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LATE LEVANTINE MOUSTERIAN SPATIAL PATTERNS AT LANDSCAPE AND INTRASITE SCALES IN SOUTHERN JORDAN

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Introduction

Despite recent advances in understanding the biological relationship of modern humans and Neanderthals, we have yet to establish with any certainty the degree to which the patterned behaviors of Neanderthals may have differed from those of quasi-contemporary and succeeding human groups. Paleogenetic (Green *et al.* 2010; Noonan *et al.* 2006) and human paleontologic (Hublin 2009) evidence indicate that Neanderthals diverged from modern human populations between 270,000 and 440,000 years ago. The Neanderthal genome, also points to a small amount of gene flow from Neanderthal to ancestral non-African groups prior to their expansion into Eurasia (Green *et al.* 2010). This is attributed to the mixing of Neanderthals with immigrant African groups in the Near East some 50,000 to 80,000 years ago (Green *et al.* 2010). Morphological features of early modern humans in Europe also point to modest levels of assimilation of Neanderthals into an expanding African population sometime before 33,000 years ago (Trinkaus 2007).

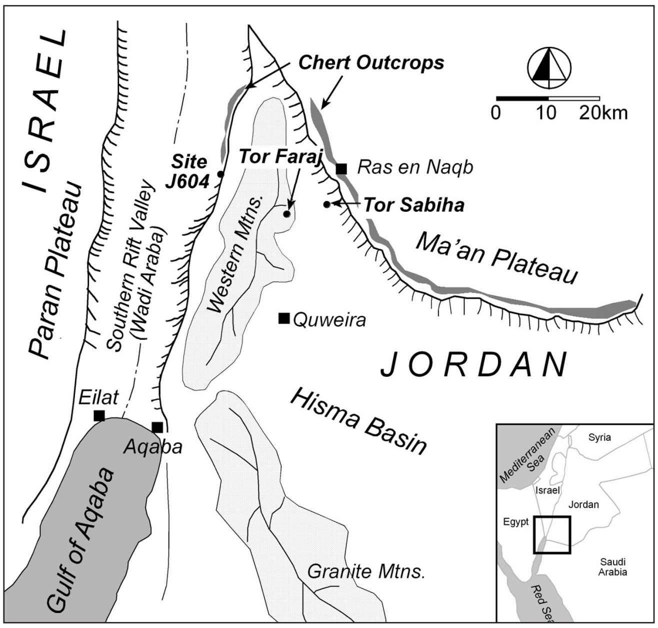

Figure 1 - Map of the study area showing site locations, landforms, and chert sources.

While we have a much more refined picture of the bioevolutionary aspects of Neanderthals than we did only a few decades ago, we still have little direct knowledge of such basic social dimensions as group size, composition, site structure and settlement-procurement patterns. What is so intriguing is to see how these behavioral features of Neanderthals compare to those of modern humans given the proposed biologic distance between these two hominin branches. In many ways this represents the ultimate level of the nature – nurture debate.

With these issues in mind, inter- and intra-site studies were undertaken at several Middle Paleolithic, Late Levantine Mousterian occupations situated along the edge of the Ma'an Plateau and Rift Valley in southern Jordan (Henry 1994; Henry 1995a; Henry *et al.* 2001; Henry 2003; Henry *et al.* 2004). The research centered on an integration of regional evidence of how groups exploited the Late Levantine Mousterian landscape coupled with site specific information on how the groups organized their behaviors within their living spaces.

Setting

The study area consists of four major landforms that fall away as steps from the Ma'an Plateau (~1,700masl) to the floor of the Rift Valley (~100masl) along a transect of about 35km (fig. 1 and 2). Beyond their striking differences in elevation, the landforms are largely associated with different bioclimatic zones and geologic substrates. Moreover, given the area's position as a land-bridge connecting Africa and Eurasia, the environmental zones represent remnants of biogeographic successions of continental scale. The high elevations of the plateau are associated with a degraded Mediterranean woodland of European association, the piedmont supports an Asiatic steppe, and the lower elevations of the broad plain of the Wadi Hisma and the flank and floor of the Rift Valley are covered in desert vegetation with African affinities. The inherent environmental diversity of the area is further enhanced by marked seasonality associated with a Mediterranean climate in which rainfall is confined to a short winter wet season followed by a long dry season.

From the perspective of Paleolithic research, another important feature of the study area is the restricted availability of

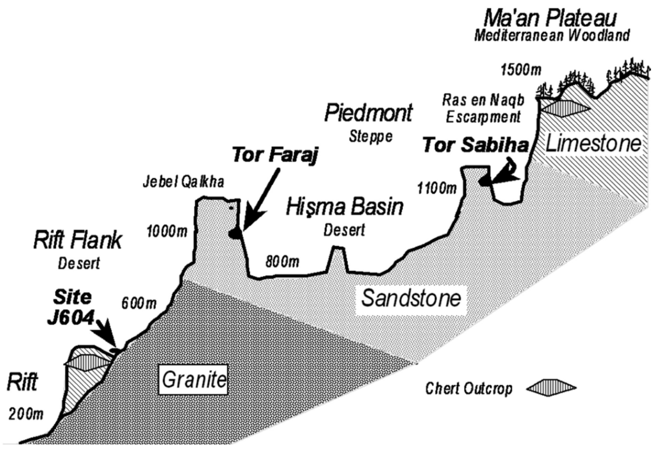

Figure 2 - Transect of the study area showing landforms, geologic substrates, plant communities, and selected site locations.

chert due to differences in geologic substrates. Extensive chert sources are found above ~1,500masl on the Ma'an Plateau and along the edge of the Rift Valley at elevations of ~200-400m in limestone formations. Chert from these sources varies widely in color, composition, and form, but most of the sources yield very high quality chert relative to knapping qualities. The greater part of the piedmont, Hisma, and Rift Valley are associated with sandstone and granitic substrates and lack chert sources. The large majority of chert varieties forming the artifact assemblages have been identified as to sources (Henry 2003:63).

Inter-site Patterns

Land-use strategies incorporating transhumance appear to have persisted in the area throughout prehistory and into recent times (Henry 1994, 1995a, 1995b). This is not surprising given that the different environmental zones are defined by elevational belts and the peaks in resources within the zones are seasonally staggered. Environmental and archaeological data suggest that during the Pleistocene groups spent the winter, wet periods at mid-low elevations and the driest part of the warm season at the highest elevations. This involved wintering in the low piedmont and Rift Valley, dependent on the severity of conditions, followed by an upland migration to the Ma'an Plateau with the on-set of the dry season.

Chronology, Hominin Association, Social Identity and Paleoenvironment

Only two of the Middle Paleolithic sites were dated, Tor Faraj and Tor Sabiha. Six assays derived from U-series and AAR on ostrich eggshell and TL on burnt chert place the two sites between 43.8 and 69kya with a mean point age of ~55.1 kya (Henry 2003:58-59). This age is consistent with other B-type Late Levantine Mousterian dates from the Levant (Henry 2003:58-59). Although no identifiable hominin fossil remains were recovered, within the Levant only Neanderthal remains have been found with this specific artifact assemblage association and time frame.

The assemblages from Tor Faraj and Tor Sabiha are characteristic of those from the other Middle Paleolithic sites recorded in the study area in two respects. First, all the assemblages are dominated by broad-based, triangular Levallois points with prominent chapeau de gendarme platforms and unidirectional, Y-convergent scar patterns; a hallmark of the B-type Late Levantine assemblages in the region. Second, artifacts displaying inverse retouch range from ~33-44% in contrast to 0-4% for other Levantine assemblages, excepting Kebara (Henry 1995a: 73). This unique feature points to a local stylistic element. In combination, the associated chronometrics, techno-typologies, specific reduction streams (*chaîne opératoire*) and retouch patterns of the assemblages in the study area point to their having been produced by Neanderthals belonging a regionally defined social unit, scaled in archaeological time.

Although faunal and pollen preservation in the deposits was generally poor, the remains of gazelle, bos, and equid, along with ostrich eggshell fragments, point to a generally arid setting, but with available surface water. Pollen (Emery-Barbier 1995) and phytolith (Rosen 2003) studies enhanced the environmental reconstruction in tracing a generally arid setting, but one more moist and cooler than that today. The Hisma and hilly uplands supported cool-season grasses and pockets of woodlands (alder, elm, and pine) forming what would be best described as a cool, moist steppe associated with a Mediterranean climate.

Settlement Structure

Within the Middle Paleolithic, eleven sites were identified at elevations ranging from ~280 masl to 1,400 masl. Sites in the highest (1200-1400masl) and lowest (280-340masl) elevational belts displayed several similar site features, but differed from sites situated in the mid-level elevational belt (900-1000 masl). Those sites found in the highest (Ma'an Plateau and high piedmont) and lowest belts (Rift Valley) exhibited relatively low site densities, small site areas, thin cultural deposits, low artifact densities and an emphasis on end-of-stream lithic processing. The mid-level elevational belt (low piedmont) yielded the highest site density, the largest sites, thickest cultural deposits, highest artifact densities, and a complete range of lithic processing activities. The identification of chert sources in the Rift Valley, lower piedmont (Humeima source) and Ma'an Plateau shows the sources to have been exploited at all of the sites in the study area, but by way of different procurement strategies.

The sites at the highest and lowest elevations are equally divided between open and rockshelter occupations, whereas only one of the seven mid-elevation sites was an open-air encampment. Taken together, these data suggest that small, highly mobile groups occupied the highest and lowest elevations for relatively short settlement segments. In contrast, mid-level elevations were associated with larger, longer-term occupations by larger groups over longer settlement segments.

