

Baryonychine teeth (Theropoda: Spinosauridae) from the Lower Cretaceous of La Cantalera (Josa, NE Spain)

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Abstract

We describe isolated teeth of baryonychine theropods coming from La Cantalera locality (Josa, Teruel province, Aragón, NE Spain), an outcrop of clays of the Blesa Formation (latest Hauterivian-earliest Barremian), with a high concentration of vertebrate remains, formed in a palustrine environment with no permanent water. Teeth are labiolingually compressed, with both edges serrated, and, unlike in *Baryonyx*, with both sides ornamented with ridges, and are assigned to Baryonychidae indet.. These teeth represent one of the oldest records of baryonychines. We propose that it is possible that baryonychines originated in Europe and migrated to Gondwana in the Barremian-Aptian. The absence of fish remains in La Cantalera allow us to propose that these baryonychines did not eat only fish but have a more general feeding range.

Introduction

The spinosaurids are a group of tetanure theropods with extensive representation in the Barremian in Europe and the Aptian-Cenomanian in Africa (CHARIG & MILNER 1997, BUFFETAUT & OUAJA 2002). In keeping with current phylogenetic proposals (ALLAIN 2002), the spinosaurids must have been represented since the Early Jurassic, however it is at the end of the Lower Cretaceous that they are well represented and diversified. They are frequently found at the accumulation deposits from the Barremian of the Iberian Peninsula, and in many cases their teeth are the most abundant theropod remains. The different morphologies found in the teeth indicate that there are several taxa represented, which are different to those described (CANUDO & RUIZ-OMEÑACA 2003). For the moment, the material is too fragmented for the description of new taxa.

We describe isolated teeth of baryonychine theropods from the locality of La Cantalera (Josa, Teruel Province, Aragón, NE Spain). La Cantalera is an outcrop of Lower Cretaceous clays («Weald facies»), specifically clays from the Calizas y margas de Blesa Formation (latest Hauterivian-earliest Barremian; biozone of *Atopochara trivolvis triquetra*, subzone *triquetra*; AURELL et al., 2004) with a high concentration of vertebrate remains, mainly isolated teeth but also bones and eggshells fragments of fishes, amphibians, turtles, crocodiles, pterosaurs, dinosaurs and mammals (RUIZ-OMEÑACA & CANUDO 2001). La Cantalera locality is situated in the SW of Josa (Fig. 1), in the valley of the river La Cantalera. Geologically, the locality is placed in the Western Iberian Range, and more exactly in the Oliete Subbasin, one of the sub basins of the Lower Cretaceous Maestrazgo Basin. The locality is a wide outcrop of grey clays with very abundant vegetal remains, carbonate nodules formed in paleosols, and reworked marine fossils. The site was formed in a palustrine environment with no permanent water and abundant vegetation in the surrounding area (RUIZ-OMEÑACA et al., 1997, RUIZ-OMEÑACA & CANUDO 2001).

Among dinosaurs, there are remains of ornithomorphs (hypsilophodontids, «iguanodontids» and a possible hadrosaur), thyrophorans (polacanthids), sauropods (euhelopodids), and teeth of different theropods: Theropoda indet., Baryonychinae indet., Coelurosauria indet., «*Prodeinodon*» sp., Dromaeosauridae indet., Aves? indet. (RUIZ-OMEÑACA et al., 1997, RUIZ-OMEÑACA & CANUDO 2001, 2003, CANUDO & RUIZ-OMEÑACA 2003, CANUDO et al., 2004). Moreover, AMO SANJUAN (1998: 28) states that this deposit includes eggshell fragments of ornithomorph (Elongatoolithidae indet.) which may belong to theropods, maybe oviraptorids. The aim of this work is to describe, for the first time, the teeth of baryonychines from La Cantalera. Its importance comes from the fact that they are the oldest (well dated) of the Iberian Peninsular record (latest Hauterivian-earliest Barremian), and that they are morphologically different to those found in the rest of the Iberian Barremian. Moreover, the great diversity of fossil vertebrates at La Cantalera allows us to check the hypothesis of the spinosaurids as piscivores.

