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The "Makarovo" Component of Sosnovyi Bor, Southern Angara, Revisited

The paper presents the findings of a revision of a flint assemblage subjected to aeolian corrasion from Sosnovyi Bor horizon VI, southern Angara, in the Angara-Belaya geoarchaeological region. Initially, the industry was attributed to the "Makarovo Paleolithic Horizon" and dated to the pre-Karga/pre-Murukta stage in accordance with the idea of extreme deflation periods in Siberia. Our revision has resulted in a more accurate assessment of the assemblage composition, correcting the views of the toolkit, flaking strategies, and aeolian corrasion of lithics. We challenge the earlier idea that narrow-faced cores were made on bifaces. Instead, the findings indicate the use of volumetric prismatic and flat-parallel cores with a maximal reduction of residual forms. Two types of blanks are described: blades and bladelets. Small tools include burins, implements with a fashioned tip ("nose" or "spur"), retouched blades (the retouch sometimes extends to proximal parts). Signs of aeolian corrasion range from weak luster to completely worn-off facets and pitted surfaces. Chronological and cultural proximity of Sosnovyi Bor to Makarovo IV industries is questioned despite similarities in post-deposition conditions and flaking, because the tool kits are markedly different. The closest parallels are found among Early Sartan small-blade industries of Trans-Baikal and Yeniseian Siberia. Abrasion could have occurred during the cold and arid maximum of the last glaciation. We conclude that the industry dates to the middle stage of the Upper Paleolithic.

Keywords: *Baikal Siberia, Paleolithic, "Makarovo Horizon", corrasion, Sartan age, blade reduction.*

Introduction

Corraded industries of the "Makarovo Paleolithic Horizon" take a special part in the cultural and chronological framework of prehistoric cultures of the Baikal Siberia (Medvedev, Sklyarevsky, 1982). This assemblage, showing technological markers of the blade and microblade edge-faceted reduction, bifacial technique, and tools, such as points, convergent side-scrapers, déjeté scrapers, burins, and chisel-like implements, was attributed to the final Middle and the earliest stage of the Upper Paleolithic, and believed to be older than 70 ka BP (Medvedev, 2001). However, studies carried out in the recent years have demonstrated that certain industries included in this "Horizon" may be associated with much later cultures (Rybin, Meshcherin, 2015; Rybin, Khatsenovich, 2020; Kuznetsov, Molchanov, Kogai, 2023).

It is especially important, therefore, to revisit previously described industries associated with the "Makarovo Horizon". Key among such complexes is

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the lithic industry of culture-bearing horizon (hereafter "horizon") VI of the Sosnovyi Bor stratified site (Medvedev, 1983). The aim of our study is to subject it to a technological and typological revision with a view of assessing its chronology and cultural attribution. In more general terms, the study touches upon the issues of scholarly semiosis (Tetenkin, 2009) by attempting not to reveal the errors made by our predecessors but to adapt previous findings to new paradigms.

Description of the site

The site of Sosnovyi Bor was discovered in 1966 by the Angara Archaeological Team of the Irkutsk State University. It was studied during the field seasons of 1967–1971, 1983, 1997, and 2000–2003 under the direction of G.I. Medvedev, I.L. Lezhnenko, and A.G. Generalov. The site is located on the steep right bank of the Belaya River, at an elevation of 18–22 m above the water's edge. The difference in elevation between the right and left banks near the site is 15–17 m (Fig. 1). Archaeological remains fall within a narrow range 1500 m long and 40 m wide. Mesorelief includes deformed dunes up to 3 m high, occupied by pine forest and oriented in the north-west direction.

The riverbank terrace is formed by tabular dolomite bedrock basement attributable to the Angara suite of the Lower Cambrian (Cm_1an) overlain by boulders and pebbles (layer 9) (Fig. 2). Quaternary deposits consist of two parts: the lower alluvial part covers Jurassic deposits (layer 7); the upper part is of aeolian genesis (layer 3). Stratigraphy shows a distinct unconformity between them (Vorobieva, 1991). Alluvial sands are deformed by cryoturbation; these are scattered and comprise loam inclusions (layer 8).

All culture-bearing layers are incorporated into the aeolian deposits. Isolated finds from horizon I in the base of the modern soil (layer 1) date to the Late Neolithic/Bronze Age; preceramic horizon II is associated with Early Holocene sediments (layer 2) (Lezhnenko, Medvedev, Mikhnyuk, 1982). Underlying horizons III–IV connected with glay sandy loams varying in degree of carbonization,

Fig. 1. Eastern part of the Angara-Belaya geoarchaeological region.

which mark the immature Bølling-Allerød soils of the final Sartan (layers 4 and 5), correlate with different stages of the Mesolithic (ca 12 ka BP) (Medvedev et al., 1971; Vorobieva, 1991). Horizon V, initially interpreted as a "contemporary" of "classic" Malta and then as a Middle Sartan complex, ultimately was attributed to the Bølling-Allerød interstadial (Lezhnenko, 1991; Berdnikova, 2012; Berdnikova, Berdnikov, Vorobieva, 2017). This supposition is corroborated by the presence of the distinct "Yubetsu" component in the lithic assemblage and by the radiocarbon date of 12,390 ± 45 BP (OxA-39086) (Zolotarev, Shegutov, 2020). Bottom horizon VI, assessed as transported, contains variously corraded lithics distributed in isolated patches, highly variable in the concentration of finds (Generalov, Slagoda, 2001). It is associated not with soil rudiments, but with the grus-pebble crust (layer 6) underlying the Sartan sequence of sands, which marks the deflation transect line (Vorobieva, 1991).

