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DATING THE EARLY MIDDLE PALAEOLITHIC LAMINAR INDUSTRY FROM DJRUCHULA CAVE, REPUBLIC OF GEORGIA

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Abstract: *Middle Palaeolithic blade industries have been known for many years from the southern part of the Great Caucasus. Recently published technological studies demonstrate strong affinities between the laminar assemblages from Djruchula Cave (Republic of Georgia) and those from several Near Eastern Early Middle Paleolithic sites. A series of new thermoluminescence dates from Djruchula Cave indicate at least two distinct human occupation phases (between 210/260 ka for Layer 2 and later around 140 ka for Layer 1), with a long chronological gap in between. Combined with the available dates from Near Eastern laminar assemblages, these new results illustrate the use of the same production systems of blades across these two large regions between 260 and 140,000 years ago.*

Résumé : *Des industries à lames du Paléolithique moyen ont été identifiées depuis longtemps dans la partie sud du Grand Caucase. Les études technologiques récemment publiées sur les industries de Djruchula en Géorgie ont montré les fortes affinités que ces dernières présentaient avec les industries laminaires de cette période, désormais bien connues au Proche-Orient. Une petite série de datations par la méthode de la thermoluminescence, provenant de la grotte de Djruchula (fouilles D.M. Tushabramishvili) met en évidence l'existence de deux périodes d'occupation dans cette grotte (entre 210 et 260 000 ans pour la couche 2, et aux environs de 140 000 ans pour la couche 1), séparées par un long laps de temps sans occupation humaine. Combinés avec les datations précédemment acquises au Proche-Orient, ces résultats montrent l'existence, entre 260 et 140 000 ans, de traditions techniques très proches, caractérisées par l'adoption des mêmes systèmes de production de lames dans ces deux grandes régions.*

Keywords: *Middle Palaeolithic; Southern Caucasus; Radiometric Dating; Laminar Assemblages.*
Mots-clés : *Paléolithique moyen ; Sud Caucase ; Datations radiométriques ; Outillages laminaires.*

Recent research demonstrates that the production of blades is an integral part of Mousterian technological variability since the last *ca* 250 ka. In addition to the well documented and dated blade assemblages from the Early Mousterian in the Levant[1] and from Northwestern Europe during the Last Interglacial,[2] we present similar new data from Djruchula Cave located in the Southern Caucasus.

In the Levant, several researchers have noted the systematic production of elongated blanks (blades and elongated

1. MARKS, 2003; MARKS and MONIGAL, 1995; MONIGAL, 2001 and 2002; MEIGNEN, 1994; 2000 and 2007a.
2. CONARD, 1990; CONARD and ADLER, 1997; DELAGNES, 2000; RÉVILLION, 1995; RÉVILLION et TUFFREAU, 1994.

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points) and the persistence of this technological tradition,[3] although these researchers have also identified technological differences among the published assemblages. Stratigraphically, elongated blanks, or blades as they are most often termed, are associated with Middle Pleistocene deposits dated to the Early Levantine Mousterian around between 270 and 160 ka ago (TL and U-series ages),[4] and several core reduction strategies were employed in the production of blades.[5] The excavators of Djruchula and Koudaro Caves in the Southern Caucasus noted certain affinities between the assemblages of these sites and the Early Levantine Middle Palaeolithic blade assemblages,[6] and the laminar character of these assemblages led V.P. Liubin[7] to classify them as immediate precursors of the Upper Palaeolithic.

The clearest example of a blade assemblage from the Southern Caucasus is that discovered by D.M. Tushabramishvili at Djruchula Cave in the 1950's. D.M. Tushabramishvili proposed the name "Djruchula-Koudaro group"[8] and recently L.V. Golovanova and B. Doronichev[9] referred to it as the "Djruchulan." The morphological resemblance of these assemblages to those from the Levant has been recognized,[10] however, they are presumed to have been produced exclusively *via* the Levallois method.[11]

In an attempt to assess these interpretations the lithic assemblages from Djruchula Cave (fig. 1) were analyzed in detail, and the results demonstrate their affinities with the Levantine industries.[12] But it is also important to establish the chronological relationship with Levantine sites and so a dating program was initiated at Djruchula Cave. It is our goal to test whether the apparent technological affinities identified across Southwestern Asia during the Middle Pleistocene reflect a geographically broad, largely contemporaneous cultural adaptation.