Seasonal Data

The most direct evidence for seasonality comes from Rosen's (2003) study of phytoliths recovered from Tor Faraj. She found among the single-celled phytoliths a small, but consistent proportion of dendritic long-cells derived from the floral parts or seed husks of grasses. From this she concluded that Tor Faraj was probably occupied between February and June given that these are the months in which Mediterranean grasses flower and produce seeds. Other phytoliths, along with starch grains, point to the consumption of dates and pistachio nuts which similarly indicate a winter occupation, although restricted to earlier in the season. Interestingly, the dates must have been imported from palms growing in the Rift Valley given their intolerance of the colder temperatures of the lower piedmont.

Other clues to the season(s) of occupation for the sites comes from landscape evidence: elevation, availability of water, and exposures of sheltered settings. The sites situated at the highest settings, an open site on the plateau (>1,400asl) and the rock-shelter of Tor Sabiha in the high piedmont (~1,300asl) with an eastern exposure, were most likely occupied during the warm, dry season. Water at this time of year would have been available from springs along the edge of the plateau as it is today. The mid-level sites (900-1,00asl) are predominantly associated with rockshelters, all of which overlook drainages and have south-southwest exposures. Standing water is known to have been near Tor Faraj as evidenced by the phytoliths of cattails. Given the limited catchments of the drainages, water is likely to only have been available seasonally during the winter wet-season stretching into early spring and in agreement with the phytolith evidence. The two Rift Valley sites (Henry *et al.* 2001), situated at elevations between 288 and 340masl, are located on the shore of ancient Lake Gharandel (J603) and a prominent drainage, the Wadi Nukhayla (J603). Again, winter wet-season occupations would have been most likely, although unlike the mid-level sites, protection from the elements appears not to have been a concern. Site J603 is an open-air occupation and site J604 is exposed both to the west and east as the artifact distribution wraps around a rock outcrop overlooking the wadi.

Provisioning and Procurement Strategies

Differences in the lithic assemblages indicate that alternative provisioning strategies were associated with the different segments of the settlement cycle. In following Kuhn's (1995) concepts on provisioning, the longer-term occupations followed a logistical strategy of provisioning a place while ephemeral occupations used more opportunistic strategies linked to provisioning activities and individuals. The provisioning of a place is typically associated with the full range of lithic reduction activities from core shaping and blank production to tool manufacture, use, and recycling. In contrast, the provisioning of activities is typically linked to tool production in support of specific tasks, as needed, and thus while limited initial core shaping and blank production are involved, the process emphasizes end-of-stream reduction activities tied to tool fabrication, use, and maintenance. Finally, the provisioning of individuals demands little in the way of initial processing, but focuses principally on tool use and maintenance.

The excavations of Tor Sabiha and Tor Faraj produced large assemblages suitable for quantitative comparisons, but the other occupations (either deflated or deeply buried) yielded assemblages of <100 specimens, too small for reliable comparisons. The lithic assemblages of both Tor Faraj and Tor Sabiha are associated with complete reduction sequences, but they show striking differences in emphasis (tab. 1). Tor Faraj exhibits much greater proportions of artifacts associated with initial processing (primary elements and cores), while Tor Sabiha displays a greater emphasis on final processing as evidenced by the higher proportions of points (Henry 1995b). Dimensional data for the assemblages also differ in pointing to greater on-site blank production (especially Levallois points) at Tor Faraj than Tor Sabiha where a good part of the assemblage appears to have been imported from off-site locations (Henry 1995a:64-65, Henry 1995b). Moreover, the artifact weights in the assemblages, an expression of portability, show those from Tor Faraj to be ~20% heavier than those of Tor Sabiha (tab. 1, Henry 1995a:113).

	Tor Faraj	Tor Sabiha
Elevation (masl)	900	1300
Exposure	S - SW	E
Site Area: Protected, Overall	136, 216	28, 116
Cultural Deposit (m)	>3	0.2-.3cm
N of Hearths	19	0
Artifact Density (0.1^2)	78	148
N of Artifacts	13, 286	6'663
% Cores [1]	2.2	0.6
% Primary Elements [1]	11.9	8.7
% Tools [2]	3.2	1.9
% Levallois Points [3]	23.5	41.1
% Chips [2]	70.1	60.6
Avg. Artifact Weight	18.5	14.7

Table 1 - A comparison of site and assemblage attributes of Tor Faraj and Tor Sabiha.

What is so surprising in these differences is that Tor Sabiha has abundant chert sources within its catchment, less than 2 km away, whereas the chert sources principally exploited from Tor Faraj are located out of its catchment some 22-35 km away. The combined evidence is clearly inconsistent with a distance-decay model in which artifact assemblages typically display greater reduction, as expressed in a progressive shift from an emphasis on initial to final processing, coupled with a decline in the size and weight of individual specimens with increasing distances from the chert sources.

The exception to the distance-decay model at Tor Faraj is thought to be attributable to a logistical procurement strategy in which the inhabitants of the site provisioned it as a place with the bulk importation of fist sized chert nodules from distant sources on the plateau. The size and shape of the nodules facilitated the production of Levallois points with little waste in material or expenditure of energy as evidenced by refits (Demidenko & Usik 2003). With as few as 5-6 removals, the nodules were prepared for the delivery of a Levallois point, a procedure that would have reduced the incentive for trimming the nodules at the chert sources. In contrast, Tor Sabiha appears to have been provisioned in support of activities and individuals. In the main, initial processing (core shaping and blank production) appears to have been conducted off-site, most likely centered

Chert Sources	Tor Faraj	Tor Sabiha
	%	%
Plateau Varieties 1-5	82	75
Plateau , All Other	4	13
Humeima	9	8
Rift Valley	5	4
Plateau 1	25.1	5
Plateau 2	11.1	2
Plateau 3	37.4	35
Plateau 4	6.9	11
Plateau 5	4	23

Table 2 - A comparison of the raw materials distributions recorded in the lithic assemblages of Tor Faraj and Tor Sabiha.

around activities that were expediently provisioned within the chert rich catchment. A comparison of the chert varieties that were exploited from the two sites shows that groups from Tor Faraj targeted fewer sources than the inhabitants of Tor Sabiha (tab. 2). This finds particular expression in the all other variety that represents chert that could not be assigned to a specific source and is >3 times more common in the Tor Sabiha assemblage.

Settlement Patterns and Implications

The patterned variability in the contexts and contents of the Late Levantine Mousterian sites in the study area suggests that Middle Paleolithic foragers ranged from the Ma'an Plateau to the Rift Valley in an annual cycle of transhumance. Most likely, the hominins responsible for the sites were Neanderthals in that in the Levant the fossil remains of Neanderthals have been dated between 42-70 Kya and associated exclusively with Middle Paleolithic assemblages of the B-Type Levantine Mousterian Industry, as are those of the study area. Embedded in the migrations were shifts in the residential mobility and sizes of foraging groups and changes in procurement strategies. This was expressed in (1) long-term winter camps in rockshelters of the lower piedmont supported through logistical provisioning, (2) occasional ephemeral winter camps in the Rift Valley, and (3) ephemeral warm season camps at high elevations on the plateau and upper piedmont in which groups dispersed into smaller social units that were sustained through local, opportunistic provisioning. These findings run counter to the prevailing notion that Neanderthals employed land-use strategies that were less productive than modern humans. Neanderthals are thought to have lacked the flexibility to adjust settlement-procurement patterns to variations in landscape and resources, especially in lacking logistical approaches to exploiting resources. The site contents and contexts of Tor Faraj and Tor Sabiha point to shifts in group size and mobility coupled with changes in procurement strategies.

Intra-site Patterns

Given the results of the inter-site comparisons, our research shifted to a high resolution intra-site investigation of Tor Faraj (Henry 2003; Henry *et al.* 2004) with a large block excavation fig. 3). The research was designed to test the proposition that modern human foraging strategies were followed by the Middle Paleolithic, most likely Neanderthal, occupants of the study area. This was addressed in two ways. First, the integrity of the local land-use model developed from inter-site comparisons was evaluated by comparing the site structure of the occupations at Tor Faraj with the complex structure predicted by the model for long-term, winter encampments in which groups had coalesced into larger demographic units. Such complex site structures typically display multiple hearths and variable activity areas representative of discrete tasks. In contrast, the simple site structure, that is thought by many to be representative of Middle Paleolithic sites, consists of a single central hearth, or no hearth at all, around which overlapping expedient, and often redundant tasks were undertaken. Relative to intra-site behavioral organization and cognition, the presence of a complex site structure implies that the occupants of a site were applying conceptual labels to certain places for conducting specific activities or tasks. Sleeping, food-preparation, butchering, initial tool fabrication and so forth would have been undertaken habitually in certain discrete places within a camp.

A second way of testing the proposition involved comparing the site structures of the living floors at Tor Faraj directly to archaeological and ethnographic examples of occupations of rock shelters by modern foragers. If the Levantine Mousterian occupants of the area were organizing their behaviors in an essentially modern fashion, we should expect the site structure identified at Tor Faraj to meet the expectations linked to the local settlement-procurement model and also resemble those site structures that are common to modern foragers.

In conjunction with the intra-site data obtained from the excavation of Tor Faraj over seasons in 1993and 1994, intra-site evidence was also drawn from an earlier (1979-80), albeit smaller excavation of Tor Sabiha. As at Tor Faraj, this intra-site evidence allows for evaluating the predicted site structure of Tor Sabiha based upon the occupation's placement in the settlement-procurement model. Unlike Tor Faraj, however, the inter-site data points to a short-term occupation by a small group supported through opportunistic provisioning strategies and this, in turn, would most likely be tied to a simple site structure.