Systematic palaeontology

Saurischia SEELEY, 1888

Theropoda MARSH, 1881

Tetanurae GAUTHIER, 1986

Spinosauroidea STROMER, 1915 (*sensu* ALLAIN 2002)

Spinosauridae STROMER, 1915

Baryonychinae SERENO, BECK, DUTHEIL, GADO, LARSSON, LYON, MARCOT, RAUHUT, SADLEIR, SIDOR, VARRICCHIO, WILSON & WILSON, 1998

Baryonychinae indet. (Fig. 2, Table 1)

Described material: We have 16 teeth and teeth fragments, recovered during the prospecting, excavating, washing and sifting process during years 1997 and 2000; they are all conserved at the Museo Paleontológico de la Universidad de Zaragoza (MPZ), with references MPZ97|468, MPZ2001|207-208 and MPZ2005|303-315). Moreover, there are some more teeth of other baryonychines, from the 2002 campaign (Teruel Palaeontology Foundation Museum collection), which have not been included in this work. Three of these teeth (MPZ97|468, MPZ2001|207-208) have been figured previously (RUIZ-OMEÑACA et al., 1997: fig. 3; CANUDO & RUIZ-OMEÑACA 2003: figs. 4A, 4B, 4G). MPZ97|468 was described as Theropoda indet. B by RUIZ-OMEÑACA et al. (1997: 21), and subsequently assigned to Baryonychinae indet. by RUIZ-OMEÑACA et al. (1998: 216); MPZ2001|207-208 were classified as Baryonychinae indet. (CANUDO & RUIZ-OMEÑACA 2003: 355), but not described.

Description and discussion

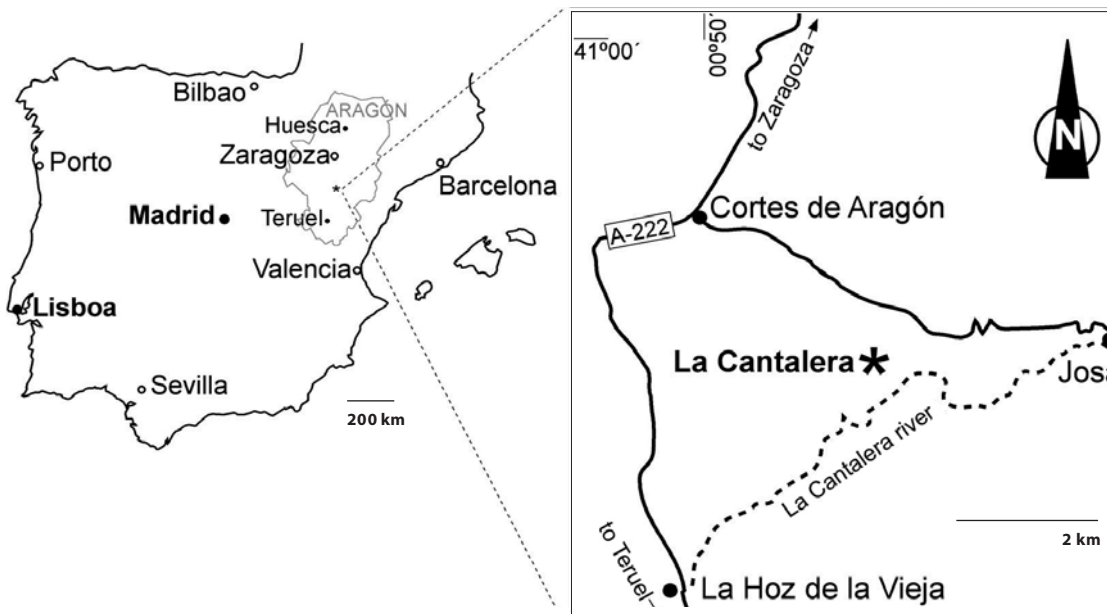
All the teeth, but MPZ2001|207-208, have no roots and can be identified as shed teeth. The teeth have no evidences of abrasion due to long-term transport. Baryonychine teeth from La Cantalera (Fig. 2) are labiolingually compressed, and have both edges serrated and both sides ornamented with ridges. The FABL of the teeth ranges from 3 to 15 mm; the number of ridges on both sides varies from 3 to 9; and the serrations are small, with 6–9 denticles|mm in the biggest specimens, and up to 13 denticles|mm in the smallest ones (Table 1).

