# THE PLEISTOCENE PEOPLING OF SIBERIA: A REVIEW OF ENVIRONMENTAL AND BEHAVIOURAL ASPECTS

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*ABSTRACT*

*The Altai Mountains in southern Siberia are one of the prime regions for archaeological investigation in Russia. We present data on the environmental, chronological and technological evidence recorded from major Pleistocene sites in the Altai. These show that hominid populations in this region lived in both forested and open environments, particularly in the Late Pleistocene, and used mainly Mousterian and Upper Palaeolithic technologies for manufacturing stone tools. The Palaeolithic archaeology of the Altai is important for increasing our knowledge of Pleistocene human adaptations in Eurasia, including the issue of the Middle to Upper Palaeolithic transition, the dynamics of human adaptation to higher elevations, and deciphering what significance the Altai may have had in regional Asian hominid dispersal.*

## INTRODUCTION

Siberia is the largest region in the Russian Federation, and ranges from the Ural Mountains in the west to the Bering Strait in the east (60°E-170°W, 50°-75°N). Siberia is here defined as the Asiatic part of the Russian Federation, covered with tundra and conifer forests. The territories of Siberia and the Russian Far East encompass 12,000,000 km$^2$. The patterns of human colonization identified in Siberia are not only important for reconstructing Siberian prehistory, but also for developing models about human dispersal in the Pleistocene and the colonization of the New World. The evidence for human occupation consists of stone artefacts, animal fossils, including humans, and evidence of butchery and fire use. Sites have been dated by radiocarbon, radiothermoluminescence (RTL), uranium-series (U-series), and electron spin resonance (ESR) methods (Table 1). From at least 300,000 years ago, there is evidence for continuous human occupation of the region. Several dozen sites have been investigated in the last 25-30 years, and ten excavated in the Altai Mountains. Among them are the multi-layered and dated sites of Denisova Cave, Okladnikov Cave, Kara-Bom and Ust-Karakol 1. The Altai sites are among the best studied in Siberia in terms of their archaeology, geochronology, palynology and palaeontology. The aim of this paper is to review the evidence for human occupation of Siberia with an emphasis on the Altai Mountain region.

## KEY SITES OF THE MIDDLE AND UPPER PALAEOLITHIC IN THE MOUNTAINOUS ALTAI

We discuss sites in the Mountainous Altai (hereafter, the Altai) that have Middle and Upper Palaeolithic occurrences in a single profile, and we also include a single-component Middle Palaeolithic site. Two of these sites, Denisova and Okladnikov Caves, have yielded human fossils (e.g., Shpakova and Derevianko 2000).

Denisova and Okladnikov Caves and the Ust-Karakol 1 site are located in the northeastern part of the Altai (Fig. 1). Okladnikov Cave is located at an elevation of 315 m above sea level (asl) in the piedmont zone of the Altai Mountains. It lies in the small valley of the Sibiryachikha River, a tributary of the Anui. The entrance of the cave faces south. Denisova Cave lies at 700 m asl and near the right bank of the Anui headwaters. The cave's entrance faces southwest and towards the Anui River. It is located about 100 m from the river and lies 28 m above the river level. Ust-Karakol 1 is an open-air site located at 700 m asl close to the Anui River, about 2 km upstream from Denisova Cave, at the confluence of the Karakol and Anui rivers.

Ust-Kanskaya Cave and the Kara-Bom site are located in the Central Altai (Fig. 1). Ust-Kanskaya is situated at an elevation of 1090 m asl, 150 m from the Charysh River, facing south. The Kara-Bom site is located 60 km from Ust-Kanskaya Cave and 100 km from Ust-Karakol 1 and Denisova Cave. Kara-Bom lies in the Elo depression, with its base at an elevation of 1000-1100 m asl; the surrounding mountains are up to 2300 m high. The site has a southern exposition, and is located about 1 km from the nearest river and close to a permanent spring. Directly behind Kara-Bom the steep rocks protect the site from the prevailing winds.

