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# The middle to upper paleolithic transition in Siberia

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# THE MIDDLE TO UPPER PALEOLITHIC TRANSITION

# IN SIBERIA

A

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THE MIDDLE TO UPPER PALEOLITHIC TRANSITION IN SIBERIA

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# Abstract

This dissertation presents results of recent research in Siberia directed at (1) developing an accurate archaeological chronology for the mid-Upper Pleistocene of Siberia (chiefly through accelerator radiocarbon methods), and (2) defining and characterizing the region's Middle to Upper Paleolithic transition.

Eleven Middle Paleolithic sites are now known from southwest Siberia. Relative age estimates of these cultural occupations range from the Last Interglacial (oxygen-isotope substage 5e, 128,000-118,000 years ago) to the mid-Middle Pleniglacial (oxygen-isotope stage 3, 50,000-40,000 years ago). Associated lithic industries are Levallois and Mousterian. Middle Paleolithic interassemblage lithic variability is hinged on the differential production of Levallois points and Levallois flakes, and the intensity of side scraper reduction. Hominid remains from two sites, Denisova Peshchera and Peshchera Okladnikov, appear pre-modern and exhibit affinities to Neanderthals from southwest Asia.

At least 15 sites have been assigned to the Siberian early Upper Paleolithic. Radiocarbon dates range from 42,000 to 30,000 years ago. Occupations at Kara-Bom (component IIa), Makarovo-4, and Varvarina Gora predate the effective range of radiocarbon dating (40,000 years ago), and may be considerably older than radiocarbon dates suggest. Initial Upper Paleolithic industries are characterized by the detachment of blades from "flat-faced" parallel blade cores, the absence of Levallois techniques, the presence of bifacial and burin secondary reduction technologies, and tool kits with end scrapers, angle burins, wedges, gravers, bifacial knives, and slender retouched points on blades. Also occurring for the first time are worked bone, ivory, and antler points, awls, and needles, pendants and other items of personal adornment, and rare examples of mobiliary art. Diagnostic hominid fossils are absent.

The Middle to Upper Paleolithic transition involved dramatic and multi-faceted changes in tool technologies and tool forms. Patterns of change are discrete rather than discontinuous; no transitional industries have been identified. Stratigraphic evidence indicates rapid succession from one technocomplex to the other. This evidence supports population replacement rather than continuity for the origins of the Siberian Upper Paleolithic. Whether this event also signals the appearance of modern humans in this and surrounding areas of inner Asia must await additional hominid fossil discoveries.

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This dissertation is dedicated to the memory of

Demitri B. Shimkin

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# CHAPTER 1

## Introduction

Few topics in anthropology have generated more debate than the origins and dispersal of modern humans (Aitken et al. 1993; Brown 1990; Day et al. 1986; Fagan 1990; Mellars 1990; Mellars and Stringer 1989a; Smith and Spencer 1984; Stringer and Andrews 1988; Trinkaus 1989a). This interest has been stimulated, in part, by the discovery of new fossil and archaeological evidence (Bräuer 1989; Mellars 1989a), and the development of new methods in molecular biology for estimating dates of phylogenetic divergence (Cann et al. 1987; Stoneking and Cann 1989; Wilson et al. 1985). This Upper Pleistocene event involved two distinct but related components: (1) the biological evolution from anatomically archaic to anatomically modern humans; and (2) a number of shifts in hominid behavior commonly correlated with the Middle to Upper Paleolithic transition, including the emergence of mobiliary art, complex hunting technologies, and the true logistical procurement of megafauna.

### OBJECTIVES AND ORGANIZATION OF THIS STUDY

Recent archaeological excavations of a series of mid-Upper Pleistocene sites in Siberia, in conjunction with warming East-West political relations, created a unique opportunity to bring together important Paleolithic archaeological information from a poorly known area of Asia and to further our understanding of the origins and dispersal of modern humans. Siberia, contained within the bounds of the Russian Federation, lies completely above 50° N latitude (Fig. 1.1), and offers a view of mid-Upper Pleistocene human evolution from one of the northernmost outposts of both Middle Paleolithic and early Upper Paleolithic cultures.

This report describes the results of an analysis of 22 lithic assemblages from 14 Siberian Middle and early Upper Paleolithic sites dating to before 30,000 B.P. The major goals of this analysis are twofold: (1) to document the mid-Upper Pleistocene archaeological record of Siberia; and (2) to describe and characterize the Siberian Middle to Upper Paleolithic transition and its implications for understanding the emergence of modern humans in this region of Asia.

This study offers what to some will be their first glimpse of Paleolithic archaeology in Siberia. For this reason, it is detailed and descriptive. Chapter 2 reviews Upper Pleistocene climate, vegetation, and geography, and presents a regional chronostratigraphic framework based on loess and paleosol sequences, which, due to inadequate absolute dates, remains tenuous. In Chapter 3, 32 Middle and early Upper Paleolithic sites are profiled. These sites are located in south Siberia, between 50° and 60° N latitude, and are scattered from the Altai in southwest Siberia to the Transbaikal in southeast Siberia (Fig. 1.1, 1.2). Each site profile is based on published descriptions and contains information on site location, gemorphologic and stratigraphic context, integrity, and age, as well as brief characterizations of artifact assemblages, faunal inventories, features, and other aspects of site structure.

A major objective of this work is to create a firm regional site chronology for the mid-Upper Pleistocene. As discussed in detail in Chapter 4, past attempts at dating the Siberian Middle and early Upper Paleolithic relied almost exclusively on conventional radiocarbon methods, which repeatedly have proven problematic and controversial. Many sites were conventionally dated using bone collagen or apatite, and even when wood charcoal was available, small samples were often combined to obtain amounts required for conventional dating. The result: a number of spurious, often misleading age determinations. In order to overcome these chronological problems, AMS $^{14}C$ methods were applied to charcoal and bone samples from 12 Middle and early Upper Paleolithic sites from the region. In Chapter 4, these new dates are presented, and a new absolute chronology for the Siberian Middle and early Upper Paleolithic is constructed.

The main focus of this study is on describing the mid-Upper Pleistocene period in Siberian prehistory and monitoring change across the Middle to Upper Paleolithic transition through an analysis of lithic technologies and tool kits. In Chapter 5, methodological issues are discussed, including observational and statistical methods. The methods presented attempt to overcome the acknowledged shortcomings of some of the past studies of the Middle to Upper Paleolithic transition in Europe. An important methodological improvement advanced here is the use of a standardized and comprehensive approach to describing lithic assemblages. In contrast to formal typological approaches, lithic assemblages are characterized in terms of tool manufacturing systems, including primary reduction technologies, secondary reduction technologies, and tool

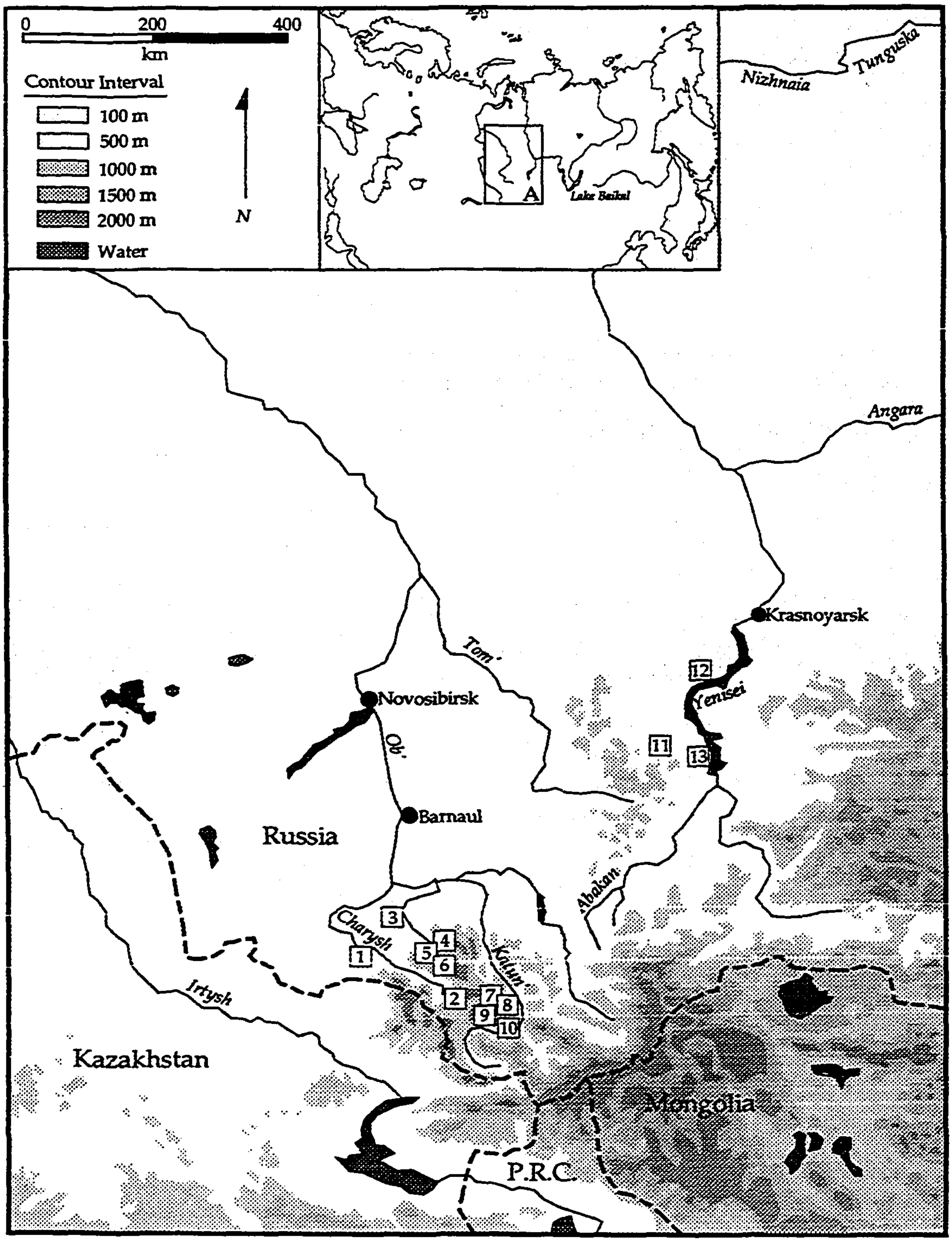


**Fig. 1.1.** Map of western Siberia showing location of Paleolithic sites described in text: (1) Strashnaia Peshchera, (2) Ust'-Kanskaia Peshchera, (3) Peshchera Okladnikov, (4) Denisova Peshchera, (5) Anui-1, (6) Ust'-Karakol, (7) Tiumechin-1, (8) Tiumechin-2, (9) Kara-Bom, (10) Maloialomanskaia Peshchera, (11) Malaia Syia, (12) Kurtak, and (13) Dvuglazka.

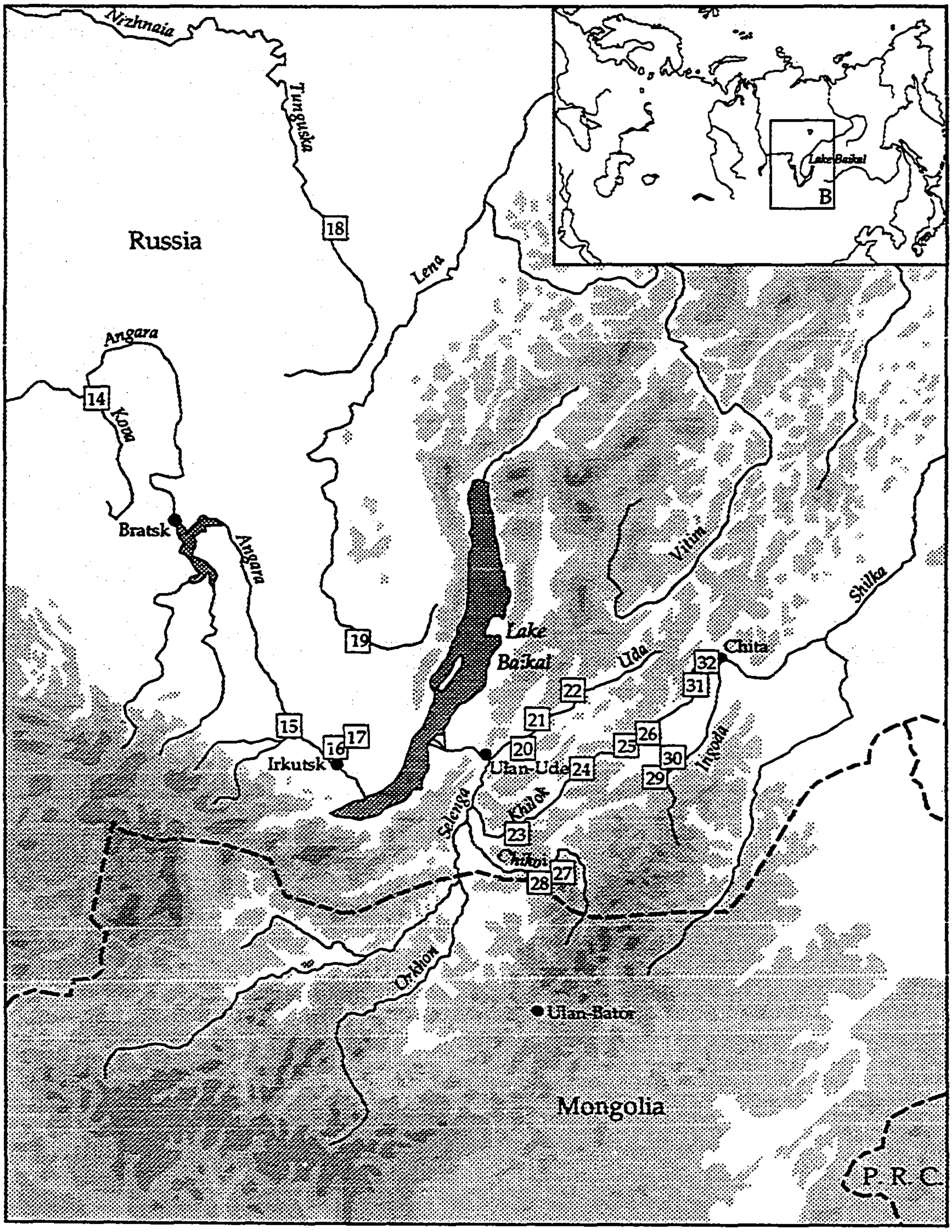


**Fig. 1.2.** Map of east Siberia showing location of Paleolithic sites discussed in text: (14) Ust'-Kova, (15) Sosnovyi Bor, (16) Voennyi Gospital, (17) Arembovskii, (18) Ineiskii Bor, (19) Makarovo-4, (20) Varvarina Gora, (21) Sannyi Mys, (22) Sapun, (23) Kunalei, (24) Tolbaga, (25) Masterov Gora, (26) Masterov Kliuch', (27) Ust'-Menza-5, (28) Priiskovoe, (29) Arta-2, (30) Arta-3, (31) Sokhatino-1, (32) Sokhatino-6 (legend is shown on Fig. 1.1).

assemblages. The same descriptive framework is used for both Middle Paleolithic and early Upper Paleolithic assemblages. Assemblages dating after 30,000 B.P. are excluded, so that changes occurring considerably later in the Upper Paleolithic are not confused with those taking place during the transition.

Middle Paleolithic assemblages and early Upper Paleolithic assemblages are described and analyzed in chapters 6 and 7. Interassemblage technological and typological variability are defined through general descriptions, univariate comparisons, and multivariate analyses. Definitions of variables are provided in Appendix 1.

The Middle to Upper Paleolithic transition is described in Chapter 8. Similarities and differences between Middle Paleolithic and early Upper Paleolithic tool manufacturing systems are summarized, followed by a brief review of changes in non-lithic systems. Changes documented across the transition are then characterized in terms of their magnitude, scope, pattern, and tempo. The characterization of change in tool manufacturing systems is then evaluated with respect to the series of contrasting expectations derived from the spread-and-replacement and regional continuity models. However, the analysis presented is essentially a pattern-recognition analysis, and is by nature too preliminary to test hypotheses concerning the course of human biological and cultural evolution in Upper Pleistocene Siberia. The study concludes with a review of the Siberian Middle to Upper Paleolithic transition in a wider Eurasian context, and, finally, with a proposal of a model explaining the origins of the inner Asian Upper Paleolithic.

## BACKGROUND: THE EMERGENCE OF MODERN HUMANS

### Anatomy

Two contrasting models have emerged to explain the evolutionary transition from archaic to fully modern *Homo sapiens sapiens*. These models are known by a multiplicity of names, but will be referred to here as the "spread-and-replacement" and "regional continuity" models. The spread-and-replacement model posits that there was a single, recent (late Middle to early Upper Pleistocene) origin of anatomically modern humans in Africa, followed by their dispersal into Eurasia and other parts of the world. According to this scenario, modern racial characteristics were established outside Africa during the late Upper Pleistocene and Holocene (Andrews 1986; Howells 1976; Mellars 1989a;

Stringer 1989b; Stringer and Andrews 1988). Proponents argue that anatomically modern human fossils are oldest in Africa (Andrews 1986; Bräuer 1989; Klein 1989; Rightmire 1989; Stringer and Andrews 1988), and progressively younger elsewhere in the Old World (Bar-Yosef 1989, 1993; Habgood 1989; Stringer 1989b; Trinkaus 1986). Mitochondrial DNA (mtDNA) and genetic evidence further support an early Upper Pleistocene dispersal out of Africa (Cann et al. 1987; Cavalli-Sforza et al. 1988; Lucotte 1989; Mountain et al. 1993; Stoneking and Cann 1989; Stoneking et al. 1993; Wainscoat et al. 1989). Furthermore, only in Africa have fossils intermediate between anatomically archaic and modern *Homo sapiens* been found (Andrews 1986; Bräuer 1989; Stringer and Andrews 1988).

In contrast, the regional continuity model sees modern human variation as a product of the dispersal of *Homo erectus* out of Africa around 1 million years before the present (B.P.). Regional distinctions were established early and persisted throughout the Pleistocene (Pope 1988; Smith 1984; Thorne and Wolpoff 1981; Trinkaus 1984; Weidenreich 1939, 1943; Wolpoff 1989; Wolpoff et al. 1984). Proponents argue that transitional fossils have been found in many regions (Pope 1988; Smith 1984; Wolpoff 1989; Wolpoff et al. 1984), and that continuity in regionally distinct morphological features is evident between archaic and more modern forms (Aigner 1976; Pope 1988; Smith 1984; Wolpoff 1989; Wolpoff et al. 1984). Reintrepretation of the mtDNA "clock" also supports a split between African and Eurasian populations at around 850,000 B.P. (Lewin 1987; Wolpoff 1989).

A consensus on the issue of the origins of modern humans is far from being reached, with both the spread-and-replacement and regional continuity "camps" claiming that the fossil and genetic evidence are weighted in their favor (Clark 1992; Stringer 1993; Wolpoff 1992). Resolution of this controversy will require a firmer calibration of the mtDNA and genetic clocks, as well as a greater number of well-dated, well-preserved hominid fossils, especially from the more easterly regions of the Old World, including Southeast Asia, China, and Siberia.

## Behavior

### *Spread-and-Replacement*

According to proponents of the spread-and-replacement model, at the onset of the Upper Pleistocene, Africa and Eurasia were inhabited solely by anatomically archaic humans displaying Middle Paleolithic behavioral patterns quite different in technology, subsistence, social organization, and perhaps cognition from those of recent hunter-gatherers (Binford 1985, 1989; Gamble 1986; Klein 1989; Soffer 1989, 1990; Trinkaus 1989b). They argue that by 30,000 B.P., a series of fundamental behavioral transformations had taken place, which archaeologically are evidenced by the transition from the Middle Paleolithic to the Upper Paleolithic. To Klein (1992:5), this transition represents the "most dramatic behavioral shift that archaeologists will ever detect."

Although proponents of spread-and-replacement have repeatedly enumerated the changes documented across the Middle to Upper Paleolithic transition (Mellars 1973, 1989b; Klein 1992; Knecht et al. 1993; Trinkaus 1989a; White 1982), they are worth restating here.

1. Tool technologies: a shift from flake-producing to blade-producing lithic technologies; the appearance of lithic assemblages with well-defined and standardized tool forms which vary greatly through time and space (e.g., end scrapers, perforators, burins); and the appearance of intentionally worked bone, antler, and ivory.

2. Regional and temporal variability: an increase in spatial and temporal variation in archaeological complexes, or "cultures," marked by specific artifact styles, or "type-fossils."

3. Symbolism: the proliferation of items of personal adornment (e.g., beads and pendants); the appearance of mobiliary art; and an elaboration of human burial practices.

4. Subsistence and economy: a broadening of the subsistence base; a shift from opportunistic foraging to specialized, logistical procurement of single prey species; and the appearance of long-distance procurement of shell, flint, and other raw materials.

5. Settlement: the development of more substantial, well-built dwelling structures; an increase in site density; and the appearance of large social aggregation sites.

Overall, this list of archaeological contrasts suggests that the Middle to Upper Paleolithic transition involved fundamental changes in hominid technology, behavior, and cognition. Some regard this as evidence that the emergence of the Upper Paleolithic represents the advent of linguistically structured, symbolic behavior (Chase and Dibble 1987; Clark 1993:173); others regard the transition as representative of the materialization of "Culture," "cultures," and "the fully modern way of doing things" (Binford 1989; Klein 1992:5).

According to proponents of the spread-and-replacement model, not only was the behavioral shift documented at the Middle to Upper Paleolithic transition dramatic, it was also abrupt and widespread. In Europe, the transition is marked by the sudden appearance of the Aurignacian technocomplex, which lacks a convincing archaeological progenitor in Europe (Allsworth-Jones 1986:193; Klein 1992:7; Kozlowski 1988:231; Mellars 1989a:375; Otte 1990:451). Some researchers have even noted a westward "time-transgressive wave" for the European Aurignacian, implying the steady march of a new intrusive population across the continent (Harrold 1988:184; Mellars 1993:202). The origins of the Aurignacian are thought to be rooted in the Levant, where transitional Upper Paleolithic industries may date to as early as 50,000 B.P. (Mellars 1989a:375, 1993:210; Mellars and Tixier 1989:767).

Spread-and-replacement proponents interpret European archaeological complexes containing both Middle and early Upper Paleolithic elements (such as the Châtelperronian in western Europe, the Szeletian in central Europe, and the Uluzzian in Italy) not as intermediate, transitional industries, but as examples of acculturation of Middle Paleolithic populations (Allsworth-Jones 1986:190, 1990:235-236; Goia 1990:241; Harrold 1988:185, 1989:705; Klein 1992:8; Mellars 1989a:375). The discovery of "classic" Neanderthal fossils in surprisingly late Châtelperronian contexts at St. Césaire and Arcy-sur-Cure, France, argues against the gradual transformation of Mousterian-making Neanderthals into Aurignacian-producing anatomically modern humans (Harrold 1988:184-185; Klein 1992:7; Stringer and Grün 1991).

### *Regional Continuity*

Rejecting the replacement model of modern human origins, a number of archaeologists have argued instead for a gradual, *in situ* transition from the Middle Paleolithic to the Upper Paleolithic (Clark 1989; Clark and Lindly 1989; Lindly and Clark 1990). Proponents of regional continuity argue that the generalized "before and after" kitchen list of differences between the Middle Paleolithic and the Upper Paleolithic overlooks the similarities between the two technocomplexes, and incorrectly characterizes the magnitude and tempo of change across the transition (Clark and Lindly 1989:634; Reynolds 1990:262; Simek and Price 1990:243; Straus 1990:276). They suggest that when the transition is viewed diachronically, it becomes evident that many of the changes did not occur abruptly or evenly, but gradually over the course of thousands of years. For example, Straus (1990:298) portrays the transition in Cantabrian Spain not as a "punctuated event," but as a "gradual, uneven process" that for some elements took 15,000 to 20,000 years to occur. Likewise, in the Perigord of southwest

France, the transition is considered to have begun sometime in the late Middle Paleolithic (i.e., the Mousterian of Acheulian Tradition [MAT]) (around 50,000 B.P.), and continued on at a slow but steady pace through the whole of the early Upper Paleolithic (to roughly 25,000 B.P.) (Reynolds 1990:273; Rigaud 1989:152-153; Simek and Price 1990:257).

Some proponents of gradualism argue that, in fact, there was no behavioral "revolution" across the Middle to Upper Paleolithic transition, and that the changes evident are relatively minor (Clark and Lindly 1989:666; Simek and Price 1990:257; Straus 1990:276). They argue that comparisons between the two technocomplexes have relied too heavily on typological arguments, which provide little information useful for monitoring change in lithic reduction technologies and tool manufacturing strategies (Clark and Lindly 1989:635). When all variables of a lithic industry are considered, including raw material procurement, core preparation, blank selection, and retouch intensity, many similarities between the two technocomplexes are evident. Furthermore, proponents argue that the apparent differences between the Middle Paleolithic and the Upper Paleolithic are the result of the use of two separate typologies to describe the two technocomplexes. The Upper Paleolithic typology consists of 92 types (de Sonneville-Bordes and Perrot 1956), while the Middle Paleolithic typology consists of only 63 types (Bordes 1961), suggesting that the Middle Paleolithic typology does not measure variability in stone tool assemblages to the same degree as the Upper Paleolithic typology (Reynolds 1990:263). In addition, the two typologies monitor interassemblage variability in different ways. Middle Paleolithic type designations are based primarily on the location and shape of retouched edges, while Upper Paleolithic type designations are based primarily on overall morphological form and emphasize attributes that act as chronological markers (Clark and Lindly 1989:663). Thus, Clark (1992:186) states, "if one looks at anything more comprehensive than the retouched stone tools emphasized by traditional European typological systematics, *there is continuity over the Middle-Upper Paleolithic transition on every single archaeological monitor of human adaptation.*"

Some proponents of regional continuity propose that the real behavioral rubicon in human evolution took place at the onset of the late Upper Paleolithic (20,000-15,000 B.P.) (Clark 1992:197; Clark and Lindly 1989:666; Simek and Snyder 1988; Straus 1990:276; Straus and Clark 1986). This period witnessed a phenomenal increase in the quantity and complexity of mobiliary and parietal art, and the development of complex hunting technologies, true logistical procurement of megafauna, and many other characteristics of modern hunter-gatherer behavior. According to such gradualist constructions, then, the Middle to Upper Paleolithic transition represents a relatively small step in the gradual accumulation of modern behavioral traits, and the early Upper Paleolithic is regarded as "incipient" to the "creative explosion" of the late Upper Paleolithic.

### Common Ground

There are points about the transition that both camps agree on, and several shortcomings in the present record that are acknowledged by all. Proponents of both replacement and continuity agree that it is impossible to account for the emergence of modern humans in a universal way when evidence for behavioral and biological change is drawn essentially from an area making up less than 10% of the Old World (Gowlett 1987b; Klein 1992; Mellars 1988; Mellars and Stringer 1989b; Soffer 1989:714; Stringer 1989a; Trinkaus 1989b:3). Upper Paleolithic origins in Africa and Asia are not well-understood, and few sites in these areas are known where the Middle to Upper Paleolithic transition is represented.

In southern Africa, Upper Pleistocene occupations at Klasies River Mouth and Border Cave reveal a hiatus between the youngest Middle Paleolithic (Middle Stone Age) components and earliest Upper Paleolithic (Late Stone Age) components, possibly due to intensified aridization during the Middle Pleniglacial period (oxygen-isotope stage 3 [60,000-30,000 B.P.]) (Ambrose and Lorenz 1990:26; Deacon 1993:108; Klein 1989:534; Singer and Wymer 1982:204-206). Although Klein (1992:12) posits that the earliest Upper Paleolithic will likely be found in equatorial East Africa, the evidence for this has yet to be documented. Likewise, in East and Southeast Asia, a Middle to Upper Paleolithic transition is not apparent in the archaeological record, but this may be the result of a prehistoric emphasis on nonlithic, vegetal materials like bamboo for making tools (Pope 1988:64-65), or perhaps because this area's Upper Pleistocene archaeological and fossil records are poorly understood (Klein 1992:9).

Another problem concerning identification of the Middle to Upper Paleolithic transition concerns the limitations of traditional dating techniques. A major impetus behind the recent interest in the orgins and dispersal of modern humans is the development of new dating techniques, including electron spin resonance (ESR), thermoluminescence (TL), Uranium-series (U-series), and radiocarbon ($^{14}C$) accelerator mass spectrometry (AMS), which sometimes allow the dating of sites lying beyond the range of conventional

$^{14}C$ methods (Bar-Yosef 1989, 1993; Grün and Stringer 1991; Klein 1992; Mellars and Bricker 1986). Dates based on these new methods have challenged our understanding of the pattern and timing of human biocultural evolution during the Upper Pleistocene. In Africa, transitional Middle-Late Stone Age industries are now thought to lie beyond the range of conventional $^{14}C$ dating and likely date to between 50,000 and 40,000 B.P. (Brooks et al. 1990; Grün and Stringer 1991). Likewise, transitional early Upper Paleolithic occupations in Israel have been recently AMS $^{14}C$ dated to as early as 42,000 B.P. (Bar-Yosef et al. 1992:517; Hedges et al. 1990:103) and U-series dated to as early as 47,000 ± 3000 B.P. (Schwarz 1993:22). The age of the early Aurignacian in Europe, once set at about 35,000 B.P., is now considered to be earlier than 40,000 B.P., based on AMS $^{14}C$ dates from Willendorf II, Austria, and L'Arbreda and El Castillo Caves, Spain (Allsworth-Jones 1990:231; Bischoff et al. 1989; Kozlowski 1988:219; Mellars 1993; Valdes and Bischoff 1989), as well as U-series dates from Abric Romaní, Spain, (Bischoff et al. in press), and TL dates from Temnata, Bulgaria (Kozlowski 1992; Mellars 1993:202). Thus, through the increased use of AMS $^{14}C$, U-series, and TL dating, we appear to be pushing back the antiquity of the Middle to Upper Paleolithic transition throughout Europe, the Near East, and Africa. Mid-Upper Pleistocene cultural chronologies built upon conventional $^{14}C$ methods are obsolete.

The relationship between anatomical and behavioral changes in the Upper Pleistocene is also unclear. In western Eurasia, the appearance of Aurignacian and other early Upper Paleolithic industries has long been considered to signal the appearance of anatomically modern humans; however, this generality has been complicated by the recent discovery of a "classic" Neanderthal in a clear Upper Paleolithic, Châtelperronian context at St. Césaire, France (Lévêque et al. 1993), as well as the continued absence of diagnostic modern hominid fossils from early Aurignacian occupations in western Europe (Stringer et al. 1984). In central Europe, however, there is ample evidence that early Aurignacian industries were the product of anatomically modern humans (Smith 1984), suggesting that in this region changes in anatomy and behavior were correlated.

In the Near East and Africa, on the other hand, anatomically modern human fossils from Qafzeh, Skhul, Dar-es-Soltan, and Klasies River Mouth, found associated with Mousterian or Middle Stone Age industries dating to 110,000-70,000 B.P., suggest that in these regions the emergence of anatomical modernity preceded the emergence of behavioral modernity by as much as 50,000 years (Bar-Yosef 1993; Bräuer 1989; Clark and Lindly 1989; Rightmire 1989). However, in the Near East, later Middle Paleolithic sites dating from 65,000-50,000 B.P. (i.e., Amud and Kebara) have produced only Neanderthal fossils (Bar-Yosef et al. 1992; Suzuki and Takai 1970; Vandermeersch 1989), and it is not until the early Upper Paleolithic (<40,000 B.P.) that anatomically modern human fossils reemerge, as evidenced at Ksar-Akil, Lebanon (Bergman and Stringer 1989). Klein (1992:12) argues that early Upper Pleistocene modern humans from the Near East and Africa were not fully modern but "near modern," and it was not until the onset of the Upper Paleolithic (or Late Stone Age) in sub-Saharan Africa, after 50,000 B.P., that fully modern people emerged. Klein's model implies that the Middle to Upper Paleolithic transition in Africa and western Eurasia signals not only the emergence of fully modern behavior, but also the emergence of fully modern anatomy.

Thus, while issues of the synchroneity between the emergence of anatomical and behavioral modernity are currently unresolved (Trinkaus 1989b), proponents of both the spread-and-replacement model and the regional continuity model agree that the issue of modern human origins must continue to be treated as a biocultural one. The two areas of change comprising the "human revolution" are inseparable, and each must be addressed in order to understand the other (Clark 1992:198; Mellars and Stringer 1989b; Stringer 1989a; Trinkaus 1989b, 1989c).

# CHAPTER 2

## The Pleistocene Setting

Siberia is a vast land, an area roughly the size of the continental United States. It stretches across northern Asia from the Ural Mountains in the west to the Lena and Amur basins in the east. To the north is the Arctic Ocean, and to the south are the Altai and Saian Mountains, forming a natural border with the neighboring countries of Kazakhstan, Mongolia and the People's Republic of China. Despite its immense size, Siberia displays remarkable uniformity in climate and physiography, with only minor regional contrasts.

The Middle and early Upper Paleolithic sites discussed in the present study are located in the southern regions of Siberia, in the foothills zones of the Altai and Saian mountains and in the Cisbaikal and Transbaikal regions. The northernmost sites, Ineiskii Bor and Ust'-Kova, lie at 59° and 58° N latitude, respectively. The remaining sites lie further south, between 50° and 55° N. For this reason, the following discussion of of modern and Upper Pleistocene environments concentrates on the southern regions of Siberia. North Siberia (the West Siberian Plain and the Central Siberian Plateau) is also treated, though in less detail, to provide supplementary records of Upper Pleistocene stratigraphy, paleoenvironments, and climate change.

### MODERN CLIMATE AND PHYSIOGRAPHY

Siberia has a continental climate, influenced chiefly by arctic air masses. Winters are long and cold, with temperatures frequently persisting well below -30°C (Fig. 2.1a). Summers are short and often very warm; July temperatures average 20°C but often reach 30° or even 40°C (Fig. 2.1b) (Knystautas 1987:27). In the Siberian interior, normal high and low air temperatures in summer and winter consistently differ by more than 60°C. Such temperature extremes are intensified in northeast Siberia, where winter temperatures plunging below -60°C and summer temperatures reaching 40°C are not uncommon.

Siberia's severe continental climate is controlled by a strong arctic anticyclone centered over the northern interior. In the summer, cold arctic air interacts with warm southern air to produce limited cloud cover and rain. On occasion, moisture-bearing Atlantic air encroaches over western Siberia leading to strong cyclones with high winds, clouds, and rain or snow. Annual precipitation for most of Siberia (Fig. 2.2), however,

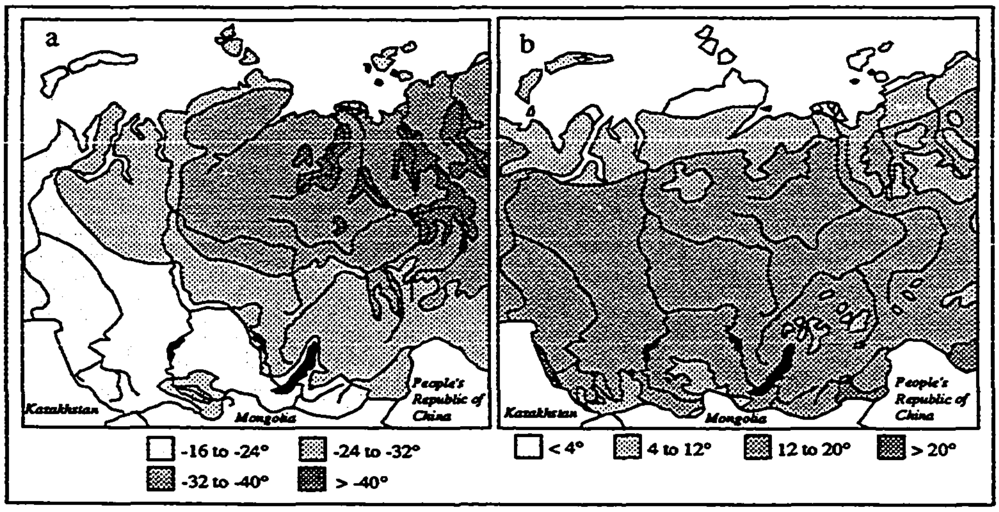


**Fig. 2.1.** Average January (a) and July (b) air temperatures (8° C isotherms).

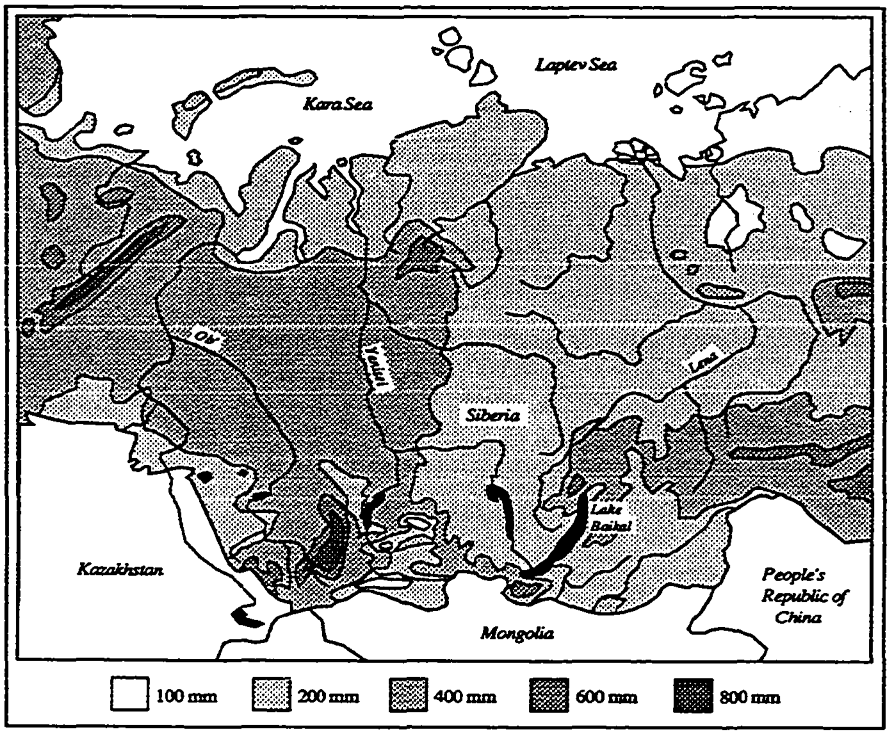


**Fig. 2.2.** Average annual precipitation across Siberia (after Baranov 1969).

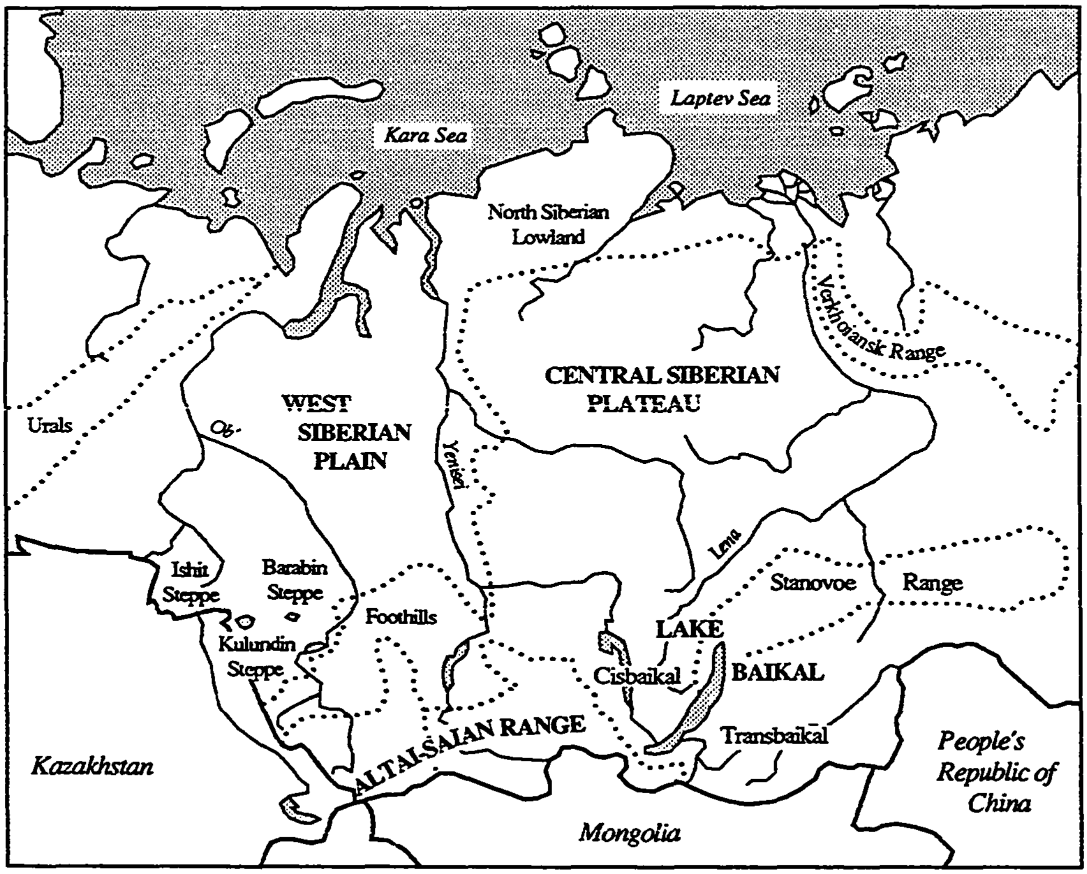


**Fig 2.3. Modern physiographic zones of Siberia described in text.**

is low, registering from 200 to 500 mm (Baranov 1969:84), except in the south Siberian Altai where annual precipitation frequently exceeds 1,000 mm.

Russian geographers conventionally divide Siberia into four physiographic zones: the West Siberian Plain, the Central Siberian Plateau, the Altai-Saian Mountains, and the Lake Baikal region (Fig. 2.3) (Knystautas 1987:18-25).

The West Siberian Plain is a flat, poorly drained lowland stretching from the Ural Mountains eastward to the Yenisei River. It is drained primarily by the northward-flowing Ob' River and its numerous tributaries. In the north this region is underlain by thick permafrost. Vegetation zones include tundra and shrub tundra north of the Arctic Circle, and a vast taiga in the subarctic dominated by Siberian stone pine (*Pinus sibirica*) and silver birch (*Betula pendula*) (Fig. 2.4) (Baranov 1969:90-93). In southwest Siberia in the upper Irtysh and Ob' River basins the taiga gives way to a vast forest-steppe and steppe spanning westward to the Russian Plain (Baranov 1969:90-91). The steppe is is made up of three regional components, the Ishit, Barabin, and Kulundin steppe

The Central Siberian Plateau includes the immense area of northern Siberia stretching between the Yenisei and Lena rivers (Knystautas 1987:22; Kushev and Leonov 1964). It is a relatively flat tableland carved by numerous ancient river systems including the Khatanga, Nizhnaia Tunguska, Angara, Olenëk, Viliui, and Lena. Siberian larch (*Larix sibirica*) dominates the subarctic taiga in northcentral Siberia, while Siberian stone pine (*Pinus sibirica*) is dominant in the taiga south of the Podkamennaia Tunguska River (Baranov 1969:91).

The Altai and Saian mountains form a natural southern boundary for Siberia. The Altai is an extensive system of towering mountains with intervening deep, narrow valleys. Peaks reach 4,300 m above sea level in the east, and 2,900 m in the west. Today these mountains contain over 1,000 active glaciers that cover an area of over 700 km$^2$ (Adamenko et al. 1969; Kimmerikh et al. 1963). High elevation landscapes include

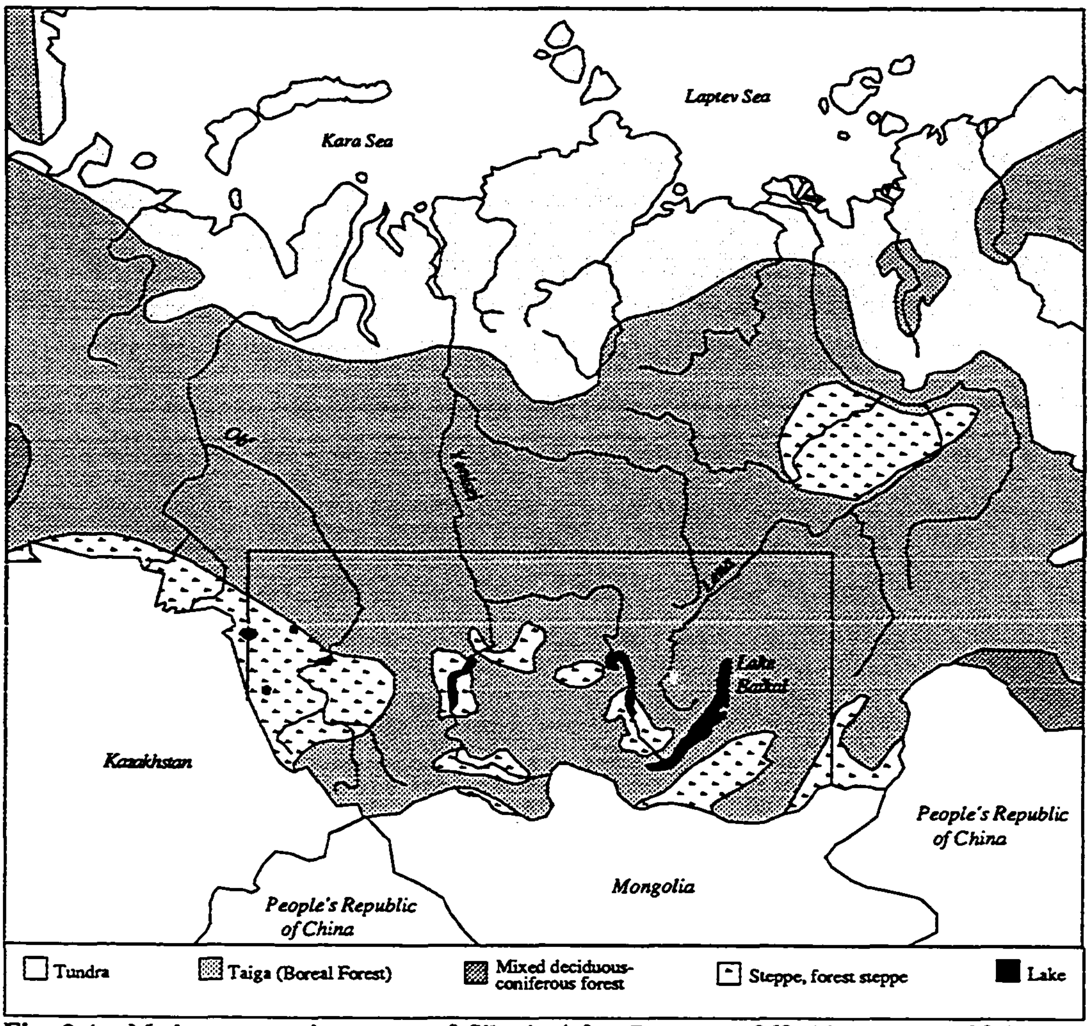


**Fig. 2.4.** Modern vegetation zones of Siberia (after Baranov 1969; Knystautus 1987) (study area outlined).

alpine meadows, alpine tundra, and open stands of Siberian stone pine (*Pinus sibirica*). Meadow-steppes occur along valley bottoms, while open larch (*Larix*) and pine (*Pinus*) forests mantle steep valley slopes. In the northwestern foothills of the Altai vast stands of fir (*Abies*) are also common (Derevianko et al. 1990b:12; Knystautas 1987:146-148).

The Saian Range extends from the Altai eastward across southern Siberia to Lake Baikal. The highest peaks reach 2,500-3,000 m in elevation and are for the most part unglaciated (Knystautas 1987:148). Mountain slopes are mantled by a vast larch (*Larix*) and pine (*Pinus sibirica*) taiga. Much of this mountain system is drained by the Yenisei River and its tributaries, the Abakan, Kan, and Chuna rivers. In its upper reaches the Yenisei flows through a wide and very dry steppe-covered valley called the Tuva depression. Similar "islands" of steppe occur in the foothills north of the Saian Mountains, along the middle Yenisei (Minusinsk depression) and Angara rivers, in mountain rain shadows that receive very little precipitation (Fig. 2.4).

Lake Baikal is the major physiographic feature of southeast Siberia. This immense body of water contains one-fifth of all the freshwater on Earth. Due to its vast size, the lake has a moderating effect on the region's climate, with winter temperatures slightly warmer and summer temperatures slightly cooler than the surrounding territory. The Cisbaikal, the immediate area west of Lake Baikal, is an area drained by two major river systems, the Angara and Lena. East of the lake is the Transbaikal, an extensive territory drained by the Selenga and Viliui rivers in the west, and the Ingoda and Onon rivers in the east. The Ingoda and Onon are major tributaries of the Amur, a major waterway of the Russian Far East that empties into the Pacific Ocean. Surrounding Lake Baikal is a series of moderately high mountain ranges (<1,500 m) with long, intervening valleys. Mountain ridges are covered with forests of larch (*Larix*) and Siberian stone pine (*Pinus sibirica*) (Knystautas 1987:22), while valleys are covered with meadow-steppes dominated by feather grass (*Stipa baicalica*) and a variety of composites (Compositae) (Knystautas 1987:39). In the southern Transbaikal this forest-steppe opens onto an arid, treeless steppe that extends southward into the Gobi Desert of Mongolia and northern China.

## GLOBAL PALEOCLIMATIC FRAMEWORK

The Middle to Upper Paleolithic transition in Siberia occurred during the late Quaternary Period, beginning roughly 130,000 years ago (B.P.). The Quaternary has been a period of dramatic worldwide climatic fluctuations between glacial and interglacial conditions. The most complete records of these climatic fluctuations are drawn from cores drilled into deep ocean-floor sediments containing numerous minute skeletons of benthonic and planktonic foraminifera. When alive, these foraminifera absorb oxygen-isotopes ($^{16}O$ and $^{18}O$) from the surrounding marine environment, making them unique archivists of Quaternary climate change. The ratio of $^{16}O$ and $^{18}O$ in the world's oceans varies through time, due to fluctuations in the evaporation of sea water. During periods of continental ice sheet expansion sea level falls and evaporation is high; more of the lighter $^{16}O$ isotope is drawn into the atmosphere and the oceans become thick with the heavier $^{18}O$. During interglacial periods as polar ice caps recede, sea level rises, evaporation subsides, and the disparity in the amounts of $^{16}O$ and $^{18}O$ decreases. Since at any given time benthonic and planktonic foraminifera absorb both $^{16}O$ and $^{18}O$ in the proportions standard in the oceans, we can use this ratio as a measure of relative ocean volume and, conversely, relative continental ice volume.

Deep sea sediment cores have now been studied from every ocean, revealing oxygen-isotope curves that outline the entire Quaternary period (Bradley 1985:187; Dawson 1992:22-23). Together these curves record a long series of oxygen-isotope fluctuations reflecting major trends in global climate change (Dawson 1992:10). The standard core of reference (Dawson 1992:10; Gamble 1986:77; Imbrie and Imbrie 1979; Sutcliffe 1985:59) is the V28-238 deep sea core from the Solomon Plateau in the equatorial Pacific (Fig. 2.5) (Shackleton and Opdyke 1973). In this core Shackleton and Opdyke (1973) discern 16 climatic stages spanning the Middle and Upper Pleistocene; these include eight glacials (labeled with even numbers) and eight interglacials (labeled with odd numbers). The uppermost segment of the core offers one of the most detailed records of the last interglacial/glacial cycle (stages 5-2, 128,000-10,000 B.P.).

According to this oxygen-isotope record, the "Last Interglacial" (oxygen-isotope substage 5e) began around 128,000 B.P. as ocean volumes reached a record high for the Middle and Upper Pleistocene. This was followed by two brief cold oscillations (substages 5d and 5b) separated by two intervals of sustained warmer conditions (substages 5c and 5a). This period of relatively warm but oscillating climate is commonly referred to as the "Early Glacial" (118,000-75,000 B.P.) (Nilsson 1983:256).

The moderate conditions of the Early Glacial were followed by a period of fluctuating, although consistently cooler climate called the "Pleniglacial" (oxygen-isotope

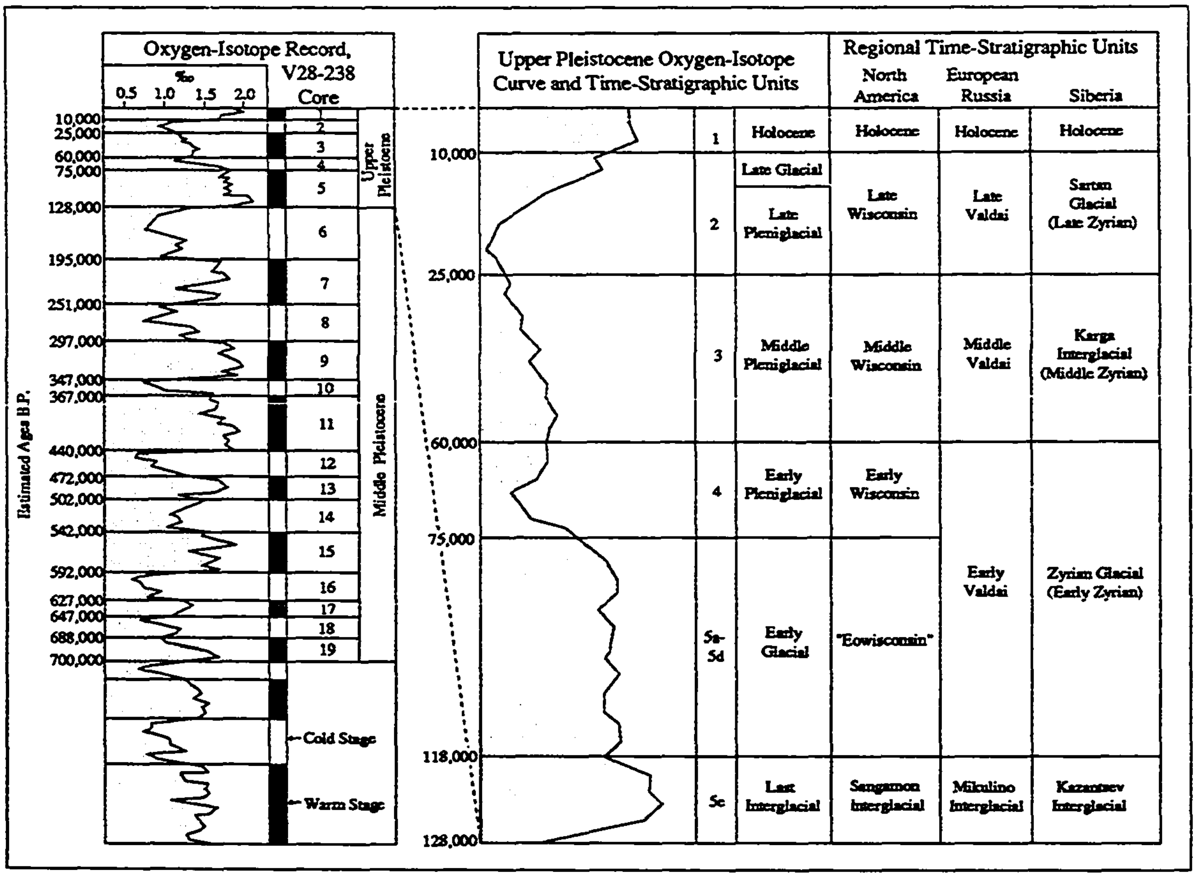


**Fig. 2.5.** Stratigraphic framework for the Middle and Upper Pleistocene, with emphasis on major time-stratigraphic units for the last 128,000 years B.P. (oxygen-isotope stages 5-2) (after Shackleton and Opdyke 1973; Dawson 1992; Gamble 1986).

stages 4-2, 75,000-16,000 B.P.) (Nilsson 1983:256). It is commonly divided into three phases, the Early, Middle, and Late Pleniglacial. The Early Pleniglacial (stage 4) occurred from 75,000 to 60,000 B.P.; it reflects a period of intense cold and widespread glacial expansion in northern Eurasia and North America. The Middle Pleniglacial (stage 3) was a relatively mild period lasting from 60,000 to 25,000 B.P. During this interval global climate was considerably warmer than during the preceding Early Pleniglacial, but not as warm as during the Last Interglacial. The Late Pleniglacial (25,000-16,000 B.P.) represents the last glacial maximum of the Upper Pleistocene (stage 2), an interval when global ocean volumes were at their lowest and polar ice cap volumes were at their highest. Deglaciation began after 16,000 B.P. (the "Late Glacial"), signalling the transition back to full interglacial conditions (stage 1, the Holocene).

The oxygen-isotope record for the Upper Pleistocene, then, records a number of "incessant switches" between cool and warm conditions (Dawson 1992:23). The isotopic curves, however, should *not* be viewed as exact records of past climate change. They are merely signals of global trends in climate, not precise records of regional climatic fluctuations. Regional and local records of Upper Pleistocene climate are often inconsistent with the oxygen-isotope record in terms of the duration, number, and intensity of interglacial/glacial and interstadial/stadial events. Local climates are affected by numerous variables, including physiography, precipitation, solarity, and patterns in atmospheric circulation. Furthermore, the deep-sea oxygen-isotope records are incapable of discerning short-term (i.e., century-long or millenium-long) cold fluctuations (e.g., the Younger Dryas) recently recognized in ice cores. For these reason, to accurately and fully reconstruct the Upper Pleistocene climate history of Siberia, it is necessary to "fit" the oxygen-isotope record with the region's sometimes fragmentary yet more specific geological and paleobotanical records.

Because most of Siberia lies within arctic and subarctic latitudes, far removed from the world's ice-free oceans, Upper Pleistocene climatic shifts were often amplified to extremes not seen elsewhere in Eurasia. During the Upper Pleistocene the region's landscapes were repeatedly transformed from dense boreal and temperate forests during interglacials to cold treeless steppes and deserts during glacials.

## SIBERIA IN THE UPPER PLEISTOCENE

The following review of Upper Pleistocene geology and palynology has two goals. First, it is important to build an accurate chronological framework for the Siberian Paleolithic, through the use of various proxy records, especially alluvial terrace sequences and aeolian loess stratigraphy in the south, and glacial and marine stratigraphy in the north. Second, the geologic records are combined with regional paleobotanical information to reconstruct the dynamic environmental and climatic setting of Paleolithic Siberia. Much of this discussion is based on conventional radiocarbon chronologies. The reader should use caution in interpreting many of these dates, especially those that approach the limit of radiocarbon dating (i.e., 40,000-30,000 BP). It is possible that numerous sediments currently assigned to Middle Pleniglacial (oxygen-isotope stage 3) based on radiocarbon determinations could actually be much more ancient, perhaps as old as the Last Interglacial (substage 5e).

Russian Quaternary geologists and palynologists conventionally divide the Siberian Upper Pleistocene into four stages, the Kazantsev Interglacial, the Zyrian Glacial, the Karga Interglacial, and the Sartan Glacial. This time scale is comparable to those reported for the Upper Pleistocene of western Eurasia and North America, and appears to conform well to the deep sea oxygen-isotope record (Figure 2.5). The Kazantsev Interglacial corresponds to substage 5e (the Last Interglacial), the Zyrian Glacial to substages 5d-5a and stage 4 (the Early Glacial and Early Pleniglacial), the Karga Interglacial to stage 3 (the Middle Pleniglacial), and the Sartan Glacial to stage 2 (the Late Pleniglacial and Late Glacial) (Arkhipov 1989:28). The Kazantsev, Zyrian, and Karga time-stratigraphic intervals are profiled regionally below, in terms of geologic history and chronology (i.e., glacial, loess, and paleosol stratigraphy), as well as vegetation history and paleogeography. The Sartan Glacial is not discussed in detail since it post-dates the Middle and early Upper Paleolithic archaeological periods.

## The Kazantsev Interglacial, 128,000-118,000 B.P.

There have been few times during the Quaternary when global climate was warmer than today. The last time was during the Last Interglacial (oxygen-isotope substage 5e), 128,000-118,000 B.P. At this time global ice volume reached one of its lowest marks since 730,000 B.P., and sea level rose to levels higher than in contemporary times (Gamble 1986:82). In Siberia this period is referred to as the Kazantsev Interglacial. It is marked by a major marine transgression of the Kara and Laptev seas southward across the West Siberian Plain, and by the northward advance of a mixed coniferous-deciduous forest as far as 60° N latitude.

### *North Siberia*

During substage 5e relative sea level along the north Siberian coast rose 160-180 m, to a mark about 7-10 m higher than today (Bylinskii 1982:274). This event is called the Kazantsev Transgression, and is dated to 135,000-110,000 B.P. (according to electron spin resonance [ESR] and thermoluminescence [TL] dates) (Arkhipov 1989:26; Arkhipov and Votakh 1982). Geologically, the transgression is marked by a series of marine terraces found along the Kara Sea shore (Danilov 1982:370). Foraminifera from these

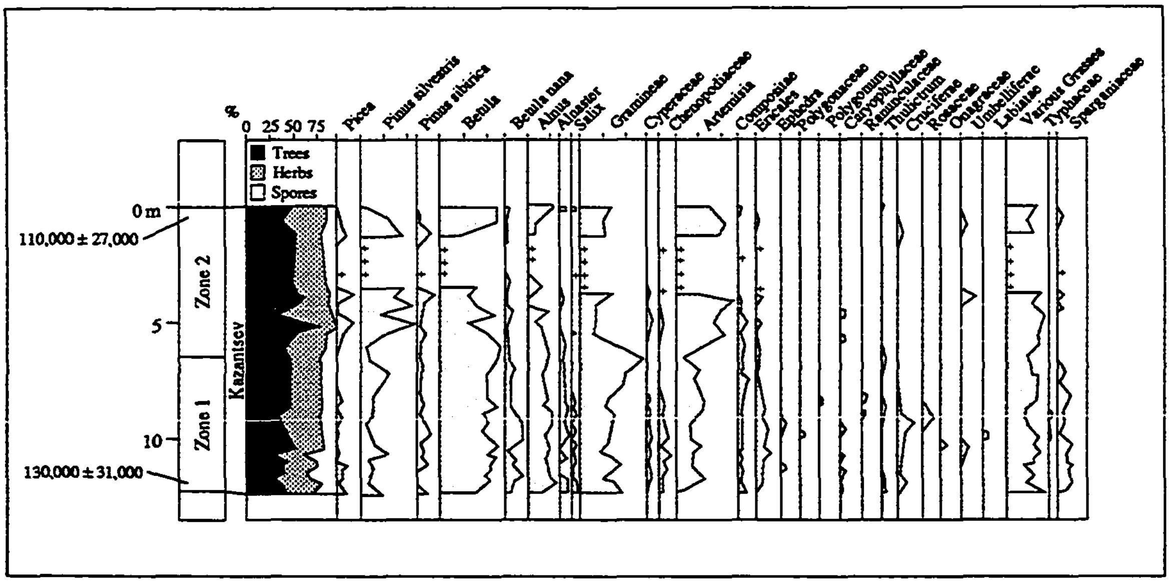


**Fig. 2.6.** Pollen diagram of Kazantsev lacustrine sediments at Kormuzhikhanskii Iar (showing TL dates at left) (after Arkhipov and Votakh 1982).

terraces are similar to those found in Eemian transgressive sediments in northwestern Europe (Gudina 1976), indicating that the waters of the Arctic Ocean off Siberia and northern Europe were much warmer than today (Danilov 1982:370).

Kazantsev-aged palynological data from north Siberia are meager (Grichuk 1984:165). Arkhipov and Votakh (1982:55), however, present a detailed spore-pollen profile from a 12-m thick lacustrine deposit at Kormuzhikhantskii Iar, just south of the confluence of the Ob' and Kazym rivers (Fig. 2.6). Here lake sediments are sandwiched between morainal deposits assigned to the Tazov (stage 6) and Zyrian (stage 4) glacials. Two pollen zones have been delineated for the Kazantsev sediments. Pollen Zone 1 (the lower 6.3 m of the section) consists of lacustrine clays and silts, and has a basal TL date of 130,000 B.P. Zone 2 (the upper 5.8 m of the section) is made up of lacustrine clays and sands TL dated to 110,000 B.P. (Arkhipov and Votakh 1982). In Zone 1 tree pollen dominates, especially birch (*Betula*), while grass and herb pollen (chiefly Gramineae and *Artemisia*) are less common. Among spores, tundra species (*Lycopodium*) dominate. Overall the Zone 1 pollen spectrum indicates the existence of a northern birch-coniferous taiga with some grass and tundra elements, reflecting slightly cooler climatic conditions than today. Zone 2 is dominated by tree pollen; pine (*Pinus*) is well-represented, while birch (*Betula*) decreases in frequency. Among herbs, wormwood (*Artemisia*) sharply increases at the expense of herbaceous plants (Gramineae). Spores decline in both frequency and diversity. All of this indicates the presence of a pine-birch middle taiga (Arkhipov and Votakh 1982). This likely represents the climatic optimum of the Kazantsev.

Like the pollen record from Kormuzhikhantskii Iar, other paleobotanical records from north Siberia demonstrate that tree line significantly advanced northward during the Kazantsev Interglacial (Giterman et al. 1982:233; Grichuk 1984:167). The northern taiga belt (dominated by birch [*Betula*] in the west and pine [*Pinus*] and larch [*Larix*] in the east) advanced as far north as the Kara Sea shore in northwest and northcentral Siberia, while the more northerly forest-tundra belt (dominated by spruce [*Picea*], birch [*Betula*], and larch [*Larix*]) was restricted to a thin band along the Laptev Sea shore east of the Olenëk River. Shrub-tundra and tundra zones were limited to small pockets in highlands of the far northeast (Grichuk 1984:167).

### *Southwest Siberia*

Kazantsev-aged alluvial terraces in the Altai and steppe zones of southwest Siberia are rare (Tseitlin 1979:47), but a few have been delineated and studied. These include the fifth (40 m) terrace along the Biia River in the Altai (Tseitlin 1979:42), the third (25-30 m) terrace on the Ob' River in the vicinity of Novosibirsk and Tomsk (Tseitlin 1979:48), and the lower portion of the third (30-45 m) alluvial terrace on the Yenisei River (Drozdov et al. 1990a:20)

Kazantsev loess deposits along the Ob' mantle late Middle Pleistocene (Tazov-aged) terraces. These loess deposits often display a major paleosol horizon referred to as the Lower Berd Soil (Volkov and Zykina 1982, 1984). This soil is a 60-cm thick, well-developed leached chernozem with distinct A, B, and BCk horizons (Fig. 2.7) (Volkov and Zykina 1982:21, 1984:120). It appears to have developed under a widespread forest-steppe during warm and moderately mesic climatic conditions (Volkov and Zykina 1984:121).

In the Yenisei, when loess sections are visible, the Kazantsev Interglacial is represented by a thick paleosol locally referred to as the Kamennyi Log Soil (Zykina 1992). This is a mature, well-developed leached chernozem with distinct A, Bk, and Ck horizons (Fig. 2.8). It is heavily deformed by two generations of frost cracks and ice wedge pseudomorphs. According to Zykina (1992), this soil formed under a forest-steppe or steppe.

The Kazantsev paleobotanical record for the foothills zone of southwest Siberia is perhaps best represented by the Tegul'det pollen record (Fig. 2.9), extracted from alluvial

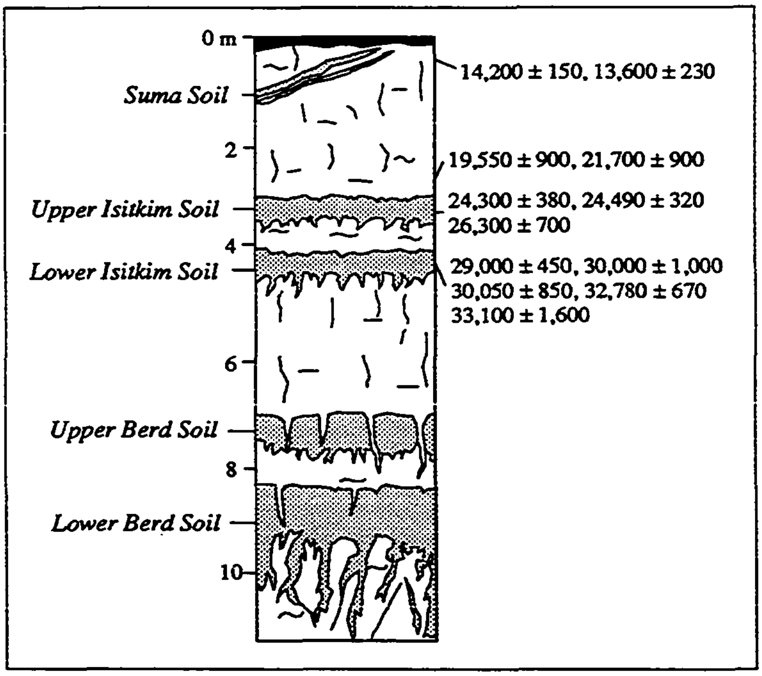


**Fig. 2.7. Composite Upper Pleistocene loess profile, Ob' River valley, showing paleosol chronology and radiocarbon dates (B.P.) (after Volkov and Zykina 1984).**

deposits under the second terrace of the Chulym River, 200 km east-northeast of Tomsk. This core bears four major pollen zones (Grichuk 1984:165). Zones 1a and 1b are assigned to the late Tazov Glacial (oxygen-isotope stage 6) and represent a cryoxeric steppe and forest-steppe, respectively. Zones 2-4 are assigned to the Kazantsev Interglacial. Zone 2 represents a thermoxeric, mixed birch-coniferous forest with a strong steppe element, and Zone 3 is a "transitional" zone representing a shift from thermoxeric to thermomesic conditions and possibly the climatic optimum of the Kazantsev. Wormwood (*Artemisia*) and other dry steppe elements drop out of the spectrum, while tree pollen increases. Trees represent a mixed temperate forest including birch (*Betula*), fir (*Abies*), spruce (*Picea*), pine (*Pinus*), oak (*Quercus*), elm (*Ulmus*), and basswood (*Tilia*). The latter three are presently absent from the Chulym region. Zone 4 records peaks in birch and two species of pine (*Pinus silvestris* and *P. sibirica*), suggesting the emergence of a birch-dark coniferous taiga and climatic conditions similar to those seen in this region of southwest Siberia today (Baranov 1969).

Extensive paleobotanical studies of last interglacial sediments in the Saian region have been conducted by Belova (1985), but none are from lacustrine deposits. She characterizes climatic conditions for the region as optimal and temperate (Belova

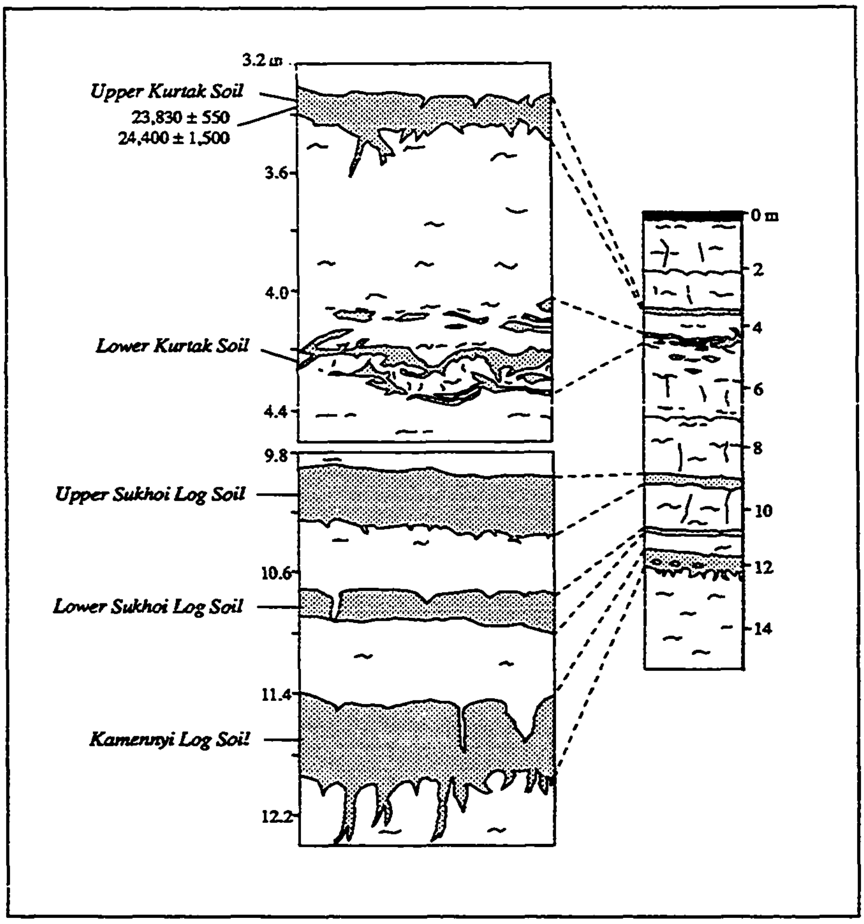


**Fig. 2.8.** Upper Pleistocene loess profile from Kurtak, Yenisei valley, showing paleosol chronology and radiocarbon dates (B.P.) (after Zykina 1992).

1985:120). Across the foothills zone of southwest Siberia pollen spectra are characterized by a heterogeneous collection of trees, including Siberian fir (*Abies sibirica*), Siberian spruce (*Picea obovata*), Scots pine (*Pinus silvestrus*), Siberian stone pine (*Pinus sibirica*), European white birch (*Betula verrucosa*), and Siberian elm (*Ulmus pumila*). In the upper Yenisei basin and western Saian Mountains, a series of central Asian species including Siberian basswood (*Tilia sibirica*), maple (*Acer*), and walnut (*Juglans*) are also found (Belova 1985:120). Today these trees are exotic to southwest Siberia.

### *Southeast Siberia*

Geomorphologically the Kazantsev Interglacial in southeast Siberia is represented by the fifth (30-35 m) terrace of the Angara River (Tseitlin 1979:148), and the

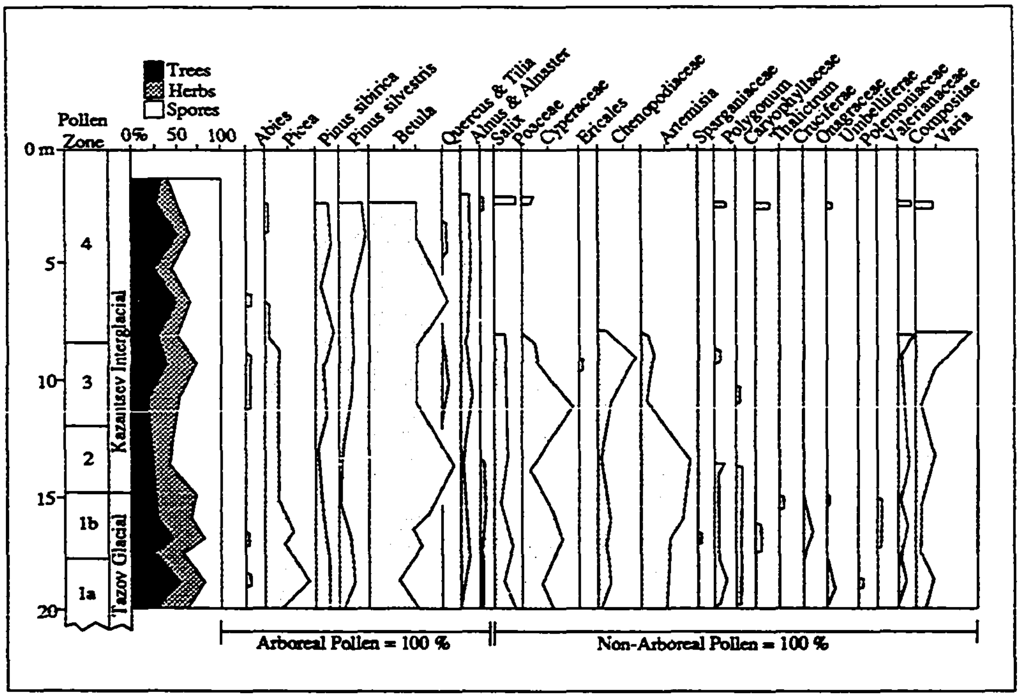


**Fig. 2.9. Pollen diagram of Kazantsev alluvial sediments at Tegul'det, Chulym River basin (no dates) (after Grichuk 1984).**

fourth (17-19 m) terrace of the Selenga River and its tributaries (Bazarov and Bazarova 1986:55; Imetkhenov and Savinova 1987:31; Rezanov 1986:8). Along Lake Baikal a minor transgression occurred, leading to the formation of the third (10-12 m) beach terrace along the southern shore of the lake (Imetkhenov and Savinova 1987:31).

In the southern Angara region the Kazantsev soil is referred to as the Lower Igetei Soil (Medvedev et al. 1990; Vorob'eva 1992). This is a 1-m to 1.2-m thick strongly humified and leached chernozem (Fig. 2.10) (Vorob'eva and Medvedev 1984). It likely developed during warm and moderately xeric conditions of the last interglacial, under a forest-steppe on hillslopes and under a treeless steppe on valley bottoms (Vorob'eva 1992). In the Transbaikal, loess deposits are rare, and no Kazantsev soil has been identified.

Upper Pleistocene lake deposits are also rare in southeast Siberia (Belova 1985); the majority of paleobotanical data has been gleaned from alluvial contexts. In the southern Angara region, studies of macrofossils indicate the south Siberian mixed coniferous-deciduous forest was characterized by an interesting suite of Manchurian exotics, including Dahurian birch (*Betula dahurica*), Siberian hazelnut (*Corylus heterophylla*), Mongolian oak (*Querqus mongolica*), and Amur basswood (*Tilia amurensis*). This flora also contained a heterogeneous package of 22 families of herbaceous plants, indicating that while the Angara region enjoyed relatively warm temperatures during the Kazantsev, it was not mesic.

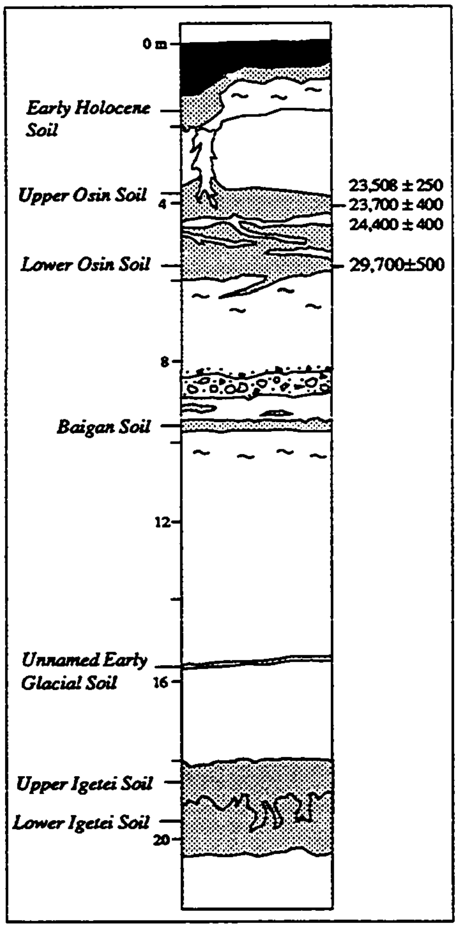

**Fig. 2.10.** Upper Pleistocene loess profile from Igeteiskaia Gora, Angara River valley, showing paleosol chronology and radiocarbon dates (B.P.) (after Medvedev et al. 1990).

Similarly, pollen spectra from the fourth terrace of the Selenga indicate that climatic conditions in the Transbaikal during the Last Interglacial were temperate (i.e., warm and moderately mesic) (Bazarov et al. 1984:14; Belova 1985:70-71; Imetkhenov and Savinova 1987:32; Rezanov 1986:8). Low mountain slopes were mantled by a pine-birch forest mixed with isolated spruce (*Picea*), pine (*Pinus sibirica*), alder (*Alnus*), and hemlock (*Tsuga*) (Bazarov et al. 1984:14; Rezanov 1986:8), and a grass-herb spectrum limited largely to herbaceous plants (Gramineae) and wormwood (*Artemisia*) (Imetkhenov and Savinova 1987:32). Along river valleys, forests consisted chiefly of coniferous species (fir [*Abies*], spruce [*Picea*], pine [*Pinus*], and pine [*Pinus sibirica*]) with occasional deciduous forms (hazelnut [*Corylus*], elm [*Ulmus*], maple [*Acer*], and oak [*Quercus*]) (Imetkhenov and Savinova 1987:32). The associated grass-herb spectrum along river bottoms included herbaceous plants (Gramineae), wormwood (*Artemisia*), and goosefoots (Chenopodiaceae) (Imetkhenov and Savinova 1987:32).

## *Discussion*

Based on paleobotanical data collected from 108 different fossil plant sites, Grichuk (1984:167-168) presents a generalized paleoenvironmental reconstruction for all of Siberia during the Kazantsev Interglacial (Fig. 2.11). Most of these data, however, are from alluvial settings, a typically complicated context with unidentified disconformities and biased pollen preservation and redeposition. Stratigraphic correlations are also tentative. The portrayal of the Kazantsev presented below is thus provisional.

During the Kazantsev Interglacial, the Kara Sea rose to a level 7-10 m higher than today, and encroached across a large area of north Siberia. Grichuk (1984) places shoreline as far south as 64°N latitude along the Ob' and Taz rivers; however, this may be a result of inaccurately identifying earlier Middle Pleistocene

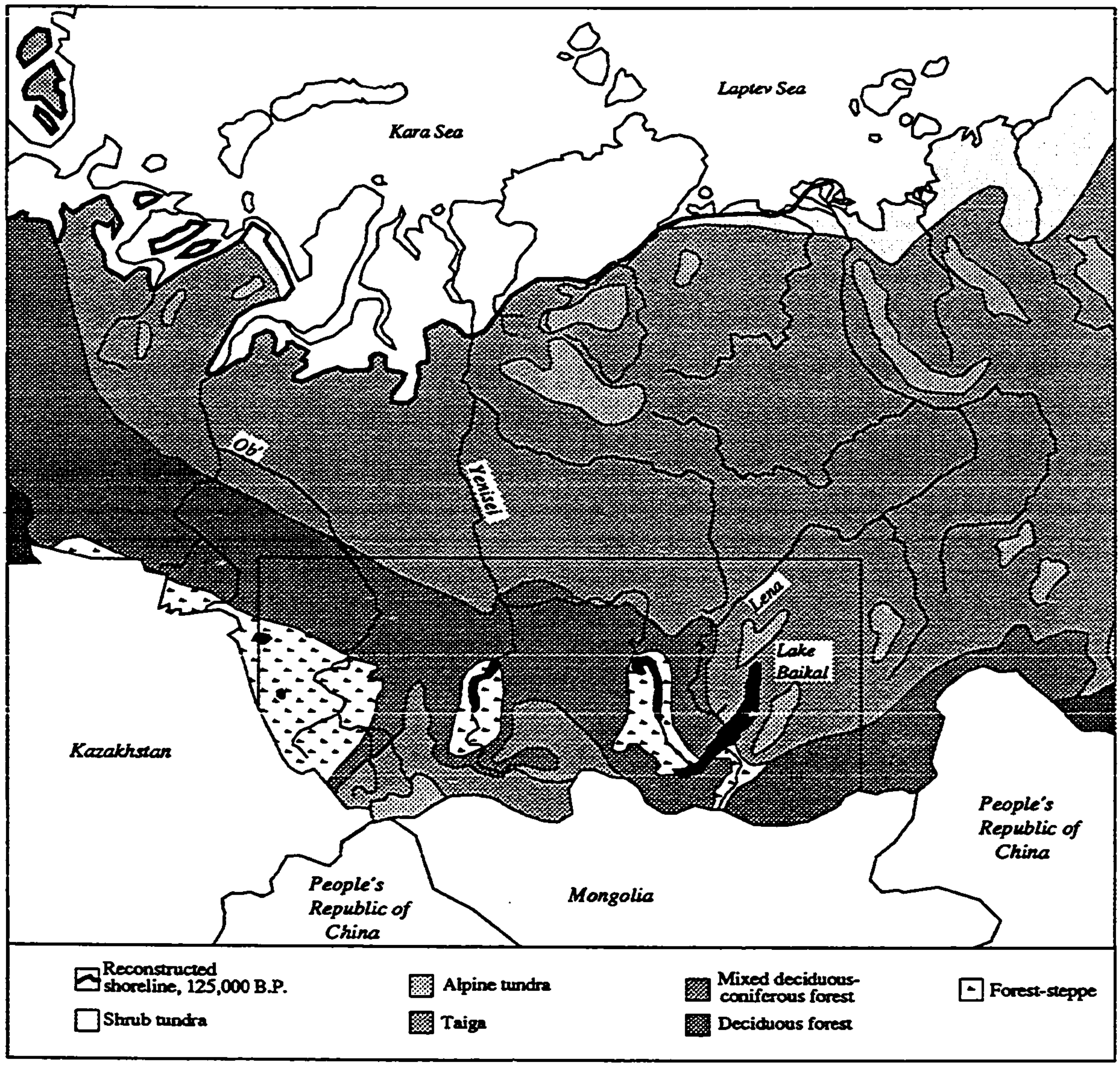


**Fig. 2.11.** Distribution of major vegetation zones of Siberia during the Kazantsev Interglacial (oxygen-isotope substage 5e) (after Grichuk 1984) (study area outlined).

interglacial sediments (i.e, oxygen-isotope stage 11) as Last Interglacial (substage 5e) sediments.

Palynological reconstructions suggest that a birch-dominated taiga blanketed most of subarctic Siberia (60-66°N) during the Kazantsev, although higher elevations of the northcentral Siberian Plateau were probably covered by alpine meadows and tundra. Landscapes across south Siberia were dominated by mixed birch-coniferous forests with minor deciduous elements (including oak, maple, elm, and hazelnut). The Altai and Saian mountains were covered by a dense coniferous taiga of spruce, fir, and pine. In the rain shadow of the Saian Mountains along the upper Yenisei, Angara, and lower Selenga Rivers there may have been "islands" of dry, treeless steppe; however, the area west of Novosibirsk that today makes up the Barabin, Kulundin, and Ishit steppes was blanketed by a vast forest-steppe that extended west to the Russian Plain. The treeless central Asian steppe was limited to Kazakhstan and the western foothills of the Altai.

Siberia during the Kazantsev Interglacial, then, was warm and mesic, perhaps slightly warmer than in modern times. Sea level was higher, tree line was farther north, and the central Asian steppe and desert was greatly reduced. Temperate-loving, deciduous trees were present across south Siberia, indicating that annual temperatures likely averaged 5°C higher than now (Derevianko et al. 1990b).

### The Zyrian Glacial, 118,000-75,000 B.P.

Following the Last Interglacial, global temperatures gradually dropped from 118,000 to 75,000 B.P. (the Early Glacial, oxygen-isotope substages 5d-5a), culminating with the onset of full glacial conditions from 75,000 to 60,000 B.P. (the Early Pleniglacial, oxygen-isotope stage 4). The Early Glacial is characterized by global climates oscillating between relatively cool (substages 5d and 5b) and relatively warm (substages 5c and 5a) (Gamble 1986:82; Nilsson 1983:256). Two cold "spikes" appear short lived and occurred around 110,000 and 90,000 B.P. (Dawson 1992:20; Gamble 1986:85) (Fig. 2.5).

The ensuing shift to full glacial conditions is clearly marked in the oxygen-isotope record as stage 4; however, it persisted no more than 15,000 years, from 75,000 to 60,000 B.P. Nonetheless, ocean levels dropped significantly, and glacial buildup reached record high volumes for the Upper Pleistocene in northern Asia and perhaps North America (Dawson 1992:44,60). In Siberia glaciers advanced from multiple centers over the Kara Sea Shelf, Central Siberian Plateau, and Altai, Saian, Stanovoi, and Verkhoiansk mountains. During the Early Glacial the vast forests of the Kazantsev underwent gradual degradation, and during the Early Pleniglacial they were fully replaced by treeless, periglacial steppes and polar deserts in the north, and by semi-arid steppes and forest-steppes in the south.

### *North Siberia*

Zyrian-aged glacial deposits are locally assigned to the Ermakovo Glacial in northwest Siberia (Arkhipov 1989:26; Fainer and Komarov 1986:29), and to the Muruktin Glacial in northcentral Siberia (Isaeva et al. 1986:13). Such deposits, however, are rare; most Zyrian-aged moraines and outwash terraces were destroyed during later Upper Pleistocene glacial advances. For this reason the extent of glaciation in northwest Siberia during the Early Pleniglacial has long been, and continues to be, a topic of debate among Russian Quaternary geologists (see Dawson 1992:47-49; Fainer and Komarov 1986:29). Arkhipov (1984), Grosswald (1977), and Isayeva (1984), on the one hand, argue that the Kara Sea Shelf was extensively glaciated, bridging ice sheets covering the Barents Sea to the west and the Central Siberian Plateau to the east. According to this model of glacier expansion, ice advanced as far south as the confluence of the Ob' and Kazym rivers, damming the Ob' and creating an immense proglacial lake that submerged 1.5 million $km^2$ of the West Siberian Plain (Fig. 2.12). Velichko et al. (1984), on the other hand, hold that the Zyrian glacial maximum was too short to have allowed the coalescence of a single "superdome" of ice across the Eurasian north, and that the Kara Sea Shelf remained largely ice-free throughout the Upper Pleistocene.

There is now clear evidence, however, that in northwest Siberia along the lower Ob' River the Zyrian Glacial advance reached as far south as the Belogor'e narrows (64°N latitude), where it is represented by the Khashgort moraine, dating to about 70,000 B.P. (Arkhipov 1984:15, 1989:26). This moraine is underlain by an older Zyrian-aged glacial deposit, the Kormuzhikhant moraine (Arkhipov 1984:13, 1989:27). The Kormuzhikhant moraine lies on Kazantsev sediments TL dated to 130,000 ± 25,000 B.P., and its base has been TL dated to 100,000 ± 17,000 and 110,000 ± 25,000 B.P. (Arkhipov 1989:27). South of Belogor'e along the Ob' River, Arkhipov (1984:17, 1989) and others (Goncharov 1991:66; Isayeva 1984:27) have also identified a number of lacustrine deposits interbedded with Kormuzhikhant and Khashgort-aged glacial deposits. This evidence strongly suggests that during these glacial advances, ice dammed the lower Ob' River and extensively flooded the West Siberian Plain.

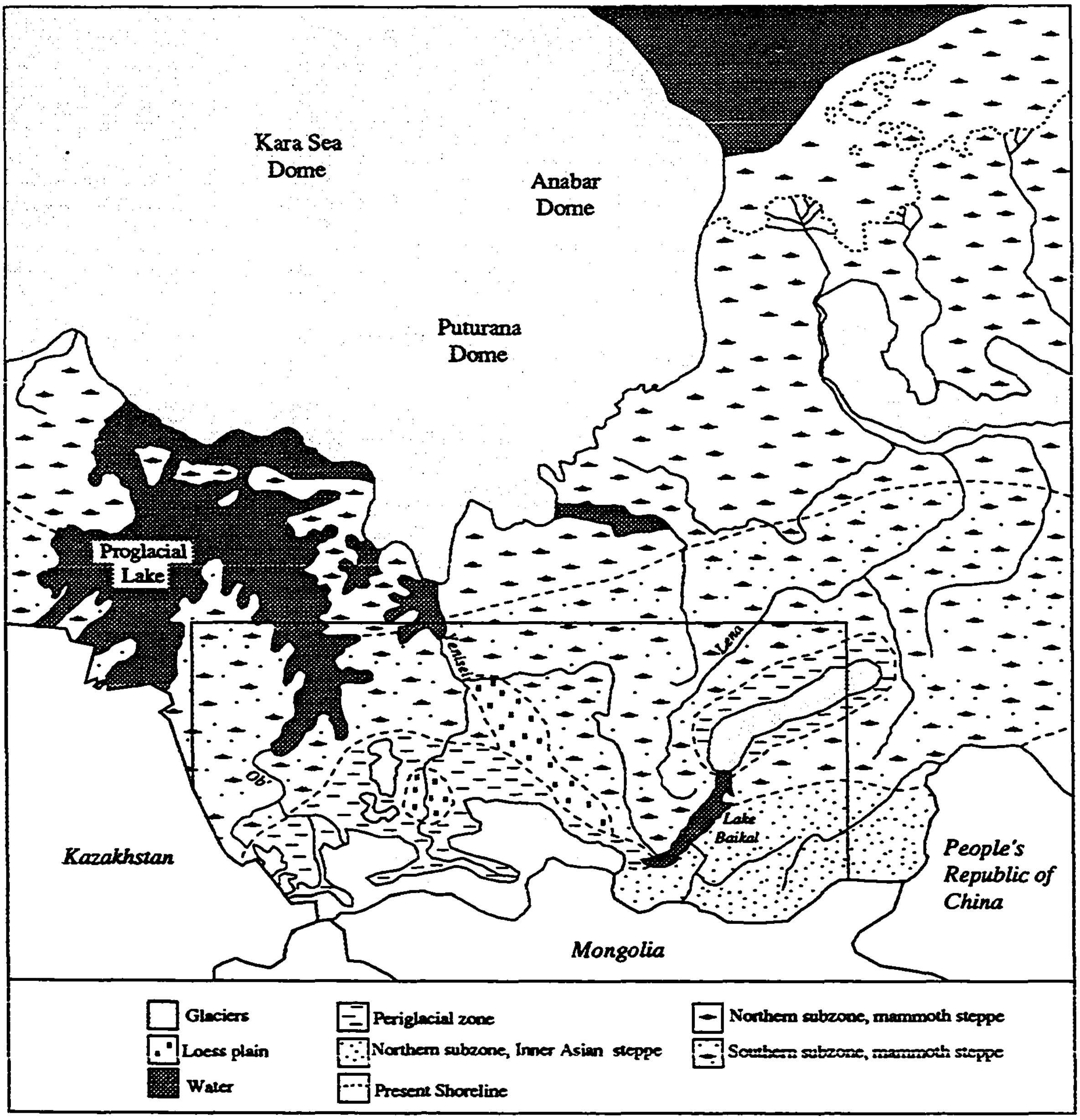


**Fig. 2.12.** Siberia during the Zyrian glacial maximum, 70,000 B.P. (after Arkhipov 1984; Derevianko et al. 1990b; Fainer and Komarov 1986; Goncharov 1991; Isayeva 1984) (study area outlined).

In northcentral Siberia, the Zyrian ice sheet advanced even further south than in northwest Siberia. Glacial moraines dating to this period have been identified along the Yenisei and Elogui rivers as far south as the village of Komsa, 62°N latitude (Fainer and Komarov 1986:34; Goncharov 1991:66). Like on the Ob', this "finger" of the north Eurasian ice sheet appears to have dammed the middle Yenisei basin, as well as the Nizhnaia Tunguska basin to the east (Arkhipov 1984:17; Goncharov 1991:66; Isayeva 1984:27). Lacustrine sediments assigned to the Zyrian and later Sartan glacials have been identified at ten localities along the Yenisei and Elogui rivers; these deposits occur at elevations of 80, 120, and 160 m above sea level, and are interdigitated with different-aged glacial moraines (Goncharov 1991:66). Thus, the flooding of the Yenisei and perhaps the Ob' basins occurred more than once during the Upper Pleistocene. This new evidence from northwest and northcentral Siberia clearly supports a model of extensive Zyrian glaciation, as originally suggested by Grosswald (1977).

Paleobotanical remains from the Zyrian Glacial of north Siberia are scarce. At Belogor'e narrows, lying between the Early Glacial and Pleniglacial Khashgort and Kormuzhikhant moraines, Arkhipov (1989:27-29) describes lake sediments (the Bogdashin formation) containing three bands of peat with numerous macrofossils of Siberian spruce (*Picea obovata*), birch (*Betula*), spike moss (*Selaginella*), and spearwort buttercup (*Ranunculus flamulla*). TL dates include 80,000 ± 11,000 B.P. on the lowermost band of peat and 70,000 ± 15,000 and 65,000 ± 8,000 B.P. on the upper bands (Arkhipov 1984:13; Arkhipov 1989:27). These lacustrine peats appear to represent an early interstade of the Zyrian Glacial when climatic conditions were sufficiently warm to permit the development of a dark coniferous forest in northwest Siberia (>60°N latitude). The subsequent Khashgort (or Zyrian) glacial advance during the Pleniglacial led to the complete degradation of this forest and its replacement by a periglacial "tundra-steppe" (Arkhipov 1984:15). Accordingly, the Kormuzhikhant stade can tentatively be assigned to oxygen-isotope substage 5b, the Bogdashin interstade to substage 5a, and the Khashgort stade to stage 4 (Arkhipov 1989:29).

Pollen derived from alluvial deposits elsewhere in the north indicates that during the Zyrian glacial maximum (stage 4) the taiga was replaced by tundra (>65°N latitude) and forest-tundra (<65°N latitude) zones (Giterman et al. 1982:234). Isayeva (1984:27) characterizes these zones as a "peculiar periglacial tundra-steppe" dominated by herbaceous plants (Gramineae), wormwood (*Artemisia*), goosefoots (Chenopodiaceae), mosses (Lycopodiaceae, Selaginellaceae), and lichens. Farther south, shrubs and trees are added to the spectrum, including birch (*Betula*) and larch (*Larix*) in the northwest, and birch (*Betula*), larch (*Larix*), and alder (*Alnus*) in the northeast (Giterman et al. 1982:234).

### *Southwest Siberia*

During the Zyrian Glacial in southwest Siberia, terrace formation included the third (25-30 m) terrace of the Ob' River, the fourth (25-30 m) terrace of the Biia River

(Tseitlin 1979:42), and the third (30-45 m) terrace of the Yenisei River (Drozdov et al. 1990a:20; Abramova et al. 1991:24). In the Altai during the Zyrian Glacial, mountain valley glaciers expanded to their maximum size for the Upper Pleistocene (Fig. 2.12) (Borisov 1984), and in some valleys (eg., the Katun') proglacial lakes formed (Baryshnikov 1990; Derevianko et al. 1990b:19). Locally this advance is referred to as the Chibit Glacial and is considered coeval with the Zyrian of north Siberia (Derevianko et al. 1990b:19). In the Saian Mountains of southcentral Siberia mountain valley glaciers also expanded and coalesced along the banks of the upper Yenisei River in the Tuva depression (Abramova et al. 1991).

Loess accumulation intensified in the steppe and foothills zones surrounding Barnaul, Novosibirsk, and Tomsk. The Upper Berd Soil developed during an interstade of the Early Glacial (substage 5c or 5a) (Volkov and Zykina 1982, 1984). This paleosol, found throughout the region, is a 70-cm thick meadow chernozem with distinct A and Bk horizons (Volkov and Zykina 1984:120). Stratigraphically it lies 0.5-1 m above the Lower Berd Soil of the Last Interglacial (Fig. 2.7). It is broken by a series of dessication cracks up to 3 m deep and 2 cm wide. These cracks, as well as the Tula Loess, a 1.5-m to 2.5-m thick formation of unweathered, massive, and cryoturbated loess, likely represent the full glacial conditions of the Zyrian (Early Pleniglacial) (Volkov and Zykina 1982:22-23, 1984:121).

In the middle Yenisei area, two stratigraphically separate soils formed during the Early Glacial, the Lower Sukhoi Log and Upper Sukhoi Log soils (Fig. 2.8) (Zykina 1992). Both are relatively thin, weakly-developed chernozem-like soils breached by small ice wedge pseudomorphs. Zykina (1992) suggests they formed at the same time as the Upper Berd Soil of southwest Siberia; the Lower Sukhoi Log Soil is assigned to oxygen-isotope substage 5c, and the Upper Sukhoi Log Soil substage 5a. The ensuing full glacial (stage 4) is represented by nearly 4 m of unweathered, heavily cryoturbated loess.

Vegetation in the Altai Mountains consisted of tundra, tundra-steppe, and forest-tundra zones; shrub birch (*Betula*), larch (*Larix*), joint firs (*Ephedra*), heathers (*Calluna*), and goosefoots (Chenopodiaceae) were common (Derevianko et al. 1990b:20). Outside the Altai in the foothills and plains of southwest Siberia, a vast, cryoxeric grass-herb steppe blanketed the landscape.

Along the Yenisei during the Early Glacial, forests underwent gradual degradation and replacement by a forest-tundra of tree and shrub birch (*Betula*), larch (*Larix*), and alder

(*Alnus*) (Abramova et al. 1991:25). As glaciers in the Saian Mountains expanded, this forest-tundra was in turn supplanted by a periglacial steppe dominated by herbaceous plants (Gramineae), wormwood (*Artemisia*), goosefoots (Chenopodiaceae), and ephedra (Ephedraceae) (Abramova et al. 1991:25).

*Southeast Siberia*

During the Zyrian Glacial the Baikal region was for the most part ice-free. Mountain glaciers expanded from a single isolated center located in the Stanovoi Mountains in the northern Transbaikal (Figure 2.12) (Bazarov 1986:160). The mountains surrounding the southern portion of Lake Baikal (the Morsk, Ulan-Burgasu, Kurbinsk, and Khamar-Daban ranges), as well as the Selanga River basin, remained unglaciated (Rezanov 1986). During the Early Glacial, rainfall increased and snowline was lowered in the Baikal mountains, while in the Early Pleniglacial, conditions became increasingly arid (Rezanov 1986:8-9). Zyrian landforms include the fourth (23-27 m) terrace of the Angara River (Tseitlin 1979:148), and the third (10-12 m) terrace of the Selenga River and its tributaries (Imetkhenov and Savinova 1987:32; Rezanov 1986:9).

Two Early Glacial soils are known from the southern Angara region (Fig. 2.10) (Vorob'eva 1992). The earlier of the two is referred to as the Upper Igetei Soil of the Igetei Pedocomplex (Medvedev et al. 1990:111; Vorob'eva 1992:46-48; Vorob'eva and Medvedev 1984:30,32). This soil is widespread but less humified than the Lower Igetei Soil of the Last Interglacial. It appears as either a 1.0-m thick brown to gray forest soil, or, less frequently, as a saline chernozem (Medvedev et al. 1990:12). It typically displays a columnar structure with small dessication cracks; solifluction features are absent (Vorob'eva and Medvedev 1984:30). The character of this soil suggests that the Early Glacial in southeast Siberia was a period of increasing aridization leading to the expansion of a dry steppe (Vorob'eva and Medvedev 1984:30). The second Early Glacial paleosol is an undeveloped gray forest soil referred to as the Baigan Soil (Medvedev et al. 1990:tablitsa 1). It likely formed during a late interstade of the Early Glacial when climatic conditions were less warm than in previous interstades. Stratigraphically, the Upper Igetei and Baigan soils are assignable to oxygen-isotope substages 5c and 5a, respectively.

Full glacial conditions along the Angara and Upper Lena rivers were extremely harsh. In numerous stratigraphic sections this period is represented by a lag deposit that formed as a result of extremely strong winds, a lack of vegetation cover, and the deflation of sediments (Aksenov 1989a; Medvedev et al. 1990; Tseitlin 1979:168; Vorob'eva and Medvedev 1984). Frequently the Baigan Soil and other Early Glacial deposits were swept away and replaced by a thin band of residuum consisting of material too heavy to be moved by wind. These "lag" deposits are made up of sandblasted cobbles, pebbles, and, as at the Makarovo-4 and Sosnovyi Bor sites, lithic artifacts (Aksenov 1989a; Tseitlin 1979).

Vegetation history of the Early Glacial and Pleniglacial in southeast Siberia follows patterns recorded for southwest Siberia. Along the Angara and upper Lena two vegetation zones formed, a periglacial zone and a mountain-intermountain zone (Belova 1985:120-121). The periglacial zone was widely distributed throughout the area, especially along major rivers. Subarctic species were common, including fir club moss (*Lycopodium selago*), alpine club moss (*L. alpinum*), bog bilberry (*Vaccinium uliginosum*), alpine mountain sorrel (*Oxyria didyna*), and viviparous bistort (*Polygonum viviparum*). Herbaceous plants were dominated by ephedra (*Ephedra monosperma*), herbaceous plants (Gramineae), sedges (Cyperaceae), goosefoots (Chenopodiaceae), composites (Compositae), and wormwood (*Artemisia*). Few boreal species thrived; these include dwarf birch (*Betula exilis*), Siberian spike moss (*Selaginella sibirica*), and Dahurian larch (*Larix gmelinii*). This interesting mix of tundra, steppe, and boreal species indicates the presence of an arid "tundra-steppe" (Belova 1985) or "mammoth-steppe," which today has no analog in northern Eurasia (Guthrie 1990).

The mountain-intermountain vegetation zone was distributed over the mountain ranges of the Baikal region (Belova 1985:121). Commonly represented in this zone were arctic-alpine species such as polar willow (*Salix polaris*), caespitosa willow (*S. caesia*), few-flowered sedge (*Carex pauciflora*), alpine pondweed (*Potamogeton alpinus*), and crowfoot (*Ranunculus pedatifidus*). Infrequently, trees occurred, including Scots pine (*Pinus silvestris*), Siberian stone pine (*P. sibirica*), Japanese stone pine (*P. pumila*), Siberian fir (*Abies sibirica*), Siberian spruce (*Picea obovata*), middendorff birch (*Betula middendorfii*), dwarf birch (*B. exilis*), and Dahurian larch (*Larix gmelinii*). By all indications, then, these mountain-intermountain areas were covered by a forest-tundra, suggesting slightly more mesic conditions than in the lowland periglacial zones.

New palynological studies in the Selenga, Chikoi, and Ingoda valleys (Bazarov 1986:161-162; Belova 1985:121) suggest that the Transbaikal region did not witness such harsh periglacial conditions as the Cisbaikal. A number of pollen profiles demonstrate that herbaceous plants characterized the landscape, including wormwood (*Artemisia*), goosefoots (Chenopodiaceae), herbaceous plants (Gramineae), and composites (Compositae). Shrubs and trees were also present in smaller numbers (Belova 1985:121; Imetkhenov and Savinova 1987:32), including dwarf birch (*Betula exilis*), Dahurian larch (*Larix gemelinii*), and pine (*Pinus*). Tundra plants are absent.

The character of the region's flora, as well as the peculiar absence of cold-loving fauna (eg. musk ox [*Ovibos moschatus*], lemmings [*Lemmus obensis, Dicrostonyx torquatus*], polar fox [*Alopex lagopus*], and caribou [*Rangifer tarandus*]) in the region's paleontological or archaeological sites (Bazarov 1986:161-164), points to the existence not of a periglacial "mammoth-steppe," but of a less cryoxeric "Inner Asian" steppe. The Transbaikal appears to have been a northern component of a vast "supercontinental" steppe that stretched across all of Interior Asia during the Early Pleniglacial (Bazarov 1986:164).

### *Discussion*

This review of Siberian Early Glacial and Pleniglacial vegetation and climate demonstrates that the various regional proxy records closely follow patterns seen in the global oxygen-isotope record. First, there is evidence of one to two relatively warm interstadials during the Early Glacial. Arkhipov (1989) presents clear paleobotanical evidence demonstrating the occurrence of interstadial conditions in subarctic northwest Siberia around 80,000-70,000 B.P. In south Siberia, conditions during the Early Glacial were sufficiently warm to permit the formation of the Upper Berd Soil along the upper Ob' River (Volkov and Zykina 1982), the Lower and Upper Sukhoi Log soils along the Yenisei River (Zykina 1992), and the Upper Igetei and Baigan soils along the Angara River (Medvedev et al. 1990). Based on their stratigraphic positions, these successive periods of Early Glacial soil formation likely correlate to oxygen-isotope substages 5c and 5a, respectively.

The Zyrian glacial maximum (stage 4) was a brief interval of extremely cold and arid conditions. Ice caps in the north as well as mountain glaciers in the south reached their maximum sizes for the Upper Pleistocene (Dawson 1992; Velichko 1984), blocking the flow of Siberia's major northward-flowing rivers, the Ob' and Yenisei. Large proglacial lakes formed, submerging most of west Siberia under approximately 100 m of water (Arkhipov 1984; Goncharov 1991). The rest of unglaciated Siberia was blanketed by a cryoxeric mammoth-steppe, except for isolated periglacial regions of the Cisbaikal where arctic desert conditions prevailed. Deep mantles of loess accumulated along the upper Ob' and Yenisei River valleys, and in the southern Angara and upper Lena regions intense winds deflated unconsolidated sediments and sandblasted cobble-pebble surfaces along terrace edges. The Transbaikal, finally, appears to have been somewhat warmer than the rest of south Siberia, yet hyperarid.

## The Karga Interglacial, 60,000-25,000 B.P.

According to the oxygen-isotope record, the Early Pleniglacial was followed by a period of sustained warmer temperatures, commonly referred to as the Middle Pleniglacial, or stage 3 (Bradley 1985:187). During this period, which persisted from 60,000 to 25,000 B.P., several interstadials occurred; these were interrupted by brief episodes of cooler climate. Optimal conditions for the Middle Pleniglacial appear to have occurred at about 55,000-50,000 B.P., with each successive interstade becoming progressively cooler. At no time during the Middle Pleniglacial, however, were global temperatures as warm as during the Last Interglacial.

In Siberia the Middle Pleniglacial, or "Karga Interglacial," maintains interglacial status (Kind 1974). This partitioning of the Siberian Upper Pleistocene into two interglacial/glacial cycles (i.e., the Kazantsev-Zyrian and the Karga-Sartan) is based on a series of paleoenvironmental records from throughout north Asia that appear to reveal that temperatures during the Middle Pleniglacial were as warm as or warmer than temperatures today (Abramova et al. 1991:25; Kind 1974). Some geologists, however, follow European reconstructions by treating the Karga as a mid-Upper Pleistocene interstadial, and therefore do not separate the Zyrian and Sartan into distinct glaciations. According to this framework, the Upper Pleistocene (excluding the Last Interglacial) is subsumed within a Zyrian "Superhorizon," including Lower (or Murukta), Middle (or Karga), and Upper (or Sartan) Zyrian horizons (Arkhipov and Shelkoplias 1982:12; Arkhipov 1984:14; Isayeva 1984:21). Although this system of classification may more closely follow the global climatic record, it does not appear to accurately reflect Siberia's regional glacial, loess, and paleobotanical records for the Middle Pleniglacial. In the present study, the Karga is treated as an interglacial separate from the Zyrian and Sartan Glacials; however, the interglacial status of the Karga is considered provisional, due to shortcomings in dating correlations. Numerous reconstructions of the Karga as an interglacial are based on radiocarbon dates that approach the limit of radiocarbon dating (40,000-30,000 B.P.). These deposits actually could be much more ancient, as old as or older than the Kazantzev Interglacial (128,000-118,000 B.P.). The outline and reconstruction of the Karga presented below, then, is based exclusively on the past work of Siberian Quaternary scientists. These results are tentative, and in the future will surely change as non-radiocarbon dating methods are applied in building a geochronological framework for the Siberian Middle Pleniglacial.

Kind (1974) proposes the following chronology of stades and interstades for the Karga Interglacial, on the basis of conventional radiocarbon dating of mid-Upper Pleistocene sediments throughout the Yenisei and Lena basins (Fig. 2.13). The Karga began with an "Early Interstade" around 50,000 to 45,000 B.P., followed by a brief cold episode, the "Early Stade," from 45,000 to 43,000 B.P. The Malokheta Interstade, a warm period considered the optimum of the Karga Interglacial, continued from 43,000 to 35,000 B.P. This was followed by a brief episode of cooler climate, the Konoshchel'e Stade, which occurred from 34,000 to 31,000 B.P. The final warm interval of the Karga Interglacial, the Lipovsko-Novoselovo Interstade, continued from 31,000 to 25,000 B.P. (Kind 1974). Tseitlin (1979:14) argues that this division of the Karga Interglacial is confirmed with numerous data sets from throughout Siberia, in spite of the fact that the earliest unamed interstade and stade are not yet well-established, and that conventional radiocarbon dates on Malokheta and Konoshchel'e deposits fall perilously close to the limit of this dating method.

### *North Siberia*

The mid-Upper Pleistocene of northwest Siberia is marked by the Karga or Kharsoim Transgression (Andreeva 1980:183; Arkhipov 1989:26; Bylinskii 1982:274). Karga marine terraces occur at the mouth of the Ob' River, and suggest that the level of the Siberian coastline during the Middle Pleniglacial was close to that of today (Danilov 1982; Hopkins 1982). According to Bylinskii (1982:274), however, this transgression was not extensive; the rising Kara and Laptev seas spread only along major river valleys and across low-lying divides. ESR and $^{14}C$ dates run on foraminifera and wood, respectively, from seven terrace exposures across the northwest Siberian coastline range from 60,000 to 40,000 B.P. (Arkhipov 1989:26). More detailed studies are needed to ascertain whether these deposits represent a single Karga transgression or a series of two

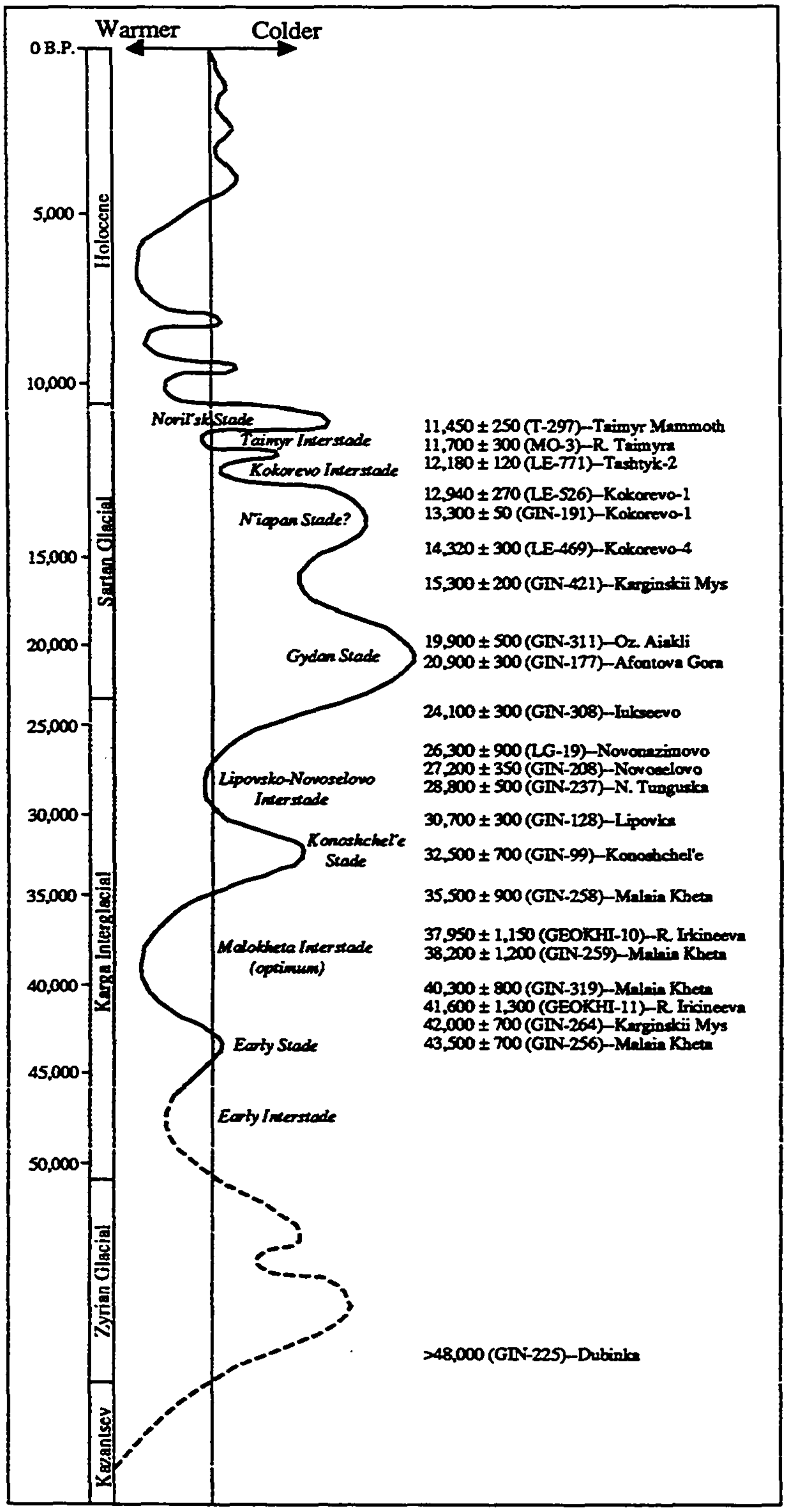


**Fig. 2.13.** Hypothetical temperature curve and geochronology of the Karga Interglacial and Sartan Glacial, with radiocarbon dates from lower and middle Yenisei valley (with radiocarbon dates [B.P.]) (after Kind 1974:109).

or three transgressions that may correspond to Kind's (1974) Early, Malokheta, and Lipovsko-Novoselovo interstades.

Arkhipov (1984:13-14), working in the Salekhard region of the lower Ob' River, describes three sediment packets assigned to three subhorizons of the Karga Interglacial: the Kharsoim interstade, Lokhpodgort stade, and Karginsk interstade. Kharsoim interstadial deposits include transgressive estuarine and marine clays interbedded with peats $^{14}C$ dated to >40,000 B.P. Paleobotanical remains from the peats indicate the lower Ob' basin was densely forested during the early Karga; today this area supports only a forest-tundra vegetative cover. Climatic conditions appear to have been milder during this period of the Middle Pleniglacial than they are at present (Arkhipov 1984:17). Resting on Kharsoim sediments at the mouth of the Ob' River are morainal and glacio-lacustrine facies assigned to the Lokhpodgort stade. These sediments have been $^{14}C$ dated to 39,900 ± 80 (SOAN-681) and 37,850 ± 80 B.P. (SOAN-658) (Arkhipov 1984:14). They are overlain by the Karginsk formation, a packet of alluvial sands and clays with lenses of peat $^{14}C$ dated to 29,500 ± 520 (SOAN-974) and 25,900 ± 240 B.P. (SOAN-671) (Arkhipov 1984:14). Paleobotanical remains from these peats indicate a forest-tundra vegetation similar to that seen in the area today (Arkhipov 1984:17). When taken at face value, the stratigraphic positions and $^{14}C$ dates of the Kharsoim marine sediments and Lokhpodgort glacial moraines suggest a correlation to Kind's (1974) "Early Interstade" and "Early Stade" of the Karga Interglacial, respectively, while the Karginsk peats appear to correspond to Kind's (1974) Lipovsko-Novoselovo Interstade. The $^{14}C$ dates, however, should be treated as minimum age estimates; the Kharsoim and Lokhpodgort deposits could just as easily be assigned to the Last Interglacial (substage 5e).

In the far north of central Siberia along the Bolshaia Baty-Sal River (a tributary of the Khatanga River), Andreeva (1980:186) describes a geologic section with three putative Middle Pleniglacial marine transgressions. The lowermost transgressive sequence lies stratigraphically above sediments assigned to Zyrian Glacial, and has been $^{14}C$ dated to 50,000-44,000 B.P. The the second transgression has been $^{14}C$ dated to 42,000-33,000 B.P., while the third has not been $^{14}C$ dated (Fig. 2.14). Andreeva (1980:183) uses the radiocarbon chronology to sugest that sea level rose along the north Siberian coast at least three times during the Middle Pleniglacial, during the Early, Malokheta, and Lipovsko-Novoselovo interstades (Andreeva 1980:183). Other dating methods, however, are needed to confirm such a reconstruction.

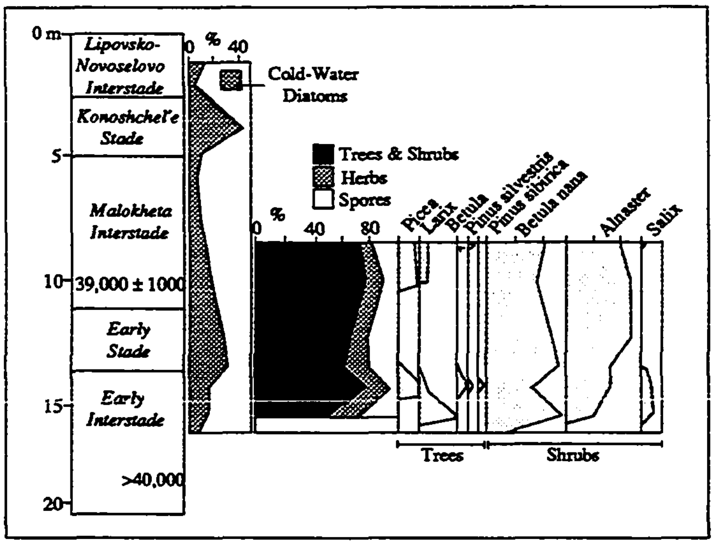


**Fig. 2.14. Pollen diagram of Karga marine sediments along the Bolshaia Baty-Sal River, north Siberia (with radiocarbon dates [B.P.]) (after Andreeva 1980).**

Marine diatoms from the sediments at Bolshaia Baty-Sal indicate that the Laptev Sea was relatively warm and perhaps warmer during interstadials (Fig. 2.14) (Andreeva 1980:186-187). Accompanying palynological data demonstrate that trees and shrubs thrived on the surrounding landscape during these interstades, with spruce (*Picea*), larch (*Larix*), Scots pine (*Pinus silvestris*), birch (*Betula*), willow (*Salix*), and Siberian stone pine (*Pinus sibirica*) dominating the pollen spectrum (Fig. 2.14). Herbs including grass (Gramineae), wormwood (*Artemisia*), and sedge (Cyperaceae) also occurred, but less frequently.

This evidence suggests that during the time of the deposition of these deposits, arctic Siberia was forested, and that temperatures were warmer than at present (Andreeva 1980:191). Today tree line lies about 100 km south of Bolshaia Baty-Sal (Baranov 1969; Giterman et al. 1982:235), and the nearest spruce grow 500 km south (Isayeva 1984:28). Reliable assignment of these interstades to the Middle Pleniglacial (as suggested by Andreeva [1980]), or to the earlier Last Interglacial, however, must await the application of dating techniques other than radiocarbon.

### *Southwest Siberia*

During the early Karga, mountain glaciers receded in the Altai and Saian mountains. Along the Biia River, the third (18-20 m) terrace formed (Tseitlin 1979:42). Loess deposition decreased in the foothills and steppe zones, leading to the formation of the Isitkim Pedocomplex, a set of two paleosols found throughout the Ob' basin (Fig. 2.7) (Volkov and Zykina 1982:22-23, 1984:121-123). The Lower Isitkim Soil is a well-developed though soliflucted and cryoturbated chernozem with distinct A, B, and Ck horizons. It has been $^{14}C$ dated to 33,100 ± 1,600 (SOAN-165) (on charcoal), 30,050 ± 850 (SOAN-1587) (on charcoal), 32,780 ± 670 (SOAN-629) (on a woolly rhinoceros skull), 30,000 ± 1,000 (IGAN-169) (on humic acids), and 29,000 ± 450 B.P. (IGAN-168) (on humic acids) (Volkov and Zykina 1984:122). The two humic acid dates are considered anomalously young; they were likely contaminated by younger carbon (Volkov and Zykina 1984:122). The same could be argued for the charcoal dates, since they too approach the effective limit of $^{14}C$ dating. The Upper Isitkim Soil is also a chernozem; however, it is less developed and more heavily soliflucted and cryoturbated than the Lower Isitkim Soil. It consists of an illuvial B horizon and a carbonated Ck horizon (Volkov and Zykina 1982:23). Radiocarbon dates are 24,490 ± 320 (SOAN-1623) (charcoal), 26,300 ± 700 (IGAN-167) (humic acids), and 24,300 ± 380 B.P. (IGAN-199) (humic acids) (Volkov and Zykian 1984:123). Based on the $^{14}C$ dates, Volkov and Zykina (1984:123) assign the Lower and Upper Isitkim soils to the Malokheta (43,000-35,000 B.P.) and Lipovsko-Novoselovo interstades (30,000-25,000 B.P.), respectively.

In the middle Yenisei valley two stratigraphically separate paleosols formed, the Lower Kurtak and Upper Kurtak soils. These belong to the Kurtak Pedocomplex, and appear as either chernozem-like soils or gray forest soils (Fig. 2.8) (Zykina 1992). At the Kashtanka archaeological site near the village of Kurtak, wood charcoal from the Upper Kurtak Soil has been conventionally $^{14}C$ dated to 23,830 ± 550 (IGAN-1050) and 24,400 ± 1,500 B.P. (IGAN-1048) (A. Bokarev, pers. comm.). Zykina (1992:104) also reports a date of 29,410 ± 310 B.P. for this pedocomplex, (although she does not specify which soil this date refers to). Likely the Upper Kurtak Soil formed during the Lipovsko-Novoselovo interstade (30,000-25,000 B.P.), and the Lower Kurtak Soil, given its stratigraphic position, formed during the Malokheta Interstade (43,000-35,000 B.P.).

The paleobotanical record from southwest Siberia indicates warm conditions persisted throughout most of the Karga Interglacial. A detailed palynological record for this period has been obtained from floodplain sediments upon the lower portion of the second (16-18 m), early Zyrian terrace of the Irtysh River, near the village of Zagvozdino (Fig. 2.15) (Volkova and Nikolaeva 1982). Karga sediments include a series of bedded sands, silts, and loams nearly 12 m thick. A $^{14}C$ date of 44,620 ± 110 B.P. (SOAN-1894)

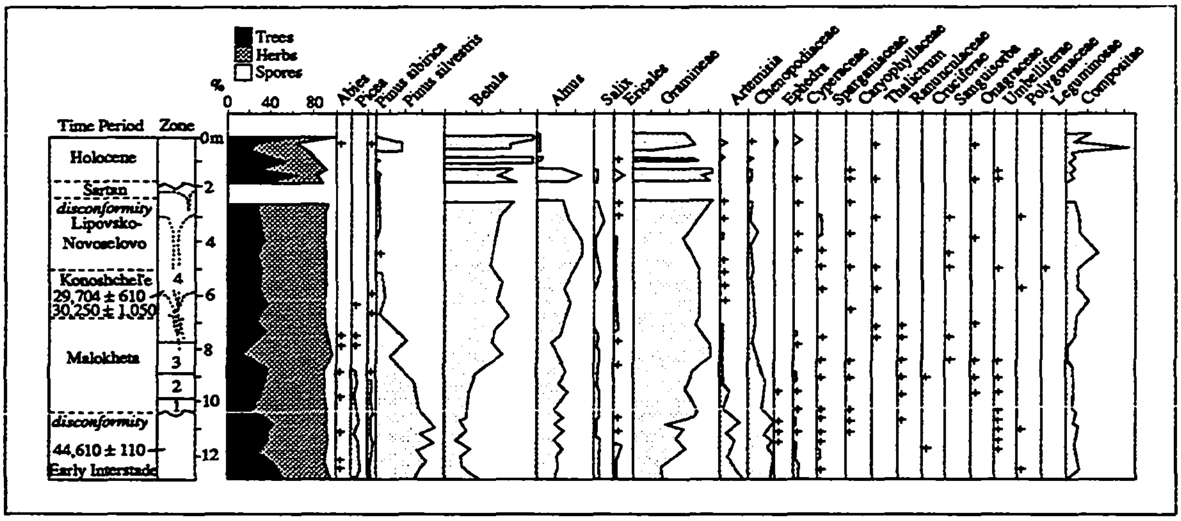


**Fig. 2.15.** **Pollen diagram of Karga alluvial sediments at Zagvozdino, Irtysh River basin (with $^{14}C$ dates [B.P.]) (after Volkova and Nikolaeva 1982).**

was obtained on plant remains from near the base of the profile immediately below a major disconformity; this level is accordingly assigned to the Early Interstade of the Karga (50,000-45,000 B.P.), but could easily be much older, perhaps as old as the Last Interglacial (128,000-118,000 B.P.). Two meters above the disconformity, in association with a series of ice wedge pseudomorphs, $^{14}C$ dates of 30,250 ± 1,050 (SOAN-43) and 29,704 ± 610 B.P. (SOAN-1004) have been obtained (dated materials not reported). The cryogenic cracks and wedges appear to have formed during the Konoshchel'e Stade (34,000-31,000 B.P.) (Volkova and Nikolaeva 1982:84,88).

The pollen record from Zagvozdino above the disconformity is divided into four successive vegetation zones (Fig. 2.15). Zone 1 is dominated by herbaceous plants (Gramineae), goosefoots (Chenopodiaceae), and wormwood (*Artemisia*), while tree pollen (spruce [*Picea*], birch [*Betula*], and pine [*Pinus*]) occurs less frequently and may be redeposited. This zone indicates the presence of a xeric "Gramineae-*Artemisia* steppe" (Volkova and Nikolaeva 1982:85), and likely represents the Early Stade of the Karga Interglacial (45,000-44,000 B.P.). Zone 2 records an increase in tree pollen, especially pine (*Pinus*) and birch (*Betula*). Herbaceous plants (Gramineae) and goosefoots (Chenopodiaceae) are also common, indicating the formation of a "forest-steppe" at this time (likely the Malokheta interstade) (Volkova and Nikolaeva 1982:85). Zone 3 registers a slight increase in herbaceous plants (Gramineae) and a sharp increase in shrubs (shrub birch [*Betula*], alder [*Alnus*], and willow [*Salix*]), and may represent cooler conditions of the Konoshchel'e Stade. Zone 4 includes sediments 8 to 2 m below the surface. This zone is characterized as a "forest-steppe" based on high frequencies of birch (*Betula*), alder (*Alnu* sp.), pine (*Pinus*), and spruce (*Picea*), as well as relatively high frequencies of herbaceous plants (Gramineae), composites (Compositae), goosefoots (Chenopodiaceae), and wormwood (*Artemisia*) (Volkova and Nikolaeva 1982:85). Volkova and Nikolaeva (1982) assign Zone 4 to the Lipovsko-Novoselovo Interstade of the Late Karga.

In the Altai, pollen spectra from Middle Pleniglacial indicate the spread of a dark coniferous-birch taiga, again indicating conditions warmer than at present (Derevianko et al. 1990b:20). According to Belova (1985:134), vegetation in the Yenisei basin was characterized by a rich and heterogeneous fir-spruce-pine forest. In the vicinity of Krasnoyarsk, Karga Interglacial pollen spectra are characterizedy by pine (*Pinus silvestris*), birch (*Betula*), and numerous deciduous species, including oak (*Quercus*), elm (*Ulmus*), and hazelnut (*Corylus*), as well as moderate amounts of grasses and herbs (Belova 1985:78). Near the mouth of the Podkamennaia Tunguska River, the landscape was mantled by a pine-birch forest-steppe with isolated stands of basswood (*Tilia*) and elm (*Ulmus*) (Laukhin 1982), and further north along the lower Nizhnaia Tunguska River, Tseitlin (1964) describes a forest pollen spectrum dominated by spruce (*Picea*) and pine (*Pinus*), with low frequencies of birch (*Betula*) and alder (*Alnus*). According to Belova (1985:78), all of this illustrates that conditions in southcentral Siberia during the Karga were temperate, and that a "pine-birch forest-steppe with deciduous elements" dominated the landscape.

### *Southeast Siberia*

During the Karga Interglacial in southeast Siberia, unconsolidated wind-blown sediments continued to accumulate upon terrace surfaces, although at a slower rate than during the Zyrian Glacial. In the southern Angara region this period is represented by a set of two paleosols grouped in the Osin Pedocomplex (Fig. 2.10) (Vorob'eva 1992). The Lower Osin Soil appears as a 0.8-m thick meadow-chernozem in the walls of gullies, and as a gray forest soil or chernozem on slopes and terrace surfaces (Medvedev et al. 1990:14, Tablitsa 1). The Upper Osin Soil is thinner (less than 0.6 m thick), less humified, and appears as a dark gray forest soil in walls of gullies and as a light gray forest soil on slopes (Medvedev et al. 1990:14, Tablitsa 1). Both the Upper and the Lower Osin Soils usually contain strong Ck horizons (Vorob'eva and Medvedev 1984).

Judging by the soils, during the Karga Interglacial, the southern Angara region was warm, mesic, and forested (Medvedev et al. 1990:14).

Karga-aged pollen cores from southeast Siberia are not well-known. At the Ust'-Kova archaeological site on the middle Angara River, a paleosol $^{14}C$ dated to about 30,000 B.P. contains pollen indicative of an open forest-steppe. The pollen spectrum is dominated by herbaceous plants (Gramineae), composites (Compositae), wormwood (*Artemisia*), and heaths (Ericaceae) (Belova 1985:77), while trees (<19% of the assemblage) include pine (*Pinus*), birch (*Betula*), and spruce (*Picea*) (Belova 1985:75-76). Near the village of Prospikino, 50 km west of Ust'-Kova, another Karga pollen spectrum indicates the presence of a "pine-spruce-fir taiga" with isolated stands of oak (*Quercus*), hazelnut (*Corylus*), and elm (*Ulmus*) (Belova 1985:78).

In the southern Angara region, pollen profiles from near the mouths of the Kuda River and Oka River have been described. These spectra are dominated by tree pollen, including spruce (*Picea*), Siberian pine (*Pinus sibirica*), pine (*Pinus*), and birch (*Betula*) (Belova 1985:78). In addition, Belova (1985:81-82) reports a detailed pollen study of Karga Interglacial peats and lake bottom muds exposed under the second (12-14 m) terrace of the Irkut River near the village of Tibel'ti. Three pollen zones for the Karga have been delineated (Fig. 2.16). Zone 1 includes pollen recovered from lake bottom muds $^{14}C$ dated to 40,060 $\pm$ 820 B.P. (SOAN-1592). This zone reflects a pine-spruce-birch taiga with fir (*Abies*) and deciduous elements, including hemlock (*Tsuga*), elm (*Ulmus*), basswood (*Tilia*), and oak (*Quercus*) (Belova 1985:81). Zone 2, including pollen from sandy loams overlying the lake muds, reflects a sharp change in vegetation. Herbaceous plants dominate, especially wormwood (*Artemisia*), goosefoots (Chenopodiaceae), and grasses (Gramineae), while trees (pine [*Pinus*], spruce [*Picea*], birch [*Betula*], and elm [*Ulmus*]) occur less frequently, reflecting more arid conditions and an open forest-steppe (Belova 1985:81). Zone 3, which includes pollen collected from a peat bed $^{14}C$ dated to 31,860 $\pm$ 370 B.P. (SOAN-1583), records a shift back toward more mesic, forested conditions. A number of deciduous species occur, including elm (*Ulmus*), hemlock (*Tsuga*), basswood (*Tilia*), and hazelnut (*Corylus*), in addition to pine (*Pinus*), spruce (*Picea*), fir (*Abies*), and birch (*Betula*) (Belova 1985:82). Belova (1985:84) assigns zones 1, 2, and 3 to the Malokheta Interstade (43,000-35,000 B.P.), Konoshchel'e Stade (34,000-31,000 B.P.), and Lipovsko-Novoselovo Interstade (30,000-25,000 B.P.), respectively.

In the Transbaikal conditions during the Karga Interglacial were warm and moderately humid, although drier than during the Kazantsev Interglacial (Bazarov et al.

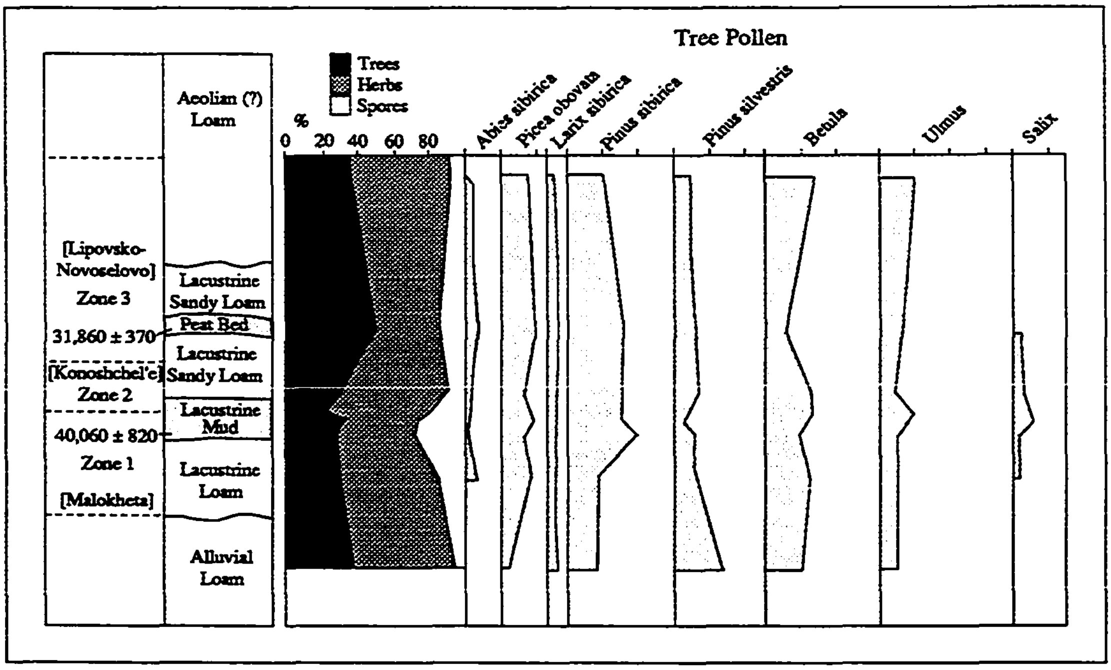


**Fig. 2.16. Pollen diagram of Karga lacustrine sediments at Tibel'ti, Irkut River basin (with radiocarbon dates [B.P] (after Belova 1985).**

1984:15; Rezanov 1986). Along the Selenga River, the second (9 m) terrace formed (Bazarov et al. 1984:15), and along the southern shore of Lake Baikal the upper part of the 10-12 m terrace formed (Imetkhenov and Savinova 1987:33). Loess accumulated on terraces during the colder stades of the Karga (Bazarov et al. 1984:15; Rezanov 1986). Vegetation along the Lower Selenga River and the southern shore of Lake Baikal was a dark coniferous forest with high frequencies of pine (*Pinus sibirica*), spruce (*Picea*), and fir (*Abies*), as well as moderate frequencies of pine (*Pinus*), birch (*Betula*), and alder (*Alnus*) (Bazarov et al. 1984:18; Imetkhenov and Savinova 1987:33; Rezanov 1986). The Uda, Khilok, and Chikoi River valleys, however, were mantled by a thin, pine-pine-birch forest-steppe (Bazarov et al. 1984:15; Belova 1985:78; Imetkhenov and Savinova 1987:33), with isolated stands of hazelnut (*Corylus*), walnut (*Juglans*), oak (*Quercus*), beech (*Fagus*), and elm (*Ulmus*) (Bazarov et al. 1984:15; Rezanov 1986). Steppe elements included wormwood (*Artemisia*), herbaceous plants (Gramineae), goosefoots (Chenopodiaceae), meadow rue (*Thalictrum* sp.), and aster (*Aster* sp.) (Belova 1985:84).

