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Marine mammals fossil remains and synthesis of the sedimentary and paleontological record of the Furninha Cave Pleistocene (Peniche, Portugal)

Restos fósiles de mamíferos marinos y síntesis del registro sedimentario y paleontológico del Pleistoceno de la Cueva de Furninha (Peniche, Portugal)

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Abstract

The Gruta da Furninha is a cave-site in Lower Jurassic limestones, of mainly marine genesis located at ~850 m SE of the Carvoeiro Cape, on the southern coast of the Peniche peninsula (central western mainland Portugal). The entrance of the gallery, situated in the middle of the cliff, is at ~15 m of altitude. This cave contained a rich and diverse fossiliferous set of Late Pleistocene vertebrates, distributed in several stratigraphic levels, currently housed at the Geological Museum of LNEG (Lisbon). The cave had a record of primitive human occupations documented by 106 Middle to Late Paleolithic artefacts, found in the lower lithostratigraphic unit (Pleistocene). It had also another human occupation in an upper unit (Neolithic, Holocene), where human skeleton elements and artefacts were found. This study focuses on two teeth previously identified as crocodile, housed in collections of the Geological Museum in the assemblages of the Furninha Cave and on a set of five bones, housed at Centro Português de Geo-História e Pré-História (CPGP) and collected in a marine terrace in the Furninha cliff. The occurrence of crocodile remains in the Upper Pleistocene of Portugal is not consistent with the fossil record of this period or with the environmental conditions associated with the fully marine paleoenvironments around Furninha Cave. A more detailed analysis of these teeth and their stratigraphic location now supports that they are cetacean teeth with ~80 ka, which is consistent with the fossil association, depositional environments and climate conditions of the Late Pleistocene in mainland Portugal. To add to these two teeth, five bones remains were found during the 2017 year sedimentary field work in the marine terraces on the Furninha Cave cliffs, at 4-7 m a.s.l. level , which could be carpal bones of marine mammals.

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Keywords: cetacean teeth; Furninha Cave; Upper Pleistocene; Middle Palaeolithic; western-central mainland Portugal.

Resumen

La Gruta da Furninha es una cueva localizada en las calizas del Jurásico Inferior, de origen principalmente marino, que está ubicada a unos 850 m al SE del Cabo Carvoeiro, en la costa sur de la península de Peniche (centro-oeste continental de Portugal). La galería de entrada, situada en medio del acantilado, está a unos 15 m de altitud. Esta cueva contenía un rico y diverso conjunto fosilífero de vertebrados del Pleistoceno tardío, con fósiles distribuidos en varios niveles estratigráficos, actualmente conservados en el Museo Geológico de LNEG (Lisboa). La cueva tenía un registro de ocupaciones humanas primitivas documentadas con 106 artefactos del Paleolítico Medio al Paleolítico tardío, encontrados en la unidad litoestratigráfica inferior (Pleistoceno). También tuvo otra ocupación humana en una unidad superior (Neolítico, Holoceno), donde se encontraron elementos esqueléticos humanos y artefactos arqueológicos. Este estudio se centra en dos dientes previamente identificados como pertenecientes a un cocodrilo, que se conservan en las colecciones del Museo Geológico entre los materiales de la Cueva de Furninha, y en un conjunto de cinco huesos, conservados en el Centro Português de Geo-História e Pré-História (CPGP), que se recogieron en una terraza marina en el acantilado de Furninha. La presencia de restos de cocodrilos en el Pleistoceno Superior de Portugal no es consistente con el registro fósil de este período ni con las condiciones ambientales asociadas con los paleoambientes completamente marinos alrededor de la cueva de Furninha. Un análisis más detallado de estos dientes y su ubicación estratigráfica apoyan que son dientes de cetáceos de hace aproximadamente 80 ka, lo que es consistente con la asociación fósil, los ambientes de depósito y con las condiciones climáticas del Pleistoceno tardío en Portugal continental. Además de los dos dientes, durante los trabajos de campo sedimentarios realizados en 2017 en las terrazas marinas de los acantilados de la Gruta da Furninha, a la altura de 4 a 7 m, se encontraron cinco nuevos restos óseos, que podrían corresponder a huesos carpianos de mamíferos marinos.

Palabras clave: dientes de cetáceo; Cueva de Furninha; Pleistoceno superior; Paleolítico Medio; centro-oeste de Portugal continental.

1. Introduction

The Furninha Cave is located in the Peniche peninsula, about 75 km north of Lisbon (39° 21’ 23’’ N and 9° 26’ 14’’ W) (Fig. 1). It was excavated by Nery Delgado (1884), who defined an upper stratigraphic unit (~3 m thick; Holocene) and a lower unit (~9 m thick; Pleistocene) containing stratigraphic levels rich in well-preserved faunal bones and with some Middle to Late Paleolithic artefacts.

In the first vertebrate inventory of this cave (Nery Delgado, 1884), about three dozen of mammalian taxons were listed, and also the presence of birds, fish and chelonians. Later, the fauna was further studied by Edouard Harlé (Harlé, 1910-11) based on fossil collections, housed in several Museums in Bordeaux, Toulouse and Paris, to make the faunal comparation. The mammals were later revisited in the light of further knowledge, providing new analyses (Ferreira, 1964; Roche, 1972; Cardoso, 1993; Brugal, 2012). In the case of birds, it was only during the 21st century that new detailed studies were made on paleontology, taxonomy, taphonomy and paleoenvironmental analysis on the fossil birds of the Furninha Cave (Pimenta *et al*., 2008; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo and Rosa, 2014; Figueiredo *et al*., 2017 a, b).

