Artifact Abrasion, Fluvial Processes, and "Living Floors" from the Early Paleolithic Site of 'Ubeidiya (Jordan Valley, Israel)

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Early Acheulian assemblages in fluviolacustrine contexts at the Early Pleistocene site of 'Ubeidiya (Jordan Valley, Israel) have been described as "living floors." A study of variation in the surface abrasion of stone tools from several such "living floors" suggest a mixture of cultural and geological factors were involved in the formation of these assemblages. © 1999 John Wiley & Sons, Inc.

INTRODUCTION

No greater cultural, chronological, or evolutionary gap so separates archaeologists from the subjects of their research as the one between us and Early Paleolithic/Plio-Pleistocene hominids. A crucial development in Early Paleolithic research occurred between the 1950s–1980s, as interpretations of the Early Paleolithic record shifted their focus from "evolutionary" trends in artifact designs to behavioral interpretations of whole archaeological assemblages. Field research during this period emphasized broad horizontal exposures of stone tool and bone concentrations, often reflexively described as "living floors" (Villa, 1977). These "living floors" were interpreted by formal analogy with the occupation debris of recent human hunter-gatherers (Dart, 1957; Isaac, 1977; 1978; Leakey, 1971), resulting in vivid scenarios of early hominid adaptations (Isaac, 1976; Leakey and Lewin, 1978:124–127). Since the late 1980s, however, there has been a growing recognition that most of the large concentrations of bones and stone tools of Early Paleolithic antiquity accumulated over prolonged periods of time, through complex geological processes, and possibly from multiple and chronologically separate events (Bosinski, 1996; Hill, 1994:326; Isaac, 1984b; see articles in Roebroeks and Van Kolfschoten, 1995; Schick, 1986; Toth and Schick, 1986). Stern (1993) coined the term,"palimpsests," for such assemblages; and as she asserts, such sites pre-

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sent a formidable challenge to archaeological interpretations rooted in (geologically) short-term observations of human behavior (Potts, 1988).

Archaeologists have developed a battery of techniques for measuring the nature and degree of geological disturbance to prehistoric sites. Comparisons of the size distribution of lithic artifacts to nonartifactual material, spatial distributions of artifacts, preferred patterns of orientations (i.e., dip and strike) among lithic and faunal finds, orientations of conjoining relationships between stone tools and bone fragments have all been employed in such studies (for an overview, see Dibble et al., 1997).

For assessing postdepositional movement of stone tools, archaeologists have often relied on the degree of edge damage and surficial abrasion to identify fluvial depositional processes (Petraglia, 1994; Petraglia and Potts, 1987). While it is generally recognized that edge damage will increase with prolonged fluvial transport, using edge damage to infer degrees of fluvial disturbance can be problematical. First, lithic raw materials can have different degrees of hardness and resistance to fracturing (even materials of the same basic rock type, such as flint). Second, it is difficult to distinguish transport-induced microfracturing from use-wear or from trampling damage, or from relatively "light" retouch (Flenniken and Haggarty, 1979; McBrearty, et al., 1998; Shea and Klenck, 1993). Surficial abrasion also increases with prolonged transport (Shackley, 1974, 1978), and the ethnographic literature reveals no uses of stone tools that replicate such surficial abrasion. In this respect, surficial abrasion of stone tools may be a more effective indicator of the fluvial displacement of lithic artifacts than are patterns of edge damage.

This article uses surficial abrasion of stone tools to investigate the role of fluvial processes in the formation of Early Paleolithic "living floors" at 'Ubeidiya, an Early Paleolithic site located in the Central Jordan Valley (Israel). Since the early 1960s excavations at 'Ubieidiya have identified concentrations of large stone cobbles embedded in clayey deposits accompanied by numerous large mammal bones and stone tools. Inspired by the high quality of faunal preservation, these concentrations of cobbles were initially described as "living floors" (Stekelis, 1966:66), but their anthropogenic status remains unresolved (Bar-Yosef and Goren-Inbar, 1993: 189–191; Bar-Yosef and Tchernov, 1972:19). Recent (1988–1994) excavations at 'Ubeidiya exposed several such "living floors," and a detailed examination of abrasion on stone tool surfaces, furnishes new information about the origin of these unusual structures. These data also shed light on the probable nature of early hominid activities near the edge of Rift Valley lakes during their initial colonization of temperate Eurasia.

