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Research Paper

The chronology of the late Lower Paleolithic in the Levant based on U–Th ages of speleothems from Qesem Cave, Israel

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ABSTRACT

We present here the results of a U–Th dating project at Qesem Cave, a Middle Pleistocene, late Lower Paleolithic site in Israel. It provides 54 new MC-ICP-MS U–Th ages for speleothems from the cave. The results indicate that human occupation started sometime between ~420 and 320 ka and ended between 220 and 194 ka. A survey of dates from culturally similar sites in the Levant indicates that the general range of ca. 400–ca. 200 ka is an appropriate estimate for the life span of the Acheulo-Yabrudian Cultural Complex (AYCC).

1. Introduction

Qesem Cave was discovered on October 2000 following road construction, east of Tel-Aviv (Fig. 1) and assigned to the Acheulo-Yabrudian Cultural Complex (AYCC) of the late Lower Paleolithic. Stratigraphically, the Acheulo-Yabrudian complex of the Levant repeatedly appears above Lower Paleolithic Acheulian and below Middle Paleolithic Mousterian. Acheulo-Yabrudian sites are known from the central and southern Levant in caves and open air sites (Fig. 1). The AYCC was defined by Rust (1950) and is comprised of three major industries – Acheulo-Yabrudian, Yabrudian and Pre-Aurignacian/Amudian (Garrod, 1956, 1970; Jelinek, 1982, 1990; Bar-Yosef, 1994; Goren-Inbar, 1995; Copeland, 2000; Ronen and Weinstein-Evron, 2000). Two of its industries are noteworthy; the Yabrudian dominated by Quina scrapers; and the Amudian dominated by blades and shaped blades (tools).

The chronology of the AYCC was discussed by Bar-Yosef (1998), Copeland (2000) and Mercier and Valladas (1994, 2003). U-series, TL and ESR available ages indicate that the earliest dates for the Acheulo-Yabrudian are ca. 400 ka (Barkai et al., 2003; Rink et al., 2004; Le Tensorer et al., 2007a). The end of the AYCC is considered to be ca. 200 ka (Barkai et al., 2003; Le Tensorer et al., 2007a), although early work has indicated dates up to ~150 ka (e.g. Schwarcz, 1980; Grün et al., 1991; Farrand, 1994; Grün and Stringer, 2000; and see also Valladas et al., 1998).

The time span between 400 and 200 ka is an important chapter in the cultural and biological evolution of humans. This period includes early signs of, what is referred to in recent years as, modern human behavior. This pertains to behavioral patterns that are well established at Qesem Cave such as blade production – this is the dominant lithic technology throughout the Qesem Cave sequence (Gopher et al., 2005; Barkai et al., 2005); the habitual use of fire – exhibited at Qesem Cave (Karkanas et al., 2007); spatial activity patterning – apparently well established for Qesem Cave (Barkai et al., 2009); systematic hunting and butchering techniques and unique meat sharing habits (Stiner et al., 2009). Nothing is known of the hominids preceding the appearance of

