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Characterization of a rapid climate shift at the MIS 8/7 transition in central Spain (Valdocarros II, Autonomous Region of Madrid) by means of the herpetological assemblages

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ABSTRACT

Climate instability with high-amplitude and rapid shifts during the Middle Pleistocene is well known from pollen records and deep-ocean sediment cores. Although poorly correlatable with such long climate/environment records, the successive fossil amphibian and reptile assemblages from the Middle Pleistocene site of Valdocarros II (Autonomous Region of Madrid, central Spain) provide a unique opportunity to characterize the climatic and environmental features of such rapid (certainly less than 1000 years) shifts from cold to warm conditions in a terrestrial sequence. As the amphibians and reptiles do not differ at species level from the extant herpetofauna of the Iberian Peninsula, they can contribute to the reconstruction of the landscape and climate. In this paper, the mutual climatic range and habitat weighting methods are applied to the herpetofaunistic assemblages in order to estimate quantitative data. The difference in mean annual temperature between "cold" and "warm" periods is estimated at 3.2 °C, with a greater increase in temperature during winter (+3 °C) than during summer (+1 °C). During "cold" periods the climate was more Oceanic (although preserving some dryness during the summers), whereas during "warm" periods the climate became Mediterranean (with mild winters and a long period of dryness in the summer and early autumn). Though higher during cold periods, the continentality (or atmospheric temperature range) remained roughly similar, in accordance with the geographical location of the site in the centre of the Iberian Peninsula. A greater amount of open landscape occurred during "cold" periods, whereas during "warm" periods the wooded areas expanded from 20% to 40% of the landscape surface. Such climatic/environmental changes, together with the numeric datings of the site, suggest that this shift may correspond to the transition from MIS 8 to MIS 7, also called Termination III.

1. Introduction

The pattern of the varying climatic conditions (deduced from the vegetation development) in southern Europe over the last 450 ka is well known from the long pollen records that have been produced for sedimentary sequences from Greece, Italy and off Portugal (Wijmstra, 1969; Wijmstra and Smit, 1976; Follieri et al., 1998; Tzedakis et al., 1997, 2003, 2006; Roucoux et al., 2006). These sequences have revealed a pattern of forested intervals alternating with periods characterized by more open vegetation, varying on time scales of 10^4–10^5 years that represent a response to the Milankovitch-driven global climatic changes recorded in marine isotope records of global ice volume (Roucoux et al., 2006). Moreover, deep-ocean sediment cores have provided more quantitative and better-dated evidence for temperatures and total ice volumes (McManus et al., 1999). Both pollen records and ocean sediment cores have evidenced various abrupt and strong climatic and environmental shifts (Roucoux et al., 2006). Because of their incompleteness and dating uncertainties, the correlation and comparison of paleoecological proxies from archaeological sites with long and detailed pollen or marine records is far from easy. However, paleoecological reconstructions from archaeological sites

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are useful in that they are often the only way of knowing how the fauna was linked with the climate at a particular moment and also of putting the hominin activities in their environmental and climatic context. Here we show for the first time that fossil herpetological assemblages can be used to demonstrate such abrupt shifts and to characterize them quantitatively in terms of landscape, temperature and rainfall.

2. Geological and chronological setting

Geologically, the study area is in the middle stretch of Jarama River. This valley section lies in the continental Tertiary basin (Madrid Basin), in the area of transition between intermediate detritic facies (gravels and sands) and central facies (marls to evaporite-gypsum). The development of terraces was controlled, during the Middle-Upper Pleistocene, by synsedimentary subsidence due to the karstification of the evaporite bedrock. This process has led the development of terraces with alluvial thickness of over 50 m (Pérez-González, 1971; Uribelarrea, 2008). Over detritical facies, a total of nineteen stream terraces have been identified, since +8 m to +190 m (Pérez-González, 1994). Downstream, over evaporitic bedrock, fluvial terraces below +40 m are overlapped, forming the so-called complex terrace of Arganda (CTA). Synsedimentary subsidence in CTA has favored the development of overbank facies and the preserving of tens of archaeological sites. CTA is composed by four well defined beds, from older to younger, Arganda I, II, II and IV (Pérez-González, 1971).

Valdocarros unit represents a widespread unit of overbank facies in Arganda II. It is formed by fine layers of silty-clay, few centimeters thick and hundreds of meters in lateral extend (facies Fl and Fm). These fine-grained deposits were sedimented in low-energy environments, including ephemeral sheet floods and more permanent floodplains ponds.

