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Cova del Rinoceront (Castelldefels, Barcelona): a terrestrial record for the Last Interglacial period (MIS 5) in the Mediterranean coast of the Iberian Peninsula

J. Daura [a, b, *], M. Sanz [a, b], R. Julià [c], D. García-Fernández [a], J.J. Fornós [d], M. Vaquero [e, f], E. Allué [e, f], J.M. López-García [g], H.A. Blain [e, f], J.E. Ortiz [h], T. Torres [h], R.M. Albert [i, j], À. Rodríguez-Cintas [i], A. Sánchez-Marco [k], E. Cerdeño [l], A.R. Skinner [m], Y. Asmeron [n], V.J. Polyak [n], M. Garcés [o], L.J. Arnold [p], M. Demuro [q], A.W.G. Pike [r], I. Euba [s], R.F. Rodríguez [a], A.S. Yagüe [a], L. Villaescusa [a], S. Gómez [a], A. Rubio [a, t], M. Pedro [a], J.M. Fullola [b], J. Zilhão [b, j]

[a] GRQ, Grup de Recerca del Quaternari, SERP, Dept. Prehistòria, H. Antiga i Arqueologia, Facultat de Geografia i Història, Universitat de Barcelona, C/Montalegre, 6, 08001 Barcelona, Spain
[b] SERP, Dept. Prehistòria, H. Antiga i Arqueologia, Facultat de Geografia i Història, Universitat de Barcelona, C/Montalegre, 6, 08001 Barcelona, Spain
[c] Institut Ciències de la Terra "Jaume Almera", CSIC, C/Lluís Solé Sabarís s/n, Barcelona 08028, Spain
[d] Departament de Ciències de la Terra, Universitat de les Illes Balears, Ctra. Valldemossa km 7, 5, 07122 Illes Balears, Spain
[e] IPHES, Institut Català de Paleoecologia Humana i Evolució Social, C/Escorxador s/n, 43003 Tarragona, Spain
[f] Àrea de Prehistòria, Universitat Rovira i Virgili (URV), Avinguda de Catalunya 35, 43002 Tarragona, Spain
[g] Sezione di Scienze Preistoriche e Antropologiche, Dipartamento di Studi Umanistici, Università degli Studi di Ferrara, C.so Ercole 1 d'Este 32, 44121 Ferrara, Italy
[h] Laboratorio de Estratigrafía Biomolecular, Departamento de Ingeniería Geológica, Escuela Técnica Superior de Ingenieros de Minas, Universidad Politécnica de Madrid C/Rios Rosas 21, 28003 Madrid, Spain
[i] ERAAUB, Equip de Recerca Arqueològica i Arqueomètrica de la Universitat de Barcelona, Departament de Prehistòria, Història Antiga i Arqueologia, Universitat de Barcelona, Carrer Montealegre, 6, 08001 Barcelona, Spain
[j] ICREA, Catalan Institution for Research and Advanced Studies, Spain
[k] ICP, Institut Català de Paleontologia Miquel Crusafont, Campus de la UAB, 08193 Bellaterra, Spain
[l] Paleontología, IANIGLA, CCT-CONICET-Mendoza, Avenida Ruiz Leal s/n, 5500 Mendoza, Argentina
[m] Chemistry Department, Williams College, 47 Lab Campus Drive, 01267 Williamstown, MA, USA
[n] Department of Earth & Planetary Sciences, University of New Mexico, Albuquerque, 87131 New Mexico, USA
[o] Grup de Geodinamica i Analisis de Conques (GGAC), Universitat de Barcelona, Departament d'Estratigrafia, Paleontologia i Geociencies Marines, Facultat de Geologia, C/Martí Franques s/n, 08028 Barcelona, Spain
[p] The Environment Institute and School of Earth and Environmental Sciences, University of Adelaide, 5005 Adelaide, SA, Australia
[q] The Institute for Photonics and Advanced Sensing (IPAS), School of Physical Sciences, University of Adelaide, 5005 Adelaide, SA, Australia
[r] Dept. Archaeology, University of Southampton, Highfield Road, Southampton, SO17 1BF, UK
[s] ICAC, Institut Català d'Arqueologia Clàssica, Plaça Rovellat s/n, 43003 Tarragona, Spain
[t] Laboratorio de Antropología Física, Facultad de Medicina, Universidad de Granada, Av. de Madrid, 11, 18012 Granada, Spain

