Studenoe-2 and the origins of microblade technologies in the Transbaikal, Siberia

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Analysis and dating of new Upper Palaeolithic sites suggest that microblades emerged in the Transbaikal after 18,000 years ago. These findings encourage review of earlier assertions that such technologies developed in northeast Asia prior to the last glacial maximum.

Key-words: Siberia, Upper Palaeolithic, microblade, AMS dates, fauna, hearths

Introduction

Microblade technology is the hallmark of the late Pleistocene archaeological record of northeast Asia and northwest North America. Efficient, economical and highly standardized, microblades are a marvel of human ingenuity and adaptability. Microblades are tiny (typically less than 20 mm long and 5 mm wide) elongate blades with parallel lateral margins and dorsal ridges, serially detached from the ends of 'wedge-shaped cores' made on flakes or biface fragments (Flenniken 1987; Kobayashi 1970; Morlan 1976). A small matchbook-size core could produce literally dozens of microblades, which were inset along the margins of slotted bone or antler points (Abramova *et al.* 1991; Medvedev *et al.* 1990; Petrin 1986). The resulting composite tools — knives and projectiles — were razor-sharp and lethal. During the latest Pleistocene, microblade technologies spread throughout northeast Asia and northwest North America, from the Ural Mountains to central British Columbia (Aikens & Higuchi 1982; Derev'anko 1998; Goebel & Slobodin 1999; Hamilton & Goebel 1999; Matson & Coupland 1995).

The origin and adaptive significance of microblade technology remain uncertain. This is due largely to difficulties associated with interpreting geological contexts and dating Palaeolithic sites in the north (Hopkins *et al.* 1982; Kuzmin & Tankersley 1996; Tseitlin 1979; Yi & Clark 1982). Many late Upper Palaeolithic sites are not in pristine, primary contexts, so that radiocarbon-dated materials cannot be tied reliably to microblades and other cultural materials. Often wood charcoal samples suitable for conventional radiocarbon (^{14}C) dating are not recovered during excavations, leading to a reliance on dating of bone, which often yields aberrant age estimates. Thus, interpretation of radiocarbon age estimates from Siberian Palaeolithic sites must proceed with caution, taking into consideration a multitude of factors, especially

1 geologic context,
2 material analysed, and
3 concordance with associated materials (i.e. stratigraphy, ecofacts and other radiocarbon ages).

This paper presents new accelerator (AMS) ^{14}C age estimates for the site of Studenoe-2, located in the Transbaikal, southeast Siberia (54°4'N, 108°13'E). Dated samples were collected from clearly defined hearths and living floors, and were unequivocally associated with wedge-shaped core and microblade industries. Resulting age estimates suggest that late Upper Palaeolithic microblade technology emerged in the Transbaikal immediately after the last glacial maximum, as early as 17,800 years ago (BP). On this basis we argue that the Studenoe-2 materials are among the earliest unequivocally dated microblade assemblages in northeast Asia.

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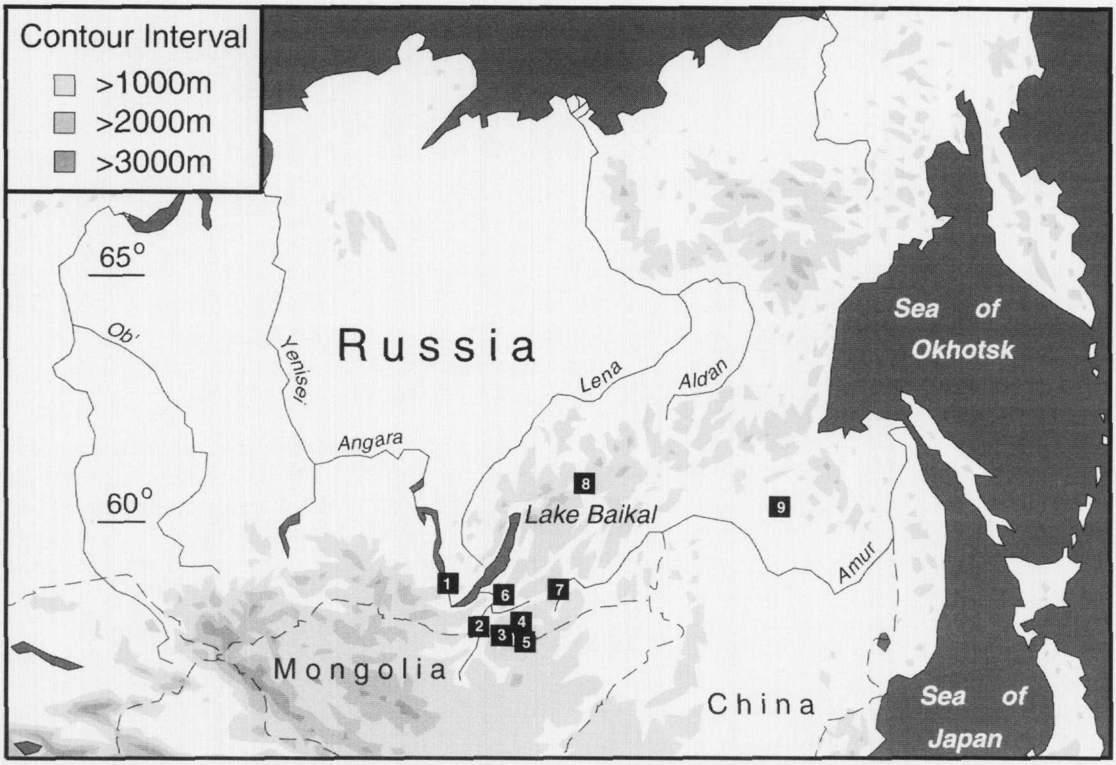