3. BAR-YOSEF, 1998; BAR-YOSEF and KUHN, 1999; MARKS, 2003; MEIGNEN, 2007a-b; MONIGAL, 2001 and 2002.
4. MERCIER *et al.*, 1995; 2000 and 2007; RINK *et al.*, 2003 and 2004; VALLADAS *et al.*, 1998.
5. MARKS and MONIGAL, 1995; MEIGNEN, 2000 and 2007a-b.
6. LIUBIN, 1977 and 1989; TUSHABRAMISHVILI, 1969; TUSHABRAMISHVILI, 1994.
7. LIUBIN, 1977 and 1989.
8. *Ibid*.
9. GOLOVANOVA and DORONICHEV, 2003.
10. BELIAEVA and LIUBIN, 1998.
11. *Ibid.*; LIUBIN, 1977; TUSHABRAMISHVILI, 1969; TUSHABRAMISHVILI, 1994.
12. MEIGNEN et TUSHABRAMISHVILI, 2006; MEIGNEN and TUSHABRAMISHVILI, in press.

DJRUCHULA CAVE AND ITS CONTEXT

Djruchula Cave is located in the Imereti region of the Republic of Georgia (fig. 2), in the southern foothills of the Great Caucasus.[13] The Caucasus is a major range reaching heights of 5,000 m asl and stretches roughly 1,000 km between the Black and Caspian seas. It is conceivable that during glacial periods the higher Caucasus served as a geographic boundary that limited human movements only to the coastal areas along the Black or Caspian seas. Such boundary conditions prevailed during the Late Mousterian (~38,000 ^{14}C BP) as evidenced by the recovery of very different types of Middle Palaeolithic industries on either side of the Caucasus (*e.g.*, Mezmaiskaya Cave and Ortvale Klde).[14] However during the Early Upper Palaeolithic (< 38,000 ^{14}C BP) significant technological and typological similarities are clearly evident between the two regions, probably reflecting the swift penetration of this geographic boundary by Early Upper Palaeolithic people.[15]

Djruchula Cave is situated at an altitude of about 600 m asl and at an elevation of about 40 m above a tributary of the Kvirila River that bears the same name. It is a large hall that opens to the northeast. During the excavations of D.M. Tushabramishvili, conducted from 1958-1967, almost the entire volume of the cave was excavated, leaving only a two-meter deep section (*témoin*) of sediment along the back wall. D.M. Tushabramishvili identified several lithostratigraphic layers, mostly composed of clayey sediments with angular limestone fragments (figs. 3-4). In this sequence two archaeological layers were identified, namely Layers 1 and 2, separated by about one meter of sterile sediment.[16] At the top, archaeological Layer 1 is composed of lithostratigraphic Sub-Layers I-VII, with the majority of archaeological material deriving from Layers II-VI. Archaeological Layer 2 includes lithostratigraphic Layers IX-XVI, but the archaeological material was collected essentially from Layer XII (fig. 4).

D.M. Tushabramishvili and N. Tushabramishvili conducted lithic analyses of the assemblages from Layers 1 and 2, focusing on typological classification, but this research was not published; a summary of the lithic data is available in D.S. Adler and N. Tushabramishvili.[17] Recently L. Meignen

13. TUSHABRAMISHVILI, 1969 and 1984.
14. ADLER *et al.*, 2006a-b and 2008; GOLOVANOVA *et al.*, 2006.
15. *E.g.*, ADLER *et al.*, 2006a-b and 2008; BAR-YOSEF *et al.*, 2006; GOLOVANOVA *et al.*, 2006; MESHVELIANI *et al.*, 2004.
16. ADLER and TUSHABRAMISHVILI, 2004; TUSHABRAMISHVILI, 1984.
17. ADLER, 2002; ADLER and TUSHABRAMISHVILI, 2004.