Cetaceans are found in almost every aquatic environment on the planet. In the current days, in coastline mainland Portugal five species of dolphins are identified: *Tursiops truncates* and

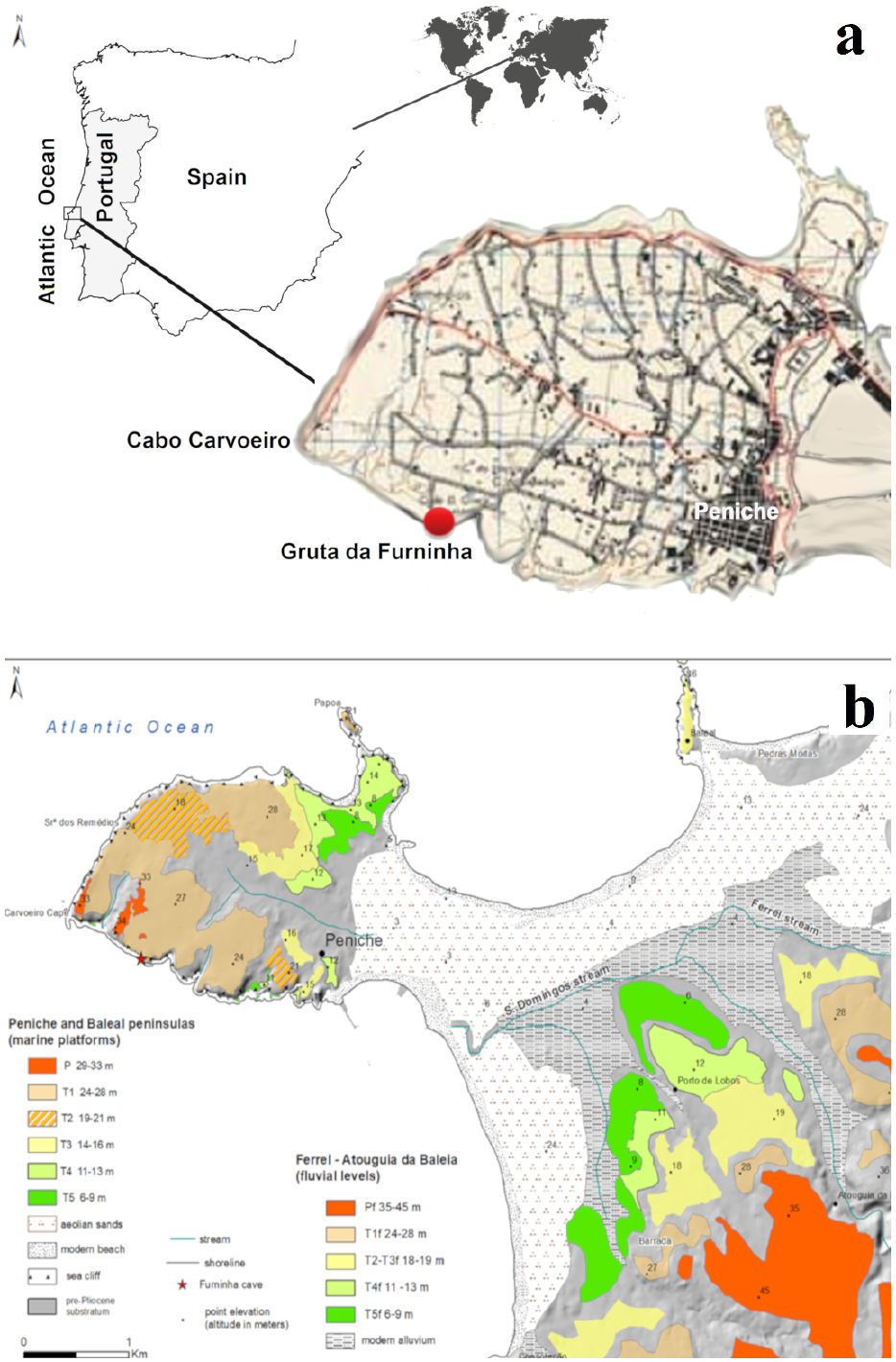

Fig. 1 – a - Location of the Gruta da Furninha, at Peniche peninsula, facing the Atlantic Ocean; b - Geomorphological map of the Peniche peninsula (identification of the several wave-cut platforms - T) and the adjacent inland area (fluvial terraces at higher altitudes) (adapted from Cunha *et al.*, 2017).

Fig. 1 – a - Localización de la Gruta da Furninha, en la península de Peniche, frente al Océano Atlántico; b - Mapa geomorfológico de la península de Peniche (identificación de varias plataformas de abrasión litoral - T) y el área interior adyacente (terrazas fluviales a mayores altitudes) (adaptado de Cunha et al., 2017).

Delphinus delphis, the most common species, and *Stenella coeruleoalba, Stenella frontalis* and *Grampus griseus*, the less common species (Moura *et al*., 2017). The presence of cetacean remains on the Pleistocene record in Portugal is rare. The presence of these animals is only described in the Gruta da Figueira-Brava (Antunes, 2000a,b). It is a set of six vertebrates assigned to *Delphinus delphis* (Antunes, 1990-1991, 2000a, b). These remains belong to immature and young adult individuals. Some of them seem to have been carved by man (Antunes, 2000b).

The purpose of this work is the study of two conical teeth crowns housed at the Museu Geológico do Laboratório Nacional de Energia e Geologia (MG-LNEG), in Lisbon, from the Furninha Cave assemblages, and a set of five bones, housed at Centro Português de Geo-História e Pré-História (CPGP). The two teeth were collected in the XIX century by Nery Delgado and the bones were collected in 2017 in a marine terrace, at 4-7 m above mean sea level (a.s.l), in the Furninha cliff. We also intend to discuss the original taxonomic classification of the two teeth that were classified as crocodile teeth and to make a synthesis of the Pleistocene sedimentary and paleontological record of the Furninha Cave.

2. Settings

2.1. Geological and stratigraphic framework

The Peniche peninsula has diverse Lower Jurassic marine carbonates, ranging from marls to siliciclastic limestones (França *et al*., 1960). The Cenozoic record comprises a culminant wave-cut platform, at 29-33 m a.s.l. (Pm), formed by a 3.7-3.6 Ma transgression (e.g., Cunha, 2019) and a Pleistocene terrace staircase of five wave-cut platforms and associated sedimentary deposits (Fig. 2) (Cunha *et al.*, 2017): a wave-cut platform at 24-28 m (Tm1); a wave-cut platform at 19-21 m (Tm2), with a beach conglomerate and sandstone; a wave-cut platform at 14-16 m(Tm3), with a beach conglomerate and sandstone, and capping travertine; a wave-cut platform at 11-13 m (Tm4), with beach conglomerate and sandstone followed by travertine; a wave-cut platform at 6.0-8.5 m (Tm5), with beach conglomerate, sandstone and travertine; a wave-cut platform at 4.0 m (Tm6), probably spanning 125-90 ka (MIS 5); Upper Pleistocene sand unit; Holocene aeolian sand unit and modern beach sediments.

