Raw Material Exploitation, Transport, and Mobility in the Northern Caucasus Eastern Micoquian

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ABSTRACT

This paper presents a study of raw material procurement strategies during the Late Middle Paleolithic Eastern Micoquian industry in the Northwestern Caucasus, Russia. The study is based primarily on the data collected by the authors from the cave sites of Mezmaiskaya and Matuzka, the Baranaha-4 open-air site, and the Hadjoh-2 open-air flint-knapping workshop, as well as 51 flint outcrops that we surveyed and sampled in the region from 2007 to 2014. A comparative petroarchaeological analysis of 268 rock samples collected from these outcrops and the Eastern Micoquian assemblages indicates three zones of raw material procurement, each related to a specific model of mobility and strategies of raw material use and transport.

INTRODUCTION

Many researchers (e.g., Binford 1980; Kelly 1983; Grove 2009; Morgan 2009) have noted that the relationship between hunter-gatherers and landscapes, including the availability of raw material resources, is one of the basic aspects of hunter-gatherers' survival. The study of raw material procurement, exploitation, and transport allows for a better understanding of issues of mobility through the landscape (Adler et al. 2006; Demars 1982; Géneste 1985; Féblot-Augustins 1993; Le Bourdonnec et al. 2012; Roth and Dibble 1998; Turq et al. 2013), territoriality and adaptation (Aubry et al. 2012; Chabai and Uthmeier 2006; Ekshtain et al. 2014; Frahm et al. 2014; Hovers 1990; Miller and Barton 2008), cognitive abilities (Andrefsky 2009; Barsky et al. 2010; Nehoroshev 1999; Roebroeks et al. 1988; Turq 1992), social identity (Féblot-Augustins 1993; Shackley 2005) and trade networks (Hughes 1994) in different regions and ecological niches occupied by the Paleolithic hunter-gatherers.

Until recently raw material procurement strategies in the Northern Caucasus Middle Paleolithic had never been the object of petroarchaeological study. Researchers generally used only visual descriptions of rock types present in lithic collections at different sites. A common practice was to identify the 'local' or 'non-local' character of flint artifacts in the Paleolithic sites and to suggest the most probable raw material sources for them, usually selected from among the nearest known outcrops (e.g., Beliaeva 1999; Liubin and Beliaeva 2009). The petroarchaeological study of the Middle and Upper Paleolithic assemblages and sources of stone raw materials in the Northwestern Caucasus only began in 2007 (see Doronicheva 2010; 2011; Doronicheva and Kulkova 2011; Doronicheva et al. 2012; Doronicheva et al. 2013; Doronicheva and Shackley 2014).

This paper presents the first comprehensive synthesis of raw material procurement strategies adopted by Neanderthals in the Late Middle Paleolithic (LMP) Eastern Micoquian industry in the Northwestern Caucasus. The study is based on the data that we collected from the cave sites of Mezmaiskaya (1987–2001 collections) and Matuzka (1986–2003 collections), the Baranaha-4 open-air site (1996 collection), and the Hadjoh-2 (2009–2010 and 2013 collections) open-air flint-knapping workshop that were available for study. The authors analyzed a total 6,768 lithic artifacts from 10 cultural levels in these sites, including 261 flint artifacts selected using criteria described below, including petrographic analysis (Table 1).

We report the results of a comparative petroarchaeological analysis of these lithic assemblages and incorporate the data available from other Eastern Micoquian sites in the region. Fifty-one flint and chert outcrops were sur-

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TABLE 1. NUMBERS OF FLINT ARTIFACTS ANALYZED FROM LMP SITES FOR PETROARCHAEOLOGICAL COMPARISON WITH FLINT SAMPLES FROM GEOLOGICAL OUTCROPS IDENTIFIED IN THE NORTHWESTERN CAUCASUS.

MP SITE	KR-1	KR-2	KR-3–5	KR-7–8	KR-6, 9–10	KR-11	KR-12	KR-14	KR-23	KR-42–44	KR-47
Mezmaiskaya	19	13	57	21	46	6	0	0	4	14	9
Matuzka	0	0	15	0	12	2	0	0	0	0	0
Baranakha-4	0	0	15	0	0	0	5	4	0	12	0
Hadjoh-2	0	0	0	0	6	0	0	0	0	0	1

veyed and sampled in the region in 2007–2014, and 268 rock samples collected from these outcrops were analyzed. The flint outcrops reported in this work essentially represent all potential sources of flint and chert known to date within the study area of about 7,500km^2 (approximately 150km x 50km). Based on the results of petroarchaeological analyses, we identified 15 raw material sources that were exploited in the regional LMP Eastern Micoquian assemblages (Table 2).

ARCHAEOLOGICAL CONTEXT

Twelve stratified Eastern Micoquian sites are known in the Northwestern Caucasus (Figure 1), including Mezmaiskaya (Golovanova et al. 1998), Matuzka (Golovanova et al. 2006), Monasheskaya (Beliaeva 1999) and Barakaevskaya Caves (Liubin 1994), Gubs 1 Rockshelter (Liubin 1977), and the open-air sites of Ilskaya 1 and 2 (Shchelinskii 1998, 2011), Baranakha-4 (Golovanova and Doronichev 2003), Besleneevskaya-1 (Golovanova et al. 2015) and Hadjoh-2 (Doronicheva 2013; Doronicheva et al. 2015), of which the two latter sites are flint-knapping workshops. They contain in total about 27 occupational layers with Micoquian assemblages.

As discussed by Golovanova and Doronichev (2003), the research history of the local Micoquian is complex. At the present time, the majority of Paleolithic researchers assign these assemblages to the Eastern European/Eastern Micoquian or Micoquian (Beliaeva 1999; Beliaeva and Lioubine 1998; Golovanova 2015; Golovanova et al. 1998; Golovanova and Doronichev 2003). However, recently Shchelinskiy (2005) proposed to use the term 'Keilmessergruppen' to describe the Micoquian assemblages in Central Europe, accepted now by many scholars (Conard and Fischer 2000; Jöris 2006; Ruebens 2013) As discussed below, however, the term 'Keilmesser Group' narrows the definition of the Micoquian bifacial assemblages, including those known in the Northwestern Caucasus.

The earliest Eastern Micoquian assemblages appear in the Northwestern Caucasus after or slightly earlier than 70 Ka (the lower layer in Il'skaya 1 and Layer 3 in Mezmaiskaya; Figure 2). The latest assemblages are recorded from the uppermost LMP levels in several sites (Layer 2 in Mezmaiskaya, Layer 4B in Matuzka, Layer 2 in Monasheskaya, Gubs 1 Rockshelter, and Layer 2 in Baranaha-4) before ~40 Ka, when the Middle Paleolithic disappears from the entire Caucasus. In general, the local Micoquian industry spans a long period of time from probably late MIS 5 throughout MIS 3, from ~90/80 to 40 Ka, when the climate in this region was much cooler than today (Golovanova 2015; Golovanova and Doronichev 2003).

The Mezmaiskaya Cave, discovered in 1987, provides the longest and best dated stratigraphical sequence of seven LMP layers in the Northwestern Caucasus. Based on this sequence it has become possible to incorporate the regional Mousterian assemblages into one developmental lineage of the local Micoquian tradition, assess the chronology of other Micoquian sites that are undated, and identify temporal trends in the regional Micoquian throughout the Middle Paleolithic (Golovanova 2015; Golovanova and Doronichev 2003; Golovanova et al. 1998, 1999).

The Micoquian assemblages, including the Northwestern Caucasus Micoquian, are characterized by a specific combination of several groups of bifacial and unifacial tools, which distinguishes them from other Middle Paleolithic cultural entities. These groups include specific bifacial tools, a combined group of typical Mousterian convergent tools, various and numerous simple side-scrapers, Upper Paleolithic tools (end-scrapers and individual burins), and relatively rare denticulate and notched pieces. The group of bifacial tools comprises four specific sub-groups: 1) small broad triangular bifaces (small handaxes), 2) laurel leaf-shaped elongated projectiles, 3) various bifacial and partial bifacial (with ventral thinning) convergent tools and scrapers, and 4) asymmetric bifacial backed scrapers or knives. This stone tool making tradition is spread over a huge territory from Central Europe to the Volga River in Eastern Europe (Bosinski 1967; Chabai et al. 2004; Conard and Fischer 2000; Gabori 1976; Golovanova 2015; Golovanova et al. 1998; Jöris 2006; Kozlowski 2013; Ruebens 2013).

The presence of backed bifacial scrapers or knives with asymmetric backs and outlines (Keilmesser) is a distinctive feature of the Micoquian tradition, also named by many as the 'Keilmessergruppen' or 'Keilmesser Group' (KMG), for describing the Micoquian assemblages in Central Europe, mostly in Germany (Conard and Fischer 2000; Jöris 2006; Ruebens 2013). However, the term 'Keilmesser Group' nar-

TABLE 2. PETROGRAPHY OF FLINT SOURCES EXPLOITED IN THE LMP IN THE NORTHWESTERN CAUCASUS.

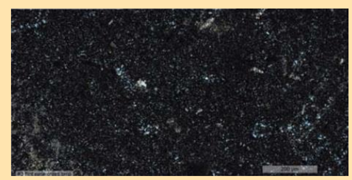
№	Source name & ID	Color	Geology & thickness of flint stratum	Primary or secondary source	Structure	Composition	Thin sections
1	Azish-Tau (KR-1)	Light-grey with carbonate cortex 1–2mm	Oxford-Kimme-ridgian (Upper Jurassic) limestone 0.5m	Primary	Fine siltstone, grain size ~0.014mm	Quartz: 50%, typical grain size ≤0.014mm, some grains >0.014mm, angular, undulating extinction. Calcite: 35%, grain size ≤0.014mm. Concrete-zonal chalcedony crystals concentrate in small fissures. Geode size up to 1–2mm. High quantity of organic siliceous marine organisms (shells and spicules); size 0.3–1mm. Quantity of organic inclusions is about 15%. Matrix consists of quartz and calcite regenerates at the border with organic remnants.	  Plane-polarized light (scale 200μm)  In crossed nicols (scale 200μm)
2	Unakozov-skoye-1 (KR-2)	light-brown with light-grey carbonate cortex	Oxford-Kimme-ridgian (Upper Jurassic) limestone 5m	Primary	Fine siltstone, grain size ~0.010mm	Quartz: 50%. Calcite: 20%. Organic remnants (mainly spicules and radiolarians) replaced by chalcedony, size up to 0.5–2mm. Thin diffused goethite and hydro goethites are present.	

TABLE 2. PETROGRAPHY OF FLINT SOURCES EXPLOITED IN THE LMP IN THE NORTHWESTERN CAUCASUS (continued).

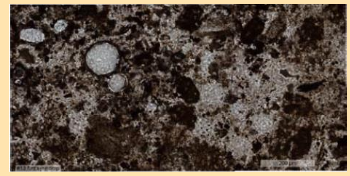
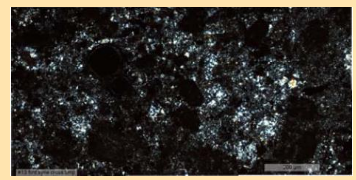
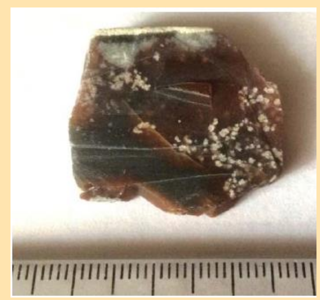
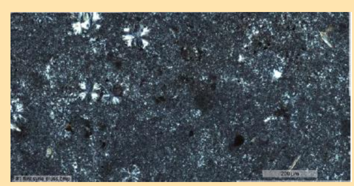
№	Source name & ID	Color	Geology & thickness of flint stratum	Primary or secondary source	Structure	Composition	Thin sections
2	Unakozov-skoye-1 (KR-2)					Matrix is crustified.	 Plane-polarized light (scale 200µm)  In crossed nicols (scale 200µm)
3–4	Besleneevskaya-I and II (KR-3-4-5)	red/ brown, honey, grey, black	Senonian (Upper Cretaceous period)	Primary	Density is 0.25 to 0.6m. Fine siltstone, grain size ~0.010–0.014mm	**Type 1** – Quartz: 50%, grain size 0.014mm and less, undulating extinction. Chalcedony: 50%. Round chalcedony geodes (size up to 1mm) occur. Organic inclusions are absent. Thin diffused goethite, hematite and hydro goethite are present. Basal matrix. **Type 2** – Quartz: 30%, grain size 0.014mm and less, undulating extinction. Carbonates make up the matrix: 20%.	  Plane-polarized light (scale 200µm)  In crossed nicols (scale 200µm) 

TABLE 2. PETROGRAPHY OF FLINT SOURCES EXPLOITED IN THE LMP IN THE NORTHWESTERN CAUCASUS (continued).

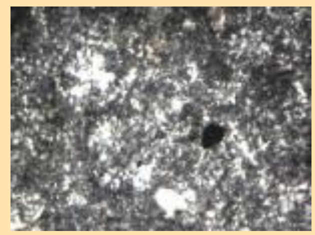
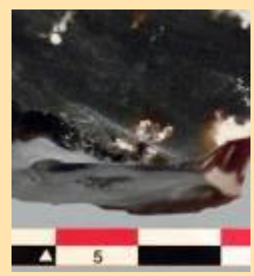
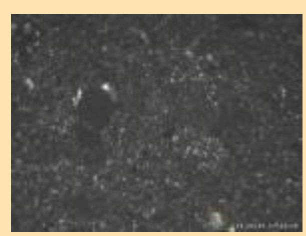
№	Source name & ID	Color	Geology & thickness of flint stratum	Primary or secondary source	Structure	Composition	Thin sections
3–4	Besleneevskaya-I and II (KR-3-4-5)					**Type 2** – (cont.) Chalcedony: 50%. Round chalcedony geodes occur; sizes up to 1mm. Organic inclusions are rare. Thin diffused goethite, hematite and hydro goethite are present. Basal matrix. **Type 3** – Quartz: 10%, grain size 0.010mm and less, undulating extinction. Chalcedony: 80%. Rare organism inclusions (spiculas, size up to 1mm), replaced by chalcedony, occur. Thin diffused goethite: 10%, hydro goethite is present in less quantity. Calcite and large amount of organic inclusions (shells, spiculas) occur at the border with cortex. Basal matrix.	 Plane-polarized light (x65).  In crossed nicols (x65).   Plane-polarized light (x65).  In crossed nicols (x 65).

TABLE 2. PETROGRAPHY OF FLINT SOURCES EXPLOITED IN THE LMP IN THE NORTHWESTERN CAUCASUS (continued).

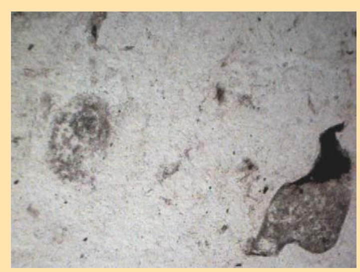
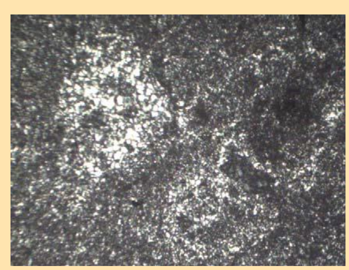
№	Source name & ID	Color	Geology & thickness of flint stratum	Primary or secondary source	Structure	Composition	Thin sections
5	Shedok (KR-23)	red, light-brown flint	Senonian (Upper Cretaceous period)	Primary	Density is about 0.5m. Fine siltstone, grain size about 0.014mm	Quartz: 30%, grain size 0.014mm and less, undulating extinction. Chalcedony is 70%. Round chalcedony geodes (size up to 1mm) occur. Individual organic inclusions are represented. Thin diffused goethite, hematite and hydro goethite are present. Basal matrix.	 Without analyzer (x160).  In crossed nicols (x160).
6	Gubs (KR-7)	light-grey flint	Oxford-Kimme-ridgian (Upper Jurassic)	Primary	Density is 0.5m. Fine siltstone, grain size about 0.007mm	Quartz: 10%, grain size 0.010mm and less, undulating extinction. Chalcedony-agate: 80%. Thin diffused goethite and gethite: 10%. Basal matrix.	  Plane-polarized light (x160).  In crossed nicols (x160).

TABLE 2. PETROGRAPHY OF FLINT SOURCES EXPLOITED IN THE LMP IN THE NORTHWESTERN CAUCASUS (continued).

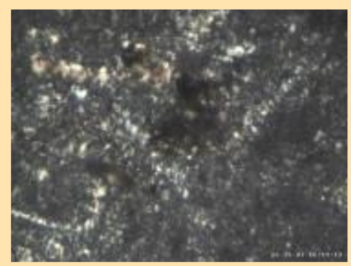
№	Source name & ID	Color	Geology & thickness of flint stratum	Primary or secondary source	Structure	Composition	Thin sections
7	Shahan-1 (KR-6)	grey flint with patina white cortex 2–3mm	Oxford-Kimme-ridgian (Upper Jurassic)	Primary	Density varies from 0.5 up to 8–10m. Fine siltstone, grain size about 0.014mm	Quartz: 50%, grain size 0.014mm and less; some grains up to 0.014mm angular, undulating extinction. Concrete-zonal chalcedony crystals concentrate in small fissures. Geode size can be up to 0.3mm. High quantity (up to 40%) of organic siliceous marine organisms (shells and spicules); size 0.1–0.7mm. Carbonization of organic inclusions is 10%. Rare olivine grains are present; size 0.1mm. Thin diffused goethite and hydro goethite formations (isotropic, without crossed nicols: black and dark-brown color). Patinization zones exposed to limonitization. Limonite presented by ovoid formations, colloid, and amorphous inclusions. Basal matrix is regenerated at the border with organic remnants.	  Plane-polarized light (x65).  In crossed nicols (x65).