Technical and morphological revision of the assemblage

Artifacts were counted and subjected to technological and typological analysis to reveal technologically meaningful

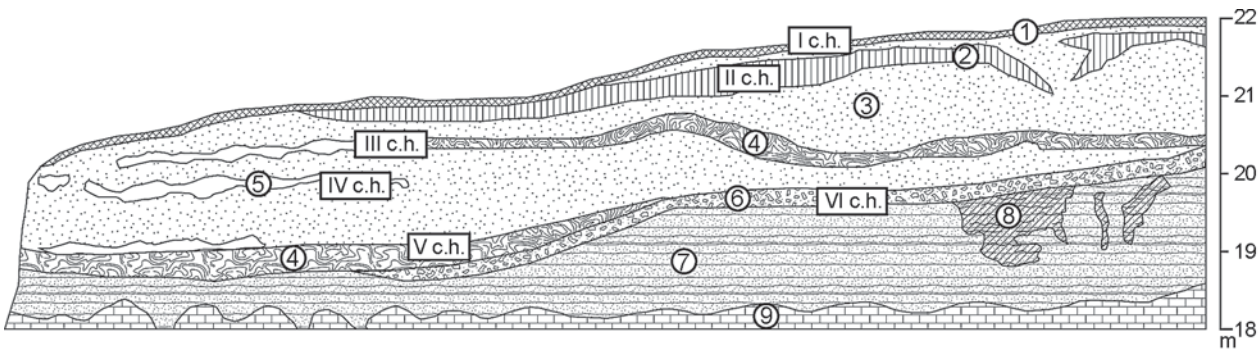

Fig. 2. Combined stratigraphic profile (after (Vorobieva, 2010: 52, fig. 12D)).

criteria required for the reconstruction of knapping strategies (Pavlenok, Belousova, Rybin, 2011). Traces of corrasion were analyzed with regard to qualitative characteristics ("heavy", "moderate", "weak", and "absent") of three variables: luster, erosion, and worn-off facets (Durand, Bourquin, 2013).

Lithic assemblage from horizon VI of Sosnovyi Bor comprises 347 artifacts:

	Spec.	%*
Core-like pieces	7	3.7
Core-trimming elements	57	30.2
Blades	31	16.4
Bladelets	22	11.6
Microblades	1	0.5
Flakes	71	37.6
Debitage	158	45.5

*Proportions were calculated without debris.

The raw material represented by bedded chert of gray-white-black coloration is characterized by fissured structure both along striae and inner cavities. Nodules of this material, small in diameter, were "soldered" into Lower Cambrian dolomites of rock walls, including the basement of the coastal bluff, in the lower reaches of the Belaya.

The flat core technique represented by three artifacts is associated with a simple sequence of unidirectional knapping with a minimal preparation of surfaces (Fig. 3). A single-platform core with two flaking surfaces opposing each other illustrates the volumetric core technique (Fig. 4, *2*). An exhausted flat bilongitudinal core (Fig. 5, *1*) suggests the utilization of narrow-faced cores. Core-like fragments cannot be used for the assessment of reduction technique, but they bear negatives of bladelets.

The assemblage contains various core-trimming elements:

	Spec.	%
Decortication flakes	15	26.3
Working surface rejuvenation flakes	14	24.6
Longitudinal lateral flakes	8	14
Semi-crested blades	6	10.5
Flakes removed from core's base	4	7
Debitage surface preparation flakes	3	5.3
Semi-tablet flakes	2	3.5
Natural lateral flakes	2	3.5
Crested blades	2	3.5
Core convexity maintenance flakes	1	1.8

The number of complete flakes is 24. They illustrate stages of primary reduction such as decortication, shaping of flaking surfaces and striking platforms, maintenance of

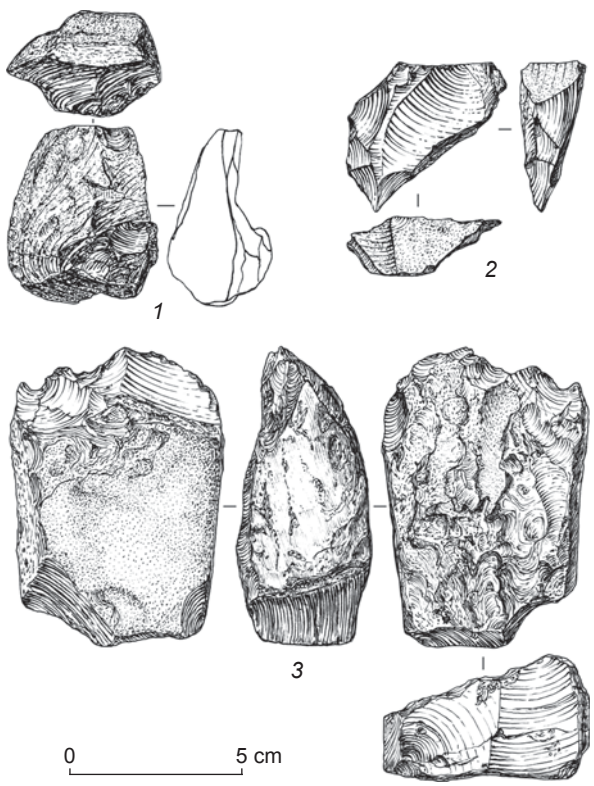

Fig. 3. Flat-faced cores.