The Gruta da Furninha entrance is around 15 m a.s.l., 3 m wide and the cave has a total length of ~30 m. A first gallery turns right toward a corridor, parallel to the first gallery, ended by a deep pit where most of the Pleistocene material was found, generally covered by more recent deposits.

The excavation of the Quaternary sedimentary infill of the Furninha Cave allowed the identification of two main lithostratigraphic units (Nery Delgado, 1884) (Fig. 2):

— (i) A younger lithostratigraphic sedimentary unit (called “Entulho Superior”, by Nery Delgado, 1884) (Holocene), up to 3 m thick, of clayish-sandy layers containing human bones and an Early to Late Neolithic industry, including burial grounds with primary and secondary positions, pottery, personal adornments, bone tools, pottery along with polished and knapped stone tools (Nery Delgado, 1884; Harlé, 1910; Breuil and Zbyszewski, 1945; Zilhão 1997; Bicho and Cardoso, 2010; Cardoso and Carvalho, 2011; Brugal *et al*., 2012; Figueiredo, 2010; Figueiredo *et al*., 2017).

— (ii) An older unit, 9.3 m thick, comprised of thirteen subunits (numbered 1 to 13), seven of them with vertebrate remains (Nery Delgado, 1884). Subunit 1 is the basal layer (~1 m thick) of a bioclastic conglomerate (with *Patella* and *Littorina*) at ~7-8 m a.s.l. (Cardoso, 1993), which can be correlated with the Tm5 basal marine conglomerate ~6-8 m (a.s.l.). Subunits 2 to 13 (Fig. 2), with a probable age of ~80 to 12 ka (Upper Pleistocene), comprise aeolian yellowish fine sands containing

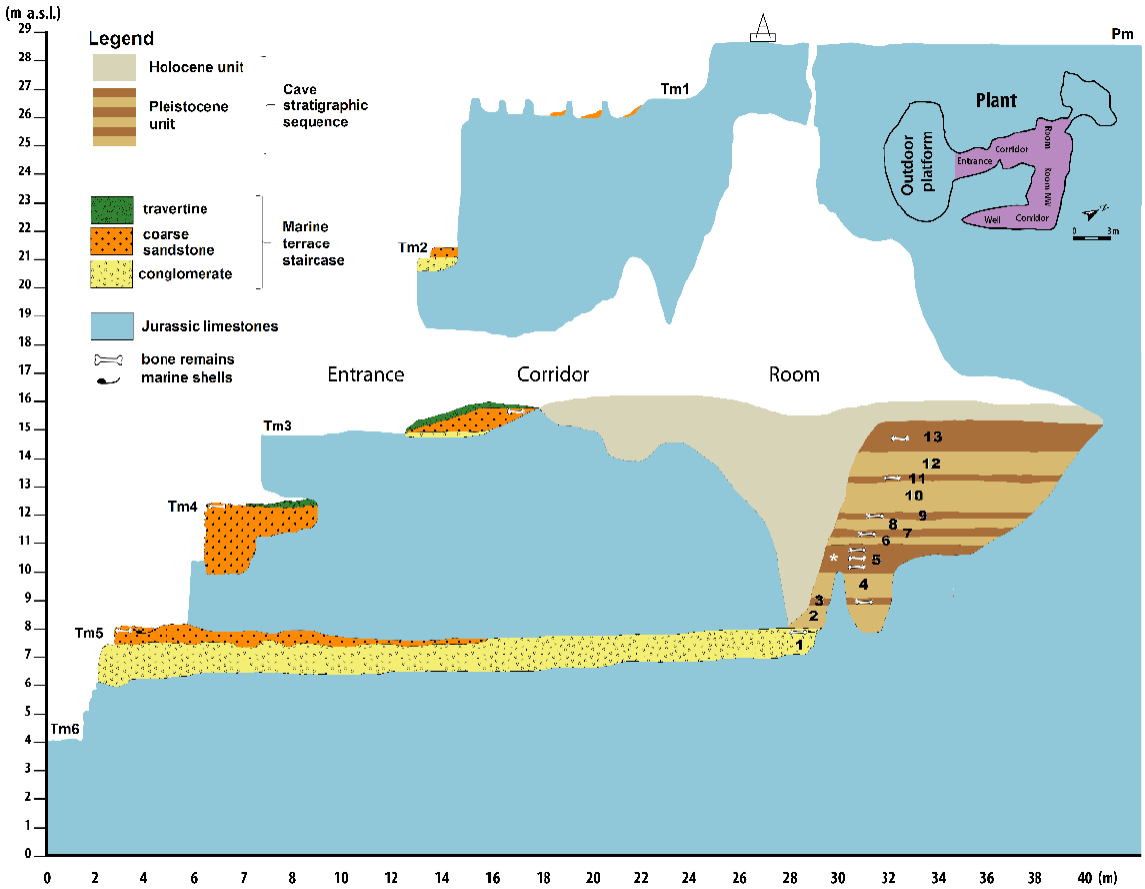

Fig. 2. a - Geomorphological map of the Peniche peninsula (identification of the several wave-cut platforms - T) and the adjacent inland area (fluvial terraces at higher altitudes) (adapted from Cunha *et al*., 2017); b - Plan (inset) and schematic representation of the geometry and lithostratigraphy of the Furninha Cave. Pm (culminant wave cut surface); Tm (1 to 6) are wave-cut platforms and associated marine deposits. The Furninha Cave infill is described by a Pleistocene unit comprising a lower marine conglomerate (subunit 1) and upper subunits of aeolian sands (numbered as 2 to 13); the Holocene unit consists of clayish sands. The continuity between the Tm5 deposits at the cliff and the marine bioclastic conglomerate (subunit I) is proposed (a paleo sea connection by a sea cave and karstic gallery). Representation of the geometry and lithostratigraphy of the cave is according to Nery Delgado (1884). The asterisk (*) on the subunit 5 represent the level where was made the dating by U-series on a bone. Art by Fernanda Sousa.

