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Hovk 1 and the Middle and Upper Paleolithic of Armenia: a preliminary framework

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ABSTRACT

The territory of present day Armenia is a geographic contact zone between the Near East and the northern Caucasus. Armenian Middle and Upper Paleolithic records are both few and patchy as a result of the historical paucity of systematic archaeological research in the country. Consequently, it is currently difficult to correlate the Armenian Middle and Upper Paleolithic records with those from other neighboring regions. We present new archaeological and chronometric data (luminescence, U-Th, and ^{14}C) from our ongoing research at Hovk 1 Cave in northeast Armenia. We discuss in particular two activity phases in Hovk 1 Cave for which we have outline chronometric data: (1) an early Middle Paleolithic occupational phase, dated by optically stimulated luminescence (OSL) to 104 ± 9.8 ka BP_{OSL}; and (2) a Paleolithic occupational phase characterized by microlithic flakes dated by AMS ^{14}C to $39{,}109 \pm 1{,}324$ calibrated years BP_{Hulu}. The two phases are separated by a hiatus in hominin occupation corresponding to MIS 4 and an episode in early MIS 3. These chronometric data, taken together with the preliminary paleoenvironmental reconstruction of the Hovk 1 Cave and environment, suggest that these activity phases represent short-lived and seasonal use of the cave presumably by small groups of hunters during episodes of mild climate. Neither tool manufacture nor butchery appears to have taken place within the cave, and consequently, the archaeological record included, for the most part, finished tools and blanks. We address the chronology and techno-typological aspects of Hovk 1 lithics in relation to: (1) the Paleolithic records of Armenia, and (2) the broader interregional context of early Middle Paleolithic hominin occupation and the Middle-Upper Paleolithic transition in the Caucasus.

Introduction

The Middle-Upper Paleolithic transition in Eurasia (~45–30 ka ^{14}C BP) is associated with the extinction of Neandertals (*Homo neanderthalensis*), who had occupied parts of the area for the preceding 150,000 years, and their replacement by *Homo sapiens sapiens*. Social, cultural, and evolutionary change consequent of this extinction/colonization event has long been debated in the archaeological literature (e.g., Bar-Yosef, 1995, 2000, 2002; Mellars, 1996, 2005; Hoffecker, 1998; Cohen and Stepanchuk, 1999; D'Errico, 2003; Adler and Tushabramishvili, 2004; Hovers and Belfer-Cohen, 2006). The prevalent consensus among both paleoanthropologists and archaeologists is that the Aurignacian techno-complex in Western Europe is associated with early modern humans and that Neandertals were the makers of all European Middle Paleolithic industries (Howell, 1998; Mellars, 1996, 2005). However, the Middle-Upper Paleolithic transition beyond Western Europe is not necessarily associated with the Aurignacian, but rather a number of

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early Upper Paleolithic "transitional" industries, many of which lack the symbolic and ornamental characteristics of the western European Aurignacian (Kozlowski, 1998; Bar-Yosef, 2002; Otte, 2004; Finlayson, 2007).

Recent research on the chronology of early Upper Paleolithic occupational phases in the sites of Kostenski 1, 12, 14, and 17 in the Upper Don Region of Russia, yielded an Upper Paleolithic assemblage rich in non-stone elements indicating "behavioral modernity" (d'Errico, 2003) that are dated by radiocarbon (^{14}C BP) and optically stimulated luminescence (OSL) to between 45–42 ka BP (Anikovich et al., 2007). No Middle-to-Upper Paleolithic continuity was detected in this region, and the "pre-Aurignacian" assemblage is believed to represent an early colonization of modern humans in the eastern European Plain as early as anywhere in northern Eurasia. AMS ^{14}C BP dates of mammoth tusks with cut marks and other mammoth bones from the lower strata of the site of Mamontovaya Kurya in the Russian Arctic indicate the human occupation of the Arctic around $\sim$36 ka ^{14}C BP (Pavlov et al., 2001). These finds imply either the presence of Neandertals in ecologically-marginal high-latitude regions (and hence point to their ability to survive in this habitat), or that modern humans managed to colonize this region only a few thousand years after their initial appearance in Europe (Pavlov et al., 2001). These data call for a re-evaluation of previous models that assume that the southern Levantine sites of Boker Tachtit and Ksar Akil mark the origin of early Upper Paleolithic technologies (Mellars, 1996). It now appears to be just as plausible that the core regions in which Upper Paleolithic culture first evolved may have been located in the eastern European Plain or further east in Asia (Goebel, 2007), or that the Upper Paleolithic did not spread from a single core region.

The growing interest in the role of eastern Europe and Asia in the Middle-Upper Paleolithic transition suggests that the study of the southern Transcaucasus would be illuminating given that this is a geographic corridor facilitating migration between Africa, the Near East, Europe, and Asia. However, until recently this area has not been extensively studied and consequently, its Middle and Upper Paleolithic chronology is poorly understood (Liubin, 1993; Adler and Tushabramishvili, 2004).

The first reports of Middle Paleolithic lithic artifacts in Armenia were from surface finds recovered in the 1930s (Baiburtian, 1937, 1938). Sardarian (1954) later reported surface finds of Acheulean, Mousterian, and Neolithic tools from the sites of Satani-Dar, Areguni-Blur, Yerkaruk-Blur, and Arzni, near Mount Arteni (Fig. 1). However, prior to 2003, the Middle Paleolithic sequence in Armenia was based solely on excavations of Yerevan 1 Cave (Yeritsian, 1970a, b) and the rock shelters of Lusakert 1 and 2 (Yeritsian, 1975; Yeritsian and Ghazarian, 1978; Fourloubey et al., 2003). Excavations prior to the late 1990s did not use modern archaeological methods, while chronometric dating was limited to a very few samples submitted for ^{14}C dating after 2000. Since 1999, several projects sponsored by western European universities and research organizations have been initiated (e.g., Fourloubey et al., 2003; Dolukhanov et al., 2004, Pinhasi et al. 2006). As a result, several Middle Paleolithic open-air sites were discovered in 2003 during a survey of paleolake shorelines in the Aparan region (e.g., the sites of Rya-Taza 1, Mirak 1 and 2, and Mulki 4; Jaubert and Ollivier, 2003; Gasparian et al., 2004; Fig. 1). Moreover, late Middle Paleolithic material was recently recovered during a test excavation at the Angeghakot 1 Rockshelter in the southeastern part of the Lesser Caucasus (Liagre et al., 2007). However, none of these sites contained in situ stratigraphic sequences, and thus, their attribution to the Middle Paleolithic record is solely based on the techno-typological assessment of the lithics that were recovered.

In this paper, we report on results from our ongoing investigations of the Hovk 1 Cave in northeast Armenia, which is based on the analysis of data from the 2005 and 2006 excavation seasons. Our aim is to shed light on the nature and timing of Middle and Upper Paleolithic human occupation in this region, in relation to fluctuations in the local paleoenvironmental conditions. Following this report we review the Middle and Upper Paleolithic chronometric record of Armenia and discuss the implications of results from Hovk 1 to the broader context of human occupation in the southern Caucasus.

The Paleolithic record of Hovk 1 Cave

Hovk 1 Cave is situated 2,040 m above sea level on a limestone ridge of the Lesser Caucasus mountain range (Fig. 1). At present the Hovk area of northern Armenia has summer temperatures that average between 10 and 20 °C, but in winter these drop below freezing and the Hovk 1 site is well above the snow line. Hovk 1 is a 2–3 m wide and 14 m long double-gallery cave (Fig. 2). Excavations have revealed more than 3.5 m of stratified fill comprising a sequence of flowstones and mixed endogenous weathering products derived from the cave walls and animal fecal material, and exogenous sediment comprising eolian material and deposits washed into the cave by fluvial processes (sensu Waters, 1992: 242–243). In the text that follows deposits of mixed endogenous and exogenous origin are collectively termed 'cave earth' (sensu Lowe and Walker, 1997: 129; Fig. 2).

In this section we outline the main results of our investigation in Hovk 1 and place a particular emphasis on the timing and nature of human occupation in this high-elevation region in relation to data obtained from the analysis of paleoenvironmental proxies (macro fauna, palynology, sedimentology). By doing so, we attempt to address possible site function and activity pattern in this region during the Middle and Upper Paleolithic.

Excavation and sampling methods

The Hovk 1 site was excavated during three seasons of fieldwork, each four weeks long, between 2005 and 2007. In 2005, a grid of 1 m squares was established inside the cave using a total station. Grid square markers were hung from the cave roof. A local coordinate system and datum was then associated with the grid. This was linked to the UTM (WGS 84) coordinate system and geoid elevation by surveying into the cave with a total station from permanent control points established with a differential GPS on the plateau below.

Excavation was carried out in 50–100 mm thick 'spits' within each depositional sedimentary unit ('Unit') and grid square. All artifacts and faunal remains were recorded with respect to local grid coordinates and site datum using a total station. Articulated animal bone, such as a complete cave bear skeleton in Unit 6 encountered during the 2006 season, was planned by tracing using the ArcGIS software package, the outline of the bones recorded in vertical digital photographs taken on site, and georeferenced by means of total station-recorded control points. Pre-medieval sediment was bagged separately by unit, spit, and grid square, removed from the cave, and then processed using a standard flotation machine (sensu French, 1971) and using meshes of 0.5 mm for both flot and residue, in order to recover micro-artifacts and biological remains.

