of the folk theaters were held annually, with the participation of the oldest Buryat amateur theater group—the Galsanov Iroi Folk Theater from the Selenginsky District.

In 2008, the Kok-ool Tyva State Musical Drama Theater, together with the association of national wrestling sports competitions, initiated a mass theatrical performance at the “Khuresh” stadium, under the motto: “Kuchum – theater, kuzhum – khuresh, chureem – Tyva” (‘My soul is theater, my strength is wrestling, my love is Tyva’). The annual holding of this event, which attracts audiences of many thousands of people, has become a tradition. In 2016, the theater was awarded the Order of the Republic of Tyva for the outstanding services in the development of national culture and art.

Thus, theaters occupy the priority position in the national-cultural and linguistic component of ethno-cultural identity of the Siberian region, as well as in the promotion of theatrical traditions at Russian and world levels.

Festival format of regional identity construction

During the last two decades, a broad entry of the culturally rich performative forms of leisure into the sociocultural space of settlements has been recorded. The ethnic culture in Russia has started to acquire a convivial and festival character due to the grant funding of the relevant projects. This has manifested itself in the festivals of different genres (musical, literary, historical, book, folk- and ethno- festivals, as well as festivals of culture, arts, and crafts), which can be interpreted as the “invention of tradition”. The emphasis on the ethnic specificity has been noted by researchers as an essential feature of transformation of the festival culture in the 1990–2000s. For example, the traditional celebrations of the indigenous peoples of the Altai Republic Dyilgayak and Tyuryuk Bayram were revived in the festival format, their boundaries having expanded from the family level to the republican level (Chemchieva, 2016: 198). Along with professionals, ordinary residents of the republic are also widely involved as experts and connoisseurs of the folk culture. Ethno-political function of the events becomes the demonstration of social ties of the indigenous Turkic-speaking population with the representatives of other ethnic groups, primarily the Russians and Kazakhs (Samushkina, 2017: 209). The festival format allows the national culture to remain alive and still fruitful (Chemchieva, 2016: 197). The younger generation, and especially the academic youth, successfully incorporates popular culture into the subculture of social media (Krasavina, 2017) and conducts relevant research.

The ethno-confessional atlas of the Novosibirsk Region, containing the analysis of holidays and festivals, was prepared by the scientists from the Institute of Archaeology and Ethnography SB RAS (Novosibirskaya oblast..., 2017). It has become a real communicative sociocultural practice for strengthening the unity of the Russian nation in its regional dimension and forming the multiculturalism as one of the most important skills of adaptation.

Folk festivals in the Krasnoyarsk Territory actualized the broad layers of folk culture and crafts. The multi-ethnic festival “Seveki—Legends of the North” (the Velmo settlement) reproduces an authentic Evenki holiday with a shaman’s appointment, traditional dances, tasting of dried muksun, and the atmosphere of nomadic life. The festival of folk

culture and ethnic music “Solstice” held at the Buzim recreation camp is based on the historical reconstruction of the Old Slavonic holiday called “Kupala Night”, with traditional rituals, round dances, and firewalking. The international festival “WORLD of Siberia” in the village of Shushenskoye, held with the active role of the museum-reserve, attracts lovers of ethnic music and crafts.

In 2019, the staff of the Cultural Center “Akademiya” in the Sovetsky District, Novosibirsk (Novosibirsk Akademgorodok) initiated the city ethno-cultural forum “Manifold Siberia: Dialogues of Cultures and Generations” with the interregional participation. At present, it has received some considerable public attention, support from the state and from scientific and national civic organizations, representatives of business structures, and from the media. In 2023, at the Fifth Interregional Forum, a number of events were held, including the Interregional Festival of Pedagogical Proficiency of Ethnic Cultures of the Peoples of Russia, with the support of the Ministry of Education and Science of the Republic of Khakassia, with the inclusion of platforms dedicated to ethno-cultural educational components of the regions. The next stage of the forum “Manifold Siberia: Dialogues of Cultures and Generations” is scheduled to be held in the Altai Republic, to present the successful multi-ethnic practices. The event is focused on expanding the information space in the field of ethno-cultural education, creativity, and constructive inter-ethnic communication in the Siberian region.

In general, the festival format reflects the efficiency of integration of regional authorities, as well as cultural, scientific, educational, and business institutions. It also symbolically visualizes the images of the whole Siberia and its regions, cities, and towns. The performative sociocultural practices are increasingly perceived as the platforms for confirmation/redefinition of the identity. They act as a place of publicly available escapism, with the possibility to be a person who feels and experiences directly. They communicate the identity of feelings, unity, and kinship to the participants of convivial-festival and time-space continuum. Obviously, the festival life of Siberia in the modern dynamic everyday life, on the one hand, strengthens the sensual-emotional component of the Siberian ethno-cultural identity, and on the other hand, enhances the civilizational component in the all-Russian identity of the Siberians, thus introducing them to the global sociocultural space.

Conclusions

The interdisciplinary study of ethno-cultural identity that began on the cusp of the 20th and 21st centuries is currently at the stage of active scientific reflection and requires the formation and systematization of the empirical base, as well as the search for new approaches to the creation of universal models of regional identity, with the selection of ethno-cultural aspects. In this paper, we have presented for the first time a set of empirical knowledge and conclusions in relation to the activities of basic cultural institutions and sociocultural practices in Siberia. These correlate with the four criteria of ethno-cultural identity: territorial, cultural, national, and linguistic. The ethno-cultural component was established to be one of the dominants in the museumization of the region in the range from large environmental museums to museum-tourist development of especially significant sites of the indigenous population of the region, the creation of a wide range of exhibitions of ethno-cultural heritage with presentation of traditional and modern spiritual ethnic culture.

Activities of theaters working in natural languages and of festivals and forums as the emotionally framed processes of identification provide conditions “for self-identification of an individual or a social group with another person, group, or model, for interiorization of the occupied social statuses, and for acquisition of significant social roles” (Monakov, 2008: 85).

Noteworthy is the integration of actors in the construction of regional identity: public authorities, national-cultural associations, local communities, basic cultural institutions, and representatives of creative industries. This creates the potential for improving the sociocultural infrastructure to acquaint the local population and the residents of other regions with the Siberian multi-ethnicity as a priority factor in the development of all aspects of ethno-cultural identity.

Taking into account the results of the study of sociocultural practices in the Siberian region in the social constructivist paradigm, we suggest to single out the ethno-cultural aspect in the collective regional identity model, along with cognitive, value, sensual-emotional, and regulatory aspects, the ethno-cultural aspect being a significant one in the modern development of Russia and its regions. It is synthesizing in its character, being complementary and diffusive in regard to the above aspects. Its content is formed on the basis of sociocultural practices correlated with territorial, national, cultural, and linguistic

criteria of ethno-cultural identity and implemented by basic cultural institutions (museums, theaters, and libraries), as well as in the course of museum-tourist and educational projects, and the festival movement. The identified positions ensure organic integration of the multi-ethnic Siberian region into the Russian and world culture; it has a pronounced identity that is concentrated in the construct of “manifold Siberia”. The essence and content of the ethno-cultural aspect of the regional identity model are focused on ethno-cultural education and upbringing of young people; the use of sociocultural practices that are adequate to modern realities allow to strengthen and broadcast the positive Siberian identity and promote the harmonious civilizational development of our state in the context of the Russia’s northernness as its key identity.

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A.V. Zubova¹, V.G. Moiseyev¹, A.M. Kulkov², and S.A. Kulakov³

¹Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences,
Universitetskaya nab. 3, St. Petersburg, 199034, Russia
E-mail: zubova_al@mail.ru, vmoiseyev@mail.ru

²Centre for X-ray Diffraction Studies,
Saint-Petersburg State University,
Universitetskaya nab. 7–9, St. Petersburg, 199034, Russia
E-mail: aguacrystals@yandex.ru

³Institute for the History of Material Culture,
Russian Academy of Sciences,
Dvortsovaya nab. 18, St. Petersburg, 191186, Russia
E-mail: kazvolg@yandex.ru

An Upper Second Molar from Akhshtyrskaya Cave and Population Affinities of the Middle Paleolithic Hominins of the Caucasus

The Akhshtyrskaya cave site in northwestern Caucasus dates mostly to the Middle Paleolithic. In 1961, during the analysis of faunal assemblage from layer 3a, a permanent upper second molar of *Homo* (AKH 1) was discovered. Initially, it was attributed to fossil *Homo sapiens*. Here, we present new findings related to this specimen, specifically to its external and internal morphology, amount of enamel and dentine in the lateral part of its crown, and a comparison of metric and nonmetric characteristics with those of Denisovans, *H. ergaster/erectus/georgicus*, *H. erectus*, *H. antecessor*, *H. neanderthalensis*, *H. sapiens*, Middle Pleistocene *Homo* of Europe, and Middle and Late Pleistocene *Homo* of China, distinct from *H. erectus*. At the first stage, frequencies of nonmetric traits were subjected to principal component analysis. At the second stage, obtained PCA scores were integrated with measurements of the same specimens using PC analysis with grouping variable. Results suggest that the molar from Akhshtyrskaya by no means belongs to *H. sapiens*. Its morphology is very archaic, linking it to mostly Middle Pleistocene hominin teeth from China. The volume of lateral dentine opposes AKH 1 to molars of Late Pleistocene *Homo* of Europe and those of *H. sapiens*, revealing a shift toward Denisovans. The specimen likely belongs to an evolutionary line that has thus far not been found in Europe. Probably, it is of Asian origin.

Keywords: Middle Paleolithic, Caucasus, Neanderthals, Denisovans, microCT, dental anthropology.

Introduction

The Caucasian region has always, since the most ancient times, been an outpost for human colonization of Eurasia. During the whole history of humanity, it has served as a corridor connecting Europe, Near East, and Central Asia (Lyubin, 1997: 11; Ghasidian

et al., 2023). The position of the Caucasus at the crossroad of several migratory passageways provided a possibility of admixture between various groups of ancient hominins. At the same time, the complex mountainous terrain has always been and still is a natural factor of forming refugees and isolating some human populations. Thus, the Caucasus can be

theoretically considered as an ideal region for studying various models of population processes and evolutionary factors. Nevertheless, the population affinities of the Early and Middle Paleolithic Caucasian hominins are still insufficiently studied owing to the low number of available skeletal specimens and the chronological limitations of paleogenetics. Most published anthropological studies on Caucasian human fossils discuss mainly their phylogenetic position (Gabunia, Tushabramishvili, Vekua, 1977; Gabunia, Vekua, Lordkipanidze, 2001; Peshchera..., 2006: 52–53; Hajdinjak et al., 2018; King et al., 2016; Pinhasi et al., 2012; Martínón-Torres et al., 2008). Only the Neanderthal fossils from Mezmayaskaya Cave in the Northwest Caucasus were preserved enough to study not only their taxonomy but the population affinities as well (Hajdinjak et al., 2018).

This article outlines the results of our study of an upper human molar (hereinafter, AKH 1) found in the Akhshtyrskaya cave site in the Northwest Caucasus (43°31'N, 39°59'E) (Kulakov, Baryshnikov, Levkovskaya, 2007).

The first attempt to determine if the tooth belonged to a Neanderthal or a *H. sapiens* individual was made in the 1960s, but the limitations of the dental anthropology methods available at that time did not allow solving this question. It was concluded that the tooth belonged to *Homo sapiens fossilis* (Vekilova, Zubov, 1972: 62). Nevertheless, the preliminary results of our studies of AKH 1 morphology (Zubova, Moiseyev, Khartanovich, 2017; Zubova et al., 2018) made this suggestion doubtful.

In the present study, a detailed analysis of external and internal AKH 1 morphology was carried out, and a comparison of the AKH 1 dental characteristics with various Eurasian Middle and Late Pleistocene populations was performed.

Material and methods

Archaeological context. The Akhshtyrskaya site is located in the Adlersky District of Sochi, in Bolshaya Kazachebrodsкая Cave, at the left bank of the Mzymta River (Fig. 1). This karst cavity belongs

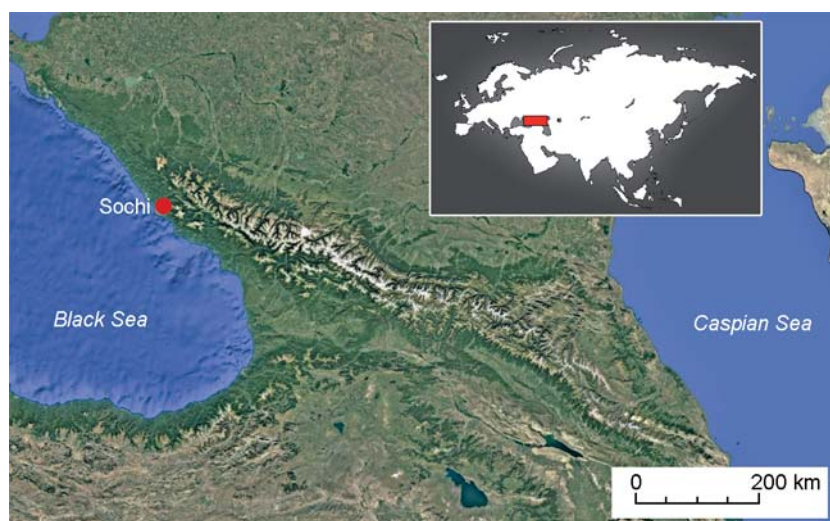


Fig. 1. Location of the Akhshtyrskaya Cave site.

to “corrosion-erosion caves—ponors” and has two entrances: the southern lies 100–102 m above the river level and the eastern 95–97 m. The total length of the cave is more than 150 m, while its width varies from 7 m at the entrance to 2 m in the narrowest points of the passages. The thickness of Pleistocene deposits reaches 3 m and more (Kulakov, 2015).

