doi:10.17746/1563-0110.2023.51.3.050-058

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Variability in the Sibiryachikha Assemblages of the Altai Mountains (Based on Materials from Okladnikov Cave Layer 2)

This article, based on new data from comprehensive studies of assemblage from Okladnikov Cave layer 2, explores the variability of Middle Paleolithic Sibiryachikha variant of the Altai Mountains. Using methods such as scar pattern analysis, experimental use-wear analysis, attributive analysis, etc., we specify the characteristics of the assemblage by extending the nomenclature of technical flakes relating to radial flaking, evaluating the share of the bifacial component including bifaces, their fragments, and bifacial technical flakes, revising the typology of the tools. The Sibiryachikha assemblage of Chagyrskaya Cave layer 6c/1 is correlated with that of Okladnikov Cave layers 1 and 2, revealing not only common features but also differences in primary and secondary reduction. At Okladnikov Cave, unlike Chagyrskaya, the reduction cycle is incomplete, the tools are smaller, and the share of convergent scrapers and chips resulting from the processing of bifaces is higher. We conclude that the distinctive feature of Okladnikov industry is a considerably more intense modification of raw materials owing to their less availability. Because Okladnikov Cave is situated in the immediate vicinity of the sources of raw material, implying its abundance, we suggest that pebbles of suitable quality and size were less available. As a result, rejuvenation of lithic tools was more intense, and bifacial thinning flakes were used as tool blanks. The Okladnikov Cave industry reveals the complex behavioral models, previously unknown, among eastern Neanderthals, which do not rule out the import of bifacial tools or blanks made of high-quality raw material.

Keywords: *Middle Paleolithic, Sibiryachikha variant, Altai Mountains, bifacial technology, model of raw material use, Neanderthals.*

Introduction

In recent years, the studies of Paleolithic assemblages of North and Central Asia have been largely focused on the behavioral models of various species of ancient hominins over vast regions in various periods, on their migrations, and on the related changes in subsistence systems (Khatsenovich et al., 2019; Derevianko, 2020; Zolnikov et al., 2020; Barzilai et al., 2022). Important information about ancient populations is provided by the results of studies of human habitation in various ecological niches and adaptation to local paleoenvironmental conditions (Delagnes, Rendu, 2011; Turq et al., 2017; Rybin et al., 2022). Such studies often explain the technical and typological variability within a particular cultural community. They involve revisions of the known data and supplementary research using modern techniques; this helps not only to evaluate the findings in a new way, but also to obtain additional information (Uthmeier, 2013; Shalagina, Kolobova, Krivoshapkin, 2019; Kolobova et al., 2019).

Okladnikov Cave, located on the left bank of the Sibiryachikha River in the Anuy valley, can be a source of new information about the behavioral patterns of Neanderthals. The karst cavity, with a southern exposure, is located at an altitude of 368 m above sea level (Derevianko, Markin, 1992). The site was discovered by A.P. Derevianko and V.I. Molodin in 1984, and has been studied under the supervision of A.P. Derevianko, S.V. Markin, and V.T. Petrin for four years. By 1992, it had been excavated almost completely; the materials from the site were described in detail in the same year (Ibid.: 4). On the basis of several stratigraphic sections of the cave deposits, nine lithological layers were identified, among which five (layers 1–3, 6, and 7) contained cultural remains. The recent chronometric studies have shown that the age of Neanderthal remains from layers 2 and 3 of the cave is >40,000 and >44,000 BP (Vernot et al., 2021). In 2013, the Okladnikov Cave lithic industry, together with materials from Chagyrskaya Cave, were classified as the Sibiryachikha variant of the Altai Middle Paleolithic, which technical and typological characteristics differ from those of the Denisova and Kara-Bom variants of the region. The following features are specific to the Sibiryachikha variant: the predominance of radial flaking, the use of modifying secondary reduction, the dominance of side-scrapers of the déjeté type, scraper-knives, points, and bifaces in numerous toolkits, and a small proportion of Levallois spalls (Derevianko, Markin, Shunkov, 2013).

The present paper is focused on reconstructions of the behavioral models of Eastern Neanderthals by determining the features of the internal variability of the Sibiryachikha assemblages.