FIGURE 1. *Map showing location of Palaeolithic sites mentioned in text.*
1 *Krasnyi-Iar;* 2 *Ust'-Kiakhta;* 3 *Studenoe;* 4 *Ust'-Menza;* 5 *Kosaia Shivera;* 6 *Oshurkovo;* 7 *Sokhatino;* 8 *Bol'shoi Iakor;* 9 *Ust'-Ul'ma.*

Studenoe-2

The multi-component Studenoe sites are located along the Chikoi River, at its confluence with Studenoe Creek, 13 km south of the village of Nizhnii Narym (FIGURE 1). Initial test excavations at Studenoe-2 occurred from 1974 to 1980 (Bazarov *et al.* 1982: 68), and large-scale excavations occurred during two phases, first from 1986 to 1990 (Konstantinov 1994), and more recently from 1996 to the present (Kazantseva 1997; Konstantinov 1997; Konstantinov & Razgil'deeva 1998). More than 300 sq. m have been excavated to a depth of about 5 m.

The main Upper Palaeolithic cultural components at Studenoe-2 occur in alluvial sediments comprising the fill of the second terrace (T-2) of the Chikoi River. The site's stratigraphic profile consists of a series of silts, silty sands and sands grouped into three lithostratigraphic units, labeled I–III from oldest to youngest (FIGURE 2) (Buvit 2000). Unit I is gravel overlain by sand, the result of a laterally accreting river channel. Unit II consists of silts, silty sands, sands and a few laminae of clay. Within this unit are 43 fining-upward sequences of sand overlain by silt or silty sand, and numerous sand lenses. These features indicate that Unit II is the product of a vertically accreting floodplain. Unit III is a thick bed of homogeneous silty sand on which the modern soil has formed. These sediments were also deposited by overbank flooding. No buried soils are present in the alluvial sequence, indicating that sedimentation was very rapid throughout the late Pleistocene.

Given these observations of the Studenoe-2 sediments, we offer the following scenario of site formation. Upper Palaeolithic hunters at Studenoe established their camps on the floodplain overlooking the river. After each occupation, fine-grained sediments carried in by overbank floodwaters blanketed their structures, features and artefacts. Because the site was repeatedly occupied, a sequence of superimposed occupation surfaces became preserved within the 5-m thick sequence of alluvial sediments. Further, because sedimentation was rapid, each

