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CHRONOLOGY AND FAUNAL REMAINS OF THE KHAYRGAS CAVE (EASTERN SIBERIA, RUSSIA)

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ABSTRACT. The Khayrgas Cave in Yakutia (eastern Siberia) is one of the most important Upper Paleolithic sites in northern Asia, and has been the subject of extensive ^{14}C dating and study of mammal bones. The upper part of the cave sequence (Layers 2–4) dates to the Holocene (~4100–8200 BP), and the lower part (Layers 5–7) to the Late Pleistocene (~13,100–21,500 BP). In Layers 2–4, only extant animal species are known; ecologically they belong to a forest-type ecosystem. In Layers 5–7, several extinct species were identified, and the environment at that time corresponded to open and semi-open ecosystems. The Khayrgas Cave provides rare but reliable evidence of human occupation in the deep continental region of eastern Siberia at the Last Glacial Maximum, ~20,700–21,500 BP.

KEYWORDS: AMS dating, archaeozoology, Eurasia, Paleolithic.

INTRODUCTION

The Khayrgas Cave in the Middle Lena region of Yakutia (59°56′N, 117°28′E) is now one of the richest sites in the central part of eastern Siberia (Figure 1) in terms of archaeological and faunal data. Its discovery is an important step in the study of the Paleolithic in the Lena River basin since pioneering work done in the 1960–1970s (Mochanov and Fedoseeva 1996; Mochanov 2010). This site is also significant in terms of the issue of human presence in Siberia at the Last Glacial Maximum (LGM), a topic that has been hotly debated for the last 10–15 yr (e.g. Hoffecker 2005; Kuzmin and Keates 2005, 2013, 2016; Kuzmin 2008; Pitulko et al. 2015). This paper presents new information on the chronology and faunal remains from this site, and discusses its implication for the broader area of northern Eurasia.

MATERIAL AND METHODS

The Khayrgas Cave was found and initially excavated in 1984–1985 by N M Cherosov and A S Kirillin (Yakutsk State University, now North-Eastern Federal University). Excavation continued in 1998–1999, with a total of 103 m^2 unearthed (Stepanov et al. 2003). The general stratigraphy in shown in Figure 2. The most important cultural material was obtained from Layers 5–7 (Figures 2–3); it has an Upper Paleolithic appearance, and belongs to the Dyuktai cultural complex of Yakutia (e.g. Mochanov and Fedoseeva 1996). Archaeological material is described in Stepanov et al. (2003); here we briefly describe the characteristics. In Layer 5, 522 stone artifacts and more than 75 bone artifacts were recovered (including adornments). Several cores (wedge-shaped, flattened, and prismatic) were found, as well as tools including burins, arrowhead, skreblos (large scrapers), scrapers, points, knives, and insets. Bone tools are represented by a smoother, beads, awls, points, pendants, arrowheads, fish hooks, and a harpoon. Of particular interest is the bone dagger made of mammoth rib, 34 cm long and 2.9 cm wide.

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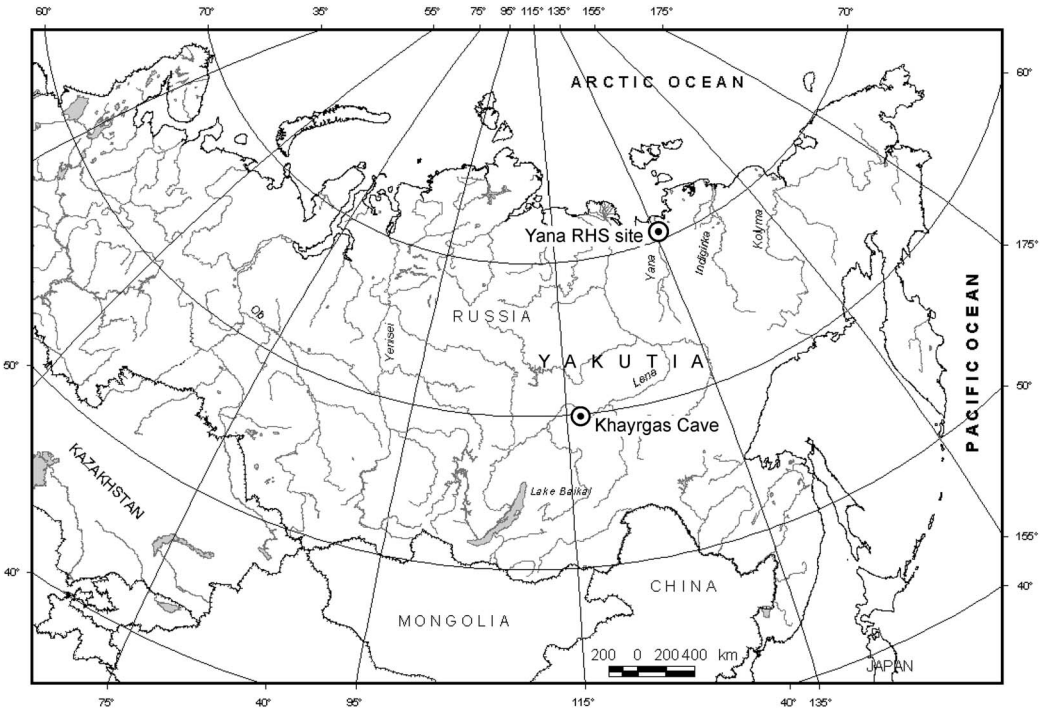