Results

The assemblage from Okladnikov Cave layer 2 is a classic set of the Sibiryachikha lithic industry: like other industries of the cave, it shows radial and Levallois flaking, a high percentage of tools, with a dominance of déjeté-type side-scrapers, and a large amount of production waste (Derevianko, Markin, 1992).

Table 1. **Composition of the lithic industry from Okladnikov Cave layer 2**

Artifact type	Spec.	%	%, omitting unidentifiable
Cores	4	0.31	0.66
Bifacial tools	10	0.79	1.65
Spalls:	590	46.38	97.20
blades	14	1.10	2.31
flakes	410	32.23	67.55
technical flakes	164	12.89	27.02
unidentifiable debitage	2	0.16	0.33
tools	174	13.68	28.67
Percussion-abrasive tools	3	0.24	0.49
Shatters	163	12.81	–
Chips	502	39.47	–
Total	1272	100	100

The lithic industry includes 1272 artifacts, of which 52.3 % are production waste (Table 1). Primary reduction was targeted at the production of flakes (67.6 % of the total number of artifacts, excluding production waste) of trapezoidal*, triangular, and rectangular forms (44.9 %), in which the artifact's long axis most often coincides with the flaking axis (65.6 % of flakes). The assemblage contains four cores for the production of flakes: orthogonal, Levallois centripetal (Fig. 1, *1*), radial (Fig. 1, *2*), and narrow-faced. Three of these cores demonstrate the terminal stage of exhaustion. The 3D models were analyzed by Artifact 3D software (Grosman et al., 2022).

This set of cores corresponds well to the set of technical flakes (27 %), which is dominated by lateral flakes from radial cores (44 spec., 26.8 % of all technical flakes) (Fig. 1, *3*, *4*), lateral cortical (16.5 %), and lateral flakes (24.4 %) (Fig. 1, *5*). In the set of cores from Okladnikov Cave layer 2, numerous bifacial thinning flakes were identified, which were used in a plano-convex bifacial reduction sequence (22 %) (Fig. 1, *6*). Among the single technical flakes, the following forms

*Blanks for two bifacial tools are included in the flake category.

