AN INVESTIGATION OF THE PREHISTORY AND PALEOENVIRONMENTS OF SOUTHERN JORDAN (1979 Field Season)

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During the summer of 1979, an archaeological investigation was initiated in the vicinity of Ras en Naqb in southern Jordan. The investigation seeks to define and trace the changes in prehistoric adaptive strategies which took place in the region during the late Pleistocene and early Holocene. Adaptive strategies are viewed as the ways in which populations select and secure resources from their environments. Prehistoric adaptive strategies are manifested in the archaeological record in various ways, but subsistence modes, sizes of residential groups, and the permanency of settlements are particularly diagnostic of specific adaptive strategies.

Within the history of human development a major adaptive transition occurred at the end of the Pleistocene and in the early Holocene when hunting and gathering economies were replaced, or at least augmented, with food production. Although this topic has captured the attention of scholars for over a half a century and many of the questions on the chronology and the mechanics of domestication have been addressed, we still know very little of the processes which led to food production. We know much more of when, where, and how than why such an adaptive transition occurred. The question of why a general Paleolithic hunting and gathering subsistence pattern was abandoned after several million years of success remains unanswered. Similarly, we presently do not, in the Near East, understand why the traditional Paleolithic adaptive strategy was replaced some 10,000 years ago and not a 100,000 years or a million years earlier.

Clearly, in order to address these questions it is necessary that the specific adaptive strategies which were operative immediately prior to early experiments at food production be compared to adaptive approaches employed during earlier periods of the Pleistocene. In this manner, the social and environmental conditions which were unique to the terminal Pleistocene, and possibly contributive to early food production, may be isolated.

In an effort to trace the evolution of prehistoric adaptive strategies in southern Jordan, research was initiated in the vicinity of Ras en Naqb on the southern edge of the Ma'an Plateau. The study focuses on the examination of changes in prehistoric settlement patterns and paleoenvironments as a means of defining prehistoric man-land relationships for the region. Several basic observations concerning the spatial distribution, density, size, permanency, and function of sites are used to identify prehistoric settlement patterns. Geological, palynological, and faunal studies are being

conducted to reconstruct past environments of the area. During the first season of investigation primary evidence was sought relative to the: (1) overall antiquity and chronology of sites in the study area, (2) the density of sites in the area, (3) the geologic history of the area and (4) the past environmental settings of the area. This report will concentrate on the results of this first season of investigation.

Modern Environment and Physiography

The study area, in resting on the boundary between the Ma'an Plateau and the broad Wadi Hisma, exhibits striking relief with elevations ranging from around 900m to over 1500m above sea level (Figure 1). The marked diversity in topography of the area results in three distinct environmental zones being in close proximity. The environments are characterized by botanic communities which are elevationally zoned, with Mediterranean, Irano-Turanian, and Saharo-Sindian communities occurring in sequence with decreasing elevation (Zohary, 1962:51-53).

These modern geographic and environmental characteristics of the area result in an ideal setting for collecting information on past climates and prehistoric settlement patterns. The elevational differences of the region which cause the area's current environmental diversity probably played a similar role in prehistoric times. One would suspect that the area was quite sensitive to climatic fluctuations of the past with the elevational zonations of plant communities shifting in concert with changes in precipitation and temperature patterns. The area's environmental diversity and the area's potential for dramatic environmental shifts, associated with climatic change, furnish an ideal situation for examining prehistoric settlement patterns and economics on the basis of seasonal adjustments and long-term changes in adaptive strategies.

Previous Investigations in the Region

Although intensive systematic surveys of Paleolithic sites had not been conducted in southern Jordan prior to the investigation of the Ras en Naqb area, several reconnaissances provide some idea of the varieties and densities of Paleolithic occupations in the region (Kirkbride and Harding, 1947; Zeuner et al., 1957; Kirkbride, 1960; Huckreide and Wiesemann, 1968; Copeland and Hours, 1971; Price and Garrad, 1975; Henry, 1979). These studies indicate that the region contains a high density of prehistoric sites which represent considerable time-depth from Lower Paleolithic to Neolithic periods (Stockton, 1969). A preliminary reconnaissance conducted in the vicinity of Ras en Naqb in 1977 indicated that the area contained a high density and great time-depth of prehistoric sites. The initial season of intensive systematic investigation of the area confirmed the indications of the 1977 reconnaissance with the discovery of 57 prehistoric sites (Table 1). Three additional sites were located outside the primary study area.

Results of the 1979 Survey

A systematic 100% survey of approximately 12 sq.km. was completed in the study area near Ras en Naqb and brief reconnaissances were undertaken near Quweira and the Jafr Depression; located to the south and northeast of the study area, respectively (Figure 1).

Within the study area near Ras en Naqb,

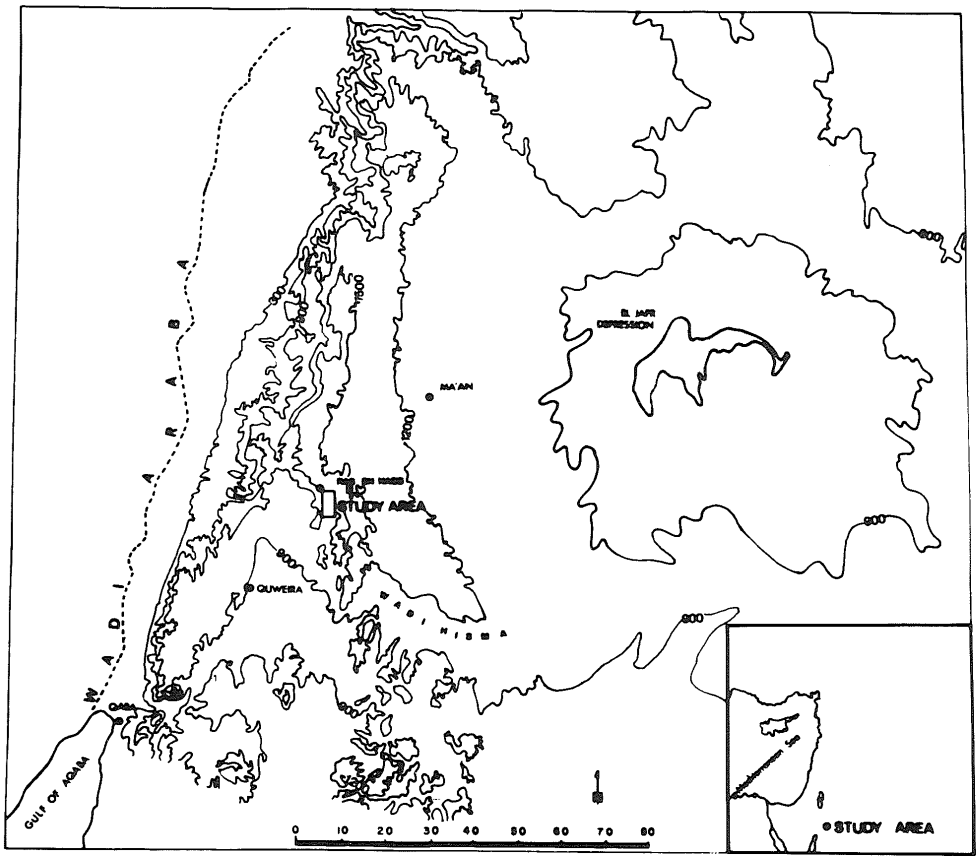

Figure 1: A topographic map of the region showing the location of the primary study area.

survey was conducted in the basin of Wadi Judayid (between 950-1,200m asl) and in the uplands of Ras en Naqb (from 1,200 to 1,600m asl). Approximately 8 sq. km. were surveyed within the basin, while 4 sq. km were surveyed in the uplands. Of the 57 sites discovered in the study area, only 6 were located in the uplands.

Reconnaissances near Quweira and the Jafr Depression resulted in the discovery of three sites. Two *in situ* Epipaleolithic occurrences (J201, J202) were recorded in rockshelters near Quweira, while an open-air Upper Paleolithic site (J301) was found in the area of the Jafr Depression.

The sites discovered during the 1979 season have been ordered chronologically through artifact seriation and geologic associations. A series of radiocarbon dates on materials recovered from Middle Paleolithic, Epipaleolithic, Aceramic Neolithic, and Chalcolithic occurrences should provide greater chronologic resolution.

Middle Paleolithic

Although the uplands of Ras en Naqb are littered with Levallois materials (cores, flakes, point cores, points) suggestive of an intensive occupation, only four sites (J6, J53, J55, J56) were identified due to the heavy erosion of the area. All four of these sites have been severely deflated. A single Middle Paleolithic site (J8) was discovered in the basin. The *in situ* site, located on a terrace, in front of a small cave, yielded Levantine Mousterian artifacts from a white, poorly weathered sand derived from the nearby sand-stone cliff face.

Upper Paleolithic

Only six sites identified as Upper Paleolithic were recorded in the survey and five of these failed to yield sufficient artifact samples for an unqualified designation. The only confirmed Upper Paleolithic site (J301) was discovered on a low hill top on the edge of the Jafr Depression. While the site is deflated, its mere presence on the shore of the dry lake located some 80 km into the eastern desert, has important climatic and environmental implications. A surface collection of the site (4 sq. m) provided 442 artifacts of which 61 were tools. A modest Levallois component implies an early Upper Paleolithic occupation of the site. Five tentative Upper Paleolithic sites (J30, J31, J34, J52, J54) were found in the study area. These sites appeared to be eroding out of reddish sand associated with a former alluvial fan which had coalesced to form a bajada or alluvial fan plain in the basin. Although debitage (large blades and blade cores) and tools (end-scrapers and blades) suggestive of Upper Paleolithic occupations were recovered from the surface, test excavation at two of the sites (J30, J31) failed to isolate discrete Upper Paleolithic horizons.

Epipaleolithic

Epipaleolithic occurrences, defined by microlithic artifacts, account for over 40% of the sites discovered during the survey. With exception to Natufian occurrences in the basin, Epipaleolithic sites were found within or eroding from reddish sands belonging to the bajada, as previously described. Natufian sites (J2, J14) appear in drift sand overlying the bajada. Outside the basin, two other Epipaleolithic sites were found in rockshelters overlooking dry lake beds. Three of the sites (J26, J201, and

J202) contain stratified multicomponent occupations. These occupations display an evolution in the microlithic component of the assemblages from non-geometric elements to trapeze/ rectangles and finally to lunates. Microburins appear throughout the sequence, but increase in frequency with geometric assemblages. Charred materials suitable for C-14 dates were collected from four of the Epipaleolithic sites (J2, J26, J14, J201). Faunal remains were recovered in abundance from J2 and J14.

Aceramic Neolithic

A single Aceramic Neolithic occurrence was discovered underlying a Chalcolithic occupation at site J24. The Aceramic Neolithic horizon is separated from the overlying Chalcolithic occupation by 20-30 cm of sterile sand.

Technologically, the assemblage is characterized by narrow blades and bladelets in sharp contrast to the overlying Chalcolithic levels which are dominated by blades and broad bladelets. Although high densities of debitage (+ 400) were recovered, only 21 tools were recorded. One of these was a point exhibiting unifacial basal retouch and lateral notches identical to Cauvin's (1974) type 26a described for Phase II at Mureybet. A charcoal sample recovered from a hearth associated with the horizon should provide a more precise chronologic determination.

Chalcolithic

Some 25% of the sites discovered in the survey contained a Chalcolithic component. Most of these sites contained one or more circular or semi-circular stone structures in association with thick ash lenses and refuse pits. Well preserved faunal remains and charred materials were normally identified in test excavation or in treasure hunter's backdirt from these sites. The sites normally display moderate densities of lithic artifacts. Assemblages are characterized by microlithic cores (from which rather wide bladelets of flakes have been struck) in conjunction with large, thick flakes. Diagnostic tools consist of large fan scrapers and small bifacial points. Although pottery is relatively rare, rim sherds of holemouth jars were recovered from test excavation. While it is possible that some or all of these sites could belong to the earlier Pottery Neolithic or the later Bronze Age, the combination of attributes point to the Chalcolithic. A series of radiocarbon dates from the sites in conjunction with detailed analysis of the assemblages should resolve the problem.

