GEOMORPHOLOGICAL ASSESSMENT OF MIDDLE PALEOLITHIC SITES ON THE MĀDABĀ PLATEAU

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Abstract

The assessment of geomorphic features, sediments, and soils associated with Mousterian lithics was one of the primary objectives of the 2002 and 2005 field surveys of Middle Paleolithic sites in several localities of the Mādabā Plateau. Stratified occurrences of Mousterian lithics are found in Red Mediterranean soils and sediments of colluvial and eolian origin. Intense erosion by water, wind, and plowing has modified these soils and their associated lithics. Therefore, a proper interpretation of soil horizons and Optically Stimulated Luminescence (OSL) dating helps understand the stratigraphic occurrences of lithic materials. Cave breccias exposed in road cuts and quarries often contain Levallois cores. Debris talus at cave entrances and rock shelters also contain a variety of Levallois lithics, while the deposits inside the cave are devoid of such materials. This suggests intentional scouring by more recent occupants of the caves. Despite modifications by erosional processes and humans, there is potential for finding Middle Paleolithic habitation sites in this region.

Introduction

Geomorphic processes such as weathering and wind and water erosion have modified the landscape of poorly vegetated areas of Jordan. For Paleolithic sites, this means modifications and sometimes total obliteration. In the light of this problem, the survey of Middle Paleolithic sites of on the edges of the Mādabā Plateau required an assessment of the geomorphologic context of areas with abundant Mousterian lithics.

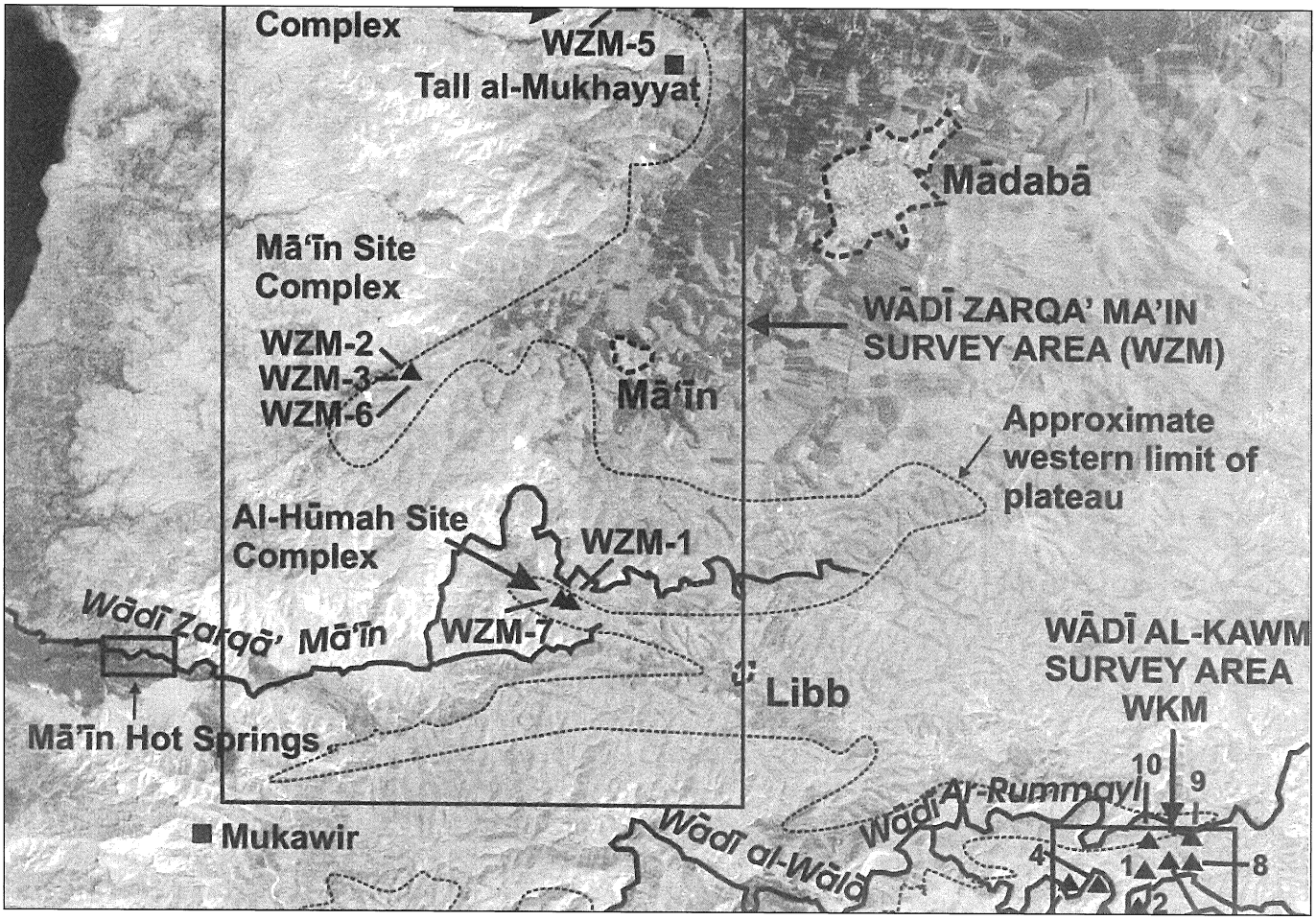
In addition to natural agents, humans have also contributed to modifying the archaeological record. One of the main examples of human agency on Middle Paleolithic sites in Jordan is the modification of rock shelter sediments by shepherds. This means the removal of sediments and the addition of younger cultural sediments, particularly dung. This is one of the reasons why many rock shelters have not yielded Paleolithic materials (Shea and Crawford 2003). Additionally, open sites have undergone transformation through plowing and construction.

