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A new species of *Pseudhimalayites* (Ammonitina, Aspidoceratoidea) from the Lower Tithonian of the Betic Range, Southern Spain

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Key words: *Pseudhimalayites carchelejensis* n.sp., Aspidoceratoidea, Aspidoceratidae, Tithonian, Ponti Zone, Betic Range.

Abstract. The Late Jurassic aspidoceratoid genus *Pseudhimalayites* Spath is scarcely recorded but widely distributed in the Andean basins, the Caribbean region, and in the European Tethys. From Ponti Zone (Lower Tithonian) rocks of the Betic Range in Carchelejo we describe here the new species *Pseudhimalayites carchelejensis*, based on a macroconch (female) holotype. The corresponding microconch (male), described from the same ammonite assemblage, would belong to the morphogenus *Simocosmoceras* Spath which groups the microconchs of *Pseudhimalayites*. *P. carchelejensis* n. sp. differs from the coeval *Pseudhimalayites steinmanni* (Haupt) by lacking ventral tubercles in the phragmocone and by bearing umbilical tubercles only from the adult whorl of the phragmocone. These differences illustrate a significant morphologic divergence between the Andean and the Tethyan lineages.

INTRODUCTION

Records of ammonites of the genus *Pseudhimalayites* Spath, 1925 in the Tithonian are rare; most of them are from the Semiforme Zone in the Mediterranean and Submediterranean Tethys, the Caribbean area and the Andes (see Cecca, 1999 and references therein). The most frequent ones are the records of *Simocosmoceras* Spath, 1925, a morphogenus which includes the corresponding microconchs of the macroconchiate *Pseudhimalayites* (see Schweigert, 1997). In the most recent studies of the genus (Főzy, Scherzinger, 2013; Főzy *et al.*, 2022) the Tithonian representatives of *Pseudhimalayites* have been assigned to the Semiforme Zone taxa *Pseudhimalayites kondai* Vigh, 1984 and *Pseudhimalayites subpretiosus* (Uhlig, 1878), as well as the associated microconchs.

The Fallauxi and Ponti zones are not recorded in detail in many sections through the western Tethys, and macroconchiate *Pseudhimalayites* might be hidden under unidentified aspidoceratids. Moreover, the ammonite assemblages can be mixed (either originally or due to sampling), as in Benetti *et al.* (1990) from the Lessinian Alps of Italy, making accurate biostratigraphical conclusions impossible. However, one of the authors (ERA) has obtained in the last years an important collection of ammonites collected bed-by-bed from the Ponti-Jacobi zones of a section near Carchelejo, southern Jaén Province, Spain (Fig. 1).

