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Paleolithic caves and hillslope processes in south-western Samaria, Israel: Environmental and archaeological implications

Amos Frumkin [a,*], Boaz Langford [a], Ofer Marder [b], Micka Ullman [a]

[a] Israel Cave Research Center, The Hebrew University of Jerusalem, Jerusalem, 91905, Israel
[b] Archaeology Division, Ben-Gurion University of the Negev, POB 653, Beer Sheva 84105, Israel

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ABSTRACT

South-western Samaria is emerging as a major province of Paleolithic cave sites. Most recently discovered caves have been naturally filled with terra-rossa type colluvial deposits when the hillslopes above the caves were stripped from vegetation during late Quaternary times. Site formation processes differ significantly between caves with pit-like openings, such as Qesem, Emanuel, and Rantis caves, vs. those with cliff-side entrances, such as Shukbah, Tinshemet, and Deir Kaddis caves. The former favored accumulation of colluvial debris, while the latter were relatively protected from these deposits. Caves discovered in the 20th century were mainly of the latter, cliff-face type, while in the 21st century new discoveries commonly occur where construction works intersect previously unnoticed filled caves.

1. Introduction

Caves have been a major source of information about Paleolithic life. This is due to both preferences of prehistoric populations as well as to inherent research biases. The preference of particular caves within a hominin group's territory involved a system of decision-making based on selection criteria. Some caves were used as a home base or as central activity sites, while other, commonly smaller caves were used ephemerally (Bar-Yosef and Belfer-Cohen, 1988; Ullman et al., 2013). Such choices created long-term material culture records that sampled a broad range of social, economic and technological behaviors of Paleolithic hominins (Hovers and Belfer-Cohen, 2013; Sharon et al., 2014). The use of caves has become part of the habitual behavior of hominins only during the late Early and Middle Pleistocene: rarely during the Late Acheulian, and increasingly frequently during the Acheulo-Yabrudian and Mousterian (Hovers, 2001; Goldberg and Bar-Yosef, 2005; Gopher et al., 2010).

There are many examples of archaeological sites which were buried or deformed by hillslope processes such as mass-wasting (Waters, 1992; Goldberg and Bar-Yosef, 1995; Field and Banning, 1998; Butzer, 2005). During recent years previously unknown Paleolithic caves are discovered (e.g. AmE-15 Cave, Ullman et al., 2013; Ureide Cave, Davidovich, 2015). Some newly discovered caves contain archaeological and archaeozoological evidence indicating previous access to the cave from the surface, followed by blockage of the entrance by colluvial sediments (e.g. Manot Cave, Marder et al., 2013; Hershkovitz et al., 2015). Such modifications can indicate changes of surface processes such as hillslope erosion and accumulation. Normally, hillslope erosional history is difficult to decipher as most of the material is washed down, accumulating in the foot of the slope. Understanding prehistoric land-use decisions and human use of such caves depends on our knowledge of mass-wasting processes during and after the phases of occupation.

The life of a cave ends either by complete filling, collapse, or both. In the 20th century, prior to recent intensive construction works, filled caves were rarely observed. An example of a naturally breached cave with archaeozoological remains is the mid-Pleistocene Bear's Cave in northern Israel (Tchernov and Tsoukala, 1997). The remains of the cave, cut by natural subaerial denudation, included deposits of stalagmitic breccia and carnivore remains. Recent finds discussed here indicate that the distribution of filled caves is more significant than previously assumed.

While rapid and total filling by colluvium is possible in a cave with a large opening at a hillslope, caves whose only opening is in a vertical cliff may be better protected from hillslope mass-wasting processes. Such a cave with an inward inclination of the floor may accumulate thick anthropogenic deposits, e.g. Tabun and Hayonim caves. The cliff also protects the cave entrance from the elements, such as rainfall, wind and sunshine. Consequently, most studied Paleolithic caves are located in cliff-faces (Ullman et al.,

* Corresponding author.
E-mail address: amos.frumkin@mail.huji.ac.il (A. Frumkin).

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2013). When denudation opens a hole, or chimney, in the roof of such caves, colluvial filling can be enhanced.

Here we demonstrate that the recently studied province of south-western Samaria emerges as a major location of karstic and Paleolithic caves, comparable with Mt. Carmel and Galilee (Fig. 1). The sediments within Paleolithic cave sites of south-western Samaria are briefly reviewed, based on literature and field observations before and during the excavations of the 21st century. One of the Paleolithic cave sites (Deir Kaddis Cave) is presented here for the first time. Post-occupation site formation processes associated with subaerial mass-movement are discussed. The focus here is the filling of caves by colluvial terra-rossa, and their relation to cave setting. We investigate to what degree the unfilled caves became primary targets for prehistoric studies due to their present-day visibility. The future potential of finding caves in similar morpho-climatic setting is evaluated.

