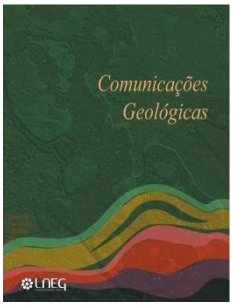
Comunicações Geológicas

Comunicações Geológicas (2021) 108, Especial I, 149-152
**ISSN:** 0873-948X; **e-ISSN:** 1647-581X

# First evidence of a non-thalattosuchian mesoeucrocodylian from the Upper Jurassic of Spain (Villar del Arzobispo Formation, Alpuente)




# Primeira evidência de um Mesoeucrocodylia não-Thalattosuchia do Jurássico Superior de Espanha (Formação de Villar del Arzobispo, Alpuente)

S. Sánchez-Fenollosa[1,2*], M. Suñer [2], A. Gamonal[2], C. de Santisteban[1]

DOI: https://doi.org/10.34637/y79b-h231
Recebido em 07/04/2021 / Aceite em 29/08/2021
Publicado online em maio de 2022


Artigo original
Original article

**Abstract**: Non-thalattosuchian mesoeucrocodylian fossil remains from the Upper Jurassic of Europe are mainly comprised by isolated teeth, and come from Portugal, France and Germany. In the present study, we report the occurrence of a small crocodylomorph tooth from a new fossil site named "Puente de La Hortichuela" located in the Villar del Arzobispo Formation on the municipality of Alpuente (Valencia, Spain). The tooth has been recovered from the lower third of this lithostratigraphic unit with an Upper Jurassic age. The tooth has molariform or tribodont morphology, kidney-shape cross section, and enamel ornamentation formed by parallel basiapical ridges. These characteristics lead us to tentatively identify the tooth as belonging to the middle or posterior dentition of a bernissartiid. This finding is the oldest record of a non-thalattosuchian mesoeucrocodylian from Spain and provides new information about the fauna that inhabited this region.

**Keywords**: Bernissartiidae, Crocodylomorpha, eastern Iberia Peninsula, fossil tooth, Upper Jurassic.

**Resumo**: Restos fósseis de mesoeucrocodilos não-thalattosuchio do Jurássico Superior da Europa correspondem principalmente a dentes isolados, provenientes de Portugal, França e Alemanha. No presente estudo, registamos a ocorrência de um pequeno dente de crocodiliforme recolhido numa nova jazida, chamada "Puente de La Hortichuela", da Formação Villar del Arzobispo no município de Alpuente (Valencia, Espanha). O dente foi recuperado do terço inferior desta unidade litostratigráfica de idade Jurássico Superior. O dente tem morfologia molariforme ou tribodonte, seção transversa em forma de rim e ornamentação do esmalte formada por cristas basiapicais paralelas. Estas características permitem-nos identificar o dente como pertencendo à dentição média ou posterior de um bernissartídeo. Este achado é o registo mais antigo de um mesoeucrocodilo não-thalattosuchio de Espanha e fornece nova informação sobre a fauna que habitava esta região.

**Palavras-chave**: Bernissartiidae, Crocodylomorpha, Península Ibérica oriental, dente fóssil, Jurássico Superior.

[1] Department of Botany and Geology, Universitat de València. Av. Dr. Moliner, 50, 46100 Burjassot, Spain.
[2] Museo Paleontológico de Alpuente, Av. San Blas 17, 46178 Alpuente, Spain.

* Corresponding author / Autor correspondente: sersanfe.paleo@gmail.com

## 1. Introduction

The Upper Jurassic to Lower Cretaceous vertebrate assemblages from Los Serranos region in NE Spain have been studied by different researchers over the last three decades. Mesozoic deposits, specifically in this area of Valencia and the south of Teruel Province, have yielded a large quantity of vertebrate fossils, testifying a great diversity of taxa (see Gamonal *et al*., 2018 and references therein). But, despite the numerous dinosaur systematic studies published, studies involving other archosaur analyses are relatively scarce.

Crocodylomorph remains are not uncommon in these deposits, but most of them consist of isolated teeth, osteoderms or other fragmentary postcranial elements (Royo-Torres *et al*., 2006; Suñer and Martín, 2009). Nevertheless, Royo-Gómez (1926) and more recently Gamonal *et al*. (2018; 2019), have reported the occurrence of the large marine teleosaurid *Machimosaurus* sp., in this area based on dental and postcranial remains.

