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The stratigraphy and paleogeography of the Middle Paleolithic open-air site of 'Ein Qashish, Northern Israel

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ABSTRACT

The Middle Paleolithic site of 'Ein Qashish is located on the floodplain of the Qishon stream, northern Israel, which drains into the Mediterranean Sea. It is located at the inlet to a narrow water gap between Mt. Carmel and Tiv'on Hills. The excavation and 3 trenches up to 5 m deep provide the stratigraphy and allow a reconstruction of the paleogeography and depositional environments. The archaeological layer, OSL dated to about 64 ± 4 ka, is composed of carbonate gravel and overlies 66 ± 4 ka (MIS4) black, heavy alluvial clays deposited by the Qishon Stream, which represents marsh environment. The site is covered by another clay unit, representing a second marsh period between 50 ± 3 and 41 ± 3 ka (MIS3). This sedimentary complex is unconformably covered by coarse gravel and reddish clay matrix, dated to between 15.1 ± 0.7 and 10.5 ± 0.5 ka, which is derived from Wadi Qashish – a steep mountainous stream of Mt. Carmel. The mineralogical analyses of the clays indicate high quartz concentrations and smectitic IS, which support the interpretation of Qishon basin origin, versus illitic IS from Mt. Carmel slopes.

The duration of the prehistoric human activity is estimated at <10 kyr, during which the Qishon stream transported fine clay by relatively low-magnitude flows over a relatively stable floodplain. The site is located over the toe of the gravelly alluvial fan of Wadi Qashish. During the end of the Pleistocene to the Holocene, the site was covered by coarse gravel from Mt. Carmel alternating with fine clay sediments of the Qishon stream.

Sea level during the occupation period was between 100 and 60 m b.s.l. and the coastline was located 10–7 km westward. The proposed mechanism for the marsh development is: (a) repeated episodes of blockage of the Qishon stream outlet at the narrow water gap by aeolian sand transported by westerly winds inland over the exposed continental shelf. The accumulation of sand and sandstone over the coastal plain during this period supports this idea.

(b) Based on hydrological correlation with the Lake Lisan Levels the flows in the Qishon stream were low with large component of baseflows characterizing warmer and wetter periods that could not cut through the sand blockage and forced the water upstream into marshes. The marshes drained during the colder and drier Heinrich events H6/H5a and H4 which were characterized by higher frequency of large floods.

1. Introduction

Mt. Carmel and its immediate surroundings has been a focal geographic region of prehistoric research in the Levant. A century of work has revealed the existence of numerous caves and open-air sites, many of which contained material culture records associated with the Middle Paleolithic (MP) period (Garrod and Bate, 1937; Ronen and Olami, 1978; Olami, 1984; Lengyel, 2007; Nadel et al., 2008). Whereas the MP cave sites of Mt. Carmel are well known and are considered among the most important archaeological sites in Eurasia, less attention was given to MP open-air sites. In part, this was due to the lower visibility of open-air sites on the modern day landscape, but also to the difficulties in establishing chronological controls in the absence of deep stratigraphic sequences and suitable dating methods. The early excavations of MP open-air sites have concentrated on the coastal plain, where sites could potentially be related to the dated sequence of changing sea levels (Hovers, 2009: appendix 1). Therefore, sites located inland,