THE 'UBEIDIYA PALEOLITHIC SITE

The 'Ubeidiya Paleolithic site (Figure 1) is a low hill located in the central Jordan Rift Valley approximately 3.5 km south of the Sea of Galilee and west of the Jordan River. Sediments of the Early Pleistocene 'Ubeidiya Formation extend northward

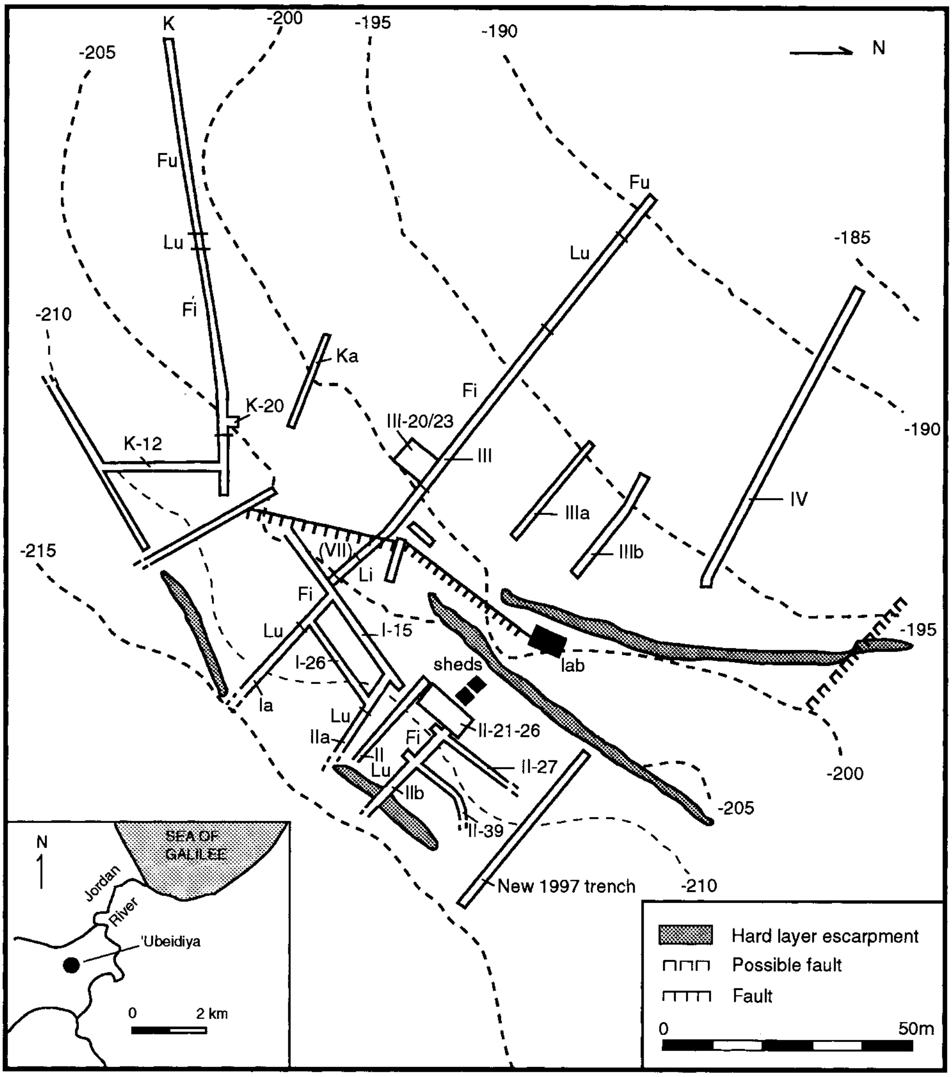

Figure 1. Map of the 'Ubeidiya site showing the principal excavation trenches and the main members of the 'Ubeidiya Formation.

from the protected part of the site along the western side of the Jordan River to the hills behind Kibbutz Degania. Other possible outcrops have been identified on the eastern side of the Rift Valley, in the Yarmuk River Basin and near Tabaqat Fahl in northwestern Jordan (Bender, 1974: 93–94; Macumber, 1992). 'Ubeidiya was first recognized as an important Early Pleistocene archaeological locality in

1959 and was the subject of repeated archaeological-paleontological excavations between 1960 and 1974 (Bar-Yosef, 1989; Bar-Yosef and Goren-Inbar, 1993; Bar-Yosef and Tchernov, 1972; Stekelis, 1966; Tchernov, 1986) and between 1988 and 1994 (Guérin et al., 1996). Early excavations recovered a small set of cranial and dental remains attributed to Homo sp. indet. (Tobias, 1966). The reversed magnetism of the 'Ubeidiya Formation (Verosub and Tchernov, 1991) and biostratigraphic comparisons of nonhuman faunal remains suggest a date of ca. 1.4–1.6 MA (million years ago) for the entire 'Ubeidiya Formation (Tchernov, 1987; Tchernov, 1992). If this estimate is correct, then 'Ubeidiya is one of the oldest archaeological and hominid fossil sites outside of Africa (Bar-Yosef, 1987; 1994).

Geological observations of the 'Ubeidiya Formation have revealed two major cycles of limnic-fluvial sedimentation (Picard and Baida, 1966). The earliest, the Limnic Inferior (LI) Member preserves sediments from a deep freshwater lake. The overlying Fluvial Inferior (FI) Member contains most of the archaeological finds and preserves a variety of shoreline environments. The Limnic Upper (LU) and Fluvial Upper (FU) Members reflect (respectively) a rise in lake level, followed by fluvial transgression. The 'Ubeidiya Formation has been deformed into an anticline (truncated by recent erosion) in which most levels are tilted 60–90°. Pollen remains and micromammals from the'Ubeidiya Formation indicate a temperate Quercus-dominated woodland, while the larger mammalian fauna consist of a mixture of characteristically European species (e.g., *Dicerorhinus etruscus*) and African species (e.g., *Pelorovis oldowayensis*) (Bar-Yosef and Tchernov, 1972; Guérin and Faure, 1988; Horowitz, 1979:230–231; Tchernov, 1986).