Here, we present a description of the first evidence of a non-thalattosuchian mesoeucrocodylian from the Villar del Arzobispo Formation found on the municipality of Alpuente (Province of Valencia, Spain) and the oldest record of this group from Spain.

## 2. Geographical and geological setting

The Puente de La Hortichuela site is found near of the confluence of Arquela and Reguero dry riverbed, in the municipality of Alpuente (Los Serranos region, NW Valencia Province), and is located within the Calizas, areniscas y arcillas de Villar del Arzobispo Formation, a mixed siliciclastic-carbonate unit at the eastern part of the Mesozoic Iberian Trough (Mas *et al*., 1984).

The studied material was recovered on sandy grey-bluish marls from a discontinuous level from the lower third of the Villar del Arzobispo Formation with an age of Upper Jurassic.

This unit, on the Northern sector of the Los Serranos region, comprises the Upper Jurassic–Lower Cretaceous? transition. On this sector, the Villar del Arzobispo Formation contains material of two facies associations (Baldovar facies association and

Riodeva facies association *sensu* Santisteban and Santos-Cubedo, 2010).

The fossil site is located in the materials from the Baldovar facies association, defined by a set of depositional sequences bounded by erosion surfaces. Every depositional sequence can be formed by one to fifteen parasequences. The basic most complete parasequence present a transgressive-regressive pattern and it is composed by a lithological succession of sandy grey-bluish marls, white micaceous sandstones, red clays and siltstones, and a calcareous paleosoil. Environmentally, deposits from shallow marine platform, delta and/or estuary, beach and fluvio-deltaic floodplain define this succession.

In figure 1, the sedimentology succession from the locality is shown, in which the three of these depositional sequences are represented. The intermediate one is limited by erosion surfaces, with a marked paleo-relief. The lower surface has a concave configuration with an abrupt edge that interrupts the continuity of a level of red clays and siltstones and an edaphic calcareous level with rhizocretions; and another edge, with less dip, with a terrace system in descent to the middle. Both surfaces isolate a channel-shaped body with and N-S orientation.

The infilling of this channel is comprised of sandy grey-bluish marls (fossiliferous level) and red clays and siltstones. On the environmental context of a wave-dominated delta system, the sandy marls correspond to the infilling of a non-tidal estuary. Dynamically this estuary is the result of the marine flooding, by transgression, of an incised valley developed previously the encroachment of the deltaic distributaries after a relative eustatic sea-level drop.

## 3. Material and methods

The studied material consists of an isolated tooth (MPA-1020) deposited in the Museum of Paleontology of Alpuente. It was found in Puente de La Hortichuela site and comes from the Villar del Arzobispo Formation. Currently, MPA-1020 has been the only fossil remain discovered at this fossil site.

This study is based on a 20 kg sample of sediments collected during a field campaign in June 2019. These were dried for four and five days. Later, the sample was put in water one week to break up the rock. The sediments were washed using a sieving table to remove particles < 0.5 mm and left it drying afterwards. When the sample was properly dry, we sifted it in different fractions (> 5 mm, > 2.5 mm, > 1.5 mm > 0.75 mm and > 0.5 mm). Finally, fossil remains were handpicked.

The photographs were made by a Scanning Electron Microscope (SEM) Hitachi S4800 at the University of Valencia. Previously, the tooth received a gold-palladium bath for two minutes.

## 4. Systematic paleontology

CROCODYLOMORPHA Walker, 1970 (*sensu* Clark, 1986)
MESOEUCROCODYLIA Whetstone and Whybrow, 1983 (*sensu* Benton and Clark, 1988)
NEOSUCHIA Benton and Clark, 1988
BERNISSARTIIDAE Dollo, 1883