Longitudinal and lateral sections were drawn and described by the geoarchaeological specialists on completion of each season of excavation. Kubiena tin samples (measuring $75 \times 60 \times 35$ mm) were taken from the vertical sections for micromorphological study and were transported back to the UK for preparation and analysis. Thin sections (70×50 mm) were made in laboratories of the Department of Geography, Royal Holloway University of London (RHUL), following the procedures set out by Lee and Kemp (1994), and subsequently viewed with a petrological microscope.

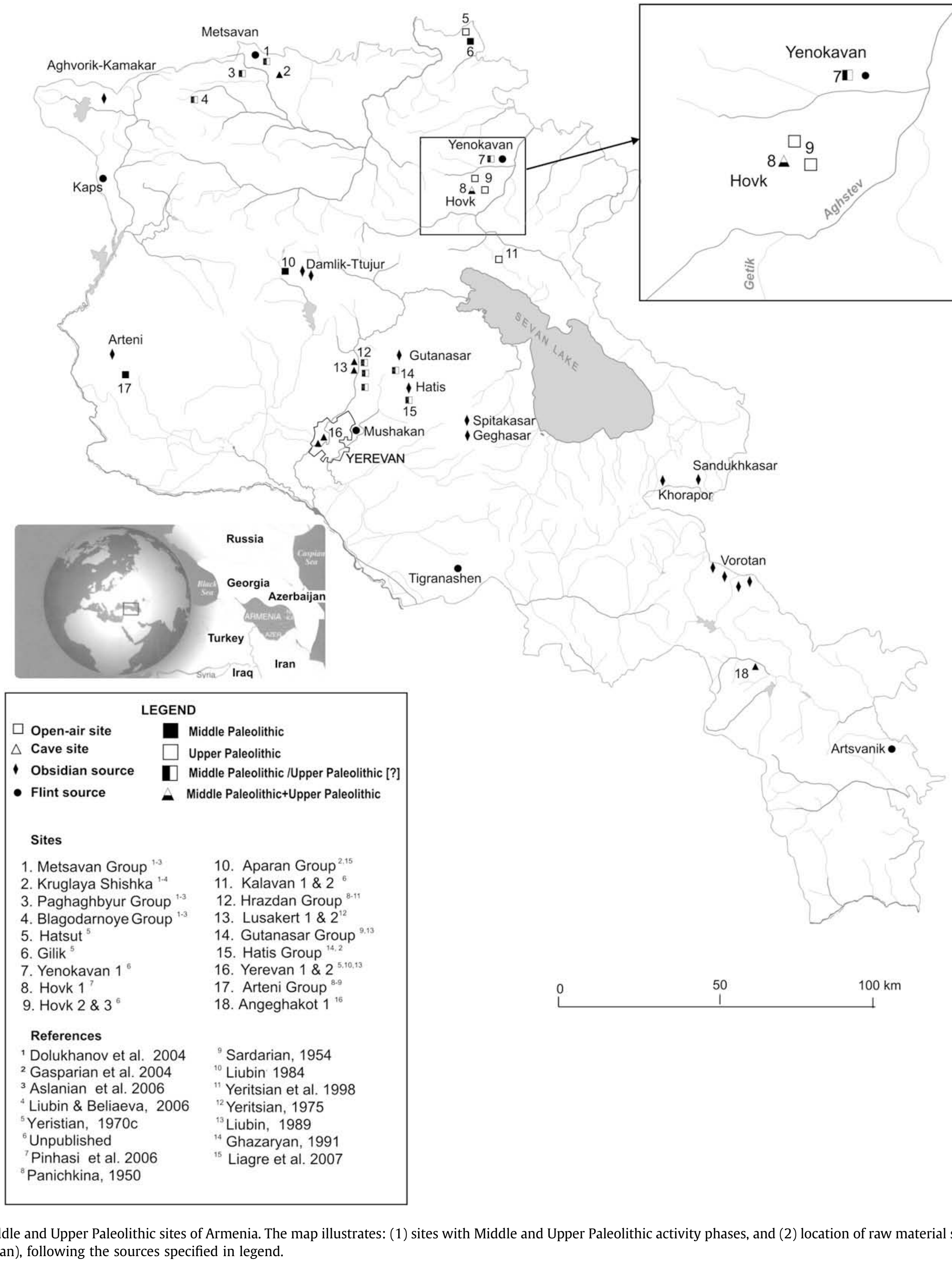

Fig. 1. Middle and Upper Paleolithic sites of Armenia. The map illustrates: (1) sites with Middle and Upper Paleolithic activity phases, and (2) location of raw material sources (flint and obsidian), following the sources specified in legend.

Vertebrate bones recovered from the excavation were studied by Bar-Oz in Yerevan, excepting material recovered from the flotation residues of the 2005 field season, which were examined by Schreve in London.

Spot samples for preliminary pollen analysis were taken from Units 4, 5, 6, 7, and 8 (Fig. 3) during the 2005 season and then examined by Bruch in Frankfurt. About 40 g of material was processed from each sample using standard palynological methods. After the addition of *Lycopodium* tablets for estimation of pollen concentrations, the material was treated with HCl, HF, and KOH, sieved through a 6 μm mesh, and the residue centrifuged with $ZnCl_2$. Little residue resulted from this process, and therefore, permanent slides were prepared with glycerine-jelly to avoid loss of material. Two slides per sample were counted. The analyzed

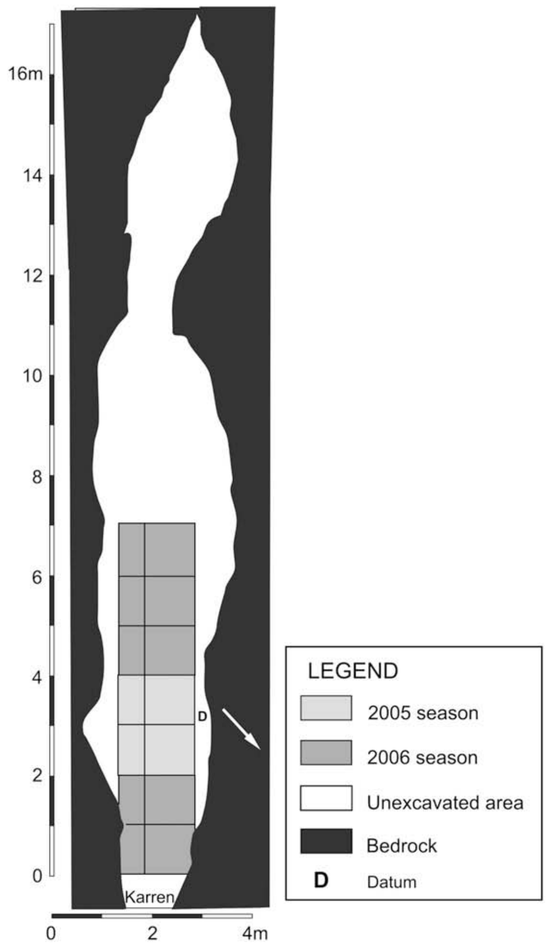

Fig. 2. Plan view of Hovk 1 Cave showing the area excavated and the site grid.

samples have low pollen concentrations, while exine preservation was poor, and only in Units 4, 5, and 6 were enough identifiable grains recovered to provide a meaningful interpretation.

Sub fossil plant remains were obtained from both flots and residues of samples taken from Units 1–8. About 600 plant remains were extracted and identified by Hovsepyan in Yerevan using a standard low-power stereomicroscope, and a total of 35 plant taxa were identified. Most of the botanical macro remains are preserved by charring in Units 1–3 (medieval), but ~20 seeds and fruits were preserved by calcification (i.e., calcium carbonate replacement) in Units 5, 6, and 8 (Paleolithic).

Stratigraphy, macro fauna, and lithics

The relatively tall but narrow morphology of Hovk 1 Cave acts to channel depositional energy along a longitudinal path (Fig. 2). A natural 'chimney' towards the back of the cave, now blocked by collapse of the cave wall and roof, once allowed water to enter the rear of the cave and flow towards the entrance. Micromorphological studies conducted on the cave stratigraphy demonstrate that periodic water flow along this axis resulted in unconformities in the stratigraphic record. It is notable that Unit 6 contains a high percentage of exogenous sand and silt grains and is likely to be reworked sediment. In contrast, the micromorphological study of Unit 8 and Units 5–1 indicate that these sediments were, for the most part, the product of endogenous in situ weathering.

The lowermost, and thus, oldest deposit, Unit 11, rests on the Cretaceous limestone bedrock and slopes downwards towards the cave entrance (Fig. 3). Unit 11 was first encountered in the 2007 field season and is currently the subject of micromorphological study. However, descriptions made in the field suggest that the unit is predominantly comprised of angular and subangular limestone gravels, and therefore, it is likely that it formed as a result of roof collapse, perhaps caused by freeze-thaw weathering processes or earthquake activity (Karakhanian et al., 1997).

