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MOUSTERIAN LITHIC ASSEMBLAGES OF MERDIVENLI CAVE

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ABSTRACT

Most scientists agree that modern humans left Africa relatively recently. However, there is less agreement about the number of dispersal events and the route or routes taken by humans and when they migrated out of Africa. The earliest evidence for a dispersal of *Homo sapiens* into Eurasia comes from the central Levant, but it is unclear how geographically extensive this early dispersal was. Likewise, many researchers agree that Neanderthals dispersed back into the Levant during MIS 5 (123-130 Ka.), but it is uncertain where those populations originated. Information from areas geographically intermediate between the Levant and more distal parts of Eurasia is crucial to obtaining a more realistic understanding of the ebb and flow of human Pleistocene populations. This article examines Middle Paleolithic artifact assemblages from Merdivenli Cave in the Hatay Region, southern Anatolia (Turkey) in order to assess the similarities with better known assemblages from neighboring areas. The stone tools from Merdivenli Cave are characterized Levallois production similar to "Tabun C type" Mousterian assemblages, and therefore it is possible that these assemblages were also associated with archaic *Homo sapiens*, as in the central Levant.

KEYWORDS: Turkey, Levant, Middle Paleolithic, Human Dispersals

1. INTRODUCTION

Research conducted over the past two decades in the Levant has shown the Middle Paleolithic to have been a period of dynamic evolutionary change in both anatomy and behavior. The early modern human fossils from Skhul and Qafzeh caves (80–130 Kyr.) are similar in age to early *Homo sapiens* fossils from Africa. In contrast Levantine Neanderthal fossils date to 47–112 Kyr, primarily the latter end of that range (Shea 2003). The general consensus is that the Neanderthals are of European origin but that early *Homo sapiens* came to the Levant from Africa. Yet although the Levant appears to have been a corridor for movement of diverse Middle Paleolithic hominin populations, we know comparatively little about the adjoining regions, the places from which those hominin populations might have come or to which they might have dispersed. The great majority of high-quality archaeological and fossil evidence comes from the central and southern Levant. Comparatively little is known of the northern Levant (but see Akazawa et al. 1971, 1995; Hauck 2011). This paper describes the lithic assemblages from the Middle Paleolithic site of Merdivenli cave. Merdivenli cave is situated on the Mediterranean coast of Hatay province, Turkey, near the village of Mağaracık and at the edge of the ancient city of Seleukia (modern Çevlik) (figure 1), placing it at the most northern edge of the coastal Levantine zone. Given the site's position at the interface between the Levant and Anatolia, the industry is important to our understanding of the Levantine Middle Paleolithic, the Mousterian in Turkey and potential exchanges of populations between Anatolia and the Levant during the late Pleistocene.

2. COASTAL GEOLOGY AND TOPOGRAPHY OF THE MERDIVENLI AREA

The Hatay is located at the northern end of the Levantine coastal corridor where it meets the Anatolian landmass south of the Toros Mountains. The north-south trending Dead Sea Rift system, a northern continuation of the Great Rift that forms the Red Sea, extends into the Hatay. The Rift is bordered on the east and west by mountain. The main and regional structure leading the study area strike-slip neotectonic domain (Doğan *et al.,* 2012) is the East Anatolian Fault System. Three major seismicity structures are the North Anatolian Fault System, the East Anatolian Fault System and the Dead Sea Fault System. The geological structure of the area includes magmatic and sedimentary with metamorphic rocks. In the Hatay, the magmatic rocks are ophiolitic, Upper Cretaceous in age. These are covered with Cretaceous and Oligo-Miocene limestones. The sediments of the lower altitudes and plains date to the lower Paleozoic and Quaternary (Mentzer 2011).

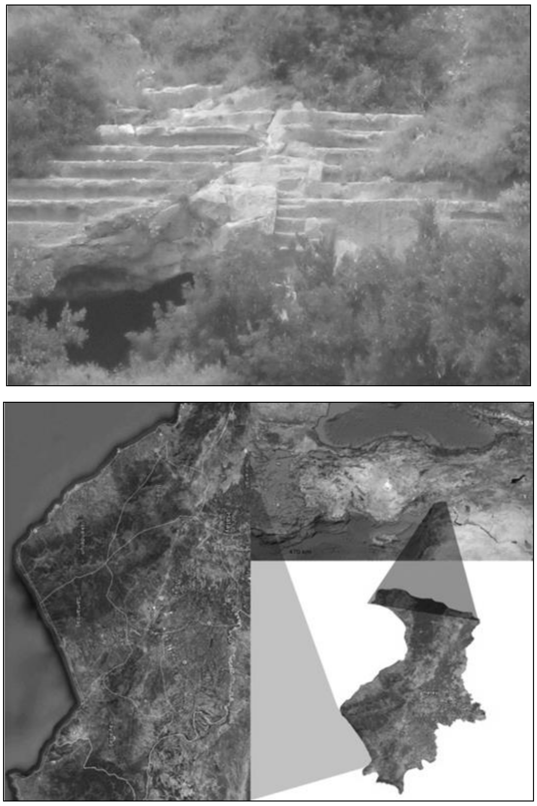

Figure 1. Location and photo of Merdivenli Cave

Merdivenli cave is located at the foot of the Amanos-Musa mountain range, the southeastern part of which is covered by the lower Asi (Orontes) river delta. The Helvetian (Miocene) limestones which form the lower slopes of the mountians contain many caves. Erol (1963) suggested that the physical structure of the limestones, combined with high rates of tectonic uplift and erosion from sea waves combined to form the caves in the Çevlik/Mağaracık area. There are several other documented Paleolithic sites in the Çevlik/Mağaracık area in addition to Merdivenli cave, including Tıkalı (Bostancı 1968) and Kanal caves (Şenyurek 1959) and Üçağızlı and Üçağızlı II caves about 10 km to the south on the other side of the Asi river mouth. Tıkalı cave was described as containing a Levantine-type "Upper-Levallois Mousterian" industry. Kanal Cave contained both Upper and Middle Paleolithic strata. Bostancı (1968) described the Upper Paleolithic of Kanal as early Aurignacian, but Kuhn et al (1999) found that the assemblages belonged to the Initial Upper Paleolithic, as in Üçağızlı I. Üçağızlı I, excavated from 1997 to the present, preserves a deep sequence (> 3 m) of early Upper Paleolithic deposits dating from 27.000 through 41.000 (Uncalibrated C^{14}) years BP (Kuhn et al. 2009; Güleç et al. 2000, 2008). A test trench excavated at Üçağızlı II in 2005 and 2007, revealed a two-meter deep sequence of Mousterian deposits.