Figure 1 Position of the Khayrgas Cave and Yana RHS site in eastern Siberia

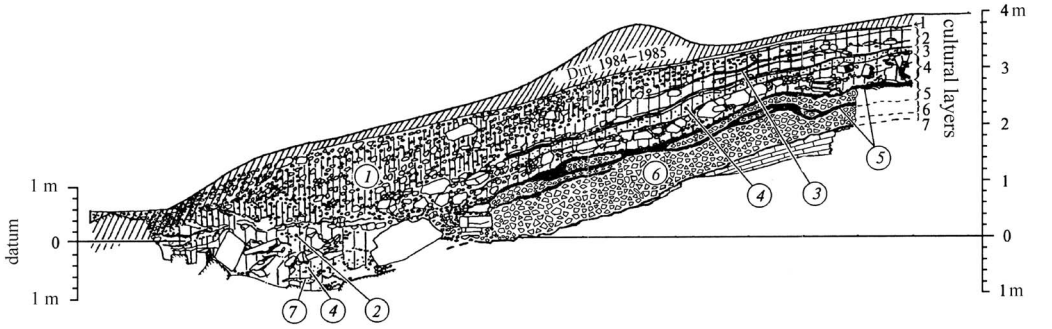

Figure 2 Stratigraphy of the Khayrgas Cave (modified after Stepanov et al. 2003). Numbers in circles are sedimentary strata: 1 – dark-brown sandy loam (contains cultural Layers 1–2); 2 – brown sandy loam with gruss and large stone blocks (might contain cultural layer 2); 3 – greenish-brown sandy loam (contains cultural layer 2); 4 – greenish-brown laminated sandy loam (contains cultural layer 3); 5 – "black layer": sandy loam with pieces of charcoal and soot, and gruss (contains cultural layer 5); 6 – gruss with dark-gray sandy loam (contains cultural Layers 6–7); 7 – sandy lens.

In Layer 6, 1203 stone artifacts and 59 bone items were found. Cores (conical, flat-faced, and wedge-shaped), retouched blades, and scrapers constitute the stone tool assemblage. Bone tools are represented by arrowheads, harpoons, pendants, and items with grooves for stone insets. From Layer 7, 705 stone artifacts and 20 bone artifacts were recovered. The stone assemblage includes mostly wedge-shaped cores, blades, scrapers, and numerous flakes. Bone items are represented mainly by inset points and arrowheads. Of particular importance are numerous eye needles made of mammal bones from Layers 5–7 (Figure 4).