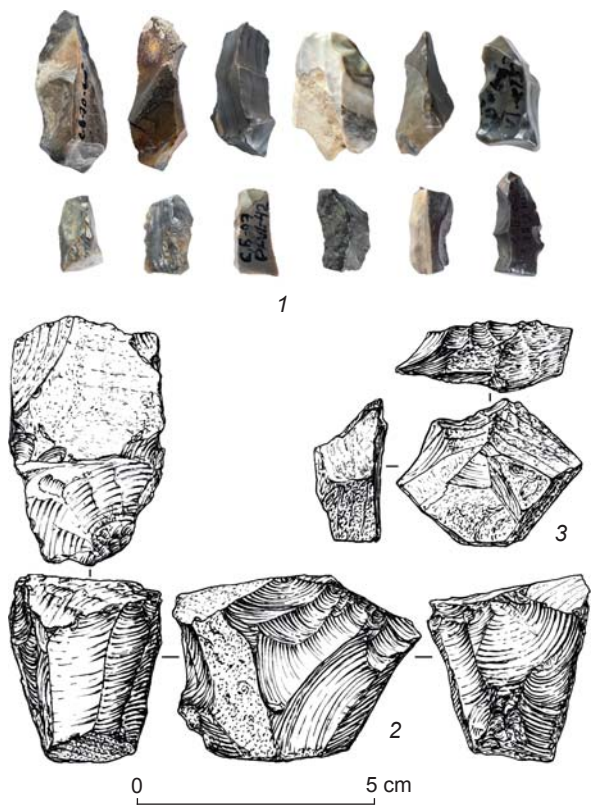

Fig. 4. Longitudinal lateral flakes (*1*); volumetric core (*2*); transverse core rejuvenation flake (*3*).

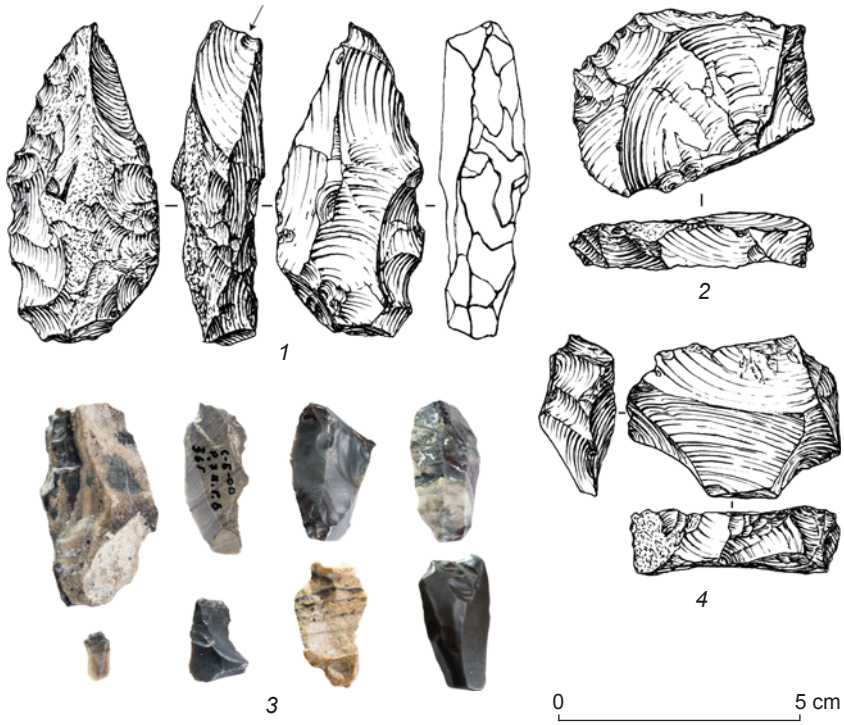

Fig. 5. Narrow-faced core (*1*); longitudinal lateral rejuvenation flake (*2*); blades (*3*); debitage surface preparation flake (*4*).

required core volume, and correction of erroneous flaking (see Fig. 4, *1*, *3*; Fig. 5, *2*, *4*). The artifacts vary in length (25–36 mm) and width (16–39 mm). Residual striking platforms are mostly plain and dihedral (40.7 % each); natural, polyhedral, and unidentifiable platforms are represented by solitary specimens. The depth of striking platforms is 3–7 mm. Isolated specimens demonstrate evidence of trimming of platforms by direct and reverse reduction. Bulbs of percussion are observed on 78 % of the artifacts retaining proximal parts.

Flakes vary in length (15–46 mm) and width (16–29 mm). Only 9 specimens are complete. Dorsal faces demonstrate in roughly equal parts traces of bilongitudinal, convergent, orthogonal, and unidentifiable flaking. Two flakes retained natural surface. Platforms are mostly plain (42.9 %); dihedral platforms are less common (21.4 %); polyhedral and linear platforms are represented in equal parts (14.3 % each); unidentifiable remnant platforms are also available (7.1 %). Evidence of platform trimming by direct reduction is visible on 28.6 % of the flakes. The depth of the platforms vary mostly in the range of 3–4 mm. Bulbs of percussion are present on 71.4 % of the flakes.

