



The Eocene vertebrate fossil record of the Ainsa Basin (Huesca, Spain): new sirenian fossil sites in the Sobrarbe Deltaic Complex

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Journal webpage:

<http://cienciasdaterra.novaidfct.pt/>

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ISSN: 0254 - 055X

eISSN: 2183 - 4431

Abstract

In the last years, the previously unknown Eocene macrovertebrate fossil record of the Ainsa Basin (Southern Pyrenees Basin, Huesca, Spain) has been improved. It is composed by pleurodiran and cryptodiran testudines and the basal sirenian *Sobrarbesiren cardieli*. In 2018, a survey campaign was conducted to search for new Eocene sirenian fossil sites in the Ainsa Basin. Thirty-three new sites with macrovertebrate fossils were found increasing to a total of forty the number of fossiliferous points in this basin. They are mainly concentrated in the deltaic plain facies of the Sobrarbe Fm. (middle Lutetian) but the fossil record covers a temporal range from the upper Ypresian? to the late Lutetian-Bartonian. Principally, the recovered fossils are testudines, sirenians and scarce crocodiles, but also a lophodontid perissodactyl and other still indeterminated mammals evidencing that the Ainsa Basin is a very important area to study Eocene mammals and specially sirenians.

Keywords: Sirenia, Testudines, Lophodontids, Lutetian, Southern Pyrenees.

1. Introduction

The Ainsa Basin is a small foredeep basin located in the Southern Pyrenees (Comarca de Sobrarbe, Huesca province, Northeastern Spain), limited by the Boltaña anticline at the west and the Mediano anticline at the east (Fig. 1). It conforms the east edge of the Jaca-Pamplona Basin at the southwest of the South Pyrenean Central Unit (Dreyer *et al.*, 1999; Mochales, 2011). The Eocene sediments range from the Ypresian (early Eocene) to the Priabonian (late Eocene) in age (Mochales, 2011), which are overlying the Upper Cretaceous basement. During the Eocene, this area was a deep marine gulf (the Bay of Biscay) located between the Iberian Peninsula and Europe, which opened northwestwards into the Atlantic Ocean, delimited to the east by the emergence of reliefs associated with the Pyrenean orogen (Plaziat, 1981). During the middle Eocene, a deltaic system is emplaced in the basin, the Sobrarbe Deltaic Complex (Dreyer *et al.*, 1999), which lithostratigraphically encompasses lower slope marls and turbidite sandstones (San Vicente Fm.), delta-front sandstones and deltaic plain mudstones (Sobrarbe Fm.) and alluvial plain facies (Escanilla Fm., Mondot Mb.) (Fig. 1, D).

The Aragosaurus-IUCA research team of the University of Zaragoza has been working in the Ainsa Basin for the last 10 years. Several Eocene vertebrate species have been published including sirenians and testudines. The most important site is Castejón de Sobrarbe-41 (CS-41), the type locality of the middle Lutetian quadrupedal sirenian *Sobrarbesiren cardieli* (Díaz-Berenguer *et al.*, 2018a). In CS-41, more than 700 macrovertebrate fossils together with abundant microfossils have been recovered including chondrichthyans, osteichthyans, testudines, crocodiles, squamates, sirenians, micromammals, invertebrates and plants (Díaz-Berenguer *et al.*, 2018a). The testudines are represented by five cryptodiran and pleurodiran taxa from several fossiliferous beds of the Sobrarbe Fm. (Pérez-García *et al.*, 2013, 2019). Sporadic palaeontological prospections during field seasons revealed new fossiliferous points in the Sobrarbe Fm. To test the fossiliferous potential of the Ainsa Basin in Eocene vertebrate fossils, a systematic palaeontological survey was carried out during 2018 in order to look for new sirenian fossil sites. As a result, abundant Eocene vertebrate fossil-bearing beds were found, most as result of the continuous surveys carried