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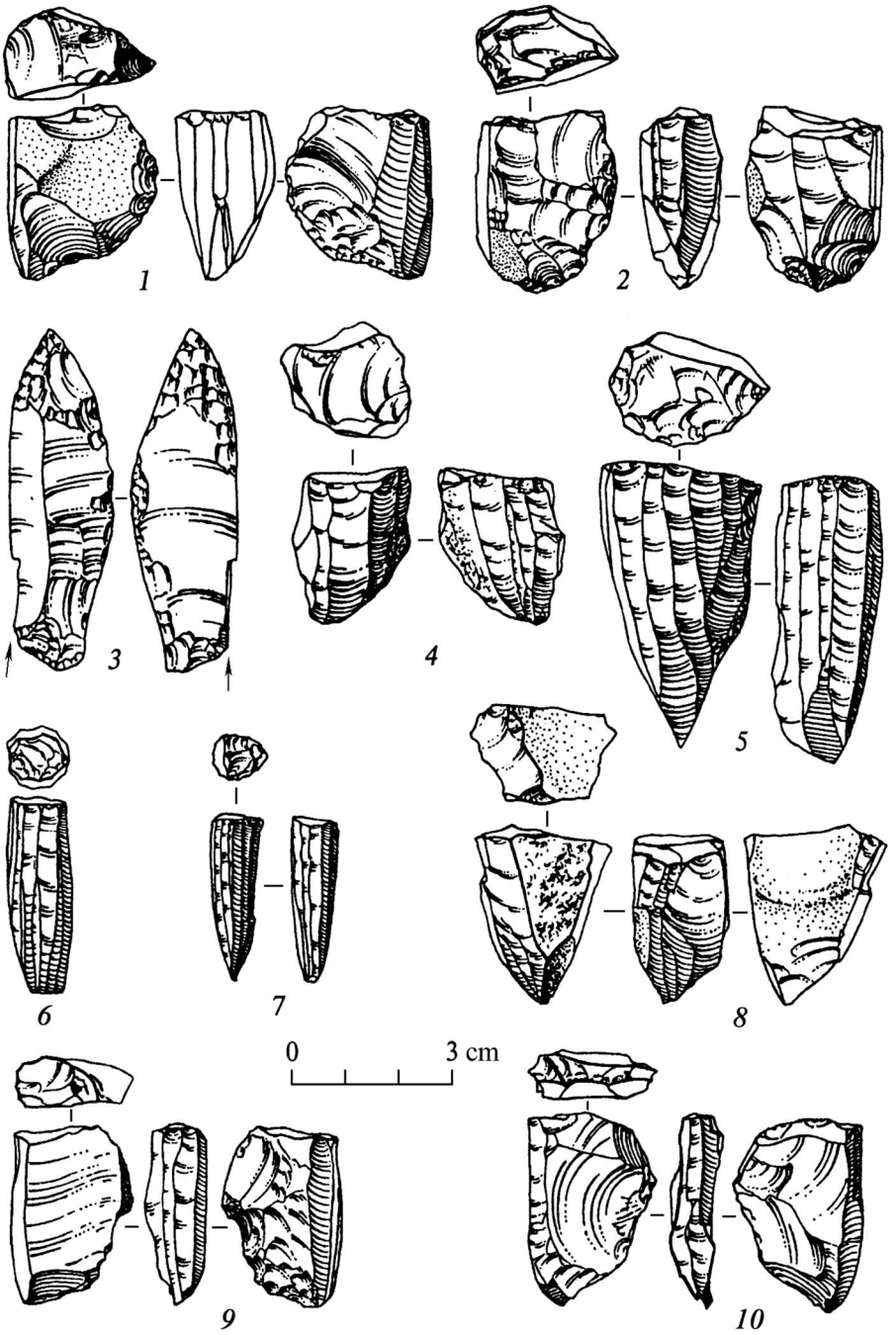

Figure 3 Stone tools from Upper Paleolithic layers (5–7) of the Khayrgas Cave (modified after Stepanov et al. 2003): 1–6 – Layer 5; 7, 8–9 –Layer 6; 10 – Layer 7. Scale in centimeters.

The first ^{14}C dates from the Khayrgas Cave were generated on large samples of animal bones in the late 1990s: Layer 2 (1998–1999 pit), ~4100 BP; Layer 6 (1985 pit), ~16,000 BP; and Layer 7 (1998–1999 pit), ~21,500 BP (Stepanov et al. 2003). In 2007, more bone samples were taken