Unit 8 overlies Unit 11 and is a poorly-to-moderately-sorted fine cave earth. It contained four Early Mousterian elongated Levallois points and blades (Fig. 4), two flakes, a notched tool (all made on limestone), ash, frequent charcoal fragments, and animal bone fragments. A total of 60 identified bones were retrieved from Unit 8. The faunal assemblage is dominated by ungulate remains and comprised predominantly of *Capra* specimens (Number of identified specimens: NISP = 36), red deer (NISP = 10), and roe deer (*Capreolus capreolus*, NISP = 1). Presence of a horn base fragment of *Capra* allows its identification as *Capra caucasica* (i.e., Caucasian tur) with high confidence. Bear bones are represented by only four specimens (three nearly complete vertebrae and a clavicle). Other bone elements retrieved include the remains of small carnivores (most probably the red fox, *Vulpes vulpes*). Evidence for carnivore ravaging of bones is also present and appears on at least 11 specimens, including two digested phalanges of tur. The 2007 excavation indicates that additional fluvial deposits (Units 9 and 10) underlay Unit 8 towards the rear of the cave and that some of these contain macro fauna and lithics. These are the subject of ongoing analysis.

Unit 7 overlies and seals Unit 8. It is a very poorly-sorted deposit containing frequent angular boulders, and as with Unit 11, it slopes towards the cave entrance (Fig. 3). Unit 7 yielded no pollen or macro botanical remains. The unit has similar morphological characteristics to Unit 11 and is also indicative of roof collapse through weathering or earthquake activity. Unit 7 was largely devoid of archaeological finds except for a notched tool and two blades similar to those excavated from Unit 8, and all made of limestone. As with Unit 11, Unit 7 is likely to have formed during an episode of roof collapse, and therefore, the archaeological and vertebrate material was either originally deposited on the surface of Unit 8 and sealed by the collapse event, or became incorporated into Unit 7 during reworking of the collapse deposits. The macro fauna of the unit includes 23 identified bones. Ungulate remains, which include Caucasian tur (NISP = 10) and red deer (NISP = 2), outnumber carnivore (7 ursid bones and 2 teeth of fox). Carnivore bone modification is present only on a single medial-shaft of a bear's ulna.

Unit 6a partially covers Unit 7 in the present entrance of the cave (Fig. 3) and comprises a single stalagmite together with laminar flowstone. The latter coats the walls of the cave and partially extends across the surface of Unit 7. The presence of flowstone is indicative of the ingress of water supersaturated with CO_2, possibly as a result of warm climatic conditions and soil formation above the cave.

Unit 6a is uncomformably overlain by Unit 6, which is a predominantly sand-sized grain that was possibly the result of sorting by the action of running water. No artifacts were found in Unit 6 and the sediment shows no traces of anthropogenic processes. The fluvial origin of Unit 6 may suggest that the hiatus between Unit 6a and 6 is the result of partial erosion of the prior sedimentary record by water running along the axis of the cave.

Numerous bones were recovered from Unit 6 (NISP = 73), including Caucasian tur (NISP = 7), red deer (NISP = 2), and wild boar (*Sus scrofa*, NISP = 1). Carnivore bones are abundant, particularly those of bear (NISP = 54). The bear remains derive from at least two individuals, an adult and a juvenile. Other carnivores include wolf (*Canis lupus*, NISP = 1) and fox (NISP = 7). Signs of carnivore modification are few and appear only on four bear bones.

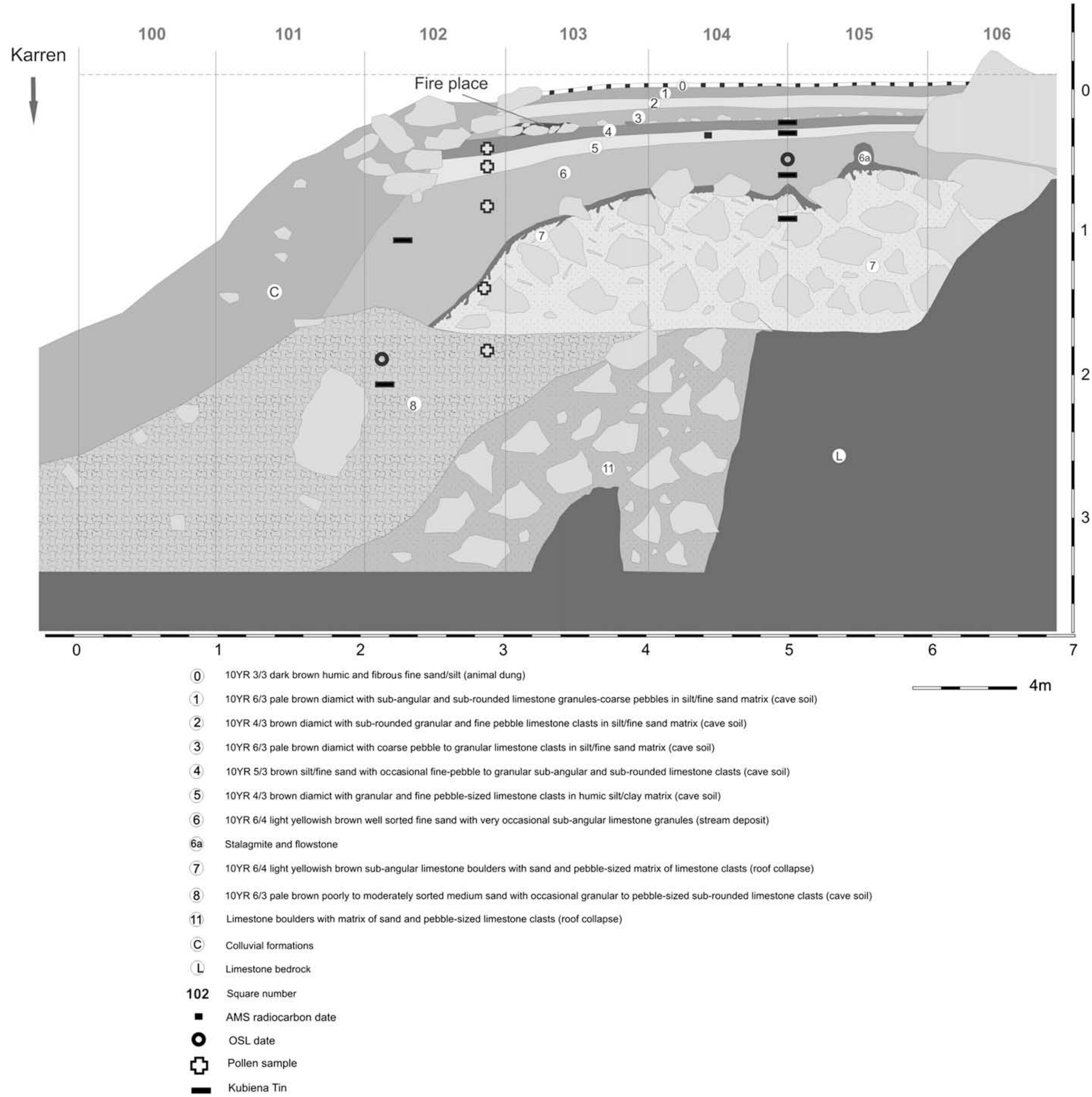

Fig. 3. Longitudinal cross section through Hovk 1 Cave.

Units 5–0 are a series of fine cave earths, each about 5–10 cm thick. Unit 5 contained four small irregular flakes made on obsidian, chalcedony, and flint; a small flake with traces of usage; a scraper made on obsidian; and a knapped limestone pebble. Caucasian tur dominate the bone assemblage (NISP = 44 from at least two individuals), followed by red deer (NISP = 2), a single bone of a roe deer, and of a boar. Carnivores are represented by 26 bones of fox, 27 bones of bear, and a single specimen of leopard (*Panthera paradus*). Evidence for carnivore ravaging was present on three ursid specimens and a single tur bone.

Unit 4 overlies Unit 5 and has broadly similar sedimentary properties. It contained worked obsidian flakes and a similar faunal composition as Unit 5. In Unit 4 Caucasian tur outnumbers other taxa, comprising 49 specimens derived from at least two individuals. Other ungulates present include two bones of red deer and a single bone of a roe deer. Unit 4 also differs from Unit 5 in having very few carnivores. Only 4 bear and 10 fox bones were present, while evidence for carnivore gnawing is also found only on two tur specimens.

Unit 3 uncomformably overlies Unit 4, and while the latter is unquestionably of Pleistocene age, the former is of medieval date as evidenced by the presence of pottery and a hearth. The uppermost deposits (Units 1 and 2) are also of medieval age as indicated by the presence of a few recovered coarse-ware sherds.