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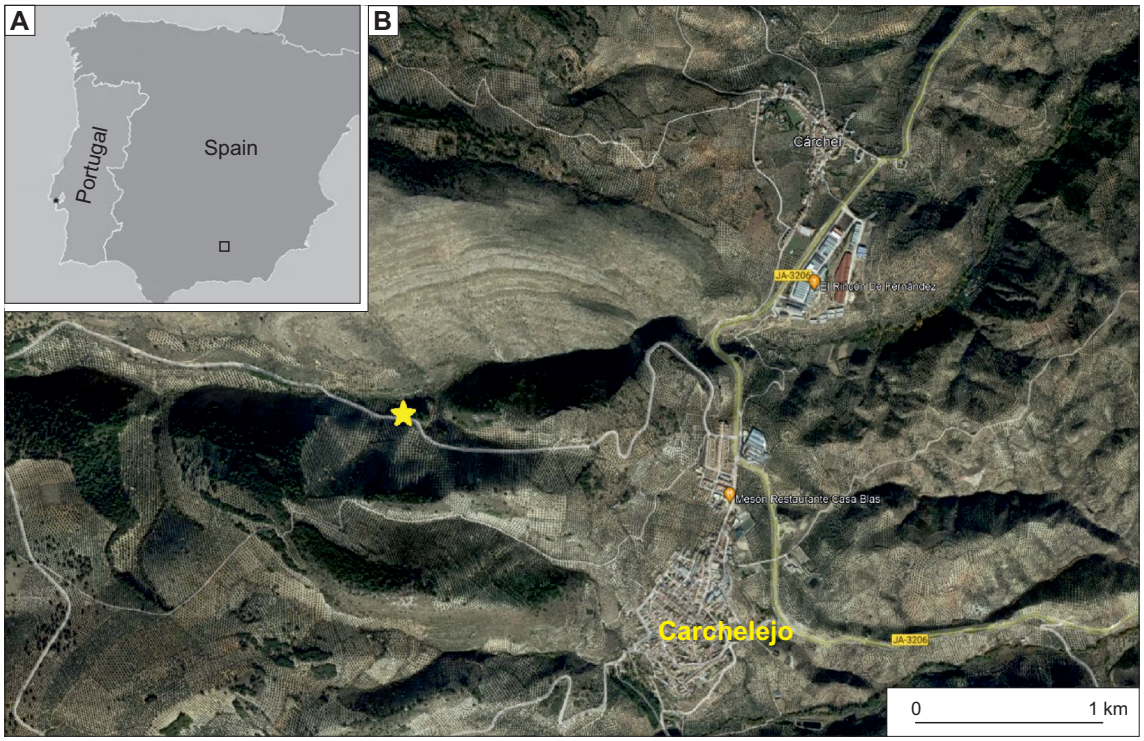

Fig. 1A. Location of the type locality (rectangle). **B.** Site of collection (asterisk) in the type locality

In this paper we describe a new species of *Pseudhimalayites* from the Ponti Zone assemblage of this collection.

SYSTEMATIC PALAEONTOLOGY

The studied specimens are housed in the museum of the Centro de Interpretación Cabra Jurásica (CJ), Cabra, Spain.

Order **Ammonitida** Haeckel, 1866

Suborder **Ammonitina** Fischer, 1882

Superfamily **Aspidoceratoidea** Zittel, 1895
sensu Parent, Schweigert and Scherzinger, 2020

Family **Aspidoceratidae** Zittel, 1895

Subfamily **Aspidoceratinae** Zittel, 1895

Genus ***Pseudhimalayites*** Spath, 1925

Type species. *Aspidoceras steinmanni* Haupt, 1907; by original designation.

Remarks. As reviewed by Schweigert (1997), *Pseudhimalayites* is a long-lived lineage, recorded from the Oxfordian. It is mostly known by its macroconchs, typically coarsely ribbed aspidoceratids with more or less depressed whorls, and umbilical, lateral and ventral tubercles at some stages. The lateral tubercles appear first in the inner whorls, later accompanied by umbilical tubercles which can be indistinct. The ventral pairs of tubercles, which can be present from the inner whorls, gradually merge into a ventral rib in the adult phragmocone (Parent *et al.*, 2013). The microconchs have been recognized as those smaller ammonites which are grouped in the genus *Simocosmoceras*; type species: *Ammonites adversus* Oppel, 1865 (see Schweigert 1997; Főzy, Scherzinger, 2013; Parent *et al.*, 2015; Énay, Howarth, 2019).

The early Andean *Pseudhimalayites* from the Tithonian Zitteli and Proximus zones have been long generally assigned to *Pseudhimalayites steinmanni* (*e.g.*, Leanza, Olóriz, 1987; Parent, 2001; Riccardi, 2008; Parent *et al.*, 2011, 2015). However, the records from Cerro Lotena-Cerro Granito, Argentina (Parent, Garrido, 2021) have shown that (1) these early forms are noticeably different from the lectotype and must be separated as a different species, and (2) *P. steinmanni* is restricted to the Internispinosum Zone

(the latter roughly aequivalent to the Mediterranean Ponti Zone) in its type locality Cerro Lotena. In the early Andean forms, the inner whorls are almost identical to the holotype of *Pseudhimalayites subpretiosus* and were considered synonymous (Schweigert, 1997; Parent, 2001). However, the holotype of the latter species, from beds of the Semiforme Zone of Rogoźnik (Poland), is too small to show diagnostic features beyond the genus level.

