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The last hadrosaurid dinosaurs of Europe: A new lambeosaurine from the Uppermost Cretaceous of Aren (Huesca, Spain)

Xabier Pereda-Suberbiola [a], José Ignacio Canudo [b,*], Penélope Cruzado-Caballero [b], José Luis Barco [c], Nieves López-Martínez [d], Oriol Oms [e], José Ignacio Ruiz-Omeñaca [b,f]

[a] *Universidad del País Vasco/EHU, Facultad de Ciencia y Tecnología, Dpto. Estratigrafía y Paleontología, Apdo. 644, 48080 Bilbao, Espagne*
[b] *Grupo Aragosaurus - IUCA, Paleontología, Facultad de Ciencias, Universidad de Zaragoza, Pedro Cerbuna 12, 50009 Zaragoza, Espagne*
[c] *Paleoymás SL, Polígono Inbisa-Empresarium, Retama 17, Nave 24-C, 50720 La Cartuja Baja, Espagne*
[d] *Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, 28040 Madrid, Espagne*
[e] *Universitat Autònoma de Barcelona, Departament de Geologia, 08193 Cerdanyola-del-Vallès, Espagne*
[f] *Museo del Jurásico de Asturias (MUJA), 33328 Colunga, Espagne*

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Abstract

A new hadrosaurid dinosaur, *Arenysaurus ardevoli* gen. et sp. nov., from the Late Maastrichtian of Aren (Huesca, South-central Pyrenees) is described on the basis of a partial, articulated skull, mandibular remains and postcranial elements, including vertebrae, girdle and limb bones. *Arenysaurus* is characterized by having a very prominent frontal dome; nearly vertical prequadratic (squamosal) and jugal (postorbital) processes, and deltopectoral crest of the humerus oriented anteriorly. Moreover, it possesses a unique combination of characters: short frontal (length/width approximately 0.5); midline ridge of parietal at level of the postorbital-squamosal bar; parietal excluded from the occiput; squamosal low above the cotyloid cavity. A phylogenetical analysis indicates that *Arenysaurus* is a rather basal member of Lambeosaurinae and the sister-taxon to *Amurosaurus* and the Corythosaurini-Parasaurolophini clade. The phylogenetic and biogeographical relationships of *Arenysaurus* and other lambeosaurines suggest a palaeogeographical connection between Asia and Europe during the Late Cretaceous. ***To cite this article: X. Pereda-Suberbiola et al., C. R. Palevol 8 (2009).***

Résumé

Les derniers dinosaures hadrosauridés d'Europe : un nouveau lambéosauriné du Crétacé terminal d'Arén (Huesca, Espagne). Un nouveau dinosaure hadrosauridé, *Arenysaurus ardevoli* gen. et sp. nov., du Maastrichtien supérieur d'Arén (Huesca, Pyrénées méridionales) est décrit ici à partir d'un crâne partiel articulé, de restes mandibulaires et d'éléments postcrâniens, y compris des vertèbres et des os des ceintures et des membres. *Arenysaurus* est caractérisé par un dôme frontal très proéminent, par des processus postcotyloïde (squamosal) et jugal (postorbital) verticalisés et par une crête deltopectorale de l'humérus, orientée antérieurement. De plus, *Arenysaurus* montre une combinaison unique de caractères : frontal court (longueur/largeur environ 0,5) ; crête médiane du pariétal située au niveau de la barre postorbital-squamosal ; pariétal exclu de l'occiput ; squamosal bas au-dessus

* Corresponding author.
E-mail addresses: xabier.pereda@ehu.es (X. Pereda-Suberbiola), jicanudo@unizar.es (J.I. Canudo), penelope@unizar.es (P. Cruzado-Caballero), jlbarco@paleoymas.com (J.L. Barco), lopezmar@geo.ucm.es (N. López-Martínez), joseporiol.oms@uab.cat (O. Oms), jigruiz@unizar.es (J.I. Ruiz-Omeñaca).
URL: http://www.aragosaurus.com (J.I. Canudo).

