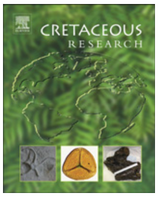
Cretaceous Research 31 (2010) 433–446

Contents lists available at ScienceDirect

Cretaceous Research

journal homepage: www.elsevier.com/locate/CretRes



Amphibians and squamate reptiles from the latest Maastrichtian (Upper Cretaceous) of Blasi 2 (Huesca, Spain)

Hugues-Alexandre Blain [a,*], José-Ignacio Canudo [b], Gloria Cuenca-Bescós [b], Nieves López-Martínez [c]

[a] *Institut de Paleoecologia Humana i Evolució Social (CSIC associated unit), Àrea de Prehistòria, Universitat Rovira i Virgili, Plaça Imperial Tarraco 1, E-43005 Tarragona, Spain*
[b] *Grupo Aragosaurus-IUCA, Paleontología, Facultad de Ciencias, Universidad de Zaragoza, E-50009 Zaragoza, Spain*
[c] *Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, E-28040 Madrid, Spain*

ARTICLE INFO

Article history:
Received 22 June 2009
Accepted in revised form 3 June 2010
Available online 9 June 2010

Keywords:
Amphibia
Squamata
Maastrichtian
Iberian Peninsula

ABSTRACT

An assemblage of amphibians and squamates from the Upper Maastrichtian of the Iberian Peninsula is described here for the first time. The material is disarticulated and comes from the Blasi 2 site of Huesca, Spain). The site is made up of grey marls belonging to the lower part of the Tremp Formation, and contains dinosaurs, crocodilians, testudines and Osteichthyes. The amphibians from Blasi 2 include one albanerpetontid (*Albanerpeton* aff. *nexuosum*) and two different anuran taxa: a discoglossid and a palaeobatrachid. The squamates comprise three lizards (two indeterminate lizards and one anguid) as well as an indeterminate snake (Alethinophidia). The vertebrate assemblage may be interpreted as pertaining to an aquatic environment and its terrestrial surroundings. The presence of estuarine fishes, freshwater amphibians and marine invertebrates together suggests that Blasi 2 may correspond to a coastal, mangrove-like swamp. The amphibians and squamates of Blasi 2 are typically Laurasiatic taxa. This contrasts with the older (Campanian-Maastrichtian) sites of the Iberian Peninsula, where typical Gondwanan taxa have been identified. Blasi 2 provides important information on the biodiversity of amphibians and squamate reptiles in the north of the Iberian Peninsula during the late Maastrichtian, from a point just a few hundred thousand years before the K-T boundary event. These taxa have representatives in the Cenozoic, so as a group they do not appear to have been affected by the boundary event.

1. Introduction

Amphibians and squamate reptiles are a relatively important component of modern terrestrial ecosystems (e.g. Zug et al., 2001). Globally, their latest Late Cretaceous fossil record is rather poorly known (Sanchíz, 1998; Rage, 2002), probably because their small size often requires the use of screening-washing techniques which remain under used (Evans, 2003). This is not, however, true of the USA (Dingus and Rowe, 1997). In Europe, latest Late Cretaceous terrestrial microvertebrates are mainly known from the Hateg Basin in Romania (Grigorescu et al., 1999; Codrea et al., 2002; Venczel and Csiki, 2003; Folie and Codrea, 2005) and from some localities in the Pyrenees and Basque Country (France and Spain). Indeed, the Pyrenees have good geological sections with vertebrate fossils from the late Maastrichtian, where an important effort has been made to document their ancient biodiversity and how this relates to the Cretaceous-Tertiary (K-T) boundary event (López-Martínez et al., 2001; Laurent et al., 2002; Oms et al., 2007). The late Maastrichtian localities of Arén (Blasi 1–5) are well known for their richness and diversity in hadrosaurid dinosaur fossils (López-Martínez et al., 2001; Cruzado-Caballero et al., 2005; Pereda-Suberbiola et al., 2006; Pereda-Suberbiola et al., 2009). One of these localities (Blasi 2) presents one of the richest and most diverse small-vertebrate faunas of the end of the European Cretaceous (López-Martínez et al., 2001).