The presence of both fine serrations and fluted enamel allow us to assign the teeth to the spinosaurid subfamily Baryonychinae (SERENO et al., 1998). These teeth differ from *Baryonyx walkeri* CHARIG & MILNER, 1986, from the Barremian of England (NAISH et al., 2001), by having both labial and lingual sides ornamented (only the lingual one in *B. walkeri*; CHARIG & MILNER, 1997) as in the isolated teeth of *Baryonyx* sp. from the Barremian of the Isle of Wight (MARTILL & HUTT 1996). The teeth from La Cantalera have an average of 6–13 denticles per millimetre, whereas those of *B. walkeri* have 7, and the Isle of Wight teeth have 7–8 (MARTILL & HUTT 1996). The teeth of *Suchomimus tenerensis* SERENO, BECK, DUTHEIL, GADO, LARSSON, LYON, MARCOT, RAUHUT, SADLEIR, SIDOR, VARRICCHIO, WILSON & WILSON, 1998, from the Aptian of Niger (SERENO et al., 1998) have

number	status	FABL (mm)	dent mm mesial	dent mm distal	number of ridges labial lingual sides
MPZ97 468	broken apex	6	~ 9–10 (very faint)	9.3	6 > 4 (broken)
MPZ2001 207	complete with root	15	6–8	6–7	8 3 (very faint)
MPZ2001 208	complete with root	8.1	7–8	6–7	7 5
MPZ2005 303	broken base	> 7.7	6–7	6–8	4 3 (very faint)
MPZ2005 304	broken apex	8.7	broken edge	6–7	6 3
MPZ2005 305	broken apex and base	> 5.6	no denticles? (enamel lose)	broken edge	6 6
MPZ2005 306	broken apex, only one side preserved	6.6	broken edge	broken edge	9 –
MPZ2005 307	broken apex, only one side preserved	6.4	broken edge	8–9 very faint	6 –
MPZ2005 308	very cracked	~ 9	6–7	broken edge	at least 5 3
MPZ2005 309	complete	4.7	~ 10 (very faint)	9–11	6 4
MPZ2005 310	complete	2.5	no denticles	12–13	6 6
MPZ2005 311	broken apex	3	no denticles	11	7 7
MPZ2005 312	only one side preserved	> 2.7	broken edge	9–10	4 –
MPZ2005 313	broken apex and base	> 4	broken edge	9 eroded	8 8
MPZ2005 314	broken base	> 2.5	12	12–13	3 1
MPZ2005 315	broken base	> 2.8	8 (very faint)	9	7 4

Table 1: Measurements of the teeth of *Baryonychinae* indet. from La Cantalera (Josa, Teruel, NE Spain).

Fig. 1: Geographic map of La Cantalera locality (Josa, Teruel, NE Spain), Hauterivian-Barremian transition.



not been described in detail, so a comparison with those of La Cantalera is not possible. After SERENO et al. (1998) *S. tenerensis* is distinguished from *B. walkeri* only by the premaxillary form and several features of the postcranial skeleton. Nevertheless, it is possible that *S. tenerensis* and *B. walkeri* were congeneric (NAISH et al., 2001, BUFFETAUT & OUAJATT 2002), indeed SUES et al. (2002) propose the name *Baryonyx tenerensis* for the Nigerian remains. A third possible baryonychine spinosaurid is *Cristatusaurus lapparenti* TAQUET & RUSSELL, 1998, also from the Aptian of Niger (TAQUET & RUSSELL 1998). The teeth of this species (a *nomen dubium* after SERENO et al., 1998, and a synonym of *Baryonyx* after CHARIG & MILNER 1997, BUFFETAUT & OUAJA 2002) have longitudinal ridges in the specimen type (juvenile) but not in the referred specimen (adult) (TAQUET & RUSSELL 1998). After TAQUET & RUSSELL (1998), the absence|presence of enamel striations is an uncertain taxonomic character in both spinosaurines and baryonychines, so we assign the La Cantalera teeth only to *Baryonychinae* indet.