Concentrations of Middle Paleolithic materials in Jordan have been reported on a variety of geomorphic and depositional contexts, of which the most common have been high wadi terraces (Besançon and Hours 1985; Parenti *et al.* 1997, Cordova *et al.* 2005), fluviolacustrine deposits in Wādī al-Ḥimma (Edwards 2004) and deep soils on plateaus (Cordova *et al.* 2005). In areas where rock shelter deposits have not been altered or removed, Paleolithic materials can be found. This is the case of ʻAyn ad-Dufla (Clark *et al.* 1997), Ṭūr Faraj and Ṭūr Ṣabīḥa (Henry 2003). However, cave and rock shelter sites with hominid bone remains have not been found in Jordan, prompting the extensive search of Mousterian lithics in caves and rock shelters formed calcareous formations of the plateau. For this reason, this project focused on the edge of the Mādabā Plateau where several calcareous formations with karstic cavities are found (**Fig. 1**).

This paper describes the main geomorphic and pedological aspects of Middle Paleolithic sites surveyed on the southern and western end of the Mādabā Plateau. These are the Wādī al-Kawm and the Māʻīn, al-Ḥimma, and Ṣiyāgha areas (**Fig. 1**). It also includes the stratigraphic sequences, some of which have been dated using Optically Stimulated Luminescence (OSL).