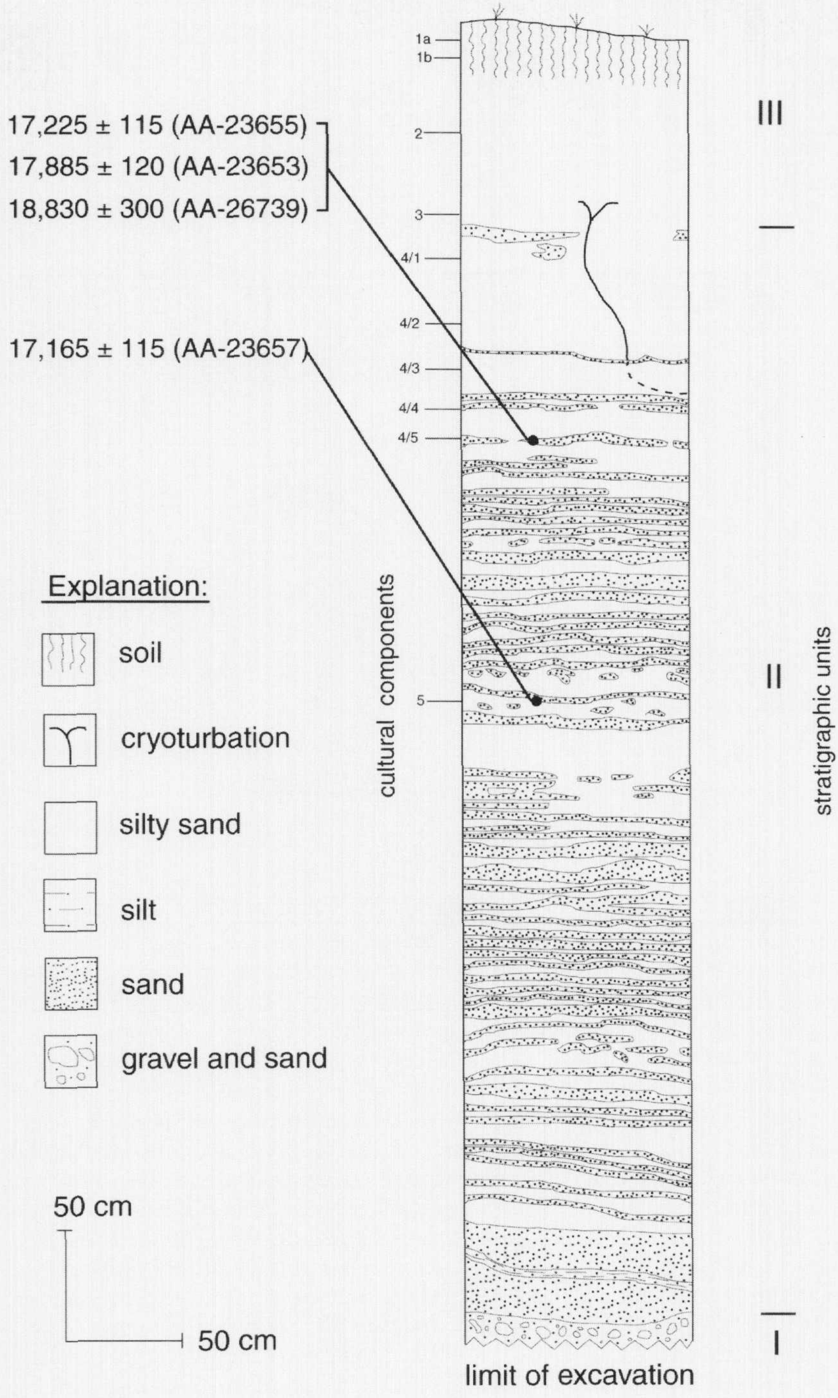

FIGURE 2. *Stratigraphic profile from Studenoe-2, showing cultural components and provenience of radiocarbon dates.*

occupation surface probably represents a brief and single episode of occupation.

Ten cultural components (5, 4/5–4/1, 3, 2, 1b, 1a) have been exposed at Studenoe-2. Components 5, 4/5–4/1 and 3 contain late Upper Palaeolithic microblade industries; components 2 and 1 are assignable to the late Mesolithic and Bronze Age, respectively. Radiocarbon dating samples were collected from the two lowest components with microblades, components 5 and 4/5.