Excavations at 'Ubeidiya have been structured around the five main geological trenches (enumerated as I, II, III, IV, and K [from kerem, "vineyard" in Hebrew]). Individual archaeological levels are exposed by digging "horizontal" trenches perpendicular to the main geological trenches. The main specific archaeological levels previously identified as "living floors" at 'Ubeidiya occur in the FI Member and include I-15, I-26 a-d, K20e, K29 V.B. (Bar-Yosef and Goren-Inbar, 1993:22–68). Although they differ somewhat from one another in their degree of consolidation and the density of stones and fossils, all of these living floors are similar in preserving large (10–20 cm) boulders clustered together on a clayey matrix and interstratified with flaked stone tools and mammalian fossils. In these basic structural aspects, the "living floors" of 'Ubeidiya are similar in size and composition (but not necessarily in substrate) to concentrations of cobbles, bones, and stone tools known from Early Pleistocene sites in East Africa, such as Olorgesailie DE/89 (Isaac, 1977:45), Olduvai DK (Leakey, 1971:21), and Garba (Chavaillon, 1979). In terms of their lithic and faunal composition, the 'Ubeidiya "living floors" do not differ substantively from non-"living floor" levels. All of these assemblages feature relatively thick (sometimes trihedral) picks, handaxes, and protobifaces, a wide range of pebble-cores (choppers, discoids, polyhedrons, subspheroids), and various flake-tools (scrapers, notches, denticulates) (Bar-Yosef and Goren-Inbar, 1993; Goren-Inbar, 1995). Faunal assemblages from these "living floors" vary widely among each other, but the most numerous large mammal taxa are in most cases *Hippo-*

potamus behemoth, followed by *Praemegaceros verticornis* and various unidentified cervids (Tchernov and Guérin, 1986:357–359). The associated molluscan remains for most of the "living floors" are generally thick-shelled taxa about evenly divided among littoral rock dwellers (*Theodoxus jordani*, *Melanopsis praemorsa*) and littoral mud dwellers (*Valvata saulcyi*, *Melania tuberculata*, *Melania dadiana*, *Lymnaea lagotis*, *Planorbis planorbis*, and *Gyraulus piscinarium*) (Bar-Yosef and Tchernov, 1972:11–12). These biotic associations indicate a turbid shoreline, although a granulometric study of the I-15 and I-26 living floors (Bowman and Giladi, 1979) was unable to assign the cobbles to a specifically fluvial or lacustrine (wave-motion) origin. In their overview of the issue, Bar-Yosef and Goren-Inbar (1993:190) suggest the 'Ubeidiya "living floors" formed on the lake edge, possibly reaching their present configurations through a combination of fluvial, colluvial, and wave-related forces.

The resumption of archaeological-paleontological investigations at 'Ubeidiya in 1992–1994 (Guérin, et al., 1996) provided an opportunity to reexamine the "living floors" issue. These excavations focused on the transition between LI and FI Members in Trench III (Levels 19–25) and Trench K (Levels 19–29) (see Figure 2). In both the K trench and the III trench, this transition follows a 4-m-thick level of varves (K-19 and III-19), and culminates in conglomeratic deposits (K-28 to K-29 and III-23 to III-25). Between these lacustrine and fluvial deposits is a complex sequence of clay deposits (K-20 to K-27 and III-20 to III-22) containing archaeological assemblages. Four of these levels, K-20, K-25, III-20, and III-22a, preserve concentrations of cobbles matching previous descriptions of "living floors." In fact, excavations between the K and III trenches with a bulldozer revealed K-20 and III-20 to be parts of the same level, both probably northern extensions of the "living floor" originally observed in K-20e. Extensive horizontal exposures were made of K-20 and III-20, and of III-22b-e (hereafter III-22) (see Table I). (The K-25 and III-22a "living floors" were not excavated between 1992–1994, although III-22a was tested in 1997–1998). III-22b-e differs from these "living floors" primarily in the absence of concentrations of large cobbles, and in sedimentary evidence (isolated cobbles, small lenses of gravel, a larger silt/sand component) for formation under more fluvial conditions (Picard and Baida, 1966: 30–31).

Notwithstanding the differences in the density of artifacts in III-20, K-20, and III-22, the technological and typological inventories of artifacts from these strata are essentially similar (Shea and Bar-Yosef, in press). Insamuch as K-20 and III-20 differ from III-22 primarily in terms of "living floor" structures, a comparison of these levels presents an opportunity to examine how the "living floors" at 'Ubeidiya differ from other, more fluvial contexts in the FI Member.

