




First evidence of a bothremydid turtle (crown Pleurodira) in the middle Cretaceous of Castile and Leon (Spain)

Adán Pérez-García¹ 

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Abstract

The internal cast of a turtle shell, found near the town of Cabrejas del Pinar (Soria Province, Castile and Leon Autonomous Community, Spain), is presented here. It is the first fossil vertebrate recognized in the vicinity of that town. This specimen was found in a middle Cretaceous bed (Cenomanian), deposited in a coastal marine environment. It is recognized as attributable to a member of the crown group Pleurodira. No representative of this clade had so far been found in pre-Campanian strata in the Castile and Leon Autonomous Community. In fact, the pre-Campanian record of the crown Pleurodira is very limited in Laurasia. The hitherto known record of pre-Campanian turtles from Castile and Leon consisted of basal forms (members of the terrestrial clade Helochelydridae and of the freshwater Pleurosternidae) and of freshwater representatives of Eucryptodira, all of them found in layers older than that where the new turtle remain was found. The availability of characters in the analyzed specimen allows it to be recognized as compatible with the littoral bothremydid turtle *Algorachelus*.

Keywords Testudines · Bothremydidae · *Algorachelus* · Cenomanian · Spain

Resumen

Se presenta aquí el molde interno del caparazón de una tortuga, procedente del término municipal de Cabrejas del Pinar (Provincia de Soria, Comunidad Autónoma de Castilla y León, España). El ejemplar corresponde al primer resto de un vertebrado fósil hallado en las inmediaciones de dicha población. Su hallazgo se produjo en un nivel del Cretácico medio (Cenomaniense), depositado en un ambiente marino costero. El espécimen es atribuible a un miembro del grupo corona Pleurodira. Ningún representante de este clado había sido previamente reconocido en niveles pre-campanienses de Castilla y León. De hecho, el registro pre-campaniense de Pleurodira es muy escaso en Laurasia. Las tortugas hasta ahora notificadas en los niveles pre-campanienses de Castilla y León estaban restringidas a formas basales (miembros del clado terrestre Helochelydridae y del acuático Pleurosternidae) y a representantes dulceacuícolas de Eucryptodira, todas ellas provenientes de niveles más antiguos que aquel del nuevo hallazgo aquí notificado. La disponibilidad de caracteres en el espécimen de Cabrejas del Pinar permite reconocerlo como compatible con el botremídido litoral *Algorachelus*.

Palabras clave Testudines · Bothremydidae · *Algorachelus* · Cenomaniense · España

1 Introduction

The internal cast of a turtle shell is presented here. This Spanish find comes from the lower part of the Upper Cretaceous (Cenomanian) of Cabrejas del Pinar (Soria Province, Castile and Leon Autonomous Community; Fig. 1).

No remain of this group of reptiles had previously been recognized in that locality.

The analyzed specimen cannot be attributed to a basal turtle, although only representatives of Helochelydridae (terrestrial members of Testudinata not attributable to Testudines) and Pleurosternidae (freshwater members of Testudinata not attributable to Testudines) had so far been identified in the Mesozoic record of Soria (Pérez-García 2009, 2017a; Pérez-García et al. 2019). It also does not belong to a member of Eucryptodira, which corresponded to the other clade of turtles previously found in pre-Campanian

✉ Adán Pérez-García
paleontologo@gmail.com

¹ Grupo de Biología Evolutiva, Facultad de Ciencias, UNED, Paseo Senda del Rey 9, 28040 Madrid, Spain

