Towards the Origin of Microblade Technology in Northeastern Asia

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Microblade technology is one of the most remarkable phenomena in the Upper Paleolithic of northern Eurasia, primarily the northern and eastern regions of Asia. Here we present an overview of the most recent developments in attempting to understand the emergence and spread of this technology, based on data known for Siberia and the Russian Far East, Mongolia, China, Korea, and Japan. The main assumptions for selection of the earliest microblade

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complexes are: 1) the presence of three artifact types: wedge-shaped microcores; microblades; and retouched (utilized) microblades; 2) a reliable chronology based on critical evaluation of radiocarbon dates; and 3) the stratigraphic integrity of artifacts. The pressure flaking was a technique to make microblades, and this is important issue which was often not taken into account previously. Based on these criteria, the oldest microblade-bearing complexes for each of the regions listed above were selected. Using these data, we can conclude that the earliest evidence of microblade technology is known from the Korean Peninsula where it is dated to ca. 25,500–24,200 BP. In other regions (China, Siberia, Russian Far East and Japan), the first microblade assemblages are dated to ca. 21,100–19,400 BP. As a result of our analysis, two possible explanations for the emergence of microblade technology in northern and eastern Asia can be considered: 1) invention and diffusion from a single core area; and 2) independent creation in several places and subsequent expansion. Currently, we cannot solve this issue, but generate some suggestions which may bring us closer toward identifying its origin and spread. Factual data as presented in this paper can be used as a primary source for future research.

Keywords: Upper Paleolithic, microblade technology, lithic analysis, chronology, spatiotemporal patterns, Asia.

К происхождению микропластинчатой технологии в Северо-Восточной Азии

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Микропластинчатая технология является одним из самых выразительных явлений в верхнем палеолите Северной Евразии, в основном в северных и восточных регионах Азии. В работе представлен обзор новейшей информации для попытки понять появление и распространение этой технологии с опорой на данные по Сибири и Дальнему Востоку России, Монголии, Китаю, Корее и Японии. Основными критериями для выбора самых ранних микропластинчатых комплексов являются: 1) присутствие трех типов артефактов: клиновидных микронуклеусов, микропластин и ретушированных (утилизованных) микропластин; 2) надежная хронология, основанная на критической оценке радиоуглеродных дат; 3) стратиграфическая целостность комплексов артефактов. На этих основаниях выбраны самые древние комплексы с микропластинами для каждого из перечисленных регионов. Анализ данных позволяет заключить, что самое раннее свидетельство микропластинчатой технологии известно на Корейском полуострове, где оно датировано около 25 500–24 200 радиоуглеродных лет назад (л. н.). В других регионах (Китай, Сибирь, Дальний Восток России и Япония) первые микропластинчатые комплексы датируются около 21 100–19 400 л. н. В результате можно рассматривать два допустимых объяснения появления микропластинчатой технологии в Северной и Восточной Азии: 1) изобретение и проникновение из единственного очага; 2) независимое появление в нескольких местах и последующее распространение. В настоящее время данная проблема неразрешима, однако могут быть предложены некоторые соображения, приближающие к пониманию особенностей культурного развития региона, причин появления и распространения микропластинчатой технологии. Фактические данные, собранные в работе, представляют собой основу для последующих исследований в этом направлении.

Ключевые слова: верхний палеолит, микропластинчатая технология, анализ каменного материала, хронология, пространственно-временно́й анализ, Северо-Восточная Азия.

1. Introduction

The origin of the Upper Paleolithic in Eurasia is among the most important issues in Old World prehistory[1]. As a part of Upper Paleolithic studies, microblade technology is one of the most remarkable phenomena[2], the origin of which is still not well known[3]. Recent discoveries of Upper Paleolithic sites and excavations in Siberia and East Asia[4] show a more complex picture of the development of lithic technology compared to what was known 20 years ago.

Several volumes have appeared in the last 25 years regarding the emergence and diffusion of microblade technology in northern Eurasia[5]. The latest developments and new data call for an evaluation of the existing evidence on the origin and expansion of microblade technology in the northeast Asian region (Fig. 1). We argue that only the combined presence of microblade cores, microblades, and backed microblades in an assemblage represents confirmation for intentional microblade manufacture. We take into account the most recent research results from the northern and eastern parts of Asia, and also consider the current status of the identification of pressure flaking, an essential technique in the manufacture of microblades[6].

The aim of this paper is to present a critical analysis of the earliest microblade complexes in Siberia and the Russian Far East (both in Russia), Mongolia, China, Korea, and Japan (Fig. 1) in the context of the spatiotemporal patterns of the origin and spread of this technology in the northern and eastern regions of Asia.

2. Material and Methods

2.1. Main assumptions

In this study, we suggest that microblade technology in northern and eastern Asia emerged from the use of flat-faced core technology. An important component of this technology was the application of pressure flaking to produce microblades. At some Upper Paleolithic sites in Siberia *tortsovy* (narrow-faced) cores for making small irregular bladelets appear to be preforms (i. e., background) for the development of the wedge-

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[1] The early Upper Paleolithic beyond Western Europe / eds P. J. Brantingham, S. L. Kuhn, K. W. Kerry. Berkeley; Los Angeles, 2004. P. 1–15.

[2] Origin and spread of microblade technology in Northern Asia and North America / eds Y. V. Kuzmin, S. G. Keates, C. Shen. Burnaby, 2007. P. 1–24.

[3] *Inizan M.-L.* Pressure *débitage* in the Old World: Forerunners, researchers, geopolitics — handing on the baton // The emergence of pressure blade making / ed. by P. M. Desrosiers. New York, 2012. P. 11–15; *Gómez Coutouly Y. A.* The emergence of pressure knapping microblade technology in Northeast Asia // Radiocarbon. 2018. Vol. 60, iss. 3. P. 821–824.

[4] Emergence and diversity of modern human behavior in Paleolithic Asia / eds Y. Kaifu, M. Izuho, T. Goebel, H. Sato, A. Ono. College Station TX, 2015. P. 1–16.

[5] The origin and dispersal of microblade industry in Northern Eurasia / ed. by Kimura H. Sapporo, 1993. P. 1–45; Origin and spread of microblade technology in Northern Asia and North America; The emergence of pressure blade making / ed. by P. M. Desrosiers. New York, 2012. P. 1–65.

[6] *Takakura J.* Emergence and development of the pressure microblade production: a view from the Upper Paleolithic of northern Japan // The emergence of pressure blade making / ed. by P. M. Desrosiers. New York, 2012. P. 285–290; *Gómez Coutouly Y. A.* The emergence of pressure knapping microblade technology in Northeast Asia // Radiocarbon. 2018. Vol. 60, iss. 3. P. 821–824.

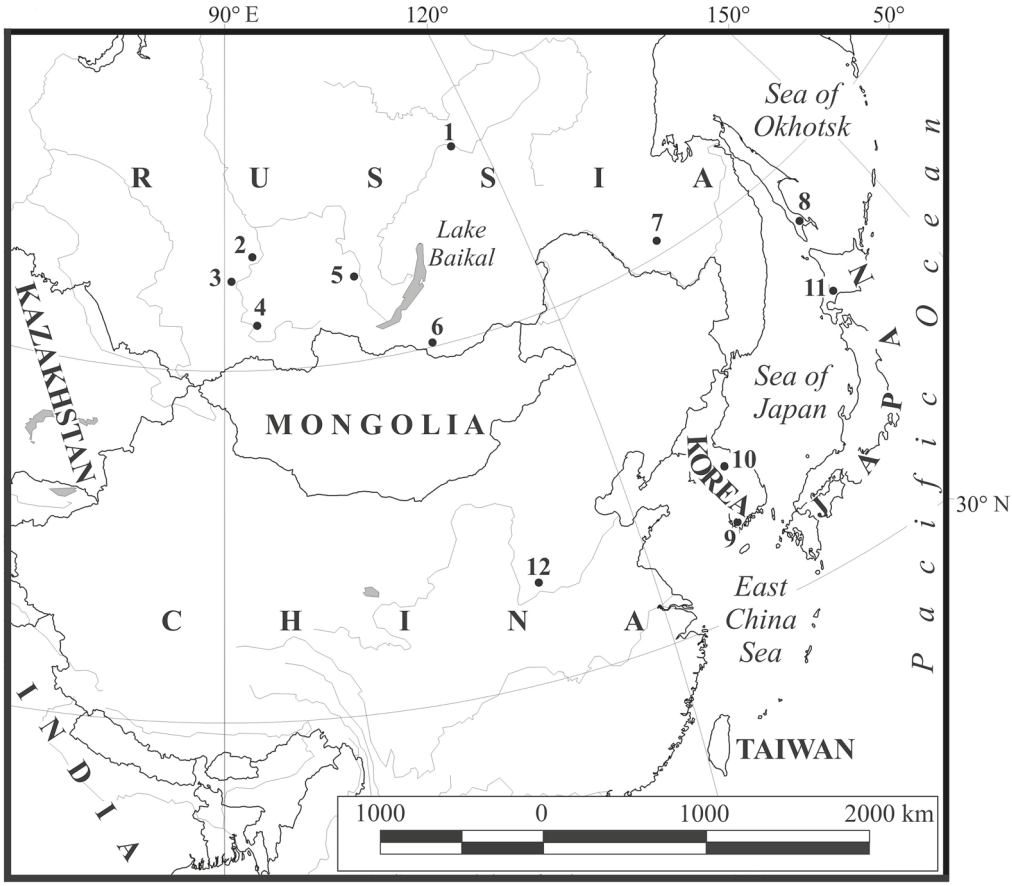

Fig. 1. The position of early microblade sites mentioned in the text (see also Table 1).

1 — Khayrgas; 2 — Listvenka; 3 — Tarachikha; 4 — Maininskaya; 5 — Krasny Yar; 6 — Studenoe 2; 7 — Ust'-Ul'ma 1; 8 — Ogonki 5; 9 — Sinbuk; 10 — Jangheung-ri; 11 — Kashiwadai 1; 12 — Xiachuan (created by authors)

shaped core technique[7]. The narrow-faced core is a core worked on its narrow side; it has also been described as an edge-faceted or end core[8]. It is crucial to understand that the narrow-faced core must have a volumetric appearance in order to allow the production of multiple blades from the same narrow front (face). In this case, numerous blades can be detached, by either percussion (narrow-faced core *sensu stricto*) or pressure flaking (microblade core). The former core type emerged in the Initial Upper Paleolithic in northern Asia at least at ca. 43,000 radiocarbon years ago (hereafter. — *B. P.*)[9].