3. SITE SITUATION AND HISTORY OF INVESTIGATION

Merdivenli cave is approximately 1 km from the current Mediterranean Sea shore at an elevation of about 39 meters above sea level (figure 2). The main chamber is roughly 20 meters long, six meters wide and four meters high. On the eastern and western walls and the ceiling of the cave adhering deposits of cemented sandstone contain fossils of mammals and terrestrial gastropods. This sandstone is thought to represent a period when fresh water flooded the cave to the ceiling. Enver Bostancı and Muzaffer Şenyürek from Ankara University excavated Merdivenli cave in three separate field seasons in 1956/57, briefly reporting their findings in publications in Turkish (Şenyürek and Bostancı 1958a,b). The investigators excavated five different trenches in Merdivenli cave, four of which adjoin each other. Maximum final depths differ among the five trenches. The deepest point excavated was 5.7 meters below the surface. The cave was used as a quarry in Roman times and the east wall was heavily altered by quarrying activities. A stairway carved into the bedrock above the cave mouth gives the site its name (cave with a stairway). As a consequence of these activities most of the Paleolithic cultural layers are mixed with quarry debris, especially in the front part of the cave. Only trenches I and IV seem to have escaped most of the disturbance.

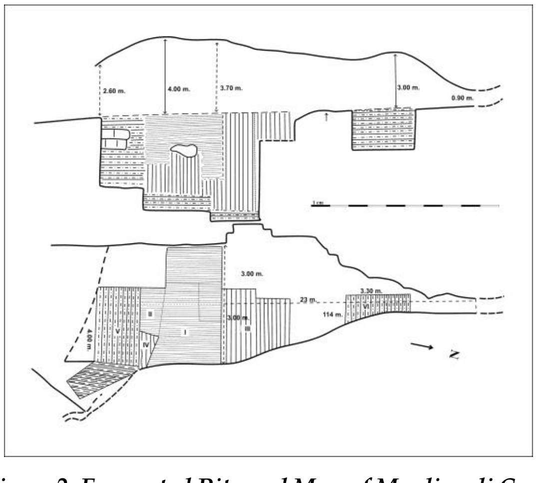

Figure 2: Excavated Pits and Map of Merdivenli Cave (Adopted from Şenyürek and Bostancı 1958a)

The excavators defined five stratigraphic layers at the site based on field observations. Layer I supposedly belonged to Roman times; Layers II and III were considered Upper Paleolithic based on the presence of blades, scrapers and burins; and layers IV and V were attributed to the "Upper-Levallois Mousterian" culture with points and side scrapers. Layer I is described as black in color, and was 25-35 cm thick. Layer II was lighter brown and up two 118 cm thick. Layer III is again described as black, and is approximately 50 cm thick. The thickness of layer IV amounts to 191 cm, and the sediments are dark brown. Layer V is underlain by a very thick deposit of culturally sterile marine sand, which Bostancı and Şenyürek further subdivided into seven units. In the fourth trench, large blocks of limestone fallen from the cave's ceiling were found between Layer V and the sand, prompting Şenyürek and Bostancı (1958a) to suggest "*a rather long interval of time had elapsed between the time this sea sand was deposited and the settlement of the cave by the makers of the Upper Levallois – Mousterian culture*" (translation ours). Based on the gastropod shells found within it, the upper part of the marine sand was assigned to the Pleistocene, whereas the lower part was attributed to the Miocene (Şenyürek and Bostancı 1958a).

4. ARCHAEOLOGICAL MATERIAL FROM MERDIVENLI CAVE

The present report is based on a recent re-analysis of the collections from Bostancı and Şenyürek's excavations at Merdivenli, which are housed in the Laboratory of Anthropology Department at Ankara University. Bostancı and Şenyürek did not describe their methods of excavation and recovery in detail. It is obvious that the excavators did not retain all the artifacts from the excavation, but preferentially collected the retouched pieces and a non-random sample of the larger unretouched flakes and cores. We are confident that the retouched pieces constitute a representative and relatively complete sample, but the collection of unretouched flakes and cores should be considered an informal "grab sample" subject to unknown biases. It is clear from the absence of derbis for example that Bostancı and Şenyürek typically collected only the largest flakes. Given the disturbance by quarrying activates in trenches II, III and V it is impossible to reliably assign artifacts to a single stratigraphic layer. Even in Pits I and IV, where strata were comparatively intact compared with the more obviously disturbed layers there are inconsistencies. Importantly, the curated collections provide no evidence for the Upper Paleolithic assemblages that Bostancı and Şenyürek describe. Based on the analysis of the collections housed in University of Ankara all of the assemblages should be attributed to the Middle Paleolithic.

5. THE ARTIFACT SAMPLE

For this article, we studied a total of 2010 lithic artifacts, which includes 969 retouched tools, 968 unretouched flakes and 73 cores. The collection of retouched pieces from Merdivenli Cave is summarized in Tables 1 and 2 according to F. Bordes's (1961) typology and indices. Almost all of these artifacts were made from flint (Figure 4) although volcanic rocks were occasionally used as well. During the excavation of Üçağızlı cave and surveys of the surrounding area we have identified both primary and secondary sources of common flint types in the area around the site. Some of the flints used by the inhabitants of Merdivenli Cave came from Upper Cretaceous limestone. Surface exposures near the town of Yayladağı, roughly 20 km from the cave, contain nodules up to 40 cm in length of a light grey or brown, medium-grained fossiliferous flint. A second group of bedrock flint sources occurs in Oligo-Miocene limestone. Surface exposures near the village of Şenköy contain a fine-grained dark brown to black flint (Kuhn et al., 2009). We have not identified primary flint sources on Musa Mountain, behind Merdivenli, but that does not mean that they do not exist. A range of flints and other materials can be collected in secondary deposits of heavily rolled flint pebbles on fossil beaches much closer to the cave.

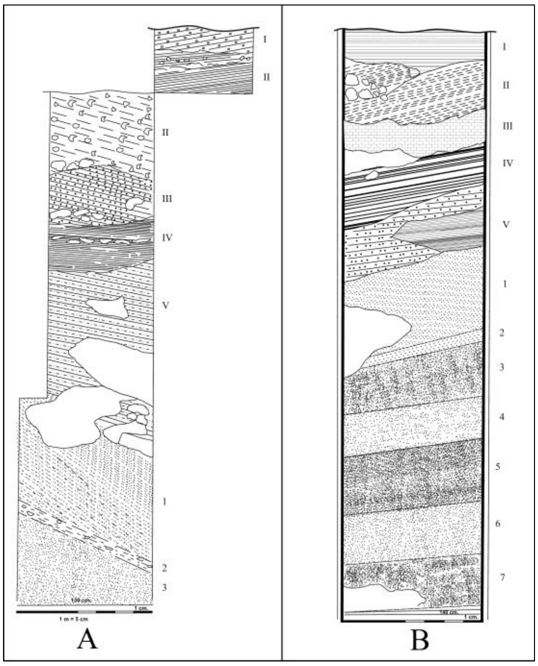

Figure 3: Stratigraphic Sequence of Merdivenli Cave (A shows the north pace of trench I; B shows the east face of trench V) (Adopted by Şenyürek and Bostancı 1958a)

Cortex preserved on the archaeological specimens can help establish the potential origins of some artifacts. ''Fresh nodular cortex'' refers to a soft white chalky or opaline rind that preserves its original, irregular surface. Rolled nodule cortex preserves the chalky rind but it has been smoothed and rounded, presumably by water transport. ''Pebble cortex'' is a distinctively abraded, pitted outer surface, indicating extensive water transport and reworking: none of the original chalk or opal cortex is retained. These criteria, along with observations of color, texture, and fossil inclusions, allow us to determine whether cortex-bearing artifacts were collected from primary or secondary sources, and in some instances, the primary source area. Table 1 shows flint cortex distributions in the five layers at Merdivenli Cave. Pebble flints from secondary deposits dominate every assemblage, but specimens with rolled or fresh nodular cortex can make up as much as 25% of cortical pieces. To the extent that we can tell from the incomplete assemblage, these pebble flints are represented by the full range of debitage products, from cores and debris to retouched tools.

