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The reconstruction of past environments through small mammals: from the Mousterian to the Bronze Age in El Mirón Cave (Cantabria, Spain)

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ABSTRACT

El Mirón is a large cave in the Cantabrian Cordillera of northern Spain that presents a long archaeostratigraphic sequence radiocarbon-dated by over 60 assays to between 41,000 and 2000 BP. The sediments, collected from four areas within the cave and sieved-washed with fine wire meshes, contain microvertebrate remains of fish, frogs, lizards, birds and mammals, of which the latter are most abundant. Preliminary taphonomic analysis suggests that the microvertebrates were naturally collected by owls and (less) small carnivores. Small mammal assemblages are useful for palaeoenvironmental reconstruction because they are linked to particular habitats and are sensitive to environmental changes. The small mammals from El Mirón are ideal for this because sample sizes are large, bone preservation is good, and the stratigraphic sequence is long. In this paper we reconstruct the late Quaternary environments in the Cantabrian region of Spain using small-mammal assemblages from El Mirón Cave. On the basis of the ecologic adaptations of this suite of fauna, the majority still extant, we have identified seven habitat types, which are plotted through time. The evolution of the small mammal assemblages at El Mirón reveals seven major climatic shifts that correspond closely to the climatic changes recognized in the Iberian Peninsula during the last 41 kyr.

1. Introduction

One of the key objectives of faunal study in archaeostratigraphic sequences is the reconstruction of landscapes humans have inhabited. Changes in the environment greatly influence the amount and nature of the natural resources that humans exploit. Palaeoenvironmental studies rest on the assumption that changes in vegetation and small mammals can be correlated with environmental and climatic changes (Bertolini et al., 1996; Cuenca-Bescós et al., 2005; Flynn, 2003; Pokines, 1998; Repenning, 2001). Most aspects of the physical environment that are important to organisms are ultimately regulated by climate (Barnosky, 1994; Grayson, 2000). For example, climatic and environmental factors may have caused the extinction of archaic human groups, such as the Neanderthals during the Palaeolithic (Finlayson et al., 2006; Hockett and Haws, 2005; Jiménez-Espejo et al., 2007). For this reason and given the increasing concern about the future of humanity in the context of climate change, there is a profuse literature on the global and local climatic shifts of the last thousand years (Davis et al., 2003; Heinrich, 1988; Indermuhle et al., 1999; Johnsen et al., 1992; Pérez-Folgado et al., 2003, Sánchez Goñi and d'Errico, 2005, among many other authors).

Long Pleistocene-to-Holocene continental sequences are rare in the Iberian Peninsula. El Mirón is one of the few instances in which there is a long, nearly continuous, cultural sequence, with extensive and controlled excavations, and abundant ^{14}C dates (Straus and González Morales, 2003, 2007) for the Pleistocene/Holocene boundary. The aim of this work is, with the information recovered thus far, (1) to document the small-mammal contents of one of the longest late Quaternary sequences in Spain; (2) to establish the biostratigraphic last-appearance data of certain Pleistocene taxa (meaning local or global extinction); (3) to identify faunal changes that occur in the El Mirón sequence; (4) to reconstruct palaeoenvironmental and climatic changes across the late Pleistocene and Holocene of the El Mirón sequence that may correlate with the climatic events occurring during the last 41 kyr in the Iberian Peninsula; and (5) to ascertain the possible relation

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between human activity and environmental change during this period.

2. El Mirón Cave

El Mirón is a large cave in the Ason River Valley of the Cantabrian Cordillera of northern Spain (Fig. 1A). The cave sediments form a long archaeostratigraphic sequence radiocarbon-dated by over 60 assays to between 41,000 and 2000 years BP (Straus and González Morales, 2001a,b; 2003, 2007). Excavated strata are attributed to the late Mousterian, initial Upper Palaeolithic, Solutrean, Lower, Middle and Upper Magdalenian, Azilian, Mesolithic, Neolithic, Chalcolithic and Bronze Age periods. The cave is in the Urgonian (Cretaceous) limestone from which the extensive Monte Pando karstic system is developed (Marín Arroyo et al., 2007). Monte Pando is known for its cave art and living sites (Straus et al., 2006). The cave lies in the midst of mountains reaching up to or above 1000 m above present sea-level (a.p.s.l.). During the late Last Glacial, it was 5–10 km farther from the Atlantic shore than it is now (25 km). The huge mouth of the cave faces west and is around 260 m a.p.s.l. The cave has been used fairly continuously by humans, at least since the Mousterian (Altuna et al., 2004; Marín Arroyo, 2007; Marín Arroyo et al., 2007; Straus et al., 2006).

