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Analysis of a Lithic Assemblage from the Multi-component Habitation Site Gorelyi Les, Siberia

by

Kurzybov Petr

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Abstract

The research presented in this thesis examines a lithic assemblage from the multi-component habitation site Gorelyi Les in the Belaia river valley, Cis-Baikal region, Siberia. The distinctive traits of this collection are the relatively small size of the lithic assemblage and the large proportion of debitage. The chosen methodological framework for this research concentrates on obtaining maximum information from the available materials through application of typological, technological, use-wear, and spatial analyses.

The results suggest that there were differences in the organization of the technological process of lithic tool manufacture during the Early Neolithic and Late Neolithic. During the Early Neolithic, lithic tool manufacture and use were rather intensive and diversified, while during the Late Neolithic, tool manufacture and use were limited to a narrower range of technological operations and functions.

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Introduction

Technology plays an important role in human adaptations. It allows people to alter naturally occurring raw materials and to accommodate them for current needs. Studying and understanding the relationships between lithic technologies and human behaviour is one of the key objectives in archaeological research.

In the Cis-Baikal region one can observe a continuous record of hunter-gatherer history during Middle Holocene. The hunter-gathering populations, their biocultural parameters, and mechanisms responsible for the spatial and temporal cultural variability among them are the focus of the research conducted by the Baikal Archaeological Project (BAP) (e.g., Weber et al. 2002, 2008). Lithic technologies, however, were not comprehensively studied until recent times. Contemporary lithic studies in the region include petrographic and use-wear analyses applied to the materials derived from mortuary complexes of the Neolithic and Early Bronze age (e.g., Khuzhir-Nuge XIV, Shamanka II, Kurma XI) (Bazaliiskii et al. 2007; Kungurova et al. 2006, 2008, 2009). Other scholars concentrated traditionally on the typological classification of formal tool categories (Medvedev 1981; Medvedev et al. 1981; Savel'ev 1986). Debitage has never been closely examined in any research in the Cis-Baikal region, despite attempts to create classificatory and interpretational systems to explain variability in this category (Berdnikova 2003).

The research presented here examines prehistoric lithic technology during the Neolithic (~8000– 000 BP), based on the examination of materials recovered from the archeological habitation site Gorelyi Les in the Cis-Baikal, Siberia. Unlike most previous studies, this research will concentrate not only on the examination of formal tools but will also include debitage that dominates the archaeological collections from habitation sites across the region.

Research objectives

The primary goal of the present work is to explore the variability of the lithic assemblage at Gorelyi Les. Recording this variability is the first step in the sequence of analytical techniques that are aimed at explaining decision-making processes and behavioural patterns of the site's inhabitants in relation to lithic technology. Taken together, the description and explanation of lithics variability are the focuses of the present research. Another important goal of this study is to produce a body of quantitative data and a specific algorithm or unified, consistent coding system for describing lithic artifacts (mostly debitage) that can be used consistently to produce comparable results among various archaeological assemblages of different ages and from different locations across the Cis-Baikal region.

The following issues will be addressed in the present thesis: (1) how the technological process at Gorelyi Les was organized; (2) what techniques were involved in tool manufacturing processes; (3) how the lithic tools were used and what range of activities was performed at the site; (4) what are the patterns of lithic distribution and intra-site structure; (5) were there any diachronic changes in the above patterns during the Holocene, when the site was occupied by Early Neolithic and Late Neolithic hunter-gatherers?

In other words, the present study is designed to reconstruct the lithic manufacturing process (technological organization), the use of lithic tools in various activities, their role in subsistence practices of ancient hunter-gatherers, and their discard. The following research will provide some insights beyond basic classification, and will include an assessment of the relationships between technology, subsistence, and settlement patterns in the past.

Thesis structure

The thesis is comprised of six chapters. Chapter 1 contains background information about the archaeological site Gorelyi Les: its environmental setting, geographic location, paleoclimatic data, geological structure of the region, and biological resources. Following this, a brief outline of culture history in the region during the Late Pleistocene and Holocene is provided.

Chapter 2 examines more closely the archaeological context of Gorelyi Les in terms of the characteristics of sediments and sedimentation processes and site chronology. Also presented in this chapter is brief information about faunal remains, ceramics, and lithics recovered at the site during excavations in 1994 – 1996.

Chapter 3 provides detailed description of the methodology employed in analyzing the lithic assemblage from Gorelyi Les. It begins with a discussion of contemporary theoretical approaches in lithic studies, with an emphasis on debitage analysis. Following this is a detailed description of the methods employed in this research, such as typological, technological, use-wear and spatial analyses.

Chapter 4 includes a description of the lithic artifacts recovered at Gorelyi Les. The description concentrates on the morphological and technological characteristics of lithics, identification of use-wear patterns on them, and on analysis of their spatial distribution within the site by layer. The formal tools and debitage are divided into typological and technologically meaningful categories on the basis of morphological criteria, and are described within these groups. The documented use-wear patterns are organized into categories according to the activity type that created them. Finally, the horizontal and spatial distribution of all lithics is studied with emphasis on the technologically important debitage, formal tools, and tools with use-wear. Attention is paid to revealing correlation patterns between the stone tools and other features discovered at the site (e.g., hearths).

Chapter 5 provides a synthesis of the data on lithic tool manufacture at the site, types of activities performed with lithic tools, and patterns of their distribution. Also, this chapter concentrates more closely on revealing technological aspects of lithic tool manufacture, and the overall organization of lithic technologies during different periods of time represented at the site.

Chapter 6 summarizes the results obtained during analysis of the lithic assemblage excavated in 1994 – 1996 from the habitation site Gorelyi Les. Following this, is the discussion of the contemporary archaeological problems, the directions of archaeological studies in the region, and the ways in which the analyzed materials contribute to increments to our understanding of the cultural history and behavioral patterns of Middle Holocene hunter-gatherer populations.

A concluding statement evaluates the results of the whole study and provides suggestions for additional research.

Chapter 1
Environmental context

1.1 Geographic context

The Lake Baikal region, or Baikal Siberia (Figure 1.1) is situated in central Asia between 50–67° N latitude and 94–118° E longitude. The area encompasses the Angara river basin down to Ust'-Ilimsk, the drainage of the Upper Lena down to Kirensk, and the islands and coast of the lake itself (Weber 1995).The habitation site Gorelyi Les is located on the right bank of the lower section of the Belaia River, a left tributary of the Angara River, about 50 km upstream from the confluence of the two rivers (Figure 1.2). The Belaia is one of the shortest tributaries of the Angara (359 km long), with a drainage area up to 17,600 sq. km (Medvedev et al. 2001).

The geological structure of the region is diverse and contains rocks of various age and genesis (Figure 1.3). This area belongs to the southern part of the Siberian platform (Middle Siberian Plateau). It includes the Baikal Rift Zone with the Primorskii and Baikal'skii mountain ranges in the east and the Eastern Sayan mountain range in the south. The geological structure of these ranges is similar, being characterized by Archean and, to a lesser extent, Proterozoic and Paleozoic structures (Lut 1978). The source of the Belaia River is located in the Eastern Sayan Mountain range, its middle stream runs through the depression of the Sayan piedmont, and the lower stream crosses the Irkutsk-Cheremkhovo valley (Medvedev et al. 2001). Metamorphic and igneous rocks – quartzite, gneiss, schist, granite, basalt, and trachyte prevail on the southern edge of the Siberian platform. Also, sedimentary rocks are present in the southern part of the Cis-Baikal region, e.g., grey cherty dolomites, sandstones, siltstones, coals, limestones, argillites, etc., which indicates marine conditions in the past. Continental deposits consist of Jurassic conglomerates, sandstones, siltstones, argillites, sands, pebbles, and loams (Medvedev et al. 2001). Within the Irkutsk-Cheremkhovo valley there are several areas with different geomorphological structures and characteristics: (1) zones of slight neotectonic elevation with altering processes of sedimentation, such as accumulation and denudation; (2) zones of slight neotectonic depression, where accumulation of sediments prevails; (3) areas of substantial depression, where accumulation of sediments prevailed during either the Pleistocene or Holocene (Medvedev et al. 2001)

The landscape of the Irkutsk-Cheremkhovo valley is marked by rolling hills with valleys between them. The average elevation of these hills is around 500 m above sea level, while the mean elevation around the Belaia River decreases to 395 m above sea level. Currently, the main influence on the area's geomorphology is the Belaia, a meandering stream that cuts a winding path through the region at a low gradient.

The climate of the Cis-Baikal is markedly continental, owing to the location of this area in the deep interior of the Asian mainland. It features five-month-long cold winters, two-month-long warm and rather dry summers, and relatively long transitional seasons. The interaction of geographical location, specific atmospheric circulation, topography, and the lake itself creates a variety of isolated microclimates. The average July and January temperatures are about 18° and – 22° C, respectively. Total average precipitation is 400–600 mm, most of it falling during the growing period, while the Eastern Sayan range and the Belaia River valley may receive up to 800 mm (Galazii 1993).

The variety of microclimates contributes to the high differentiation of local vegetation communities. The boreal forest (taiga) covers most of the Cis-Baikal region: river and stream valleys, lower parts of mountain slopes and gorges, and extensive rolling hills of the Central Siberian Plateau. The southern part of the region is mainly open space with patches of coniferous forest, and represents a transitional zone between the boreal forest and steppe. This transitional area is characterized by mixed boreal forest, where coniferous and deciduous trees grow in relatively equal proportions. The vegetation is dominated by pine (*Pinus sylvestris*), larch (*Larix sibirica*), Siberian pine (*Pinus sibirica*), spruce (*Picea obovata*), birch (*Betula*), and fir (*Abies sibirica*). Common forest-steppe zone vegetation includes wormwood (*Artemisia*), fescue (*Fectusa*), feather grass (*Stipa*), and steppe sedge (*Carex*) (Galazii and Molozhnikov 1982).

The combination of the described geographical conditions produces considerable biodiversity. The distribution of the three large Eurasian faunal complexes (European/Siberian, Central Asiatic, and Eastern Asiatic species families) overlaps in the Cis-Baikal region (Shvetsov et al. 1984). Among the mammal species of importance for ancient hunter-gatherers (used for various purposes, such as food, clothes, ect.) were roe deer (*Capreolus pygargus*), red deer (*Cervus elaphus*), moose (*Alces alces*), boar (*Sus scrofa*), brown bear (*Ursus Arctos*), wolf (*Lupus lupus*), fox (*Vulpes vulpes*), hare (*Lepus timidus*), and sable (*Martes zibellina*). Geographic distribution of many of these species covaries with the distribution of plant communities. The boreal forest (taiga) and forest-steppe environments of the southern part of the Cis-Baikal region are natural habitat for roe deer, red deer, moose, boar, fox, wolf, hare, etc. (Shvetsov et al. 1984). Siberian dace (*Leuciscus leuciscus*), arctic grayling (*Thymallus arcticus*), lenok (*Brachymystax lenok*), taimen (*Hucho taimen*), humpback whitefish (*Coregonus pidschan*), freshwater perch (*Perca fluviatilis*), northern pike (*Esox lucius*), and roach (*Rutilus rutilus lacustris*) are the most abundant fish species in the Angara river section adjacent to the Belaia, Kitoi and Oka rivers (Kozhov 1950).

In sum, the Lake Baikal region during the Holocene period exhibited significant biodiversity and was rich in potential food resources, both terrestrial and aquatic, for ancient hunter-gatherer populations.

1.2 Paleoenvironmental context

Reconstructions of climate dynamics in the Cis-Baikal may play a significant role in understanding the behavioural patterns of ancient hunter-gatherers and their change through time. The effects of climate fluctuations on ancient populations in the Cis-Baikal have become the subject of much research in recent decades (Berdnikova et al. 2005; Bezrukova et al. 2009; White and Bush 2010). The inferences about paleoclimate in the Cis-Baikal region are based on the results of palynological analyses, on paleontological materials (e.g., molluscan sequences), and on the analyses of sediments from archaeological sites (Vorob'eva et al. 1992; Berdnikova et al. 1998; Bezrukova et al. 2009; White, 2006).

The valley of the Belaia River exhibits a continuous paleoenvironmental record for much of the Late Pleistocene and Holocene. The Belaia River drains the Eastern Sayan mountain range and is subject to substantial seasonal fluctuations of hydrodynamic activity caused by ice and snow melting in the mountains. The sediments deposited on the floodplain register these fluctuations well, and provide insights into the past climatic patterns.

According to the regional geochronological scheme (Table 1.1), the Late Pleistocene and Holocene in the Cis-Baikal region are characterized by recurrent changes in the climate. This local pattern rather well matches the general climatic model in this part of the Northern Hemisphere (Bezrukova et al. 2006). Each geochronological sub-stage is characterized by distinctive environmental conditions which are reflected in the sediment characteristics, in the pollen record, and in other paleoclimate proxy records.

The transition from the Pleistocene to Holocene took place around 11,500 cal yr BP and was marked by substantial changes in the climate. The cold and arid conditions of the Late Pleistocene were replaced by a relatively warm and humid climate. The role of eolian activity and cryoturbation in the sedimentation processes decreased (Vorob'eva et al. 1992). Tundra landscapes with larch, spruce, and shrub birch transitioned to diverse vegetation communities, such as boreal forest, forest-steppe, and meadow during the twelfth millennium BP.

Substantial warming during the Preboreal period increased the channel capacity of the Belaia River; frequent floods took place during the spring and summer periods, caused by ice melting in the mountains. Sediments of this age, deposited in thick beds, consist primarily of coarse-grained poorly sorted sands, with inclusion of gravel, pebbles, and boulders. The mix of steppe landscapes and isolated forests are found throughout the region during this period of time.

The period between ~9000 and 7000 cal yr BP was marked by increasingly wet and warm climate (Bezrukova et al. 2009). The climate regime was moderate continental: cool summers and mild winters with high precipitation. The major indicator of these conditions is an extreme abundance of Siberian fir

(*Abies sibirica*) pollen in the sediment of this age. Siberian fir prefers to grow in areas with an extra-moist, moderate continental climate, with mean annual precipitation of 700–1000 mm and annual mean temperature of –1° C. In general, Siberian fir and Siberian pine comprised most of the dark-coniferous moist taiga forest and more arid areas of the Cis-Baikal region (Bezrukova et al. 2006). Also, the warm and humid climate with rich vegetation favoured pedogenesis. Sediments of this age are primarily humus-rich loams, sandy loams, and paleosols with well developed structure (often with several consecutive soil horizons) (Vorob'eva et al. 1992).

The period between approximately 7000 and 6000 cal yr BP is characterized by environmental instability, resulting in a spatial shift in the distribution of dominant forest communities – namely Siberian and Scots pine replaced the dark coniferous fir-dominated forests (Bezrukova 1999). This period is marked by significant climatic and environmental variability. During a relatively short time there was a sharp decrease in atmospheric precipitation and a decline in summer and winter temperatures, with high amplitudes of fluctuation (Bezrukova et al. 2007). However, the trend towards greater aridity appears to have been transgressive across the Cis-Baikal (White 2006).

The interval after ~6000 cal yr BP is marked by a climatic shift towards a more continental climate: decreasing precipitation, rise of summer and drop of winter temperatures. The channel capacity of streams gradually decreased during the Subboreal and Subatlantic periods and high floods did not occur often, which changed the sedimentation dynamics on the rivers' floodplains, e.g., eolian processes recommenced, cryoturbational deformations of the deposits developed, and subaerial sedimentation processes prevailed (Vorob'eva et al. 1992). Landscapes were dominated by steppe and forest-steppe vegetation. Expansion of light coniferous larch, Siberian and Scots pine forests, and formation of more xerophytic vegetation communities of a modern character occurred (Bezrukova et al. 2009). Overall, the Middle Holocene period demonstrates greater aridity and substantial variability of temperature regimes in time across the region (White and Bush 2010).

Faunal materials from Early to Middle Holocene times generally support the inferences made on the basis of stratigraphic sequences and pollen analysis. The faunal assemblages in the Upper Angara basin are dominated by the remains of ungulates, particularly roe deer and red deer. Also the fauna includes the remains of musk deer, horse, moose, hare, bison, brown bear, gray wolf, sable, red fox, and badger (Igumnova and Batrakova 2002; Klement'ev et al. 2005). During the Atlantic period beaver appeared in the region (Savel'ev et al. 2001).

To summarize, the geographical location of the Cis-Baikal in the centre of Asia, its orographical isolation and circulation of atmosphere in this region made the climate markedly continental (Vorob'eva et al. 1992). General climate trends after the last glaciation until ~6000 cal yr BP were continuous warming and increasing moisture with a period of cooling and aridization at ~6500 cal yr BP (Bezrukova, 1999). Thi period was rather substantial and, presumably, had an impact on various aspects of past hunter-gatherers' lifeways in the Cis-Baikal region (Bezrukova et al. 2007). Bezrukova (1999) terms the period of ~8000–5000 cal yr BP the *climatic humid optimum* of the Holocene, which was characterized by the most abundant precipitation during the entire Holocene in the Cis-Baikal region. After ~5000 cal yr BP the climate approximated modern conditions, with gradually decreasing precipitation and changes in the temperature regime. Lesser and short-term fluctuations of vegetation and climate (cooling and aridization followed by the degradation of forests) occurred at ~500–2400 cal yr BP and ~600–1200 cal yr BP (Bezrukova et al. 2009).

1.3 Sources and availability of lithic raw materials

Sourcing raw materials plays an important role in lithic analysis. It contributes greatly to a better understanding of the entire technological process of tool manufacture, where the choice of rock type is crucial for subsequent operations. For the present research, the important questions are whether the raw materials were local or imported to the site and whether the rock type influenced the choice of knapping strategy (technique).

In fact, throughout history hunter-gathers in the Cis-Baikal region exploited the raw material sources that were located in the vicinity of their habitat and easily available to them (Bazaliiskii et al. 2007; Berdnikova et al. 2005; Lipnina et al. 2001). The exceptions included rocks that occured in a limited number of locations, e.g., nephrite, black steatite, graphite, etc. They were collected by people even in places remote from their original habitat (Goriunova et al. 2007; Sekerin and Sekerina 2000). The important criteria in choosing material for manufacturing stone tools were, predominantly, physical characteristics of the rocks, such as conchoidal fracture, elasticity, hardness, grain size, and silica content (Vorob'eva, 2002). During the Paleolithic and Neolithic periods various types of quartz, chalcedony, quartzite and microquartzites, nephrite, chert, slate, shale, argillite, agalmatolite, basalt, and andesite were the preferred materials for manufacturing stone tools (Vorob'eva 2002). Most of these rocks were easily available for hunter-gatherers due to the fact that the geology of the Cis-Baikal region, especially its southern part, demonstrates considerable variability in the geological structure (Figure 1.4). Almost the entire spectrum of rocks used by ancient people in the Cis-Baikal region could be found in the alluvium of streams within the Irkutsk mountain basin (Bazaliiskii et al. 2007). Rivers erode the bedrock and transport the mineral materials in the form of boulders, pebbles, and gravel within their drainage basin over large distances.

In the Belaia river valley the following three complexes of sedimentary rocks dominate: Early Cambrian (*Cm*), Jurassic (*J*), and Cenozoic (*Kz*) (Lezhnenko and Vorob'eva 2002). The oldest sedimentary rocks are Early Cambrian dolomites and dolomitized limestones. They belong to the Angarskaia and Bulaiskaia suites. The bedrock mass contains layers of chert and cherty materials (e.g., fine-grained quartzite and microquartzite) of black, gray, maroon, yellow, and white colors in various combinations. The quality of these rocks (isotropy and conchoidal fracture) is satisfactory but far from ideal for manufacturing fine stone tools. The thickness of the cherty layers is usually 10–15 cm and it is difficult to obtain large nodules without cracks; also, this type of chert is subject to unpredictable breakage, crumbling, and spalling (Bazaliiskii et al. 2007; Lipnina et al. 2001). Nevertheless, these raw materials were abundant and easily accessible from the surface of the floodplain or from outcrops.

The rocks of Jurassic age such as limestones, argillites, gravelites, cherty formations, conglomerates, slates, and sandstones with various sizes of grains prevail on the right bank of the Belaia River. These rocks are either abundant in alluvial sediments or can be found in outcrops. Cenozoic sediments are represented by the products of erosion of the bedrock (sand, sandy loams, and loams) and quaternary alluvial and lacustrine deposits (Lezhnenko and Vorob'eva 2002).

In addition to the common rocks, exotic minerals were also available in this area. The drainage basin of the Belaia River includes the Eastern Sayan mountain range, which contains sources of rare and valuable rocks such as nephrite and soft stone talcite (Figure 1.4). The river transported these rocks downstream up to the Angara River and saturated the alluvial deposits of the river terraces (Bazaliiskii et al. 2007). Besides exotic materials, common basalts, conglomerates, and other rocks also were transported downstream.

In sum, it appears that the sources of raw material in the Cis-Baikal region were abundant and diverse, having the potential to meet all needs of the ancient inhabitants of the region for manufacturing various stone implements. Moreover, some highly valuable exotic rocks could be transported by human means over large distances (e.g., green and white nephrite).

1.4 Culture-historical context

The prehistory of the Lake Baikal region is generally organized into broad technological periods termed the Paleolithic, Mesolithic, Neolithic, Bronze, and Iron ages. During the Middle Holocene period a set of culturally distinctive prehistoric societies developed or appeared in this region. One can observe within this timeframe the development and diversification of cultures of hunter-gatherers exploiting natural resources (game, fish, and plants).

Throughout time the hunter-gatherer lifestyle was rather stable, although changes occurred and affected different aspects of human behavioural patterns (Weber et al. 2002). One of the technological innovations during the Middle Holocene was pottery making, which became a principal indicator of the

Neolithic period in the region (Savel'ev 1986; Weber 1995). All these processes occurred within the same adaptive formation – hunter-gatherer societies associated with the Mesolithic, Neolithic, and Bronze Age periods.

The Baikal Archaeology Project focuses on cultures inhabiting the Lake Baikal region during the Middle Holocene between approximately 8,800 and 3,400 cal. years BP. These groups – Kitoi, Serovo, and Glazkovo, named after mortuary traditions – date to the Early Neolithic, Late Neolithic, and Early Bronze Age, respectively, with a gap in the mortuary record occurring during the Middle Neolithic (Table 1.2). The recently revised chronological model developed by Weber et al. (2010) is based on an analysis of a large set of radiocarbon dates from mortuary sites. However, there are numerous other models of the regional culture history. They are based on materials from habitation sites, or from mortuary complexes but involving mostly typological criteria, stratigraphic observations. These models often contradict each other and are still extensively debated; most of them are summarized by Weber (1995).

Furthermore, the above-mentioned prehistoric cultural groups represent three distinct patterns of hunter-gatherer adaptations, each related with a specific culture historical period (Early Neolithic, Middle Neolithic, and Late Neolithic and Bronze Age) (Weber and Bettinger 2010). The Early Neolithic Kitoi populations presumably are thought to have inhabited places where the food resources were most favourable to support them – for example, near river confluences (Weber et al. 2008). They exploited fish resources and ungulates within annual ranges, practicing low residential mobility combined with high individual mobility (Weber et al. 2002; Lieverse 2010). The narrow spectrum of foraging activities may have made the Kitoi populations susceptible to small-scale changes in the natural environment that might have resulted in physiological stress and poorer overall community health (Weber et al. 2002).

The Middle Neolithic period is marked by a lack of mortuary record. Apparently, Kitoi populations abandoned the practice of formal cemetery use during this time. It is possible that they dispersed into small mobile groups that spread out across the broader Baikal region (Weber et al. 2008). However, there is still no sufficiently justified explanation of the nature and causes of this phenomenon in the archaeological record.

The Late Neolithic and Bronze Age stages are characterized by *in situ* development of Serovo-Glazkovo cultural complexes, which exhibit similar archaeological patterns and are believed to be genetically related (Weber et al. 2002). The Serovo-Glazkovo people apparently represented a relatively large and evenly distributed regional population (Weber et al. 2008). Their diet was based on a broad spectrum foraging strategy focused on a variable balance of ungulates, fish, and seals (Katzenberg et al. 2010). Such diversified and flexible subsistence activities produced a substantial amount of seasonal food supplies. Bioarchaeological data indicate a better overall community health of the Serovo-Glazkovo populations, as well as their biological discontinuity with the Kitoi population (Lieverse 2010).

To summarize, the Middle Holocene hunter-gatherers in the Cis-Baikal region display evidences of significant variability in their behavioural patterns reflected in the archeological record.

Table 1.1. Regional geochronological scheme (after Vorob'eva et al. 1992).

Holocene	**Ky BP**	**Period**	**Phase**	**Types of vegetation**	**Site, number of cultural horizons**	**C14 dates BP**	**Stage**	**Sediment characteristics**	**Events**	**Climate trend**
Late	0 1	Subatlantic	SA-3	Forest-steppe, mixed forest and coniferous forest	Gorelyi Les I Lugovaia I	–	Iron Age	Sandy loam and loam, weakly laminated, rich in organic matter with interlayers and lenses of sand of alluvial and eolian genesis 0.2–0.8 m	Traces of eolian processes	Decreasing moisture, stabilization of temperature conditions
	2		SA-2							
			SA-1							
Middle	3	Subboreal	SB-3	Meadow steppe and forest with shrub birch	Gorelyi Les II, III Lugovaia II, III	–	Bronze Age	Humus rich loams with thin interrupted sandy bonds 04–0.8 m	Cryoturbational activities	Alternating phases of warming and cooling
	4		SB-2							
			SB-1		Ust'-Belaya II[a] Gorelyi Les IV, V		Neolithic	Sands with 2-3 interbeds of humus-rich sandy loam 0.2–1.5 m	Cryoturbations	
	5		AT-3	Birch forest and meadow steppe	Gorelyi Les V[a] Lugovaia VI-VIII	5430±60			Traces of floods: accretional sediment, and erosion	Gradual warming and increasing moisture content

Table 1.1. Regional geochronological scheme (after Vorob'eva et al. 1992) continued.

Holocene	Ky BP	Period	Phase	Types of vegetation	Site, number of cultural horizons	C14 dates BP	Stage	Sediment characteristics	Events	Climate trend
Middle	6 7	Atlantic	AT-2		Mishelevka VII-VIII Gorelyi Les VI	6695±150 6995±150		Humus-rich sandy loams and loams with light-colored sand bands 0.5–1 m		
Middle Early	8	Atlantic Boreal	AT-1 B0-3 BO-2	Meadow and steppe (predominantly open spaces)	Ust'-Belaia I Lugovaia IX Ust'-Belaia III-IV V-XII	8960±60	Late Mesolithic Middle Mesolithic	Sands and sandy loams with humus-rich interlayers 0.3–0.5 m	–	Slight cooling and aridization
Early	9	Boreal	BO-1	Meadow and steppes			Middle Mesolithic	Humus-rich sandy loams and loams 0.1–0.2 m	–	Warming and increasing moisture content

Table 1.2. Culture history model for the Cis-Baikal region (after Weber et al. 2010)

Period	Mortuary tradition	Angara, S. Baikal cal BP	Upper Lena cal BP	Little Sea cal BP
Late Mesolithic	n/a	8800–8000	8800–8000	8800–8000
Early Neolithic	Kitoi and other	8000–7000/6800	8000–7200	8000–7200
Middle Neolithic	Lack of archaeologically visible mortuary sites	7000/6800–6000/5800	7200–6000/5800	7000/6800–6000/5800
Late Neolithic	Isakovo, Serovo Tightly flexed	6000/5800–5200	6000/5800–5200/5000	6000/5800–5200/5000
Early Bronze Age	Glazkovo Tightly flexed	5200/5000–4000	5200/5000–4000	5200/5000–4000

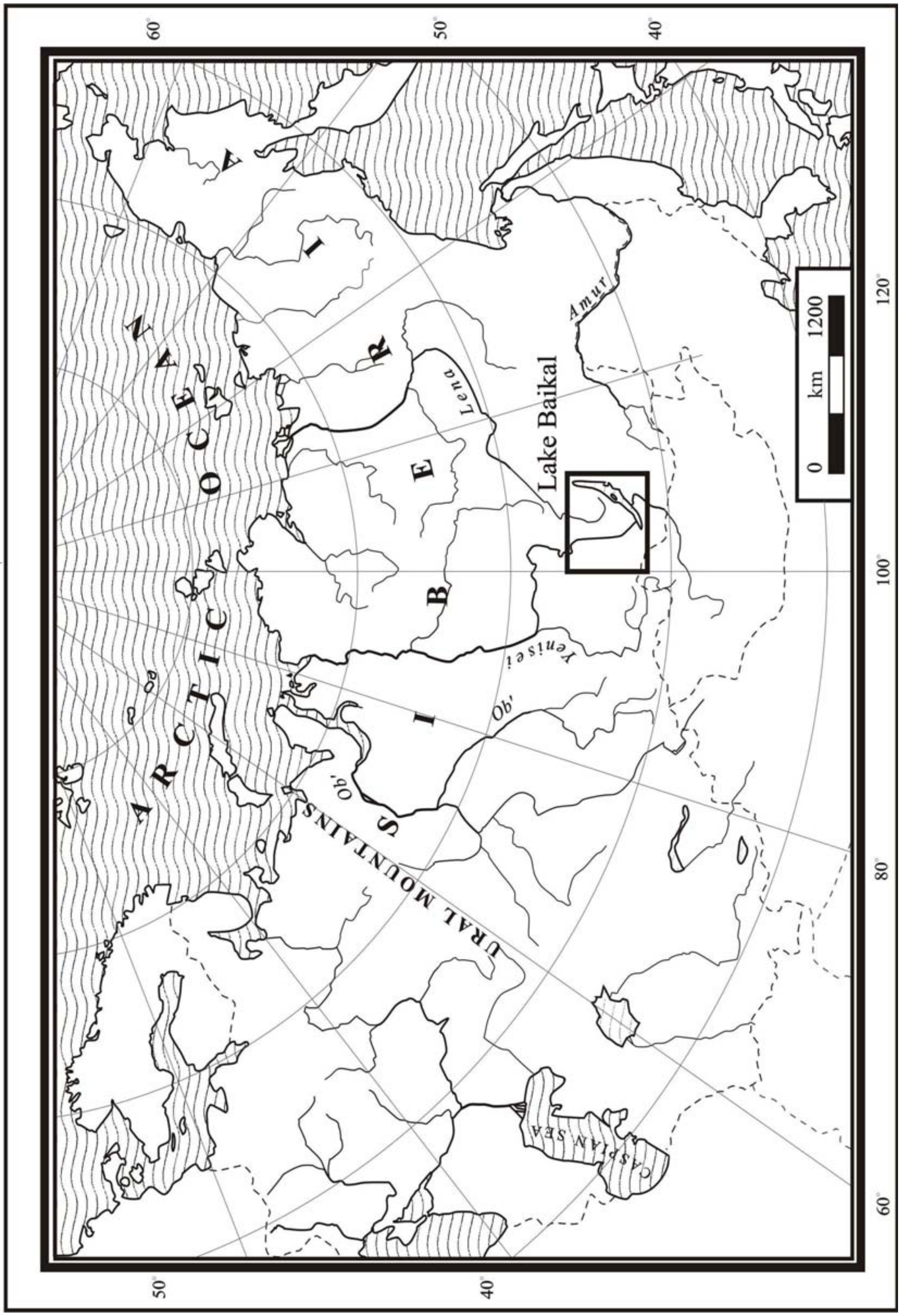

Figure 1.1: Map of Siberia indicating location of the Lake Baikal area

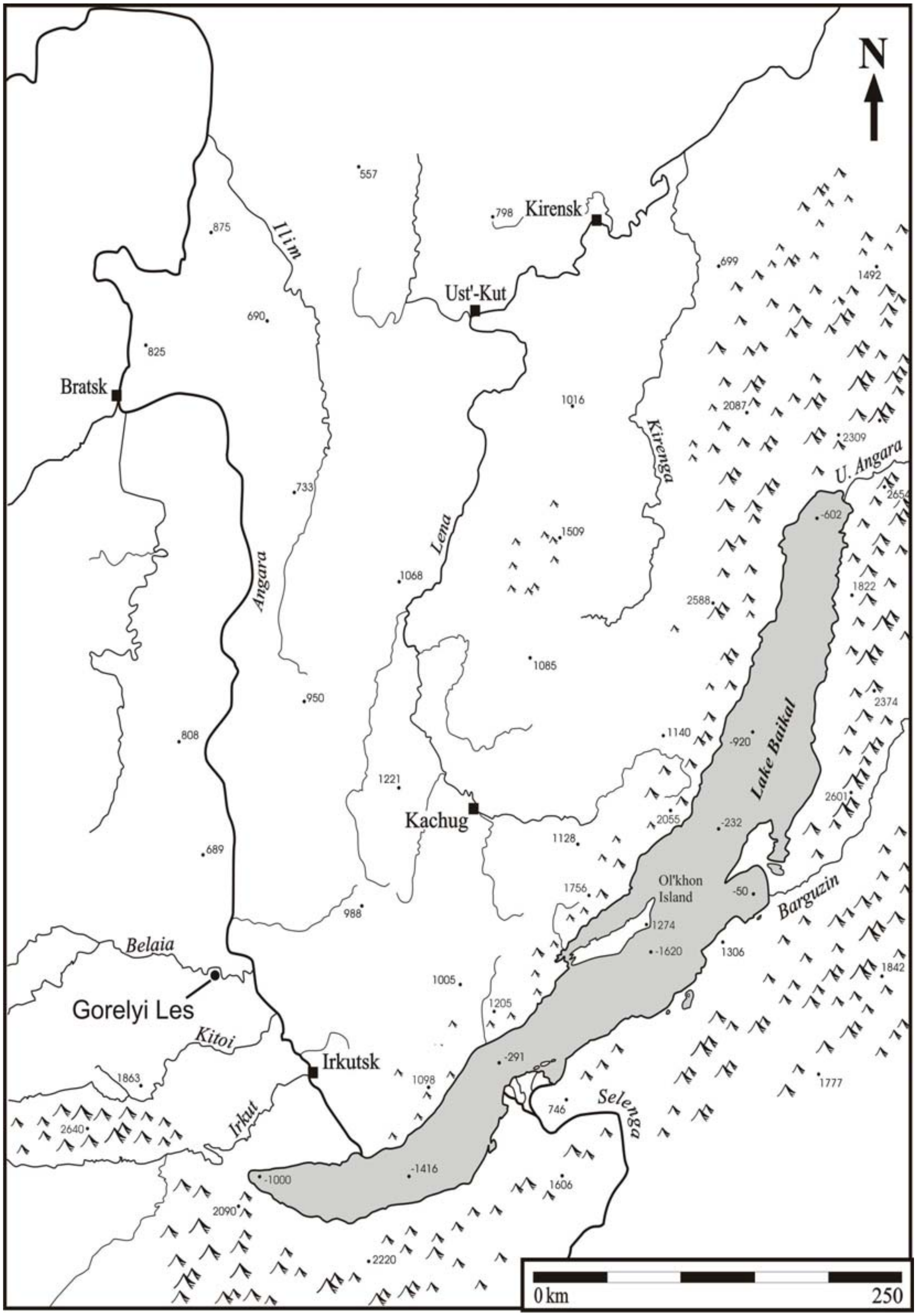

Figure 1.2: Map of the Cis-Baikal indicating location of Gorelyi Les.