Genus and species undetermined

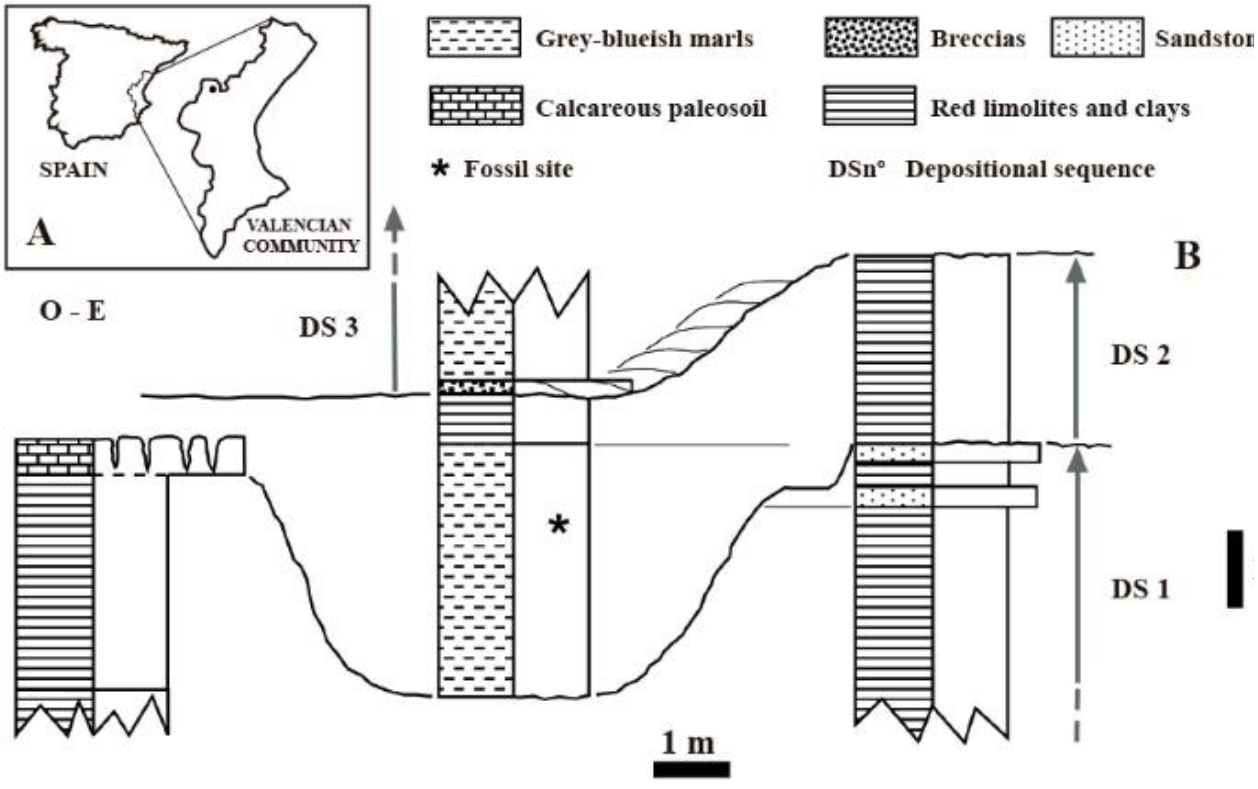



Figura 1. (a) Localizaçao geográfica de Alpuente. (b) Três sequências deposicionais presentes no sítio fóssil Puente de La Hortichuela.

Figure 1. (a) Geographic location of Alpuente, (b) Three depositional sequences present on the Puente de La Hortichuela fossil site.