A Pattern Found in Wādī al-Kawm Sites

Wādī al-Kawm, a tributary of Wādī al-Wāla,

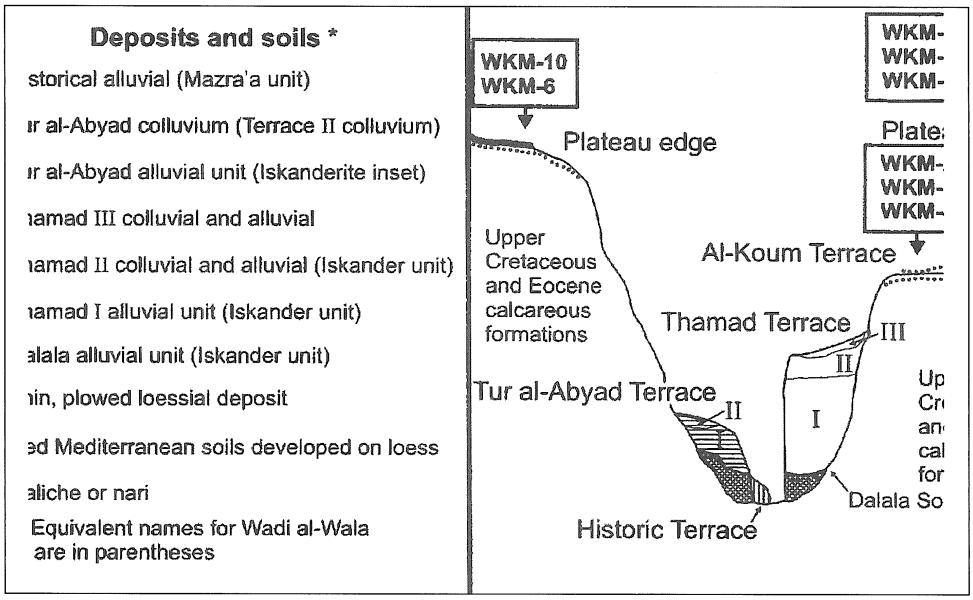


1. Location of surveyed areas and sites on the Mādabā and Dhībān plateaus.

dissects the plateau forming a steep canyon. The archaeological survey area comprised Wādī al-Kawm proper, the northern bank of Wādī ar-Rumayl and long stretches of interfluvial plateaus (**Fig. 1**). Surface concentrations of Mousterian lithics in the Wādī al-Kawm area were found in two main settings: on the edge of the plateau and on the highest terraces of the wadi (**Fig. 2**). On the edge of the plateau the densest concentrations of Mousterian lithics occur where erosion of the red Mediterranean soils has been more intense. In order to test that concentrations were the result of soil erosion, we assessed soil stratigraphy in test pits and road cuts. Exposures of these soils revealed that most lithics are associated with carbonate nodules (i.e., Btk horizon), which are usually found between 1 and 2 meters below the surface (Cordova *et al.* 2005). However, in the plateaus on both sides of Wādī al-Kawm, Mousterian materials lie on the surface. Soil profiles observed in test pits showed that erosive processes have removed the top horizons of the soil, exposing those horizons where Mousterian lithics are embedded. This is the case with sites WKM-1, 6, 7, 8 and 10, all of which are located on plateau edges (**Fig. 2**).

The other occurrence of high concentrations of Mousterian lithics is on the upper-most terrace in the wadi, named the al-Kawm Terrace (**Fig. 2**). It is an erosional terrace (strath terrace) covered by a mantle of wind-laid silt. This terrace contains relatively large amounts of Levallois cores similar to the ones found on the edge of the plateau. In most cases these sites are located near flint sources on the walls of the canyon (Nowell *et al.* 2003). Sites in this type of context are WKM-2, 3, and 4 (**Fig. 2**). In these locations it was not possible to associate soil horizons with the presence of lithics because silt mantles are deeply modified by plowing. Silt deposits on al-Kawm terraces are in most cases less than 1 meter thick.

Rock shelters and caves in the canyon contained no Middle Paleolithic material. However, cones of debris below the rock shelters produced Mousterian material mixed with younger mate-



2. Site locations in relation to the geomorphology, stratigraphy, and soils of the Wādī *al-Kawm.*

rials, including pottery fragments. It is evident that the sediment in the cave has been removed to make it habitable for sheep. This pattern is widely found in the canyons of this region, as well as in other parts of Jordan (Shea and Crawford 2003). This was the case for a rock shelter at site WKM-9. Additionally, the geological formations in this area have few karstic cavities, making the possibilities of finding rock shelters difficult.

The Western Rim of the Mādabā Plateau

The observations previously made in the Wādī al-Kawm area indicated that we should look for more sites in areas with thicker red soils on geologic formations with more karstic cavities. We found areas with these characteristics on the western edge of the Mādabā plateau.

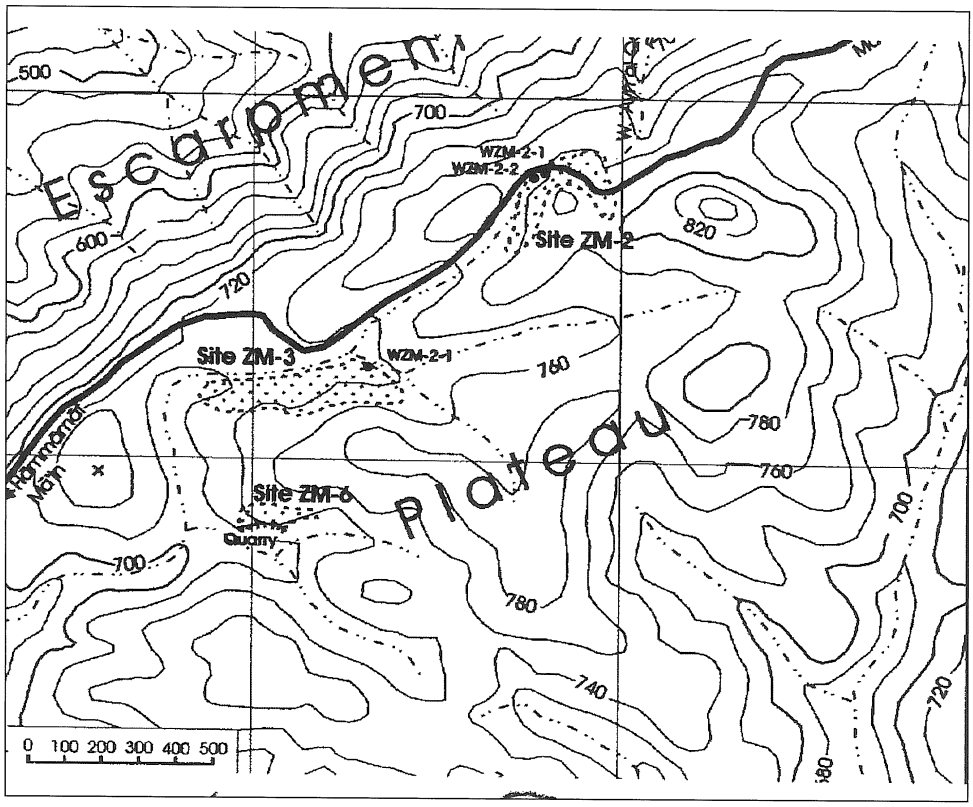
In 2005 we were granted permission from the Department of Antiquities of Jordan to survey the area comprising part of the escarpment along the rim of the Mādabā plateau from Mount Nebo to Mukāwir (**Fig. 1**). The sites surveyed within this broad area were grouped into three complexes: the Mā'īn Site Complex (three sites), the al-Ḥimma Site Complex (two sites) and the Ṣiyāgha Complex (two sites). These three site complexes share topographic, geomorphic, geologic, and pedologic characteristics. All three lie on spurs projecting out of the plateau. All three straddle at least one of the two Cretaceous limestone formations with flint bands and nuclei (the Wādī al-Ghudrān and 'Ammān Silicified Limestone formations). These formations also present abundant karstic cavities and topographic depressions where red Mediterranean soils and other Pleistocene are protected from erosion.

