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P. V. Moroz[a], V. S. Slavinsky[b], S. B. Vereshchagin[a], G. A. Yurgenson[c], Yu. V. Ryzhov[d], Ya. V. Kuzmin[e], A. A. Tsybankov[b]

[a] Transbaikal State University, 30 Alexandro-Zavodskaya St., Chita, 672039, Russia [frostius.81@mail.ru]

[b] Tyumen Scientific Center SB RAS, 86 Malygin St., Tyumen, 625026, Russia [slavinski@yandex.ru; tsybankov@yandex.ru]

[c] Institute of Natural Resources, Ecology and Cryology SB RAS, 16a Nedorezova St., Chita, 672014, Russia [yurgga@mail.ru]

[d] Irkutsk State University, 1 Karl Marx St., Irkutsk, 664003, Russia [ryzhovyurij@yandex.ru]

[e] Institute of Geology and Mineralogy SB RAS, 3 Academician Koptyug St., Novosibirsk, 630090, Russia [kuzmin@fulbrightmail.org]

[a] Забайкальский государственный университет, Александро-Заводская ул., 30, Чита, 672039, Россия [frostius.81@mail.ru]

[b] Тюменский научный центр СО РАН, ул. Малыгина, 86, Тюмень, 625026, Россия [slavinski@yandex.ru; tsybankov@yandex.ru]

[c] Институт природных ресурсов, экологии и криологии СО РАН, ул. Недорезова, 16а, Чита, 672014, Россия [yurgga@mail.ru]

[d] Иркутский государственный университет, ул. Карла Маркса, 1, Иркутск, 664003, Россия [ryzhovyurij@yandex.ru]

[e] Институт геологии и минералогии СО РАН, ул. Академика Коптюга, 3, Новосибирск, 630090, Россия [kuzmin@fulbrightmail.org]

# The easternmost Late Middle Paleolithic and Initial Upper Paleolithic industries in Asia: assemblages of the Sukhotino workshop, Eastern Transbaikal, Russia[1, 2]

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**Abstract.** This article deals with the materials of the Sukhotino workshop site in the Transbaikal region of Siberia, where the easternmost Late Middle Paleolithic and Initial Upper Paleolithic industries were discovered. Primary attention is given to reconstructing the knapping schemes used by the inhabitants of the site. Of particular importance are the quantitatively rich assemblages from layers 3–5. Layers 3 and 4 yielded an Initial Upper Paleolithic industry. The Middle Paleolithic assemblage of Layer 5 contains solid evidence of the use of the convergent Levallois technique for obtaining unidirectional elongated points.
**Keywords**: Transbaikal, Titovskaya Sopka, Sukhotino workshop, Middle Paleolithic, Levallois technique, Initial Upper Paleolithic.

**Мороз П. В., Славинский В. С., Верещагин С. Б., Юргенсон Г. А., Рыжов Ю. В., Кузьмин Я. В., Цыбанков А. А. Самые восточные в Азии индустрии среднего и начального верхнего палеолита: комплексы Сухотинской мастерской, Восточное Забайкалье, Россия.** В статье рассматриваются материалы Сухотинской мастерской в Забайкальской Сибири, где выявлены самые восточные индустрии среднего и начального верхнего палеолита. Основное внимание уделено реконструкции схем расщепления камня, использовавшихся обитателями памятника. Особый интерес представляют богатые комплексы слоёв 3–5. В слоях 3 и 4 представлена индустрия начального верхнего палеолита. Среднепалеолитический комплекс слоя 5 содержит свидетельства использования конвергентной техники леваллуа для получения удлинённых остий.
**Ключевые слова**: Забайкалье, Титовская сопка, Сухотинская мастерская, средний палеолит, леваллуазская техника, начальный верхний палеолит.

## Introduction

Studies of archaeology and ancient DNA of the Paleolithic in Northern Eurasia (Slon et al., 2017; Chen et al., 2019; Hublin at al. 2020; Mafessoni et al. 2020) has allowed researchers to establish an association between hominin species and lithic assemblages. The materials of the final Middle Paleolithic (MP) (for example, in the Altai Mountains of Siberia: Krause et al. 2007; Mafessoni et al. 2020) are associated with the activity of the Neanderthals. As for the Initial Upper Paleolithic (IUP), until recently a connection with a particular species of hominin has not been identified. However, the results of studies of the Bacho-Kiro cave in the Balkans (Hublin at al. 2020), as well as the discovery of an early modern human in West Siberia (Fu et al. 2014), seem to relate the IUP to the activity of the latter. The assemblages of the Sukhotino workshop site in Transbaikal extend the limit of the distribution of MP and IUP industries in Northern Eurasia further to the east compared to what was known before and opens up prospects for more discoveries of MP and IUP assemblages in Eastern Siberia.

This article focuses on the results of the 2019 test excavations of the Sukhotino workshop site, which contains large quantities of artifacts of both the MP and IUP in a clear stratigraphic context. Despite the specific functional purpose of the site, as a workshop for the primary lithic processing at outcrops of high quality raw materials, the assemblages contain a series of ready-to-use tools; there are also remains of organic materials in the form of worked antler. This makes it possible to determine the cultural and chronological affiliations of the archaeological complexes at this site.

