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PALEOENVIRONMENT. THE STONE AGE

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KALAVAN-2 (NORTH OF LAKE SEVAN, ARMENIA): A NEW LATE MIDDLE PALEOLITHIC SITE IN THE LESSER CAUCASUS

During a survey conducted in 2005, the open-air site of Kalavan-2 was discovered located at an altitude of about 1600 m in the mountains dominating the northern bank of Lake Sevan (Armenia). The site yielded a Paleolithic industry associated with faunal remains, indicating that this is an important locality in the study of Armenian prehistory. Excavations at Kalavan-2 have revealed a stratigraphic sequence with several phases of occupation attributed to the Middle Paleolithic period. A radiocarbon date of a fragment of dental enamel from a large bovid provided an age of 34,200 ± 360 BP for the Mousterian level 7, confirming the attribution of this deposit to the final phase of the Middle Paleolithic and the importance of this site for the study of the last presence of Neanderthals in the Southern Caucasus.

Keywords: *Mousterian, Late Middle Paleolithic, Lesser Caucasus, Armenia.*

Introduction

The geographic distribution of prehistoric human populations throughout the territory of Armenia, which occupies the southernmost part of the isthmus of the Caucasus (Fig. 1), is strongly tied to its geographic position and to climatic conditions which fluctuated throughout the Quaternary. The isthmus is crossed by the Greater Caucasus range, which constitutes a climatic and cultural barrier between the plains to the north (European

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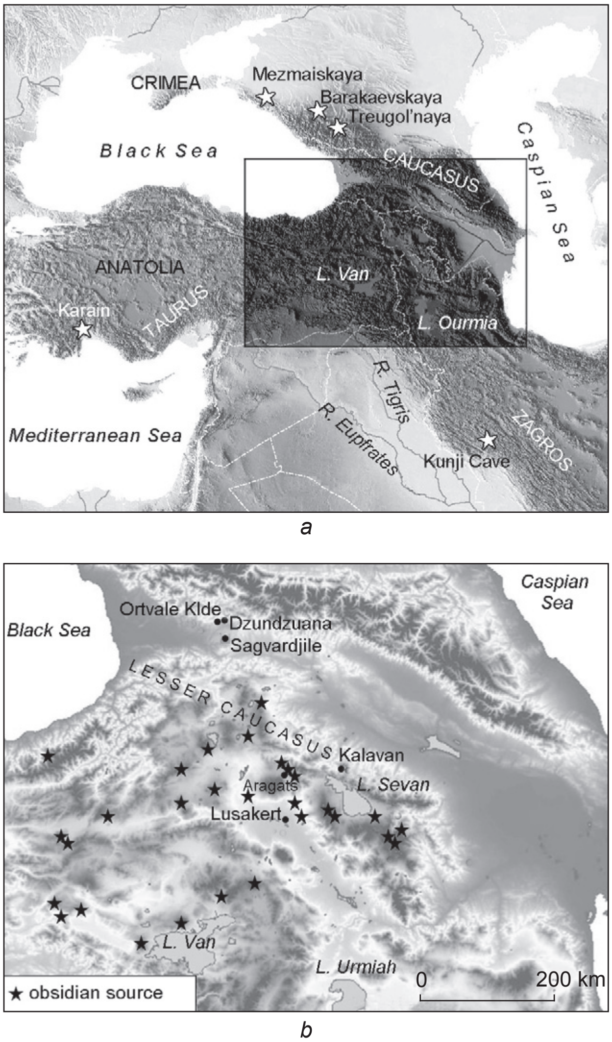


Fig. 1. Geographic location of Kalavan-2 (*a*) and the main sources of obsidian in the Lesser Caucasus (*b*).

continent), and the highlands to the south (Transcaucasia) that open towards the Near East.

The Armenian territory is formed by the mountains of the Lesser Caucasus and by high volcanic plateaus cut by river valleys and lake basins, forming ecological niches amenable to human occupation. However, this territory has an average altitude of 1700–1800 m, and the changing climatic conditions of the Interpleniglacial would very likely have been conducive to alternating phases of occupation and abandonment.

A recent archaeological survey carried out in northwest Armenia, in the forested northern slopes of the Areguni Mountains (Barepat River valley), dominating the northern bank of Lake Sevan brought to light the open-air site Kalavan-2. The preliminary results of the first excavation seasons (2006 and 2007), which have revealed a sequence of deposits belonging to the final phase of the Middle Paleolithic (Colonge et al., 2006, 2007), are presented here.

Description of the site

The Kalavan-2 site is located at 1630 m asl, on the left bank of the Barepat River, one of the main hydrological systems that drains the Areguni Mountains. This third–fourth order river mainly follows the NW–SE fault that defines the border between volcanic and sedimentary geological units of the Mesozoic era (sandstones, porphyrites, andesites, conglomerates, tuff breccias, etc.). At least five Pleistocene terrace levels, fitted and tiered, can be distinguished in this area, evidencing the Quaternary landscape changes caused by climatic and/or geodynamic factors in northern Armenia. Kalavan-2 is situated on the third alluvial terrace, corresponding to the upper Pleistocene level, at the confluence of the Barepat River and a small second order tributary. This terrace today is evolving in a perched hydrographic system 30 m above the main river. This evolution is caused by recent tectonic activity, lateral slope contributions, mass movements and block's rotational lurching that are derived from the east bank's escarpments, which have at times been relatively destabilized.

The main excavation area (trench 2) is situated on the longitudinal axis of the spur, near its northern extremity, where the rocky substratum shows through due to regressive erosion (Fig. 2). This sector was occupied in the Late Bronze Age and in the Iron Age, as indicated by the presence of a cemetery, of which several tombs have been robbed by clandestine excavations. The flat surface of this sector is actually sliding slowly to the northeast as a result of mass movement.