Fig. 2. Planta (recuadro) y representación esquemática de la geometría y litoestratigrafía de la Gruta da Furninha. Pm (superficie culminante erosionada por las olas); Tm (1 a 6) son plataformas erosionadas por las olas y depósitos marinos asociados. El relleno de la cueva de Furninha está descrito por una unidad del Pleistoceno que comprende un conglomerado marino inferior (subunidad 1) y subunidades superiores de arenas eólicas (numeradas de 2 a 13); la unidad del Holoceno consiste en arenas arcillosas. Se propone la continuidad entre los depósitos de Tm5 en el acantilado y el conglomerado bioclástico marino (subunidad I) (una paleoconexión marina por una cueva marina y una galería kárstica). La representación de la geometría y la litoestratigrafía de la cueva es según Nery Delgado (1884). El asterisco (*) en la subunidad 5 representa el nivel donde se hizo la datación de un hueso por el método de las series de Uranio. Dibujo de Fernanda Sousa

some limestone clasts, fossils of vertebrates (e.g. carnivorous mammals, herbivores, flying mammals, amphibians, turtles, lizards and birds) and artefacts spanning from the Middle to Late Palaeolithic. The fossil vertebrates, allow an interpretation of paleoclimates (comprising wet-temperate, wet-cold, dry-temperate and dry-cold conditions) and regional paleoenvironments (coastal areas, wetlands, rocky areas, freshwater lakes, open field areas, woods, forest areas and relief areas) (Figueiredo *et al*., 2017b). The subunit 5 (at 4 m above the base of the subunit 1) provided the two teeth that were studied and several bones, one of them dated as 81 (+42/-31) ka (U-series; Raposo, 1995).

2.2. Occupation of the Furninha Cave during the Pleistocene

The archaeological materials obtained from the excavation (Nery Delgado, 1884) have been successively studied (Fontes, 1917, 1923; Obermaier, 1925; Breuil, 1918; Breuil and Zbyszewski, 1945; Ferreira, 1964; Roche, 1972; Zilhão, 1997; Cardoso and Bicho, 2010; Cardoso and Carvalho, 2011).

The lower lithostratigraphic unit of the Furninha Cave sedimentary infill has lithic artefacts encompassing a sequence which comprises the Magdalenian, Solutrean, Gravettian, Mousterian and Acheulean (only one hand axe) (Nery Delgado, 1884; Bicho and Cardoso, 2010; Cardoso and Carvalho, 2011) (Table 1). Most of the artefacts —especially the Mousterian— are associated with abundant and diverse faunal remains (Nery Delgado, 1884; Harlé, 1909, 1911; Ferreira, 1964; Roche, 1972; Cardoso, 1993; Burgal *et al*., 2011; Figueiredo, 2010; Pimenta *et al*., 2010; Figueiredo and Rosa, 2014; Figueiredo *et al*., 2017a,b). The flint is the preferential row material (Nery Delgado, 1884).

2.3. Vertebrate Pleistocene fauna of the Furninha Cave

The Pleistocene unit of the Furninha Cave infill yielded very rich and diversified vertebrate fossil assemblages, with more than 5,000 vertebrate remains (teeth and bones) and some artefacts included in seven of the 13 subunits, called “níveis ossíferos” (bone levels): subunits 1, 3, 5, 7, 9, 11 and 13. The first description of this fauna was given by Nery Delgado (1884), with some additional information by other authors (i.e. Harlé, 1910-11; Roche, 1970; Cardoso, 1993; Figueiredo, 2010, Figueiredo *et al*., 2017b). The distribution by layers on the number of remains (NISP), shows that mammals are represented in all layers and that birds are the second largest group present in the different layers. The amphibians, reptiles and

Table 1. Distribution of the fauna groups and presence of artefacts in the subunits of the Pleistocene lithostratigraphic unit of the Furninha Cave infill, according to Nery Delgado (1884).* = presence.

Tabla 1. Distribución de los grupos faunísticos y presencia de artefactos arqueológicos en las subunidades de la unidad litoestratigráfica del Pleistoceno del relleno de la Gruta da Furninha, según Nery Delgado (1884). = presencia.*

Subunits containing fossils (“níveis ossíferos”)	*13 (VII)*	*11 (VI)*	*9 (V)*	*7 (IV)*	*5 (III)*	*3 (II)*	*1 (I)*
Mammals	*	*	*	*	*	*	*
Birds		*	*		*	*	*
Reptiles		*	*				
Amphibians			*		*		
Fishes						*	*
Invertebrates							*
Artefacts	*	*		*	*	*	

fishes are the less represented specimens (Table 1). This abundance and distribution of mammal and bird remains is coherent with species that used the cave or with the animals that were hunted nearby by carnivorous or primitive humans and brought into the cave. The fossil material has the highest abundance in subunit 5 (around 72% of the fossil collection), especially in subunit 5a.