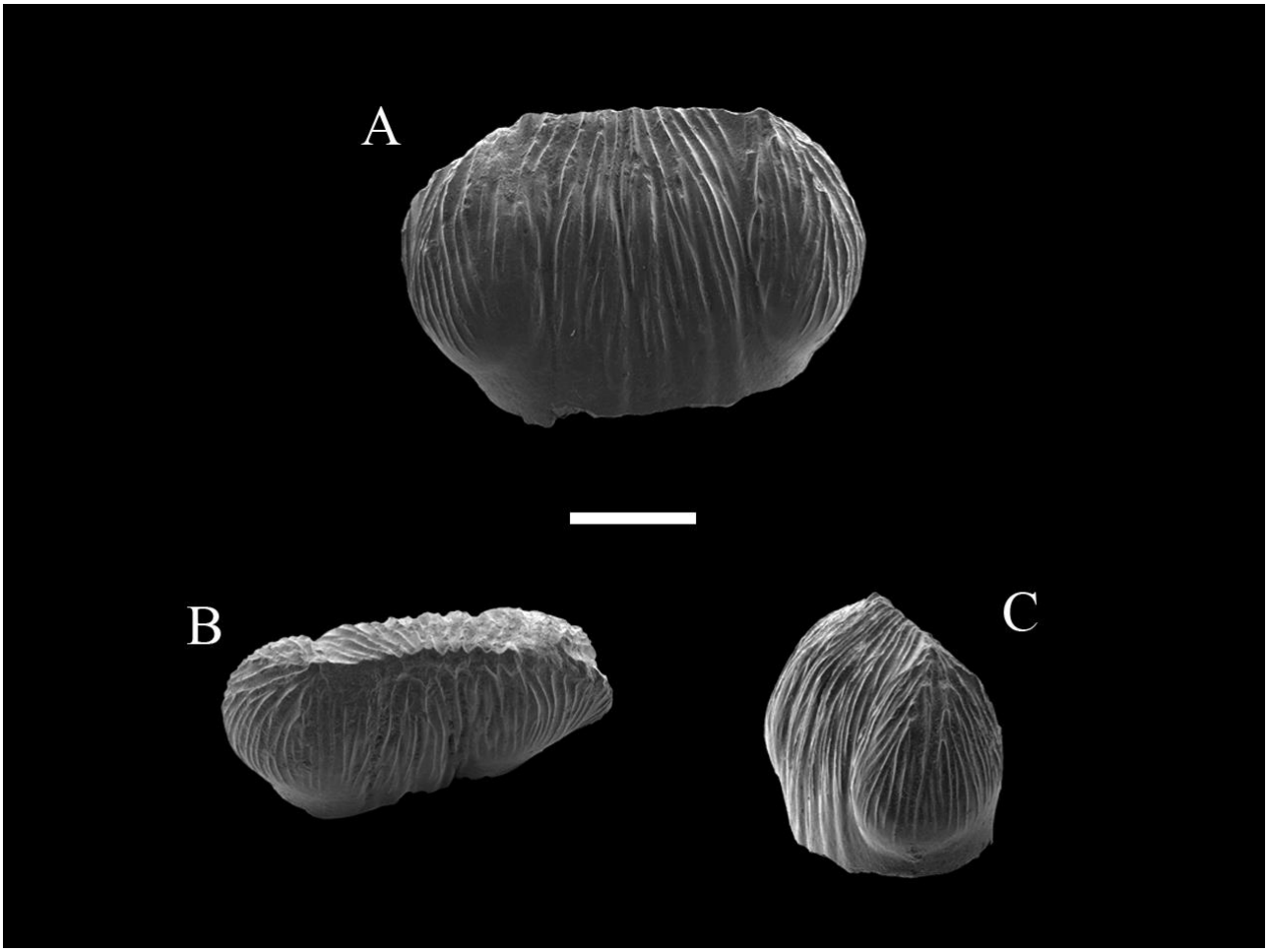



Figura 2. MPA-1020, dente isolado in visão labial (a), apical (b) and distal/mesial (c). Barra de escala: 0,5 mm.
Figure 2. MPA–1020, isolated tooth in labial (a), apical (b) and distal/mesial (c) views. Scale bar: 0.5 mm.

*Referred material*. Isolated tooth (MPA-1020).
*Locality*. Puente de La Hortichuela site, in the municipality of Alpuente (Valencia, Spain).
*Horizon and age*. MPA-1020 comes from the lower third of the Villar del Arzobispo Formation (Upper Jurassic).

*Description*. MPA-1020 (Fig. 2) is a molariform or tribodont tooth, bulky, with low crown and blunt apex. Its height is 1.2 mm and its width is 1.8 mm. Therefore, it is significantly wider than it is tall with an H/W ratio of 0.6. The base of the crown is labiolingually and mesiodistally constricted. It has an elliptical/kidney shaped cross-section. The labial surface is slightly more convex than the lingual surface. The morphology of the distal and mesial margins is rounded. The enamel ornamentation is formed by thin parallel basiapical ridges that do not reach the base of the crown at the distal and mesial regions. The apical surface is faintly worn, and an occlusal crest can be observed.