TABLE 2. PETROGRAPHY OF FLINT SOURCES EXPLOITED IN THE LMP IN THE NORTHWESTERN CAUCASUS (continued).

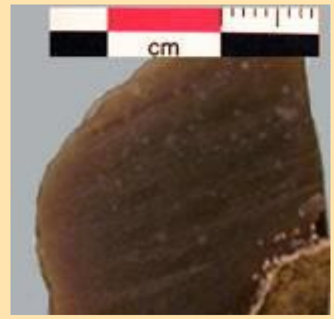
№	Source name & ID	Color	Geology & thickness of flint stratum	Primary or secondary source	Structure	Composition	Thin sections
8	Shahan-2 (KR-9/10)	grey-brown flint	Oxford-Kimme-ridgian (Upper Jurassic)	Secondary	Fine siltstone, grain size about 0.014mm	Quartz predominates, grain size 0.014mm and less; rare grain sizes more than 0.014mm; angular, undulating extinction. Concrete-zonal chalcedony crystals concentrate in small fissures. Geode size up to 0.3mm. High quantity of organic siliceous marine organisms (shells and spicules), size 0.1–0.7mm. Quantity of organic inclusions near 40%. Rare olivine grains (size 0.1mm) are present. Thin diffused goethite and hydro goethite formations (isotropic, without crossed nicols: black and dark-brown color). Patinization zones exposed to limonitization. Limonite present in ovoid formations, colloid and amorphous inclusions. Basal matrix is regenerated at the border with organic remnants.	  Plane-polarized light (x65).  In crossed nicols (x65).

TABLE 2. PETROGRAPHY OF FLINT SOURCES EXPLOITED IN THE LMP IN THE NORTHWESTERN CAUCASUS (continued).

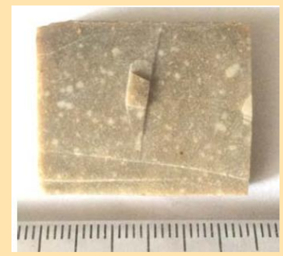
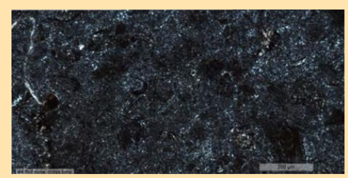
№	Source name & ID	Color	Geology & thickness of flint stratum	Primary or secondary source	Structure	Composition	Thin sections
9	Shahan-3 (KR-9/10)	grey flint with patina grey cortex	Oxford-Kimme-ridgian (Upper Jurassic)	Secondary	Fine siltstone, grain size about 0.014mm	Quartz predominates, grain size 0.014mm and less; rare grain sizes more than 0.014mm; angular, undulating extinction. Concrete-zonal chalcedony crystals concentrate in small fissures. Geode size up to 0.3mm. High quantity of organic siliceous marine organisms (shells and spicules), size 0.1–0.7mm. Quantity of organic inclusions near 40%. Rare olivine grains (size 0.1mm) are present. Thin diffused goethite and hydro goethite formations (isotropic, without crossed nicols: black and dark-brown color). Patinization zones exposed to limonitization. Limonite present in ovoid formations, colloid and amorphous inclusions. Basal matrix regenerated at the border with organic remnants.	  Plane-polarized light (scale 200µm)  In crossed nicols (scale 200µm)

TABLE 2. PETROGRAPHY OF FLINT SOURCES EXPLOITED IN THE LMP IN THE NORTHWESTERN CAUCASUS (continued).

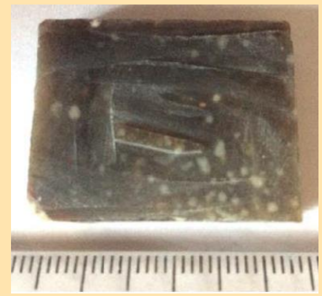
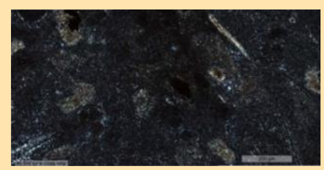
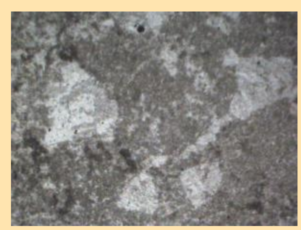
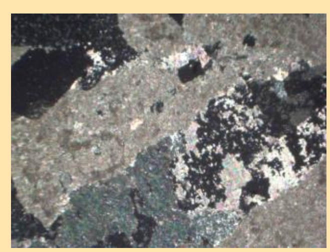
№	Source name & ID	Color	Geology & thickness of flint stratum	Primary or secondary source	Structure	Composition	Thin sections
10	Shahan-4 (KR-9/10)	grey flint with patina grey cortex	Oxford-Kimme-ridgian (Upper Jurasic)	Secondary	Fine siltstone, grain size about 0.014mm	Quartz: 20%, grain size 0.014mm and less; undulating extinction. Chalcedony: 70%. Concrete-zonal chalcedony crystals concentrate in small fissures. Geode size up to 1mm. Rare organic marine organisms (shells and spicules). Thin diffused goethite: 10% and less - hydro goethite formations. Secondary carbonates are found in fissures. Basal matrix.	  Plane-polarized light (scale 200µm)  In crossed nicols (scale 200µm)
11	Berezovaya Balka (KR-12)	light grey, beige not transpare nt flint.	Oxford-Kimme-ridgian (Upper Jurassic)	Primary	Density is 0.2–1.0m. Fine siltstone, grain size about 0.014mm	Carbonate: 60%, grain size 0.014mm and less, undulating extinction. Chalcedony is 40%. Calcite crystals (less than 1mm) and thin dispersed goethite are represented. Overgrowth matrix is crustified.	 Plane-polarized light (x160).  In crossed nicols (scale 200µm)

TABLE 2. PETROGRAPHY OF FLINT SOURCES EXPLOITED IN THE LMP IN THE NORTHWESTERN CAUCASUS (continued).

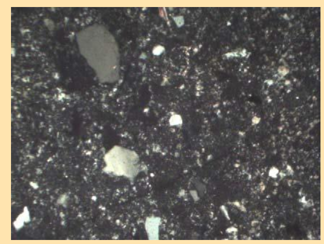
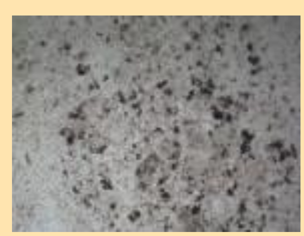
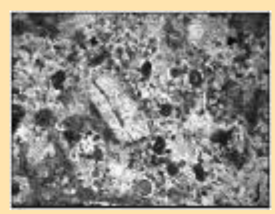
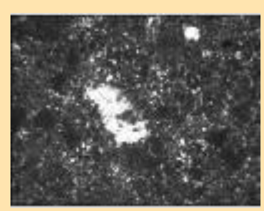
№	Source name & ID	Color	Geology & thickness of flint stratum	Primary or secondary source	Structure	Composition	Thin sections
12	Baranakha (KR-14)	milk-white, light-grey not transparent flint	Oxford-Kimmeridgian (Upper Jurassic)	Primary	Density is 0.2–1.0m. Fine siltstone, grain size about 0.014mm	Chalcedony prevails, grain size 0.014mm and less, some grains >0.014mm are angulated, undulating extinction. Concrete-zonal chalcedony crystals concentrate in small fissures. Geode size up to 0.3mm. High quantities of organic siliceous marine organisms (shells, spicules), size 0.1–0.7mm. Quantity of organic inclusions near 40%. Rare quartz grains (size 0.1–0.7mm) are present. Basal matrix is regenerated at the border with organic remnants.	 Plane-polarized light (160).  In crossed nicols (x160)
13	Akhmat-Kaya-2 (KR-42-44)	light-grey chalcedony flint with inclusions of thin dispersed goethite and carbonate cortex	Cretaceous period (Senonian epoch) (?)	Primary	Density is 0.3 to 0. 5m. Fine siltstone, grain size about 0.0007mm	Chalcedony: 90%. Individual organic inclusions (spicules) are presented. Thin dispersed goethite and hydro goethite: 10% are present. Basal matrix.	  Plane-polarized light (x160).

TABLE 2. PETROGRAPHY OF FLINT SOURCES EXPLOITED IN THE LMP IN THE NORTHWESTERN CAUCASUS (continued).

№	Source name & ID	Color	Geology & thickness of flint stratum	Primary or secondary source	Structure	Composition	Thin sections
13	Akhmat-Kaya-2 (KR-42-44)						 In crossed nicols (x160)
14	Akhmat-Kaya-3 (KR-42–44)	black and dark-grey chalcedon y flint with large amounts of thin dispersed goethite and carbonate cortex	Cretaceous period (Senonian epoch (?)	Primary	Density is 0.5-1m. Fine siltstone, grain size about 0.0007mm	Quartz: 10%, grain size 0.010mm and less, undulating extinction. Chalcedony is 80%. Individual inclusions of organisms (spicules) are present; they are replaced by chalcedony, size <1mm. Thin dispersed goethite (10%) is present, in lesser amounts: hydro goethite. Basal matrix.	 Plane-polarized light (x160).  In crossed nicols (x160)
15	Meshoko (KR-47)	grey/bro wn flint with light-grey carbonat e cortex	Oxford-Kimme-ridgian (Upper Jurassic)	Primary	Density is up to 4–10m. Fine siltstone, grain size about 0.010mm	Chalcedony: 90%. Flint includes a lot of organic remnants (mainly, spicules and radiolarians), replaced by chalcedony and limonithized, their size is 0.5–2mm. Quartz, grain size less 0.010mm. Thin dispersed goethite and hydro goethite are present. Matrix is crustified.	 Plane-polarized light (x160).  In crossed nicols (x160)

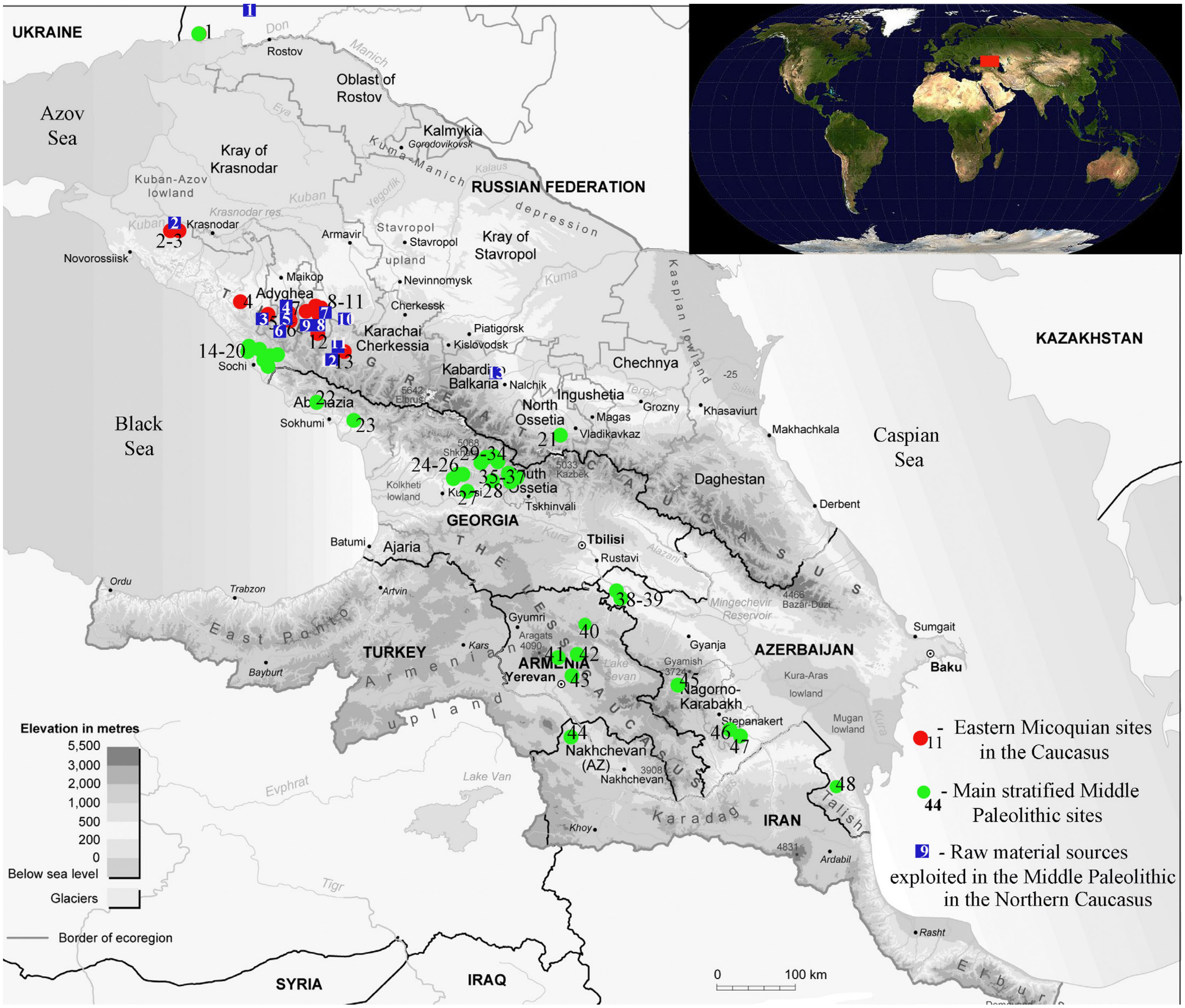


Figure 1. Map showing locations of the main stratified Middle Paleolithic sites in the Caucasus and neigboring regions (mentioned in the text). Middle Paleolithic sites (including Eastern Micoquian): 1) Rojok 1 (Azov sea coast region), 2–3) Ilskaya I and Ilskaya II, 4) Matuzka Cave, 5) Mezmaiskaya Cave, 6) Dakhovskaya II Cave, 7) Hadjoh-2 open-air site, 8–11) Barakaevskaya, Gubs Rockshelter 1, Monasheskaya, and Autlevskaya (probably) Caves, 12) Besleneevskaya-1, 13) Baranakha-4, 14–20) Atsinskaya, Malaya Vorontsovskaya, Navalishenskaya, Khostinskaya I and II, Ahshtirskaya, and Kepshinskaya Caves, 21) Mushtulagti Lagat, 22) Machagua, 23) Apiancha, 24–26) Chakhati, Ortvala, and Sakajiya, 27) Sagvarjile, 28) Ortvala klde, 29–34) Tsutskhvatian Cave complex and Djruchula, 35–37) Tsona, Kudaro I and III, 38–39) Damdjili and Dashsalahli, 40) Hovk 1, 41) Lusakert II, 42) Lusakert I, 43) Erevan, 44) Gazma, 45) Zar, 46–47) Azikh and Taglar, and 48) Buseir. Raw material sources, exploited in the Middle Paleolithic in the Northern Caucasus: 1) Lysogorka outcrop (Azov sea coast region), 2) flint sources near Il'skaya I–II, 3) Azish-Tau outcrop (KR-1), 4) Meshoko outcrop (KR-47), 5) Shahan-1–4 outcrops (KR-6 and 9/10), 6) Unakozovskoye-1 outcrop (KR-2), 7) Gubs outcrop (KR-7), 8) Shedok outcrop (KR-23), 9) Besleneevskaya-I and II outcrops (KR-3-5), 10) Akhmet-Kaya-2–3 outcrops (KR 42-44), 11) Berezovaya Balka (KR-12) outcrop, and 12) Baranakha outcrop (KR-14).

rows the definition of the Micoquian bifacial assemblages, because bifacial backed knives (Keilmesser) are not the only tool group that specifies this stone industry and also because not every Micoquian assemblage contains typical Keilmesser forms. As discussed by many researchers (e.g., Burdukiewicz 2000; Conard and Fischer 2000; Jöris 2006; Koz1owski 2013; Kulakovskaya et al. 1993; Ruebens 2013; Urbanowski 2003), bifacial backed knives in each lithic assemblage are very variable and usually display numerous transitional forms deviating from the 'classical' defining types.