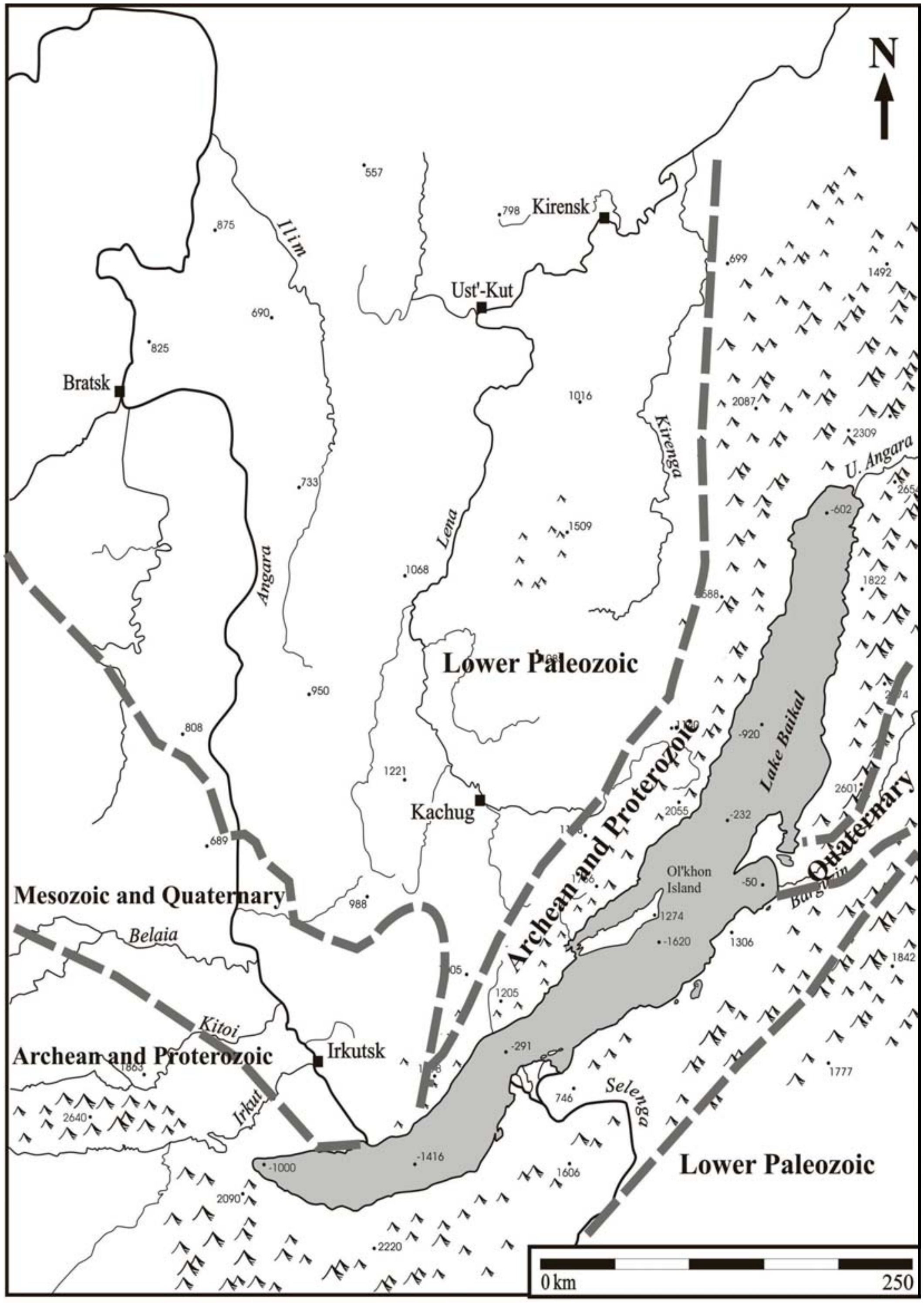

Figure 1.3: General geological map of the Cis-Baikal region.

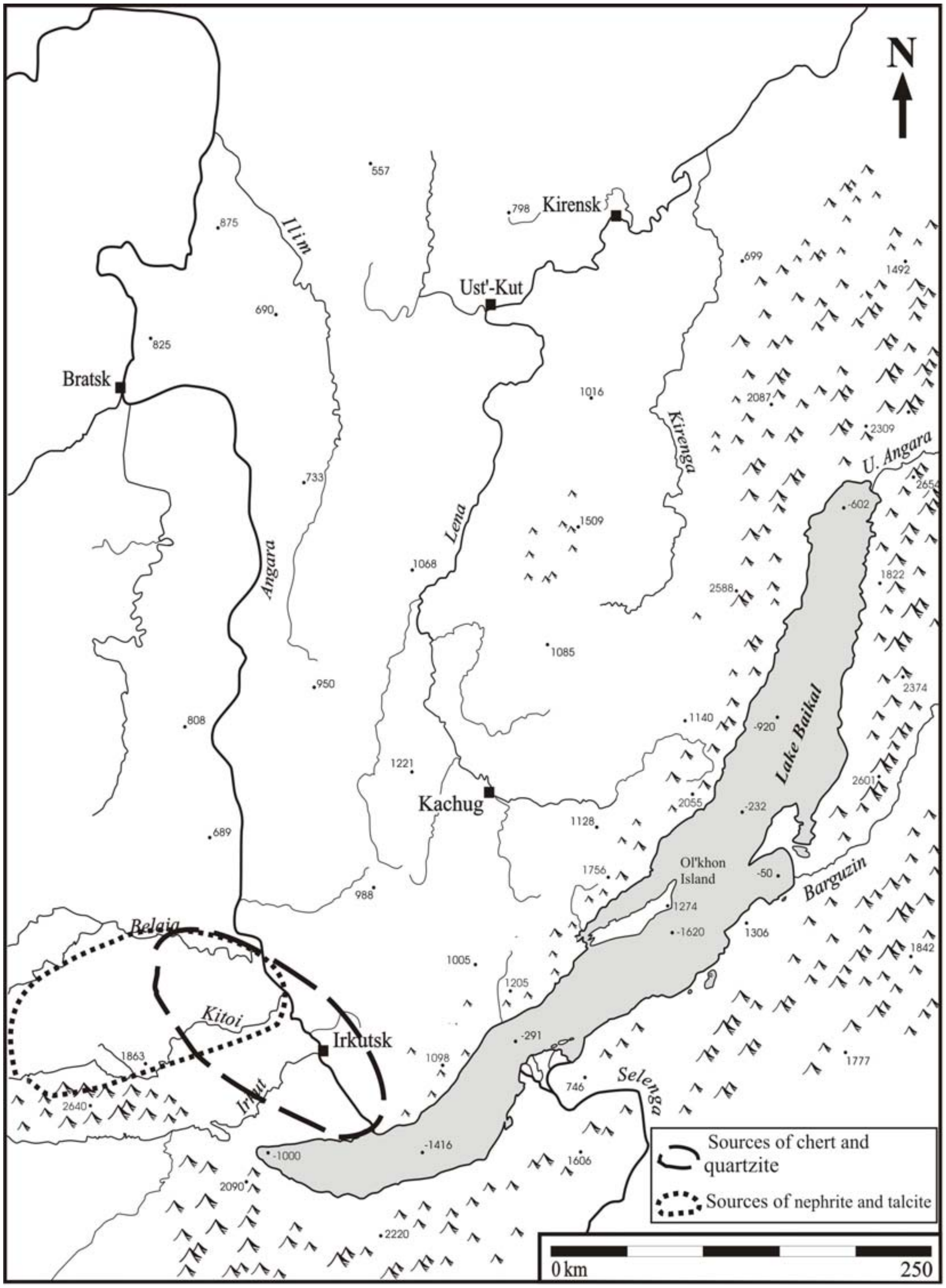

Figure 1.4: Sources of raw materials in the Cis-Baikal region (after Bazaliiskii et al. 2007)

Chapter 2
Archaeological context

2.1 Site description

2.1.1. Archaeological fieldwork at Gorelyi Les

The archaeological site Gorelyi Les is located on the right bank of Belaia River, ~100 km north of Irkutsk in the southern part of the Cis-Baikal region, Eastern Siberia (Figure 1.2). The Gorelyi Les site was discovered in September 1970 by an Irkutsk State University expedition lead by N.A. Savel'ev (Berdnikova et al. 1991). The clean-up of a high floodplain bank exposure revealed clear stratigraphic separation of several horizons containing archaeological materials – a rare situation in the Cis-Baikal region (Weber 1997). In 1971–1972 and 1974 the same research team under supervision of N.A. Savel'ev continued its investigations at Gorelyi Les (Berdnikova et al. 1991). During these years more than 750 sq. m were excavated (Figure 2.1), making this site one of the largest multilayered and multi-component habitation sites ever excavated in the Cis-Baikal region (Berdnikova et al. 1991). The importance of this archaeological site is in the presence of a continuous archaeological record from the Mesolithic to the Iron Age. The clear stratigraphic separation of these cultural materials makes this site a valuable source for studying prehistoric hunter-gatherers in the region (Savel'ev et al. 1974). Moreover, the archaeological materials obtained there represent much of the overall spectrum of artifacts from habitation sites throughout the Holocene.

Unfortunately, interpretation of these materials has been complicated by: (1) lack of information about the geomorphology of the Belaia river valley, which has constrained our understanding of formation of the archaeological record at Gorelyi Les; and (2) absence of a comparative stratified multilayered site in the southern part of the Cis-Baikal region (Savel'ev et al. 1974).

Moreover, a noteworthy problem is the fact that the results of the 1970s excavations have not been published, except for several publications with only preliminary and generalized information (Berdnikova et al. 1991; Igumnova and

Batrakova 2002; Goriunova, 1974; Savel'ev et al. 1974; Weber 1995; Weber et al. 2002). Nevertheless, the significance of Gorelyi Les for Cis-Baikal prehistory has been established, and it has become an important reference site.

Subsequent investigations at Gorelyi Les were conducted by a Russian-Canadian Baikal Archaeology Project. During the summers of 1994–1996 an international team under the supervision of A.W. Weber (Dept. of Anthropology, University of Alberta) and N.A. Savel'ev (Dept. of Archaeology, Ethnography, and History of Ancient World, Irkutsk State University) continued excavating at Gorelyi Les (Figure 2.2). The objectives of this project were to verify the reported stratigraphy of the site, evaluate the nature of site formation and transformation processes, assess the degree of vertical separation of various cultural levels, in particular the Late Mesolithic and Neolithic deposits, and, finally, correlate the identified cultural levels with mortuary traditions in the Cis-Baikal region (Weber 1997).

Despite the relatively small size of the excavated area (8 sq. m) (Figure 2.3), valuable refined information has been obtained owing to improved excavation methods and more attention to microstratigraphy. In particular, during the excavations starting from cultural layer V, trowel shaving was supplemented by screening the sediments using a 1/8-in (or 3.17-mm) wire mesh; consistent three-dimensional provenience control was used to register the artifacts; and finds from the areas affected by various post-depositional disturbances (that might have affected the archaeological context) were recorded and omitted from further analysis. The combination of these factors helped to obtain precise and comprehensive information about the site.

The excavations contributed to improving the model of cultural change during the Holocene in the Cis-Baikal region. Pursuing this further, the pattern documented at Gorelyi Les provided additional evidence for some important differences in general adaptation strategies and approaches to exploiting resources (e.g. game, fish, etc.) by Holocene hunter-gatherers in the Cis-Baikal region. For instance, early Neolithic Kitoi groups resided at this location for longer periods of time engaging in various activities, while Middle/Late Neolithic Serovo-Glazkovo peoples occupied this place for much shorter intervals and left fewer traces of their activities. While ungulates were presumably the basic subsistence resources for both groups, the strategies of their procurement and processing might have differed substantially (Weber et al. 2002). The origin and nature of these differences still remain unclear. The materials examined in this study were obtained during excavations in1994–1996.

The work at Gorelyi Les and the adjacent area was continued in 1998 by a multidisciplinary research team of Russian scholars with the project “Integration (Cultural and Natural Phenomena in the Late Pleistocene and beginning of Holocene)” (Berdnikova et al. 1998). As opposed to previous investigations, the aim of this project was primarily to study the geomorphology of the Belaia river valley, to elucidate aspects of sedimentation processes, and to reconstruct the paleoenvironmental history of the region overall. Most of the excavation activities of this team were concentrated at Gorelyi Les. The total unearthed area was ~32.5 sq. m including three test pits, two trenches, and a series of clean-ups of bank exposures (Berdnikova et al. 1998). In relation to previously excavated territory this area has been located on the northern side of Trench E, excavated in 1994–1996.

The results of this project are of additional value for analysis and interpretation of archaeological materials, and for revealing the history of sediments deposition. For the first time, the formation and age of deposits of the floodplain were scrutinized, as well as of the first terrace of the middle section of the Belaia River. The excavations also yielded interesting archaeological materials that provided new data for the history of the southern part of the Cis-Baikal region. Generally, these materials are similar to those obtained during previous stages of research at Gorelyi Les.

In sum, diverse archaeological materials and paleoenvironmental information have been collected at Gorelyi Les during extensive excavations over the past approximately 40 years. Regrettably, these materials have rarely been used in comprehensive analysis, other than in several publications with brief descriptions of artifacts, stratigraphy, and site chronology coupled with unsubstantiated conjecture about ancient hunter-gatherer subsistence patterns, settlement systems, and technology (Oshibkina 1996; Berdnikova et al. 1991; Savel'ev et al. 1974; Weber 1995; Weber et al. 2002).

2.1.2. Geoarchaeological context

According to the geoarchaeological classification system for the region (Medvedev et al. 1996), the Gorelyi Les site belongs to the *Gorelolesskii* archaeological microregion – an area with archaeological sites that usually share similar geomorphological characteristics and exhibit a consistent succession of archaeological and paleontological deposits (Medvedev 2001). The Gorelolesskii microregion occupies the right bank of the Belaia River and continues along it for ~6 km in a SW–NE direction. The northern and southern borders of this area are the Belaia River and the Khaita River, respectively. A narrow part of the valley near the village Uzkii Lug forms its northeastern edge. Hence, it appears that the Gorelolesskii archaeological microregion occupies an orographically isolated area suitable for minute examination of unconsolidated sediments, owing to the presence of several relief elements with a varying history of sedimentation and with a specific character of distribution of cultural remains (Berdnikova et al. 1998).

The dominant depositional processes in the Belaia river valley are associated with hydrological factors. The fact that the river runs through a natural depression (Sayan piedmont) predetermined the accumulation of sandy, loamy, and sandy-loamy sediments throughout all times (Medvedev et al. 2001). Archaeological sites in the valley, including Gorelyi Les, are usually attached to the high flood plain (Berdnikova et al. 1998). The part of the valley where Gorelyi Les is situated is rather wide and experiences flood, generated by heavy precipitation, usually in spring, that rapidly covers the cultural remains with alluvial sediments (Weber 1997). In other words, during the high-water periods the stream velocity at this section of the valley decreases, water dissipates, and fine-grained sediments fall out of suspension on the floodplain without destroying previously deposited beds. Recurring floods contribute to a gradual aggradation of the sterile layers of sediments separating the cultural horizons. Consequently, discrete depositional events that took place in the past, and their approximate duration, can be identified to some degree.

On the other hand, sediments of the alluvial floodplain at Gorelyi Les usually exhibit similar physical properties within this facies (e.g., grain size, sorting, bedding pattern, etc.). This fact can distort our ability to identify the interrelationships between strata, unless other factors assist in recognizing them. Among these factors are *cryoturbational disturbances* and *pedogenesis*.

Cryoturbational disturbances are indicators of climate change, particularly of decreasing temperature and aridization; they correlate with the appropriate periods within the chronological model of the region (e.g., Subboreal and Subatlantic), which helps to establish the relative chronology of a site (Vorob'eva and Medvedev 1984). At Gorelyi Les, cryoturbation effects are represented by frost wedges only in the lower horizons, although frost wedges are weakly developed and do not affect the integrity of the layers significantly (Weber 1997). Second, pedogenesis at Gorelyi Les occurred during the periods of environmental stability, and this process became an important chronological indicator. The degree of development of paleosols is determined by the duration of this stability – the longer sediments were exposed at the surface, the more developed the soil structure became.

A picture of cross-section of Trench E II and a schematic stratigraphic column are presented in Figure 2.4 and Figure 2.5, respectively**.** This column reflects a consistency of the stratigraphic observations with those made during earlier excavation periods. Of the 14 pedostratigraphic units, the 3Cb, 4Ab, and 5Ab strata (which coincide with the cultural layers V, VI, and VII respectively) are of particular interest for this research. Their further description is based on data collected during the excavations of 1994–1996 (Weber 1997).

Unit 3Cb is a 26–31cm thick, very dark grayish-brown (2.5Y3/2) loam. It has few very fine roots, with a clear smooth boundary, and represents slightly altered parent material. This unit, however, shows much discontinuity and in some spots more pedological units could be identified within it. The main cause of such a pattern is unstable environmental conditions accompanied by an intensive deposition of alluvial sediment at the site. The soil discontinuity corresponds well with the intermittent character of the fifth cultural level reported earlier (Savel'ev et al. 1974). Unit 4Ab is a 15–20 cm thick, very dark gray (5Y3/1) loam. It has many fine roots, as well as a clear smooth boundary. Thus, horizon 4AB is a paleosol that was covered by sediments during a flood episode(s) and then itself subjected to pedogenesis, becoming horizons 3Ab and 3Cb. Consequently, two of the aforementioned horizons (3Cb and 4Ab) are separated by geological unconformity. The duration of this unconformity is somewhat unclear (it may be either a short or relatively protracted period of time, up to several hundred years). Unit 5Ab is a 9–12 cm thick, black (2.5Y2.5/1) loam. It has a clear smooth boundary, abundant fine roots, and is separated from unit 4Ab by the sterile loamy sand layer 4Cb.

Finally, one can conclude that every layer containing archaeological materials is well separated and is not extensively affected by post-depositional disturbance. The nature of the sedimentation processes at Gorelyi Les reflects a series of stable periods and aggradational events (floods). This situation might have affected ancient hunter-gatherer behavioural patterns in terms of their selection places for residing and performing various activities. Namely, the occupation periods were intermittent, presumably had a seasonal character, and occurred between flood episodes (Savel'ev et al. 1974).

2.1.3. Site chronology

The chronology of periods and cultures in the Cis-Baikal region is established on the basis of chronometric and relative dating methods; both of these categories have their own specific character, which should be taken into consideration when describing the chronology of Gorelyi Les. Firstly, the radiocarbon dates obtained from mortuary contexts in the Cis-Baikal region significantly outnumber the dates obtained from habitation sites. Thus, the dates obtained from mortuary site are mostly used for building the culture-historical models in the region (Weber 1995; Weber et al. 2010). One of the possible explanations for this is that the radiocarbon dates that were obtained from materials other than human bones (e.g., charcoal, animal bone, etc.) may not be linked to the humans and their activity directly. For example, radiocarbon dates obtained from sediments (e.g., soils) represent rather history of sedimentology and provide larger time span where the discrete cultural event took place.

Most of the habitation sites of Middle Holocene age in the Cis-Baikal region dated with chronometric techniques are well-studied multi-layered sites from Ol'khon Island region on Lake Baikal such as Ulan-Khada, Berloga, Ityrkhei, and from the Angara basin, e.g. Ust'-Belaia and Ust'-Khaita (Goriunova and Vorob'eva 1986; Savel'ev et al. 2001; Vorob'eva et al. 1992). However, the information about the samples submitted for radiocarbon dating, and the archaeological context they derive from, as well as the comprehensive evaluation of the obtained dates), is scarce and rarely presented in the publications of Russian scholars.

The BAP has managed recently an extensive radiocarbon dating of habitation sites in the Cis-Baikal region, such as Ityrkhei, Sagan-Zaba, Bugul'deika, and Gorelyi Les, with modern techniques that provide more reliable results. However, most of these new dates are still unpublished. In general, the disparity between the sets of radiocarbon dates from cemeteries and habitation sites is gradually decreasing.

Relative dating techniques

Relative and chronometric dating techniques have been used to establish the Gorelyi Les chronology. The relative dating of Gorelyi Les is based on analysis of the stratigraphic succession of deposits and comparison of the archaeological remains with morphologically similar artifacts from other archaeological sites that are attributed to the particular historical period.

The Pleistocene environmental history of the middle section of the Belaia River has been studied thoroughly and in greater detail than the Holocene environmental record for the same area (Berdnikova et al. 1998; Lezhnenko and Vorob'eva 2002). However, the general environmental dynamics of the Holocene period are relatively well known and have been correlated with the existing geochronological framework. At Gorelyi Les, the Late Mesolithic and Early

Neolithic levels are associated with pedostratigraphic units 5Ab and 4Ab, respectively (Figure 2.5). They are humus-rich soil horizons that developed during periods of environmental stability. The 4Ab level is thick (20 cm) and saturated with archaeological finds that may indicate a substantially longer period of conditions conducive to pedogenesis (Weber 1997). Despite the fact that the environmental situation during both periods might have been quite similar, the marked discrepancy in density of archaeological materials between the two layers suggests a higher frequency of occupation episodes and their longer duration during the Early Neolithic period at Gorelyi Les.

Units 3Ab and 3Cb represent a series of flooding episodes that reflect a relatively long period of environmental instability. The archaeological materials of the Late Neolithic age came from the 3Cb horizon (Figure 2.5). Unstable conditions (floods and active eolian processes) did not facilitate the development of well defined soils and, presumably, may account for the vertical separation of various Late Neolithic occupations. As well as their distribution in the form of distinct horizontal clusters sealed in two soil horizons, neither of which is continuous throughout the site (Weber 1997).

Thus, the sediments, their characteristics, and their place within the stratigraphic sequence correlate well with the regional geochronological scheme, and this helps to establish the age of the deposits at Gorelyi Les. The designation of stratigraphic units 5Ab, 4Ab, and 3Cb as Mesolithic, Early Neolithic, and Middle Neolithic periods, respectively, appears to be reasonable and supported by the paleoenvironmental inferences. Furthermore, these observations were confirmed during excavations of the multilayered habitation site Ust'-Khaita located in a similar geomorphological setting and exhibiting direct parallels with Gorelyi Les (Savel'ev et al. 2001).

Comparison of morphologically similar artifacts for determining site chronology is less advantageous, because of the differences in archaeological context in every particular case. The Cis-Baikal region does not exhibit a uniform and contemporaneous development of archaeological cultures during all cultural periods. Archaeological sites of the same period in various microregions of the

Cis-Baikal region have slightly different chronological patterns and possess their own specific characteristics (Weber et al. 2010). Among all categories of archaeological remains at Gorelyi Les, only ceramics and certain tool types can be used to some extent to establish site chronology. The presence of ceramic vessels in the archaeological record indicates that the archaeostratigraphic unit containing them is no older than Early Neolithic (or ~ 7000 years BP). It is conventionally accepted that pottery appeared in the Cis-Baikal region at the turn of the eighth and seventh millenia BP during the Neolithic period, and in fact, became a diagnostic characteristic of this cultural stage (Goriunova 2003; Savel'ev 1986). Among a variety of pottery styles, the net-impressed vessels are believed to be the oldest in the region (Weber 1995). At Gorelyi Les, net-impressed sherds were found in Layer VI in conjunction with cord-impressed (Khaita style) pottery. This situation has often been documented at habitation sites in the Angara basin and characterizes the Early Neolithic (Savel'ev 1974; Weber 1997). Moreover, the only type of pottery found in Early Neolithic Kitoi graves is net-impressed ceramic (Bazaliiskii 2010). Despite the fact that the correlation of materials from cemeteries and habitation sites remains disputable, the above-mentioned fact can be treated as indirect evidence when establishing the chronological patterns at Gorelyi Les. It should be mentioned also that several net-impressed sherds were recorded during excavation of in the 1970s and 1990s in Layer VII, which is believed to be of Late Mesolithic age. This situation could be explained by post-depositional disturbances (Weber 1995); namely, frost wedging and rodent activity might be responsible for the displacement of artifacts to lower levels.

As for lithic artifacts, the important categories of tools for developing chronological inferences are composite fishhooks of Kitoi type and arrowheads, found, respectively, in Layers VI and V of Gorelyi Les. Kitoi-type shanks of composite fishhooks are culturally significant artifacts for the Kitoi mortuary tradition (Bazaliiskii 2003). Their very frequent presence in graves clearly indicates the Early Neolithic age of these objects. Similarly, Kitoi fishhooks at habitation sites can be attributed with certainty to the same period. However, few Kitoi-type fishhooks (two specimens) have been found in Layer V (Late

Neolithic) at Gorelyi Les (Berdnikova 1998; Savel'ev et al. 1974). Apparently, it can be explained by post-depositional disturbances and/or inaccurate excavation techniques (Weber 1995). Also, it seems that mixing of archaeological materials from different cultural layers to some extent (presumably only minor and in rather small local areas) took place owing to those above-mentioned factors.

The arrowheads, in turn, exhibit wide range of variability and recognizing and assigning a particular type to an exact chronological stage is a challenging task. The Kitoi type arrowheads are usually characterized by the leaf-shaped form, concave base, and asymmetrical barbs. Two of them were found in Layer VI at Gorelyi Les and this is also an evidence of its Early Neolithic age. However, the arrowheads found in Early Neolithic Kitoi graves exhibit greater variability of morphological traits (Bazaliiskii 2010). In sum, the relative dating methods provide only approximate chronological framework for Gorelyi Les.

Chronometric dating techniques

Radiocarbon and paleomagnetic dating were the chronometric dating techniques employed for materials from Gorelyi Les. Paleomagnetic dating did not provide satisfactory results, and will be omitted from further discussion (out of 11 ceramic fragments submitted for dating only two provided the reliable results) (Weber 1997). However, the radiocarbon dating method provided sufficient data for further discussion.

Uncalibrated radiocarbon dates will be used in this work for the purpose of consistency, because they dominate the Russian archaeological literature and were used for establishing most of the existing cultural historical schemes in the Cis-Baikal region. Moreover, for the present research it is more important to establish a time range for the various occupations at Gorelyi Les rather than to establish an exact calendar age. Thus, all available dates have been calibrated using OxCal v. 4.1 and the most recent calibration dataset the INTCAL 09 calibration curve (Reimer et al. 2009). The online Bayesian program BCal was used to identify potential outliers in the available set of dates and a posterior probability of distribution for length of time elapsed between the earliest and oldest date for Layer VI and Layer V (http://bcal.sheffield.ac.uk; Buck et al. 1999).

The first set of radiocarbon dates was obtained shortly after extensive excavations of the 1970s (Veksler and Putans 1974). Today, the lack of information about the cultural context of the samples and about handling procedures make the accuracy of these dates arguable (Weber 1995). On the other hand, they are worth mentioning since they do not contradict the stratigraphy of the site and are consistent with modern AMS dates. The next stage of radiocarbon dating at Gorelyi Les took place after the 1990s excavations, in the IsoTrace Laboratory at the University of Toronto. Finally, several samples from Gorelyi Les have been submitted recently for radiocarbon dating to Oxford University. The purpose of the last dating project was to confirm the chronological pattern of the site and to assess the chronology of Layer VI, which is believed to reflect a long period of numerous repetitive occupations by ancient hunter-gatherers. Unfortunately, the samples of pottery submitted for radiocarbon dating did not provide results, due to low carbon yield, but the bone samples were dated successfully.

All the available dates are presented in Table 2.1. Out of 14 radiocarbon dates, three were obtained from charcoal, eight were obtained from animal bones, and the sources of the last three dates are unknown. The value of these dates for reconstructing the chronological pattern of the site is not equal. For example, dates that came from unknown contexts cannot be associated with human activities.

In general, there is an inherent difficulty in establishing associations between the dated material and specific activities or occupations, especially within habitation sites, because their stratigraphic units represent a combination of various and numerous site formation processes (e.g., cultural activities, natural sedimentation processes, etc.) accumulated over long periods of time, in the range of hundreds and thousand years (Weber et al. 2008). Consequently, it is not expected that the radiocarbon dates would exhibit a tight distribution within any of the three dated cultural layers at Gorelyi Les.

According to the available dates, Layer VII corresponds to the Late Mesolithic, or end of the 7th millenium BP. The boundary between the Mesolithic and Neolithic stages has been drawn at the end of 8th – beginning of 7th millennium BP on the basis of the date from the bottom of Layer VI (6995 ± 150 Ri-50) (Savel'ev et al. 1974). Newly obtained dates (7000 ± 50 OxA-20575, 7100 ± 50 OxA-20576) for the bottom of the same layer are slightly older but generally confirm the previous dates. The upper chronological limit of this layer reaches roughly the middle of the 8th millennium BP (6500 ± 100 To 4830); it is also confirmed by a recent date (6500 ± 50 OxA-20573). Consequently, the occupation of Gorelyi Les spanned at least five centuries during the Early Neolithic period. In terms of microchronology of Layer VI, it is reasonable to suggest on the basis of the vertical distribution of the archaeological remains that one can delineate at least two stages of occupation of the site during that time: an initial phase (beginning of 8th millennium BP) and a final phase (middle of 8th millennium BP). Such a partition is arbitrary because this layer, undoubtedly, represents a palimpsest of numerous repetitious occupations and, moreover, many more dates should be obtained before reliable conclusions can be drawn. Nevertheless, such a hypothesis should be considered unless and until the new information that can support or disprove this theory becomes available for analysis.