*Discussion*

The diverse proxy records presented above suggest that climatic conditions during the Middle Pleniglacial in Siberia reached interglacial proportions. In the north this period appears to be marked by a transgression that peaked nearly as high as in the Holocene, and tree line in the arctic encroached northward at least 100 km further than where it stands today. Across south Siberia, a series of soils formed, the Isitkim Pedocomplex along the Ob' River, the Kurtak Pedocomplex along the Yenisei, and the Osin Pedocomplex along the Angara. During the height of the Karga, southwest Siberia was covered with a forest-steppe and steppe, while nearly all of southeast Siberia was covered by a forest or forest-steppe.. Pollen from deciduous trees today exotic to the region have been encountered in pollen cores from all of south Siberia. All of this demonstrates that during the Karga Interglacial, average annual temperatures were 2-3°C warmer than in the Holocene.

The records also indicate that the Karga was a period of oscillating climate. In all regions there is evidence for at least two episodes when warm temperatures peaked, the Malokheta (43,000-35,000 B.P.) and Lipovsko-Novoselovo (31,000-25,000 B.P.). An Early Interstade is also noted in some records. This interstade lies at or beyond the limit of $^{14}C$ dating and therefore is not securely dated; however, it appears to fall within the period of 50,000 to 45,000 B.P. Sandwiched between these three warm intervals of the Karga are two brief stades when conditions deteriorated somewhat. These include an Early Stade (45,000-43,000 B.P.) and the Konoshchel'e Stade (34,000-31,000 B.P.). These are represented in the north by brief glacial advances, and in the south by episodes of intensified loess deposition and the cessation of soil development, as well as the formation of cryogenic cracks and wedges.

The preceding reconstruction of the Siberian Middle Pleniglacial, however, is for the most part based on a series of seemingly inacurrate radiocarbon age estimates. Clearly, radiocarbon dates greater than 30,000 B.P. should be treated as minimum dates, unless confirmed by other evidence. At present, this "prevailing" view of the Karga as an interglacial should be regarded as provisional, especially until geologic deposits and pollen profiles can be reliably dated through non-radiocarbon methods.

## SUMMARY: INTER-REGIONAL STRATIGRAPHIC CORRELATIONS

The development of an inter-regional geochronology for the Siberian Upper Pleistocene will aid in dating the Middle and early Upper Paleolithic sites of the region. Of all the available proxy records, the loess and paleosol chronologies from south Siberia provide the most complete and detailed record of Upper Pleistocene climate history, recording numerous episodes of alternating cold and warm conditions.

Three sections serve as regional reference profiles: (1) the Ob' composite profile (Fig. 2.7), (2) the Kurtak profile, Yenisei valley (Fig. 2.8), and (3) the Igeteiskaia Gora profile, Angara valley (Fig. 2.10). Especially informative is the Igeteiskaia Gora section, where a series of paleosols and cryogenic features occur in a deposit of aeolian sediments over 20 m thick. The following summary discussion offers proposed correlations between the regional reference profiles and the Siberian and global paleoclimatic records (Fig. 2.17). Because absolute dates from the profiles are lacking, inter-regional correlations are based chiefly on relative dating and paleoenvironmental indicators. At present only three horizons can be firmly assigned to the oxygen-isotope chronology: the last interglacial, Kazantsev soil (substage 5e), cryogenic deformation of the full Zyrian Glacial (stage 4), and the radiocarbon dated final Middle Pleniglacial (stage 3) soil. These "marker horizons" occur in the three regional profiles, as described below.

*Last Interglacial.* The Kazantsev Interglacial (oxygen-isotope substage 5e) is represented at Igeteiskaia Gora by the distinct Lower Igetei Soil. This chernozem is over 1 m thick and strongly humified. Although not absolutely dated, it reflects the warm, temperate conditions of the last interglacial. In southwest Siberia, this period is represented by the Kamennyi Log and Lower Berd soils in theYenisei and Ob' regions, respectively.

*Early Glacial.* At Igeteiskaia Gora the Kazantsev paleosol is broken by a series of massive ice wedge pseudomorphs and frost cracks. These likely formed at the beginning of the Zyrian Glacial (oxygen-isotope substage 5d), as climatic conditions became cooler and drier. The oxygen-isotope record date this "cold snap" to about 120,000-115,000 B.P. Elsewhere in Siberia this cooling episode is not well-documented; however, the Lower Berd Soil on the Ob' River, like the Lower Igetei Soil, is severely broken by a generation of cryogenic cracks and wedges. These features probably signal the beginning of the Zyrian Glacial.

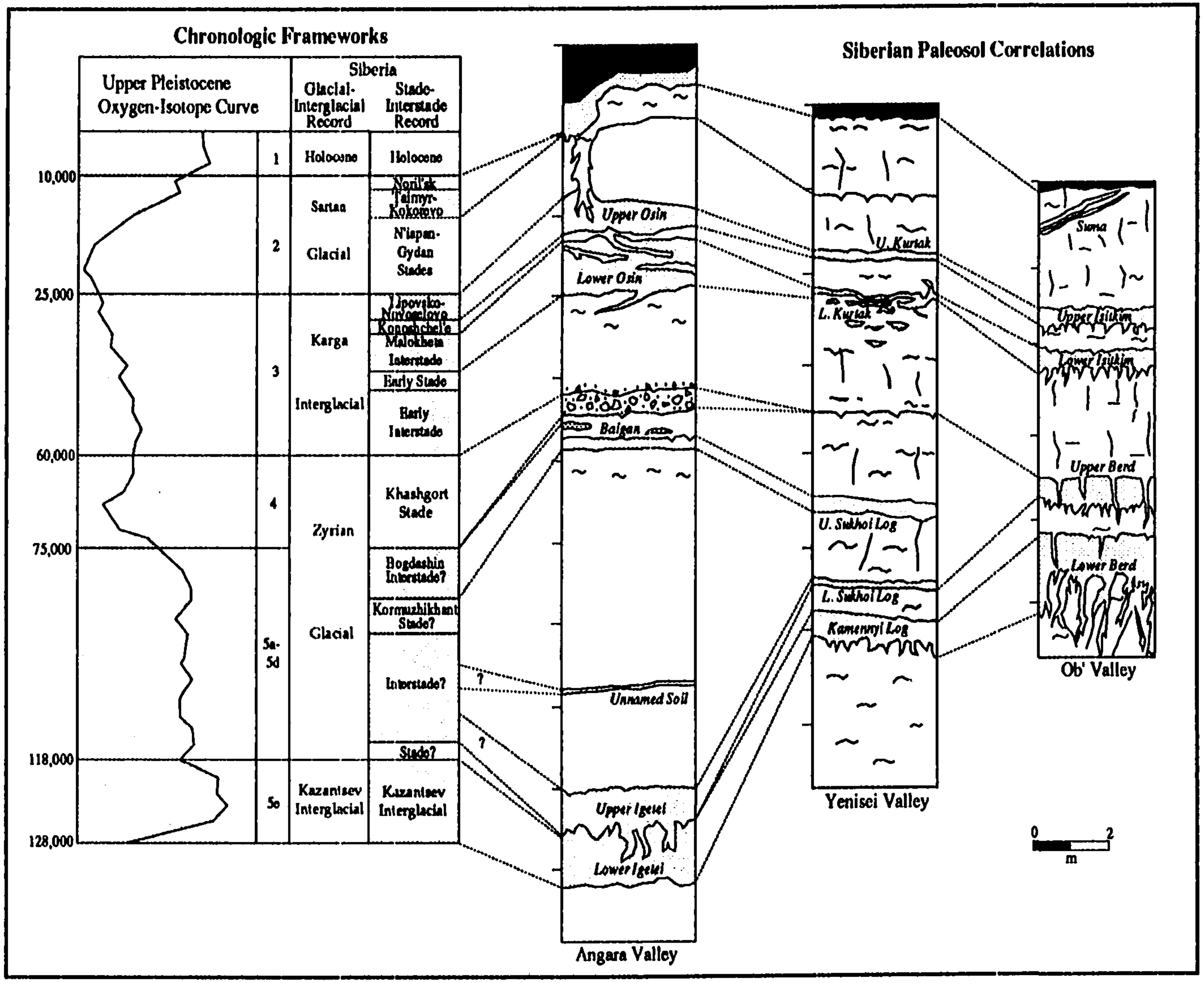


**Fig. 2.17.** Upper Pleistocene loess stratigraphy of south Siberia and proposed correlations among sequence of major time - stratigraphic units represented in regional pollen cores (after Arkhipov 1984; Kind 1974).

A return to warmer, interstadial conditions shortly after 115,000 B.P. (oxygen-isotope substage 5c?) is also noted in the south Siberian loess profiles. The Upper Igetei Soil in the Angara and the Lower Sukhoi Log Soil in the Yenisei probably formed at this time. These Early Glacial soils are less developed than the older Kazantsev soils, indicating conditions were not as warm or mesic during this interval. A second interstade of the Zyrian Glacial (also assigned to substage 5c) is reflected in the Igeteiskaia Gora profile, by a thin and immature soil which remains unnamed. It has only been identified at one locality, however, and its exact age and relationship to other Early Glacial soils can not be reliably judged.

A second Early Glacial stade (oxygen-isotope substage 5b) is represented in north Siberia by the Kormuzhikhant moraine on the lower Ob' River, TL dated to around 100,000 ± 20,000 B.P. (Arkhipov 1984). In the south Siberian loess profiles, this cold snap may be represented by packets of unweathered, cryoturbated loess. At Igeteiskaia Gora this loess reaches 6 m thick; in southwest Siberia it usually is less than 2 m thick. Although not heavily cryoturbated, this stratum at Igeteiskaia Gora contains remains of horse (*Equus caballus*) and reindeer (*Rangifer tarandus*) (Medvedev et al. 1990:Tablitsa 1).

The final warm episode of the Zyrian Glacial is referred to in northwest Siberia as the Bogdashin Interstade (Arkhipov 1984). This period is TL dated to around 75,000 ± 15,000 B.P., and may correspond to oxygen-isotope substage 5a. In the south Siberian loess profiles this interstade is represented by the Baigan Soil in the Angara valley, the Upper Sukhoi Log Soil in the Yenisei valley, and the Upper Berd Soil in the Ob' valley. The Upper Sukhoi Log and Upper Berd soils are weak chernozems and the Baigan is an undeveloped forest soil, indicating relatively warm conditions, but not nearly as warm as during the Kazantsev Interglacial.

Thus, according to the south Siberian loess record, the Early Glacial period is represented by at leat two stades and two intervening interstades. This record appears to conform with the oxygen-isotope record, but absolute dates are needed to confirm these relationships.

*Early Pleniglacial.* The full glacial of the Zyrian (oxygen-isotope stage 4, 75,000-60,000 B.P.) is documented in north Siberia by the Khashgort or Ermakovo moraines along the lower Ob' River (Arkhipov 1984), and the Muruktin or Zyrian moraines along the lower Yenisei River (Medvedev et al. 1990). These moraines advanced further south than their Late Pleniglacial (Sartan) counterparts, indicating that at this time the north Eurasian ice sheet expanded to its maximum size for the Upper Pleistocene.

In the south Siberian loess profiles the early full glacial is marked by the cessation of soil formation and an increase in the intensity of loess accumulation. Nearly 6 m of loess accumulated along the Yenisei River. Frost cracks and ice wedges also formed at this time; these are visible in the Yenisei profile at about 7 m below the surface, and in the Ob' profile at the upper contact of the Upper Berd Soil. In the Angara and Upper Lena regions, high winds deflated loess and sandblasted residual lag deposits. These features suggest climatic conditions in south Siberia were more severe during the Zyrian full glacial than at any other time since the Last Interglacial.

*Middle Pleniglacial.* In arctic Siberia the Middle Pleniglacial (60,000-25,000 B.P.) is characterized by three separate episodes of warming, the Early (50,000-44,000 B.P.), Malokheta (43,000-35,000 B.P.), and Lipovsko-Novoselovo (31,000-25,000 B.P.) interstades. Geologically, these are represented by three marine transgressions (Andreeva 1980), and palynologically by three episodes of forest expansion into the north (Kind 1974). Pollen profiles indicate that in south Siberia this forest was composed of a mix of coniferous and deciduous tree species, some of which are presently exotic to the region (eg., elm, oak, walnut, baswood). Separating the three interstades of the Karga are two abbreviated cold snaps, referred to by Kind (1974) as the Early (45,000-43,000 B.P.) and Konoshchel'e (34,000-31,000 B.P.) stades. This record of three interstades and two intervening stades appears to conform with both the oxygen-isotope record and the various terrestrial records (e.g., pollen and paleosol chronologies) from western Eurasia (Shotton 1977; Müller-Beck 1988); however, some of these deposits may have been mistakenly assigned to the Middle Pleniglacial instead of the Last Interglacial or Early Glacial due to the exclusive use of radiocarbon dating.

The loess records from south Siberia show just two interstades separated by one stade. Only two paleosol horizons have been identified. The earlier horizon includes the Lower Osin Soil in the Angara, the Lower Kurtak Soil in the Yenisei, and the Lower Isitkim Soil in the Ob' valley. Radiocarbon dates suggest these soils formed before 30,000 B.P., providing a tenuous link to the Malokheta Interstade. Each of these paleosols is paired with a second soil slightly higher in the stratigraphic profiles. These include the Upper Osin, Upper Kurtak, and Upper Isitkim soils, respectively, each firmly $^{14}C$ dated to the Lipovsko-Novoselovo Interstade (30,000-25,000 B.P.).

The absence of an older paleosol dating to the Early Interstade is peculiar, especially since this first warming event of the Karga is recorded in most Siberian pollen cores. Perhaps loess deposition during the Karga had slowed to the point that any such early soil became masked by later soil development. Or perhaps the Early Stade separating the Early and Malokheta interstades was too brief to be recorded in the south Siberian profiles, thereby "blending" any soil development that occurred early on in the Karga with that of the later Malokheta interstade. The second and final cold snap of the Karga, the Konoshchel'e Stade, is clearly evident. Although short in duration, the Konoshchel'e was cold, windy, and dry. Soil formation ceased and loess deposition increased. Temperatures were sufficiently cool to permit the formation of frost cracks, small ice wedges, and other croygenic features, and the mixed taiga of the Malokheta was replaced wholesale by an open steppe and forest-steppe.

Thus, the Middle Pleniglacial in Siberia was a dynamic period, characterized by fluctuating climates and numerous turnovers in vegetation. During warm intervals, temperatures may have been warmer than today, leading to the expansion of a mixed deciduous-coniferous forest. These warm periods were interrupted by brief episodes of intense cold. The Karga Interglacial came to an abrupt end around 25,000 B.P., when global temperatures plummeted and glaciers advanced for the last time in the Upper Pleistocene. Full glacial conditions in Siberia (the Gydan and N'iapan stades) persisted for nearly 10,000 years, after which interglacial climatic conditions rapidly returned.

The Upper Pleistocene geochronological framework outlined above facilitates the relative dating of the Middle and early Upper Paleolithic sites of Siberia. Because only radiocarbon methods have been used to date these sites, detailed stratigraphic comparisons are necessary in order to build even the coarsest of cultural chronologies. In the following chapters (3 and 4), provisional relative age estimates and intersite stratigraphic correlations are made according to this scale, resulting in a tentative chronological ordering of sites before, during, and after the Middle to Upper Paleolithic transition.

# CHAPTER 3

## The Sites

This chapter describes 32 archaeological sites in Siberia that contain Middle Paleolithic and/or early Upper Paleolithic cultural occupations and are thought to date to oxygen-isotope stages 5 through 3 (128,000-25,000 B.P.). Some of these sites lack absolute dates; their assignment to this period of the Upper Pleistocene is based largely on geology and stratigraphy. Several sites (eg., Sokhatino-1) are included based solely on technological/typological grounds.

Most of the information presented in this chapter is from the published Russian literature. Detailed reports for some sites are available (eg. Peshchera Okladnikov, Ust'-Karakol, the Tiumechin sites, Makarovo-4), while others have never been fully described (eg. Malaia Syia, Varvarina Gora). Many of the sites have only been preliminarily tested (Maloialomanskaia Peshchera, Ineiskii Bor, Masterov Kliuch', Masterov Gora); others are currently being excavated (Denisova Peshchera, Kara-Bom, Priiskovoe). All of this makes for an uneven record for the Middle and early Upper Paleolithic. With this caveat in mind, this chapter presents a critical and current review of each site, including geologic context, dating, and archaeological inventory.

Each site profile first outlines site location and excavation history. This is followed by a summary of site geomorphology and stratigraphy. When possible, representative stratigraphic profiles are illustrated. For consistency and clarity geologic units are referred to as levels, and archaeological units are called components. Following Russian terminology, stratigraphic numbers always start at the top and increase downward (with the exception of Kara-Bom).

Cultural components are defined according to (1) geologic context, (2) integrity (i.e., degree of preservation or deformation), and (3) age. Radiocarbon ($^{14}C$) dates are presented in uncalibrated years before present (B.P.). All published interpretations of a given site's age are reviewed. Artifact assemblages are briefly characterized; results of detailed lithic analyses are presented in chapters 4 and 5. Archaeological features are also described, as are faunal and floral remains. Faunal nformation consists mostly of "kitchen lists" of mammalian taxa present; basic statistics including Number of Individual Specimens Present (NISP) and Minimum Number of Individuals (MNI) have been reported for only four sites (Ust'-Kanskaia Peshchera, Malaia Syia, Varvarina Gora, Tolbaga). This information is unavailable for the remaining sites.

Sites are ordered from west to east, following major river systems. Site numbers in the text correspond to those on site location maps (Fig. 1.1, 1.2, 3.1, 3.23, 3.31, 3.50). Geographically the sites form two major clusters located in southwest and southeast Siberia. Those in the southwest cluster in the Altai (upper Irtysh and Ob' River basins) and Saian (Chulym and Yenisei River basins) regions, and those in the southeast cluster in the Cisbaikal (upper Angara, Nizhnaia Tunguska, and Lena River basins), and Transbaikal (Selenga and Ingoda River basins) regions (Fig. 1.1).

## SOUTHWEST SIBERIA

### The Altai

#### *1. Strashnaia Peshchera*

Strashnaia Peshchera [*Frightful Cave*] is located in the northwestern foothills of the Gornyi Altai, along the Inia River 5 km northwest of the village of Chitena, Altai Krai (Fig. 3.1) (51°21' N, 83°7' E). The cave was discovered in 1966 by a group of amateur spelunkers from Tomsk University. Okladnikov conducted archaeological tests here in 1969-1970, excavating 17 $m^2$ (Okladnikov et al. 1973; Derevianko and Markin 1990b:76-81). Fieldwork was resumed in 1989, leading to the excavation of an additional 20 $m^2$ (Derevianko et al. 1990b).

The cave is situated 45 m above the modern floodplain of the Inia River, along a steep limestone escarpment. Its arched entryway, measuring 6 m high and 3 m wide, opens to the southeast and forms a narrow passageway which extends 16 m inward (Fig. 3.2, 3.3). In the back of the cave, the passageway expands to form a chamber 10 m wide and 6 m long (Fig. 3.2). Outside the cave is a small (3 x 10 m) ledge of level ground. This platform offers a wide, panoramic view of the Inia River and its tributary, the Tigirek River.

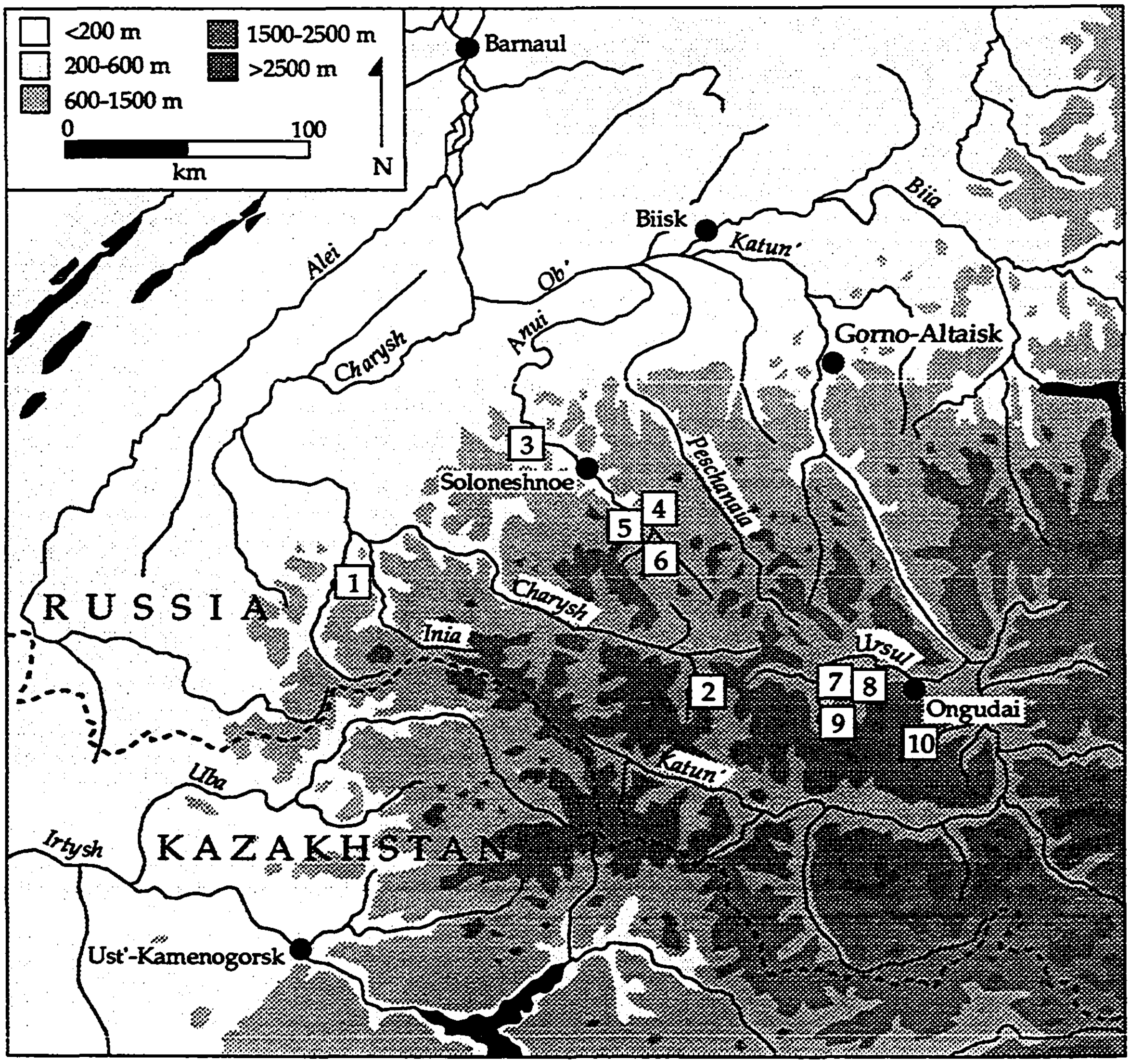


**Fig. 3.1.** Map of Siberian Altai showing location of Paleolithic sites discussed in text: (1) Strashnaia Peshcherha, (2) Ust'-Kanskaia Peshchera, (3) Peshchera Okladnikov, (4) Denisova Peshchera, (5) Anui-1, (6) Ust'-Karakol, (7) Tiumechin-1, (8) Tiumechin-2, (9) Kara-Bom, (10) Maloialomanskaia Peshchera.

In 1969-1970 two test pits were placed at the cave entrance and in the rear of the chamber (Okladnikov et al. 1973:5-7). From the cave entrance test pit Okladnikov et al. (1973:7-10) describe a stratigraphic profile measuring over 6 m thick (Fig. 3.4). Levels 1 and 2 at the top of the section are massive, unweathered silt loams containing small angular inclusions of limestone and isolated flecks of charcoal. Level 3 is a 5-m thick deposit of carbonated loam, with unevenly distributed limestone scree. This level is divided into three sub-units ($3_1$, $3_2$, and $3_3$). Scree is rare in levels $3_1$ and $3_3$. Level $3_2$,

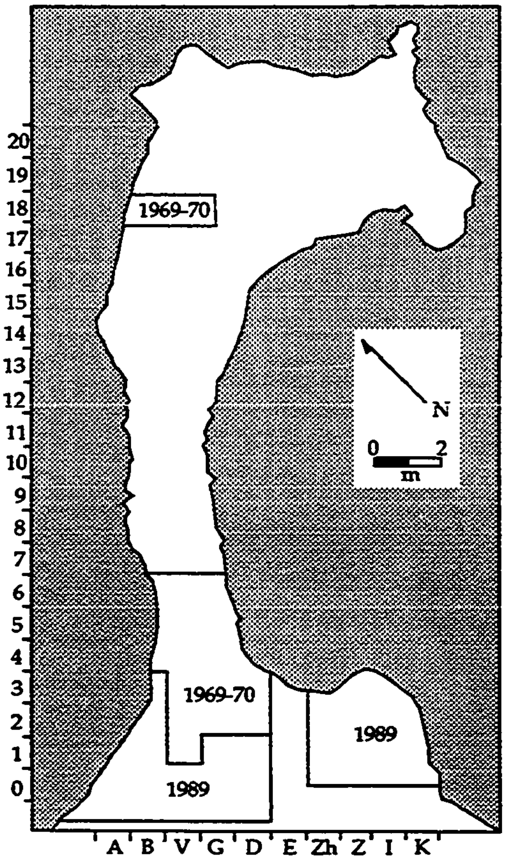


**Fig. 3.2.** Strashnaia Peshchera floor plan (after Okladnikov et al. 1973; Derevianko et al. 1990b).

which bisects $3_1$ and $3_3$, is a 20-cm thick bed of limestone scree with loam fill. Underlying level 3 is a bed of clay reaching 2 m thick (level 4), followed by 1.8 m of fine-grained, silty sand and clay (level 5). Basal sediments consist of a series of alternating bands of fine-grained sands and clays (level 6).

Ovodov (1975) reports three $^{14}C$ dates from Strashnaia Cave run on bone through conventional methods. One sample, derived from a depth of 3-4 m (perhaps geologic levels $3_3$ or 4), yielded a date of around 25,000 B.P. (SOAN-785) [the precise date and standard deviation have not been published]. The other two samples of bone originated from a depth of 4-6 m (perhaps geologic levels 5 or 6) and yielded infinite dates of >40,000 B.P. (SOAN-786, SOAN-787) (Ovodov 1975:36).

Archaeological materials are found throughout the deposit, from the surface to the base of the profile. Neolithic artifacts are restricted to the upper two geologic levels, with Paleolithic materials occurring in the lower-lying sediments (Okladnikov et al. 1973). Okladnikov, assuming that all of the Paleolithic remains from the cave were redeposited (Abramova 1989:160), excavated the site by arbitrary 20 cm increments, not by geologic stratigraphy.

The Paleolithic assemblage reported by Okladnikov et al. (1973:16-43) includes 469 lithic artifacts (recently described by Derevianko and Markin [1990b]). The overall character of this assemblage is Mousterian. Primary reduction technology is characterized by Levallois and radial flake cores and their removals. Nearly 35% of all blanks have faceted platforms (Derevianko and Markin 1990b:78). All tools are retouched unifacially. The tool assemblage, which includes 48 lithic artifacts, is dominated by side scrapers and retouched Levallois flakes and points, as well as a denticulate, notch, burin, end scraper, and wedge (Derevianko and Markin 1990b:81).

**Fig. 3.3. View of Strashnaia Peshchera (photo courtesy of R. Powers).**

Excavations in 1989 revealed three stratigraphically distinct cultural levels (Fig. 3.5) (Derevianko et al. 1990b:122-123). Cultural component I is situated within geologic level 2 and includes a small collection of late Holocene lithic, ceramic, and metal artifacts. Component II consists of a series of lithic artifacts from near the top of geologic level 3 (apparently Okladnikov's level $3_1$) (Derevianko et al. 1990b:123); these appear early Upper Paleolithic in character. Component III is a small collection of lithics recovered from sediments that correspond to Okladnikov's level $3_3$. This assemblage contains some Mousterian elements analogous to Okladnikov's Mousterian collection described above.

Forty taxa of mammals have been identified from Strashnaia Peshchera (identifications by Ovodov); 13 of them are extinct mammal species (Derevianko and Markin 1990b:118). Steppe, alpine, forest-steppe, forest, and tundra species are represented (Table 3.1). The mixed nature of the faunal assemblage may have resulted

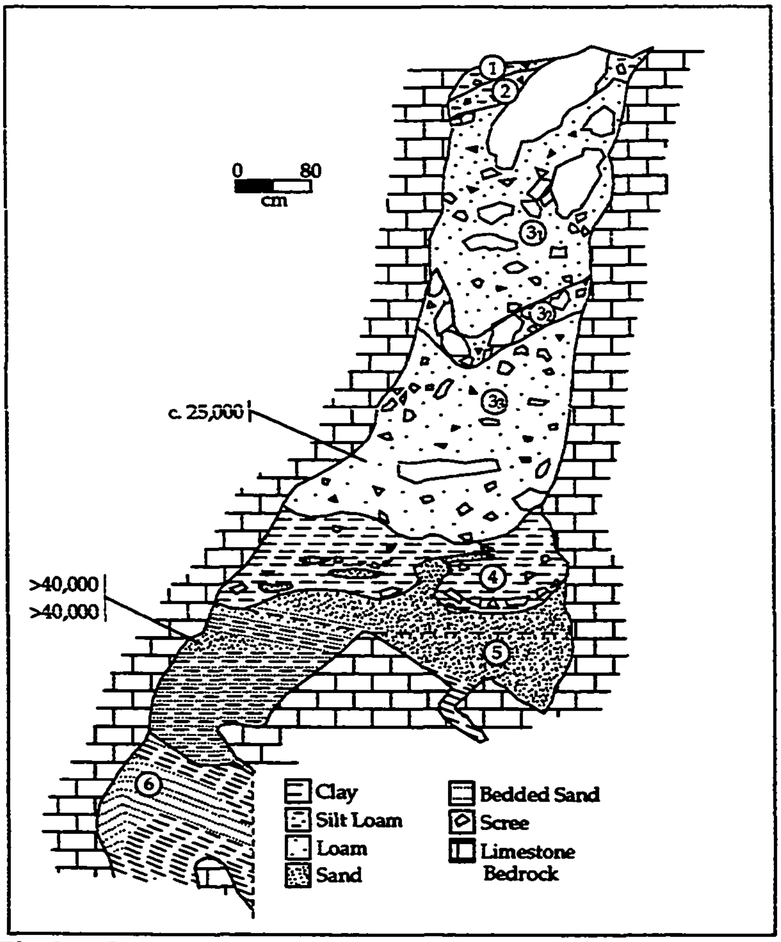


**Fig. 3.4.** Stratigraphic profile from Strashnaia Peshchera (radiocarbon dates shown in years before present) (after Okladnikov et al. 1973).

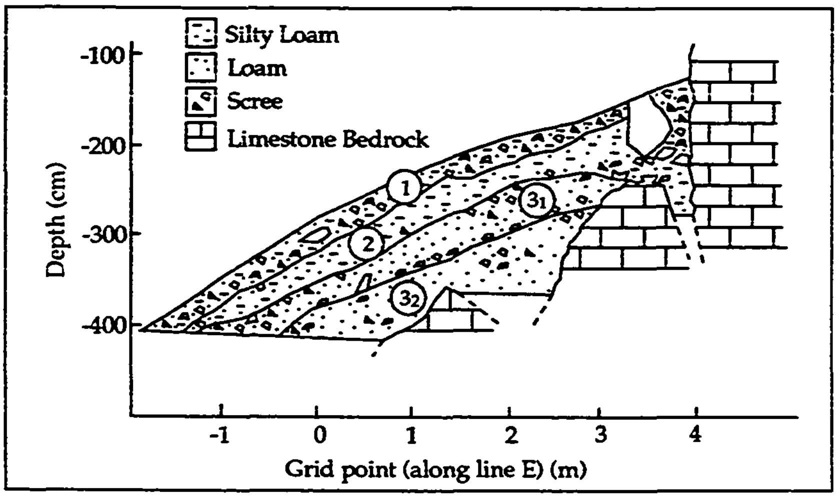


**Fig. 3.5.** New stratigraphic profile from entrance area at Strashnaia Peshchera (after Derevianko et al. 1990b).

**Table 3.1.** Fauna Represented in Altai Paleolithic Sites

| Species by ecotone | STR* | KAN | OKL | DEN | ANU | BOM | MAL |
|---|---|---|---|---|---|---|---|
| Semi-Desert | | | | | | | |
| *Erinaceus sp.* | | | • | | | | |
| *Eolagurus luteus* | | | • | | | | |
| *Felis manul* | | | | | | | • |
| *Gazella cf. gutturosa* | | • | | | | | |
| Steppe | | | | | | | |
| *Lepus tolai* | | | • | | | | • |
| *Marmota sp.* | | | • | • | | • | |
| *Citellus sp.* | | | • | • | | | |
| *Cricetulus sp.* | • | | • | | | | |
| *Lagurus lagurus* | | | | • | | | • |
| *Ellobius sp.* | | | • | • | | | |
| *Allactaga sp.* | • | | • | • | | | |
| *Vulpes corsac* | | | • | • | | | |
| *Putorius eversmanni* | • | | | | | | |
| *Equus caballus* | • | • | | | • | | |
| *E. hemionus* | • | • | | | • | | • |
| *Coelodonta antiquitatis*** | • | • | • | • | • | • | • |
| *Bison priscus* | • | | • | | | | |
| *Spirocerus kiakhtensis* | | • | | | | • | |
| *Saiga tatarica* | • | | | | | | |
| Alpine | | | | | | | |
| *Ochotona alpina* | • | | | | | | • |
| *Ochotona sp.* | | | • | • | | | |
| *Marmota baibacina* | • | | | | | | • |
| *Alticola sp.* | • | | • | | | | • |
| *Arvicola terrestris* | • | | • | | | | • |
| *Panthera uncia* | | | | | | | • |
| *Poephagus gruniens*† | | • | | | | • | • |
| *Ovis ammon* | • | • | • | • | | • | |
| *Ovis sp.* | | | | | | | • |
| *Capra sibirica* | | | • | | | | • |
| *Capra sp.* | | | | | • | | |
| Forest-Steppe | | | | | | | |
| *Cricetus cricetus* | • | | • | | | | • |
| *Myospalax myospalax* | • | | • | | | | • |
| *Myospalax sp.* | | | | • | | | |
| *Microtus oeconomus* | | | • | | | | |
| *M. arvalis-agrestis* | | | • | | | | • |
| *M. gregalis* | | | • | • | | | |
| *Cuon alpinus* | | | • | | | | |
| *Cuon sp.* | | | | • | | | |
| *Mustela nivalis* | • | | | • | | | |
| *Cervus elaphus* | • | | • | • | | | • |
| *Capreolus capreolus* | • | | • | • | | | • |

**Table 3.1. Continued**

| Species by ecotone | STR | KAN | OKL | DEN | ANU | BOM | MAL |
|---|---|---|---|---|---|---|---|
| Forest | | | | | | | |
| *Sorex sp.* | • | | • | • | | | • |
| *Crocidura sp.* | • | | • | | | | • |
| *Talpa europea* | | | | | | | • |
| *Talpa sp.* | | | • | • | | | |
| *Pteromys volans* | • | | • | | | | • |
| *Castor fiber* | | | • | | | | |
| *Myopus schisticolor* | | | • | | | | |
| *Clethrionomys sp.* | • | | • | | | | • |
| *Microtus agrestis* | | | • | | | | • |
| *Ursus arctos*†† | • | • | • | | | | |
| *Mustela erminea* | • | • | | • | | | |
| *Martes zibellina* | | | • | • | | | |
| *Meles meles* | • | • | | | | | |
| *Lutra lutra* | • | | | | | | |
| *Alces alces* | • | | | • | | | |
| Tundra | | | | | | | |
| *Citellus undulatas* | • | | | | | | • |
| *Rangifer tarandus* | | | • | • | | | |
| Multiple Ecotones | | | | | | | |
| Chiroptera gen. sp. | • | | | | | | • |
| *Lepus timidus* | • | | | • | | | • |
| *Lepus sp.* | | | | | | • | |
| *Eutamias sibiricus* | • | | | | | | |
| Cricetinae gen. sp. | | | | • | | | |
| *Microtus sp.* | • | | | • | | | • |
| *Apodemus sp.* | • | | | | | | • |
| *Rattus norvegicus* | • | | | | | | |
| *Canis lupus* | • | • | • | • | | • | • |
| *Vulpes vulpes* | • | • | • | • | | | • |
| *Usrus sp.* | • | | | • | | | • |
| *Mustlea sp.* | | | • | • | | | |
| *Crocuta spelaea* | • | • | • | | | • | • |
| *Crocuta sp.* | | | | • | | | |
| *Panthera spelaea* | | | • | | | | |
| *Mammuthus primigenius* | • | | • | | | | |
| *Equus sp.* | • | | • | • | | • | • |
| *Bison sp.* | | | | • | • | • | • |

*STR = Strashnaia Peshchera, KAN = Ust'-Kanskaia Peshchera, OKL = Peshchera Okladnikov, DEN = Denisova Peshchera, ANU = Anui-1, BOM = Kara-Bom, MAL = Maloialomanskaia Peshchera.

**Ust'-Kanskaia Peshchera: Rudenko (1960:108) reports *Rhinoceros tichorinus*, presumably woolly rhinoceros; Tseitlin (1979:81) recovered a single tooth of *Coelodonta antiquitatis*.

†Also known as *Bos gruniens* and *Poephagus baikalensis* (yak).

††Strashnaia Peshchera: Derevianko and Markin (1990b:77) report *Ursus uralensis*, presumably cave bear.

from redeposition of sediments or treatment of the entire profile as one cultural component. Pollen samples taken from depths of 600-620 cm (presumably level 6) and 380-560 cm (levels 4-5) suggest forest-steppe and xerophytic steppe conditions, respectively.

### 2. *Ust'-Kanskaia Peshchera*

Ust'-Kanskaia Peshchera [*Mouth of Kan Cave*] is located along the right bank of the Charysh River, 3.5 km east of the town of Ust'-Kan, Gorno-Altai Autonomous Oblast' (Fig. 3.1) (50°49' N, 84°58' E). The cave is situated in a steep limestone escarpment 52 m above the Charysh River (Derevianko and Markin 1990b:74). The cave opens to the south; its arched entrance is 8 m wide at its base and 3 m high (Rudenko 1960:106, 1961:205). Rudenko (1961:205) describes Ust'-Kanskaia Peshchera as "a spacious grotto" 17 m long, 9 m wide, and 12 m high.

Rudenko discovered the cave in July, 1954. He and Pavliuchenko conducted excavations there later that year, excavating about 21 $m^2$ at the cave entrance (Rudenko 1960:108). Paleolithic cultural remains were recovered throughout the 1.75-m thick stratigraphic profile (Anisiutkin and Astakhov 1970:28; Rudenko 1960:108). Rudenko (1960), however, grouped all finds into a single complex (Anisiutkin and Astkhav 1970:28), and failed to record their depth below surface and stratigraphic provenience. Geological studies were not carried out (Tseitlin 1979:79). Rudenko (1961:206) describes the stratigraphic context of the Paleolithic articles in the following cursory manner:

> The layer containing the cultural remains proved to be up to 1.75 m thick. The underlying layer of red clay spread out to the north into the depths of the cave. Bed rock was revealed in the northern third of the floor. In the cultural layer and on its surface a considerable space was occupied by limestone boulders that had fallen from the ceiling of the cave. The spaces between the boulders were filled with loose soil, with products of the disintegration of the limestone, separate slabs of limestone both large and small, rubble, and cultural remains: stone flakes, tools, and animal bones.

Years later, Tseitlin revisited Ust'-Kanskaia Peshchera and conducted geoarchaeological tests. He describes a 1.93-m thick stratigraphic profile located about 8 m from the cave entrance (Tseitlin 1979:79). This profile is divided into six geologic levels (unfortunately no stratigraphic profile was illustrated). Level 1 (at the top of the profile) is a 0.03-m thick unit of biogenic sediments. Level 2 is a white sandy loam 0.15 m thick with abundant inclusions of scree and isolated chunks of limestone. Level 3 is a 0.35-m thick bed of limestone rubble with a dark gray sandy loam matrix. Level 4 is a gray-brown sandy loam 0.3 m thick with abundant scree and isolated chunks of limestone. Levels 5 and 6 form a 1.1-m thick basal layer of yellow sandy loam with high clay fractions and abundant limestone angular rubble and gravel. The lower part of level 6 grades into a red-brown sandy clay with numerous large chunks of limestone. Tseitlin (1979:79) notes that levels 5 and 6 are heavily weathered and ferruginized, while levels 2, 3, and 4 are gray and display much rubble, suggesting a period of intensified physical weathering. With these observations he concludes that the lower levels were deposited during a period of warm and mesic climate (the Karga Interglacial), and the upper levels during much colder times (the Sartan Glacial) (Tseitlin 1979:83).

During the cleaning of this stratigraphic profile, Tseitlin (1979:79) also encountered lithic artifacts and faunal remains throughout the entire deposit, but noted that artifacts are more densely concentrated near the top of level 4 and in the central portion of level 5. He interprets these as separate cultural components (Tseitlin 1979:79) and concludes that Rudenko's earlier studies incorrectly grouped two occupations.

Vereshchagin conducted an extensive study of the faunal remains recovered from Rudenko's excavations (Rudenko 1960:108-109). He identified 13 mammal species, the

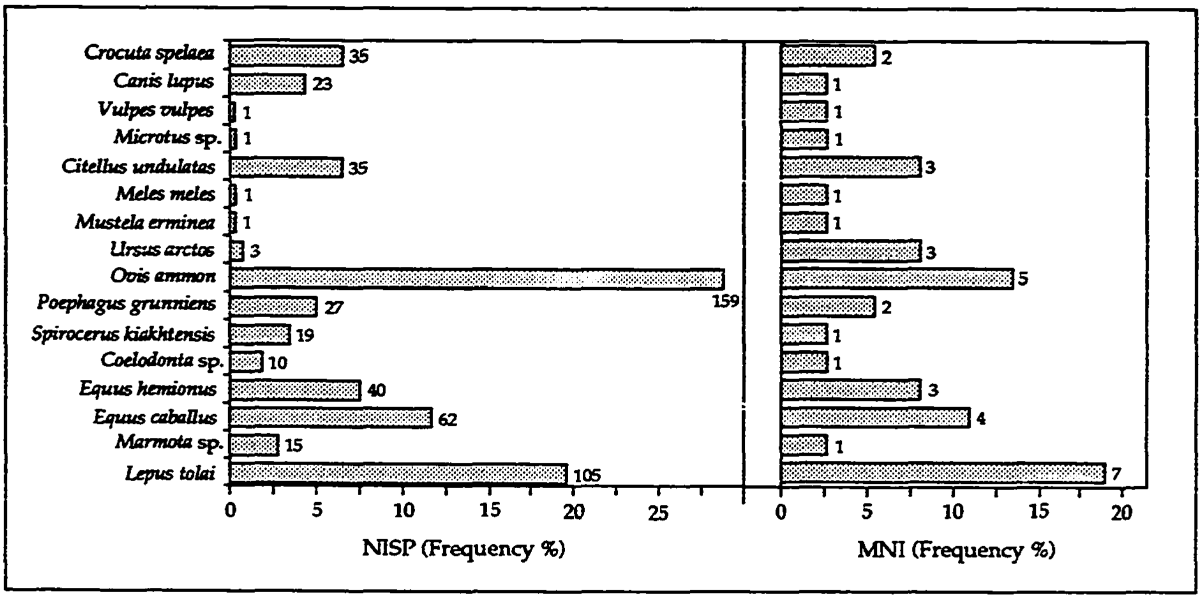


Fig. 3.6. Ust'-Kanskaia Peshchera faunal assemblage (after Rudenko 1960).

majority of which are small- and medium-sized ungulates (eg., argali sheep [*Ovis ammon*], horse [*Equus caballus*], Asiatic wild ass [*E. hemionus*]) and lagomorphs (tolai hare [*Lepus tolai*]) (Table 3.1) (Fig. 3.6). Tseitlin (1979:81) points out that this faunal assemblage includes both cold steppe and warm forest species, and argues that the assemblage contains fauna from two stratigraphic levels reflecting two climatic episodes.

Anisiutkin and Astkahov (1970) and Shun'kov (1990) conducted detailed analyses of Rudenko's lithic artifact assemblage. Their results are comparable, although Shun'kov (1990) studied a slightly smaller, less complete industry. Anisiutkin and Astakhov (1970) studied 520 artifacts, including 24 cores and 41 tools. Cores are predominantly Levallois, discoidal, and spheroidal. Platforms are frequently faceted. The tool assemblage includes side scrapers, Levallois points, retouched Levallois flakes, retouched blades, denticulates, and notches, as well as end scrapers and angle burins on blades, wedges, a graver, a bifacial knife, and a small bone pendant with a drilled hole (Anisiutkin and Astakhov 1970:31-32; Shun'kov 1990:44,55). The presence of Upper Paleolithic tools in an otherwise typical Levalloiso-Mousterian context again suggests Rudenko's collections are mixed, and that they actually represent separate Middle Paleolithic and Upper Paleolithic occupations (Anisiutkin and Astakhov 1970:33; Derevianko and Markin 1990b:99-100; Tseitlin 1979:83). Derevianko and Markin (1990b:100) also point out that the small size of the assemblage and the abundance of relatively large-sized artifacts indicate a significant degree of sorting, probably a result of Rudenko's coarse excavation techniques and failure to screen excavated sediments.

### *3. Peshchera Okladnikov*

Peshchera Okladnikov [*Cave of Okladnikov*] is located along the Sibiriachikha River, a small tributary of the Anui River, 20 km northwest of the village of Soloneshnoe, Altai Krai (Fig. 3.1) (51°42' N, 84°9' E). The cave was discovered by Derevianko and Molodin in 1984, and excavated by Derevianko and Markin from 1984 through 1987 (Derevianko and Markin 1990a, 1990b; Derevianko et al. 1987k, 1990b). Peshchera Okladnikov is the most extensively studied of the cave sites in Siberia, and little of the cave remains unexcavated (Derevianko and Markin 1990b:81).

Peshchera Okladnikov is situated in the northwestern foothills of the mountainous Altai, about 400 m above sea level. It is formed in a Devonian-aged limestone escarpment that flanks the Sibiriachikha River. The cave opens to the south and is 14 m above the modern level of the river (Derevianko and Markin 1990b:81; Maloletko 1990). It consists of a complex series of interconnected cavities which formed along tectonic fissures in the limestone bedrock (Derevianko et al. 1987k:14; Derevianko and Markin 1990b:81). These cavities include a rock shelter (or overhang), grotto, five galleries (two of which remain unexcavated), and three unexplored chambers (or halls) (Fig. 3.7). The majority of the Paleolithic cultural remains were recovered from the shelter, grotto, and gallery 1; all have been completely excavated (Derevianko et al. 1987k:21).

The shelter area of the cave is 42 m long, 8 m wide and 2 m high. Immediately behind the shelter is a small grotto measuring 2.7 m long, 1.7 m wide, and 1.35 m high. The grotto was nearly filled with sediment; less than 0.25 m of open space existed between the ceiling and the top of the sediment fill. The various galleries inside the cave vary in length and are 1-2 m wide. As in the grotto, their ceilings are quite low, usually less than 1 m from the top of the cave fill. Prior to excavation, their entrances were sealed.

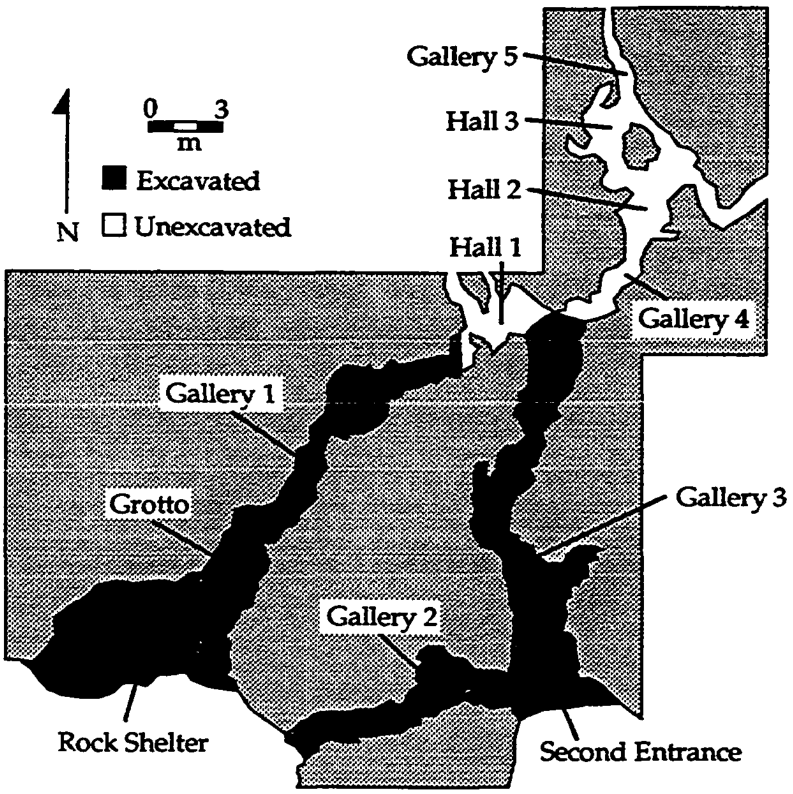


**Fig. 3.7.** Peshchera Okladnikov floor plan (after Derevianko and Markin 1990b).

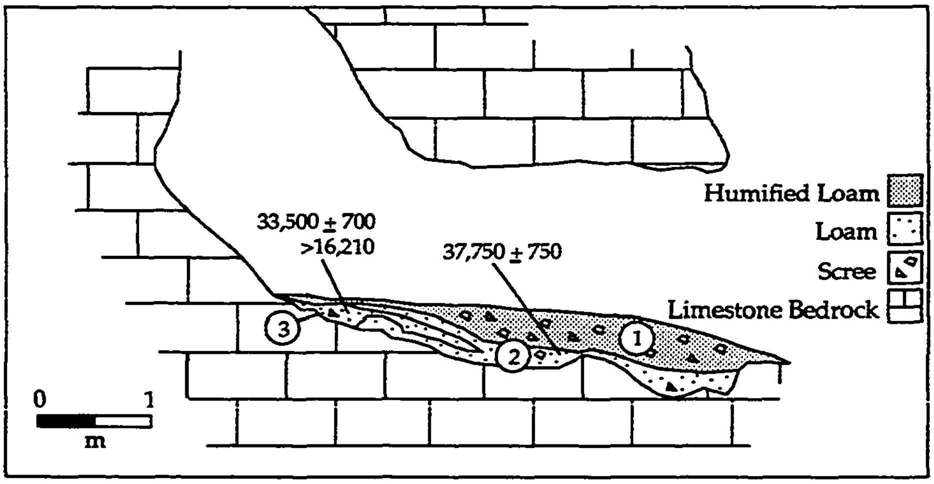


**Fig. 3.8.** Stratigraphic profile of rockshelter area, Peshchera Okladnikov (after Derevianko et al. 1990b).

The Quaternary sediments are difficult to characterize since they do not form a consistent mantle over the entire floor of the cave. Sediments in the shelter area form three stratigraphic units (Fig. 3.8). Level 1, the uppermost unit, is a dark brown humified loam with fine inclusions of scree and medium-sized angular fragments of limestone. Immediately underlying this is Level 2, an unweathered loam containing numerous inclusions of scree and isolated fragments of limestone. Level 3 is a brown-gray loam with rare inclusions of limestone scree. These sediments are shallow, measuring no more than 0.75 m thick (Derevianko et al. 1990b:105).

Inside the grotto and galleries sediments range from 0.35 to 1.8 m thick (Fig. 3.9) (Derevianko and Markin 1990b:84). These sediments are similar to those under the rock shelter. Levels 1 and 3 occur in the grotto and galleries 1, 2, and 3; however, level 2 is found only in the entrance area of gallery 2. Additional strata not encountered in the rock shelter sporadically occur inside the cave. Three of these, levels 4 through 6, occur

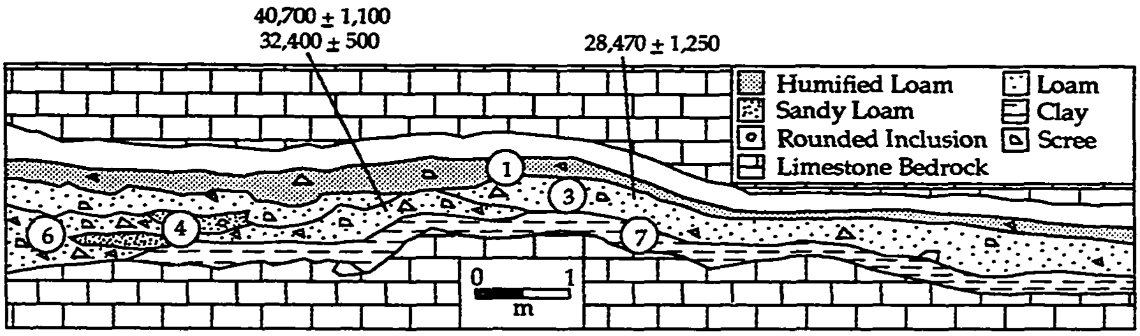


**Fig. 3.9.** Stratigraphic profile from inside Peshchera Okladnikov (after Derevianko et al. 1990b).

only in the grotto. Level 4 is a massive yellow sandy loam with rare rounded limestone inclusions and detrital organics. Level 5 is a finely laminated dark brown sandy loam, and level 6 is a massive dark brown loam with abundant inclusions of scree. Level 7, found inside the grotto as well as in all three excavated galleries, is a red brown clay loam with epigenetic limestone concretions and occasional gravels of quartz, slate, and sandstone. This clay loam forms the cave's basal level.

Absolute dates from Peshchera Okladnikov include conventional and AMS $^{14}C$ dates and one Uranium-series date. Bone from level 3 in the rock shelter and inside gallery 1 yielded conventional dates of >16,210 (SOAN-2458) and 28,470 ± 1,250 B.P. (SOAN-2459), respectively (Derevianko and Markin 1990a:24; Panychev and Orlova 1990:139-140). In contrast, AMS dating of bone from under the rock shelter resulted in dates of 33,500 ± 700 B.P. (RIDDL-718) for level 3 and 37,750 ± 750 B.P. (RIDDL-719) for level 2. A split-sample of bone from level 6 inside the grotto yielded two AMS dates, 32,400 ± 500 (RIDDL-721) and 40,700 ± 1,100 (RIDDL-720). The latter date was run on a sample of collagen limited to molecules weighing greater than 30,000 Daltons; it is considered more reliable than the younger date, run on collagen molecules weighing less than 30,000 Daltons (J. Cinq-Mars pers. comm., May 1993). In addition, an AMS date of 43,300 + 1,300 / - 1,500 B.P. (RIDDL-722) was obtained on collagen from a sample of bone recovered from level 7; its provenience inside the cave has not been reported. The Uranium-series analysis (by J. Bischoff) of a bison femur from level 3 under the rock shelter yielded a date of 38,725 + 1,435 / - 1,419 B.P. (Derevianko and Markin 1990a:24; Derevianko et al. 1990b:117). According to Bischoff (pers. comm., May 1993), this date should be treated as a minimum age. In addition, a bone from level 7 at Okladnikov yielded a $^{230}Th$ age of 44,800 ± 4,400 B.P., and a $^{231}Pa$ age of 44,600 ± 3,300 B.P. (Mead pers. comm., October 1993).

Archaeological materials reported from the rock shelter area of Peshchera Okladnikov can be divided into two sets. The first set includes pottery shards and a bone point attributed to Bronze Age and Iron Age cultures (Derevianko et al. 1987k:20). These late Holocene artifacts are scattered through levels 1, 2, and 3. The second set consists of a large assemblage of Middle Paleolithic materials, also found in levels 1, 2, and 3. According to Derevianko et al. (1987k:19), these two distinct groups of artifacts became associated secondarily by occasional rodent activity.

Inside the cave only Middle Paleolithic cultural remains have been found. The majority of these come from the shelter, grotto, and gallery 1, although isolated lithic artifacts were also encountered in galleries 2 and 3. Stratigraphically, most of the Paleolithic finds derive from levels 2 and 3, with rare occurrences in levels 1, 6, and 7 (Derevianko et al. 1987k:21).

The lithic inventory from Peshchera Okladnikov (levels 1-7) totals 3,819 artifacts manufactured on locally-available microdiorites, cherts, and hornfels (Vrublevskii 1990). Levallois cores and blanks occur in all levels; however, Levallois cores and end products are uncommon (Derevianko and Markin 1990b:93). Platform faceting occurs frequently, however, and secondary reduction technology is exclusively unifacial (Derevianko and Markin 1990b:86). Tool assemblages are characterized by high frequencies of side scrapers, as well as points, denticulates, and retouched flakes. End scrapers, burins, knives, gravers, wedges, and retouched blades are rare (Derevianko et al. 1987k:25). These assemblages have been diagnosed as "Typical Mousterian" (Derevianko and Markin 1990a:25; Derevianko et al. 1987k:26).

During excavations all sediments were wet-screened, leading to extensive samples of megafauna, microfauna, macrofossils, and plant remains (i.e., pollen and spores). These "ecofacts" have been studied and reported by Derevianko and Markin (1990a:110-111), Ivleva (1990), Martynovich (1990), Nikolaeva (1990), Volkova (1990), Zhadina (1990), and Zykin (1990). Palynological studies indicate that during the Mousterian occupation the region surrounding Peshchera Okladnikov was a dry forest-steppe, similar to that of modern times (Ivleva 1990:93; Volkova 1990:64; Zhadina 1990). Twenty species of large mammals (3,763 specimens) have been identifed (Table 3.1) (Derevianko et al. 1990b:110); most prevalent are steppe and alpine species. The majority of specimens belong to horse (*Equus* sp.) (29.5%), cave hyena (*Crocuta spelaea*) (15.9%), red fox (*Vulpes vulpes*) (9.7%), Siberian mountain goat (*Capra sibirica*) or argali sheep (*Ovis ammon*) (9.3%), woolly rhinoceros (*Coelodonta antiquitatis*) (7.1%), steppe bison (*Bison priscus*) (6.2%), gray wolf (*Canis lupus*) (5.7%), and red deer (*Cervus elaphus*) (2.5%) (Derevianko and Markin 1990b:110). Of 2,819 specimens of microfauna, 2,353 (85%) are steppe, forest-steppe, or alpine species. The context and provenience of these faunal remains, however, has not been reported.

Hominid skeletal material was recovered from levels 2 and 3 at Peshchera Okladnikov. These specimens include three long bone fragments and five teeth (a lower premolar and four lower molars) (Derevianko and Markin 1990a:117, 1990b:84; Turner 1990a, 1990b). While the post-cranial remains are too fragmentary to indicate either a pre-modern or modern status, the premolar appears pre-modern and exhibits close affinities to Neanderthal teeth from Shanidar Cave, Iraq (Turner 1990b:240). Likewise, the third

**Fig. 3.10.** View of Denisova Peshchera, during excavations at cave entrance, August 1991 (photo by author).

lower molars are more similar to those of European Neanderthals than to early modern Europeans (Turner 1990b:241).

*4. Denisova Peshchera*

Denisova Peshchera [*Denisov's Cave*] is located 6 km northwest of the village Chernyi Anui, along the right bank of the Anui River, near the northwestern border of the Gorno-Altai Autonomous Oblast' (51°37' N, 84°30' E). This cave is situated 28 m above the right bank of the Anui River, along the southwest face of a steep limestone escarpment (Fig. 3.10) (Derevianko et al. 1985a:8; Markin 1987:11). The cave entrance forms a 2-m high and 7-m wide arch. The cave includes a well-lighted entrance chamber measuring 32 m long, 11 m wide, and 10 m high (Fig. 3.11). Along the chamber's right wall are two passageways, one of which extends nearly 110 m into the dark recesses of the cave (Derevianko et al. 1985a:8). Only the entrance chamber, however, has been tested.

The cave has been known historically for over a century (Derevianko et al. 1985a:3). As a Paleolithic site, however, it was not discovered until 1977, when Ovodov excavated two small test pits immediately inside the cave entrance and discovered bones of extinct megafauna associated with numerous stone artifacts, some of which appeared Mousterian (Okladnikov and Ovodov 1978:266). Detailed investigations began in 1982, with the excavation of a series of late Holocene Bronze Age occupations inside the mouth of the cave (Derevianko et al. 1985b, 1985h). In 1984, study of the Pleistocene-aged deposits began with the 9 m$^2$ expansion of one of Ovodov's original test pits (Derevianko et al. 1985c, 1985d, 1985e, 1985f, 1985g, 1987k; Markin 1987), the walls of which had collapsed (Markin 1987:11). This investigation revealed multiple Paleolithic occupational levels, most of which contain Mousterian artifacts (Markin 1987). Since 1986, work at Denisova Peshchera has concentrated on the excavation of Middle and Upper Paleolithic levels at the cave entrance (Derevianko et al. 1990a, 1990b, 1992a, 1992b). Excavations continued in this part of the cave through 1993. In 1992 Nash renewed work alongside the original test pit inside the cave (Nash et al. 1993).

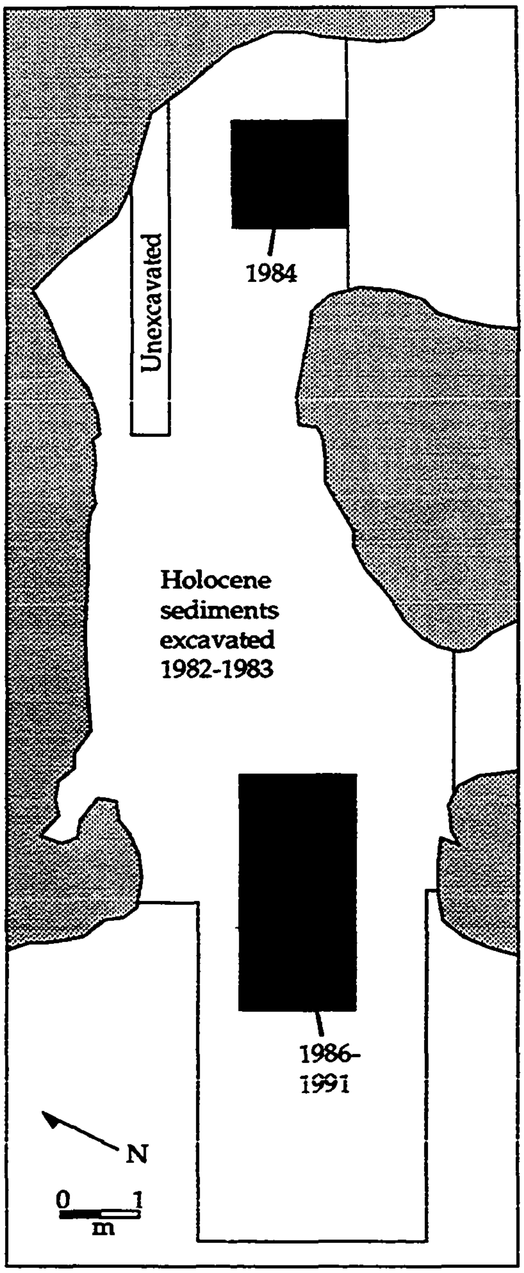

**Fig. 3.11.** Denisova Peshchera floor plan (after Derevianko et al. 1990b).

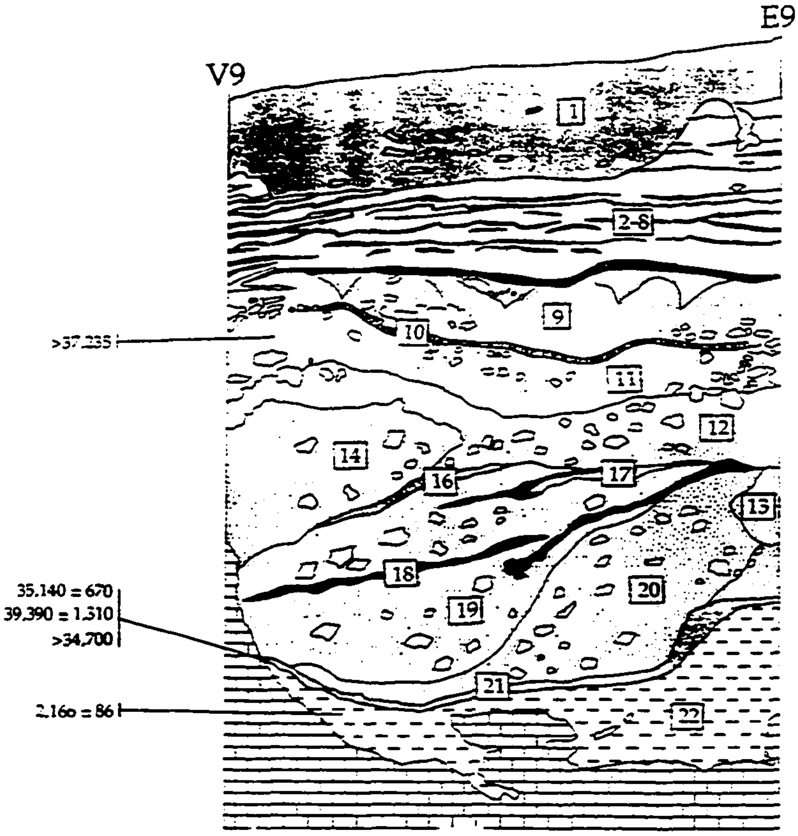


**Fig. 3.12. Stratigraphic profile from Markin's (1984) excavations inside Denisova Peshchera (after Derevianko et al. 1985a).**

The stratigraphic profile revealed inside the cave is markedly different from that at the cave entrance. Descriptions of each are presented below. These descriptions and interpretations of cave stratigraphy should be considered preliminary, since excavations are still in progress.

The stratigraphic profile exposed inside the cave (Fig. 3.12) is complex (Markin 1987). Twenty-two geologic levels have been delineated which can be grouped into three sets of deposits (Derevianko et al. 1985c:3-10; Markin 1987:11-13). Set 1, which includes levels 1 through 8 at the top of the profile, is a series of alternating black, gray, and white organic bands. These sediments are 2 m thick and late Holocene in age. Set 2 consists of a series of sandy loams (levels 9 through 21) containing varying amounts of angular limestone scree. Levels 9A, 11A, 16, 17, 18, and 21 are organic-rich (Derevianko et al. 1985c; Derevianko et al. 1990b:41-42). Markin (1987:14) notes that this 2-m thick packet of sediments is heavily deformed through processes of subsidence, horizontal spreading, frost cracking, ice wedge formation, and erosion. These sediments lie immediately beneath a ceiling chimney, a feature well-known for complicating cave stratigraphy (Bar-Yosef et al. 1992:508). Set 3 includes level 22, a bright yellow band of compact clay containing abundant angular fragments of limestone. It is distinct from the above-lying sediments, and blankets the entire floor of the test pit.

Level 8 has been conventionally $^{14}C$ dated to the late Holocene. Three samples of wood charcoal yielded dates of 1,990 $\pm$ 25 (SOAN-2507), 1,975 $\pm$ 80 (SOAN-2509), and 2,080 $\pm$ 35 B.P. (SOAN-2508) (Derevianko et al. 1987k:7). "Carbonized nodules" from level 8 yielded $^{14}C$ dates of 1,935 $\pm$ 45 (SOAN-2505) and 1,950 $\pm$ 30 B.P. (SOAN-2506) (Derevianko et al. 1987k:7). Radiocarbon dating the Pleistocene sediments has proven more difficult. Bone from level 11 yielded a single conventional date of >37,235 BP (SOAN-2504), and humic acids from level 21 yielded two conventional dates of >34,700 (SOAN-2488) and 39,390 $\pm$ 1,310 B.P. (SOAN-2489) (Panychev and Orlova 1990). In addition, small samples of wood charcoal collected by the author in 1991 from the exposed wall of Markin's test pit resulted in AMS $^{14}C$ dates of 35,140 $\pm$ 670 B.P. (GX-17,599) for level 21 and 2,166 $\pm$ 86 B.P. (GX-17,601) for level 22 (Goebel in press). The latter date is clearly discordant, probably due to modern contaminants in the sample.

With these absolute dates it is apparent that levels 1-8 date to the late Holocene. Although not $^{14}C$ dated, level 9 contains Mesolithic artifacts and can be tentatively assigned to the Late Glacial (Derevianko et al. 1987k). Level 11 may be mid-Upper Pleistocene in age, given its infinite $^{14}C$ date; however, the bone which yielded this date more likely was redeposited from lower sediments (Derevianko et al. 1987k). The lowermost deposits, levels 21 and 22, have been radiocarbon dated to 35,000-40,000 B.P.; however, the associated infinite date from level 21 indicates the sediments could be much older than 40,000 B.P. (Goebel in press).

Sediments at the cave entrance have been heavily influenced by geologic processes from outside the cave, including rock falls, colluviation, and pedogenesis. The geologic profile shown in Fig. 3.13 was exposed in 1986 (Derevianko et al. 1987k:4; Derevianko et al. 1990b:34). It is divisible into 15 geologic levels, which can be grouped into four major sets. Set 1 at the top of the profile includes levels 1 through 4. These sediments are characterized by abundant amounts of scree, variable in size. Level 1 is a relatively thick stratum of unsorted rock debris (predominantly angular limestone scree) with a humified silty loam fill. Levels 2, 3, and 4 are unweathered deposits of angular scree in a loam matrix. Levels 3 and 4 are lens-shaped gully-fill deposits which have truncated the upper portion of Level 5. This gully formation is oriented diagonally to the modern

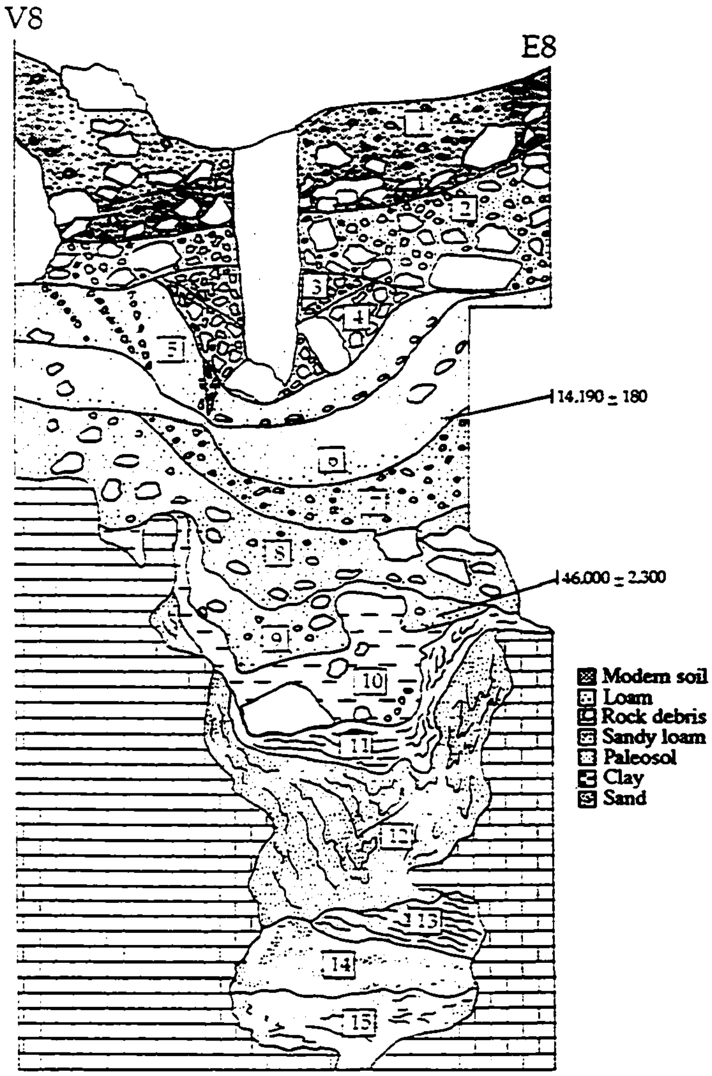


**Fig. 3.13. Stratigraphic profile from 1990 excavations at entrance of Denisova Peshchera (after Derevianko et al. 1990b).**

slope (Derevianko et al. 1990b:34). Set 2 includes levels 5 and 6, and is characterized by brown loam and silty loam deposits with rare rock inclusions. Its upper contact represents a major unconformity. Level 5 is breached by a series of frost cracks and small ice wedge pseudomorphs. At the base of Level 6 is a humified band of sediment; it contains numerous small chunks of charcoal and ash (Derevianko et al. 1990b:34). Set 3 includes geologic levels 7, 8, and 9. These are sandy loams (levels 7 and 8) and loams (level 9) bearing abundant small and unsorted angular rock debris. Level 9 contains a considerable bright yellow clay fraction. Levels 10 through 15 are ascribed to Set 4, characterized as a heterogeneous series of clays (levels 10, 11, and 14) and bedded sands (levels 12 and 13) (Derevianko et al. 1990b:34-35). Level 15 is a massively-bedded deposit of yellow to orange sands containing round inclusions of clay. This level is extensively deformed and possibly redeposited.

Radiocarbon dates from the cave entrance profile are more internally consistent than those from the profile inside the cave. Three samples of wood charcoal from level 1 produced conventional dates of 9,890 ± 40 (SOAN-2864), 10,690 ± 65 (SOAN-2866), and 10,800 ± 40 B.P. (SOAN-2865) (Derevianko et al. 1992b:84). These dates demonstrate that level 1 was deposited during the Late Glacial or early Postglacial period. Accelerator $^{14}C$ dates obtained on tiny samples of wood charcoal collected from the bases of level 6 and level 9 yielded dates of 14,190 ± 180 (GX-17,896) and 46,000 ± 2,300 B.P. (GX-17,602), respectively (Goebel in press).

Paleomagnetic studies of the cave entrance profile indicate that most of the sediments were deposited during a period of normal polarity (Derevianko et al. 1992b:85); however, samples from the top of level 11 up to the bottom of level 9 display signals of reversed polarity. According to Derevianko et al. (1992b:85), this may correlate with the Blake Reversal Episode, dated elsewhere to early oxygen-isotope stage 5, 120,000 to 110,000 B.P. (Denhem 1976; Kawai et al. 1972; Valet and Meynadier 1993; Verosub 1982; Wintle and Westgate 1986).

Pollen from these sediments provide a proxy record of environmental change for the period of their deposition. Especially interesting is the pollen spectrum from level 10 at the cave entrance, which records four warm peaks and three intervening cold episodes. The first three warm periods are characterized by pollen of elm (*Ulmus*), walnut (*Juglans*), oak (*Quercus*), and pistachio (*Pistachia*), as well as a number of water-loving plants including aldrovanda (*Aldrovanda*), water plantain (*Alisma*), and water chestnut (*Trapa*) (Derevianko et al. 1992a:75-76). The presence of these exotic, warm-loving plants suggests a remarkably warm and mesic climate analogous to that seen in central Asia today. The fourth and final warm peak, recorded at the top of level 10, is characterized by oak (*Quercus*) and elm (*Ulmus*) pollen (Derevianko et al. 1992a:76). The three intervening cold episodes are marked by pollen of shrub birch (*Betula*) and alder (*Alnus*), indicating a cooler and drier climate. The climatic oscillations defined by the pollen from level 10 are assigned to oxygen-isotope substages 5e-a, 128,000-73,000 B.P. (Derevianko et al. 1992a:77).

Comparisons of the two Denisova Peshchera stratigraphic profiles show some stratigraphic correlations (Fig. 3.14). The bright yellow clay of level 22 inside the cave can be linked to a similar clay at the cave entrance, level 10. These sediments are assigned to the last interglacial cycle (stage 5e-a). In addition, level 9 inside the cave, although not radiocarbon dated, can be provisionally assigned to the Sartan glaciation, based on the presence of frost cracks, small ice wedge pseudomorphs, and other cryogenic features. At the cave entrance, level 5 contains similar cryogenic features, and is bracketed by radiocarbon dates of 14,190 ± 180 (from level 6) and 10,800 ± 40 B.P. (from level 1). Thus, level 9 inside the cave and level 5 at the cave entrance are probably contemporaneous sediments. Tentatively, levels 21-8 inside the cave and levels 9-4 at the cave entrance can be joined as a set of Upper Pleistocene sediments spanning isotope

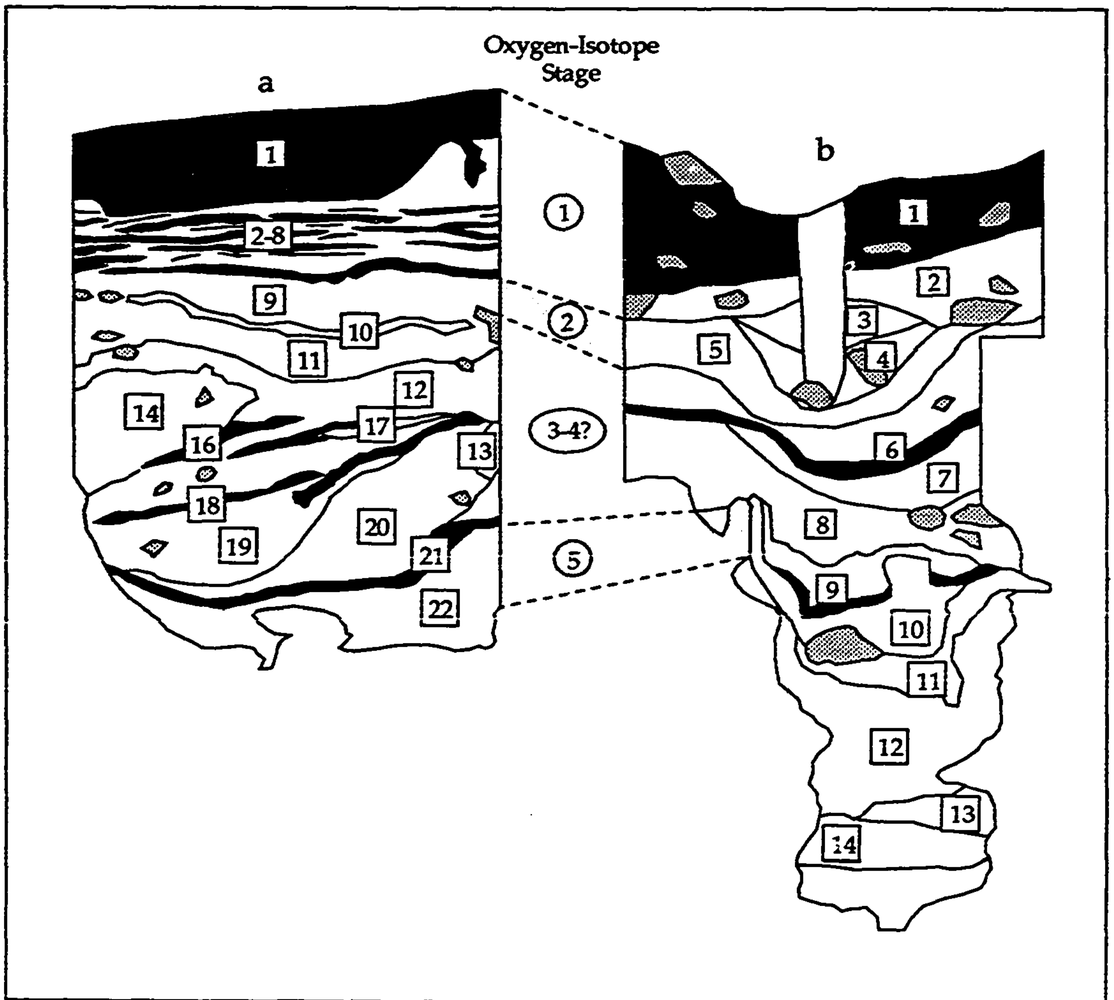


**Fig. 3.14.** Correlation of stratigraphic levels from Denisova Peshchera profiles: (a) from inside the cave, (b) from cave entrance.

stages 4 through 2 (73,000-10,000 B.P.). As excavations continue the stratigraphic relationships between the two profiles and their absolute ages should become clearer.

Paleolithic archaeological assemblages from the two excavations at Denisova Peshchera are also treated separately. Inside the cave Paleolithic artifacts were revealed in every geologic level from level 9 down to level 22, except for level 10. The cultural remains from level 9 are late Upper Paleolithic, consistent with their hypothesized Late Glacial age. The artifact industry is characterized by microblades, burins, end scrapers, wedges, and retouched bladelets, some segmented and shaped into microliths (Derevianko et al. 1985c:11-12,14-25). Denticulates, notches, and side scrapers, as well as an isolated Levallois point, also occur, suggesting some mixing and redeposition. Bone artifacts include a needle with an eye and a small bone plate with a drilled hole.

Archaeological materials from level 22 at the base of the profile are Mousterian (Derevianko and Markin 1990b:93; Markin 1987:19). The lithic assemblage, which consists of 112 pieces, includes 8 cores and 24 tools (Derevianko et al. 1985g). Levallois cores and end products are present, but few platforms are faceted (Markin 1987:14). Tools include Levallois points, side scrapers, notches, denticulates, truncated tools, beaked tools, knives, and a burin (Derevianko et al. 1985g:9-12).

The intervening levels (11-21) are more difficult to characterize. Levels 13, 15, 16, 17, 18, and 21 have yielded small lithic assemblages of less than 100 artifacts each (Markin 1987:14), while levels 11, 12, 14, 19, and 20 have yielded larger assemblages (n > 200). Levallois cores and end products occur infrequently, as do faceted platforms. Among the cores are Levallois, radial, and parallel forms. Tools include Levallois points, side scrapers, denticulates, notches, knives, and retouched Levallois flakes, as well as retouched blades, end scrapers, burins, gravers, wedges, and truncated tools (Markin 1987:15). In addition, numerous bone tools were found in level 11, including fragments of bone awls and needles, tooth pendants, and several other small items of personal adornment (Derevianko et al. 1985d). A single bone plate with a drilled hole was also found in level 13 (Markin 1987:15). Whether these levels are Mousterian or Upper Paleolithic or both is debatable. Markin (1987:19) assigns level 22 to the Mousterian, levels 14-21 to a Mousterian-like technocomplex gradually becoming Upper Paleolithic, and levels 11-13 to the Upper Paleolithic. However, Derevianko et al. (1987a:12) and Derevianko and Markin (1990a) assign levels 11-22 unequivocally to the Mousterian, arguing that the "Upper Paleolithic" bone implements found in levels 11 and 13 are intrusive from level 9. Overall, the lithic inventories from levels 21 through

11 appear mixed, possibly redeposited through a number of post-depositional factors (e.g., bear denning).

Archaeological materials from the cave entrance occur from the top of the profile downward through level 10. Artifacts from levels 7, 8, 9, and 10 are Levalloiso-Mousterian; tool assemblages include Levallois points and retouched Levallois flakes, side scrapers, denticulates, notches, truncated spalls, and beaked tools. Level 7 also contains some early Upper Paleolithic elements; among the lithic artifacts are parallel ("flat-faced") blade cores, points on blades, end scrapers, side scrapers, retouched blades, gravers, denticulates, notches, and Levallois spalls. Levels 5 and 6 contain late Upper Paleolithic industries with wedge-shaped cores, microblades, end scrapers, a laterally-grooved bone point and an eyed bone needle (Derevianko et al. 1990b:38-39, 1992b:84).

While faunal remains have not yet been analyzed by level, a combined list of fauna from the cave interior has been presented. Identified megafauna include numerous steppe, forest-steppe, and interzonal species, as well as some alpine, forest and tundra species (Table 3.1). Microfauna have been analyzed by level (Ivleva 1990:98); nearly 70% of all specimens represented are steppe, forest-steppe, and alpine species.

Hominid skeletal remains from Denisova Peshchera are meager, consisting of only two teeth, an upper incisor and a deciduous lower first molar (Turner 1990a, 1990b). Turner (1990b:240) attributes the incisor to a Neanderthal, calling attention to similarities in size and morphology with Neanderthal incisors from Shanidar Cave, Iraq.

### *5. Anui-1*

This open site is located along the left bank of the Anui River, 0.5 km south of Denisova Peshchera, 6 km north of the village of Chernyi Anui, Gorno-Altai Autonomous Oblast' (Fig. 3.1) (51°20' N, 84°44' E). Derevianko and Molodin discovered the site in 1983 (Derevianko and Zenin 1990). A total of 204 $m^2$ was excavated between 1986 and 1988 (Derevianko and Zenin 1990; Derevianko et al. 1990b:49-58); however, Paleolithic cultural remains are restricted to a 70 $m^2$ portion of the excavated area (Derevianko et al. 1990b:49).

Anui-1 lies upon a 10 m terrace surface inside a sharp bend of the Anui River. A 5-m mantle of consolidated sediments overlies cobble alluvium (Fig. 3.15). The modern soil (level 1a, 1b) is 0.8 m thick and displays clear O and A horizons. Underlying the modern soil is nearly 2 m of unweathered, massive aeolian (possibly colluvial) loess (loam) (level 2). Levels 3 through 10 are a series of interbedded colluvial and alluvial loams, sands, and scree deposits (Derevianko and Zenin 1990:32-33; Derevianko et al. 1990b:50-51). No distinct paleosols occur in the profile; however, the lower colluvial sediments (levels 3 and 5) contain isolated lenses of reworked humus.

Excavations delineated three cultural components. Component I, the uppermost component, lies within the modern soil (level 1), and consists of several Holocene-aged ceramic shards, lithic flakes, and faunal remains (Derevianko and Zenin 1990:33). Component II occurs within geologic level 4, and includes 108 faunal remains, 11 flakes, and 2 flaked cobbles. This material appears redeposited and is undated (Derevianko and Zenin 1990:33-34).

Component III materials derive from geologic levels 6 and 7 and include 279 lithic artifacts and 86 faunal remains (Derevianko and Zenin 1990:34). This assemblage is made up of 191 flakes (65 cortical spalls), 11 blades, 19 cores and core-like fragments,

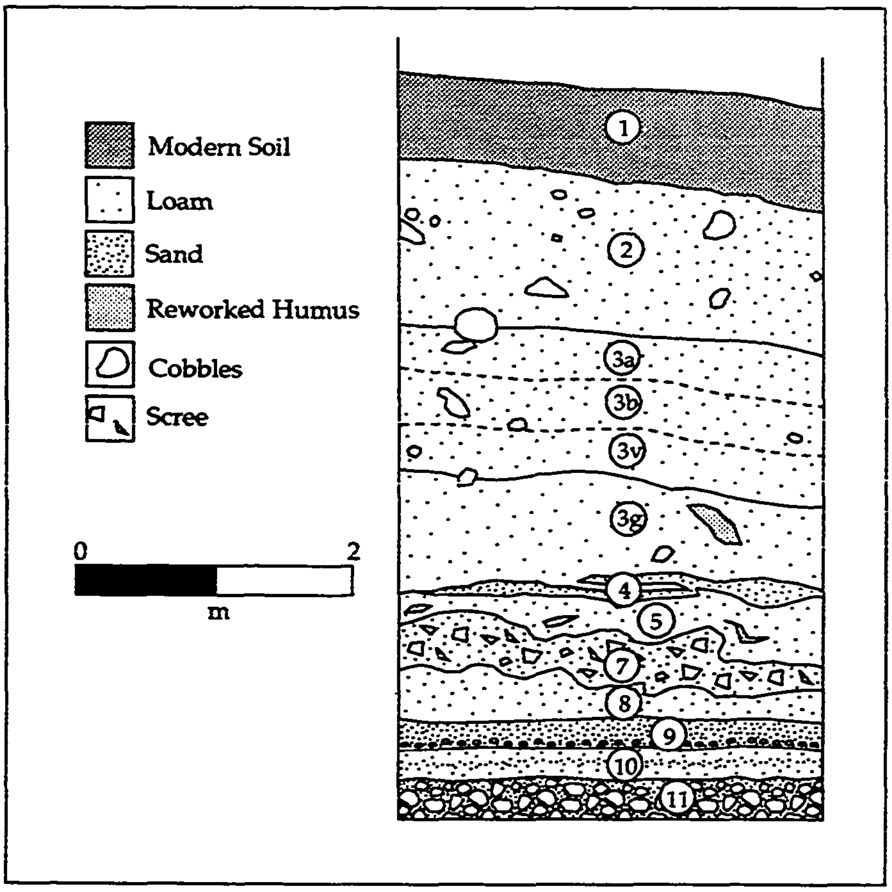


**Fig. 3.15. Stratigraphic profile of Anui-1 (level 6 is absent from this profile) (after Derevianko et al. 1990b).**

14 cobbles (unworked and initially flaked), and 44 tools. Primary reduction technology is characterized by parallel and sub-prismatic cores and blades and bladelets. The tool assemblage includes side scrapers, cobble tools (choppers and cobble scrapers), retouched flakes, burins, end scrapers, notches, denticulates, bifaces, wedges, a retouched blade, hammerstone, and retoucher (Derevianko and Zenin 1990:34-35; Derevianko et al. 1990b:53-55). This industry is typologically early Upper Paleolithic (Derevianko and Zenin 1990:38; Derevianko et al. 1990b:58); however, it may be redeposited and dating is inconclusive.

Faunal remains from Component III are chiefly (cold) steppe and forest-steppe taxa (Table 3.1) (Derevianko et al. 1990b:53). No faunal analyses have been undertaken.

### *6. Ust'-Karakol*

Ust'-Karakol [*Mouth of Karakol River*] is an open-air site located 4 km northwest of the village of Chernyi Anui, at the confluence of the Karakol and Anui rivers, Gorno-Altai Autonomous Oblast' (Fig. 3.1) (51°23' N, 84°45' E). The site is situated on a northeast-facing terrace-like knoll approximately 25 m above the left bank of the Anui River (Fig. 3.16). Derevianko discovered Ust'-Karakol in 1984. Markin excavated the site in 1986 (Derevianko et al. 1987k, 1990b; Maloletko and Panychev 1990), exposing a 120 $m^2$ area containing four cultural levels.

The Upper Pleistocene stratigraphic profile (Fig. 3.16) at Ust'-Karakol is 5 m thick and includes fluvial and aeolian sediments (Derevianko et al. 1987k, 1990b; Maloletko and Panychev 1990). The basal deposits (levels 10, 9, and 8) are alluvial silts, sands, and gravels thought to represent Zyrian terrace alluvium. Level 7 is a colluvial slope deposit, consisting mainly of angular limestone blocks in a dark gray loam matrix. Levels 6 and 5 are gray and yellow-brown loesses, respectively, that reach 2 m thick. At the surface of level 6 are a series of frost cracks. Level 4 is a colluvial deposit (0.7 m thick) consisting of a series of silty clay bands (levels 4a and 4c), laminated loams (level 4b), and reworked humus (paleosol 1). Level 3 is a 25-cm thick band of limestone debris in a clay matrix, and levels 2 and 1 are loesses. Level 2 (0.45 m thick) is extremely cryoturbated and bears numerous frost cracks; it is considered to date to the Sartan Glacial. The modern soil found at the top of the section (levels 1a, 1b) is a 0.7-m thick mountain chernozem with distinct O and A horizons.

The lower floodplain deposits (levels 10, 9, and 8) are for the most part reworked and devoid of pollen. Levels 6 through 1, on the other hand, have yielded much palynological data. The pollen spectra for levels 6 and 5 reflect an open forest-steppe (Derevianko et al. 1990b). Pollen and spores from level 4 also indicate the existence of an open forest-steppe, but with a shift toward more mesic climatic conditions (Derevianko et al. 1990b). Levels 3, 2, and 1 include progressively fewer arboreal elements, and a concomitant rise in grasses and herbs.

Four cultural levels have been identified at Ust'-Karakol, three of which are Paleolithic. The lowermost occupation, component IV, is situated in the zone of cryturbation and frost cracking of level 6. Component III occurs near the base of Level 5, and component II within the loess of level 2. Component I is found within the modern soil of level 1a.

Component IV consists of only six lithic artifacts, including three flakes, two Levallois points, and one lanceolate biface. Component III comprises 637 lithics, including 142 blades, 52 cores, and 52 tools. Primary reduction technology is characterized by the production of blades from parallel ("flat-faced") blade cores.

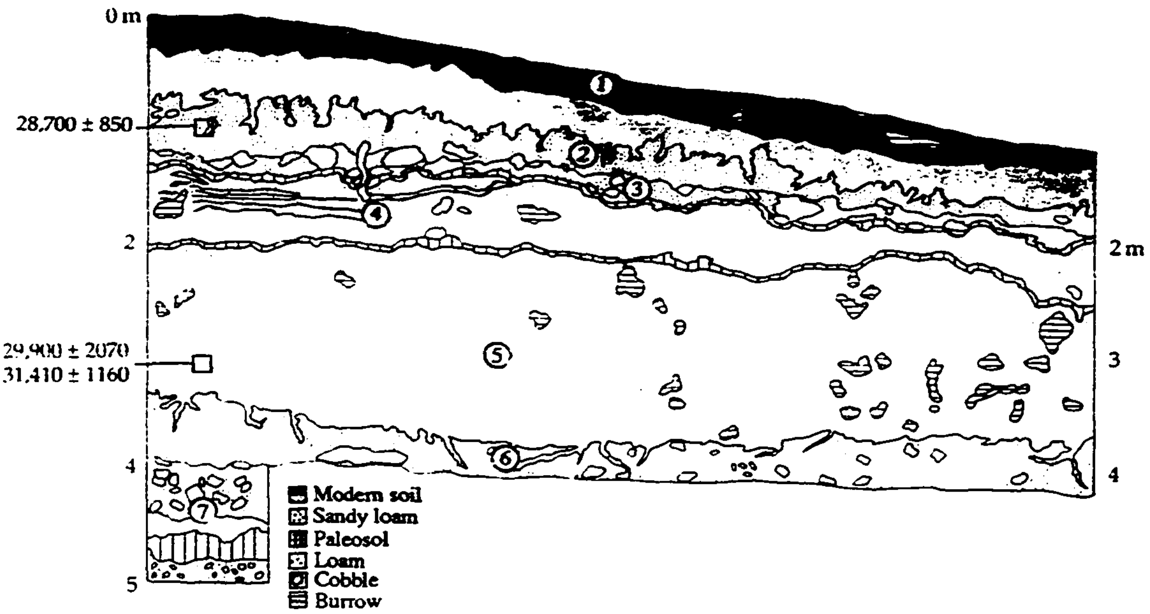


**Fig. 3.16.** Stratigraphic profile from Ust'-Karakol (after Derevianko et al. 1990b).

Secondary reduction technology is marked by unifacial and bifacial retouching. The tool assemblage consists of side scrapers, unifacial points on blades, bifacial "knives," end scrapers, burins, notches, denticulates, retouched blades, and retouched flakes. Component II is represented by a small artifact assemblage attributed to the late Upper Paleolithic (Derevianko et al. 1990b:75). Component I is assigned to the Bronze Age Afanase'va culture.

Three unlined oval hearths 0.7-0.8 m in diameter occur in component III (Derevianko et al. 1987k). Lithic artifacts and isolated bone fragments are clustered in and around these hearth features. The associated faunal assemblage consists of only eight unidentifiable bone fragments.

Three conventional $^{14}C$ dates have been obtained from Ust'-Karakol. Two samples of cultural charcoal from two unlined hearths at the base of level 5 (component III) yielded dates of 31,410 ± 1,160 (SOAN-2515) and 29,900 ± 2,070 B.P. (IGAN-837). A bison bone from level 2 (component II) was dated to 28,700 ± 850 B.P. (SOAN-2614) (Derevianko et al. 1990b). In addition, Cherkinskii et al. (1992:249) report a conventional $^{14}C$ date of 31,430 ± 1,180 B.P. (IGAN-1077) on bone from a corresponding level 5 at Ust'-Karakol-2, located less than 50 m from the main site of Ust'-Karakol.

The sedimentology, pollen record, and $^{14}C$ chronology support a Zyrian or early Karga age for component IV (60,000-45,000 B.P.) (Derevianko et al. 1987k). Component III likely dates to the Konoshchel'e stade of the Karga Interglacial (33,000-30,000 B.P.) (Derevianko et al. 1987k, 1990b). Based on the extensive frozen ground disturbances within level 2, Derevianko et al. (1990) assign component II to the late Lipovsko-Novoselovo interstade of the Karga Interglacial (around 25,000 B.P.), implying that the single $^{14}C$ date for this component is aberrantly too ancient. Levels 1b and 1a are considered late Sartan and late Holocene in age, respectively.

### *7. Tiumechin-1*

The Tiumechin sites are situated along the right bank of the Ursul River, a tributary of the Katun' River, 2 km northeast of the village of Elo, Gorno-Altai Autonomous Oblast' (Fig. 3.1) (50°43' N, 85°8' E). Tiumechin-1 is situated along the west-facing slope of the second (8 m) alluvial terrace (or side valley fan) of the Ursul River (Fig. 3.17). Posrednikov (1977) discovered the site in 1977, and Shun'kov excavated an area of 50 m² in 1978 (Shun'kov 1983) and 1980 (Shun'kov 1990). Redeposited Paleolithic

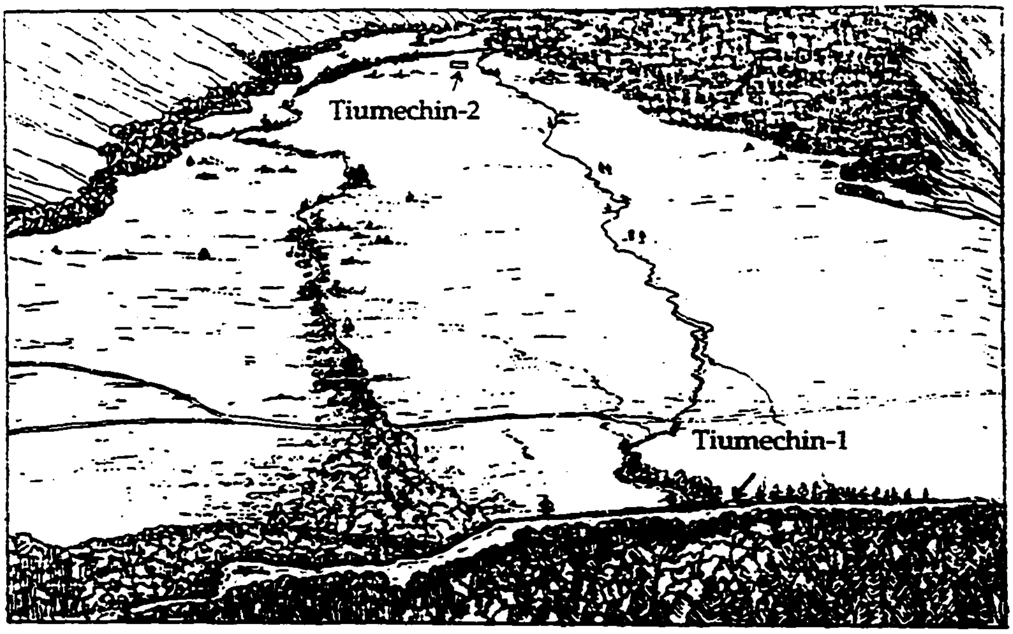


**Fig. 3.17.** Map of Tiumechin area, showing location of the Mousterian sites, Tiumechin-1 and Tiumechin-2 (after Shun'kov 1990).

materials were found throughout the alluvial gravels of the second terrace down to a depth of 3.2 m from the modern surface (Fig. 3.18) (Shun'kov 1983:31; 1990:60). No datable materials were found during excavations, but according to Tseitlin (in Shun'kov 1990:60) the terrace containing the Tiumechin-1 artifacts formed during the Sartan glaciation (25,000-13,000 B.P.), providing an upper-limiting date for the Tiumechin-1 complex.

Shun'kov (1983:31; 1990:61) describes the lithic assemblage as a single Paleolithic complex. The assemblage consists of 576 lithics, of which 46 are cores and 161 are tools (Shun'kov 1990:61-67). The lithic industry is Mousterian with high frequencies of Levallois cores and end products, and high frequencies of platform faceting. The tool assemblage includes side scrapers, Levallois points, notches, and denticulates (Shun'kov 1983:31-32; 1990:80-81).

### *8. Tiumechin-2*

Tiumechin-2 is located near where the Tiumechin Creek side valley opens onto the Ursul River plain (Fig. 3.17), 2 km east of Tiumechin-1 and 4 km east-northeast of the village of Elo, Gorno-Altai Autonomous Oblast' (Fig. 3.1) (50°43' N, 85°8' E). The site

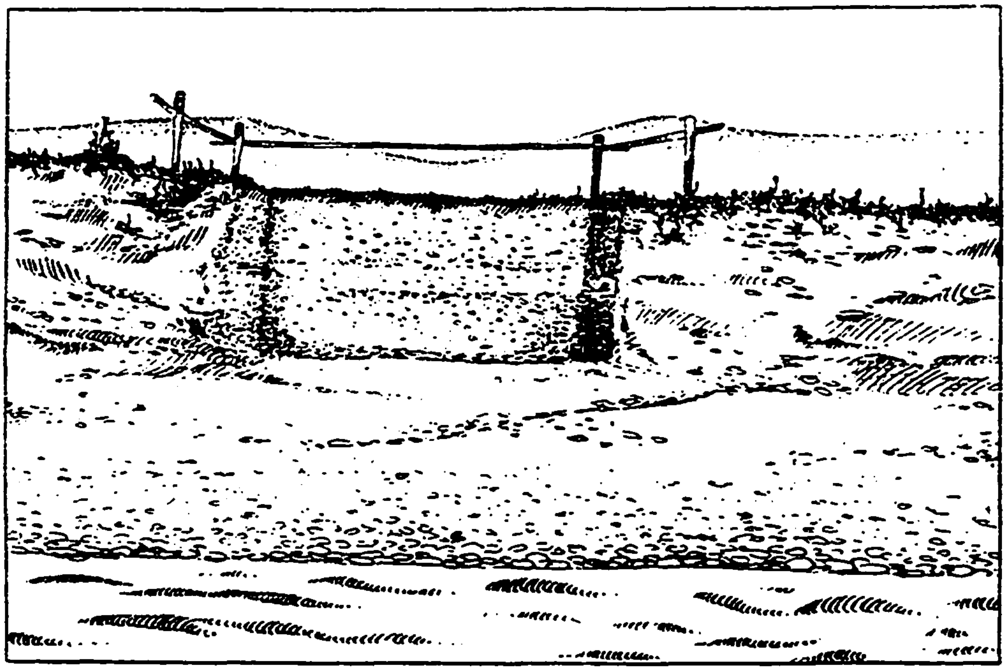

**Fig. 3.18. Tiumechin-1 stratigraphic profile (after Shun'kov 1990).**

was discovered by Shun'kov in 1978. In 1979 he excavated 50 $m^2$ of the site (Shun'kov 1982, 1990).

Like at Tiumechin-1, Paleolithic cultural remains occur in a redeposited context in unconsolidated and massively-bedded colluvial/alluvial sediments. Lithic artifacts were recovered from the surface of a bed of scree downward to a depth of 1.4 m. Faunal remains and other datable material are absent; the site remains undated (Shun'kov 1990:84).

Shun'kov (1982:134; 1990:84-87) describes a lithic assemblage of 332 artifacts, including 12 cores and 62 tools. Cores are radial (9) and prismatic (1). Levallois cores and spalls are absent, but faceted platforms are common (Shun'kov 1990:87). Notches and denticulates dominate the tool assemblage; Shun'kov (1990:97) reports a "Notch-Denticulate Index" of 49.0. Side scrapers, chopping tools, and beaked tools also occur. This industry is assigned to the "Denticulate Mousterian" of the Altai Middle Paleolithic (Shun'kov 1990:97).

## *9. Kara-Bom*

Kara-Bom [*Place Where Road Runs Against Rock*] is an open-air site located 4 km south of the village of Elo, Gorno-Altai Autonomous Oblast' (Fig. 3.1) (50°43' N,

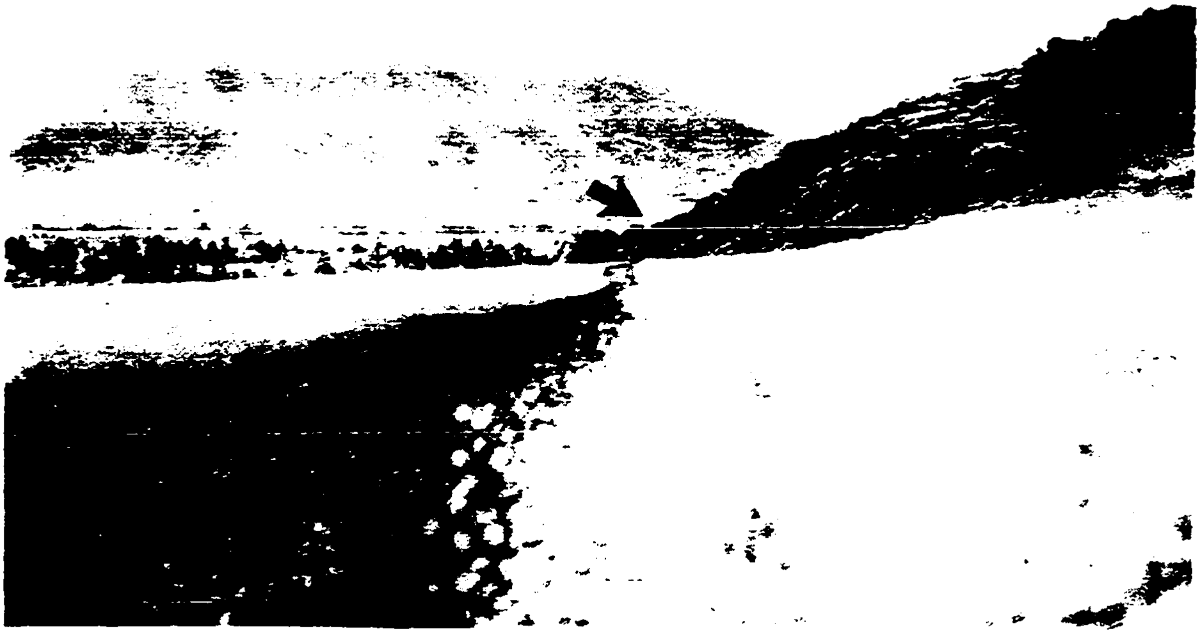

**Fig. 3.19. View of Kara-Bom, arrow points to location of site (photo by author).**

85°42' E). The site was discovered by Okladnikov, who excavated there in 1980-81 (Okladnikov 1983). Intensive excavations under the direction of Petrin began in 1987; fieldwork continued through the summer of 1992 (Derevianko and Petrin 1988; Derevianko et al. 1990b; Petrin and Chevalkov 1992). Excavations have revealed seven stratigraphically separate Upper Pleistocene cultural occupations; two are characteristically Mousterian (components Ia-b), four early Upper Paleolithic (IIa-d), and one late Upper Paleolithic (III).

Kara-Bom is situated on a colluvial talus cone at the base of a steep bedrock cliff overlooking the confluence of the Semisart and Kaerlyk rivers, tributaries of the Ursul River (Fig. 3. 19). The site is well-stratified, and cultural components occur in a clearly defined stratigraphic sequence. Sediments reach 5 m in thickness and have been divided into six geologic levels (Fig. 3.20). Geologic level 1 is bedrock. Levels 2 through 4 are sandy loam and scree colluvial deposits, and level 5 is aeolian loam. Levels 3, 4, and 5 contain a series of humic bands recording episodes of the near-cessation of sediment deposition. These humic bands likely represent warmer intervals of the mid-Upper

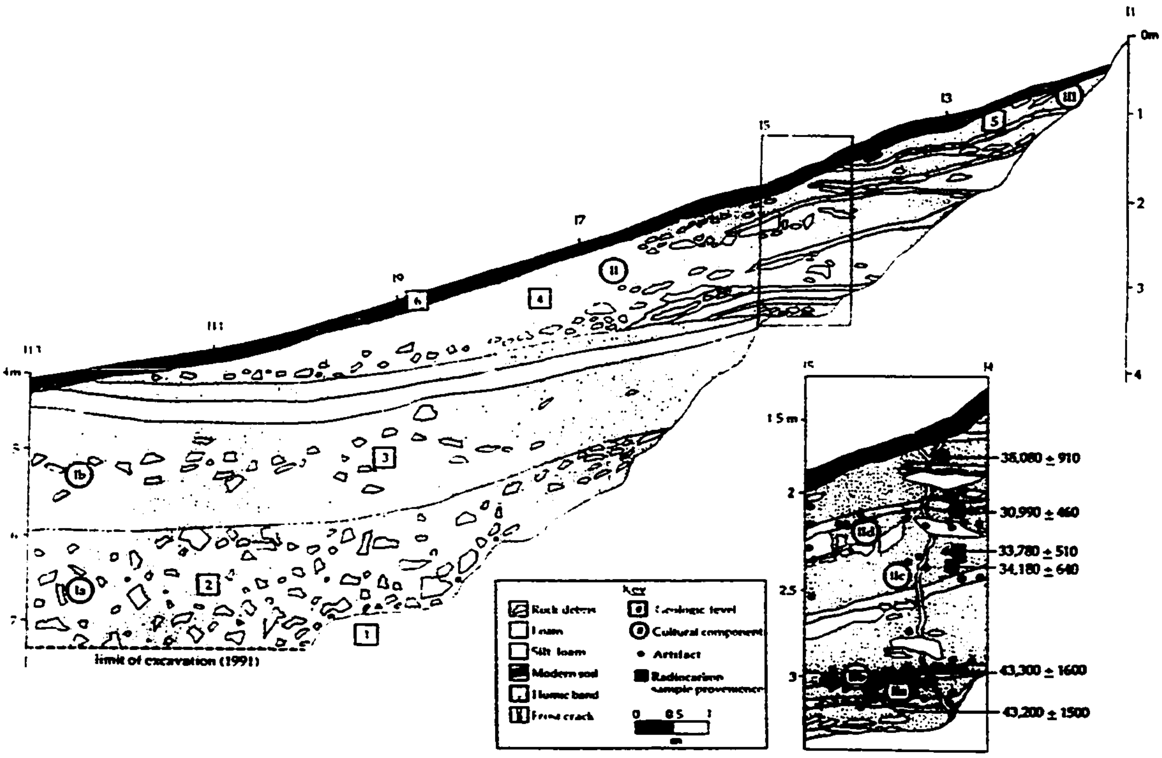


**Fig. 3.20.** Stratigraphic profile of Kara-Bom (after Goebel et al. 1993).

Pleistocene and have been assigned to the Karga Interglacial (oxygen-isotope stage 3, 60,000-25,000 B.P.) (Derevianko and Petrin 1988).

Three sets of cultural occupations have been delineated. Middle Paleolithic industries, components Ia-b, occur in geologic levels 2 and 3, respectively, and are characterized by a Levallois primary reduction technology involving the manufacture of Levallois points and flakes. Tool assemblages from components Ia and Ib contain Mousterian points, side scrapers, denticulates, notches, and knives. These industries are distinctly Mousterian and display affinities with other Mousterian sites in the Siberian Altai, such as Okladnikov, Denisova, and Strashnaia caves (Goebel et al. 1993).

Four stratigraphically separate early Upper Paleolithic components (IIa-d) occur within geologic level 4. These lithic industries are distinct from the underlying Mousterian industries of component I. Primary reduction technology focuses on the production of blades; blade cores include parallel ("flat-faced") and sub-prismatic forms. Most tools were retouched unifacially, although two bifaces occur. Tool assemblages include retouched blades, end scrapers, burins, side scrapers, denticulates, and notches. The overall character of these component II industries suggests affinities with other Siberian early Upper Paleolithic sites including Ust'-Karakol and Malaia Syia (Derevianko et al. 1987k; Muratov et al. 1982).

Component III, situated within geologic level 5, is a late Upper Paleolithic microblade industry considered to date to the Sartan Glacial (oxygen-isotope stage 2, 25,000-10,000 B.P.) (Derevianko and Petrin 1988).

Two samples of bone collected by the author in 1991 from near the top of component Ia yielded AMS $^{14}C$ dates of >42,000 (AA-8873) and >44,400 B.P. (AA-8894). These dates clearly indicate that the Middle Paleolithic occupation at Kara-Bom predates the range of $^{14}C$ dating.

Two conventional $^{14}C$ dates have been reported for component II from Kara-Bom (Derevianko and Petrin 1988). One is a date of 32,200 ± 600 B.P. (GIN-5934) on bone collagen from geologic level 4. While the cultural association of this date is unclear, its reported depth of 1.2 m below the surface indicates it may correspond to component IIc. The second conventional date is 33,800 ± 600 B.P. (GIN-5935) on wood charcoal from a hearth feature uncovered in component IIb.

New AMS $^{14}C$ dates from Kara-Bom indicate that components IIa and IIb date to at least 5,000 years earlier than conventional dates suggest (Goebel et al. 1993). Small samples of cultural charcoal from two hearth features in components IIa and IIb yielded AMS dates of 43,200 ± 1,500 (GX-17597) and 43,300 ± 1,600 B.P. (GX-17596), respectively. In addition, charcoal from Component IIc has been AMS $^{14}C$ to 34,180 ± 640 (GX-17595) and 33,780 ± 570 B.P. (GX-17593), and charcoal from Component IId has been AMS $^{14}C$ dated to 30,990 ± 460 B.P. (GX-17594) (Goebel et al. 1993). An AMS date of 38,080 ± 910 B.P. (GX-17592) was also obtained from charcoal recovered from above these early Upper Paleolithic components; it was not associated with cultural remains and likely was redeposited (Goebel et al. 1993).

Because Middle Paleolithic and early Upper Paleolithic occupations occur in an open site and clear stratigraphic context, Kara-Bom has taken on great significance. Furthermore, this site is rich in faunal remains; field identifications indicate the presence of steppe and alpine taxa (Table 3.1).

### *10. Maloialomanskaia Peshchera*

This cave site [*Little Ialoman River Cave*] is located along the left bank of Malyi Ialoman River, a minor tributary of the Katun' River, 10 km west of the village of Inia, Gorno-Altai Autonomous Oblast' (Fig. 3.1) (50°23' N, 86°29' E). In the vicinity of the cave, the Malyi Ialoman River flows rapidly through a narrow canyon. About halfway up the south-facing wall of this canyon, 27 m above the modern level of the river, are two cave openings designated the East and West Grottos of Maloialomanskaia Peshchera. The East Grotto is the smaller of the two; it is only 1.8 m wide, 1.5 m high, and 6.5 m deep. The West Grotto is much larger, 3.75 m wide, 2.3 m high, 32 m deep (Fig. 3.21) (Derevianko and Petrin 1989:16).

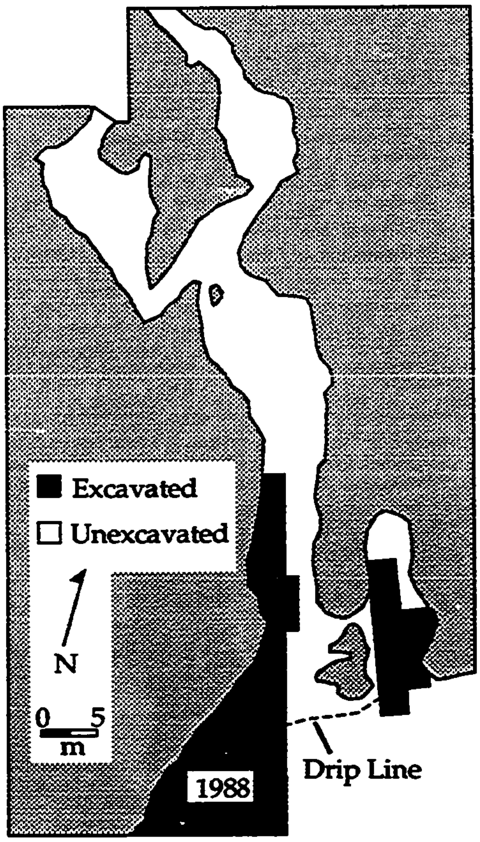


**Fig. 3.21. Maloialomanskaia Peshchera floor plan (after Derevianko et al. 1990b).**

The first archaeological materials from the cave were found in 1983 when Maloletko and Ovodov excavated a small test pit in each grotto (Alekseeva and Maloletko 1984:26; Derevianko and Petrin 1989:16). In 1988 Petrin conducted full-scale archaeological research, excavating a 45 $m^2$ area inside and outside the West Grotto (Fig. 3.21) (Derevianko and Petrin 1989; Derevianko et al. 1990b:149-156).

Sediments within the West Grotto measure less than 1 m thick and are divided into four major geologic levels (Fig. 3.22) (Derevianko et al. 1990b:150-152). Level 1 includes a series of dark gray/black humic bands with isolated angular fragments of limestone and porphyry. Level 2 is a massively-bedded, unweathered loess-like loam, perhaps aeolian, with rare angular limestone inclusions. Underlying this is a relatively thick deposit loess-like loam (level 3) subdivided into two units, horizons 3a and 3b. The upper horizon (3a) contains a series of up to 12 bands of peat (each 1-6 cm thick) alternating from black to brown in color. The black bands are rich in charcoal, and the brown bands consist chiefly of preserved plant remains. Horizon 3b is a 20-cm thick gray loam with isolated lenses of peat (or coprolites) measuring 7-12 mm in diameter (Derevianko et al. 1990b:152). The basal cave deposit (level 4) is a 20-cm band of finely laminated brown clay with small angular fragments of limestone, chipped bone, and charcoal flecks.

A single conventional $^{14}C$ date of 33,350 ± 1,145 B.P. (SOAN-2500) was obtained on wood charcoal collected from near the top of Level 3a (Derevianko et al. 1990b:153).

Cultural remains occur in geologic level 1 (Neolithic), and levels 3 and 4 (Paleolithic). Finds from levels 3 and 4 are treated as one cultural component, designated component II (Derevianko et al. 1990b:153). This component consists of 57 artifacts, including four unworked cobbles, one split cobble, two preforms, one spall, one large flake, 17 small flakes, five blades and blade fragments, and 18 tools (Derevianko and Petrin 1989:17; Derevianko et al. 1990b:154). The tool assemblage is characterized by retouched blades and blade fragments, retouched flakes (one Levallois), denticulates, and a Levallois point. In addition, a small pendant made on a red deer (*Cervus elaphus*) canine was also recovered. It bears a biconically drilled hole and a series of 11 incised lines. On one wall of the cave, there is a vertical line of red ochre 3 cm long and 1 cm wide. Whether this line was drawn during the Paleolithic, however, is unknown, but Derevianko et al. (1990b:155-156) also report that a cobble with traces of ochre was found in the Paleolithic level. Overall the character of this assemblage is Mousterian (Levallois point and spall) as well as early Upper Paleolithic (blades, some ventrally-proximally retouched); it probably incorporates multiple Paleolithic occupations.

The charcoal lenses encountered in geologic level 3a have been interpreted as hearths (Derevianko and Petrin 1989:17); however, the lack of cultural remains in and around these stains suggests that they may represent natural fires. A large assemblage of faunal remains has also been recovered from throughout the profile, although it has not yet been analyzed.

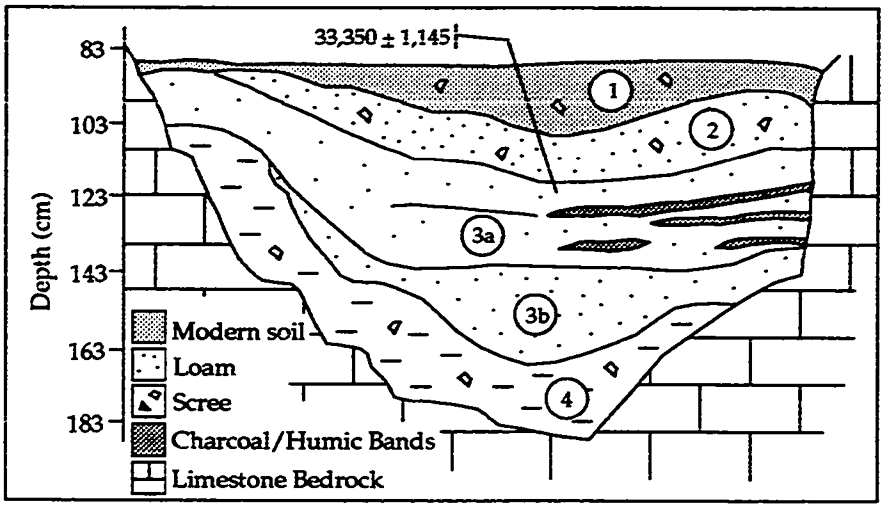


**Fig. 3.22.** Maloialomanskaia Peshchera stratigraphic profile (after Derevianko et al. 1990b).

Represented taxa are listed in Table 3.1. Steppe, forest-steppe, and forest species are represented. Evidently the majority of these remains are not directly associated with the cultural remains.

Alekseeva and Maloletko (1984:27) also report the discovery of a human tooth, but neither its provenience nor its morphology have been described.

## The Saian

### *11. Malaia Syia*

Malaia Syia [*Little Syia River*] is located in the northeastern spur of the Kuznetsk Alatau along the left bank of the Belyi Iius River, a tributary of the Chulym River, in the Shirinsk region, Krasnoyarsk Krai (Fig. 3.23) (54°20' N, 89°37' E). Ovodov discovered Malaia Syia in 1974 when he noticed artifacts eroding from the wall of a quarry of a local brick factory. At that time, Ovodov estimated that around 500 $m^2$ of the site had been destroyed, but over 2,000 $m^2$ remained unaffected by quarry activities (Muratov et al. 1982). In 1975 Ovodov and Okladnikov conducted test excavations and preliminary geologic research (Muratov et al. 1982). Larichev (1978a; Larichev et al. 1988) later excavated extensively at the site, but only limited information is available on his work. The description of Malaia Syia presented here is therefore based largely on the results of Muratov et al. (1982). Materials excavated by Larichev remain undescribed.

The site is situated on heavily-weathered Pliocene alluvium (Muratov et al. 1982), 38 m above the floodplain of the Belyi Iius River (Fig. 3.24). The site itself sits on the edge of a terrace-like surface overlooking the mouth of a small ravine (possibly an abandoned river meander) cut into the Pliocene alluvium. Just to the north of the site are two lower alluvial terraces situated 13-15 m and 3 m above the modern floodplain. Alluvium of the middle (13-15 m) terrace dams the small ravine cut into the upper terrace; in the spring the ravine fills with meltwater (Muratov et al. 1982).

Upper Pleistocene sediments at Malaia Syia consist of a homogeneous mantle of loess (aeolian loam) reaching 3 m thick (Fig. 3.25) (Muratov et al. 1982). Level 1 is the modern soil, and is formed on massively bedded loess-like loam. Level 2 is an unweathered and massive loess-like loam nearly 2 m thick. It is dissected by deep frost cracks that form a network of polygons up to 4 m in diameter (Larichev 1978a). Level 3 consists of a series of thin (<10 cm) bands and intermittent lenses of clay, some of which are humified. To Muratov et al. (1982:36), these are detrital organics, remnants of a redeposited soil. Underlying this reworked soil horizon is level 4, a strongly humified, dark gray clay loam. This paleosol is well-developed with distinct soil horizons, but it is also heavily deformed through cryoturbation (frost cracks and solifluction features are evident). At the bottom of the profile is level 5, an unweathered and massive loess-like loam similar to level 2. The very top of level 5 is gleyed (Muratov et al. 1982:36).

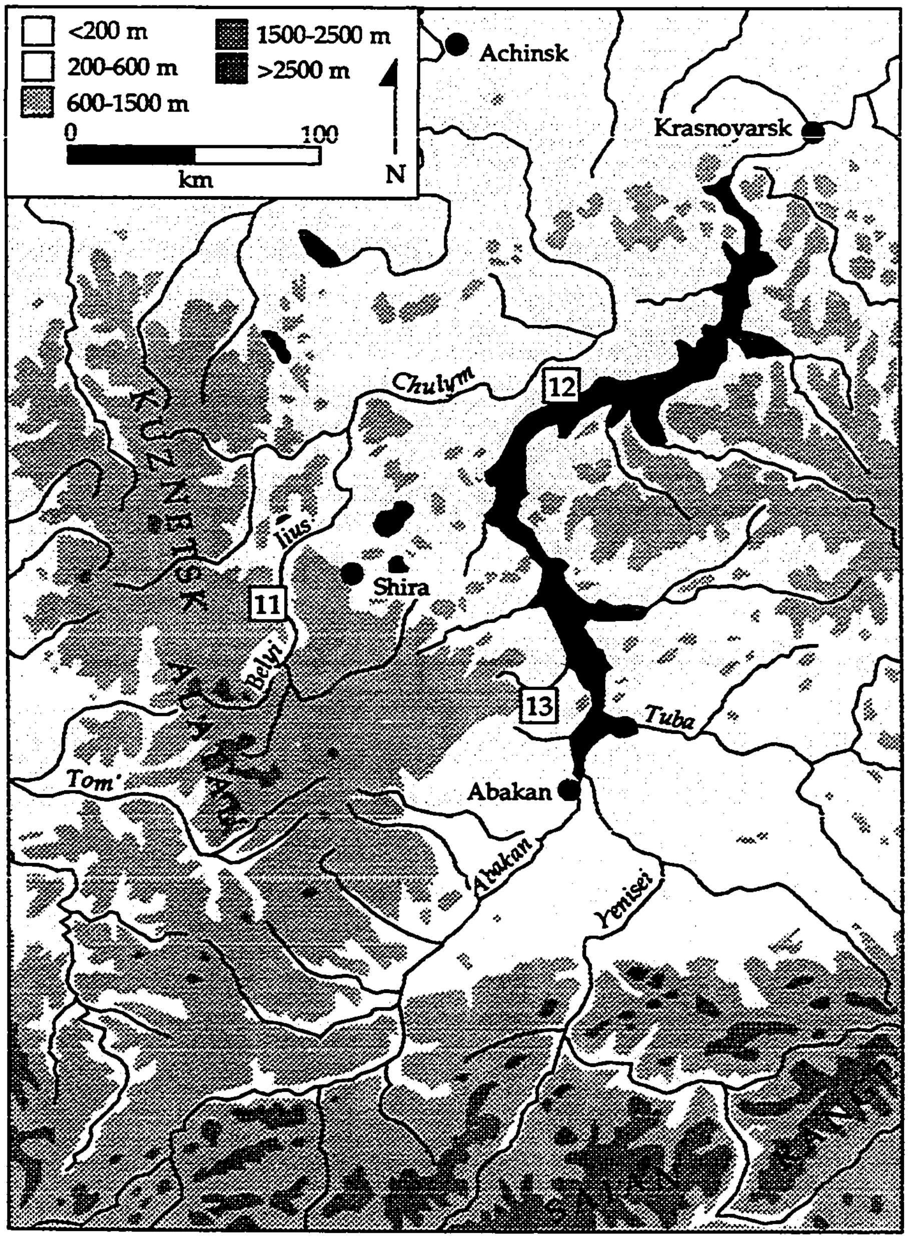


**Fig. 3.23.** Map of Yenisei region of south central Siberia showing location of Paleolithic sites discussed in text: (11) Malaia Syia, (12) Kurtak, (13) Dvuglazka Grot.

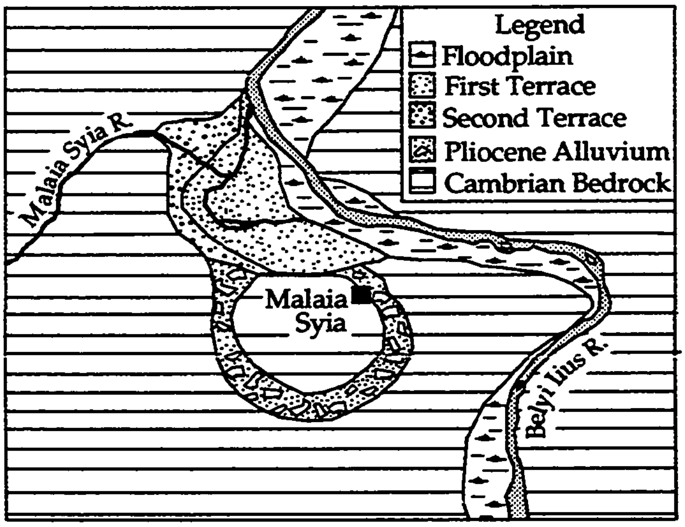


**Fig. 3.24. Map of Malaia Syia area showing major Quaternary landforms (after Muratov et al. 1982).**

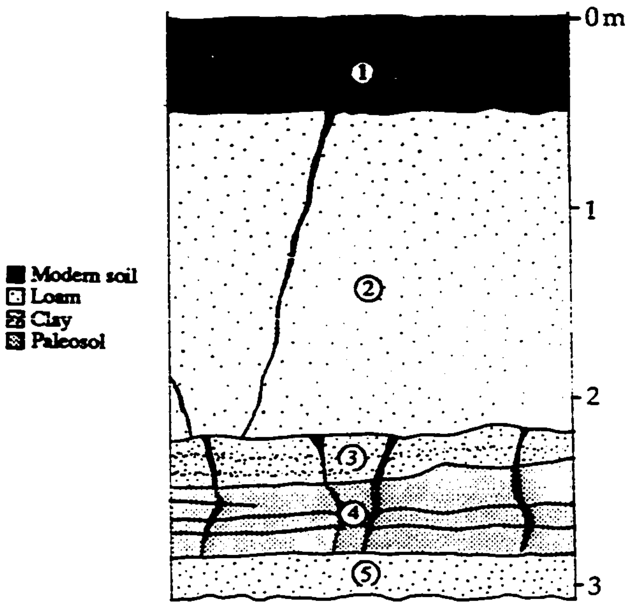


**Fig 3.25. Malaia Syia stratigraphic profile (after Larichev 1978a).**

Cultural remains from Malaia Syia occur in a single cultural level, designated component I, situated within the paleosol of level 4. Radiocarbon dates are problematic. A combined sample of natural charcoal from level 4 yielded a conventional $^{14}C$ date of 20,370 ± 340 B.P. (SOAN-1124). Conventionally $^{14}C$ dated bone from component I produced dates of 34,500 ± 450 (SOAN-1286) and 34,420 ± 360 B.P. (SOAN-1287) (Muratov et al. 1982). Larichev (1978a, Larichev et al. 1988), however, presents a different date, 33,060 ± 300 B.P., for date number SOAN-1287. It is unclear whether the date or the lab number is incorrectly reported, or whether the radiocarbon lab revised their age calculations. In addition to these dates, the present study reports one previously unreported AMS $^{14}C$ date of 29,450 ± 420 B.P. (AA-8876).[1] This date was run on a sample of bone collected in 1975 from component I by Ovodov and given to the author in 1991. Given these $^{14}C$ dates, the age of component I, then, probably dates to the Malokheta interstade of the Karga Interglacial (43,000-35,000 B.P.), and the cryogenic cracks deforming it probably date to the Konoshchel'e stade (34,000-31,000 B.P.). The loess of level 2 likely accumulated during the late Karga or early Sartan (30,000-20,000 BP), and the large ice cracks formed during the last glacial maximum (20,000-18,000 BP).

In 1975 Ovodov collected an assemblage of 583 lithic artifacts (51 cores, 89 cobbles, 374 flakes, 29 blades, 40 tools). Larichev's collections have not been described, nor have they been available for study. Primary reduction technology is characterized by the production of blades from large parallel ("flat-faced") cores. The tool assemblage includes cobble choppers and transverse scrapers on choppers, end scrapers, retouched blades, burins, notches, and denticulates (Muratov et al. 1982; Larichev et al. 1988). Bone and antler tools also occur; they include four complete or nearly complete antler points ranging from 90 to 180 mm long. They are wide (1-4 cm) but thin (<1 cm). None are slotted or split-based. Also present are two thick antler billets apparently used to retouch stone tools. Overall, this industry displays many technological affinities with apparently contemporaneous early Upper Paleolithic industries in the Transbaikal (e.g., Tolbaga, Varvarina Gora), which are discussed in detail below (Muratov 1982; Larichev et al. 1988).

Larichev (1978a, 1978b, 1979, 1980, 1984, Larichev et al. 1988) has written much on the putative mobiliary art from Malaia Syia. He presents a series of lithic flakes,

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[1]This date (AA-8876) is discordantly younger than the conventional $^{14}C$ dates from Malaia Syia, and may have been contaminated by younger or modern carbon. At the time of this writing, this sample was being retested at the NSF-Arizona AMS facility, University of Arizona, Tucson (AA).

cortical spalls, and tools that appear to have been shaped into animal forms (e.g., tortoises, eagles, horses, mammoths). All of these, however, are equivocal. In addition, proposed etchings of wild animals (e.g., horse, bison, lion, wolf) are neither clear nor indisputable.

The faunal assemblage is quite extensive (4,779 pieces), but only preliminarily studied (Muratov et al. 1982). Steppe, tundra, and alpine species are well-represented, while forest species are absent (Table 3.2) (Fig. 3.26). This megafaunal assemblage is characteristic of the Upper Pleistocene north Eurasian "Mammoth Steppe" (as defined by Guthrie 1990). Likewise, the pollen spectra from level 4 are dominated by grasses (Gramineae), composites (Compositae), goosefoots (Chenopodiaceae), caryophylles (Caryophyllaceae), and peas (Leguminosae), while arboreal pollen is absent (Muratov et al. 1982), again indicating cold and arid conditions at the time of the early Upper Paleolithic occupation.

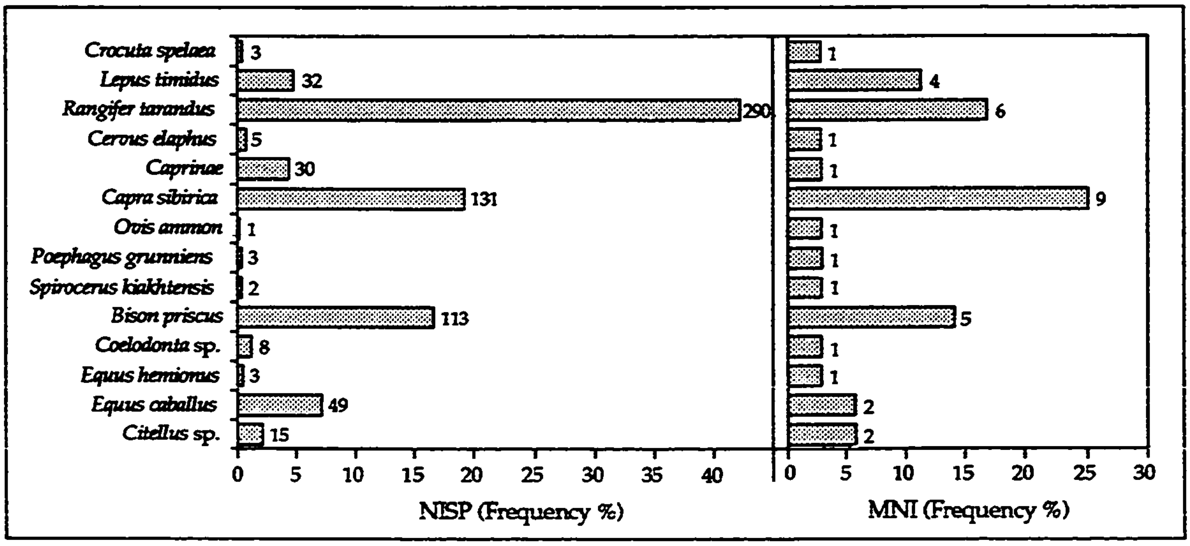


**Fig. 3.26.** Malaia Syia faunal assemblage (after Muratov et al. 1982).

## *12. Kurtak*

In the vicinity of the village of Kurtak (55°9' N, 91°37' E), 165 km north of Abakan, along the eastern shore of the Krasnoyarsk Reservoir (formerly the left bank of the Yenisei River), are a series of newly discovered Paleolithic localities known mainly from surface surveys conducted by Drozdov et al. (1990a, 1990b) in 1988 (Fig 3.23).