Linear dimensions of blades vary in length (17–42 mm) and width (12–24 mm). Only 11 specimens are complete (see Fig. 5, *3*). Dorsal faces of most blades show evidence of longitudinal flaking; isolated specimens demonstrate counter and convergent flaking. Three blades retained natural surface. Most platforms are plain (68.8 %); dihedral and unidentifiable platforms are represented in equal parts (12.5 % each); one blade has a natural remnant striking platform. Rejuvenation of platforms exclusively by direct reduction is observed on 68.8 % of the blades. The depth of the platforms is 2–4 mm. Half of the blades have bulbs of percussion.

Bladelets measure 13 to 15 × 8 mm. Only two of them are complete. Dorsal faces bear evidence of longitudinal flaking. Platforms of complete specimens and those retaining the proximal part are plain, linear or unidentifiable (28.6 % each); one bladelet demonstrates remnant punctiform striking platform. Three specimens bear traces of rejuvenation by direct reduction. The depth of the platforms is 1–3 mm. Five bladelets have bulbs of percussion. The assemblage comprises one microblade. It measures 10 × 5 mm; the dorsal face demonstrates elements of longitudinal flaking; the platform is linear, without traces of rejuvenation or a bulb of percussion.

The toolkit consists of 27 implements. Tools were fashioned on flakes (16 spec.), blades (5 spec.), bladelets (5 spec.), and on a core-trimming flake. Complete tools form 18.5 %. The assemblage contains a series of burins (4 spec.). All of them are of the angle longitudinal single type (Fig. 6, *1*). Two burins were fashioned on the distal parts of blades; two others, on fragments of flakes. Three burins have a single-facetted top; the tip of one burin is double-facetted. Burin spalls are up to 8 mm long.

One of the blades, in addition to a burin facet, bears traces of utilization on the longitudinal edge. Tools with fashioned working tips (6 spec.) are morphologically and technologically amorphous (Fig. 6, *4*). A "spur"/"nose" is fashioned by fine retouch (2 spec.), dorsal trimming (2 spec.), or by notches (2 spec.). In this group, a longitudinal-lateral flake with the trimmed proximal part and reduced bulb of percussion is noteworthy (Fig. 7, *5*). The category of formal tools is represented by fragments of flakes with extensive abrupt retouch (3 spec.) (Fig. 6, *5*; 7, *3*, *4*), a blade with dorsal retouch on the proximal part (see Fig. 6, *3*), a blade with retouch on the longitudinal edge and with opposing natural back, and flakes with retouched notches up to 6 mm wide (2 spec.). The assemblage contains ten unformal tools with use-wear retouch: bladelets (2 spec.), blades (4 spec.), and flakes (4 spec.). Blades and bladelets with a maximum length of 32 and 16 mm, respectively, are represented by complete and fragmented specimens (see Fig. 6, *2*); traces of corrasion on them range from weak luster to smoothing of retouch.

The collections of 1968 and 1971 contain two corraded bifaces. They show scars of later removals (see Fig. 7, *1*, *2*). These artifacts were found in overlying horizons IV and V, though the heads of the excavations interpret them as manuports from horizon VI (Lezhnenko, 1991).

Undiagnosed waste products make up nearly half of finds from horizon VI. Among the noteworthy features of this group are concave/convex negatives (possibly anthropogenic) on opposite faces; certain artifacts are nearly worn-off by corrasion; in one fragment, corrasion degree varies across the surface.

In this study, the quartzite component from horizon VI that does not belong to the "Makarovo Horizon" (Generalov, Slagoda, 2001) was not examined. These products resulted from simple flaking (fracturing) of small and medium-sized pebbles in one transversal or longitudinal plane. The dimensions of the pebbles (2.5 to 3.5 × 5.5 cm) and the fact that these, like numerous cleavage products, were registered only during the 1997 season, raise doubts as to their anthropogenic origin (Ibid.: 95).

Discussion

Archaeological materials from Sosnovyi Bor were examined in several publications describing both the site in general and its Paleolithic horizons. The publications of 1982 summarizing results of the six-year cycle of studies mentioned the small size of collection from horizon VI (n=162), the presence of a single lateral flake, a prismatic core, a retouched blade, and a prismatic microblade (Lezhnenko, Medvedev, Mikhnyuk, 1982). The cultural attribution of finds from the bottom layer and the flaking technique were not specified, because data were scarce. However, it was suggested that the artifacts dated to the early Upper Paleolithic; also, it was proposed for the first time that the Sosnovyi Bor industry resembled that of Makarovo IV.

In 1983, G.I. Medvedev, in his doctoral dissertation, attributed with certainty the finds from horizon VI of