In the Northwestern Caucasus Micoquian, some high-

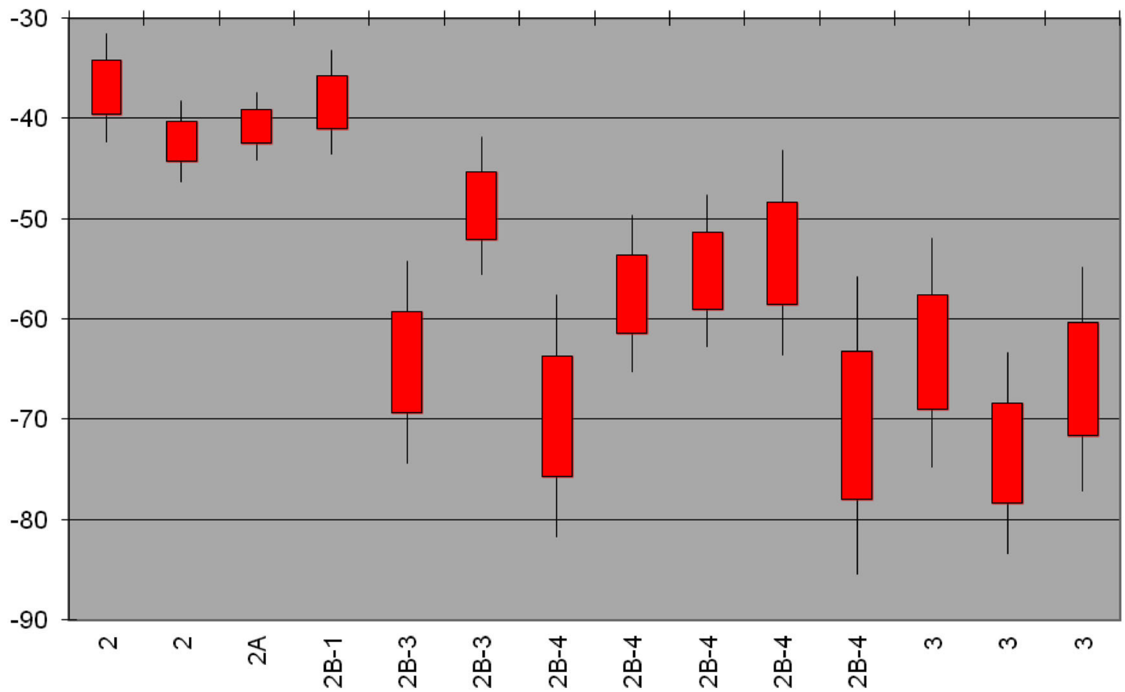


Figure 2. Mezmaiskaya Cave. ESR dating of the Middle Paleolithic layers (based on data from Skinner et al. 2005).

reference types (Klausennische, Königsaue, Balve, Lichtenberg, and Buhlener) identified in the Central European Micoquian (KMG) assemblages are not present. Other types, such as Bockstein and Prondnik or Ciemna, are represented by tools that are similar to the 'classic' Central European types of Bockstein and Prondnik and the East European type of Wolgograd (Golovanova and Doronichev 2003; Golovanova and Hoffecker 2000; Golovanova et al. 2010). In defining, for example, the Prondnik type in the materials from Mezmaiskaya and Ilskaya-1, Golovanova and Doronichev (personal communication) use a broader definition (see discussion in Ruebens 2013), applying this term to bifacial, partial bifacial, and also unifacial pieces sharpened by a lateral blow made from an oblique back relative to the active edge.

Although these bifacial and partial bifacial tools provide the most striking feature of the Eastern Micoquian assemblages in the Northwestern Caucasus, the 'core' of the industry are simple side-scrapers and typical Mousterian convergent tools (Mousterian points, and convergent and angled scrapers) that together compose about 50% of total tools (in average, the percent of convergent tools varies around 20% and the proportion of simple side-scrapers is about 20%–30%) in almost all assemblages (Golovanova 2015). Rare limaces and more numerous end scrapers are present in all Micoquian assemblages in the region. Also, a rich bone industry, represented mostly by numerous bone retouchers, is reported from several sites, including Ilskaya 1 (Zamiatnin 1934), Barakaevskaya (Philippov and Liubin 1994) and Mezmaiskaya (Golovanova et al. 1998) Caves.

GEOLOGICAL CONTEXT, SAMPLING, AND ANALYTICAL METHODS

In the Northwestern Caucasus, flint outcrops are mainly derived from limestones of the Oxford-Kimmeridgian stratum of the Upper Jurassic (Doronicheva and Kulkova 2011; Doronicheva et al. 2012; Doronicheva et al. 2013; see Table 2). Chalcedonic and chalcedony-quartz flints with goethite, quartz, and carbonate impurities, frequently limonitized, and with a considerable number of fossil inclusions, such as shells and spicules replaced by chalcedony or carbonate are characteristic of this stratum. Flints of grey and brown colors prevail (Figures 3–7). Individual grains of olivine (the Shahan outcrops) could be embedded into flint during the formation of flint deposits in marine conditions. In the Caucasus, basalt and andesite-basalt lavas of the Devonian and Jurassic ages are widespread in many areas. One of the areas is the Goytskho-Achishhinskaya zone (Kray of Krasnodar). Gabbros and granitoids are known in the Sancharo-Kardyvachskiy area.

In the Besleneevskaya outcrop, various colored flints (red, honey, and others), dated to the Cretaceous period of the Senonian epoch, are present (Figure 8). The Senonian flints differ from the Upper Jurassic flints in general texture and the lower frequency of mineral and organic inclusions. Flints from the Ahmet-Kaya outcrops also are preliminarily dated to the Cretaceous period. Most flint sources exhibit small and medium-size (5cm to 20cm) flint nodules. The only large nodules are found in the Shahan outcrops (where some nodules are up to 90cm, more typically about 20–40cm), Besleneevskaya outcrops (nodules up to 40–50cm) and Akhmat-Kaya outcrops (nodules up to

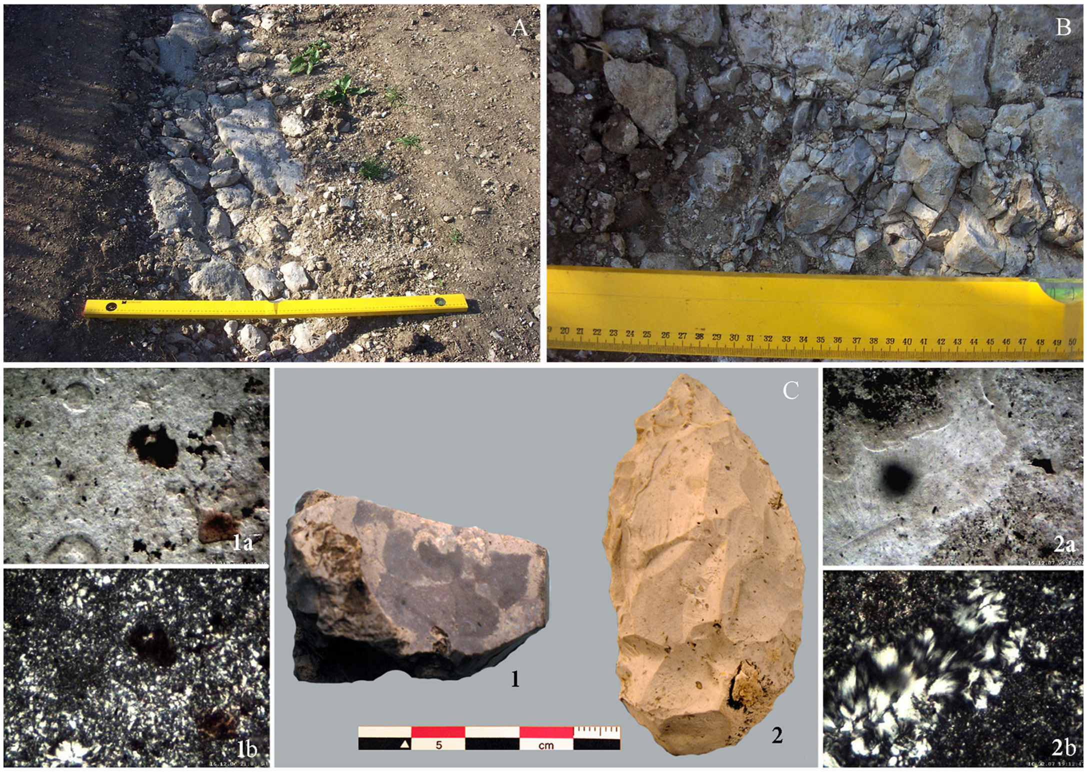


Figure 3. Exploitation of the Azish-Tau (KR-1) outcrop: a, b) photos of the Azish-Tau outcrop; c) bifacial tool from Layer 3 in Mezmaiskaya and sample of Azish-Tau flint (KR-9) from the outcrop and their macrographs (x65). Plane-polarized light and in crossed nicols.

Figure 4. The Meshoko outcrop.

Figure 5. The Unakozovskoye outcrop.

Figure 6. The Gubs outcrop: a) view from Monasheskaya Cave on the Gubs river valley; b) flint nodules incorporated in the limestone walls of Monasheskaya Cave; c and d) flint nodules incorporated in the limestone cliffs along the Gubs River Valley.

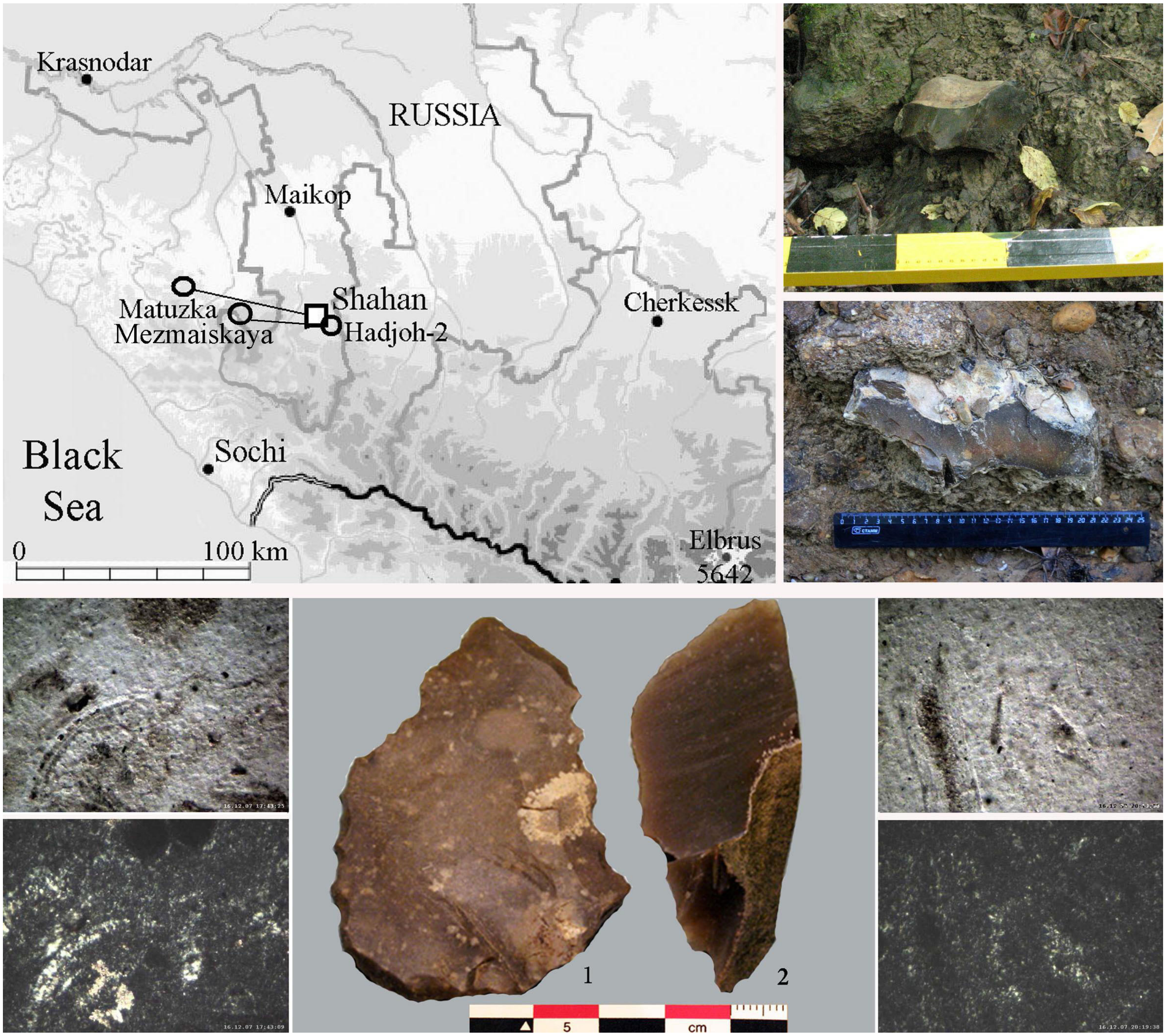


Figure 7. Exploitation of the Shahan outcrop (KR-9/10). Top right: photos of the Shahan outcrop; below: denticulate tool from Layer 3 in Mezmaiskaya and samples of Shahan flint (KR-9) from the outcrop and their macrographs (x65). Plane-polarized light and in crossed nicols.

30–40cm).

We identified flint sources based on published geological reports, references in the archaeological literature, and initial discoveries in the course of specific surveys. Surveying of geological outcrops in the Northwestern Caucasus was done using geological maps created by the A.P. Karpinsky Russian Geological Research Institute (VSEGEI, St. Petersburg). These maps allow comparison of the age and distribution of different geological strata containing flints in different territories. Coordinates of outcrops were identified using a GPS navigating device (Garmin eTrex–Vista). Because flints can vary within the same outcrop, although flints from different outcrops often have a similar composition, we collected several visually distinguishable flint samples from different parts of each outcrop.

Petrographic analyses were performed in the A.E. Fersman Laboratory of Geochemistry of Environments at the Department of Geology and Geoecology of the Herzen State Pedagogical University in St. Petersburg, Russia. The petrographic study of the flints was made on thin sections under the polarizing microscope POLAM-111 in plane polarized and cross-polarized light, with a magnification of 60x and more. The study of refraction parameters of minerals and their comparison with parameters of the Canada balsam allowed for the recognition of different types of minerals, structural features, and structure of cement in each sample.

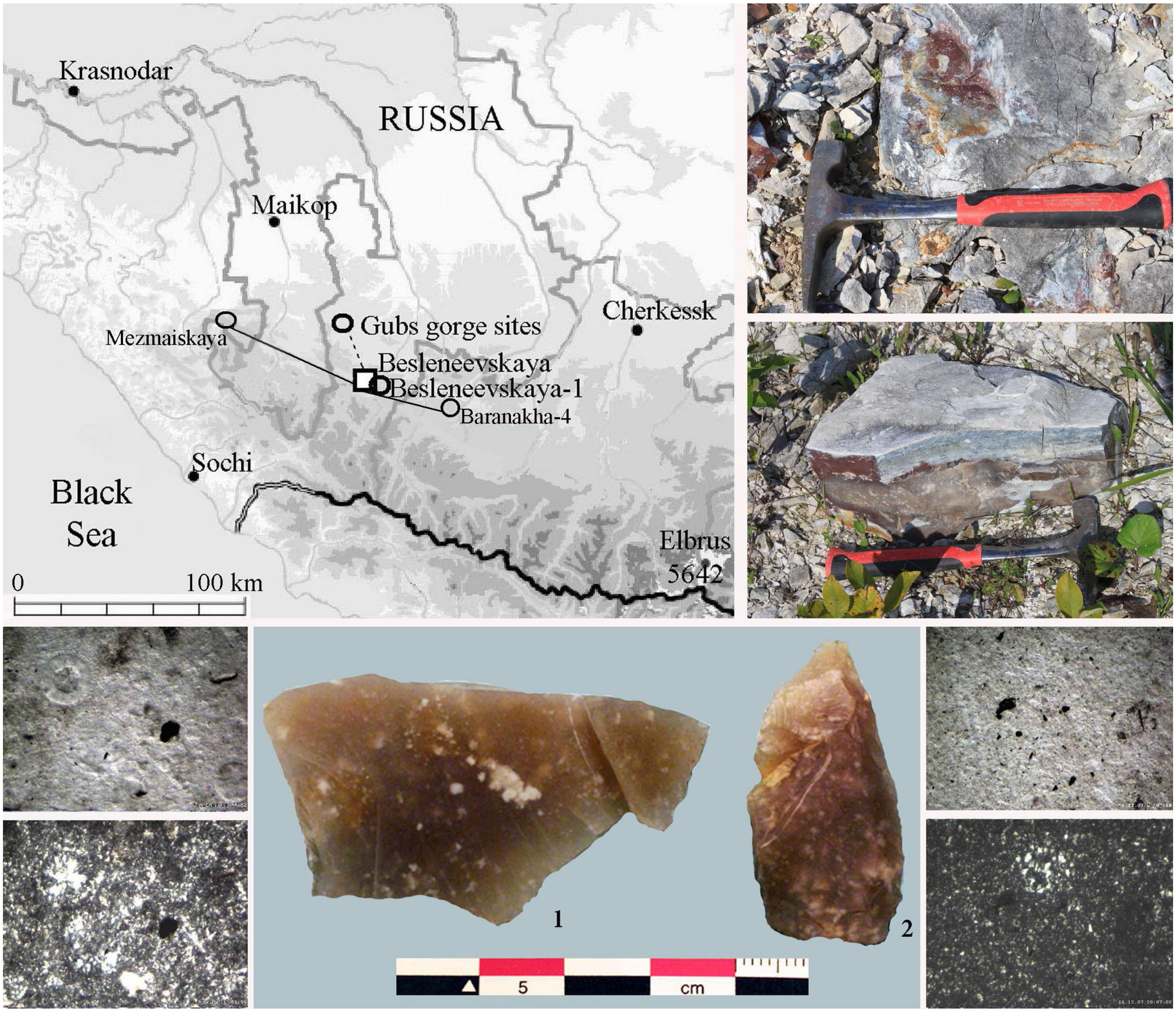


Figure 8. Exploitation of the Besleneevskaya outcrop (KR-3-5). Top right: photos of the Besleneevskaya outcrop; below: Mezmaiskaya Cave, Layer 2B-4, Etalon Besleneevskaya flint (KR-4) and its macrographs (x65). Plane-polarized light and in crossed nicols. Sidescraper (KR-4) and its macrographs (x65). Plane-polarized light and in crossed nicols.