A karstic shaft, or karren, was found exposed in section by cliff collapse at the front of the cave during the 2006 field season and

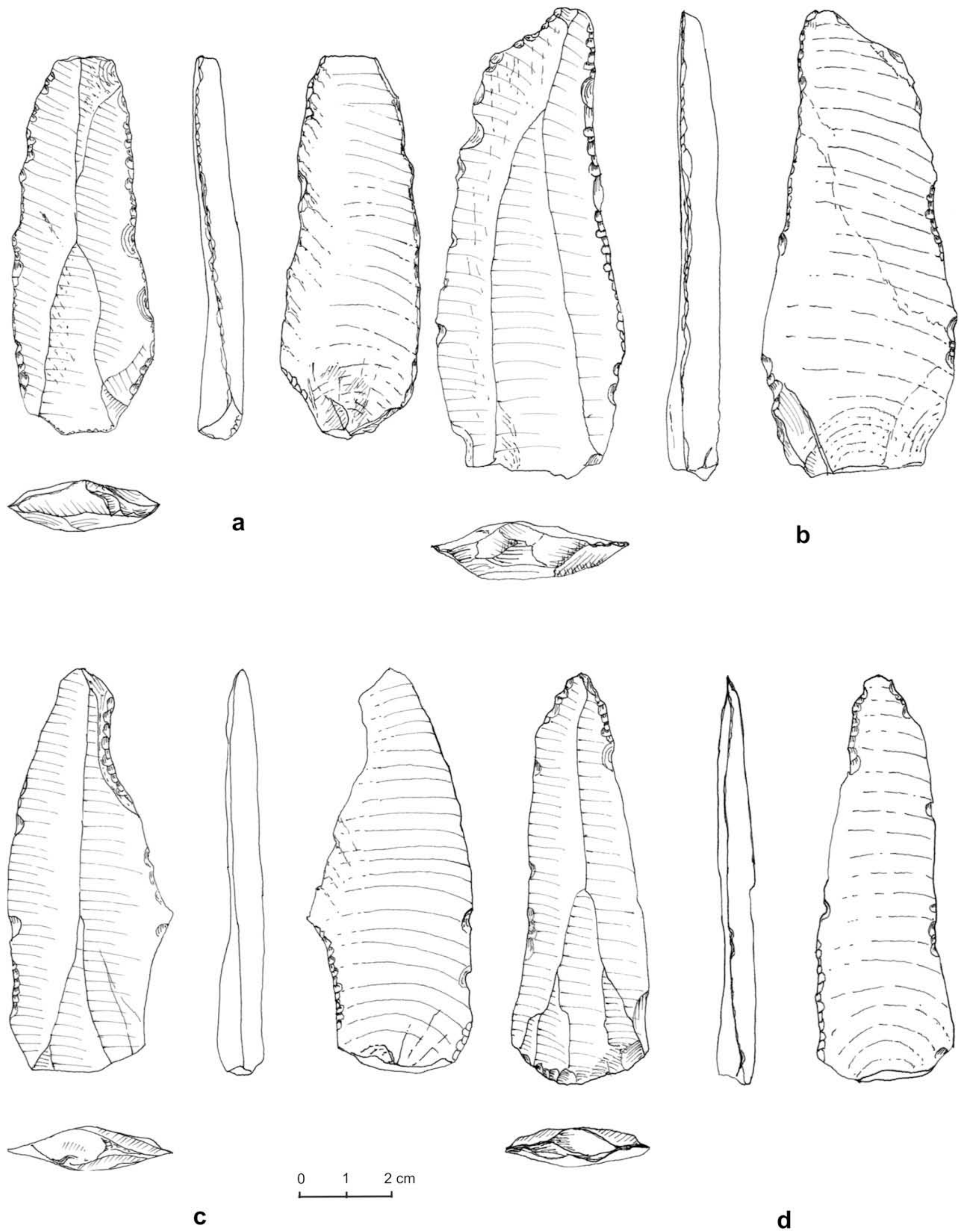

Fig. 4. Middle Paleolithic Levallois points and blades from Hovk 1, Unit 8. See text for details concerning specific tools 4a-d.

was subsequently excavated (Fig. 3). The karren contains a fill of angular limestone, gravel-dominated, colluvial deposits together with poorly-preserved vertebrate remains. The latter differ from those recovered from the other units in two ways. Firstly, the bones from the karren are solely of tur (NISP = 31) and cave bear (NISP = 23). The cave bear bones are from a single adult and include a nearly complete skull. The tur remains are from at least two individuals, but skeletal parts from almost the entire body are represented. Secondly, the bones are not fragmented, carnivore modification is absent, and it seems likely that complete animals are present. It may therefore have been the case that the karren acted as a pitfall trap.

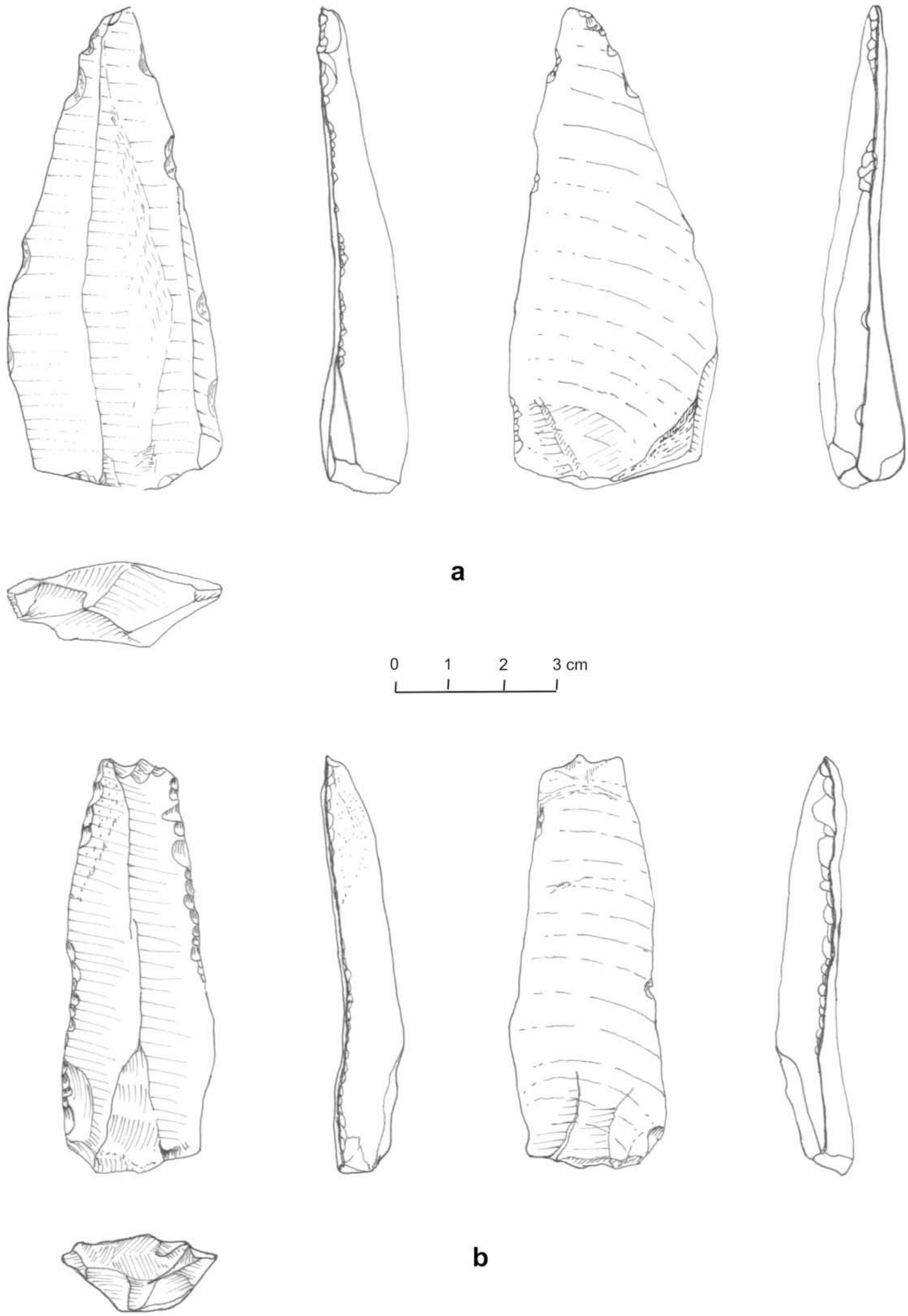

Fig. 5. Middle Paleolithic artifacts from the Hovk 1 karren: a) an elongated Levallois blank, and b) a Levallois blade.

A single Levallois point and single Levallois blade, both made of limestone (Fig. 5), were recovered from the contact zone between the bottom of the karren and the cave terrace. Additionally, two Levallois flakes made from limestone and an elongated Levallois point made on obsidian were recovered from the upper part of the karren. These artifacts appear similar to those recovered from Unit 8, although at this stage of investigation, deposits infilling the karren cannot be correlated with those in the cave itself, and it is unclear whether the artifacts from the karren are in situ.

Optically stimulated luminescence (OSL) analysis

Homogeneous fine-grained sediment was sampled for OSL dating in Units 6 and 8 (Fig. 2). Pure quartz ($\sim$5–15 μm) was extracted from each sample using standard laboratory treatments.