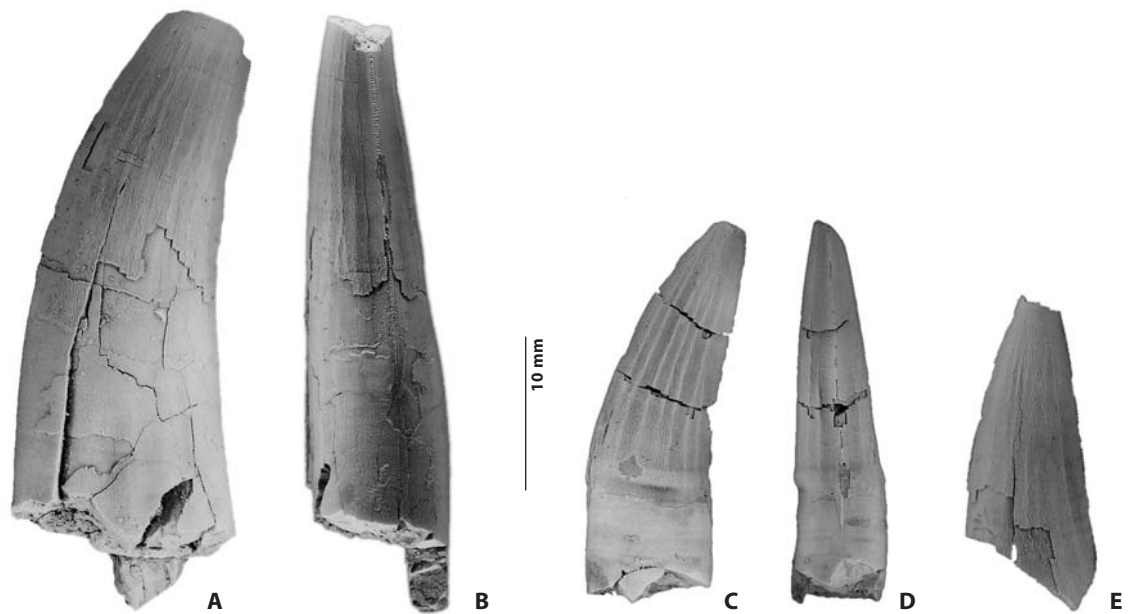
The teeth of baryonychines are relatively frequent in the latest Hauterivian-early Aptian of the Iberian Peninsula (provinces of Burgos, Castellón and Teruel), and have been assigned to *Baryonychinae* indet.

or cf. *Baryonyx* (see quotes in CANUDO & RUIZ-OMEÑACA 2003). The teeth of La Cantalera are the oldest (latest Hauterivian-earliest Barremian), with those of Vallipón (Teruel) of the late Barremian (RUIZ-OMEÑACA et al., 1998), those of the areas of Salas de los Infantes (Burgos) of the late Barremian-early Aptian (TORCIDA FERNÁNDEZ et al., 2003) and those of Morella (Castellón) of the early Aptian (CANUDO et al., 2004). The teeth of La Cantalera are different from those of the rest of localities in the fact they have a section which is more labiolingually compressed. The teeth of Vallipón lack mesial denticles (RUIZ-OMEÑACA et al., 1998), for which reason it is probable that there are at least two different baryonychines in the Iberian Peninsula (CANUDO & RUIZ-OMEÑACA 2003), both different from *B. walkeri*, without ornamentation on the labial face.

The teeth of La Cantalera, along with some English Hauterivian teeth (CHARIG & MILNER 1997), represent the oldest record of baryonychines, and are older than the African representatives («*Cristatusaurus*», «*Suchomimus*»), for which reason it is possible that the baryonychines originated in Europe and migrated to Gondwana in the transition between Barremian and Aptian (CANUDO & RUIZ-OMEÑACA 2003).

Fig. 2: Teeth of *Baryonychidae* indet. from La Cantalera (Josa, Teruel, NE Spain), in labial | lingual (A, C, E, F–H) and distal (B, D) views, with detail of the distal denticles (G).

