



## Review

## Chronological and environmental context of the Middle Pleistocene human tooth from Mollet Cave (Serinyà, NE Iberian Peninsula)

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## ABSTRACT

Mollet Cave is a small cave situated in Serinyà (north-east Iberian Peninsula). It was excavated in 1947–48, 1958 and 1972 by Josep M. Corominas. An archaic human molar comes from its base layer (Layer 5). Up till now, this layer has only been dated based on a relative and imprecise chronology of macromammals and the archaeostratigraphic evidence from the early excavations. Recent excavations, conducted between 2001 and 2005, have made it possible to ascertain more precisely the archaeological and palaeontological contents of Mollet Cave, gather microvertebrates, and collect samples for radiometric dating. The aim of this paper is to present the absolute dating of Layer 5, as well as its palaeo environmental and climatic characterisation. The macromammal assemblage seems to have been the result of accumulations produced by the most abundant carnivore, the hyena, which would have used the cave as a den. The results obtained using uranium-series disequilibrium dating ascribe to Layer 5 an age of ca. 215 ka (thousands of years ago), which would correspond to MIS 7. The faunal association suggests a landscape formed by an open and humid woodland characteristic of an interstadial phase, which would have been an environment well suited to sustaining both hyenas and human groups.

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## Introduction

In recent years, the findings of human fossils from the Middle Pleistocene of the Iberian Peninsula have increased greatly, though very much centred on the site at Atapuerca-Sima de los Huesos (Burgos), which is where most of the specimens come from (e.g., Arsuaga et al., 1993, 1997). Other sites are Atapuerca-Galería (Burgos) (Bermúdez de Castro and Rosas, 1992; Arsuaga et al., 1999; Rosas and Bermúdez de Castro, 1999), Bolomor (Valencia) (Arsuaga et al., 2001), Mollet (Girona) (Maroto et al., 1987; Cortada and Maroto, 1990), and very probably Lezetxiki (Basque Country) (Basabe, 1966; Arrizabalaga, 2006) (Fig. 1).

## Site description

Mollet Cave is situated at a latitude of 42° 09' 47" north and a longitude of 2° 44' 52" east, at an altitude of roughly 200 m above the sea level. It is located within the municipality of Serinyà, some 5 km to the north of the city of Banyoles (Girona, north-east

Catalonia, north-east Iberian Peninsula) (Fig. 1). It is a small cave (Fig. 2), which constitutes part of a set of archaeological sites formed by travertine cascades (Brusi et al., 1999) and known as the Reclau Caves, the most notable of which are the Arbreda and Reclau Viver Caves (Maroto et al., 1987).

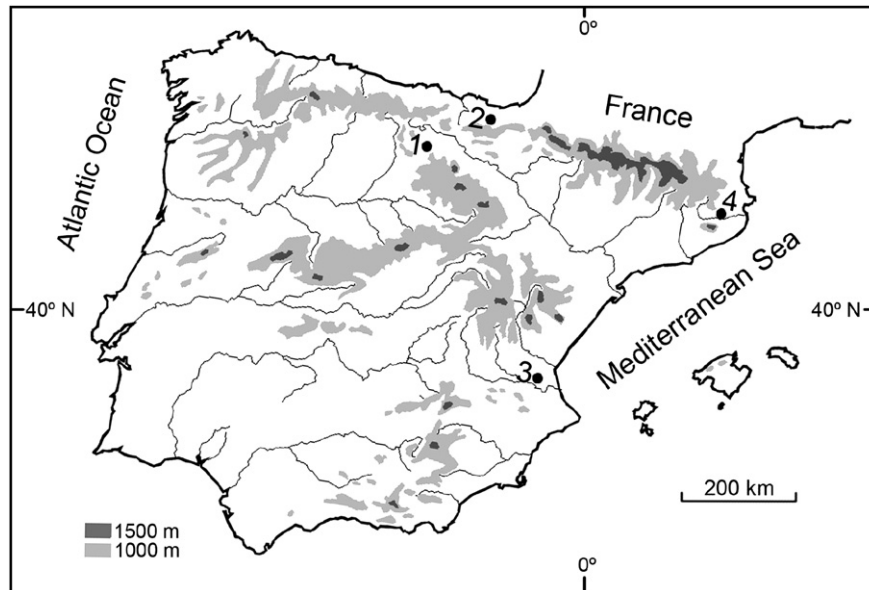
The site was discovered in 1947 and partially excavated in 1947–48. In 1958, a new excavation campaign was undertaken, and in August 1972, the final work was carried out on what are referred to as the 'early' excavations. All of these excavation campaigns were directed by Josep M. Corominas, with the collaboration of Eduard Ripoll and Lluís Pericot in 1958, and Miquel Oliva, Josep M. de Bedoya and Josep Canal in 1972 (Maroto et al., 1987; Solés and Maroto, 2002). Most of the cave filling was excavated in these campaigns. Between 2001 and 2005, work on the excavation of the cave was taken up again. The current campaigns have consisted of the excavation of the partial cores of Layer 5, with the purpose of characterising the layer and acquiring a better understanding of the site's archaeological and palaeontological assemblage.