In the previous paleontological studies of the fossil remains of the Furninha Cave no marine mammals have been identified. However, these studies allowed the identification of an abundant vertebrate taxa and their distribution by the various stratigraphic levels (Table 2) (Fig. 3): terrestrial carnivorous mammals, the most abundant taxa, with nine different species identified (*Ursus arctos, Hyaena-prisca, Panthera pardus, Felis silvestris, Lynx pardina, Canis lupus, Vulpes vulpes, Meles meles* and *Martes* sp.); terrestrial herbivores, with very few ungulates remains and 5-6 species identified (*Cervus elaphus*, *Dama* sp.(?) *Dicerorhinus hemitoechus, Bos primigenius, Equus caballus* and *Sus scrofa*); the proboscidean, *Paleoloxodont antiquus*. There is an abundant mesofauna (ca. 40 taxa): *Oryctolagus* (order Lagomorpha), flying mammals (order Chiroptera), rodents, amphibians, turtles, lizards and snakes and birds. In the case of birds, a total of 37 taxa were identified (Figueiredo, 2010). Although the species *Tadorna tadorna* (Aves; Anseriformes; Anatidae) predominates, Furninha Cave has a large taxonomic diversity, when compared with other Portuguese Pleistocene sites with bird remains. The predominant groups are the passerines and the Anseriformes. Anseriformes are dominated by marine species, which is explained by the location of the cave (Nery Delgado, 1884; Harlé, 1910-11; Ferreira, 1964; Roche, 1970; Cardoso, 1993; Brugal *et al*., 2012; Pimenta *et al*, 2008; Figueiredo, 2010; Figueiredo and Rosa, 2014; Figueiredo *et al.,* 2017a,b).

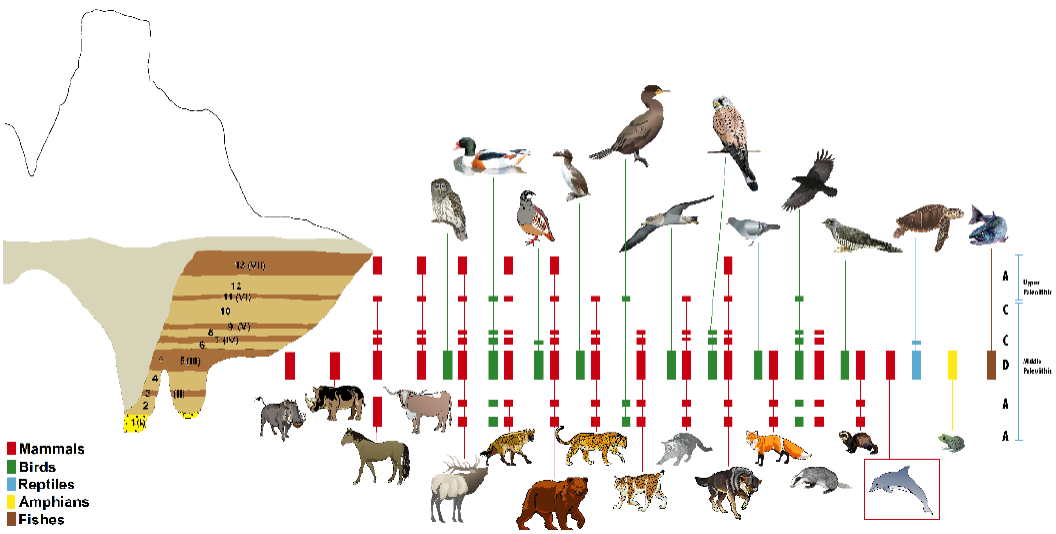

Fig. 3. Distribution of major groups of vertebrates by the different stratigraphic Pleistocene subunits of the Furninha Cave infill (Nery Delgado, 1884; Brugal *et al*., 2011; Figueiredo, 2010; Figueiredo *et al*., 2017b). On the right side, the letters indicate the type of climate conditions suggested by the bird species: A (wet-temperate), B (wet-cold), C (dry-temperate), D (dry-cold). The seven subunits with fossil fauna remains are identified by Roman numbers (I to VII). Art by Fernanda Sousa.

Fig. 3. Distribución de los principales grupos de vertebrados en las diferentes subunidades estratigráficas del Pleistoceno del relleno de la cueva de Furninha (Nery Delgado, 1884; Brugal et al., 2011; Figueiredo, 2010; Figueiredo et al., 2017b). En el lado derecho, las letras indican el tipo de condiciones climáticas sugeridas por las especies de aves: A (húmedo-templado), B (húmedo-frío), C (seco-templado), D (seco-frío). Las siete subunidades con restos de fauna fósil se identifican por números romanos (I a VII). Dibujo de Fernanda Sousa.

The faunal remains accumulation in the Furninha Cave will have, in the case of carnivores, an origin derived from the use of the cave by these animals. In the case of the remains of herbivores they will have been brought to the cave by carnivores or by primitive humans. In the case of birds, most of the remains belong to groups of birds that frequent caves (Figueiredo, 2010; Figueiredo *et al*., 2017b). However, there is a small number of bird remains that should have resulted from the transport by carnivores into the cave (Figueiredo, 2010; Figueiredo *et al.,* 2017b). In the case of the two cetacean teeth described in this study, we cannot define their origin: they can have been brought to the cave by carnivores, by primitive humans or by sedimentary transport.

2.4. Materials and methods

This study analyses two conical teeth crowns (GFP.1088.2) housed at the Museu Geológico do Laboratório Nacional de Energia e Geologia, in Lisbon, from the Furninha Cave assemblages. These teeth were collected from the subunit 5, at 3-4 m above the base of the Pleistocene unit (Fig. 2). We will also analyze a set of five bones (CPGP.56.1; CPGP.55.2017.2; CPGP.55.2017.3; CPGP.55.2017.4 and CPGP.55.2017.5) collected in a marine terrace at 4-7 m above mean sea level (a.s.l), in the Furninha cliff (Fig. 2), and housed at Centro Português de Geo-História e Pré-História. This study was based on literature analysis and on comparison with reference osteological collections, as well as with the association of the data according to the stratigraphic levels from which they were collected.

3. Results

3.1. The Furninha Cave fossil cetacea

In the collections of the Museu Geológico do LNEG, in Lisbon, in the assemblages of the Furninha Cave, there are two teeth crowns, not published but informally identified as of crocodile in the museum inventory. However, the presence of crocodiles in Portugal during the Pleistocene is not likely. For this reason, these dental crowns have been studied in detail, leading to the conclusion that they are cetacean teeth.