Table 1: Distribution of cortex types on artifacts by Layer from Merdivenli cave (cortical pieces only)

	I	II	III	IV	V
Pebble cortex	75.0	77.8	81.0	84.4	76.9
rolled nodule cortex	18,2	7,4	8,9	4,4	4,5
Fresh nodular cortex	6,8	14,8	10,1	11,2	18,6

Table 2 presents counts of Levallois (Figure 5) and retouched pieces (Figure 6) from the five layers described by Bostancı and Şenyürek at Merdivenli Cave. Overall the assemblages contain relatively high frequencies of Levallois flakes, blades and points, and sidescrapers, but relatively few denticulates/notches and Upper Paleolithic tools types. The scarcity of denticulates and notches may be real, but it could also be a function of collection biases by the excavators, who may have preferentially retained the best, most easily-identified tools. The proportion of Levallois pieces increases from Layer V (36.8%) to I (62.1%). The two layers identified by Bostancı and Şenyürek as Upper Paleolithic (II and III) actually contain only 2.7% endscrapers, burins and other typical UP tool forms, well within the range of other Mousterian assemblages.

The largest group of scrapers is the simple side scrapers, but points and convergent scrapers are nearly as abundant in some levels. Transverse scrapers are quite rare. Although sidescrapers are the dominant tool forms throughout the Middle Paleolithic sequence of the Merdivenli their forms vary somewhat from layer to layer. Blanks for scrapers are mainly flakes (56.5%) but elongated flakes or blades are also common (32.7%). Although generally well-made, most of the retouched pieces are not heavily reduced or resharpened. The category of "unretouched tools" consists of flakes and blades with well-developed macroscopic edge damage. However, given the collection strategy and curation history of the assemblage this count should be considered a very rough estimate

Figure 4: Flint Types from Hatay Province

Layers I, II, III, and IV appear quite similar in the proportions of retouched tools. However Layer V has the highest proportion of scrapers and other retouched tools and fewest unretouched Levallois specimens. In layer V only, non-pebble cortex is more abundant (11.6%), than pebble cortex (10%) on scrapers; in contrast, secondary pebble raw material was used more often to make scrapers in other levels. This difference could be related to land use strategy and blank selection by the inhabitants of the cave.

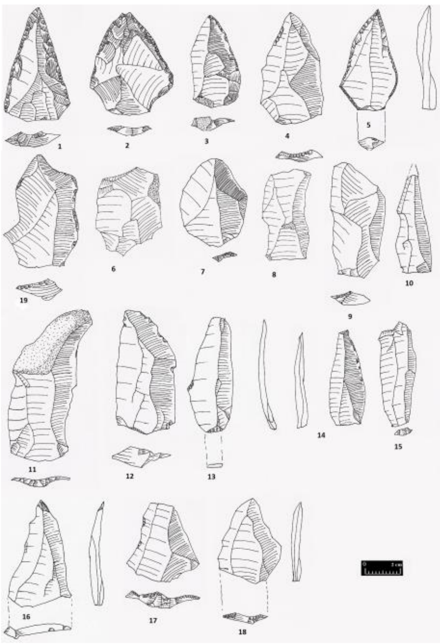

Figure 5: Levallois and retouched tools from Merdivenli Cave (Mousterian point: 1,2,3,5; Levallois Point: 4, 16,17,18; Levallois Flake: 6,7,8,9,12, 19; Plain Blades, 10, 13, 15, Levallois Blade, 15; Core Trimming Element, 11)

Table 2: Distribution of major retouched tool classes in Merdivenli Cave by Layers

	I	II	III	IV	V
Levallois Flake	13	17	112	47	27
Levallois Blade	6	12	28	27	13
Levallois Point	17	21	45	46	41
Pseudo-Levallois Point	-	-	18	6	3
Mousterian Point	6	4	12	11	26
Single Side Scrapers	6	12	38	33	47
Double Side Scrapers	1	2	3	8	20
Convergent Side Scrapers	-	-	-	2	7
Transverse Side Scrapers	-	1	4	3	3
Upper Paleolithic Tool Types (Bordian 30 - 40)	2	1	10	2	10
Naturally Backed Knife	3	1	26	23	11
Notch	3	6	18	23	6
Denticulate	1	7	12	15	6
Total	**58**	**84**	**326**	**247**	**220**
"utilized" flakes and blades	**60**	**145**	**417**	**207**	**139**

Table 3 shows the Bordes indices for Merdivenli cave. Overall the five assemblages are fairly homogeneous. The Levallois index increases gradually from top to bottom, although the largest increase is between layer V and layer IV. Levallois blade production, with intentional preparation resulting in longitudinal, parallel and occasionally multidirectional exterior flake scars, is not very well represented. The highest blade index (ILam) is found in Layer I, a mixed context, whereas the lowest blade index is in Layer II, which was originally identified as Upper Paleolithic. The faceting indices at Merdivenli Cave are also consistently high among the five layers, varying between 48.2 and 58 (IF) or between 39.6 and 43.7 (Ifs). Points are also scarce in Layers III-IV-V but relatively common in Layers I-II. Other tool types in Bordes typology are relatively rare in the Merdivenli cave lithic assemblages. As observed above there are few Upper Paleolithic tool types (III) and denticulates and notches (IV).

Table 3: Typological and Technological indices percentage of Merdivenli Layers

	IL	IF	IFs	ILam	ILty	IR	I	II	III	IV
I	35	58	44	39	60	13	60	23	3	7
II	21	51	42	29	58	17	58	22	1	15
III	26	48	40	27	55	14	55	23	3	9
IV	32	53	42	32	47	18	47	25	1	15
V	30	52	41	31	35	34	35	47	4	5

6. TECHNOLOGICAL FEATURES

For the description of basic technological features of the Merdivenli Cave assemblages we follow the following sources: platform types are adopted from Inizian *et al*. (1999), whereas origin and orientation dorsal scars and the core typology are adopted from our previous studies of Üçağızlı I and II cave.

Table 4 summarizes blank forms in the Middle Paleolithic assemblages of Merdivenli Cave. In terms of the inventory of retouched and "utilized" pieces, these are clearly flake-based assemblages. However, there are distinct biases in the choice of blanks for retouched tools. Levallois flakes and blades were more commonly used than plain flakes and blades as blanks for retouched tools in all layers. Plain flakes and Levallois blades are the next most abundant blanks for retouched tools. Plain (non-Levallois) blades were very seldom used to make retouched tools.

