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The Younger Dryas black mat from Ojo de Agua, a geoarchaeological site in Northeastern Zacatecas, Mexico

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ABSTRACT

New explorations in the desert of northeastern Zacatecas, in central-northern Mexico, revealed dozens of archaeological and geoarchaeological sites. One of them, Ojo de Agua, contains the remains of a Pleistocene spring-fed hydrographic system located at the southeastern end of a large elongated endorheic basin. The locality yielded a particularly dark, highly organic stratigraphic layer commonly known in the Americas as Black Mat (BM), exposed on the natural profiles of a creek, but not associated with cultural materials. Several radiocarbon assessments confirmed the formation of the Ojo de Agua Black Mat during the Younger Dryas chronozone, with ten calibrated results clustering between 12,700–12,100 cal BP. This multi-proxy study confirmed the peculiarity of the deposit and found similarities and differences with other contexts of Younger Dryas age. The Ojo de Agua Black Mat (stratum C2) is far richer in charcoal specks than the related strata, but lacks phytoliths, diatoms or ostracods. No further biological remains were found in it, except for intrusive capillary roots. Clearly water-lain in a shallow pond, the stratum qualifies as a clayey silt with an acidic-to-neutral pH. Rich in heavy metals and with high contents of titanium, the Ojo de Agua Black Mat yielded significant indicators of intense wildfires during the Younger Dryas, but produced no carbon spherules or nanodiamonds supposedly linked to the impact theory.

1. Introduction

The archaeology of early prehistoric occupations faces evident difficulties when working in regions with no previous geoarchaeological work, like northern Zacatecas, Mexico. Lacking chronostratigraphic markers for key Quaternary geo-climatic events is working in darkness, especially during initial archaeological surveys. Without investing time and resources in dating methods, it is still difficult to recognize the Pleistocene-Holocene transition on stratigraphic profiles, visually. Learning to read the end of the Ice Age when working in the field means learning where to look for early human occupations. But can systematic

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exploration identify reliable chronostratigraphic markers of regional validity, able to discern between Pleistocene and Holocene deposits and guide future geoarchaeological research in the region? Our working hypothesis departed from a positive answer.

This paper reports the discovery of a black mat layer of Younger Dryas age in Mexico, derived from geoarchaeological investigations conducted within a large-scale project directed by the first author, in a remote and never-studied-before region in the northeast of the State of Zacatecas, Northern Highlands, on the Tropic of Cancer (Fig. 1). Since 2010, the project focused on an area with high potential for the study of hunter-gatherer societies, cultural diversity and geo-climatic dynamics along the Pleistocene-Holocene continuum (Ardelean, 2013; Ardelean and Macías-Quintero, 2016; Macías-Quintero, 2017). Intentionally looking for easy-to-see potential stratigraphic markers on naturally-formed profiles, the explorers discovered a black silty layer commonly known in Americas as "black mat" (BM).

Recent investigations pointed at specific stratigraphic and pedogenic horizons related to the Pleistocene-Holocene transition in the north, west and center of the country, but those layers could only reveal their chronological relevance after specialized laboratory analyses, lacking the physical attributes of a good visual guide for archaeologists (see paleosols in Sonora, northwestern Mexico; Cruz-y-Cruz et al., 2014, 2015). A batter case has been recently presented by Israde-Alcántara et al. (2017), with several dark-colored strata found in different regions of Mexico, dating to the Younger Dryas chronozone, some of them qualifying as black mats themselves. The sound investigations recently undertaken at the Clovis-age archaeological site of El Fin del Mundo in Sonora and neighboring areas yielded many relevant aspects of archaeological and geoarchaeological relevance, such as diatomite layers with organic lenses, but not a proper stratum similar to a black mat (Sánchez et al., 2014).

Since the original discovery at the Murray Springs archaeological site in Arizona (Haynes and Huckell, 2007), black mats used to be perceived as an ideal stratigraphic indicator for the end of the Pleistocene and an argument in favor of a global manifestation of the Younger Dryas. Although several authors showed that black mats could reflect diverse events from very different moments during the Quaternary (Quade et al., 1998; Pigati et al., 2012; Harris-Parks, 2014), many archaeologists understood them as synonymous to Younger Dryas. When Ardelean and Macías-Quintero first saw the black stratum at Ojo de Agua in 2010, they felt they had discovered the first "proper" BM in Mexico and a recognizable chronostratigraphic marker for the Pleistocene-Holocene transition.