Results of a Study of the Local Geology

The geomorphological units in the Ras en Naqb area include: the Ma'an-Ras en Naqb Plateau, Ras en Naqb escarpment, alluvial fans, outliers and inselbergs, wadi terraces, modern wadi, and aeolian sand.

The Ma'an Ras en Naqb (Edom) Plateau

This plateau represents a part of theCentral Desert Area of East Jordan in the geomorphological classification of Bender (1947:9). It is bounded in the west by the Ash Sherah highlands of the Eastern rim of the rift valley and slopes eastward to the Jafr Depression. From the north it is bounded by Wadi el Hasa and from the south by the Ras en Naqb escarpment.

The plateau reaches maximum heights just north of Ras en Naqb with an elevation of 1670

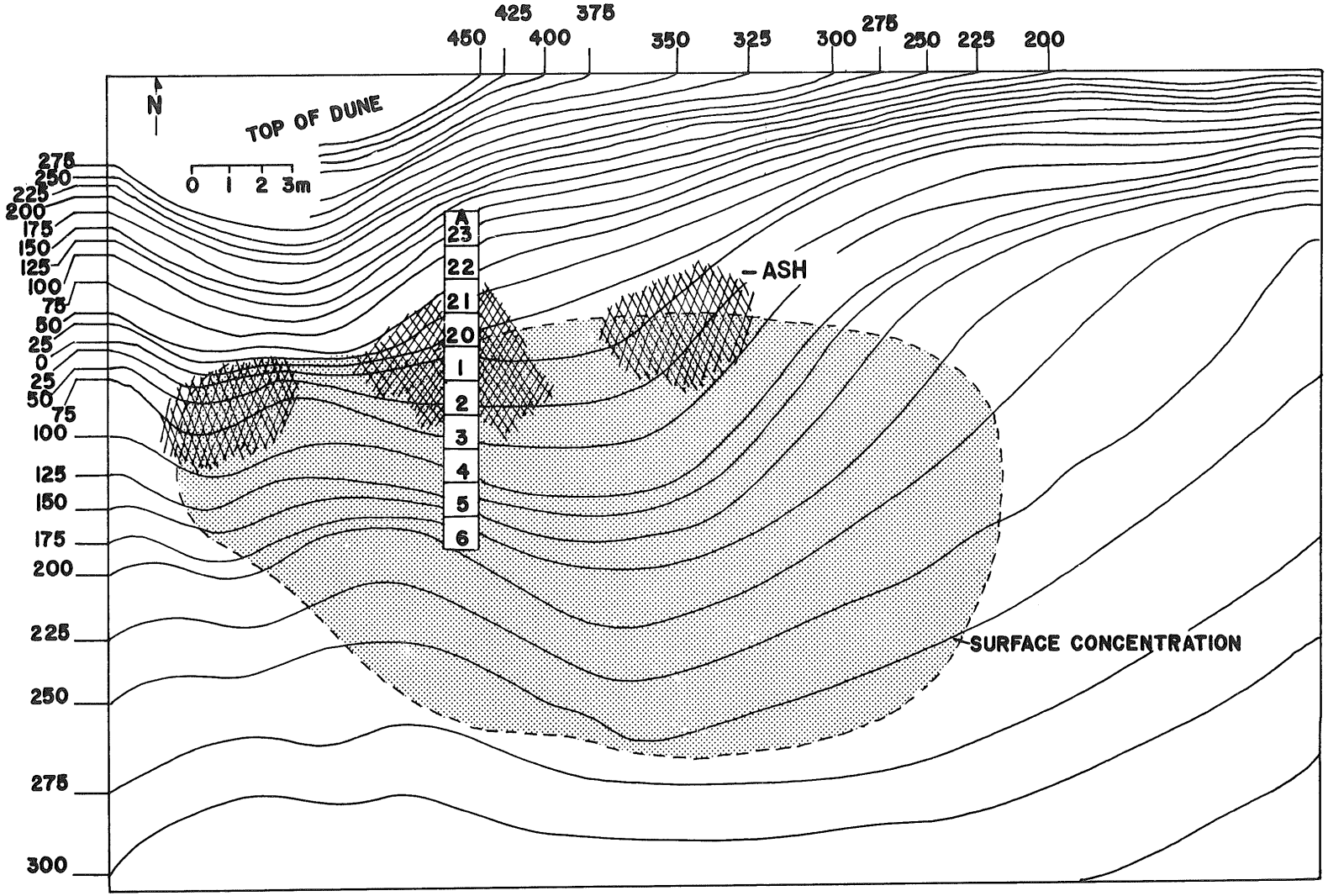

Figure 2. Topographic map of Site J2 showing surface evidence and location of test trench. Note that contours decrease in elevation from "0" contour to the south.

meters asl at Shudayid and Naqb Ishtar. The Plateau slopes both to the east and north to elevations slightly more than 1000 meters. The surface is a hamada desert, i.e., a stony desert covered with clastic detritus. At Ras en Naqb, the stones are mostly made of flint and are variable in size from a few centimeters to 25 centimeters in diameter. The gravel is angular and poorly sorted and is embedded in a sandy matrix of brown-reddish yellow 7.5 YR 5.5/5 color. The surface deposits also include carbonate nodules. The surficial deposits are only tens of centimeters thick and seem to represent residual lag deposits of a Mediterranean red soil. In places, the stones are removed to clear plots for cultivation.

The Ras en Naqb Escarpment

At Ras en Naqb the Ma'an plateau drops precipitously toward the Quweira-Disa depression. The escarpment is controlled by S 33° E - N35 W trending faults. Faults also run a 30°W-N30E direction and guide the drainage toward the escarpment shows three pediments. The top pediment (I) is at 1600 meters asl and its relicts are represented by Tilal Ras en Naqb el Qibliya and its dissected surface represents the surface of the Ma'an plateau described above. The middle pediment (II) of Naqb Ishtar is at 1400 meters asl and also is represented by Jebel el Jill. The Naqb Ishtar Pediment (II) represents a rock surface cover with a thin (0-40 centimeters) mantle of a stony lag deposit. The stones range in size from about five to 25 centimeters. They are palty in shape, angular, and are made of chert, siliceous limestones, and dolomites. The matrix is loamy sand of yellowish brown-brown color (10YR 5.5/6) and seems to represent a residual of a Mediterranean or Yellow Steppe soil. The low, Sumei's Pediment (III) is covered by a surficial mantle about 30 centimeters in thickness. The surface is stony with a loamy sand matrix of brownish yellow color (10YR 6.5/6). The stones consist of siliceous quartzstone and occasionally chert. This reflects the lithology of the bedrock which consists of sandstone. The surficial deposits seem to represent the residue of a yellow steppe soil.

The slopes of the Ras en Naqb escarpment are therefore composite showing, when the surface of the older pediments are preserved, a discontinuous cliff face of vertically connected J-shaped slopes.

The formation of the escarpment and the retreat of the slope seem thus to have progressed in cycles each terminated by a period of relative stability and relaxation of downcutting with lateral planation by stream action. The present surface of the basin bounded by the Ras en Naqb escarpment seems to represent a stage in the development of a fourth pediment.

Alluvial Fans

The Ras en Naqb escarpment overlooks a basin representing the headwater of Wadi Judayid. The basin is filled with alluvial fan deposits. The fans coalesce to form a bajada dissected by more recent gulleys and are eroded toward the center of the basin by stream action.

The fans show the typical profile of alluvial fans in semiarid region. The apex of the fans is steep (gradient 36%) and covered with large stones and grades upward in talus cones (gradient 50%). The middle segment is less

steep (10%, i.e., 10 meters per 100 meters of horizontal distance). The toe of the fans has been modified by stream downcutting and its morphology is not clear. It should be also noted that near gulleys the surface of the fans show a reduction in elevation. The fans consist of massive sand laminated in parts. The sand is medium grained and contains numerous angular flat pebbles and cobbles as well as spheroidal clasts of sandstones. Pockets of large stone blocks are also present. The fans seem to consist of two units: A lower unit of hard compact sand with carbonate nodules. The color of the sediments ranges from light brown 7.5 YR 6.5/4 to strong brown-reddish yellow 7.5 YR 5.5/6. The upper units consist of friable sand, reddish yellow to light brown or pink in color (7.5 YR 7/5 YR 6/6).

Outliers and Inselbergs

These features which represent remnants of the Ma'an Plateau include conical and elongated hills rising in elevation to 1350 at Jebel el Jill and 1200+ in other hills.

Wadi Terraces

Six cut-terraces and one fill-terrace were observed. The cut-terraces stand above the wadi floor at 10 meters (Terrace I), 4.5m (Terrace II), 1.7m (Terrace III), 0.5m (Terrace IV), 1.7 meters (Terrace VI), 1.2 meters (Terrace VII). The fill-terrace (Terrace V) rises at 3.5 meters above the floor of the Wadi.

The highest terrace is the most widespread in the wadi basin. The other terraces are restricted to a band of 200 meters or less along the course of the modern wadi. The gradient of the highest terrace is slightly less than that of the modern wadi. It measures 3% compared with 3.8% for the wadi bed at present. The gradient for the lower terraces approximates that of the modern wadi.

The fill-terrace consists of friable sand, in places laminated with a relatively high content of rubble. The color of the sediments is reddish yellow (7.5 YR 7/8, 7.5 YR 6/6) and is apparently inherited from the sediments of the alluvial fan.

The Modern Wadi

The modern wadi is incised into the deposits of the older alluvial fan fill and the young alluvium of the fill-terrace. The channel is sinuous and quite narrow. It ranges in width from 7 meters to 17 meters. Where the channel widens it often consists of a point bar about 20 cm above the incised channel which can be as narrow as 4.6 meters. On the concave side of the point bars chutes cut across the bar. The walls of the wadi are destroyed by undercutting and mass-wasting. The floor of the wadi channel is covered with sand, whereas the point bars are strewn with flat angular cobbles.

Aeolian Sand

Wind-blown sand consists mostly of drift sand. It consists generally of a thin cover with a maximum of 30 centimeters. The sand is medium grained and moderately sorted. It accumulated in the wadi floor on top of the terraces, and in places drapes over the middle and top segments of the fans. It builds up around bushes forming low hummocks. The sand is in the most part reworked from the top sands of the alluvial fans and from sands of an earlier

episode of mechanical weathering which produced an abundant supply of fresh sand. A slightly moist, and warm, yet still desertic, climate seems to have succeeded the episode of weathering. That episode could have been characterized by a dry, cool climate. The Ordovician and Lower Cretaceous sandstones provide an ample supply of sand. The strata are jointed and the sandstone is semi-consolidate and crumbles easily.

Sequence of Geologic Events

Following the formation of the Wadi Judayid depression, alluviation by tributaries draining the adjoining catchment basin led to the formation of a valley or fill of coalesed alluvial fans. The Mousterian site (J8) in a dune unit may date back to the period following the major episode of an alluviation that led to the formation of the lower member of the alluvial fan. The formation of the depression might thus have taken place in the early part of the Late Pleistocene. The early fan deposits of hard, alluvial sand are cemeted by carbonates and include zones rich in carbonate nodules. The deposits seem to indicate a subarid environment, moist and warm with rainfall perhaps in the magnitude of 300 mm. The development of a reddish yellow color is suggestive of the warm, moist conditions, that were sufficient to mobilize the iron oxides. Seasonal dryness seems also to be indicated by the precipitation of carbonates, which were presumably introduced by solution during the rainy season. The vegetation was perhaps represented by steppe with wooded areas in places, especially at high elevation. Downcutting and accumulation of dunes from freshly weathered sandstone under dry, cool conditions ensued. A relict of these dune sands is preserved in an embayment in the Jebel el Jill in association with artifacts of Mousterian affinity (site J8).

Alluviation resumed under conditions of more open vegetation, warm and somewhat moist conditions, rainfall was perhaps in the range of 250 mm. In the lower parts of the depression, finer sediments accumulated and thin crusts of calcium carbonates were developed. The lack of carbonate concretions and the presence of thin crusts of carbonates suggest drier climate than that which prevailed during the alluviation of the lower unit of the fan deposits. The climate was probably similar to that under which yellow steppe soils are formed. Frequent cut-and-fill structure, rapid lateral and vertical changes in facies, and frequent occurrence of large stone blocks and boulders suggest occasional torrential rainfall. Epipaleolithic sites (sites J26, J31) were located *in situ* in the top part of the upper unit of the fan and it may be thus inferred that alluviation might have lasted until ca. 17,000-13,000 B.P.