The dates from Layer V fall between the beginning and middle of 6th millennium BP (5700 ± 50 OxA-20574, 5400 ± 100 Ri-52). Thus, the Early Neolithic and Late Neolithic layers are separated by a relatively protracted period of time (~800 years).

A plot of the posterior probability distribution of all 14 calibrated radiocarbon dates suggests rather clear situation regarding chronological separation of cultural layers (Figure 2.6). However, one date (TO-6484) falls in the period between the Late Mesolithic and the Early Neolithic and appears to deviate markedly from the rest of dates from Layer VI (Figure 2.6). If this date is accurate and correctly reflects the sample age it may indicate a continuous occupation of the site through the Late Mesolithic and Early Neolithic. Nevertheless, a single radiocarbon date could not be a sufficient evidence to support or disprove such a statement. On the other hand, several reasons may account for this deviation: (1) mishandling of the sample; (2) laboratory error; and (3) taphonomic processes that displaced the dated sample from its original location. Since, the validity of this date is impossible to confirm through resubmitting the sample for dating because none of it is left, the date (TO-6484) is omitted from further analysis.

Another important problem for present research is estimating what amount of time is represented by the radiocarbon dates from Layer VI and Layer V. However, one should be aware that this amount of time does not directly correlate with the duration of site occupation by prehistoric populations. The most probable time spans represented by the radiocarbon dates from Layer VI and Layer V were calculated with BCal program. This online Bayesian radiocarbon calibration tool allows us to view all possible estimates of the posterior probability distribution for the length of time elapsed between pairs of parameters (in this case, between the oldest and youngest dates). In other words, we can identify the minimal duration of a time period that produces the given distribution of radiocarbon dates. The most probable time span represented by the radiocarbon dates from Layer VI is between ~600 and 700 years (Figure 2.7). The most probable time span represented by the radiocarbon dates from Layer V is between ~800 and 1,000 years (Figure 2.8).

In sum, when the dates are considered in relation to stratigraphy, no stratigraphic reversals are present. Occupation of the site spanned much of the Holocene and, presumably, was most intensive roughly between ~7000 and 6500 BP. Taken as a whole, the culture-historical designation of the layers at Gorelyi Les is rather reliably established. Thus, layer VII is Late Mesolithic, layer VI is Early Neolithic, and layer V is Late Neolithic. These correlations have been confirmed to be valid during several excavation periods on the basis of stratigraphic observations, typological analysis of archaeological materials, and chronometric dating results.

2.2 Archaeological materials

The archaeological assemblage recovered at Gorelyi Les during excavations in 1994–1996 from trench E II consists of three major components: lithic objects (including modified rocks and manuports, e.g., unmodified rocks which have been intentionally brought to the site), fragments of ceramic vessels, and faunal remains. Below, I will briefly describe them and provide basic quantitative data for all categories of artifacts.

2.2.1 Pottery

Fragments of ceramic vessels constitute a minor part of the whole archaeological assemblage recovered in the mid-1990s. However, previous excavations during the mid-1970s yielded rather substantial quantity of various pottery sherds (at least 49 refitted vessels from 750 m^2), including a unique sherd with a zoomorphic/anthropomorphic image (Goriunova 1974; Savel'ev et al. 1974; Spiridonova 2008). The total amount of ceramic sherds recovered in 1994–1996 is 54, and most of them (52 sherds, or 96%) were found in Layer VI, and only two sherds came from Layer V (Table 2.2). The pottery sherds recovered in the mid-1990s purportedly represent only two or three ceramic vessels (Weber 1997). Despite the fact that some sherds were refitted, their relatively small size did not provide enough information to reconstruct vessel size and shape. Most of them (48 sherds) are body parts and only six are rim fragments (Table 2.2).

Among all sherds one can identify two types of pottery with different morphological and technological characteristics. The first type, which dominates the assemblage, is net-impressed pottery with specific imprints on the exterior surface. The thickness of the sherds varies between 0.4 cm and 0.6 cm, and four pieces are 0.7–0.9 cm thick. Besides net imprints (a technological ornament formed during the manufacturing process), the sherds also have stamped impressions of an oval shape on the rim. The rim sherds are bent slightly outward, with a flat lip and square cross-section.

The second type is cord-impressed (Khaita style) pottery, represented by seven sherds. This style is typified by thin cord impressions on the exterior surface and several rows of incised lines near or below the rim (Savel'ev 1989). The thickness of the sherds varies between 0.4 and 0.6 cm.

Also, there are three sherds that are impossible to identify owing to their small size or severely weathered surfaces.

All pottery had a paste with inclusions of a mineral temper such as sand, gravel, and grog. Overall, these pottery styles are typical for the Neolithic of the middle section of the Belaia River, and correlate well with materials obtained from other archaeological sites in this area, such as Ust'-Khaita, Lugovaia, Mishelevka Sad, etc. (Savel'ev et al. 1974; Spiridonova 2008).

2.2.2 Faunal remains

Faunal remains are the largest category (83%) of all archaeological finds recovered at Gorelyi Les and, moreover, the only type found in all cultural layers. Recently, a zooarchaeological analysis of faunal remains from the excavations of 1994–1996 was undertaken by Elspeth Ready, University of Alberta, as part of her honours undergraduate thesis (Ready 2008).

There were 11,575 bone fragments, weighing 2126.07g, recovered from Trench E II at Gorelyi Les (Table 2.3), of which 10,069 specimens, weighing 998.85 g (87% of the remains by number, 47% by weight), could not be further identified. These specimens are mostly fragmented mammalian bones, too small to be positively identified. It can be said, however, that a large number of fish or bird remains are unlikely to be present among these fragments.

The Late Mesolithic Layer VII contained 417 bone fragments, weighing 30.70 g, of which 404 were unidentified and nine could only be identified as mammal (Table 2.4).

The Early Neolithic Layer VI contained 10,623 bone fragments weighing 1920.72 g (Table 2.4). The vast majority of these specimens were unidentifiable (9,254 specimens) or identifiable only to the class Mammalia (1,084 specimens). Most of these unidentifiable bone fragments were found near or in three hearths in this layer, which yielded large quantities of tiny fragments of charred and/or calcined bones. Other fragments that could not be identified to species included

53 artiodactyl fragments, as well as four petrous portions of the temporal bone that are probably cervid. Identified species included bear (*Ursus arctos*), represented by fragments of a worked canine; a large bovid, represented by a large incisor; pike (*Esox lucius*), represented by one vertebra and also seven fragments of the dentary bone (MNI 1), and finally roe deer (*Capreolus pygargus)*, represented by 211 specimens (MNI 5).

In Layer V there were 209 fragments, weighing 79.75 g (Table 3.4). These included four fragments belonging to two incisors of the genus *Lepus* (MNI: 1), one rodent mandible and three *Capreolus pygargus* specimens (one distal tibia, one distal humerus, and a lateral malleolus, MNI 1). The remainder of the fragments were unidentified (NISP: 141) or identified only to the class Mammalia (NISP: 60).

Three kinds of bone modification are represented at Gorelyi Les: butchering marks, spiral fractures (181 specimens in sum), and burning (1,683 specimens). The only specimen exhibiting use-wear is a bear canine with a sharp, curved point, used presumably for incising or scraping.

Overall, medium- and large-sized cervids such as moose, red deer, and roe deer heavily dominate the bone remains in the Gorelyi Les assemblage. Roe deer and red deer prefer the open landscapes of the forest-steppe zone, and inhabited Angara river basin, providing the bulk of food intake of ancient hunter-gatherers (Weber et al. 2002; Nomokonova et al. 2009). The small number of fish, hare, bison, and bear remains suggests that these resources were not a major subsistence focus at the site at any time.

The composition of the faunal assemblage implies that the hunter-gatherers at Gorelyi Les exploited productive forest edges, river valleys, and meadow patches within open forest areas, where red deer and roe deer were abundant.

2.2.3 Lithic assemblage

Lithic artifacts are the second-largest group of archaeological remains at Gorelyi Les. There were 2,320 pieces (17% of all finds) recorded, weighing

5,238.70 g. These materials are the particular focus of this research and will be analyzed in greater detail in the following chapters. The lithics at Gorelyi Les are mostly debitage, dominated by small-sized pieces. The use of sieves during excavation significantly reduced the recovery bias toward large objects and made possible the retrieval of even very small fragments of rock. Formal tools (e.g., burins, arrowheads, drills, points, etc.), cores, and tool blanks constitute only a minor part of the entire assemblage. Also, the lithics include raw materials and unmodified rocks intentionally brought to the site (e.g., hearthstones).

Table 2.1. Radiocarbon dates from Gorelyi Les

No.	Lab. No.	Layer	Dated material	Collagen yield, %	Age BP	SD
1	KRiL-0234[a]	VII	unknown	-	8850	±300
2	Ri-0051[a]	VII	charcoal	-	8440	±125
3	TO-6485	VI	bone	0.5	6500	±100
4	Ri-0050[a]	VI	charcoal	-	6995	±150
5	Ri-0050a[a]	VI	unknown	-	6695	±150
6	TO-4830[b]	VI	charcoal	-	6510	±70
7	TO-6483	VI	bone	0.8	6520	±70
8	TO–6484	VI	bone	1.3	7890	±80
9	OxA-20573	VI	bone	7.3	6540	±40
10	OxA-20575	VI	bone	4.0	7000	±40
11	OxA-20576	VI	bone	6.9	7100	±40
12	Ri-0052[a]	V	unknown	-	5430	±120
13	GIN-4366[a]	V	bone	-	4880	±180
14	OxA-20574	V	bone	6.3	5670	±30

[a] after Weber 1995; [b] after Weber 1997

Table 2.2. Ceramics from Gorelyi Les (excavations in 1994–1996)

Vessel part	Layer VI			Layer V		
	Net-impressed	Cord-impressed	Unknown	Net-impressed	Cord-impressed	Unknown
body	40	4	2	-	2	-
rim	4	1	1	-	-	-
Subtotal	44	5	3	-	2	-
Total	**52**			**2**		

Table 2.3. Summary of faunal remains (excavations in 1994–1996) (after Ready 2008).

Taxon	Common Name	Trench E-II		
		NISP	MNI	Weight g
Unidentified total		**10,069**		**998.85**
Mammalia	mammal	1160		625.84
Artiodactyla	even-toed ungulate	58		44.20
Bison spp. Aut *Bos* spp	bison	3	1	4.34
Cervid	deer	4		10.28
Capreolus capreolus	roe deer	214	5	373.75
Cervus elaphus	red deer	44	1	59.69
Ursus arctos	bear	4	1	6.69
rodentia	rodent	7	4	0.96
Lepus spp.	hare or rabbit	4	1	0.47
Mammal total		1,498		1,126.20
Esox lucius	northern pike	8	1	1.00
Fish total		8		1.00
Total		**11,575**		**2,126.07**

Table 2.4. Distribution of faunal remains by layer (after Ready 2008).

Taxon	**Trench E-II**								
	Layer V			**Layer VI**			**Layer VII**		
	NISP	**MNI**	**Weight g**	**NISP**	**MNI**	**Weight, g**	**NISP**	**MNI**	**Weight g**
Unidentifed	141		11.51	9,254		933.90	404		28.73
Mammal	60		47.04	1,084		574.10	9		1.14
Artiodactyl				53		37.26			
Cervidae				4		10.28			
Capreolus pygargus	3	1	20.68	211	5	353.10			
rodentia	1	1	0.04	2	1	0.09	4	2	0.83
Lepus	4	1	0.47						
Ursus arctos				4	1	6.69			
Bison spp. Aut *Bos*spp.				3	1	4.34			
Esox lucius				8	1	1.00			
Total	**209**		**79.74**	**10,623**		**1,921.00**	**417**		**30.70**

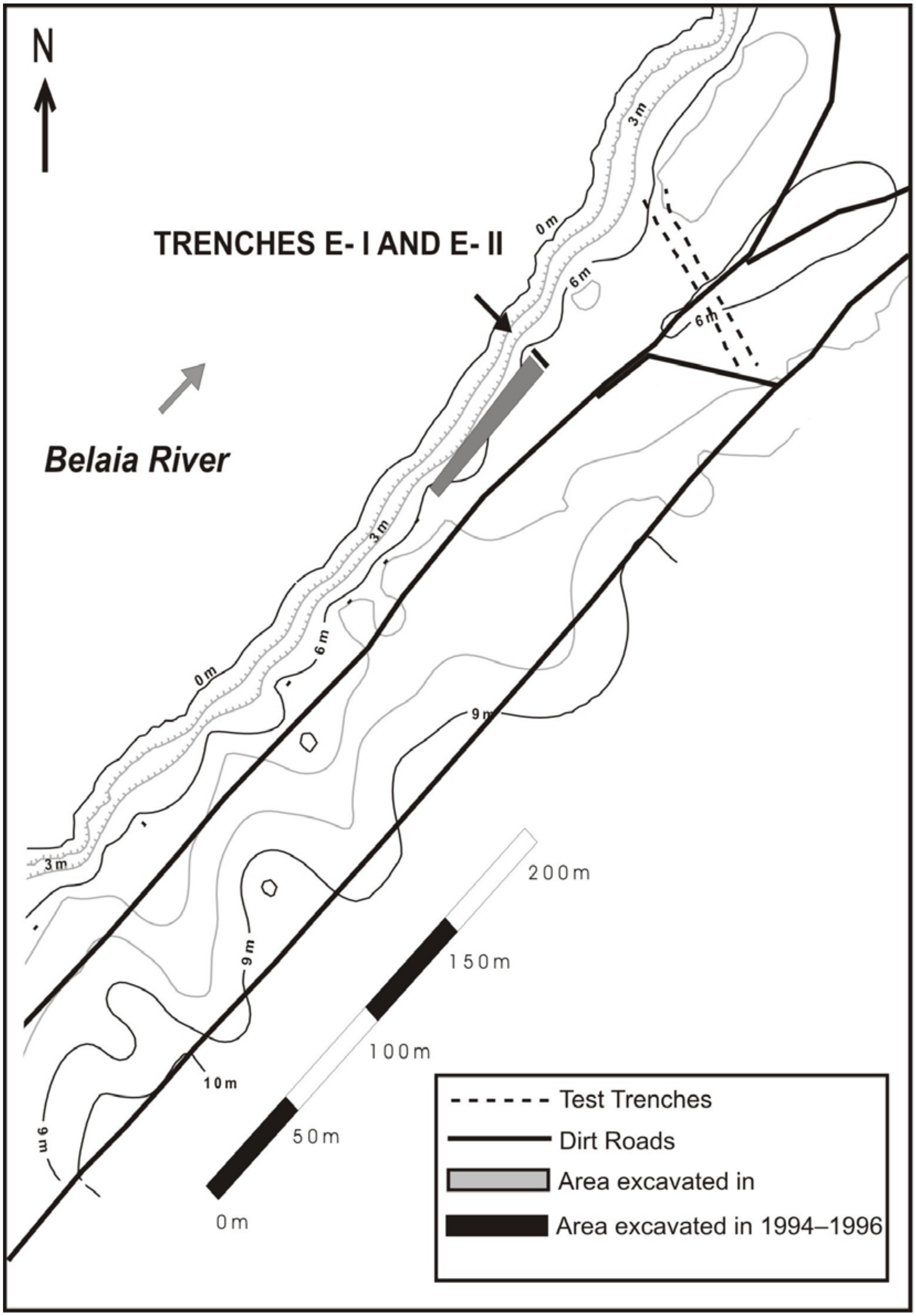

Figure 2.1: Gorelyi Les site plan of excavated areas (after Weber 1997).

Figure 2.2: Photo of Gorelyi Les, view from NW (after Weber 1997).

Figure 2.3: Photo of Gorelyi Les, Trench E, view from SE (after Weber 1997).

Figure 2.4: Photo of cross-section of Trench E II, western wall (after Weber 1997).

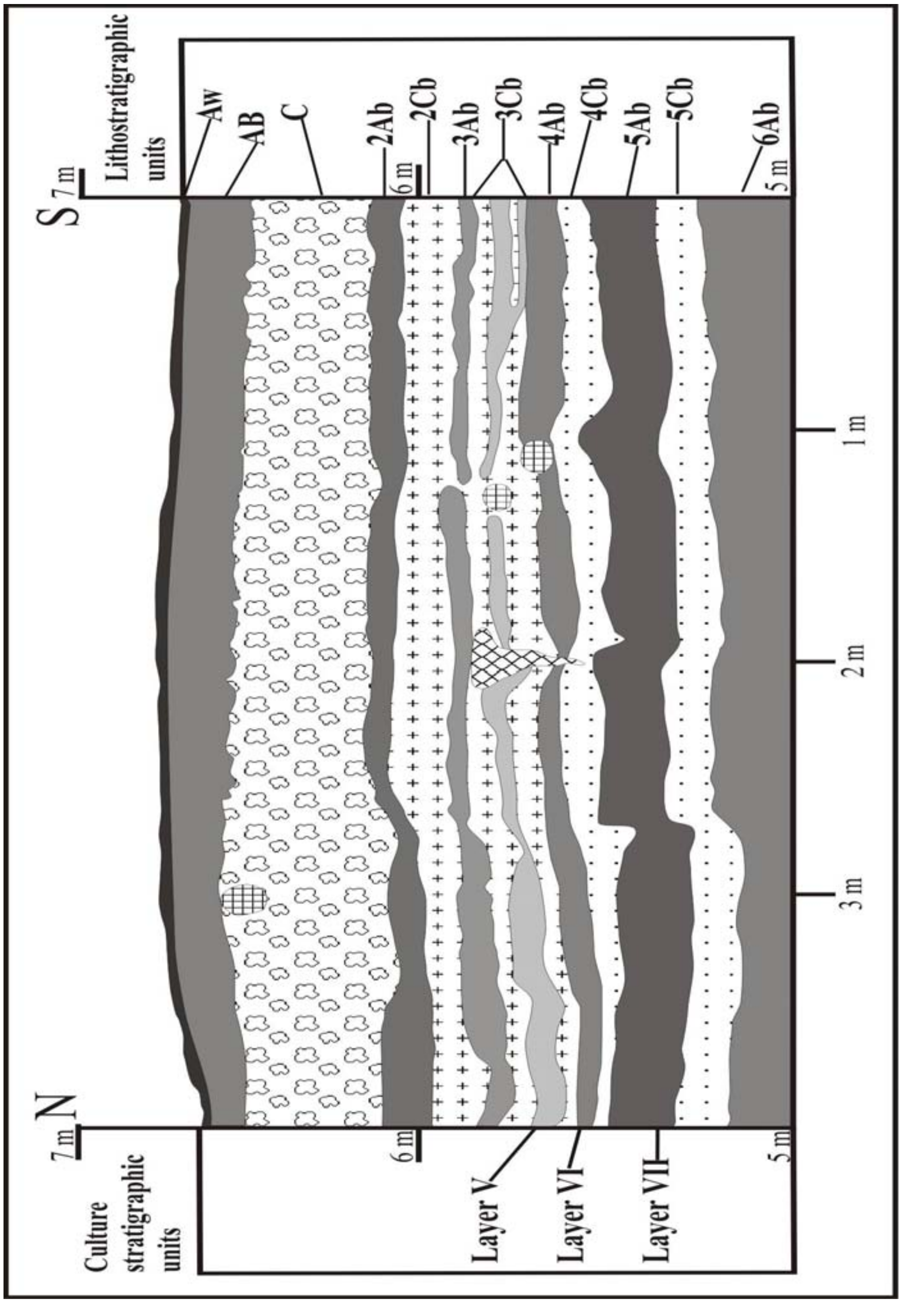

Figure 2.5: Stratigraphic column of Trench E II, eastern wall (after Weber 1997).

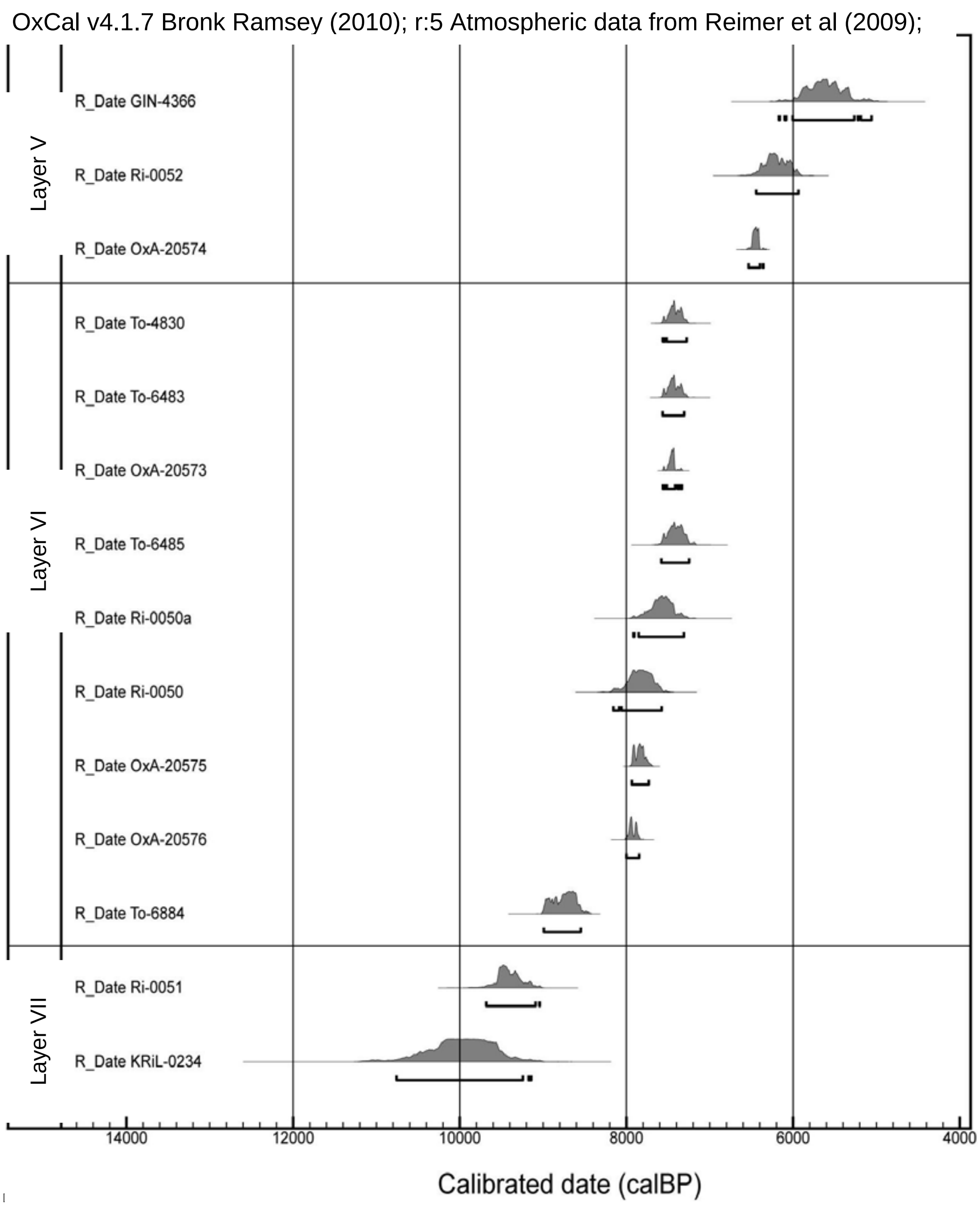

Figure 2.6: Calibration results for radiocarbon dates from Gorelyi Les.

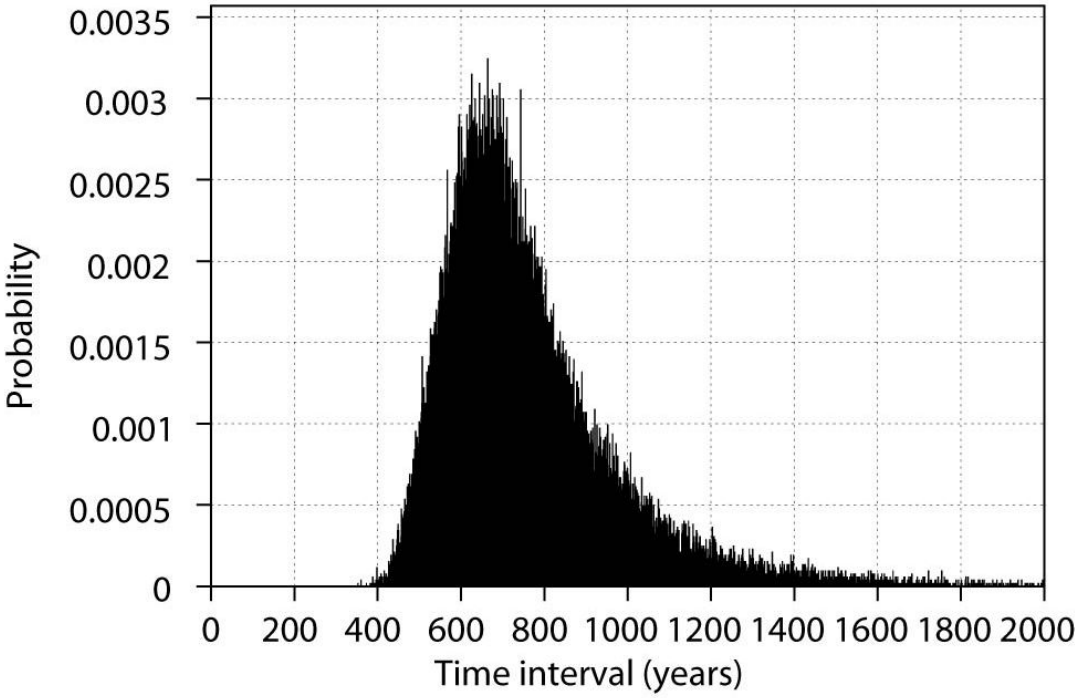

Figure 2.7: Posterior probability of distribution for length of time elapsed between the earliest and oldest radiocarbon dates from Layer VI.

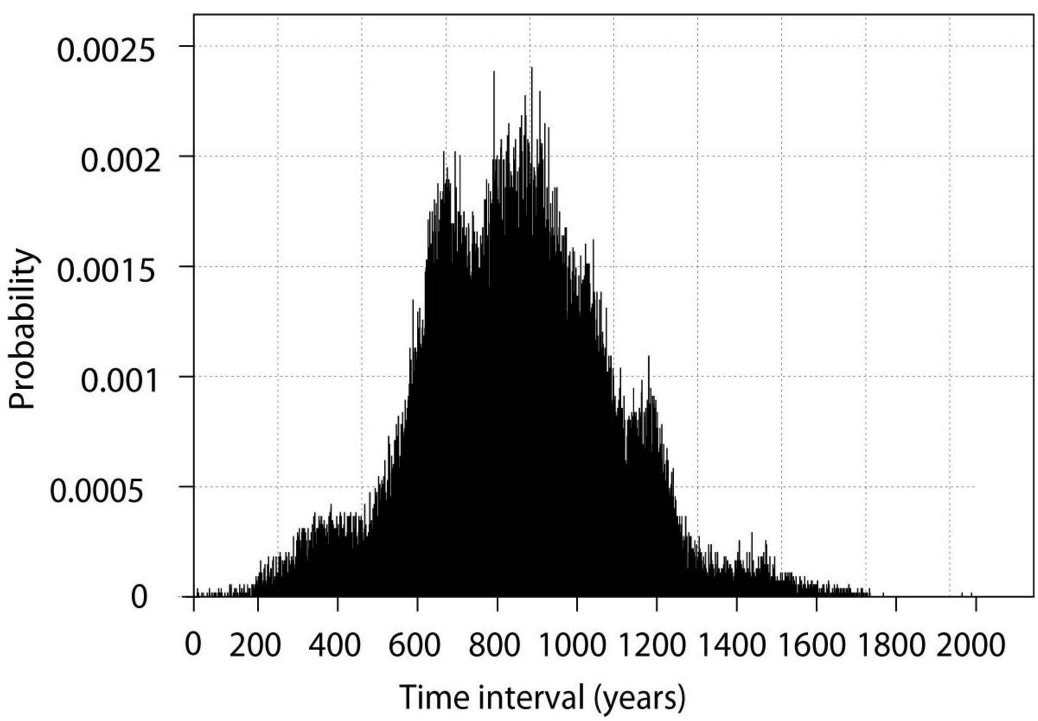

Figure 2.8: Posterior probability of distribution for length of time elapsed between the earliest and oldest radiocarbon dates from Layer V.

Chapter 3
The Lithic Assemblage

Theoretical approach and methods

Contemporary lithic studies address sophisticated questions regarding human adaptations and the role of technologies that cannot be solved by application of a single research tool. Such research demands the use of several different methods that are not only of significance in their own right but also can be mutually complementary. The lithic industry is a system in which all elements are interdependent. These systems possess an objective inner logic of a spatial-geometrical character, and any change of a single element results in a change of the whole system (Suleimanov 1972). Therefore, the combination of multiple vectors of research provides more refined and detailed information about the lithic artifacts and, consequently, about the behaviour of their producers in diachronic and synchronic perspectives. Moreover, the results of several independent methods can be used for mutual verification.

The methodological framework that is employed in this study can be best described as a multidimensional or comprehensive approach (*kompleksnaia metodologiia*) to studying lithic assemblages, following the description of G.N. Poplevko (2007). It includes the application of typological, technological, use-wear, experimental, and spatial analytical approaches. An important aspect of this compilation is the imperative correlation of the results obtained with each individual technique. The combined use of these tools maximizes the information about the techniques employed in producing stone implements, technologically important characteristics of the lithic artifacts, reduction sequence and knapping strategies, tool use, and the internal structure of archaeological sites (Poplevko 2007). Another advantage of this methodological framework is its versatility, which makes it suitable for studying lithic assemblages in various temporal and spatial contexts. All of the above-mentioned aspects are especially applicable in the analysis of our relatively small multi-component lithic assemblage from the archaeological site Gorelyi Les.

Important factors that were taken into consideration in the process of developing the methodological framework of this research were the specific structure of the Gorelyi Les lithic assemblage and its size. The largest category of lithics represented at Gorelyi Les is debitage, while formal tools, cores, blanks, nodules, and some other categories constitute only a minor part of the assemblage. Therefore, significant attention is paid to the methods of debitage analysis. Nevertheless, a complete record of lithic artifacts production and use cannot be found either in tools or debitage alone; they are deserving of equal attention (Shott 1994). In other words, the reconstruction of technological process requires thorough analysis of all available lithic artifacts either formal tools or by-products of their manufacture.

Debitage is a broad category that includes all flaked stone materials not recognized as cores or retouched tools (Fish 1981). More specifically, debitage represents the discarded and unused detached pieces of lithic material produced from the reduction of an objective piece (Andrefsky 2005). Despite the fact that for a long time debitage was not considered a reliable source of information in archaeological research, and it was often omitted in analyse, or was not even recorded and collected during excavations, its importance in lithic studies has increased significantly over the past several decades, providing new lines of research (Andrefsky 2001; Hall and Larsson 2004). Debitage should be routinely analyzed as an integral part of the total artifact assemblage, in order to realize the potential contribution of debitage to cultural interpretations (Fish 1981). There are many areas of cultural interpretation which could be explored using debitage: correlation between lithic wastes and raw material type, patterning within technological and typological facies, temporal and spatial variability, etc. In sum, the present research was designed to represent all categories of lithics, and to analyze each stone artifact.

3.1 Typological and technological analyses

Typological analysis is a basic research tool that provides initial classification of a lithic assemblage into types based upon one or more characteristics. The types often have some kind of technological or functional meaning (Andrefsky 2001). They encode some of the variability discernible in the assemblage along certain dimensions but lack the "specificity and comprehensiveness necessary to capture more than a moderate portion of information about lithics" (Odell 2003:125). The analysis employed here can be classified according to Andrefsky (2005) as a free-standing typology. This uses objective, replicable criteria such as size and weight in conjunction with analysis of other characteristics of individual artifacts (cortex, dorsal scars, etc.). The free-standing typology method helps overcome the limits of the "type" category by increasing the amount of information obtained during description.