[7] *Abramova Z. A.* Klinovidnye nukleusy v paleolite Severnoi Azii // Paleolit i neolit. Leningrad, 1986. P. 11–14.

[8] *Vasil'ev S. A., Bozinski G., Bredli B. A., Vishniatskii L. B., Giria E. V., Gribchenko Iu. N., Zheltova M. N., Tikhonov A. N.* Chetyrekh"iazychnyi (russko-anglo-franko-nemetskii) slovar'-spravochnik po arkheologii paleolita. St. Petersburg, 2007. P. 156.

[9] *Rybin E. P.* Middle and Upper Paleolithic interactions and the emergence of modern behavior in Southern Siberia and Mongolia // Emergence and diversity of modern human behavior in Paleolithic Asia. College Station, 2015. P. 470–475.

According to the studies by M.-L. Inizan and coauthors[10], a fine-grained stone is needed for the successful application of the pressure flaking technique, which is important for achieving the standardization of microblade manufacture. The "Very straight and regular parallel arrises" — and, one should add, the narrow scars found on microblades — identify cores worked by pressure from other nuclei[11]. Other distinguishing marks include, for example, edges and arrises that are parallel and usually straight on microblades[12]. The analysis of obsidian microblades identified fracture wings under the microscope that can differentiate between direct percussion and pressure percussion[13]. In this respect, when publishing microblade cores, it would be helpful if authors included clear, detailed photographs of areas that were pressure flaked.

In order to properly examine the earliest microblade complexes in northern and eastern Asia, we chose the following criteria. As the main criterion, and a novel approach, we used the presence of three artifact types: 1) wedge-shaped microcores (as the most common of microblade nuclei); 2) microblades; and 3) retouched (utilized) microblades. A similar view was expressed earlier[14]. This can ensure that only those artifacts are recognized as microblades that were not made accidentally but intentionally, and were used as such. The existence of this trio represents solid evidence for microblade technology. This kind of caution is necessary because in the early Upper Paleolithic, percussion was employed to detach blades[15]. Thus, without microblade cores and evidence of microblades since ca. 40,000–45,000 BP many small blades (bladelets) and blade fragments were produced by use of percussion, and it would be a mistake to regard these small blades as indicators of microblade technology. The second criterion is the secure age determination based on critical analysis of radiocarbon (^{14}C) dates[16]. We refer to ^{14}C-dated sites only because ^{14}C is the most reliable dating method for the time range under consideration. The third criterion is the stratigraphic integrity of artifacts. Only those assemblages found in an *in situ* context are taken into account here.

2.2. Definition of microblade technology

We use the following terms of microblade technology and its elements. A microblade generally refers to a small and narrow blade produced mostly from conical or wedge-shaped microcores[17]. B. Kipfer[18] defines a microblade as "a small, narrow stone blade, ranging from less than 5 to 11 mm (0.1–0.4 inches) wide and about 15–45 mm (0.6–

[10] *Inizan M.-L., Roche H., Tixier J.* Technology of knapped stone. Meudon, 1992. P. 1–32.

[11] Ibid. P. 63.

[12] Ibid. P. 63–64.

[13] *Takakura J.* Emergence and development of the pressure microblade production: a view from the Upper Paleolithic of northern Japan. P. 285–291.

[14] *Abramova Z. A.* Klinovidnye nukleusy v paleolite Severnoi Azii. P. 11–13.

[15] Ibid. P. 11–14.

[16] *Kuzmin Y. V., Keates S. G.*: 1) Dates are not just data: Paleolithic settlement patterns in Siberia derived from radiocarbon records // American Antiquity. 2005. Vol. 70, iss. 4. P. 773–775; 2) Dynamics of Siberian Paleolithic complexes (based on analysis of radiocarbon records): the 2012 state-of-the-art // Radiocarbon. 2013. Vol. 55, iss. 2–3. P. 1314–1317.

[17] *Darvill T.* The concise Oxford dictionary of archaeology. Oxford, 2003. P. 1–506; The new Penguin dictionary of archaeology / ed. by P. Bahn. London, 2004. P. 1–537.

[18] *Kipfer B. A.* Dictionary of artifacts. Singapore, 2007. P. 195.

1.7 inches) long". T. Akazawa and coauthors[19] determine microblade dimensions as with a length more than twice the width, while the width is smaller than 12 mm.

Some authors[20] also refer to microblades as "microbladelets" and "bladelets". However, unlike microblades, bladelets can be produced from any blade cores, including narrow-faced ones, while microblades were usually made on either wedge-shaped, prismatic, or conical cores by pressure flaking[21]. Here we distinguish also between microblades and microliths; the latter is a more general category determined as "any of various very small stone tools varying in size from 1 to 5 cm (0.4–2 inches) — mainly thin blades or blade fragments with sharp cutting edges, usually geometric in shape… using the microburin technique"[22]. In China, microliths also include some small lithic artifacts[23].

J. Flenniken[24] established the use of the pressure blade technique for making microblades in the Dyuktai culture of Yakutia as part of greater northern Asia. It is now obvious that people who invented the microblade technology almost always employed pressure blade flaking[25]. While this technique (more strictly, pressure retouch[26]) had appeared a long time before microblade technology and was known in the Middle Stone Age of South Africa[27], it was not in use in northern and eastern Asia until microblade production emerged there.

3. Regional perspectives

3.1. Siberia

The first summaries on microblade technology for Siberia were published in the 1980s[28]. Z. A. Abramova established four stages of the Upper Paleolithic in Siberia; the distinct feature of stages 1 (end of Karginian interstage, corresponds to MIS 3 isotope

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[19] *Akazawa T., Oda S., Yamanaka I.* The Japanese Palaeolithic: A techno-typological study. Tokyo, 1980. P. 74.

[20] *Akazawa T., Oda S., Yamanaka I.* The Japanese Palaeolithic: A techno-typological study. P. 74–75; *Inizan M.-L., Roche H., Tixier J.* Technology of knapped stone. P. 65; *Vasil'ev S. A., Bosinski G., Bradley B. A., Vishniatskii L. B., Giria E. V., Gribchenko Iu. N., Zheltova M. N., Tikhonov A. N.* Chetyrekh"iazychnyi (russko-anglo-franko-nemetskii) slovar'-spravochnik po arkheologii paleolita. P. 147.

[21] *Morlan R. E.* Wedge-shaped core technology in northern North America // Arctic Anthropology. 1970. Vol. 7, iss. 2. P. 17–20.

[22] *Kipfer B. A.* Dictionary of artifacts. P. 196; *Inizan M.-L., Roche H., Tixier J.* Technology of knapped stone. P. 69–70.

[23] *Chen C., Wang X.-Q.* Upper Paleolithic microblade industries in North China and their relationships with Northeast Asia and North America // Arctic Anthropology. 1989. Vol. 26, iss. 2. P. 128.

[24] *Flenniken J. J.* The Paleolithic Dyuktai pressure blade technique of Siberia // Arctic Anthropology. 1987. Vol. 24, iss. 2. P. 117–120.

[25] *Inizan M.-L.* Pressure *débitage* in the Old World: Forerunners, researchers, geopolitics — handing on the baton. P. 11–15; *Takakura J.* Emergence and development of the pressure microblade production: a view from the Upper Paleolithic of northern Japan. P. 285–291; *Gómez Coutouly Y. A.* Migrations and interactions in prehistoric Beringia: the evolution of Yakutian lithic technology // Antiquity. 2016. Vol. 90, iss. 349. P. 9–15.

[26] *Inizan M.-L.* Pressure *débitage* in the Old World: Forerunners, researchers, geopolitics — handing on the baton. P. 11–14.

[27] *Mourre V., Villa P., Henshilwood C. S.* Early use of pressure flaking on lithic artifacts at Blombos Cave, South Africa // Science. 2010. Vol. 330, iss. 6004. P. 659–660.

[28] *Abramova Z. A.* Klinovidnye nukleusy v paleolite Severnoi Azii. P. 11–14; *Abramova Z. A.* Paleolit Severnoi Azii // Paleolit Kavkaza i Severnoi Azii. Leningrad, 1989. P. 145–150.

stage) and 2 (the beginning of the Sartan glaciation, correlates with the early part of the Last Glacial Maximum [LGM], or early MIS 2) is the absence of wedge-shaped micro-cores[29]. Stage 3 of the Siberian Upper Paleolithic (second part of the Sartan glaciation, corresponds to the late LGM, or late MIS 2) includes sites where wedge-shaped micro-cores appear and become widespread, and is associated with the microblade technique necessary to equip slotted tools with insets. The individual sites and cultural complexes are: Mogochino; Afontova Culture (sites of Afontova Gora 2 and 3; Kokorevo 2; Tashtyk 1 and 2; Maininskaya; and Kantegir); Kokorevo Culture (sites of Kokorevo 1; and Novoselovo 6 and 7); Golubaya 1; upper layers of Ust-Kova and Krasny Yar; Sosnovy Bor (Layer 5); Makarovo 2; and Verkhne-Troitskaya, Ezhantsy, and Dyuktai Cave[30].

The Dyuktai Culture of Yakutia was always connected with the microblade technology[31]. However, the chronology of this cultural complex was a topic of intense discussion until recently[32]. It was proposed[33] that the earliest ^{14}C dates from the Dyuktai Culture sites, dated to ca. 23,000–35,000 BP according to another view[34], were too old, and that no microblade complexes of a similar age existed in Siberia. Later, it was suggested that the beginning of the Dyuktai Culture can be dated to ca. 17,000/18,000–10,000/11,000 BP, and possibly older, beginning at ca. 22,000/23,000 BP[35].

Recent progress with ^{14}C dating of the Khayrgas site in central Yakutia[36] (see Fig. 1), with its layers 6–7 associated with the Dyuktai Culture[37] (Fig. 2, A), allowed researchers to establish the beginning of this complex to at least ca. 20,700 BP. Layer 7 of the Khayrgas site contains a few wedge-shaped cores and microblades, and more items directly related to microblade technology are found in Layer 6 dated to ca. 16,000 BP (Table 1). Thus, we can tentatively accept that the earliest evidence of microblade production in Yakutia is now dated to ca. 20,700 BP. It is clear that more data are needed to resolve the issue of the beginning of the Dyuktai Culture in Yakutia.