The cave was discovered in 1936 by S.N. Zamyatnin and M.Z. Panichkina and then excavated by the same specialists in 1937–1938, and by E.A. Vekilova and M.Z. Panichkina in 1961 (Zamyatnin, 1961: 104–117; Vekilova et al., 1978). The study of the cave was resumed in 1996–2008 by the Black Sea expedition of the Institute for the History of Material Culture RAS. The site has 9 stratigraphic layers. The lower three (7–9) are archaeologically sterile. Layers 3–6 contain Middle Paleolithic stone assemblages. The upper part of layer 3 (3/1, previously 3a) reveals a mixture of Upper and Middle Paleolithic finds (Kulakov, 2005). The AKH 1 molar was discovered in the faunal sample of layer 3/1. The layer was dated to $35,000 \pm 2000$ BP (Cherdyntsev et al., 1965), but the reliability of this date is doubtful.

AKH 1 molar (Fig. 2). The specimen is a well-preserved upper right second molar of an adult individual. Post-mortem damage of crown enamel is minor; ante-mortem attrition corresponds to grade 4 on Molnar’s scale (Molnar, 1971). The vestibular roots were broken and restored in the 1960s. A small enamel fragment from the cervical area (where the root was broken) was lost. Though the external enamel pattern is worn, the position of the main fissures and presence of several accessory grooves (reaching the surface of the crista oblique in the central fovea area) could be determined.

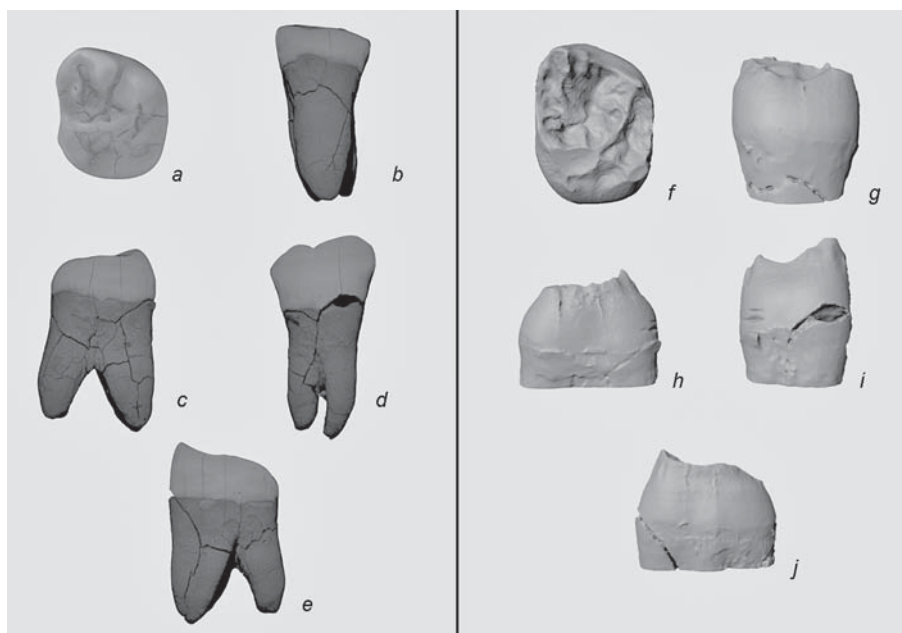


Fig. 2. 3D-model of the AKH 1 molar based on microtomographic images.

a–e – external morphology; *f–j* – internal morphology. *a, f* – occlusal plane; *b, g* – lingual plane; *c, h* – distal plane; *d, i* – vestibular plane; *e, j* – mesial plane.

Methods. External AKH 1 morphology was described following standard protocols (Zubov, 2006; Turner, Nichol, Scott, 1991; Bailey, 2002; Martín-Torres et al., 2012). The following traits were scored: number of main cusps, relative size and shape of the metacone and hypocone, presence or absence of the parastyle, positions of the main intertubercular fissures, number and shape of the roots. The mesio-distal and buccolingual diameters of the crown were measured. Other traits could not be scored owing to the enamel wear.

The enamel-dentin junction (EDJ) was reconstructed after micro-CT scanning, to score the following traits: presence or absence of the anterior and posterior fovea, plagyocristids, epicristids, C5, postparaconule, accessory mesial cusps, Carabelli's cusp, central shift and inclination of the apexes of the dentin horns at the main crown cusps, odontoglyphic pattern.

The volumes of enamel and dentin of the lateral part of the crown were measured in CTAn (Bruker-micro CT). According to the protocols (Olejniczak, 2006: 125–128, Martín-Francés et al., 2018: 3, 7) measurements were taken in the area between the cervical plane, i.e., the plane in halfway between the most apical continuous ring of enamel and the plane containing the last hint of enamel, and the occlusal basin plane, which is parallel to the cervical plane and tangent to the lowest enamel point of the occlusal basin.

Micro-CT scanning was carried out at the Research Centre for X-ray Diffraction Studies of the Saint-Petersburg State University, employing a NEOSCAN 80 X-ray scanner with the following settings: tube voltage 101 kV, current 40 μ A, with an aluminum filter. Spiral scanning was performed with a rotation step of 0.25° and averaging 4 frames. Resolution: 6 μ m. The reconstruction of the raw data was carried out in NRecon (Bruker-microCT). The 3D-model used for the virtual separation between enamel and dentin was built in CTAn (Bruker-microCT) and visualized in CTvox (Bruker-microCT).

The morphological pattern of AKH 1 was compared with upper second molars of Denisovans (DEN), *Homo ergaster/erectus/georgicus* (HE/E) from Dmanisi, *H. erectus* (HE), *H. antecessor* (HA), *H. neanderthalensis* (NEA), early and modern *H. sapiens* (HS), Middle Pleistocene European *Homo* (EMPH), non-*H. erectus* Middle and Late Pleistocene *Homo* from China (EAMLP), and MC 8 specimen from Manot Cave (probably a hybrid individual).

The dentin and enamel volumes were compared using box-and-whiskers diagrams, depicting the mean values and ranges of variation (standard deviation, standard error of the mean) for both variables.

The individual non-metric data were compared via principal components analysis (PCA) in Statistica for Windows, 8.0 (module “Multivariate Exploratory Techniques”), based on trapezoid shape of the crown,

Table 1. Reference sample of upper second molars

Taxon	Fossils	Publication
<i>H. ergaster/erectus/georgicus</i>	Dmanisi (2700, 2282)	(Martínón-Torres et al., 2008; Gabunia, Vekua, Lordkipanidze, 2001)
<i>Homo antecessor</i>	Atapuerca, Gran Dolina (TD6 12, TD6 69)	(Bermúdez de Castro et al., 1999; Martín-Francés et al., 2018)
<i>Homo erectus</i>	Zhoukoudian (40, 41); Yiyuan, Hexian (PA 833, PA 837)	(Weidenreich, 1937; Xing et al., 2015, 2016)
East Asian Middle and Late Pleistocene <i>Homo</i>	Hualongdong 6, Chaoxian, Xujiayao (PA 11480-6), Diushan 1	(Bailey, Liu, 2010; Liao et al., 2019; Wu et al., 2019; Xing et al., 2015)
European Middle Pleistocene <i>Homo</i>	Atapuerca, Sima de los Huesos (SH) (AT-46, AT-960, AT-824, AT-2179, AT-407, AT-4319, AT-12, AT-2175, AT-815, AT-588, AT-817, AT-821, AT-15, AT-170), Visogliano (Vis 3), Biache-Saint-Vaast	(Martínón-Torres et al., 2012; Martín-Francés et al., 2018, 2020, 2022; Zanolli et al., 2018)
Neanderthals	Rozhok I, Chagyrskaya Cave (CH1141, CH10, CH57), Leuca, Le Moustier, Moula-Guercy (M-G2-117 M-F3-215), Krapina (F/H MX M, KRD98, D96, D165, D166, D169), Stajnia (S5000)	(Benazzi, Bailey, Mallegni, 2013; Hlusko et al., 2013; Martín-Francés et al., 2018; Picin et al., 2020; Zubova et al., 2022)
Denisovans	Denisova Cave (Denisova 4, 8), Harbin	(Zubova, Chikisheva, Shunkov, 2017; Ni et al., 2021)
<i>Homo sapiens</i>	Daoxian (PA 1554, PA 1556, PA 1587, PA 1592), Qafzeh 11, Sungir 2, 3, Kostyonki 18, Cherepakha 13 (MAE NVF 95-2, 95-18, 95-22, 95-27), modern Papuans (MAE 212-11, 20), Bosco-Pontini 5, 6, 9, Pigorini	(Gromov, Zubova, Moiseyev, 2017; Khaldeeva, Kharlamova, Zubov, 2010; Liu et al., 2015; Martín-Francés et al., 2018; Zubova et al., 2022). Unpublished data of A.V. Zubova and V.G. Moiseyev
Unknown	Manot, MC 8	(Sarig et al., 2021)

Carabelli's trait (grades 2–5), accessory distal cusp, hypocone reduction (grades 3, 3+), posterior fovea, parastyle, epicrista, plagyocrista, odontoglyphic grooves of the third order. All the traits were scored in a binary form: presence or absence.

To reconstruct the taxonomic position and biological affinities of the AKH 1 molar, the non-metric and metric (crown diameters) data were integrated in the same analysis. This was also carried out using PCA but employing the following set of variables: PC1–4 coordinates of individual fossils from the non-metric analysis (see above), mesio-distal and buccolingual diameters of the crown. The PCA with a grouping variable (Statistica 8.0, module “PLS/PCA Multivariate/Batch SPC”) was used. The name of the groups and samples included are listed in Table 1.

Results

Morphology of AKH 1. The crown (Fig. 2) is large: mesio-distal diameter 11.2 mm, buccolingual diameter 13 mm. It exhibits a trapezoid shape. Its vestibular margin is oblique due to the reduction of the metacone, while the hypocone is moderately reduced (4-). On the external enamel surface the following features

are present: posterior fovea, a deep fissure separating the metacone and paracone, and several small transverse grooves reaching the surface of the continuous crista oblique.

The mesial and distal marginal ridges of occlusal surface at EDJ run close to the margins of the crown. The basal part of the crown is only subtly wider than the occlusal one. The hypocone is connected with the protocone and metacone by continuous ridges. The marginal ridges do not cross the intertubercular fissures. There are small dentin protrusions on the distal marginal ridge marking the presence of two accessory cusps (C5). Two segments marking the presence of accessory mesial cusps branch from the mesial marginal ridge towards the central fovea. The transverse crest (epicrista) is interrupted by an intertubercular fissure.

A Carabelli's cusp was detected in the protocone. The cusp reaches grade 2 or larger: a more precise definition is not possible due to attrition. A deep triangular talon basin present in the distal area. The protocone and metacone are connected by a continuous crista oblique. The apex of the dentin horn of the metacone is slightly inclined inwards. The degree of inclination of the other cusps' apices cannot be determined due to attrition. A postparaconule is present in the paracone.

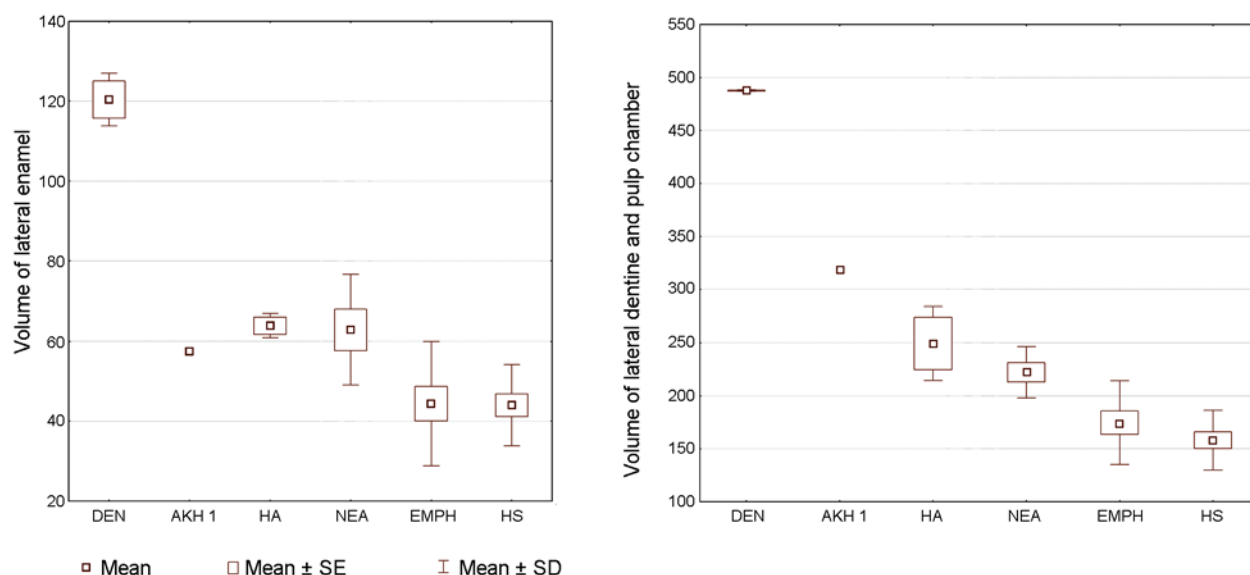


Fig. 3. Enamel and dentin volumes of AKH 1 and in the reference samples.