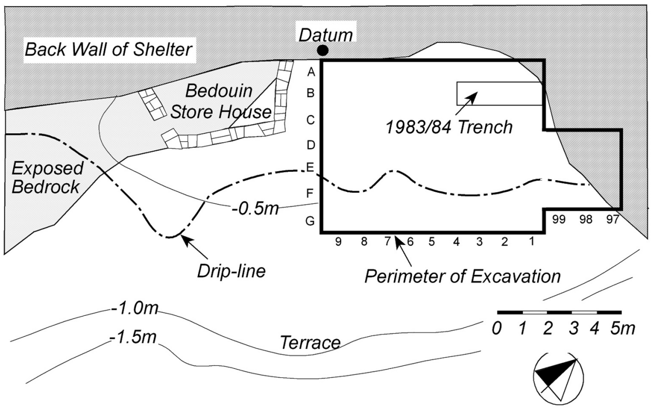

Figure 3 - Site plan of Tor Faraj showing the natural features of the rockshelter, the Bedouin store house, and the excavation block.

The block excavations at the two sites, quite different in size (Tor Sabiha -13m² and Tor Faraj - 67m²), revealed different compositions of cultural horizons. Whereas artifacts at Tor Sabiha were distributed within a single 20-30cm thick horizon, artifacts at Tor Faraj were concentrated in 10-15cm thick stratified horizons within a >3m thick cultural deposit. Numerous hearths (19) were associated with the cultural horizons at Tor Faraj, but none was found at Tor Sabiha.

The excavation methods followed at the two sites varied considerably. This was partly due to differences in research goals, but also to technical advances in archaeology. Tor Sabiha was excavated as part of a region-wide survey (32 km²) that resulted in discovery of 109 sites (Lower Paleolithic to Chalcolithic) involving test excavations at 32 of these and block excavations at six. The excavation of Tor Sabiha was conducted within a 1 m² grid (each unit divided into 50 cm x 50 cm quadrants) and dug in 5 cm arbitrary levels. In contrast, Tor Faraj, discovered and initially tested in 1983/84, was the focus of two seasons of research a decade later. Prompted by the results of the test excavation that had revealed thin horizons and hearth associations, perhaps indicative of living floors, the excavation emphasized high resolution recovery techniques (Gowlett 1997). The excavation followed a découpage approach proceeding with the excavation of 5 cm levels within a 1 m² grid further divided into 50cm2 quadrants. All artifacts >0.25mm, other objects (rocks, bones), and features were three-dimensionally plotted using a Sokia Set-6 total station for subsequent spatial analyses. Ultimately, this involved an attribute study of 3,126 artifacts and the refitting of 251 (8%) of these into 87 constellations. In addition to the high resolution procedures in the recovery and analysis of artifacts, phytolith, pollen, geochemical, floor temperature, and sunlight/shadow data were collected across the excavation block.

The Presence of Living Floors

The definition of site structure through the use of high resolution spatial analysis faces two important challenges. These involve establishing the degree to which the behavioral residuals (artifacts, manuports, and ecofacts) are in primary context and overcoming the palimpsest problem in isolating specific occupational events that encompassed relatively brief intervals of real-life time. A common criticism of intrasite spatial studies is that researchers often are too willing to view artifacts and associated evidence in primary context, as living floors, and thus appropriate for tracing site structure (Bailey 2007; Dibble *et al.* 1997; Stern 1993; Stevenson 1991). This "Pompeii Premise" (Ascher 1961:324; Binford 1981:196) ignores the wide range of processes, both cultural and natural, that may act to blur or confuse connections between past behaviors and their material residuals. In response, researchers have developed several ways to determine the degree to which archaeological materials experienced post-depositional disturbance. These include: the specific sedimentary processes that formed the artifact bearing deposit, the degree that artifacts are sorted by size, the orientation and plunge of the long-axes of elongated artifacts, the degree of weathering or ablation of the surfaces of artifacts, the spatial distributions of behaviorally meaningful artifacts, the distributions of artifacts in three-dimensional space, the distribution of refitted artifacts, and the presence and condition of archaeological features. These attributes have been used singly or in combination to establish the integrity of living floors (Isaac 1967; Rick 1976; Fuchs *et al.* 1977; Baumler 1985; Behm 1985, Schick 1986; Schiffer 1987; Petraglia 1993; Waters & Kuehn 1996; Straus 1997; Dibble *et al.* 1997; Shea 1999; Vaquero *et al.* 2001a, 2001b; Henry *et al.* 2004; McPherron *et al.* 2005).

Tor Sabiha

At Tor Sabiha the combined evidence suggests that the cultural horizon was sealed rapidly and experienced little post-depositional disturbance. The cultural material is found within a 30 cm thick layer (C) of a relict dune deposit formed from freshly weathered local, sandstone (Hassan 1995). The layer consists of a finely sorted sand, framed by sharp contacts, and lacks coarse grained lenses formed by winnowing episodes associated with sustained diastems or weathered surfaces. The chert artifacts exhibit fresh edges and little if any desilification, again suggestive of rapid burial and limited surface exposure. The orientation and inclination of the long axes of artifacts was not systematically recorded, but the data available indicate inclinations of 0-5° oriented to the SW, compared to the modern slope of ~15° to the SE.

While this may indicate some degree of disturbance from sheetwash (depending on the proportion of artifacts with a common orientation), the absence of size sorting shows this to have had only limited impact. The recovery of over 4,000 chips, representing ~60% of the assemblage, is a strong indicator that the cultural material is largely in primary context. The strong spatial co-variation of cores and primary elements also meets the criterion of behaviorally meaning artifact distributions. A refit study was not undertaken at Tor Sabiha, nor were features such as hearths found.

Tor Faraj

At Tor Faraj a more impressive array of evidence was gathered in an effort to evaluate the integrity of living floors. The processes of the formation of the shelter and its sedimentation with fine grained silts and sands acted to preserve archaeological evidence in primary context. The shelter was created by the differential weathering of sandstone bedrock that created an undercut in the cliff face. The deposit accumulated as a result of the episodic weakening and collapse of the brow of the overhang and an accumulation of predominantly wind-borne sediments behind the natural wall formed by fallen rubble from the brow.

The stratigraphy, revealed in the excavation of the upper 1.65 m of the 3.5-4 m deep deposit, gave no indication of a prolonged interruption of sedimentation. Four strata associated with the Levantine Mousterian occupation were identified underlying a modern (Bedouin herder) anthropogenic layer (A) and a layer containing a mixture of modern and prehistoric materials (B). The undisturbed prehistoric deposit included layers of aeolian silty sand (C and D2) separated by a layer of rockfall (D1) confined to an area near the drip-line. Another strata of fine silty sand (E) was exposed underlying Layer D2 in a deep sounding. A suite of five chronometric determinations derived from amino acid racemization, uranium series, and thermoluminescence dating techniques brackets layers C - D2 of the deposit to 49-69 Kya with an average age of ca. 55.1 ± 5.6 Kya (Henry 2003:18-19). This age range is very similar to dates of other Late Levantine Mousterian (B-type) occupations.

Bedding planes displayed by aeolian sediments, carbonate laminae, and disintegrated roof-fall trace a nearly level-bedded stratigraphy running parallel to the back-wall and beds inclined from 0-50 running perpendicular to this line. Hearths and ash lenses furnish additional confirmation of a nearly level to very gently sloping floor over the excavation area of ca. 67 m². The contacts between the fine silty sand deposits of Layers C and D2 are conformable, suggesting that their deposition was not separated by an extended period of surface stability or erosion. The laminae tracing the pulses of sedimentation within layers are typically fine grained and do show some cross-bedding. But, in lacking coarse-grain, lag deposits associated with extensive winnowing and long diastems, the deposit appears unlikely to have been exposed to sustained wind erosion. The presence of fragile hearths and ash lenses also points to little in the way of post-depositional disturbance.

During excavation and subsequent analysis, two occupational horizons were identified within the shelter's deposit based upon stratigraphic peaks in the densities of artifacts, hearths, and rocks. These were initially identified as Floor I (160-170 cm BD, Layer C & D1) and Floor II (levels 180-195 cm BD, Layer D2), but even at this stage of the research it was recognized that each of the two floors may have represented two or even three discrete occupational events (Henry 2003:260).

In order to check for post-depositional disturbance, the orientations of artifacts were recorded along their long axes in the direction of their smallest ends and grouped into twelve sectors of 15° each. In replication experiments, Schick (1986) found that post-depositional movement of artifacts from sheet-wash resulted in orientations disproportionately skewed toward the source of flow or perpendicular to the direction of flow depending on flow-rate. At Tor Faraj a minor "spike" in the orientations of artifacts does point up-slope, toward the back of the shelter, but this accounts for only 17.8% of the specimens and other orientations are relatively balanced (ranging from 6-11%) in their representation. Petraglia (1993) noted a similar orientation pattern (with spikes of 17-19%) at the French site of Abri Dufaure and he interpreted this as evidence for an intact, undisturbed deposit. In reporting upon artifact orientations and site formation processes at another French site, Pech de l'Azé IV, McPherron *et al.* (2005) note that the orientation data collected with a total station allow for tracing the slopes of paleosurfaces that are difficult to see even in the stratigraphic profiles. The artifact orientation data from Tor Faraj indicate that the deposit is in primary context with only minor post-depositional disturbance from low energy sheet-wash from the back of the shelter.

The chipped stone artifacts from the deposit show remarkably little weathering, an indication of rapid burial by fine sediments. Their edges are fresh and their surfaces display only slight patination or desilicification. An exception to this pattern appears in the area of the brow collapse that formed Layer D1. In this area artifacts were recovered resting at various angles on edges and ends, rather than flat as in the rest of the site, and they showed strong signatures (white speckled and milky surfaces) of desilicification. This is thought to reflect artifacts that had lodged into the crevices between the rocks from the roof-fall and were exposed to weathering for a much longer period of time than those buried in the fine sediments of Layers C and D2 deposited behind the rubble wall.