IDENTIFYING VARIABILITY IN DEPOSITIONAL MECHANISMS

The topographic setting of 'Ubeidiya suggests potential for wide variation and complexity in depositional environments. Yet there are several factors that make

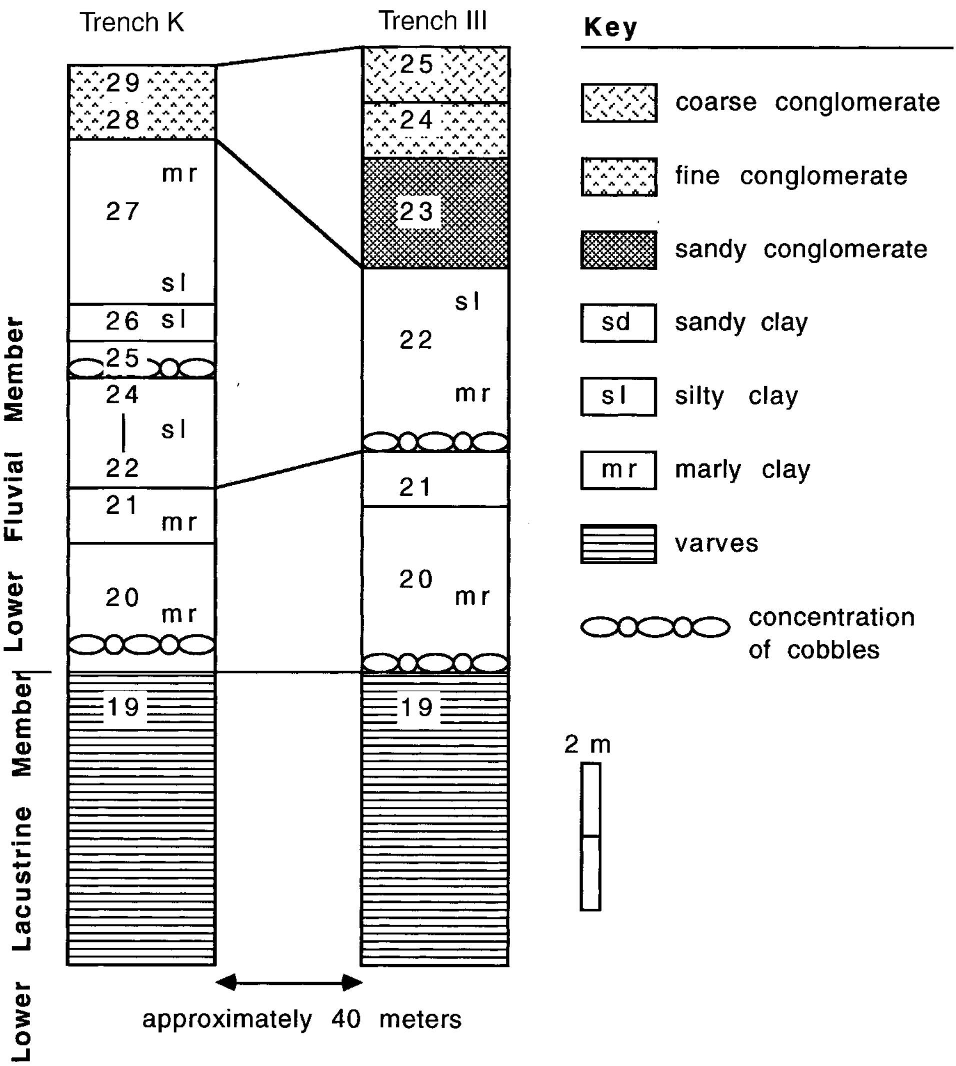

Figure 2. Schematic profile showing stratigraphic relationships among the principal levels of the 'Ubeidiya Formation discussed in this article.

it difficult to use conventional archaeological approaches to assess the role of fluvial processes in the formation of the "living floors." Comparisons of artifact versus nonaritifact size distributions is complicated by recovery procedures. The dense clay matrix of all the living floors makes fine screening in the field difficult, and such screening has not been done consistently for all levels. Apart from a single, narrow, boulder-filled erosional gully in III-20, our excavations revealed no

Table I. Principal features of the 'Ubeidiya Assemblages.

	III-20	K-20	III-22
Length of exposure along strike (m)	12	5.5	14
Mean elevation of exposure (m)	2	1.5	2
Mean thickness of exposure (m)	2.2	1.6	3.5
Volume of sediment excavated (m^3)	52.8	13.2	98.0
Artifacts/m^3	9.0	3.9	3.0
Total artifacts	476	52	289
Pounded pieces	10 (2%)	1 (2%)	8 (3%)
Battered cobbles	9	1	6
Subspheroids	1		2
Cores	79 (17%)	5 (10%)	56 (19%)
Choppers	32	2	30
Discoids	13	2	9
Polyhedrons	18		7
Bifaces/picks			1
Cores-on-flakes	13	1	6
Other cores	3		3
Retouched Flakes	35 (7%)	6 (16%)	33 (11%)
Scrapers	13	1	11
Notches	15	5	12
Denticulates			3
Awls	2		3
Other	5		4
Debitage	352 (75%)	40 (77%)	192 (66%)
Whole flakes	270	30	162
Flake fragments	82	10	30
All flakes/cores	4.4	7.7	3.5
Retouched flakes/debitage	0.1	0.2	0.2

gross fluvial structures that would implicate fluvial processes in distributing the majority of the stones comprising the "living floors." The tilting and faulting of the sediments makes determining preferred patterns of artifact and bone fragment orientations problematical. Refitting sets of bones and stone tools have been identified, but these are too few in number to allow statistical inference about preferred orientations.

