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Signs and Images in Prehistoric Art: New Data, Recent Findings, and Current Research Directions

The article integrates the data reported at the All-Russian conference with international participation “Signs and Images in the Art of the Stone Age”, commemorating the tercentenary of the Russian Academy of Sciences and held at the Institute of Archaeology and Ethnography SB RAS in Novosibirsk Akademgorodok on October 21–24, 2024. During the event, various aspects of Stone Age art and symbolic behavior were discussed. We outline the key issues raised in geographically and temporally wide-ranging conference talks and in ensuing discussions, many of which concerned cave and rock art dating to the Paleolithic and to the Pleistocene-Holocene transition in Europe, North Africa, China, the Eastern Pamir, Mongolia, and Russia. Many experts focused on symbolic behavior during the Paleolithic, Mesolithic, and Neolithic on the Russian Plain, in Crimea, in the Urals, in the Altai Mountains, in the Minusinsk Basin, in Western Transbaikalia, and the Yana-Indigirka lowland. The significance of the conference for further research is highlighted. We touch upon various approaches to ancient mineral pigments, technology of prehistoric art, and the environmental context of sites. Testifying to the high level and wide scope of prehistoric art studies, the conference outlined important prospects for further research.

Keywords: Prehistoric art, rock art, portable art, symbolic behavior, Stone Age, research conferences.

Prehistoric art is one of the most complex, versatile, and enigmatic phenomena in people’s lives in the past. In addition to expanding and improving the basic scientific techniques of studying, the discussion of key issues of the early artistic activities manifestations by specialists is an integral part of the process of studying and understanding it. The previous conferences “Signs and Images in the Art of the Stone Age” were organized to meet this purpose. These were held at the leading research organizations of Moscow (Institute of Archaeology of the Russian Academy of Sciences) and St. Petersburg (Peter the Great Museum of Anthropology and Ethnography (Kunstkamera) of the Russian Academy of Sciences) in 2017 and 2019. In continuing this tradition and in connection

with celebration of the 300th anniversary of the Russian Academy of Sciences, the next conference “Signs and Images in the Art of the Stone Age” was held at the Institute of Archaeology and Ethnography SB RAS in Novosibirsk Akademgorodok on October 21–24, 2024. The Peter the Great Museum of Anthropology and Ethnography (Kunstkamera) RAS (St. Petersburg), the Institute of Archaeology RAS (Moscow), and the “Tomskaya Pisanitsa” Kuzbass Museum-Reserve (Kemerovo) were the co-organizers of this event.

More than 100 specialists from academic and university centers of Russia (Vladivostok, Vladimir, Yekaterinburg, Kemerovo, Krasnoyarsk, Moscow, Novosibirsk, Rostov-on-Don, St. Petersburg,

Tyumen, Ufa, and Khabarovsk) and other countries (Australia, Austria, Germany, Spain, Kazakhstan, China, Mongolia, Tajikistan, France) took part in the conference (see *Figure*). Basic issues in the field of Stone Age Art both in Eurasia and beyond were discussed.

The conference participants presented reports in the sessions “Cave and Rock Art: Chronology, Technique, Style and Context”, “Methods in the Study of Rock and Portable Art”, “Portable Art in the Stone Age: Materials, Processing, Content of Images”, “Art and Identity: The Stone Age Personal Ornaments”. At the plenary session, reports were held by G.A. Khlopachev (“Geometric Signs and Ornamentation in Portable Art of the Upper Paleolithic of Eastern Europe”), V.I. Molodin (“Rock Art Research at the IAET SB RAS” (2024)) and J.-M. Geneste (“The Perception of Time and Duration in the Compositions of the Lascaux Cave 22,000 Years Ago”).

The meeting participants presented the results of the recent studies in the Stone Age Rock Art in Europe, North Africa, China, the Eastern Pamirs, Mongolia, and Russia (see, e.g., (Santos da Rosa, 2025; Guy, 2025; Cheremisin, Komissarov, Soloviev, 2024; Bobomulloev, Shnaider, 2024; Batbold, 2024; Zaika, Klyuchnikov, 2024; Svoiskiy et al., 2025; Abolonkova, Zotkina, Kolobova, 2025)). New findings on personal ornaments, portable art, and other symbolic evidence of the Paleolithic, Mesolithic, and Neolithic were reported from many regions of Russia: the Russian Plain, the Crimea, the Urals, the Altai Mountains, the Minusinsk Basin, Western Transbaikalia, and the Yana-Indigirka lowland (see, e.g., (Khlopachev et al., 2025; Bazilevich, Khlopachev, Gavrilov, 2024; Lev, Zheltova, 2025; Lozovskaya, 2024; Zhilin, Simonenko, 2024; Dublyansky, 2024; Skochina, Enshin, 2024; Fedorchenko, Shunkov, Kozlikin, 2024; Kharevich et al., 2024; Miklashevich, 2025; Pavlenok, Kozhevnikova, Zotkina, 2024; Pitulko, Pavlova, 2025)).

Another important topic of presentations concerned the documentation and revision of the previous attribution of rock images (see, e.g., (Batbold, 2024; Svoiskiy et al., 2025)). Notably, in some cases, resuming the research at the previously studied and described archaeological sites provides fundamentally new data, helps take another look at well-known objects and propose new interpretations. Revision of long known archaeological evidence is particularly relevant for the Stone Age Art studies. This was brilliantly demonstrated by French colleagues in the reports addressing the phenomenon of prehistoric art

of the Mediterranean region (see, e.g., (Guy, 2025)). Noteworthy is the importance of reviewing archival materials—these studies serve as solid basis for researchers to make significant discoveries, which sometimes change the established viewpoints on the broad variety of scientific topics. For example, E.A. Miklashevich presented the results of her analysis of the “Angara Style” based on the well-known materials on the portable art from the Neolithic site of Bazaikha (2025).

A special attention of the conference participants was paid to the discussion of new methodological approaches to attribution, dating, and interpretation of archaeological evidence of human symbolic behavior in the Stone Age (see, e.g., (Santos da Rosa, 2025; Dublyansky, Miklashevich, Zhang, 2024; Zotkina, 2024; Araque Gonzalez, Paniago, Polo, 2024; Fedorova, 2024; Malikov et al., 2024)). The fruitful discussion touched upon a wide variety of aspects of human artistic activities.

The topics related to ancient dyes in both rock and portable art images were also discussed (see, e.g., (Davydov, Gubar, 2025; Zheltova, 2024; Kozlikin, Fedorchenko, Shunkov, 2024)). A special procedure of chemical analysis of composition of dyes using Raman spectroscopy of rock art images on red-colored rocks was proposed (Davydov, Gubar, 2025). This is an important step in the adaptation of non-invasive techniques of studying rock paintings.

Several speakers addressed the study of environmental, paleoclimatic, and geomorphological context of rock art sites (Dublyansky, 2024; Malikov et al., 2024) and presented the latest findings on conditions and period of creation of the earliest rock images in the Minusinsk Basin and the Southern Urals.

A set of presentations touched upon the results of study of Stone Age personal ornaments, technologies of their manufacture, and functions of these artifacts in various social interactions in the prehistoric communities (Fedorchenko, Shunkov, Kozlikin, 2024; Pavlenok, Kozhevnikova, Zotkina, 2024; Pitulko, Pavlova, 2024, 2025; Bazilevich, Khlopachev, Gavrilov, 2024; Khlopachev et al., 2025). Hoards were discussed as a particular phenomenon associated with the symbolic behavior of prehistoric man (Skochina, Enshin, 2024; Lev, Zheltova, 2025). At the session “Art and Identity...”, interesting ideas about the meaning of various signs and motifs in the ornamental patterns were suggested (Lozovskaya, 2024). The discussion also touched upon the mechanisms forming the rhythms of ornamenting patterns and



Participants of the conference “Signs and Images in the Art of the Stone Age” in Novosibirsk.

compositions based on natural phenomena, their subsequent schematization and simplification in the evolution of semantic structures.

The conference featured online presentations and simultaneous translations of lectures delivered by scholars from various regions of the world (from Australia to France). A large-scale exhibition “The Earliest Petroglyphs of the Minusinsk Basin” prepared by the researchers from the “Tomskaya Pisanitsa” Museum-Reserve was presented to the participants of the forum. The exhibition displayed high-precision facsimile copies of rock images.

The Novosibirsk conference “Signs and Images in the Art of the Stone Age” demonstrates the expansion of research in this area of archaeology both in territorial-chronological terms and in terms of thematic diversity, and, importantly, the increase in the range of approaches to comprehension of fundamental issues in the study of a broad variety of sources in prehistoric art.

Some of the reports were published in a special collection edited by the authors of this paper (Signs and Images..., 2024). Following the conference,

the participants prepared a series of papers published in the present issue of the journal *Archaeology, Ethnology and Anthropology of Eurasia*.

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The organization and realization of the All-Russian (with international participation) scientific conference “Signs and Images in the Art of the Stone Age” were supported by the “History of the Fatherland” Foundation (Contract No. 70-2024-000549 of June 11, 2024).

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A Mammoth Tusk with Representational Engraving from the Yana Complex of Sites and Its Archaeological Context

Mass manufacture of non-utilitarian objects, which are informational in essence, is a characteristic feature of the Upper Paleolithic. A unique sample of such items (pendants, beads, decorated diadems, and bracelets) comes from the Yana complex of sites. These items testify to advanced views of identity, held by people of the Eastern Siberian Arctic ~32 ka BP. These views formed a three-level information system ("friend or foe" recognition, intra-group distinction, personal identification). A mammoth tusk with representational engraving takes a special place among such items. The drawing appears to be a mnemonic record, possibly with mythological content. Its archaeological context reveals the complex social behavior of the Yana site dwellers, in whose advanced mentality animistic beliefs, specifically the wolf cult, played a special role. Such a cult presupposed the existence of complex collective rites in the form of shamanism. One of those rites is apparently depicted in the engraving on the mammoth tusk. Its composition attests to the knowledge of perspective—one of the earliest instances of this kind. Also, the drawing represents motion, evidencing the artist's cognitive level and technical skill. Apparently, the evolution of the Upper Paleolithic people's cognitive capacities passed through certain stages, marked by creative and technical achievements, and documented by artifacts such as the Yana engraving. This representation helps to see the world as viewed through the eyes of ancient hunters inhabiting the Eastern Siberian Arctic.

Keywords: Upper Paleolithic, personal ornaments, mammoth ivory bracelets, complex social and symbolic behavior, information system, mammoth tusk with representational engraving, decorated mammoth tusk, rituals.

Introduction

The Yana complex of sites (YCS) is exceptional in the realm of global Paleolithic archaeology not only because of its geographical location at 71° N in the Eastern Siberian Arctic (Fig. 1, *A*) and due to the age of the objects (ca 40–30 ka BP), but also because of the rare completeness and excellent preservation of the archaeological context of the sites (Pitulko, Pavlova,

2016: 92–98). Study of the site, which has been undertaken continuously since its discovery in 2001, has provided an extensive collection of non-utilitarian artifacts and decorated items made of tusk and antler, most of which come from the Severny (Northern Point) locality (hereafter NP locality). These finds reveal the sophisticated culture of one of the earliest stages of the peopling of the Arctic ca 32 ka BP in detail. According to formal periodization, this complex of sites can be



Fig. 1. Place of discovery of the tusk with engraving. Photo by E.Y. Pavlova.

A – geographical location of the YCS (shown in a fragment of the image from the publicly available Google Earth resource); B – southern part of excavations at the Northern Point locality (the Central permafrost polygon area is in the foreground).

dated to the middle stage of the Siberian Upper Paleolithic (Markin, Shunkov, 2022: 127, fig. 83), but more precisely, it concludes the Early Upper Paleolithic and belongs to the transitional period. This set of evidence is unique in quantitative and qualitative terms; it reveals symbolic activities of the Upper Paleolithic inhabitants living in the Eastern Siberian Arctic in the second half of the Late Pleistocene (Pitulko et al., 2012).

Elements of sophisticated social behavior of the ancient Arctic Siberian population have been established using collections of non-utilitarian artifacts from the Yana materials (mass finds, such as beads, diadems, bracelets, etc.). Similarities at a macroregional level are clearly visible (for example, decorated eyed needles and Kurtak-type* pendants), as well as unequivocal



Fig. 2. The tusk with representational engraving (A) and close-ups of the images in the upper (B), central (C) part, and in the area of the tip (D). Photo by S.V. Arsentiev.

connection of the materials with the general context of the Upper Paleolithic antiquities of the Eurasian Holarctic (Pitulko, Pavlova, 2019; Pitulko et al., 2012). One such piece of evidence is a small mammoth tusk with elaborate representational engraving (Fig. 2, 3), discovered during the YCS excavations at the NP locality (see Fig. 1, B).

*Similar serial artifacts (flat ring-shaped pendants made of mammoth tusk with a diameter of 3–4 cm) were first discovered by N.F. Lisitsyn (2000: 47) at the Kurtak-4 site in the Chulym-Yenisei Basin. The age of this site was close to that of the main sites from the Yana complex. Similar items were found, although rarely, at other sites in Northern Eurasia

and serve as an important cultural indicator. For emphasizing the cultural importance of these artifacts, it was proposed to call them Kurtak-type pendants (Pitulko et al., 2012: 647).

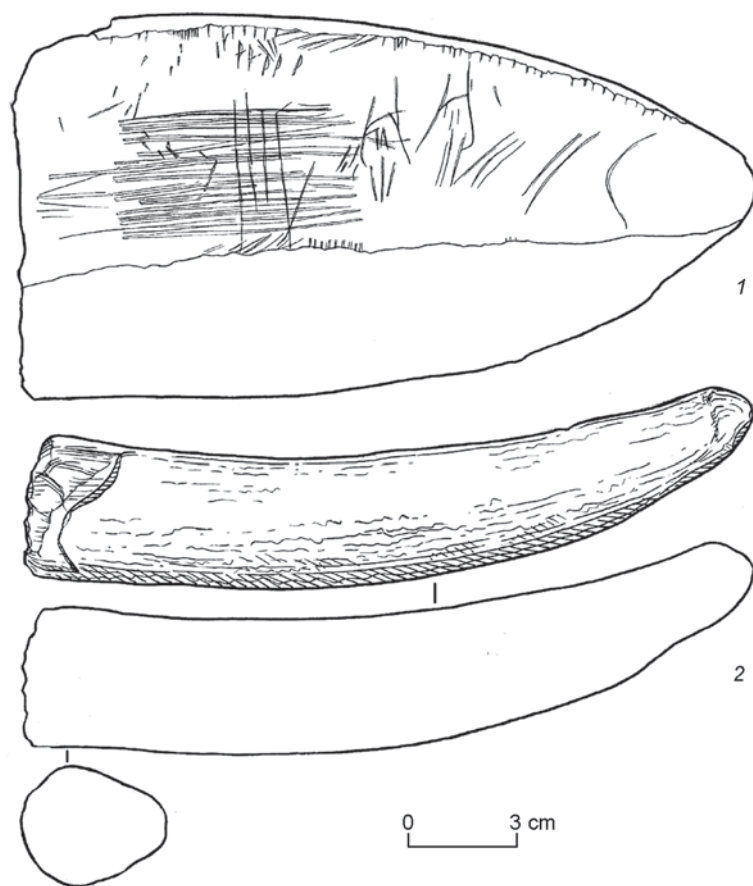


Fig. 3. Trace-drawing of the surface (developed view) of the tusk with engraved images (1), and general view of the reverse side of the item, longitudinal section, and transverse profile in the base (2). Drawing by A.O. Mashezerskaya and E.Y. Pavlova.

Context of the find

Spatial organization of the YCS (Pitulko, Pavlova, 2016: 87–91), its geology and chronometry of deposits (Pitulko, Pavlova, 2022), as well as the surface structure and chronology of cultural remains (Pitulko, Pavlova, Nikolskiy, 2015; Pitulko, 2019) have been discussed many times. Therefore, only the most important features should be mentioned. Most of the sites of the YCS, including one of the two best preserved localities—NP (fully studied) and Yana B (research is ongoing)—are situated on the second floodplain terrace (T2) on the left bank of the Yana River. The cultural layer is confined to the middle part of the terrace (T2) at a level of about 7.5 m above the water edge, and lies in syngenetic frozen deposits of the ice complex.

Both localities are distinguished by hearth structures (simple, deep, round-shaped hearths with diameters of about 1.0–1.5 m and depths of about 0.2–0.4 m,

lenticular in cross-section). There are some differences between the materials from them owing to seasonality (Pitulko, 2019). The analysis of radiocarbon dates (Pitulko, Pavlova, Nikolskiy, 2015; Pitulko et al., 2013) has shown several (at least three) cycles of human settlement in this area in the range of ca 33–30 ka BP, with the age of 32 ka BP taken as an average.

A special feature of the spatial pattern of the cultural layer of the YCS is its visual disunity into fragments within a single hypsometric level (Fig. 4), corresponding to outlines of ground permafrost polygons with acute cryogenic deformations in their marginal zones (Pitulko, Pavlova, 2016: 89). The ground polygons were separated from one other by ice-wedges forming the main generation (Pitulko, Pavlova, 2022) due to their gradual expansion over several tens of thousands of years. Each of these polygons (“baydzharakh formations”) was given its own name for easier orientation in space.

A tusk with engraving (see Fig. 2, 3) was found at the NP locality on the Central polygon, in the marginal zone of the eastern part of the ground column (see Fig. 1, 4). It was discovered *in situ* in the cultural layer in sq. K22.

A fragment of a mammoth tusk similar in size and engraving, preserved in small fragments, was found nearby in sq. G22 (see Fig. 4).

This polygon is surrounded by powerful veins of ice-wedges about 2–4 m wide; in the nodes of the network, the space occupied by ice reaches 8 m. The cultural layer in the central part of the ground column occurs in the range of absolute marks of 12.95–13.30 m, and along the edges of the columns it sharply bends to marks of 14.5–16.0 m, indicating vertical deformation of sediments (galling) emerging from extrusion of material as a result of the syngenetic ice-wedges growing over centuries (Pitulko, Pavlova, 2022).

The cultural layer is the former habitation surface. It contains multiple roots of herbaceous plants and demonstrates high saturation with cultural remains (lithic artifacts and debitage, tusk and antler items, faunal materials), as well as local distribution of hearth lenses of various areas and thickness. Their origin is associated with repeated

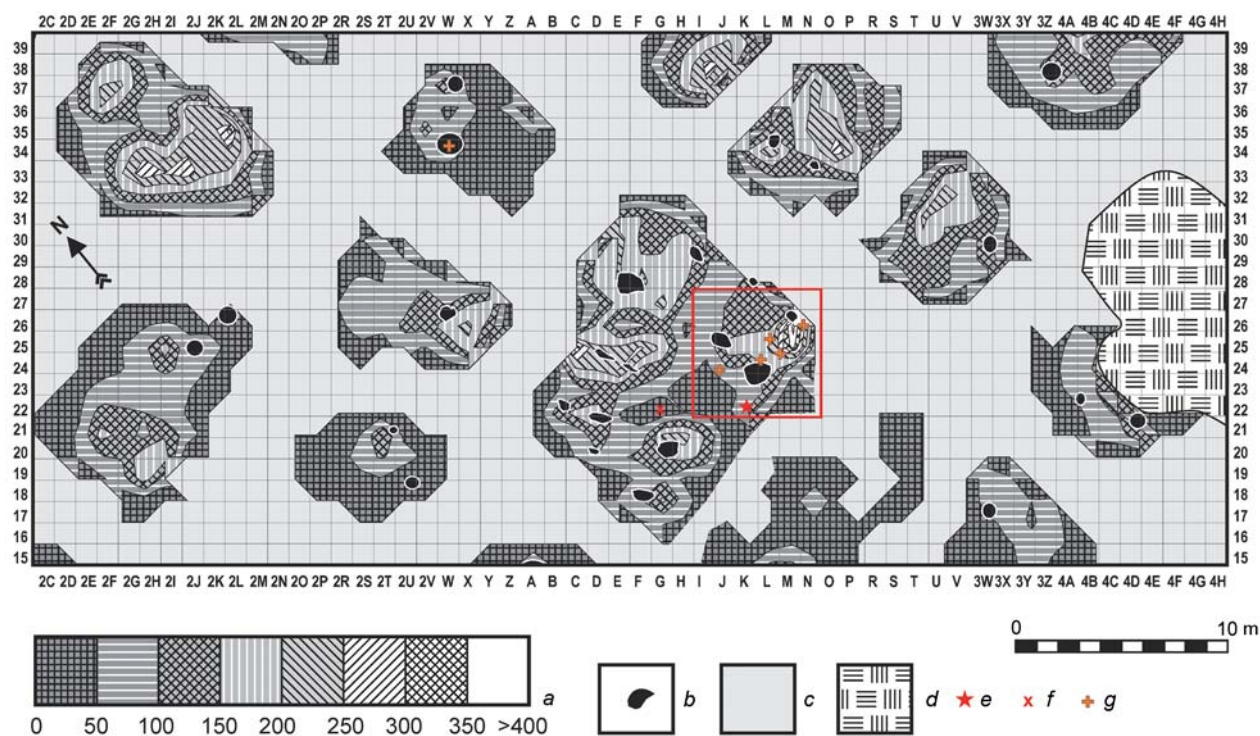


Fig. 4. Map of the density of finds in the southern part of the excavated area at the Northern Point locality (red frame indicates the area of the tusk). Drawing by S.G. Kritsuk (data preparation) and E.Y. Pavlova (design).

a – density of finds, expressed as their number per 1 m²; *b* – hearth; *c* – ice-wedges; *d* – sod-covered surface of the second terrace; *e* – location of the tusk with the representational engraving; *f* – location of another tusk of similar size with engraved strokes dividing the surface into two panels; *g* – wolf skull.

placement (or moving (Pitulko, 2019; Pitulko et al., 2013)) of above-ground dwelling structures on the same surface given extremely slow sedimentation under subaerial conditions (Pitulko, Pavlova, 2022). The cultural layer is filled with compacted siltstone of reddish-brown-gray color with thin grass roots in the state of their lifetime, and is 15–20 cm thick.

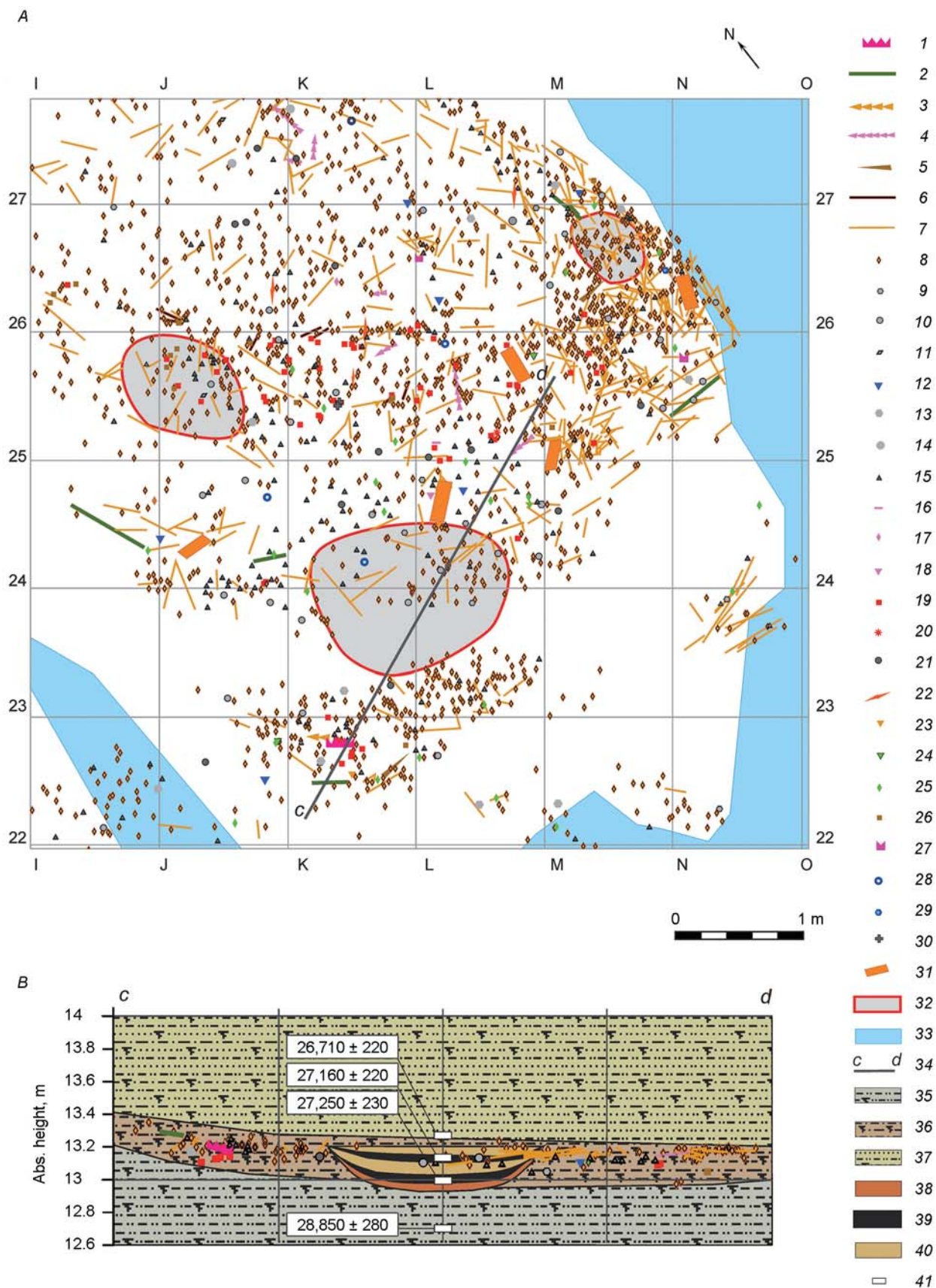
Three hearth spots with diameters of 0.7 to 1.7 m (Fig. 5, A) were located near the place where the engraved tusk was discovered, in the area bounded by lines I–O and 22–28. The tusk was located 50 cm to the south-southwest of the hearth which occupied sq. K23, K24, L24, and L23. The size of the hearth spot was 1.7 × 0.9 m; the depth of the hearth was 30 cm. Two black carbonaceous layers 4–5 cm thick, covered by ash-cinder interlayers of light brownish-yellow color, 4–6 cm thick, were visible in the structure of its cross-section.

Detailed radiocarbon dating of the hearth profile (Fig. 5, B; see Table) has revealed that the underlying deposits (sandy silt of greenish-gray color) had a ¹⁴C date corresponding to 34,059–32,197 cal BP. The filling was dated to 31,697–31,003 cal BP;

sediments overlapping the cultural layer were dated to 31,184–30,399 cal BP. These results are in agreement with the stratigraphy and do not contradict the previously obtained data both for the entire NP locality and that specific area (Pitulko, Pavlova, Nikolskiy, 2015; Pitulko et al., 2013). Thus, the time of engraving the tusk appears to be 31,697–31,003 cal BP.

Density of finds in the area studied at the NP locality varies. Near the hearths (see Fig. 4), it is most often average; in the “area of the tusk” bounded by lines I–O and 22–28, it changes from 0–50 to 350 items/m²; in sq. K22 it is about 100 items/m².

Naturally, the most common category of finds in the “area of the tusk” (see Fig. 5; 6, A) are osteological remains of Pleistocene animals (*n*=1872), including both complete and fragmented bones (mainly of bison and reindeer). Some of them were found in anatomical order (parts of the spine and limbs). The others included anterior and posterior metapodia, phalanges, ribs, and isolated scapulae, which were the parts of animal carcasses, suitable for food consumption. Bones of the skull, pelvis, and sacrum were absent.



Results of radiocarbon dating

Lab code	Field number of the sample	Description of the sample	Absolute height, m	Dating material	¹⁴ C-date, BP	Calibrated age (IntCal 20, σ 95.4%), years BP
Beta-223415	LY06-L23/19	Siltstone with numerous small grass roots in the state of their lifetime	13.35–13.30	PM*	26,710 $\pm$ 220	31,184–30,399
Beta-223414	LY06-L23/16	Lens of peat material	13.15–13.16	Sod	27,160 $\pm$ 220	31,650–31,003
Beta-223413	LY06-L23/8	Charcoal mass	12.99–13.01	Charcoal	27,250 $\pm$ 230	31,697–31,047
Beta-223417	LY06-K23/6	Sandy siltstone with grass roots in the state of their lifetime	12.67–12.73	PM	28,850 $\pm$ 280	34,059–32,197
Beta-231443	Sq. N26, No. 19251	Mandible, left side	13.21–13.26	Tooth	28,520 $\pm$ 240	33,560–31,929
Beta-231447	Sq. L25, No. 21016	Complete skull with mandible	13.11–13.18	Lower right canine tooth	27,840 $\pm$ 220	32,815–32,540 (σ 4.7%) 32,270–31,220 (σ 90.7%)

*Plant macroresidues, roots of herbaceous plants in the growth position.

The density of faunal remains in the studied squares varied from isolated finds to >250 items/m², depending on the location relative to the hearth spots. As many as 66 bones and their fragments were found immediately in sq. K22.

Skeletal elements of animals from the “area of the tusk” included an unusually large number of remains of Pleistocene gray wolves. These were only skulls and/or fragments of cranial bones (Nikolskiy et al., 2018: Pl. 1, 2, fig. 2) of five individuals. Bones of the postcranial skeleton of the wolf are extremely rare in the materials from NP locality. Such concentration of wolf skulls is unique for the YCS. The finds originate from a group of the neighboring squares (J24, L24, L25, M25, and N26) adjacent to sq. K22 (see Fig. 5, *A*). There are three hearth spots in this place, forming a triangle. Skull J24 was found between the large and medium-sized hearth spots; L24 was east of the larger spot; N26 was south of the smaller spot, and L25 and M25 were between the small and large spots (see Fig. 4).

Lithic artifacts were few in number (see Fig. 6, *B*). A total of ten cores of silicified argillite, 183 flakes, 27 side-scrappers, five tools of unclear purpose, two bifaces (the final form of core utilization), 11 blanks, and 14 fired stones were found in this area (36 m²). Sq. K22 contained only 13 flakes and a blank or unfinished tool of unclear purpose. Most of the lithic artifacts were confined to the edges of the hearth spots.

Finds relating to the bone industry were rare, but quite diverse; they attested to the processing of mammoth ivory and bone, from which various items of both utilitarian and non-utilitarian purpose were manufactured (see Fig. 6, *C, D*). Nine complete bone needles and four fragments, as well as seven bone awls, were found in the “area of the tusk”. These finds, as well as the side-scrappers discovered in the northern and northeastern parts of the area, indicate activity related to skin processing and sewing, which was carried out in the residential area near the hearths,

Fig. 5. Distribution of finds in the eastern part of the Central permafrost polygon area (*A*) and profile from west to east crossing the area near the location of the engraved tusk (*B*). Drawing by S.G. Kritsuk (data preparation) and E.Y. Pavlova (design).

1 – mammoth tusk with representational engraving; 2 – mammoth tusk; 3 – bone tool; 4 – foreshaft; 5 – awl; 6 – wood fragment; 7, 8 – bones of Pleistocene animals and their fragments; 9–18 – lithic artifacts: 9 – core, 10 – side-scraper, 11 – biface, 12 – tool, 13 – blank, 14 – pebble, 15 – flake, 16 – bladed flake/blade, 17 – flake from quartz crystal, 18 – microtool from quartz crystal; 19 – red ochre; 20 – slag-like substance; 21 – burnt stone; 22 – bone needle; 23 – bone tool; 24 – ivory tool; 25 – tusk fragment; 26 – wood fragment; 27 – decorated item; 28 – bead; 29 – bead blank; 30 – pendant; 31 – place of discovery of the wolf skull; 32 – hearth structure; 33 – ice-wedges; 34 – profile line; 35 – sandy siltstone with thin grass roots in the state of their lifetime; 36 – siltstone with numerous small grass roots in the state of their lifetime (filling of the cultural layer); 37 – alternating layers of fine-grained sand, sandy siltstone, and siltstone with thin grass roots in the state of their lifetime; 38 – calcined layer of sandy siltstone (hearth bottom); 39 – charcoal layer; 40 – layer of ash and cinders; 41 – place of sampling for radiocarbon dating.

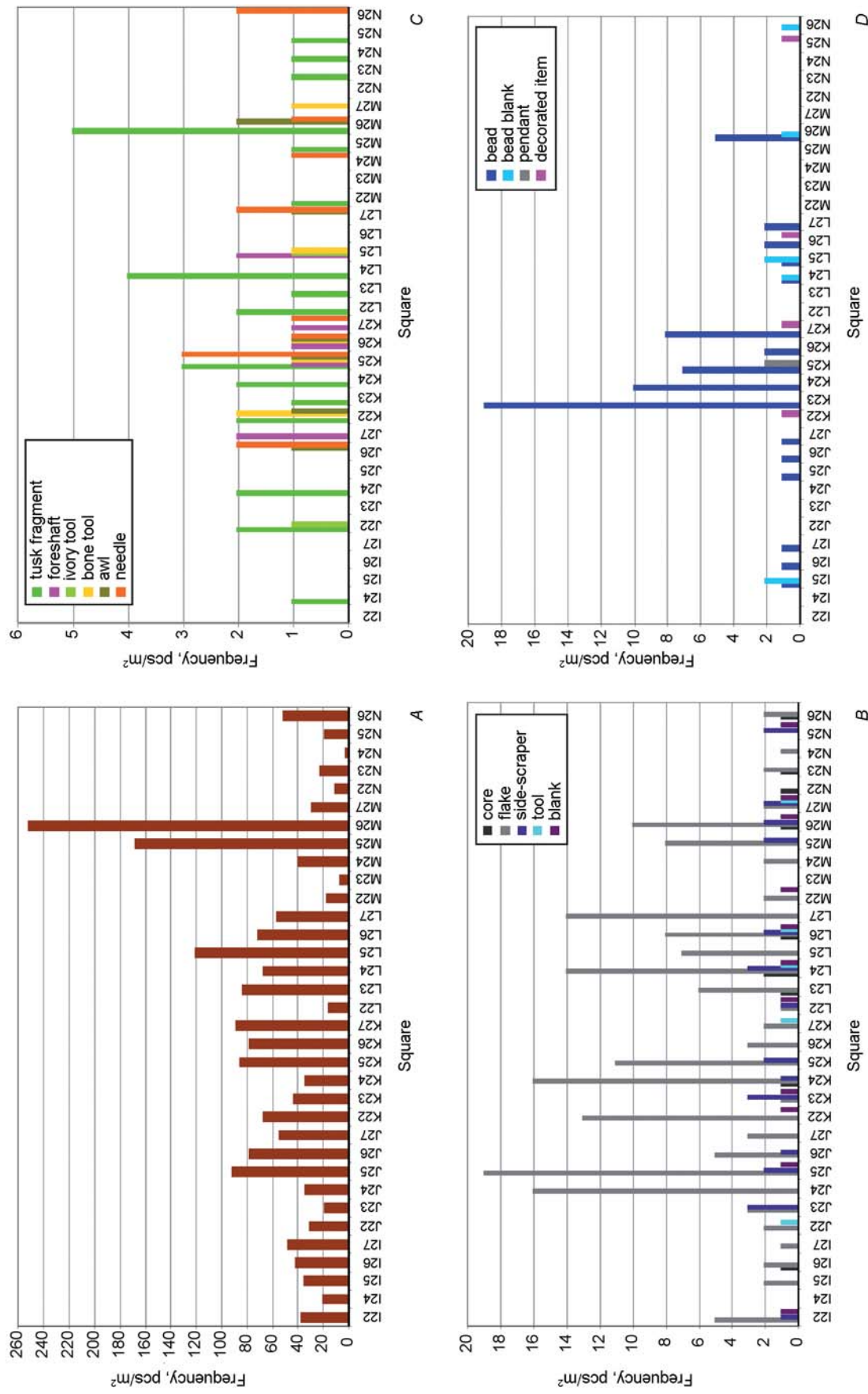


Fig. 6. Structural features of the collection of artifacts discovered at the site in the immediate vicinity of the engraved tusk. Drawing by E.Y. Pavlova.

A – bones of Pleistocene animals; B – lithic artifacts; C – artifacts made of mammoth bone and tusk; D – non-utilitarian items.

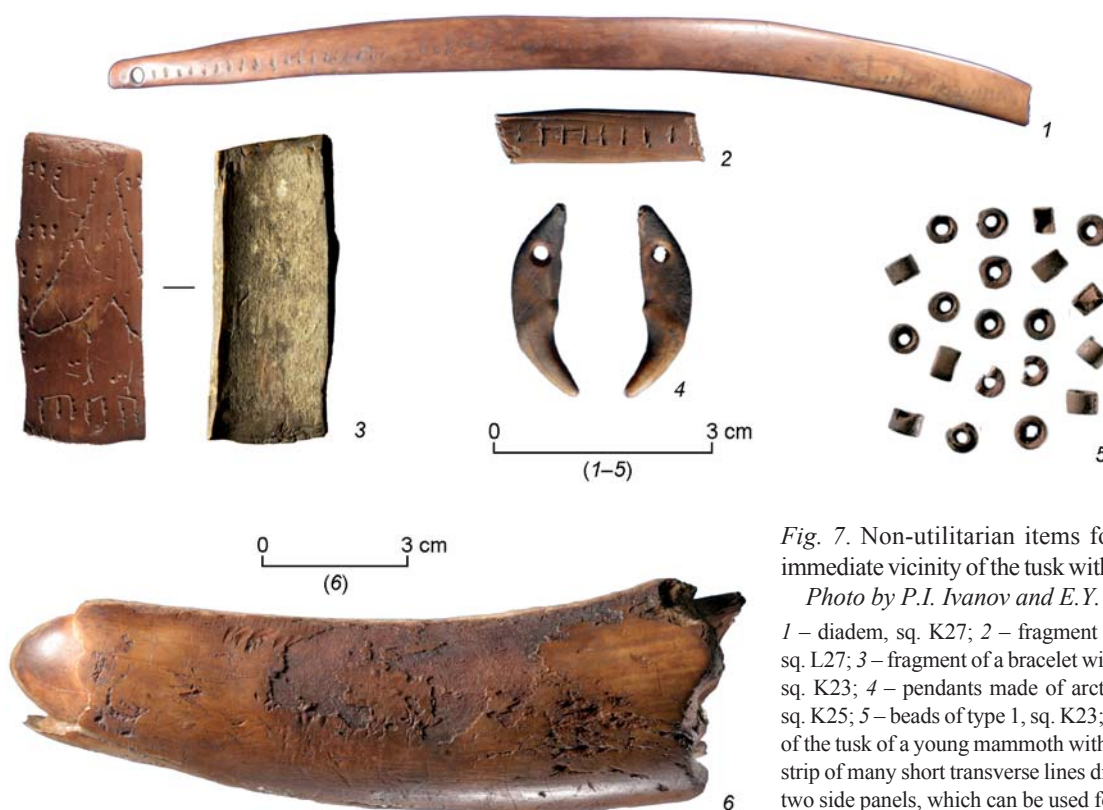


Fig. 7. Non-utilitarian items found in the immediate vicinity of the tusk with engraving.
Photo by P.I. Ivanov and E.Y. Pavlova.

1 – diadem, sq. K27; 2 – fragment of a diadem, sq. L27; 3 – fragment of a bracelet with engraving, sq. K23; 4 – pendants made of arctic fox fangs, sq. K25; 5 – beads of type 1, sq. K23; 6 – fragment of the tusk of a young mammoth with longitudinal strip of many short transverse lines dividing it into two side panels, which can be used for engraving.

including the area where the tusk with engraving was found. Thirty tusk fragments and items made from tusk, including seven foreshafts* and their blanks, also came from this area. Individual stone microtools and

*A foreshaft (the head of a shaft; sometimes replaceable, the extension of an arrow or spear shaft) is a rod made of bone, deer antler, or mammoth tusk, most often with rounded cross-section and one-sided flattened ends; items of various size groups are known (from 10 to 40 cm long) (Bradley, 1995; Wygal et al., 2022). These items were typical of the Stone Age of the Final Pleistocene and the turn of the Holocene in Northern America. They are associated with hunting weaponry of the Clovis and Folsom cultures in the central part of the continent (Bradley, 1995; O'Brien et al., 2016), that is, with the area of distribution of fluted points. The earliest examples of foreshafts in Northern America are known from the evidence found at the sites in Central Alaska (Wygal et al., 2022), where they were dated to 13,600–13,300 BP. The issue of the purpose of these items, despite the history of a 90-year discussion, has not been ultimately resolved (Ibid.: 4). In Siberia, with the exception of the YCS that belonged to the Paleolithic, foreshafts are known from isolated Neolithic sites in the Middle Lena River region (Fedoseeva, 1980: 84–85; 1992: Fig. 11). Later, these items became a part of the ancient Eskimo harpoon complex (the so-called *kolok*, which is a holder for a harpoon head (Pitulko, 2008–2009)).

micropoints were also found there, which indicated processing of tusks, in particular, production or repair of hunting weapons (foreshafts and points).

In the “area of the tusk” (see Fig. 1, 4), a few but varied non-utilitarian items were discovered, including the fragment of a bracelet with an anthropomorphic image (sq. I23; Fig. 7, 3), two fragments of diadems (sq. K27 and L26; Fig. 7, 1, 2), beads typical of the YCS (Pitulko et al., 2012), and pendants made of arctic fox teeth with holes biconically drilled in the root area (Fig. 7, 4, 5).

Beads of type 1 (simple, round, made of mammoth tusk, 16 complete and 38 fragments) included both finished and semi-finished items, reflecting different stages of their production. There were unpolished square beads with drilled holes (six complete and two fragments), one subsquare and four narrow rectangular blanks. Beads of type 2 (tubular), which were far less numerous than type 1 in the total sample (Pitulko, Pavlova, Ivanova, 2014), included one complete bead and a fragment.

Ornamentation on the diadems and the image on the bracelet were made by engraving on the polished surface of the completely finished item, most likely using bone tools with working surfaces of various configurations and areas. Dotted or oblong notches

were often connected to each other and formed individual elements of the pattern. The diadem from sq. K27 (Fig. 7, 1) represents one of the rarest ornamental patterns in the collection (type 3.3) (Pitulko, Pavlova, 2014: Pl. 5, fig. 6), while the fragment of the diadem from sq. L27 demonstrates one of the most common patterns (type 1.2) (Fig. 7, 2).

The decoration of the bracelet fragment has no parallels in the collection. It shows a part of an elaborate composition; its central image is a large, stylized anthropomorphic figure of a smoothed triangular outline with legs and feet. A double line extends to the left of the apex of the triangle, that is, from the head. Initially, it is subparallel to the edge of the item, and then arched, directed perpendicular to the edge. The drawing conveys the features of a hairstyle (braid), but is not a specific marker of sex.

Strips made of short vertical lines formed by double pinholes extend on both sides of the figure. The distance between the pinholes is approximately equal; between the strips the distance varies—the lower and middle strips are located closer to each other than the upper and middle ones. Strips of rhythmic lines are also present at the level of the feet of the anthropomorphic figure. These lines are parallel to the lower edge and are located much more sparsely. They are alternately shifted up and down relative to the axis of the element, and turn up near the break of the left edge of the fragment while maintaining the same rhythm. In our opinion, this is the image of a trail of footprints left by the human, while the two closely spaced strips of lines (lower and middle) may indicate the tracks of slowly moving feeding animals.

The upper row of lines forms the boundary of the ornamental field. Along the lower edge, it is completed by a row of alternating (?) geometric elements. There are two types of symbols: II-shaped (there are two of them) and in the form of an inverted III (the sequence III–II–II). The II-shaped symbol is most likely a variant of a more expressive anthropomorphic sign “A” (Pitulko et al., 2012). The inverted III is a zoomorphic symbol, specifically depicting a mammoth (any proboscis animal at rest observed in profile from a distance visually has three supports—the trunk and legs).

The ornamental composition of the bracelet is not devoid of some representational meaning. However, it is not a narrative, but rather a description of the personality of its wearer—a successful fast-footed tracker and hunter. The combination of symbols

(the image of a human, trail of footprints, a “braid” thrown to the side) conveys fairly fast movement.

The above evidence constitutes the archaeological context of the tusk with the representational engraving. Despite the fact that it is an extremely rare item, a fragment of tusk of similar size was discovered slightly to the west of the “area of the tusk” within the same polygon (see Fig. 4) and on the same line (sq. G22). Most likely it also had an engraving (see Fig. 7, 6). Unfortunately, just as with the main find, only one side is legible on this item, while the surface of the other side has been completely lost.

Tusks with engravings

Both items are the tips of young mammoth tusks with the pulp cavity area carefully removed (cut off), the length of which takes up over half the length of the whole tusk in such items. The diameter of both objects is about 40 mm; the length of the first one (from sq. G22) is 138 mm; the length of the second one (from sq. K22) is 205 mm. The surviving surfaces were carefully polished, although the quality of polishing is inferior to the diadems and bracelet, where it was improved by constant contact with body and clothing.

Rows of multiple short transverse lines 3–5 mm long were made along the long axis of the tusks at the top and bottom. The distance between them is 1–3 mm (see Fig. 3, 1; 7, 6). These lines are somewhat wider than engraved lines of the drawings. Thus, the surface of the tusk was divided into two symmetrical planes by the rows of short transverse lines. This method of preparation has been observed on all four similar items available in the collection from the NP locality of the YCS.

Surfaces located at the top of the cultural layer (see Fig. 3, 2) were heavily damaged by chemical and cryogenic weathering (soil processes and freeze/thaw cycles when the items were on the boundary of the seasonally thawed layer), for which reason only isolated, unsystematic grooves and dots penetrating deeply into the body of the tusk are visible. Similar deep dots are also present on the intact surfaces (see Fig. 2, A; 3, 1).

The surfaces that preserved the drawings are of unequal artistic value. The tusk from sq. G22 shows numerous, yet unsystematic engraved lines. The drawing, covering the surface of the tusk from sq. K22, is much more sophisticated. It is a linearly organized composition consisting of two rows of

images (see Fig. 2, *A*; 3, *I*). The engraving was made with a very hard tool with a narrow blade, possibly a simple flake of rock crystal. Such tools are abundant in the collection (Pitulko et al., 2013) and obviously were widely used for processing ivory.

The bottom row begins (from left to right) with a group of four vertical lines and a short slanted line adjoining the beginning of the far right line at an angle of 45° (the pattern resembles the image of a left hand with extended thumb). Crude shading forming a rectangle was made over that image. Then there follow two large anthropomorphic figures standing next to each other (see Fig. 2, *C*; 3, *I*). The row ends with incised slanted lines; the first lines are grouped in threes and twos; the last one is single (see Fig. 2, *D*; 3, *I*).

The top row shows even more generalized anthropomorphic symbols of much smaller size, arranged in a line that turns into a semicircle enclosing something depicted with unclear oblique lines (see Fig. 2, *B*; 3, *I*). This object corresponds in size to the anthropomorphic symbols and could be a fire or a grave. The figures surrounding it, at least some of them, can be identified as male hunters armed with spears (see Fig. 2, *B*). Despite the static nature of the image, they are apparently performing some kind of collective ritual, walking around some object counterclockwise.

Discussion

The archaeological context of the mammoth tusk with representational engraving from sq. K22 at the Northern Point locality of the YCS demonstrates an extremely unusual combination of various testimonies as to the sophisticated social behavior of the Upper Paleolithic inhabitants of the Eastern Siberian Arctic, which have not been found anywhere else in such concentrated form over the entire area researched (> 3000 m²).

Some of the discovered non-utilitarian items belong to the category of personal ornaments (Pitulko et al., 2012), including multiple (beads, over 3000), serial (diadems and pendants made of animal teeth, over 50), and individual items (bracelets; although there are 50 of them, yet formally similar, they show unique ornamentation) (Pitulko, Pavlova, 2014). They provide a vivid manifestation of the informational essence of Paleolithic art (Barton, Clark, Cohen, 1994). Taken together, these finds constitute a three-level information system. All of its components were found in the “area of the tusk”. The most general level consists of bead ornaments and pendants made of

animal teeth (“friend or foe” recognition (Barth, 1969: 110–112))*). The ornamentation of the diadems might have served as an indicator of intra-group differences, while bracelets were literally personal, individual items containing information about the wearer and his or her social status (Pitulko, Pavlova, 2014).

A special feature of the “area of the tusk” is the unusually high concentration of wolf skulls. These are associated with a hearth structure in sq. K23-K24-L24-L23. A tusk with engraving was found in sq. K22, and wolf skulls were found not far from it in sq. J24, L24, L25, M25, and N26. Another skull was discovered slightly farther from the “area of the tusk”, in sq. W34 (see Fig. 4). All the skulls showed no traces of separation from the neck. Taphonomic study of these finds has revealed that the skulls had traces of weathering, which means that before being buried in the cultural layer they had been on the surface with already detached soft tissues. They were taken from naturally deceased animals and brought to the site by humans (Nikolskiy et al., 2018), which allows us to view these actions as manifestation of systemic behavior carried out with some purpose. At least one skull was placed in the central area of the hearth structure in sq. W34. The microstratigraphy of that square suggests that the hearth was not used after that (Pitulko et al., 2012). The skulls in the “area of the tusk” were also likely used in some ritual associated with the hearth. Three hearth structures of different sizes were as if “connected” by these skulls (see Fig. 4).

The wolf is a special animal in human culture. The obvious special attitude towards that animal and systematic activities described above point to an animalistic cult associated with the wolf among the YCS inhabitants (Nikolskiy et al., 2018; Pitulko et al., 2012). In that respect it is curious that scarce pendants made of canine teeth—arctic fox ($n=7$) and wolf ($n=2$), as well as their blanks (four arctic fox fangs without holes)—are found in isolation. However, in the “area of the tusk”, two of them (see Fig. 7, 4) were found in the same sq. K25, i.e. near the hearth, as with the wolf skulls, and could have been associated with the wolf cult.

*For example, the spatial analysis of certain types of personal ornaments in Western Europe has shown the possibility of identifying “ethnolinguistic boundaries” of the territories occupied by different groups of the Upper Paleolithic population (Vanhaeren, d’Errico, 2006). The function of symbolic images as a means of identification of “friends” in prehistoric societies is considered on the example of quadriforms in the Paleolithic rock art of Cantabria, Spain (Sauvet et al., 2017).

Noteworthy is the discovery of lion skulls, lying on top of each other at the edge of the hearth, in dwelling VI at the Kostenki IV site, which replicates the special attitude towards the wolf manifested in archaeological contexts of the YCS; disks of shale and a marl sculpture of a lion's head were also found there (Rogachev, 1940: 37, fig. 10). We believe that these finds reflect behavior associated with ritual practices, like in the YCS, possibly in the form of a shamanic cult.

It is unknown when shamanic cults emerged. They probably appeared during the Middle to Upper Paleolithic transition and subsequently became a critical aspect of Paleolithic art (Winkelman, 2002). Some of the Aurignacian figurative images from the sites in Southwestern Germany (Vogelherd, Geissenklösterle, Hohlenstein-Stadel), which were clearly earlier than the Yana sites, may be viewed in that sense (Dowson, Porr, 2001). Shamanism already existed in the Initial Upper Paleolithic*, at least starting in 40,000 BP (Wolf et al., 2020), and its evidence, dating back to the middle and late periods, is quite widespread and well-documented by examples of both rock and portable art (Filippov, 2004: 209–212; Clottes, 2000).

Interestingly, wolf fangs, which were quite accessible to YCS dwellers, were almost never used in ritual practice and were replaced by teeth of a similar predator. This was obviously an important symbol. The presence of such pendants in the “area of the tusk” emphasizes its distinctiveness, which can be seen, in particular, in the ornamentation of the diadem, one of the rarest in the collection (see Fig. 7, *I*), as well as in decoration of the bracelet, reproducing a variant of an anthropomorphic figure (see Fig. 7, *3*) depicted on the tusk (see Fig. 2, *C*).

The representational engraving deserves several important remarks. It is quite unusual, since the element of the upper row of the composition (see Fig. 2, *A*, *B*) is apparently one of the earliest (if not the earliest) experiments in conveying visual perspective—its geological age is ca 32,000 BP. Notably, the anthropomorphic symbols located “in a circle” form rather an ellipse, that is, they are depicted from a watchpoint located to the side and above the conventional surface on which the figurines stand. Some rock representations of comparable age and possibly earlier ones (for example, a group of rhinoceroses, lion hunt, etc. in the Chauvet Grotto

(Clottes, 2000)) can be viewed in this vein, but there are always uncertainties associated with the dating of images and their connection in time (Von Petzinger, Nowell, 2014; Pettitt, Bahn, 2015). After 20,000 BP, in the Magdalenian period, this technique was undoubtedly in use, and not only in rock art (the group of deer in Limeil Cave, herd of horses in the Grottes du Chaffaud), but also in portable art (herd of reindeer on a bone plaque from the Cave of the Mairie near Teyjat) (Filippov, 2004: 210–211, fig. 110).

Small anthropomorphic symbols of the upper group (see Fig. 2, *A*, *B*) are almost identical to those on the bone plaques from Les Eyzies Cave (Marshack, 1972: Fig. 94a, b) and Raymondens Grotto (Ibid.: Fig. 96a, b), where a bison hunt was depicted. The known features of geology of cave sites and methods of their study at the dawn of Paleolithic archaeology provide a confident age estimate of these objects, but they are evidently not earlier than ca 18,000 BP, which is almost twice as young as the tusk from the YCS.

In the lower row of the Yana engraving (see Fig. 2, *A*; 3, *I*), there is a stylized image of a person's left hand, which was as if “erased” by rough overlapping shading. This is certainly not the removal of the image as an unsuccessful one, but the cancellation of what it symbolizes. This technique also finds parallels in the Paleolithic art of Western Europe, in the Cave of Pech Merle (the image of a giant deer “erased” by shading (Elinek, 1982: 290, fig. 459)). The age of that drawing is at least 30,000 years (based on the chronology of extinction of the species in Belgium and France) (Lister, Stuart, 2019: Fig. 1, *a*). Stylized images of hands (“palms”) in movable and rock art, as well as imprints on cave walls (positive and negative), are extremely common and appear both in Early and Late Upper Paleolithic sites (see, e.g., (Filippov, 2004: 112–115; Marshack, 1972: 169–175)), with the number of stylized images increasing at later stages. Interestingly, similar symbols are present on the Les Eyzies plaque mentioned above.

The anthropomorphs in the central part of the lower row on the Yana engraving (see Fig. 2, *A*, *C*; 3, *I*) are stylized images of people wearing cloaks, which conceal the entire figure except for the legs. This is comfortable and practical clothing providing protection from the rain and helping people to be camouflaged in the terrain during hunting. Although there are no direct parallels to these images, triangular “hut-of-branches-like figures” are known from the symbols and images in caves overviewed by A. Leroi-Gourhan (see: (Marshack, 1972: Fig. 90, 197–199)). A.K. Filippov discussed them in the context of the

*Scholars do not reject the idea that shamanic cults could have existed as early as the Middle Paleolithic (see, e.g., (Mussi, Cinq-Mars, Bolduc, 2000)).

antiquity of shamanism from the perspective of the outfit, an important element of which was the cloak (2004: 210).

Finally, the method of organizing the figurative surfaces by applying rows of transverse lines on small, specially prepared mammoth tusks finds parallels in remote sites of different periods of the Middle and Late Upper Paleolithic on the Russian Plain, such as Timonovka, Suponevo, Gontsy, Klinets, and Avdeev (Abramova, 1962: Pl. XXVII, 4; XXX, 13; XXXVI, 9, 17, 18; XXXIX, 2; XL, 1). The objects belong to the same size class (15–25 cm); they have dividing lines, but lack clear images or ornamentation*.

These parallels do not lead to any conclusions about intercultural ties, communications and mutual influence, kinship and inheritance. These are coincidences, some of which, for example small stylized anthropomorphic images on the Yana tusk and plaque from Pech Merle, might have been the result of technical issues (material, tool, size of the drawing). Much more important are other coinciding details, which for a long time existed at a cognitive level among the Upper Paleolithic population of Northern Eurasia. Common Western Eurasian genetic roots could have contributed to long-term preservation of mental algorithms associated with creativity and symbolic activities.

One of the most important elements that coincides is the symbol of the open palm, probably the earliest in human culture (Carpenter, Schuster, 1996: 150; Wilson, 1998: 18–21; Achrafi, 2003). Its generally accepted meaning is personification of non-conflict, but also vitality, especially if the hand is the left one. It has long been noted that palm imprints on the walls of caves were left mostly by the left hand (Faurie, Raymond, 2004); they also predominate in symbolic images. In the former case, it could have been caused by quite ordinary circumstances (the right hand

was holding a light source), but this explanation is unsuitable for engravings on pieces of portable art. Therefore, the images of the left hand carry some separate meaning (see above). It is precisely the left hand/palm that is engraved on the Yana tusk.

An important feature of the Yana engraving and the corresponding archaeological context is the established repeatability of the images. The engraved anthropomorphic figures on the tusk (see Fig. 2, C) and bracelet (see Fig. 7, 3) are similar. Thus, different objects share not only stratigraphy and chronology, but also a single figurative style.

The images of the engraved composition (see Fig. 2) are united by a subject line into a sequence following the contour of the object. The starting point is the tip of the tusk. The subject unfolds from right to left and from bottom to top, forming a mnemonic record of some events, legend, or myth (Pitulko et al., 2012). The presence of mythology already in the Early Upper Paleolithic on par (and in connection) with shamanism is considered to be quite acceptable (Filippov, 2004: 202–204). In terms of meaning, possible interpretation of the Yana drawing could be variants of narrative about the Divine Twins (Ward, 1968: 125–131)—one of the most ancient myths in the world. Its Eastern Siberian Arctic version is probably the Yukaghir tales of the Ice Old Men—chthonic creatures, humanoid giants, contacts with whom are harmful to people (Iokhelson, 2005: 275–282). It is possible to view the paired anthropomorphic figures, many times larger in size than the humanoid symbols in the upper row of the engraving (see Fig. 2, A–C), in this sense (Pitulko et al., 2012).

Although other interpretations of the subject are also possible, we believe that its most viable interpretation is a narrative about the life cycle of a person; his path in the surrounding world. Initially, this was the path of a loner, then of a pair, later of three, then there are many of them, and a group appears. However, there comes a moment when the supply of vital force is exhausted, non-existence cancels it (the “removed” symbol of the hand), but the community, after parting with the ancestor, remains, performing collective ritual actions (movement around the grave/fire where a wolf skull could have been placed; in many cases, movement during the shamanic ritual/dance is performed counterclockwise (Nam, 2017: 175–176), which is shown in the figure). In any case, this is a message recorded in a code, the keys to which were lost in the flow of time.

This find has no direct parallels. However, ornamented tusks have been found, although rarely,

*The scope of this article does not cover the entire variety of tusks with images and/or ornamentation, which include items of varying sizes (for example, from the Eliseevichi site (Grekhova, 1978; Polikarpovich, 1968: 67) or from the Mamontova Kurya site (Pavlov, Svendsen, Indrelid, 2001)), as well as decorated tusks (see, e.g., (Abramova, 1962: Pl. XXVII, 4; XXX, 13; XXXVI, 9, 17, 18; XXXIX, 2; XL, 1; Grigorieva, 2000; Kulakovskaya, Khlopachev, Usik, 2019; Khlopachev, 2020)) or items with animal images (Bader, 1972; Esin et al., 2020). In our opinion, the so-called ornamented tusk hoes from Kostenki also belong to this class of items (see, e.g., (Abramova, 1962: Pl. XXIV, 30, 31; Gavrilov, 2023: Fig. 3)). Particular attention is given to those items that most accurately reproduce the principle of surface division typical of the finds from the YCS.

at somewhat younger sites of Northern Eurasia, for example, Pavlov I (Klima, 1988) and Předmostí in Moravia (Svoboda, 2017; Svoboda, Ložek, Vlček, 1996), Kirillovskaya on the Russian Plain (Gavrilov, 2023), etc. (see, e.g., (Kulakovskaya, Khlopachev, Usik, 2019; Khlopachev, 2020; Stupak, 2011)). Although images on each of them are unique, they demonstrate conceptual parallels to the Yana engraving and reflect the general pattern of development of human cognitive abilities. This is a manifestation of a kind of “stratigraphy of consciousness”. The condition for its emergence was the common genetic roots of the population (Sikora et al., 2019) where these processes evolved.

Conclusions

The analysis of the mammoth tusk with the representational engraving from the eastern part of the Central permafrost polygon within the excavation at the Northern Point locality of the Yana complex of sites and its archaeological context makes it possible to draw the following main conclusions.

The inhabitants of the Eastern Siberian Arctic ca 32 ka BP had sophisticated social behavior. Its material manifestation is non-utilitarian items demonstrating highly developed symbolic activities of the region’s population at the end of the second half of the Early Upper Paleolithic (Pitulko, 2023). These people possessed developed ideas about personality, reflected in the creation of elaborate multi-level information systems. Their reconstruction is possible through analysis of collections of ornaments and patterns.

The social organization of the YCS population was apparently quite sophisticated. These people had the capacity to encode, transmit, and store information, including that in the form of mnemonic records. The population was distinguished by a high level of spiritual culture in which the animalistic cult (wolf cult) played an important role. This fact is beyond doubt. It entails collective ritual actions in the form of complex rituals. They could have been accompanied by myths, one of which has reached us through the millennia in the form of the representational engraving on the tusk. In combination with highly developed symbolism, this indicates a developed capacity for abstraction, intrinsic to the inhabitants of the Yana sites.