In the Yenisei River basin (see Fig. 1), some sites can be associated with the early microblade technology (Fig. 2, B–D). At the Maininskaya site (Layer A-3), several wedge-shaped cores and some microblades (the exact number is not indicated) were found

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[29] *Abramova Z. A.* Klinovidnye nukleusy v paleolite Severnoi Azii. P. 240–243.

[30] Ibid.

[31] *Mochanov Y. A.:* 1) Paleolithic finds in Siberia (resume of studies) // Beringia in Cenozoic era / ed. by V. I. Kontrimavichus. New Delhi, 1984, P. 694–700; 2) The earliest stages of settlement by people of Northeast Asia. Anchorage, AK, 2009. P. 1–286; *Abramova Z. A.* O vozraste paleolita Aldana // Sovetskaia arkheologiia. 1979. No. 4. P. 5–12; *Flenniken J. J.* The Paleolithic Dyuktai pressure blade technique of Siberia. P. 117–120; *Gómez Coutouly Y. A.* Migrations and interactions in prehistoric Beringia: the evolution of Yakutian lithic technology. P. 9–14.

[32] *Abramova Z. A.* O vozraste paleolita Aldana. P. 9–12; *Yi S., Clark G.* The "Dyuktai culture" and New World origins // Current Anthropology. 1985. Vol. 26, iss. 1. P. 1–12; *Kuzmin Y. V., Orlova L. A.* Radiocarbon chronology of the Siberian Paleolithic // Journal of World Prehistory. 1998. Vol. 12, iss. 1. P. 22–33; *Pitulko V. V., Pavlova E. Y.* Geoarchaeology and radiocarbon chronology of Stone Age Northeast Asia. College Station, TX, 2016. P. 112–130.

[33] *Abramova Z. A.* O vozraste paleolita Aldana. P. 10–14.

[34] *Mochanov Y. A.* The earliest stages of settlement by people of Northeast Asia. P. 264–265.

[35] *Pitulko V. V., Pavlova E. Y.* Geoarchaeology and radiocarbon chronology of Stone Age Northeast Asia. P. 125–130.

[36] *Kuzmin Y. V., Kosintsev P. A., Stepanov A. D., Boeskorov G. G., Cruz R. J.* Chronology and faunal remains of the Khayrgas Cave (Eastern Siberia, Russia) // Radiocarbon. 2017. Vol. 59, iss. 2. P. 575–580.

[37] *Stepanov A. D., Kirillin A. S., Vorobeva S. A., Soloveva E. N., Efimov N. N.* Peshchera Khaiyrgas na Srednei Lene (rezultaty issledovanii 1998–1999 gg.) // Drevnie kul'tury Severo-Vostochnoi Azii. Astroarkheologiia. Paleoinformatika, 2003. P. 98–100.

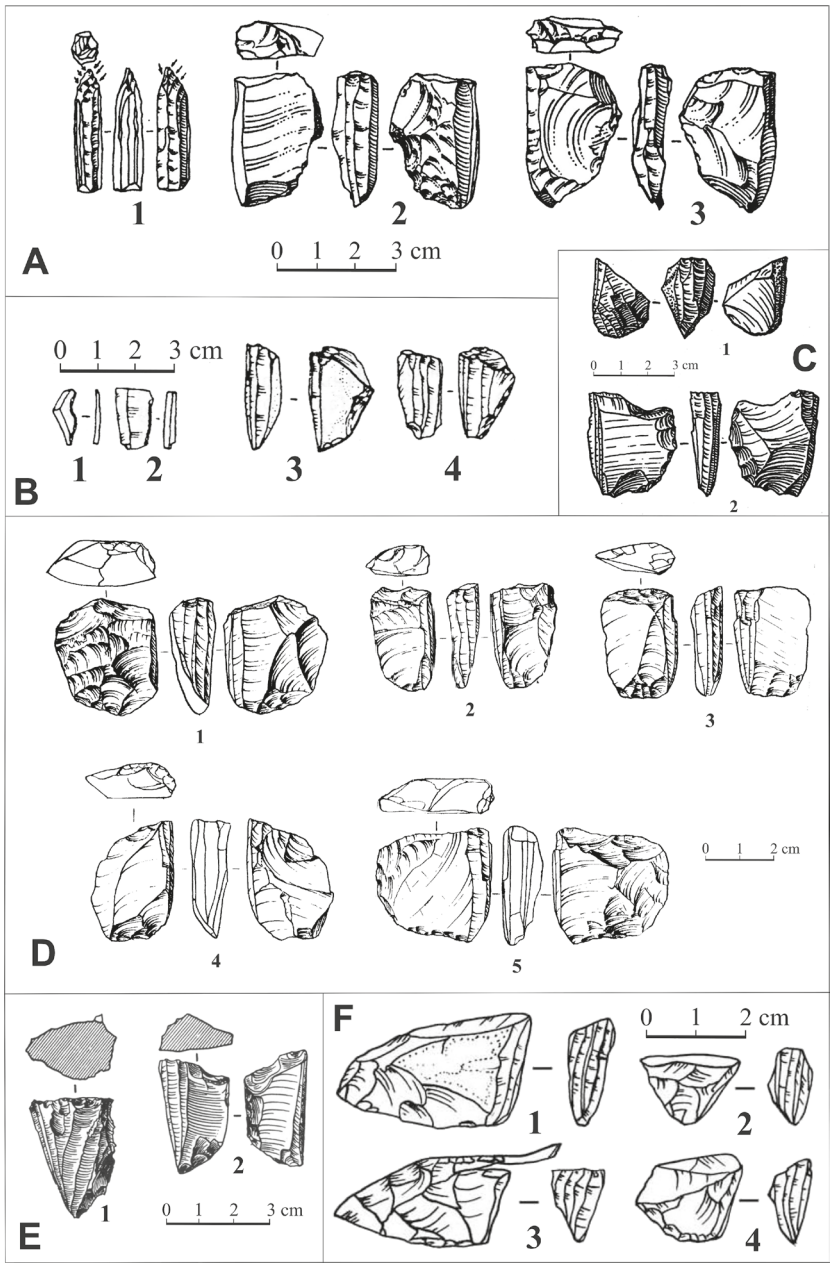

Fig. 2. Wedge-shaped and other cores, and microblades from the early microblade complexes of Siberia:

A — *Khay*rgas site: 1 — pencil-like core (Layer 6); 2 — wedge-shaped core (Layer 6); 3 — wedge-shaped core (Layer 7) [Stepanov et al., 2003]; B — Mainiskaya site, Layer A-3: 1–2 — retouched microblades; 3–4 — wedge-shaped cores [Vasil'ev, 1996]; C — Tarachikha site, Layer 1: 1–2 — wedge-shaped cores [Lisitsyn, 2000]; D — Listvenka site, Layer 15A: 1–4 — wedge-shaped microcores; 5 — wedge-shaped core [Akimova et al., 2005]; E — Krasny Yar, Layer 2: 1–2 — wedge-shaped cores [Abramova, 1965]; F — Studenoe 2, Layer 4/5: 1–4 — wedge-shaped cores [Konstantinov, 2001]

(Tab. 1)[38]. The latest chronological data show the age of this stratum as ca. 19,300 BP[39]. At the Tarachikha site, the microblade complex can be associated with ^{14}C dates of ca. 18,930 BP and ca. 19,850 BP[40]; however, no information exists about the direct association between these values and the microblade-bearing layer[41]. At the Listvenka site, Layer 15A contains five wedge-shaped cores and numerous microblades (Table 1); the ^{14}C date of this component is ca. 17,100 BP[42].

In the Angara River basin, the Krasny Yar (a.k.a. Krasnyi Iar) site has the earliest evidence of microblade technology (Figs 1 and 2, E; Table 1). It has been studied several times, and a ^{14}C date of ca. 19,100 BP was obtained for Layer 2[43]. Despite a disagreement about the numbering of the cultural layers[44], the association between the ^{14}C value, wedge-shaped cores and microblades looks secure.

In the Transbaikal region, the Studenoe 2 site (see Fig. 1) contains the earliest microblade complex (Fig. 2F; Fig. 3A). Layer 5, dated to ca. 17,200 BP, has seven wedge-shaped cores and more than 150 microblades (Table 1). In Layer 4/5 directly above it, artifacts related to the manufacture of microblades are also found. The chronology of this component is to some extent controversial, with a wide range of ^{14}C values: from ca. 14,490 BP to ca. 18,300 BP[45]. While the youngest ^{14}C date may well be an outlier, the oldest ^{14}C value is accepted by some scholars[46]. However, this contradicts the site's stratigraphy, and the most reliable age estimate for Layer 4/5 is ca. 16,200–17,200 BP.

3.2. The Russian Far East

In the middle part of the Amur River basin, the Ust'-Ulma 1 site (Fig. 1) contains the earliest representation of microblade technology in the region. Two wedge-shaped cores were found in the lowermost component, Layer 3[47]. In Layer 2b immediately above Layer 3, there are 18 wedge-shaped cores and one prismatic core, and two microblades (Tab. 1; Fig. 3, B). The ^{14}C age of Layer 3 is undetermined; Layer 2b is dated to ca. 19,400 BP.

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[38] *Vasilev S. A.* Pozdnii paleolit verkhnego Eniseia (po materialam mnogosloinykh stoianok raiona Mainy). St. Petersburg, 1996. P. 200–215.

[39] *Vasil'ev S. A., Yamskikh A. F., Yamskikh G. Yu., Kuzmin Y. V., Jull A. J. T.* Novye dannye po khronologii i paleosrede mnogosloinykh stoianok Maininskogo raiona na Verkhnem Enisee // Aktualnye voprosy evraziiskogo paleolitovedeniia / eds A. P. Derevianko, M. V. Shunkov. Novosibirsk, 2005. P. 25–30.

[40] *Kuzmin Y.V., Orlova L. A., Zenin V. N., Lbova L. V., Dementiev V. N.* Radiouglerodnoe datirovanie paleolita Sibiri i Dalnego Vostoka Rossii: materialy k katalogu ^{14}C dat (po sostoianiiu na konets 2010 g.) // Stratum plus. 2011. No. 1. P. 186.