The refitting of artifacts was also employed to evaluate the integrity of the living floors (Demidenko & Usik 2003). Two hundred forty-seven artifacts were refitted into 87 constellations with an average artifact separation of slightly more than 1 m horizontal distance and 7.5 cm vertical distance. A more telling statistic, relative to the stratigraphic integrity of the deposit, is that only five artifacts (representing 2% of the refitted artifacts) show vertical separations exceeding 15 cm. The refits also inform us about the integrity of Floors I and II, in that only five refitted artifacts bridge the two living floors and these are the same five specimens that exceed 15 cm vertical separation. Three of these are stratigraphically inverted, relative to the other artifacts forming their constellations, and appear to have come from a small area disturbed by Bedouin construction activities that cut the floors in the northwest corner of the excavation block. One constellation in particular underscores the lack of post-depositional disturbance at Tor Faraj. This is represented by a burin with five of its small spalls (recovered from within a 2 m radius) that were refitted.

In addition to forming the foundation for the examination of site structure, the spatial patterns of behavioral residues also furnish a means of testing the integrity of living floors. Dibble *et al.* (1997) argue that behaviorally meaningful data should be expected to display a non-random distribution in the context of a living floor. At Tor Faraj, there are several lithic data-sets (chips, cores, Levallois points, side-scrapers, and notches) and other cultural residuals (hearths, manuports, phytoliths, and phosphorous concentrations) that are non-randomly distributed. The hearths, in the form of shallow fire-pits, perhaps provide the most definitive signature of an intact deposit. When the distributions of the cultural residues at Tor Faraj are examined contextually, it is evident that their spatial patterns resulted principally from the behaviors of the shelter's inhabitants and not from natural forces.

Spatial Patterns and the Palimpsest Problem

Although both Tor Sabiha and Tor Faraj appear to have suffered little in the way of natural post-depositional disturbances, there remains the problem of determining the number of occupational events represented at the sites. In such situations it is difficult to tease apart the remnants of individual occupations, stratigraphically (Straus 1997; Carr 1987; Galanidou 2000; Wadley 2006; Bar-Yosef *et al.* 2007). Yet if not separated by occupation, the cultural residue may, even at the highest resolution, represent a smear or mixture of real-life time events. Therefore, the contextual relationships identified from such a mixture of occupational events are likely to yield a blurred definition of site structure and an inaccurate reconstruction of prehistoric behaviors.

Tor Sabiha displayed a single concentration of artifacts in an area of 2-3 m², whereas Tor Faraj exhibited 4 concentrations of artifacts of 2-4 m² in each area. This, in part, may be explained by the difference in the excavated areas of the two sites (Tor Sabiha -13 m² and Tor Faraj - 67 m²), but the concentrations also show important qualitative differences. The concentration at Tor Sabiha, represented by the peak densities of cores, primary elements, points, and tools, indicates that the full reduction sequence from core shaping through tool fabrication was undertaken in that location.

In contrast, the artifact concentrations at Tor Faraj vary relative to the densities of artifact classes. Some concentrations contain high densities of cores and primary elements, but low point and tool densities, whereas other concentrations show just the reverse. Unlike Tor Sabiha, the artifact concentrations at Tor Faraj trace a spatial segregation of the reduction sequence into places associated with core shaping and blank production and other areas associated with tool use and abandonment. The study (Henry 2003, fig. 4) revealed a discrete central area (Area B) of the shelter in which tool use and maintenance were emphasized, and two peripheral areas in which core shaping and blank production formed the principal lithic processing activities (Areas A and C). Ancillary evidence, including the spatial distributions of hearths, phytoliths, phosphorus values, lithic wear data, and exposure to direct sunlight showed strong patterned co-variation with the three activity areas defined by the lithic data. These data-sets pointed to the central area having been used for the processing of plant (cattail, date, pistachio) and meat resources, coupled with tool fabrication, maintenance, and rejuvenation. Concentrations of grass phytoliths along the wall of the shelter in Area B were interpreted as bedding. In contrast, the two smaller peripheral activity areas contained evidence indicative of tasks associated with core shaping, blank production, and butchery. The fourth area (Area D) situated along the rock fall following the edge of the terrace, was thought to reflect a refuse dump because of its mixture of artifacts linked to initial and

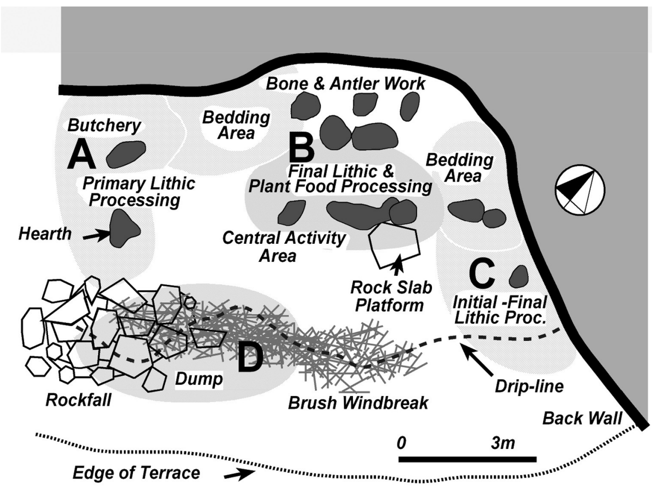

Figure 4 - Plan of Tor Faraj showing the locations of hearths and inferred activity areas associated with Floor II.

final processing, relatively low tool frequencies, and high frequencies of burnt artifacts in the absence of evidence for a hearth. Very high frequencies of phytoliths from woody plants along the rock fall were interpreted as a brush windbreak and fuel depot. Although the activity areas were defined by artifact concentrations, a strong spatial association was observed between the activity areas and hearths.

The spatial co-variation of hearths, artifacts, and other evidence appears to define living floors at Tor Faraj and the spatial associations of artifacts at Tor Sabiha may represent a similar thin slice of time, but how do we know if the associations resulted from single or multiple occupation events? Relative to Tor Sabiha, this question may never be answered, but at Tor Faraj insights into the contemporaneity of artifact spatial distributions were developed through an analysis of the positioning of hearths relative to one another (Hearth Pattern Analysis) and analyses of the spatial distributional patterns of artifacts surrounding the hearths (Ring and Sector Analysis).

Hearth Pattern Analysis

When the hearths of Tor Faraj were examined in relation to their density and distribution, it became clear that the initial stratigraphic definition of two living floors within the shelter should be refined. Specifically, the hearth information suggested that Floor II, with its 13 hearths, most likely represented more than one floor. Also, the regular spacing between hearths was especially revealing in separating this originally defined single floor into two floors, Floor II and Floor III.

Gamble (1986, 1991:12) noted that hearths recorded in ethnographic and archaeological encampments from around the world tend to be spaced about 3 m apart. Although Gamble's 3 m Rule has been refined by subsequent studies that indicate hearths to be more closely spaced, there nevertheless does appear to be a regular pattern in hearth spacing. In Binford's (1996:230) studies of "hearth centered" behaviors, he found that in addition to the regular patterns that delimited drop and toss zones, a "circle defined by the area occupied by seated persons surrounding the hearth" regularly measured 1.76 m in radius from the center of a hearth. Such a circular zone set aside for hearth-side activities would strongly influence the spacing of hearths relative to other hearths and also to the physical features (i.e., back-walls and drip-lines) of shelters. Human anatomical requirements for sitting and reaching, coupled with the limits of heat and light from the fire for conducting various tasks, are likely to have influenced the general regularity in the size of the hearth-side zone, but social preferences may also have played a role. Some years ago, Freeman (1978:113) observed that a stationary individual can conveniently reach an area of 2.5-3 m². If this is viewed as a circular area, it involves a diameter of ca. 180-194 cm, a dimension remarkably close to Binford's ethnographic observation. The distances between the hearths and their related activity zones would be largely determined by the degree to which each hearth's occupants desired social interaction (e.g., conversation or physically sharing tools and resources) or privacy. This is consistent with ethnographic evidence in which hearth function, e.g., cooking versus sleeping (Nicholson & Cane 1991) has been observed to influence hearth to hearth distance. Although not examining the distances separating hearths in her comparative study of ethnographic rockshelter sites, Galanidou (2000:247) found no relationship between the forms of hearths and their functions.

In order to compare these ethnographic regularities in hearth spacing to the hearths exposed in the Tor Faraj living floors, circles of 1.8 m radius, representing the estimated hearth-side activity zone noted by Binford and Freeman, were centered on each of the hearths. The basic logic of this analysis assumed that only a single hearth should command a hearth-side activity zone at the time of use; other hearths falling within the zone are presumed to have been used at another time and representative of a different occupational event. Moreover, a corollary to this line of thought would hold that hearths resting on or near the boundaries of other hearth-side activity zones would be likely to have been in use at the same time, thus explaining their regular pattern of spacing.

At Tor Faraj, an examination of the six hearths of Floor I shows Hearths 3, 6, and 21 to fall on or very near the boundaries of the hearth-side zones of others, whereas Hearths 2 and 7 fall within other hearth-side zones (fig. 5). Hearth 8 is an outlier spatially unrelated to the hearth-side zones of the others. This suggests that Hearths 2 and 7 represent a specific occupational event distinct from that of Hearths 3, 21, and 7. Beyond being positioned roughly equidistant from each other at a distance of about 2m from the centers of adjacent hearths, Hearths 3, 21, and 8 show their hearth-side zone to end with the backwall of the shelter. These patterns suggest that the six hearths of Floor I reflect two specific occupational events with Hearths 3, 6, and 21 seeing synchronous use, while Hearths 2 and 7 were used at another time or times. The precise length of time separating the use of the two sets of hearths is impossible to establish. The close proximity of the anomalously positioned hearths with patterned ones (i.e., Hearths 2 and 21, Hearths 6 and 7), however, may simply represent subtle repositions of hearths during a single interval of encampment in the shelter.