## General background to the site

The site is a part of the Sukhotino geoarchaeological cluster (Filatov 2016) and is associated with the flattened slope of a hill named Titovskaya Sopka, with an elevation of 725–767 m above the Baltic datum (zero level in Russia). The hill is formed by lava flows of about 1000 $m^2$. The site is located on the southwestern outskirts of Chita, the capital of the Zabaykalsky Krai in Transbaikal (Fig. 1 and 2). The first studies of Sukhotino were undertaken by M. V. Konstantinov, who has been conducting surveys in this area since 2012, and who, in 2013, dug a test pit at the site. According to Filatov, the excavation yielded a collection of more than 12,000 specimens, obtained from five units of loose deposits (Filatov 2016: 35). Unfortunately, no detailed descriptions of the materials have yet been published.

In 2019, a new test pit of 2 $m^2$ was excavated next to the 2013 test pit in order to establish a complete profile of the section and to determine a clear stratigraphic position for the artifacts. The archaeological materials obtained in 2019 derive from two excavation grids, Squares 1 and 2, and five cultural layers, layers 1–5 (MP and IUP) with high densities of artifacts. Layers 3–5 occur in a clear stratigraphic position.

The total thickness of the Quaternary sediments uncovered during the 2019 fieldwork is 2.16 m. The stratigraphy of the eastern wall of the 2019 test pit (Fig. 3) can be described as follows (Table 1).

*Table 1.* **Sedimentary profile of the Sukhotino site with finds**

| Layer | Thickness (cm) | Description |
|---|---|---|
| 1 | 30–42 | The layer consists of modern soil penetrated by the root system of meadow plants in the upper horizon, gradually turning into brownish humified silty sandy loam with artifacts of cultural layer 1 and a significant amount of clastic material — hornfels rocks of various sizes from 2–3 cm length to blocks of 35 cm length. There is no clear contact between the modern soil and the lower horizon. The stratum in Square 1 has a clear drop to 8–9° towards Square 2 |
| 2 | 27–38 | Orange-yellow silty sandy loam containing small (2–3 cm) and medium (5–10 cm) sized fragments of hornfels rocks. This stratum contains material from cultural layer 2. The stratum has a clear drop to 7–9° towards Square 2, and its greatest thickness is observed in Square 1 |
| 3 | 18–23 | Light loam of yellowish-ash color. Contains small and medium-sized fragments of hornfels rocks ranging from 2–3 to 7–8 cm along the long axis. Contains cultural layer 3. The artifacts at this level are mostly patinated on one surface, in contrast to the overlying cultural layers. There is a clear drop to 7–9° from Square 1 towards Square 2 |
| 4 | 50–65 | Heavy, weakly carbonated sandy loam with a high content of gruss and crushed stone with the inclusion of medium-sized clastics up to 10 cm in size along the long axis. Contains cultural layer 4. Its greatest thickness is in Square 1 |

| Layer | Thickness (cm) | Description |
|---|---|---|
| 5 | 70–85 | A stratum of light, purple-colored loams, saturated with small, medium, and coarse-grained clastic material, containing admixtures of heavy brown loams with traces of manganese. Contains cultural layer 5. Its greatest thickness is in Square 2 |

No absolute dates have yet been obtained, though a number of antler and soil samples were taken for radiocarbon and OSL dating, respectively.

## The lithic assemblages

As a result of the 2019 research, 3693 artifacts were found, including 544 specimens from Layer 5, 967 from Layer 4, 387 from Layer 3, 725 from Layer 2, and 1070 from Layer 1. Almost all artifacts from layers 1 and 2 have patina that covers both surfaces, which is not the case with the artifacts from the other layers. In addition, the artifacts from the two upper layers show clear traces of redeposition associated with the downslope movement of the sediments. Because of this, we did not include these materials in the present analysis.

The raw material from all cultural layers is local hornfels. In the Sukhotino complex, artifacts from almost all cultural layers are composed of metamorphosed volcanic rocks of Triassic age. All these rocks underwent intensive thermal impact during the Jurassic period as a result of the intrusion of granite nearby. As a result of this, the volcanic rocks underwent recrystallization and transformation into hornfels. This is why the lithic materials form a conchoidal fracture and a feather-like termination as a result of hominin manufacture. The raw materials are available mainly in the form of prismatic blocks of hornfels.

The collection of Layer 5 (Fig. 4) consists of five cores (simple parallel, edge-faceted and Levallois types), 322 flakes (including Levallois ones), 202 technical flakes and debris, 13 tools and two hammerstones. Tools are represented by a chopper, a biface, two side-scrapers, three backed knives, two spur-like tools and four notches.

Layer 4 (Fig. 5; 6) yielded 15 cores (simple parallel and bipolar ones), six core preforms, 35 blades and lamellar flakes, 529 flakes, 360 technical flakes and debris, 15 tools and two hammerstones. The tool set consist of four bifaces, a side-scraper, a combined tool (a steep-shaped side-scraper and a knife), a borer, and eight notched pieces.

The assemblage of Layer 3 consists of five cores (all are unidirectional), 38 blades and lamellar flakes, 232 flakes, 110 technical flakes and debris, and two tools. The latter are represented by a side-scraper on a flake and an end-scraper on a blade.

The artifacts of Layer 5 can be attributed to the Middle Paleolithic, and those from layers 4 and 3 to the Initial Upper Paleolithic. The boundaries between the layers are clear but without sterile interlayers. Therefore, at the contacts of the individual layers, there is a slight mixture of artifacts. Given that a series of split blocks of raw materials were recorded at the site, their refits (without taking into account any blanks that may have been carried away by the manufacturers from the site to use elsewhere), make it possible to separate the cultural assemblages by layers. However, due to the limited area of excavation the number of refits is small.