DEN – Denisovans; HA – *Homo antecessor*; NEA – Neanderthals; EMPH – European Middle Pleistocene *Homo*; HS – *H. sapiens*.

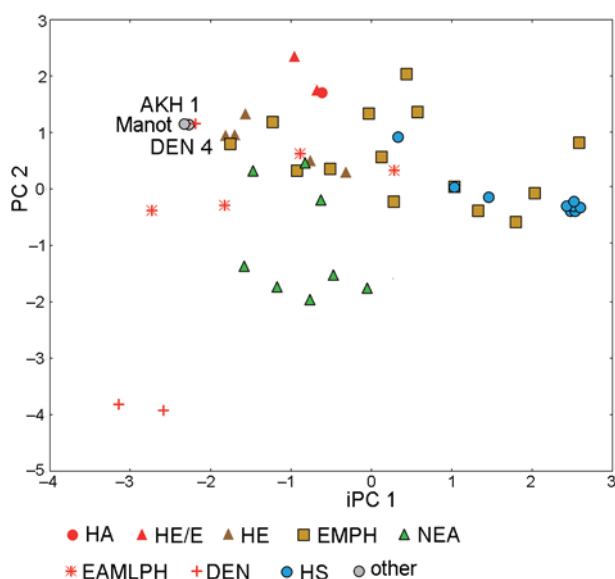


Fig. 4. Principal component analysis of the non-metric variables.

DEN – Denisovans; HA – *Homo antecessor*; NEA – Neanderthals; EMPH – European Middle Pleistocene *Homo*; HS – *H. sapiens*; EAMLPH – East Asian Middle and Late Pleistocene *Homo*; HE – *H. erectus*; HE/E – *H. ergaster/erectus/georgicus*.

The odontoglyphic pattern of AKH 1 is specific. All the fissures are very deep. The cusp fissures observed at EDJ form small “pools” around themselves, widening with distance from the intertubercular fissures. Such morphology was only observed in Chinese *H. erectus* so far (Bermudez de Castro et al., 2021: Tab. 4, fig. 11).

Proportions of enamel and dentin. The volumes of enamel and dentine of the lateral part of the AKH 1

crown can be compared with a limited number of samples (Fig. 3). Its enamel volume is average for a Middle Paleolithic, and falls into the transgression zone between Neanderthals and Middle Pleistocene *Homo* from Atapuerca (SH). This volume is larger than in *H. sapiens* and smaller than in Denisovans. The dentin volume is rather large: AKH 1 stands out of all the European samples, differing sharply from *H. sapiens* and shifting towards Denisovans.

PCA results. The results of the first stage of PCA reveal that the non-metric features of upper second molar effectively differentiate almost all the reference taxonomic groups (Fig. 4). Exclusion is EMPH, demonstrating an extremely wide range of variation. Along PC1, they transgress with Neanderthals, EAMLPH, *H. antecessor* and, mostly, with *H. sapiens*. The similarity with the individuals of the modern *Homo* is due to the high frequency of reduced hypocone in the EMPH sample (Table 2). The authors of the original publication of the Atapuerca (SH) fossils explained the reduction of the hypocone by homoplasy but not an affinity with the direct ancestors of *H. sapiens* (Arsuaga et al., 2014). Nevertheless, the presence of such homoplasy only in Atapuerca SH make this explanation doubtful.

All the samples are distributed in a predictable manner, although a small transgression zone between Neanderthals and the Chinese hominins can be seen in the center of the plot. PC 1 contrasts *H. sapiens* and EMPH, on the one hand, and Denisovans and the Chinese hominins, on the other hand (Fig. 4). The former exhibit an exceptionally high frequency

of the marked hypocone reduction, while the latter display the maximum frequencies of all the accessory cusps, fissures, and ridges of the crown except for the epicrista (Table 2). Neanderthals occupy an intermediate position in the plot.

PC 2 differentiates Denisovans and Neanderthals (negative values) from the other samples. The negative extreme of this axis is occupied by the Denisova 8 and Harbin individuals (Fig. 4)

possessing parastyles but lacking the trapezoid shape of the crown. Neanderthals are characterized by moderate negative values owing to the absence of the parastyle, while the trapezoid shape of the crown is rare. The *H. sapiens* are plotted around the zero. All the other specimens display positive values of the PC 2 (Fig. 4).

The AKH 1 molar falls into both PC1 and PC2 values typical of the Chinese *Homo*, while being substantially distant from *H. sapiens* and, to a lesser extent, from Neanderthals. The most similar fossils to AKH 1 are Denisova 4 and the upper second molar from Manot Cave in the Near East (Fig. 4). The upper second molars from Longtan (Hexian) and Yiyuan in China, as well as the single EMPH specimen (Visogliano 3), plot more distantly from AKH 1 and closer to the European fossils.

The PCA integrating metric and non-metric traits (iPCA) revealed similar picture of biological distances between the samples and individual fossils,

Table 2. PCA loadings of the non-metric variables

Trait	PC 1	PC 2	PC 3	PC 4
Trapezoid crown shape	0.37	0.74	0.05	0.09
Hypocone reduction	0.80	−0.11	−0.04	0.05
Carabelli's cusp	−0.52	0.46	0.43	0.12
Accessory distal cusp	−0.35	0.14	−0.44	0.78
Parastyle	−0.34	−0.60	−0.42	−0.04
Transverse crest (epicrista)	0.04	0.50	−0.56	−0.47
Posterior fovea	−0.70	0.34	−0.28	−0.08
Continuous crista oblique	−0.59	−0.14	0.41	−0.04
Accessory fissures	−0.75	−0.05	0.00	−0.26

though the zones of inter-sample transgression became narrower, and the polarity of PC1 changed (Fig. 5). As in the previous analysis, the main trend was the differentiation between the *H. sapiens* and Asian fossils. This difference is related to both non-metric PC1 variation and the crown diameters very strongly correlated with iPC1 (Fig. 5; Table 3). Neanderthals occupy an intermediate position between European and Asian groups, but closer to EMPH and HS.

The second iPC differentiates Neanderthal, Denisovan, and, to an extent, EAMLPH from the other samples. The values of this vector are highly correlated with values of non-metric PC2. The similarly negative iPC2 values of Neanderthal and Denisovans correspond to their genetic affinities as sister groups. They are differentiated by iPC3, which has the highest loading from the non-metric PC4.

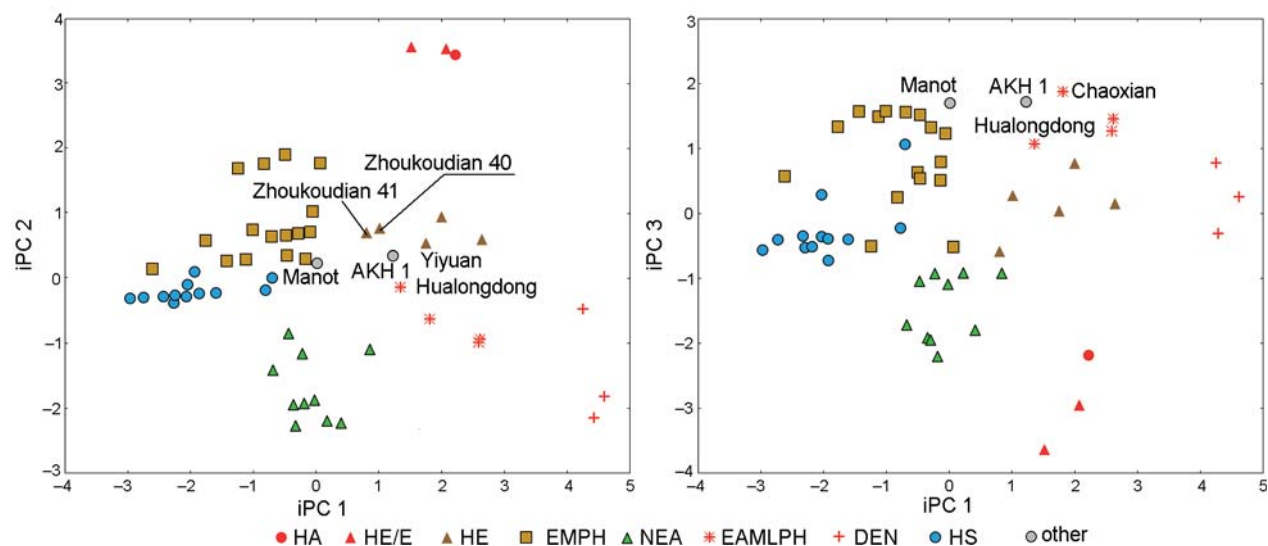


Fig. 5. Integral principal component analysis.

Legend same as on Fig. 4.

Table 3. Integrative PCA loadings of the metric and non-metric variables

Variable	iPC 1	iPC 2	iPC 3
Mesio-distal crown diameter	0.92	0.04	−0.08
Buccolingual crown diameter	0.82	0.03	0.22
Non-metric PC 1	−0.8	0.15	0.02
Non-metric PC 2	−0.03	0.81	0.11
Non-metric PC 3	−0.26	−0.32	0.22
Non-metric PC 4	−0.02	−0.16	0.75
Neanderthals	−0.02	−0.59	−0.53
<i>Homo sapiens</i>	−0.57	−0.08	−0.11
East Asian Middle and Late Pleistocene <i>Homo</i>	0.46	−0.2	0.31
<i>Homo erectus</i>	0.29	0.17	0.04
Denisovans	0.46	−0.19	0.02
European Middle Pleistocene <i>Homo</i>	−0.28	0.4	0.43
<i>Homo antecessor</i>	0.17	0.34	−0.23
<i>H. ergaster/erectus/georgicus</i>	0.09	0.04	0.18
AKH 1	−0.09	−0.17	0.12
Manot	0	0.03	0.18
Eigenvalue	3.23	1.82	1.64
% of total variation	18.97	10.73	9.62

The AKH 1 molar falls into the range of the Chinese fossils and separates from either *H. sapiens* or Neanderthals in any iPCs combination (Fig. 5).

Discussion

The results of the present study have shown the presence of a number of archaic features in AKH 1 morphology, including: specific odontoglyphic pattern, talon and trygonid “basins”, large crown dimensions, and a very large volume of the lateral dentin. Thus, the hypothesis assigning the AKH 1 fossil to *H. sapiens* must be rejected. In the same time, the absence of specific “Neanderthal” markers prevents diagnosing the tooth as a typical Neanderthal. Both versions of PCA put AKH 1 to the range of Chinese fossils—much more ancient than the published date of layer 3/1 (3a) of the Akhshtyrskaya site.

We acknowledge that the taxonomic interpretation of the results based on only one tooth must be made very cautiously. But the correct distribution of the other fossil (including isolated teeth), with established taxonomic diagnoses, in the PCA plots suggests that the position of AKH 1 can also be considered reliable. Thus, the similarity of the molar to the Chinese samples is hardly only a statistical artifact. This finding suggests that the Middle Paleolithic population dynamics in the Caucasus were more complicated than it was previously

thought. Besides “classic” Neanderthals, it might have been the home for other members of the *Homo* genus possessing archaic dental morphology similar to Chinese fossils. The taxonomic status of those hominins can hardly be precisely diagnosed at the moment, but various scenarios of their migration to the Caucasus can be discussed.

The first option is long-term preservation of the dental features typical of the earliest waves of hominin colonization of Eurasia in this mountainous region. It is feasible from the theoretic point of view, since during the last 2 millions years the Caucasus has been inhabited, besides *H. sapiens* and Neanderthals, by *H. ergaster/erectus/georgicus* and *H. heidelbergensis* (Martínón-Torres et al., 2008; King et al., 2016). For how long they retained in the region and how possible was their admixture with more advanced hominin groups is not clear.

Thus, the possibility of such long-term preservation of their dental pattern in the Middle Paleolithic Caucasian population cannot be completely excluded as well. But according to both distribution of all the variables and PCA results (see Fig. 4, 5) AKH 1 differs from the upper second molars from Dmanisi as well as from the *H. antecessor* and EMPH samples. As these fossils represent all the archaic evolutionary lineages in Europe potentially synchronous with AKH 1, the first hypothesis does not seem to be well substantiated at the moment.