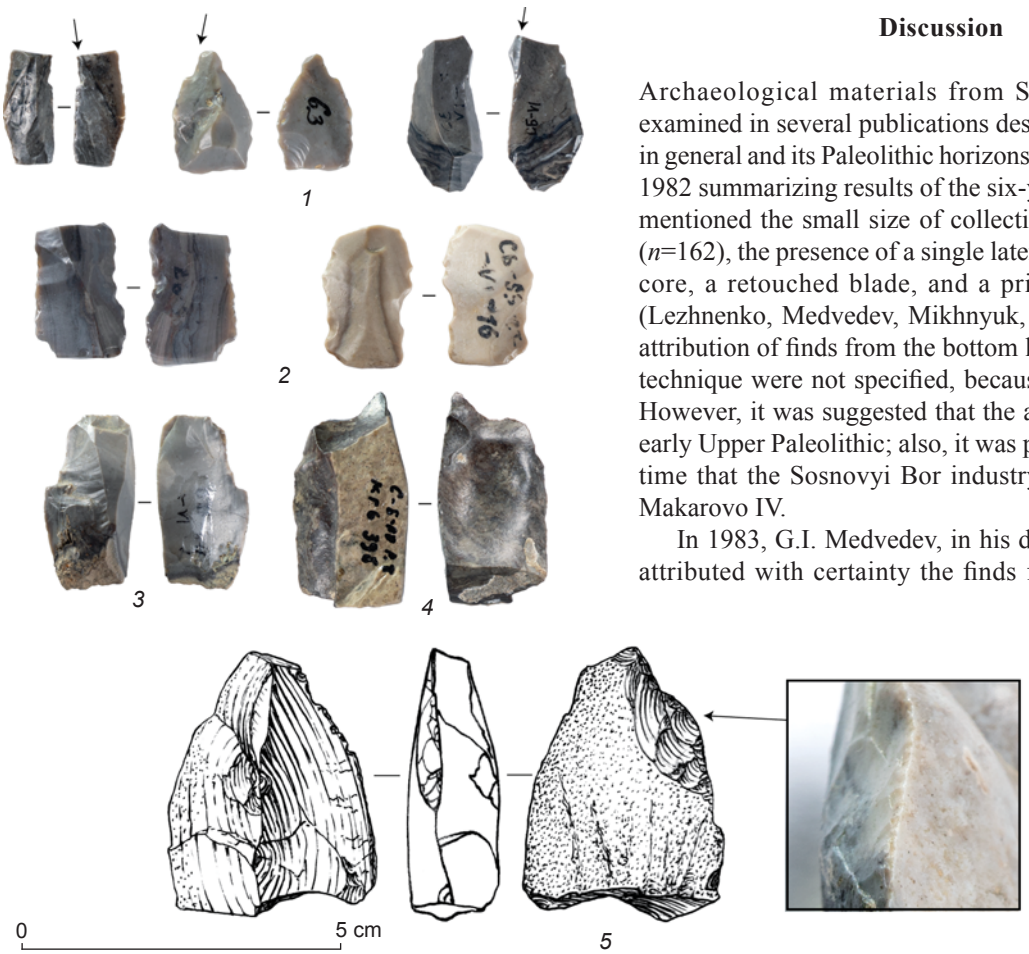

Fig. 6. Burins (*1*); fragments of retouched blades (*2*); blade with dorsal retouch on the proximal part (*3*); "spurred" blade (*4*); flake with abrupt retouch (*5*).

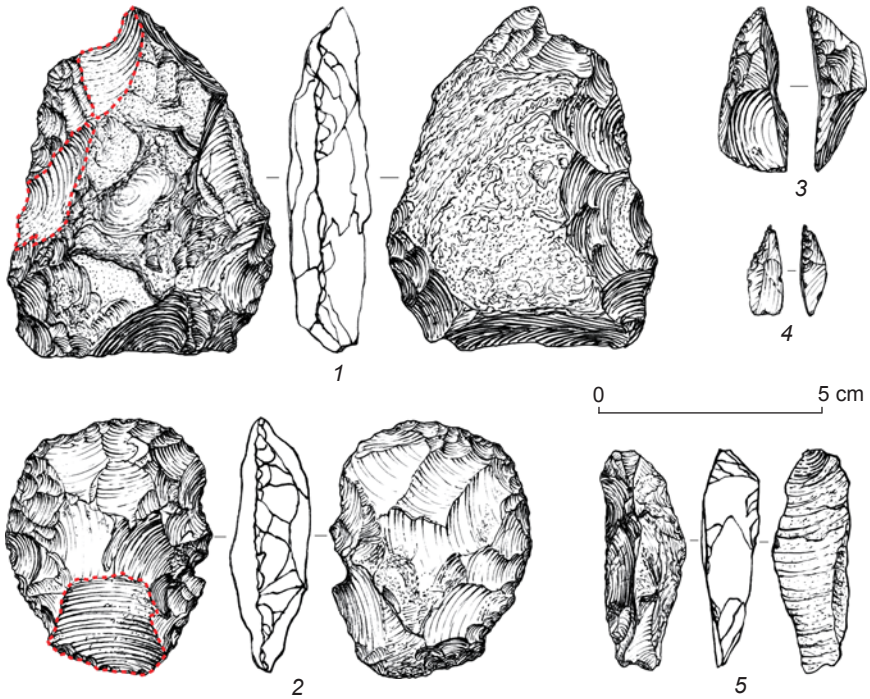

Fig. 7. Bifaces (uncorraded negatives are shown by dashed lines) (*1*, *2*); flakes with abrupt retouch (*3*, *4*); longitudinal-lateral flake with the trimmed proximal part (*5*).

Sosnovyi Bor and lithic industries from Gora Igetei I and Makarovo IV to the "Makarovo Horizon". The attribution was based on stratigraphic and petrographic data, traces of corrasion, and on flaking techniques, particularly, "specific microflaking… utilization of prismatic cores" (1983: 328). The number of artifacts (*n*=176) indicated in this work increased in comparison with the publication of 1982 at the expense of retouched blades, pebble hammerstones, and core-trimming elements. The period of corrasion was dated to 60–40 ka BP (Ibid.: 327).