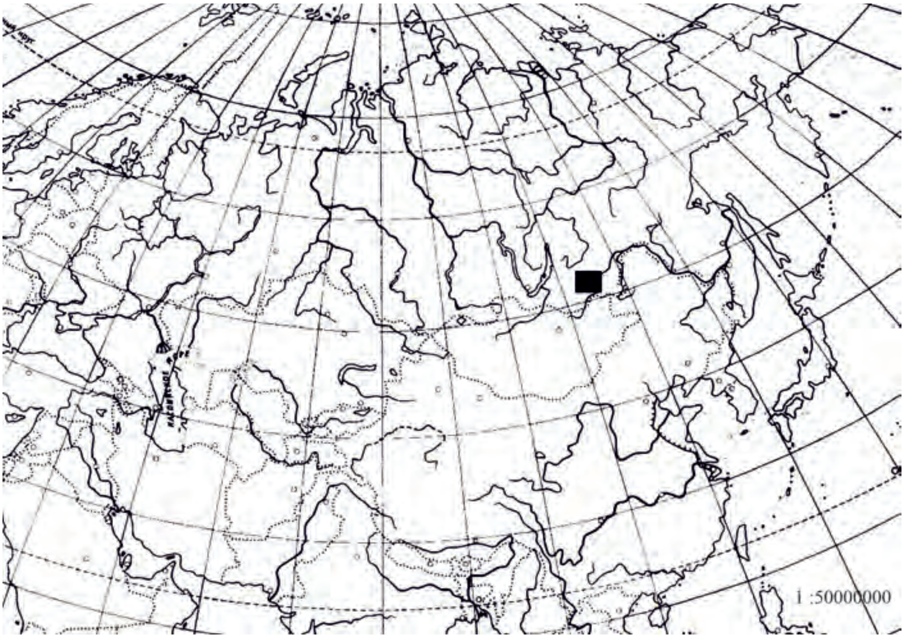


*Fig. 1.* Location of the research area of the Sukhotino site in Transbaikal, Russia
*Рис. 1.* Место расположения Сухотинского комплекса памятников в Забайкалье

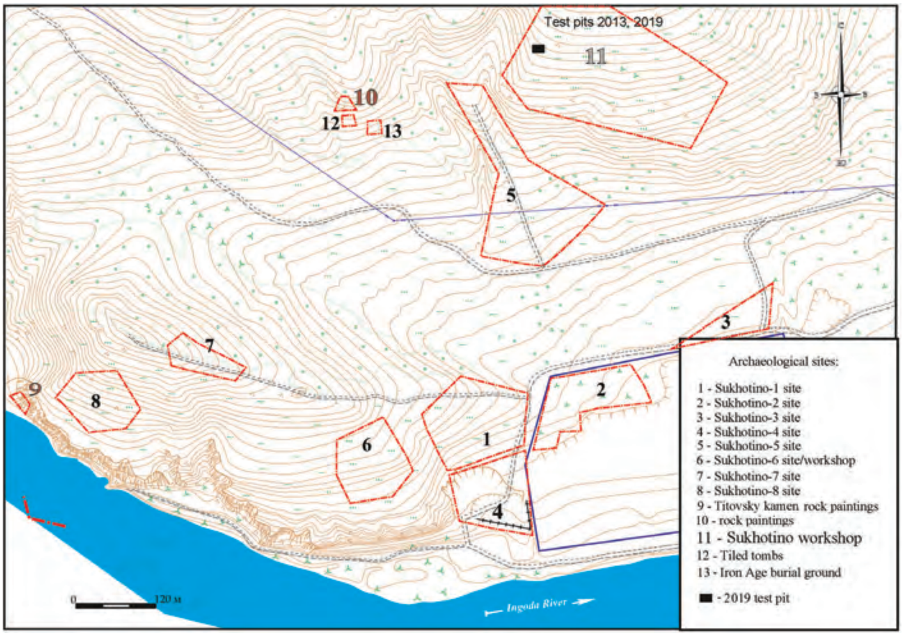


*Fig. 2.* Map of the Sukhotino site complex showing the location of archaeological sites
*Рис. 2.* Карта расположения археологических памятников Сухотинского комплекса