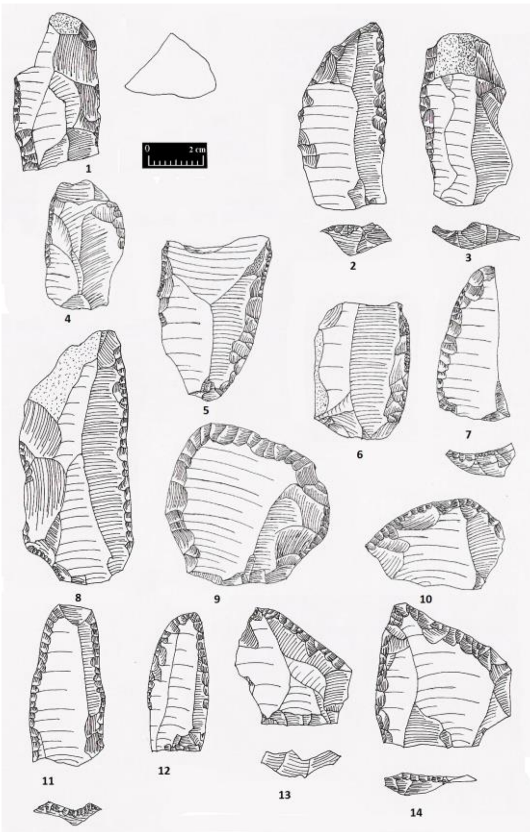

Figure 6: Retouched Tools from Merdivenli Cave (Single Scrapers: 1, 2, 3, 6, 7, 3; Double Scraper: 4, 5, 8, 9,11; Convergent Scraper: 12; dejeté scraper, 14, Transverse scraper: 10)

Table 5 presents platform types for retouched and "utilized" pieces from the cave. The platform morphologies and treatments indicate that hard hammer percussion was consistently used to detach flakes throughout the sequence. In all layers 85% or more of the retouched and unretouched tools have either plain or faceted platforms: plain and facetted platform types are about equal in abundance. Other platform types are very scarce. The scarcity of cortical platforms is noteworthy given the use of small pebbles for cores in many instances. While there is little variation overall in platform types, there are some differences in the abundance of faceted platforms within the sample of Levallois pieces (Table 6).

Table 4: Selected Retouched and Total Tool Blanks forms in assemblages from Merdivenli Cave (specimens for which blank types could not be determined are excluded, P; Plain, L: Levallois)

	P.Flake	P. Blade	L. Flake	L.Blade
	Total flakes and tool blanks			
I	30,3	26,9	16	5,9
II	47,8	21,5	8,3	5,3
III	38,1	20,7	17	4,2
IV	36,4	21,4	15,5	6,8
V	37,3	22,1	16	6,7
	Retouched Tool Blanks			
I	19	6,9	32,8	10,3
II	26,2	9,5	22,6	14,3
III	15	6,4	39	9,5
IV	17	11,3	28,7	12,6
V	22,7	15	25,9	10,9

Table 5: Merdivenli cave lithic assemblage platform type by layer.

	I	II	III	IV	V
Cortical	**-**	4,7	3	2,1	1,8
plain	38,4	40,1	46,3	41,5	42,2
Dihedral-not retouched	15,2	9,9	8,6	11,1	9,7
Dihedral-partly retouched	-	0,5	-	0,5	-
Faceted	46,4	44,8	41,7	44,9	45
Chapeau-de-gendarme	-	-	0,4	-	1,2

Table 6: Frequencies of faceted platforms, Levallois blanks only

	I	II	III	IV	V
Levallois Flake	47,4	57,9	59,1	46,5	31,6
Levallois Blade	33,3	75	45,2	64,5	25
Levallois Point	50	70,6	73,2	60,5	72

Figure 7 shows the orientation of dorsal scars on Levallois and non-Levallois blanks. There is substantial variability within the Levallois sample, as well as between the Levallois and non-Levallois samples. Within the Levallois group, multi-directional and orthogonal dorsal scars along with convergent scar patterns are the most common. The first is typical of centripetal Levallois preparation, whereas convergent scar patterns may be attributed to Levallois point production as well as centripetal preparation. Parallel dorsal scar orientations, indicative of uni/bi-directional Levallois reduction are somewhat less common throughout the Merdivenli sequence. In most layers, flakes with convergent scars slightly outnumber those with centripetal or orthogonal scars. However, in layer IV they are twice as abundant.

Dorsal scar patterns on non-Levallois blanks differ from those on Levallois pieces. There seems to be greater consistency among the layers in the production of non-Levallois blanks. Moreover, parallel dorsal scars are abundant in all layers, making up between 44% and 55% of the total, while convergent scar patterns are comparatively rare. Parallel dorsal scars result from repeated removals from the same platforms, but from the forms of the blanks (Table 4) it is clear that this was not necessarily systematic blade production. Flakes with just one or two proximally-originating dorsal scars could come from early stages of almost any reduction process, and indeed many of the specimens from Merdivenli retain dorsal cortex. A much smaller proportion of flakes with multiple dorsal scars, between 7.8% and 14.8%, show evidence for repeated parallel flake removals. Considering only flakes with multiple dorsal scars, many of the non-Levallois flakes with multi-directional dorsal scar patterns may represent pieces derived from the preparation and shaping of Levallois cores, pieces that are *predetermening* but not *predetermined* in form.

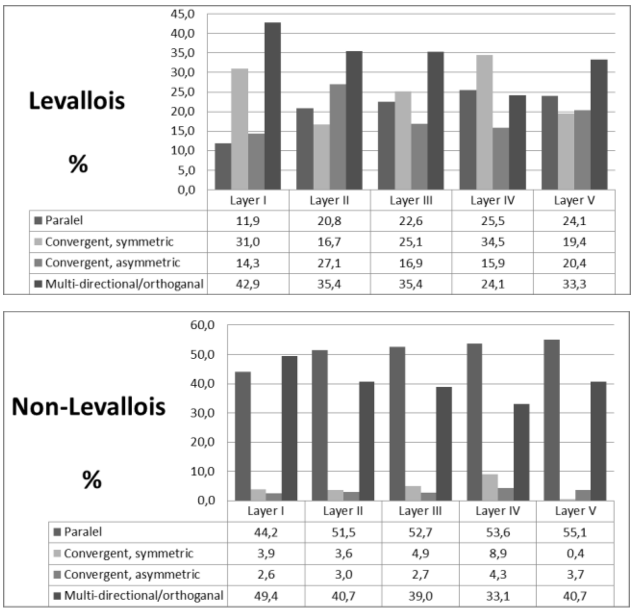

Figure 7: Orientations of dorsal scars of Levallois and non-Levallois blanks.

Table 7 contains counts of core types in the Merdivenli Cave assemblages. Due to uncertainties about the collection strategy we do not know how representative this sample is. Certainly the small number of cores compared to large blanks (a ratio of 26 blanks per core) suggests that a large part of the core assemblage is missing. Moreover, the cores collected provide a rather different view of blank production than do dorsal scar patterns on blanks. The sample of non-Levallois cores is very small, but in light of the abundance of blanks with parallel dorsal scar patterns it is surprising that no prismatic or pseudo-prismatic cores were recorded. The category of "unifacial core" refers to cores that have had removals from one flat face, but which lack preparation of the platform or the lateral edges For the most part these cores were exploited from one platform, so could have provided some of the flakes and blades with parallel scars. The somewhat larger sample of Levallois cores is more consistent with the scar patterns on blanks. The sample is dominated by centripetally-prepared cores and cores with parallel removals from one or two striking platforms. The former would have been the source of flakes with multi-directional or orthogonal scar patterns while the latter could have produced flakes with parallel or convergent dorsal scars.