The composition of the drawing on the tusk used the concept of visual perspective. This is one of the earliest testimonies of this kind, if not the most early. Static images on the bracelet and tusk convey movement, which indicates, along with

the above-mentioned features, a high cognitive level of the people who created these artifacts. Their artistic and aesthetic capacities were not inferior to those of the population from other regions of Northern Eurasia.

There were apparently certain stages in the development of cognitive capacities of the people living in the Upper Paleolithic. Creative and technical achievements of each stage received physical (archaeologically visible) embodiment in the form of rare distinctive artifacts, with the engraved mammoth tusk from the YCS being one of them. The subject of the engraving allows us to see a picture of the world through the eyes of ancient humans of the Eastern Siberian Arctic. This is precisely what embodies the informational and scientific value of the tusk.

This study involved the iconographic analysis of the most important items. Wide comparative evidence was used, including rock representations from Paleolithic caves. This approach shows that sound results may be obtained after the combined analysis of signs and symbols both in portable and figurative art, since both represent inextricably linked aspects of creative activities of Paleolithic humans.

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“Caches” in Mammoth Skulls at Sites of the Kostenki-Avdeyevo Culture (Zaraysk and Kostenki 1 layer I)

We analyze the archaeological evidence of the deliberate placement of valuables (“caches”) in mammoth skulls at sites of the Eastern Gravettian Kostenki-Avdeyevo culture (Zaraysk A, E, F, and Kostenki 1 layer I). Six such finds are examined, specifically their spatial arrangement, stratigraphic context, and composition. Special attention is paid to the connection of “caches” with living structures (semi-subterranean dwellings) and ritual complexes, as evidenced by the presence of ocher, specific placement of artifacts, etc. A classification of “caches” is suggested: lost (accidentally left), returnable (intended for subsequent retrieval), and irretrievable (ritual sacrifices). The composition of such complexes is diverse. A “special” cache at Zaraysk E contained 24 artifacts including Kostenki knives, placed in the alveolus of a mammoth skull; at Kostenki 1, a spatula made of a rib with a figured top had been hidden in the skull. Notably, the tradition of using mammoth skulls for storing valuables has been traced over a long period of time at sites of the Upper Paleolithic Kostenki-Avdeyevo archaeological culture belonging to the Eastern Gravettian. It was practiced on the Russian Plain even after the LGM at sites of the Anosovo-Mezin type, representing another cultural tradition. Our findings indicate a complex interaction of utilitarian and symbolic practices among ancient hunters, expanding our knowledge of their worldview.

Keywords: Upper Paleolithic, Gravettian, Zaraysk, Kostenki 1 (I), Kostenki-Avdeyevo culture, cache.

Introduction

Hoarding is an ancient stereotype of human behavior. In this article, we analyze “caches” inside mammoth skulls that were used as constructive elements in settlements of the Eastern Gravettian Kostenki-Avdeyevo culture. This practice was much less widespread than utilization of skulls in this capacity. However, it existed for a long time. We found six “caches” in mammoth skulls at the sites of Zaraysk and Kostenki 1 layer I (hereinafter (I)). We will

hardly ever know the reason why those “caches” originated: either their owners wanted to hide valuables from foreign eyes or merely to avoid the risk of losing them, or again certain ritual beliefs were involved. These two spheres of life appear to be largely inseparable. The term “non-utilitarian items”, therefore, is a convention, and can have various meanings.

A joke goes that whenever an archaeologist finds anything for which no traditional explanation relating to the utilitarian domain is available, s/he

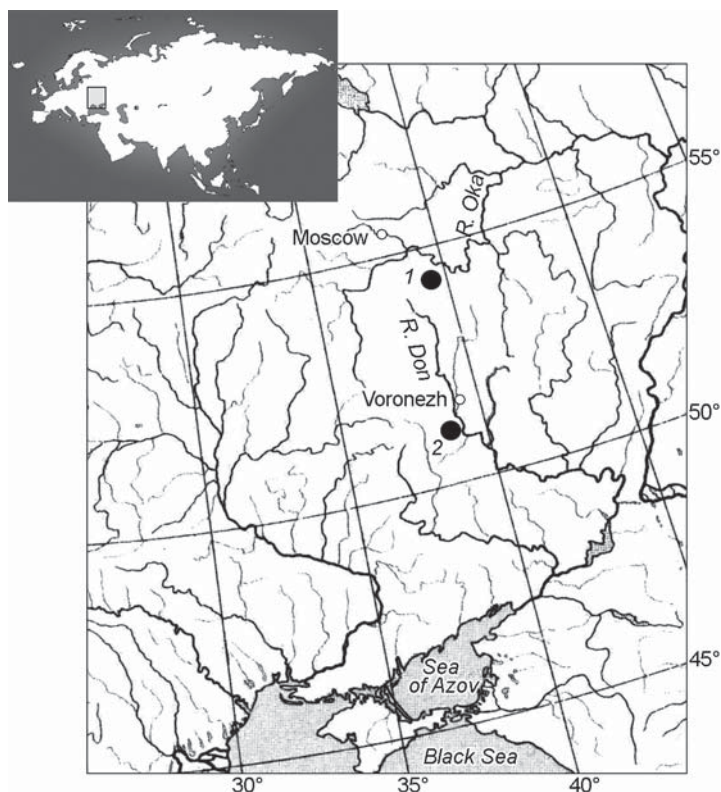


Fig. 1. Location of the Zaraysk (1) and Kostenki 1 (2) sites.

attributes the find to the ritual domain. In some cases, such attribution is quite justified though requires an evidence base. We can talk about a unique object or a feature of cultural layer. This can be an object or a group of objects deliberately placed in a certain context or creating such a context. The context can be whether artificial (for instance, a pit or an accumulation of fauna remains) or natural (a frost crack, a washed-out cavity with intentionally placed items, etc.).

There are a lot of artifacts, found at sites of the Kostenki-Avdeyevo culture (and at Eastern Gravettian sites in general), that can hardly be interpreted in the context of the hunters' utilitarian activities alone. The Eastern Gravettian is a cultural tradition represented in Central and Eastern Europe by sites of "mammoth hunters" dating to the period from 30 to 21 ka BP (uncalibrated) or, in view of the date from the upper layer of Zaraysk, even to 16–15 ka BP. This is the so called stratum of sites with "venuses", shouldered points, and Kostenki knives (Amirkhanov, 2000; Vostochnyi gravett, 1998).

The following types of "non-utilitarian objects" can be attributed to materials of the Kostenki-

Avdeyevo culture: 1) "cache"; 2) accumulation of large faunal remains; 3) objects of portable art; 4) various artifacts with ornament and engraving; 5) Paleolithic "ceramics"; 6) pigments. Noteworthy is also the "ritual complex", which can include several of the above-mentioned objects. Because, clearly, all the variety of non-utilitarian practices known within this cultural tradition cannot be addressed in a single article, we will examine but one of them—"caches".

"Caches". We use the term "caches" with reference to buried or otherwise hidden valuables. In archaeological sense, this is an assemblage. "Caches" are normally classified into lost (left against the will of the owner), returnable (intended for subsequent retrieval), and irretrievable (hidden forever, ritual sacrifices). It is difficult to separate the latter from the term of "ritual complex", which also implies some sacral, ritual component and irretrievability of hiding. A good example of the ritual complex with a clear archaeological context and a reliable evidence base is the bison statuette placed in a specially prepared pit at the Zaraysk

site. An intentionally made triangular elevation on the bottom of the pit, ocher strewn onto the figurine, and a mammoth scapula covering it attest to a preplanned rite. The assemblage can be considered ritual because of several reasons: deliberate damaging of the statuette, coloring it with ocher, pointed bone fragment located near the bison's neck, etc. (Amirkhanov, Lev, 2009: 290–317). This ritual complex may have been related to magic acts intended to secure lucky hunting.

Pits with female figurines or with other intentionally buried symbolic items are also attributed to the ritual complexes, in case the archaeological context provides us with a sufficient evidence base. In Zaraysk, examples of this sort are two storage pits containing "venuses" covered with mammoth scapulae; an ornamented cone of mammoth tusk with a drilled hole, located in a small pit with ocher (Ibid.: 331–332); a heavily worn bifacial point placed at the bottom of a pit and covered with ocher (Lev, Giry, 2022). At Kostenki 1 (I), such artifacts are rather common. One of the most striking examples is a complete female figurine, which was placed in a pit covered with a mammoth scapula (Praslov, 1986: 15–16).

Accumulation of large faunal remains. Certain experts believe that accumulations of bones are caused by ancient hunting and/or natural cataclysms killing animals on a large scale. According to J. Svoboda, S. Péan, and P. Wojtal (2005: 210), Milovice G can be interpreted as a site where mammoths were repeatedly killed and butchered. M. Oliva writes about similar objects at Kraków-Spadzista and Dolní Věstonice I in a somewhat different way: “For the most part, these were remains after the consumption of meat, but humans might not have just thrown them away but also piously deposited them according to the habits of the period. Other bones, mainly the large non-meat ones, were dragged up for the purpose of the presentation of the group, or perhaps of individuals, and maybe also to honour the remains of the killed animals, or their “guardian spirits”... The piled remains of mammoths (and later also the huts of mammoth bones) certainly served for all passers-by as a marking of a place to which a group of capable hunters undoubtedly returned over time... This already suggests that the accumulation of mammoth bones wasn’t a common economically-conditioned phenomenon. This unusual behaviour aimed to express something special. The situations at Kraków-Spadzista B and Dolní Věstonice I indicate that the bones were brought (intentionally?) to former living floors and, at Dolní Věstonice I, were burned on large surfaces, which cannot be confused with standard hearths” (Oliva, 2021: 15).

Similar accumulations are also known at Zaraysk (Amirkhanov, 2009), Kostenki 1 (I), and Khotylevo-2. This tradition persisted on the Russian Plain at a later time. K.N. Gavrilov wrote: “Bone- and earthen structures of the Anosovo-Mezin type demonstrate the final, highest stage of the tradition underlying large piles of animal bones heaped by Paleolithic hunters of Central and Eastern Europe. Their immediate precursors are accumulations of mammoth bones intentionally placed by Eastern Gravettians at Milovice-1 and Khotylevo-2” (2015: 200). Remarkably, intentionally stored valuables were repeatedly found in mammoth skulls forming structures of the Anosovo-Mezin type (Khlopachev, Gavrilov, 2019: 35).

Other categories of “non-utilitarian objects”, specific of the Kostenki-Avdeyevo culture (and of other cultures) and definitely deserving a no less close attention, are nonetheless not mentioned in this publication. Further on, we will focus on the “caches” found in the mammoth skulls at Zaraysk A, E, F, and Kostenki 1 (I) (Fig. 1).

Zaraysk A. “Cache” between tusks in sq. 5-2

The “cache”, comprising large stones, cores, and a chunk of ocher, was placed in a mammoth skull, between bases of tusks No. 3 and 4 in sq. 5-2 (Fig. 2). The occlusal plane of the cranium in whose alveoli these tusks were found was directed upwards. With a rather high probability this complex stratigraphically belongs to the second cultural layer with a typical occupation area manifested by a line of large hearths and semi-subterranean dwellings. The skull lay 1.5 m from the entrance zone of semi-subterranean dwelling E. It is possible that in close proximity there was another dwelling destroyed during the construction of the St. Nicholas tower in the Zaraysk Kremlin.

The right distal end of tusk No. 3 sunk at a depth of 60 cm into the infill of the first generation natural deformation, which during the formation of the second cultural layer had been preserved in the form of hollows or cavities incompletely filled with ground. The skull, the proximal end of tusk No. 3, and the medial part of tusk No. 4, laying on the surface for a long time, were subject to considerable erosion. The distal end of tusk No. 3 is much better preserved due to quick burying.

Left tusk No. 4 and tusk No. 3 belonged to an adult male mammoth (not older than 30 years, age identification by E.N. Mashchenko). The diameter of tusk No. 4 is about 10 cm, the curve length is 140 cm, the chord length is 100 cm. The surface of the tusk is in a state of decay. A part of the tusk was compressed vertically due to soil deformations. Another part shows longitudinal foliation. The tusk covered a hearth belonging to the earliest first cultural layer. The medial and worst preserved part of the tusk lay in humified loam of Zaraysk upper paleosol, with its ends penetrating into brownish sandy loam (Fig. 2).

The hearth is slightly extended along the southwest–northeast line. It has a small depth and typical lens-like shape. Similarly to other hearths of the first cultural layer, it is covered by an ocher lens represented by fragments in the section. The hearth is also overlain by lenses of light fine-grained sand serving as a microstratigraphic marker.

The finds were lying close to each other and formed a cluster. It is hardly possible to reconstruct their initial position because of extremely poor preservation of bones. The artifacts were squeezed between the alveoli or between the tusks below

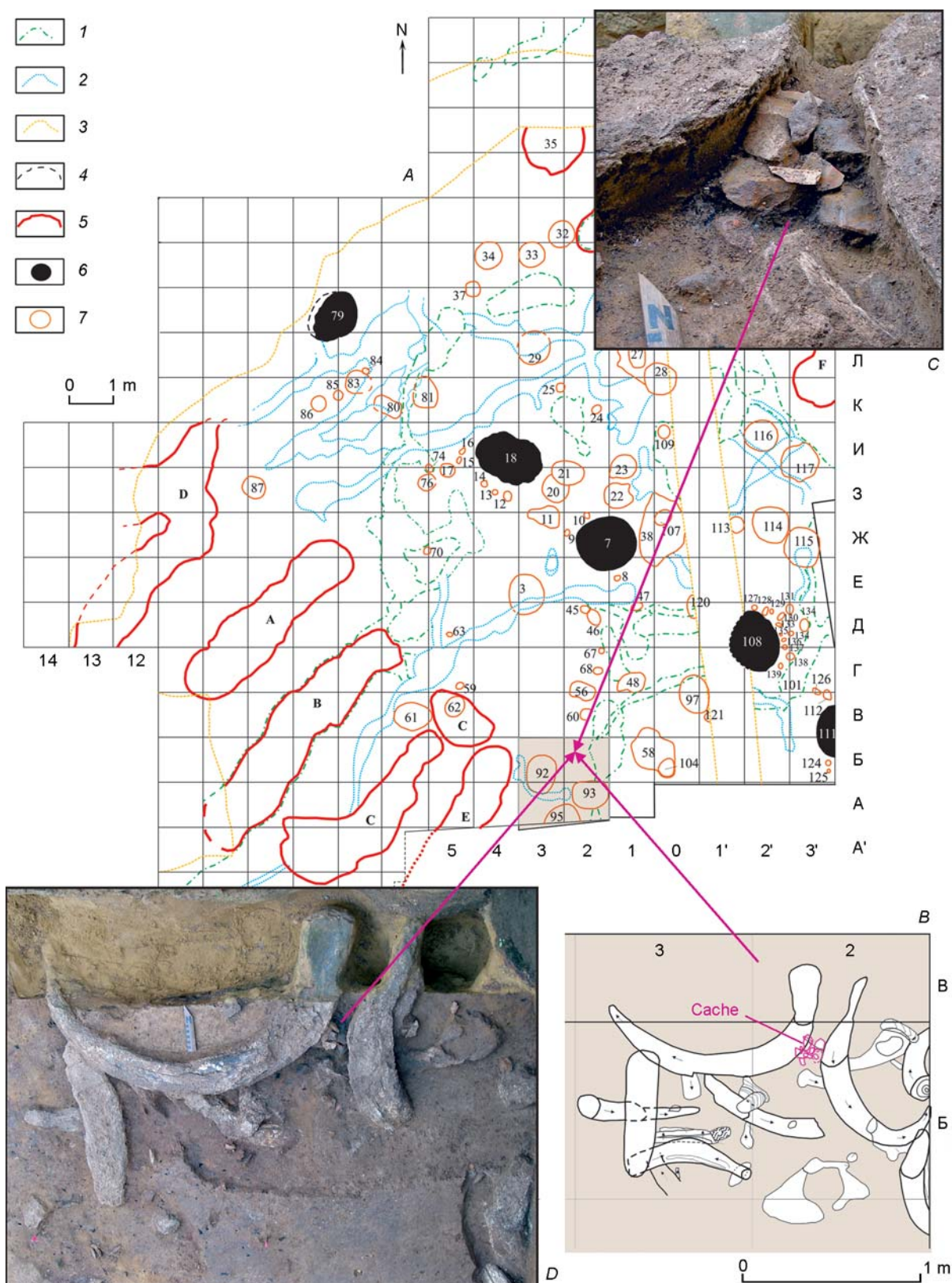


Fig. 2. "Cache" in mammoth skull, sq. B-2, Zaraysk A.

A – plan of features in the second cultural layer and location of the "cache" (1 – disturbances of the first generation; 2 – cracks of the second generation; 3 – places with missing habitation layer; 4 – presumed contours of the objects; 5 – boundaries of pits; 6 – hearths; 7 – semi-subterranean dwellings); B – "cache" on the plan of sq. B-2; C, D – photograph of artifacts *in situ*, close-up, view from above.

the alveoli. The typological composition of the cluster is noteworthy: three cores, three hearth stones, a flake, and two blades of medium size one of which is retouched. The finds lay in brownish sandy loam; a solid chunk of ocher mass underlay one of the cores.

Zaraysk E. “Cache” in mammoth skull in sq. И-7, 8

One of the most remarkable features of the Zaraysk E site, excavated since 2016 (Lev, 2018), is a “cache” of flint artifacts, which the camp dwellers had hidden in the alveolus of a mammoth skull. The facial part of the mammoth skull was dug into the ground to a depth of 20–25 cm in sq. И-7, 8, near the entrance to the semi-subterranean dwelling (pit 18), to the left of the center (Fig. 3). Right near the entrance, there was a suboval pit measuring 115 × 135 cm. The pit was lens-like in the section and up to 25 cm deep. It was filled with burned bone lenses; a thick lens of ocher was located among them. A similar pit in front of semi-subterranean dwelling C was found at Zaraysk A, 2 m from the first “cache” (see Fig. 2). Hearth 3 was located within a distance of 1 m from pit 23. The entrance to semi-subterranean dwelling 18 was oriented towards the hearth.

The skull is heavily deformed and destructed by modern soil processes. Its remains are clustered on an area stretching in the north-to-south direction and forming a projection oriented to the east. The outline of the skull measure 600 × 300 mm. According to E.N. Mashchenko, the skull belonged to a 16–25-year old female. The occipital part was missing, and the alveoli were dug into the parent sediment nearly upright, at a small angle. The alveoli are about 30 cm long.

Tools and blades were intentionally and compactly placed in the left alveolus of the skull dug into the parent sediment 30 cm below the upper line of the dwelling’s wall. The bottom of the dwelling was 5 cm above the parent sediment—a feature typical of the second cultural layer, associated with classic living structures of the Kostenki type.

Large flint artifacts dominated the assemblage: a flake, two flake-blades, a crested blade, retouched blades and bladelets, two end-scrappers, two dihedral burins, five Kostenki knives, including two double-edged pieces, and a hearth stone (24 spec. altogether). In other words, only seven

items of 24 artifacts were not tools (Fig. 4, Table 1). The artifacts were placed very compactly and formed two groups. Six items of the first group were located in the middle part of the alveolus. They were found by accident, because the artifacts had been hidden behind the alveolus from all sides. After they had been extracted, the dense ochreous infill of the alveolus became visible. During its clearing, 18 new artifacts emerged. They were situated close to one another, clustering near the proximal part of the alveolus.

Notably, fragments of alveoli were also found in the sediment filling the entrance zone of the dwelling in sq. И, K-7, very close to the skull placed on its wall. The poor preservation of bone prevented us from conserving the skull or extracting it as a monolith for further cleaning at the laboratory.

No doubt this was a “cache” made before the cranium was placed on it. Its meaning remains unclear: whether these were tools destined for a specific work or for some rite. The context makes the latter possibility more likely, since a very dense placement of artifacts and the digging of alveoli into the ground hardly presupposed future extraction.

Zaraysk F. “Cache” in mammoth skull in sq. Б-63

Mammoth skull No. 121 was discovered in sq. Б-63, 64 of the site. It was found in horizontal position in lilac-colored sandy loam rich in coals and ocher, next to the wall of pit 7, in the upper part of the infill. The facial part was directed downward and somewhat inclined to the southwest (Fig. 5). The braincase was decayed. According to some morphological and stratigraphic traits, pit 7 can be classified as a semi-subterranean dwelling. Its base consisted of the first generation natural structure. The left alveolus of the skull contained a large tusk in the initial anatomical position. It had a significant curve; its roundish end rested against parent light sand with iron stains on the bottom of the pit. Sand around the tusk was greenish in color. A part of the alveolus exfoliated from the tusk was located nearby.

There was no tusk in the right alveolus. During the cleaning, it was found out that this cavity was used for storing two large flint blades. They penetrated the alveolus, filled with brown sandy loam, for at least 10 cm. The blades lay horizontally: one of them was found with its

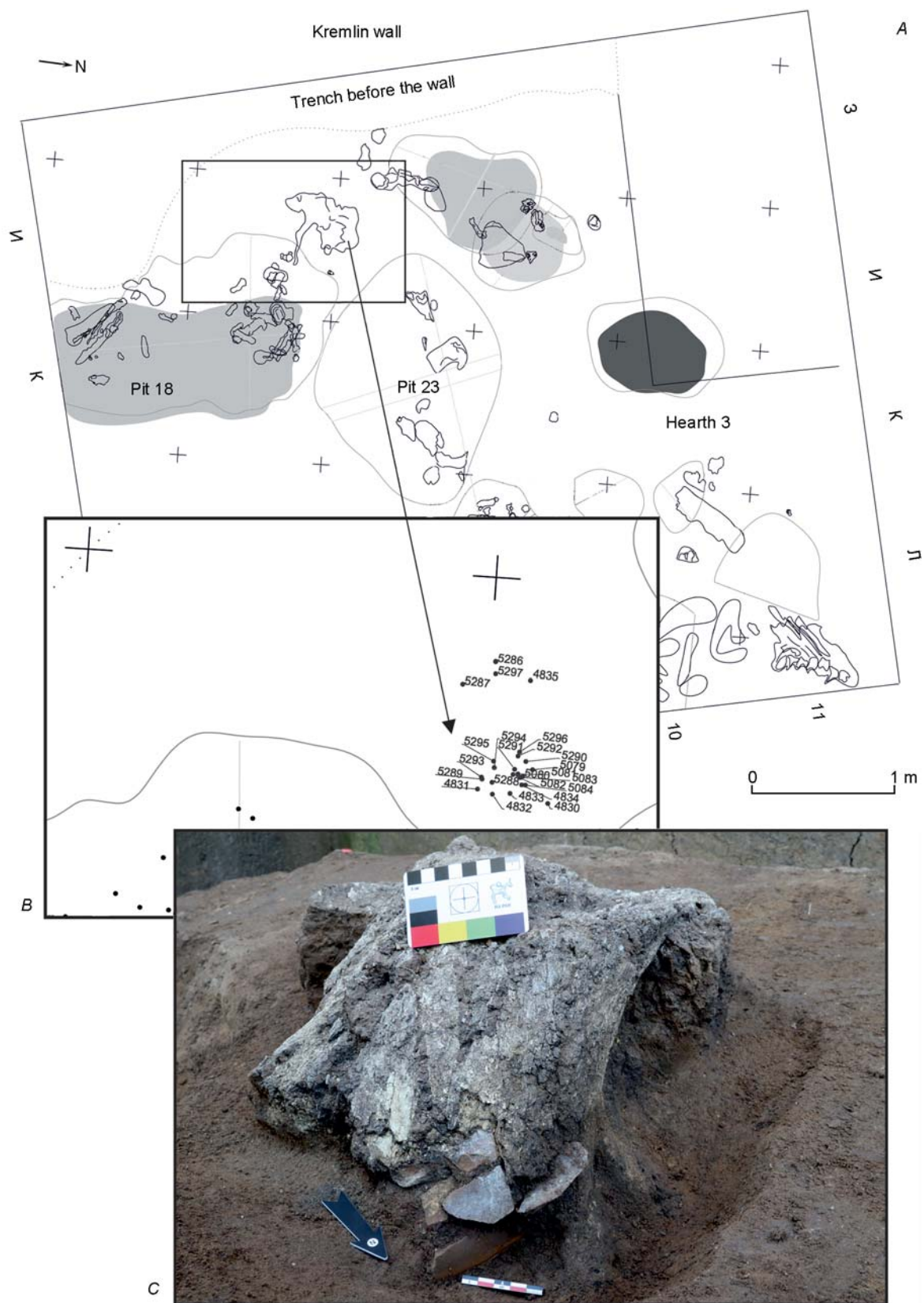


Fig. 3. "Cache" in mammoth skull, sq. И-7, 8, Zaraysk E.

A – plan of the excavated area with pits and faunal remains; B – plan showing the location of the finds in the skull; C – photograph of the artifacts *in situ* in the skull.

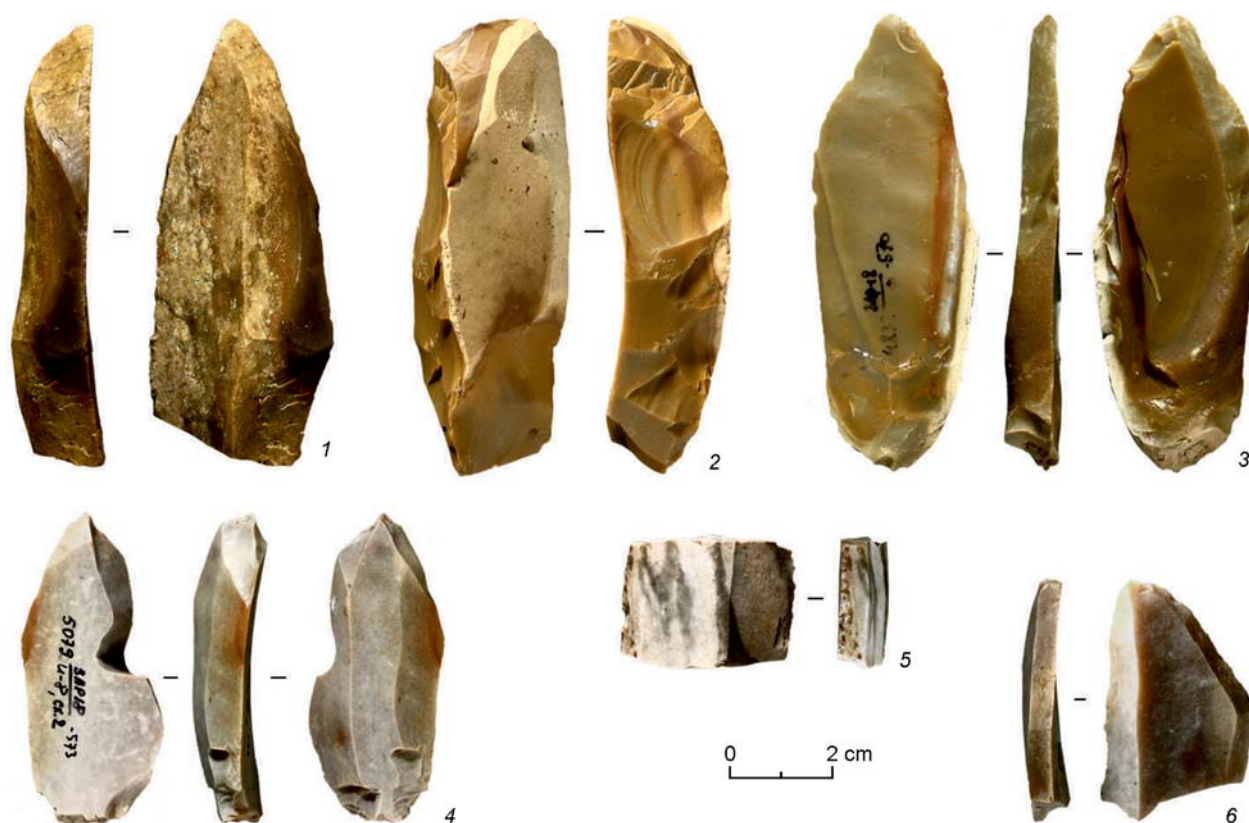


Fig. 4. Items from “cache” in mammoth skull, sq. II-7, 8, Zaraysk E.

1, 3, 6 – Kostenki knives; 2 – end-scraper; 4 – dihedral burin; 5 – fragment of a retouched blade.

ventral surface up, the other one rested on its ridge. A medium-sized flake with a chalky cortex, two small flakes, and a microblade with irregular retouch lay on the ridge near the blades. These small items could have been transported into the alveolus by taphonomic processes, together with earth from the cultural horizon, and then the skull was gradually displaced to the bottom of the pit. The southeastward shift of the tusk from the edge of the pit was registered stratigraphically in the excavation baulk. The skull was apparently situated on the wall of the semi-subterranean dwelling, with its occipital part directed downwards, and the tusk was part of the ceiling, which eventually collapsed. This “cache”, same as two others described above, was associated with the second cultural layer.

The flint blades are noteworthy. The blades are long (155 mm and 165 mm), with a curved profile. They demonstrate striking platforms carefully prepared in the Kostenki technique and retouch along the right edge. The first blade has a distal end modified in the technique of Kostenki knives (Klaric et al., 2015). The platform of the knife for detaching longitudinal edge flakes was formed

Table 1. Composition of finds from the mammoth skull in sq. II-8

Category	Number of specimens
Kostenki knife	3
Double-edged Kostenki knife	2
Retouched blade	3
Retouched bladelet	4
Retouched flake-blade	1
Dihedral burin	2
End-scraper	2
Flake	1
Flake-blade	2
Bladelet	2
Crested blade	1
Hearth stone	1
<i>Total</i>	24

by a flat burin spall removed from the right edge; it runs at an angle to the ventral face (Fig. 5, B). The dorsal surface bears small thinning flakes. The blade shows scars of two successive detachments



Fig. 5. "Cache" in mammoth skull, sq. Б-63, Zaraysk F.

A – location of the artifacts in the alveolus, close-up; B – Kostenki knife; C – retouched blade.

from the right edge and fine retouch along the edge above the latter scar (possibly, use-wear traces). Flat retouch along the right edge was partially removed by the first edge spall almost reaching the middle of the blade lengthwise.

The profile of the second blade is more curved (Fig. 5, C). Its left edge bears a spot of chalky cortex; the distal end is broken. The right side of the distal part exhibits fine dorsal flat retouch. The proximal part is retouched on both the ventral and dorsal faces. The central third of the right edge is unretouched. Typologically, such blades can be regarded as knives. At a certain stage of their utilization, they were rejuvenated in the technique used for Kostenki knives to maintain the sharpness of the working edge. Traceological analysis will hopefully shed light on the destination of those blades.

Kostenki 1 (I), 1982. "Cache" in mammoth skull in semi-subterranean dwelling E₁

Three-chamber semi-subterranean dwelling E is located in the northwestern part of the second complex. The dwelling consisted of three adjacent isolated pits/chambers (Fig. 6; 7, A, B). Judging by the infill, chambers E₁ and E₂ were destined for habitation, while chamber E₃, being not so wide and deep as two others, served as a bone carving

workshop. Entrances to the chambers are clearly visible both in plan and in profile view; chambers E₂ and E₃ had a common entrance, whereas chamber E₁ had a separate entrance, and the pit adjoining it was situated in sq. УФ-7, whose border with the pit of the dwelling was marked by a gentle ledge, and its sides, by shelf-like steps. A large mammoth skull lay on the ledge across the entrance, and close to it lay a large part of the cranium without teeth or condyles. Apparently, cranial bones had been placed at the edge of the deeper part of the entrance to make the aperture higher; they collapsed together with the dwelling. Cavities inside the

skulls were used as storages. Three large flint blades were found inside the right tusk alveolus (Fig. 7, D). The forth blade of the same size lay under the skull. A polar fox scapula was located on the entrance ledge. Among the few finds in the entrance zone, on the floor of the outermost border of chamber E₁, there was a typically Kostenki-Avdeyevo diadem made of mammoth ivory blade with carved out lugs (Fig. 7, C). Judging by the location, the diadem lay on a shelf formed by the ledge near the entrance. There were also found flint blades (in the alveolus of the skull and under it) and an ivory polisher (under the skull).

Kostenki 1 (I), 1983. "Cache" in mammoth skull in sq. p-66

On the line of squares ппс-62-70, a massive accumulation of several groups of large mammoth bones was excavated. The accumulation was oriented roughly to the northwest–southeast, stretching downward along the slope (the angle of inclination is 45°). No doubt the bones were heaped intentionally, as evidenced by their position: some of them were thrust between others and dug into the ground. A part of the accumulation in sq. ппс-65, 66 included two fragmented mammoth skulls (Fig. 8, A); both were located in sq. p-66. One of them rested on its occipital part; teeth and tusk alveoli were

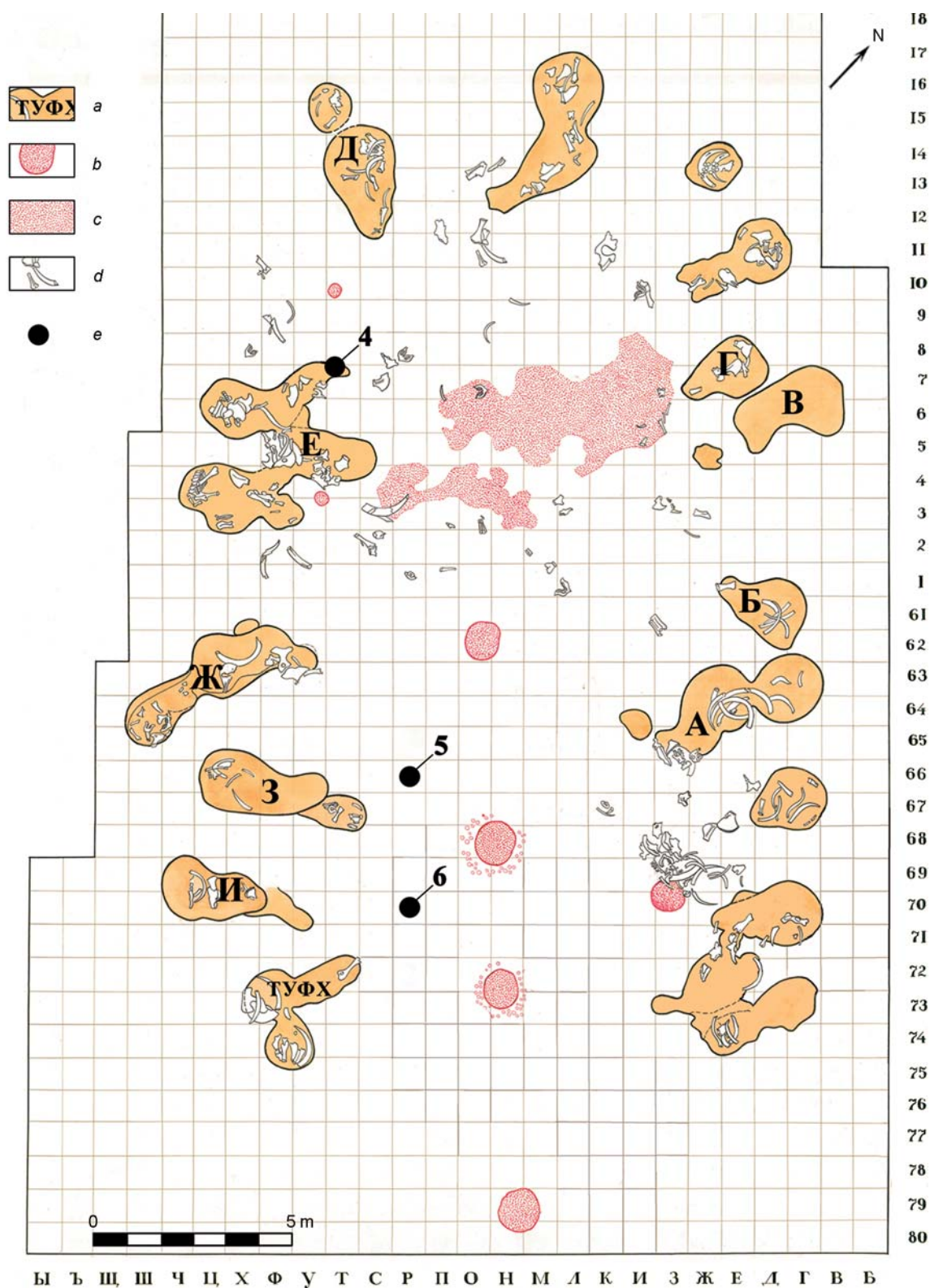


Fig. 6. General plan of the second complex at Kostenki 1, layer I. Figures 4–6 correspond to the numbers of “caches” in mammoth skulls in the order they are described in the text.

a – semi-subterranean dwellings and storage pits; *b* – hearths and pits with ash and coals; *c* – ashy and coaly spots; *d* – bones and tusks; *e* – locations of the “caches”; А, Б, В, Г, Д, Е, Ж, З, И, ТУФХ – designations of the semi-subterranean dwellings.



Fig. 7. Complex of semi-subterranean dwellings E, Kostenki 1, layer I, 1982.

A – general view; B – part of the complex in sq. yφxu-6-7; C – diadem; D – “cache” of flint blades in the alveolus of mammoth skull. Photographic Department of the Institute for the History of Material Culture RAS Archives. Albums O.3495-5, O.3495-41, O.3495-44, and O.3495-91.

directed to the west; a large femoral fragment had been hammered into the nasal aperture (which was later destroyed), penetrating the cranial cavity. Another skull belonged to a younger individual; its facial part was oriented to the north-northwest. The frontal and parietal parts were destroyed down to the zygoma, and the alveoli were dug into the parent sediment to the depth of ~30 cm.

An alveolus of one of these skulls (possibly directed to the north-northwest) contained a “cache” comprising over 20 blades and flakes of chalk flint and quartzite (Table 2). The “cache” lay compactly; therefore, it was extracted from the alveolus as a monolith. Cleaning of the “cache” was conducted in laboratory conditions, with detailed recording of arrangement of the finds (Fig. 8, B, C, D, E). The artifacts were located at different angles; some of them lay perpendicular to each other. A small wedge

of a long bone epiphysis (Fig. 8, B) was situated among them. A fragment of a colored flint concretion underlay the artifacts.

Kostenki 1 (I), 1984. “Cache” in mammoth skull in sq. p-70

A skull of an adult mammoth was found between the line of hearths and the semi-subterranean dwelling in sq. ryφx-72-75 (see Fig. 6), in a hollow filled with colored sandy loam in sq. pc-71. The occipital part of the skull rested on bones hammered into ground at an angle of 60°—a tibia split lengthwise and a fibula. The tibia (48 cm long) rose above the colored layer to a height of 22 cm, the fibula to a height of 10 cm. The frontal part of the skull was directed to the northwest, alveoli were situated in sq. p-70

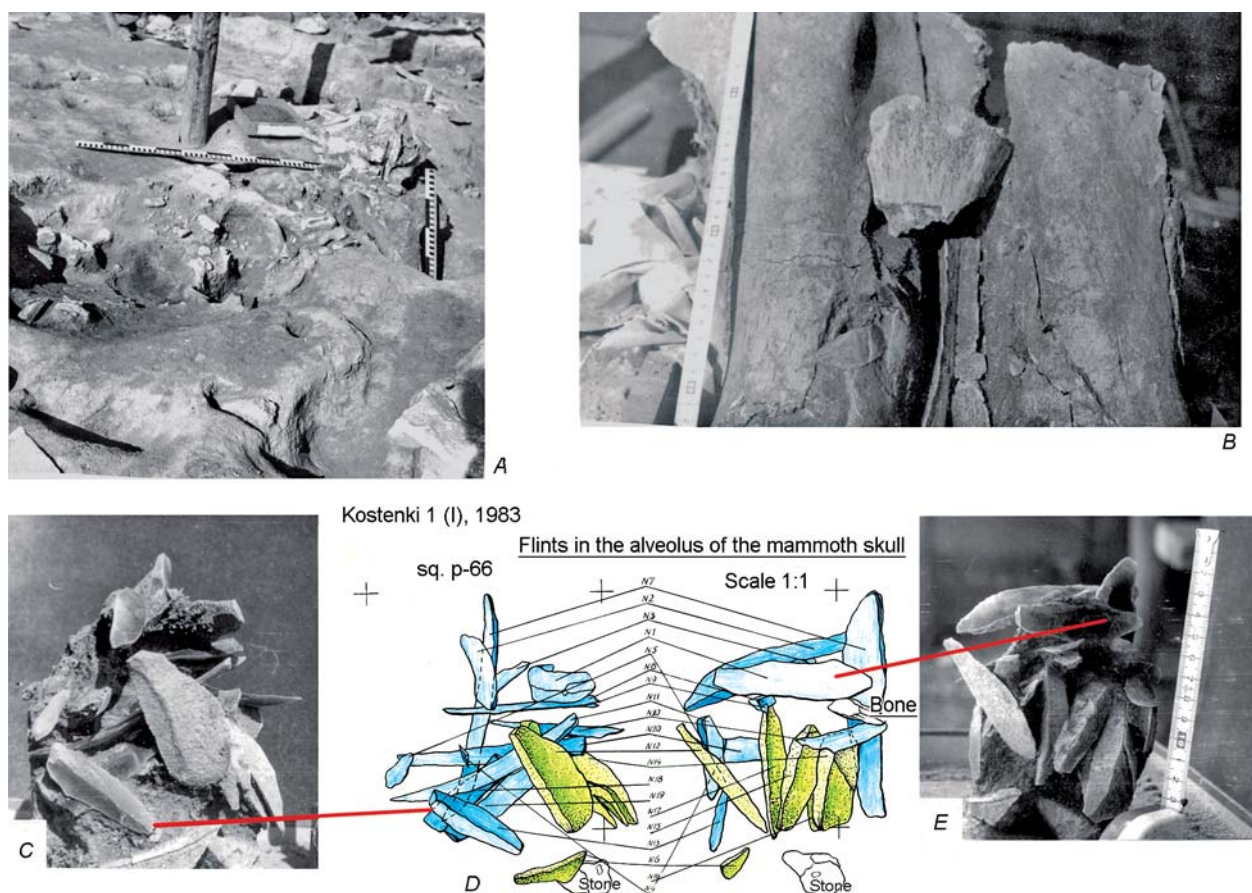


Fig. 8. Hollow in sq. pc-65 and mammoth skulls dug in sq. p-66 (A); alveoli with the “cache” of flint artifacts extracted as a monolith; above, a bone wedge from the “cache” (B); flints from the alveolus of the mammoth skull from sq. p-66 (C, D, E). Kostienki 1, layer I, 1983. Photographic Department of the Institute for the History of Material Culture RAS Archives. Albums O.3479-9, O.3480-70, O.3480-72, and O.3480-73.

(Fig. 9, A). The maxilla was missing; teeth were knocked out, and the parietal and occipital parts were destroyed evidently by camp dwellers. Southwest of the skull, the layer had intensive dark red color. The layer was loose, from 5 to 2–3 cm thick, almost homogeneous. A large fragment of a pelvic bone, lying inclined, adjoined the skull from the north.

The cavities inside the skull were filled with dusty fine-grained gray sediment without admixture of cultural layer. The left alveolus contained a complete spatula with a figured top made of a rib and positioned longwise (Fig. 9, B). The top was found deep inside the alveolus, and the working edge below touched the cultural layer, which blocked the alveolus from below. Under the spatula on the alveolus wall, there lay a flat, green, rounded pebble with traces of wear suggesting

Table 2. Composition of finds of various raw materials from the mammoth skull in sq. p-66

Category	Number of specimens
<i>Chalk flint</i>	
Kostienki knife on a crested spall	1
Blade	2
Fragment of a blade	4
Fragment of a retouched blade	2
Retouched crested blade	1
Microblade	1
Flake-blade	2
Flake	1
Total	14
<i>Quartzite</i>	
Lateral crested spall	1
Retouched lateral crested spall	1
Blade with cortex	2
Retouched blade with cortex	1
Fragment of a retouched blade with cortex	1
Flake	1
Total	7
<i>Colored flint</i>	
Fragment of a concretion	1
Total	22

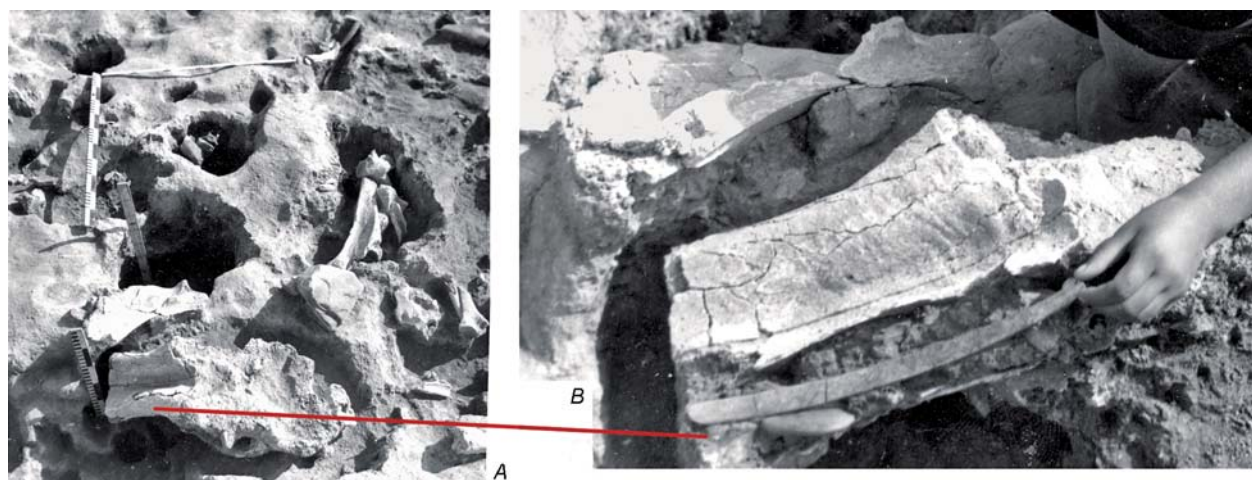


Fig. 9. “Cache” in sq. p-71 of Kostenki 1, layer I, 1984.

A – general view, alveoli of the mammoth skull are in the foreground; B – bone spatula in the alveolus of the mammoth skull. Photographic Department of the Institute for the History of Material Culture RAS Archives. Albums O.3465-41 and O.3465-43.

its use as a retoucher. The right alveolus was filled with the sediment of cultural layer—dense loam containing small bone coals and ocher coating. A small flake was found within the sediment. The left alveolus was obviously empty and closed, while the ground from the cultural layer freely flowed into the right one. Several flints lay compactly directly on the loam, under the alveoli. A little further south, near the upright positioned long bones, on which the occiput of skull rested, lay one more small ivory spatula with missing ends.

Discussion

The practice we have discussed consisted of hiding things, which ancient hunters deemed valuable, in cavities of large mammoth bones, primarily crania. This practice, documented at certain sites of the Eastern Gravettian, can apparently be regarded as a cultural tradition, which existed in the periglacial zone. Such caches were placed in interdental cavities and alveoli of teeth, including tusks. In Central Europe, despite the abundance of Gravettian sites with large accumulation of faunal remains, such caches are very few. One of them was discovered at Dolní Věstonice I. As M. Oliva notes, “The alveolus of a lower mammoth jaw enlarged by a suppurating process held a large prismatic core of the Kraków-Częstochowa Jurassic flint. It is the largest piece of this precious raw material, brought from a distance of about 300 km, in the entire Gravettian below the Pavlov Hills” (2021: 11–12). As we see, at this Early Graverrian site with large accumulations of mammoth

bones (as at the sites described above), valuables were cached in natural cavities of mammoth crania. At later Epigravettian sites of the Russian Plain, this custom was more common.

Notably, a considerable number of caches in mammoth skulls are spatially associated with semi-subterranean dwellings. Regardless of the animals’ age or sex, one half of the crania had been placed directly on the walls of those dwellings, and the other half at a distance of 1.5–2.0 m from their entrances. Typologically, cached flint artifacts belonged to the Kostenki-Avdeyevo industry. Similar high-quality blades were also found in pits specially destined for caches, which will be addressed in a separate study. The purpose of assembling the toolkits and supplementing them with hearth stones is unclear. The absence of bone tools in “caches” at Zaraysk, too, needs explanation; a possible reason being poor preservation of bone artifacts and of faunal remains in general.

So far, it can be concluded that in Eastern Europe, the practice of caching valuables in mammoth skulls had survived the LGM and was documented by sites of the Anosovo-Mezin tradition, which is not directly derivable from the Kostenki-Avdeyevo culture either typologically or technologically or in terms of any other criteria (Khlopachev, Gavrillov, 2019: 35).

Conclusions

Over the long history of the Eastern Gravettian studies, experts have more than once mentioned

evidence of rites practiced by the sites' dwellers. However, by far not all objects we mention as non-utilitarian were regarded as evidence of rituals. A long-standing paradigm that prevailed in Paleolithic studies was purely utilitarian, forcing one to consider all finds in the context of subsistence strategies in the harsh conditions of the periglacial zone. Though, many artifacts demonstrated the shortcomings of such approach. Figurines, ornaments, pigments, "ceramics", caches in animal crania, pits, and elsewhere, as well as structures composed of large bones but obviously having nothing to do with houses (Gavrilov, 2024), unambiguously demonstrate that the ancient hunters' mentality was richer than previously believed. "Caches" in mammoth skulls take a special place, but they should definitely be viewed in the general cultural context.

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Ivory Bead Ornaments from the Sungir Paleolithic Site

This article presents the results of a study of composite ornaments made of ivory beads from burials of a man and two adolescents, discovered by O.N. Bader at Sungir, a site dating to the Final Early Upper Paleolithic (30–26 ka BP). The burials are excessively rich in such ornaments, which were made by stringing many beads on a sinew or thread made of organic material. Strings of beads preserved in burials and retaining the order of constituent elements were used as a source for identifying typologically meaningful forms of beads. Owing to the alternation of elements of various shapes or similar in form but made from different blanks, a specific rhythmic structure was generated. The composition of strings suggests that eight types of ivory bead were employed. Two main techniques of stringing were used: by isolating the central group of beads, and by arranging them in the order of size gradually decreasing from one end to the other. The search for cultural parallels has revealed that the principle of combining different types of beads to create strings was similar to that used at contemporaneous sites in southern Germany dating to the Final Aurignacian.

Keywords: Upper Paleolithic, Streletskian, Sungir, funerary offerings, composite ornaments, ivory beads.

Introduction

Mammoth ivory beads are small items of complicated standardized shape; these are among the most widespread types of personal ornaments frequently discovered during excavations of Upper Paleolithic sites in Northern Eurasia. Some Central and Eastern European sites yielded tens, hundreds, and even thousands of beads (Scheer, 1985; White, 1993; Eiseitschmuck..., 2003; Khlopachev, 2006). Beads

are usually found in cultural layers as individual finds or concentrations of scattered items. The features of bead occurrences in Paleolithic burials indicate that they were used as elements of composite ornaments, similarly to mollusk shells and animal teeth. At present, complete beaded ornaments made of large numbers of ivory beads, which retained their original position on various parts of human body, have been reported only from the Sungir Paleolithic site, which makes it a unique archaeological source.

Sungir: cultural, chronological, and archaeological context

The site of Sungir has been dated to the terminal stage of the Early Upper Paleolithic of Eastern and Central Europe. Currently, its absolute radiocarbon age is determined to be in the range of 30–26 ka BP (uncal) (Gavrilov, Kuzmin, Chechushkova, 2024). In Eastern Europe, this period is represented at the sites of the Aurignacian, Early Gravettian, Gorodtsovian, and Streletskian archaeological cultures. Sungir is roughly contemporaneous with the sites of the Final Aurignacian in Western and Central Europe, the Final Szeletian in Central Europe, and the Early Gravettian in Central and Southern Europe.

There are two main hypotheses regarding the cultural attribution of the Sungir site. O.N. Bader proposed to attribute Sungir to the Streletskian archaeological culture; some researchers argued attribution to the Aurignacian. The present authors believe that the Sungir site can be considered an Eastern European parallel to the Final Szeletian of Central Europe. This cultural-chronological assessment is in good agreement with modern data on the widespread distribution in Europe since 29–28 ka BP (uncal) of human burials containing mineral pigment (ocher), personal ornaments, and sometimes tools and weapons (for more details, see (Khlopachev, 2024; Gavrilov, Khlopachev, 2025)).

The burials in question were made in two grave-pits with two levels in each. The lower levels contained the main burials: grave 1—a man aged 45–55 years (S-1), grave 2—two adolescents laid in a line, head to head. The skeletal remains of one of them belonged to a boy aged 12–13 years (S-2), and the other skeleton to a girl (Poltoraus, Kulikov, Lebedeva, 2000) or a boy (Sikora et al., 2017) aged 7–10 years (S-3). The burial rite involved the use of red ocher powder, which was generously applied first to the grave floor and then to the bodies of the deceased in several layers. Part of the rite apparently included placing the remains of other people in the upper tier of the pits. Above the man's burial, there was a skull, and above the adolescents' burial, a poorly preserved skeleton without a skull (Bader, 1998: 32–37, 51–63). It was established that the main burials were associated with the middle level of the cultural layer, and the human remains located above them were associated with the lower part of the upper cultural stratum. Thus, the main burials can be dated to the range of 29–28 ka BP (uncal), and the upper ones about 26 ka BP (uncal) (Gavrilov, Kuzmin, Chechushkova, 2024).

The abundant accompanying bone offerings are a characteristic feature of the burials under consideration; these were noticeably more diverse in the paired burial, containing straighteners made of reindeer antlers, “bâtons de commandement”, fibula hairpins, ivory disks with radial incising, animal figurines, a human bone filled with ocher inside, and various weapons laid out in a certain order. A common feature of the funerary offerings of the man and the adolescents was a huge number of personal ornaments. Many of these retained their original position on the bodies of the deceased. The ornaments included flat stone pendants with holes at the ends, arctic fox fangs, rings, plate bracelets, and beads carved from mammoth tusk. Beads were the most common and largest category of finds (Bader, 1998: 85).

Mammoth ivory beads as archaeological source

The abundance of ivory beads at Sungir is unique and has no parallels in the Paleolithic of Europe. The beads were found in large quantities not only in the cultural layer, but also in the three closed archaeological complexes. Thousands of such finds were discovered in the burials, with many hundreds of beads retaining their original positions in the burial space. The drawings and photographs of cleared burials show rows of ivory beads located very close to one another. In scientific literature, these are designated by the term *nizka* (‘string’)—an ornament made by stringing beads on a cord. This method of making beaded ornaments is confirmed both by the position of the strung objects in relation to each other (Khlopachev, Bazilevich, 2024), and by the data of traceological analysis of a series of flat beads used to make strings with beads of other shapes. The localization of non-utilitarian wear exclusively on the narrow-end surfaces corresponds to the distribution of traces that appear precisely on beads tightly strung on a thread*.

The strings of ivory beads were located on the chest, back, head, legs, and arms of the buried. Unlike the beads that were located in dense, often several-layered clusters, being scattered composite ornaments, the remains of bead strings provide us with the information not only about their location on the body

*The traceological analysis was carried by the senior researcher of the Experimental-Traceological Laboratory of the Institute for the History of Material Culture of the Russian Academy of Sciences, E.Y. Giryva.

of the deceased, but also about their design features. In the publication of Sungir burials, Bader gives a lot of facts regarding the order of stringing the beads. For example, to make strings for decorating the outerwear of the man and children (Bader, 1998: 87–88, 92, 95) and the headdress of the young adolescent (Ibid.: 92), the artisans should have taken into account the shapes and sizes of individual beads. However, Bader identified not only the order of bead stringing; he paid great attention to the bead groups located *in situ* relative to the skeletal remains. These beads and their positions in the grave served as the main basis for the reconstruction of clothing of the ancient Sungir people (Ibid.: 103).

In 1978, Bader proposed the classification of ivory beads into three types (for more details, see (Khlopachev, Bazilevich, 2024)); it was based on the bead typology that he had elaborated earlier using materials from cultural layers but not from burials (1966). The typology was developed by the intuitive assessment of the geometrical shape of the ornaments, and the supposed methods of their attachment. The 1978 classification was made using the entire collection of beads from the site of Sungir, numbering about 10 thousand units. However, like the previous one, it did not consider the archaeological context of the ornaments in the burials for determining their morphological features. At the time of introducing the classification to the scientific community, Bader argued that none of the identified types of beads had any reliable direct cultural-chronological parallels in the Upper Paleolithic materials of Europe; the type of bead with cutouts he considered as the local cultural feature of Sungir (1978: 169–170).

We proposed the approach to identification of typologically significant forms of ivory beads based on the analysis of a large sample of the well-preserved bead strings from the burials of men and adolescents. It has shown that, on the one hand, the 1978 classification requires some adjustment; while on the other hand, the features of string manufacture provide completely new opportunities for studying the socio-communicative role of personal ornaments in the Old Stone Age.

Specifics of bead stringing

The studied sample consisted of 11,850 ivory beads (both complete and fragments) from the Sungir burials (S-1 – 2888 pcs., S-2 – 3753 pcs., S-3 – 5209 pcs.) and 308 ivory beads and blanks from the cultural

layer*. Funerary offerings of the main burials did not contain bead blanks. Therefore, the study of unfinished products and small rods with traces of blank detachment, which were recovered from the cultural layer, was important for a better understanding of the specifics of bead shaping and for the reconstruction of the operation sequence. Ready-to-use beads from the cultural layer were used for comparison with the identified types of beads from the burials. In the studies of the materials from the burials, the main attention was paid to the analysis of shapes of beads in strings, which retained the original order along the entire length. Such beaded ornaments were recorded with all three buried individuals and consisted of transverse and longitudinal rows on the torsos, arms, legs, and heads of the deceased. On the basis of the positions of strings relative to the skeletal remains, the ornaments can be subdivided into four groups: 1) transverse strings located on the floor of the grave under the bones in the torso area and compositionally unrelated to the transverse rows of beads located on the chest of the buried individual; 2) strings tightly encircling the humerus, ulna, tibia, and skull; 3) transverse rows in the chest area, longitudinal rows on the bones of arms and legs (or along them), often lying on top of the strings of group 2; 4) transverse rows of beads located on the body above the strings of group 3.

The most complete, holistic idea of the specifics of making beaded ornaments was gained in the course of studying the strings of beads of groups 2–4 from the burial of a man, groups 1, 2, 4 and some strings of group 3 from the burial of adolescents. The strings of group 1 from the burial of a man, as well as those covering his skull, are not present in the SVSMR collection**. Assessment of the sequences of beads in the strings of group 3 from the burial of adolescents was somewhat difficult. In the process of casting the block of the burial sediments with cleared skeletons, some of the beads and fragments of the strings were removed together with the cast. During the subsequent documentation of the positions of beads in this burial,

*At present, collections of beads from the Upper Paleolithic site of Sungir are deposited in the archaeological collection of the State Vladimir-Suzdal Museum-Reserve (SVSMR).

**The skull was removed from the layer and taken away for study by M.M. Gerasimov during the burial excavation, while the lower part of the filling of the grave-pit, containing the man's bones, was removed in separate blocks and analyzed in the laboratory of the Institute of Archaeology of the USSR Academy of Sciences.

these were recorded separately. Notably, the arrangement of beads in the strings from the man's burial was described in more detail. For example, in contrast to the adolescents' burial, the multi-row bead strings covering the arms and legs were recorded by rows and separately for the finds on and under the bones.

Analysis of morphometric features of beads in the well-preserved composite ornaments showed that these were strung in a certain rhythmic pattern. In some cases, the sequence was an alternation of groups of beads of different types; in others, the sequence was of beads of the same type, but made from different blanks. Three main types of rhythmic alternation of beads (groups of beads) of different shapes were identified. All of the three alternations together were noted in the strings forming a triple transverse band located on the man's chest. The upper string was composed of 86 beads, constituting a row of groups of massive beads, sub-rectangular in plan view (Fig. 1), with wide cutouts in the middle of opposite surfaces and biconical holes in the centers, separated by single large flattened beads of a rounded shape with a hole in the center, without cutouts (Fig. 2, 3, 5). The middle row consisted of 74 beads. This string, on the contrary, showed large groups of big rounded beads separated by single massive beads of sub-rectangular shape with cutouts. The lower string, which included 101 beads, was made up of the same beads, but showed a more complex rhythmic composition based on the alternation of both single beads of various types and groups of 3, 6, 10, and 20 one-type beads.