The geologic history of the area since that time seems to have been predominantly erosional, with the exceptional episode of wadi alluviation. A series of cut-terraces were established with the lowest visible terrace at .5 meters above the modern wadi floor. The erosional processes seem to have taken place under dry climatic conditions, a thin vegetation cover, and occasional rains feeding streams of high veolcity. Following the formation of the highest terrace (Terrace I), an early Natufian settlement (site J2) was established providing a limiting date for the termination of episode of erosion. The erosional period may have thus lasted from sometime before 11,000 B.P to about 12,000 B.P. Cooler, drier conditions followed

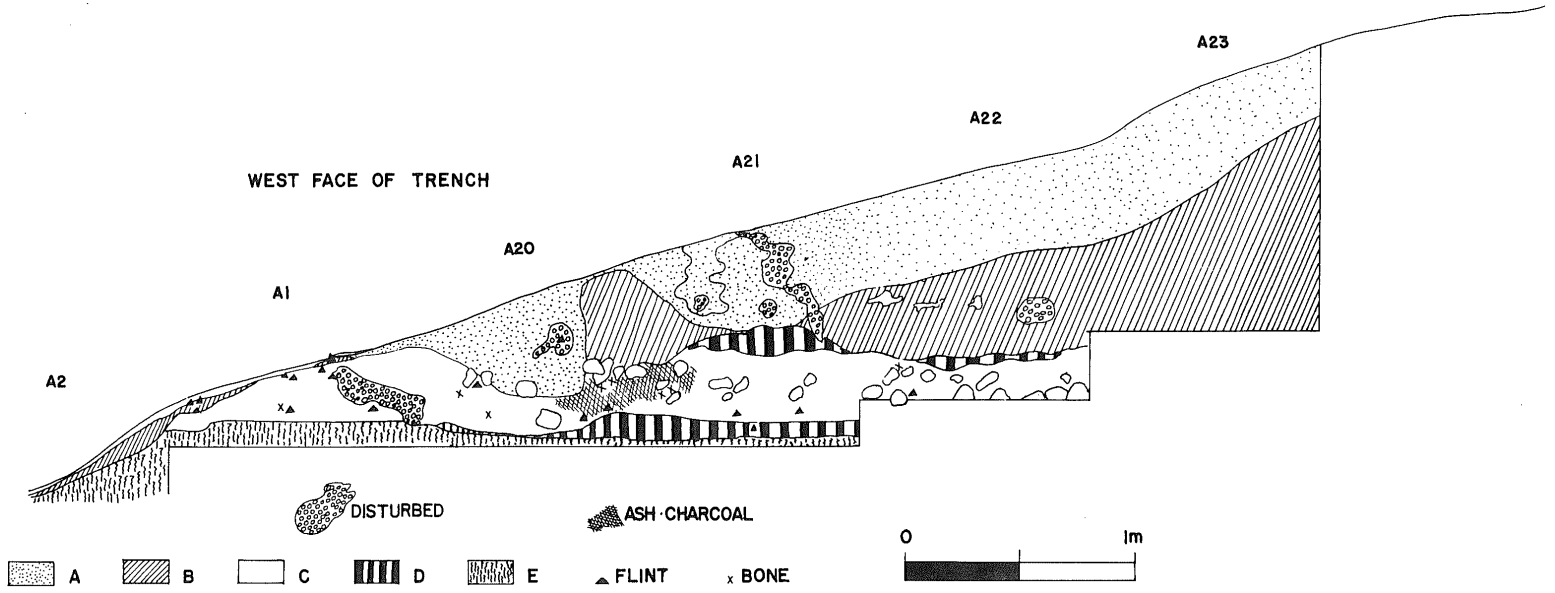

Figure 3. Stratigraphic profile of trench at Site J2. Vertically barred zones represent carbonate lenses.

leading to intensive mechanical weathering and aeolian activity. Dune sands were formed covering the debris of the Natufian occupation. Warmer and somewhat moist conditions followed leading to the liberation of iron oxides. Reddish sands were reworked into drift sand on top of the earlier deposits. The wadi aggradation may date to that period. By correlation with other areas in the Near East and North Africa it is possible that this moist phase dates back to ca. 9,000 - 7,000B.P. Drier and cooler conditions characterized later time periods. The most recent intensification of aridity beginning in 1890 A.D. (Burdon 1959: Fig. 7) seems to have been culminating in the last few years according to observations by local informants. Springs near the Natufian site which were flowing in the recent past (about 60 years ago) are now dried up.

Results of Test Excavations

Nineteen of the 60 sites which were discovered in the 1979 survey were test excavated. Twelve of these 19 sites proved to be *in situ* with four or perhaps five of these sites containing multiple archaeological horizons. The test excavations of eight sites are described in this report because of their importance in achieving the overall goals of the project. These sites include: J2 (Natufian), J8 (Mousterian), J14 (Chalcolithic, Natufian), J24 (Chalcolithic, Aceramic Neolithic), J26 (Epipaleolithic), J31 (Epipaleolithic, Upper Paleolithic), J301 (Epipaleolithic), and J302 (Epipaleolithic).

Site J2 - Natufian

The site is situated along the base of a low sand hill which follows the northern bank of the Wadi Ras en Naqb. A high density of habitation debris (i.e. flint artifacts, bone burned rocks, and ash) is distributed over the surface of the site which encompasses an area of about 400 sq. m. A trench, excavated into the base of the hill, defined the stratigraphy of the site and revealed *in situ* artifacts in a 30-50cm thick layer (Figure 2).

Stratigraphically, the site consists of four distinct layers (A,B,C, and D) in conjunction with two carbonate lenses (Figure 3). Layer A is composed of a medium grained reddish yellow (7.5 YR 7/7) sand of aeolian origin. The layer did not yield artifacts. Layer B consists of a medium grained reddish yellow (7.5 YR 6.5/7) sand of aeolian origin and contains very low densities of artifacts. Layer C, a dark gray (10YR 4.5/1) sand, contains a high density of artifacts, in conjunction with ash, charcoal, burned rock, and bone. Anthropogenic carbonate lenses, associated with layer C, exhibited high densities of charred materials which were collected for radiocarbon dating. Layer D consists of a crumbly reddish yellow alluvium (5YR 6.5/6) which is equivalent with the earliest alluvial unit defined within the study area. No artifacts were recovered from this Layer.

The microlithic assemblage recovered from the test excavation displays consistent typological and technological configurations with depth. Preliminary analysis of two 1 meter square units defined 118 flint tools and over 1,400 specimens of debitage and debris. The tool assemblage is characterized by geometric elements in the form of lunates with predominantly bifacial retouch. Other tool forms and technologic attributes are consistent with an early Natufian designation for the site. Radiocarbon determinations from three charcoal samples recovered from Layer C should provide a check on this cultural-historic designation.

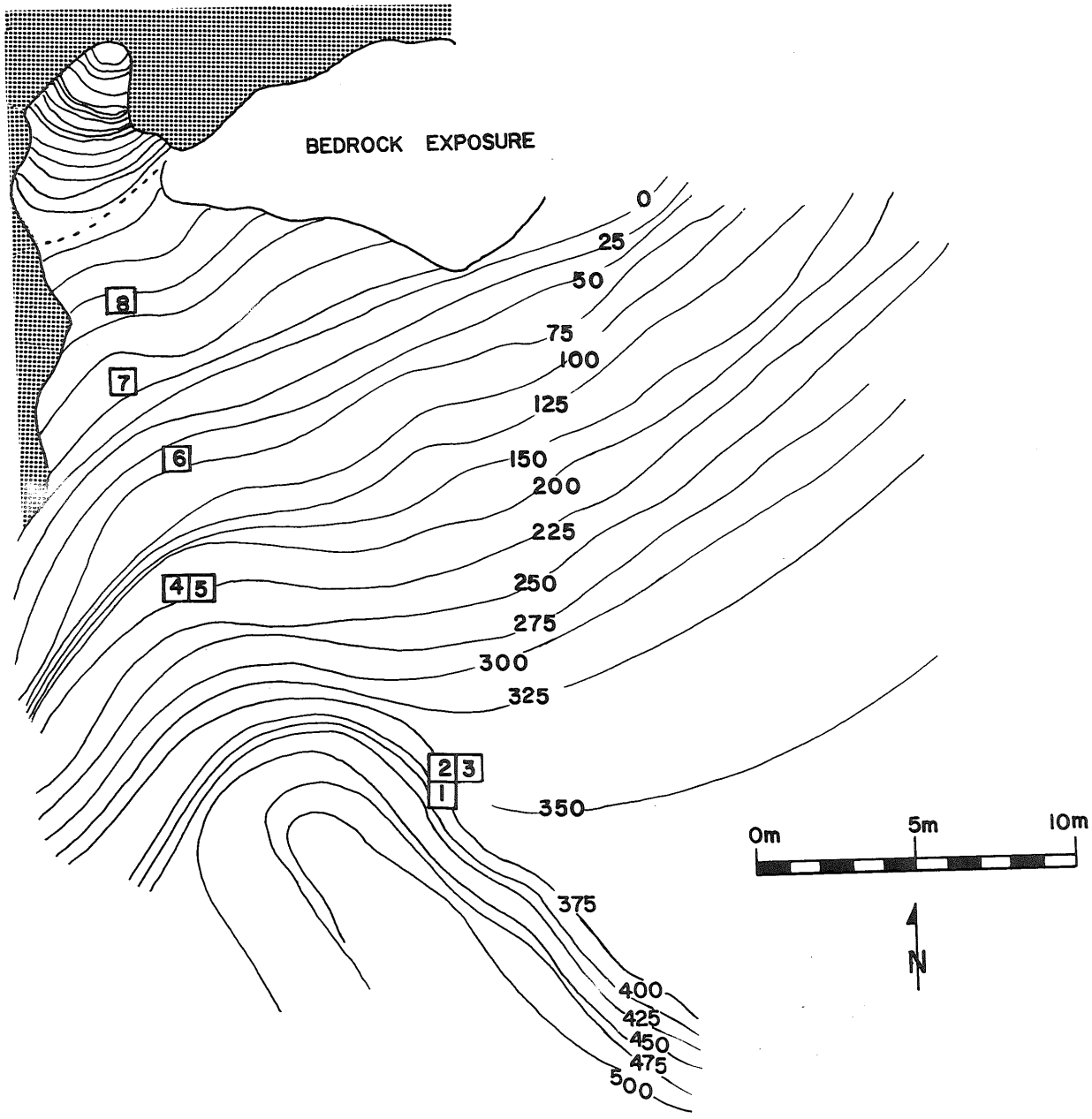

Figure 4. Topographic map of Site J8 showing cave and locations of test units. Note contours appear as below datum "0" readings.

Site J8 - Mousterian

The site is situated on a terrace in front of a small cave at the base of the sandstone escarpment which forms the eastern flank of Jebel el Jill. A high density of flint artifacts were discovered in an erosional channel which delimits the edge of the terrace. A series of eight test units, placed on the terrace from the edge of the erosional cut to the mouth of the cave (Figure 4), isolated the highest concentration of artifacts in the middle section of the terrace beneath the cave (units 4,5,6, and 7).

The test excavations exposed four stratigraphic units (Layers A,B,C,D) with the upper three units containing archaeological evidence (Figure 5). Layer A was composed of a reddish brown friable sand in association with varying amounts of organic material, principally in the form of goat dung, which increased in concentration in the area of the cave. The unit (T8) excavated near the mouth of the cave revealed a 1.7 m thick deposit of dung interspersed with numerous ash lenses. Layer B consisted of a light reddish brown (5YR 6/4) medium grained sand and contained varying amounts of sandstone rubble. Layer C, a pinkish gray (5YR 6/2) friable sand, contained the highest density of artifacts. Layer D, a white (10YR 8/2) coherant sand, failed to yield cultural material.

The assemblage recovered from the test excavations consists of 32 tools and 964 specimens of debitage and debris. Moderate quantities of predominantly poorly preserved bone were also recovered. Typologically, the assemblage is dominated by Levallois points which account for 59% of the tools. Blanks are principally in the form of blades with flakes being much less common.