**Table 3.2.** Fauna Represented in Saian, Cisbaikal, and Transbaikal Sites

| Species by ecotone | SYI* | DVU | KOV | VOE | VAR | SAN | TOL |
|---|---|---|---|---|---|---|---|
| <u>Steppe</u> | | | | | | | |
| *Lepus tolai* | | | | | • | | |
| *Marmota sibirica* | | | | | • | | |
| *Citellus sp.* | • | | | | | • | • |
| *Microtus brandti* | | | | | | • | • |
| *Vulpes corsac* | | | | | • | | |
| *Equus caballus* | • | • | | • | | | |
| *E. hemionus* | • | • | • | | • | | • |
| *Coelodonta antiquitatis* | • | • | • | | • | • | • |
| *Bison priscus* | • | • | | | | | |
| *Spirocerus kiakhtensis* | | | | | • | | • |
| *Spirocerus sp.* | | | | | | • | |
| *Procapra gutturosa* | | | | | • | | • |
| *Saiga sp.* | | • | | | | | |
| <u>Alpine</u> | | | | | | | |
| *Marmota baibacina* | • | | | | | | |
| *Poephagus gruniens* | | | | | • | | • |
| *Ovis ammon* | • | • | | | • | | • |
| *Hemitragus jemlahicus* | | | | | | • | |
| *Capra sibirica* | • | | | | • | | |
| <u>Forest-Steppe</u> | | | | | | | |
| *Megalocerus sp.* | | | | • | | | |
| *Cervus elaphus* | • | • | | • | | | • |
| <u>Forest</u> | | | | | | | |
| *Ursus arctos* | • | | | | • | | |
| *Gulo sp.* | | • | | | | | |
| <u>Tundra</u> | | | | | | | |
| *Rangifer tarandus* | • | | • | • | • | | • |
| <u>Multiple ecotones</u> | | | | | | | |
| *Lepus timidus* | • | | | | • | | |
| *Lepus sp.* | | • | | | | | |
| *Canis lupus* | | • | | | • | | • |
| *Vulpes vulpes* | | | | | • | | |
| *Vulpes sp.* | | • | | | | | |
| *Ursus sp.* | | • | | | | | |
| *Crocuta sp.* | | • | | | | | |
| *Panthera sp.* | | • | | | | | |
| *Mammuthus primigenius* | • | • | • | | | | |
| *Equus sp.* | | | | • | • | • | • |
| *Bison sp.* | • | | | • | | | • |

*SYI = Malaia Syia, DVU = Dvuglazka Grot, KOV = Ust'=Kova lower complex, VOE = Voennyi Gospital, VAR = Varvarina Gora, SAN = Sannyi Mys component VI, TOL = Tolbaga.

Most cultural remains were collected from eroded beach and bank deposits along the shore of the reservoir; however, test excavations at several localities (Bereshekovo, Kamennyi Log, Kashtanka-1, Kurtak-4) have led to the discovery of Paleolithic finds *in situ*, but apparently in secondary contexts (Drozdov et al. 1990b:103).

Of particular relevance to the present study is the locality Kurtak-Chanin-2 (Drozdov et al. 1990a:66-70; 1990b:50-60), where a small assemblage of lithic artifacts and faunal remains was found on the surface of the beach, 1 km southeast of the village of Kurtak. Among the artifacts are two radially-prepared Levallois flake cores and four unretouched Levallois points with faceted platforms (Drozdov et al. 1990a:66, 1990b:60). Although not found *in situ*, their occurrence here, along with the evidence from Dvuglazka Cave, suggests that the Mousterian occupation of the Siberian Altai extended northeastward into the northern foothills of the Saian mountins (Drozdov et al. 1990a:70, 1990b:60).

### *13. Dvuglazka Grot*

This multi-component cave site [*Two Eyed Grotto*] is located 6.5 km west of the village of Tolcheia, 45 km north of Abakan, Khakasiia Autonomous Oblast' (Fig. 3.23) (53°58' N, 91°9' E). Abramova discovered the cave in 1974; she excavated a total of 38 m² in 1975, 1978, and 1979, uncovering traces of a Mousterian occupation dating to the mid-Upper Pleistocene or earlier (Abramova 1981, 1985; Abramova et al. 1991:67-68; Ermalova 1980).

The cave is situated 50 m above the head of a dry, narrow gully 500 m from the left bank of the Tolcheia River, a small tributary of the Yenisei. The cave's arched entrance measures 7 m high and 6 m wide and faces south. The escarpment at Dvuglazka is part of an extensive limestone massif that runs westward along the Kosinsk Range. The cave itself is formed within this limestone; its cavity measures 7-10 m wide, up to 7.5 m high, and 15 m deep (Fig. 3.27). Outside the cave is a small ledge measuring 15 x 25 m (Abramova 1981:74, 1985:93).

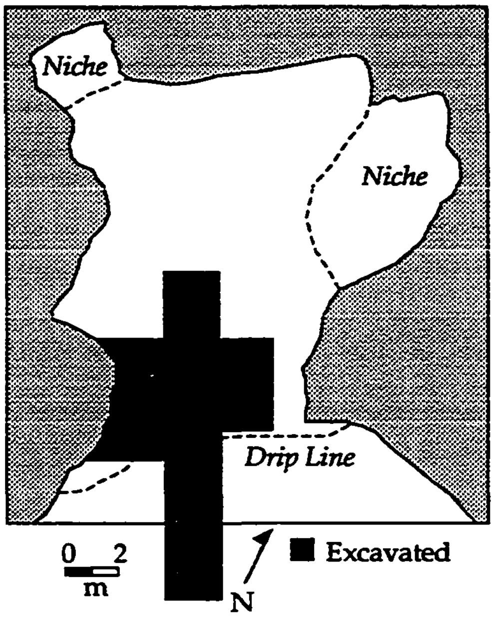


**Fig. 3.27.** Dvuglazka Grot floor plan (after Abramova 1985).

Cave geomorphology and stratigraphy have been studied by V. Muratov and S. Tseitlin (Abramova 1985:94-97). The profile presented in Figure 3.28 is a transverse section from 4 m inside the drip-line of the cave. Sediments reach 4 m thick; eight geologic levels have been delineated. Level 1 is modern animal dung, and levels 2-4 are loams and sandy loams with variously-sized angular scree. These levels display numerous rodent burrows filled with fine silt loams and loams. Levels 5 and 6 are thick bands of loam with abundant fragments of spalled limestone. This mass of angular scree constitutes 70% of the total volume of level 5. According to Abramova (1985), these levels also appear to have been extensively reworked by groundwater. Level 7 is a complex series of orange clay bands with convoluted interbeds of charcoal (level 7a), white clay (7b), and yellow loam (7c). Level 8 is a bright-orange band of clay that mantles the floor and lower walls of the cave.

No $^{14}C$ dates have been obtained from these sediments, but gross age estimates are assigned on the basis of archaeological data. Level 2 contains Mesolithic (early Holocene) cultural materials (component I), including an end core, numerous microblades, and two

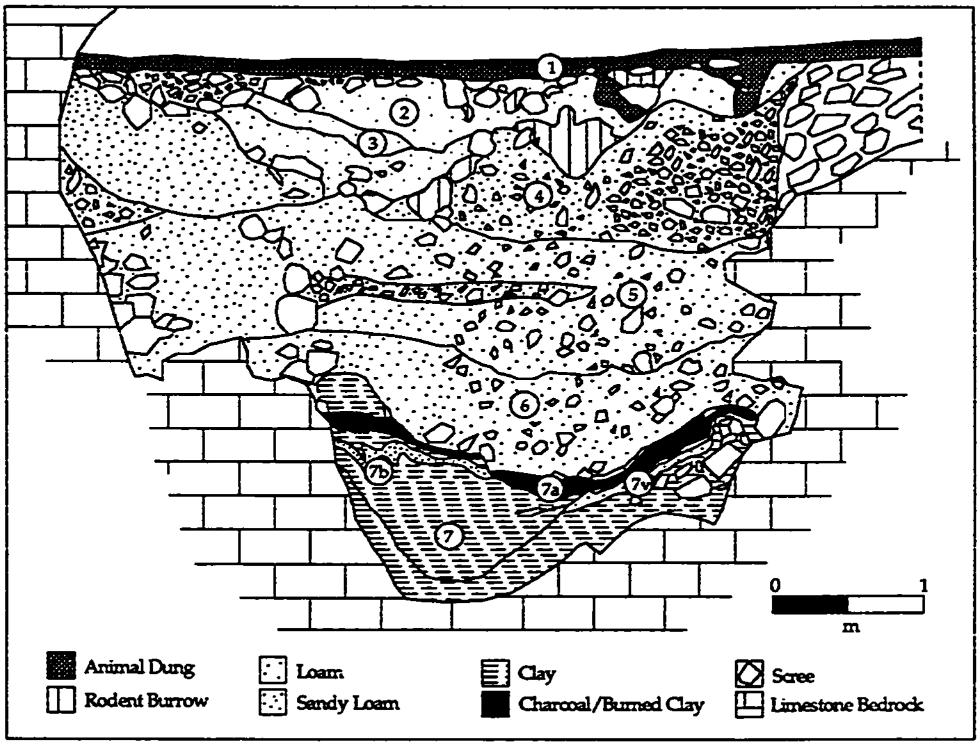


Fig. 3.28. Stratigraphic profile of Dvuglazka Grot (after Abramova 1985).

bone implements (Abramova 1985:97). Level 4 contains a late Upper Paleolithic archaeological component (component II) that is characterized by a small lithic assemblage including a subprismatic blade core and several bifacial point fragments, retouched blades, end scrapers, side scrapers, and an antler billet.

Mousterian artifacts have been recovered from the lower levels of the cave (levels 5 and 6) (component III). Levallois and discoidal cores are common, as are Levallois flakes and points with faceted and dihedral platforms. The tool assemblage is small, consisting of Levallois points, denticulates, side scrapers, retouched flakes (some Levallois), and a notch (Abramova 1981:77-78; Abramova et al. 1991:68).

Megafaunal remains from levels 5 and 6 (component III) are predominantly steppe, forest-steppe, and alpine species (Table 3.2). Carnivore remains are abundant, as are rodent and bird remains (Abramova 1985:96). According to Ermolova (1980) this faunal assemblage reflects warm, dry steppe conditions. Based on the fauna as well as the Mousterian lithic assemblage, Abramova (1984:147; Abramova et al. 1991:26-27) assigns the Mousterian levels of component III at Dvuglazka Cave to the early Karga interglacial (around 50,000 B.P.).

## SOUTHEAST SIBERIA

### The Cisbaikal

#### *14. Ust'-Kova*

The multi-component Ust'-Kova site [*Mouth of Kova*] is located along the left bank of the Angara River, 2 km upriver from its confluence with the Kova River, 20 km east of the village of Balturino (Fig. 1.1, 3.29) (58°20' N, 100°19' E). Although Okladnikov discovered Ust'-Kova in 1937, Paleolithic remains were not found there until 1971 when Drozdov began a full-scale study of the site (Drozdov and Dement'ev 1974:211-214; Drozdov and Laukhin 1979). Excavations were conducted in 1971-1972 (Drozdov and Dement'ev 1974), in 1976-1982 (Akimova 1984; Akimova and Bleinis 1986; Drozdov 1981; Drozdov et al. 1990a:147-181; Vasil'evskii et al. 1988) and again in 1986-1987 (Drozdov and Akimova 1987).

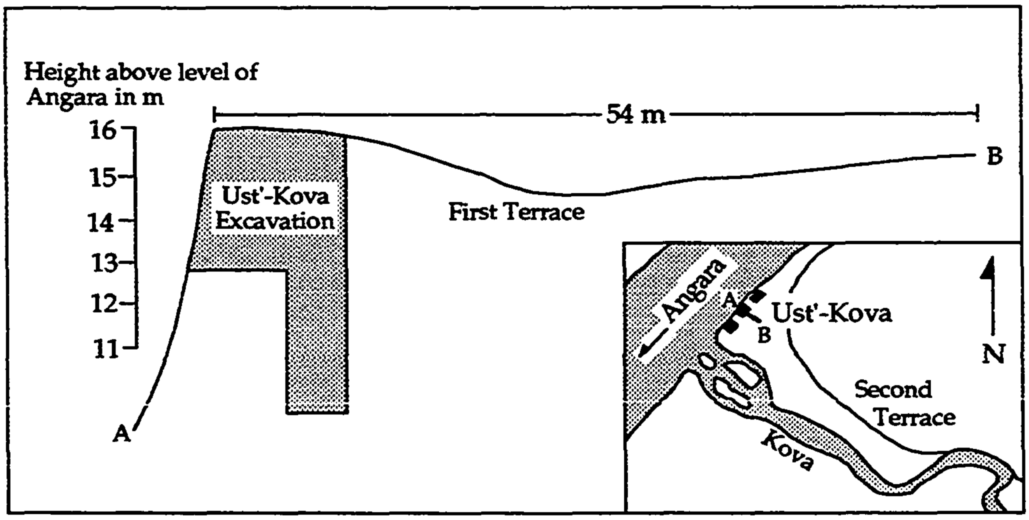


**Fig. 3.29.** Schematic map of Ust'-Kova area (inset and transect of first terrace of Angara River at main excavation (after Drozdov et al. 1990a).

Site geomorphology and stratigraphy have been studied by Laukhin (Drozdov and Laukhin 1979; Laukhin et al. 1980), Demidenko (1990) and Chekha (1990; Drozdov and Chekha 1990). The site is situated immediately adjacent to the Angara River on the second (14 m) terrace of the river (Drozdov et al. 1990a:148). Loose Quaternary sediments overlying alluvium of the second terrace are 2 m thick and consist primarily of aeolian and alluvial loams, sandy loams, and fine-grained sands (Fig. 3.30) (Drozdov and Chekha 1990:175; Vasil'evskii et al. 1988:77-78). Stratigraphic profiles are exceedingly complex (Drozdov and Chekha 1990:175; Vasil'evskii et al. 1988:79); numerous episodes of solifluction and at least four generations of ice wedge pseudomorphs are said to have essentially removed cultural remains from their primary contexts (Drozdov

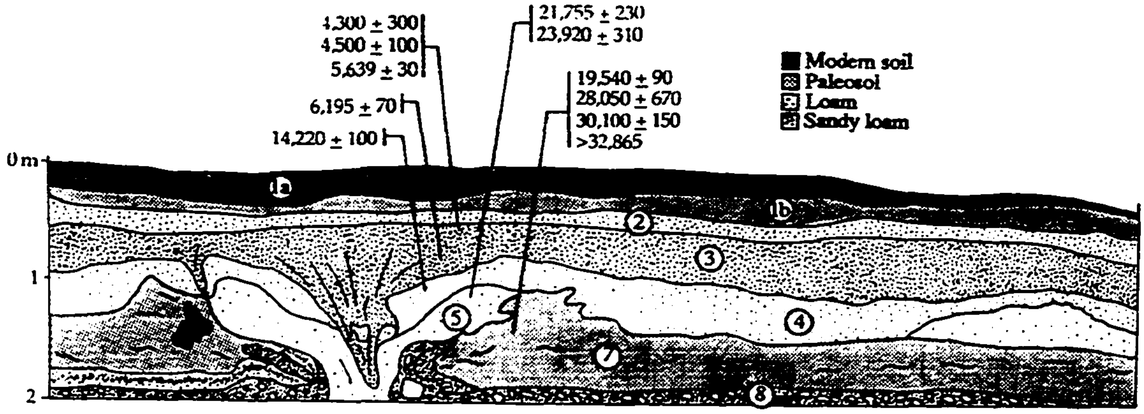


**Fig. 3.30.** Ust'-Kova stratigraphic profile (level 6 absent from this profile) (after Chekha 1990).

and Chekha 1990:174; Drozdov et al. 1990a:152). Level 7 is a loam masked by a major paleosol horizon. It overlies river alluvium (level 8) and has been extensively reworked through solifluction and massive ice wedge pseudomorphs.

Cultural remains are divided into three cultural components. Components I and II are assigned to the Iron Age and Neolithic, respectively (Drozdov et al. 1990a:154-162). Component II is Neolithic and has been dated to the mid-Holocene (4,500 ± 100 [KRIL-379], 6,195 ± 70 [KRIL-380], 5,639 ± 30 [SOAN-1898], and 4,300 ± 300 B.P. [SOAN-1899]) (Drozdov et al. 1990a:162). Component III is Paleolithic and includes three occupations referred to as the early, middle, and late complexes (or "sub-components") (Drozdov 1991; Drozdov and Akimova 1987:111; Drozdov et al. 1990a:162; Vasil'evskii et al. 1988:86). For component III an area of over 1,200 $m^2$ has been excavated. The majority of Paleolithic artifacts were found within ice wedge pseudomorphs and "cupola-shaped" frost heaves (Drozdov et al. 1990a:162). Apparently, assignment of some of these artifacts into specific complexes was arbitrary (Abramova 1989:197; Akimova pers. comm., October 1991).

The late complex of component III occurs within the loess of level 4, $^{14}C$ dated to 14,220 ± 100 B.P. (LE-1372) (Laukhin et al. 1980). This date was run on wood charcoal that does not appear to be culturally produced. It may not reflect the actual age of the associated artifacts, which are terminal Paleolithic or Mesolithic in appearance (Akimova and Bleinis 1986:63; Drozdov and Laukhin 1979:41).

Cultural remains attributed to the middle complex of component III are tied to heavily carbonated loess-like loams that comprise level 5 (Drozdov et al. 1990a:168). Most artifacts, however, were actually found in disturbed contexts in ice wedge pseudomorphs and frost heave features, and were assigned to the middle complex because of carbonate encrustations on their surfaces. Wood charcoal from level 5 yielded a conventional $^{14}C$ date of 23,920 ± 310 B.P. (KRIL-381) (Laukhin et al. 1980; Vasil'evskii et al. 1988:87), while bone from level 5 yielded an AMS $^{14}C$ date of 21,755 ± 230 B.P. (AA-8887) (this study). Given these dates, the middle complex appears to date to the early Sartan Glacial, around 24,000-20,000 BP. The middle complex is represented by a lithic assemblage totalling 2,731 artifacts, including 211 tools (Vasil'evskii et al. 1988:87). This is a subprismatic core and blade industry, with a tool assemblage consisting of perforators, retouched blades and flakes, cobble planes, wedges, end scrapers, bifaces, side scrapers, points, burins, and knives (Akimova 1984:37-38; Drozdov et al. 1990a:168-171). Bone and ivory art objects are common (Vasil'evskii and Drozdov 1983). Over

10,000 faunal remains have been recovered; identified species include woolly mammoth (*Mammuthus primigenius*), reindeer (*Rangifer tarandus*), bison (*Bison* sp.), horse (*Equus* sp.), Manchurian deer (*Capreolus manchuricus*), and moose (*Alces alces* ) (Vasil'evskii et al. 1988:90).

The early complex of component III is difficult to characterize, since nearly all artifacts (268) and faunal remains (327) were found in ice wedge pseudomorphs. According to Drozdov et al. (1990:171) this complex is tied to the buried soil of level 7, conventionally $^{14}C$ dated to 19,540 ± 90 (SOAN-1900), 28,050 ± 670 (SOAN-1875), 30,100 ± 150 (GIN-1741), and >32,865 B.P. (SOAN-1690) (all dates run on wood charcoal) (Drozdov et al. 1990a:171; Vasil'evskii et al. 1988:80-81). The lithic assemblage consists mostly of flakes and spalls. Cores are absent, and tools include "artifacts with beaks," sidescrapers, planes, and chopping tools (Vasil'evskii et al. 1988:91). According to Drozdov et al. (1990a:171), some of these artifacts display traces of wind-induced polishing, and were likely redeposited from the higher, third terrace of the Angara. They have "no true analog among the known late Paleolithic cultures of northern Asia" (Drozdov et al. 1990a:178), and are therefore assigned to the Middle or Lower Paleolithic. Faunal remains include woolly mammoth (*Mammuthus primigenius*), Asiatic wild ass (*Equus hemionus*), reindeer (*Rangifer tarandus*), and woolly rhinoceros (*Coelodonta antiquitatis*).

### *15. Sosnovyi Bor*

Sosnovyi Bor [*Pine Woods*] is located along the right bank of the Belaia River, 16 km above its confluence with the Angara River, Usol'sk region, Irkustk Oblast' (Fig. 3.31) (52°46' N, 103°19' E). Medvedev discovered the site in 1966 and excavated an area of 1,290 m² from 1967 through 1971 (Abramova 1989:208-210; Lezhnenko 1982; Lezhnenko et al. 1982; Medvedev 1983). Six cultural components have been identified; three are Upper Paleolithic, two Mesolithic, and one Neolithic. Only the lowest archaeological level, component VI, will be considered here.

Sosnovyi Bor site geology and stratigraphy have been studied in depth by Tseitlin (1979) and Vorob'eva and Medvedev (1984). The site is situated along the edge of a steep bedrock cliff 18-24 m above the modern level of the Belaia River (Fig. 3.32). Quaternary sediments are characteristically aeolian, and consist of a series of dunes and blow-out/lag features (Fig. 3.32) (Vorob'eva and Medvedev 1984:24-25).

No $^{14}C$ dates are available for the basal cultural level (component VI). Lithic artifacts occur on the surface of a cobble bed (Fig. 3.32) (apparently a deflated lag deposit) and are heavily polished from wind-induced sandblasting. Tseitlin (1979) concludes that this intense aeolian activity took place during the height of the Sartan

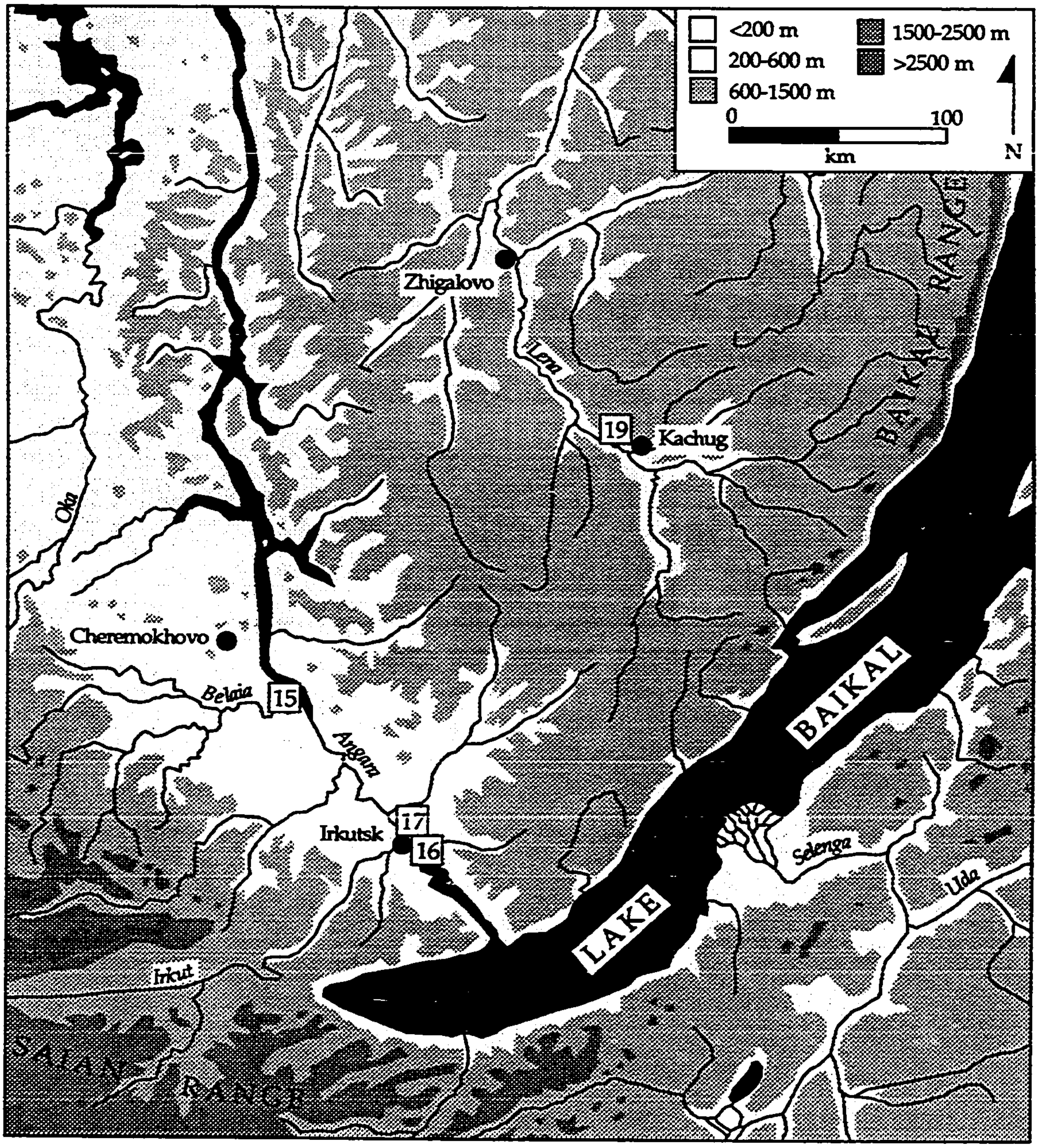


**Fig. 3.31.** Map of Cisbaikal region of south Siberia showing location of Paleolithic sites discussed in text: (15) Sosnovyi Bor, (16) Voennyi Gospital (the Military Hospital), (17) Arembovskii, (19) Makarovo-4.

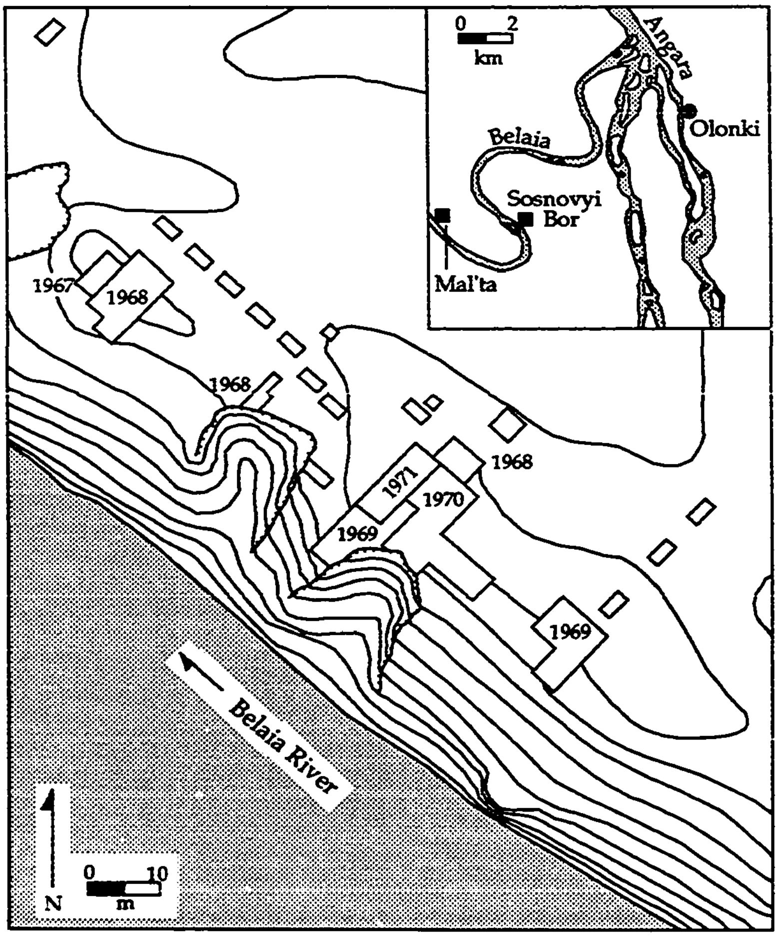


**Fig. 3.32. Topographic map of the Sosnovyi Bor site area (contour interval equals 1 m) (after Lezhnenko et al. 1982).**

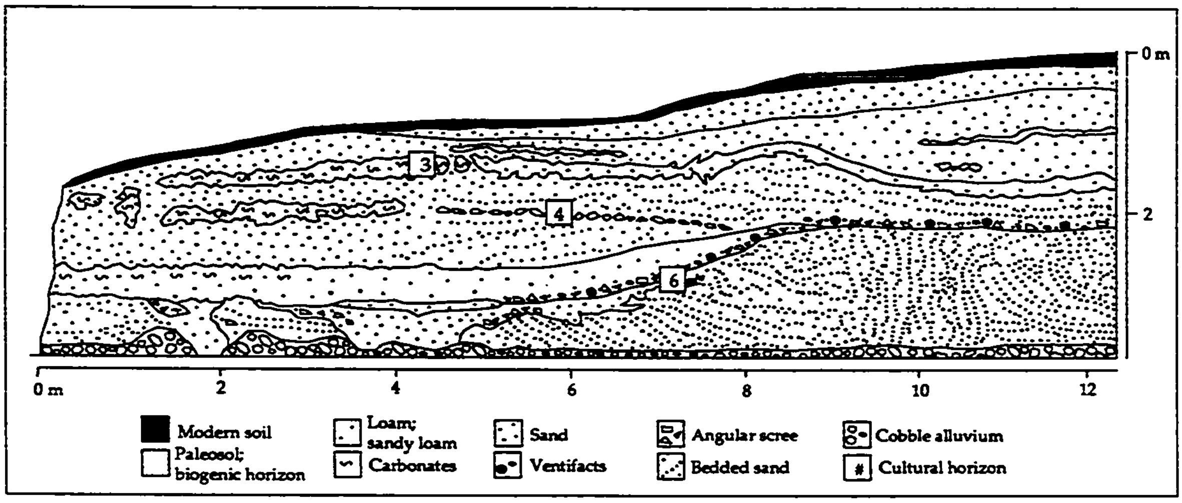


**Fig. 3.33. Sosnovyi Bor stratigraphic profile (after Vorob'eva and Medvedev 1984).**

glacial, roughly 19,000-16,000 B.P., indicating that this cultural occupation must have occurred prior to this time. Vorob'eva and Medvedev (1984:23), however, place the deflation and wind-polishing event much earlier in the Upper Pleistocene, during the Middle Zyrian (or Murutkin) Glacial (70,000-60,000 B.P.). Without $^{14}C$ dating, however, it is impossible to ascertain which assessment of the age of component VI is more accurate.

Cultural remains from component VI include 162 lithic artifacts found over an area of approximately 50 $m^2$. Few diagnostic artifacts occur in this assemblage, making it difficult to characterize the lithic industry (Lezhnenko et al. 1982:99). Among the artifacts are core preforms and core fragments, hammerstones, worked cobbles, technical spalls, blades, a microblade and a large retouched blade. Both Lezhnenko et al. (1982:99) and Medvedev (1983:17) place these finds at the beginning of the Upper Paleolithic.

### *16. Voennyi Gospital*

The Voennyi Gospital [*Military Hospital*] site is located along the right bank of the Ushakovka River, near its confluence with the Angara River (Fig. 3.31) (52°17' N, 104°15' E). This locality is located well within the city limits of Irkutsk and has been largely destroyed by 20th century construction.

The site was discovered in 1871 during the building of a military hospital in what was then the northeastern outskirts of the city. A laborer uncovered several stone and bone artifacts which were given to Bel'tsov, Cherskii, and Chekanovskii of the Siberian branch of the Russian Geographic Society (Larichev 1969:30). Cherskii, a geologist and paleontologist, identified them immediately as prehistoric stone and bone artifacts. The controlled excavation of a 6 $m^2$ area soon followed in order to establish the geologic context and to ascertain whether the cultural remains were associated with bones of extinct fauna (Cherskii 1872; Larichev 1969:30). Cherskii's excavations reached a depth of nearly 2 m and recovered numerous cultural remains *in situ* (Cherskii 1872; Larichev 1969:31). These he assigned to the "Old Stone Age," based on the character of the artifacts and their association with remains of woolly mammoth (*Mammuthus primigenius*) and giant elk (*Megalocerus* sp.). The finds were curated by Bel'tsov, who stored them in the headquarters of the Geographical Society. In 1879 this building burned to the ground, and the artifacts from Cherskii's excavations were lost (Aksenov et al. 1986; Larichev 1969:32-33).

Over 100 years later, in 1983, excavations were resumed in an attempt to relocate the original Voennyi Gospital archeological locality (Aksenov et al. 1986). In 1988 Sëmin recovered *in situ* several isolated stone artifacts and faunal remains of horse (*Equus caballus*) and reindeer (*Rangifer tarandus*) (Medvedev et al. 1990:64-67). These few remians are considered to mark the location of Cherskii's original excavations.

Geoarchaeological studies undertaken by Sëmin (Medvedev et al. 1990:64-67) demonstrate that the site was situated on a low bedrock rise about 45 m above the modern Angara floodplain. Upper Pleistocene/Holocene sediments are 2-3 m thick, and are described as a series of unconsolidated loams and sandy loams (Fig. 3.34). Bedrock (level 5) is a heavily weathered Jurassic sandstone. The base of the loose sedimentary mantle is made up of a series of alternating colluvial loams and sandy loams totalling 1 m thick (level 4). Within these loams and sandy loams is a thick but discontinuous band of scree with sand matrix (level 4a) and isolated lenses of reworked humus (paleosol 2). Level 3 is a clay loam heavily weathered by paleosol 1. This paleosol consists of distinct B, Bg, and B/C horizons. Level 2 is an unweathered loess-like loam of varying thickness but never exceeding 1 m. Level 1 includes the modern soil, which displays O, A, and B horizons. These upper strata (levels 3, 2 and 1) appear to be aeolian loesses.

The Voennyi Gospital cultural remains recovered by Sëmin were situated within level 3, in association with paleosol 1. A single conventional $^{14}C$ date of 29,700 $\pm$ 500 B.P. (GIN-4440) was obtained on a bone of a horse (*Equus* sp.). Based on this date, Medvedev et al. (1990:65) assign the cultural occupation to the early Lipovsko-Novoselovo interstade of the Karga Interglacial (30,000-25,000 B.P.).

Paleosol 2 appears to have formed during a late interstade of the Muruktin glaciation (70,000-50,000 B.P.), and may represent the region's Baigan Soil (Medvedev et al. 1990). Paleosol 1 is assigned to the Upper Osin Soil of the late Karga (30,000-25,000

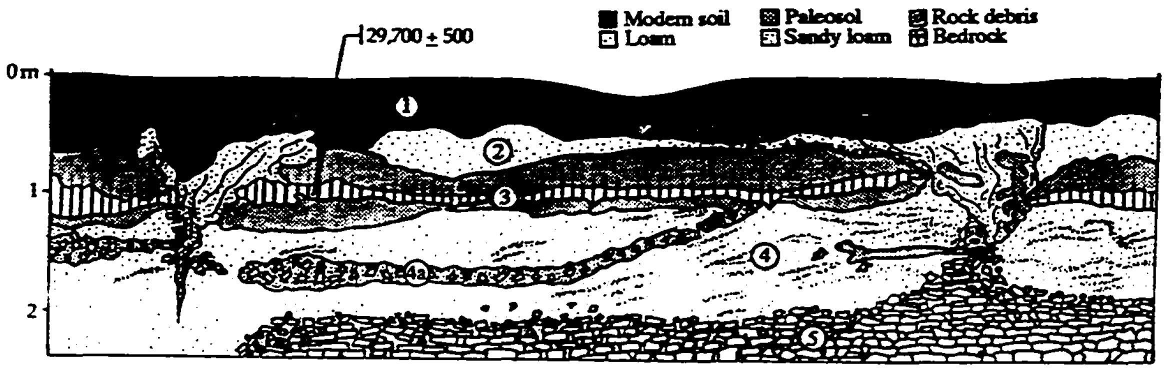


**Fig. 3.34.** Voennyi Gospital stratigraphic profile (after Medvedev et al. 1990).

B.P.). Along its base is a series of small ice wedge pseudomorphs that probably formed during the Konoshchel'e stade of the Karga (33,000-30,000 B.P.) (Medvedev et al. 1990;65). More prominent are a series of massive ice wedge pseudomorphs which cut through the entire profile and into the underlying sandstone bedrock. These wedges form a horizontal network of polygons 6-8 m in diameter which probably formed after the deposition of level 2, sometime during the Sartan glacial maximum (18,000 B.P.).

Cultural remains from Cherskii's 1871 excavations were only cursorily described (Cherskii 1872; Larichev 1969:31; Medvedev et al. 1990:30-31). Apparently the lithic industry was blade-based, with a tool assemblage containing leaf-shaped bifaces, end scrapers, side scrapers, and a cobble chopper. Cherskii (1872) also described a series of ivory and bone artifacts, including an incised mammoth ivory spheroid (or ball), a pointed ivory rod, several ivory or bone cylindrical pendants with biconically drilled holes and transverse linear incisions, a ring (or bracelet) manufactured on bison (*Bison* sp.) horn, a red deer (*Cervus elaphus*) canine bearing a biconically drilled hole, and a "chisel" (or perhaps awl) manufactured on a reindeer (*Rangifer tarandus*) metacarpal. Faunal remains recovered in 1871 include isolated elements of red deer (*Cervus elaphus*), giant elk (*Megaloceros* sp.), reindeer (*Rangifer tarandus*), woolly mammoth (*Mammuthus primigenius*), horse (*Equus caballus*), Kovalevskii's horse (*Equus* sp.), and bison (*Bison* sp.) (Larichev 1969:31-32; Medvedev et al. 1990:66). These items no longer exist.

The 1988 excavations produced the following lithic inventory: one quartz cobble chopper, two cores, two side scraper fragments on quartzite flakes, one end scraper on a jasper blade, one blade, one flake, and one flake fragment (Medvedev et al. 1990:65). Isolated remains of horse (*Equus* sp.) and reindeer (*Rangifer* sp.) were also recovered.

### *17. Arembovskii*

Arembovskii is located 1.5 km north of Voennyi Gospital, at the head of Pshenichnyi ravine, on the outskirts of the city of Irkutsk (Fig. 3.31) (52°17' N, 104°15' E) (Medvedev et al. 1990:67-71; Sëmin et al. 1990:114-115). The site is situated on the south-facing side of a watershed divide that overlooks Voennyi Gospital to the south and the late Upper Paleolithic site Verkholenskaia Gora to the north. Less than 200 m from Arembovskii is an outcrop of argillite; nearly all of the lithic artifacts from the site were manufactured on this raw material. Sëmin et al. (1990:114) have characterized the site as a workshop.

The Arembovskii site was discovered in 1938 by Arembovskii, an instructor at Irkutsk University. Surface collections were made in 1947-1949 (Arembovskii 1958;

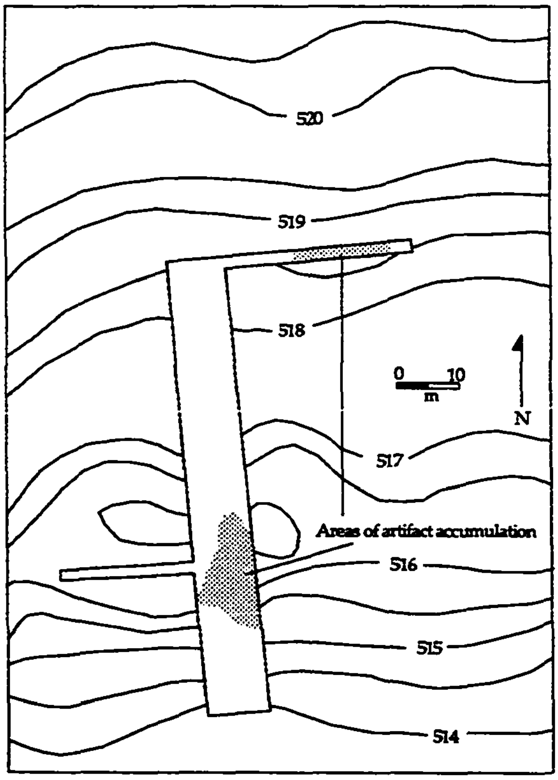


Fig. 3.35. Arembovskii site map (contour interval equals 0.5 m) (after Medvedev et al. 1990).

Arembovskii and Ivan'ev 1953). In 1989 Sëmin directed full-scale salvage excavations; to date nearly 1000 m$^2$ have been excavated (Fig. 3.35) (Sëmin et al. 1990).

Upper Pleistocene/Holocene sediments at Arembovskii measure only 1 m thick, and are divided into two levels (Fig. 3.36). Level 1, the uppermost level, is a podzol containing distinct O, A, and B horizons. Level 2 is characterized as a massively-bedded loam. It contains paleosol 1, characterized by Bb and Cgb horizons. Medvedev et al. (1990:68) identify this paleosol as a component of the Osin Pedocomplex of the mid to late Karga Interglacial (43,000-25,000 B.P.). The contact between this paleosol and the above-lying modern soil is not always clear.

Geologic levels 4 and 3 are a series of colluvial loams, sandy loams (some humified), sands, and scree. These sediments are heavily soliflucted and mixed, and are ruptured by numerous ice wedge pseudomorphs. Level 5 is an eluvial zone of eroded Jurassic siltstone. The relative age of this lower packet of sediments is difficult to determine, but likely predates the Upper Pleistocene (Medvedev et al. 1990; Sëmin et al. 1990).

Cultural remains for the most part occur within the Osin Soil of level 2; however, some artifacts were also found higher in the section within the modern soil and lower in the section in the soliflucted loams of level 3. Sëmin et al. (1990:114) consider these artifacts a single complex; their heterogeneous vertical distribution is due to various cryogenic disturbances (frost heaving, solifluction, and ice wedge formation).

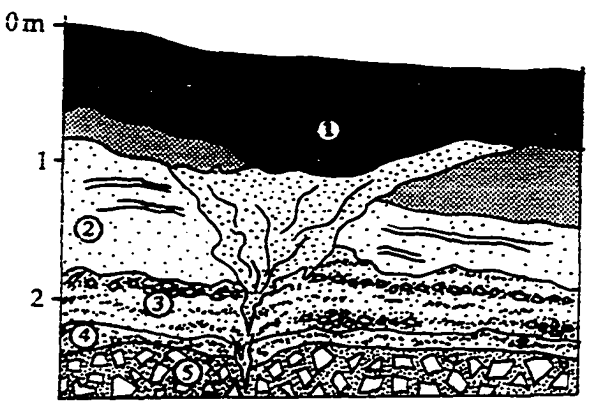


Fig. 3.36. Arembovskii stratigraphic profile (after Medvedev et al. 1990).

Dating this complex of artifacts is difficult. My attempts at AMS $^{14}$C dating have been unsuccessful; a sample of bone analyzed at the University of Arizona AMS facility (AA-8881) failed to graphitize. It retained only 0.5% of its original collagen, an insufficient proportion for AMS dating (Long pers. comm., November 1992). Both Sëmin et al. (1990:115) and Medvedev et al. (1990:71) assign the cultural component to the early Upper Paleolithic based on typological grounds and its apparent association with the Osin Soil. They estimate an age of 35,000-25,000 B.P.

Full-scale excavations in 1989 failed to produce any archaeological features. The lithic assemblage contains over 10,000 artifacts (Semin et al. 1990:115), including numerous cores and tools. Cores include both parallel ("flat-faced") blade cores and radial ("tortoise") cores. The tool assemblage is characterized by retouched blades, end scrapers on blades, side scrapers, wedges, points on blades, a bifacial preform, retouched flakes, and hammerstones. A meager assemblage of faunal remains was recovered, though none have been identified.

### *18. Ineiskii Bor*

Ineiskii Bor [*Hoarfrost Woods*] is located along the Nizhnaia Tunguska River, 2 km north of its confluence with the Ineika River, and 10 km south of the village of Kalinina (Fig. 1.1) (59°57' N, 108°10' E). Sëmin discovered the site and excavated a test area of 25 m² in 1988 (Sëmin and Shelkovaia 1991:49).

The site is situated upon the first terrace of the Nizhnaia Tunguska River, 17 m above the modern river floodplain. Upper Pleistocene sediments are relatively shallow, measuring no more than 1 m thick (Fig. 3.37). Artifacts lie on a 10-cm thick cobble bed (the lower part of level 5) approximately 60-70 cm below the modern surface. Sëmin and Shelkovaia (1991:49)

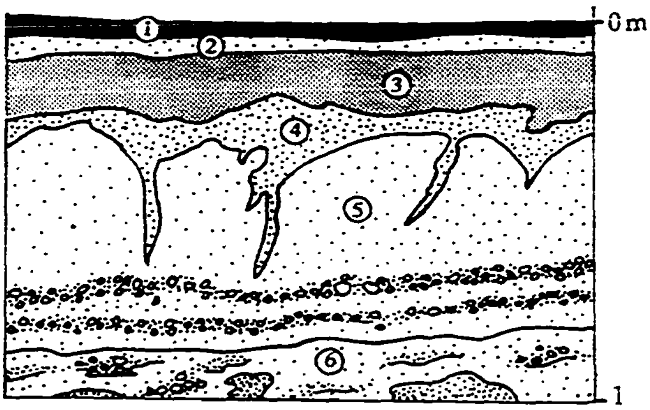


**Fig. 3.37.** Ineiskii Bor stratigraphic profile (courtesy of M. Sëmin).

interpret this as a lag deposit analogous to lag deposits identified at Makarovo-4 and Sosnovyi Bor. Associated lithic artifacts display varying degrees of wind polishing, and are relatively dated to the "Makarovo Stratum" (i.e., Makarovo-4 and Sosnovyi Bor, component VI). Loess overlying the cultural level is intensively disturbed by ice wedge pseudomorphs thought to have formed during the Sartan Glacial (20,000-18,000 B.P.).

The Ineiskii Bor lithic assemblage is small, consisting of only 72 artifacts. Primary reduction technology appears to be centered on the production of blades. The single core is sub-prismatic, bearing two platforms and two fronts. Tools include retouched blades, retouched flakes, a notch, and bifacial preform.

### *19. Makarovo-4*

Makarovo-4 is one of six Makarovo sites located along the Upper Lena River, 8 km northwest of the village of Kachug, Irkutsk Oblast' (Fig. 3.31) (53°56'N, 105°50'E). The Makarovo sites range in age from the mid-Upper Pleistocene through the early Holocene. The prehistory of the vicinity has been studied chiefly by Okladnikov (1953) and Aksenov (1970, 1974, 1978, 1989a, 1989b; Aksenov and Shun'kov 1982; Medvedev et al. 1990:98).

Aksenov (1989b) discovered the Makarovo-4 site in July 1975. Excavations were conducted from 1975 through 1982, exposing a 1,100 m² area (Aksenov 1989a, 1989b). Makarovo-4 is a single component site; Aksenov (1989a, 1989b) reports that the entire assemblage of over 4,000 artifacts was recovered *in situ*.

The site is situated along the south-facing bluff of a side valley alluvial fan (called the fourth terrace by Tseitlin [1979:199]), 40 m above the right bank of the Lena River (Fig. 3.38, 3.39) (Aksenov

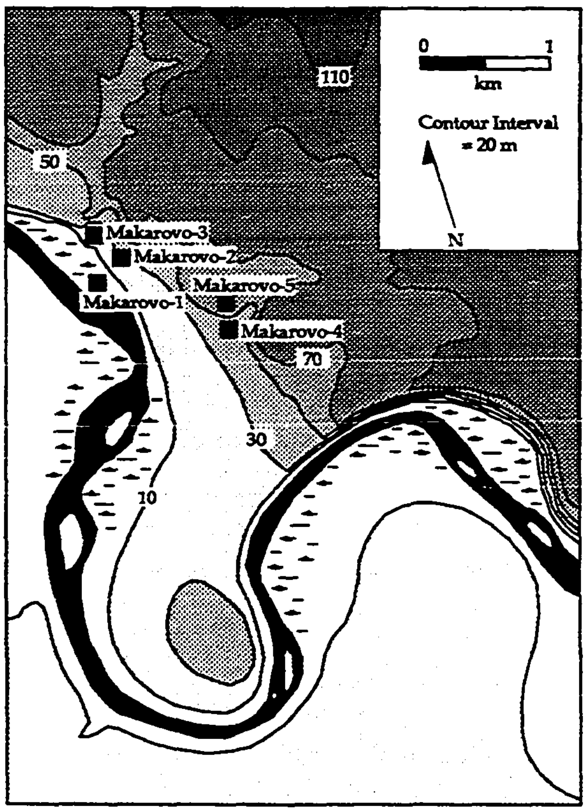


**Fig. 3.38.** Topographic map of the Makarovo area, upper Lena River valley (after Medvedev et al. 1990).


Fig. 3.39. View of Makarovo-4 and other Makarovo Paleolithic sites (from Tseitlin 1979).

1989b; Vorob'eva 1987:19). Site geology has been examined in detail by Aksenov (1989b), Tseitlin (1979:197-198), and Vorob'eva (1987:20-21). Quaternary stratigraphy can be broadly described as a series of colluvial and aeolian loams and sandy loams (Fig. 3.40). The stratigraphic profile is divisible into four sets of sediments (Vorob'eva 1987:20). Set 4 is a series of interbedded, colluvial sands, sandy loams, silts, and clays with abundant rock inclusions. Set 3 consists of two subunits, a 1.5-m thick bed of highly carbonated loess (3b) overlain by a 3 to 10-cm thick band of sand and rock debris (3a). Set 2 sediments include a series of highly carbonated aeolian loesses and sands, and Set 1, which makes up the top 40-60 cm of the profile, is an unweathered, uncarbonated loam overlain by modern soil horizons (A, E, and B).

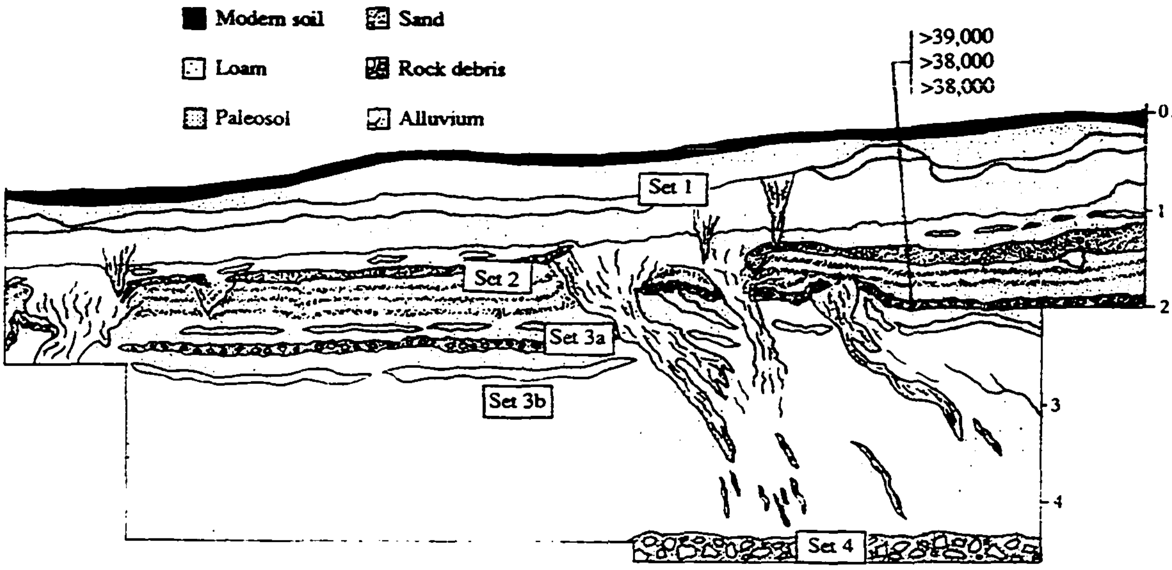


Fig. 3.40. Makarovo-4 stratigraphic profile (after Aksenov 1989a).

Archaeological materials occur along the surface of the thin band of sand and scree found at the top of Set 3a. The sedimentary materials that constitute this horizon appear to be residuum or lag left behind after finer sediments had been deflated by intense, high winds, perhaps blowing from the southeast. Lithic artifacts found on the surface of this lag deposit are markedly polished from wind-induced sandblasting. Many artifacts bear heavy polishing on their windward surfaces, grading into lighter polishing on their leeward surfaces. High winds may have sorted the lithic assemblage, blowing smaller cultural remains horizontally across the exposed surface and away from main activity areas. As shown in Fig. 3.41, many conjoined lithic artifacts appear to have been blown uphill. Cryogenic processes may have also displaced artifacts. A series of ice wedge pseudomorphs breach the artifact-bearing unit; they form a network of polygons that extend transversely across the site (Fig. 3.41). Furthermore, the site lies on a 6° slope, so that artifacts likely have been displaced laterally through solifluction or soil creep (Aksenov 1989a:125; Aksenov and

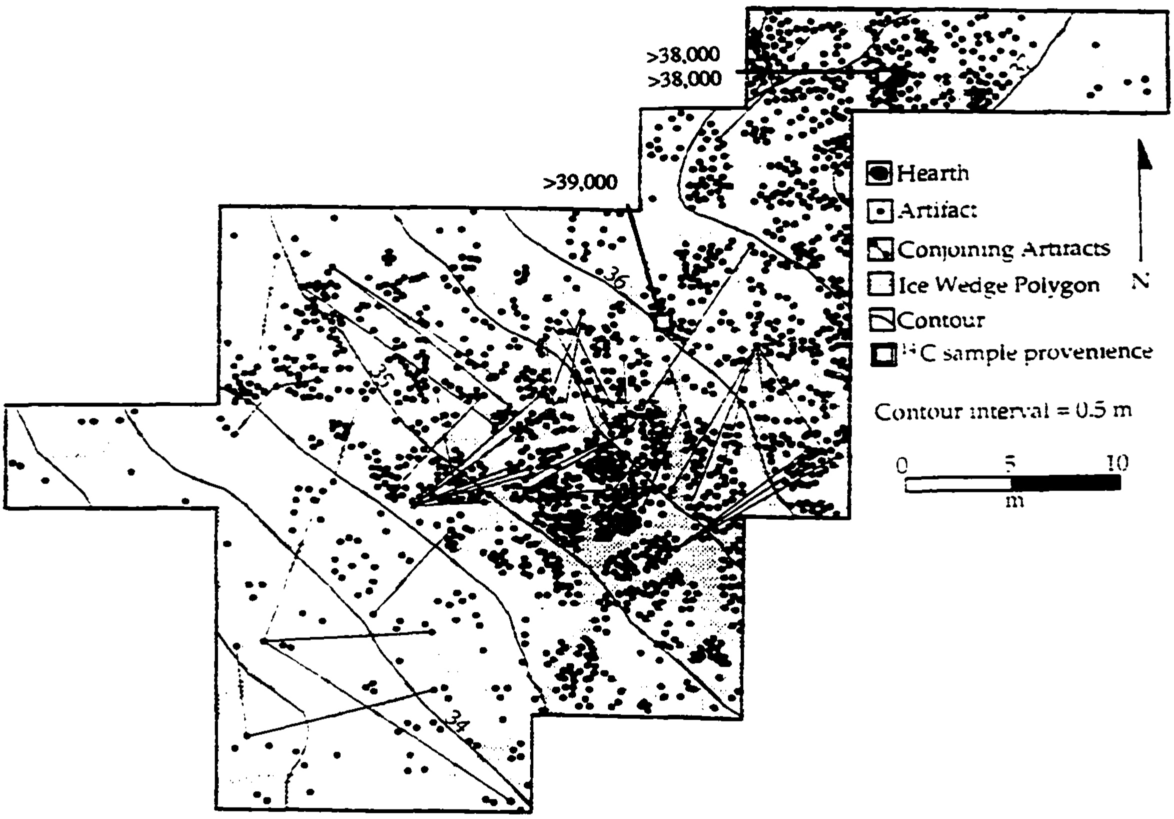


**Fig. 3.41.** Makarovo-4 artifact distribution and refits (after Aksenov 1989a).

Naidentskaia 1979). Clearly the original living floor at Makarovo-4 has been for the most part removed, through wind as well as freezing and thawing processes.

The complex context makes dating the Makarovo-4 cultural remains difficult. Tseitlin (1979) originally presumed that the deflation event recorded in Set 3a occurred during a glacial episode when the upper Lena valley was cold, dry and windswept. If Set 2 sediments record the Sartan Glacial, as Aksenov (1989b), Tseitlin (1979), and Vorob'eva (1987) concur, then the deflation event of Set 3a must have taken place during an earlier period of cold, glacial conditions. Tseitlin (1979) and Vorob'eva (1987) assign this event to the mid to late Zyrian (or Muruktin) Glacial, thereby dating the cultural remains to at least 80,000-70,000 B.P. Aksenov (1989b) disagrees, arguing that deflation and sandblasting could just have likely occurred during the Konoshchel'e stade of the Karga Interglacial; he dates the cultural occupation at Makarovo-4 to no more than 55,000-35,000 B.P. (Aksenov 1989a:16; 1989b:150; 1990:7).

This study reports three new AMS $^{14}C$ dates on the cultural occupation at Makarovo-4. Three bone fragments recovered *in situ* during excavations in 1979 and 1980 yielded AMS dates of >38,000 (AA-8878), >38,000 (AA-8879), and >39,000 B.P. (AA-8880). These dates clearly indicate that the occupation predates the range of $^{14}C$ dating, but do not help clear up the debate concerning a late (55,000-35,000 B.P.) or early (80,000-70,000 B.P.) age.

The lithic assemblage consists of 4,119 pieces, produced chiefly from cherts and quartzites (Aksenov 1989b). The 113 cores include parallel ("flat-faced"), sub-parallel, and radial forms; nearly 75% of all tool blanks are blades. The tool assemblage is characterized by retouched blades and flakes, end scrapers, side scrapers, and cobble choppers, and, less frequently, points, knives, gravers, burins, and hammerstones (Aksenov 1989b; Aksenov et al. 1987). This blade industry is the type-assemblage for the "Makarovo Stratum," which in eastern Siberia is considered to mark the beginning of the Upper Paleolithic.

Faunal remains include 502 fragments of bone; however, only 5 bones have been identified taxonomically. Species represented include woolly rhinoceros (*Coelodonta antiquitatis*), red deer (*Cervus elaphus*), and roe deer (*Capreolus* sp.) (Aksenov 1989a).

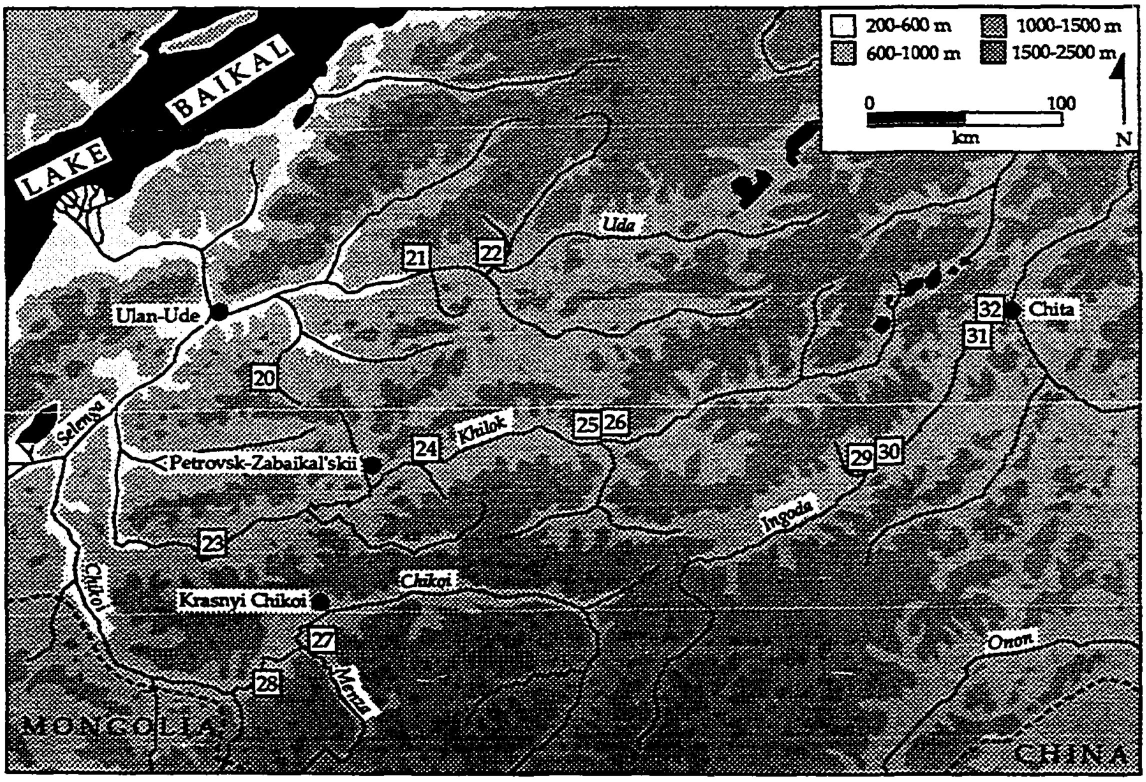


**Fig. 3.42.** Map of Transbaikal region showing location of Paleolithic sites discussed in text: (20) Varvarina Gora, (21) Sannyi Mys, (22) Sapun, (23) Kunalei, (24) Toibaga, (25) Masterov Gora, (26) Masterov Kliuch', (27) Ust'-Menza-5, (28) Priiskovoe, (29) Arta-2, (30) Arta-3, (31) Sokhatino-1, (32) Sokhatino-6.

## The Transbaikal

### *20. Varvarina Gora*

The early Upper Paleolithic site Varvarina Gora [*Barbarian's Mountain*] is located 4 km north of the village of Staraia Brian', Buriat ASSR, along the left bank of the Brianka River, a tributary of the Uda River (Fig. 3.42) (51°35' N, 108°6' E). The site was discovered in 1964 by Bazarov and Khamzina (Bazarov 1968), and excavated in 1973-1975 by Okladnikov (1974; Okladnikov and Kirillov 1980:31-34; Abramova 1989:212-214; Bazarov et al. 1982:87-90).

Site geomorphology has been studied by Bazarov (1968; Bazarov et al. 1982:87-89), Tseitlin (1979:212-214), and more recently by Lbova (1992:164). The site is situated on a high fan of colluvium (Lbova 1992:164) overlooking the Brianka valley, nearly 40 m above and 600 m west of the river (Fig. 3.43). The stratigraphic profile

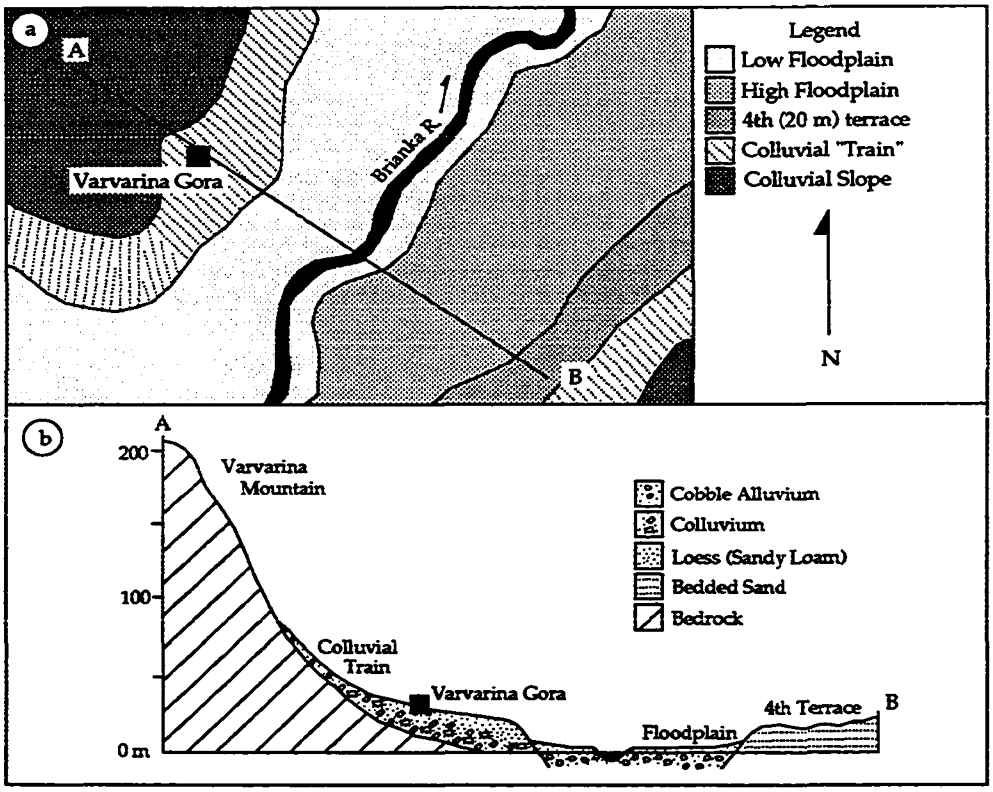


**Fig. 3.43.** Map (a) and transverse section (b) of the Varvarina Gora site area showing major Quaternary landforms (after Bazarov et al. 1982).

measures over 2 m thick and displays a complex series of reworked colluvial deposits (levels 2 and 4) with intermittent lenses of aeolian sands and loams (levels 1 and 3) (Fig. 3.44) (Bazarov et al. 1982:87-88; Tseitlin 1979:212-213). According to Bazarov et al. (1982:88), cultural remains occur within the carbonated loams of geologic level 3.

Two samples of bone from level 3 were conventionally $^{14}C$ dated to 30,600 ± 500 (SOAN-850) and 34,900 ± 780 B.P. (SOAN-1524) (Okladnikov and Kirillov 1980:34; Bazarov et al. 1982:89). In this study, two bone fragments were AMS $^{14}C$ dated to >34,050 (AA-8875) and >35,300 B.P. (AA-8893). The pollen spectrum from this level reflects cold and mesic climatic conditions, and, together with the $^{14}C$ dates, suggests the occupation dates to an early stade of the Karga Interglacial, either the Konoshchel'e Stade (34,000-31,000 B.P.) (Bazarov et al. 1982:89) or the Early Stade (45,000-43,000 BP).

Little information is available on the archaeological discoveries from Varvarina Gora (Okladnikov 1974; Okladnikov and Kirillov 1980; Lbova 1992). Okladnikov and Kirillov (1980:31-32) uncovered a series of artifact concentrations which they identified

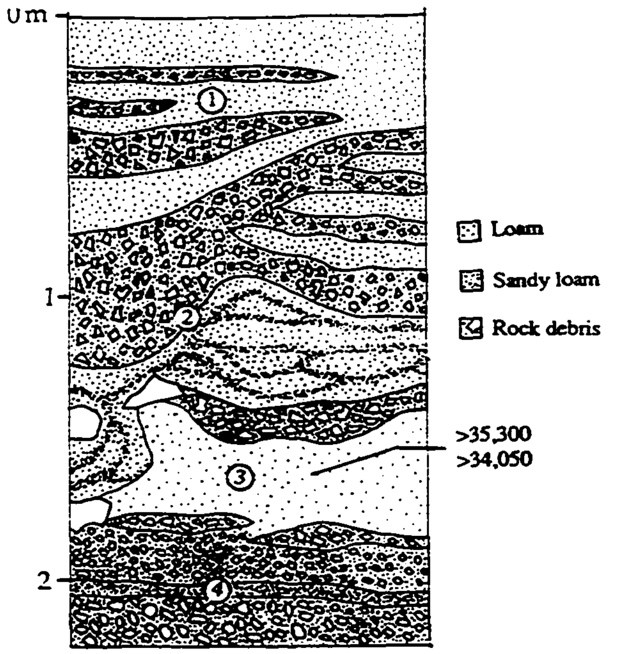


**Fig. 3.44.** Varvarina Gora representative stratigraphic profile (after Bazarov et al. 1982).

as storage pits. One pit exhibited stone walls and a stone floor, and contained a wolf's skull and a set of complete horse bones (Ovodov 1987). Okladnikov and Kirillov (1980:32) interpret this feature as "the ritual burial of a predator's head, accompanied by the sacrificial offering of an entire horse." Possibly these pits are part of a larger 80 m$^2$ circular structure, the evidence for which includes occasional blocks of stone reportedly forming the foundation of a surface dwelling (Okladnikov and Kirillov 1980;32; Lbova 1992:165).

The Varvarina Gora lithic industry consists of 1,451 artifacts, including 226 tools (Lbova 1992:165). Most cores are parallel or subprismatic, and nearly 35% of all tools were manufactured on blades (Lbova 1992:165). The tool assemblage consists of end scrapers and side scrapers (several worked bifacially), knives, wedges, perforators, burins, retouched blades and flakes, and cobble tools (choppers, chopping tools, and hammerstones) (Lbova 1992:165; Okladnikov and Kirillov 1980:32). Also present in the assemblage are a flat stone "semi-disk" (possibly a fragment of a pendant), two small incised and polished bone "awl-like points," a flat spatulate-shaped rod made on bone that appears to have served as a retoucher, and a "cut and sharpened" ivory tusk fragment (Kirillov 1987:71; Okladnikov and Kirillov 1980:33-34).

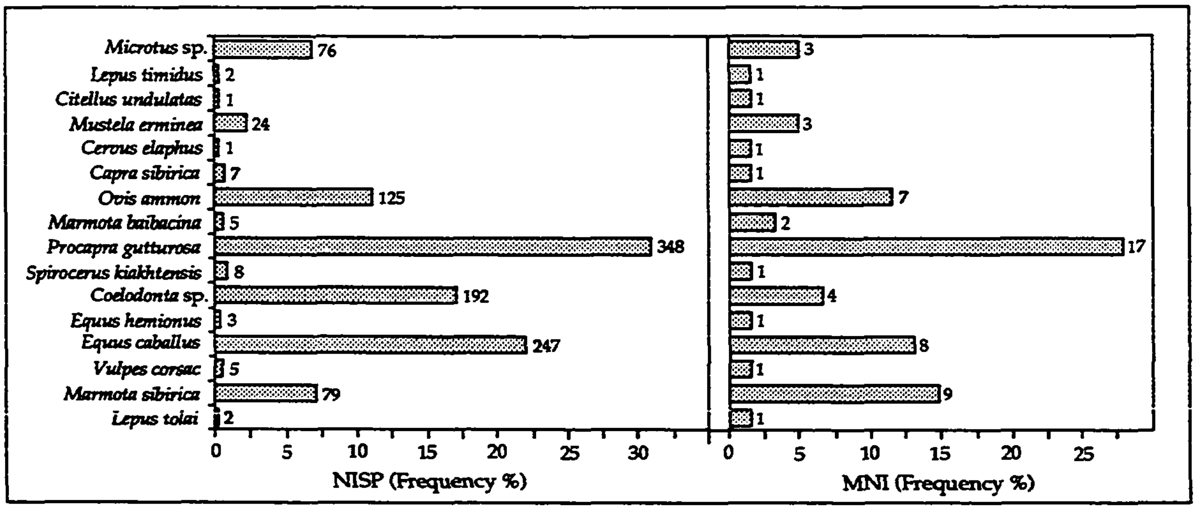


**Fig. 3.45.** Varvarina Gora faunal assemblage (after Ovodov 1987).

Faunal remains have been examined in detail by Ovodov (1987). Identified mammalian taxa are predominantly steppe and alpine forms (Table 3.2), and include numerous specimens of horse (*Equus equus*), woolly rhinoceros (*Coelodonta* sp.), Siberian mountain goat (*Capra sibirica*), argali sheep (*Ovis ammon*), Siberian marmot (*Marmota sibirica*), and gray wolf (*Canis lupus*) (Fig. 3.45).

### *21. Sannyi Mys*

The multi-component site Sannyi Mys [*Sled Cape*] is located along the right bank of the Uda River, 1.5 km northeast of the village of Sannomysskaia, 35 km west of Khorinsk, Buriat ASSR (Fig. 3.42) (52°10' N, 109°25' E). Okladnikov discovered Sannyi Mys in 1958; he and Kirillov later excavated there in 1968 (Bazarov et al. 1982; Okladnikov 1960, 1961, 1971; Okladnikov and Kirillov 1980). A total of 398 $m^2$ has been excavated (Okladnikov 1971:12).

Sannyi Mys is situated high upon a rock ledge overlooking a bend in the Uda River, nearly 10 m above the modern level of the river (Tseitlin 1979:208-209). The site appears to lie upon a remnant surface of the 2nd (6-8 m) terrace of the Uda, which is thought to have formed during the Sartan glacial (30,000-13,000 B.P.) (Tseitlin 1979:210). Sediments are interpreted as alluvial (levels 7-5) and colluvial (levels 4-1) (Florensov 1971:85-86; Okladnikov 1971:9; Tseitlin 1979:209); they are heavily deformed through cryoturbation and slope processes (Bazarov et al. 1982:85; Okladnikov 1971:9; Tseitlin

1979:210). Cultural levels are not consistently distinguishable; many artifacts appear to have been removed from their original contexts (Abramova 1989:216; Okladnikov 1971:32).

Okladnikov (1971:13) identified seven cultural components at Sannyi Mys. Components I, II, and III are Neolithic, Mesolithic, and latest Paleolithic, respectively, according to their stratigraphic position and archaeological character (Okladnikov 1971:79). Components IV and V are mixed; in these levels Neolithic microcores and pottery shards were found associated with Paleolithic artifacts and remains of extinct, Pleistocene-aged fauna (Okladnikov 1971:79-80). Components VI and VII, occurring in the lower alluvial sands of geologic level 6 and the upper part of level 7, represent early Upper Paleolithic occupations in relatively undisturbed contexts. There are no $^{14}C$ dates reported from the site.

Component VI includes the remains of an oval dwelling structure, 8 m long and 5 m wide (Fig. 3.46). Its foundation is made up of two rows of large granite boulders layed on edge. These measure about 1 m from top to bottom (Okladnikov 1971:44). Within the dwelling space are three hearths, each consisting of ash and charred bone, but lacking stone rings. A small storage pit measuring 120 x 70 cm was also uncovered along the western foundation of the dwelling; it contained a mandible of a woolly rhinoceros (*Coelodonta antiquitatis*) and a set of horns and cervicle vertebra of a Siberian mountain goat (*Capra sibirica*) (Okladnikov 1971:48). The associated lithic industry

Fig. 3.46. View of Sannyi Mys excavations and remains of Paleolitihic structure, component VI (after Tseitlin 1979).

has not been fully described. The assemblage consists of less than 200 artifacts (Okladnikov 1971:48-75; Okladnikov and Kirillov 1980:29-30). Blade cores are parallel and subprismatic. Numerous blades and flake-blades and a few microblades are present (Okladnikov and Kirillov 1980:29). The tool assemblage from Component VI includes retouched blades, retouched flakes, points on blades, burins, side scrapers, and a notch. Fauna identified include chiefly steppe and alpine species (Table 3.2), including woolly rhinoceros (*Coelodonta antiquitatis*, Himalaya tahr (*Hemitragus jemlahicus*), extinct antelope (*Spirocerus* sp.), horse (*Equus* sp.), Brandt's vole (*Microtus brandti*) and souslik (*Citellus* sp.) (Okladnikov 1971:48-50; Ovodov 1975:39).

Cultural remains attributed to component VII occur at a depth of about 70 cm below the dwelling structure, within geologic level 7. Four hearth features have been identified, each defined by an oval stain of ash and charcoal 50-100 cm in diameter (Okladnikov 1971:74). One hearth is outlined by a ring of granite stones. An associated assemblage of 40 lithic artifacts reported by Okladnikov (1971:74-5) and Okladnikov and Kirillov (1980:31) includes parallel and sub-prismatic blade cores, and a tool assemblage with retouched blades and angle burins. Faunal remains have been attributed to woolly rhinoceros (*Coelodonta antiquitatis*) and extinct antelope (*Spirocerus* sp.) (Okladnikov and Kirillov 1980:31).

### *22. Sapun*

Sapun is located along the right bank of the Ona River 6 km north of its confluence with the Uda River, near the town of Khorinsk (Fig. 3.42) (52°13' N, 109°42' E). The site was discovered and tested by Aseev in 1980 during a cultural resource survey of a planned irrigation system (Aseev and Kholiushkin 1981, 1985). Only cursory descriptions of the site have been published. The site occurs in an unstratified colluvial context and is undated (Aseev and Kholiushkin 1985:7).

The lithic assemblage consists of 1,074 artifacts, 464 of which are tools, and 15 of which are cores. Primary reduction technology is characterized by the production of blades from parallel and triangular cores. The tool assemblage consists of notches and denticulates, retouched blades and flake-blades, retouched flakes, end scrapers, burins, beaked tools, points, perforators, side scrapers, and wedges (Aseev and Kholiushkin 1985:9-10). The overall character of the assemblage suggests affinities with early Upper Paleolithic sites in the Transbaikal, including Varvarina Gora, Tolbaga, and the lower levels of Sannyi Mys (Aseev and Kholiushkin 1985:8). No faunal remains or features have been reported.

*23. Kunalei*

Kunalei is located along the right bank of the Khilok River, opposite the village of Malyi Kunalei, 125 km south of Ulan-Ude, Buriat ASSR (Fig. 3.42) (50°36' N, 107°39' E). Konstantinov (1975:44) discovered the site in 1971; he conducted excavations there from 1973 through 1977 (Bazarov et al. 1982:35-44; Konstantinov 1980:19; Konstantinov and Konstantinov 1991:15). Excavations were resumed in 1991 (Konstantinov pers. comm., December 1991).

The site is situated on a south-facing slope of the second (7 m) terrace immediately overlooking the Khilok River (Fig. 3.47). Here cobble alluvium is mantled by 5 m of

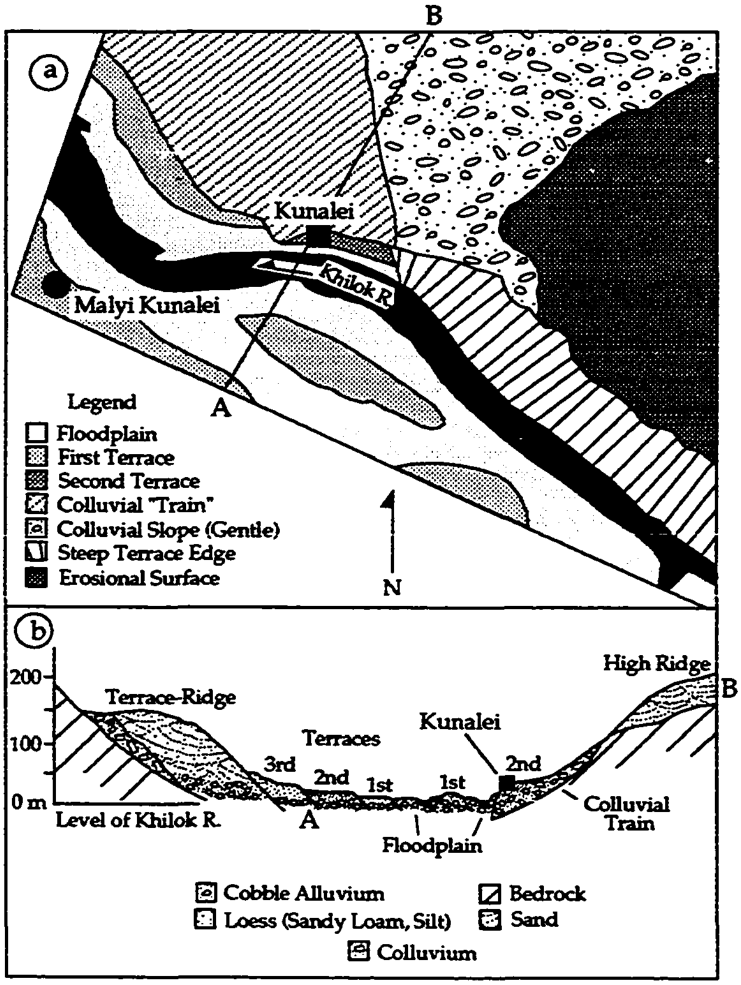


**Fig. 3.47.** Map (a) and transverse section (b) of the Kunalei site area showing major Quaternary landforms (after Bazarov et al. 1982).

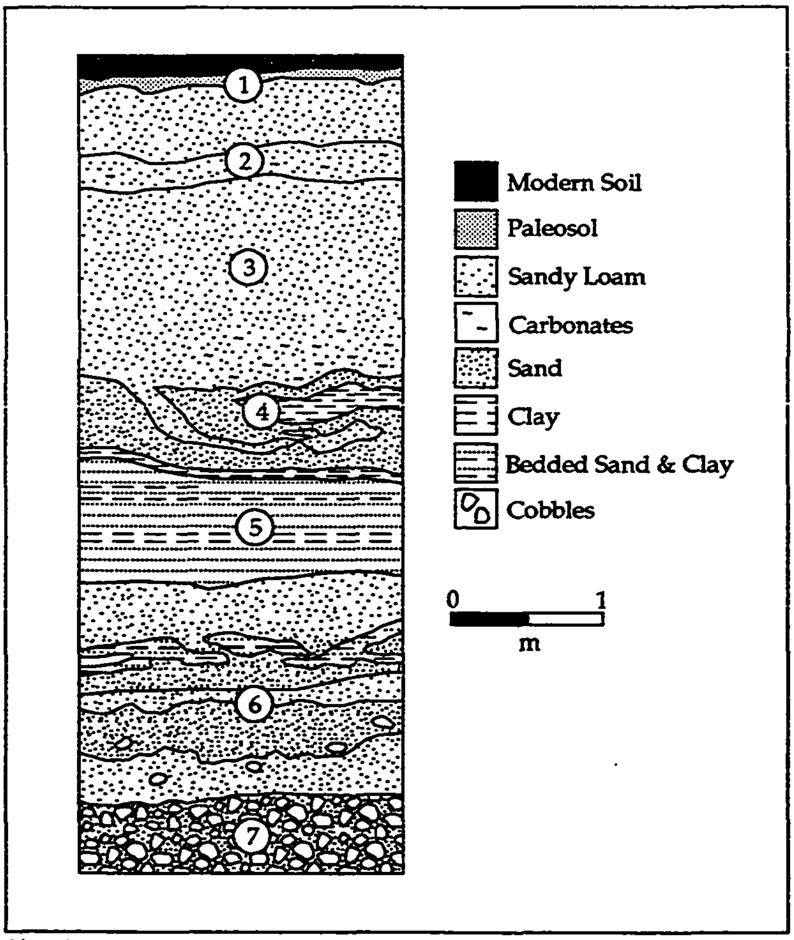


**Fig. 3.48.** Representative stratigraphic profile from Kunalei (after Bazarov et al. 1982).

sand and loess (Fig. 3.48). At the base of this mantle are a series of bedded, alluvial fine-grained sands 2.2 m thick (levels 5 and 6) (Bazarov et al. 1982:37). Overlying this is a bed of aeolian loess (sandy loams and silty sands) nearly 2.5 m thick (levels 1-4). This loess is heavily deformed by solifluction, frost cracks, and ice wedge pseudomorphs. Although not shown in Fig. 3.48, a major paleosol horizon occurs within level 4.

Three cultural components have been identified at Kunalei. The youngest (Component I) occurs within the modern soil (geologic level 1) and dates to the late Holocene. Component II artifacts are found in geologic level 3, at a depth of about 1.5 m below the modern surface. The associated lithic industry (267 artifacts) is primarily based on the production of flakes and flake-blades from "orthogonal" flake cores (bearing no primary orientation or systematic method of flake removal). The 32 tools include gravers, retouched flakes, wedges, side scrapers, end scrapers, and retouched blades (Bazarov et al. 1982:42-43). Neither faunal remains nor features have been reported.

Component III occurs within the paleosol of geologic level 4. Cultural remains totalling 2,193 lithic artifacts include 1,795 flakes, 38 blades, five microblades, 80 cores, and 264 tools. Cores are orthogonal flake cores and end cores. The tool assemblage includes side scrapers, retouched flakes, shouldered end scrapers, choppers, retouched blades, gravers, end scrapers, burins, wedges, hammerstones, notches, chopping tools, and points (Bazarov et al. 1982:29-42). Three bone awl fragments and one bone needle fragment also occur. Faunal remains include woolly rhinoceros (*Coelodonta* sp.), horse (*Equus* sp.), saiga antelope (*Saiga* sp.), bison (*Bison* sp.), and deer (*Cervus* sp.) (Konstantinov 1980:19).

Dating cultural components II and III has been controversial. Original interpretations of site geology and stratigraphy led Bazarov et al. (1982:44) to conclude that Component III dates to the Kokorev or Taimyr interstadials of the Sartan Glacial (12,700-10,800 B.P.), and that Component II dates to the slightly younger Noril'sk stade (10,800-10,300 B.P.). New interpretations of site stratigraphy, however, place the age of the paleosol containing Component III much earlier in the Upper Pleistocene. Konstantinov and Konstantinov (1991:15) argue that this paleosol (and therefore Component III) formed during the early Lipovsko-Novoselovo warming of the late Karga Interglacial (30,000-25,000 B.P.).

### *24. Tolbaga*

The Tolbaga site is located along the right bank of the Khilok River, on the outskirts of the village of Tolbaga, 10 km east of the town of Novopavlovka (Fig. 3.42) (51°14' N, 109°20' E). Konstantinov (1973, 1975:40) discovered the site in 1971; he conducted excavations there between 1972 and 1979, uncovering a 624 $m^2$ area (Bazarov et al. 1982:20-35; Bazarova 1985; Konstantinov 1980:16-20; Okladnikov and Kirillov 1980:35-39). In 1985-1986 Vasil'ev resumed work at Tolbaga, excavating an additional 340 $m^2$ (Vasil'ev et al. 1986, 1987). Their excavations have revealed an extensive collection of faunal materials and lithic artifacts which form the type assemblage of the early Upper Paleolithic "Tolbaginskaia culture" of the Transbaikal (Kirillov 1984, 1987).

Like Varvarina Gora and Sannyi Mys, the Tolbaga site lies near the top of a high hillslope, 35 m above and 200 m north of the modern river floodplain (Fig. 3.49) (Bazarov et al. 1982:21). Colluvial, hillslope sediments overlying bedrock measure 2.5

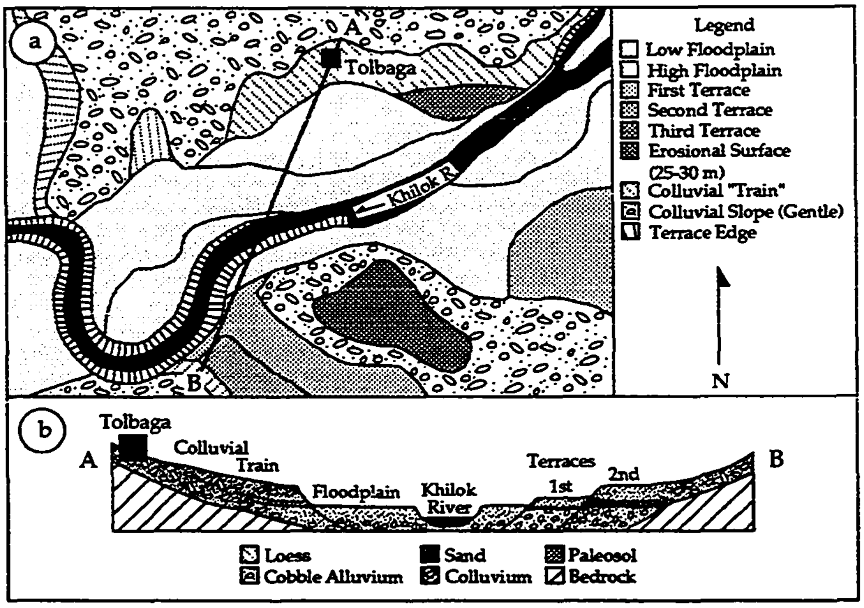


**Fig. 3.49. Map (a) and transverse section (b) of the Tolbaga site area showing major Quaternary landforms (after Bazarov et al. 1982).**

m thick (Fig. 3.50). Cultural remains lie less than 0.8 m below the modern surface, in geologic level 4. Sediments containing the cultural level are primarily sands and sandy loams, with varying amounts of scree, and represent alternating episodes of gradual creep and rapid slopewash (Bazarov et al. 1982:21-22). Isolated lithic artifacts and faunal remains are frequently encountered redeposited downslope and higher in the stratigraphic profile (in geologic levels 3, 2, and 1) (Bazarov et al. 1982:22; Vasil'ev et al. 1986:79). Vasil'ev's excavations revealed that most artifacts are oriented along the same axis (8-12°) as the slope (Vasil'ev et al. 1986:80, 1987:109-110). These factors suggest considerable slope deformation of the original Paleolithic living floor.

Three conventional $^{14}C$ dates have been obtained from combined bone samples. Bones collected from a 200 $m^2$ area at the base of geologic level 3 yielded a date of 15,100 ± 520 B.P. (SOAN-810). Bones attributed to woolly rhinoceros (*Coelodonta antiquitatis*) recovered from Level 4 (during one year's excavations) yielded a date of 34,860 ± 2,100 B.P. (SOAN-1522). Unidentified bones from various excavations of level 4 yielded a date of 27,210 ± 300 B.P. (SOAN-1523) (Bazarov et al. 1982:25; Okladnikov and Kirillov 1980:39). According to the site researchers, the first date of 15,100 ± 520 B.P. is aberrantly young, probably due to contamination from modern humic acids, since this bone sample was collected close to the modern surface (Bazarov et ai. 1982:25). Of the two older dates, the 34,860 ± 2,100 B.P. date is considered more reliable, because it apparently came from the bones of a single individual of a known extinct species recovered from a relatively small area of the site. The third date, 27,210 ± 300 B.P., although statistically more precise than the others, is considered less reliable since its provenience is less circumscribed (Bazarov et al. 1982:25). Finally, this work reports an additional AMS $^{14}C$ date on bone of 25,200 ± 260 B.P. It seems discordantly young, given the significantly older conventional dates and the technological/typological similarities between Tolbaga and Varvarina Gora. Given the discordant dates, however, the age of the Tolbaga site could fall within either the Malokheta (43,000-33,000 B.P.) or Lipovsko-Novoselovo (30,000-25,000 B.P.) interstade of the Karga Interglacial (Bazarov et al. 1982:25; Kirillov 1984:47, 1987:72; Konstantinov 1980:16; Okladnikov and Kirillov 1980:39; Vasil'ev et al. 1987:111).

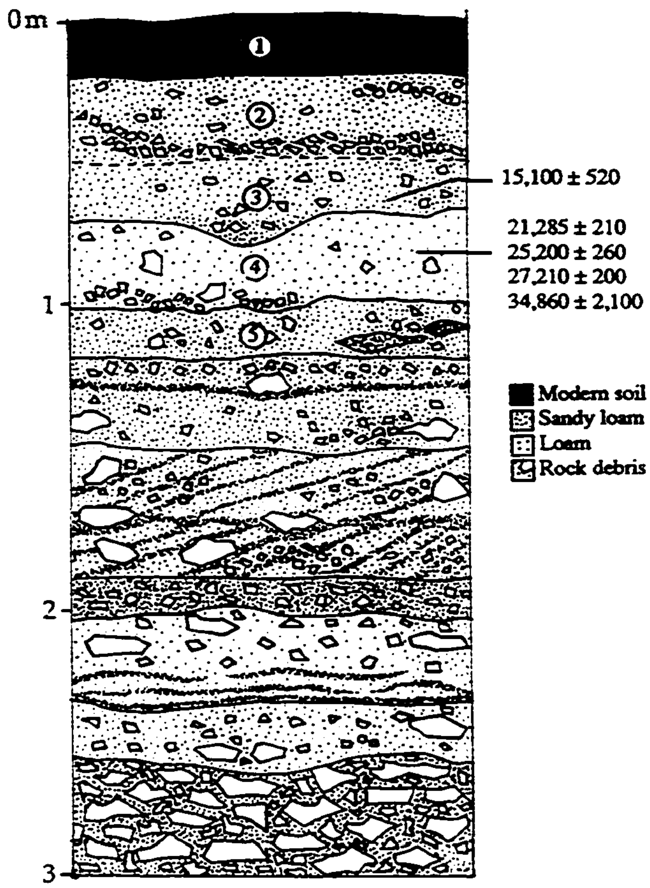


**Fig. 3.50.** Tolbaga representative stratigraphic profile (after Bazarov et al. 1982).

The Tolbaga lithic industry has been described in detail by several researchers (Bazarov et al. 1982; Kirillov 1987; Konstantinov and Konstantinov 1991; Vasil'ev et al. 1987). The assemblage consists of nearly 10,000 artifacts. Primary reduction technology is characterized by the production of blades, flake-blades, and flakes, removed chiefly from flat-faced and subprismatic blade cores; nearly 80% of all tools were manufactured on blades (Bazarov et al. 1982:28). Retouching is almost exclusively unifacial and marginal (Kirillov 1987:70; Konstantinov and Konstantinov 1991:13). The tool assemblage consists of retouched blades and flakes, wedges, end scrapers, points, gravers, burins, side scrapers, notches, choppers, chopping tools, and hammerstones (Bazarov et al. 1982:27; Vasil'ev et al. 1987:117-120).

A few bone artifacts have also been recovered, including a mammoth rib fragment bearing traces of polishing, a slotted horse rib apparently utilized as a scraper or knife handle, three polished bone needle fragments made on small mammal and bird bones (one with a partially preserved "eye"), and two possible bone pendants. Also present is a woolly rhinoceros (*Coelodonta antiquitatis*) vertebra carved into the form of a bear's head (Vasil'ev et al. 1987:114). According to Avdeev (1986) and Konstantinov et al. (1983), this artifact bears unmistakable microscopic traces of cutting and polishing from a chert knife and burin.

Although the Paleolithic living surface has been disturbed by the downhill movement of sediments, the excavations at Tolbaga have revealed the supposed remains of seven dwelling structures (Fig. 3.51). These dwellings are typically oval in shape, reaching 6-12 m in diameter, and outlined by external rings of large gneiss plates lying flat on the ground (Bazarov et al. 1982:25-26; Meshcherin 1985; Vasil'ev et al. 1987:112-114). These were surficial structures consisting of single living floors (Konstantinov and Konstantinov 1991:13-14). The number of hearths found within each dwelling ranges from one to twelve; some of these are lined with stones, others appear only as smears of charcoal and ash (Bazarov et al. 1982:25-26; Vasil'ev et al. 1987:112-114). Konstantinov's excavations also uncovered the remains of three storage pits. The most substantial of these (0.75 m in diameter, 0.35 m deep) was dug into the floor of one of the dwellings, and contained a mandible and other bones of horse (*Equus* sp.) (Bazarov et al. 1982:26).

Faunal remains from Tolbaga have been analyzed by Ovodov (1987). Megafauna are predominantly steppe species (Table 3.2) (Fig. 3.52) (horse [*Equus equus*], woolly rhinoceros [*Coelodonta* sp.], Kiakhta antelope [*Spirocerus kiakhtensis*], Mongolian gazelle

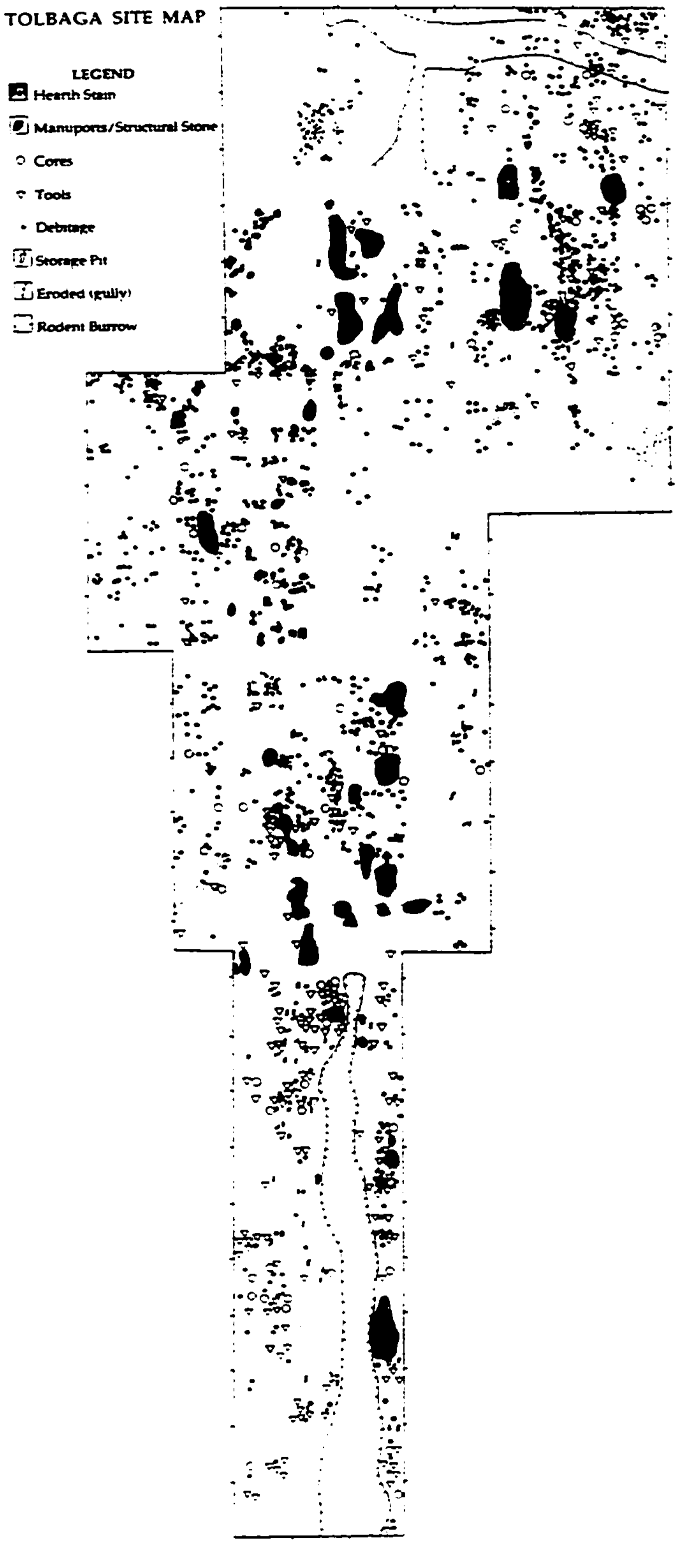


**Fig. 3.51.** Tolbaga site plan (after Bazarov et al. 1982).

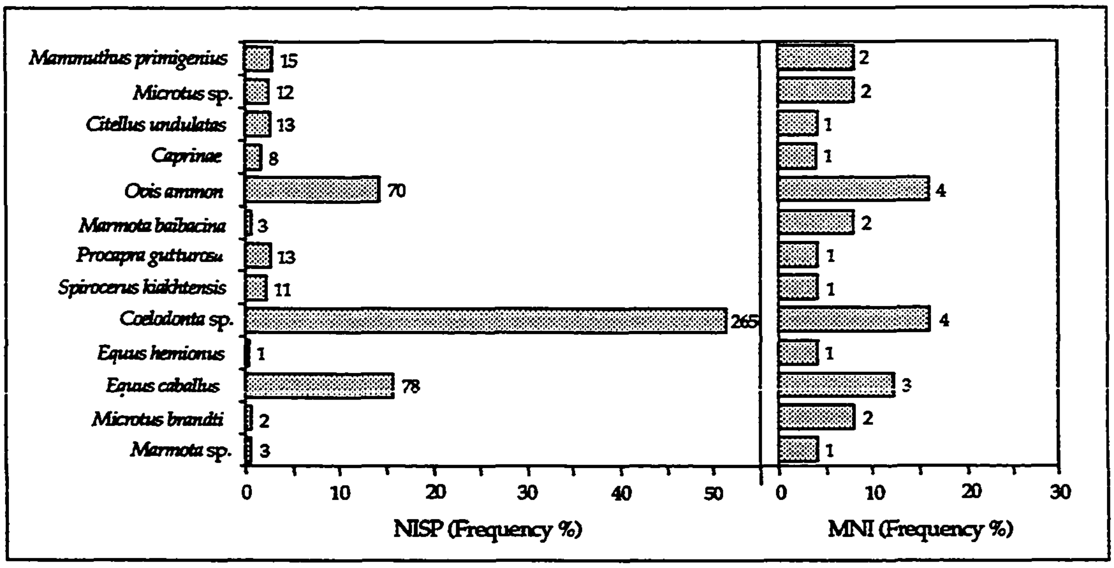


**Fig. 3.52. Tolbaga faunal assemblage (after Ovodov 2987).**

[*Procapra gutturosa*], and argali sheep [*Ovis ammon*]); however, at least one cold-adapted species is represented (reindeer [*Rangifer tarandus*]).

## *25. Masterov Gora*

Masterov Gora [*Masters' Mountain*] is located along the right bank of the Khilok River, 1.5 km northwest of the village of Gyrshelun, 15 km east of the town of Khilok, Chita Oblast' (Fig. 3.42) (51°26' N, 110°35' E). Meshcherin discovered the site in 1989; test excavations extending over 20 m$^2$ were conducted in 1990-91 (Meshcherin and Tuganov 1991).

The site lies upon an east-facing bluff 17 m above the modern floodplain overlooking Masterov Kliuch' (a spring-fed creek) and the Khilok River (Fig. 3.53) (Meshcherin and Tuganov 1991). The site's representative stratigraphic profile (Fig. 3.54) displays a 2-m thick mantle of sandy loams, colluvial (levels 4, 5) and aeolian (levels 1, 2, 3) in origin. These sediments contain a single paleosol and a single generation of cryogenic ice wedge pseudomorphs and frost cracks extending from the base of level 3 downward into level 4. Levels 4 and 5 have been preliminarily assigned to the Karga Interglacial, level 3 to the Sartan Glacial, and levels 1 and 2 to the Holocene (Meshcherin and Tuganov 1991:2-3).

Archaeological materials have been found in geologic levels 3, 4, and 5. Component I, the uppermost cultural level, consists of five lithic waste flakes recovered from level

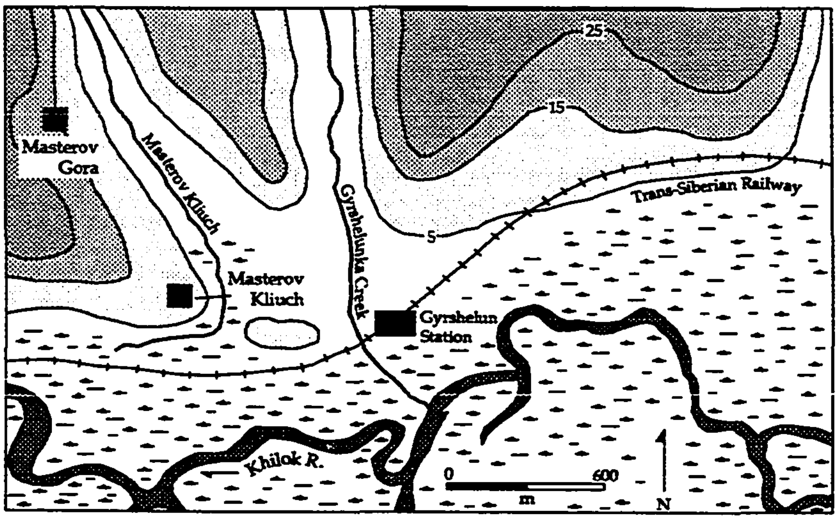


**Fig. 3.53. Map of Gyrshelun area showing location of Masterov Gora and Masterov Kliuch' sites (after Meshcherin 1991).**

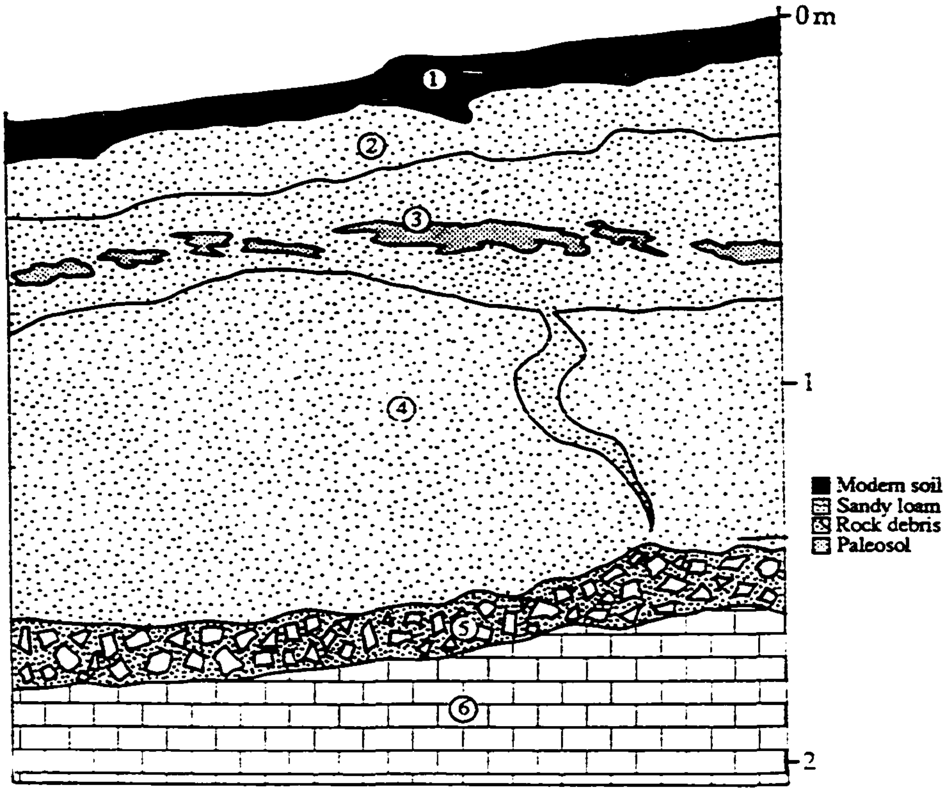


**Fig. 3.54. Masterov Gora stratigraphic profile (courtesy of M. Meshcherin).**

3. Component II, found near the base of geologic level 4, includes one small blade core (bidirectional), one blade, 15 flakes, and seven tools (end scrapers, wedge, retouched blades, retouched flakes). Component III is contained within geologic level 5, and is represented by an assemblage of nearly 150 artifacts, including 10 cores and core preforms (mostly bidirectional parallel blade cores), an angle burin, retouched blades, retouched flakes, and denticulates (Meshcherin and Tuganov 1991:4-5). Also present is a worked bone fragment bearing a drilled hole. To Meshcherin and Tuganov (1991:5-6), the two lower components display technological affinities with other Transbaikal sites including Tolbaga, Varvarina Gora, Sapun, and Sokhatino-1. Given these similarities, they have preliminarily assigned the lower occupations at Masterov Gora to the early Upper Paleolithic; $^{14}C$ dates, however, are needed to confirm this designation.

Faunal remains from components II and III are fragmentary and for the most part unanalyzed. The remains of horse (*Equus* sp.) (identified by M. Diab) were submitted for AMS $^{14}C$ dating, but failed to yield sufficient protein for $^{14}C$ analysis (AA-8890).

## *26. Masterov Kliuch'*

Masterov Kliuch' [*Masters' Spring*] is located less than 1 km west of the village of Gyrshelun, along the right bank of the Khilok River, Chita Oblast' (Fig. 3.42) (51°26' N, 110°35' E). Meshcherin discovered the site in 1990, and conducted test excavations in 1991 (Meshcherin 1991).

The site is situated on a 5-10 m high, south-facing bluff of a side valley colluvial fan incised by the the Khilok River (Fig. 3.53). Late Quaternary sediments measure nearly 3 m thick but are heavily cryoturbated (Fig. 3.55). Meshcherin (1991) divides the deposit into six geologic levels: the modern soil (level 1); Holocene loess (level 2); colluvium containing a discontinuous, reworked paleosol (level 3); unweathered loess extensively disturbed by frost cracks and ice wedge pseudomorphs (level 4); highly carbonated loess containing a thin band of colluvium and two separate paleosol horizons (level 5); and reworked, heavily soliflucted loess with intermittent lenses of sand and paleosol lenses (level 6). The profile exhibits intermittent episodes of aeolian loess accumulation followed by periods of slope degradation (colluviation, solifluction).

Archaeological materials form five stratigraphically separate cultural components. Components I and II (contained within geologic levels 1 and 2, respectively) are Neolithic, consisting of microlithic tools and ceramic shards. Component III, situated within the unweathered loess of geologic level 4, is a late Upper Paleolithic microblade industry. Components IV and V are early Upper Paleolithic industries, and are contained in geologic levels 5 and 6, respectively. They are described in more detail below.

Meshcherin's 1990 and 1991 test excavations produced a relatively small collection of 38 lithic artifacts from geologic level 5; these are assigned to component IV. The assemblage comprises two cores (a sub-prismatic bidirectional blade core and a radial flake core), 12 flakes, 17 blades and flake-blades, two bladelets, and five tools. The tool assemblage includes a retouched blade, cortically-backed knife, point on a blade, denticulate, and side scraper. This study reports a single AMS $^{14}C$ date run on bone from this component (collected *in situ* from unweathered loess near the top of level 5), 24,360 ± 270 B.P. (AA-8888).

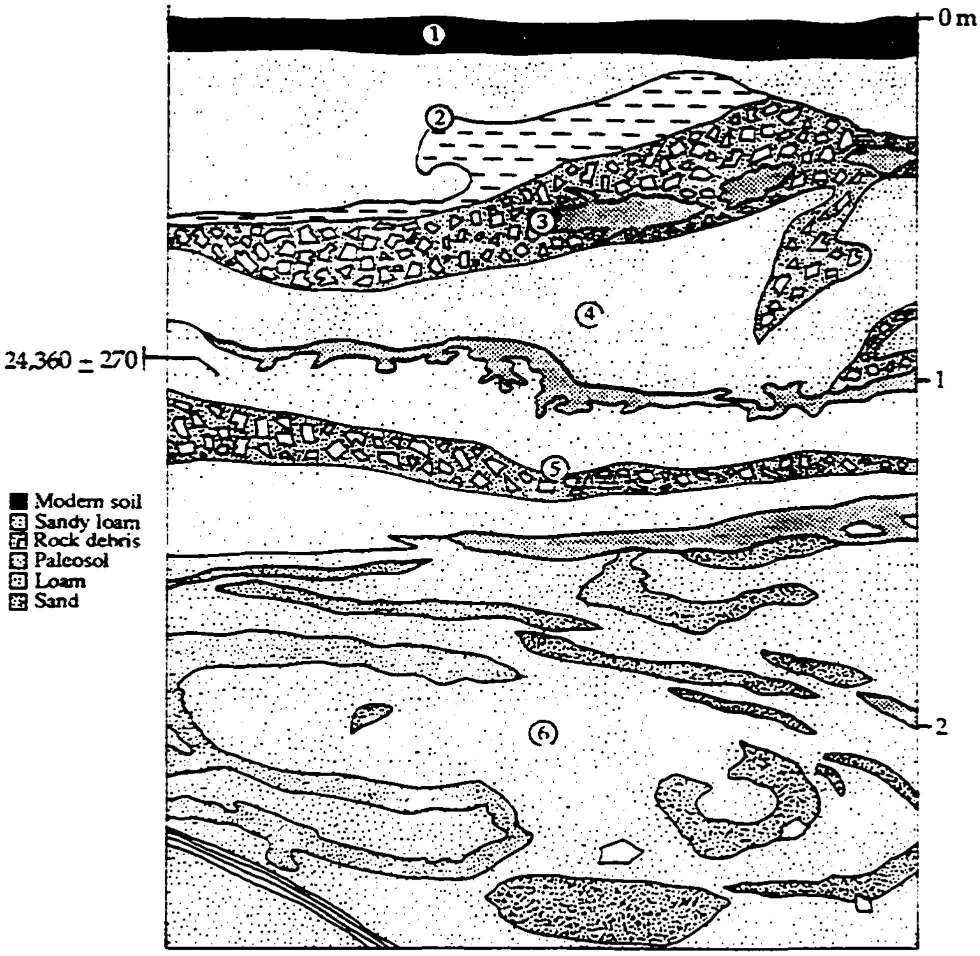


Fig. 3.55. Masterov Kliuch' stratigraphic profile (courtesy of M. Meshcherin).

Component V is represented by 24 lithic artifacts, including 10 cores (parallel blade, radial flake, "end," and orthogonal flake cores), one unworked cobble, and 12 tools (retouched flakes, denticulates, a wedge, notch, perforator, and retouched blade). According to Meshcherin (pers. comm., December 1991), component V is assigned to the transitional Upper Paleolithic technocomplex which includes Tolbaga, Varvarina Gora, and the lowest component at nearby Masterov Gora (35,000-30,000 B.P.), and component IV is assigned to the later, "Mal'ta" phase of the early Upper Paleolithic (25,000-20,000 B.P.).

Faunal remains from components IV and V at Masterov Kliuch' are rare. They include remains of horse (*Equus* sp.) from component IV (identification by M. Diab), and Siberian marmot (*Marmota sibirica*) from component V (identification by D. Grayson). The marmot, however, may have been secondarily introduced to the archaeological industry.

### *27. Ust'-Menza-5*

The Ust'-Menza [*Mouth of Menza*] area is one of the richest archaeological regions of the Transbaikal, with numerous multi-component, late Paleolithic and Mesolithic sites (Konstantinov and Shliamov 1987). Only one of these, however, has been assigned to the early Upper Paleolithic or Middle Paleolithic—the Ust'-Menza-5 locality. This site is located along the right bank of the Menza River, 0.5 km upriver of its confluence with the Chikoi River, 20 km south of the town of Krasnyi Chikoi, Chita Oblast' (Fig. 3.42) (50°13' N, 108°28' E). Ust'-Menza-5 was discovered in 1984 and excavated in 1985 by a team of Chita archaeologists led by Konstantinov (Filimonova et al. 1990; Konstantinov and Parkhomenko 1986; Konstantinov et al. 1986a, 1986b).

Ust'-Menza-5 is situated upon the fourth alluvial terrace of the Menza River, at a height of 20 m above the modern river floodplain (Konstantinov and Parkhomenko 1986; Konstantinov et al. 1986b). Near the base of a 7-m thick fine alluvial deposit (alternating bands of sand and sandy loam) are two stratigraphically separate colluvial bands containing isolated faunal remains and lithic artifacts. Relative dating places the age of the terrace and the artifact-bearing alluvial sediments within the Zyrian Glacial, 80,000-50,000 B.P. (Konstantinov and Parkhomenko 1986; Konstantinov et al. 1986a, 1986b).

Excavations in 1984-1985 uncovered 23 m² (Fig. 3.56) (Konstantinov and Parkhomenko 1986:72). Cultural remains from the lower colluvial band include two

**Fig. 3.56.** View of excavations at Ust'-Menza-5 (after Konstantinov et al. 1986a).

"battered rocks," one of which is described as a hammerstone, the other as a side scraper (Konstantinov and Parkhomenko 1986:73). The authors point out that these are not unequivocally artifacts; however, they occur in association with remains of woolly rhinoceros (*Coelodonta antiquitatis*) (a fourth metatarsal) and horse (*Equus* sp.) (the distal portion of a scapula) which display possible traces of battering by humans (Konstantinov and Parkhomenko 1986:73).

The second, stratigraphically higher cultural component is composed of 18 lithics deemed as "unquestionable" artifacts by Konstantinov and Parkhomenko (1986:73). These include two side scrapers, two "crude" subprismatic cores, two battered nodules, one blade-like spall, and 11 flakes. These artifacts have been assigned to the Mousterian (Filimonova et al. 1990:185; Konstantinov and Parkhomenko 1986:73), and are thought to indicate the presence of Neanderthals in the Transbaikal during the Zyrian Glacial (Konstantinov et al. 1986a).

### *28. Priiskovoe*

The single-component Priiskovoe [*Of the Mine*] site is located along the left bank of the Chikoi River on the outskirts of the village of Bol'shaia Rechka, 35 km southwest of Krasnyi Chikoi, Chita Oblast' (Fig. 3.42) (50°10' N, 108°21' E). The site was discovered in 1983; excavations conducted from 1985 through 1991 uncovered a 139-m² area (Konstantinov and Konstantinov 1991:14-15; Konstantinov et al. 1986b:61; Krushevskii 1991a, 1991b; Tseitlin et al. 1986, 1987).

Priiskovoe is situated upon the second (10 m) terrace of the Chikoi River, near its confluence with a small tributary, Bol'shaia Rechka (or creek) (Tseitlin et al. 1986, 1987). Site stratigraphy is complex, due to a series of frost cracks, ice wedge pseudomorphs, and solifluction features. Mantling terrace alluvium (sand) is nearly 2.5 m of alluvial (level 6) and aeolian (levels 1-5) sandy loams (Fig. 3.57) (Tseitlin et al. 1987:142). Two major paleosol horizons (levels 5c and 5a) occur within level 5; they have been extensively reworked through solifluction and heavily disturbed by frost cracks and ice wedge pseudomorphs penetrating from the upper-lying loesses (levels 3 and 4) (Krushevskii 1991a). These paleosols are separated by a continuous band of coarse sand (level 5b) (Tseitlin et al. 1986, 1987). Paleolithic cultural remains are found beneath this band of sand, at the top of the lower paleosol (5a).

Dating of the site is uncertain and has been the subject of much debate. Tseitlin et al. (1986, 1987; Konstantinov et al. 1986b) assign the paleosol complex of geologic level 5 to the late Sartan Glacial. Accordingly, the lower paleosol (5c) is thought to have formed during the Kokorevo interstade (13,000-12,200 B.P.), and the upper paleosol (5a) during the Taimyr interstade (11,800-11,400 B.P.). The band of sand (5b) separating these paleosols, then, accumulated during the intervening "cold snap" (12,200-11,800 B.P.). Konstantinov and Konstantinov (1991), however, suggest that these paleosols are much more ancient than considered by Tseitlin. They assign the lower and upper paleosols respectively to the Malokheta (43,000-33,000 B.P.) and Lipovsko-Novoselovo (30,000-22,000 B.P.) interstades of the Karga Interglacial. The intervening sand is said to have been deposited during the Konoshchel'e stade (33,000-30,000 B.P.). This study

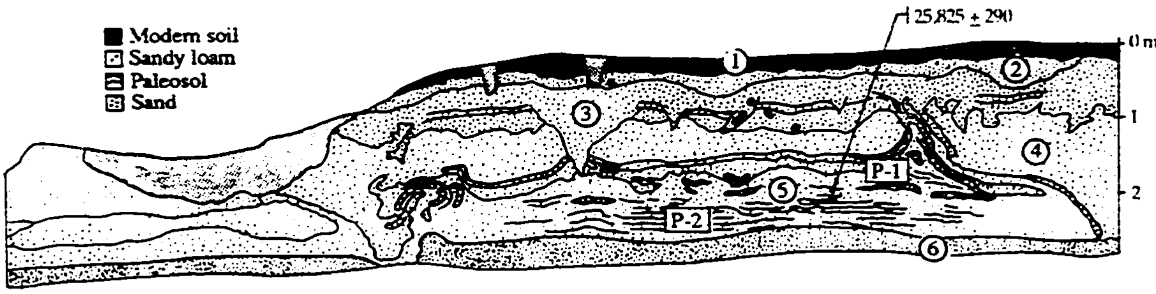


Fig. 3.57. Priiskovoe stratigraphic profile (courtesy of M. Konstantinov).

reports a single AMS $^{14}C$ date of 25,825 ± 290 B.P. (AA-8891) on bone from immediately above the lower paleosol (5a). According to this one date, then, the interpretation of Konstantinov and Konstantinov (1991) appears accurate. The Paleolithic component can be tentatively assigned to the early Lipovsko-Novoselovo interstade.

Cultural remains include 948 stone artifacts; of these, 17 are cores, 773 are flakes, 10 are blades or flake-blades, and 85 are tools (Tseitlin et al. 1987:143). The majority of tools were manufactured on flakes and flake-blades removed from orthogonal flake cores with no standard method of core preparation or blank removal. The tool assemblage includes side scrapers, retouched flakes, gravers, wedges, cobble choppers, notches, angle burins, and a hammerstone. Early publications (Tseitlin et al. 1986, 1987) also described several "microblade cores" and "microblades," which more recently have been called wedges and microblade-like spalls removed from wedges (Konstantinov and Konstantinov 1991). A single bone tool was also recovered from Priiskovoe. This is described as a long bone shaped into a "point" through the removal of a single, large longitudinal spall (Tseitlin et al. 1987:145).

Faunal remains identified include deer (Cervidae), bear (Ursidae), horse (*Equus* sp.), and bison (*Bison* sp.) (Konstantinov and Konstantinov 1991:15; Tseitlin et al. 1987:146).

Excavations in 1985-1986 revealed the remains of a Paleolithic dwelling structure. This 6.6 m x 4 m dwelling is represented by a circular ring of 38 large boulders and cobbles with a centrally-located, stone-lined hearth (Konstantinov and Konstantinov 1991:14; Tseitlin et al. 1987:142).

### *29. Arta-2*

The Arta sites are located along the left bank of the Arta River, near its confluence with the Ingoda River, 500 m from the village of Arta, 125 km southwest of Chita, Chita Oblast' (Fig. 3.42) (51°11' N, 112°21' E). These sites have been only preliminarily studied and reported.

The multi-component site Arta-2 is situated 14-20 m above the Ingoda River. The stratigraphic profile is generally described as a 6 m-thick section of alternating bands of colluvial loam, sand, gravel, and scree ovelying bedrock (Kirillov and Kasparov 1990:194). The entire profile has been heavily deformed by cryogenic processes, including multiple generations of frost cracks and ice wedge pseudomorphs.

Four cultural components have been identified. The upper two (components I and II) are reportedly late Upper Paleolithic in age and character, and occur 3 m below the surface (Kirillov and Kasparov 1990:194). Component III occurs in association with a broad paleosol horizon, 4 m below the surface. Microblade technology is absent from this level; instead the lithic industry is characterized by small, bidirectional and subprismatic blade cores, and a tool assemblage composed of end scrapers, perforators, engravers, burins, notches, and denticulates. Also from component III are three bone awls (Kirillov and Kasparov 1990:194). Faunal remains include bison (*Bison* sp.), woolly rhinoceros (*Coelodonta antiquitatis*), horse (*Equus* sp.), saiga antelope (*Saiga tatarica*), and marmot (*Marmota* sp.) (Kirillov and Kasparov 1990:194). A single charcoal sample from component III yielded a conventional $^{14}C$ date of 23,200 ± 2,000 B.P. (LE-2966).

Component IV, the basal cultural occupation at Arta-2, is found nearly 6 m below the modern surface (nearly 2 m below component III). Test excavations uncovered an initially flaked, large marble-like rock, two Levallois blades, and a chopper (Kirillov and Kasparov 1990:195). Associated with these finds is a small assemblage of faunal remains; species represented include woolly mammoth (*Mammuthus primigenius*), woolly rhinoceros (*Coelodonta antiquitatis*), bison (*Bison* sp.), cave hyena (*Crocuta spelaea*), and lion (*Panthera* sp.). A single sample of charcoal collected stratigraphically from above this level yielded a conventional $^{14}C$ date of 37,360 ± 2,000 B.P. (LE-2967). According to Kirillov and Kasparov (1990:195), this may be the most ancient Paleolithic occupation yet known in the Transbaikal.

### *30. Arta-3*

The Paleolithic locality Arta-3 was discovered and tested (35 m$^2$) in 1985 (Kirillov and Kasparov 1990:196; Kirillov pers. comm., December 1991). The site is situated 350 m from Arta-2, on a high hill 55-60 m above the modern floodplain of the Ingoda River. Cultural materials were recovered at a depth of 30-35 cm below the modern surface, in a deposit of massively bedded carbonated loams (Kirillov and Kasparov 1990:196). The assemblage comprises 88 lithic artifacts, including 42 flakes, 12 blades, four battered cobbles, 15 retouched blades, six knives, four "picks," two retouched flakes, two notches, and one point. Faunal material includes woolly rhinoceros (*Coelodonta antiquitatis*), bison (*Bison* sp.), and red deer (*Cervus elaphus*) (Kirillov and Kasparov 1990:196). Kirillov

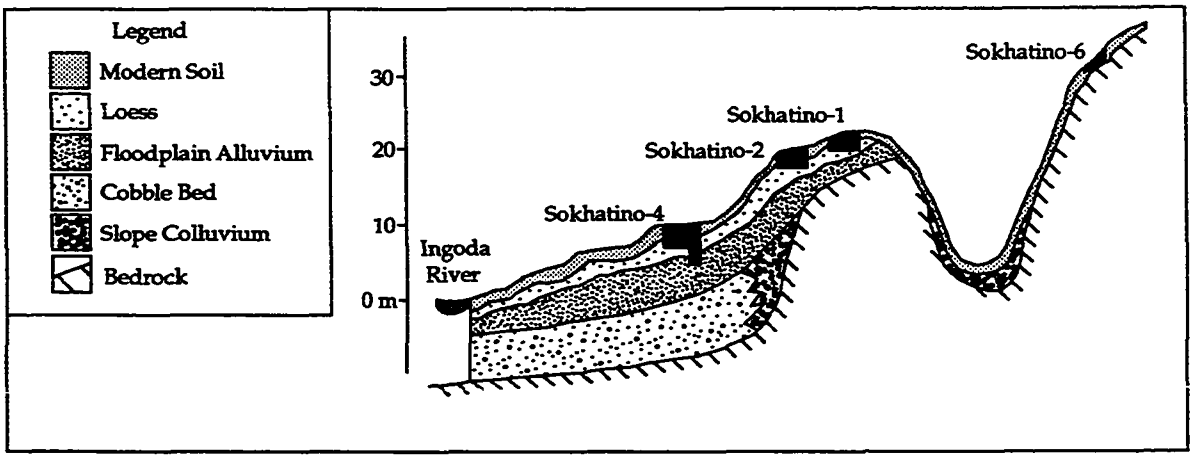


**Fig. 3.58.** Schematic stratigraphic profile of the Sokhatino area (after Okladnikov and Kirillov 1980).

(pers. comm., December 1991) links the Arta-3 assemblage stratigraphically and technologically to the material from component IV at Arta-2.

### *31. Sokhatino-1*

The well-known group of Sokhatino sites are located along the left bank of the Ingoda River, on the southeastern slope of Titovskaia Mountain, in the western suburbs of Chita, Chita Oblast' (Figures 3.42) (52°2' N, 113°29' E). The localities Sokhatino-1 and Sokhatino-6 contain early Upper Paleolithic components. Cultural remains from these sites have only been cursorily described. Neither site is absolutely dated.

Sokhatino-1 is situated upon the third (18-20 m) terrace of the Ingoda River (Fig. 3.58) (Okladnikov and Kirillov 1980:40). Paleolithic cultural remains were found in a shallow and unstratified deposit of aeolian loess, 15-30 cm below the modern surface (Okladnikov and Kirillov 1968:111; 1980:40). Representative stratigraphic profiles and details of site geomorphology and dating have not been reported. Faunal remains and features are absent.

The site's lithic assemblage has been preliminarily described by Okladnikov and Kirillov (1968:112-113, 1980:40-41). Primary reduction technology is based on the manufacture of wide blades removed from unidirectional, subtriangular "Levallois" cores (17) and subprismatic cores (2) (Okladnikov and Kirillov 1980:40-41). Among the debitage are 48 blades (Okladnikov and Kirillov 1968:112), and among the tools are notches, points, side scrapers, knives, and gravers (Okladnikov and Kirillov 1980:113).

Kirillov and Kasparov (1990:195) assign this industry to the "Tolbaginskaia culture" of the early Upper Paleolithic.

### *32. Sokhatino-6*

Sokhatino-6 was discovered in 1988 (Kirillov and Kasparov 1990:195). The site is situated at a height of 56 m above the modem river floodplain (Fig. 3.58). Sediments overlying bedrock are 2.5 m thick, and are described as a series of alternating bands of loam and scree. To date, only 12 $m^2$ has been excavated. Stratigraphic profiles and absolute dates have not been reported.

Cultural remains are reported to occur in two separate stratigraphic levels (Kirillov and Kasparov 1990:195). Assigned to the upper cultural level (component I) is a small lithic assemblage characterized by subprismatic and parallel blade cores, and a tool assemblage including end scrapers, gravers, notches, denticulates, and side scrapers. The lower cultural level (component II) contains three "Levallois" blade cores, and several notches, denticulates, side scrapers, end scrapers, and gravers (Kirillov and Kasparov 1990:195). Many of these artifacts bear traces of wind-induced polishing. Like Sokhatino-1, these lithic industries appear closely tied to the early Upper Paleolithic industries from Tolbaga, Varvarina Gora, and Sannyi Mys (Kirillov and Kasparov 1990:195).

# CHAPTER 4

## Chronology

The development of an accurate chronology for the Siberian Middle and early Upper Paleolithic continues to be hindered by the limitations of traditional dating methods. Middle Paleolithic sites assignable to the late Middle Pleistocene or early to mid-Upper Pleistocene are too ancient to be dated through radiocarbon ($^{14}C$) methods, and too young to be dated through potassium-argon ($^{40}K/^{40}Ar$) methods. Thus, constructing chronologies for events occurring from 200,000 to 30,000 B.P., such as the emergence of modern humans and the Middle to Upper Paleolithic transition, must rely on other absolute dating methods, like accelerator (AMS) $^{14}C$, electron spin resonance (ESR), thermoluminescence (TL), and Uranium-series (U-series). However, the application of these non-conventional dating methods in Paleolithic archaeology is relatively new, and so far only eleven sites have been dated through these methods. This chapter presents the results of recent attempts to date the Siberian Middle and early Upper Paleolithic. New AMS $^{14}C$ and U-series dates are presented, and a new regional chronology is constructed. The results, although preliminary, are intriguing. Middle Paleolithic occupations appear to date to as early as the Last Interglacial (oxygen-isotope substage 5e, 128,000-118,000 B.P.), and early Upper Paleolithic occupations date to at least as early as 43,000 B.P.

### PROBLEMS IN DATING THE PALEOLITHIC

Historically, Middle Paleolithic chronologies across Eurasia and Africa have been based largely on relative dating methods. Recently, however, chronologies founded on non-radiocarbon absolute dating methods, including electron spin resonance (ESR), thermoluminescence (TL), and Uranium-series (U-series), have become increasingly common. The use of these dating techniques has already had a profound impact on reconstructions of Upper Pleistocene hominid evolution, especially in sub-Saharan Africa and the Near East. In Africa, applications of these methods have completely revised

Middle Stone Age chronologies and the ages of early anatomically modern human fossils. On the basis of conventional $^{14}C$ dates, Howiesen's Poort and other Middle Stone Age complexes at Klasies River Mouth, Border Cave, and other sites in South Africa were thought to date to no earlier than 45,000 B.P. (Parkington 1990; Sampson 1974); however, TL and ESR results now demonstrate that the age of the Middle Stone Age may be as old as 130,000 B.P. (Deacon 1989; Grün and Stringer 1991; Grün et al. 1990a, 1990b). Likewise, in the Near East, ESR and TL dating of Middle Paleolithic cave occupations at Tabun, Qafzeh, Skhul, Kebara, and Amud have completely reorganized the region's Middle Paleolithic chronology and Upper Pleistocene human paleontological record (Bar-Yosef 1989, 1993; Grün and Stringer 1991).

While ESR and TL have provided accurate absolute chronologies for the Middle Paleolithic, these techniques lack the precision necessary for dating events like the Middle to Upper Paleolithic transition. In Europe, TL dates on early Upper Paleolithic occupations (e.g., Temnata, Bulgaria, and St. Cesaire, France) are characteristically bracketed by standard deviations of more than 10,000 years (Kozlowski 1992; Mellars 1993:203; Mercier et al. 1991:738). Pinpointing the exact ages of occupations such as these must rely on more precise dating methods.

Uranium-series dating of calcitic deposits (i.e., stalagmites, flowstones, travertines) is one method that can potentially provide age assessments as accurate and precise as those obtained through radiocarbon techniques. This radiometric method uses the known rates of decay of uranium isotopes (i.e., $^{234}U$, $^{235}U$) into daughter isotopes ($^{230}Th$, $^{231}Pa$) as absolute "clocks" to measure the time passed since the formation of a given calcitic deposit. U-series has been used to date late Middle Pleistocene and early Upper Pleistocene hominid sites in Europe (e.g., Petralona, Bilzingsleben, Monte Circeo) (Latham and Schwarcz 1992; Schwarcz et al. 1988; Schwarcz et al. 1989), and has recently been used to date the Middle to Upper Paleolithic transition at Abric Romaní, Spain (Bischoff et al. in press). U-series dating, however, produces reliable results only when calcium-rich geologic deposits are dated (Schwarcz 1993:17-18). Biogenic materials such as bone, teeth, and eggshell have produced unsatisfactory results, because ratios of uranium ($^{234}U$, $^{235}U$) and its daughter isotopes, thorium ($^{230}Th$), and protactinium ($^{231}Pa$), are governed by the date of post-depositional uranium accumulation, not the date of death or deposition (Schwarcz 1993:18). U-series dates on biogenic material, then, should be viewed as upper-limiting ages when $^{231}Pa/^{235}U$ ratios indicate the same age or a younger age than $^{230}Th/^{234}U$ ratios.

AMS $^{14}C$ dating also has applications for the study of the Middle and early Upper Paleolithic. Theoretically AMS procedures should allow dating of Paleolithic sites back to around 70,000 B.P., but at present the effective range of this method is only about 40,000 B.P. (Gowlett 1987a; Gowlett and Hedges 1986:63; Mellars et al. 1993:7). For dating the early Upper Paleolithic, then, AMS $^{14}C$ methods can be quite useful. They permit the precise dating of tiny samples of charcoal (Gowlett 1987a) as well as amino acid-specific samples of bone collagen (Stafford 1990; Stafford et al. 1988). The major shortcoming of AMS $^{14}C$ dating is its limited range. Most Paleolithic archaeologists now realize that $^{14}C$ dates greater than 35,000-40,000 B.P., whether obtained through conventional or AMS methods, are best considered as limiting minimum age estimates until other absolute dating techniques, including ESR, TL, and U-series, can be applied to provide complementary age assessments.

The application of new absolute dating techniques continues to transform regional characterizations of the Middle to Upper Paleolithic transition. In the Near East, transitional Upper Paleolithic industries are now thought to predate 45,000 B.P. (Bar-Yosef et al. 1992:517; Mellars 1993:202), and all across Europe, the transition appears to have been underway much earlier than previously thought—by 45,000 B.P. in southeast Europe (Allsworth-Jones 1990:231; Kozlowski 1988:219; Mellars 1993:202), and by 40,000 B.P. in southwest Europe (Bischoff et al. 1989; Valdes and Bischoff 1989).

## ABSOLUTE DATING THE SIBERIAN PALEOLITHIC

Past attempts at dating the Siberian Paleolithic have relied solely on conventional $^{14}C$ dates. Prior to this study, 14 Middle and early Upper Paleolithic occupations had been $^{14}C$ dated to the period between 40,000 and 30,000 B.P. (Table 4.1). However, the reliability of these conventional dates is questionable, due to a number of deficiencies, including the limited range of conventional $^{14}C$ methods, potential contamination, and the use of pooled samples and other inferior materials for dating.

The proposed ages of many of the sites, especially the designated Middle Paleolithic ones (Strashnaia Peshchera, Peshchera Okladnikov, Denisova Peshchera), likely fall beyond the range of conventional $^{14}C$ dating (i.e., 40,000 B.P.). Infinite conventional $^{14}C$ dates obtained for occupations at these Middle Paleolithic caves tell us only that these and other Siberian Middle Paleolithic occupations are likely more ancient than

**Table 4.1.** Conventional Radiocarbon Dates from Siberian Middle and Upper Paleolithic Sites

| Site | Lab Number[1] | Radiocarbon Date (BP) | Material Dated | Reference[2] |
|---|---|---|---|---|
| Strashnaia Peshchera | SOAN-786 | >40,000 | Bone | 1 |
| | SOAN-787 | >40,000 | Bone | 1 |
| Peshchera Okladnikov level 3 | SOAN-2458 | >16,210 | Bone | 2 |
| | SOAN-2459 | 28,470 ± 1,250 | Bone | 2 |
| Denisova Peshchera level 21 | SOAN-2488 | >34,700 | Humic acids | 2 |
| | SOAN-2489 | 39,390 ± 1,310 | Humic acids | 2 |
| Denisova Peshchera level 11 | SOAN-2504 | >37,235 | Bone | 2 |
| Ust'-Karakol | SOAN-2515 | 31,410 ± 1,160 | Wood charcoal | 2 |
| | IGAN-837 | 29,900 ± 2,070 | Wood charcoal | 3 |
| Ust'-Karakol-II | IGAN-1077 | 31,430 ± 1,180 | Bone | 4 |
| Kara-Bom component II | GIN-5934 | 32,000 ± 600 | Bone | 5 |
| | GIN-5935 | 33,800 ± 600 | Wood charcoal | 5 |
| Maloialomanskaia Peshchera | SOAN-2500 | 33,350 ± 1,145 | Wood charcoal | 6 |
| Malaia Syia | SOAN-1124 | 20,370 ± 340 | Wood charcoal | 7 |
| | SOAN-1286 | 34,500 ± 450 | Bone | 7 |
| | SOAN-1287 | 34,420 ± 360 | Bone | 7 |
| | SOAN-1287[3] | 33,060 ± 300 | Bone | 8 |
| Ust'-Kova lower complex | SOAN-1690 | >32,865 | Wood charcoal | 9 |
| | SOAN-1875 | 28,050 ± 670 | Wood charcoal | 9 |
| | SOAN-1900 | 19,540 ± 90 | Wood charcoal | 9 |
| | GIN-1741 | 30,100 ± 150 | Wood charcoal | 9 |
| Voennyi Gospital | GIN-4440 | 29,700 ± 500 | Bone | 10 |
| Varvarina Gora | SOAN-850 | 30,600 ± 500 | Bone | 11 |
| | SOAN-1524 | 34,900 ± 780 | Bone | 11 |
| Tolbaga | SOAN-1522 | 34,860 ± 2,100 | Bone | 11 |
| | SOAN-1523 | 27,210 ± 300 | Bone | 11 |
| Arta-2 component IV | LE-2967 | 37,360 ± 2,000 | Wood charcoal | 12 |

[1]Radiocarbon laboratory designations: SOAN (Geochronological Laboratory of the Institute of Geology and Geophysics, Siberian Branch of the Academy of Sciences of the U. S. S. R., Novosibirsk); IGAN (Institute of Geography, Academy of Sciences of the U. S. S. R.); GIN (Geological Institute of the Academy of Sciences of the U. S. S. R., Moscow); LE (Radiocarbon laboratory of the Radiological Institute, Leningrad).