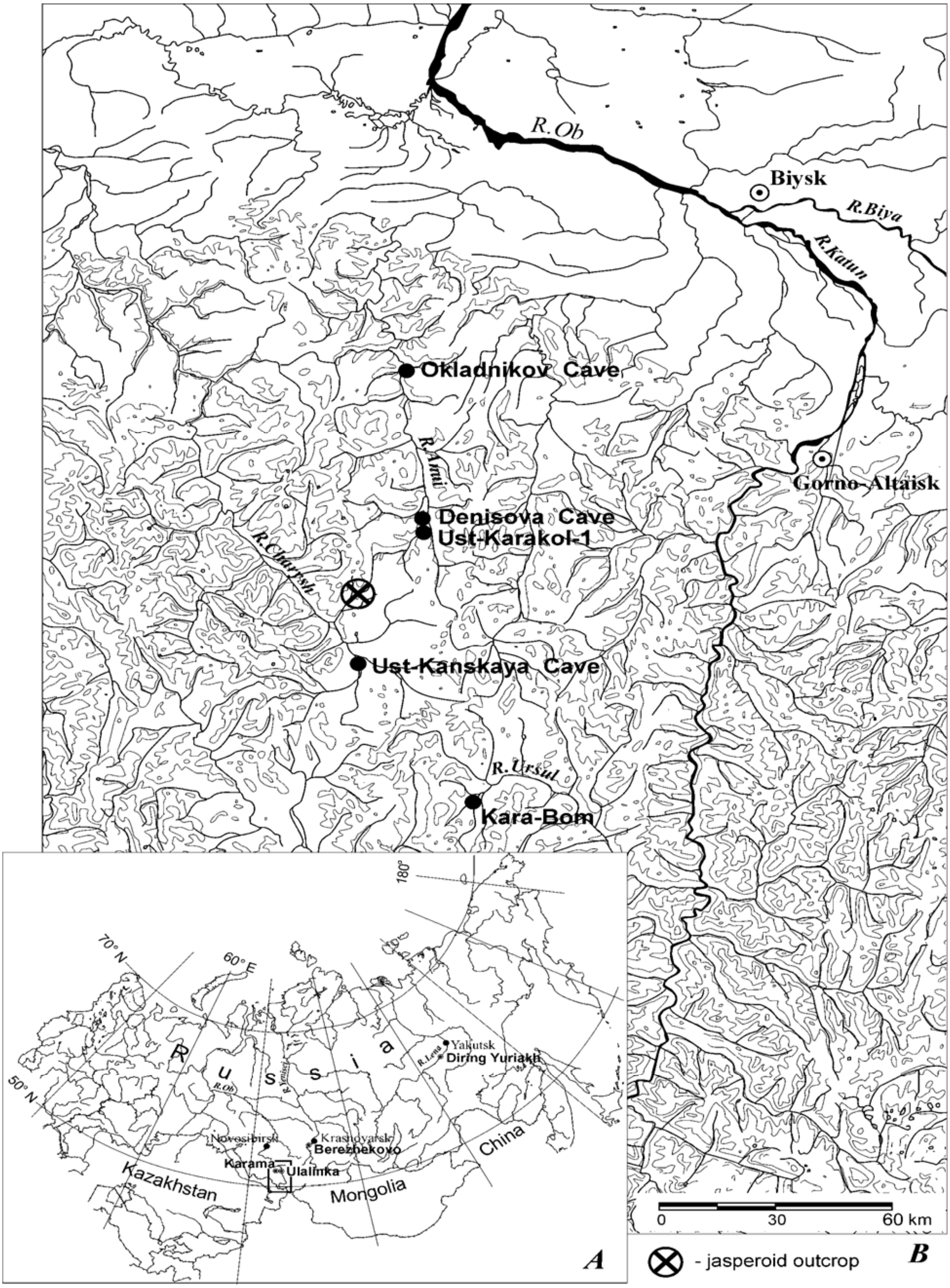


*Figure 1. Palaeolithic localities in Siberia. Inset A shows the Lower Palaeolithic sites of Diring Yuriakh in northeastern Siberia, Berezhekova in eastern Siberia, and Ulalinka and Karama in the Altai.*
*Main map B shows Middle and Early Upper Palaeolithic sites in the Altai. The location of the jasper source used by the Kara-Bom humans is indicated by an asterisk.*

Table 1. Chronometric dates of the Middle and early Upper Palaeolithic sites in the Altai Mountains (southern Siberia) (all dates are uncalibrated)

| Site and layer | Date | Dating method | Lab No. | Material dated | Reference |
|---|---|---|---|---|---|
| **MIDDLE PALAEOLITHIC** | | | | | |
| **Denisova Cave, main chamber** | | | | | |
| layer 22.2 (lower part) | 282,000 ± 56,000 | RTL | RTL-548 | Sediments | Derevianko et al. 1998 |
| layer 22.2 (upper part) | 224,000 ± 45,000 | RTL | RTL-547 | Sediments | Derevianko et al. 1998 |
| layer 22.2 (upper part) | 223,000 ± 55,000 | RTL | RTL-739 | Sediments | Derevianko et al. 1998 |
| layer 22.1 | 182,000 ± 45,000 | RTL | RTL-738 | Sediments | Derevianko et al. 1998 |
| layer 22.1 | 171,000 ± 43,000 | RTL | RTL-737 | Sediments | Derevianko et al. 1998 |
| layer 21 | 155,000 ± 31,000 | RTL | RTL-546 | Sediments | Derevianko et al. 1998 |
| layer 14.1 | 69,000 ± 17,000 | RTL | RTL-611 | Sediments | Derevianko et al. 1998 |
| **Denisova Cave, entrance** | | | | | |
| layer 14 | 163,000 ± 40,000 | RTL | RTL-610 | Sediments | Derevianko et al. 1998 |
| layer 12 | 101,000 ± 25,000 | RTL | RTL-612 | Sediments | Derevianko et al. 1998 |
| layer 10 | 66,000 ± 16,000 | RTL | RTL-549 | Sediments | Derevianko et al. 1998 |
| layer 9 | 50,000 ± 12,000 | RTL | RTL-608 | Sediments | Derevianko et al. 1998 |
| layer 9 | 46,000 ± 2,300 | 14C | GX-17602 | Charcoal | Goebel 1993 |
| **Okladnikov Cave** | | | | | |
| layer 7 | 44,800 ± 4,000 | U-series* | none given | Bone | Derevianko and Markin 1992 |
| layer 7 | 44,600 ± 3,300 | U-series* | none given | Bone | Derevianko and Markin 1992 |
| layer 3 | 38,725 ± 145 | U-series* | none given | Bone | Derevianko and Markin 1992 |
| layer 3 | 43,300 ± 1,500 | 14C | RIDDL-722 | Bone | Goebel 1993 |
| layer 3 | 40,700 ± 1,100 | | RIDDL-720 | Bone | Goebel 1993 |
| layer 3 | 32,400 ± 500 | | RIDDL-721 | Bone | Goebel 1993 |
| layer 3 | 28,470 ± 1,250 | | SOAN-2459 | Bone | Orlova 1995 |
| layer 3 | > 16,210 | | SOAN-2458 | Bone | Orlova 1995 |
| layer 2 | 37,750 ± 750 | | RIDDL-719 | Bone | Goebel 1993 |
| layer 1 | 33,500 ± 700 | | RIDDL-718 | Bone | Goebel 1993 |
| **Ust-Karakol 1** | | | | | |
| layer 20A | 210,000 ± 42,000 | RTL | RTL-640 | Sediments | Derevianko et al. 1998 |
| layer 20B | 207,000 ± 41,000 | RTL | RTL-662 | Sediments | Derevianko et al. 1998 |
| layer 19A | 133,000 ± 33,000 | RTL | RTL-661 | Sediments | Derevianko et al. 1998 |
| layer 18B | 100,000 ± 20,000 | RTL | RTL-659 | Sediments | Derevianko et al. 1998 |
| layer 18A | 90,000 ± 18,000 | RTL | RTL-658 | Sediments | Derevianko et al. 1998 |
| **Kara-Bom** | | | | | |
| layer 9C** | 62,200 | ESR | none given | Bone | Derevanko et al. 1998 |
| layer 9B*** | > 42,000 | 14C | AA-8873A | Bone | Goebel 1993 |
| layer 9B*** | > 44,000 | 14C | AA-8894A | Bone | Goebel 1993 |
| **EARLY UPPER PALAEOLITHIC** | | | | | |
| **Kara-Bom** | | | | | |
| layer 6 | 43,200 ± 1,500 | 14C | GX-17597 | Charcoal | Goebel 1993 |
| layer 5 | 43,300 ± 1,600 | 14C | GX-17596 | Charcoal | Goebel 1993 |
| **Denisova Cave, main chamber** | | | | | |
| layer 11.4 | > 37,235 | 14C | SOAN-2504 | Bone | Orlova 1995 |
| **Ust-Karakol 1** | | | | | |
| layer 10 | 35,100 ± 2,850 | 14C | SOAN-3259 | Charcoal | Derevianko et al. 1998 |
| layer 9C | 50,000 ± 12,000 | RTL | RTL-660 | Burnt sediments | Derevianko et al. 1998 |
| layer 9C | 33,400 ± 1,285 | 14C | SOAN-3257 | Charcoal | Derevianko et al. 1998 |
| layer 9C | 31,580 ± 470 | 14C | AA-32670 | Charcoal | This paper |
| layer 9C | 29,860 ± 355 | 14C | SOAN-3358 | Charcoal | Derevianko et al. 1998 |
| layer 9C | 29,720 ± 360 | 14C | SOAN-3359 | Charcoal | Derevianko et al. 1998 |

*Produced by J.L. Bishoff (U.S. Geological Survey, Menlo Park, CA). **Layer 9C is between Mousterian layers 1 and 2. ***Layer 9B corresponds to Mousterian layer 2.