Records of vertebrate faunas from just before the K-T boundary present vital information on how these faunas may have been affected by the K-T extinction event. As part of terrestrial ecosystems, amphibians and squamate reptiles – together with other groups such as sharks, bony fishes, mammals, crocodilians and dinosaurs (Dingus and Rowe, 1997; Archibald, 2002; Archibald and Fastovsky, 2004) – may be relevant to discussions of the various theories on the consequences of the asteroid impact. According to Milner et al. (2000), the events at the K-T boundary had no detectable effect on the amphibian fauna whereas lizards were affected more substantially. This seems to have been particularly

---

* Corresponding author.
E-mail addresses: hablain@iphes.cat (H.-A. Blain), jicanudo@unizar.es (J.-I. Canudo), cuencag@unizar.es (G. Cuenca-Bescós), lopezmar@geo.ucm.es (N. López-Martínez).

0195-6671/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.cretres.2010.06.001

true for teiids where some taxa became extinct in North America and Asia, possibly due to a period of cooler temperatures.

The latest Late Cretaceous is already known to have been a complex period, with a changing global climate, an important marine regression and severe volcanism events (Canudo et al., 1991; Barrera, 1994; Arenillas et al., 2006; Keller, 2008). It might be reasonable to expect changes in the herpetofauna coinciding with these environmental events and pressures.

The aim of this paper is to describe the amphibians and squamate reptiles from the latest Maastrichtian of Blasi 2 so that its fauna can be compared to other latest Late Cretaceous localities. This should provide a clearer understanding of latest Late Cretaceous terrestrial diversity and ecology prior to the K-T event. Further comparisons with Cenozoic faunas may shed light on changes linked to the K-T event itself.

2. Geological setting

The vertebrate-bearing localities of Arén (Huesca, NE Spain, see Fig. 1) are exposed along the northern limb of the Tremp syncline in the south-central Pyrenean unit. They are situated west of the village of Arén and near Blasi Hill. The fossiliferous sites have been numbered Blasi 1 to Blasi 5 and are easy to correlate (López-Martínez et al., 2001). According to Ardèvol et al. (2000), the Blasi sites represent delta-front, lagoonal and coastal deposits of the Arén 4 sequence. The fossil material described here comes from the Blasi 2 site, which is the richest one in terms of small vertebrate fossils. Blasi 2 occurs in a 6.5-m-thick interval of grey marls that interfinger with the sandstones of the Arén Formation at the base of the Tremp Formation (López-Martínez et al., 2001). Blasi 3 is a 1-m-thick layer of massive grey calcareous sandstone with a large amount of fossil remains pertaining to hadrosaurid dinosaurs (*Arenysaurus*) and other vertebrates (López-Martínez et al., 2001; Pereda-Suberbiola et al., 2009). Blasi 2 is just under Blasi 3.

Blasi 2, as well as the other sites at Blasi, has been judged to be late Maastrichtian in age on the basis of its micropalaeontological content and its correlation with basinal marine strata. The latter contain planktonic foraminifera from the Upper Maastrichtian *Abathomphalus mayaroensis* Biozone (López-Martínez et al., 2001). A refinement of the age of the Blasi sites has been carried out using magnetostratigraphy; this work shows that the Blasi sites were located at the upper part of a normal polarity chron correlated to chron C30n (i.e. slightly older than 65.6 Ma (Oms and Canudo, 2004; Pereda-Suberbiola et al., 2009).

The small vertebrate remains from Blasi 2 were obtained by concentrating the sediment after a process of washing and sieving (with a mesh size of 0.5 mm). The amount of washed and sieved sediment approximated five tons, all of it excavated during the campaign of 1997. The fossils are small and completely disarticulated. The bones are typically broken, but appear to have been deposited under relatively quiet conditions since they show little evidence of polishing or abrasion.