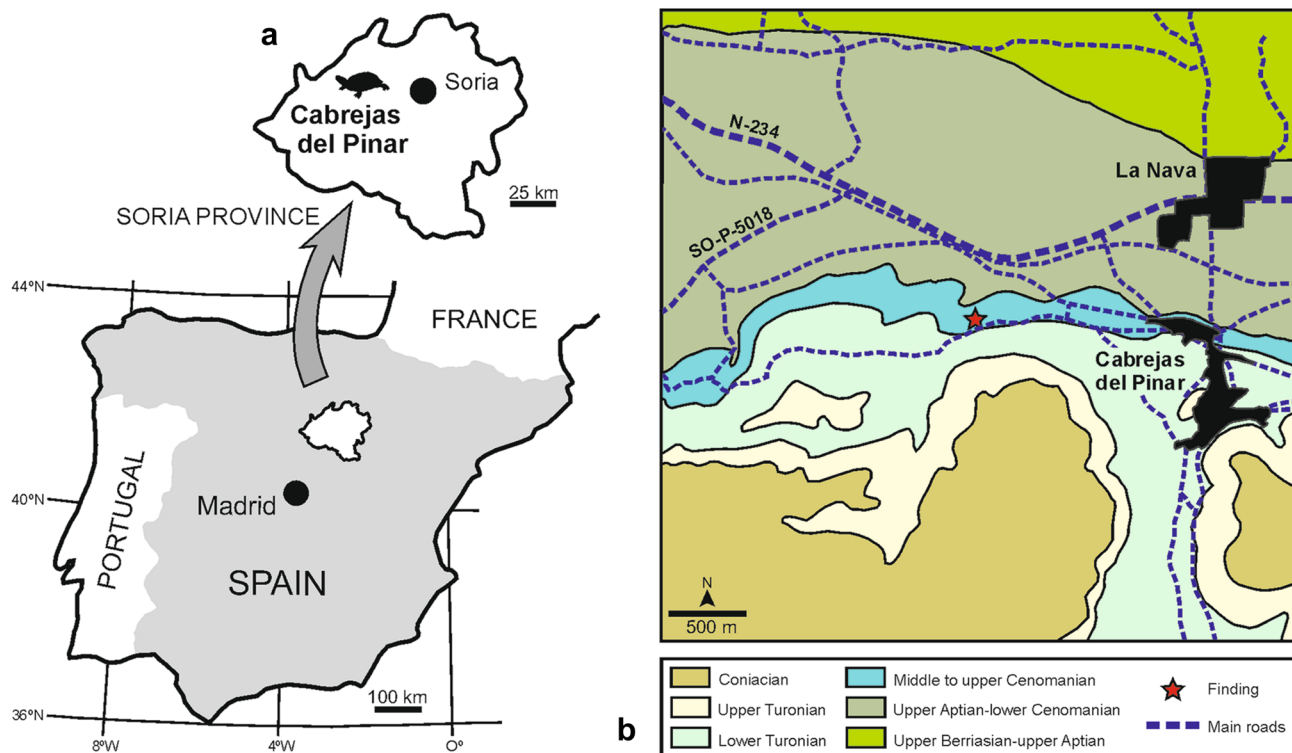


Fig. 1 Geographical (a) and geological (b) location of the find of the internal cast of the shell of cf. *Algorachelus* studied in this paper, STUS 17942, in a Cenomanian outcrop near the town of Cabrejas del

Pinar (Soria Province, Castile and Leon Autonomous Community, Spain). **b** is modified from Quintero Amador et al. (1981)

strata in the Autonomous Community of Castile and Leon (Pérez-García 2012; Pérez-García and Murelaga 2012). The systematic identification of this specimen is discussed here. This find, therefore, improves our knowledge of the diversity of turtles not only in the Mesozoic record of the Province of Soria but also in the Autonomous Community of Castile and Leon.

Institutional abbreviations: STUS, Sala de las Tortugas de la Universidad de Salamanca, Salamanca, Spain.

2 Systematic paleontology

Testudines Batsch 1788

Pan-Pleurodira Joyce, Parham and Gauthier 2004

Pleurodira Cope 1864

Pelomedusoides Cope 1868

Bothremydidae Baur 1891

Bothremyododa Gaffney, Tong and Meylan 2006

Bothremydini Gaffney, Tong and Meylan 2006

cf. *Algorachelus*

(Fig. 2)

Material:—STUS 17942, the internal cast of a shell, preserving a small region of the left hemipelvis (Fig. 2).

Locality and horizon:—Cabrejas del Pinar, Soria Province, Castile and Leon Autonomous Community, Spain (Fig. 1). Middle to upper Cenomanian (level C₂₁ in Quintero Amador et al. 1981).

Description:—STUS 17942 corresponds to the internal cast of a complete shell, with the exception of the area relative to the posterior region of the xiphiplastra (i.e., that located behind the ischia scars, including, therefore, the complete anal notch) (Fig. 2). The width of this specimen (13 cm) is slightly greater than the preserved length (11.7 cm). Therefore, this shell was almost as wide as long, with a subpentagonal shape. Thus, it had a broad and substraight anterior margin (with a very shallow and wide notch), but the posterior half of the carapace was pointed instead of rounded. The axillary and inguinal buttresses were well-developed, reaching the costal series. Due to the preservation, the layout of sutures cannot be recognized. Therefore, neither the morphology of any plate nor the number of neurals present in this individual can be characterized in detail. The anterior plastral lobe is recognized as much wider than long. Its anterior margin was located in a position close to that of the carapace. The pelvis was sutured with both the carapace and the plastron.