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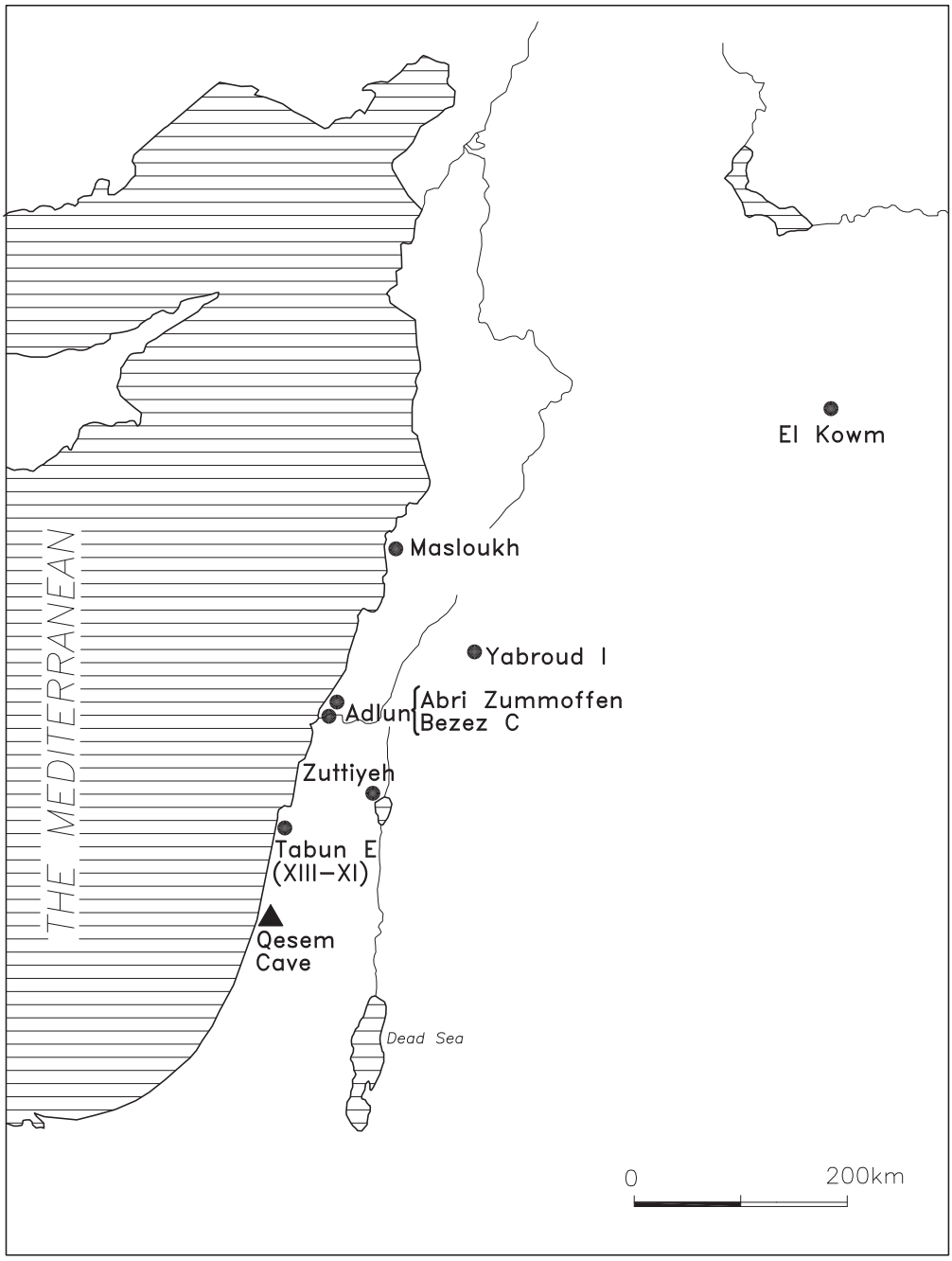

Fig. 1. Location map showing Qesem Cave and other AYCC sites mentioned in text.

Homo sapiens and the Neanderthals in the Near East, and a secure chronological framework for human remains at Qesem Cave (only teeth remains have been found so far) may be an important landmark en route to a better understanding of the evolution of modern humans. The dating of such an exceptionally well-preserved site of this age by U-series methods and additional methods (TL and ESR, currently underway) contributes significantly to better understanding of Middle Pleistocene human evolution.

A pilot U–Th speleothem dating project for Qesem Cave using thermal ionization mass spectrometry (TIMS) yielded 8 ages and indicated a general range between ca. 380 and 200 ka (Barkai et al., 2003). It was conducted during the preliminary stages of investigation at Qesem Cave and was limited in scope, focusing on only 8 samples extracted from one part of the cave. Despite these limitations, a comparison between archaeological finds and available absolute ages from Qesem Cave and from other AYCC sites supported this age range (Gopher et al., 2005).

To further constrain our understanding of the nature and timing of human adaptation and evolution during this important period, a series of field seasons were undertaken at Qesem Cave after 2004, in parallel with a continued program of U-series dating. Recent developments in our understanding of the site have emerged that require chronological constraint: (1) the recognition of two industries of the AYYC – the blade-dominated Amudian and the Quina scrapers dominated Yabrudian; (2) reassessment of the general stratigraphy and sedimentology (Karkanas et al., 2007) and the complex processes within the cave (Frumkin et al., 2009); (3) the discovery of human teeth in many different contexts throughout the caves sedimentological column.