In addition, all polished samples were studied under a binocular microscope under magnification of 15x to analyze color, surface features, macro-inclusions, etc. The details of the petrography of geological flint samples from identified flint sources, including macrographs of thin sections and descriptions of the flints, as well as details of a comparative petroarchaeological analysis of flint samples from the lithic assemblages are published in Doronicheva and Kulkova (2011, 2014).

Also, about 40 thin sections and analyses of flint sources and MP sites in the Northwestern Caucasus were done at the European Centre of Prehistory Research in Tautavel, France, under the guidance of Dr. S. Grégoire (published in: Doronicheva et al. 2012). We used a Nikon Eclipse E 400 POL microscope to analyze the thin sections. Additionally, we made 15 x-ray diffraction analyses with use of the x-ray machine PANanalytical (Formation Diffraction des Rayons x, X'Pert PRO MPD) in the Laboratory at CERP (Tautavel, France). We hope in future to continue using this method increase the sample size.

Symbol nomenclature was applied to all types of rock samples for consistency of data presentation (for example, KR-1 where KR means flint). A special collection (*lithothèque*) of geological flint samples from all outcrops studied in the region was created and used by the authors for a comparative petroarchaeological analysis of different identifiable types of flints in the archaeological assemblages that we studied to recognize the sources of the flint artifacts. The petroarchaeological analysis suggests that one type of archaeological flint (KR-11) comes from sources located outside our study area in the Northwestern Caucasus, likely in the north-eastern coast of the Sea of Azov.

Obsidian artifacts occur as individual finds in some LMP levels at Mezmaiskaya Cave, but they are absent in all other LMP sites in the region. Two obsidian artifacts from the MP levels at Mezmaiskaya were analyzed by the authors. The trace element analyses were performed at the Geoarchaeological XRF Laboratory, Department of Anthropology, University of California, in Berkeley, USA, using a Thermo/ARL Quant'X energy dispersive x-ray fluorescence spectrometer and applying the analytical methodology described in Shackley (2005: 193–195; 2011). The source identification was made using source standards published by Poidevin (1998) and source standards in the laboratory. The details of the obsidian study are described elsewhere (see Doronicheva and Shackley 2014; Doronicheva et al. 2013).

RESULTS

In the Northern Caucasus, the Eastern Micoquian industry is closely related to the Micoquian industries in Central and Eastern Europe that spans the entire LMP period. As defined by Golovanova and Doronichev (2003), three periods of local Eastern Micoquian might be recognized in the Northwestern Caucasus. Here we discuss this first synthesis of the data collected regarding prehistoric stone raw material procurement strategies and use adopted by the Eastern Micoquian Neanderthals in the region.

The **first period** of Eastern Micoquian occupation, from the end of OIS 5/early OIS 4 (ca. 90/80 Ka) until early OIS 3 (ca. 60–55 Ka), is represented in the lower layers at the Ilskaya 1 and Ilskaya 2 open-air sites, the lowest Layers 3 and 2B-4 at Mezmaiskaya Cave, and Layer 7 at the Hadjoh-2 open-air flint knapping workshop (Figure 9a).

Mezmaiskaya Cave, Layers 3 and 2B-4. Mezmaiskaya Cave is situated today on the upper boundary of mountain forest, at an elevation of 1310m above sea level (asl) and about 150m above the Suhoy Kurdjips River, preserving a stratigraphic succession of seven LMP levels, from the lower Layer 3 to the upper Layer 2 (Golovanova 2015; Golovanova and Doronichev 2003; Golovanova et al. 1998; 1999). The results of ESR dating suggest the age of Layers 3 and 2B-4 is between ca. 70 and 60 Ka (OIS 4; Skinner et al. 2005). A Neanderthal newborn skeleton and one tooth of an older individual have been found in Layer 3 (Golovanova et al. 1998; 1999; Green et al. 2010; Ponce de Leon et al. 2008). Pollen spectrums indicate that Layers 3 and 2B-4 were formed during a cool and dry climate, when sub-alpine meadows surrounded the cave (Golovanova and Doronichev 2003). A zooarchaeological study indicates that the LMP Neanderthals at Mezmaiskaya hunted large and medium-sized ungulates (primarily bison and caprids; Cleghorn 2006). Fire hearths and hundreds of lithic artifacts (90 and 61 lithics per cubic meter in Layers 3 and 2B-4, respectively) were found.

The lithic collections analyzed in this study originate from a total excavation area of 59m² for Layer 3 (2,912 lithics; see Table 2) and about 47m² for Layer 2B-4 (1,430 lithics; Table 3). A wide variety of rocks were used, including sedimentary (flint, chert, limestone, and siltstone), metamorphic (slate), and igneous (obsidian, granite), although flint, especially a local low-quality flint or chert (containing high quantities (~15%) of organic siliceous marine organisms such as shells and spicules) from the Azish-Tau outcrop (KR-1) was the most common material (96% of lithics in Layers 3 and 2B-4; see Figure 8). The nearest outcrop of this flint is found ~2km from the cave; the flint is present in dolomite limestone of the Azish-Tau ridge exposed as steep cliffs along the Kurdjips River.

Based on assemblage composition, including cores, core fragments, tested pieces of flint, core trimming elements (CTE), cortical flakes, and shatter (angular debris), we assume that knapping of the local flint took place in the cave. Cores are typically of medium sizes (5–7cm; Figure 10). Abundant shatter is present, reflecting the low-quality of this raw material, apparently often broken in the process of knapping. At the same time, a relatively small number of large fragments and cortical flakes suggest that the operations of testing and decortication of the flint nodules occurred directly at raw material outcrops, probably at specialized flint-knapping workshops.

The local flint is the main raw material used for toolmaking (39% of tools in Layers 3 and 2B-4). Among tools made on the local flint, simple scrapers predominate, and some convergent pieces and a few bifacial tools, including partial bifacial scrapers of Volgograd and Prondnik types, are present. Many unifacial flake tools from this flint exhibit ventral thinning, representing partial bifacial forms.

Non-local high-quality flints originate from sources located 30–90km from the cave. We have identified (see details in Doronicheva and Kulkova 2011) that the following flint outcrops were exploited during this period: Unakozovskoye outcrop (KR-2; about 30km away from the cave; see Figure 5), Shahan 2–4 outcrops (KR-9-10; 30–40km away; see Figure 7), Meshoko outcrop (KR-47; 40–50 km away; see Figure 4), Gubs outcrop (KR-7; 40–50 km away; see Figure 6), Besleneevskaya 1–2 outcrops (KR-3-4-5; 50–60km away) and Ahmet-kaya 2–3 outcrops (KR-42-44; ~80–110km away). Two of these sources were used more intensively (almost 1/3 of lithics from non-local flints in both layers): brown Shahan (KR-9-10; see Figure 7) and colored Besleneevskaya (KR-3-4-5; see Tables 3–4; see Figures 8, 11, and 13).

Cores from non-local flints are rare and all are heavily exhausted or fragmented (see Figure 10). This suggests that the cores from non-local flints were brought to sites only in exceptional cases, but Neanderthals typically transported non-local flints as good-quality flakes or retouched tools. Tools made on these flints include simple scrapers, convergent tools, denticulates, bifacial, and partly-bifacial tools.

In Layers 3 and 2B-4, a few lithics (mainly tools) are made on flints likely originating from the Lysogorka outcrop (KR-11; Figure 12) in the north-eastern coast of the Sea of Azov (0.3% and 0.2%, respectively). These are a high-

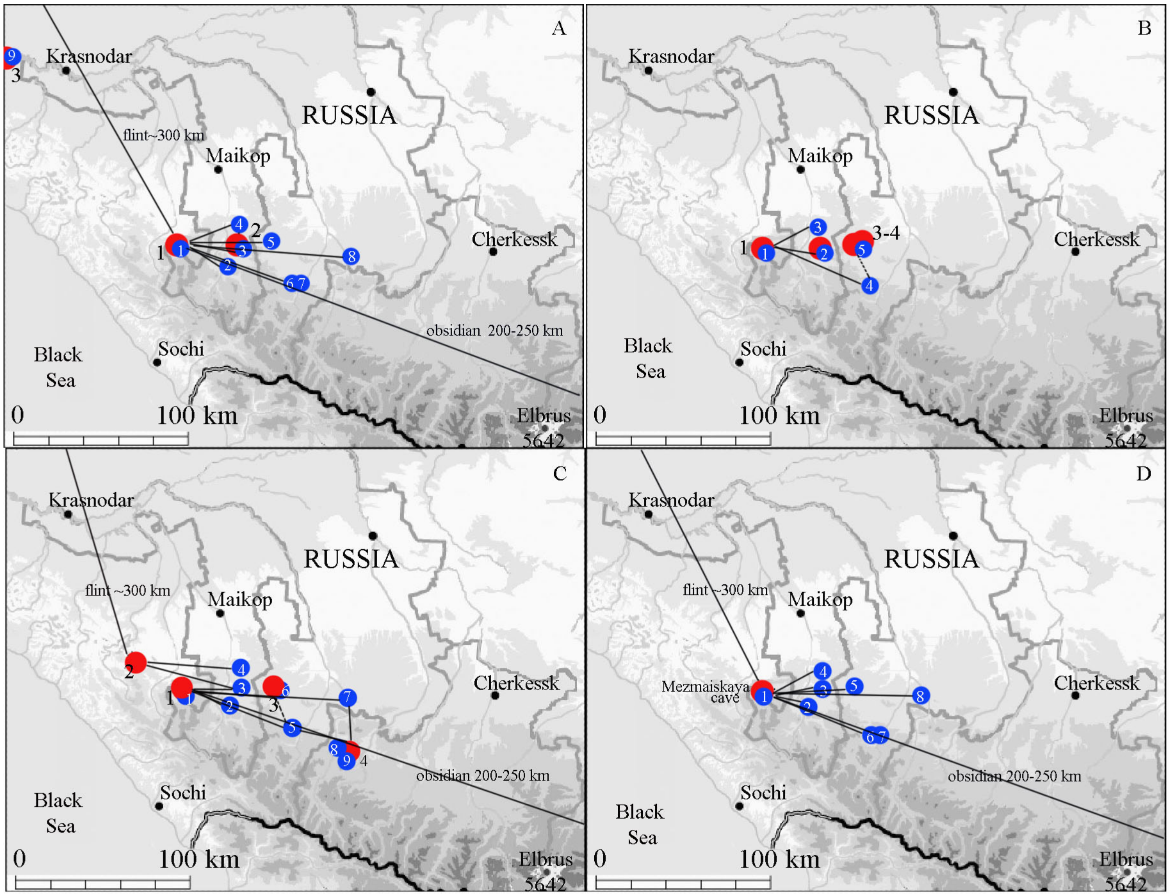


Figure 9. Simplified map, showing Eastern Micoquian sites in the Northwestern Caucasus and raw material sources which were exploited in different periods. Red dots: MP sites, blue dots: flint sources.

A: sites: 1) Mezmaiskaya Cave, 2) Hadjoh-2 workshop, and 3) Il'skaya I–II open-air sites. Flint sources: 1) Azish-Tau outcrop (KR-1), 2) Unakozovskoye-1 outcrop (KR-2), 3) Shahan-2–4 outcrops (KR-9/10), 4) Meshoko outcrop (KR-47), 5) Gubs outcrop (KR-7), 6) Besleneevskaya-I and II outcrops (KR-3-5), 7) Shedok outcrop (KR-23), 8) Akhmet-Kaya-2-3 outcrops (KR 42-44), and 9) flint sources near Il'skaya I–II.

B: sites: 1) Mezmaiskaya Cave, 2) Hadjoh-2 workshop, and 3–4) Barakaevskaya Cave and Monasheskaya Cave. Flint sources: 1) Azish-Tau outcrop (KR-1), 2) Shahan-2–4 outcrops (KR-9/10), 3) Meshoko outcrop (KR-47), 4) Besleneevskaya-I and II outcrops (KR-3-5), and 5) Gubs outcrop (KR-7).

C: sites: 1) Mezmaiskaya Cave, 2) Matuzka Cave, 3) Gubs Rockshelter I, and 4) Baranakha-4 open-air site. Flint sources: 1) Azish-Tau outcrop (KR-1), 2) Unakozovskoye-1 outcrop (KR-2), 3) Shahan-1–4 outcrops (KR-6 and 9/10), 4) Meshoko outcrop (KR-47), 5) Besleneevskaya-I and II outcrops (KR-3-5), 6) Gubs outcrop (KR-7), 7) Akhmet-Kaya-2–3 outcrops (KR 42-44), 8) Berezovaya Balka (KR-12) outcrop, and 9) Baranakha outcrop (KR-14).

D: flint sources exploited by the inhabitants of Mezmaiskaya Cave in the Middle Paleolithic: 1) Azish-Tau outcrop (KR-1), 2) Unakozovskoye outcrops (KR-2), 3) Shahan outcrops (KR-9/10), 4) Meshoko outcrop (KR-47), 5) Gubs outcrop (KR-7), 6) Besleneevskaya outcrop (KR-3-5), 7) Shedok outcrop (KR-23), and 8) Akhmet-Kaya (KR 42-44).

quality Cretaceous flint, very similar in composition (Doronicheva and Kulkova 2011). Sources of these flints are located ~300km north of Mezmaiskaya Cave. We are currently undertaking survey and sampling of flint sources in this area, trying to identify distinguishing characteristics specific to each flint source, and the results will be published in the future.

The Mezmaiskaya Neanderthals also actively exploited non-flint raw materials (4.4% in Layer 3 and 3.7% in Layer 2B-4). For example, five limestone pebbles and one granite pebble were found in Layer 3, and one limestone and two sandstone pebbles were found in Layer 2B-4. The limestone and granite pebbles in Layer 3 were used as chopping tools and one sandstone pebble in Layer 2B-4 was used as

TABLE 3. MEZMAISKAYA CAVE, LAYER 3 (1987–2001 collections).

Raw materials	Cores	Tested raw material pieces	Shatter	CTE	Cortical flakes 100%	Partly-cortical flakes 50–99%	Flakes with some cortex 0–49%	Flakes	Laminar flakes	Pebbles	Chips	Total	Incl. Tools
KR-1	39	38	482	30	8	9	114	250	26	-	397	**1393** **48%**	213
KR-2	1	1	10			1	5	25			29	**72** **2.5%**	11
KR-3–5, 23	1	8	33	1	-	-	13	47	2	-	109	**214** **7.3%**	69
KR-7			14				9	14			12	**49** **1.6%**	7
KR-9–10	7	5	119	3	-	1	23	76	2	-	375	**611** **21%**	89
KR-11	-	-	6	-	-	-	-	3	-		1	**10** **0.3%**	2
KR-42–44	-	-	15				4	16			30	**65** **2%**	12
KR-47	-	3	-	-	-	-	3	13	-	-	20	**39** **1.3%**	7
Not-defined flints	2	9	41	-	-	1	17	75	-	-	188	**333** **11.4%**	89
Silicified limestone	-	1	5	-	1	-	1	23	1	5	9	**46** **1.6%**	21
Aleurolite	-	-	2	-	-	-	1	6	-	-	6	**15** **0.5%**	4
Limonite	-	-	-	-	-	-	3	7	-	-	-	**10** **0.3%**	5
Slate	-	-	4	1	-	-	2	-	-	-	-	**7** **0.2%**	2
Quartzite	-	-	1	-	-	-	1	1	-	-	1	**4** **0.2%**	1
Sandstone	-	-	5	-	-	1	2	7	-	-	6	**21** **0.7%**	8
Stalactite	1	12	2	-	-	-	1	3	-	-	-	**19** **0.6%**	1
Calcite	-	1	-	-	-	-	-	-	-	-	-	**1** **0.1%**	-
Obsidian	-	-	1	-	-	-	-	1	-	-	-	**2** **0.1%**	-
Granite	-	-	-	-	-	-	-	-	-	1	-	**1** **0.1%**	1
Total:	51	78	740	35	9	13	199	567	31	6	1183	**2912** **100%**	542 18.6%

TABLE 4. MEZMAISKAYA CAVE, LAYER 2B-4 (1987–2001 collections).