[41] *Lisitsyn N. F.* Pozdnii paleolit Chulymo-Eniseiskogo mezhdurechia. St. Petersburg, 2000. P. 137.

[42] *Akimova E. V., Drozdov N. I., Laukhin S. A., Chekha V. P., Orlova L. A., Koltsova V. G., Sanko A. F., Shpakova E. G.* Paleolit Eniseia. Listvenka. Krasnoiarsk, 2005. P. 154.

[43] *Abramova Z. A.* Krasnyi Iar — a new Palaeolithic site on the Angara // Arctic Anthropology. 1965. Vol. 3, iss. 1. P. 122–126.

[44] *Abramova Z. A.* Krasnyi Iar — Krasnyi Iar — a new Palaeolithic site on the Angara. Arctic Anthropology, 1965. Vol. 3, iss. 1. P. 122–128. Versus: *Medvedev G. I.* Archaeological investigations of the stratified Palaeolithic site of Krasnyi Iar on the Angara in 1964–1965. Arctic Anthropology, 1969. Vol. 6, iss. 1. P. 30–44.

[45] *Kuzmin Y. V., Jull A. J. T., Razgildeeva I. I.* Chronology of the Upper-Paleolithic site Studenoe 2 (Transbaikal, Siberia): case study of the multi-hearth dwelling in horizon 4/5 // Current Research in the Pleistocene. 2004. Vol. 21. P. 6–7.

[46] *Buvit I., Waters M. R., Konstantinov M. V., Konstantinov A. V.* Geoarchaeological investigations at Studenoe, an Upper Paleolithic site in the Transbaikal region, Russia // Geoarchaeology. 2003. Vol. 18, iss. 6. P. 649–655.

[47] *Derevianko A. P., Zenin V. N.* Paleolit Selemdzhi. Novosibirsk, 1995. P. 105–114.

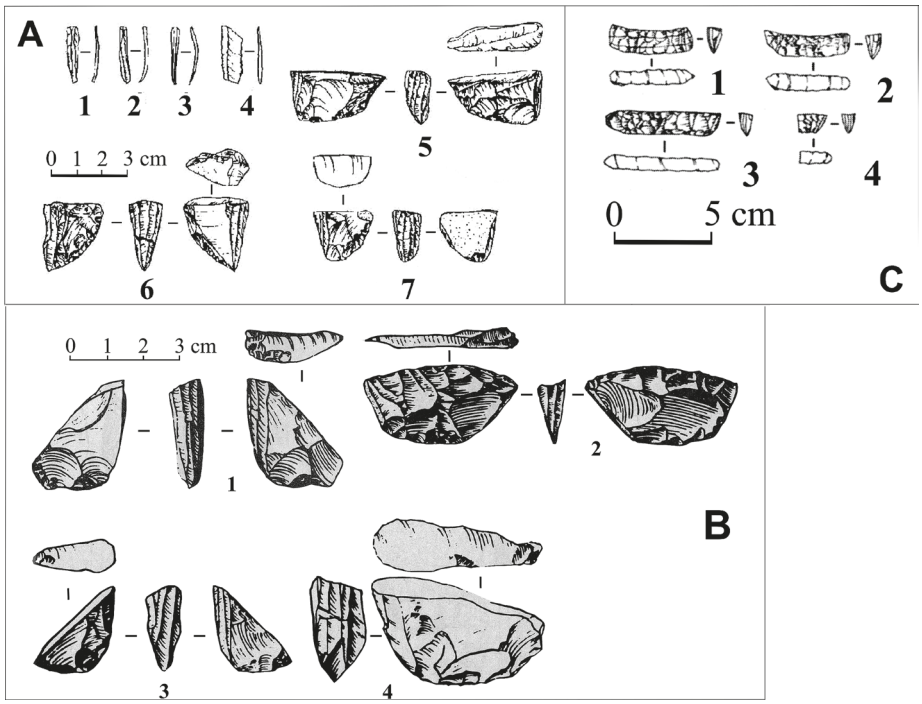

Fig. 3. Wedge-shaped cores and microblades from the early microblade complexes of Siberia and the Russian Far East:

A — Studenoe 2, Layer 5: 1–4 microblades; 5–7 — wedge-shaped cores [Konstantinov, 2001]; B — Ust'-Ul'ma 1, Layer 2b: 1–4 — wedge-shaped cores [Derevianko, Zenin, 2005]; C — Ogonki 5, Horizon 3: 1–4 — wedge-shaped cores [Vasilevsky, 2003]

Another example of an early microblade complex in the Russian Far East is the Ogonki 5 site on Sakhalin Island (Figs 1 and 3, C). It has numerous wedge-shaped cores and microblades in Horizon 3[48] (see Table 1). The ^{14}C age range of Horizon 3 is ca. 19,400–18,900 BP.

3.3. China

The earliest reliable evidence of microblade technology in China can be found in its northern part[49]. The well-known Xiachuan site complex in Shanxi Province (see Fig. 1), with 16 "microlithic" localities has yielded between 204[50] and 219[51] microblade cores,

[48] *Vasilevsky A. A.* Periodization and classification of the Upper Paleolithic of Sakhalin and Hokkaido in the light of the research conducted at the Ogonki-5 site // Archaeology, Ethnology & Anthropology of Eurasia. 2003. No. 3 (15). P. 51–60.

[49] *Lu L. D.* The microblade tradition in China: regional chronologies and significance in the transition to Neolithic // Asian Perspectives. 1998. Vol. 37, iss. 1. P. 84–90.

[50] *Wang J., Wang X., Chen Z.* Xiachuan culture // Kaogu Xuebao. 1978. No. 3. P. 259–280; *Tang C.* The Upper Palaeolithic of North China: the Xiachuan culture // Journal of East Asian Archaeology. 2000. Vol. 2. P. 37–45.

[51] *Chen C., Wang X.-Q.* Upper Paleolithic microblade industries in North China and their relationships with Northeast Asia and North America // Arctic Anthropology. 1989. Vol. 26, iss. 2. P. 134. Figs 5 and 6.

including 15 wedge-shaped cores and 186 microblades from Layer 2[52] (see Table 1). The ^{14}C dates for Cultural Layer 2 range in age from about 23,220 BP to 15,900 BP[53] and cluster around ca. 20,700–16,400 BP. The oldest dates are ca. 23,220 BP and 21,090 BP[54]. For the 21,090 ± 1000 BP date (ZK-384), the context "microlith culture layer" is specifically noted[55]. However, the dated samples are from four localities "…rather than from a sequential profile of cultural deposits."[56], and the "…ages are problematic owing to poor stratigraphic control of the samples."[57]. While we here provisionally accept the ca. 21,100 BP date for Xiachuan[58], the poor stratigraphic and relatively thick layer context from which the dating samples were collected, leave some doubts about the chronology of this site.

The existence of Pleistocene microblade technology south of the Yangtze River is still unresolved. T. Qu and coauthors[59] do not mention any microblade sites in southern China, and L. D. Lu[60] refers to microblades from Guang dong Province dated to the mid-Holocene. On the other hand, the presence of microblades in the Yangtze Phase in Jiangxi Province is indicated at ca. 24,500–17,000 BP[61].

3.4. Korea

At the Sinbuk site on the southern tip of the Korean Peninsula (Fig. 1), about 160 microblade cores were found, including five wedge-shaped cores, and also more than 300 microblades[62] (see Table 1; Fig. 4, A). The ^{14}C dates from Sinbuk can be combined in two clusters: ca. 25,500–23,900 BP and 21,800–21,000 BP[63]. The existence of a third

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[52] *Chen C., Wang X.-Q.* Upper Paleolithic microblade industries in North China and their relationships with Northeast Asia and North America; *Tang C.* The Upper Palaeolithic of North China: the Xiachuan culture // Journal of East Asian Archaeology.

[53] The Institute of Archaeology, Chinese Academy of Social Sciences (CASS). Radiocarbon dates in Chinese archaeology, 1965–1991. Beijing, 1991. P. 39–41; The Laboratory, Institute of Archaeology, Chinese Academy of Social Sciences (CASS). Report on radio-carbon dates (V) // Kaogu. 1978. No. 4. P. 280–282.

[54] The Institute of Archaeology, Chinese Academy of Social Sciences (CASS). Radiocarbon dates in Chinese archaeology, 1965–1991. 1991. P. 40–41.

[55] The Laboratory, Institute of Archaeology, Chinese Academy of Social Sciences (CASS). Report on radio-carbon dates (V). P. 281.

[56] *Chen C., Wang X.-Q.* Upper Paleolithic microblade industries in North China and their relationships with Northeast Asia and North America. P. 135.

[57] *Nian X., Gao X., Xie F., Mei H., Zhou L.* Chronology of the Youfang site and its implications for the emergence of microblade technology in North China // Quaternary International. 2014. Vol. 347. P. 113–118; see also: *Chen C., Wang X.-Q.* Upper Paleolithic microblade industries in North China and their relationships with Northeast Asia and North America. P. 135; *An Z.* Carbon-14 dating and its problems of the Late Paleolithic in China // Acta Anthropologica Sinica. 1983. Vol. 2, iss. 4. P. 342–350.

[58] *Yi M., Gao X., Li F., Chen F.* Rethinking the origin of microblade technology: a chronological and ecological perspective // Quaternary International. 2016. Vol. 400. P. 136.

[59] *Qu T., Bar-Yosef O., Wang Y.* The Chinese Upper Paleolithic: geography, chronology, and techno-typology // Journal of Archaeological Research. 2013. Vol. 21, iss. 1. P. 40–43.

[60] *Lu L. D.* The microblade tradition in China: regional chronologies and significance in the transition to Neolithic // Asian Perspectives. P. 85.

[61] *MacNeish R. S.* A Paleolithic–Neolithic sequence from South China Jiangxi Province, PRC // Interdisciplinary perspectives on the origins of the Japanese. Kyoto, 1999. P. 233–250.

[62] The Sinbuk Upper Palaeolithic site in Jangheung county, Jeollanam Province, Korea / Chosun University Museum. Gwangju, 2008. P. 1–168.