## THE ENVIRONMENTS OF THE LOWER AND MIDDLE PALAEOLITHIC IN SIBERIA

According to Arkhipov (1999), the earliest human occupation of eastern and northeastern Siberia (for example, Berezhekovo site in the Yenisei River basin) could have occurred during the Tobolian Interglacial (the Mindel-Riss or Holstein in Europe), about 380,000-260,000 years ago, though only a few sites may correspond to this time interval (such as Berezhekovo and Diring Yuriakh) (Fig. 1). More Palaeolithic sites are known for the later periods, especially for the Kazantsevo Interglacial, about 130,000-100,000 years ago. Based on palaeogeographical and geoarchaeological data, we present palaeoenvironmental reconstructions for the glacial and interglacial events in the Middle and Late Pleistocene of Siberia.

In spite of a long history of Quaternary studies in Siberia, only a few environmental reconstructions based on a modern level of research are available for the territories of western, eastern, and northeastern Siberia (cf. Velichko 1984, 1993; Arkhipov 1999). For our purposes, we will use these data as background, along with detailed results of Quaternary environmental studies in western Siberia (Arkhipov and Volkova 1994). For palaeoenvironmental reconstructions of warm interglacial conditions, data from studies of the Kazantsevo Interglacial (Riss-Würm or Eemian in Europe) are available. For the cold glacial conditions, the Ermakovo Glaciation (early Würm or lower Weichselian in Europe) will be considered.

## THE KAZANTSEVO INTERGLACIAL (130,000-100,000 YEARS AGO)

In general, the Kazantsevo Interglacial was the warmest time in the Late Pleistocene of Siberia. The areas covered with tundra and forest tundra were limited to the Arctic coast of Siberia. The characteristic vegetation of most of western, eastern, and northeastern Siberia was either larch or spruce and fir forests (*taiga* type of vegetation). In southwestern Siberia and the Transbaikal, forest steppe and steppe formations occurred.

During the optimal phase of the Kazantsevo Interglacial (130,000-120,000 years ago), forest was the characteristic vegetation of almost all of western Siberia, up to the Arctic coast. On the Arctic coast, the vegetation was birch and spruce forest (Arkhipov 1993). Most of the West Siberian lowland was covered with coniferous forests and some broad-leaved species such as elm, lime and oak. The tundra zone in the north almost disappeared, and the permafrost in the northern areas disappeared completely. The northernmost parts of the West Siberian lowland were inundated by the sea (to about 100 km inland), with the average water temperature being higher than today. South of 56˚ N latitude, forest steppe and steppe formations prevailed. In the Altai Mountains, coniferous forest was the main vegetation type. The average summer air temperatures were up to 5˚ C higher than today and in winter up to 7˚ C higher.

### *The early Zyryanka (Ermakovo) Glaciation (100,000-50,000 years ago)*

This time corresponds to one of the global glaciations, when northern parts of western and central Siberia were covered with continental ice sheets. A similar landscape structure has been identified for the earlier Samarovo Glaciation, 260,000-200,000 years ago (Arkhipov and Volkova 1994:84). In the mountains of eastern and northeastern Siberia, piedmont and mountain-and-valley glaciers occurred. Beyond the ice limits, the main vegetation types in Siberia were tundra and forest tundra, with some light conifer and birch forests in the river valleys. In the southern part of Siberia there were light coniferous forests. The northern part of the West Siberian Plain was covered with ice sheets. South of the ice sheet limit, the vegetation was tundra and forest tundra and the so-called ‘periglacial steppe’. The annual mean temperature was 9-10˚ C lower than at present. In the Altai Mountains, large glaciers of mountain-and-valley type occupied the higher elevated areas of the mountain ranges, and the upper parts of major river valleys.

### *Environment of the earliest human occupation of the Altai*

Over the last decade, significant progress has been made in environmental reconstructions of the earliest Palaeolithic sites in the Altai (Derevianko 2001a; Shunkov and Agadjanian 2000). Here we will concentrate on some of the best-studied sites: Denisova Cave, Ust-Karakol 1, Kara-Bom, and Okladnikov Cave (Fig. 1).

At Denisova Cave, palynological data from the lowest part of the main (or central) chamber (cultural layer 22) shows that birch and pine forests with an admixture of broad-leaved taxa occurred near the site (Derevianko *et al.* 1998:35; Derevianko 2001a:72). The mammal data from layer 22 indicate that the main vegetation was forest, with some large treeless areas occurring at higher elevations. The climate was quite warm and relatively dry, based on a study of the fossil mammals (Shunkov and Agadjanian 2000). In the entrance area (cultural layer 14), the pollen spectra show birch and pine forest vegetation with some broad-leaved taxa (Derevianko *et al.* 1998:45; Derevianko 2001a:72). In the main chamber, two climatic warm periods have been identified based on the large mammal fauna. The first corresponds most likely to the Kazantsevo Interglacial. The second probably corresponds to a warm stage within the Ermakovo (early Late Pleistocene) Glaciation or to the beginning of the Karginian Interglacial (late Late Pleistocene). In the entrance, the large mammal fauna from layer 10 corresponds to a warm climatic phase, which is probably synchronous with the first climatic optimum recognized in the main chamber. The coldest climatic phase was identified in the uppermost part of the cave sediments, and occurred before the Last Glacial Maximum. The majority of the Denisova Cave mammals are from open environments, and others are forest and forest-steppe species (Baryshnikov 1999).

A variety of data were used for palaeoenvironmental reconstructions of Kara-Bom (Simonov *et al.* 1998; Nikolaev 1998; Dergacheva and Fedeneva 2001). The Mousterian layers 1 and 2 correspond to the second part of the Zyryanka Glaciation (treeless cold steppes). The early Upper Palaeolithic layers 6 and 5 correspond to the beginning of the Karginsky Interstadial, with dry steppes as the main vegetation type. The pollen data from the Mousterian layers show mixed coniferous and pine-birch forests, with an admixture of alder, elm, hazelnut, Manchurian nut-tree, and other broad-leaved taxa (Derevianko *et al.* 1998:110-112). The climate was warmer and wetter than now in Mousterian layer 2, and warmer and drier than at present in Mousterian layer 1 (Simonov *et al.* 1998). The mammal fauna from Middle Palaeolithic layer 2 is represented by horse (*Equus* sp.), woolly rhinoceros (*Coelodonta* sp.), goat (*Capra sibirica*), bison (*Bison* sp.), and cave lion (*Panthera spelaea*). Middle Palaeolithic layer 1 has yielded horse, woolly rhinoceros, bison, cave lion, and woolly mammoth. In Upper Palaeolithic layer 6, horse (*Equus* cf. *hydruntinus*), cave hyena (*Crocuta spelaea*), and goat (*C. sibirica*) were documented. In Upper Palaeolithic layer 5 only bison, and in Upper Palaeolithic layers 4-1, goat, bison, and horse were found.