Mā'īn Site Complex

Sites WZM-2, WZM-3 and WZM-6 form a continuum of surface material on a hilltop area along the road to the Mā'īn Hot Springs (**Fig. 3**). The top geological unit is the Wadi Umm al-Ghudran Formation (WG) and the Wadi as-Sīr Limestone (WS) (**Fig. 4A**). Both formations contain abundant flint nodules. A series of recently dry springs on the NW side of the hilltop suggest that there was water in the area, which may have also attracted game animals. The largest of these springs in the area is about 1km down slope, at the locality known as 'Ayn al-Qaṭṭār. The Mā'īn site complex occupies the interfluvial area of two main canyons, Wādī 'Ayn al-Qaṭṭār to the north and Wādī Zarqā' Mā'īn to the south.

Site WZM-2 is located on a hillside facing NW. Sediments are exposed along the road to the Mā'īn Hot Springs. The sequence in this area includes a partially cemented breccia with Mousterian lithics overlain by colluvial material in which lithics are somewhat different (**Fig. 4B**). The lack of diagnostic pieces of lithics on the overlying deposit has not allowed age determination.

The breccia unit is cemented with carbonate which on top forms a calcrete. It is not clear what the origin of this material is, but it resembles modern spring deposits in the area. The breccia



3. The Mā'in Site Complex. Location and topography.

rests on a bench formed on the limestone and extends into the karstic cavities, where Levallois flakes were also found.

OSL dates from section WZM-2-1 are associated with lithic material that document at least part of the Middle to Upper Paleolithic transition, characterized as an evolution of single platform Levallois cores producing elongated points into unfaceted platform blade cores (See Bisson *et al.* in press). Few examples of this transition have been previously found in Jordan. These were documented at 'Ayn al-Buḥayra (Coinman 2003) and Ṭūr Ṣadaf (Fox 2003).