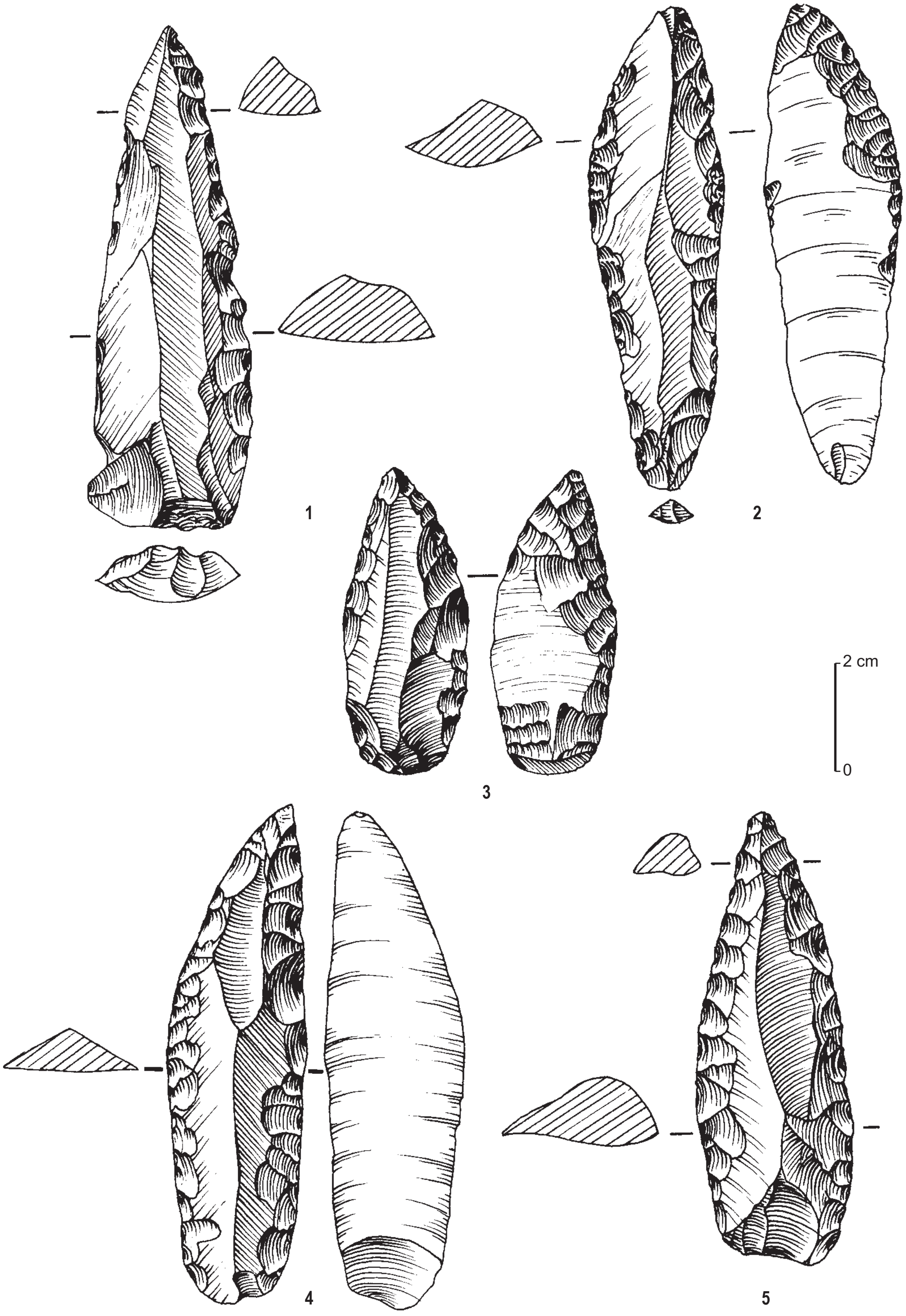

Fig. 1 – *Lithic assemblages from Djruchula Cave: elongated retouched points (2 and 3, with invasive retouches on ventral face). (Drawings originally drawn by D. TUSHABRAMISHVILI have been reworked and standardized by J. COURBET, CNRS-UMR 6130, CEPAM.)*