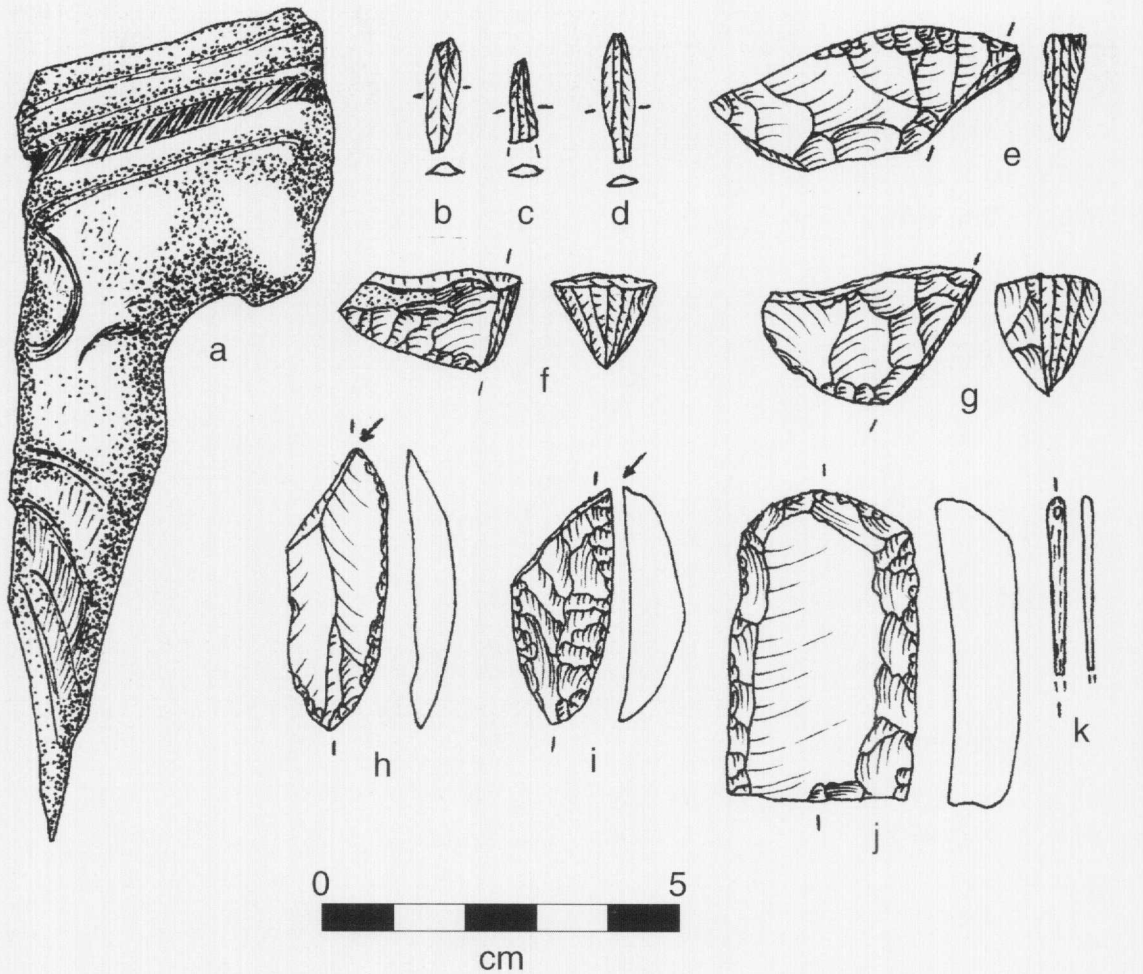

FIGURE 3. *Late Upper Palaeolithic artefacts from Studenoe-2 (component 4/5:* a; *component 5:* b–e*) and Ust'-Menza-2 (layer 22:* f, h–j; *layer 24:* g, k*).* a *decorated bone tool;* b–d *microblades;* e–g *wedge-shaped cores;* h–i *burins;* j *end scraper;* k *bone needle.*

Cultural component 5 is situated in a thin band of silt within geological unit II at a depth of about 3 m below the modern surface. Excavations in 1996 revealed a concentration of lithic artefacts, faunal remains, boulders and cobbles, as well as several hearth features marked by diffuse stains of ash and charcoal (Konstantinov 1997). Among the lithic artefacts recovered are wedge-shaped cores, numerous microblades and 12 round and cylindrical stone beads, some with biconically drilled holes (Kazantseva 1998) (FIGURE 3).

Cultural component 4/5 occurs as a thin silty band about 1·5 cm thick, situated within geological unit II, about 2 m below the surface. An oval-shaped feature 7 x 4·5 m in size was exposed in 1996 and further excavated in 1997 and 1998 (FIGURE 4). This is interpreted to be the remains of an Upper Palaeolithic dwelling (Kazantseva 1997; Konstantinov 1997; Konstantinov & Razgil'deeva 1998). Its outline is marked by a ring of at least 67 boulder- and cobble-sized stones, and its floor by a thin (<1 cm) but distinct lens of ash and ochre. Four, and possibly five, hearths are situated in a line following the long axis of the dwelling feature, and are each about 1·5 m apart. These are rock-lined oval features with ash and charcoal. Hearth 1, for example, is about 1·5 m in diameter and 3 cm thick. From the dwelling feature comes a rich inventory of artefacts, including thousands of flakes and retouching chips, microblades,