Table 1
Summary optical dating results for Hovk 1[a]

Date code	OxL-1600	OxL-1601
D_e (Gy)	37.7 ± 1.03	43.9 ± 1.61
Overdispersion	0.02 ± 0.02	0.03 ± 0.02
Repeat-ratio	1.02 ± 0.03	0.99 ± 0.02
Zero-ratio	0.02 ± 0.01	0.01 ± 0.01
Dose recovery ratio	0.99 ± 0.02	0.97 ± 0.02
K (%)	0.13 ± 0.01	0.15 ± 0.01
Th (ppm)	0.77 ± 0.04	0.63 ± 0.03
U (ppm)	1.53 ± 0.08	0.66 ± 0.03
Dc' (Gy/ka)	0.69 ± 0.07	0.42 ± 0.04
Age (ka)	54.6 ± 5.7	104 ± 9.8

[a] An a-value (Aitken, 1998) of 0.04 ± 0.01 was used for all samples. $Dc' = 0.024 \pm 0.004$ (cosmic dose rate contribution); moisture content (defined as the mass proportion of water to the total sediment mass) was given a value 0.10 ± 0.05 for all samples. Estimates of U, Th, and K sediment concentrations were made using Inductively-Coupled Plasma Mass Spectrometry (following Bailey et al., 2003a, b). Age calculations assume secular equilibrium of all relevant radio-isotopes.

The purity of the quartz was confirmed by a lack of OSL signal depletion due to infra-red (880 nm) stimulation. Optically stimulated luminescence measurements were made using an automated Risø TL/OSL DA-15 reader (Bøtter-Jensen et al., 2000) and equivalent doses were estimated using the Single-Aliquot Regenerative-dose (SAR) procedure (Wintle and Murray, 2006). Aliquots were preheated for 10 s at 260 °C prior to measurement of natural/regenerative-dose signals; a standard dose of 5 Gy followed by preheating at 220 °C for 10 s was used to monitor sensitivity changes. The D_e value quoted for each sample is that given by the Central Age Model (CAM) of Galbraith et al. (1999), with an additional error of 2.5% added in quadrature to account for β-source calibration uncertainties. Analysis of the measurement-time dependence of the D_e values (Bailey et al., 2003a, b), together with low over-dispersion (Table 1) and lack of significant skewness in D_e results, provides no indication of incomplete bleaching. Dose recovery tests (in which 12 aliquots of each sample were bleached to residual signal levels with blue [470 nm] light prior to laboratory irradiation with doses equal to the estimated paleodose) yielded accuracy ratios consistent with unity at better than 2σ precision (Table 1). The reproducibility tests and the monitoring for significant thermal transfer performed as part of the single aliquot regenerative dose (SAR) procedure are also all well within acceptable limits. The available indicators of dating accuracy therefore provide no reason to doubt the validity of the dating results. The luminescence date obtained for Unit 6 is 54.6 ± 5.7 ka (OxL-1600) and for Unit 8 is 104 ± 9.8 ka (OxL- 1601). All summary results from dose rate and luminescence measurements are shown in Table 1, along with the individual age estimates.

Uranium-Thorium (U-Th) analysis

U-series samples comprising entire blocks of samples from laterally-extensive flowstone were taken during the 2006 field season. Two fragments of flowstone (Hovk-1-1 and Hovk-1-2) from Unit 6a were analyzed for U-Th isotopic composition in the autumn of 2006. An 8 mm thick slice was cut from sample Hovk-1-2, polished, and cleaned to identify growth layers. Five subsamples, each of 80–200 mg, were cut from calcite layers of the sectioned Hovk-1-2 sample using a dedicated diamond-coated wire saw, and a further subsample was taken from the top calcite layer of Hovk-1-1 using a razor blade. To remove surface contamination, all subsamples were leached for a few seconds in 0.5 N HNO_3 and subsequently cleaned in a MQ ultrasonic bath. The samples were then dried, weighed, and dissolved in HNO_3. A mixed $^{229}Th/^{236}U$ spike was added to the solution before being processed through ion exchange columns. Analytical procedures subsequently followed those of Hoffmann et al. (2007). U-series isotope measurements were obtained using a ThermoFinnigan Neptune Multiple-Collector Inductively Coupled Plasma-Mass Spectrometer (MC-ICPMS) located in the University of Bristol, UK, and analyzed by Hoffman.

The results of the U-Th isotope measurements for the 6 subsamples are reported in Table 2. Two samples, the top layer of Hovk1-1 and the bottom layer of Hovk 1-2, have a significant ^{232}Th contribution. A ^{232}Th correction was applied using a bulk earth value for the $^{238}U/^{232}Th$ activity ratio of 0.8 ± 0.4 (Wedepohl, 1995). Hovk 1-2 has two major growth phases. The U-Th results indicate that the bottom part of Hovk 1-2 grew between 236 ± 7 and 192 ± 3 ka $BP_{U/TH}$ and the top part between 125 ± 1 and 120 ± 1 ka $BP_{U/TH}$. The top layer of sample Hovk 1-1 formed around 95 ± 5 ka $BP_{U/TH}$. It is not possible, however, to correlate the U-Th results with Units 11–7. The presence of an unconformity at the lower contact of Unit 6 (OSl date of 54.7 ± 5.7 ka BP_{OSL}) and Unit 6a (Y/Th date of 94.2 ± 4.9 ka $BP_{U/TH}$) suggests a substantial hiatus corresponding to MIS 5a- MIS 4.

Radiocarbon age estimates

An astralagus of a wild goat from Unit 5 was analyzed for Accelerated Mass Spectrometry (AMS) ^{14}C dating. The bone sample submitted to the Poznan Radiocarbon Laboratory was cleaned mechanically in deionized water in an ultrasonic bath, and 1–2 g of bone was then milled and treated with 8% HCL to remove carbonates. Extraction of collagen from the powder was performed following the procedure described by Piotrowska and Goslar (2002). The bone yielded 2.4% collagen preservation (which is intermediate between well-preserved collagen [>4%] and poor collagen [<1%]) and a C:N ratio of 3.4 that is in agreement with the average range of 3.29 ± 0.27 for $n = 2,146$ bone samples dated by the Oxford Radiocarbon Laboratory (van Klinken, 1999). Hence, there was no reason to reject this date on the basis of quality parameters although these do not indicate whether there is carbon contamination (van Klinken, 1999). Combustion of collagen was carried out as described in Czernik and Goslar (2001) and was followed by graphitization and AMS measurement. The obtained date of $33,800 \pm 500$ ^{14}C BP (Poz-14674) was calibrated using the Hulu Age model 2007 calibration curve with the Cologne Radiocarbon Calibration and Paleoclimatic Research Package (CALPAL) (CalCurve: CalPal_2007_HULU; Weninger and Jöris, this volume) which yielded a calibrated age of $39,109 \pm 1,324$ cal BP_{Hulu}.

Preliminary paleoenvironmental reconstruction

In this section we present preliminary paleoenvironmental information on Units 5, 6, and 8 that is derived from four main sources: soil micromorphology, macro fauna, macro botanical remains, and palynological samples. The results are presented by unit and are followed by a preliminary paleoenvironmental synthesis in order to address the relationship between human occupation and the natural habitat.

Unit 8 and Unit 5 yielded the most artifacts, and hence, our initial hypothesis is that human occupation occurred predominantly during the formation and accumulation of these deposits. Micromorphological analysis of these units indeed reveals evidence suggestive of a deposit produced through a combination of natural and anthropogenic processes.

Unit 8 is dominated by brown clay and sand-sized grains of limestone and abundant small fragments of pale yellow, well-preserved bone. Spherical voids or 'vesicles' occur occasionally as do relatively-thick clay cappings on the upper-surfaces of clasts (Fig. 6). Vesicles may have formed through former bioturbation, but they have also been found to occur during the thawing of ice-rich soils (e.g., Harris, 1983). Cappings of fine material on the upper surfaces of clasts are also typical features of freeze-thaw activity

Table 2
Uranium and thorium concentrations, isotopic ratios, and $^{230}Th/^{234}U$ ages for the Hovk 1-1 and Hovk 1-2 flowstones following high-precision MC-ICPMS analyses[a]

Sample ID	^{238}U	^{232}Th	$[^{234}U/^{238}U]$	$[^{230}Th/^{238}U]$	$[^{230}Th/^{232}Th]$	$[^{230}Th/^{238}U]$	$[^{234}U/^{238}U]$	U-Th age	$[^{234}U/^{238}U]$
	[ng/g]	[ng/g]	activity ratio measured	activity ratio measured	activity ratio measured	activity ratio corrected	activity ratio corrected	corrected [ka]	initial activity ratio corrected
BIG-UTh-A243	218.9 ± 0.5	99.0 ± 0.23	1.142 ± 0.002	0.720 ± 0.002	4.9 ± 0.02	0.682 ± 0.022	1.161 ± 0.011	94.2 ± 4.9	1.21 ± 0.014
BIG-UTh-A244	164.8 ± 0.6	50.3 ± 0.17	1.120 ± 0.003	1.028 ± 0.004	10.3 ± 0.06	1.030 ± 0.005	1.131 ± 0.007	235.3 ± 6.8	1.254 ± 0.009
BIG-UTh-A245	144.2 ± 0.5	10.8 ± 0.04	1.083 ± 0.003	0.916 ± 0.004	37.2 ± 0.24	0.915 ± 0.004	1.085 ± 0.003	192.3 ± 3.0	1.146 ± 0.005
BIG-UTh-A246	84.6 ± 0.3	1.1 ± 0.01	1.130 ± 0.003	0.784 ± 0.003	177.0 ± 1.33	0.783 ± 0.003	1.130 ± 0.003	124.6 ± 1.1	1.185 ± 0.004
BIG-UTh-A247	113.8 ± 0.4	3.3 ± 0.02	1.134 ± 0.003	0.784 ± 0.003	83.1 ± 0.59	0.782 ± 0.003	1.135 ± 0.003	123.1 ± 1.0	1.192 ± 0.004
BIG-UTh-A248	150.1 ± 0.5	1.0 ± 0.01	1.138 ± 0.003	0.774 ± 0.003	358.6 ± 2.66	0.774 ± 0.003	1.139 ± 0.002	120.1 ± 1.0	1.195 ± 0.003

$\delta^{234}U = ([^{234}U/^{238}U]_{activity} - 1) \times 1000$. Corrected for detrital Th contamination using an initial $[^{238}U/^{232}Th]_{act.}$ of 0.8 ± 0.4 (2σ) (Wedepohl, 1995).