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de la cavité cotyloïde. Une analyse phylogénétique montre qu'*Arenysaurus* est un lambéosauriné plutôt basal et le groupe frère d'*Amurosaurus* et du clade Corythosaurini-Parasaurolophini. Les relations phylogénétiques et biogéographiques d'*Arenysaurus* et d'autres lambéosaurinés suggèrent une connexion paléogéographique entre l'Asie et l'Europe, au cours du Crétacé supérieur. ***Pour citer cet article : X. Pereda-Suberbiola et al., C. R. Palevol 8 (2009).***

Keywords: Hadrosauridae; *Arenysaurus ardevoli* nov. gen. et sp.; Maastrichtian; Huesca; Iberian Peninsula

Mots clés : Hadrosauridae ; *Arenysaurus ardevoli* nov. gen. et sp. ; Maastrichtien ; Huesca ; Péninsule ibérique

1. Introduction

The fossil record of Iberian hadrosaurids is probably the best of Europe. Of nearly 50 localities of Late Cretaceous age (Campanian-Maastrichtian) known in Europe, almost the half are located in the Iberian Peninsula and more specifically in the South-central Pyrenees of Lleida (Catalonia) and Huesca (Aragón), in Spain. In spite of the large amount of remains discovered in the last years, only a part is available for study (numerous bones are still unprepared) and skull material remains rare. Consequently, only one Iberian named species is widely accepted: *Pararhabdodon isonensis* from the Maastrichtian of the Tremp Formation, in Lleida [3]. The status of *Koutalisaurus kohlerorum*, a species recently erected on the basis of a dentary previously ascribed to *P. isonensis* [29], remains uncertain [28]. At least three different hadrosauroid taxa are known in the Upper Maastrichtian formations of the Iberian Peninsula, though they are indeterminate at the genus and species level [20,28]. Other hadrosaurid species from the European Cretaceous archipelago that are represented by relatively complete cranial material are *Telmatosaurus transsylvanicus* from the Maastrichtian of Transylvania, in Romania [6,35], and an unnamed hadrosaurid from the Santonian-Campanian of Trieste, NE Italy [6].

Here we describe a new genus and species of hadrosaurid dinosaur from the Latest Cretaceous (Late Maastrichtian) of Aren (Huesca, Spain). Significant cranial remains, including the best preserved skull of western European hadrosauroids, and associated postcranial bones, represent the new taxon. The phylogenetical and palaeobiogeographical implications of this discovery are also discussed.

2. Methods

2.1. Terminology

The node-based definition of Hadrosauridae used here is "the clade consisting of *Telmatosaurus* and *Parasaurolophus*, their most recent common ancestor and all descendants" [19,35]. Other authors [11,29,31] have argued for a more restrictive definition of Hadrosauridae: "Lambeosaurinae plus Hadrosaurinae and their most recent common ancestor" (= Euhadrosauria [35]). The stem-based definition of Lambeosaurinae is: "all hadrosaurids more closely related to *Parasaurolophus* than to *Saurolophus*" and that of Hadrosaurinae, "all hadrosaurids more closely related to *Saurolophus* than to *Parasaurolophus*" [31]. Within lambeosaurines, Corythosaurini are "all taxa more closely related to *Corythosaurus* than to *Parasaurolophus*", and Parasaurolophini "all taxa more closely related to *Parasaurolophus* than to *Corythosaurus*" [8]. Finally, Hadrosauroidea can be defined as "all iguanodontians more closely related to *Parasaurolophus* than to *Iguanodon*" [31].

2.2. Institutional abbreviations

BMNH: The Natural History Museum, London, U.K.; **MPZ**: Museo Paleontológico de la Universidad de Zaragoza, Gobierno de Aragón, Zaragoza, Spain.

3. Geological and chronological frame

The vertebrate-bearing localities of Aren (NE Huesca, Spain, 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 Aren and near the Blasi Hill. The fossiliferous sites have been numbered Blasi 1 to Blasi 5 [20]. Blasi 1 is located on the top of the Aren Sandstone (Fig. 2) whereas the other sites are located in the lower part of the overlying Tremp Formation. These sites occur in delta-front, lagoonal and coastal deposits of the Aren 4 depositional sequence [1,20].

The hadrosaurid material described here comes from the Blasi 3 site, which is the richest one in vertebrate fossils. It is situated in a 1-m thick grey massive calcareous sandstone containing *Ophiomorpha* burrows. Blasi 3 and the other Blasi sites are physically correlated with basinal