At the Ust-Karakol 1 site, the pollen from the lowest cultural layer 19 reflects a steppe type vegetation, with smaller forested areas of birch and pine, and some broad-leaved taxa (hazelnut, elm, and linden) (Derevianko *et al.* 1998:64; Derevianko 2001a:73). The climate was similar to the present. The large mammal fauna comprises 11 species, and most of these were adapted to open environments of steppe and meadow-steppe. Two species are characteristic of forest and bush, and one of rocky terrain (Baryshnikov 1999).

Palynological data from Okladnikov Cave, cultural layers 3 and 7, show that steppe vegetation occurred near the cave, with a climate warmer than today (Derevianko *et al.* 1998:76).

## THE CHRONOLOGY OF HUMAN OCCUPATION

### Middle Pleistocene sites: Lower Palaeolithic

Derevianko (2001a, b) proposed several waves of human colonization across northern Eurasia, the first one at about 800,000 years ago and a second wave at about 300,000 years ago. A third wave occurred after 300,000 years ago, further to the north and east (Yakutia and the Arctic Coast), with a much wider spread than in previous times.

In the Altai, there is evidence of human presence in the Lower Palaeolithic at the Ulalinka and Karama sites. However, the chronological data for the Ulalinka site remain disputed (Kuzmin 2000), while the age of the Karama site, discovered in 2001 (Derevianko *et al.* 2001), has yet to be determined.

Two Lower Palaeolithic sites in eastern and northeastern Siberia have chronometric information: Berezhekovo and Diring Yuriakh (Fig. 1). Age determination is problematic for both. At Berezhekovo, thermoluminescence (TL) dates of 130,000±10,000 years above the cultural layer, and 540,000±12,000 years below the cultural layer were obtained (Arkhipov 1999). However, from neither the text nor the illustration published by Arkhipov (1999: Fig. 4) is it clear how the TL dates relate stratigraphically to the layers with artefacts. At Diring Yuriakh, an open air site in central Yakutia, the 370,000 - 270,000 year determinations by TL dating (Waters *et al.* 1999; Carlson 2001) are substantially younger than the 2.5 - 1.8 myr RTL date proposed by Mochanov (1992). Furthermore, there is still doubt about the direct association of the artefacts and the samples taken for dating (Kuzmin 2000:33-35).

The Lower Palaeolithic artefact assemblages from sites of known age in adjacent parts of Central Asia allow us to suggest that the initial peopling of Siberia could have occurred as early as 800,000 years ago and possibly earlier. There is sporadic evidence for a human presence in Siberia in the Lower Palaeolithic, but there are still not enough data to make reliable reconstructions of the initial human colonisation of this region.

### MIDDLE AND LATE PLEISTOCENE SITES: THE MIDDLE PALAEOLITHIC AND MIDDLE TO UPPER PALAEOLITHIC TRANSITION

In the Altai there are several well-excavated Middle Palaeolithic sites. They include cave sites, such as Ust-Kanskaya, Denisova, Strashnaya, Okladnikov, and open-air sites, such as Kara-Bom, Ust-Karakol 1 and 2, and Tumechin 1 and 2. Chronometric data are available for the Denisova and Okladnikov caves and for Ust-Karakol 1 and Kara-Bom (Table 1).

Denisova Cave is the earliest Middle Palaeolithic site in Siberia which is chronometrically dated (Derevianko *et al.* 1998). The main chamber has a horizontal cave surface with an area of approximately 120 $m^2$. Apart from the main chamber, excavations were also conducted in the entrance area. It should be mentioned here that there is no direct stratigraphic correlation between the layer numbers in the main chamber and the entrance. In the main chamber, the RTL date for layer 22 (the lowermost part of the cave) is c.282,000 years ago (Derevianko 2001a). The youngest RTL date for the Mousterian at Denisova Cave is c.69,000 years ago from layer 14 (Table 1). However, analysis of the small mammal fauna from layer 22 indicates that the ages of these layers cannot be older than the beginning of the Late Pleistocene (Shunkov and Agadjanian 2000: 13; Baryshnikov 1999), and further work is needed to resolve this controversy (Derevianko 2001a:76).

The earliest occupation of Kara-Bom occurred at c.43,000 BP based on C14 dates. The Middle Palaeolithic layer 1 is dated to >42,000 BP and >44,000 BP and the Early Upper Palaeolithic to c.43,200 BP (layer 6) and c.43,300 BP (layer 5). An ESR date is also available for Kara-Bom (Astashkin *et al.* 1993; Goebel *et al.* 1993; Derevianko *et al.* 1999; Table 1).

At Ust-Karakol 1, there are two excavation areas (1986 and 1993/97 campaigns) and these have different stratigraphies and layer numbers. The Mousterian layers have a sequence of RTL and C14 dates (Table 1). The earliest Upper Palaeolithic is C14 dated to c.35,100 BP (layer 10). The youngest RTL date is 50,000±12,000 for layer 9C (Table 1).

U-series dating has been conducted for Okladnikov Cave layers 3 and 7. The U-series dates (Derevianko and Markin 1992; Derevianko *et al.* 1998) correspond to the C14 dates of layer 3 (layer 7 has not been radiocarbon dated). The range of C14 dates for Okladnikov Cave is c.43,000-28,500 BP (Table 1).

## MIDDLE AND UPPER PALAEOLITHIC TOOL TECHNOLOGY IN THE ALTAI

In Denisova Cave, the basal archaeological layers are layers 22 and 21, followed by layers 20-12 with typical Mousterian assemblages. In layer 11, the Early Upper Palaeolithic occurs with rare Levallois artefacts, together with five stone pendants and beads, and 32 bone tools, including needles, a borer/point, and an animal tooth pendant. Manufacturing marks are visible on the bone pendants, a fragment of a ring made of mammoth ivory, a bead manufactured on a large mammal rib with evidence of ‘cut marks’; stone pendants with biconically drilled holes, and beads of pyrophalite and clay shale. Layer 9 is the last Upper Palaeolithic and Pleistocene layer. Bone tools include a needle, a distal fragment of a borer, a deer tooth pendant, a thin piece of mammoth ivory with an artifically made hole, and a thin fragment of mammoth ivory with a series of parallel incisions (Derevianko *et al.* 1998).

The Ust-Kanskaya Cave sediments can be easily correlated with those of Denisova Cave. The Mousterian tradition is represented in layers 10 - 3. However, the Upper Palaeolithic component, which appears for the first time in layer 5 and continues to layer 1, is represented by significantly fewer artefacts compared to the Middle Palaeolithic, reflecting less intensive use of the cave. For example, only a few microblades were found. More precise correlation of the Ust-Kanskaya and Denisova cave sediments can be made on the basis of the small mammal composition (Agadjanian *et al.* 2002).