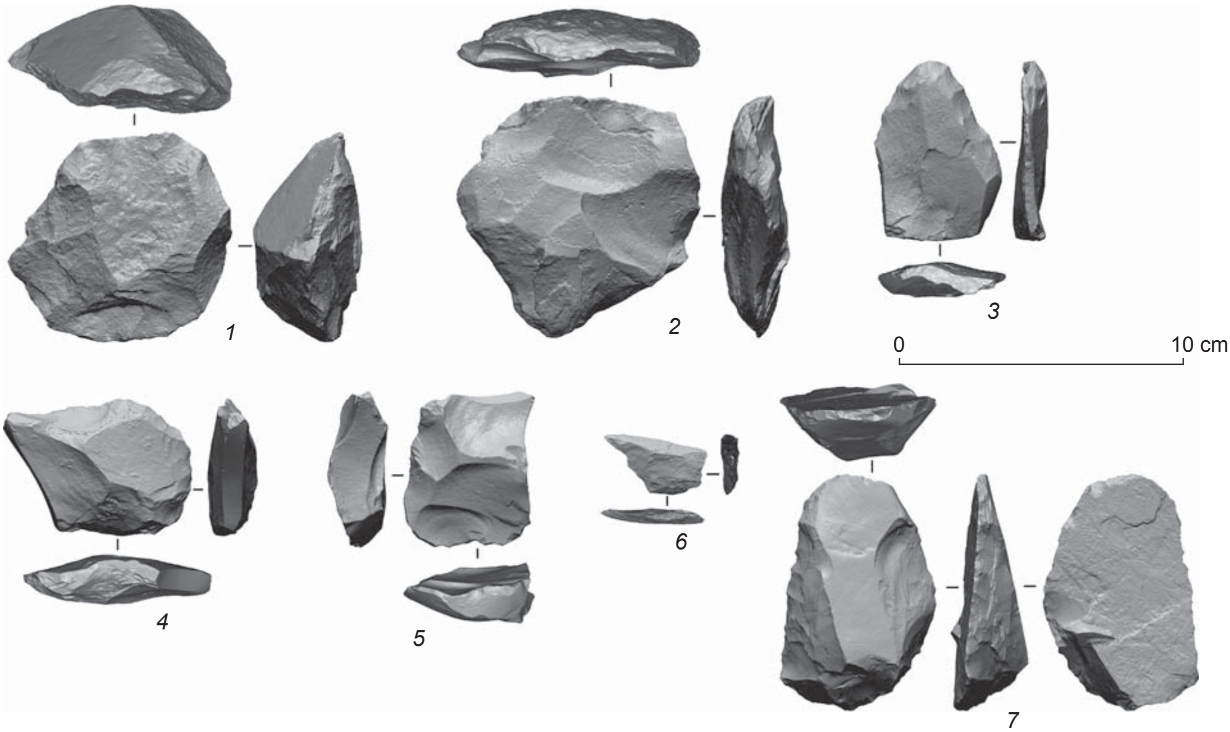

Fig. 1. Cores (*1*, *2*) and technical flakes (*3–7*) from the assemblage of Okladnikov Cave layer 2.
1 – Levallois core; *2* – radial core; *3* – sub-leaf side-scraper on lateral flake from radial core; *4* – lateral flake from radial core; *5* – lateral flake; *6* – perforator on a bifacial thinning flake; *7* – sub-ovoid side-scraper on a split pebble.

were identified: technical flakes (*Kantenabschläge* – 2 spec.) (Fig. 2, *1*), associated with the preparation of striking platforms on radial cores; semi-crested and crested flakes (11 spec.) (Fig. 2, *14*); and citron flakes (2 spec.).

In addition to the signs of core and bifacial flaking, there were traces of pebble knapping on anvil, as well as the manufacture of tools on the resulting blanks (see Fig. 1, *7*) (Kharevich, 2022).

The paucity of primary flakes (38 spec., 6.1 % of all the spalls) and spalls retaining cortical dorsal surfaces over 75 and 50 % (17 and 25 spec.) suggests that the decortication of cores and, possibly, bifacial tools was carried out beyond the cave.

Most of the flakes, including those where the long axis coincides with the technical flaking axis, have unidirectional dorsal pattern (164 spec., 27.7 %). A significant share of flakes have orthogonal (42 spec., 7.1 %), semi-crossed and radial (67 items, 11.3 %), lateral and bilateral (23 spec., 3.9 %) scar patterns.

Among the identifiable residual striking platforms of the spalls, plain platforms (238 spec., 63.8 %) dominate; faceted platforms of various shapes (73 spec., 19.6 %) and dihedral/polyhedral platforms (45 spec., 12.1 %) are also numerous. At the same time, faceted platforms more often occur on flakes (25.2 %) than on technical flakes (11.9 %). Platforms of target spalls (blanks for the manufacture of tools) were faceted twice as often (31.3 %) than of those that were not fashioned into tools (15 %).

The toolset is dominated by convergent side-scrapers (Table 2) of various shapes (semi-crescent, semi-trapezoidal, sub-trapezoidal, sub-crescent, and sub-triangular), including those retouched along the entire perimeter of the blank (48.5 % of all formal tools) (see Fig. 2, *3–8*). Less numerous are simple side-scrapers (see Fig. 2, *2*, *11*), retouched points (see Fig. 2, *9*, *12*), and bifacial tools (Fig. 3, *1–3*). The toolkit demonstrates various types of modifying retouch, including the Quina type (see Fig. 2, *5*, *7–9*, *12*).