[a] $[^{230}Th/^{238}U]_{activity} = 1 - e^{-\lambda_{230}T} + (\delta^{234}U_{measured}/1000)[\lambda_{230}/(\lambda_{230} - \lambda_{234})](1 - e^{-(\lambda_{230}-\lambda_{234})T})$, where T is the age in years. Decay constants (λ) are 9.158×10^{-6} yr^{-1} for ^{230}Th (Cheng et al., 2000), 2.826×10^{-6} yr^{-1} for ^{234}U (Cheng et al., 2000) and 1.551×10^{-10} yr^{-1} for ^{238}U (Jaffey et al., 1971).

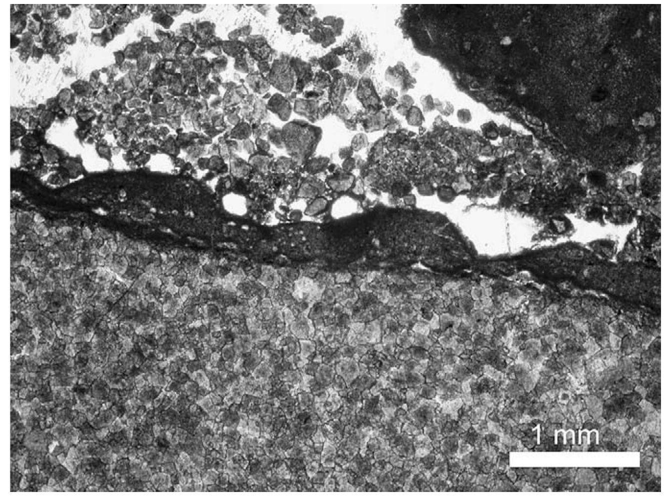

Fig. 6. Photomicrograph of Unit 8 showing a limestone clast capped on its upper surface by clay. Several vesicles are also present above the clay capping and the darkened area beneath one of the vesicles indicates that clay may have been transported down-profile and through the vesicle during thaw.

(e.g., Harris and Ellis, 1980). The greater thermal conductivity of the larger clasts promotes the growth of ice, and following thaw fine material can be washed down-profile and may accumulate on the upper surfaces of clasts in the void left behind following ice melt.

The flora of Unit 8 is poor in the number of taxa and, therefore, unspecific in terms of environmental interpretation. All determined taxa are herbaceous plants; however, some of them appear also in forests. Unit 8 yielded several calcified seeds from Asteraceae (Compositae) and Apiaceae (Umbeliferae) families. Seeds from Asteraceae are preliminarily identified as *Centhaurea sp.* (11 seeds), whereas seeds of Apiaceae are probably *Chaerophyllum sp.* (7 seeds). In addition, small pieces of herbivore coprolites with inclusions of plant remains were detected in Unit 8. Those include numerous seeds of *Viola* and different cyperaceous plants. Representatives of these genera still grow in the vicinity of the cave and are common elements of meadows (e.g., *Centhaurea*) or herbaceous elements of relatively moist and dense forests (*Chaerophyllum*), respectively.

The pollen flora of Unit 6 is strongly dominated by Asteracaea–Asteroideae (94%). All other taxa in this assemblage are herbaceous plants as well: Caryophylllaceae, Asteracaea–Cichoioideae (including *Centaurea*), Chenopodiaceae, *Polygonum*, and Poaceae. In the macro flora only two calcified seeds of *Centhaurea sp.* (Asteraceae) were recovered in Unit 6, which is a common element of meadows. As in Unit 8, herbivore coprolites also include seeds of *Viola* and different cyperaceous plants.

Preliminary micromorphological analysis of Unit 5 reveals abundant vesicles and channels indicative of ancient burrows and contains cellular plant materials from former soil formation. Angular-to-subrounded limestone clasts with a maximum diameter of 1.5 cm are present indicating small roof fall. One clast has its upper surface coated in clay, typical of freeze-thaw activity, as was previously discussed for Unit 8 and the implications for possible seasonal use of the cave. Horizontally-fissured groundmass occurs (Fig. 7) and may be the result of compaction associated with trampling by humans and/or animals (e.g., Beckmann and Smith, 1973; Davidson et al., 1992; Matthews, 1995).

The pollen flora from Unit 5 includes generally the same herbaceous taxa as Unit 6, which account for 90% of the assemblage. However, 10% of the taxa belong to arboreal plants, mainly pine (*Pinus* 9%) and some hazel (1%). Also recovered in the Unit 5 macro flora are remains of two calcified nut stones of hackberry (*Celtis sp.*).

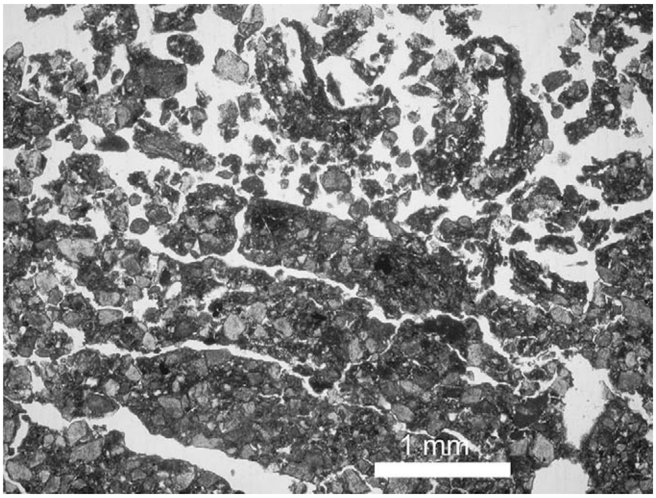

Fig. 7. Photomicrograph of Unit 5 showing a horizontally-fissured groundmass, possibly a result of compaction from trampling by humans and/or animals. The aggregated, amorphous crumb microstructure above is typical of bioturbation by soil animals.

The Middle-Upper Paleolithic transition in Armenia

At present, the nature and timing of the Middle-Upper Paleolithic transition in Armenia is limited due to the paucity of Upper Paleolithic sites with stratified cultural deposits. This lack of Upper Paleolithic facies led to claims that Armenia was unoccupied during the cold climatic phases of the pleniglacial (Dolukhanov et al., 2004). However, surface finds of prismatic cores, end scrapers, and burins in several regions in Armenia (surface finds from Metsavan, Paghaghbyur, Blagodarnoye, Hatsut, Hovk 2 and 3, Hrazdan, Hatis Kruglaya Shishka, and Angeghakot 1; Fig. 1) contradict this argument.

Our knowledge of this transition is further limited by the paucity of radiometric dates for Armenian Middle and Upper Paleolithic assemblages. Table 3 provides the most current data on the chronology of Armenia. The dates of the Mousterian facies in the caves of Lusakert 1 and Yerevan 1 imply that the Middle Paleolithic occupation in central Armenia, which may have begun with Hovk 1 Unit 8, continued during the Marine Isotope Stage (MIS) 3 and into early MIS 2. The lithic assemblages from both Yerevan 1 (layers 3, 4, 7) and Lusakert 1 (layer 4 in the excavations of 1999, 2001 that correspond to layer C2 in the original stratigraphy of the cave; cf. Fourloubey et al., 2003) are of non-Levallois Mousterian technology and show none of the characteristics of Upper Paleolithic assemblages. According to Yeritsian (1970a), the Yerevan 1 sequence represents one Mousterian facies with a gradual techno-typological change from a predominance of non-Levallois cores, bifacial side scrapers and points with bifacial retouch, borers, and a low frequency of blades (layers 5–7); to a middle stage (layers 3–4) with predominance of Levallois cores and similar tools, but of smaller average size, and the first appearance of limaces; subsequently followed by a late stage (layer 2) with mostly small cores, no bifacial tools, and high frequency of side-scrapers, leaf-shaped points, and denticulates. However, a recent reanalysis of the same lithics by Fourloubey et al. (2003) found a lack of significant change in the frequencies of the main tool types across the layers. At the present time the archaeological stratigraphy of the site and the associated radiocarbon dates for layers 3, 4, and 7 defined in the 1970s (Table 3) do not provide a coherent diachronic occupational sequence that can be compared to those from other regions in Armenia. New excavation of existing sections and dating of key cultural layers are required in order to develop a chronostratigraphic archaeological sequence for this cave sequence.