The stratigraphy and radiocarbon dates of the El Mirón sequence have been extensively described elsewhere (Courty and Vallverdu, 2001; Cuenca-Bescós et al., 2008; Straus and González Morales, 2001a,b, 2003, 2007; Straus et al., 2002). The stratigraphic studies reveal that the main source of sediments in the vestibule is the colluvial-alluvial slope at the edge of the inner cave (Fig. 1B). In addition to cryoclastic and gravity-caused rockfall and calcium carbonate precipitation from the limestone, micromorphological studies reveal the input of some allochthonous materials (redeposited loess and soils), in addition to biogenic, avian and anthropogenic depositional contributions (Courty and Vallverdu, 2001). It is likely that violent erosional episodes (attested by very large water-worn cobbles in the colluvial slope deposit and by downward-trending grooves carved into the cave walls of that slope) not only cut a channel through the inner cave deposit (sampled by a trench across the mid-section), but also emptied much of the original vestibule infilling long before human occupation of the cave (Straus and González Morales, 2001a,b). The inner cave channel was subsequently refilled in part by deposits from the Magdalenian, Bronze and Middle Age cultural levels, while the vestibule has been partly refilled since Mousterian times—mainly with sediments ultimately derived from the ancient colluvium of the inner cave. The whole stratigraphic section comprises 65 levels (Cuenca-Bescós et al., 2008; Marín Arroyo, 2007).

3. Methods

3.1. Collecting methods

Of the 65 stratigraphic levels, microvertebrates were analyzed from 44 levels. As Table 1 reflects, the microvertebrate samples are representative of the faunal remains in the cave.

Since 1996, the three areas of the vestibule (Fig. 1B) have been excavated under the direction of Straus and González Morales. Around 3250 kg of bone-filled sediments were collected in 650 samples during the field work (see the distribution of samples in the sequence in Table 1). The sediment was washed through a series of graded sieves, from 2 cm to 1 mm, during the 1996–1998 and 2000 field excavations. Bones were later sorted directly from the residue in the laboratory. Fossils were picked without the aid of magnification from residues coarser than 1 cm. The rest were picked under a binocular microscope. The fossil remains of small mammals were sorted, taxonomically classified, and studied using the binocular microscope under magnifications of 7×, 20× and 40×. The majority of bones are isolated skull fragments, long bones and teeth. More than 100,000 fossil remains were sorted; of which 3196 were identified to the species level (see Table 1).

3.2. Taphonomy

Taphonomic factors may influence interpretations of past environments. One factor that may influence species composition and relative abundance at El Miron is the agent of deposition. Small predators likely sample the environment around the cave providing a more accurate picture of the local environment while larger predators might transport prey longer distances to the cave. One taphonomic issue of interest is the agent of bone deposition. Bone digestion and breakage patterns were examined to identify depositional agents based on the work of Andrews (1990), and Hockett (1996). Extensive bone taphonomic data is not presented here because it will be published in a separated paper (in preparation). A brief and preliminary summary of results of our taphonomic study indicate that the majority of bones are accumulated by a predator Type I in the classification of Andrews (1990), being thus an opportunistic rather than a selective hunter.

3.3. The minimum number of individuals

The Minimum Number of Individuals (MNI) was calculated on the basis of the numbers of lower first molars in the majority of the arvicoline rodents, and a diagnostic molar or some equally identifiable post-cranial element for the rest of the rodents (Muridae,

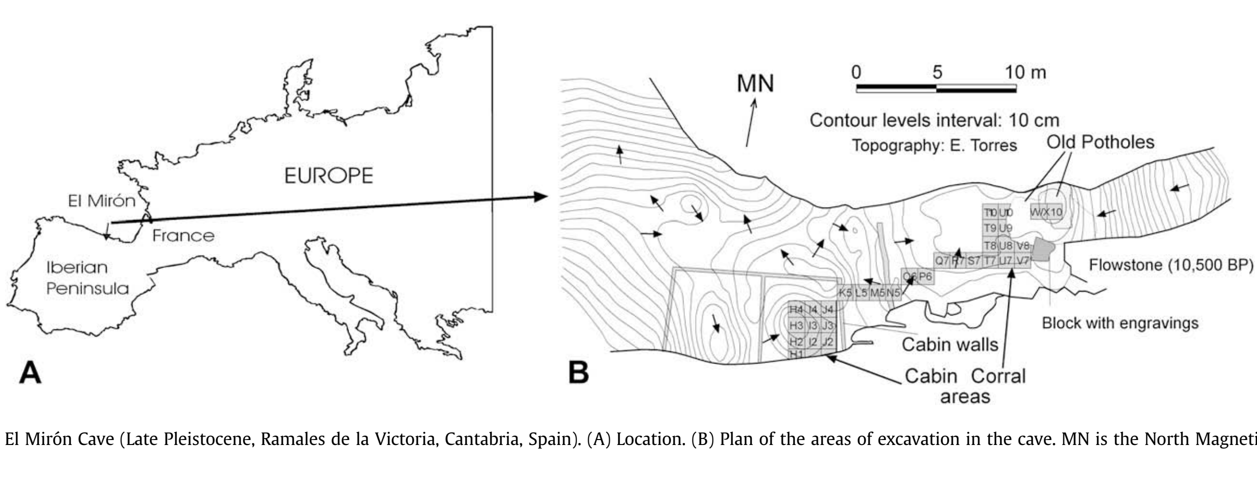

Fig. 1. El Mirón Cave (Late Pleistocene, Ramales de la Victoria, Cantabria, Spain). (A) Location. (B) Plan of the areas of excavation in the cave. MN is the North Magnetic Pole.