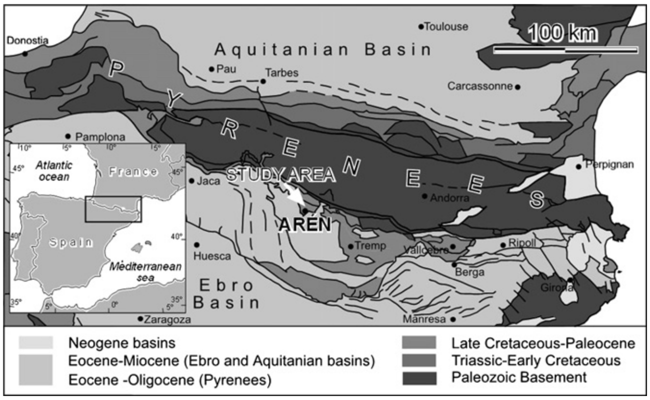


Fig. 1. Map showing the location of the Blasi sites in Arén (Huesca, south-central Pyrennees). Modified from Pereda-Suberbiola et al., 2009.

The small vertebrate assemblage is composed of isolated teeth of theropod dinosaurs (Torices et al., 2004), hadrosaurids, crocodilians ("Trematochampsidae" indet. and *Acynodon*, López-Martínez et al., 2001), the testudine *Polysternon* (Murelaga and Canudo, 2005), amphibians and squamates (this work), and fishes (Lepisosteidae indet., Pycnodontiformes indet.). Moreover, dinosaur eggshell remains are abundant (López-Martínez et al., 1999). Plant debris, charophytes and gastropods are also common; noticeable is the absence of mammals.

3. Systematic palaeontology

The material from Blasi 2 is stored in the collections of the Museo Paleontológico de Zaragoza (MPZ).

Class: Amphibia Linnaeus, 1758
Subclass: Lissamphibia Haeckel, 1866
Order: Allocaudata Fox and Naylor, 1982
Family: Albanerpetontidae Fox and Naylor, 1982
Albanerpeton aff. *nexuosum* (Estes, 1981)
Fig. 2

Material. 3 premaxillae [MPZ 2009/179-181], 4 maxillae (2 left [MPZ 2009/182-183] and 2 right [MPZ 2009/184-185]), 25 dentaries (14 left [MPZ 2009/186-199], 9 right [MPZ 2009/200-208] and 2 indet. [MPZ 2009/207-208]), 8 indeterminate partial jaws [MPZ 2009/211-218], 1 frontal [MPZ 2009/219], 5 humeri [MPZ 2009/221-225] and 2 trunk vertebrae [MPZ 2009/226-227].

Premaxillae. The premaxillae seem to be rather slender, small (the best-preserved bone is 1.5 mm deep; Fig. 2A and B), and with at least 4 preserved tooth positions. The teeth have three small cusps (Fig. 2A and B), as is characteristic of albanerpetontids (Gardner, 2001, 2002). None of the premaxillae are fused together, but they preserve an inter-premaxillary contact that is broadly sutured medially. The best-preserved premaxilla shows a well-developed dorsoventrally directed medial flange (Fig. 2A and B). The labial side of the *pars dorsalis* is not ornamented but is perforated by a few external nutritive foramina (Fig. 2B). There is no evidence of a boss on the upper part of the *pars dorsalis*. In lingual view, the suprapalatal pit is set just above the *pars palatinum* and has a ventral edge continuous with the dorsal face of the *pars palatinum*: this recalls the condition in *Albanerpeton* (with the exception of *Albanerpeton arthridion;* Gardner, 1999) and differs from *Celtedens* and *Anoualerpeton* where the ventral edge of the pit is well above the dorsal face of the *pars palatinum* (Gardner, 2002; Gardner et al., 2003; Venczel and Gardner, 2005; character 9). The diameter of the palatal foramen (Fig. 2D) is relatively small (Gardner, 2002; Gardner et al., 2003; Venczel and Gardner, 2005; ch. 14 state 0 rather than 1), unlike in *Albanerpeton galaktion*. Although sediment partially hides the suprapalatal pit area in the best-preserved premaxilla, it seems to have the same morphology as that described by Folie and Codrea (2005) in *Albanerpeton* sp. from the Maastrichtian of Romania: it is bordered by two well-developed internal supports, the bases of which are located on the *pars palatinum* and converge dorsally just above the suprapalatal pit.

Maxillae. The two best-preserved maxillae are mostly complete, with only the premaxillary lateral process being absent. The dental row length is between 2 and 3 mm, with no more than about 15 tooth positions. In lateral view, the *pars facialis* is shallow and tapers