## 5. Discussion

The presence of tribodont and bulbous crown morphology, kidney-shaped cross section and enamel ornamentation comprised by parallel basiapical ridges (Fig. 2) are characters observed in MPA-1020 tooth and in bernissartiid teeth from the middle or posterior region of the tooth row. (Guillaume *et al*., 2019 and references therein).

MPA-1020 differs from the leaf-shape to lanceolate outline observed in other contemporary non-thalattosuchian mesoeucrocodylian teeth with no conical morphology, like atoposaurids and *Lusitanisuchus* (Schwarz and Fechner, 2004; Puertólas-Pascual *et al*., 2015; Guillaume *et al*., 2019).

The crown height ranges from 3 to 6 mm for adult bernissartiid teeth (Puertólas-Pascual *et al*., 2015). Judging from the small size and the little wear of the specimen studied, it may belong to a juvenile individual.

Currently, bernissartiid and other non-thalattosuchian mesoeucrocodylian remains from the Late Jurassic of Europe are mostly comprised by teeth. They come from Guimarota and Lourinhã vertebrate microfossil assemblages in Portugal (Brinkman, 1989; Guillaume *et al*., 2019) and Purbeck-type bonebeds of Chassiron in France (Vullo *et al*., 2014).

The morphology of this specimen can be also linked to a specific ecology and diet. This type of tooth is associated with a durophagous diet, probably focused on arthropods, gastropods, bivalves and other little shelly animals. This morphology is also present in other taxa from different ages and not closely related with Bernissartiidae, such as *Unasuchus* (Brinkman, 1992),

*Acynodon* (Buscalioni *et al*., 1997), *Brachychampsa* (Gilmore, 1911), the extant *Osteolaemus* (Pauwels *et al*., 2007), etc. Therefore, the presence of this type of morphology may be more closely linked to dietary function than phylogenetic relatedness (Puértolas-Pascual *et al*., 2015; Sweetman *et al*., 2015; and references therein).

## 6. Conclusions

The tooth from Puente de La Hortichuela fossil site tentatively corresponds to the mid-posterior dentition of a bernissartiid due to the tribodont and bulbous crown morphology, kidney-shaped cross section and enamel ornamentation comprised by parallel basiapical ridges.

This is the first evidence of a non-thalattosuchian mesoeucrocodylian in the Villar del Arzobispo Formation from Alpuente area, and the oldest record from Spain. This finding provides new information about the taxa that inhabited this region and its ecosystems.

To date, MPA-1020 is the only fossil recovered from Puente de La Hortichuela fossil site, further studies on this site will reveal more data about this site and new findings could allow comparisons with coeval faunal assemblages from other regions of Europe.

## Acknowledgments

C. de Santisteban acknowledges support from the Project CGL2017-85038-P, funded by the Ministerio de Ciencia, Innovación y Universidades from the Spanish Government. SEM photographs were carried out by SSF in the framework of his Master's Degree in Applied Paleontology classes at the University of Valencia. We appreciate the useful comments and suggestions made by the reviewers J.L. Canudo, E. Puértolas-Pascual and I. Narváez and the editor A. de Celis.

## References

Brinkmann, W., 1989. Vorläufige Mitteilung über die Krokodilier-Faunen aus dem Ober-Jura (Kimmeridgium) der Kohlegrube Guimarota, bei Leiria (Portugal) un der Unter-Kreide (Barremium) von Uña (Provinz Cuenca, Spanien). *Documenta Naturae*, **56**: 1-28.

Brinkmann, W., 1992. Die krokodilier-fauna aus der Unter-Kreide (Ober-Barremium) von Uña (Provinz Cuenca, Spanien). *Berliner Geowissenschaftliche Abhandlungen*, **5**: 1-123.

Buscalioni, A. D., Ortega, F., Vasse, D., 1997. New crocodiles (Eusuchia: Alligatoroidea) from the Upper Cretaceous of southern Europe. *Comptes Rendus de l'Académie des Sciences-Series IIA-Earth and Planetary Science*, **325**: 525-530.

Gamonal, A., Granados, A., Suñer, M., Santisteban, C., 2018. Vertebrate remains from the breccia level of Cañada Judía, Alpuente, Valencia, Spain. *Libro de Resúmenes, XVI Encuentro de Jóvenes Investigadores en Paleontología*, Zarautz, Spain, 63-66.