Palaeontological taxonomy:

Cetacea Drisson, 1762

Odontoceti Flower, 1867

Delphinidae Gray, 1821

Delphinus Lennaeus, 1758

Cf. *Delphinus delphis*

Material: GFP.1088.2 (a and b) (Fig. 4, up) Two teeth crowns

Description: two conical teeth crowns. With 17.5 / 14.3 mm high and 10.1 / 8,1 mm Base Length (Table 3). These teeth present some of the characteristics of the teeth of the *Delphinus delphis*: they are wide and pointed, with longitudinal slight prominent grooves in the apical, medial and basal areas. They have smooth and sharp carinas (more evident in "b") (Fig. 4 a) without any denticulation or other ornamentation. The base has no ornamentation. Those teeth crowns are not worn and the apex is complete.

During recent field works in 2017 some bone remains were found in the marine terraces staircase, on the cliffs of the Gruta da Furninha. At the level of 4 to 7 m a.s.l. (Tm 5, Fig. 2), that consist of marine conglomerate, rolled shells and vertebrate remains were identified. The remains of vertebrates consist of five bones remains, that could be carpal bones of a marine mammal.

Palaeontological taxonomy:

Cetacea indet.

Material: five bones (Fig. 4, down) CPGP.56.1; CPGP.55.2017.2; CPGP.55.2017.3; CPGP.55.2017.4 and CPGP.55.2017.5.

Table 2. Vertebrate taxa and their position in the Pleistocene stratigraphic subunits of the Furninha Cave sedimentary infill. The Roman numbering indicates the codes of the fossiliferous subunits.

Tabla 2. Taxones de vertebrados y su posición en las subunidades estratigráficas del relleno sedimentario pleistoceno de la Gruta da Furninha. La numeración romana indica los códigos de las subunidades fosilíferas.

Taxa		***Subunit*** *("níveis ossíferos")*	***References***
Mammalia			
Carnivora	*Ursus arctos*	**1**(I); **3**(II); **7**(IV); **9**(V); **11**(VI); **13**(VII)	Roche, 1970
	Hyaenaprisca sp.	**1**(I); **3**(II); **5**(III); **9**(V); **11**(VI)	Roche, 1970
	Panthera pardus	**3**(II); **5**(III); **11**(VI)	Brugal *et al*., 2012
	Felis silvestris	**5**(III)	Nery Delgado, 1884; Harlé, 1910-11; Ferreira, 1964; Roche, 1970; Cardoso, 1993; Brugal *et al*., 2012
	Lynx pardina	**3**(II); **7**(IV)	Nery Delgado, 1884; Harlé, 1910-11; Ferreira, 1964; Roche, 1970; Cardoso, 1993; Brugal *et al*., 2012
	Canis lupus	**3**(II); **5**(III); **9**(V); **11**(VI)	Nery Delgado, 1884; Harlé, 1910-11; Ferreira, 1964; Roche, 1970; Cardoso, 1993; Brugal *et al*., 2012
	Vulpes vulpes	**5**(III)	Nery Delgado, 1884; Harlé, 1910-11; Ferreira, 1964; Roche, 1970; Cardoso, 1993; Brugal *et al*., 2012
	Meles meles	**3**(II); **5**(III)	Nery Delgado, 1884; Roche, 1970
	Martes sp.	**1**(I); **3**(II); **5**(III); **9**(V); **11**(VI)	Nery Delgado, 1884; Roche, 1970
Artiodactyla	*Cervus elaphus*	**3**(II); **5**(III); **7**(IV); **9**(V); **11**(VI)	Nery Delgado, 1884; Roche, 1970
	Dama sp. *?*	**3**(II); **5**(III); **7**(IV); **9**(V); **11**(VI)	Nery Delgado, 1884; Roche, 1970
	Sus scrofa	**5** (III)	Nery Delgado, 1884; Roche, 1970
	Bos primigeniius	**5**(III); **9**(V); **11**(VI)	Nery Delgado, 1884; Roche, 1970
Perissodactyla	*Dicerorhinus hemitoechus*	**5**(III)	Nery Delgado, 1884; Roche, 1970
	Equus caballus	**3**(II); **5**(III); **7**(IV); **9**(V)	Nery Delgado, 1884; Roche, 1970
Proboscidea	*Palaeoxodon antiquus*	**5**(III)	Figueiredo, 2012
Erinaceomorpha	*Erinaceus europaeus*	**3**(II); **9**(V)	Nery Delgado, 1884, Harlé, 1910-11; Ferreira, 1964; Roche, 1970; Brugal *et al*., 2012
Lagomorpha	*Oryctolagus* sp.	**1**(I); **3**(II); **5**(III); **9**(V); **11**(VI); **13**(VII)	Nery Delgado, 1884
Rodentia	*Arvicola* sp.	**5**(III)	Nery Delgado, 1884

Taxa		***Subunit*** *("níveis ossíferos")*	***References***
Chiroptera	*Vespertilio murinus*	**5**(III)	Nery Delgado, 1884
	Rhinolophus ferrumequinum	**5**(III)	Nery Delgado, 1884
Cetacea	*Delphinus* sp.	**5**(III)	This study
Reptilia			
Testudinata	*Testudo hermanni*	**5**(III); **11**(VI)	Nery Delgado, 1884
Squamata	Lacertidae indet.	**11**(VI)	Nery Delgado, 1884
	Serpentes indet.	**11**(VI)	Nery Delgado, 1884
Amphibia			
Caudata	Caudata (?) indet.	**5**(III)	Nery Delgado, 1884, Harlé, 1910-11
Anura	Anura (?) indet.	**5**(III)	Nery Delgado, 1884, Harlé, 1910-11
Peixes			
Chondrichthyes	*Galeus* sp.	**5**(III)	Nery Delgado, 1884
Osteichthyes	Osteichthyes indet.	**5**(III)	Nery Delgado, 1884,
Aves			
Anseriforms	*Tadorna tadorna*	**3**(II); **5**(III); **7**(IV); **9**(V); **11**(VI)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Tadorna ferruginea	**5**(III); **7**(IV); **9**(V)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Somateria mollissima	**3**(II); **5**(III); **11**(VI)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Somateria sp.	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Cygnus olor	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Anas crecca	**11**(VI)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Anas sp.	**1**(I); **3**(II)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Melanita nigra	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
Galiforms	*Alectoris rufa*	**5**(III); **7**(IV)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Coturnix coturnix	Indet.	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
Columbiforms	*Columba livia*	**5**(III); **7**(IV)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
Charadriiforms	*Numenius phaeopus*	**3**(II);	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Pinguinus impennis	**5**(III)	Pimenta *et al*, 2008; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Gallinago sp.	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b