Bifacial tools from the layer 2 toolkit are noteworthy. There are 10 bifacial tools in total: 6 complete items, 3 fragmented items, and 1 blank (see Fig. 3, *1*). More than half of the tools were made on spalls; for other tools, blanks are indeterminate, since they were subjected to extensive processing. Complete tools can be subdivided into trapezoidal (see Fig. 3, *2*), leaf-shape (see Fig. 3, *3*), crescent, and triangular in shape. According to the results of the scar pattern analysis (Shalagina, Krivoshapkin, Kolobova, 2015), all bifacial tools from layer 2 were shaped using the plano-convex technique. Notwithstanding that blanks were often

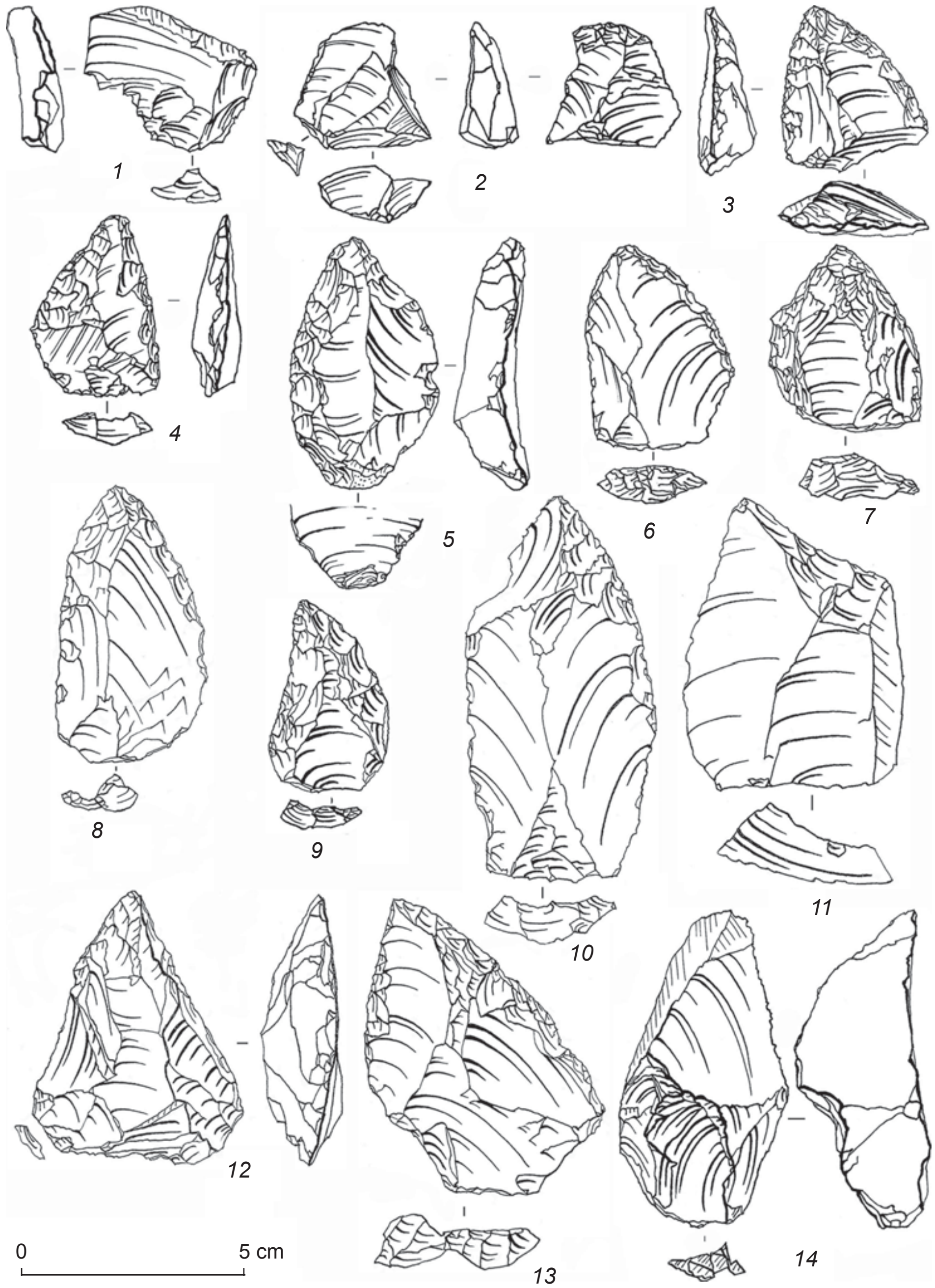

Fig. 2. Technical flakes (*1*, *14*) and tools (*2–13*) from the assemblage of Okladnikov Cave layer 2.
1 – technical flake (*Kantenabschläge*); *2* – transversal side-scraper on a lateral flake from radial core; *3*, *7* – sub-triangular side-scrapers; *4*, *6*, *13* – sub-trapezoidal side-scraper; *5* – leaf-shape side-scraper, alternative; *8* – sub-leaf side-scraper; *9* – sub-leaf point; *10* – longitudinal convex side-scraper; *11* – diagonal side-scraper; *12* – triangular point; *14* – crested spall.