[63] *Seong C.* Evaluating radiocarbon dates and Late Paleolithic chronology in Korea // Arctic Anthropology. 2011. Vol. 48, iss. 1. P. 93–110.

Table 1. **The earliest sites in northern and eastern Asia with presence of microblade technology**

Region, site, cultural layer and thickness	Wedge-shaped cores	Other microblade cores	Microblades	Retouched microblades[a]	^{14}C age, BP
Siberia					
Khayrgas Cave, Layer 7 (0.45–0.60 m)	2	—	1	—	ca. 20,700–21,500
Khayrgas Cave, Layer 6 (0.40–0.50 m)	5	2 [b]	25	3	ca. 16,000
Maininskaya, Layer A-3 (0.30 m)	12	10 [c]	778 [d]	5	ca. 19,300
Tarachikha, Layer 1 (0.30 m)	2	—	46	12	ca. 18,900–19,900 [e]
Listvenka, Layer 15A (0.02–0.03 m)	5	—	59	1	ca. 17,100
Krasny Yar, Layer 2 [f] (0.10 m)	3 [g]	?	? [h]	?	ca. 19,100
Studenoe 2, Layer 4/5 (0.10 m)	5	1[i]	48	2	ca. 16,200–17,200
Studenoe 2, Layer 5 (0.04–0.07 m)	7	—	157	—	ca. 17,200
Russian Far East					
Ust'-Ul'ma 1, Layer 2b (0.30–0.40 m)	18	1 [i]	2	—	ca. 19,400
Ogonki 5, Horizon 3 (0.40–0.70 m)	66	—	339	—	ca. 18,900–19,400
Korean Peninsula					
Sinbuk, Paleolithic layer (ca. 0.20 m)	6	ca. 160 [j]	> 300 [k]	—	ca. 18,500–25,500
Jangheung-ri, Layer 1 (0.50–0.60 m)	1	4	34	6	ca. 24,200–24,400
Japanese Islands					
Kashiwadai 1, Layer 4 (0.60 m)	5	—	638	137	ca. 19,800–20,800
Northern China					
Xiachuan, Layer 2 [l] (1.00–1.50 m)	15	204 [m]	186	?	ca. 15,900–23,220 [n]

[a] Included in the total number of microblades. [b] Pencil-like cores. [c] These are "untypical" wedge-shaped cores. [d] Including bladelets. [e] Exact layer number is not indicated. [f] Main cultural layer. [g] Minimal number; the exact number is not indicated. Sixteen "Gobi" (i. e. wedge-shaped) cores are mentioned in Horizon VI by G. I. Medvedev, most closely related to the "main cultural layer" of Z. A. Abramova. [h] Numerous microblades are mentioned by Z. A. Abramova. At least ten microblades are illustrated by G. I. Medvedev. [i] Prismatic core. [j] Exact number of cores is not indicated, these include one boat-shaped core. [k] G.-K. Lee, personal communication, August 2016. [l] Note that Layer 2 is numbered as Layer 1 in paper by Wang et al. (1978). [m] Two hundred and nineteen microblade cores according to the paper by Chen and Wang (1989). Other core types from Xiachuan are: 100 conical, 51 semi-conical, 19 boat-shaped, 10 cylindrical, and 24 funnel-shaped. [n] The dated sites are: Shunwangping, Xiachuan, and Xiaobaihua; in some sources the Shanshanyan locality is also referred to.

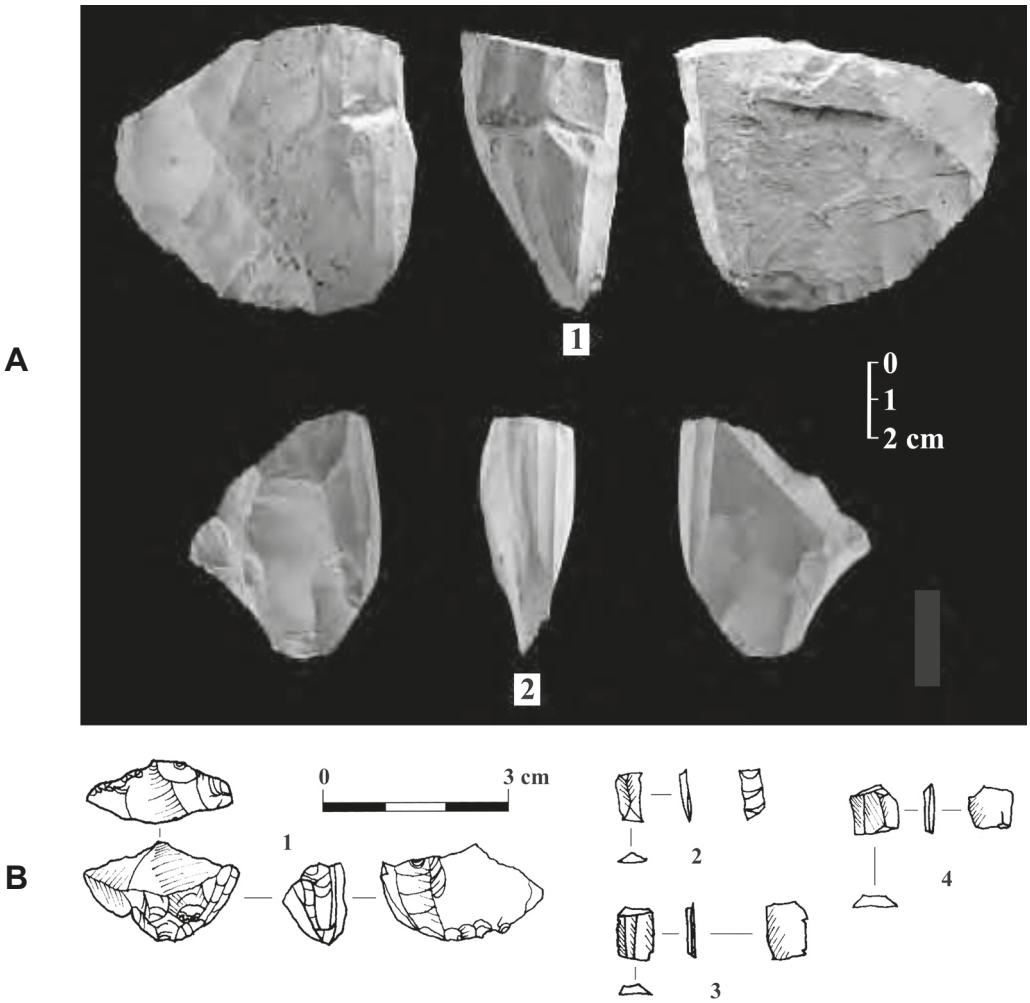

Fig. 4. Wedge-shaped cores and microblades from the early microblade complexes of Korea:
A — Sinbuk site: 1–2 — wedge-shaped cores [The Sinbuk Upper Palaeolithic site in Jangheung county, Jeollanam Province, Korea… 2008]. B — Jangheung-ri site: 1 — wedge-shaped core; 2–4 — microblades [The Janghung-ri Palaeolithic site… 2001]

cluster, at ca. 18,500 BP, is also possible[64]. The relatively wide spread of ^{14}C dates at Sinbuk[65] should not prevent us from accepting the oldest values considering that the dates were produced on charcoal from hearths[66]. Also, the phenomenon of a wide range of ^{14}C ages at Paleolithic sites in northern Asia is well-known, indicating more than one occupation[67].

[64] See discussion: *Seong C.* Evaluating radiocarbon dates and Late Paleolithic chronology in Korea. P. 106.

[65] Ibid. P. 107; *Seong C.* Diversity of lithic assemblages and evolution of Late Palaeolithic culture in Korea // Asian Perspectives. 2015. Vol. 54, iss. 1. P. 94–109.

[66] *Seong C.* Evaluating radiocarbon dates and Late Paleolithic chronology in Korea. P. 106.

[67] See: *Kuzmin Y. V., Keates S. G.* Dates are not just data: Paleolithic settlement patterns in Siberia derived from radiocarbon records. P. 780.

A site in central Korea, Jangheung-ri, yielded five microblade cores and 34 microblades[68] (see Table 1; Figs 1 and 4B). The two ^{14}C dates for Jangheung-ri are ca. 24,400 BP and 24,200 BP[69].

3.5. Japan

The Kashiwadai 1 site on Hokkaido Island (Fig. 1) has yielded five wedge-shaped cores, 638 microblades, including 137 retouched microblades from Layer 4[70] (see Table 1; Fig. 5). The ^{14}C dates for this layer are ca. 20,800–19,800 BP[71]. According to some authors[72], the dates cluster around 20,500 BP. In other parts of the Japanese Islands, microblade technology sites are significantly younger, beginning at ca. 16,000–15,000 BP[73].

3.6. Other potentially early microblade sites

Beside the complexes described above, there are other sites in northern and eastern Asia which have a certain potential to be considered. However, the ambiguities surrounding their age and artifact typology prevent us from accepting them at face value. Below, we briefly discuss these sites.

In northern Mongolia, the Tolbor 15 site yielded one boat-shaped microcore and one wedge-shaped microblade core from Layer 5 (Archaeological Horizon 5), 0.2 m thick, dated to ca. 32,200–28,500 BP[74]. However, directly above this, there is Layer 4 (thickness of 0.25 m), a stratum with numerous microblades ^{14}C-dated to ca. 14,800–14,700 BP. Because the boundary between layers 5 and 4 is irregular due to erosion[75], the possibility that microblade cores and microblades were redeposited from the upper layer to the lower one should be considered. The mixture of sediments at the Tolbor 15 site, including underlying layers 7 and 6, is evident from two ^{14}C values for layers 6–7, 15,750 ± 80 BP (Beta-263741) and 19,520 ± 280 BP (AA-93138), which are much younger than accepted ages of ca. 33,200–29,120 BP; it is also noted that Layer 5 is re-deposited[76]. The presence of animal burrows, especially in layers 5 and 4[77], could also have facilitated movement of artifacts[78].

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[68] The Janghung-ri Palaeolithic site / ed. by Choi B. K. Chuncheon, 2001. P. 1–143.

[69] The Janghung-ri Palaeolithic site. P. 123–126; *Seong C.* Evaluating radiocarbon dates and Late Paleolithic chronology in Korea. P. 106–107.