A similar analysis of the hearths for the original Floor II produced a significantly different picture (fig. 5). Five (Hearths 5, 9, 11, 1 or 18, and 14 or 15) of the thirteen hearths rested within the hearth-side zones of others. This information was consistent with the overall numbers of hearths for the "floor" in pointing to multiple occupations. In an attempt to refine the definition of the occupations, the hearths were separated into an upper group of ones in which their top elevations rested in levels 180 and 185 (labeled Floor II), and a lower group recorded in levels 190 to 200 (labeled Floor III). When these hearths were re-plotted as Floor II (upper group) and Floor III (lower group), they largely exhibited the regular pattern of spacing seen in Floor I (fig. 6). With the new groupings, only a single hearth for each floor (Hearth 9 of Floor II and Hearth 11 of Floor III) was found to violate the hearth-side zones of adjacent hearths.

While Hearth Pattern Analysis appears to offer a simple means of, at least, partially addressing the palimpsest problem, when combined with Ring and Sector Analyses our understanding of hearth related activity areas can not only be independently cross-checked, but also enhanced.

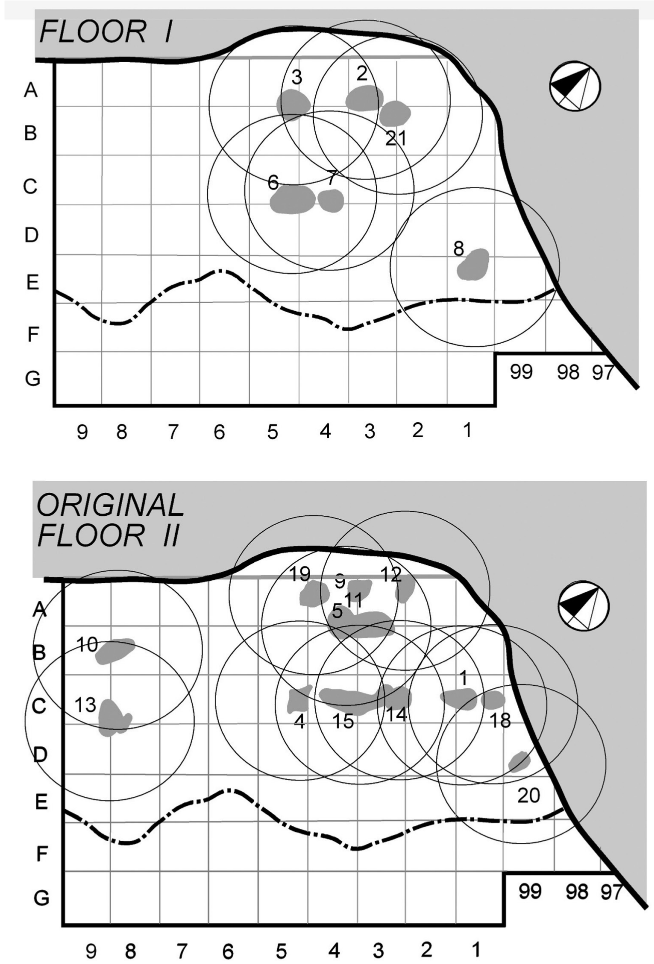

Figure 5 - The site plan of Tor Faraj showing the locations of hearths and their spacing for Floor I and original Floor II. The circles (1.8 m in radius) are drawn from the center of each of the hearths. Note the numerous overlaps in the hearth-side zones of hearths in Floor II.

Ring and Sector Analyses: Background

By mapping the positions of the hearths onto the distributions of other data-sets (e.g., phytoliths, phosphorous values, exposure to sunlight, varieties of lithic artifacts), earlier intrasite spatial studies (Henry 1998, 2003; Henry *et al.* 1996) found spatial co-variations with the hearths, but these earlier studies were unable to trace the detailed spatial patterns of artifact distributions within each of the hearth-side zones. Subsequent to these earlier research efforts, I learned of the Dutch archaeologist, Dick Stapert's (1989) "ring and sector" approach to the spatial analysis of hearths and a software, Analithic II (Boekschoten & Schweiger 1999-2004), that greatly facilitates its application. Application of Stapert's ring and sector analyses allowed for checking the hearth pattern results and enhancing our understanding of the number hearth-side occupants and their activities.

Stapert (1989, 1990a, 1990b, 1991/1992; Stapert & Street 1997) has employed his ring and sector method on several European sites to infer the presence of a dwelling wall beyond a hearth, the prevailing wind direction at the time of hearth use, the numbers of occupations attributed to a living floor, the numbers of persons using a hearth and even the likely gender composi-

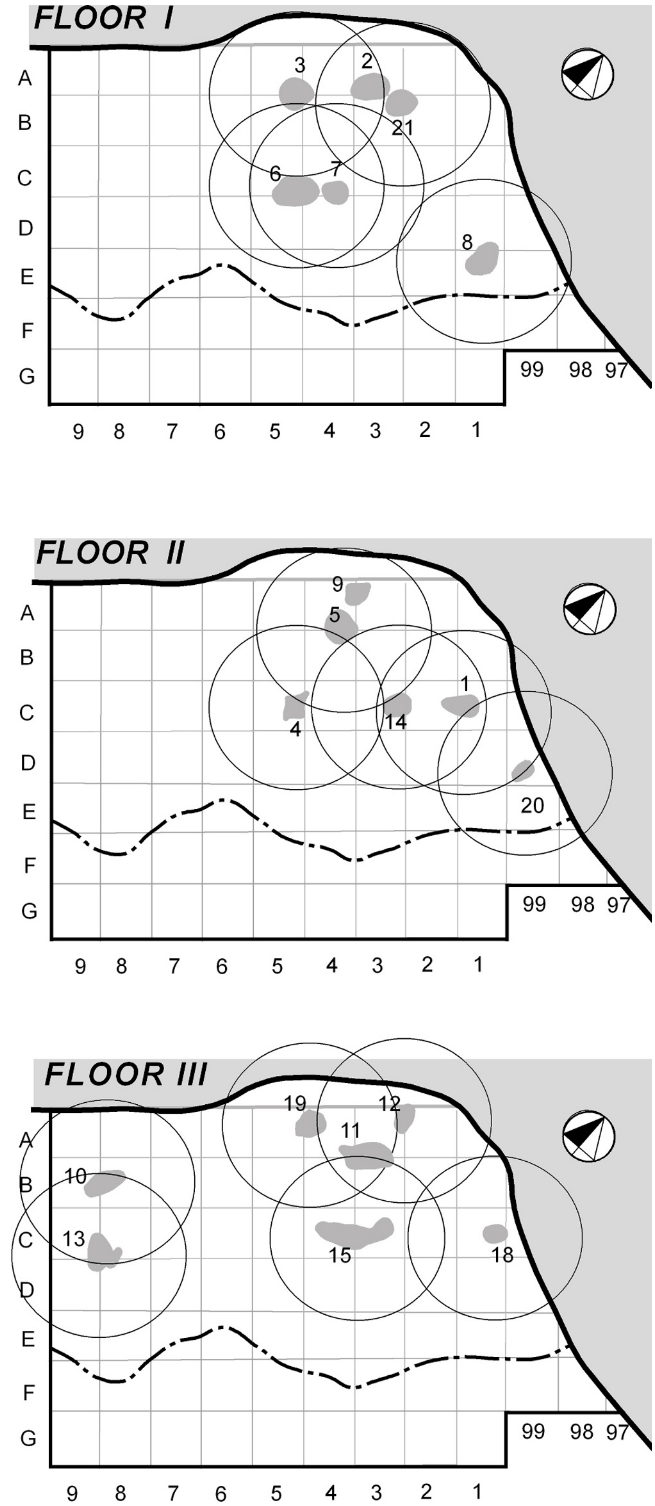

Figure 6 - The site plan of Tor Faraj showing the locations of hearths and their spacing for Floors I, II and III following the separation of Floor II. The circles (1.8 m in radius) are drawn from the center of each of the hearths. Note that the number of overlaps in the hearth-side zones of Floors II and III is significantly reduced.

tion of the users. At Tor Faraj, the objectives of analyzing the hearth-side zones by the ring and sector method were to better understand the numbers of persons using the hearths and the ways in which they were used. Moreover, this approach allowed for establishing wind direction at the time a hearth was used and this information indirectly provided an independent test for the

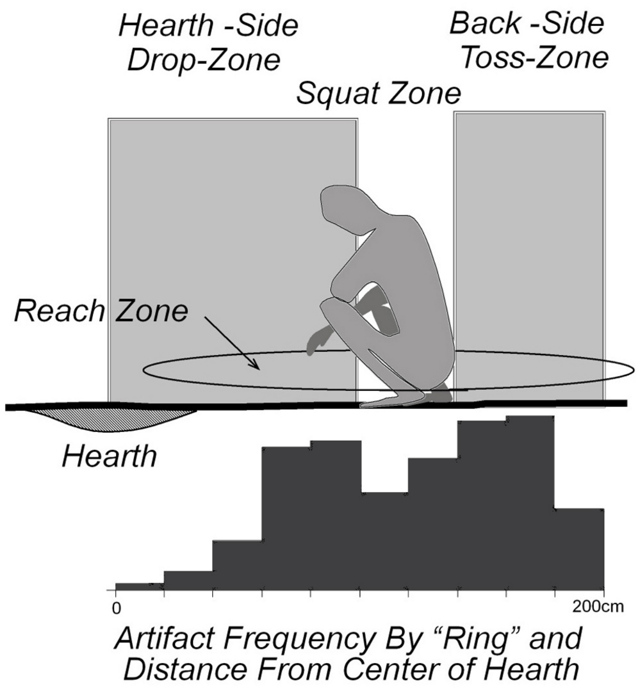

Figure 7 - A schematic illustration showing the spatial relationships of ring analysis and hearth-side zones. Note the typical low artifact densities in the near hearth area, the squat zone, and the rear edge of the toss zone.

synchroneity of the firing of multiple hearths as indicated by the hearth pattern study described earlier.