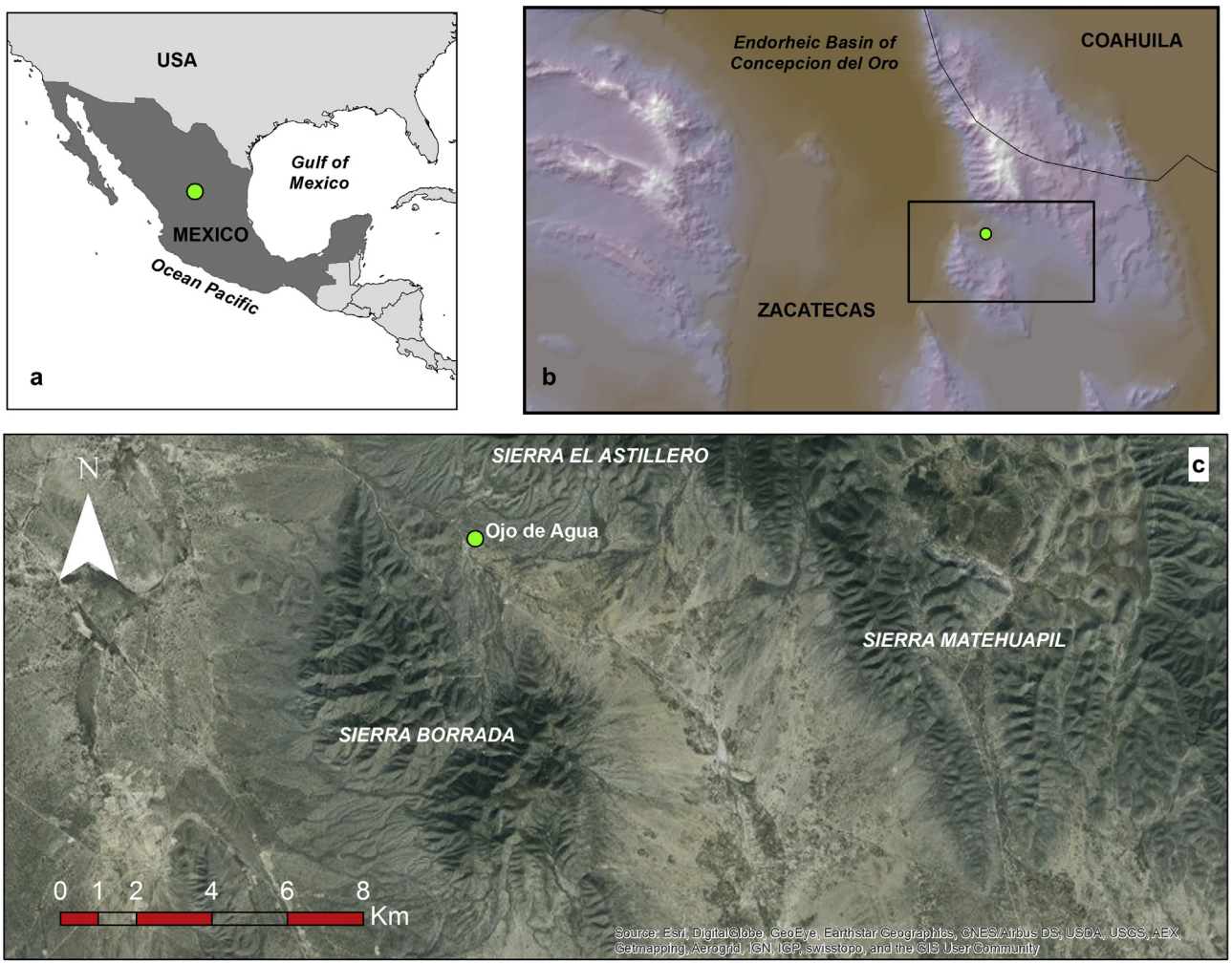

Fig. 1. Location map. The site is situated in the central-northern region of Mexico, in the northeast of the State of Zacatecas, less than 100 km north of the Tropic of Cancer (a). The Pleistocene spring-and-pond system of Ojo de Agua lies in the highlands closing the southeastern end of the Concepción del Oro endorheic basin (b), in a narrow passage between two *sierras,* El Astillero and Borrada (c).

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