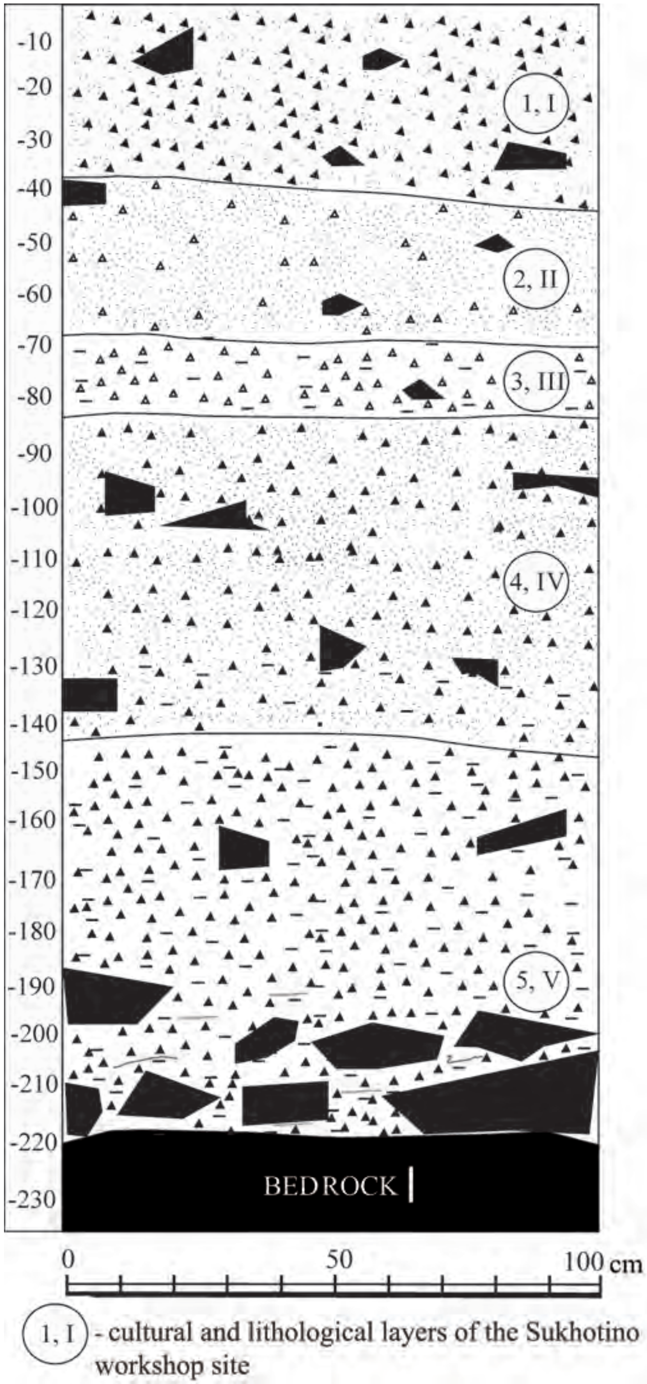


*Fig. 3.* Sukhotino workshop. The profile of the eastern wall of the 2019 test pit
*Рис. 3.* Сухотинская мастерская. Профиль восточной стенки шурфа 2019 г.

The MP assemblage contains solid evidence of the use of the convergent Levallois technique in the form of rejoined atypical unidirectional elongated points (Fig. 4: *5*). One of the two lateral edges of the points is covered with tabular cortex, replacing the previously prepared one of the flat surfaces of the Y-shaped pattern of the blank. This technique is analogous to the production of flakes of one of the restored cores of the Kara-Bom site (Slavinsky, Rybin 2007), and this demonstrates a similar technique of making blanks. In addition, the assemblage contains other intentional and technical flakes (Fig. 4: *1–4*), as well as cores of the Levallois convergent technique. In general, the knapping technology of this complex was aimed at preparing simple parallel and Levallois cores for transportation to be used off-site (primary decortication of bar-shaped hornfels blocks), in order to obtain blanks for tool production. At least some of the blanks were used occasionally at the site. This is evident by the few but ready-to-use tools: side-scrapers, knives, and notched items. The Upper Paleolithic features in the form of blade volumetric reduction, as well as Upper Paleolithic types of tools, are absent in Layer 5. A flake with traces of pecking of the edge of the residual striking platform was found at the top of Layer 5, and was most likely redeposited from the overlying IUP stratum.

The IUP assemblage consists of the two industries of layers 4 and 3, which belong to the same cultural complex but with different chronologies. How specific is the timing of these industries, and is there any cultural difference between them? This question will be discussed in broader studies in the future. We consider the industries of layers 4 and 3 as a single assemblage.

The main function of the Sukhotino site was the preparation of core-shaped blanks and cores for transportation, as well as flaking of some cores in order to obtain blanks for use at the site. Without taking into account the technical flakes of the primary processing of raw material blocks, the blade cores and blade blanks were manufactured by applying a specific reduction technique using crushing of the striking platform edge (pecking) (Fig. 5). The use of the Upper Paleolithic unidirectional and bidirectional subprismatic techniques to produce large and medium size blades was recorded at other sites. This kind of knapping is the main one in the IUP of Southern Siberia and Central Asia (Slavinsky et al. 2017; Zwyns, Lbova 2019), and it is a cultural and chronological marker in the determination of the place of IUP lithic industry in the Paleolithic of these regions. In addition to technological IUP criteria, the assemblage also includes some typical tools — bifaces, scrapers, and others (Rybin 2014).

## Discussion

The convergent Levallois technique, which was aimed to obtain typical unidirectional points, is widespread on the territory of southern Siberia and Central Asia (Rybin, Slavinsky 2015; Rybin, Khatsenovich 2020). However, the sites where the products of this method are presented in a clear stratigraphic context, without admixture of materials from other periods, are rare. Such occurrences include the open-air sites of Kara-Bom, Ust-Karakol 1 and Ust-Kan Cave, in the Russian Altai. The lithic assemblages of these sites have been comprehensively studied (Rudenko 1961; Derevianko et al. 1998a; 1998b; 2003; Lesage et al. 2020), including the technological aspect (Zwins et al. 2012; Slavinsky et al. 2016). The dominance of the Levallois convergent technique at the Kara-Bom (MP2 component) and Ust-Karakol 1 (Layer 18) sites was proved by the refitting (Slavinsky et al. 2016). Levallois elements were found practically without admixtures in layers 7–10 of the Ust-Kan Cave (Lesage et al. 2020). Denisova, Okladnikov, Strashnaya and other caves (Derevianko, Markin 1992; Derevianko et al. 2003;