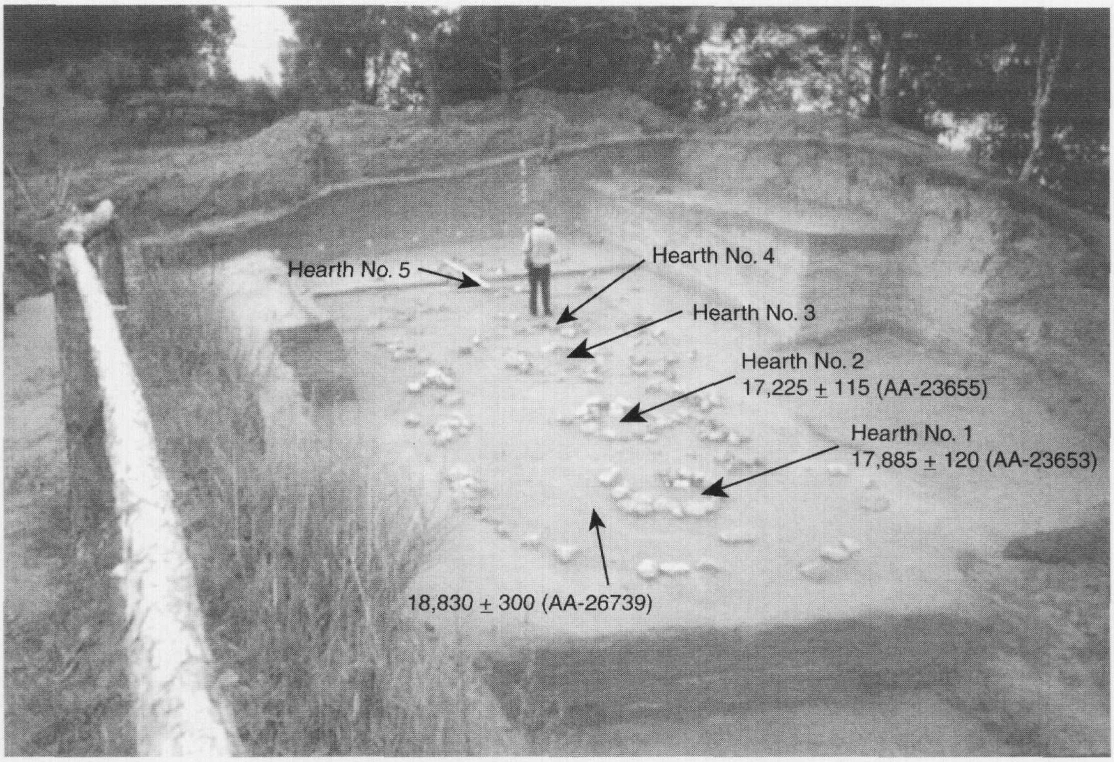

FIGURE 4. *Dwelling feature of component 4/5, Studenoe-2, excavated from 1996–1998.*

several bipolar cores, microblade core fragments and platform rejuvenation spalls, and a flake core (Konstantinov & Razgil'deeva 1998). Lithic tools include retouched blades and flakes, burins, side scrapers, end scrapers and gravers. In addition, several bone needles, a bone awl (FIGURE 3a) and three rhyolite beads and four bead preforms were recovered. Faunal remains include thousands of tiny bone fragments, as well as some diagnostic pieces described as belonging to deer and wolf.

The overlying Palaeolithic cultural components — 4/4, 4/3, 4/2, 4/1 and 3 — also contain microblade cores and microblades associated with living floors and, in some cases, hearth and dwelling features (Goebel 1999; Konstantinov 1994). Given their stratigraphic context they are thought by Konstantinov (1994) to date to the terminal Pleistocene, around 13,000–10,000 BP.

Radiocarbon dating procedures and results

In 1996 our American team of scientists and students participated in field studies at Studenoe-2 directed by M. and A. Konstantinov. While excavating the exposed living floors of

provenience	lab* no.	material	carbon yield (mg)	dry amino acid yield (%)	age determination	two-sigma age range
component 5; hearth; sq. I-25	AA-23657	charcoal	0·88	–	17,165±115	16,935–17,395
component 4/5; hearth 1; sq. P-11	AA-23653	charcoal	2·02	–	17,885±120	17,645–18,125
component 4/5; hearth 2; sq. O-9	AA-23655	charcoal	0·60	–	17,225±115	16,995–17,455
component 4/5; near hearth 1	AA-26739	bone	–	7.08	18,830±300	18,230–19,430

* AA=Arizona Accelerator, NSF-Arizona AMS Facility, University of Arizona, Tucson AZ, USA.

TABLE 1. *Description and determination of radiocarbon samples from Studenoe-2.*

components 5 and 4/5, we collected charcoal and bone samples for AMS ^{14}C dating analysis. Sample information is presented in TABLE 1.

AMS ^{14}C analysis of all samples was conducted at the NSF-Arizona AMS Facility. Bone samples were pretreated at the Laboratory of Isotope Geochemistry, University of Arizona, following standard methods described by Long *et al.* (1989). Charcoal samples were pretreated at the NSF-Arizona AMS Facility. AMS dating of all samples followed procedures outlined in Jull *et al.* (1983).

Resulting AMS ^{14}C determinations (corrected for $\delta^{13}C$ fractionation) and two-sigma ranges are presented in TABLE 1. For component 5, charcoal from a diffuse hearth-like feature yielded an AMS ^{14}C age estimate of 17,165±115 BP (AA-23657). For cultural component 4/5, charcoal from hearth feature 1 yielded a ^{14}C age of 17,885±120 BP (AA-23653), and charcoal from hearth feature 2 yielded a ^{14}C age of 17,225±115 BP (AA-23655). The mandible of a medium-sized mammal found lying on the living floor next to hearth feature 1 produced a determination of 18,830±300 BP. (AA-26739). Provenience of dated samples for component 4/5 is shown in FIGURE 4.