The second scenario is a migratory one. The origin and timing of this migration cannot be established at present. As was thoroughly demonstrated and discussed above, the Chinese *H. erectus* upper second molars are similar to AKH 1. But the Chinese fossils are dated to much earlier times (430–160 ka BP) making a direct population relationships between them and AKH 1 unlikely. Of all the Asian specimens analyzed, only Xujiayao and Denisova 4 are close to AKH 1 chronologically. But those are not among the fossils most similar to it according to the integral PCA results. Nevertheless, some “shift” of AKH 1 towards Denisovans in the volume of lateral dentin and the similarity between it and Denisova 4 in some non-metric traits (see Fig. 4) is worth noting.

The third scenario implies a wider Eurasian areal of the Middle Paleolithic populations related with Chinese *H. erectus* than previously thought. There

are some reasons to assume that hominins similar to AKH 1 were present not only in the Caucasus but in the Near East as well: non-metric traits align this molar with MC 8 specimen from Manot Cave in Israel (see Fig. 4). The comparison of EDJ features has shown that the odontoglyphic pattern of MC 8 is not as complicated as in AKH 1, but a number of accessory fissures in the mesial area display similar archaic morphology (Sarig et al., 2021: Fig. 7). The integral PCA demonstrates that the molar from Manot aligns with EMPH owing to its small dimensions. Manot Cave is dated to the early phase of the Upper Paleolithic; thus, the “AKH 1-related” component might have been “blurred” by a later *H. sapiens* migration wave. Such admixture events are not excluded for the Manot Cave population (Ibid.: 14).

Summing up, the upper second molars morphologically similar to AKH 1 but belonging to different periods, except the Caucasus, were found in two geographic zones: China and Near East. Thus, the areal of the AKH 1 evolutionary lineage can only be delimited very broadly. The earliest fossils of this possible lineage came from China: Hexian, Yiyuan, Chaoxian, Hualongdong. The latest (AKH 1 and MC 8) were excavated in the Caucasus and Near East.

The question of the relationships between the “AKH 1 lineage” and the Altaian Denisovans remains open. Some connection with Neanderthals also cannot be ruled out completely for two reasons. First, some of the Neanderthal teeth, according to the PCA results, are shifted towards EAMLP and *H. erectus* (see Fig. 4, 5). Second, only the upper second molar morphology has been studied, and other teeth of the AKH 1 individual might have displayed more Neanderthal-like features.

Conclusions

Our analysis has shown that the AKH 1 molar does not belong to a *H. sapiens* individual. Rather, it likely refers to an archaic evolutionary lineage not represented in European dental fossil collections so far. The AKH 1 molar morphology is more similar to the late Chinese *H. erectus* than to *H. antecessor*, EMPH, or Dmanisi hominins. Thus, an Asiatic origin of the “AKH 1 lineage” can be suggested. We acknowledge that the existence of this lineage, as well as determining its taxonomic status or the relationship with the Neanderthal lineage, require new fossil samples and comparisons based on wider arrays of dental traits.

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**D.S. Adamov¹, A.Y. Potanina¹, Y.V. Bogunov¹,
M.K. Zhabagin², and E.V. Balanovska¹**

¹Bochkov Research Center for Medical Genetics,
Moskvorechye 1, Moscow, 115522, Russia

E-mail: nimissin@mail.ru; potaninaaanna@gmail.com;
forbogunov@inbox.ru; balanovska@mail.ru

²LLP "National Center of Biotechnology",
Kurgalzhynskoye road 13/5, Astana, 010000, Kazakhstan
E-mail: mzhabin@gmail.com

Genetic Portraits of the Yakut Regional Populations (Based on Y-Chromosome Polymorphism Data)

We present data on SNP haplogroups and STR haplotypes of the Y-chromosome in main Yakut ethno-local populations. Clusters of STR haplotypes and median networks of principal haplogroup N3a2 (N-M1982) indicate three lines: N-M1983, N-M1933, and N-Y25011. The first one, widely distributed throughout Yakutia and present in one half of Yakut males, marks the putative descendants of Elley, the legendary progenitor of the Yakuts. Line N-M1933 is found where descendants of another legendary progenitor, Omogoy, live. The N-Y25011 line is frequent in the Vilyuy basin, where the Yakuts had migrated from the Middle Lena in the 1600s. The predominance of lines N-M1983 and N-Y25011 is less marked in the northeastern part of this region than in the southwestern one. The frequency of haplogroup N3a2 drops to 70 % in the Yakuts of the northeastern Vilyuy basin, northeastern Yakutia, and northeastern Khabarovsk Territory. The estimated time to the most recent common ancestor of Yakuts, marked by the N3a2 haplogroup, 1200 ± 480 years, shows a fair agreement with aDNA data. Samples of the Yakuts from Yakutia and the Okhotsk coast and of Sakha-speaking Evenki reveal a compact "Yakut" core area in the multidimensional genetic space of the Y-gene pools of Siberia and the Far East. This core is marked by an elevated frequency (68–95 %) of the N3a2 haplogroup, which is rare (0–21 %) in other populations of Siberia (Dolgans, Nanais, Negidals, Nivkhs, Tuvans, Ulchi, Evenki, and Evens). Regional Y-chromosome profiles are consistent with historical data regarding Yakut origins and legends.

Keywords: Gene pool, Yakuts, Y-chromosome, haplogroups, STR haplotypes, median networks.

Introduction

The problem of the origin of the Yakuts has been studied for over 300 years by historians, archaeologists, ethnographers, and linguists. Numerous studies have formulated various hypotheses and made significant progress in understanding this issue; however, a definitive solution has yet to be found. Therefore, data from population genetics can serve as an additional source when discussing the questions of the origin and settlement of the Yakuts.

Russian pioneers who established Fort Lensky (Yakutsk) in 1632, encountered approximately 28,000 Yakuts (self-designation – Sakha) (Dolgikh, 1960: 542–544). The economic lifestyle of the Sakha (northern herders and horse breeders) was markedly different from that of their closest neighbors, whose way of life was based on reindeer herding, hunting, fishing, and gathering. Their language also differed, belonging to the Turkic language group. No written records about the Yakuts have been found till the early 17th century, but oral folk tradition

points to the names Elley Bootur and Omogoy Baai as the ancestral founders of the Sakha (Ksenofontov, 1977: 16–28). The ancestors of the few Khorinsky clans are considered to be the elder Uluu Khoro and his relatives (Istoriya Yakutii, 2020: Vol. I, p. 198).

By the beginning of annexation of the territory of modern Yakutia to the Russian State (17th century), more than 90 % of the Yakuts were concentrated in its central part, exactly in the interfluvium of the Lena and Aldan rivers (Istoriya Yakutii, 2021: Vol. II, p. 9). Over the next two centuries, they settled across a vast territory: the area of the Republic of Sakha (Yakutia) is about 3 million km², by 2021 the population of the Yakuts in this region reached 470,000 people, traditionally divided into central, Vilyuy, and northern groups (Istoriya Yakutii, 2020: Vol. I, p. 251).

One of the genetic tools that allows us to look back through the centuries is the comprehensive analysis of Y-chromosome polymorphism. Since the Y-chromosome is present in the cell nucleus only in males, there is virtually no shuffling of genetic material between parental genomes, and a significant portion of the Y-chromosome is passed down unchanged from father to son across generations. Rare mutations, gradually accumulating, give rise to a global genealogical tree of the Y-chromosome, where the genome of each man occupies its own place. This tree arises from single nucleotide polymorphisms (SNPs)—nucleotide substitutions. Its branches, of varying thickness and antiquity, are reflected in a strict hierarchical system of haplogroups at different levels. For historical reconstructions, mutations of another type, known as short tandem repeats (STRs), are also widely used. STR haplotypes differ from one another by the varying number of repeats of the same “motifs” (combinations of two to six nucleotides). The probability of STR mutations (increases or decreases in the number of repeated “motifs”) is much higher than that of single-nucleotide mutations. The approach to the mutational process as “molecular clocks” is based on mathematical models of probability theory, and allows for probabilistic estimates of the age of genetic events. If the rate of SNP mutations in “molecular clocks” is likened to the movement of the hour hand, then the rate of STR mutations is akin to the movement of the second hand. The use of both allows for reconstructing the timing of genetic events with varying degrees of accuracy.

All studies of the Y-gene pool of the Yakuts indicate a striking feature: an extremely low diversity of Y-chromosome haplogroups, with the dominance of the N-Tat haplogroup (Zerjal et al., 1997; Puzyrev et al., 2003), whose frequency reaches 80–90 % among the Yakuts (Tambets et al., 2004; Pakendorf et al., 2006;

Kharkov et al., 2008; Fedorova, 2008: 139), exhibiting a pronounced founder effect. Time to the most recent common ancestor (TMRCA) of modern carriers of this Y-chromosome variant is ca 1300 BP (Adamov, 2022).

In a number of studies (Pakendorf et al., 2006; Fedorova, 2008: 139–154; Fedorova et al., 2014), the main Yakut ethno-local populations were investigated—central, Vilyuy, and northern. The proximity of the first two was identified, as well as a decrease in the frequency of the main haplogroup N-Tat among northern Yakuts (about 70 %) as compared to central and Vilyuy Yakuts (80–90 %).

The study of ancient DNA from anthropological materials of Yakut burials has confirmed the continuity and relative stability of Y-chromosome lineages over the past 400 years (Fedorova, Zvenigorosky, Alekseev, 2023). Analysis of 17-marker Y-STR haplotypes revealed three dominant haplotypes in ancient and modern Yakut populations: the most frequent Ht1 is present in all groups; Ht2 is prevalent in the central part of Yakutia; and Ht3 predominates in the Vilyuy region.

Following the human genome sequencing and the rapid development of whole-genome sequencing technologies, new opportunities have arisen for studying the genetic history of the Yakuts (Poznik et al., 2013; Lippold et al., 2014; Karmin et al., 2015; Ilumäe et al., 2016). It has been established that the N-M2019/M2118 lineage emerged on the phylogenetic tree of the parent N-Tat haplogroup ca 6200 BP (YFull..., 2023). The Yakut lineage N-M1982 separated from other branches of N-M2019/M2118 haplogroup about 2300 BP (Adamov, 2022). It is divided into two branches of unequal frequency: the major N-M1991 and the minor N-M1933 (Karmin et al., 2015). The former, in turn, consists of sub-branches N-M1983 and N-Y25011 (Adamov, 2022).

Owing to clear correlations between branches N-M1983, N-Y25011, N-M1933 and combinations of haplotypes at STR loci, there is an opportunity to investigate various territorial populations of the Yakuts in more detail (Ibid.). The integration of Y-chromosome data obtained by research teams with new findings allows for a more precise reconstruction of the genetic history of the Yakuts.

Material and methods

Studied samples. A total of 758 Y-STR haplotypes from Yakut samples from Yakutia were selected for analysis: 135 from our own data (hereinafter referred to as o.d.), and 623 from publications by other authors. For 561 samples (121 o.d., 440 from literature data), the geographical origin of the donors is known (see Fig. 1). The grouping of samples by regions depended

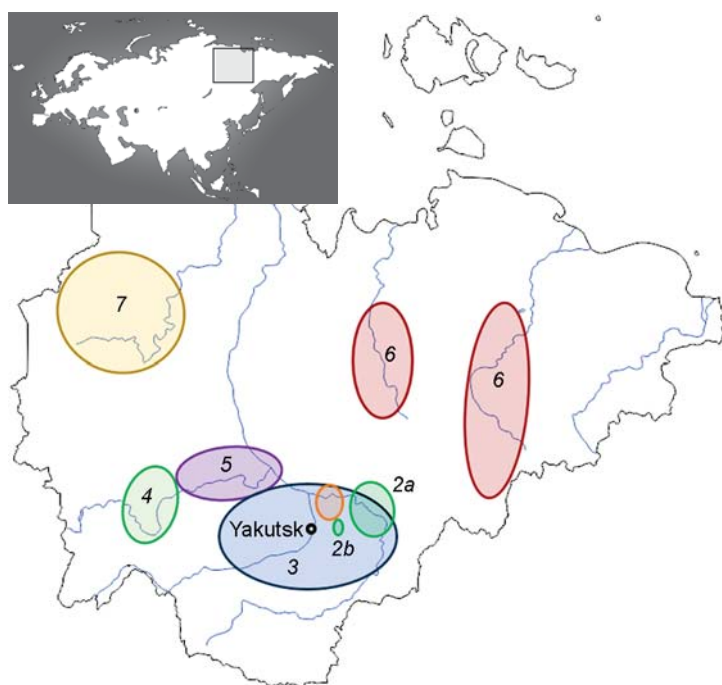


Fig. 1. Geographic location of the analyzed territorial groups of Yakuts.