[70] Kashiwadai 1 iseki / eds J. Fukui, K. Koshida. Sapporo, 1999. P. 1–312; *Sato H., Tsutsumi T.* The Japanese microblade industries: technology, raw material procurement, and adaptations // Origin and spread of microblade technology in Northern Asia and North America. Burnaby, 2007. P. 17–29.

[71] *Ono A., Sato H., Tsutsumi T., Kudo Y.* Radiocarbon dates and archaeology of the Late Pleistocene in the Japanese Islands // Radiocarbon. 2002. Vol. 44, iss. 2. P. 477–484.

[72] *Takakura J.* Emergence and development of the pressure microblade production: a view from the Upper Paleolithic of northern Japan. P. 293.

[73] *Sato H., Tsutsumi T.* The Japanese microblade industries: technology, raw material procurement, and adaptations. P. 40–43.

[74] *Gladyshev S. A., Tabarev A. V.* Mikroplastinchatoe rasshcheplenie v rannem verkhnem paleolite Mongolii // Stratum plus. 2018. No. 1. P. 339–345.

[75] *Gladyshev S., Tabarev A., Olsen J. W.* Origin and evolution of the Late Paleolithic microindustry in northern Mongolia // Current Research in the Pleistocene. 2010. Vol. 27. P. 37. Fig. 1.

[76] *Khatsenovich A. M.* Rannie etapy verkhnego paleolita Severnoi Mongolii. Diss. … kand. ist. nauk. Novosibirsk, 2018. P. 1–287.

[77] *Gladyshev S. A., Tabarev A. V.* Mikroplastinchatoe rasshcheplenie v rannem verkhnem paleolite Mongolii. P. 346–351; *Khatsenovich A. M.* Rannie etapy verkhnego paleolita Severnoi Mongolii. P. 77.

[78] *Rybin E. P., Khatsenovich A. M., Gunchinsuren B., Olsen J. W., Zwyns N.* The impact of the LGM on the development of the Upper Paleolithic in Mongolia // Quaternary International. 2016. Vol. 425. P. 69–80.

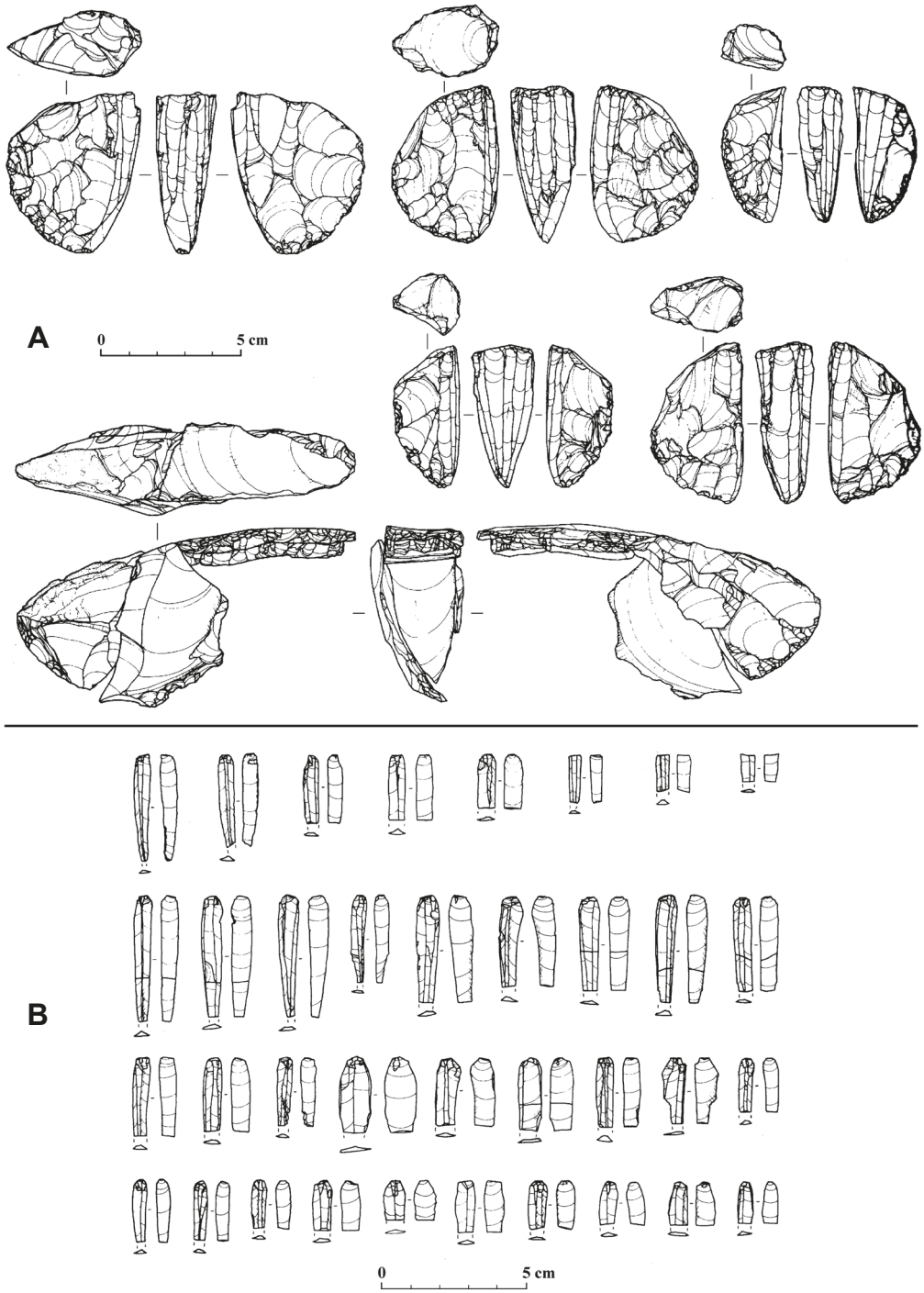

Fig. 5. Microblade cores (A) and microblades (B) from the Kashiwadai 1 site [Kashiwadai 1, 1999]

In northern China, other, potentially early microblade sites include Chaisi, Shanxi Province (Locality 77:01, Dingcun site complex), with six microblade cores (wedge-shaped, conical and boat-shaped) and 53 microblades found in a cultural layer 0.3-0.6 m thick[79]. A single ^{14}C value on shell dates the site to ca. 25,650 BP[80]. However, there are doubts about the stratigraphic integrity of the materials[81].

The lower cultural layer of the Xishi site in Henan Province has yielded three microblade cores and 82 microblades[82]. The artifacts, including blade cores and blades, were found at the base of the ca. 3 m thick Malan loess in a 0.20 m thick context[83] and ^{14}C-dated to ca. 22,100 BP[84]. Judging from the illustration[85], we cannot be certain if the specimen is a true wedge-shaped core.

At Longwangchan Locality 1 in Shaanxi Province, lithic artifacts including "microliths" were recovered from the 2.5–3.4 m thick layers 4–6 with a ^{14}C date range of ca. 24,145–20,710 BP[86]. The optically stimulated luminescent (OSL) dates are in the range of ca. 44,300–21,400 years ago[87], while another paper reports OSL ages of ca. 28,800–21,400 years ago[88]. The ^{14}C date distribution is not always consistent with depth[89], and there is inversion in the ^{14}C date sequence of Layer 6 and the OSL chronology[90]. Further, OSL dates from some Chinese Paleolithic sites such as Longwangchan and Shuidonggou 1 and 2 cannot be shown to fit the independently established ^{14}C chronology[91]. Frequencies of individual categories and specific layer origin are not provided[92]. According to M. Yi

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[79] *Wang J., Tao F., Wang Y.* Preliminary report on investigation and excavation of Dingcun Palaeolithic sites // Journal of Chinese Antiquity. 1994. No. 3. P. 1–66.

[80] The Institute of Archaeology, Chinese Academy of Social Sciences (CASS). 1991. P. 33.

[81] *An Z.* Radiocarbon dating and the Neolithic period of China // Kaogu. 1984. No. 3. P. 271–273; *Wang J., Tao F., Wang Y.* Preliminary report on investigation and excavation of Dingcun Palaeolithic sites. Journal of Chinese Antiquity. P. 1–25.

[82] *Yi M., Gao X., Li F., Chen F.* Rethinking the origin of microblade technology: a chronological and ecological perspective. P. 130–135.

[83] *Wang Y., Qu T.* New evidence and perspectives on the Upper Paleolithic of the Central Plain in China // Quaternary International. 2014. Vol. 347. P. 179.

[84] *Wang Y. P.* New evidence of modern human behavior in Paleolithic Central China // Emergence and diversity of modern human behavior in Paleolithic Asia / eds Y. Kaifu, M. Izuho, T. Goebel, H. Sato, A. Ono. College Station, TX, 2015. P. 250–253.

[85] *Yi M., Gao X., Li F., Chen F.* Rethinking the origin of microblade technology: a chronological and ecological perspective. P. 36. Fig. 3.5.

[86] *Zhang J.-F., Wang X.-Q., Qiu W.-L., Shelach G., Hu G., Fu X., Zhuang M.-G., Zhou L.-P.* The Paleolithic site of Longwangchan in the middle Yellow River, China: chronology, paleoenvironment and implications // Journal of Archaeological Science. 2011. Vol. 38, iss. 7. P. 1539.

[87] Ibid. P. 1540.

[88] *Yi M., Gao X., Li F., Chen F.* Rethinking the origin of microblade technology: a chronological and ecological perspective. P. 135–136.

[89] *Zhang J.-F., Wang X.-Q., Qiu W.-L., Shelach G., Hu G., Fu X., Zhuang M.-G., Zhou L.-P.* The Paleolithic site of Longwangchan in the middle Yellow River, China: chronology, paleoenvironment and implications. P. 1541.

[90] Ibid. P. 1541, 1543. Table 1–2.

[91] *Keates S. G., Kuzmin Y. V.* Shuidonggou localities 1 and 2 in northern China: archaeology and chronology of the Initial Upper Palaeolithic in north-east Asia // Antiquity. 2015. Vol. 89, iss. 345. P. 714–719.