Fig. 2 – *Map of Georgia and location of the three main laminar assemblages (Djruchula, Koudaro and Tsona).*

and N. Tushabramishvili[18] published a detailed techno-typological and techno-economic study that also took advantage of the available results concerning the Middle Palaeolithic blade assemblages of the Levant. This study demonstrates the strong resemblance between the lithic industries from Djruchula Cave and some Near Eastern Early Middle Palaeolithic sites (*e.g.*, Hayonim Lower E and F, Hummal and Abou Sif) in terms of core reduction strategies (coexistence of Levallois and Laminar production systems) and tool-kits (numerous diverse retouched points).[19] According to Meignen and Tushabramishvili,[20] artifact densities, calculated as the average number of finds *per* cubic meter, are low in Layers 1 and 2 (n = 14 and 19, respectively) and most of these are retouched elongated products (blades and points). This observation led previous researchers to conclude that the occupations at Djruchula Cave were brief and ephemeral.[21] The raw materials used for the production of the lithic artifacts originate from various local sources. Cenomanien-Turonien flint of red or brown-yellow colors was likely collected on the plateau above the cave (< 5 km), while a variety of other nodules and cobbles were gathered from the gravels of the Djruchula River immediately below the site. The only non-local raw material, represented in very low frequencies, is obsidian, the nearest source of which is > 100 km away, to the southeast, in Chikiani near Paravani Lake.

18. Meignen et Tushabramishvili, 2006.
19. Meignen, 2007b and in press.
20. Meignen et Tushabramishvili, 2006.
21. Adler and Tushabramishvili, 2004; Liubin, 1977 and 1989; Tushabramishvili, 1984; Tushabramishvili, 1994.

Detailed techno-economic studies[22] demonstrate that the behavioral patterns observed at Djruchula Cave shifted from the relatively intensive use of the cave (provisioning activities, such as the importation of finished tools, and *in situ* core reduction of local raw materials) in the earliest occupation (Layer 2), to more ephemeral, task-specific use during later occupations (Layer 1), as evidenced by a reliance on curated tools. In these respects Djruchula Cave does not represent a central habitation site, but rather a specialized, perhaps seasonal hunting camp. We believe that the site functioned as a known point in the landscape where small groups of hunter-gatherers occasionally brought prey after successful hunts.

DATING THE DJRUCHULA LAMINAR INDUSTRY

In order to obtain chronological information for Layers 1 and 2, a sample of artifacts showing signs of past heating were selected by N. Mercier, D.S. Adler and N. Tushabramishvili from the collections of the Georgian National Museum, Tbilisi, and subjected to Thermoluminescence (TL) dating; it was not feasible to obtain new samples from the cave as little sediment remains for excavation. Study of each sample's TL signal indicated that only six pieces had been heated to a temperature sufficiently high for dating purposes.[23] Museum records indicate that samples DJ1, DJ2, DJ21 and DJ22 were recovered from Layer 2 while DJ6 and DJ15 come from the Layer 1. Half of the samples (DJ6, DJ15 and DJ21) originated from the central part of the cave where all the original sediment was removed during past excavations, while the others (DJ1, DJ2 and DJ22) come from the back of the cave, roughly two meters away from the remnant sediment profile (*témoin*).

In the present study, the greatest difficulty in obtaining reliable dates was to estimate the radiation dose received by the samples during their burial. In particular, it was of paramount importance to get maximum information on the gamma dose-rate to which the flints were subjected in the sediments. For this purpose, three $CaSO_4$:Dy dosimeters were inserted three meters apart at the back of the cave for one year. They registered values that correspond to dose-rates of 1,479, 1,436 and 963 µGy/a. When retrieving the dosimeters, it was observed that one was situated within the vicinity of a large rock that had fallen from the roof and it is suspected that the recorded

22. Meignen et Tushabramishvili, 2006.
23. Valladas, 1992.

Fig. 3 – *View of Djruchula Cave close to the end of D. Tushabramishvili's excavations. (Photo by D.M. Tushabramishvili.)*