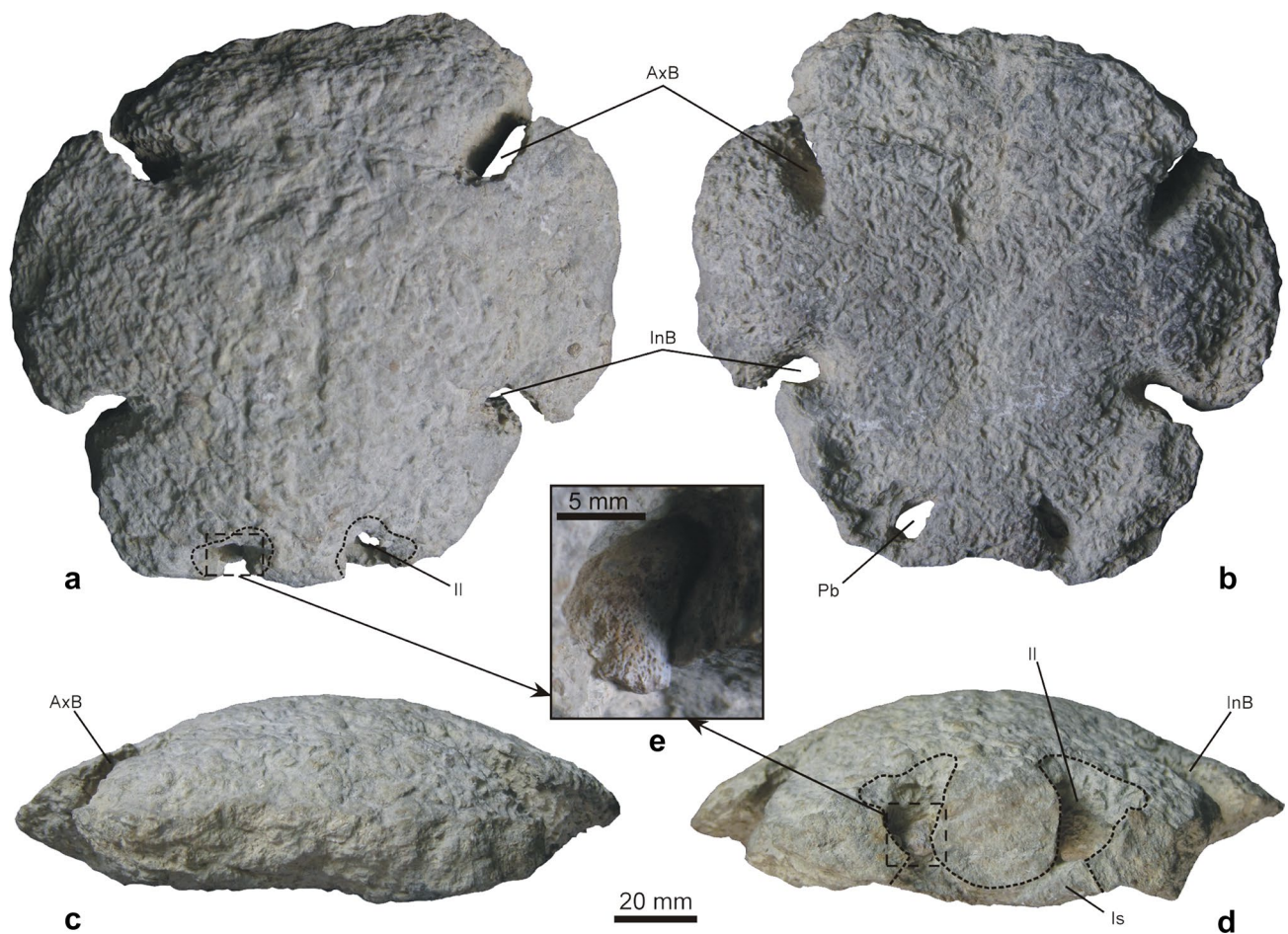


Fig. 2 STUS 17942, internal cast of a shell of cf. *Algorachelus*, from the Cenomanian of Cabrejas del Pinar (Soria Province, Castile and Leon Autonomous Community, Spain), in dorsal (**a**), ventral (**b**), anterior (**c**) and posterior (**d**) views. **e** Detail of the partially preserved

left hemipelvis, in dorso-posterior view. The margins corresponding to the pelvis mold are represented in **a** and **d**. *AxB* axillary buttress, *InB* inguinal buttress, *Il* ilium, *Is* ischium, *Pb* pubis