Raw materials	Cores	Tested raw material pieces	Shatter	CTE	Cortical flakes 100%	Partly-cortical flakes 50–99%	Flakes with some cortex 0–49%	Flakes	Laminar flakes	Pebbles	Chips	Total	Incl. Tools
KR-1	44	18	274	29/-	5	4	62	250	8	-	152	**846** **59%**	124
KR-2	1	-	1	-	-	1	1	15	-	-	1	**20** **1.4%**	3
KR-3–5	1	5	21	3/1	-	-	9	31	-	-	46	**117** **8.3%**	32
KR-9–10	-	2	45	2	-	-	13	43	8	-	133	**246** **17.3%**	31
KR-11	-	-	-	-	-	-	-	2	-	-	1	**3** **0.2%**	2
KR-23	-	-	-	-	-	-	-	3	-	-	-	**3** **0.2%**	1
KR-42–44	-	-	-	-	-	-	-	1	-	-	6	**7** **0.4%**	2
KR-47	1	1	-	-	-	-	1	17	1	-	4	**25** **1.7%**	8
Not-defined flints	1	3	12	1	-	1	6	71	2	-	15	**112** **7.8%**	59
Silicified limestone	-	-	-	1	-	-	3	13	-	1	8	**26** **1.9%**	13
Aleurolite	-	-	-	-	-	-	-	1	-	-	-	**1** **0.1%**	-
Limonite	-	-	-	-	-	-	-	2		-	-	**2** **0.1%**	-
Slate	-	-	-	-	-	-	-	8	-	-	3	**11** **0.8%**	5
Quartz	-	1	-	-	-	-	-	-	-	-	-	**1** **0.1%**	1
Sandstone	-	1	-	-	1	-	-	3	-	2	-	**7** **0.5%**	3
Calcite	-	2	-	-	-	-	-	-	-	-	-	**2** **0.1%**	-
Obsidian	-	-	-	-	-	-	-	-	-	-	1	**1** **0.1%**	-
Total:	48	33	353	36/1	6	6	95	460	19	3	370	**1430** **100%**	284 20%

Figure 10. Mezmaiskaya Cave, Layer 3: 1–2) cores from local low-quality Azish-Tau flint (KR-1), 3) core from non-local (30–40km away) Shahan flint (KR-9/10).

a chopping tool. Other pebbles could be used as retouchers or hammerstones, although no use-wear analysis has been done yet to confirm this suggestion. Limestone and granite pebbles appear to have a local origin—the Neanderthals could have collected them in the alluvium of the Kurdjips River, on which Mezmaiskaya Cave is located.

A few artifacts made on speleotherms (pieces of cave stalactites and calcite flows) also are found. They are represented by individual cores, shatter, flakes, and one tool made from stalactites in Layer 3, with three calcite pieces found in both layers. Fragments of calcite flows and stalactites could be collected by Neanderthals inside or near the cave. In addition, siltstone, limonite, slate, and quartzite are represented by individual tools, flakes, fragments, and chips in both layers. Sources of these rock types are not identified, but surveys undertaken by one of us (E.D.) along the Kurdjips River Valley failed to find all these rocks in modern river deposits.

Several obsidian artifacts (tools and chips) were found in Layers 3 (0.1%) and 2B-4 (0.1%). According to recent research by Doronicheva and Shackley (2014), the obsidian originates from the Baksan (Zayukovo) sources in the North-central Caucasus, located approximately 200–250km east of the cave (see Figure 9a).

Hadjoh-2, Layer 7 has been studied only preliminarily. This open-air site is located on a small tributary of the Belaya River, the Sredniy Hadjoh River, at the elevation of 503–507masl and 60m above the river. A geomorphological study by S. Nesmeyanov (1999) and A. Muriy indicate the river terrace, on which the site is located, dates to the late Middle Pleistocene (Doronicheva et al. 2015). A small ($8m^2$) excavation at the site in 2009–2010 and 2013 (Doronicheva

Figure 11. Mezmaiskaya Cave, Layer 3, Etalon Besleneevskaya red flint (KR-3) and its macrographs (x65). Plane-polarized light and in crossed nicols. Unfinished bifacial side-scraper (KR-3) and its macrographs (x65). Plane-polarized light and in crossed nicols.

Figure 12. Lysogorka outcrop, a source of high-quality Cretaceous flints located ~300km from Mezmaiskaya Cave in the Azov Sea coast region.

et al. 2015) revealed that the lithic assemblage from Hadjoh-2, Layer 7, represents a flint-knapping workshop located directly on a flint source.

Numerous nodules of high quality flint that occur in the Sredniy Hadjoh River Valley provided a very rich raw material source used by the Neanderthals. According to the results of a petrographic analysis (Doronicheva and Kulkova 2011), 99% of the lithic artifacts from Layer 7 are made on local Shahan (KR-9-10) flint (Table 5). Only one flake is made on Meshoko flint (KR-47), the source of which is 6–7km from the site. Also, some slate, quartzite, and silicified limestone pebbles were recovered that could be exploited as hammerstones.

Flaked debitage predominates, including cores, core fragments, tested nodules, technical flakes (CTE), flakes, and shatter, and 48% of flakes have cortex, including primary flakes (7%). Among identifiable cores, uni-platform forms predominate (70%). Eleven tools found in Layer 7 include two fragments of laurel leaf-like bifacial points, two partial bifacial tools, a chopping tool, three endscraper fragments, two simple scrapers, and one déjeté scraper. The percentage of facetted platforms, small laminar index, and some tool forms (partial bifacial tools and leaf-like bifacial point fragments) found in Layer 7 suggest the similarity of this assemblage with the early Micoquian materials from Layers 3 and 2B-4 at Mezmaiskaya (Golovanova and Doronichev 2003, 2005).

The ***Ilskaya 1*** open-air site is located in the lower foothills of the Northwestern Caucasus, on a small tributary of the Kuban River, the Il′ River, at an elevation of only 15m above the river. The lithic industry, as well as the stratigraphy and dating, poses many inconsistencies. Hoffecker (2002: 83) associates the Ilskaya 1 occupation with a cold period during OIS 4–3 and suggests that the site is "a repeatedly occupied long-term habitation and multiple-activity site" or base-camp located near sources of raw material.

At Ilskaya 1, the Neanderthals exploited local rocks: flint, black jasper (lydite), siltstone, silicified sandstone, dolomite, and others (Gorodtsov 1941; Nehoroshev 1987). These researchers assumed that the Neanderthals could procure most of the raw materials used for making stone tools (flint, black jasper, quartz, quartzite, chalcedony, sandstone) from the pebble alluvium of ancient terraces along the Il′ River. It was suggested that the small size of many pebbles caused the size reduction of artifacts that are often made on complete small pebbles. Shchelinskii (2011), however, notes that the main classes of tools (points, sidescrapers, and bifacial knives) are made from flint and si-

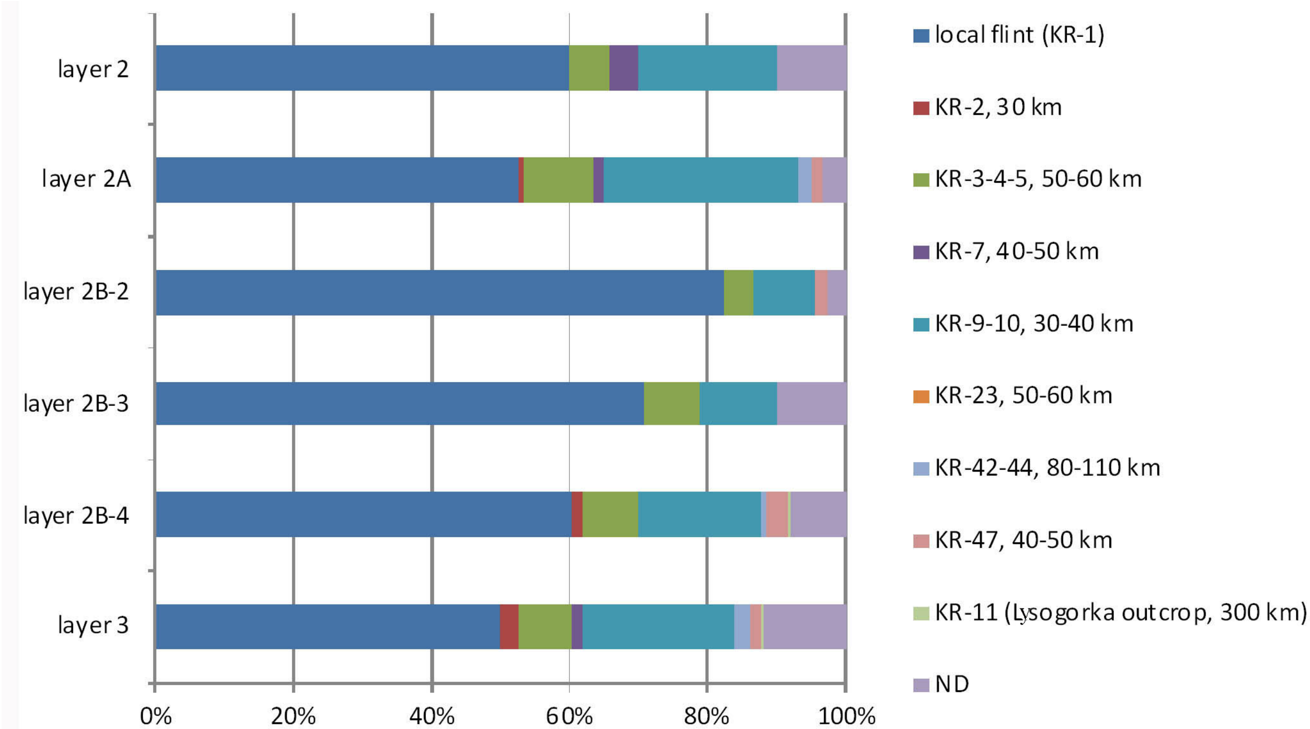


Figure 13. Mezmaiskaya Cave. Different flint types exploited in the Middle Paleolithic.

TABLE 5. HADJOH-2, LAYER 7 (2010 and 2013 collections).

Raw materials	Cores/cores fragments	Split nodules	Shatter	CTE	Cortical flakes 100%	Partly-cortical flakes 50–99%	Flakes with some cortex 0–49%	Flakes	Laminar flakes/ Blades	Pebbles	Chips	Total	Incl. Tools
KR-9	29/45	36	121	13	28	37	130	184	11/1	-	36	**671 99.6%**	11
KR-47	-	-	-	-	-	-	1	-	-	-	-	**1 0.1%**	-
Sandstone	-	-	-	-	-	-	-	-	-	1	-	**1 0.1%**	-
Quartzite	-	-	-	-	-	-	-	-	-	2	-	**2 0.2%**	-
Total:	74	36	121	13	28	37	131	184	12	3	36	**675 100%**	11

TABLE 6. MEZMAISKAYA CAVE, LAYER 2B-3 (1987–2001 collections).

Raw materials	Cores	Tested raw material pieces	Shatter	CTE	Flakes with some cortex 0–49%	Flakes	Chips	Total	Incl. Tools
KR-1	3	1	37	2	5	21	8	**77** **69%**	16
KR-3–4	-	-	5	-	-	3	1	**9** **8.1%**	3
KR-9–10	-	-	2	-	-	3	7	**12** **11%**	2
Not-defined flints	-	-	-	-	-	8	3	**11** **11%**	5
Silicified limestone	-	-	-	-	-	1	-	**1** **0.3%**	1
Aleurolite	-	-	-	-	1	-	-	**1** **0.3%**	-
Slate	-	-	1	-	-	-	-	**1** **0.3%**	1
Total:	3	1	45	2	6	36	19	**112** **100%**	28 25%

licified rocks, while dolomite is mainly present among the flakes and blades with fine retouch.

Ilskaya 2 is located 170m from Ilskaya 1, and was excavated in 1981–1991 by Shchelinskii (1998). In Ilskaya 2, the excavator identified seven stratigraphic levels and reported that almost all of them, except the first and sixth ones, represent long-term Neanderthal occupations. In occupational Layer 3 at Ilskaya 2, Shchelinskii (2005) posits a workshop for flaking dolomite, from which numerous flakes and blades were made. Unfortunately, no detailed information about these lithic assemblages and their raw materials is published.

The **second period** dates to early OIS 3, from c. 55–56 to 45 Ka. Layers 2B-3 and 2B-2 at Mezmaiskaya, Layer 2 at Barakaevskaya, and probably Layer 4 at Monasheskaya and Layer 6 at Hadjoh-2 might be dated to this period, for which a cool climate is typical (see Figure 9b).

In ***Mezmaiskaya Cave, Layers 2B-3 and 2B-2***, short-term Neanderthal occupations were identified (Golovanova and Doronichev 2005). As mentioned above, Layer 2B-3 was formed in cool and dry climatic conditions, when sub-alpine meadows surrounded the cave. In Layer 2B-2, a forest-steppe spectrum indicates that the cave was located near the upper boundary of the forest zone. The results of ESR dating (Skinner et al. 2005) suggest that the LMP Layers 2B-3 through 2B-1 date to between 60 and 42 Ka (see Figure 2).

The lithic assemblages from Layers 2B-3 and 2B-2 are not as numerous as in the lower LMP Layers 3 and 2B-4. We studied 112 lithics from Layer 2B-3 (Table 6) excavated from a total area of ~40m² and 195 lithics from Layer 2B-2 (Table 7) excavated from an area of 32m². Our petroarchaeological study suggests a significant decrease of stone raw material sources used by local Eastern Micoquian Neanderthals during this period of time. Only four flint outcrops are identified for this period (Doronicheva and Kulkova 2011).

The main raw material used by the Neanderthals in Layers 2B-3 and 2B-2 was a local grey flint (KR-1; see Figure 13). In comparison to the lower Layers 3 and 2B-4, the local flint was exploited less intensively (69% of artifacts in Layer 2B-3 and 81.5% in Layer 2B-2). The artifacts made on local flint in both layers include a few cores and tested pieces of flint, some CTE and flakes, and numerous shatter (48% in Layer 2B-3 and 85% in Layer 2B-2). The artifact compositions suggest that this flint was transported to the cave as cores and pieces of flint were intensively knapped on the site. Also, 57% and 36% of tools in Layers 2B-3 and 2B-2, respectively, are made on the local flint. The tools include

TABLE 7. MEZMAISKAYA CAVE, LAYER 2B-2 (1987–2001 collections).

Raw materials	Cores	Tested raw material pieces	Shatter	CTE	Cortical flakes 100%	Flakes with some cortex 0–49%	Flakes	Laminar flakes	Chips	Total	Incl. Tools
KR-1	1	1	136	1	-	4	10	4	2	**159** **81.5%**	4
KR- 3–5	-	-	4	-	-	-	1	3	-	**8** **4%**	1
KR-9–10	2	-	8	-	-	1	4	-	2	**17** **8.6%**	-
KR-47	-	-	-	-	-	3	1	-	-	**4** **2%**	1
Not-defined flints	1	-	-	-	-	1	3	-	-	**5** **2.5%**	5
Limonite	-	-	-	-	-	1	-	-	-	**1** **0.5%**	-
Granite	-	-	-	-	1	-	-	-	-	**1** **0.5%**	-
Total:	4	1	148	1	1	10	19	7	4	**195** **100%**	11 5.6%

the prevailing simple scrapers and tool fragments, and significant portions of chips (10% and 1.2% in Layers 2B-3 and 2B-2, respectively) suggest that some tools were retouched on-site.

Non-local high-quality flints originate from three sources (Doronicheva and Kulkova 2011; see Figures 9b and 13). The Shahan flint (KR-9-10) is represented only by some flakes, tools, and chips in Layer 2B-3, and two cores, few shatter and flakes, but no tools in Layer 2B-2 (Figure 14). The Besleneevskaya flints (KR-3-4-5) are represented also by only a few tools, flakes, shatter, and chips in both layers. In Layer 2B-2, one tool and three flakes are made on the Meshoko flint (KR-47). Individual flakes and tools are made from other rocks, such as silicified limestone, siltstone, and slate in Layer 2B-3 and limonite and granite in Layer 2B-2.

Barakaevskaya Cave, Layer 2. The cave is located in the mid-mountain zone (800–900 masl) of the Northwestern Caucasus, in a small valley of the Gubs River. A mandible and 10 isolated teeth attributed to Neanderthals were found at this cave (Liubin 1994). The overall lithic assemblage from Layer 2 comprises 21,402 lithics. Liubin and Autlev (1994: 101) presume that the site represents a basecamp with active Neanderthal occupation.

Along the Gubs River gorge local flint is present as intrusions in limestone cliffs, including intrusions in the walls of Barakaevskaya Cave and other LMP cave sites (Monasheskaya Cave and Gubs 1 Rockshelter) in the area (see Figure 6). The flint was described as being chalcedonic, variable in color from black to grey and including numerous remnants of fossilized organisms (Liubin and Autlev 1994). Liubin (1977) assumed that the low quality of the local flints explains the appearance of numerous debris and shatter, as well as medium and small sizes of artifacts in the LMP assemblages in this area (Liubin 1977).