Pseudhimalayites carchelejensis n. sp.
Fig. 2A, B; Tab. 1

Material. Two specimens. Holotype (Fig. 2A), a well-preserved phragmocone of an adult? macroconch (collection number CJ-126). Paratype (Fig. 2B), a well-preserved microconch with a quarter whorl of body-chamber (CJ-127). These specimens were collected from the same stratigraphic level of a section at Carchelejo.

Type locality and horizon. Carchelejo, southern Jaén Province, Spain (Geological Sheet 969, Valdepeñas de Jaen). Ponti Zone, Lower Tithonian.

The local ammonite stratigraphy and fauna were studied by Olóriz (1978) and Tavera (1985). The holotype and paratype come from an about 1.5-m-thick bed of reddish marly limestone with no evident signs of condensation, assigned to the so-called Formación Ammonitico Rosso Superior (*e.g.*, Molina *et al.*, 1992). The age of this bed is given by its diagnostic ammonite assemblage which in part was studied by Olóriz (1978). The main ammonite taxa are: *Volanoceras volanense* (Oppel, 1863), very abundant "*Burckhardticeras*" *peroni* (Roman, 1936), *Lytogyroceras subbeticum* (Olóriz, 1978), *Protetragonites* gr. *quadrisulcatus* (d'Orbigny, 1841), *Haploceras carachtheis* (Zejszner, 1846), *Haploceras tithonium* (Oppel, 1865), *Lemencia* sp., *Lytoceras* sp. and abundant phylloceratids such as *Holcophylloceras mediterraneum* (Neumayr, 1871), *Ptychophylloceras ptychoicum* (Quenstedt, 1845), *Calliphylloceras kochi* (Oppel, 1865) and *Phylloceras* aff. *saxonicum* (Neumayr, 1871). In this level also abundantly occur biplicate perisphinctoid ammonites which are often reported in the literature as *Parapallasiceras* and *Subdichotomoceras.* Additionally, a single specimen of *Spiticeras* sp. was collected from this level. This *Spiticeras*