3 Discussion

3.1 An update on the record of Mesozoic turtles in Castile and Leon

Several turtle lineages have been identified in the Mesozoic record of the Spanish Autonomous Community of Castile and Leon, in both Lower Cretaceous and Upper Cretaceous strata. One of them corresponds to the clade of terrestrial basal turtles (stem Testudines) Helochelydridae, two representatives having been recognized: aff. *Helochelydra*, in the Lower Cretaceous (Hauterivian-Barremian) record of Barbadillo del Mercado and Cabezón de la Sierra (Burgos Province), and of Golmayo (Soria Province) (Pérez-García 2009, 2017a; Pérez-García et al. 2011); and at least one representative of the genus *Solemys* (i.e. *Solemys vermiculata* de Lapparent de Broin and Murelaga 1996), in the Upper Cretaceous (late Campanian–Maastrichtian) record of Laño and Quecedo de Valdivielso (Burgos Province), and of

Armuña (Segovia Province) (Murelaga et al. 2005; de Lapparent de Broin and Murelaga 1996, 1999; Pereda-Suberbiola et al. 2015a; Pérez-García et al. 2016). Basal turtles (sensu Pérez-García 2020) have also been recently identified by a freshwater lineage: Paracryptodira. Thus, an indeterminate member of Pleurosternidae, which could correspond to a new form, has been recognized in Ágreda (Soria Province), in a stratum located near the Jurassic-Cretaceous transition (Pérez-García et al. 2019). The crown Testudines is represented in the Mesozoic record of Castile and Leon by representatives of both Eucryptodira and Pan-Pleurodira. Thus, two basal members of Eucryptodira have been recognized in the Hauterivian-Barremian record of Salas de Los Infantes (Burgos Province): *Chitracephalus dumonii* Dollo 1885 and *Larachelus morla* Pérez-García and Murelaga 2012 (Pérez-García 2012; Pérez-García and Murelaga 2012). A more derived indeterminate form, corresponding to Cheloniidae (crown Cryptodira), was recognized in the Santonian of San Pantaleón de Losa (Burgos Province) (Bardet et al.

1993; Pérez-García 2017a). A representative of Dortokidae (stem Pleurodira), *Dortoka vasconica* de Lapparent de Broin and Murelaga 1996, was identified in the upper Campanian-lower Maastrichtian records of Armuña (Segovia Province) and Laño (Burgos Province) (de Lapparent de Broin and Murelaga 1996, 1999; Pereda-Suberbiola et al. 2015a; Pérez-García et al. 2016). Bothremydidae (crown Pleurodira) has been recognized in the upper Campanian to upper Maastrichtian records of several sites in Castile and Leon (i.e., Laño, Albaina and Arauzo de Miel, in the Burgos Province; and Armuña, in the Segovia Province), where the presence of two species is currently recognized: *Polysternon atlanticum* de Lapparent de Broin and Murelaga 1996 and *Iberocitanemys convenarum* (Laurent, Tong and Claude 2002) (de Lapparent de Broin and Murelaga 1996, 1999; Pérez-García et al. 2011, 2016; Pereda-Suberbiola et al. 2015a, b; Pérez-García 2017a).

Therefore, stem turtles and members of Eucryptodira are represented in both the Lower Cretaceous and the Upper Cretaceous records of Castile and Leon. However, the currently known Pan-Pleurodira record is restricted to the uppermost Cretaceous (i.e. late Campanian to late Maastrichtian) (Pérez-García 2017a). In fact, the most abundant and diverse pan-pleurodiran lineage in this region (as well as in the whole of the European Mesozoic record), Bothremydidae, had not been identified, until recently, in pre-Santonian European strata, its record in the Southwest of the continent being restricted to the Campanian and Maastrichtian (de Lapparent de Broin 2001; Gaffney et al. 2006; Pérez-García et al. 2012). However, the currently known oldest representative of the crown Pleurodira in Laurasia has recently been described (Pérez-García 2017b). This form of Gondwanan origin, *Algorachelus* Pérez-García 2017b, is currently represented by three species: *Algorachelus parva* (Haas 1978), in the middle Cenomanian of Palestine; *Algorachelus peregrina* Pérez-García 2017b, in the middle to upper Cenomanian of the Iberian Peninsula; and *Algorachelus tibert* (Joyce, Lyson and Kirkland 2016), in the uppermost Cenomanian of Utah (see Pérez-García 2018 and references therein). Although the material of this pleurodiran genus is very abundant in the type locality of its type species (the Spanish uppermost middle-lowermost upper Cenomanian site of Algora, Guadalajara Province, Castile-La Mancha Autonomous Community), that species has also been identified in another Iberian site: the middle Cenomanian of Nazaré, in Portugal (Pérez-García et al. 2017a). The pre-Santonian record of Dortokidae was extremely poorly known worldwide, being, until recently, limited to a single find in the Barremian at the Spanish town of Vallipón, in Teruel Province (Autonomous Community of Aragon) (Murelaga Bereikua 1998). Its presence in pre-Campanian layers has recently been confirmed, thanks to the find of material in several Spanish Lower Cretaceous regions (Pérez-García et al. 2017b). The oldest species that has been described is *Eodortoka morellana* Pérez-García,