At Barakaevskaya Cave, the absolute prevalence of artifacts from local black and dark grey flints was reported (Lubin et al. 1994: 100). Because flint nodules are incorporated in the cave walls and limestone ridges along the river, the local flint was intensively knapped in the cave. Flaking debris comprise 91% of the total assemblage, including a dominance of small flakes and chips (89%). This was calculated by counting the entire collection, including small shatter (some part of which could be the result of flint falling from the cave walls, where nodules are incorporated). Low proportions of cores (0.27%, 60 pieces) and retouched tools (3.7%) in the entire collection could also have resulted from this. Taking into account that 60 cores were discovered

Figure 14. Mezmaiskaya Cave, Layer 2B-2 cores: 1) from local flint (KR-1), and 2) from Shahan flint (KR-9–10, 30–40km away).

in 27m^2 total, this is twice that of Layer 3 at Mezmaiskaya and Barakaevskaya Caves. Artifacts made from non-local flints of light grey, white, grey-bluish, light brown, yellow-honey, greenish, and some other colors were all brought to the site as ready-to-use flakes or retouched tools.

Monasheskaya Cave, Layer 4. Liubin (1977) characterized the Middle Paleolithic occupations at Monasheskaya Cave as camp-workshops used by Neanderthals for a long time. Beliaeva (1999) published the lithic assemblages and reports that the main raw material exploited by the hominids in the cave was a local dark grey or black flint, of which intrusions occur in the cave wall and the nearest limestone cliffs.

A composition of the lithic assemblage from the lower LMP Layer 4 suggests that the whole process of knapping of the local flint occurred directly on the site. In Layer 4, tested pieces of flint make up 7.1% of total artifacts, cores typically are medium size and quite numerous, most flakes have cortex areas, and chips are numerous (13.1%). However, a low percentage of tools (in the entire collection analyzed) is characteristic for all LMP layers at Monasheskaya Cave (4.2% in Layer 4).

Like in Barakaevskaya Cave, artifacts from non-local flints are not numerous at Monasheskaya (Beliaeva 1999). The percentage of tools made of non-local flints is high (32.7% of total tools in Layer 4), but the percentage of chips from non-local flints is much lower (~3% of total chips), suggesting that non-local flints were typically transported to the cave as retouched tools that sometimes were rejuvenated on-site if necessary.

TABLE 8. HADJOH-2, LAYER 6 (2009 collection).

Raw materials	Cores/cores fragments	Split nodules	Shatter	CTE	Cortical flakes 100%	Partly-cortical flakes 50–99%	Flakes with some cortex 0–49%	Flakes	Laminar flakes	Chips	Total	Incl. tools
KR-9–10	3/30	11	92	2	13	15	40	63	2	24	**295** **100%**	1

Hadjoh-2, Layer 6. This assemblage includes 295 lithics that originate from a small excavated area of 6m² (2009 excavation). All lithics are made from a local brown colored Hadjoh flint (KR-9), abundant sources of which are known near the site (Table 8; see Figure 7). The climatic conditions were cold and dry, close to sub-alpine and alpine meadows and steppes.

The assemblage includes cores, fragments of tested flint nodules, CTE, shatter, and flakes. Among cores, 90.1 percent are tested cores or pieces of flint. Among identifiable cores, bifacial multi-platform cores predominate (66%). Half of the flakes (50.3%) exhibit cortex including primary flakes (9.6%) with 100% cortex on the dorsal surfaces. Parallel negatives predominate on dorsal surfaces of flakes (69.1%). Only one tool (a transverse scraper made on a flake) is found in Layer 6 in these collections. Chips are not numerous (8.1%). The lithic assemblage shows all steps of on-site flint knapping, including testing of flint nodules, decortication and preparation of cores, and striking of blanks (flakes) from the cores, suggesting that the site may be defined as a specialized flint knapping workshop for production flakes.

The **third period**, dated to 45–40 Ka, corresponds to the end of LMP in the Caucasus. The raw material data suggest a wider exploration of local environments by Neanderthals at that time. Different site types are represented, including Monasheskaya Cave (Layers 2-3B), Gubs 1 Rockshelter, Matuzka Cave (Layer 4B), Mezmaiskaya Cave (Layers 2 and 2A), Baranakha-4 (Layer 2), and probably Besleneevskaya-1 (Layers 3-4) and the upper layers at Autlevskaya (probably) Cave (see Figure 9c). The latest Eastern Micoquian assemblages from these sites have a lower percentage of bifacial tools but a higher percentage of tools made on blades in comparison to the earlier assemblages (Golovanova 2015; Golovanova and Doronichev 2003).

Mezmaiskaya Cave, Layers 2 and 2A. In the uppermost LMP Layers 2A and 2, short-term Neanderthal occupations dated to more than 40 Ka ago (Skinner et al. 2005) are present (see Figure 2). The skull fragments found in Layer 2 were attributed to a Neanderthal child of 1–2 years old (Golovanova and Doronichev 2005), which directly dates to 42,960–44,600 cal BP (Pinhasi et al. 2011). During this period, climate was cold and arid. Layers 2A and 2 are characterized by rodents typical of alpine meadows (Golovanova and Doronichev 2005). In Layer 2, grasses and shrubs predominate, suggesting depletion of the local flora. The archaeological material suggests that Neanderthals rarely visited this high elevation site.

The lithic collections that we have studied include 188 lithics (Table 9) from Layer 2A and 478 lithics (Table 10) from Layer 2, excavated from an area of 32m² and 20m², respectively. The main raw material is a local grey low-quality flint (KR-1), from which 51% of artifacts are made in Layer 2A and 59.5% in Layer 2, including 39% of tools in Layer 2A and 53% of tools in Layer 2. Among the tools, there are retouched flakes, simple scrapers, convergent tools, end-scrapers and a few partly-bifacial tools. Also, there are numerous chips made of this flint (12% and 23% of total lithics in Layers 2A and 2, respectively. The composition of these lithic assemblages suggests that the local flint was knapped and retouched in the cave.

Non-local flints also were important raw materials for the last Neanderthals who inhabited Mezmaiskaya Cave during the end of Middle Paleolithic (Doronicheva and Kulkova 2011). It is interesting that most laminar products are made from non-local high-quality flints. Almost 1/3 of the tools (27% in both layers) are made from Shahan flint (KR-9-10) and 9.5% and 5.7% of tools in Layers 2A and 2, respectively, are made from Besleneevskaya flints (KR-3-4-5). Among the tools there are convergent pieces, denticulates, retouched laminar flakes, a few end-scrapers and bifacial pieces. Numerous chips (see Tables 9–10) indicate that tools from non-local flints were retouched at the site. One tool from Layer 2A is made on the Unakozovskaya flint (KR-2), and some artifacts (8% in Layer 2A and 14% in Layer 2) are made of black, orange, green, and milky flints of various

TABLE 9. MEZMAISKAYA CAVE, Layer 2A (1987–2001 collections).

Raw materials	Cores	Tested raw material pieces	Shatter	CTE	Partly-cortical flakes 50–99%	Flakes with some cortex 0–49%	Flakes	Laminar flakes	Pebbles	Chips	Total	Incl. tools
KR-1	6	1	32	1	-	9	35	-	-	11	**95 51%**	14
KR-2	-	-	-	-	-	-	-	1	-	-	**1 0.5%**	1
KR-3–5	-	-	5	1	-	-	8	2	-	2	**18 9.7%**	5
KR-7	-	-	-	-	-	1	2	-	-	-	**3 1.5%**	2
KR-9–10	1	-	8	2	2	8	13	4	-	13	**51 27.3%**	10
KR-42–44			2				1				**3 1.5%**	1
KR-47			2					1			**3 1.5%**	1
Not-defined flints	-	-	3	-	-	1	1	-	-	1	**6 3%**	2
Silicified limestone	-	-	-	-	-	-	2	-	1	-	**3 1.5%**	-
Sandstone	-	-	2	-	-	-	-	-	1	1	**4 2%**	-
Obsidian	-	-	-	-	-	-	-	-	-	1	**1 0.5%**	-
Total:	7	1	54	4	2	19	62	8	2	29	**188 100%**	36 19%

petrographical compositions, for which the sources are currently unknown.

Among other types of rocks used in these levels, silicified limestone and sandstone are identified (3.5% in Layer 2A and 0.8% in Layer 2), including one limestone pebble and three sandstone pebbles that could have been used as hammerstones or stone retouchers. Also, some chips, shatter, and flakes made from these materials were found. One retouched tool made from silicified limestone was found in Layer 2. Obsidian artifacts, found only in Layer 2, are represented by a few pieces originating from the Baksan (Zayukovo) source (Doronicheva and Shackley 2014).

Matuzka Cave, Layer 4B. Matuzka Cave, located about 720masl on the Lago-Naki highland, contains a deep stratigraphical succession of 12 Middle Paleolithic levels, dated from ca. 130 to 40 Ka (Golovanova et al. 2006). Only short-term Neanderthal occupations are present in all the layers.

Layer 4B is a 10–20cm thick stratum that was excavated in a total area of about 40m². During the formation of Layer 4B, the cave was located in the forest zone. The climate was dry and warm. A thick ash and charcoal lens was found in almost the entire excavated area. The overall lithic assemblage recovered from Layer 4B is not numerous but typologically it was assigned to the Eastern Micoquian industry found in other LMP sites in the region (Golovanova et al. 2006).

The collection from Layer 4B (from the 1986–2003 excavations) used in our study is small (59 lithics; Table 11) and consists mainly of tools and flake fragments (Figure 15). There are no sources of good quality raw material and no sources of flint near the cave, indicating that all artifacts made on these raw materials were transported by hominids

TABLE 10. MEZMAISKAYA CAVE, Layer 2 (1987–2000 collections).

Raw materials	Cores	Tested raw material pieces	Shatter	CTE	Cortical flakes 100%	Partly-cortical flakes 50–99%	Flakes with some cortex 0–49%	Flakes	Laminar flakes	Blades/bladelettes	Pebbles	Chips	Total	Incl. Tools
KR-1	15	6	97	12	1	6	25	54	3	1/-	-	64	**284 59.5 %**	51
KR-3–5	1	-	2	-	-	1	1	10	3	-/1	-	8	**27 5.6%**	11
KR-7			4					11	1			4	**20 4.2%**	2
KR-9	3	1	9	2	1	2	9	26	7	-/2	-	33	**95 19.9%**	26
Not-defined flints	6	-	7	1	-	1	-	10	3	-	-	20	**48 10%**	6
Silicified limestone	-	-	-	-	-	-	1	-	-	-	-	-	**1 0.2%**	1
Sandstone	-	-	-	-	-	-	-	1	-	-	2	-	**3 0.6%**	-
Total:	25	7	119	15	2	10	36	112	17	4	2	12 9	**478 100%**	97 20%

to the cave. Non-local flints are the main raw materials. On the basis of petrographic analyses (see details in Doronicheva and Kulkova 2011), flints from three sources were identified: Shahan-1 (KR-6; approximately 30km north-east of the cave) and Meshoko (KR-47; 35–40km to the north-east of the cave), and preliminarily, the Lysogorka source (KR-11) located approximately 300km to the north-west of the cave, in the Azov Sea region (see Figure 9c). Identification of sources for a few artifacts made on other types of flint requires further research.

The assemblage composition shows very little evidence of stone knapping in the cave. Only one core fragment made of flint from an unknown source (2001 collection) is heavily reduced (dimensions less 2–3cm) and another small core fragment made on the Shahan flint (KR-6) was reworked into a tool. These individual cores found in the layer suggest that Neanderthals rarely transported non-local raw materials as cores to the cave. On the contrary, ready-to-use flakes and retouched tools were typically brought by the hominids to Matuzka, and a few chips suggest that some of the tools could be retouched or rejuvenated on the site. The tools are represented by convergent and simple scrapers, several bifacial tools and some denticulates. A majority of tools and flakes (63%) are fragmented.

The Neanderthals used small amounts of artifacts made from local silicified limestone and stalactites that are available directly in the cave (see Figure 15-5). Other rocks, such as siltstone, slate, limonite, and sandstone, all of which can be found in modern alluvium of Matuzka and Psheha rivers, were also sporadically exploited. There are two sandstone pebbles (probably used as retouchers) and one limestone pebble. Flakes from siltstone, slate, limonite, and quartz were used as blanks for making retouched tools.

Baranakha-4, Layer 2. The open-air site of Baranakha-4 is situated in a small ravine, a small tributary of the Urup River, at an elevation of about 1500masl. The site was excavated only twice, in 1996 and 2011. It is the most eastern and the most elevated Eastern Micoquian site in the Northern Caucasus. A few faunal remains indicate that local Neanderthals hunted large mammals, probably bison, suggesting that Baranakha-4 represents a seasonal multi-activity site where cool climate and open landscapes were present with grass pollen dominant (Golovanova and Doronichev 1997; Golovanova et al. 2015).

A total of 424 artifacts were found in Layer 2 in the 1996 excavation (Table 12). In 2011, one of us (E.D.) undertook

TABLE 11. MATUZKA CAVE, Layer 4B (1986–2003 collections).

Raw materials	Cores	Shatter	CTE	Cortical flakes 100%	Partly-cortical flakes 50–99%	Flakes with some cortex 0–49%	Flakes	Laminar flakes	Blades	Pebbles	Chips	Total	Incl. Tools
KR-6	1	-	1	-	-	-	2	-	-	-	1	**5**	3
KR-11	-	-	-	-	-	-	3	-	-	-	-	**3**	3
KR-47	-	-	-	-	1	-	1	-		-	-	**2**	2
Not-defined flints	1	1	1	-	-	4	8	3	3	-	4	**25**	17
Silicified limestone	-	1	-	-	-	1	-	-	-	1	-	**3**	1
Aleurolite	-	2	1	-	-	2	4	-	1	-	-	**10**	6
Slate	-	-	-	-	-	-	1	-	-	-	-	**1**	-
Limonithe	-	1	-	-	-	-	3	-	-	-	-	**4**	1
Sandstone	-	2	-	-	-	-	-	-	-	2	-	**4**	1
Quartz	-	-	-	-	-	-	1	-	-	-	-	**1**	-
Stalactite	-	-	-	1	-	-	-	-	-	-	-	**1**	-
Total:	2	7	3	1	1	7	23	3	4	3	6	**59**	34

raw material surveys on the Baranakha plateau, which resulted in the discovery of several local outcrops of low-quality white and grey flint. The petrographic analyses of flint samples from the Baranakha-4 site and these outcrops (see details in Doronicheva and Kulkova 2011; 2014) indicate that the two local outcrops were used as main flint sources by the LMP Neanderthals on the site. The first source (Baranakha outcrop; KR-14) is located approximately 300–400m from the site in the same ravine (Figure 16). The second source (KR-12) is located in the Berezovaya Balka ravine, approximately 5–6km from the site (Figure 17).

These local low-quality flints are the main raw materials used by the Neanderthals at Baranakha-4, Layer 2 (75.9% of total lithics). They are represented mainly as flaked debitage, including various flakes (some are cortical flakes), cores, fragments, and small shatter. Most cores and tools are fragmented. The assemblage composition suggests that knapping of these flints was done directly at the site. Among tools, mostly simple scrapers and few convergent pieces, limaces, end scrapers, and retouched flakes are present.

High-quality non-local flints also were often used by the Neanderthals (17.2% of total lithics) at the Baranakha-4 site. Most commonly (14.6%) the hominids used flints from the Akhmet-Kaya 2–3 sources (KR-42-44) located in the Bolshaya Laba River Valley, approximately 30–50km from the site. Several cores and CTE, and more numerous flakes made from this flint, suggest that the Neanderthals transported it as cores and knapped directly on the site. All cores made on this flint are heavily exhausted and most of them lack cortex; the biggest core is less than 5cm is size. Tools are not numerous, but typical Eastern Micoquian types are represented. Among them are a Prondnik-like bifacial scraper-knife and several convergent tools. Also, a high ratio of good quality flakes (35.3% of them are laminar flakes) made from this raw material suggests that it was brought to the site as ready-to-use flakes that were produced in other places, probably in flint-knapping workshops located directly on the flint outcrops.

The Besleneevskaya flint outcrops (KR-3-5) located approximately 70km away from the site were another source of high-quality flint for the Baranakha hominids (Figure 18). Lithic artifacts from this flint comprise only 1.2% of total lithics in Layer 2 (see Table 12). The assemblage composition suggests that only ready-to-use flakes and retouched tools made of this flint were brought to the site and subsequently on-site retouched if necessary. Also, several tools and flakes in Layer 2 are made on flints originating from currently unidentified sources.

In addition, hominids used non-flint rocks such as slate, chert, quartzite, calcite and sandstone (7.1%). Sandstone pebbles could possibly be used as retouchers and hammers. Slate, quartzite and chert were all used to produce flakes and make tools (various scrapers). The Neanderthals could procure these rocks from the alluvium of the nearest rivers, in which the same rocks occur today.

Figure 15. Various types of raw materials exploited at Matuzka Cave, Layer 4B: 1–2) Matuzka Cave and silicified limestone inside the cave, 3–4) flint, and 5) stalactite.

We conclude that the Neanderthal occupants at Baranakha-4 preferentially exploited local flints. In addition, they used high-quality flints from distant sources (KR-44 and KR-5), transported to the site as flakes, tools, and individual cores. The Besleneevskaya flints (KR-5), identified also at Mezmaiskaya, were transported from the greatest distance, about 70km. Other (non-flint) rocks were utilized sporadically for making retouched tools and producing flakes, and also as hammerstones and stone retouchers.