The strings were also made up entirely of the beads of the same shape. These could be flattened rounded beads without cutouts, as, e.g., in the first and second strings, which encircled the shin bones (in the upper part) of the man's right leg. However,

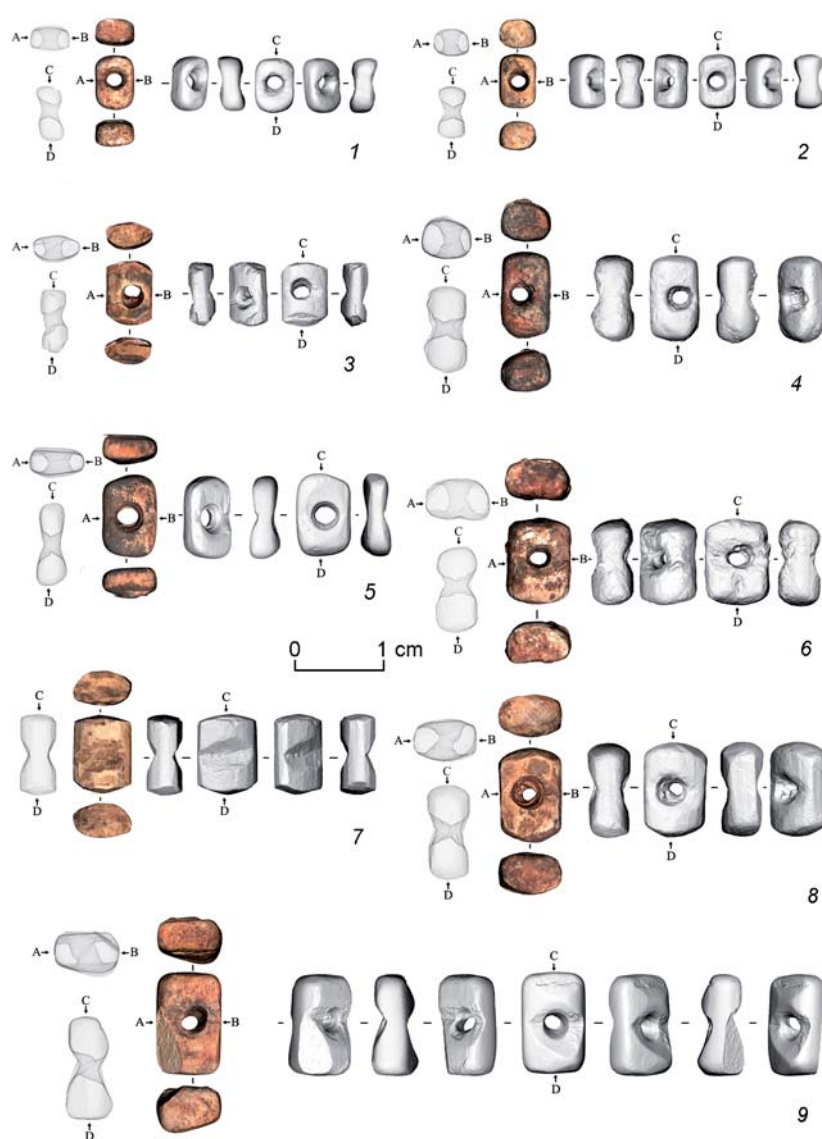


Fig. 1. Robust ivory beads, sub-rectangular in plan view, with symmetrical cutouts in the opposite surfaces and biconical holes in the center. From the SVSMR collection.

1–3, 6 – short; 4, 5, 8 – shortened; 7 – non-finished short; 9 – long. 1 – B-33898/4752; 2 – B-33898/4750; 3 – B-33897/78; 4 – B-33898/4787; 5 – B-33898/4788; 6 – B-33897/87; 7 – B-15304/12336; 8 – B-33898/4780; 9 – B-33898/4737.

more abundant are strings of beads with cutouts on the surfaces. Two of such strings formed the upper double band on the back of the older adolescent. These consisted of 28 (upper string) and 69 (lower string) beads measuring $0.6 \times 0.5 \times 0.3$ cm. The composition showed rhythmically alternating groups of similar items made from different blanks—with a rounded (see Fig. 1, 2, 4) or flattened-oval (see Fig. 1, 1, 3, 9) cross-section. The same pattern is revealed in the string of 27 beads encircling the ulna and radius (in the lower part) of the man's left arm.

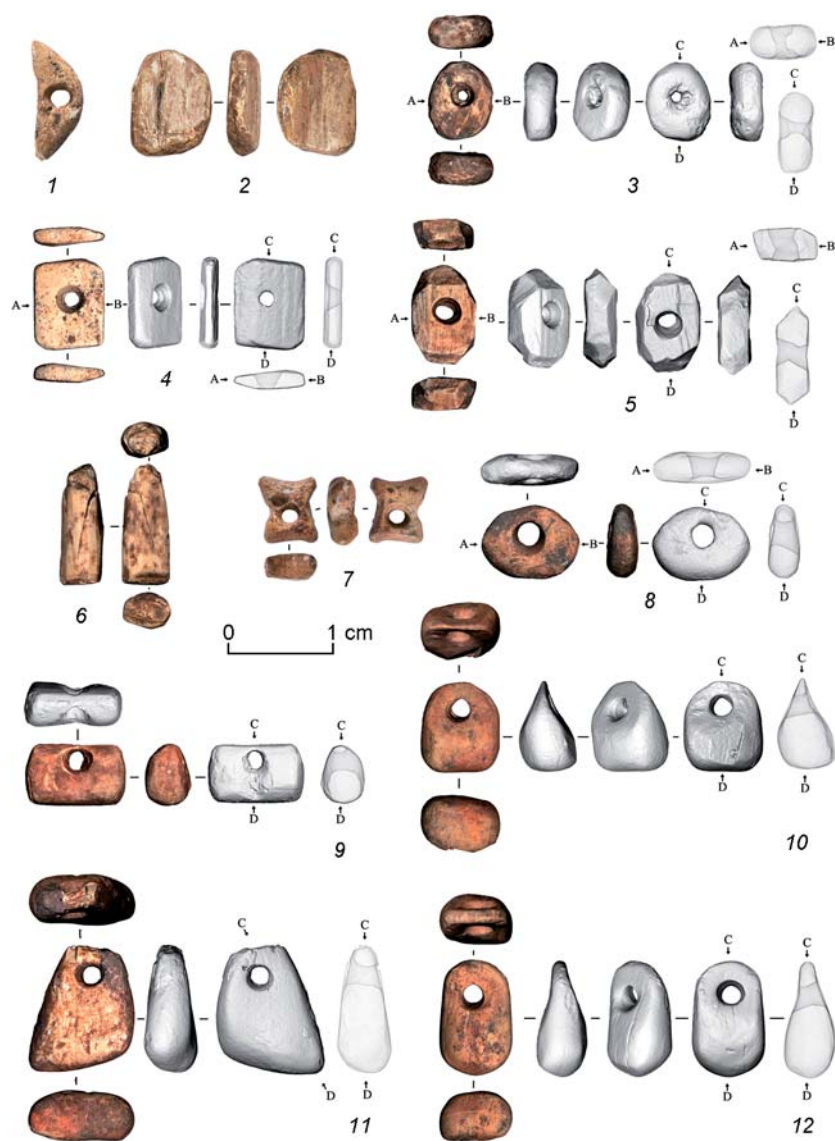


Fig. 2. Elements of the mammoth tusk beaded ornaments. *From the SVSMR collection.*

1 – crescent-shaped bead; 2 – non-finished flat rounded bead; 3, 5 – flattened rounded beads with holes in the centers; 4 – flat, thin, square-shaped bead with a hole in the center; 6 – small rod bearing traces of bead detachment at its end; 7 – bead in the form of lilac flower; 8, 9 – pendant beads stylized as basket-shaped items; 10, 12 – basket-shaped pendant beads; 11 – pendant bead imitating a rudimentary deer tooth. 1 – B-33898/2462; 2 – B-15304/12255; 3 – B-33897/83; 4 – B-33898/4745; 5 – B-33897/79; 6 – B-15304/12335; 7 – B-33898/8417; 8 – B-33898/4778; 9 – B-33897/100; 10 – B-33898/4725; 11 – B-33897/408; 12 – B-33898/4726.

If a string was constructed mainly of beads with cutouts, the ornament made of beads strung together could acquire a characteristic crisscrossing relief (Fig. 3, 2, b). Owing to the peculiar shape of the cutouts, the beads spontaneously turn and stand perpendicular to each other, cutout to cutout. This suggests that the cutout was a more significant feature for the classification of beads than was previously thought.

Furthermore, quite frequent were the constructions of strings based on dimensions of beads. These could be assembled from elements of the same type or those of various forms creating rhythmic compositions. The beads in the strings were arranged in such a way that their size gradually decreased from one end to the other. The largest beads had a size of $1.0 \times 0.7 \times 0.4$ cm, and the smallest ones $0.5 \times 0.4 \times 0.3$ cm. Such compositions were most often noted in the strings that embraced the bones of arms and legs. This is for example the string of 116 elements on the lower part of the right leg's tibia of a young adolescent. The rhythmic alternation of beads of various shapes here followed the same pattern as that in the upper string from a triple band located on the man's chest.

In the burials, there are also strings made of beads of various sizes used for the creation of centric compositions, when a small group of small beads of the same shape was placed in the medial part of a composite ornament, and sequences of larger beads were arranged on either side of it. Such are the strings from the burial of an older adolescent. One of them lay on the right femur and consisted of 47 ivory beads and three arctic fox fangs. The middle part of the composition was formed by a group of alternating rather small beads with cutouts and rounded flat varieties; three very thin square beads with holes made by one-

sided drilling were placed in the middle (see Fig. 2, 4). Arctic fox fangs were placed at the ends of the medial composition; groups of 13 large beads with cutouts followed on either side, ended with an arctic fox fang. The second string was located in the torso area and included 68 elements: nine small beads with cutouts and one flat rounded bead in the center, with 29 large beads on each side of this group. On one side, there

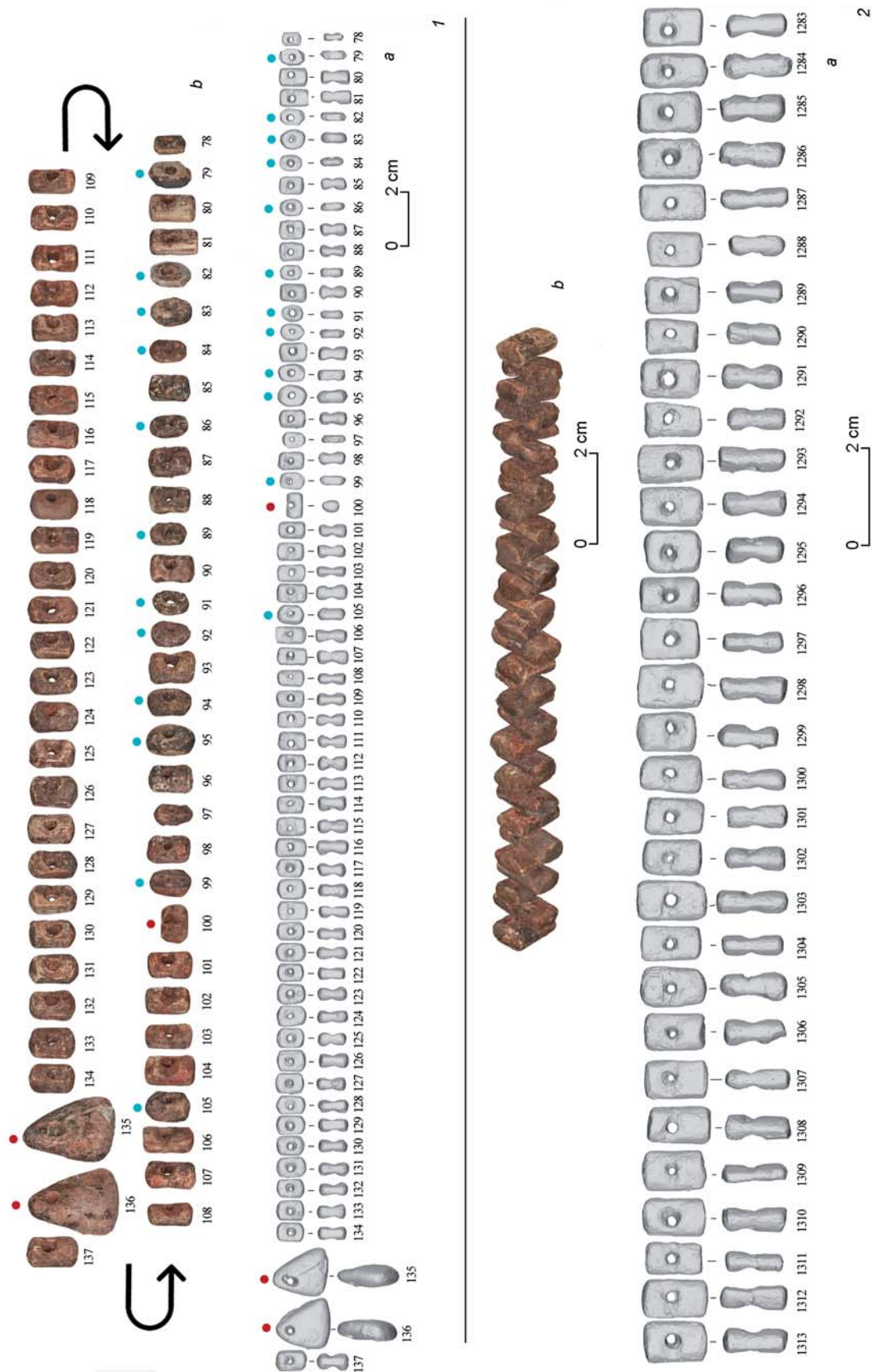


Fig. 3. Ivory bead strings from the man's burial.

1 – sequence of beads in the string lying along the right tibia and femoral bone: a – front and side view of the beads; b – position of beads in $\frac{3}{4}$ (blue dots mark rounded beads, red dots mark pendant beads imitating rudimentary deer teeth and those stylized as basket-shaped items). SI/SMR collection: B-3389778–137; 2 – sequence of beads in the string of the lower transversal row (upper layer): a – front and side view of the beads; b – reconstruction of the crisscrossing position of beads. SI/SMR collection: B-338977/1283–1313.

were only beads with cutouts, on the other, 27 beads with cutouts and two basket-shaped pendant beads, located in six and twelve beads from the central composition.

Pendant beads made of mammoth tusk and imitating a rudimentary tooth (tusk) of a deer (see Fig. 2, 11), or having a basket shape, were recorded in the strings of all the three buried individuals. These belonged to the ornaments located both on the torso and on the arms and legs of the deceased. The position of such pendant beads in the composition of the strings was apparently not accidental. This is confirmed by the revealed practice of using the simplest structural elements stylized as basket-shaped items.

Analysis of the string construction patterns has revealed a special design of their endings. The terminal element can be a bead of a large size or an individual shape, or a small group of beads including a non-standard item. The use of beads of an individual shape to complete a composite ornament was recorded twice—in burials S-2 and S-3. The string from the lower layer on the knee joint of the older adolescent ended with a bead in the form of a lilac flower (see Fig. 2, 7), and the terminal element in the string on the right humerus of the younger one was crescent-shaped (see Fig. 2, 1).

The purpose and meaning of such ornaments have not been determined so far. Undoubtedly, this is a separate topic for future research. At present, some principles underlying the construction of individual composite ornaments are gradually becoming clear. For example, the strings located on the left and right arms/legs of the buried man were composed in a mirrored fashion by the types of beads used. Another construction pattern of many strings involved the inclusion of both heavily tumbled beads (see Fig. 2, 4) and those with unworn traces of manufacture on the surface (see Fig. 1, 3; 2, 5; 3, 1).

Types of constituent elements of strings

The findings on the rhythmic nature of the alternation of beads (groups of beads) in the strings allowed us to determine the most typical morphometric features of their constituent elements. At present, eight types of ivory beads have been identified.

1. Robust beads with wide flattened cutouts in the middle of the opposing surfaces, often at an angle to the edge, bearing a biconical inclined hole in the center (see Fig. 1). This created the characteristic constriction on the item, clearly visible in side view (see Fig. 1;

3, 1, a, 2, a). The ends of beads of this type have a rounded dome-shaped form; simple straight ends are less common. By proportions*, the beads can be subdivided into elongated (see Fig. 1, 9), shortened (see Fig. 1, 4, 5, 8) and short (almost square) (see Fig. 1, 1–3, 6); by cross-section, into flattened-oval (see Fig. 1, 1, 3, 9) and rounded (see Fig. 1, 2, 4); by size, into large (longer than 1.0 cm), medium (0.6–0.9 cm), and small (not exceeding 0.5 cm). A similar metric division is also applicable for beads of other types, with the exception of those imitating a rudimentary deer tooth. The latter beads were made of small rods, which were subjected to secondary working to derive a rounded or oval cross-section (see Fig. 2, 6). Drilling a hole (see Fig. 1, 7; 2, 2) and finishing the surface (see Fig. 1, 3; 2, 5) of beads of this type and others were carried out after detaching the blank from the rod.

2. Flattened beads, often rather robust, rounded or sub-oval in shape, with a biconical hole in the middle and without cutouts (see Fig. 2, 3, 5). Such beads were made from small, heavily flattened (0.3–0.5 cm thick) rods with prepared surfaces.

3. Basket-shaped pendant beads (see Fig. 2, 10, 12)—short or slightly elongated items, with a thick rounded lower part and a bilaterally flattened opposite end, where a biconical hole was made. These were made from the blanks detached from a small robust bar with a sub-oval cross-section.

4. Pendant beads stylized as basket-shaped items (see Fig. 2, 8, 9). These were fashioned on the same blanks as the beads with cutouts and flattened rounded beads sub-triangular in cross-section. A biconical hole was cut in the thin part of the blank, at the very edge. The location of the hole, the features of the edge design, and traces of wear suggest the use of these items as pendant beads.

5. Pendant beads imitating a rudimentary deer tooth (see Fig. 2, 11; 3, 1)—the largest components of a string. The smallest of these are comparable to the largest pendant beads with a basket shape.

6. Flat and thin beads of a sub-square shape (0.65×0.60 cm), with slightly rounded edges and a central hole usually made by one-sided drilling (see Fig. 2, 4). The beads' thickness does not exceed 0.10–0.15 cm,

*Morphometric data (volume, surface area, linear dimensions of the enclosing rectangular parallelepiped) of the beads were determined instrumentally, as well as through an automatic procedure for extracting geometric parameters from 354 digital images (3D-models) constructed by photogrammetric method.

which indicates that these were manufactured on the same blanks as composite plate bracelets. The collection includes 77 such beads, 11 of which were parts of the string on the older adolescent (S-2), and 66 items were recovered from a cluster in sq. E-144/145 of excavation III, where beads of other types were also found. The cluster was found at the level of reference horizon 3, which corresponds to the middle part of the buried soil containing the cultural layer of the site (Stulova, 2021: 46, 48).

7. Crescent-shaped bead (see Fig. 2, 1).

8. Bead in the form of a lilac flower (see Fig. 2, 7).

Among the types of ornaments described above, basket-shaped beads are chronologically significant. By morphometric features and manufacturing technique, these are generally parallel to similar pendants of the Developed (Late) Aurignacian in Europe. The items showing a simplified stylization of this shape also resemble teardrop-shaped beads of the Early Gravettian. Parallels to them are reported from the layers transitional from the Aurignacian to the Early Gravettian (28–27 ka BP) in cave sites in southern Germany (Conard, 2003), which roughly correlates to the available dates for the main burials at Sungir. A certain similarity between the Early Upper Paleolithic ornaments from Germany and the Sungir artifacts is also illustrated by the combination of ivory beads of various types. At the Aurignacian sites of southern Germany, basket-shaped pendants were found together with numerous beads of a peculiar shape with holes at the ends, which is regarded by German researchers as a regional specific (Ibid.), as well as with rounded flat beads with a hole in the center (Ibid.; Scheer, 1985). The Sungir materials demonstrate a similar combination: they contain basket-shaped pendants, beads with cutouts, which are a distinctive feature of the site (Bader, 1978: 206), and flat rounded beads occurring at the Aurignacian sites of Eastern Europe, in particular at Kostenki 1 (layer III). The similarity of the set of ornaments from the Aurignacian layers of the sites in southern Germany and the Sungir collection is also manifested in the use of predator teeth.

Conclusions

The analysis of the composite ornaments made of ivory beads, retaining their original order in the graves of a man and adolescents at Sungir, has shown that these ornaments were created by stringing many individual elements onto a single

base, which could have been either a sinew or a thread made of some organic materials. Eight types of bead were used for these ornaments: robust beads with cutouts, flattened rounded ones, flat thin sub-square ones, pendant basket-shaped beads, beads with a stylized basket (drop) shape, those imitating a rudimentary deer tooth, and beads of individual shapes—in the form of a crescent or a lilac flower. The elements on the string were not arranged randomly, but followed a certain sequence forming a stable rhythmic structure that was determined by the shapes of both the beads themselves and the bead blanks. Two main techniques of stringing have been identified: by isolating the central group of beads, and by arranging them in order of size, gradually decreasing from one end to the other.

Certain parallels in the pattern of combining ivory beads of various types in similar ornaments were revealed in the chronologically close materials from Final Aurignacian sites in southern Germany.

The present findings make it possible to consider the strings of ivory beads as a unique archaeological source, which provides significant information on cultural and chronological issues of the Upper Paleolithic in Europe, and the sign system of communication of Old Stone Age people in general.

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The Earliest Petroglyphs of Rashaan-Khad, Mongolia: New Observations

We present preliminary findings relating to the Rashaan-Khad (Arshan-Khad, Mongolia) petroglyph site studied by the Russian-Mongolian expedition in 2016 and 2023. Special attention is paid to petroglyphs that, in A.P. Okladnikov's words, appear archaic and those that can with various degree of certainty be interpreted as representations of Late Pleistocene mammals such as woolly rhinoceros or mammoths. Okladnikov wrote that six petroglyphs stand out mostly by their large size, carved outlines, "primitivism", and robustness. Our study has revealed eight figures that could be interpreted as those of large Upper Paleolithic animals or archaic-looking ungulates, but one of the figures published by Okladnikov has not been found. We discuss the correlation of such images with wavy lines, groups of intertwined lines, and what can be seen as a representation of a "bear paw print". Despite the limited time for fieldwork, we were able to identify panels especially relevant to the chronology of the site, refine the trace-drawings, obtain new data on already known images, and detect new ones. Comparison of petroglyphs published by Okladnikov in the 1980s with 3D-models and curvature maps based on them demonstrated yet again the need for and efficiency of advanced digital documentation in the study of rock art and the re-documentation of already known sites.

Keywords: Mongolia, rock art, Rashaan-Khad, petroglyphs, Upper Paleolithic, 3D-modeling.

Introduction

The petroglyph site of Rashaan-Khad (also known as Arshan-Khad or Arshaan-khad) is situated in the Khurkhyn Gol valley (Batshireet sum, Khentii

aimag, Mongolia), on a low remnant rock massif at the eastern extremity of the spur of Dulyn Godzgor Mountain. The site has been known since 1942. It was studied by Mongolian archaeologist H. Perlee (1975) from 1960 on. Then the petroglyphs were

documented and examined by E.A. Novgorodova and A.P. Okladnikov, who partially published the collected materials (Novgorodova, 1980; Novgorodova, 1983, 1984: 16–18; 1989: 52–53; Okladnikov, 1981: 191–193; 1983; Okladnikov, Vasilievsky, 1982). A detailed review of past work can be found in our summary of longstanding debates around the attribution and relative chronology of the petroglyphs (Svoiskiy et al., 2021), and in a recent review of Mongolian rock-art studies (Ankhsanaa et al., 2023).

We started the field studies at Rashaan-Khad in 2016. Mapping of the site was conducted and a topographic base for further study was created. The first stage of the study resulted in the preliminary publication of several documented surfaces with petroglyphs (Svoiskiy et al., 2021). At the same time, we concluded that the information about the site was insufficient, and further fieldwork was required. This plan was implemented in autumn 2023*.

The present study is focused on the petroglyphs attributable to the earliest group. These are primarily representations of Upper Pleistocene animals and those similar in style and technique of rendering. At one time, A.P. Okladnikov wrote that six petroglyphs at this site stand out mostly by their large size, carved outlines, “primitivism”, and robustness. In sum, he defined these traits as “archaic appearance” (Okladnikov, 1981: 77–79). The species composition of the depicted animals serves as the main chronological marker that allows us to determine reliably the upper boundary for the earliest group of Rashaan-Khad petroglyphs. While it is not yet clear when mammoth theriofauna, specifically woolly mammoths (*Mammuthus primigenius*) and rhinoceros (*Coelodonta antiquitatis*), went extinct in Mongolia, available facts point to the disappearance of these animals in the adjacent regions about 23–20 ka BP in China and ca 11 ka BP in Southern Siberia (Stuart, Lister, 2012). The latest dates of woolly rhinoceros’ extinction (12–15 ka BP) were recorded in the Altai and Angara region (Garutt, Boeskorov, 2001), the earliest date (20 ka BP) in Eastern China (Burovsky, 2010).

Previous attempts at identifying animals were based on the chronology of styles, which was assessed by less than perfectly accurate trace-drawings. Our

principal objective was to obtain more reliable and detailed material for analysis. As a result, the group of the earliest Rashaan-Khad petroglyphs was somewhat enlarged. In this article, images from later periods (representations of a horse’s hoof, “bear paw print”, tamga-like signs, and others) are not considered, except in the cases where they were located on panels with animal figures of definitely “archaic appearance”.

Study methods

In 2016, fieldwork at Rashaan-Khad concentrated on mapping the site using aerial photographs from UAVs. The photographs were photogrammetrically processed, and orthophotoplans with 2 cm resolution were generated along with digital relief model, point clouds, and 3D polygonal models. In addition, we conducted selective documentation of panels with petroglyphs. In 2023, accurate documenting was a priority, and more sophisticated techniques, elaborated by our team since the initial experiments of 2016, were implemented. All relevant rock surfaces were scanned for petroglyphs, which were re-catalogued and re-mapped by direct differential GNSS measurements. There were found 32 panels bearing petroglyphs from different periods of time (from the Paleolithic to the ethnographically modern period) as well as Tibetan and Ancient Mongolian inscriptions made by pecking, abrading, and engraving or written with ochre and ink. In 2023, 25 of them were digitally recorded using photogrammetry and subjected to 3D-modeling. Five panels recorded with insufficient accuracy in 2016 were re-documented. The surfaces had not been cleaned of lichen before being photographed. The high resolution of modeling enabled us to use the Multi-Scale Integral Invariant algorithm (Mara, 2012), which made the images more “legible”*.

Main results

In 2016 and 2023, 28 panels with petroglyphs were documented and 3D polygonal models for them were created. The analysis of the collected data

*Fieldwork was conducted by Y.M. Svoiskiy, G. Amar-sanaa, D. Ulziibayar, and E.A. Galkina under the overall supervision of D. Uranchimeg and Y.M. Svoiskiy. E.V. Romanenko processed the collected data. Illustrations to this paper were made by D.M. Pavlov and A.N. Uralskaya.

*Also, colored raster images were generated from 3D polygonal models by a de-correlation stretching algorithm to detect traces of ochre. This procedure was unsuccessful (surfaces cleaned of lichen had evidently been cleaned of ochre too, whereas on uncleaned surfaces ochre could be invisible under the lichen).

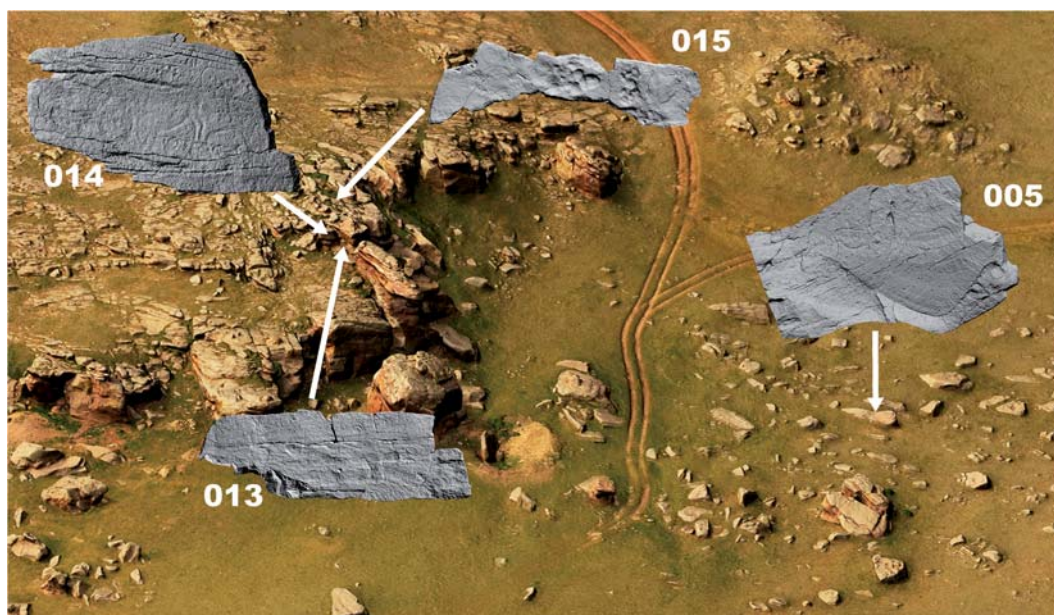


Fig. 1. Location of panels with representations of Late Pleistocene animals at Rashaan-Khad (numbers refer to 2023 materials; neither A.P. Okladnikov nor E.A. Novgorodova provided continuous numbering of panels with petroglyphs).

demonstrated that all the Rashaan-Khad petroglyphs published by A.P. Okladnikov, E.A. Novgorodova, D. Tseveendorj, and M.Y. Shishin (Okladnikov, 1981: 191–193; 1983; Novgorodova, 1983; 1984: 16–18; 1989: 52–53; Tseveendorj, 2012: 119–120, 356; Shishin, 2015) were localized at the site, with one sole exception: the image of a bovid reproduced in the monograph by Okladnikov (1981: 192, pl. 108, 4) was not detected. At the site, at least four panels with petroglyphs representing animals of “archaic appearance” (Fig. 1) were identified. These were interpreted as a horse, a bovid, a wooly rhinoceros, and, with a low probability, a mammoth. The representations of wooly rhinoceros and mammoth can only be Late Pleistocene, while those of horse and bovid can be both Late Pleistocene and Holocene. However, the style and technique of execution are so similar that with a high probability the images can be attributed to a single chronological period. Images on three of the mentioned panels (005, 013, 014) were previously published; and those on panel 015, found by student E.A. Galkina in 2023, remain unpublished.

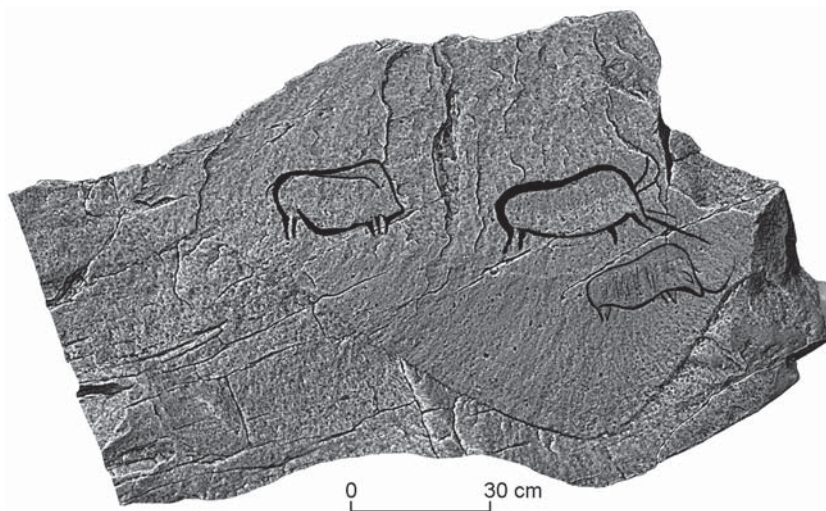


Fig. 2. Panel 005.

Panel 005 (Fig. 2)*. Images are located on the slickenside of a remnant of a firm, medium-grained, sandstone rock. The surface roughly faces south, has a positive slope, and lacks natural protection. Earlier, the stone was covered with lichen, which was removed during the study conducted there in the first half of the 2010s. Three figures of animals are executed

*In figures 2, 4, 6, and 7, the trace-drawing is done using the 3D polygonal model processed with the multiscale integral invariant algorithm.



Fig. 3. Landscape context of panels 013 and 014. Photograph by Y.M. Svoiskiy.



Fig. 4. Panel 013.

by contour groove. Two of them represent woolly rhinoceros (*Coelodonta antiquitatis*) with a curved or straight horn and a hump on the back. These figures resemble Upper Paleolithic images of such animals. The upper left figure portrays a bovid (Fig. 2). These petroglyphs and animal species identification were previously published (Svoiskiy et al., 2021: 314, fig. 1). Analysis of the newly formed model of the panel provides for only minor clarification of their appearance.

We face an entirely different situation when examining the results of modeling and algorithmic

visualization of panels 013 and 014. The comparison of these results with those previously published shows that digital methods provide a much more complete and detailed picture. Although panel 014 was documented without preliminary removal of lichen, traces of pecking were nearly as distinct there as on panel 013, where lichen was virtually absent. We present the observations below.

Panel 013 (Fig. 3, 4). Petroglyphs are located on a rock massif composed of large-grained sandstone without signs of displacement; lichens are absent. The surface is exposed to the south; it is almost vertical

and has no natural protection from above. The best observation is in the morning hours. This panel is one of the few Rashaan-Khad surfaces oriented to the south, while most of them face rather the southeast. Images on panel 013 belong to two generations. The earlier ones (figure of a large herbivore stylistically similar to the representations on panels 005 and 014, and some others) were made by pecking (then possibly abraded). Apart from these, certain drawings in the bottom right part of the panel are done by thin polishing, which removed the superficial layer of rock with exogenous changes (“patina”) without affecting the rock itself. The panel is breached by several large cracks (with no displacement along them). Its lower part was damaged by desquamation (peeling of the rock cortex), which destroyed some images.

Comparison of the figures observable on the model with the most detailed trace-drawings (Okladnikov, 1981: 193, pl. 109, 1) shows some significant differences in their configuration. The most interesting is the image of a large animal in the upper left corner (Fig. 4, 1). It can be interpreted as a horse or a mammoth (owing to the partially preserved representation of a trunk or an upturned tusk; regrettably, since a part of the panel is missing, it is impossible to determine reliably if this line was the continuation of the figure).

In addition to the animal figure, within the panel, there can be seen an uninterpretable group of

intertwined smooth lines (Fig. 4, 2) obviously linked by some general idea, a combination of a “bear paw print” (Fig. 4, 3) and a long circumflex wavy line (Fig. 4, 4), and a meandering line located below other figures (Fig. 4, 5). There are also a tamga-like sign (Fig. 4, 6) and a representation of two people holding hands (Fig. 4, 7) made in other technique and clearly much younger. Some figures present on Okladnikov’s trace-drawings (Fig. 5) are not confirmed by our observations. For example, in reality, one image (Fig. 5, a) is absent, while another one (Fig. 5, b) is a combination of a “bear paw print” with coarsely pecked toes (see Fig. 4, 3) and a long wavy line (see Fig. 4, 4). It should also be noted that in Okladnikov’s publication, two anthropomorphic figures (see Fig. 4, 7) are grouped with a figure made on panel 030 located 40 m southeast (Ibid.: Pl. 109, 3).

Panel 014 (see Fig. 3, 6). Images are made on a dislocated block of coarse-grained sandstone, which lithologically differs from the rock bearing panel 013. The images were probably made at the time when the block was a part of a stable rock massif and was easy to access. At present, the surface is oriented towards the southeast; however, in the past, it faced the south or the east. After the drawings had been made, gravitational processes probably transported the block 1–3 m southeast (the vertical shift was up to 1.5 m) and turned the panel, which retained its vertical position. Gradual

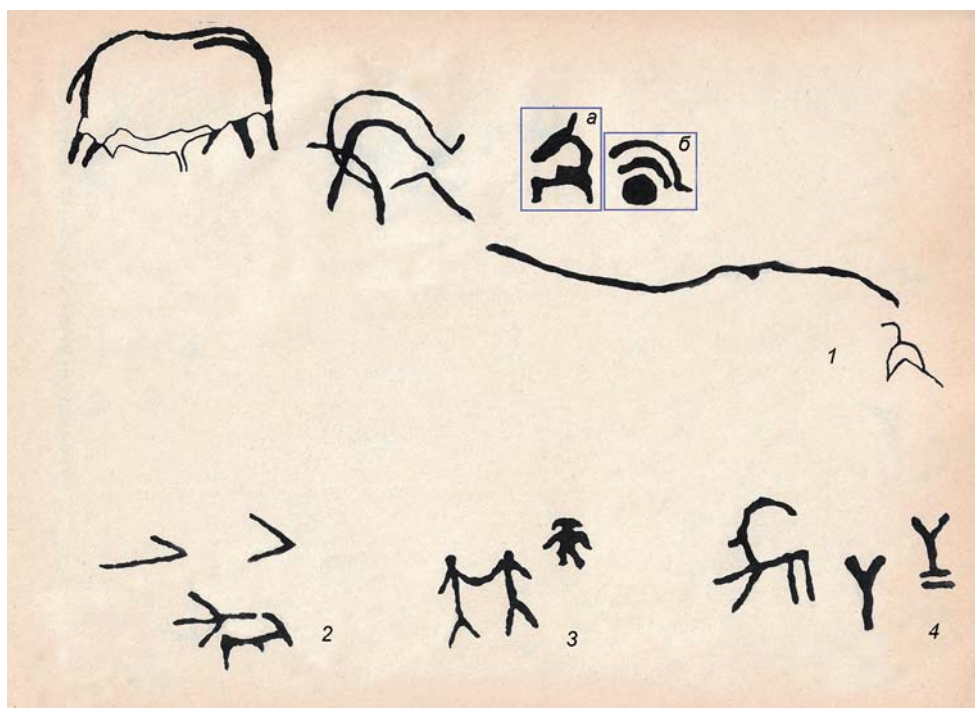


Fig. 5. Plate 109. Arshan-Khad (after (Okladnikov, 1981: 193)).

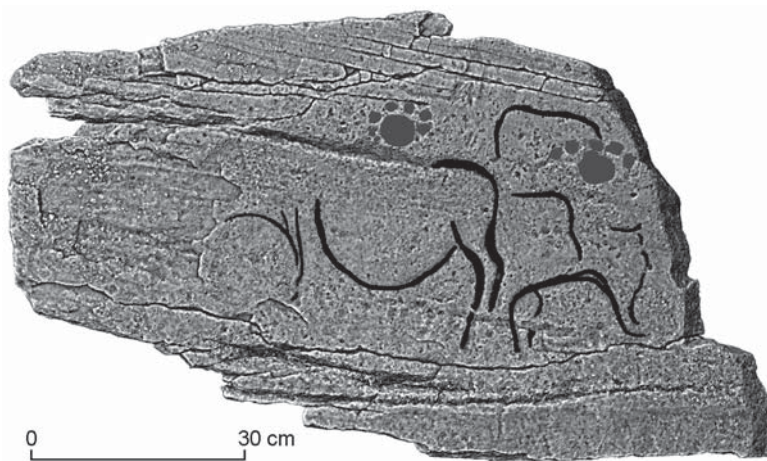


Fig. 6. Panel 014.

destruction of rock in the base of the block may eventually lead to its collapse. The upper part of the panel had been subjected to cryogenic cracking even before the petroglyphs appeared (there are no traces of pecking here), while the left part was damaged later, whereby some petroglyphs were destroyed. The cause of the destruction was presumably a combination of cryogenic cracking and biogenic processes that made the outer layer of the stone weak. The panel is almost entirely covered with lichens of various species.

Comparison of the figures on the model with the most detailed published trace-drawings (Ibid.: 192, pl. 108, 7) has also demonstrated some significant differences. The largest representation of an animal looks somewhat different in reality. One “bear paw print” is shown as an indistinct figure; the other one lacks a “toe”. A contour in the upper right corner is close enough to reality; it can be interpreted as part of an animal figure. In addition, in the lower right corner, another contour is observed, which probably shows a partial figure of a woolly rhinoceros or, less likely, a mammoth.

Panel 015 (Fig. 7). Images are located on a subhorizontal surface of the rock massif located 5 m west-north-west of the above-mentioned panels 013 and 014, near the top of the remnant. The surface is composed of poorly sorted coarse-grained sandstone. Some parts of the panel are modified by corrosion

that caused the formation of deflation hollows. Apparently, some of them had existed before the petroglyphs appeared, and they may have drawn people’s attention to this surface. Most images are covered with lichens. Imagery on the surface includes a contour figure of an animal (Fig. 7, 1), which has some similarities with representations on panels 013, 014, and to a lesser degree on panel 005; a yet uninterpreted group of intertwined smooth and wavy lines obviously linked by some general idea (Fig. 7, 2); a less sophisticated group of lines, also uninterpreted (Fig. 7, 3); and a representation of a horse’s hoof, located on the periphery of other figures

(Fig. 7, 4). The latter shows rectilinear segments of the contour and, unlike other figures, is not smoothed by polishing. As a result, it looks more distinct than others.

The technique used for making petroglyphs on panels 005, 013, 014, and 015 has some elements in common. The figures were executed by smoothed contour lines pecked on stone and then abraded. The lines are grooves with smoothed edges. The maximum depth of the grooves reaches 10 mm, though in most cases it is 2–6 mm; their width varies from 7 to 35 mm. Figures on all the panels are mostly made in the same technique. The exceptions are images located in peripheral areas and possibly

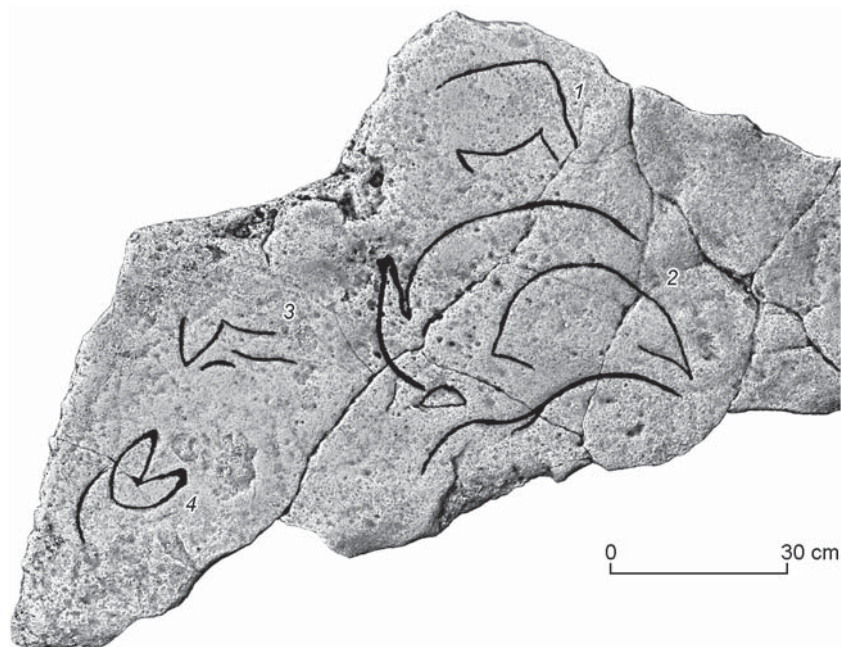


Fig. 7. Panel 015.

relating to later periods: the “horse’s hoof” on panel 015 (contour pecking without polishing) and the figures made by superficial abrasion in the right lower corner of panel 013.

In the context of the earliest animal images at Rashaan-Khad, a figure discovered in 2015 deserves a mention. It is located below and to the left of panel 005 and was interpreted as a “bovid-bison” (Shishin, 2015: 17). We documented and examined this panel (006) using the integral invariant algorithm. The study has shown that all outer contours of the figure coincide with natural cracks on the stone. No evidence of additional modification was found, except maybe for the “head” area, where a rounded depression is present on the surface; whether it is artificial is hard to say. In terms of general proportions, the figure has nothing in common with other representations at Rashaan-Khad. In our view, there is no reason to attribute it to animal figures or to petroglyphs in general.

Conclusions

At Rashaan-Khad, the total number of figures that may, with various degrees of certainty, be considered representations of large Upper Paleolithic mammals (wooly rhinoceros or mammoths) or archaic-looking images of ungulates amounts to eight: three on panels 005 and 014 each, and one on panels 013 and 015 each (one of the images described by A.P. Okladnikov has never been found). A certain correlation can be traced between these figures and wavy lines and groups of intertwined lines (panels 014 and 015) absent on other surfaces, as well as with the “bear paw print” observed on two of four panels. The latter element has not been encountered in any other associations at Rashaan-Khad (with the exception of panel 26, where at least five such representations can be observed, whereas any other images are absent). At the same time, the representation of a horse’s hoof made in the technique of deep relief pecking, fairly common at the site (11 panels of 32 examined), is not observed on the surfaces bearing figures of supposedly Pleistocene animals. The only image of this sort, located on panel 015, was made in a completely different technique and apparently belongs to a later period. “Double lines” associated with horse’s-hoof images are also absent on surfaces with figures of supposedly Pleistocene animals. These observations suggest that apart from representations of large animals, the group of earliest petroglyphs at Rashaan-Khad includes only wavy and intertwined lines, and possibly “bear paw prints”.

The methods applied allowed us to improve the database on the earliest petroglyphs at Rashaan-Khad substantially. The collation of the published trace-drawings with their prototypes observed on 3D-models and with curvature maps based on them provides yet another demonstration of the need for and efficiency of a comprehensive digital documentation of petroglyphs, including those already known and published before the introduction of digital techniques.

The study of Rashaan-Khad has not been completed, and a lengthier work is required, with a focus on cleaning petroglyphs of lichens and search for new surfaces with drawings. The remaining potential of this site is considerable, and the detection of new Stone Age petroglyphs is quite probable.

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Qurta Rock Art: Cultural Exchange in the Mediterranean

The discovery in the early 2000s of animal rock engravings near the village of Qurta in the Nile Valley (Upper Egypt) remains little discussed. This article focuses on the numerous stylistic links between these engravings and European Pleistocene figurations. These analogies allow us to date Qurta approximately to the end of the Last Glacial Maximum (between the end of Gravettian-Solutrean art and the beginning of Magdalenian art). This estimate is confirmed by OSL-dating obtained from a buried engraved panel from Qurta. The hypothesis as to European origin of the images is also reinforced by the presence of schematic female engravings identical to those scattered throughout Eurasia. The possibility of Mediterranean cultural exchange is considered. Several communication routes were possible. Taking into account the published documentation, we infer that the engravings at Qurta are less isolated than they appear and that rock engravings located on the Cyrenaican coast and in the Sinai could be the result of repeated contacts (including migrations) of people inhabiting the two shores of the Mediterranean.

Keywords: Qurta, Paleolithic cave art, Last Glacial Maximum, long-distance diffusion, Middle East.

Introduction

In the early 2000s, around two hundred rock engravings were discovered (more accurately, rediscovered, as the engravings were first reported by a Canadian team in the early 1960s) in the Nile valley near the village of Qurta (about 30 km south of Edfu). The engravings were deeply incised into the cliffs of the sandstone massifs overlooking the Kom Ombo plain on the eastern bank of the Nile. Very different in both theme and style from the predynastic petroglyphs of the region, these engravings do, however, offer astonishing similarities with European Paleolithic art (Huyge et al., 2007; Otte, 2012, 2014). Most of the Qurta engravings depict animals (aurochs, hippos, gazelles, fish, birds, etc.), as well as a few anthropomorphic figures.

But it is above all the arrangement of the subjects that is irresistibly reminiscent of European art: the animals are depicted outside their natural environment. The petroglyphs overlap, face each other or, on the contrary, turn their backs on each other, without any explicit action linking them together (Fig. 1). Similar engravings have been spotted in the vicinity of Qurta: at El-Hosh, about 10 km to the north, and at Wadi Abu Subeira, about 50 km to the south. Despite their obvious resemblance to European art, the Qurta engravings have so far received very little comment from prehistorians*. However, as soon as the discovery was announced, the Belgian team in charge of the study, led by Dirk Huyge, emphasized the age of the engravings and their stylistic proximity to

*With the notable exception of Marcel Otte (2012, 2014).

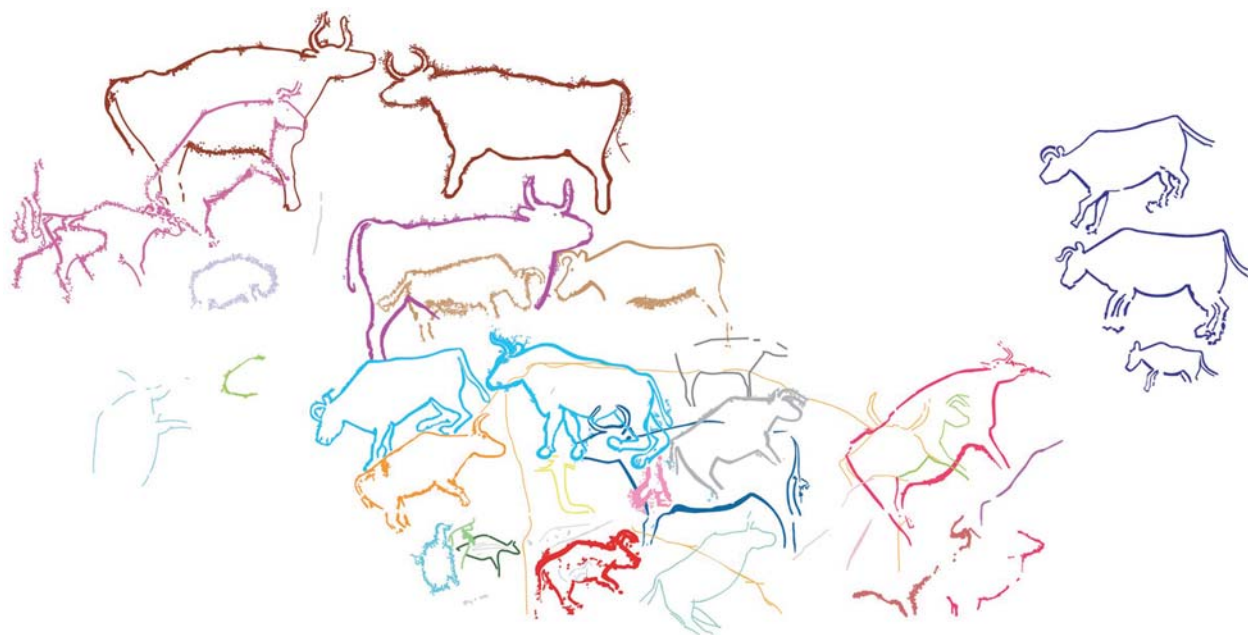


Fig. 1. One of Qurta's main engraved panels, with a total length of 4 m (after (Huyge, 2008)).

European cave art. The question of the links between the Qurta engravings and European art was revived a few years later by the dating of the engravings. OSL measurements carried out on a buried engraved panel gave a minimum age of deposition around 15,000 BP. Given the patina of the tracings, a chronological range between 19,000 and 17,000 BP was adopted (Huyge et al., 2011). Thus, all the Qurta engravings date back to the Paleolithic, and their age coincides with several occupations in the north of Egypt, including Wadi Kubbaniya located just 5 km from the Wadi Abu Subeira rock art site (Wendorf et al., 1988). Of course, the contemporaneity of Upper Egyptian engravings with European art is no guarantee of their European origin. Despite the legitimate mistrust that such distant comparisons might arouse, in this article we emphasize the formal and thematic arguments in favor of the spread of European artistic concepts to the Nile Valley and, more broadly, to other little-known sites in North Africa.

Common stylistic conventions

The stylistic links between the Qurta rock engravings and Western artistic concepts are particularly evident in European representations from around 20,000 BP, i.e. contemporary with the Egyptian engravings. In a number of works, we have endeavored to

demonstrate the existence at this time of an artistic tradition present over a large part of southwestern Europe, from Andalusia to the Ardèche* (Guy, 2011, 2021). Initially marked by a strong schematic bias, this Gravetto-Solutrean tradition evolved over the millennia towards much more naturalistic forms, as witnessed at Lascaux (ca 18,000 BP) and other contemporary caves in the southwest of France (Gabillou, La Mouthe, Villars, Saint-Cirq, Roc-des-Sers, etc.). The style of Qurta's engravings seems to us to be precisely at the hinge between the Gravetto-Solutrean representations of the Côa valley type and those of the later period in the above-mentioned caves, including Lascaux. So, we propose a closer look at these relationships.

Outlines still geometrically defined. The properties of the Gravetto-Solutrean stylistic tradition are based on three major stylistic assumptions. The first is the use of a single linear outline to represent the subjects. Even more significant is the fact that this linear outline is based on overtly geometric constructions, for example, arched belly lines, angular profiles, effects of curves and counter-curves, etc. One of these geometric constructions concerns the design

*Examples include representations from la Frise noire at Pech-Merle (France), La Tête-du-Lion (France), the Côa Valley (Portugal), El Castillo (Spain), Parpalló (Spain), La Pileta (Spain) and Nerja (Spain).

of the belly and the front edge of the hind leg, systematically expressed as two perpendicularly juxtaposed arcs. Although this geometric pattern has been partially replaced by more descriptive lines on the Qurta engravings and later European representations, it is clearly present on several occasions (Fig. 2, I).

The geometric concept of outline also led, for example, to aurochs' heads being drawn in an exaggeratedly rectangular shape. Here again, as will also be the case at Lascaux, the profiles of Qurta aurochs are less geometric than in the past, but some subjects still feature the same straight, elongated head characteristic of the Gravetto-Solutrean tradition. Another reason could explain the rarity of this convention at Qurta. In Gravetto-Solutrean art, the angular profile is usually reserved for cows only, bulls having a shorter, stockier head in accordance with their natural morphology (see the contrast between the profiles of the red cows in the Diverticule Axial and those of the bulls in the Grande Salle at Lascaux). The rarity of aurochs with rectangular heads at Qurta may be linked to the fact that the engravings depict mainly males and not females, as shown by the frequent indication of a penile sheath.

Absence of internal details. The second stylistic convention of European figurations from this period is their lack of interest in internal anatomical details. These are either entirely absent or treated in a particularly elliptical manner (a dot for the eye, a line for the mouth, no depiction of coats, etc.). One might imagine that this is determined by the technique used, deep engraving, which is not very conducive to detailed representation of subjects. However, the simultaneous existence of finely engraved but also painted or drawn Solutrean figures (La Tête du Lion, El Castillo, La Pileta, Nerja, etc.), marked by the same absence of detail, suggests that this is indeed a stylistic convention. The same absence of internal information can be seen in the Qurta engravings. The coexistence of fairly subtle information, whose presence is limited to the outline, suggests that the artists deliberately neglected generic information (particularly coats) in favor of features that most directly characterize the species. In fact, the Qurta aurochs show the same interest in details that identify the species: pronounced rounding of the dewlap and bulging of the dorsal line to mark the relief of the loins and withers

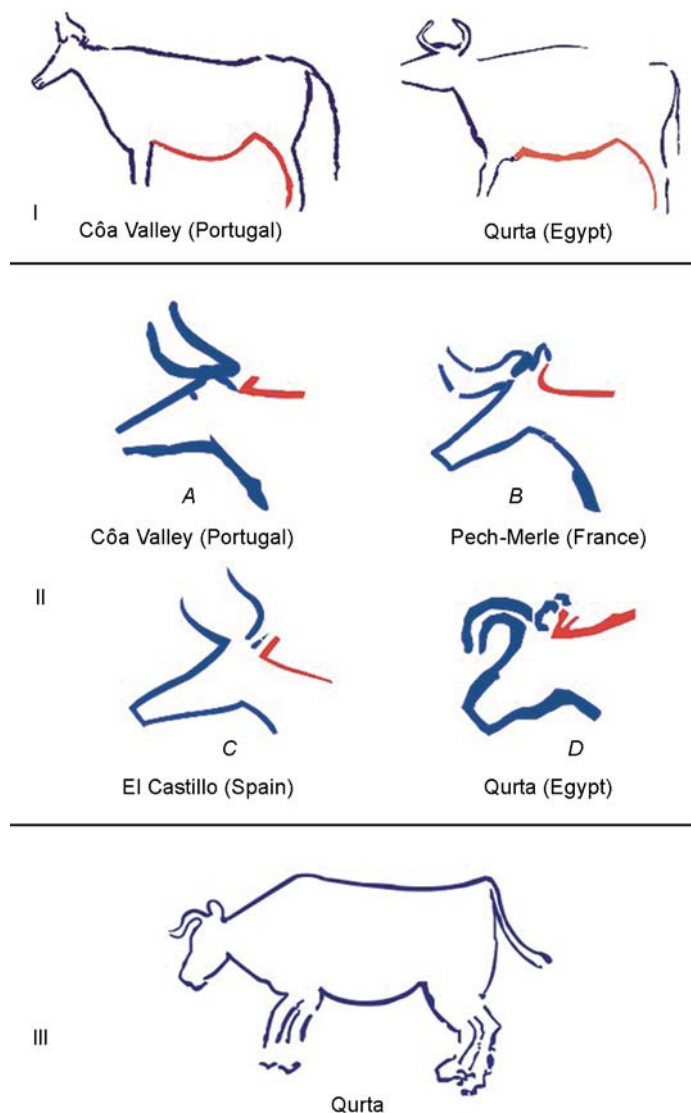


Fig. 2. Same type of geometric contour design in the Qurta rock art and Gravetto-Solutrean tradition (I); same graphic shortcut used to draw the single ear of the Qurta's aurochs and in the Gravetto-Solutrean art (II); example of ball-shaped representation of the auroch's hoof (III).

(see Fig. 1). Note in passing the presence of another clue to probable kinship. In Gravetto-Solutrean art, the subjects' single ear is most often expressed by a simple fold at the end of the cervical-dorsal outline, sometimes supplemented by a few lines that specify its shape (see Fig. 2, II, A–C). The permanence of this convention in Lascaux is probably behind the ear “planted” on the nape of the neck so often noted by observers (Guy, 2011) (Fig. 3). The documents at our disposal do not allow for a totally exhaustive analysis, but it does seem that this same mode of representing the ear was also applied at Qurta (see Fig. 2, II, D).



Fig. 3. Conventional graphic shortcut used to draw aurochs' ears in Lascaux.

Same representation of legs. The third convention specific to Gravetto-Solutrean figurations concerns the representation of legs, generally reduced to a single paw with no extremities on each train. This non-representation of legs no doubt stems from the same schematic approach that led the artists to focus on the most distinctive descriptive elements. The same treatment of legs can be found in many of Qurta's engravings. There are, however, exceptions: some subjects have one leg with a tip, others two legs on each train, others are alternately endowed with one or two legs at the front or rear, depending on the case (see Fig. 1). We will come back to the possible meaning of these nuances later.

More advanced features

More descriptive outlines. While the Qurta rock art bears clear resemblances to Gravetto-Solutrean figurations, it also displays more advanced features that bring it closer to the later items from Lascaux

and other contemporary sites. It is not impossible that there were at least two successive artistic periods at Qurta. In any case, it has been pointed out that the outlines were often less overtly geometric than on Gravetto-Solutrean figurations of the Côa Valley type. This greater descriptive preoccupation is also reflected in a greater interest in anatomical detail.

As briefly mentioned, the same panels contain single-leg subjects left open and others with complete, detailed legs (see Fig. 1). It is striking to observe the same type of variations in legs design on Gravetto-Solutrean representations (as is the case on the Frise noire of Pech-Merle). The more detailed drawing of the legs at Qurta is characterized by the interest in indicating the point of the hock and the hooves, which take the form of a ball at the end of the leg (see Fig. 2, III). In addition to the fact that Gravetto-Solutrean engravings show the same insistence on the anatomical elements mentioned, the ball-shaped hoof design obviously echoes a well-known convention in Lascaux representations. The analogy can even

be taken a step further, since at Qurta, as at Lascaux, the ball-shaped hoofs are generally accompanied by the dewclaw.

Juxtaposed legs. At Qurta, the animals are represented with paired legs, always juxtaposed side by side. In our view, this misjudgment stems from a two-dimensional conception of drawing that is characteristic of Gravetto-Solutrean art. Indeed, on all the examples of even* legs, they are systematically folded back onto the drawing plane like shadow puppets. This strictly two-dimensional representation is the consequence of the principle of outline linearity in force at the time. It prohibits any crossover between tracings and, by the same token, eliminates any possibility of rendering depth. This logic of linearity has the effect of systematically folding even legs onto the single plane of the drawing, as if they were seen from the front (Fig. 4, I, A, B). The same two-dimensional design concept is at work at Qurta: the legs (and, where applicable, the paired horns) are shown side by side on a body in profile (Fig. 4, I, D). What is different at Qurta as compared to Cõa or Pech-Merle, and what brings this art closer to Lascaux, is the consideration of distinct planes. Whereas in Cõa or Pech-Merle, the legs remain systematically fused together, the Qurta engravers take care to attach the leg intended for the background to the subject's body, rather than linking it to the other leg; the outlines of the legs are not juxtaposed. However, at both Qurta and Lascaux (Fig. 4, I, C), the distancing effect remains incomplete. The leg supposedly in the background should be masked by the one preceding it, in accordance with optical vision. In the above cases, the two legs remain juxtaposed (Fig. 4, I, A, D), thus creating contradictory angles of view between the different elements of the figure (what Abbé Breuil called “twisted perspective”). It is not impossible that these constraints of three-dimensional representation in a two-dimensional

*The implication is that the leg that is closest to us is the first, and the leg that is partially visible from behind it is the second.