J14 - Chalcolithic, Natufian

The site is situated in a saddle between sandstone promontories on the western edge of the basin. Flint artifacts are distributed over the southern portion of the saddle in association with remnants of circular stone structures (Figure 6). A series of eight test units, excavated along a north-south axis, revealed a relatively shallow (20-30 cm) cultural deposit in the southern portion of the site and a 50-80cm deposit in the northern section (Figure 7). While a single stratigraphic layer was exposed in the southern portion, alternating ash layers associated with a floor (unit 8) and a refuse pit (unit 6) were encountered in the northern section (Figure 7).

Excavation of the eight test units resulted in the recovery of 41 flint tools and 2392 specimens of debitage and debris. Several ground stone artifacts, rim sherds of a holemouth jar, worked bone specimens, dentalia and other perforated marine shells were recorded in association with the flint assemblage. Well preserved faunal remains were also recovered in abundance.

The flint tool assemblage included typical Chalcolithic elements (i.e. large fan scrapers, large thick flakes with marginal retouch) in association with small abruptly retouched lunates; specimens which are normally affiliated with late Natufian occupations. While the lunates may be part of the Chalcolithic flint assemblage, not previously noted, the seven lunates recorded at J14 may have been introduced from an underlaying Natufian horizon during construction of refuse pits in Chalcolithic times.

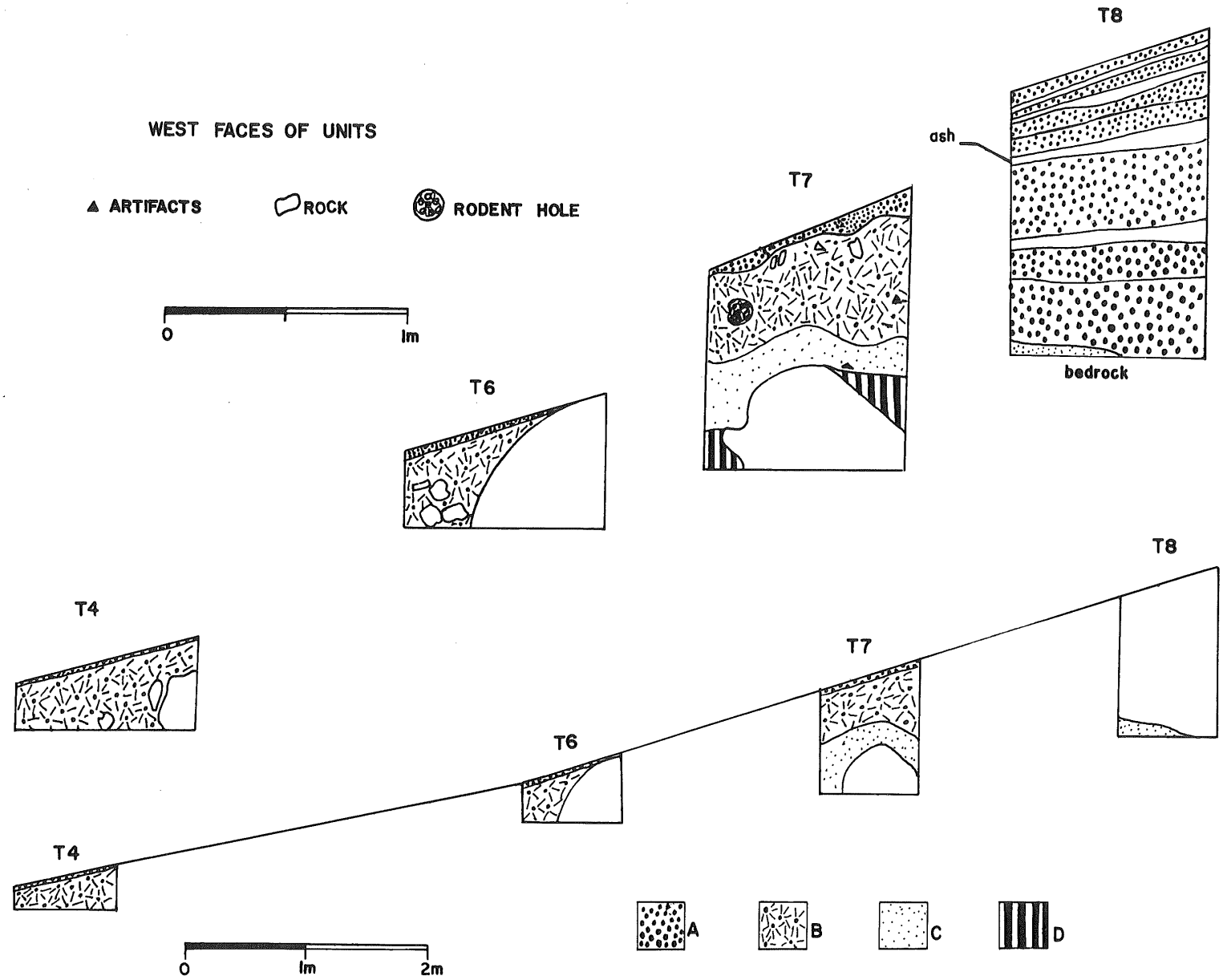

Figure 5. Stratigraphic profile of selected test units at Site J8.

J24 - Chalcolithic, Aceramic Neolithic

The site, defined by a dense surface scatter of flint artifacts, rests on a narrow sand bench beneath a steep sandstone cliff near the western margin of the basin. Remnants of two circular stone structures were also recorded (Figure 8).

The excavation of five test units revealed three stratigraphic layers (Figure 9). The layers were distinguished primarily on the basis of differing ash content. While layers A and B contained typical Chalcolithic artifacts (i.e. holemouth pottery, fan scrapers, small bifacial points), layer C yielded an assemblage identified tentatively as Aceramic Neolithic. Samples of charcoal were collected from hearths associated with each of the layers for radiocarbon dating. Well preserved faunal remains were also recovered from layers A and B.

Preliminary analysis of the artifacts recovered from three of the test units (units 1, 2, and 3) identified roughly equal numbers of specimens for the Chalcolithic and Aceramic Neolithic horizon. The Chalcolithic assemblage consists of 523 pieces of debitage and debris in conjunction with 12 tools. As mentioned the limited tool sample contained typical Chalcolithic elements. Approximately 20-30cm of sterile sand (upper layer C) separated the Chalcolithic horizon from a markedly different assemblage that contained high densities of thin blades and bladelets. A change in the utilization of raw material paralleled the typological and technological transition. Although 423 specimens of debitage and debris were recorded for this lower horizon, these elements were principally restricted to units 1 and 2 due to the distribution of layer C. The excavation of units 4 and 5 also revealed high densities of artifacts in the lower horizon, but these were not analyzed in the field. While only 21 tools were recorded for this lower horizon, one of these was in the form of a unifacially retouched point with a basal stem and single opposed lateral notches. The point was fabricated on a thin pointed blade similar to the other blades recovered from the horizon. This point type is identical to type A26a (Cauvin, 1974) which is associated with Phase 11 at Tel Mureybet in Syria.

J26 - Epipaleolithic

The site, situated on a steep slope on the bank of a deeply incised wadi, is defined by a moderate density of surface material distributed parallel to the wadi (Figure 10). The excavation of five test units indicate that the artifacts are eroding from the member 2 alluvial fan. The excavation revealed *in situ* artifacts to a depth of 70cm. A hearth was exposed in association with the artifacts and a burned matrix sample was collected for radiocarbon dating.

The microlithic assemblage recovered from the site consists of 60 tools and 265 specimens of debitage and debris. Technologically, the microlithic element is composed of rather thin bladelets and blades. Endscrapers, burins, and backed bladelets dominate the tool assemblage. A single geometric piece (trapeze) was recorded in unit F, thus raising the question of whether the site contains two components.

J31 - Epipaleolithic

The site rests on a steep slope between two minor drainages of an alluvial fan on the western margin of the basin (Figure 11). Artifacts are distributed over the surface in high density as they are eroding from sediments of the member

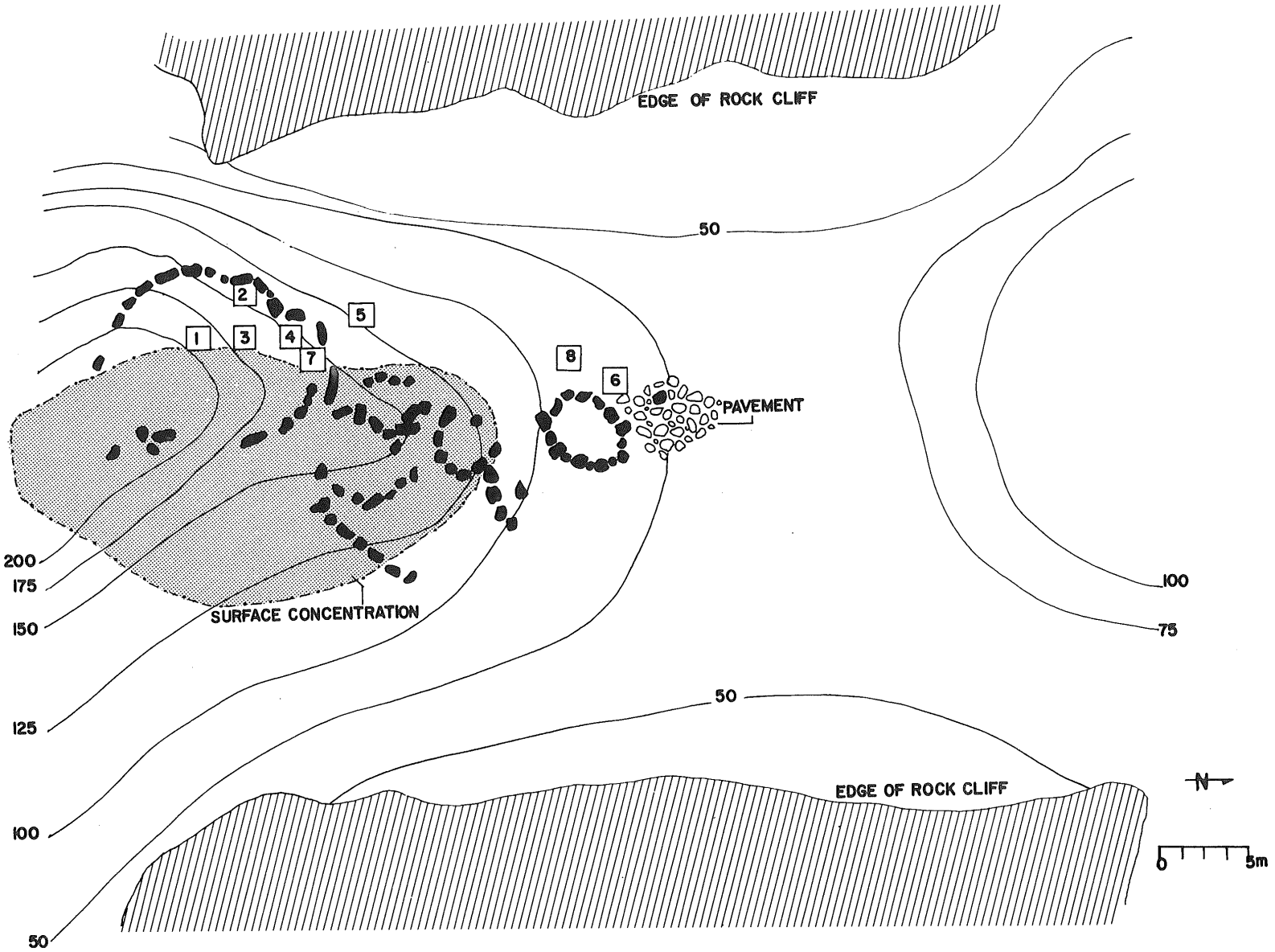

Figure 6. Topographic map of Site J14 showing surface evidence and the positions of units. Note that increasing contour values denote decreasing elevation.