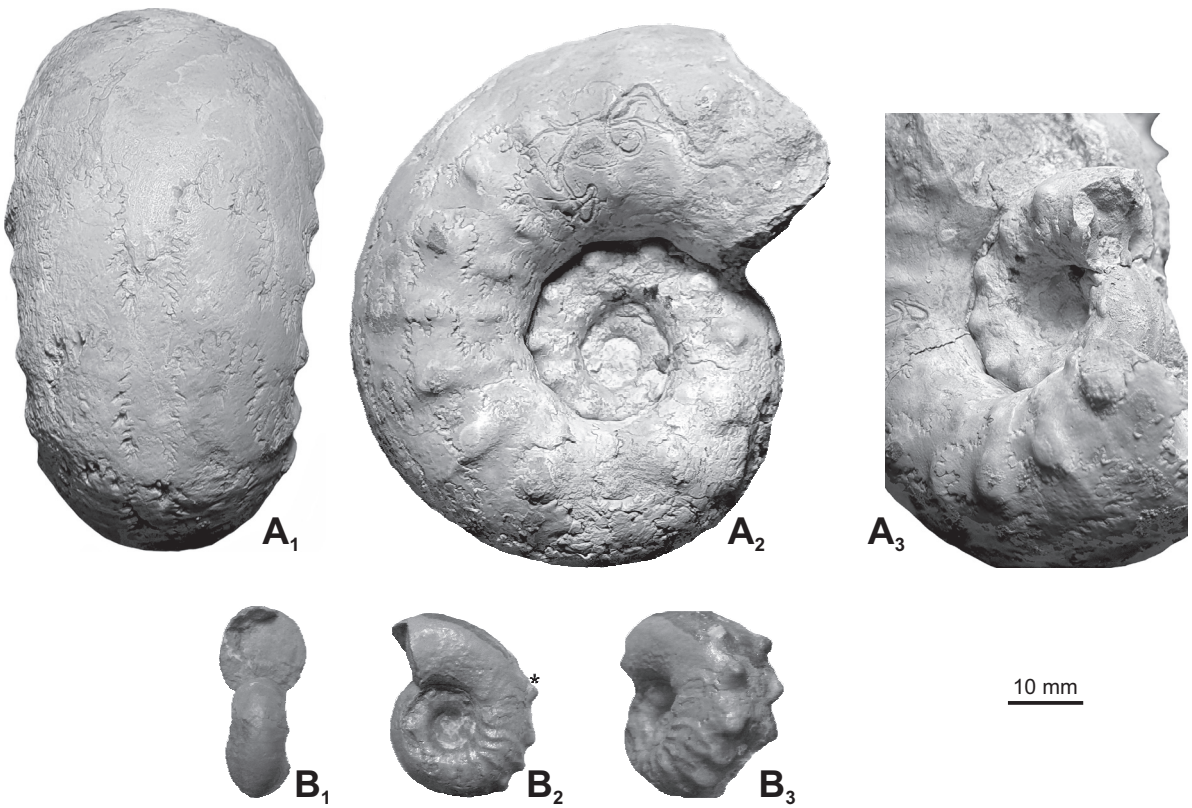

Fig. 2. ***Pseudhimalayites carchelejensis*** **n. sp.**

A. Holotype (CJ-126), adult? macroconch phragmocone; A3: view of the inner whorls after the beginning of the last whorl removed. **B.** Paratype (CJ-127), adult microconch with incomplete body-chamber (asterisk at last septum).
All natural size (×1). Ponti Zone; Carchelejo, Spain

Table 1

Dimensions and shape indexes of *Pseudhimalayites carchelejensis* n. sp.

	Diameter D [mm]	Umbilical width/ diameter U/D	Whorl width/ diameter W/D	Whorl height/ diameter H_1/D	Whorl ventral height/ diameter H_2/D	Number of umbilical tubercles* T_U	Number of lateral tubercles* T_L	Number of ventral tubercles* T_V	Phragmocone/ Bodychamber Ph/Bc
Holotype (Fig. 2A) macroconch	75.00**	0.35	0.50	0.36	0.30	9	9	0	Ph
	53.00	0.29	0.66	0.45	–	0	6	0	Ph
	32.00	–	–	–	–	0	6	0	Ph
	18.00	–	–	–	–	0	6	0	Ph
Paratype (Fig. 2B) microconch	26.00**	0.35	0.43	0.38	0.31	0	0	5	Bc
	17.70	0.28	0.44	0.41	–	0	4	0	Ph

* all per half-whorl.
** maximum preserved diameter.

is of outstanding interest since it seems to be the earliest known record of this genus in Europe. It is almost identical to the specimen figured as *Negreliceras* sp. by Főzy and Scherzinger (2013: pl. 27: 2) from the late Early or Late Tithonian of the Szomód section-I in the Gerecse Mountains, Hungary.

The beds underlying the type horizon did not yield ammonites, but the immediately overlying ones belong to the Microcanthum Zone, and the ammonite record further upwards includes the Durangites/Andreaei and Jacobi zones (Tavera, 1985: 359). The main ammonites recorded from the beds immediately overlying the type horizon of *P. carchelejensis* n. sp., are *Micracanthoceras microcanthum* (Oppel, 1865), *Simplisphinctes* sp., *Oloriziceras* cf. *faucium* (Tavera, 1985), *Cordubiceras cordubae* (Olóriz and Tavera, 1979a), *Simospiticeras lojense* Olóriz and Tavera, 1979b, *Tithopeltoceras parakasbensis* (Fallot and Termier, 1923), and *Paraulacosphinctes transitorius* (Oppel, 1865).