[2]References: (1) Ovodov 1975; (2) Panychev and Orlova 1990; (3) Derevianko et al. 1990b; (4) Cherkinskii et al. 1992; (5) Dervianko and Petrin 1988; (6) Derevianko and Petrin 1989; (7) Muratov et al. 1982; (8) Larichev 1978a; (9) Drozdov et al. 1990a; (10) Medvedev et al. 1990; (11) Bazarov et al. 1982; (2) Kirillov and Kasparov 1990.

[3]Two dates have been reported for lab number SOAN-1287, one by Muratov et al. (1982) (34,420 ± 360), and the other by Larichev (1978a) (33,060 ± 300). It is unclear which is the correct date, or whether two dates were obtained from a split sample of bone.

associated finite $^{14}C$ dates indicate. How much older can not be determined without application of different absolute dating techniques.

Further, some previously dated Siberian Paleolithic sites occur in redeposited contexts, and cultural materials are not demonstrably related to the organic substances dated. This has led to dates for some cultural occupations being considered "too old," as at Ust'-Kova, where lithic artifacts assigned to the "lower complex" were found in ice wedge pseudomorphs but were arbitrarily linked to a paleosol dated to about 30,000 B.P.

Another problem with the conventional 14C dating of the Siberian Paleolithic has been the widespread use of unreliable organic substances. Wood charcoal, the best material for $^{14}C$ dating (Taylor 1987), has been dated at only five of the occupations listed in Table 4.1 (excluding Ust'-Kova). However, even at these sites, separate samples of charcoal were combined in order to obtain the large samples needed to allow conventional $^{14}C$ dating of sites older than 20,000 B.P. At Malaia Syia such a combined charcoal sample yielded a date of 20,370 ± 340 B.P. (SOAN-1124), which, when compared to other dates obtained on bone (34,900 ± 780 [SOAN-1524], 30,600 ± 500 [SOAN-850] B.P.), is noticeably aberrant (Muratov et al. 1982). Aberrant charcoal dates such as this could have resulted from combining charcoal of differing ages into one sample, and also from ineffective sample pretreatment in the radiocarbon laboratory. It is extremely difficult to remove all organic contaminants from large bulk samples, especially when they are of great antiquity (Gowlett 1987a). The addition of just 1% modern $^{14}C$ to a sample with a real age of 35,000 B.P. will decrease the $^{14}C$ age of the sample by as much as 6,000 years (Taylor 1987). Thus, sample contamination may explain the discrepencies between the wood charcoal and bone dates at Malaia Syia, as well as the discordant wood charcoal dates from Ust'-Kova (Table 4.1). It also calls into question single conventional dates on charcoal that have not been amply confirmed by additional $^{14}C$ dates or dates based on absolute dating procedures (e.g., Maloialomanskaia Peshchera).

The lack of wood charcoal at most Middle and early Upper Paleolithic sites in Siberia has also forced the use of less reliable materials, including bone and soil organics, for $^{14}C$ dating. Bone and soil organics are exposed to numerous contaminants, both older and younger, often resulting in disparate conventional $^{14}C$ dates obtained from the same level or even the same sample (Mellars 1986; Taylor 1987). Among the early Upper Paleolithic sites with conventional $^{14}C$ dates run on bone, a number of inconsistencies occur. Bone samples from the same unit at Tolbaga yielded conventional dates of 34,860 ± 2,100 and 27,210 ± 300 B.P.; three sigma ($\sigma$) ranges for these dates (i.e., 41,160-28,560 B.P., 28,110-26,310 B.P.) are not even contemporaneous. The same is true for the bone dates from Varvarina Gora, 34,900 ± 780 and 30,600 ± 500 B.P., which have 3s ranges of 37,240-32,560 B.P. and 32,100-29,100 B.P., respectively. Preference toward any of these incongruous dates is undefendable without complementary evidence, since all may be inaccurate due to the effects of contamination. The numerous incongruities in $^{14}C$ dates for the Siberian Middle and early Upper Paleolithic, then, illustrate the need to apply new absolute dating methods, to analyze multiple samples and entire stratigraphic profiles, and to understand the geoarchaeology of cultural occupations.

## BUILDING A CHRONOLOGY

An important component of the present study is the construction of a Siberian site chronology through the redating of key Middle Paleolithic and early Upper Paleolithic occupations. In this work, 27 new AMS $^{14}C$ dates and two U-series dates from 22 Middle and early Upper Paleolithic occupations are presented (Tables 4.2, 4.3). Five AMS dates from Peshchera Okladnikov were collected by J. Cinq-Mars and analyzed by E. Nelson at the Radio-Isotope Direct Detection Laboratory (RIDDL), Simon Fraser University. The remaining AMS $^{14}C$ dates were collected by the author or given to the author along with precise contextual date by original site excavators. U-series analyses of bone samples from levels 7 and 3 at Pehshchera Okladnikov were analyzed by R. Ku (University of Southern California) and J. Bischoff (U. S. Geological Survey, Menlo Park), respectively. They are presented here through the courtesy of J. Bischoff, J. Mead (Northern Arizona University), and A. Derevianko (Institute of Archaeology and Ethnography, Novosibirsk).

### Dating Methods and Results

#### *Accelerator Radiocarbon Dates*

AMS $^{14}C$ age determinations on wood charcoal samples were carried out at the DSIR AMS facility in Lower Hutt, New Zealand, and sample pretreatments were conducted at Geochron Laboratories (Cambridge, Mass.). Charcoal samples were

**Table 4.2.** Accelerator Radiocarbon Dates from Siberian Middle and Early Upper Paleolithic Sites

| Site | Lab Number[1] | AMS Radiocarbon Date (BP) | Material Dated | % Protein Yield | Reference[2] |
|---|---|---|---|---|---|
| Strashnaia Peshchera | AA-8884 | Undatable[3] | Bone | ? | 1 |
| Peshchera Okladnikov level 7 | RIDDL-722 | 43,300 ± 1,500 | Bone | - | 1 |
| Peshchera Okladnikov level 6 | RIDDL-720 | 40,700 ± 1,100 | Bone | - | 1 |
| | RIDDL-721 | 32,400 ± 500 | Bone | - | 1 |
| Peshchera Okladnikov level 3 | RIDDL-718 | 33,500 ± 700 | Bone | - | 1 |
| Peshchera Okladnikov level 2 | RIDDL-719 | 37,750 ± 750 | Bone | - | 1 |
| Denisova Peshchera Entrance level 9 | GX-17602 | 46,000 ± 2,300 | Wood charcoal | - | 2 |
| Denisova Peshchera level 22 | GX-17601 | 2,166 ± 86 | Wood charcoal | - | 2 |
| Denisova Peshchera level 21 | GX-17599 | 35,140 ± 670 | Wood charcoal | - | 2 |
| Kara-Bom component I | AA-8873 | >42,000 | Bone | 35.0 | 2 |
| | AA-8894 | >44,400 | Bone | 9.0 | 2 |
| Kara-Bom component IIa | GX-17597 | 43,200 ± 1,500 | Wood charcoal | - | 3 |
| Kara-Bom component IIb | GX-17596 | 43,300 ± 1,600 | Wood charcoal | - | 3 |
| Kara-Bom component IIc | GX-17594 | 33,780 ± 570 | Wood charcoal | - | 3 |
| | GX-17595 | 34,180 ± 640 | Wood charcoal | - | 3 |
| Kara-Bom component IId | GX-17593 | 30,990 ± 460 | Wood charcoal | - | 3 |
| Malaia Syia | AA-8876 | 29,450 ± 420 | Bone | 35.0 | 2 |
| Arembovskii | AA-8881 | Undatable | Bone | 0.5 | 2 |
| Makarovo-4 | AA-8878 | >38,000 | Bone | 37.0 | 2 |
| | AA-8879 | >38,000 | Bone | 52.0 | 2 |
| | AA-8880 | >39,000 | Bone | ? | 2 |
| Varvarina Gora | AA-8875 | >34,050 | Bone | 8.0 | 2 |
| Varvarina Gora | AA-8893 | >35,300 | Bone | 1.2 | 2 |
| Tolbaga | AA-8874 | 25,200 ± 260 | Bone | 10.2 | 2 |
| Masterov Gora, component III | AA-8890 | Undatable | Bone | ? | 2 |
| Masterov Kliuch', component IV | AA-8888 | 24,360 ± 270 | Bone | 23.0 | 2 |
| Priiskovaia | AA-8891 | 25,825 ± 290 | Bone | 38.0 | 2 |

[1]Radiocarbon laboratories: AA (NSF-Arizona AMS Facility, University of Arizona); RIDDL (Radio-Isotope Direct Detection Laboratory, Simon Fraser University); GX (Geochron Laboratories, Cambridge).

[2]References: (1) J. Cinq-Mars and E. Nelson, pers. comm.; (2) present study; (3) Goebel et al. 1993.

[3]These bones were undatable due to a lack of preserved protein in the samples.

**Table 4.3.** Uranium-Series Dates on Bone from Peshchera Okladnikov

| Level | Sample | Uppm | $^{234}U/^{238}U$ | $^{230}Th/^{232}Th$ | $^{230}Th/^{234}U$ | $^{231}Pa/^{235}U$ | $^{230}$Th Age | $^{231}$Pa Age | Ref.[1] |
|---|---|---|---|---|---|---|---|---|---|
| 7 | MB-5 | — | 1.45 ± 0.03 | — | 0.34 ± 0.02 | 0.59 ± 0.03 | 44,800 ± 4,400 | 44,600 ± 3,300 | 1 |
| 3 | Okl-2a | 2.51 ± 0.06 | 1.51 ± 0.04 | >1,000 | .09 | — | $10,287^{+406}_{-404}$ | — | 2 |
| 3 | Okl-2b | 4.62 ± 0.10 | 1.54 ± 0.03 | >1,000 | .31 ± 0.01 | — | $38,725^{+1,435}_{-1,419}$ | — | 2 |

[1]References: (1) J. Mead, pers. comm.; (2) J. Bischoff, pers. comm.

separated from any rootlets or other modern contaminants and pretreated with hydrochloric acid and sodium hydroxide to remove carbonates, humic acids, and fulvic acids. After drying, each pretreated sample was converted to carbon dioxide by combustion with cupric oxide powder. Carbon dioxide samples were then converted into graphite accelerator targets (by the method of Jull et al. [1983]), which were then used for AMS dating.

For bone samples, AMS $^{14}C$ analyses were carried out at the NSF-Arizona AMS Facility, and sample pretreatments were conducted at the Laboratory of Isotope Geochemistry, University of Arizona (Tucson). Pretreatment methods are described in detail by Long et al. (1989). Briefly, each bone sample was physically separated from any sediment and soil-derived organic matter, decalcified in weak hydrochloric acid, and bathed in hot (90°C) water to extract protein gelatin for analysis. Once filtered and freeze dried, each gelatin sample was hydrolyzed by heating at 110°C for twenty-four hours, and then passed through XAD-2 resin to separate amino acids from humic acids, fulvic acids, and other potential contaminants. The XAD-purified gelatin hydrolyzate was then converted to a graphite accelerator target (by the method of Jull et al. [1983]) and used for AMS dating.

Results of AMS $^{14}C$ dating is presented in Table 4.2. Accelerator $^{14}C$ dates from Peshchera Okladnikov range from 43,300 ± 1,300 B.P. (RIDDL-722) for level 7, the basal unit in the cave, to 37,750 ± 750 B.P. (RIDDL-719) for level 2. The two dates for level 6, 40,700 ± 1,100 (RIDDL-720) and 32,400 ± 500 B.P. (RIDDL-721), were obtained from the same sample of bone; however, this sample was prepared using a collagen extraction technique which separates molecules weighing greater than 30,000 Daltons from those weighing less than 30,000 Daltons. The >30,000 Dalton sample yielded the more ancient date (RIDDL-720), and is considered to be more accurate (J. Cinq-Mars pers. comm.). The single AMS date from level 3 (33,500 ± 700 B.P. [RIDDL-718]) (Fig. 4.1) seems discordantly young; its 2σ range does not overlap with the date of 37,750 ± 750 B.P. from the above-lying level 2.

This suite of dates from Peshchera Okladnikov can be interepreted in two ways. On the one hand, they may indicate that the Middle Paleolithic occupation at Peshchera Okladnikov is very late in age (spanning from about 45,000 to 37,000 B.P.). On the other hand, because they press the limit of $^{14}C$ dating, they may be artifically young. Perhaps these dates should be treated as minimum limiting ages until other more accurate methods of absolute dating can be applied.

From Denisova Peshchera, there are two sets of dates: those from the cave entrance, and those from the cave interior. A single sample of wood charcoal collected from level 9 in the cave entrance profile (in association with Middle Paleolithic artifacts) yielded a date of 46,000 ± 2,300 B.P. (GX-17602). This date should be viewed cautiously since it lies at the limit of $^{14}C$ dating. From the cave interior profile come two new $^{14}C$ AMS dates on wood charcoal. The sample from level 22 yielded a date of 2,166 ± 86 B.P. (GX-

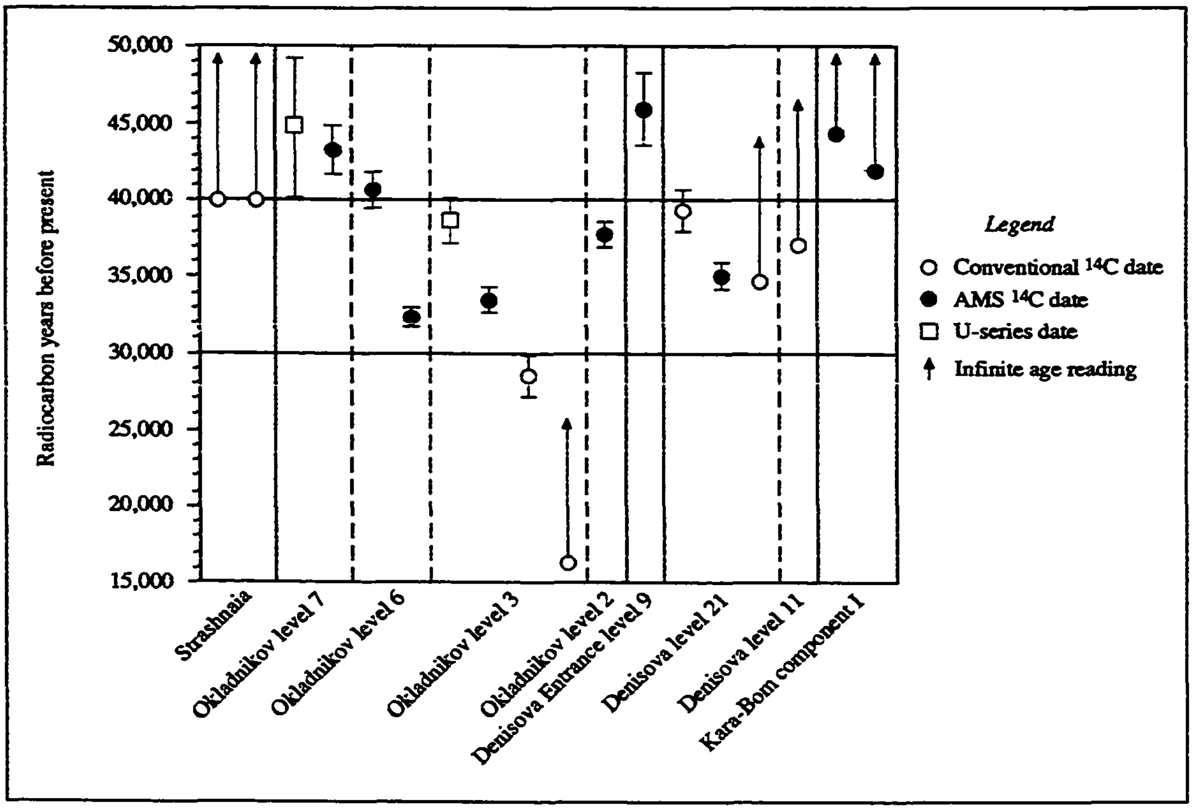


**Fig. 4.1.** Absolute age measurements for Middle Paleolithic occupations in Siberia.

17601) that is clearly aberrant; it was collected from a previously exposed profile and appears to have been contaminated by modern carbon. The charcoal sample from level 21 yielded a date of 35,140 ± 670 B.P. (GX-17599). This date also seems too young, especially in light of the infinite dates from levels 21 and 11 previously obtained through conventional methods (Table 4.1), and the probable stratigraphic correlation of level 21 with level 9 at the cave entrance (AMS $^{14}C$ dated to 46,000 ± 2,300 B.P.). Given these inconsistencies, the dating of the Denisova Peshchera interior profile should be considered unresolved. The infinite dates suggest that, as at the cave entrance, the Middle Paleolithic occupations from the cave interior are too ancient to be reliably dated by the $^{14}C$ method.

AMS $^{14}C$ dating of bone from the Middle Paleolithic occupations at Kara-Bom (component I) yielded two infinite dates: >44,400 (AA-8894) and >42,000 B.P. (AA-8873). They indicate that this component predates the range of $^{14}C$ dating.

Despite the series of new AMS and conventional $^{14}C$ dates, the dating of the Siberian Middle Paleolithic remains unsettled. The use of AMS $^{14}C$ has confirmed that some, if not all, of these occupations are older than 40,000 B.P. Application of other absolute dating techniques, such as thermoluminescence and electron spin resonance, will be necessary to determine exactly how ancient these occupations are. Presently, then, the building of a Middle Paleolithic chronology must rely almost exclusively on stratigraphic and other contextual information.

AMS $^{14}C$ dating of the Siberian early Upper Paleolithic has produced better results. Prior to this study, conventional $^{14}C$ dates from Malaia Syia, Varvarina Gora, and Tolbaga suggested that the early Upper Paleolithic in Siberia emerged around 35,000 B.P. (Abramova 1984, 1989; Larichev et al. 1988). New AMS $^{14}C$ dates from Kara-Bom components IIa and IIb, however, indicate that the earliest Upper Paleolithic industries are considerably more ancient, perhaps dating to as early as 45,000 B.P. (Goebel et al. 1993). Wood charcoal samples (collected from a hearth feature) from these basal Upper Paleolithic occupations yielded dates of 43,200 ± 1,500 (GX-17597) and 43,300 ± 1,600 (GX-17596) (Goebel et al. 1993). In addition, two overlying early Upper Paleolithic occupation levels, components IIc and IId, were AMS $^{14}C$ dated to about 34,000 and 31,000 B.P., respectively (Table 3.2) (Goebel et al. 1993).

New AMS $^{14}C$ dates from other Siberian early Upper Paleolithic occupations support the results from Kara-Bom. At Makarovo-4, three samples of bone recovered *in situ* in clear association with lithic artifacts yielded infinite dates of >39,000 (AA-8880), >38,000 (AA-8879), and >38,000 B.P. (AA-8878) (Table 4.1; Fig. 4.2). In addition, fossil bone

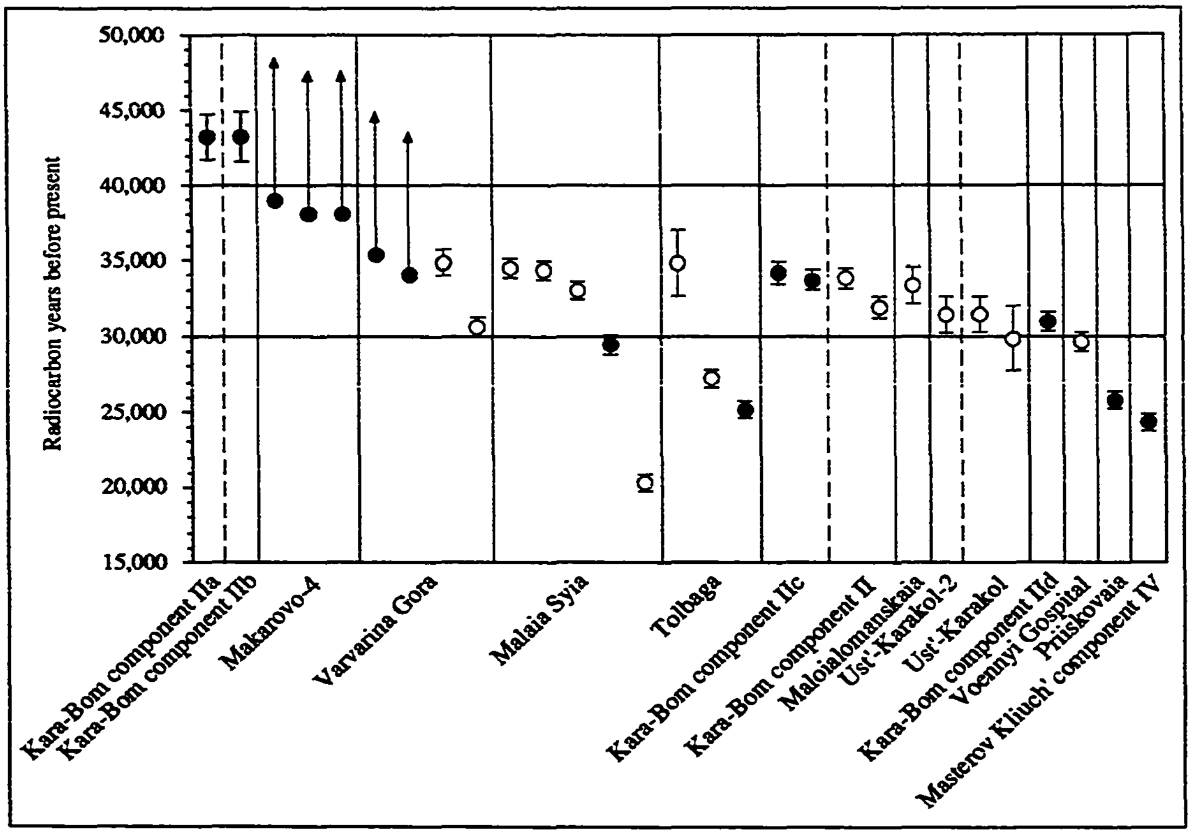


**Fig. 4.2.** Absolute age measurements for early Upper Paleolithic occupations in Siberia.

recovered during Okladnikov's excavations at Varvarina Gora yielded AMS dates of >35,300 (AA-8893) and >34,050 B.P. (AA-8875) (Table 4.1; Fig. 4.2). Because they are infinite, the new dates indicate that the earliest Upper Paleolithic in southeast Siberia is more ancient than the AMS $^{14}C$ dating of bone allows. Further chronometric work at these sites, including AMS $^{14}C$ dating of wood charcoal and thermoluminescence dating of burnt flints and eolian sediments may firm up the chronology of this time period.

Other early Upper Paleolithic occupations appear slightly younger in $^{14}C$ age. A single sample of bone from Malaia Syia resulted in an AMS $^{14}C$ date of 29,450 ± 420 B.P. (AA-8876), which when compared to conventional $^{14}C$ dates on bone from the same occupation (ranging from 35,000 to 33,000 B.P.), is younger than expected. Similarly, one sample of bone from Tolbaga yielded a date of only 25,200 ± 260 B.P. (AA-8874). This date is significantly younger (even at 3σ) than the previously run conventional dates of 34,860 ± 2,100 (SOAN-1522) and 27,210 ± 300 B.P. (SOAN-1523) (Table 4.1). The reason for these discrepancies is not clear; the AMS sample was extremely well-preserved in terms of its original protein content (Table 4.2). Additional dates are necessary to confirm the ages of these sites. Finally, bone from Priiskovaia and Masterov Kliuch' component IV yielded AMS $^{14}C$ dates of 25,825 ± 290 (AA-8891) and 24,360 ± 270 B.P. (AA-8888). These are the first $^{14}C$ dates reported from these two sites, and should be considered provisional until supplemented by further dating.

### *Uranium-Series Dates*

Uranium-series dates presented in Table 4.3 were run on bone. Procedures for U-series dating bone can be found in Rae and Ivanovich (1986) and Bischoff et al. (1988), and are not detailed here. Testing the reliability of U-series bone dates is typically achieved by comparing $^{231}Pa/^{235}U$ and $^{230}Th/^{234}U$ ratios. If both ratios produce concordant age estimates, it is assumed that uranium uptake in the sample took place over a relatively short period, and that there has been no detectable migration of uranium or its daughter elements (thorium and protactinium) in or out of the bone since that time (Chen and Yuan 1988:62). This procedure was employed in analyzing a bone sample from Pehshcera Okladnikov level 7 (MB-5) (Table 4.3). This bone yielded concordant $^{230}Th$ and $^{231}Pa$ dates, suggesting that this sample accurately reflects the timing of uranium accumulation (i.e., 49,000-40,000 B.P.). However, it is unclear whether this date reflects the actual age of the bone, so it should be considered as an upper-limiting age.

A different procedure for calculating accuracy in U-series bone dating was developed by Rae and Ivanovich (1986) and Bischoff et al. (1988). In this procedure, two separate samples from the same bone are analyzed, a whole bone sample and an outer surface sample. It was found that when the outer surface of the bone is analyzed separately, resulting dates are typically closer to the true age of the sample than when the entire bone is analyzed (Rae and Ivanovich 1986). The U-series bone sample from Peshchera Okladnikov level 3 (sample Okl-2) was analyzed according to this method (Table 4.3). U-series dates based on $^{230}Th/^{234}U$ ratios were calculated on the entire bone and on surface only "scrapes." The resulting surface age (38,725 + 1,435 / - 1,419 B.P.) turned out to be much older than the bulk age (10,287 + 406 / - 404 B.P.), implying that the outer surface of the bone had not undergone secondary uranium depletion through leaching. This date, however, should not be treated as a definitive date for the level 3 Middle Paleolithic occupation; surface U-series determinations provide only minimum age estimates, as it is impossible to presume how soon after deposition uranium accumulation began (Bischoff et al. 1988:150).

Taken literally, then, the two U-series dates from Peshchera Okladnikov, 44,800 ± 4,400 B.P. for level 7 and 38,725 ± 1,400 B.P. for level 3, along with the complementary AMS $^{14}C$ dates from the cave, suggest that associated Middle Paleolithic occupations post-date 50,000 B.P. However, like the AMS $^{14}C$ dates, the U-series dates are better considered as minimal age estimates; the Middle Paleolithic at Peshchera Okladnikov could be much more ancient than the absolute dates suggest.

## A Tentative Middle Paleolithic Chronology

The brief survey of the available conventional and AMS $^{14}C$ dates for the Middle Paleolithic of Siberia presented above indicates that nearly every Middle Paleolithic occupation predates the range of $^{14}C$ dating. Radiocarbon dates obtained on bone from Strashnaia Peshchera, Denisova Peshchera, and Kara-Bom component I are infinite, and dates from Peshchera Okladnikov press the limit of AMS $^{14}C$ dating and should be interpreted as minimal age estimates. U-series dates as well should be treated as minimum dates, although at face value they suggest that the Middle Paleolithic occupation at Okladnikov dates from roughly 50,000 to 37,000 B.P. Clearly other absolute dating methods need to be applied to the Siberian Middle Paleolithic record. Without thermoluminescence dates on burnt flints or eolian sediments, or U-series dates on calcitic deposits, chronology-building must continue to rely almost exclusively on stratigraphic and other relative, contextual information. Nonetheless, the discussion below provides an up-to-date perspective on the chronological ordering of the Middle Paleolithic sites of south Siberia (Fig. 4.3). It relies heavily upon new contextual data (i.e., paleomagnetic and palynological records) from the entrance to Denisova Peshchera (Derevianko et al. 1992a, 1992b).

Sedimentological, palynological, and paleomagnetic evidence suggest that the lowermost Middle Paleolithic occupation at Denisova Peshchera Entrance (level 10) dates to the earliest Upper Pleistocene (oxygen-isotope stage 5). Level 10 is a brightly-colored clay deposit that sedimentologically is characteristic of extreme warm and wet conditions. The associated palynological spectrum is made up of warm-loving deciduous tree species (elm, walnut, oak, pistachio) that are today exotic to south Siberia. The last time that climatic conditions were warm enough to allow the expansion of these temperate species into the Altai was the Last Interglacial, 128,000-118,000 B.P. (oxygen-isotope substage 5e). Complementing this is paleomagnetic data indicating that level 10 was deposited during a period of reversed polarity, perhaps the Blake Reversal Episode, dated elsewhere to oxygen-isotope substage 5e (Valet and Meynadier 1993). Thus, by all indications the basal Middle Paleolithic occupation at Denisova Peshchera dates to the Last Interglacial (128,000-118,000 B.P.). If this is the case, then level 9, the overlying clayey loam, which contains a thin humic horizon indicating relatively warm and wet conditions, perhaps dates to a later interstade of the Early Glacial (i.e., the Bogdashin interstade) (substages 5d-5a), roughly 118,000-75,000 B.P. Accordingly, levels 8 and 7, which also contain Middle Paleolithic artifacts, may span the Early Pleniglacial (stage 4) and early Middle Pleniglacial (stage 3), 75,000-50,000 B.P.

The stratigraphic profile from the interior of Denisova Peshchera can be loosely fitted to this relative scheme as well (Fig. 3.14). Level 22, a brightly colored clay deposit lying on the cave floor, correlates to level 10 at the cave entrance, and is

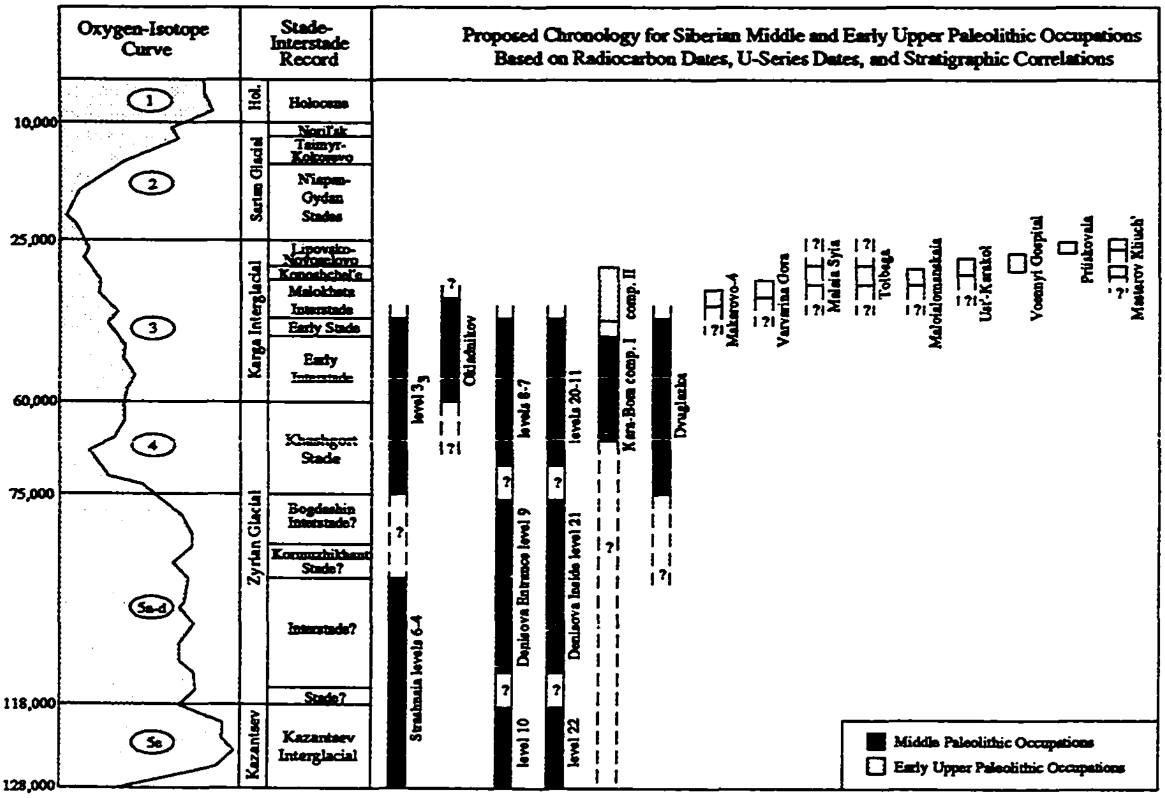


**Fig. 4.3.** A proposed chronology for Siberian Middle and early Upper Paleolithic sites. Question marks indicate uncertainties in dating. Proposed ages for the Middle Paleolithic occupations are based only on relative dates (i.e., sedimentology, palynology, paleomagnetism).

therefore assignable to the Last Interglacial (oxygen-isotope substage 5e). Likewise, level 21 can be correlated to level 9 at the cave entrance, and thus tentatively assigned to the Early Glacial (substages 5d-5a). Levels 20 through 11, however, are more difficult to correlate stratigraphically, but, like levels 8 and 7 at the cave entrance, they appear to span the Early Pleniglacial and early Middle Pleniglacial periods (75,000-50,000 B.P.).

This relative stratigraphic framework for Denisova Peshchera can be tentatively applied to other Middle Paleolithic cave sites in south Siberia. The Pleistocene stratigraphic profile at Strashnaia Peshchera, for example, shares the same basic features as seen at Denisova. The floor of the cave is covered by a series of brightly-colored clays (levels 6 and 4), conventionally $^{14}C$ dated to >40,000 B.P. These clays contain some Middle Paleolithic material. Overlying the clay of level 4 is a rocky loam deposit (level $3_3$) which also contains remnants of Middle Paleolithic occupation(s). Using the Denisova profile as a reference, levels 6-4 at Strashnaia can be tentatively assigned to the Last Interglacial-Early Glacial (128,000-75,000 B.P.), and the above-lying Middle Paleolithic occupation(s) of level 3 can be assigned to the Early Pleniglacial-early Middle Pleniglacial (75,000-40,000 B.P.). Thus, the Middle Paleolithic occupations at Strashnaia Peshchera may span oxygen-isotope stages 5 and 4, and the early part of stage 3.

Dvuglazka Grot, although not absolutely dated, may only date to the Early Pleniglacial or early Middle Pleniglacial. Based on sketchy comparisons with the representative profile from Denisova, the lowermost geologic unit at Dvuglazka Grot, a brightly colored clay band called level 7, likely was deposited during the Last Interglacial or Early Glacial. It does not contain Paleolithic materials. Middle Paleolithic artifacts, however, occur throughout the loam and clay loam deposits (levels 6 and 5) overlying the clay of level 7. Based on their stratigraphic positions above the clay assigned to the Last Interglacial-Early Glacial, the Middle Paleolithic occupation(s) of levels 6 and 5 can be attributed to the Early Pleniglacial-early Middle Pleniglacial period (stage 4 and early stage 3 [75,000-50,000 B.P.]). Abramova (1984:147), based on paleontological information from these levels, also assigns these levels at Dvuglazka to the early Middle Pleniglacial.

As discussed in the previous section the dating of the Middle Paleolithic occupations at Peshchera Okladnikov is so far inconclusive. AMS $^{14}C$ and U-series chronologies indicate a relatively late age spanning from around 50,000 B.P. to 37,000 B.P. The use of such dates as anything but minimal age estimates, however, is ill-advised, given the current range of $^{14}C$ dating and the problems presently associated with the U-series dating of bone. Other contextual evidence suggests a relatively late date for the Okladnikov occupations. Microfaunal studies by Ivleva (1990) indicate that forest-steppe, steppe, and desert species are common throughout the profile, while interglacial, forest species are absent. Similarly, pollen spectra from all levels lack the exotics noted in the basal clays at Denisova that have been assigned to the Last Interglacial. Instead, the pollen spectra reflect climatic conditions that were drier and slightly cooler than during the Last Interglacial, climatic conditions characteristic of the early Middle Pleniglacial (Volkova 1990). Thus, the Middle Paleolithic occupations at Peshchera Okladnikov likely are later than the Last Interglacial and Early Glacial (stage 5), and probably date to the early part of the Middle Pleniglacial (60,000-45,000 B.P.).

The open sites of the Middle Paleolithic are equally difficult to date. Tiumechin-1 and Tiumechin-2, of course, can not be absolutely or relatively dated, since they occur in a redeposited context. The Middle Paleolithic occupations at Kara-Bom (components Ia and Ib), on the other hand, occur in a clear stratigraphic context and can be relatively dated and potentially absolutely dated through TL or ESR methods. AMS $^{14}C$ dates on bone from component Ib, representing the upper Middle Paleolithic occupation, are infinite. This component is stratigraphically associated with a broad humic horizon (Fig. 3.20), which together with associated AMS dates on bone from within and above, suggests an age of greater than 45,000 B.P., and may date to the Early Interstade of the Middle Pleniglacial (60,000-50,000 B.P.). However, immediately above this lowest humic horizon is what appears to be a disconformity, suggesting a gap of some indeterminable length in the mid-Upper Pleistocene stratigraphic record. The humic horizon underlying this disconformity could actually date to an earlier interstade of the Early Glacial (i.e., the Bogdashin Interstade [85,000-75,000 B.P.]), or perhaps even to the Last Interglacial (128,000-118,000 B.P.). If this is the case, then the Middle Paleolithic record from Kara-Bom would be among the most ancient Middle Paleolithic occurrences in Siberia.

In sum, developing a site chronology for the Siberian Middle Paleolithic is at present hampered by a lack of well-dated stratigraphic profiles. Only the crudest chronometric distinctions can be made. Several occupations may date to the Last Interglacial or Early Glacial; these include the occupations marked by brightly colored clay horizons at Denisova Peshchera (levels 10 and 9 at the cave entrance and levels 22 and 21 in the cave interior) and Strashnaia Peshchera (levels 6 through 4). The remaining cave occupations, including level $3_3$ at Strashnaia Peshchera, all five levels at Peshchera

Okladnikov, levels 8 and 7 at the Denisova entrance, levels 20 through 11 in the Denisova Peshchera interior, and levels 6 and 5 at Dvuglazka Grot, likely date to the Early Pleniglacial or early Middle Pleniglacial (75,000-40,000 B.P.). Finally, other Middle Paleolithic sites, including Ust'-Kanskaia Peshchera, Tiumechin-1, Tiumechin-2, and Kurtak-Chanin-2, can not presently be dated. This chronology is extremely coarse, and will certainly be adjusted and refined as new profiles are described and interpreted, as new paleoecological information comes to light, and as new dates are obtained through non-radiocarbon absolute dating methods.

## A Provisional Early Upper Paleolithic Chronology

While the regional chronology for the Siberian early Upper Paleolithic rests on slightly firmer ground, the earliest Upper Paleolithic occupations have nevertheless been found to be too old for accurate dating through conventional or AMS $^{14}C$ techniques. Precise ages for these occupations are currently indeterminable.

Presently, the earliest dated Siberian Upper Paleolithic industry occurs at Kara-Bom. Basal Upper Paleolithic occupations (components IIa and IIb) lie stratigraphically above Middle Paleolithic occupations and are AMS $^{14}C$ dated to 43,200 ± 1,500 and 43,300 ± 1,600 B.P. (Goebel et al. 1993) (Fig. 3.20). Like many of the AMS dates obtained for the Siberian Middle Paleolithic, these dates press the limit of $^{14}C$ dating. They demonstrate, however, that the Upper Paleolithic appeared in Siberia prior to 40,000 B.P., at least 5,000 years earlier than previously thought (Goebel et al. 1993).

New AMS dates from Makarovo-4 and Varvarina Gora confirm this hypothesis. As at Kara-Bom, early Upper Paleolithic industries at these sites are more ancient than currently can be determined by $^{14}C$ dating. Makarovo-4 dates to greater than 39,000 B.P., while Varvarina Gora dates to more than 35,000 B.P. The infinite dates, however, do little to resolve the issues concerning the age of the early Upper Paleolithic occupation at Makarovo-4. The deflation that formed the lag deposit that contains the early Upper Paleolithic artifacts and dated bone samples could still be assigned to the Sartan Glacial, Konoshchel'e stade, or Zyrian Glacial. Technological and typological similarities with other early Upper Paleolithic industries, especially Kara-Bom component II (as demonstrated in Chapter 7), favor a Malokheta age for the cultural occupation, and therefore a Konoshchel'e or Sartan age for the deflation event, as suggested by Aksenov (1990:7). Resolution of this issue will require additional dating of the entire Makarovo-4 profile.

Varvarina Gora, located in the Transbaikal, occurs in a colluvial "train" deposit, and relative stratigraphic dating is impractical. AMS dates are infinite (>35,300, >34,050); other methods are needed in order to ascertain the precise age of the occupation. Although the pollen spectrum from the cultural stratum suggests relatively cool and mesic conditions, thought by Bazarov et al. (1982:89) to indicate a Konoshchel'e age (35,000-31,000 B.P.), associated fauna (Fig. 3.45) suggest the existence of a dry, interstadial forest-steppe (Ovodov 1987:137). Since the site lies in a colluvial context, the pollen could be redeposited, making the faunal assemblage a better indicator of climatic conditions during the mid-Upper Pleistocene. In all likelihood, the cultural occupation at Varvarina Gora, like that from Kara-Bom (component IIa and IIb) and Makarovo-4, dates to the Malokheta Interstade, currently assigned an age of roughly 43,000-35,000 B.P.

Other dated early Upper Paleolithic occupations in south Siberia appear to be slightly younger in age (Fig. 4.3), although for some of these occupations this could be an artifact of $^{14}C$ dating. The discordantly young AMS $^{14}C$ dates for Malaia Syia and Tolbaga are puzzling, but could be explained by a number of factors. Both sites appear to be large open settlements, and may have been repeatedly occupied throughout the Malokheta, Konoshchel'e, and Lipovsko-Novoselovo intervals, hence the dates spanning from 35,000 to 25,000 B.P. A more likely explanation, however, is that the conflicting dates are due to the use of bone, an inferior medium in conventional $^{14}C$ dating. Presently, these sites can not be assigned precise absolute ages, but the bone dates thus far obtained suggest ages within the range of 35,000-25,000 B.P.

In the Altai, early Upper Paleolithic occupations dating to between 35,000 and 30,000 B.P. occur at Kara-Bom (components IIc and IId), Ust'-Karakol, and Maloialomanskaia Peshchera. Dates from these occupations were run on wood charcoal; however, those from Ust'-Karakol and Maloialomanskaia Peshchera are conventional. As noted above, extremely large samples are needed to conventionally date charcoal of such an age, and pretreatment procedures do not always throroughly remove all potential contaminants. The slightest amount of modern carbon in a sample predating 30,000 B.P. can decrease the resulting age by thousands of years. Because of these problems, the charcoal dates from Ust'-Karakol and Maloialomanskaia Peshchera should be treated provisionally, until AMS procedures can be applied. Early Upper Paleolithic occupations at these sites may very well predate conventional ages of 34,000-30,000 B.P.

Several undated early Upper Paleolithic occupations, including Anui-1, Arembovskii, Sannyi Mys (level 7), and Sapun, are technologically and typologically similar to early

Upper Paleolithic sites known to predate 30,000 B.P. The cultural component at Arembovskii, furthermore, is stratigraphically associated with a distinct paleosol horizon, that, as suggested by Medvedev et al. (1990:68), is assignable to the mid-Middle Pleniglacial. Dates of 40,000-30,000 B.P. for these industries seem likely.

AMS $^{14}C$ dates from other south Siberian early Upper Paleolithic occupations, including Voennyi Gospital, Masterov Kliuch' (component IV) and Priiskovaia, indicate that these and other industries like them (i.e., Kunalei) post-date 30,000 B.P., and fall chronologically within the Lipovsko-Novoselovo Interstade, as previously suggested by Konstantinov and Konstantinov (1991:15). Early Upper Paleolithic components at Ineiskii Bor, Masterov Kliuch (component V), Masterov Gora (component III), and Sokhatino remain undated, and because the lithic assemblages are small, cannot be assessed typologically. Sosnovyi Bor (component VI), finally, is considered by Medvedev (1983:17) to be early Upper Pleistocene in age; however, the presence of microblades and articles suggestive of a wedge-shaped core technology indicate an age of less than 25,000 B.P.

Thus, the new site chronology for the Siberian mid-Upper Pleistocene (Fig. 4.3) illustrates that early Upper Paleolithic industries emerged in the region prior to 40,000 B.P. Earliest occupations occur in southwest Siberia at Kara-Bom (components IIa and IIb), and in southeast Siberia at Makarovo-4 and Varvarina Gora. The precise dating of these occupations, however, is at present unknown, due to shortcomings in the the present range of AMS $^{14}C$ dating. Other early Upper Paleolithic sites, including Ust'-Karakol, Malaia Syia, and Tolbaga, appear slightly younger in age; according to conventional and AMS $^{14}C$ dates these sites were occupied sometime after 35,000 B.P. Stratigraphically, the early Upper Paleolithic in south Siberia appears correlated to the Malokheta Interstade of the mid-Middle Pleniglacial (Fig. 4.3), a major warming event recorded in numerous south Siberian loess profiles by a broad paleosol horizon (i.e., the Lower Isitkim [Ob'], Lower Kurtak [Yenisei], and Lower Osin [Angara] soils) (Fig. 2.17). However, like many of the associated early Upper Paleolithic occupations, Malokheta paleosols have only been dated by conventional $^{14}C$ methods, and the ascribed dates may be too young.

## CONCLUSIONS

Of utmost importance in reconstructing the Siberian Middle to Upper Paleolithic transition, then, is the application of non-radiocarbon dating methods to Middle Paleolithic and early Upper Paleolithic occupations. Although the timing of the transition can not be determined precisely, we do know that it occurred quite early in the Middle Pleniglacial, as early as 45,000 B.P. in southwest Siberia, and as early as 40,000 B.P. in southeast Siberia. Stratigraphically, earliest Upper Paleolithic occupations appear to correlate with the relatively warm conditions of the Malokheta Interstade, but this correlation is based on questionable radiocarbon dates. The role of climate in the Middle to Upper Paleolithic transition, and the synchroneity of the transition throughout south Siberia are issues that must await additional research.

# CHAPTER 5

## Methods

The present study describes and analyzes lithic assemblages from Middle and early Upper Paleolithic sites in Siberia. Documenting these assemblages is valuable in itself, since the Mid-Upper Pleistocene is a poorly understood period in Siberian prehistory. However, the central question guiding this study is whether the Siberian archaeological record supports a continuity model or a replacement model for the Middle to Upper Paleolithic transition. This question is best addressed through a culture history approach, which focuses on identifying and relating prehistoric populations in time and space.

The historical nature of the problem guided the choice of archaeological data and methods used. Stone tools are an appropriate data set, not only because of their ubiquity and durability, but also because they provide technological and typological information useful for isolating prehistoric populations and assessing relationships among industries (Young and Bonnichsen 1984). Morphological attributes on artifacts can be measured and analyzed to reconstruct stone tool manufacturing systems, or *chaînes opératoires*, which trace the technical choices made by early humans during the manufacture, use, reuse, and eventual discard of stone tools (Bar-Yosef and Meignen 1992; Boëda et al. 1990; Turq 1992; Van Peer 1992).

Relationships among assemblages can be assessed through a study of variation in lithic manufacturing systems within and between the Middle Paleolithic and early Upper Paleolithic. Assessing assemblage relationships first requires an understanding of the underlying causes of variation. Other studies of lithic variability have revealed numerous sources of interassemblage differences, including cultural, functional, and situational factors (Beyries 1987; Dibble 1988; Kuhn 1992; Rolland and Dibble 1990; Sackett 1990). The goal of the present study is to identify the sources of variability between the Middle Paleolithic and early Upper Paleolithic of Siberia and to determine whether the nature and extent of differences indicate a single gradually evolving technical tradition or the appearance of a new technical tradition at the expense of a previously existing one.

To this end, a suite of technological and typological variables was chosen that would aid in understanding variability in lithic manufacturing systems. The present study analyzes three components of the tool manufacturing system: (1) primary reduction technology, (2) secondary reduction technology, and (3) the tool assemblage. Primary reduction technology involves the technical choices employed during the preliminary stages of tool manufacture, including the selection and procurement of a raw material, the preparation of a core, the removal of a blank (or end product) from that core, and the selection of a blank for use as a tool. Secondary reduction technology involves the systematic retouching of a blank to achieve a desired shape or form, as well as the reduction of a tool through repeated episodes of resharpening and recycling. The tool assemblage refers to the utilized end products, which are categorized according to specific morphological attributes produced during manufacture, retouch, and use.

Patterns of variation were revealed through statistical summaries as well as univariate and multivariate statistical comparisons. Finally, observed patterns are compared to a series of expectations concerning the origins of the Siberian Upper Paleolithic that are derived from the two competing models, spread-and-replacement and regional continuity.

Under the spread-and-replacement model, we would expect to see (1) extensive and significant differences between Middle Paleolithic and early Upper Paleolithic tool manufacturing systems and other expressions of behavior, (2) discontinuities in technology and typology and a lack of "intermediate" assemblages, and (3) abrupt stratigraphic succession of technocomplexes and a demonstrated spatial-temporal cline in the appearance of Upper Paleolithic industries. On the other hand, under the regional continuity model, we would expect to see (1) restrictive or subtle differences between Middle Paleolithic and early Upper Paleolithic tool manufacturing systems and other expressions of behavior, (2) a continuum of variability from one technocomplex to another and the presence of "intermediate" assemblages, and (3) gradual, protracted stratigraphic succession and a demonstrated temporal, non-spatial cline in the appearance of Upper Paleolithic industries.

Observational methods and statistical methods are presented below.

## Observational Methods

### *Assemblage Selection Criteria*

Prior to analysis, the Middle and early Upper Paleolithic sites described in Chapter 3 were evaluated according to two fundamental criteria: (1) integrity of site context, and

(2) integrity of sampling strategy employed during excavation. Only those sites occurring in clearly defined primary contexts were included in the analysis. Sites in secondary contexts or locations were excluded, including the assemblages from inside Denisova Peshchera, Anui-1, Tiumechin-1, Tiumechin-2, Ust'-Kova lower complex, Sapun, and Ust'-Menza-5. One assemblage, Ust'-Kanskaia Peshchera, was excluded due to poor excavation techniques and the probable mixing of separate cultural levels. In addition, some assemblages were unavailable for analysis. Those from Voennyi Gospital and Sannyi Mys component VII are lost. Kunalei and Priiskovoe are currently being excavated; in 1991 the assemblages from these sites were not fully cataloged. The Dvuglazka Grot and Kurtak assemblages are housed in St. Petersburg, where I was unable to visit, and the assemblages from Malaia Syia, Arta, and Sokhatino were not available for study because site reports were incomplete and unpublished.

Thus, the analysis presented here is based on 23 lithic assemblages from 15 Middle and early Upper Paleolithic sites. These include the Middle Paleolithic assemblages from Strashnaia Peshchera, Peshchera Okladnikov, the entrance to Denisova Peshchera, and Kara-Bom, and the early Upper Paleolithic assemblages from Ust'-Karakol, Kara-Bom, Maloialomanskaia Peshchera, Malaia-Syia, Sosnovyi Bor, Arembovskii, Ineiskii Bor, Makarovo-4, Varvarina Gora, Tolbaga, Masterov Gora, and Masterov Kliuch'. Observational methods were directed at reconstructing tool manufacturing systems, more specifically, the primary reduction technologies, secondary reduction technologies, and tools of each assemblage.

### *Primary Reduction Technology*

Characterization of primary reduction technology was accomplished through a study of cores and a suite of technological attributes identified on tools (retouched or utilized end products). Debitage was not analyzed due to inconsistencies in sampling and collecting. Even today few Siberian archaeologists use screens while excavating, and many debitage assemblages from earlier excavations have been misplaced, lost, or disposed of due to space considerations in museums.

Cores were scored on two technological attributes, (1) core type and (2) platform surface preparation. The core typology is based on the work of Markin (1986; Derevianko and Markin 1987, 1990b) and Medvedev et al. (1974). Detailed definitions are presented in Appendix 1.

Six attributes reflecting primary reduction technology were measured on tools:
(1) raw material;
(2) degree of dorsal cortex;
(3) platform surface preparation;
(4) platform exterior preparation;
(5) dorsal scar;
(6) blank.

Together with cores, the study of these technological attributes on tools permits an assessment of primary reduction technology—raw material procurement, core preparation, and blank manufacture and selection.

### *Secondary Reduction Technology*

Characterization of secondary reduction technology focused on the analysis of tool edges (after Barton 1988), which provide information about the technological methods employed to secondarily shape tools and the degree to which tools were resharpened and curated. These technological attributes include:
(1) retouch face;
(2) retouch style;
(3) invasiveness of retouch;
(4) intensity of retouch.
Definitions of the variables and their categories are given in Appendix 1.

### *Tools*

Tools were classified according to a standardized morphological typology modified after Markin (1986; Derevianko and Markin 1987, 1990b). This typology follows the Bordian method, although it is also hierarchical, allowing study at both the class and type levels. It is based strictly on morphological attributes; the use of functional names for classes and types (eg., scraper, graver) is incidental. Definitions of tool classes are provided in Appendix 1.

## Statistical Methods

Data were input, organized, and analyzed on a VAX mainframe computer using SPSS version 4.1. Basic descriptive statistics for each lithic assemblage were prepared through use of the SPSS program FREQUENCIES. Comparative statistical procedures were performed only on assemblages with $n \geq 40$. This subset comprised seven Middle Paleolithic assemblages, including Strashnaia Peshchera, Peshchera Okladnikov levels 7, 6, 3, 2, and 1, and Kara-Bom component I, and six Upper Paleolithic assemblages, including Ust'-Karakol, Kara-Bom component II, Arembovskii, Makarovo-4, Varvarina Gora, and Tolbaga. Assemblages were first compared *within* the Middle Paleolithic and early Upper Paleolithic, through both univariate and multivariate methods. Assemblage variation was then analyzed *between* the Middle Paleolithic and Upper Paleolithic, through univariate summaries of frequencies and a series of multivariate analyses.

### *Univariate Analyses*

To test for differences in type distributions among assemblages, individual nominal scale artifact variables were subjected to contingency table analysis. Variables analyzed with this method include several attributes of primary reduction technology (raw material, platform surface preparation, platform exterior preparation, dorsal scar, and tool blank), two attributes of secondary reduction technology (retouch face and retouch style), and tool class. Because of small sample size, tool classes were combined into major tool groups. Following Zar (1984:72) and Williams (1967), the log-likelihood ratio, denoted $G$, was used as the test statistic in place of the standard $X^2$.

To test for differences in means among assemblages, two measures of secondary reduction technology, retouch invasiveness and retouch intensity, were subjected separately to a one-way ANOVA on ranks (Conover and Iman 1981). The rank transformation procedure is a nonparametric method for interval scale variables with non-normal distributions. It is equivalent to the nonparametric Kruskal-Wallis H test, but it allows the application of a multiple comparisons procedure. Here the Tukey-"Honestly Significant Difference" (HSD) multiple comparisons procedure was employed to determine which pairs of assemblages differ significantly (Zar 1984).

**Table 5.1.** Artifact attributes and types included in multivariate analyses presented in Chapters 6, 7, and 8

| | Multivariate analyses | | |
|---|---|---|---|
| Artifact feature and type | Middle Paleolithic | Upper Paleolithic | Combined |
| *Surface platform preparation* | | | |
| Smooth | * | * | * |
| Dihedral | * | * | * |
| Faceted | * | * | * |
| *Exterior platform preparation* | | | |
| Absent | * | * | * |
| Trimming | * | * | * |
| *Dorsal scar pattern* | | | |
| Radial | * | | |
| Parallel/subparallel (combined) | * | * | * |
| Opposing parallel | | * | * |
| Irregular | * | * | * |
| *Tool blank* | | | |
| Blade | | * | * |
| Flake-blade | | * | * |
| Blade/flake-blade (combined) | * | | |
| Flake | * | * | * |
| Cortical spall | * | * | * |
| Levallois point | * | | * |
| Levallois flake | * | | |
| *Retouch face* | | | |
| Unifacial dorsal | * | * | * |
| Unifacial ventral | * | * | * |
| Alternating | * | * | * |
| Bimarginal/bifacial (combined) | | * | * |
| *Retouch style* | | | |
| Scalar | * | * | * |
| Nibbling | * | * | * |
| Large and small irregular (combined) | * | * | * |
| Notching | * | | * |
| *Tool class* | | | |
| Retouched blade | * | * | * |
| End scraper | | * | * |
| Side scraper | * | * | * |
| Notch | * | * | * |
| Denticulate | * | * | * |
| Knife | * | * | * |
| Wedge/cobble tool (combined) | | * | |
| Point | * | | * |
| Retouched flake | * | * | * |

## *Multivariate Analyses*

Exploratory multivariate analyses were conducted on (1) Middle Paleolithic assemblages, (2) Upper Paleolithic assemblages, and (3) Middle Paleolithic and Upper Paleolithic assemblages together. In the multivariate procedures, the objects analyzed were assemblages measured on several type frequency variables representing seven artifact attributes: (1) platform surface preparation, (2) platform exterior preparation, (3) dorsal scar, (4) tool blank, (5) retouch face, (6) retouch style, and (7) tool class. While the same artifact attributes were represented in each of the three series of analyses, types varied somewhat as shown in Table 5.1. Cores were excluded because they are absent from some assemblages, and infrequently occurring types were combined into "other" categories. For each analysis, the least represented type for each artifact attribute (usually the "other" category) was deleted to avoid redundancy of information.

Principal components analyses were performed using the SPSS FACTOR program to explore relationships between types and to explore the underlying dimensions of assemblage variability. For each analysis, assemblage scores on the first two principal components were retained and displayed in two-dimensional scatterplots.

Cluster analyses were performed to explore relationships between assemblages, using the SPSS CLUSTER program. The clustering method employed was average linkage, an agglomerative, hierarchical algorithm. The proximity measure employed was city-block (or Manhattan) distance (Kachigan 1982). Results of the cluster analyses are displayed in dendrograms.

A discriminant analysis was performed to find the variables that best separate the Middle Paleolithic and the Upper Paleolithic, and to assess the strength of the contrast. The discriminant analysis was conducted using the BMDP DISCRIM program. Predictor variables were entered into the analysis using a stepwise method in which variables were entered or removed to maximize the F value between the two groups. Default F-to-enter and F-to-remove values were used. Discriminant scores and classification information were printed for each assemblage.

# CHAPTER 6

## Middle Paleolithic Industries

This chapter describes and examines interassemblage variability for the Middle Paleolithic industries of Siberia. Detailed site-by-site assemblage descriptions review the primary reduction technology, secondary reduction technology, and tool assemblage of each industry. Interassemblage variability is explored through univariate and multivariate statistical analyses. Included in the interassemblage analysis are Strashnaia Peshchera (level 3), Peshchera Okladnikov (levels 1, 2, 3, 6, and 7), and Kara-Bom (component I). The assemblages from the entrance to Denisova Peshchera (levels 7, 8, 9, and 10) are described in detail but not statistically analyzed. Samples from levels 9 and 10 are too small and perhaps too ancient (they may date to the Last Interglacial [oxygen-isotope substage 5e, 128,000-118,000 B.P.]), and levels 7 and 8 appear mixed and contain elements of both Middle Paleolithic and later Upper Paleolithic assemblages. Brief descriptions of other Middle Paleolithic industries (Ust'-Kanskaia, inside Denisova Peshchera, Tiumechin-1, Tiumechin-2, Dvuglazka Grot, Kurtak-Chanin-2, Ust'-Kova [lower complex], and Ust'-Menza-5) can be found in Chapter 3. These assemblages were not analyzed because of contextual problems or small sample sizes. The latter two sites, Ust'-Kova lower complex and Ust'-Menza-5, do not appear to contain Middle Paleolithic industries, despite claims by excavators. Methods of analysis are described in detail in Chapter 4, and definitions of variables and values are presented in Appendix 1. Following presentation of results, industrial facies of the Mousterian are defined and explored.

### THE LITHIC INDUSTRIES

#### Strashnaia Peshchera

Recent work at the Strashnaia Peshchera by Derevianko et al. (1990b) demonstrates that Middle Paleolithic artifacts occur almost exclusively in Level $3_3$, as originally indicated by Okladnikov et al. (1973). Included in the present analysis are 30 artifacts

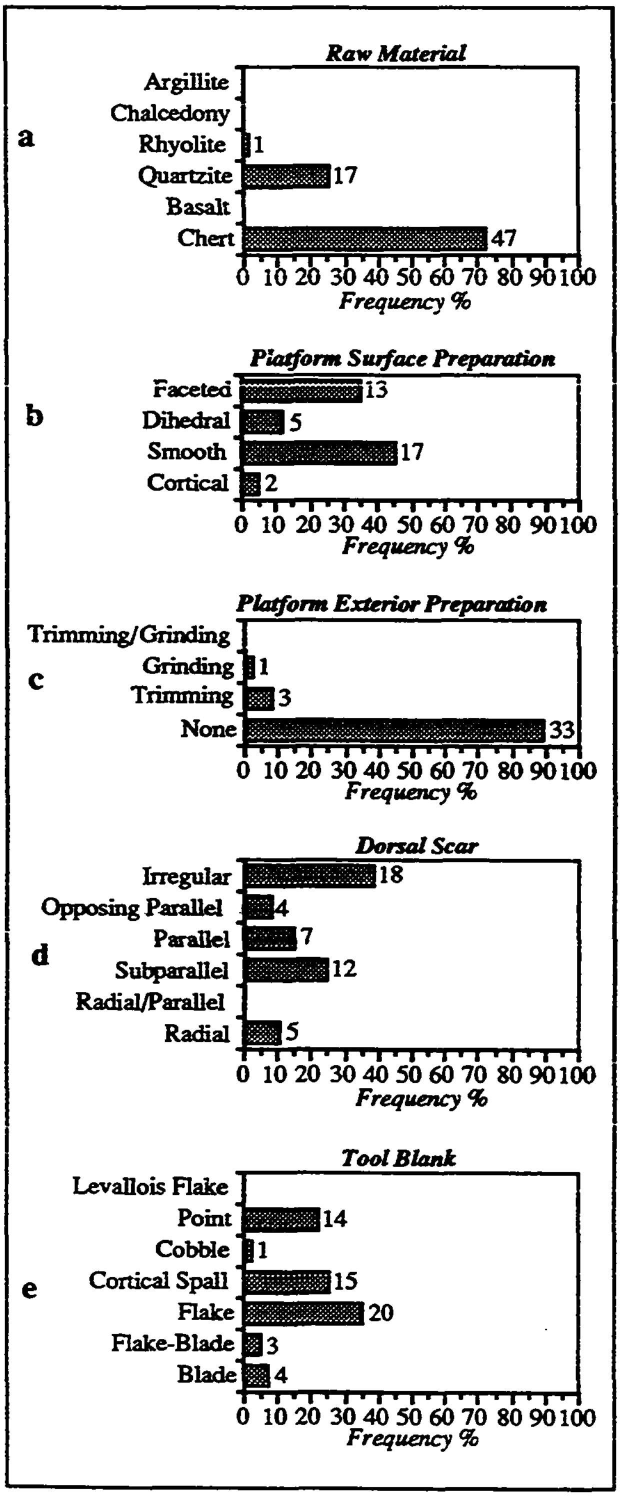


**Fig. 6.1.** Strashnaia Peshchera: attributes of primary reduction technology.

from Okladnikov's excavations in 1970, and 35 artifacts from Derevianko's excavations in 1988-1990. This assemblage consists of 58 tools and seven cores.

*Primary Reduction Technology.* Raw materials include chert, quartzite, and rhyolite (Fig. 6.1:a). Cherts are most frequently dark gray (85%), although green, maroon, and tan varieties also occur infrequently. Nearly 25% of all tools have cortex on their dorsal surfaces; 12% are more than half covered with cortex. There are four core preforms (Table 6.1). Three display radial flake scars; one has a faceted platform. Finished cores include two Levallois flake cores prepared radially with faceted platforms, and one bidirectional flake core with two opposing platforms. Platforms on blanks are frequently faceted or dihedral (Fig. 6.1:b), producing a faceting index of 48.6. Platform exterior preparation is rare (Fig. 6.1:c). Few blanks show radial scar patterns; parallel, subparallel, or opposing parallel scars are more common (Fig. 6.1:d). Tool blanks are predominantly

**Table 6.1.** Strashnaia Peshchera: Core Types

| Core type | n | % |
|---|---|---|
| Unidirectional monofrontal flake | 1 | 14.3 |
| Levallois flake | 2 | 28.6 |
| Radial core preform | 4 | 57.1 |
| Total | 7 | |

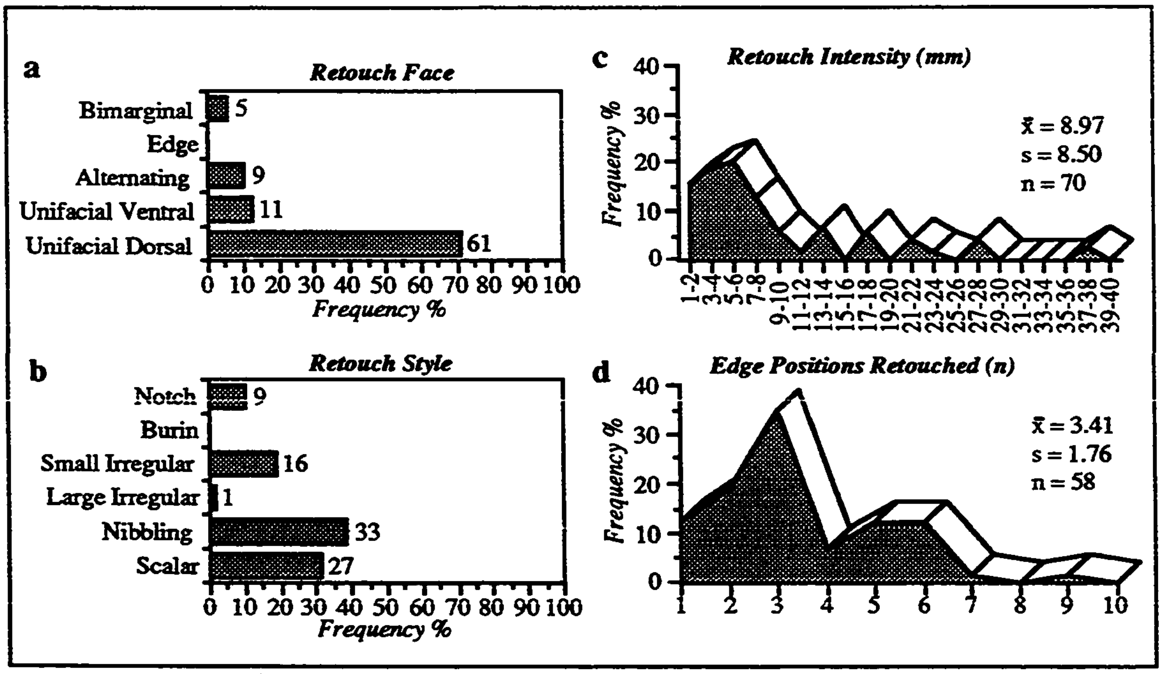


**Fig. 6.2.** Strashnaia Peshchera: attributes of secondary reduction technology.

flakes, cortical spalls, and Levallois points (Fig. 6.1:e). Blades and flake-blades are rarely utilized, and no tools appear to be made on Levallois flakes.

*Secondary Reduction Technology.* Most tools in this industry are retouched unifacially and dorsally (Fig. 6.2:a). Bifacial retouch is absent, but two tools are bimarginally worked (a cortically backed knife and an angle scraper). Alternating retouch is also rare, and is most frequently seen on points, knives (Fig. 6.3:b,h,i), and retouched blades (Fig. 6.3:j). Among retouch styles, nibbling and small irregular retouch clearly occur most frequently (Fig. 6.2:b). Retouch invasiveness is moderate, with nearly 80% of all retouched edges displaying flake scars less than 10 mm deep (Fig. 6.2:c). Retouch intensity is low; only 35% of all tools have four or more retouched edge positions (Fig. 6.2:d).

*Tool Assemblage.* The tool assemblage consists of Levallois points, side scrapers, notches, retouched blades and flakes, knives, and denticulates (Fig. 6.3, Table 6.2). Most points are fragmentary and represented by basal sections (Fig. 6.4:f), although a few are complete (Fig. 6.5:k). Side scrapers are usually worked along only one edge, with single straight and single convex types being most common (Fig. 6.4:d, e, g). Three angle scrapers (Fig. 6.5:e) and one transverse scraper also occur. A single end scraper, wedge, and graver were found near the top of level 3. The graver is made on a small flake of tan chert, a raw material otherwise not noted in the assemblage. According to Derevianko et al. (1990b:123), these three tools may represent a later occupation of the cave.

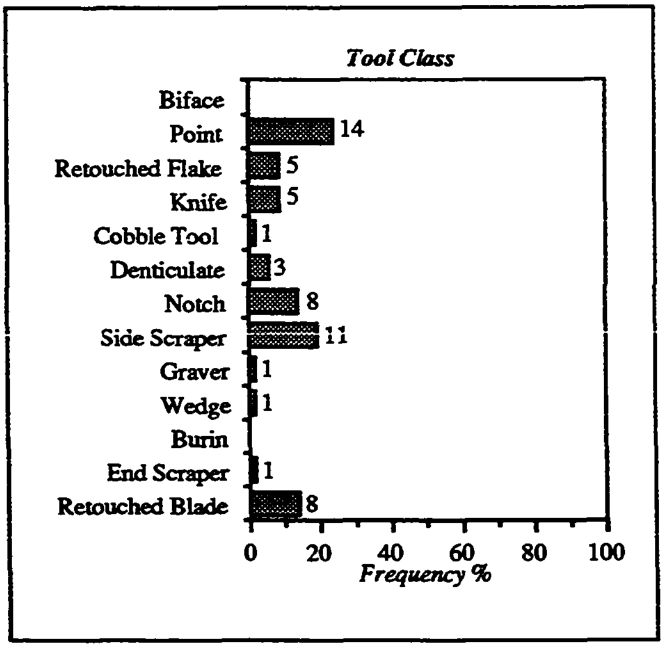


**Fig. 6.3. Strashnaia Peshchera: tool class.**

**Table 6.2. Strashnaia Peshchera: Tool Types**

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 2 | 3.4 | Multiple notch | 2 | 3.4 |
| Bilaterally retouched blade | 2 | 3.4 | Single concave denticulate | 1 | 1.7 |
| Unilaterally retouched flake-blade | 2 | 3.4 | Single straight ventral denticulate | 1 | 1.7 |
| Bilaterally retouched flake-blade | 2 | 3.4 | Transverse denticulate | 1 | 1.7 |
| End scraper on flake | 1 | 1.7 | Chopping tool | 1 | 1.7 |
| Wedge | 1 | 1.7 | Naturally backed knife | 2 | 3.4 |
| Single graver | 1 | 1.7 | Smooth-backed knife | 3 | 5.2 |
| Single straight side scraper | 3 | 5.2 | Retouched flake | 4 | 6.9 |
| Single convex side scraper | 4 | 6.9 | Retouched ventral flake | 1 | 1.7 |
| Straight transverse ventral scraper | 1 | 1.7 | Levallois point fragment | 6 | 10.3 |
| Angle scraper | 2 | 3.4 | Levallois point | 5 | 8.6 |
| Angle alternate scraper | 1 | 1.7 | Atypical Levallois point | 3 | 5.2 |
| Single notch | 6 | 10.3 | | | |
| | | | Total | 58 | |

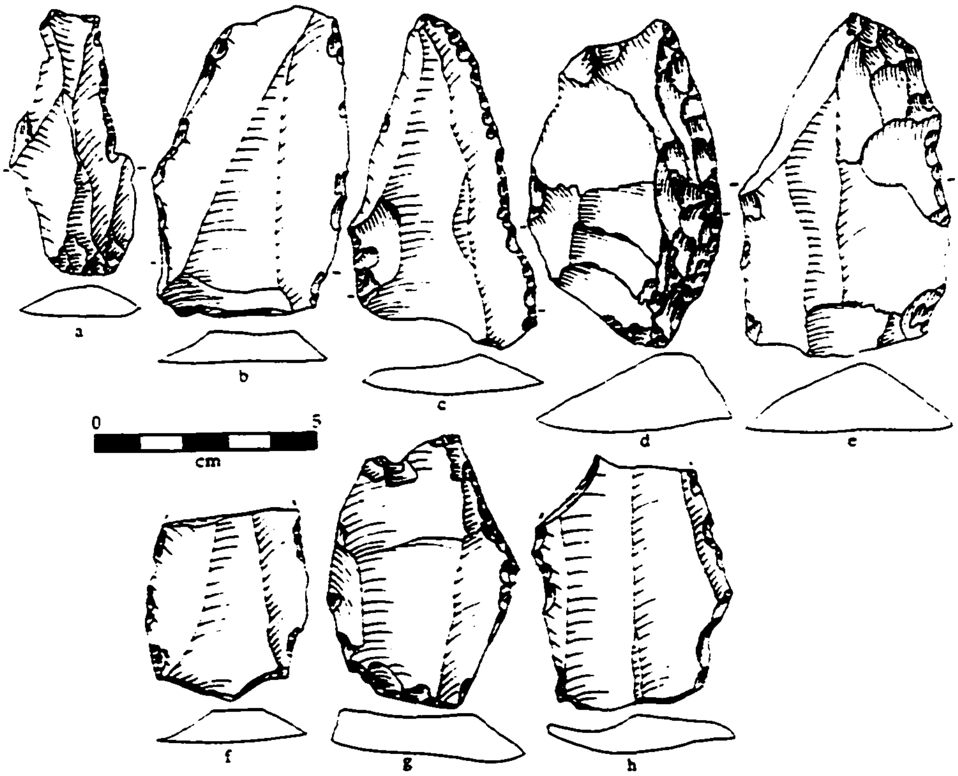


**Fig. 6.4.** Lithic artifacts from Strashnaia Peshchera: unilaterally retouched flake-blade (a); atypical Levallois point (b); Levallois points and point fragments (c, f, h); single convex side scrapers (d, e, g).

This lithic industry, then, is Levallois and Mousterian. Primary reduction technology is characterized by Levallois cores and end products as well as by faceted platforms. Although no point cores were identified in the assemblage, the propensity of parallel, subparallel, and opposing parallel dorsal scars and the relatively high number of point blanks (as well as blade and flake-blade blanks) in the assemblage indicate this Levallois technology was directed toward the production of points for use as tools. Secondary reduction technology is predominantly unifacial; retouch intensity is weak, and nibbling and small irregular retouch styles are common. The tool assemblage is distinctively Mousterian, with high frequencies of points and side scrapers, and moderate frequencies of notches, denticulates, and knives.

## Peshchera Okladnikov Level 7

The lithic assemblage from Level 7 at Peshchera Okladnikov originated from cave sediments in the grotto and galleries 1, 2, and 3. The assemblage

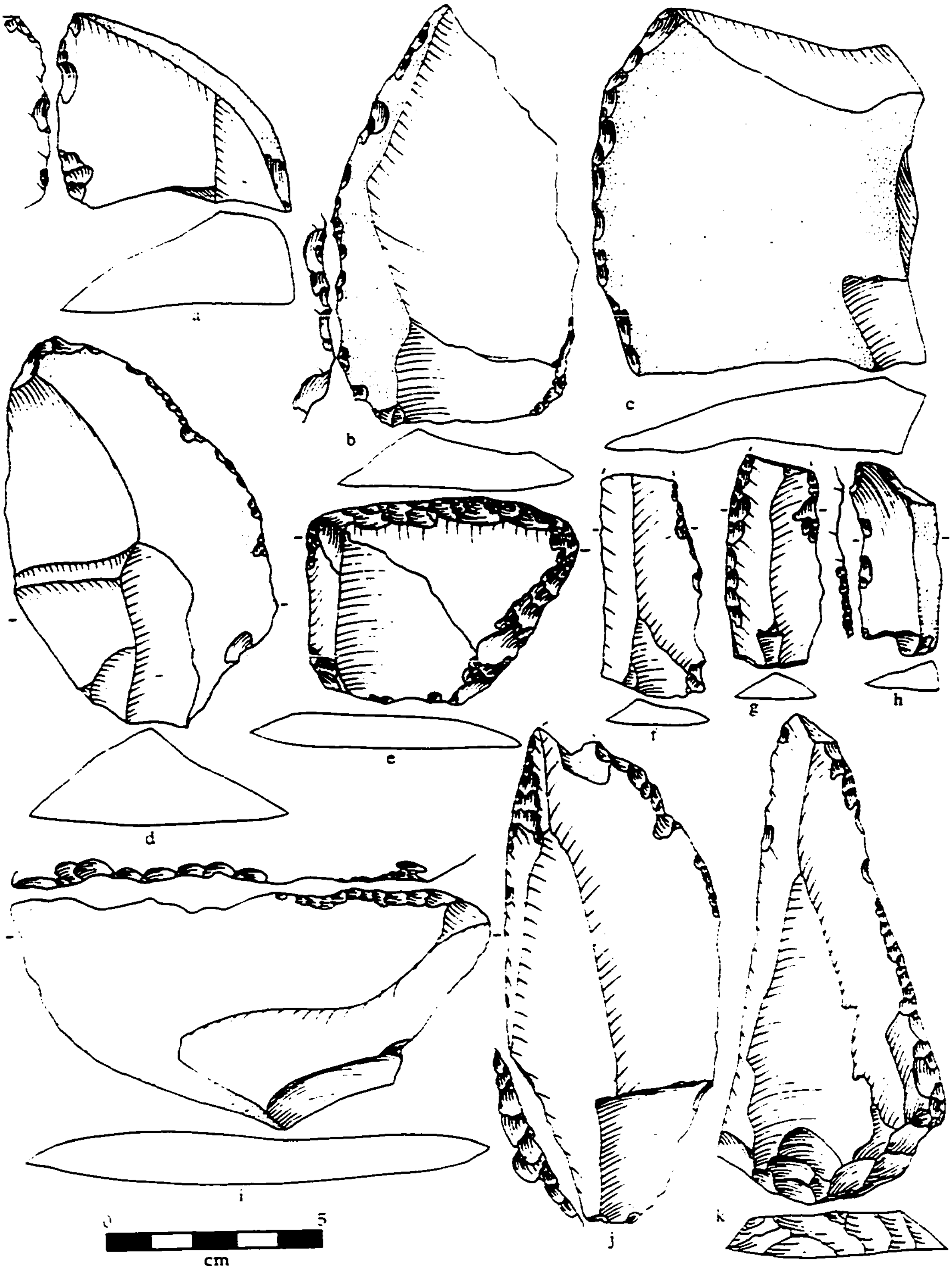


**Fig. 6.5.** Lithic artifacts from Strashnaia Peshchera: smooth-backed knives (a, c, i); possible atypical Levallois point (b); retouched flake (d); angle scraper (e); unilaterally retouched flake-blade (f); bilaterally retouched blade (g); cortically backed knife (h); bilaterally retouched flake-blade (j); Levallois point (k).

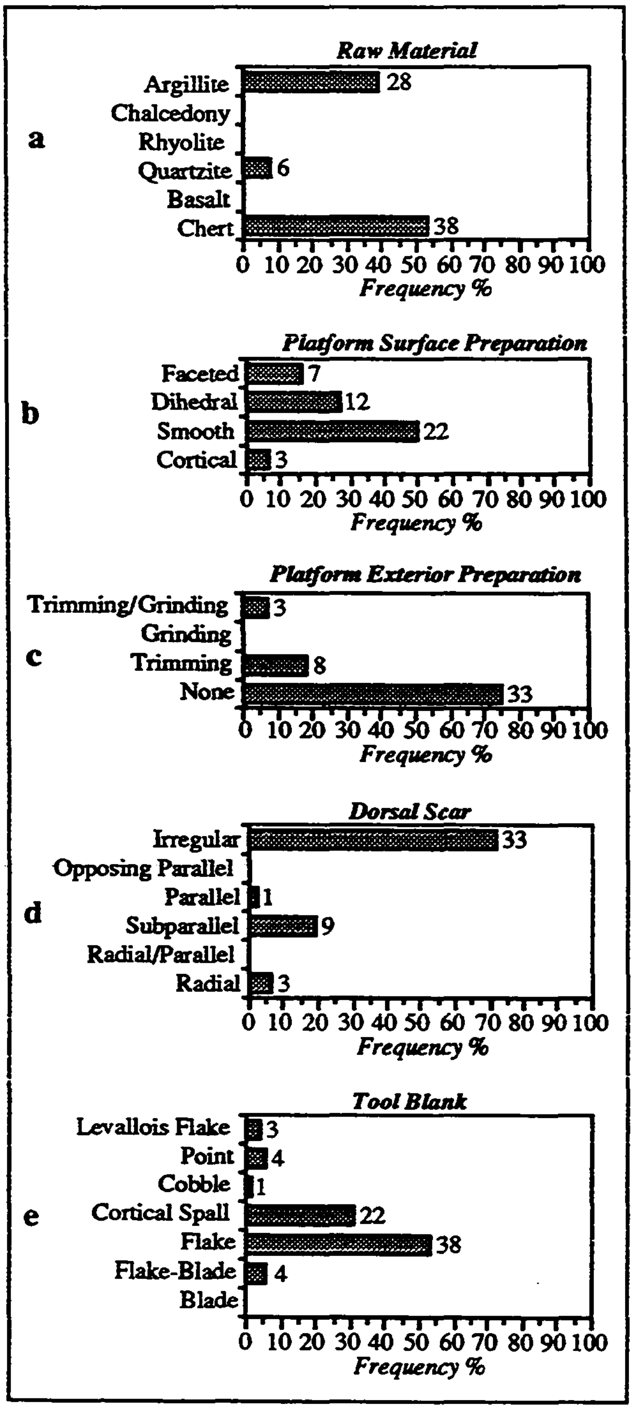


**Fig. 6.6.** Peshchera Okladnikov Level 7: attributes of primary reduction technology.

studied here includes 72 tools and no cores.

*Primary Reduction Technology.* Raw materials include four varieties of chert (dark gray, gray, reddish brown, tan) and two varieties of argillite (or silicified claystone [Vrublevskii 1990]) (dark gray, gray) (Fig. 6.6:a). Among blanks, 36% have cortex on their dorsal surfaces, and 13% have cortex on more than half their dorsal surfaces. Platform surface preparation is predominantly smooth (Fig. 6.6:b); however, faceted and dihedral platforms are also present, giving a high faceting index of 43.2. Few platforms are prepared exteriorly (Fig. 6.6:c). Irregular dorsal scarring is prevalent, while subparallel and radial patterns occur infrequently (Fig. 6.6:d). Over half the tools are manufactured on flakes, and only 10% are manufactured on Levallois end products (points and flakes) (Fig. 6.6:e).

*Secondary Reduction Technology.* Nearly all edges are retouched unifacially and dorsally (Fig. 6.7:a). Nibbling and small irregular retouch occur most frequently, at the expense of more intensive scalar retouch (Fig. 6.7:b). Retouch invasiveness is low, with 68% of all edges bearing retouch scars less than 6 mm deep (Fig. 6.7:c). Likewise, retouch

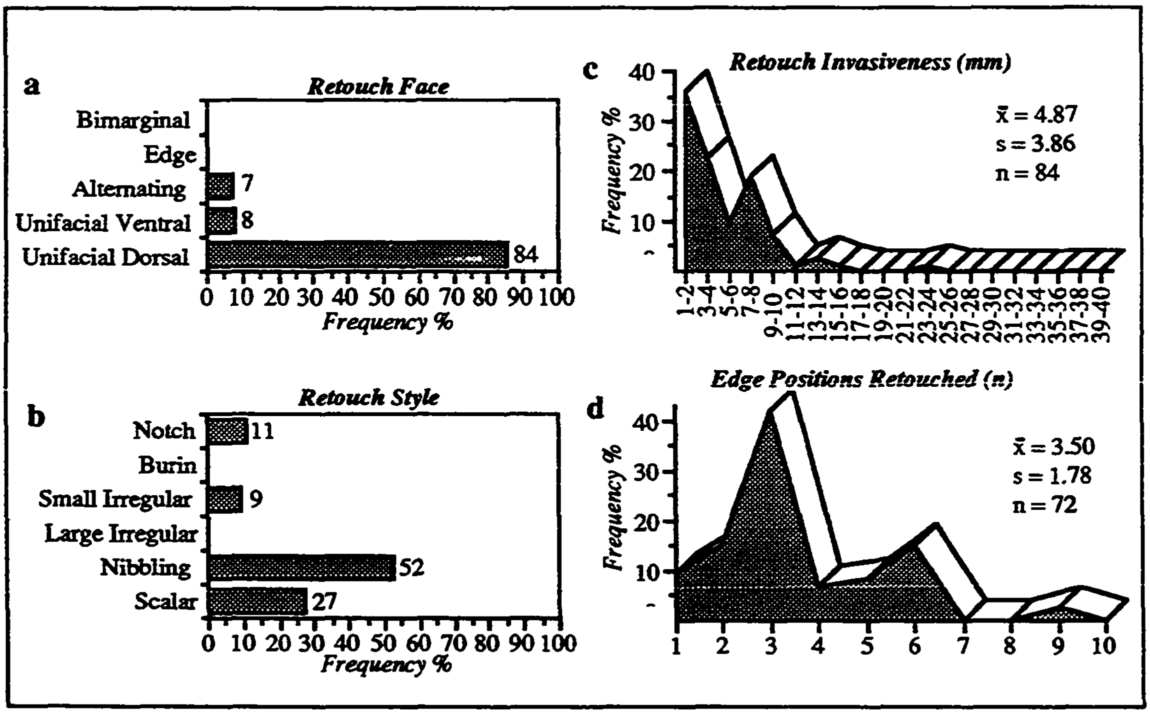


**Fig. 6.7.** Peshchera Okladnikov Level 7: attributes of secondary reduction technology.

intensity is low; among tools, 67% bear three or fewer retouched edge positions (Fig. 6.7:d).

*Tool Assemblage.* The tool assemblage consists primarily of retouched flakes, side scrapers, denticulates, notches, and Levallois points (Fig. 6.8). Side scrapers as a group are intensively retouched; transverse, convergent, and angle forms dominate the assemblage (Table 6.3) (Fig. 6.9:h, j-k, o, q-s). Levallois points include three complete, one fragmented, and one atypical specimen (Fig. 6.9:a, f-g, m). Both knives are cortically backed (Fig. 6.9:n).

The Peshchera Okladnikov level 7 industry can be broadly characterized as Levallois and Mousterian. Its primary reduction technology is flake-based; some flakes were manufactured using Levallois techniques. These bear radial dorsal scar patterns and faceted or dihedral platforms. In addition, several tools are manufactured on Levallois point blanks. Secondary reduction technology is almost exclusively unifacial. Tool edges are for the most retouched marginally, except for side scrapers which show more invasive and intensive retouch. The tool assemblage is essentially Mousterian, with high frequencies of side scrapers and retouched flakes, and moderate frequencies of notches, denticulates, and points.

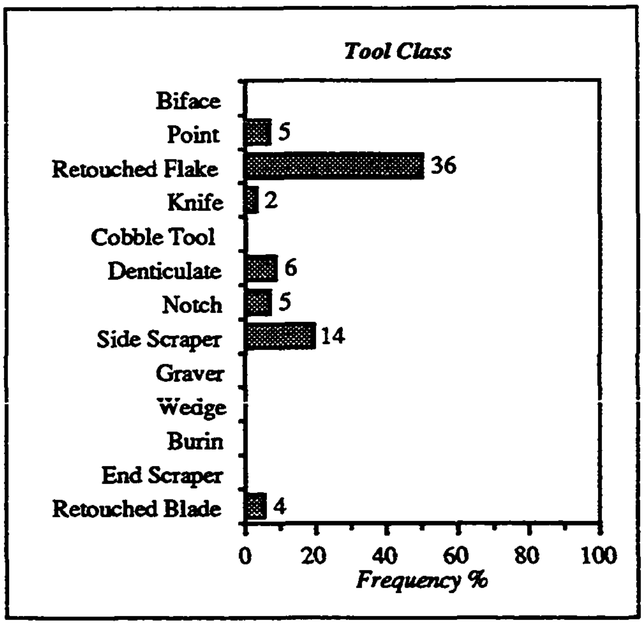


**Fig. 6.8.** Peshchera Okladnikov level 7: tool class.

**Table 6.3.** Peshchera Okladnikov Level 7: Tool Types

| Tool Type | n | % | Tool Type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched flake-blade | 1 | 1.4 | Double straight denticulate | 1 | 1.4 |
| Unilaterally retouched ven. flake-blade | 1 | 1.4 | Straight-convex denticulate | 1 | 1.4 |
| Bilaterally retouched flake-blade | 2 | 2.8 | Double straight alternate denticulate | 1 | 1.4 |
| Single straight side scraper | 1 | 1.4 | Naturally backed knife | 2 | 2.8 |
| Single convex side scraper | 1 | 1.4 | Retouched flake fragment | 1 | 1.4 |
| Straight transverse scraper | 1 | 1.4 | Retouched flake | 25 | 34.7 |
| Convex transverse scraper | 4 | 5.6 | Retouched ventral flake | 2 | 2.8 |
| Convergent side scraper | 3 | 4.2 | Retouched flake alternate | 5 | 6.9 |
| Angle scraper | 4 | 5.6 | Utilized flake | 3 | 4.2 |
| Single notch | 4 | 5.6 | Levallois point fragment | 1 | 1.4 |
| Multiple notch | 1 | 1.4 | Levallois point | 3 | 4.2 |
| Single straight dentifulate | 3 | 4.2 | Atypical Levallois point | 1 | 1.4 |
| | | | Total | 72 | |

## Peshchera Okladnikov Level 6

The lithic assemblage presented here includes 40 tools and no cores recovered by Derevianko et al. (1987k; Derevianko and Markin 1990b) in the cave's grotto.

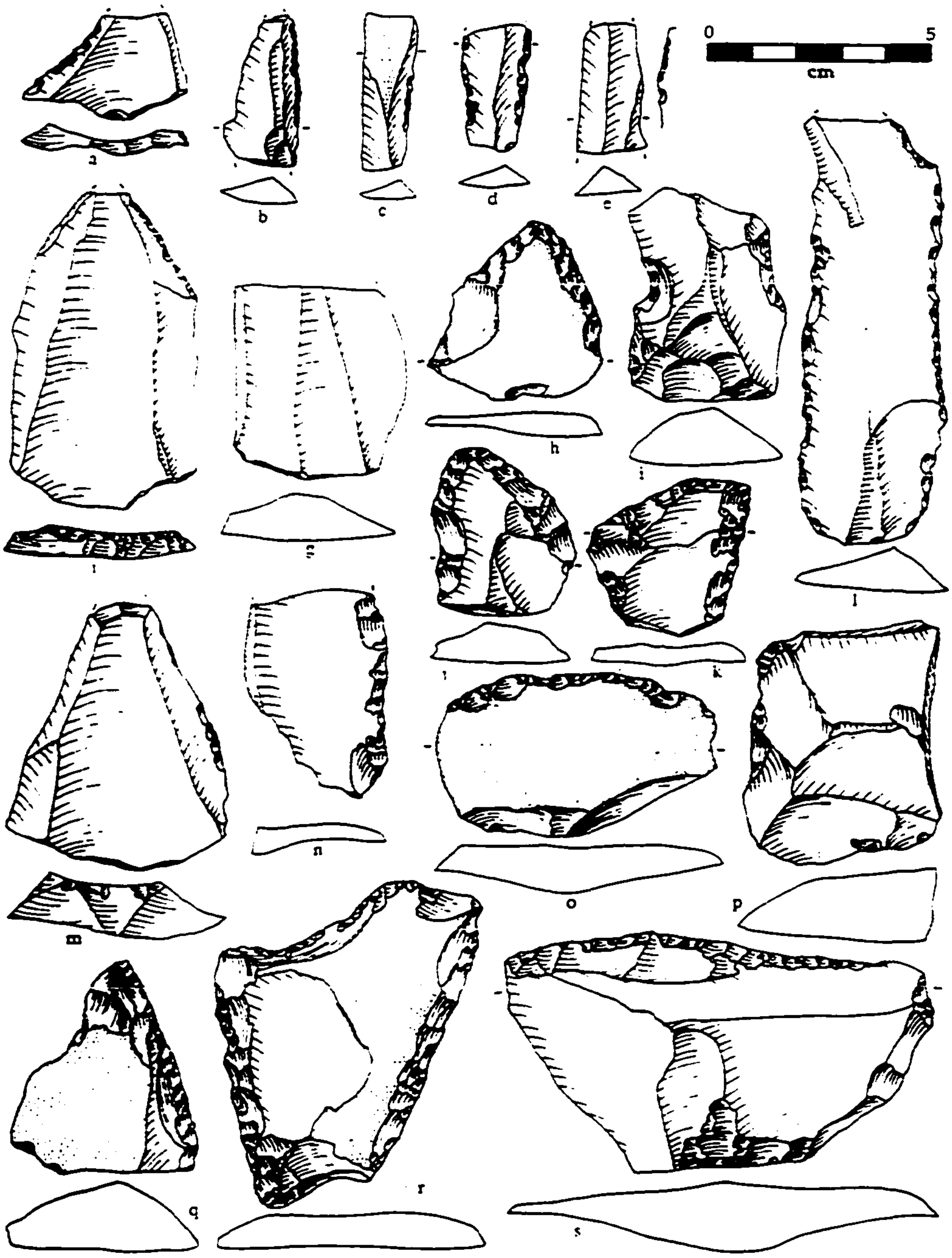


**Fig. 6.9.** Lithic artifacts from Peshchera Okladnikov level 7: atypical Levallois point (a); unilaterally retouched flake-blade (b); utilized flake (c); bilaterally retouched flake-blade (d); unilaterally retouched ventral flake-blade (e); Levallois points and point fragments (f, g, m); convergent scrapers (h, q); notch (i); angle scrapers (j, k, r); double straight denticulate (l); cortically backed knife (n); convex transverse scraper (o); single straight side scraper (p); straight transverse scraper (s).

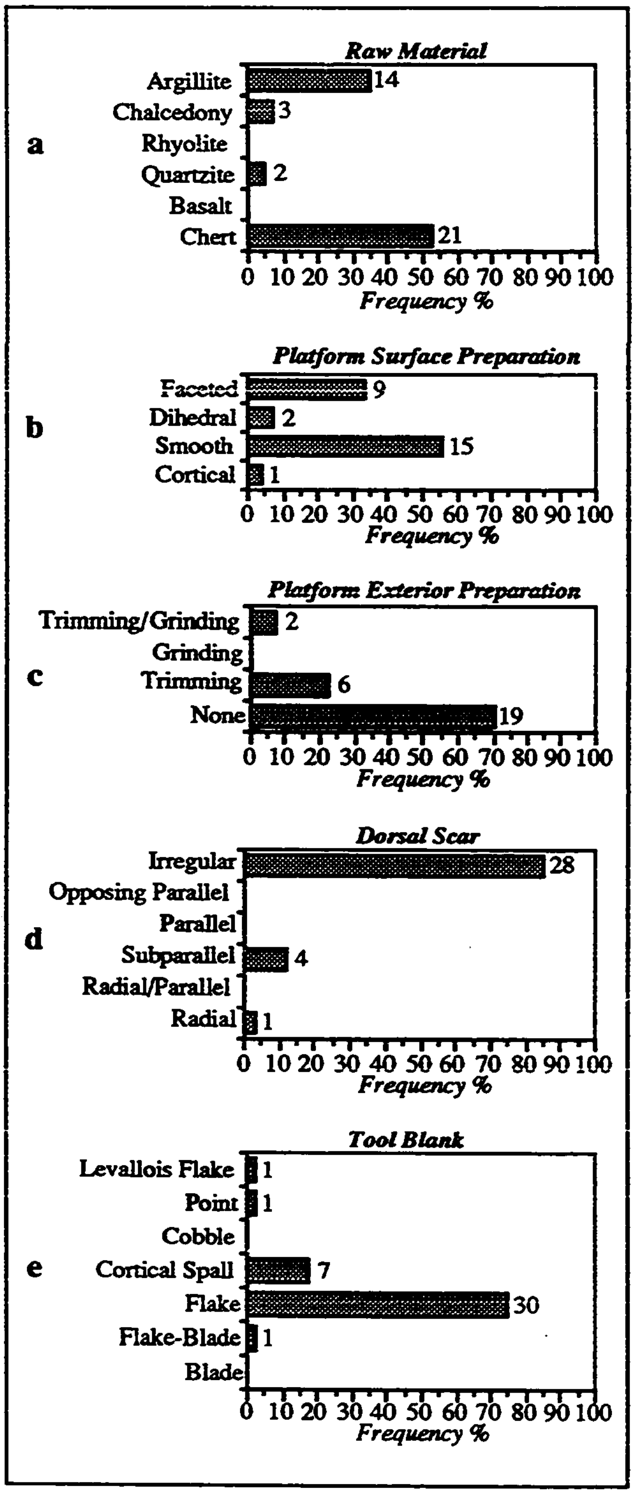


**Fig. 6.10.** Peshchera Okladnikov level 6: attributes of primary reduction technology.

*Primary Reduction Technology.* Most (87.5%) artifacts are manufactured on either chert or argillite (Fig. 6.10:a). Cherts are dark gray, gray, or reddish brown, and argillites are dark gray or gray. Only 15% of the blanks studied bear cortex on their dorsal surfaces, and only 2.5% bear cortex on more than half their dorsal surfaces. The majority of platforms are smooth, although faceted and dihedral platforms are also common (faceting index = 40.7) (Fig. 6.10:b). Interestingly, nearly one-third of the blanks studied bear some exterior platform preparation (either trimming or trimming and grinding) (Fig. 6.10:c). Dorsal scar patterns are almost exclusively irregular, while subparallel and radial patterns occur infrequently (Fig. 6.10:d). Most tools are manufactured on flakes or cortical spalls (Fig. 6.10:e). Levallois end products are uncommon as tool blanks.

*Secondary Reduction Technology.* Nearly all tools are retouched unifacially, usually on the dorsal face (Fig. 6.11:a), while ventral and alternating retouch is rare. Nibbling and small irregular retouch occur on a slight majority of edges (Fig. 6.11:b), while a little over a third display scalar retouch. Retouch invasiveness is low; 70% of all edges bear retouch scars less than or

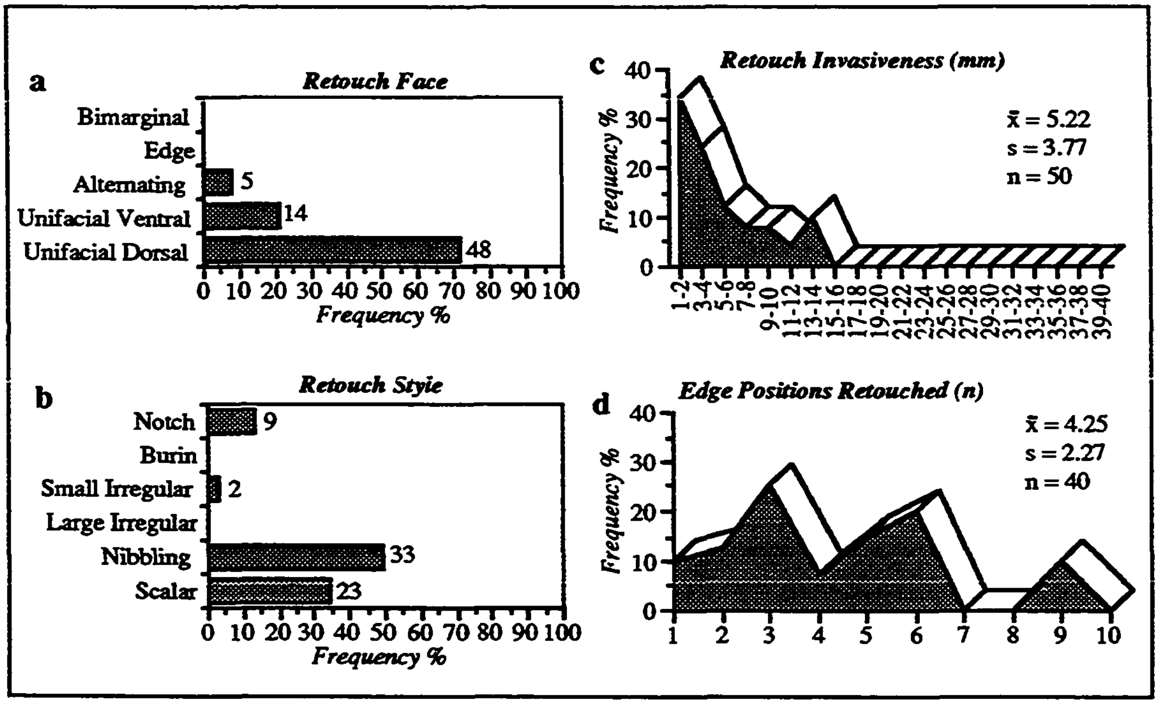


**Fig. 6.11. Peshchera Okladnikov level 6: attributes of secondary reduction technology.**

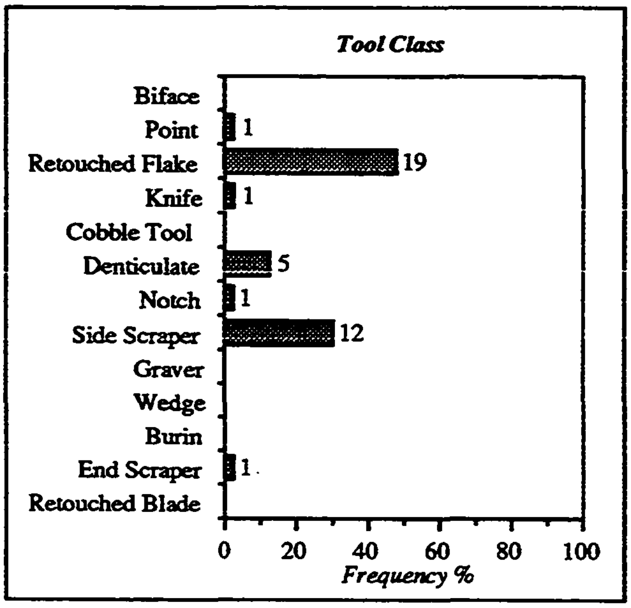


**Fig. 6.12. Peshchera Okladnikov level 6: tool class.**

equal to 6 mm deep (Fig. 6.11:c). This is interesting considering the number of edge positions retouched (Fig. 6.11:d). Retouch intensity is high, with only 48% of all tools bearing three or fewer retouched positions. Thus, numerous tool edges were retouched, but only marginally. Only side scrapers are repeatedly invasively retouched.

*Tool Assemblage.* The tool assemblage is rich in retouched flakes and side scrapers (Fig. 6.12). Denticulates are uncommon, and notches, end scrapers, knives, and Levallois points are rare. Seven of 12 side scrapers are worked along more than one edge (Table 6.4); these include one double straight, one straight-convex, one convergent, and four angle scrapers (Fig. 6.13:c-e, k-l). These multiply-edged side scrapers are unusually small in size, indicating prolonged use and resharpening. The one end scraper bears retouch along its distal end and one side. The Levallois point is long and thin with traces of small irregular retouch along one dorsal margin (Fig. 6.13:j).

To sum up, the primary reduction technology of this industry is based on the production of flakes for use as tools. Levallois techniques were occasionally employed to produce flakes and points. In such cases platforms were frequently faceted and trimmed or ground. Secondary reduction technology is exclusively unifacial. Only side scrapers were intensively resharpened, while numerous small, unmodified flakes were utilized and resharpened along multiple edges, albeit marginally. The tool assemblage, which includes side scrapers, retouched flakes, denticulates, a knife, point, and end scraper, is decidely Mousterian.

## Peshchera Okladnikov Level 3

In the present study, a sample of 166 tools and four cores from Peshchera Okladnikov level 3 was analyzed. The majority were recovered from the rock shelter of the cave prior to 1985, although some were found in later years in the grotto and in galleries 1, 2, and 3 (Derevianko and Markin 1990b:85).

*Primary Reduction Technology.* Raw materials are predominantly cherts and argillites (Fig. 6.14:a). Five varieties of chert occur, with gray, dark gray, and reddish-brown cherts predominating. Argillites are gray and dark gray. Among blanks, 29% display cortex on their dorsal surfaces, and 12% display cortex on more than half their dorsal surfaces (Fig. 6.14:b). Of the four cores (Table 6.5), two are flake cores (one with two platforms and one front, the other with two platforms and three fronts), one is a bidirectional Levallois point core (Fig. 6.17:e), and one is a Levallois flake core (Fig.

**Table 6.4.** Peshchera Okladnikov Level 6: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| End/side scraper | 1 | 2.5 | Single concave denticulate | 1 | 2.5 |
| Side scraper fragment | 1 | 2.5 | Single straight ventral denticulate | 1 | 2.5 |
| Single straight side scraper | 3 | 7.5 | Three-sided alternate denticulate | 1 | 2.5 |
| Double straight side scraper | 1 | 2.5 | Smooth-backed knife | 1 | 2.5 |
| Single convex side scraper | 1 | 2.5 | Retouched flake fragment | 1 | 2.5 |
| Straight-convex side scraper | 1 | 2.5 | Retouched flake | 9 | 22.5 |
| Convergent scraper | 1 | 2.5 | Retouched ventral flake | 5 | 12.5 |
| Angle scraper | 4 | 10.0 | Retouched alternate flake | 3 | 7.5 |
| Single notch | 1 | 2.5 | Utilized flake | 1 | 2.5 |
| Single convex denticulate | 2 | 5.0 | Levallois point | 1 | 2.5 |
| | | | Total | 40 | |

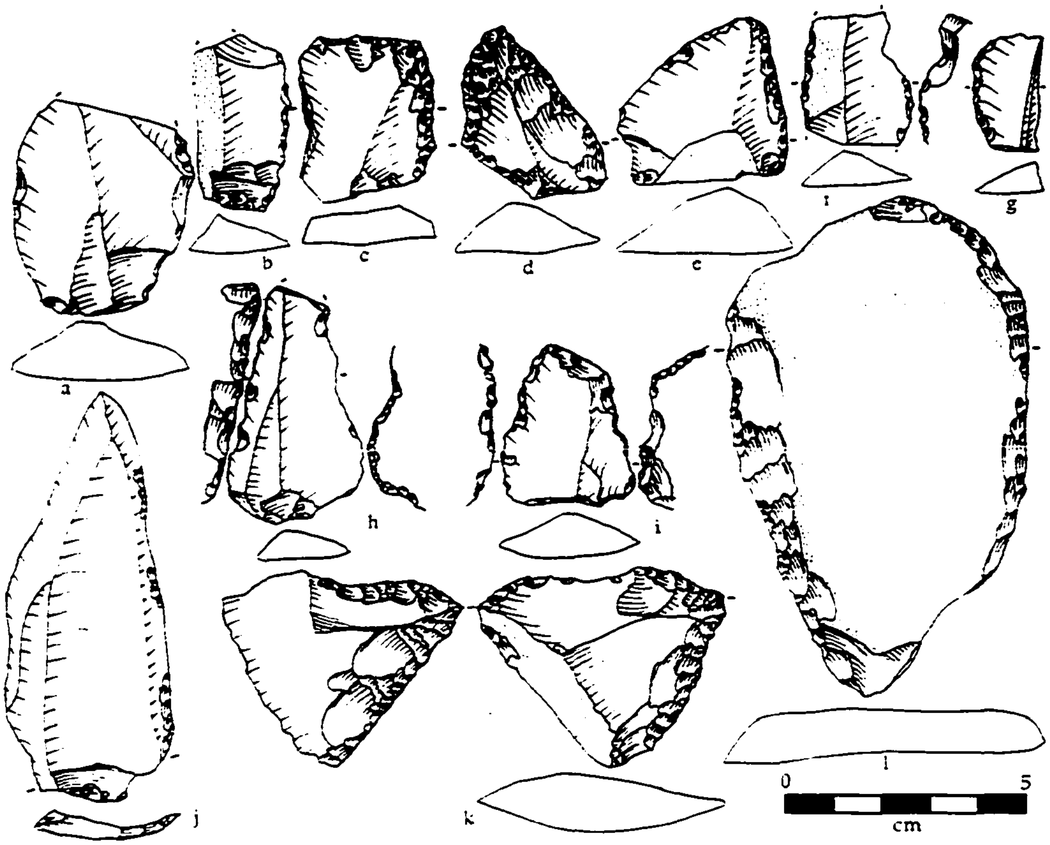


**Fig. 6.13.** Lithic artifacts from Peshchera Okladnikov level 6: single convex denticulate (a); retouched flake (b); angle scrapers (c, d, k); double straight side scraper (e); notch (f); smooth-backed knife (g); single straight ventral denticulate (h); three-sided alternate denticulate (i); Levallois point (j); straight-convex side scraper (l).

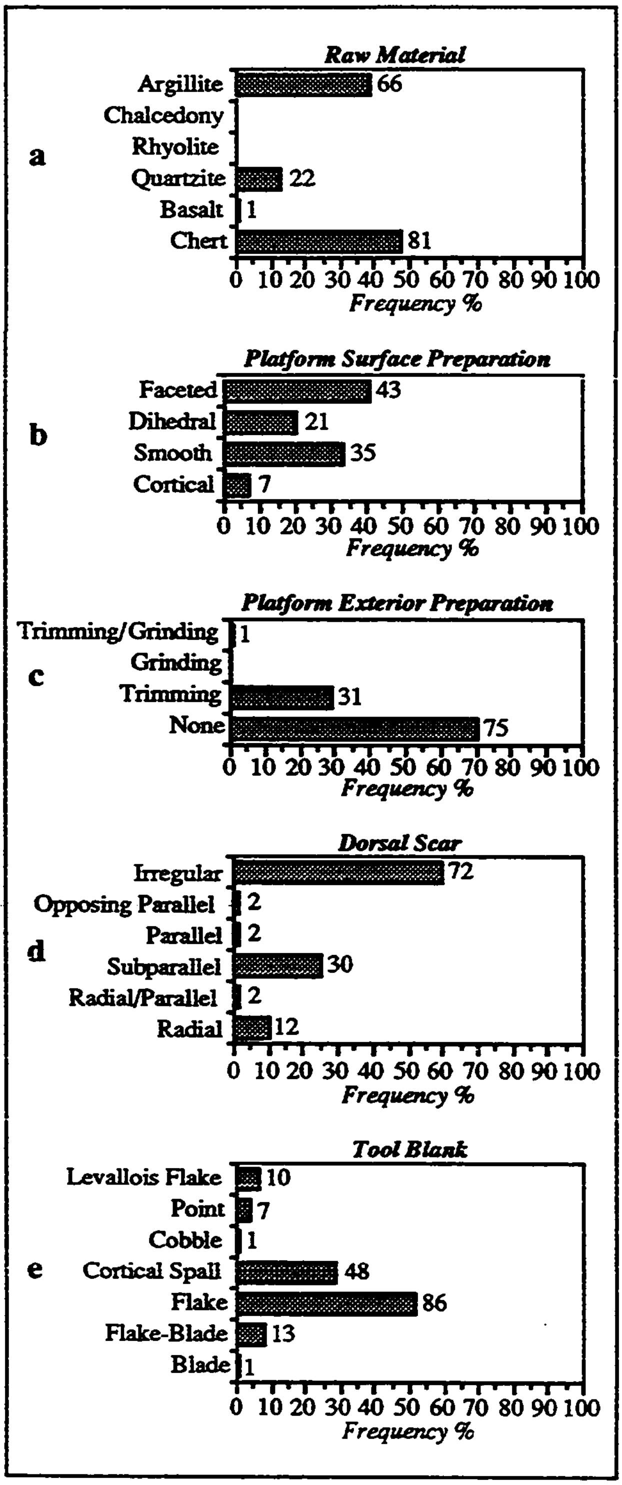


**Fig. 6.14.** Peshchera Okladnikov level 3: attributes of primary reduction technology.

6.17:b). Both Levallois cores bear faceted platforms. The Levallois flake core is radially flaked with a single large negative spall produced through the removal of a primary Levallois flake. On blanks, faceted platforms occur more often than smooth platforms (Fig. 6.14:b), leading to a very high faceting index of 60.4. In addition, platform exterior preparation, especially trimming, is somewhat common (Fig. 6.14:c). Dorsal scar patterns are primarily irregular (Fig. 6.14:d); however, subparallel and radial patterns also occur. The majority of tools are made on flakes and cortical spalls, while only 10% are made on Levallois end products (flakes and points) (Fig. 6.14:e).

*Secondary Reduction Technology.* Retouch is almost exclusively unifacial and dorsal (Fig. 6.15:a). Two tools were retouched bimarginally, an end scraper and a side scraper. Scalar retouch predominates (Fig. 6.15:c). Retouch

**Table 6.5.** Peshchera Okladnikov Level 3: Core Types

| Core type | n | % |
|---|---|---|
| Bidirectional monofrontal flake | 1 | 25.0 |
| Bidirectional trifrontal flake | 1 | 25.0 |
| Bidirectional monofrontal Levallois point | 1 | 25.0 |
| Levallois flake | 1 | 25.0 |
| Total | 4 | |

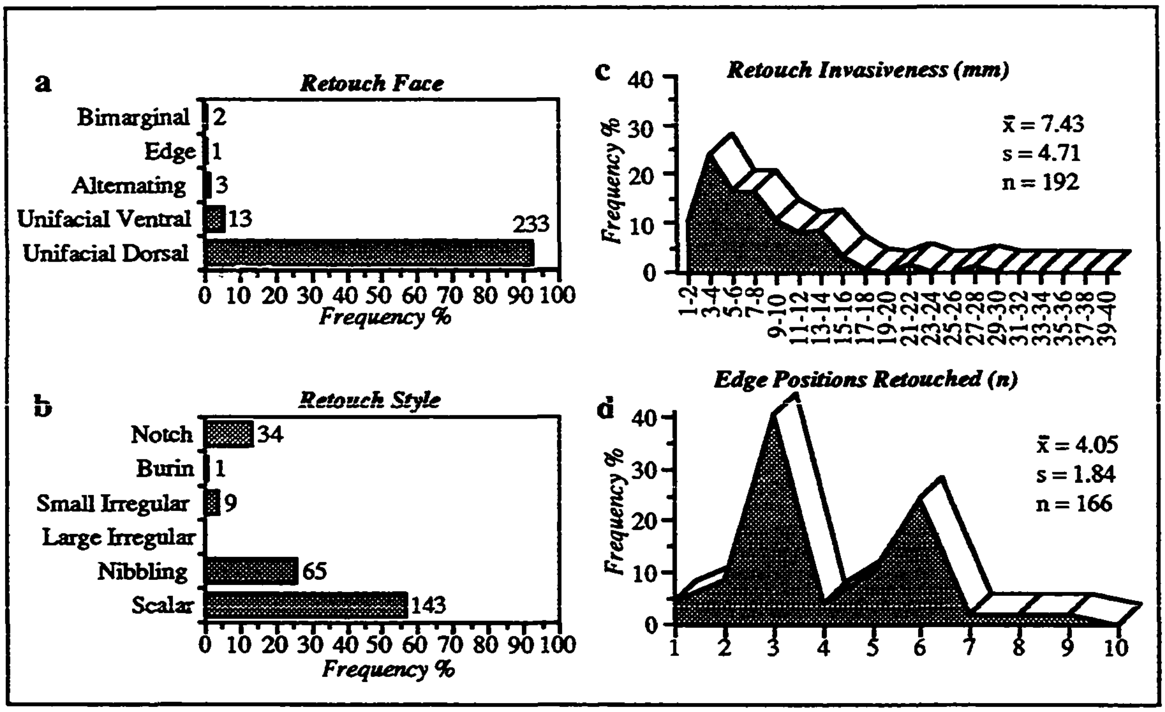


**Fig. 6.15.** Peshchera Okladnikov level 3: attributes of secondary reduction technology.

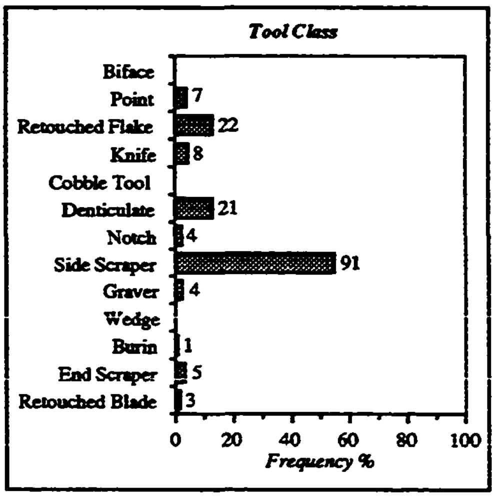


**Fig. 6.16.** Peshchera Okladnikov level 3: tool class.

invasiveness is high; 50% of all edges have retouch scars deeper than 6 mm (Fig. 6.15:d). Retouch intensity is moderately high, with 45% of all tools displaying retouch along four or more edge positions (Fig. 6.15:e).

*Tool Assemblage.* The tool assemblage consists mostly of side scrapers (Fig. 6.16). Other tool classes are rare; they include retouched flakes, denticulates, knives, points, end scrapers, notches, gravers, and burins. Among side scrapers single straight and single convex types are most common (Fig. 6.17:c; 6.18:f, i), although convergent, angle, and transverse scrapers also occur (Fig. 6.17:d, g-h; 6.18:c-e, h, j, p) (Table 6.6). Unlike side scrapers, denticulates are unintensively retouched, usually along only one lateral margin (Fig. 6.18:b; 6.19:b). End scrapers are small, round, and made on flakes (Fig. 6.18:g, m). Levallois points are either atypical or fragmented (Fig. 6.18:n; 6.19:h-j, m).

The primary reduction technology of this industry is flake-based, with moderately low incidences of Levallois flakes and points. Platforms, however, are usually faceted. Secondary reduction technology is characterized by unifacial yet extremely invasive and moderately intensive retouch. Scalar retouch is common, as are tools with multiply-retouched edges. Side scrapers overwhelm the tool assemblage, but points, knives, denticulates, notches, gravers, burins, and end scrapers also occur. In sum, this industry can be characterized as Mousterian with minor Levallois elements and a high frequency of platform faceting.

**Table 6.6.** Peshchera Okladnikov Level 3: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched flake-blade | 2 | 1.2 | Single straight denticulate | 8 | 4.8 |
| Bilaterally retouched flake-blade | 1 | 0.6 | Double straight denticulate | 1 | 0.6 |
| End scraper on flake | 4 | 2.4 | Double straight alternate denticulate | 1 | 0.6 |
| End/side scraper | 1 | 0.6 | Convex denticulate | 3 | 1.8 |
| Angle burin | 1 | 0.6 | Straight-convex denticulate | 1 | 0.6 |
| Single graver | 4 | 2.4 | Straight-concave denticulate | 1 | 0.6 |
| Side scraper fragment | 6 | 3.6 | Convex-concave denticulate | 1 | 0.6 |
| Single straight side scraper | 19 | 11.4 | Convex-concave alternate denticulate | 1 | 0.6 |
| Single straight ventral side scraper | 2 | 1.2 | Convergent denticulate | 2 | 1.2 |
| Double straight side scraper | 3 | 1.8 | Angle denticulate | 1 | 0.6 |
| Single convex side scraper | 12 | 7.2 | Knife fragment | 1 | 0.6 |
| Single concave side scraper | 2 | 1.2 | Naturally backed knife | 3 | 1.8 |
| Double concave side scraper | 1 | 0.6 | Smooth-backed knife | 4 | 2.4 |
| Convex-concave side scraper | 1 | 0.6 | Retouched flake fragment | 2 | 1.2 |
| Straight-convex side scraper | 3 | 1.8 | Retouched flake | 14 | 8.4 |
| Straight transverse scraper | 3 | 1.8 | Retouched ventral flake | 3 | 1.8 |
| Convex transverse scraper | 6 | 3.6 | Retouched alternate flake | 1 | 0.6 |
| Convergent side scraper | 20 | 12.0 | Utilized flake | 2 | 1.2 |
| Angle scraper | 13 | 7.8 | Levallois point fragment | 3 | 1.8 |
| Single notch | 2 | 1.2 | Levallois point | 1 | 0.6 |
| Multiple notch | 2 | 1.2 | Atypical Levallois point | 3 | 1.8 |
| Denticulate fragment | 1 | 0.6 | | | |
| | | | Total | 166 | |

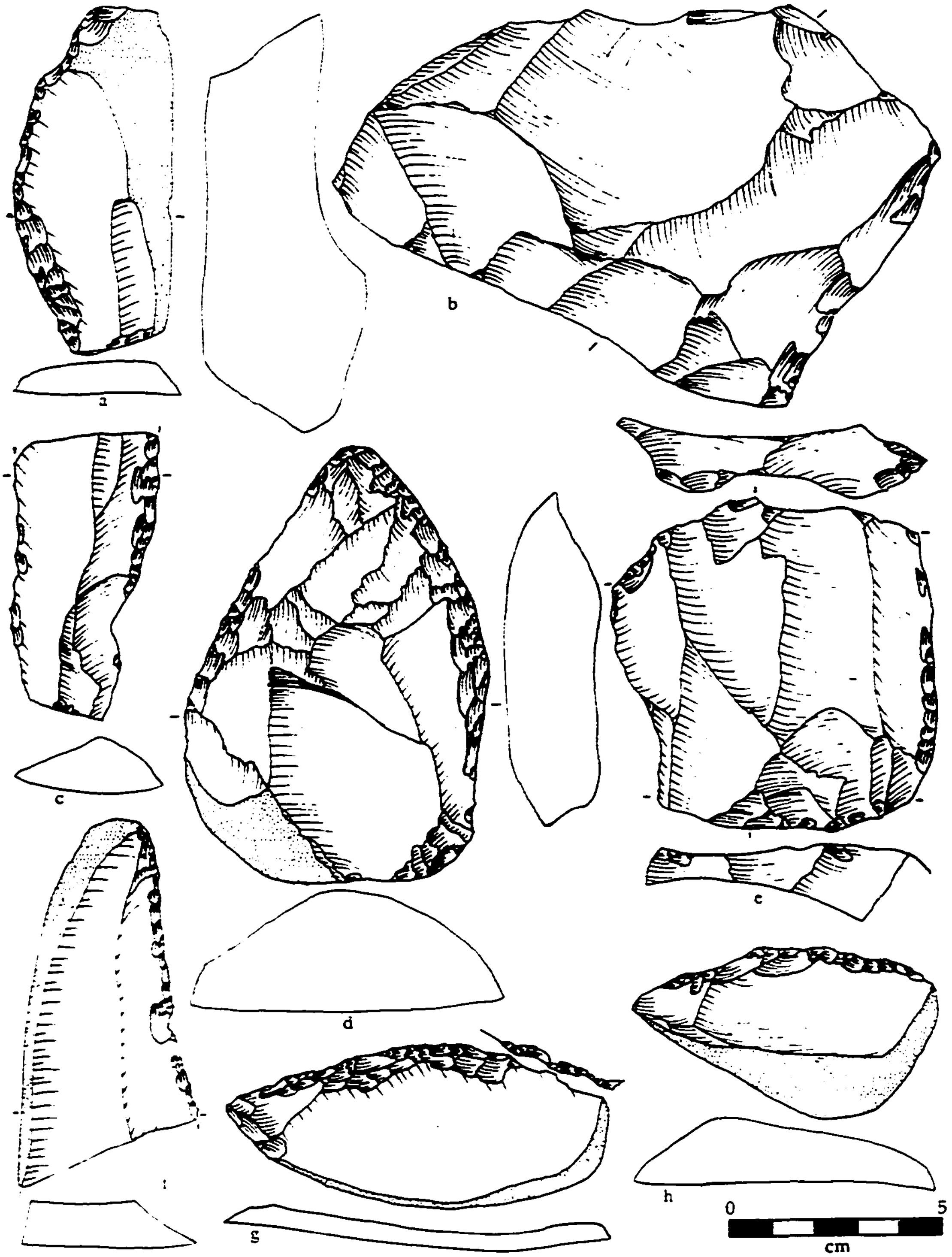


**Fig. 6.17.** Lithic artifacts from Peshchera Okladnikov level 3: naturally backed knives (a, f); Levallois flake core (b); single straight side scraper (c); convergent side scraper (d); possible Levallois point core (e); convex transverse scrapers (g, h).

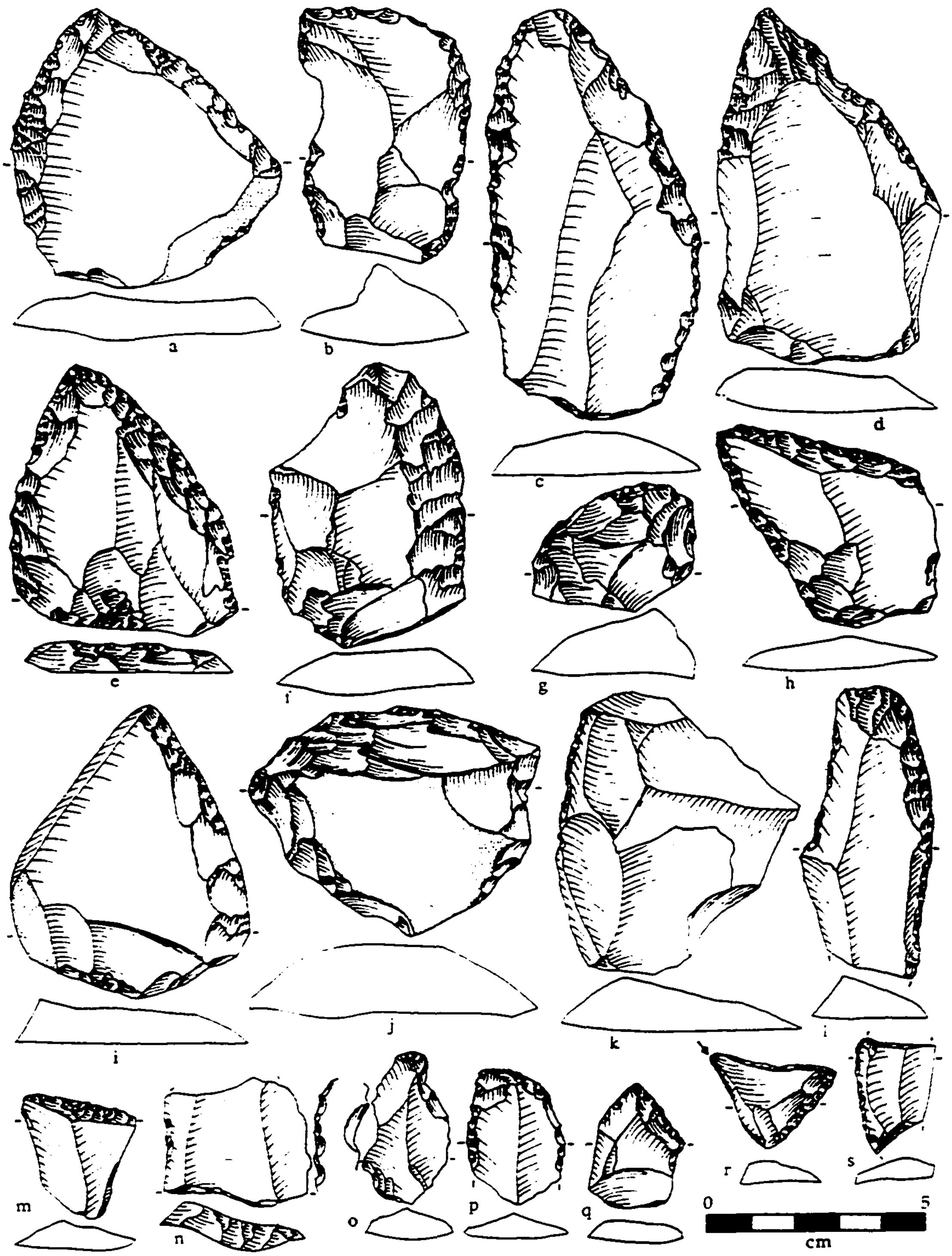


**Fig. 6.18.** Lithic artifacts from Peshchera Okladnikov level 3: angle scrapers (a, d, e, h, j, p); single convex denticulate (b); convergent scraper (c); single convex side scrapers (f, i); end scrapers on flakes (g, m); retouched flake (k); smooth-backed knife (l); Levallois point fragment (n); notch (o); graver (q); angle burin (r); unilaterally retouched flake-blade (s).

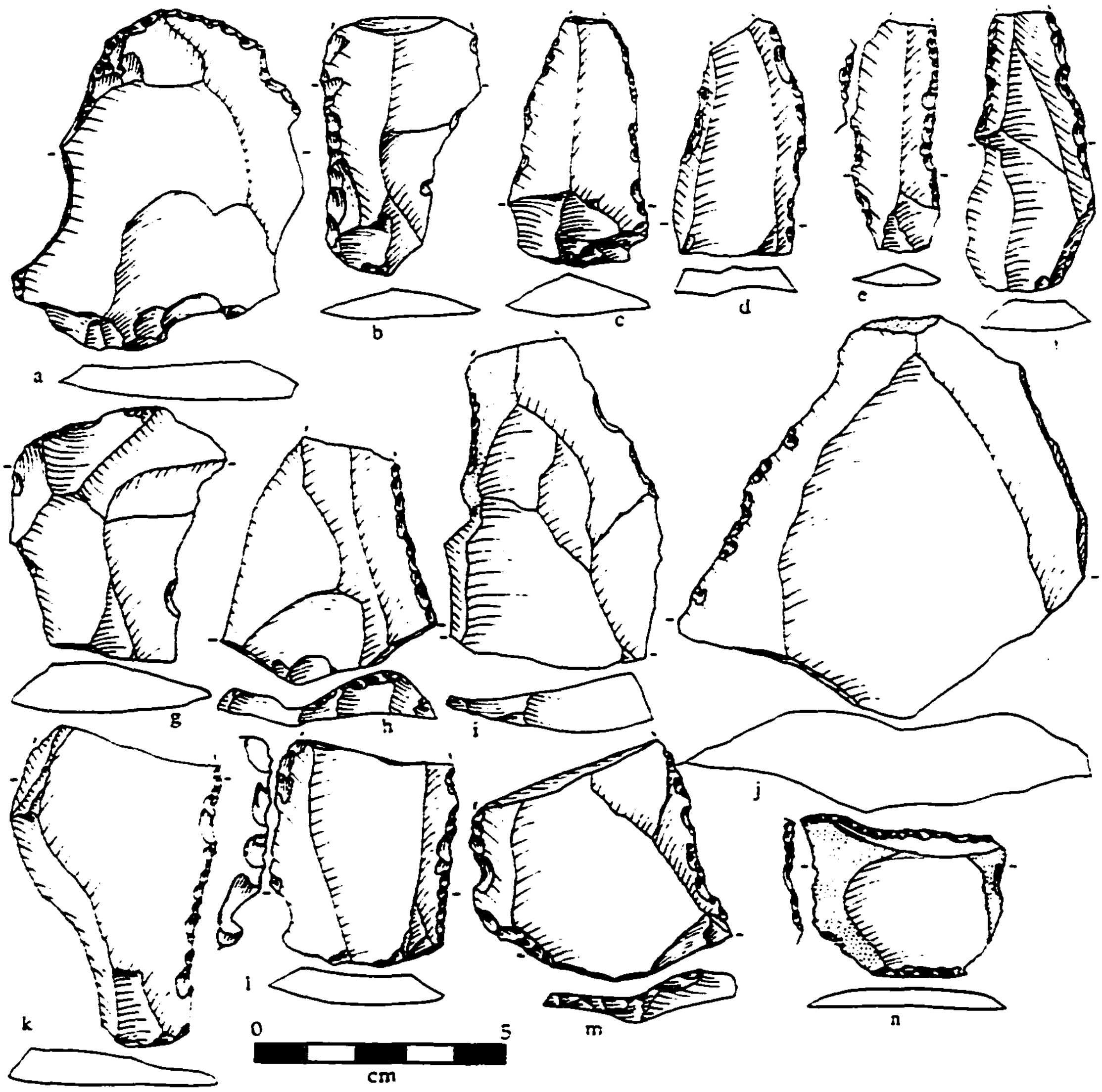


**Fig. 6.19.** Lithic artifacts from Peshchera Okladnikov level 3: end scraper on (Levallois) flake (a); single straight denticulate (b); bilaterally retouched flake-blade (c); straight-convex denticulate (d); double straight alternate denticulate (e); double straight denticulate (f); retouched (Levallois) flake (g); Levallois point fragment (h); atypical Levallois points (i, j, m); smooth-backed knife (k); double straight alternate denticulate (l); graver (n).

## Peshchera Okladnikov Level 2

Available for analysis from Peshchera Okladnikov level 2 were 152 tools and three cores. All were recovered from the rock shelter at the cave's entrance (Derevianko et al. 1987k; Derevianko and Markin 1990b).

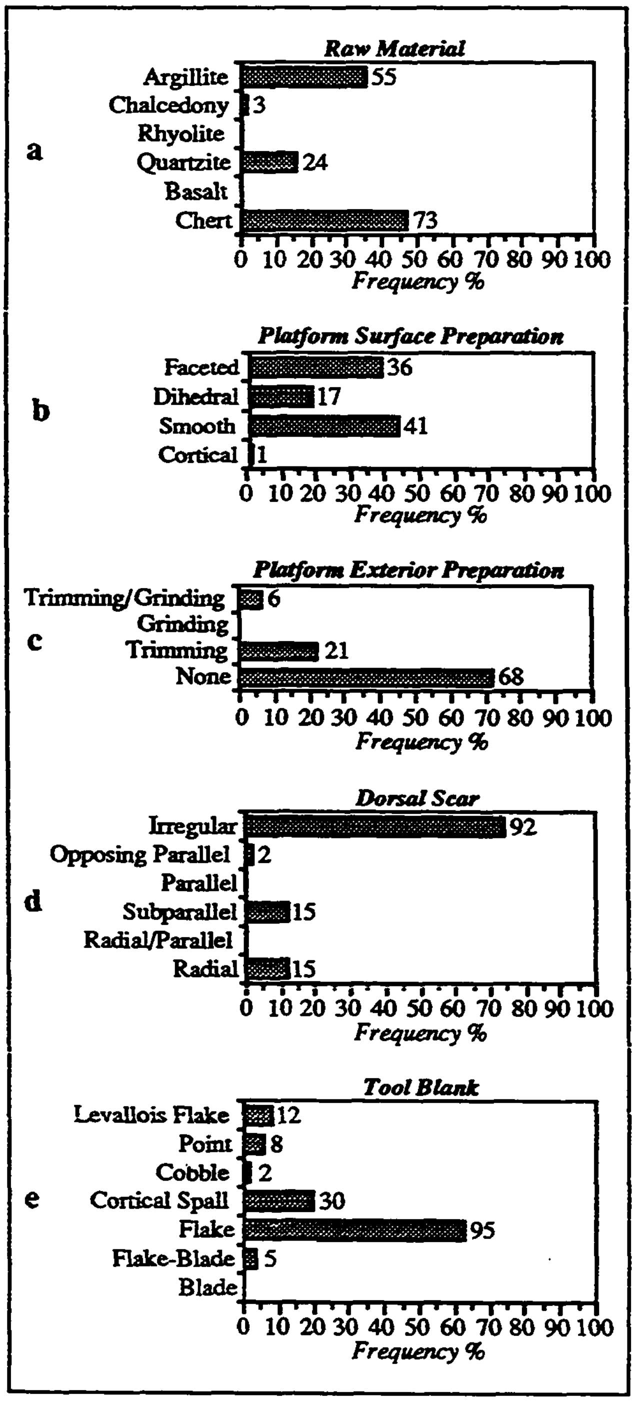


**Fig. 6.20.** Peshchera Okladnikov level 2: features of primary reduction technology.

*Primary Reduction Technology.* Raw materials include chert, argillite, quartzite, and chalcedony (Fig. 6.20:a). Cherts include dark gray, gray, and reddish-brown varieties, while argillites are gray and dark gray. Twenty-four tools, including 13 side scrapers and four Levallois points, are manufactured on gray quartzite. Blanks with cortex are uncommon; less than 20% of all tools display cortex on their dorsal surfaces, and only 6.4% have more than half their dorsal surfaces covered by cortex. Two of the three cores are radially-prepared Levallois flake cores with faceted platforms (Fig. 6.23:a, g). Both have a prominent negative scar produced through the removal of a primary Levallois flake. The third core is actually a core fragment, a frontal rejuvenation spall removed from a bidirectional flat-faced blade core (Fig. 6.23:b). It bears remnants of both platforms, one of which is faceted. Although platforms on blanks are predominantly smooth, the assemblage has a faceting index of 55.8 (Fig. 6.20:b). Nearly 30% of all blanks display some platform exterior preparation (Fig. 6.20:c). Dorsal scar patterns are almost entirely irregular, while radial, subparallel, and opposing parallel patterns occur rarely (Fig.