Similar to the Denisova Cave stone industries, sandstones were the most common raw material used at Ust-Karakol 1 for the manufacture of points, denticulate tools, and to some extent Levallois spalls. Most unstandardised tools were also made of sandstone. This might mean that sandstone was used for the manufacture of tools which were used for short-term and single operations, and did not require much time to produce. Although in the neighbouring territories of the Altai the use of local high-quality raw material is documented at contemporaneous Palaeolithic sites, the Ust-Karakol 1 bearers preferred to use the local material, which was less easy to knap (Postnov *et al.* 2000).

The Mousterian assemblages at Ust-Karakol 1 include manufacturing debitage and tools. A significant number of tools were made on spalls with cortex, or so-called primary spalls, and demonstrate the use of the natural faceting of rock fragments. The preference for so-called ‘primary spalls’ indicates a high level of economic planning during the decision-making process about the selection of raw materials, with maximal use of natural forms and minimization of activity during tool production. These spalls include flake tools with and without shape retouch (Fig. 2). Most of the retouched blades have cortical dorsal faces. On retouched flakes one edge only was used (Fig. 2A:1-17), and the flat cortex of the sedimentary rocks was exploited. It should be noted that not only natural facets but also ridges of sedimentary rocks were used in the process of tool manufacture. In such cases, the cortex played the function of controlling the form of the tool surface, which can be observed on several racloirs made on aleurite (Fig. 2A:5) and oligomictic sandstone (Fig. 2A:7), for example. Porphyric rock cortex most commonly was used as a facet for retouched blades, pointed tools (Fig. 2B:21, side scrapers (Fig. 2B:23, racloirs (Fig. 2B: 24, 27), and denticulate tools (Fig. 2B:25). The natural surface was rarely used for the manufacture of racloirs (Fig. 2B:19, 20). It should be emphasized that, on all of the tools, cortex is present only on fine-grained raw materials.

The development of stone tool technocomplexes at Kara-Bom can be traced in a clear stratigraphic sequence, and has been studied for the Middle and early Upper Palaeolithic (Derevianko *et al.* 2000) (Fig. 3). The main changes were traced for the primary reduction: the transition from the Levallois technology, represented by flat-faced cores for making blades and points, to the serial reduction of blanks from prismatic and narrow-faced cores in the Upper Palaeolithic layers. In the lowest Upper Palaeolithic layers 6 and 5, there are also traces of hearths. In layer 5, dated to c.43,000 BP (see Table 1), there are non-utilitarian items, such as a pendant made on a tooth and a drilled bone found with a reddish-brown mineral (goethite), undoubtedly brought to the site by humans (Derevianko and Rybin 2003).

A large outcrop of high quality effusive (lava) raw material occurs about 4-5 km from Kara-Bom, at a height of 1300-1500 m asl. Throughout the Kara-Bom occupation, local raw material was predominantly used. However, some changes can be observed. The amount of waste from primary reduction with cortex varies significantly in different layers, from 29.8% in the Middle Palaeolithic to 13.1% in Upper Palaeolithic layer 6 (Fig. 4C), suggesting that by this time primary reduction occurred mostly outside of the excavated area. Mountain and valley glaciation in the Middle Palaeolithic made access to the main sources, located on the slopes covered with glaciers, difficult. At this time, the main source was material from the alluvial deposits. During the Karginsky Interstadial, access to the bedrock source became easier, and the amount of unworked material brought to the site decreased. This is clear from a study of the degree of cortex preservation (N.A. Kulik, pers. comm., 2002). The main activity was at the sources of raw material and not at the site. Other evidence of use intensification of raw material sources is the appearance of exotic stone such as jasper in Upper Palaeolithic layers 6 and 5, with the