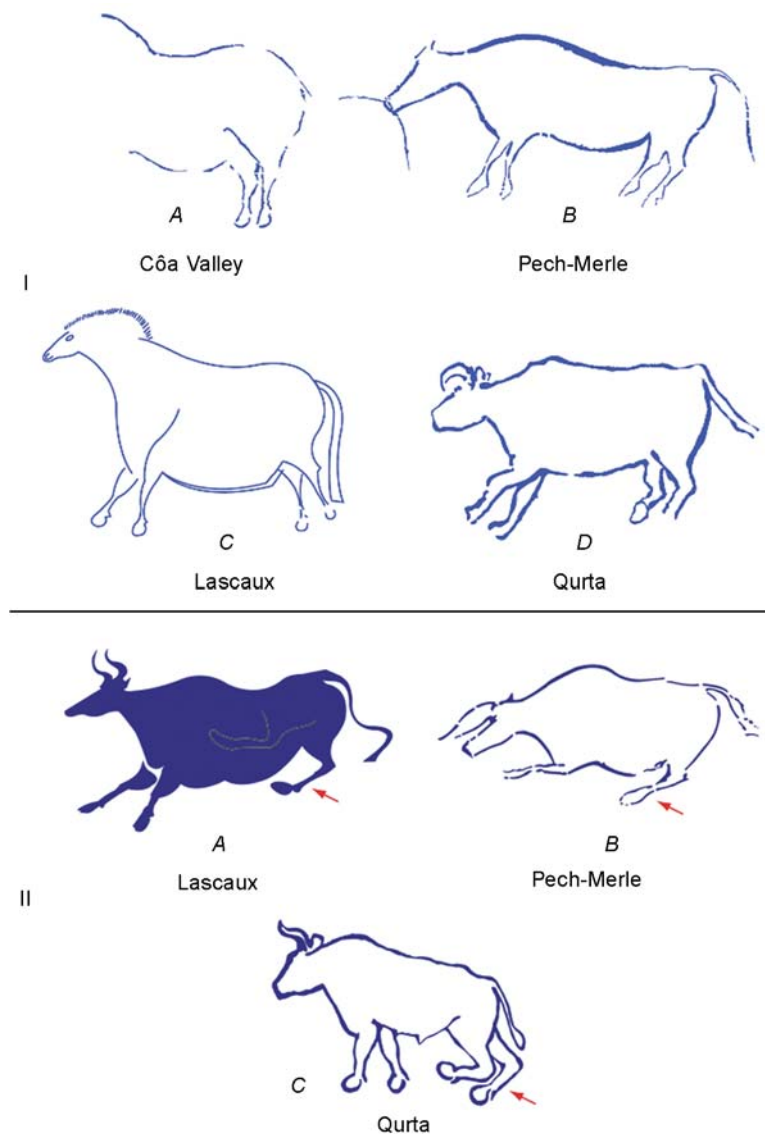


Fig. 4. The same two-dimensional design of legs can be found on the Qurta engraved animals and on Gravetto-Solutrean representations (and up to Lascaux) (I); the same abnormal position of hind legs folded under the body can be seen in Qurta engravings and in European art of the Gravetto-Solutrean age (and up to Lascaux) (II).

conception of drawing are at the origin of the unusual variations in the number of legs (single leg, paired legs, single and paired legs on the same figure) present in Gravetto-Solutrean engraving art such as at Qurta. It is as if their authors, inexorably faced with the problem of frontality, alternated by default between a single leg or juxtaposed even legs. It is possible that the same difficulty affected the design of the horns, which varied between juxtaposition of even horns and translation of a single horn. In any case, as at Lascaux, the difficulty of recording

legs in three dimensions is undoubtedly behind the doubling of the ventral line on certain Qurta animals, creating a depth effect by linking legs on “artificially” differentiated planes.

The same stereotyped movements

As we all know, the Lascaux artists deliberately left a blank space between the legs and the body to express perspective. The introduction at Lascaux of this three-dimensional process onwards probably freed up the expression of movement hitherto hampered by the old two-dimensional conception of drawing. At Lascaux and in contemporary sites, we can see the diversity of postures (walking, running, trotting, galloping, etc.) of the represented animals. While not reaching this level, probably due to the persistent difficulty of depicting legs on separate planes, some Qurta subjects are animated. As in the same period in Europe, the force of convention takes precedence over freedom of observation, and these movements retain a stereotyped appearance. For example, the placement of the front paws often follows the same animation pattern: the foreground paw is positioned in front of the background paw (see Fig. 1). One is spontaneously tempted to explain this strange position by simple individual clumsiness, despite the assertive and repeated nature of this placement. We can see that this position is comparable to that of the hind legs of the famous “jumping” (or falling) cow in Lascaux (see Fig. 4, I, C). It can also be found on several engravings in the Lascaux Abside. Given many stylistic features they share, it seems unlikely that this unusual position of the hind legs is simply a coincidence. It is all the more true as one of the aurochs from the Frise noire at Pech-Merle has a rigorously similar position (see Fig. 4, II, B), which seems to foreshadow the Lascaux and Qurta models.

Schematic female figures

The last but not least point of convergence of the Qurta and European art are female images. At Qurta, there are several schematic female figures (FFS) identical to the European Lalinde-Gönnersdorf model (also known as “headless women” in the words of G. Bosinski): same spindle-shaped silhouette without head or feet, same exaggeration of the buttocks (Fig. 5, A). The arrangement of the figures in single file at Qurta is in keeping with numerous European

examples (Fig. 5, B). A coincidental convergence seems all the more improbable as these women’s silhouettes are completely reinterpreted in symbolic terms. From this point of view, they constitute one of the major arguments in favor of a common cultural origin between European art and the Qurta rock engravings.

In Europe, there was a marked resurgence of this symbol from the Upper and Final Magdalenian periods, but there are earlier cases. Similar forms can be found at Gravettian sites such as Cussac and Pech-Merle. Other morphologically similar examples are known from Villars, whose age is contemporary with Lascaux. Others have been identified in the Solutrean caves of Rochefort and Margot in Mayenne. They are also found in southern Spain, in Ardales (Andalusia) and on several engraved plates from the Parpalló region, including one from the Middle Solutrean and another from the Early Magdalenian.

How and when might these trans-Mediterranean contacts have occurred?

The above-mentioned common stylistic and thematic elements suggest a cultural link between Qurta and European art. If we accept the possibility that European artistic knowledge and the beliefs that underpin it could have been exported to Upper Egypt, it remains to be seen how and by what means. Were there migrations to the African continent? Or are they the result of repeated exchanges between groups in the Mediterranean basin? The age of the engravings coincides with the Last Glacial Maximum. This may well have encouraged intercontinental contacts. The 120-meter drop in sea level would also have reduced the Strait of Gibraltar to a width of 7 km at its narrowest point (instead of the present 14 km). Dotted with several intermediate islands, it would have been passable even for inexperienced navigators (Collina-Girard, 2005). Lower sea levels also made passage through the Siculo-Tunisian Strait more accessible.

If contact routes did exist, the apparent isolation of the Qurta engravings in the region is surprising. If trade took place on both sides of the Mediterranean at this time, why is there no trace of it around these supposed points of contact? A lack of archaeological research in the region may explain this absence, but post-glacial warming and the subsequent rise

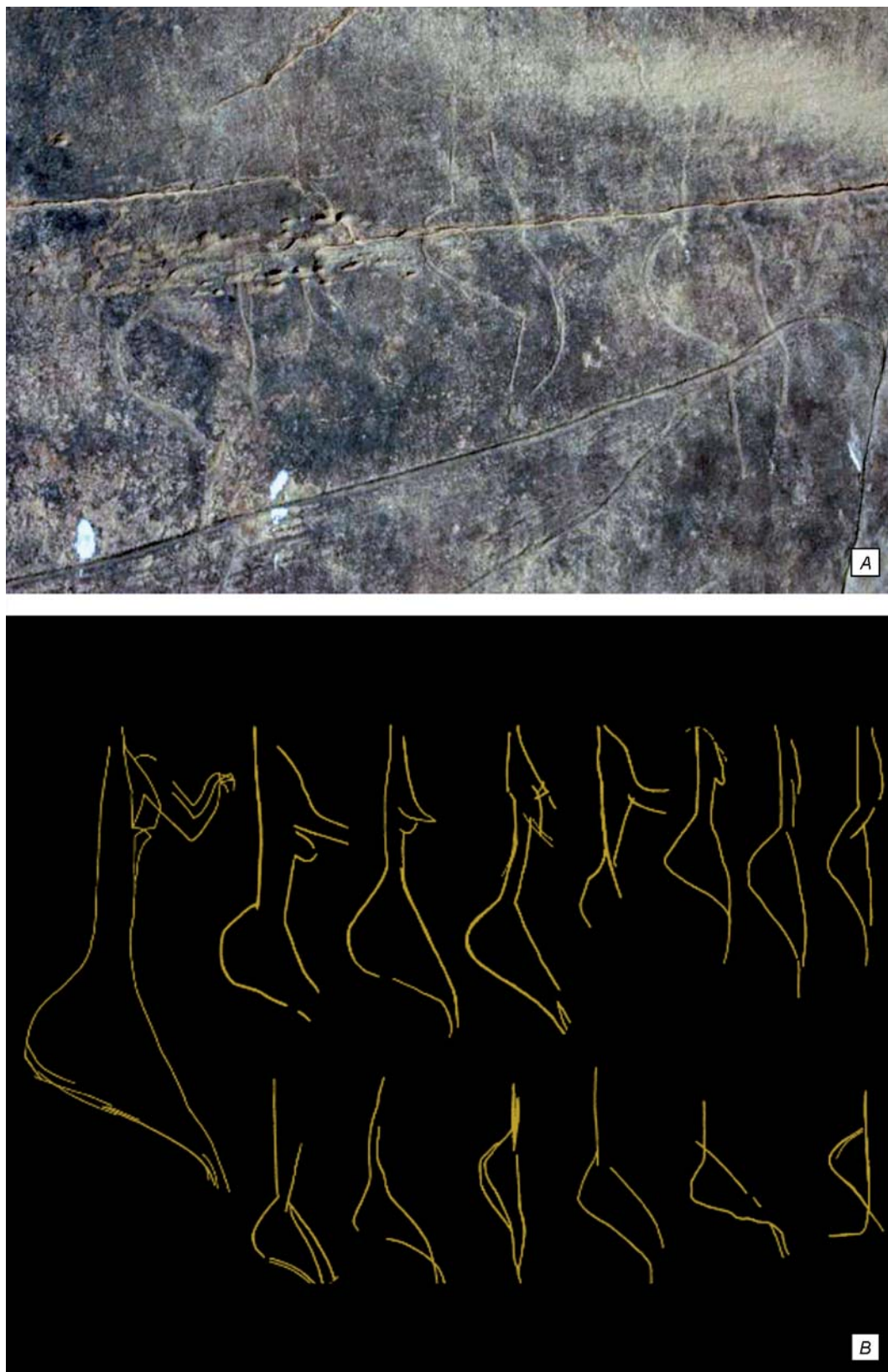


Fig. 5. Engraved schematic female figures.
A – Qurta; *B* – Gönnersdorf (Germany) (after (Bosinski, 2011)).

in sea level must also be taken into consideration. If contemporary Qurta habitats existed on the North African coast at the time, they now lie at a depth of 100 meters. But are we really sure that the Qurta engravings are as isolated as we think? Could it be that we have overlooked possible artistic milestones linking Southern Europe to the Nile Valley?

Other underestimated artistic representations

The above scenario does not seem impossible. For example, Dirk Huyge points to the existence of deep engravings of very similar appearance in the Jebel Akhdar in Cyrenaica (North Africa) (Huyge et al., 2015). This is the case of the Kaf Eligren cave, near the town of Shahat, whose close proximity to European art was emphasized by Umberto Paradisi as early as the mid-1960s (1965). The Kaf Atjur cave (known as the Bird Cave) near the town of Tobra contains numerous deep engravings of birds and a few gazelles in a style similar to Kaf Eligren (Jelinek, 1982).

Difficult to access, the region's mountain ranges have not been systematically prospected. In 2009, a Franco-Libyan team, while planning to visit the Kaf Atjur cave, discovered a second decorated site, the Kaf Tahr cave (Marini, de Faucamberge, Nasser Katab, 2010). Its walls bear deep engravings of birds, fish and gazelles (including several cases of animals of the same species in a confronted position). Here too, the style resembles that of two other previously discovered cavities. In northern Tripolitania, some engravings at Bir Miji also display stylistically European features (Jelinek, 2003), including unfinished aurochs with legs that are alternately paired and single.

The concentration of rock engravings potentially related to Qurta in northern Libya seems to lend credence to the hypothesis of contacts via the Sicilian Channel. This feeling is reinforced by the existence of numerous Sicilian engravings stylistically close to the North African examples. We know the predominant place of the auroch in southern Spain and southern Italy (Genovesi, Puntali, Niscemi, Addaura, Romito, Giovanna, etc.) (Tusa et al., 2013). In Puglia, the walls of the Romanelli cave are engraved with several representations of aurochs comparable to those at Qurta, and possible schematic female silhouettes have been reported (Mussi, De Marco, 2008). In the same region, a detached block from the ceiling

of the Paglicci cave bears the remains of a painted horse's hindquarters, whose single leg features ball-shaped hoof identical in every way to those found on the Lascaux horses (Martini, 2012). The animal's leg reproduces the same body-folding movement also seen at Pech-Merle, Lascaux, and Qurta (see Fig. 4, II).

The same particular translation of aurochs horns, present in Qurta as in Cyrenaica, is also frequently observed on Sicilian examples, consisting of two parallel sinuous lines forming a tube. This similarity does not, however, imply a passage through Sicily, as the same procedure is found on the Spanish Mediterranean coast (El Parpalló, La Pileta, etc.). Moreover, the findings of the region's archaeological studies reveal that northern Libya is not the only region likely to offer links with Qurta and, more broadly, with Europe. At this stage of our research, we do not claim to be able to offer an exhaustive inventory of these possible connections, but similarities can be noted around Oran and Tiaret, and undoubtedly as far as Morocco. These extensions could point to the establishment of European figurative (and ritual) conceptions along the North African coast, echoing Paolo Graziosi's prediction of the possible existence of a Euro-African artistic province (1968). This European cultural influence may have extended even further, to the Near East. An engraved shelter in north-central Sinai contains deeply incised representations of ibex, antelope or gazelle, horses, camels and a probable ostrich (Zboray, 2012). Here we find the main stylistic features observed at Qurta and in contemporary European art: description limited to a simple linear outline, legs without extremities, absence of internal details. While these features are still fairly general, the relationship goes further, as shown by the typically Gravetto-Solutrean convention, also found at Qurta, of expressing the belly and the front edge of the hind leg in two perpendicularly juxtaposed arcs. Even more striking, among the animals are two headless female figures with enlarged breasts and buttocks, very close to the European model and consequently to Qurta examples (Fig. 6).

In Saudi Arabia, close to the border with Jordan, the Kilwa site has yielded several sets of rock engravings. In 1938, Hans Rother, a disciple of Leo Frobenius, endeavored to classify and date them. The earliest figurations show similarities with Qurta art (A. Zboray, *pers. comm.*). Further downstream, in central Arabia, several engraved sites reported by Emmanuel Anati also belong to the same European-type tradition (2015). Among these engravings is

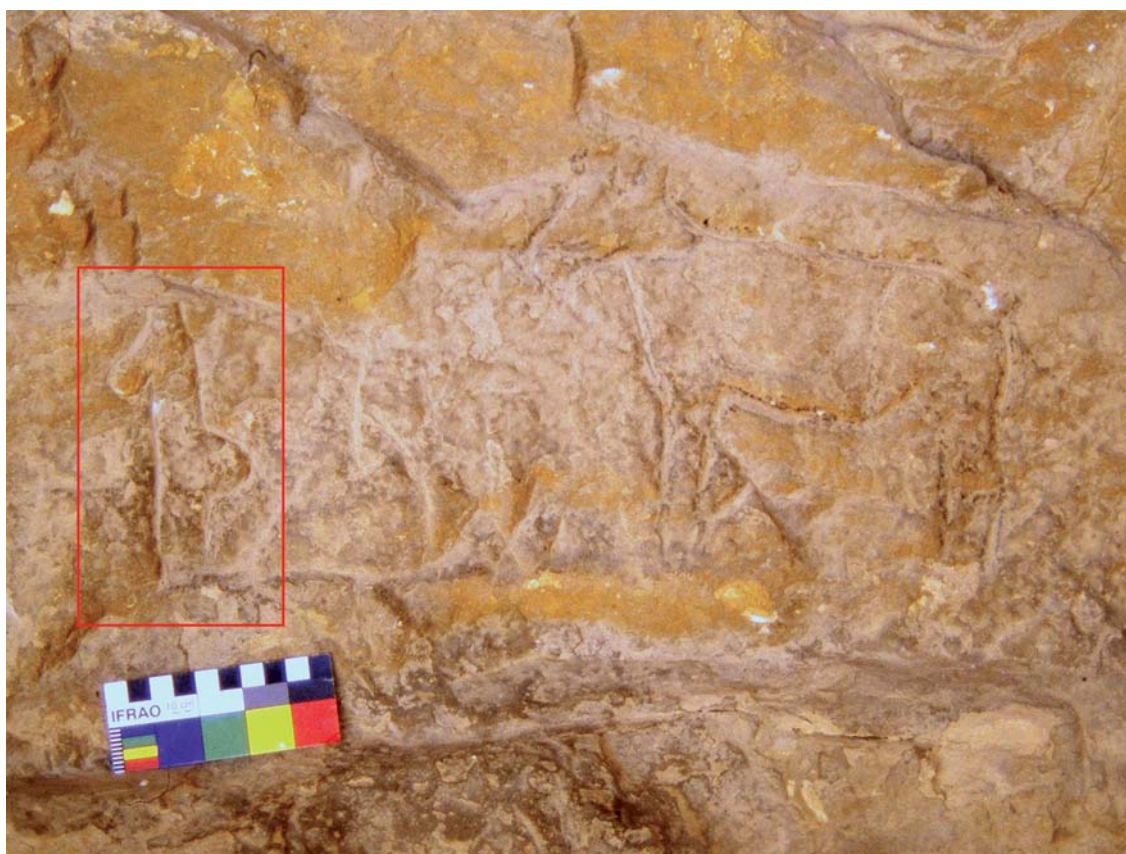


Fig. 6. Animals and schematic female figures from an engraved shelter in Sinai. Photo © Andras Zboray.

a headless female figure comparable to those found in Sinai (Zboray, 2012).

Without necessarily contradicting the possibility of exchanges via the Mediterranean, the spread of European symbols in the Middle East also opens up the possibility of contacts with Europe via the Caucasus. On the shores of the Caspian Sea, in Azerbaijan, certain Gobustan rock engravings are strongly reminiscent of European Gravetto-Solutrean art (Paradisi, 1965): horses or aurochs in line, single leg without extremity, geometrization of certain lines, single auroch horn in the shape of a tube, and, here again, friezes of headless female silhouettes associated with aurochs (Fig. 7), as is the case at Qurta, but also more often in Europe (Bosinski, 2011). Morphologically a little different from the European examples, these alignments of headless and legless women with marked sexual attributes undoubtedly echo the European model.

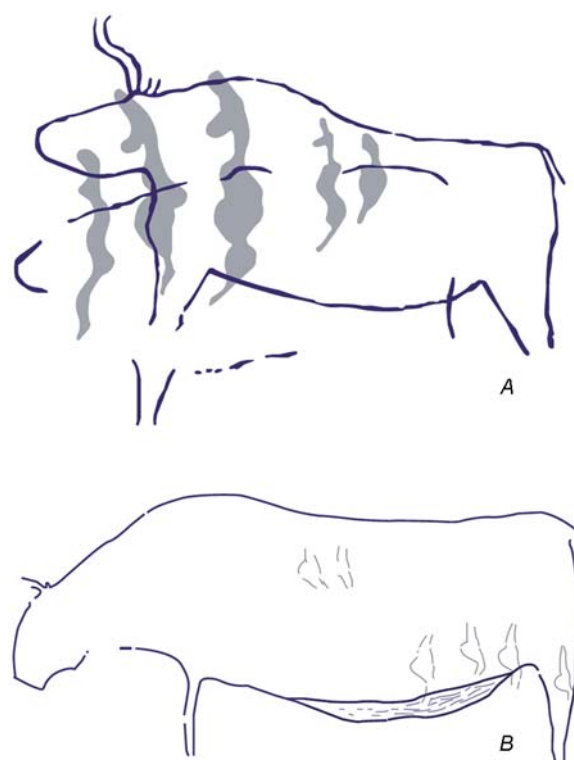


Fig. 7. Engraved aurochs with associated schematic female figures from Gobustan (A) and Qurta (B).

Conclusions

To conclude this quick overview, the Qurta engravings do not seem to be as isolated as one might think. Of course, in the absence of any archaeological context or dating, and given that these images are most often located in areas inaccessible to any research, the existence of a historical link between certain North African figurations and European art will doubtless remain open to question for a long time to come. It should also be noted that these long-distance similarities do not belong to just any period of the Upper Paleolithic. From East to West and from North to South, these analogies all relate to the same artistic expression known in Europe approximately between 22,000 and 17,000 BP, which coincides more or less with the period of the Last Glacial Maximum. It is likely that this major climatic crisis led to major population movements, particularly towards the more hospitable southern regions. Another likely consequence of the cooling is a widening of social exchange networks in the face of difficult living conditions, as ethnology sometimes shows (Smith, 1992). It is therefore tempting to establish a link between the climatic crisis and this artistic transhumance, which has no known equivalent in the Upper Paleolithic.

In this respect, it should be remembered that Gravetto-Solutrean conventions appear to have circulated in Eurasia over considerable distances, not only in southwestern Europe (from Andalusia to the Ardèche), but also far to the east, as suggested by the recent discovery of a staked slab in the Hunsrück massif (Germany) (Welker, 2016), the aforementioned rock engravings in Azerbaijan, and even some rock engravings from the Kalgutinsky Rudnik site in the Altai (Molodin, Cheremisin, 2002; Cretin et al., 2018), whose latest chronological estimates indicate an age of around 20,000 BP (Deline et al., 2023). Recently, other petroglyphs (Baga-Oigur-5 site) clearly related to this same tradition (“Kalguty style”) were discovered on the right bank of the Baga-Oigur River, less than 50 km east of the Kalgutinsky Rudnik site (Molodin et al., 2024).

It is perhaps no coincidence, then, that the Paleolithic engravings found in North Africa and the Near East belong to an artistic tradition characterized by the extent of its territorial expansion on the Eurasian continent.

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Stylistic Parameters of Minusinsk Rock Art Style

This study focuses on the formal typology of petroglyphs belonging to the Minusinsk tradition. While these are widely distributed, we analyze only zoomorphic images from the Minusinsk Basin, because the earliest rock art in Southern Siberia and Central Asia, we believe, refers to a definite chronological stage, whereas the Minusinsk Style is its regional manifestation associated with the local cultural tradition. The purpose of the study is to identify the specific features of the classic regional Minusinsk Style, distinguishing it from other manifestations of the earliest rock art, peripheral relative to it. We present the results of the stylistic analysis based on formal typological criteria mentioned by various specialists in Minusinsk zoomorphic images. Representations of animals fall in several groups in terms of species, and a set of characteristics has been proposed for each. Because they are highly variable both in the Minusinsk tradition and in the earliest rock art in general, criteria specific for the Minusinsk Style alone (first-order criteria) have been separated from those relevant to other traditions (second-order criteria). The core of the classic Minusinsk Style is defined by a stable combination of formal typological features. Another group of the earliest petroglyphs is nominally described as peripheral, because it doesn't show this combination.

Keywords: Rock art, Minusinsk rock art tradition, Minusinsk Style, formal typological analysis, core and periphery of style, Minusinsk Basin.

Introduction

The Minusinsk rock art tradition was identified by N.L. Podolsky for the rock art of the Minusinsk Basin (1973: 270–272). Its area of distribution, once limited to the Middle Yenisei basin, has significantly expanded in recent decades, owing mainly to discoveries of a large number of Altai rock art sites (Kovtun, 2001: 90, pl. 93–95; Cheremisin, 2000; Matochkin, 2011; and others).

The age and cultural attribution of this rock art tradition remain controversial to this day. Researchers

agree on one thing: this is the most archaic group of images in the rock art of Southern Siberia (Miklashevich, 2020). The early origin of this group of petroglyphs is suggested by the fact that they never overlap representations of other styles, while being themselves often overlapped by later ones. The repertoire of the Minusinsk rock art tradition includes presumably wild animals, mainly deer, but also bovid, horse, bear, boar, and others (Sher, 1980: 190; Sovetova, Miklashevich, 1999: 53). No images other than zoomorphic ones are known in the Middle Yenisei Minusinsk tradition.

The issues of age estimation and possible cultural affiliation of the images of this rock art style have been discussed in detail elsewhere (Podolsky, 1973; Sher, 1980: 190–193; Kovtun, 2001: 142–153; Rusakova, 2005; Esin, 2010; Sovetova, Miklashevich, 1999; Miklashevich, 2015, 2020; Zotkina et al., 2023). The proposed age estimations fall in the range between the Upper Paleolithic and the Early Bronze Age (Sher, 1980: 186–193; Podolsky, 1973: 275; Miklashevich, 2015: 67; Malikov et al., 2025); advocates of the latter hypothesis associate the Minusinsk Style with the Afanasyevo culture (Kovtun, 2001: 144–153; Rusakova, 2005: 215; Esin, 2010). However, the features of the style indicate its heterogeneity and a high degree of variability (Kovtun, 2001: 142–143; Miklashevich, 2015: 67).

In her recent publications, E.A. Miklashevich argued that the identification of the Minusinsk Style was made without due respect to its heterogeneity, the lack of evident standardization of the artistic execution, and a considerable amount of forms tending to the Angara style; she believed it was most reasonable to attribute this group of images to the earliest rock art in Southern Siberia and Central Asia (2015: 67; 2020). However, she did not identify any specific features indicating the stylistic characteristics of the group in question.

On the one hand, the high variability of the earliest images in such a large area makes it almost impossible to identify a set of specific formal typological features consistent to one another; and on the other hand, these images certainly demonstrate some common traits, probable markers of the period, rather than a narrow stylistic affiliation. We believe that the search for local features of rock art is quite promising, and support the thesis that “denial of classification of styles within the earliest rock art does not contribute to the resolution of the problem, but, on the contrary, complicates the situation” (Molodin et al., 2021: 202).

This study is aimed at the identification of features determining the conventionally classic images of the Minusinsk Style in the Middle Yenisei, which constitute the style core, and the so-called peripheral images. We rely on a formal typological approach to classifying zoomorphic images in terms of animal species, which makes it possible to systematize the typical features of the local Minusinsk rock art tradition and clarify our understanding of this subject. The proposed classification can be considered a basis for the relative dating of the earliest rock art of the Minusinsk Basin and adjacent regions.

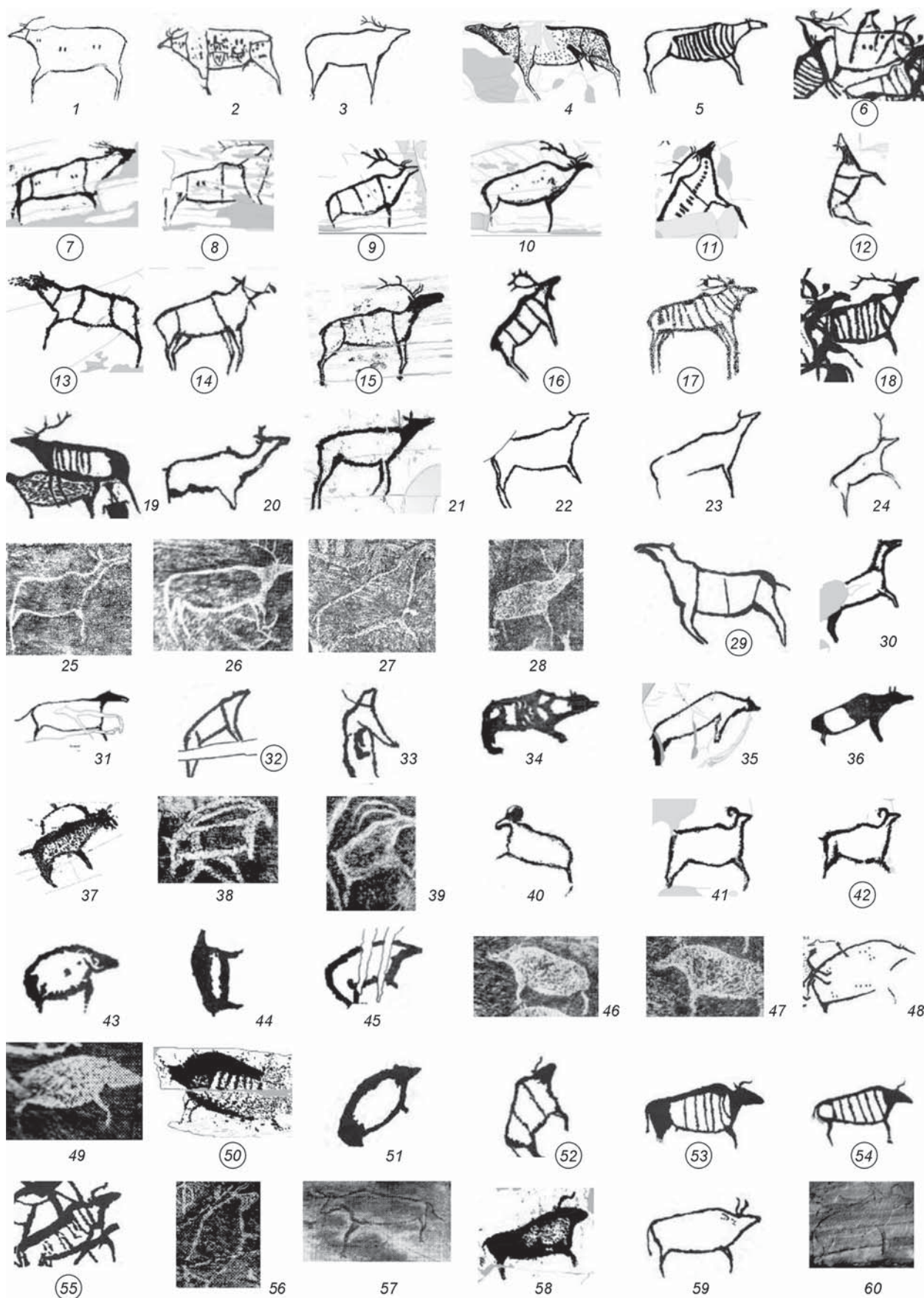
Material and methods

The stylistic analysis, despite the existing alternative approaches to dating (see, e.g., (Aubry et al., 2007; Zotkina et al., 2014, 2020; Aubert et al., 2019; Atlas..., 2020)), still remains the leading technique of cultural-chronological attribution of images (Fortea et al., 2004; Le Brun, 2012; Domingo Sanz, Fiore, 2014; Bourdier, Pinçon, 2016; Ponomareva, Taçon, 2019; Molodin et al., 2019; Zotkina et al., 2023). An artist deliberately makes a certain choice or unconsciously follows a set of techniques existing in a specific cultural context. In both cases, the technique of rendering images is manifested through formal typological characteristics that mark the style (Domingo Sanz, Fiore, 2014: 7109). These are shape, size, content of images, interrelation of images (compositions and scenes), additions and overlaps, and positions of images in the natural and cultural context. Formal features are analyzed visually and described systematically, their repeatability is recorded; the findings provide grounds for identification of the style as a cultural phenomenon localized in time and space (Ibid.).

Formal typological analysis of zoomorphic images is based on the species's exterior features in order to distinguish between the artistic technique of rendering details and the anatomic traits. A series of images should be examined in order to record the repeatability of formal features and thereby exclude their random occurrence, as well as to confirm the correctness of selected criteria (Guy, 2000: 416).

In order to avoid circular reasoning when analyzing figurative characteristics (chronological attribution of images by style features, and style by chronological affiliation), researchers consciously did not take into account direct and indirect data on the age of petroglyphs, and create classifications on the basis of noted formal features exclusively. According to morphological criteria, visual similarity of images at different sites is established; after that, the resulting classifications are compared with their age estimations (Fortea et al., 2004: 164). Such a sequence of analysis makes it possible to systematize rock art data, correlate them with specific archaeological cultures, and trace the dynamics of development and interaction of styles in rock art.

The area of dispersal of the Minusinsk Style images is quite large; we deliberately limited our study to the territory of the Minusinsk Basin. A similar study of the earliest petroglyphs in adjacent regions will provide data on region-specific features



and propose a classification of the earliest rock art of Southern Siberia and Central Asia.

A rather contradictory situation has arisen in the historiography of the Minusinsk rock art tradition: everybody acknowledges the existence of the Minusinsk Style in one form or another, but uses different, sometimes opposite criteria (see the next section) in identifying “Minusinsk” images. Some descriptions do not fully meet the requirements of formal typological analysis and often characterize the individual perception of petroglyphs by a researcher. Nevertheless, certain specific features occur repeatedly in many publications; these features can be considered the key characteristics of the Minusinsk Style.

The present study is based on a sample of 60 images (Fig. 1) selected by visual characteristics of the Minusinsk figurative style ever mentioned by researchers, including subjective ones, which in some cases contradict each other as well as our own viewpoint on what determines the Minusinsk Style. The sample included petroglyphs from both large rock art sites, with more than one thousand images from various periods (Oglakhty – 24 images, Shalabolino – 20, Tepsey – 9), and smaller ones (Sukhanikha – 3, Georgievskaya – 2, Maidashy – 2). The criteria for formal typological analysis included only the features that were repeated more than once by various scholars and described specific features of the image, rather than the subjective perception of work of art. As a result, a set of stable morphological parameters inherent in the Minusinsk Style in the region under consideration has been identified.

The derived data were subjected to statistical analysis (Fig. 2). Each available feature was designated by figure one (1), and its absence by zero (0). At the first stage, an unconstrained seriation was carried out, which arranged the petroglyphs by availability of features—from two to eight (see the next section) (Kolobova et al., 2025). The second

stage included a hierarchical cluster analysis using the single linkage clustering algorithm, combined with the Hamming metric, to classify images depending on the available features (variables). The Hamming distance metric, originally used for linguistic structures, is suitable for analyzing nominal data by the presence or absence of features. The third stage is a nonparametric correspondence analysis with designation of variables’ vectors. This is a method of visualizing contingency tables based on chi-square statistics. The result is a plot where the distance between points reflects the degree of difference between petroglyphs, depending on the variables used (Fig. 2). All calculations were performed using the PAST-3 program (Hammer, Harper, Ryan, 2001).

Criteria for the Minusinsk Style identification

The images were selected and included in the sample with respect to all the Minusinsk-style features mentioned by researchers. These are “static position of figures”, “strictly horizontal placement” (Podolsky, 1973: 270), “relatively large sizes of animal figures and their ‘realistic presentation’”, “markedly heavy outlines of the body with a comparatively small head” (Sher, 1980: 190–192), “certain schematic features combined with realistic manner” (Sovetova, Miklashevich, 1999: 53). “Some images suggest that the artisans used the principles of constructing orthogonal configurations” (Kovtun, 2001: 143). The following individual features of zoomorphic images were recorded: “narrow, almost pointed profile of the head”, “the head is shown with a straight line running from nose to ears; the mouth is not shown; line of the back is horizontal and straight; the body is rendered as a regular rectangle; short legs (shorter than the body height); the legs are vertical or slightly apart; straight, obliquely directed tail” (Podolsky, 1973: 270); “robust body, slightly pendulous belly,

Fig. 1. Images of the earliest rock art in the Minusinsk Basin.

1–3, 6, 8–10, 13, 18, 19, 24, 29, 30, 33, 35, 40–42, 51, 53–55, 59 – Oglakhty; 4, 11, 12 – Sukhanikha; 5, 14, 16, 17, 25, 26, 28, 31, 34, 36–39, 43–47, 49, 56, 57 – Shalabolino; 7, 15, 20, 21, 32, 48, 50, 52, 58 – Tepsey; 22, 23 – Georgievskaya; 27, 60 – Maidashy. The encircled figures designate the images showing a large number of the Minusinsk Style features and belonging to its core.

1–3, 6, 18, 19, 33, 51, 53–55, 59 – after: (Sher et al., 1994: Pl. 4, 12.6; 13, 36.1; 15, 39.1; 16, 45.11, 45.20; 19, 53.2; 38, 91.5, 91.9, 92.14; 40, 95.9, 41, 98.1; 43, 101.6); 4, 8, 11–13, 27, 30, 35, 60 – after: (Miklashevich, 2015: Fig. 2, 3, 4, 3, 1, 2, 4, 1, 5, 2); 5, 25, 26, 28, 31, 34, 36, 38, 39, 43–47, 49, 56, 57 – after: (Pyatkin, Martynov, 1985: Fig. 7, 27, 51, 69, 71, 73, 84, 107, 125; Tab. 10, 4, 5, 9; 12, 4; 14, 7, 13; 27, 2); 7, 15, 21, 50, 58 – after: (Sovetova, Shishkina, Abolonkova, 2021, Catalogue: Fig. 16, 76, 110, 83, 60); 9, 10, 16, 24, 40 – after: (Miklashevich, 2020: Fig. 1, 1, 2, 4, 7, 16); 14 – after: (Sovetova, Miklashevich, 1999: Tab. 1, 2); 17, 37 – authors’ trace-drawings; 20, 32, 48, 52 – after: (Blednova et al., 1995: Pl. 4, 11.1, 14.1; 5, 12.2; 64, 79.2); 22, 23 – after: (Leontiev, Pankova, 2012: Fig. 3); 29 – after: (Sher, 1980: Fig. 88); 41, 42 – after: (Miklashevich, 2022: Fig. 2).

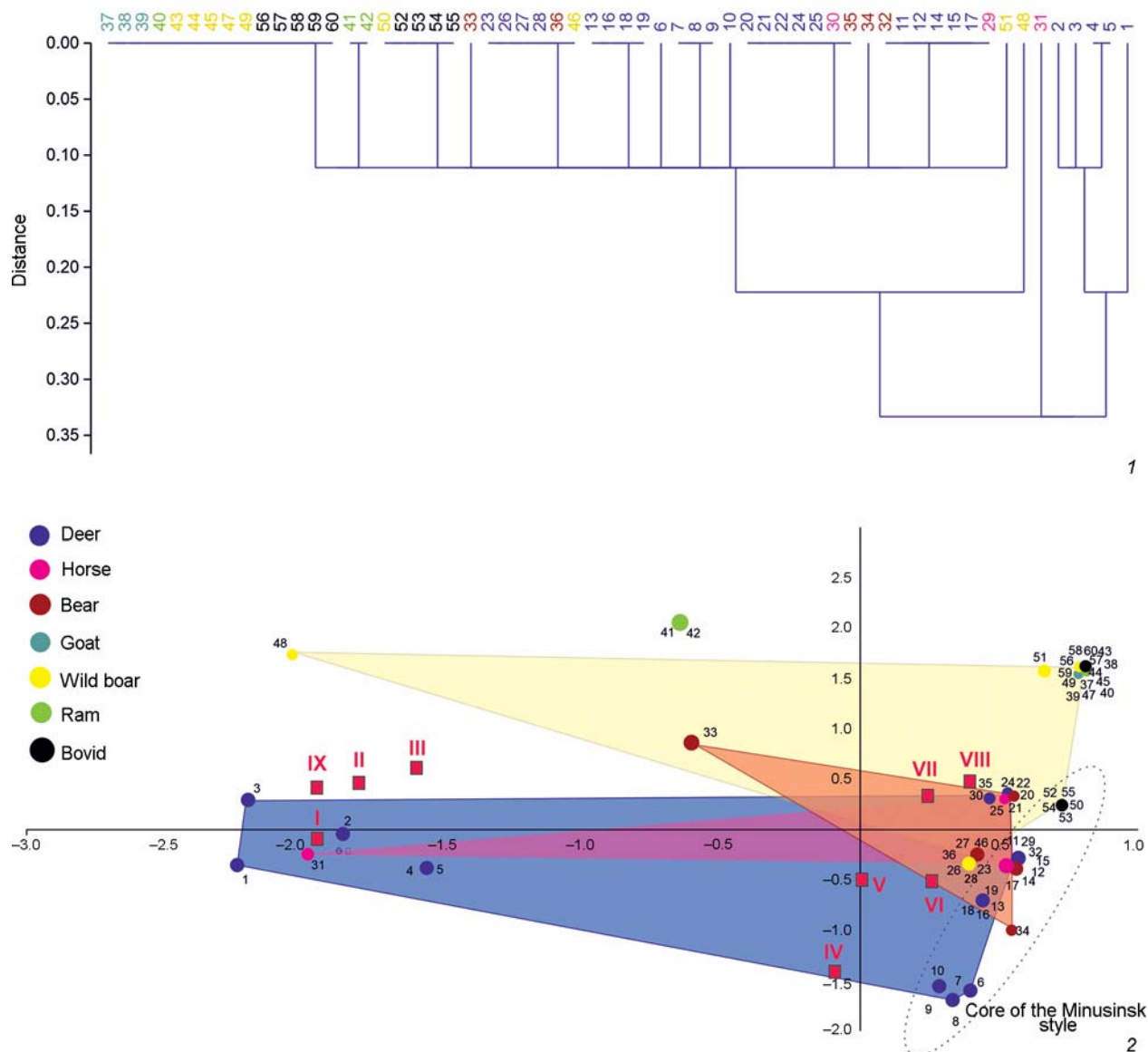


Fig. 2. Findings from the statistical analysis of the earliest rock art sample.

1 – dendrogram of hierarchical cluster analysis using the single linkage algorithm and the Hamming metric (colors of the numbers reflect the species affiliation according to the legend); 2 – correspondence analysis plot displaying similarity between petroglyphs based on attribute variance: I – strictly horizontal position; II – short straight neck; III – heavy outlines of the body; IV – body ornamentation; V – pointed profile; VI – body decoration; VII – “hanging legs”; VIII – slight or significant inclination of the animal’s body; IX – small head.

short straight neck, robust legs” (Sher, 1980: 192), “heavy body, small head with a muzzle extended forward”, seemingly “hanging legs” (Sovetova, Miklashevich, 1999: 53); the body may be ornamented with transverse stripes or “anatomical pattern”* (Kovtun, 2001: 143).

*In the case of the Minusinsk Style, it means transverse lines inside the body contours, emphasizing the shoulder and hip of the animal (see, e.g., Fig. 1, 4, 7, 13, 15). Some

I.V. Kovtun was among the first who drew attention to the iconographic heterogeneity of the Minusinsk rock art tradition. He noted that some deer images were rendered with robust bodies and miniature heads, without special elaboration of necks, while other deer had graceful bodies with exaggerated long necks; representations of animals with bent or

images demonstrate a greater number of the transverse lines (see Fig. 1, 8, 9, 16, 17).

straight front legs; those decorated with transverse stripes or anatomical patterns and those devoid of any ornamentation (Ibid.: 142–143).

The available numerous descriptions of the Minusinsk Style contain rather few formal typological features of images, and these are often repeated. The following features can be distinguished: “short straight neck” (Sher, 1980: 192) and “exaggerated long neck” (Kovtun, 2001: 143); “strictly horizontal position” (Podolsky, 1973: 270) and an inclined or almost vertical position of the animal’s body, often combined with an elegantly raised head. This latter feature we have introduced in our study based on the analysis of the sample of images (see Fig. 1, 6–30, 32–60). This technique occurs also in other rock art traditions, for example, in the Angara style. Nevertheless, its repeatability in the petroglyphs under consideration suggests the emergence of this stylistic convention in the earliest rock art. The same is true for the ornamentation of an animal body with vertical lines, which has been noted in the rock art of the Minusinsk Basin and adjacent territories up until the Middle Ages.

Thus, the analysis of the derived sample of images was based on the following characteristics: 1) strictly horizontal position of the body*; 2) large size and heavy outlines of the body (the body height is equal to or exceeds the length of the legs); 3) small head (its height does not exceed the width of the neck) with a muzzle pulled forward; 4) short straight neck (its length does not exceed 1/5–1/6 of the body length); 5) transverse stripes or anatomical pattern distinguishing the shoulder blade and thigh on the body; 6) “hanging legs”; 7) inclined or almost vertical position** of the animal’s body, often in combination with an elegantly raised head; 8) two closely located dots in the front and/or back part of the body; 9) pointed profile of the head, often designated by two lines—lower lip and forehead (the angle between them is approximately 40°).

Results

The selected images do not comprise all the zoomorphic figures known in the Minusinsk Basin

*The angle of inclination of an imaginary line drawn along the animal’s back equals $0 \pm 5^\circ$.

**The angle of inclination of an imaginary line drawn along the animal’s back equals $90 \pm 5^\circ$, which corresponds to strictly vertical position; that in the range from 0 to 90° corresponds to inclined position.

that could be attributed to the rock art tradition under consideration. However, this sample of 60 images provides the ground for detecting the trends of the Minusinsk Style in relation to each specific species of the depicted animals.

The most numerous group included the images of cervids (deer, elk, roe deer) ($n=28$). The following elements were used to convey these images: 1) inclined or almost vertical position of the body; 2) transverse stripes or anatomical pattern on the body; 3) pointed profile of the head; 4) “hanging legs”; 5) two closely located dots in the front and/or back part of the body.

The other combination of features, including a strictly horizontal position of the animal, heavy outlines of the body, a short straight neck, and a small head with an elongated muzzle, together with some other traits, was recorded on five images of cervids (see Fig. 1, 1–5); apparently, these images can be distinguished into a separate group of the earliest petroglyphs of the Minusinsk Basin (see Fig. 2). They exhibit the greatest number of features under consideration: from six to seven combined in one image. Noteworthy is also a series of partial images mainly of deer, more rarely of bovids (Sovetova, Shishkina, Abolonkova, 2021, Catalogue: Fig. 4; Miklashevich, 2020: Fig. 1, 9, 13; and others). Some of these images demonstrate the features characteristic of the Minusinsk rock art tradition: a pointed profile of the head, in combination with an elongated and slightly raised muzzle of the animal. No partial images of bear, boar, ram, and goat have been recorded. We believe that this finding deserves a special study.

The images of cavicornians are dominated by bovids ($n=9$) (see Fig. 1, 52–60). The following conventions have been identified: 1) inclined or almost vertical position of the body; 2) decoration of the animal’s body with transverse stripes or anatomical patterns; 3) “hanging legs”. A few images of goats and rams ($n=6$) show a slight inclination of the body and “hanging legs” (see Fig. 1, 37–42). Isolated ram images demonstrate the use of such conventions as heavy outlines of the body, decoration of the body with anatomical patterns, and pointed profile of the head (see Fig. 1, 41, 42).

Five bear images have been identified (see Fig. 1, 32–36). They are characterized by the following features: 1) inclined or almost vertical position of the body; 2) anatomical patterns on the body; 3) pointed profile of the head; 4) “hanging legs”.

There are three horse images showing the features of the Minusinsk Style (see Fig. 1, 29–31),

which undoubtedly include those from the sites of Oglakhty II (Sher, 1980: Fig. 88) and VI (Miklashevich, 2015: Fig. 2, 4). These images show the slight inclination of the animal's body, decoration with anatomical patterns, and "hanging legs". Other archaic horse images, which are often mentioned in publications in the context of the earliest rock art, do not show any formal typological features identified by specialists as typical of the Minusinsk Style.

Nine wild boar images have been recorded (see Fig. 1, 43–51). The conventions include an inclined or almost vertical position of the body, "hanging legs", and transverse stripes on the body. The zoomorphic image at Ust-Tuba III (see Fig. 1, 48) (Blednova et al., 1995: Pl. 64, 79.2), combining the features of both a bovid and a wild boar, raises some doubts. However, the outline of the animal's body suggests its identification as a boar.

The statistical analysis of the nominative data has shown that, regardless of the animals' species, the following figurative features are most frequent: 1) "hanging legs" (59 figures); 2) an inclined or almost vertical position of the animal's body (54); 3) a pointed profile of the head, often rendered by two lines—lower lip and forehead (37); 4) transverse stripes or anatomical patterns on the body (24).

Two closely located dots in the front and/or back part of the animal's body are noted only on six images of deer-family members (see Fig. 1, 1–10). The deer images demonstrate the greatest variability and the maximum number of features mentioned in this paper.

The combination of such features as a strictly horizontal position, large size and heavy outlines of the body, a small head with the muzzle extended forward, and a short straight neck, is typical of the cervids figures (see Fig. 1, 1–5). Images of animals of other species, for example, wild boar (see Fig. 1, 48) or ram (see Fig. 1, 41–42), only rarely show some of these features. Decoration of the body with anatomical patterns or transverse lines is absent in the images of goats (see Fig. 1, 37–39) and very rarely occurs in those of ram (see Fig. 1, 42) and wild boar (see Fig. 1, 50).

Thus, all the analyzed petroglyphs (with the exception of a series of deer images, which demonstrate the largest number (six to seven) of the features under consideration (see Fig. 1, 1–5)) can be classified into two main groups (see Fig. 2). Group 1 is characterized by a combination of three to four most frequently encountered features from the list mentioned above, which suggests a considerable

standardization of the stylistic manner. This set forms the core of the Minusinsk Style. It comprises images of animals of various species, the deer being the most frequent. Group 2 includes the figures that bear no more than two of the features under consideration, but sometimes exhibit other conventions that are not found in the classic Minusinsk Style (see, e.g., Fig. 1, 57). Various combinations of these conventions provide for the high variability of this group, which we define as the periphery of the Minusinsk Style or the images of the earliest rock art.

Discussion

The series of petroglyphs under study shows recurrent combinations of formal typological features mentioned above, regardless of the species of depicted animals. These have been noted in 21 figures (see Fig. 1, 6–9, 11–19, 29, 32, 42, 50, 52–55), which can be considered as a separate group within the earliest rock art of the Minusinsk Basin. This series of images obviously forms the core or classic Minusinsk Style, because they demonstrate a formal set of specific conventions rendering a stable combination of formal typological features. The images represent deer, horse, bear, ram, and bovid.

Notably, our findings do not suggest that other images, bearing three or even two of the four features under consideration, do not belong to the Minusinsk Style. The selected group of petroglyphs provides the characteristics of a stable set of recurrent formal typological features describing a certain established stylistic standard. However, it is very likely that the deviations from the selected set of features in some rock images that are rarely encountered or not included in the group of classic Minusinsk images (such as horse, ram, goat, and wild boar) are due to their species characteristics. For this reason, we have classified all the images by species. This approach seems promising for further analysis of the zoomorphic images of the earliest rock art of the Minusinsk Basin as a whole.

The listed formal typological features can be conventionally subdivided into two groups: the first-order features, characterizing the Minusinsk tradition only; and the second-order features, which are observed in other styles too. For example, the inclined position of the animal's body is also typical of the Angara style, and the decoration of the body with transverse stripes is recorded in many rock art traditions. At the same time, the ornamentation

of the front or back part of the body with two closely located dots is noted exclusively on the images of the Minusinsk Style. The combination of such features as “hanging legs” and transverse lines or anatomical patterns on the animal’s body is characteristic only of the Minusinsk tradition in the region under consideration. Thus, to determine the Minusinsk Style, the latter three features can be used as the first-order criteria, and all the others as the second-order criteria. This division allows us to identify those images that implicitly belong to the Minusinsk rock art tradition, even if they do not show all the formal typological features that make up the core of the style.

Since the Minusinsk Style correlates with the earliest rock images of the Minusinsk Basin, it is no wonder that many of its elements were broadly used in other rock art traditions. Currently, we could hardly assess the chronological affiliation of these images. It is difficult to determine when a particular convention appeared, whether it correlates specifically with the Minusinsk Style or with another group of the earliest images. However, the repeatability of the set of features forming the core of the style points to a deliberate choice of certain forms, a random combination of which is unlikely, and requires knowledge of the established artistic canon. This determines the Minusinsk Style as a cultural, rather than a chronological phenomenon.

At the same time, various combinations of the above formal typological features together with other conventions, including those atypical of the Minusinsk tradition, ensure a high variability of the visual characteristics of the earliest rock art as an epochal phenomenon. Thus, a considerably larger group of the earliest petroglyphs in the Minusinsk Basin is peripheral relative to the core of the Minusinsk Style. The earliest petroglyphs were a more global phenomenon, characterizing the chronological stage in the rock art of a vast territory of Southern Siberia and Central Asia. Moreover, this was the context that presumably created the environment for the development of the local Minusinsk Style in the Middle Yenisei.

Conclusions

Identification of formal typological features of zoomorphic images, taking into account animals’ species, the determination of first- and second-order

features within a single rock art tradition, and the separation of the core and periphery of the style made it possible to systematize some of the earliest petroglyphs and to establish a group of images that can be confidently designated classic for the Minusinsk Style. This approach provides a way to solve the problem of classifying petroglyphs within the rock art tradition of a vast region. Since the classification by formal typological features should precede chronological constructions, it is this stage of the study that forms the basis for subsequent attribution of rock images of the Minusinsk tradition and the earliest rock art in the Minusinsk Basin and adjacent regions.

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Ivan Savenkov's Finds from Neolithic Burials on the Bazaikha River and the Age of Siberian Rock Art

This study examines objects of portable art such as realistic three-dimensional figurines of elk and an anthropomorphic figurine, carved from elk antler, which were found by Ivan Savenkov in 1885 during his excavations of burial VI at Bazaikha, near Krasnoyarsk, in the mouth of the eponymous river. This burial, like others at the same site, yielded also stone and bone artifacts of Neolithic appearance. This unusual sample is one of the main arguments favoring the Neolithic age of numerous examples of Siberian rock art (elks and other animals rendered in the so-called Angara style). The Neolithic attribution of figurines and stylistically similar petroglyphs is problematic largely because the Bazaikha sample has not yet been analyzed by modern methods or even documented or fully published. Here, an overview of the sample, based on available archival and literary records, is given, and the possibility of comparing figurines and petroglyphs is discussed with reference to the "Angara style". I propose to select from the heterogeneous array of representations those actually showing stylistic parallels with the Bazaikha figurines. Two avenues of further research are mentioned: a focus on the Bazaikha sample (archival studies, 3D documentation, cataloging, radiocarbon dating, etc.), and a revision of the notion of "Angara style" in rock art based on modern views and facts.

Keywords: Bazaikha, Neolithic, portable art, rock art, Yenisei, Angara style.

Introduction

Siberian rock art contains a lot of images that are attributed by many scholars to the Neolithic. Relatively realistic (with distinctive stylization) elk figures, carved and painted on rocks of the Yenisei, Angara, Lena, and other areas, are considered the most typical. Neolithic attribution is based on indirect evidence; the most important is the stylistic similarity of rock images with objects of portable art from the Neolithic (or presumably considered as such) sites of Siberia and the entirety of Northern Eurasia. A key role in the identification was played by a collection of artifacts discovered by Ivan Savenkov in 1885

in the burials near the village of Bazaikha at the mouth of the Bazaikha River, the tributary of the Yenisei, in the vicinity of Krasnoyarsk. Realistic 3D images of elk, masterfully carved from antler, and an anthropomorphic figurine were particularly important. Various accompanying goods helped Savenkov to suggest the Neolithic age for the burials; he also noticed a stylistic similarity between these figurines and some of those from the Middle Yenisei region. In further studies, these findings were of great importance for identifying the Neolithic stratum in the rock art of Siberia. However, not all scholars accepted the Neolithic age of the Bazaikha burials, and even more controversial was the attribution of

the corresponding rock art to the “Angara style” or “Angara figurative tradition” (Podolsky, 1973; Sher, 1980: 186–190; Kovtun, 2001: 48–55; Ponomareva, 2016; and others). Generally, these are two separate and pertinent research areas, yet they are closely related to each other. This article makes it possible to discuss only some aspects of these problems. It intends to describe the available material evidence gathered by Savenkov at Bazaikha; using it as example, to discuss the possibility of correlating portable art and rock art; to identify precisely those representations from the heterogeneous array of rock art in the Angara style, which can be correlated with figurines from Bazaikha; and to outline the prospects for further research in each of these areas.

Evidence gathered by Ivan Savenkov at Bazaikha

This unique collection was associated with equally unique circumstances. It is hard to imagine that the most interesting, rare material evidence, obtained 140 years ago and analyzed in numerous publications, has still not been documented and studied by current research methods, and has not been published according to modern standards. The evidence and documentation have not been lost, and are kept in museums*. It appears that apart from photographs taken in the 19th century (FO NA IIMK RAN. Q 393-1, 393-2; RO NA IIMK RAN. F. 1, D. 156, fol. 59), the only available images of the artifacts were published in the mid-20th century (Okladnikov, 1950: Fig. 90; 1957: Fig. 5, 12, 13; 1966: Fig. 35, 36; 1971: Fig. 108, 109). Therefore, after Ivan Savenkov, the originals must have been studied only by A.P. Okladnikov. The manuscripts of Savenkov “Journal of Archaeological Excursions and Excavations of 1885” and “Bazaikha Site of the Stone Age” (Archive of the Minusinsk Museum of Local History. Inv. 3, D. 89, 124) have not been fully deciphered and published. Nevertheless, information about this site, photographs,

and drawings of the artifacts are present in archives and in the literature, which allows us to provide a preliminary description of this evidence.

Ivan Timofeevich Savenkov (1846–1914) made a significant contribution to Russian science and culture in many fields (to learn more about him, see (Vdovin, Makarov, Maizik, 2024)), including archaeology. He is especially well-known as a researcher of the Stone Age and rock art of the Yenisei region. In the vicinity of Krasnoyarsk, Savenkov discovered the first Paleolithic site in the region (Afontova Gora) and Neolithic burials (Bazaikha). He found the first burial with the relevant goods in the Bor locality near the village of Bazaikha in 1883 while collecting surface finds on sand dunes, which marked the beginning of Savenkov’s work as an archaeologist (Auerbach, 1929: 176). In subsequent years, the collection of materials continued, and the evidence of various periods also yielded Neolithic finds. In 1885, with the assistance of the East Siberian Department of the Russian Geographical Society, five more flat graves were excavated. Two of them contained incomplete skeletons without burial goods, while two others contained complete skeletons; the deceased were buried in the extended position on their backs with their heads to the west, and were accompanied by stone and bone items, and animal teeth. The most interesting was burial VI, containing parts of a human skeleton, stone and bone artifacts, and a unique set of five figurines carved of elk antler (Fig. 1, 2).

In 1892, at the International Anthropological Congress in Moscow, Ivan Savenkov made a report “On the Neolithic Remains Found in the Yenisei Governorate (Eastern Siberia) on the Banks of the Yenisei River, near the Mouths of the Bazaikha and Chadobets Rivers” and demonstrated his finds, which provoked great interest. The text of the report with the ground plan of burial VI, a drawing, and a photograph of some of the finds were published (Savenkov, 1893) (for its Russian translation, see (Savenkov, 2003)). A delegate to the Congress, Baron de Baye, delighted with the discoveries of Ivan Savenkov, soon made a report about them at the Academy of Sciences in Paris (Baye, 1894). Thus, the finds from Bazaikha became famous in Europe; but Savenkov felt that in his homeland, his discovery remained undervalued (Auerbach, 1929: 181–185). By 1912, he had prepared a detailed manuscript about the Bazaikha site, which remained an archival document (Archive of the Minusinsk Museum of Local History, Inv. 3, D. 124). N.K. Auerbach planned to edit Savenkov’s field

*Finds from the Neolithic burials of Bazaikha are kept in the MAE RAS (coll. No. 1259). In addition, there are materials from deflated areas also containing Neolithic artifacts, including small objects of portable art (coll. No. 234, 274, 275, 277, 280, 282–285, and 2385) (Popova, 1988: 176–177). Finds from deflated areas on the banks of the Bazaikha River are also kept in the Krasnoyarsk Regional Museum of Local History (coll. No. 107, 124, 148, 194, 210, 519, and 625) (Okladnikov, 1957). The manuscripts are stored in the Minusinsk Museum of Local History.



Fig. 1. Ground plan of burial VI at Bazaikha (A) and accompanying goods therefrom (B).

a – humerus and skull with a hole in the temporal area; *b* – pelvis, femurs, and shin bones; *c* – reddish-brown spots; *d*, *e* – bone spear- or dart-heads; *f* – bone dagger (?); *g* – polishing tools; *h* – animal figurines; *i* – various bone tools; *k* – piece of roe-deer antler.
1–4, 15 – stone; 5–14 – bone.

A – after (Savenkov, 1893); B, 1, 3, 5, 6–12, 15 – after FO NA IIMK RAN, Q 393–2; B, 1a, 2, 3a, 4, 5a, 13, 14 – after (Okladnikov, 1957).

journals with appendices containing cross-sections of the site, drawings of the burials, and sketches (1929: 177), but this was not done either.

Without dwelling on specific features of all the burials, we will give a brief description of burial VI by Ivan Savenkov. The surviving remains of the skeleton included the skull, with a hole in the temporal area, the pelvis next to it, and almost all the

leg bones. At a distance of 70–80 cm from the skull, there were three quadrangular polishing tools made of yellow-brown sandstone, a polished axe or a chisel made of stone (gray chert), an end-scraper, an insert bone dagger, various bone tools possibly intended for making stone products, and figurines carved of elk antler: a fragment of a small idol with a bird's beak, an ungulate with an open mouth, a female elk

(with a small hole for a strap), an elk calf, and a horse's head* (Savenkov, 1893: 325–326). Regarding this unique set, Savenkov wrote the following: “The figures of wild animals are remarkable not only for their relative correctness of representation as a whole, but also for the precision of executing various details of the constitution of young and adult animals... These remains of primitive art undoubtedly belonged to hunters” (Ibid.: 328).

A.P. Okladnikov, who reviewed the collections of artifacts from all the burials excavated by Ivan Savenkov, as well as the evidence found in the deflated areas on the banks of the Bazaikha River (some of which could have originated from destroyed burials), identified several more items of portable art (Fig. 2, 6–9) (1957: Fig. 12, 13).