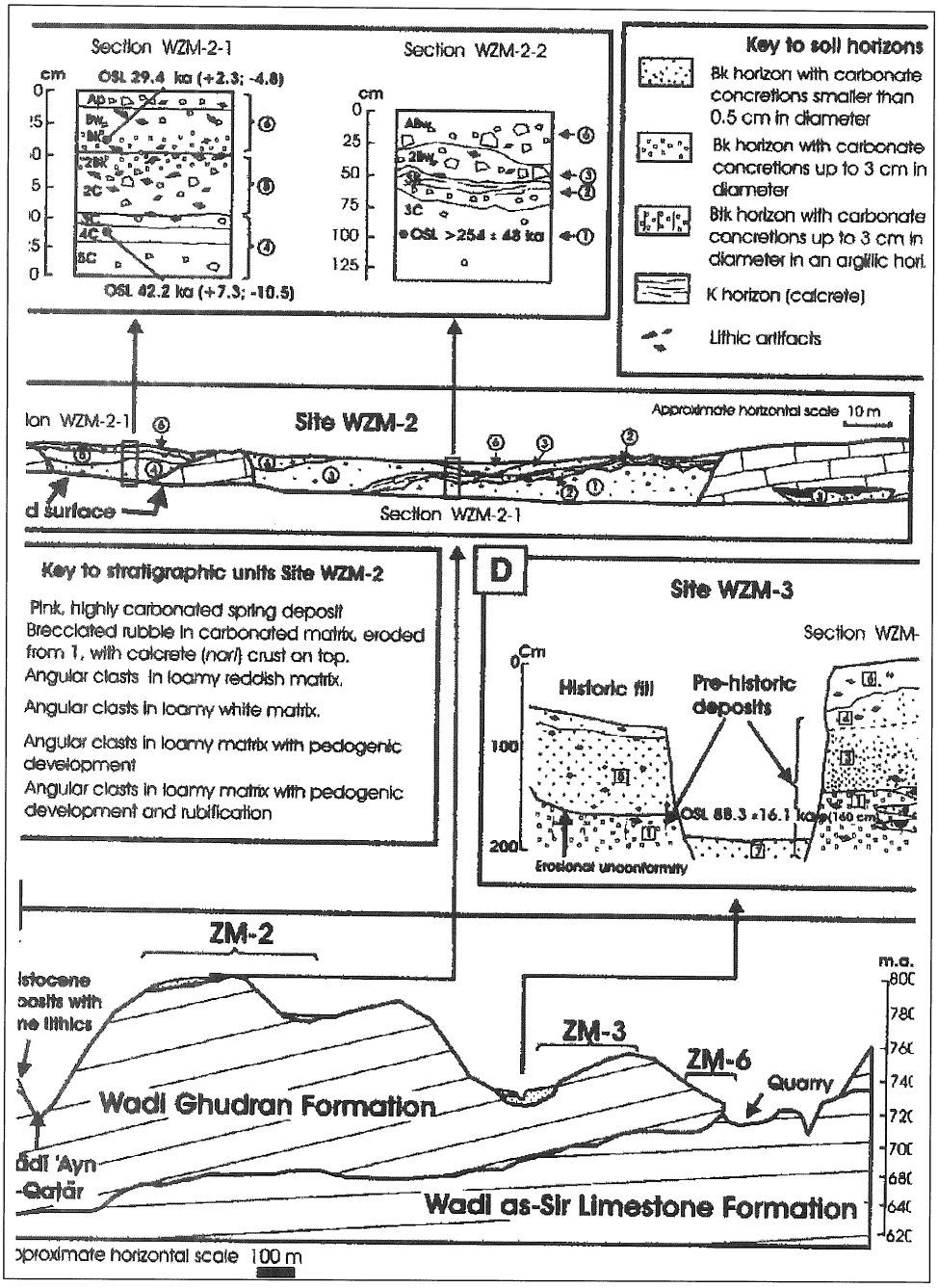
Site WZM-3 is a small valley and a hillside. The valley bottom is filled with two units of alluvium (**Fig. 4D**). One of the units contains a reddish-brown deposit with soil development in the form of Btk horizons which are typical for Pleistocene soils in the region according to the chronology proposed by Cordova *et al.* 2005. Abundant Levallois flakes and cores appear in association with this deposit. The OSL date agrees with the Middle Paleolithic age of the material (**Fig. 4D**). An alluvial inset of much younger age forms another terrace. This inset contains lithics and pottery dating to the Roman and Byzantine periods.

Site WZM-6 is in a geomorphological setting similar to site WZM-3, but the opening of a quarry has modified the landscape. A series of karstic cavities are exposed on the north and west walls of the quarry. As in other areas around the site, cavities are filled in with cave breccia and lenses of red soil (i.e., terra rossa). Hypothetically, the presence of Mousterian lithics in these cavities can be explained as a process of sediment filling by a combination of colluvial and eolian sedimentation (**Fig. 5**). The stratigraphy of these sediments has no occupation surfaces and no hearths, and the lithic materials in them are usually found at random. It is possible that lithic materials accumulated in the cavities as part of the colluvial accumulation of breccias and terra rossa sediments. Nonetheless, the sedimentological context of Mousterian lithics in these cavities shows the presence of Neandertal populations at a time when the cavities were filling in with sediments and at the time when red Mediterranean soils were forming. However, this hypothetical reconstruction needs further detailed analysis and interpretation.