## Stratigraphy

On the basis of recent activities (Solés and Maroto, 2002) in conjunction with the data provided by the early excavations

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**Figure 1.** Location of the middle Pleistocene sites in the Iberian Peninsula with human remains. 1. Atapuerca-Galería and Sima de los Huesos (Burgos); 2. Lezetxiki (Basque Country); 3. Cova Bolomor (Valencia); 4. Mollet (Girona).

(Corominas, 1948, 1958; Ripoll and Lumley, 1965; Lumley, 1971; Mir and Salas, 1976; Villalta and Estévez, 1977; Soler, 1986; Maroto et al., 1987), the following lithological units have been characterised within Mollet Cave. From the top downwards these are (Figs. 2 and 3):

#### Layer 1

From 0.20 m (present-day works) to 0.85 m (1970s works). Red clays. Holocene. Poor archaeological assemblage. Remains from human burials from the Chalcolithic or Bronze Age.

#### Layers 2–3

From 1 m (present-day works) to 1.10 m (1970s works). Grey clays with travertine blocks. Upper Pleistocene. Two archaeological assemblages: Archaic or Ancient Aurignacian (Upper Palaeolithic), dated to ca. 34 ka BP (thousands of years ago before present), poor in remains; and Mousterian (Middle Palaeolithic), rich in lithic industry.

#### Layer 5

From 0.40 m (present-day works) to 1.55 m (1970s works). Calcified yellowish muddy sands (generally tufaceous sands) with laminated tufa and oncolithic gravels. Middle Pleistocene. Palaeontological assemblage rich in macromammals.

The base is formed by tufa beds (minimum of 1.25 m in depth), which transitionally pass over to Layer 5 where they are intercalated with tufaceous sands. We have maintained the layer nomenclature as defined by Henry de Lumley (Ripoll and Lumley, 1965; Lumley, 1971). Mir and Salas (1976) defined the same layers with the letters from a to e. These authors were able to observe the deposit with a depth greater than 3 m, in contrast with the 1.6 m compressed depth of the current core. This core does not enable us to differentiate between Layers 2 and 3. Layer 4 corresponded to a local facies that cannot be generalised to the filling as a whole.

Layer 5 contains few remains of anthropic activity (a few lithic elements made of quartz and some burnt travertine rocks). By contrast, it is rich in faunal remains that were not brought by humans. In addition to the presence of carnivores and ungulates, this layer is also where the human tooth was found in the 1972 campaign (Fig. 4). When the early excavations collected their material, they grouped it according to its depth, but without any stratigraphic attribution. The assignation of the human molar to Layer 5 is further corroborated by the fossilisation of the skeletal remains in this layer, as well as the colouring and texture of its sedimentary matrix, which is very different from that of the upper layers.

The tooth in question is the first upper right molar of a child, with morphological and morphometric characters that coincide with those of pre-Neanderthals and Neanderthals (Fig. 4) (Cortada and Maroto, 1990). The age calculated for the layer does not help us at present to infer which of these two groups it comes from.

The accumulation of skeletal remains in Layer 5 suggests that the cave would have functioned at the time as a den for carnivores, above all the spotted hyena, of which there are abundant remains.

#### U/Th chronology

Eleven samples were taken from the internal part of each outcrop of travertine bodies (Fig. 3) to avoid surface contamination and the formation of any recrystallised portions. The isotopic composition was determined by alpha spectroscopy, following the total sample dissolution procedure described in Bischoff and Fitzpatrick (1991), and age calculations using the UDATE1 computer program (Rosenbauer, 1991). These analyses were carried out in the U/Th Laboratory of the 'Jaume Almera' Institute of Earth Sciences (CSIC, Barcelona).

Table 1 shows the results of the radiometric data obtained by alpha spectroscopy. Only one sample is free from  $^{232}\text{Th}$  and can be used as chronological data. This sample was taken from inside a sub-vertical tufa bed from the external part of the upper cascade deposits.

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