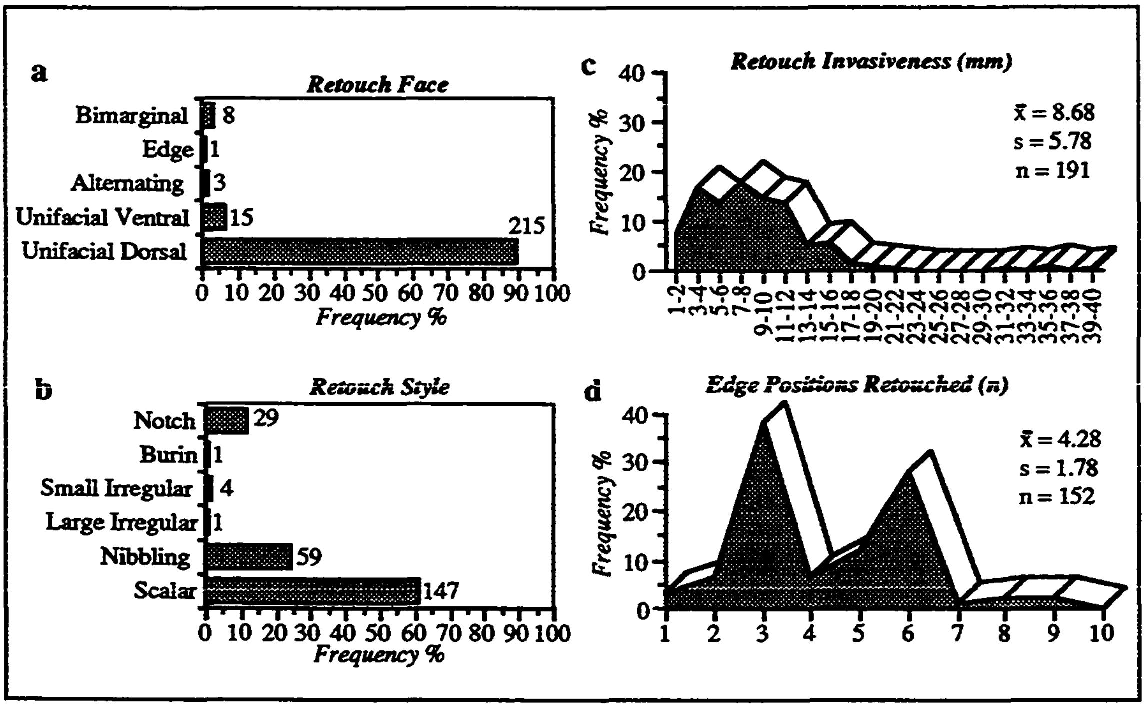


**Fig. 6.21. Peshchera Okladnikov level 2: features of secondary reduction technology.**

6.20:d). Tools are usually made on flakes and cortical spalls, while Levallois flakes and points are uncommon (Fig. 6.20:e).

*Secondary Reduction Technology.* Edges with unifacial retouch dominate the assemblage (Fig. 6.21:a). Five tools (four side scrapers and one knife) are bimarginally retouched. Among retouch styles, scalar is most common, while nibbling occurs less frequently (Fig. 6.21:b). Retouch invasiveness and intensity are high, among the highest among the Middle Paleolithic industries analyzed. Only 38% of all edges have retouch scars less than or equal to 6 mm deep (Fig. 6.21:c), and 52% of all tools have four or more retouched edge positions (Fig. 6.21:d).

*Tool Assemblage.* The tool assemblage is dominated by side scrapers, while denticulates, retouched flakes, knifes, notches, Levallois points, and cobble tools occur infrequently (Fig. 6.22, Table 6.7). A single burin, end scraper, and retouched blade are also present. As a group, side scrapers are intensively retouched. Angle, convergent, and transverse scrapers are the most common types, together making up 31% of the tool assemblage (Fig. 6.23:d, 6.24:f, h-j, m-n). Denticulates, on the other hand, are usually retouched along only one margin (Table 6.7).

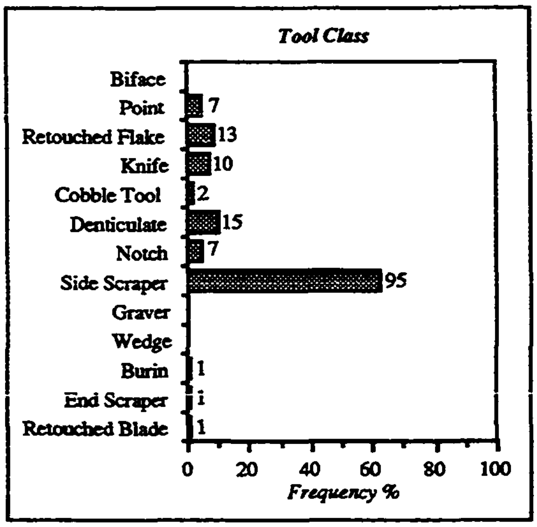


**Fig. 6.22.** Peshchera Okladnikov level 2: tool class.

**Table 6.7.** Peshchera Okladnikov Level 2: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 1 | 0.7 | Single straight denticulate | 1 | 0.7 |
| End scraper on flake | 1 | 0.7 | Single straight ventral denticulate | 3 | 2.0 |
| Angle burin | 1 | 0.7 | Double straight denticulate | 1 | 0.7 |
| Side scraper fragment | 9 | 5.9 | Double straight alternate denticulate | 1 | 0.7 |
| Single straight side scraper | 12 | 7.9 | Single convex denticulate | 3 | 2.0 |
| Double straight side scraper | 2 | 1.3 | Single convex ventral denticulate | 1 | 0.7 |
| Double straight alternate side scraper | 1 | 0.7 | Double convex denticulate | 1 | 0.7 |
| Single convex side scraper | 13 | 8.6 | Concave ventral denticulate | 1 | 0.7 |
| Single convex ventral side scraper | 1 | 0.7 | Straight convex denticulate | 1 | 0.7 |
| Double concave ventral side scraper | 1 | 0.7 | Straight concave denticulate | 1 | 0.7 |
| Straight-convex side scraper | 4 | 2.6 | Angle denticulate | 1 | 0.7 |
| Straight-concave side scraper | 1 | 0.7 | Chopper | 1 | 0.7 |
| Convex-concave alternate side scraper | 1 | 0.7 | Chopping tool | 1 | 0.7 |
| Straight transverse scraper | 3 | 2.0 | Naturally backed knife | 5 | 3.3 |
| Convex transverse scraper | 4 | 2.6 | Smooth-backed knife | 5 | 3.3 |
| Convergent side scraper | 19 | 12.5 | Retouched flake | 10 | 6.6 |
| Angle scraper | 20 | 13.2 | Retouched ventral flake | 2 | 1.3 |
| Angle alternate scraper | 1 | 0.7 | Retouched alternate flake | 1 | 0.7 |
| Three-sided scraper | 3 | 2.0 | Levallois point fragment | 2 | 1.3 |
| Single notch | 6 | 3.9 | Levallois point | 3 | 2.0 |
| Multiple notch | 1 | 0.7 | Atypical Levallois point | 2 | 1.3 |
| | | | Total | 152 | |

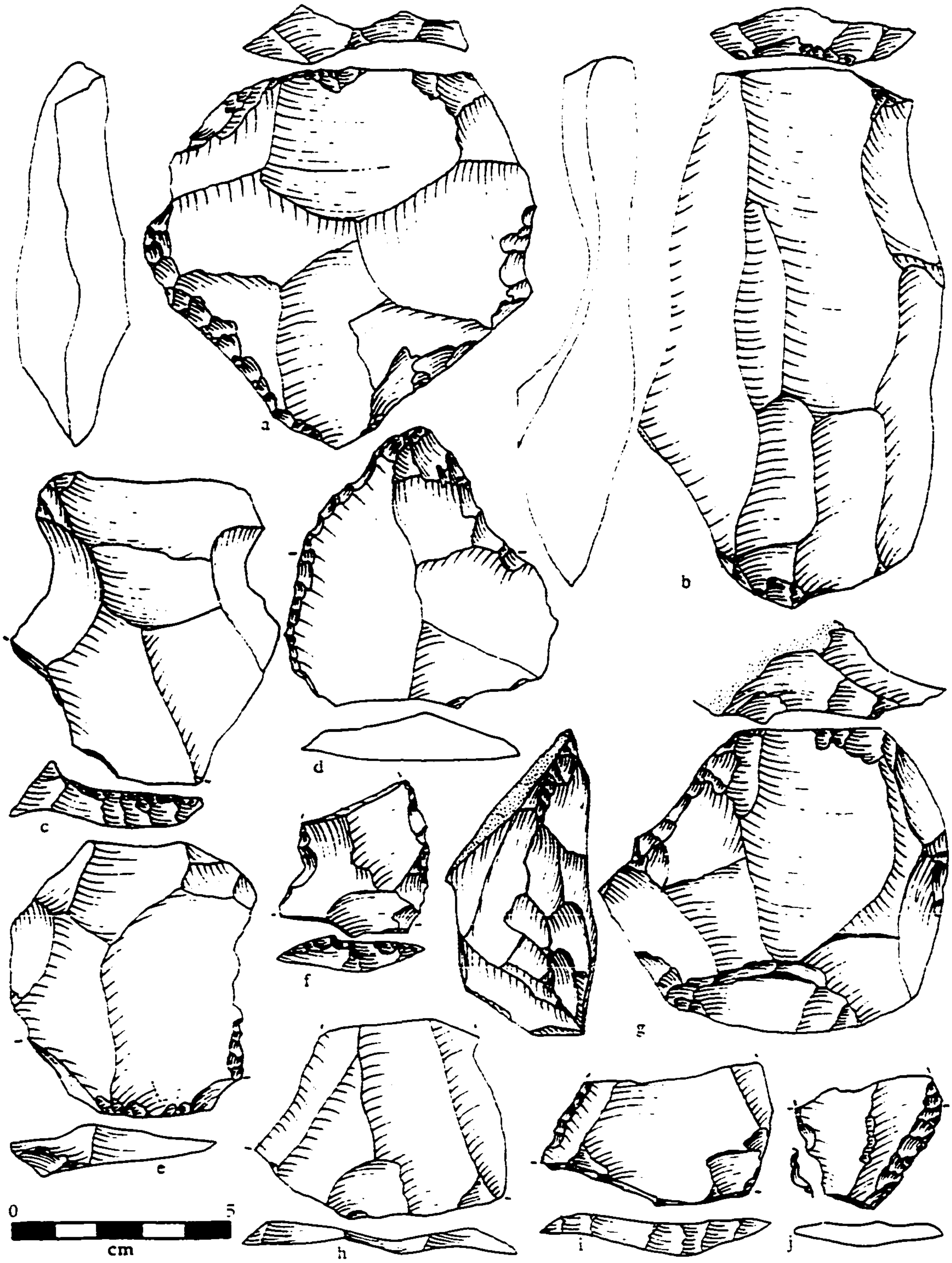


**Fig 6.23.** Lithic artifacts from Peshchera Okladnikov level 2: Levallois flake cores (a, g); frontal rejuvenation spall removed from bidirectional core (b); unretouched Levallois flake (c); convergent scraper (d); retouched (Levallois) flake (e); notch (f); Levallois point fragments (h, i); single straight side scraper (j).

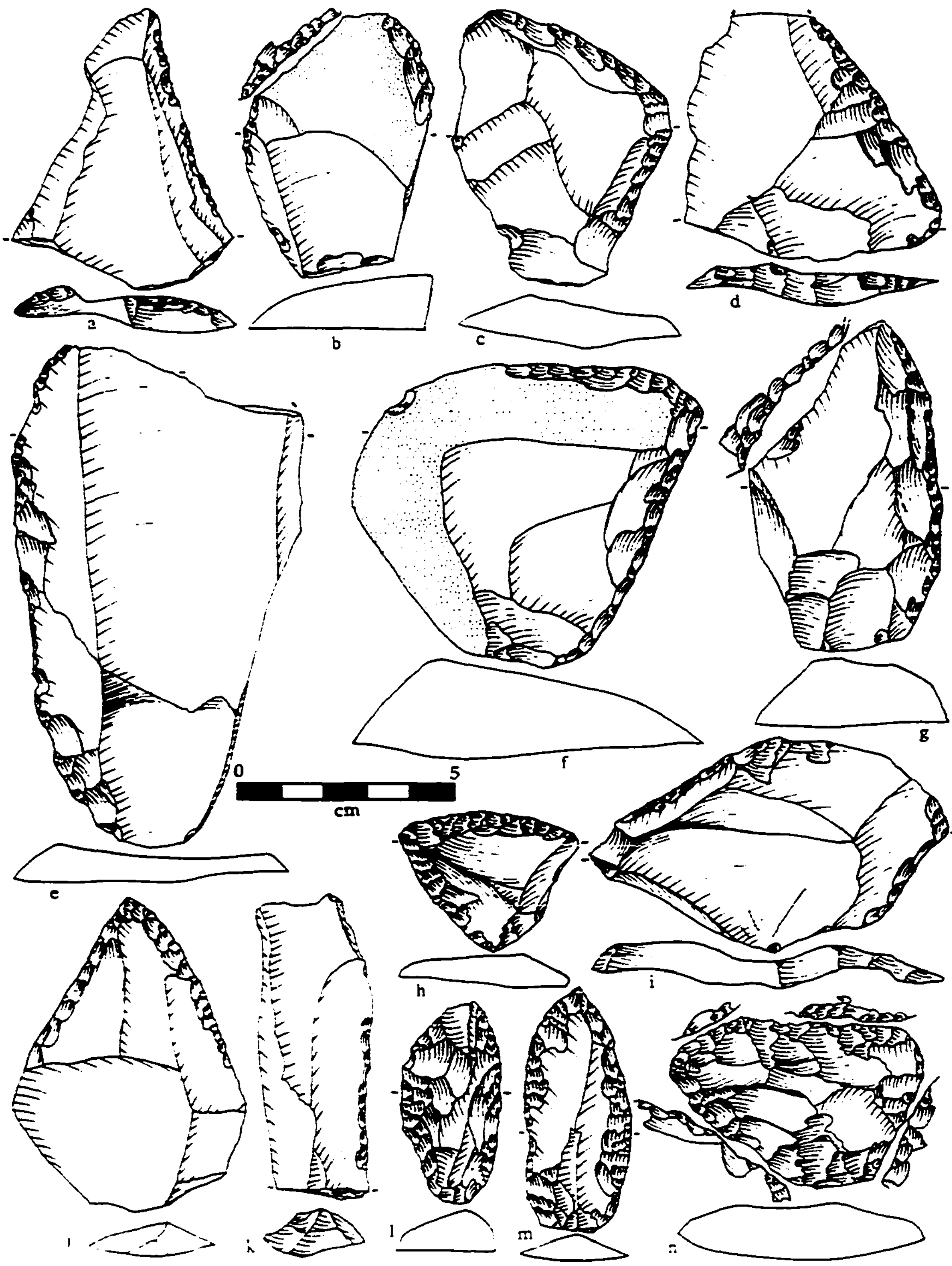


**Fig. 6.24.** Lithic artifacts from Peshchera Okladnikov level 2: Levallois point (a); smooth-backed knife (b); single convex side scraper (c, e); single straight side scraper (d); angle scraper (f, h, n); convex-concave alternate side scraper (g); convex transverse scraper (i); convergent scraper (j, m); unilaterally retouched blade (k); straight-convex side scraper (l).

This industry is characterized by a flake-oriented primary reduction technology. Platforms are regularly faceted and Levallois end products (especially flakes) are present. Secondary reduction technology is marked by an abundance of edges with invasive, scalar retouch. Side scrapers dominate the assemblage, and, along with denticulates, knives, and points, give the tool assemblage a markedly Mousterian quality.

## Peshchera Okladnikov Level 1

Included in the present study is a lithic assemblage numbering 136 tools and one core. The majority of these were recovered from the rock shelter in front of the cave and in gallery 1, although isolated artifacts were also recovered in the grotto and gallery 3 (Derevianko et al. 1987k; Derevianko and Markin 1990b).

*Primary Reduction Technology.* Raw materials are more diverse than in the lower-lying levels at Peshchera Okladnikov; chert, argillite, quartzite, rhyolite, basalt, and chalcedony are well-represented (Fig. 6.25:a). Cherts are dark gray, gray, or reddish-brown, argillites are gray, dark gray, or green, and chalcedonies are dark gray or brown. Cortex occurs on 26% of all blanks; 12% have more than half their dorsal surfaces covered with cortex. The single core in the assemblage is a radially-prepared Levallois flake core with a faceted platform (Fig. 6.28:p). It bears scars of primary as well as secondary Levallois removals (as defined by Boëda [1988]; Van Peer [1992:10-11]). The majority of platforms are smooth, although faceted and dihedral platforms occur in moderate numbers, leading to a faceting index of 35.2 (Fig. 6.25:b). One out of three blanks display some exterior platform preparation (Fig. 6.25:c). Dorsal scar patterns are predominantly irregular, while subparallel and radial patterns occur less frequently (Fig. 6.25:d). Most tools are made on flakes or cortical spalls (Fig. 6.25:e); Levallois end products (flakes and points) were utilized only 12% of the time.

*Secondary Reduction Technology.* Retouch is primarily unifacial (Fig. 6.26:a), although two bifaces occur in the assemblage. Retouch styles are for the most part scalar or nibbling (Fig. 6.26:b). Retouch invasiveness is relatively low, with 66% of all edges bearing retouch scars less than or equal to 6 mm deep (Fig. 6.26:c). Retouch intensity is moderate; 47% of all tools have four or more retouched edge positions (Fig. 6.26:d). Both bifaces are retouched along all ten edge positions.

*Tool Assemblage.* The tool assemblage is dominated by side scrapers and retouched flakes. Denticulates, end scrapers, and notches also occur, while knives, retouched

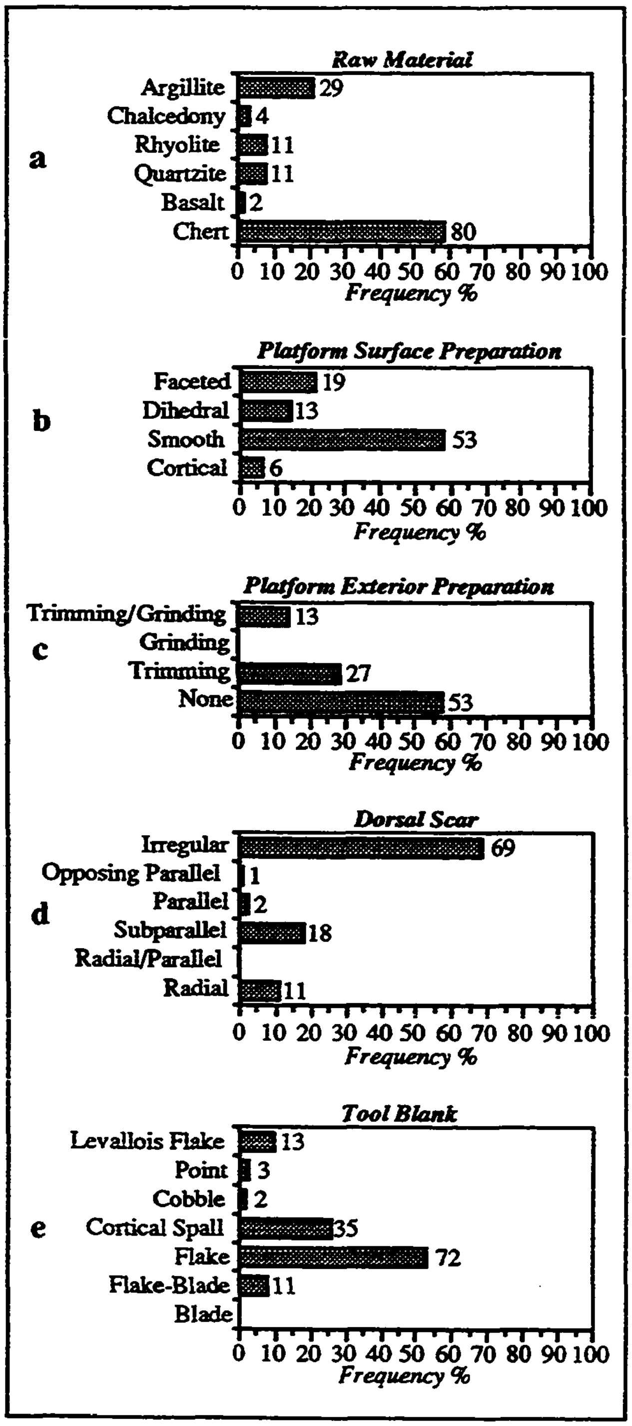


**Fig. 6.25.** Peshchera Okladnikov level 1: attributes of primary reduction technology.

blades, Levallois points, bifaces, cobble tools, and gravers are rare (Fig. 6.27). Most side scrapers are intensively retouched and have been reduced to a small size. Transverse, convergent, and angle scrapers make up 18% of the assemblage (Table 6.8) (Fig. 6.28:c, d, f, h; 6.29:f, h, k-l, n). End scrapers are typically small and round and manufactured on flakes (Fig. 6.28:l-m). Denticulates represent a diverse group; seven are worked along one lateral margin, four along two lateral margins, and six transversely. One biface is oval, lenticular in cross section, and heavily worked on one face (Fig. 6.28:g). The second biface is very small (20 mm long x 18 mm wide) and worked around its entire perimeter (Fig. 6.28:k).

In sum, the Peshchera Okladnikov level 1 industry is Levallois and Mousterian. Primary reduction technology is directed at the production of flakes for use as tools; some of these flakes were manufactured through Levallois techniques. Levallois points are rare. Few platform surfaces are faceted. Secondary reduction technology is characterized by unifacial and intensive scalar retouch; however, two bifacially worked implements do occur and many flakes bear only nibbling or

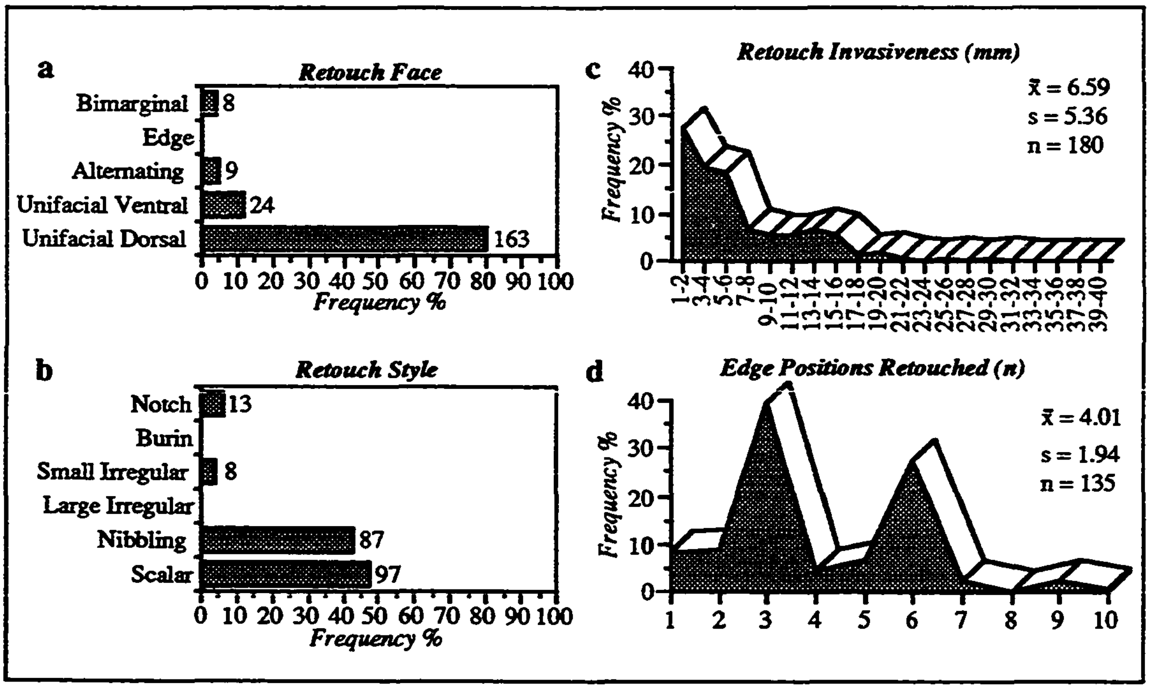


**Fig. 6.26.** Peshchera Okladnikov level 1: features of secondary reduction technology.

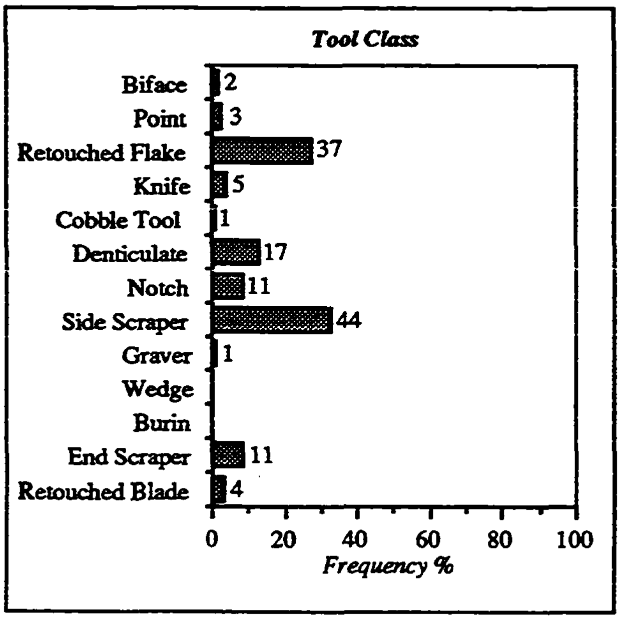


**Fig. 6.27.** Peshchera Okladnikov level 1: tool class.

**Table 6.8.** Peshchera Okladnikov Level 1: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched ven. flake-blade | 1 | 0.7 | Single straight ventral denticulate | 2 | 1.5 |
| Bilaterally retouched flake-blade | 3 | 2.2 | Double straight denticulate | 2 | 1.5 |
| End scraper on blade | 1 | 0.7 | Single convex denticulate | 1 | 0.7 |
| End scraper on flake | 5 | 3.7 | Double convex denticulate | 1 | 0.7 |
| End scraper on half round flake | 1 | 0.7 | Concave ventral denticulate | 1 | 0.7 |
| Lateral end scraper | 1 | 0.7 | Double concave denticulate | 1 | 0.7 |
| End/side scraper | 3 | 2.2 | Transverse denticulate | 3 | 2.2 |
| Single graver | 1 | 0.7 | Transverse ventral denticulate | 1 | 0.7 |
| Single straight side scraper | 7 | 5.1 | Transverse alternating denticulate | 1 | 0.7 |
| Double straight side scraper | 3 | 2.2 | Angle denticulate | 1 | 0.7 |
| Single convex side scraper | 5 | 3.7 | Hammerstone | 1 | 0.7 |
| Single convex ventral side scraper | 1 | 0.7 | Naturally backed knife | 3 | 2.2 |
| Single concave side scraper | 1 | 0.7 | Smooth-backed knife | 2 | 1.5 |
| Straight-convex side scraper | 1 | 0.7 | Retouched flake | 22 | 16.2 |
| Convex-concave side scraper | 1 | 0.7 | Retouched ventral flake | 5 | 3.7 |
| Convex transverse scraper | 5 | 3.7 | Retouched alternate flake | 3 | 2.2 |
| Convergent scraper | 7 | 5.1 | Retouched bimarginal flake | 1 | 0.7 |
| Angle scraper | 10 | 7.4 | Utilized flake | 6 | 4.4 |
| Angle alternate scraper | 2 | 1.5 | Levallois point fragment | 1 | 0.7 |
| Three-sided scraper | 1 | 0.7 | Levallois point | 2 | 1.5 |
| Single notch | 9 | 6.6 | Oval biface | 1 | 0.7 |
| Multiple notch | 2 | 1.5 | Miscellaneous biface | 1 | 0.7 |
| Single straight denticulate | 3 | 2.2 | | | |
| | | | Total | 136 | |

small irregular retouch. The tool assemblage is Mousterian in character, with high frequences of side scrapers and retouched flakes, as well as moderately low frequencies of denticulates, notches, end scrapers, knives, and Levallois points.

## Denisova Peshchera Entrance Level 10

Cultural remains from the entrance to Denisova Peshchera have been only cursorily described (Derevianko et al. 1990b:38-39), and since excavations still continue, the

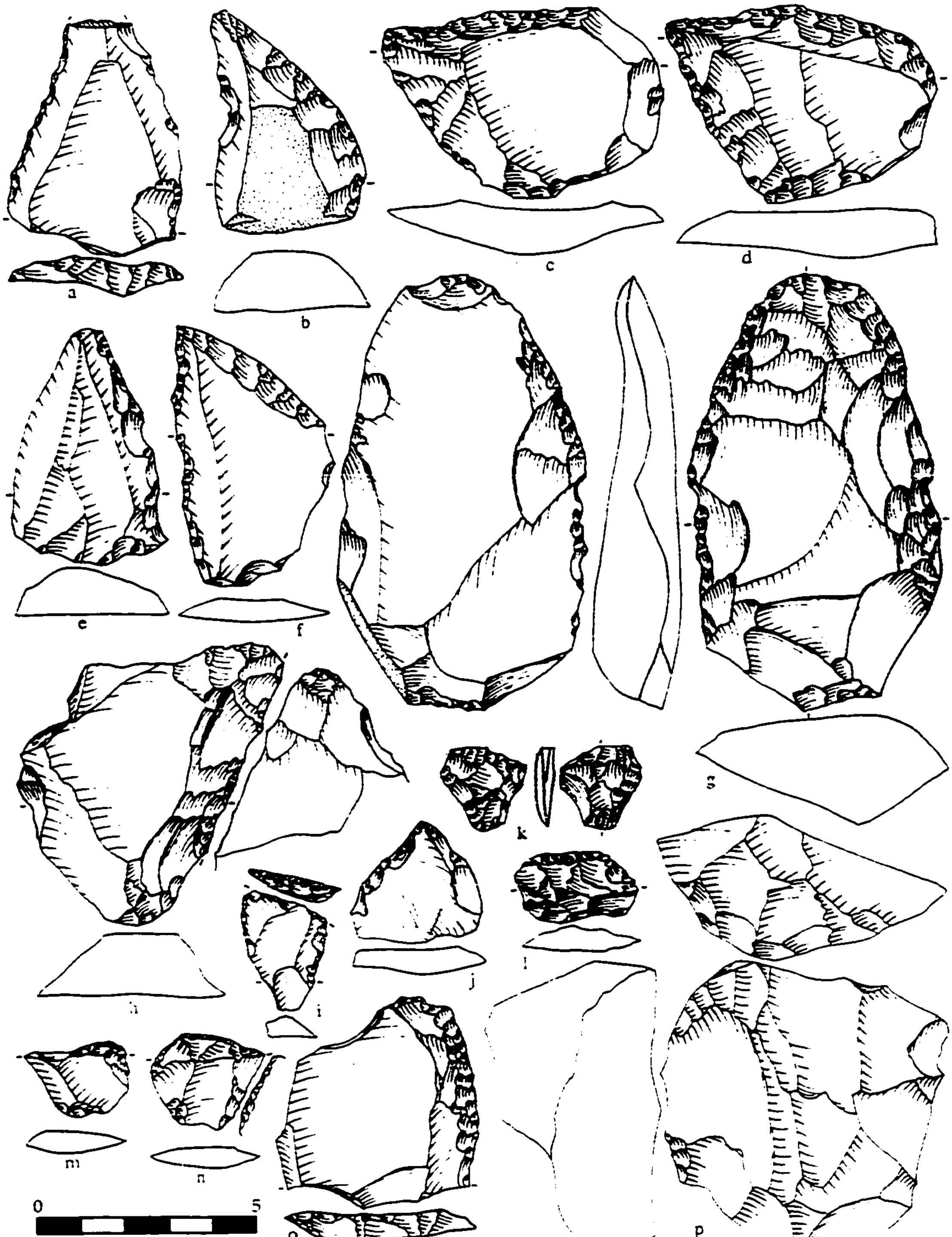


**Fig. 6.28.** Lithic artifacts from Peshchera Okladnikov level 1: Levallois points (a, e); single convex side scraper (b, o); angle scraper (c, d, f); oval biface (g); angle alternate scraper (h); end/side scraper (i); graver (j); miscellaneous biface (k); end scrapers on flakes (l, m); retouched alternate flake (n); Levallois flake core (p).

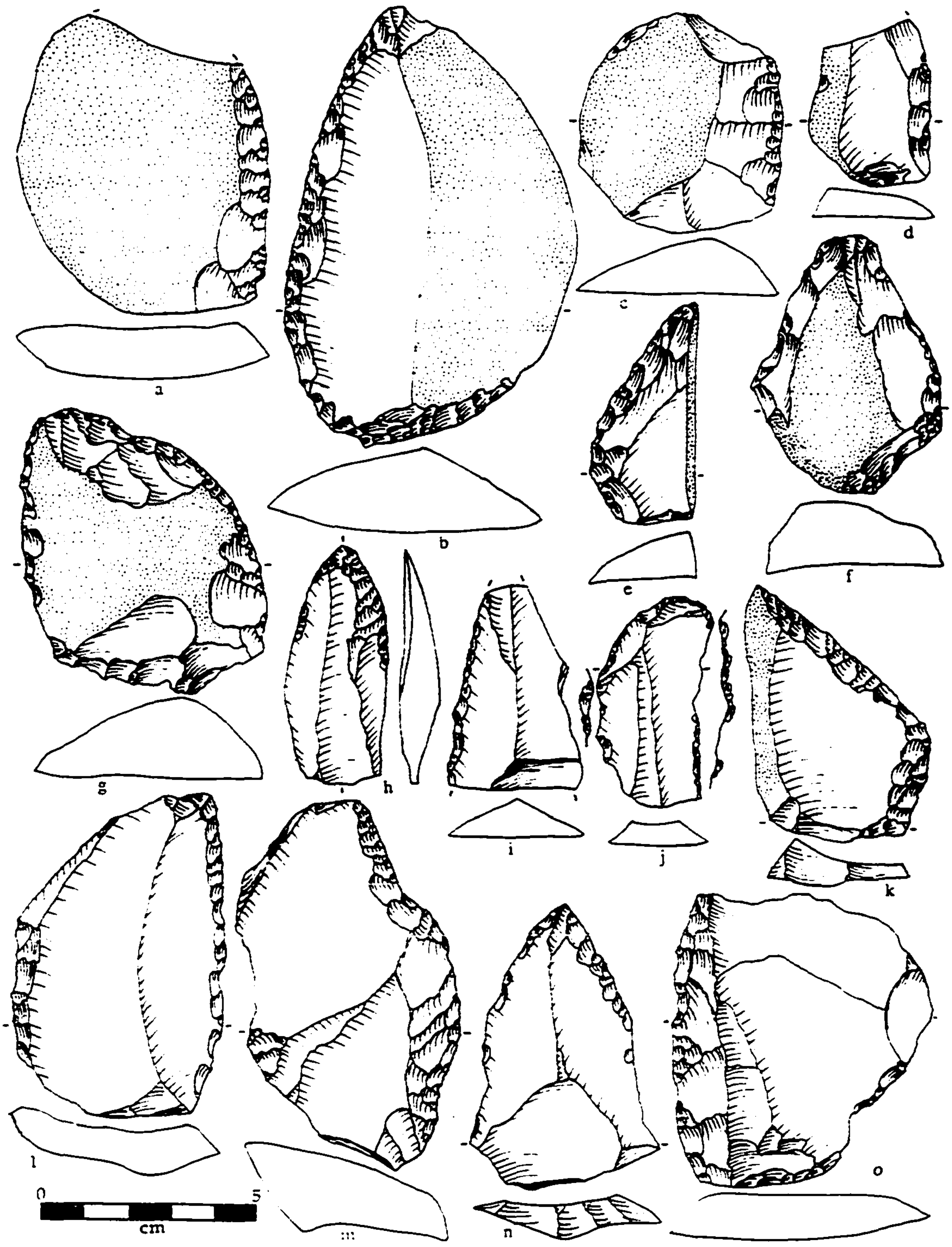


**Fig. 6.29.** Lithic artifacts from Peshchera Okladnikov level 1: single straight side scraper (a, c, o); single convex side scraper (b, g); cortically backed knife (d, e); convergent scraper (f, h, i, n); Levallois point fragment (i); end scraper on blade (j); angle scraper (k); smooth-backed knife (m).

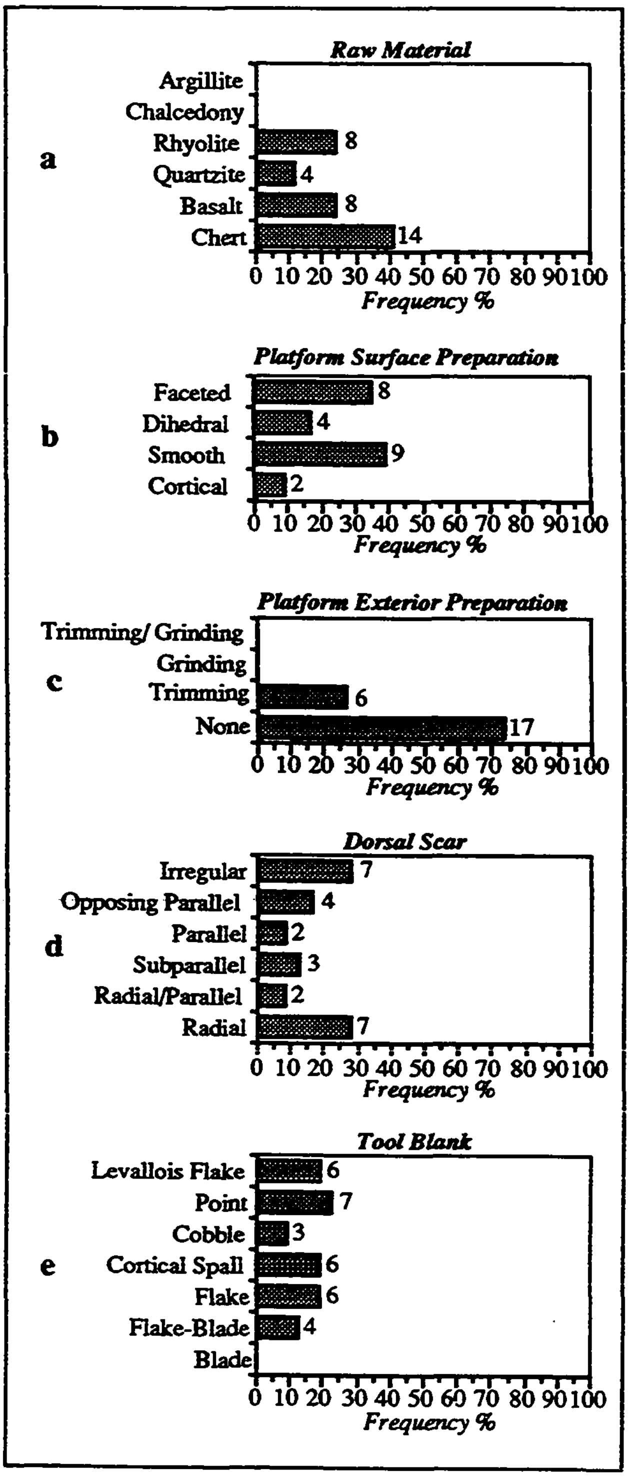


**Fig. 6.30.** Denisova Peshchera level 10: attributes of primary reduction technology.

results of the present analysis should be considered preliminary. Artifact frequencies will surely change somewhat as the sample continues to grow in size. In the present study, 32 tools and 2 cores are analyzed.

*Primary Reduction Technology.* Raw materials include a high percentage of chert and low percentages of basalt, quartzite, and rhyolite (Fig. 6.30:a). Cherts include gray, green, and dark gray varieties. Cortex occurs on 27% of all blanks; 12% bear cortex on more than half their dorsal surfaces. The two cores are Levallois flake cores. One displays a faceted platform (Fig. 6.33:k) and the other a dihedral platform; both are flaked radially but discarded prior to the removal of a primary Levallois end product. Blank platform surfaces are mostly faceted or dihedral (Fig. 6.30:b), giving the industry a faceting index of 52.2. Only six blanks bear platform exterior preparation (Fig. 6.30:c). Dorsal scar patterns are heterogeneous; the most frequent types are radial, irregular, and opposing parallel (Fig. 6.30:d). Nearly half the tools were manufactured on Levallois end products, including six Levallois flakes and seven Levallois points (Fig. 6.30:e). Cortical spalls, flakes, and flake-blades also served as tools.

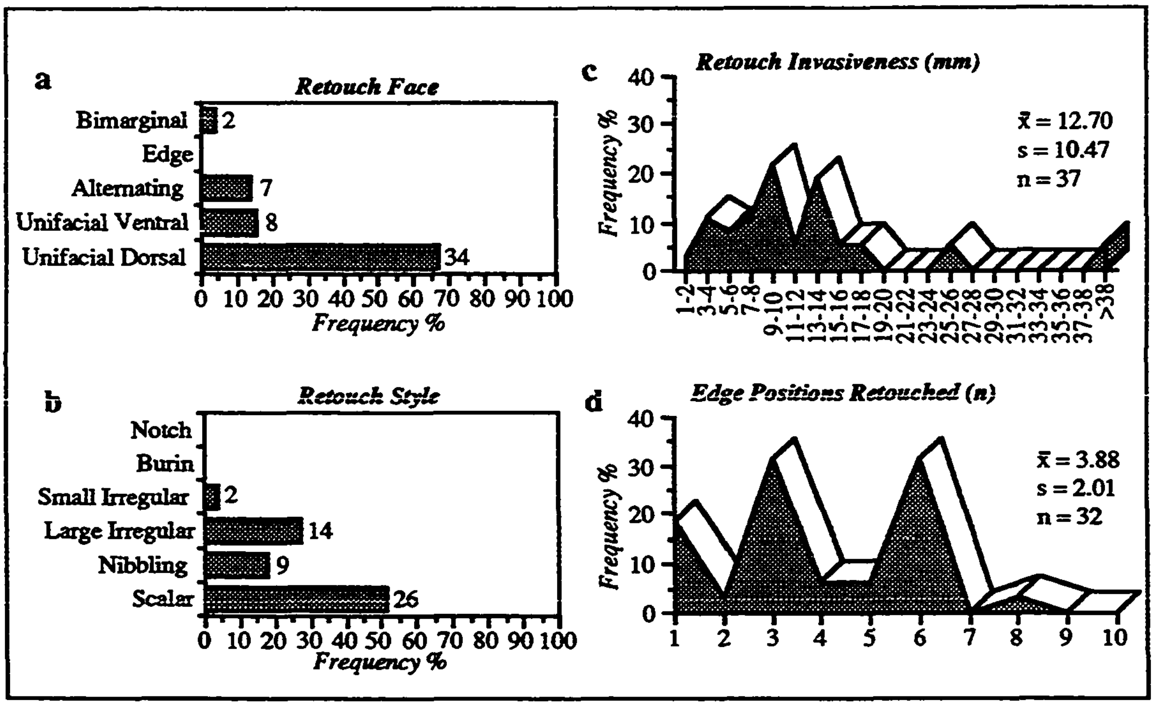


**Fig. 6.31.** Denisova Peshchera level 10: attributes of secondary reduction technology.

*Secondary Reduction Technology.* Retouch is chiefly unifacial (dorsal and ventral) (Fig. 6.31:a). Bimarginal retouch occurs on one cobble chopping tool and one denticulate, while alternating retouch occurs on three denticulates, one notch, one side scraper, and one Levallois point. Among retouch styles, scalar and large irregular retouch are most common (Fig. 6.31:b). Likewise, tools are extremely invasively retouched, with 88% of all edges displaying retouch scars greater than 6 mm deep (Fig. 6.31:c). Retouch is also moderatly intensive, with 47% of all tools displaying four or more retouched edge positions (Fig. 6.31:d).

*Tool Assemblage.* The tool assemblage is rich in notches and denticulates, with moderate frequencies of Levallois points and side scrapers (Fig. 6.32, Table 6.9). Side scrapers include two single convex, one convergent, and one angle scraper (Fig. 6.33:g-h). Denticulates are heterogeneous and for the most part intensively retouched (Fig. 6.33:f, i-j). Only two of five Levallois points are unbroken (Fig. 6.33:a-e).

Although the Denisova Peshchera level 10 lithic industry is represented by a small sample of tools and cores, this industry is definitely Levallois and Mousterian. Primary reduction technology is directed at the production of Levallois flakes and points. Cores as well as blanks reflect Levallois principles of core preparation characterized by platform faceting as well as radial and opposing parallel flaking. Secondary reduction technology is predominantly unifacial and typified by invasive scalar and large irregular retouch.

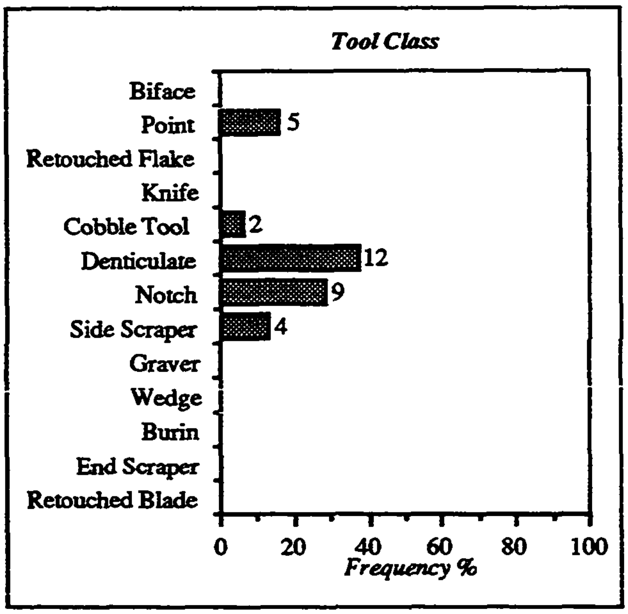


**Fig. 6.32.** Denisova Peshchera Entrance level 10: tool class.

**Table 6.9.** Denisova Peshchera Entrance Level 10: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Single convex side scraper | 2 | 6.3 | Single straight ventral denticulate | 1 | 3.1 |
| Convergent side scraper | 1 | 3.1 | Double straight ventral denticulate | 1 | 3.1 |
| Angle scraper | 1 | 3.1 | Transverse denticulate | 1 | 3.1 |
| Single notch | 6 | 18.8 | Convergent denticulate | 1 | 3.1 |
| Multiple notch | 3 | 9.4 | Convergent alternate denticulate | 2 | 6.3 |
| Single convex denticulate | 2 | 6.3 | Three-sided denticulate | 1 | 3.1 |
| Single concave denticulate | 1 | 3.1 | Chopping tool | 2 | 6.3 |
| Double convex denticulate | 2 | 6.3 | Levallois point | 5 | 15.6 |
| | | | Total | 32 | |

The tool assemblage is Mousterian and dominated by denticulates and notches as well as Levallois points and side scrapers.

## Denisova Peshchera Entrance Level 9

The lithic assemblage studied from Denisova Peshchera Entrance level 9 includes 34 tools and 5 cores. Since excavations are in progress, the results of this analysis are preliminary.

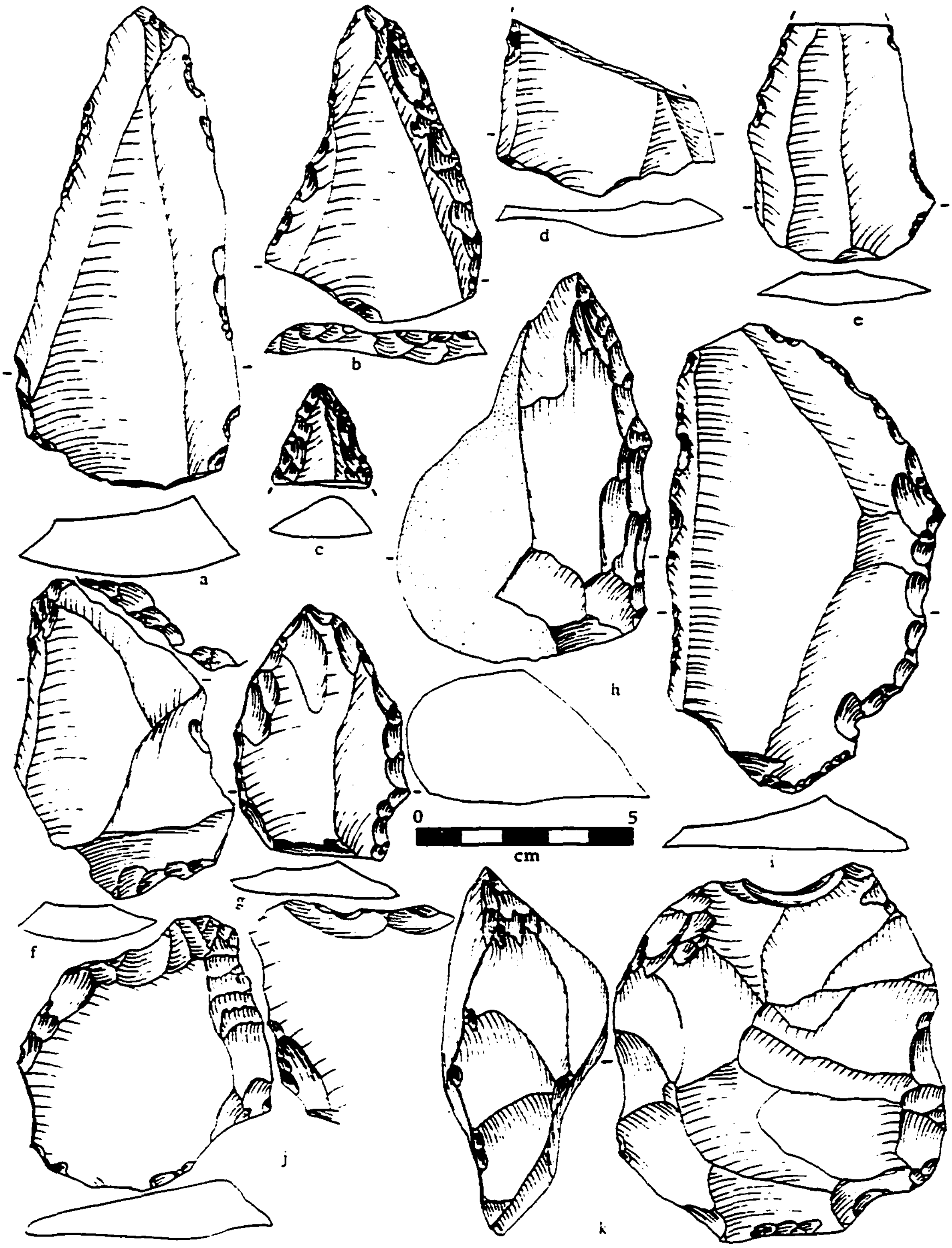


**Fig. 6.33.** Lithic artifacts from Denisova Peshchera Entrance level 10: Levallois points and point fragments (a-e); convergent alternate denticulate (f); convergent scraper (g); single convex side scraper (h); single convex denticulate (i); convergent denticulate (j); Levallois flake core (k).

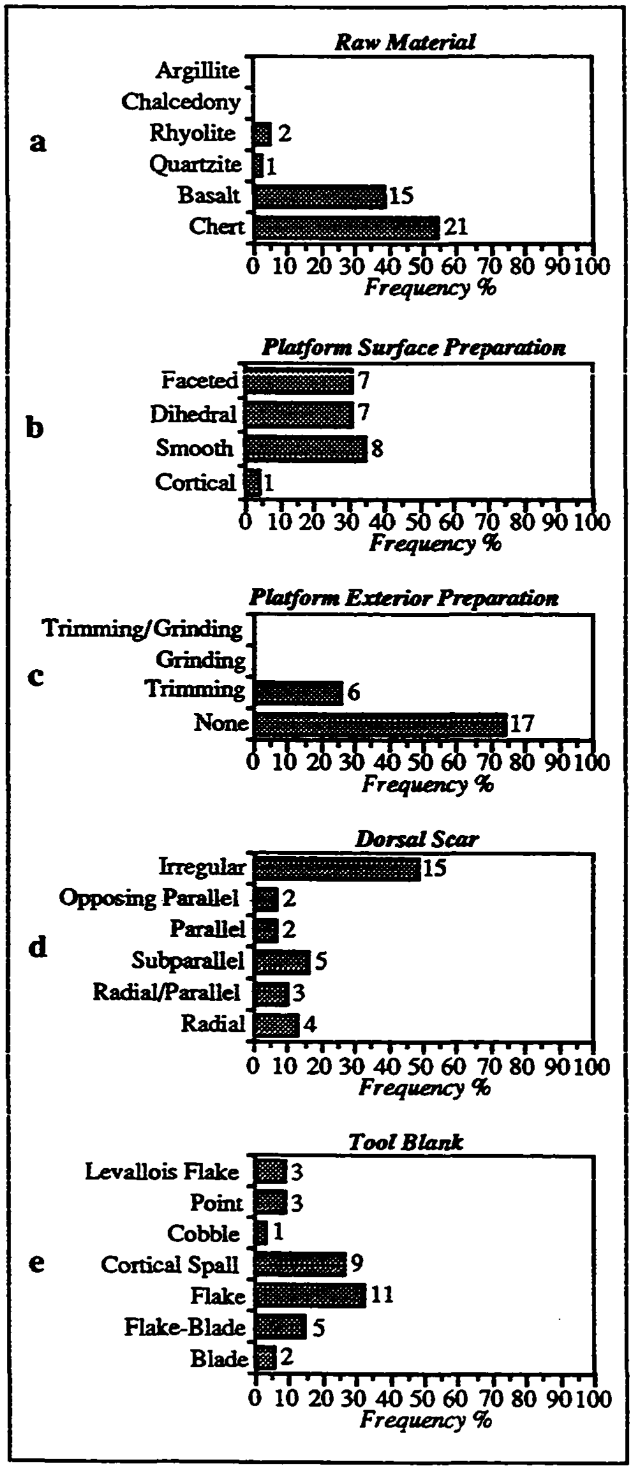


**Fig. 6.34.** Denisova Peshchera Entrance level 9: attributes of primary reduction technology.

*Primary Reduction Technology.* Raw materials are mainly cherts and basalt. Cherts include gray, green, and dark gray varieties (Fig. 6.34:a). Cortex occurs on 13% of all tool blanks; only 3% have more than half their dorsal surfaces covered with cortex. Cores include three monofrontal unidirectional flake cores, one bidirectional flat-faced blade core, and one Levallois flake core (Table 6.10). The flat-faced blade core has a radial/parallel scar pattern and two opposing faceted platforms (Fig. 6.37:k), while the Levallois flake core, although fragmented, has a radially flaked front and counterfront and a faceted platform (Fig. 6.37:h). Platforms on blanks are predominantly faceted or dihedral (Fig. 6.34:b), giving the industry a very high faceting index of 60.8. Exterior platform preparation in the form of trimming occurs on over one-quarter of all blanks (Fig. 6.34:c). Dorsal scar patterns are predominantly irregular,

**Table 6.10.** Denisova Peshchera Level 9: Core Types

| Core type | n | % |
|---|---|---|
| Unidirectional monofrontal flake | 3 | 60.0 |
| Bidirectional monofrontal flat-faced blade | 1 | 20.0 |
| Levallois flake | 1 | 20.0 |
| Total | 5 | |

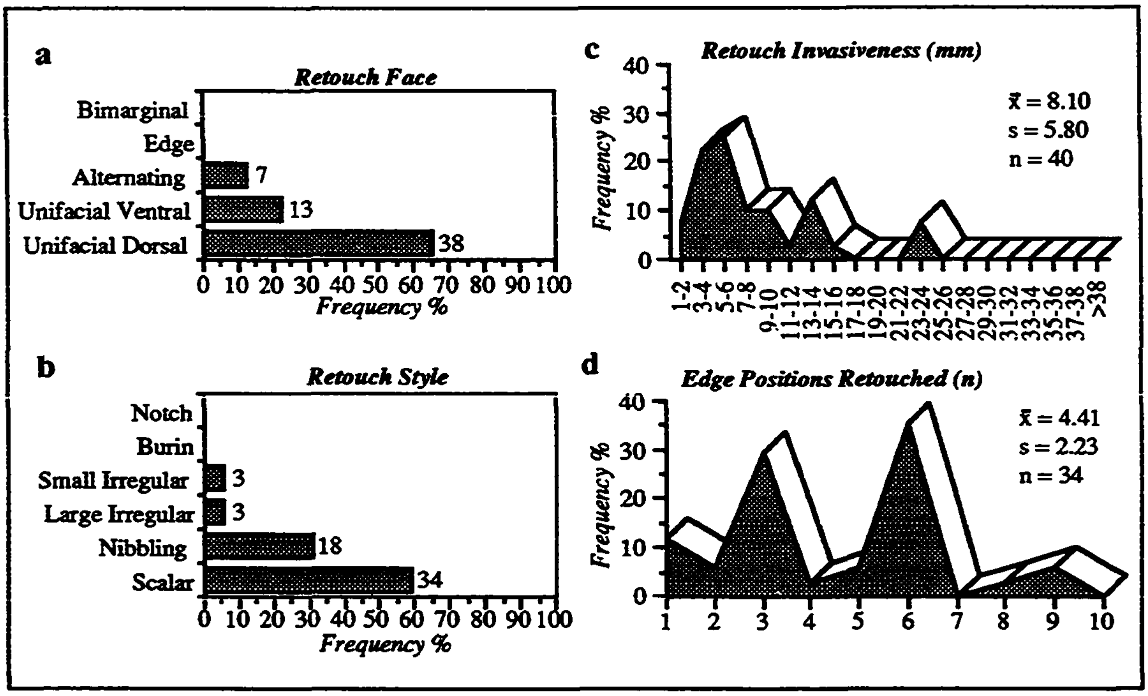


**Fig. 6.35.** Denisova Peshchera Entrance level 9: attributes of secondary reduction technology.

although subparallel, radial, and radial/parallel patterns are also common (Fig. 6.34:d). The majority of tools are manufactured on flakes and cortical spalls, while flake-blades, Levallois flakes, and Levallois points are used less frequently (Fig. 6.34:e). Levallois end products produce a Levallois index of 17.9.

*Secondary Reduction Technology.* Retouching is predominantly unifacial, with the two-thirds of all edges being retouched dorsally and a small proportion ventrally (Fig. 6.35:a). Alternating retouch is found on two notches, two denticulates, one Levallois point, and one retouched flake-blade (Fig. 6.37:b). A majority of edges bear scalar retouch; nibbling retouch is less common (Fig. 6.35:b). Retouch invasiveness is moderate, with 55% of all edges displaying retouch scars less than or equal to 6 mm deep (Fig. 6.35:c). Retouch intensity, however, is high, with over half (53%) the tools displaying four or more retouched edge positions (Fig. 6.35:d).

*Tool Assemblage.* The tool assemblage is characterized by high frequencies of denticulates and notches, as well as moderate frequencies of Levallois points, side scrapers, and retouched flake-blades (Fig. 6.36, Table 6.11). Denticulates are heterogeneous; seven have retouch along one lateral margin and four along two lateral margins (Fig. 6.37:i-j, l; 6.38:m-p). Side scrapers are intensively retouched and include two transverse scrapers and one convergent scraper (Fig. 6.37:d, f). All three Levallois points are fragmentary (Fig. 6.37:a-c).

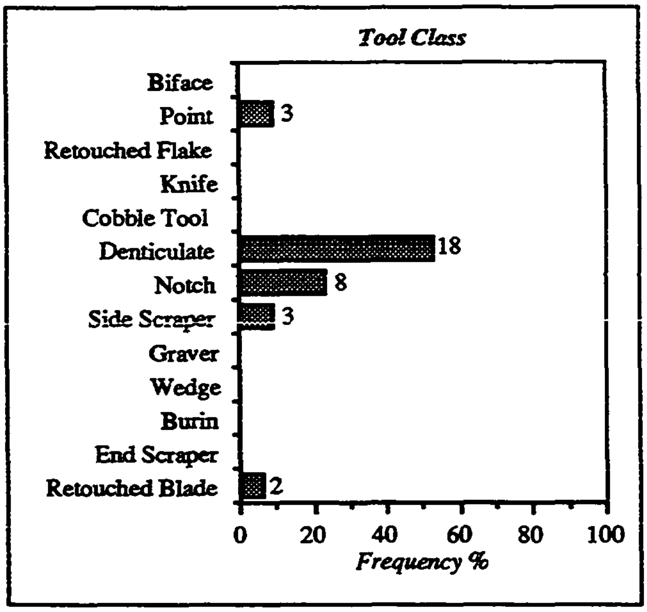


**Fig. 6.36.** Denisova Peshchera Entrance level 9: tool class.

**Table 6.11.** Denisova Peshchera Entrance Level 9: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched flake-blade | 1 | 2.9 | Double straight denticulate | 1 | 2.9 |
| Bilaterally retouched flake-blade | 1 | 2.9 | Single straight ventral denticulate | 1 | 2.9 |
| Straight transverse scraper | 1 | 2.9 | Double straight ventral denticulate | 1 | 2.9 |
| Convex transverse scraper | 1 | 2.9 | Double convex ventral denticulate | 1 | 2.9 |
| Convergent side scraper | 1 | 2.9 | Double straight alternate denticulate | 1 | 2.9 |
| Single notch | 5 | 14.7 | Single straight alternating denticulate | 2 | 5.9 |
| Multiple notch | 3 | 8.8 | Transverse denticulate | 3 | 8.8 |
| Single straight denticulate | 1 | 2.9 | Convergent alternate denticulate | 3 | 8.8 |
| Single convex denticulate | 2 | 5.9 | Three-sided alternate denticulate | 1 | 2.9 |
| Single concave denticulate | 1 | 2.9 | Levallois point fragment | 3 | 8.8 |
| | | | Total | 34 | |

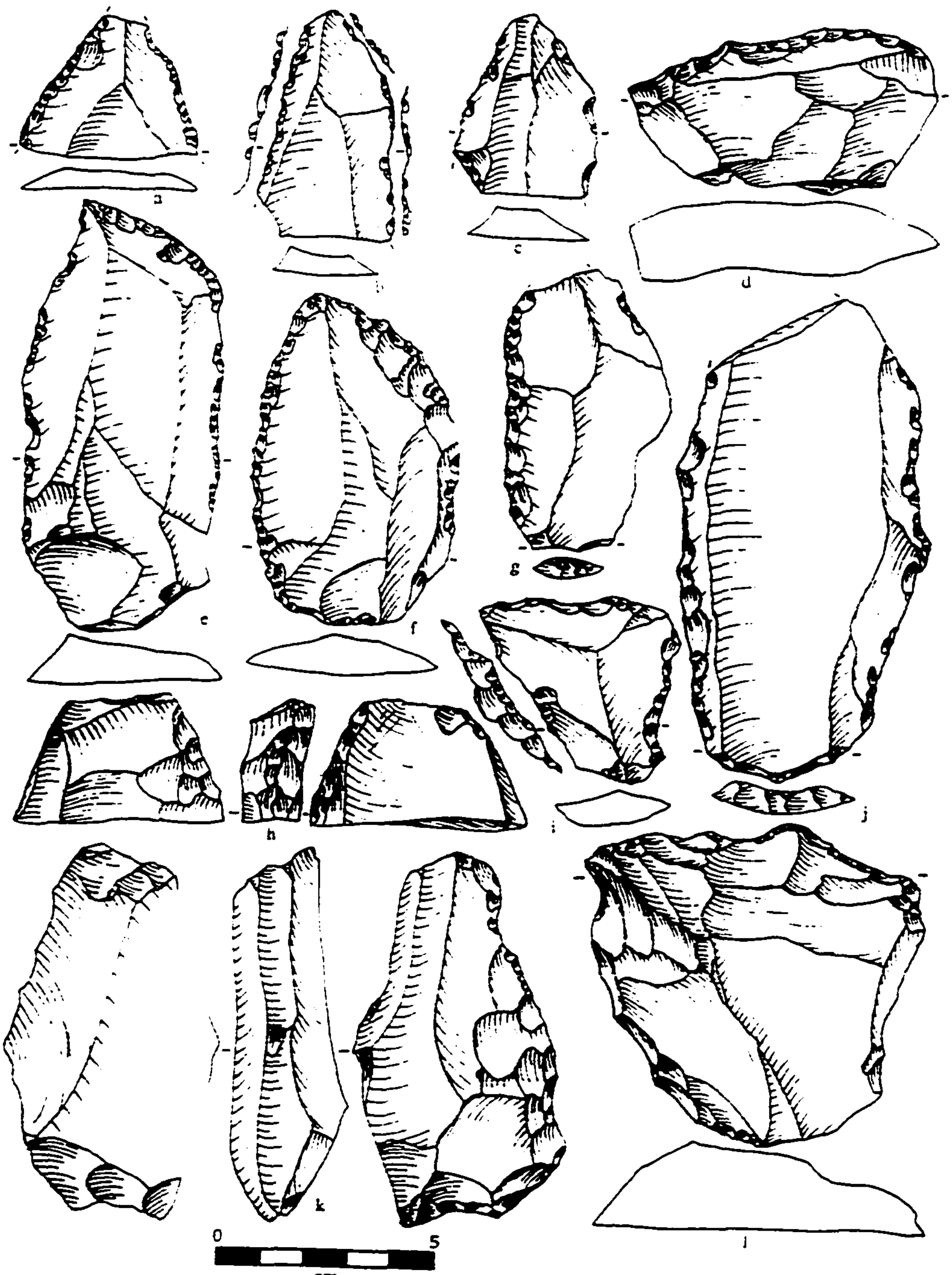

**Fig. 6.37.** Lithic artifacts from Denisova Peshchera Entrance level 9: Levallois point fragments (a-c); convex transverse scraper (d); bilaterally retouched flake-blade (e); convergent scraper (f); unilaterally retouched flake-blade (g); Levallois flake core (h); three-sided alternate denticulate (i); double straight denticulate (j); unidirectional flat-faced blade core (k); transverse denticulate (l).

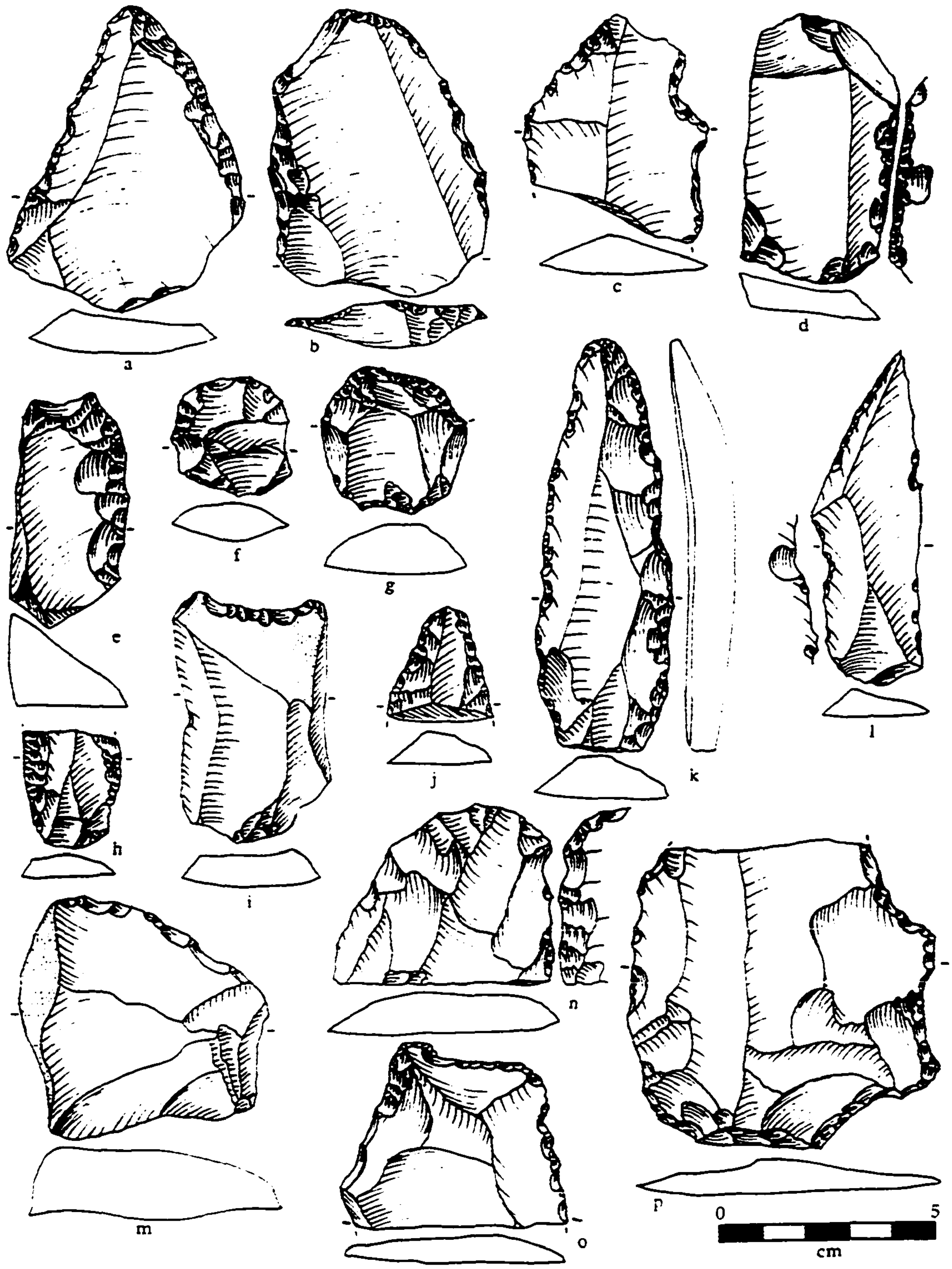


**Fig. 6.38.** Lithic artifacts from Denisova Peshchera Entrance level 9 (m-p) and level 8 (a-l): Levallois points and point fragments (a, b, j); notch (c); smooth-backed knives (d-e); end scrapers on flakes (f, g); bilaterally retouched blades (h); transverse denticulate (i, m); single straight side scraper (k); bilaterally retouched flake-blade (l); convergent alternate denticulate (n); three-sided denticulate (o); single convex denticulate (p).

Overall, this small lithic assemblage appears Levallois and Mousterian. Primary reduction technology is characterized by the production of flakes and points from radially prepared cores and bidirectional flat-faced cores, respectively. Secondary reduction technology is unifacial, scalar, and intensive. The tool assemblage is rich in denticulates and notches, but side scrapers and points are also present.

## Denisova Peshchera Entrance Level 8

The lithic assemblage analyzed here is made up of 89 tools and 16 cores. Since excavations are in progress, the results of the analysis presented below are preliminary.

*Primary Reduction Technology.* Chert is the primary raw material, while basalt, rhyolite, quartzite, and argillite are less common (Fig. 6.39:a). Cherts are heterogeneous and include seven varieties: gray, dark gray, green, reddish-brown, black, light gray, and red. Cortex occurs on 25% of all blanks; however, only 5% are more than half covered with cortex. The 16 cores include seven Levallois flake cores, five simple flake cores, two flat-faced blade cores, one core preform, and one core fragment (Table 6.12). All seven Levallois flake cores display radially prepared fronts and clearly expressed primary Levallois flake removals, and all but one have faceted platforms (Fig. 6.42:d-f). The two flat-faced blade cores are bidirectional with opposing faceted platforms (Fig. 6.42:g). The remaining five flake cores are monofrontal with one (4) or two (1) platforms. Platforms on blanks are predominantly faceted and dihedral (Fig. 6.39:b), leading to a high faceting index of 50.8. Exterior platform preparation is uncommon (Fig. 6.39:c). Most dorsal scar patterns are irregular, but radial, subparallel, and parallel patterns also occur (Fig. 6.39:d). Tools are manufactured primarily on flakes and cortical spalls, while Levallois end products (flakes and points), blades, and flake-blades are less frequently utilized (Fig. 6.39:e).

*Secondary Reduction Technology.* Retouch is chiefly unifacial (dorsal and ventral) (Fig. 6.40:a). Alternating retouch occurs on ten tools (four denticulates, two notches, two points, one retouched blade, and one knife), and bimarginal retouch occurs on one knife (Fig 6.38:d). Scalar retouch is the most prevalent retouch style (Fig. 6.40:b), and retouch invasiveness is relatively high. The majority (57%) of edges display retouch scars more than 6 mm deep (Fig. 6.40:c). Retouch intensity, however, is very low, with only 36% of all tools having four or more retouched edge positions (Fig. 6.40:d).

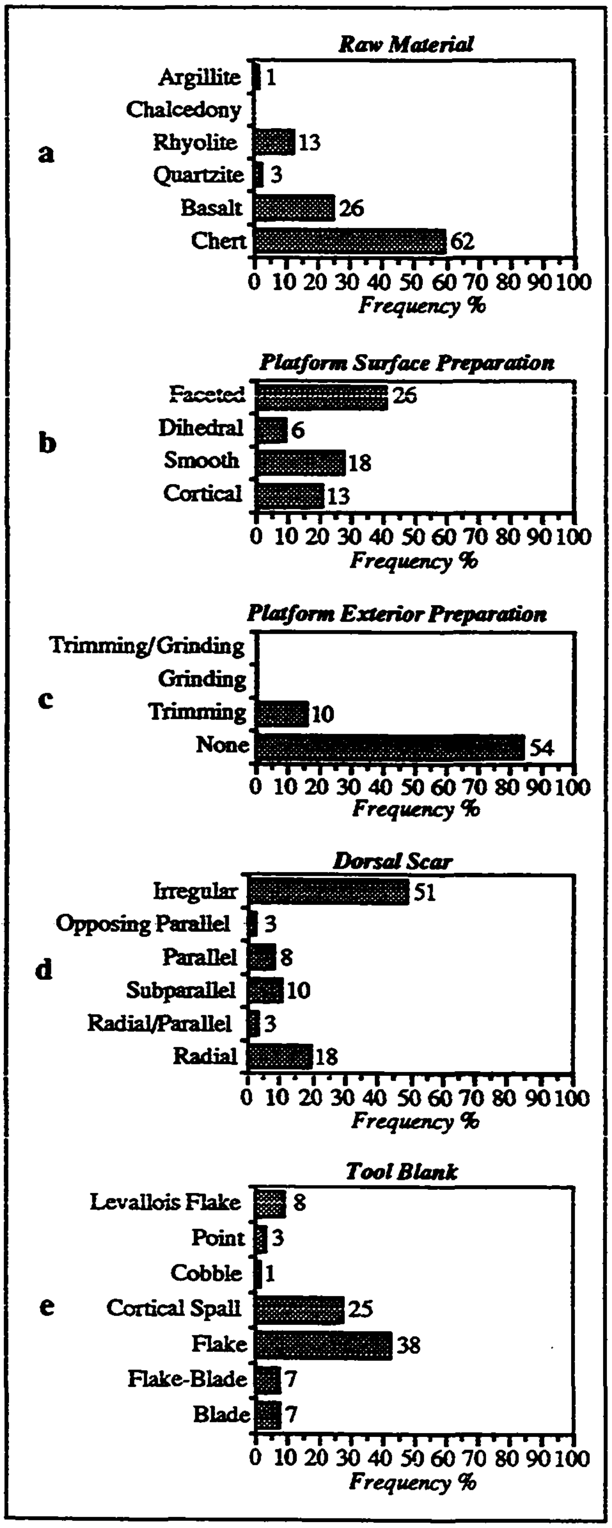


**Fig. 6.39.** Denisova Peshchera Entrance level 8: attributes of primary reduction technology.

*Tool Assemblage.* The tool assemblage is rich in denticulates and notches, while retouched blades, retouched flakes, Levallois points, side scrapers, end scrapers, and knives occur less frequently (Fig. 6.41). Denticulates are heterogeneous and include single sided, double sided, transverse, and convergent types (Table 6.13) (Fig. 6.38:i; 6.42:a, h). Two of four Levallois points are complete (Fig. 6.38:a-b); the remaining point fragments are tip sections (Fig. 6.38:j; 5.42:j).

The preponderance of radially prepared cores, faceted platforms, and Levallois end products in this industry indicates that the primary reduction technology is Levallois. Secondary reduction technology is characterized by unifacial, scalar, and invasive yet unintensive retouch. Denticulates, notches, side scrapers, and points typify

**Table 6.12.** Denisova Peshchera Entrance Level 8: Core Types

| Core type | n | % |
|---|---|---|
| Core fragment | 1 | 6.3 |
| Unidirectional monofrontal flake | 4 | 25.0 |
| Bidirectional monofrontal flake | 1 | 6.3 |
| Bidirectional monofrontal flat-faced blade | 2 | 12.5 |
| Levallois flake | 7 | 43.8 |
| Core preform | 1 | 6.3 |
| Total | 16 | |

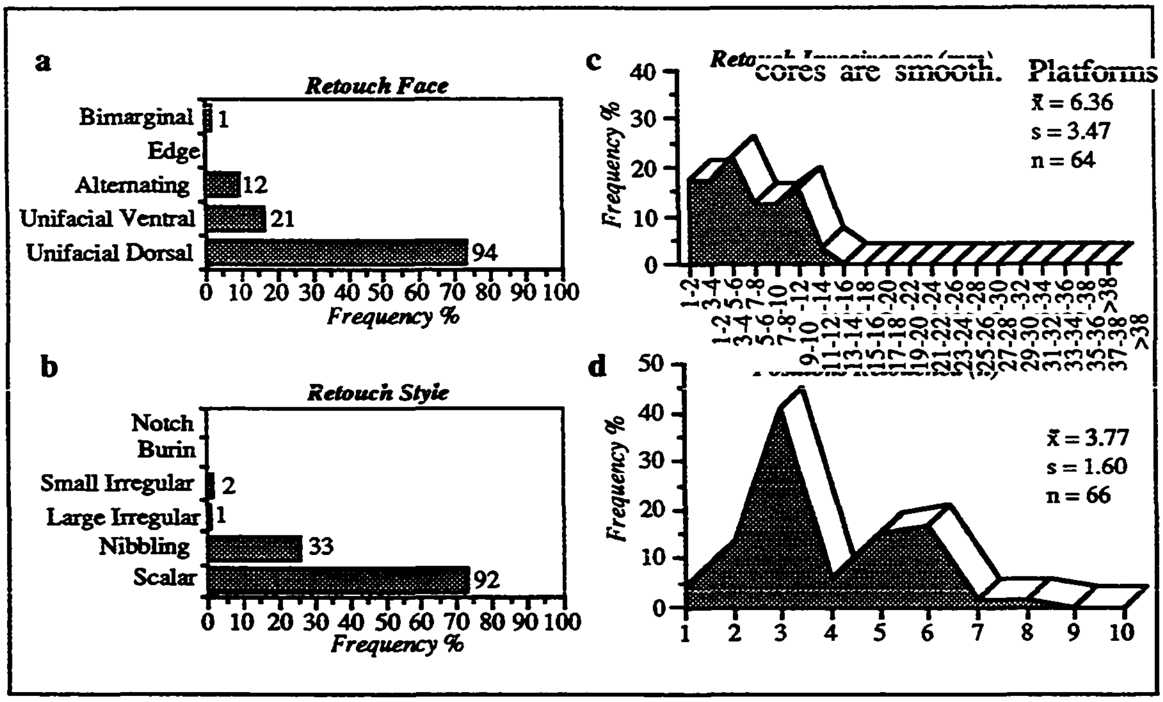


**Fig. 6.40. Denisova Peshchera Entrance level 8: attributes of secondary reduction technology.**

the tool assemblage, giving it a decidedly Mousterian quality. The presence of retouched blades and end scrapers, however, is unusual; these tool types are more commonly found in later Upper Paleolithic industries in the region.

## Denisova Peshchera Entrance Level 7

This assemblage consists of 66 tools and two cores. It has not been previously described, and since excavations are in progress, results presented here are preliminary.

*Primary Reduction Technology.* Raw materials include chert, quartzite, rhyolite, and basalt (Fig. 6.43:a). Cherts are mostly gray, with occasional examples of dark gray, green, reddish-brown, light gray, red, and white varieties. Cortex is seen on 27% of all blanks; only 9% display cortex on more than half their dorsal surfaces. Cores include one flake core with two platforms and three fronts and one unidirectional subprismatic blade core. The subparallel scars on the front of the latter were produced through the removal of a series of small bladelets and microblades (Fig. 6.46:l). Platforms on both cores are smooth. Platforms on blanks are usually smooth, occasionally faceted, and

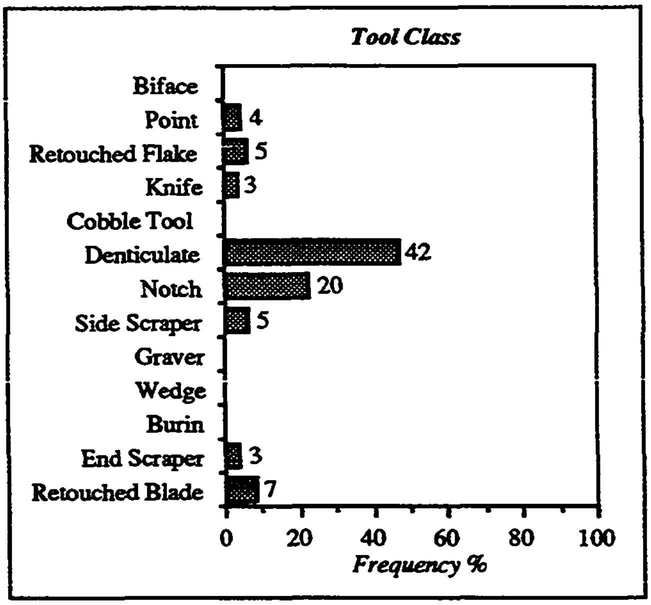


**Fig. 6.41.** Denisova Peshchera Entrance level 8: tool class.

**Table 6.13.** Denisova Peshchera Entrance Level 8: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 1 | 1.1 | Double straight ventral denticulate | 1 | 1.1 |
| Unilaterally retouched ventral blade | 1 | 1.1 | Double convex ventral denticulate | 2 | 2.2 |
| Bilaterally retouched blade | 3 | 3.4 | Single straight alternating denticulate | 2 | 2.2 |
| Bilaterally retouched flake-blade | 2 | 2.2 | Double straight alternate denticulate | 2 | 2.2 |
| End scraper on flake | 3 | 3.4 | Convex-concave alternate denticulate | 1 | 1.1 |
| Single straight side scraper | 4 | 4.5 | Transverse denticulate | 6 | 6.7 |
| Straight transverse scraper | 1 | 1.1 | Transverse ventral denticulate | 1 | 1.1 |
| Single notch | 11 | 12.4 | Transverse alternating denticulate | 1 | 1.1 |
| Multiple notch | 9 | 10.1 | Convergent denticulate | 2 | 2.2 |
| Single straight denticulate | 11 | 12.4 | Convergent alternate denticulate | 1 | 1.1 |
| Single convex denticulate | 6 | 6.7 | Naturally backed knife | 1 | 1.1 |
| Single concave denticulate | 1 | 1.1 | Smooth-backed knife | 2 | 2.2 |
| Double straight denticulate | 3 | 3.4 | Retouched flake | 5 | 5.6 |
| Single straight ventral denticulate | 1 | 1.1 | Levallois point | 3 | 3.4 |
| Single convex ventral denticulate | 1 | 1.1 | Levallois point fragment | 1 | 1.1 |
| | | | Total | 89 | |

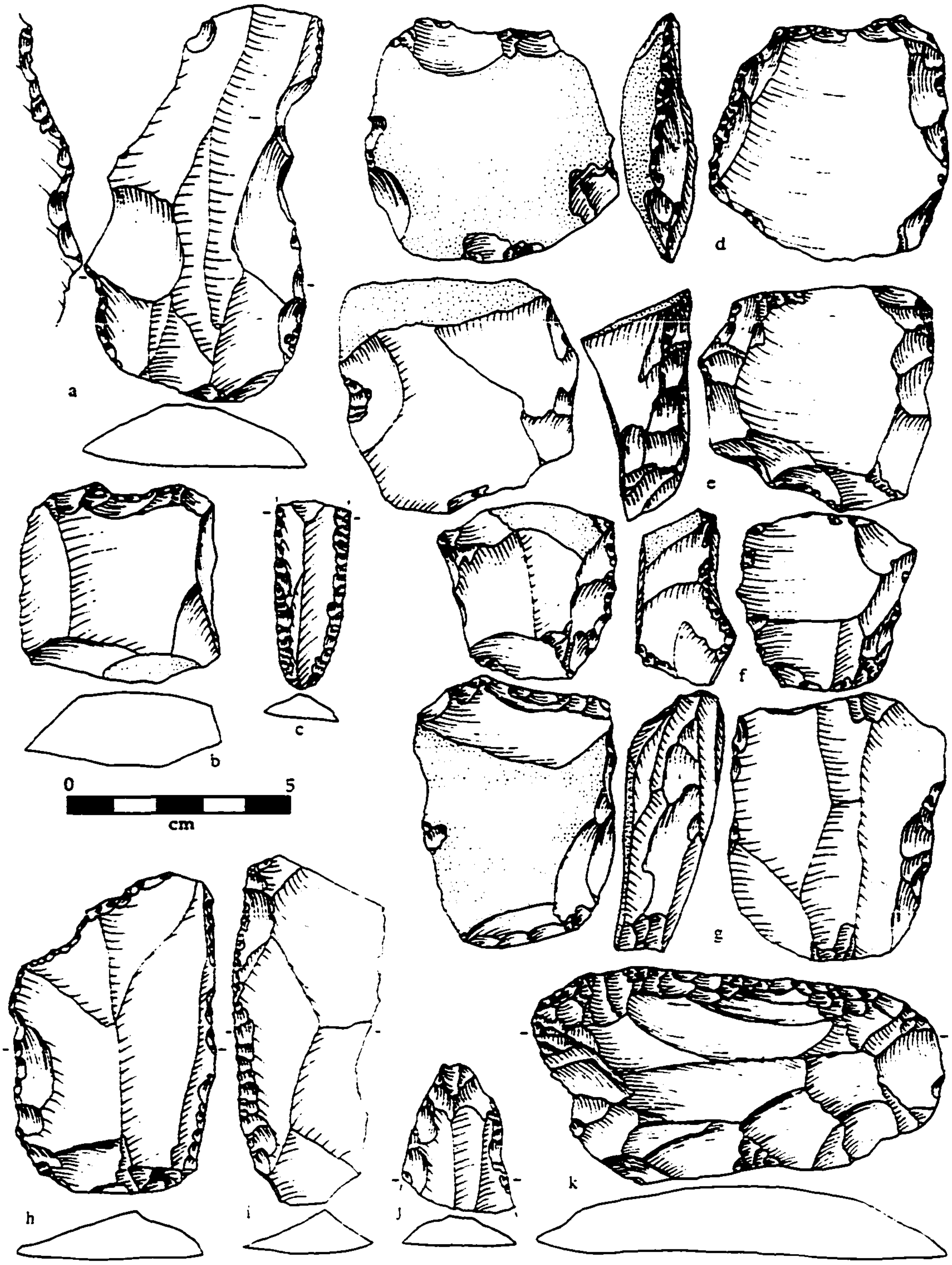


**Fig. 6.42.** Lithic artifacts from Denisova Peshchera Entrance level 8: double straight alternate denticulate (a); notch (b); bilaterally retouched blade (c); Levallois flake cores (d-f); bidirectional flat-faced blade core (g); convergent denticulate (h); single straight side scraper (i); Levallois point fragment (j); straight transverse side scraper (k).

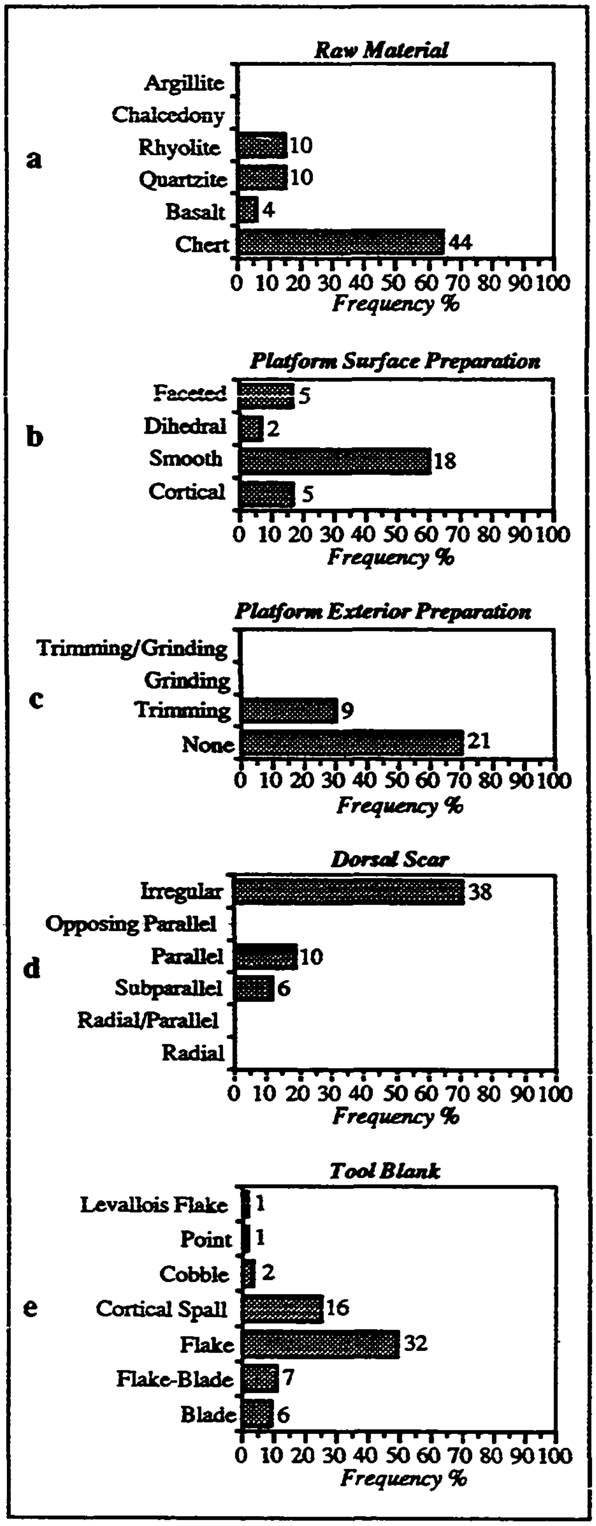


**Fig. 6.43.** Denisova Peshchera Entrance level 7: attributes of primary reduction technology.

seldom dihedral (Fig. 6.43:b), giving the assemblage a relatively low faceting index of 23.4. Exterior platform preparation (trimming) occurs on one-third of all blanks (Fig. 6.43:c). Dorsal scar patterns are chiefly irregular, while parallel and subparallel patterns are less common (Fig. 6.43:d). Nearly half the tools are made on flakes; the remainder are made on cortical spalls, blades or flake-blades, and only 3% on Levallois end products (one flake and one point) (Fig. 6.43:e).

*Secondary Reduction Technology.* Retouch is predominantly unifacial (Fig. 6.44:a). Four burins display edge retouch. Retouch styles are for the most part scalar; however, nibbling and small irregular retouch occur on one-third of all edges (Fig. 6.44:b). Retouch invasiveness is moderate, with 44% of all edges bearing scars greater than 6 mm deep (Fig. 6.44:c). Likewise, retouch intensity is moderate, with 41% of all tools displaying retouch on four or more edge positions (Fig. 6.44:d).

*Tool Assemblage.* The assemblage of tools is diverse, with moderate frequencies of denticulates, notches, retouched flakes, retouched blades, knives, side scrapers, burins, and end scrapers, as well as one Levallois point and one cobble tool (Fig. 6.45). Denticulates have single (46%) or double (54%) retouched lateral

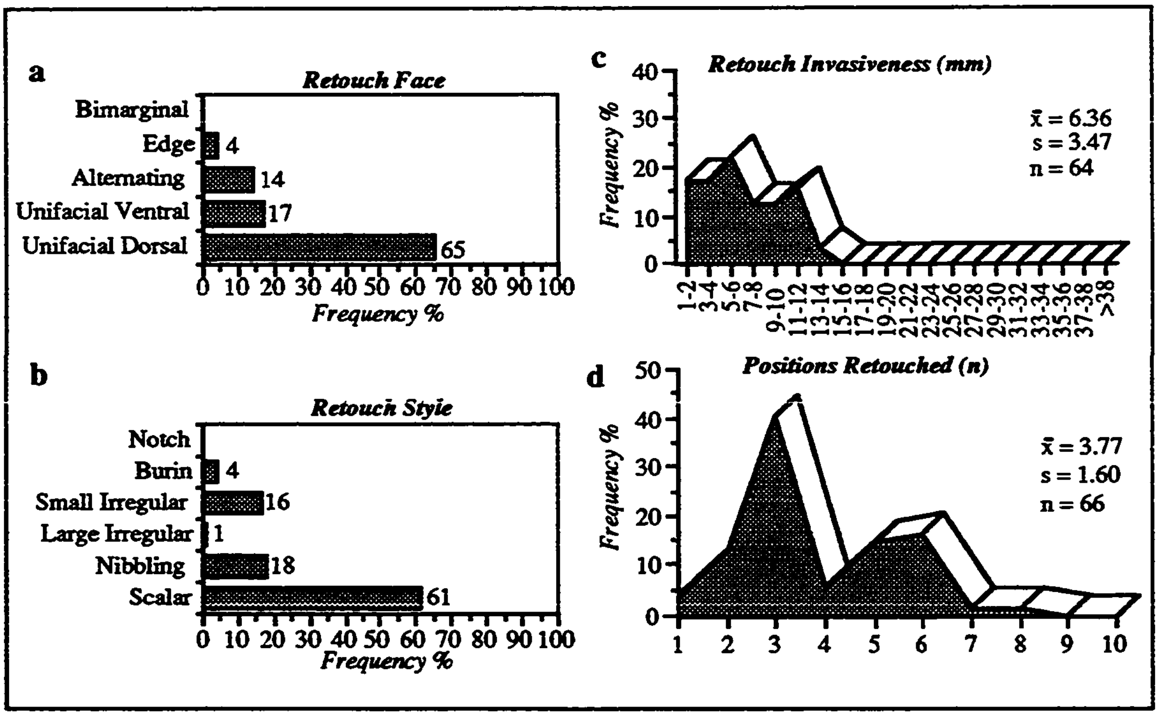


**Fig. 6.44.** Denisova Peshchera Entrance level 7: attributes of secondary reduction technology.

margins (Table 6.14). Most of the unilaterally and bilaterally retouched blades display very regular edges and arises (Fig. 6.46:e-g), and appear to have been removed from small, well-prepared blade cores like that shown in Fig. 6.46:l. The retouched flake-blades are larger and wider (Fig. 6.46:i, o-p), perhaps detached from flat-faced parallel blade cores. These may be by-products of a Levallois point technology. Knives are predominantly smooth-backed (Fig. 6.46:j, k), and all burins are angle burins (Fig. 6.46:c-d). Side scrapers include single straight, single convex, double convex, and convex-concave varieties (Fig. 6.46:m). All end scrapers are made on flakes (Fig. 6.46:a-b); one in particular is nosed and made on a broad Levallois flake (Fig. 6.46:n). The single Levallois point is unbroken.

This industry is difficult to characterize. Primary reduction technology seems to be directed toward the production of flakes and cortical spalls for use as tools; however, blades and flake-blades were also frequently produced and used. Levallois end products (points and flakes) are present but rare. Secondary reduction technology is characterized as unifacial, scalar, and moderately invasive and intensive. The tool assemblage is heterogeneous, with much diversity at the class level. Overall the tool assemblage appears Mousterian, with high frequencies of denticulates and side scrapers, and the presence of a Levallois point. Nevertheless, the variety of raw materials, and the

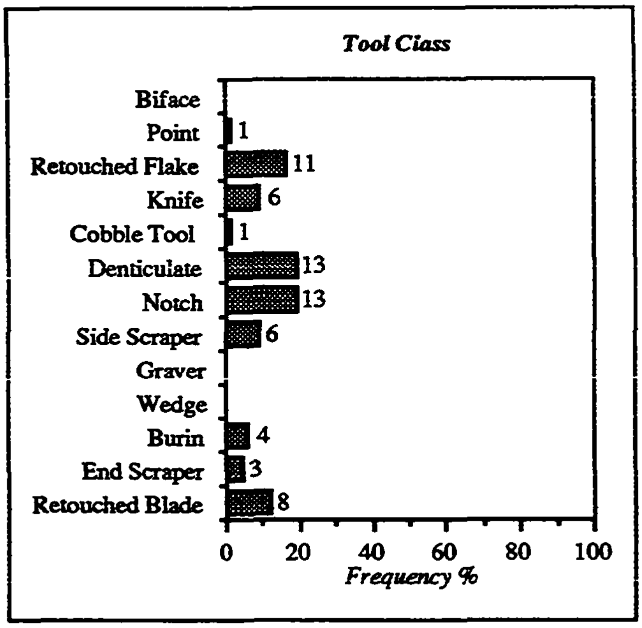


**Fig. 6.45.** Denisova Peshchera Entrance level 7: tool class.

**Table 6.14.** Denisova Peshchera Entrance Level 7: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 2 | 3.0 | Single straight denticulate | 3 | 4.5 |
| Bilaterally retouched blade | 2 | 3.0 | Single convex denticulate | 1 | 1.5 |
| Unilaterally retouched flake-blade | 3 | 4.5 | Double straight denticulate | 3 | 4.5 |
| Bilaterally retouched flake-blade | 1 | 1.5 | Double convex denticulate | 2 | 3.0 |
| End scraper on flake | 2 | 3.0 | Single straight ventral denticulate | 2 | 3.0 |
| Nosed end scraper | 1 | 1.5 | Double straight ventral denticulate | 1 | 1.5 |
| Angle burin | 4 | 6.1 | Double convex ventral denticulate | 1 | 1.5 |
| Single straight side scraper | 1 | 1.5 | Chopper | 1 | 1.5 |
| Single convex side scraper | 1 | 1.5 | Naturally backed knife | 1 | 1.5 |
| Double convex side scraper | 2 | 3.0 | Smooth-backed knife | 5 | 7.6 |
| Convex-concave side scraper | 1 | 1.5 | Retouched flake | 6 | 9.1 |
| Straight transverse scraper | 1 | 1.5 | Retouched ventral flake | 4 | 6.1 |
| Single notch | 10 | 15.2 | Retouched alternate flake | 1 | 1.5 |
| Multiple notch | 3 | 4.5 | Levallois point | 1 | 1.5 |
| | | | Total | 66 | |

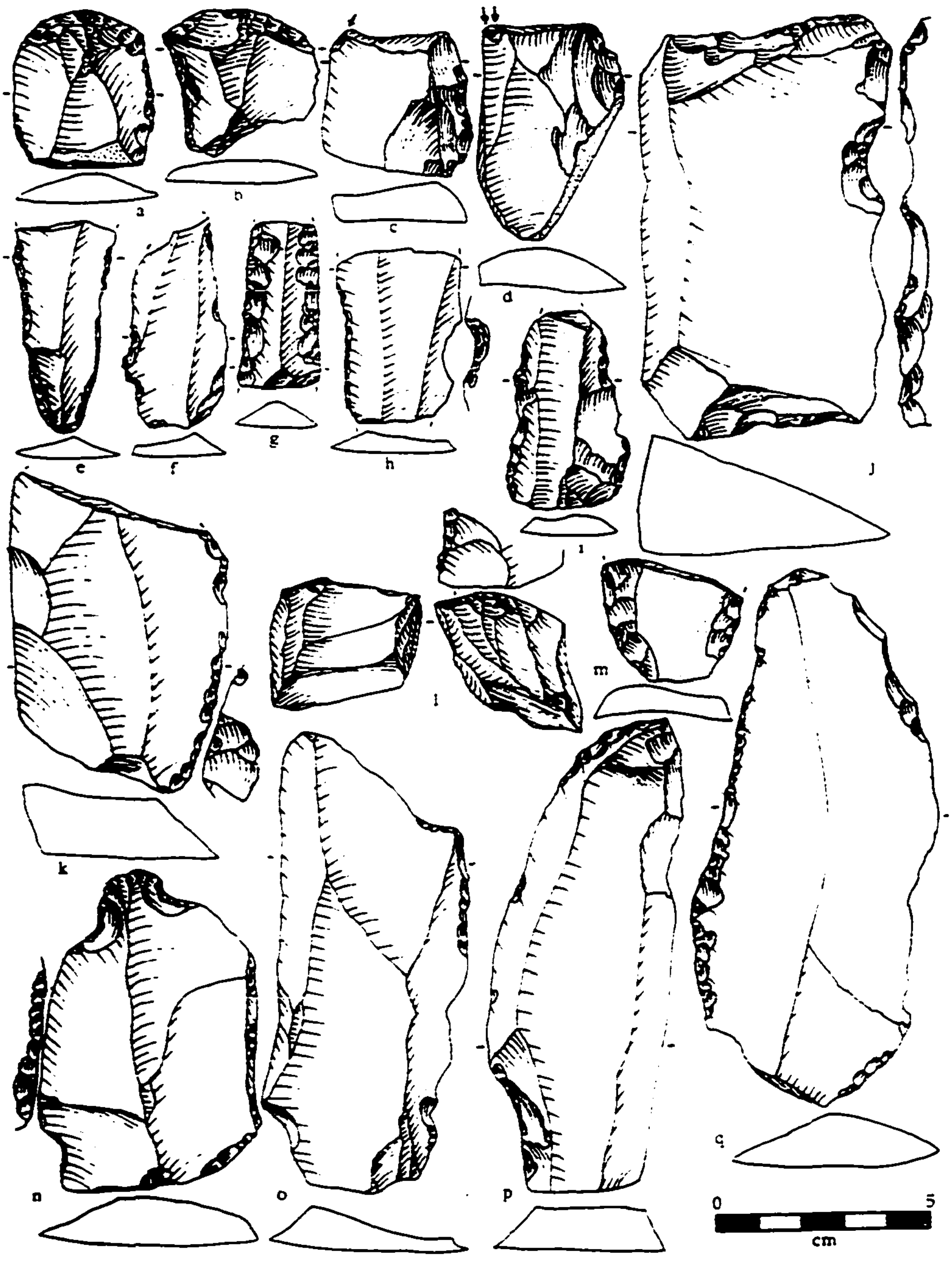


**Fig. 6.46. Lithic artifacts from Denisova Peshchera Entrance level 7: end scrapers on flakes (a, b); angle burins (c, d); bilaterally retouched blades (e, g); unilaterally retouched blade (f); notch (h); bilaterally retouched flake-blade (i); smooth-backed knives (j, k); end core (l); double convex side scraper (m); nosed end scraper (n); unilaterally retouched flake-blades (o, p); bilaterally retouched flake-blade with cortex (q).**

presence of a small prismatic blade core and numerous retouched bladelets, angle burins, and end scrapers are peculiar.

### Kara-Bom Component I

The lithic assemblage from Kara-Bom component I includes artifacts recovered in 1990 by Petrin. Descriptions of this material have not been published. Excavations are still in progress; additional Mousterian artifacts were recovered from component I during 1991 and 1992. Therefore, the results of the present analysis should be considered tentative. The sample is relatively small, consisting of 52 tools and eight cores.

*Primary Reduction Technology.* Raw materials are almost exclusively a dark gray chert locally available in alluvium of the Semisart River and Altairy Creek (Fig. 6.47:a). Cortex occurs on 22% of all blanks; 7% display cortex on more than half their dorsal surfaces. Cores include four Levallois flake cores, two flat-faced blade cores (Fig. 6.50:l), one unidirectional Levallois point core (Fig. 6.50:j), and one core fragment (Table 6.15). All four Levallois flake cores are radially prepared with faceted platforms. The Levallois point core is triangular in outline and has a single faceted platform. Surface platform preparation on blanks is predominantly faceted and dihedral (Fig. 6.47:b), leading to an extremely high faceting index of 75.4. Nearly one-third of the blanks have some platform exterior preparation (Fig. 6.47:c). Dorsal scar patterns are predominantly subparallel and opposing parallel (Fig. 6.47:d). Very few tools, however, are made on blades or flake-blades. Instead the majority of tools are made on Levallois points (Fig. 6.47:e).

*Secondary Reduction Technology.* Retouch is characteristically unifacial (Fig. 6.48:a). Alternating retouch occurs on 13 tools, including six denticulates, two Levallois points, two retouched blades, two side scrapers, and one knife (Fig. 6.50:b, 6.51:b), while bimarginal retouch occurs on one denticulate (Fig. 6.51:a). Retouch styles are heterogeneous, with a small majority showing scalar retouch and the remainder nibbling or small irregular retouch (Fig. 6.48:b). Retouch invasiveness is low, with 67% of all edges bearing retouch scars less than or equal to 6 mm deep (Fig. 6.48:c). Retouch intensity, however, is moderate; 44% of all tools have four or more retouched edge positions (Fig. 6.48:d).

*Tool Assemblage.* The tool assemblage is rich in Levallois points and denticulates, while side scrapers, notches, knives, and retouched blades are less common (Fig. 6.49,

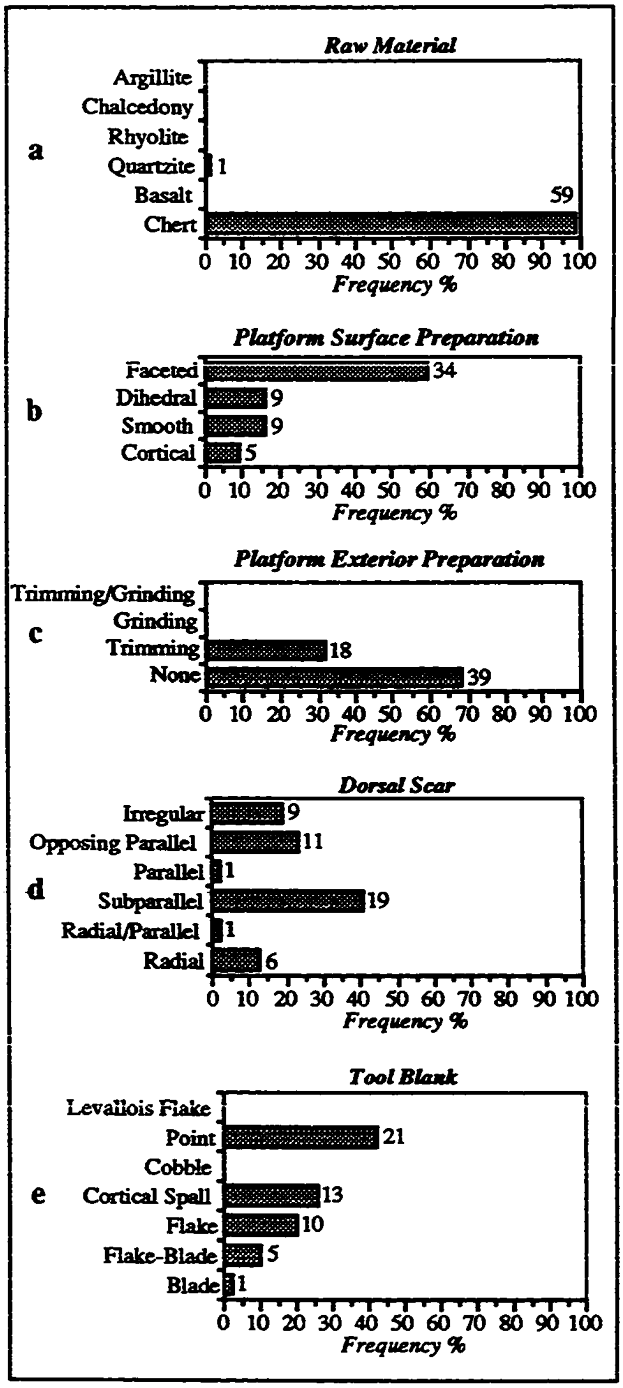


**Fig. 6.47.** Kara-Bom component I: attributes of primary reduction technology.

Table 6.16). The majority of points are complete and only marginally and irregularly retouched (Fig. 6.50:b-i, m; 6.51:b, d, h-i). Ten of 14 denticulates are worked along two or more margins (Fig. 6.50:a; 6.51:a). The one burin in the assemblage is an angle burin with two overlapping burin facets (Fig. 6.51:f). The end scraper is nosed and is combined with a notch along the right lateral margin (Fig. 6.51:j). It is made on a large Levallois flake.

The primary reduction technology of this industry, then, is primarily directed toward the production of Levallois points, which make up nearly half of the tool assemblage. Point core preparation involved the faceting of opposing platforms, as well as the bidirectional removal of a series of elongate, parallel flake-blades.

**Table 6.15.** Kara-Bom Component I: Core Types

| Core type | n | % |
|---|---|---|
| Core fragment | 1 | 12.5 |
| Bidirectional monofrontal flat-faced blade | 2 | 25.0 |
| Unidirectional monofrontal Levallois point | 1 | 12.5 |
| Levallois flake | 4 | 50.0 |
| Total | 8 | |

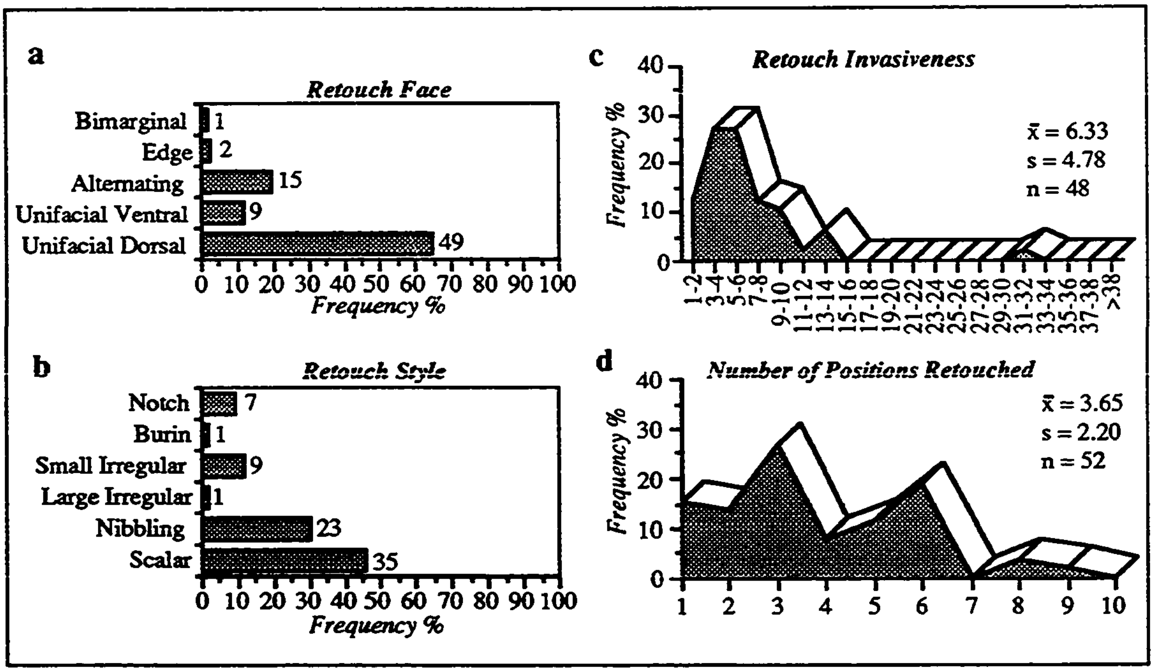


**Fig. 6.48.** Kara-Bom component I: features of secondary reduction technology.

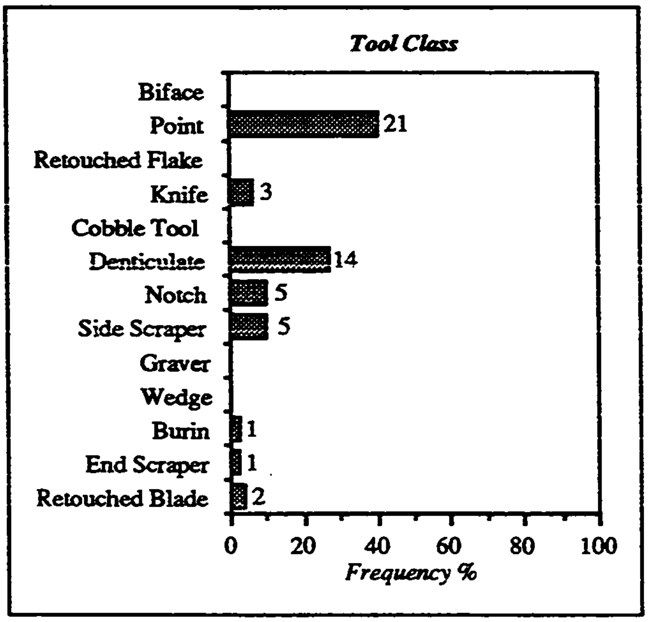


**Fig. 6.49.** Kara-Bom component I: tool class.

**Table 6.16.** Kara-Bom Component I: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Bilaterally retouched flake-blade | 2 | 3.8 | Straight-concave denticulate | 1 | 1.9 |
| Nosed end scraper | 1 | 1.9 | Double concave ventral denticulate | 1 | 1.9 |
| Angle burin | 1 | 1.9 | Transverse denticulate | 1 | 1.9 |
| Single straight side scraper | 1 | 1.9 | Transverse alternate denticulate | 1 | 1.9 |
| Double straight side scraper | 2 | 3.8 | Convergent denticulate | 1 | 1.9 |
| Single convex side scraper | 1 | 1.9 | Convergent alternate denticulate | 1 | 1.9 |
| Straight-convex side scraper | 1 | 1.9 | Three-sided denticulate | 1 | 1.9 |
| Single notch | 4 | 7.7 | Three-sided alternate denticulate | 1 | 1.9 |
| Multiple notch | 1 | 1.9 | Naturally backed knife | 2 | 3.8 |
| Single convex denticulate | 2 | 3.8 | Smooth-backed knife | 1 | 1.9 |
| Double straight denticulate | 2 | 3.8 | Levallois point fragment | 3 | 5.7 |
| Double convex denticulate | 1 | 1.9 | Levallois point | 13 | 25 |
| Double convex ventral denticulate | 1 | 1.9 | Atypical Levallois point | 5 | 1.9 |
| | | | Total | 52 | |

Secondary reduction technology is heterogeneous, with nearly equal proportions of scalar and nibbling retouch. Retouch invasiveness is low, and retouch intensity is moderate. The tool assemblage is Mousterian and includes, in addition to Levallois points, a number of denticulates, side scrapers, and notches.

## INTERASSEMBLAGE STATISTICAL COMPARISONS

### Univariate Results

Table 6.17 provides results of contingency table analyses of lithic variables by site. Analysis of variance (ANOVA) results of retouch invasiveness and retouch intensity are presented in Table 6.18. These univariate analyses reveal significant variation between sites for nearly every variable, but do not reveal a consistent, comprehensible pattern.

#### *Primary Reduction Technology*

Contingency table analysis indicates a significant difference ($p < .001$) in proportions of raw material type (chert, quartzite, argillite, or other)between sites. Three assemblages

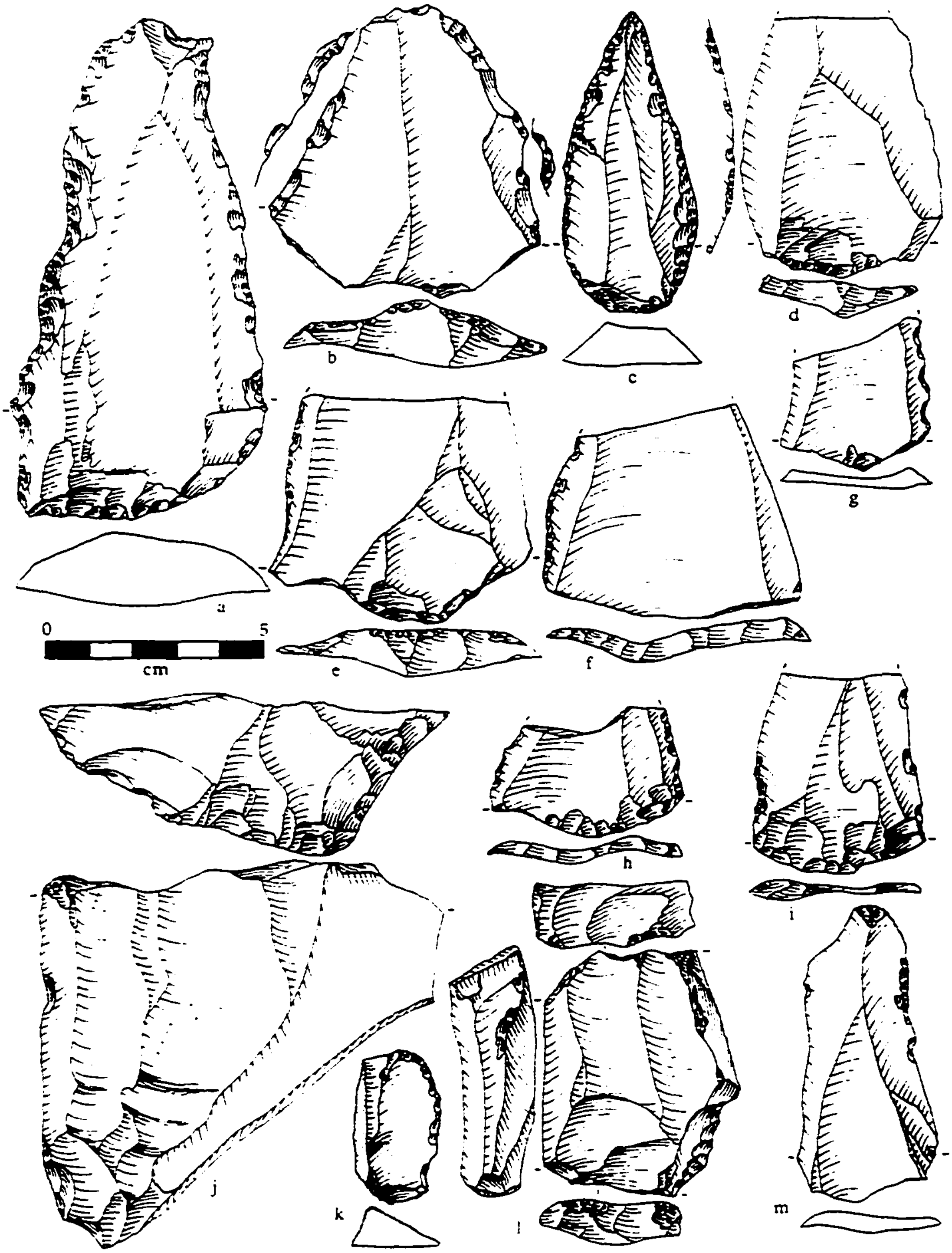


**Fig. 6.50.** Lithic artifacts from Kara-Bom component I: double straight denticulate (a); atypical Levallois point (b); Levallois points and point fragments (c-i, m); Levallois point core (j); cortically backed knife (k); bidirectional flat-faced blade core (l).

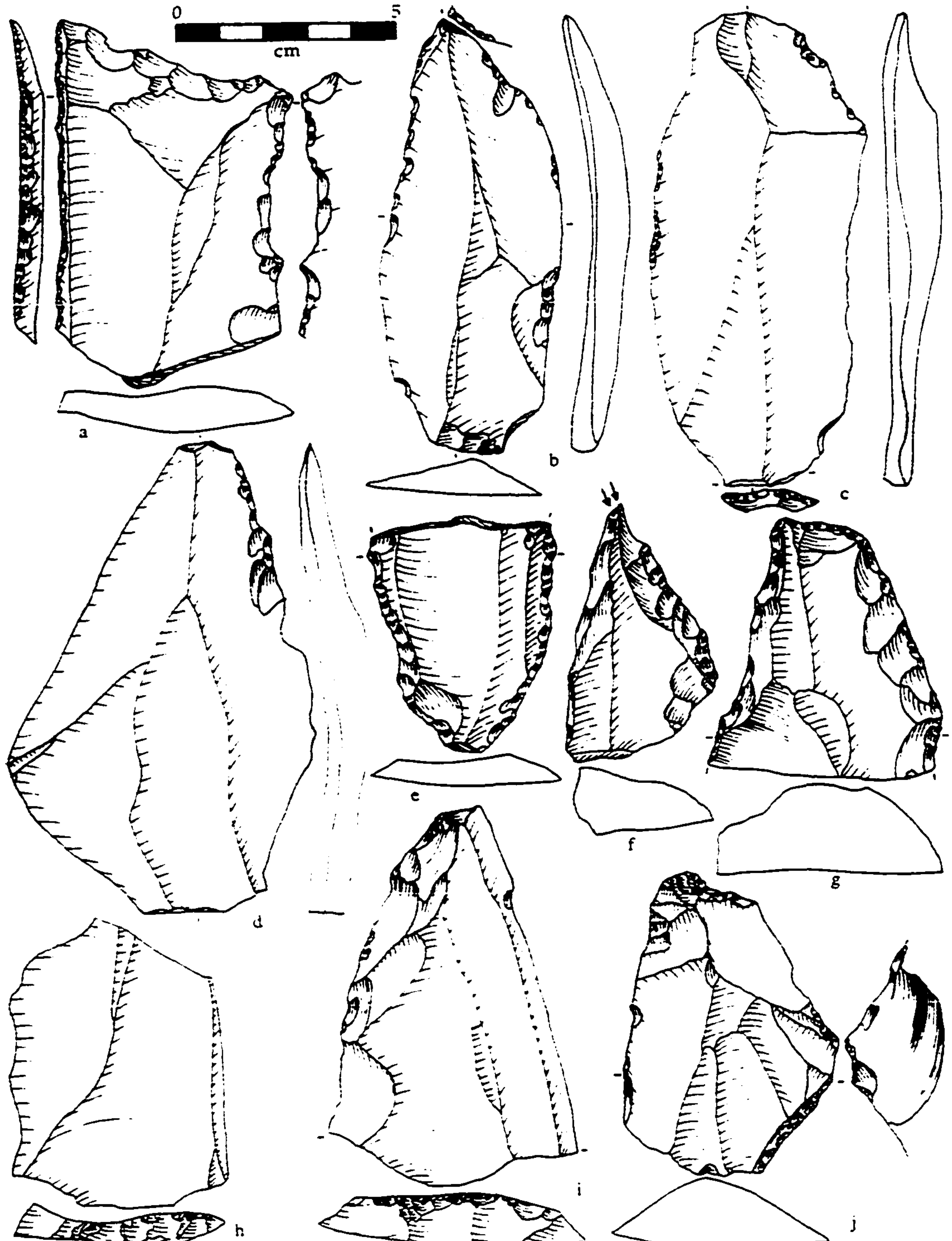


**Fig. 6.51.** Lithic artifacts from Kara-Bom component I: three-sided denticulate (a); Levallois points and point fragments (b, h, i); atypical Levallois point (d); bilaterally retouched flake-blade (i); double straight side scraper (e); angle burin (f); single convex side scraper (g); nosed end scraper (j).

**Table 6.17.** Contingency Table Analysis of Type Frequencies for Various Artifact Features between Seven Mousterian Assemblages

| Artifact feature | Sample size | G statistic | df | P |
|---|---|---|---|---|
| Raw material | 699 | 169.106 | 18 | <.001 |
| Presence of platform surface preparation | 457 | 7.099 | 6 | .312 |
| Technique of platform surface preparation | 432 | 47.642 | 12 | <.001 |
| Presence of platform exterior preparation | 460 | 15.532 | 6 | .017 |
| Dorsal scar | 517 | 77.000 | 12 | <.001 |
| Tool blank | 669 | 64.739 | 18 | <.001 |
| Retouch face | 1026 | 66.291 | 12 | <.001 |
| Retouch style | 1023 | 104.599 | 18 | <.001 |
| Major tool group | 674 | 134.785 | 18 | <.001 |

are distinctive in terms of raw material. Strashnaia Peshchera has a high frequency of quartzite and a low frequency of argillite; Kara-Bom component I has a large amount of chert, and Peshchera Okladnikov level 1 has a high proportion of "other" raw materials (rhyolite, chalcedony, and basalt). Presence of platform surface preparation does not vary significantly among sites. However, when present, platform surface preparation type (smooth, dihedral, faceted) does differ significantly ($p < .001$). Two industries (Kara-Bom component I and Peshchera Okladnikov level 2) exhibit faceted platforms more frequently than expected, while three industries (Peshchera Okladnikov levels 1, 6, and 7) show faceted platforms less frequently than expected. The presence of platform exterior preparation differs significantly ($p = .017$) by site. At Strashnaia Peshshcera and Peshchera Okladnikov level 1 platform exterior preparation occurs in unusually low and high frequencies, respectively. Differences between sites are significant ($p < .001$) for dorsal scar patterns (irregular, radial, and parallel). Strashnaia Peshchera and Kara-Bom component I have high frequencies of blanks with parallel scars, while the remaining industries have high frequencies of blanks with irregular scars. Frequencies of radial scar patterns are constant across all industries. Contingency table analysis indicates a significant difference exists among the seven industries in the frequencies of tool blank types (cortical spall, Levallois spall, flake, and blade), with Strashnaia Peshchera and Kara-Bom component I showing high frequencies of tools on Levallois spalls and blades, Peshchera Okladnikov levels 3 and 7 having high frequencies of tools on cortical spalls, and Peshchera Okladnikov levels 1, 2, and 6 exhibiting high frequencies of tools on flakes.

**Table 6.18.** One-way ANOVA of Mean Retouch Invasiveness and Mean Retouch Intensity between Seven Mousterian Assemblages

| Artifact feature | F ratio | Groups df | Error df | *P* |
|---|---|---|---|---|
| Retouch invasiveness | 11.19 | 6 | 808 | <.001 |
| Retouch intensity | 3.15 | 6 | 668 | .005 |

### *Secondary Reduction Technology*

Contingency table analysis shows that the proportions of retouch face (unifacial dorsal, unifacial ventral, and bifacial/bimarginal/alternating) differ significantly ($p < .001$) between the seven industries. All industries have high frequencies of unifacial dorsal retouch, but differences are evident in the relative proportions of unifacial ventral and bifacial/bimarginal/alternating retouch. Peshchera Okladnikov levels 1 and 6 have high frequencies of unifacial ventral retouch, while Strashnaia Peshchera and Kara-Bom component I have high frequencies of bifacial/bimarginal/alternating retouch. Proportions of retouch style differ significantly ($p < .001$) by site, with Peshchera Okladnikov levels 2 and 3 and Kara-Bom component I having high frequencies of scalar retouch, Strashnaia Peshchera and Peshchera Okladnikov levels 6 and 7 having high requencies of nibbling and small irregular retouch, and Peshchera Okladnikov level 1 having moderately high frequencies of all three styles. All seven industries display relatively low frequencies of notching, and large irregular and burin retouch are always rare or absent.

Results from a one-way ANOVA on ranks (Table 6.18) shows that mean retouch invasiveness differs significantly among the seven industries ($p < .001$). A multiple comparisons test (Tukey-HSD) (Table 6.19) further revealed that Peshchera Okladnikov levels 2 and 3 are distinctive in having significantly higher invasiveness means from all other Middle Paleolithic industries. Mean retouch intensity also differs significantly between industries ($p = .005$). Multiple comparisons show that one industry, Peshchera Okladnikov level 2, is unusual. This industry has the highest mean retouch intensity, and is significantly different from Strashnaia Peshchera and Peshchera Okladnikov level 7.

**Table 6.19.** Multiple Comparisons (Tukey-HSD) Procedure Comparing Mean Retouch Invasiveness and Mean Retouch Intensity between Pairs of Mousterian Assemblages

| Industries compared | Difference between means: Retouch invasiveness | Retouch intensity |
|---|---|---|
| Strashnaia-Okladnikov lev. 7 | 4.10* | -0.09 |
| Strashnaia-Okladnikov lev. 6 | 3.75 | -0.84 |
| Strashnaia-Okladnikov lev. 3 | 1.54 | -0.64 |
| Strashnaia-Okladnikov lev. 2 | 0.29 | -0.87* |
| Strashnaia-Okladnikov lev. 1 | 2.38 | -0.60 |
| Strashnaia-Kara-Bom comp. I | 2.64 | -0.24 |
| Okladnikov lev. 7-Okladnikov lev. 6 | -0.35 | -0.75 |
| Okladnikov lev. 7-Okladnikov lev. 3 | -2.56* | -0.55 |
| Okladnikov lev. 7-Okladnikov lev. 2 | -3.81* | -0.78* |
| Okladnikov lev. 7-Okladnikov lev. 1 | -1.72 | -0.51 |
| Okladnikov lev. 7-Kara-Bom comp. I | -1.46 | -0.15 |
| Okladnikov lev. 6-Okladnikov lev. 3 | -2.21* | 0.20 |
| Okladnikov lev. 6-Okladnikov lev. 2 | -3.46* | -0.03 |
| Okladnikov lev. 6-Okladnikov lev. 1 | -1.37 | 0.24 |
| Okladnikov lev. 6-Kara-Bom comp. I | -1.11 | 0.60 |
| Okladnikov lev. 3-Okladnikov lev. 2 | -1.25 | -0.23 |
| Okladnikov lev. 3-Okladnikov lev. 1 | 0.84* | 0.04 |
| Okladnikov lev. 3-Kara-Bom comp. I | 1.10 | 0.40 |
| Okladnikov lev. 2-Okladnikov lev. 1 | 2.09* | 0.27 |
| Okladnikov lev. 2-Kara-Bom comp. I | 2.35* | 0.63 |
| Okladnikov lev. 1-Kara-Bom com. I | 0.26 | 0.36 |

*Significant at 0.05 level

## *Tool Assemblage*

To facilitate statistical analysis, tool classes were combined into four major groups, modified after Bordes (1972:51-52). Group I includes retouched Levallois flakes and points, Group II (also referred to as the Mousterian group) includes side scrapers, Group III (the Upper Paleolithic group) includes end scrapers, burins, gravers, smooth-backed knives, and truncated blades, and Group IV includes notches and denticulates. By design, retouched blades and flakes are excluded. Contingency table analysis (Table 6.17) indicates a significant difference ($p < .001$) in proportions of major tool groups, with Strashnaia Peshchera and Kara-Bom component I having high frequencies of Group I tools (especially Levallois points), and Peshchera Okladnikov level 1 having high frequencies of Group III tools (especially end scrapers).

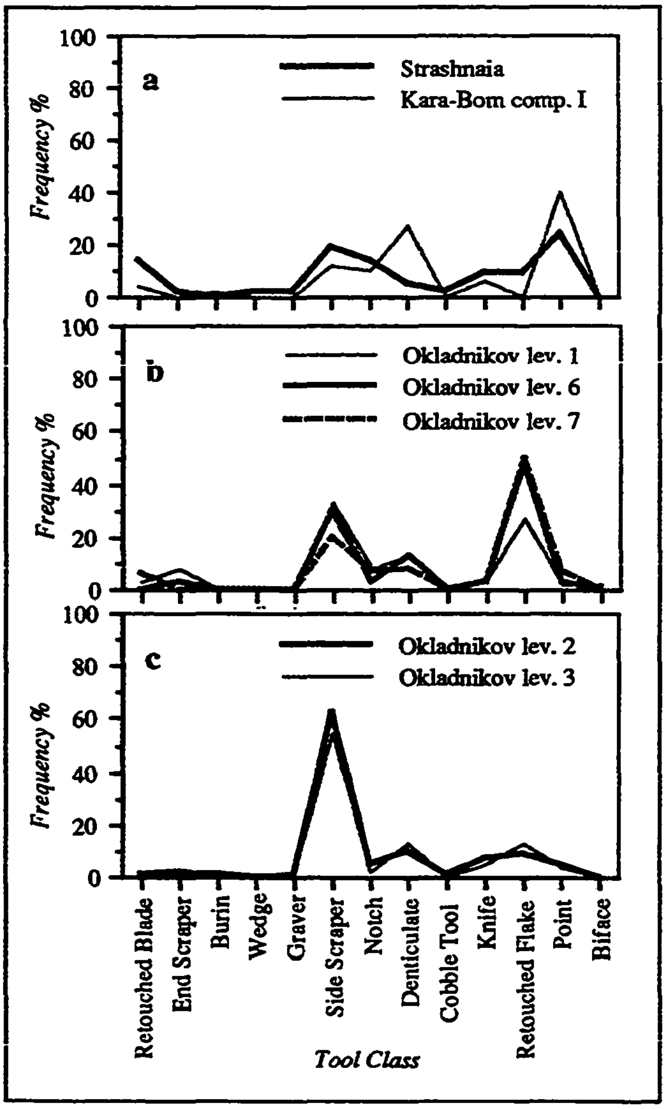


**Fig. 6.52. Relative frequencies of tool classes among major Altai Mousterian assemblages.**

Upon closer examination (Fig. 6.52), it is apparent that there are three sets of tool assemblages present in the Altai Mousterian. The first group includes sites rich in Levallois points, Strashnaia Peshchera and Kara-Bom component I (Fig. 6.52a). The second group includes sites rich in retouched flakes, Peshchera Okladnikov levels 1, 6, and 7 (Fig. 6.52b). Side scrapers also occur frequently in these industries, but not in as high numbers as retouched flakes. The third group includes three industries exceedingly rich in side scrapers, Peshchera Okladnikov levels 2 and 3 (Fig. 6.52c).

## Multivariate Results

### *Principal Components Analysis*

Principal components analysis of 27 variables from seven industries identified two principal components which together account for 67% of the variance in the sample. Principal component loadings are presented in Table 6.20.

Inspection of loadings for principal component (PC) 1, which explains nearly half (44.5%) of the total sample variance, indicates that it is a dimension of primary reduction technology. Variables with high positive loadings are associated with the production and use of Levallois points: parallel dorsal scarring, blade blank, retouched blade tool,

**Table 6.20.** Loadings for Mousterian Assemblage Variables

| Variable | PC 1 loading | PC 2 loading |
|---|---|---|
| Irregular dorsal scar | -.97785 | |
| Levallois point (tool) | .96729 | |
| Levallois point blank | .96393 | |
| Subparallel/parallel dorsal scar | .96186 | |
| Flake blank | -.95266 | |
| Blade/flake-blade blank | .89235 | |
| Irregular retouch style | .86433 | |
| Alternating retouch face | .82914 | |
| Notch (tool) | .78358 | |
| Levallois flake blank | -.71817 | |
| Smooth surface platform preparation | -.68396 | -.58134 |
| Unifacial dorsal retouch face | -.65867 | |
| Retouched flake (tool) | -.64960 | -.64309 |
| Retouched blade (tool) | .64221 | -.51596 |
| Knife (tool) | .63701 | |
| Faceted surface platform preparation | .62309 | .53522 |
| Scalar retouch style | | .95386 |
| Nibbling retouch style | | -.88004 |
| Radial dorsal scar | .61607 | .71035 |
| Trimming exterior platform preparation | | .70068 |
| Side scraper (tool) | -.62084 | .63425 |
| Unifacial ventral retouch face | | -.62165 |

NOTE: Based on a principal components analysis of 27 type frequencies (representing seven artifact features) from seven Mousterian assemblages. Small factor loadings (< 0.5) suppressed.

faceted platform, irregular retouch style, and alternating retouch face. A Levallois point is produced by detaching a series of parallel and elongate flake-blades from the face of a carefully prepared core with single or opposing faceted platforms, in effect producing a triangular, subparallel dorsal scar pattern allowing the controlled removal of one or more points. Once detached from a core, the point is ready for use; when retouching or resharpening is necessary, it is usually irregular in style and alternates between faces. Two industries have high positive PC1 scores, Kara-Bom component I and Strashnaia Peshchera (Fig. 6.53). Both industries are characterized by Levallois point primary reduction technologies.

Variables with large negative loadings for PC1 include irregular dorsal scar, flake blank, Levallois flake blank, smooth platform, unifacial dorsal retouch face, retouched flake tool, and side scraper tool. These variables represent an alternative primary reduction technology from that discussed above, one geared toward the production of irregular flakes detached from Levallois, radial, or simple flake cores. Industries with negative PC1 scores include Peshchera Okladnikov levels 1, 2, 3, 6, and 7 (Fig. 6.53).

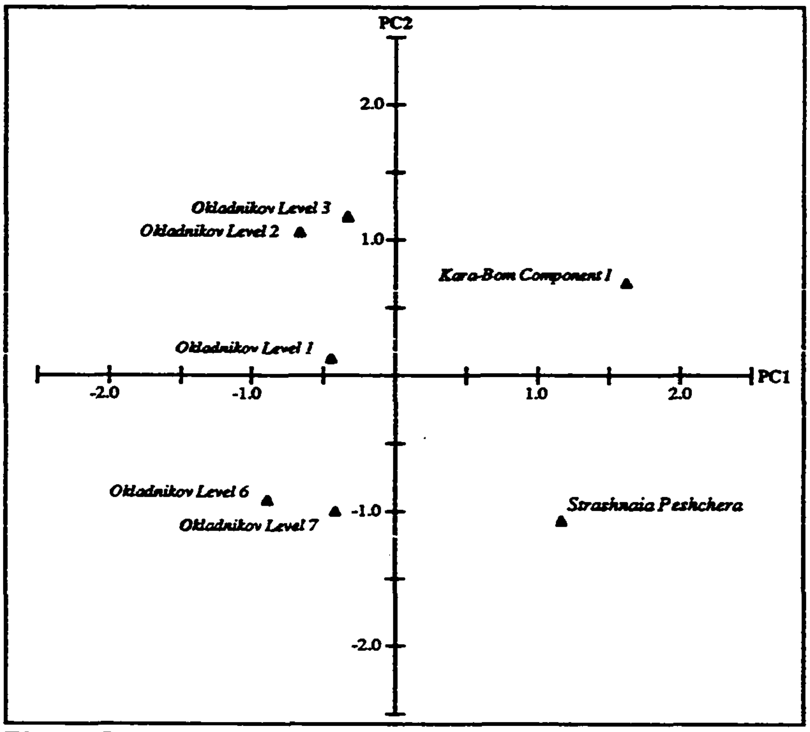


**Fig. 6.53. Mousterian assemblage scores on the first two principal components extracted from a factor analysis of 27 type frequencies (representing seven artifact features).**

Principal component 2, accounting for 22.5% of the variance in the data set, describes a package of primary and secondary reduction technology involved in the manufacture and retouching of side scrapers. Variables with high loadings include scalar retouch, radial dorsal scar, exterior platform trimming, side scraper tool, and faceted platform. A positive PC2 score indicates not only the overwhelming presence of side scrapers in the tool assemblage, but also the technologies employed in their manufacture and use. According to this technological subsystem, the face of a core is prepared radially, and its platform is faceted and carefully trimmed. A blank suitable for use as a side scraper is detached from the core. Continued use and resharpening results in the formation of scalar retouch along the side scraper's utilized edge or edges. Industries with high PC2 scores include Peshchera Okladnikov levels 1, 2, and 3 and Kara-Bom component I (Fig. 6.53).