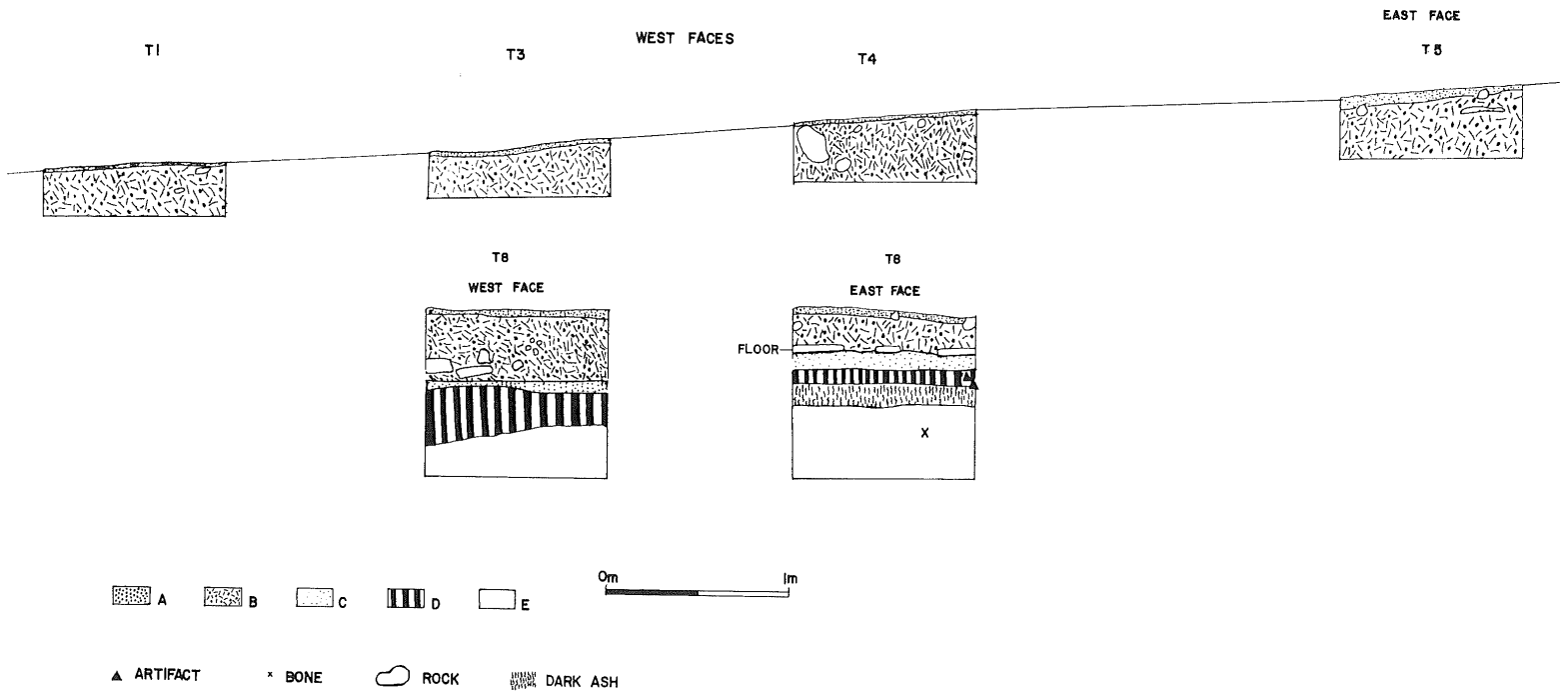

Figure 7. Stratigraphic profile of selected test units at Site J14.

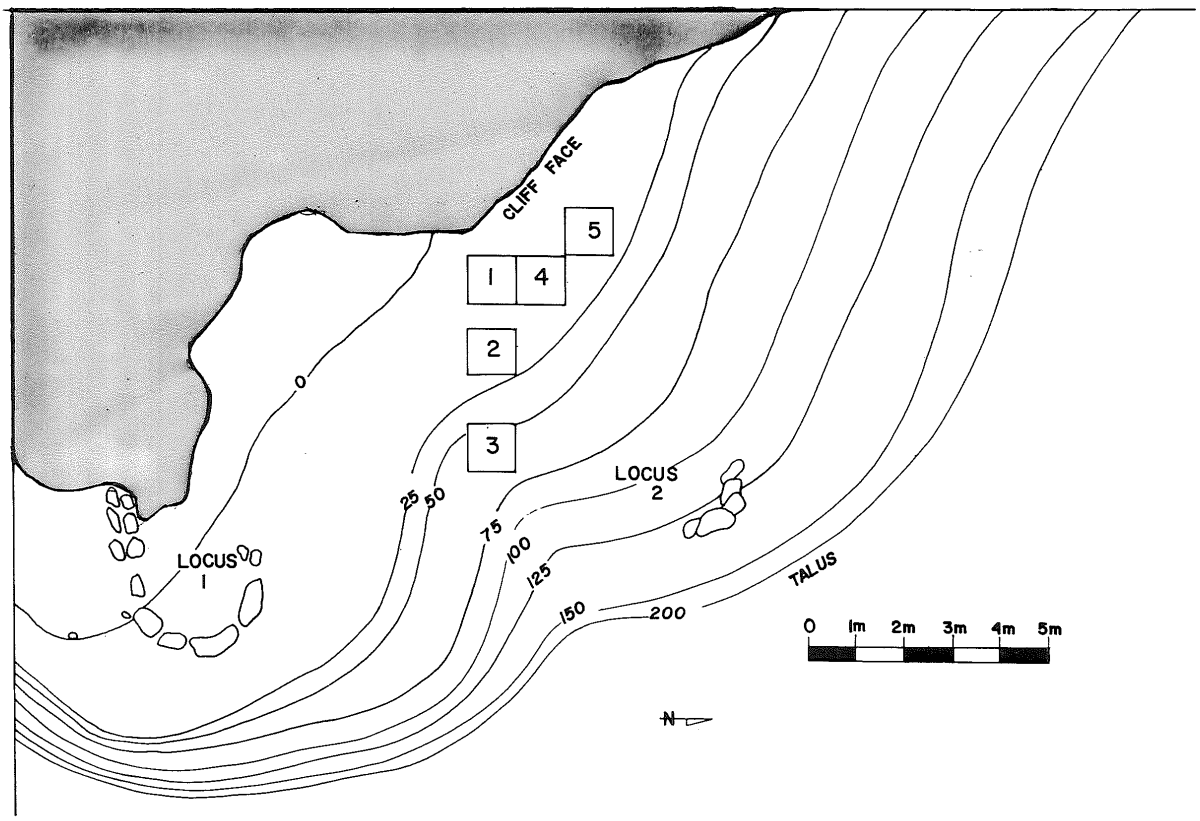

Figure 8. Topographic map of Site J 24 showing the locations of surface features and test units. Note contours appear as below datum "0" readings.

2 alluvial fan. The excavation of eight test units produced *in situ* artifacts to a depth of 70cm. The artifacts were recovered from two stratigraphic layers (Figure 12). The numerous lenses of fine grained material in layer A suggest that it represents layer B sediments which have been reworked through sheetwash of the steep slope. In this respect it is noteworthy that features in the form of ash deposits are restricted to the lower layer. The ash deposits, apparently relicts of former hearths, failed to provide sufficient charred material for radiocarbon dating. Faunal remains were not encountered.

Excavation of the site provided 109 lithic tools and 476 specimens of debitage and debris. The microlithic assemblage is characterized by abruptly retouched and truncated bladelets in addition to geometrics. Over 20% of the tools were in the form of trapezes and rectangles. Microburins were present in low numbers.

Although several artifacts that are typically found in Upper Paleolithic assemblages were noted within the surface collection from J31, the text excavations failed to isolate an Upper Paleolithic horizon.

J201 - Epipaleolithic

The site is located within a rockshelter overlooking a dry lake bed on the southern edge of the Wadi Hisma approximately 20km south of the study area. Lithic artifacts appear in high densities within the shelter and on the slope in front of the cliff face (Figure 13). Text excavations and exposures of erosional cuts on the slope revealed *in situ* artifacts to a depth of 60cm (Figure 13). Faunal remains were recovered throughout the deposit.

The excavation furnished 267 lithic tools and 1636 specimens of debitage and debris. Although the assemblage is microlithic throughout the deposit there is a noticeable increase in the size (length and breadth) of lamellar elements at a depth of 30 to 40 cm which appears to be associated with the layer A - layer B contact. The increased size of elements at 30 to 40 cm coincides with a marked decline in geometrics. Geometric microliths within the assemblage are in the form of trapezes and rectangles. Microburins were not recovered.

J202 - Epipaleolithic

The site is situated in a south facing rockshelter located about 2km east of J201. The rockshelter exhibits a weak talus and rests only 2-3m above a dry lake bed some 400cm to the east. Moderate densities of artifacts are distributed parallel to the cliff face in front of the rockshelter. The excavation of two test units revealed *in situ* artifacts to a depth of 40cm.

The microlithic assemblage contains 257 tools and 4236 pieces of debitage and debris. Although geometrics compose from 12-23% of the tools throughout the deposit, lunates appear to be replaced by trapezes and rectangles with depth. Abruptly retouched bladelets show an inverse relationship to the lunates as they increase with depth. In that these typologic trends define the Geometric Kebaran - Natufian transition in Palestine, it may be that J202 represents such a transition in southern Jordan.

Discussion and Conclusions

The first season's investigation of the prehistory of the Ras en Naqb area resulted in

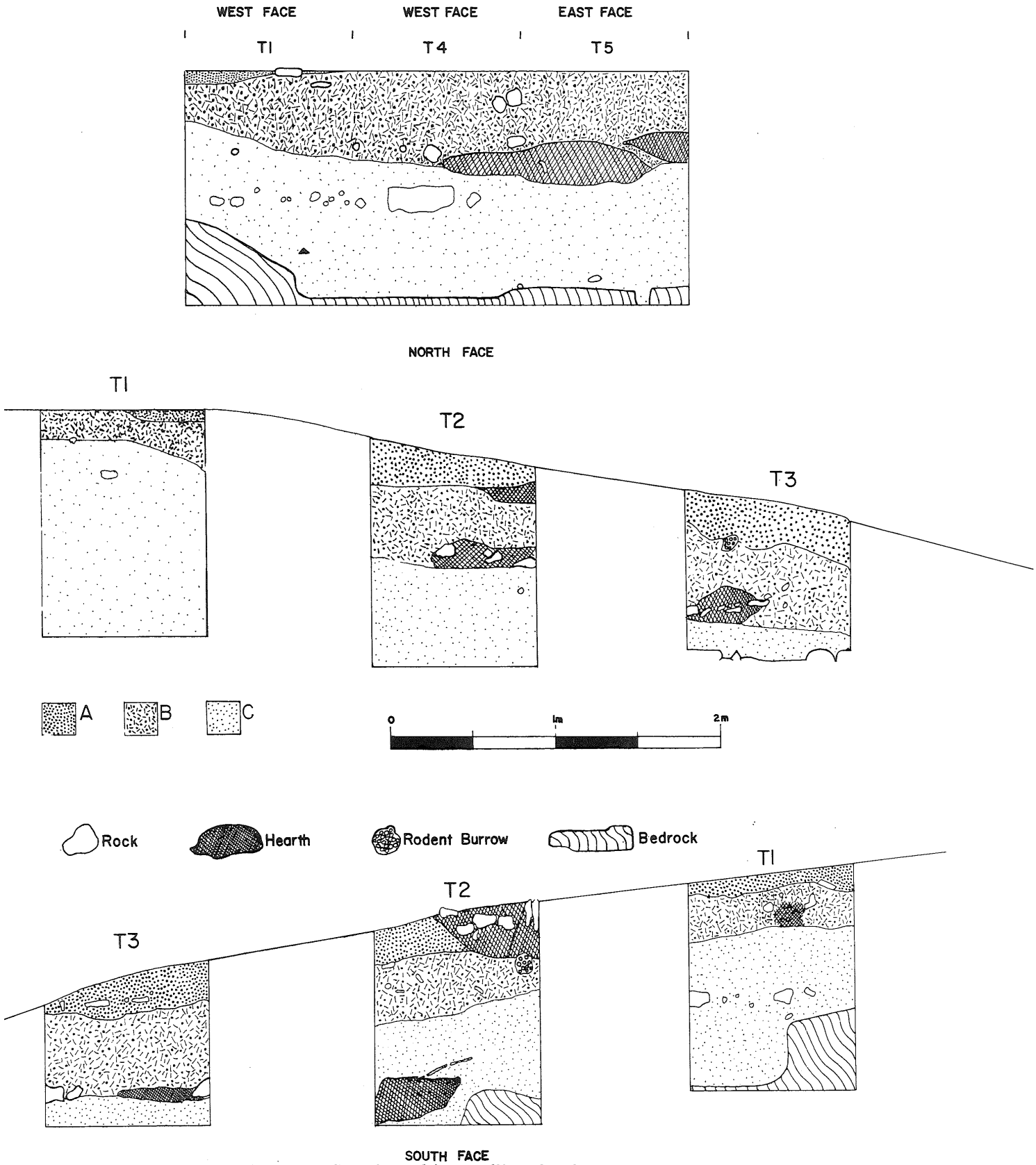

Figure 9. Stratigraphic profile of selected units at Site J24.