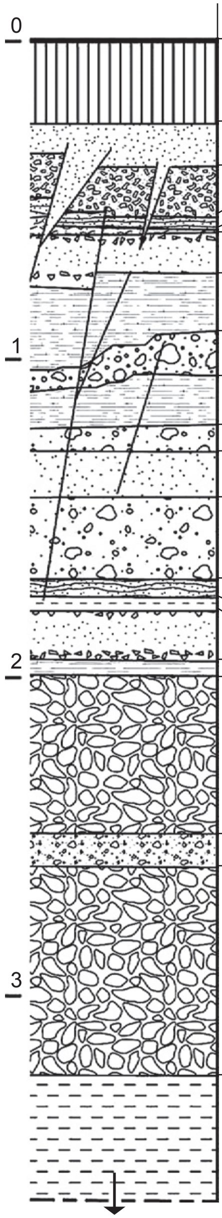
In order to better understand the stratigraphic sequence of the deposit and the spatial organization of each of the layers, the surface area of trench 2 was enlarged to 7 m^2. The whole area was excavated to a depth of 99–115 cm (layer 11) and a deep trench was dug in square L22 to a depth of 380 cm (layer 20). At the same time, two other trenches were made on both sides of the shoulder, on the edge of the slope: trench 1 in the east and trench 3 in the west. Chronostratigraphic correlations between the different trenches will be determined during the next campaign in the light of additional dating and future lithic studies.

Kalavan-2 has actually yielded 20 principal stratigraphic layers, which represent particular sedimentary units (Fig. 3) with both related paleoclimatic and morphogenic information (Colonge, Nahapetyan, Monchot, 2007; Ollivier, Nahapetyan, 2008). The entire stratigraphic sequence shows evidence of depositional dynamics fluctuating between alluvial, erosive torrential, colluvial, and immature pedogenetic processes. According to the various features observed (gravel and pebbles belonging to a hydrologic system of the reduced rank) and the geometry of the numerous layers (notably dip orientation), the alluvial and torrential component seems to belong to the right tributary of the Barepat River.

Fig. 2. Topographic map of the spur of Kalavan-2 (after Government Office Cadastral Register).

Layers 19 to 16 form the main body of the alluvial terrace, with an alternation of various sedimentary dynamics relating to hydrodynamic components (pebbles, sands, and silts) while layers 15 to 11 correspond to a short alluvial-nival sequence with sub-angular gravel and sandy-silty lenses that could correspond to cyclic seasonal deposits (repetitive feature alternation) in a cool humid climate. Next, a sedimentary process with mixed colluvial/diffuse streaming accumulation occurs (layers 10 to 6) under what were probably, relatively short-term, temperate conditions with poor pedogenetic development. Alteration processes (corrosion of the gravel) and secondary diagenetic expressions (carbonatizations) underline the maturity of the post-depositional sedimentary evolution and the relative impact of pedogenic processes previously described in these layers. From layer 5 to 3, numerous small detrital discharges (sub-angular to sub-blunted gravels and stones) occur in erosive contact as a result of major dynamic changes that began with torrential (slope erosion) followed by alluvial characteristics. These components are possibly due to unstable climate conditions (variability of rainfall intensity, regime or distribution?). Layer 2 that represents the end of the well-preserved upper Pleistocene unit, corresponds to a silty-sandy deposit (with very small and diffuse sub-blunted gravel) underlying the last recurrence of a low-energy alluvial phase in small meandering crossed channels eroding the subjacent layers in a cool-humid environment and relative morphogenic stability (without significant slope erosion). The last layer corresponds to a humus-bearing horizon related to recent to present-day edaphic conditions with soil development based on alteration of layer 2 deposits.

The upper part of the sequence (layers 2 to 13), which reaches the maximum thickness of 1.80 m, is affected by fissures and frost-wedges caused by freezing during cold climate conditions and which present the secondary carbonatization related to water circulation across various sedimentary textures. Some of these cracks have literally cut (in normal or inverse faults) layers 2 to 7 into compartments, which have been displaced vertically several centimeters to a decimeter by mass movement, creating real steps which dip to the north-east. In section, these fissures developed obliquely in layers 2 to 7 and sub-vertically in layers 8 to 13. In the light of the preliminary sedimentary analysis of the entire sequence, these features clearly show by the presence of lenses of segregated ice



Level	Nature	Fauna	Lithic artifacts	Other	Date
1	Soil with plant remains: dark-brown (almost black) clayey silt with a polyhedral structure	Domestic	Various	Pottery, human bones	Contemporary (Protohistory)
2	Light-yellow silty sand, highly leached	Large bovid unidentified fragments	Holocene indeterminate	Same	Holocene
3	Angular stones in a gray-brown sandy matrix	Unidentified fragments	Disturbed	»	–
4	Bedded black sands	–	–	–	–
5	Brown-gray silty-clayey "paleosoil"	–	–	–	–
6	Brown-ochre silty sand with medium dense angular stones	Unidentified fragments, horse (*Equus caballus*?), aurochs (cf. *Bos primigenius*), Caprini, red deer (*Cervus elaphus*?)	Mousterian (Zagros type)	–	16,740 ± 130 – 20,020 ± ± 100 BP (uncal.)
7	Brown-red clayey-silty sediment with small sandy lenses			Reddening, charcoal	27,000 ± 400 BP 34,200 ± ± 360 BP (uncal.)
8	Heterometric diamicton in a brown sandy-silty matrix	–	–	–	–
9	Brown-gray clayey-silty sediment with rare alluvial gravels	Aurochs (cf. *Bos primigenius*), Caprini, red deer (*Cervus elaphus*?)	Mousterian	–	–
10	Sub-angular stones in a sandy matrix	–	–	–	–
11	Light-brown fine silty sand	Aurochs (cf. *Bos primigenius*), Caprini, red deer (*Cervus elaphus*?)	Mousterian	Reddening, charcoal	–
12	Sub-angular stones in a sandy matrix	–	–	–	–
13	Gray-green alluvial sand with rare angular gravels	–	–	–	–
14	Beige sandy clay	–	–	–	–
15	Small angular stones in a sandy-silty matrix	–	–	–	–
16	Dark-gray sandy-silty clay, organics	–	–	–	–
17	Alluvial gravel in a sandy matrix, pebbles of 15 cm maximum	–	–	–	–
18	Sand with small pebbles and small angular gravels	–	–	–	–
19	Alluvial gravel in a sandy matrix, with pebbles of 5 to 6 cm maximum and sub-angular gravel lenses	Large bovid	Mousterian	Reddening, charcoal	42,040 ± 400 BP (uncal.)
20	Slightly silty clay with little angular gravels (2–3 cm), dark gray-brown mixed with beige	Unidentified fragments	»	Charcoal	–