Derivation of the name. After the type locality.

Diagnosis. Macroconch. Phragmocone moderately involute; inner whorls with a lateral row of long spatulate tubercles, bullae in the internal mold; outer whorls with the row of lateral tubercles connected by a rib with indistinct umbilical tubercles.

The body-chamber is not preserved.

Microconch moderately involute. Three sculpture stages: (I) as inner whorls of macroconch, with median lateral, spatulate tubercles, (II) short stage of falcoid ribs on flanks and prominent ventral tubercles, and (III) adult body-chamber showing the last few ventral tubercles then becoming smooth, at least half a whorl long.

Description. The holotype (macroconch) is a phragmocone with a maximum diameter of 75 mm. Coiling is moderately involute; the umbilicus occupies little more than one third of the diameter. The whorl section is suboval, wider than high throughout the ontogeny from about 12 mm diameter onwards.

The inner whorls, partially observed, are moderately involute with suboval whorl section. In the flanks a row of spatulate lateral tubercles and venter smooth from at least 12 mm in diameter.

From about 45 mm diameter the lateral tubercles migrate slightly upper in the flanks and a row of indistinct umbilical tubercles, connected by a rib with the corresponding lateral ones, appear.

The septal suture line, partially visible, is typical of the subfamily. The body-chamber is not preserved and the last whorl does not clearly show signs of maturity as uncoiling.

The paratype (microconch) is well preserved with a quarter of whorl of body-chamber preserved. Whorl section suboval, slightly wider than high throughout the ontogeny from about 10 mm diameter. The phragmocone is smooth other than a row of lateral spatulate tubercles. Towards the end of the phragmocone the lateral tubercles are replaced by flexuous primary ribs, some with a little umbilical bulla. The ribs end, some fused in pairs, in a prominent ventrolateral tubercle. The venter between the tubercles is smooth. The tubercles fade off at the beginning of the body-chamber which becomes completely smooth in the preserved portion. Septal suture line typical of the subfamily, with a narrow lateral lobe and the wide lateral saddle placed in the same position than the ventrolateral tubercle.

Remarks and comparison. The assignment of the new dimorphic species to *Pseudhimalayites* is based on two criteria: (1) ontogeny/morphology: persistent lateral row of large tubercles from the inner whorls with later development of indistinct umbilical tubercles, and (2) sexual dimorphic correspondence of the macroconch with a typical "*Simocos-*

moceras" microconch, which shows identical inner whorls, and later the diagnostic combination of falcoid ribs with ventral tubercles in the adult phragmocone.

The microconch figured by Cecca *et al.* (1986: pl. 5: 5) from the Ponti Zone of Colle Tordina (Appennino Marchigiano, Italy) clearly belongs to *P. carchalejensis* n. sp. This specimen was later cited as *Simocosmoceras* aff. *adversum* (Oppel, 1865) by Cecca and Santantonio (1988: 539) and seems to be the only additionally published occurrence of the present new species.

P. carchelejensis n. sp. (Europe) and *P. steinmanni* (Andes) are the latest known representatives of the *Pseudhimalayites* lineage, both being Ponti Zone in age. The macroconchs differ in the well-developed ventral tubercles in the Andean species which, furthermore, develops umbilical tubercles from the inner whorls (see Haupt, 1907; Schweigert, 1997; Parent *et al.*, 2013).