In drawing conclusions about blank production from dorsal scars on flakes and the shapes of residual cores it is important to consider the effects of raw material. The majority of artifacts collected from Merdivenli were made using small, heavily rolled marine pebbles of flint. The small initial nodule size limited the amount of shaping that could be done and required careful selection of nodules appropriate for planned core forms. It also meant that core forms probably did not change very much during reduction. Thus, the poor fit between forms of residual cores and blanks probably reflects sampling rather than consistent transformation of cores form one form to another.

Table 7: Counts of the core forms

Non-Levallois Core Types	**I**	**II**	**III**	**IV**	**V**
Tested	-	-	1	-	-
Discoid	3	2	1	1	-
Unifacial	2	2	4	2	-
Amorphous	-	-	1	2	-
Levallois Core Types	**I**	**II**	**III**	**IV**	**V**
Centripetal Levallois	-	-	10	6	
Centripetal Levallois with preferential	-	-		3	2
Levallois Unidirectional	-	2	6	10	6
Levallois Bidirectional			1	4	1
Total	**5**	**6**	**24**	**28**	**9**

7. DISCUSSION - CONCLUSION

The five assemblages from Merdivenli Cave described above are comparatively similar from typological and technological perspectives. The lithic collections from Şenyürek and Bostancı's excavations show no signs of an Aurignacian or other Upper Paleolithic component. The stone artifacts from Layers I through V are all Mousterian in character. Generally, the assemblages are flake-based: blades make up less than 30% of retouched and unretouched blanks throughout the sequence. There is also a strong emphasis on Levallois production in both unretouched flakes and points and in tool blanks. The most common retouched tool forms are simple side scrapers, followed in abundance by notches and denticulates. Scrapers as a group tend not to be heavily reduced although there are a few individual exceptions. Typical Quina scraper types (transverse and *dejete* scrapers) and Upper Paleolithic tools types are scarce throughout the sequence. The data do not point to major technological differences between layers, but there is some variability over the sequence in how Levallois blanks in particular were produced or selected. The differences between Levallois and non-Levallois production are more striking. The high frequencies of flakes and blades with parallel scars suggest that non-Levallois uni/bipolar production was comparatively common. In contrast, most Levallois production resulted in centripetal or convergent scar patterns. The small collection of cores is not entirely consistent with the evidence from flake dorsal scar patterns, but this is probably a result of having an incomplete and biased sample.

Medivenli cave is located at the northern end of the coastal Levant, fully astride one of the likely corridors of human movements between Anatolia and the Levant. The alternating presence of *Homo sapiens* and Neanderthals in the Levant between 130 and 50 Kya raises the possibility that populations of both taxa passed along the Mediterranean coast of the Hatay in the course of moving into or out of the Levant. If lithic assemblages track hominin populations in at least a general way, comparisons with adjacent areas are of considerable interest as possible evidence of population movements and/or cultural exchanges at different times during the Pleistocene. Appendix 1 contains basic typological and technological indexes to facilitate comparison with Mousterian assemblages from the surrounding regions.

The most obvious comparisons are with the closest and best-known region. In the Levant researchers have long recognized chronological sequencing of Mousterian industries on the basis of differences in how flakes, blades and points were produced. The succession of Levantine Mousterian lithic assemblages is usually described in terms of a three-phase model proposed by Copeland and modeled after the major lithostratigraphic divisions of Tabun Cave (Bar-Yosef, 1998; Bar-Yosef 2000; Shea 2003).

The earliest Middle Paleolithic industries are the "Tabun D-type." Typically elongated blanks (blades and points) were obtained from unipolar (rarely bipolar) cores with parallel or convergent removals. The bidirectional flaking served to shape the opposite end of the core from the main striking platform. At some sites, such as Tabun itself, reduction is predominantly Levallois in character, but in most other localities (e.g., Hayonim, Hummal, Rosh ein Mor) blades and points were also produced using non-Levallois, "laminar cores" (Meignen 1998). TL dates in Tabun indicate a time span from 270 ka through 170 ka (Bar-Yosef 1998, 2000; Bar-Yosef and Meignen 1992; Crew 1976; Meignen 1998;).

The "Tabun C-type" Mousterian assemblages are typified by oval-rectangular flakes, sometimes quite large, struck from Levallois cores through centripetal and/or bidirectional preparation. Triangular points appear in small numbers and in definite horizons, such as the top of Layer C in Tabun, layer XV in Qafzeh, Skhul, Ras el-Kelb, and Naamé (Bar-Yosef 1998; Shea 2003). Bar-Yosef (2000) and Hovers (2009) observed that there is quite a bit of technological variation within and among these various assemblages. TL dates range from 170 ka to 90/85 ka while ESR readings suggest a similar time range.

The most recent Levantine Middle Paleolithic assemblages correspond to the "Tabun B-type". The blanks were removed mainly from unipolar convergent Levallois cores. Typical products from sites such as Kebara cave are short points with broad bases, commonly with a *chapeau de gendarme* striking platform, and with a distinctive profile, although flakes and blades were also produced (Bar-Yosef *et al.* 1992; Henry *et al.* 1996; Meignen 1995). However, there is some technological variability within these late Mousterian assemblages. Hovers (1998) noted that the reduction sequence of Amud Cave B2-B4 assemblages was characterized with "one axis or radially prepared cores" and flakes more typically take a "laminar and narrow form." Henry *et al.* (1996) added that Levallois point production was combined with unidirectional and bidirectional flaking systems incorporated blade production in the assemblages from Tor Faraj and Tor Sabiha.

In contrast to the Levant, the Zagros Mousterian shows greater technological and typological homogeneity, and exhibits little directional change through time (Baumler and Speth 1993; Lindly 1997) although dates are few. All of the Zagros assemblages appear to be quite heavily utilized, with high proportions of retouched tools, high core -to-flake ratios, and many pieces with multiple retouched edges. The assemblages show very high values of the scraper index (IR), as well as high frequencies of converging pieces. Technologically, Zagros Mousterian assemblages are typified by high faceting indices (IF, IFs) (Baumler and Speth 1993; Dibble 1991) and modest blade indices (ILam): actual blade production was very rare (Baumler and Speth 1993; Dibble and Holdaway 1993). The Levallois index (IL) is typically low in the Zagros Mousterian, except at Bisitun Cave which has high proportion of the Levallois tools (Baumler and Speth 1993; Dibble 1991) .