Variables with negative PC2 loadings include nibbling retouch, unifacial ventral retouch, retouched flake tool, retouched blade tool, and smooth platform. Together these variables represent the inverse of the positive PC2 loadings. Core preparation is minimal, tools are only marginally retouched, and simple retouched flakes and flake-blades predominate over carefully prepared and intensively retouched side scrapers. Industries with negative PC2 scores include Strashnaia Peshchera and Peshchera Okladnikov levels 6 and 7 (Fig. 6.53).

### *Cluster Analysis*

Inspection of the same data set through a cluster analysis (Fig. 6.54) using the city block distance measure and an average-link algorithm resulted in a dendrogram displaying three major branches of industries. The first major split separates Strashnaia Peshchera and Kara-Bom component I from the Peshchera Okladnikov industries. This equates with PC1 and the production of points in lieu of flakes for use as tools. The second major split further divides the Peshchera Okladnikov industries into two groups: (1) levels 2 and 3, and (2) levels 1, 6, and 7. This split compares with PC2 and the manufacture and retouching of side scrapers rather than simple retouched flakes and blades.

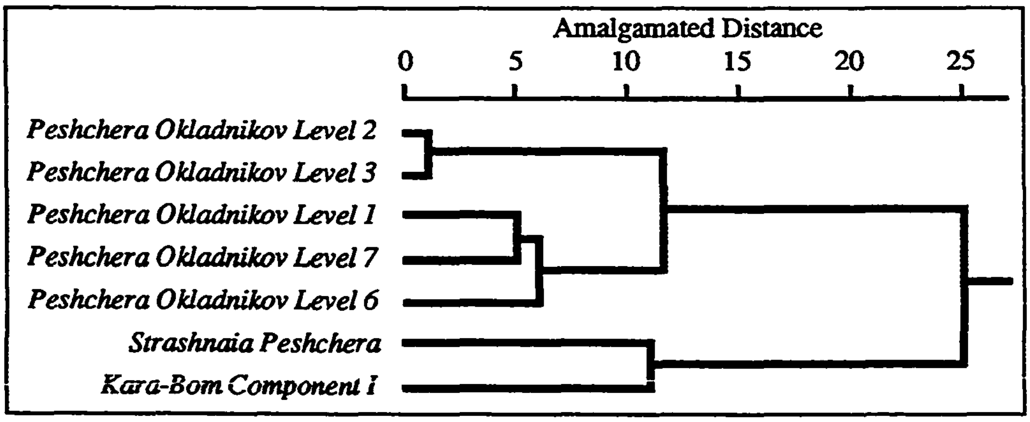


**Fig. 6.54.** Dendrogram based on average-linkage clustering Mousterian assemblages. Cluster analysis based on City-block distance measure calculated from 27 type frequencies (representing seven artifact features).

# CHAPTER 7

## Early Upper Paleolithic Industries

In this chapter, the early Upper Paleolithic industries of Siberia are described, and interassemblage variability is examined. Site-by-site descriptions provide detailed reviews of the primary reduction technology, secondary reduction technology, and tool assemblage of each industry. Interassemblage variability is explored through univariate and multivariate statistical analyses. The relatively large lithic assemblages from Ust'-Karakol, Kara-Bom (component II), Arembovskii, Makarovo-4, Varvarina Gora, and Tolbaga are described in detail and analyzed statistically, while the assemblages from Maloialomanskaia Peshchera, Malaia Syia, Sosnovyi Bor, Masterov Gora (component III), and Masterov Kliuch' (component V) are described but not statistically analyzed, due to exceedingly small sample sizes. Brief descriptions of other early Upper Paleolithic industries (Anui-1, Voennyi Gospital, Ineiskii Bor, Sannyi Mys [level 7], Arta-2, Arta-3, Kunalei, Priiskovoe, Sokhatino-1, and Sokhatino-6) are presented in Appendix III. Following the site-by-site assemblage descriptions, industrial facies of the early Upper Paleolithic are defined and explored.

### THE LITHIC INDUSTRIES

#### Ust'-Karakol Component III

The sample of lithic artifacts available for analysis in this study includ3 43 tools, 19 cores, and one core fragment, the majority of which were excavated in 1986 (Derevianko et al. 1987k, 1990b).

*Primary Reduction Technology*. Raw materials are 100% chert (Fig. 7.1:a) occurring in six varieties (dark gray, gray, greenish gray, light gray, coarse gray, and maroon). Eight tools (19%) display cortex on their dorsal surfaces; two (5%) of these are more than half covered with cortex. Cores include flat-faced (parallel) blade cores, subprismatic blade cores, simple flake cores, a Levallois flake core, and a core tablet (Table 7.1).

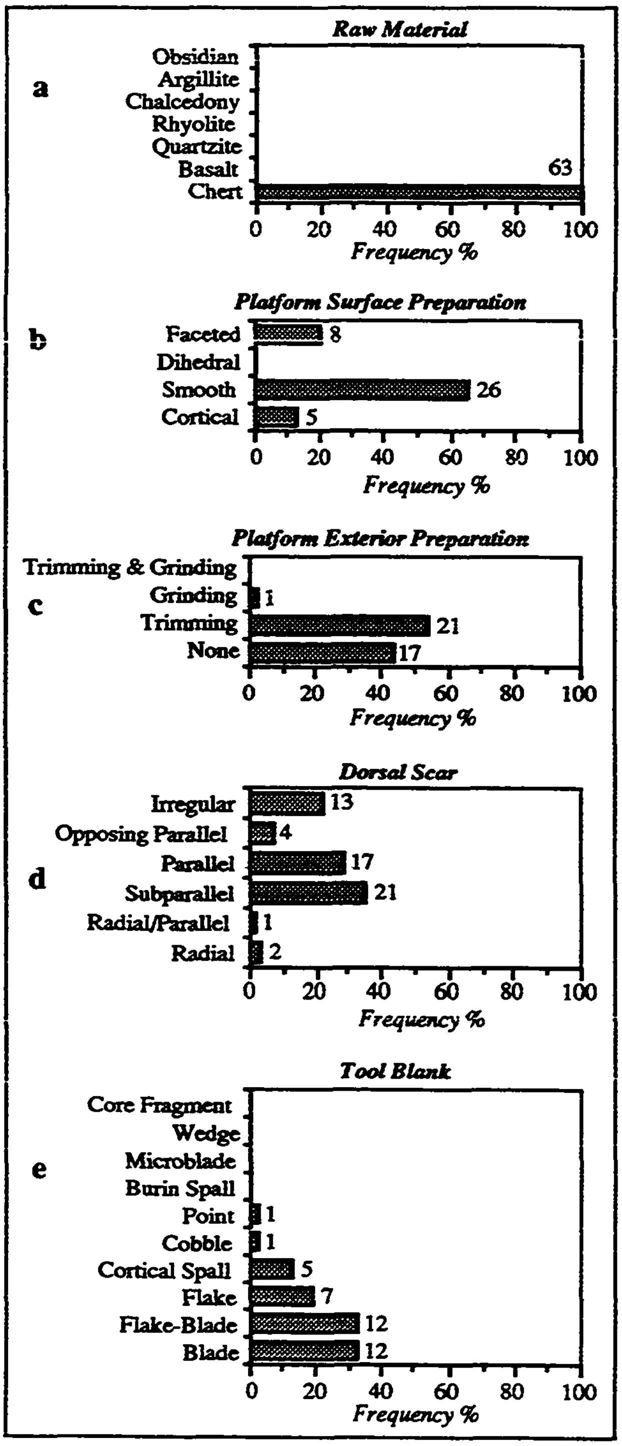


**Fig. 7.1.** Ust'-Karakol: attributes of primary reduction technology.

Among the flat-faced blade cores, one is unidirectional monofrontal, five are bidirectional monofrontal, and three are bidirectional bifrontal (Fig. 7.2:c-e). Platforms on these cores are usually smooth, sometimes faceted, and rarely cortical. Subprismatic blade cores are typically unidirectional monofrontal with smooth platforms (Fig. 7.2:f). Several are small and appear exhausted (Fig. 7.2:a-b). The Levallois flake core is oval shaped and bifacially worked, and exhibits radial flaking, a faceted platform, and primary as well as secondary Levallois flake scars. The core tablet appears to have been removed from a subprismatic blade core and it has a smooth platform.

Platforms in the assemblage are predominantly smooth (Fig. 7.1:b);

**Table 7.1.** Ust'-Karakol: Core Types

| Core type | n | % |
|---|---|---|
| Monofrontal unidirectional flake | 2 | 10.0 |
| Bifrontal bidirectional flake | 1 | 5.0 |
| Monofrontal unidirectional flat-faced blade | 1 | 5.0 |
| Monofrontal bidirectional flat-faced blade | 5 | 25.0 |
| Bifrontal bidirectional flat-faced blade | 3 | 15.0 |
| Monofrontal unidirectional subprismatic blade | 6 | 30.0 |
| Levallois flake | 1 | 5.0 |
| Core tablet | 1 | 5.0 |
| Total | 20 | |

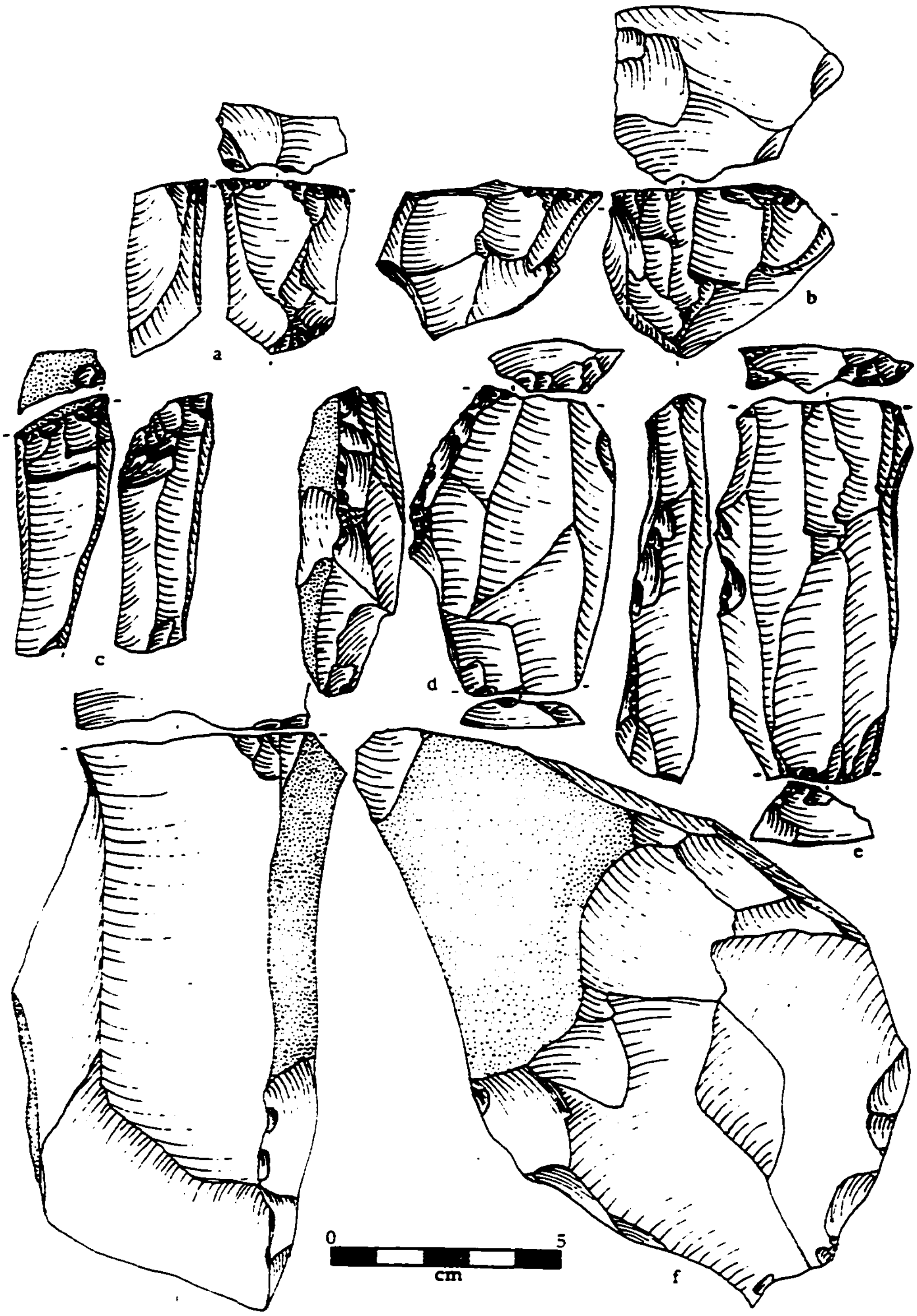


**Fig. 7.2. Cores from Ust'-Karakol: unidirectional subprismatic blade cores (a-b, f); bidirectional flat-faced blade cores (c-e).**

however, faceted and cortical types also occur (faceting index = 20.5). The majority of tools and cores exhibit some platform exterior preparation, especially trimming (Fig. 7.1:c). Parallel dorsal scar patterns are abundant (i.e., subparallel, parallel, opposing parallel), while irregular and radial scar patterns are less common (Fig. 7.1:d). Most tools are made on blades or flake-blades (Fig. 7.1:e).

*Secondary Reduction Technology.* Retouch is predominantly unifacial dorsal, although six tools are bifacially worked (Fig. 7.3:a). Most edges display scalar retouch, while less invasive marginal forms of retouch (i.e., nibbling, small irregular) occur infrequently (Fig. 7.3:b). Burin edge retouch is apparent on six edges. Retouch invasiveness is high, with 67% of all edges having retouch scars greater than 6 mm deep (Fig. 7.3:c). Retouch intensity is moderate; 47% of all tools have four or more retouched edge positions (Fig. 7.3:d).

*Tool Assemblage.* The tool assemblage is characterized by relatively high frequencies of side scrapers and retouched blades, and moderate frequencies of denticulates, burins, and bifaces (Fig. 7.4, Table 7.2). Less common are unifacial points, retouched flakes, a wedge, and a knife. Among side scrapers, eight are retouched along one lateral margin, and three along two lateral margins (Fig. 7.5:a, c, Fig. 7.6:c, f-g, l). Transverse, angle,

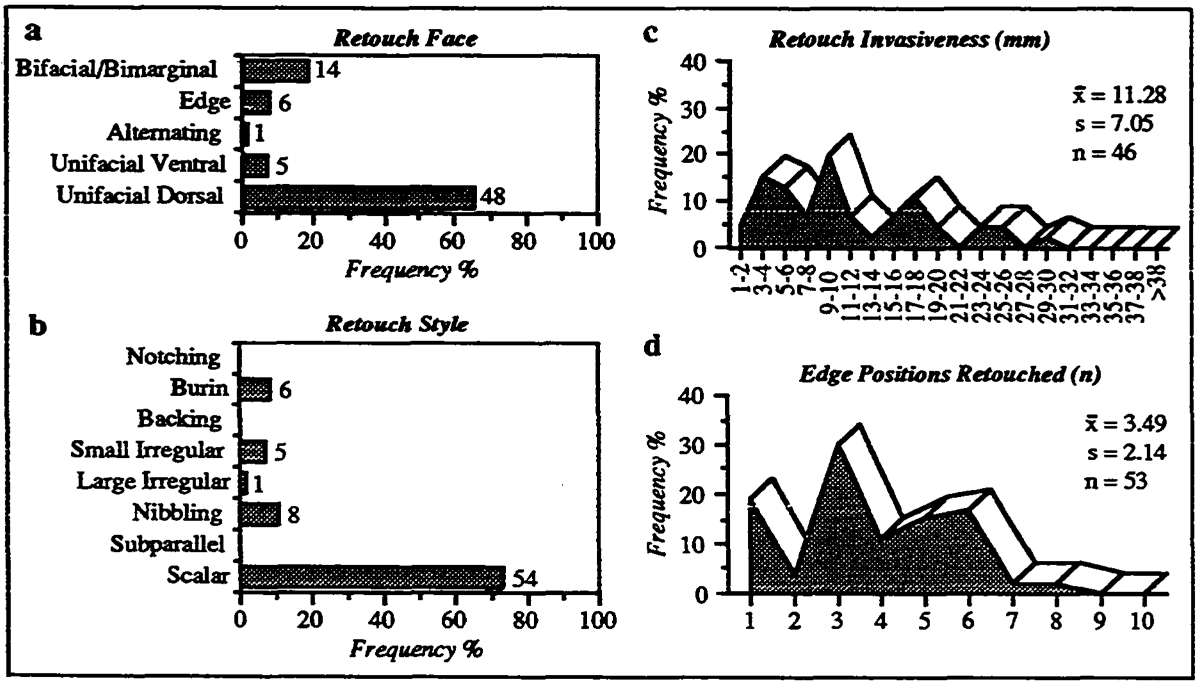


**Fig. 7.3.** Ust'-Karakol: attributes of secondary reduction technology.

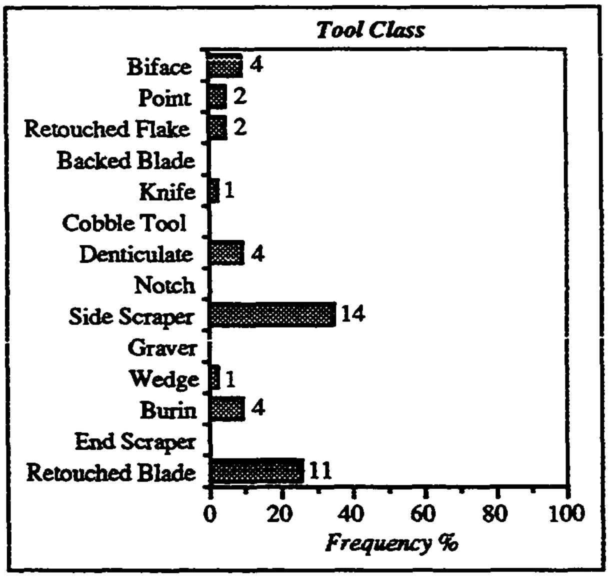


**Fig. 7.4.** Ust'-Karakol: tool class.

**Table 7.2.** Ust'-Karakol: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 2 | 4.7 | Double convex side scraper | 1 | 2.3 |
| Unilaterally retouched ventral blade | 1 | 2.3 | Straight transverse scraper | 1 | 2.3 |
| Unilaterally retouched bimarginal blade | 3 | 7.0 | Angle scraper | 2 | 4.7 |
| Bilaterally retouched blade | 3 | 7.0 | Single convex ventral denticulate | 1 | 2.3 |
| Unilaterally retouched flake-blade | 2 | 4.7 | Single concave denticulate | 1 | 2.3 |
| Angle burin | 2 | 4.7 | Double straight ventral denticulate | 2 | 4.7 |
| Double angle burin | 1 | 2.3 | Smooth-backed knife | 1 | 2.3 |
| Dihedral burin | 1 | 2.3 | Retouched flake | 1 | 2.3 |
| Wedge | 1 | 2.3 | Utilized flake | 1 | 2.3 |
| Single straight side scraper | 4 | 9.3 | Point | 2 | 4.7 |
| Single convex side scraper | 4 | 9.3 | Biface fragment | 1 | 2.3 |
| Double straight side scraper | 2 | 4.7 | Leaf-shaped biface (fragmented) | 3 | 7.0 |
| | | | Total | 43 | |

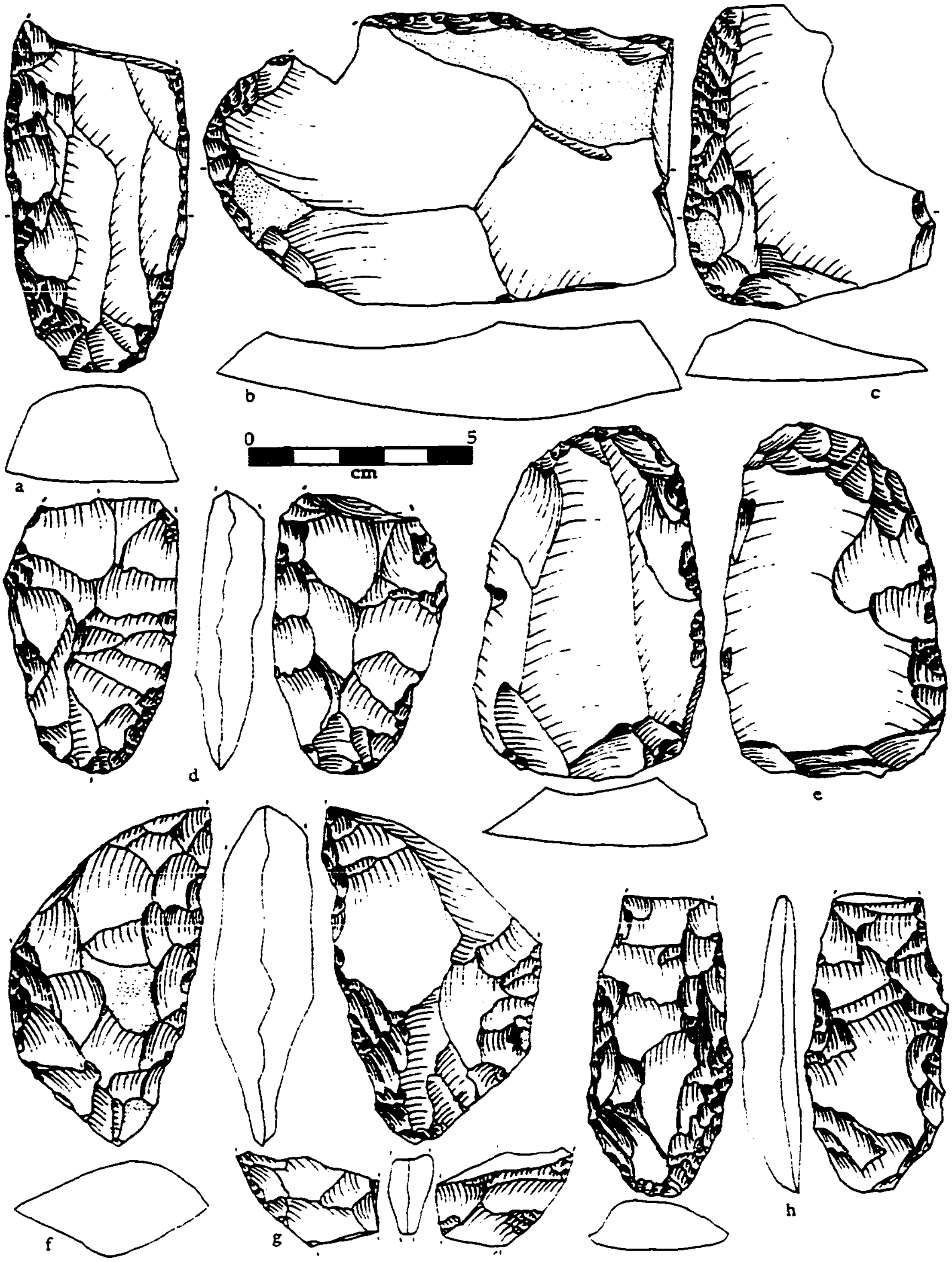


**Fig. 7.5. Lithic artifacts from Ust'-Karakol: double convex side scraper (a); angle scraper (b); single straight side scraper (c); leaf-shaped biface fragments (d, f, h); wedge (e); biface fragment (g).**

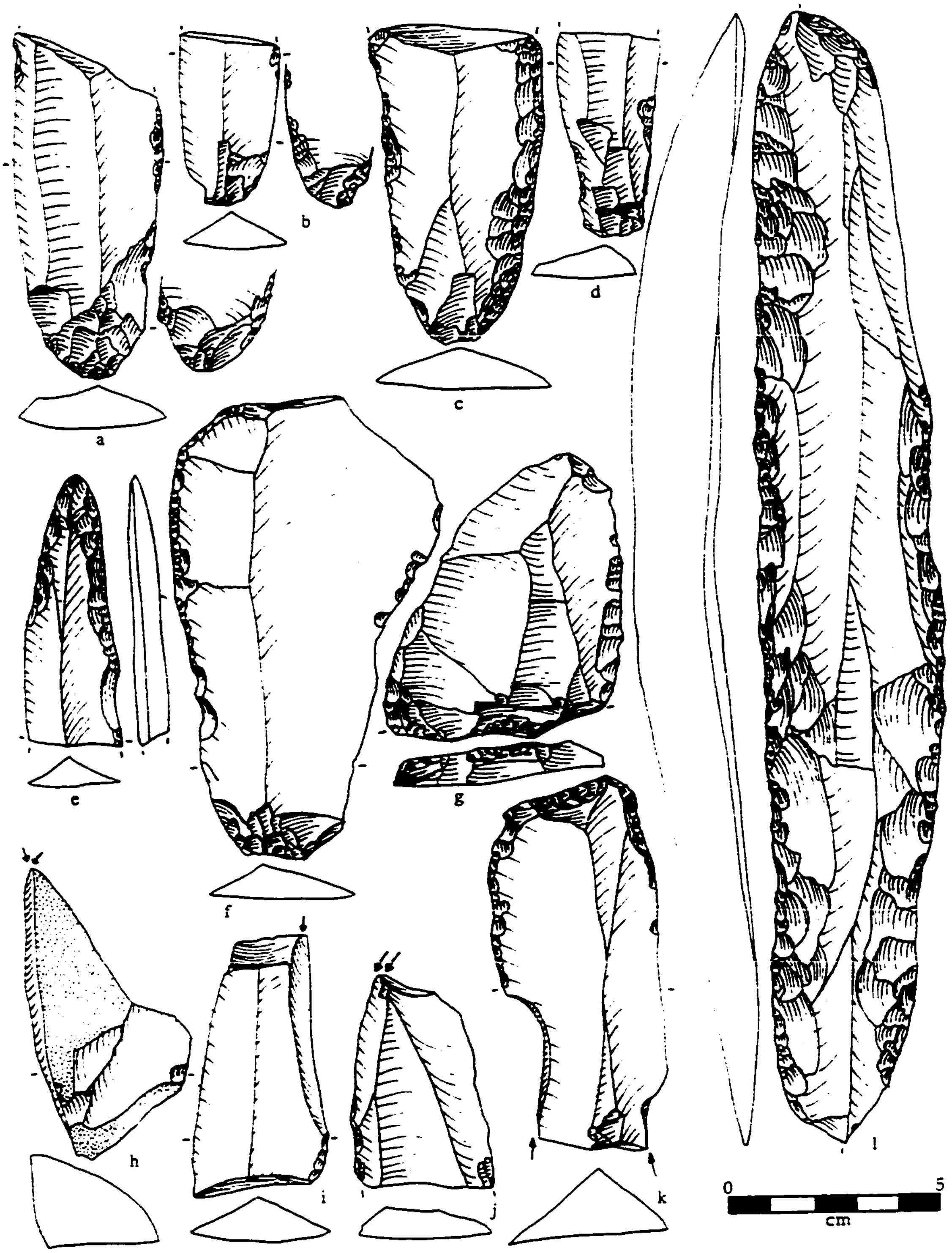


**Fig. 7.6.** Lithic artifacts from Ust'k-Karakol: unilaterally retouched bimarginal blades (a, b); single straight side scrapers (c, f); bilaterally retouched blade (d); point on blade (e); single convex side scraper (g); dihedral burin (h); angle burins (i-j); double angle burin (with end scraper) (k); double straight side scraper (l).

and convergent scrapers also occur, but in smaller frequencies (Fig. 7.5:b). Seven side scrapers are made on large blades or flake-blades; one is on a particularly massive blade measuring 263 mm long and 41 mm wide (Fig. 7.6:l). Three retouched blades are thinned ventrally through the removal of their bulbs of percussion (Fig. 7.6:a-b). Two of the three bifaces are nearly complete and leaf-shaped (Fig. 7.5:f, h). The wedge (*pièce ésquillée*) is made on a wide flake-blade and retains two parallel dorsal arises (Fig. 7.5:e). Burins include two angle burins on blades (Fig. 7.6:i-j), one double angle burin combined with an end scraper on a blade (Fig. 7.6:k), and one dihedral burin on a cortical spall (Fig. 7.6:h). One of the two points is made on a slender blade and exhibits unifacial retouch forming a symmetrical point at its distal end (Fig. 7.6:e). The other point is made on a large triangular cortical spall and is only irregularly retouched.

The Ust'-Karakol industry has a primary reduction technology directed toward the production of blades and flake-blades for use as tools. Cores are flat-faced and subprismatic; Levallois elements are rare. Secondary reduction technology is typified by invasive and moderately intensive unifacial as well as bifacial retouch. Edge retouch employed to produce burins is also common, as is the ventral thinning of the proximal ends of blades. Although small in number, the tool assemblage is diverse. It is dominated by side scrapers, nearly half of which are made on blades or flake-blades. Other distinctive tools include retouched blades, bifacial knives, angle burins (one combined with an end scraper), a wedge, and a unifacial point on a blade.

## Kara-Bom Component II

The lithic assemblage from Kara-Bom component II that is presented here includes 231 tools and 15 cores recovered during Petrin's excavations in 1990 and 1991.

*Primary Reduction Technology.* Raw materials are 100% chert (Fig. 7.7:a) in three varieties (dark gray, light gray, and green). All are locally available in alluvium of the Semisart River and Altairy Creek. Rarely do blanks have cortex on their dorsal surfaces (8%). Cores include flat-faced parallel blade cores, subprismatic blade cores, a simple flake core, and a core tablet (Table 7.3). Among the flat-faced blade cores are two monofrontal unidirectional cores, five monofrontal bidirectional cores (Fig. 7.8:g-h), and one bifrontal bidirectional core. Platforms on these cores are primarily faceted (57%), although smooth (36%) and dihedral (7%) platforms also occur. Two of the

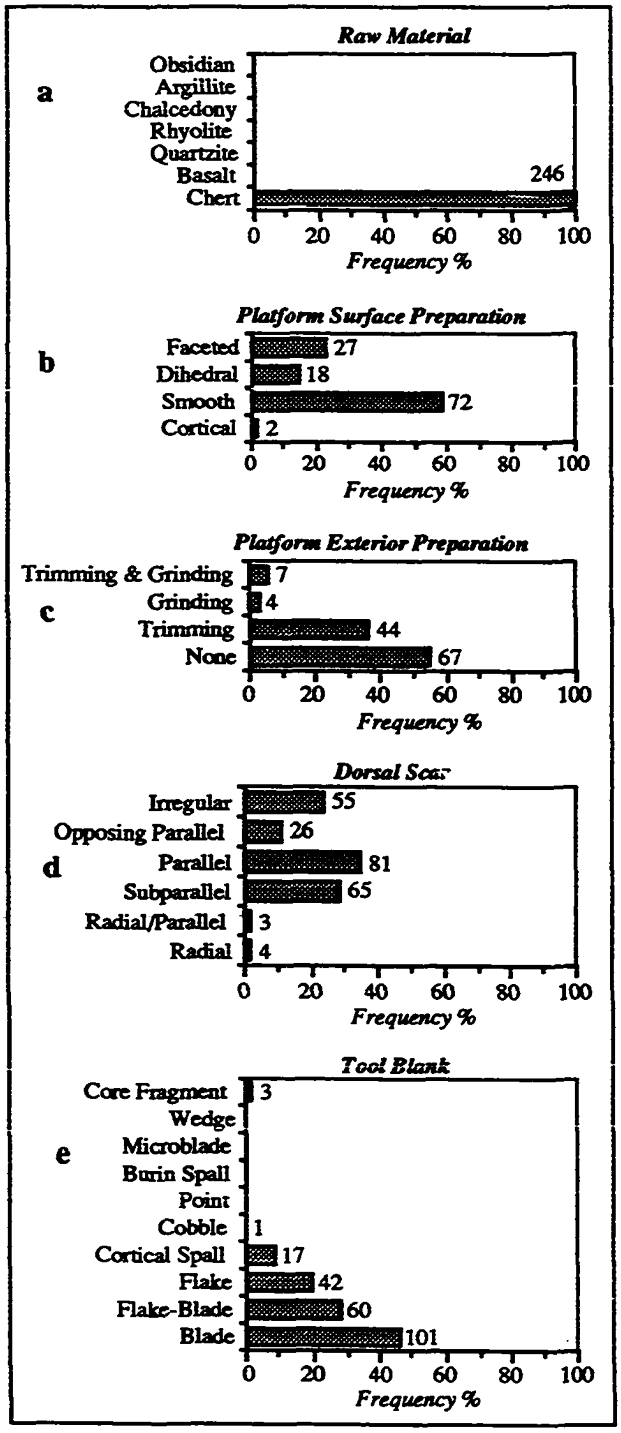


**Fig. 7.7.** Kara-Bom component II: attributes of primary reduction technology.

subprismatic blade cores are monofrontal unidirectional (Fig. 7.8:c, f), and three are monofrontal bidirectional (Fig. 7.8:b, e). Most of these subprismatic cores are small and appear exhausted (Fig. 7.8:f), and their platforms are usually smooth (67%) instead of faceted (33%). Technical spalls noted in the assemblage include core tablets (Fig. 7.8:d) and crested blades (Fig. 7.8:a).

Overall, the majority of platforms on blanks are smooth, while faceted and dihedral types are less common (Fig. 7.7:b) (faceting index = 37.8). Platform exterior preparation is common, especially trimming (Fig. 7.7:c). Dorsal scar patterns are most frequently parallel, subparallel, or opposing parallel (Fig. 7.7:d), and the majority of tools are made on blades or flake-blades (Fig. 7.7:e).

**Table 7.3.** Kara-Bom Component II: Core Types

| Core type | n | % |
|---|---|---|
| Core fragment | 1 | 6.7 |
| Bifrontal unidirectional flake | 1 | 6.7 |
| Monofrontal unidirectional flat-faced blade | 2 | 13.3 |
| Monofrontal bidirectional flat-faced blade | 5 | 33.3 |
| Bifrontal bidirectional flat-faced blade | 1 | 6.7 |
| Monofrontal unidirectional subprismatic blade | 2 | 13.3 |
| Monofrontal bidirectional subprismatic blade | 3 | 20.0 |
| Total | 15 | |

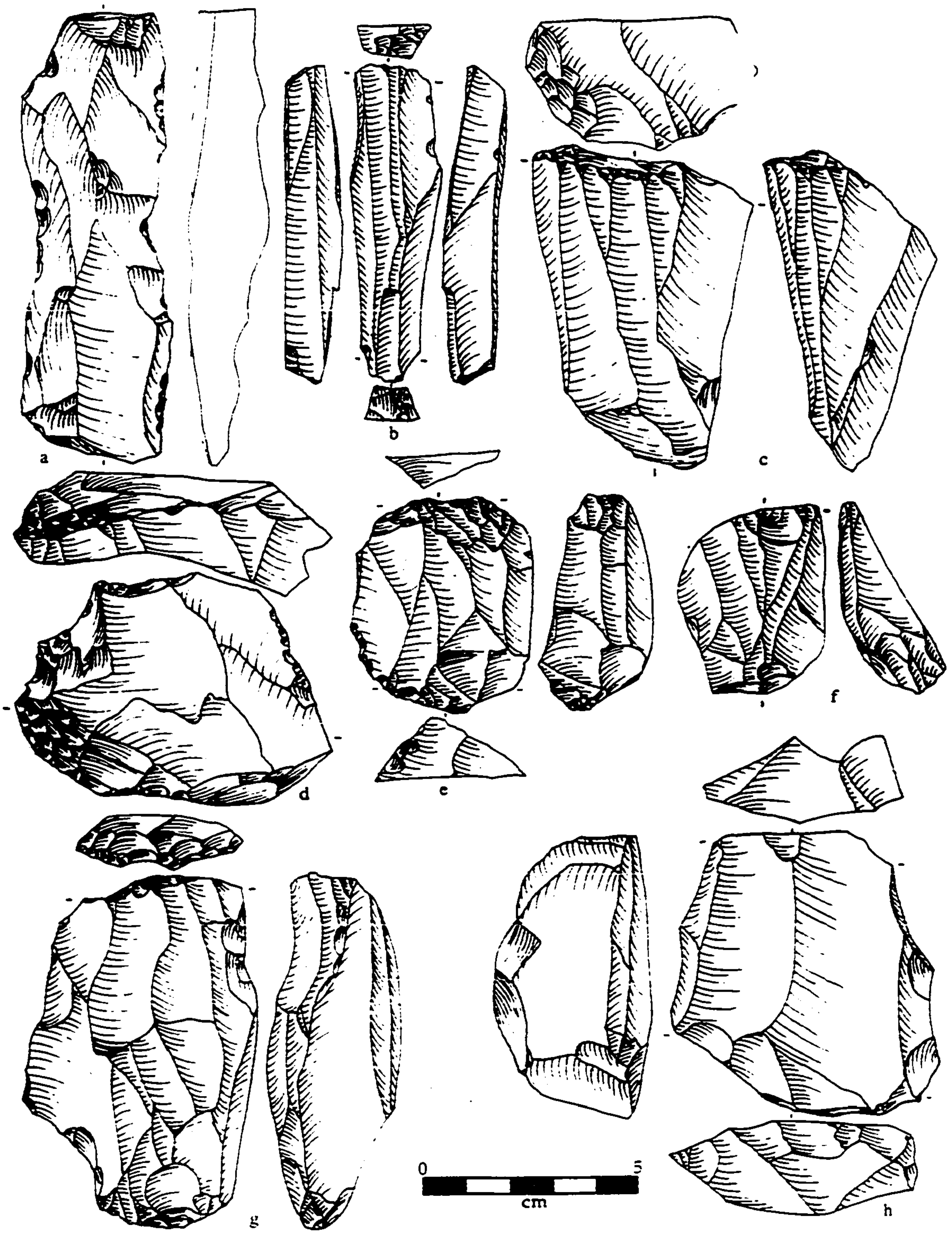


**Fig. 7.8.** Cores and technical spalls from Kara-Bom component II: crested blade (a); bidirectional subprismatic blade cores (b, e); unidirectional subprismatic blade cores (c, f); single convex denticulate on a core tablet (d); bidirectional flat-faced blade cores (g-h).

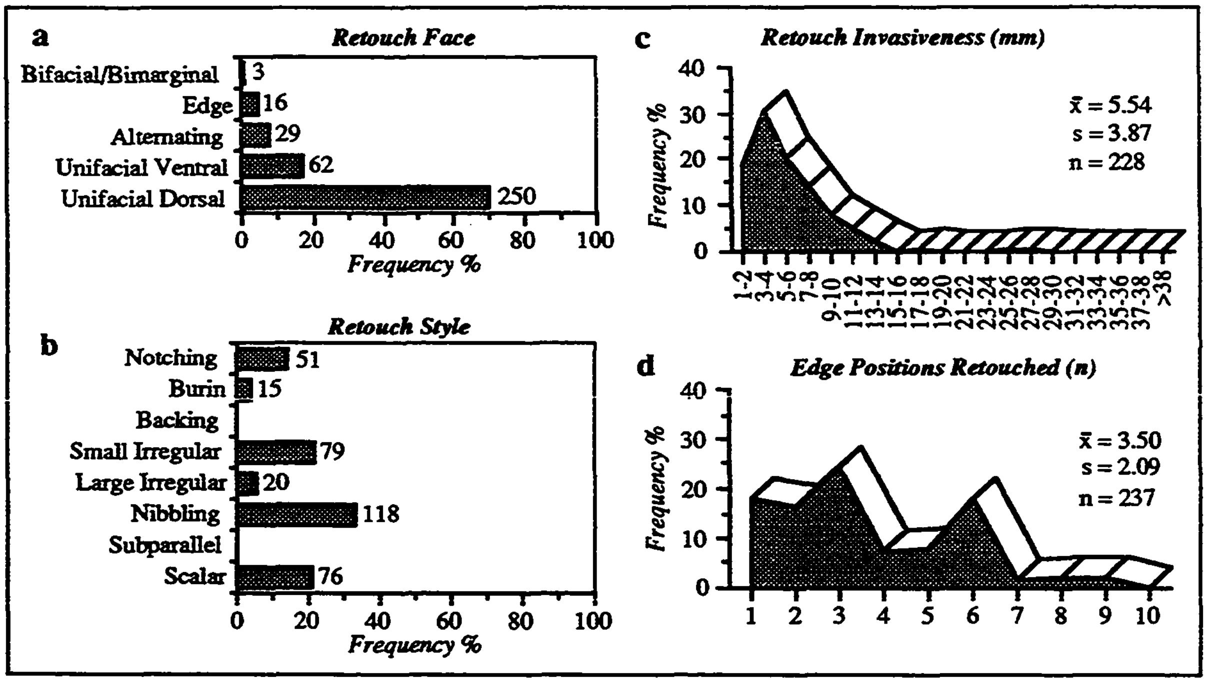


**Fig. 7.9.** Kara-Bom component II: features of secondary reduction technology.

*Secondary Reduction Technology.* Most tools are unifacially retouched (Fig. 7.9:a); however, one tool is worked bifacially (Fig. 7.12:f). Alternating retouch also occurs, although infrequently. Retouch styles include high frequencies of nibbling, small irregular, and scalar retouch (Fig. 7.9:b). Notching also occurs fairly frequently, while burin retouch is less common. Retouch invasiveness is low, with 70% of all edges displaying flake scars less than or equal to 6 mm deep (Fig. 7.9:c). Retouch intensity is moderately low; only 39% of all tools display four or more retouched edge positions (Fig. 7.9:d).

*Tool Assemblage.* Tools are predominantly retouched blades, notches, and denticulates (Fig. 7.10, Table 7.4). Retouched flakes, burins, end scrapers, knives, side scrapers, and unifacial points occur in lower frequencies, and gravers and bifaces are rare. Among retouched blades, those with unilateral and bilateral retouch are almost equally represented (Table 7.4) (Fig. 7.11:b-c, 7.12:i-j). Notches are usually made on blades and flake-blades (Fig. 7.12:k, 7.13:c, e), while denticulates are usually made on wide flake-blades or flakes (Fig. 7.13:b, d, f-h). Burins are most frequently angle or double angle burins (Fig. 7.12:a-e). On most of these the burin blow originates on a snap, rather than a notch or other retouched surface. The single transverse burin is made on a wide flake, and a deep notch served as the burin platform. Among end scrapers, three are made on long, slender blades (Fig. 7.11:e-f), two are carinated (Fig. 7.13:a), and one is pan-shaped (Fig. 7.12:g). Six of the eight knives are smooth-backed (Fig.

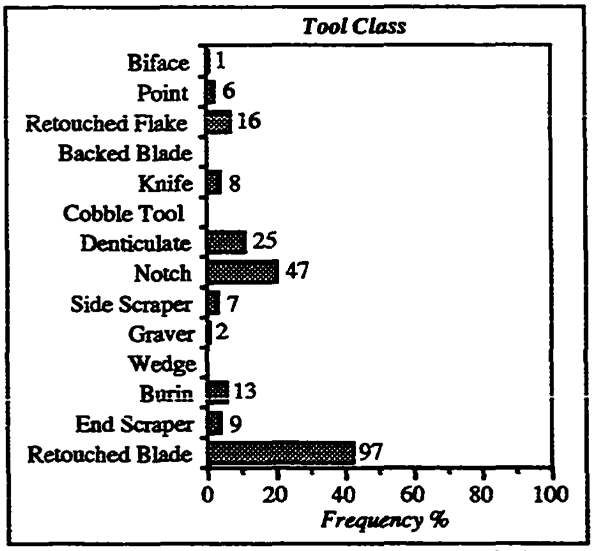


**Fig. 7.10. Kara-Bom component II: tool class.**

**Table 7.4. Kara-Bom Component II: Tool Types**

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 18 | 7.8 | Convex transverse scraper | 1 | 0.4 |
| Unilaterally retouched ventral blade | 5 | 2.2 | Single notch | 37 | 16.0 |
| Bilaterally retouched blade | 31 | 13.4 | Multiple notch | 10 | 4.3 |
| Bilaterally retouched ventral blade | 4 | 1.7 | Single straight denticulate | 3 | 1.3 |
| Bilaterally retouched alternate blade | 4 | 1.7 | Single straight ventral denticulate | 3 | 1.3 |
| Unilaterally retouched flake-blade | 16 | 6.9 | Single straight alternate denticulate | 2 | 0.9 |
| Unilaterally retouched ventral flake-blade | 5 | 2.2 | Single convex denticulate | 6 | 2.6 |
| Bilaterally retouched flake-blade | 14 | 6.1 | Single convex ventral denticulate | 1 | 0.4 |
| End scraper on blade | 3 | 1.3 | Single concave denticulate | 1 | 0.4 |
| End scraper on flake | 2 | 0.9 | Double straight denticulate | 2 | 0.9 |
| Lateral end scraper | 1 | 0.4 | Double convex denticulate | 2 | 0.9 |
| Carinated end scraper | 2 | 0.9 | Convex-concave denticulate | 1 | 0.4 |
| Pan-shaped end scraper | 1 | 0.4 | Transverse denticulate | 4 | 1.7 |
| Angle burin | 8 | 3.5 | Naturally backed knife | 2 | 0.9 |
| Double angle burin | 4 | 1.7 | Smooth-backed knife | 6 | 2.6 |
| Transverse burin | 1 | 0.4 | Retouched flake | 10 | 4.3 |
| Single graver | 2 | 0.9 | Retouched ventral flake | 4 | 1.7 |
| Single straight side scraper | 1 | 0.4 | Retouched alternating flake | 1 | 0.4 |
| Single convex side scraper | 2 | 0.9 | Utilized flake | 1 | 0.4 |
| Double straight side scraper | 2 | 0.9 | Point | 6 | 2.6 |
| Double convex side scraper | 1 | 0.4 | Oval biface | 1 | 0.4 |
| | | | Total | 231 | |

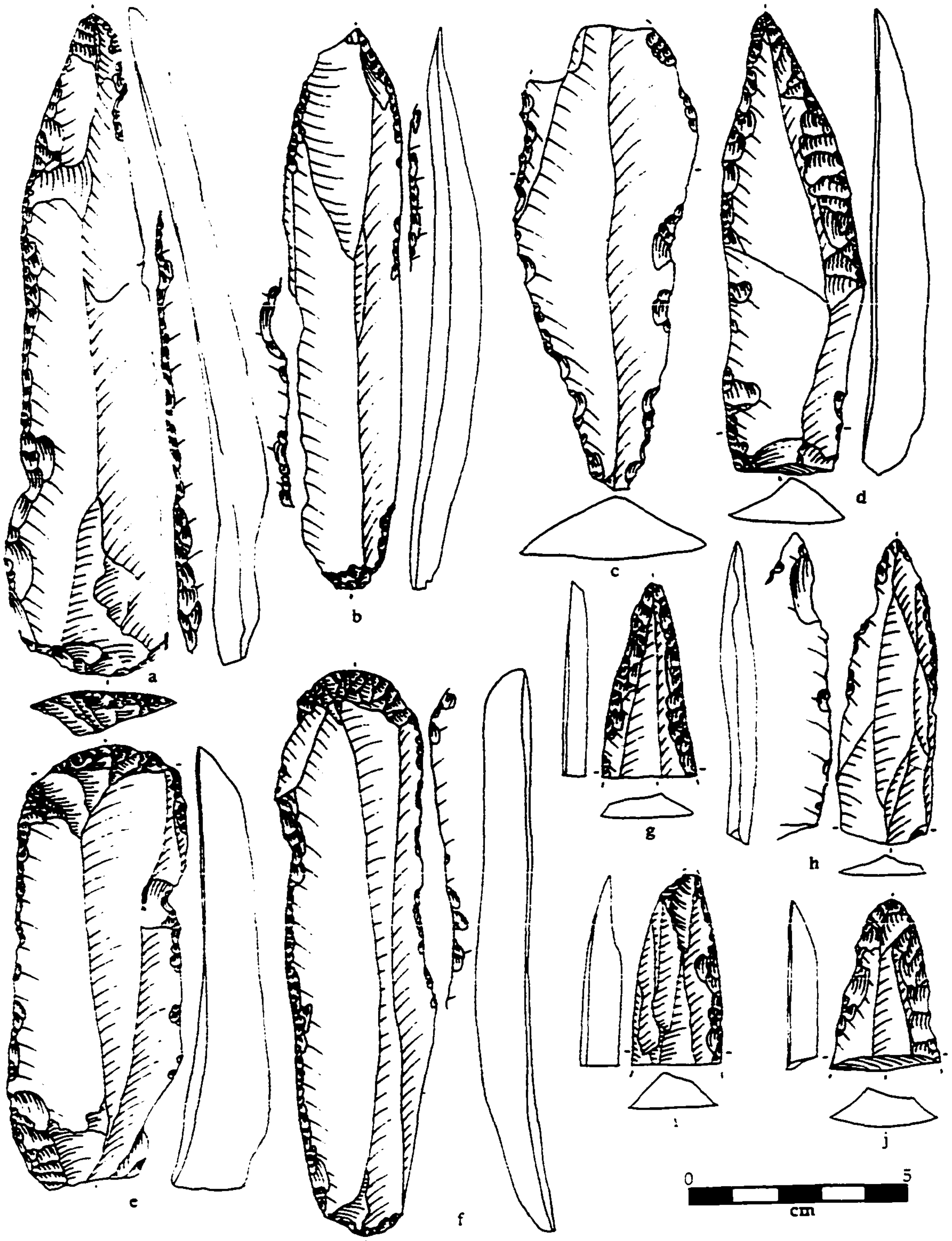


**Fig. 7.11.** **Lithic artifacts from Kara-Bom component II: points on blades (a, d, g-j); bilaterally retouched (alternating) blade (b); bilaterally retouched blade (c); end scrapers on blades (e-f).**

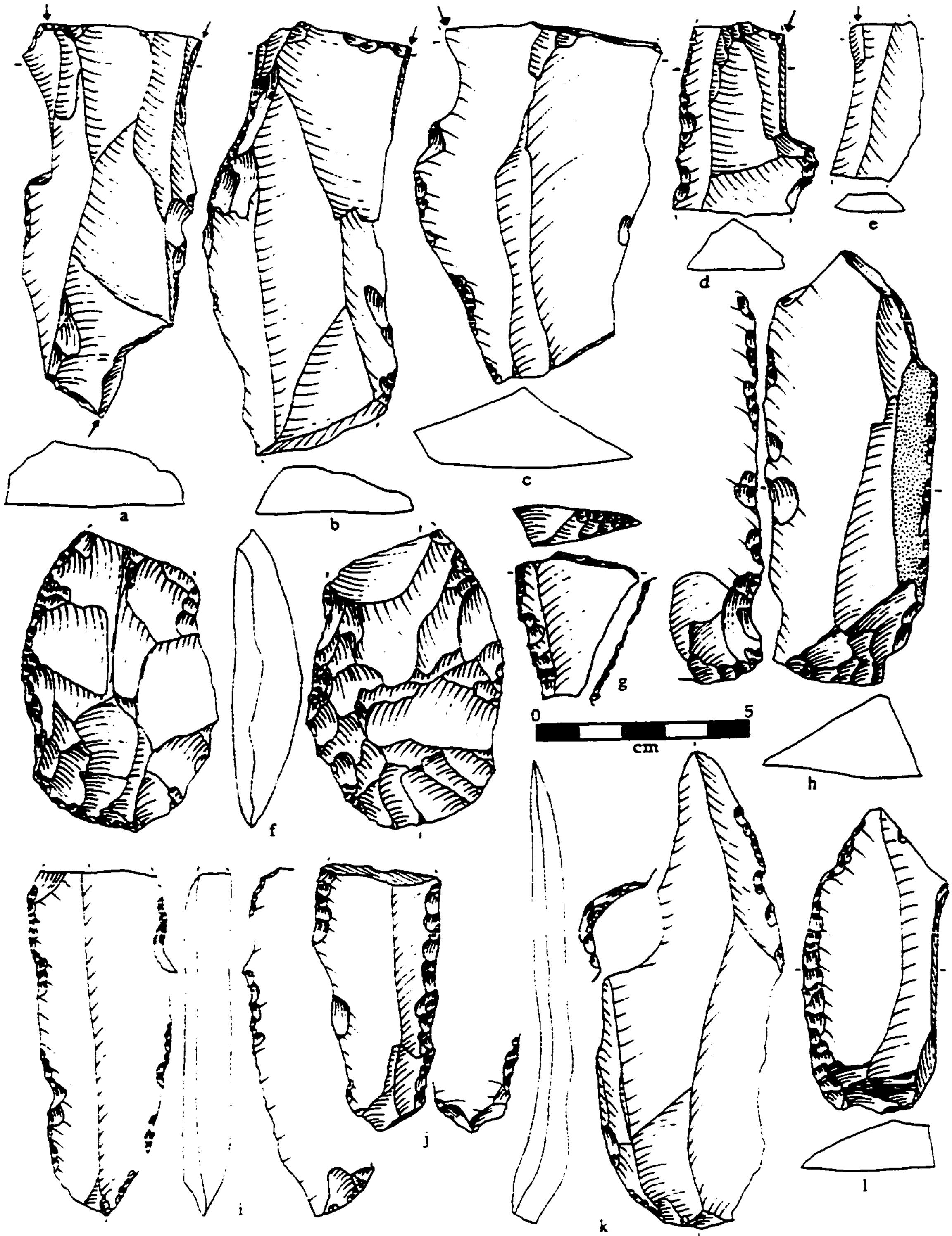


**Fig. 7.12.** Lithic artifacts from Kara-Bom component II: double angle burin (a); angle burins (b-e); oval biface (f); pan-shaped end scraper (g); cortically backed knife with ventral retouch on proximal end (h); bilaterally retouched blades with ventral retouch on proximal ends (i-j); notch (k); smooth-backed knife (l).

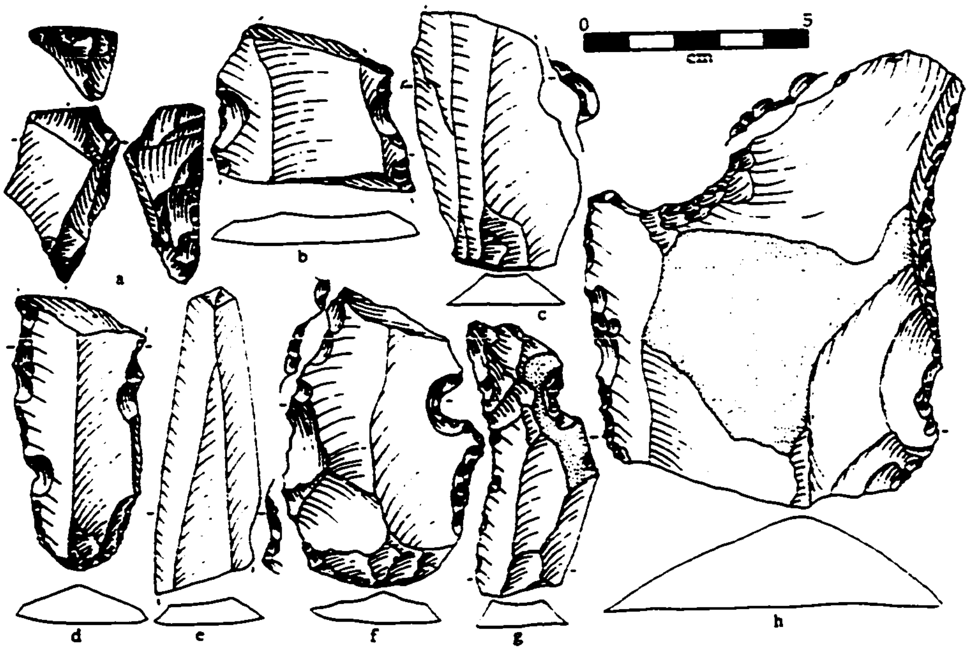


**Fig. 7.13. Lithic artifacts from Kara-Bom component II: carinated end scraper (a); double straight denticulates (b, d); notches (c, e); double convex denticulate (f); single convex denticulate (g); convex-concave denticulate (h).**

7:12:l). All points are made on blades. They are long and slender, and have unifacial dorsal or sometimes alternating retouch forming a distal point (Fig. 7.11:a, d, g-j). Two are complete, while four are distal fragments. The single biface is oval, lenticular in cross-section, and completely worked around its perimeter on both faces (Fig. 7.12:f).

The Kara-Bom component II industry reflects a core and blade primary reduction technology. Blades were detached from flat-faced as well as subprismatic blade cores prepared with single or opposing platforms. While platform surfaces are typically smooth, their perimeters are carefully prepared. Secondary reduction technology is unifacial, marginal, and unintensive. The single biface is unique. Retouched blades, notched blades, burins on blades, end scrapers on blades, and points on blades dominate the tool assemblage.

### Maloialomanskaia Peshchera Component II

Derevianko and Petrin (1989:17) report an assemblage of 57 artifacts from component II at Maloialomanskaia Peshchera. Eighteen of these are tools; none are cores. For the

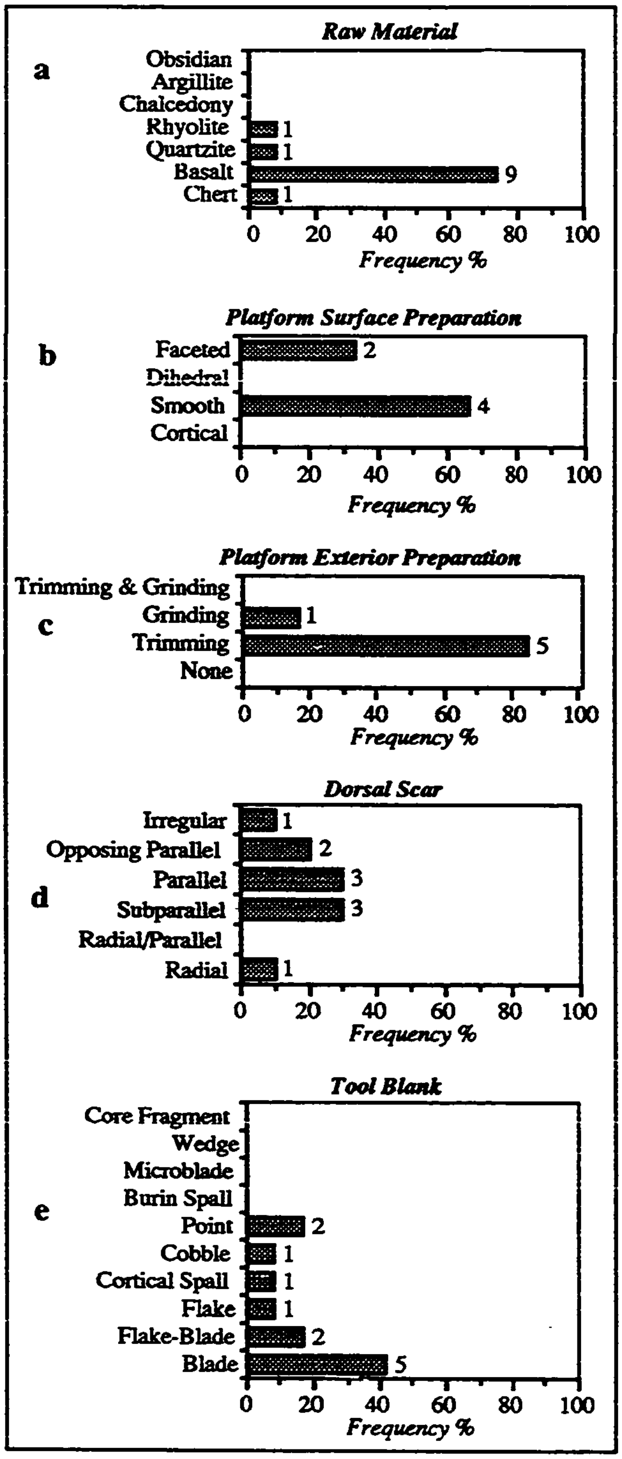


**Fig. 7.14.** Maloialomanskaia Peshchera: attributes of primary reduction technology.

present study, 12 tools were available for analysis.

*Primary Reduction Technology.* Raw materials are diverse (Fig. 7.14:a). Basalt dominates, but chert, quartzite, and rhyolite are also present. Although no cores have been recovered from the site, there is one crested blade fragment (Fig. 7.17:h) presumably removed from a prismatic or subprismatic blade core. Among the six artifacts with platforms, four are smooth and two are faceted (Fig. 7.14:b), while all display some platform exterior preparation (Fig. 7.14:c). Dorsal scars are heterogeneous, with subparallel and parallel scars occurring most frequently, followed by opposing parallel, irregular, and radial (Fig. 7.14:d). Tool blanks are predominantly blades and flake-blades (Fig. 7.14:e), although two tools are made on Levallois points.

*Secondary Reduction Technology.* The majority of tool edges are retouched unifacially on the dorsal surface (Fig. 7.15:a). Nibbling is the most common retouch style although several edges display scalar retouch (Fig. 7.15:b). Retouch invasiveness is low, with nearly 75% of all edges displaying retouch scars less than 6 mm deep (Fig. 7.15:c). Retouch intensity is moderate, with over half the tools showing four or more retouched edge positions (Fig. 7.15:d).

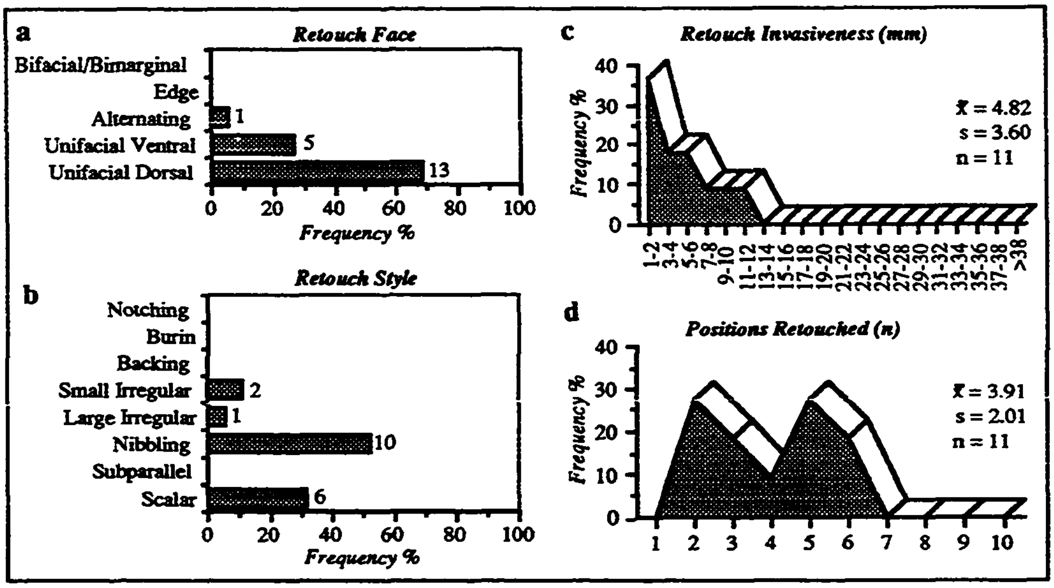


Fig. 7.15. Maloialomanskaia Peshchera: attributes of secondary reduction technology.

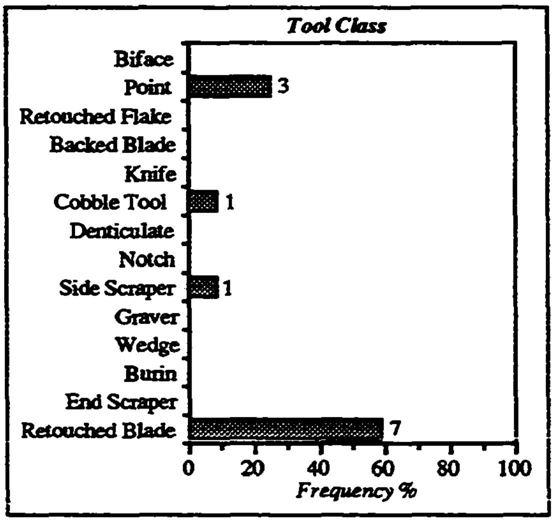


Fig. 7.16. Maloialomanskaia Peshchera: tool class.

Table 7.5. Maloialomanskaia Peshchera: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 1 | 8.3 | Single convex side scraper | 1 | 8.3 |
| Unilaterally retouched ventral blade | 1 | 8.3 | Hammerstone | 1 | 8.3 |
| Bilaterally retouched blade | 2 | 16.7 | Levallois point | 1 | 8.3 |
| Unilaterally retouched flake-blade | 2 | 16.7 | Atypical Levallois point | 1 | 8.3 |
| Bilaterally retouched ventral flake-blade | 1 | 8.3 | Point on blade | 1 | 8.3 |
| | | | Total | 12 | |

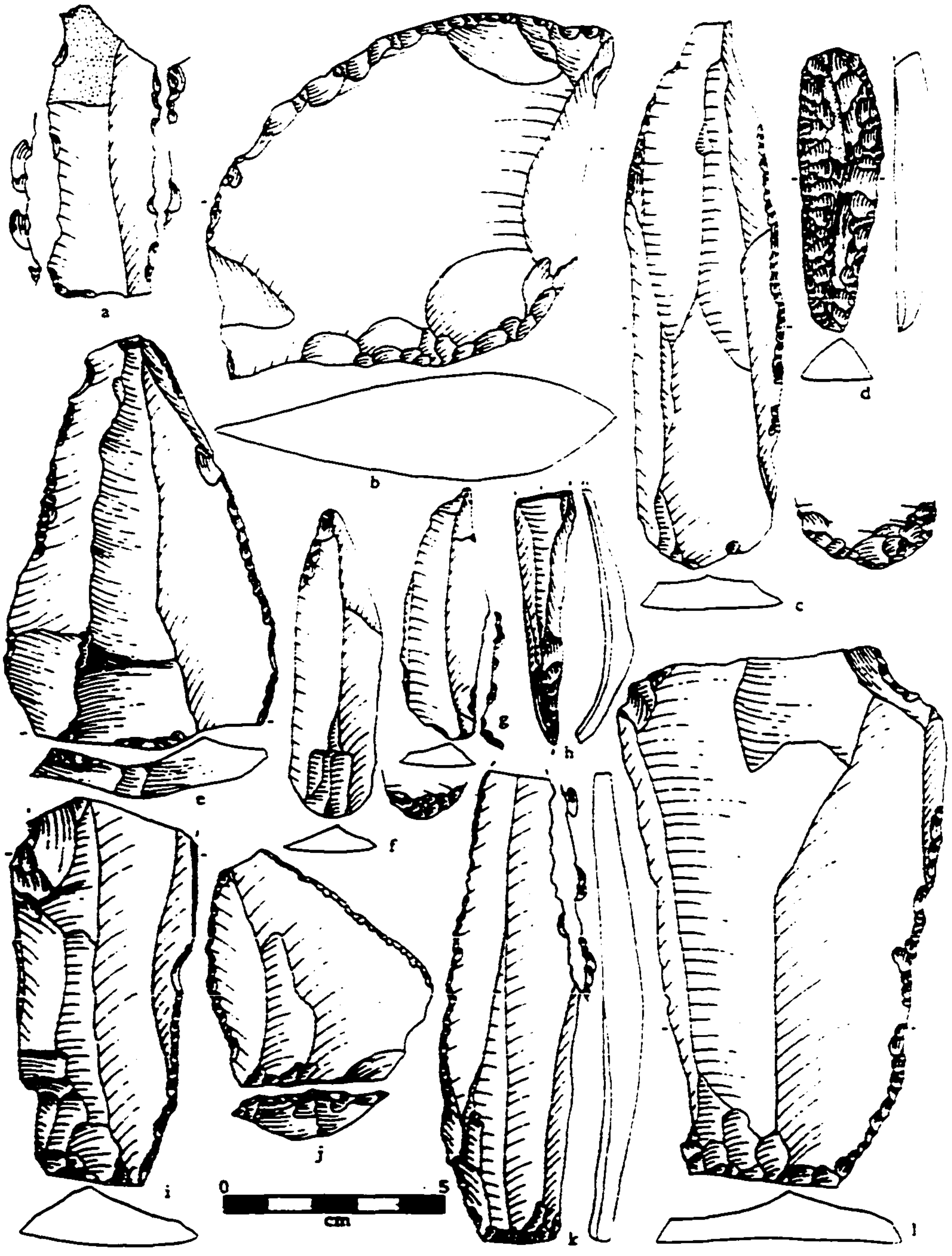


**Fig. 7.17.** Lithic artifacts from Maloialomanskaia Peshchera: bilaterally retouched flake-blade (a); convex side scraper (b); bilaterally retouched blade with ventral retouch on proximal end (c); bilaterally retouched blade (d); Levallois point (e); point on blade with ventral retouch on proximal end (f); unilaterally retouched ventral blade (g); crested blade (h); unilaterally retouched flake-blades (i, l); atypical Levallois point (j); unilaterally retouched blade (k).

*Tool Assemblage.* The tool assemblage consists of only 12 tools, the majority of which are retouched blades (Fig. 7.15, Table 7.5). Points, side scrapers, and cobble tools occur less frequently. The proximal ends of one retouched blade and one point on a blade were retouched ventrally in order to remove the bulb of percussion (Fig. 7.17:c, f). The other two points, a typical Levallois point (Fig. 7.17:e) and an atypical Levallois point (Fig. 7.17:j), are manufactured on wide Levallois point blanks and have faceted platforms. The side scraper is a large single convex side scraper (Fig. 7.17:b), and the cobble tool is a hammerstone made on a coarse quartzite cobble.

This small assemblage displays both Mousterian and early Upper Paleolithic elements. The Levallois points with faceted platforms are typically Mousterian tool forms, as is the convex side scraper. The remainder of the tool assemblage, however, is distinctly early Upper Paleolithic. The crested blade, retouched blades, and unifacial point on blade with proximal ventral retouch are technological-typological elements seen in other Altai early Upper Paleolithic industries including Ust'-Karakol and Kara-Bom component II. Given that the assemblage is so small, and that it represents a component of cave sediment nearly 1 m thick, it is likely that the assemblage is a product of the geologic mixing of multiple hominid occupations.

## Malaia Syia

The lithic assemblage studied here was collected by Ovodov in 1975 (Muratov et al. 1982) and consists of 59 cores and 31 tools.

*Primary Reduction Technology.* Raw materials are principally argillite, occasionally quartzite, and rarely chert (Fig. 7.18:a). There are three varieties of argillites (gray, dark gray, and pink), four varieties of quartzite (gray, tan, green, and dark gray), and two varieties of chert (gray and dark gray). Sixty-percent of all cores and tools display cortex, and 40% are more than half covered with cortex. Cores are typically simple flake cores with multiple platforms and/or multiple fronts (Table 7.6). These cores are minimally worked with limited platform surface preparation. Other cores include flat-faced blade cores (Fig. 7.19:a, c), subprismatic blade cores, a bifacially flaked radial core (Fig. 7.19:d), and a Levallois flake core (Fig. 7.19:b). The two flat-faced blade cores are monofrontal bidirectional, as are three of the four subprismatic blade cores. The Levallois flake core is oval with a radially prepared flaking surface and a faceted platform.

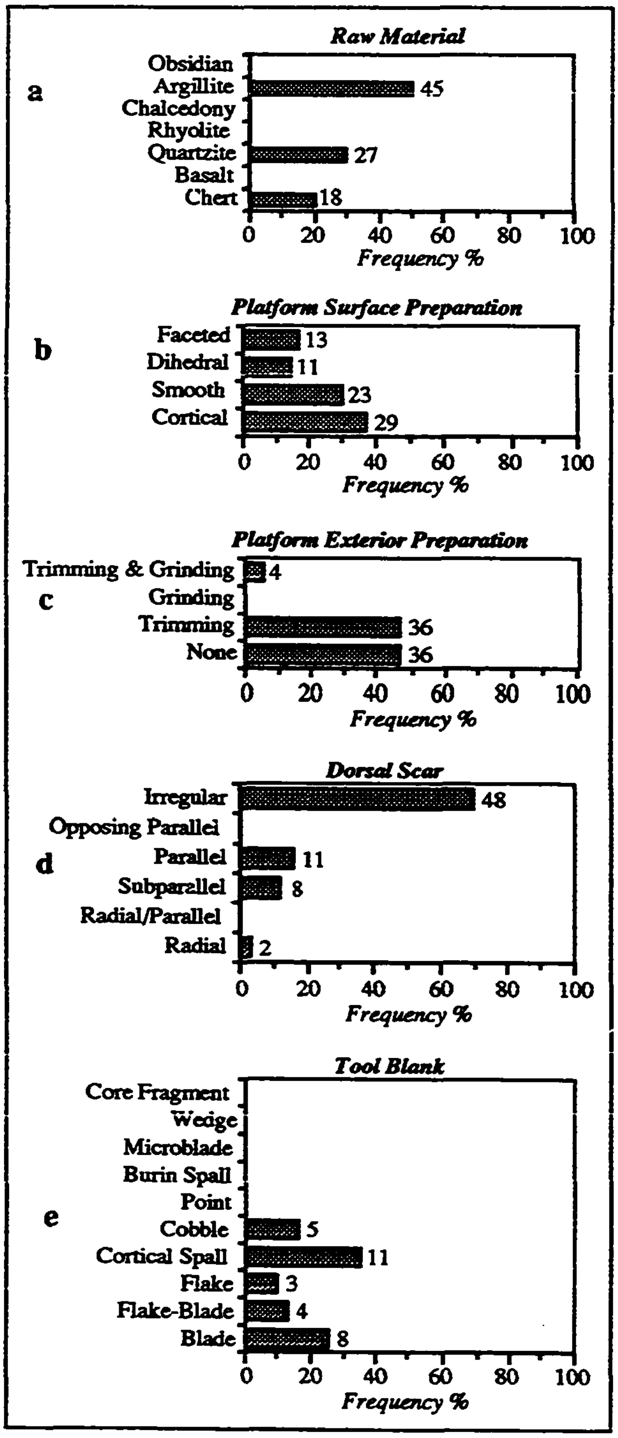


**Fig. 7.18.** Malaia Syia: attributes of primary reduction technology.

Platforms on cores and end products are principally cortical or smooth (Fig. 7.18:b). Dihedral and faceted platforms are moderately frequent, yielding a faceting index of 31.6. While platform surfaces are typically unprepared, platform exterior preparation is high, with over half the cores and blanks displaying either trimming or trimming and grinding (Fig 7.18:c). Irregular dorsal scar patterns predominate (Fig. 7.18:d), while parallel and subparallel patterns occur in modest numbers. Most tool blanks are either cortical spalls, blades, or flake-blades (Fig. 7.18:e). Tools on cobbles and tools on flakes are also present.

**Table 7.6.** Malaia Syia: Core Types

| Core type | n | % |
|---|---|---|
| Monofrontal unidirectional flake | 22 | 37.3 |
| Monofrontal bidirectional flake | 5 | 8.5 |
| Bifrontal unidirectional flake | 6 | 10.2 |
| Bifrontal bidirectional flake | 8 | 13.6 |
| Trifrontal unidirectional flake | 1 | 1.7 |
| Trifrontal bidirectional flake | 2 | 3.4 |
| Rotated flake | 7 | 11.9 |
| Monofrontal bidirectional flat-faced blade | 2 | 3.4 |
| Monofrontal unidirectional subprismatic blade | 3 | 5.1 |
| Monofrontal bidirectional subprismatic blade | 1 | 1.7 |
| Levallois flake | 1 | 1.7 |
| Bifacial radial | 1 | 1.7 |
| Total | 59 | |

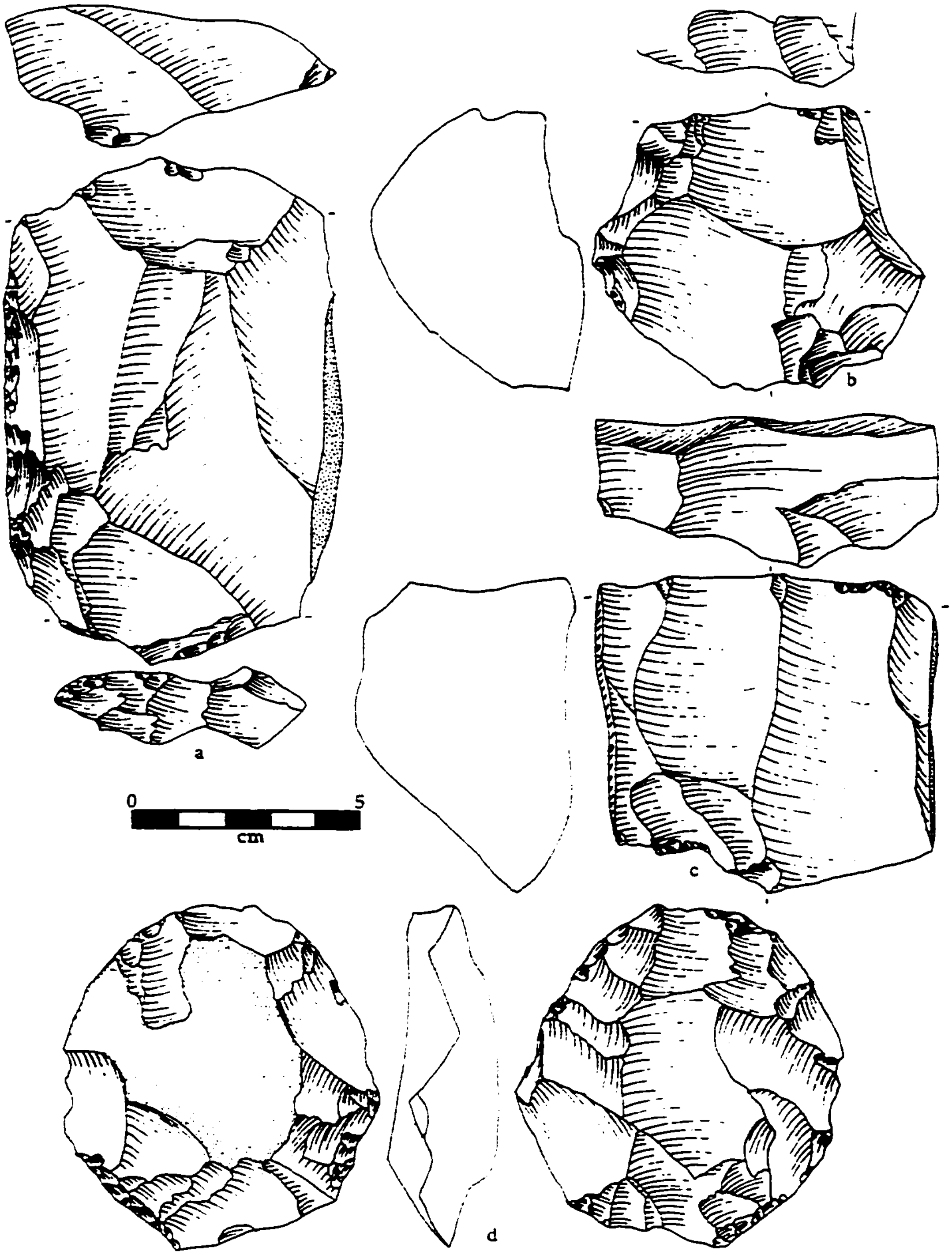


**Fig. 7.19.** Cores from Malaia Syia: bidirectional flat-faced blade cores (a, c); Levallois flake core (b); bifacially worked radial core (d).

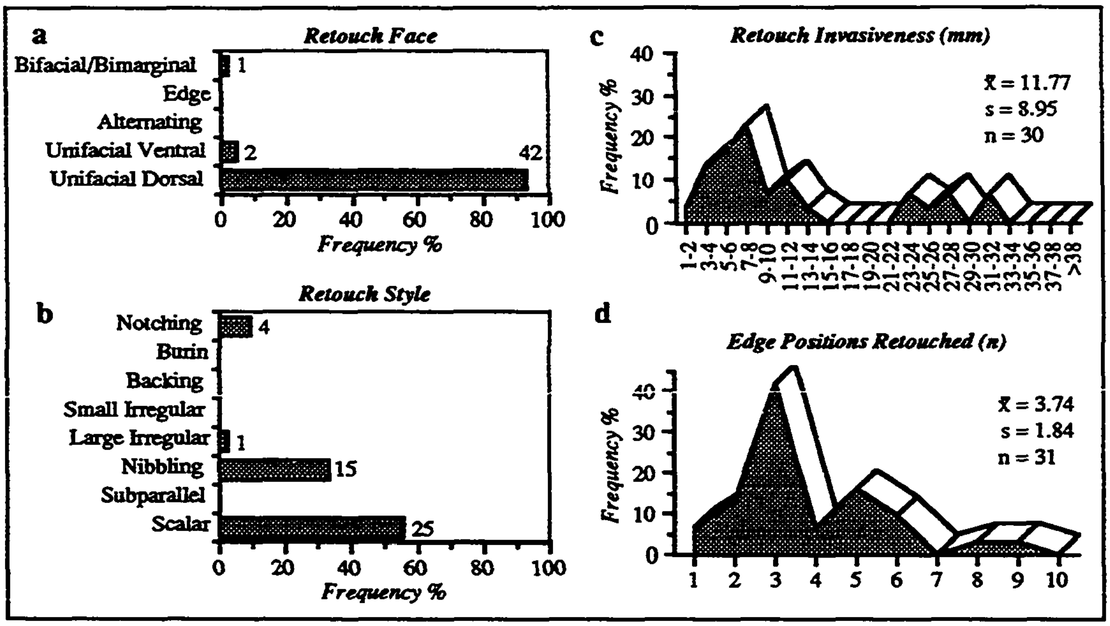


**Fig. 7.20.** Malaia Syia: attributes of secondary reduction technology.

*Secondary Reduction Technology.* Nearly all tool edges are retouched unifacially on the dorsal surface (Fig. 7.20:a). One artifact (a chopping tool) is retouched bifacially. Retouch styles are principally scalar and nibbling (Fig. 7.20:b), and a few edges are notched. Retouch invasiveness is high, with nearly 40% of edges with retouch scars greater than 10 mm deep (Fig. 7.20:c). Retouch intensity, however, is low (Fig. 7.20:d). Less than 40% of tools have four or more retouched edge positions.

*Tool Assemblage.* Side scrapers, retouched blades, end scrapers, and cobble tools are abundant, while denticulates, knives, notches, and retouched flakes are present but rare (Fig. 7.21, Table 7.7). Side scrapers are not usually intensively retouched, with the majority being worked along only one lateral margin (Fig. 7.22:a, k). Three side scrapers are made on blades, and one on a crested blade. End scrapers are typically made on long, slender blades or cortical spalls (Fig. 7.22:b-e, h). One is worked along one lateral margin as well as on its distal end (Fig. 7.22:b). The cobble tools include three unifacially worked choppers, one bifacially worked chopping tool, and one plane. Any of these could have functioned as cores as well as tools. Both knives are smooth-backed (Fig. 7.22:i).

Primary and secondary reduction technologies at Malaia Syia are peculiar in several respects. First, there are more cores than tools. Second, most cores are only preliminarily worked and have cortical platforms. Third, most end products have cortical platforms as well as cortex on their dorsal surfaces. All of this suggests that Malaia Syia functioned as a place where lithic raw materials in cobble-sized packages were procured, cores were

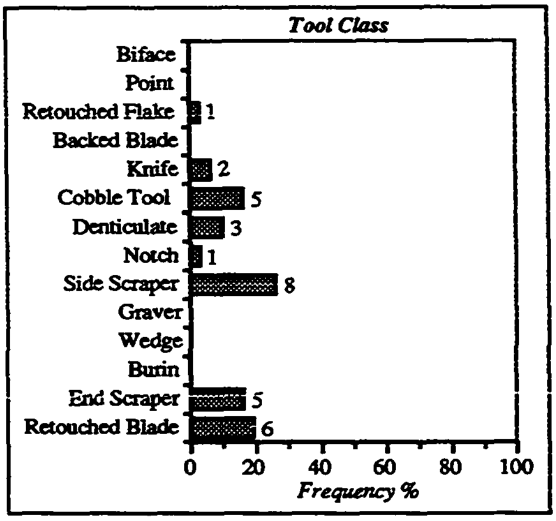


**Fig. 7.21.** Malaia Syia: tool class.

**Table 7.7.** Malaia Syia: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 3 | 9.7 | Convergent scraper | 1 | 3.2 |
| Bilaterally retouched blade | 2 | 6.5 | Single notch | 1 | 3.2 |
| Unilaterally retouched flake-blade | 1 | 3.2 | Single straight denticulate | 1 | 3.2 |
| End scraper on blade | 3 | 9.7 | Single straight ventral denticulate | 1 | 3.2 |
| End scraper on flake | 1 | 3.2 | Single convex denticulate | 1 | 3.2 |
| End/side scraper | 1 | 3.2 | Chopper | 3 | 9.7 |
| Single straight side scraper | 3 | 9.7 | Chopping tool | 1 | 3.2 |
| Single convex side scraper | 1 | 3.2 | Plane | 1 | 3.2 |
| Single convex ventral side scraper | 1 | 3.2 | Smooth-backed knife | 2 | 3.2 |
| Straight-convex side scraper | 2 | 6.5 | Retouched flake | 1 | 3.2 |
| | | | Total | 31 | |

prepared (sometimes only preliminarily), and blanks (usually blades and flake-blades) were produced for use as tools. Finished tools were unintensively yet invasively retouched. The tool assemblage is rich in side scrapers and end scrapers. The assemblage studied, however, is a small sample of the total lithic assemblage thus far excavated at Malaia Syia. Further examination of Larichev's collections could change the present interpretation of this site.

## Sosnovyi Bor Component VI

There are 162 lithic artifacts from the basal cultural component at Sosnovyi Bor. Few, however, are diagnostic. In the present study a sample of one core and 35 tools was inspected.

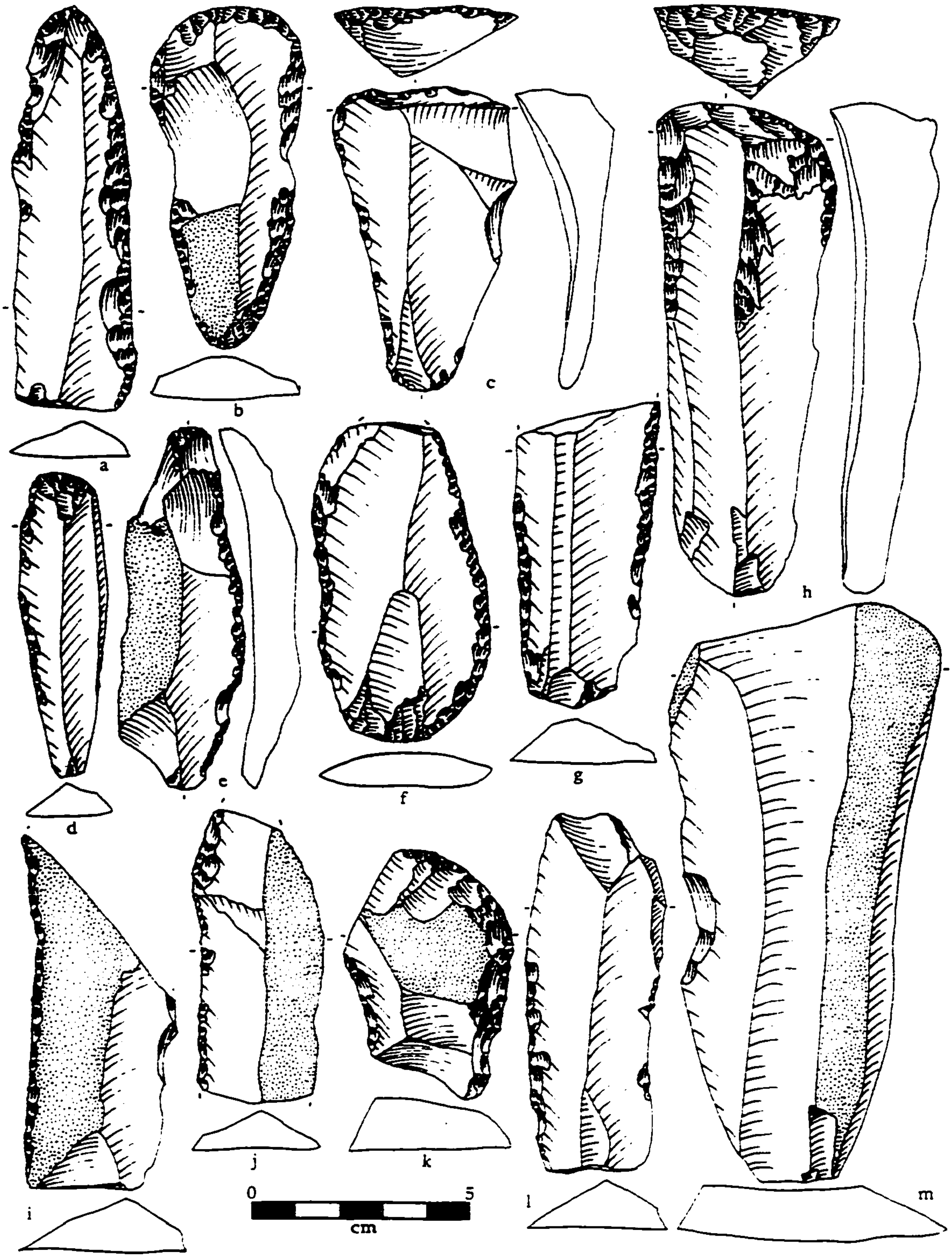


**Fig. 7.22.** Lithic artifacts from Malaia Syia: convergent scraper (a); end/side scraper (b); end scrapers on blades (c-d, h); end scraper on crested blade (e); straight/convex side scrapers (f, k); bilaterally retouched blades (g, l); smooth-backed knife (i); unilaterally retouched blade (with cortex) (j); notch (m).

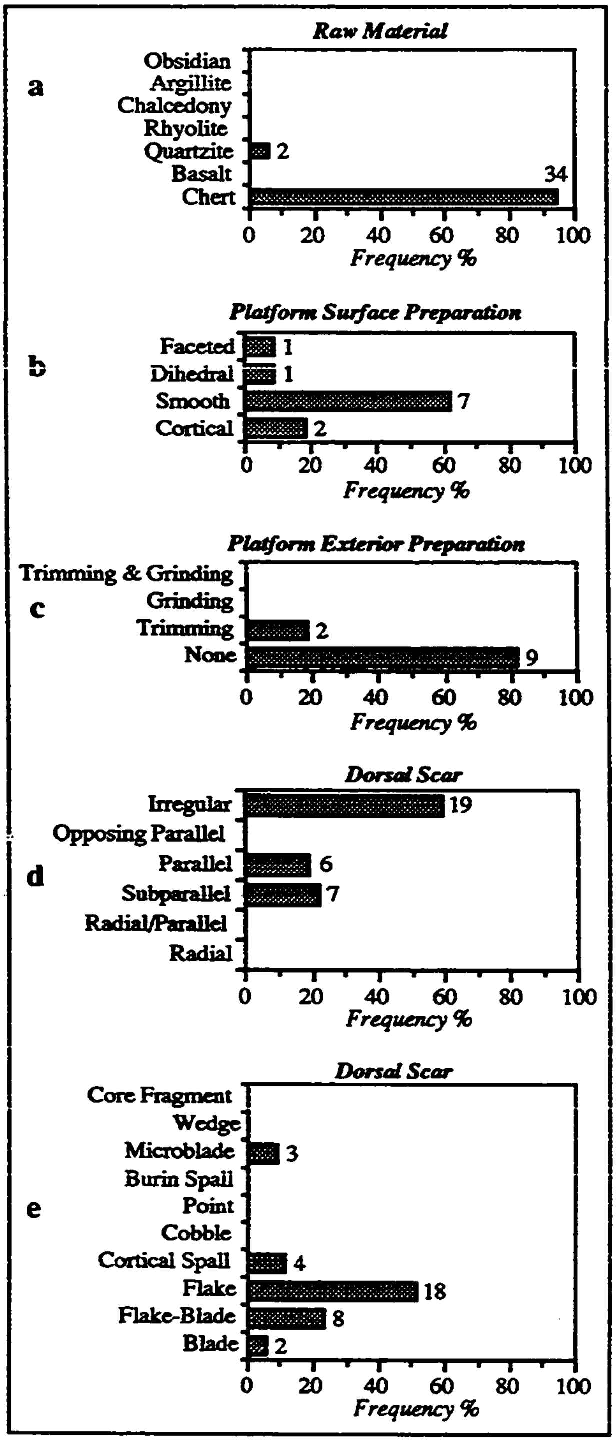


**Fig. 7.23.** Sosnovyi Bor component VI: attributes of primary reduction technology.

*Primary Reduction Technology.* Raw materials are predominantly cherts (Fig. 7.23:a). Cortex is present on the dorsal surfaces of four tools and covers over half of the dorsal surfaces of two tools. The single core has a faceted platform; unfortunately its pattern of flaking was unobservable. It is rectangular and thick, similar to flat-faced blade cores from other early Upper Paleolithic industries. A crested blade is also present (Fig. 7.26:e) and it appears to have been removed from the front of a bifacially prepared wedge-shaped microblade core. Most of the artifacts in the assemblage are fragmentary and do not display platforms. When platforms are present, surface preparation is predominantly smooth (Fig. 7.23:b), and exterior preparation (trimming) is rare (Fig. 7.23:c). The majority of dorsal scar patterns are irregular, although modest numbers of subparallel and parallel patterns also occur (Fig. 7.23:d). Tool blanks include high frequencies of flakes and flake-blades, and low frequencies of cortical spalls, microblades, and blades (Fig. 7.23:e).

*Secondary Reduction Technology.* Most edges are retouched unifacially, primarily on the dorsal surface (Fig. 7.24:a). One tool, a side scraper, is bimarginally retouched (Fig. 7.26:k).

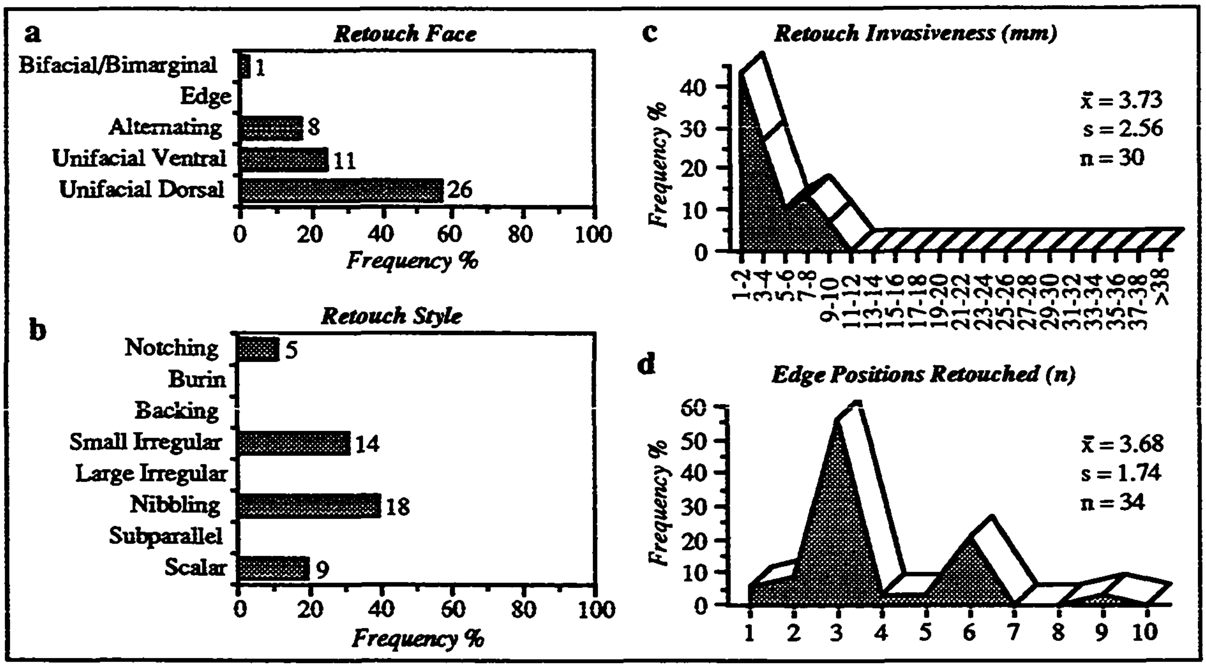


**Fig. 7.24. Sosnovyi Bor component VI: attributes of secondary reduction technology.**

Retouch styles are predominantly nibbling and small irregular (Fig. 7.24:b). Retouch invasiveness is extremely low; over 80% of edges have retouch scars less than 7 mm deep (Fig 7.24:c). Retouch intensity is also low, with less than 30% of tools having four or more retouched edge positions (Fig. 7.24:d).

*Tool Assemblage.* Retouched blades, retouched flakes, and side scrapers are well represented (Fig. 7.25) (Table 7.8). Other tools occur in low frequencies, including end scrapers, denticulates, notches, knives, and a graver. Four retouched blades are actually microblades (Fig. 7.26:f, i-j), likely removed from specially-prepared microblade cores. The remaining retouched blades are small and fragmentary (Fig 7.26:l-m). Side scrapers include examples of single straight, single straight ventral, double straight, and transverse straight types (Fig. 7.26:c, k, q). The single straight side scraper is made on a large quartzite cortical spall and is heavily wind polished, making retouch scars difficult to distinguish (Fig. 7.26:q). End scrapers are small, usually fragmentary, and made on flakes (Fig. 7.26:). Denticulates are not intensively worked, usually along only one lateral margin (Fig. 7.26:o-p). Of notched tools, one displays two notches, one on the right lateral margin and the other on the transverse distal margin (Fig. 7.26:b). Knives are represented by one cortically backed (Fig. 7.26:a) and one smooth-backed form (Fig. 7.26:n).

The Sosnovyi Bor primary reduction technology is directed toward the production of flakes, blades, and microblades. Most blanks are small or fragmented. Platform

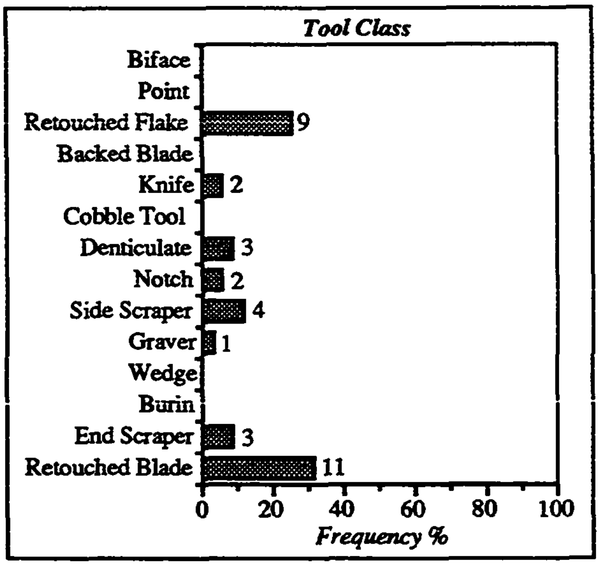


**Fig. 7.25.** Sosnovyi Bor component VI: tool class.

**Table 7.8.** Sosnovyi Bor Component VI: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 1 | 2.9 | Single straight ventral side scraper | 1 | 2.9 |
| Bilaterally retouched blade | 1 | 2.9 | Double straight side scraper | 1 | 2.9 |
| Unilaterally retouched flake-blade | 1 | 2.9 | Straight transverse bimarginal scraper | 1 | 2.9 |
| Unilaterally retouched ventral flake-blade | 2 | 5.7 | Single notch | 1 | 2.9 |
| Bilaterally retouched ventral flake-blade | 2 | 5.7 | Multiple notch | 1 | 2.9 |
| Unilaterally retouched microblade | 1 | 2.9 | Denticulate fragment | 1 | 2.9 |
| Bilaterally retouched microblade | 1 | 2.9 | Single straight denticulate | 2 | 5.7 |
| Bilaterally retouched ventral microblade | 2 | 5.7 | Naturally backed knife | 1 | 2.9 |
| End scraper fragment | 1 | 2.9 | Smooth-backed knife | 1 | 2.9 |
| End scraper on flake | 1 | 2.9 | Retouched flake fragment | 1 | 2.9 |
| Lateral end scraper | 1 | 2.9 | Retouched flake | 4 | 11.4 |
| Single graver | 1 | 2.9 | Retouched alternate flake | 1 | 2.9 |
| Single straight side scraper | 1 | 2.9 | Utilized flake | 3 | 8.6 |
| | | | Total | 35 | |

surfaces are predominantly smooth and platform exteriors are mostly unprepared. Secondary reduction technologies are unifacial, uninvasive, and unintensive. The tool assemblage is made up of marginally retouched blades, microblades, and flakes, as well as relatively intensively retouched side scrapers. End scrapers, notches, and denticulates

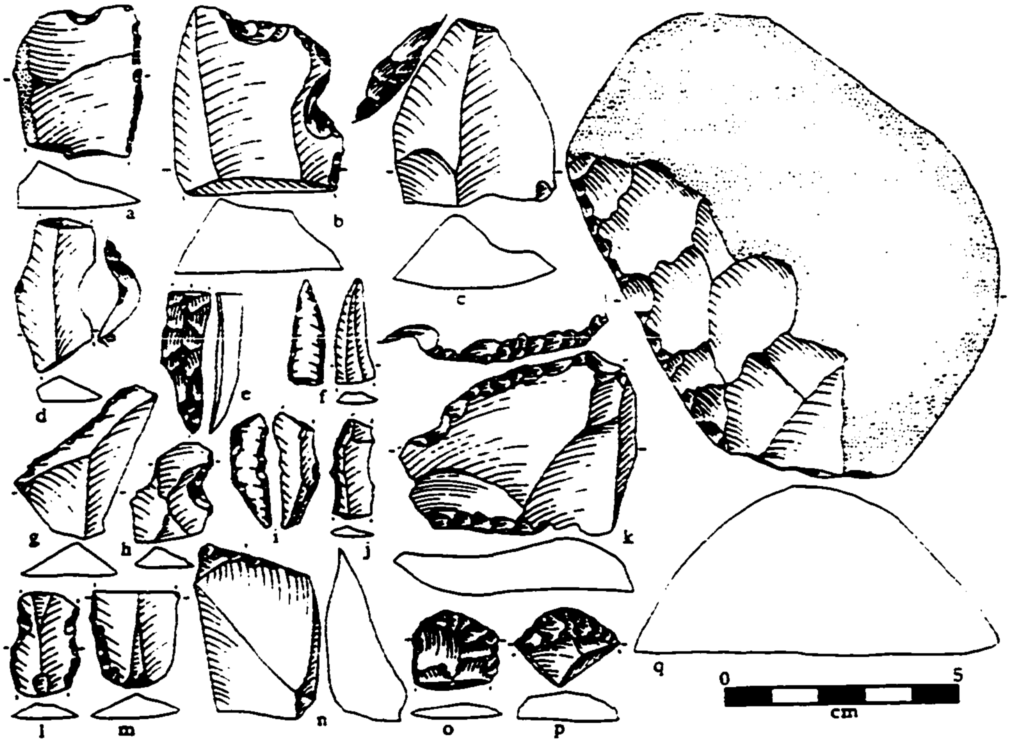


**Fig. 7.26.** Lithic artifacts from Sosnovyi Bor component VI: cortically backed knife (with notch) (a); multiple notch (b); single straight ventral side scraper (c); single straight denticulate (d); crested blade (e); bilaterally retouched ventral microblades (f, i); retouched flake (g); notch (h); unilaterally retouched microblade (j); straight-convex alternate side scraper (k); bilaterally retouched blade (l); unilaterally retouched blade (m); smooth-backed knife (n); end scraper on flake (o); end scraper fragment (p); single straight side scraper (q).

are also common. Interestingly, scrapers, denticulates, and retouched flakes are heavily polished from wind-induced sandblasting, while microblades are only lightly polished. Possibly these represent two separate complexes.

## Arembovskii

The lithic assemblage discussed here was excavated by Sëmin in 1989 (Sëmin et al. 1990; Medvedev et al. 1990). It includes 39 cores and 51 tools previously undescribed.

*Primary Reduction Technology.* Raw materials include argillite (silicified claystone), quartzite, and chert (Fig. 7.27:a). Argillite dominates the industry; it was procured from an outcrop exposed less than 100 meters from the site. Cortex occurs on eight blanks

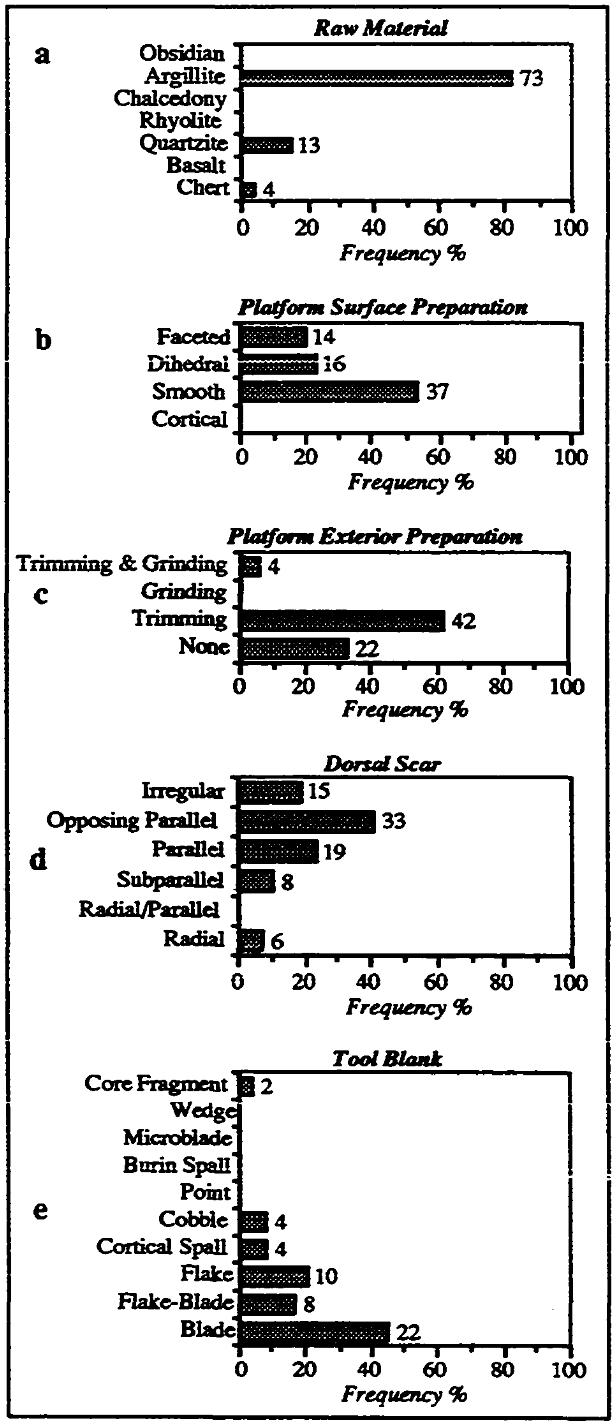


**Fig. 7.27.** Arembovskii: attributes of primary reduction technology.

and one core. Cores are predominantly flat-faced blade cores (Fig. 7.28:a, c-d), but subprismatic blade cores (Fig. 7.28:b), radial cores, and simple flake cores also occur (Table 7.9), as does one core tablet (Fig. 7.32:j). Flat-faced blade cores are overwhelmingly monofrontal and bidirectional. Their platforms are smooth (41%), dihedral (35%), or faceted (24%). Among radial cores, four are worked bifacially. Two of these have faceted platforms and evidence of failed Levallois removals. The subprismatic blade cores include unidirectional as well as bidirectional types.

Platform surface preparation is predominantly smooth, although dihedral and faceted varieties are also common

**Table 7.9.** Arembovskii: Core Types

| Core type | n | % |
|---|---|---|
| Monofrontal unidirectional flake | 1 | 2.6 |
| Monofrontal bidirectional flake | 2 | 5.1 |
| Rotated flake | 1 | 2.6 |
| Monofrontal unidirectional flat-faced blade | 2 | 5.1 |
| Monofrontal bidirectional flat-faced blade | 23 | 59.0 |
| Monofrontal unidirectional subprismatic blade | 2 | 5.1 |
| Monofrontal bidirectional subprismatic blade | 2 | 5.1 |
| Levallois flake | 1 | 2.6 |
| Unifacial radial | 1 | 2.6 |
| Bifacial radial | 3 | 7.7 |
| Core tablet | 1 | 2.6 |
| Total | 39 | |

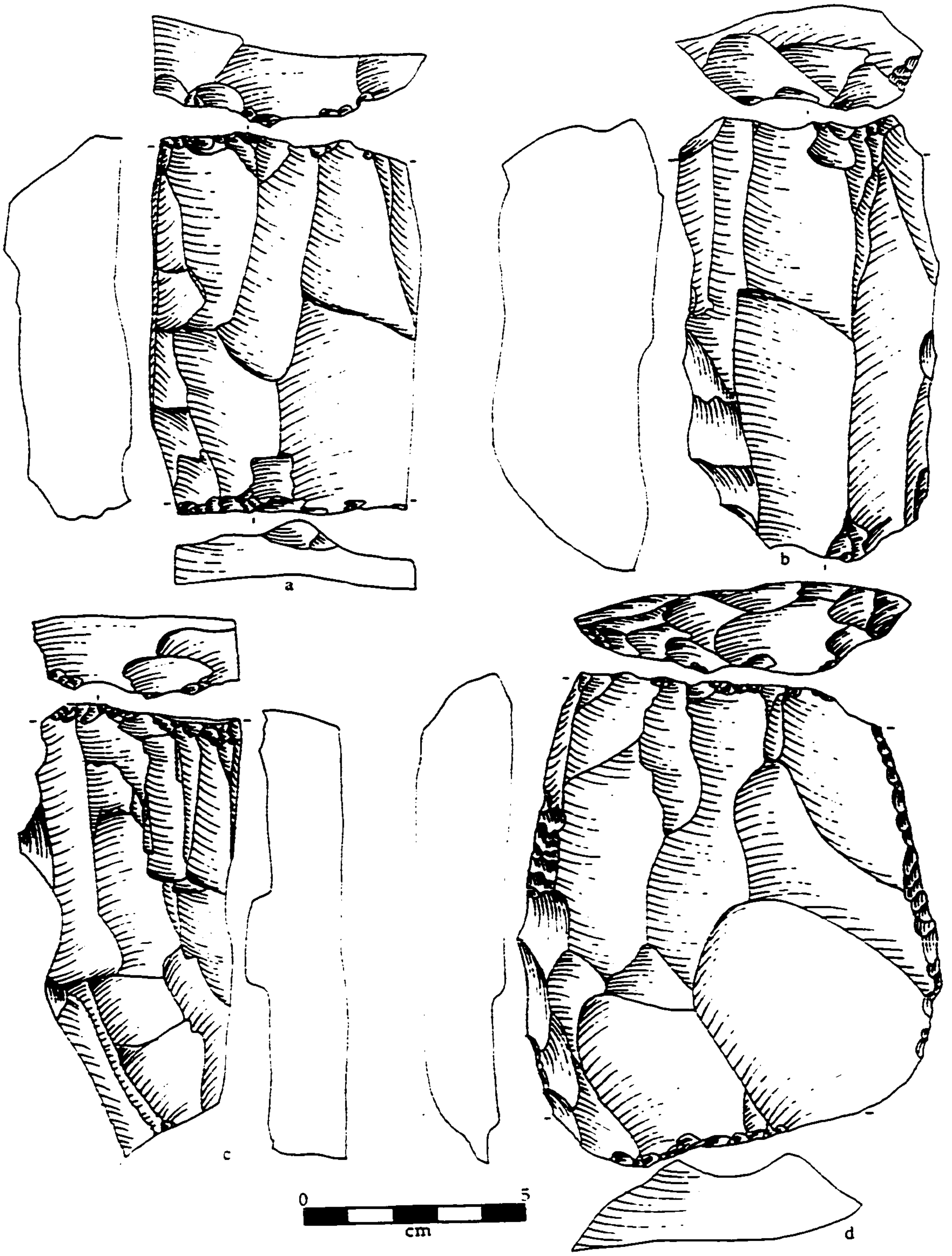


**Fig. 7.28. Cores from Arembovskii: bidirectional flat-faced blade cores (a, c-d); bidirectional subprismatic blade core (b).**

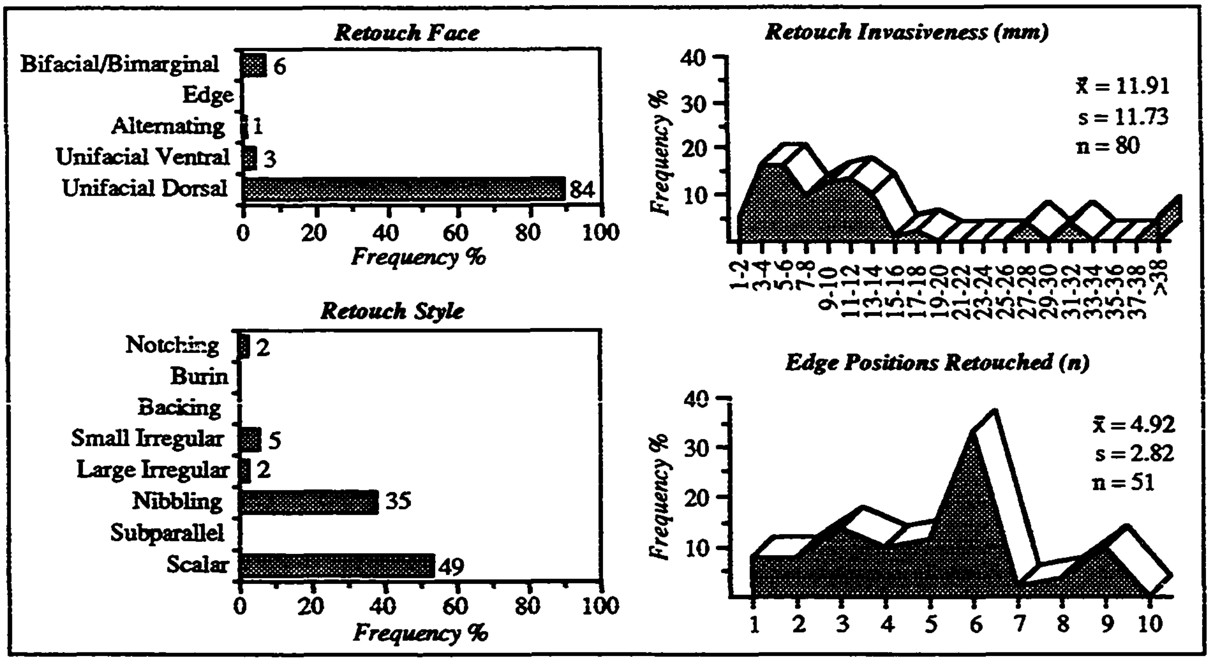


**Fig. 7.29.** Arembovskii: attributes of secondary reduction technology.

(Fig. 7.27:b) (faceting index = 44.8). Platform exterior preparation is prevalent (Fig. 7.27:c), especially on blades and blade cores. The majority of dorsal scar patterns are opposing parallel; however, parallel and subparallel patterns are also common (Fig. 7.27:d). Complementing this is a relatively high frequency of tools made on blades and flake-blades (Fig. 7.27:e).

*Secondary Reduction Technology.* Retouch is principally unifacial dorsal (Fig. 7.29:a). Bifacial retouch is also present, although rare. Retouch style is usually scalar or nibbling (Fig. 7.29:b). Retouch invasiveness is variable but high overall (Fig. 7.29:c), with 40% of edges displaying scars greater than 10 mm deep. Retouch intensity is likewise high, with over 70% of all tools having four or more retouched edge positions (Fig. 7.29:d).

*Tool Assemblage.* For its size, the Arembovskii tool assemblage is very diverse. Retouched blades, end scrapers, and side scrapers are abundant, while retouched flakes, cobble tools, points, wedges, gravers, notches, knives, and bifaces are present but in low frequencies (Fig. 7.30, Table 7.10). Retouched blades are usually worked along both lateral margins, either dorsally or ventrally (Fig. 7.31:b, f; 7.33:i-k). The majority of end scrapers are made on long, slender blades or flake-blades (Fig. 7.32:e-g, i, k; 7.33:a-e). Among side scrapers, convex and convergent types are most common (Fig. 7.31:d, g-h, j, l; 7.32:a-c). Both points are made on blades; one is marginally retouched forming a distal point (Fig. 7.33:g),

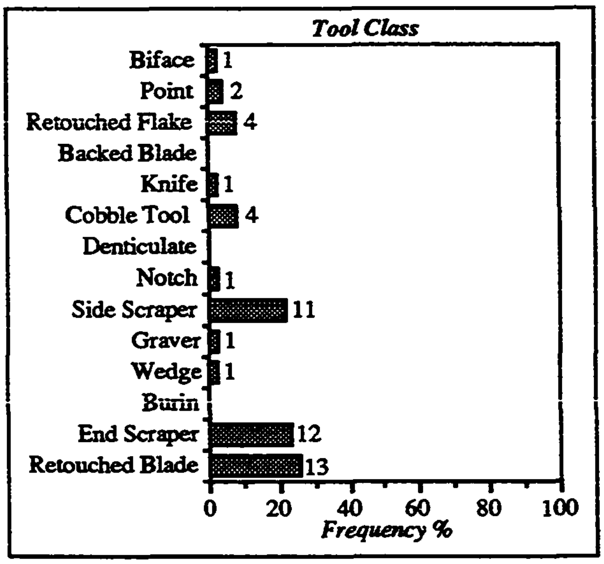


**Fig. 7.30.** Arembovskii: tool class.

**Table 7.10.** Arembovskii: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 3 | 5.9 | Double straight side scraper | 1 | 2.0 |
| Bilaterally retouched blade | 6 | 11.8 | Double convex side scraper | 1 | 2.0 |
| Unilaterally retouched flake-blade | 1 | 2.0 | Straight-convex side scraper | 2 | 3.9 |
| Unilaterally retouched ventral flake-blade | 1 | 2.0 | Convergent scraper | 2 | 3.9 |
| Bilaterally retouched flake-blade | 2 | 3.9 | Multiple notch | 1 | 2.0 |
| End scraper on blade | 5 | 9.8 | Chopper | 2 | 3.9 |
| End scraper on flake | 2 | 3.9 | Chopping tool | 1 | 2.0 |
| Double end scraper | 1 | 2.0 | Hammerstone | 1 | 2.0 |
| End/side scraper | 4 | 7.8 | Smooth-backed knife | 1 | 2.0 |
| Wedge | 1 | 2.0 | Retouched flake fragment | 1 | 2.0 |
| Single graver | 1 | 2.0 | Retouched flake | 3 | 5.9 |
| Single straight side scraper | 1 | 2.0 | Point on blade | 2 | 3.9 |
| Single convex side scraper | 4 | 7.8 | Triangular biface | 1 | 2.0 |
| | | | Total | 51 | |

while the other is retouched only irregularly. The wedge (or *pièce ésquillée*) is made on a cortical spall and displays bipolar, bifacial retouch (Fig. 7.32:h). The biface is fragmented but appears triangular in shape; its three unbroken sides are bifacially worked (Fig. 7.32:l).

According to Sëmin et al. (1990), the Arembovskii site served as a site where preliminary stoneworking took place. Argillite appears to have been procured fresh from a nearby

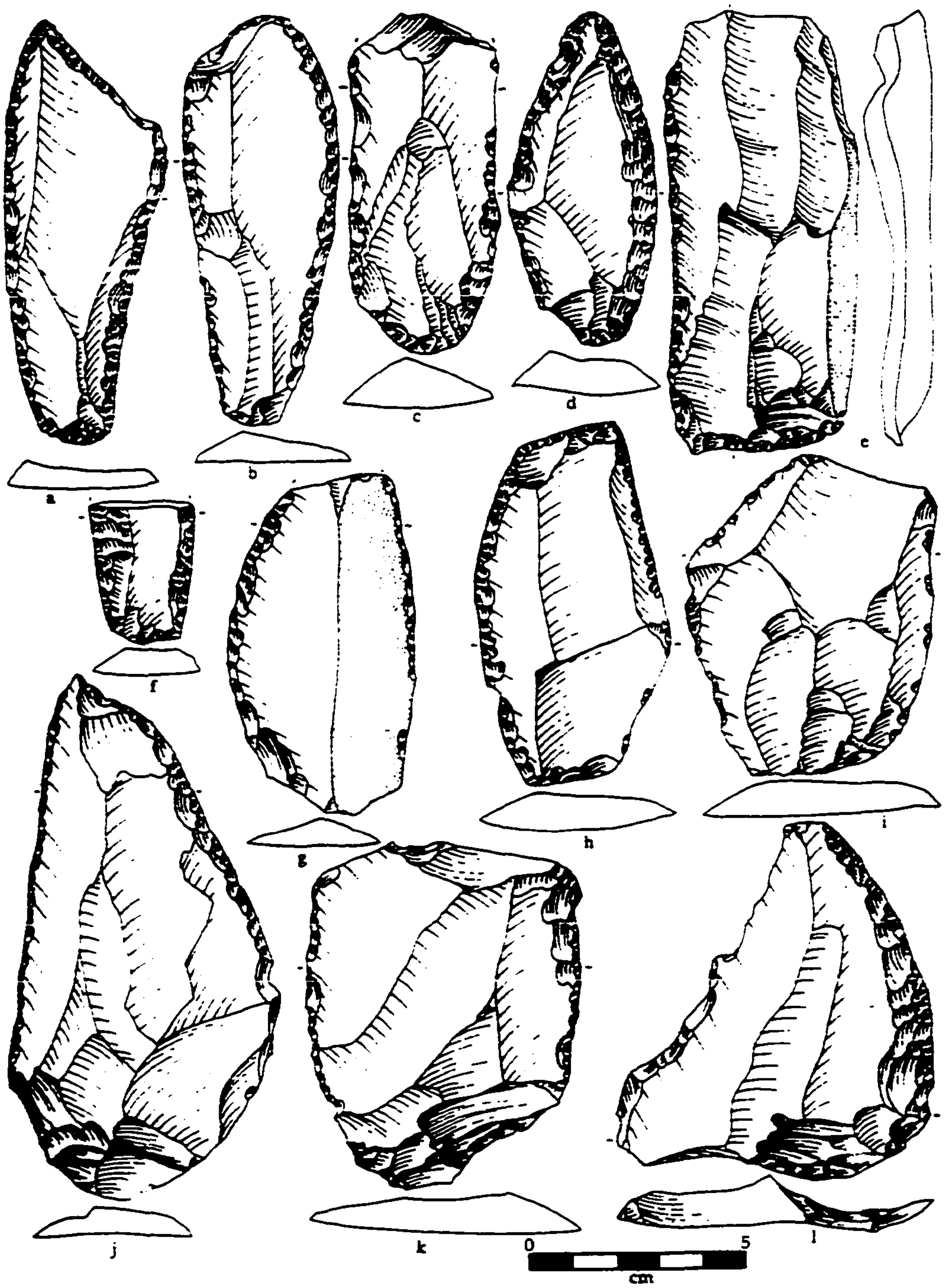


**Fig. 7.31.** Lithic artifacts from Arembovskii: possible graver (a); bilaterally retouched flake-blade (b); double straight side scraper (c); convergent scraper (d); unilaterally retouched flake-blade (e); bilaterally retouched blade (f); straight-convex side scraper (g); single convex side scraper (h, j, l); retouched flake (i); single straight side scraper (k).

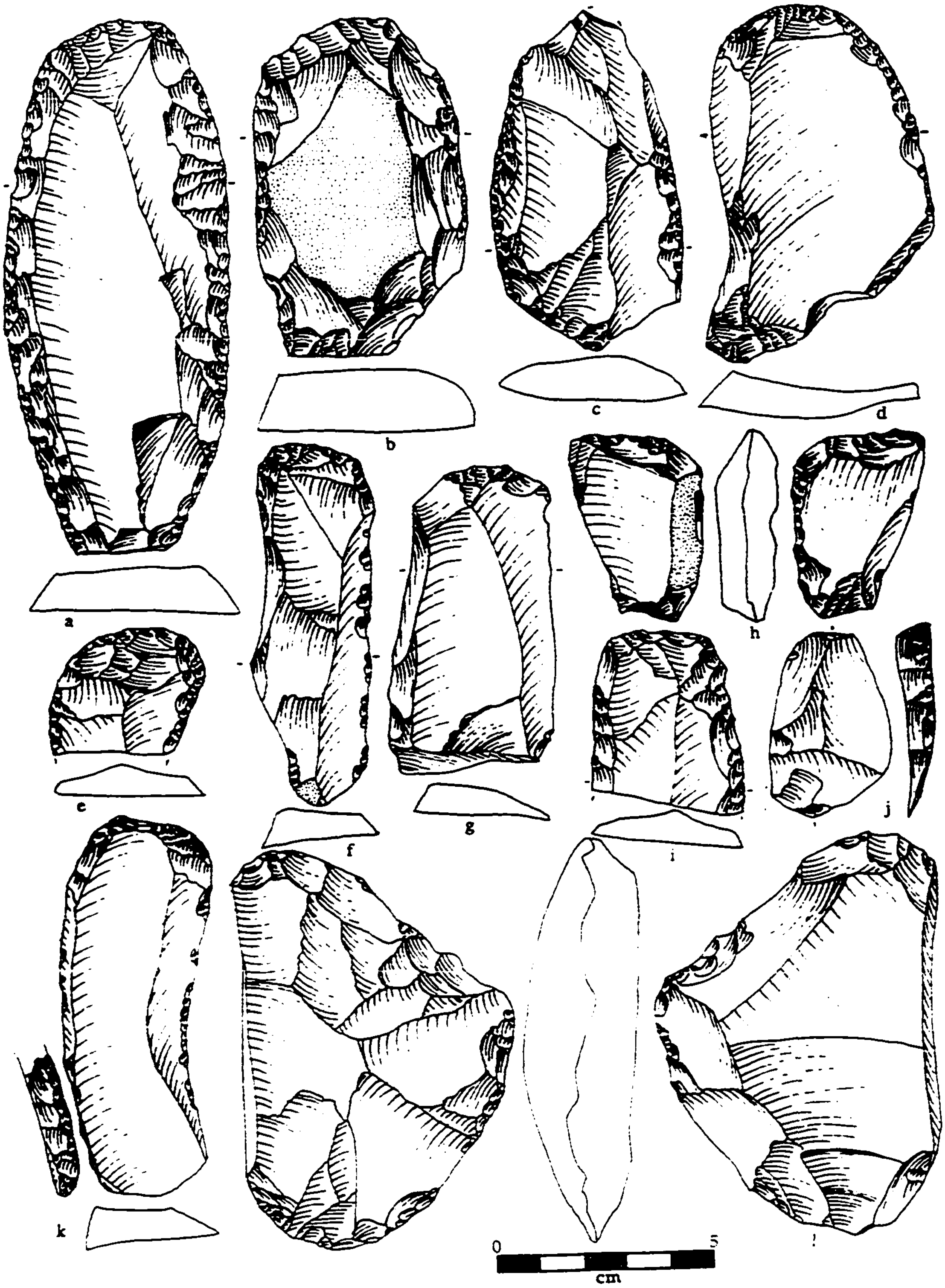


**Fig. 7.32.** Lithic artifacts from Arembovskii: double convex side scraper (a); convergent side scraper (b); straight-convex side scraper (c); end scraper on flake (d); end scrapers on blades (e-g, k); wedge (h); end/side scraper (i); core tablet (j); biface (l).

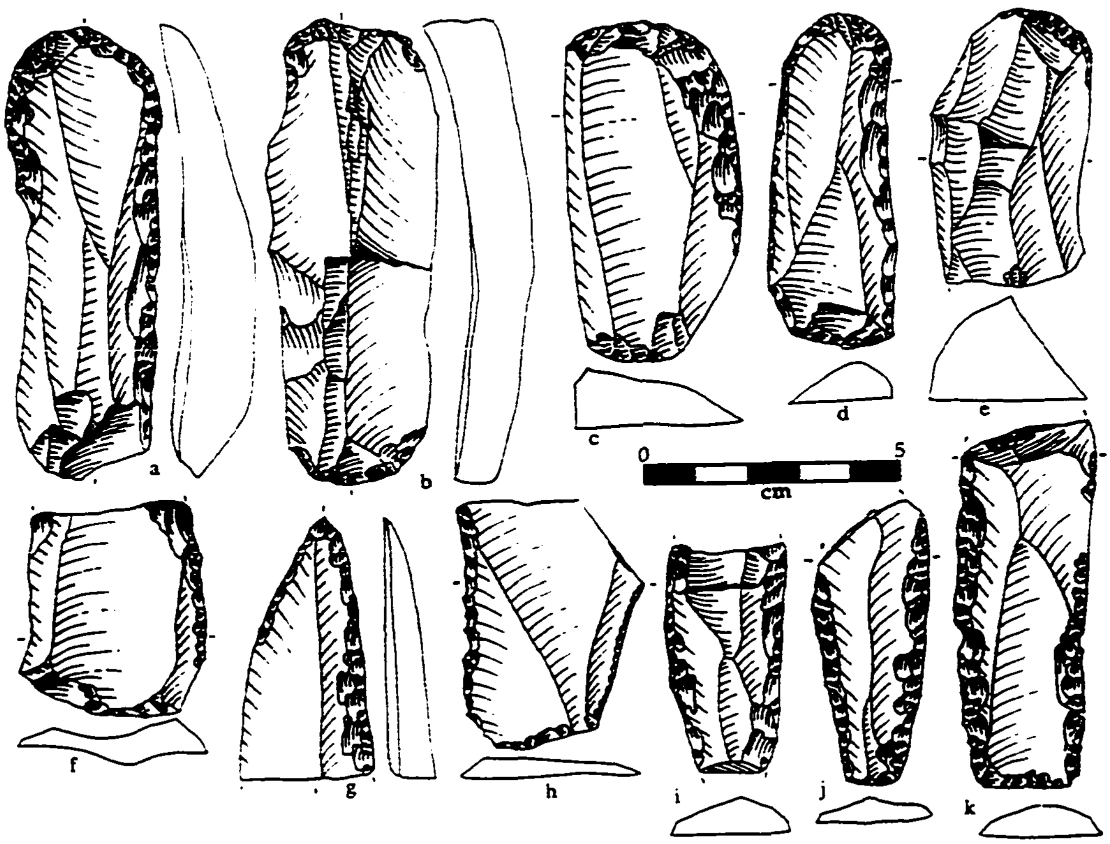


**Fig. 7.33. Lithic artifacts from Arembovskii: end/side scrapers (a, c-d); double end scraper (b); end scraper on blade (e); unilaterally retouched blade (f); point on blade (g); retouched flake (h); bilaterally retouched blade (i-k).**

outcrop, while the quartzite was procured in cobble form from local alluvium. Primary reduction technology is characterized by the production of blades typically from bidirectional flat-faced cores. Platform preparation is variable, with smooth platforms predominating. The faceting index for this industry, however, is high. Secondary reduction technology is unifacial, invasive, and intensive. The tool assemblage is rich in retouched blades, end scrapers, and side scrapers. Other diagnostic artifacts include points on blades, a wedge, and a biface.

## Makarovo-4

Aksenov (1989a, 1989b) describes a lithic assemblage from Makarovo-4 that consists of over 4,000 artifacts. In the present study, all available tools (n = 280) and cores (n = 45) were analyzed.

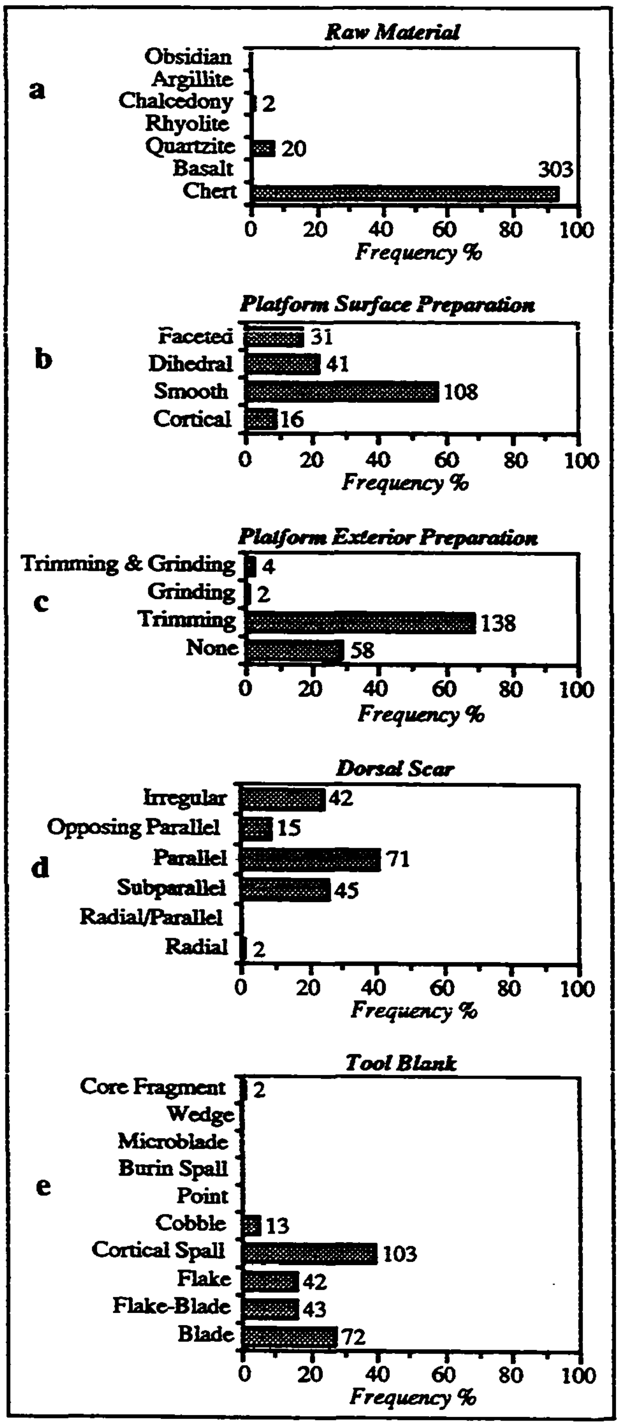


**Fig 7.34.** Makarovo-4: attributes of primary reduction technology.

*Primary Reduction Technology.* Raw materials are exclusively cherts (Fig. 7.34:a), occurring in nine varieties, dark gray (60%), gray (33%), tan (3.6%), cream (1%), gray-green (<1%), green (<1%), light gray (<1%), brown (<1%), and red (<1%). Cortex covers more than half the dorsal surface on 21% of the collection. Among cores, flat-faced blade cores are prevalent, with unidirectional and bidirectional varieties being almost equally represented (Table 7.11) (Fig. 7.35:a, c-e). Platforms on these cores are usually smooth, and occasionally dihedral or faceted. The subprismatic blade cores (Fig 7.35:b, f), however, often display faceted platforms more often than smooth platforms. The single end core in the assemblage is made on a thick flake and displays at least three microblade-like removals (Fig. 7.35:g). Like other cores, it is heavily wind polished.

**Table 7.11.** Makarovo-4: Core Types

| Core type | n | % |
|---|---|---|
| Monofrontal unidirectional flake | 5 | 11.1 |
| Bifrontal unidirectional flake | 1 | 2.2 |
| Monofrontal unidirectional flat-faced blade | 16 | 35.6 |
| Monofrontal bidirectional flat-faced blade | 14 | 31.1 |
| Monofrontal unidirectional subprismatic blade | 6 | 13.3 |
| Monofrontal bidirectional subprismatic blade | 2 | 4.4 |
| End core | 1 | 2.2 |
| Totai | 45 | |

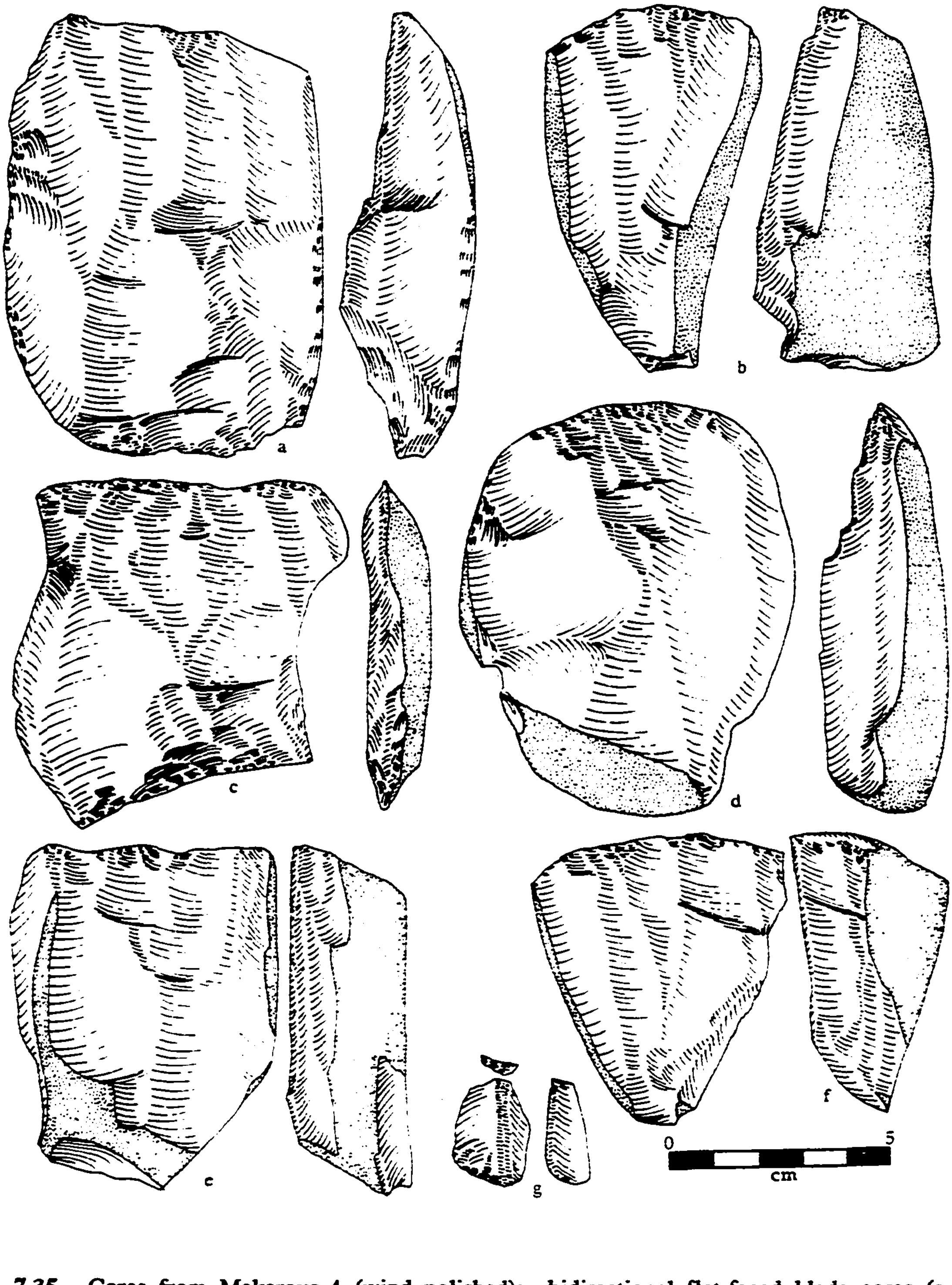


**Fig. 7.35.** Cores from Makarovo-4 (wind polished): bidirectional flat-faced blade cores (a, c); unidirectional subprismatic blade cores (b, f); unidirectional flat-faced blade cores (d-e); end core (g).