[92] *Zhang J.-F., Wang X.-Q., Qiu W.-L., Shelach G., Hu G., Fu X., Zhuang M.-G., Zhou L.-P.* The Paleolithic site of Longwangchan in the middle Yellow River, China: chronology, paleoenvironment and implications. P. 1540–1543; *Yi M., Gao X., Li F., Chen F.* Rethinking the origin of microblade technology: a chronological and ecological perspective. P. 135–136.

(pers. comm. July 2015), a few microblade cores were found. At least four microblade cores, classified only as "microlithic cores" were recorded: these are conical and cylindrical[93].

While there is a claim that the Youfang site (Hebei Province) is the earliest microblade complex in northern China[94], the ages of ca. 29,000–26,000 years ago are based on OSL dating of the thick (1.9–3.1 m) cultural layer. Other OSL dating results[95] determined the age of the Youfang site as ca. 16,000–14,000 years ago. With regard to the Youfang chronology and their preferred use of OSL dating, it is contended that "charcoal from archaeological sites is readily contaminated…"[96] citing several references[97]. In fact, the samples used for the ^{14}C dates in these papers derived from disturbed and fluvial contexts; the results of ^{14}C-dated charcoal are described as "reliable"[98].

Concerning the Siberian sites of Ust'-Karakol 1 and Anui 2[99], it is not certain if pressure flaking was used on the not fine-grained stone material available. At other Siberian sites, Kamenka B[100], Barun-Alan[101], and Malta[102], there are no wedge-shaped cores. A caution was expressed about the absence of true wedge-shaped cores at the Malta and Buret sites, as well as other sites in Western Siberia and Central Asia, which contain small blades (bladelets) produced from flat-faced cores[103]. In our opinion, there are no early microblade assemblages dated to before ca. 20,000 BP in most of Siberia, including the Altai Mountains, the Angara River basin and Transbaikal, unlike views expressed earlier[104].

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[93] *Zhang J.-F., Wang X.-Q., Qiu W.-L., Shelach G., Hu G., Fu X., Zhuang M.-G., Zhou L.-P.* The Paleolithic site of Longwangchan in the middle Yellow River, China: chronology, paleoenvironment and implications. P. 1540, Fig. 3.

[94] *Nian X., Gao X., Xie F., Mei H., Zhou L.* Chronology of the Youfang site and its implications for the emergence of microblade technology in North China // Quaternary International. 2014. Vol. 347. P. 113–121.

[95] *Nagatomo T., Shitaoka Y., Namioka H., Sagawa M., Wei Q.* OSL dating of the strata at Paleolithic sites in the Nihewan Basin, China // Acta Anthropologica Sinica. 2009. Vol. 28, iss. 3. P. 276–280.

[96] *Nian X., Gao X., Xie F., Mei H., Zhou L.* Chronology of the Youfang site and its implications for the emergence of microblade technology in North China. P. 116.

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[101] *Tashak V. I., Antonova Y. E.* Paleoenvironment and peculiarities of stone industry development on Barun-Alan-1 site (Western Transbaikal) // Quaternary International. 2015. Vol. 355. P. 126–133.

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[103] *Abramova Z. A.* Klinovidnye nukleusy v paleolite Severnoi Azii. P. 14–16.

[104] See: *Derevianko A. P., Shunkov M. V., Agadzhanian A. K., Baryshnikov G. F., Malaeva E. M., Ulianov V. A., Kulik N. A., Postnov A. A., Anoikin A. A.* Prirodnaia sreda i chelovek v paleolite Gornogo Altaia. P. 224–235; *Derevianko A. P., Volkov P. V.* Evolution of lithic reduction technology in the course of the Middle to Upper Paleolithic transition in the Altai Mountains. P. 31–35; *Keates S. G.* Microblade technology in Siberia and neighbouring regions: an overview // Origin and spread of microblade technology in Northern Asia and North America. Burnaby, 2007. P. 125–146; *Kuzmin Y. V.* Geoarchaeological aspects of the origin and spread of microblade technology in Northern and Central Asia // Origin and spread of

4. Discussion

The following spatiotemporal patterns in northern and eastern Asia can now be proposed (see Table 1, Fig. 6). The earliest evidence of microblade technology is known from the two microblade complexes on the Korean Peninsula, Shinbuk and Jangheung-ri, and can be placed at ca. 25,500–24,200 BP.

After examining the spatiotemporal features of the earliest microblade assemblages in northern and eastern Asia, we suggest two possible scenarios for the emergence of microblade technology: 1) invention and diffusion from a single core area; and 2) independent creation in several places and expansion from them.

The early dates from Korea and the later ages for other early microblade technology sites (in Siberia, the Russian Far East, China and Japan) suggest that an origin of this technology in the northeast Asian region may point to a single 'core area' (i. e., Korea). The increasing regularity (standardization) and higher lithic numbers at the later sites would appear to support this scenario, that is, progressive sophistication of knapping technology to manufacture increasingly more refined and numerous specimens. Several scholars are in favor of a single core area, with the Altai Mountains as the place of origin for microblade technology[105].

In northern and eastern Asia, pressure flaking may have its origin in regions where narrow-faced core technology developed, and these are Siberia, Mongolia, Korea, and Japan[106]. Tortsovy cores (i. e., a kind of narrow-faced core) have not been identified in China. It therefore seems possible that microblade technology was invented in several places. We can provisionally suggest at least three centers of origin: Korea, Yakutia (as part of Siberia), and Hokkaido (Fig. 6).

At least one of these centers (most probably, Korea) may be responsible for the appearance of microblade technology in North China. This is supported by the non-existence of blades in North China before the emergence of microblades[107]. The proposed early

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microblade technology in Northern Asia and North America. Burnaby, 2007. P. 115–124; *Yi M., Gao X., Li F., Chen F.* Rethinking the origin of microblade technology: a chronological and ecological perspective. P. 135–136; *Terry K., Buvit I., Kontsantinov M. V.* Emergence of a microlithic complex in the Transbaikal Region of southern Siberia // Quaternary International. 2016. Vol. 425. P. 88–99; *Buvit I., Izuho M., Terry K., Konstantinov M. V., Konstantinov A. V.* Radiocarbon dates, microblades and Late Pleistocene human migrations in the Transbaikal, Russia and the Paleo-Sakhalin-Hokkaido-Kuril Peninsula // Quaternary International. 2016. Vol. 425. P. 100–119.

[105] *Derevianko A. P., Volkov P. V.* Evolution of lithic reduction technology in the course of the Middle to Upper Paleolithic transition in the Altai Mountains. P. 31–35; *Yi M., Gao X., Li F., Chen F.* Rethinking the origin of microblade technology: a chronological and ecological perspective. *Quaternary International*, 2016, vol. 400, pp. 130–139; *Terry K., Buvit I., Kontsantinov M. V.* Emergence of a microlithic complex in the Transbaikal Region of southern Siberia. P. 92–99; *Buvit I., Izuho M., Terry K., Konstantinov M. V., Konstantinov A. V.* Radiocarbon dates, microblades and Late Pleistocene human migrations in the Transbaikal, Russia and the Paleo-Sakhalin-Hokkaido-Kuril Peninsula. P. 105–119.

[106] *Rybin E. P.* Middle and Upper Paleolithic interactions and the emergence of modern behavior in Southern Siberia and Mongolia // Emergence and diversity of modern human behavior in Paleolithic Asia. College Station TX, 2015. P. 470–480; *Lee G.-K.:* 1) Characteristics of Paleolithic industry in southwestern Korea during MIS 3 and MIS 2 // Quaternary International. 2012. Vol. 248. P. 12–20; 2) The characteristics of Upper Paleolithic industry in Korea // Emergence and diversity of modern human behavior in Paleolithic Asia. College Station, 2015. P. 270–280; *Ono A., Yamada M.* The Upper Palaeolithic of the Japanese Islands: an overview // Archeometriai Műhely. 2012. Vol. 9, iss. 4. P. 219–226.

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presence of blade technology at the Shuidonggou 1 and 2 sites at ca. 36,300–29,800 BP[108] requires further chronological research because the current evidence for this age is questionable[109].

For the mainland Russian Far East with the oldest microblade assemblage dated to ca. 19,400 BP, it is plausible to suggest that the Korean 'center' was responsible for the appearance of microblade technology in the Amur River basin (Ust'-Ul'ma 1 site; see Fig. 6) because contacts existed in the Upper Paleolithic between Korea and the Russian Far East as testified by the exchange of obsidian[110].

The Siberian region of Yakutia with its relatively old microblade assemblage at the Khayrgas site (dated to ca. 20,700 BP) could have served as a core area for the southern Siberian regions of Transbaikal, and the Angara and Yenisei River basins (Fig. 6).

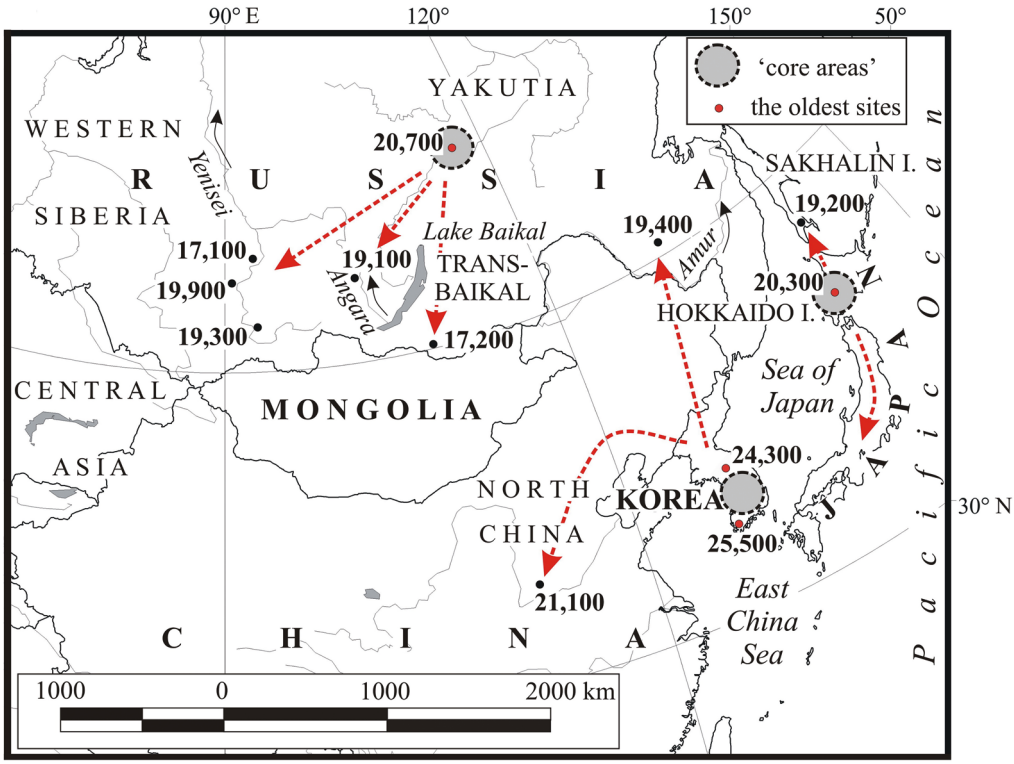

Fig. 6. Spatiotemporal patterns of the earliest microblade complexes in northern and eastern Asia, and possible ways of spread of microblade technology from three 'core areas'. Numbers correspond to the uncalibrated ^{14}C dates for each key site (see Table 1) (created by authors)

[108] *Li F., Gao X., Chen F., Pei S., Zhang Y., Zhang X., Liu D., Zhang S., Guan Y., Wang H., Kuhn S. L.* The development of Upper Palaeolithic China: new results from the Shuidonggou site // Antiquity. 2013. Vol. 87, iss. 336. P. 368–381.