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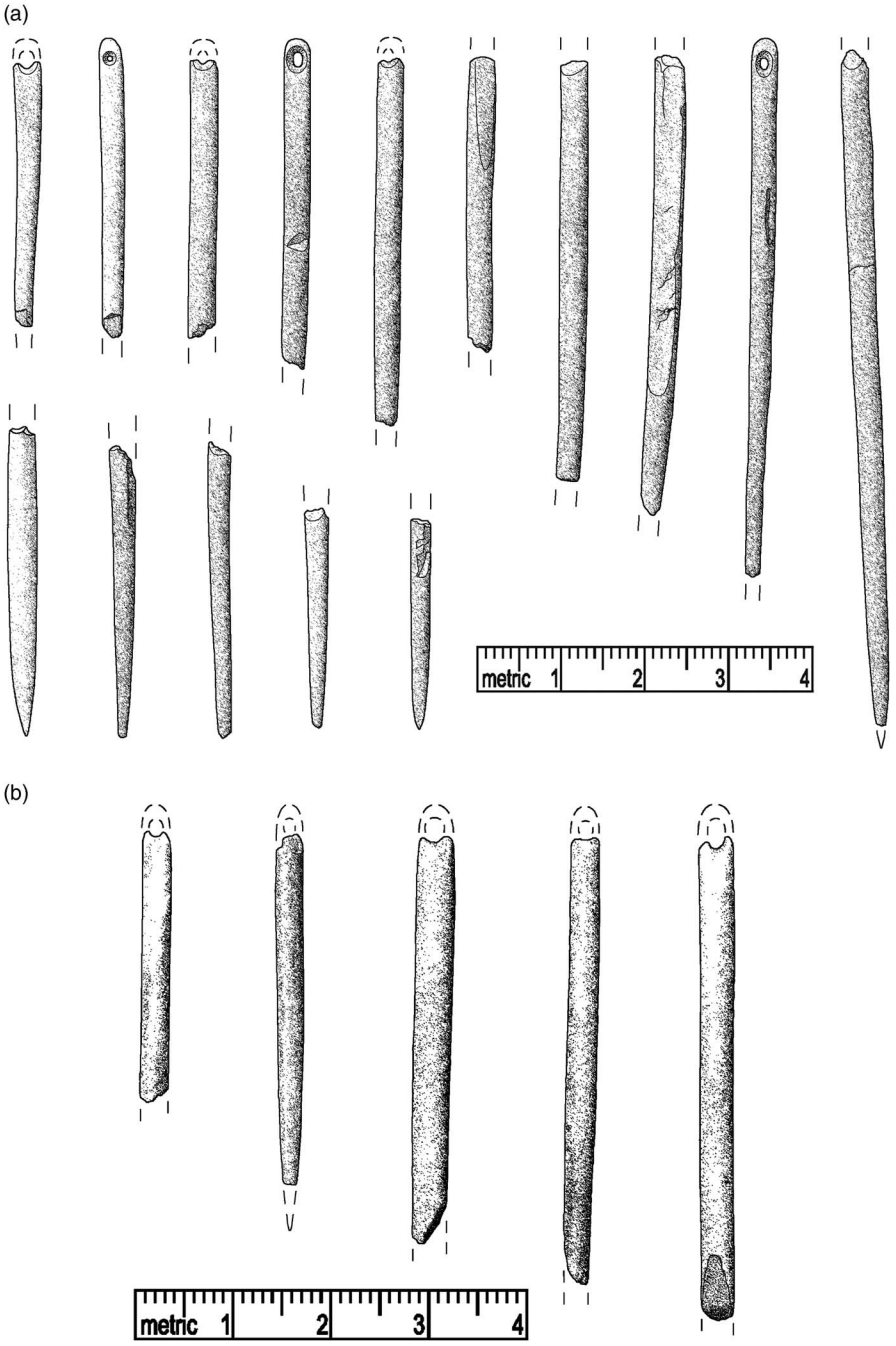

Figure 4 Fragmented eye needles from the Khayrgas Cave: A – Layer 6; B – Layer 7. Scale in centimeters.

from the material collected during the 1999 excavations and AMS ^{14}C dated at the University of Arizona (Table 1). Sample preparation followed the standard procedure for bones (e.g. Ovodov et al. 2011: 3).

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Table 1 ^{14}C dates from the Khayrgas Cave.