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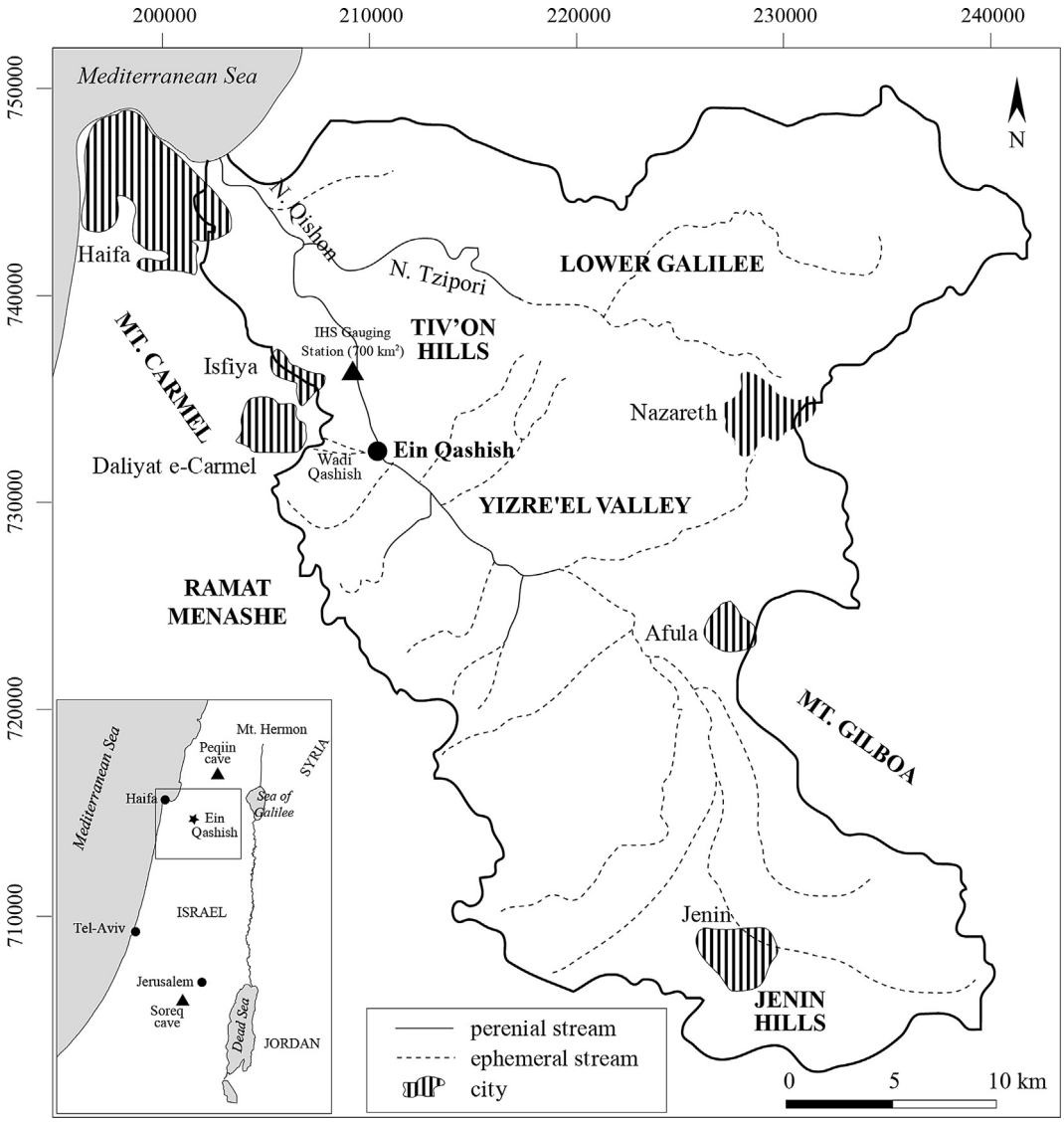

Fig. 1. Location map and drainage basin of the Qishon stream including channel network, cities, geographic regions, hydrometric station and the 'Ein Qashish MP open-air site.

even if known through surveys, have been studied more sporadically. The broadening of the scope of MP research from chronological and stratigraphic frameworks to behavioral questions, coupled with improvements in dating techniques and the resolution of field and laboratory analyses, has recently allowed researchers to focus more closely on open-air sites as important sources of information about land use and subsistence behaviors of MP hominins outside their cave sites. Located at the geographic center of the main MP cave sites of Mt. Carmel and the Galilee, the site of 'Ein Qashish is of special interest in the wider perspective of the prehistory of the region.

Open-air sites are an integral part of the landscape on which they are situated. Contrary to cave sites, which are special sheltered places with obvious advantages to hominins as habitation sites (protection, and recognizable spots that can be occupied repeatedly), the appeal of open-air sites or the nature of activities carried out in them are not always readily clear from their location on the modern landscape. To glean some understanding of these aspects, it is necessary to reconstruct the past geographical and environmental settings at the time of site use, which influence the nature of activities on-site and in turn, shape the natural processes affecting the site during and after occupation. In this paper, we present the paleoenvironmental reconstruction of the site of 'Ein Qashish, given its specific location at the foot of Mt. Carmel and in proximity to the Qishon stream and the Mediterranean coast. Based on stratigraphic and dating considerations, we identify cyclic changes from marshy to alluvial fan sedimentological regime during the late Pleistocene to the early Holocene at the site and in its close vicinity. The dynamics of the depositional processes and events in the area of 'Ein Qashish are evaluated in the context of the broader paleoenvironmental and climatic records in Israel, and the northern coastal plain in particular.

Continuous paleoclimatic records for the late Pleistocene in the region are derived mainly from oxygen and carbon isotopes from speleothems in caves (Frumkin et al., 1999, 2000; Bar-Matthews et al., 2003; Grant et al., 2012; Ayalon et al., 2013) indicating changes in temperatures. The $\delta^{18}O$ values of present cave waters and annual rainfall serve as calibration for past $\delta^{18}O$ values and enable estimates of past mean annual rainfall (Bar-Matthews et al., 2003). The Dead Sea, a terminal lake to the lower Jordan River, which is sensitive to climatic-related hydrological fluctuations, serve as a continuous hydrological record (Klein, 1986; Machlus et al., 2000; Bartov et al., 2002; Bookman et al., 2006). This 70 ky-long hydrological record was correlated to worldwide oxygen