2. Regional setting

The studied sites are located on low limestone hills forming the transition from the coastal plain in the west to the Samaria ridge in the east (Fig. 1a). Structurally the region is within the western flanks of the Ramallah anticline (Fig. 1b), where the sedimentary bedrock layers commonly dip gently to the west. Bedrock is mostly composed of well-lithified, massive karstic carbonates of the upper Judea Group, formed mostly in the shallow epicontinental southern Tethys Ocean of the late Cretaceous (Sass and Bein, 1978). The upper Judea Group is commonly karstified within south-western Samaria (Frumkin and Fischhendler, 2005; Frumkin and Gvirtzman, 2006; Frumkin et al., 2009). Paleokarstic dolines filled with sand and Senonian marine sediments (Livnat, 1971) indicate that karstification initiated already during the late Turonian to early Santonian, when the area emerged episodically above sea level. The Senonian transgression covered the entire area with chalk, which was later mostly eroded except in limited areas such as paleo-dolines, structural lows, and the vicinity of Shechem syncline. During the mid-to late Cenozoic the entire ridge was finally uplifted above sea level, promoting further karstification. Since the late Miocene the area has been exposed subaerially, promoting erosion, deposition of conglomerates, and karst denudation (Dimant, 1971; Livnat, 1971; Fischhendler and Frumkin, 2008). Uplift and tectonic tilting during the early Pleistocene was followed by erosional entrenchment of stream valleys prior to human occupation of the prehistoric caves (Ryb et al., 2012).

Regional drainage comprises fluviokarst-type ravines flowing generally westward, to the Mediterranean Sea. Today the climate is dry Mediterranean, with moderate cool rainy winters and dry, hot summers. Mean annual precipitation is ~600 mm, potential

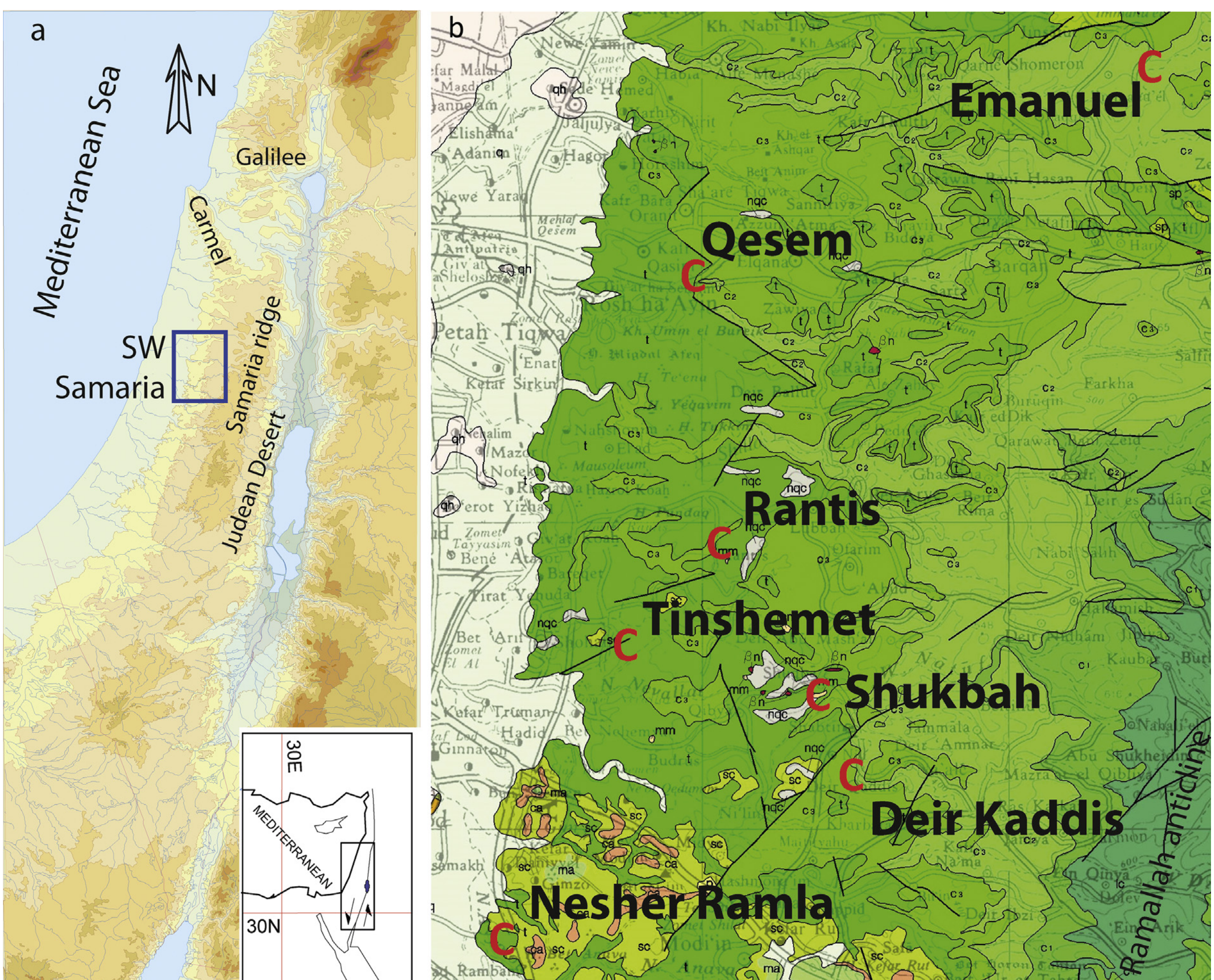

Fig. 1. Location map. a. South-western Samaria caves province in relation to other major prehistoric caves provinces of Israel on a topographic map. b. South-western Samaria caves discussed in this paper (location indicated by C), together with Nesher-Ramla site whose cave has collapsed prior to human habitation. Geological map (courtesy Geological Survey of Israel) shows that the studied caves are within late Cenomanian (C_3) to Turonian (t) Age marine carbonates.