1 – Ust-Aldansky ulus (after (Kharkov et al., 2008)); 2a – Tattinsky and Tomponsky uluses; 2b – the villages of Tolon and Chyappara in Churapchinsky ulus (after (Karafet et al., 2018)); 3 – central Yakutia (after (Thèves et al., 2010)); 4 – southwestern Vilyuy basin (after (Zvénigorosky et al., 2020)); 5 – northeastern Vilyuy basin (after (Xu et al., 2014)); 6 – northeastern Yakutia (Verkhoyansky, Oymyakonsky, Momsky, Abyisky uluses); 7 – Olenek Sakha-speaking Evenki.

on the sample size. The Vilyuy Yakuts are divided into two territorial groups: the southwestern Vilyuy basin – 48 samples (o.d.) from the Suntarsky and Nyurbinsky uluses; northeastern Vilyuy basin – 109 samples from the Vilyuysky, Verkhnevilyuysky, and Kobyaitsky uluses (17 o.d., 92 (Thèves et al., 2010)). The Yakuts of northeastern Yakutia are represented by 89 samples: from Abyisky (3 o.d.), Verkhoyansky (1 o.d.), Momsky (50 (Zvénigorosky et al., 2020)), and Oymyakonsky (35 (Ibid.)) uluses. The group of central Yakutia includes 176 samples from the Ust-Aldansky ulus (6 o.d., 108 (Kharkov et al., 2008), 62 (Karafet et al., 2018)); 78 from the Tattinsky (6 o.d.), Tomponsky (4 o.d.) uluses, and western Churapchinsky (41 (Thèves et al., 2010), 27 (Zvénigorosky et al., 2020)); 61 samples from other uluses (36 o.d., 25 (Xu et al., 2014)). Data on 157 samples are presented for the first time: 135 from Yakutia and 22 samples from the Yakuts living in the northeastern part of the Khabarovsk Territory. Samples from o.d. were collected after signing a voluntary informed consent form for examination, which was approved by the ethics committee of the Bochkov Research Center for Medical Genetics.

DNA extraction and genotyping. DNA was extracted from 153 samples of venous blood using the

phenol-chloroform extraction method with proteinase K. Genotyping (fragment analysis) was carried out on an ABI 3130xl instrument (Applied Biosystems) with the Y-filer PCR Amplification Kit (Applied Biosystems) (a 17-locus panel of Y-chromosome STR markers). Four samples of buccal epithelium were genotyped in a commercial laboratory FTDNA (12 STR loci).

Determination of haplogroups. Most samples used in this study had information on the Y-SNP haplogroup, with varying degrees of detail regarding its position on the Y-chromosomal haplogroup tree. For 158 samples, which were provided only with Y-STR haplotype data (Thèves et al., 2010; Xu et al., 2014), the haplogroup was predicted based on Y-STR haplotypes. The haplogroups of these samples were established by comparing them with haplotypes from other studies where haplogroups had been tested. In rare cases, the online predictor Nevgen (<https://www.nevgen.org>) was used.

Multidimensional scaling. Nei's genetic distances were calculated using the DJgenetic program (Balanovsky et al., 2008) based on the frequency of 13 Y-haplogroups: N3a2 (N-M2019/M2118), C-M407, C-M48, C-M217(xM504, M407, M48), N-F4205, N-P43, N-M231(xM2019/M2118, F4205, P43), Q-M242, O-M175, I-M170, J-M304, R1a-M420, R1b-M343. The “other” category includes the rarest haplogroups: C-M504, E1b1b1-M35.1, G1-M285, G2a-P15, and others. The matrix of Nei's genetic distances was visualized using multidimensional scaling (MDS) in Statistica version 7.1.

Phylogenetic networks. For a more detailed analysis of the structure of the Yakut haplogroup N-M1982, phylogenetic networks were constructed by median-joining (median networks) (Bandelt, Forster, Röhl, 1999) for the 17-marker haplotypes of the Y-filer set. The weight of each marker was set to 10, with a parameter $\epsilon = 0$. Median networks were constructed using Network v.10.2.0.0 and visualized in Network Publisher v.2.1.2.5.

The number of tandem repeats at locus DYS389B is defined as the difference in the number of repeats between loci DYS389II and DYS389I. There is a high probability that the N-M1991 lineage corresponds to 16 or more repeats at locus DYS392, while N-M1933 corresponds to 15 (cluster Ht2) (Adamov, 2022). The branches N-M1983 and N-Y25011 within haplogroup N-M1991 are separated by the alleles of locus DYS389B. In the N-M1983 lineage, 18 or more

repeats are observed (cluster Ht1). The N-Y25011 branch shows 17 or 16 repeats (cluster Ht3). However, a portion of haplotypes with DYS392 = 16 and DYS389B = 17 belongs to the N-M1983 lineage owing to a back mutation from 18→17 (Ibid.). The frequency ratio of branches N-Y25011 and N-M1983 within cluster Ht3 is currently unknown.

Results and discussion

Gene pools of local Yakut populations based on Y-SNP haplogroup data

Among the 15 Y-SNP haplogroups identified in the Yakuts (Table 1), N-M1982 predominates (85 %); it includes two main branches: N-M1991 (70 %) and N-M1933 (15 %). This dominance influences the multidimensional scaling plots based on Nei's genetic distance matrices across all haplogroups (Table 2; Fig. 2). For comparability with data from different publications, the “Yakut” haplogroup N-M1982 is included in the parent N3a2 one (also referred to as N-M2019/M2118).

In the gene pools of peoples of the Far East and Siberia, the Yakut cluster is clearly identified (Fig. 2), uniting all Yakuts and Sakha-speaking Evenki (see Fig. 1). This is due to the high frequency of haplogroup N3a2 (68–95 %), which ensured their remoteness from other peoples of Siberia and the Far East (Dolgans, Nanais, Negidals, Nivkhs, Tuvans, Ulchi, Evenki, Evens), where the N3a2 frequency varies from 0 to 21 % (on average 6 %). The values of genetic distances from the averaged Yakut population (see Fig. 2) clearly demonstrate its remoteness from other populations. The closest to the Yakuts are the Evens (Duggan et al., 2013). However, the genetic distance to them ($d = 0.90$) is significantly greater than the average genetic distances between Yakut groups ($d = 0.01$).

The positioning of populations within the Yakut cluster (see Fig. 2) indicates the predominant contribution of haplogroup N3a2 to its structure. In groups that are more distant from the center, the frequency of this haplogroup is lower than in core populations, but it remains majoritarian: the combined contribution of other haplogroups does not exceed 30 %. The Sakha-speaking Evenki are the only non-Yakut group within the Yakut cluster, having joined it owing to the high frequency of N3a2, although their gene pool also includes haplogroups characteristic of the Evenki (C-M48, 15 %) and other populations neighboring the Yakuts: N-P43 (6 %), R1a-M420 (6 %).

When analyzing the positioning of populations in the multidimensional genetic space, all STR haplotypes of the Yakut haplogroup N-M1982 were considered as a whole. The next step will be a more detailed analysis

of individual territorial groups of the Yakuts, using data on the distribution of various STR haplotypes of the dominant haplogroup N-M1982 within them.

Genetic history of the Yakuts based on STR haplotypes of dominant haplogroup N-M1982

To construct median networks, 338 samples of haplogroup N-M1982 were used, whose tandem repeats are known in 17 STR loci of the Y-filer panel. The estimation of the time to the most recent common ancestor of main lines N-M1991 and N-M1933 of haplogroup N-M1982 based on STR markers gives an estimate of 1200 ± 480 years. Since these lines are young, STR haplotypes within them generally coincide, except for two STR loci: DYS392 and DYS389B. In the consolidated median network, the STR haplotypes of N-M1982 are distinctly divided into three clusters: Ht1, Ht2, and Ht3 (Fig. 3, a; Table 2).

The legendary Turkic-speaking ancestor of the Yakuts, Elley (Istoriya Yakutii, 2020: Vol. I, p. 174), is conditionally associated with the Ht1 branch, which is observed in half of the modern Yakuts (see Table 1) (Adamov, 2022). The haplotype of this branch was identified in ancient human sample SS1 from the burial site of Sytygan Sihe, believed to be a descendant of Tygyn Darkhan (Zvénigorosky et al., 2020). The latter, according to legends, was a direct descendant of Elley.

Central Yakutia. According to legends, the second ancestor of the Yakuts, Omogoy Baai, the father-in-law of Elley, was from the Batulintsy tribe (Istoriya Yakutii, 2020: Vol. I, p. 192). A participant of the Second Kamchatka Expedition, G.F. Miller, in 1736–1737, recorded a message from the Yakut shaman Sotoy Trekin about the composition of this tribe: “Baksintsy, Batulintsy, Silangtsy, Igideitsy, Dzhokdzokhontsy, Torasintsy, Orgoty, Baigantaytsy” (cited after (Elert, 2001: 112–113)). The naslegs formed from the names of the Batulintsy clans are currently located in different uluses of Yakutia, including Churapchinsky, Tattinsky, and Tomponsky (see Fig. 1). The Bakhstytsky (village of Tolon) and Alagarsky (village of Chyappara) naslegs border each other to the west of Churapchinsky ulus. In the 17th–18th centuries, the Alagarsky clan was part of the Sylanskaya volost (Dolgikh, 1960: 376). According to legends, the Bakhstytsy and Sylanttsy are descendants of Omogoy (Aprosimov, Popov, 2015: 38).

The high frequency of the N-M1933 lineage (approximately 58 %) observed in the Tattinsky and Tomponsky uluses, as well as in the western part of the Churapchinsky ulus, may indicate the contribution of modern descendants of bootulu (Batulintsy) clans to the gene pool of the region. Notably, the

Table 1. Frequency of Y-chromosome haplogroups in regional populations of the Yakuts, %

Haplogroup, branch	Central Yakutia						Vilyui		Northeastern Yakutia	Northeastern Yakutia (Fedorova et al., 2013)	Northeastern Yakutia, Verkhoyansky ulus (Pakendorf et al., 2006)	Olenek Sakha-speaking Evenki (Pakendorf et al., 2006)	Yakuts from the Republic of Sakha (Yakutia) as a whole	Ayano-Mayaysky, Tuguro-Chumikansky, and Okhotsky Yakuts
	Ust-Aldansky ulus	Tattinsky, Tomponsky uluses, western Churapchinsky ulus	Other uluses	(Fedorova et al., 2013)	(Pakendorf et al., 2006)	Southwestern Vilyui basin	Northeastern Vilyui basin	(Fedorova et al., 2013)	(Pakendorf et al., 2006)					
	n = 176	n = 78	n = 61	n = 92	n = 95	n = 48	n = 109	n = 57	n = 56	n = 89	n = 66	n = 32	n = 33	n = 758
N-M2019/M2118	86.9	93.6	85.2	84.8	90.5	89.6	73.4	91.2	98.2	69.7	68.2	87.5	72.7	84.9
N-M1982	86.9	93.6	85.2	84.8	90.5	89.6	73.4	91.2	98.2	69.7	68.2	87.5	72.7	84.9
N-M1991	82.4	35.9	77.0	72.8	...	87.5	59.6	84.2	...	60.7	65.2	...	51.5	69.9
DYS389B = 18	68.2	33.3	54.1	...	...	45.8	31.2	...	...	56.2	...	...	45.4	50.9
DYS389B = 17	14.2	2.6	22.9	...	...	41.7	28.4	...	...	4.5	...	...	6.1	19.0
N-M1933	4.5	57.7	8.2	12.0	...	2.1	13.8	7.0	...	9.0	3.0	...	21.2	15.0
N-M231(xM2019/M2118)	5.7	2.6	1.6	3.3	4.1	4.2	4.5	1.8	—	17.9	13.6	—	6.1	5.3
N-F4205	0.6	—	—	1.1	1.0	2.1	1.8	—	—	6.7	1.5	—	—	1.5
N-P43	1.7	2.6	1.6	2.2	1.0	—	0.9	—	—	5.6	10.6	—	6.1	1.7
N-M231(xM2019/M2118, F4205, P43)	3.4	—	—	—	2.1	2.1	1.8	1.8	—	5.6	1.5	—	—	2.1
C-M217	5.1	2.6	6.5	1.1	2.1	4.2	12.8	3.5	—	2.2	13.6	6.2	15.1	5.1
C-M407	0.6	—	4.9	1.1	2.1	—	1.8	—	—	—	4.5	—	—	1.1
C-M504	—	1.3	1.6	—	—	2.1	0.9	—	—	—	—	—	—	0.7
C-M48	3.4	—	—	—	—	2.1	10.1	3.5	—	2.2	6.1	3.1	15.1	2.8
C-M217(xM407, M504, M48)	1.1	1.3	—	—	—	—	—	—	—	—	3.0	3.1	—	0.5
I-M170	—	—	4.9	2.2	—	—	3.7	1.8	—	1.1	—	—	—	1.1
J-M304	—	—	1.6	—	—	—	—	—	1.8	2.2	—	—	—	0.5
O-M175	—	—	—	—	—	2.1	1.8	—	—	—	—	—	—	0.4
Q-M242	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1
R1a-M420	2.3	1.3	—	6.5	—	—	3.7	1.8	—	5.6	4.5	3.1	6.1	2.5
R1b-M343	—	—	—	2.2	—	—	—	—	—	1.1	—	—	—	0.1

Table 2. Genetic distances of populations from the aggregate Yakut sample

Abbreviation	Population	Genetic distance*	Sample size
Ya-total-2	Yakuts	0.000	995
Ya-total-1	Yakuts from the Republic of Sakha (Yakutiya) as a whole	0.000	758
Ya-center	Yakuts from central Yakutiya	0.000	502
Ya-vil-FP	Vilyui Yakuts	0.001	113
Ya-vil-sw	Yakuts from southwestern Vilyui basin	0.002	48
Ya-ne	Yakuts from Northeastern Yakutia	0.004	187
Ya-vil-ne	Yakuts from northeastern Vilyui basin	0.006	109
Sakha-ev	Sakha-speaking Evenki (Pakendorf et al., 2006)	0.018	33
Okhotsky	Okhotsky Yakuts	0.023	22
Evens-D	Evens (Duggan et al., 2013)	0.893	89
Evenki-baik	Evenki from Transbaikalia	1.35	50
Evenki-K	Western Evenki (Karafet et al., 2018)	1.37	91
Evenki-amur	Evenki from the Amur region	1.64	81
Dolgans-K	Dolgans, Taimyr (Karafet et al., 2018)	1.79	57
Ulchi	Ulchi	2.59	52
Tuvans	Tuvans	2.99	450
Evenki-P	Evenki, Podkamennaya Tunguska (Pakendorf et al., 2006)	3.12	40
Nanais	Nanais	3.15	267
Negidals	Negidals	3.22	14
Evens-okhot	Evens	3.25	88
Nivkhs	Nivkhs	3.35	63

*The color scale reflects genetic proximity (green) to the Yakuts or distance (red) from them.