Problem of dating the Bazaikha burials

After analyzing the collection of artifacts he had gathered, Ivan Savenkov came to the following conclusion in the manuscript “Materials on Stone Age sites in the Vicinity of Krasnoyarsk”: “The Bazaikha site can be attributed to the first half of the Neolithic Stone Age, if we note the absence of drilled tools and extremely small share of polished tools. On the other hand, the abundance of arrowheads,

*Ivan Savenkov noted that the horse's head was not executed as skillfully as elk figurines, and suggested that “this animal was less known to the Yenisei aborigines” (1893: 328). In fact, this fragmentary image (Fig. 2, 2) might also have represented an elk, as indicated by distinctive shape of the nose and nostrils; the resemblance to horse resulted from the damage that looks like horse's eye, but the eyes were marked there by bulges high on the forehead, as in the other figurines. A more definitive conclusion can only be made after documentation of the collection.



Fig. 2. Portable art (finds by Ivan Savenkov) from burial VI at Bazaikha (1–5) and other burials, or from surface finds (6–9).

1–5 – antler (bone?); 6–9 – stone (agalmatolite).

1, 2, 3, 4, 5 – after FO NA IIMK RAN, Q 393–1; 1a, 3a, 5a – after RO NA IIMK RAN. F. 1, D. 156, fol. 59; 3b, 4a – after (Okladnikov, 1950); 5b, 6–9 – after (Okladnikov, 1957).

relatively artistic patterns on the shards of ancient clay pots... an amulet—an animal's head—incline us to attribute the site not only to the Neolithic, but even to its end” (Archive of the Minusinsk Museum of Local History. Inv. 3, D. 124, fol. 5; cited after (Vdovin, Makarov, Maizik, 2024: 137)). He was particularly dubious about the copper celt found in one burial. The skeleton's position was no different from those in other burials. Between the knee joints, there was a celt axe; on the thoracic vertebrae, a triangular flint arrowhead; under the leg bones, two end-scrapers and a “figurate fragment”; and on the humerus, an

elongated cylindrical pebble (Savenkov, 1893: 324). Savenkov took into account the fact that evidence from different periods might have become mixed in the conditions of dune sites and sand blowing, and yet in his report at the Congress he designated the age of all the burials as the Final Neolithic–Initial Bronze (Copper) Age (Ibid.: 327). However, in the field journal, it was recorded that the burial with the celt axe was located above those with Neolithic goods (see (Vdovin, Makarov, Maizik, 2024: 137)).

The Neolithic dating of finds from Bazaikha (from burials and surface collections on sand dunes) was later substantiated by A.P. Okladnikov, who analyzed the Neolithic of the Middle Yenisei region in the context of parallels with the evidence from better-studied sites in the Baikal region, the Urals, and the northwest of the USSR (1957). He identified many parallels between the finds from the Yenisei and Baikal regions (categories and types of artifacts, stone type, pottery, portable art, etc.) and came to conclusion “that in the Serovo period (late 4th–3rd millennium BC), the Yenisei tribes were not only in close proximity, but also in close cultural ties with the population of the Baikal region” (Ibid.: 50)*. Many parallels were also found in the evidence of the Kitoy period, which Okladnikov considered to be Late Neolithic, thereby extending the dating of the Yenisei Neolithic to the 3rd–2nd millennium BC (Ibid.: 37). As far as the Bazaikha figurines are concerned, Okladnikov undoubtedly attributed them to the Neolithic and dated them to the 4th–3rd millennium BC (1971: 88–89). He strongly denied the doubts of some scholars regarding the copper (bronze?) celt axe being in a vague connection with the Bazaikha** burials (Okladnikov, 1957: 35). However, this did not put an end to the problem. The doubts remained, from a cautious “the belonging of the above-mentioned sculptures to the Neolithic is not indisputable” (Leontiev, 1978: 102) to a categorical “the facts confirm the correctness of attributing the elk figurines from the Bazaikha burials on the Yenisei to the Initial Bronze Age”

*Notably, S.V. Studzitskaya did not see anything “Serovo-like” in Bazaikha (1987: 347), while according to L.P. Khlobystin, many categories of lithic artifact found in the vicinity of Krasnoyarsk (including those from the Bazaikha burials) cannot be reliably associated with specific cultures (1996: 295).

**Given the assumption that all the burials are contemporaneous and should be dated by the celt axe, is it possible to determine the Early Bronze Age culture within the modern chronological framework of the Middle Yenisei that this complex as a whole could belong to?

(Studzitskaya, 1987: 347). The arguments included not only the notorious celt axe, but also other considerations, such as the “bird-headedness” of the anthropomorphic figurine, as well as technological and iconographic features of elk images compared with portable art of the Bronze Age. Yet in the summary table in the same work, the Bazaikha figurines were attributed to the transitional period from the Neolithic to the Bronze Age (Ibid.: Fig. 137).

Currently, the concept of the development of the Baikal Neolithic has been dramatically revised thanks to radiocarbon dating and the determination of absolute dates. For example, the Kitoy complexes have been singled out as a separate culture and attributed not to the Late, but to the Early Neolithic, with dates of ca 7500–7000 cal BP (see (Berdnikov, 2018)). Without challenging the Baikal parallels noticed by Okladnikov, the dating of the finds from Bazaikha can be shifted to an earlier period. Moreover, over the past years, new sites have been studied in the adjacent territories; new artifacts (including portable art) related to the Neolithic have been discovered, and the dates have been established using the scientific methods (Polyakov, Smirnov, Fribus, 2022: 11–13). From the most recent finds, we can mention a highly artistic artifact from a sanctuary on the Tartas River (Novosibirsk Region)—a pommel carved of elk antler and shaped as an elk’s head, which was dated to the 7th millennium BC (Ranneneoliticheskoye svyatilishche..., 2023: Fig. 68: 67). We believe that this item is quite close to the heads of elk figurines from Bazaikha. At present, this similarity can only be seen on the available photographs, and 3D modeling would allow for the more accurate comparison of their stylistic and technological features.

However, most importantly, the problem of dating the objects of portable art from Bazaikha can now be solved by the radiocarbon method.

Bazaikha figurines and the issue of the “Angara style” in rock art

The same year that the Bazaikha burials were excavated, Ivan Savenkov made a large “excursion” along the banks of the Middle Yenisei River, searching for Stone Age sites and examining locations of rock art (1886). He found many sites with petroglyphs, sketched many compositions, and made descriptions. Later, this evidence formed the basis of his book, “On Ancient Monuments of Fine Art on the Yenisei River” (1910). Naturally, Savenkov immediately noticed the

diversity in the style, technique, and subject matter of the petroglyphs, and therefore became interested in their chronological attribution. Allowing for the possibility of the great antiquity of the petroglyphs, Savenkov insightfully observed the similarity of some images on rocks with Bazaikha figurines: “Based on the general outline of some wild animals, outline of the head, open mouth, and many specific features of drawing, we allow ourselves to express a certainly hypothetical suggestion that the bone figurines of animals that we obtained this year during excavations of the Bazaikha site... may be contemporaneous with the most ancient Tuba, and some Kopeny and Trifonovo petroglyphs” (Savenkov, 1886: 54–55). That book included drawings of the Bazaikha figurines for comparison with the corresponding petroglyphs (Savenkov, 1910: Pl. I, III, IV, VI) (Fig. 3, *a–f*). The conventionality of the sketchy drawings does not make it possible to observe distinctive stylistic features of either the figurines or petroglyphs, but keep in mind that Savenkov had an opportunity to compare the originals. This was probably the first experience for Siberia in dating rock art using stylistic parallels with objects of portable art from the excavated sites. In any case, Savenkov was absolutely right in noting the similarity. It is enough to compare the copies (rubblings) with his sketches of the same compositions (cf. Fig. 3, *b* and *h*, *c* and *g*) and with photographs of the figurines. The “earliest Tuba” petroglyphs are those from the earliest layer of the Shalabolino rock art site, and precisely at this site in the Middle Yenisei region (see (Pyatkin, Martynov, 1985)) we find the greatest number of elk figures, stylistically comparable with those from Bazaikha; there are even anthropomorphic images resembling the Bazaikha ones (Fig. 3, *h*).

In many of his works, Okladnikov described zoological, processing, and artistic features of figurines from Bazaikha in detail (see, e.g., (Okladnikov, 1950: 280–282)). He regarded the evidence from that site to be important, not only for understanding the Yenisei Neolithic as a whole, but also as a basic factor in the chronological attribution of some groups of rock representations in various areas of Siberia: “Along with sculptural elk figures from Bazaikha described above, dated by their connection with the Neolithic artifacts of specific kind, flat images of these animals on the rocks known near the village of Shishkino and Vorobyovo, on the Upper Lena, as well as in a number of places on the Middle Lena, and on the Angara below and above Bratsk—in the area of Dolgy Porog and Kamenny Island—should be regarded as

no less remarkable in their style and age. <...> These images clearly and distinctly stand out from all other Siberian petroglyphs by their special style and age” (Ibid.: 281) (Fig. 4). Okladnikov observed particularly close parallels on the rocks of Kamenny Islands of the Angara River: “Images on the rocks and sculptures from Bazaikha are sometimes almost identical; it seems sometimes that petroglyphs on the stone were pecked by the same hand that carved the sculptural figures from antler” (1971: 89).

The correlation of Bazaikha figurines with a specific group of elk images on the Angara rocks (and, accordingly, the attribution of the latter to the Neolithic) did not raise objections from most scholars. However, then followed the correlation of rock images of these animals in many other regions of Siberia, not with the Bazaikha figurines, but with elk figures in the Angara petroglyphs in general (as if already reliably dated), although not all of them were comparable with the Neolithic portable art of Bazaikha (and not only of that site). Thus, in the process of analyzing the Yenisei rock art, which contains a lot of images of elk and other animals showing remarkable resemblance to the Angara rock representations, the “Angara figurative tradition” (“Angara style”) was identified (Podolsky, 1973; Sher, 1980: 186–190). After that, this term spread to other areas of Siberia, and gradually almost any elk figures, at least in style little resembling the prototypes, began to be attributed to the Angara figurative tradition. This gave rise to discussions about dating the entire array of data, which had become heterogeneous and blurred, and which was united by the concept of the “Angara style”, and individual groups of images within it.

Perhaps the greatest number of problems in this matter was created by incorrect, but by then already traditional, comparison of the elk figures from Bazaikha with the images of these animals on the rocks of the Tom River. In order to prove the Neolithic dating, the elk figure with the lost hind legs at the Tutalskaya rock art site was correlated with an elk calf figurine from Bazaikha, whose hind legs were also lost and whose ears, similar to those appearing on the petroglyph, were added in the accompanying drawing. The elk head at the same site was correlated with the head of the Bazaikha figurine, separated from the body for greater similarity (Okladnikov, Martynov, 1972: Fig. on pp. 181, 183). In fact, numerous elk images on the Tom River rocks are distinguished by their original and recognizable style, and are similar to neither the Bazaikha figurines nor elk images on the Angara River rocks, which were correlated with

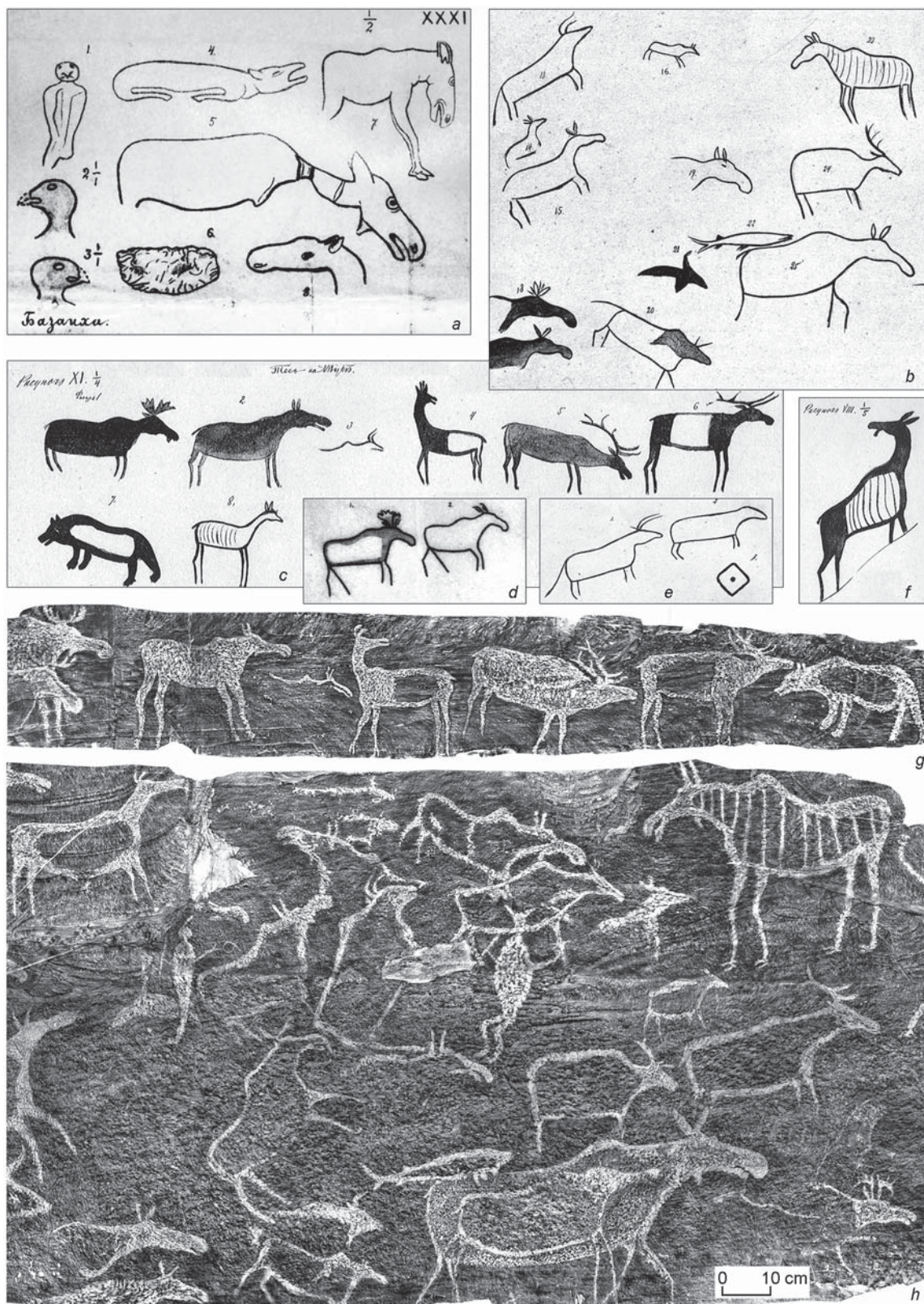


Fig. 3. Finds from Bazaikha and rock art of the Yenisei region.

a – Bazaikha; b, c, f–h – Shalabolino rock art site; d, e – Trifonovo rock art site. a–f – drawings by Ivan Savenkov (after (Savenkov, 1910)); g, h – copies (rubblings) (Museum “Archaeology, Ethnography and Ecology of Siberia” at the Kemerovo State University, coll. 38, No. 4, 103).

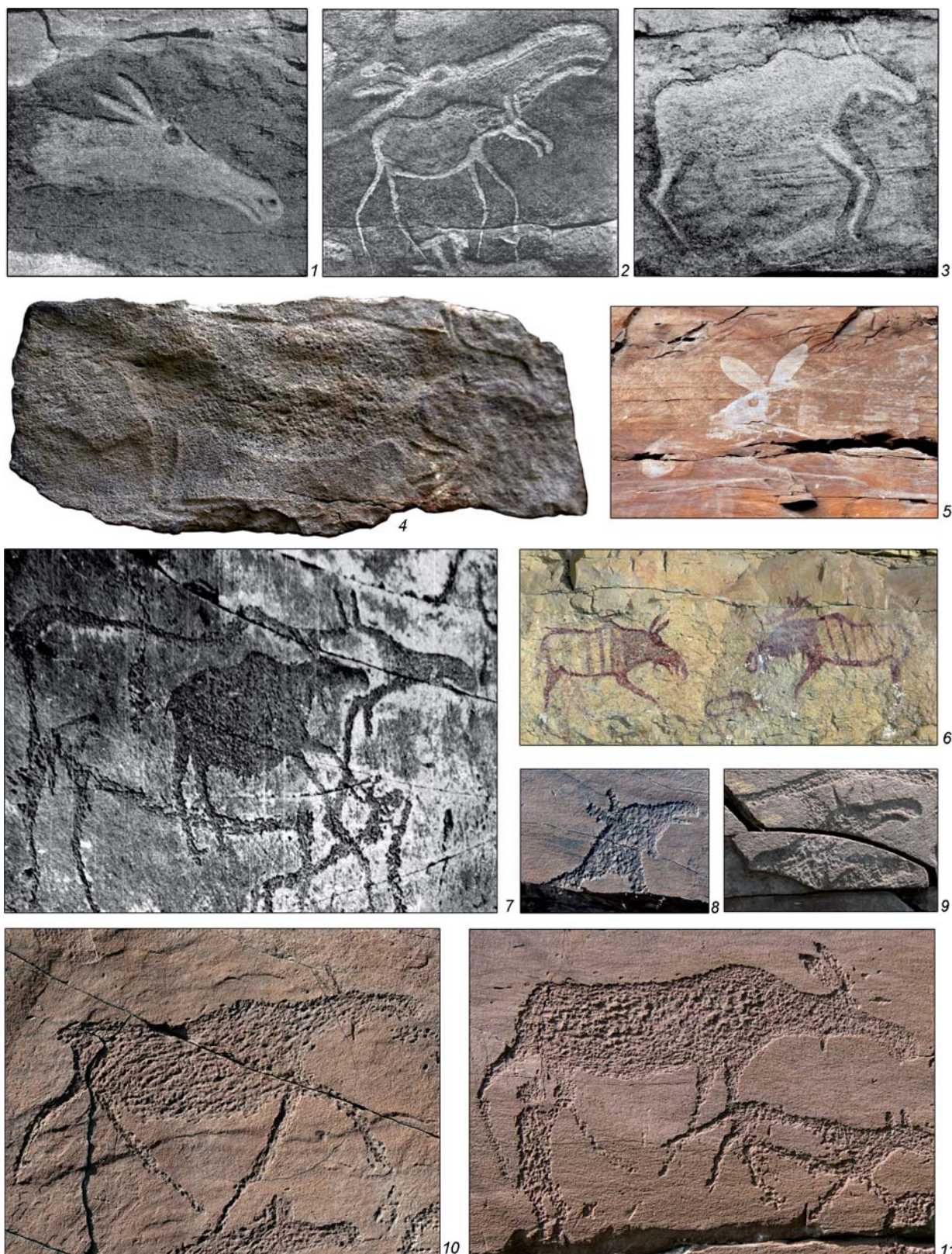


Fig. 4. Siberian rock art comparable in style to finds from Bazaikha.

1–4 – Kamenny Islands, the Angara River; 5 – Shishkino rock art site, Upper Lena region; 6 – Toyon-Ary, Lower Lena region; 7, 8 – Oglakhty, Middle Yenisei region; 9, 10 – Ust-Tuba, Tuba; 11 – Shalabolino rock art site, Tuba.

1–3 – after: (Okladnikov, 1966); 4, 5, 8–11 – photo by E.A. Miklashevich; 6 – photo by N.S. Kiryanov; 7 – after: (Sher, 1980).

them by Okladnikov. Almost all scholars who wrote about the “Angara style” noted the originality of the Tom images. I.V. Kovtun even identified the “Tom” and “Tutalskaya” groups within the Angara figurative tradition and attributed them, along with others, to the Bronze Age (2001: 48–55). Their similarity with rare images of elk in the art of the Okunev culture (Bronze Age) of the Minusinsk Basin, which were also sometimes attributed to the “Angara style”, was also mentioned. However, the Okunev images are also different! Perhaps they, like the Tom ones, demonstrate similarity with some Angara figures of elk with legs spread out in rapid run, but they are definitely not like the Bazaikha figurines, except that both represent elk, and all, naturally, show species features—distinctive muzzle, hump on the back, etc.

The accumulated contradictions have triggered the need to revise the approach to rock art of the Angara tradition. I.A. Ponomareva, who quite rightly pointed out that this concept “remains not entirely clear, carried out a special study on this topic. Images are attributed to the Angara tradition more intuitively than on the basis of specific stylistic features”, and precisely this uncertainty prompts “discussions about chronology, development, and directions of the spread of this tradition” (Ponomareva, 2016: 70, 71). Her study was a successful attempt to “figure out” what the Angara style is (reviewing the points of view, clarifying the area of distribution, establishing internal dynamics of development of the style based on the analysis of palimpsests, etc.). The researcher came to conclusion that “this is an epochal phenomenon with Eastern Siberian roots, and the peak of its development fell to the Late Neolithic” (Ibid.: 77). In addition, the Tom style was finally separated from the Angara style as an independent tradition among the Bronze Age cultures (Ibid.: 77–78). It seems that this is the direction in which research should be continued to revise the concept of the “Angara style” in rock art based on modern concepts and data.

Going back to the collection from Bazaikha, we should say that the comparison of rock representations with portable art in terms of style is not only possible, but is one of the most important methods for indirect dating of rock art. Okladnikov’s correlation of some elk images on the Angara rocks (not all those that were attributed to the “Angara style” by his followers) with the Bazaikha figurines is a brilliant example of application of this method. We would also like to mention the meticulous study of Studzitskaya with comparative analysis of objects of portable art in the Baikal region (and other areas) and rock

representations in the Angara style (1987, 2007). As far as the parallels to the Bazaikha figurines in the rock art of the Yenisei region are concerned, it seems necessary to narrow their circle significantly. Not all elk images in the Yenisei rock art can be correlated with these examples of portable art. In our opinion, the greatest similarity in style appears in the figures from Shalabolino, Oglakhty, Ust-Tuba, and other sites, similar to those shown in Fig. 3, *g*, *h* and 4, 7–11. The elk are depicted in calm poses, not running, not with lean bodies; the position of their necks and heads is similar to that of the Bazaikha figurines; the ears are often pressed back, and the eye, located high on the forehead line close to the ears, is always emphasized. The eyes of the Bazaikha figurines are shown in exactly the same way, but in volume. Actually, some petroglyphs contain a hint of relief in rendering the eye, nostril, and mouth line (see, e.g., Fig. 4, *l*). One of the figures at the Shalabolino rock art site seems to be the most similar to the Bazaikha figurine (see Fig. 4, *ll*).

Conclusions

This article presents the main problems associated with the unique collection of artifacts from Bazaikha, which is of great importance both in terms of studying the Neolithic of the Middle Yenisei region and of attributing some groups of the earliest rock art in this region to the Neolithic. As we see it, the prospects for solving these problems may be associated with research in two areas.

The first area is a comprehensive study of the archaeological collection from Bazaikha, not only from the burials excavated by Ivan Savenkov, but also from rich surface finds. Presently, it is not a problem to apply well-developed methods of documentation and analysis (radiocarbon dating, petrography, traceological analysis, anthropology, etc.). Three-dimensional modeling will serve as a basis for cataloging, and simultaneously will provide great opportunities for stylistic and process analysis of the portable art and for the usual studies of all artifacts. Archival research aimed at searching for documents, deciphering the field journals and manuscripts of Ivan Savenkov, and clarifying information about the context of the finds, is also required.

The second area is a deeper study of the “Angara style” in Siberian rock art, and specifying the content of that term. The imagery usually attributed to the “Angara style” currently constitute an overly

heterogeneous and “blurred” array. Moreover, it has long been obvious that the images included in that definition (various representations by various scholars) belong to various cultural and chronological groups (from the Neolithic to Bronze Age, not to mention various cultures from various areas). It is necessary to substantiate the division of this array into groups in accordance with style, iconography, and other criteria; revise outdated attributions of rock art imagery taking into account new chronological models that have recently appeared, sources for comparative analysis from excavated (that is, dated) sites, and new methods for dating objects of rock art. As far as the Middle Yenisei region is concerned, in addition to the above, it is especially important to update the corpus of sources for the earliest rock art as a whole, which involves field research, redocumentation of the known sites using modern methods, reconstruction of what has been lost based on archival data, etc. (Miklashevich, 2015). Only then will it be possible to define more clearly the features of the “Angara style” in Yenisei art, and to single out the exact group that is definitely similar in style to the figurines from Bazaikha, and, accordingly, to date it in the same way as these figurines.

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Raman Spectroscopy of Rock Art Paintings in the Minusinsk Basin: Testing the Method and Practical Implications

This article presents the use of Raman spectroscopy to test the composition of paint detected in petroglyphs on old red sandstone in the Minusinsk Basin. Because this sandstone is saturated with iron compounds, it is extremely difficult to distinguish components of red paint based on mineral raw materials from those of the rock surface. We elaborated a two-stage technique. First, the composition of the rock surface was analyzed using Raman spectroscopy. Second, the concentration of substances on the surface was assessed using indexes of relative peak intensity in the spectra using statistical methods (Mann-Whitney U-test, principal component analysis). The procedure was tested at three rock art sites in the Minusinsk Basin. The examination of panel 15 at Tepsei I (Krasnoturansky District, Krasnoyarsk Territory) suggests that when the rock is heavily damaged by environmental processes such as ferruginization, oxalate accretions, oxidation and weathering products, the composition of the paint is indistinguishable from that of the substrate. At Oglakhty IV (Bogradsky District, Republic of Khakassia), analysis revealed that local mineral raw materials from metamorphosed sandstone subjected to heat treatment were used. On panels 7–9 in section 1A of Shalabolino (Kuraginsky District, Krasnoyarsk Territory), two paints were used. The lighter color was made of ocher, the outcrops of which in the form of metamorphosed sandstone were found within the boundaries of the site. The darker paint was made from apatite-magnetite ore. In both cases, the mineral raw materials were subjected to heating. This method will be used to study a larger sample of rock art paintings in the Minusinsk Basin.

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

Introduction

Paintings of various chronological periods, from the earliest rock art to the ethnographic period, have been discovered at all key rock art sites of the Minusinsk Basin (the Kavkazskoye, Malye Arbaty, and Shalabolino rock art sites, Tepsei I and Boyary I sites, etc.) (Sher, 1980: 122, 132; Leontiev, Bokovenko, 1985). However, due to relatively poor preservation of images and complexity of their analysis, there have been almost no studies on the composition of their paints (Esin et al., 2014). Difficulties are associated with the rock paintings being located in open complexes that are subjected to significant environmental

influences on their chemical features (Hernanz, Gavira-Vallejo, Ruiz-López, 2006). The composition of the rock substrate whose surface contains the image is a key factor. This factor causes particular difficulties in studying the composition of paints in the representations from the Minusinsk Basin. Most of the images in the region were made with red paint, which usually consists of iron oxides and hydroxides (magnetite, hematite, goethite, etc.). The vast majority of rock surfaces with drawings are composed of red-colored Devonian sandstone containing significant amounts of similar iron compounds (Morozov et al., 2019: Pl. 1; Bábek et al., 2025), which hampers the identification of the components

of the paint and their separation from components of the rock substrate. This problem requires a special approach to analysis and interpretation of data on the composition of pigments.

This study was intended to test the method of Raman spectroscopy for determining the composition of paints in rock representations on old red sandstone in the Minusinsk Basin.

Material and methods

Raman spectroscopy identifies the molecular structure of a sample, and is a qualitative method of analysis (determining the presence of certain substances without assessing their concentration). As a result, a spectrum is formed that horizontally consists of the Raman shift (cm^{-1}) and vertically uses a standard unit to compare the intensity. Substances are identified by interpreting peaks in the spectrum.

The research was carried out using a SPEKTR-M RaPort M532 portable spectrometer (laser wavelength 532 nm, power up to 30 mW, focal length 50–75 mm, entrance slit 20 μm , spectral range of wavenumber readings 140–4000 cm^{-1}). The instrument was controlled and spectra were analyzed using EnSpectr Professional software. The spectra collection time was 180–600 sec.

On each panel studied, several points of the rock surface without traces of paint were analyzed; then, spectra were collected in the areas with paint residues. Depending on the state of the panels, oxalate accretions and natural ferruginization were additionally examined. In total, from 8 to 32 analyses were done on each panel.

The first stage of the Raman spectroscopy data reduction involved the identification of the substances present in the zone under analysis, as well as differences between the rock surface and the painted areas. In the absence of distinctive differences, at the second stage, the data were analyzed using methods of mathematical statistics.

The magnitude of peaks marking specific substances is expressed in standard units in the spectra. Thus, their comparison reveals a relative difference in intensity. The ratio of standard units (the index) shows which of any two peaks is more pronounced in the spectrum and to what degree. For example, if peak 1 has an intensity of 600 standard units and peak 2 has an intensity of 450 standard units, the index of peak 1 to peak 2 is $600/450 = 1.3$ (the first peak is 1.3 times more intense than the second). A similar approach was

used for comparative assessment of the content and structural features of substances (Jorio et al., 2010; Filippov, 2014).

The groups of spectra were compared by peak intensity indexes using the Mann-Whitney U-test. Absence of normal distribution of data in all the cases was confirmed by the Shapiro-Wilk, Anderson-Darling, and Jarque-Bera tests (Kobzar, 2006: 238, 454). Principal component analysis was an additional method given sufficient sample size (at least 30 spec.) (Kosovsky, Adams, Bronte, 2009). Analysis was carried out using the PAST software environment (Hammer, Harper, Ryan, 2001).

The method was tested on material from Shalabolino (section 1A, panels 1, 7–9), Oglakhty IV, and Tepsei I (panel 15). The earliest rock art paintings, those of the Okunev culture, and unidentifiable spots were studied. For better quality, the photographs were processed in the DStretch plug-in (color filtering) (Gunn, Douglas, Whear, 2014).

Study results

The *Shalabolino rock art site* is located in the Kuraginsky District of the Krasnoyarsk Territory, on the bank of the Tuba River. The site is divided into 12 sections (1–8, 1A, 2A, 4A, 8A) where over 500 panels with images were found, numbered from west to east (Uchetnaya karta..., 2010). A large number of paintings were discovered in the southwestern part of the site (Zaika, Solodeinikov, 2018). The survey of the site revealed an ocher outcrop emerging from disintegrated old red sandstone. It contained quartz marked by pronounced peaks of 124, 205, 360, 461, and 1160 cm^{-1} in the spectra, hematite (peaks of 220, 290, 1320 cm^{-1}), and goethite (peaks of 405, 681, and 700 cm^{-1}) (Froment, Tournie, Colomban, 2008: Fig. 2).

In the eastern part of section 1A, a large palimpsest of painted images of the Okunev culture (late 3rd to early 2nd millennium BC) was found. It was located on panels 7–9 on a block of red sandstone divided into three parts. In addition to paintings, carved images of animals and engraved drawings were discovered on the block (Fig. 1, I).

Most of the rock art paintings were located on the middle third of the panel. A.L. Zaika identified two layers of paintings: the early layer—masks without an external contour and a mask with arched “edging” in the middle of the block, and the later layer—cross-shaped masks and signs in the left and central parts (Zaika, Solodeinikov, 2018). The early images were

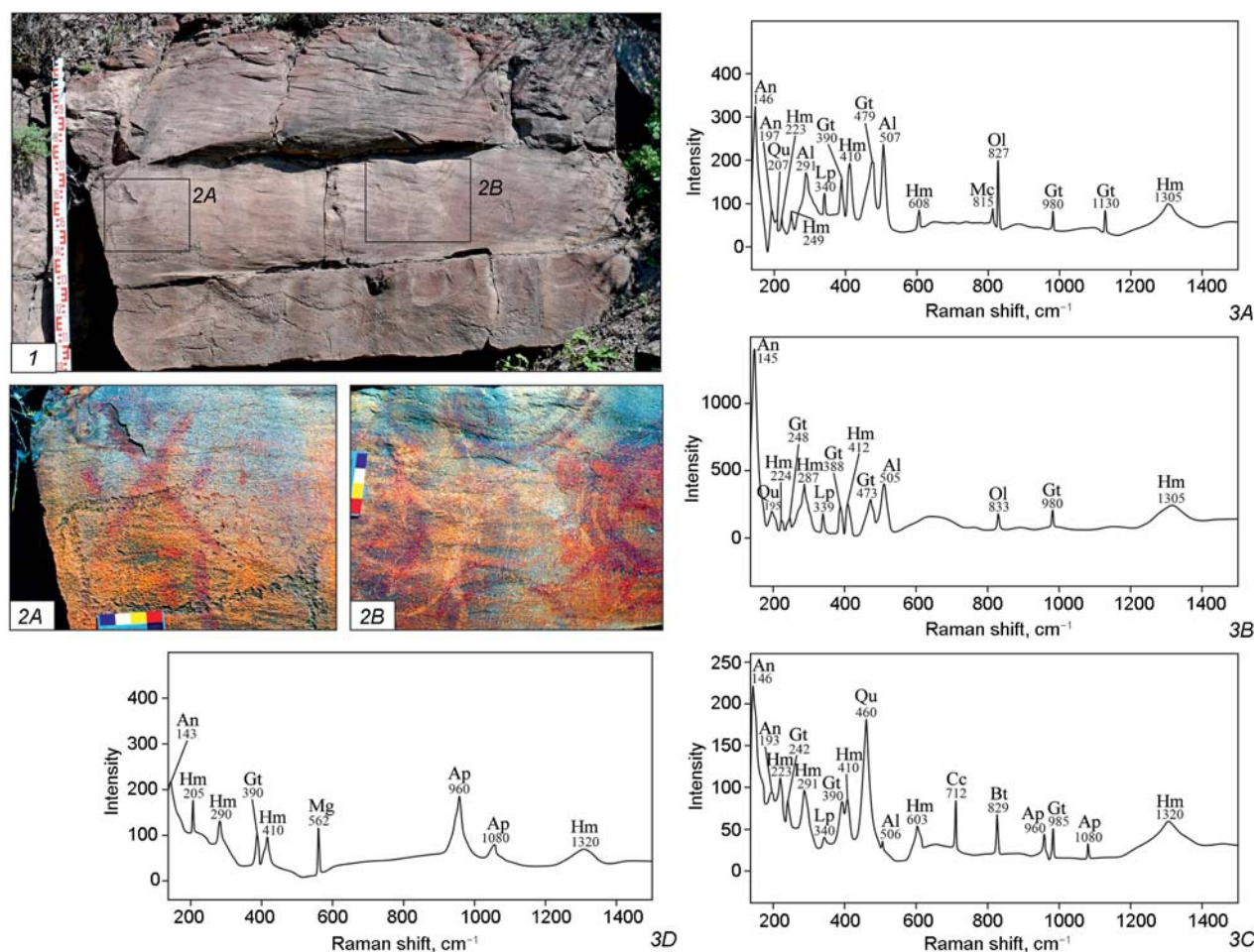


Fig. 1. Results of analysis of painted images from section 1A of the Shalabolino rock art site.

1 – photograph of panels 7–9; 2A, 2B – photographs of sections with painted images after processing with the DStretch plug-in (2A – cross-shaped mask on the left part of the block, 2B – palimpsest in the central part); 3A–3D – Raman spectra (3A – rock surface, 3B – light paint, 3C – dark paint, 3D – ore inclusions). An – anatase, Al – albite, Ap – apatite, Bt – biotite, Hm – hematite, Gt – goethite, Qu – quartz, Cc – calcite, Lp – lepidocrocite, Mg – magnetite, Mc – microcline, Ol – olivine.

colored light red to light brown; the later images ranged from purple-gray to gray-brown (Fig. 1, 2A, 2B).

A total of 44 spectra was obtained: 10 of the rock surface and 34 of coloring substances (17 spectra of light and dark paint). The composition of the rock surface was homogeneous and typical of sandstone (Fig. 1, 3A). Anatase (peaks of 146 and 197 cm⁻¹), albite (291 and 507 cm⁻¹), microcline (815 cm⁻¹), quartz (207 cm⁻¹), and olivine (827 cm⁻¹) were identified. Hematite (223, 249, 410, 608, and 1305 cm⁻¹), goethite (390, 479, 980, and 1130 cm⁻¹), and lepidocrocite (340 cm⁻¹) were also clearly expressed in the spectra (De Faria, Silva, De Oliveira, 1997: 877).

The spectra of areas with light paint also demonstrated the presence of anatase (145 cm⁻¹), albite (505 cm⁻¹), quartz (195 cm⁻¹), and olivine (833 cm⁻¹) (Fig. 1, 3B). Peaks of hematite (224, 287, 412, and

1305 cm⁻¹), goethite (248, 388, 473, and 980 cm⁻¹), and lepidocrocite (339 cm⁻¹) were observed.

The spectra of areas with dark paint were predominantly (11 spectra) distinguished by apatite peaks (960 and 1080 cm⁻¹) (Fig. 1, 3C) (Zhang et al., 2023). In the rest of the areas with dark paint, the same compounds were present, including anatase (146 and 193 cm⁻¹), albite (506 cm⁻¹), quartz (460 cm⁻¹), biotite (829 cm⁻¹), lepidocrocite (340 cm⁻¹), hematite (223, 291, 410, 603, and 1320 cm⁻¹), and goethite (242, 390, and 985 cm⁻¹). Areas contaminated with calcite (712 cm⁻¹) were identified (Donnelly et al., 2017).

The surface with dark paint yielded six spectra of unknown material showing particularly marked peaks of apatite (960 and 1080 cm⁻¹) and containing magnetite (562 cm⁻¹), anatase (143 cm⁻¹), hematite

(205, 290, 410, and 1320 cm^{-1}), and goethite (390 cm^{-1}) (Fig. 1, 3D).

Comparison of the four resulting groups confirmed the increased intensity of the apatite peak in the spectra of dark paint and unknown material as compared with the rock surface and light paint. When comparing the groups (each containing from 6 to 17 spectra) across three indexes (apatite, 960 cm^{-1} to hematite, 290 cm^{-1} ; apatite, 960 cm^{-1} to quartz, 461 cm^{-1} , and apatite, 960 cm^{-1} to albite, 506 cm^{-1}) according to the Mann-Whitney U-criterion, a statistically significant difference was observed (in all the cases, $U < 4$ at $p < 0.004$). The significance criterion p determines the probability of a null hypothesis (in this case, the equality of the samples). If it is less than 0.05, the difference between the groups by a certain feature is considered statistically significant (Kobzar, 2006: 454). The median values of the indexes increased: apatite/hematite from 0.48 (light paint) to 1.31 (unknown material), apatite/quartz

from 0.34 (light paint) to 2.7 (unknown material), and apatite/albite from 0.61 (rock surface) to 4.03 (unknown material).

The magnetite peaks manifested a similar increase in intensity. A statistically significant difference was observed for the indexes of magnetite (562 cm^{-1}) to quartz (461 cm^{-1}) and magnetite (562 cm^{-1}) to albite (506 cm^{-1}) with $U < 18$ and $p < 0.0007$. The median values of the indexes increased: magnesium to quartz from 0.43 (rock surface) to 1.15 (unknown material), and magnesium to albite from 0.65 (rock surface) to 1.7 (unknown material).

The similarity/difference of the groups by the indexes of albite (506 cm^{-1}) to apatite (960 cm^{-1}), quartz (461 cm^{-1}) to apatite (960 cm^{-1}), and quartz (461 cm^{-1}) to magnetite (562 cm^{-1}) was additionally subjected to principal component analysis. This is used to reduce dimensionality of data by constructing new axes forming a plot in which the proximity of units determines their similarity or difference (Fig. 2, 1).

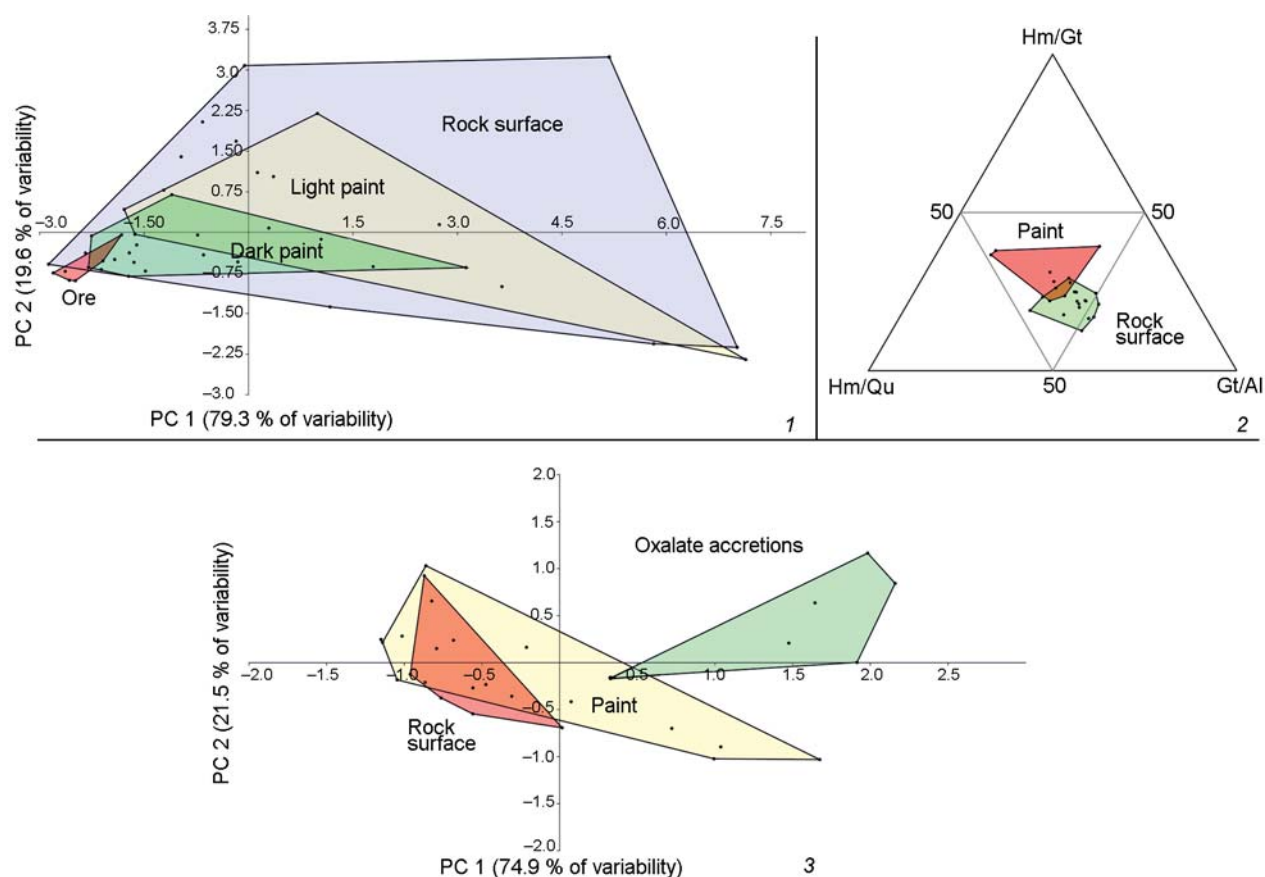


Fig. 2. Results of analysis of the ratio of peak intensities in the spectra of various materials.

1 – spectral distribution plot for panels 7–9 of section 1A at Shalabolino with PC 1 and PC 2 values by the indexes of albite/apatite, quartz/apatite, and quartz/magnetite; 2 – spectral distribution diagram for Oglakhty IV by the indexes of hematite/quartz, hematite/goethite, and goethite/albite; 3 – spectral distribution diagram for panel 15 at Tepsei I site with PC 1 and PC 2 values by the indexes of gypsum/quartz, albite/quartz, and quartz/lepidocrocite.

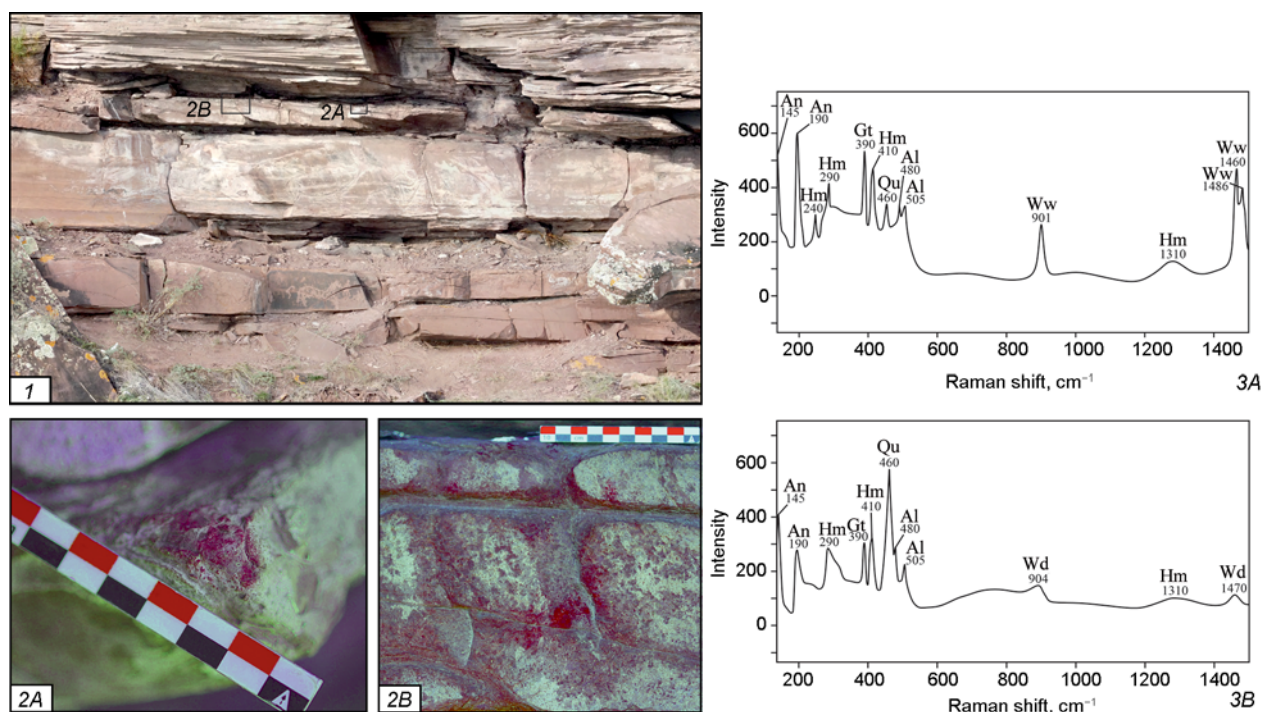


Fig. 3. Results of analysis of painted images from the Oglakhty IV site.

1 – photograph of the area with paint spots; 2A, 2B – photographs of areas with paint after processing with DStretch plug-in (2A – spot, 2B – round symbol); 3A, 3B – Raman spectra (3A – rock surface, 3B – paint). Ww – whewellite, Wd – weddellite. For the rest of the designations, see Fig. 1.

Three variables were considered in the analysis. The samples contained 44 elements, which meets the conditions for using this method (over 30 spec.) (Kosovsky, Adams, Bronte, 2009). Two principal components covered 98.9 % of the sample variability. A gradual change in the indexes was observed moving towards an increase in the intensities of magnetite and apatite (the highest was in the unknown material). The nonparametric multivariate PERMANOVA test was performed for verifying the obtained data and confirmed the difference between the groups ($F = 4.24$, $p = 0.004$).

It can be concluded that the composition of the rock surface and light paint differed from the dark coloring agent and unknown material, revealing an increased content of magnetite and apatite in the latter two.

The light paint could have been obtained from local metamorphosed sandstone, which explains its similarity to the rock surface material. The presence of iron oxides and hydroxides in other outcrops at the site confirms this possibility. The dark paint differed from the local material. The increased apatite content suggests the use of apatite-magnetite ore. In this case, the unknown material with a large amount of apatite

and magnetite consists of inclusions of incompletely processed mineral raw material.

The *Oglakhty IV site* is a part of the Mount Oglakhty rock art complex in the Bogrady District of the Republic of Khakassia. It is located on a steep southwestern slope called “Forty Teeth”, has a length of 4 km, and contains over 260 panels (Miklashevich, 2015). Spots of red paint (Fig. 3, 1)—four non-figurative spots up to 3×2 cm in size and one poorly preserved symbol consisting of a circle with a dot in the middle (Fig. 3, 2A, 2B)—were discovered in its southeastern part (the “first tooth”), above the panels with carved zoomorphic images. Similar circles are known from the art of the Okunev culture (Studitskaya, 1997: Pl. I, 4).

Twenty five spectra were obtained from the site, including 17 of the rock surface and eight of paint. The rock surface had a composition typical of sandstone (Fig. 3, 3A). The spectra revealed peaks of anatase (145 and 190 cm^{-1}), albite (480 and 505 cm^{-1}), quartz (460 cm^{-1}), hematite (240, 290, 410, and 1310 cm^{-1}), and goethite (390 cm^{-1}). A special feature of the rock surface under study was the presence of whewellite (901, 1460, and 1486 cm^{-1}), which was detected in all areas regardless of the presence of

paint and could be interpreted as a metabolic product of microorganisms living in the upper layers of the rock substrate (Hernanz, Gavira-Vallejo, Ruiz-López, 2006: Fig. 7, pp. 1059–1060).

The paint spectra demonstrated a similar composition (Fig. 3, 3B). Anatase (peaks of 145, 190 cm^{-1}), albite (480 and 505 cm^{-1}), and quartz (460 cm^{-1}) were detected. Iron compounds were represented by hematite (peaks of 290, 410, and 1310 cm^{-1}) and goethite (390 cm^{-1}). The presence of calcium oxalate in the form of weddellite was also observed (peaks of 904 and 1470 cm^{-1}) (Ibid.: Fig. 7).

Analysis of the intensity ratio revealed a significant decrease in the power of the goethite peak in the spectra of paint, which was expressed in a statistically significant increase in the hematite (290 cm^{-1}) to goethite (390 cm^{-1}) index ($U = 7$, $p < 0.0001$) from 0.71 (rock surface) to 1.06 (paint), and decrease in the

goethite (390 cm^{-1}) to albite (508 cm^{-1}) index ($U = 33$, $p = 0.04$) from 1.51 to 1.19 (see Fig. 2, 2). No other differences between the groups of spectra were detected.

The paint could have been made from local material similar to the sandstone of the rock surface.

The *Tepsei I* site is a part of the rock art site of “Listvyagovo. Petroglyphs of Tepsei” (Krasnoturansky District, Krasnoyarsk Territory), which includes Tepsei I–VI and Ust-Tuba I–VI. Tepsei I is located on the partially flooded shore of the Krasnoyarsk Reservoir and has at least 50 panels. Panels 1–25 are on higher ground at the northern end of the site. Panel 15 was examined, revealing five images of ungulates painted in red (Fig. 4, 1, 2) (Abolonkova, Solodeinikov, 2021). The panel was covered with whitish oxalate accretions partially concealing the images. A reddish amorphous spot resulting from natural ferruginization was in the upper left part of the panel.

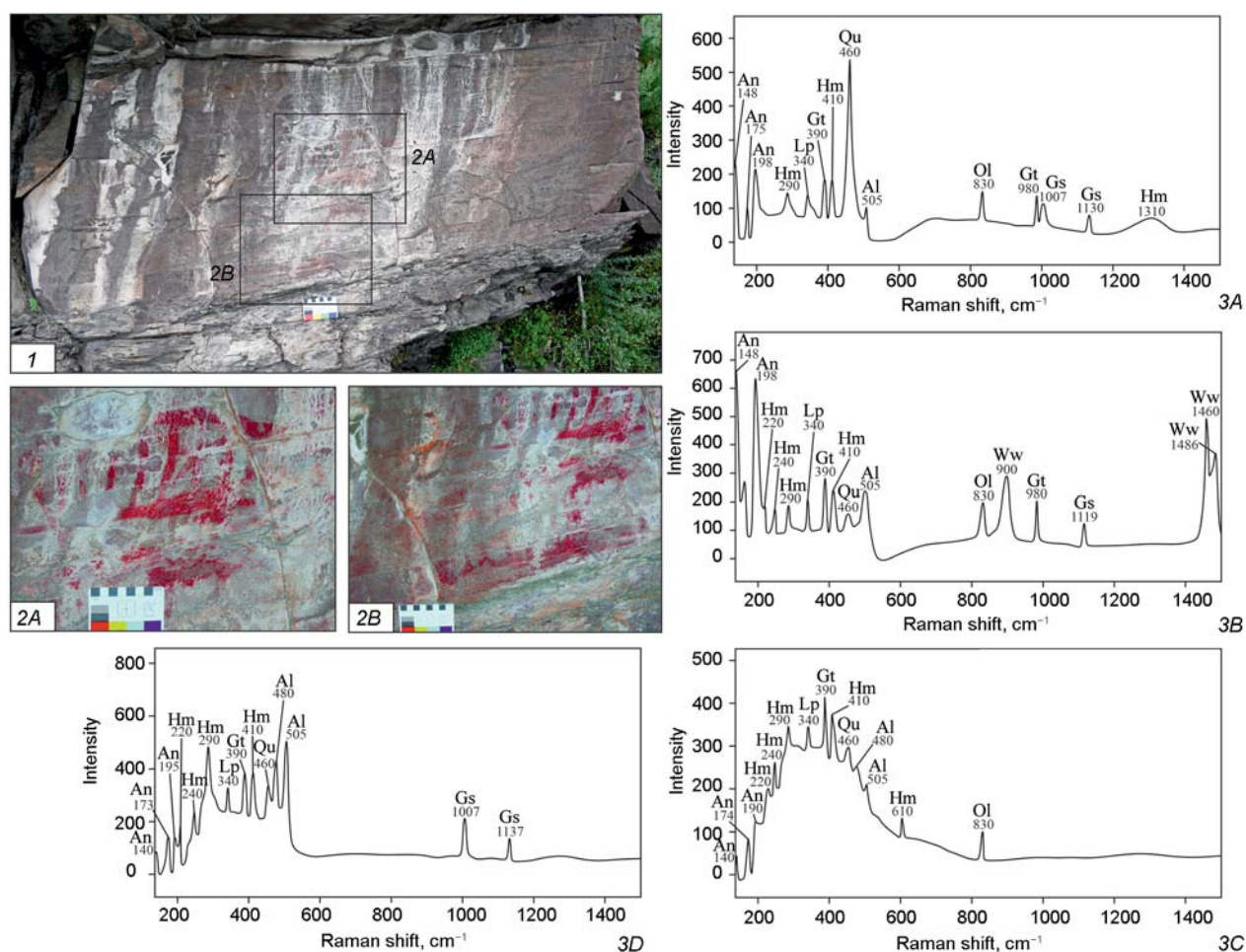


Fig. 4. Results of the analysis of painted images from the Tepsei I site.

1 – photograph of panel 15; 2A, 2B – photographs of painted images after processing with DStretch plug-in (2A – central part of the panel, 2B – lower part); 3A–3D – Raman spectra (3A – rock surface, 3B – oxalate accretion, 3C – natural ferruginization, 3D – paint).

Ww – whewellite, Gs – gypsum. For the rest of the designations, see Fig. 1.

In total, 32 spectra were obtained from the panel, including 15 of the rock surface, six of oxalate accretions, one of natural ferruginization, and 10 of paint. The rock substrate differed from those described earlier by the presence of gypsum (marked by peaks of 1007 and 1130 cm^{-1}), which is a typical product of sandstone disintegration (Fig. 4, 3A) (Ilmi et al., 2022). Otherwise, the spectra of the rock surface were quite typical, manifesting the presence of anatase, albite, quartz, olivine, hematite, goethite, and lepidocrocite. In addition to the sandstone components, oxalate accretions contained whewellite (marked by peaks of 900, 1460, and 1486 cm^{-1}) (Fig. 4, 3B). Natural ferruginization was located outside of the oxalate accretions and areas of sandstone disintegration, so it did not contain gypsum or any forms of calcium oxalates (Fig. 4, 3C). The spectra showed pronounced peaks of hematite (220, 240, 290, 410, and 610 cm^{-1}), goethite (390 cm^{-1}), and lepidocrocite (340 cm^{-1}) (De Faria, Silva, De Oliveira, 1997: 877). Anatase, quartz, albite and olivine were present. Paint spectra from the areas not covered by oxalate accretions demonstrated presence of anatase, quartz, and albite (Fig. 4, 3D). Peaks of hematite (220, 240, 290, and 410 cm^{-1}), goethite (390 cm^{-1}), and lepidocrocite (340 cm^{-1}) were clearly expressed; gypsum was also present (peaks of 1007 and 1137 cm^{-1}).

Comparison between the groups of spectra showed the absence of statistically significant differences between the rock surface and paint. Difference between the coloring agent and surrounding oxalate accretions was more noticeable due to the increased intensity of quartz peaks in the spectra. This pattern was revealed by the indexes of gypsum (1007 cm^{-1}) to quartz (460 cm^{-1}), albite (505 cm^{-1}) to quartz (460 cm^{-1}), and quartz (460 cm^{-1}) to goethite (390 cm^{-1}). The median values of gypsum to quartz decreased from 0.79 (incrustations) to 0.42 (paint), whereas the albite to quartz indexes lessened from 1.69 to 0.3, respectively. This difference was statistically significant (when comparing samples, in the former case $U = 3$, $p = 0.005$; in the latter case $U = 5$, $p = 0.01$). The quartz to goethite index increased from 0.45 to 1.07 ($U = 4$, $p = 0.007$).

To verify this pattern, all the samples were compared using principal component analysis for the following indexes: gypsum (1007 cm^{-1}) to quartz (460 cm^{-1}), albite (505 cm^{-1}) to quartz (460 cm^{-1}), and quartz (460 cm^{-1}) to lepidocrocite (340 cm^{-1}) (see Fig. 2, 3). There were 32 elements in the sample, which corresponded to the conditions for using that method. Principal components 1 and 2 covered

96.4 % of the variability. According to the index values, paint spectra were almost identical to those of the rock surface; a difference was detected only for oxalate accretions.

Verification of the results using the PERMANOVA test confirmed these findings. For three samples (excluding ferruginization), $F = 8.36$, $p = 0.0008$. When comparing the spectra of paint and the rock surface, $F = 0.86$, $p = 0.39$, which shows the absence of differences.

Difference between oxalate accretions from the rock surface and the paint was quite expected. Absence of this difference could indicate, as in other cases considered, similarity of the material. Noteworthy is the presence of two iron hydroxides, strong oxalate accretions, and gypsum, which together suggest the intensive transformation of the rock surface in a humid environment (Alekseev, Alekseeva, 2000; Ilmi et al., 2022). For this reason, the chemical characteristics of the rock surface might have become similar across the entire panel.

Discussion

Analysis of rock art paintings at three sites in the Minusinsk Basin proves this method to be relatively effective. In most cases, the composition of the paint and of the rock surface was very similar, and any regularities could only be revealed by analyzing the ratio of peak intensities (Oglakhty IV, dark and light paints on panels 7–9 of section 1A of the Shalabolino rock art site).

In the context of this study, an exception was panel 15 at Tepsei I, with distinctive differences between the rock surface and paint. The results of analysis were greatly influenced by changes in the chemical features of the panel. The presence of goethite and lepidocrocite indicated oxidation processes involving organic matter (Alekseev, Alekseeva, 2000; Vodyanitsky, 2010: 12–14), which caused the development of oxalate accretions from bacterial activity on the rock surface (Hernanz, Gavira-Vallejo, Ruiz-López, 2006: 1058, 1062). Another evidence of disintegration of the panel was the presence of gypsum formed during sandstone weathering (Ilmi et al., 2022). Natural ferruginization also suggests active oxidation processes. Panel 15 at Tepsei I was subjected to intense chemical exposure, which could have been due to its location directly on the shore of the Krasnoyarsk Reservoir. Relatively good preservation of the rock art paintings probably resulted from oxalate accretions.

In other cases, the method used has made it possible to identify specific features of pigment composition. The light paint on panels 7–9 of section 1A at Shalabolino and Oglakhty IV was made from local mineral raw materials. This is manifested by the compositions of pigments and the rock surface being almost identical, without traces of the significant impact of natural factors as was the case at Tepsei I.

The composition of ocher, which had an outcrop at Shalabolino, was also very typical of ordinary old red sandstone (quartz, hematite, and goethite) (Morozov et al., 2019; Wojcieszak, Wadley, 2019). Similar outcrops of natural mineral pigments were recorded in the area of the Kavkazskoye rock art site, containing large series of painted images of the Early Iron Age (Leontiev, Bokovenko, 1985: 87). The raw material strategy, which implied the use of pigments from local mineral sources for making paints, was common in rock art from the Stone Age (Chalmin, Menu, Vignaud, 2003: 1596; Bu, Cizdziel, Russ, 2013).

Hence, the images of the Okunev culture at Shalabolino and Oglakhty IV were made with paint based on local ocher, which emerged after disintegration of old red sandstone. The composition of individual samples of red pigment from steles at the Okunev burials demonstrates a similar combination of hematite and ocher, with the admixture of quartz and calcite (Esin et al., 2014: 87). The use of mineral raw materials from rock outcrops must have been widespread, but the sample is so far not large enough to make generalizations.

The dark paint on panels 7–9 of section 1A at Shalabolino turned out to be different in composition than the local sandstone. Intense peaks of magnetite and apatite suggest the use of apatite-magnetite ore as a mineral raw material. It is widespread in the Altai-Sayan, including the Kuraginsky District of Krasnoyarsk Territory (the Kazyr group of deposits) (Dolgushin, Pavlov, 1987: 31). Thus, that kind of ore could well have served as an alternative source for the pigment. Notably, A.L. Zaika attributed the images made with dark paint to a later chronological period of the Okunev culture than those painted with pigment based on local raw materials (Zaika, Solodeinikov, 2018).