flakes (see Fig. 3, *2*), both faces of most items show extensive processing following the "long" reduction sequence (see Fig. 3, *3*). Both ventral and dorsal surfaces of the flakes were treated equally extensively.

The share of the bifacial thinning chips makes up 35.8 % of the identifiable chips in the assemblage (88 spec.). Six artifacts in the toolkit were fashioned on bifacial thinning flakes (see Fig. 1, *6*).

Use-wear analysis of pebbles, slabs, and shatters from Okladnikov Cave layer 2 made it possible to identify three lithic percussion-abrasive tools: a hammerstone and two anvils for the retouch of lithic tools (see Fig. 3, *4*).

Table 2. **Type list of the lithic industry from Okladnikov Cave layer 2**

Tool types	N	%	%, omitting unidentifiable
Retouched points	15	8.15	9.09
Side-scrapers:	132	71.74	80.00
simple	37	20.11	22.42
convergent	80	43.48	48.49
unidentifiable	15	8.15	9.09
Bifacial tools	10	5.43	6.06
Truncations	2	1.09	1.21
Notches	1	0.54	0.61
Perforatores	5	2.72	3.03
Retouched flakes	14	7.61	–
Retouched blades	3	1.63	–
Unidentifiable tools	2	1.09	–
Total	184	100.00	100