Gamonal, A., Suñer, M., Santisteban, C., 2019. New post-cranial remains of a large teleosaurid in the Villar del Arzobispo Formation, Alpuente, Valencia, Spain. *Book of Abstracts, 4t$^h$ International Meeting of Early-Stage Researchers in Palaeontology*, Cuenca, Spain, 27.

Gilmore, C. W., 1911. A new fossil alligator from the Hell Creek beds of Montana. *Proceedings of the United States National Museum*, **41**(1860): 297-302.

Guillaume, A., Moreno-Azanza, M., Puértolas-Pascual, E., Mateus, O., 2019. Palaeobiodiversity of crocodylomorphs from the Lourinhã Formation based on the tooth record: insights into the palaeoecology of the Late Jurassic of Portugal. *Zoological Journal of the Linnean Society*, **189**(2): 549-583. https://doi.org/10.1093/zoolinnean/zlz112

Mas, R., Alonso, A., Meléndez, A., 1984. La formación Villar del Arzobispo: un ejemplo de llanuras de mareas siliciclásticas asociadas a plataformas carbonatadas. Jurásico terminal. (NW de Valencia y E de Cuenca). *Publicaciones de Geología*, **20**: 175-188.

Pauwels, O. S. G., Barr, B., Sanchez, M. L., Burger, M., 2007. Diet records for the dwarf crocodile, *Osteolaemus tetraspis tetraspis* in Rabi oil fields and Loango National Park, Southwestern Gabon. *Hamadryad*, **31**(2): 258-264.

Puértolas-Pascual, E., Rabal-Garcés, R., Canudo, J. I., 2015. Exceptional crocodylomorph biodiversity of 'La Cantalera' site (lower Barremian; Lower Cretaceous) in Teruel, Spain. *Palaeontologia Electronica*, **18**: 1-16. https://doi.org/10.26879/514

Royo-Gómez, J., 1926. Notas geológicas sobre la provincia de Valencia. *Boletín de la Real Sociedad Española de Historia Natural*, **26**: 66-87.

Royo-Torres, R., Cobos, A., Alcalá, L., 2006. A Giant European Dinosaur and a New Sauropod Clade. *Science*, **314**(5807): 1925-1927. https://doi.org/10.1126/science.1132885

Santisteban, C., Santos-Cubedo, A., 2010. Patrones de variación de facies en relación con regresiones forzadas en los depósitos de la Formación Villar del Arzobispo (Cuenca Íbero-Levantina). *Comunicaciones del V Congreso Jurásico de España, V Congreso Jurásico de España*, Colunga, Spain, 142-148.

Suñer, M., Martín, M., 2009. Un nuevo yacimiento del tránsito Jurásico-Cretácico de Alpuente (Los Serranos, Valencia, España): resultados preliminares. *Paleolusitana*, **1**: 441-447.

Schwarz, D., Fechner, R., 2004. *Lusitanisuchus*, a new generic name for *Lisboasaurus mitracostatus* (Crocodylomorpha: Mesoeucrocodylia), with a description of new remains from the Upper Jurassic (Kimmeridgian) and Lower Cretaceous (Berriasian) of Portugal. *Canadian Journal of Earth Sciences*, **41**: 1259-1271. https://doi.org/10.1139/e04-059

Sweetman, S. C., Pedreira-Segade, U., Vidovic, S. U., 2015. A new bernissartiid crocodyliform from the Lower Cretaceous Wessex Formation (Wealden Group, Barremian) of the Isle of Wight, southern England. *Acta Palaeontologica Polonica*, **60**: 257-268. https://doi.org/10.4202/app.00038.2013

Vullo, R., Abit, D., Ballèvre, M., Billon-Bruyat, J. P., Bourgeais, R., Buffetaut, E., Daviero-Gomez, V., Garcia, G., Gomez, B., Mazin, J. M., Morel, S., Néraudeau, D., Pouech, J., Rage, J. C., Schnyder, J., Tong, H., 2014. Palaeontology of the Purbeck-type (Tithonian, Late Jurassic) bonebeds of Chassiron (Oléron Island, western France). *Comptes Rendus Palevol*, **13**: 421-441. https://doi.org/10.1016/j.crpv.2014.03.003