Cultural layers and excavation years	^{14}C date, BP	Calibrated date, cal BP*	Lab nr	Material dated
2 (1999)	4100 ± 90	4420–4840	SOAN-4248**	Charcoal
4 (1998)	4785 ± 60***	5330–5640	AA-79321	Bone (squirrel)
4 (1998)	8085 ± 80	8660–9270	AA-79320	Bone (sable)
4 (1998)	8160 ± 80	8790–9410	AA-79779	Bone (roe deer)
5 (1998)	4210 ± 55***	4580–4860	AA-79783	Bone (unidentified)
5 (1999)	13,150 ± 150	15,300–16,190	AA-79780	Bone (horse)
5 (1998)	13,260 ± 140	15,460–16,330	AA-79778	Bone (bison)
5 (1999)	13,350 ± 140	15,650–16,490	AA-79785	Bone (red deer)
5 (1998)	13,390 ± 140	15,710–16,540	AA-79784	Bone (unidentified)
4–5 (1999)****	13,620 ± 140	16,040–16,910	AA-79322	Bone (mountain hare)
5 (1999)	13,660 ± 140	16,090–16,950	AA-79319	Bone (wild sheep)
6 (1985)	16,000 ± 200	18,850–19,810	IM-887**	Bone (unidentified)
6 (1999)****	5865 ± 65***	6500–6850	AA-79318	Bone (musk deer)
7 (1999)	20,720 ± 320	24,170–25,680	AA-79786	Bone (unidentified)
7 (1999)	21,500 ± 775	24,060–27,350	SOAN-4249**	Bone (mammoth)

*IntCal13 data set (see Reimer et al. 2013), with ±2 sigma, and all calibrated intervals are rounded to the next 10 yr and combined.
**These dates are from Stepanov et al. (2003); others were not published previously.
***Outlier.
****Sample was obtained from disturbed layer.

In total, there have been about 17,000 bones found at the Khayrgas Cave (Stepanov et al. 2003). Most of them are too fragmentary for species and genera identification, and only a small fraction (about 6%) can be examined zooarchaeologically. Initially, only a small part of the collection was identified from the excavations of 1985 (Kasparov 1998) and 1998–1999 (Boeskorov 2003). Later on, an additional zooarchaeological study was conducted, and this is why current data are different from previous ones (Table 2).

RESULTS AND DISCUSSION

All ^{14}C dates available for the Khayrgas Cave are given Table 1. Layer 2 can be dated to ~4100 BP, and Layer 4 to ~8100–8200 BP. Archaeologically, Layers 2–3 can be assigned to the Neolithic, and Layer 4 to the Mesolithic (Sumnagin cultural complex), which has numerous ^{14}C dates in the range of ~6000–10,300 BP (Mochanov 2010; see also Kuzmin and Orlova 1998: 40). Layer 5 can be dated to ~13,200–13,700 BP; Layer 6 to ~16,000 BP; and Layer 7 to ~20,700–21,500 BP.

There are some outliers in the ^{14}C date series (Table 1), which can be easily identified due to inconsistencies in general chronology of the site. Some of the samples, such as the one that produced a ^{14}C date AA-79318 from Layer 6, were collected in disturbed strata, and this was not easy to recognize at the time of excavation because of the mixed nature of stratigraphy on the periphery of cave. This value, however, is a clear outlier. Another sample (AA-79322) gave a reasonable ^{14}C date, although it was obtained from the disturbed part of Layer 5.

For archaeozoological purposes, we divided material from the 1985 pit and 1998–1999 pit (Table 2). The reason is that in the 1985 pit the largest disturbance of strata was noted. From the

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Table 2 Mammal bones from the Khayrgas Cave (1985 and 1998–9 excavation campaigns); numbers for each pit correspond to cultural layers.

	1985 pit						1998–1999 pit				
Species	1	2	3	4	5	6	2–3	4	5	6	7
Pike (*Ochotona* sp.)		2	3	2	6						
Mountain hare (*Lepus timidus*)		13	15	9	19	16		22	1	3	2
Squirrel (*Sciurus vulgaris* L.)	13	11	42	19	32	2		33			
Chipmunk (*Tamias sibiricus*)		7	15	6	12	1					
Ground squirrel (*Spermophilus* sp.)		2			3			1			1
Red-backed vole (*Cletrionomys* sp.)								2			
Water vole (*Arvicola terrestris*)	1	6		1	1	1		2			
Grey vole (*Microtus* sp.)								5		1	
Wolf (*Canis lupus*)								4	2		2
Polar fox (*Vulpes lagopus*)										1	2
Red fox (*Vulpes vulpes*)		1			1	4	1	2			
Wolverine (*Gulo gulo*)		1									
Brown bear (*Ursus arctos*)				1						1	1
Sable (*Martes zibellina*)		10	20	12	9	4	2	12		1	
Ermine (*Mustela erminea*)										1	1
Cave lion (*Panthera spelaea*)									2		
Lynx (*Lynx lynx*)								1			
Woolly mammoth (*Mammuthus primigenius*)											1
Red deer (*Cervus elaphus*)				1		1		3		1	1
Roe deer (*Capreolus pygargus*)		5		1	5			3			
Musk deer (*Moschus moschiferus*)										1	
Moose (*Alces alces*)		3						4			
Reindeer (*Rangifer tarandus*)		2			1	8		6	32	3	1
Pleistocene bison (*Bison priscus*)											2
Saiga (*Saiga tatarica*)									1		
Mountain sheep (argali) (*Ovis ammon*)						5					
Siberian snow sheep (*Ovis nivicola*)		1				5			1	1	
Sheep (*Ovis* sp.)					1	5					
Pleistocene horse (*Equus ferus lenensis*)					1	1			3	2	
Woolly rhinoceros (*Coelodonta antiquitatis*)										1	2
Chiroptera gen. indet.		1		1						1	
Mammalia indet., middle size								7	2	1	
Mammalia indet., large size				3				29	17	35	2
Birds (Aves gen. indet.)		79	67		87	38		51	4	5	
Fish (Pisces gen. indet.)		11	17		9			28		10	