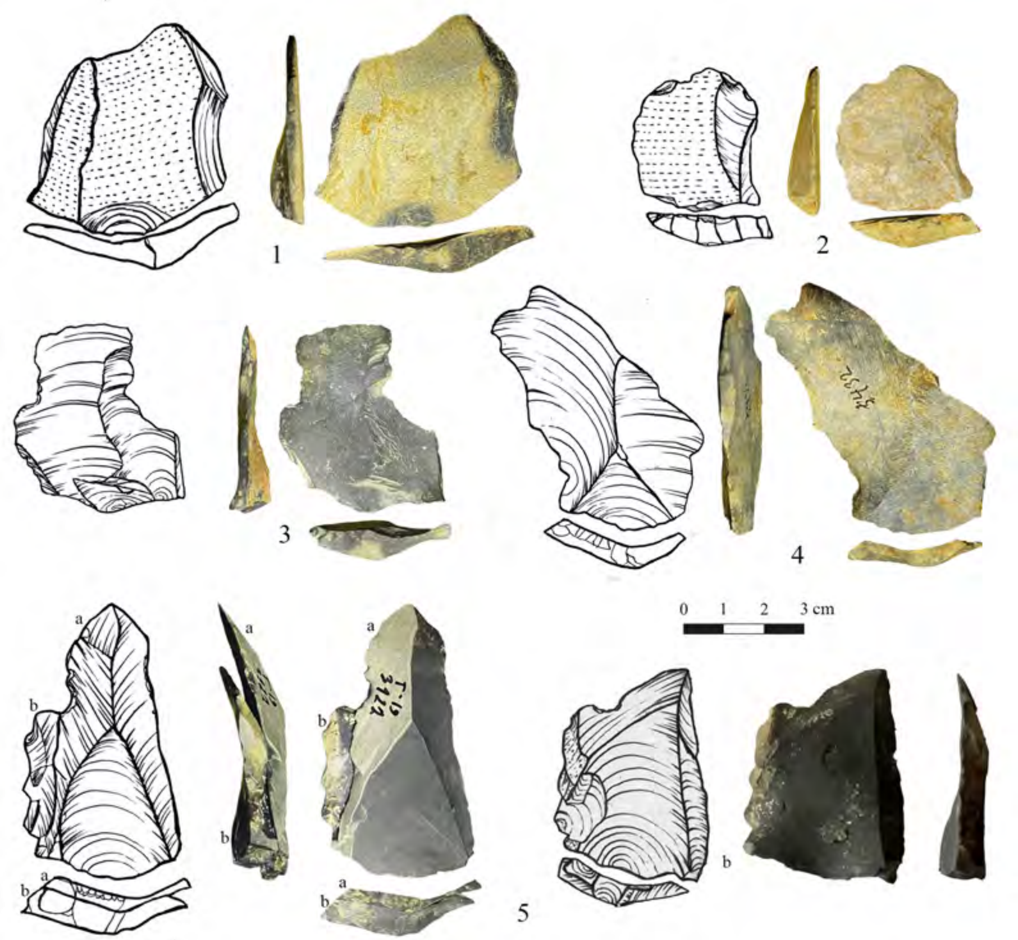


*Fig. 4.* Sukhotino workshop. Cultural layer 5. *1–4* — Levallois blanks; *5* — refitted atypical Levallois points
*Рис. 4.* Сухотинская мастерская. Культурный слой 5. *1–4* — леваллуазские заготовки; *5* — апплицированные атипичные леваллуазские острия

Shunkov et al. 2020) also have products of this technique, but artifacts are found in heavily disturbed layers with materials from other cultural-chronological complexes of the Paleolithic (for more details see Slavinsky, Tsybankov 2020; Kuzmin et al. 2021). The closest similarity to the Sukhotino workshop in terms of the use of the Levallois convergent technique, represented by typical unidirectional points, can be traced to northern Mongolia at the Moiltyn-am site (Derevianko et al. 2010; Rybin, Khatsenovich 2020), and has also, possibly, been identified in western Transbaikal at the the Barun-Alan 1 site (Tashak 2018). However, these assemblages do not have a clear stratigraphic context, and the technique to obtain these artifacts has not been precisely established. Therefore, in our opinion, it is impossible to completely exclude the possibility that these artifacts were manufactured using a non-Levallois method, without having the results of refitting.

The researchers of the open-air sites of Kara-Bom and Ust-Karakol 1, as well as of the Denisova, Okladnikov and Ust-Kan caves, correlate the layers with the Levallois convergent industry with the period from MIS6 to the early MIS3. The chronology is based primarily on the age determinations obtained by the RTL and OSL dating methods of the Paleolithic sites in the Anui River valley — Ust-Karakol 1 and Denisova Cave (e. g., Derevianko et al. 2003; Douka et al. 2019; Jacobs et al. 2019). Criticism of the use of these chronometric methods and the apparent aim of researchers to obtain older dates are described in detail in recently published papers (Kuzmin, Keates 2020; Slavinsky, Tsybankov 2020; Kuzmin et al. 2021). In our opinion, these assemblages