Technological analysis revolves mostly around technological classifications that separate the detached pieces into groups based upon some characteristics of stone tool technology. The most frequent technological types are bifacial thinning flakes, bipolar flakes, striking platform preparation flakes, and ridge flakes (or flakes of rejuvenation) (Andrefsky 2005; Root 2004). Such an approach is limited to the recognition of technologically significant types, and to description of the technologies involved in their production. Nekhoroshev (2009) states that technological analysis of lithic industries should include a detailed analysis of the entire body of lithic artifacts in a collection: studying the variability of forms and morphology of the artifacts, establishing relationships between morphologically and formally different knapping products, and establishing sequences of reduction that do not contradict the principle and logic of the reduction process. This statement moves the technological analysis beyond simple classification, and implies a reconstruction of the entire technological process of reduction.

Technology in its broad sense is not simply a sum of material products. Rather, technology represents a system of knowledge, information, and sets of interrelated procedures for doing things – or, from the perspective of evolutionary ecology, a problem solving strategy (Kuhn 1995). An analysis of technology from such a strategic perspective can be seen as learning about the factors that might have influenced the actions of organisms, and about evolutionary solutions that became selectively advantageous (Kuhn 1995). Technological aspects of lithic manufacture, apparently, are among the most important factors that help relate artifacts and the methods of their manufacture with human behavioural patterns. Particular observations such as the direction of flake scars on lithics, proportions, measurements, and their statistical distribution in the industry ultimately reflect a work process, distinctive manufacturing techniques, and the general dynamic of the entire manufacturing process (Suleimanov 1972). Also, one should keep in mind that the discrete knapping event is not always discernible in a lithic assemblage, especially when the lithic assemblage consists primarily of debitage.

In sum, typological analysis explores and documents lithic variability, while technological analysis attempts to explain this variation and to link it to the various aspects of human technological behaviour. In spite of the differences, both these methods are based on an analysis of the characteristics of each stone artifact. The most reliable conclusions about the kinds and amount of stone tool manufacture are based on analyzing debitage attributes linked directly to production technology (Root 2004). Using lithic characteristics, especially at the preliminary stage of lithic analysis, it is not always clear which variables should be considered and which manipulations should be performed in order to derive interpretable results (Fish 1981). We can single out an endless number of attributes, but not all of them are always useful in most of the cases (Magne 1985; Suleimanov 1972). Hence, empirical, often intuitive, observations and choice of attributes, appropriate in every particular situation, precede description. After all, detailed analysis can reveal the real meaning and usefulness of the chosen attributes.

Researchers often design the attribute system they use in lithic analysis according to the research goals addressed. Therefore, the choice of lithic attributes varies, sometimes significantly, from case study to case study (Andrefsky 2005; Odell 2003; Magne 1985). Nevertheless, there have been attempts to develop a unified system of attributes that should be recorded during the analysis of any lithic assemblage (Andrefsky 2005; Odell 2003; Poplevko 2007; Shott 1994). Shott states that “formal analysis requires a minimum set of attributes not linked by assumption to particular knapping behaviours, that can be measured reliably to resist measurement error, that ideally can be measured quickly and efficiently, and that impart a maximum of information with a minimum effort" (1994:79). The "minimum set" usually includes the following variables in different combinations: raw material, linear dimensions, number of dorsal scars, cortex, completeness, and striking platform type and its linear dimensions (Andrefsky 2005; Magne 1985; Shott 1994).

Lithic attributes can be measured and recorded in several different ways. According to Andrefsky (2005), all attributes can be divided into several categories and ranked on the basis of their potential state. For example, on the interval and ratio scales, attribute states are arbitrarily assigned. The nominal scale implies the presence of mutually exclusive or exhaustive states of attributes (e.g., colour, raw material). The ordinal (ranked) scale involves relative ordering of attribute states (e.g., small, medium, and large sizes). Thus, a detailed description of the attributes recording procedure of each variable is necessary for the purpose of replicability – the likelihood that two researchers measuring the same variable can consistently achieve the same result. In other words, "if measurement cannot be successfully replicated, results may vary depending on who is taking measurements rather than on the contribution that variable makes in the overall study" (Odell, 2003:126).

The attributes in the present study were chosen to document the assemblage variability as much as possible. These are: linear dimensions, amount of cortex, number of dorsal scars, striking platform type, termination type, éraillure scar, type of cross-section, form of the bulb of percussion, raw material, breakage pattern, retouch, and use-wear (Table 3.1). The number of recorded attributes varies between different groups of lithics (e.g., cores, microblades, etc.). For instance, only the type of raw material and the maximum size (any dimension) were recorded for the lithics with indistinguishable dorsal and ventral surfaces and for small-sized (0.1–1 cm) artifacts. Weight was measured, but was not used in analysis, due to the prevalence of a small-sized debitage in the assemblage from Gorelyi Les. All attributes used here are considered on the nominal, ordinal, interval, or ratio scales. The choice of a scale for a particular variable is driven by the intention to design a refined and, what is the most important, replicable system of description.

The definitions of the chosen variables follow those given by Andrefsky (2005). All measurements are in the metric system (mm and cm). *Linear dimensions* are the basis of lithic analysis and include length, width, and thickness of the artifacts. Maximum length is measured as a straight-line distance from the proximal to the distal end, perpendicular to the striking platform. When the perpendicular line intersects the lateral margin before reaching the distal end, the maximum length is measured to the distal end of the flake as a line perpendicular to the flake length line at the most remote point on the distal end. Width is recorded as a straight-line distance perpendicular to the flake length line at the widest point. Maximum flake thickness is measured in a similar manner – distance from the dorsal side to the ventral side in the thickest point of the flake.

Raw material is an essential characteristic of any lithic artifact, and it is generally an important factor in choosing the reduction trajectory (e.g., quartzite would not be chosen to make microblades, owing to its coarse-grained structure). Homogeneity of the rocks, their isotropy, elasticity, and the size and form of nodules may significantly affect the variation in formal attributes, independent of the reduction mode (Shott 1994). Raw material is described here in terms of type of rock (e.g., chert, quartzite), color, and grain size (fine- or coarse-grained).

The *striking platform* is a surface that usually receives a blow by a percussor to detach a flake. This part of the lithic is very important for analysis, because it potentially contains information about the type of hammer used, type of objective piece being modified, stage of tool production, and size of detached pieces (Andrefsky 2005). Therefore, in the following analysis multiple attributes of the striking platform are used. Width and thickness are recorded on the ratio scale. The width is the distance across the striking platform between lateral margins. Thickness is defined by a line perpendicular to the striking platform width; it is the greatest distance on the striking platform from the dorsal to the ventral surface, following that line. The types of striking platform incorporate a great range of variability in platform preparation for detaching the flakes, and have direct links to overall technology. The following three types are recorded here: cortical, flat, and complex. A cortical striking platform is composed of the unmodified cortical surface of the objective piece. A flat striking platform is represented by the smooth flat surface formed by a single blow; in most cases this type of platform indicates a flake detaching from a nonbifacial tool. A complex striking platform is composed of multiple flake scars. Usually it has an angular surface created by removal of several preparation flakes, and also small step fractures.

Andrefsky (2005) provides a fourth type of striking platform: abraded. This is basically a complex platform, but with traces of abrasion on it. However, the abrasion is a separate technological operation that is used for striking platform preparation, and can be observed on both complex and flat striking platforms. In the present study, abrasion is described as a separate attribute that pertains to any type of striking platform. Abrading or grinding can be treated as an indicator of more careful preparation of the objective piece, to detach the flake of precise shape at the final stage of tool manufacture. Moreover, this procedure increases overall control over the knapping process (e.g., over propagation of the shear wave, and over the contact area with the hammer). Abrasion is recorded simply as being present or absent without further differentiation; it can be recognized by a slightly rough and smoothed surface.

Flake termination is a condition or characteristic of the distal end of detached pieces. The initial classification of this variable is given in Hayden (1979) and represents a conventionally established scheme. This parameter reveals information about the kind of force used to detach a piece, and about the propagation of the shear wave in the solid body of the rock. There are four types considered here: (1) feather termination, created by the gradual smooth detachment of the piece; (2) stepped termination appears on flakes which snap or shatter during removal, and forms an almost 90° angle with the ventral surface; (3) hinge termination, represented by a sloped or rounded distal end; and (4) plunging termination (or overshot) forms when the force of the impact rolls toward the objective piece and removes its large portion attached to the distal end of the flake.

Breakage pattern has a great impact on the process of how other flake attributes should be recorded and interpreted (e.g., recognizing the medial fragment limits the number of attributes that can be described). The values for this variable are complete, proximal, medial, and distal. Complete value refers to lithics with an intact striking platform and distal end; proximal fragments have only an intact striking platform; medial flake fragments include all broken specimens that have no proximal end and a stepped distal end; and distal fragments have no striking platform and exhibit signs of one of the above-mentioned termination types.

The amount of *cortex* on the dorsal surface is recorded on an ordinal scale where the values are precisely defined: a value of 0 is assigned to pieces with no cortex (the lowest rank:; the value of 1 is given to pieces with greater than 0% but less than or equal to 50% cortex; a value of 2 is given for lithics that have less than 100% but greater than 50% cortex; and a value of 3 refers to lithics with the entire dorsal surface covered with cortex (the highest rank in this scale). The cortex amount is easily estimated, unless it is close to 50%. In such a situation, a grid sheet composed of dots is superimposed over the specimen, and the number of dots on the cortical portion is counted. This attribute is often considered as an indicator of the stage in a reduction sequence. Also, the cortex amount has been found useful in the identification of the earliest and the latest stages of reduction (Amick et al. 1989).

Dorsal flake scars are negatives of the flakes, caused by the removal of previous flakes from the given piece. Their number often reflects the stage of reduction sequence: a piece in its earlier stages would have a few scars, while at later stages it would exhibit many smaller scars from previous removals. The ordinal scale is used to determine the number of scars. A value of 0 is assigned to pieces with no flake removals or cortical dorsal surface; pieces with a single flake removal and with two scars are given values of 1 and 2, respectively; and flakes with more than two dorsal flake removals are given a value of 3.

Flake curvature or profile can be defined as the arc created at the height of an isosceles triangle that best fits into the length of a flake. Researchers link this parameter to the type of hammer used during the manufacture process (hard or soft hammer percussion), or in biface to the stage of manufacture (Andrefsky 2005). This attribute is evaluated on the ordinal scale, with only two arbitrarily assigned values: (1) flat or (2) slightly curved profile.

The size of *bulb of percussions* is evaluated in a similar manner to flake curvature, on the ordinal scale. Two values are assigned arbitrarily to this variable: (1) prominent or (2) diffuse. The size of the bulb of percussion is usually associated with the type of hammer applied: a prominent bulb indicates use of a hard hammer (e.g., stone), while a diffuse bulb indicates use of a soft hammer (e.g., billet); it can also be linked to the angle of applied force, or to the reduction technique (e.g., pressure flaking) (Andrefsky 2005).

The *éraillure scar* is a small flake scar on the ventral surface of a flake near the bulb of percussion, formed by the application of excessive force or by irregularities on the dorsal surface. It initiates at a radial striation on the bulb and propagates perpendicular to it, usually ending in a feather or hinge termination (Odell 2003). The presence of this variable is often associated with the use of a hard hammer. The éraillure scar is recorded as being present or absent.

Retouch is a secondary modification of lithics, and is rarely observed on the debitage from Gorelyi Les. This variable is described as being present or absent. The type and location (dorsal, ventral) are recorded in the cases when retouch is observed. *Signs of wear* are recorded as present or absent, too. Identified wear traces are then considered in greater details below.

The last attribute recorded is *form of cross-section*: triangular, rectangular, lenticular, or plano-convex. This variable can be reliably estimated only for the fragmented microblades, blade-like flakes, and some categories of formal tools (e.g., arrowheads). The form of cross-section of the artifact relates primarily to the core shape (e.g., triangular microblades might have been detached from conical, prismatic, or cylindrical cores).

The ability to obtain consistent descriptions by different people who analyze the same artifacts (or by the same person but some time later), as mentioned earlier, is very important for the present research. Two hundred lithics from the Gorelyi Les assemblage, chosen randomly, were measured and described iteratively in order to test the consistency and accuracy of previous descriptions, to identify possible errors, and to test the replicability of the results. The received results did not deviate significantly (less than three percent discrepancy) from the initial results. This basically supports the validity of the description procedure applied to the Gorelyi Les assemblage.

3.2 Use-wear analysis

Use-wear analysis is a methodology for establishing the function of tools. This method follows the approach developed by S.A. Semenov (1964) at the St. Petersburg School of Traceology in the USSR Academy of Sciences' Institute of Material Culture.

Use-wear analysis considers tool function as an interplay of many factors, of which the following are the most important: (1) the general type of working motion (or kinematic) and positioning of the tool during its use; (2) the material the tool is made of and its properties; (3) the material being worked and its physical characteristics; and (4) the length of tool use, degree of resharpening, and reuse (Levitt 1979). Consideration of these factors helps to establish how a particular stone tool was used in the past. Basically, use-wear analysis consists of three stages (Korobkova 1994; Korobkova et al. 1983). The first step is examination of the artifacts macroscopically and microscopically. The whole tool is inspected, including all possible working edges. The second step is a controlled experiment, where an attempt to approximate the prehistoric environment is made. It includes the replication of the studied tools and performing various activities with them. Finally, the macro- and microwear patterns on the experimental specimens are compared with those on the archaeological examples.

Initial identification of functions of the lithic tools from Gorelyi Les was performed by N.U. Kungurova. All formal tools, artifacts with retouch, blades and microblades, large- and middle-sized flakes, and tool fragments from the Gorelyi Les assemblage without exception were examined in order to identify the traces of wear on their edges. During the analysis special attention was paid to signs of wear such as edge damage, striations, pitting, serrations, and polishes. Identification of the basic variables of wear patterns follows those described by Semenov (1964), Ahler (1979), and Odell (1979). Firstly, the artifacts were examined with the aid of a hand lens with magnification up to 10 times. Edge damage, micro-chipping, well developed polish, overall surface condition, and alterations of the working edge (e.g., decreasing its area, or deformation) are easily observable at the macro level. Secondly, the lithics were examined under a Wild Heerbrugg M5 stereoscopic microscope, with magnification capacity from 32.5 to ~70 times, under reflected light from a fibre-optic microscope illuminator. A Leica DMRM metallographic microscope with 100x magnification and incidental polarizing light was used to examine tool surface topography more closely in cases when the wear traces were weakly developed and not clearly discernible with lower magnification. The polishes, striations, micro-cracks, and overall surface micro-relief (or micro-topography) were examined at the micro level. The two levels of observation complemented each other, helping to establish with high reliability how the lithic tools were used. All traces of wear observed on the tools were photographed with a Nikon P90 digital camera with a range of magnification between ~15x and ~75x (the higher magnification of 100x was found to be less suitable for photography, due to the small depth of field). The software program Helicon Focus (http://www.heliconsoft.com/heliconfocus.html) was used to improve picture quality by removing the constraints of the shallow depth of field problem, creating completely focused pictures of wear traces on the different parts of the tools.

3.3 Spatial analysis

Spatial analysis can be described generally as the retrieval of information from archaeological spatial relationships, as well as the study of spatial consequences of past human activity patterns, within and between archaeological features and structures, and their articulation within sites, site systems, and their environments (Clarke 1977). In the present research this method is employed to elucidate the correlation patterns between different categories of lithics and other features and to place them in the spatial framework of the Gorelyi Les site. Moreover, spatial analysis incorporates the results of other methods revealing the existing patterns of intra-site variability (Poplevko 2007).

The relative proportions of the different categories of lithics, and the frequency of their occurrence at the site, were examined. Special attention was given to the lithics with identified function, and to technologically significant lithic categories (e.g., decortication flakes, bifacial flakes, etc.). All the examined lithic artifacts were considered in horizontal and vertical dimensions and plotted on the site plan. Analysis of *horizontal spatial structure* was used to establish functionally significant areas within the excavated area, where various activities (tool manufacture, maintenance, food processing, etc.) were performed. In other words, the artifact locations were recorded not only with reference to grid systems, but also considered in terms of behaviourally significant designation of space (such as activity areas) (Schiffer 1987).

Evaluation of the *vertical distribution* of artifacts (or microstratigraphic analysis) is aimed at assessing the behavioural and cultural site formation processes at Gorelyi Les, such as the frequency of occupations, their duration, and the range of activities performed there (Stevenson 1985). Several vertically separated cultural components are well discernible at Gorelyi Les. Layer VI particularly, with the densest concentration of archaeological remains, is the most suitable for analyzing the vertical distribution of archaeological remains within a single cultural layer, and is of great importance to understanding the diachronic patterns of site occupation. According to Stevenson (1985) the workshop/habitation sites of most hunter-gatherers who exploited patchy, seasonally available resources are expected to form through three overlapping periods of activity that are distinct in kind, intensity, and duration – settling in, exploitation, and abandonment phases. Consequently, the refuse produced during each phase would differ with respect to the kind, quantity, and quality of information it may yield. The hypothesized phases within a single occupational episode are almost impossible to discern at Gorelyi Les. However, the variability of lithics is considered on the basis of their location in the vertical dimension, as they might have been produced during the different occupational phases of site use (e.g., during a particular cultural-historical period such as the Early Neolithic).

Leonova et al. (2006) developed a methodology for *microstratigraphic analysis* that helps to analyze the vertical distribution of archaeological materials. Considering ideas similar to Stevenson (1985), the authors concentrate rather on the methodological aspects of this kind of study. The method of microstratigraphic analysis as a compound part of spatial analysis helps to distinguish, most importantly, the character of accumulation of the archaeological materials: either continuous or discrete. This forms the basis for subsequent evaluation of the duration of occupation, intensity, etc. Application of this method requires 3-dimensional provenience control over artifact position during excavation. Further, all finds should be plotted on a graph having intervals of no more than 1 m. Thus, one will create a microprofile of a given cultural layer, with the desired resolution (e.g., 10 cm, 20 cm, etc.). In sum, the described method is suitable for application to the Gorelyi Les materials because of the presence of exact information about artifact position within the site.

Additional factors that are considered during the spatial analysis are *recovery biases* and *post-depositional disturbances* that affected the archaeological record. As was mentioned earlier, postdepositional disturbances have a minor effect on the integrity of the cultural layers at Gorelyi Les (Weber 1997). Moreover, the careful three-dimensional provenience control during excavation provided accurate information about the position of the artifacts within the site. The Early Neolithic Layer VI was enclosed in the lithostratigraphic unit 4Ab, represented by loam (Chapter 1). According to Gifford-Gonzalez et al. (1985), the lithics deposited in loam sediments tend themselves more to horizontal dispersal than vertical, but in more permeable, loose sediments (e.g., sand) artifacts usually are subject to displacement within the body of sediment, as a result of cultural (e.g., trampling) and natural effects (e.g., cryoturbation). In the case of Gorelyi Les, one can assume that trampling processes were less responsible for the vertical dispersal of archaeological materials than the process of gradual aggradation of sediments and archaeological remains. Layer VI reflects, presumably, a constant accumulation of archaeological materials, representing a sequence of occupations of the site. In sum, the horizontal and vertical distribution of artifacts at Gorelyi Les is not significantly affected by the natural disturbances, and reflects, presumably, slightly altered patterns of various cultural activities, approximating their initial state.

Table 3.1. Codebook of lithic attributes.

No.	Variable name	Label or value range	Description
1	Raw material	Type of rock	Type of raw material
2	Flake length	0.1–10 cm	Maximum flake length
3	Flake width	0.1–10 cm	Maximum flake width
4	Flake thickness	0.1–10 cm	Maximum flake thickness
5	Striking platform type	Cortical	Cortex covers the striking platform
		Flat	One facet of the striking platform
		Complex	Several facets on the striking platform
6	Striking platform length	0.1–10 cm	Maximum length of striking platform
7	Striking platform width	0.1–10 cm	Maximum width of striking platform
8	Abrasion of striking platform	Absent	No abrasion present
		Present	Striking platform is abraded
9	Termination type	Feathered	Feathered distal end
		Stepped	Broken distal end
		Hinged	Rounded distal end
		Plunging	Large (thick) distal end
10	Breakage pattern	Complete	Complete flake
		Proximal	Proximal segment with the striking platform remnant
		Medial	Medial segment
		Distal	Distal part with one of the 4 termination types
11	Cortex amount	0	No cortex on the dorsal surface
		1	Less than or equal to 50%
		2	More than 50% but less than 100%
		3	Cortex covers entire dorsal surface
12	Number of dorsal flake scars	0	No flake scars
		1	Single flake scar
		2	Two flake scars
		3	More than two flake scars
13	Flake curvature	Flat	Flake is flat in profile
		Slightly curved	Flake is slightly curved in profile
14	Size of the bulb of percussion	Diffuse	Bulb of percussion is barely observable
		Prominent	Thick, easily observable bulb
15	Éraillure scar	Present	Visible scar on the ventral surface
		Absent	No éraillure scar observable
16	Form of the cross-section	Particular shape	Shape of the cross-section
17	Retouch	Present	Secondary modifiction
		Absent	
18	Use-wear	Present	Signs of wear such as polish, striations, etc.
		Absent	

Chapter 4
Evaluation of the Gorelyi Les lithic assemblage

4.1 General description of lithics by layer

4.1.1 Layer VII (Late Mesolithic)

Out of 49 lithics found in Layer VII, only 4 (or ~10%) are formal tools (Figure 4.1). All of them are blade and microblade fragments made of black banded chert. The large complete blade (proximal segment, with the striking platform partially broken) has a plunging termination, triangular cross-section, and flat profile. Its linear dimensions are the following: length is 4.6 cm, width is 1.4 cm, and thickness is 0.4 cm. The distal segment of this blade bears the remnant of a striking platform too. Also, the blade has three dorsal scars that are variously directed. Therefore, one can conclude that this blade was detached from a core that had at least two striking platforms, and that the core from which this blade was detached was multi-directional (flakes were detached from the opposite direction).

The microblades are represented by three fragments. The first one is a proximal segment with a triangular cross-section. Its length is 0.7 cm, width is 0.9 cm, and thickness is 0.3 cm. Its ventral surface demonstrates a prominent bulb of percussion; the striking platform is complex and is 0.5 cm wide and 0.2 cm thick. Another two microblades comprise small fragments (length 0.5–0.6cm, width 0.8–0.9 cm, and thickness 0.2–0.3 cm) which represent medial segments of a microblade with the triangular cross-section.

Debitage

Debitage in the Late Mesolithic horizon is represented by 44 specimens, or ~90% of all the lithics found in this layer (Figure. 4.1). The largest category of debitage in this layer is *shatter*, with 33 specimens (75%). Shatter includes unrecognizable broken flakes, angular blocky pieces and stone pieces with unrecognizable either dorsal or ventral surfaces, and other lithic pieces or material lacking negative flake scars. Table 4.1 provides summary of the shatter sizes from all three examined layers, organized with respect to raw material type. Most of the shatter is made of grey banded chert (17 specimens), while quartzite and marble shatter are represented by 16 pieces (eight specimens each). The predominant size of the shatter for all raw material types is less than 1 cm. The second-largest size category is between 1.1 and 1.5 cm (four specimens), and few other size classes are represented by several artifacts. The mean size of the chert shatter is 0.9 cm, of quartzite shatter is 1.4 cm, and of marble shatter is 0.9 cm. About 50% of the dorsal surface of all quartzite shatter pieces is covered with cortex while chert and marble shatter demonstrate no cortex.

Another debitage category is *cobble/nodule shatter*, usually large-sized (starting from about 2 cm) parts of pebbles and cobbles lacking definable flake attributes (e.g., recognizable margins, platform area, etc.). This category comprises seven artifacts (or 14%). All of them are made of quartzite, and their dorsal surfaces are entirely covered with cortex. Table 4.2 displays the distribution of sizes within this category. The mean size of cobble/nodule shatter is 3.3 cm, and no observable patterns in the size distribution are identified.

The only decortication flake was found in Layer VII. It is made of brown-yellow quartzite and has a triangular, adze-like shape (Figure 4.2). It is relatively large: length is 7.0 cm, width is 5.3 cm, and thickness is 1.8 cm. The working surface of this flake is represented by a bevelled edge, created by a single flake removal from the ventral surface (presumably, this facet was formed by the primary cortex removal). It has no intentional modifications except several large facets on the working edge, created during use. Its dorsal surface is entirely covered with cortex.

The last category of lithics, with four specimens, is flakes. Three of them are medial segments, with discernible dorsal and ventral surfaces. Their size is 0.8 cm each in the largest dimension. One flake is a proximal segment 0.8 cm long, 1.2 cm wide, and 0.3 cm thick. Its dorsal surface exhibits three flake scars. The striking platform is flat with 0.4 cm width and 0.2 cm thickness. The bulb of percussion is slightly convex and exhibits an éraillure scar.

4.1.2 Layer VI (Early Neolithic)

Formal tools from the Early Neolithic horizon are the most abundant and diverse compared to other cultural layers at Gorelyi Les. This category comprises 65 specimens and constitutes 3% of all lithics found in Layer VI (Figure 4.3).

Microblades

The most numerous distinctive category of the lithic artifacts are blades and microblades, with 41 specimens (Figure 4.4). The raw material used for their manufacture is chert of four distinctive types that differ in colour, grain size, and overall quality: light-coloured white chert of high quality (five specimens); dark grey/black chert of high quality (six specimens); light- and dark-coloured grey banded chert of a medium quality (28 specimens); platy red chert (two specimens). The basic criterion for describing blades and microblades is width; this parameter varies between 0.4 and 1.3 cm for the analyzed specimens (Figure 4.5).Blades length varies between 0.9 and 4.9 cm, and thickness between 0.1 and 0.3 cm. The majority of microblades segregate into two consistent size categories on the basis of their width: (1) the largest group, with width of about 0.6 cm (average length is about 1.2 cm); (2) and the smaller group, with width of about 0.9 cm (lengths vary significantly within this group; average is about 2.8 cm) (Figure 4.5). Most of the microblades are broken, and only two of them are complete: 22 specimens are medial segments, 13 microblades are proximal segments bearing the remnants of a striking platform, and four microblades are represented by distal segments. Out of seven microblades exhibiting an intact distal, end five specimens have feather termination, while plunging and hinged terminations are represented by one specimen each. The majority of the microblades are flat in profile and triangular in cross-section, with the exception of five specimens with rectangular cross-sections.

Composite fishhooks

One of the most distinctive tools found at Gorelyi Les was a shank of a composite fishhook of Kitoi type (Figure 4.6 e). The distinctive morphological trait of this type is the frontal fastening of the barb to the shank's body (Georgievskaia 1989). The shank found at Gorelyi Les is rounded in profile, with slightly flattened dorsal and ventral surfaces. Its distal and proximal ends are crescent-shaped; the proximal part has notches for a line attachment, and the distal part has a notch on the ventral surface for a barb attachment. This shank was carved of black slate and was then finished with grinding. Traces of these manufacturing techniques (long, deep, and abraded (smoothed) linear striations) are visible to the unaided eye along the entire tool surface. The shank length is 3.0 cm, the maximum thickness is 0.4 cm, and the width of the medial part is 0.6 cm, while the distal crescent-shaped end is 0.4 cm wide and the proximal end has a width of 0.6 cm. In general, the above-described implement is a typical Kitoi-type shank. The only specific feature is the flatness of the shank, which presumably reflects the initial shape of the tool blank.

Arrowheads

Another culturally distinctive category is arrowheads. Four of them were found in Layer VI. One arrowhead is complete, made of light-coloured grey chert (Figure 4.6 a); the second one is represented by the distal part, with an intact tip, and is made of black slate (Figure 4.6 d). Two specimens are represented by proximal segments (arrowhead bases) and are made of white and red chert, respectively (Figure 4.6 b, c). One of the arrowheads exhibits a distinctive breakage pattern — a facet on the ventral/dorsal surface with wide step termination (0.7 cm) that penetrates into the surface of the tool for 0.2 cm. This facet is an impact fracture, and indicates the use of this arrowhead as a projectile weapon (for hunting?); it broke when it hit a solid target (e.g., animal body). All of the arrowheads share similar morphological characteristics: triangular shape, concave base with slightly asymmetrical barbs, lenticular shape of cross-section, relatively small overall size, and flat covering retouch. The linear dimensions of the complete arrowhead are the following: length 1.3 cm, width 0.9 cm, and thickness 0.2 cm. The length of the other specimens varies between 0.8 and 1.2 cm, their width varies between 1 and 1.1 cm, and their thickness varies between 0.1 and 0.2 cm. All of these arrowheads are shaped by the pressure flaking technique, with deliberate retouch covering the entire tool surface, including the bases, with uniform long parallel facets.

Cores and core fragments

Twelve cores and core fragments were identified. Only two of them are morphologically diagnostic (represent a particular identifiable morphological type) — cylindrical core and an exhausted rotated core (presumably of cylindrical shape, as well). Both are made of light-coloured grey banded chert. The first cylindrical core is unidirectional, and has only one striking platform (Figure 4.6 f). Its length (the longest measurement perpendicular to the striking platform and parallel to the removal of detached pieces) is 3.7 cm, and the maximum width at the striking platform is 2.6 cm. It was used for microblade production and was intensively worked. The reduction front of the core exhibits numerous facets of unsuccessful microblade removals that ended with either step or hinge terminations. The width of these facets varies between 0.4 and 0.7 cm, and length varies between 2.0 and 2.7 cm. The overall shape of the core is cylindrical, and the blades were detached from the entire striking platform perimeter. The wedge (keel) of the core is formed by flake removal in a bifacial manner, in a direction parallel to the striking platform. The striking platform itself exhibits several small facets with step termination, indicating careful striking platform preparation during core reduction (e.g., removal of overhanging parts and rough/angular parts, which complicates the precision of microblade detaching). The second core is multi-directional, with several platforms located in different planes. The negative flake scars from previous flake removals were used as platforms, and were not deliberately shaped by subsequent operations. The overall shape of the core is amorphous, and the only part that exhibits some initial preparation treatment is a wedge-like projection formed by bifacial flake removal (similar to the wedge (keel) of the previously described core). The presence of such a morphological element indicates that this core was presumably cylindrical/prismatic. A wedge (keel) would serve to stabilize the core in a slot or groove in the anvil during the reduction process (Dönmez and Brice 1951). The maximum length of this specimen is 3.9 cm, and the maximum width/thickness is 3.2 cm. Despite the fact that the core is exhausted, a small portion of cortex (2.0 x 1.7 cm) can still be seen on one of its surfaces.

Another two cores are blocky, angular pieces that have at least some indication of negative flake scars, while appear to be core parts broken during the reduction process. They have cortical striking platforms, and are made of dark-coloured grey banded chert. The first, larger core, exhibits minor platform preparation — several large facets with stepped and hinged terminations. The length of this core is 4.4 cm, and the maximum width is 5.8 cm. The second, smaller core also exhibits no platform preparation. Its length is 3.1 cm and width is 4.5 cm. This core exhibits only several small flake scars. Apparently, these nodules did not produce the required controlled fracture or desired flakes, owing to the knapper's mistake or to the inner defects of the raw material, and were abandoned after several test flake removals.

The other twelve specimens are core fragments. Nine of them are made of dark-coloured grey banded chert, two of sand-coloured siltstone/argillite, and one of light-coloured grey banded chert. All the core fragments are amorphous, blocky, and angular nodules, with only a few distinguishable facets from previous flake removals. All of them exhibit little or no cortex. The maximum linear dimension is the only measurement that can be reliably measured for the described core fragments; it varies between 3.1 and 6.1 cm.

Points

Points are the third-largest formal tools category, with six artifacts. This is a broad category of elongated, usually narrow flakes that are by-products of microblade manufacture (e.g., ridge flakes, initial microblades containing evidence of preparation on their dorsal surface). The points from Gorelyi Les include three small bifacially retouched points and three specimens that are made on ridge flakes (or lame à crête). The first three points are made of black chert, red, and maroon platy chert, respectively. All three specimens exhibit small portions of cortex on one of their either ventral or dorsal surfaces. The presence of cortex on them, in spite of the high degree of retouching, indicates the use of flat flake blanks or naturally occurring flat chert slabs for manufacturing these points. One of the points is broken proximally and distally, and other two specimens are broken proximally; all three have a lenticular cross-section. Their linear sizes are virtually equal: width is 1.0 cm, thickness is 0.4 cm, and only length varies between 2.3 and 4.0 cm. Bifacial retouch covers the entire surface of the points but does not penetrate deep; it creates sinusoidal wavy edges. Two points demonstrate traces of wear on their tips, and one exhibits wear along one of the margins.