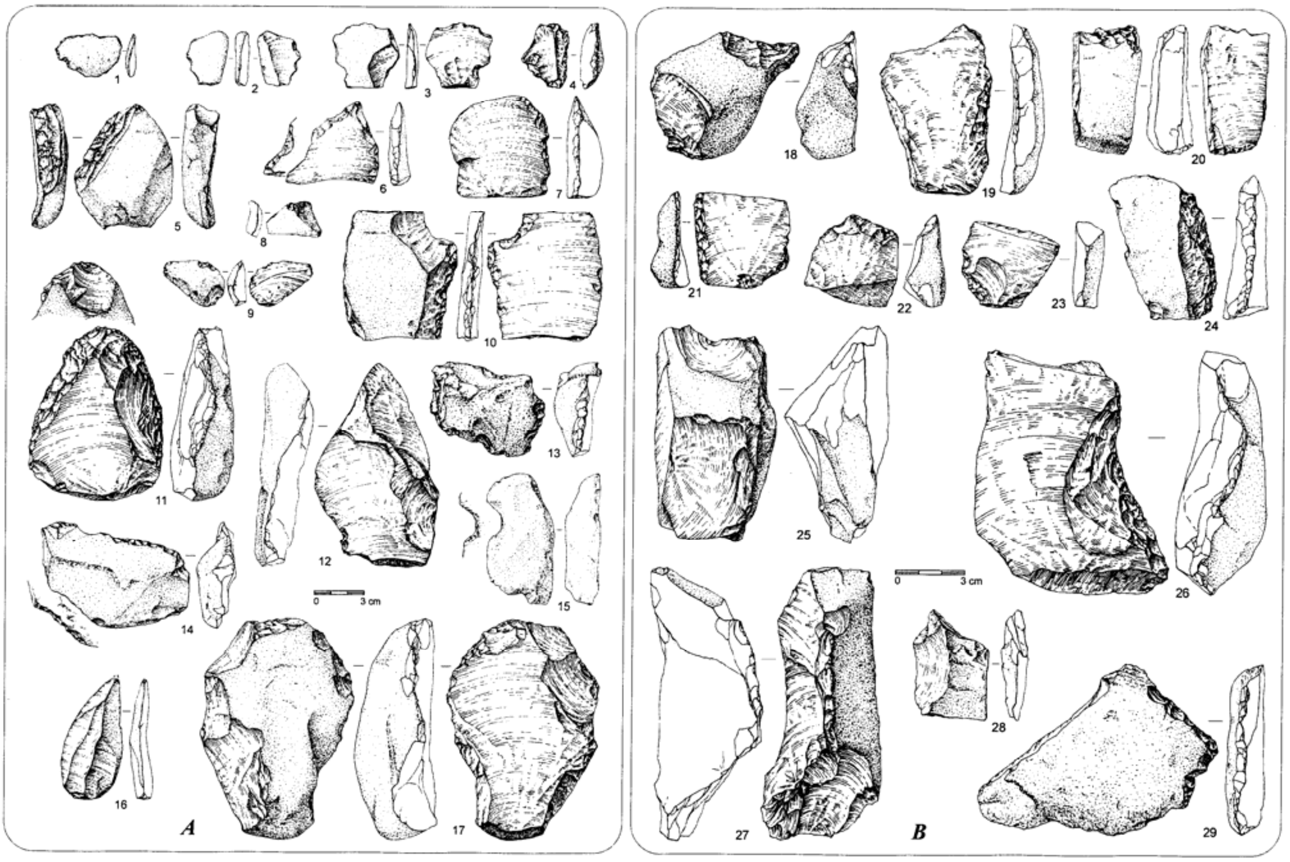

*Figure 2. Characteristic artefacts from the Ust-Karakol 1 site.*
*A. Tools retaining pebble cortex on sedimentary and metamorphic rocks. 1. Stratum 9B, notch (arkosic sandstone); 2. Stratum 19 A, denticulate tool (arkosic sandstone); 3. Stratum 9C, notch (sandstone); 4. Stratum 18A, side-scraper (sandstone); 5. Stratum 9C, racloir (aleurolite); 6. Stratum 10, tool with a spur (sandstone); 7. Stratum 9C, racloir (sandstone); 8. Stratum 11C, retouched flake (aleurolite); 9. Stratum 18A, retouched flake (aleurolite); 10. Stratum 8, racloir (aleurolite); 11. Stratum 10, racloir (aleurolite-sandstone); 12. Stratum 11B, beak-shaped tool (aleurolite with admixture of sand); 13. Stratum 9C, racloir (hornfels); 14. Stratum 9C, racloir (aleurolite-sandstone); 15. Stratum 19A, notch (hornfels); 16. Stratum 11A, atypical point (sandstone); 17. Stratum 5, racloir (sandstone).*
*B. Tools retaining pebble cortex on effusive rocks. 18. Stratum 9C, massive tool with a spur, porphyrite; 19. Stratum 18A, racloir of effusive rock; 20. Stratum 4, fragment of a racloir, effusive rock; 21. Stratum 9C, retouched blade, effusive rock; 22. Stratum 3, tool with a spur, effusive rock; 23. Stratum 16, side scraper, effusive rock; 24. Stratum 18A, racloir, effusive rock; 25. Stratum 9C, notch, effusive rock; 26. Stratum 10, racloir, effusive rock; 27. Stratum 18A, racloir, effusive rock; 28. Stratum 3, tool with a spur, effusive rock; 29. Stratum 13, tool with a spur, effusive rock.*

nearest source located at 80 km distance from Kara-Bom in the basin of the Talitsa River, a tributary of the Charysh River (Fig. 1).

The degree of core utilization at Kara-Bom is very high. Furthermore, the ratio of tools to cores and debitage is unusually high, up to 39% in Middle Palaeolithic layer 1 (Fig. 4B), and this may be associated with assumptions about hunting activity in the vicinity of the site. The tool assemblage can be subdivided into specialized tools (retouched points, scrapers, burins, borers, and combination tools), and non-specialized tools (spalls with episodic and regular retouch, denticulate and denticulate-notched tools) (or, informal and formal tools, *sensu* Andrefsky 1994, 1998; Fig. 4C). If we assume that a higher frequency of specialized tools reflects a high level of residential mobility, and consequently A high percentage of non-specialized tools means low residential mobility, the Kara-Bom occupants should be considered as highly mobile. Use-wear analysis shows a continuous prevalence of butchery activity: the frequency of knives used for cutting meat in Middle Palaeolithic layer 2 is 87% of the total number of tools, and in Upper Palaeolithic layer 6 it is 79%. The number of scrapers for working hide in Upper Palaeolithic layer 5 is 25% (Volkov 1998).

Beyond the Altai, the closest analogues of the Kara-Bom tool assemblage can be found in the Obi-Rakhmat grotto in Central Asia (Derevianko *et al.* 2001), in the Near Eastern Initial Upper Palaeolithic (Kuhn *et al.* 1999), and in the Central European Bohunician industries (Svoboda and Skrdla 1995).