The LMP assemblages from **Gubs Rockshelter 1**, like in the nearby Monasheskaya Cave, are based almost completely on local flint sources available along the Gubs River gorge (Liubin 1977; see Figure 6). Unfortunately, only limited data about raw material procurement is available from publications. It is reported that local black flints are widely represented among tools in the assemblages, but (in contrast to the assemblage from Manasheskaya) they are not numerous among cores and flakes. At the same time, non-local flints (pink-honey or light colored) are identified but are represented only as individual tools at Gubs Rockshelter 1.

TABLE 12. BARANAKHA-4, Layer 2 (1996 collection).

Raw materials	Cores	Fragments >3 cm	Shatter <3 cm	CTE	Cortical flakes 100%	Partly-cortical flakes 50–99%	Flakes with some cortex 0–49%	Flakes	Laminar flakes	Pebbles	Chips	Total	Incl. tools
KR-14	11	44	24	2	4	9	16	40	1	-	-	**151 36%**	9
KR-12	4	18	26	1	2	5	36	54	11	-	11	**168 39.9%**	30
KR-44	4	-	8	4	-	-	9	18	12	-	7	**62 14.6%**	9
KR-5	-	-	-	-	-	-	-	4	1	-	-	**5 1.2%**	3
Not-defined flints	-	-	-	-	-	-	1	5	-	-	-	**6 1.4%**	4
Sandstone	-	-	-	-	-	-	-	-	-	2	-	**2 0.2%**	-
Slate	-	-	-	-	-	-	-	2	-	-	-	**2 0.2%**	-
Chert	1	-	-	-	-	-	2	4	-	-	-	**7 1.6%**	
Quartzite	1	7	1	-	-	-	-	11	-	-	-	**20 5%**	1
Calcite	-	-	1	-	-	-	-	-	-	-	-	**1 0.1%**	-
Total:	21	69	60	7	6	14	64	138	25	2	18	**424 100%**	56

DISCUSSION

In Middle Paleolithic studies, stone raw materials are usually divided into 'local' (found at a distance of 0–5km from the site) and 'non-local' (brought from a distance greater than 5km). Many studies indicate that the Neanderthal lithic assemblages are produced predominantly on local stone raw materials, generally with a low proportion of tools made from rocks transported from long distances (e.g., Burke 2006; Doronicheva et al. 2012, 2013; Geneste 1988; Meignen et al. 2009; Soressi 2004; Turq 1989). The largest body of data on Middle Paleolithic raw material procurement and use now is available from the Perigord region (France), in which more than 1,000 flint and chert outcrops have been sampled and lithic assemblages from about 40 stratified Middle Paleolithic sites have been studied using the petroarchaeological approach (Demars 1982; Geneste 1988, 1990; Geneste and Rigaud 1989; Turq 1989, 1992). These baseline studies revealed that patterns of raw material procurement and use appear to be very stable through the Middle Paleolithic and identify three zones of raw material procurement by the Neanderthals, each having a specific model of raw material use:

1. Zone 1 includes local raw materials (predominantly cherts) from outcrops located in the radius of about 5km from the site. Lithics procured from these outcrops comprise 82%–98% (Geneste 1988) or 85%–95% (Turq 1989) of artifacts in lithic assemblages and were transported to sites mostly as cores prepared and tested on sources and then subsequently flaked at the sites.
2. Zone 2 includes raw material sources located within 5–20km from the site. Artifacts from these raw materials comprise 10%–20% of lithic assemblages and were transported to sites as cores, ready to use flakes, and retouched tools.
3. Zone 3 includes raw material sources located

Figure 16. The Baranakha outcrop (KR-14), located ~300–400m from the Baranakha-4 open-air site.

Figure 17. The Berezovaya Balka outcrop (KR-12), located 5–6km from the Baranakha-4 open-air site.

Figure 18. Exploitation of the Besleneevskaya flint (KR-3–5) outcrop at the Baranakha-4 open-air site: a, b) photos of the Besleneevskaya outcrop; and, c) flake fragment from Layer 2 at Baranakha-4 and geological sample of Besleneevskaya black flint (KR-5) from the outcrop and their macrographs (x65). Plane-polarized light and in crossed nicols.

more than 20km but usually no more than 100km from the site. Artifacts from these raw materials comprise no more than 5% of lithic assemblages and were transported to sites only as high-quality blanks and finished tools.

In Central Europe, researchers also note that patterns of raw material procurement and use were unchanged through the entire duration of the Middle Paleolithic and identify similar zones of raw material procurement (Rensink et al. 1991), excluding Zone 4, which is discussed below: Zone 1 (0–5km), Zone 2 (from 5 to 20km), Zone 3 (from 20 to 100km), and Zone 4 (from 100 to 200–300km). Local raw materials (from Zone 1) were most actively used, followed by artifacts made on rocks coming from the 'intermediate' Zone 2 (5.1–20km), although the percentage of artifacts made on rocks originating from more distant (>20km from the site) sources is extremely low (<3% and usually <1%) at most sites. The artifacts made on rocks transported from moderate (50–100km) or great (200–300km) distances are present in most cases only as a few pieces and mainly as high-quality blanks or finished tools and rarely as poor-quality flakes, fragments, and cores (Féblot-Augustins 1993).

The frequent predominance of local (<5km) rocks (cherts or flints) among the assemblages suggests that Middle Paleolithic Neanderthals depended on the availability of stone raw materials directly on or close to the site. This finding has been interpreted as evidence for Neanderthal stone procurement as a part of economic and subsistence activities that took place within the spatial scale of everyday foraging zones around residential sites (e.g., Féblot-Augustins 1997, 2009; Geneste 1988). This pattern of mobility has been described as the 'radiating' (Mortsensen 1972 in Burke 2006) or 'logistical' (Binford 1980) model, which assumes a number of activity-specific sites to feed resources to a residential site.

In the LMP, Zagros Mousterian assemblages in Armenia, in the Lesser Caucasus, are mostly produced on obsidian (Golovanova and Doronichev 2003). Recent obsidian studies provide new and meaningful data about Neanderthal raw material procurement and transport. In Lusakert 1 Cave, more than 99% of artifacts are made on obsidian, and recent study (Frahm et al. 2014, 2016) indicates that approximately 93% of obsidian artifacts are derived from obsidian lava flows from the Gutansar volcano located <5km from the site. Only 7% of the artifacts came from more distant sources throughout the Armenian volcanic highland, from Pokr Arteni in the west (~70km from the site) to Geghasar in the southeast (~40km from the site).

Using a newly developed approach, based on the application of a portable X-ray fluorescence (pXRF) device to characterize archaeological obsidian, alongside the use of magnetic susceptibility, Frahm and co-authors (2015) argue that their results support the model that Neanderthals collected obsidian adjacent to the cave landscape, apparently during their day-to-day foraging activities around the residential site. A spatial scale of the everyday foraging zone at Lusakert 1, within the radius of <5km from the cave, is confirmed by magnetic results indicating the rarity of obsidian from the more distant (~9km from the cave) obsidian outcrops of Gutansar volcano and obsidians from Hatis volcano located 12km from the site. This result is consistent with that mentioned above and discussed below, indicating that Neanderthals rarely exploited rocks from non-local (>5km from the site) outcrops in most sites and regional contexts.

In the southern Greater Caucasus, the Imereti region of west Georgia is rich in natural sources of high quality flints (red, pink, yellowish, yellow-brown, and grey in color) that occur in the Turonian and Cenomanian limestones of the Upper Jurassic period (Lubin 1977). The Early Middle Paleolithic sites in the region are assigned to the Djrichula-Kudaro Mousterian which is similar to the Early Levantine Mousterian Tabun-D type (Golovanova and Doronichev 2003; Meignen and Tushabramishvili 2006). Eight different types of flint are distinguished at Djruchula Cave, among which three types predominate. The Cenomanian-Turonian outcrops of high quality flints of red and brown-yellow colors are found on the plateau, and the nearest ones are located <5km from the site. Nevertheless, Neanderthals that inhabited the cave often used other local and lower quality raw materials (flints and argillite) that they gathered as nodules and cobbles in gravels of the Djruchula River just few hundreds meters from the site (Adler and Tushabramishvili 2004; Mercier et al. 2010).

The raw material studies at Djruchula and other sites (Kudaro 1 and Kudaro 3 and Tsona Caves) representing the Djrichula-Kudaro Mousterian industry suggest that, despite the distance from sources of high quality flints, varying from <5km (Djruchula Cave) to 60–80km (Kudaro 1 and 2, and Tsona), the lithic assemblages are characterized by several common features (Liubin 1977, 1989; Meignen and Tushabramishvili 2010; Mercier et al. 2010):

- In all these lithic assemblages there are significant numbers of artifacts made of strictly local (i.e., available in the close vicinity of the site) raw materials, such as slate and sandstone in the Kudaro 1 and Kudaro 3 Caves (about 80% of the lithic assemblages), that were mostly collected from gravels of the nearby rivers and knapped directly at sites.
- The artifacts made on rocks not found in the immediate vicinity of the sites are mainly high-quality blanks and retouched tools (mostly retouched points); they are most often made on high quality Cenomanian-Turonian flints originating from the Imereti upland.
- Primary knapping of the Cenomanian-Turonian flints occurred directly on flint outcrops but not in the caves, including the Djruchula Cave; this is indicated by the scarcity of pieces of primary debitage (with cortex) from these flints at Djruchula and the absence of such products in the Kudaro caves and Tsona.
- In the Kvirila River Valley cutting through the Imereti upland there are about 20 surface localities, most of which are confined to outcrops of high quality Cenomanian-Turonian flint. The lithic assemblages found in these localities comprise large numbers of cores, flakes, and waste products made of this flint, and likely represent flint knapping workshops. Unfortunately, the lithic assemblages from these sites, including the Khvirati locality assigned to the Kudaro-Djruchula Mousterian, remain mostly unpublished (Liubin 1977).

The exploitation of non-local sources of stone raw materials is found in the overwhelming majority of Neanderthal occupations across Europe and Western Asia. In the Central European Micoquian, the exceptional example is Kulna Cave, where local raw materials comprise only 1.2% to 2.7% in different levels, but the closest source of the most commonly used felsitic quartz porphyry (86.5% to 90% of total artifacts) are found 10km west of the site (Feblot-Augustin 1993). High-quality flint derived from sources located ~25km from the site was predominantly used by the LMP hominids at Karabi Tamchin, in Crimea. However, only two other sites provide evidence of flint artifacts transported more than 20km from the site while evidence for raw material transfers beyond this distance are absent in Crimea (Burke 2006; Marks and Chabai 2001).

In Central Europe, there are a few small Middle Paleolithic assemblages known, such as Zwolen and Ballavölgyi, in which Neanderthals brought mostly ready to use blanks or finished tools made from non-local high-quality raw materials coming from great distances (Féblot-Augustins 1993). At Zwolen, 70% of only 47 artifacts found in the site are made on high-quality flint brought from a distance of 40km. At Ballavölgyi, eight tools made on Carpathian obsidian coming from 100km away were recovered. Such exceptional sites are known in other regions, including the Caucasus (see Golovanova and Doronichev 2005; Golovanova et al. 2006).

In the Southern Caucasus, as noted above, the Djruchula-Kudaro Mousterian assemblages in the Kudaro 1, Kudaro 3, and Tsona Caves contain some high-quality blanks and retouched tools (mostly retouched points) made from high-quality red flint transported from sources located approximately 60–80km from these sites in the Imeretian region of west Georgia (Liubin 1977).

Assuming a great distance from natural sources, it is apparent that transport of non-local, low-inclusion, and high-quality rocks (flints or obsidians) does not reflect Neanderthal everyday activities. Apparently, the data are consistent with the model suggesting that Neanderthals scheduled their subsistence activities not only on the day-to-day basis but also on circular annual mobility, probably following seasonal movements of prey (Burke 2006).

A circular mobility of Neanderthal groups based on summer and autumn seasonal cycles is suggested for the LMP Micoquian (KMG) cultural tradition in Central Europe (Cep and Waiblinger 2001; Richter 2001) and for the Crimean Micoquian and Levalloise-Mousterian traditions (Burke 2006; Marks and Chabai 2001) in Eastern Europe. The circular model of mobility involved organization of seasonal base camps, short-term camps in the summer cycle, and long-term camps in the autumn cycle as proposed for the LMP occupations at Sesselfelsgrotte, in Germany (Richter 2001). These base camps were used as primary residential sites, from which small groups moved around to acquire local resources—movements described by the radiating model.

Similarly, in the Levant during the LMP, stone raw material was procured usually from distances no greater than 10–20km (as analogs of Zones 1 and 2 in Western and Central Europe) and rarely from sources located at greater distances (Hovers 2001; Meignen et al. 2005). The authors suggest a circular mobility, with the organization of temporary camp-sites, similarly to the model proposed for the Middle Paleolithic in Central and Eastern Europe.

In addition to local and non-local rocks, Neanderthals used very small amounts of 'exotic' rocks originating from more remote stone raw material sources (>100km from the site). The increasing evidence from different regions indicates that the transportation of exotic rocks represents an important feature of the Neanderthal behavioral repertoire (Féblot-Augustins 1993, 1997, 2008; Geneste 1988; Le Bourdonnec et al. 2012; Rensinket al. 1991; Slimak and Giraud 2007). The maximum distance of raw material transport in the Middle Paleolithic usually does not exceed 100km in France (Geneste 1988) and 100–150km in Greece (Féblot-Augustins, 2008), but it reaches up to 200–300km in some LMP assemblages in Central Europe (Féblot-Augustins 1993; Rensink et al. 1991). Recent studies at the site of Champ Grand in central France suggest that Neanderthals brought some rocks from different sources located more than 250km to the south and to the north from the site (Slimak and Giraud 2007), as in the Central European LMP assemblages.

In LMP levels at Ortvale Klde, in the Southern Caucasus, the obsidian study by Le Bourdonnec and colleagues (2012) indicates that two obsidian flakes were transported from Chikiani-Paravani outcrops in the south of Georgia, about 100km from the site, but one is derived from more distant sources in Armenia or north-eastern Anatolia in Turkey, located almost 300km from the site. The transport of these obsidian artifacts to the cave involved a linear walking distance of about 170km and 350–400km, respectively. It is noted that obsidian artifacts found in the LMP levels at Ortvale Klde are represented as small debitage and highly utilized retouched tools (Adler et al. 2006). It is revealing that no obsidian from the closer Baksan source in the Northern Caucasus has been found in the LMP levels at Ortvale Klde (Le Bourdonnec et al. 2012), suggesting that the Neanderthal mobility between the Southern and Northern Caucasus was constrained by the Greater Caucasus mountain range. In the Djruchula-Kudaro Mousterian assemblages, in the same region, the only exotic stone raw material is obsidian represented by a few lithics (small debitage and retouched tools) at Djruchula Cave and one artifact at Tsona Cave, likely originating from the same Chikiani-Paravani area (>100km to the southeast from the sites), in southern Georgia (Liubin 1989).

The percentage of exotic rocks is very low (from <1% to <0.5%) in almost all Neanderthal occupations, but their presence appears to indicate extensive long-range Neanderthal mobility (Le Bourdonnec et al. 2012; Moncel et al. 2015; Riel Salvatore and Negrino 2008). Féblot-Augustins (1993, 1997) interpreted the evidence of long-distance transport up to 250km from a site in terms of seasonal movements of Neanderthal groups, assuming that the annual exploitation territory of each group might reach 13,000km^2; however, she also proposed that exotic rocks transported from greater distances might point to potential interactions among different Neanderthal groups. More recent studies suggest that most exotic rocks are evidence of sporadic cultural contacts among Neanderthal groups (Slimak and Giraud 2007), and some authors suggest that the appearance of extensive and developed social networks among various cultural groups of Neanderthals is similar to network systems known among anatomically modern humans (Kaufman 2002).

CONCLUSIONS

The data reported in this paper suggest that each period of Eastern Micoquian development in the Northwestern Caucasus, defined by Golovanova and Doronichev (2003), is characterized by some specific features related to raw material exploitation and transport as summarized below.

During the first period (from ~80/70 to 60/55 Ka), Mezmaiskaya Cave and Ilskaya 1 and 2 (probably) dated to this time span (see Figure 9a) are base-camps or seasonal camp-sites with evidence of active hominid habitation, and one site (Hadjoh-2, Layer 7) is an open-air flint-knapping workshop located directly on the flint source. We defined eight raw material outcrops used by the Eastern Micoquian Neanderthals during this period. The abundance and diversity of flint sources both suggest that local Neanderthals established an extensive network for regular stone raw material procurement within the Northwestern Caucasus in the initial stage of their occupation of this region.

For the second period (~55-56–45 Ka), we have four Neanderthal sites (see Figure 9b). They show a higher diversity of occupation types, represented by short time seasonal camp-sites at Mezmaiskaya Cave, base-camps with evidence of active hominid habitation at Barakaevskaya Cave, and a flint-knapping workshop at Hadjoh-2, Layer 6. Only four raw material outcrops were identified for this period, indicating a reduction of the Neanderthal raw material network during that time. As a consequence, we found that local flint sources were used more intensively in this period, in comparison to the previous one. High-quality flints from distant sources (more than 30km from the site) also were used. At the same time, non-flint rocks such as slate, limestone, quartzite, limonite, and sandstone were used only sporadically, and the evidence of obsidian or Azov flint is absent.