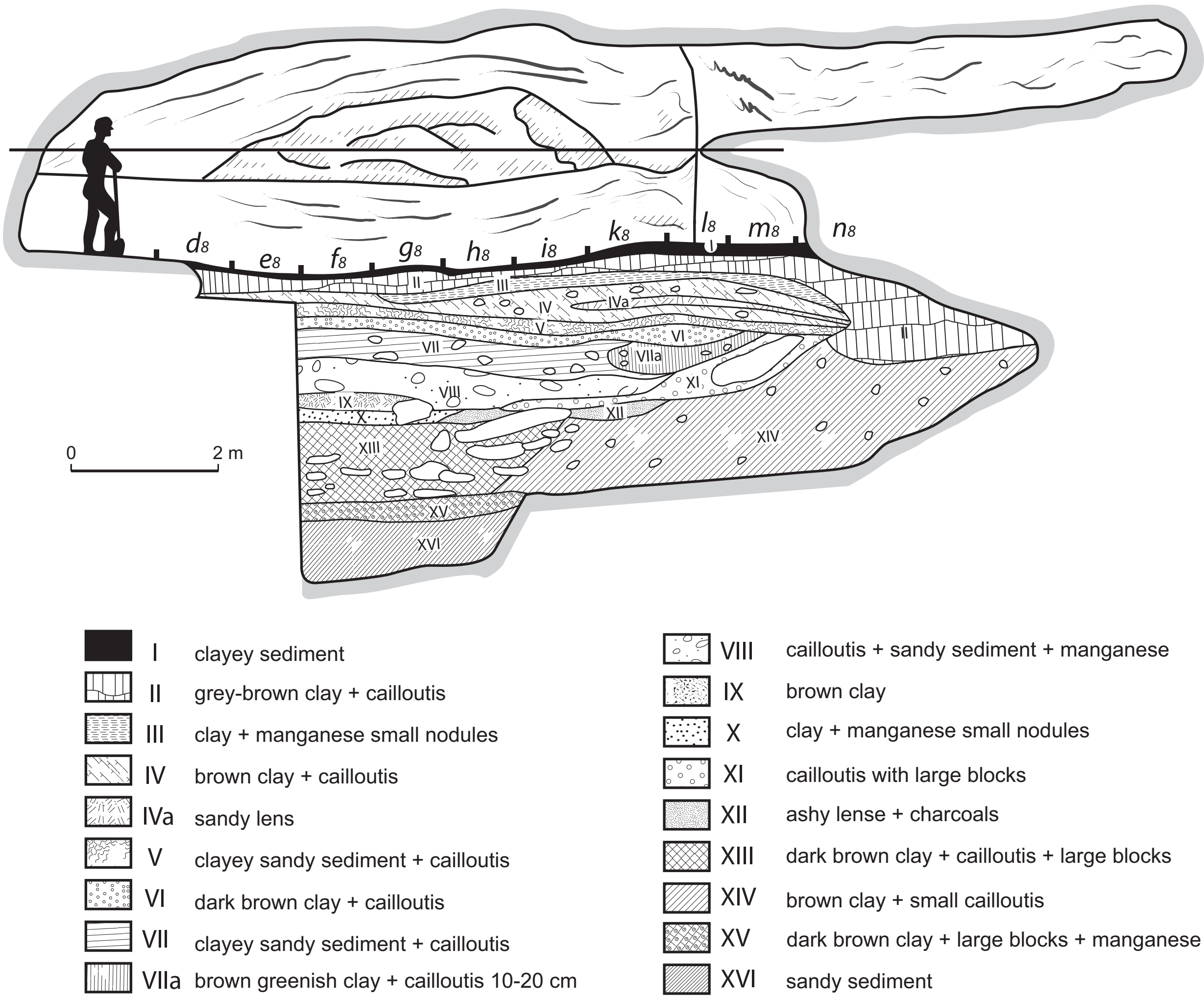

Fig. 4 – *Profile of Djruchula Cave after D.M. Tushabramishvili 1960-1961 (unpublished).*