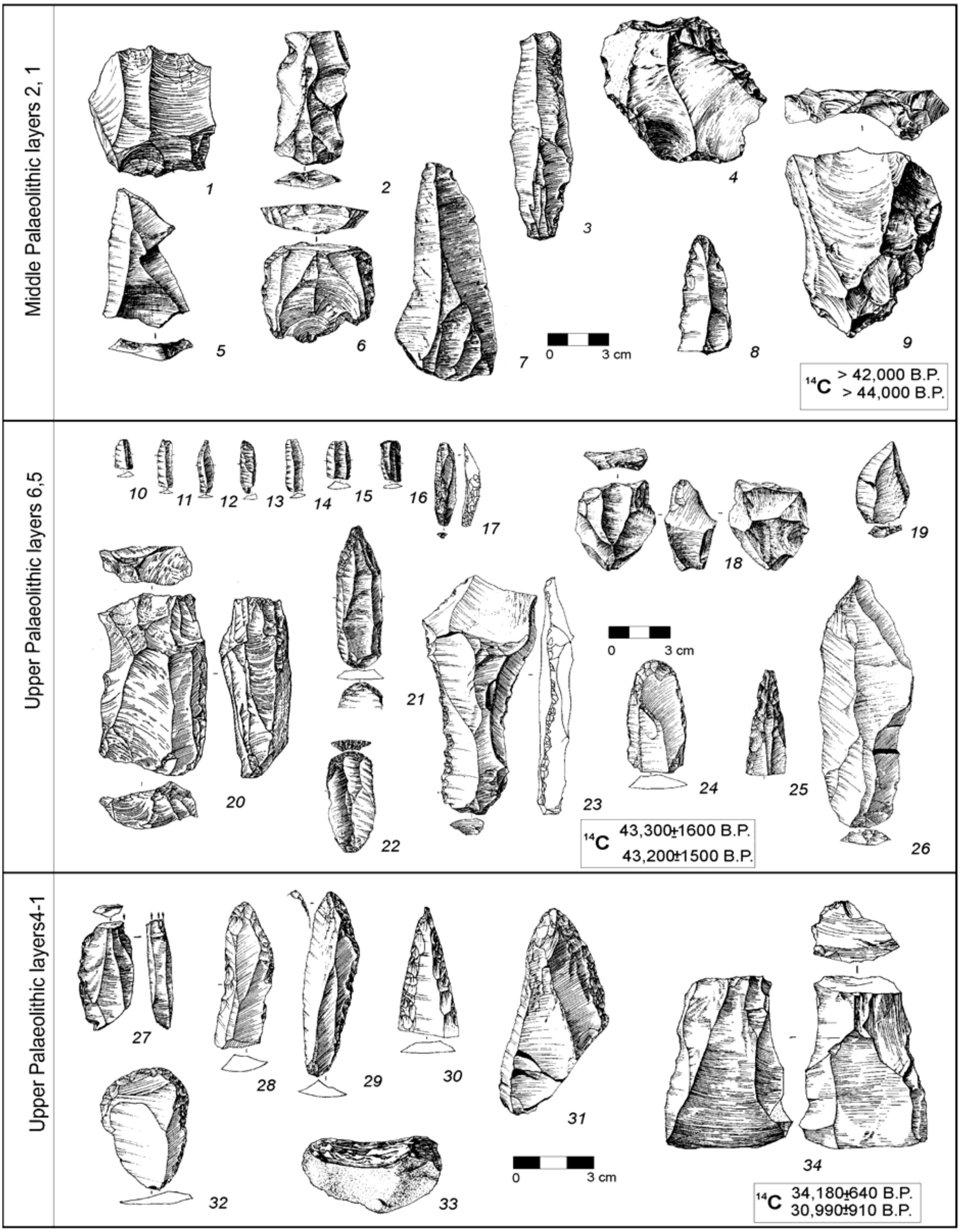


*Figure 3. Some characteristic artefacts from the Kara-Bom site.*
*Middle Palaeolithic layers 2, 1: 1 and 9, cores; 2 and 3, blades; 4 and 6, sidescrapers; 5, 7 and 8, points.*
*Upper Palaeolithic layers 6, 5: 10-16, microblades; 17, crested blade; 18 and 20, cores; 19, 21 and 25, points; 22 and 24, endscrapers; 23 and 26, blades.*
*Upper Palaeolithic layers 4-1: 27, burin; 28-30, points; 31 and 33, sidescrapers; 32, endscraper; 34, core.*

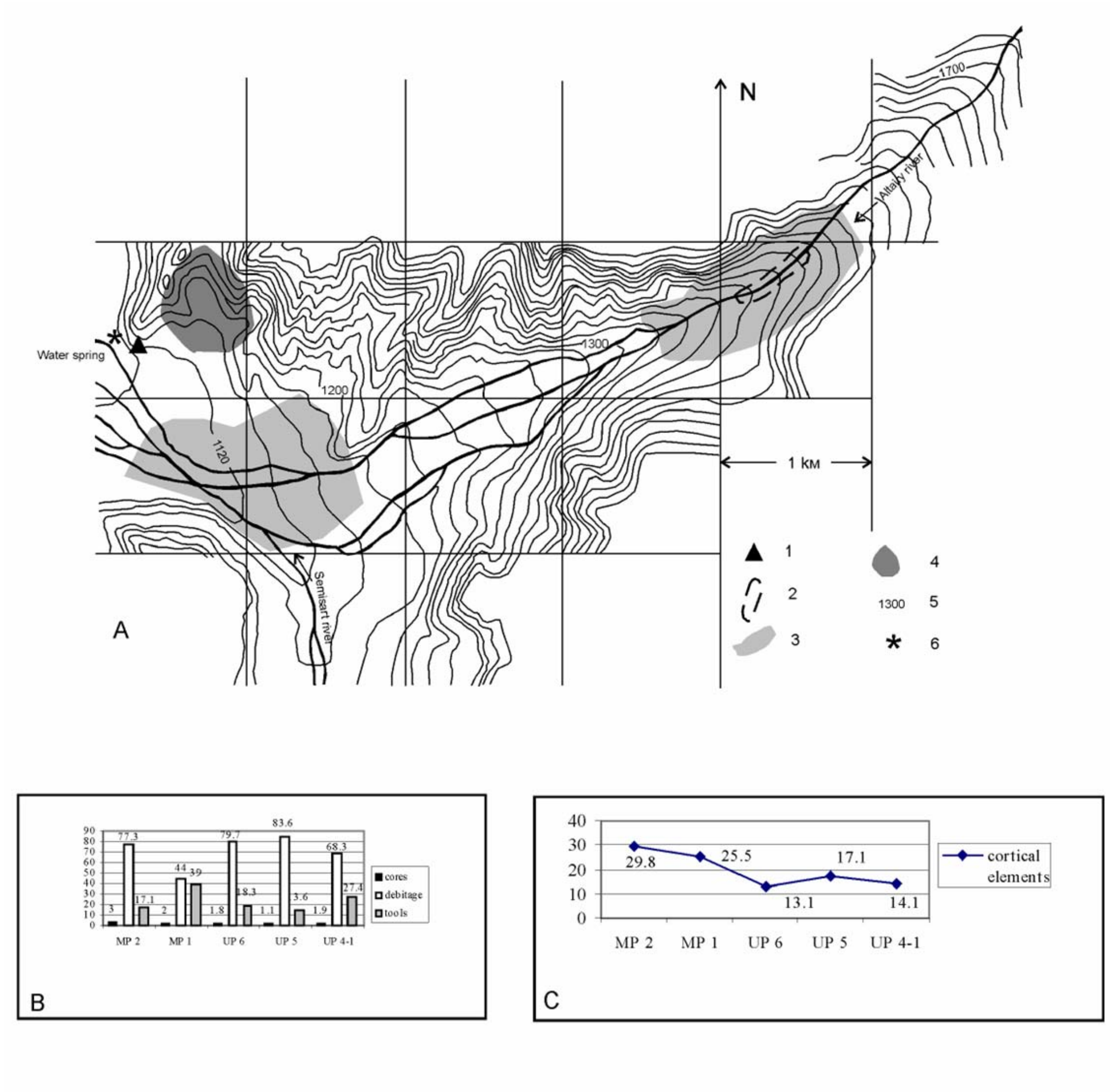


*Figure 4. The Kara-Bom site. A. The Kara-Bom site in landscape context: 1. Kara-Bom site; 2. accumulation of boulders from washed-out moraine; 3. raw material source and hypothetical areas of raw material acquisition; 4. hypothetical hunting area; 5. elevation in metres above sea level; 6. spring. B. Tool kit composition of the Kara-Bom site by layer (in percent). C. Frequencies (in percent) of waste from primary reduction with cortex in the Kara-Bom assemblage, by layer. MP is Middle Palaeolithic, UP is Upper Palaeolithic.*

Most of the stone artefacts from Okladnikov Cave are made on flakes. The tool inventory consists mainly of Mousterian points, denticulate tools, notches, knives, end and side scrapers, perforators, and retouched flakes (Derevianko 1998: 97), and is typical of Mousterian assemblages for southern Siberia.

## SUBSISTENCE IN THE ALTAI

The Altai sites are located near rivers and in valleys in strategically important places in terms of looking out for potential animal prey (Baryshnikov 1999). People appear at Denisova Cave for the first time at the end of the Middle or at the beginning of the Late Pleistocene. Humans used the cave as an occasional occupation site. The cave at this time served as a refuge for a colony of bats, for wintering bears, and as a shelter for other predators. The frequency of human occupation increased when the warm climate of the Kazantsovo Interglacial promoted colonization of the southern areas of western Siberia by groups of Mousterian hunters. However, people did not live in the cave constantly during this time. Predators, especially cave hyena, continued to use the cave as a den. The cave became especially attractive to humans in the coldest periods of the Late Pleistocene. At this time we have evidence for fire use, such as burnt bones, and other human activities, including stone and bone tool manufacture and bone ornaments.