In 1991, a paper presenting the new findings in study of the Paleolithic horizons at Sosnovyi Bor was published. The collection, reduced to 52 artifacts, was divided into three different age groups, depending on the degree of corrasion (Lezhnenko, 1991). The author noted utilization of radial and parallel flaking, as well as citrus and slice techniques. The lateral flake mentioned in the publication of 1982 was interpreted as a product detached "from a biface that served most likely as a blank for a wedge-shaped core" (Ibid.: 34). The list of finds was supplemented with corraded artifacts from the overlying horizons: two bifaces and a fragment of a microscraper. Based on the analysis of flaking technique and corrasion degree, it was concluded that "horizon VI is chronologically heterogeneous" (Ibid.: 34).

In 2001, a paper was published, in which the composition of the collection (*n*=436) was significantly enlarged due to artifacts excavated in 1997 (Generalov, Slagoda, 2001). These were different-sized flint blades demonstrating parallel and subparallel flaking pattern (104 spec.), including a crested variety; bifaces (4 spec.), including those with a burin facet; an angle burin on a microblade; large flakes retouched on their dorsal faces, possibly end-scrapers (4 spec.); split quartzite pebbles (183 spec.); and quartzite flakes (Ibid.). As compared to previously published data, the number of blades has increased manifold, burins have been identified, and the possibility has been raised that certain tools are end-scrapers. Elaborating on I.L. Lezhnenko's idea, the authors reconstructed a technological evolutionary line, whereby small blades and microblades resulted from the reduction of bifaces, which became preforms of wedge-shaped cores. The corraded bifaces and the "crested blade" mentioned in earlier publications were used as evidence of application of terminal-lateral flaking. Removal of the bulb of percussion was described as a characteristic technique of stone treatment. It was assumed that large flakes resulted from knapping of pebble core-choppers and/or large cores of radial technique of flaking. A flake with scars of radial removals was given as an example (Ibid.: 99).

Our revision has made it possible to identify core-like specimens evidencing flat, volumetric, and possibly, narrow-faced flaking aimed at obtaining small (7–9 mm and 12–14 mm wide) blades. The presence of prismatic blades has been affirmed, though specimens with parallel contours and standardized sections are singular. The suggestion concerning the utilization of bifaces as

preforms for flaking from their narrow face, which was put forward by A.G. Generalov, does not find evidence in the assemblage: the group of core-trimming elements contains neither primary boat-shaped nor secondary ski-shaped spalls reliably confirming the use of such technique. The distal part of the crested flake, which was previously used as an indicator of flaking bifaces and/or wedge-shaped cores, illustrates the technique of shaping an elongate blank by transversal uni- or bifacial removals.

Our revision has revealed a series of burins, retouched blades, including those with natural backs; tools with working tips shaped by trimming or retouching, and flakes with use-wear retouch. The assumption about the presence of microscrapers and end-scrapers on flakes in the industry has not been confirmed. The corraded bifaces can be attributed to the lower complex; however, it is possible that these artifacts were collected from the ground surface elsewhere. Generally speaking, no distinct cultural markers have been observed in the industry; small sizes of tools can be regarded as an additional feature.

Superficial corrasion degree, which I.L. Lezhnenko had used as a chronometric indicator, was likewise revised. Lithics belonging to this industry reveal various degree of luster, smoothed facets, and superficial erosion. The correlation between these variables is relatively low ($r = 0.71$; $r = 0.72$; $r = 0.67$)*. Moreover, the collection contains 11 artifacts without signs of corrasion, though all of them bear the code of horizon VI.

Looking for parallels, we must take into account the view expressed by researchers of Sosnovyi Bor, who claimed that its industry was close to that from Makarovo IV. One of the common features of these sites is the specifics of the culture-bearing layer composed of sand abound in pebbles, gravel, and grus (Aksenov, 2009; Vorobieva, 1991). Traces of corrasion on the artifacts suggest similar post-deposition conditions at both sites. Despite the fact that the industries are based on different raw materials (tabular and clastic concretions at Sosnovyi Bor, and pebbles at Makarovo IV), the common (sub) parallel protoprismatic principle of stone knapping can be traced in the morphological similarity of cores and in the composition of final products (Aksenov, 2009; Rybin, Khatsenovich, 2020). In Makarovo IV collection, crested forms are rare, though this difference can be associated with the specifics of raw materials (Rybin, Khatsenovich, 2020: 298). At the level of tool morphotypes, this contrast is obvious. The collection from Sosnovyi Bor lacks choppers, choppings, typical end-scrapers, or retouched points; though it comprises bifaces absent in Makarovo IV collection. Parallels can be seen only in the group of burins and spurred tools; however, the former constitute just 3 % of all the tools at Makarovo IV (Ibid.: 296, tab. 20).

The comparison of the industry from horizon VI at Sosnovyi Bor with other complexes of Baikal Siberia and contiguous regions makes it possible to attribute it to the middle Upper Paleolithic (MUP). Such attribution is primarily based on the size and "irregular" shape of the blades. Parallels to the Sosnovyi Bor industry in the Yenisei region can be found at the sites of Shlenka, Afanasieva Gora, Achinskaya, Tarachikha, and Novoselova-13 horizon 3. These are small-blade industries, dating to ca 20 ka BP (Lisitsyn, 2000; Kharevich, 2019). In Trans-Baikal, these are industries from Kunalei (horizon 3), Masterov Klyuch (cultural layer 4), and Ust-Menza-6 (cultural layer 4) (Konstantinov, 1994; Meshcherin, 2014; Vikulova, 2023). A certain similarity with the industry of Sosnovyi Bor horizon VI can be found in the collections, representing the "transition" from blade to flake technologies, from horizons 4a and 4b of Tolbor-4 in Mongolia (Rybin et al., 2022).