Taxa		***Subunit*** *("níveis ossíferos")*	***References***
	Larus sp.	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
Procellariiforms	*Puffinus puffinus*	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
Pelicaniforms	*Phoenicopterus ruber*	Indet.	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
Phoenicopteriforms	*Phalacrocorax aristotelis*	**1**(I); **3**(II); **11**(VI)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
Strigiforms	*Tito alba*	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*, 2018
	Bubo bubo	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Asio flammeus	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
Falconiforms	*Falco tinuculus*	**9**(V)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Aquila chrysiateus	**9**(V)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Aquila sp.	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Gyps fulvus	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
Passeriforms	*Pyrrhoorax pyrrhocorax*	**5**(III); **7**(IV); **11**(VI)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Pyrrhocorax graculus	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Corvus corone	**5**(III); **7**(IV)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Corvus frugilegus	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Corvus monedula	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*.., 2018
	Turdus merula	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Turdus philomelos	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Turdus pilaris	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Turdus iliacus	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Turdus sp.	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
	Pica pica	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b
Cuculiforms	*Cuculus canorus*	**5**(III)	Harlé, 1910-11; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b

Fig. 4: Up - Teeth GFP.1088.2 (a and b). Left: lingual view (GFP.1088.2-a); right: mesial view (GFP.108.2-b). Abbreviations: flu —interdenticular sulcus; Ca— carina. Scale 1 cm; Down - Probable carpus of marine mammals (CPGP.56.2017.1-5), found on the marine terrace 5 (Tm5); a- Palmar view; b - lateral view. Scale: 2 cm

Fig. 4: Arriba - Dientes GFP.1088.2 (a y b). Izquierda: vista lingüística (GFP.1088.2-a); derecha: vista mesial (GFP.108.2-b). Abreviaturas: gripe — surco interdenticular; Ca— carina. Escala 1 cm; Abajo - Probable carpo de mamíferos marinos (CPGP.56.2017.1-5), encontrado en la terraza marina 5 (Tm5); a- vista palmar; b - vista lateral. Escala: 2 cm

Table 3 - Measurements (mm) of the teeth crowns. CBC/CBL: comprimento da base da coroa/crown base length; AC/CH: altura da coroa/crown height.

Tabla 3 - Medidas (mm) de las coronas dentarias. CBL: longitud de la base de la corona; CH: altura de la corona.

	GFP.1088.2(b)	*GFP.1088.2(a)*
CBC (CBL)	10.1	8.1
AC (CH)	17.5	14.3

Description: those five bones have an irregular shape, they are mediolaterally flattened and have ossified centres. Although they do not have many diagnostic characteristics, they have the main characteristic on the marine mammals' carpal bones.

4. Discussion

The living Crocodylia are found mainly in the humid tropics (the main exceptions are the American and Chinese alligators) of the Northern and Southern hemispheres and most crocodilians live in the lowlands, where the temperatures are typically about 5 °C lower than at the coast (Alcala and Dy-Liacco, 1990). Various types of aquatic habitats are used by different crocodilians and the type of vegetation bordering the rivers and lakes inhabited by crocodilians is mostly humid tropical vegetation, with mangrove swamps in estuarine areas (Alcala and Dy-Liacco, 1990; Richardson, Webb and Manolis, 2000). On the other hand, the sex of a developing crocodile embryo is determined by incubation temperature (TDSD). The incubation at constant temperatures of 28-30°C gives 100% females; at 31°C around 50% males and 50% females; at 32°C it gives 100% males; but at 33-34°C swings back to 50-100% females respectively (Webb and Manolis, 1989; Richardson, Webb and Manolis, 2002; Marzola, Russo and Mateus, 2015).

The two teeth here presented were previously identified as of crocodile in the Geological Museum inventory (Fig. 5). However, an occurrence of crocodile in the Upper

Pleistocene is not consistent with the fossil record of this period in Portugal or with the environmental conditions associated with the faunal and sedimentary context of the Furninha Cave. The crocodiles' teeth are similar to the delphinidae teeth, because both type of teeth are conic and with a similar size. Dolphin remains are described in the Pleistocene of Portugal, especially in Gruta da Figueira-Brava (Antunes, 2000). As above presented, the environments in the Furninha area, associated to the listed species of birds and mammals are the following: coastal habitats, forests, open fields, woods, wetlands and mountain areas. Several bird species indicate a climate colder than the present one. However, other bird species, as well as mammal species collected in stratigraphic association, suggest temperate climate conditions. Nevertheless, several of these environments (rocky coastal habitats, forests, open fields, woods, and mountain areas) and climate conditions (colder than present) are not consistent with the existence and reproduction of crocodilian (Webb and Manolis, 1989; Alcala and Dy-Liacco, 1990; Richardson, Webb and Manolis, 2002; Marzola, Russo and Mateus, 2015). So, the presence of dolphins is more consistent with the fossil associations, depositional environments and climate conditions of the Late Pleistocene in mainland Portugal and with the paleoenvironmental conditions of the Furninha Cave.

The paleoenvironmental interpretation on the Pleistocene record of Furninha Cave was performed basically on the remains of birds (Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b). Although the species identified are not typical of caves, they are marine species and the Furninha Cave is located on a sea cliff. It is believed that the accumulation of bird remains would have resulted from animals that died inside the cave, but also that some remains were brought by other animals and primitive humans using the cave. The Furninha Cave avian assemblage is dominated by seabirds (anseriforms and pelecaniforms). However, the presence of species related to terrestrial environments is relevant (such as the grey partridge): coastal habitats, forests, open fields, woods, wetlands and mountain areas. The presence of birds such as the *Pinguinus impennis, Tadorna tadorna, Cygnus olor* and *Somateria mollissima* point to a climate colder than the present one. Other bird species, such as *Anas crecca* and *Numenius phaeopus*, as well as mammal species collected in stratigraphic association, suggest humid and hot to temperate climate conditions (Pimenta *et al*., 2008, 2018; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo and Rosa, 2014).