As regards the hunting strategy, Baryshnikov (1999) has suggested that in winter people hunted both small and large ungulates; these were the most numerous animals in the vicinity of the site. Humans may have, for example, selected rutting male rams weakened by strong snowfalls. In summer time people probably collected plants, small mammals, and perhaps fish. The zooarchaeological data from Denisova Cave and Ust-Karakol 1 do not show essential differences between Middle and Upper Palaeolithic food strategies. It should, however, be noted that cut marks have been identified on the Upper Palaeolithic bones and this might indicate an increased role of hunting in human subsistence strategy. Most of the bones from Denisova cave are very fragmentary, and only about 15 cut marks have so far been identified in the main chamber (Baryshnikov 1999:57).

Small and medium-sized ungulates were introduced by humans into the cave as either whole or almost whole carcasses, while the larger animals were butchered away from the cave and only their most meat-rich parts were taken to the cave. The major agent responsible for the fragmentary condition of the bones were carnivores rather than humans according to Baryshnikov's (1999) taphonomic studies, based on the identification of gnaw marks and regurgitated fragments (acidic corrosion), including those from hyena coprolites. Carnivores represent the major faunal group at Denisova (11-12 species) and include one hyena species (*Crocuta spelaea*) (Baryshnikov 1999). Cut marks on bones of small to large sized ungulates show that at least some ungulates were butchered by humans (Baryshnikov 1999). There is no direct evidence for hunting of any animals. Fish remains could have been introduced by bears (but see below).

Two kilometres from Denisova, the taphonomic pattern of Ust-Karakol 1 is substantially different (Baryshnikov 1999). Bones are more complete and carnivores less numerous. This applies especially to the Lower Mousterian layer. Based on the death profile and the ratio of skeletal elements, human and non-human predators were responsible for the accumulation of large (bison, yak, and horse) and small to medium sized ungulates (goat, red deer and sheep) at Ust-Karakol 1 (Baryshnikov 1999). Most fossils are from adult individuals, and none are from old individuals (total NISP=107). Very young and subadult fossils are uncommon and show evidence of processing by hyenas. The age profile of large ungulates indicates bone accumulation by humans. Based on the lack of acid corrosion of deciduous horse teeth, horses do not appear to have been processed by hyenas and we assume that humans killed and transported them to the site. Only selected, meat-rich bones of larger animals were brought to the site by humans (Baryshnikov 1999). Frequencies of MNI cannot be calculated because of the fragmentary state of the fauna.

Most carpals, metapodia, and phalanges found at Ust-Karakol 1 are from small sized mammals; these bones are rare for larger mammals. The composition of skeletal elements indicates that small mammals were introduced to the site as whole carcasses (Baryshnikov 1999). The abraded state of the deciduous teeth of maral deer (*C. elaphus*) and horse, and the shed antlers of deer, indicate that some animals were killed in summer and autumn. The composition of skeletal elements identifies Ust-Karakol 1 most probably as a seasonal hunting camp. This is not contradicted by use-wear analysis of the tools from layer 10. P.V. Volkov’s (pers. comm., 1998) study of 300 artefacts identified traces of use on several specimens, including soft tissue (meat).

The permanent spring adjacent to Kara-Bom may have attracted animals, with access through the low pass 0.3 km from the spring. The source of this spring is surrounded by steep slopes in the shape of an amphitheatre. At the same time, even though raw material procurement and subsistence activity indicate a high degree of hominid planning activity, the composition of the fauna (see above) indicates that there was no specialization on a particular kind of prey. There was a slight preference of mountainous and steppe species. The degree of bone preservation is low (probably due to the chemical composition of soils). Many of the bones have traces of burning, which indicates that the prey was utilized directly at the site.

Mammal remains from Okladnikov Cave layers 7 and 3 include horse (29.5%), cave hyena (15.9%), fox (9.7%), goat/sheep (*Capra sibirica* / *Ovis* cf. *ammon*) (9.3%), woolly rhinoceros (7.1%), bison (6.2%), red deer (2.5%), and other species such as wolf, brown bear, cave lion, and woolly mammoth. Birds include mainly blackcock, pigeon, jackdaw, corncrack, and quail, with a few remains of white owl and ptarmigan (Derevianko and Markin 1992:82-83). It has been suggested that people hunted horse, goat, woolly rhinoceros, bison and red deer. For layer 7, the numerous fish remains (ribs, vertebrae, and scales) indicate fishing activity (Derevianko and Markin 1992:207). Fish bones have also been documented in the Mousterian layers of Ust-Kanskaya Cave. The fish remains are of particular interest, also in view of studies which found that aquatic resources did not constitute an important part of the human diet in Europe until the mid-Upper Palaeolithic (Richards *et al.* 2001).

## CONCLUSION

Forests with abundant mammalian resources allowed prehistoric people to settle permanently in the lower mountains of the Altai by at least 300,000 years ago. It was particularly in the more northern latitudes of Eurasia that humans had to deal with warm and cold climatic fluctuations and the consequences in terms of food availability. The Altai, covered with forest and forest-tundra, was a refugium for conifer and some broad-leaved species. The environmental conditions for human existence in the Altai Mountains in the early to middle Late Pleistocene were quite favourable.

Raw material is available from many outcrops in the region, and also in rivers and streams. Study of the petrophysical properties of the lithic raw materials, and the ratio of tools with cortex to those without from the Altai, suggest that ancient humans in the Middle and Upper Palaeolithic selected occupation places with the most suitable opportunities for hunting rather than for obtaining the raw material. The accumulated data show that when raw materials were not of high quality, or when access to them was restricted due to snow cover, people were still able to find them. This emphasizes the high adaptive abilities (intellectual rather than physical) of ancient humans, already developed in the Middle Palaeolithic.

For ancient populations in the Middle and Upper Palaeolithic, high mobility was typical. However, the size of the home range at the beginning of the Upper Palaeolithic, as is evident from the data on raw material sources, increased, also due to favourable natural conditions. The developed river network of the Altai was favourable for long-distance human migration (Fig. 1). The river valley setting shows a developed network of sites with different kinds of human activity throughout the Middle and Upper Palaeolithic. In the Altai, the Upper Palaeolithic appears to have developed directly from the Middle Palaeolithic about 43,000 BP (Derevianko 2001a; Derevianko *et al.* 2000). Characteristic features of the Altai Upper Palaeolithic include the microblade technique, high-backed scrapers, and burins. In general, land use changed toward intensification and greater complexity in the Upper Palaeolithic. Non-utilitarian items and new types of material treatment, such as drilling, also appeared in the Upper Palaeolithic. There is also evidence of the use of goethite as pigment. The repeated occupation of the Kara-Bom site indicates a high level of comprehension and planning by the ancient people in their subsistence strategy.

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