Most small-blade industries of the Trans-Baikal and Yenisei regions mentioned above comprise carinated artifacts, providing a connection with the key MUP Siberian site—Malta. Corraded artifacts from Stoilo (Kuznetsov, Molchanov, Kogai, 2023) and the industry from the lower horizon of Sosnovyi Bor, in the view of the mentioned authors, form a joint cultural complex together with Malta assemblage. Recent studies of the "classic" Malta industry have revealed evidence of cultural homogeneity of the corraded and non-corraded components (Kuznetsov, Molchanov, 2024).

The main obstacle to attribution of Sosnovyi Bor to MUP is the chronostratigraphic interpretation of the culture-bearing grus-pebble layer as being formed during the Murukta age (Vorobieva, 1991; Generalov, Slagoda, 2001). However, according to S.M. Tseitlin (1979), this layer may well be of the Early Sartan age. In this case, sandblasting of the material could have occurred during the cold and arid maximum of the last glaciation (Sr^{l}_{2}), in the range of ~21–18 ka uncal BP (Vorobieva, 2010). Accordingly, the manufacture of the artifacts and their subsequent "aeolization" could fall in the same climatic and stratigraphic interval. This disagrees with traditional beliefs about corrasion in the archaeology of Baikal Siberia (Medvedev, 2001), but, as the experiments have demonstrated, aeolian traces can emerge without extreme winds or long time intervals (Knight, 2008).

Conclusions

Since the discovery of Sosnovyi Bor, the assessments of age and cultural attribution of materials from its Paleolithic horizons have more than once been revised. Owing to their connection with the "Makarovo Horizon",

*Multiple correlation coefficients were generated with the CORR function in Excel. The sample (n=189) includes all lithics identified as artifacts in which quantitative traits could be estimated.

age estimates of finds from horizon VI were claimed to be older than previously believed. This revision was motivated by the complex stratigraphic situation, the limitations of absolute dating techniques, and the absence of organic remains in horizon VI. Our analysis of the lithic component in this assemblage challenges a number of earlier proposals about the reduction strategy, and allows us to extend the nomenclature of lithics.

The revision indicates the use of prismatic and flat parallel blade flaking. The toolkit includes angle burins, implements with a "spur"/"nose", retouched and notched blades and flakes, and bifaces. In our opinion, there is no typological resemblance between the Makarovo IV and Sosnovyi Bor collections, so there is no reason to attribute the Sosnovyi Bor industry to the "Makarovo Horizon". We propose to date this industry to the Early Sartan age and to attribute it to the middle stage of the Upper Paleolithic, which disagrees with the idea of the pre-Karga/pre-Murukta age of the stratum (Medvedev, 2001). Further studies, in our view, must include a more detailed comparative analysis of aeolian-corraded assemblages of the Angara-Belaya geoarchaeological region.

Acknowledgements

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References

Aksenov M.P. 2009
Paleolit i mezolit verkhnei Leny. Irkutsk: Izd. Irkutsk. Gos. Tekh. Univ.

Berdnikova N.E. 2012
Zaklyuchitelnaya stadiya pozdnego paleolita yuga Baikalskoi Sibiri. Geoarkheologicheskiye syuzhety. In *Pervobytnye drevnosti Evrazii: K 60-letiyu Alekseya Nikolaevicha Sorokina*. Moscow: IA RAN, pp. 103–122.

Berdnikova N.E., Berdnikov I.M., Vorobieva G.A. 2017
Arkheologicheskiye kompleksy Belling-Allereda v doline r. Beloi: Dannye biostratigrafii. *Evraziya v kainozoye. Stratigrafiya, paleoekologiya, kultury*, iss. 6: 168–177.

Durand M., Bourquin S. 2013
Criteria for the identification of ventifacts in the geological record: A review and new insights. *Comptes Rendus. Géoscience*, vol. 345 (3): 111–125.

Generalov A.G., Slagoda E.A. 2001
Mnogosloinoye verkhnepaleoliticheskoye mesto-nakhozhdeniye Sosnovyi Bor. In *Kamennyi vek Yuzhnogo Priangariya. Belskiy geoarkheologicheskiy raion*, vol. 2, G.I. Medvedev (ed.). Irkutsk: Izd. Irkutsk. Gos. Univ., pp. 4–100.

Kharevich V.M. 2019
Rekonstruktsiya tekhnologii pervichnogo rasshchepleniya v kamennykh industriyakh verkhnego paleolita Eniseya. In *V Severnyi arkheologicheskiy kongress: Materialy dokladov*. Ekaterinburg, Khanty-Mansiysk: Alfa-Print, pp. 44–46.

Knight J. 2008
The environmental significance of ventifacts: A critical review. *Earth-Science Reviews*, vol. 86: 89–105.

Konstantinov M.V. 1994
Kamennyi vek vostochnogo regiona Baikalskoi Azii. Ulan-Ude: Inst. obschestv. nauk Buryat. nauch. tsentra SO RAN; Chita: Chitin. Ped. Inst.

Kuznetsov A.M., Molchanov D.N. 2024
Korradirovannyi komponent "klassicheskoi" Malty (po rezultatam analiza kollektsii MAE RAN). *Vestnik Novosibirskogo gosudarstvennogo universiteta*. Ser.: Istoriya, filologiya, vol. 23. No. 3: Arkheologiya i etnografiya: 47–61.