Differences in Abrasion States/Codification of Variation

Comparitive studies of surficial abrasion and edge damage, however, seem to suggest variation in depositional mechanisms within each level. During the course of cataloging and recording technotypological measurements of stone tools from 'Ubeidiya, each artifact was examined for macroscopic evidence of surficial abrasion. Following the general practice in Paleolithic archaeology, the degree of this damage was coded in an ascending ordinal scale. Tools featuring surfaces with a matte texture and edges without significant microfracturing damage were classified as "fresh/unabraded." Tools whose edges featured continuous or near-continuous

Table II. Percentage of stone tool abrasion states at 'Ubeidiya and other Paleolithic open-air sites.

Assemblage (n artifacts)	Fresh or Unabraded	Slight Abrasion	Heavy Abrasion	Reference
Ubeidiya K-20 (52)	6	81	13	
Ubeidiya III-20 (476)	3	89	8	
Ubeidiya III-22 (289)	41	38	21	
Olduvai FCW (73)	56	1	42	a
Olduvai FLK-22 (44)	82	0	18	a
Olduvai HWKE-4 (152)	50	23	27	a
Olduvai MNK-M (134)	51	0	49	a
Olduvai TKU (56)	75	0	25	a
Gesher Benot Yaacov "Bar" (61)	0	34	66	b
Latamne 1962 (899)	70	11	19	c
Latamne 1964 (1831)	67	16	16	c
Berekhat Ram (2662)	77	20	3	d
Azraq Lion Spring 4a-e (35)	89	11	0	e
Azraq Lion Spring 5a2-a (135)	87	13	0	e
Azraq Lion Spring 5e-b (151)	79	19	2	e
Tirat Carmel Level 2 (118)	30	40	30	f
Tirat Carmel Level 3 (205)	30	30	40	f
Tirat Carmel Level 4 (151)	30	30	40	f
Biqat Quneitra Area A (3589)	80	17	3	g
Biqat Quneitra Area B (9157)	55	37	9	g

Reference key: (a) Petraglia (1994:245), (b) Goren-Inbar et al. (1992:34); (c) Clark (1967:Table 4), (d) Goren-Inbar (1985), (e) Copeland (1989), (f) Ronen (1974:41), (g) Goren-Inbar (1990:63).

microfracturing but whose surfaces retained a matte texture, were described as "slightly-abraded." Tools with continuously-fractured and/or rounded edges and flattened dorsal ridges were classified as "heavily-abraded."

If it can be established that mechanisms for abrading stone tools in place were either absent or minimal, then the relative frequency of artifacts in these different categories can serve as a rough indicator of the degree of fluvial disturbance. The two principal alternative depositional forces proposed for the formation of the "living floors," colluviation and wave motion, would both have necessarily involved cycles of burial and exposure during which tools would have been repeatedly exposed to sunlight for prolonged periods of time. When Cenomanian or Eocene flints are exposed to direct sunlight for any significant amount of time, the result is a characteristic "blanching" (a shift in surface appearance towards a white or tan color). This blanching occurs so rapidly that tools left in the sun at 'Ubeidiya have become significantly blanched during the course of a 1-month field season. Only a few of the stone tools excavated from III-20, III-22, and K-20 exhibit such blanching. While this obviously does not rule out some *in situ* abrasion, from trampling, for example, it does suggest the stone tools in Levels III-20, K-20, and III-22 were rapidly buried, and thus possibly insulated from the effects of postdepositional weathering processes.

Variation in Abrasion

The relative frequency of different abrasion states among the 'Ubeidiya assemblages is presented in Table II. Relative frequences of fresh/unabraded (3–6%), slightly abraded (81–89%), and heavily abraded artifacts (8–13%) are similar in III-20 and K-20, the two assemblages associated with "living floors." Contrary to expectations, a significantly higher percentage of tools in a "fresh/unabraded" state occur in III-22, a level whose sedimentary characteristics suggest a more fluvial depositional environment.