1985 pit, mammals from Layers 2–5 belong to the forest and forest steppe ecosystems representative of the Holocene (only extant species), and assemblage from Layer 6 can be correlated with the open landscapes of the final Pleistocene. However, from Layer 6, bones of typical forest species, squirrel and Siberian chipmunk, were identified. These bones have a Holocene appearance, and they were redeposited into older sediments.

From the 1998–1999 excavation pit, two kinds of mammalian complexes can be distinguished. In Layers 2–4, only extant species are known; ecologically they belong to the forest-type

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ecosystem and are ^{14}C dated to ~4100–8200 BP. In Layers 5–7, several extinct species were identified, including cave lion, woolly mammoth, and rhinoceros, and Pleistocene bison and horse. These species correspond to the open and semi-open ecosystems common for the final Pleistocene of Yakutia. According to the ^{14}C data, this complex belongs to the final Late Pleistocene, ~13,200–21,500 BP. ^{14}C dates also confirm the existence of redeposition: bones of musk deer were found in the Pleistocene strata (Table 1, date AA-79318). This could be related to human activity in the Holocene.

Human-modified bones are detected in the Pleistocene Layers 5–6 (1985 pit), Layers 5–7 (1998–1999 pit), and in the Holocene layers of the 1985 and 1998–1999 excavations. Some of the mammal and bird remains have traces of carnivore activity (gnawed bones and digested bone fragments). Thus, bone accumulation in the Khayrgas Cave during the Late Pleistocene and the Holocene was due to activity of predatory mammals and birds of prey (cave lion, wolf, red fox, ermine, and eagle-owl), and humans.

The new data from Khayrgas Cave confirm that it was occupied by humans in the LGM, ~20,700–21,500 BP. Currently, the duration of the LGM was set at ~16,000–22,000 BP, corresponding to ~19,000–26,500 calendar years ago (cal BP) (Clark et al. 2009). The coldest conditions were observed during the GS-3 interval dated to ~23.3–27.5 ka (Rasmussen et al. 2014), which on a ^{14}C timescale is equal to ~19,300–23,300 BP (Reimer et al. 2013). There is growing evidence that humans were well adapted to the cold and dry conditions of Siberia during the LGM (e.g. Kuzmin 2008; Kuzmin and Keates 2016). Recently, new data on the LGM presence of Paleolithic people were published by Pitulko et al. (2015), with several sites in the extreme northern part of eastern Siberia (~70°N) around the pre-LGM Yana RHS site and on the neighboring Yana-Indigirka interfluve (Figure 1), with ^{14}C dates of ~21,300–22,700 BP. Therefore, the occupation of the Khayrgas Cave at ~60°N throughout the LGM does not look unrealistic anymore. The sophisticated bone technology, including the making of eye needles, which were necessary for manufacture of warm cloths, confirms the high degree of adaptation to cold environment. Prey animals were plentiful, and people easily existed during the LGM in the middle course of the Lena River.

CONCLUSIONS

Khayrgas Cave represents unequivocal evidence of human presence in deep continental regions of eastern Siberia (60°N) during the LGM (~20,700–21,500 BP), Late Glacial (~13,100–16,000 BP), and the Holocene (~4100–8200 BP). The inhabitants exploited a wide range of natural resources, including mammals, fish, and birds.

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