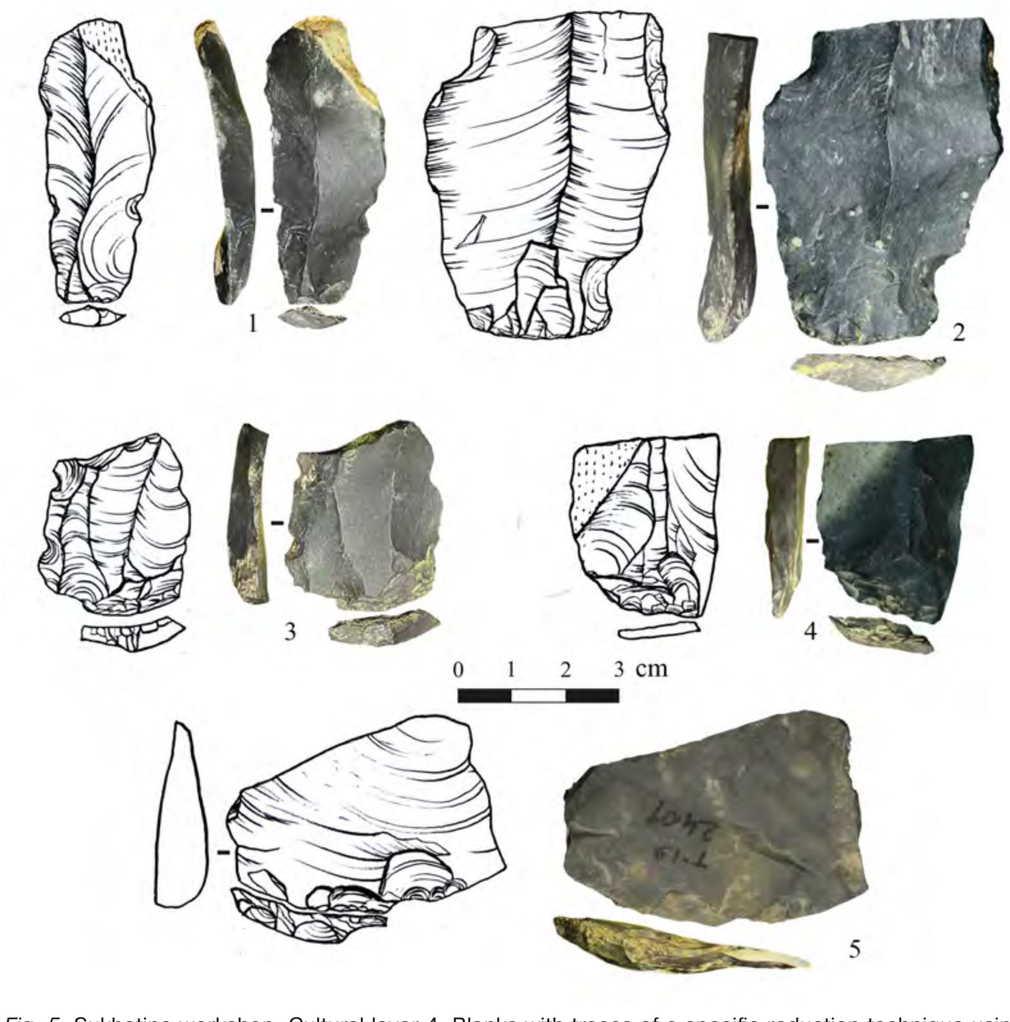


*Fig. 5.* Sukhotino workshop. Cultural layer 4. Blanks with traces of a specific reduction technique using crushing of the striking platform edge
*Рис. 5.* Сухотинская мастерская. Культурный слой 4. Заготовки со следами специфической техники редуцирования края ударной площадки посредством дробления

should be correlated only with the early stage of MIS3, namely with the Early Karginian warming, and this time interval should be limited to the final MIS4 — the beginning of the Early Karginian cooling corresponding to the Heinrich event H5 (Heinrich 1988). The length of MIS3 is determined for southern Siberia in the range of ca. 55 (±5) — 25 (±5) ka BP (Prokopenko et al. 2001; Zander et al. 2003), or in calibrated values — 59–29 ka cal BP (e. g. Swann et al. 2005). Based on the Lake Baikal drilling core, and in particular, from columns of sediments of the Selenga-Buguldeyka area (cores BDP-93–2 and 339), where this event is characterized by a sharp decrease in diatom productivity, the H5 dates to about 50 ka BP (Prokopenko et al. 2001). By taking into account the drilling data of deep-sea sediments of the North Atlantic, the H5 event occurred at 47–48 ka BP (Gillevich et al. 2014). Therefore, the extended interval can be indicated as 50–47 ka BP. The assemblages containing artifacts of the Levallois convergent technique are recorded in the Altai in particular, and most likely in southern Siberia as a whole, in the interval of about 60–50 ka BP. The occupation of high latitudes by ancient populations was obviously limited by the harsh climatic conditions of the cold MIS4 stage and a short-term, but no less severe, intra-Karginian cooling correlated with the H5 event. It seems to us that the emergence of the convergent Levallois industry of the final MP at the beginning of MIS3 in southern Siberia should be associated with the migration of a Neanderthal population from the Levant in the northeastern direction starting at the MIS4 — MIS3 boundary. The Levantine Mousterian B complex (e. g. Tabun and Kebara), where the main method of knapping was the Levallois convergent technique, has been dated to ca. 70–50 ka BP (Rebollo et al. 2011; Meignen 2012). Considering the rare evidence of the Levallois technique in the region between the Eastern Mediterranean and the Altai (for example, Levallois layers 19–21 of the Obi-Rakhmat site, eastern Uzbekistan; Derevianko et al. 2004), a scenario of rapid migration of Neanderthals can be assumed.

The IUP industries are widespread in Central Asia and southern Siberia, from east Kazakhstan and Dzungaria to Transbaikal and northern Mongolia and China. The assemblages of the Altai Mountains are the best-studied ones. The technological methods of knapping from the initial stages of core reduction to the production of blanks were reconstructed by the refitting. The assemblages are characterized by a similar technological system, with the dominant bidirectional method of the reduction of sub-prismatic cores, including the specific burin-core technology for making blades. Specific types of IUP tools consist of points with ventral base thinning and oblique points; blanks with ventral trimming of the transverse distal edge; leaf-shaped bifaces; stemmed blades; and backed bladelets (Derevianko et al. 1998b; Zwyns 2012; Zwyns et al. 2012; Rybin 2014; Slavinsky et al. 2016; 2018). This industry is represented without admixtures at the Kara-Bom (occupation horizons 6–1) (Derevianko et al. 1998b; Zwyns et al. 2012; Rybin 2014), Ust-Karakol 1 (Layer 5, 1986 excavation) (Derevianko et al. 1998a; Zwyns et al. 2012), and Ushbulak 1 sites (Shunkov et al. 2019), and some other sites with small collections of stone tools.