Fig. 3. Stratigraphic section of trench 2. Drawing by S. Nahapetyan and D. Colonge.

that the frost-wave reached level 17 indicating very cold climatic conditions favorable to the persistence of a local or more global permafrost area during this period. This needs to be precisely dated in the future. By contrast, mass movement processes were caused by the return of humid temperate climate conditions and probably by the subsiding of the base level of the Barepat River during a major incision phase that created the banks of the river and slope destabilization (during Last Pleniglacial to Postglacial or other interstadial transitions?).

Eight archaeological layers were found which have produced variable quantities of archaeological remains. These comprised about 3/4 lithics and 1/4 fauna – relative volumetric quantities. The archaeological material from the living plant horizon (layer 1) was not counted, as it contained colluvial elements from higher up the slope, as well as artifacts from nearby Iron Age tombs.

However, despite these numerous and complex morpho-sedimentary expressions, the stratigraphic integrity is well preserved, making it possible to correlate archaeological and paleontological layers. Shifts of sedimentary units are minor (within a few centimeters to a decimeter at most).

The Late Middle Paleolithic in Armenia

Before examining the lithic industry of Kalavan-2, it is important to briefly summarize the present data concerning the Late Middle Paleolithic in Armenia (Gasparyan, 2007).

Few sites of the Middle Paleolithic age have been found in Armenia, although research into this period began in the early 20th century, undertaken by Jacques de Morgan, who collected numerous artifacts on the obsidian deposits lining the plain of Ararat (de Morgan, 1927; Liubin, 1984). To date, the sites that have been excavated are the caves of Yerevan-1 and Lusakert-1 and 2 located in the valley of the Hrazdan, a tributary of the Araxes River. These sites were studied in 1967–1975 (Yeritsyan, 1970, 1975). Hovk Cave overlooking the valley of Debed in northern Armenia has been subject to excavation since 2005 (Pinhasi et al., 2006). Other open-air sites attributable to the Middle Paleolithic have been recently discovered during surveys in the southeast of the country, at Angeghakot in the Zangezour Mountains (Liagre et al., 2006), as well as in the Aparan basin, northeast of the massif of Aragats (Jaubert, 2003; Colonge, Gasparyan, Nahapetyan, 2004, 2005). However, none of these open-air sites contained *in situ* stratigraphic sequences and thus their attribution to the Middle Paleolithic is solely based on the techno-typological assessment of the lithics that were recovered.

Yerevan-1 Cave contained seven cultural horizons with a total depth of approximately 3 m, but the lithic industry (95 % obsidian) evolves little within this deposit. This industry is characterized by the predominance of unidirectional primary flaking, by a large percentage of retouched tools including different types of side-scrapers and points, and by the use of truncating-faceting techniques for tool fashioning (Yeritsyan, 1970; Beliaeva, Lioubine, 1998). A radiocarbon date places the median horizon (layer 4) around 49,000 BP (Cohen, Stepanchuk, 1999). The lithic assemblage of Yerevan-1 is similar to that found in the very eroded shelter in the region of Angeghakot in southeastern Armenia (Liagre et al., 2006), as well as in the caves of Taglar and Zar in Azerbaijan (Djafarov, 1983; Mansurov, 1990). All these industries closely resemble the Zagros-Taurus Mousterian (Golovanova, Doronichev, 2003; Fourloubey et al., 2003; Adler, Tushabramishvili, 2004; Bar-Yosef, Belfer-Cohen, Adler, 2006).

In the caves of Lusakert-1 and 2, situated in the valley of Hrazdan, near the obsidian deposits of Gutansar, the lithic industry was almost exclusively in obsidian. At Lusakert-1, the excavations by B. Yeritsyan in 1970–1975 (Yeritsyan, 1975), followed by the sounding made by C. Fourloubey in 1999 (Fourloubey, 1999) on a preserved part of the terrace (Fourloubey et al., 2003), clearly showed six archaeological levels, without reaching bedrock. This sequence testifies to an alternation of facies: a recurrent unidirectional Levallois technique, with elongated and relatively thin products (layers F–H = level 6); a rather similar facies, but with numerous denticulates probably of taphonomic origin (modification of the edges by shocks within the sediment) (layers D and C2 = levels 5–4); again a laminar faceted Mousterian with numerous points (layer C1 = level 3); then a return to a denticulate Mousterian – of taphonomic origin – (layer B = level 2) (Ibid.). However, the main characteristics, invariably found from the bottom to the top of the stratigraphic profile at Lusakert-1, are the predominance of a recurrent unidirectional convergent Levallois reduction and the presence of the truncating-faceting technique, features that are characteristic of the Zagros-Taurus Mousterian (Fourloubey, 1999).