Judging by iron oxides and hydroxides in the paints, the mineral raw materials used at Shalabolino and Oglakhty IV were subjected to heat treatment. The key difference in the coloring agent at Oglakhty IV was the reduced content of iron

hydroxide. In the dark paint at Shalabolino, magnetite did not appear as much as in unprocessed ore inclusions. Mineral pigments acquire a rich red color from hematite into which iron hydroxides (goethite, magnetite) pass during firing (Nurdini et al., 2022). Heat treatment for increasing color intensity has been observed in reconstructions of paint manufacturing techniques starting from the Upper Paleolithic (Praslov, 1992: 100; Pomiès, Menu, Vignaud, 1999; Nurdini et al., 2022).

Thus, Raman spectroscopy and analysis of relative peak intensities in the spectra have revealed that Okunev images at the Oglakhty IV site and panels 7–9 of section 1A at the Shalabolino rock art site were created with paint made of local ocher (disintegrated old red sandstone) or apatite-magnetite ore subjected to heat treatment.

Conclusions

Research of ancient paints on old red sandstone is significantly complicated by its composition. Presence of iron compounds in the rock hampers identification of pigments, and makes the sandstone itself the accessible raw material for pigments, which are then almost identical in composition to the rock substrate.

Raman spectroscopy, supplemented by analysis of the ratio of peak intensities, makes it possible to identify specific features of paint composition. The exception is situations when the rock surface is heavily contaminated.

Our findings show that the paint used on panels 7–9 of section 1A at Shalabolino and Oglakhty IV was made of local raw materials, which underwent heat treatment to enhance their color. Firing was also applied in the manufacture of dark pigment based on apatite-magnetite ore, which is observed in some masks at the Shalabolino rock art site.

The method tested in this research can be further used in rock art studies in the Minusinsk Basin and other regions.

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From Questions to Inferences: Methodological Principles for the Use of Experimental Archaeology in Rock Art Research

This article addresses the challenge of employing experimental archaeology in rock art research and proposes a structured framework to guide the design and implementation of experiments in this field. It distinguishes between experimental and experiential archaeology, establishing that proper experiments require solid theoretical foundations and rigorous hypothesis testing. A comprehensive methodological approach is then presented, involving strict control of variables and a sequential strategy of pilot, systematic, and replicative experiments that balances internal and external validity. Building on an illustrative example concerning how paint composition influences the long-term preservation of rock art images, the article demonstrates how experimental procedures can conform to standards of scientific rigor, reproducibility, and archaeological relevance. In this context, it addresses aspects related to the connection between laboratory-controlled conditions and field validation, which are crucial to ensure both analytical robustness and contextual applicability. Furthermore, it discusses the inferential constraints of experimental data, emphasizing that these function as heuristic tools for evaluating hypothesis plausibility rather than providing absolute certainties. Ultimately, the proposed approach can be applied to explore a wide range of research questions concerning the production, preservation, and degradation of rock art, enhancing our capacity to formulate empirically grounded inferences about prehistoric artistic practices.

Keywords: Experimental archaeology, rock art, experimental design, hypothesis testing, taphonomy, methodology.

Introduction

Experimental archaeology is a research method that enables the testing of hypotheses put forward to explain different processes linked to the formation of the archaeological record and the production and use of material culture in the past through the development of controlled experiments in the present. Although its origins date back to the 19th century, the consolidation of this methodological approach took place from the 1950s onward, driven by the need for verification mechanisms that extended beyond direct observation

and the mere documentation of archaeological evidence (Morgado, Baena Preysler, García Gonzalez, 2011). Under these circumstances, experimental archaeology emerged as a promising alternative. Rooted in the principle of uniformitarianism—which assumes that the fundamental natural laws governing past processes remain unchanged, even if their specific rates and manifestations may vary over time (Shea, 1982; Domínguez-Rodrigo, 2008)—it facilitated the construction of inferential bridges between actualistic processes and past phenomena, providing a structured framework for refining theoretical models

and archaeological interpretations (Millson, 2010; Nami, 2011).

Since then, rock art researchers have employed this experimental approach to study paintings and engravings across different chronologies and geographic regions worldwide, with most investigations focusing on identifying the binders used in paint recipes and the techniques and tools employed to produce the images (see, e.g., (Johnson, 1957; Pérez-Seoane, 1988; Clottes, Menu, Walter, 1990; Lorblanchet, 1991; Álvarez, Fiore, 1995; Álvarez et al., 2001; Santos da Rosa, 2012, 2019a; Prinsloo et al., 2013; Santos da Rosa et al., 2014; Santos da Rosa, Fiore, Viñas, 2023, 2024; Vergara, Troncoso, 2015; López-Montalvo et al., 2017; Zotkina, Kovalev, 2019; Zotkina, Davydov, 2022; Landino et al., 2023)). More recently, experimentation has expanded beyond these aspects to include studies on the taphonomic processes affecting the preservation of rock art in diverse environment (see, e.g., (Lacannete et al., 2013; Ozán et al., 2023)), the cognitive abilities of the image-makers (Rivero et al., 2024), and even cultural practices related to the use of sites where these representations are found (Santos da Rosa et al., 2023b, 2025).

However, despite the significant advances achieved through the application of experimental archaeology in rock art research, a critical assessment of the literature on this topic reveals that many investigations still exhibit substantial methodological issues, which undermine the robustness and analytical scope of their findings. More specifically, it is possible to observe that practical experiences are still mistakenly referred to as experiments, and that many experimental programs continue to be conceived without being structured around a solid and testable hypothesis. Furthermore, numerous studies lack a clear definition and strict control of variables, as well as proper consideration of confounding factors that may influence the resulting outcomes. Similarly, many are conducted without an experimental design that ensures methodical data collection, reproducibility, and the structured progression of the research in a logically coherent manner. Finally, there are also cases in which the limits of the inferences drawn from experimental data are significantly overlooked, leading to the construction of biased interpretations regarding archaeological record and the prehistoric artistic practices.

In light of these methodological challenges, this article addresses the differences between experimental and experiential archaeology and proposes a structured framework for the use of

experiments in rock art research, emphasizing the principles that should guide their design and implementation. Building on an illustrative example on how the composition of paint recipes influences the long-term preservation of rock art paintings, it outlines the main methodological steps necessary to ensure that both the experimental procedures and the results they generate conform to standards of scientific rigor, reproducibility, and archaeological relevance. Subsequently, it discusses the inferential constraints of experimental data and concludes by highlighting the broader implications of this methodological approach for advancing experimental research in rock art studies.

“All that glitters is not gold”: distinguishing experimental from experiential archaeology

Observing a system or process in operation is a fundamental step toward understanding its mechanisms and effects (Montgomery, 2017: 1). Therefore, the best means of investigating the processes involved in, for example, the production of rock art, would be to travel back in time and observe prehistoric people creating images on the walls of caves and shelters. Given the unfortunate impossibility of such a task, analyzing the material outcomes of these processes and attempting to reconstruct them in the present—following a logic of reverse engineering—emerges as the most effective method to investigating their working principles and operational sequences (Santos da Rosa, 2019b). However, just as not everything that appears valuable at first glance actually is—as cautioned by the famous aphorism immortalized by William Shakespeare in *The Merchant of Venice* (ca 1596–1599)—not all attempts at replication can be considered an experiment. In this sense, a crucial distinction must be made between “experimental archaeology” and “experiential archaeology”, since although both involve a practical engagement with past processes, their epistemological foundations and goals differ in a highly significant way (Outram, 2008; Morgado, Baena Preysler, 2011).

Experimental archaeology follows a structured and scientific approach, aimed at generating knowledge about the past through the rigorous testing of hypotheses via controlled and replicable experiments. Thus, a proper experiment is grounded in a solid theoretical framework, well-defined research questions that drive the investigation, and explicitly stated assumptions

and premises that underpin hypothesis formulation (Domínguez-Rodrigo, 2008; Eren et al., 2016). Furthermore, its design allows for the manipulation of relevant variables and the identification of potential relationships between specific outcomes and their causal factors (Lin, Rezek, Dibble, 2018). To ensure reproducibility and independent verification, the entire process is systematically documented in an objective and preferably quantitative manner, with detailed records of all experimental conditions under which the results were obtained (Cuartero, Alcaraz-Castaño, Baena, 2016; Magnani et al., 2019a). Finally, the procedure is carried out with a clear awareness of the inferential limitations of experimental data and the epistemic constraints inherent to their use in the construction of archaeological interpretations (Eren, Meltzer, 2024).

In contrast, experiential archaeology is anchored in a reconstructive, demonstrative, and practice-based perspective, primarily focused on obtaining a material result that closely resembles a given archaeological reference (Reynolds, 1999; Morgado, Baena Preysler, 2011). Consequently, it is not committed to hypothesis testing to generate scientific knowledge, nor does it aim to systematically comprehend and replicate the processes that underpinned material culture production in the past. Furthermore, variable control is typically minimal or entirely absent, as there is no concern with identifying causal relationships between specific factors and their corresponding outcomes. Additionally, when documentation is conducted, it tends to be superficial and predominantly qualitative, which precludes the procedure from being reproduced and independently validated. For this reason, although these activities can be valuable as practical exercises for skill acquisition (e.g., training the gestures required to paint with hair brushes on a rock surface), they do not generate data with the methodological rigor necessary to support inferences about the past or contribute to the advancement of archaeological knowledge (Baena, 1997).

In the field of rock art, this means that the mere act of producing a painting or engraving with technological features similar to those of an image found at an archaeological site—regardless of the artist's level of skill or the degree of fidelity between the replica and the original motif—is not sufficient for such an activity to be classified as experimental archaeology. After all, as stated by Eren et al. (2016: 106), equating this type of experience with scientific experimentation would be like equating the act of pouring chemicals into a beaker with a chemistry experiment.

Research questions, assumptions, premises and hypotheses: the epistemological basis of archaeological experiments

The design and implementation of an archaeological experiment must begin with the formulation of specific research questions and the explicit definition of assumptions and premises that will provide the foundation for the hypotheses to be tested. This is a crucial step, as the validity of experimental results depends not only on the precision of data collection but also on the internal coherence, transparency, and justification of the theoretical framework underpinning the study (Domínguez-Rodrigo, 2008: 68). Clearly articulating these elements ensures that the research remains methodologically rigorous, empirically testable, and analytically robust, preventing biases that could lead to circular reasoning—a logical flaw in which conclusions are drawn based on assumptions that the experiment itself is supposed to test—or to the mere reinforcement of pre-existing interpretations—an issue in which experimental designs and analytical choices inherently favor expected outcomes, thereby limiting the potential to critically evaluate alternative explanations (Lin, Rezek, Dibble, 2018).

In this context, research questions set the direction of the experimental study, shaping its design and defining the scope of inquiry. Accordingly, they should be well-defined and precisely formulated to ensure alignment with the study's objectives. However, translating these questions into experimental investigation requires a set of underlying assumptions that establish the conditions necessary for obtaining reliable results. Such assumptions function as auxiliary propositions within a broader theoretical framework—they are not directly tested in the context of the experiment, but they are necessary for ensuring the validity of the experimental outcomes and the soundness of the inferences drawn from them (Hempel, 1966: 22–25). These include, for example, suppositions about the accuracy of measurement instruments, the adequacy of experimental conditions, and the validity of conceptual categories used in analysis. Thus, if any of these assumptions prove incorrect or inadequate, the reliability of experimental results may be compromised, leading to misleading conclusions or distorted interpretations.

While assumptions establish the background conditions for conducting experiments, they do not, by themselves, constitute the logical foundation

for hypothesis formulation. This role is fulfilled by premises—explicit propositions that support the reasoning behind hypotheses, ensuring logical coherence and empirical relevance (Popper, 1959: 37–38). Therefore, premises link research questions to hypotheses by drawing on prior knowledge to structure testable claims; without them, experiments risk producing results with limited explanatory power and unreliable conclusions (Domínguez-Rodrigo, 2008: 68).

Once defined, premises serve as the basis for formulating hypotheses—specific, testable propositions that can be empirically evaluated through experimentation (Cohen, Nagel, 1934: 200–201). In this sense, while premises establish the rationale for selecting variables and methodologies, hypotheses structure how these variables interact and what outcomes can be expected under controlled conditions. More precisely, hypotheses operationalize premises into testable statements, allowing for the support or rejection of the theoretical expectations they entail. Support, in this context, does not imply that a hypothesis is “true”, but rather that its underlying principles remain usable until rejected and replaced by a more robust explanatory framework (Outram, 2008: 1).

To demonstrate how research questions, assumptions, premises, and hypotheses are articulated within a structured line of reasoning, let us consider an illustrative experimental scenario. In this regard, it is worth noting that, although the example presented below is simplified for explanatory purposes, it draws directly on the methodological principles that underpin a series of experimental programs developed as part of the TaphArt project, funded by the Marie Skłodowska-Curie Actions (MSCA) and aimed at investigating how taphonomic processes affect the preservation of rock art. This approach—including the narrative style adopted—was chosen to facilitate a generalizable and pedagogically oriented presentation of the experimental reasoning discussed herein.

With this in mind, imagine a group of researchers seeking to understand why some prehistoric paintings—created around 2000 years BP in shelters dispersed throughout a mountainous region of southern Africa—exhibit a high level of preservation, while others, found within the same study area, display significant deterioration due to the effects of taphonomic processes such as humidity fluctuations, temperature variation, and ultraviolet radiation (for details on the impact of these taphonomic

agents on rock art, see (Chalmin, Hœrlé, Reiche, 2017)). Faced with this scenario, the researchers formulated the following research question: *What factors influence the long-term preservation of rock art paintings exposed to the impact of taphonomic processes in the study area?* To address this question, they evaluated possible explanations and formulated the following hypothesis: *The long-term preservation of rock paintings in the study area is influenced by the composition of the paint recipes used in their production.*

This hypothesis relies on a set of underlying assumptions that must hold for it to be meaningfully tested, including—but not limited to—the following:

(a) The paintings were produced within a relatively narrow chronological timeframe, ensuring that differences in preservation are not merely the result of age-related degradation;

(b) The images were painted following a consistent technical process across the study area, making it possible to consider that variations in preservation are primarily influenced by paint composition rather than differences in paint application techniques, paint layer thickness, or other production-related factors;

(c) The taphonomic processes affecting the rock art sites operate in consistent and comparable ways across the study area, allowing observed differences in preservation to be reasonably attributed to the properties of the paint rather than to environmental variability;

(d) The rock substrate in all shelters under study is homogeneous in terms of geological and topographic characteristics, thereby reducing the likelihood that variation in the substrate has significantly influenced the degree of preservation of the paintings.

These assumptions are essential to evaluate whether the composition of the paint recipes is indeed the key factor influencing the long-term preservation of the images. However, if any of them prove incorrect—for example, if there is a significant variability in the intensity with which taphonomic processes affect each site—the validity of the hypothesis might be undermined, and alternative explanations must be considered.

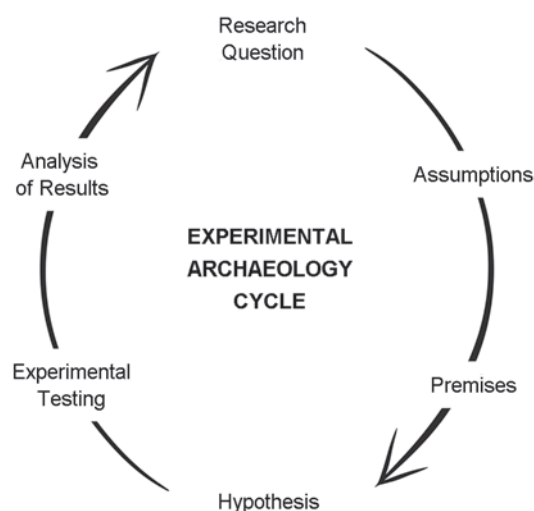
Moreover, to justify testing this particular hypothesis over other possible explanations, the researchers relied on the following premise: *The long-term preservation of rock art paintings tends to be influenced by the chemical and physical properties of their pigment-binder compositions—which interact differentially with environmental*

factors over time—as evidenced by studies conducted in other regions (see, e.g., (Chalmin, Hœrlé, Reiche, 2017; Ozán et al., 2023)). This premise, grounded in prior knowledge and empirical observations, connects the research question to the hypothesis and provides a logical foundation for testing whether the composition of the paint recipes plays a significant role in the preservation of the images.

Thus, the research question identified the problem; the assumptions defined the conditions necessary for testing the proposed explanation; the premise provided justification for considering paint composition as a key factor in the preservation of the paintings; and the hypothesis presented a specific, testable proposition. Building on this hypothesis, the researchers considered various approaches to testing it and concluded that the most effective method would be to apply different paint recipes to a rock substrate and subject them to the impact of taphonomic processes under controlled conditions in a climate chamber—a device designed to perform accelerated ageing experiments that simulate the impact of environmental factors such as temperature, humidity, and light exposure through programmable cycles that reproduce weathering in a controlled and repeatable manner (for an overview of the use of climate chambers, see (Jelle, 2012); for an application of this equipment in rock art research, see (Lacanette et al., 2013)). If the hypothesis were supported, certain experimental paintings would exhibit greater long-term preservation. If rejected, experimental paintings would show no significant differences in preservation—suggesting that paint composition is not the primary factor influencing preservation—and a new hypothesis would need to be formulated, following the same structured approach (see *Figure*).

Defining experimental variables: a fundamental step for control and valid inference

To operationalize the experiment and rigorously test the formulated hypothesis, the researchers first needed to define the variables that structured the investigation. These included independent variables, which correspond to factors systematically manipulated by the experimenter; dependent variables, which represent the measurable outcomes influenced by these manipulations; and control variables, which are maintained constant throughout the experiment to prevent external factors from distorting the results (Montgomery, 2017: 14–17).



Schematic representation of the Experimental Archaeology Cycle, illustrating the sequential process from proposing a research question to defining assumptions, establishing premises, and formulating a hypothesis, followed by experimental testing and the analysis of results, which refine archaeological interpretations and guide further investigation.

Accordingly, both the independent variables and their range—the set of levels in which they would be manipulated during the experiment—had to be selected based on their relevance to testing the hypothesis and their compatibility with archaeological scenarios (Cuartero, Alcaraz-Castaño, Baena, 2016). Similarly, the dependent variables had to be chosen for their relevance to understanding the process under study. However, their definition also needed to account for their sensitivity to variations in the independent variables, their measurability, their capacity to generate data pertinent to archaeological interpretation, and their potential for replication to support broader scientific validation. In this context, to ensure the reliability of the results, the effects of the independent variables on the dependent variables had to be assessed using adequate measurement protocols, given that a lack of resolution or precision in the control system may obscure subtle variations in the experimental outcomes and limit the ability to discern and evaluate causal relationships.

Within the framework of our illustrative example, the researchers took the study's premise into account and selected the type of pigment and the type of binder as the independent variables, as these were expected to influence paint preservation and could be systematically manipulated in the experiment. Given the need to explore variability in preservation

patterns while maintaining experimental feasibility, they considered that a range composed of three levels for each independent variable would be appropriate. Next, drawing on data from archaeometric analyses conducted on rock art paintings in the study area—along with the need to incorporate materials with distinct chemical and structural properties—the researchers selected iron oxide, manganese oxide, and charcoal as pigments. Likewise, considering ethnographic accounts indicating that native communities who lived in the region centuries ago mixed pigments with water, blood, and egg white, they selected these substances as binders. In this way, it was possible to ensure that the raw materials used were not only representative within the scope of the experiment but also aligned with the archaeological context relevant to the study. On the other hand, considering the relevant parameters for their selection, the researchers defined the degree of reduction in the painted layer thickness, the extent of painted surface loss, the density of cracks in the painted area, and the rate of color fading as dependent variables, which would be measured with precision through micro-photogrammetry and using a portable 3D microscope. Moreover, to minimize interference from external factors, they defined the geologic and topographic features of the rock substrate as control variables, which would be kept constant throughout the experiment.

Bridging the laboratory and the field: a structured approach to conducting experiments

After defining the experimental variables, the researchers needed to determine the strategy that would guide the practical execution of the experiments. To ensure that the data generated would be both reliable and archaeologically meaningful, this strategy had to balance the levels of internal and external validity in the experimental research. Finding this balance is particularly crucial in archaeological experimentation, where achieving high internal validity—ensuring that observed effects are genuinely attributable to the manipulated variables—can sometimes come at the expense of external validity, which refers to the extent to which experimental results can be extrapolated to archaeological contexts (Lycett, Eren, 2013: 525–526; Eren et al., 2016: 106). As noted by A. Mesoudi (2011: 161), tightly controlled experimental conditions enhance internal

validity by isolating causal relationships and reducing confounding factors, but they often lack contextual realism. Conversely, increasing external validity by replicating conditions closer to those of the past improves contextual relevance but reduces experimental control, making it more challenging to determine causality with precision.

This methodological trade-off underscores the need for a structured approach that integrates controlled testing with real-world applicability, ensuring both reliability and interpretative depth. Therefore, the researchers decided to employ a strategy based on the sequential execution of pilot, systematic, and replicative experiments, which complement one another by addressing different methodological scales, levels of control, and analytical perspectives.

Pilot experiments. As an initial step in implementing this structured and sequential approach, the researchers adopted an exploratory perspective and conducted a small-scale version of the systematic experiment planned, with the aim of confirming whether the methods chosen for its execution were indeed the most suitable and identifying potential technical and logistical difficulties that could compromise its feasibility. To carry out this procedure, they prepared a set of experimental paintings whose resistance to weathering they intended to test, and subjected them to accelerated ageing, while seeking to determine both the number of ageing cycles and the climate chamber settings that would best replicate the long-term impact of the humidity fluctuations, the temperature variation, and the ultraviolet radiation affecting the archaeological paintings in the study area.

During this pilot experiment, the researchers had the opportunity to practice the technical procedures that would later be systematically performed to test the hypothesis, ensuring that they were both functional and replicable. Simultaneously, they assessed the suitability of the selected raw materials and gained familiarity with their behavior, verifying that these performed consistently under the experimental conditions. Through this procedure, they also verified whether the selected independent, dependent, and control variables were appropriate for understanding the specificities of the phenomenon under investigation and for detecting potential sources of variability that could act as confounding factors. Additionally, the scholars evaluated the efficiency and suitability of the measurement methods and, when necessary, calibrated them to ensure the accuracy and precision of the experimental data. They then analyzed the level of variability in the effects observed on the dependent

variables and obtained a preliminary estimate of the experimental error, which allowed them to determine the sample size and the number of replicates required to obtain robust results—from both a qualitative and quantitative perspective.

After completing the pilot experiment, the researchers realized that although this procedure allows for a certain degree of operational flexibility (i.e. it does not need to be conducted in a strictly systematic and highly controlled manner), it should not be mistaken for an experiential archaeology activity, as its development is directly linked to the objectives of the experimental research and the hypothesis under investigation. Confident that the methodological framework had been sufficiently refined, they then decided to advance to the next phase of the study.

Systematic experiments. Unlike pilot experiments, systematic experiments are characterized by a high level of control and a strong emphasis on internal validity and reproducibility. Their fundamental objective is to investigate causal relationships between independent and dependent variables under strictly controlled conditions. Hence, they must be conducted with rigor and methodological precision. Aware of this principle, the researchers in our example decided to employ a full-factorial design, in which each independent variable was systematically manipulated at all its predefined levels, in conjunction with every level of the other independent variables included in the study (Anderson, Whitcomb, 2015). This does not imply that all variables were altered simultaneously in a single instance, but rather that all possible combinations of their levels were tested throughout the experiment. As a result, it became possible to identify not only the main effect of each independent variable but also the effects generated by their interactions, leading to a comprehensive understanding of their influence on the dependent variables.

Following this approach, the researchers carefully combined the three levels of the previously selected independent variables—type of pigment (iron oxide, manganese oxide, charcoal) and type of binder (water, blood, egg white)—to construct a 3×3 matrix comprising nine distinct paint recipes. Subsequently, to ensure a precise comparison between samples, each recipe was used to paint three identical 1×1 cm² squares on 10×10 cm rocky supports. Nevertheless, just as the experimental paintings were about to be placed in the climate chamber, the researchers recalled that, to ensure the reliability of the results and the identification of clear trends in the outcomes, the use of a full-factorial design must be complemented

by multiple replicates. Thus, considering the degree of variation in the effects observed in the dependent variables during the pilot experiments, a decision was made to produce a total of 27 samples (three replicates for each paint recipe) and 81 painted squares (see *Table*).

After detailed documentation of the samples through micro-photogrammetry and 3D digital microscopy, these were subjected to accelerated ageing through 360 six-hour cycles designed to simulate the effect of the taphonomic processes across the four seasons of the year. Although humidity, temperature, and UV radiation varied simultaneously during these cycles, the variation was strictly controlled, repeatable, and uniformly applied to all samples. This ensured that each painted square was exposed to exactly the same environmental conditions, allowing differences in preservation to be confidently attributed to the paint composition rather than to uneven environmental fluctuations. Moreover, to prevent uncontrolled sources of variation from affecting the data, the arrangement of the samples within the chamber was randomized, meaning their placement was determined by chance rather than following a fixed pattern.

Just as before the accelerated ageing, every 30 cycles the dependent variables were assessed following the measurement protocol to determine the extent to which different paint recipes influenced the preservation of the painted squares. Based on the data obtained at the end of the experiment, the researchers developed a statistical model using multivariate regression analysis to evaluate the causal relationship

Experimental matrix corresponding to the full-factorial design applied in the illustrative study

Recipes	Pigments	Binders	Number of samples	Number of painted squares
1	Iron oxide	Water	3	9
2	Iron oxide	Blood	3	9
3	Iron oxide	Egg white	3	9
4	Manganese oxide	Water	3	9
5	Manganese oxide	Blood	3	9
6	Manganese oxide	Egg white	3	9
7	Charcoal	Water	3	9
8	Charcoal	Blood	3	9
9	Charcoal	Egg white	3	9
<i>Total</i>			27	81

between independent and dependent variables and to quantify the association between paint composition and degradation patterns. This procedure revealed that paint recipes containing iron oxide or manganese oxide mixed with egg white exhibited significantly higher resistance to surface loss, color fading, reduction in layer thickness, and crack formation. Those recipes that contained charcoal and water showed the greatest deterioration rates across all these variables. The remaining recipes displayed varying degrees of degradation. Notably, these results were only possible due to the rigorous control of variables implemented in the experiment. Because each pigment and binder combination was tested under identical environmental conditions—while all other factors were held constant—it was possible to isolate the specific effect of paint composition on the observed degradation patterns. Moreover, the use of a full-factorial design enabled the detection of interaction effects, such as cases in which the influence of a particular pigment varied depending on the binder with which it was combined.

In a subsequent stage, a traceological comparison between the experimental samples and archaeological paintings (rock art images) was carried out. Based on the identification of diagnostic micro- and macro-scale degradation patterns associated with the dependent variables, meaningful correspondences were revealed, which reinforced the relevance of the experimental data as a proxy for understanding the causal relationship between paint composition and degradation patterns. However, given the high level of control employed in this systematic experiment, the researchers recognized that the results, while robust under controlled conditions, still required validation in more complex and dynamic environments. For this reason, further experimentation was deemed necessary to evaluate whether the degradation patterns would persist under natural taphonomic conditions and could potentially be extrapolated to the archaeological context.

Replicative experiments. To validate the results obtained through the systematic procedures, the researchers implemented a replicative experiment to assess whether the patterns identified in the laboratory would also be observed when experimental samples were exposed for extended periods to naturally occurring taphonomic processes. Importantly, the research program developed in this illustrative example could not have relied on this type of experiment alone, since replicative experiments are not designed to establish causality but rather to test the robustness

of previously identified patterns under less controlled and more variable conditions (Skibo, 1992; Outram, 2008). Any degradation observed solely in natural settings would remain open to multiple interpretations, making it difficult to determine with confidence which factors were responsible for the observed outcomes. Therefore, the systematic phase was not only crucial for testing the hypothesis, but also indispensable for building the analytical baseline necessary for external validation.

In the replicative experiment, the researchers recreated the 3×3 matrix of paint recipes, maintaining the same combinations of pigments and binders, with three replicates for each combination. However, instead of painting standardized squares on uniform rocky supports, each paint recipe was used to create three identical rock art motifs on the walls of an experimental shelter—characterized by geological, topographic, and microclimatic conditions similar to those of the rock art sites—where a portable meteorological station was installed to monitor local environmental variables throughout the duration of the experiment. To maintain consistency with the previous phase of the study, the 81 images were randomly distributed across the shelter to minimize potential biases related to microtopographic and microenvironmental variation.

At this stage of the research, a long-term perspective was adopted, with quarterly documentation of the experimental paintings over an initial period of five years, using the same measurement protocol employed in the systematic experiments. Although this timeframe is not directly comparable to the millennia that have passed since the creation of the archaeological images, nor does it allow for the observation of degradation processes on the same scale, it was deemed sufficient to evaluate whether the different paint recipes exhibited consistent preservation patterns under natural taphonomic conditions, particularly in relation to the reduction in painted layer thickness, the extent of painted surface loss, the density of cracks in the painted area, and the rate of color fading.

Over the course of multiple visits to the shelter, micro- and macroscopic analysis revealed that the patterns emerging in the experimental paintings closely mirrored those identified in the systematic experiments, reinforcing the external validity of the findings and supporting their interpretative applicability to the archaeological context. In this sense, the differential transformation of the painted surfaces under real environmental conditions provided

compelling evidence that the relationships between paint composition and preservation—originally established in the laboratory—retained their empirical relevance when tested in the field.

From experimentation to interpretation: the inferential limits of experimental results

Building upon the patterns documented through laboratory and field experiments, the researchers proceeded to compare these results with traceological features observed on actual rock art panels, concluding that the evidence supported the hypothesis that the composition of the paint recipes played a key role in the long-term preservation of the paintings in the study area. Despite the significance of this finding, the reader may feel somewhat disappointed by the fact that, even after all the time, effort, and resources invested in designing and conducting the experimental study, the researchers obtained data that supported the hypothesis but did not arrive at a definitive answer that would allow them to prove it in an absolute and indisputable manner. Yet, this very sense of disappointment is not only expected but necessary, as it sets the stage for the discussion of a foundational principle: experimental archaeology does not operate in terms of absolute certainties but rather within a framework of interpretative plausibility and probabilistic reasoning (Nami, 2011: 38).

In this sense, given that any experiment addressing the formation of the archaeological record or the production and use of material culture in the past is designed with a limited number of variables that approximate a controlled and simplified version of reality, the resulting data come with inherent limitations that constrain the scope of the interpretations they can support (Morgado, Baena Preysler, 2011). Thus, instead of providing definitive conclusions, experimental results function as heuristic tools for evaluating the plausibility of hypotheses, refining interpretative models, and delineating the conditions under which certain processes could have occurred.

Moreover, it is essential to acknowledge that, even when experimental data display patterns closely resembling those observed in archaeological sites and materials, such correspondence does not fully eliminate the possibility of equifinality, as unknown alternative processes could have led to similar outcomes (Baena, 1997). For this reason, Eren and Meltzer (2024: 3)

emphasize that one of the greatest mistakes experimental archaeologists can make is being overly confident in the inferential power of their experiments. According to these scholars, we must learn to accept the notion that inferences derived from archaeological experiments, much like those in archaeology more broadly, are inherently constrained and always provisional. After all, beyond the issue of equifinality, no experiment is perfect, truly comprehensive, or ultimately conclusive (Ibid.: 7).

These considerations do not imply a pessimistic or skeptical view of experimental archaeology. On the contrary, recognizing these limitations and exercising caution when making inferences and drawing conclusions is a sign of the methodological maturity the field has developed over the past decades, and reflects its commitment to scientific rigor and the continuous refinement (Eren et al., 2016). Moreover, as underscored by Magnani et al. (2019b: 808), this constructive process of self-criticism is crucial to ensuring that this valuable methodological approach is applied properly and does not risk being reduced to a form of pseudo-scientific practice.

Conclusions

Despite the growing contributions of experimental archaeology to rock art research, its application in this field still faces significant methodological challenges, which hinder its full potential as a tool for testing propositions related to the production of images and the formation of the prehistoric artistic record. In response to these issues, this article proposed a structured framework based on the appropriate articulation of research questions, assumptions, premises, and hypotheses, the rigorous control of variables, and the sequential development of pilot, systematic, and replicative experiments. Although methodologically structured, this model remains versatile and can be applied to a wide range of research questions. In this sense, it is worth emphasizing that the replicative phase does not always require a long-term perspective such as that adopted in the illustrative example, which was specifically designed to address taphonomic processes. Santos da Rosa et al. (2024), for instance, conducted an experimental study aimed at identifying the paint application tools used in the production of Levantine rock art in eastern Spain. In that case, the replicative experiments were conducted over a short period of time and served to validate the results of the systematic experiments by

testing whether the tools identified as most efficient for painting simple standardized shapes would also perform effectively when used to produce complex full-scale replicas of Levantine motifs, thereby allowing the researchers to evaluate the technical performance of each tool under conditions resembling the original painting context.

Therefore, this approach helps to ensure that experimental research in rock art achieves the critical balance between internal and external validity, generating data that are analytically robust, replicable, and archaeologically relevant. Moreover, it provides a solid foundation for the development of epistemological bridges between the paintings and engravings that persist in the present and the complex processes through which they were created and transformed in the past, which significantly enhances our capacity to investigate them and to formulate empirically grounded inferences about the prehistoric artistic practices.

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The Origin of Anatomically Modern Humans in China

Genetic, skeletal, and archaeological studies alike demonstrate that anatomically modern humans originated ~200–150 ka BP in Africa, and this finding cannot be questioned. Over the last 4–5 decades, however, human fossils with undoubtedly modern skeletal markers, dating to 120–40 ka BP, have been discovered in China and Southeast Asia, suggesting that those territories, too, may have been part of the region where *H. s. sapiens* arose convergently on the basis of *H. erectus*. An important fact supporting this hypothesis is that a new taxon, Denisovan (informally *H. s. denisovan*), was established on the basis of the genetic analysis of a bone sample from a phalanx of the fifth finger of a 9–12-year-old girl from Denisova Cave. Also, genetic studies show that all three taxa, African anatomically modern humans, European Neanderthals, and Central Asian Denisovans, had interbred and produced fertile offspring, implying that all these taxa formed an open genetic system with processes such as admixture and assimilation, suggestive of a single species. Based on this conclusion, the following scenario of the origin of *H. sapiens sapiens* can be proposed: 80–60 ka BP anatomically modern migrants engaged in such processes with *H. s. neanderthalensis* in Europe, Denisovans in Central Asia, and early anatomically modern descendants of *H. erectus* (informally *H. s. orientalis*) in East and Southeast Asia. The key role in the origin of *H. s. sapiens*, then, was played by migrants from Africa (informally *H. s. africanensis*), who were engaged in interbreeding and assimilation with *H. s. neanderthalensis*, *H. s. orientalis*, and *H. s. denisovan*.

Keywords: *H. erectus*, Neanderthals, Denisovans, early anatomically modern humans, pebble-flake industry, Paleolithic, Pleistocene, assimilation.

Introduction

Currently, two main alternative hypotheses on the origin of anatomically modern humans are being discussed. According to the first (African Eve) hypothesis, based on the results of genetic and archaeological studies, early modern humans originated around 200–150 thousand years ago in Africa. Proponents of this hypothesis believe that ca 80–60 ka BP, or perhaps earlier, modern humans started expanding over Eurasia replacing the indigenous population—archaic hominins—or partially mixing with them (Stringer, Andrews, 1988; and others). The second hypothesis (multiregional human evolution) suggests the origin of

modern humans in Africa; it implies that anatomically modern humans could have also originated in Eurasia populated by *H. erectus*, in the course of divergence, adaptation to special environmental conditions, and genetic drift (Wolpoff, Wu, Throne, 1984; Wolpoff, 1989, 1992; Wolpoff, Caspari, 1996; and others).

There are also other hypotheses. One of these suggests that the dispersal of modern humans over Eurasia resulted in the interbreeding with indigenous population rather than the replacement of locals by migrants; this process could have been long-lasting and widespread (Smith, 1992a, b; Smith, Hutchinson, Janković, 2012; Smith et al., 2017). A compromise hypothesis was proposed by Chinese

anthropologists and archaeologists; the idea is based on the anthropological remains discovered in China that show well-defined modern morphological markers and date back to the first half of the Upper Pleistocene. Researchers admit the possibility of the origin of early modern humans in China in the course of the evolution of *H. erectus* and gene exchange with western populations (Wu Xinzhi, 2004, 2006; Gao et al., 2010).

All the proposed hypotheses on the origin of modern humans share certain provisions. The main is the provision on the origin of the earliest modern humans in Africa, from where they expanded to Eurasia. The discovery of a new taxon (Denisovans) and the data of paleogenetic studies of the remains of *H. s. neanderthalensis* provide the grounds to propose a slightly different scenario for the origin of *H. sapiens sapiens*.

Genetic studies have shown that early modern humans from Africa, Neanderthals, and Denisovans interbred and gave birth to fertile offspring. This is confirmed by the fact that nowadays the entire human population (non-Africans) retains 1–2 % of the Neanderthal genetic heritage, and some modern populations of Southeast Asia up to 5–6 % of the Denisovan genome. Interbreeding occurred between Denisovans and Neanderthals, too. The remains of a girl (Denisova 11), whose father was a Denisovan and mother was a Neanderthal, were recovered from Denisova Cave (Slon et al., 2018). Consequently, all the three taxa—African early modern humans, Neanderthals, and Denisovans—formed an open genetic system; they could exchange genes, and it was not an interspecific but intraspecific assimilation (Derevianko, 2019).

At the next stage of the evolution of genus *Homo*, in the chronological range of 200–100 ka BP, three taxa were formed in Africa and Eurasia at a huge distance from one another, with an open genetic system and a capability to exchange genes. This inference gives the reason to assert that during the almost 3-million-year long evolution of *Homo*, all the species that were identified by anthropologists retained their open genetic system and the capability to assimilate (Derevianko, 2019, 2022).

Thus, the long phylogenetic development of the genus *Homo* in Africa and Eurasia followed the sapient line of human evolution; the development was determined by three features: open genetic system and capability of hominins to interbreed; natural and sexual selection; fluctuations of environmental conditions in the Pleistocene and the necessity to subsist in new environmental settings. The sapient evolutionary

trend, which forms the basis of the morphological and cognitive development of the *Homo* clade, distinguishes humans from the entire animal world.

The analytical findings on the issues of evolution of the genus *Homo* show that in the Late Early and the first half of the Middle Pleistocene in Africa and Eurasia human evolution occurred along the sapient lineage: these territories could have been populated by *H. erectus*, *H. heidelbergensis/rhodesiensis*, and *H. antecessor* (late European *H. erectus*), forming the ancestral basis for modern humans in Africa, Neanderthals in Europe, and Denisovans in Central Asia. In the Middle Pleistocene in China, a new taxon, informally named *H. s. orientalis*, evolved convergently on the ancestral basis of *H. erectus*.

Dispersal of *H. erectus* over the territory of China in the Early and the first half of the Middle Pleistocene

Physical anthropologists have identified certain common basic features for all *H. erectus*: small brain capacity (on average, about 900 cm³)*, low cranial vault, absent mental protuberance, pronounced frontal torus, and others. The eastern and southeastern populations of *H. erectus* diverged due to adaptation to other environmental settings and natural selection. These populations differed in certain morphological features from European and African populations. Some anthropologists distinguish them into a separate group, *Homo erectus* *senso stricto*. Others do not exclude the possibility of dividing a single taxon into two categories: African and Asian *H. erectus* (Andrews, 1984; Stringer, 1984; Wood, 1984; and others).

Homo erectus of South and Southeast Asia form a single species together with European and African *H. erectus*, but owing to their divergence and habitation in different environmental settings, each of these groups, during the Early and Middle Pleistocene, retained both ancestral (plesiomorphic) and evolutionarily acquired (apomorphic) traits (Andrews, 1984; Stringer, 1984; Turner, Chamberlain, 1989; Bräuer, 1990, 2008; Bräuer, Mbua, 1992; Rightmire, 1998a, b; 2001; Wood, 1994; and others). *H. erectus* of East and Southeast Asia, which formed a group somewhat different from that of western populations, were separated from one another by a distance of about 4–5 thousand km

**H. erectus* species is characterized by a wide range of cranial capacity, ranging from 600 to 1251 ml (Rightmire, 2004).

and in time, and lived in different environmental conditions; as a result, they had not only common but also some distinctive morphological features (Weidenreich, 1941, 1943, 1946, 1947a–c; Howells, 1980; Santa Luca, 1980; Rightmire, 1993, 1998b; and others). Some researchers distinguish subspecies among the East Asian population of *H. erectus* (Howells, 1980; and others): for example, *H. erectus erectus* (early Indonesian forms) and *H. erectus pekinensis* (Chinese). However, the distinction of subspecies or demes among the East Asian *H. erectus* population (Howell, 1999) is hardly sufficiently justified.

Archaeological evidence suggests that *H. erectus* dispersed over the China territory as early as 1.7–1.6 Ma BP. However, some available data suggest the possible emergence of hominins in this area prior to 2 million years ago. The Renzidong site in Anhui Province is dated to 2.0–2.4 Ma BP (Han, Jin, Wei, 1999), the age of the Danangou site in Hebei Province is 3 million years old (Tang, Chen W.Y., Chen C., 2000). The majority of researchers do not consider these localities as human habitation sites, and the items found there as “lithic artifacts”. Noteworthy are the stone tools found in a stratigraphic sequence in the vicinity to the village of Shangchen, 4 km north of Gongwangling (Zhu Z. et al., 2018). Researchers have no doubt that this site contains lithic artifacts, but the preliminary estimate of its age—2.1 million years—requires further research.

In China, the earliest paleoanthropological remains and stone tools were discovered at the Longgupo site near Mount Wushan. However, the issues concerning the stratigraphic sequence, the availability of processed tools, and the age estimations of the site are still debatable. The taxonomic affiliation of the Longgupo fossil is debated, too.

Huang Wanbo and colleagues initially classified the paleoanthropological finds from the Longgupo site as a new subspecies of *H. erectus*/*H. erectus wushanensis* (Huang Wanbo, Fan Qiren, Gu Yumin, 1991). In the course of further research, Huang Wanbo and his colleagues decided that the mandible of Wushan man was older than that of *H. erectus*, shared certain features with the lower jaw of *H. habilis* and *H. ergaster*, and the stone tools are close to the Oldowan industry. Other researchers classified this fossil as *H. indeterminate*, believing that the fossil shared some common features with *H. habilis* and *H. ergaster* (Huang Wanbo et al., 1995; Wood, Turner, 1995). There is an alternative point of view, according to which this find belongs to *Paleopithecus* (Etler, Zhou, 1998; Etler, Grummer, Wolpoff, 2001).

The issues of dating this locality are controversial, too. Based on paleomagnetic data, layers 7 and 8, in which the teeth were found, have been attributed to the Oldowan episode (1.96–1.78 Ma BP). For layer 4, dates of 750 ka BP and 1.02 ± 0.12 Ma BP were generated on the deer tooth (Huang Wanbo et al., 1995; Chen Tiemei, 2004).

The Yuanmou site, discovered in the early 1970s in the vicinity of the village of Shangnaban, 5 km southeast of the county town of Yuanmou in Yunnan Province, is considered equally problematic (Jia Lanpo, 1989; Zhang Xinyong, Zhou Guoxing, 1978; Zhou Guoxing, Hu Chengzhi, 1979; Ji Hongxiang, Li Yanxian, 1979). Two upper incisors were found at the site. In 1984, the diaphysis of the tibia of a young female individual was found in the same area. Zhou Guoxing, Huang Wanbo, Di Huang (1991), Wu Rukang (1990) and his colleagues (Wu Rukang et al., 1999) expressed doubts about the attribution of this bone to an *Archanthropus*. Later, at the University of California, Zhou Guoxing conducted a comparative study of the Yuanmou tibia with fossils of *Australopithecus afarensis*, *H. habilis*, *H. ergaster*, *H. erectus*, and *H. sapiens*, and came to the conclusion on the closest similarity of the fossil under study to KNM-ER-1500 (Zhou Guoxing, 2004; Zhu R.X. et al., 2008). According to Zhou Guoxing, the paleoanthropological finds from Yuanmou represent to the earliest *H. erectus* in China. The age estimations of these fossils arouse debate. Some scholars provide the dates of 1.7 ± 0.1 Ma BP (Li Pu, Jian Fang, 1984) and 1.6 ± 0.1 Ma BP (Cheng Guoliang, Li Suling, 1977). There is a paleomagnetic date of about 1.7 Ma BP (Zhu R.X. et al., 2008). Other researchers suggested that the Yuanmou fossil should be associated with the Middle Pleistocene (Aigner, 1981). F.C. Howell attributed these finds to the Middle Pleistocene (1986: 460). Reiterated paleomagnetic and lithostratigraphic studies have shown that the archaeological and anthropological finds are no older than 700 thousand years (Hyodo et al., 2002).

In Lantian County, Shaanxi Province, in the north of China, quite a number of Paleolithic sites were discovered in the mid-1960s, of which 27 were attributed to the Middle Pleistocene. Among them, the two sites with paleoanthropological finds: Gongwangling, 16 km from Lantian, and Chenjiawo, 11 km northwest of this city, approximately 35 km from Xi'an, were subjected to the most profound studies. The distance between the sites is approximately 21 km. Both are located on the Gongwangling Uplands in the northern foothills of the Qinling Range,

in the Baihe River basin, a tributary of the Weihe, which flows into the Yellow River.

In the vicinity to the village of Chenjiawo, a well-preserved mandible of an elderly woman was discovered at the foot of the red loam layer. Wu Rukang (Woo Ju-kang, 1964) pointed out its morphological similarity to the mandibles of *Sinanthropus* from Zhoukoudian 1 cave. The bones of an elephant, tiger, red wolf, wild boar, sika deer, small rodents, and other animals were recovered from the same lithological horizon with the mandible. In terms of faunal composition, the site is close to the lower horizons of Zhoukoudian 1 and 13.

Particularly important hominin remains—a skull cap, a large part of the maxilla with two teeth, and several small bone fragments—were found at Gongwangling.

Wu Rukang (Woo Ju-kang, 1964, 1966) and his colleagues (Wu R., Wu X., 1999) analyzed the paleoanthropological finds from Lantian and inferred that the age of the *Archanthropus* was over 30 years, the brain case was extremely small—about 780 cm³. According to Wu Rukang, the jaw from Chenjiawo and the skull from Gongwangling belonged to the same species as *Sinanthropus* and Javan *Pithecanthropus*, but showed different subspecific features; the scientist designated the new finds as *H. erectus lantianensis*.

The age of the Lantian remains controversial. The Gongwangling site is considered the oldest, and the site of Chenjiawo is younger. The majority of researchers believed that these sites fall within the chronological range from 600 ka to 1 Ma BP, the age of the jaw from Chenjiawo was approximately 650 thousand years, and the Gongwangling skull was 750–800 thousand years old (Ma Xinghua, Qian Fang, 1978; Ma Xinghua et al., 1978). However, other scientists attributed the finds from Gongwangling to the period of about 1 Ma BP, and those from Chenjiawo to 530 ka BP (Wu Xinzhi, Wang Linghong, 1985). The results of subsequent paleomagnetic studies, supported by data from the analyses of loess-soil sequences and faunal remains, made it possible to date the most ancient culture-bearing horizon, containing Lantian *Homo erectus* fossils and stone tools, to within 1 Ma BP (An, Ho, 1989). The emergence of bifacial technology in China can also be attributed to that period.

In 1979, on the top of a cape overlooking the Hanshui River, a tributary of the Yangtze, 40 km from the city of Yunxian in Hubei Province, a local resident found a fragment of an elephant tusk in the course of agricultural work. In 1989, the curator of the Yunxian

Museum dug a test pit at this place and discovered a well-preserved *Archanthropus* skull in limestone breccia under the arable land. In the 1990s, Chinese scientists have conducted field research at that place for several years.

From 1999 to 2002, the materials from the Yunxian site were studied jointly by Chinese scientists and researchers of the Prehistory Laboratory of the National Museum of Natural History and other scientific centers of France, under the direction of Professor A. de Lumley (Le site..., 2008). Two well-preserved human skulls, stone tools, and various Lower Pleistocene faunal remains were recovered from this site. Layer 3, which contained the skulls, was dated through various techniques within the range of 984–780 ka BP and attributed to the Santa Rosa episode of the Matuyama Chron of the reverse polarity. The age of the skulls is 936 thousand years (Ibid.).

The Yunxian skulls were identified as belonging to *H. erectus*, but given certain specific features, these *Archanthropes* were classified as the *H. erectus yunxianensis* subspecies (Li Tianyuan et al., 1994; Li Tianyuan, Ai Dan, Feng Xiaobo, 1996). French and Chinese scientists re-examined the skulls and compared them with other paleoanthropological remains (Le site..., 2008). They came to the following conclusions: the skulls belonged to a male and a female; the brain cases were 1152 and 1123 cm³, respectively, which is greater than the value of *H. erectus* from Sangiran, close to the upper values of *H. erectus* from Zhoukoudian, and corresponds to the average values of the well-developed Asian *H. erectus* and European *H. heidelbergensis* (Ibid.).

The researchers compared the Yunxian skulls with the skulls of *Archanthropes*, *Paleoanthropes*, and *H. sapiens sapiens*, and inferred that the Yunxian hominins differed both from ancient forms (*H. habilis/rudolfensis*, *H. georgicus*, *H. ergaster*) and from younger ones (*H. neanderthalensis*, *H. s. sapiens*). They belonged to a polyform group that lived 1.0–0.3 Ma BP. It is difficult to distinguish particular types with common features in the group. The greatest spatio-temporal proximity was traced between the Yunxian fossils and the Lantian remains. In addition, the Yunxian hominins fall within a wide range of Eurasian *H. erectus* and *H. heidelbergensis*, but possess specific features that make them recognizable among all the others. However, the grounds to distinguish Yunxian man as a separate subspecies are insufficient (Ibid.).

The fossils from Zhoukoudian Cave are of great importance for establishing the continuity in the

evolutionary development of *H. erectus* in China in the Middle Pleistocene. The remains of more than 45 hominins were found: 6 skulls, 12 skull fragments, 12 mandible parts, 157 teeth (73 individual), and about 14 postcranial fragments. Fossils and stone tools were found in layers 1–11 and 13 of the cave (Black, 1927a, b; 1932; 1933; Zhang Senshui, 1985, 1989; Jia Lanpo, 1980). Anthropological remains were most often recovered from cultural layers containing stone tools, ash, and charcoal fragments.

The fossils from Zhoukoudian Cave are unique: cranial and postcranial remains of individuals of various ages were found in a single site (at least 20 % of the fossils belonged to adolescents). The anthropological finds were recovered from cultural layers that were accumulated in the range of 400–450 ka BP (layer 2 is dated to 221 ± 84 BP, and layer 12 to 669 ± 84 BP). The anthropological finds were studied by many experts in physical anthropology; the research results have been presented in a large number of publications, including monographs.

The most informative comparative material in addressing the issue of continuity in the evolution of *H. erectus* are cranial fragments, which have been studied for about 90 years (Black, 1927a, b; 1933; Dubois, 1933; Ariens-Kappers, 1934; Weidenreich, 1941, 1943, 1946, 1947a–c; Ariens-Kappers, Bouman, 1939; Broadfield et al., 2001; Holloway, Broadfield, Yuan, 2004; Wu Xijie, Schepartz, Liu, 2009; Wu Xijie, Schepartz, Norton, 2010; and others).

The cave yielded six human skulls: Zhoukoudian V was found in layer 3, Zhoukoudian II, X, XI, and XII in layer 8/9, and Zhoukoudian III in layer 11 (Lin, 2004). The dates derived for these fossils aroused significant disagreement. The ESR-dates of all the samples fall within the range from 0.28 to 0.58 Ma BP (Huang Peihua et al., 1993; Grün et al., 1997). The Zhoukoudian V sample produced the youngest date of 0.28 Ma BP; while the Zhoukoudian III sample the oldest date of 0.58 Ma BP; the samples of Zhoukoudian II, X, XI, and XII were dated to ca 0.42 Ma BP. The $^{230}\text{Th}/^{234}\text{U}$ dating of the speleothem with the aid of thermal ionization mass spectrometry (TIMS) of the uranium series showed the age of the cranial samples from 0.4 to 0.8 million years (Shen et al., 2001). However, the age of the sample of Zhoukoudian V falls within the range of 0.4–0.5 million years, the youngest age of the samples from the lower layers is 0.6 million years, and the oldest age is 0.8 million years.

Wu Xijie and co-authors calculated the size of the brain case of the most ancient skull Zhoukoudian III to

be 915 cm^3 , the sizes of samples Zhoukoudian II, X, XI, and XII to be 1072 cm^3 on average, and the size of the youngest cranium Zhoukoudian V to be 1140 cm^3 (Wu Xijie, Schepartz, Norton, 2010). Thus, the *H. erectus*-like hominins from Zhoukoudian Cave show a stable increase in brain capacity, which was 1058 cm^3 on average. Besides, the scholars provide data on the cranium capacity of the modern population of China, ranging from 1110 to 1600 cm^3 (1382 cm^3 on average). They note the most progressive morphological features in Zhoukoudian V, distinguishing it from other specimens and indicating the evolutionary development towards sapienization.

The Zhoukoudian culture-bearing layers containing anthropological materials are dated within the range of ca 400 thousand years. Most researchers note the features typical for *H. sapiens*, the closeness of their morphology, as well as the similarities and differences from the remains of *H. erectus* found in other regions of Eurasia and Africa. These issues have caused some discrepancies in the researchers' conclusions.

Wu Xijie and co-authors noted that the analyses of skulls from Zhoukoudian Cave revealed certain distinguishing features possibly separating African *H. erectus* from that of Asia (Ibid.: 2010). Some researchers believe that the skulls from Zhoukoudian Cave demonstrate unique morphological and morphometric features that are absent in African and other Asian fossils of *H. erectus*, although, in general, Chinese and southeastern *H. erectus* form a single whole from the morphological point of view (Kidder, 1998; Antón, 2002; Kidder, Durband, 2004). According to other scientists, some morphological features identified exclusively in Asian *H. erectus* have also been noted in African *H. erectus* (Bräuer, 1990; Bräuer, Mbua, 1992; Rightmire, 1998a; and others). Most anthropologists emphasize the amazing morphological unity of Asian and African *H. erectus* in the main parameters (Etler, 1996; Weidenreich, 1946; Wu Xinzhi, Poirier, 1995), although some scholars point to minor morphological changes associated with chronological differences in the fossils (Wolpoff, 1999; Wu Xijie, Schepartz, Norton, 2010).

Dispersal of *H. erectus* over the territory of China in the second half of the Middle Pleistocene

The sites of Hexian, Chaoxian, Jinniushan, Panxian Dadong, Hualongdong, and others containing anthropological finds belong to the second half of

the Middle Pleistocene. Unfortunately, it is hardly reasonable to consider these sites in accordance with their chronological position; each site produced very different date estimations. In this paper, these are analyzed in sequential order from north to south.

The archaeological sites of Jinniushan and Dali are the most archaeologically significant in the northern part of China. At Jinniushan, the main anthropological materials were found at locus A, together with stone tools, Pleistocene faunal remains, and hearths. In total, 51 specimens, including cranial and postcranial fossils, have been documented: a skull, cervical and thoracic vertebrae, ribs, wrist bones, phalanges, a coccyx, and a calcaneus, among others (Wu Rukang, 1990; Lü Zun'e, 1995, 1996, 2003; Ho Chuan Kun, Jiang Peng, 1993; and others). Human bones were found over an area of 1.6 m², at a depth of 2 m. The carpus and tarsal bones were located in the anatomical order, indicating that they belonged to a single individual. Initially, Wu Rukang (1988) identified the Jinniushan human fossils as the remains of a male ca 30 years old. Subsequent analysis of the skull and patella morphology, as well as metric data, executed by Lü Zun'e revealed the presence of distinct female traits. Taking into account the narrow ischiofemoral space, triangular obturator foramen, prominent iliac fossa, fused cranial sutures, and the presence of unworn third molars, the age of the individual was determined around 18 years old (Lü, 1985).

He Chuankun and Jiang Peng carried out a comparative analyses of the Zhoukoudian *H. erectus* and the archaic *H. sapiens* from Dali and compiled a morphological characteristics of the Jinniushan man's remains: the skull is almost complete; the supraorbital ridge (torus susorbitaire) and the occipital protuberance (chignon occipital) are less pronounced; the cranium (4.5 mm thick on average) is thinner than that of *H. erectus* from Zhoukoudian (8.1 mm thick on average), and thicker than that of modern humans (2.3 mm); the cranial capacity of the Jinniushan fossil (ca 1390 cm³)* is larger than that of the Dali hominin (1160 cm³), and close to that of modern humans (1400 cm³ on average); the maximum width is between the external auditory meatus and the parietal tubercle (He Chuankun, Jiang Peng, 1993).

Some researchers classify the Jinniushan hominin as one of the earliest archaic *H. sapiens* and consider it to be more evolutionarily advanced than *Sinanthropus* from Zhoukoudian 1 and *H. sapiens* from Dali (Wu

Rukang, 1988, 1990; Jia Lanpo, 1988; Pope, 1988). Other scientists believe that the Jinniushan hominin was an intermediate form between *Sinanthropus* and *H. sapiens sapiens* (Lü Zun'e, 2003). There are also other viewpoints on the taxonomic affiliation of this individual.

The age of the site of Jinniushan is also controversial. The faunal assemblage from the low layers at Jinniushan is similar to that from the upper cultural horizons at Zhoukoudian 1. The dating analysis of a sample from layer 8, containing paleoanthropological materials, carried out in the laboratory of the Peking University, has shown the age of 310–240 thousand years. Another sample was dated by the U-technique to $286 \pm 36/28$ thousand years. Thus, the fossil can be dated in the range of 310–240 thousand years, and the average date is 280 ka BP (Ibid.). Another sample from layer 8 was dated to 187 thousand years (Chen, Yang, Wu, 1994). Gao Xing and C. Norton estimated the age of the site of Jinniushan in the range of 300–170 ka BP (2002). Notably, the paleoanthropological materials from this site are probably the earliest in China; these fossils can be attributed to archaic *H. sapiens* or a transitional form between *H. erectus* and anatomically modern humans.

In northern China, in Dali County, Shaanxi Province, in the late 1970s and early 1980s, excavations were carried out at the site of Dali, locus 78006 A. The site yielded a human skull, stone tools, and bones of Pleistocene animals. Close to this locus, another one, locus 78009, yielded a small amount of faunal remains and artifacts (Wang Yongyan et al., 1979; Wu Xinzhi, 2004; Wu Xin-zhi, 2009; Keates, 1994, 2000, 2001a, b; and others).

The most significant find at Dali was a well-preserved human skull. Many publications provide descriptions of this hominin and determine its place in the taxonomic series among other Middle Pleistocene fossils. I would like to point out the research that provides the most detailed metric analysis made by Wu Xinzhi (2009, 2014; Wu Xin-zhi, 2009). Based on a comprehensive study of the Dali skull, its morphological features, as well as comparison with other Middle Pleistocene fossils, the researcher made the following conclusions:

1) The Dali skull has many morphological features that indicate its intermediate position between *H. erectus* and anatomically modern humans. The skull is characterized by a mosaic combination of features of these taxa;

2) Some features of the Dali skull are closer to those of modern humans than to many other Middle

*According to other data, the cranium capacity was 1260 cm³ (Lü Zun'e, 2003).

Pleistocene human skulls; these features even fall within the range of modern human morphology;

3) Some morphological characteristics of the Dali fall within the range of Middle Pleistocene human variations in China, Eurasia, and Africa;

4) Many features of the Dali fossils are more closely related to those of other Pleistocene *Homo* individuals in China than to those of contemporaneous hominins in Eurasia and Africa;

5) Some morphological features of the Dali skull are closer to those of contemporaneous individuals in Eurasia and Africa than to the remains of other representatives of *H. erectus* in China (Wu Xin-zhi, 2009: 234).

The findings made by Wu Xinzhi allow us to conclude on the mosaic morphology of the Dali skull. The skull shows common features with Chinese *H. erectus*, anatomically modern humans, and Eurasian and African hominins. Despite the mosaic morphology of the skull, the scholar hypothesized that Dali fossil was an intermediate form between *H. erectus* and anatomically modern humans. Wu Xinzhi also noted that the presence of brow ridge in Dali skull, similar to those of Bodo, Kabwe, and Petralona, supported the idea of the possible gene flow between the ancient populations of China and Europe.

Many scholars agree that the Jinniushan and Dali fossils show common morphological features, and according to uranium dates, these were quite close chronologically. Some researchers explain the greater robustness of the Dali skull, as compared to the Jinniushan skull, by sexual dimorphism (Kaifu, 2017). The fossils were classified as archaic *H. sapiens* and interpreted differently: *Homo daliensis* (Bae, 2010) and late archaic *Homo* (Kaifu, 2017). After the discovery of the skull in Harbin, northern China, researchers proposed to combine the Jinniushan and Dali fossils into a new taxon *H. longi* (Ji et al., 2021).

The issue of the origin and taxonomic status of the Jinniushan and Dali fossils arouses debates. C. Groves (1994) proposed to classify these paleoanthropological finds as *Homo heidelbergensis*. He argued that these fossils showed a combination of morphological features typical of both *H. erectus* and *H. sapiens*. Many *H. sapiens* traits were identified in the Dali skull, which provided solid grounds to classify this hominin as *Homo sapiens* (Johanson, Blake, 1996).