Stapert's (1989) ring analysis, drawing inspiration from Binford's concept of drop and toss zones about a hearth, involves a computation of artifact frequencies within concentric bands (rings) surrounding a hearth. The artifact frequencies of the rings are typically presented as a histogram that allows for a quick visual inspection of a hearth's ring profile (fig. 7). The radius of the circle established from a hearth's center and ring-width employed in the analysis is arbitrary. In his numerous studies, Stapert employed radii of 3 m - 7 m from hearth centers and ring widths of 0.5 m. Given the multiple, nearby hearths for the floors at Tor Faraj and hearth-side zones of 180-200 cm radius from hearth centers, a smaller scale, than that employed by Stapert, was used in the ring analysis. This consisted of a radius of 200 cm and ring-widths of 20 cm.

In contrast to the ring analysis, sector analysis traces the distributions of artifacts within the hearth-side zone by compass direction. Sectors are arbitrarily established as sweeps of equal degrees radiating from a hearth's center and extending to the edge of the circle that defines the hearth-side zone. In his studies, Stapert regularly employed six, 60 0 sweeps to define his sectors. At Tor Faraj eight sectors, each with sweeps of 45 0, were employed for the sector analysis and these are labeled relative to grid north. Stapert has principally used sector analysis to infer prevailing wind direction; the logic being that hearth-side occupants would have situated themselves on a hearth's windward side with their backs to the wind thus avoiding smoke and cinders. Beyond using sector analysis to determine prevailing wind direction and indirectly the probable synchroneity of hearth use at Tor Faraj, the analysis is also employed to provide information on the numbers of persons seated about a hearth. The reasoning here is simply that there should be a direct correlation between the number of hearth-side occupants and the number of sectors with high artifact frequencies.

Artifact data-sets from the initial study (Henry 2003; Hietala 2003; Henry & Hietala 2004) were reconfigured to reflect the three floors as defined by the hearth pattern study (i.e., Floor I - levels 160-170 BD; Floor II - levels 180 -190BD; and Floor III - levels 190 -195 BD). The specific artifact sub-sets selected for analysis with the software Analithic II for each of the floors was "All Artifacts", a category representing all of the chipped stone specimens that were recovered for the floor with exception to "Chips" (those specimens with a maximum dimension <30 mm and often considered as waste flakes). The reason for excluding the chips is that they were not plotted individually, but collected by unit quadrants of 0.25 m² (squares 50 cm on a side) and as such could not be meaningfully analyzed in a ring analysis using rings of 20 cm width (Stapert & Johansen 1995/96). The artifact sample recorded within the hearth-side zones of the three living floors totaled 2,577 specimens with 1,057 specimens coming from the hearths of Floor I, 1,146 specimens from those of Floor II, and 374 specimens from those of Floor III. This compares to 3,186 specimens that were recovered for the floors as a whole. Thus about 81% of all the artifacts found in the excavation of the three floors were found within the 2 m radius, hearth-side zones; a statistic that underscores the notion of hearth-centered activities.

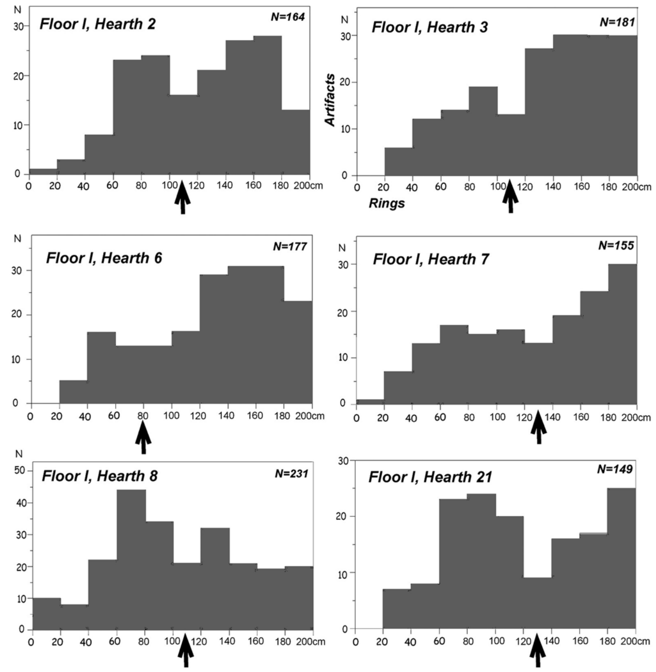

Figure 8 - Histograms of the ring profiles of hearths from Floor I. N = artifact number and the vertical arrow points to the center of the squat zone.

Ring Analysis: Applied at Tor Faraj

The ring analysis at Tor Faraj revealed hearth profiles dominated by a bimodal artifact distribution (figs. 8, 9 and 10). Eleven of the hearths (Hearths 2, 3, 6, 8, 21, 4, 5, 20, 11, 15 and 18) showed a bimodal profile, two hearths (1 and 14) exhibited multi-modal profiles, two hearths displayed unimodal profiles (10 and 13), and two (19 and 12) contained samples too small for meaningful computation. In his studies, Stapert has observed a dichotomy in ring profiles broken between unimodal and bimodal ones. He suggests that the unimodal profiles were produced by a "centrifugal effect" linked to a high density of artifacts in the drop zone surrounded by a lower density of artifacts in the more outward lying toss zone (Stapert 1989). In contrast to the unimodal profile, he proposed that a bimodal ring profile reflects a "barrier effect" in which the high density drop zone was matched by a high density toss zone where artifacts accumulated against some kind of a barrier such as the wall of a structure.

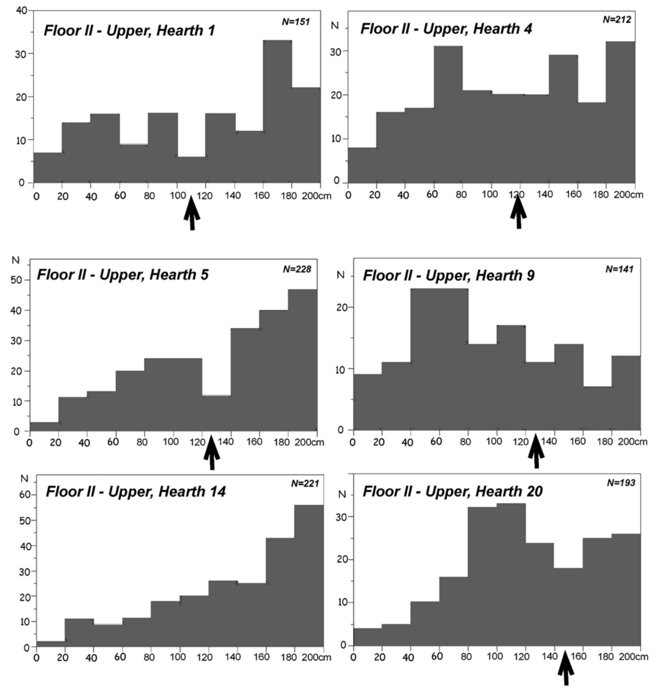

Figure 9 - Histograms of the ring profiles of hearths from Floor II. N = artifact number and the vertical arrow points to the center of the squat zone.

Given the close proximity of neighboring hearths and the small scale of the hearth-side zones at Tor Faraj, the bimodal profiles on the floors of the shelter were unlikely to have been generated by walls of tents or windbreaks. Although some of the hearths positioned near the shelter's wall may reflect the barrier effect, this would not explain the bimodal profiles of those in the central area (e.g., 6, 7, and 15). An alternative explanation may rest in the lower density of artifacts in the immediate area under the persons sitting or squatting next to a hearth (fig. 7). This "squat zone" should contain relatively few artifacts when compared to the drop zone close to the hearth and the toss zone located beyond the squat zone. Even with the accumulation of artifacts within the same ring as the squat zone, but at the elbows and lateral to each of the hearth-side occupants, the effect of the artifact void immediately beneath a squatting person would result in a relatively lower net artifact density for the rings of the squat zone than in the surrounding rings.

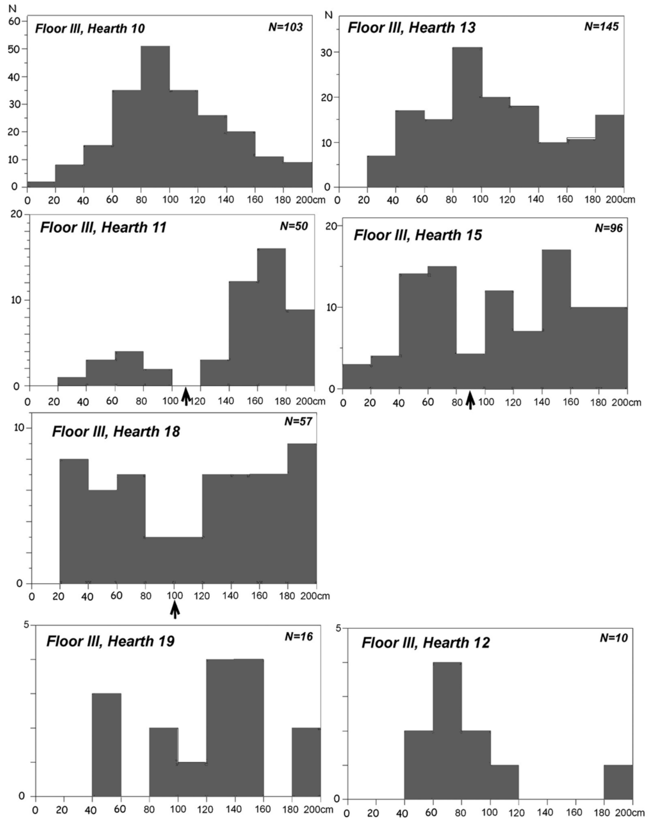

Figure 10 - Histograms of the ring profiles of hearths from Floor III. N = artifact number and the vertical arrow points to the center of the squat zone.