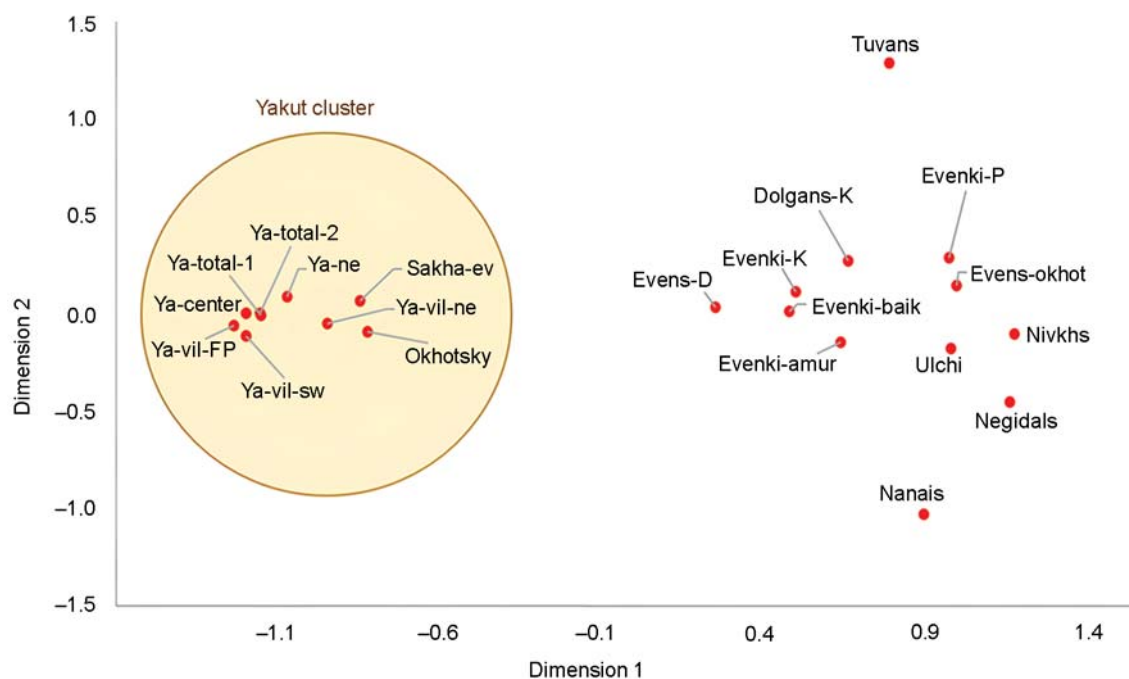


Fig. 2. Position of nine united groups of Yakuts in the genetic space of populations of Siberia and the Far East (multidimensional scaling plot, stress coefficient 0.07, alienation 0.09).

See Table 2 for explanations.

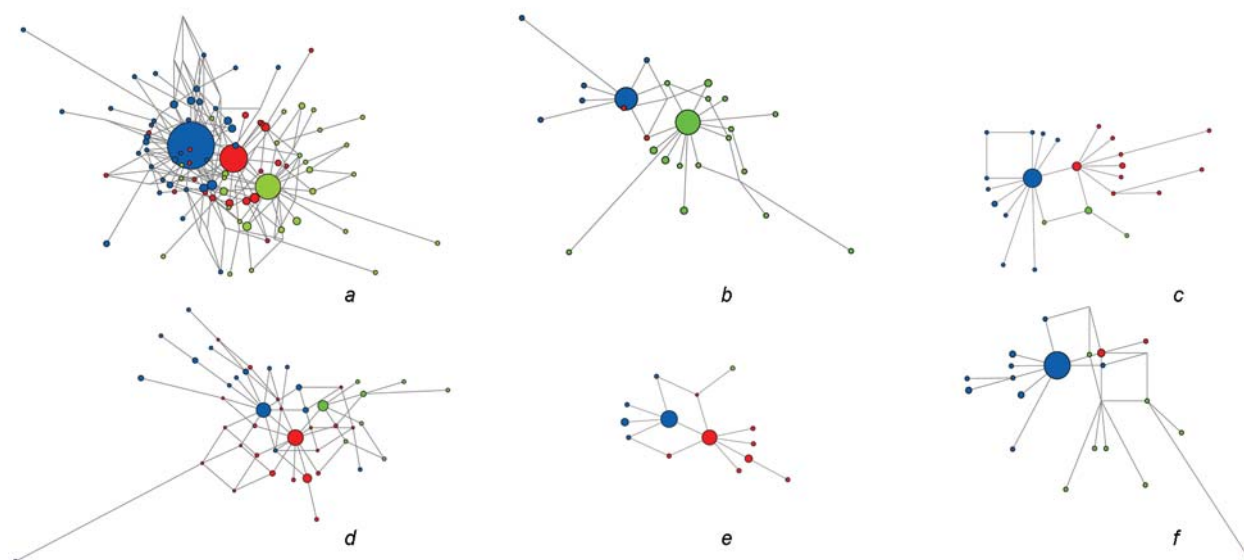


Fig. 3. Median networks of STR haplotypes of haplogroup N-M1982.

a – Yakuts in general ($n=338$); *b* – Tattinsky, Tomponsky, and western Churapchinsky (Chyappara, Tolon) uluses ($n=73$); *c* – central Yakutia, excluding the above-mentioned uluses ($n=54$); *d* – northeastern Vilyuy basin ($n=80$); *e* – southwestern Vilyuy basin ($n=42$); *f* – northeastern Yakutia ($n=62$).

Branch Ht1 (blue) – haplotypes N-M1991, DYS389B = 18; Ht2 (red) – haplotypes N-M1991, DYS389B = 17; branch Ht3 (green) – haplotypes N-M1933.

Table 3. Main (modal) 17-marker STR haplotypes of Yakut samples with haplogroup N-M1982

Cluster	Ht1	Ht2	Ht3
DYS19	14	14	14
DYS385a	11	11	11
DYS385b	13	13	13
DYS389I	14	14	14
DYS389B	18	17	17
DYS390	23	23	23
DYS391	11	11	11
DYS392	16	15	16
DYS393	14	14	14
DYS437	14	14	14
DYS438	11	11	11
DYS439	10	10	10
DYS448	19	19	19
DYS456	14	14	14
DYS458	16	16	16
DYS635	22	22	22
GATA H4	12	12	12

anthropological materials from the 17th–19th burials in the Zhuleisky and Bayaginsky naslegs, as well as in the village of Ytyk-Kyuel (Kien-Ebe) in the Tattinsky ulus, are dominated by haplogroup N-M1933 (Crubézy et al., 2010). Out of 12 ancient STR haplotypes, 11 belong to cluster Ht2. The prevalence of the N-M1933 branch (Ht2) is also demonstrated by the median network of

17-marker haplotypes, constructed from samples from the above-mentioned uluses (Fig. 3, *b*). Ht3 haplotypes are rarely found in these areas.

A large group of uluses in central and southern Yakutia—Khangalassky, Megino-Kangalassky, Gorny, Namsky, eastern part of Churapchinsky, Amginsky, Olekminsky, and Aldansky—yielded 61 samples. Clearly, further and more in-depth study is required. At this stage, the distribution of branches of haplogroup N-M1982 among these samples does not significantly differ from the general Yakut distribution (see Table 1).

The ratio of modern haplotypes Ht1 to Ht3 is approximately 2.5 to 1. The dominance of branch Ht1 is also noted in ancient Yakut samples: in six out of seven samples from the Meginty Yakuts, in eight out of ten samples from the Erkeeni valley in Khangalassky ulus (Keyser et al., 2015; Zvéni gorosky et al., 2020), and in seven out of nine from burials in the eastern part of Churapchinsky ulus (Crubézy et al., 2010).

A separate median network for the Yakuts of Ust-Aldansky ulus cannot be constructed owing to the small number ($n=5$) of 17-marker haplotypes N-M1982. However, the high frequency (68 %) of haplotypes from cluster Ht1 aligns with the legends of the Dyupsyuntsy and Borogontsy clans about their descent from the legendary ancestor Elley (Aprosimov, Popov, 2015: 28, 31).

The combined median network of Yakut haplotypes from other uluses in central Yakutia (see Fig. 3, *c*) shows similarity to the overall Yakut distribution (Fig. 3, *a*).

Vilyui Basin. The Vilyui Yakuts are dominated by lineage N-M1991. The frequencies of 17 or 18 repeats at locus DYS389B are approximately equal, indicating an increased frequency specifically for branch N-Y25011. However, in the northeastern Vilyui basin, the dominance of haplogroup N-M1991 is less pronounced (about 60 %) than in the Yakuts living upstream, in the Nyurbinsky and Suntarsky uluses (about 87 %). This distribution is related to the fact that at the time of the Russian pioneers' arrival, lower reaches of the Vilyui were populated by various groups of "hiking Yakuts" of unknown origin—Kyrgydai, Kirikei, Ontuly, Olesy, etc. (Dolgikh, 1960: 462–469). As a result of mass migration in the 17th–18th centuries of various populations from central Yakutia, some local Tungus clans transitioned to pastoralism and became assimilated.

The ancestor of some naslegs in the northeastern Vilyui basin is believed to be Omogoy Baai, according to local legends (Aprosimov, Popov, 2015: 50–58). The Batulintsy (bootulu) occur among the Vilyui and northern Yakuts (Ushnitsky, 2015). This may explain the presence of samples from haplogroup N-M1933 (14 %) in the dataset. The median network of haplotypes N-M1982 for the northeastern Vilyui basin (Fig. 3, *d*) shows a minor proportion of haplotypes Ht2.

The territory of the modern Suntarsky, Nyurbinsky, and Verkhnevilyuysky uluses, during the 17th–18th centuries, was settled by Bordontsy, Zharkhantsy, and other migrants from central Yakutia, considering themselves the descendants of Elley (Parnikova, 1971: 47–50, 60–61; Ushnitsky, 2017; Petrov, 2017). In the southwestern Vilyui basin, samples from the "Omogoy branch" N-M1933 are almost absent (see Table 1). A high frequency of lineage N-M1991 is also observed in samples from ancient Yakut burials in the Suntarsky and Nyurbinsky uluses (Keyser et al., 2015; Zvenigorosky et al., 2020), in eight out of nine cases. The median network for the southwestern Vilyui basin (Fig. 3, *e*) clearly demonstrates the aforementioned predominance of lineage N-M1991 (with an equal ratio of haplotypes Ht3 and Ht1) and the almost complete absence of cluster Ht2.

Northeastern Yakutia. In this case, samples from different uluses were used (see Fig. 1). The dominance of lineage N-M1991 is accompanied by a relatively high frequency of haplogroup N-M1933 (approximately 9 %). This is probably related to the resettlement of some Bayagantaysky people to the Oymyakon area and along the Moma River. Overall, the frequency of the Yakut haplogroup N-M1982 remains high, around 70 %. All ancient samples (except for one) from burials in the Verkhoyansky (16 samples) and Oymyakonsky (3 samples) uluses

belong to cluster Ht1 (Keyser et al., 2015; Zvenigorosky et al., 2020). The increased proportion of this branch is also evident in the median network (Fig. 3, *f*).

Northeastern Khabarovsk Territory. In the group represented by Ayano-Maysky, Tuguro-Chumikansky, and Okhotsky Yakuts (see Table 1), the predominance of lineage N-M1982 remains at 68 %. The other haplogroups (except for I-P37.2 (9 %))—C-M48 (14 %), N-P43 (4.5 %), and O-M268 (4.5 %)—have Tungus-Manchu or local pre-Yakut origins. Haplotype O-M268 matches that of the Verkhoyansky Evenk across nine STR markers, as reported by B. Pakendorf et al. (2007).