Table 1 – *Radioisotope contents (U, Th, K) of each flint sample were measured by neutron activation analysis at the Pierre Süe Laboratory (*Joron*, 1974) and have a precision of 10%. The µ-sensibility (µGy/a/10^3 alpha/cm^2) was determined by comparing the TL signals induced by alpha and beta particles originating from a Pu-238 and a Sr-90 artificial sources, respectively. The alpha and beta dose-rates were deduced from the radioisotope contents and dose-rate conversion factors calculated by* Adamiec *and* Aitken*, 1998. The cosmic dose-rate was estimated to 20 µGy/a from the thickness of the rock roofing and data from* Prescott *and* Hutton*, 1988. The equivalent dose was computed according to* Mercier et al.*, 1992 in using the 380°C TL signal.*

Sample N°	Layer	Square	U (ppm)	Th (ppm)	K (%)	^{a}-sens.	Dose-Rate (µGy/a)								Equivalent Dose (Gy)		Age (ka)	
							Alpha	Beta	Internal		External		Annual					
										±		±		±		±		±
DJ6	1	H8	1.454	0.076	0.037	22.5	560	244	813	68	1233	111	2046	130	286	14	140	13
DJ15	1	I7	0.659	0.139	0.064	14.4	170	150	326	22	1220	110	1546	112	213	16	138	15
DJ1	2	I13	0.096	0.050	0.031	23.5	44	40	85	7	1207	109	1293	109	294	26	227	30
DJ2	2	C14	0.960	0.099	0.039	18.0	300	173	486	38	1169	106	1655	112	348	59	210	34
DJ21	2	I8	0.359	0.061	0.028	14.6	93	76	171	14	1233	111	1404	112	364	15	259	26
DJ22	2	F13	0.145	0.084	0.033	19.3	55	49	106	7	1207	109	1314	109	319	17	243	26

dose-rate (963 µGy/a) is not representative of the sediment. This measurement was discarded. To get additional data, three analyses were performed in the remaining sediments with a probe sensitive to gamma rays. Analysis of the spectra determined the following dose-rates (1,220, 1,350 and 1,209 µGy/a), which are in the same range as the dosimeters results. The combination of the five selected values led to an average dose-rate of 1,339 ± 123 µGy/a. Since the standard deviation does not exceed 10%, it seems that the gamma dose-rate is relatively homogeneous in the sediments over distances of several meters. This average value was used to calculate the TL age estimates listed in table 1.

The four samples from Layer 2 produced coherent TL ages (DJ1: 227 ± 30 ka; DJ2: 210 ± 34 ka; DJ21: 259 ± 26 ka; DJ22: 243 ± 26 ka), which are significantly older than the two age estimates obtained for Layer 1 above (DJ6: 140 ± 13 ka and DJ15: 138 ± 15 ka). It is also noteworthy that two samples, DJ6 and DJ15, produce similar results despite significantly different radioisotopic contents and internal dose-rates differing by more than a factor of two (see table 1). The same coherence can be noticed for Layer 2 since samples DJ1 and DJ2 show internal dose-rates of 85 and 486 µGy/a, respectively. The consistency of these results support the idea that the average gamma dose rate estimate is likely representative for all the dated specimens.

By plotting these radiometric data against the marine isotopic scale[24] (fig. 5), it seems that the TL ages reflect at least two distinct human occupation phases, one (or perhaps two) at the boundary Marine Isotopic Stages (MIS) 8-7 or during MIS 7, and another in the second half of MIS 6. Consequently, these results show that human occupations occurred 210/260 ka ago and later around 140 ka, with a long chronological gap between them corresponding to the sterile layer observed in the field and to possible erosive episodes not fully identified in the excavation records. These new chronological data indicate that the makers of the laminar Early Middle Palaeolithic industries in the Southern Caucasus were generally contemporary with their counterparts in the Levant, and shared a techno-typological tradition of blade production and use. However it is currently impossible to test whether these similarities result from the range expansion of a single population, information exchange over large territories, or technological convergence.