Al-Ḥimma Site Complex

Sites WZM-1 and ZM-7

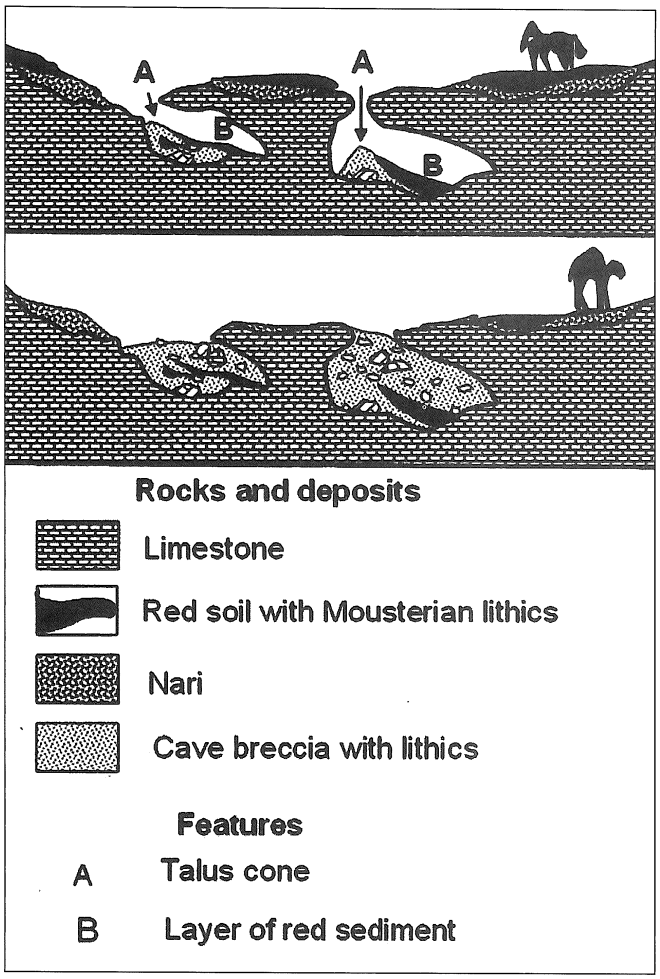
These two sites are located in the al-Himma area, which is a ridge along a spur between



4. The Mā'in Site Complex. Geology and detailed stratigraphy of sites WZM-2 and WZM-3 with OSL dates A) Geological formations; B) WZM-2 site stratigraphy; C) Dated sections at WZM-2; D) Section at site WZM-3.

Wādī Zarqā' Mā'īn to the north and Wādī Libb to the south. This spur is capped by the Amman Silicified Limestone, a formation that is not only rich in flint, but also with abundant caves, rock shelters, and sinkholes. Of the ten caves visited in this area, only two may have sediments containing Middle Paleolithic material. The first is WZM-1, a rock shelter formed on the edge of a sinkhole. Although most sediments are eroded from the rock shelters, the sinkhole presents possibilities. Levallois cores and flakes are abundant around the area, suggesting that the area had a substantial Middle Paleolithic occupation. Abundant artifacts from the Chalcolithic, Early Bronze Age, and other periods suggest that this locality was reoccupied consequently modifying soils, sediments, and caves. Occupation of the al-Ḥimma area during these periods is also evidenced by the large amounts of dolmens and menhirs in the area, most of which have been assigned to these periods (Savage and Rollefson 2001).

The sinkhole is a 15-m deep shaft with a talus of debris approximately ten meters deep and seven meters long. The potential for finding prehistoric materials is high, since erosion of sediments in the sinkhole is unlikely to have occurred. However, the stratigraphic sequence



5. Relation between karstic cavities and soil/sediment filling.

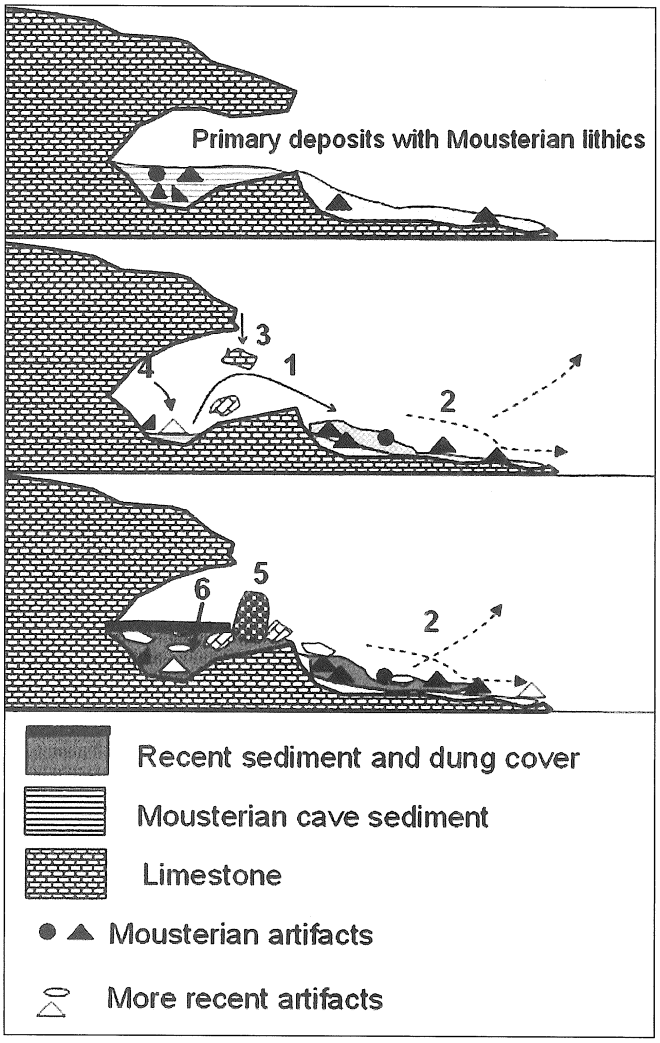
may consist of continuous accumulation of sediment for several millennia. This means that Pleistocene deposits containing Middle Paleolithic material may be buried underneath Holocene sediments.