Following the Russian pioneers who founded Fort Okhotsk in 1647, the first Yakuts reached the Sea of Okhotsk in the late 17th to early 18th centuries (Parnikova, 1971: 57), as the rapid extermination of sables, necessary for paying tribute, in central Yakutia forced them to undertake long expeditions for hunting or purchasing sable furs. However, more mass migrations of the Yakuts, both voluntary and forced, occurred later owing to the transportation of goods along the Okhotsk (1731–1852) and Ayan (1852–1867) routes (Ibid.: 91–97). Various goods (fabrics, tea, foodstuffs, manufactured goods, etc.) were transported to ports, and then delivered by sea to Petropavlovsk-Kamchatsky and Alaska. Furs from America (beaver pelts, sea otter furs, etc.) and marine products were unloaded from ships in the ports. Some Yakuts were hired to work for the Russian-American Company. Haplotype N-M1991 of a descendant of one of these Yakuts—a Native American from the Athabaskan tribe (Alaska, USA)—has been published (Davis et al., 2011).

Genetic history of the Yakuts with other haplogroups

Other haplogroups are observed in 15 % of 114 samples of the Yakuts from the Republic of Sakha (see Table 1). According to legends, one of the ancestors of the Sakha, along with Elley and Omogoy, is the elder Uluu Khor—the leader of the Khorinsky clans. The language of the Khorinsky people was not understood by the Yakuts; therefore, modern researchers believe that the Khorinsky represent a Mongolian component of the Sakha ethnogenesis. Haplogroups C-M407, N-F4205, and C-M504 ("starcluster"), predominant among the Buryats and Barguts, are observed among the Yakuts with an overall frequency of about 3 %. This aligns with the estimated population of Khorinsky people: about 2 % of the total Yakut population in the early 20th century (Ksenofontov, 1992: 161). Notably, one haplotype from the "starcluster" was identified in a resident of the village of Khor in the Suntarsky

ulus. Anthropological materials from Yakut burials of the 17th–19th centuries yielded two samples with haplogroup C-M407 and two with haplogroup N-F4205 (Crubézy et al., 2010; Zvéni gorosky et al., 2020).

The overall frequency of haplogroups presumably of Tungus or local pre-Yakut origin (C-M48, N-P43, Q-M242) among the Yakuts does not exceed 5 %. Samples from the Early Iron Age in Yakutia have shown the presence of haplogroup N-P43 (individual from the village of Dyupsya) (Ma et al., 2021) and the absence of the Tat mutation (Pokrovsk man) (Amory et al., 2006).

The paragroup N-M231(xM1991, M1933, F4205, P43) is mainly represented by European branches of N-Tat. Together with other haplogroups atypical for Northeast Asia (I, J, R1a, R1b), it contributes about 6 %. The ancestors of the donors of samples O-P49 (two haplotypes) and O-M1706 (one haplotype) were apparently migrants from the Korean Peninsula.

On the origin of the Yakuts

The observed characteristics of the above territorial groups are explained by the mass migration of the Yakuts from central to more remote areas of Yakutia, and partly beyond its borders, in the 17th–18th centuries. The core of the Yakut people was formed in central Yakutia as a result of a demographic explosion, dated by the polymorphism of haplogroups N-M1991 and N-M1933 to the 14th century AD (Adamov, 2022). Calculations of the founder effect based on autosomal data also point to this date (Tournebize, Chu, Moorjani, 2022). Patrilinearity and patrilocality ensured the stable transmission of the Y-chromosome in the territories inhabited by Yakut clans. Marriages among the Yakuts were determined by exogamous traditions: brides were sought from other uluses or at least from other naslegs. Yakut men easily married Tungus women, but Yakut women rarely married Tungus men (Fedorova, 2008: 183; Fedorova, Khusnutdinova, 2022). These features of Yakut marriage traditions are reflected in the dominance of one relatively young Y-chromosome haplogroup, N-M1982, and a sufficiently high diversity of the mitochondrial DNA pool (Fedorova, 2008: 183–185; Fedorova, Khusnutdinova, 2022).

Conclusions

The combination of results from mass parallel sequencing of the Y-chromosome and the accumulated data on STR haplotypes allowed for the division of the young haplogroup N-M1982, which dominates among the Yakuts (at a level of 85 %), into three branches. The following features have been identified in the main Yakut ethno-local groups:

1. Throughout the territory inhabited by the Yakuts, branch N-M1991 with DYS389B = 18 is recorded with high frequency, which is associated with the legendary progenitor Elley. According to tradition, he is considered the male ancestor of most Yakuts: the “Elley line” is found in half of the men.

2. Branch N-M1933 is widespread in the areas inhabited by the descendants of the Batulintsy people; in the folk tradition, the latter are related to the second legendary ancestor of the Yakuts, Omogoy, and his tribesmen. In central Yakutia, a high frequency of the “Omogoy line” has been identified in the Tattinsky and Tomponsky uluses, and in the western part of Churapchinsky (Bakhsytsky and Alagarsky naslegs).

3. The high frequency of branch N-M1991 with DYS389B = 17 in the Vilyuy basin is apparently associated with the migration of the Bordontsy and Zharkhantsy clans from the middle Lena region in the 17th century, as recorded in Russian written sources. The dominance of haplogroups N-M1983 and N-Y25011 in the northeastern Vilyuy basin is less pronounced than that in the southwest.

4. The frequency of Yakut haplogroup N-M1982 decreases to about 70 % in the territorial groups of Yakuts in the northeastern Vilyuy basin, Yakutia, and Khabarovsk Territory.

5. The minor Yakut haplogroups have different origins. Haplogroups C-M407, N-F4205, C-M504 (“starcluster”) may reflect a Mongolian component in the Yakut ethnogenesis (frequency 3 %). The frequency of haplogroups of Tungus or local pre-Yakut origin—C-M48, N-P43, Q-M242—is also low (about 5 %) among the Yakuts. Haplogroups that joined the Yakut people at a later time (I, J, R1a, R1b, etc.) have a combined frequency of about 7 %.

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PERSONALIA

Walking the Paths of the Past. To the 80th Birthday of Professor V.V. Bobrov

Vladimir Bobrov was born on June 5, 1945 to a family of war veterans Vasily Ivanovich and Nina Egorovna. His school years were typical of the children of military servants. He studied in his father's places of service—the Ukraine, Germany, and later in the city of Kemerovo. Siberia and Kuzbass became his home. Already in high school, the young man decided to commit to archaeology.

In 1962, Vladimir Bobrov entered the Department of History and Philology at the Kemerovo State Pedagogical Institute (since 1974, Kemerovo State University). After successfully completing his studies in 1966, he became an Assistant at the Division of General History of the same department. In those years, this was an exceptional case for a graduate. The gift that V.V. Bobrov's destiny gave him was his outstanding teachers. A.I. Martynov—later, Doctor of Historical Sciences and Full Professor—laid the knowledge foundation and unleashed the potential of V.V. Bobrov's organizational talents. The scholarly supervisor of the already postgraduate student was A.P. Okladnikov, Member of the Soviet Academy of Sciences, who shaped the breadth of V.V. Bobrov's thinking. Vladimir Bobrov went through the school of field research of both these great teachers. His development was also influenced by M.P. Gryaznov, who, like no one else, was able to penetrate the essence of the source under study.

An important milestone in the life of Vladimir Bobrov was his service in the Soviet Army on Sakhalin. One of the most important events in Bobrov's life happened after the military service—he married an amazing girl. Vladimir Bobrov's wife Natalya—a true companion and friend for over 50 years—shared both difficult Siberian expeditions and life's joys and hardships with him.

In 1972, V.V. Bobrov received his first state permit for excavating a Tagar burial mound near Lake Berchikul, in the Tisulsky District, Kemerovo Region. In the same year, he was elected to the position of Senior Lecturer. In 1973, Vladimir Bobrov defended his doctoral dissertation, *Deer in Scythian-Siberian Art of the Animal Style (Tagar Culture)*, and became an Associate Professor.



In 1975, the Department of Archaeology was opened at the Kemerovo State University, and in 1977, Bobrov was appointed the Deputy Head of this department. Looking ahead, we should say that in 1998 he would become its head until 2022. In 1992, the scholar brilliantly defended his post-doctoral dissertation *Kuznetsk-Salair Mountain Region in the Bronze Age*, and in 1994 he was awarded the academic title of full professor.

Vladimir Bobrov has made a great contribution to education. The topics of the lecture courses that he taught in different years are wide and include "Problems of Siberian Archaeology of the Stone and Bronze Ages", "Prehistoric Art", "Archaeological Source Studies", "Siberia in the Bronze Age", etc. Over 80 graduate theses of students specializing in archaeology of Eurasia were prepared under the supervision of Bobrov. For many decades, he has been supervising archaeological practical training of students.

Vladimir Bobrov proved himself to be a talented organizer; under his supervision, the Department of

Archaeology at the Kemerovo State University has reached the pinnacle of its development. In 1999, V.V. Bobrov raised money and resumed the tradition of publishing the collections of articles and monographs of the department employees. Vladimir Bobrov actively supports the research areas in the scope of the department's work. In 2009, the Kemerovo State University Academic Council approved the status of the scholarly archaeological school "Study of Culture and Art of Ancient Societies at the Junction of Northern and Central Asia (Traditions and Innovations)". In 2004 and 2009, under the supervision of V.V. Bobrov, professors and students of the department prepared and held the XLIV and XLIX Regional Archaeological and Ethnographic Conferences of Students and Young Scholars, which were attended by young researchers from Siberia, the Far East, Central Russia, and neighboring countries.

In 1995, a joint Kuzbass Laboratory of Archaeology was established on the initiative of A.P. Derevianko, Director of the Institute of Archaeology and Ethnography of the SB RAS, Academician of the RAS, and Y.A. Zakharov, Rector of the Kemerovo State University, Corresponding Member of the RAS. V.V. Bobrov headed the laboratory since its creation until 2018. According to the Charter of the SB RAS, the laboratory territorially belonged to the Kemerovo Scientific Center, and thus Vladimir Bobrov was incorporated into its Presidium. The laboratory's activities included studying various issues of demographic and social processes in ancient societies of Siberia, as well as mechanisms of cultural interaction and their historical importance; special attention was paid to identifying the features of historical and cultural processes in the mountain ecosystem of Southern Siberia.

In 2004, the Institute of Human Ecology of the SB RAS was founded in Kemerovo on the initiative of the Presidium of the SB RAS, with direct participation of V.V. Bobrov. Vladimir Bobrov was appointed its Deputy Scientific Director and headed the department of research in humanities. In 2016, the institute became a part of the newly formed Federal Research Center for Coal and Coal Chemistry of the SB RAS.

Scholarship has always been and remains the main calling of Professor V.V. Bobrov. He is the head of the Kuzbass Archaeological Expedition at the Institute of Human Ecology of the SB RAS and Kemerovo State University, whose work is associated primarily with his native Kuzbass. The range of V.V. Bobrov's research concerns various areas of ancient human activities from the Neolithic to the Middle Ages.

Important results were obtained during the fundamental study of the Tanai Archaeological Microdistrict on the border of Novosibirsk and Kemerovo regions (1986–2006). In the same years, Vladimir Bobrov elaborated the concept of development of historical and cultural processes in the Neolithic and Bronze Ages in the Kuznetsk-Salair Mountain Region.

Since 2003, every July, the Kuzbass Archaeological Expedition of the Institute of Human Ecology of the SB RAS and Kemerovo State University, under the leadership of Professor Bobrov, has been carrying out archaeological works at the sites near the village of Vengerovo in the Novosibirsk Region. In this area, V.V. Bobrov's research works focus on Neolithic settlement complexes. Vladimir Bobrov and his colleagues and students are the discoverers of the Early Neolithic flat-bottomed pottery in the Baraba forest-steppe. Unique items of production and household types were found and studied at the Late Bronze Age settlement of Lozhka-6.

Today, Doctor of Historical Sciences, Professor Vladimir Bobrov is known as an outstanding archaeologist of Siberia. He is the author and co-author of over 440 scholarly works, including 12 monographs. Eighteen doctoral dissertations were defended under his supervision; he was a scholarly consultant in preparation of three post-doctoral dissertations.

High scholarly rating of V.V. Bobrov is evidenced by the constant support of his projects by the leading Russian foundations. His great authority in professional circles is confirmed by his long-term participation in the editorial board of the international journal *Archaeology, Ethnography and Anthropology of Eurasia*, and editorial boards of the *Bulletin of the Kemerovo State University* and *Bulletin of the Irkutsk State University*. He is a member of several dissertation councils.

The work of V.V. Bobrov has been highly appreciated by the federal and regional governments. He was awarded medals "For Special Contribution to the Development of Kuzbass" of the II and III degrees (2003, 2007), is an honored employee of higher education of the Russian Federation (2002), Honorary Professor of Kuzbass (2008), Honored Professor of Kemerovo State University (2021), etc.

The hero of the day has new expedition roads, new discoveries, books, and articles ahead. Let us wish Vladimir Bobrov bright achievements, interesting, bold ideas, and creative happy moments in the field and at the desk.