Most (46%) of the squat zones of the hearths at Tor Faraj appear in the 100-120 cm ring and the rest fall in the 80-100 cm (31%) and 120-140 cm (23%) rings. These metrics are remarkably consistent with Freeman's (1978:113) observation about the size of the area around a stationary person, within which objects could be manipulated and ultimately abandoned. When centered at 120 cm radius within the squat zone, such a reach zone of 90-97 cm radius fits uncannily well between the center of the hearth and the outer edge of the 2 m radius hearth-side zone. The presence of a squat-zone beginning about 1 m from the center of a hearth is also supported by the metrics of unimodal ring profiles at Tor Faraj (Hearths 10 and 13). In these the artifact density peaks in the drop zone within the 80-100 cm ring and then declines through the squat and toss-zones. Stapert's (1989:16-17) studies of unimodal ring distributions for eleven hearths at the French site of Pincevent (in which he employs a 50 cm ring width) are also consistent with such a squat-zone position in that all of the hearths show the peak artifact density in the 50-100 cm ring.

Sector Analysis: Applied at Tor Faraj

At Tor Faraj, those sectors displaying high frequencies of artifacts were viewed as proxies of the prevailing wind direction at the time a hearth was in use. In conducting sector analysis with the software Analithic II, the results are displayed as a circle which represents the mean value of the artifact frequencies of the sectors within the hearth-side zone and bars that indicate the artifact frequency of each sector. Those sectors with artifact frequencies less than mean are depicted as open bars inside the circle and those sectors with artifact frequencies greater than mean are shown as closed bars outside the circle.

The hearths of Floor I indicate a prevailing wind (relative to grid north) from the NWw for one burn and the SSE for another, those of Floor II suggest a predominant wind from the S and SE, and the hearths of Floor III point to a mix of wind directions (fig. 11). This information alone offers additional confirmation for the presence of three discrete floors as evidenced by prevailing winds from different directions for each floor, but a more detailed examination of the sector data furnishes an even greater understanding of specific real-time occupational events for each floor. The comparison of wind direction for hearths distributed across a living floor would appear to be uncomplicated, and this is likely so for an open-air occupation, but in rock shelters drafts are often channeled or deflected by the walls of the shelter. At Tor Faraj, winds blowing down the canyon from the west are funneled along the back wall of the shelter into the nook and exit to the southeast. This explains, in part, why the hearths in the nook and along the eastern wall show some indications of use in their N and NE sectors despite a prevailing northwestern wind. Similarly, Hearths 10 and 13 show wind from the NE sector as it is funneled out from the backwall after entering the shelter from the S –SE.

A comparison of the burn synchroneity identified in the hearth pattern analysis with the dominant wind directions for the hearths offers compelling evidence in support of the results of the hearth pattern study (fig. 12). In short, those hearths that were identified as having been used at the same time are likely to have enjoyed a common wind direction. And along the same lines, hearths burned at different times are more likely to have experienced different wind directions. Floor I shows that the three hearths (3, 6 and 21) indicated to have been used at the same time (Burn 1) in the hearth pattern analysis also experienced wind from a common direction as two adjacent sectors (6 and 7) were dominant. The other set of hearths (2, 7 and 6) from Floor I that was determined to have been fired at the same time shows a similar pattern with wind coming from the NE, as evidenced by dominant artifact densities in sectors 1 and 3. Floor II shows that the five hearths used at the same time were exposed to wind from the S, or perhaps SE, as evidenced by artifact peaks in adjacent sectors 3-6. Floor III displayed three sets of paired hearths of which those of Burn 1 and 2 were determined to have been fired at different times, but given the isolation of the third set, its time of use could not be established relative to the other hearths. When compared to wind direction, the Burn 1 set fails to show a common direction as seen in all the other examples, suggesting that the hearth pattern analysis is in error with respect to these two hearths. The hearths of Burn 2 and Burn 3, however, conform to expectations with hearths with common burn times sharing common wind directions. Moreover, the sector analysis offers a clue as to how the Burn 3 hearths may have fit into the burn sequence of Floor III. The dominant sectors of the hearths in Burn 3 match those of Burn 2 given the way in which wind entering the shelter from the SE wraps around the back-wall and exits from the NE (fig. 11).

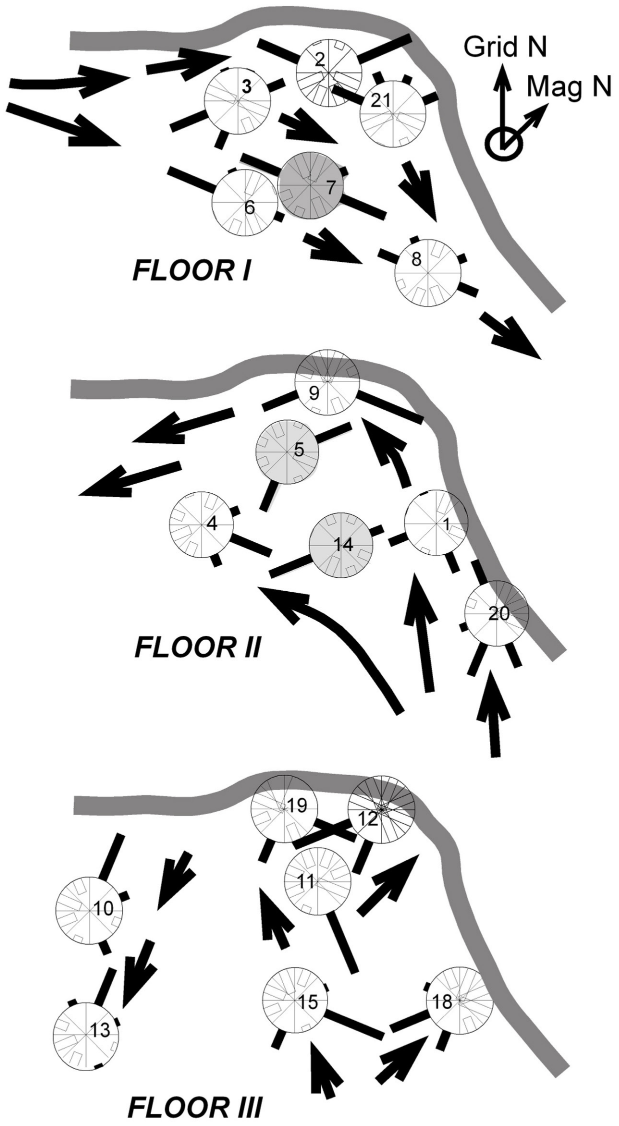

Figure 11 - Diagrams of the hearths of the three floors at Tor Faraj showing the wind directions inferred from variations in the frequencies of artifacts by sector. Note the differences in prevailing wind directions between floors. Multiple wind directions within a floor are thought to denote distinct occupations.

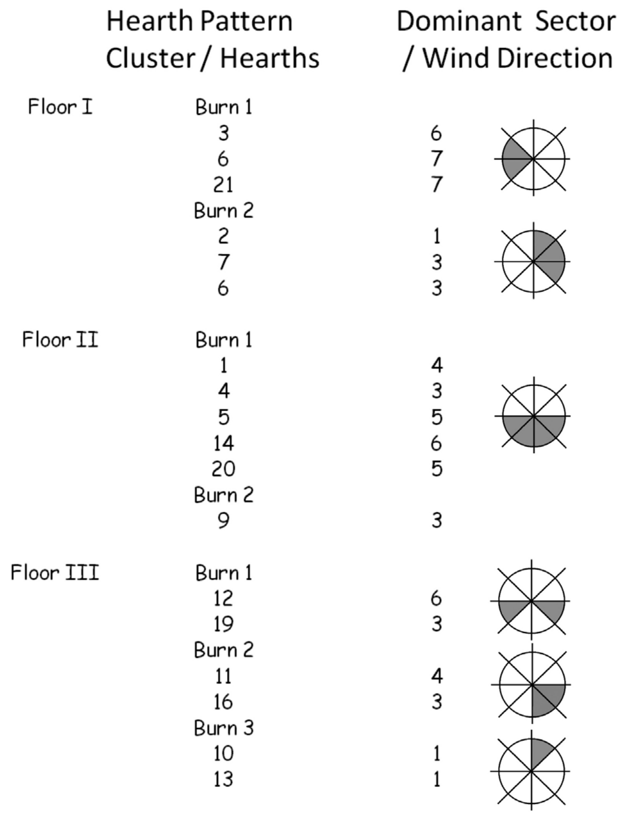

Figure 12 - Comparison of the hearths tied to specific burn events established through hearth pattern analysis and the dominant sectors, relative to artifact densities, of these hearths. Note that if wind direction is inferred from the dominant sector, those hearths associated with a specific burn event are also associated with a common wind direction with exception to Floor III, Burn 1.