An equid tooth from level 4 (layer C2) at Lusakert-1 was dated by AMS to 26,920 ± 220 BP (GRA 14949/Ly1006) (Fourloubey et al., 2003). The potential errors caused by diagenesis and contamination by relatively younger intrusions must be kept in mind.

At Lusakert-2, the sounding, undertaken in 1999 by D. Colonge, partly confirms the results of excavations by B. Yeritsyan in bringing to light three levels (bedrock not reached). These yielded a Levallois lithic assemblage, with an overwhelmingly recurrent unidirectional core reduction. Side-scrapers, Mousterian points, and "Yerevan points" (retouched triangular points with truncated-faceted bases) dominate the tool kit. This assemblage is characteristic of the Zagros-Taurus Mousterian (Ibid.).

In the contiguous nearby region of western Georgia, the Middle Paleolithic is characterized by a large variety of facies. Tushabramishvili (1984), Liubin (1989), and Nioradze (1990) defined five local cultural variants representing different Middle Paleolithic cultural groups that occupied the region simultaneously (Adler, Tushabramishvili, 2004). The grouping is based largely on technological and typological considerations. However, Adler and Tushabramishvili (2004) have shown that this variability is more likely due to diachronic change, modification in environmental conditions or resource availability, and diffusion of people or technologies rather than closely-spaced hunter-gatherer groups maintaining coherent and distinct cultural and technological traditions. Among the chronological variants, the earliest (Djruchula-Kudaro) can be linked to the early Levantine Mousterian (Adler, Tushabramishvili, 2004; Bar-Yosef, Kuhn, 1999; Meignen, 2000; Meignen, Tushabramishvili, 2006) and the latest (Ortvale Klde, Sakajia, Sagvardjile layer V, etc.) to the Zagros-Taurus Mousterian (Adler, Tushabramishvili, 2004; Adler et al., 2006).

In the Southern Caucasus, the change from these last sites of the Late Middle Paleolithic to those of the Early Upper Paleolithic is very controversial. According to one theory, in several sites located on the southern slope of the Greater Caucasus (Sakajia, Ortvala Klde – according to the early 1970s excavations – Sagvardjile layer V, etc.), the Upper Mousterian layers include many Upper Paleolithic tools and might be "transitional" to the Upper Paleolithic (Tushabramishvili, 1994; Nioradze, Otte, 2000; Golovanova, Doronichev, 2003). These Middle to Upper Paleolithic transitional industries may have existed even after the Denekamp Interstadial, that is after 28 ka BP, and the Caucasus may have seen a very late survival of Middle Paleolithic traditions and their long coexistence with the Upper Paleolithic.

The second theory is based on the re-excavations of Ortvale Klde* (Adler, Tushabramishvili, 2004; Bar-Yosef, Belfer-Cohen, Adler, 2006), which did not find any evidence for an *in situ* cultural transition between the terminal Middle Paleolithic and the earliest Upper Paleolithic, but on the contrary showed a distinct archaeological, stratigraphic, occupational, and temporal break between the late Middle Paleolithic (layer 5) and the early Upper Paleolithic (layer 4). The last Middle Paleolithic occupation (layer 5) is followed by a hiatus of undetermined length. The reoccupation of the site by Upper Paleolithic human groups (layer 4) would be linked to the onset of the Denekamp Interstadial.

Kalavan-2 lithic assemblage

Lithic artifacts are generally well preserved (preservation depends upon deposition depth and/or the raw material), and can be easily identified in most cases (Table 1). However, it is important to point out the presence of numerous carbonate incrustations in the upper part of the sequence (layers 1 to 13). These carbonatizations are related with water infiltration facilitated by the porosity of the sediments, the fissures and the frost-wedges associated with the periglacial conditions mentioned above.

The diversity of the lithic raw material found at Kalavan-2 evidences the geological complexity of this region of the Lesser Caucasus at the juncture of two complexes, volcanic and sedimentary. Thus, three different groups of raw material are found at the site. The first two groups represent local raw materials: sedimentary rocks (34 % of the artifacts, silicified limestone, chert, flint or jasper) of various colors, which are present in the alluvium of the rivers bordering the site, and volcanic rocks (basalt), that are much more rare (2 %), coming from ancient eruptive formations of the mountain chain which separates Lake Sevan from the basin of the Getik, into which the Barepat River flows.

The third and the largest group (64 %) consists of obsidian, volcanic glasses usually black in color, sometimes brown, red or transparent. These are exogenous to the Barepat basin. The closest sources of obsidian are located to the west and south of Lake Sevan, about 80 to 90 km as the crow flies (Badalyan, Chataigner, Kohl, 2004). As the Armenian territory is mountainous, straight distances are misleading. Therefore, the attempt has been made to explore the possibilities of GIS (Geographic Information System) so as to take the relief into account and evaluate the importance of this factor in the procurement of obsidian (Barge, Chataigner, 2004).

The spatial analysis functions of ESRI's ArcGIS ("cost-weighted distance" and "least-cost path" analyses) have enabled us to calculate the travel time between points on the actual landscape and determine the routes requiring minimal effort and time. The study showed that about 24 to 28 hours (three or four days' trip) were necessary to travel from Kalavan-2 to the closest sources of obsidian (Chataigner, Barge, 2008).

The industry from layers 9–11. The rare lithic artifacts from the lower levels suggest the presence of the Mousterian. Layer 11 produced a laminar flake and three flake fragments, including a convex side-scraper on a proximal fragment of thick flake (Fig. 4, *17*). Layer 9 (8 specimens) produced a laminar flake which is the only element comparable to the products of layer 7, made with a recurrent convergent unipolar Levallois method.