The Caucasus borders Anatolia on the north, and was another potential source of populations dispersing from central Europe or central Asia into Anatolia and the Middle East during upper Pleistocene (Pinhasi *et al.* 2012). The region is separated into Northern and Southern areas by the high elevations of the Caucasus Mountains (Great and Little Caucasus). According to Bar-Yosef *et al.* (2006), the Caucasus Mountains presented an important biogeographical and social barrier to the Neanderthals. Because of the geographic settings, Middle Paleolithic settlement and industries differ on either side of the mountains. Mousterian lithic assemblages from the Northern Caucasus resemble industries from Eastern Europe and the Crimea (Cohen and Stepanchuck 1999; Golovanova and Doronichev 2003; Pinhasi *et al.,* 2012). The early Mousterian lithic industries are characterized by the presence of leaf points, bifacial and partly bifacial convergent tools, and bifacial side-scrapers. Convergent tools and simple side scrapers are the most common tools types, but bifacial tools are very scarce in the latest stage of the Micoquian (from OIS 7 through 5) (Golovanova and Doronichev 2003). At the well- known site of Mezmaiskaya, layers dated to 39,700 have yielded a Neanderthal burial (Pinhasi *et al*. 2012). The southern slope of the Greater Caucasus contains an abundance of sites (Tsopi, Khosta, Tsutskhvati, Tskhaltsitela, Kudaro, Tskhinval) especially in Georgia. The lithic industries from these sites are similar to Levantine and Karain or Zagros Mousterian (Golovanova and Doronichev 2003). It is not surprising that the Mousterian assemblages from the southernmost part of the Caucasus, located close to the Zagros Mountains are similar to the Zagros Mousterian (Bar-Yosef *et al.* 2006). Levallois flakes, little blade production and many truncated-faceted pieces are typical characteristics of the region (Golovanova and Doronichev 2003). Pinhasi et al (2012) suggested that Neanderthals did not survive after 39,000 either the Southern (Mermaiskaya) or Northern Caucasus (Ortvale Klde).

In Central Europe late Middle Paleolithic assemblages show considerable variability. Sitlivy and Zieba (2006) argue that the most important differences among the Middle Paleolithic industries relate to core reduction strategies. The region contains a range of different Mousterian facies characterized by both Levallois and non-Levallois flake debitage, manufactured during OIS 5-OIS 3. Tool kits are dominated by side scrapers and some contain leaf points or other bifacial pieces (Ivanova 2008; Sitlivy and Zieba 2006). Middle Paleolithic open-air sites in the Bosporus/Marmara region of European Turkey contain discoidal cores, core-choppers, small bifaces, Levallois flakes, scrapers and denticulates/notches tool kits. According to Runnells and Özdoğan (2001), the surface assemblages are similar to the typical Balkan Mousterian except for the presence of some Upper Paleolithic types, which could be a consequence of later re-occupation.

Closer to Merdivenli, the well-known site of Karain Cave in Turkey contains Mousterian or Middle Paleolithic assemblages dating from OIS 8 to 4: complexes I, H, and F have yielded radiometric dates of 60-70ka, 110-120ka, and 130ka respectively (Otte et al. 1995,1998). Mousterian assemblages from these levels are flake-dominated (Otte *et al.* 1995) with high frequencies of extensively retouched and heavily resharpened tools, especially side scrapers and Mousterian points, and rare denticulated and notched pieces. These features lead to definition of the Karain assemblages as Taurus-Zagros Mousterian or Karain type Mousterian (Yalçinkaya *et al.* 1993). Levallois debitage is mainly centripetal while non-Levallois production may be bipolar or discoidal (Otte *et al.* 1998). In addition, the occurrence of a few pieces with bifacial retouch on flakes and blades and bifacial "leaf-shaped" points and knives suggests a link to the central European and Balkan Middle Paleolithic. Thus, the Karain Mousterian resembles industries from both the Zagros or the Balkans and southeastern Europe, but differs from the contemporaneous Levantine Mousterian (Otte *et al*. 1995).

The Göllü Dağ region, located in the Central Anatolian Volcanic Province south of the well-known Cappadocia region,is fairly well researched due to the presence of high-quality obsidian sources. The excavated site of Kaletepe Deresi 3 (KD3), as well as many surface find spots, has yielded Lower and Middle Paleolithic artifacts (Slimak *et al.* 2008). At KD3, Mousterian levels include I, I′, II. Levels I and I′ postdate the deposition of a volcanic tephra at around 160 ka, while level II's is below the tephra, dating to at least OIS 6. Level I and I′ produced is Levallois and Kombewa flakes, and many blanks exhibit facetted platforms. Retouched tools are limited to fragments of side scrapers. In the archaeological assemblage from level II, two main Levallois production systems resulted in manufacture of different kinds of end product, blades from unipolar cores and flakes from centripetally prepared cores. In addition, attributes of some of the blades suggest that they were produced from unipolar, non-Levallois cores. Retouched tools from level II are exclusively by Mousterian scrapers and points. During surveys of Göllü Dağ and surrounding volcanic features teams collected large samples of Lower and Middle Paleolithic artifacts. Core reduction is dominated by Levallois production, especially preferential centripetal production. Unipolar Levallois cores are also abundant, though they produced flakes and not blades (Balkan-Atlı et al. 2008, 2009). In marked contrast to Merdivenli, Levallois points are extremely scarce around Göllü Dağ. It should be noted that there is an important workshop component to most of the Göllü Dağ localities due to their proximity to high quality raw material. This makes it more difficult to compare them directly to cave sites with more residential functions.

When we compare the collection from Meridvenli Cave with Mousterian assemblages from the Caucasus, Balkans, and Anatolian Turkey (Karain Cave and Göllü Dağ), there are conspicuous differences. It is clear that the materials from Merdivenli Cave are quite distinct from the Zagros Mousterian and the materials from Karain cave. The main points of difference include the much lower frequencies of Levallois, and the heavily used and rejuvenated scrapers in the Zagros and Karain assemblages, and the scarcity of heavily reduced scrapers at Merdivenli. Technologically, Merdivenli and Zagros Mousterian show similarly high Faceting indices (IF), but the Levallois Index (IL), typically is much lower in the Zagros Mousterian than in the collections from Merdivenli Cave. Although centripetal Levallois technology is a widespread characteristic, many assemblages from across this region are characterized by high frequencies of heavily-modified and reduced scrapers (Kozlowski 2002). The heavy reliance on Levallois technology, low levels of retouch and reduction and in particular the abundance of Levallois points, show that the Merdivenli Cave assemblages are much closer to Levantine Mousterian assemblages. The other Mousterian sites from the Hatay region, such as Tıkalı and Kanal caves and Üçağızlı II, have similar technological profiles to Merdivenli.

Although Levallois points and pointed flakes are common at Merdivenli, the technological hallmarks of Levantine "Tabun B type" Mousterian assemblages, recurrent convergent Levallois and *chapeau de gendarme* striking platforms, are poorly represented. The Merdivenli cave assemblages are even more distinct from the "Tabun D type" Mousterian. Most importantly, elongated flakes and points are scarce at Merdivenli. Parallel scar patterns are common on non-Levallois blanks, but these are mainly flakes, not blades. In general, the "Tabun D-type" assemblages include higher frequencies of retouched pieces on blades (Meignen 1998) and large numbers of Upper Paleolithic tool types (Marks 1992), again very different from Merdivenli. At the same time the Merdivenli materials also show distinctive features, including the different modes of Levallois (centripetal) and non Levallois (unipolar) production.