The IUP assemblages of Mongolia have also been comprehensively studied. The most important sites are Tolbor 4 (cultural horizons 4–6, excavation of 2007; Derevianko et al. 2007), Tolbor 16 (archaeological horizon 6; Zwyns et al. 2014; 2019), Tolbor 21 (archaeological horizon 3; Rybin et al. 2017) and Kharaganin-gol 5 (archaeological horizon 5; Khatsenovich et al. 2017). The IUP industries of these sites have direct technological and typological analogies with the Altai materials.

In Transbaikal, the best-studied IUP assemblages are from the Khotyk (cultural levels 2 and 3; Lbova 2000), Kamenka A (Zwyns, Lbova 2019), Podzvonkaya (cultural horizon 3 of the eastern complex; Tashak 2016), Barun-Alan 1 (cultural layers 7, 7d and 8; Tashak and Antonova 2015), Varvarina Gora (cultural level 2; Lbova 2000) and Tolbaga (Layer 4; Konstantinov 1994; Vasiliev, Rybin 2009; Izuho et al. 2019) sites. These assemblages also have almost direct analogies with the materials of the Altai and are associated (along with the sites in northern Mongolia) with the industry of the Sukhotino workshop.

The assemblages of layers 3–4 of the Sukhotino workshop are characterized (without taking into account the debitage of the primary reduction of raw materials) by the bidirectional method of sub-prismatic core reduction to obtain large and medium-sized blades (Fig. 6: *1–6*). The parallels in the flake technique are especially striking. Traces of pecking on the edge of the joint of the striking platform and the dorsal surface of the blanks, which is one of the key markers of the IUP, clearly illustrate the method of preparing a spall for removal in the industries known from the sites in the Altai, northern Mongolia and Transbaikal (Slavinsky et al. 2017; Zwyns, Lbova 2019). An equally significant marker to compare materials from the Sukhotino workshop with other IUP complexes in Central Asia and southern Siberia is the presence of bifaces. The most representative collection of bifaces from the Altai IUP industries comes from the Anui 3 (Layer 18), Ust-Karakol 1 (1986 excavations, Layer 5) and Denisova Cave (Layer 11) (Shalagina et al. 2019), including leaf-like forms. To the east of the Altai, in northern Mongolia, leaf-shaped and oval bifaces are known in the industries of the Tolbor group of sites (Shalagina et al. 2019). The bifaces of the Sukhotino workshop are not leaf-shaped; however, an oval biface on a flake has a thin profile and shows careful shaping by very acute spalls (Fig. 6: *7*).

The IUP industries in Central Asia and southern Siberia chronologically fit into the Middle Karginian (Malaya Kheta) warming associated with the middle period of MIS3 and limited by the Heinrich events H5 and H4, approximately 50 and 35 ka BP, respectively (Prokopenko et al. 2001). The H4 event correlates with the Konoshchelye cooling (Kind 1974) at the global level, and clearly links it with the Bond climatic cycles (Bond et al. 1993) and the data of deep-water drilling of Lake Baikal. These data are in complete agreement with the results of studies of the loess-paleosol sequence of Western and Central Siberia, where this cooling is dated in the interval of about 36–32 ka BP and corresponds to the interval between the intra-Karginian warmings (Zander et al. 2003; Frechen et al. 2005). Taking into account the drilling data of deep-sea sediments of the North Atlantic, the H5 event occurred at 47–48 ka BP, and H4 — at about 39 ka BP. (Guillevic et al. 2014). Therefore, it is more expedient to indicate these events with extended intervals of 50–47 ka BP and 39–35 ka BP, respectively. In averaged values, the IUP assemblages in Central Asia and southern Siberia can be assigned to a time interval of 49–48 — 38–37 ka BP, i. e. they existed in these regions for about 10,000 years. The Altai IUP complexes have a slightly earlier age relative to industries located to the east (Rybin 2014). The penetration of IUP populations, in turn, into the Altai territory, in our opinion, is associated with migration from Western Asia, most likely, from the Levant, along approximately the same route as the MP populations (see above) traveled. In our opinion, the most studied IUP materials from layers 7–14.1 of the intermediate site of the Obi-Rakhmat Grotto, dated to ca. 49–36 ka BP (Krivoshapkin et al. 2010), as well as the assemblage from the Khuji site, uncal. 42–36 ka BP (Ranov et al. 2002), can serve as confirmation of this migration. The earliest IUP industries in the Levant are dated to about 50 ka BP (Olszewski 2017), and are represented by the Boker-Takhtit (Layer 1) and Kzar-Akil (layers XV–XXI) assemblages. Judging from the age of the IUP industries in the Levant and Central Asia, the migration to southern Siberia took place within a short time span, about 1000 to 2000 years.