The industry of layer 7. This is the richest layer in the Kalavan-2 sequence. It contains 214 artifacts including 130 specimens made of obsidian. It is interesting to note the high proportion of small pieces (61.7 % are less than 20 mm in length) which are mainly obsidian, unlike the pieces in local flint, mauve or green, which are mostly longer than 20 mm. Such a degree of exhaustion

*__Adler D.S.__ Late Middle Paleolithic Patterns of Lithic Reduction, Mobility, and Land Use in the Southern Caucasus. Unpublished Ph.D. Thesis, 2002, Harvard University.

Table 1. **Number of finds (by piece/fragment) according to archaeological layer**

Layer	Lithics			Faunal remains	Total
	Sedimentary rocks	Volcanic rocks	Obsidian		
2	5	2	22	2	31
3	1	0	3	2	6
6	7	1	33	2	43
6/7	0	0	18	1	19
7	81	3	120	105	309
9	6	0	2	4	12
11	4	0	0	7	11
19	0	0	0	1	1
20	0	0	0	1	1
Total	104	6	198	125	433

among the obsidian finds could illustrate their greatly extended use-lives (Adler, Tushabramishvili, 2004). The production of the largest elements was carried out using a Levallois method which is exclusively recurrent, converging and unipolar. The main products are laminar flakes (5 complete and 5 fragments); less numerous are Levallois points (3 specimens) and oval pieces (2 specimens) which are clearly laminar elements or points aborted by a shift in the shock wave due to poor convexity on the flaking surface.

The tendencies which emerge from the layer 7 sample (Fig. 4, *10–16*) are exclusivity of the recurrent convergent unipolar Levallois method in the production process and the fact that half the tool kit is composed of side-scrapers and retouched Levallois points, clearly denoting the type of Mousterian which has already been found in Armenia, in particular in the lower layers (F–H) at Lusakert-1. However layer 7 at Kalavan-2 seems devoid of Yerevan points.

The industry of layer 6. Forty-one artifacts (including 33 pieces of obsidian) from this layer provide evidence for three methods of production. There is production of middle-sized flakes (30 to 50 mm), produced by the discoid method to obtain products mainly having convergent cutting edges, sometimes opposed to the backs but often with thick heels; some of these products are typical pseudo-Levallois points. A very rare lamellar reduction is

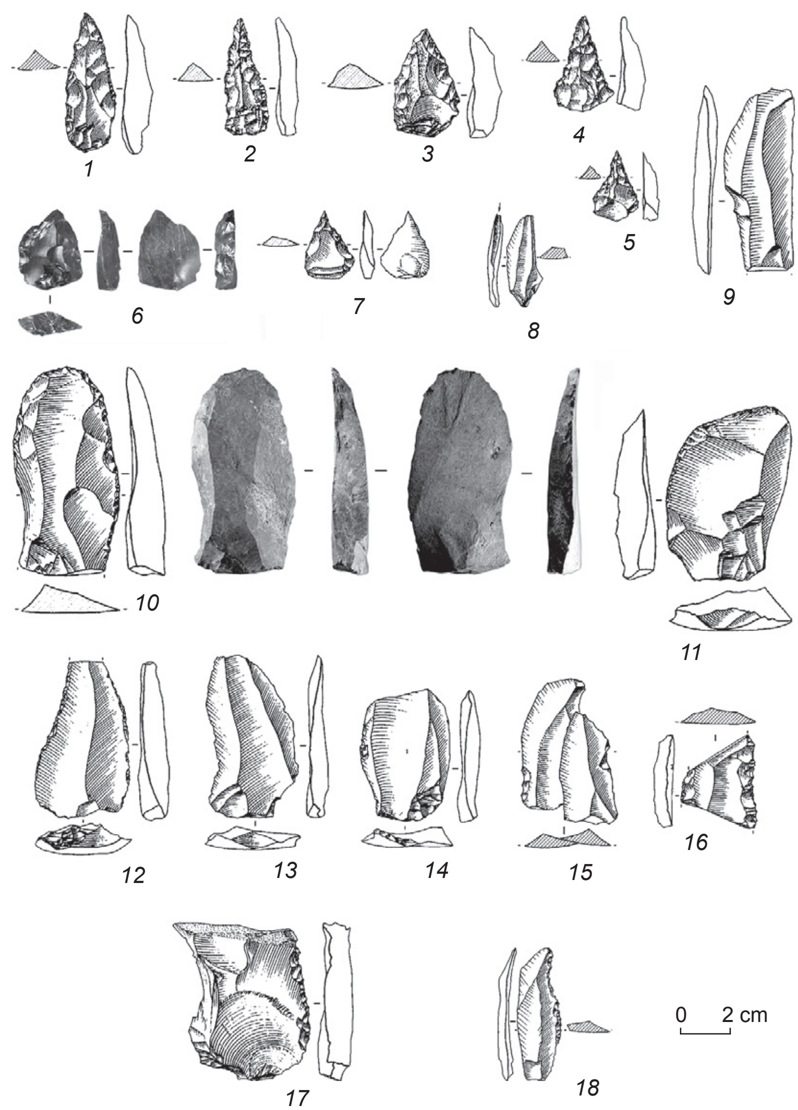


Fig. 4. Lithic artifacts from layers 6 (*1–9*), 7 (*10–16*) and 11 (*17*, *18*) of trench 2. Drawing by G. Devilder.

represented by a complete object and a fragment, while laminar flakes were obtained by a convergent unipolar method of Levallois type, very similar to those recorded in layer 7 below (their badly preserved surfaces suggest secondary deposition). The tools are exclusively retouched and number only 12 pieces: four retouched points of obsidian of standard size (27 to 37 mm long, 17 to 23 mm wide, 6 to 9 mm thick), a flint point slightly larger than the latter (55 × 19 × 10 mm), two end-scrapers and an atypical burin, a scraper with abrupt peripheral retouch, a *pièce esquillée*, and two indeterminate pieces (Fig. 4, *1–9*).