Compared to lithic assemblages from other Early and Middle Paleolithic open-air sites (also Table II), the 'Ubeidiya "living floor" assemblages are distinctive in two ways, in the pronounced modality of artifacts with slight abrasion and in the relatively low percentages of artifacts in fresh condition. Such comparisons as these, however, are complicated by the chemical weathering properties of different lithic raw materials. At 'Ubeidiya, flint does not appear to be substantially affected by chemical weathering. (At most, some tools acquire a black patina). Basalt and (to a lesser extent) oolitic limestone both develop a clayey or chalky rind whose diminished tensile strength makes them abrade more readily than flint. A comparison of abrasion-states of the different lithic raw materials stratified by lithic raw material type (Table III) shows the markedly higher proportion of basalt tools exhibiting heavy abrasion. Comparing the three 'Ubeidiya assemblages solely in terms of flint reinforces the similarity of the K-20 and III-20 assemblages.

Sources of Abrasion Variability

What factors can account for the relatively high incidence of abrasion on artifacts from III-20 and K-20, levels that seem to provide minimal evidence for weathering

Table III. Rat material and abrasion in the 'Ubeidiya assemblages.

	K-20	III-20	III-22	% by Category
Total artifacts	52	476	289	100
Flint	51	455	243	92
Limestone	0	12	11	3
Basalt	1	9	35	6
Flint	51	455	243	100
Fresh	3 (6%)	14 (3%)	116 (48%)	18
Slight abrasion	42 (84%)	416 (91%)	97 (40%)	74
Heavy abrasion	6 (12%)	25 (6%)	30 (12%)	8
Limestone	0	12	11	100
Fresh	0	0	3	13
Slight abrasion	0	9	7	70
Heavy abrasion	0	3	1	17
Basalt	1	9	35	100
Fresh	0	0	0	0
Slight abrasion	0	0	5	11
Heavy abrasion	1	9	30	89

in situ or for fluvial disturbance? A consideration of local topographic features and the distribution of abrasive traces among the lithic assemblage provides some insights into the assemblage formation processes associated with the ‘Ubeidiya “living floors.”

‘Ubeidiya is located at the base of the western escarpment of the Jordan Rift Valley, about 0.5 km south of the point where the Yavneel Valley traverses this escarpment (Figure 3). As flowing water entered the Jordan Valley through the Yavneel, deltaic deposits formed, periodically meandering southward across the present position of the site and northward, away from ‘Ubeidiya. The result of this process would have been frequent intercalation of fluvial and limnic depositional environments. Evidence for regular fluvial input into even the most limnic of the archaeological levels at ‘Ubeidiya can be seen in the common finds of small, subangular to rounded, and black-patinated flint fragments in Levels K-20 and III-20 (Picard and Baida, 1966:30–31). Similarly, thick clay beds (e.g., III-26, III-28, III-31) are often interstratified with conglomeratic levels in the FI Member (Picard and Baida, 1966:31–32). This suggests that even though III-20 and K-20 appear to be primarily lake shore deposits, significant short-term fluvial input cannot be ruled out, and indeed, should be considered as a possible source for lithic artifacts.

If the entire lithic assemblage from the “living floor” levels arrived through fluvial transport, one would expect surficial abrasion to be distributed through this assemblage roughly paralleling artifact size (or mass). Larger artifacts collide with other particles in a flume with greater momentum, accelerating the abrasive process. If, on the other hand, the “living floor” assemblages were flintknapped in place, and worn solely by treadage and wave action, then abrasion should be distributed roughly evenly, independent of size.

Cross-tabulation of abrasive wear states for both cores and whole flakes supports the hypothesis of a significant role for fluvial processes in the formation of the III-20 and K-20 living floor assemblages. In III-20 and K-20, cores in the more advanced stages of abrasion are significantly larger than cores exhibiting less-marked abrasion (Table IV). This pattern is replicated in the lithic sample from the fluvial deposits of level III-22 and persists among the flint subassemblage when limestone and basalt cores (which tend to be larger than flint cores) are removed. This correlation between artifact size and the degree of abrasion does not necessarily indicate that all of the cores in III-20 were washed into their archaeological contexts; but, from a strictly methodological perspective (i.e., Occam’s Razor), it does remove the necessity of invoking hominid agency in the deposition of cores at these ‘Ubeidiya “living floor” sites. A similar relationship between artifact size and abrasion appears to exist among whole flakes as well (Table V), but this concordance disappears when larger and intrinsically softer basalt and limestone flakes are removed from the comparison. In this case, it seems plausible to infer that factors other than fluvial transport could have played a role in the accumulation of large whole flakes in lake-margin contexts at ‘Ubeidiya. The presence of large essentially unabraded flakes in these same deposits requires a consideration of other factors, such as hominid stone tool discard patterns.