Platform surface preparation is predominantly smooth (Fig. 7.34:b), although dihedral and faceted platforms produce a faceting index of 36.7. The majority of cores and blanks display platform exterior preparation, usually in the form of trimming (Fig. 7.34:c). Dorsal scar patterns are frequently parallel, while subparallel and irregular patterns occur on occasion (Fig. 7.34:d). Opposing parallel scar patterns are also present but rare. A large percentage of tool blanks are cortical spalls (Fig. 7.34:e). Most of these are elongate and display parallel or subparallel dorsal scar patterns (Fig. 7.38:b-d, i, l, w, bb-cc). Other blank forms include blades, flake-blades, and flakes.

*Secondary Reduction Technology.* The vast majority of tool edges are retouched unifacially (Fig. 7.36:a). A few edges, however, display bimarginal or bifacial retouch. These edges occur on three wedges, two notches, one retouched blade, one retouched flake, and one biface. Nibbling and small irregular retouch characterize nearly 75% of edges (Fig. 7.36:b). Scalar retouch is less common. Retouch invasiveness is moderately low, with slightly less than 40% of edges displaying retouch scars greater than 6 mm deep (Fig. 7.36:c). Retouch intensity is also low (Fig. 7.36:d). Only 35% of tools have four or more retouched edge positions.

*Tool Assemblage.* The Makarovo-4 tool assemblage is rich in retouched blades and retouched flakes (Fig. 7.37, Table 7.12). Tools occurring in lesser numbers include end

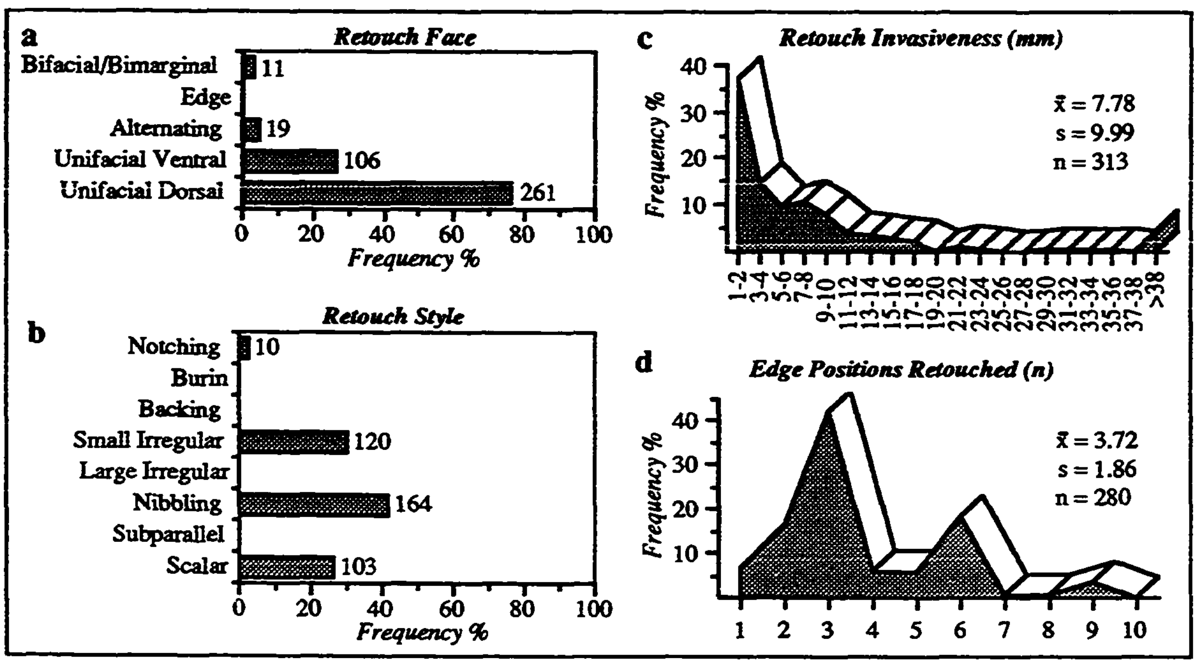


Fig. 7.36. Makarovo-4: attributes of secondary reduction technology.

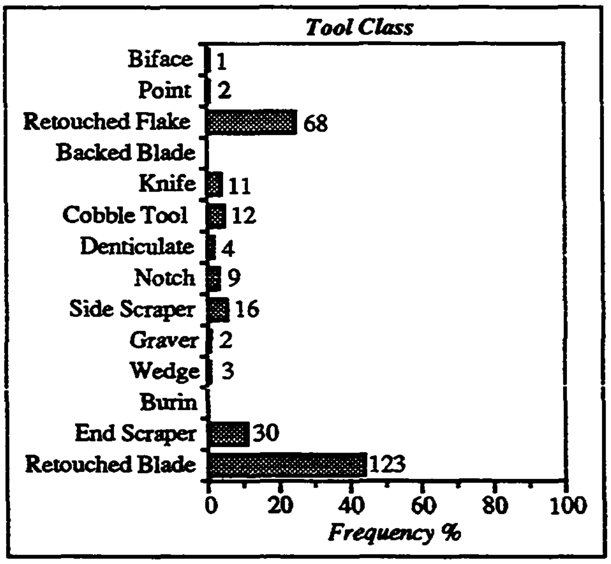


**Fig. 7.37.** Makarovo-4: tool class.

scrapers, side scrapers, cobble tools, knives, notches, denticulates, wedges, gravers, points, and a biface. Most retouched blades and flake-blades are retouched along one lateral margin. End scrapers are heterogeneous, including two carinated, two small round, and two pan-shaped types (Fig. 7.38:h). The majority of end scrapers, however, are made on blades or elongate cortical spalls (Fig. 7.38:d, e, j, t). Side scrapers are usually single-sided (Fig. 7.39:a, e-h, m), but two are transverse. Nearly all cobble tools are classified as planes. These typically have a plano-convex cross-section and cortical dorsal and ventral surfaces (Fig. 7.39:l). Retouch is steep, usually along one margin or end. These planes may have served as cores as well as tools, or perhaps as core preforms. Their retouched faces are usually steep and oblique to a flat ventral surface, suggesting that they were being prepared to serve as platforms. Cortically backed and smooth-backed knives are almost equally represented. The four denticulates are intensively retouched and include two convergent and one transverse type (Fig. 7.39:i). Wedges display bipolar and bimarginal retouch (Fig. 7.38:q-r). One also displays distinctive use-wear along its worked end. Each graver has a sharp, retouched drill bit (Fig. 7.38:x-y). One point is is made on a thin, elongate cortical spall and retouched around nearly its entire perimeter, producing a convex-based, leaf-shaped outline (Fig. 7.39:o). The other point is made on a blade; one lateral margin is retouched dorsally to form a point on its distal end (Fig. 7.38:p). Another retouched blade displays ventral retouch on its proximal end (Fig. 7.38:v). The only biface in

**Table 7.12.** Makarovo-4: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 25 | 8.9 | Double straight side scraper | 1 | 0.4 |
| Unilaterally retouched ventral blade | 12 | 4.3 | Double straight ventral side scraper | 1 | 0.4 |
| Unilaterally retouched bladelet | 1 | 0.4 | Straight-convex side scraper | 2 | 0.7 |
| Bilaterally retouched blade | 21 | 7.5 | Convex-concave side scraper | 1 | 0.4 |
| Bilaterally retouched ventral blade | 10 | 3.6 | Straight transverse scraper | 1 | 0.4 |
| Bilaterally retouched alternate blade | 2 | 0.7 | Convex transverse scraper | 1 | 0.4 |
| Unilaterally retouched flake-blade | 21 | 7.5 | Single notch | 8 | 2.9 |
| Unilaterally retouched ventral flake-blade | 13 | 4.6 | Multiple notch | 1 | 0.4 |
| Bilaterally retouched flake-blade | 15 | 5.3 | Denticulate fragment | 1 | 0.4 |
| Bilaterally retouched ventral flake-blade | 3 | 1.1 | Single convex denticulate | 1 | 0.4 |
| End scraper fragment | 2 | 0.7 | Single convex ventral denticulate | 1 | 0.4 |
| End scraper on blade | 9 | 3.2 | Transverse ventral denticulate | 1 | 0.4 |
| End scraper on flake | 11 | 3.9 | Chopper | 1 | 0.4 |
| End scraper on half round flake | 2 | 0.7 | Plane | 11 | 3.9 |
| Lateral end scraper | 1 | 0.4 | Cortically backed knife | 6 | 2.1 |
| Carinated end scraper | 2 | 0.7 | Smooth-backed knife | 5 | 1.8 |
| Pan-shaped end scraper | 2 | 0.7 | Retouched flake fragment | 1 | 0.4 |
| End/side scraper | 1 | 0.4 | Retouched flake | 24 | 8.5 |
| Wedge | 3 | 1.1 | Retouched ventral flake | 21 | 7.5 |
| Single graver | 2 | 0.7 | Retouched alternate flake | 1 | 0.4 |
| Side scraper fragment | 1 | 0.4 | Retouched bimarginal flake | 1 | 0.4 |
| Single straight side scraper | 6 | 2.1 | Utilized flake | 20 | 7.1 |
| Single convex side scraper | 1 | 0.4 | Point on blade | 2 | 0.7 |
| Single convex ventral side scraper | 1 | 0.4 | Oval biface | 1 | 0.4 |
| | | | Total | 281 | |

the assemblage represents a primary stage of manufacture. This preform displays cortex on one surface and is oval in shape (Fig. 7.40).

The Makarovo-4 industry is peculiar in that nearly all artifacts are polished from sandblasting. This makes examinations of retouching and use-wear difficult or impossible. Some of the artifacts classified here as tools (eg., the planes and wedges), may instead have served solely as cores. Raw materials are predominantly chert, although many raw material types are represented. Cherts were procured in cobble form, probably from local river alluvium. Cobbles with oblique flat surfaces seem to have been selected over round cobbles. Primary reduction technology is directed at the production of elongate

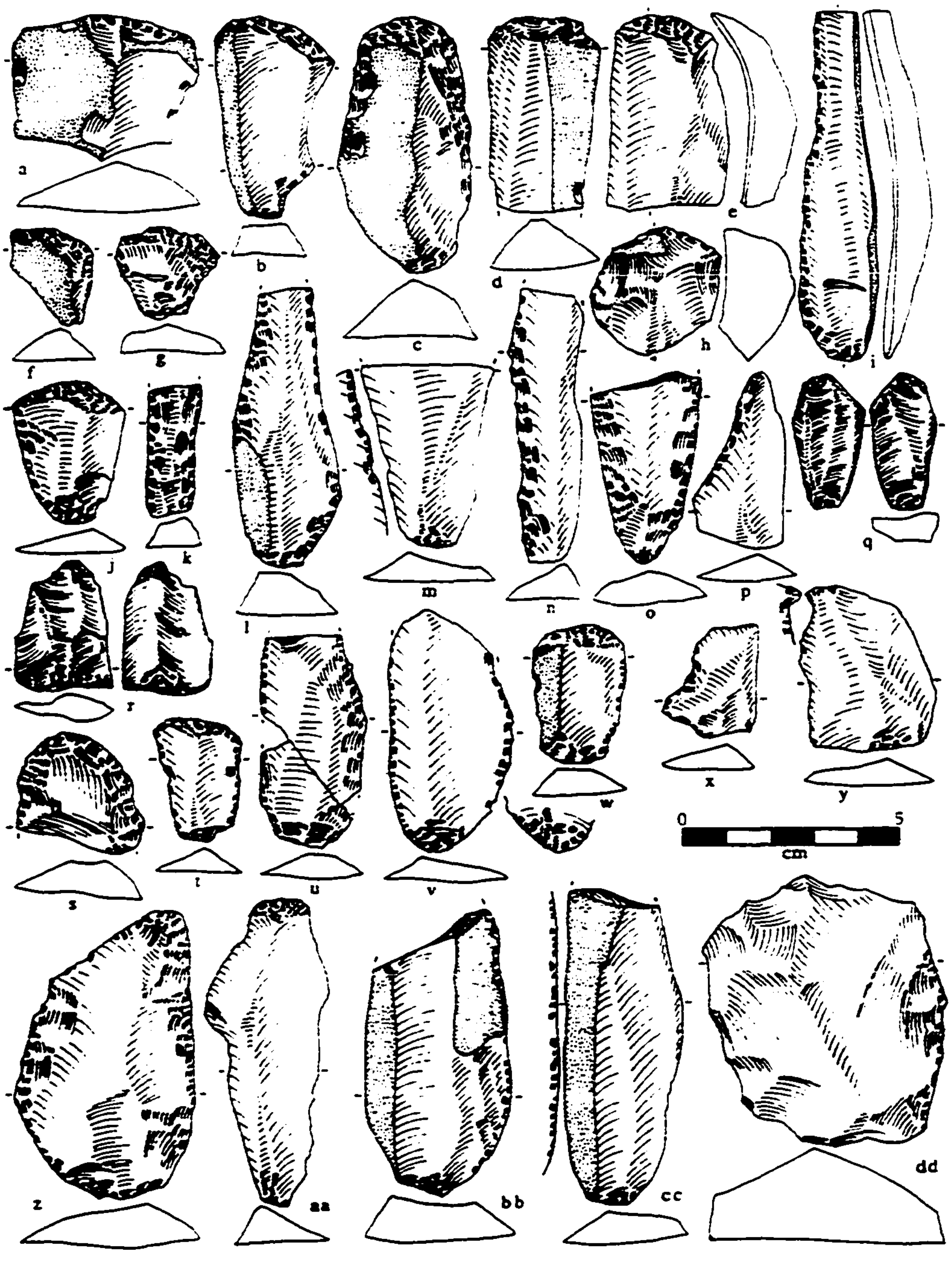


**Fig. 7.38.** Lithic artifacts from Makarovo-4 (wind polished): end scrapers on flakes (a-b, f-g, s, w); end/side scraper (c); end scrapers on blades (d-e, j, t, aa); carinated end scraper (h); cortically backed knife (i); bilaterally retouched blades (k-l, o, u); unilaterally retouched ventral blades (m, cc); unilaterally retouched blade (n); possible point on blade (p); wedges (q-r); bilaterally retouched flake-blade with ventral retouch on proximal end (v); gravers (x-y); straight-convex side scrapers (z, dd); unilaterally retouched flake-blade (bb).

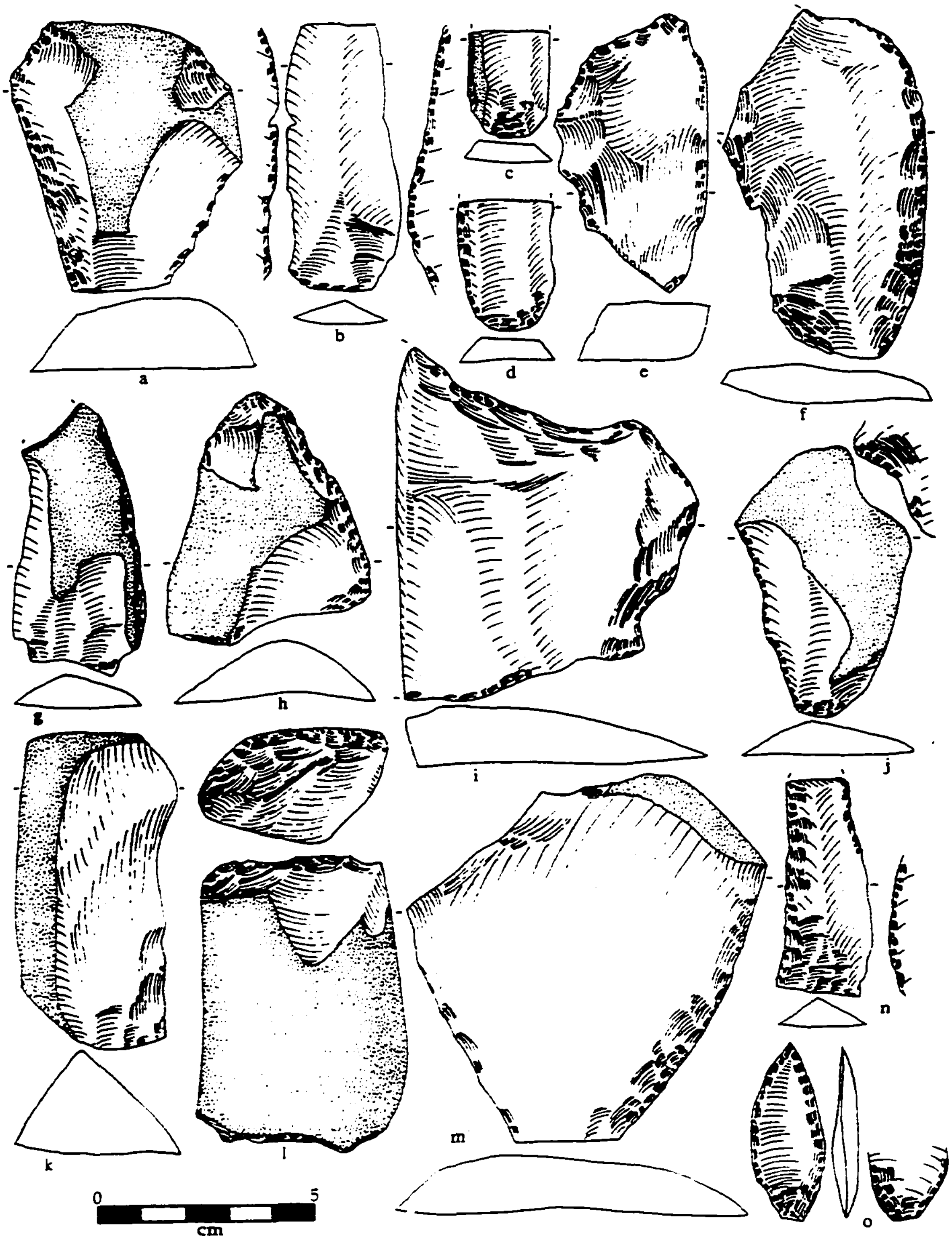


**Fig. 7.39.** Lithic artifacts from Makarovo-4 (wind polished): single convex side scrapers (a, f-g); bilaterally retouched ventral blade (b); unilaterally retouched blade (c); bilaterally retouched blade (d); single convex ventral side scraper (e); single straight side scrapers (h, m); single convex denticulate (i); notch (j); retouched flake (k); plane (l); bilaterally retouched alternate blade (m); point on blade with ventral retouch on proximal end (o).

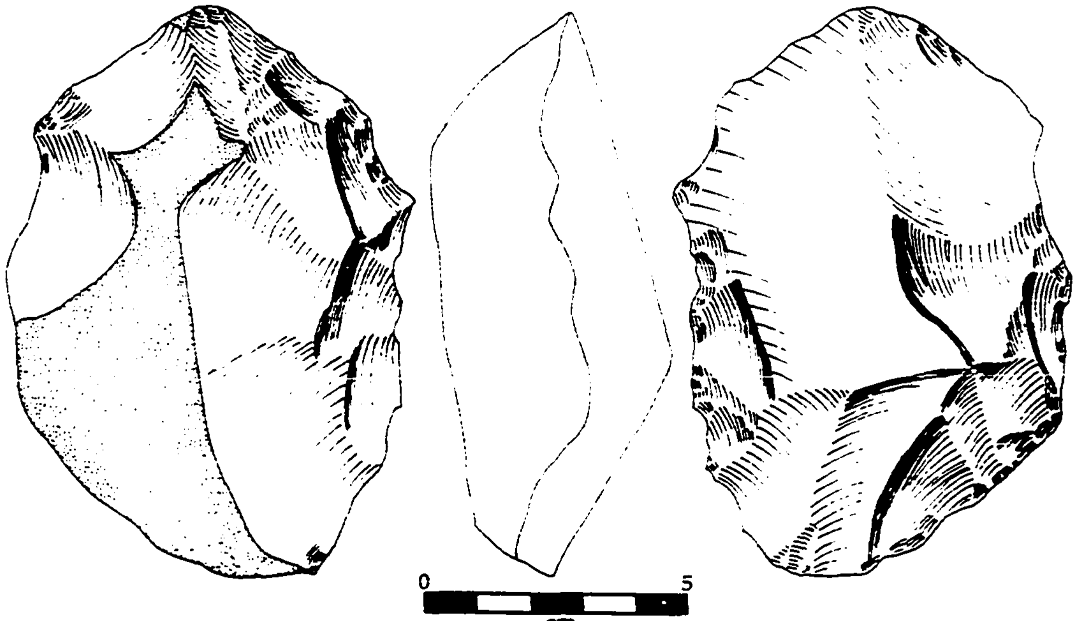


**Fig. 7.40. Oval biface from Makarovo-4.**

cortical spalls, blades, and flake-blades for use as tool blanks. Most cores are not intensively reduced; they often display only one or two series of removals. Because of this, many cores and tools still retain cortex on their flaking surfaces. Most platforms are smooth. Unidirectional and bidirectional removal of blades from flat-faced cores are the most common techniques of blank manufacture. Secondary reduction technology is unifacial, marginal, and unintensive. The tool assemblage is heterogeneous, consisting principally of marginally retouched blades, flake-blades, and flakes. Other frequently occurring tool forms include end scrapers, gravers, wedges, and unifacial points. One biface is present, but interestingly, burins are absent.

## Varvarina Gora

The Varvarina Gora lithic assemblage has never been completely described. According to Lbova (1992), the assemblage consists of 1,451 artifacts, 226 of which are stone tools. All that was available for study in 1991 was nine cores and 152 tools.

*Primary Reduction Technology.* Raw materials are varied, but consist primarily of chert and basalt (Fig. 7.41:a). There are ten varieties of chert: tan (47%), dark gray (26%), gray (9%), greenish tan (6%), dark tan (3%), light gray (2%), greenish gray

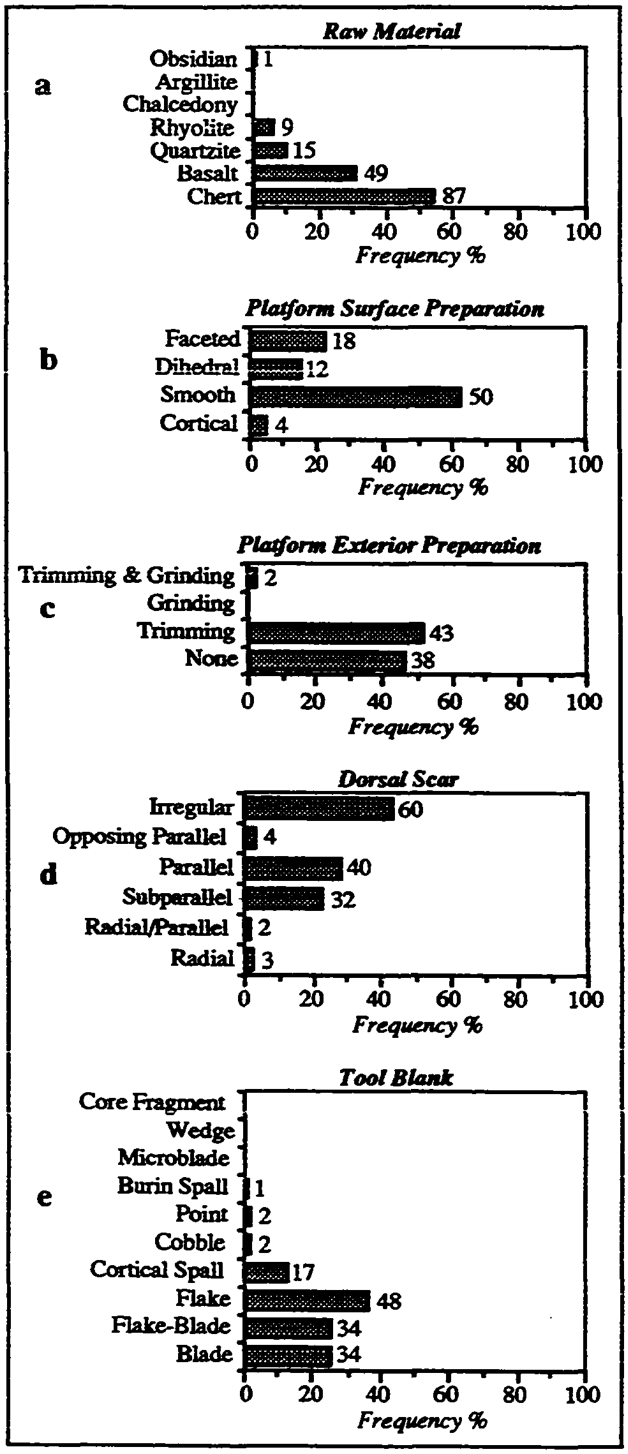


**Fig. 7.41.** Varvarina Gora: attributes of primary reduction technology.

(2%), maroon (2%), white (1%), and dark brown (1%). In addition, one tool, an end scraper, is made on a flake of obsidian. Only 11% of the artifacts display cortex, and only 5% are more than half covered with cortex. Of the nine cores (Table 7.13), five are flat-faced blade cores. Three are bidirectional (Fig. 7.42:a-b) and two are unidirectional. The subprismatic blade core is unidirectional and has a faceted platform and keeled counterfront (Fig. 7.42:d). The Levallois flake core is radially prepared, has a faceted platform, and displays scars of two secondary Levallois flake removals (Fig. 7.42:c).

Platforms on blanks are frequently smooth and occasionally dihedral or faceted (Fig. 7.41:b) (faceting index = 35.7). Many blanks display platform exterior preparation, especially

**Table 7.13.** Varvarina Gora: Core Types

| Core type | n | % |
|---|---|---|
| Core fragment | 1 | 11.1 |
| Monofrontal unidirectional flat-faced blade | 2 | 22.2 |
| Monofrontal bidirectional flat-faced blade | 3 | 33.3 |
| Monofrontal unidirectional subprismatic blade | 1 | 11.1 |
| Levallois flake | 1 | 11.1 |
| Core preform | 1 | 11.1 |
| Total | 9 | |

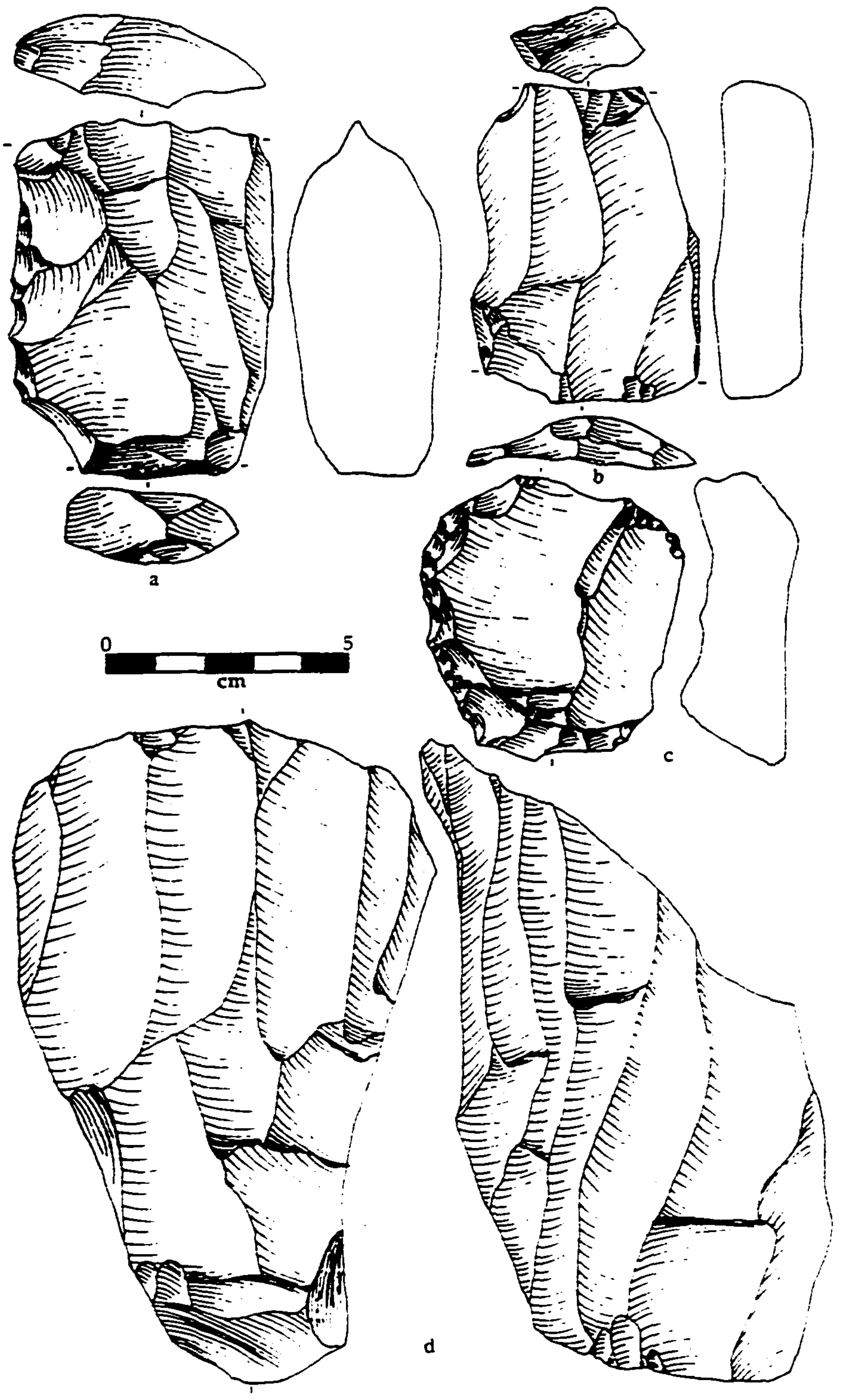


**Fig. 7.42.** Cores from Varvarina Gora: bidirectional flat-faced blade cores (a, b); possible Levallois flake core (c); unidirectional subprismatic blade core (d).

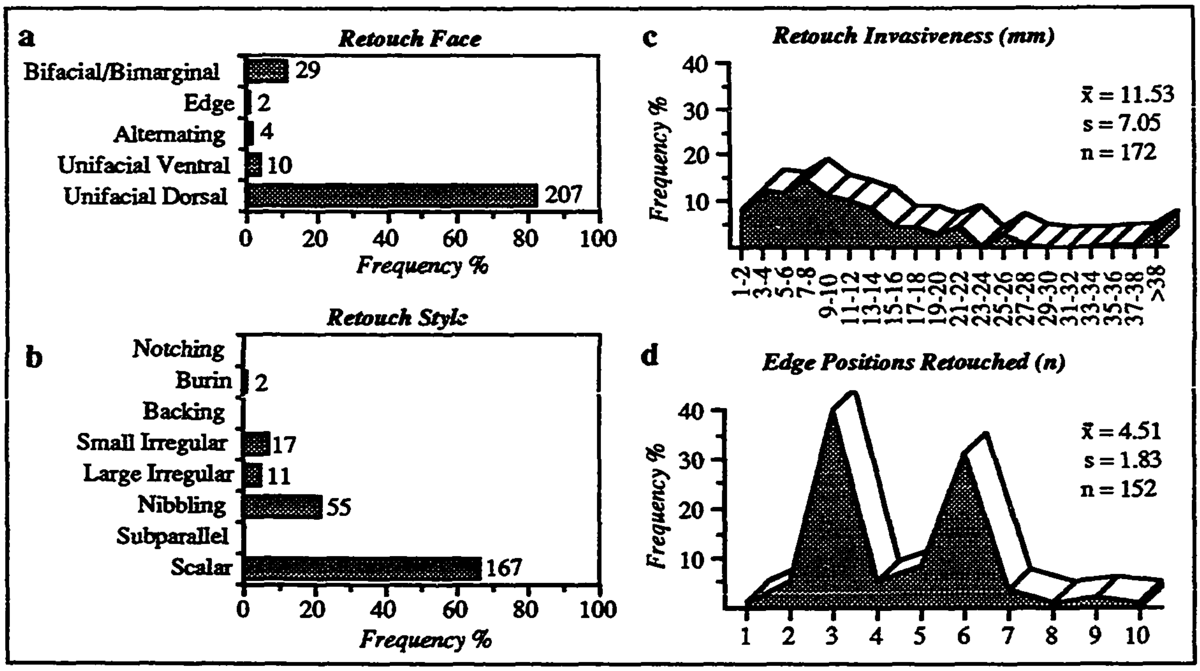


**Fig. 7.43.** Varvarina Gora: attributes of secondary reduction technology.

trimming (Fig. 7.41:c). While the majority of dorsal scar patterns are parallel or subparallel, irregular patterns are also prevalent (Fig. 7.41:d). Opposing parallel, radial/ parallel, and radial patterns are rare. Most tools are made on blades or flake-blades (Fig. 7.41:e), although tools on flakes also occur in relatively high numbers. One tool is made on what appears to be an atypical Levallois point (Fig. 7.46:p).

*Secondary Reduction Technology.* Although unifacial retouch predominates, some edges display bifacial or bimarginal retouch (Fig. 7.43:a). These include 12 wedges and three bifaces that are retouched bifacially, and one wedge and end scraper retouched bimarginally. Retouch styles are predominantly scalar; nibbling and small irregular retouch occur infrequently (Fig. 7.43:b). Retouch invasiveness is high, the highest among the early Upper Paleolithic assemblages analyzed. Nearly 70% of all edges display retouch scars greater than 6 mm deep (Fig. 7.43:c). Retouch intensity is moderately high, with a little over half the tools having four or more retouched edge positions (Fig. 7.43:d).

*Tool Assemblage.* The Varvarina Gora tool assemblage, while dominated by retouched blades and side scrapers (Fig. 7.44, Table 7.14), is varied. Tools occurring in moderate to low frequencies include retouched flakes, knives, wedges, denticulates, points, end scrapers, cobble tools, gravers, notches, bifaces, and burins. The majority of retouched blades and flake-blades are retouched unilaterally (Fig. 7.45:d, f, h, j). One

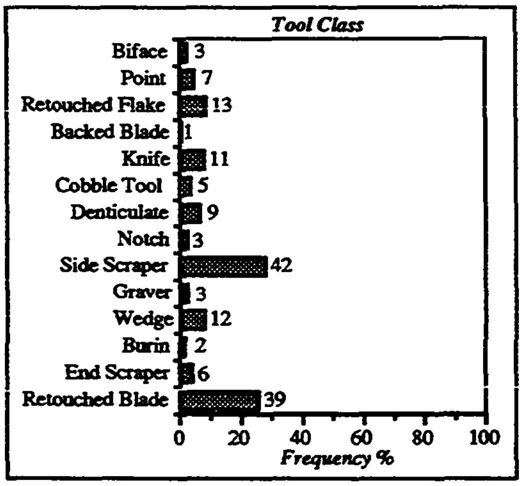


**Fig. 7.44. Varvarina Gora: tool class.**

**Table 7.14. Varvarina Gora: Tool Types**

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 10 | 6.4 | Angle scraper | 1 | 0.6 |
| Unilaterally retouched ventral blade | 5 | 3.2 | Three-sided scraper | 2 | 1.3 |
| Bilaterally retouched blade | 9 | 5.8 | Single notch | 2 | 1.3 |
| Bilaterally retouched bladelet | 1 | 0.6 | Multiple notch | 1 | 0.6 |
| Unilaterally retouched flake-blade | 8 | 5.1 | Single straight denticulate | 3 | 1.9 |
| Unilaterally retouched ventral flake-blade | 1 | 0.6 | Single convex denticulate | 2 | 1.3 |
| Bilaterally retouched flake-blade | 5 | 3.2 | Double straight denticulate | 2 | 1.3 |
| End scraper fragment | 1 | 0.6 | Double convex bifacial denticulate | 1 | 0.6 |
| End scraper on flake | 4 | 2.6 | Three-sided denticulate | 1 | 0.6 |
| End/side scraper | 1 | 0.6 | Chopper | 1 | 0.6 |
| Angle burin | 1 | 0.6 | Hammerstone | 4 | 2.6 |
| Burin spall | 1 | 0.6 | Cortically backed knife | 6 | 3.9 |
| Wedge fragment | 4 | 2.6 | Smooth-backed knife | 5 | 3.2 |
| Wedge | 8 | 5.1 | Backed blade | 1 | 0.6 |
| Single graver | 3 | 1.9 | Retouched flake | 11 | 7.1 |
| Side scraper fragment | 5 | 3.2 | Retouched ventral flake | 1 | 0.6 |
| Single straight side scraper | 2 | 1.3 | Utilized flake | 1 | 0.6 |
| Single convex side scraper | 7 | 4.5 | Point on blade (fragment) | 6 | 3.9 |
| Double straight side scraper | 7 | 4.5 | Atypical Levallois point | 1 | 0.6 |
| Double convex side scraper | 1 | 0.6 | Biface fragment | 1 | 0.6 |
| Straight-convex side scraper | 8 | 5.1 | Leaf-shaped biface | 1 | 0.6 |
| Convex transverse scraper | 2 | 1.3 | Oval biface | 1 | 0.6 |
| Convergent scraper | 7 | 4.5 | | | |
| | | | Total | 156 | |

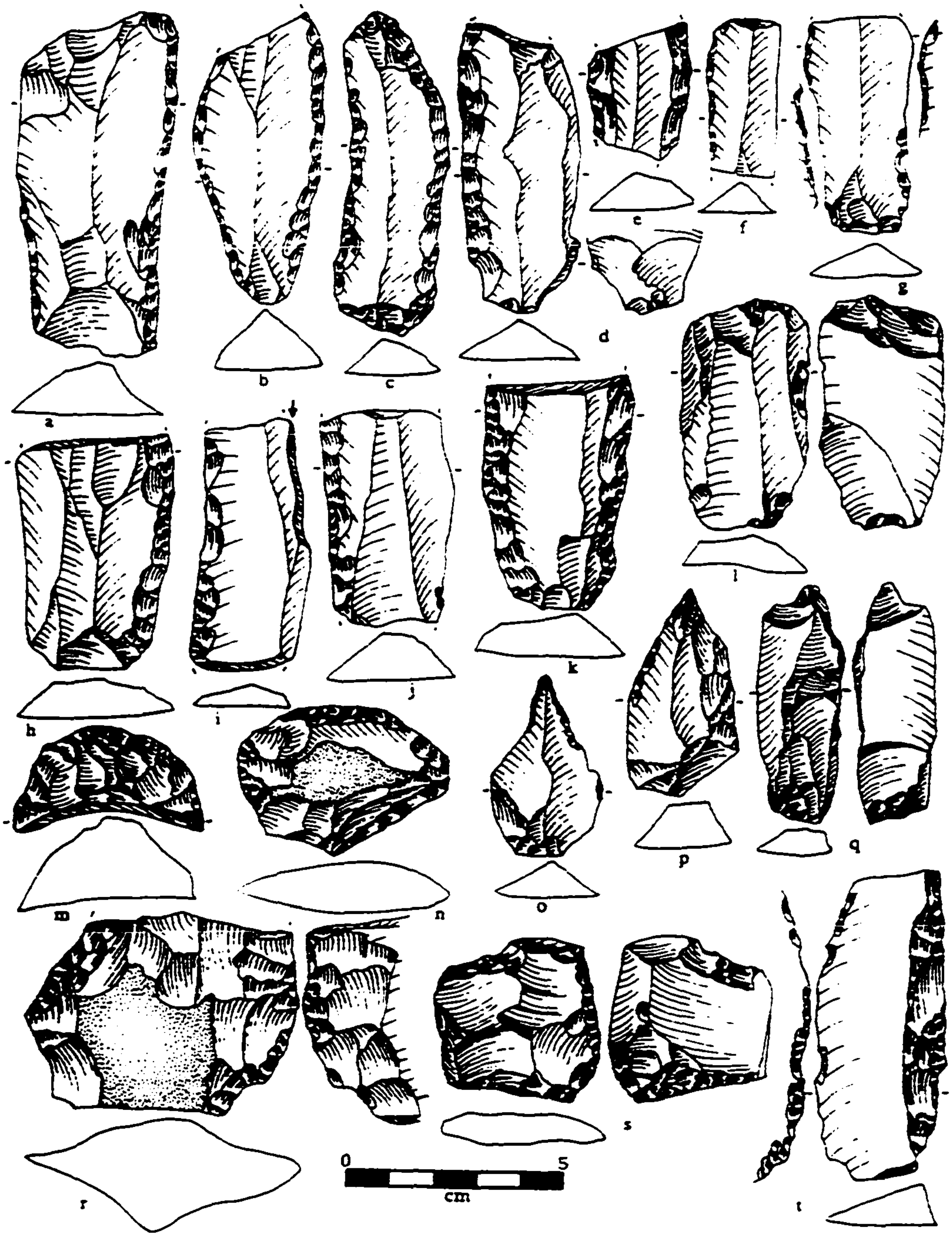


**Fig. 7.45.** Lithic artifacts from Varvarina Gora: bilaterally retouched blades (a-c, e, g); unilaterally retouched blade with ventral retouch on proximal end (d); unilaterally retouched blades (f, h, j); angle burin (i); double straight side scraper (k); wedges (l, q, s); end scraper fragment (m); end scraper on flake (n); gravers (o-p), double convex bifacial denticulate (r); backed blade (t).

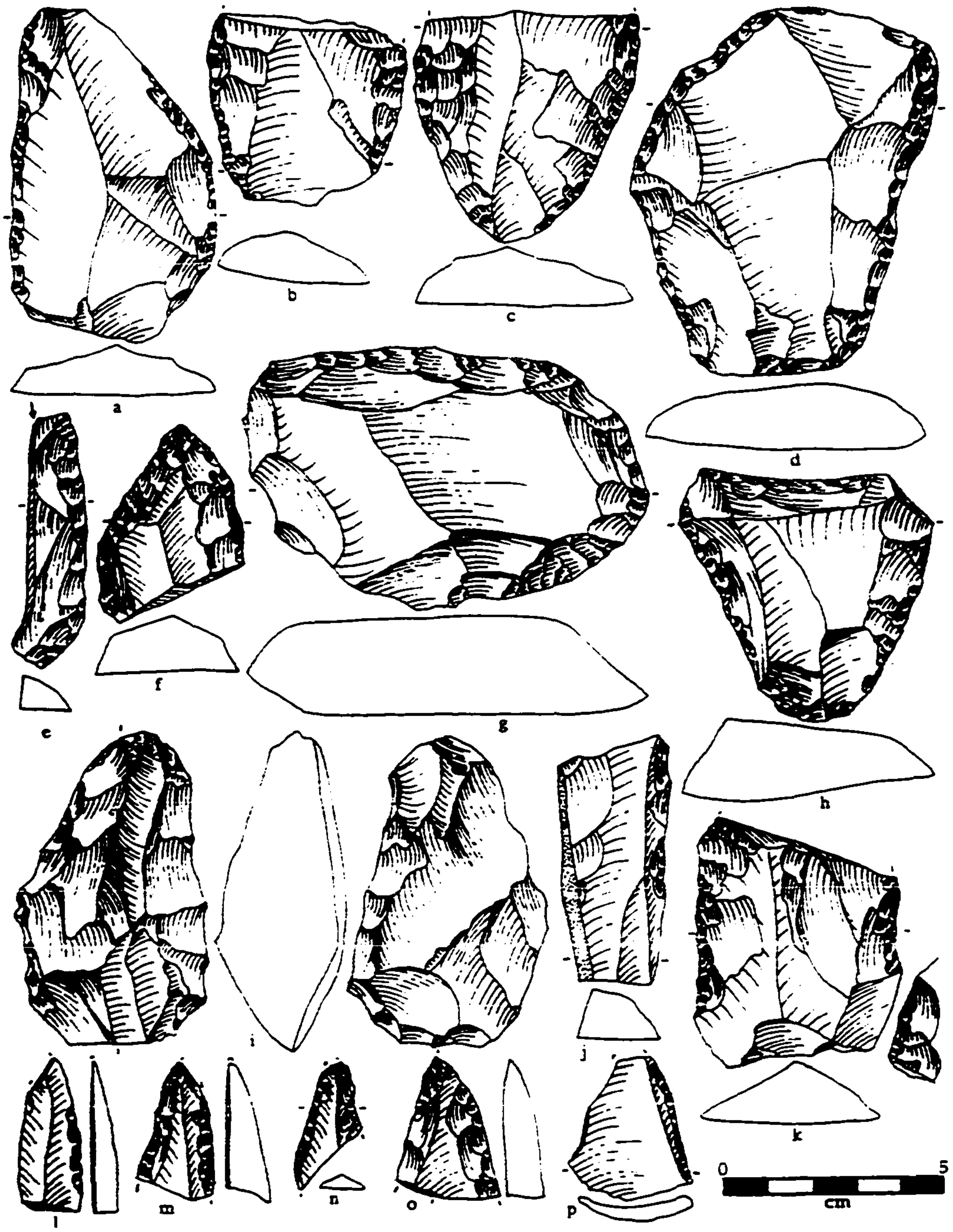


**Fig. 7.46. Lithic artifacts from Varvarina Gora: straight-convex side scrapers (a-b, d); double convex side scraper (c); burin spall (e); convergent scraper (f); angle scraper (g); three-sided scraper (h); biface (i); cortically backed knife (j); double straight side scraper (k); point on blade fragments (l-o); atypical Levallois point fragment (p).**

has ventral retouch on its proximal end (Fig. 7.45:d). Side scrapers are typically double-sided (Fig. 7.45:k; 7.46:a-d, k), transverse, convergent, angle, or three-sided (Fig. 7.46:f-h). Retouched flakes are almost exclusively retouched solely on the dorsal surface. Cortically backed and smooth-backed knives are almost equally represented (Fig. 7.45:j). One backed blade also occurs (Fig. 7.45:t). Wedges with bifacially worked bipolar ends are often made on blades (Fig. 7.5:l, q, s:). Denticulates are few but varied, with examples of single straight, single convex, double straight, convex-concave, and three-sided types. One displays bifacial retouch along one of its margins (Fig. 7.45:r); the rest are retouched dorsally. Points are fragmentary, usually manufactured on blades, and retouched dorsally (Fig. 7.46:l-o). One may be an atypical Levallois point (Fig. 7.46:p). End scrapers are small, round, and often made on flakes (Fig. 7.45:m-n). One is retouched on both its distal end and one lateral margin. Gravers are unifacially retouched to form a symmetrical tip at their distal end (Fig. 7.45:o-p). One biface is leaf-shaped and another is oval; both are invasively retouched around their entire perimeters (Fig. 7.46:i). The third biface is fragmentary and worked bifacially along one margin. Burins include one angle burin manufactured on a blade (Fig. 7.45:i) as well as one retouched burin spall (Fig. 7.46:e). Among the cobble tools are four hammerstones made on quartzite. These have flat to slightly concave surfaces with pecked areas at their centers. They may have been hammers or anvils used while retouching or utilizing wedges.

The primary reduction technology of this industry is directed at the manufacture of blades, flake-blades, and flakes for use as tools. A variety of raw materials, mostly cherts, were employed. Flat-faced blade cores are common. Platform surfaces are usually smooth, and platform exteriors often trimmed. Secondary reduction technology is characterized by unifacial scalar and large irregular retouch. Retouch invasiveness and intensity are high. The tool assemblage consists of a wide variety of types, with high frequencies of side scrapers and retouched blades. Other diagnostic tool forms include end scrapers, gravers, burins, wedges, knives, and points on blades. With the exception of end scrapers, the majority of these were made on blades and flake-blades rather than flakes.

## Tolbaga

The lithic assemblage from Tolbaga consists of nearly 10,000 artifacts, including 188 cores and core fragments and 1,063 tools (Kirillov 1987). In the present study, 146 cores and 681 tools were available for study.

*Primary Reduction Technology.* Raw materials are predominantly cherts, while argillite, quartzite, and basalt occur in small frequencies (Fig. 7.47:a). Cherts occur in at least nine varieties, including dark gray (44%), gray (32%), tan (11%), brown 11%), maroon (1%), dark brown (<1%), cream (<1%), red (<1%), and green (<1%). Cortex occurs on 26% of the artifacts; nearly 11% have cortex covering more than half their dorsal

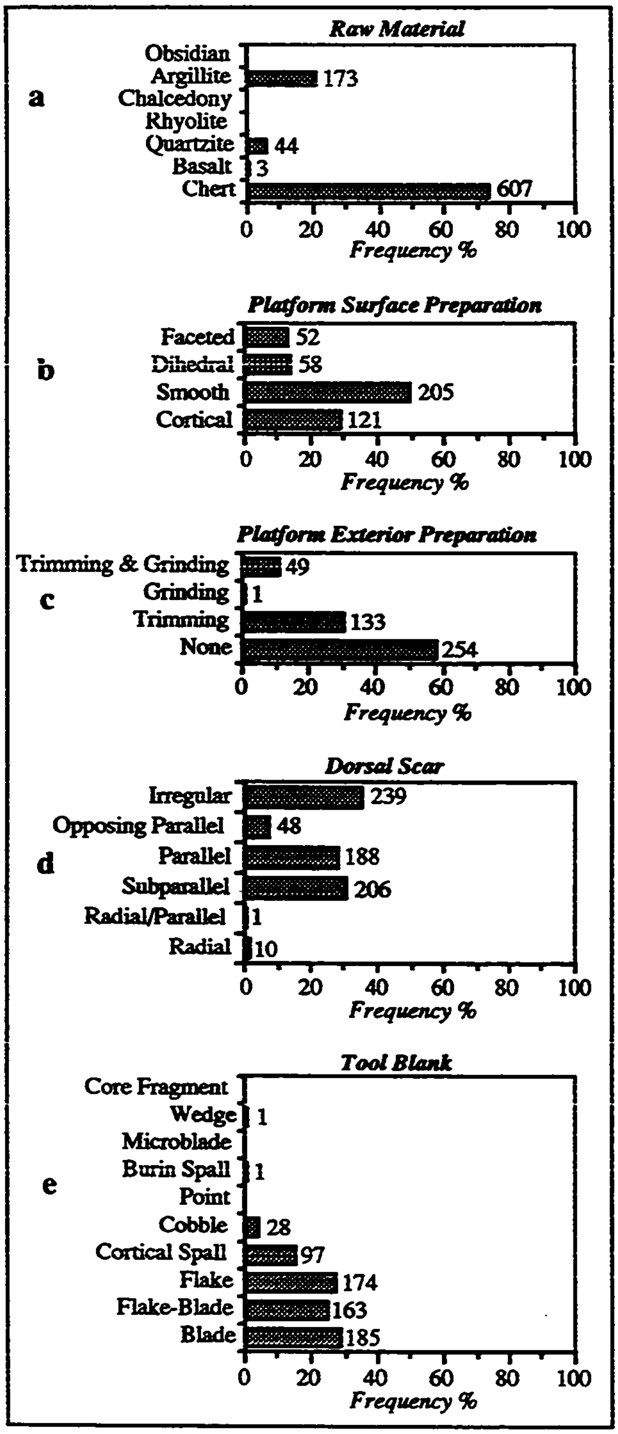


**Fig. 7.47.** Tolbaga: attributes of primary reduction technology.

**Table 7.15.** Tolbaga: Core Types

| Core type | n | % |
|---|---|---|
| Core fragment | 3 | 2.1 |
| Monofrontal unidirectional flake | 58 | 39.7 |
| Monofrontal bidirectional flake | 14 | 9.6 |
| Bifrontal unidirectional flake | 5 | 3.4 |
| Bifrontal bidirectional flake | 14 | 9.6 |
| Trifrontal bidirectional flake | 2 | 1.4 |
| Rotated flake | 6 | 4.1 |
| Monofrontal bidirectional flat-faced blade | 13 | 8.9 |
| Monofrontal unidirectional subprismatic blade | 15 | 10.3 |
| Bifrontal unidirectional flat-faced blade | 1 | 0.7 |
| Trifrontal unidirectional flat-faced blade | 2 | 1.4 |
| Monofrontal unidirectional subprismatic blade | 2 | 1.4 |
| Monofrontal bidirectional subprismatic blade | 3 | 2.1 |
| End | 2 | 1.4 |
| Unifacial radial | 3 | 2.1 |
| Bifacial radial | 2 | 1.4 |
| Core preform | 1 | 0.7 |
| Total | 146 | |

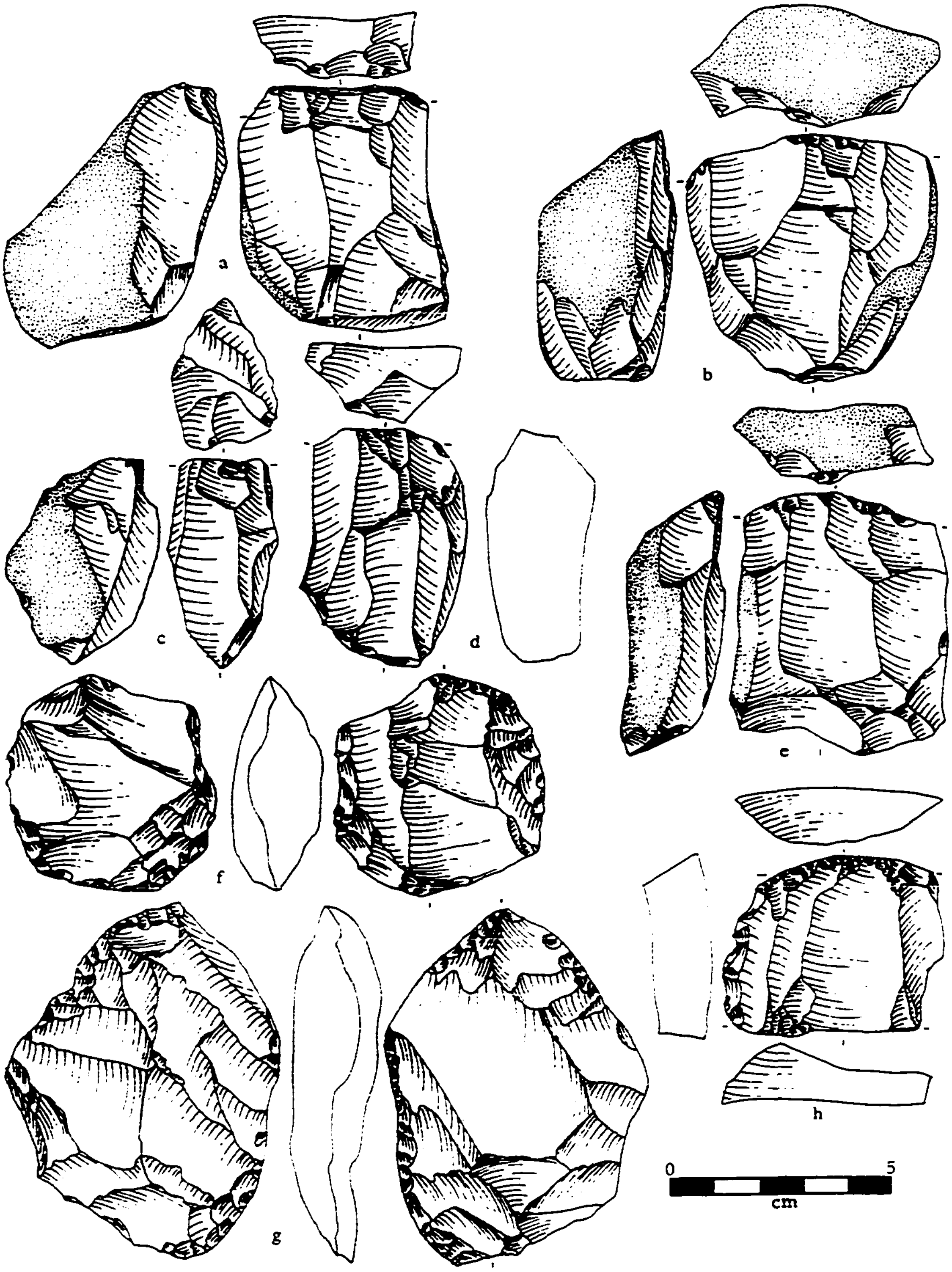


**Fig. 7.48. Lithic artifacts from Tolbaga: unidirectional flat-faced blade cores (a-b, d-e); end core (c); bifacial radial core (f); biface (g); bidirectional flat-faced blade core (h).**

surfaces. Among cores, simple flake cores predominate (Table 7.15). Most of these are monofrontal unidirectional and have cortical platforms. Flat-faced blade cores are also common, occurring chiefly as monofrontal unidirectional or monofrontal bidirectional types (Fig. 7.48:a-b, d-e, h). Most have cortical or smooth platforms. Subprismatic blade cores are rare. The end cores are small but do not appear to have been prepared for the production of microblades (Fig. 7.48:c). Their removals were short but wide. One is monofrontal unidirectional with a smooth platform, while the other is trifrontal bidirectional with smooth and faceted platforms. Radial cores include both unifacial and bifacial varieties (Fig. 7.48:f).

Platform surfaces are principally smooth or cortical (Fig. 7.47:b). Dihedral and faceted platforms are present but rare, leading to a faceting index of 25.2. Platform exterior preparation in the form of trimming and/or grinding is present on 42% of the pieces studied (Fig. 7.47:c). Parallel, subparallel, and opposing parallel scars characterize over two-thirds of the assemblage (Fig. 7.47:d). Tool blanks include relatively high frequencies of blades and flake-blades, as well as flakes (Fig. 7.47:e).

*Secondary Reduction Technology.* Retouch face is mostly unifacial (Fig. 7.49:a). However, bifacial retouch is also common, occurring on 27 wedges, three chopping tools, three bifaces, and one side scraper, knife, retouched blade, and retouched flake.

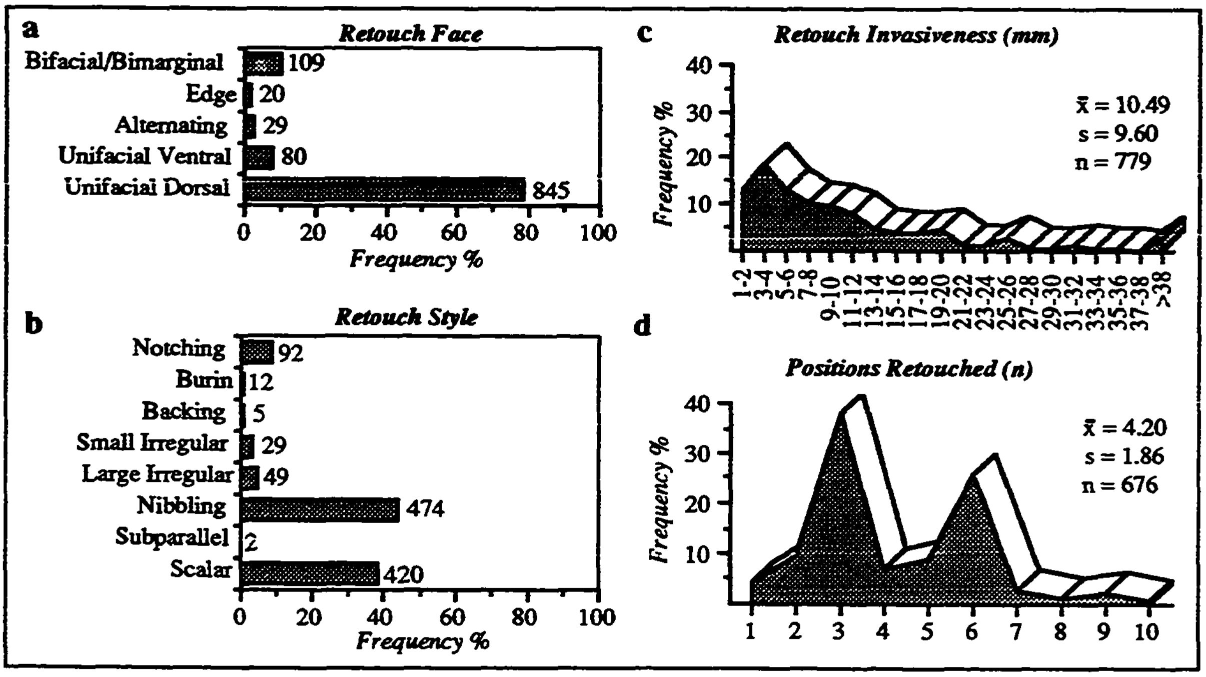


**Fig. 7.49.** Tolbaga: attributes of secondary reduction technology.

Additionally, one denticulate displays bimarginal retouch along one edge. Among retouch styles, nibbling and scalar are almost equally represented, together characterizing over 80% of all edges (Fig. 7.49:b). Other retouch styles include notching, large and small irregular, burin, backing, and subparallel. Retouch invasiveness is moderate, with a slight majority of edges displaying retouch scars greater than 6 mm deep (Fig. 7.49:c). Retouch intensity is also moderate; 51% of all tools have three or fewer retouched edge positions (Fig. 7.49:d).

*Tool Assemblage.* The tool assemblage, which includes 681 pieces, is rich in side scrapers, retouched blades, and retouched flakes (Fig. 7.50, Table 7.16). Moderate frequencies of wedges, denticulates, notches, knives, and end scrapers are found, while points, burins, cobble tools, backed blades, gravers, and bifaces occur infrequently. Side scrapers include many examples of single straight, double straight, and single convex types. Most of these (61%) are made on blades and flake-blades. Convergent scrapers are also common (Fig. 7.51:i, r; 7.52:b, g, i, k, m), while transverse scrapers, angle scrapers (Fig. 7.51:q), and three-sided scrapers are rare. Retouched blades and flake-blades are typically bilaterally retouched (Fig. 7.52:a, o, v; 7.53:b-c). Wedges are commonly made on blades or flake-blades. Many have preserved parallel arises and blade facets on their dorsal surfaces, and bulbs of percussion and concentric rings on their ventral surfaces (Fig. 7.51:b-c). Denticulates are a diverse group, but most are notched along only one lateral margin (Fig. 7.52:q). Knives are primarily smooth-backed, not cortically backed. Six backed blades also occur; these are essentially knives with steep, unifacially retouched backs opposite acutely retouched edges (Fig. 7.51:a, e). End scrapers are typically made on flakes or flake-blades (Fig. 7.52:c-f, h, j, l, p, r-s; 7.53:d).

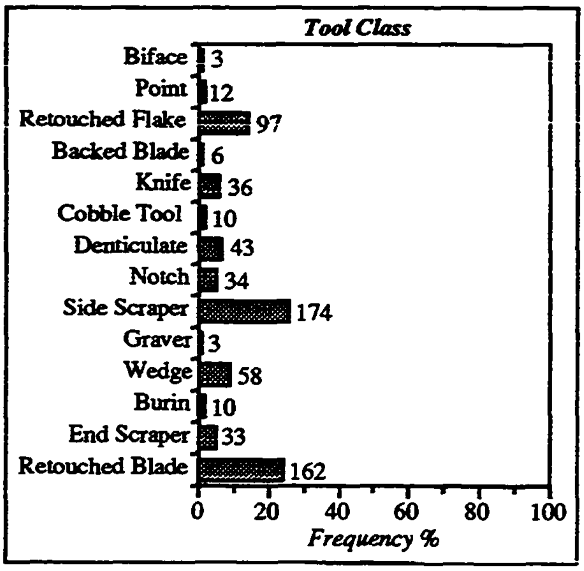


**Fig. 7.50.** Tolbaga: Tool Class.

**Table 7.16.** Tolbaga: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 33 | 4.8 | Convex transverse scraper | 3 | 0.4 |
| Unilaterally retouched ventral blade | 6 | 0.9 | Convergent scraper | 25 | 3.7 |
| Bilaterally retouched blade | 55 | 8.1 | Angle scraper | 5 | 0.7 |
| Bilaterally retouched ventral blade | 5 | 0.7 | Three-sided scraper | 1 | 0.1 |
| Bilaterally retouched alternate blade | 12 | 1.8 | Single notch | 28 | 4.1 |
| Unilaterally retouched flake-blade | 38 | 5.6 | Multiple notch | 6 | 0.9 |
| Bilaterally retouched flake-blade | 12 | 1.8 | Denticulate fragment | 2 | 0.3 |
| Bilaterally retouched ventral flake-blade | 1 | 0.1 | Single straight denticulate | 13 | 1.9 |
| End scraper fragment | 2 | 0.3 | Single straight ventral denticulate | 6 | 0.9 |
| End scraper on blade | 6 | 0.9 | Single straight alternating denticulate | 1 | 0.1 |
| End scraper on flake | 4 | 0.6 | Single convex denticulate | 3 | 0.4 |
| End scraper on half round flake | 1 | 0.1 | Single convex alternating denticulate | 1 | 0.1 |
| Lateral end scraper | 1 | 0.1 | Single concave denticulate | 1 | 0.1 |
| Nosed end scraper | 3 | 0.4 | Double straight denticulate | 4 | 0.6 |
| Double end scraper | 3 | 0.4 | Double straight ventral denticulate | 1 | 0.1 |
| End/side scraper | 13 | 1.9 | Double straight alternate denticulate | 3 | 0.4 |
| Angle burin | 4 | 0.4 | Double convex denticulate | 1 | 0.1 |
| Double angle burin | 1 | 0.1 | Double concave denticulate | 1 | 0.1 |
| Transverse burin | 1 | 0.1 | Double concave alternate denticulate | 1 | 0.1 |
| Dihedral burin | 3 | 0.4 | Straight-convex denticulate | 1 | 0.1 |
| Burin spall | 1 | 0.1 | Transverse denticulate | 3 | 0.4 |
| Wedge fragment | 15 | 2.2 | Angle alternate denticulate | 1 | 0.1 |
| Wedge | 43 | 6.3 | Chopper | 2 | 0.3 |
| Single graver | 3 | 0.4 | Chopping tool | 3 | 0.4 |
| Side scraper fragment | 14 | 2.1 | Hammerstone | 5 | 0.7 |
| Single straight side scraper | 43 | 6.3 | Cortically backed knife | 9 | 1.3 |
| Single straight ventral side scraper | 2 | 0.3 | Smooth-backed knife | 27 | 4.0 |
| Single convex side scraper | 25 | 3.7 | Backed blade | 6 | 0.9 |
| Single convex ventral side scraper | 1 | 0.1 | Retouched flake fragment | 1 | 0.1 |
| Single concave side scraper | 5 | 0.7 | Retouched flake | 78 | 11.5 |
| Double straight side scraper | 26 | 3.8 | Retouched flake ventral | 4 | 0.6 |
| Double straight ventral side scraper | 2 | 0.3 | Retouched flake alternating | 2 | 0.3 |
| Double convex side scraper | 4 | 0.6 | Utilized flake | 12 | 1.8 |
| Double concave side scraper | 1 | 0.1 | Point fragment | 5 | 0.7 |
| Straight-convex side scraper | 15 | 2.2 | Point on blade | 7 | 1.0 |
| Straight-concave side scraper | 1 | 0.1 | Biface fragment | 1 | 0.1 |
| Straight transverse scraper | 1 | 0.1 | Oval biface | 2 | 0.3 |
| | | | Total | 681 | |

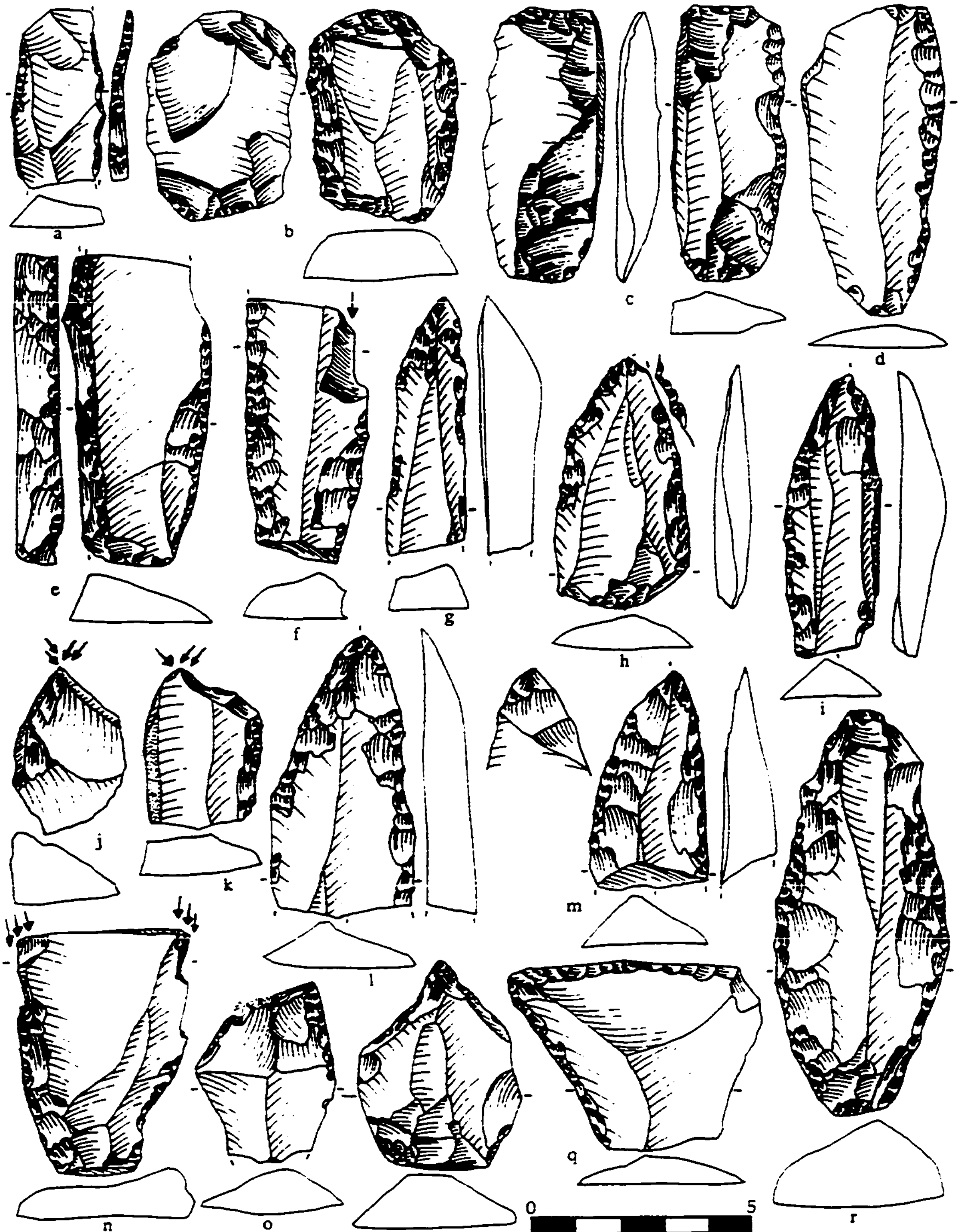


**Fig. 7.51.** Lithic artifacts from Tolbaga: backed blades (a, e); wedges (b-c); unilaterally retouched blade (d); angle burin (f); points on blades (g-h, l-m); possible point on blade or convergent scraper (i); dihedral burins (j-k); double angle burin (n); gravers (o-p); angle scraper (q); double convex side scraper (r).

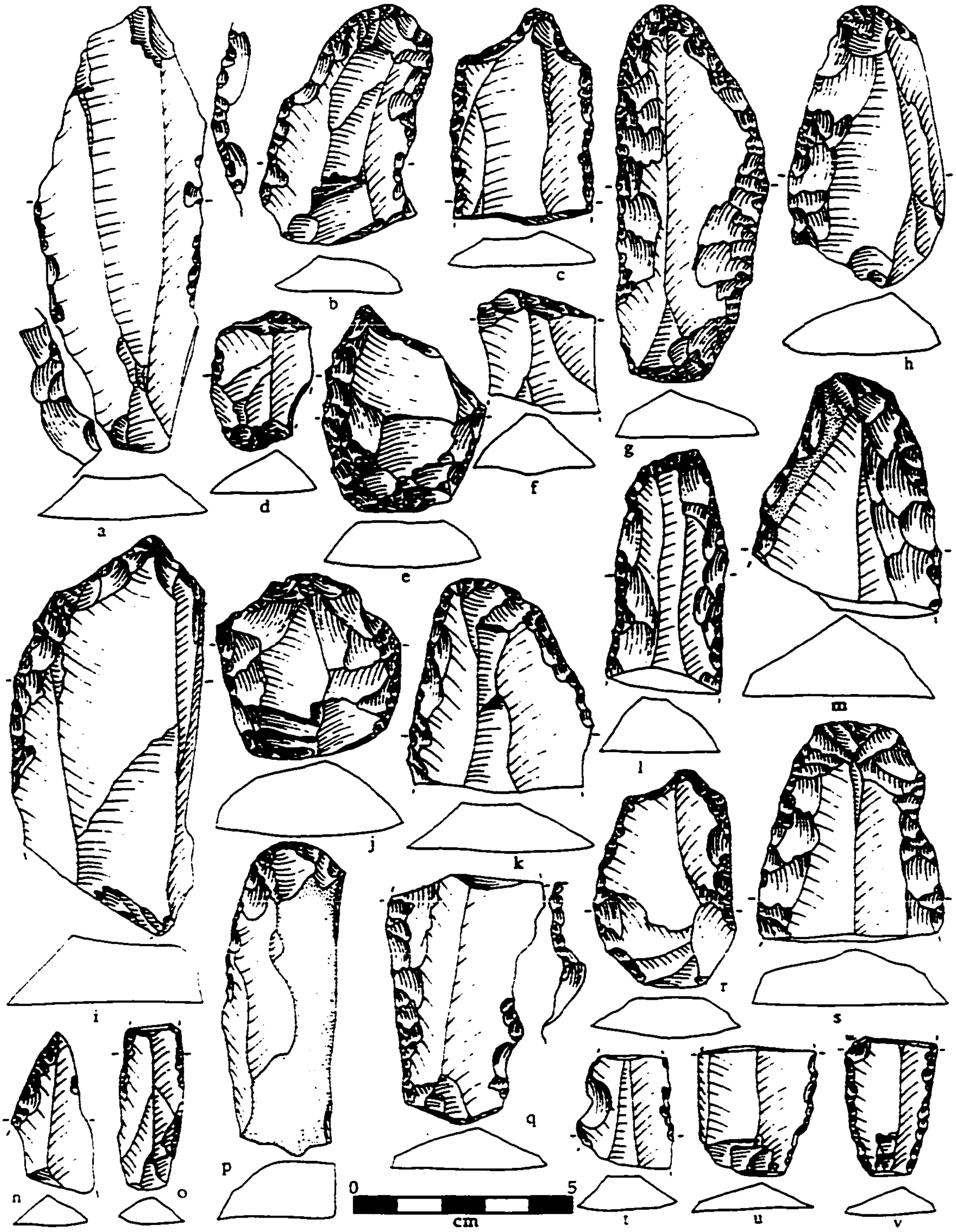


**Fig. 7.52. Lithic artifacts from Tolbaga: bilaterally retouched alternate blade (a); convergent side scrapers (b, g, i, k, m); nosed end scrapers (c, r); double end scraper (d); nosed end scraper or graver (e); end scrapers on blades (f, p); end-side scrapers (h, l, s); end scraper on round flake (j); point on blade (n); bilaterally retouched blades (o, v); double sided denticulate/side scraper (q); notch (t).**

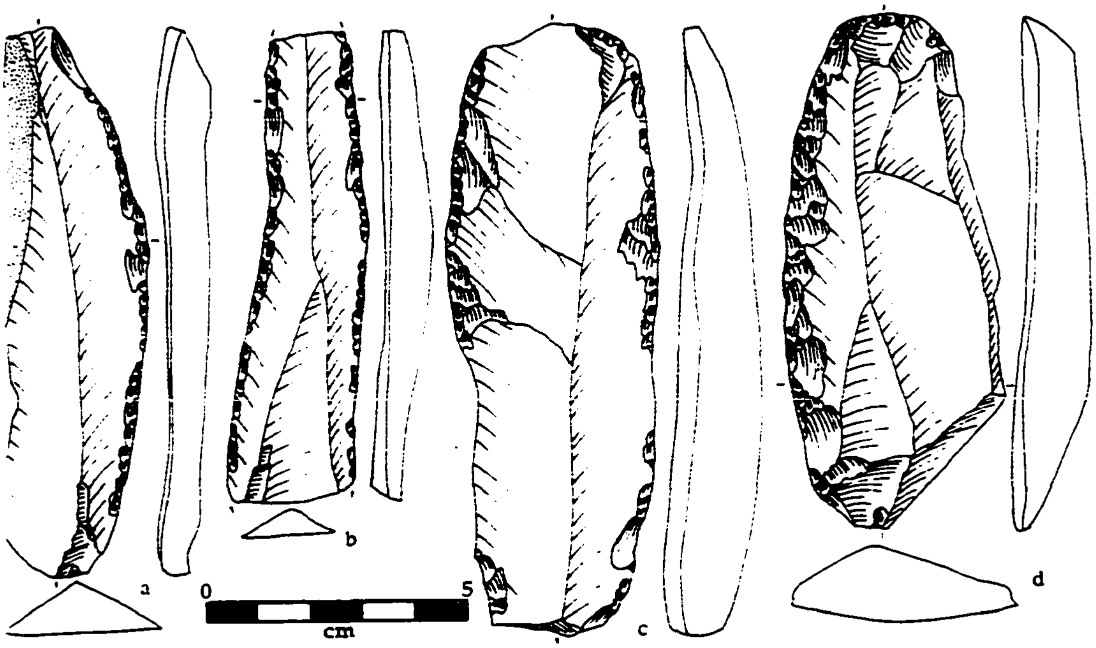


**Fig. 7.53. Lithic artifacts from Tolbaga: unilaterally retouched blade (a); bilaterally retouched blades (b-c); end/side scraper (d).**

Three are "nosed" end scrapers, which have a scraper end narrowed on both sides by unifacially retouched concavities (Fig. 7.52:c, r). Points are made on blades and unifacially sharpened to form a point (Fig. 7.51:g-h, l-m; 7.52:n). Most are represented by tip fragments. Burins include angle, double angle, transverse, and dihedral types (Fig. 7.51:f, j-k, n). Most of these are made on blades. Among the cobble tools are five quartzite hammerstones. One of these has a pecked depression near the center of a flat surface, similar to that seen on the hammerstones at Varvarina Gora. This hammerstone appears to have been used to aid in the manufacture or use of wedges. Gravers are unifacial and often symmetrical (Fig. 7.51:o-p). Bifaces include two oval types and one fragment (Fig. 7.48:g).

The Tolbaga lithic industry has a primary reduction technology directed at the production of blades, flake-blades, and flakes for use as tool blanks. Blades were typically removed from flat-faced blade cores with cortical or smooth platforms. Flakes were often removed from simple flake cores with cortical platforms, although several radial cores also served in the production of flakes. Platform surface preparation is principally smooth, and platform exterior preparation is common. Many cores and end products display trimming and grinding. Secondary reduction technology is principally unifacial, although a large number of wedges and several bifaces display bifacial retouch. Retouch is moderately invasive and intensive. The tool assemblage is rich in side scrapers and marginally retouched blades and flakes. Other tool forms include unifacial points on blades, angle burins, backed blades, gravers, and wedges.

## Masterov Gora Component III

Limited test excavations at Masterov Gora have produced four cores and seven tools (Meshcherin and Tuganov 1991).

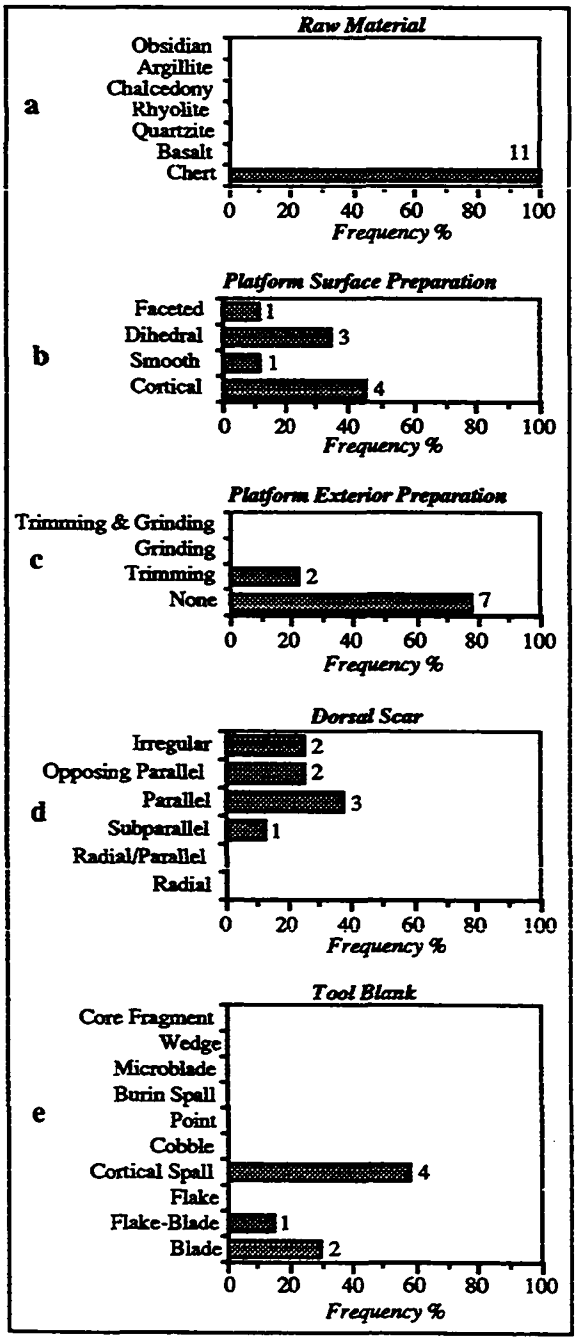


**Fig. 7.54.** Masterov Gora: attributes of primary reduction technology.

*Primary Reduction Technology.* All pieces are made on chert (Fig. 7.54:a), occurring in three varieties: dark gray, gray, and maroon. Five pieces (45%) have cortex on their dorsal surfaces; two of these (18%) are more than half covered with cortex. Cores include two monofrontal unidirectional flake cores and two monofrontal bidirectional flat-faced blade cores (Fig. 7.57:d). Platforms include cortical, dihedral, smooth, and faceted types (Fig. 7.54:b). In addition, trimming is seen on the exterior surface of two platforms (Fig. 7.54:c). Dorsal scars are principally parallel, opposing parallel, or subparallel (Fig. 7.54:d). Tool blanks include cortical spalls, blades, and a flake-blade (Fig. 7.54:e).

*Secondary Reduction Technology.* Ten of eleven retouched edges are unifacially retouched (Fig. 7.55:a). Nibbling is the most common retouch style (Fig. 7.55:b). Retouch invasiveness is low, with all edges measured displaying retouch scars no more than 6 mm deep (Fig. 7.55:c). Retouch intensity is moderate, however, with a little over half the tools displaying four or more retouched edge positions (Fig. 7.55:d).

*Tool Assemblage.* The Masterov Gora tool assemblage consists of four retouched blades and one notch, denticulate, and

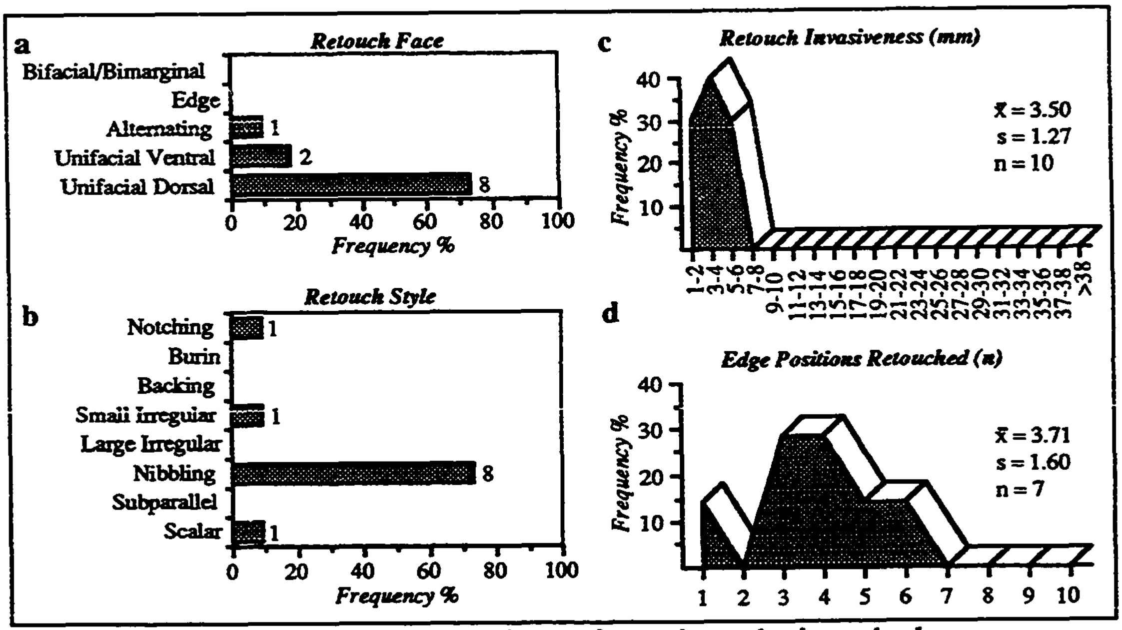


**Fig. 7.55.** Masterov Gora: attributes of secondary reduction technology.

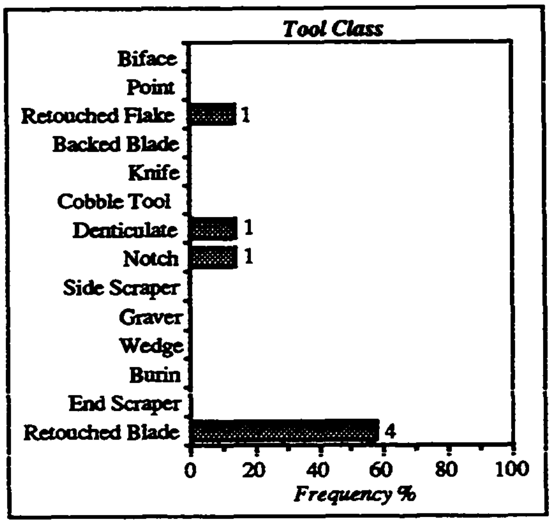


**Fig. 7.56.** Masterov Gora: tool class.

**Table 7.17.** Masterov Gora: Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched blade | 1 | 14.3 | Multiple notch | 1 | 14.3 |
| Bilaterally retouched blade | 2 | 28.6 | Transverse denticulate | 1 | 14.3 |
| Unilaterally retouched ventral flake-blade | 1 | 14.3 | Retouched flake | 1 | 14.3 |
| | | | Total | 7 | |

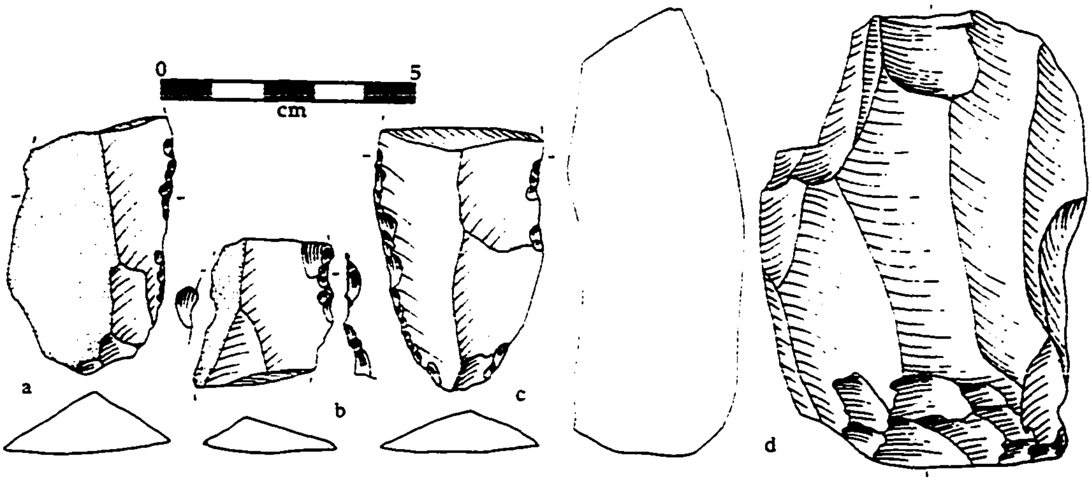


**Fig. 7.57.** Lithic artifacts from Masterov Gora: unilaterally retouched flake-blade (a); multiple notch (b); bilaterally retouched blade (c); bidirectional flat-faced blade core (d).

retouched flake (Fig. 7.56, Table 7.17). Two retouched blades are unilaterally retouched, and two are bilaterally retouched (Fig. 7.57:a, c). One notched tool has multiple notches on both lateral margins (Fig. 7.57:b). The denticulate displays a transversely worked edge.

The lithic assemblage from Masterov Gora, although small, contains some diagnostic elements. Primary reduction technology is directed toward the manufacture of blades and flake-blades from flat-faced blade cores. Platforms are principally cortical and unprepared. Secondary reduction technology is unifacial, marginal, and moderately intensive. The tool assemblage includes a small set of retouched blades, a notch, and a denticulate.

## Masterov Kliuch' Component V

Masterov Kliuch' has only been preliminarily excavated (Meshcherin 1991). The lithic assemblage from the basal cultural component, component V, includes ten cores and 13 tools.

*Primary Reduction Technology.* Raw materials are 100% chert (Fig. 7.58:a). Four varieties are represented: dark gray, gray, brown, and maroon. Cortex occurs on 60% of the pieces; 30% have cortex covering more than half their dorsal surfaces. Cores include simple flake cores, flat-faced blade cores, an end core, and a unifacial radial

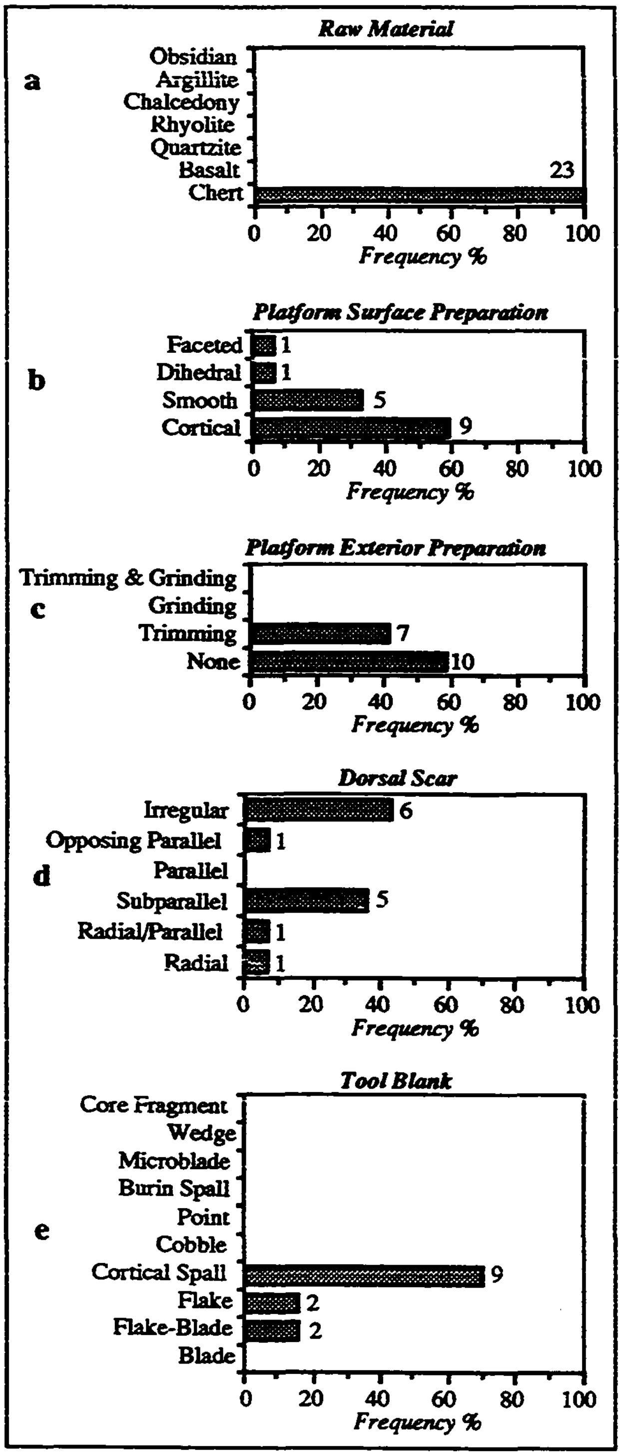


**Fig. 7.58.** Masterov Kliuch': attributes of primary reduction technology.

core (Table 7.18). One flat-faced blade core is unidirectional with a smooth platform (Fig. 7.61:a); the other is bidirectional with opposing faceted platforms. The end core has a cortical platform and was prepared for the removal of small flake-blades. Platforms on cores and tools are usually cortical or smooth (Fig. 7.58:b). Platform exterior preparation (i.e., trimming) occurs occasionally (Fig. 7.58:c). Irregular and subparallel dorsal scar patterns are common, while opposing parallel, radial/ parallel, and radial patterns occur infrequently (Fig. 7.58:d). Tools are typically made on cortical spalls, sometimes on flake-blades or flakes (Fig. 7.58:e).

*Secondary Reduction Technology.* Retouching is unifacial and dorsal (Fig. 7.59:a), with the exception of one wedge displaying bifacial retouch (Fig. 7.61:c),

**Table 7.18.** Masterov Kliuch: Core Types

| Core type | n | % |
|---|---|---|
| Core fragment | 1 | 10.0 |
| Monofrontal unidirectional flake | 4 | 40.0 |
| Bifrontal bidirectional flake | 1 | 10.0 |
| Monofrontal unidirectional flat-faced blade | 1 | 10.0 |
| Monofrontal bidirectional flat-faced blade | 1 | 10.0 |
| End | 1 | 10.0 |
| Unifacial radial | 1 | 10.0 |
| Total | 10 | |

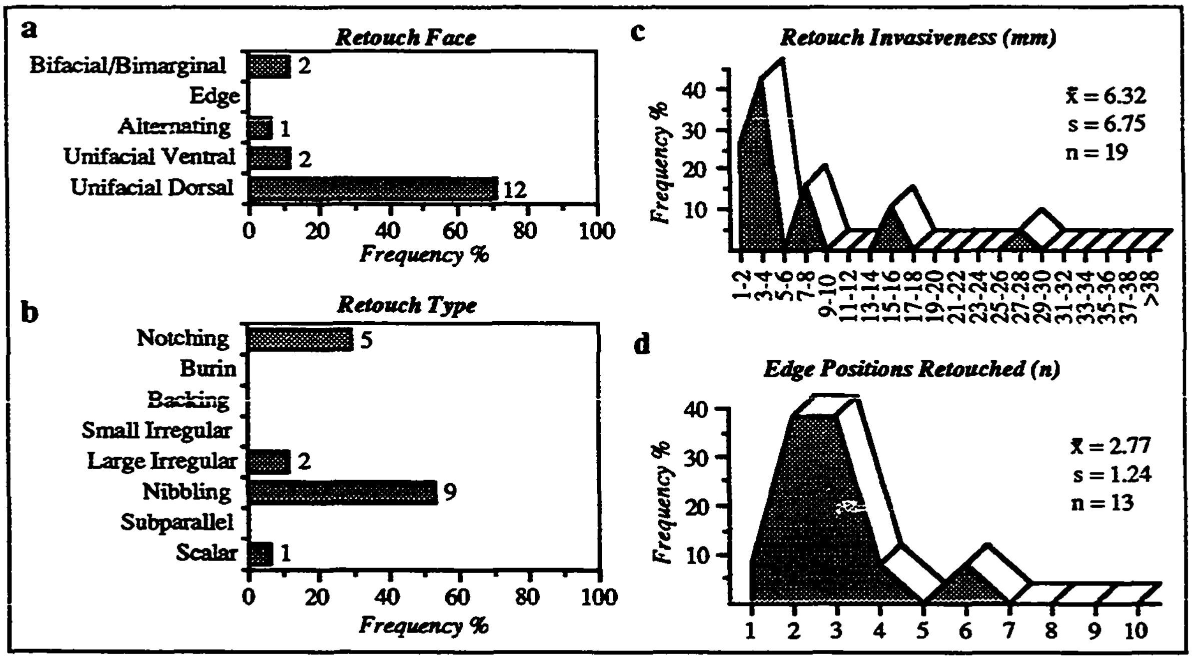


**Fig. 7.59.** Masterov Kliuch': attributes of secondary reduction technology.

and one denticulate displaying alternating retouch. Retouch style is principally nibbling or notching, although large irregular and scalar retouch also occur (Fig. 7.59:b). Retouch invasiveness is low. Only 31% of the edges have retouch scars greater than 6 mm deep (Fig. 7.59:c). Intensity is also low, with just 15% of the tools displaying more than three retouched positions (Fig. 7.59:d).

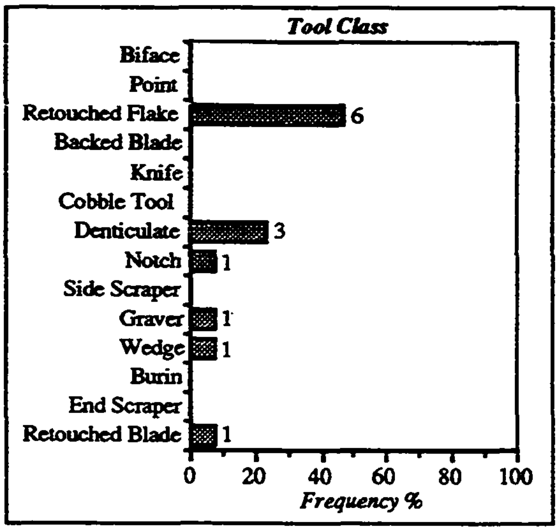


**Fig. 7.60.** Masterov Kliuch': tool class.

**Table 7.19.** Masterov Kliuch': Tool Types

| Tool type | n | % | Tool type | n | % |
|---|---|---|---|---|---|
| Unilaterally retouched flake-blade | 1 | 7.7 | Single straight denticulate | 2 | 15.4 |
| Wedge | 1 | 7.7 | Convex alternating denticulate | 1 | 7.7 |
| Single graver | 1 | 7.7 | Retouched flake | 5 | 38.5 |
| Multiple notch | 1 | 7.7 | Retouched ventral flake | 1 | 7.7 |
| | | | Total | 13 | |

*Tool Assemblage.* The Masterov Kliuch component V tool assemblage is dominated by retouched flakes and denticulates (Fig. 7.60, Table 7.19). Five of the six retouched flakes are made on cortical spalls. Three of these are elongate, blade-like. Other tools include a retouched blade, a wedge (Fig. 7.61:c), a graver, and a notch (Fig. 7.61:b).

This lithic industry is characterized by a primary reduction technology geared toward the production of cortical spalls, blades, and flakes for use as tool blanks. The cortical spalls are elongate; they appear to represent some of the initial removals from flat-faced blade cores. Secondary reduction technology is for the most part unifacial, uninvasive, and unintensive. The tool assemblage includes retouched cortical spalls, retouched flakes, and a retouched blade, as well as several denticulates, a notch, and a wedge.

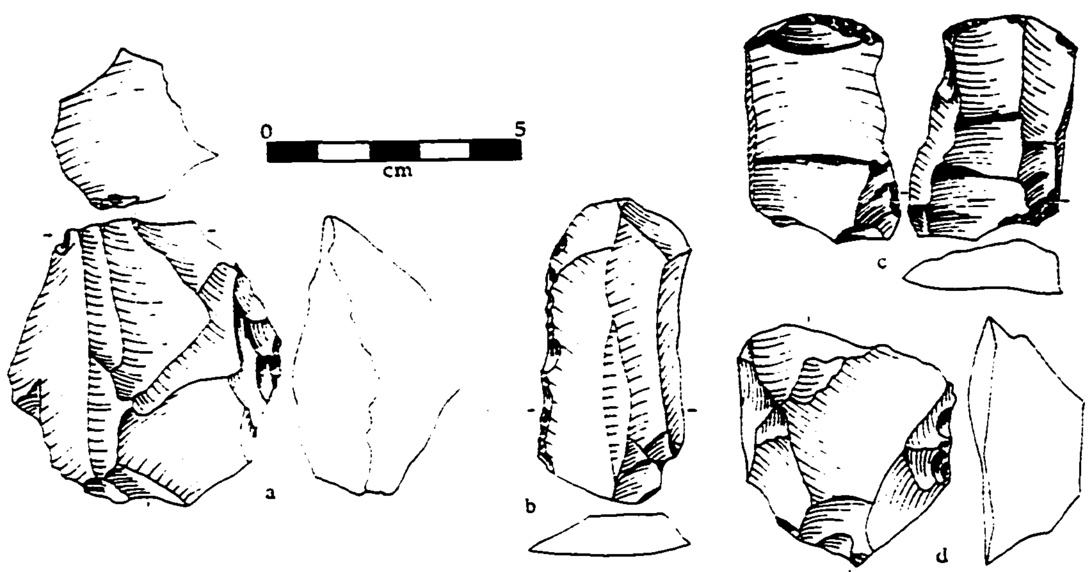


**Fig. 7.61.** Lithic artifacts from Masterov Kliuch': unidirectional flat-faced blade core (possibly radially prepared (a); unilaterally retouched flake-blade (b); wedge (c); unifacial radial core (d).

# INTERASSEMBLAGE STATISTICAL COMPARISONS

## Univariate Results

Table 7.20. lists results of contingency table analyses of lithic artifact attributes by site. Analysis of variance (ANOVA) results of retouch invasiveness and retouch intensity are given in Table 7.21. These results are briefly reviewed below.

### *Primary Reduction Technology*

Contingency table analysis of raw material indicates a significant difference ($p < .001$) in proportions of rock types (chert, quartzite, argillite, other) among assemblages (Table 7.20). Chert is the most common raw material, except for Arembovskii, which is unusually high in argillite, and Malaia Syia, which is unusually high in both argillite and quartzite. Also Varvarina Gora has an unusually high percentage of "other" (i.e., basalt, rhyolite, obsidian).

Presence of platform surface preparation varies significantly between sites ($p < .001$). Two industries, Malaia Syia and Tolbaga, have much higher than expected frequencies of cortical platforms. Type of platform surface preparation also varies significantly between assemblages ($p = .013$). Arembovskii and Makarovo-4 have higher than expected frequencies of dihedral platforms, while Malaia-Syia and Tolbaga have higher than expected frequencies of faceted platforms. Platform exterior

**Table 7.20.** Contingency Table Analysis of Type Frequencies for Various Artifact Features Between Seven Early Upper Paleolithic Assemblages

| Artifact feature | Sample size | G statistic | df | *P* |
|---|---|---|---|---|
| Raw material | 1712 | 828.243 | 15 | <.001 |
| Presence of platform surface preparation | 1017 | 130.956 | 6 | <.001 |
| Technique of platform surface preparation | 840 | 25.401 | 12 | .013 |
| Presence of platform exterior preparation | 1027 | 58.877 | 6 | <.001 |
| Dorsal scar | 1450 | 85.199 | 12 | <.001 |
| Tool blank | 1614 | 396.423 | 24 | <.001 |
| Retouch face | 2305 | 64.958 | 12 | <.001 |
| Retouch style | 2261 | 409.931 | 18 | <.001 |
| Major tool group | 640 | 169.299 | 18 | <.001 |

preparation differs significantly ($p < .001$) between the seven industries. At Kara-Bom component II and Tolbaga, the occurrence of platform exterior preparation is unusually low, while at Arembovskii and Makarovo-4 it is unusually high.

Contingency table analysis of dorsal scar pattern by site revealed a significant difference ($p < .001$) in the proportions of irregular, radial, and parallel scars between sites. Ust'-Karakol, Kara-Bom component II, and Makarovo-4 have higher than expected frequencies of parallel scars, while Malaia Syia, Arembovskii, Varvarina Gora, and Tolbaga have higher than expected frequencies of irregular scars. Frequencies of radial scars are low in all seven assemblages. Tool blank type also differs significantly ($p < .001$) between assemblages. Ust'-Karakol, Kara-Bom component II, and Arembovskii are characterized by high frequencies of tools made on blades, while Varvarina Gora and Tolbaga are characterized by high frequencies of tools made on flakes. At Makarovo-4, many tools are made on cortical spalls, and at Malaia Syia many tools are made on cobbles. In all assemblages, however, blades and flake-blades predominate.

### *Secondary Reduction Technology*

Contingency table analysis of retouch face demonstrated that the relative proportions of unifacial, edge, and bifacial/bimarginal retouch face differ significantly ($p < .001$) between the seven assemblages (Table 7.20). One assemblage, Ust'-Karakol, displays a higher than expected frequency of bifacial/bimarginal retouch, while two assemblages, Kara-Bom component II and Ust'-Karakol, have higher than expected frequencies of edge retouch. The remaining assemblages are low in bifacial/bimarginal retouch and edge retouch. Retouch style (scalar, nibbling, irregular, notching) also differs significantly ($p < .001$) by site. This variable distinguishes two groups of assemblages: (1) those with higher than expected frequencies of scalar retouch (Ust'-Karakol, Malaia Syia, Arembovskii, Varvarina Gora, and Tolbaga), and (2) those with higher than expected frequencies of irregular and marginal retouch (Kara-Bom component II and Makarovo-4). In addition, Kara-Bom component II and Tolbaga display relatively high frequencies of notching.

A one-way ANOVA on ranks resulted in a significant difference ($p < .001$) in mean retouch invasiveness among sites (Table 7.21). A multiple comparisons (Tukey-HSD) test (Table 7.22) revealed that two assemblages, Kara-Bom component II and Makarovo-4, differ significantly from all other assemblages, but not from each other. Mean

**Table 7.21.** One-way ANOVA of Mean Retouch Invasiveness and Mean Retouch Intensity Between Seven Early Upper Paleolithic Assemblages

| Artifact feature | F ratio | Groups df | Error df | *P* |
|---|---|---|---|---|
| Retouch invasiveness | 25.66 | 6 | 1641 | <.001 |
| Retouch intensity | 10.10 | 6 | 1473 | <.001 |

retouch invasiveness is notably low in both of these assemblages. A one-way ANOVA on ranks of retouch intensity also resulted in a significant difference between assemblages ($p < .001$). A multiple comparisons test again distinguished Kara-Bom component II and Makarovo-4 from most of the remaining assemblages. These two sites have the lowest retouch intensity means and differ significantly from Arembovskii, Varvarina

**Table 7.22.** Multiple Comparisons (Tukey-HSD) Procedure Comparing Mean Retouch Invasiveness and Mean Retouch Intensity Between Pairs of Early Upper Paleolithic Assemblages

| Industries compared | Difference between means: Retouch invasiveness | Retouch intensity |
|---|---|---|
| Ust'-Karakol-Kara-Bom comp. II | 5.74* | -0.01 |
| Ust'-Karakol-Malaia Syia | -0.49 | -0.25 |
| Ust'-Karakol-Arembovskii | -0.63 | -1.43* |
| Ust'-Karakol-Makarovo-4 | 3.50* | -0.23 |
| Ust'-Karakol-Varvarina Gora | -0.25 | -1.02 |
| Ust'-Karakol-Tolbaga | 0.79 | -0.71 |
| Kara-Bom comp. II-Malaia Syia | -6.23* | -0.24 |
| Kara-Bom comp. II-Arembovskii | -6.37* | -1.42* |
| Kara-Bom comp. II-Makarovo-4 | -2.24 | -0.22 |
| Kara-Bom comp. II-Varvarina Gora | -5.99* | -1.01* |
| Kara-Bom comp. II-Tolbaga | -4.95* | -0.70* |
| Malaia Syia-Arembovskii | -0.14 | -1.18 |
| Malaia Syia-Makarovo-4 | 3.99* | 0.02 |
| Malaia Syia-Varvarina Gora | 0.24 | -0.77 |
| Malaia Syia-Tolbaga | 1.28 | -0.46 |
| Arembovskii-Makarovo-4 | 4.13* | 1.20* |
| Arembovskii-Varvarina Gora | 0.38 | 0.41 |
| Arembovskii-Tolbaga | 1.42 | 0.72 |
| Makarovo-4-Varvarina Gora | -3.75* | -0.79* |
| Makarovo-4-Tolbaga | -2.71* | -0.48* |
| Varvaraina Gora-Tolbaga | 1.04 | 0.31 |

*Significant at 0.05 level

Gora, and Tolbaga. To sum up, three of four attributes of secondary reduction technology point to the distinctiveness of Kara-Bom component II and Makarovo-4. These two assemblages are characterized by nibbling and irregular retouch styles, as well as low retouch invasiveness and intensity.

### *Tool Assemblage*

Contingency table analysis of major tool groups by site (Table 7.20) indicates that a significant difference ($p < .001$) exists between the seven early Upper Paleolithic assemblages. Group I tools (retouched Levallois flakes and points) are absent or nearly absent from all industries. Group II, III, and IV tools, although present in all assemblages, vary in their relative frequencies (Fig. 7.62). The

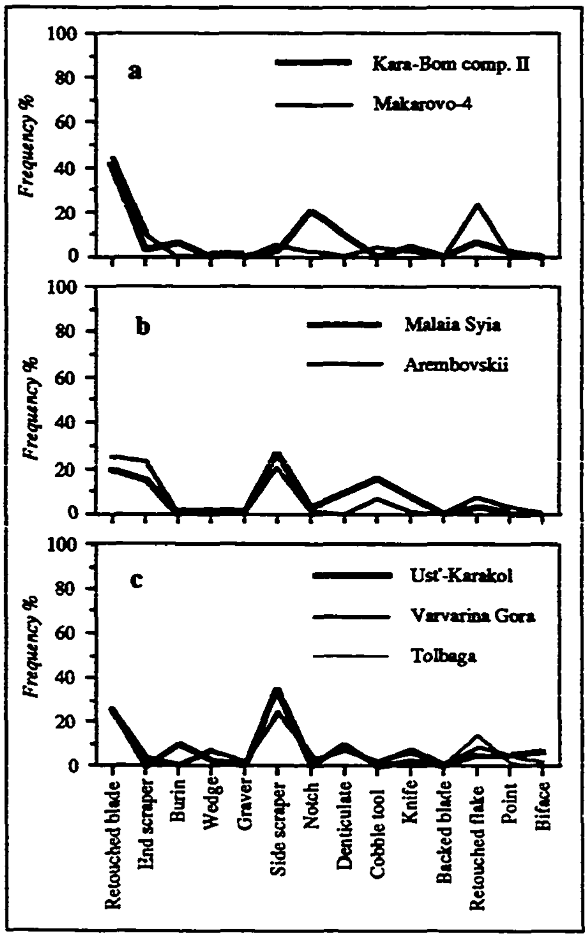


**Fig. 7.62.** Relative frequencies of tool classes among major early Upper Paleolithic assemblages.

frequency of Group II tools (side scrapers) is higher than expected at Ust'-Karakol, Varvarina Gora, and Tolbaga, and lower than expected at Kara-Bom component II and Makarovo-4. Group III tools (end scrapers, burins, gravers, smooth-backed knives) occur at higher than expected frequencies in two assemblages, Makarovo-4 and Arembovskii, and Group IV tools (notches and denticulates) occur at higher than expected frequencies in one assemblage, Kara-Bom component II. Interestingly, the two Transbaikal sites, Varvarina Gora and Tolbaga, are nearly identical in all respects.

## Multivariate Results

### *Principal Components Analysis*

Principal components analysis of 27 variables (representing seven artifact attributes) from six industries (Ust'-Karakol, Kara-Bom component II, Arembovskii, Makarovo-4, Varvarina Gora, and Tolbaga) identified two principal components that account for 61% of the variability among these assemblages. Variable loadings are presented in Table 7.23.

The first principal component (PC1) explains one-third (33%) of the total sample variance. Inspection of its variable loadings indicates that this PC is a dimension of secondary reduction technology, more specifically retouch intensity. Variables with high positive loadings include retouched blades and retouched flakes, as well as variables associated with their secondary reduction: unifacial ventral retouch face, alternating retouch face, irregular retouch style, and nibbling retouch style. Together these variables reflect low retouch intensity. Two industries have high PC1 scores, Kara-Bom component II and Makarovo-4 (Fig. 7.63). Arembovskii also has a positive but low PC1 score.

Large negative PC1 loadings include side scrapers, scalar retouch style and bifacial/ bimarginal retouch face (Table 7.23). These variables represent two elements of secondary reduction: (1) the retouching of blanks to produce specific tool forms, and (2) the repeated resharpening of those tools. Other variables with large negative loadings on PC1 include flake-blade blank and flake blank. These two variables may also be manifestations of intense secondary reduction. Flake-blades and flakes are typically stouter than true blades, offering a greater surface area for secondary reduction. These "fatter" blanks can be more extensively resharpened before exhaustion, thereby increasing the use-life of the tool. Three industries have large negative PC1 scores: Ust'-Karakol, Varvarina Gora, and Tolbaga (Fig. 7.63).

**Table 7.23. Loadings for Early Upper Paleolithic Assemblages**

| Variable | PC 1 loading | PC 2 loading |
|---|---|---|
| Side scraper (tool) | -.93441 | |
| Scalar retouch style | -.88534 | |
| Bifacial/bimarginal retouch face | -.88506 | |
| Retouched blade (tool) | .87965 | |
| Unifacial ventral retouch face | .87002 | |
| Irregular retouch style | .85545 | |
| Alternating retouch face | .70584 | .59543 |
| Retouched flake (tool) | .68270 | |
| Nibbling retouch style | .67957 | |
| Dihedral platform surface preparation | .65117 | -.66253 |
| Flake-blade blank | -.64063 | |
| Flake blank | -.64063 | |
| Cortical spall blank | .57874 | |
| Denticulate (tool) | | .88791 |
| End scraper (tool) | | -.86468 |
| Parallel/subparallel dorsal scar | | .85634 |
| Wedge/cobble tool | | -.84929 |
| Unifacial dorsal retouch face | | -.81689 |
| Opposing parallel dorsal scar | | -.72240 |
| Notch (tool) | | .53324 |
| Cortical platform surface preparation | | .51842 |
| Smooth platform surface preparation | | .51118 |

NOTE: Based on a principal components analysis of 27 type frequencies (representing seven artifact features) from six early Upper Paleolithic assemblages. Small factor loadings (< 0.5) suppressed.

The second principal component (PC2) accounts for 28% of the variance in the data set. This principal component describes two facets of variability: (1) tool assemblages, and (2) primary reduction strategies of blade cores. Variables with high PC2 loadings include denticulate, parallel/subparallel dorsal scar, and flake-blade blank, and variables with moderately high PC2 loadings include alternating retouch face, notch tool, absence of platform exterior preparation, and smooth platform surface preparation (Table 7.23). Two industries, Kara-Bom component II and Ust'-Karakol, have high PC2 scores (Fig. 7.63). These two assemblages have the highest frequencies of denticulates among the early Upper Paleolithic assemblages; Kara-Bom also has many notches. In addition, these two assemblages have the highest frequencies of (unidirectional) parallel and subparallel dorsal scar patterns.

Variables loading negatively into PC2 include end scraper, wedge/cobble tool, unifacial dorsal retouch face, opposing parallel dorsal scar, and dihedral platform surface preparation (Table 7.23). Both end scrapers and wedges are negatively correlated with denticulates. Put simply, as end scrapers and/or wedges rise in relative frequency, denticulates fall. Similarly, opposing parallel dorsal scar is negatively correlated with parallel/subparallel dorsal scar, indicating a dichotomy between unidirectional and bidirectional techniques of blade removal on flat-faced and subprismatic blade cores. The difference in tool classes may be a result of differential activity patterns, while the difference in blade core reduction strategies may be a result of extended core use. As blades are serially removed from a blade core, difficulties in platform preparation and the controlled removal of blades often resulted in the creation of a second, opposing platform. In PC2, parallel/subparallel scar pattern is correlated with absence of platform

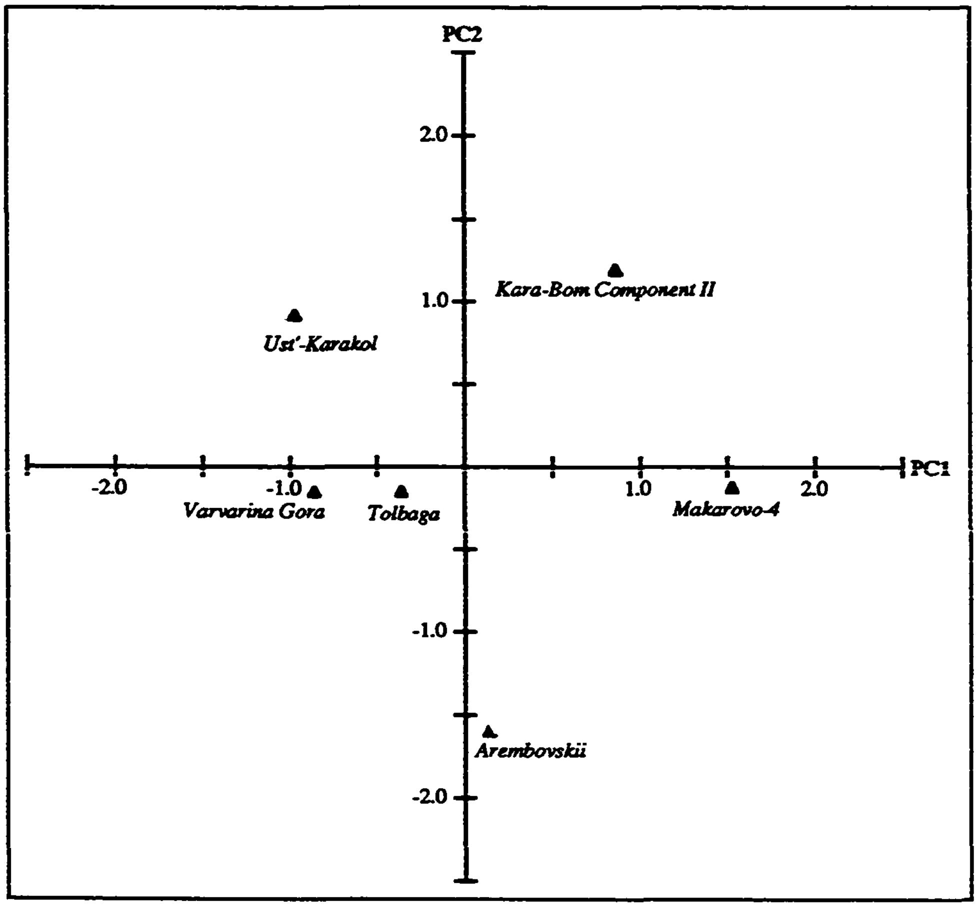


**Fig. 7.63.** Early Upper Paleolithic assemblage scores on the first two principal components extracted from a factor analysis of 27 type frequencies (representing seven artifact features).

exterior preparation and smooth platform surface preparation. Together these variables reflect minor blade core preparation and reduction. When bidirectional scars are prevalent, not only does platform extreior preparation rise in frequency, but so does dihedral platform surface preparation. These trends reflect more extensive blade core preparation and reduction. Industries with negative PC2 scores are Arembovskii, Makarovo-4, Varvarina Gora, and Tolbaga (Fig. 7.63). Arembovskii has an extremely low negative PC2 score, a product of high frequencies of both end scrapers and opposing parallel scars. The remaining three sites have moderate frequencies of end scrapers and wedges.

### *Cluster Analysis*

Analysis of the same data set through a cluster analysis using a city block distance measure and a complete-linkage (furthest-neighbor) algorithm resulted in the dendrogram illustrated in Fig. 7.64. The dendrogram shows two major clusters, (1) Kara-Bom component II and Makarovo-4, and (2) Varvarina Gora, Tolbaga, Ust'-Karakol, and Arembovskii. This split corresponds to PC1, a measure of secondary reduction, or retouch intensity. Both Kara-Bom component II and Makarovo-4 scored high on PC1 (Fig. 7.63), and both were repeatedly found to be significantly different from the remaining assemblages in retouch invasiveness and retouch intensity means (Fig. 7.63). Within the second cluster, Arembovskii is isolated from the remaining three sites. This split may correlate with PC2, which isolates Arembovskii becuase of high frequencies of end scrapers and opposing parallel dorsal scar patterns. In relation to this, the Arembovskii

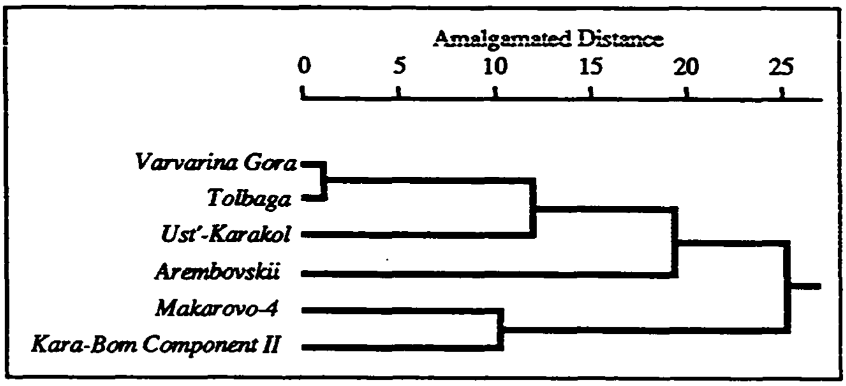


**Fig. 7.64.** Dendrogram based on complete-linkage clustering of early Upper Paleolithic assemblages. Cluster analysis based on City-block distance measure calculated from 27 type frequencies (representing seven artifact features).

blade cores are almost exclusively unidirectional in preparation, while at Ust'-Karakol, Varvarina Gora, and Tolbaga unidirectional and bidirectional blade cores are almost equally represented. According to the cluster analysis, Ust'-Karakol is next isolated from the Transbaikal sites, Varvarina Gora and Tolbaga. The latter two assemblages have fewer burins and bifaces, and more end scrapers and wedges than Ust'-Karakol.

# CHAPTER 8

## The Transition

In the previous chapters, discussion centered on defining the lithic technological systems characteristic of the Siberian Middle and early Upper Paleolithic, and on assessing assemblage differences within the two technocomplexes. In this chapter, comparisons are made *between* these two technocomplexes, and changes in lithic technological systems and tool assemblages are examined across the transition. First, differences in primary reduction technologies, secondary reduction technologies, and tool assemblages are defined and discussed on an attribute-by-attribute basis. Then results of multivariate analyses are presented, including principal components analysis, cluster analysis, and discriminant analysis. Changes in non-lithic systems are also reviewed, including bone and antler technologies, personal adornment, artwork, faunal inventories, settlement patterns, and hominid remains. Finally, the archaeological evidence is synthesized and brought to bear on the question of the origins of the Upper Paleolithic in Siberia and its relation to modern human origins.

### DEFINING THE TRANSITION: TECHNOCOMPLEX COMPARISONS

#### Univariate Results

##### *Primary Reduction Technologies*

The Siberian Middle and early Upper Paleolithic do not appear to differ with respect to lithic raw material use. Both technocomplexes are based on the use of high quality cherts and argillites, with little use of low quality quartzites, rhyolites, and basalts (Fig. 8.1a). Differences in local and long-distance procurement strategies can not be measured at this time.

The Middle and early Upper Paleolithic clearly differ in terms of techniques of platform surface preparation. Concerning platform surface preparation, faceting indexes in the Mousterian range from 35.2 to 75.4 and average 52.4 (Fig. 8.1b). In the early Upper Paleolithic industries, faceting and dihedral platforms are present, but infrequent. Faceting indexes range from 20.5 to 44.8 and average 33.2. Platform exterior preparation is uncommon in the Middle Paleolithic (Fig. 8.1c), ranging from 11% to 43% and averaging 28%. In the early Upper Paleolithic industries, on the other hand, the frequency of platform exterior preparation is nearly twice as high, averaging 55%. Thus, while platform faceting declines in the early Upper Paleolithic, platform exterior preparation increases.

The Middle and early Upper Paleolithic diverge in terms of dorsal scar patterns. As shown in Fig. 8.1d, Middle Paleolithic blanks are characterized by high frequencies of irregular dorsal scars and moderate frequencies of radial dorsal scars. These appear correlated to Levallois core reduction technologies. Parallel/subparallel scars are frequent

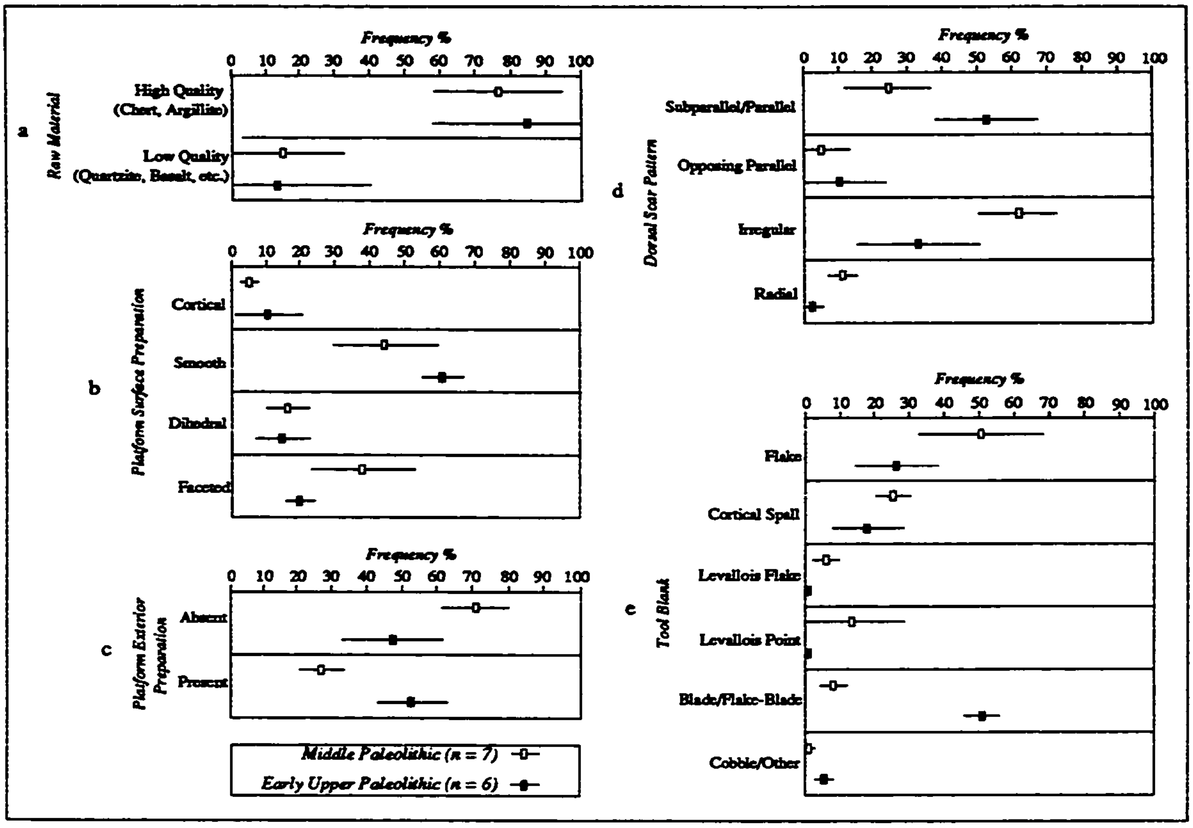


**Fig 8.1.** Means (box) and standard deviations (horizontal bar) of primary reduction technology attribute percentages for Middle and early Upper Paleolithic assemblages.

only at Kara-Bom component I and Strashnaia Peshchera, both of which exhibit high incidences of Levallois points and specially prepared pyramidal cores.

Early Upper Paleolithic dorsal scars, on the other hand, usually display parallel/ subparallel patterns, reflecting removal from flat-faced blade cores. Only Malaia Syia diverges from this pattern. This site has numerous initially prepared flake cores, and many blanks display cortex on their dorsal surfaces. Radial and irregular patterns are rare in all of the early Upper Paleolithic assemblages.

Tool blanks also indicate a contrast in primary reduction technologies between the Middle and early Upper Paleolithic (Fig. 8.1e). In the Middle Paleolithic industries, most tools are made on flakes or Levallois flakes and points, while in the early Upper Paleolithic industries the vast majority of tools are made on blades. Levallois blanks are absent or rare in the early Upper Paleolithic.

*Discussion: Differences in Core Reduction and Blank Production.* Individual attributes of primary reduction technology combine to illustrate a striking difference between the Middle and early Upper Paleolithic in the manufacture and use of blanks. Middle Paleolithic primary reduction technologies are largely centered around Levallois core reduction techniques and the manufacture of flakes and points. Early Upper Paleolithic industries, on the other hand, are characterized by high frequencies of blade cores and tools made on blades.

Three Levallois techniques are evident in the Siberian Mousterian: lineal, centripetal recurrent, and unidirectional/ bidirectional recurrent. In the lineal method of reduction (as defined by Boëda 1988), a cobble is reduced through the removal of a series of flakes centripetally around the entire perimeter of the core front and sometimes counterfront (Fig. 8.2a). Once a primary platform is prepared and the core front is shaped to a desired form, a single Levallois flake is struck from the core (Fig. 8.2b). At this point the core is typically discarded; the lineal method, therefore, results in the removal

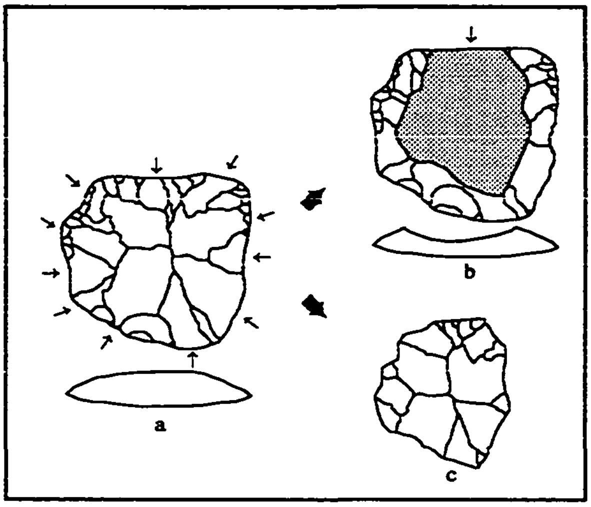


Fig. 8.2. Schematic representation of the lineal Levallois method: (a) radially prepared core; (b) core with Levallois flake scar; (c) detached Levallois flake (after Boëda 1988).

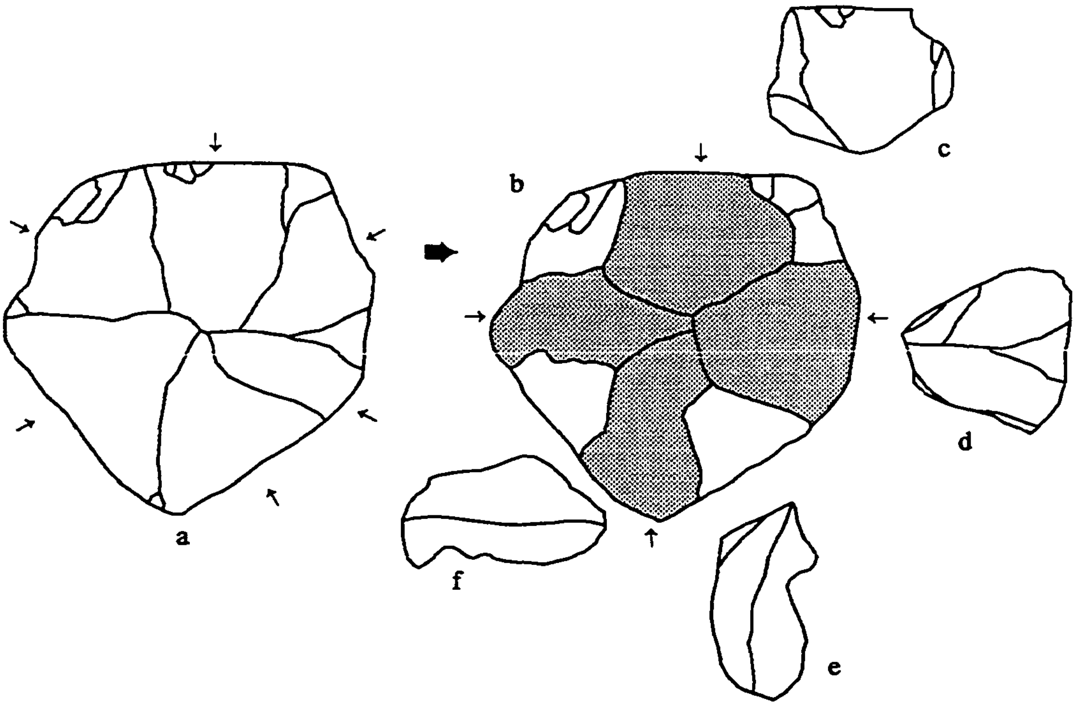


**Fig. 8.3.** Schematic representation of the centripetal recurrent Levallois method: (a) radially prepared core; (b) core with Levallois flake scars; (c-f) detached Levallois flakes (after Boëda 1988:23).

of a single (or primary) Levallois flake displaying a radial dorsal scar pattern (Fig. 8.2c). Cores reflecting such a reduction system are present at Strashnaia Peshchera (Derevianko and Markin 1990b:82), Denisova Peshchera Entrance (level 8), Denisova Peshchera Inside (level 16) (Derevianko et al. 1985e), Tiumechin-1 (Shun'kov 1990:121), and Ust'-Kanskaia Peshchera (Shun'kov 1990:114). Blanks with radial dorsal scar patterns are common in all of the Siberian Middle Paleolithic assemblages.

The centripetal recurrent Levallois technique (Boëda 1988) is also common in the Siberian Middle Paleolithic. As in the lineal method, a core is prepared radially along its entire perimeter (on one or both faces) (Fig. 8.3a). Once the platform(s) is prepared and the core front has been worked to its desired shape, a series of Levallois flakes are removed radially around the front of the core (Fig. 8.3b). The resulting blanks typically display irregular dorsal scar patterns and occasionally show radial or even subparallel scar patterns (Fig. 8.3c). Cores displaying a centripetal recurrent Levallois system of blank production are found in the assemblages from Peshchera Okladnikov (levels 3, 2, and 1), Denisova Peshchera Entrance (level 10), Denisova Peshchera Inside (level 14)

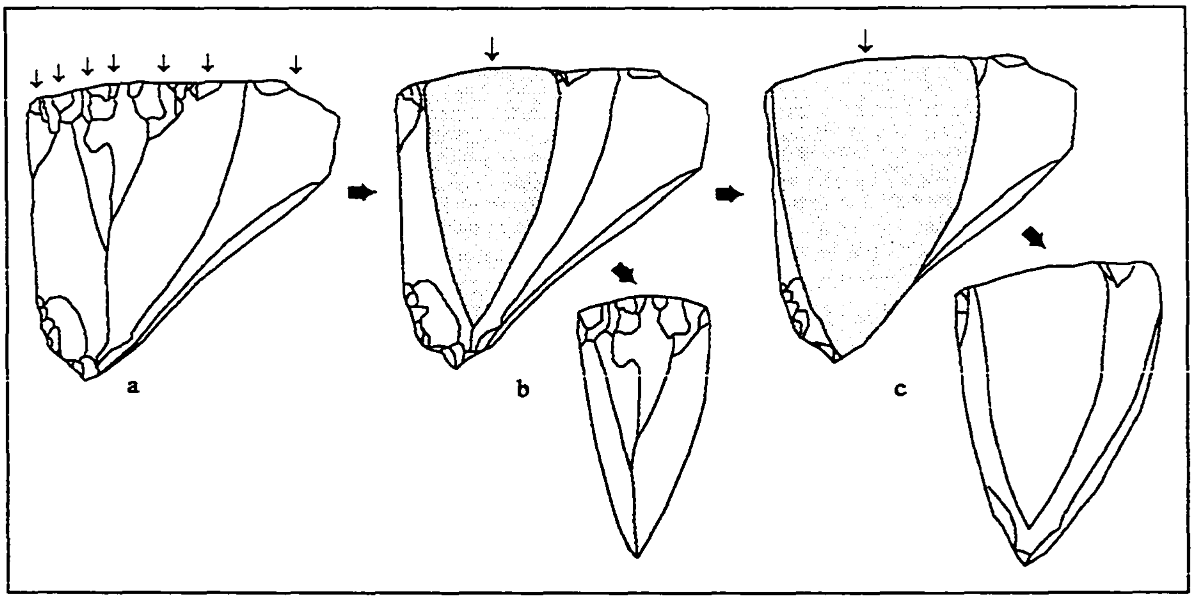


**Fig. 8.4. Schematic representation of the unidirectional recurrent Levallois method: (a) unidirectionally prepared pyramidal core; (b) detachment of initial Levallois point; (c) detachment of second Levallois point (after Boëda 1988:20).**

(Derevianko et al. 1985e:46), Ust'-Kanskaia Peshchera (Shun'kov 1990:113), Tiumechin-1 (Shun'kov 1990:120), Tiumechin-2 (Shun'kov 1990:149), and Dvuglazka Grot (Abramova 1985:77).