Three other points are made on ridge flakes, or core rejuvenation flakes, or initial blades; two are of light-coloured grey chert and one is red platy chert. The largest specimen is 4.0 cm long, 0.9 cm wide, and 0.5 cm thick (Figure 4.7 b). The smallest point is broken proximally and is 2.2 cm long, 0.5 cm wide, and 0.3 cm thick (Figure 4.7 d). Both are triangular in cross-section and have no cortex on their dorsal surfaces. All three points exhibit a specific pattern of a dorsal flake scar distribution: only one of two dorsal sides is covered by retouch facets, while the second side of a dorsal surface is formed by a single flake removal and exhibits no signs of retouch. One point demonstrates additional retouch on its distal end, which creates a working edge; this retouch covers one-third of the entire tool length, from all three surfaces of the point at the distal end (Figure 4.7 b). The tip of another point is partially broken, but it is still discernible that retouch was not applied to its distal end. The length of this point is 3.4 cm, width is 0.6 cm, and thickness is 0.4 cm (Figure 4.7 e). All these points except one specimens exhibit traces of wear on their tips.

Burins

Burins and their fragments are represented by four specimens, all made on microblades, two on proximal segments, and two on medial segments. The raw material used for the burin manufacture is light-coloured banded grey, white, and black chert. The largest burin is 3.5 cm long, 1.0 cm wide, and 0.3 cm thick (Figure 4.8 a). It is made on the proximal segment of microblade, and exhibits a triangular cross-section and large éraillure scar on the bulb of percussion. The burin spall, with hinge termination, was removed from the right margin of this microblade. The other burins demonstrate the same pattern of burin spalling from the right margin of the microblades. The only exception is the specimen where the burin spall did not produce a hinge termination, but proceeded further to the proximal end and removed part of the striking platform (plunging termination) (Figure 4.8 b). This burin is made on the proximal segment of a microblade and has a rectangular cross-section; its length is 1.9 cm, width is 0.7 cm, and thickness is 0.2 cm. The last two specimens are made on medial segments of microblades and have a rectangular cross-section (Figure 4.8 c). Their length is 1.0 cm and 1.1 cm, width is 0.7 cm and 0.8 cm, and thickness is 0.1 cm and 0.2 cm, respectively.

Borers

Two specimens are borers — tools with prepared sharp points, intended for piercing. One of them is made on a medium-sized flake of grey chert (Figure 4.8 d). Its length is 2.0 cm, width of the widest proximal end is 1.0 cm, and thickness is 0.3 cm. Its working edge is shaped by alternate retouch on the distal part of the flake, and covers one third of its entire length. The second borer is made on the distal part of a microblade made of black chert. Its length is 2.3 cm, width is 0.7 cm, and thickness is 0.2 cm; it has a rectangular cross-section. The working edge of this borer is shaped by small alternating retouch, but, as opposed to the other borer, the retouch extends along the entire length of the two blade margins. The working tips of both borers exhibit traces of wear.

Scrapers

Scrapers at Gorelyi Les are represented by two specimens. The first of them is made on the proximal segment of a large flake (Figure 4.9 a). It is made of light-coloured grey banded chert and has a plano-convex cross-section. The length of this scraper is 1.8 cm, width is 2.7 cm, and thickness is 0.4 cm. The small retouch covers the right margin of the tool and, partially, the proximal end adjacent to the striking platform. The dorsal surface exhibits several multi-directional flake scars, while the ventral surface exhibits pronounced ripple marks. The striking platform was partially removed by subsequent retouching. The second scraper is made on a flat slab of red chert, with minor modifications of natural surfaces (Figure 4.9 b). Its length is 3 cm, width is 2.2 cm, and thickness is 0.4 cm. A few large steep retouch facets cover only a small portion of its edge. The ventral and dorsal surfaces of the scraper are covered with cortex. Both scrapers exhibit traces of wear on the working surfaces.

Miscellaneous

There are four tool fragments in the assemblage that cannot be reliably attributed to a particular tool type. The first of these is an arrowhead-like fragment of triangular shape, with a lenticular cross-section. It is made of black chert and shaped by bifacial retouch. The retouch from one margin penetrates deep into the tool surface, while the retouch facets on the opposite margin are much smaller and cover only the edge of the tool; such a retouch pattern creates an asymmetrical point. The length of this fragment is 1.5 cm, width is 1.0 cm, and thickness is 0.3 cm. The tool retouch pattern, its shape (especially the asymmetrical point), and its thickness distinguish it from the three arrowheads found at Gorelyi Les. One could suggest that this tool fragment represents a segment of an insert of a composite tool (e.g., knife).

The second tool fragment is an extremely weathered piece with numerous cracks and potlids on both surfaces. The semi-abrupt bifacial retouch covers both intact margins, and converges at the corner of the tool under an obtuse angle creating a point. The length of this fragment is 2.1 cm, width is 1.4 cm, and thickness is 0.2 cm. It is made of light-coloured grey banded chert. The function and the initial shape of this specimen are impossible to identify, owing to the weathering and relatively small size of the fragment. This type, however, of retouch was not identified on any other artifact from the Gorelyi Les assemblage. Because of its sharp edges, this fragment may represent a fragment of knife or cutting tool.

The third tool fragment is the proximal segment of a bifacially retouched tool. The length of the fragment is 1.0 cm, width is 1.2 cm, and thickness is 0.3 cm. It is made of red platy chert and has a lenticular cross-section. The bifacial retouch covers the entire fragment, and is produced by the pressure flaking technique; the retouch facets are uniform in size (their width is about 0.1 cm) and parallel to each other. All of the above-mentioned characteristics place this fragment together with the arrowheads found in Layer VI. However, none of the previously described arrowheads has a rounded base.

The last tool fragment is made of black chert and is severely weathered. The blank of this fragment is, presumably, a microblade with the following linear dimensions: length is 1.2 cm, width is 0.6 cm, and thickness is 0.2 cm. It demonstrates a lenticular cross section and small blunting retouch from the ventral side along one of the margins. The shape of the tool and the type of retouch suggest that this fragment represents an insert blade of a composite tool.

Debitage

Shatter

Shatter dominates the lithic assemblage from Layer VI, with 1,787 specimens, or 82%. The prevailing majority of these artifacts are made of grey chert (95%), quartzite 3%, and red chert and other rocks (graphite and marble) are represented by 1% each. The size distribution of the shatter is summarized in Table 4.1. The greater part of chert shatter (72%) comprises small-sized pieces less than 1.0 cm in size. The second-largest size group (17%) is between 1.1 cm and 2.0 cm. We may observe an obvious trend in size distribution of the chert shatter: the quantity of artifacts drastically decreases when their size increases. The mean size of chert shatter is 0.9 cm. The shatter made of other raw materials is also dominated by the small-sized specimens, except quartzite group, where the distribution of sizes is more even. The mean size of the quartzite shatter is 1.4 cm, of red chert is 0.9 cm, and of other rocks is 1.8 cm. Forty-three specimens exhibit cortex, which usually covers more than 50% of their surface.

Flakes

Eighty-eight flakes, comprising 4% of the whole lithic assemblage, were recovered. Most of them – 81 specimens, or 93% – are made of grey chert, three (3%) are made of red chert, and three (3%) are made of quartzite. The raw material of some flakes exhibits striking similarities in colouration patterns and texture with the cores found in the same layer. Thus, one may conclude that these flakes were undoubtedly detached from these cores, despite the fact that these artifacts do not refit together. Complete flakes and proximal segments of flakes are represented by 36 specimens each (41%), while distal and medial segments account for 14 (16%) and 2 (2%) specimens, respectively. Out of 50 flakes with an intact distal end, 36 specimens (72%) demonstrate feathered termination, 11 (22%) exhibit hinged termination, and three flakes (6%) have stepped termination. Most of the flakes are medium-sized and fall in the size category between 1.0 cm and 2.0 cm; their length varies between 0.5 cm and 3.8 cm (mean=1.7 cm), width varies between 0.5 cm and 3.5 cm (mean=1.3 cm), and thickness varies in the range between 0.1 cm and 1.3 cm (mean=0.3 cm). The majority of the flakes (72 specimens, or 82%) exhibit no cortex on the dorsal surface; cortex values 1 and 2 are represented by six specimens in each category, and the remaining four exhibit dorsal surfaces entirely covered with cortex. The dorsal flake scar distribution is the following: 54 flakes have three and more dorsal scars, two scars are represented on 22 flakes, and eight flakes exhibit only one dorsal flake scar. Out of 72 striking platforms, 55 (78%) are flat, 15 (21%) are complex, and two (1%) are cortical. Their width varies between 0.3 cm and 1.9 cm (mean=0.6) and their thickness varies between 0.1 cm and 1.1 cm (mean=0.2 cm). Only 29 striking platforms (4 complex and 25 flat) were abraded. Some of the flat striking platforms are of distinctive semi-circular shape, which may indicate the use of bifacially prepared cores for their reduction. The bulbs of percussion on the ventral surfaces of the flakes are not pronounced — they are mostly slightly convex in profile or diffuse. Only seven specimens exhibit éraillure scars along with a convex bulb of percussion.

Bifacial reduction flakes

Bifacial reduction flakes are a distinctive, technologically meaningful group of the debitage that is comprised of 21 specimens, or 2% of all the lithics in Layer VI. These artifacts are identified on the basis of platform morphology (particularly the presence of an overhanging lip on the striking platform from the ventral side) and some other characteristics (e.g., pronounced curvature in profile and specific correlation of linear dimension). An additional distinctive characteristic of the bifacial reduction flakes in the Gorelyi Les assemblage is the raw material — almost all of them are made of red chert. Eleven of the bifacial flakes are represented by proximal segments, and the other 10 are complete. The length of the bifacial flakes varies between 0.5 cm and 3.0 cm (mean=1.2 cm); width varies between 0.5 cm and 3.2 cm (mean=1.3 cm); and thickness varies between 0.1 cm and 0.4 cm (mean=0.2 cm). There is an evident pattern in the correlation of length and width of the complete bifacial flakes (fragmented pieces also exhibit a similar pattern): the flake width is slightly larger or equal to the flake length. Out of 10 artifacts with an intact distal end, six and four flakes exhibit feathered and hinged termination, respectively. Most of the bifacial flakes have no cortex, except five specimens with no more than 50% of dorsal surface covered by cortex (cortex value 2). The majority of the flakes, 13 specimens, demonstrate three and more dorsal flake scars, while three and five specimens demonstrate two and one dorsal scars, respectively. Thirteen striking platforms are flat and eight are complex. All the flat platforms are abraded, while only one complex striking platform shows abrasion. The width of the striking platforms varies between 0.2 cm and 1.0 cm (mean=0.6 cm), and thickness varies between 0.1 cm and 0.4 cm (mean=0.2 cm). In terms of reduction stage, five specimens can be attributed to the early stage and 15 specimens can be attributed to the middle/late stage of biface reduction.

Cobble and nodule shatter

Another distinctive category of debitage is cobble/nodule shatter and unmodified cobbles and pebbles, with 125 specimens represented or 6% of all lithics in the cultural layer. The distribution of raw materials in this category is the following: quartzite 39%, grey chert 24%, red chert 6%, and other rocks (caolinite (gypsum?), marble, conglomerates, and granite) 30%. Summaries of sizes by raw material in this debitage category are provided in Table 5.2. As follows from this table, there is no distinctive pattern in size distribution; the mean size of the shatter is 2.9 cm (most of the artifacts fall in the range between 2.0 and 5.0 cm). The absence of small-sized pieces should be mentioned, however, with the only artifacts with smaller than 1.0 cm being rounded pebbles of caolinite (gypsum?). The distribution of cortex values is more diverse (Figure 4.10); however, most of the specimens demonstrate a dorsal surface entirely covered with cortex.

Decortication flakes

Decortication flakes comprise 13 specimens (1%), which include larger pieces of cobbles and nodules with their dorsal surface covered by cortex having at least two recognizable flake attributes (striking platform area and definable margins). Six of them are made of quartzite, six of grey chert, and one specimen is made of red platy chert. Eleven specimens are complete, one specimen is represented by a proximal segment, and one by a medial segment. Out of 11 artifacts with an intact distal end, 10 exhibit feathered termination and 1 demonstrates plunging termination. The decortication flakes are usually large — the mean size of the quartzite specimens is 4.25 cm, while the mean size of the chert flakes is 3.8 cm. Three decortication flakes demonstrate pronounced bulbs of percussion.

Ridge flakes

Another debitage category is ridge flakes, a small group of artifacts in the Gorelyi Les assemblage, with only seven specimens (less than 1% of the total). This category includes triangular cross-section flakes with a bifacially or unifacially shaped ridge on the dorsal surface; usually they exhibit numerous transverse dorsal flake scars. These flakes were detached from objective piece (cores) to rejuvenate either the striking platform or front of the core, in order to create a prismatic fracture front for subsequent microblade removal. All of them are made of grey chert. Four ridge flakes are medial segments, two specimens are distal segments, and only one is a proximal segment. Of the two specimens with an intact distal end, one flake demonstrates a plunging termination and the other one exhibits a feathered termination. All of the ridge flakes have more than three dorsal flake scars and no cortex on their dorsal surface. Their length varies between 1.2 cm and 2.4 cm, width varies between 0.6 cm and 0.9 cm, and thickness varies between 0.3 and 1.6 cm. The only striking platform represented in this category is flat, 0.5 cm wide and 0.1 cm thick.

4.1.3 Layer V (Late Neolithic)

Only 14 formal tools were found in Layer V (Figure 4.11). This number constitutes only 6% of all the lithics in this cultural horizon. All the tools are made of light-coloured grey banded chert.

Microblades

Blades and microblades are the most numerous tool categories, with 10 specimens. The largest blade is 2.3 cm long, 1.3 cm wide, and 0.4 cm thick. It represents a medial part of the blade, has a triangular cross-section and small blunting retouch along the right margin. The presence of such a type of retouch might indicate the use of this blade as an insert in some type of composite tool. Also the blade exhibits heavy wear along the left margin. The other blade is a medial fragment with a trapezoid cross-section; 1.0 cm long, 1.5 cm wide, and 0.3 cm thick. One of its margins is heavily weathered, while the second margin is abraded; consequently, the wear is not recognizable if present at all. The other microblades are small fragments broken proximally, distally, and laterally, which represent, presumably, medial parts of microblades. Their maximum linear dimension is 1.2 cm (no other measurements are applicable). Two of them exhibit wear.

Arrowheads

There were two arrowheads found in Layer V. One of them has an elongated triangular shape, concave base, and asymmetrical barbs (Figure 4.12 a). It is 2.5 cm long, 1.2 cm wide, and 0.3 cm thick. This arrowhead was carefully shaped with the pressure flaking technique; the facets of bifacial retouch on both sides of the tool are uniform (about 0.1 cm wide), parallel to each other, and cover the entire surface of the tool. The base of the arrowhead, on the contrary, is shaped by small, blunting retouch, is thicker than the tip and medial part of the specimen. The other arrowhead has a broken tip and represents approximately two-thirds of initial tool size; it has a concave base (Figure 4.12 b). The length is 1.4 cm, width is 1.0 cm, and thickness is 0.25 cm. This arrowhead was shaped by bifacial retouch, with a pressure flaking technique. Unlike the first arrowhead, the retouch does not penetrate deep into the surface and was applied under a more obtuse angle. This could be explained by the fact that the shape of initial blank of this arrowhead was either a thin flake or a flat chert slab that did not require substantial thinning. The retouch at the base of the arrowhead did not differ from other parts of the implement.

Burins

The only burin in this layer was made on the medial part of a blade, rectangular in cross-section (Figure 4.12 c). Its length is 3.1 cm, width is 1.3 cm, and thickness is 0.3 cm. This tool can be best described as an ordinary transverse burin. Two burin spall facets are observable on the burin's working surface; a larger facet and a smaller one that, probably, was made for resharpening the working edge. The left margin exhibits inverse irregular retouch, with relatively large facets that alternate toward the working edge by the dorsal semi-abrupt retouch used to stabilize the working edge. Such a pattern of retouch might indicate that the burin was rejuvenated several times, and that the burin tip was located initially on the right margin.

Points

The last tool is a fragment of a point made on the distal part of a ridge flake (or rejuvenation flake from a core reduction front) (Figure 4.12 d). The point has a triangular cross-section. It is 1.7 cm long, 0.6 cm wide, and 0.3 cm thick. The working tip of the fragment is shaped by retouch which covers the ventral surface and both margins.

Debitage

Shatter

Shatter is the largest category of debitage in Layer V, with 126 artifacts or 83% of all the lithics found in this horizon. The majority of the shatter (94%) is made of grey chert, two specimens are made of red platy chert, one specimen is made of quartzite, and three artifacts and a single piece are made of hematite and graphite, respectively. According to Table 4.1, the distribution of shatter size favours small-sized debitage of less than 1.0 cm (more than half of the specimens in this category are 0.5 cm). Other size categories are represented only by several artifacts. The mean size of the shatter is 0.6 cm.

Flakes

The flakes category includes seven specimens, or 5%. Six of them are made of light-coloured grey banded chert, and only one specimen is made of black chert. This last flake is represented by a proximal segment, and is the smallest among the others, with length of 0.7 cm, width of 0.8 cm, and thickness of 0.1 cm. Two specimens are represented by two distal segments, one specimen is a proximal segment, and two more specimens are complete. Their length varies between 1.0 cm and 2.0 cm (mean=1.4 cm), width varies between 0.7 cm and 1.9 cm (mean=1.3 cm), and thickness varies between 0.2 cm and 0.4 cm (mean=0.3 cm). Among the flakes with an intact distal end, three show a hinged termination and two have feathered terminations. All four striking platforms are flat, and only two of them are abraded. Their width varies between 0.4 cm and 0.7 cm (mean=0.5 cm) and thickness is either 0.1 cm or 0.2 cm. With regard to dorsal flake scars, three specimens exhibit three and more scars, and two specimens exhibit only one scar on their dorsal surfaces.

Bifacial reduction flakes

The bifacial reduction flake category is comprised of five specimens, or 2%. It is the smallest group of debitage in Layer V. All of the bifacial flakes are whole and made of red platy chert. Their length, with the exception of a single specimen, varies between 0.6 and 1.6 cm (mean=1.0 cm), width varies between 0.6 and 1.1 cm (mean=0.9 cm), and thickness varies between 0.1 and 0.3 cm (mean=0.1 cm). One bifacial flake is noticeably larger than the others; its length is 3.7 cm, width is 2.4 cm, and thickness is 0.3 cm. All of the described flakes are slightly curved in profile and exhibit feathered termination. All of them demonstrate no cortex on their dorsal surface, except one flake which exhibits less than 50% cortex. Four flakes have three or more dorsal flake scars, while one specimen exhibits only one flake scar. The striking platforms of these flakes (except the large one) are rather uniform, flat and abraded. Their width varies between 0.3 and 0.5 cm (mean=0.4 cm) and thickness is 0.1 cm. The striking platform of the large flake is complex without abrasion, 1.4 cm wide and 0.4 cm thick. All of the striking platforms, however, have diffuse bulbs of percussion and pronounced lips from the ventral surface.

4.2 Functional identification

The total number of tools identified on the basis of typological criteria (secondary modification) is 48, or 2% of the whole lithic assemblage at Gorelyi Les. Only 17 of them were used in the past and display traces of wear on their working surfaces. Four implements with use-wear traces demonstrate no secondary modifications and are typologically classified as flakes. A majority of the used tools — 16, or 80% of all functionally identified lithics — were found in Layer VI, while only three and two implements were found in Layer V and Layer VII, respectively. The majority of the lithics, including some categories of formal tools (e.g., arrowheads, burins, and fragments of unidentified tools) and debitage (large- and medium-sized flakes), exhibit no evidence of wear. Nevertheless, these lithics might have been used in the past and the wear removed from their surfaces by consequent rejuvenation (e.g., burin spalls) or, simply, weakly developed wear could have been obliterated by chemical and physical weathering after the tools were discarded.

Use-wear analysis revealed six functional types of implements, including cutting tools, borers, drills, scrapers, inserts for composite projectiles (e.g., composite spears or darts), and chopping tools (Table 4.3). The examined use-wear characteristics (e.g., polishes, linear striations, etc.) are mostly pronounced and easily observable, suggesting the intensive use of lithic tools at Gorelyi Les in various activities before they were discarded.

Drills

The largest functional group is drills, with five specimens, all found in Layer VI. Their working tips are shaped by retouch in order to stabilize the edge and protect it from breakage during use. The working surfaces of all drills display a distinctive roundness and heavy polish evenly distributed on their working tips.

Two drills are made on bifacially shaped points. One was used for drilling soft stone (e.g., talc). The tip of this drill is extremely worn, being significantly rounded in profile, and the sharp edges are obliterated (Figure 4.13 a). Also, it exhibits well-developed polish, with an opaque lustre that covers approximately 0.5 cm of the distal part of the tool and is visible with the unaided eye. The other drill is also made on a bifacial point, but was used for drilling fibrous material such as wood. The very tip of this tool is rounded, while the areas adjacent to it are less affected by use-wear. A very bright lustrous polish is well developed on the tip of the drill and covers 0.3 cm of the tool along one of its margins (Figure 4.13 b). This type of polish is very distinctive and pertains to wood processing activities (Volkov 1999). An obvious asymmetry of the wear trace distribution along the drill's working surface indicates that it was applied to the surface of the worked material under an acute angle (~45–80°).

Two other drills were made on ridge flakes, with a triangular cross-section shape and retouch along the three edges of the working tip. They were used for drilling antler/stone and soft stone/shell, respectively. Their tips are slightly rounded and have small facets, formed during contact with the worked materials (Figure 4.13 c, d). The last drill is made on a microblade and was used for processing soft stone/shell (Figure 4.13 e). The working tip of this implement is formed by bilateral retouch that created two facets on it. The edges of these facets are slightly rounded and exhibit a lustrous polish. The linear striations formed during use are oriented perpendicularly to the working edge of the drill.

Meat knives

With five specimens, meat knives are the second-largest functional group of artifacts. Two of them were found in Layer VI, a medial segment of a large blade with the working edge located along the right margin, and a bifacial point with the working edge along one of the margins. Of the three other meat knives, from Layer V, one was made on a blade and two were made on microblades. The latter are small fragments and probably were used as inserts of a composite tool (e.g., composite knife). The large blade has a blunting ventral retouch on the right margin that helped to immobilize the insert in the haft; other microblades have no retouch.

Meat processing activity resulted in deformations, micro-retouch, and serration observable on the tools. These traces are evenly distributed along the entire working edges of all the examined meat knives. Clearly visible striations are oriented either diagonally to the cutting edge under an acute angle (around 40–50°) or nearly parallel to it (Figure 4.13 f; Figure 4.14 a, d, e). The polish is dull and penetrates deep to the surface of the tools from both sides (Figure 4.14 a, b; Figure 4.15 a, b). All the meat knives demonstrate substantial deformation of the working edges that suggest their long use. The variations of striation incline and polish intensity on the different meat knives may indicate different patterns in meat processing activity (e.g., butchering carcasses versus cutting boneless or skinless meat; cutting fresh meat versus frozen meat, etc.). However, more detailed analysis (e.g., using SEM) and additional experiments should be conducted to distinguish these slight variations.

Borers

Another large functional group at Gorelyi Les is borers, four specimens found in Layer VI. One of the borers was made on a ridge flake. The tip of its working edge is partially broken (Figure 4.15 c). Other three borers were made on medium-sized flakes; two of them exhibit no secondary modifications and the last borer demonstrates bilateral retouch on the tip. The absence of additional treatment of the borers' working edges (e.g., retouch) suggests their use for processing relatively soft materials, such as hides, bark, etc. (Kungurova et al. 2008). The wear traces on all borers are similar — blunting of the working edge, a slight roundness of the tip, indentations, crumbling, and weakly developed polish (Figure 4.15 c, d, e, f; Figure 4.16 a, b).

Composite projectile inserts

Three microblades found in Layer VI were identified as inserts for composite projectiles. They were parts of some kind of composite tools, such as speard or darts used predominantly for hunting. All of them are made on small microblades with a triangular cross-section. Two inserts exhibit retouch along one of the margins; one has a small blunting retouch and the other has a small sharpening retouch. The third insert exhibits no secondary modifications. The inserts of composite missile weapons penetrate into their target (e.g., an animal during hunting) and receive the brunt of the impact, resulting in specific breakage patterns and other types of damage (Odell and Cowan 1986). The inserts from Gorelyi Les exhibit vertical spalls and crumbling resulting from cutting through a fibrous medium (Figure 4.16 e). Also, one of the inserts displays a small diagonal split at the corner of the tip (Figure 4.16 c). These traits are typical damage represented on tools used as missile weapons (Nuzhnyi 2007).

Scrapers

Scrapers are represented by two artifacts, both from Layer VI. One of them was made on the proximal part of a large flake, with the working edge located on the right margin. The material processed with this scraper could not be established; the traces of use are weakly developed, and are represented by linear traces perpendicular to the working edge and by patchy areas of polish on the salient parts of the tool, whose working edge is slightly smoothed (Figure 4.17 a, b). The second scraper was made on a red chert slab. The remnants of its working edge are represented by several retouch facets only, while the other parts of the working surface were removed either by resharpening or weathering. This scraper was used for processing bone; the traces of use are crumbling, perpendicular striations, and deformation of the working edge (Figure 4.17 c, d).

Chopping (hewing) tools

Only one such functionally identified artifact was found in Layer VII. This tool is a large decortication flake, made of quartzite without secondary modification, and it was used for chopping or hewing a relatively soft, fibrous material such as wood. The use of this flake resulted in several large facets (1–2 cm) on its dorsal surface, and in intensive micro-chipping of the working edge (Figure 4.17 e). On the surfaces of quartzite tools, wear traces develop slowly. Thus, the heavy wear observed on this tool indicates its intensive, long-term use.

4.3 Spatial distribution by layer

The following description is organized by cultural layers within Trench E II, excavated in 1994–1996 (Figure 4.18).

All the lithic artifacts from Layer VII are concentrated in the southern part of Trench E II, specifically in units A9 and B9 (Figure 4.19). No archaeological features were discovered in Layer VII, although a distinctly higher yield of charcoal fragments in units A9 and B9 may indicate the presence of a hearth in the areas adjacent to it. Most of the lithics (42 out of 49) are concentrated within this light charcoal stain, including all typologically and functionally identified tools (Figure 4.19). The differences in the vertical position of the artifacts within Layer VII are minor; depth of occurrence of lithic artifacts varies between 5.19 m and 5.21 m above the datum point, with the only exception being a fire-cracked pieces of shatter, found at a depth of 5.27 m.

The horizontal distribution of artifacts in Layer VI reveals substantial differences between excavation units (Figure 4.20). Lithic remains are unevenly distributed within the excavated area (Table 4.4). Most of the lithics in this layer are concentrated in the southern part of Trench E II in units B8 (988 artifacts, or 47%) and B9 (619 artifacts, 29%); unit A9, adjacent to them, exhibits the third-largest number of lithics in the trench (188 artifacts or 9%). The number of lithics in each of the five other units does not exceed 100 artifacts (a total of 234 artifacts, or 15%). Furthermore, lithic artifacts have a tendency to concentrate in the eastern part of Trench E II while, archaeological features (e.g., hearths and charcoal stains) are located predominantly in the western part of the trench. The distribution of different categories of formal tools and debitage by units is summarized in Table 4.4. The majority of formal tools as well as functionally identified tools is also concentrated in units B8 and B9. Several exceptions including the shank of a composite fishhook, several tool fragments, and several blades are located in unit A6 and this is the only deviation from the general pattern.

All the lithics from Early Neolithic layer are distributed between 5.50 m and 5.30 m above the datum point. Out of 2,119 lithics, only about 587 (27%)

have an exact depth recorded, whereas the height of the lithics that were found during sediment screening was arbitrarily assigned to these artifacts (according to the excavation technique described in Chapter 2). When all the lithic artifacts are plotted on a micro-profile (Figure 4.21) one can observe at least minor micro-stratification of the cultural layer on the basis of the density of lithic concentration. Thus, a first concentration appears to be associated with the bottom of Layer VI, at a depth between 5.30 and 5.36 m; about 8% of all the lithics in layer are located at the bottom. Interestingly, about 25 formal tools are also concentrated at the bottom, including one arrowhead, three borers, two burins, scraper, and two points. A second concentration of lithics is associated with the middle part of the cultural layer, at a depth between 5.37 and 5.43 m (Figure 4.21). This is the densest concentration of lithics (about 67%). The top of the layer, at a depth between 5.44 and 5.50 m, demonstrates rather even saturation with lithics, and seems to have a continuous character along with the middle concentration. Neither concentration has distinctively different proportions of lithics tools and debitage categories in it, while the bottom concentration has more diverse formal tools represented there.

Archaeological features in Layer VI are represented by the three hearths, located in units A6, A8, and B6/B7, all somewhat different from each other. The first hearth (unit A6) is a small dark charcoal stain, approximately 50 cm in diameter, without cobbles marking surface. This feature occupies the top of the Early Neolithic layer (Figure 4.22) and is only about 10 cm thick. The second hearth (unit A8) was found in the top or middle of the Early Neolithic horizon (Figure 4.22). It is different from the other two features because it has a distinct, clearly visible pit, about 50 cm wide and 20 cm deep. This pit is filled with numerous small calcified bone fragments and charcoal. Several small limestone cobbles mark the hearth on the surface. The third hearth occupies parts of units B6 and B7. It is represented by a large charcoal stain, about 1 m in diameter, without cobbles on top. The depth of matrix discoloration under this hearth is about 15 cm. In relation to the vertical arrangement of the Early Neolithic horizon this hearth occupies the bottom of the cultural layer (Figure 4.10).

The last feature associated with Layer VI is a deliberate arrangement of 15 small pebbles found in unit A7 (Fig 4.22). The pebbles, mostly conglomerates and quartzite raw materials, form a small cluster (about 15 × 15 cm) that is clearly recognizable among other artifacts and features. They had been very carefully placed (the rounded/oval-looking side of the pebbles is always facing up) and probably formed three rows. This arrangement associates stratigrafically with the bottom of Layer VI. Articulated deer bones were found at the same depth, about 70 cm to the north (unit A6). However, it is more likely that these features do not correlate with each other.

The Late Neolithic Layer V exhibits no clear patterns of artifact distribution in the horizontal dimension. However, the number of lithics is slightly greater in the eastern part of Trench E II (Figure 4.23). The distribution of lithics by category and unit is summarized in Table 4.5. Half of all the lithics in this layer are concentrated in unit B8; other lithics are evenly distributed between the rest of the units, except unit A7, which has only one stone artifact. Functionally identified tools are concentrated in units B7 and B8 (all are meat knives) (Figure 4.23). In the vertical dimension, all the Middle Neolithic finds occurred at a depth between 5.75 and 5.58 m above the datum point. Two clusters can be delineated within this layer; one between 5.65 and 5.75 m and the other between 5.58 and 5.62 m. Most of the lithics are associated with the lower level of the layer, while only 3 flakes are associated with the upper part. In fact, the upper cluster is defined primarily on the basis of the stratigraphic position of archaeological features (hearths) (Weber 1997).

Layer V contained two hearths. The first was an oval, 120 × 100 cm in size, and paved with one layer of limestone cobbles; these limestones cobbles are abundant in the vicinity of the site. However, no clear evidence of the use of fire, such as charcoal, burnt bone, or fire-cracked lithics, was found here; no discoloration of the matrix was observed in cross-section, either. The second hearth was located about 1 m south from the first hearth, in units A7 and A8 (Figure 4.23). This hearth consisted of a circular arrangement of four cobbles, of which three were quartzite and one was limestone; the cross-section demonstrated a distinct, reddish matrix discoloration. This discoloration, irregular in shape, was located immediately adjacent to cobbles. Also, a few faint charcoal stains were revealed in the southern part of the trench (units B8 and B9), at the bottom of the cultural layer (Figure 4.23).