The predominance of the technology involving unidirectional preparation of the cores, a moderately laminar flaking, a high frequency of convergent pieces (retouched points, convergent side-scrapers), and the presence of truncated-faceted pieces are characteristic of the Mousterian of the Zagros-Taurus. This Mousterian assemblage group extends from western Iran (Kunji Cave, Warwasi) (Dibble, Holdaway, 1990, 1993; Baumler, Speth, 1993) to Central Anatolia (Karain Complex I) (Otte et al., 1995) where it is dated to OIS-3 (60,000–25,000 BP).

As stressed by D.S. Adler*, Late Middle Paleolithic hominins occupying the Southern Caucasus were members of a large prehistoric social and mating network demarcated by the Caucasus Mountains to the north and by the Zagros and Taurus Mountains to the south.

Faunal remains

At the entire excavated area of Kalavan-2, only 129 bones were found with a low rate of identification to species and/or skeletal element (14 %). Most of the elements belong to Mousterian layer 7 (Table 2). The bones are very poorly preserved, for the most part with a whitish porous (chalky) aspect. The outer surface is usually missing, often rendering determination impossible and fragments of spongy bone are rare. All the fauna remains have suffered strong weathering, including the teeth, which are highly altered and split where the enamel has been unable to withstand various cycles of freezing and thawing (Todisco, Monchot, 2008).

Aurochs cf. *Bos primigenius*. During the first mission in 2006, in layer 7, a maxillary fragment was recovered with two right molars (M^2 and M^3) belonging to a young adult large bovid (Fig. 5, *1–5*). In 2007, in the same layer a remarkable piece was found, unfortunately in very poor condition: an almost complete back part, occipital and parietals of a skull, and the right and left horn cores. The anterior part that was preserved was crushed by the weight of the sediments, scattered maxillary fragments, upper teeth (M^1 right, P^4 right, M^2 left, M^3 left), and many different fragments such as the *pars petrosa* of the temporal bone were discovered nearby. The skull appeared to be lying on its anterior face. The very poor state of preservation did not allow reliable measurement. The destruction of the enamel, associated with its very fragmentary state, did not permit measurements of the teeth. The structure and form of the horn core is however, more reminiscent of aurochs than of bison. There are very few identifiable post-cranial remains, these being limited to fragments of the diaphysis of the long bones (humerus, tibia, and metacarpal), which were attributed to this large bovid based on the thickness of the cortical bone.

Various morphometric criteria have been described in the literature to separate *Bos* from *Bison* (Slott-Moller, 1990; McCuaig Balkwill, Cumbaa, 1992; Brugal, 1984, 1993), but most of them can only be used on samples, which are large enough. However, it can be noted that the upper molars of the Kalavan-2 specimen contain a large amount of cementum, which covers a thick column between the lobes, suggesting *Bos* (Fig. 5, *1*). The entostyle in *Bison* is shorter and is hidden between the lobes towards the neck of the tooth. The left upper M^1 clearly presents a central island, which is more frequent in *Bos*. All these criteria are suggestive of aurochs rather than bison. However, because of the great difficulty in making a reliable generic attribution, identification has been limited to cf. *Bos primigenius*.

The bone remains of representatives of the *Bison* genus are rare at sites in the Crimea, but dominate in the Northern Caucasus (Baryshnikov, 1999). Bison is also present in the Southern Caucasus, in western Georgia, in contexts dating to the end of the Middle Paleolithic and beginning of the Upper Paleolithic (e.g., Ortvale Klde, Dzudzuana) (Adler et al., 2006; Bar-Oz et al., 2008). The aurochs, which is an animal of open spaces, is also recorded at Paleolithic sites in western Georgia. It is mentioned as a certainty in the Epipaleolithic level of Dzudzuana (layer B, ca 13,000–11,000 BP) (Bar-Oz et al., 2008) and in the Middle Paleolithic levels of Ortvale Klde (Adler, Tushabramishvili, 2004; Bar-Oz, Adler, 2005).

Wild goat/ibex *Capra* sp. A few remains belonging to wild goat were found in layer 7 at Kalavan-2. We were able to identify a proximal extremity of a second phalange (L = 22.6; B = 26.5) and a distal extremity of a first phalange (L = 21; B = 17.6). These two elements were found in anatomical connection and exhibit morphology and biometry similar to the genus *Capra* (Boessneck, Muller, Teichert, 1964; Prummel, Frisch, 1986; Clutton-Brock et al., 1990; Fernandez, 2001). The third element is a complete sesamoid. In the absence of horn cores, it is impossible to define the *Capra* species at Kalavan-2.

Wild goats live in rocky, open spaces and are resistant to rigorous climatic conditions. Caprinae (*Ovis* and *Ovis/Capra*) were hunted at the nearby Late Upper Paleolithic site of Kalavan-1 (Liagre, Balasescu, 2007).

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*__Adler D.S.__ Late Middle Paleolithic Patterns of Lithic Reduction, Mobility, and Land Use in the Southern Caucasus. Unpublished Ph.D. Thesis, 2002, Harvard University.

Table 2. **List of species present at Kalavan-2***

Species	Layer	Bones	
		Number	%
Large bovid (cf. *Bos primigenius*)	7	12	9.3
Horse (*Equus caballus*)	6/7	1	0.8
Wild goat/ibex (*Capra* sp.)	7	3	2.3
Red deer (*Cervus elaphus*)	7	2	1.6
Fragments of large-size mammals (*Bos.* sp.)	–	37	28.7
Fragments of medium-size mammals (*Capra/Cervus*)	–	31	24
Fragments of mammals of indeterminate size	–	39	30.2
Microfauna (intrusive animals)	–	4	3.1
Total		129	100

*The size of splinters is estimated by cortical bone thickness.