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ABSTRACT

The Cova del Rinoceront, a site in NE Iberia, contains a thick sedimentary fill preserving a faunal archive from the penultimate glacial and the the last interglacial periods. Layers I to III have been dated to between 74 and 147 ka, coinciding with MIS 5a to 5e, a period poorly represented in the Mediterranean terrestrial record. The results from Cova del Rinoceront are of broader interest for the reconstruction of ecological dynamics during warm stages and the understanding of the evolution and geographical variation of several taxa. The palaeoecological evidence suggests a landscape dominated by mixed wooded vegetation with mild climatic conditions, slightly more humid than today. Several vertebrate taxa, including *Haploidoceros mediterraneus*, *Stephanorhinus hundsheimensis* and *Glis glis*, are documented for the first time in the early Upper Pleistocene of Europe, showing that these species persisted across the

* Corresponding author. GRQ, Grup de Recerca del Quaternari, SERP, Dept. Prehistòria, H. Antiga i Arqueologia, Facultat de Geografia i Història, Universitat de Barcelona, C/Montalegre, 6, 08001 Barcelona, Spain.
E-mail address: jdaura_lujan@ub.edu (J. Daura).

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region for longer than previously thought. In addition, the recovery of a small lithic assemblage indicates human presence in the surroundings of the site. The 11 m-thick stratigraphic section also provides an ideal setting in which to compare several geochronological methods. U–Th dating of the flowstones that cap the deposit, of speleothems formed along the cave walls, and of speleothems buried by the deposit at different elevations provides minimum and maximum ages of 74 and 175 ka, respectively, for the accumulation. The ages obtained by luminescence, electron spin resonance (ESR), amino acid racemisation (AAR), palaeomagnetism and U-series dating of bone are in good agreement with each other and are stratigraphically consistent. This well-dated faunal succession presents a unique opportunity to assess changes in the Pleistocene fauna of the Mediterranean coast over an interval of more than 100 ka.

1. Introduction

It is generally understood that the Eemian interglacial, first described by Harting (1852) and commonly used by palaeontologists to define faunal and vegetal assemblages, corresponds to parts of marine and ice core records dated to MIS 5 (Shackleton et al., 2003). High resolution analyses of these cores (Sánchez-Goñi et al., 1999, 2012, 2013) demonstrate the existence of warm climate conditions, and studies of speleothems have been used to reconstruct terrestrial responses to climate change during this period (Plagnes et al., 2002; Hodge et al., 2008; Wainer et al., 2011).

Last Interglacial palaeoecological evidence from terrestrial records is typically imprecise and fragmentary due to the absence of long stratigraphic sequences. Archaeological and palaeontological studies carried out in central Europe (Kolfschoten, 2000), southeast France (Crégut-Bonnoure et al., 2010) and Britain (Currant and Jacobi, 2001) provide recent information, while cave speleothems have been used to reconstruct the climate during this period in the Mediterranean (Bar-Matthews, 2003; Muñoz-García et al., 2007).

Below latitude 41°, however, biotic records are poor, particularly in the Iberian Peninsula. Cueva del Camino in Central Iberia (Arsuaga et al., 2012; Blain et al., 2014) and Lezetxiki in the Cantabrian Range (Falguères et al., 2005) date to this time period but, given their geographical location (Cueva del Camino is situated in the northern Meseta at ~1114 m amsl and Lezetxiki is in the bioclimatic Eurosiberian region), the palaeoclimatic and environmental parameters derived from these records cannot be extrapolated to Mediterranean areas. Here, the data are scant and from only a few localities – namely, Cova de Bolomor and Cova Negra in the País Valencià (Blasco et al., 2008; Fernández Peris et al., 2008), and Teixoneres (Rosell et al., 2010) in Catalonia. Palaeobotanical reconstructions derived from pollen sequences exist for a few lacustrine and caves sequences, namely Padul and La Carihuela, respectively (González-Sampériz et al., 2010, 2013; Carrión, 2012). Anthracological data are also available for Abric del Pastor (Vidal-Matutano, 2015), where, however, the data are insufficient to warrant secure chronological assignment to the Last Interglacial.