The third period (45–40 Ka) again shows a wider exploration of local environments, including the increase of stone raw material sources used, and a diversity of occupation types (see Figure 9c). Nine raw material outcrops used during this period were identified. Also, flint from the Sea of Azov coast is found at Matuzka Cave and obsidian from the Baksan (Zayukovo) source area appears again (as in the first stage) at Mezmaiskaya.

The results of our study suggest that three zones of raw material (flint) procurement, each involving different ranges of mobility and particular strategies of raw material use and transport, can be defined in the Northwestern Caucasus Eastern Micoquian:

- Zone 1 includes local flint sources situated in the radius of about 5km from the site or directly at the site. If flint was not available directly at the site, Neanderthals transported flints from local sources as cores and fragments that have been preliminary decorticated and tested, probably in specialized flint-knapping workshops located directly on flint sources.
- Zone 2 includes flint outcrops located at a distance of 5–100km from the site. The high-quality flints derived from distant sources comprise from 10% to 50% of artifacts in the lithic assemblages analyzed in this study, but the average proportion is closer to the minimum limit and the number of artifacts made on non-local flints is usually statistically insignificant.
- Zone 3 includes exotic raw materials originating from outcrops located from 100 to 200–300km from the site. These stone raw materials comprise <1% of total artifacts in the Eastern Micoquian lithic assemblages analyzed in this study and occur only as flakes, tools, chips, and small fragments; no cores produced from exotic raw material are present in the studied collections.

We have identified that the typical area of resource exploitation during LMP in the Northwestern Caucasus usually did not exceed the radius of about 0–5 km from the site (Zone 1), indicating that Neanderthals mainly used local stone raw materials even if their quality was poor. In addition to local flints or cherts, the Neanderthals exploited other local rocks such as slate, siltstone, limonite, and others, but the intensity of exploitation of these rocks was low.

Our data show that the Neanderthals that produced the Eastern Micoquian industry in the Northwestern Caucasus preferred to establish their sites, especially sites of active occupation, no more than 2km from the nearest source of flint or chert. All Neanderthal campsites (the caves of Mezmaiskaya, Monasheskaya, Barakaevskaya, and Gubs Rockshelter 1, and the open-air sites of Ilskaya 1, Ilskaya 2, and Baranakha-4) are located in areas rich in local sources of these raw materials. If flint/chert sources are absent, Neanderthals rarely visited these areas. These data suggest that the availability of suitable flints/cherts is one of the key factors contributing to the settlement of the Eastern Micoquian Neanderthals in the region. We define two distinct patterns of local raw material exploitation in the Northwestern Caucasus Eastern Micoquian:

- When raw materials were available directly on or in the close vicinity of a site, a complete cycle of core reduction and tool production occurred on the site, i.e., the site was exploited not only as a residential camp but also as a stone-knapping workshop. The camp-workshop type of occupation is found at Monasheskaya and Barakaevskaya Caves, Gubs 1 Rockshelter, Ilskaya 2, and Baranakha-4.
- When sources of flint/chert were not available in the immediate proximity of a site, acquisition and primary flaking of the raw materials occurred in special workshops situated directly on raw material sources, and consequently pieces without cortex were transported to the site for subsequent on-site reduction to produce blanks and to use these blank. This type of occupation is found at Mezmaiskaya Cave located 2km away from the nearest flint source (see Figure 9).

The Eastern Micoquian Neanderthals also always transported some quantity of high-quality raw materials (various flints) from distant sources (Zone 2). Our petroarchaeological study shows that artifacts from non-local flints at Mezmaiskaya originate from five flint sources located 20–100km from the site. It is obvious that Neanderthal procurement of non-local stone raw materials within Zone 2 depended on distance to raw material sources. For example, at Mezmaiskaya Cave, 6–11.3% of total artifacts in various levels are produced from flints transported from distances of 40.1–70km, but only 0.5–2% of total artifacts are made on flints transported from distances of 70.1–100km (Figures 19–21).

However, our study shows no significant differences in the use of non-local flints transported from distances of 40.1–70km or 70.1–100km. All these non-local high-quality flints were predominantly transported to sites as ready to use flakes and retouched tools, and rarely as preliminarily tested cores. These results are consistent with a widespread set of data on Neanderthal stone procurement discussed above and suggest that a dependence on local resources is a common and important characteristic of Middle Paleolithic procurement.

Our data also indicate that some distant sources of high-quality flints were exploited more intensively and flints from them were transported more extensively, in comparison to other sources. For example, high-quality Senonian flints from the Besleneevskaya outcrop were transported to almost all Eastern Micoquian sites in the region, some located a relatively great distance from the source (see Figure 10): Mezmaiskaya (50–60km from the source) and Matuzka (80–90km) Caves, Baranakha-4 (70–90km) and probably some sites in the Gubs River gorge (20–25km). The Oxford-Kimmeridgian flints from the Shahan outcrops found at Mezmaiskaya and Matuzka Caves are located 30–40km and about 30km from the source, respectively (see Figure 9). The Cretaceous flints from the Ahmet-kaya outcrops are identified at Baranakha-4 (~50km from the source) and Mezmaiskaya (90–100km from the source).

Like other regional contexts discussed above, the data on Neanderthal procurement and use of stone raw materials in the Northwestern Caucasus might be interpreted in

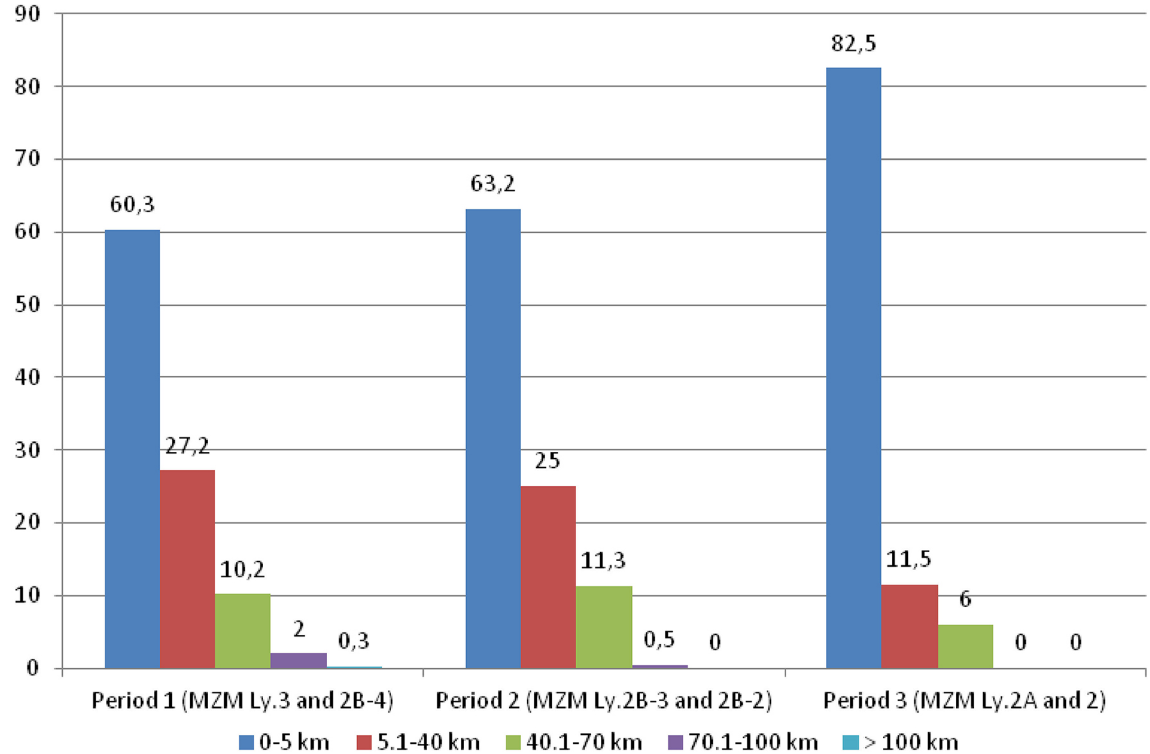


Figure 19. Total flints from different distances in the MP collections of Mezmaiskaya Cave in different periods (layers). Calculated from the percentage of flints from defined flint sources.

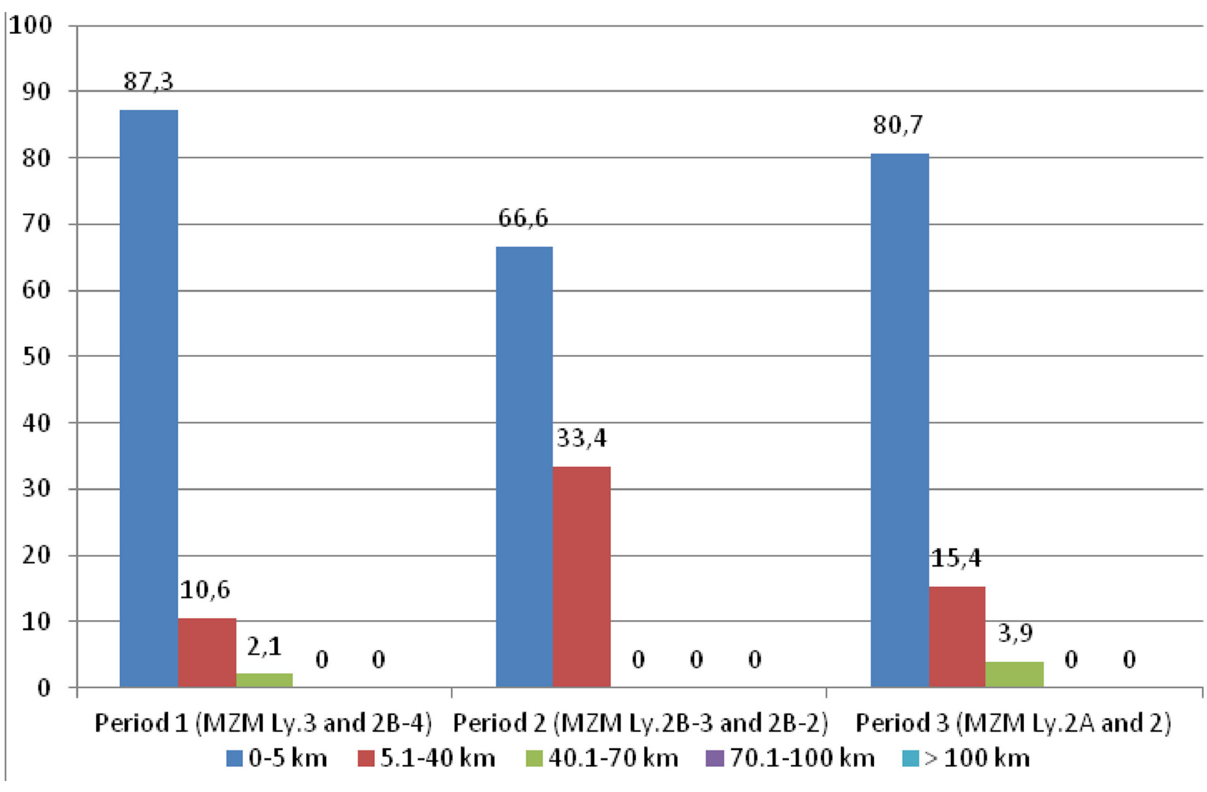


Figure 20. Tools from flint sources from different distances in the MP collections of Mezmaiskaya Cave in different periods (layers). Calculated from the percentage of tools from defined flint sources.

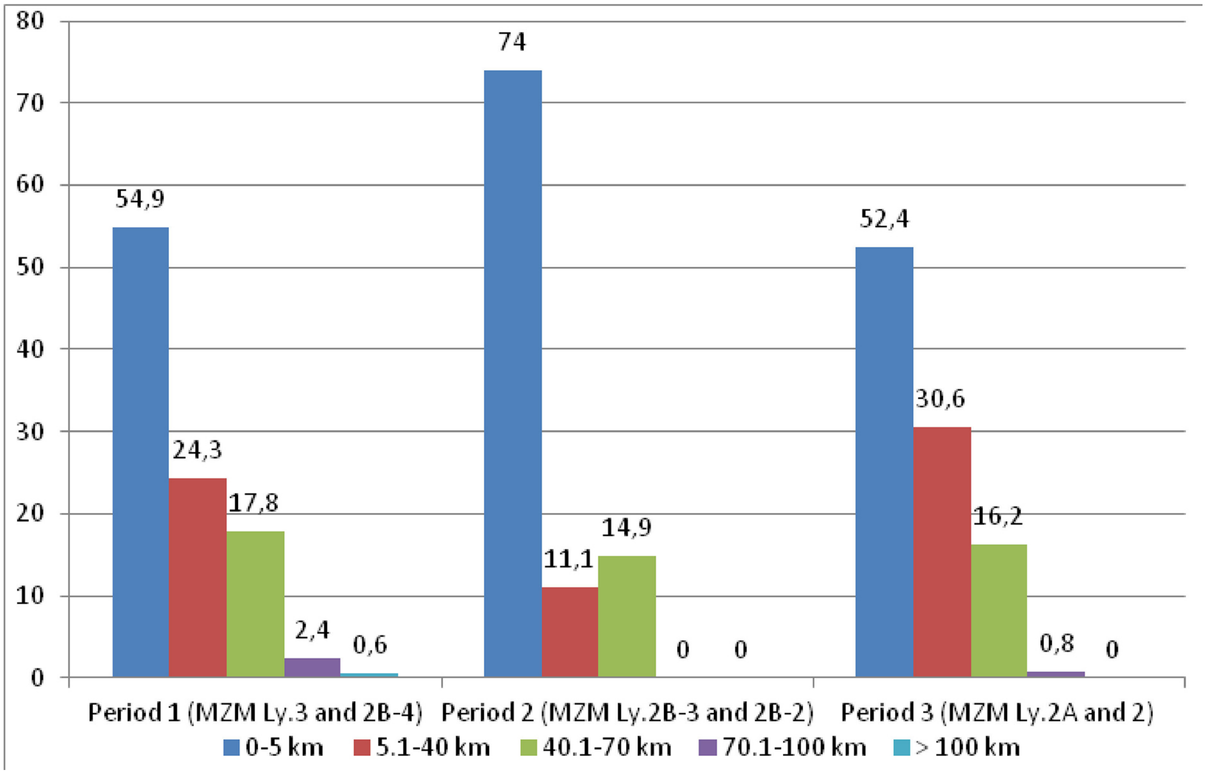


Figure 21. Cores from flint sources from different distances in the MP collections of Mezmaiskaya Cave in different periods (layers). Calculated from the percentage of cores from defined flint sources.

terms of everyday procurement of local resources (within Zone 1) around a residential camp and the procurement of non-local resources (within Zone 2) in the course of circular mobility during the annual round. However, the clear and abundant evidence of a long-distance transport of non-local flints from some remote outcrops and the existence of specialized workshops on these raw material sources (Hadjoh-2 and probably Besleneevskaya 1) allow us to assume the existence of an extensive Neanderthal network for regular raw material procurement within the Northwestern Caucasus region, which likely involved radial movements of small groups to collect and knap high-quality flints to produce flakes and fabricate tools directly on the sources.

It was found that the Eastern Micoquian Neanderthals transported artifacts from non-local flints mainly in the form of finished tools and flakes, although cores from non-local flints are individual finds in all LMP assemblages. The transport of artifacts procured from remote raw material sources in the form of ready-to-use tools or flakes appears to represent *the* important feature of Neanderthal behavior related to the raw material procurement. This pattern is opposite to those identified among the Upper Paleolithic humans who transported non-local flints or obsidians mostly as prepared cores and pre-cores, as we discuss elsewhere (see Doronicheva et al. 2013).

The study of obsidian artifacts from the LMP levels at Mezmaiskaya Cave (Doronicheva and Shackley 2014) indicates that the obsidians were transported from sources located about 200–250km from the site in the North-central Caucasus. Also, we identified in the LMP levels at Mezmaiskaya a few artifacts made on flint derived from sources located about 300km from the site, on the north-eastern coast of the Sea of Azov. These data suggest some contact with the Northwestern Caucasus Eastern Micoquian Neanderthals, and with another Eastern Micoquian Neanderthal group known from the Rojok and Nosovo sites on the north-eastern coast of the Sea of Azov, as well as with the North-central Caucasus, in which Eastern Micoquian sites are currently unknown.

Our raw material study provides significant data for inferences of intra-regional movements and interregional contacts of Neanderthal groups, which at times are not constrained within specific Mousterian cultural entities identified in the Caucasus and adjacent territories. The data on rare exotic rocks brought from very distant outcrops located more than 100km and up to 200–300km from the site (Zone 3) that involves a walking distance at least to about 300–400km, suggests sporadic contacts with other Neanderthal groups or random visits to adjacent regions. The presence of exotic rocks in the Northwestern Caucasus Micoquian is exceptionally rare making it difficult to posit any network established by Neanderthal groups for raw material/artifact exchange, but the data are sufficient to indicate extensive long-range Neanderthal mobility within a huge area from the northeastern coast of the Sea of Azov in the north to the western Greater Caucasus in the south, and from the Black Sea coast in the west to the central Greater Caucasus in the east.

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