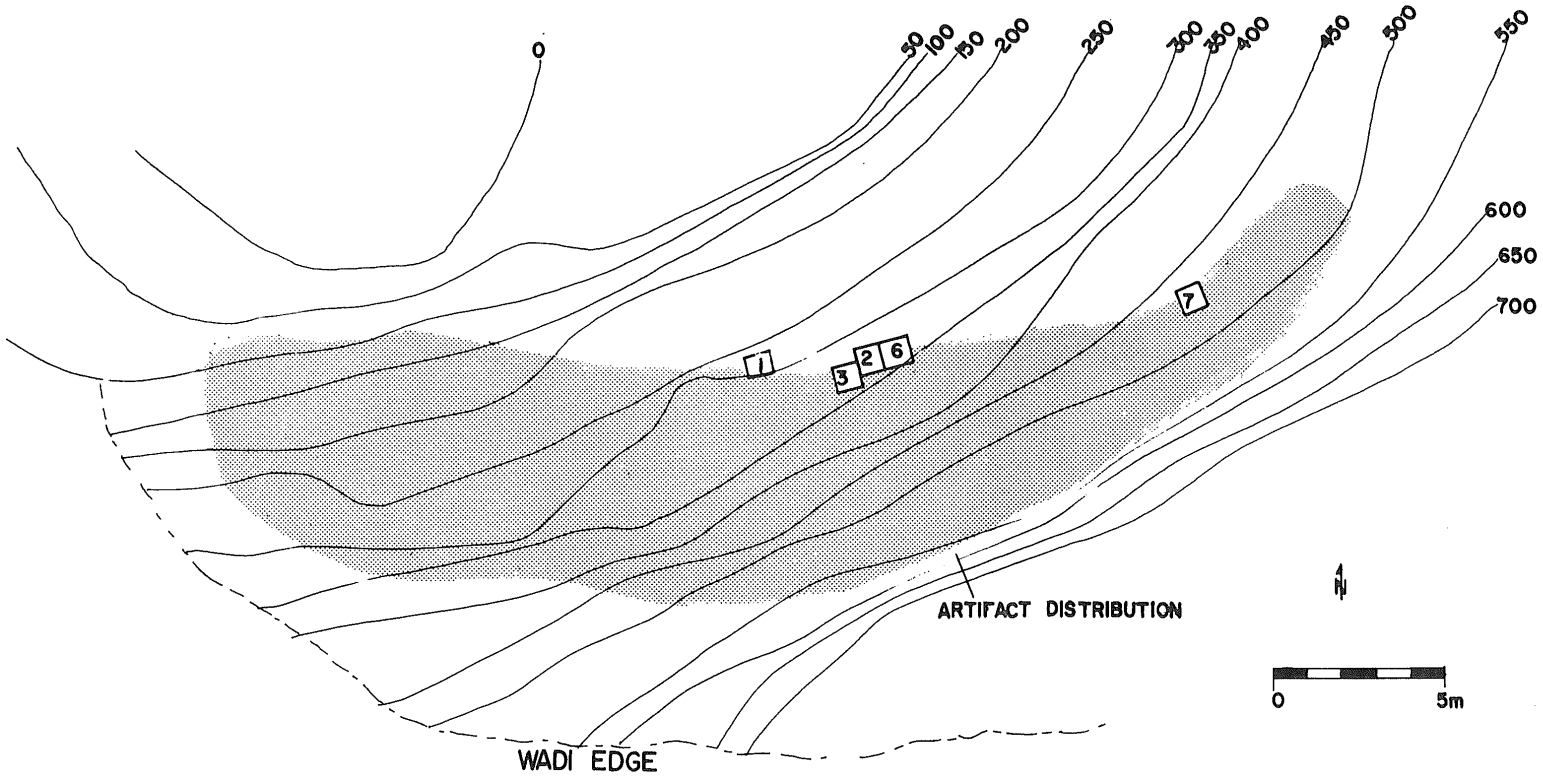

Figure 10. Topographic map of Site J26 showing the surface distribution of artifacts and the locations of test units. Note contours appear as below datum "0" readings.

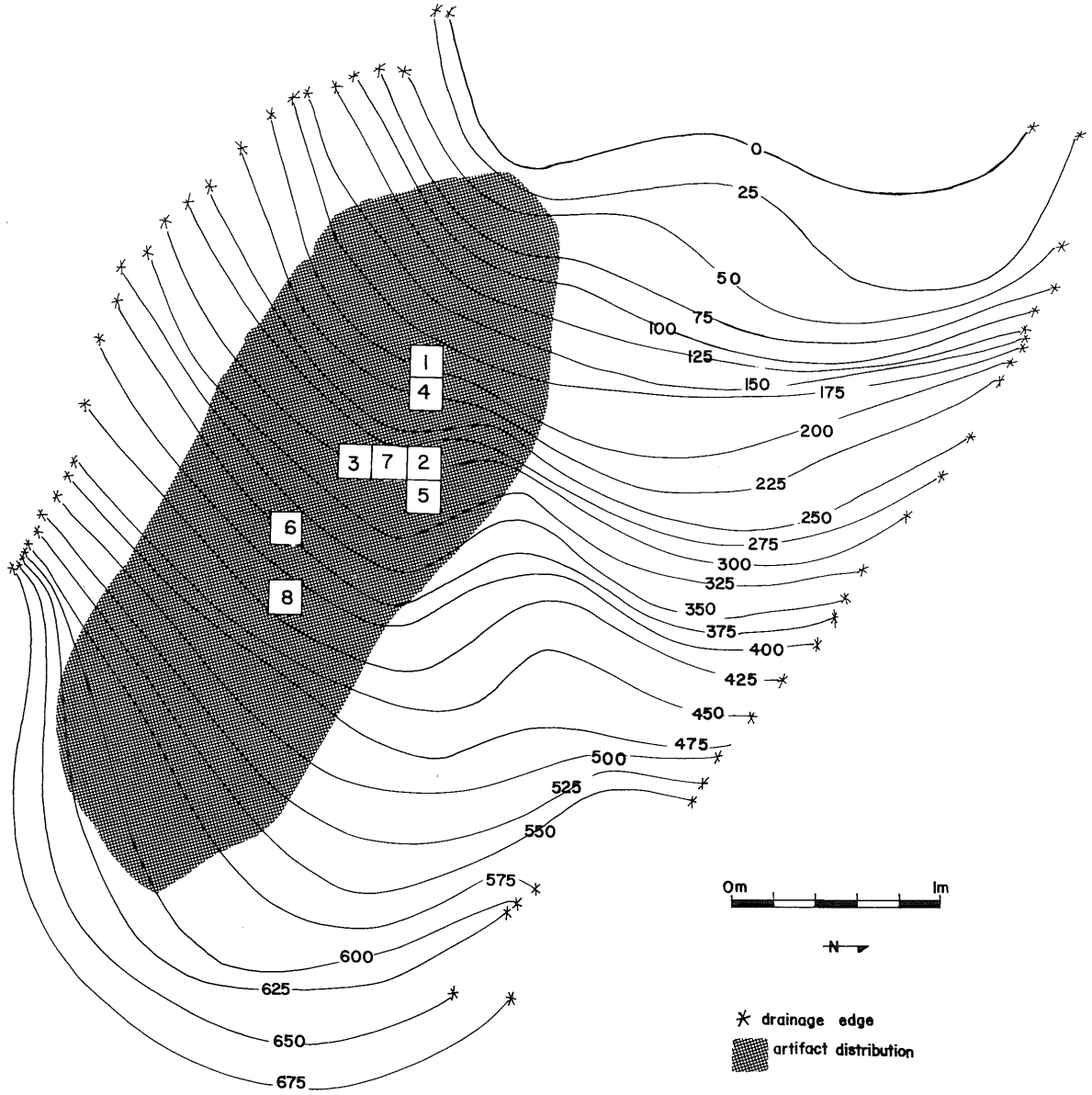

Figure 11. Topographic map of Site J26 showing the surface artifact distribution and the locations of test units.

the development of a tentative cultural-historical and enviornmental sequence. The sequence, as presently understood relies on a chronology generated from the typological/technological seriation of artifactual assemblages and their positions in the depositional history of the area. The paleoenvironmental reconstruction is drawn from geologic evidence and the distribution of archaeological sites. While the cultural and environmental sequence, as presented here, provides a useful framework in which to organize and evaluate data acquired in future studies of the area, the sequence will no doubt undergo significant modification and refinement once faunal and pollen studies have been completed and a series of radiometric determinations becomes available.

The earliest depositional unit defined in the study area is represented by an alluvial fan which filled the basin probably during the early part of the late Pleistocene (Figure 14). Although this unit is not independently dated, either through seriation or radiometric determinations, the presence of Mousterian artifacts in a relict dune immediately overlying the fan suggests a late Pleistocene age. In that this early fan apparently formed under subarid conditions, with annual rainfall on the order of 300mm, it may be equivalent with a moist episode dating to the early part of the last glaciation. This period of greater available moisture has been recognized in pollen records from the Ghab Basin in Syria (Niklewski and Van Zeist, 1970), the Hula Basin in the northern Jordan Valley (Horowitz, 1971), the cave site of Tabun in Israel (Jelinek et al, 1973), and the open site of Rosh Ein Mor in the Negev (Horowitz, 1976; Marks, 1977), among others. Although this moist phase, perhaps a lower latitude expression of an early Würm stadial (Jelinek, et al, 1973: 177, Copeland, 1975:329, Horowitz, 1975:220), has had broad recognition in palynological and sedimentological studies (Butzer, 1975), within the region it is presently poorly dated due to the inherant limitations of the radiocarbon technique. The few available dates and ancillary evidence, however, suggest that moist conditions prevailed from about 75,000 to 60,000 years ago (Copeland, 1975:329; Horowitz, 1975:220, Marks, 1977:6). Early Mousterian occupations are associated with this moist interval in the northern and central Levant and appear to have expanded into such marginal areas as the Negev during this episode of climatic improvement. The intensive Mousterian occupation of the uplands around Ras en Naqb is probably related to this period as are numerous Mousterian sites reported in the vicinity of what was then the extant Jafr Lake (Huckriede and Wiesemann, 1968).