In the neighboring region of western Georgia, at Ortvale Klde, *Capra caucasica* was hunted intensively and constitute more than 90 % of the faunal remains in both final Middle Paleolithic and Upper Paleolithic deposits (Adler et al., 2006). The morphometry and biochronology of this species have been described in the sequence of Kozarnika in northern Bulgaria, starting from the Middle Pleistocene (Fernandez, Crégut-Bonnoure, 2007).

Horse *Equus caballus.* Only one lower molar (M_1/M_2) (Fig. 5, *6–8*) found in the contact zone between layers 6 and 7 provides evidence of equids at the site. Although it is impossible to determine the position of the tooth with certainty (probably M_2, because of the developed mesial part of the hypoconulid and the strong incurvation of the crown), its morphology indicates attribution to *Equus caballus*. Its dimensions are the following (in mm): occlusal length, 26.3; occlusal width, 16.2; height, 52; postflexid length, 10.3; double-knot length, 14 (after (Eisenmann, 1981)). The wild horse, which is synonymous with open environments, is never fully represented in Paleolithic faunal lists of the Caucasus; it is mentioned at Taglar and Dashsalakhli in Azerbaijan, Yerevan-1 and Lusakert-1 in Armenia (Liubin, 1989), at Dzudzuana in Georgia (Bar-Oz et al., 2008), at Ilskaya-1, Ilskaya-2, and Barakaevskaya in the Northern Caucasus (Baryshnikov, Hoffecker, 1994; Doronichev, 2000), but is absent at Ortvale Klde in Georgia (Bar-Oz, Adler, 2005).

Red deer *Cervus elaphus*. The presence of red deer is proven by a fragment of the medio/lateral diaphysis of a metacarpal and a fragment of the dorsal diaphysis of a metatarsal found in layer 7. These fragments exhibit the characteristics of a cervid, while the thickness of the cortical bone excludes the possibility of roe-deer, which is much more slender. The red deer is a common animal in the faunal lists of the Middle and Upper Paleolithic of the Caucasus and the Near and Middle East. It inhabits open wooded zones and is resistant to cold conditions.

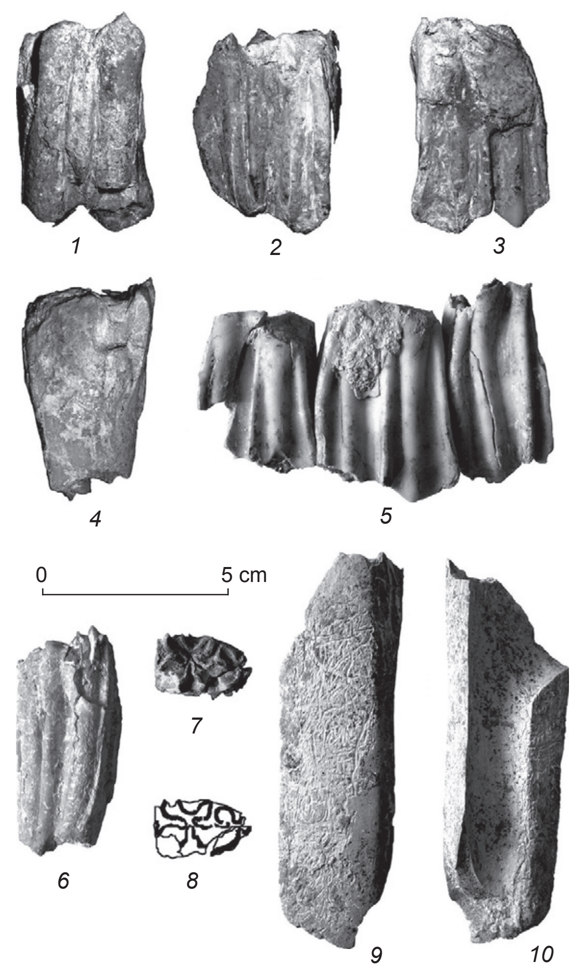

Fig. 5. Faunal remains from trench 2.
1–5 – upper molars of a large bovid (*Bos sp.*) (*1* – lingual view, *3* – vestibular view, *4* – mesial view of the right upper M^2, *2* – right upper M^3, vestibular view; *5* – right upper M^1, M^2, M^3, vestibular view); *6–8* – lower molar of *Equus caballus* (*6* – lingual view; *7–8* – occlusal view); *9*, *10* – fragment of diaphysis of metacarpus of a large bovid (*9* – posterior view; *10* – anterior view). Photographs by H. Monchot and M. Coutureau.

Taphonomy

Several types of modification have been identified on the surface of the bones which attests to the site's complex taphonomic history. Above all, it should be noted that most bones have traces of root etching on their external surfaces (Fig. 5, *9*). These traces in the network form indicate that the bones remained in the active zone of vegetation for a long period before being buried (Mottershead et al., 2003). The anthropogenic origin of the material is also indicated by the presence of a typical cutmark made by a stone tool on a small fragment of bone (Monchot, Horwitz, 2007), and by seven bones (e.g., the caudal diaphysis of the tibia of a large bovid) which show traces of burning (Perinet, 1964; Stiner et al., 1995). Finally, some fragments of large bovid bones have edges of smooth fracture, in spiral form, indicating fragmentation by blows (Fig. 5, *10*), but these should be considered with caution due to their origins (Morlan, 1983).