Discussion

Disregarding the bone date, the new AMS dates for Studenoe-2 support an age range of about 17,000–18,000 BP for components 5 and 4/5 (TABLE 1). The bone date (AA-26739) appears to be discordantly older than the charcoal ages; they do not overlap even at two sigma. We prefer the charcoal age estimates not only because charcoal is typically a more reliable dating medium than bone (Taylor 1987), but also because they are from human hearths and have much smaller standard errors. The average of the component 4/5 pair of charcoal dates, 17,445±85 BP (obtained through the formula of Long & Rippeteau 1974), is statistically contemporaneous (at two sigma) with the date obtained from hearth charcoal for component 5 (17,165±115 BP). The similarity of these dates is not surprising because rates of alluvial deposition were shown to be high during the late Pleistocene. With reasonable certainty, then, we can assign both components 5 and 4/5 to 17–18,000 BP.

The new ages from Studenoe-2 correspond to dates from another wedge-shaped core and microblade site in the southern Transbaikal, Ust'-Menza-2 (Konstantinov 1994). At this site, located along the Chikoi River about 50 km east of Studenoe, M. Konstantinov's excavations yielded a series of late Upper Palaeolithic cultural components in a well-stratified set of overbank flood deposits similar to those at Studenoe-2. The upper cultural components have conventional ^{14}C determinations (on charcoal) ranging from 16,900 to 14,800 BP (TABLE 2), while the two lowermost cultural components have ^{14}C determinations greater than 16,900 BP: 16,980±150 (GIN-5465) BP for layer 20, and 17,190±120 (GIN-5464A) and 17,600±250 (GIN-5464) BP for layer 21 (Konstantinov 1994). These are conventional dates obtained from wood charcoal from hearths, and are associated with wedge-shaped cores and microblades (FIGURE 3).

Other sites in the Transbaikal with microblades are younger in age. Bol'shoi Iakor, Kosaia Shivera, Oshurkovo, Studenoe-1, Ust'-Kiakhta-17 and Ust'-Menza-1 appear to date to between 10,000 and 12,500 BP (Abramova 1989; Konstantinov 1994; Tashak 1996) (TABLE 2; FIGURE 5). Sokhatino-4 has two conflicting ^{14}C dates of 26,100±200 (SOAN-1138) and 11,900±130 (SOAN-841) BP (Okladnikov & Kirillov 1980), and we concur with Abramova (1989) that the younger date is probably closer to the real age of this microblade occupation, given the occurrence of forest-adapted fauna including moose and roe deer in the associated faunal assemblage. Thus, the radiocarbon and associated contextual evidence suggests that wedge-shaped core and microblade technology in the Transbaikal is a late glacial phenomenon, one that emerged shortly after the last glacial maximum and persisted into the early Holocene, 18,000–10,000 BP.

The 18,000–17,000 BP sites in the southern Transbaikal may be among the earliest microblade sites in northeast Asia. Two microblade sites that border the Transbaikal, Krasnyi-Iar-1 (to the west in the southern Angara valley) and Ust'-Ul'ma-1 (to the east in the upper Amur valley), however, may be as old as 19,300 BP (Derev'anko 1998; Medvedev *et al.* 1990). Age estimates from these sites, however, are based on single radiocarbon dates (19,100±100 (GIN-5530) BP for Krasnyi-Iar, and 19,360±65 (SOAN-2619) BP for Ust'-Ul'ma), and additional work is necessary to confirm these proposed ages.

Elsewhere in northeast Asia, outside the greater Baikal area, there are no microblade sites with unequivocal ^{14}C ages from clear primary contexts that predate the last glacial maximum.