DISCUSSION

The archaeological and radiometric data from Djruchula Cave speak to the short-term occupation of the site by Early Middle Palaeolithic hominins between 260 and 140 ka ago. Most of the lithic artifacts from Layer 1 are retouched points that arrived on site as prepared blanks, perhaps as a form of "personal gear,"[25] and were resharpened and modified as indicated by their high frequency of retouch and the small number

24. Bassinot *et al.*, 1994.

25. Binford, 1977 and 1979; Kuhn, 1995.

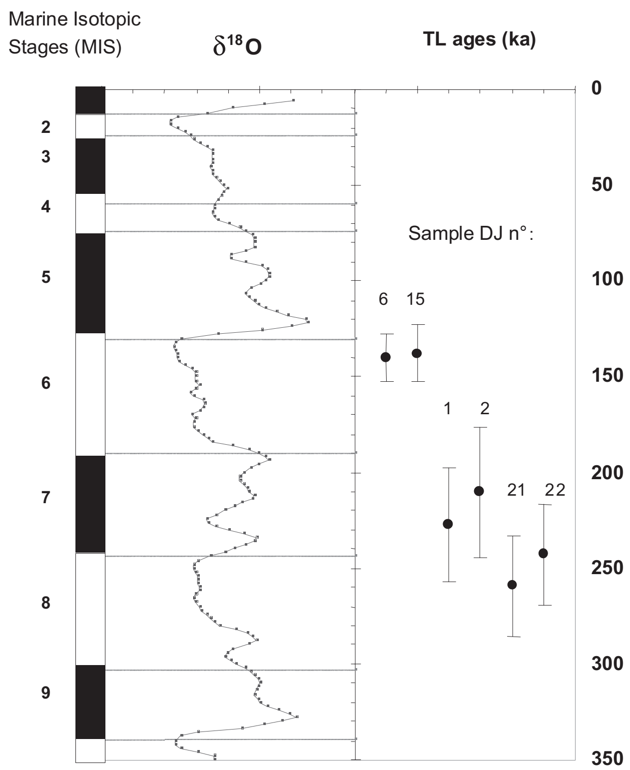

Fig. 5 – *TL ages* versus *Marine Isotopic Stages (MIS) (*Bassinot *et al., 1994). The results indicate a possible occupation of the cave at the end of MIS 8 or at the beginning of MIS 7 and during this stage. Human presence also seems possible at the end of MIS 6.*

of cores. The lithic assemblage from Layer 2, which contains fewer imported retouched points, is represented by a higher frequency of cores and by-products and flakes, often on strictly local raw material, and documents the production of an expedient industry. These data are generally in agreement with studies that suggest highly mobile foragers should preferentially choose to transport blanks (as in Layer 1), rather than cores (as in Layer 2), assuming issues of mass *versus* potential utility are of primary concern.[26] In these respects the qualitative and quantitative difference identified between the assemblages from each layer reflect differing strategies of mobility and raw material transport and use.

Early blade technologies in the Middle Palaeolithic and even the Late Lower Palaeolithic are known from several localities in the Old World, but few of these are securely dated. Assemblages containing blades produced from large prismatic cores are known from the Kapthurin Formation, Kenya, and date to > 240 ka (K-Ar ages)[27] and 509-545 ka (Ar-Ar ages) at the base of the Formation.[28] Systematic and intensive blade production is documented at Middle Pleistocene sites in Southwestern Asia stratigraphically included in the Acheuleo-Yabrudian sequence (Lower Palaeolithic). These include the "Pre-Aurignacian" from Yabrud[29] and the "Amudian" from Tabun Cave,[30] Abri Zumoffen/Adlun,[31] Zuttiyeh Cave,[32] Maslouk[33] and Qesem Cave.[34] Recent U-series dating of the long archaeological sequence at Qesem Cave provides an age range from 210-380 ka[35] for the Amudian layers, which is close to the TL date of 264 ± 28 ka for the same industry from Unit XI at Tabun Cave.[36] Nevertheless, more radiometric analyses are required in order to precisely date these late Lower Palaeolithic laminar assemblages.