The second site in this area with great potential for uncovering Middle Paleolithic materials is WZM-7. It consists of a cave and its debris talus. The cave is approximately 10 meters deep, 15 meters wide and the highest part of its roof is two meters from the bottom. Its low roof is due to a thick deposit of sediment in the bottom. A modern sheep and goat dung layer covers a yellowish gray deposit. A test pit in this area revealed a mixture of Early Bronze and Islamic pottery, but by the geometry of the walls, it is evident that the sediment continues much further. Outside the cave, a wide talus apron extends down slope with relatively abundant amounts of Levallois cores and flakes. Because the entrance forms a threshold of about a meter and half, it is not possible that the debris forming the talus was deposited through erosion of cave sediments. Abundant pottery and lithics of the Chalcolithic and Early Bronze period in the talus suggest that these sediments were once deposited in the area along with the Middle Paleolithic. The hypothetical scenario of taphonomic processes involved in the modification of the Middle Paleolithic deposits can be reconstructed using evidence from deposits of later age (**Fig. 6**). This scenario implies the digging of older sediments in the cave in order to make it habitable. Sediment dug out from the cave is more likely to be deposited down slope. This process may have been repeated several times. In recent years, shepherds have done this in most caves and rock shelters of the region.

Ṣiyāgha Site Complex

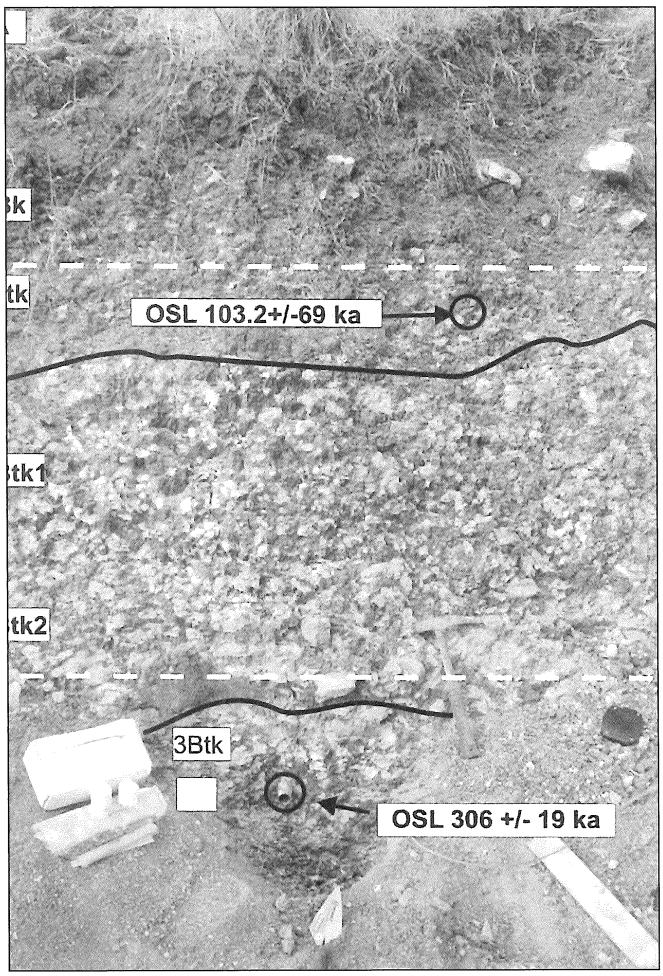
Site WZM-4

This site is located on the edge of the plateau



6. Sequence of cave/rock shelter transformation through natural and cultural processes.

about five kilometers north of Tall al-Mukhayyaṭ. The site is situated within a depression filed in with red soil. A soil profile exposed along a road cut shows a soil horizon sequence typical of the red Mediterranean soils of the region. They present a Bk horizon with small carbonate concretions (often smaller than 1cm in diameter) and a lower Btk horizon with large concretions (up to 4cm in diameter). The latter has been associated with the appearance of Levallois cores in the region (Cordova *et al.* 2005). At WZM-4 Levallois cores and flakes appear again associated with two Btk horizons with large carbonate nodules (**Fig. 7**). Optically Stimulated Luminescence dates produced a bracket for the Levallois flakes in this section. The youngest date suggests that the flake-bearing horizons date to the last interglacial period (130-120 ka BP). The oldest date at the bottom corresponds to an older soil horizon with no lithic material. This soil is separated from the flake-bearing horizon by an erosional unconformity. This suggests a gap in deposits corresponding to 200 ky years of separation between the two horizons.