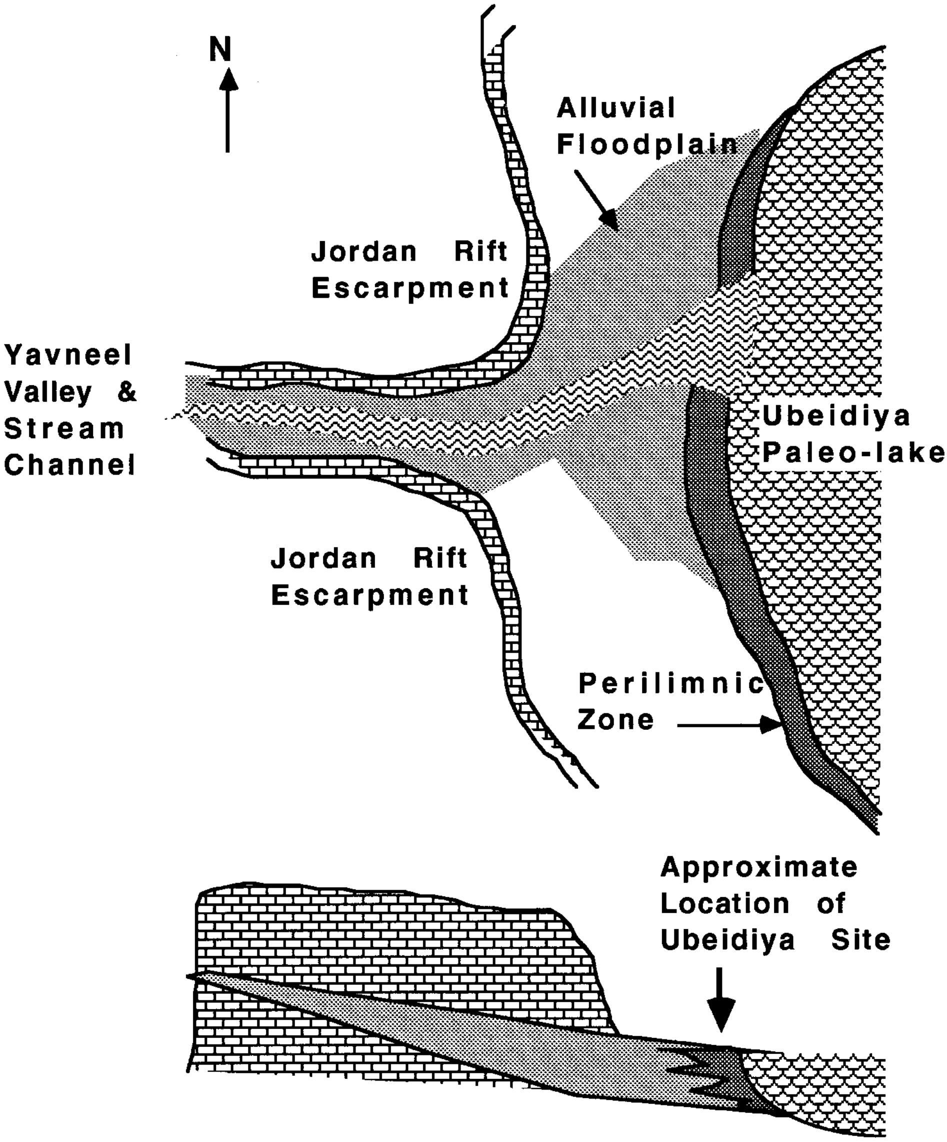

Figure 3. Schematic plan (top) and profile (bottom) of the ‘Ubeidiya site during Early Pleistocene times showing the spatial relationships among major geological environments.

Table IV. Core volume (length × width × thickness) in cm^3 by abrasion state.

Preservation	III-20	K-20	III-22
All materials			
Fresh unabraded			
Mean	43.0		71.2
sd	29.2		109.3
n	3	0	23
Slightly abraded			
Mean	88.5	45.1	252.6
sd	122.1	38.4	548.5
n	77	5	17
Heavily abraded			
Mean	175.8	944.5	674.1
sd	127.5	0	929.8
n	9	1	24
Flint only			
Fresh unabraded			
Mean	43.0		29.3
sd	29.2		27
n	3	0	18
Slightly abraded			
Mean	76.7	45.1	37.8
sd	86.5	38.4	95.6
n	73	5	12
Heavily abraded			
Mean	122.4	944.5	94.0
sd	107	0	122.5
n	3	1	6

DISCUSSION

It is always risky to equate archaeological patterns with behavioral processes; nevertheless, it is worth considering whether preferential discard of flakes, as opposed to cores, in lake-shore contexts makes sense in terms of our current understanding of early hominid land-use strategies. Clearly, any such consideration requires some basic assumptions to be made about what early hominids were doing at the shore of the ‘Ubeidiya paleo-lake. Analogy with recent ecozones surrounding Rift Valley lakes suggests that these perilimnic environments would have presented early hominids with abundant subsistence opportunities, including numerous plant food sources, small mammals, reptiles, amphibians and invertebrates, migratory birds, fish trapped by receding lake levels, as well as carcasses of larger mammals killed by carnivores (Foley, 1987:206–211; Stewart, 1994). Notwithstandng the breadth of subsistence opportunities, such lake-shore environments seem intuitively unlikely places for hominid habitation sites. Abundant remains of hippopotamus and crocodiles hint at some of the dangers lurking in the lake itself, while fossils of several large carnivores, *Crocuta crocuta* and *Megantereon cultiridens*,

Table V. Volume of whole flakes (length × width × thickness) in cm^3 by abrasion state.