A–B: MPZ2001|207 in labial | lingual and distal views,
C–D: MPZ2001|208;
E: MPZ2005|303;



Paleobiological Implications

Almost all the teeth have no roots, so they are shed and lost during mastication. It has been proposed that La Cantalera was a feeding area for herbivore dinosaurs, the most numerous at the locality (RUIZ-OMEÑACA et al., 1997, RUIZ-OMEÑACA & CANUDO 2001), whilst different carnivore organisms would also feed there. Despite the abundance of fossil vertebrate remains, the presence of fish is almost insignificant, the same being exceedingly small specimens. The lacustrine facies of the Lower Cretaceous of the Iberian Range contain abundant fish remains, for which reason their absence in La Cantalera is an additional motive to interpret that the water was rather short-lived. Moreover, the presence of ostracods and gasteropods resistant to periods of drought could indicate that the deposit possibly did not have a constant source of water in which fish could survive. It has been put forward that the spinosaurids, with very long faces similar to current aquatic crocodiles, specialised in eating fish (CHARIG & MILNER 1997). Recently, evidence has been put forward to show that the spinosaurids preyed on the pterosaur (BUFFETAUT et al., 2004), which would indicate a less selective diet, at least of some groups. The fossil record of La Cantalera would seem to indicate that these theropods did not eat only fish, at least in a context in which the same are not found. For this reason they must have had a more general feeding range, possibly on phytophage dinosaurs.

Acknowledgments

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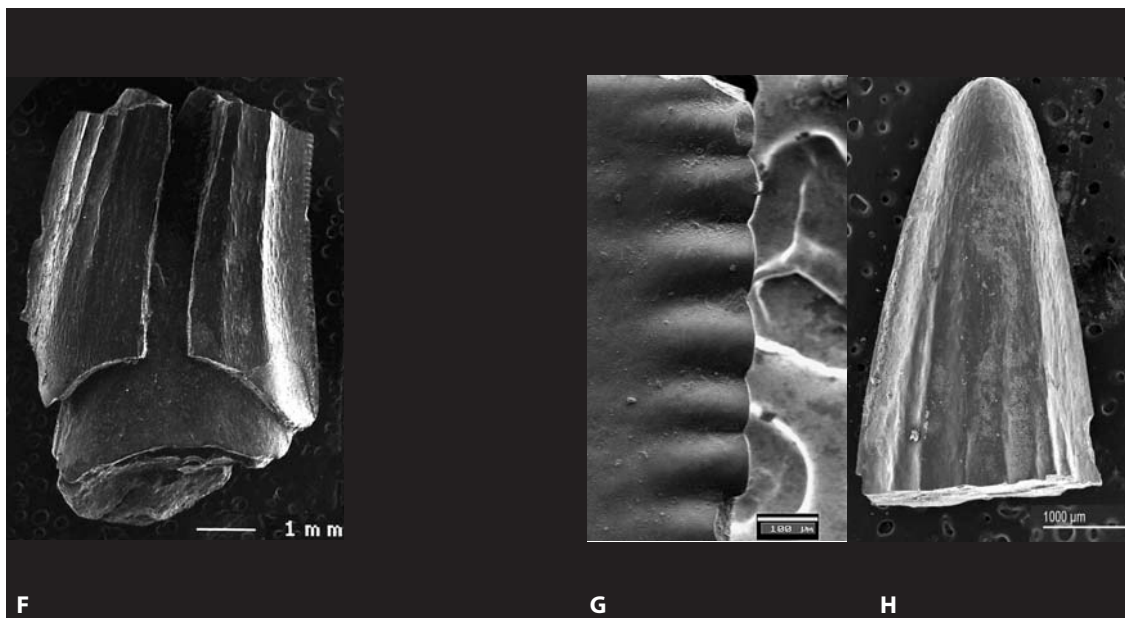


Fig. 2: Teeth of *Baryonychidae* indet. from La Cantalera (Josa, Teruel, NE Spain), in labial | lingual (A, C, E, F–H) and distal (B, D) views, with detail of the distal denticles (G).

F–G: MPZ97 | 468; H: MPZ2005 | 315. Scale bar: 10 mm (A–E), 1 mm (F, H) or 100 µm (G). A–E, specimens whitened with ammonium chloride; F–H, scanning electron microscope photographs.

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