The earliest Upper Paleolithic occupation in Armenia appears to be represented by the sites of the Aghstev River Basin (e.g., Hovk-1 Cave, Kalavan-2 open-air site, and Hovk-2 and Hovk-3 open-air sites; Fig. 1). Only the sites of Hovk 1 and Hovk 3 yielded surface finds of a stone tool industry containing burins and end scrapers made on local limestone, flint, and obsidian. A small number of microlithic obsidian flakes, one of which has traces of direct usage without secondary retouch, were found in Unit 5 of Hovk 1 Cave. A preliminary analysis of these lithics indicate that the closest potential obsidian sources are those from the Damlik and Tujur volcanoes—Tsaghkunyats Range, and Hatis and Gutanasar volcanoes—Hrazdan Range (Fig. 1). These are located approximately 60 kilometers away from Hovk 1 (Blackman et al., 1998; Fig. 1). The techno-typological aspects of the lithics that show evidence of the use of microlithic flakes, as well as the 33.8 ka ^{14}C BP date for Unit 5 suggest that this unit may represent an early Upper Paleolithic facies.

Kalavan 2 is located on the second 50 m high terrace of the Barepat River, a tributary of Getik. The site sits on the southwestern slopes of the Areguni Range, at 1650 m asl. Two test trenches (during 2005–6) yielded stratified deposits containing bones of large mammals (bison, according to a preliminary study) and several hundred tools made from obsidian, flint, and local limestone. The use of a centripetal, or radial, core reduction strategy resulted in flakes and irregular blades. Typical Mousterian points and borers predominate; side scrapers and burins are present. An AMS ^{14}C date (Poznan AMS Lab) was obtained from a bison tooth from layer 4, yielding an AMS date of 34,200 ± 360 ^{14}C BP (P_{oz}-20,366) or 39,643 ± 886 cal BP_{HuLu}.

Kalavan 1 is located on the right bank of the river Barepat, east of the village of Kalavan. This site yielded numerous bones belonging

Table 3
A summary of radiocarbon and luminescence dates for the Middle and Upper Palaeolithic records of Armenia

Culture	Site	Layer	Lab No.	Date B.P. UNCAL	Type	Material	Reference
Middle Paleolithic	Hovk 1	8	OxL-1600	104 ± 9.8	OSL	Quartz	Previously unpublished
?Mousterian	Kalavan 2	4	Poz-20366	34,200 ± 360	^{14}C	Bone	Previously unpublished
Mousterian	Lusakert 1	C2	GRA-14949/Lyon 1006	26,920 ± 220	^{14}C	Bone	Fourloubey et al., 2003
Mousterian	Yerevan 1	3	GrN 8028a	32,600 ± 800	^{14}C	Charcoal	Previously unpublished
Mousterian	Yerevan 1	3	GrN 8028b	31,600 ± 800	^{14}C	Charcoal	Previously unpublished
Mousterian	Yerevan 1	4	GrN 7665	>47,800	^{14}C	Charcoal	Previously unpublished
Mousterian	Yerevan 1	4	GrN 7665	>49,000	^{14}C	Bone	Previously unpublished
Mousterian	Yerevan 1	7	GrN 8860	27,000 ± 650	^{14}C	Charcoal	Previously unpublished
Mousterian	Yerevan 1	7	GrN 8860	28,000 ± 500	^{14}C	Charcoal	Previously unpublished
Upper Paleolithic (?)	Hovk 1	5	Poz-14674	33,800 ± 500	^{14}C	Bone	Pinhasi et al., 2006
Upper Paleolithic	Kalavan 1	7	Poz-19665	14,060 ± 70	^{14}C	Bone	Previously unpublished
Upper Paleolithic	Kalavan 1	7	Poz-19664	13,800 ± 60	^{14}C	Bone	Previously unpublished
Upper Paleolithic	Kalavan 1	7	Ly-3538	13,750 ± 60	^{14}C	Bone	Previously unpublished
Upper Paleolithic	Kalavan 1	7	Ly-3537	14,070 ± 60	^{14}C	Bone	Previously unpublished

exclusively to wild sheep or goats and a lithic assemblage that contains a very high frequency of microliths made of either flint or obsidian. The AMS ^{14}C dates from Kalavan 1 cluster between 15,030–14,266 ^{14}C BP (Table 3) and indicate an MIS 2 occupational phase in the Getik River Basin. The chemical analysis of 18 obsidian samples (Gratuze, 2007) suggests procurement from sources located in the central part of the Lesser Caucasus (Tsaghkunyats, Gutansar, Hatis, and Geghasar), west and southwest of Lake Sevan.

Discussion

Based on the results of three field seasons it is clear that there are two in situ phases of Pleistocene hominin activity in Hovk 1 Cave. The earlier activity phase corresponds to Unit 8 and is dated by OSL to ~100 ka BP_{OSL}, an age which is stratigraphically consistent with a U-Th estimate of ~94 ka $BP_{U/TH}$ from the overlying Unit 6a (see Fig. 2). Purely on the grounds of artifact typology, it is also possible that deposits filling the karren are of similar age to Unit 8, suggesting that this phase of activity extended to the terrace fronting the cave. The cave thus provides firm indication of early Middle Paleolithic occupation in the southern Caucasus during MIS 5.

A partial collapse of the cave roof resulting in the formation of Unit 7 seems to have followed the deposition of Unit 8, while flowstone spread from the cave walls to cap the collapse later in MIS 5 (Unit 6a). Thereafter, there is a hiatus in the Hovk 1 stratigraphic record corresponding to late MIS 5 and MIS 4, while sediments laid down early in MIS 3 (Unit 6) are devoid of artifacts and may indicate that the cave was not then a locus of hominin activity. However, the numerous ursid bones, which include an almost complete articulated individual, suggest that the cave was used by hibernating bears during at least some parts of this period.

A second phase of in situ hominin activity in Hovk 1 Cave is evidenced by artifacts in Unit 5 and is associated with an AMS ^{14}C date of 39.12 ± 1.32 ka cal BP_{Hulu}. If this single age estimate is accepted as a reliable indicator for the age of Unit 5 (the results of further OSL and ^{14}C dates from this unit are forthcoming), it would indicate a further hiatus in the Hovk 1 record corresponding to most of MIS 3. Even though there is a lack of radiometric dates from Armenian Paleolithic strata for MIS 3 (Table 3, which outlines all current chronometric dates from Paleolithic sites in Armenia, demonstrates how acute this problem is), it is likely that layers from several sites correspond to this period. If the ~29–49 ka ^{14}C BP dates of Mousterian facies in the caves of Lusakert 1 and Yerevan 1 are accepted at face value, the data would imply that the Middle Paleolithic of central Armenia extended from at least mid-MIS 3 into early MIS 2 (see Fourloubey et al., 2003).

Floral and faunal data may serve as indicators of past environmental and ecological conditions. However, the quality of these data is not uniform and much of the new data from Hovk-1 are preliminary. Therefore, habitat reconstruction and the identification of climatic change is not a straightforward task at the current state of research. The paleoenvironmental data indicates that the floristic assemblages in units 4 through 8 are generally dominated by herbaceous plants, mainly Asteraceae and Caryophyllaceae. The pollen assemblages of all three pollen bearing units (4, 5, and 6) point to a pollen source that is an open vegetation with few trees in the vicinity. The plant remains of Unit 6 strongly imply an open landscape without any forest in the vicinity of Hovk-1. In Unit 5, tree pollen is rare and mainly dominated by *Pinus*. This flora attests to the existence of trees in the vicinity of the cave implying increased temperatures and a rise of tree line compared to Unit 6. The pollen flora of Unit 4 shows a further increase of tree line compared to Unit 5. The flora of Unit 4 contains fern spores that are generally not transported over considerable distances, and hence, the edge of the forest should have been located relatively close to the cave. Therefore, the three samples seem to document a change in vegetation from a pure grassland (Unit 6) to a more forested vegetation, and a rise of the tree line, indicating increasing temperatures in units 5 and 4.

While the existing floral dataset suggests that Units 4 and 5 experienced periods of increased warmth and moisture, as is evident from the rise of tree line, the faunal data do not reveal a clear pattern. Units 8, 5, and 4 all yielded the remains of woodland species (in particular roe and red deer). Future analysis of the micro-fauna and palynological samples from the site are required in order to reveal the role of environmental changes.

In terms of paleocological aspects, the high prevalence of Caucasian tur in Unit 5 has its parallels in the open air Upper Paleolithic site of Kalavan 2, and in the Ortvale Klde Rockshelter in Imereti, Georgia in which layer 4 (earliest Upper Paleolithic) and layers 5–7 (Middle Paleolithic) yielded 90% and 92.7–96.6% of *Capra caucasica* bones, respectively (Bar-Oz and Adler, 2005; Adler et al., 2006). High ratios of turs were also found in the Upper Paleolithic bone assemblage at Dzudzuana Cave, which is located nearby Ortvale Klde (Bar-Oz et al., in press).

The techno-typological analysis of the Hovk 1 Unit 8 artifacts highlights some typological similarities with assemblages from the Kudaro-Djruchula group (cf. Meignen and Tushabramishvili, 2006), for example those from Djruchula Cave (Imereti, Georgian Republic), Kudaro 1 and 3, and Tsona (South Osetia, Georgian Republic; Fig. 8). The lithic assemblages from these sites contain a high frequency of elongated Levallois points and blanks with low frequencies of debitage, cores, and other tool forms. The elongated Levallois points and blades share techno-typological similarities with Levantine and other Near Eastern early Middle Paleolithic industries such as those from Tabun D, Hayonim E, Abu Sif, Doura, and Hummal (Liubin, 1977, 1984, 1989; Beliaeva and Liubin, 1998; Bar-Yosef and Kuhn, 1999).