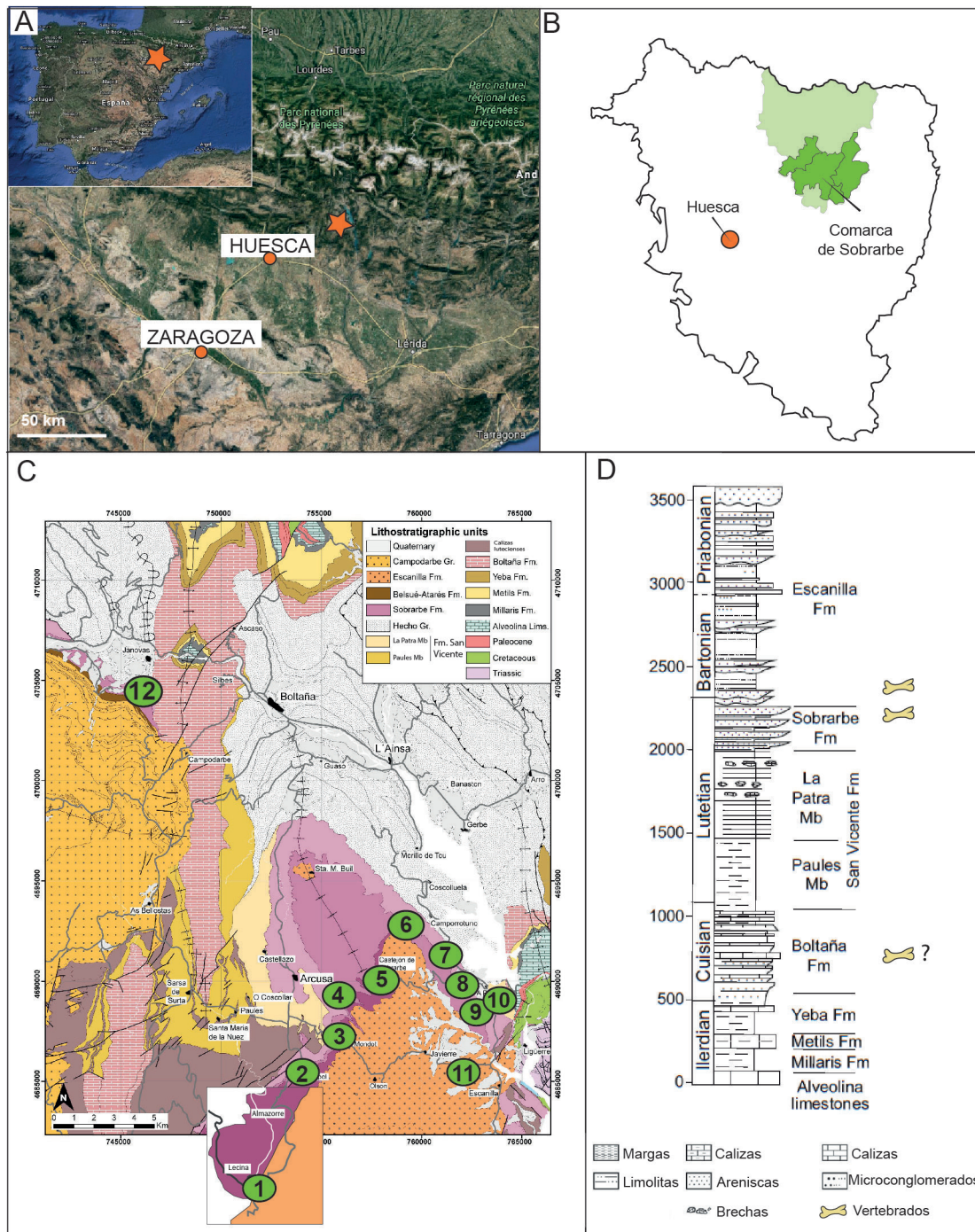


Fig. 1. -A- Location of the studied area in the Iberian Peninsula (orange star). Images from Google maps; B- The studied area in the province of Huesca (green); C- Geological location of the studied Eocene vertebrate fossil-bearing beds (depicted in numbered green circles) in the Ainsa Basin (modified from Mochales, 2011); D- Simplified stratigraphic section of the Ainsa Basin and the Eocene formations with vertebrate fossil finds (depicted with bone symbols) (modified from Mochales, 2011).

out by one of us (J. C.) during the last 20 years. In this work, we present the main results of these survey campaigns.

2. Material and methodology

Three survey campaigns with a total of 10 days duration were carried out in the Eocene outcrops of the Ainsa Basin during 2018. The first phase of work was to determine the surveying areas in the Sobrarbe

Fm. and their access according with geological maps and aerial photos. Posteriorly, a survey permission was requested to the Dirección General de Cultura y Patrimonio of the Gobierno de Aragón (DGA).

The methodology followed in the survey campaigns was as follows: in every new fossiliferous point-identified GPS coordinates and photographs for its localization were taken. Whenever possible, surface fossils were picked up for posterior identification. In

the case of fossils in danger of destruction, they were extracted. In addition, observations on the lithology and stratigraphy of the outcrops were made, as well as on the fossil invertebrates, tracks and fossil plants in order to situate the fossiliferous points within the geological framework of the Ainsa Basin. All the recovered fossils are deposited in the Museo de Ciencias Naturales of the Universidad de Zaragoza.

3. Results

During the survey campaigns 33 new localities with Eocene vertebrate fossils were recorded, and 7 previously known fossil sites were revised. These points are situated in the municipalities of Abizanda, Aínsa-Sobrarbe, Bárcabo, Boltaña, Fiscal and La Fueva. They have been grouped in 12 areas (Fig. 1C). Of the total sites surveyed, 37 are located in the Sobrarbe Fm., one in the Escanilla Fm., one in the Boltaña Fm./Hecho Group? and by first time, one in the San Vicente Fm. according with the existing geological maps (Fig. 1D; Dreyer *et al.*, 1999; Mochales, 2011). The vertebrates identified include testudines, crocodiles, sirenians, perissodactyls and indeterminate mammals. Fossil sirenians were found in 22 localities.