The archaeological site (Valdocarros-II) is located in an abandoned meander of the Valdocarros unit (Fig. 1). Amino-Acid Racemization have been made in the Laboratory of Biomolecular

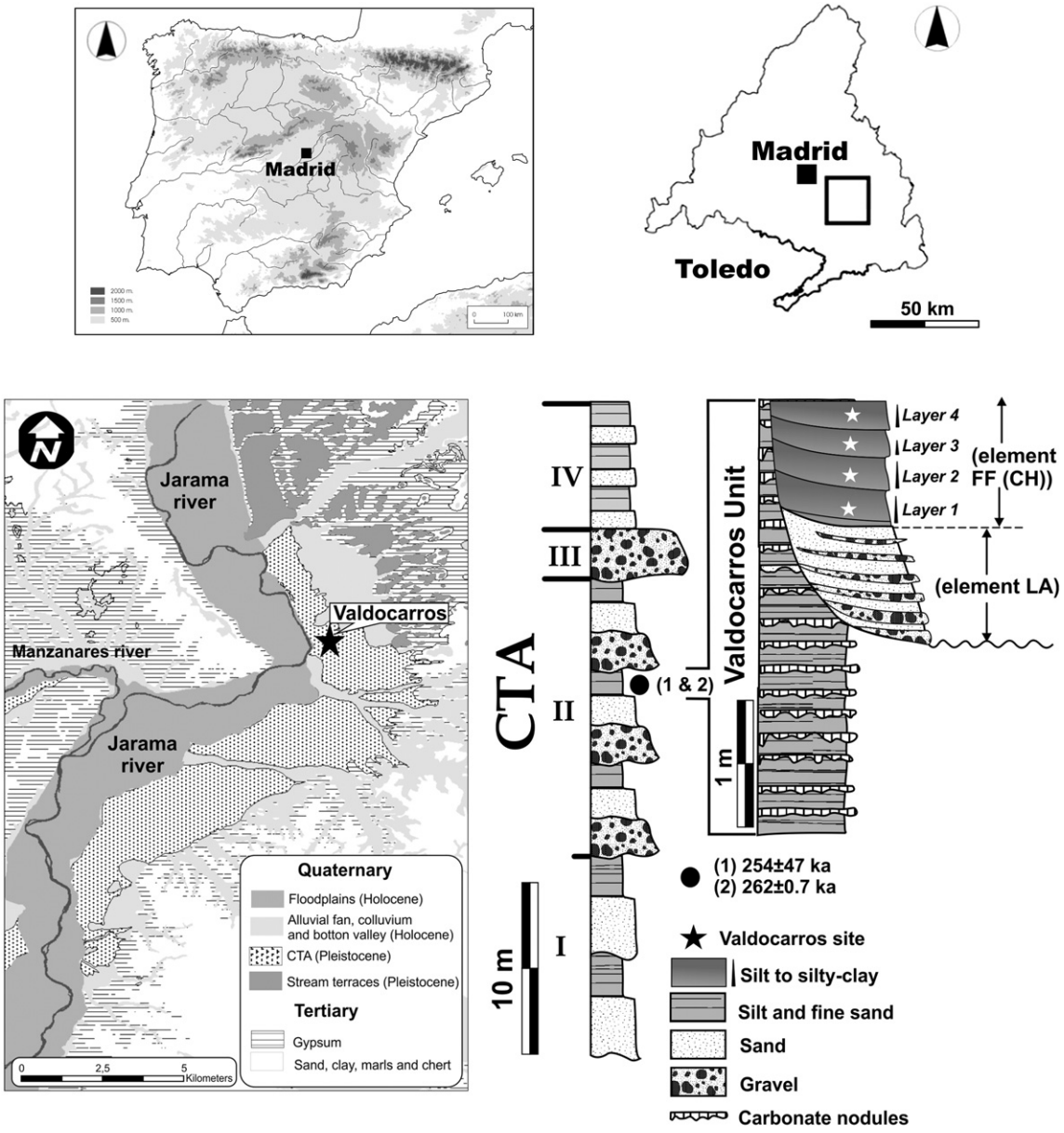

Fig. 1. Geographical, geological and chronological location of Valdocarros site (Autonomous Region of Madrid, central Spain).