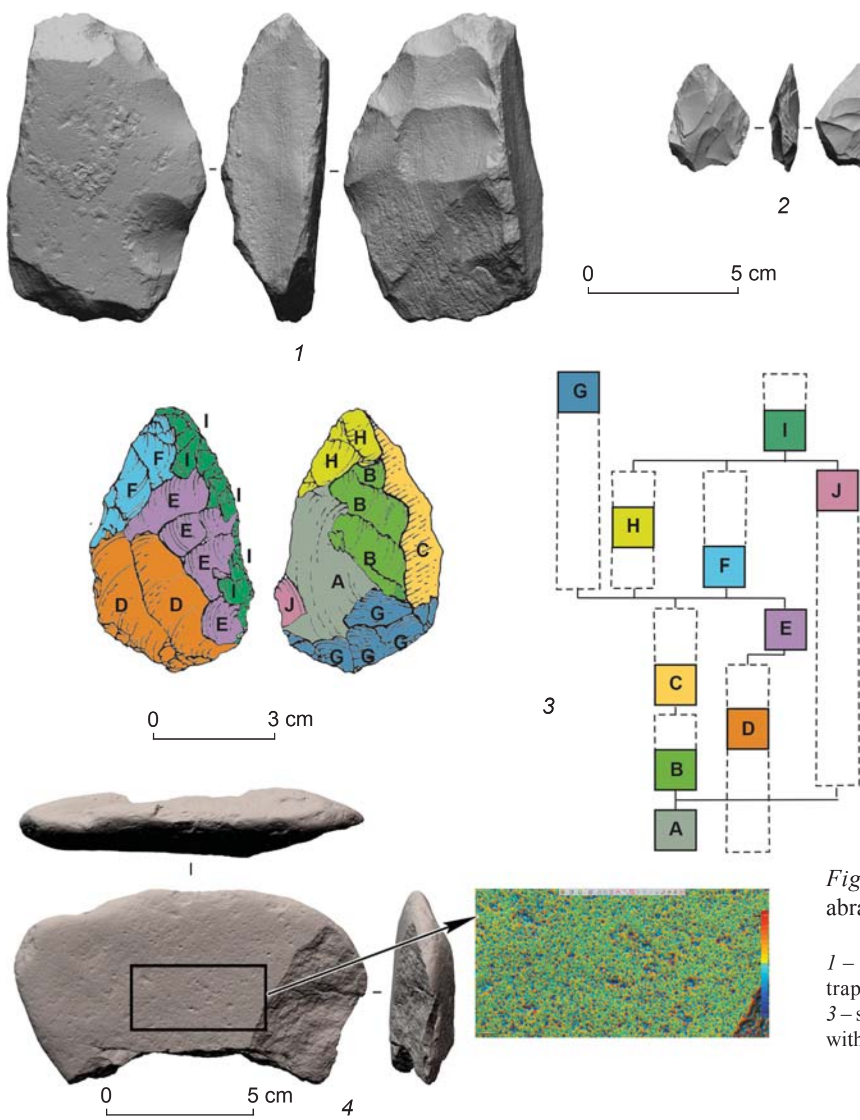

Fig. 3. Bifacial (*1–3*) and percussion-abrasive (*4*) tools from the assemblage of Okladnikov Cave layer 2.
1 – blank of bifacial tool with back; *2* – semi-trapezoidal bifacial side-scraper with back; *3* – scar pattern analysis of sub-leaf side-scraper with back; *4* – anvil for the retouching of lithic tools.

Discussion

Archaeological materials from Okladnikov Cave layer 2 indicate that the primary knapping was aimed at the detachment of trapezoidal, rectangular, and triangular flakes from radial, orthogonal, and Levallois cores. The typology of technical flakes corresponds to the reduction of cores through radial and, possibly, narrow-faced knapping techniques. This conclusion is supported by the scar patterns, mainly unidirectional and orthogonal/sub-cross/radial. The presence in the collection of six bifacial side-scrapers, fragments, and blanks of bifacial tools suggests plano-convex bifacial processing. This technique is illustrated by 22 % of bifacial thinning flakes and 35.8 % of bifacial thinning chips. This study, for the first time for this industry, has revealed evidence of pebble knapping on anvil, as well as the anvils for retouching tools, and a hammerstone.

The complexes of the Okladnikov and Chagyrskaya caves constitute the Sibiryachikha variant in the Middle Paleolithic of the Altai Mountains; the variant is characterized by a combination of core and bifacial knapping, the dominance of radial flaking, the production of flakes with mismatched flaking and long axes, and numerous toolkits dominated by various side-scrapers including déjeté varieties (Derevianko, Markin, Shunkov, 2013).

A recent comparative analysis of the Sibiryachikha industries at a qualitatively new level has provided additional data on their internal variability. The assemblages from layers 1 (Kolobova et al., 2022) and 2 from Okladnikov Cave, as well as layer 6c/1 of Chagyrskaya Cave (Mezhdistsiplinarniye issledovaniya…, 2018) were compared. The analysis of the components of these industries showed that the primary knapping was dominated by radial and orthogonal techniques, while the total number of cores was small. The Okladnikov Cave assemblages yielded the Levallois cores that were atypical of the Chagyrskaya Cave collection (see Fig. 1, *1*), and the associated spalls (Derevianko, Markin, 1992; Kolobova et al., 2022). Technical flakes were identified, with a predominance of lateral flakes from radial cores and various core-edge flakes (Mezhdistsiplinarniye issledovaniya…, 2018). The industries under study illustrated the use of the technique of pebble knapping on anvil and the subsequent use of the obtained blanks for the production of uni- and bifacial tools (Shalagina et al., 2020). In general, all the industries were aimed at the detachment of trapezoidal, rectangular, and triangular flakes with plain and faceted straight striking platforms.

The analysis of the axis of scar pattern has shown a significant difference between the industries of the Okladnikov and Chagyrskaya caves. The materials of Chagyrskaya Cave are dominated by spalls with mismatched long and flaking axes (60.9 %); in contrast, both lithic assemblages of Okladnikov Cave contain spalls with coinciding axes (layer 1 – 59.2 %; layer 2 – 65.6 %).