site/context	lab no.	determination	material	reference
Bol'shoi Iakor'-1, layer 4A	LE-4173A	10,070±540	charcoal	Belousov *et al.* 1990
Bol'shoi Iakor'-1, layer 4A	SOAN-968	10,320±130	charcoal	Belousov *et al.* 1990
Bol'shoi Iakor'-1, layer 6	LE-4172	10,400±650	charcoal	Belousov *et al.* 1990
Bol'shoi Iakor'-1, layer 6	LE-4172A	12,400±150	charcoal	Belousov *et al.* 1990
Kosaia Shivera, layer 14	GIN-6123	12,070±300	hearth charcoal	Konstantinov 1994
Oshurkovo	GIN-5788	9700±700	hearth charcoal	Konstantinov 1994
Oshurkovo	GIN-302	10,900±500	charcoal	Abramova 1989
Oshurkovo	GIN-5787	11,230±80	hearth charcoal	Konstantinov 1994
Oshurkovo	GIN-6121	11,630±40	hearth charcoal	Konstantinov 1994
Sokhatino-4	SOAN-841	11,900±130	bone	Abramova 1989
Sokhatino-4	SOAN-1138	26,110±200*	charcoal	Abramova 1989
Studenoe-1, horizon 14	SOAN-1654	10,975±135	charcoal	Konstantinov 1994
Studenoe-1, horizon 14	SOAN-1655	11,395±100	charcoal	Konstantinov 1994
Studenoe-1, horizon 14	GIN-2925	12,300±700*	charcoal	Konstantinov 1994
Studenoe-1, horizon 15	GIN-6128	1226±390*	charcoal	Konstantinov 1994
Studenoe-1, horizon 15	GIN-2931a	11,340±180	charcoal	Konstantinov 1994
Studenoe-1, horizon 15	GIN-2930	11,660±400	charcoal	Konstantinov 1994
Studenoe-1, horizon 15	LE-2062	12,290±130	charcoal	Konstantinov 1994
Studenoe-1, horizon 15	GIN-2931	14,900±2000*	charcoal (humic fraction)	Konstantinov 1994
Studenoe-1, horizon 16	GIN-2932	11,340±200	charcoal	Konstantinov 1994
Studenoe-1, horizon 16	SOAN-1656	11,630±50	charcoal	Konstantinov 1994
Studenoe-1, horizon 17	GIN-2933	6030±400*	charcoal	Konstantinov 1994
Studenoe-1, horizon 17	GIN-2934a	12,130±150	charcoal	Konstantinov 1994
Studenoe-1, horizon 17	GIN-2934	12,140±150	charcoal	Konstantinov 1994
Studenoe-1, horizon 18/1	GIN-6129	2100±100*	charcoal	Konstantinov 1994
Studenoe-1, horizon 18/1	GIN-2935	12,110±150	charcoal	Konstantinov 1994
Studenoe-1, horizon 18/1	LE-2061	13,430±150	charcoal	Konstantinov 1994
Studenoe-1, horizon 18/2	GIN-2947	12,800±400	charcoal	Konstantinov 1994
Studenoe-1, horizon 19/1	GIN-6139	12,330±60	charcoal	Konstantinov 1994
Studenoe-1, horizon 19/1	GIN-6133	18,550±35*	charcoal	Konstantinov 1994
Studenoe-1, horizon 19/4	GIN-2938	11,030±380*	charcoal	Konstantinov 1994
Studenoe-1, horizon 19/4	IEMEZh-199	11,314±160*	charcoal	Konstantinov 1994
Ust'-Kiakhta-17, horizon 3	SOAN-3091	11,680±155	bone	Tashak 1996
Ust'-Kiakhta-17, horizon 5	SOAN-3092	11,500±100	bone	Tashak 1996
Ust'-Kiakhta-17, horizon 5	GIN-N84-93a	12,100±80	bone	Tashak 1996
Ust'-Kiakhta-17, horizon5	GIN-N84-93b	12,230±100	bone	Tashak 1996
Ust'-Menza-1, layer 13	GIN-5503	11,350±250	charcoal	Konstantinov 1994
Ust'-Menza-1, layer 14	GIN-7161	11,820±120	charcoal	Konstantinov 1994
Ust'-Menza-2, layer 11	GIN-6116	14,830±390	charcoal	Konstantinov 1994
Ust'-Menza-2, layer 17	GIN-6117	16,900±500	hearth charcoal	Konstantinov & Sokolova 1996
Ust'-Menza-2, layer 17	GIN-5478	15,400±400	hearth charcoal	Konstantinov & Sokolova 1996
Ust'-Menza-2, layer 20	GIN-5465	16,980±150	hearth charcoal	Konstantinov & Sokolova 1996
Ust'-Menza-2, layer 21	GIN-5464	17,600±250	charcoal	Konstantinov 1994
Ust'-Menza-2, layer 21	GIN-5464A	17,190±120	charcoal	Konstantinov 1994

* Discordant date.

TABLE 2. *Conventional radiocarbon age estimates from Transbaikal Upper Palaeolithic sites with wedge-shaped core and microblade industries.*

To the west and north, in the Yenisei, Ob' and Lena basins, microblade technology probably appeared after 16,000 BP (Goebel 1999; Yi & Clark 1982). Sites that are reportedly older than this have either problematic contexts or inconsistent radiocarbon dates. In the Russian Far East, north China and Japan, the earliest radiocarbon-dated industries may be even younger, perhaps younger than 14,000 BP (Chen 1984; Chen & Olsen 1990; Elston *et al.* 1997; Kuzmin &