It is important to note the poor representation of the so-called "short" bones (carpals, tarsals, malleolar bones, patella, and phalanges), and the quasi-absence of isolated teeth and articular extremities (generally *spongiosa*). The overabundance of tibia and humerus diaphyses is due to differential determination that enables easy recognition (Morlan, 1994). Differential preservation does not explain the lack of epiphyses (there is a very poor correlation between bone density and abundance at the site). As C. Badgley (1986) notes, the frequency of certain pieces is closely correlated to the sedimentary nature of the sites considered: delta environments contain a large quantity of vertebrae and phalanges, while channels and alluvial deposits in the plains mainly contain teeth.

Radiocarbon dating

Four samples from trench 2 were radiocarbon dated: two by the laboratory at Poznan (Poland) and two by the Center for Applied Isotope Studies of the University of Georgia (USA). The sequence of dates (Table 3) obtained raises a lot of questions. Sample UGAMS-2295 (layer 19) gives a date of 42,040 ± 400 BP (~43,500 ± 800 cal BC) which is at the limit of the method and thus should be taken as a minimum age. The age difference obtained between the two fragments of bovid teeth (NC 2006 and 2007; layer 7), probably deriving from the same animal and analyzed by the same laboratory, could be explained by contamination. Sample Poz-22181 can be omitted due to its young age and layer 7 can be dated to 34,200 ± 360 BP (~37,700 ± 880 cal BC). The ^{14}C dates for the horse tooth, at the meeting point between layers 6 and 7 indicate the last glacial maximum between 16 and 20 ka (OIS-2), but this seems particularly late and raises issues concerning contamination as well as stratigraphy. These dates appear too recent given the techno-typological characteristics of the lithic artifacts.

A critical evaluation of radiometric dating in late Middle and early Upper Paleolithic samples from the Georgian site of Ortvale Klde (Adler et al., 2008) indicates a long period of Neanderthal occupation in the area followed by their relatively rapid demise and replacement by anatomically modern humans ca 38–34 ka ^{14}C BP (40–37 ka cal BC). A detailed comparison with neighboring sites in the Southern and Northern Caucasus has revealed some discrepancy between AMS ages, the end of the late Middle Paleolithic at Mezmaiskaya Cave being estimated at about 32 ka ^{14}C BP (35 ka cal BC). The AMS dates from Kalavan-2 correspond well with this last result. However, other radiocarbon and ESR dates are required to increase confidence in the reliability of the data.

Conclusions and perspectives

The issues explored above give grounds to propose a new assessment of Kalavan-2 deposits, making it a prospective site for understanding the early population history of Armenia and the Lesser Caucasus in general.

Table 3. **Absolute dates**

Sample number	Layer	Specimen	Laboratory code	Uncalibrated BP	Calibrated BC*		Calibrated BP**	Calibrated BC**
					1 σ	2 σ	1 σ	1 σ
L20 No. 15	6/7	Equid tooth	UGAMS-2296	16,740 ± 130	18,168–17,859	18,315–17,598	19,971 ± 309	18,021 ± 309
			UGAMS-2296a (bioapatite)	20,020 ± 100	22,196–21,799	22,360–21,572	23,946 ± 324	21,996 ± 324
NC-2006	7	Bovid tooth	Poz-20366	34,200 ± 360	37,682–36,728	38,484–36,514	39,643 ± 886	37,693 ± 886
NC-2007	7 ?	Bovid tooth	Poz-22181	27,000 ± 400	29,621–29,136	30,330–28,892	31,657 ± 358	29,707 ± 358
L22 No. 82	19	Bovid long bone	UGAMS-2295	42,040 ± 400	43,776–43,108	44,132–42,794	45,442 ± 809	43,492 ± 809

*Calibrated using the IntCal 09 calibration curve and OxCal 4.1 program (Reimer et al., 2009).

**Calibrated using the CalPal2007_HULU calibration curve and CalPal program (Weninger, Jöris, 2008).

Layer 6 may be linked with the Zagros-Taurus Mousterian, with the predominance of the truncating-faceting technique.

Layer 7 represents the classic Mousterian of Armenia, with a Levallois reduction aimed at the production of Levallois laminar flakes and Levallois points. This industry is associated with fauna composed of aurochs, wild goat and red deer, and with ^{14}C dates falling in OIS-3 (34,200 ± 360 BP). The presence of some artifacts of Mousterian fabrication in the lower layers (9 and 11) seems promising. The conditions of deposition, which suggest horizons of flooding with fine lateral accumulations alternating with larger detritic formations from the upper slope, makes the clear definition of this archaeological material problematic.

That the site of Kalavan-2, situated at 1600 m asl in the Barepat River valley seems to have been inhabited by a group of hunter-gatherers is indicated by an abundance of raw material in the river bed. In addition, its proximity to a probable seasonal migration route for ungulates, moving upslope towards summer pastures in spring, and downslope in autumn for mating and feeding (Adler et al., 2006) supports the same reasoning. Indeed, on the opposite bank of the Barepat River, approximately one hundred meters from Kalavan-2, the site Kalavan-1, dating to the end of the Upper Paleolithic with radiocarbon dates ranging from 14,070 ± 60 to 13,750 ± 60 BP, was found and excavated. Kalavan-1 contains a rich fauna assemblage composed almost exclusively of wild caprids (Liagre, Balasescu, 2007). It is probable that the Kalavan territory occupied a strategic location from which Mousterian and Upper Paleolithic hunters could plan and launch hunting forays.

All these discoveries need to be refined by a systematic survey of the Barepat River valley, complemented by geoarchaeological and geomorphological studies, in order to gain a better understanding of the structure and post-depositional history of the site. New finds, their radiometric dates, and their typological and technological analyses will hopefully provide more insight into the behavior, lifestyles and environment of the hominid groups inhabiting Armenia in the Upper Pleistocene. Finally, as the bedrock has not yet been reached at Kalavan-2, the possible discovery of anthropogenic evidence in the lowest layer 20 may lead to the discovery of archaeological horizons predating the Middle Paleolithic.

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