7. Soil stratigraphic section and OSL dates at site WZM-4. Levallois flakes were abundant inside the area marked by the discontinuous line.

Site WZM-5

This site is part of a scatter of Middle Paleolithic material originally reported by Mortensen and Thuesen (1998) as site MN-360. Although their survey reports mainly a bench that has now been plowed, the material extend upslope where a series of debris taluses associated with rock shelters and other colluvial deposits show relatively large amounts of Middle Paleolithic material. On one of the road cuts, a paleochannel was filled in with debris containing Middle Paleolithic material. The top of this deposit has a soil developed on it. The development of Bk (carbonate horizon) and Btk horizons in this soil make it correlative with the soil in WZM-4.

Upslope from site MN-360, a talus of sediment with Levallois cores descend from cliff areas, where entrance to karstic cavities have been blocked by collapse rubble and colluvium. Therefore, site WZM-5 includes former site MN-360 and the slopes north of it.

Paleoenvironmental Implications

The OSL dates suggest a sequence of sediment deposition and soil formation concomitant with Middle Paleolithic occupations. The oldest Middle Paleolithic bearing material is found at WZM-4 (**Fig. 7**), which according to the OSL dates it as a soil formed and occupied during the last interglacial and the beginning of the last glacial period. In the marine isotopic chronology, this period is known as Stage 5e, which is wetter in the Near East (Bar-Matthews *et al.* 2000). The degree of rubification (redness) and clay formation indicate a period of intense pedogenic development resulting from climatic conditions wetter than today. Carbonate formation may be the result of various pedogenic processes, probably a dry period following the interglacial, possible Marine Isotopic Stage 5d (120-110 ka). See the relations between marine isotopic stages and records in the Levant in Cordova (2007: 123).

The soil at WZM-3 (**Fig. 4D**) has less development, suggesting that conditions were humid, but not as humid as the soil at WZM-4. At WZM-2 (**Fig. 4C**) conditions appear to have been drier. However, reddening and clay formation at the top

suggest moister conditions towards 30 ka. Unfortunately, due to the lack of high resolution paleoclimatic records in this region, it is difficult to correlate the pedogenic developments of these soils with climatic fluctuations during the Pleistocene.

Conclusions

Middle Paleolithic sites in our study area are affected by intense erosion and recent human activities. Nonetheless, large amounts of Mousterian lithics occur in association with Red Mediterranean soils in close proximity to flint sources, and springs. Geomorphological and soil stratigraphy research in our surveys has helped us develop a predictive model for the location of Middle Paleolithic sites on the Mādabā Plateau.

In the Wādī al-Kawm Area, concentrations of Mousterian lithics occur on plateaus and high alluvial terraces where red Mediterranean soils have been reduced by deflation, sheet erosion, and plowing. The sites of the western edge of the Mādabā Plateau present also alterations of the tops by plowing, but in general soil erosion has been less intense than in the Wādī al-Kawm area.

Most of the sites in the surveyed area are near or on surfaces formed by the Amman Silicified Limestone and the Wadi al-Ghudran Limestone, two of the Cretaceous formations with abundant nodules and veins of flint.

Caves and rock shelters are abundant in the two areas, but none of the surveyed localities presented evidence of Middle Paleolithic occupations. This is apparently the result of washing of sediments by erosion and transformation by shepherds. This, however, does not undermine the possibility that caves and rock shelters containing Middle Paleolithic deposits exist.

Optically Stimulated Luminescence helped place the lithic material and the pedogenic features of deposits in a time bracket. Abundant Middle Paleolithic materials are associated with the Last Interglacial (120-130 ka) or marine isotopic stage 5e. The subsequent stages present variable amounts, suggesting perhaps some relation with the climatic fluctuations associated with the first half of the glaciation. OSL dates from deposits in the Mā'īn Site Complex show deposits with Middle to Upper Paleolithic transitional material, which presents an important source of information not only on the cultural transition, but also on the climatic changes associated with it.

Research Status and Future Development

Our next efforts in the area of geoarchaeology will include the study of cave taphonomy, particularly in the case of the cave breccia deposits, which at this point seem to be the most promising venues for finding stratified Middle Paleolithic deposits. During our next field season we will also excavate the WZM-2 site and map in detail the Mā'īn and al-Ḥimma site complexes.

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