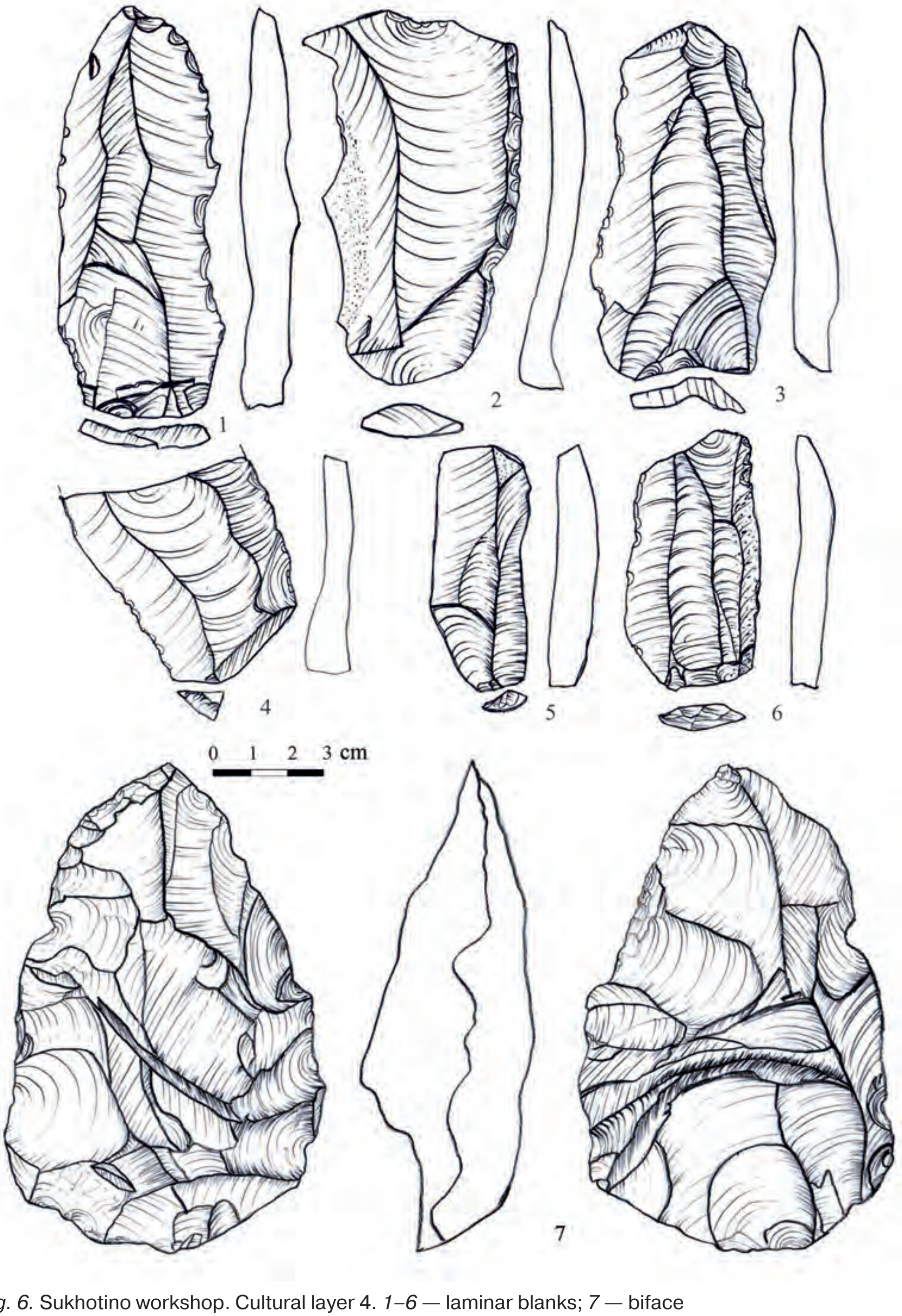


*Fig. 6.* Sukhotino workshop. Cultural layer 4. *1–6* — laminar blanks; *7* — biface
*Рис. 6.* Сухотинская мастерская. Культурный слой 4. *1–6* — пластинчатые заготовки; *7* — бифас

## Conclusion

The Sukhotino industries today represent the eastern limit of the spread of the Levallois MP and the lamellar complexes of the IUP, and are associated with the presence, in our opinion, of the late Neanderthals and early modern humans in eastern Eurasia. If the movement of the IUP bearers hundreds of kilometers in the eastern direction does not cause much surprise, since now there is evidence of the spread of early modern *H. sapiens* far to the north (Mochanov, Fedoseeva 2013), up to the polar regions (Pitulko et al. 2016; Sikora et al. 2019), documenting the presence of Neanderthals in eastern Russia opens up unexpected prospects for the exploration of the possible spread of Neanderthals toward the east. The most promising way to search for MP and IUP sites in this region are the river valleys of the Shilka and Amur, including the northern tributaries of the Amur, Zeya and Bureya rivers. The Amur River basin extends along the offspurs of the Borshchovochny Range, Olekminsky Stanovik, Tukuringra, Turan, Stanovoy and Bureinsky ranges, stretching to the Pacific Ocean coast. These mountains are rich not only in food resources, but also have a variety of lithic raw materials, including high-quality metamorphosed rocks in the form of hornfels which have a homogeneous structure and an optimal bar-like shape of raw material clasts. In the future, the search for MP and IUP sites should be focused on these areas.

Further research of the Sukhotino workshop by more extensive excavations and analysis of new data, including radiocarbon and OSL dates, will allow us to obtain a clear chronology of the site, its full technical and typological features and, accordingly, a place among the synchronous MP and IUP assemblages of Southern Siberia and Central Asia. This, in turn, opens up opportunities for further study of the phenomenon of adaptive capabilities, including the migration potential of late Neanderthals and early modern *H. sapiens* in the climatic conditions of the northern latitudes of Eurasia.

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