Gasulla and Ortega 2014, from the Barremian of Morella (Castellon Province, Autonomous Community of Valencia) (Pérez-García et al. 2014, 2017a).

3.2 Systematic attribution of STUS 17942

STUS 17942 can be identified as a representative of Pan-Pleurodira considering the morphology and position of the pelvis, which shows sutural articulations with both the carapace and the plastron. The presence of a wide but relatively short anterior plastral lobe allows its attribution to Bothremyododa. It shares with the only representative of this clade so far found in the Cenomanian record of Europe, *Algorachelus*, the relative small size, less than 25 cm; the low but wide shell (being almost as wide as long); and the absence of a deep nuchal notch, showing a wide anterior carapace margin, subperpendicular to the axial plane (de Lapparent de Broin and Murelaga 1999; Gaffney et al. 2006; Pérez-García 2017b, 2018). In fact, this combination of characters is recognized as exclusive to the representatives of the Cenomanian genus *Algorachelus* (Pérez-García 2017b, 2018).

Algorachelus was characterized as a littoral form (Pérez-García 2017b; Pérez-García et al. 2017a). STUS 17942 was found in beds deposited in a coastal marine environment, corresponding to a unit overlying the Utrillas facies (Quintero Amador et al. 1981); the type locality of *Algorachelus peregrina* (Algora, Guadalajara Province) being located in these facies (Torices et al. 2012). Therefore, the availability of characters in the analyzed specimen, the age of the strata from which it comes, and the sedimentary environment in which they were deposited, would support the attribution of STUS 17942 to *Algorachelus*, which has been identified as the oldest representative of the crown group Pleurodira known in Laurasia. The presence of the anterior plastral margin reaching a level close to that of the anterior margin of the carapace is compatible with the condition recognized for both the Iberian *Algorachelus peregrina* and the North American species *Algorachelus tibert*, but not for that of Palestine *Algorachelus parva* (Pérez-García 2018). In fact, the subpentagonal shape, with a posteriorly pointed carapace, also differs from the shell morphology of *Algorachelus parva* (Pérez-García 2018). Although STUS 17942 could correspond to *Algorachelus peregrina*, previously identified in both Spain and Portugal, it is attributed to cf. *Algorachelus* considering the limited availability of characters provided by this individual.

4 Conclusions

No evidence was so far available on the presence of members of the crown Pleurodira (Testudines, Pan-Pleurodira) in the hitherto known pre-Campanian record of the Spanish

Autonomous Community of Castile and Leon. In fact, only remains of basal turtles (Helochelydridae and Pleurosternidae) and of Eucryptodira formed that record. A specimen attributable to the crown Pleurodira is recognized here. This find comes from the Cenomanian of Cabrejas del Pinar (Soria Province). No other turtle remains from Cabrejas del Pinar is currently recognized. The new specimen is compatible with *Algorachelus*, a Cenomanian bothremydid genus known in the fossil record of Europe (Iberian Peninsula), North America (Utah) and Middle East (Palestine). Considering the relatively scarce information provided by the new specimen, corresponding to an internal cast in which the boundary between the sutures cannot be recognized, it is attributed to cf. *Algorachelus*. Cabrejas del Pinar is identified as one of the few European pre-Santonian regions where the presence of a member of the Crown Pleurodira has been notified.

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Author contributions The only author of this paper has carried out the complete research and has written the manuscript.

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Compliance with ethical standards

Conflicts of interest The author declare that he has no conflict of interest.

Availability of data and material The specimen studied here is deposited in a public institution.

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