*A.P. Derevianko, V.I. Molodin, N.V. Polosmak,
L.N. Mylnikova, M.S. Nesterova, Y.N. Nenakhova,
V.P. Mylnikov, and A.I. Solovyev*

AN SSSR – USSR Academy of Sciences
 AN TadjhSSR – Academy of Sciences of Tajik SSR
 GAIMK – State Academy for the History of Material Culture (Moscow)
 GI KNC RAN – Geological Institute, Kola Science Center, Russian Academy of Sciences (Apatity)
 IA NANU – Institute of Archaeology National Academy of Sciences of Ukraine (Kyiv)
 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)
 IIFF SO AN SSSR – Institute of History, Philology and Philosophy, Siberian Branch, USSR Academy of Sciences (Novosibirsk)
 IIMK RAN – Institute for the History of Material Culture, Russian Academy of Sciences (St. Petersburg)
 IOP – Institute of Physics (London)
 KSIA – Brief Communications of the Institute of Archaeology, Russian Academy of Sciences
 MAE RAN – Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences (St. Petersburg)
 MIA – Materials and Investigations on Archaeology in the USSR
 PNAS – Proceedings of the National Academy of Sciences
 SAA – Society for American Archaeology
 VSEGEI – Karpinsky Russian Geological Research Institute (St. Petersburg)
 YaNC SO RAN – Yakut Scientific Center, Siberian Branch, Russian Academy of Sciences (Yakutsk)

TO WHOM IT MAY CONCERN

In the issue 53 (1) 2025, on page 45, there was an error in the left column, lines 16–17 from the top:

Cited as:

Should be cited as:

...sea-mollusk shell, crown of sable tooth, and red-deer tooth a the hole...

sea-mollusk shell and red-deer tooth with a hole...

- Adamov D.S.**, Senior Researcher, Bochkov Research Center for Medical Genetics, Moskvorechye 1, Moscow, 115522, Russia. E-mail: nimissin@mail.ru; <https://orcid.org/0009-0009-3527-4195>
- Agatova A.R.**, Senior Researcher, Sobolev Institute of Geology and Mineralogy, Siberian Branch, Russian Academy of Sciences, pr. Akademika Koptiyuga 3, Novosibirsk, 630090, Russia; Senior Researcher, Yeltsin Ural Federal University, Mira 19, Yekaterinburg, 620062, Russia. E-mail: agatr@mail.ru; <https://orcid.org/0000-0002-1823-218X>
- Balanovska E.V.**, Head of the Human Population Genetics Laboratory, Bochkov Research Center for Medical Genetics, Moskvorechye 1, Moscow, 115522, Russia. E-mail: balanovska@mail.ru; <https://orcid.org/0000-0002-3882-8300>
- Barinov V.V.**, Senior Researcher, Siberian Federal University, pr. Svobodny 79, Krasnoyarsk, 660041, Russia. E-mail: nelisgar@mail.ru; <https://orcid.org/0000-0002-3582-3440>
- Berezkin Y.E.**, Department Head, Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya nab. 3, St. Petersburg, 199034, Russia. E-mail: berezkin1@gmail.com; <https://orcid.org/0000-0001-6001-7339>
- Bogunov Y.V.**, Assistant, Bochkov Research Center for Medical Genetics, Moskvorechye 1, Moscow, 115522, Russia. E-mail: forbogunov@inbox.ru; <https://orcid.org/0000-0001-7643-3660>
- Bravina R.I.**, Professor, Chief Researcher, Institute for Humanities Research and Indigenous Studies of the North, Siberian Branch, Russian Academy of Sciences, Petrovskogo 1, Yakutsk, 677027, Russia. E-mail: bravinari@bk.ru; <https://orcid.org/0000-0002-4902-8288>
- Davydov R.V.**, Junior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: puer-viro@mail.ru; <https://orcid.org/0000-0001-6580-2811>
- Derevianko A.P.**, Professor, Scientific Director, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Laboratory Head, Altai State University, pr. Lenina 61, Barnaul, 656049, Russia. E-mail: derev@archaeology.nsc.ru; <https://orcid.org/0000-0003-1156-8331>
- Dubova N.A.**, Chief Researcher, Miklukho-Maklai Institute of Ethnology and Anthropology, Russian Academy of Sciences, Leninsky pr. 32a, Moscow, 119334, Russia. E-mail: dubova_n@mail.ru; <https://orcid.org/0000-0002-4340-1037>
- Dyakonov V.M.**, Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia; Senior Researcher, Institute for Humanities Research and Indigenous Studies of the North, Siberian Branch, Russian Academy of Sciences, Petrovskogo 1, Yakutsk, 677027, Russia. E-mail: arkh_muz@mail.ru; <https://orcid.org/0000-0002-4899-6148>
- Filatova M.O.**, Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: mayaphylatova@gmail.com; <https://orcid.org/0000-0001-5828-4809>
- Garkusha Y.N.**, Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: garkusha_y@list.ru; <https://orcid.org/0000-0002-0935-0213>
- Grishin A.E.**, Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: artem-grishin@mail.ru; <https://orcid.org/0000-0001-8367-2272>

- Gubar Y.S.**, Laboratory Assistant, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: julfxxxxx@gmail.com; <https://orcid.org/0000-0002-1799-8327>
- Gusev A.V.**, Researcher, Shemanovsky Yamal-Nenets District Museum and Exhibition Complex, Chubynina 38, Salekhard, 629008, Russia. E-mail: gusev_av2004@mail.ru; <https://orcid.org/0000-0003-1812-4741>
- Hidayati D.**, Researcher, Research Center for Prehistoric and Historical Archaeology, National Research and Innovation Agency of Indonesia, Jend. Gatot Subroto rd. No. 10, Sasana Widya Sarwono building, Fl. 8, Kuningan Barat, Mampang Prapatan, Jakarta Selatan, Jakarta 12710, Indonesia. E-mail: terangdamaringrat@gmail.com; <https://orcid.org/0000-0001-5677-138X>
- Kulakov S.A.**, Leading Researcher, Institute for the History of Material Culture, Russian Academy of Sciences, Dvortsovaya nab. 18, St. Petersburg, 191186, Russia. E-mail: kazvolg@yandex.ru; <https://orcid.org/0000-0001-7156-1591>
- Kulkov A.M.**, Engineer, Centre for X-ray Diffraction Studies, Saint-Petersburg State University, Universitetskaya nab. 7–9, St. Petersburg, 199034, Russia. E-mail: aguacrystals@yandex.ru; <https://orcid.org/0000-0002-2001-2231>
- Mahmud M.I.**, Researcher, Research Center for Prehistoric and Historical Archaeology, National Research and Innovation Agency of Indonesia, Jend. Gatot Subroto rd. No. 10, Sasana Widya Sarwono building, Fl. 8, Kuningan Barat, Mampang Prapatan, Jakarta Selatan, Jakarta 12710, Indonesia. E-mail: mirf001@brin.go.id; <https://orcid.org/0000-0003-1067-6912>
- Maksimova A.A.**, Teaching Assistant, Novosibirsk State University, Pirogova 1, Novosibirsk, 630090, Russia. E-mail: rock.nastaya64@gmail.com; <https://orcid.org/0000-0002-5068-555X>
- Marchenko Z.V.**, Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: afrika_77@mail.ru; <https://orcid.org/0000-0002-4729-8575>
- Moiseyev V.G.**, Senior Researcher, Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya nab. 3, St. Petersburg, 199034, Russia. E-mail: vmoiseyev@mail.ru; <https://orcid.org/0000-0003-1748-2686>
- Molodin V.I.**, Professor, Department Head, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: molodin@archaeology.nsc.ru; <https://orcid.org/0000-0002-3151-8457>
- Myglan V.S.**, Leading Researcher, Siberian Federal University, pr. Svobodnyi 79, Krasnoyarsk, 660041, Russia. E-mail: dend_ro@mail.ru; <https://orcid.org/0000-0002-5268-653X>
- Nepop R.K.**, Senior Researcher, Sobolev Institute of Geology and Mineralogy, Siberian Branch, Russian Academy of Sciences, pr. Akademika Koptyuga 3, Novosibirsk, 630090, Russia; Senior Researcher, Yeltsin Ural Federal University, Mira 19, Yekaterinburg, 620062, Russia. E-mail: rnk@mail.ru; <https://orcid.org/0000-0002-2046-6030>
- Pankina A.I.**, Junior Researcher, Institute of History, Archaeology and Ethnography of the Peoples of the Far East, Far Eastern Branch, Russian Academy of Sciences, Pushkinskaya 89, Vladivostok, 690001, Russia. E-mail: pankina1995b@mail.ru; <https://orcid.org/0000-0003-3997-4702>
- Parhusip D.**, Researcher, Research Organization for Agriculture and Food, National Research and Innovation Agency of Indonesia, Kawasan Sains dan Teknologi (KST) Soekarno, Jl. Raya Jakarta-Bogor KM 46, Cibinong, West Java 16911, Indonesia. E-mail: dork001@brin.go.id; <https://orcid.org/0000-0001-9447-8424>
- Petrova N.Y.**, Researcher, Institute of Archaeology, Russian Academy of Sciences, Dm. Ulyanova 19, Moscow, 117292, Russia; Senior Researcher, Margulan Institute of Archaeology, pr. Dostyk 44, Almaty, 050000, Kazakhstan. E-mail: petrovanatalya7@mail.ru; <https://orcid.org/0000-0002-9112-1160>

- Petrozhitskiy A.V.**, Researcher, Budker Institute of Nuclear Physics, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 11, Novosibirsk, 630090, Russia; Engineer, AMS Golden Valley, Novosibirsk State University, Pirogova 2, Novosibirsk, 630090, Russia. E-mail: petrozhav@gmail.com; <https://orcid.org/0000-0002-6653-2232>
- Potanina A.Y.**, Junior Researcher, Bochkov Research Center for Medical Genetics, Moskvorechye 1, Moscow, 115522, Russia. E-mail: potaninaanna@gmail.com; <https://orcid.org/0009-0000-7911-4673>
- Rakhimzhanova S.Z.**, Leading Researcher, Margulan Institute of Archaeology, pr. Dostyk 44, Almaty, 050000, Kazakhstan. E-mail: saule-rahim@inbox.ru; <https://orcid.org/0000-0003-1429-1470>
- Schmidt I.V.**, Associate Professor, Dostoevsky Omsk State University, pr. Mira 55a, Omsk, 644077, Russia. E-mail: rebewster@gmail.com; <https://orcid.org/0000-0001-8608-5321>
- Sebayang A.**, Researcher, Research Organization for Agriculture and Food, National Research and Innovation Agency of Indonesia, Kawasan Sains dan Teknologi (KST) Soekarno, Jl. Raya Jakarta-Bogor KM 46, Cibinong, West Java 16911, Indonesia. E-mail: amelia.sebayang@gmail.com; <https://orcid.org/0000-0003-4400-804X>
- Selin D.V.**, Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: selin@epage.ru; <https://orcid.org/0000-0002-6939-2917>
- Sevostyanov D.A.**, Associate Professor, Novosibirsk State Medical University, Krasny pr. 52, Novosibirsk, 630091, Russia. E-mail: dmitry.sevostyanov1964@yandex.ru; <https://orcid.org/0000-0002-7142-3188>
- Shelegina O.N.**, Leading Researcher, Institute of History, Siberian Branch, Russian Academy of Sciences, Nikolaeva 8, Novosibirsk, 630090, Russia. E-mail: oshelegina@yandex.ru; <https://orcid.org/0000-0003-3715-4380>
- Shulga P.I.**, Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: shulgapi55@yandex.ru; <https://orcid.org/0000-0003-4684-8456>
- Wiradnyana K.**, Researcher, Research Center for Prehistoric and Historical Archaeology, National Research and Innovation Agency of Indonesia, Jend. Gatot Subroto rd. No. 10, Sasana Widya Sarwono building, Fl. 8, Kuningan Barat, Mampang Prapatan, Jakarta Selatan, Jakarta 12710, Indonesia. E-mail: Ketut_wiradnyana@yahoo.com; <https://orcid.org/0000-0002-7461-7981>
- Zaporozhchenko G.M.**, Senior Researcher, Institute of History, Siberian Branch, Russian Academy of Sciences, Nikolaeva 8, Novosibirsk, 630090, Russia. E-mail: galinakoop@yandex.ru; <https://orcid.org/0000-0002-1237-0792>
- Zhabagin M.K.**, Laboratory Head, LLP “National Center of Biotechnology”, Kurgalzhynskoye road 13/5, Astana, 010000, Kazakhstan. E-mail: mzhabagin@gmail.com; <https://orcid.org/0000-0003-3414-0610>
- Zotkina L.V.**, Senior Researcher, Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia. E-mail: lidiazotkina@gmail.com; <https://orcid.org/0000-0002-1912-3882>
- Zubova A.V.**, Senior Researcher, Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences, Universitetskaya nab. 3, St. Petersburg, 199034, Russia. E-mail: zubova_al@mail.ru; <https://orcid.org/0000-0002-7981-161X>