In the Chagyrskaya Cave assemblage, flakes without cortex make up 56.5 %, and primary flakes 11.4 %; on this basis, it was preliminarily concluded that the site represents a complete sequence of primary reduction, from decortication to the manufacture and rejuvenation of tools (Mezhdistsiplinarniye issledovaniya…, 2018). The Okladnikov Cave industries are characterized by their smaller share of primary flakes (layer 1 – 9.3 %, layer 2 – 6.1 %), which suggests that the processes of decortication were carried out beyond the site.

All the Sibiryachikha industries show a significant bifacial component: bifaces made using plano-convex technique; bifacial thinning flakes; tools on bifacial thinning flakes (see Fig. 1, *6*); and bifacial thinning chips. However, in the Chagyrskaya collection, only 18 % of identifiable chips are the products of bifacial thinning, while the relevant share in Okladnikov Cave layer 2 is 35.8 %, suggesting more intense processes of treatment and rejuvenation of working edges of tools. In all the assemblages, bifacial thinning flakes range from 18 to 22 %.

Among the tools on flakes, side-scrapers dominate in all the assemblages, including convergent ones (from 70.9 % in Chagyrskaya Cave layer 6c/1 to 80 % in Okladnikov Cave layer 2). The Chagyrskaya collection is dominated by simple types of side-scrapers, mainly single-edged (54.2 %); while in the Okladnikov Cave assemblages, convergent forms prevail, i.e. those with working edges prepared over 1/2 or a greater part of the tool perimeter (layer 1 – 57.8 %, layer 2 – 60.6 %). In addition, the Okladnikov collections contain more tools fashioned on bifacial thinning flakes (3 spec. in layer 1 and 6 spec. in layer 2) than the Chagyrskaya collection (1 spec.).

The comparison of the toolkits of the studied collections by their numbers of simple, convergent side-scrapers and bifacial tools has shown that the Okladnikov Cave assemblages contain a greater proportion of convergent side-scrapers and a slightly larger proportion of bifaces, which numbers significantly exceed those of Chagyrskaya Cave (Fig. 4). A Kruskal-Wallis test of metric indicators of the tools in all the three complexes (since the samples are not normally distributed) did not reveal any differences in the lengths of tools, but showed a width mismatch: the tools from Okladnikov Cave are narrower than those from Chagyrskaya Cave (H – 10.42, p – 0.005). This discrepancy is most likely due

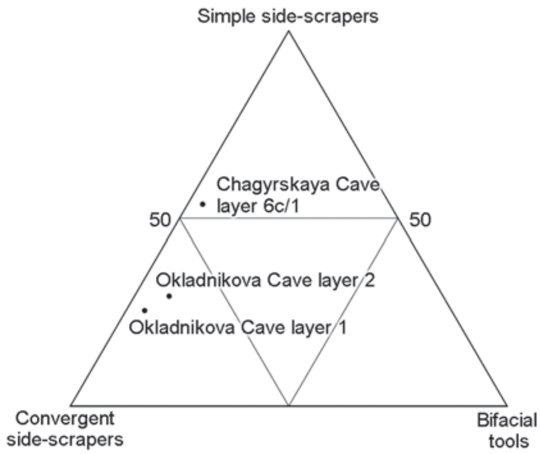

Fig. 4. Ternary plot displaying the proportions of simple, convergent side-scrapers and bifacial tools in the Sibiryachikha assemblages.

to the greater intensity of utilization and rejuvenation of tools in Okladnikov Cave. The calculations were carried out in the PAST3 software (Hammer, Harper, Ryan, 2001).

The study has shown that bifacial tools from Okladnikov Cave layer 2 correspond to the general trends in the production of bifaces in the Sibiryachikha variant of the Altai Middle Paleolithic (Kharevich, 2022). At the same time, the differences between this collection and that of Chagyrskaya Cave are noteworthy. The Okladnikov tools were subjected to a more intense processing. This is evidenced by the results of scar pattern analysis and the tools' morphology. In addition, bifacial tools from Okladnikov Cave, unlike those from Chagyrskaya, are represented mainly by the items with multiple retouched edges or with traces of continuous treatment along the margins. Notably, the Okladnikov bifaces are much smaller than those from Chagyrskaya Cave (see Fig. 3, *2*).