In the southeastern part of China, faunal remains and anthropological finds (but no stone products) were found in Longtan Cave, Hexian County (Huang W.-P., Fang, Ye, 1981). The collection of human fossils included: a cranial vault, facial and parietal fragments,

left part of the mandible containing the second and third molars, the left upper molar, the left lower first and second molars, the right premolar, and five isolated teeth (Wu Xinzhi, Poirier, 1995). Many researchers rightly considered the Hexian fossils to be unique both in terms of morphological features of the skull and dental system (Antón, 2002; Cui, Wu, 2015; Durband, Kidder, Jantz, 2005; Etler, 1996; Wolpoff, 1999; Kaifu, 2017; and others). The occipital bone of the Hexian specimen is wide, which distinguishes it from the narrow occipital bones of *H. erectus* from Zhoukoudian (Antón, 2002; Cui, Wu, 2015; Durband, Kidder, Jantz, 2005). The Hexian skull fragment shows the greatest similarity to the cranial finds from Zhoukoudian Cave, but at the same time it exhibits a number of distinguishing secondary features including the gracile structure of the postorbital region. The greatest similarity is noted between the Hexian skull and the Zhoukoudian V skull, which dates back to the final Middle Pleistocene (Wu Xinzhi, Poirier, 1995). The researchers consider this fact as the evidence of the undoubted morphological continuity between these fossils.

Noteworthy is the peculiarity of the mandible and the whole dental system of the Hexian hominin. Most researchers attribute *H. erectus* fossils from China to one morphologically distinct homogeneous taxon. Some of the existing differences are explained by the chronological position, divergence, or sexual dimorphism (Wu Xinzhi, 2004; Zhang Y.Y., Liu, 2002). But then, how can we explain the fact that the Hexian fossil, which shows an undeniable similarity to *H. erectus* fossils from Zhoukoudian and especially to Zhoukoudian V, exhibits a completely different dental system? Anthropologists note that in the process of evolution, the *H. erectus* population of East and Southeast Asia in the Pleistocene showed a trend towards a decrease in the robustness of teeth and jaws (Kaifu, 2006; Zanolli, 2013). The Wu Liu and co-authors gave a more detailed description of the mandible and dentition of the Hexian specimen, which showed its differences from *H. erectus* (2017).

Experts believe that the structural pattern of the Hexian mandible is plesiomorphic, as evidenced primarily by the corpus robustness and a subparallel and low-positioned mylohyoid line separating the swollen subalveolar planum from the shallow subalveolar fossa. As compared to early *Homo*, several features, such as moderately curved dental arcade, a well-developed lateral prominence placed at the M_2 – M_3 level, and multiple mental foramina, are derived. The dental enamel surface and strong, stout root structure of the Hexian fossil are primitive for the

Homo clade. The markedly crenulated “dendrite-like” enamel-dentine junction of the molars is apparently a feature specific to continental Asian *H. erectus*. Metrically and nonmetrically, then, the Hexian fossil is more primitive as compared to most *H. erectus* fossils of the late Middle Pleistocene, specifically owing to large and archaic crowns and roots.

The dentition of the Hexian specimen differs significantly from the fossils from Zhoukoudian Cave. The scholars also concluded that it lacks any jaw characteristics typically associated with the Neanderthal lineage (Ibid.: 2017). The researchers pointed to the similarity of the Hexian jaw with the mandible of Penghu 1 discovered in the Taiwan Strait (Chang et al., 2015), and suggested that both finds are paleodemes, belonging to a local population morphologically distinct from classic *H. erectus*. They argue that this conclusion aligns with the notion that combinations of primitive and evolving traits cannot be arranged in a chronological sequence, since the younger populations were not necessarily more developed than the older ones.

Wu Liu et al. (2017) proposed an alternative interpretation: the owners of these jaws could have been genetically related to unknown paleodemes with robust jaws. They retained the dentition of the earliest hominins, who initially populated this region around 1.7–1.6 Ma BP; hominins of this type might have inhabited the territory of China along with *H. erectus* evolving towards sapienization.

Kaifu Yousuke analyzed the Hexian and Penghu 1 fossils and inferred that, in terms of the general evolutionary trend, these primitive and robust mandibles and teeth suggest the existence of another distinct regional population of *H. erectus*, whose evolutionary history and origin is currently unknown (Kaifu, 2017: S424).

Thus, the analysis of dentition morphology of the Hexian individual suggests that, along with *H. erectus* communities evolving towards sapienization, the territory of China was inhabited by a population of *H. erectus* that resided in complete isolation and retained the archaic morphological traits inherent in the first settlers of East Asia. The question arises about the reasons that did not allow this *H. erectus* group to evolve along the *H. sapiens* lineage, same as representatives of this taxon developed in other regions of China. The whole territory of China, particularly its southeastern part, where the Hexian fossil was found, revealed the typical pebble-flake industry, which, despite the absence of stone tools at Hexian, excludes the possibility of dispersal

of another, archaic evolutionary line of *H. erectus* over this area.

The dentition of the Hexian hominin, along with morphological traits similar to those of *H. erectus* in China, has shown certain archaic features that resemble the fossil of Penghu 1. The answer to the question of the taxonomic affiliation of the Hexian and Penghu 1 fossils is provided by the discovery of a new taxon in Denisova Cave in the Altai. After divergence from Neanderthals, the morphologically and genetically evolving Denisovans migrated from the Levant to Central Asia, where they intermixed with indigenous population—the Central Asian *H. erectus*. As a result of the hybridization, they acquired an archaic dentition. About 350–300 ka BP, representatives of this morphologically and genetically developing taxon dispersed not only over Central Asia, but also in adjacent regions, including the western part of China, which is confirmed by the finds of Hexian and Penghu 1 (Derevianko, 2022, 2024a–d). This issue will be discussed in more detail in the paper that will be published in the next issue of the journal.

The age of the site of Hexian remains controversial. The faunal collection of the cave includes bones of animals that lived both in cold and warm climatic conditions of the second half of the Middle Pleistocene. Initial U-series dating of the animal bones yielded a chronological range of 130–220 ka BP (Chen T.M. et al., 1987; Chen T.M., Yuan, 1988). The ESR-dating of the animal teeth produced an age of 160–220 thousand years (early uranium uptake) and 350–250 thousand years (linear uranium uptake) (Huang Wanbo et al., 1995). Dating through ESR and U-series techniques, which make the derived date series more homogeneous, made it possible to establish the age of the hominin fossil sample as 412 ± 25 thousand years (Grün et al., 1998).

In 1982 and 1983, a human occipital bone and a maxilla were found in Chaoxian County, 50 km southwest of the Hexian site (Xu et al., 1984; Wu Xinzhi, Poirier, 1995). These fossils from the Chaoxian site were recovered from cave deposits of the Yinshan Mountain near the village of Yinshan in Anhui Province. No stone tools were found at this site, same as at Hexian. U-dating of samples from layer 2, where the fossils were found, yielded an age of 160–200 thousand years (Chen T.M. et al., 1987). An additional analysis of eight stalagmite carbonate samples and three bone samples from the same layer produced an age of more than 310 thousand years (Shen G.J., Jiu, Jin, 1997).

Wu Xinzhi and F. Poirier (1995) attributed the Chaoxian occipital bone and maxilla to archaic *H. sapiens*, who had, unlike *H. erectus*, some derived features, but at the same time they noted that the fossils were more robust and archaic than modern *H. sapiens*. According to Sh.E. Bailey and Wu Liu, the Chaoxian hominin dentition is archaic and lacks the derived features identified in Neanderthals. The teeth are large; the occlusal morphology retains primeval features observed in the hominins from Hexian, Xujiayao, Tongzi and some others (Bailey, Wu, 2010). Wu Xinzhi (1990), taking into account the chronological position and morphology, included the Chaoxian fossil in the same group with the finds from Dali, Jinniushan, Xujiayao, Maba, and others, whom many Chinese researchers classify as archaic *H. sapiens*; this group is considered by the same scientists as an intermediate link between *H. erectus* and anatomically modern humans.

The late Middle Pleistocene anthropological remains from China demonstrate both definitive *H. sapiens* traits and plesiomorphic ancestral features in morphology. Mosaic morphology is largely the result of two main factors: divergence in the dispersal of some groups of late *H. erectus* and assimilation with hominins from adjacent territories, primarily with Denisovans. Mosaic craniofacial and dentition morphology noted in hominins populating China in the Late Pleistocene demonstrates a complex pattern of morphological diversity. This provided the grounds to hypothesize the existence of several hominin species in China (Liu et al., 2013; Xing et al., 2015, 2019; Li et al., 2017; Chen F. et al., 2019), which could have included late archaic *H. sapiens*, early unknown humans, Denisovans, and another unknown group (Xing et al., 2015; Li et al., 2017; Chen F. et al., 2019).

In my opinion, the territory of China in the late Middle Pleistocene could have been settled only by *H. erectus* evolving along the *H. sapiens* lineage and by the Denisovans migrating in small groups from Central Asia and the Altai. The archaic Denisovan dentition is revealed in individuals of that time; this feature was identified on the skulls from Xujiayao, Dingcun, and other sites, along with modern morphological features such as shovel-shaped incisors typical of the modern Chinese population.

The Maba skull with the U-date of 125–129 thousand years presents a profound interest to researchers. The morphological analysis of this fossil has been carried out with great detail (Wu Xinzhi, Wu Maolin, 1985; Wu X.Z., 1988; Wu Xinzhi, Poirier, 1995). The fragments of frontal, parietal, occipital and facial bones of the skull are available (Wu Xinzhi, Poirier,

1995; Wu Xiu-Jie et al., 2011). The frontal bone is huge and rather thick (10 mm). The supraorbital torus and occipital angle are similar to those of *H. erectus* from Zhoukoudian. The Maba skull retained most of the calvaria and the upper facial parts (Wu Xinzhi, Poirier, 1995). The Maba skull bones at their thinnest point are thinner than those of Dali and similar to the bones of Xujiayao (Wu X.Z., 1988). The available uranium data suggest the age of Maba in the range of 119 to 169 thousand years (Yuan, Chen, Gao, 1986; Chen T.M., Yuan S.X., 1988; Wang L.H., 1989).

The teeth from the Panxian Dadong cave site in Guizhou Province in southwestern China date back to the late Middle Pleistocene. The cave belongs to a large karst system consisting of interconnected caves. Excavations were conducted there from 1992 to 2005, and revealed lithic artifacts, a large number of bones, and four animal teeth (Special..., 1997). Notably, in the lithic assemblage, some researchers identified the artifacts manufactured using the Levallois technique (Huang W. et al., 2015). It cannot be excluded that some changes in the pebble-flake industry of the genetically and morphologically developing *H. sapiens* could have been induced by the contacts with Denisovans.

Human teeth have been discovered at the site in various strata and across different years. Scientists conducted a study of the teeth, which, in their opinion, is not sufficient to determine their taxonomic status (Liu et al., 2013). Anthropologists believe that the upper central incisor and canine have more archaic features than the lower and upper premolars. The canine shows a symmetrical, incisor-like crown along with a slightly elevated central ridge on the lingual surface. The latter trait is considered more apomorphic than that of *H. erectus* from Zhoukoudian. The features of the lingual surface of the upper central incisor are regarded as archaic. The prominent basal elevation and well-developed finger-like projections of this tooth make it similar to early *Homo* specimens. The combination of primitive and apomorphic traits in the four fossils from Panxian Dadong is probably due to their differences in age (the specimens were discovered in different cultural layers). In general, the teeth from Panxian Dadong demonstrate both primitive and derived features, making them comparable to Middle and Late Pleistocene fossils found across East and West Asia and Europe.

Studies in the Hualongdong cave site, Dongzhi County, Anhui Province, is of great importance for understanding continuity in the evolution of hominins in China. Initially, fieldworks at the site began in 2006, and were continued annually from

2014 to 2019. In the course of excavations, a large number of stone tools, bones of Pleistocene animals, and paleoanthropological fossils were recovered (Gong et al., 2014; Tong et al., 2018; Wu Xiu-Jie et al., 2019; Wu Xiujie, 2023; and others).

The excavations at Hualongdong revealed two main strata of deposits: the one of carbonate-cemented cave breccia and the other consisting of loose clay mixed with gravel. The available U-Th dates on speleothems suggest that the breccia's maximum age is in the range of 330.5 ± 14.5 thousand years. The youngest age of the calcite crust formed around the void in the cave is 274.8 ± 9.2 thousand years. Thus, the average age of the finds is about 300 thousand years. Faunal remains of animals of the second half of the Middle Pleistocene confirm the proposed age of the site. Some bones bear cuts marks associated with the activity of hominins that inhabited the cave.

Unique remains of hominins were found in the brecciated deposits of Hualongdong Cave (Wu Xiu-Jie et al., 2019): eight skull fragments, seven isolated teeth, three femoral diaphyseal fragments, and a partial skull of an HLD 6 adolescent. The frontal bone indicates low and thick skull bones. The femur diaphyses exhibit a thick cortex and cross-sectional proportions of Middle Pleistocene hominins.

The HLD 6 skull has been preserved in the form of 11 fragments, which include a significant portion of the frontal bone, the left parietal bone, the maxilla, and the left zygomatic bone, as well as the posterior temporal region, the palatine bones, and the lateral left sphenoid bone. The mandible retains the right side, the posterior left part, and the ramus to the condylar neck. The estimated age of individuals from Hualongdong Cave is 13–15 years old. The skull and the mandible of HLD 6 were thoroughly examined by Wu Xiujie et al. (Ibid.). The endocranial capacity of the skull was approximately 1150 cm³, which is generally consistent with that of late Middle Pleistocene hominins of the same age (Ibid.). The HLD 6 individual exhibits a low vault (without parietal sagittal keel and angular torus), a low and broad nasal aperture, a prominent supraorbital torus, and the absence of third molars. While the maxilla lacks a zygomatic incisor, a large medial pterygoid tubercle is present.

A large amount of information was derived from studying the morphology of the facial part of the skull (Wu Xiu-Jie et al., 2021). The entire maxilla and its dental arch were reconstructed on the basis of four fragments. The scan of this reconstruction enabled the researchers to create a virtual reconstruction of the skull using high-precision computed microtomog-

raphy (Wu Xiu-Jie et al., 2019; Fig. 2; 2022: Fig. 2). They concluded that the face of the HLD 6 adolescent demonstrated moderate prognathism. The analysis of all fragments of the facial part of the skull has shown that the HLD 6 face morphology retains some archaic features and demonstrates certain *H. sapiens* traits. Moreover, while previously studied Upper Pleistocene finds, such as the Dali skull and Panxian Dadong teeth, displayed the features resembling modern humans (Wu Xin-zhi, 2009; Liu et al., 2013), the adolescent from Hualongdong Cave has even more pronounced *H. sapiens* features. According to the researchers, this individual is the first late Middle Pleistocene hominin whose facial part has the largest number of morphological characteristics similar to those of anatomically modern humans. The HLD 6 facial morphological type with such a number of derived features was identified among the Middle Pleistocene hominin fossils from China for the first time (Wu Xiu-Jie et al., 2022: 18).

Chinese anthropologists examined the HLD 6 mandible as thoroughly as its facial part (Wu Xiujie et al., 2023). When the mandible was found, it consisted of four jaw fragments and an isolated first molar (Wu Xiu-Jie et al., 2019). Later, in the laboratory, the researchers managed to find a part of the right mandible ramus, which matched the previously recovered fragments. A comprehensive analysis of the morphological features of the mandible and its comparison with similar Pleistocene fossils revealed some archaic features. The results of geometric morphometric analysis point to mosaic morphology of the HLD 6 mandible.

The study of the nearly complete skull and mandible of HLD 6 has shown a combination of features typical of Middle Pleistocene hominins of East Asia (Wu Xiu-Jie et al., 2019, 2022). Preliminary examination of the HLD 6 dentition revealed a simplified occlusal morphology, most similar to that of modern humans.

The mosaic morphology of paleoanthropological finds from China dating back to the late Middle Pleistocene hampered an unambiguous differentiation of fossils into taxonomic groups due to their varying degrees of preservation, insufficient information, lack of date estimations for some specimens, and the possible subjectivity of researchers' approach to assessing morphological markers (Liu, Wu X.J., 2022; Liu et al., 2022; Wu Xiu-Jie et al., 2022). With discoveries of new fossils and emergence of new analytical techniques, scholars sometimes changed their point of view. In one case, researchers subdivided the available fossils into several groups

(Liu, Wu X.J., 2022), while in the other case, they did not exclude the possibility of simultaneous dispersal of several species over the territory of China in the late Middle Pleistocene, only some of which can be attributed to the hypothetical ancestors of *H. sapiens* (Liu et al., 2013; Liu, Wu X.J., 2022; Xing et al., 2015, 2019; Chen F. et al., 2019). Given the morphological diversity of hominins, some researchers do not exclude the possibility of sapienization in some areas of China and the dispersal of more archaic hominins in other areas (Chen F. et al., 2019; Li et al., 2017; Mounier, Lahr, 2019).

Late Middle Pleistocene hominins showed a considerable morphological diversity, although each available fossil—fragments of skull, cranial-zygomatic and maxillo-dental sections of face, skeleton fragments—had fairly well-defined derived *H. sapiens* features suggesting the evolution of the late *H. erectus* towards sapienization. The human fossils from Hualongdong demonstrate the most noticeable derived *H. sapiens* features and attract great attention of researchers; the age of the fossil of about 300 thousand years makes it possible to assume that HLD 6 might have been a representative of the first ancestral group that can be classified as modern humans. The HLD 6 fossil was an undoubted intermediate link between plesiomorphic and apomorphic morphological types (Wu Xiujie et al., 2023).

Hominins of China in the first half of the Late Pleistocene

Over forty localities containing Upper Pleistocene hominin fossils have been reported from China (Dennell, 2014, 2020; Wu Xinzhi, Poirier, 1995; Martín-Torres et al., 2017). Among them, several fossils—Lingjing, Xuchang, Luna, Fuyan (Daoxian), Zhiren, Huanglong—have been classified as early modern humans. Scientists define their taxonomic status differently: some believe that these fossils represent early modern humans who evolved by convergence on the ancestral basis of *H. erectus*; others classify them as modern humans that migrated from Africa or Southeast Asia.

The Lingjing multi-layered site was discovered in Xuchang County, Henan Province, central China, in 2007; it was excavated for several years (Li et al., 2019). The site is located at a water source. The earliest cultural layers with paleoanthropological remains contained a pebble-flake lithic industry dating back to the early stage of the Upper Pleistocene. Hominins

made stone tools mainly from quartz (Ibid.). In 2014, in culture-bearing layer 11, researchers discovered two crushed and disconnected crania—Xuchang 1 and Xuchang 2. The fossil remains were found in association with bones of Pleistocene fauna, including horses, cloven-hoofed ungulates, giant deer, gazelles, and rhinoceroses. The layer also contained stone tools (Li et al., 2017). The anthropological finds were dated by OSL-method to 105–125 ka BP; the age of overlying layers 10 and 9 was 100 and 90 thousand years, respectively.

Among the fossils from this site, the Xuchang 1 cranium is the best preserved, consisting of the nearly complete neurocranial vault and a portion of its base (Ibid.). The fossil exhibits well-preserved fragments of the parietal, occipital, and temporal bones, as well as a considerable number of small fragments of the frontal bone sufficient for structural localization of the transverse supraorbital region. The Xuchang 2 skull includes the posteroinferior part of the neurocranium with an almost complete occipital bone and petrotympanic fragments of the temporal bones. Three poorly preserved fragments of another skull were also recovered from layer 11.

According to the researchers, skulls Xuchang 1 and Xuchang 2 are characterized by a mosaic combination of morphological traits, revealing the continuity with populations represented by Middle Pleistocene fossils not only in China, but also in some westward areas of Eurasia. It seems quite natural, because, despite the divergence, the morphological development of hominins in Africa and Eurasia in the Middle Pleistocene proceeded followed a *H. sapiens* lineage. Owing to geographic remoteness of these hominin habitats, different environmental conditions, and possibly different degrees of genetic drift, both common and distinctive features were developed in the hominins. The fossils of Xuchang 1 and 2 display some traits that can be traced in Neanderthals. But other specific features of these skulls resemble early modern humans, primarily the gracility and neurocranium capacity. The size of the skull of Xuchang 1 is approximately 1800 cm³. This size significantly exceeds that of *H. erectus* (about 900 cm³ on average) and Neanderthals (1400 cm³). The size of the Xuchang 1 skull fits well into the variation series of the skull size of modern humans. The skull of Xuchang 2 is somewhat smaller; however, judging by the width of its base, it falls within the average range of Late Pleistocene humans.

The skulls of Xuchang 1 and 2 are characterized by a prominent supraorbital ridge, but it is smaller than

that of Neanderthals and some early modern humans. Moreover, these fossils, like the Late Pleistocene early modern humans, display a constant thickness of this ridge, with minimal lateral expansion. The gracility of the skulls is indicated by the moderate thickness of the parietal bones, the small occipital protuberance of Xuchang 1, limited by the two middle thirds of the occipital bone; Xuchang 2 lacks the occipital protuberance.

It has been reported that the skulls of Xuchang 1 and 2 demonstrate both plesiomorphic ancestral features of Middle Pleistocene hominins, along with derived characteristics that bring them closer to modern humans and distinguish them from Neanderthals. Evidence of the evolution of Chinese *H. erectus* along the *H. sapiens* lineage is the encephalization of hominins in the Middle Pleistocene, which caused the large brain case of Xuchang 1. The researchers specifically noted that this process was reflected in the combination of a wide base with a low vault, which points to the continuity with earlier hominins who populated the east of Eurasia in the Middle Pleistocene. At the same time, scientists noted the two clearly Neanderthal features: in theinion region and in the ear labyrinth structure. This suggests the interaction between the Eurasian populations in the late Middle to early Late Pleistocene (Ibid.). Notably, the typical Neanderthal structure of the ear labyrinth was identified in the Denisovan individual from Obi-Rakhmat Cave (Derevianko, 2025); this feature is also reported in early modern humans (Razhev et al., 2024).

In 2016, scholars identified premeditated scratches and traces of ocher on one of the bones discovered in Lingjing in 2009 (Li et al., 2019). Hominins used animal bones and horns as retouchers at this site.

Of particular interest are 44 teeth recovered from Fuyan Cave in Daoxian County, Hunan Province, southern China. The cave belongs to a complex karst system consisting of several interconnected and consecutive cavities. Large-scale excavations in the cave were carried out in 2011–2013 (Liu et al., 2015).

In various publications, the teeth from the cave are referred to either by the name of Fuyan Cave or by the name of Daoxian County. I will use the name of the cave. The researchers compared the teeth from Fuyan Cave with various Late Pleistocene dentition samples from Africa, Europe, and Asia, and inferred that the Fuyan teeth are smaller than those from Africa and Asia and are closer to European Late Pleistocene teeth, as well as to the teeth of modern Europeans. The roots and crowns of the Fuyan teeth demonstrate morphological traits characteristic of

H. sapiens (Ibid.: 698). M. Martín-Torres and co-authors carried out a comparative analysis of the Fuyan teeth and the teeth from Qafzeh Cave and concluded that the derived features of the former were closer to the teeth of modern humans (2017). A thorough and comprehensive study of the dentition of the Fuyan hominins provided solid grounds to attribute the recovered remains to anatomically modern humans. The dentition of the Fuyan individual indicates that modern humans populated southern China in the early Late Pleistocene.

The age of the fossils from Fuyan Cave remains controversial. Nine speleothem samples from layers 2 and 3, and two samples of a small stalagmite from the upper part of layer 1, cementing the underlying layers, were collected for the age estimation of layer 2, in which the fossils were found. These samples were carefully prepared to isolate a pure fraction suitable for ^{230}Th isotope dating. Eight fragments of speleothem dripstones from layer 2 provided the dates of a wide chronological range of 556–120 ka BP, while the sample from layer 3 a date of older than 600 ka BP. Two samples from a stalagmite from the surface of layer 1 yielded an age of 80.1 ± 1.2 ka BP and 79.5 ± 2.8 ka BP (Liu et al., 2015). Because layer 1 covered completely the underlying layer 2 from any disturbances, the researchers accept the date of 80 ka BP as the youngest for layer 2; hence, the age of the Fuyan fossils is estimated in the chronological range of 120–80 ka BP.

A different interpretation was proposed by V. Michel and co-authors. These researchers doubted the correctness of the sample selection for analysis, as well as the fact that layer 2 was not mixed, and proposed the date of 43 ka BP for the layer where the teeth were found as more reliable (Michel et al., 2016). R. Dennell considered the presence of the Upper Pleistocene faunal remains to be a quite sufficient ground for recognizing the youngest age of the Fuyan fossils as 80 thousand years; he also admitted that the finds could have belonged to an earlier period (2020: 293).

Zhiren Cave differs from many others by the thickness (up to 20 m) of its soft sediment layer. The cave is located in the Guangxi Zhuang Autonomous Region in southern China (Liu et al., 2010b). It is a karst cavity in Triassic deposits, located at an altitude of 34 m above the Hejiang River and 179 m asl. In the rear part of the cave, there is a chamber that was filled with loose deposits in the Early Pleistocene. Subsequently, most of them were removed, probably by water flows. Traces of these deposits remained on the walls and ceiling of the cave. Later, the cave was refilled with the younger soft sediments.

Traces of sedimentation hiatus have been identified by ring-shaped dripstone formations overlying loose sediments. Several hiatuses were recorded. The age of the two upper dripstone formations was determined by the uranium method to oxygen isotope stage 3 (28–52 ka BP on average). A series of dates in the range of 87 to 74 ka BP were derived for the underlying horizon. The soft sediments of layer 2 containing two molars and the external part of a human mandible belonged to section B and were dated to the range of 110–55 ka BP. W. Liu and his colleagues determined the age of the fossils to be ca 100 thousand years (Ibid.).

Such an early date and the attribution of the fossils to early modern humans raised objections from some researchers (Dennell, 2010; Kaifu, Fujita, 2012; and others). Further studies of the cave deposits through paleomagnetic sounding, stratigraphic observations, and OSL-dating made it possible to more accurately determine the chronological position of the Zhiren Cave fossils, in the range from 106 to 110 ka BP (Cai et al., 2017).

The mandible from Zhiren Cave demonstrates a derived modern human anterior symphyseal morphology with a projecting tuber and distinct mental fossae. The combination of progressive symphyseal pattern with relatively small crowns and moderately developed lateral tubercles, in the view of several specialists, opposes this fossil to those of all late archaic *Homo*. However, its lingual symphyseal surface and the robustness of corpus are typical of later Pleistocene archaic humans.

The researchers compared the abovementioned fossils dated to the second half of the Middle Pleistocene from Africa, Western Eurasia, and China to the Late Pleistocene anthropological finds from North Africa and Europe (mostly Neanderthals) and to younger individuals up to early modern humans; it was inferred that the Zhiren fossils demonstrated the oldest derived morphology of modern humans in East Asia. Anthropologists argued that the age and morphology of the human remains from the cave suggest that anatomically modern humans emerged in East Asia as a result of either migration and subsequent assimilation, or continuous evolutionary development of ancient human types in this area and gene flow between populations.

Significant morphological diversity and the recorded plesiomorphic features suggest that the Zhiren fossils belong to “gracile *H. erectus*” or to some kind of hybrid with representatives of *H. sapiens* populations that arrived in East Asia at that early period (Dennell, 2010, 2014, 2020).

Martinón-Torres and colleagues (2017) inferred that the fossils from Zhiren Cave, despite some archaic features, should be classified as modern humans.

Huanglong Cave is located in the Yunxi County of Hubei Province. The cave is a huge karst cavity; its estimated length is over 400 m, the entrance is 27.8 m wide and 11 m high. The Dashui River flows 50 m from the cave entrance. The cave was excavated in 2004–2006 (Wu Xianzhu et al., 2006; Liu et al., 2009, 2010a). Five culture-bearing layers were identified in the cave. Seven hominin teeth and stone tools were found in the main cultural layer 3. The researchers found out that the inhabitants of the cave used fire.

The excavations in the cave yielded 36 stone tools and some bone items. The cave contained a lot of faunal remains. In total, about three thousand bones of Upper Pleistocene animals were found, belonging to 91 species, 20 % of which represented extinct taxa. Notably, traces of cuts, scraping, artificial crushing and fracturing were noted on 40 bones of the collection.

Seven hominin teeth can be regarded as the most significant finds. The researchers provided detailed descriptions of morphological features of these fossils, compared them to the dentitions of hominins of the Middle and Upper Pleistocene, and inferred that most of the features were typical of modern humans. The teeth are quite gracile, their main morphological traits, despite of some archaism, correspond to the teeth of modern humans. Moreover, these teeth demonstrate some dental traits of modern East Asian populations. C.G. Turner (1990) established eight features that were most common and pronounced in modern East Asians, especially in the Chinese. Three of these features (shovel-shaped incisors, double shovel-shaped upper central incisors, interradical enamel extension of upper molars) were identified by the analysis of human teeth from Huanglong Cave, which retained some dental features of the Late Pleistocene humans (mostly robust upper anterior teeth). Martinón-Torres et al. believed that “Huanglong Cave fossils represent robust evidence of the presence of *H. sapiens* in China during the early Late Pleistocene” (2017: S439).

Age estimations of the fossils from Huanglong Cave are disputable. The first results were derived by U-series dating of two rhinoceros teeth— 94.7 ± 12.5 to 79.4 ± 6.3 ka BP (Wu Xianzhu et al., 2006). U-series dating of a stalagmite sample from the horizon containing the anthropological fossils provided the age of the latter in the range of $103,739 \pm 1616$ to $103,119 \pm 1348$ BP. Estimations of the age of the rhinoceros tooth yielded a young date of $44,180 \pm 3280$ to $34,780 \pm 4540$ BP. Subsequently, new dates—81 and

101 ka BP—were generated, which were accepted by many researchers (Shen G.J. et al., 2013).

In Luna Cave, which (like Zhiren Cave) is located in the Guangxi Zhuang Autonomous Region in southern China, two teeth were found *in situ*: the upper right second molar and the lower left second molar (Bae et al., 2014). The teeth were recovered from a stratigraphic sequence that, based on several uranium series, fell within the time range from 126.9 ± 1.5 to 70.2 ± 1.4 ka BP.

The researchers classified the LNDM2 tooth as metrically closest to those of modern Mesolithic and Neolithic humans. The tooth falls within the range of late Neanderthal tooth sizes; its metric indicators do not coincide with those of the teeth of earlier hominin populations. According to geometric morphology, this tooth is believed to be similar to those of a group of chronologically recent human populations and is most closely related to the teeth of Koreans of the Joseon Dynasty.

The researchers argue that the LNDM2 tooth, with its convex walls, does not fully correspond to the Upper Paleolithic and Mesolithic modern *H. sapiens*. In terms of geometric morphology, it shows certain similarities with recent modern humans and is close to the tooth of Ternifine 3. In general, as per C. Bae et al., metric and geometric morphometric analysis of the LNDM2 tooth indicates its closest affinity with modern *H. sapiens*.

Other sites dating back to the first half of the Late Pleistocene have also been discovered in China. Martín-Torres and colleagues refer to four more sites—Ganqian, Tongtianyan, Dingcun, and Jimuyan—which they consider promising to assess the evolution of modern humans. However, owing to the low information content of the fossil morphology and/or uncertainties regarding their age, the scholars consider them less significant than those from the caves of Fuyan, Luna, Zhiren, and Huanglong (Martín-Torres et al., 2017: S435).

Discussion

The hypothesis of a continuous evolutionary development of Pithecanthropus-Sinanthropus (*H. erectus*) in East and Southeast Asia from the arrival of these hominins to the area till the origin of modern humans was proposed by F. Weidenreich—one of the greatest anthropologists of the first half of the 20th century. He relied on the results of detailed studies of paleoanthropological finds from Indonesia

and China. He paid a particularly great attention to the unique fossils from Zhoukoudian (Weidenreich, 1941, 1943, 1946, 1947a–c, etc.). The researcher carried out a comprehensive analysis of all available paleoanthropological materials from Zhoukoudian, and made original casts of the skulls, which, after the tragic loss of the originals during the Japanese aggression in China, are considered the only sources for studying these fossils. Weidenreich identified 12 morphological features that, in his opinion, indicate continuous human development in East Asia. He also distinguished four possible phylogenetic evolutionary lines of human development—Africa, Europe, East Asia, Southeast Asia and Australia (Weidenreich, 1946).

The most consistent supporter of the hypothesis of continuity in the evolutionary development of hominins since the initial dispersal of *H. erectus* over the territory of China is Wu Xinzhi. Back in 1998, based on extensive paleoanthropological materials, he developed a hypothesis that was best known as “continuity with hybridization” (Wu Xinzhi, 1990). The findings of his studies of cranial remains indicated that the evolutionary development of humans in China during the Pleistocene was continuous. He also did not rule out genetic drift, which could have been concealed by hybridization processes during the subsequent migrations.

Wu Xinzhi noted that all ancient skulls found in China demonstrated many common features indicating evolutionary continuity (2004, 2006). Furthermore, the crania showed morphological features of both *H. s. erectus* and *H. s. sapiens*. This suggests a gradual transition from one subspecies to another (Wu Xinzhi, 2004: 131, 133), and that *H. sapiens sapiens* is a chronological subspecies of *H. sapiens erectus*.

The uncertainty about the possibility of dispersal of hominins with clearly expressed derived features of modern humans in China in the first half of the Upper Pleistocene is connected not only with the subjective approach and the lack of generally accepted criteria for the selection of *H. sapiens* markers in fossils, but also with the lack of undoubted evidence that fossils were found *in situ*, as well as the unreliable dating, and other problems (Norton, Jin, 2009; Bae, 2010; Dennel, Martín-Torres, Bermúdez de Castro, 2011; Kaifu, Izuhō, Goebel, 2015; Kaifu, 2017; Dennel, 2020; and others).

In China, more than 70 sites with anthropological remains dating back to the range of 200–40 ka BP have been discovered (Wu Xinzhi, 2004, 2006; Gao et al., 2010). The studied fossils, despite their morphological variability, lead to the conclusion that there was an

undoubted continuity in the evolutionary development from *H. erectus* to anatomically modern humans.

There are two leading hypothesis on the hominin dispersal over the territory of China. Hypothesis 1 implies that under the favorable environmental conditions this process was continuous (Zhu R.X. et al., 2004; Ciochon, Bettis, 2009; Ao et al., 2010). According to hypothesis 2, the dispersal of hominins was disruptive and recurrent; moreover, as a result of divergence, some populations became isolated from each other and subsequently merged again (Dennell, 2010; 2013a, b; 2014).

One of the leading researchers of the Asian Paleolithic, R. Dennell, relying on the analysis of fossils from Fuyan, Zhiren, Luna, and other sites, supports the idea of other scholars that *H. sapiens* inhabited the south of China 80 ka BP, although this inference is not ultimate. He believes that these populations originated most probably from Southeast Asia; *H. sapiens* representatives were recorded in the caves of Lida Ajer (Sumatra) and Tam Pa Ling (Laos) as early as 73–63 ka BP (Dennell, 2020: 294–295).

This conclusion is based on the results of genetic studies by S. Oppenheimer and other researchers, who assume that modern humans could have arrived in Melanesia and Australia around 70 ka BP (2004a, b; 2009; 2012). Among archaeologists, one of the convinced supporters of this assumption is P. Mellars (1989a, b; 2005a, b; 2006a, b; etc.). However, there is no archaeological evidence of the possible dispersal of modern humans from Africa to Southeast Asia 70–40 ka BP. As an evidence in favor of the said assumption, Mellars and co-authors give information about the discovery of geometrically shaped tools at the Patne (India) and Batadomba (Sri Lanka) sites, similar to the Howiesons Poort industry from South Africa (Mellars, 2013; Mellars et al., 2013). But the researchers do not take into account that the Howiesons Poort industry in Africa is dated to 70–60 ka BP, while the sites in India and Sri Lanka are no older than 40,000 years. In addition, sites with the Howiesons Poort industry have not been recorded in the transit area from Africa to South Asia. Moreover, N. Boivin and co-authors have proven that geometrically shaped tools from Africa and South Asia have only an external resemblance (2013). Anthropological remains found in the transit area between Africa and Southeast Asia also do not confirm the dispersal of early modern humans 70–40 ka BP. I have considered this issue in detail in a number of monographs (Derevianko, 2011, 2020, etc.).

The proposed hypothesis on the dispersal of modern humans from Africa to Southeast Asia 120–80 ka BP

should be confirmed by convincing evidence of the emergence of such humans in Eurasia in the late Middle to early Upper Pleistocene. At present, two Eurasian localities with anthropological finds are known that some researchers attribute to anatomically modern humans: Misliya in Israel and Apidima in Greece.

The earliest anthropological find possibly representing early modern humans is the left half of the maxilla from Misliya Cave, dating to 194–177 ka BP (Hershkovitz et al., 2018). The fossil has preserved most of the alveolar and zygomatic processes (each half of the jaw contains one alveolar and one zygomatic process), part of the palate, nasal floor, as well as a complete left dentition starting from the first incisor (represented by a broken root) to the third molar (Ibid.: 456).

Analysis of this fossil has yielded some important insights.

1. The incomplete maxilla of Misliya 1 shows no derived skeletal or dental features of Neanderthals (Ibid.: 458–459).

2. Comparison of the dental component of the Misliya 1 fossil with the maxillary and mandibular teeth from Qesem Cave in Israel, dating back to 400–220 ka BP, revealed a number of differences. In particular, Qesem incisor I² has a more developed lingual tubercle than that of Misliya specimen. The Qesem upper canine displays more pronounced shoveling, along with the presence of a lingual tubercle, and a canine mesial ridge. All these morphological features, which distinguish the Qesem anterior teeth from those of Misliya 1, are most often found in Neanderthals.

3. Misliya 1 resembles younger Levantine *H. sapiens* fossils from Skhul and Qafzeh in most dental features, and differs from them in the degree of hypocone reduction.

4. Misliya 1 is the oldest evidence of expansion of *H. sapiens* clade out of Africa.

We can hardly agree with the last conclusion. The earliest fossil remains, whose morphological features are sometimes defined as modern, come from Northeast Africa (Jebel Irhoud); their age is ca 300 thousand years (Hublin et al., 2017; Richter et al., 2017). However, these fossils can be attributed to modern humans only relatively. Researchers of Misliya Cave compared its early Middle Paleolithic industry with the Middle Stone Age technocomplexes of the Maghreb (Jebel Irhoud), East Africa (the formations of Gademotta and Kulkuletti in Ethiopia, Kapthurin in Kenya). However, the Misliya lithic industries demonstrate only feeble distant resemblance to the

Middle Stone Age industries of East and Northeast Africa; and even under the widest assumption, it is impossible to find any manifestations of continuity with the Jebel Irhoud industry. No convincing evidence of morphological similarity of the Misliya human remains with African fossils dating back to the late Middle to early Upper Pleistocene were found either.

The taxonomic status of fossils discovered at the Apidima cave site in southern Peloponnese, Greece, is uncertain. Two skulls, ca 160,000 years old, were discovered in the breccia that filled the space between the walls of Apidima A Cave. M.-A. de Lumley attributes the skulls of Apidima 1 and Apidima 2, as well as human remains from Grotte du Lazaret, to the population of developed European *H. erectus* in the stage of Neanderthalization. In her opinion, they preceded the classic Neanderthals (Lumley, 2019). Lumley dates classic Neanderthals in Western Europe to 120–37 ka BP. G. Bräuer and co-authors hold a similar point of view on the taxonomic affiliation of the anthropological finds from Apidima Cave. The authors infer: “Thus, from our results it can be concluded that the Apidima crania should be classified as early Neanderthal and taxonomically, as *H. sapiens neanderthalensis* based on a concept of *H. sapiens s.l.*” (Bräuer et al., 2020: 1390).

In Europe, the earliest sites of modern humans date back to ca 45 ka BP. In the transit area from Europe to China, no sites of early modern humans older than 40–45 ka BP have been reported. Thus, there is no convincing evidence of the arrival of early modern humans in China in the course of their migration from Africa 120–40 ka BP.

The noted homogeneity of lithic industry of hominins bracketing the period from the initial occupation of this area by *H. erectus* up to 40 ka BP, when the blade-based industry emerged in the area, is regarded as one of the important pieces of evidence for the convergent evolution of modern humans—*H. sapiens orientalis*—on the ancestral basis of *H. erectus* in the territory of China in the early Upper Pleistocene.

Experts in the Chinese Paleolithic have no doubt that the development of the Paleolithic industry in this area differed significantly from that in Africa and Europe. The main feature of the Chinese Paleolithic was the continuity of development from the early to the terminal Paleolithic. Even when the blade industry emerged at some sites in northern China ca 40 ka BP, the traditional pebble-flake industry continued to be produced with some innovations at most sites. Of course, this does not mean that the industry was

extremely archaic and that the hominins of East Asia lagged behind the hominins of Europe in cognitive development. It was as effective for the subsistence of hominins as the industry of western regions of Eurasia. Hominins who settled in China began to use the technique of bifacial working of lithic implements and to produce tools of the Acheulean handaxe type earlier than in Europe. This technique of making bifaces, which originated around 1 Ma BP, could have appeared and disappeared in the Middle Pleistocene, and then appeared again, which alterations could apparently be explained by the change in hominins’ adaptation strategies due to environmental changes in their habitat (Derevianko, 2018).

The continuity in the development of lithic industry among the hominins of China in the Paleolithic was manifested above all in the primary reduction, dominated by three techniques of producing blanks: *chuijifa* (the technique of striking a core with a hammer stone), *zajifa* (detaching flakes using an anvil), and *pengzhenfa* (striking a core against a stone anvil). Disc-shaped and orthogonal pebble cores were used; Levallois reduction technique was absent. Flakes served mainly as blanks for tool manufacturing. Moreover, in certain areas and periods, hominins preferred either small or large flakes in tool manufacturing. Researchers characterize the Paleolithic industry of China as homogeneous, but with certain differences in the industries of the North and South; the border line between them was the Qinling mountain range.

Researchers distinguish local variants (cultures) in the industries of South and North; this situation refutes the assertion about the technical and typological homogeneity of the Paleolithic industry in China. The specificity of the Paleolithic industry in China, the pebble-flake trend, was determined mainly by the lack of the Levallois technique of primary reduction. Blade and Levallois technique emerged in the northern regions of China ca 45 (43) ka BP as a result of the Denisovan (*H. s. altaiensis*) migration to this region from Mongolia and partly from the Altai.

Thus, from the time of the initial occupation of China territory by *H. erectus*, this taxon evolved towards sapienization, which was expressed in the continuity of the human morphology and lithic industry throughout the Early, Middle, and Upper Pleistocene (in the chronological range from 1.7 (1.6) to 0.04 Ma BP). Fossils dating to the early Upper Pleistocene, despite their small number and severe fragmentation, can be attributed to early modern humans (informal name *H. s. orientalis*) based on

their main morphological traits. These populations, as well as *H. s. africanensis*, *H. s. neanderthalensis*, and *H. s. denisovan*, retained an open genetic system. In this regard, a new scenario of the evolution of anatomically modern humans *H. sapiens sapiens* can be proposed. This species originated during the migration of modern humans (*H. s. africanensis*) from Africa to Eurasia 80–60 ka BP, on their morphological and genetic basis. In Eurasia, they assimilated *H. sapiens neanderthalensis* in Europe, *H. sapiens denisovan* in Central Asia, and *H. sapiens orientalisensis* in East and Southeast Asia (Derevianko, 2011, 2019, 2022, etc.).

I realize the complexity of the issues discussed in this article, but I believe that the data obtained from the discoveries made by experts in physical anthropology, archaeology, and genetics provide sufficient grounds to consider the complicated fundamental problem of the origin of modern humans in the proposed scenario.

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Bone Carving Among Early Iron Age Nomads of Eastern Kazakhstan: The Case of Berel

This study addresses carved bone artifacts crafted by Early Iron Age nomads of Eastern Kazakhstan as compared to those from more easterly areas of the Altai-Sayan Highland. A large sample of carved horn details of harness and bridle from a horse burial in mound 36 at the Berel cemetery, Altai, is described with a view to revealing the peculiarities of this craft among the Early Iron Age nomads of Kazakhstan. A comprehensive analysis (structural, morphological, and technological) suggests that all the artifacts were manufactured using two types of horn plate as blanks. The collection evidences a variety of techniques for processing antlers. Details of bridle and harness, made of various materials, attest to mobility, rationality, and cyclicity in Early Iron Age nomadic societies of Eurasia.

Keywords: Bone carving, nomadic societies, local peculiarities, Early Iron Age, Berel cemetery, Pazyryk culture, Altai-Sayan Highland.

Introduction

Specific aspects of bone carving depend on the methods of economy, which also applies to multivariant nomadism with significant local differences (Tairov, 2007: 64–70; Gutsalov, 2011: 12). Carved items of horn were typical objects of Early Iron Age nomadic cultures (Sarmatian, Tasmola, Pazyryk) in the mountain-steppe belt of Eurasia (Kadyrbaev, 1966: 324, 325; Smirnov, 1976: 74–89; Grach, 1980: 77–80, 178, 179). The emergence of graves with horse burials in the early 1st millennium BC was one of the main features of the transition to nomadism (Bokovenko, 1994, 2011). The set of horse equipment from those burials was the most dynamically evolving category of material culture of the Early Iron Age (Bokovenko, 1981, 1986; Marsadolov, 1998; Gorbunova, 2001;

Valchak, 2009: 9; Besetaev, 2014: 17–18; Shulga, 2015: 9). Such items reflect one of the main features of nomadic way of life—mobility (Masanov, 1995: 112), which is also revealed in specific aspects of bone carving. Details of horse harness play a special role in this context. First, they clearly show local features (Gorbunova, 2001: 194). Second, treatment of raw horn materials is most fully manifested precisely in manufacturing the elements of horse harness in the Early Iron Age (Borodovsky, 2007: 96, fig. 74, 75). Third, the complete and consistent technological process of such items provides wide opportunities for description of local features of bone carving in nomadic societies.

Another trait of nomadic way of life is dispersion of production (Masanov, 1995: 115, 122). This precludes accumulation of artifacts and blanks of bone carving

in specific places (camps, settlements, or necropolises). Funerary offerings from nomadic burials do not always provide information about the entire production cycle of bone carving. However, there is one exception in Eastern Kazakhstan, a part of the vast Altai-Sayan Highland—a set of numerous horn details of horse harness from mound 36 at the Berel necropolis (Samashev, Borodovsky, 2004; Samashev, 2011: 287, 288). For several reasons, it is the most important source among the carved horn details of horse harness ever discovered in burial complexes of the Early Iron Age nomads in Eurasia. First, by the mid 1st millennium BC, the process of development of the nomadic economic and cultural type in this region had been completed (Veinstein, 1973; Veinstein, Kryukov, 1984), and the Berel necropolis belongs precisely to that period (Evraziya..., 2005: 75; Samashev, 2011: 287, 288). Second, nomadic tradition in different regions of Eurasia has varying degrees of self-sufficiency (Samashev, 2017a: 17), which is fully manifested in ancient bone carving. Third, as compared to the steppe regions of Kazakhstan, the southwestern part of the Altai Mountains shows peculiarity of the nomadic way of life (Ibid.). All these factors make the set of horn details of horse harness from Berel mound 36 particularly representative and informative.

Material and methods

The material for studying bone carving in nomadic societies has become the collection of horn details of horse bridle and harness (64 spec.) from Berel mound 36 (Fig. 1), which was explored by Z.S. Samashev in 2002–2004 (Samashev, Borodovsky, 2004). Almost all of the items have preserved the obvious remnants of natural structure of original horn raw material in the form of distinctive curvature, fragments of superficial keratinized canals, and combination of bone tissue and spongy substance. The methodological basis for studying horn items was structural and technological analysis, which made it possible to reveal the relationship between the natural features of raw material and the technology of manufacturing artifacts from organic material (solid horn). This method elucidates the influence of the original form of raw material on the morphology of blanks, reveals the operation sequence from the selection of material to finished items, and identifies specific features of some local and historical technological traditions. A constructive-morphological approach (Shchapova, 2000: 60, 67), in shaping the external appearance of the item, implies active use of the advantages given by the natural form of the original horn blank obtained from a certain

part of the antler (tines, branches, forks, beams, and burrs). Technical-morphological analysis (Pankovsky, 2015: 277) focuses primarily on the technique of processing raw materials, which in their finished form retained their natural shape affecting the final morphology of the item.

A combination of these approaches has made it possible to reveal that almost all horn items from Berel mound 36 (Fig. 2)* were made from one-piece horn plates (Fig. 3; see *Table*) of various sizes. Such blanks were obtained by cutting the beam of a solid deer (elk) antler and its forks. In all studied items, the dissection of antler beam and its forks appeared quite consistent (Fig. 3). Items made from tines, beams, and burrs of solid horn were absent from the details of horse harness. This feature clearly distinguishes Berel mound 36 from other Pazyryk burial complexes where a wide range of carved bone blanks was found.



Fig. 1. Location of the Berel necropolis.

*All photos and drawings are by A.P. Borodovsky.

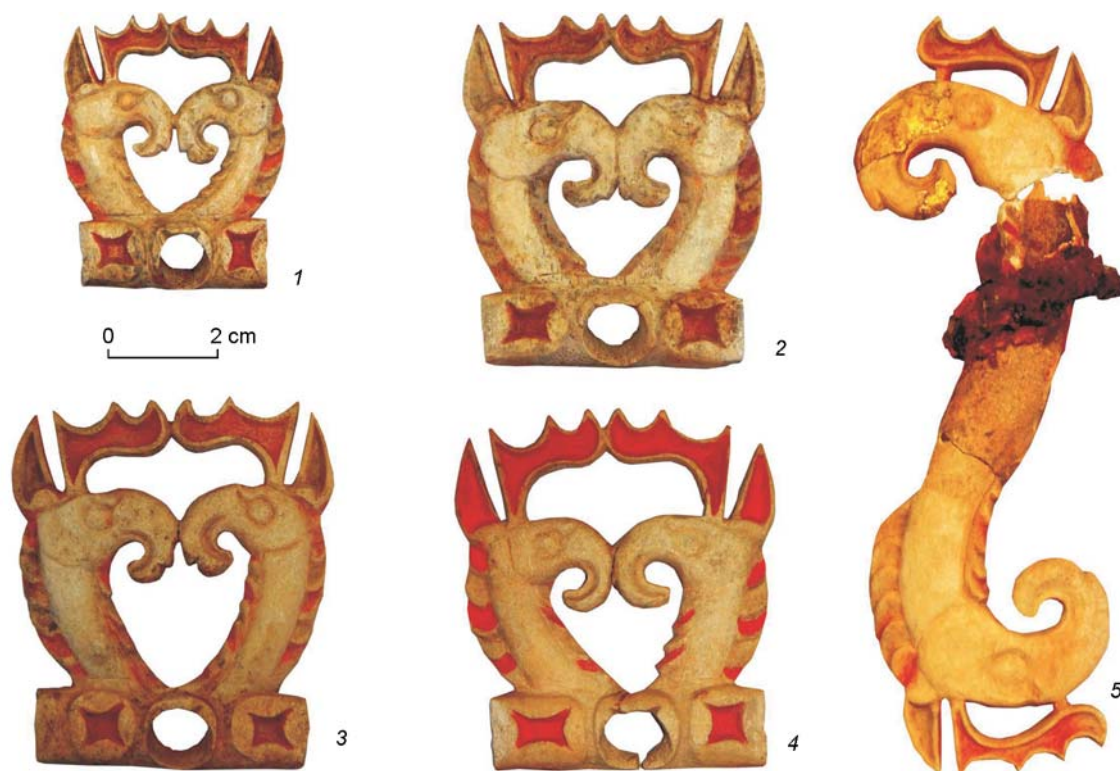


Fig. 2. Horn details of horse bridle and harness.

Noteworthy also is the use of one-piece plates obtained from antler forks and used in manufacturing some details of horse harness and bridle (B-36/15, 33, 39, 45, 46, 66), which makes the funerary offerings from Berel mound 36 look similar to those from the 2nd Pazyryk mound. An example is the forehead plaque with a carved image of horned predator devouring two waterfowl (Rudenko, 1948: Pl. III), which was also made of a one-piece plate cut from an antler fork.

Use-wear analysis of the collection of horn details of horse harness from Berel mound 36 has provided ambiguous results. According to E.Y. Girya, there were no traces of marking on horn items, while A.N. Usachuk identified them (Samashev, 2017b: 292, 293). However, it should be emphasized that preliminary marking before manufacturing various elements (spikes, holes) in the Early Iron Age bone carving were many times observed on mass-produced items (arrowheads, belt plaques, buckles, tubular beads, and combs) (Borodovsky, 1997: Pl. 31, 1–3; 52, 5; 53, 1). Marking indicates not only a plan of treatment, but also some kind of “blueprint” for the future product as reflection of a carrier of certain technological information before starting the process of item manufacture.

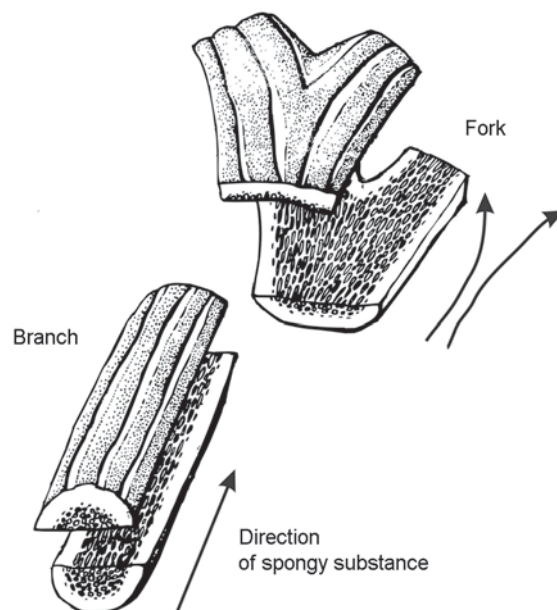


Fig. 3. Horn plates for parts of horse bridle and harness.

Notably, in manufacturing stock-produced articles, templates are needed for replication. Obvious similarity between a number of horn plaques (B-36/21, 23, 28, 30, 38, 40, 55, 57, 61, 62) with paired images of griffins from Berel mound 36 suggests the use of

Elements of bridle and harness from burial mound 36 at the Berel cemetery

Name of the item	Numbers	Amount	Blank
Plaque with griffin images	B-36/17–19, 21, 23, 25, 26, 28, 30, 32, 34, 35, 47–49, 51, 55, 57, 61, 62, 67	21	One-piece horn plate (wall of antler branch)
Y-plate (arched pendant)	B-36/15, 39, 46, 66	4	One-piece horn plate (antler fork)
Rounded horn plaque (round browband)	B-36/33	1	"
Large teardrop-shaped plaque (ring-shaped poitrail)	B-36/45	1	"
Elongated teardrop-shaped plaque (nose pendant)	B-36/41	1	One-piece horn plate
Cheek-pieces	B-36/54, 56	2	One-piece horn plate (wall of antler branch)
Bone plate	B-36/3, 4, 43	3	One-piece horn plate
Narrow plate	B-36/1, 2, 10	3	"
Oblong plate	B-36/36, 37, 40, 44, 52, 60, 63	7	"
Strip with ornamentation in relief	B-36/9, 13, 14, 16, 20, 22, 24, 27, 29, 31, 58, 64, 65	13	"
Bone clasp with a hole in the middle	B-36/5	1	"
Bone rim of saddle pad	B-36/6	1	"
Fragment of a bone item	B-36/7	1	"
Girth buckle	B-36/8	1	"
Front fragment of saddle rim	B-36/11	1	"
Front right fragment of saddle rim	B-36/12	1	"
Small rounded detail	B-36/59	1	"
Small detail with a hole	B-36/68	1	"

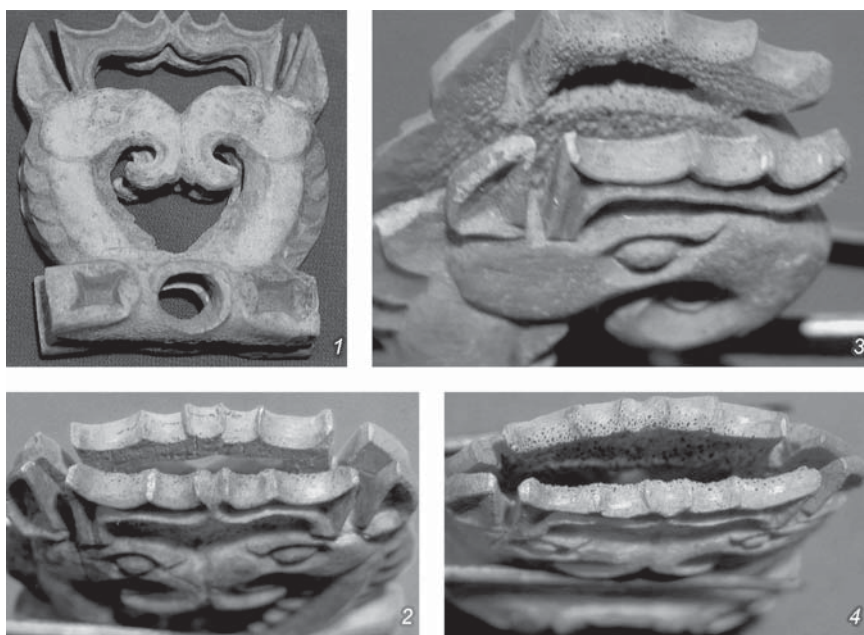


Fig. 4. Paired horn plates with images of griffins.

some initial sample as a basis for marking. An indirect confirmation is the mirror-like joining of a number of finished plaques (Fig. 4). Such correspondence was also typical of plate cheek-pieces with griffin

images (see Fig. 2, 5; 5). This evidence suggests that some finished product served as initial sample (Shchapova, 2000: 113). Such item was a carrier of information, and some population, personified by carver craftsmen, knew its methods of reproduction (Ibid.: 114). Moreover, the sample itself (griffin image) was one of the most vivid symbols of the Early Iron Age nomadism and had clearly expressed local features.

The absence of traces of raw material cutting on the horn items from Berel can be explained by their multiple processing, manifested not only by thoroughness in executing all

decorative and contour elements on the items, but also by the application of various holes on their ornamented surfaces (Fig. 6, 1). This production algorithm is especially clearly revealed in cutting inclined holes

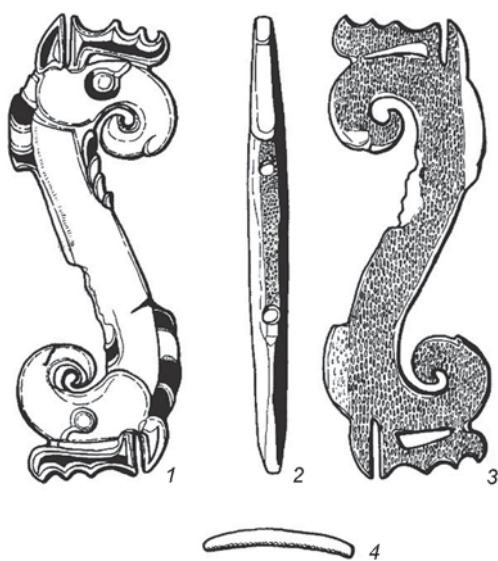


Fig. 5. Trace-drawing of a horn cheek-piece.

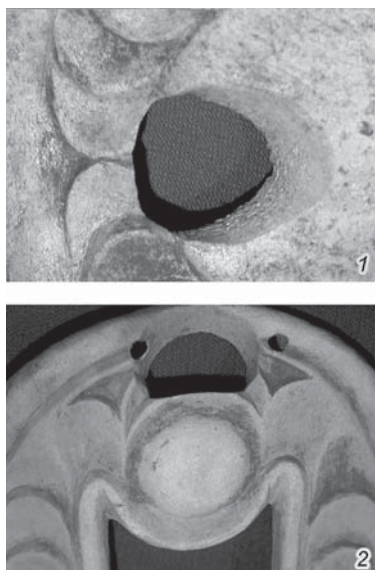


Fig. 6. Holes cut in ornamentation.

for inserts in the bases of horn plaques. The base strips were decorated with three rounded bulges with cross-shaped depressions (see Fig. 2, 1–4). Traces of cutting off the décor for making the hole are clearly visible in the central part. Along with these items, the collection contains several similar decorated strips where such an ornamental element was not cut off (Fig. 7, 5, 6; 8, 3, 4). All this clearly shows the sequence of creating decorative elements and their subsequent cutting off for making fastening holes. No less important is the

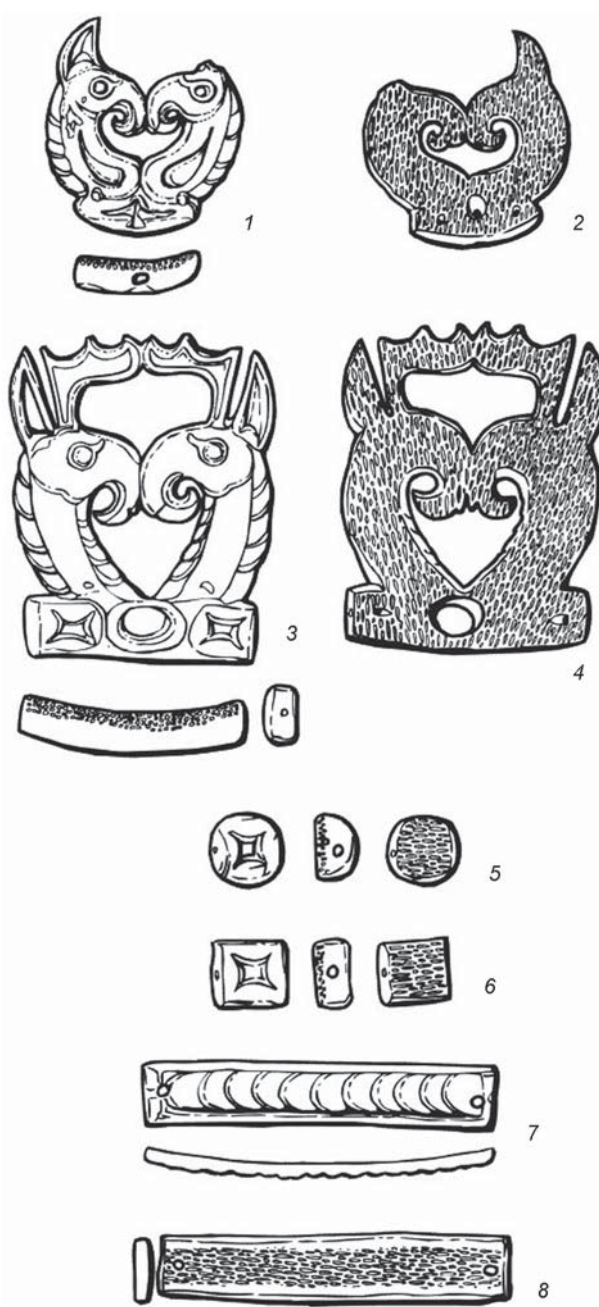


Fig. 7. Trace-drawings of parts of horse bridle and harness.

fact that the strip with three bulges and cross-shaped cutouts thereon appears both as part of the item (B-36/18, 32, 38) and as individual similar elements (B-36/59, 68) (see Fig. 7, 3–6; 8).