On the whole, the assemblages from Merdivenli cave most resemble the "Tabun C type" Levantine Mousterian assemblages (Appendix 1), in which centripetal preparation dominates (Hovers 2009). Moreover, the Levallois indices of the Merdivenli Cave assemblages fit within the range of the Qafzeh assemblages (Hovers 2009) and the Ksal Akil 26A and 26B assemblages (Marks and Volkman 1986). The Qafzeh and Merdivenli Cave assemblages also show similar frequencies of platform types (Hover 2009), with facetted and plain platforms being most common. Also in common with the "Tabun C type" Mousterian, the Merdivenli collections commonly show a fairly high value of Levallois Types Index (Ilty) and relatively low frequencies of retouched tools. The scraper index (IR) of Merdivenli Cave is close to that of the Qafzeh and Tabun C assemblages but quite different from Ksar Akil and Ras el-Kelb assemblages (Appendix 1).

Turkey is potentially a geographic conduit between the Caucasus, Central Asia, the Levant, and Eastern Europe, and is a probable route of overland movement among these regions. As such, it ought to contain traces of hypothesized movements of populations out of (*Homo sapiens*) and into (Neanderthals) the Levant. Two of the three major variants of the Levantine Mousterian are associated with hominin fossils: there are no clear fossil associations with the earliest, D-type Mousterian. Multiple burials from the sites of Skhul and Qafzeh suggest that Tabun C-type industries were produced by early *Homo sapiens* populations (Clark and Lindly 1989; Hovers 2009). Meanwhile, fossil remains from Kebara and Amud indicates that the more recent "B-type" Mousterian was the product of Neanderthal (Clark and Lindly 1989; Bar-Yosef and Meignen 1992). The fossil evidence is commonly interpreted as evidence for an early expansion of African *Homo sapiens* into the Levant under interglacial conditions of Marine Isotope Stage 5, followed by a southward expansion for Neanderthal populations into the region during colder, drier conditions associated with MIS 4. To the extent that technological and typological feature of

Merdivenli Cave resemble the Levantine "C type" Mousterian, we could predict that the assemblages from Merdivenli and other nearby sites were also associated with *Homo sapiens*. Provided the beach deposit underlying the archaeological deposits dates to MIS 5e then the chronology would also be more or less similar to the Central Levantine sites with comparable assemblages: if it dates to a later transgression (5c or 5a) then Merdivenli would be later than technologically comparable sites farther south. If so, the Merdivenli cave assemblages record a more northerly expansion of early *Homo sapiens* than was previously documented. However, associations between hominin morphology and Levallois technology may not extend beyond the central and southern Levant.

The Toros mountains may have acted abarrier to further northward expansion to Levantine *Homo sapiens*, with Eurasian Middle Paleolithic populations (Neanderthals) permanently established to the north. If this scenario is valid, then we might also expect evidence in the Hatay for a replacement of Tabun C-type assemblages with other forms of Mousterian showing connections to areas to the north and west, marking the expansion of Neanderthals into the area. However, neither Merdivenli nor any other sites in the region have so far provided evidence for the kinds of late Mousterian industries associated with Neanderthals in the Levant. Instead, there is a distinctive pan-regional late Mousterian complex, the Karain-Zagros Mousterian. This raises difficult questions about the origins of the late Levantine (Tabun B type) Mousterian. If it was carried by an intrusive population of Neanderthals it remains to be determined where they originated. As Hovers and Belfer-Cohen (2013) note, the entire Levantine sequence is also somewhat paradoxical in that it shows considerable technological continuity despite evidence for the presence of at least two, and possibly more, hominin populations. Consequently that answers to persistent questions about the movement of populations into and out of the Levant may have to come from areas "at the margins."

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APPENDIX 1: TECHNOLOGICAL AND TYPOLOGICAL INDICES FROM MERDIVENLI CAVE, ZAGROS AND LEVANTINE MOUSTERIAN ASSEMBLAGES.