Conclusions

The attributive analysis has provided significant details concerning the lithic industry from Okladnikov layer 2. For example, an important bifacial component was identified, including plano-convex tools (10 spec.), bifacial thinning flakes (1/4 of the technical flakes), bifacial thinning chips (1/3 of all chips), and tools made on bifacial thinning flakes (6 spec.). The technique of pebble knapping on an anvil and the subsequent manufacture of tools on the resulting spalls have been recorded. Three percussion-abrasive tools were found, including two anvils for the retouch of lithic tools. The technical flake category comprises lateral flakes from radial cores, typical of the prevailing radial flaking technique.

The comparison between the Sibiryachikha assemblages under study revealed not only similar features—for example, in the primary reduction, a set of technical flakes, toolkit, etc.—but also specific traits: in the primary reduction technique, there is the dominance of spalls with coinciding long and flaking axes in the Okladnikov Cave and spalls with mismatched axes in the Chagyrskaya. Unfortunately, a comparison of the bone industries from these sites is impossible, because the Okladnikov bone collection is missing; however, it can be assumed that it contained a significant number of bone retouchers (Baumann et al., 2020).

The characteristics of the Okladnikov Cave assemblages, such as a large number of convergent side-scrapers, small size of tools on spalls, occurrence of tools made on the bifacial thinning flakes and those reshaped after breakage, a high degree of modification and small size of bifacial tools, and a great number of thinning flakes from bifaces/scrapers, indicate a shortage of raw materials.

The petrographic data from previous studies suggest that most of the tools from Okladnikov and Chagyrskaya were made from local raw materials—primarily high-quality Zasurye jasperoids. The inhabitants of Okladnikov Cave used pebbles from the alluvium of the Sibiryachikha and Sibiryachonok rivers. The Neanderthals selected Zasurye jasperoids, sandstones, and sandy siltstones. In the cave lithic collection, 2–12 % of artifacts were made of effusive rocks of the Anuy type, occurring in the Anuy River bed, 3 km from the site (Derevianko et al., 2015). Judging by the archaeological data, inhabitants of Okladnikov Cave brought there predominantly ready-made tools or blanks, because there was probably less raw material of suitable quality and size in its vicinity than near Chagyrskaya Cave. Most of the heavily modified tools were made from Zasurye jasperoids; apparently, the pebbles of this rock were rare.

The shortage of raw materials in the area around Okladnikov Cave determined its more economical use, more thorough modification of lithic pieces, and more frequent rejuvenation of tools than in the Chagyrskaya lithic industry. This influenced the size of the tools and the typological structure of the toolkits. Tools were manufactured from any suitable blanks, including numerous spalls detached during biface manufacturing, specific chips resulting from tool rejuvenation, and anvils for retouching.

The internal variability of the Sibiryachikha assemblages is the result of the adaptation of the ancient population of Okladnikov Cave to the scarcity of raw materials; it is reflected in various technological characteristics of the assemblages, such as the coincidence of the technological axis of most flakes with the long axis, and signs of the use of Levallois technique. To understand the essence of this variability, further careful studies of the archaeological collections from Chagyrskaya and Okladnikov caves are required.

The Altai Middle Paleolithic sites, in contrast to the contemporaneous complexes of other regions (Middle East, Europe), are located near sources of lithic raw materials (Postnov, Anoikin, Kulik, 2000; Rybin, Kolobova, 2009). This excludes the possibility of conducting classic research on the export-import of raw materials or tools and tracing the links between separate regions. The Okladnikov lithic industry shows that even in the proximity of raw materials sources, Neanderthals practiced quite complex behavioral patterns of, which did not preclude the possibility of transporting tools or blanks to the site.

Acknowledgements

The analyses of the lithic collection of Okladnikov Cave layer 2 were supported by the Russian Science Foundation, Project No. 21-18-00376; the comparison of lithic industries of the Sibiryachikha variant were carried out under State Assignment of the Ministry of Education and Science of the Russian Federation, Project “Interdisciplinary Study of Ancient and Medieval Societies of the Altai” (No. FZMW-2023-0009).

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Received March 10, 2023.
Received in revised form April 7, 2023.