Other cores in the Siberian Mousterian reflect uni/bidirectional recurrent Levallois techniques of reduction (Boëda 1988). Again, cores are initially prepared through radial or centripetal preparation; however, primary Levallois blanks (flakes and points) are removed along a single axis, either unidirectionally from one prepared platform or bidirectionally from two opposing prepared platforms. Initial blanks removed from such cores display radial or radial/parallel scars, but subsequent blanks show subparallel, parallel, or opposing parallel scars. Many Levallois cores prepared in a recurrent fashion have a pyramidal or triangular shape (Fig. 8.4a). Pyramidal cores facilitate the detachment of Levallois points (Fig. 8.4b-c). Unidirectional and bidirectional recurrent Levallois cores are common in the Kara-Bom component II and Strashnaia industries, and are also present at Peshchera Okladnikov (levels 7, 3, 2, and 1 [Dervianko and Markin 1990b:88-89]), Denisova Peshchera Entrance (levels 9 and 8), Ust'-Kanskaia Peshchera (Shun'kov 1990:114), and Tiumechin-1 (Shun'kov 1990:122-125).

In the early Upper Paleolithic industries of Siberia, centripetal and unidirectional recurrent Levallois techniques are present but rare, and lineal Levallois techniques are

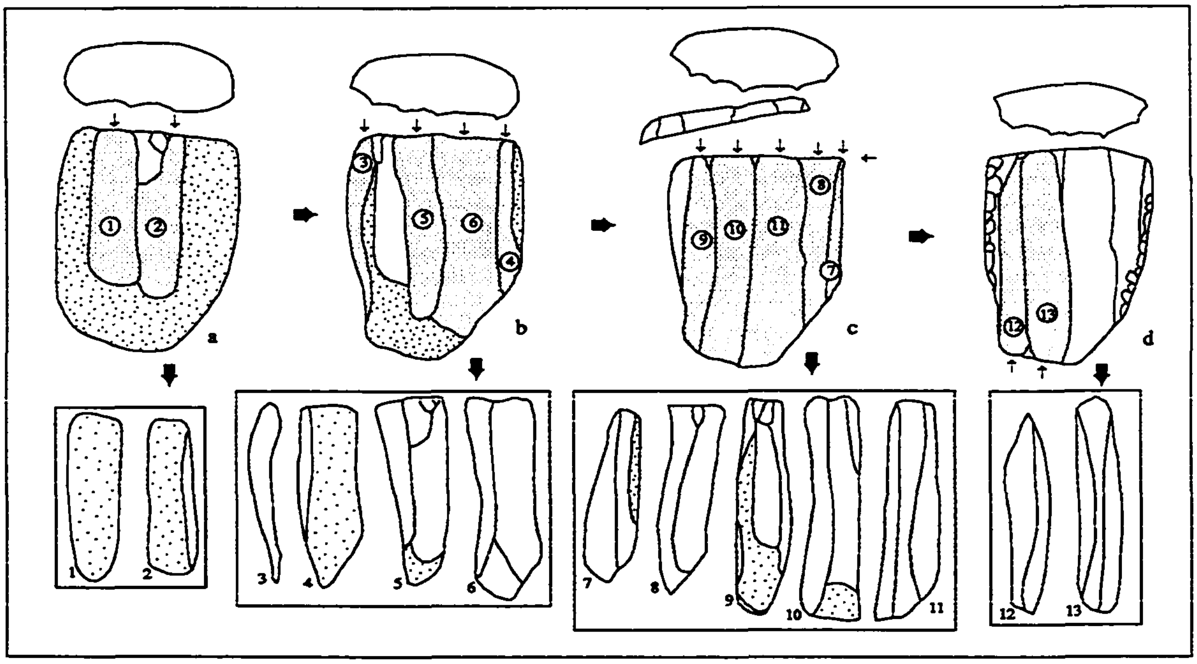


**Fig. 8.5.** Schematic representation of the initial preparation of a "flat-faced" parallel blade core representative of early Upper Paleolithic technologies in Siberia.

absent. Single examples of centripetal recurrent flake cores are seen at Ust'-Karakol, Malaia Syia, and Arembovskii, and single examples of unidirectional recurrent Levallois flake cores are seen at Arembovskii and Varvarina Gora. Other than these rarities, cores in the early Upper Paleolithic follow a non-centripetal, non-Levallois principal of reduction. Blank production is based on the parallel detachment of blades. Cores are manufactured on flat, rectangular-shaped cobbles or blocks. Typically, core fronts are initially prepared through the removal of a series of parallel-oriented spalls, often cortical, following the longitudinal axis of the piece (Fig. 8.5a). No other preparation occurs, and often core platforms remain cortical. Sometimes, as at Makarovo-4, the blade-like cortical spalls serve as tools, and the cores are discarded without further reduction. Usually, however, cores are further reduced through the removal of a series of parallel blades and/or flake-blades (Fig. 8.5b). After considerable reduction, core platforms are often rejuvenated by the complete removal of a core tablet (or platform rejuvenation spall) (Fig. 8.5c), or by trimming the platform surface (creating dihedral and sometimes faceted surfaces). Sometimes a second, diametrically opposed platform is prepared (Fig. 8.5d), and blades and flake-blades proceed to be removed bidirectionally. Frequently, after considerable reduction, blade cores are retouched along their lateral margins, apparently to facilitate control of blank detachment. In this system of core reduction, the flat face of the core increasingly becomes subprismatic in profile (Fig. 8.5d). True prismatic cores like those found in the western Eurasian Aurignacian are rare in the Siberian early Upper Paleolithic.

In sum, clear differences are documented in nearly every attribute of primary reduction technology across the Siberian Middle to Upper Paleolithic transition. Platform surfaces in the Middle Paleolithic are frequently faceted, while in the Upper Paleolithic platform exteriors are frequently trimmed or ground. Tools in the Middle Paleolithic are chiefly manufactured on flakes and Levallois endproducts (flakes and points), while tools in the early Upper Paleolithic are chiefly manufactured on blades and flake-blades. Correlated with this is a decline in the frequencies of radial and irregular dorsal scar patterns and a rise in the frequency of parallel/subparallel dorsal scar patterns. Blank production technologies shifted from Levallois-based systems in the Middle Paleolithic to non-Levallois, parallel-based systems in the early Upper Paleolithic.

### *Secondary Reduction Technologies*

A major feature of interassemblage variability within the Siberian Middle Paleolithic and within the early Upper Paleolithic is differential retouch intensity and invasiveness. When compared across the transition, however, intensity and invasiveness means do not appear to differ significantly (Fig. 8.6).

Both technocomplexes are characterized by high degrees of unifacial retouch as well as scalar and nibbling retouch styles. A significant point of variation does occur in the frequencies of edge (burin) retouch, bifacial retouch, and notching. Notching decreases in frequency across the transition, while burin and bifacial retouch become more common. The addition and standardization of such new technologies in the early Upper Paleolithic points to a fundamental difference in underlying tool manufacturing systems.

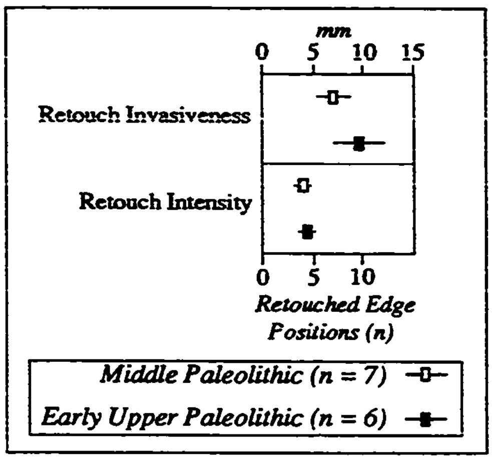


**Fig. 8.6.** Means and standard deviations of retouch invasiveness and retouch intensity for Middle and early Upper Paleolithic assemblages.

In the Middle Paleolithic, secondary reduction technologies were chiefly employed to resharpen tool edges, rather than to shape tools.

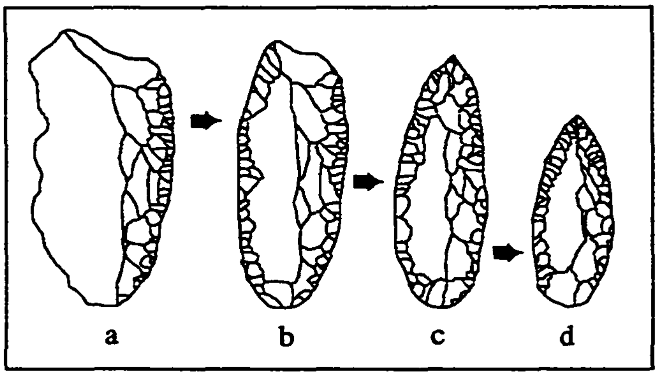


**Fig. 8.7.** Schematic representation of the reduction of a single side scraper through repeated retouching of two lateral edges: (a) single straight side scraper; (b) double convex side scraper; (c) convergent scraper; (d) reduced convergent scraper (after Dibble 1987:37).

Most tools were shaped while still on the core; this is the defining characteristic of Levallois blank production strategies. Specific side scraper types, for example, do not appear to be products of intentional secondary working. Instead, they are products of variable retouch intensity, merely points on a continuous scale of secondary reduction (Fig. 8.7) (Dibble 1987, 1988; Dibble and Rolland 1992). Similarly, Levallois points, as discussed earlier in Chapter 6, were detached from specially-prepared pyramidal cores; once detached, little or no retouching was necessary to produce a sharp point. Secondary reduction technologies in the Middle Paleolithic, then, were employed in the *resharpening* of tools, but not in the actual *manufacture* of tools.

This was not the case in the early Upper Paleolithic. Instead, this technocomplex produced a blank in the truest sense of the word: "a piece of material prepared to be made into something by a further operation" (*Webster's Ninth New Collegiate Dictionary*, 1986). The blade was the blank; secondary reduction technologies were employed to work blanks into desired tool forms. While the predominant method of retouching in the early Upper Paleolithic was unifacial, other techniques were also employed, including bifacial retouch, edge/burin retouch, ventral thinning, and backing. Below four examples are given that illustrate the degree to which these various secondary reduction technologies were utilized to create specific tool forms in the early Upper Paleolithic, as opposed to in the Middle Paleolithic.

Among Middle Paleolithic industries, bifaces and bifacially retouched tools are absent, with the exception of Peshchera Okladnikov level 1. In this assemblage there are two bifaces. These appear to be anomalous; possibly they were secondarily introduced into the Middle Paleolithic context, as Derevianko and Markin (1990b) have suggested for a number of other artifacts, (i.e., Bronze and Iron Age pottery shards).[1] In the early Upper Paleolithic, bifacial reduction is present though in low frequencies. Bifacially worked tools are found at Ust'-Karakol (9%), Arembovskii (2%), Varvarina Gora (2%), Tolbaga (0.5%), Kara-Bom component II (0.5%), and Makarovo-4 (0.5%). Only the sample from Malaia Syia lacks bifaces; however, Larichev et al. (1988:371) report the discovery of a series of "blades with bifacial retouch" from this site. These early Upper Paleolithic bifaces were shaped secondarily through the removal of successive series of flakes around their entire perimeters. Recurring forms are leaf-shaped (e.g., Ust'-Karakol, Varvarina Gora) and oval (e.g., Kara-Bom component II, Tolbaga).

Burin edge retouch is rare in the Middle Paleolithic but common in the early Upper Paleolithic. Among Mousterian industries, single examples of burins occur at Kara-Bom component I and Peshchera Okladnikov (levels 3 and 2), while in early Upper Paleolithic industries burins are fairly numerous, as seen at Ust'-Karakol, Kara-Bom component II, Tolbaga, and Varvarina Gora. Larichev et al. (1988:371) also report the occurrence of burins at Malaia Syia. Burins in the Middle Paleolithic are atypical and perhaps incidental, while in the early Upper Paleolithic they recur in three principal forms: angle burins, dihedral burins, and transverse burins. The steep working edge seen in Upper Paleolithic burins is clearly a special type of secondary edge reduction. Retouching occurs through the removal of an entire working edge longitudinally, rather than facially through the detachment of a series of small retouching chips.

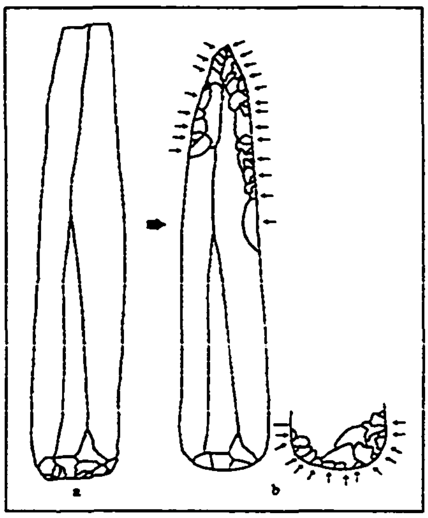


**Fig. 8.8.** Schematic representation of the secondary manufacture of a retouched point on a blade.

Points are found in both the Middle Paleolithic and the early Upper Paleolithic. However, in the former they are made on wide triangular Levallois blanks, while in the latter they are made on narrow rectangular blades. Early Upper Paleolithic points are

[1]Siberian Bronze Age cultures (including the Afanas'eva Culture, represented in level 1 at Peshchera Okladnikov), maintained a sophisticated bifacial point technology. The finely worked biface fragment shown in Fig. 6.28k is more indicative of late Holocene bifacial technologies than Middle Paleolithic or even early Upper Paleolithic technologies.

shaped through a secondary reduction technology in which distal margins are retouched dorsally to form sharp symmetric tips (Fig. 8.8). Some early Upper Paleolithic points are also retouched ventrally around their proximal ends, in order to thin the platform and ventral bulb of percussion. This ventral thinning likely facilitated hafting. At many sites, a number of similarly retouched proximal blade fragments occur; these may be basal fragments of points. On a number of points and proximal blade fragments, ventral retouching resulted in the formation of a convex base (Fig. 8.8) (e.g., Ust'-Karakol [Fig. 7.6:a], Maloialomanskaia Peshchera [Fig. 7.17:c,f], Makarovo-4 [Fig. 7.38:v]).

Secondary backing of tools is evident at Varvarina Gora and Tolbaga, where there are several backed knives made on blades. Backing on these pieces is achieved through the secondary manufacture of a steep, nearly 90° edge along one lateral margin that opposes an acutely angled working edge (Fig. 7.45:t; 7.51:a,e). Backing is not encountered in the early Upper Paleolithic assemblages west of Lake Baikal, nor does it occur in the Siberian Mousterian.

Thus, differences between Middle and early Upper Paleolithic industries can not be explained by variation in retouch intensity and invasiveness. Instead, variation exists in the techniques and objectives of secondary reduction. In the Middle Paleolithic, secondary reduction techniques were employed solely to resharpen tools formed during primary stages of reduction. Almost exclusively, this was accomplished through unifacial retouch. In the early Upper Paleolithic, secondary reduction technologies were employed not only to resharpen tools, but also to shape specific tool forms from a standardized blank. While unifacial retouch was the most common type of secondary reduction, a series of specialized techniques were also utilized, including bifacial retouch, edge retouch, and backing.

### *Tool Assemblages*

Middle and early Upper Paleolithic tool assemblages differ both quantitatively and qualitatively. Siberian Middle Paleolithic industries are typified by high frequencies of side scrapers, retouched flakes, denticulates, points, notches, and knives (Fig. 8.9). Interassemblage variability within the Mousterian is centered chiefly on the differential frequencies of side scrapers, retouched flakes, and Levallois points (Fig. 8.9). Although the frequencies of these tools vary from site to site, all assemblages have the same basic Mousterian tool forms: side scrapers typically made on stout Levallois flakes that are retouched to varying degrees of intensity, marginally retouched flakes, denticulates, notches, Levallois points, and knives. Retouched blades occur infrequently in the Siberian Mousterian; they are typically correlated with Levallois point manufacturing strategies. Other stone tool types, including end scrapers, gravers, cobble tools, burins, wedges, and bifaces, are extremely rare or absent.

Early Upper Paleolithic tool assemblages exhibit a different pattern. Retouched blades are the most common tool type (Fig. 8.9). Common Mousterian tools, such as side scrapers, denticulates, and notches, are present but in reduced frequencies. Not only do frequencies differ, but also underlying tool blanks differ, with sidescrapers, denticulates, and notches being made on blades rather than flakes in the early Upper Paleolithic (Fig. 8.10). Additionally, Levallois points are absent, and retouched flakes are less common.

At the same time, in early Upper Paleolithic assemblages, tool forms rare or absent in the Mousterian multiplied, including end scrapers, burins, points on blades, bifaces, gravers, wedges, and backed blades. End scrapers are present in all early Upper Paleolithic assemblages. They occur at Arembovskii and Makarovo-4 in relatively high frequencies (23.53% and 10.68%, respectively), at Tolbaga, Kara-Bom component II, and Varvarina Gora in relatively low frequencies (4.85%, 3.90%, and 3.85%), and at Ust'-Karakol as a single example made on a double angle burin. Gravers are present in all

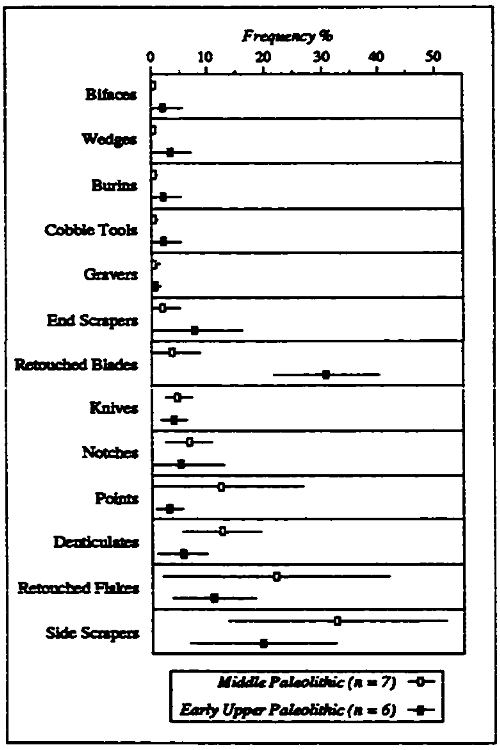


**Fig. 8.9.** Means and standard deviations of percentages of tool groups for Middle Paleolithic and early Upper Paleolithic assemblages.

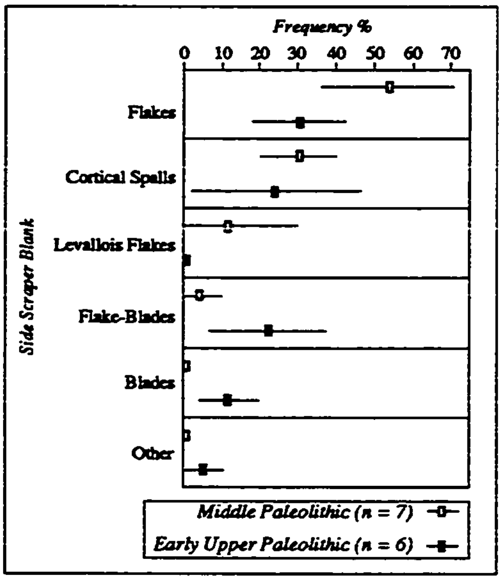


**Fig. 8.10.** Means and standard deviations of percentages of side scraper blanks for Middle Paleolithic and early Upper Paleolithic assemblages.

the early Upper Paleolithic assemblages except Ust'-Karakol, while wedges are common in all early Upper Paleolithic assemblages except Kara-Bom component II. Likewise, burins, points on blades, and bifaces recur in nearly all the assemblages.

In sum, Middle Paleolithic and early Upper Paleolithic tool manufacturing systems are disparate in many features of primary reduction technology, secondary reduction technology, and tool assemblages. Middle Paleolithic industries are flake-based and characterized by Levallois core reduction strategies, as well as tool assemblages clearly Mousterian in appearance. Tool manufacturing systems in the early Upper Paleolithic, on the other hand, are blade-based, with tools being shaped secondarily through a variety of reduction techniques. Early Upper Paleolithic tool assemblages are characterized by large numbers of retouched blades and numerous tool types that are rare or absent in the Siberian Mousterian, including end scrapers, burins, bifaces, wedges, points on blades, and backed blades.

## Multivariate Results

### *Principal Components Analysis*

Principal components analysis of 29 type frequencies (representing seven attributes) from seven Middle Paleolithic and six early Upper Paleolithic assemblages identifed two principal components which together account for 50% of the variance in the sample. Principal component loadings are presented in Table 8.1.

Principal component (PC) 1 accounts for 31% of the total sample variance. Loadings for PC1 indicate that it is a technocomplex dimension which contrasts the Middle and early Upper Paleolithic. Variables with high positive PC1 loadings include absence of platform exterior preparation, flake blank, irregular dorsal scar pattern, faceting platform surface preparation, denticulate tool, and cortical spall blank. Seven industries have high PC1 scores: Strashnaia Peshchera, Kara-Bom component I, and Peshchera Okladnikov levels 7, 6, 3, 2, and 1 (Fig. 8.11). These are the Mousterian industries included in the analysis. Variables with large negative PC1 loadings include blade blank, retouched blade tool, flake-blade blank, trimming platform exterior preparation, subparallel/parallel dorsal scar pattern, bifacial/bimarginal retouch face, smooth platform surface preparation, and end scraper tool (Table 8.1). Industries with negative PC1

**Table 8.1. Loadings for Middle and Early Upper Paleolithic Assemblage Variables on PC 1 and PC 2**

| Variable | PC 1 loading | PC 2 loading |
|---|---|---|
| Blade blank | -.93493 | |
| Retouched blade (tool) | -.89951 | |
| Absence of platform exterior preparation | .86949 | |
| Flake-blade blank | -.86774 | |
| Trimming platform exterior preparation | -.85644 | |
| Subparallel/parallel dorsal scar pattern | -.81829 | |
| Flake blank | .78877 | -.52090 |
| Irregular dorsal scar pattern | .75721 | -.54525 |
| Bifacial/bimarginal retouch face | -.62478 | |
| Faceting platform surface preparation | .58057 | |
| Smooth platform surface preparation | -.56763 | |
| End scraper (tool) | -.52426 | |
| Denticulate (tool) | .50877 | |
| Cortical spall | .50059 | |
| Alternating retouch face | | .82609 |
| Unifacial dorsal retouch face | | -.73460 |
| Point (tool) | | .70756 |
| Point blank | | .70003 |
| Side scraper (tool) | | -.67604 |
| Notch (tool) | | .58620 |
| Irregular retouch style | | .55414 |

Based on principal components analysis of 29 type frequencies (representing seven artifact attributes) measured on seven Middle Paleolithic and six early Upper Paleolithic assemblages. Loadings <0.5 suppressed.

scores include Kara-Bom component II, Makarovo-4, Tolbaga, Varvarina Gora, Arembovskii, and Ust'-Karakol (Fig. 8.11). These are the six early Upper Paleolithic industries included in the analysis.

PC1 clearly highlights the basic technological differences between the Middle and early Upper Paleolithic. Middle Paleolithic industries are characterized by flake-producing technologies, as indicated by the high negative loadings for the variables flake blank, irregular dorsal scar pattern, and cortical spall blank. Early Upper Paleolithic industries, however, are characterized by blade-producing technologies, as reflected in the large negative loadings for blade blank, flake-blade blank, subparallel/parallel dorsal scar pattern, and retouched blade tool. Further, attributes of core platform preparation also

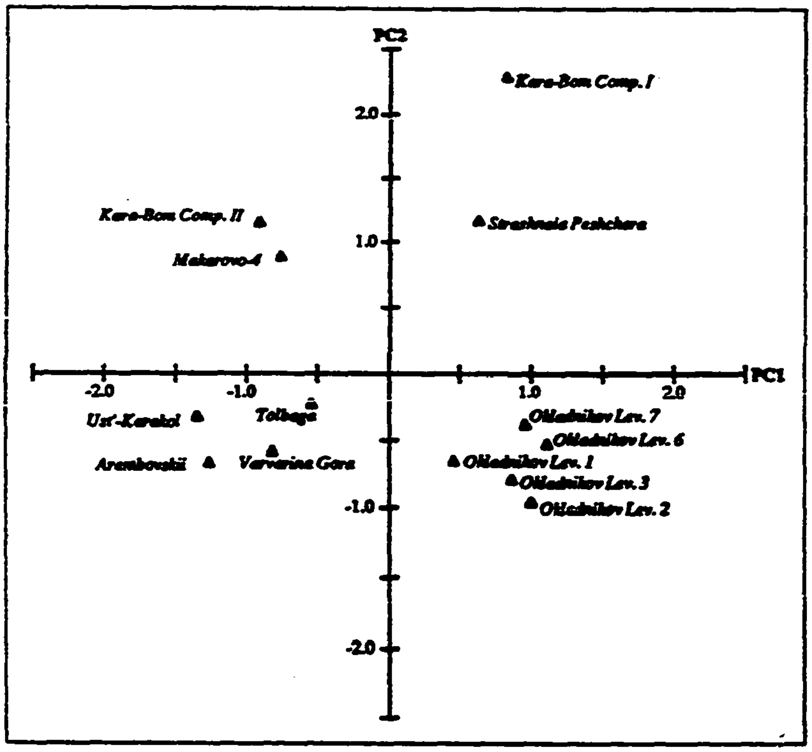


**Fig. 8.11. Assemblage scores on the first two principal components extracted from a factor analysis of 29 type frequencies representing seven artifact attributes.**

have large loadings on PC1. The absence of platform exterior preparation and the presence of faceting platform surface preparation are Middle Paleolithic traits and load positively on PC1, while the presence of platform exterior preparation and smooth platform surface preparation are early Upper Paleolithic traits and load negatively on PC1.

The only element of secondary reduction technology contributing to PC1 is bifacial/bimarginal retouch face, a form of retouching almost nonexistent in the Middle Paleolithic but present in the early Upper Paleolithic. Elements of the tool assemblage that contrast the Middle and early Upper Paleolithic are also incorporated into PC1. Retouched blade and end scraper have large negative loadings; these tool types are common in early Upper Paleolithic assemblages but rare in Middle Paleolithic assemblages. Denticulates, which are common in the Middle Paleolithic but uncommon in the early Upper Paleolithic, load positively on PC1.

Thus, the first principal component accentuates the major differences between Middle Paleolithic and the early Upper Paleolithic tool manufacturing systems. These two technocomplexes exhibit divergent primary reduction technologies. The Middle Paleolithic is flake-based and platform surfaces are well-prepared (faceted) but platform exteriors are not. The early Upper Paleolithic is blade-based and platform surfaces are more simply prepared (smooth) but platform exteriors are more extensively trimmed. Some differences in terms of tool assemblages are also highlighted. It should be kept in mind, however, that many of the tool groups noted to occur in greater frequencies in the early Upper Paleolithic (i.e., burins, wedges, gravers) were excluded from this analysis due to their overall low frequencies. As demonstrated earlier in the chapter, there are some subtle changes in the occurrences of these tool forms.

Principal component 2 explains nearly 19% of the total sample variance. PC2 expresses variation in tools and their manufacture, and separates assemblages within the Middle Paleolithic and within the early Upper Paleolithic. In fact, PC2 mirrors the first principal components extracted in the analyses performed separately for the Middle Paleolithic and the early Upper Paleolithic. The component is bipolar and indicates that attributes concerned with side scraper manufacture and retouching do not generally occur with attributes concerning point or notch manufacture and retouching. Variables with large positive loadings include unifacial dorsal retouch face, flake blank, irregular dorsal scar pattern, and side scraper tool, while variables with large negative loadings include alternating retouch face, irregular retouch style, point tool, point blank, and notch tool (Table 8.1). Thus, among the Middle Paleolithic industries two groups emerge, those with negative PC2 scores characterized by side scrapers and associated flake manufacturing systems (Peshchera Okladnikov levels 7, 6, 3, 2, and 1), and those with positive PC2 scores characterized by Levallois points and associated point manufacturing systems (Kara-Bom component I and Strashnaia Peshchera) (Fig. 8.11). This pattern follows that seen in the analysis of Middle Paleolithic technological facies presented in Chapter 6.

Similarly, early Upper Paleolithic assemblages are distinguished according to the presence or absence of side scraper manufacturing systems; however, in this case, the associated manufacturing system affected is the secondary reduction technology, not primary reduction technology. Among the early Upper Paleolithic industries, two assemblages, Kara-Bom component II and Makarovo-4, are distinguished by low frequencies of side scrapers and high frequencies of irregular retouch style, alternating retouch face, and (in the case of Kara-Bom component II) notch tools (Fig. 8.11). The remaining early Upper Paleolithic industries, Ust'-Karakol, Arembovskii, Varvarina Gora, and Tolbaga, have higher frequencies of side scrapers and lower frequencies of marginal, irregular retouch. In this respect, then, PC 2 describes the major point of variation within the early Upper Paleolithic, low retouch intensity vs. high retouch intensity, which also emerged in the principal components analysis presented in Chapter 7.

### *Cluster Analysis*

The same data set was subjected to a cluster analysis using the city block distance measure and an average-linkage algorithm. The resulting dendrogram delineated two major branches of industries (Fig. 8.12). The first branch includes the Middle Paleolithic industries, and the second branch includes the early Upper Paleolithic industries.

Within the two major technocomplex clusters, smaller clusters mirror the patterns identified through earlier cluster and principal components analyses. Middle Paleolithic assemblages form three clusters: (1) Strashnaia Peshchera and Kara-Bom component I (assemblages rich in Levallois points), (2) Peshchera Okladnikov levels 3 and 2 (assemblages rich in side scrapers ), and (3) Peshchera Oklandikov levels 7, 6, and 1 (assemblages rich in retouched flakes and side scrapers).

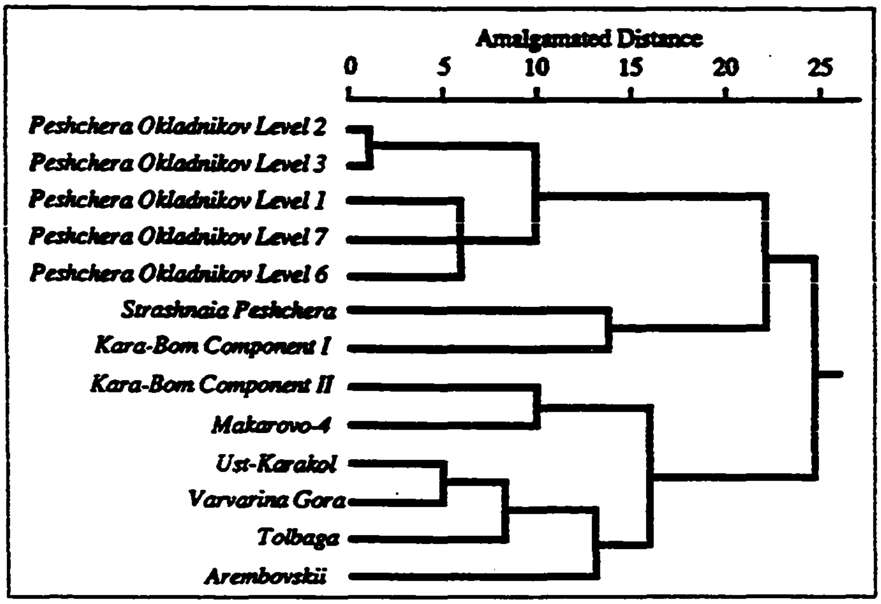


**Fig. 8.12.** Dendrogram based on average-linkage clustering of Middle and early Upper Paleolithic assemblages. Cluster analysis based on City-block distance measure calculated from 29 type frequencies representing seven artifact attributes.

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in primary reduction technologies, secondary reduction technologies, and tool assemblages. Not surprisingly, multivariate analyses reveal that the major distinction between these two technocomplexes centers on primary reduction technology, especially a shift from flake-producing technologies to blade-producing technologies, as well as a decrease in the frequency of platform faceting and an increase in the frequency of platform exterior trimming. Secondary reduction technologies also diverge. Fundamental elements of early Upper Paleolithic secondary reduction technologies include bifacial retouching and burin edge retouching, which are absent or rare in the Mousterian. These and other attributes of retouching indicate that early Upper Paleolithic tools were more often shaped after the removal of blanks from cores, whereas Mousterian tools were shaped prior to detachment from cores. Retouch intensity and invasiveness, however, do not seem to vary across the Middle to Upper Paleolithic transition. Tool assemblages differ in many respects, especially in the increase of a number of tool forms in the early Upper Paleolithic that are rare in the Mousterian, including end scrapers, burins, gravers, wedges, bifaces, and unifacial points on blades, and the decline of other tool forms common in the Mousterian, including denticulates, retouched flakes, and side scrapers.

## NonLithic Comparisons

### *Bone-Working Technology*

Formally worked bone, antler, and ivory tools are absent from the Siberian Mousterian but present in the early Upper Paleolithic. Every early Upper Paleolithic site with faunal remains (with the exception of Kara-Bom component II) contains a handful of carefully worked non-lithic implements. Recurring forms include small points made on cervid antler, bone awls and needles, and cut and polished ivory and bone retouchers (Fig. 8.14:b-j). At Tolbaga, there is also a horse rib with an incised longitudinal slot; perhaps this served as a handle for a stone blade or scraper. Bone-working technology is clearly present in the early Upper Paleolithic.

### *Personal Adornment*

Jewelry and other items of personal adornment are absent in the Siberian Mousterian and rare in the early Upper Paleolithic. Among the early Upper Paleolithic sites, there

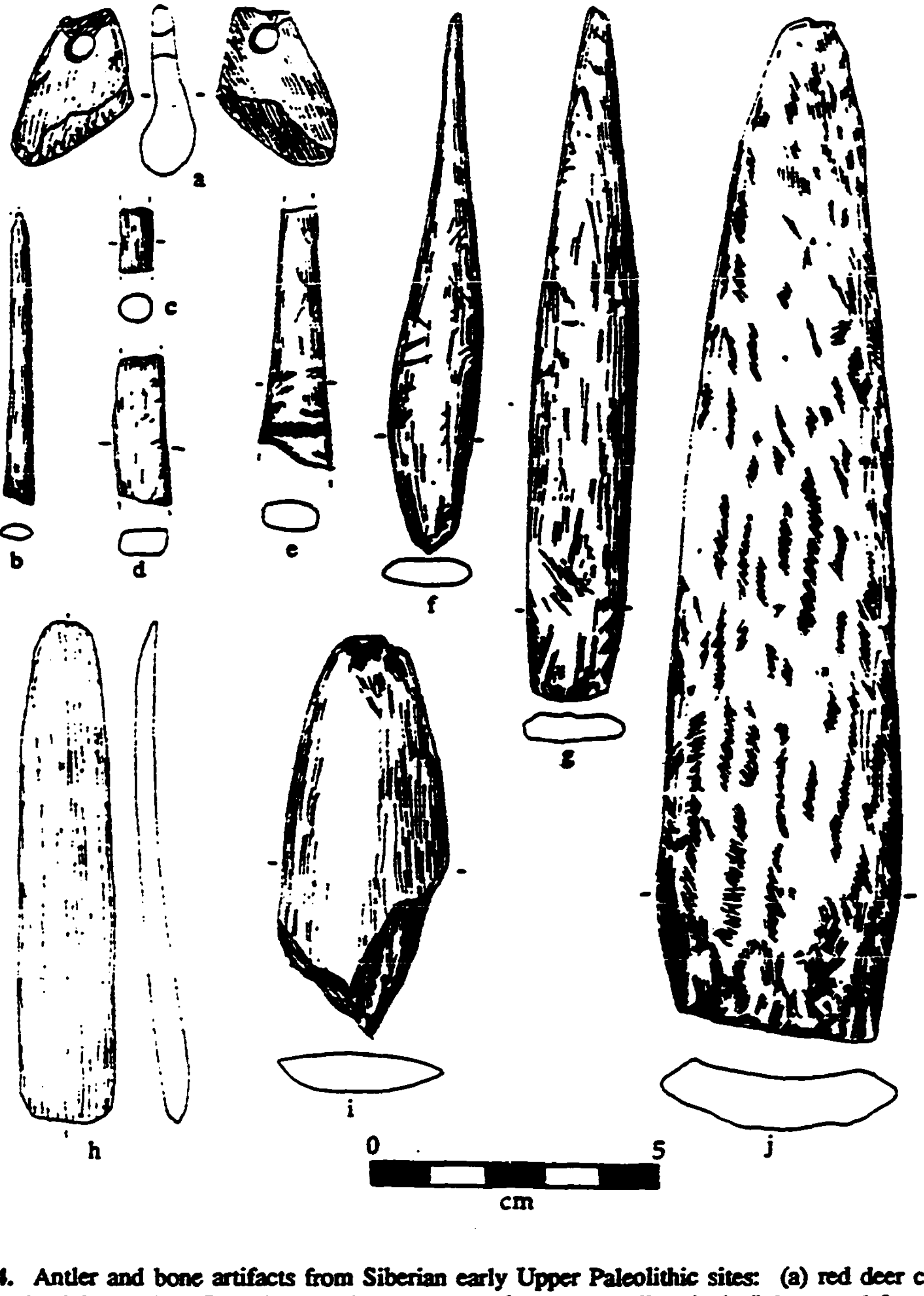


**Fig. 8.14.** Antler and bone artifacts from Siberian early Upper Paleolithic sites: (a) red deer canine pendant (Maloialomanskaia Peshchera); (b) bone needle fragment (Tolbaga); (c,d) bone awl fragments (Tolbaga); (e-g, j) antler points and point fragments (Malaia Syia); (h,i) bone retouchers or billets (h, Varvaraina Gora; i, Malaia Syia); (after Abramova 1989; Muratov et al. 1982; Vasil'ev et al. 1987).

are cervid tooth pendants from Maloialomanskaia Peshchera (Fig. 8.14:a) and Voennyi Gospital, a softstone "semi-disk" colored with red ochre at Varvarina Gora, and small bone fragments with what appear to be intentionally drilled holes at Tolbaga and Masterov Gora. The cervid tooth pendants are reminiscent of those described for the European Aurignacian (White 1989).

### *Art*

In the Siberian Middle Paleolithic examples of artwork are unknown, while in the Siberian early Upper Paleolithic examples exist, but they are problematic and controversial. Red ochre has been found at Maloialomanskaia Peshchera and Malaia Syia; at Maloialomanskaia Peshchera it was used to draw a small line on the wall of the cave. The putative mobiliary art from Malaia Syia (Larichev 1978a, 1978b; Larichev et al. 1988) is equivocal; the pieces I examined were unconvincing. Perhaps the "bear's head" carved on a woolly rhinoceros vertebra found at Tolbaga is a true example of early Upper Paleolithic mobiliary art, but it was found together with a jumble of other woolly rhinoceros bones, an unusual context for a work of art. Perhaps the only unequivocal work of art for the Siberian early Upper Paleolithic is the mammoth ivory spheroid found over a hundred years ago at Voennyi Gospital. Unfortunately, this piece is lost and we have only an illustration provided by Cherskii (1872). Thus, the evidence for mobiliary art in the Siberian early Upper Paleolithic is meager.

### *Subsistence Practices*

An important aspect of the Middle to Upper Paleolithic transition involves the study of hominid behavior from the perspective of faunal remains. While faunal analysis is not the focus of this study, a few comments can be made. In western Eurasia, recent zooarchaeological studies have opened up a new avenue of debate concerning changes in subsistence behavior across the transition. Recently Binford (1984, 1985) and others have suggested that Middle Paleolithic hominids were not efficient hunters of big-game animals, but instead were opportunistic foragers who scavenged large mammal carcasses and hunted only small- or medium-sized prey species. Others have suggested the opposite, that Neanderthals and other Middle Paleolithic hominids were shrewd hunters who sometimes specialized in procurement of a single prey species (Chase 1988, 1989;

Hoffecker et al. 1991). Similar arguments have arisen concerning subsistence strategies in the early Upper Paleolithic. Reconstructions of Aurignacian and Upper Perigordian subsistence presented by Spiess (1979) and Enloe (1993), for example, indicate an opportunistic foraging pattern (*sensu* Binford 1980), while others (Klein 1989; Mellars 1989b; Pike-Tay 1991, 1993; Simek 1987) find evidence for logistical collecting, including specialization toward a single prey species, strategic planning, and monitoring of seasonal herd movements.

In Siberia, questions concerning Middle Paleolithic and early Upper Paleolithic subsistence have not been researched. At present, we simply do not have the information necessary to make any but the most preliminary statements regarding hunting behavior. Two points, however, are worthy of note. First, in the Mousterian-bearing cave sediments of south Siberia, non-hominid carnivore remains are ubiquitous (Tables 3.1, 3.2), indicating the likelihood that hominids were not the sole agents engaged in the accumulation of faunal remains in the caves. Taphonomic studies are needed to evaluate the extent to which these faunal accumulations are the product of Middle Paleolithic hominid activity. Second, a review of NISP data from Malaia Syia, Varvarina Gora, and Tolbaga (Fig. 3.26, 3.45, 3.53) indicates that three or four species consistently make up the majority of the faunal assemblages, implying a pattern of generalized opportunistic foraging rather than specialization toward a single prey species. These data, however, are meager and should be used cautiously when trying to draw similarities or differences between the Middle and early Upper Paleolithic. More detailed studies of subsistence are needed in order to reconstruct whether this area of behavior underwent change during the transition.

### *Site Structure and Settlement*

There are at least ten Middle Paleolithic sites now known from Siberia. Of these, five are cave sites and five are open sites. Archaeological features (e.g., hearths, storage pits, remains of structures) have not been identified at these sites, and activity areas have not been defined, possibly because contexts are disturbed. The open sites reflect either ephemeral occupations (e.g., the basal component at Ust'-Karakol) or redeposited materials (Tiumechin-1, Tiumehcin-2, possibly Kurtak-Chanin-2). Only one open site, Kara-Bom component I, appears to represent a non-redeposited and extensive Middle Paleolithic occupation. Even so, most of the Mousterian artifacts were recovered from sediments reworked by a fossil spring (Goebel et al. 1993), and Petrin, the current excavator of the site, has not yet described any features or activity areas.

Early Upper Paleolithic occupations are characterized by clear intrasite as well as intersite heterogeneity. Nearly all are open-air sites. There is little indication that hominids during this period used caves, although ephemeral occupations occur at Maloialomanskaia Peshchera (Derevianko and Petrin 1989), Ust'-Kanskaia Peshchera (Shun'kov 1990), and perhaps Denisova Peshchera (D. Nash, pers. comm.).

Open sites are typically situated on high terrace-like colluvial deposits overlooking broad floodplains (e.g., Ust'-Karakol, Kara-Bom, Arembovskii, Makarovo-4, Varvarina Gora, Tolbaga, Sannyi Mys, Sapun, Masterov Kliuch, Sokhatino). Some sites are also situated adjacent to confluences of side valley streams and rivers (Ust'-Karakol, Kara-Bom, Malaia Syia, Masterov Gora, Masterov Kliuch', Priiskovoe, Arta-2). Two sites, Arembovskii and Kara-Bom, appear to be workshops located adjacent to high quality raw material sources.

Compared with Mousterian occupations, early Upper Paleolithic sites show clear spatial patterning. Features are common, and activity areas are definable in most cases. Hearths have been identified at Ust'-Karakol, Kara-Bom, Sannyi Mys, Varvarina Gora, Tolbaga, and Priiskovoe. Many of these are stone-lined, while others are "smears" of charcoal, ash, charred bone, and lithics. Structural remains of dwellings are also common. Larichev (1978a:105; Larichev et al. 1988:369) reports the discovery of a series of "dwelling complexes" at Malaia Syia, and nearly all the Transbaikal sites have revealed remnants of structures. At Sannyi Mys, Tolbaga, and Priiskovoe, these are defined by circular rings of large stone plates, and sometimes, centrally-located hearths. Dwellings appear to have been surficial, circular, and 3-6 m in diameter. "Outdoor work areas" have also been defined at some of these sites, as have trash heaps. At Sannyi Mys, Varvarina Gora, and Tolbaga, there are features considered to be storage pits. At Varvarina Gora, one such pit contained a large bird skull and an articulated partial skeleton of a horse, and at Tolbaga, a similar pit contained a horse mandible and other horse bones. The repeated occurrence of dwellings, hearths, and storage pits, as well as large accumulations of lithic artifacts, debitage, and faunal remains at these early Upper Paleolithic sites suggest to some researchers (i.e., Kirillov 1987:71; Meshcherin 1985) that they were occupied for relatively long periods of time.

Among the open early Upper Paleolithic sites, then, three site types can be distinguished: (1) large camps with dwellings, pits, hearths, and large accumulations of lithics and faunal remains (Malaia Syia, Varvarina Gora, Tolbaga); (2) small camps with unlined hearths and clearly defined activity areas (Ust'-Karakol, Makarovo-4); and (3) lithic workshops (Arembovskii, Kara-Bom). More detailed intrasite spatial analyses are needed to ascertain the functions of these different site types; however, from this preliminary review, it appears that site structure in the early Upper Paleolithic differed from that in the Middle Paleolithic.

### *Hominid Remains*

Hominid skeletal material from Mousterian occupations in Siberia is meager, consisting of teeth from Denisova Peshchera, and teeth and fragmented postcranial remains from Peshchera Okladnikov. According to Turner (1990a, 1990b), these hominid remains appear Neanderthal in morphology. If this is so, then the known range of Neanderthals has been expanded nearly 2,000 km northeastward beyond Teshik-Tash, Uzbekistan (Ranov 1990).

Hominid remains from early Upper Paleolithic sites are likewise scarce and unstudied. Isolated hominid teeth have been found at Maloialomanskaia Peshchera (Alekseeva and Maloletko 1984:27), and apparently at Malaia Syia (V. Larichev, pers. comm.). None of these has been described.

### *Discussion*

Clearly, the mid-Upper Pleistocene in Siberia witnessed profound changes in hominid lithic technology, bone- and antler-working technology, and personal adornment. Although less well-documented, there also appear to have been significant changes in site structure and settlement, although these aspects of the archaeological record demand greater attention in the future, as does evidence for subsistence behaviors. Additional hominid fossils are needed to ascertain whether Neanderthals made all of the region's Middle Paleolithic industries, and whether anatomically modern humans made any or all of the region's early Upper Paleolithic industries.

# DATING THE TRANSITION

## The Middle Paleolithic

The age of the Siberian Mousterian is not fully resolved. Elsewhere in western Eurasia, Mousterian sites date to earlier than 40,000 B.P., and are thus beyond the effective range of radiocarbon ($^{14}C$) dating (Bar-Yosef, 1989, 1992, 1993; Mellars, 1986). Given the infinite $^{14}C$ date obtained on Mousterian occupations at Strashnaia Peshchera, Denisova Peshchera, and Kara-Bom component I (Tables 4.1, 4.2), the same is evidently true for Siberia. These occupations are clearly too old to be dated using $^{14}C$ techniques; instead other absolute dating methods, including electron spin resonance and thermoluminescence, are needed to confirm the chronology.

Perhaps the earliest Mousterian occupation in Siberia occurs in the lowermost deposits at Denisova Peshchera, levels 10 and 9 at the cave entrance and level 22 from the cave interior. Based on paleomagnetic and pollen records, this occupation appears to span the Last Interglacial and Early Glacial (oxygen-isotope substages 5e-5a), roughly 130,000-75,000 B.P. Mousterian artifacts occur in a brightly-colored clay deposit that blankets the cave floor. Similar clay deposits occur at Strashnaia Peshchera and Dvuglazka Grot; however, at these caves the clay deposits do not contain Mousterian artifacts. Instead, Mousterian occupations occur stratigraphically above the clay, in loam deposits containing abundant scree and angular rock debris. Assuming that the clay deposits formed during the Last Interglacial and Early Glacial, as at Denisova, then the overlying Mousterian occupations at Strashnaia Peshchera, Denisova Peshchera (levels 8 and 7 at the cave entrance, levels 21-11 the cave interior), and Dvuglazka Grot likely were deposited sometime during the Early Pleniglacial or early Middle Pleniglacial (75,000 to 45,000 B.P.). The presence of cold-loving fauna at Dvuglazka led Abramova (1984) to assign the Mousterian occupation there to the Early Pleniglacial, about 70,000 B.P. The same argument can be made for level 3 at Strashnaia Peshchera and the upper Mousterian levels (8 and 7 and 21-11) at Denisova Peshchera (Derevianko et al. 1990b). Thus, based on contextual evidence, these Mousterian occupations can be tentatively assigned to the Early Pleniglacial or early Middle Pleniglacial.

At Kara-Bom, the age of the Mousterian occupations (components Ia and Ib) can also be judged contextually. Component Ib is partially contained within a broad plaeosol which, by virtue of its stratigraphic position underneath a series of later Middle Pleniglacial soil horizons, can be tentatively assigned to the Early Interstade of the early Middle Pleniglacial, thus providing an upper-limiting age of about 50,000 B.P. for this occupation. The age of the lower component (Ia), however, is indeterminable, but must be older.

The Mousterian levels at Peshchera Okladnikov have been extensively dated by conventional and AMS $^{14}C$ dating techniques. The results, however, are not easily interpreted. AMS dates from levels 3, 2, and 1 range from 43,000 to 33,000 B.P. None are infinite, perhaps indicating that these Mousterian occupations are younger than elsewhere in Siberia. Because some of the dates lie at the limit of $^{14}C$ dating, but it is more likely that the dates are artificially young, and that the Mousterian occupation is more ancient than the $^{14}C$ dates suggest. How much more ancient is unclear. Uranium-thorium dating of bone suggests that the basal occupation (level 7) at Peshchera Okladnikov is younger than 50,000 B.P. If this is the case, then the occupations at Peshchera Okladnikov may represent a late phase of the Siberian Mousterian post-dating 50,000 B.P. Confirmation of this sequence must await the application of additional absolute dating techniques.

## The Early Upper Paleolithic

Prior to the application of AMS methods, $^{14}C$ dates suggested the earliest Upper Paleolithic sites in Siberia dated to between 35,000-30,000 B.P. (Abramova 1989; Larichev et al. 1990; Vasil'ev 1992). However, AMS $^{14}C$ dates from the base of component II at Kara-Bom indicate that the early Upper Paleolithic emerged much earlier, perhaps earlier than 43,000 B.P. This finding is complemented by the suite of infinite dates from Makarovo-4 and Varvarina Gora, as well as the newly documented cultural sequence for the rest of the Siberian early Upper Paleolithic. Radiocarbon dates from 12 early Upper Paleolithic occupations throughout south Siberia range from 43,000 B.P. to 30,000 B.P. (Table 4.3). Taken at face value, these dates suggest a continuous occupation of the region spanning over 10,000 years of time.

Like the absolute chronology for the Mousterian, however, the dating of the Middle to Upper Paleolithic transition presented here should be considered tentative, since without determination of the discrete ages of the occupations at Makarovo-4, Varvarina Gora, and Kara-Bom components IIa-IIb, we can not ascertain unequivocally the timing of the transition. In addition, without further dating of the occupations at Peshchera Okladnikov, we can not ascertain whether the late Mousterian in Siberia coexisted alongside the early Upper Paleolithic for any length of time.

## CHARACTERIZING THE TRANSITION: REPLACEMENT OR CONTINUITY?

So far, this study has been exploratory and descriptive in scope, directed at dating and defining the Siberian Middle to Upper Paleolithic transition. Here we take the mid-Upper Pleistocene archaeological record of Siberia and assess its fit to a series of contrasting expectations derived from the two competing hypotheses explaining the origins of the region's Upper Paleolithic.

As outlined in Chapter 1, Hypothesis 1 follows the "spread-and-replacement" theory of modern human origins (Klein 1992:8), and states that the early Upper Paleolithic in Siberia represents an intrusive tradition or culture that replaced authochthonous Middle Paleolithic populations. Hypothesis 2 is based on the "regional continuity" theory of modern human origins, and states that the Siberian early Upper Paleolithic developed independently from the local Mousterian. These hypotheses can be evaluated by deriving a series of expectations under each model and assessing the "goodness-of-fit" of each to the archaeological record. The expectations described in Chapter 5 are restated below.

Under the replacement model, we would expect to see (1) extensive and significant differences in tool manufacturing systems and other expressions of behavior, (2) discontinuities in technology and typology and a lack of "intermediate" assemblages, and (3) abrupt stratigraphic succession of technocomplexes and a demonstrated spatial-temporal cline in the appearance of Upper Paleolithic industries.

On the other hand, under the continuity model, we would expect to see (1) restrictive and subtle differences in tool manufacturing systems and other expressions of behavior, (2) a continuum of variability from one technocomplex to another and the presence of "intermediate" assemblages, and (3) gradual, protracted stratigraphic succession and a demonstrated temporal, non-spatial cline in the appearance of Upper Paleolithic industries.

## The Magnitude and Scope of Change

This study has shown that the differences between the tool manufacturing systems of the Middle Paleolithic and early Upper Paleolithic are not isolated or subtle, but extensive and significant, occurring over many attributes of primary and secondary reduction technologies and tool assemblages. Most importantly, technocomplex comparisons demonstrate that the very foundation of Paleolithic tool manufacturing systems--blank production--shifted from flake-based to blade-based, as manifested in changes in cores, blanks, and dorsal scar patterns. Additionally, a number of other significant changes in tool manufacturing systems have been documented across the transition. Platform surface faceting decreased, and platform exterior trimming and grinding increased. Bifacial and burin retouch techniques became more prevalent, and discrete tool forms were more frequently shaped secondarily from "true" blanks. Along with these modifications in lithic technologies came the introduction of antler, ivory, and bone working technologies in the early Upper Paleolithic. Thus, by all indications the Siberian Middle to Upper Paleolithic transition involved profound changes in many of the fundamental aspects of tool manufacturing systems.

Differences between Middle and early Upper Paleolithic tool assemblages are also substantial, with a clear shift in type frequency distributions as well as a florescence of several rare types. Tool forms that occur in high frequencies in the Middle Paleolithic decrease significantly in the early Upper Paleolithic. This decline is particularly marked for side scrapers, denticulates, and Levallois points. Additionally, a series of tool types that are rare in the Middle Paleolithic become more common in the early Upper Paleolithic. These include end scrapers, burins, gravers, wedges, pointed blades, bifaces, and retouched blades. Among these "Upper Paleolithic" tool groups, new discrete forms emerge, including carinated, pan-shaped, and nosed end scrapers, angle, dihedral, and transverse burins, and symmetrical and canted gravers.

While many tool classes are common to both technocomplexes, most types reflect divergent technological frameworks. In the early Upper Paleolithic, side scrapers are typically made on blades and flake-blades rather than flakes. Levallois points detached from pyramidal cores, which are common throughout the Middle Paleolithic, are absent in the early Upper Paleolithic, being replaced by long and slender points made on blades or on cut and polished antler. Likewise, although many early Upper Paleolithic denticulates, notches, and knives are made on flakes as they are in the Middle Paleolithic, the proportion made on blades and flake-blades increases substantially. Among "Upper Paleolithic" tool forms that are found in the Mousterian, end scrapers occur most commonly; however, Mousterian end scrapers are typically made on small round flakes, or sometimes on small Levallois flakes. In the early Upper Paleolithic, on the other hand, end scrapers are again typically made on blades.

In sum, the Middle Paleolithic and early Upper Paleolithic of Siberia express comprehensive and qualitative differences in technologies, as well as distinct contrasts in tool assemblages. Clearly, the scope and magnitude of change in tool manufacturing systems support a replacement model of Upper Paleolithic origins.

## The Pattern of Change

The pattern of variation between the Middle Paleolithic and the early Upper Paleolithic is discrete rather than continuous, as illustrated by the multivariate analyses. One of the most telling features of the cluster analysis is the grouping of assemblages into two disparate technocomplexes and the absence of an intermediate group. This contrast is also recognized in the principal components plot (Fig. 8.11) and the discriminant analysis (Fig. 8.13). In the latter, all Middle Paleolithic and early Upper Paleolithic assemblages were discriminated correctly, and again no intermediate group was identified. Thus, according to the multivariate results, the shift from flake-producing to blade-producing technologies in Siberia was abrupt rather than seriate.

In a related vein, no indisputable transitional industries have been identified in Siberia. Although numerous researchers in the past have pointed to several industries in Siberia as being intermediate between the Middle and Upper Paleolithic in technology and typology, all have been demonstrated to be "mixed" assemblages, reworked secondarily either by geologic processes or by archaeologists' error. Ust'-Kanskaia Peshchera, long considered an intermediate industry reflecting a local transition (Rudenko 1960), was excavated with total disregard to geologic stratigraphy and artifact context, leading to the mixing of separate Middle Paleolithic and early Upper Paleolithic assemblages (Anisiutkin and Astakhov 1970; Shun'kov 1990; Tseitlin 1979). More recently, Okladnikov's (1983) excavations at Kara-Bom presented another "intermediate" industry displaying many of the same characteristics of Rudenko's contaminated assemblage from Ust'-Kanskaia. However, Petrin's recent excavations at Kara-Bom have shown that Okladnikov's collections were mixed post-depositionally by springwater activity, and that where undisturbed sediments occur, Upper Paleolithic occupations overlie Middle Paleolithic occupations (Goebel et al. 1993). Finally, the upper Middle Paleolithic levels at the entrance to Denisova Peshchera (levels 8 and 7), as discussed in Chapter 6, could also be considered as intermediate assemblages. However, the microblade core found in level 7 is undoubtedly redeposited and demonstrates that some mixing from an overlying late Upper Paleolithic occupation has occurred, making other "Upper Paleolithic" elements found in these assemblages suspect.

At present, then, there is no good case for a "transitional" industry in Siberia. When recovered from clearly defined stratigraphic situations, tool manufacturing systems are either entirely Middle Paleolithic or entirely early Upper Paleolithic. There is little evidence pointing toward a gradual emergence of the Upper Paleolithic in Siberia. Instead, the abrupt nature of the transition and the absence of an intermediate phase imply a rapid replacement of the Middle Paleolithic by an intrusive early Upper Paleolithic.

## The Tempo of Change

Study of the tempo of the Siberian Middle to Upper Paleolithic transition is hampered by the coarseness of the temporal resolution. Because early Upper Paleolithic occupations lie at or beyond the limit of radiocarbon dating, it is presently difficult to precisely date the transition, or to perceive any spatial-temporal patterns within this event. However, we can roughly group Middle Paleolithic and early Upper Paleolithic assemblages into "early" and "late" occupations, in order to detect whether changes occurred gradually or rapidly.

In the cluster analysis (Fig. 8.12), Middle Paleolithic assemblages form two groups: (1) an Okladnikov group, and (2) a Strashnaia/Kara-Bom (component I) group. These two clusters may reflect temporal, as well as technological patterns. The Okladnikov occupations appear to date to the period from 50,000 to 40,000 B.P., while the Strashnaia and Kara-Bom Mousterian occupations appear to be older, predating 50,000 B.P. (discrete ages of these occupations can not be determined). In the more ancient Middle Paleolithic cluster, elements of Levallois point manufacturing systems are dominant, and blades and flake-blades occur relatively frequently (12.0-12.3%) as the by-products of point production. The younger Okladnikov group, on the other hand, is characterized by primary reduction technologies centered on the detachment of flakes from specially-prepared cores. Tools made on flakes and Levallois endproducts dominate the assemblages, while tools made on blades and flake-blades are rare (2.5% in level 6 to

8.4% in level 3). In the late Mousterian at Peshchera Okladnikov, then, there is no apparent trend toward increased blade production; if there is a trend, it is toward increased flake production. Further, in the Okladnikov cluster, the temporal pattern is distorted with the latest assemblage (level 1) clustering more closely with the cave's earliest assemblages (levels 7 and 6). The principal components plot (Fig. 8.11) further illustrates that the late Mousterian Okladnikov industries are no closer to being "Upper Paleolithic" than are the earlier Strashnaia and Kara-Bom (component I) industries.

Early Upper Paleolithic assemblages do not appear to cluster in a chronological fashion; earlier Upper Paleolithic assemblages are not less Upper Paleolithic than are later assemblages. Although two of the earliest assemblages, Kara-Bom (component II) and Makarovo-4, are grouped separately from the rest of the Upper Paleolithic assemblages, another early assemblage, Varvarina Gora, is most similar to the latest assemblage, Ust'-Karakol. All early Upper Paleolithic assemblages, whether they be early or late, are dominated by parallel core and blade technologies and numerous tools made on blades. Tools made on blades consistently range between 50% and 60% throughout the early Upper Paleolithic period.

The lack of vectored change also holds true when just tool assemblages are considered. Among the latest Middle Paleolithic industries at Peshchera Okladnikov (levels 3, 2, and 1), side scraper frequencies are among the highest documented for the Siberian Mousterian, and Levallois points are present throughout the sequence. On the other hand, in the two earliest Upper Paleolithic assemblages, Kara-Bom component II and Makarovo-4, side scrapers are very rare and, of course, Levallois points are absent. As noted above, side scraper frequencies increase later in the early Upper Paleolithic, but they are usually made on blades or flake-blades. "Early Upper Paleolithic" tools, especially end scrapers, occur sporadically throughout the late Middle Paleolithic assemblages at Peshchera Okladnikov. In level 1, end scrapers make up 12% of the formal tools (excluding retouched flakes and blades); however, burins, gravers, wedges, and bifaces are rare in this and other late Middle Paleolithic industries. Of course, these tool forms occur in relatively high frequencies in the earliest Upper Paleolithic (i.e., Kara-Bom component II [26%], Makarovo-4 [48%], and Varvarina Gora [31%]), as well as in later early Upper Paleolithic assemblages (28%-33%). Thus, besides the presence of end scrapers in the Peshchera Okladnikov level 1 assemblage, there is little evidence of vectored change in tool assemblages through the late Mousterian and early Upper Paleolithic.

Stratigraphic and $^{14}C$ chronologies also support an abrupt Middle to Upper Paleolithic transition. The $^{14}C$ chronology, for what it's worth, suggests that there was no temporal gap between the Middle Paleolithic and the early Upper Paleolithic. Quite possibly, the late Mousterian occupations at Peshchera Okladnikov overlapped chronologically the early Upper Paleolithic occupation at Kara-Bom. This, however, is not supported by the stratigraphic evidence at Kara-Bom, the only site in the region where both technocomplexes are clearly represented in a well-stratified context. Here, early Upper Paleolithic horizons lie stratigraphically above, and are chronometrically younger than, Middle Paleolithic horizons. The absence of Upper Paleolithic horizons sandwiched between Middle Paleolithic horizons, or vice-versa, suggests that these technocomplexes did not overlap in time; however, additional stratigraphic profiles are needed to confirm this observation. The chronometric and stratigraphic abutting of the two technocomplexes at Kara-Bom argues against the possibility of an extended archaeologically unsampled period in which the Middle Paleolithic was evolving locally into the Upper Paleolithic.

Clearly, change in technological systems and tool assemblages was abrupt, supporting a replacement model. Late Mousterian industries can not be described as "evolving" in an early Upper Paleolithic direction, and the earliest Upper Paleolithic industries are not "less" Upper Paleolithic than their later counterparts. In sum, the technological shifts documented for the Middle to Upper Paleolithic transition were not gradual or incremental. Changes occurred swiftly and simultaneously, and by 40,000 B.P. full-blown early Upper Paleolithic technologies existed across south Siberia.

## Conclusions

In Siberia the Middle to Upper Paleolithic transition involved dramatic and multi-faceted changes in tool technologies and forms. The pattern of change is discrete rather than continuous, and no transitional industries have been identified. Chronometric and stratigraphic evidence indicates rapid succession from one technocomplex to the other, and no gradual evolutionary trends in technology and tool assemblages can be demonstrated. Thus, the evidence from the Siberian archaeological record overwhelmingly supports population replacement rather than continuity for the origins of the Upper Paleolithic.

The implications of these findings, of course, are that the Middle to Upper Paleolithic transition in Siberia signals the appearance of modern humans in this region, and the concomitant extinction of Neanderthals. However, testing of the replacement model should continue, as new archaeological discoveries are made, and as analyses of lithic industries, faunal exploitation, and site structure proceed. Continued work is especially needed at Denisova Peshchera and Strashnaia Peshchera; the eventual excavation of these important cave sites will surely increase our understanding of Middle Paleolithic technology and subsistence in Siberia. Also, all Middle and early Upper Paleolithic occupations need to be further evaluated chronologically, especially through the application of thermoluminescence, electron spin resonance, and other non-radiocarbon absolute dating techniques. Without such work, interpretations of the transition will continue to be hampered by problematic stratigraphic correlations and relative chronologies. A firmer chronology will also allow an examination of the transition in light of various environmental and climatic factors. Finally, diagnostic hominid fossils are needed to document whether the dramatic technological changes were indeed accompanied by a replacement of Neanderthal populations by anatomically modern human populations. At present, we can only assume that such was the case.

## THE TRANSITION IN A WIDER CONTEXT

A noticeable shortcoming of past research concerning the mid-Upper Pleistocene "human revolution" has been the overwhelming emphasis on information from Europe and the Near East, thus limiting the scope of our understanding of modern human origins. A major goal of the present study has been to convey archaeological information from a region of Asia unfamiliar to most participants in the human revolution debate. In this section, the new Siberian record is compared to corresponding records from surrounding regions of Asia, especially Yakutia, the Russian Far East, and China to the east, Mongolia to the south, and central and southwest Asia to the west. By integrating the Siberian Paleolithic record into a wider Eurasian context, a more comprehensive model of modern human origins and the Middle to Upper Paleolithic transition can be developed.

### Yakutia and the Russian Far East

In Yakutia, Lower and Middle Paleolithic industries are equivocal (i.e., Diring Iuriakh [Mochanov 1988]), and early Upper Paleolithic industries are controversial.

These are the "proto-Diuktai" sites, Ust'-Mil'-II, Ikhine-II, and Ezhantsy (Fig. 8.15), considered by Mochanov (1977) to date to as early as 35,000 B.P. Stratigraphic profiles are complex (Tseitlin 1979; Yi and Clark 1985), with artifacts occurring in alluvial contexts at Ust'-Mil' and Ikhine-II (Mochanov 1977:36,44), and in association with immense ice wedge pseudomorphs at Ezhantsy (Mochanov 1977:51). A suite of radiocarbon dates from Ust'-Mil'-II and Ikhine-II suggest ages of between 35,000 and 25,000 B.P., but the majority of these were run on wood samples, which likely became associated with lithic artifacts secondarily through alluvial or colluvial processes (Hopkins et al. 1982:438; Yi and Clark 1985:10). Ezhantsy, furthermore, has not been radiocarbon dated; its early age assignment (35,000-30,000 B.P.) is based on tenuous stratigraphic correlations with Ust'-Mil'-II (Mochanov 1977:50-51). Many of the artifacts at Ezhantsy occur within cryogenic cracks and wedges; their "early" stratigraphic context is probably a result of artifact-bearing younger sediment slumping into open wedges late in the Pleistocene.

While undated, Ezhantsy displays obvious Diuktai affinities. Wedge-shaped cores, microblades, transverse burins, and other Diuktai features are common in this industry, but rare or absent in the other industries absolutely dated to the early Upper Paleolithic period, 35,000-25,000 B.P. Connections between the Diuktai culture and the remaining "proto-Diuktai" sites, Ikhine-II and Ust'-Mil'-II, are not so clear. The lowest levels at Ikhine-II, levels IIv and IIg, considered by Mochanov (1977:48) to date to 26,000 and 35,000 B.P. respectively, contain a total of just four lithic pieces—one small flake, two split or initially flaked cobbles, and one large side scraper (which appears rolled and polished by water transport). None of these are reminiscent of later Diuktai industries; they could be virtually any age. At Ust'-Mil'-II, only 12 artifacts are associated with the 35,000 B.P. wood chunks. As at Ikhine-II, most of these are undiagnostic, and illustrations of a wedge-shaped core and burin are unconvincing (Mochanov 1977:37). In sum, recognition of the "proto-Diuktai" complex is hindered by the lack of clear geologic contexts, reliable radiocarbon dates, and diagnostic artifacts. At present these sites can not be considered as unequivocal evidence of an early Upper Paleolithic occupation of Yakutia.

In the Russian Far East, sites assigned to the Lower or Middle Paleolithic are problematic. Filimoshki and Ust'-Tu, long thought to represent a "pre-Mousterian" occupation of the Amur River basin (Derevianko 1983), may not be sites at all, but simply concentrations of naturally fractured cobbles (Dibble and Montet-White 1988:301).

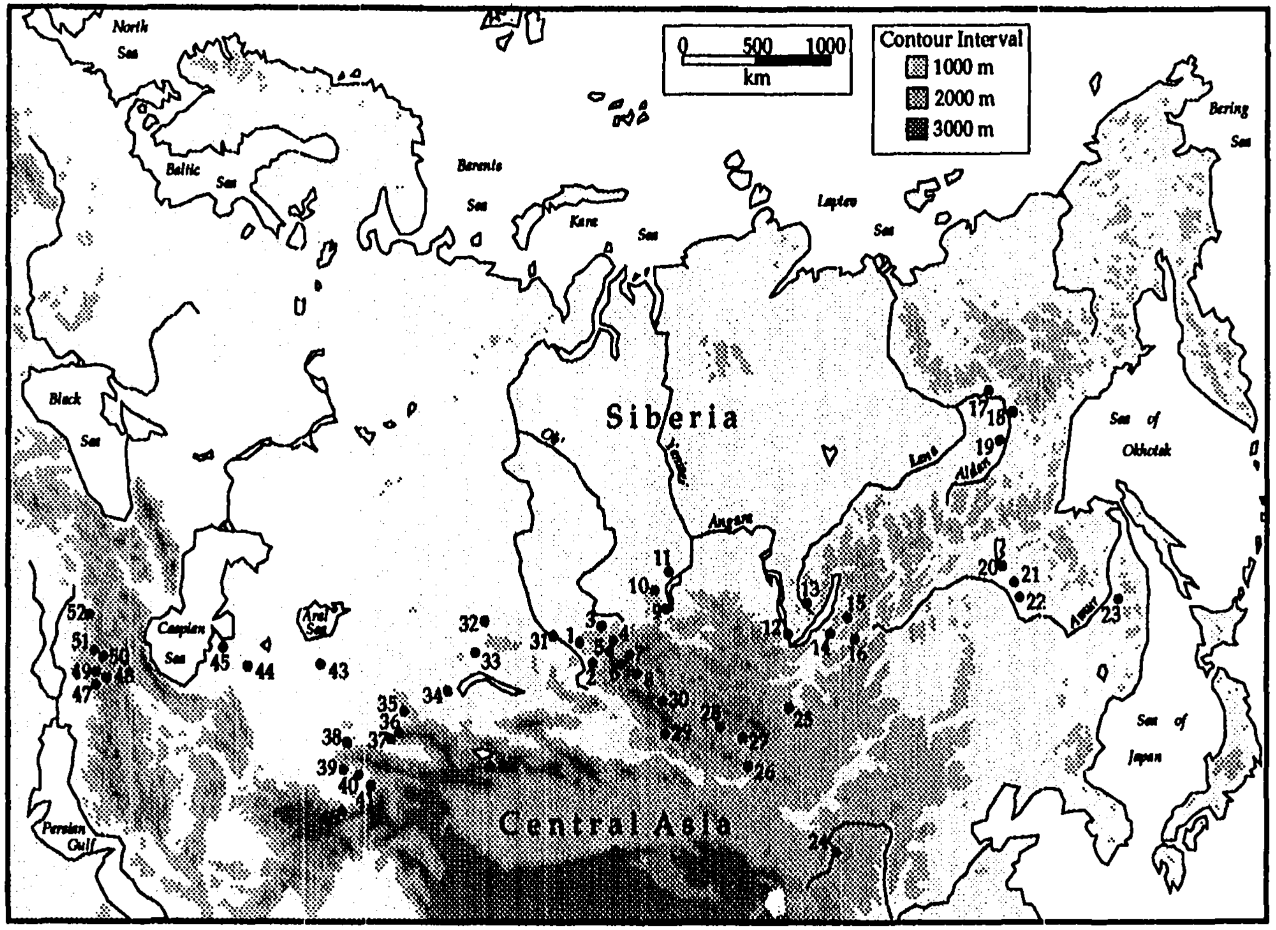


Fig. 8.15. Map of inner and north Asia, showing locations of Paleolithic sites mentioned in text: (1) Strashnaia Peshchera; (2) Ust'-Kanskaia Peshchera; (3) Peshchera Okladnikov; (4) Denisova Peshchera; (5) Ust'-Karakol; (6) Kara-Bom; (7) Tiumechin; (8) Maloialomanskaia Peshchera; (9) Dvuglazka Grot; (10) Malaia Syia; (11) Kurtak-Chanin-2; (12) Arembovskii; (13) Makarovo-4; (14) Varvarina Gora; (15) Sannyi Mys; (16) Tolbaga; (17) Ikhine-II; (18) Ezhantsy; (19) Ust'-Mil'-II; (20) Filimoshki; (21) Ust'-Tu; (22) Gromatukha; (23) Almazinka; (24) Shuidonggou; (25) Orkhon; (26) Orok-Nur; (27) Nariin-Gol; (28) Baidarik; (29) Barlagin-Gol; (30) Olon-Nur; (31) Shul'binka; (32) Batpak; (33) Perederzhka; (34) Khantau; (35) Valikhanova; (36) Obi-Rakhmat; (37) Kul'bulak; (38) Kuturbulak; (39) Teshik-Tash; (40) Kara-Bura; (41) Ogzi-Kichik; (42) Tossor; (43) Kyzylnura; (44) Begarslandag; (45) Kaskyr-Bulak; (46) Kara-Kamar; (47) Gar Arjenah; (48) Pa Sangar; (49) Yafteh; (50) Ghar-i-Khar; (51)Warwasi; (52) Shanidar.

Putative Mousterian finds are troublesome as well. At two localities in the middle Amur basin, Gromatukha and Borodin Lake, isolated Levallois cores were picked up from the surface (Derevianko 1983; Powers 1973:18). Both cores are undated and may not be Middle Paleolithic in age, since "epi-levallois" cores are common in late Upper Paleolithic and Mesolithic contexts throughout this region (Powers 1973; Vasil'evskii and Gladyshev 1989).

Early Upper Paleolithic industries are equally uncommon in the Russian Far East. Few have been absolutely dated, since stratigraphic profiles are typically thin, and datable materials are rare or absent. The small sample of lithic artifacts and faunal remains from Geographical Society Cave (Powers 1973:25-27), located in southern Primor'e, has been recently radiocarbon dated to 32,570 ± 1510 (IGAN-341) B.P. (Kuzmin 1989:16). However, only undiagnostic material is represented in the lithic assemblage (Powers 1973:26-27), precluding comparisons with the early Upper Paleolithic of Siberia. Other buried Upper Paleolithic sites in the region, including the Osinovka, Ustinovka, and Suvorovo sites, are now considered to date to the latest Pleistocene, 20,000-10,000 B.P., based on typological comparisons with materials from North China and Japan (Lynsha 1992; Vasil'evskii and Gladyshev 1989:102-105).

Perhaps an early Upper Paleolithic occupation is present at Almazinka, a site located along the Arma River in northern Primor'e (Lynsha 1992). Almazinka was discovered in 1990. Initial test excavations have produced an assemblage of around 200 artifacts, including a subprismatic core fragment and a tool assemblage consisting of retouched blades, side scrapers on flakes, end scrapers on blades, an angle burin, and a point on a blade (Fig. 8.16). Gobi and wedge-shaped microblade cores are absent, and although the sample is small, Lynsha (1992) lists the Siberian early Upper Paleolithic as Almazinka's closest analog. Unlike other Paleolithic sites in the Primor'e, Almazinka is stratified, and charcoal collected from paleosols sealing the cultural level will surely aid in the future dating of the site. If Almazinka does turn out to pre-date 30,000 B.P., as Lynsha (1992) has surmised, then it will provide the first link between the early Upper Paleolithic complexes of the Transbaikal and the Russian Far East.

## North China

Mousterian industries have not been reported from China, and blade technologies are not regular occurrences there until after 20,000 B.P. (Aigner 1981; Chen and Olsen

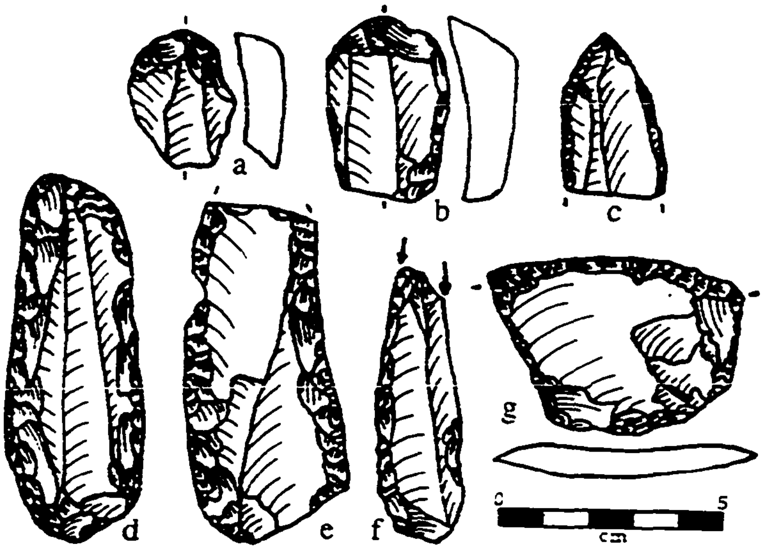


**Fig. 8.16.** Lithic artifacts from Almazinka, northern Primor'e: (a, b) end scrapers; (c) retouched point on blade; (d-e) retouched blades; (f) double angle burin; (g) angle scraper (after Lynsha 1992).

1990; Jia and Huang 1985; Qiu 1985). Instead, Chinese Paleolithic industries throughout the early and mid-Upper Pleistocene are commonly described as technologically flake-based and typologically "unformalized" (Movius 1949; Pope 1988). Levallois technologies are absent; simple flakes were detached from minimally-prepared cores. Tools are often irregularly retouched and do not conform to standardized morphological typologies. Hutterer (1985) and Pope (1988, 1989) contend that the unformalized nature of the East Asian Paleolithic is an indication that tool technologies focused on nonlithic materials like bamboo and other highly versatile and easily workable organic materials. As a result, patterned technological changes in the Chinese Paleolithic record are difficult to trace, and conventional terms like "Middle Paleolithic" and "Upper Paleolithic" are meaningless (Aigner 1981:276-277). Clearly, the Chinese Upper Pleistocene archaeological record preceding the last glacial maximum is remarkably unlike the Siberian record.

At least one mid-Upper Pleistocene site in North China, however, does not follow this model for the Chinese Paleolithic. This is Shuidonggou, located 30 km southeast of the town of Yinchuan, Ningxia Hui Autonomous Region. Shuidonggou was originally investigated in 1923 by French archaeologists (Boule et al. 1928), and later by Jia et al. (1964, cited in Aigner 1981:254). The latter researchers excavated a 6 $m^2$ test and recovered a small assemblage of lithic artifacts *in situ*. This collection includes a bidirectional subprismatic blade core, several retouched blades, retouched points on blades, side scrapers, end scrapers, a few cobble tools, and an ostrich eggshell pendant (Aigner 1981:257; Chen and Olsen 1990:290; Olsen 1988:136). Although Aigner (1981:254) states that the 'blades' are not really blades, but merely the "more symmetrical flakes" sorted from the rest of the collection, the illustrated artifacts (Compiling Group of the Atlas 1980:132-134) are clearly retouched blades, and the core is clearly a subprismatic blade core.

Uranium-series dating of horse teeth recovered from Shuidonggou suggests an age of 40,000-35,000 B.P. for this unique North Chinese blade industry (Chen and Yuan 1988:76). The similarities in age and character between the Shuidonggou and Siberian early Upper Paleolithic industries are intriguing, especially since the site has no known analog in China (Olsen 1988:136) and is situated near the edge of the Inner Mongolian Plateau, which, during most of the Upper Pleistocene, was part of an extensive inner Asian steppe zone stretching northward to Lake Baikal in Siberia (Fig. 2.12) (Bazarov 1986). Perhaps future work in Inner Mongolia will reveal additional Shuidonggou-like industries, confirming an early Upper Paleolithic relationship with Siberia.

## Mongolia

In western and central Mongolia over 50 Middle Paleolithic sites are known (Derev'anko 1990). Most were discovered between 1983 and 1988 through a series of reconnaissance surveys led by Derevianko, Dorzh, and Petrin (Derevianko and Petrin 1990a, 1990b; Derevianko et al. 1987a-j, 1989, 1990a; Zenin and Dorzh 1990). Few sites, however, have been found in buried contexts, and fewer still have been excavated or absolutely dated. The eastern Mongolian Gobi Desert, stretching from the southern Transbaikal south to Inner Mongolia, has yet to be surveyed for Paleolithic remains.

In the Mongolian Altai of western Mongolia, Middle Paleolithic sites are chiefly open and surficial (Derevianko et al. 1990a). They are undatable, and assignments to the Middle Paleolithic are typological. Many collections contain Levallois and Mousterian elements, but are often mixed with Gobi microblade cores and microlithic tools characteristic of the Asian late Upper Paleolithic through Neolithic periods. Several localities are worthy of note, however. At Olon-Nur-1 and Olon-Nur-2, located in northwest Mongolia about 50 km east of the town of Baian Ul'gi, surface collections recovered numerous Levallois cores, side scrapers, and denticulates (Derevianko et al. 1990a:230-256). At Barlagin-Gol-1, located in the southern Kobdo region, southwest

Mongolia, nearly 150 wind-polished lithic artifacts were collected (Derevianko et al. 1990a:427-433). Among them are a number of Levallois flake and point cores, as well as numerous Levallois flakes, points, and side scrapers. These sites are among those assigned by Derevianko et al. (1990a) to the Levalloiso-Mousterian complex of Mongolia.

Middle Paleolithic occupations are also known from southcentral Mongolia, at the sites of Orok-Nur-1, Orok-Nur-2, Nariin-Gol, and Baidarik-8 (Derevianko and Petrin 1990b; Derevianko et al. 1987d, 1987e, 1987i; Zenin and Dorzh 1990). Again, however, these are surface scatters of artifacts, which can not be absolutely dated. Lithic industries are Levallois and Mousterian in character. Levallois flake and point cores are common,

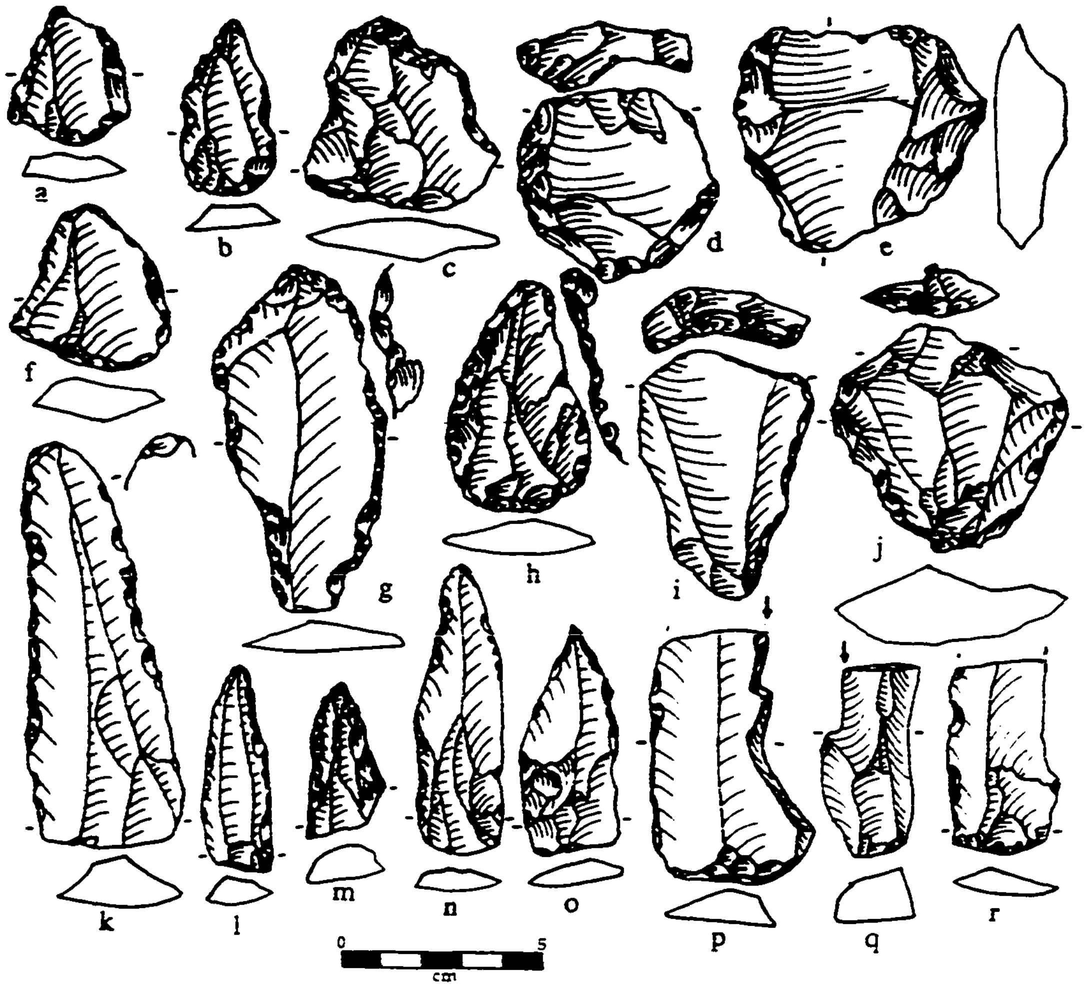


**Fig. 8.17.** Lithic artifacts from Orok-Nur-1 (a-g) and Orok-Nur-2 (h-r): Levallois points (a-b, f); denticulates (c, g); Levallois flake cores (d-e); side scraper (h); Levallois point cores (i-j); points on blades (k-n); graver (o); angle burins (p-q); retouched blade (r) (after Derevianko and Petrin 1990b).

as are their removals (Fig. 8.17). Tool assemblages from these sites (especially Orok-Nur-2) are characterized by numerous side scrapers, Levallois points, marginally retouched blades, flake-blades, and flakes, as well as end scrapers, gravers, burins, and wedges (Fig. 8.17). The "Upper Paleolithic" component of the Orok-Nur-2 industry is reminiscent of the Siberian early Upper Paleolithic, suggesting to Derevianko and Petrin (1990b:38) a late Mousterian (<38,000 B.P.) age for this southcentral Mongolian complex. However, it is just as likely that this surface collection and many others like it (i.e., Baidarik-8) may represent multiple Paleolithic occupations spanning the mid-Upper Pleistocene (Zenin and Dorzh 1990:48). Surface collections of "mixed" appearance should not be viewed as evidence for a local "evolved" Mousterian or "transitional" industry, as Derevianko and Petrin (1990b) are inclined to believe.

Along the upper Orkhon River valley, near the geographic center of Mongolia, are two buried, stratified sites that contain Middle Paleolithic occupations, Orkhon-1 and Orkhon-7. These sites were excavated in the late 1980s by Petrin, but only Orkhon-1 has been described (Derev'anko 1990; Derevianko and Petrin 1990a). Two stratigraphically separate cultural components have been identifed; the lower component is assigned to the Middle Paleolithic, and the upper to the early Upper Paleolithic. Although neither component has been directly radiocarbon dated, bone from sediments immediately overlying the lower component yielded a date of 38,500 ± 600 B.P. (RIDDL-716), while bone from sediments immediately underlying the upper component was dated to 34,200 ± 600 B.P. (RIDDL-717).[2]

The lower, Middle Paleolithic occupation at Orkhon-1 appears Mousterian in character. Numerous Levallois cores and Levallois endproducts, some with faceted platforms, dominate the assemblage (Fig. 8.18). Side scrapers, denticulates, notches, knives, Levallois points, and irregularly retouched flake-blades make up the tool assemblage. The flake-blades are wide and short, and appear to be by-products of point production.

The upper component at Orkhon-1 has been ascribed to the early Upper Paleolithic (Derevianko and Petrin 1990a:173), based on the absence of Levallois elements and the presence of flat-faced and subprismatic blade cores and numerous tools made on blades (Fig. 8.18). The tool assemblage consists of side scrapers, end scrapers, retouched

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[2]These dates were originally reported by Derevianko and Petrin (1990a:169) incorrectly as 38,600 ± 800 and 34,400 ± 600, respectively (Cinq-Mars, personal comm.).

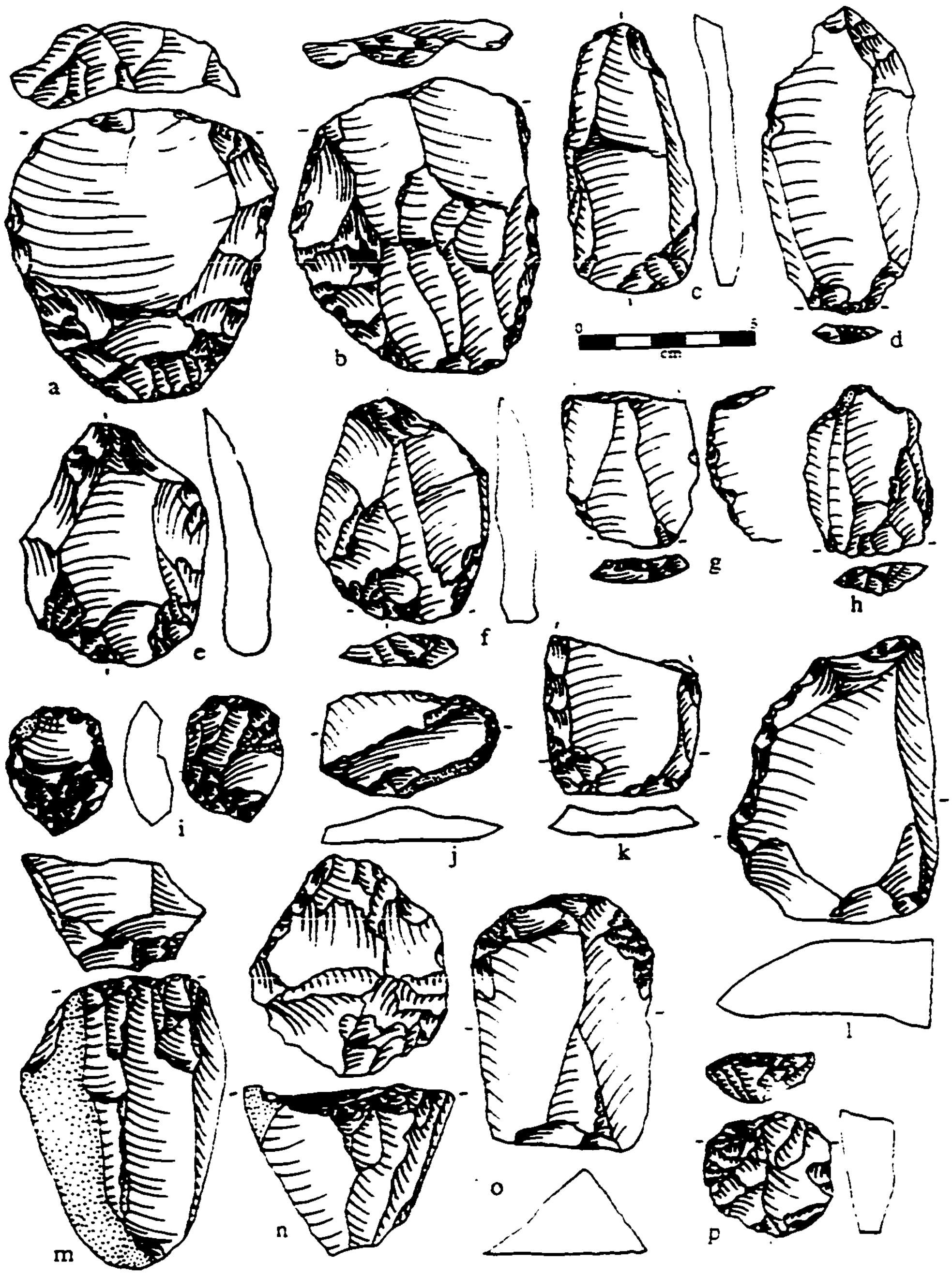


**Fig. 8.18.** Lithic artifacts from Orkhon-1, lower cultural level (a-h) and upper cultural level (i-p): Levallois cores (a-b); retouched flake-blades and fragments (c-d, g-h); retouched Levallois flakes (e-f); wedge (i); end scrapers (j, o-p); retouched blade fragment (k); knive (l); sub-prismatic blade cores (m-n).

blades, notches on blades, denticulates, and wedges (Fig. 8.18). Overall, the industry is reminiscent of Siberian early Upper Paleolithic assemblages in the Transbaikal, which are also located in the Orkhon/Selenga River basin, although about 750 km to the northeast.

The evidence from Orkhon-1 is significant in that it represents the only site in Mongolia where Mousterian *and* early Upper Paleolithic occupations occur in a stratified context. Like at Kara-Bom in the Siberian Altai, the record from Orkhon-1 indicates an abrupt appearance of early Upper Paleolithic technologies during the mid-Upper Pleistocene, as early as 38,000 B.P.

## Central Asia

Here central Asia is defined as the region comprising Afghanistan and former Soviet central Asia, including the republics of Kazkhstan, Kirgizistan, Tadzhikistan, Uzbekistan, and Turkmenistan. As in Mongolia, Middle Paleolithic sites in these countries are widespread but undated. According to Abramova (1984:140) and Gábori (1988:287), more than 80 Middle Paleolithic sites are known from central Asia, the majority in Tadzhikistan and Uzbekistan. Early Upper Paleolithic occupations, on the other hand, are less common; they occur only at a handful of sites in Kazakhstan, Uzbekistan, and Afghanistan.

The Middle Paleolithic of central Asia is documented by dozens of undated surface sites (Ranov and Nesmeianov 1973), and, less commonly, by buried and stratified occupations in caves (Teshik-Tash, Aman-Kutan, Ogzi-Kichik, Khodzhakent [Uzbekistan]) and open sites (Batpak, Valikhanova, Perederzkha, Kozhkurgan, Khantau [Kazakhstan]; Tossor [Kirgizistan]; Kara-Bura [Tadzhikistan]; Kul'bulak, Kuturbulak, Kyzyl-Nura-1 [Uzbekistan]; Begarslandag, Kazkyr-Bulak [Turkmenistan]) (Fig. 8.20). Many of these sites are redeposited (e.g., Ogzi-Kichik and Kara-Bura), and none has been successfully absolutely dated (Abramova 1984; Ranov and Nesmeianov 1973).

As a whole, central Asian Middle Paleolithic industries are Mousterian in character but quite variable. As many as seven different industrial facies have been identified (Kulakovskaia 1990; Ranov and Nesmeianov 1973; Tashkenbaev and Suleimanov 1980). Most industries, however, are characterized by Levallois technologies directed at the production of flakes and, less commonly, points, and tool assemblages containing varying frequencies of side scrapers, denticulates, notches, knives, Levallois points, and retouched

Levallois flakes and flake-blades. Some industries also contain a number of cobble tools (i.e., choppers and chopping tools), while others are said to be rich in Upper Paleolithic elements (end scrapers, burins, gravers, retouched blades) (Abramova 1984; Amosova 1990; Artiukhova 1990; Kulakovskaia 1990; Ranov and Nesmeianov 1973; Taimagambetov 1990a, 1990b, 1992; Voloshin 1992). This variability is not well-understood, especially since so few of the region's Mousterian sites are dated (Abramova 1984:141; Davis 1987:122). Nonetheless, Kulakovskaia (1990:213) delineates three technological peculiarities of the central Asian Mousterian: (1) specialized Levallois point industries are rare; (2) bifacial secondary reduction technologies are absent; and (3) micro-industries like those in the Zagros Mountains of western Iran are absent.

Hominid fossils from the central Asian Middle Paleolithic are rare. Neanderthal remains have been found in Mousterian contexts at Teshik-Tash, Uzbekistan (Okladnikov 1949), and possibly at Darra-I-Kur, Afghanistan (Angel 1972). The Neanderthal from Teshik-Tash is considered to date to the late Middle Paleolithic (Ranov and Nesmeianov 1973:67), possibly coeval with Neanderthal teeth from Peshchera Okladnikov in the Siberia Altai.

The early Upper Paleolithic of central Asia is known from only four sites: Shul'binka and Valikhanova (Kazakhstan), Obi-Rakhmat (Uzbekistan), and Kara-Kamar (Afghanistan). Other Upper Paleolithic localities are known, but these appear to date to the late Upper Paleolithic (i.e., <20,000 B.P.) (Davis 1990).

Shul'binka is an open and stratified site situated near the confluence of the Irtysh and Shul'binka rivers, eastern Kazakhstan. It was discovered and excavated in the early 1980s by Taimagambetov (1983). Lithic artifacts were found at the base of a 1-m thick loess section; they include unidirectional and bidirectional flat-faced blade cores, retouched blades, end scrapers, side scrapers, knives, gravers, and several bifaces. Taimagambetov (1983:163-165) compares this industry to the east Siberian Tolbaga and Varvarina Gora sites, and typologically assigns a date of 30,000 B.P.

Valikhanova is located in central Kazakhstan. It contains a series of five stratigraphically separate Paleolithic occupations that, although undated, appear to span the Upper Pleistocene (Taimagambetov 1990a, 1990b). Large-scale excavations conducted during the 1980s identified three Mousterian occupations overlain by two Upper Paleolithic occupations. Preliminary reports indicate that Upper Paleolithic assemblages are characterized by subprismatic and prismatic blade cores, retouched blades, end scrapers, and "typical Mousterian tools" (Taimagambetov 1990a:282). To Taimagambetov

(1990a:282), this implies "gradual evolution" from the local Mousterian into the early Upper Paleolithic. More detailed reports and absolute dates, however, are needed to evaluate this interpretation.

Obi-Rakhmat is a cave site located 100 km northeast of Tashkent, Uzbekistan. Its stratigraphic profile reaches 10 m thick and is divided into 21 geologic levels, all of which contain Paleolithic articles (Suleimanov 1972). The record at Obi-Rakhmat has been described as representing a gradual change from Mousterian to early Upper technologies (Davis 1987:125); however, there is little in the published reports or the cave's record to support a Mousterian occupation. Throughout the entire sequence, from bottom to top, Levallois elements are rare or absent (Suleimanov 1972). Abramova (1984:142) points out that subprismatic (or flat-faced) blade cores are ubiquitous in all levels, and Suleimanov (1972:134) provides evidence that all tool assemblages are dominated by Upper Paleolithic tool types. Among the assemblages at Obi-Rakhmat are uni/bidirectional flat-faced blade cores, marginally retouched blades, angle and dihedral burins, denticulates, notches, gravers, end scrapers, and side scrapers, all commonly made on blades (Fig. 8.19). If there was a gradual Middle to Upper Paleolithic transition in central Asia, it occurred prior to the initial occupation at Obi-Rakhmat. In fact, the early Upper Paleolithic industries from Obi-Rakhmat are very similar to those in south Siberia. Absolute dates are needed, however, to confirm this relationship and to determine whether the emergence of the early Upper Paleolithic in Uzbekistan was coeval with this event in Siberia.

In Afgahnistan, there is one site assignable to the early Upper Paleolithic. This is Kara-Kamar, a rockshelter originally excavated by Coon in the early 1950s (Coon 1957). Coon's excavations revealed at least two early Upper Paleolithic levels which yielded infinite radiocarbon dates (Coon and Ralph 1955). Although published descriptions of these industries are cursory, in 1992 the author conducted an analysis of the Kara-Kamar collections currently curated at the University Museum, University of Pennsylvania. Among the artifacts from the lower cultural occupation, level IV, are end scrapers, a unifacially retouched point on a blade, and a wedge (Fig. 8.20). Overlying this in level III were found several prismatic blade cores, a Gobi microblade core, and a tool assemblage consisting of long slender retouched blades, burins, end scrapers, denticulates, side scrapers, and a point on a blade (Fig. 8.20). Overall, the assemblages from Kara-Kamar, although small, display affinities with the industries from Obi-Rakhmat, 700 km to the north. Together the assemblages from these two cave sites, along with those from

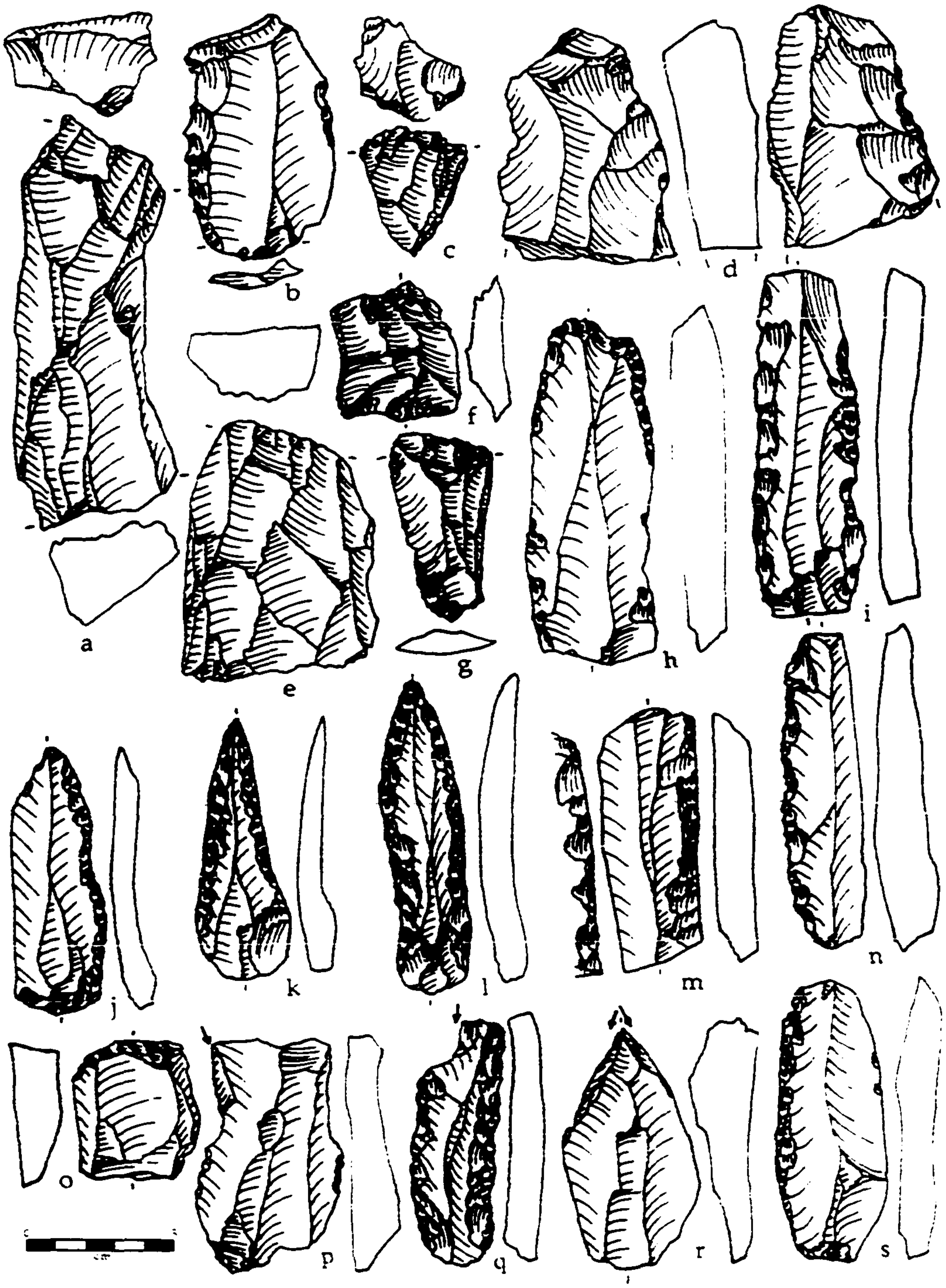


**Fig. 8.19.** Lithic artifacts from Obi-Rakhmat: bidirectional subprismatic blade cores (a, e); denticulate (b); unidirectional prismatic blade core (c); possible biface) (d); wedges (f-g); end scrapers (h, o); retouched blades (i, m, n, s); retouched points on blades (j-l); angle burins (p-q); dihedral burin (r) (after Suleimanov 1972).

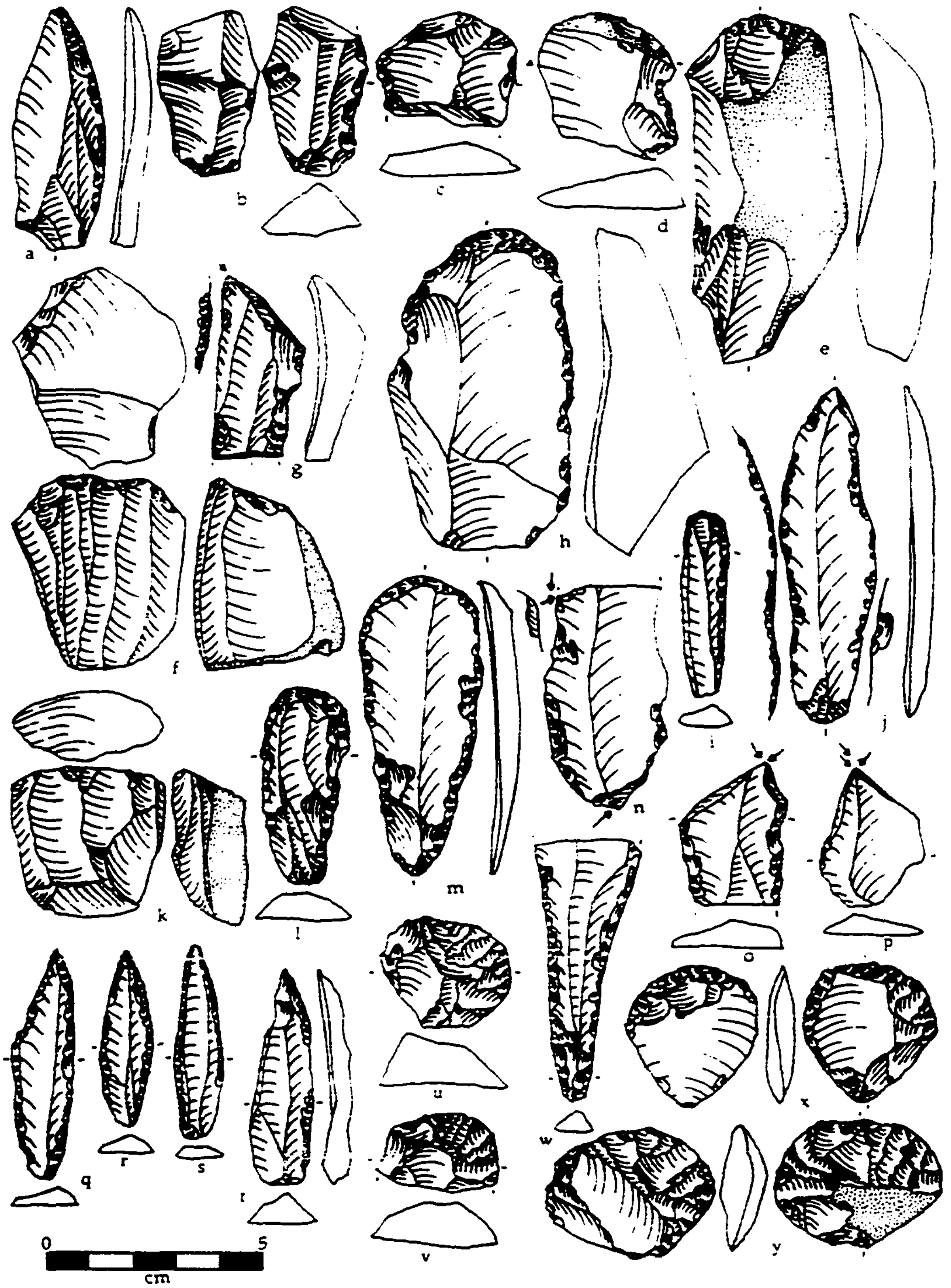


**Fig. 8.20.** Lithic artifacts from Kara-Kamar level IV (a-d), Kara-Kamar level III (e-h, j), and Yafteh Cave Lower Baradostian (i, k-y): retouched point on blade (a); wedge (b); end scrapers (c-e, h-i, l-m, u-v, x-y); subprismatic blade cores (f, k); burins (g, n, o-p); retouched blades (j, w); Arjeneh points (q-s).

Shul'binka and Valikhanova in Kazakhstan, appear to represent an emerging early Upper Paleolithic complex in central Asia that is technologically and typologically comparable to the early Upper Paleolithic of Siberia. Additional absolute dates from the central Asian sites, however, are needed to confirm this observation.

## Southwest Asia

Mousterian industries in southwest Asia occur in two principle areas, the Levant (Israel, Lebanon, and surrounding regions) and the Zagros Mountains (Iran and Iraq). The age of the Levantine Mousterian spans from 200,000 to 45,000 B.P. (Bar-Yosef 1993); elsewhere in southwest Asia Middle Paleolithic absolute chronologies are not well-established (Smith 1986:20). In the Levant and the Negev Desert, Mousterian industries are based on Levallois technologies and are often called Levalloiso-Mousterian. Tool assemblages are rich in points and side scrapers, and often include retouched blades and "Upper Paleolithic" tool types (i.e., end scrapers, burins) (Marks 1992:135). In the Zagros, Levallois flake technologies occur far less frequently than in the Levant, perhaps due to raw material constraints (Hole and Flannery 1967:155-156; Smith 1986:21), although several Mousterian industries do not fit this pattern (Dibble 1984). Like in the Levant, however, the Zagros Mousterian is characterized by side scrapers and Levallois points (Hole and Flannery 1967:152).

The earliest Upper Paleolithic occupations in the Levant occur at three sites, Boker Tachtit, Ksar-Akil, and Kebara Cave (Bar-Yosef et al. 1992; Marks 1983, 1988, 1990). At Boker Tachtit, located in the central Negev Desert, southern Israel, there is evidence for a local transition from Levallois-based to blade-based tool manufacturing systems, which appears to have occurred between 47,000 and 38,000 B.P. concurrent with deteriorating climatic conditions and an increase in residential mobility (Marks 1983:68). Bar-Yosef (1993:141) has argued, however, that the absence of a typical Levantine Mousterian industry at the base of the Boker Tachtit sequence muddles Marks' interpretation of a transitional sequence. Blade cores and crested blades (*lames à crête*) occur in all levels at Boker Tachtit, and Upper Paleolithic tool forms, especially burins and end scrapers, occur in relatively high frequencies throughout the sequence (Marks and Kaufman 1983). Possibly, Boker Tachtit represents a series of industries illustrating rapid acculturation similar to that of the Châtelperronian in France (Bar-Yosef 1993:141). Nonetheless, the record from Boker Tachtit demonstrates that the Middle to Upper Paleolithic transition in the southern Levant occurred earlier than 45,000 B.P.

Transitional industries also occur at Ksar Akil (levels 23-21) (Ohnuma and Bergman 1990). These appear similar in age and technology to the basal levels at Boker Tachtit (Marks 1990:70; Ohnuma and Bergman 1990:133-134), and are characterized by Levallois point cores as well as flat-faced and subprismatic blade cores, and tool assemblages consisting of retouched points on blades, end scrapers, angle burins, and chamfered blades (i.e., transverse burins) (Ohnuma and Bergman 1990:109-110). Although not absolutely dated, the transition at Ksar Akil is considered to date to between 52,000 an 50,000 B.P., based on radiocarbon dates from other levels and an inferred sediment accumulation rate (Mellars and Tixier 1989).

At Kebara Cave, Mt. Carmel, Mousterian occupations are late in age, roughly 64,000-48,000 B.P. (according to ESR and TL dating techniques) (Bar-Yosef et al. 1992:532-533), and are overlain by a series of four early Upper Paleolithic levels, units IV-I. The basal Upper Paleolithic levels (units IV and III) have been radiocarbon dated to 42,500 ± 1800 (Bar-Yosef et al. 1992:506; Hedges et al. 1990:103), and are characterized by lithic assemblages with numerous pointed blades, retouched blades, and end scrapers (Bar-Yosef et al. 1992:517).

The evidence from Kebara Cave, Ksar-Akil, and Boker-Tachtit indicates that the Middle to Upper Paleolithic transition in the Levant occurred well before 40,000 B.P. The early Upper Paleolithic industries from these sites appear to predate the Aurignacian in Europe by at least 5,000 years, and are peculiarly non-Aurignacian in technology and typology.

Further east in the Zagros highlands of Iraq and Iran, the early Upper Paleolithic is typified by the Baradostian technocomplex. Baradostian occupations occur at several caves and rockshelters in the region, most notably Shanidar Cave (Solecki 1971:256), Yafteh Cave, Pa Sangar, and Ghar-i-Khar (Hole and Flannery 1967:156-158; Smith 1986; Young and Smith 1966). Lithic industries are characterized by small subprismatic and flat-faced blade cores, retouched blades, burins, end scrapers (some worked bifacially), side scrapers, and small retouched points on blades, called Arjeneh points (Fig 8.20) (Hole and Flannery 1967; Smith 1986). Bone points and awls also occur, while Levallois elements are absent (Smith 1986:26-27). Radiocarbon dates on early Baradostian occupations at Yafteh Cave are as early as >40,000 B.P. (SI-335) (Hole and Flannery 1967:153), and, according to Smith (1986:26), the Baradostian may be "one of the earliest Upper Paleolithic manifestations anywhere." At present, there are no transitional industries known from the Zagros, and there is no evidence that the Baradostian evolved directly from the local Mousterian (Hole and Flannery 1967:154; Smith 1986:25). The Baradostian instead appears more similar to earliest Upper Paleolithic materials at Kebara Cave in the Levant and Kara-Kamar in Afghanistan.

## CONCLUSIONS

The mid-Upper Pleistocene archaeological record of Siberia documents a radical shift in human behavior that occurred around 45,000-40,000 B.P. The evidence documenting this transition is summarized below.

Middle Paleolithic industries in southwest Siberia are distinctly Levallois and Mousterian. Mousterian lithic reduction technologies are relatively homogeneous, but vary according to Levallois point-producing and flake-producing strategies, and relative frequencies of side scrapers, Levallois points, denticulates, and marginally retouched pieces. The transition to Upper Paleolithic technologies is marked by a dramatic increase in the production of blades and the concomitant disappearance of Levallois flake and point technologies. Bifacial and burin retouching techniques are added to the tool manufacturing system, and a series of tool forms appear in greater frequencies, including retouched pointed blades, end scrapers, burins, wedges, gravers, and bifaces. In addition, antler points and bone awls and needles appear in Siberia for the first time, as do items of personal adornment, and, possibly, mobiliary art. Technologically and typologically, then, differences between the Middle and early Upper Paleolithic are sweeping and significant. Further, the transition was clearly abrupt, not gradual, and "transitional" industries in reliable contexts are absent. While associated hominid fossils are lacking, this dramatic and abrupt behavioral transformation is more consistent with the spread-and-replacement model of modern human origins than it is with the regional continuity model.

Dating the transition is still unsettled. Mousterian site chronologies are not well-established; however, some occupations may date to as early as the Last Interglacial and Early Glacial (128,000-75,000 B.P.) (e.g., Denisova Peshchera levels 10 and 9), while others may date to as late as the mid-Middle Pleniglacial (50,000-40,000 B.P.) (Peshchera Okladnikov, levels 7-1). Early Upper Paleolithic industries emerged in Siberia as early

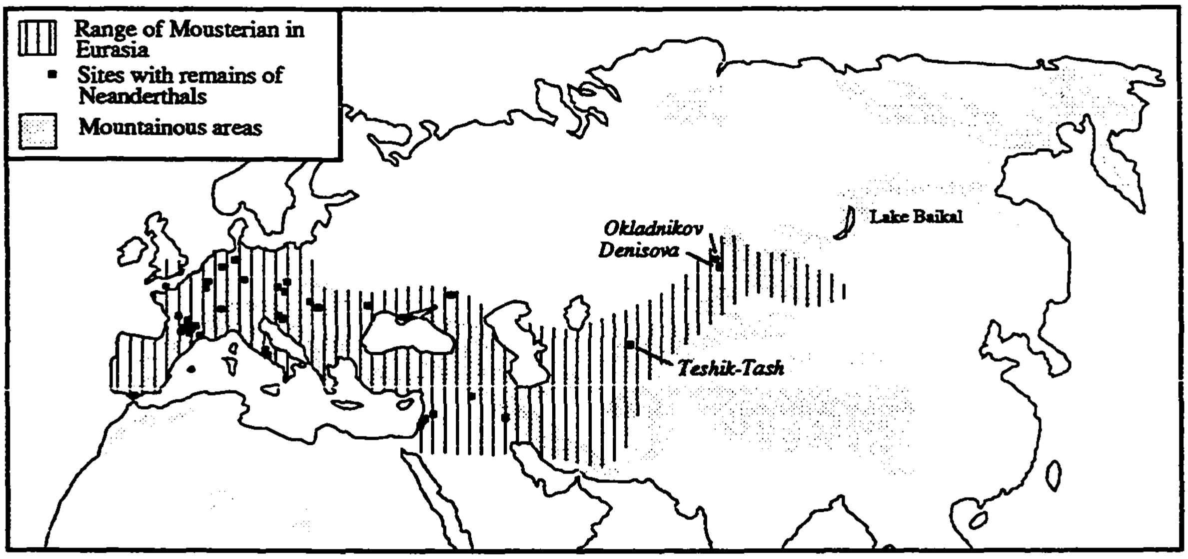


**Fig. 8.21.** Geographical distribution of Mousterian technocomplex in Eurasia, compared with locations of sites yielding Neanderthal fossil remains (after Gowlett [1984], Klein [1989], and others).

as 43,000 B.P., and perhaps earlier. They remained relatively unchanged until after 30,000 B.P.

Fossil hominid remains found in Mousterian contexts in the Siberian Altai are Neanderthal in morphology. Diagnostic hominid fossils, however, have not been found in association with the Siberian early Upper Paleolithic.

Mousterian industries occur throughout the Siberian Altai and upper Yenisei regions, but have not been documented further east in the Angara, Lena, and Selenga basins of southeast Siberia, nor in Yakutia or the Russian Far East. The Mousterian has also been identified repeatedly in western and central Mongolia, but no further east than the upper Orkhon River valley. Thus, the geographic limit of the Mousterian technocomplex, as well as Neanderthal populations can be drawn nearly 2,000 km further east than previously considered, to roughly longitude 100° E (Fig. 8.21) (Trinkaus and Howells 1979; Gowlett 1984; Klein 1989b; Lewin 1984). Central Siberia and Mongolia appear to represent the eastern frontier of Middle Paleolithic Neanderthal populations.

Early Upper Paleolithic industries, on the other hand, occur throughout south Siberia, and have been found in the Russian Far East (Almazinka), North China (Shuidonggou), central Mongolia (Orkhon), and central Asia (Obi-Rakhmat and Kara-Kamar). When dated, these industries predate 35,000 B.P., and demonstrate that the emergence of Upper Paleolithic technologies in Siberia was not an isolated event, but part of a

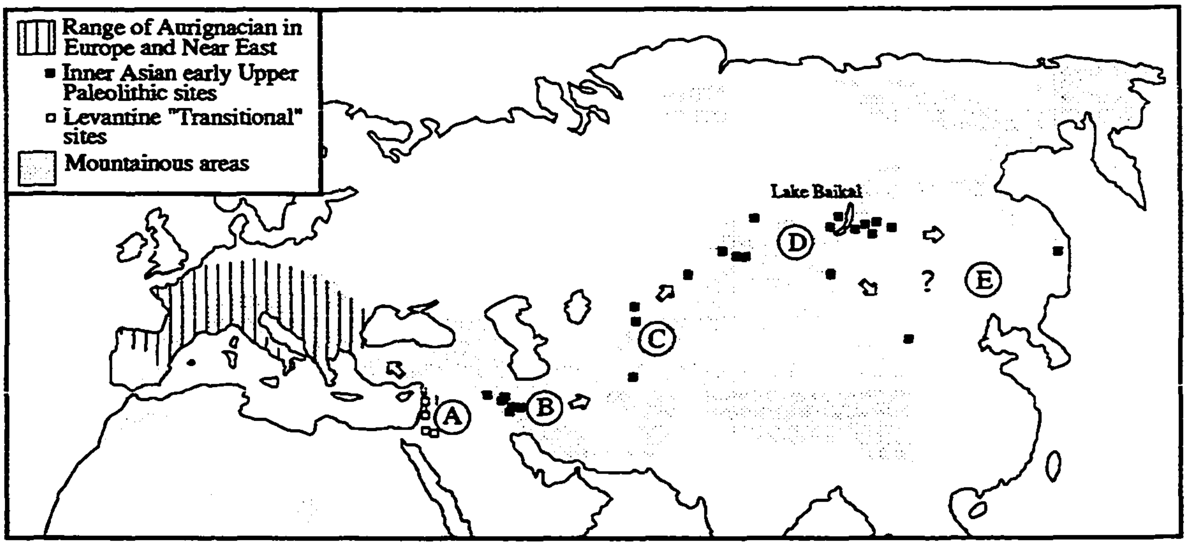


**Fig. 8.22.** Geographical distribution of Aurignacian technocomplex in Europe and the Near East (after Mellars [1993]), compared with the locations of non-Aurignacian, early Upper Paleolithic sites in Asia: Levantine "Transitional" (A); Zagros Baradostian (B); central Asian early Upper Paleolithic (e.g., Kara-Kamar, Obi-Rakhmat) (C); Siberian early Upper Paleolithic (e.g., Kara-Bom, Makararovo-4, Varvarina Gora) (D); Far Eastern early Upper Paleolithic (Shuidonggou, Almazinka).

widespread event that occurred throughout inner Asia and began prior to 40,000 B.P. The origins of this inner Asian early Upper Paleolithic technocomplex are unknown. It is distinct from local Mousterian technocomplexes found throughout the region; nowhere in inner Asia is there unequivocal evidence for an industry intermediate or transitional between the Middle and the early Upper Paleolithic. Instead, affinities can be drawn with the Baradostian of northern Iran-Iraq, which also appears to predate 40,000 B.P., and with transitional Upper Paleolithic industries in the Levant (Ksar-Akil levels 23-21, Kebara Cave unit IV), which may date to as early as 50,000-45,000 B.P. The age and character of the Levantine initial Upper Paleolithic suggest that southwest Asia was the proximate source of the inner Asian Upper Paleolithic.

The inner Asian early Upper Paleolithic is distinct from the European and Levantine Aurignacian, in that it lacks true prismatic core and blade technologies, split-base antler points, and other diagnostic features. The emergence of Aurignacian industries throughout Europe after 40,000 B.P. appears to have been an event separate but related to the spread of early Upper Paleolithic technologies into the heart of Asia. However, the Aurignacian did not give rise to the inner Asian early Upper Paleolithic, nor did the inner Asian early Upper Paleolithic, as far as we can tell, give rise to the Aurignacian. Instead, both may have dispersed from a common southwest Asian source.

The emerging Eurasian archaeological record for the mid-Upper Pleistocene, then, suggests the following, admittedly speculative, scenario. Upper Paleolithic technologies emerged in the Levant prior to 45,000 B.P., foreshadowing similar events in inner Asia and Europe by 5,000 to 10,000 years. Near Eastern early Upper Paleolithic technologies then spread eastward into central and north Asia before 40,000 B.P., where they displaced authochthonous Middle Paleolithic populations (Fig. 8.22). At roughly the same time, or perhaps slightly later, Near Eastern early Upper Paleolithic technologies spread westward into Europe, again replacing regional Middle Paleolithic populations. This event probably signals the spread of anatomically modern humans into Siberia and Europe, and the peripheralization and ultimate extinction of Neanderthals.

Thus, the origins of the Siberian early Upper Paleolithic appear rooted in southwest Asia. Although this spread-and-replacement model best fits the evidence currently available from Siberia, it will surely be subject to rigorous testing in the future. Many aspects of the transition have yet to be defined and synthesized--changes in human biology, subsistence, social organization, settlement, and ideology. With a clearer and more detailed picture of the transition, we can turn our attention to the broader implications of these changes and begin to address the ultimate causes of this behavioral revolution. Undoubtedly, some of the next century's more illuminating and exciting Upper Pleistocene discoveries will be made in Siberia.

# Appendix 1: Lithic Artifact Variable Definitions

## PRIMARY REDUCTION TECHNOLOGY

Primary reduction technology refers to the technical choices employed during the preliminary stages of tool manufacture, including the selection and procurement of a raw material, the preparation of a core, the removal of a blank (or end product) from that core, and the selection of a blank for use as a tool. Technological and morphological attributes were measured on cores and blanks.

***Raw Material.*** Raw materials were visually inspected, leading to two levels of identification. First, each raw material was identified to one of eight rock types—chert, basalt, quartzite, rhyolite, obsidian, chalcedony, argillite, or other, and second, to a Munsell color code. In addition, raw material types were ordinally scaled as either high-quality or low-quality. High quality materials include chert, obsidian, chalcedony, and argillite, while low quality materials include basalt, quartzite, rhyolite, and other.

***Degree of Cortex.*** Cortex refers to the natural, weathered surface of a rock or cobble. Each core and blank was analyzed according to the amount of cortex observed on its dorsal surface. This was measured using the following ordinal scale: 0%, <10%, 10-50%, 50-90%, and >90%.

***Platform Surface Preparation.*** This refers to the way in which the surface of a striking platform has been readied to facilitate the detachment of blanks.

1. Cortical platform surface preparation: platform surface is unprepared with retention of the natural surface of the cobble.
2. Smooth platform surface preparation: platform surface has a prepared surface characterized by a single flaked facet.

3. Dihedral platform surface preparation: platform surface consists of two flaked facets separated by a ridge or aris, giving the platform a triangular cross-section.
4. Faceted platform surface preparation: platform surface consists of three or more flaked facets, each separated by a ridge or aris; they typically have a convex cross-section.
5. Other platform surface preparation: Visible platform surface does not fall into any of the above categories.
6. Missing platform surface preparation: Platform has been removed or disfigured so that analysis is impossible.

***Platform Exterior Preparation.*** This refers to the way in which the margin of a core platform is prepared prior to detachment of a blank.

1. Trimming platform exterior preparation: Small chips or flakes have been systematically detached from the platform edge in order to by reshaped the platform in between detachment of blanks. This results in a series of tiny flake scars on the proximal dorsal face of the detached blank.
2. Grinding platform exterior preparation: The platform margin has been shaped or dulled by rubbing a rock or other hard object against the edge of the platform. The resulting ground surface is apparent on the proximal dorsal face of the detached blank.
3. Trimming and grinding platform exterior preparation: The platform margin retains marks of both trimming and grinding.
4. Absence of grinding platform exterior preparation: No evidence of trimming or grinding of the platform margin is evident on the blank or core.
5. Missing platform exterior preparation: Platform or proximal end of blank has been removed or disfigured so that analysis is impossible.

***Dorsal Scar.*** This refers to the pattern of negative flake scars evident on the dorsal surface of a blank or on the active flaking surface of a core. Dorsal scars are good indicators of the direction and pattern of core reduction.

1. Radial dorsal scar pattern: Flake scars originate from around the entire perimeter of the core or blank, and are directed toward the center of the piece. This scar pattern reflects a centripetal method or direction of flaking.

2. Parallel dorsal scar pattern: Flake scars are characterized by a series of very regular and elongate scars oriented parallel to one another, always originating from a single platform. This scar pattern reflects a unidirectional parallel method of flaking.
3. Subparallel dorsal scar pattern: This is essentially the same as parallel dorsal scar pattern, except that flake scars are less regular, less parallel, and sometimes less elongate. This scar pattern reflects a unidirectional parallel method of flaking.
4. Opposing parallel dorsal scar pattern: This is essentially the same as parallel dorsal scar pattern, in that flake scars are characterized by a series of regular and elongate scars oriented parallel to one another, but these scars originate from two opposing platforms. This scar pattern reflects a bidirectional parallel method of flaking.
5. Radial/parallel dorsal scar pattern: Together flake scars display attributes of both radial and parallel dorsal scar patterns.
6. Irregular dorsal scar pattern: The pattern of flake scars is unsystematic, with no dominant method or direction of flaking.
7. Indeterminable dorsal scar pattern: The dominant flaking pattern is unidentifiable.

***Blank.*** The article used as a tool, typically detached from a core. This is the essential product of primary reduction technology.

1. Blade blank: An elongate blank with a rectangular outline and two or more parallel longitudinal facets (or scars) separated by parallel ridges (or arises).
2. Flake-blade blank: An elongate blank with a rectangular outline less regular than blades, and with a series of subparallel longitudinal facets (scars) and arises. Although elongate, flake-blades are typically shorter and wider than blades.
3. Flake blank: A relatively short blank that is round, oval, or irregular in outline. Flakes typically display irregular dorsal scar patterns.
4. Point blank: A purposefully shaped triangular blank with parallel or subparallel, unidirectional or bidirectional, facets and arises.
5. Levallois flake blank: A purposefully shaped blank with a radially flaked dorsal scar pattern and usually a round or oval outline.

6. Cortical spall blank: Any blank with cortex.
7. Cobble blank: Any blank obviously made on a cobble, not on a detached end product.
8. Other blanks: On occasion burin spalls, microblades, wedges, and core fragements were used as tools.

***Core Types.*** Cores were defined according to the following typology (after Medvedev et al. 1974).

1. Core fragment
2. Monofrontal unidirectional flake core
3. Bifrontal unidirectional flake core
4. Monofrontal bidirectional flake core
5. Bifrontal bidirectional flake core
6. Trifrontal unidirectional flake core
7. Trifrontal bidirectional flake core
8. Rotated flake core
9. Monofrontal unidirectional flat-faced blade core
10. Bifrontal unidirectional flat-faced blade core
11. Trifrontal unidirectional flat-faced blade core
12. Monofrontal bidirectional flat-faced blade core
13. Bifrontal bidirectional flat-faced blade core
14. Trifrontal bidirectional flat-faced blade core
15. Monofrontal unidirectional (sub)prismatic blade core
16. Bifrontal unidirectional (sub)prismatic blade core
17. Trifrontal unidirectional (sub)prismatic blade core
18. Monofrontal bidirectional (sub)prismatic blade core
19. Bifrontal bidirectional (sub)prismatic blade core
20. Trifrontal bidirectional (sub)prismatic blade core
21. Monofrontal unidirectional Levallois point (pyramidal) core
22. Monofrontal bidirectional Levallois point (pyramidal) core
25. Discoidal flake core
26. Single-platform Levallois flake core
27. Multiple-platform Levallois flake core
28. Unifacial radial flake core

29. Bifacial radial flake core
30. Wedge-shaped microblade core
31. End blade/microblade core
32. Core tablet
33. Core preform

## SECONDARY REDUCTION TECHNOLOGY

Secondary reduction technology involves the systematic retouching of a blank to achieve a desired shape or form, as well as the reduction of a tool through repeated episodes of resharpening or recycling. Analysis of secondary reduction technology focused on technological attributes measured on tool edges.

***Retouch Face.*** This refers to the position of retouch on a given edge, whether it is dorsal and/or ventral, or edge.

1. Unifacial dorsal retouch face: Retouch scars are evident only on the dorsal face of the tool.
2. Unifacial ventral retouch face: Retouch scars are evident only on the ventral face of the tool.
3. Alternating retouch face: Retouch scars along an edge alternate from unifacial dorsal to unifacial ventral.
4. Edge retouch face: Retouch scars occur on a burinated, snapped, or segmented surface, not on the dorsal or ventral face of the tool.
5. Bifacial retouch face: Invasive retouch scars are evident on both the dorsal and ventral faces of the tool.
6. Bimarginal retouch face: Marginal retouch scars are evident on both the dorsal and ventral faces of the tool.

***Retouch Style.*** This refers to the morphology or style of retouch on a given edge. Retouch style was classified according to eight types.

1. Scalar retouch: Transverse retouch scars are invasive and multiply rowed.
2. Subparallel/parallel retouch: Transverse retouch scars are oriented parallel to one another; they can be single-rowed or multiply-rowed.
3. Nibbling retouch: Transverse retouch scars are marginal and single-rowed.

4. Large irregular retouch: Transverse retouch scars occur sporadically along a tool edge and are invasive.
5. Small irregular retouch: Transverse retouch scars occur sporadically along a tool edge and are marginal.
6. Backing retouch: Retouch is steep and serves to blunt the tool edge.
7. Burin retouch: The retouch scar is oriented longitudinally along the edge of a tool, not transversely across the face of a tool.
8. Notching retouch: Transverse retouch scar forms a deep concavity along the tool edge.

***Retouch Invasiveness.*** Retouch invasiveness was measured (in mm using a dial caliper) as the chord extending from the edge of the tool inward to the retouch scar farthest from the edge. This is a maximum measurement of invasiveness; only one measurement per edge was taken.

***Retouch Intensity.*** Retouch intensity was ordinally measured by counting the number of edge positions displaying retouch scars. Positions were determined in reference to 10 numbered segments around the perimeter of the tool (after Barton 1988). For a blank in standard orientation (platform down and dorsal face up), positions were numbered beginning with 0 at the platform and moving clockwise. Positions 1-3 are located along the left lateral margin, 4-6 along the distal margin, and 7-9 along the right lateral margin. To measure retouch intensity, the number of edge positions displaying retouch was summed. Therefore, a tool retouched along its entire distal margin has a retouch intensity of 3 (edge positions 4, 5, and 6 display retouch), while a tool retouched along its entire perimeter excluding the platform has a retouch intensity of 9 (edge positions 1-9 display retouch).

## TOOL ASSEMBLAGE

The tool assemble refers to the set of utilized end products, which are typed according to specific morphological attributes produced during manufacture, retouch, and use. The tool typology is hierarchical; all tools are typed at both the class and type levels. Classes are outlined below.

1. Retouched blade: A blade blank with use-wear and/or retouch along one or both lateral margins. Retouched blade types are defined according to the face and location of retouch.
2. End scraper: A blank with retouch along its distal margin; retouch is typically steep and forms a convex arc.
3. Burin: A blank with an edge retouched through the removal of a longitudinal "burin" spall, forming a steep working margin. Burin types are defined according to the number and location of burinated edge(s).
4. Wedge: A blank displaying bipolar and bifacial crushing and/or flaking. Whether wedges served as cores or tools is presently indeterminable. In many contexts, it is clear that wedges are exhausted bipolar cores (*pièces esquillées* or *outils écaillés*) from which a series of small flakes were detached through the block-on-block technique (Spiess and Wilson 1987:67; Toth and Schick 1988). In Siberian early Upper Paleolithic assemblages, however, wedges were often made on blades or flake-blades removed from large blade cores. The bipolar, bifacial reduction of these artifacts appears to have been the result of secondary reduction, not primary reduction. For this reason, wedges in the early Upper Paleolithic may have served as tools as well as cores, or perhaps only as tools (as has been noted elsewhere [Frison and Stanford 1982:122; Lothrop and Gramly 1982; MacDonald 1968:88-90; Semenov 1964:148; Spiess and Wilson 1987:67-68]).
5. Graver: A blank with a small retouched point or bit that projects from the edge of the piece. Gravers can be symmetrical in shape with a distal bit following the longitudinal axis of the tool, or they can be asymmetric with "canted" bits. They are also referred to as perforators or drills.
6. Side scraper: Tool blank with definite, usually scalar, retouch along one or both lateral margins. Side scraper types are defined according to the location of retouch along the tool margin.
7. Notch: Tool blank with a single concavity per retouched edge.
8. Denticulate: Tool blank with a series of notches along a given edge.
9. Cobble tool: Any retouched piece made on a cobble or pebble (i.e., hammerstones, choppers, and chopping tools).
10. Knife: A tool blank with a sharp utilized margin opposing a steep, blunt margin that is either cortically backed or smooth-backed.

11. Backed blade: A blade blank with a sharp utilized margin opposing a steep margin displaying backing retouch.
12. Retouched flake: A flake blank with an edge or edges displaying use-wear or marginal retouch.
13. Point: A blank with a symmetrical distal point, often retouched, but sometimes produced without retouch on a triangular blank (i.e, a Levallois point).
14. Biface: A blank displaying bifacial retouch. Biface types are defined according to the shape of the piece.

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