Preservation	III-20	K-20	III-22
All Materials			
Fresh/unabraded			
Mean	20.0	2.5	12.5
sd	28.1	0.8	14.1
n	10	2	73
Slightly abraded			
Mean	16.4	16.8	10.8
sd	21.9	18.2	18.0
n	242	24	62
Heavily abraded			
Mean	47.5	9.8	112.3
sd	71.0	12.0	287.3
n	21	5	28
Flint only			
Fresh/unabraded			
Mean	20.0	2.5	11.9
sd	28.1	0.8	13.3
n	10	2	71
Slightly abraded			
Mean	16.6	16.8	9.1
sd	22.1	18.2	14.9
n	238	24	58
Heavily abraded			
Mean	18.0	4.7	9.0
sd	22.6	4.2	4.4
n	16	4	16

indicate the potential risks for early hominids lingering in the open lake shore. The clayey composition of III-20 and K-20 indicates stone tools were discarded by early hominids onto a muddy shoreline substrate. Unless we can envision early hominids camping, flintknapping, and dividing up animal carcasses while ankle-deep in mud, all the while being exposed to both aquatic and terrestrial predators, it is exceedingly improbable that the lithic assemblages from these levels are residues of habitation sites, or “living floors.”

Instead, it seems far more plausible that the less-abraded flake component of ‘Ubeidiya III-20 and K-20 may reflect the abandonment of stone tools at resource procurement sites. Several studies of Early Pleistocene lithic assemblages from sites in East Africa roughly contemporaneous with ‘Ubeidiya, such as Olduvai Gorge Beds I-II and The Karari Formation of East Turkana, indicate early hominids transported stone tool material as cores from the margins of sedimentary basins to lake margin environments (Isaac, 1984a; Potts, 1988, 1994; Rogers et al., 1994, Toth, 1985). Simple flake tools would have been useful in collecting and processing plant foods or animal carcasses preserved near lake margins, and there is evidence—including conjoining flakes—that indicates stone tool production probably occurred on-site. Once these flake tools had been used, however, there would have been relatively little energetic payoff for transporting them further. Lithic raw materials are likely to have been just as abundant, if not even more abundant in fluvial deposits up-slope than they were in lake margin environments. Moreover, flakes of such relatively small size and great thickness as those found at ‘Ubeidiya have limited potential for curation by resharpening. Thus, hominids who had jettisoned the smaller stone tools (especially flakes) at the lake edge in order to carry greater quantities of food to some other, safer, locality would have enjoyed an evolutionary advantage over hominids who attempted to transport cores, flakes, food, and other equipment away from lake-edge enviroments. Such selective abandonment of stone tools in lake-margin environments may have occurred episodically over the course of several millennia, creating lithic “drop zones” at numerous places along the edges of the ‘Ubeidiya paleo-lake. In a sense, these “drop zones” may be more structurally analogous to the incremental accumulations of nut-cracking stones created by chimpanzees (Boesch and Boesch, 1984; McGrew, 1992:204) than they are to the domestic residues of ethnographic hunter-gatherers.

The seemingly close juxtapositioning of flaked stone tools and large basalt cobbles in the “living floors” may also reflect a number of other cultural and geological factors. The association may reflect these cobble beds’ ability to trap large sedimentary particles, such as flakes, and to insulate them from further fluvial displacement. Such cobble beds may have been attractive to early hominids as sources of hammerstones, anvils, or even for raw material to replace cores nearing the end of their use-lives.

CONCLUSIONS

Creating plausible and testable models of early hominid behavior depends on understanding the geological structure of the Early Paleolithic archaeological record. For nearly 40 years, archaeologists have been struggling to describe Early Paleolithic assemblages. Initially, researchers focused on the morphological features of selected lithic “index fossils,” such as Acheulian handaxes, as clues to early hominids’ cognitive, organizational, and cultural capacities. This approach was eventually augmented by models comparing archaeological sites to the occupation residues of ethnographic hunter-gatherers. More recently, Paleolithic archaeologists have developed an appreciation of the complex interplay of behavioral and geological factors in site formation processes. This latter development has resulted in a recognition that most Early Paleolithic sites have probably undergone some degree of postdepositional modification.

Relatively few studies have attempted to analytically isolate those components of individual assemblages that have undergone greater or lesser degrees of disturbance. This article has attempted to show how examining variability in the surficial abrasion of stone tools can help to shed light on the formation of so-called “living floor” assemblages at the Early Pleistocene site of ‘Ubeidiya. The distribution of abrasive wear on cores from ‘Ubeidiya III-20 and K-20 is roughly congruent with a model of fluvial transport and redeposition, as is seen among the cores from the fluvial component of III-22. For flakes, the distribution of abrasion suggests some other factor is at work in site formation processes. A plausible model can be framed in which flakes were differentially abandoned by hominids in lake-margin resource procurement zones. Future excavations at ‘Ubeidiya will undoubtedly furnish additional opportunities to test this model.

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