Table 4.1. Distribution of shatter by size class.

Size, cm	Layer VII			Layer VI				Layer V		
	grey chert	quartzite	other	grey chert	red chert	quartzite	other	grey chert	quartzite	other
0.5 – 1.0	13	4	8	1,290	19	25	1	101	-	6
1.1 – 1.5	3	1	-	226	5	15	2	10	1	-
1.6 – 2.0	-	1	-	75	2	10	5	5	-	-
2.1 – 2.5	1	1	-	45	-	4	3	1	-	-
2.6 – 3.0	-	-	-	34	-	6	-	1	-	-
3.1 – 3.5	-	1	-	11	-	1	-	1	-	-
3.6 – 4.0	-	-	-	6	-	1	-	-	-	-
4.1 – 4.5	-	-	-	-	-	-	-	-	-	-
4.6 – 7.0	-	-	-	1	-	-	-	-	-	-
Totals	**17**	**4**	**8**	**1,688**	**26**	**62**	**11**	**119**	**1**	**6**

Table 4.2. Distribution of cobble/nodule shatter and pebbles by size class.

Size classes, cm	Layer VII	Layer VI				Layer V
	quartzite	grey chert	red chert	quartzite	other	
0.5–1	-	-	-	-	21	-
1.1–1.5	1	1	1	1	3	-
1.6–2	1	3	2	2	2	-
2.1–2.5	-	7	1	10	1	-
2.6–3	1	6	1	8	2	-
3.1–3.5	2	4	3	4		-
3.6–4	-	5	-	5	2	-
4.1–4.5	1	3	-	8	3	-
4.6–5	-	1	-	6	3	
5.1–7	1	-	-	3	1	
7.1–9	-	-	-	2	-	-
Totals	**7**	**30**	**8**	**49**	**38**	**0**

Table 4.3. Functional tool types and their correlation with typological categories.

Functional type \ Blank form		blade	micro-blade	flake	ridge flake	bifacial points	decortication flake	**Total**
Drills	antler				1			**5**
	stone		1		1	1		
	shell							
	wood					1		
Borers		1		2	1			**4**
Meat knives		2	2			1		**5**
Inserts for composite projectiles			3					**3**
Scrapers	bone			1				**2**
	unknown			1				
chopping implement (soft material)							1	**1**
Total		**3**	**6**	**4**	**3**	**3**	**1**	**20**

Table 4.4. Distribution of lithic tool categories by excavation unit in Layer VI.

Unit	A6	B6	A7	B7	A8	B8	A9	B9
Formal tools	-	2	1	1	4	2	7	6
Microblades	1	1	3	5	7	6	10	8
Cores & core fragments	1	2	3	1	1	-	2	2
Flakes	1	2	4	4	9	36	5	27
Bifacial flakes	-	1	-	-	2	10	5	3
Shatter	13	50	39	41	60	880	156	548
Ridge flakes	-	-	-	-	1	4	-	2
Decortication flakes	1	2	-	2	1	6	1	-
Cobble/nodule shatter	10	12	28	-	8	44	2	23
Totals	**27** **1%**	**72** **3%**	**78** **4%**	**54** **3%**	**93** **4%**	**988** **47%**	**188** **9%**	**619** **29%**

Table 4.5. Distribution of lithic tool categories by excavation unit in Layer V.

Unit	A6	B6	A7	B7	A8	B8	A9	B9
Formal tools	-	-	-	-	-	2	1	1
Microblades	-	3	-	1	2	4	-	-
Flakes	1	2	-	-	-	1	3	-
Bifacial flakes	2	1	-	1	-	1	-	-
Shatter	10	15	1	11	7	64	5	13
Totals	**13** **9%**	**21** **14%**	**1** **1%**	**13** **9%**	**9** **6%**	**72** **46%**	**9** **6%**	**14** **9%**

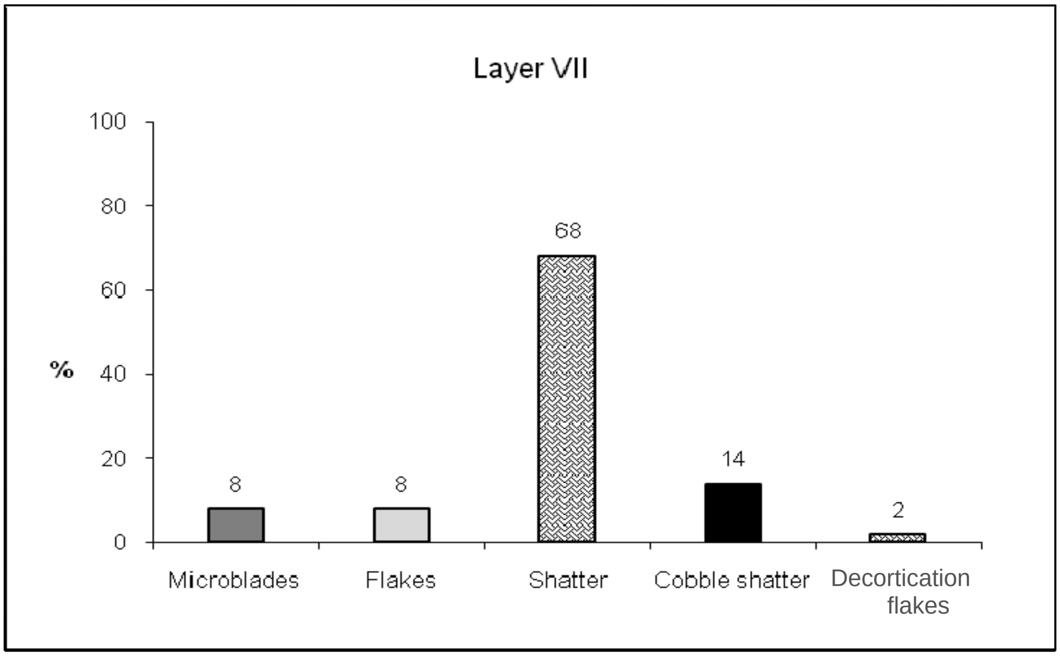

Figure 4.1: Lithic assemblage structure, Layer VII.

Figure 4.2: Photo of decortication flake, Layer VII

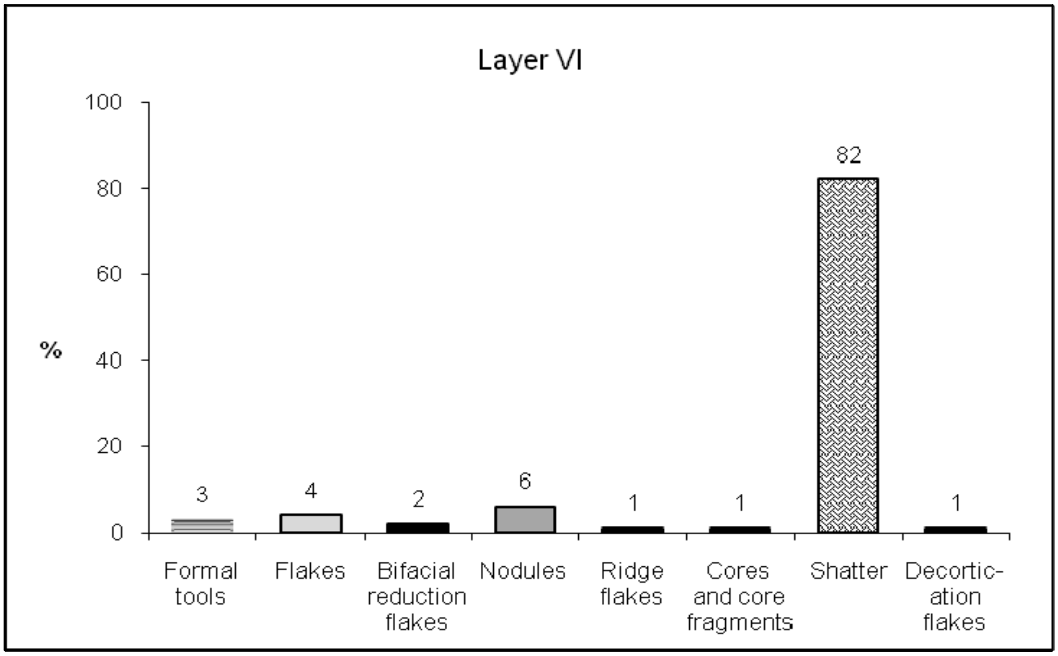

Figure 4.3: Lithic assemblage structure, Layer VI.

Figure 4.4: Photo of microblades, Layer VI

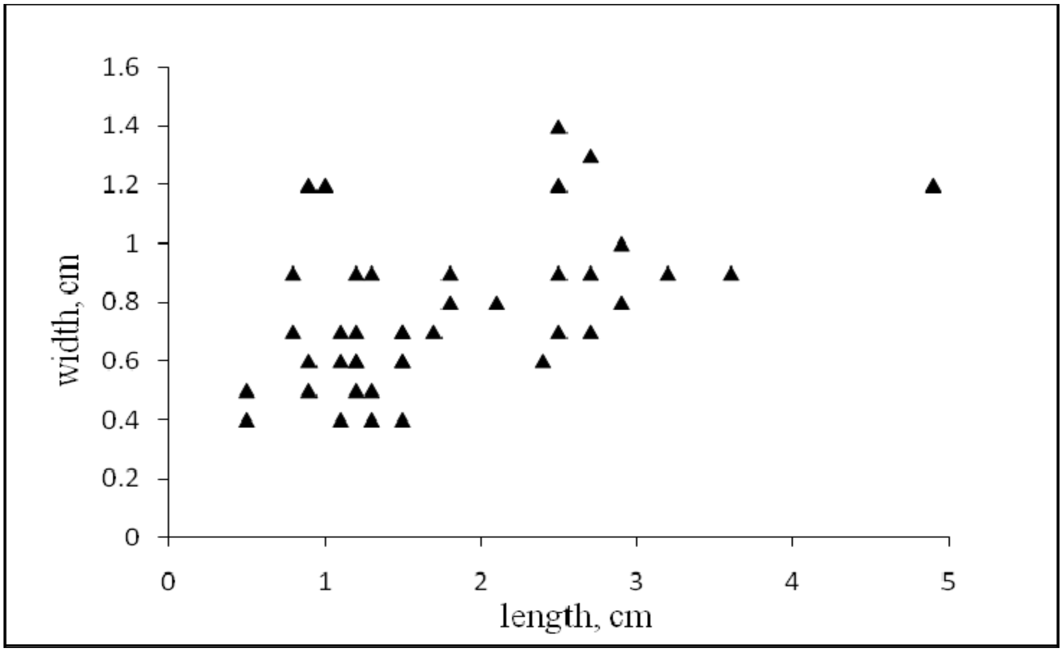

Figure 4.5: Blade and microblade dimensions (length by width), Layer VI.

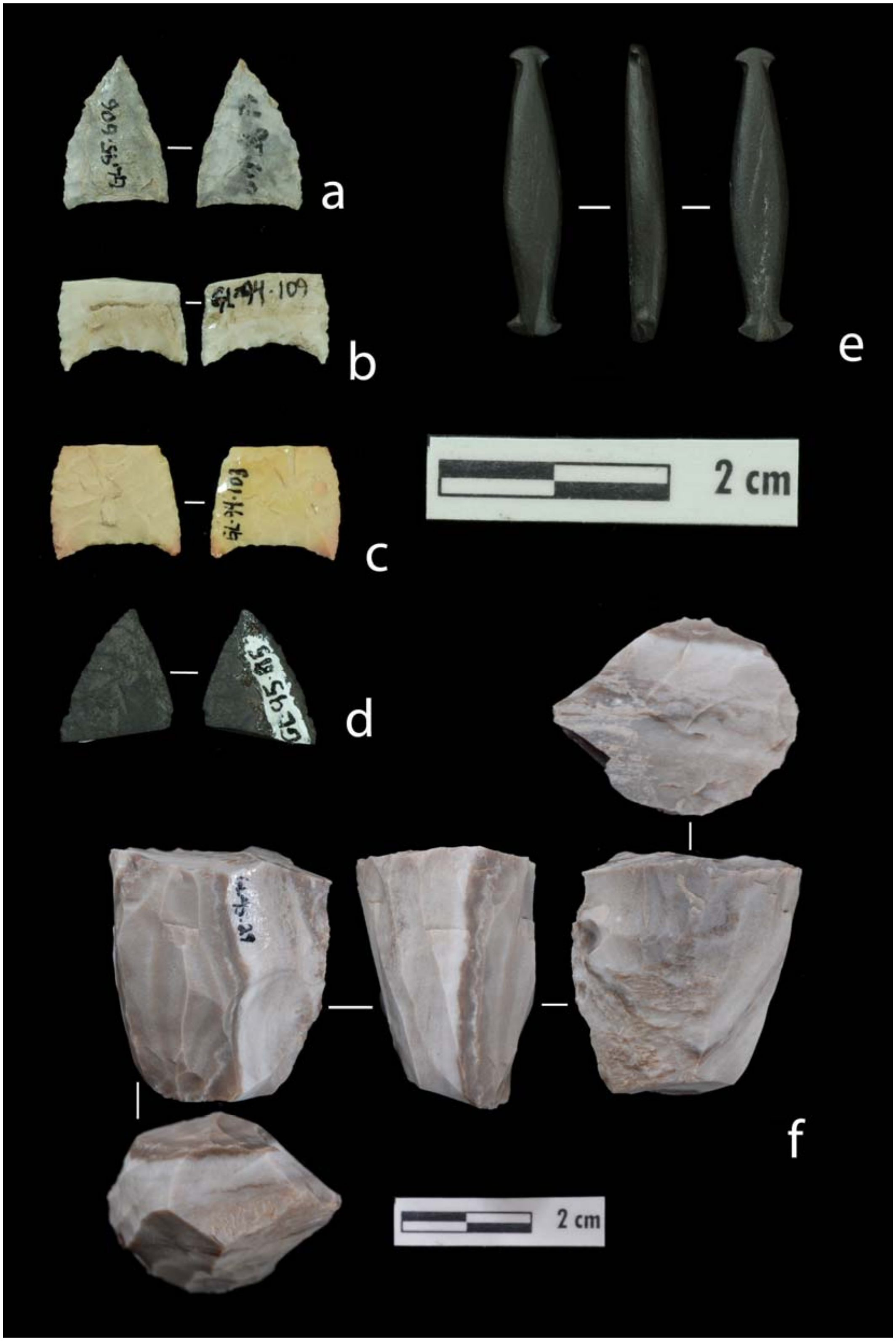

Figure 4.6: Photo of (a, b, c, d) arrowheads, Layer VI; (e) composite fishhook shank, Layer VI; (f) cylindrical core, Layer VI.

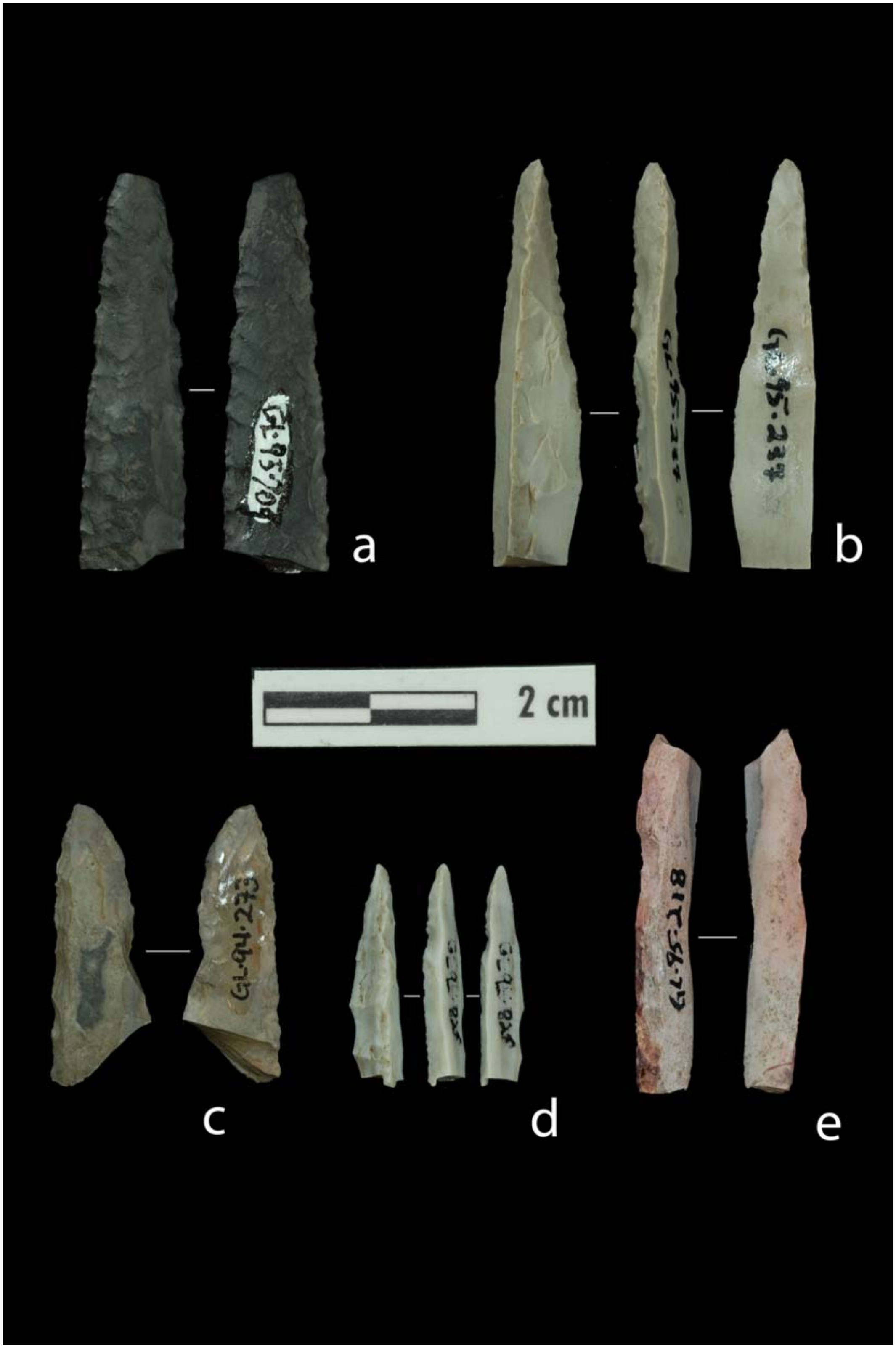

Figure 4.7: Photo of (a, c) bifacially shaped points, Layer VI; (b, d, e) points on initial microblades, Layer VI.

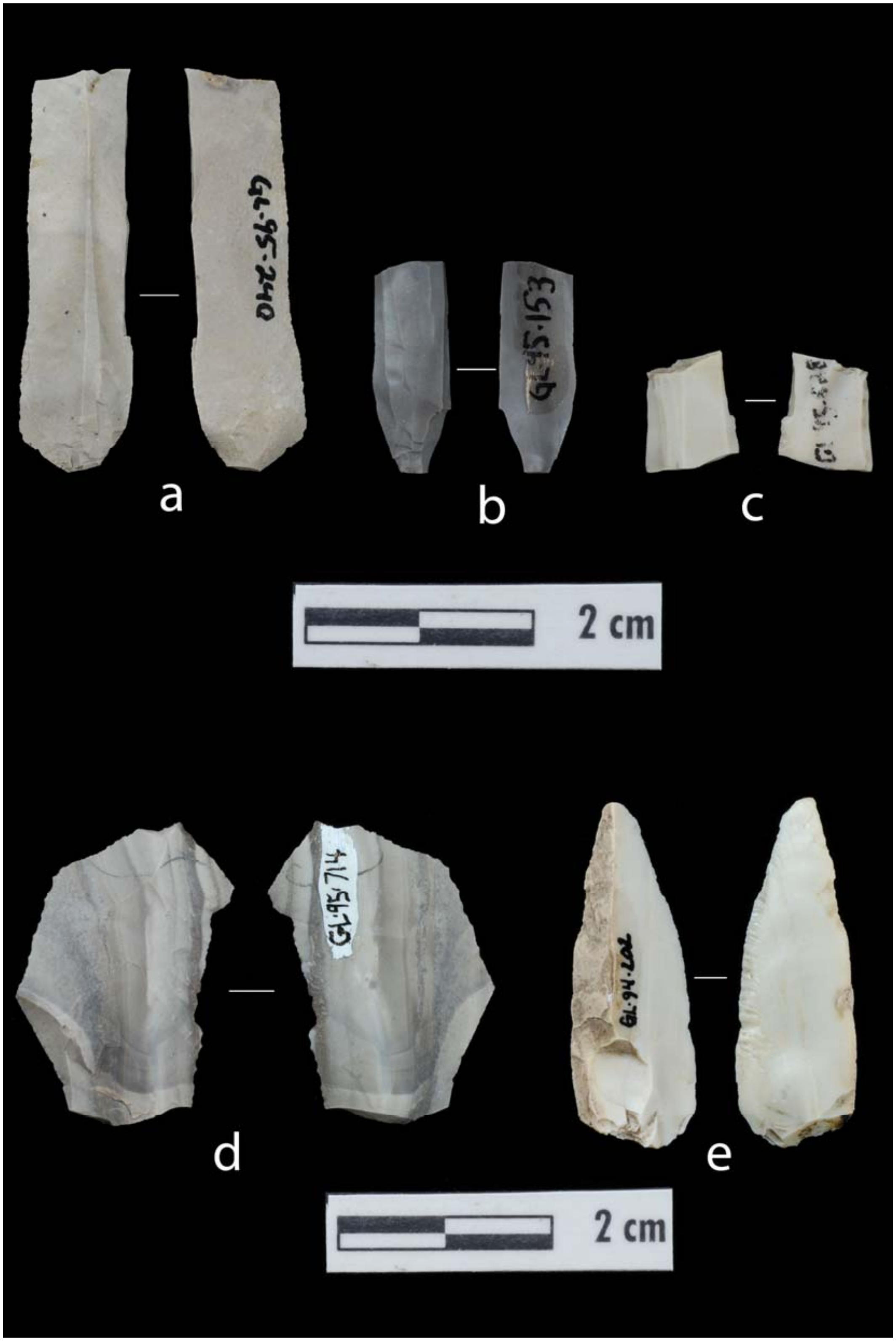

Figure 4.8: Photo of (a, b, c) burins, Layer VI; (d, e) borers, Layer VI.

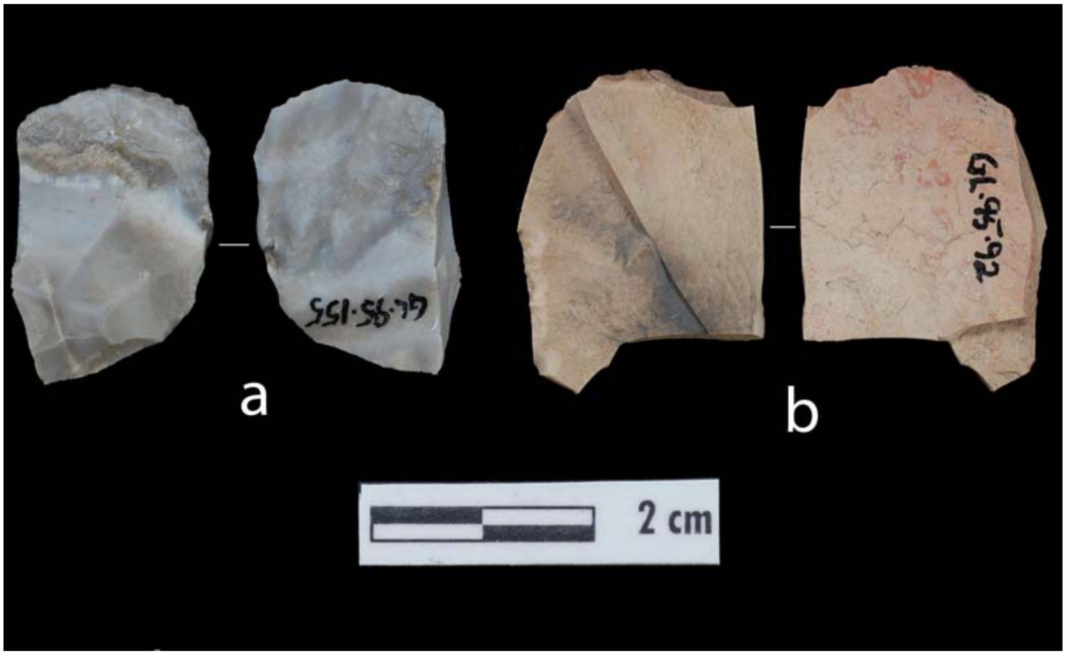

Figure 4.9: Photo of (a, b) scrapers, Layer VI.

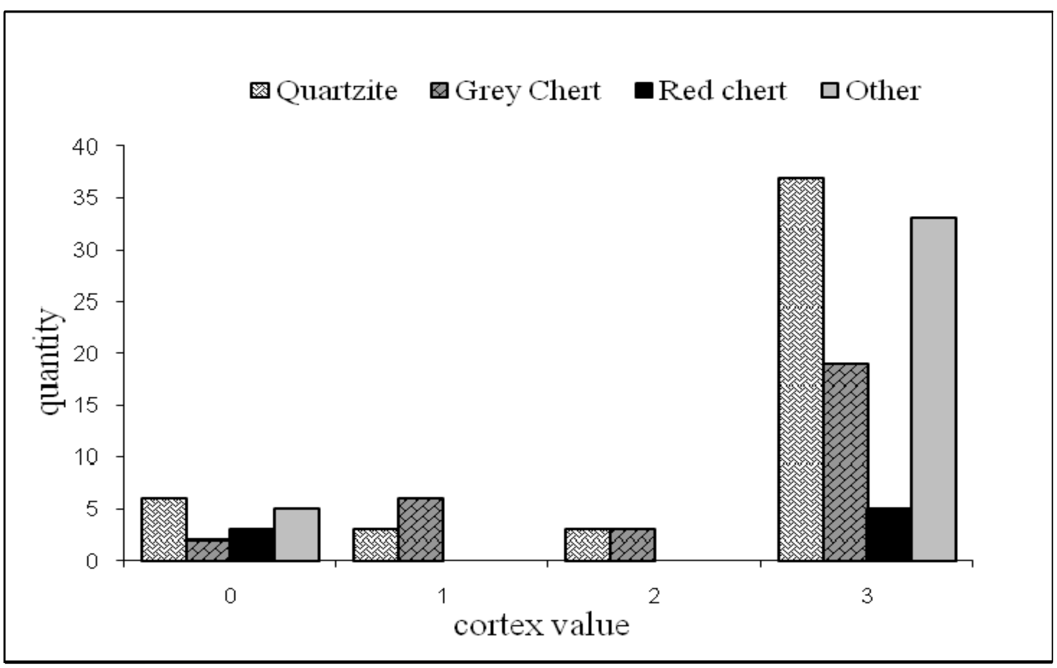

Figure 4.10: Distribution of cobble/nodule shatter by cortex class (0–no cortex; 1–less than 50% of cortex; 2–more than 50% of cortex; 3–cortical dorsal surface).

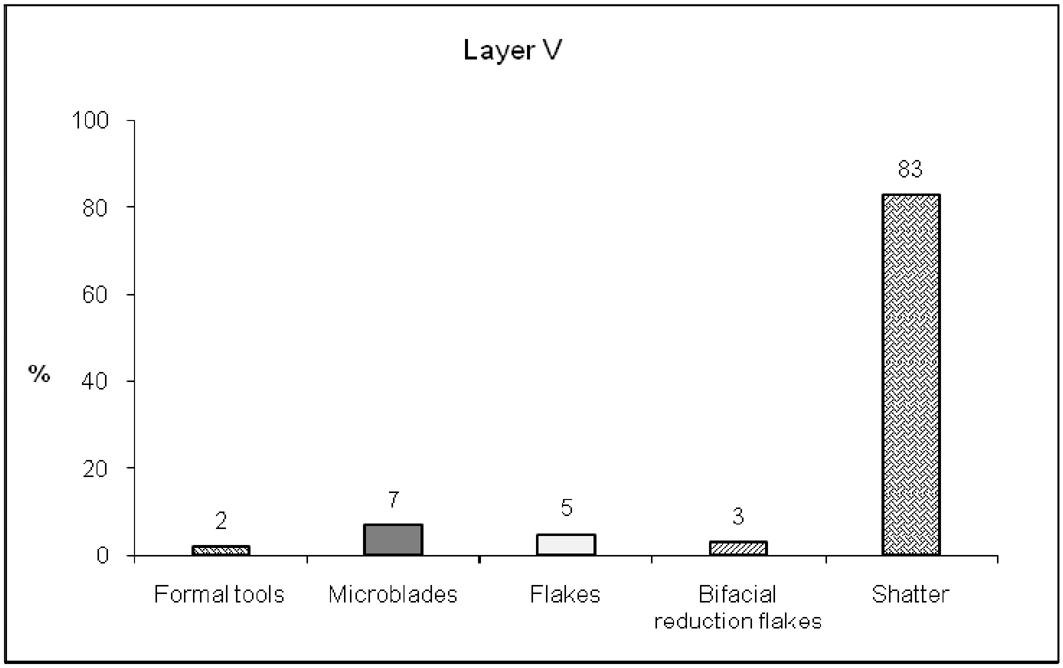

Figure 4.11: Lithic assemblage structure, Layer V.

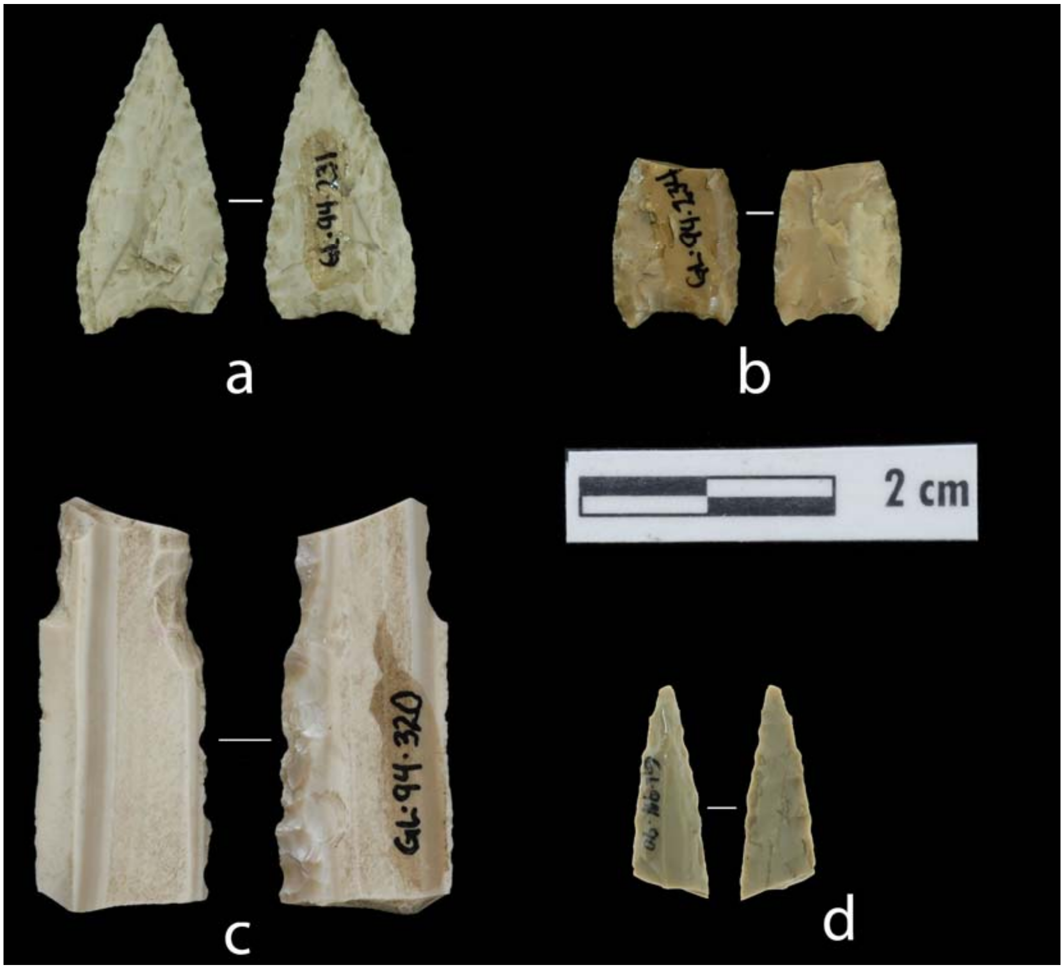

Figure 4.12: (a, b) Photo of arrowheads, Layer V; (c) burin, Layer V; (d) point, Layer V.