	IL	IF	IFs	ILam	ILty	IR	I	II	III	IV	
Merdivenli I	*35,3*	*58,0*	*43,7*	*38,7*	60,0	13,3	60,0	23,3	3,3	6,7	
Merdivenli II	*21,1*	*51,3*	*41,7*	*28,5*	58,1	17,4	58,1	22,1	1,2	15,1	
Merdivenli III	*26,3*	*48,2*	*39,6*	*27,0*	54,8	13,6	54,8	22,5	3,0	8,9	
Merdivenli IV	*31,6*	*53,4*	*42,5*	*31,6*	47,1	17,9	47,1	24,9	0,8	14,8	
Merdivenli V	*30,3*	*51,5*	*41,5*	*31,1*	35,4	33,6	35,4	46,7	4,4	5,2	
Bisitun E+	45,7	71,8	58,8	2,5	19,3	63,6	19,3	70,5	2,3	3,4	Dibble 1984
Bisitun E-	59,6	61,3	57,7	5,0	17,2	62,5	17,2	66,4	10,2	2,3	Dibble 1984
Bisitun F+	52,1	67,6	56,1	4,7	13,1	66,5	13,3	72,7	6,4	3,2	Dibble 1984
Bisitun F-	46,7	61,9	48,9	4,4	2,8	75,6	2,8	79,8	7,3	3,7	Dibble 1984
Bisitun G	24,4	61,0	48,8	0,0	15,0	52,5	15,0	52,5	17,5	5,0	Dibble 1984
Warwasi C	7,5	45,9	30,8	38,0	4,4	53,8	4,4	62,6	10,1	7,6	Dibble and Holdaway 1993
Warwasi B	7,4	53,8	39,6	45,3	9,3	57,4	9,3	67,3	8,3	8,0	Dibble and Holdaway 1994
Warwasi A	13,1	50,2	40,6	43,2	15,6	62,2	15,6	59,2	5,3	5,9	Dibble and Holdaway 1995
Shanidar D	3,0	43,2	0,0	12,7	1,8	59,2	1,8	79,4	11,3	2,5	Akazawa 1974
Hazar Merd C	7,0	47,1	0,0	20,3	2,1	45,4	2,1	92,4	3,3	2,1	Akazawa 1974
Kunji	11,1	72,1	22,8	18,2	7,6	58,8	7,8	65,8	4,4	2,1	Baumler and Speth1993
Tabun D	56,3	61,4	48,4	76,0	62,2	36,1	62,2	43,4	19,3	3,2	Marks and Volkman 1986
Ksar Akil XXVIIIA	11,8	78,8	57,2	23,7	55,0	5,2	55,0	9,9	15,8	7,3	Marks and Volkman 1986
Ksar Akil XXVIIIB	13,5	67,5	44,6	27,6	58,6	3,0	58,6	13,6	13,6	5,1	Marks and Volkman 1986
Jerf Ajla B	62,0	53,1	0,0	47,2	66,7	1,3	66,7	1,3	12,7	2,7	Akazawa 1974
Jerf Ajla C	62,0	63,6	0,0	39,3	73,6	2,0	73,6	2	12,0	0,8	Akazawa 1974
Jerf Ajla E	81,7	63,4	0,0	43,3	80,6	8,3	80,6	10	3,9	0,6	Akazawa 1974
Abou Sif B	44,9	51,3	0,0	52,1	53,8	25,5	53,8	33,5	10,1	1,1	Akazawa 1974
Abou Sif C	34,2	38,4	0,0	57,1	49,5	24,8	49,5	24,8	3,3		Akazawa 1974
Rosh Ein Mor	14,6	54,6	34,7	19,5	60,6	8,6	60,6	10,8	30,4	14,3	Crew, 1976
Tabun C	22,0	52,0	36,0	35,7	66,1	23,6	66,1	25,0	3,6	8,2	Marks and Volkman 1986
Ksar Akil XXVIa	30,3	75,9	62,9	23,7	26,4	62,2	26,4	73	14,7	2,9	Marks and Volkman 1986
Ksar Akil XXVIb	26,5	75,2	57,8	19,7	43,5	57,0	43,5	68	7,0	15,0	Marks and Volkman 1986
Ksar Akil XXVIIa	8,9	76,2	55,1	24,5	28,6	29,5	28,6	57,9	17,9	10,5	Marks and Volkman 1986
Ksar Akil XXVIIb	8,6	78,9	59,9	25,7	27,6	28,4	27,6	48,7	15,9	9,4	Marks and Volkman 1986
Qafzeh III	12,6	42,9	31,8		50,0	5,0		10,0	5,0	7,5	Hovers 2009
Qafzeh IV	17,5	44,8	29,7		60,0	6,7		8,9	8,9	0,0	Hovers 2009
Qafzeh V	15,6	43,5	31,3		77,7	2,7		3,6	4,5	0,9	Hovers 2009
Qafzeh VI	16,4	43,7	32,7		56,7	13,4		13,4	4,1	3,1	Hovers 2009
Qafzeh VII	22,3	49,6	41,1		58,3	5,8		5,8	7,8	4,9	Hovers 2009
Qafzeh VIIa	21,9	49,5	37,7		58,4	5,5		7,5	6,5	3,0	Hovers 2009
Qafzeh VIIb	24,7	54,6	44,9		60,5	3,5		4,4	9,5	3,5	Hovers 2009
Qafzeh VIII	29,7	66,7	49,3		53,9	7,7		15,4	10,3	2,6	Hovers 2009
Qafzeh IX	27,2	57,1	45,9		66,6	7,3		7,8	4,5	3,0	Hovers 2009
Qafzeh X	35,3	49,4	39,8		69,7	7,0		7,4	4,1	1,6	Hovers 2009
Qafzeh XI	28,8	51,4	38,3		62,8	9,6		9,6	4,3	2,7	Hovers 2009
Qafzeh XII	36,1	52,4	43,1		54,7	9,4		9,4	9,0	4,5	Hovers 2009
Qafzeh XIII	25,8	49,4	39,3		54,6	11,2		12,0	3,1	4,0	Hovers 2009
Qafzeh XIV	36,0	56,5	47,2		53,9	1,3		1,7	8,2	6,5	Hovers 2009
Qafzeh XV	26,9	55,8	44,2		69,4	2,2		2,7	4,6	1,5	Hovers 2009
Qafzeh XVa	18,6	40,6	27,4		67,9	3,3		4,1	6,0	1,7	Hovers 2009
Qafzeh XVb	21,2	37,3	23,3		69,8	1,2		1,2	1,2	2,3	Hovers 2009
Qafzeh XVf	18,1	36,4	24,4		74,7	0,3		2,2	2,5	0,3	Hovers 2009
Qafzeh XVII	43,0	44,2	30,0		68,0	4,7		5,2	6,4	4,5	Hovers 2009
Qafzeh XVIIa	0	0,0	0,0		75,0	0,0		0,0	0,0	12,5	Hovers 2009

Qafzeh XVIII	0	37,1	22,9		53,3	11,1		11,1	11,1	6,7	Hovers 2009
Qafzeh XIX	39,6	39,1	30,6		73,8	3,9		4,3	6,9	4,7	Hovers 2009
Qafzeh XX	0	31,8	27,3		85,7	0,0		0,0	0,0	0,0	Hovers 2009
Qafzeh XXI	42,0	37,6	29,9		72,1	2,0		2,0	4,8	4,8	Hovers 2009
Qafzeh XXII	33,3	28,9	20,3		68,5	2,7		2,7	2,7	11,0	Hovers 2009
Qafzeh XXIII	0,0	0,0	0,0		62,5	0,0		0,0	0,0	0,0	Hovers 2009
Qafzeh XXIV	0,0	0,0	0,0		80,0	0,0		0,0	0,0	3,3	Hovers 2009
Ras el-Kelb Rail Level D	68,7	70,3	65,0	20,8	81,6	40,0	81,6	46,7	2,2	4,4	Copeland 1998
Ras el-Kelb Rail Level C	61,2	62,5	53,3	10,0	55,3	60,5	55,5	72,1	3,5	10,5	Copeland 1998
Ras el-Kelb Rail Level B	49,7	51,2	42,0	18,1	69,0	31,6	67,0	44,4	15,8	14,3	Copeland 1998
Ras el-Kelb Tunnel Level O	41,5	61,5	51,3	8,9	58,8	42,3	61,8	50,0	7,7	15,4	Copeland 1998
Ras el-Kelb Tunnel Level N	28,8	57,6	50,2	12,6	47,4	46,7	48,1	53,3	11,1	11,1	Copeland 1998
Ras el-Kelb Tunnel Level M	27,7	55,3	48,0	6,8	48,2	56,0	48,2	59,9	7,0	12,3	Copeland 1998
Ras el-Kelb Tunnel Level L	54,8	71,4	67,7	11,3	59,1	62,0	59,1	69,1	8,0	10,9	Copeland 1998
Ras el-Kelb Tunnel Level K	55,8	52,4	41,0	4,7	69,2	57,0	69,3	67,0	3,0	8,5	Copeland 1998
Ras el-Kelb Tunnel Level J	66,5	63,5	47,7	6,1	49,7	58,5	49,7	65,4	3,2	12,0	Copeland 1998
Tabun B	36,0	59,9	50,5	64,2	64,7	31,5	64,7	31,5	13,0	7,4	Marks and Volkman 1986
Kebara VII	18,1	58,2	53,1	12,0							Meignen ve Bar-Yosef 1988, Bar-Yosef ve Meignen, 1992a
Kebara VIII	19,4	59,1	54,1	10,9							Meignen ve Bar-Yosef 1988,
Kebara IX	11,8	79,3	78,1	9,6							Bar-Yosef ve Meignen, 1992a
Kebara X	20,0	75,4	71,9	13,3							Meignen ve Bar-Yosef 1988,
Kebara XI	22,6	70,2	64,1	20,2							Bar-Yosef ve Meignen, 1992a
Kebara XII	30,5	87,5	83,3	22,9							Meignen ve Bar-Yosef 1988,
Tor Sabiha C	4,0	38,0	0,0	37,0				3,0	4,0	18,0	Shea 2003
Taor Faraj C	24,0	50,0	33,0	17,0				4,0	8,0	5,0	Shea 2003
Amud B1	31,0	49,0	40,0	0,0							Shea 2003
Amud B2	32,0	56,0	28,0	22,0							Shea 2003
Amud B4	31,0	50,0	18,0	10,0							Shea 2003