Following this moist interval there was an onset of drier conditions, as revealed in middle Mousterian deposits in the central and northern Levant (Jelinek, et al. 1973:178; Copeland, 1975: 330) and geologic/pollen localities in the Ghab Basin, Hula Basin, and the Negev. The climatic deterioration was accompanied by intense erosion as evidenced by some 80m of downcutting of the Nahal Zin within the central Negev (Marks, 1977). This episode appears to have persisted for some 20,000 years until climatic improvements occurred some 30,000 to 40,000 years ago (Horowitz, 1975:220). During this dry episode the marginal zones of the southern Levant appear to have been unoccupied or at most sparsely inhabited by the middle and late Mousterian groups recognized further to the north (Marks, 1977). Within the study area, the Mousterian site of J8 may be

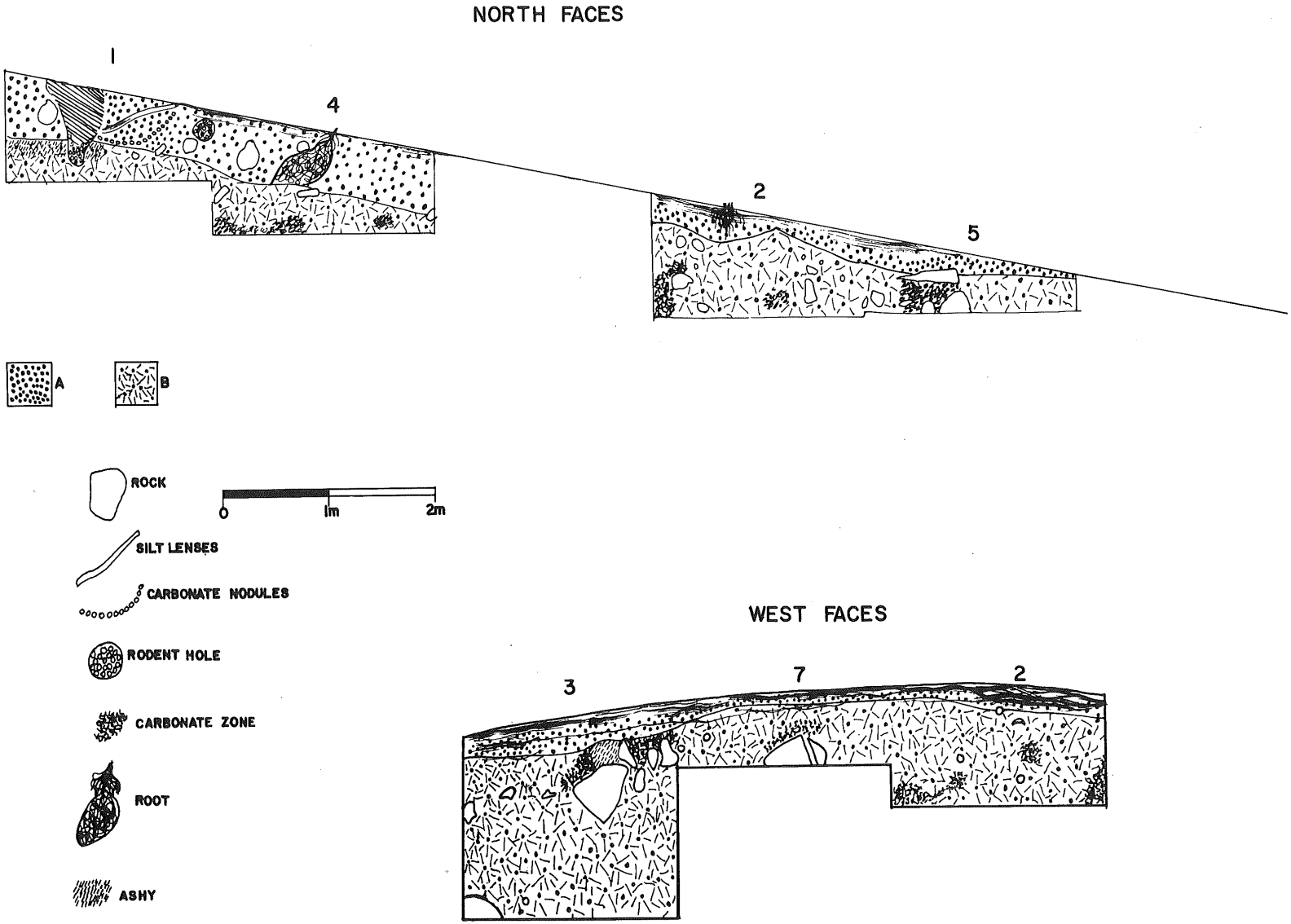

Figure 12. Stratigraphic profile of selected units at Site J31.

TABLE 1: Summary of sites recorded in 1979 survey

Number	Technology	Characteristics	Context	Minimum Area	Maximum Thickness of Cultural Dep.	Artifact Density	Fauna	Datable Material	Paleolithic Period	Comments
J 1	Microlithic	Bladelet; NDT	Deflated	125	0	Low	No	No	E	Deflated on member II alluvial fan
J 2	Microlithic	Bladelets, Bifacial Lunates	In Situ	400	70	High	Yes	Yes	E	Early Natufian , rich midden
J 3	Microlithic	Bladelets, Bladelet Cores	Deflated	250	0	Mod	No	No	E	Deflated on member II alluvial fan
J 4	Microlithic	Bladelets, Pottery	In Situ	400	0	Mod	No	No	C	Structures
J 5	Blade	Blade, NDT	Deflated	150	0	Mod	No	No	?	
J 6	Levallois	Lg, Cores, Lev, Flks, Patinated	Deflated	250	0	Low	No	No	M	Resting on pediment II
J 7	Blade	Blades; NDT	Deflated	100	0	Low	No	No	?	Hilltop, edge of basin
J 8	Levallois	Lev. pts, Lamellar	In Situ	200	60	Mod	Yes	Yes	M	Terrace & small cave
J 9	Microlithic	Core Scrapers, Pottery	Deflated	250	0	Low	No	No	C	
J10	Microlithic	Small Scrapers, Pottery	Deflated	180	0	Low	No	No	C	
J11	Microlithic	Bladelet Cores, Lunates, Pottery	In Situ	300	40	Mod	Yes	Yes	C/E	Multi-component, Chal./Natufian?
J12	Microlithic	Bladelets, Bladelet Cores, NDT	Deflated	150	0	Low	No	No	?	
J13	Microlithic	Bladelet Cores	Deflated	200	0	Low	No	No	?	
J14	Microlithic	Bladelet Cores, Lunates, Pottery	In Situ	1050	80	Mod	Yes	Yes	C/E	Multi-component, Chal./Natufian?
J15	Microlithic	Bladelet Cores	In Situ	125	+	Mod	Yes	Yes	C	Chalcolith Hearth
J16	Blade	Blades, Cores, NDT	Deflated	750	0	Low	No	No	?	
J17	Microlithic	Bladelet Cores, Pottery	In Situ	800	+100	Mod	Yes	Yes	C	Chalcolithic, Vandalized
J18	Microlithic	Bladelet	Deflated	400	0	Low	No	No	?	
J19	Microlithic	Bladelets	Deflated	100	0	Low	No	No	?	

M-Mousterian, Up-Upper Paleolithic, E-Epipaleolithic, N-Neolithic, C-Chalcolithic

Number	Technology	Characteristics	Context	Minimum Area	Maximum Thickness of Cultural Dep.	Artifact Density	Fauna	Datable Material	Paleolithic Period	Comments
J20	Microlithic	Bladelets, Cores, Pottery	Deflated	400	0	Low	No	No	C	
J21	Microlithic	Bladelets, NDT	Deflated	480	0	Mod	No	No	E	
J22	Microlithic	Bladelts, Geometrics	Deflated	1500	0	Low	No	No	E	Trapezes, Rectangles mem.II alluvial
J23	Undetermined	Flakes, NDT	Deflated	240	0	Low	No	No	?	
J24	Microlithic	Bladelet Cores, Bladelets	In Situ	250	170	Mod	Yes	Yes	C/N	Multi-component Chalcolithic/Aceramic
J25	Microlithic	Bladelet Cores, Backed Bladelets	Deflated	640	0	Mod	No	No	E	Member II alluvian fan
J26	Microlithic	Bladelets. Geometric Microlithic	In Situ	256	50	Mod	No	Yes	E	Member II alluvian fan
J27	Microlithic	Bladelets, End Scrapers on Blades	Deflated	600	0	Mod	No	No	E	Member II alluvian fan
J28	Microlithic	Bladelets Cores	Deflated	200	0	Low	No	No	E	Member II alluvian fan
J29	Microlithic; Blade	Bladelets, Blades, Cores	Deflated	120	0	Mod	No	No	E	
J30	Blade	Blade, Blade Cores	In Situ	100	?	Low	No	No	E,UP?	Eroding out of Member II alluvian fan
J31	Microlithic Blade	Blade, Bladelet, Cores	In Situ	200	70	High	No	No	E,UP?	Eroding out of Member II alluvian fan
J32	Microlithic	Cores, Pottery	In Situ	2000	+100	Mod	Yes	Yes	C	Structures, vandalized
J33	Microlithic	Blades, Bladelets, Cores	Deflated	625	0	Mod	No	No	E	
J34	Blade	Blade Cores	In Situ	300	?	Low	No	Yes	E,UP?	Associated hearth eroding out of Member II
J35	Microlithic	Bladelets	In Situ	500	?	Low	No	No	C	Structures
J36	Undetermined	Rounded Structure	In Situ	120	?	Low	No	No	C 1	

M-Mousterian, Up-Upper Paleolithic, E-Epipaleolithic, N-Neolithic, C-Chalcolithic

Number	Technology	Characteristics	Context	Minimum Area	Maximum Thickness of Cultural Dep.	Artifact Density	Fauna	Datable Material	Paleolithic Period	Comments
J37	Microlithic	Bladelets Cores	In Situ	1500	?	High	No	No	C	Structures
J38	Microlithic	Bladelet Cores, Pottery	In Situ	2000	?	Mod	No	No	C	Structures
J39	Microlithic	Bladelet Cores, Pottery	In Situ	2500	?	Mod	No	No	C	Structures
J40	Microlithic	Bladelet, Lg, Flakes	In Situ	1500	?	Mod	No	No	C	Structures
J41	Blade	NDT	Deflated	100	0	Low	No	No	?	
J42	Microlithic	Endscraper, Bladelet Cores	Deflated	750	0	Low	No	No	E	
J43	Microlithic	Bladelets, Geometrics	Deflated	600	0	Low	No	No	E	
J44	Microlithic	Bladelet Cores	Deflated	500	0	Low	No	No	E	
J45	Microlithic	Bladelet Cores	Deflated	50	0	Low	No	No	E?	
J46	Undetermined	Flakes	Deflated	60	0	Low	No	No	?	
J47	Microlithic	Bladelet Cores	Deflated	55	0	Low	No	No	?	
J48	Microlithic	Bladelet Cores	Deflated	200	0	Low	No	No	E	
J49	Microlithic	Bladelets	Deflated	225	0	Low	No	No	E	
J50	Undetermined	Flakes	Deflated	100	0	Low	No	No	?	
J51	Microlithic	Bladelet Cores, Bladelets	Deflated	200	0	Low	No	No	?	
J52	Blade	Flakes, Blades	Deflated	600	0	Mod	No	No	UP?	
J53	Levallois	Lev. Pts., Lev. Cores	Deflated	150	0	Low	No	No	M	Artifacts abraded
J54	Blade	NDT	Deflated	125	0	Low	No	No	UP?	
J55	Levallois	Lev. Pts, Lev. Bld. Core	Deflated	25	0	Low	No	No	M	Artifacts abraded
J56	Levallois	Lev, Pt. Cores	Deflated	25	0	Low	No	No	M	Artifacts rolled
J57	Microlithic	Bladelet. Bladelet cores	Deflated	500	0	Low	No	No	E	
J201	Microlithic	Bladelet; Geometrics	In Situ	112	80	High	Yes	Yes	E	Stratified geometric/non geometric
J202	Microlithic	Bladelet; Geometric	In Situ	500	75	High	No	Yes	E	Late Natufian
J301	Blade	Blade, Blade Cores	Deflated	500	0	High	No	No	UP	Artifacts heavily patinated

1. NDT No Diagnostic Tools.

M-Mousterian, Up-Upper Paleolithic, E-Epipaleolithic, N-Neolithic, C-Chalcolithic