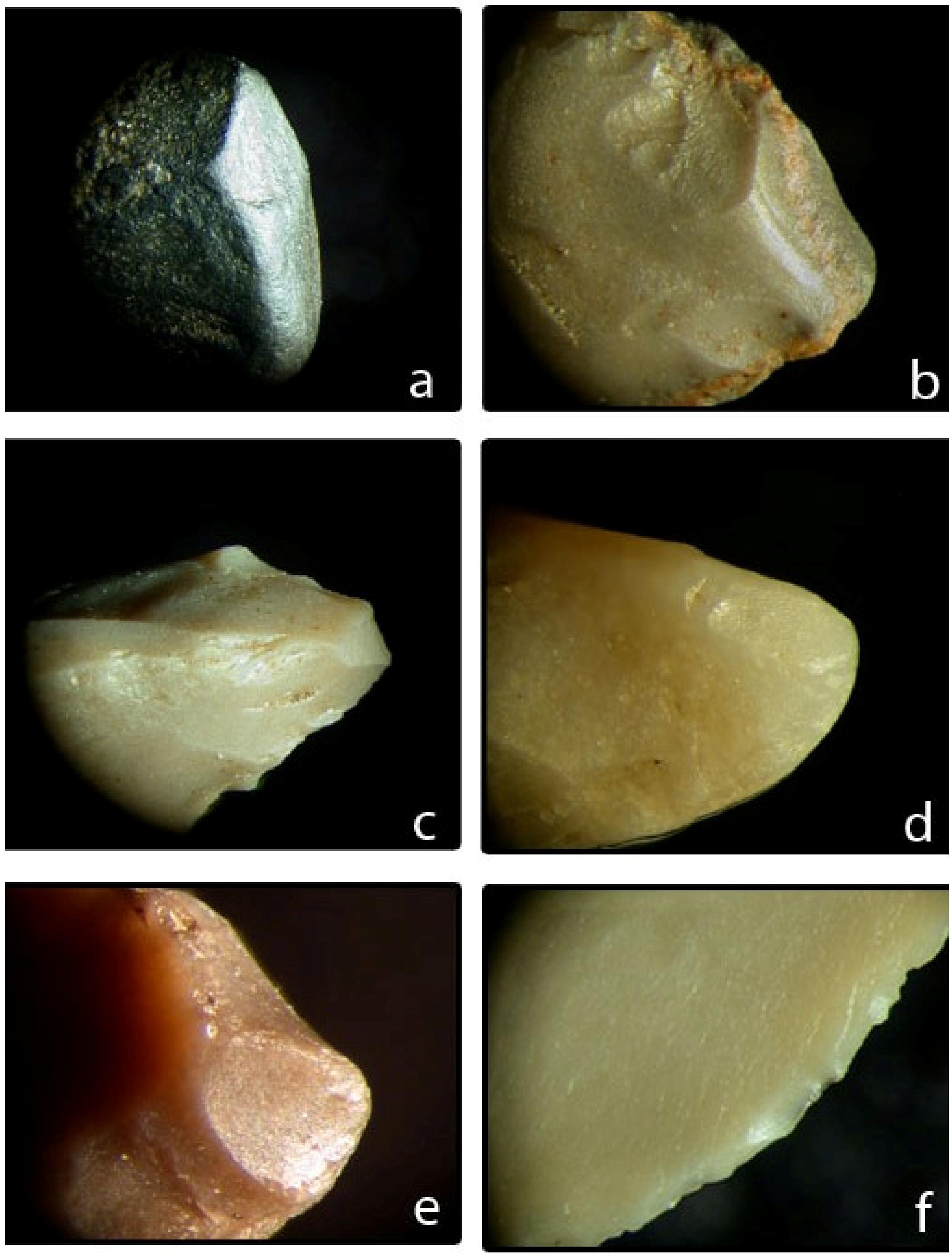

Figure 4.13: Photo of (a) drill for working stone (~35×); (b) drill for working wood (~35×); (c) drill for working antler/stone (~35×); (d) drill for working stone/shell (~35×); (e) drill for working stone/shell (~45×); (f) meat knife (~35×).

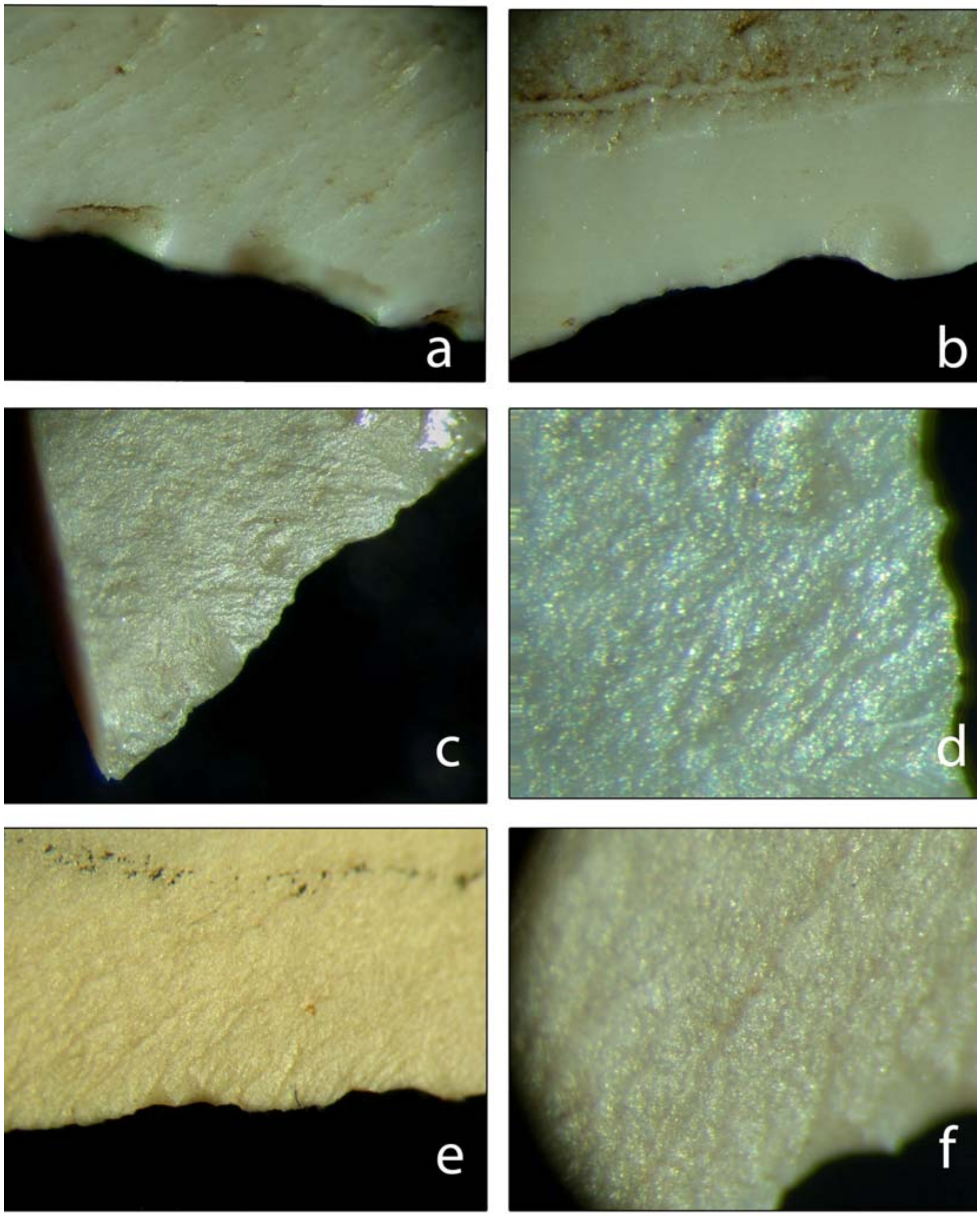

Figure 4.14: Photo of (a, b) meat knife (~65×); (c, d) meat knife (~35× and ~65×); (e, f) meat knife (~35× and ~65×).

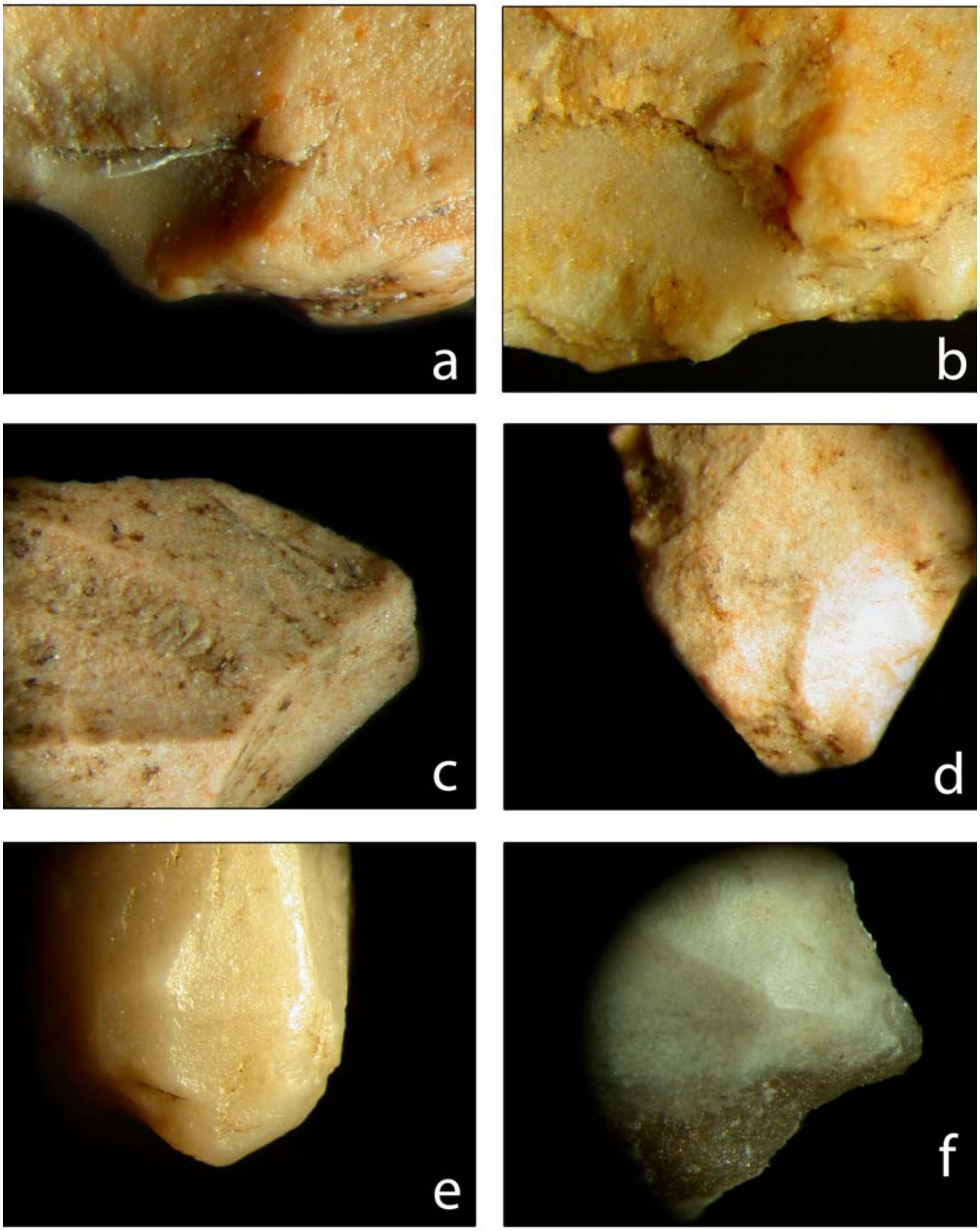

Figure 4.15: Photo of (a, b) meat knife (~35×); (c, d) borer (~35×); (e) borer (~35×); (f) borer (~35×)

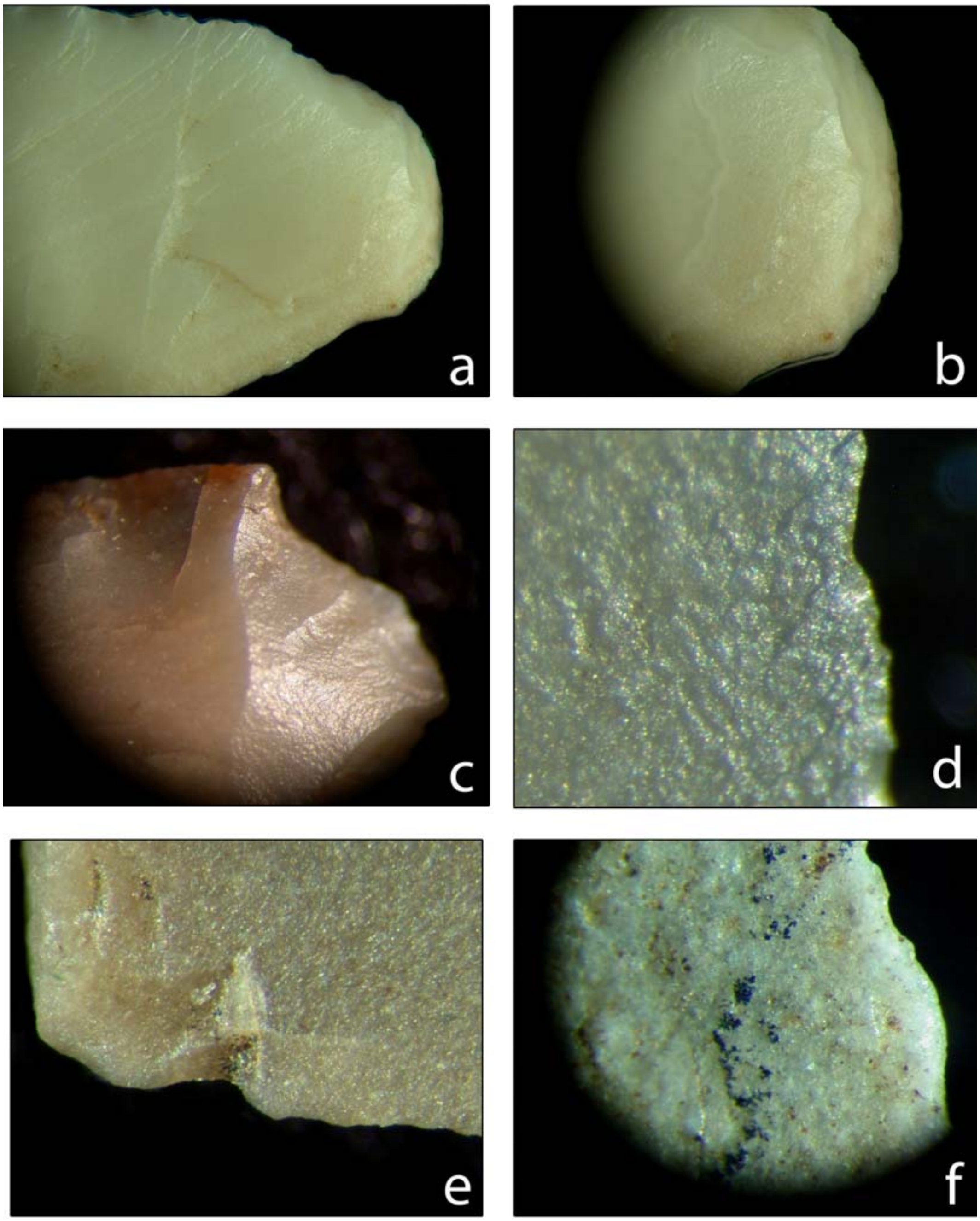

Figure 4.16: Photo of (a; b) borer (~35× and ~45×); (c) projectile insert (~35×); (d) projectile insert (~45×); (e) projectile insert (~35×); (f) projectile insert(~45×)

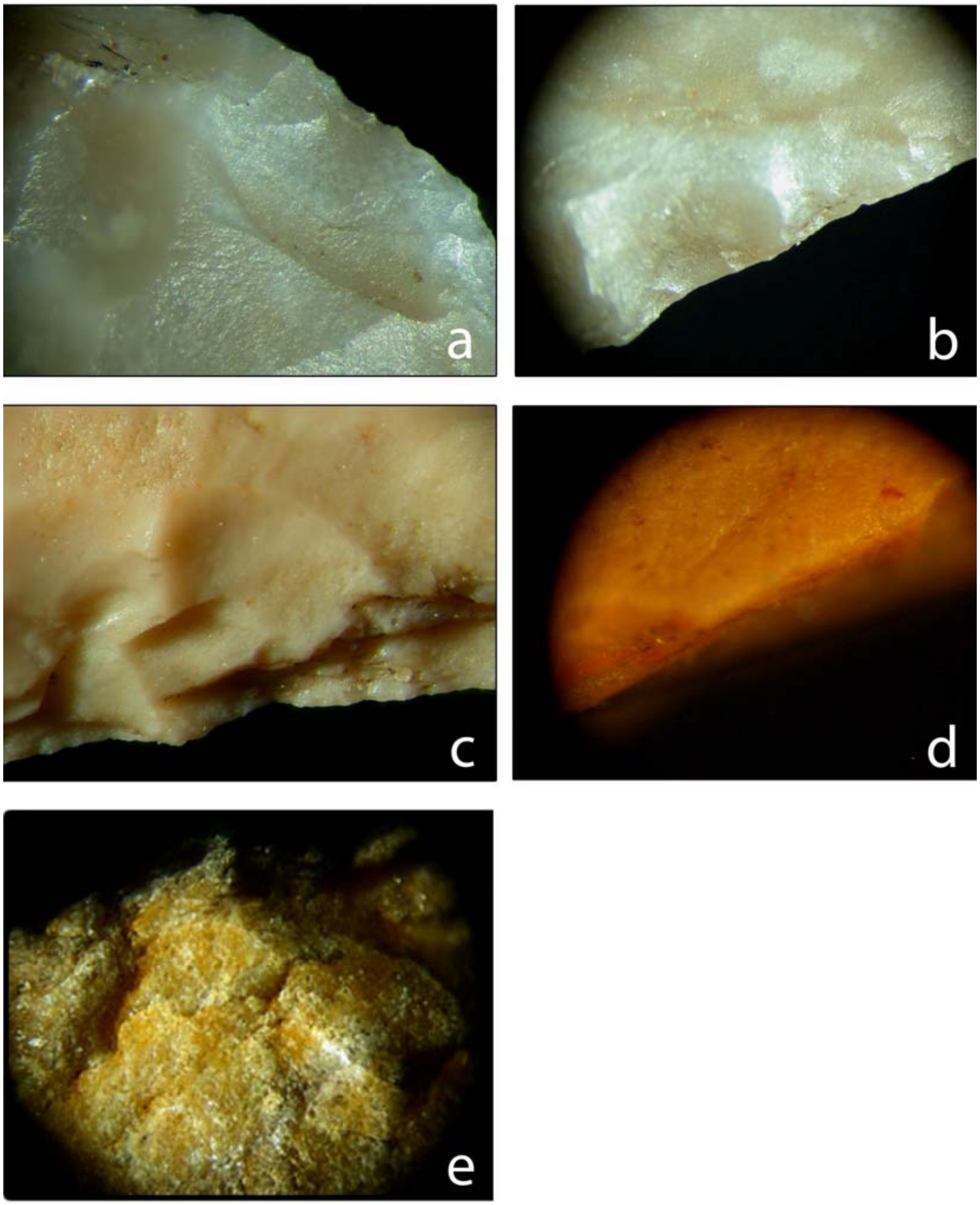

Figure 4.17: Photo of (a, b) scraper (~65×); (c, d) scraper for working bone (~65× and ~35×); (e) tool for chopping/hewing fibrous material (wood?) (15×)

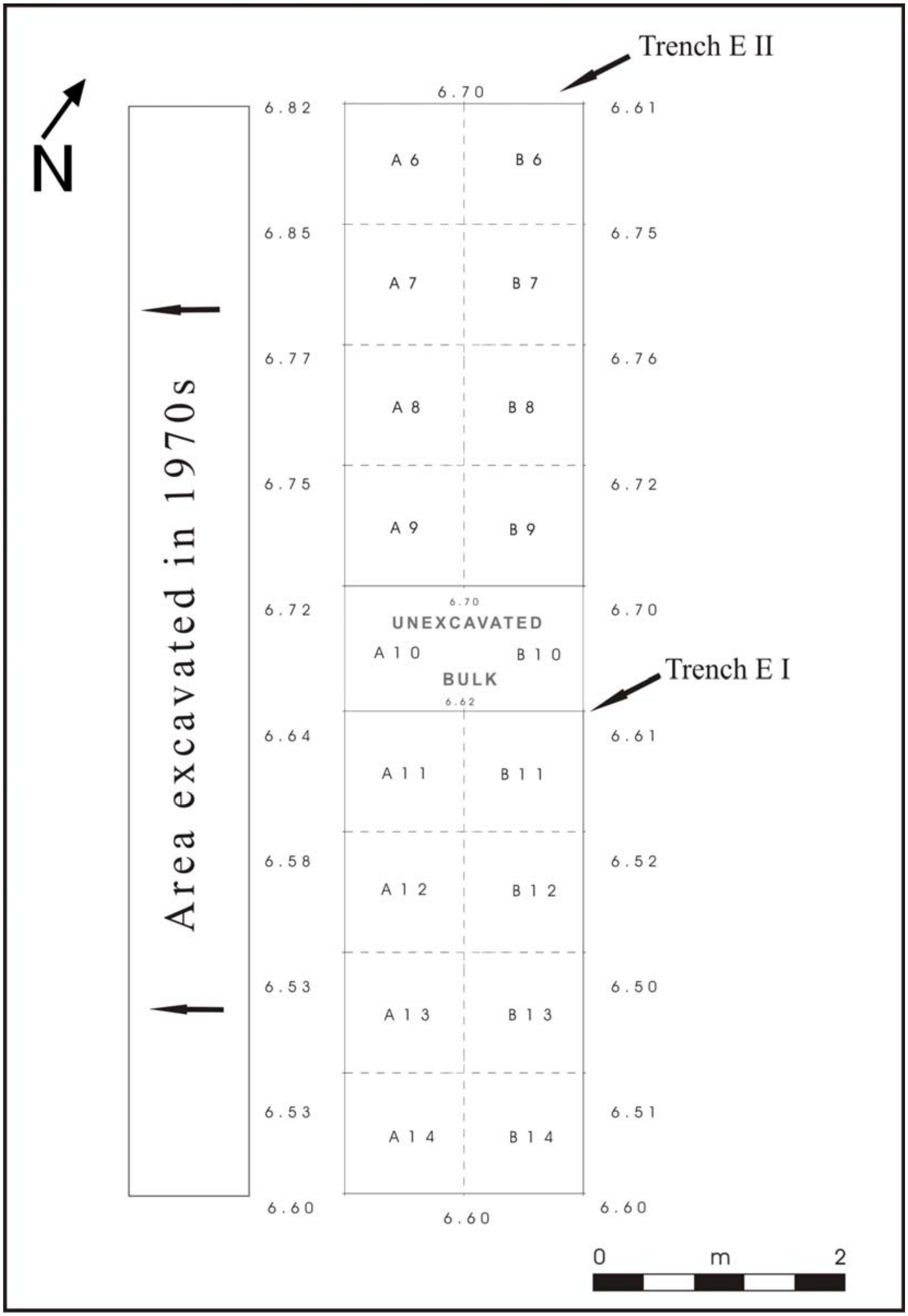

Figure 4.18: Layout of excavation units, Trench E, Gorelyi Les

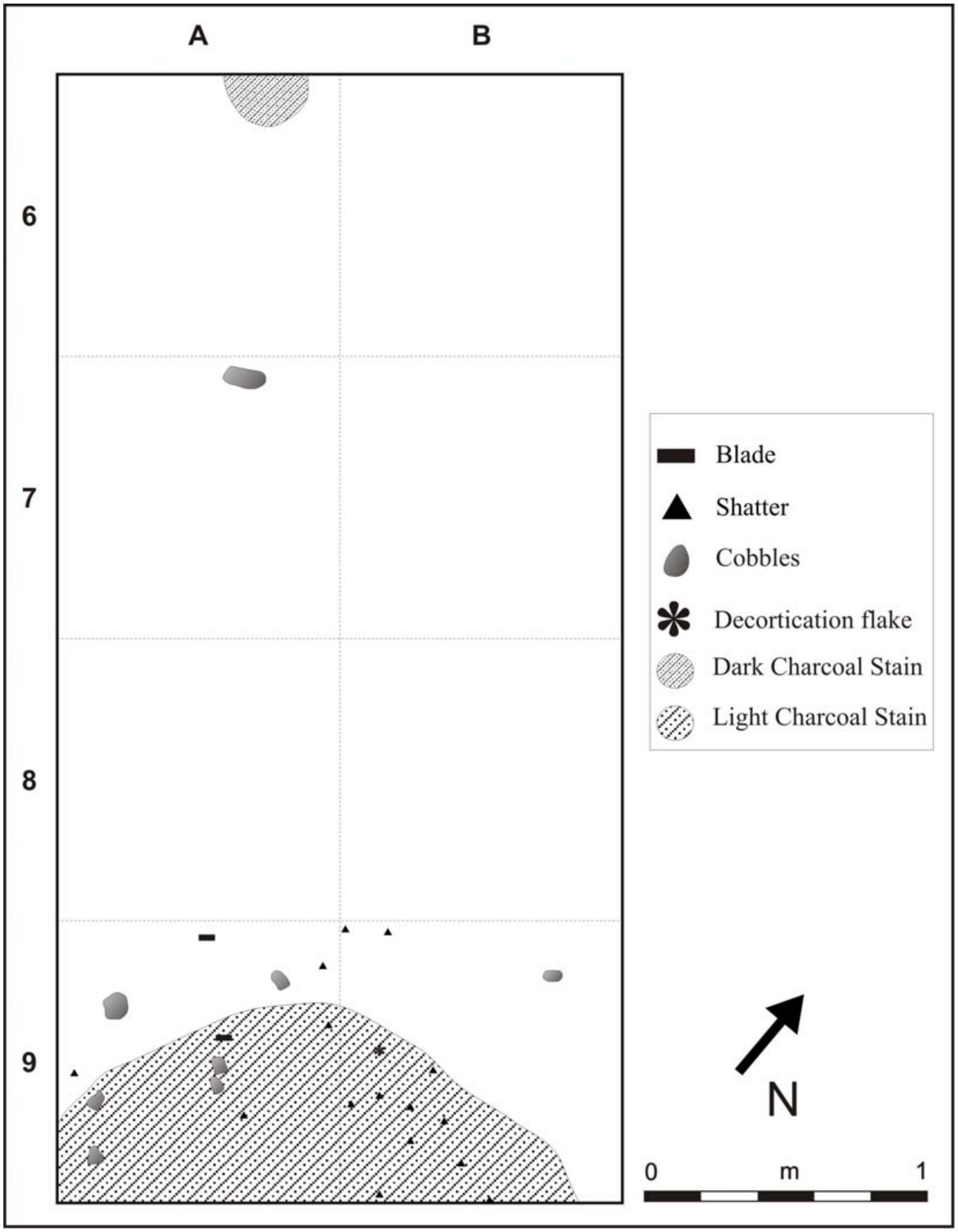

Figure 4.19: Artifact distribution in Layer VII.

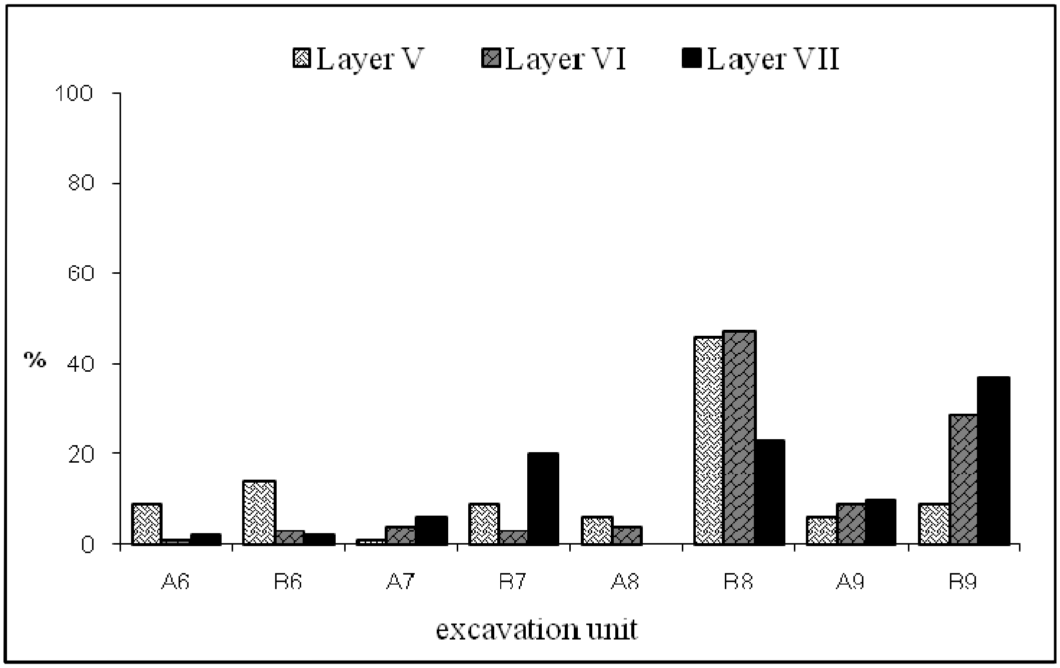

Figure 4.20: Distribution of lithic artifacts among cultural layers and excavation units, Trench E II.

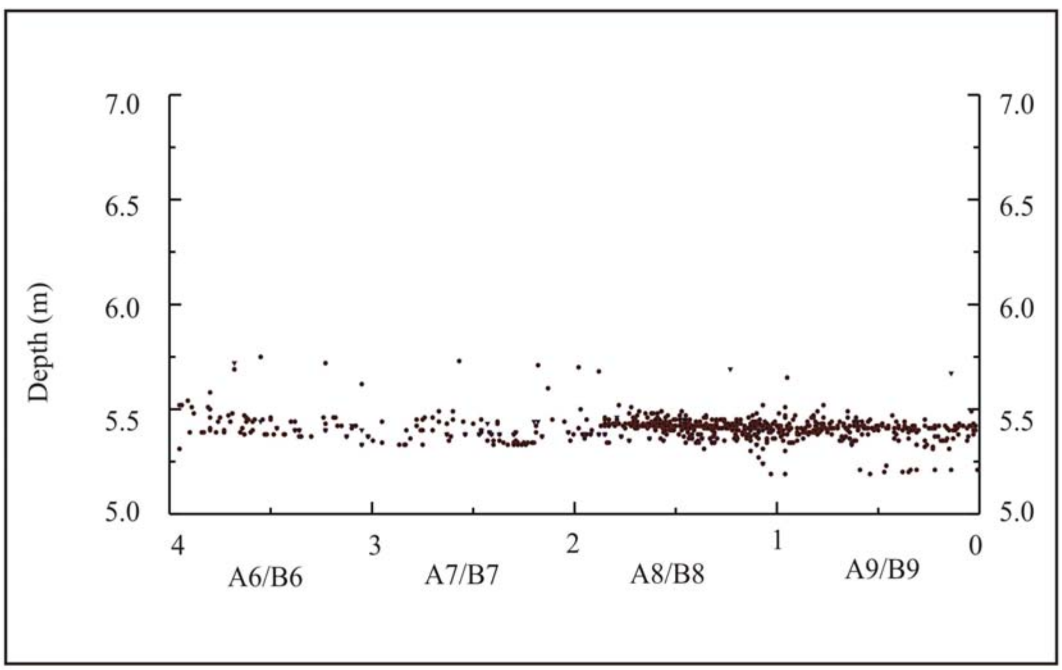

Figure 4.21: Vertical distribution of lithic artifacts, Trench E II.