Boltaña Fm.-Hecho Group?

In the west flank of the Boltaña Anticline, close to the village of Jánovas (Fig. 1C, 1D, point 12), a partial articulated skeleton of a sirenian was recovered in an isolated block. The fossil preserves the spinal column, ribs, and humerus and is embedded in a calcareous block with invertebrate fossils and fossil chondrichthyan teeth. Gagnaison *et al.* (2016) proposed that this block pertains to the Boltaña Fm., late Ypresian-early Lutetian in age. Nevertheless, we cannot discard that it pertains to the Hecho Group (erroneously assigned to the Sobrarbe Fm. in Díaz-Berenguer *et al.*, 2018b).

San Vicente Fm.

One fossiliferous point was located in the San Vicente Fm. (Fig. 1C, 1D, point 10). The fossils consist in fragments of sirenian vertebrae and ribs. They come from a level of marly limestones, which exhibit abundant nummulitids interbedded with metric levels of marls, which contain abundant remains of gastropods, echinoderms and burrows. However, the exact location of the fossil is unknown. These deposits have been interpreted as distal slope facies; thus, probably isolated carcasses were swept from proximal

areas. The San Vicente Fm. is middle Lutetian in age (Mochales, 2011).

Sobrarbe Fm.

In the 37 fossiliferous localities recorded, fragments of testudines carapaces, isolated teeth and cranial remains of crocodiles, postcranial bones of sirenians, a complete mandible of a lophiodontid perissodactyl and postcranial bones of indeterminate mammals have been found. The fossils appear in metric levels of brown silty marls alternating with decimetric levels of sandstones with mollusc remains. These levels are situated in the upper part of the Sobrarbe Fm., close to the contact with the Escanilla Fm. (Fig. 1C, 1D, points 1 to 9). The facies are similar to that observed in the CS-41 fossil site, interpreted as deltaic plain facies (Díaz-Berenguer *et al.*, 2018a); thus, a similar depositional environment is proposed. The Sobrarbe Fm. is middle Lutetian in age (Mochales, 2011).

Escanilla Fm.

One fossiliferous point is present in the Escanilla Fm. (Fig. 1C, 1D, point 11). The identified fossils are fragmentary turtle carapaces and a crocodile tooth. The fossils appear in isolated blocks of conglomerates. In this point the conglomerates are interbedded with levels of sandstones and they are interpreted as alluvial facies. According with the geological map of Labourdette (see figure 2 in Labourdette, 2011), these levels pertain to the Mondot Mb. of the Escanilla Fm. late Lutetian-Bartonian in age.

4. Discussion and conclusions

The Lutetian vertebrate fossil record of the Iberian Peninsula is scarcely represented in comparison with the Bartonian or Priabonian record (Badiola *et al.*, 2009 and references therein). The Eocene sirenian fossils of Spain are concentrated in the South Pyrenean basin, in Catalonia, Huesca and Navarre. Nevertheless, the sirenian fossils of Catalonia and Navarre, which chronologically range from the late Lutetian to the Priabonian in age, are mainly isolated findings and, in many cases, fragmentary remains (Díaz-Berenguer *et al.*, 2018b, and references therein). According to our fieldworks, the Ainsa Basin arise as an specifically rich area in Eocene vertebrate fossils, whose record cover to date a broad temporal range from the late Ypresian? to the late Lutetian-Bartonian so, this further increases

the paleontological interest of this area. The deltaic plan facies of the Sobrarbe Fm. (middle Lutetian) are specially rich, from where *Sobrarbesiren cardieli*, the oldest sirenian species in western Europe was found. On the other hand, the existence of new sirenian fossil sites in the Ainsa basin both in the San Vicente and the Sobrarbe Fms., confirms that the Lutetian sirenian fossil record of the Iberian Peninsula is much more abundant than previously known. In addition, the finding of a lophiodontid perissodactyl and other still indeterminate mammals evidence that in the Lutetian deposits of the Ainsa Basin also terrestrial mammals can be found. The future studies based on the new fossils recovered will contribute to a better knowledge of the paleobiodiversity of the Eocene vertebrate fossil record of the Southern Pyrenees, especially that of the Lutetian sirenians.

Acknowledgements

Author thanks to the numerous colleagues from the Zaragoza University and the Basque-Country University (UPV/ EHU) involved in the excavation campaigns. Financial support was provided by the Research Grant 2017 of the Geoparque de Sobrarbe. This research forms part of the project CGL2017-85038-P and is subsidized by the Spanish Ministry of Science and Innovation, the European Regional Development Fund, and the Government of Aragón (Grupo Aragosaurus: Recursos geológicos y Paleoambientes) and Basque Country (IT1004-16), and the UPV/EHU (GIU18/163).

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