[109] See: *Keates S. G., Kuzmin Y. V.* Shuidonggou localities 1 and 2 in northern China: archaeology and chronology of the Initial Upper Palaeolithic in north-east Asia // Antiquity. 2015. Vol. 89, iss. 345. P. 716–720; *Li F., Kuhn S. L., Gao X.* A response to Keates and Kuzmin // Antiquity. 2015. Vol. 89, iss. 345. P. 722–723.

[110] *Kuzmin Y. V.* Obsidian as a commodity to investigate human migrations in the Upper Paleolithic, Neolithic, and Paleometal of Northeast Asia // Quaternary International. 2017. Vol. 442. P. 5–10.

The ca. 20,700 BP old microblade technology at the Kashiwadai 1 site on Hokkaido is older than the microblade assemblages from Honshu Island (ca. 14,250 BP) and Kyushu Island (ca. 16,000 BP)[111]. The Kashiwadai 1 wedge-shaped cores and microblades are very standardized and advanced. For Sakhalin Island (Ogonki 5 site), Hokkaido is the most probable source area for the introduction of microblade technology (Fig. 6). The exchange of raw material (obsidian) is known to have existed between these regions since ca. 19,200 BP[112].

The proposal that microblade technology was introduced to Hokkaido from the Altai and possibly Transbaikal via Mongolia, and to Transbaikal from Hokkaido via Sakhalin and the Russian Far East[113], ignores the evidence from the Korean Peninsula. It can also not account for the lack of sites between Hokkaido and Mongolia because of the absence of microblade complexes south of Hokkaido within the Japanese archipelago (Kyushu and Honshu islands) where around 13,670 Paleolithic sites are known[114]. There is also no reliable evidence for human migration from Hokkaido Island to the Transbaikal via Sakhalin Island and mainland Russian Far East[115].

With regard to misinterpretations and misrepresentations of our views in terms of the age and origin of microblade technology, three recent cases deserve attention. O. Bar-Yosef[116] states that "…the early pottery examples from Japan and from eastern Siberia are found in the context of microblade industries, the origin of which is currently attributed to northern China", with reference to our volume[117]. However, this book[118] does not contain any information about northern China as the place for the origin of microblade complexes, and Bar-Yosef's opinion is a plain misrepresentation[119].

It is stated that "…the Lake Baikal region of Siberia was the cradle of microblade technology…"[120], citing our work[121]. There are no claims in these publications that Lake Baikal

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[111] *Sato H., Tsutsumi T.* The Japanese microblade industries: technology, raw material procurement, and adaptations. P. 17–25; *Iwase A.* A functional analysis of the LGM microblade assemblage in Hokkaido, northern Japan: A case study of Kashiwadai 1 // Quaternary International. 2016. Vol. 425. P. 140–152.

[112] *Kuzmin Y. V.* Obsidian as a commodity to investigate human migrations in the Upper Paleolithic, Neolithic, and Paleometal of Northeast Asia. P. 7–10.

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[114] Palaeolithic sites in the Japanese Islands: A database / Japanese Palaeolithic Research Association. Tokyo, 2010. P. 1–312.

[115] *Kuzmin Y. V.* Comment on "Radiocarbon dates, microblades and Late Pleistocene human migrations in the Transbaikal, Russia and the Paleo-Sakhalin-Hokkaido-Kuril Peninsula" by Buvit I., Izuho M., Terry K., Konstantinov M. V. and Konstantinov A. V. (Quaternary International, 425, 100–119) // Quaternary International. 2017. Vol. 436. P. 171–172.

[116] See: *Taylor R. E., Bar-Yosef O.* Radiocarbon dating: An archaeological perspective. Walnut Creek, CA, 2014. P. 196.

[117] Origin and spread of microblade technology in Northern Asia and North America / eds Y. V. Kuzmin, S. G. Keates, C. Shen. Burnaby, 2007. P. 1–222.

[118] Ibid.

[119] See also: *Kuzmin Y. V.* Radiocarbon and Archaeology — Long-Term Alliance: Review of R. E. Taylor, O. Bar-Yosef. Radiocarbon Dating: An Archaeological Perspective. 2nd ed. Walnut Greek, 2014 // Radiocarbon. 2016. Vol. 58, iss. 3. P. iii–vi.

[120] *Nian X., Gao X., Xie F., Mei H., Zhou L.* Chronology of the Youfang site and its implications for the emergence of microblade technology in North China. P. 113.

[121] *Kuzmin Y. V.* Geoarchaeological aspects of the origin and spread of microblade technology in Northern and Central Asia. P. 115–124; *Keates S. G.* Microblade technology in Siberia and neighbouring

was a possible place for the origin of microblade technique[122]. X. Nian and coauthors[123] do not cite the right reference for S. G. Keates[124], instead referring to another paper[125] which is not relevant to the issue of the origin of microblade technology. In contrast to this, it was stated that "…it is possible to conclude that the earliest evidence of microblade technology is now known from the Altai Mountains region of southern Siberia, dated to c. 35,000 BP…"[126]. We have no idea how Nian and coauthors[127] arrived at these opposite conclusions.

Although Buvit et al. (2016) assume that the earliest microblades in the Altai are dated to more than 41,000 calendar years[128], citing our work[129] as one of the sources, it does not reflect what was actually published[130].

5. Conclusions

After a critical review of the earliest microblade complexes in northern and eastern Asia, it seems clear that we cannot solve the issue of the appearance of microblade technology, but only come closer toward identifying its origin and spread. It is certain that there are strengths and weaknesses for each of the major scenarios for the emergence of the regional microblade assemblages.

In some cases, migration may explain the occurrence of microblades at sites dated after the initial or oldest finds in Korea. Thus, a "single origin scenario" would reflect the spatiotemporal patterns of the spread of the technology. However, there are large geographic gaps where no microblade sites have been reported. This prevents us from creating a more detailed picture of microblade origin(s). Alternatively, a "multiple origin scenario" could be the mechanism responsible for the emergence of microblade technology at ca.

regions: an overview // Origin and spread of microblade technology in Northern Asia and North America. P. 125–145.

[122] *Keates S. G.* Microblade technology in Siberia and neighbouring regions: an overview. Origin and spread of microblade technology in Northern Asia and North America / eds Y. V. Kuzmin, S. G. Keates, C. Shen. Burnaby, B. C. (Canada), Archaeology Press. 2007. P. 125–146; *Kuzmin Y. V.* Geoarchaeological aspects of the origin and spread of microblade technology in Northern and Central Asia. Origin and spread of microblade technology in Northern Asia and North America / eds Y. V. Kuzmin, S. G. Keates, C. Shen. Burnaby, B. C. (Canada). Archaeology Press. 2007. P. 115–124..

[123] *Nian X., Gao X., Xie F., Mei H., Zhou L.* Chronology of the Youfang site and its implications for the emergence of microblade technology in North China. P. 114.

[124] *Keates S. G.* Microblade technology in Siberia and neighbouring regions. P. 125–144.

[125] *Keates S. G., Hodgins G. W. L., Kuzmin Y. V., Orlova, L. A.* First direct dating of a presumed Pleistocene hominid from China: AMS radiocarbon age of a femur from the Ordos Plateau // Journal of Human Evolution. 2007. Vol. 53, iss. 1. P. 1–4.

[126] *Kuzmin Y. V.* Geoarchaeological aspects of the origin and spread of microblade technology in Northern and Central Asia. P. 123.

[127] *Nian X., Gao X., Xie F., Mei H., Zhou L.* Chronology of the Youfang site and its implications for the emergence of microblade technology in North China. P. 115.

[128] *Buvit I., Izuho M., Terry K., Konstantinov M. V., Konstantinov A. V.* Radiocarbon dates, microblades and Late Pleistocene human migrations in the Transbaikal, Russia and the Paleo-Sakhalin-Hokkaido-Kuril Peninsula. P. 100.

[129] *Keates S. G.* Microblade technology in Siberia and neighbouring regions: an overview // Origin and spread of microblade technology in Northern Asia and North America. P. 125–144.

[130] See details: *Kuzmin Y. V.* Comment on "Radiocarbon dates, microblades and Late Pleistocene human migrations in the Transbaikal, Russia and the Paleo-Sakhalin-Hokkaido-Kuril Peninsula" by Buvit I., Izuho M., Terry K., Konstantinov M. V. and Konstantinov A. V. (Quaternary International, 425, 100–119) // Quaternary International, 2017. Vol. 436. P. 170–172.

25,500 BP and later, at ca. 24,300–20,300 BP. The inhabitants of the earliest microblade sites, i. e. in Korea, may have invented the technology independently. A major problem in resolving this is the lack of any microblade-containing localities between the earliest 'core areas' in the geographically distant regions (Fig. 6).

The continuation of research in the northern and eastern regions of Asia will bring new knowledge on the Upper Paleolithic allowing a more detailed examination of the issue. The selection of sites presented in this paper (see Table 1) can be used as a basic source for future research.

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