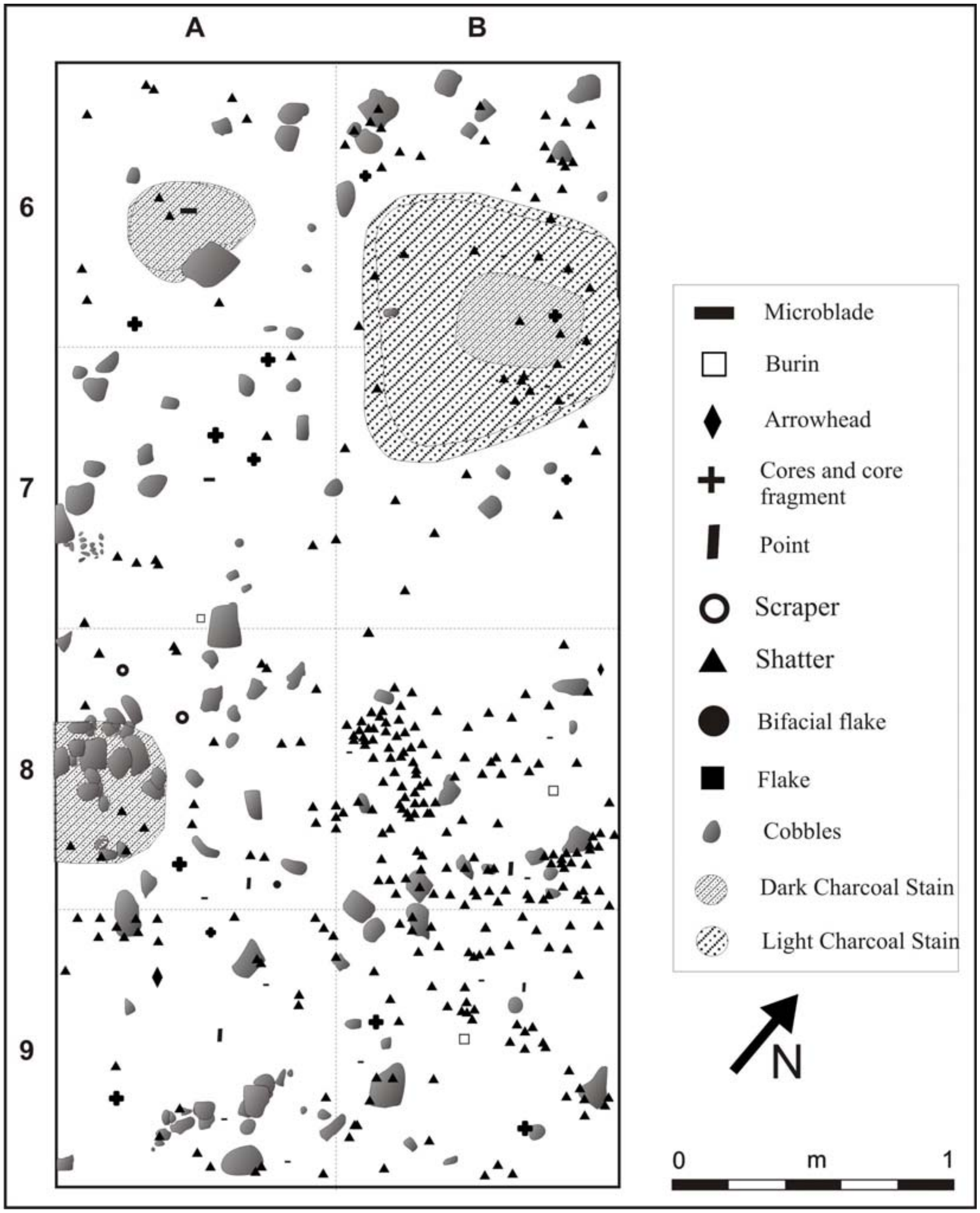

Figure 4.22: Artifact distribution in Layer VI.

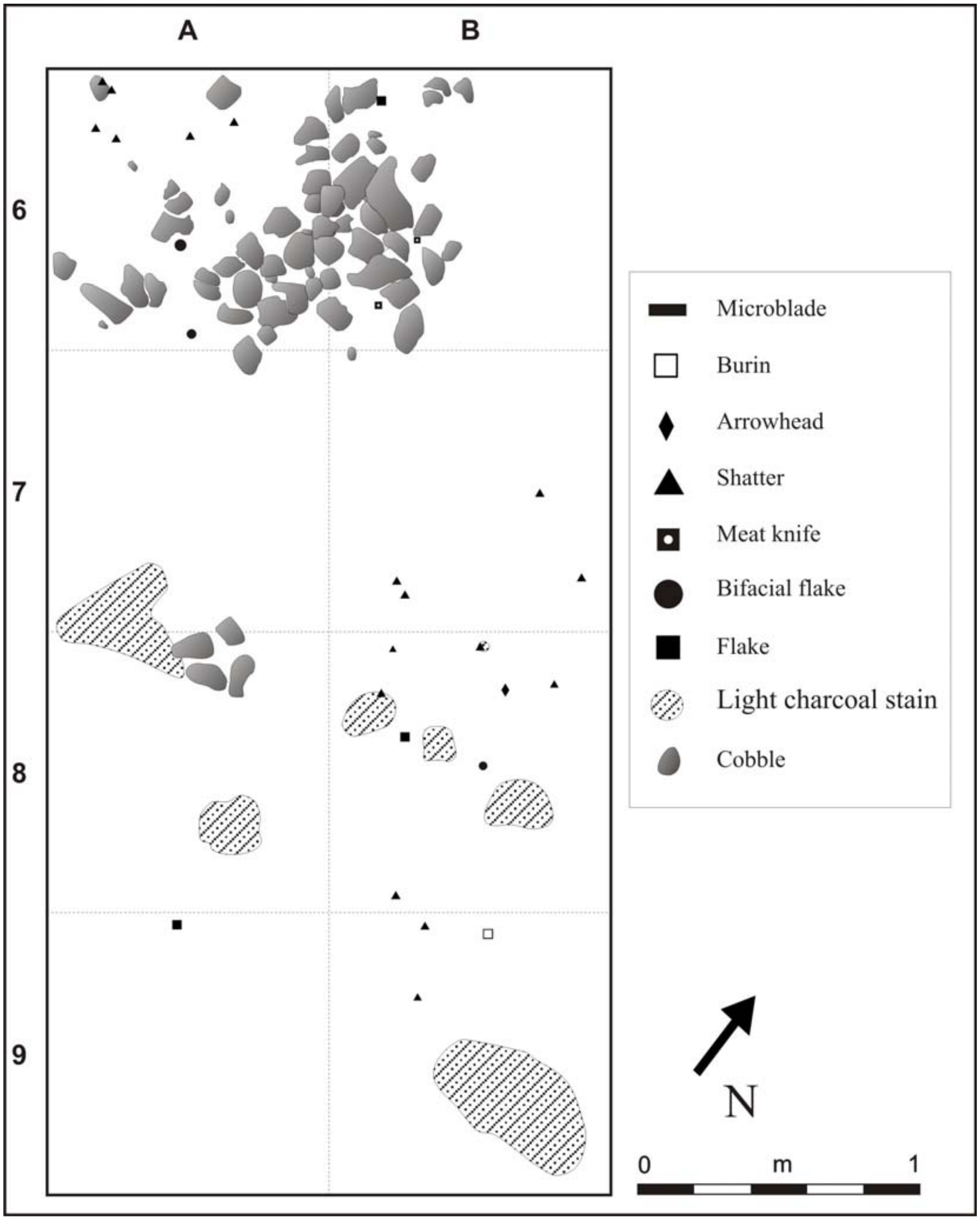

Figure 4.23: Artifact distribution in Layer V.

Chapter 5

Discussion

It is widely accepted in Russian archaeological literature that lithic technologies do not vary substantially during the Neolithic period in the Cis-Baikal region, and that they represent a continuous record of the same technique and strategies of tool manufacturing throughout this period (Medvedev 1981; Weber 1995). For instance, the Neolithic period inherited a set of technological traits (e.g., blade industry) from the Mesolithic, and exhibited the same range of tool manufacture techniques (Savel'ev 1986). Debitage was considered as a homogeneous category of artifacts rather consistently for this time, which had little value for resolving questions of archaeological chronology or for revealing the behavioural patterns of ancient populations (Medvedev 1981). This chapter considers the patterns of lithic technologies, use, and discard at Gorelyi Les, based on the results of typological, technological, use-wear, and spatial analyses.

Functional studies of materials from archaeological sites in the Cis-Baikal region are rare. To date, use-wear analysis has been applied exclusively to materials derived from mortuary complexes (Kungurova et al. 2006, 2008a, 2008b, 2009; Semenov 1941, 1964). On the other hand, use-wear analysis of lithic tools from habitation or camp sites has never been conducted in the Cis-Baikal region. Thus, the functional study of archaeological remains — specifically, the lithics — from Gorelyi Les in the present research is one of the first attempts to apply use-wear analysis to materials from a habitation site context. Recent studies in the Cis-Baikal region focus primarily on examining hunter-gatherer behavioural patterns in subsistence, diet, migrations, social relations, etc. The lithic archaeological materials, undoubtedly, should contribute to our understanding of those patterns. Detailed typological and technological studies of debitage in the Cis-Baikal region were not conducted before,either.

5.1 Cultural and chronological patterns

5.1.1 Late Mesolithic

The number of lithic artifacts recovered from the Late Mesolithic layer at Gorelyi Les is too small to produce any well-grounded conclusions about lithic manufacture and models of site use during this time. The analyzed lithics are all made of locally available raw materials: quartzite, grey chert, black chert, and marble. The types of raw material in this layer (Figure 5.1) do not differ from those found in other layers at Gorelyi Les, although a relatively higher proportion of black chert is represented. This fine-grained black chert of good quality was used to manufacture blades. In terms of technological strategies, the presence of blade manufacturing at the site is evident (however, it is impossible to recognize the reduction trajectory of these blades); manufacturing of large quartzite tools from quartzite pebbles is also represented here. The only recognized activity that was performed by the tools found in this layer is the processing (hewing?) of soft fibrous material such as wood.

5.1.2 Early Neolithic

Among all the cultural horizons at Gorelyi Les, lithic artifacts from Layer VI are the most abundant and diverse, and their analysis has provided ample information about the lithic technologies of Early Neolithic hunter-gatherers.

Analysis of all the lithics in the layer indicates two major strategies of raw material procurement and use. First, materials locally available from Belaia River alluvial sediments and outcrops along the river course — such as light- and dark-coloured banded grey cherts, red platy chert, quartzite pebbles, argillite, and conglomerates — were all collected in the vicinity of the site and were extensively used for lithic tool manufacture. Thus, the time and labour expended on procurement of these rocks were minimal. The abundance of these local materials resulted in a large amount of lithic waste made of them. Second, raw materials such as slate and light-colored white banded high-quality chert were also locally available, but apparently in lower quantities than other materials. These types of raw materials are underrepresented in the lithic waste and this would indicate that they were either procured or used for tool manufacturing in other areas at Gorelyi Les or in other locations distant from the site.

In general, locally available light- and dark-colored grey banded chert dominates all the categories of lithics. However, the category of formal tools demonstrates a greater variability of raw materials (chert of various colors, slate, argillite, etc.). Our analysis revealed a discrepancy between the types of debitage and formal tool raw materials. For example, all the debitage categories lack artifacts made of white-colored fine-grained chert, and red platy chert is not numerous, either, whereas the formal tool categories include implements made of almost all types of raw materials present at the site. This situation may be interpreted in several ways. First, the most probable explanation is that some tools were manufactured in other places and were introduced to Gorelyi Les in the form of already finished tools or tool blanks. Indirect evidence that supports this proposition is well-developed use-wear on most of the functionally identified formal tools; e.g., those made of white-colored chert. The tools were introduced to the site after intensive use and discarded when they were no longer suitable for performing their task. However, one should keep in mind that the analyzed lithic assemblage is rather limited and represents only part of the whole archaeological site Gorelyi Les. Additional information is definitely needed in order to validate the observed patterns and to investigate their nature.

Also, the lithic assemblage from Gorelyi Les contains relatively few unmodified pieces of shatter of hematite and graphite, and small rounded pebbles of kaolinite (gypsum?). These minerals are not exotic for the Belaia river valley and are abundant in this region (Kuznetsov and Khrenov 1982). However, these rocks could not be used for knapping because they are anisotropic and do not exhibit a conchoidal fracture pattern; rather, hematite and graphite might have been used to produce pigments (e.g., red ochre) and kaolinite (gypsum?) to make beads. Such use of these rocks is the most probable and was common for Middle Holocene hunter-gatherers in the Cis-Baikal region (e.g., use of red ochre in a mortuary context) (Bazaliiskii 2010).

The composition of the lithic assemblage in this layer (e.g., the presence of cores and their fragments, nodules of raw materials (cracked quartzite pebbles and chert nodules), decortication flakes, and small- and mid-sized debitage) indicates that most technological stages of the tool manufacturing process took place at Gorelyi Les. These materials likely represent the entire sequence of technological operations involved in the process of manufacturing stone tools. It seems that the reduction strategies at Gorelyi Les have followed two trajectories: bifacial reduction and core reduction. Apparently, the latter trajectory prevailed (judging by the large number of core reduction flakes and core shatter). However, it is not possible to segregate completely the debitage detached from bifaces or cores, because the attributes described earlier may pertain to both types of these lithic artifacts. Hence, the overlap of lithic characteristics cannot be determined on the basis of typological observations only.

Blade manufacturing was evidently an important part of the lithic industry. Mostly, they were microblades reduced from prismatic and cylindrical cores. The dorsal flake scarring pattern and striking platform morphology of bifacial reduction flakes indicates that all three stages (early, middle, and late) of biface manufacturing are present here. However, the number of bifacial reduction flakes with three or more dorsal flake scars that are associated with the late stage of reduction is slightly greater than the number of flakes with one-two or no dorsal flake scars. Differences in lithic raw material use are also noticeable, and occur with respect to the reduction trajectory. Specifically, all the bifacial reduction flakes are made of red platy chert. This would indicate a suitability of certain types of raw material for a particular reduction trajectory, or for a particular activity performed with these tools. In this case, the red chert is represented by flat slabs of various thicknesses (mostly several cm), with naturally occurring striking platforms that are easy to shape with the bifacial technique and their use for biface production seems to be more time-efficient than the use of large blocky grey chert nodules.

It is difficult to evaluate the amount of flintknapping activity that took place at the site, because even a single episode of stone tool manufacturing may yield a large number of waste (Andrefsky 2005). Moreover, we do not possess sufficient data to answer this question (e.g., to conduct a minimal nodule analysis, etc.). Nevertheless, the amount of waste and its composition, rather large and diverse, would probably indicate that the flintknapping activity here was intensive. The knapping techniques employed for lithic reduction were presumably direct percussion and pressure flaking. The types of hammerstones employed in tool manufacturing were probably rock hammers (pebbles and cobbles) and antler billets. They do not produce the usually prominent bulb of percussion and éraillure scars on the flakes ventral surfaces. However, none of latter was found in the assemblage, while some rocks that might have been used as hammerstones did not exhibit any traces of use associated with flintknapping activity (e.g., circular microcracks, indentions, and pits). Platform abrasion was widely used in tool manufacturing; this also might indicate latter stages of tool manufacturing (Magne 1985).

Despite the relatively small number of functionally identified tools at Gorelyi Les, they represent a wide range of activities and provide insight on subsistence patterns. Those activities are related either to food procurement or to processing various materials and producing other tools and goods. The first group of activities includes hunting and meat butchering. The second group includes drilling soft stone, antler, shell, and wood, and scraping bone and other materials. The working edges of the five functionally identified tools (borers and meat knives) were not intentionally modified in order to adjust them for performing various activities. The working surfaces of other tools were either shaped or modified by retouch for more efficient use in a particular operation, such as scraping, drilling, and butchering meat. This situation might indicate that some of the tools were used only in specialized operations and were produced specifically for these purposes; for example, the bifacial points (except for one specimen used for cutting meat) were used exclusively for drilling. However, some tools were only occasionally chosen to perform an activity simply because of their morphological characteristics or availability (e.g., cutting edge for meat knives and sharp point of flakes for piercing hides).

The presence of three hearths with a well-developed structure that were used during an extended period of time supports the statement that Gorelyi Les was used by Early Neolithic hunter-gatherers as a long-term camp associated presumably with a wide range of activities performed either at the site or at the vicinity.

The most intriguing feature at Gorelyi Les is the deliberate arrangement of pebbles. These pebbles exhibit no traces of intentional modification or use. However, they are manuports and were chosen and brought to the site according to some criteria, presumably their shape (either spherical or slightly oval) and weight (between 34 and 50 g). The pebbles came from alluvial river sediments and are composed of quartzite, conglomerates, and basalt. One can suggest several possible ways of interpreting this feature: firstly, pebbles of such a shape and weight might have been used for hunting with a sling (as a projectile weapon); secondly, assuming that the Early Neolithic hunter-gatherers exploited fish resources, one can suggest the use of these pebbles as net sinkers; finally, their organization into rows may point to their use for games (children's activity?). Nevertheless, neither of these conjectures have any satisfactory support. Therefore, the actual functional designation of the described pebble arrangement remains unknown. Similar features have been discovered at several archaeological sites in the valley of the Belaia River; pebble arrangements were recorded in the Early Neolithic Layers V and Va (C14 dates on charcoal 7400 ± 150 (SOAN-4431), 6450 ± 70 (SOAN-4439), and 7200 ± 90 (SOAN-4428)) at the multi-component habitation site Ust'-Khaita, located several kilometres south from Gorelyi Les (Savel'ev et al. 2001). Despite the fact that the arrangements were recognized as an archaeological feature, the authors did not provide any interpretation of their arrangement in rows and their presence at the site. It is worth mentioning that such a pebble arrangement was not found at Gorelyi Les during the 1970s excavations; moreover, they have not been reported at habitation sites outside the Belaia river valley.

5.1.3 Late Neolithic

The number of artifacts in this layer is greater than in Layer VII, but still much smaller and less diverse than in Layer VI. Nevertheless, even a small number of artifacts provides some information to distinguish particular patterns among the lithic tools of the assemblage.

It seems that tool manufacturing during the Late Neolithic period at Gorelyi Les was minimal, and was restricted to only several technological operations, such as tool maintenance (e.g., resharpening, rejuvenation of working surfaces) and manufacture of flakes of irregular shape for expedient needs. The absence of any nodules of raw materials, cores and core fragments, large-sized flakes with a high percentage of dorsal surface covered with cortex, or decortication flakes all support the inference that only a small part of the technological cycle of tool manufacturing occurred at the site. Thus, the majority of tools that hunter-gatherers used were manufactured either at different parts of the site or even in another location. The available materials suggest the presence of bifacial knapping trajectory. Several small bifacial reduction flakes, presumably produced at the late stage of bifacial reduction, support the above statement. Other than that, some shatter, flakes, and microblades indicate a use of core reduction trajectory, too. It seems that the tool manufacturing/maintenance activity at the site had a sporadic, short-term character and did not produce large amounts of waste.

The range of activities performed by the lithic tools identified with the use-wear analysis was apparently very narrow and specialized. These are the traces of meat processing on microblades. This evidence, coupled with the presence of arrowheads, suggests that hunted game was brought to the site and was processed here (butchered) and cooked. No other types of use-wear were found on the lithics, despite the presence of several typologically identified tools (e.g., burin and distal fragment of the point).

5.2 Gorelyi Les in the settlement-subsistence system of Middle Holocene hunter-gatherers

Gorelyi Les undoubtedly played an important role in the subsistence and settlement systems of prehistoric hunter-gatherers throughout the Middle Holocene period. The location of the site in a forest-steppe zone, with abundant and diverse food resources (either riverine or terrestrial), the presence of various easily accessible lithic raw materials, and other factors influenced the appearance of prehistoric population settlement in this area. Nevertheless, it is evident that prehistoric hunter-gatherers exploited this location in various ways, which is reflected in the lithic assemblage and in other archaeological remains.

Although a reliable reconstruction of the lithic technologies at Gorelyi Les, the site's function, and other aspects of prehistoric hunter-gatherer populations are difficult to produce based on this relatively small assemblage, analogies with previously excavated materials (1970s excavations) would help to accomplish this task. Moreover, some preliminary hypotheses about the place of Gorelyi Les in the settlement-subsistence system of hunter-gatherers have been formulated in Weber et al. (2002), and an analysis of the faunal assemblage from Gorelyi Les was conducted by Ready (2008). Therefore, the reference basis for future researches was established. For instance, Weber et al. (2002) proposed that the patterns documented at Gorelyi Les provide evidence for distinguishing differences in the general adaptation strategies of Early Neolithic and Late Neolithic populations. These assumptions were mostly based on analysis of faunal materials. According to Weber et al. (2002), the Early Neolithic population used Gorelyi Les as a long-term residential home base and resided here for long periods of time. The main activities performed here were ungulate hunting, processing and consumption, stone tool manufacturing, and other habitation activities. On the other hand, Gorelyi Les served as a short-term hunting camp for Late Neolithic populations. Consequently, traces of tool manufacturing, food procurement, and processing, and consumption activities are underrepresented in archaeological record.

The present study suggests that ancient hunter-gatherers used Gorelyi Les intensively for a long period of time, which resulted in the accumulation of large amounts of various archaeological remains. There are not sufficient grounds to talk about possible seasonal patterns of occupation during this period; however, it is reasonable to suggest that seasonal changes in the site's occupation did take place. The faunal assemblage from Gorelyi Les analyzed in Ready (2008) did not produce information relative to seasonality. Nevertheless, one may conclude that red deer and roe deer, which dominated the faunal assemblage, were hunted during the winter and may have been taken in groups (herds), rather than individually during the spring and summer periods. Pike, however, may have been obtained throughout most of the season, and even during winter, using various fishing techniques.

Diachronic changes of the lithic assemblage between Layers V and VI, at first glance, are very pronounced (e.g., substantial disparity in quantity of lithics between cultural layers, variability of stone tool categories within cultural layers, and overall volume of tool manufacturing). Such strong differences in lithic assemblages can indicate major differences in site roles throughout their time of use (Cowan 1999). The quantitative differences in the lithic assemblages between cultural layers at this site are indeed rather extreme. However, these differences should be considered in relation to subsistence patterns, mobility patterns, and other aspects of hunter-gatherers behaviour. A detailed qualitative analysis, that focuses rather on technological aspects of the tool manufacturing process, exhibits a different picture. Comparison of the use of raw materials during two Neolithic periods indicates no significant differences; grey banded chert and red chert were the main lithic raw materials used for tool manufacturing. However, more diversified lithic sources are present in the Early Neolithic horizon. Two major reduction strategies (core and biface reduction) were both present during the Early and Late Neolithic. Thus, all the techniques used in lithic tool production were employed during both periods. The biggest difference between the two examined periods seems to be an organization of the technological processes of tool manufacturing: all the stages of stone working occurred at Gorelyi Les during the

Early Neolithic, while only some technological operations (e.g., maintenance) occurred at the site during the Late Neolithic.

It is also useful to bring other types of data to elucidate the patterns of Middle Holocene hunter-gatherer behaviour. For example, reconstruction of prehistoric hunter-gatherer diet based on stable isotope data may also contribute indirectly to revealing patterns of Gorelyi Les occupation and use. Early Neolithic hunter-gatherers in the Belaia river valley relied on a wide range of food resources (terrestrial mammals and some benthopelagic fish), and presumably exploited those available in the vicinity of their camps within a relatively small annual range (Weber et al. 2002; Katzenberg et al. 2010). The stone tool assemblage from Layer VI contains both hunting tools (e.g., arrowheads, inserts of projectiles) and fishing implements (a composite fishhook shank) and seems to support the inferences of the stable isotope analysis. However, Layer VI yielded little fish remains, while terrestrial game dominated the faunal assemblage (Ready 2008). On the other hand, materials from the archaeological site Ust'-Khaita, synchronous to the materials from Gorelyi Les examined here, demonstrate a substantial amount of fish remains in the faunal assemblage (Savel'ev et al. 2001). Therefore, one can assume that the minimal amount of fish remains at Gorelyi Les reflects recovery biases or poor preservation of these faunal remains rather than objective patterns existing in the past.

Late Neolithic hunter-gatherers also exploited a wide range of food resources, but with an emphasis on terrestrial mammals and the addition of some fish. In general, their diet was more generalized, flexible, and seasonally balanced (Weber et al. 2002). The hunting implements (arrowheads) and tools for processing meat (meat knives) indicate that Late Neolithic hunter gatherers hunted terrestrial game and processed their carcasses at Gorelyi Les. The faunal remains, although not numerous, include the remains of roe deer and several small mammals.

The most controversial question of this discussion is the duration of occupation at Gorelyi Les during the Early Neolithic period. A detailed analysis of the vertical distribution of artifacts demonstrates a differentiation of the materials within the cultural layer to some extent. Moreover, the archaeological features (e.g., hearths) confirm this conjecture. The three hearths recognized in Layer VI were all established at different levels within this layer: bottom, middle/top, and top. However, it is difficult to associate a particular lithic category with those levels, because they are drawn arbitrarily. The only observation that is applicable to the present situation is a slightly higher concentration of formal tools, and tools with use-wear, at the bottom of the cultural layer. Georgievskaia (1989) recognizes cultural layers that correlate with Kitoi mortuary complexes at several multi-component habitation sites in the Cis-Baikal region (e.g., Tsar'-Devitsa, Ust'-Belaia, Sosnovyi Island). Usually these layers are divided into two horizons that are not homogeneous in terms of chronology. The above-mentioned microstratification pattern at Gorelyi Les is rather similar. Moreover, Georgievskaia (1989) mentions the similarity of the Kitoi mortuary tradition materials with the artifacts from Layer VI of Gorelyi Les (although the author does not state directly that these materials are of the same age and belong to the same culture-historical period). Thus, the revealed vertical distribution pattern of artifacts at Gorelyi Les is not unique and may represents a distinctive situation that is reproduced at other habitation sites in the region.

Georgievskaia (1989) supposes that the presence of two horizons within the Kitoi cultural layers reflects the chronological differences in the formation of this cultural layer. This situation, in her opinion, indicates a consecutive *in situ* development of material culture, with gradual development and improvement of the implements (e.g., composite fishhooks shanks). However, the author omits to mention the presence of a sterile layer of sediments separating the two horizons within the Kitoi layers. Consequently, this assumption is made on the basis of the vertical distribution and density of artifacts only. On the other hand, Leonova et al. (2006) state that the difference in age is an insufficient explanation for this pattern of artifact distribution within the cultural layer. Detailed microstratigraphic and paleolandscape analyses need to be conducted to reveal the nature of the described phenomenon. In sum, the most probable explanation for the vertical separation of artifacts in Layer VI is the chronological interval in their accumulation. A short-term flood occurring in the past might also contribute to a hiatus in site use. Moreover, such a sedimentation episode would not be recognizable if the pedogenesis took place, and altered parent material was introduced to the site, during such flood events.

Conclusion

6.1 Gorelyi Les in the context of Middle Holocene archaeology of Cis-Baikal

Recent studies conducted by the BAP have concentrated on analysing materials from habitation sites and, among other objectives, seeking archaeological materials that correspond to the Middle Neolithic period. This period has been identified as a hiatus in the mortuary record across the entire Cis-Baikal region (Weber et al. 2010). The nature and causes of this phenomenon are still unclear and disputable. Initially, it was hypothesized that the Early Neolithic Kitoi populations may have gradually ceased the practice of using large formal cemeteries, and dispersed over the region in relatively mobile groups. The forces that may have driven this process are unknown, but hypothetically they altered not only the patterns of mortuary behaviour of hunter-gatherers but also the entire system of their settlement-subsistence practices. In any case, this phenomenon of the hiatus was documented only on the basis of mortuary complexes, whereas materials from habitation sites have never been used to shed light on the apparent problem. However, there are also other difficulties related to this question. Most of the existing cultural-chronological schemes refer to the material culture of Middle Holocene hunter-gatherers inhabiting the Cis-Baikal region using the terms *Kitoi*, *Serovo*, *Isakovo*, *Glazkovo*, etc. The model was developed by A.P. Okladnikov (1950) on the basis of his analysis of mortuary complexes in the Cis-Baikal region. However, the mortuary record does not reflect the entire material culture of its ancient populations. Rather, these materials represent a very specific set of artifacts used in mortuary ritual. The correlation of these cultures with materials from habitation sites remains one of the major problems in the archaeology of the Cis-Baikal, owing to the variations in archaeological materials derived from different contexts (mortuary and habitational), as well as to the overall lack of detailed information about habitation sites, and partially to the poor resolution of the archaeological record at habitation sites, e.g., compression of various Neolithic horizons into one layer (Berdnikova et al. 2005; Savel'ev 1986; Weber 1995; Weber et al. 2008, 2010).

The suggested gap in the mortuary archaeological record that corresponds presumably to the Middle Neolithic period is represented at Gorelyi Les by geological unconformity between lithostratigraphic units 3Ab (Late Neolithic) and 4Ab (Early Neolithic), although at the present moment there is not enough information to determine the timespan this unconformity represents. The available radiocarbon dates for Gorelyi Les suggest a gap in site occupation for approximately 500 years. Nevertheless, we need to obtain more information to produce reliable conclusions to respond to the sophisticated questions on the cultural history of Gorelyi Les.

In sum, Gorelyi Les is important archaeological site for improving our understanding of the diachronic changes in the hunter-gatherer lifestyle (subsistence, technological behaviour, settlement system, etc.) during the Middle Holocene. The Belaia river valley contains a number of well-stratified multi-component archaeological sites that represent a continuous record of archaeological remains for much of the Middle Holocene (e.g., the Paleolithic sites Mal'ta, Bel'sk, and Sosnovyi Bor; and the Mesolithic and Neolithic sites Ust-Khaita, Ust'-Belaia, Mishelevka Sad, Lugovaia, Molotkova, and Kholmushino). Thus far, comparison of the described materials with synchronous materials from other sites located in the Belaia river valley have been conducted at the level of formal tool categories only, because the debitage in the Cis-Baikal region has never been described and analyzed and no functional studies were conducted. Nevertheless, we can conclude that Gorelyi Les was an important locale for Middle Holocene hunter-gatherers.

6.2 Suggestions for future research

The research presented in this thesis has demonstrated the potential of lithic studies, particularly of debitage analysis and use-wear analysis, in learning about ancient hunter-gatherer populations. Unified systems of lithic debitage description and analysis have been developed. The application of this methodology to materials from previous excavations at Gorelyi Les is necessary to validate the inferences made about ancient lithic technologies at the site. Also, it is necessary to expand the database of lithics analyzed in the same fashion to include other habitation sites in the Belaia river valley and the entire Cis-Baikal region. This would create a basis for valid comparison between assemblages from different locations and time periods. Also, consistency of the methodology that would be employed in analysing various assemblages is a crucial aspect of future studies, especially for debitage analysis. This approach would contribute to our better understanding of the diachronic changes of lithic technologies. Also, lithic studies in the region should be assessed from the position of contemporary archaeological theoretical frameworks such as behavioural ecology and various issues of prehistoric hunter-gatherers behaviour and history should be addressed.

Experimental work is of great importance for the reconstruction of prehistoric lithic technologies, and for a better understanding of lithic reduction strategies, and of overall technological process of lithic tool manufacture. Experiments with the use of lithic tools in various activities (e.g., processing different materials) are also necessary for validating and refining the rconclusive effectivness of use-wear analysis. Another important direction of lithic studies is sourcing of raw materials and, particularly, their mineralogical determination. This type of research should include not only the already analyzed materials from the mortuary context (Weber et al. 2008), but also materials from habitation sites. Finally, the present research has provided some promising results despite the small size of the analyzed assemblage, and more studies on the lithic artifacts from Gorelyi Les and from the Cis-Baikal region are definitely needed.

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