In the Fallauxi Zone, there seem to be only few records with reliable stratigraphic information. One of them is the microconch figured as *Simocosmoceras simum* (Oppel, 1865) by Kutek and Wierzbowski (1986: pl. 2: 4). The body-chamber of this specimen is similar to the end of the phragmocone of the microconch of the present new species. On the other hand, this specimen differs from the stratigraphically earlier microconchs of the Semiforme Zone of Poland and Hungary (see *e.g.*, Olóriz, 1978; Kutek, Wierzbowski, 1986; Schweigert, 1997; Főzy, Scherzinger, 2013; Főzy *et al.*, 2022); hence, it could represent the microconch of an intermediate form linking the populations from the Semiforme Zone and the new species from the Ponti Zone. Nannarone and Bilotta (2021: fig. 4e) described a specimen from the Fallauxi Zone of the Appennino Umbro-Marchigiano as *Simocosmoceras pampalonii* Cresta and Pallini, 1984. It is even closer to *P. carchalajensis* n. sp., but differs by showing lateral ribs on the body-chamber and smaller ventral tubercles, well in the style of *S. adversum*.

In the Semiforme Zone (time-equivalent to the Zitteli Zone of the Andes) the genus is more abundant and apparently varied (*e.g.*, Olóriz 1978; Checa, 1985; Schweigert, 1997; Főzy, Scherzinger 2013; Parent *et al.*, 2011; Sarti, 2020; Főzy *et al.*, 2022). Many of these occurrences were assigned to *P. steinmanni*, but they must belong to *Pseudhimalayites kondai* and/or *P. subpretiosus* (see Főzy *et al.*, 2022), since *P. steinmanni* in its type locality (Cerro Lotena) is confined to the Internispinosum Zone (roughly equivalent to the Mediterranean Ponti Zone) of the Neuquén Basin.

The microconch *Simocosmoceras pszczolkowski* Myczyński, 1989 from Cuba, cannot be accurately compared since it is not clear whether the last preserved whorl of the holotype belongs to the body-chamber or to the phragmocone. This Cuban specimen (also figured in Myczyński, 1990: pl. 1: 1) differs from the microconch of *P. carchelejensis* n. sp. by its densely ribbed flanks from the inner whorls. It seems to come from an older stratum since is was accompanied by an ammonite determined as *Pseudolissoceras zitteli* (Burckhardt, 1903). *Pseudolissoceras* Spath, 1925 does not range above the lower Proximus Zone or lower Fallauxi Zone (Parent, 2001). The Cuban specimen is very similar to the material from the Pieniny Klippen Belt of Poland figured by Kutek and Wierzbowski (1986: pl. 2: 8–10) from the Semiforme Zone.

Kvantaliani (2000: pl. 9: 7) figured a microconchiate aspidoceratid from the Tithonian of the Lesser Caucasus as *Simocosmoceras* sp. This specimen is somewhat similar to the microconch of *P. carchelejensis* n. sp., especially in having prominent ventral tubercles. A small nucleus figured as *Aspidoceras rogoznicum* (sic) in the same paper (Kvantaliani, 2000: pl. 8: 4 and 9: 1) can be clearly assigned to *Pseudhimalayites* and is very similar, at comparable size, to the inner whorls of *P. carchelejensis* n. sp. However, these specimens come from an undefined horizon within the Tithonian which hampers meaningful comparisons.

P. carchelejensis n. sp. differs from the older species *P. kondai* and *P. subpretiosus* mainly by its conspicuous microconch and the late ontogenetic occurrence of umbilical tubercles in the macroconch.

CONCLUSION

Based on the phragmocone of an adult female and a rather complete adult male from the upper Lower Tithonian Ponti Zone of southern Spain, the new species *Pseudhimalayites carchelejensis* is introduced.

The sculptural ontogeny of the new species shows that the Andean and the southern Tethyan Tithonian representatives of *Pseudhimalayites* have diverged morphologically to some extent, at least from the Fallauxi Zone, and probably even earlier.

The incompleteness of the fossil record and the very sparse occurrence/record of some species, produced by taphonomic processes, migration, and chance, is well demonstrated by the discovery of the present new species, 116 years after the description of the coeval type species of its genus by Haupt (1907) and thousands of kilometers far away from the type locality.

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