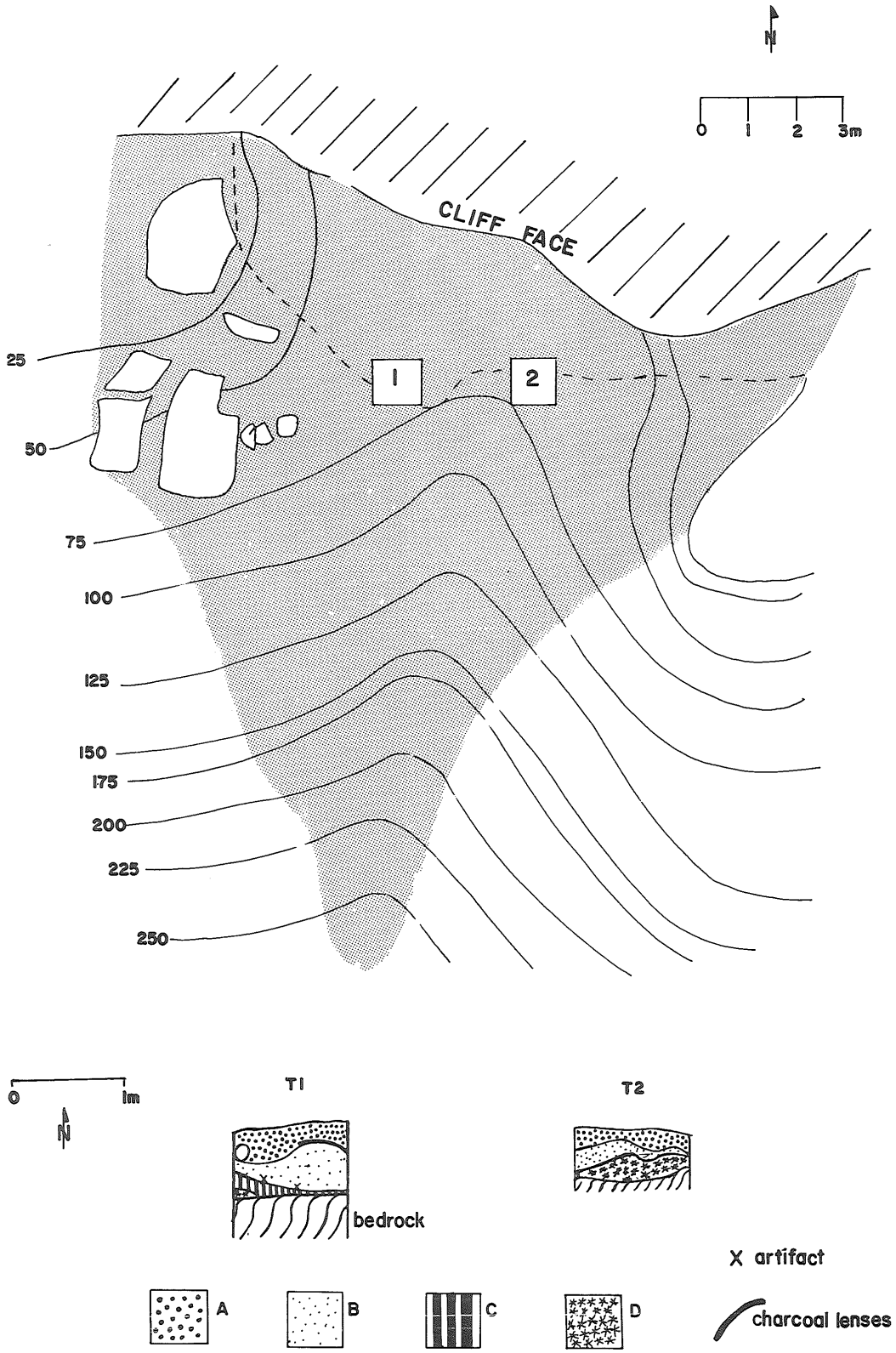

Figure 13. Topographic map of Site J201 showing the surface distribution of artifacts and the location of the te st units.

equivalent with this interval. The position of the site, in a relict dune formed after the down-cutting of the early alluvial fan, is in concert with the regional evidence of an erosional episode followed by a deterioration in climate during middle and late Mousterian times. As a result of the study area being significantly higher in elevation than the surveyed areas (i.e. the central Negev and Sinai) of the southern Levant, the impact of the arid episode was probably moderated by orographic precipitation. Although the evidence suggests that the area experienced a drier climate during this period, the climatic deterioration was apparently not of the magnitude as in the lower elevations of the southern Levant and continued occupation of the Jordanian Plateau was possible.

Climatic improvement, demarking the end of this dry interval, was associated with Upper Paleolithic occupations in the Negev (Marks, 1977:61) and Sinai (Bar-Yosef and Phillips, 1977: 256-257). A series of radiocarbon dates from these occupations indicate that this climatic reversal commenced some 37,000 to 32,000 years ago, but by 26,000 to 27,000 years ago another arid cycle had begun. Another expression of these climatic oscillations is found in geomorphic evidence from the Jafr depression where an episode of extreme aridity, is followed by moister conditions associated with Upper Paleolithic and supposedly Middle Paleolithic (Matakhuim) artifacts (Huckriede and Wiesemann, 1968). Huckriede and Wiesemann interpret these geomorphic successions as having been post Lisan (i.e. 18,000 B.P. according to Begin, et al., 1974) in age and support this interpretation with a single radiocarbon date of ca. 28,000 for the preceding moist interval. The presence of supposedly Middle Paleolithic artifacts in these deposits is not consistent with this interpretation. If Site J301, which was discovered on the northeastern edge of the Jafr depression, is representative of the "Matakhium" an early Upper Paleolithic age would be more appropriate for its antiquity as the assemblage is dominated by Upper Paleolithic tools on blades in conjunction with a modest Levallois element. While an early Upper Paleolithic age for the Matakhium would be inconsistent with the proposed post-Lisan date for the climatic oscillation, such an age would be in concert with the chronology of the climatic events and related archaeology recognized in the Negev and Sinai.

The arid conditions which began some 27,000 years ago appear to have persisted until some 13.000 years ago. At that time dry conditions were giving way to a terminal Pleistocene moist phase associated with late Geometric Kebaran and Moshabian occupations as evidenced by geomorphic data from the Negev and Sinai as well as pollen information from the western Galilee (Henry and Leroi-Gourhan, 1976). Within the study area, the formation of the second alluvial fan probably encompasses this episode of climatic amelioration although the fan may have begun forming during the preceding arid phase. The lack of archaeological evidence from lower portions of the fan prohibits the establishment of a beginning date for its formation. The presence, however, of Epipaleolithic sites (J26 and J31) in the upper portions of the fan in conjunction with an early Natufian occupation (site J2) in an overlying deposit indicates that the alluvial fan ceased to form by 12,000 B.P.

The geomorphic expressions of subsequent

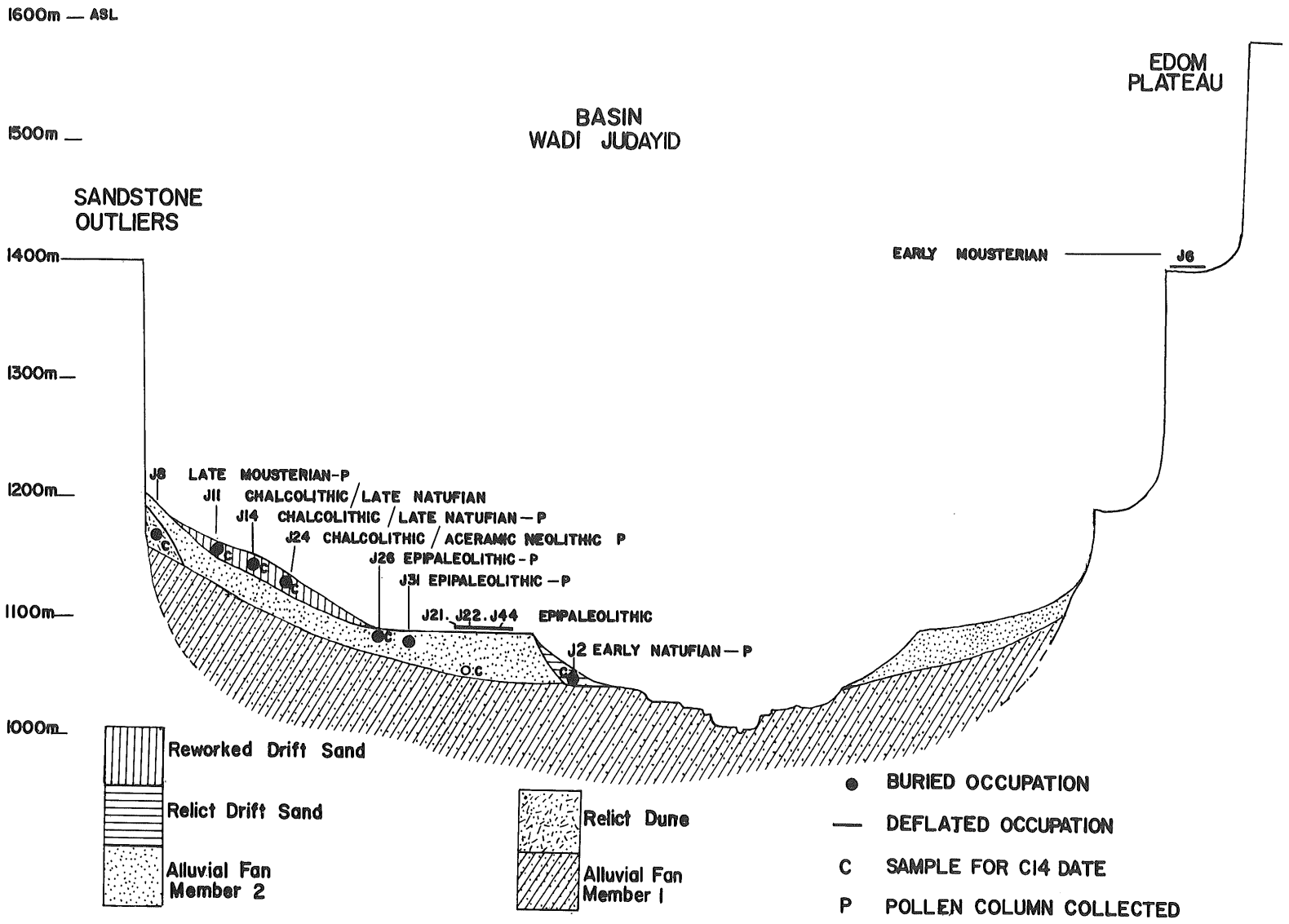

Figure 14. A generalized cross-section of the Basin Wadi Judayid (looking north) showing the positions of archaeological sites in the geologic sequence and associated evidence.

climatic/environmental oscillations within the study area were partially obscured by a predominantly erosional history of the basin during the terminal Pleistocene and most of the Holocene.

Archaeological occurrences attributed to the early and mid-Holocene consist of late Natufian, Aceramic Neolithic, and Chalcolithic occupations. Occupations of these periods are situated in deposits of reworked sand overlying the second alluvial fan.

Following the formation of the second alluvial fan, an erosional episode established the highest of a series of cut-terraces. An early Natufian occupation (Site J2) on this terrace indicates that the erosional interval took place between approximately 12,000 and 13,000 years ago. The erosional episode may have reflected a marked increase in precipitation, as opposed to drier conditions, for there is strong regional evidence for increased available moisture at this time (Henry and Leroi-Gourhan, 1976). An ensuing decline in available moisture, which has been associated with late Natufian occurrences (Henry and Leroi-Gourhan, 1976; Bar-Yosef et al, 1974), is represented by increased aeolian deposition within the basin during this interval. Drier conditions are indicated by dune sand covering the early Natufian occupation at Site J2 in conjunction with late Natufian (Sites J11 and J14) and Aceramic Neolithic (Site J24) occupations appearing in sands which evidence limited mobilization of iron oxides.

A final moist episode followed with reddish sands being reworked into the drift sand on the older deposits and possibly some wadi aggradation occurring. This episode probably took place during the mid-Holocene as based on correlation with similar conditions in North Africa and the southern Levant (Butzer, 1977: 404). In the study area, however, the associated archeological evidence is limited to the later part of this period in the form of Chalcolithic occurrences (Sites J11, J14, J24, and others) as no evidence for a Pre-Pottery Neolithic B occupation of the basin was found. Given the widespread distribution of PPNB sites in the presently marginal regions of the Near East, including Sinai (Bar-Yosef and Phillips, 1977), the Negev (Servello, 1976), and the Jordanian Eastern Desert (Waechter and Seton-Williams, 1938) in conjunction with PPNB sites in the immediate vicinity of the study area (Kirkbride, 1966; Price and Garrad, 1975), the apparent absence of PPNB sites in the basin is probably more of an expression of bias in the survey or geologic exposures, than a real lack of occupation by PPNB groups.

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