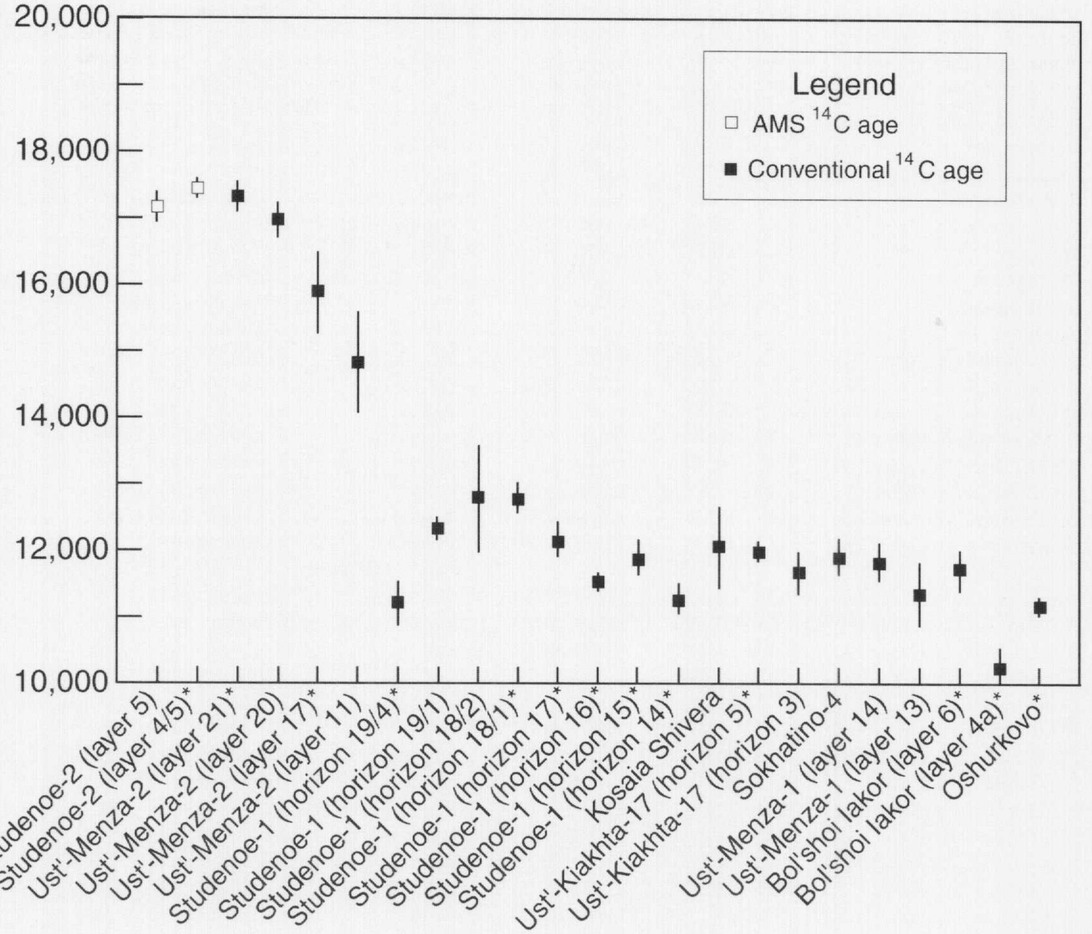

FIGURE 5. *Radiocarbon age measurements for some late Upper Palaeolithic microblade industries in the Transbaikal. (* Weighted average age.)*

Orlova 1998; Reynolds & Kaner 1990). In the Bering Land Bridge area, microblades are clearly a terminal Pleistocene phenomenon, perhaps no more ancient than about 11,000 BP (Goebel & Slobodin 1999; Hamilton & Goebel 1999; Hoffecker *et al.* 1993), despite Morlan (1987) and West (1996).

Our interpretation of the radiocarbon evidence from Studenoe-2 and other Palaeolithic sites in northeast Asia is that the transition to microblade technology occurred relatively late in the Upper Palaeolithic sequence, at or immediately after the last glacial maximum (18,000–17,000 BP), and that this event occurred first in the southern Baikal/central Mongolian region of inner Asia. The emergence of this light and highly specialized lithic technological system was part of a major reorganization in hunter–gatherer adaptation. Tool kits, faunal remains, site structure and settlement data suggest that late Upper Palaeolithic hunters were much more mobile than earlier Upper Palaeolithic northeast Asians, and that they concentrated subsistence on a few key mammal species (e.g. reindeer, red deer and occasionally mammoth) (Goebel 1999). Microblades were a key component of this adaptive system, one that facilitated high mobility and efficient hunting. Two results of this reorganization were rapid recolonization of Siberia and far northeast Asia after the last glacial maximum around 17,000–14,000 BP, and ultimately migration to the Americas via the Bering Land Bridge by microblade-producing populations around 11,000–10,000 BP.

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