Beyond tracing wind direction, a sector analysis of the hearth-side zone also provided a means of estimating the numbers of persons at a hearth. The reasoning here is simply that as additional occupants join a hearth they will leave behind behavioral residue (e.g., lithic artifacts) in the sectors that they occupy. Given human body dimensions, a person squatting at a hearth would likely leave material within one to two 45 0 sectors (fig. 13). Schematic diagrams (drawn to scale) that depict one, three and four persons occupying the 100-140 cm squat zone suggest that more than four persons would likely leave a high density of material in more than four sectors (fig. 13). In using sector patterns as a proxy of the number of hearth-side occupants, however, we need to keep in mind the differences in the body sizes and biomechanics of men, women, and children. For Floor I at Tor Faraj, only Hearth 21 and Hearth 8 display multiple, contiguous or nearby sectors with above average artifact frequencies; a pattern that would be expected for multiple persons positioned shoulder to shoulder around a hearth. While the sector pattern of Hearth 21 points to 3-4 persons having occupied the northern half of the hearth-side zone, the sector pattern of Hearth 8, with a low artifact density sector separating the two nearby high density sectors, is perhaps more consistent with 2-3 occupants situated around the northern portion of the hearth. In Floor II, Hearth 20 shows a similar pattern. Floor III lacks hearths displaying a high density of artifacts in four sectors, but four hearths (Hearths 10 , 13, 15, and 18) show a three sector pattern suggestive of 2-3 occupants each.

Site Structure and Implications

The intra-site study of Tor Sabiha defined a spatial co-variation in the peak densities of artifact classes connected to initial (cores, primary elements) and final (tools, points) lithic reduction. This implies a simple site structure of overlapping activities and is consistent with the intersite evidence for the site that points to a small, ephemeral occupation largely provisioned for activities. However, we presently have no way of knowing with certainty if the spatial distributions accurately trace a single occupational event or the combination of multiple, overlapping occupations, the palimpsest effect.

The research at Tor Faraj, emphasizing a high resolution spatial analysis, traced three stratified floors with discrete segregated activity areas indicative of a complex site structure. Several lines

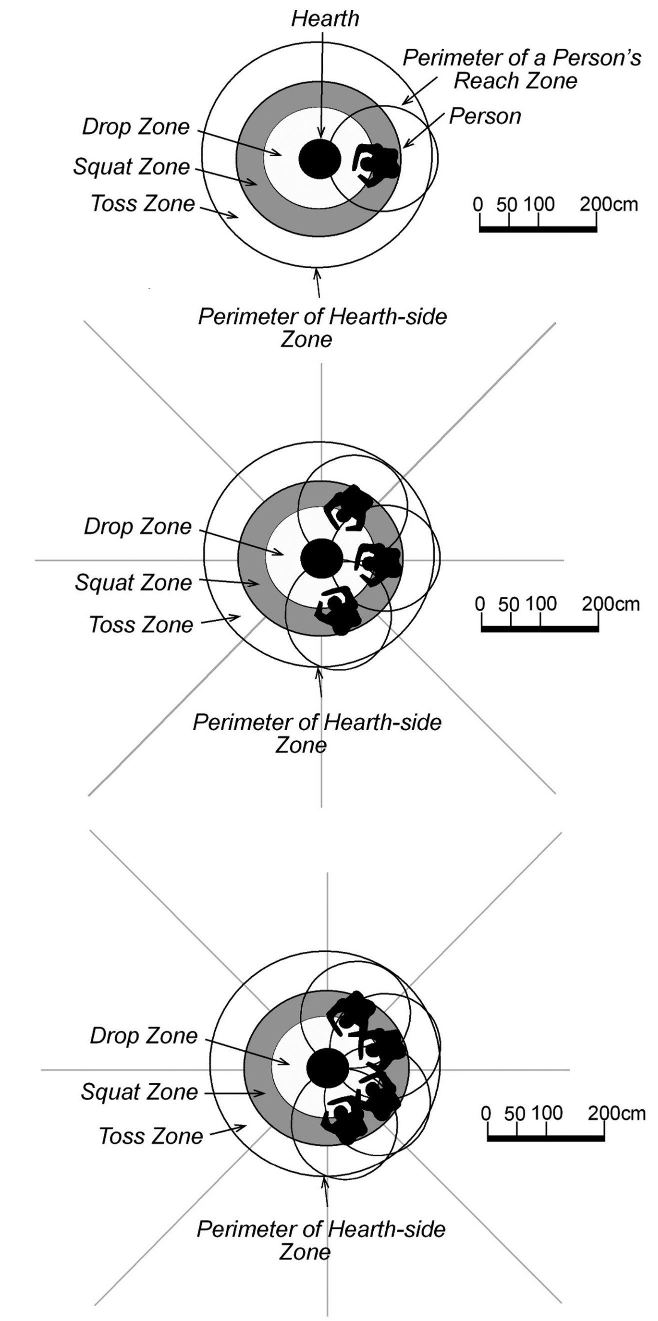

Figure 13 - A schematic of the structure of a hearth-side zone showing the relationships of the sub-zones and their metrics with one, three, and four-persons seated about a hearth.

of evidence were explored in the study to specifically evaluate the integrity of the living floors relative to post-depositional disturbance through natural agencies. These included the examination of the specific sedimentary processes that formed the artifact bearing deposit, the degree that artifacts were sorted by size, the orientation and plunge of the long-axes of elongated artifacts, the degree of weathering or ablation of the surfaces of artifacts, the spatial distributions of behaviorally meaningful artifacts, the distributions of artifacts in three-dimensional space, the distribution of refitted artifacts, and the presence and condition of archaeological features. In addition, novel approaches, involving Hearth Pattern Analysis and Ring and Sector analyses, were employed to assess the degree to which the palimpsest problem may have impacted the spatial integrity of the floors. These hearth- related approaches were also used in developing estimates for the numbers of hearth-side occupants and concomitant group sizes. In combination, the high resolution study showed the living floors to have integrity and represent very brief intervals of discrete occupational events.

Summary and Conclusions

Intersite and intrasite data collected from area-wide and site specific studies in southern Jordan point to behaviors not traditionally viewed as those associated with the Middle Paleolithic or Neanderthals. The area-wide research traced a transhumant settlement pattern in which Late Levantine Mousterian groups moved seasonally between low and high elevations accompanied by shifts in their group sizes, mobility levels, and provisioning strategies. Of particular importance here, was the apparent practice of supporting the long-term winter occupations of lower elevation rockshelters (such as Tor Faraj) by larger, coalesced groups through a logistical procurement strategy that involved the provisioning of a place. This was associated with the lithic processing of chert nodules imported in bulk from distant sources resting well out-side site catchments. High elevation encampments (such as Tor Sabiha), occupied by small, ephemeral groups were supported through opportunistic procurement that largely involved provisioning of activities from chert sources within the site catchment. These settlement- procurement strategies involved both adjustments and scheduling in the decision making of these Middle Paleolithic foragers and, in turn, this indicates both flexibility and planning depth in their thinking.

When combined with intrasite evidence the research suggests co-variation between the long-term winter occupations supported logistically and complex internal site structures defined by spatially segregated activities. In contrast, the small, ephemeral occupations situated at high elevations during the warm season and supported opportunistically appear to have been linked to a simple site structure, defined by a single locus of spatially overlapping activities. Although the critical evaluation of the presence of living floors did not provide unambiguous support for a floor at Tor Sabiha, diverse lines of evidence were consistent in pointing to the presence of three stratified floors at Tor Faraj.

This is important in that it is the complex site structure of the floors of Tor Faraj that is thought not to emerge until the Upper Paleolithic in modern human occupations. From the perspective of behavioral organization, the site structure at Tor Faraj suggests that the inhabitants of the shelter conceptually labeled specific places for conducting certain activities such as preparing and cooking foods, sleeping, initial or final lithic processing, butchering and so forth. The use of Area A, Floor II, for core shaping and blank production at Tor Faraj underscores the conceptual labeling of that locus. In addition to the initial core processing from nodules, thick flakes were returned to Area A for recycling as cores. Thus, chert nodules imported to the site from distant sources and thick flakes returned for recycling as cores were introduced to same place for shaping and blank (mostly Levallois point) production. This clearly indicates that the shelter's Archaic occupants conceptually labeled Area A as a specific place for primary processing regardless of the chert source and it seems highly unlikely that their reason for doing so was conditioned by the natural constraints of the shelter or the biomechanics or expedient behaviors of its occupants.

Researchers have speculated that various modes of behavior related to planning depth, land-use strategies and social organization were underdeveloped in Neanderthals, rendering them less successful when faced with competition from modern humans. The notion of a social brain (Dunbar 1998) provides another dimension to examine the ways in which Neanderthals organized their behaviors in comparison to modern humans, especially as this is related to group size and composition, settlement-procurement decisions, the use of living spaces, and fire (Dunbar *et al*. 2010). In many ways, these notions parallel those advanced by E.O. Wilson (1998) in which selective forces come to generate epigenetic rules (incest avoidance, innovation, status, territoriality, etc.) governing certain heritable behaviors or as in the concept of a social brain heritable predispositions for certain behaviors (e.g. group awareness, networking, altruism, management of fires, etc.). Where advances in our understanding of the Neanderthal genome may well trace some of the genetic origins of cognitive differences between Archaic and modern humans, such paleogenetic advances will ultimately need to be evaluated in conjunction with basic archaeological investigations involving regional, landscape approaches accompanied by high resolution recovery of behavioral events within thin slices of time. In the study presented here it seems clear that the hominins associated with the Late Levantine Mousterian sites in the study-area organized their behaviors at inter- and intra-site scales very much along the lines of modern humans.

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