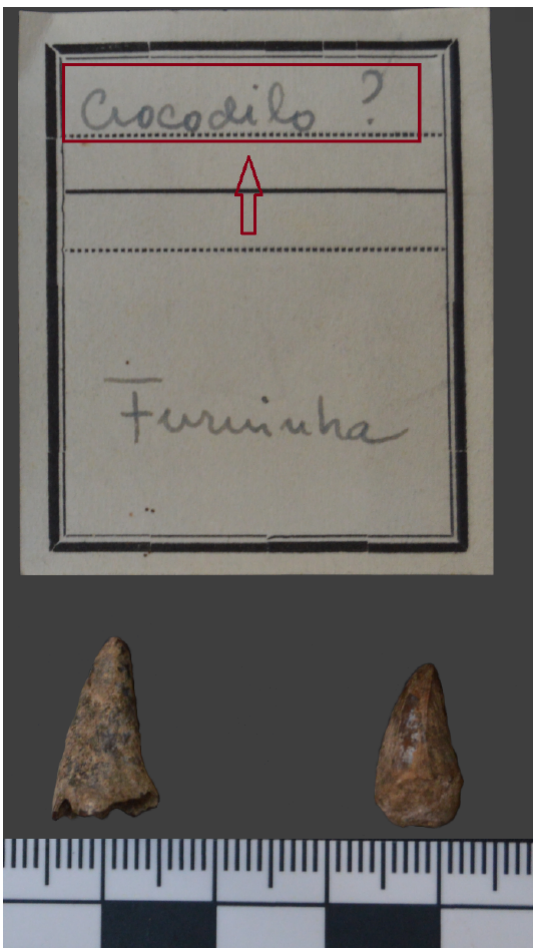

Fig. 5. Marker of the inventory of the Geological Museum with the indication that the teeth could be of crocodile.

Fig. 5. Inventario del Museo Geológico con la indicación de que los dientes probablemente son de cocodrilo.

The biological remains, which comprise a large proportion of broken bones, also contributed to the sedimentary infilling of the cave, which mainly consists of sand brought by wind and limestone debris provided by gravity processes. The subunits 2, 4, 6, 8, 10 and 12, which only comprise aeolian fine sands (without fossil remains), record periods of intense introduction of aeolian sands inside the cave. The subunits 3, 5, 7, 9, 11 and 13 record periods of less relevant aeolian activity, compatible with the use of the cave by primitive humans and animals.

The coastal location of the Furninha Cave is also more consistent with the fossil record of marine animals, than with the presence of crocodiles. On the other hand, in the subunit 5 these two teeth are associated with remains of other marine vertebrates, such as fish and Charadriiformes. In the case of the Charadriiformes, a remain of *Pinguinus impennis*, which also occurs in the Figueira-Brava Cave (Mourer-Chauviré and Antunes, 2000; Pimenta *et al*., 2008; Figueiredo, 2010; Brugal *et al*., 2012; Figueiredo *et al*., 2017b).

Delphinus delphis is common in coastal waters, which is consistent with the geographical position of Furninha Cave. However, this species has a huge geographic dispersion in rather different conditions but avoids very cold waters (Rise, 1998). Some of the fauna of Furninha Cave, such as *P. impennis, T. tadorna, C. olor* and *S. mollissima* indicate a colder climate than in the present, but other bird species, such as *A. crecca* or *N. phaeopus*, as well as mammal species collected in stratigraphic association of Gruta da Furninha, suggest humid and hot to temperate climate conditions. This kind of climates are those in which *Delphinus delphis* is common.

In Brugal (2012), it is indicated that these remains come from the Jurassic limestones where the cave is located. We believe that this attribution of provenance is incorrect for two reasons: (1) the Lower Jurassic marine carbonates of the study area were deposited in a marine platform and only contain marine invertebrate fossils (such as bivalves, echinoderms or cephalopods), without any paleontological record of vertebrates (either terrestrial or continental shelf), and some levels are even of turbidites (França *et al*., 1960); (2) on the other hand, these two teeth do not present a diagenesis compatible with those limestones, but instead similar to that of the other Pleistocene remains of the Furninha Cave.

5. Conclusions

This study focusses on two conic teeth crowns housed at the Geological Museum of LNEG (Lisbon), in the assemblages of the Furninha Cave. Those teeth were previously identified as crocodile, but the occurrence of crocodile in the Upper Pleistocene of Portugal is not consistent with the fossil record of this period or with the environmental conditions associated with Furninha OR conditions found at Furninha.

The attribution of these teeth to *Delphinus delphis*, with a probable age of 80 ka, is consistent with the fossil associations, depositional environments and climate conditions of the Late Pleistocene in mainland Portugal. This occurrence is also consistent with the geographical location of Furninha Cave and with the climates indicated by the vertebrate fauna of this cave. Currently, several species of dolphins are frequent in fully marine and coastal aquatic environments (river mouths) in mainland Portugal.

Furninha Cave has an abundant and diversified Pleistocene fauna, with several species of birds and mammals in some subunits which alternate with other subunits which only comprise aeolian sands. A few artefacts, ascribed to the Early (?), Middle and Late Palaeolithic, indicate episodic presence of primitive human occupations in the cave. Several carnivorous and birds used the cave. Some herbivorous or fish remains were brought into the cave by the carnivorous or by the primitive humans. Regarding the two cetacean teeth described in this study, collected

from a stratigraphic subunit of ~80 ka, they were brought into the cave by carnivorous or by Neandertals. By ~80 ka the Atlantic littoral was at short distance from the modern coastal cliff and the intertidal zone was surely very rich in food items for the Neanderthal groups and carnivorous animals.

The presence of cetaceans teeth in the Furninha Cave sedimentary infill adds to the record of cetaceans in the Pleistocene of Portugal, complementing the fossil record of this marine mammals in the Figueira-Brava Cave.

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