In both Djruchula Cave and Hovk 1 Unit 8, most of the tools and blanks are made of local raw materials of variable quality (Meignen and Tushabramishvili, 2006). At Djruchula Cave, layer 1 and layer 2 contain a high proportion of elongated blanks (62.6% and 42.2%, respectively) that were frequently transformed into points (Meignen and Tushabramishvili, 2006). Most of the artifacts from Unit 8 and the karren of Hovk 1 are either elongated Levallois blanks or retouched elongated Levallois points/blades ($n = 7$, or 58% in total). While no cores were recovered from Hovk 1 Unit 8, the dorsal scars on all blanks and tools indicate a unidirectional reduction technique. All elongated points are either slightly curved and/or twisted in profile (e.g., Fig. 4a, Fig. 5a). The Hovk 1 Unit 8 elongated tools have retouch along both edges (Fig. 4a), predominantly along one edge (Fig. 4b), only on the distal end (Fig. 4d), or in a non-uniform pattern (Fig. 5b). In all of these sites, the majority of Levallois tools and blanks are made on local raw material (for example, local flint in the case of Djruchula, [Meignen and Tushabramishvili, 2006], local limestone in Hovk) and tools made on obsidian are rare. These sites therefore share several techno-typological and economic aspects: (1) the Middle Paleolithic facies indicate a preference for Levallois elongated points/blades; (2) the high percentage of tools and blanks and the low percentage of debitage and cores indicate that the manufacturing process took place elsewhere, perhaps near the raw material sources; and (3) most of the utilized raw material is made from variable local sources, and tools made on high-quality materials from distant sources (e.g., obsidian, high quality flint) are very rare.

There are currently no published chronometric dates for Djruchula Cave, but preliminary TL analysis suggests that the Middle Paleolithic deposits fall between 250,000–150,000 years ago (Meignen and Tushabramishvili, 2006). The available thorium isotope, thermoluminescence, and radiocarbon dates for the Acheulian and Mousterian layers at Kudaro 1 and 3 do not provide

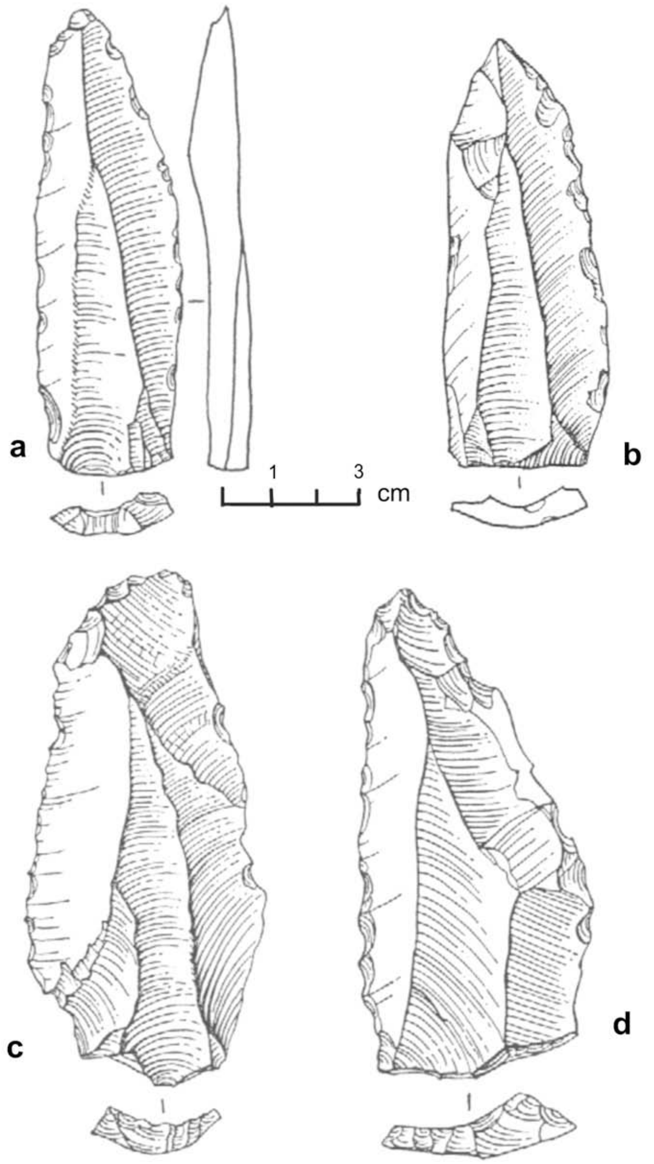

Fig. 8. Middle Paleolithic artifacts from Djruchula Cave (8:a) in Georgia, and Kudaro 1 Cave (8:b–d) in southern Osettia, modified from Liubin (1977).

a reliable sequence for the early Middle Paleolithic occupation in these sites (cf. Liubin, 2002). However, according to Liubin (1984, 1989), the Mousterian layers of Kudaro 1 and 3 caves were formed during hot climatic conditions, which most likely correspond to either MIS 7 or the Eemian Interglacial (MIS5e–d). We therefore hypothesize that the short episodes of occupation documented at Hovk 1 reflect the economic activities of small Middle Paleolithic hunter-gatherer groups whose lithic tradition extended across the southern Caucasus. The techno-typological similarities of these early Middle Paleolithic southern Caucasian sites with those from the Levant suggest the flow of information and possibly people across this wide geographic territory.

Radiocarbon age estimates for Upper Paleolithic levels from Mezmaiskaya Cave in the Azish-Tau Range, northern Caucasus (Golovanova et al., 1999) and Ortvale Klde Rockshelter in the southern Caucasus (Adler et al., 2006) fall between 38 and 34 ka ^{14}C BP (Adler et. al., this volume) and suggest a relatively late appearance of Upper Paleolithic cultures in these regions. The Middle-Paleolithic transition in the Zagros and Taurus regions is poorly understood at present due to limited research (Bar-Yosef, 2002). At Warwasi Cave in the Zagros, the early "Baradostian" or "Zagros Aurignacian" assemblages are dated 35.4–28.7 ka ^{14}C BP (Olszewski and Dibble, 1994), while new test excavation in Yafteh Cave, southwestern Zagros yielded a rich Aurignacian industry ^{14}C dated to ca. 35.5 ka ^{14}C BP (Otte et al., 2007). An Upper Paleolithic assemblage from Unit 8 in the open-air site of Garm Roud 2, Central Alborz, northern Iran, was ^{14}C dated to 23,920 $\pm$ 160 ^{14}C BP and 28,486 $\pm$ 190 ^{14}C BP and is contemporaneous with the Late Baradostian assemblage of Shanidar C (Berillon et al., 2007). These Upper Paleolithic assemblages appear to be a local development from the Middle Paleolithic Levallois and non-Levallois assemblages (Otte and Kozlowski, 2004). Hence, if Unit 5 in Hovk 1 indeed represents an Upper Paleolithic facies (as it may as well be a late Middle Paleolithic facies which utilized non-local obsidian sources), then the date of 33.8 ka ^{14}C BP suggests that the Upper Paleolithic transition in northeast Armenia occurred slightly after the transition in western Georgia, the Azish-Tau Range, and the Zagros region.

Conclusions

The chronology, lithics, and micromorphological analysis of Units 5 and 8 in Hovk 1 Cave provide firm evidence for human occupation in this high altitude region during the Last Interglacial and during the pleniglacial. The lithics of Unit 8 share techno-typological affinities with southern Caucasian Middle Paleolithic Levallois industries from the sites of Djruchula, Tsona, and Kudaro 1. The latter were reported to show techno-typological affinities to Early Levantine Mousterian from Hayonim lower E and F, Hummal Ia, and Abu Sif (Meignen and Tushabramishvili, 2006).

In the absence of hominid fossils from the region, we can only speculate as to who was making the lithic tools at Hovk 1. The 33.8 ka ^{14}C BP AMS date for Unit 5 indicates that the few lithic finds from this stratum may either belong to a late Middle Paleolithic or an early Upper Paleolithic facies; none of the artifacts recovered are "index fossils." No hominin fossils have so far been recovered in association with Early Mousterian assemblages (from Hovk 1, Kudaro 1 and 2, Tsona), and all Middle Paleolithic hominin fossils from Caucasian sites are of Neandertals associated with late Middle Paleolithic assemblages (Liubin, 1984). Thus, if one is to accept the conjecture that techno-typological affinities are directly associated with biological affinities, then either an Archaic *Homo sapiens*, early *Homo sapiens neanderthalensis*, or early modern *Homo sapiens sapiens* population occupied the southern Caucasus during the late middle Pleistocene/early upper Pleistocene period, and may have been part of an extensive hominin network extending as far east as the Levantine shores of the Mediterranean.

Ongoing research in the Aghstev River Basin (Hovk 1, Kalavan 1, Kalavan 2, and a new excavation in Yenokavan 1) will result in a more complete archaeological sequence for the Middle and Upper Paleolithic records of the Transcaucasus. Meanwhile, the date for Unit 8 at Hovk 1 provides the first chronometric indication of Middle Paleolithic occupation in the southern Caucasus.

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