Unlike Amudian/Pre-Aurignacian assemblages, more recent Early Middle Palaeolithic blade assemblages, called the "Early Levantine Mousterian," are known from several Northern and Southern Levantine sites that are stratigraphically positioned above the Acheuleo-Yabrudian complex. Recent technological studies show that this Early Middle Palaeolithic entity, less homogeneous than previously thought, includes assemblages with variable reduction strategies for blade production (both Levallois and/or prismatic blade technologies)[37] and different tool-kits. Based on technological and typological criteria, two separate groups of blade-dominated assemblages are discernable.[38] The first group, characterized by the prevalence of the Laminar method and numerous elongated retouched points and blades is recognized in Layers lower E and F at Hayonim Cave, TL-dated to 160-220 ka,[39] at Hummal Layers 6-7, TL-dated to 160-250 ka,[40] at Abou Sif (no dating available), and probably at Misliya.[41]

The second group, in which the Levallois method for elongated blank production is clearly dominant and the tool-kits

26. Bar-Yosef and Kuhn, 1999; Kuhn, 1994 and 1995.

27. McBrearty *et al.*, 1996; Texier, 1996.
28. Johnson and McBrearty, 2010.
29. Bakdach, 1982; Rust (von), 1950.
30. Garrod, 1956.
31. Copeland, 1975; Garrod, 1961.
32. Gisis and Bar-Yosef, 1974.
33. Skinner, 1970.
34. Barkai *et al.*, 2005.
35. Barkai *et al.*, 2003.
36. Mercier and Valladas, 2003.
37. "Laminar system" *sensu* Meignen, 2000; Boëda, 1995; Marks and Monigal, 1995; Meignen, 1994; 2000 and 2007a; Monigal, 2002.
38. Meignen, 2007b; Monigal, 2002.
39. Mercier *et al.*, 2007.
40. Richter, *in*: Le Tensorer *et al.*, 2006.
41. Weinstein-Evron *et al.*, 2003, dating in progress.

(including burins) more diversified, is represented by assemblages from Tabun Cave Unit IX, TL-dated to 256 ± 26 ka[42] and Rosh Ein Mor, tentatively dated to 201 ± 9 ka on ostrich eggshell with the U-series method.[43] The dates currently available, albeit few, demonstrate that these two groups do not represent successive stages in the evolution of laminar technology[44] but developed side by side in the Levant between 160 and 270 ka[45] and thus all belong to a single technical entity, the Leptolithic techno-complex.

The lithic assemblages from Djruchula Cave, represented by both Laminar and Levallois systems and with tool-kits composed mainly of elongated retouched points and blades, are thus closely affiliated with the first group. They could belong to this widespread technical entity identified in South-Western Asia. While the available data are insufficient to document clear demographic links between the Southern Levant and the Southern Caucasus, it is probable that sites such as Djruchula, Koudaro and Tsona Caves (2,000-2,200 m asl) are the northern-most representatives of the Early Middle Palaeolithic Leptolithic techno-complex. It seems that the High Caucasus mountains served as a natural barrier at that time and limited the expansion of the Middle Palaeolithic leptolithic tradition to the North (Russian Plains, Central Europe) where these industries are still unknown.

Laminar technologies appear somewhat later in Europe. Northern Europe is especially rich in early blade industries such as those from Northwest France,[46] Germany[47] and Belgium.[48] As in the Levant, various core reduction strategies for blade production are involved (Levallois for elongated blanks and Laminar). Interestingly, most of these assemblages date to MIS 5 a-d (beginning of the Last Glacial), and they tend to disappear from later Middle Palaeolithic assemblages found within the same regions; there is no evidence for a shift to the use of blades in the Late/Final Mousterian.

Given the geographic and temporal discrepancy between Northern Europe and the Levant, the development of the laminar assemblages in each region must be considered as a case of technological convergence, however blade technology waxes and wanes markedly over time and early blade-based assemblages are in general subsequently replaced by flake-based technologies later in the Middle Palaeolithic.[49] It appears that this technological option was utilized periodically by Middle Palaeolithic hominins only in certain regions, whereas the use of blades and bladelets was a major and widespread component of Early Upper Palaeolithic hominins who occupied the same areas of Western Eurasia 45 ka ago.

42. MERCIER and VALLADAS, 2003.
43. RINK *et al.*, 2003.
44. *Contra* MONIGAL, 2002.
45. MEIGNEN, 2007b.
46. DELAGNES, 2000; LOCHT, 2002; RÉVILLION et TUFFREAU, 1994; RÉVILLION, 1995.
47. CONARD, 1990; CONARD and ADLER, 1997.
48. OTTE, 1994.
49. BAR-YOSEF and KUHN, 1999.

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