Kuznetsov A.M., Molchanov D.N., Kogai S.A. 2023
Stoilo—a Paleolithic site in the Southern Angara region, Siberia. *Archaeology, Ethnology and Anthropology of Eurasia*, vol. 51 (4): 15–24.

Lezhnenko I.L. 1991
Paleoliticheskiye gorizonty stoyanki Sosnovyi Bor. In *Paleoetnologicheskiye issledovaniya na yuge Srednei Sibiri*. Irkutsk: Izd. Irkutsk. Gos. Univ., pp. 26–36.

Lezhnenko I.L., Medvedev G.I., Mikhnyuk G.N. 1982
Issledovaniya paleoliticheskikh i mezoliticheskikh gorizontov stoyanki Sosnovyi Bor na reke Beloi v 1966–1971 gg. In *Paleolit i mezolit yuga Sibiri*. Irkutsk: Izd. Irkutsk. Gos. Univ., pp. 80–107.

Lisitsyn N.F. 2000
Pozdniy paleolit Chulymo-Eniseiskogo mezhdurechiya. St. Petersburg: Peterburg. vostokovedeniye.

Medvedev G.I. 1983
Paleolit Yuzhnogo Priangariya. D.Sc. (History) Dissertation. Irkutsk.

Medvedev G.I. 2001
O geostratigrafii ansamblei eolovo-korradirovannykh artefaktov Baikalskoi Sibiri. In *Sovremennye problemy Evraziyskogo paleolitovedeniya*. Novosibirsk: Izd. IAET SO RAN, pp. 267–272.

Medvedev G.I., Georgievsky A.M., Mikhnyuk G.N., Saveliev N.A. 1971
Stoyanki Angaro-Belskogo raiona ("Badaiskiy" kompleks). In *Mezolit Verkhnego Priangariya*. Pt. I: Pamyatniki Angaro-Belskogo i Angaro-Idinskogo raionov. Irkutsk: Izd. Irkutsk. Gos. Univ., pp. 31–90.

Medvedev G.I., Sklyarevsky M.Y. 1982
Problemy izucheniya paleoliticheskikh izdeliy iz kamnya s eolovoi korraziei obrabotannykh poverkhnostei (vozrast – kultura – geografiya). In *Problemy arkheologii i etnografii Sibiri: Tezisy dokladov*. Irkutsk: Izd. Irkutsk. Gos. Univ., pp. 41–43.

Meshcherin M.N. 2014
O "neplastinchatykh" industriyakh v verkhnem paleolite Zabaikaliya. *KSIA*, No. 232: 90–99.

Pavlenok K.K., Belousova N.E., Rybin E.P. 2011
Atributivnyi podkhod k rekonstruktsii "operatsionnykh tsepochek" rasshchepleniya kamnya. *Vestnik Novosibskogo gosudarstvennogo universiteta*. Ser.: Istoriya, filologiya, vol. 10 (3): 35–46.

Rybin E.P., Gunchinsuren B., Khatsenovich A.M., Marchenko D.V., Bolorbat C. 2022

Finalnaya stadiya rannego verkhnego paleolita Severnoi Mongolii: Kamennaya tekhnologiya i regionalnye analogii: Tolbor-4, sloi 4a i 4b. *Teoriya i praktika arkheologicheskih issledovaniy*, vol. 34 (2): 186–206.

Rybin E.P., Khatsenovich A.M. 2020

Makarovskaya zagadka: Samyi ranniy verkhniy paleolit Evrazii ili pribaikalskiy variant tekhnokompleksa nachalnogo verkhnego paleolita perioda MIS-3 (?). *Stratum Plus*, No. 1: 279–303.

Rybin E.P., Meshcherin M.N. 2015

Stoyanka Kolpakov Ruchei: Ranniy verkhniy paleolit v srednem techenii reki Angary (Sibir, Krasnoyarskiy krai). *KSIA*, No. 242: 28–42.

Tetenkin A.V. 2009

Problematika vtorichnogo semiozisa v arkheologii. *Izvestiya laboratorii drevnikh tekhnologiy*, No. 1 (7): 9–13.

Tseitlin S.M. 1979

Geologiya paleolita Severnoi Azii. Moscow: Nauka

Vikulova N.O. 2023

Kompleksy srednei pory verkhnego paleolita basseina reki Chikoi (Zapadnoye Zabaikalye). *Pervobytnaya arkheologiya*, No. 1: 68–84.

Vorobieva G.A. 1991

Paleogeograficheskiye usloviya formirovaniya i stroeniye otlozheniy na mnogosloinom pamyatnike kamennogo veka Sosnovyi Bor. In *Paleoetnologicheskiye issledovaniya na yuge Srednei Sibiri*. Irkutsk: Izd. Irkutsk. Gos. Univ., pp. 15–25.

Vorobieva G.A. 2010

Pochva kak letopis prirodnykh sobytiy Pribaikalya: Problemy evolyutsii i klassifikatsii pochv. Irkutsk: Izd. Irkutsk. Gos. Univ.

Zolotarev D.P., Shegutov I.S. 2020

Tekhnika yubetsu v finalnopaleoliticheskikh kompleksakh Baikalo-Eniseiskoi Sibiri (MIS-2). In *Materialy LX Ros. arkheol.-etnogr. konf. studentov i molodykh uchenykh s mezhdunarodnym uchastiem*. Irkutsk: Izd. Irkutsk. Gos. Univ., pp. 68–71.

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