Europe's Late Pleistocene large mammal record is characterised by the cool-adapted *Coelodonta-Mammuthus* faunal complex (Kahlke, 1999; Stuart et al., 2002; Barnosky et al., 2004; Stuart, 2005; Kahlke et al., 2011). In the Iberian Peninsula, this faunal complex is the result of successive expansions of steppe landscapes from Central Europe. Although cold-adapted species have been observed in Iberia during MIS 6 (Álvarez-Lao, 2007), it was not until MIS 4/MIS 3 that such expansions were widespread. On closer inspection, the northeast Iberian record (Álvarez-Lao, 2007) reveals that cold-adapted taxa, such as woolly rhinoceros (*Coeleodonta antiquitatis*) and woolly mammoth (*Mammuthus primigenius*), are poorly documented, as are arid and open environment species, such as *Equus hydruntinus* (Burke et al., 2003; Orlando et al., 2006); the same applies to other large mammals that could be considered cold climate indicators at this latitude (Daura et al., 2013). This expansion of cold-adapted taxa and attendant faunal renewal conceivably occurred around the Last Interglacial–Last Glacial transition (MIS 5a/MIS 4), with the eventual disappearance of species adapted to warmer climatic conditions.

The ability to test hypotheses about palaeoenvironmental and biotic changes across the Iberian Peninsula is limited by the absence of reliable chronologies beyond the limits of radiocarbon dating. Cova de Bolomor's stratigraphic sequence is thought to span the MIS 9-MIS 5e (~500–100 ka) interval (Fernández-Peris, 2007), based on Thermoluminescence (TL), aminoacid racemisation (AAR) and magnetosusceptibility (MS) results, with a single TL age of 121 ± 18 ka on sediments from layer II, which caps the Pleistocene sequence. The results range from 55 to 350 ka (Falguères et al., 2005), but the different dating techniques (ESR, U–Th and ^{14}C) applied to this site reveal a number of contradictions. Other Iberian sites have been dated with even less certainty as results are based on one geochronological method only. For example, the age of the Cueva del Camino deposit has been constrained using multi-grain optically stimulated luminescence (OSL) dating, which yielded an MIS 5 chronology (Arsuaga et al., 2012); however, as argued by Álvarez-Lao et al. (2013), these OSL ages are not precise enough to differentiate between sub-stages of MIS 5. Elsewhere, a flowstone dated to between 100 and 94 ka provides a maximum age for layer III of Teixoneres Cave (Rosell et al., 2010; López-García et al., 2012).

As karst entry points are natural traps for biota and sediments, the debris cones formed via openings in cave roofs contain abundant fossil remains related to the exterior environment. In addition, these deposits are occasionally sealed by speleothems, which can be dated using uranium disequilibrium series methods and other geochronological techniques applicable to faunal remains and sedimentary fills. This paper presents a study of the Cova del Rinoceront site, a palaeontological archive located in the Mediterranean coast of NE Iberia containing one of the region's longest MIS 5 stratigraphic sequences. Fossil vertebrate remains are abundant and provide important data for palaeoenvironmental reconstructions of the northernmost mesomediterranean area (Rivas-Martínez, 1987) prior to the onset of the Last Glacial period.

2. General setting and site description

Cova del Rinoceront (41°16′24.92″N, 1°57′39.18″E, 25 m amsl) is located in the eastern Garraf Massif (<600 m high), in the Can'-Aymerich quarry, municipality of Castelldefels (20 km to the southwest of Barcelona). The cave formed in a fractured narrow band, known as the La Ginesta fault, that runs in NE–SW direction over 2 km (Fig. 1-1). The original morphology of the site is unknown, as a significant part of it was destroyed in the 1960s by quarrying (Fig. 1-3), which exposed the sedimentary fill along a vertical S–N trending section (Fig. 1-2). The original entrance would probably have been a now lost shaft connecting the extant