Technological features of executing similar decorative elements and images in the extensive series of carved bone items also reflect the level of professionalism of their creators. The suggestion made by Giryа and Usachuk that there were several craftsmen working on the horse harness set from

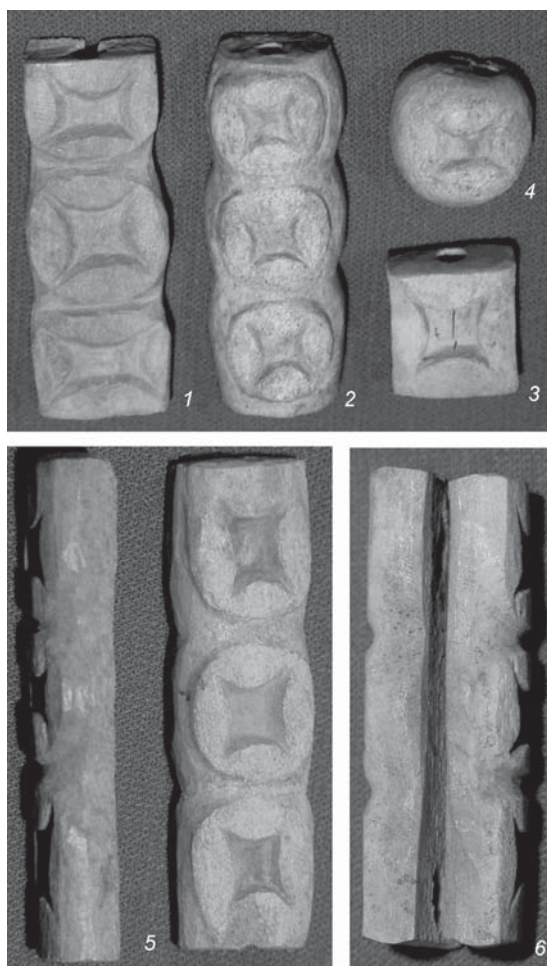


Fig. 8. Ornamented horn strips.



Fig. 9. Multidirectional trimming of plumage on the inner side of the necks of paired griffins depicted on the plaques of horse bridle and harness.

Berel mound 36 (see (Samashev, 2017b: 295)) can be illustrated not only by obvious differences in carving the general outline of the plaques, but also by the distinctive execution of some elements of griffin

images (eyes, ears, cheekbones, beaks, horns, and neck plumage). Such features appear most clearly in rendering the plumage on the inner part of griffins' necks. For example, in some items (B-36/17, 19, 26, 35, 47, 49, 61, 67) it has oppositely aligned direction (see Fig. 2, 1; 7, 3), while in others (B-36/28, 30) opposite orientation to each other (see Fig. 2, 4) or consistently directed orientation (B-36/21, 23, 57, 62) (see Fig. 2, 2, 3; 9). These features can be explained not only by the errors of the carvers, but also by the presence of several craftsmen. This might have been a reflection of work carried out by different artisans on ready-made templates on standard blanks of plaques with griffin images while finishing their decoration.

Discussion

A closer look at the set of horn details of horse harness from Berel mound 36, using material science, technical-morphological, and use-wear analysis, shows that it reflects the peculiarity of bone carving among Early Iron Age nomads in the Altai-Sayan. Its distinctive features include the following. First, finished products in the funerary offerings of burial sites are significantly dispersed*. Second, specific carved bone items quickly spread over large distances and marked the presence or influence of nomadic groups. Examples include parts of weaponry (arrowheads, bow overlays, horse-bridle fittings), as well as individual types of product made from specific blanks, such as burrs of shed antlers of animals with solid antlers (red deer, elk). In turn, items made from the bone and horn of migratory animals (roe deer, saiga, black-tailed gazelle), appearing in the areas adjacent to steppe regions, by no means always serve as a sign of mobile bone-carving tradition, since this material could have been processed by local craftsmen. Third, semi-finished items and blanks are almost completely absent from the carved bone artifacts discovered in burials of nomads. The exceptions are isolated burial sites of the Early Iron Age (Berel, mound 36) (Samashev, Borodovsky, 2004) and Middle Ages (Kara-Koba-1) (Borodovsky, Samashev, Sirazheva, 2017) in the Kazakh Altai. This

*Distances between burial complexes with bone-carved items found in the steppe Kazakhstan are quite comparable with the length of nomadic routes (Gutsalov, 2011: 12). Such localization reflects the dispersion as one of the main features of nomadic culture (Masanov, 1995: 122; Gutsalov, 2011: 12).

region is geographically, culturally, and historically more close to the Altai-Sayan Highland in the east rather than steppe regions of Kazakhstan in the west.

Different levels of production skills, which were observed after use-wear analysis of the horn details of horse harness from Berel mound 36, resulting from the work of several craftsmen (Samashev, 2017b: 295), may reflect another feature of bone carving—cooperation for the purpose of the cohesive integrity of the production process in nomadic societies (Masanov, 1995: 126). In the set of horse harness from Berel mound 36, this feature is additionally confirmed by the coloring and metal (tin, gold) coating of the items (Borodovsky, 2014, 2016; Samashev, 2017b). Such decoration was another stage of work, yet not directly related to bone carving.

Generally, carved bone parts of bridle and harness details (browband, poitrail, dispensers) from Berel mound 36 were made of one-piece horn plates obtained from antler forks. In the Early Iron Age, such blanks were also used for manufacturing wide belt plaques (Borodovsky, 2007: 119, fig. 102; p. 139, fig. 121). This emphasizes the natural connection and complementarity of individual parts of horse equipment (plaques, overlays, tubular beads, buckles) and belt fittings (Shulga, 2003: 82, 83). The technological versatility of original blanks in bone carving clearly reflects the principle of optimality typical of nomadism (Gutsalov, 2011: 12; Bokovenko, 2024: 47).

There is a marked similarity in the compositional features of the Berel horn plaques with images of griffins and wooden bridle decorations from the Pazyryk burials on the Ukok plateau (Ak-Alakha-1, -3, -5, Kuturguntas, Verkh-Kaldzhin) (Polosmak, 1994: Fig. 55, 58; 2001: Fig. 25–28, 56, 58, 60, 65, 82). Such similarity can be interpreted not only as close interaction between the bone-carving and wood-working industries in the Pazyryk period, but also as an integrative feature of various types of craftsmanship, which was quite typical of nomadic societies (Masanov, 1995: 126, 130).

Another important feature of nomadism is cyclicity (Bokovenko, 2024: 40). It occurs, among other things, in the Early Pazyryk burial complexes with burials of horses in the Altai Mountains, in the form of archaic harness (Shulga, 2015: 245, fig. 16). Usually, this feature is interpreted as a chronological paradox (Chlenova, Kubarev, 1990: 53, 54) caused by territorial isolation. However, for nomadic societies, this factor was relative, since with this type of economy, dispersion was always combined with

integration (Masanov, 1995: 115, 122, 130), which was typical not only of social aspects, but also of the production process (Ibid.: 115, 122, 126, 130).

The archaic appearance of certain elements of material culture in the form of bone carving could have been caused by cyclic processes (Bokovenko, 2024: 41, 47, 48). In this case, one and the same type of optimal blank was reproduced over a fairly long period of time. This is especially clearly demonstrated in cheek-pieces made from one-piece horn plates (see Fig. 3, 5). This type of blank for rod-shaped cheek-pieces had been widely used in vast steppe expanses of Eurasia since the Early Scythian period. The nomadic mode of production was based on rationality (Masanov, 1995: 120), which could not but be reflected in bone carving, replicating over time the optimal technology once created.

Another important feature of ancient bone carving among the nomads was marginality of processes involving concentration of cultural tradition (Ibid.: 130). In this context, it is no coincidence that the set of bone-carving items from Berel mound 36 demonstrates the highest concentration of carved bone artifacts in a Pazyryk grave with the accompanying horse burial. In other Pazyryk burial complexes of the Central Altai, both ordinary (Borotal-1, Baragash, Ala-Gail-3, Barangol-2) and elite (Pazyryk, Bashadar, Tuekta, Shibe, Katanda), such ornaments are quite rare.

In the context of identifying the local peculiarity of bone-carving in nomadic societies of the second half of the 1st millennium BC, the location of the Berel cemetery can be described as a frontier on the border of mountain and steppe zones. In the Early Iron Age, a special form of economy with limited seasonal nomadism in the intermountain basins emerged in this region (Samashev, 2017a: 14). This way of life could not but influence specific aspects of bone carving, revealed by the evidence from the Berel cemetery.

Conclusions

The Berel set of horse equipment items is extremely important for zoning the specific features of bone carving among Early Iron Age nomads in the present-day Kazakhstan. A number of unique local bone-carving industries emerged in the Scythian period in vast expanses from the Aral Sea region to the Altai Mountains. The evidence from the Berel necropolis, located in Eastern Kazakhstan, indicates a close connection of ancient bone carving with the Altai-Sayan Highland and the Upper Ob River

basin. The main features of nomadism—dynamism, dispersion, optimality, self-sufficiency, rationality, and cyclicity—are fully manifested in the set of artifacts from the grave with the accompanying horse burial in Berel mound 36. Such features are clearly associated with the mountain summer cattle-breeding. This specificity of nomadic economy provided bone carving with clear advantages in access to mass sources of raw materials (solid horn), relative stationarity of production, and continuity in specialization of craftsmen. Notably, the problem of originality of bone carving among Early Iron Age nomads is much broader, and requires identification and clarification of historical and territorial peculiarity. This concerns the Scythians, Sarmatians, Saka people, Pazyryk people, and the multicultural population of the Scythian period in present-day Tuva, as well as inhabitants of the adjacent vast regions with whom various groups of nomads came into contact.

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Embossed Silver Medallions from Northwestern Siberia

This study describes a specific category of jewelry—round medallions made from silver foil with bent edges and inside hoops made of copper wire; the obverse is decorated with representations embossed on a die. The sample includes 27 items. Compositions on the obverse are of six types: horseman smashing an unmounted warrior; rider on horseback; man riding a mythical animal; rider with saber on horseback; falconer; animals. A suggestion is made that embossed medallions imitate medieval plaques with falconers by their round shape, size, and the depiction of mounted characters. The technique of embossing silver foil on a die was elaborated on certain 12th–14th-century armguards. They could be prototypical also with regard to animal compositions, specifically those showing lions with open mouths and protruding tongues. Medallions and armguards from silver foil embossed on dies with wire hoops inside, as well as thin-walled bowls with elevated rims, belong to a group of silver items manufactured at Russian Permian jewelry center in the 15th–16th centuries. Medallions were manufactured for exchange with natives during the northward advance of Russian troops in Western Siberia. They were used in rituals by Voguls (Mansi) and Ostyaks (Khanty), who had long practiced a tradition of using imported silverware. It can be suggested that medallions with compositions resembling the canonical scene “Miracle of St. Demetrius of Thessaloniki Concerning Tsar Kaloyan” were imported to Siberia for missionary purposes.

Keywords: Medallions, embossing on dies, silver, horseman, attribute, fortified settlement.

Introduction

Details of imported silver items of the 4th–19th centuries from archaeological and ethnographic sites in northwestern Siberia have been published many times, with indication of routes and time of their arrival (see, e.g., (Smirnov, 1909; Chernetsov, 1947; Darkevich, 1976; Sokrovishcha Prioby, 1996; Baulo, 2004; Komova, Pristupa, 2012; Marshak, 2017; Fedorova, 2019; and others)). In the literature, one of the least discussed stages in the penetration of silver items is the 14th to 17th centuries—the time after the decline of the Volga Bulgaria, up to the beginning of the advance of the Russians into Siberia.

In recent years, an accumulation of evidence from collections in several Siberian museums, as well as from

archaeological and ethnographic research, has made it possible to identify a specific group of artistic items—round medallions made from thin silver sheet (foil) with bent edges and copper wire hoops inside, with the obverse decorated with representations embossed on a die. Several items in this group have been previously described as plaques, as indicated below. In my opinion, their round shape and small size allow us to designate them as medallions. The subjects on these items include several varieties of images of horsemen and animals.

Description of medallions

1. Medallions depicting a horseman and a fallen warrior. All five specimens have the base cut out



of foil and fixed to the wire hoop with bent edges; the decoration was made by embossing on a die.

1.1. Medallion (Fig. 1, *a*) was found by I.L. Istomin near the village of Shuryshkary in the Shuryshkary District of the Yamal-Nenets Autonomous Okrug. Its diameter is 7.4 cm, its weight is 5 g, the silver fineness mark is 925. The item is kept in the Museum of Nature and Man (KM 12826) (Baulo, 2007: Fig. 5; 2019: Fig. 4; Komova, Pristupa, 2012: Cat. No. 52; Karacharov, 2016: Fig. 2, 8). The edges are bent to the obverse side. There are two late uneven punched holes for fastening.

The central medallion is decorated with a groove chased on the obverse. It is followed by a wide band of ornamentation of bindweed with spiral offshoots. A rider on horseback, sitting “in the female manner”, that is, sidesaddle, is depicted in the center of the item. His face is round, with large round eyes; his nose is triangular. The rider’s torso narrows towards the belt. His clothing is decorated with horizontal stripes (fasteners?); the lap resembles a knee-length skirt. His legs are thin; his feet are turned to the right. The horse is shown in motion; its neck is decorated with horizontal stripes; four small diamond-shaped figures in relief are below on the chest. The rider is holding the horse’s bridle with his left hand; in his right hand he may be holding the handle of a whip or saber. What seems to be a rope goes down from it; the lower end of the rope encircles the neck of the lying warrior holding saber in his right hand. Another version is that it is a spear with which the rider strikes downwards.

Fig. 1. Medallions with images of horseman and defeated warrior, including those from the collections of the Museum of Nature and Man (*a*) and the Shemanovsky Yamal-Nenets District Museum and Exhibition Complex (*b*).

1.2. Medallion found by the Istomin brothers near the village of Shuryshkary (Fig. 1, *b*). Its diameter is 6 cm, its weight is 10.4 g. The edges are bent to the reverse. A loop for hanging is soldered to the medallion; a later hole has been punched through. The diameter of the item is reduced, since a wide band with bindweed ornamentation was made close to the edge. It is kept in the Shemanovsky Yamal-Nenets District Museum and Exhibition Complex (hereinafter, the Shemanovsky MEC)

(YNM-12971) (Rudenko, 2015: Ill. 173; Fedorova, 2019: Fig. 23, 3).

1.3. Medallion from the vicinity of the village of Shuryshkary. Its diameter is 6.3 cm; the edges are bent to the reverse (Rudenko, 2015: Fig. 184). The ornamentation motif is bindweed.

1.4. Medallion from the Us-Nel fortified settlement in the Severnaya Sosva River basin, Berezovsky District of the Khanty-Mansi Autonomous Okrug–Yugra. Its diameter is 6.2 cm, its weight is 6.8 g, the silver fineness mark is 925. The edges are bent to the reverse. A loop for hanging is soldered to the item; two late holes are punched through. The horseman is evidently holding a saber in his right hand. The item is kept in the Museum of Nature and Man (KM 12384) (Baulo, 2009: Fig. 6; Komova, Pristupa, 2012: Cat. No. 48).

1.5. Medallion from the vicinity of Khanty-Mansiysk (Fig. 1, c). Its diameter is 5.8 cm. The edges are bent toward the obverse. A large uneven hole is punched at the top. The wide band with herbal ornamentation is replaced by the band with a cord-like pattern.

Moreover, a larger item (12.5 cm in diameter) with a similar subject was discovered in the vicinity of the village of Urol (Cherdynsky District, Perm Territory). This is a thick round plaque consisting of several layers of silver and having a bronze loop for hanging (Baulo, 2019: Fig. 4).

Regarding the subject depicted on this type of medallion, scholars have suggested that it correlates with the canonical Christian scene “Miracle of St.

Demetrius of Thessaloniki Concerning Tsar Kaloyan” (Karacharov, 2016: 279; Baulo, 2019: 108).

2. Medallions depicting a horseman on horseback. All ten specimens have edges bent to the reverse and decoration by embossing on a die. The central circle is framed by wide band of bindweed ornamentation with spiral offshoots.

2.1. Medallion (Fig. 2, a) from the vicinity of the village of Shuryshkary. Its diameter is 7 cm, thickness is 0.2 cm. It is kept in the Shemanovsky MEC (YNM-15367/7). The horseman is depicted wearing a cone-shaped hat, with his arms down; his body is turned towards the viewer. The horse is shown moving to the left.

2.2. Medallion from the vicinity of the village of Shuryshkary. Its diameter is 6.4 cm. A hole has been punched in the upper part for fastening. It is kept in the Shemanovsky MEC (YNM-15368/12). The horseman in the center is moving to the left.

2.3. Medallion from surface finds at the Ust-Voikary fortified settlement (?), Shuryshkary District, Yamal-Nenets Autonomous Okrug. Its diameter is 6.4 cm. The edge is broken off. It is kept in the Shemanovsky MEC (YNM-15769/110). The horseman in the center is moving to the right.

2.4. Medallion from the Us-Nel fortified settlement. Its diameter is 6.6 cm, its weight is 8.9 g, the silver fineness mark is 925. It is kept in the Museum of Nature and Man (KM 12383). A loop is soldered to the item; traces of solder are visible on the back.



Fig. 2. Medallions with images of a horseman, including those from the collections of the Shemanovsky MEC (a).

Horizontal stripes (fasteners?) are on the upper part of the horseman's clothing; the lower part is hatched with vertical lines (Baulo, 2009: Fig. 7; Komova, Pristupa, 2012: Cat. No. 47; Karacharov, 2016: Fig. 2, 9; Fedorova, 2019: Fig. 23, 5).

2.5. Medallion (Fig. 2, *b*) is an attribute of the Khanty sacred place, Oktyabrsky District, Khanty-Mansi Autonomous Okrug–Yugra. Its diameter is 5.8 cm. A loop for hanging is soldered to the reverse. The horseman in the center is moving to the left.

2.6. Medallion from the Mansi sacred place in the upper reaches of the Severnaya Sosva River (Berezovsky District, Khanty-Mansi Autonomous Okrug–Yugra), used as a sacrificial gift. Its diameter is 6.8 cm. The horseman in the center is moving to the left.

2.7. Medallion from a Khanty sacred barn, Oktyabrsky District, Khanty-Mansi Autonomous Okrug–Yugra. Its diameter is 6.2 cm, its weight is 5 g. The horseman in the center is moving to the left.

2.8. Medallion from the vicinity of the village of Shuryshkary. Its diameter is 6.6 cm. A hole has been punched in the upper part (Fedorova, 2019: Fig. 23, 4). The horseman in the center is moving to the left.

2.9. Medallion from northwestern Siberia. Its diameter is 6 cm. There is a crudely punched hole. The horseman in the center is moving to the left.

2.10. Medallion from northwestern Siberia. Its diameter is 6.8 cm. There is a punched hole. The horseman in the center is moving to the left.

3. Medallions depicting a rider on a mythical animal.

3.1. Medallion (Fig. 3) was found by M.L. Istomin on the shore of Lake Shuryshkarsky Sor, Shuryshkary District, Yamal-Nenets Autonomous Okrug. Its diameter is 6.7 cm, its weight is 3.9 g. The item is kept in the Shemanovsky MEC (YNM 14250).

The base of this item was cut out of foil and fixed to the wire hoop with edges bent to the obverse. The decor was made by embossing on a die. The central circle is framed by four narrow bands and one wide band decorated with circles in groups of nine or twelve. Two narrow bands are filled with pearls; one with transverse stripes, and another band with groups of such stripes separated by a plain field.

In the central circle, a man is shown in a stylized manner mounted on an animal; his torso and legs are visible. He is holding a saber with wide blade in his left hand and mace in his right hand. The animal is depicted moving to the right; its legs have claws; the upper and lower ends of its muzzle are pointed and bent outward; a long tongue is sticking out of its mouth; its body is shaded with horizontal stripes in relief; its tail is raised.



Fig. 3. Medallion with image of man riding a mythical animal. The collection of the Shemanovsky MEC.

3.2. Medallion from a Khanty sacred barn, Oktyabrsky District, Khanty-Mansi Autonomous Okrug–Yugra, used as a sacrificial gift. Its diameter is 6.7 cm. The edge is broken off (the wire has not been not preserved); the item has a punched hole. Ornamentation is as on the previous item.

4. Medallions depicting a horseman holding a saber in his hand.

4.1. Medallion (Fig. 4, *a*) was found on a sandbank during a survey at the Alekseevka-1 fortified settlement, Kondinsky District, Khanty-Mansi Autonomous Okrug–Yugra (Sobolnikova, Kuzina, Mukhyarova, 2018: 99). Its size is 65 × 53 × 4 mm, the silver fineness mark is 900. The item is kept in the Museum of Nature and Man (KM 17366/13).

The base of this item was cut out of foil and attached to the wire hoop (not preserved) by bent edges. Seven holes for fastening were punched along the edge of the surviving part of the item. The decor was made by embossing on a die. The central circle is decorated with a groove chased on the obverse. It is followed by a wide band decorated with bindweed ornamentation with spiral offshoots. A profile image of a horseman moving to the left is in the center of the composition. He is holding a bridle with his right hand and a raised saber with his left hand. The caftan fasteners are shown as horizontal stripes in relief. The image of the horse is realistic.

4.2. Medallion (Fig. 4, *b*) is an attribute of a Khanty sacred place, Surgutsky District, Khanty-



Fig. 4. Medallions with images of horseman holding a saber in his hand, including those from the collection of the Museum of Nature and Man (a).

Mansi Autonomous Okrug–Yugra. Its diameter is 6.4 cm. Several small holes for fastening are punched in the edge. A horseman is depicted holding a saber in his right hand and wearing a conical headdress in the central circle framed by a wide band with bindweed ornamentation. A bird figure is shown above the left hand of the horseman.

4.3. Medallion from the vicinity of the village of Shuryshkary. Its diameter is 6.6 cm. A large hole has been punched at the top under the rim. The horseman is depicted holding a saber in his right hand and a bird in front of him (Fedorova, 2019: Fig. 23, 6).

4.4. Medallion from the vicinity of the village of Shuryshkary. Its diameter is 6.4 cm. A hole has been punched in the upper part. The horseman is depicted holding a saber in his right hand. The item is kept in the collection of the Shemanovsky MEC (YNM-15400/12).

4.5. Medallion (Fig. 4, c) from a Khanty sacred place in the Sob River basin, Priuralsky District, Yamal-Nenets Autonomous Okrug. Its diameter is 7.5 cm. The horseman is shown holding a saber raised above his head. The circle with the horseman is framed by a narrow strip of pseudo-twisted cord; a wide band with ornamentation of inclined pear-shaped figures in relief is behind it.

5. Medallion with a falconer image (Fig. 5) from the Trans-Urals. Its diameter is 7.8 cm. The edges are broken off; the wire hoop has not survived. The decoration was made by embossing on a die. A horseman wearing a helmet is depicted in the central circle decorated with a narrow pseudo-twisted edging. The horseman is holding a bird in his right hand; his left hand is raised up; a solar sign is above it. The horseman is surrounded by two snakes and possibly a frog.

6. Medallions with images of animals.

6.1. Medallion (Fig. 6, a) from a Khanty sacred barn, Oktyabrsky District, Khanty-Mansi Autonomous Okrug–Yugra. Its diameter is 5.9 cm. The base of the item is cut out of foil and attached to wire hoop with edges bent on the obverse. A hole for fastening has been punched in the item. The decor is made by embossing on a die. A clawed animal (lion?) is shown jumping to the right; its tail is raised; a long tongue is



Fig. 5. Medallion with a falconer image.

sticking out of the mouth. The image is surrounded by a wide band of pseudo-twisted cord.

6.2. Medallion from the Oktyabrsky District, Khanty-Mansi Autonomous Okrug–Yugra. Its diameter is 7 cm. The edges are bent on the reverse. A large hole for fastening has been punched in the item. The image of the animal is identical to the animal on the previous medallion. It is surrounded by a wide band of transverse stripes.

6.3. Medallion (Fig. 6, *b*) from a Khanty sacred barn in the Kunovat River basin, Shuryshkarsky District, Yamal-Nenets Autonomous Okrug. Its diameter is 6.3 cm. The edges are bent on the reverse. A hole for fastening has been punched in the item. The image of the animal is identical to that on the previous medallion, but is oriented to the left and surrounded by a wide band with bindweed ornamentation.

6.4. Medallion (Fig. 6, *c*) from a Khanty sacred barn, Oktyabrsky District, Khanty-Mansi Autonomous Okrug–Yugra. Its diameter is 6.2 cm. The edges are bent on the reverse. A deer with antlers is depicted in a circle of four narrow strips of pseudo-twisted cord. A wide band with braid-shaped ornamentation is between the pairs of cord stripes.

Cultural and chronological attribution of medallions

Thus, the total number of sources is 27 specimens (see *Table*). There are six subjects: horseman smashing an unmounted warrior (5 spec.), rider on horseback



a



b



c

Fig. 6. Medallions with images of animals.

Medallions from silver foil embossed on dies

No.	Composition	Place of discovery	Context of the find	Diameter, cm	Ornamentation	Loops and holes	Bent edges
1.1	Rider and warrior	Shuryshkary	Fortified settlement or sacrificial site	7.4	Bindweed	Hole	To the obverse
1.2	"	"	"	6.0	"	Loop, hole	To the reverse
1.3	"	"	"	6.3	"	–	"
1.4	"	Severnaya Sosva	Us-Nel fortified settlement	6.2	"	Loop, two holes	"
1.5	"	Khanty-Mansiysk	?	5.8	Pseudo-twisted cord	Hole	To the obverse
2.1	Rider on horseback	Shuryshkary	Fortified settlement or sacrificial site	7.0	Bindweed	–	To the reverse
2.2	"	"	"	6.4	"	Hole	"
2.3	"	Ust-Voikary	Fortified settlement ?	6.4	"	–	"
2.4	"	Severnaya Sosva	Us-Nel fortified settlement	6.6	"	Loop	"
2.5	"	Oktyabrsky District of the Khanty-Mansi Autonomous Okrug–Yugra	Sacred place of the Khanty	5.8	"	"	"
2.6	"	Severnaya Sosva	Sacred place of the Mansi	6.8	"	–	"
2.7	"	Oktyabrsky District of the Khanty-Mansi Autonomous Okrug–Yugra	Sacred place of the Khanty	6.2	"	–	"
2.8	"	Shuryshkary	Fortified settlement or sacrificial site	6.6	"	Hole	"
2.9	"	Northwestern Siberia	?	6.0	"	"	"
2.10	"	"	?	6.8	"	"	"
3.1	Rider on an animal	Shuryshkarsky District of the Yamal-Nenets Autonomous Okrug	Fortified settlement or sacrificial site	6.7	Pearls, transverse stripes	–	To the obverse
3.2	"	Oktyabrsky District of the Khanty-Mansi Autonomous Okrug–Yugra	Sacred place of the Khanty	6.7	"	Hole	?
4.1	Rider with saber on horseback	Kondinsky District of the Khanty-Mansi Autonomous Okrug–Yugra	Alekseevka-1 fortified settlement	6.5	Bindweed	"	To the reverse
4.2	"	Surgutsky District of the Khanty-Mansi Autonomous Okrug–Yugra	Sacred place of the Khanty	6.4	"	"	"
4.3	"	Shuryshkary	Fortified settlement or sacrificial site	6.6	"	"	"
4.4	"	"	"	6.4	"	"	"
4.5	"	Priural'sky District of the Yamal-Nenets Autonomous Okrug	Sacred place of the Khanty	7.5	Pseudo-twisted cord	–	"
5	Falconer	Trans-Urals	?	7.8	"	–	"
6.1	Lion	Oktyabrsky District of the Khanty-Mansi Autonomous Okrug–Yugra	Sacred place of the Khanty	5.9	"	Hole	To the obverse
6.2	"	"	?	7.0	Transverse stripes	"	To the reverse
6.3	"	Kunovat River basin	Sacred place of the Khanty	6.3	Bindweed	"	"
6.4	Deer	Oktyabrsky District of the Khanty-Mansi Autonomous Okrug–Yugra	"	6.2	Pseudo-twisted cord, braid	–	"

(10 spec.), rider on a mythical animal (2 spec.), rider with saber on horseback (5 spec.), falconer (1 spec.), and animal figures (4 spec.). The diameter of the items varies from 5.8 to 7.8 cm, with the most common diameter of 6.2–6.7 cm. Only four items have edges bent on the obverse. Four medallions have loops. Later holes were punched in 16 items. The main ornamental motif is bindweed band with offshoots (19 spec.). Pseudo-twisted cord, pearls, stripes, and braid appear on eight items.

The largest number of medallions was found in the Shuryshkarsky District of the Yamal-Nenets Autonomous Okrug (11 spec.) and Oktyabrsky District of the Khanty-Mansi Autonomous Okrug–Yugra (6 spec.). In the first area, the finds come mainly from the vicinity of the village of Shuryshkary from surface finds collected by the brothers I.L. and M.L. Istomin, and by N.G. Rochev in the late 1960s to early 1970s. Two archaeological sites—Belaya Gora and Chernaya Gora—were located there, 300 m from the western border of the village (Syrkina, 1983: 182). These sites have now completely disappeared after the terrace collapsed into Lake Shuryshkarsky Sor. The above persons could not remember any details about the location and circumstances of discovering the finds when we met. Numerous silver armguards, forehead adornments, bowls, bronze artistic casting items, and weaponry that were discovered there (see, e.g., (Syrkina, 1983; Sokrovishcha Prioby, 1996, 2003; Fedorova, 2019; and others) were most likely a part of a large medieval sanctuary which functioned at least until the early 20th century.

The attribution of the medallions is complicated by the fact that they are not associated with dated sites; in fact, all of them are surface finds from archaeological sites or modern sacred places of the Ob Ugrians. There remains the possibility of attribution from parallels. For this, we will consider three groups of silver items: plaques with a falconer image, armguards (shields), and bowls. A separate group of dishware, forehead ornaments, and plaques made of thin sheet silver by embossing on a die was identified by N.V. Fedorova. She believed that medallions with a subject of “horseman and fallen warrior” had plaques with a falconer image as their prototypes (2019: 87). Medallion No. 5 is included in this group, although images on all such plaques were made by engraving or chasing on the obverse, often using blackening and gilding; in addition, the wire hoop is missing (see, e.g., (Ibid.: Fig. 19)).

Medallion with an anthropomorphic figure (Fig. 7, *a*) from the Khanty-Mansi Autonomous Okrug–Yugra (diameter 7 cm) can be regarded as an intermediate link between plaques with a falconer image and medallions with a wire hoop. This item stands out from the general group, since one of its important features—making the image by embossing on a die—is missing. However, other principles are observed: the base of the item is cut out of foil and fixed on the wire hoop with edges bent to the obverse. The circle in the center is framed by wide band, which is ornamented with braid bounded by stripes of niello. Three holes are punched in the item. In the center of the composition, there is likely a figure of a shooter wearing long caftan with clasps. He is holding a saber in his right hand; two images are below



Fig. 7. Medallion (*a*) and plaque (*b*) with a shooter image.



Fig. 8. Silver armguards.

his left hand and next to it: one looks like a snake, the other like a club. Generally, this anthropomorphic representation resembles a figure of a shooter with a saber (diameter 6.5 cm) depicted on a silver plaque that was a sacrificial gift at a sacred site near the village of Khulimsunt, Berezovsky District, Khanty-Mansi Autonomous Okrug–Yugra. The Mansi believed that the plaque depicted *Mir-susne-khum*, the youngest son of the Supreme God (Fig. 7, b) (Gemuev, Baulo, 1999: 80).

As for the armguards found on the shore of Lake Shuryshkarsky Sor, N.V. Fedorova attributed them to the products of Volga Bulgaria of the 12th–14th centuries (Sokrovishcha Prioby, 2003: 71). These are distinguished by engraved images and braided ornamentation. An exception are three identical shields from the same period with herbal ornamentation, which were made by embossing silver sheet on a die and fastening it on the wire hoop (Syrkina, 1983: Fig. 10; Sokrovishcha Prioby, 2003: 71; Baulo, 2007: Fig. 1).

An ornamental band decorated with bindweed was found only on the Shuryshkary shield with

two figures of lions (Syrkina, 1983: Fig. 7; Fedorova, 2019: Fig. 21, 7). Their postures and tongues protruding from their mouths resemble images of animals on medallions 6.1–6.3. There is even more similarity with figures of two lions on another shield from Shuryshkary (Fedorova, 2019: Fig. 21, 2). Thus, it can be assumed that medallions 6.1–6.3 also show stylized representations of lions.

Fedorova believed that the latest armguards were items made from silver foil, sometimes covered with gilding; these can be dated to the 15th–16th centuries (Ibid.: 86, 147, fig. 21, 8). These shields are distinguished, among other things, by bindweed as ornamental motif (Ibid.; Baulo, 2013: Fig. 35a; Zykov, Koksharov, 2002: 36). Vivid examples of such items are two specimens from Essky Island, which A.P. Zykov and S.F. Koksharov also dated to the 15th–16th centuries (2002: 36), and two artifacts from the destroyed sacred barn of the Mansi in the village of Lombovozh, Berezovsky District, Khanty-Mansi Autonomous Okrug–Yugra. The pattern on one of them* (Fig. 8, a) recurs on the shield from a Pelym Mansi sacred barn; another** (Fig. 8, b) is identical to one of the shields from Essky Island.

Thus, medallions with embossing could have borrowed their round shape, size, and equestrian subject from the plaques with a falconer image. The technology of creating images by embossing silver foil on a die was perfected on a number of armguards of the 12th–14th centuries. Subjects with animals—in particular, figures of lions with open mouths and protruding tongues—could have also been borrowed from such armguards. The late group of armguards (15th–16th centuries), most likely together with embossed medallions, belonged to a single artisanal center.

Important information about the die-embossed medallions can be obtained by comparing them

*Its size is 10.7 × 6.4 cm. Two holes are punched in the edge. The item is kept in the Museum for the History and Culture of Peoples of Siberia and the Far East IAET SB RAS (4892/1).

**Its size is 10.7 × 6.3 cm. Two holes are punched in the edge. The item is kept in the Museum of Nature and Man.



Fig. 9. Thin-walled silver bowls.

with small silver thin-walled bowls. First of all is a bowl discovered in a rich collective burial at the Chastukhinsky Uriy fortified settlement, Surgutsky District, Tyumen Region. Its diameter is 16.5 cm; the bottom is decorated with curved “flat spoons” diverging from the central medallion at an angle to the right. The walls of the bowl are raised by 2 cm and are decorated with seven groups of transverse stripes. A mythical creature with a lion’s body and a human head, which was embossed on a die, is in the center of the circle. Judging by the general features of the site and the “flat spoons” motif inherent in Russian toreutics, V.I. Semenova classified the bowl as a Russian product of the 15th–16th centuries (2012: 200–201). Notably, this cultural and chronological attribution has not been questioned by scholars since its first publication in 2005.

The find from Chastukhinsky Uriy is obviously a part of the group of thin-walled bowls with elevated rim and central medallion depicting an animal. Not long ago, two items from this group were discovered in the Khanty-Mansiysky District of the Khanty-Mansi Autonomous Okrug–Yugra*. The first bowl has a diameter of 17.5 cm; the edge is bent upward

by 2 cm, and a hole is punched in it for hanging. A medallion depicting a lion is in the center of the bowl. “Flat spoons” bending towards the edge extend from the medallion (Fig. 9, a)*. The second bowl has a diameter of 16.8 cm; the edge is bent upward by 2 cm. A medallion depicting a lion is in the center. It is surrounded by figures of animals, birds and fish (Fig. 9, b). It is easy to see that animals on these bowls and medallions 6.1–6.3 are executed in the same way.

Thin-walled bowls allow us to apply their chronological and cultural attribution to embossed medallions. The latter were differently dated by scholars. B.I. Marshak, in his letter to me from October 20, 2005, proposed to date medallion 1.1 to the 11th century; he suggested that “the defeated one has the head of a dog or bear”. N.G. Komova and O.I. Pristupa (2012: 116, 118) dated the medallions to the 12th–14th centuries, but they relied on the dating given in my article of 2009, which was originally proposed by N.V. Fedorova in her publication of 2005. K.A. Rudenko dated these items to the 16th–18th centuries (2015: 96–97). K.G. Karacharov believed that the medallions appeared no earlier than the second half of the 15th century, were in use in the 16th century, and possibly for some time in the 17th century (2016: 279).

*Two similar bowls, but without animal figures, come from the sacrificial site near the village of Nyaksimvol, Berezovsky District, Khanty-Mansi Autonomous Okrug–Yugra, and one of them is decorated with a bindweed ornamentation (Shirin, 2014: 45–47), another one is kept in the funds of the Shemanovsky MEC (YNM-15400/2). Perhaps, a “saucer” from a sacred barn of the Mansi, in the village of Yany-paul, Berezovsky District, can also be included in this group (Gemuev, Baulo, 1999: 33).

*A striking example of such a variant of the bowl, in fact a reference sample, is a golden dish made by order of Ivan IV Vasilyevich for August 21, 1561—the day of his wedding with the Kabardian princess Maria Temryukovna. It is stored in the Museums of the Moscow Kremlin. The dish is decorated with strongly curved “flat spoons” diverging to the rim from a small central medallion with the image of a double-headed eagle.



Fig. 10. Embossing die. Collection of the Museum of Nature and Man.

Fedorova suggested that the workshops that made plaques and dishes with embossed ornamentation from silver foil were located in the Perm Cis-Urals. She believes that these items were in use in the 14th–15th centuries and possibly in the 16th century (Fedorova, 2019: 87). According to Karacharov, in period from the 14th to the 17th centuries, dishware produced in the Muscovite Rus (state) and probably in the towns (ostrogs) of the Russian population of the Urals and Trans-Urals was imported to the north of Western Siberia. He believes that no later than the late 14th century there appeared the Russian Permian jewelry style*, with Perm jewelers to a greater extent associated with artisanal centers of Northeastern Rus. On the contrary, no noticeable influence, for example from Novgorod, can be observed (Karacharov, 2016: 281).

Dating the medallions and the center of their production is complicated by the absence of dies. The only find of this kind so far is a die (or a blank for it) made of light-brown sandstone, which was discovered during excavations at the Berezovo fortified settlement and dated to the late 16th to first half of the 17th century (Vizgalov, Parkhimovich, Petrova, 2022: 85). It is kept in the Museum of Nature and Man (KM-14056/342). Its size is $5.7 \times 4.7 \times 1.3$ cm. A cut-out figure of rider on an animal, framed by the band with the bindweed ornamentation, is on one side (Fig. 10). The iconography of the character on the die is different from that on the

medallions described above. This indicates another production center, which could have well been Berezovo. Copper plaques were made there at the turn of the 19th–20th centuries in the workshop of the blacksmith Mikhailenko, using Samoyed examples; earlier, images of idols for the indigenous population were also cast there (Skalozubov, 1907: 7).

Notably, for the 27 medallions under consideration, different dies were used, except for items 1.2 and 1.3; 3.1 and 3.2. Nevertheless, the iconography of the images of horsemen is the same, which suggests that the medallions were made in the same workshop in a fairly short period of time no earlier than the 15th century. The late dating is also indicated by the absence of graffiti made by the local population—this tradition had not been recorded after the 14th century.

Regarding the use of medallions, it can be assumed that these were most likely brought to northwestern Siberia by the Russians for exchange with the local population. Owing to the fragility of these items, they could hardly have been worn on the neck; rather, they would immediately become a part of the cultic paraphernalia among the Voguls and Ostyaks. Medallions were left at sanctuaries as sacrificial offerings or were attached to figures of patron spirits, as evidenced by later holes. The equestrian subject was actively in demand in the religious and ritual practices of the Voguls and Ostyaks throughout the 2nd millennium: many deities appeared as men on horseback (see, e.g., (Baulo, 2004: 25–26, 32–33, 46, 50–54). Medallions with their subject resembling the canonical scene “Miracle of St. Demetrius of Thessaloniki Concerning Tsar Kaloyan”, could also have been imported for missionary purposes.

Conclusions

Medallions and armguards made from silver foil by embossing on a die, with a wire hoop, together with thin-walled bowls with elevated rims, belong to a separate group of silver items that was a part of production of the Russian Permian jewelry center in the 15th–16th centuries (and partially in the early 17th century). Prototypes of medallions and armguards were earlier plaques with images of a falconer, and the so-called Bulgar silver shields of the 12th–14th centuries. Embossed medallions belonged to a single artisanal center, which worked for a short period of time. They were made for exchange with local population during the advance of the Russian military units to northwestern Siberia. Most of the

*Details of several bowls produced in the Russian Perm center, which originated from a robber collection, were published by Y.A. Yakovlev (2011: 31–34).

finds come from two districts of the Yamal-Nenets Autonomous Okrug and Khanty-Mansi Autonomous Okrug–Yugra. It may be assumed that medallions were applied mainly in cultic practices of the Voguls and Ostyaks with stable traditions of using imported silver dishware. This fact is confirmed by the presence of medallions in modern sacred places of the Ob Ugrians.

Acknowledgments

The author is grateful to his colleagues A.V. Gusev (Shemanovsky Yamal-Nenets District Museum and Exhibition Complex), O.V. Kardash (Institute of Archaeology of the North), and T.N. Sobolnikova (Museum of Nature and Man) for the photographs and information they provided.

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PERSONALIA

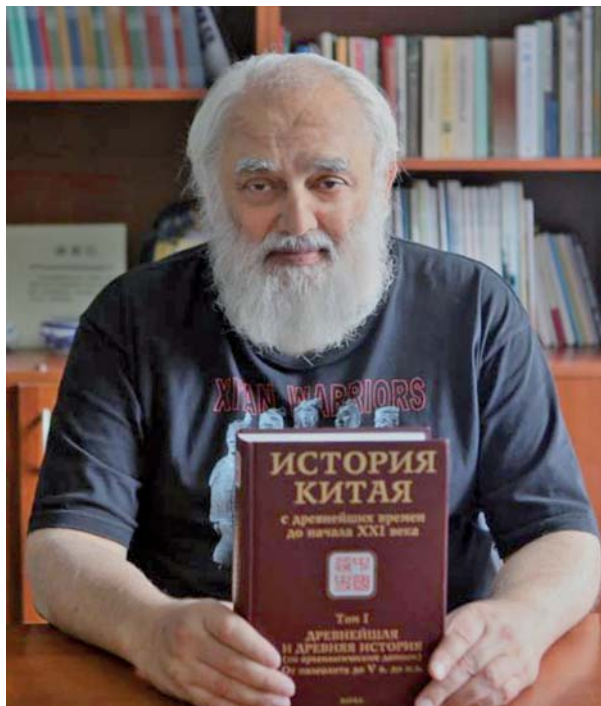
Orientalist, Archaeologist, Teacher: For the 70th Birthday of Professor S.A. Komissarov

This year Sergey Alexandrovich Komissarov, a renowned orientalist and archaeologist, expert in history and culture of China, Candidate of Historical Sciences, Senior Researcher in the Department of Metal Ages Archaeology at the Institute of Archaeology and Ethnography of the Siberian Branch of the Russian Academy of Sciences, and Professor at the Novosibirsk State University (NSU) celebrates his 70th birthday and 45th anniversary of his scholarly and educational career.

Sergey Komissarov is a graduate of the History Department of NSU and student of well-known orientalists V.E. Larichev and O.P. Frolova. During his years at the university, he was fortunate to attend lectures by such brilliant specialists as M.I. Rizhsky, N.V. Revyakina, and N.N. Pokrovsky. Sergey Komissarov was influenced not only by his professors, but also by the aura of Akademgorodok of that time, with its famous university May Day festivals, rock operas, and amateur performances. Students of those years managed to combine active participation in social and cultural events with diligent study, while the lack of specialists in some fields was compensated for by independent work in libraries.

After graduating from the university in 1977, having served in the Soviet Army, S.A. Komissarov became an employee in the Institute of History, Philology, and Philosophy of the Siberian Branch of the Soviet Academy of Sciences (later the Institute of Archaeology and Ethnography SB RAS). In the 1970–1990s, he participated in archaeological excavations in Western Siberia, Khakassia, Sakhalin and Kuril Islands, as well as Cuba. The Cuban expedition left a particularly deep mark on the soul of Sergey Komissarov, who fell deeply and forever in love with this amazing island and its remarkable people.

In 1985, under supervision of V.E. Larichev, S.A. Komissarov defended his PhD dissertation on Chinese weaponry of the Late Bronze Age. The monograph *Ancient Chinese Weaponry Complex: Late Bronze Age* (1988), prepared on the basis of



his dissertation research, is still actively used by archaeologists, weapons experts, and specialists in the culture of East Asia.

In 1987–1988, being still a young scholar, S.A. Komissarov had an opportunity to familiarize himself with archaeological sites and museum collections of China during scholarly internship at Liaoning University (Shenyang). Contacts with the leading Chinese scholars—archaeologists, ethnographers, and historians—allowed Sergey Komissarov to promptly receive the latest scientific information on the subject of his own research and consult colleagues on the issues of history and culture of China and the entire East Asia.

During his student years, S.A. Komissarov was the head of the first small group of nine students majoring in Oriental Studies at NSU. His organizational talent was manifested even at that time and fully unfolded in

the following years. Sergey Komissarov always knew how to find common ground and build understanding with a wide variety of people. This came in handy both in the difficult 1990s and later in the 2000s when a wide range of interests, which emerged during his student years, allowed him, without interrupting his research work, to engage in the emerging Russian-Chinese business. S.A. Komissarov participated in organizing traditional oriental medicine centers, along with translating specialized medical literature, which was in great demand at that time. He also translated and published beautifully illustrated collections of Chinese folk tales. At that same time, he established new contacts with archaeologists from the institutes of the Chinese Academy of Social Sciences and specialists from a number of major Chinese universities. Sergey Komissarov has a real lasting friendship with some of these scholars (primarily with professors Liu Depei and Tang Chung).

Sergey Komissarov is a diligent and very enthusiastic person who managed to carry through the years and preserve youthful passion inherent in him. He is undemanding to living conditions, which undoubtedly plays its role during regular trips to China as a part of his research projects, allowing him to dig into the depths of life of the local population, accessible not to every ethnographer. All this is reflected in the pages of his scholarly publications and popular articles.

Noteworthy is the contribution of S.A. Komissarov to the first volume of the fundamental academic *History of China* edited by Academician of the Russian Academy of Sciences A.P. Derevianko. This included not only sections on key archaeological sites and cultures of different periods, written by him and his co-authors, but also tremendous work on coordinating the efforts of the authoring team, whose members were often separated by huge distances and by differences in approaches to presenting material.

Sergey Komissarov is a recognized expert in the field of ancient and modern China research. At present, his research interests are still extensive, addressing a wide range of issues in archaeology and history of China in the Bronze Age, Early Iron Age, Middle Ages, ethnic history of East and Southeast Asia, mythology, folklore and traditional art of the peoples of the East, as well as theory and history of traditional Chinese medicine. Sergey Komissarov, together with his colleagues from the IAET SB RAS and NSU, has implemented a number of important research projects on archaeology of China. He studied archaeological evidence from certain regions (Xinjiang, Tibet, Hong

Kong and Macau, southwestern China), prepared an overview of history and main areas of rock art studies, analyzed the phenomenon of stone sculptures in Prehistoric and Medieval China, and made a thorough analysis of the problem of transition from Antiquity to the Middle Ages in the region in terms of archaeology. Works by S.A. Komissarov not only introduce Russian scholars to the latest achievements of their Chinese colleagues, but also offer a number of original solutions to current issues in archaeology and history of the East and Southeast Asia.

Breadth of his knowledge allows the celebrant, who has been working in NSU since 1980, to teach the courses such as “History of Eastern Civilizations”, “History of Asian and African Countries”, “History of China”, “History of Chinese Literature (Antiquity and Middle Ages)”, “Source Studies and Historiography of Chinese History”, “Art of China”, “Economy and International Relations of Asian and African Countries”, “Political Systems of Eurasia”, “Social Systems of Eurasia”, and various special courses. S.A. Komissarov became one of the founders of the department and chair of Oriental Studies in NSU. Together with N.V. Kutafieva and V.I. Ozhogin, he developed the first educational programs and teaching materials for this specialization and even became the main teacher of the Chinese language for the first enrolment of sinologists. Over many years, lectures and seminars by Sergey Komissarov have been determining the style of education in Oriental Studies at NSU, setting a high standard, which the students and young colleagues of S.A. Komissarov try to comply. He used to be a permanent and invited lecturer at the Higher College of Informatics at NSU, Yuzhno-Sakhalinsk Pedagogical University, Siberian Institute of Management – the Branch of the Russian Presidential Academy of National Economy and Public Administration, Novosibirsk State University of Economics and Management, as well as at Buryat, Altai, and Gornoaltai State Universities.

Over seventy graduation theses of bachelors and specialists were done under the supervision of Prof. S.A. Komissarov at NSU and the Siberian Institute of Management. Three of his students defended their PhD dissertations on archaeology of China, and several post-graduate applicants are currently working on their dissertation projects.

In 2008, S.A. Komissarov became one of the founders and first director of the Confucius Classroom (since 2018, the Confucius Institute) at NSU. Sergey Komissarov headed this project until 2017, and currently oversees its scholarly aspect, including

organization of the annual scientific and practical conference on the issues of the Great Silk Road in ancient times and today.

Along with active research and teaching work, S.A. Komissarov acts a member of the Academic Council at the NSU Institute for the Humanities and editor of the Oriental Studies issues of the journal *NSU Bulletin. Series: History, Philology*. Sergey Komissarov pays significant attention to education: he has written dozens of encyclopedic and popular science articles, and gave numerous public lectures on the traditional culture, architecture, and medicine of China, as well as specific aspects of the Chinese language. Several years ago, S.A. Komissarov participated in creating a series of radio broadcasting programs about Chinese culture, Chinese calendar systems, feasts, and important historical events. These programs, as feedback has shown, were very popular among broadcasting listeners. Sergey Komissarov is

an amazingly multifaceted person; his talent also found expression in poetry: in 2005, a collection of his poems and translations entitled “Quiet Glow” was published.

S.A. Komissarov’s work achievements have been recognized with a number of departmental awards. In 2023, his works were highly appreciated in China: the State Administration of Press and Publication of the People’s Republic of China awarded S.A. Komissarov the Special Book Award of China for his contribution to international literature about China.

Let us wish the celebrant perfect health, good spirits, keenness of perception that is always inherent in him, and fulfillment of his numerous scholarly plans!

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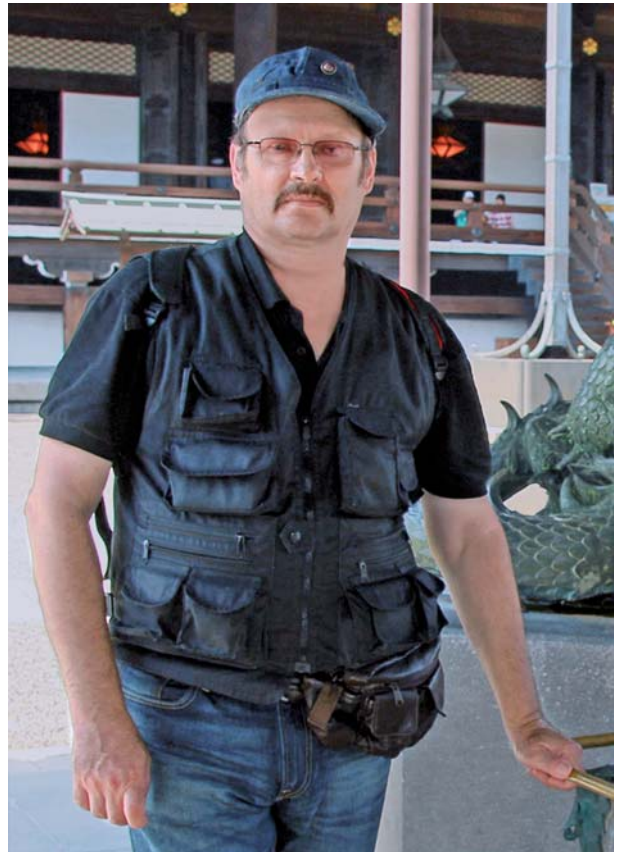
Siberian Weaponry Expert: For the 70th Birthday of A.I. Solovyev

This year marks the 70th birthday of Alexander Ivanovich Solovyev, Doctor of Historical Sciences and Leading Researcher in the Department of Metal Ages Archaeology at the Institute of Archaeology and Ethnography of the Siberian Branch of the Russian Academy of Sciences. Among professionals, he is known primarily for his scholarly work on the history of weaponry and warfare, as well as medieval archaeology of Siberia.

Alexander Solovyev was born and raised in Novosibirsk, in the family of the renowned historian Professor E.I. Solovyeva and lawyer I.P. Solovyev—veteran of the Great Patriotic War, holder of numerous military orders. Stories about the Scythians told by his mother in childhood, the extensive home library, and his parents' personal example made a significant impact on the personality of the future scholar.

A.I. Solovyev graduated from Novosibirsk School No. 10 with advanced English learning. In his final school year, he seriously considered pursuing a career in architecture, but ultimately chose history. In 1972, Alexander Solovyev entered the Department of Humanities at the Novosibirsk State University. He began his studies as a future orientalist, but subsequently transferred to the History Department. He was fascinated by history, both ancient and more recent. Alexander Solovyev's student internship at the excavations at Fort Ilmsk gave him close friends and drew him into the circle of archaeologists. Yet A.I. Solovyev's diverse interests persisted throughout his years of study; in his final year, he even began writing two graduation theses—one on history and one on archaeology. Ultimately, he chose the latter for the defense. His university and field teachers, especially Academician A.P. Okladnikov and Professor M.P. Gryaznov, played an important role in A.I. Solovyev's choice of archaeology as a professional career.

After graduating from university and having served in the Soviet Army, Alexander Solovyev became employed as Laboratory Assistant in the Institute of History, Philology, and Philosophy of the Siberian Branch of the Soviet Academy of Sciences (later



the Institute of Archaeology and Ethnography SB RAS), which would remain his permanent place of work for over 45 years. Being a staff member at the Institute, Alexander Solovyev entered postgraduate program and became the last postgraduate student of Academician A.P. Okladnikov. After the death of his teacher, preparation and defense of A.I. Solovyev's PhD dissertation, *Art of War Among the Population of the Forest Belt of Western Siberia in the Middle Ages (According to Archaeological Sources)* in 1984 was supervised by Doctor of Historical Sciences R.S. Vasilyevsky.

During his years at the IAET SB RAS, Alexander Solovyev participated in excavations of archaeological sites and field surveys in the Novosibirsk Region, Minusinsk Basin, Altai Mountains, Ob River basin, and

Angara River basin. In 1989, he became a participant in international scholarly cooperation program between the USSR and Japan. As a part of this program, A.I. Solovyev spent six months working at the Orient Museum in Tokyo and then completed a year-long internship at the Nara National Research Institute for Cultural Properties, where he learned various aspects of scientific research, from events and exhibitions to methods of restoration of archaeological finds. During his stay in Japan, he also examined a large number of evidence in museums of Tokyo, Kyoto, Nara, and Sapporo. As a part of the delegation from IAET SB RAS, Alexander Solovyev visited North Korea and saw archaeological sites and museum collections there. Extensive knowledge of evidence from the countries of Southeast Asia was then broadly applied in his subsequent research.

Alexander Solovyev played an active role in organizing and hosting exhibitions of collections from IAET SB RAS in Germany, Japan, and South Korea.

For many years, A.I. Solovyev was a member of the Western Siberian Archaeological Team of the North Asian Integrated Expedition of IAET SB RAS and participated in excavations at the sites of Sopka-2 and Kyshtovka-1, -2 etc. in the Novosibirsk Region. From 1991 to 1995, he participated in the expedition to the Ukok Plateau.

In 2006, A.I. Solovyev defended his doctoral dissertation, *Burial Sites of the Pre-Taiga Population of the Ob-Irtysh Region in the Middle Ages: Ritual, Myth, and Society*, with Academician RAS, V.I. Molodin being his scholarly advisor.

A.I. Solovyev has a broad and diverse range of research interests, covering the history of warfare, funerary rites, beliefs, social structure, potestary organizations, traditional cultures, and worldview of the indigenous populations of North Asia. About a dozen monographs and textbooks have been published based on his research findings; particularly noteworthy is the book *Arms and Armor: Siberian Weaponry from the Stone Age to the Middle Ages* (Novosibirsk, 2003). The author's excellent knowledge of sources and his remarkable artistic talent enabled him to create a number of fascinating reconstructions, which are widely used by professionals and lovers of history. These reconstructions have made the book so popular that it became a part of architectural and construction portal of the city of Novosibirsk (<https://history.novosibdom.ru>). At present, weaponry reconstructions by Alexander Solovyev are used in the exhibition design at the Museum for the History and Culture of Peoples of Siberia and the Far East IAET SB RAS. A.I. Solovyev made an important contribution

as the author of several articles and illustrator to the first and second volumes of the new edition of *History of Siberia* (Vol. 1, 2022; Vol. 2, 2019).

For several years, Alexander Solovyev served as a lecturer at the Novosibirsk State University, where he gave a part of the course on the history of Oriental countries. He was a co-author of the following textbooks for schoolchildren: *History of Siberia: History of Russia Through the History of Regions* (2015) and *History of Novosibirsk Region: History of Russia Through the History of Regions* (2017). The latter book was awarded the State Prize of the Novosibirsk Region in 2018. A.I. Solovyev is a member of the Academic Council of IAET SB RAS and specialized dissertation councils of IAET SB RAS and Kemerovo State University.

Alexander Solovyev's research has been many times supported by the Russian scientific foundations (Russian Foundation for the Humanities, Russian Foundation for Basic Research, and Russian Science Foundation). His recent works continue to reflect his comprehensive interests and address the problems of medieval archaeology in Siberia with broad ethnographic parallels, and wide range of issues in archaeology of Southeast Asia. As a member of creative team of IAET SB RAS, A.I. Solovyev studied stone sculptures of Prehistoric and Medieval China, the Dian civilization, the clay army of Qin Shi Huang, weaponry of the Kofun period in Japan, etc. One of the topics which is of particular interest to the scholar is the interaction of ancient communities along the Silk Road—a subject he considered in a number of publications and papers at international conferences from 2020 to 2025.

Alexander Solovyev is an active popularizer of historical science. He annually participates as a lecturer in the “Prince's Court” historical festival and gives public lectures at the events organized by IAET SB RAS and Novosibirsk State University.

A.I. Solovyev's work achievements have been recognized with a number of departmental awards, including the State Prize of the Novosibirsk Region (2018).

Colleagues and friends wish the celebrant to maintain his fascination with ancient history and his unique ability to find similarities in cultures and societies separated by thousands of kilometers and hundreds of years.

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A.V. Baulo, V.P. Mylnikov,
L.N. Mylnikova, S.P. Nesterov,
I.A. Durakov, E.A. Solovyeva,
A.V. Tabarev, T.A. Chikisheva*

- AN SSSR – USSR Academy of Sciences
- BAR – British Archaeological Reports
- CNRS – Centre national de la recherche scientifique
- CRC – Chemical Rubber Company
- ERAUL – Etudes et Recherches Archéologiques de l’Université de Liège
- GIN – Geological Institute, USSR Academy of Sciences (Moscow)
- IA RAN – Institute of Archaeology, Russian Academy of Sciences (Moscow)
- IAET SO RAN – Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences (Novosibirsk)
- IIF 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)
- KSIA – Brief Communications of the Institute of Archaeology, Russian Academy of Sciences
- KSIIIMK – Brief Communications of the Institute for the History of Material Culture
- MAE RAN – Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences (St. Petersburg)
- MGU – Lomonosov Moscow State University
- MIA – Materials and Investigations on Archaeology in the USSR
- PNAS – Proceedings of the National Academy of Sciences
- RSSDA – Remote Sensing and Spatial Data Analysis
- SAIPI – Siberian Association of Prehistoric Art Researchers
- SSRN – Social Science Research Network
- TIE – Transactions of the Institute of Ethnography
- VSORGO – East Siberian Department of the Russian Geographical Society

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