



Pseudorhapydioninae of the Iberian Ranges (Cenomanian, Iberian Peninsula)

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Consorti, L., Calonge, A. & Caus, E. 2016. Pseudorhapydioninae of the Iberian Ranges (Cenomanian, Iberian Peninsula). [Subfamilia Pseudorhapydioninae de la Cordillera Ibérica (Cenomaniense, Península Ibérica)]. *Spanish Journal of Palaeontology*, 31 (2), 271-282.

Manuscript received 02 December 2015

Manuscript accepted 06 May 2016

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ABSTRACT

Pseudorhapydionina laurinensis, *P. dubia*, *P. anglonensis* and *Pseudorhipidionina casertana* (Subfamily Pseudorhapydioninae) from the Iberian Range are re-studied. The age of the deposits containing these species is late Cenomanian. However, a small *Pseudorhapydionina* (named in this work as *P. aff. laurinensis*) occurs in the lower Cenomanian deposits suggesting that the origin of the group is in the earliest Cenomanian.

Keywords: Pseudorhapydioninae, porcelaneous foraminifera, Cenomanian, Iberian Ranges, Spain.

RESUMEN

En este trabajo se han restudiado los géneros *Pseudorhapydionina laurinensis*, *P. dubia*, *P. anglonensis* y *Pseudorhipidionina casertana* (Subfamilia Pseudorhapydioninae) de la Cordillera Ibérica. La edad asignada a los depósitos que contienen estos taxones es Cenomaniense superior. No obstante, especímenes de pequeño tamaño, atribuidos en este trabajo a *P. aff. laurinensis*, han sido también encontrados en depósitos atribuidos al Cenomaniense inferior, lo que sugiere un origen del grupo en la base del Cenomaniense.

Palabras clave: Pseudorhapydioninae, foraminíferos porcelanáceos, Cenomaniense, Cordillera Ibérica, España.

1. INTRODUCTION

The Iberian Ranges consist of a NW-SE intra-plate fold belt extending about 400 km in length and more than 200 km in width at the east of the Iberian Peninsula, and surrounded by the Ebro, Duero and Madrid basins and the Valencia Trough (Capote *et al.*, 2002). The Iberian Ranges were formed as the result of the Alpine Orogeny, and within them, five structural units are identified: the Demanda-Cameros (NW), Aragonian Branch (central NE), Maestrazgo (SE), Castilian Branch (central SW) and Sierra de Altomira (SW) (Fig. 1a). The Castilian Branch and Maestrazgo units have been the only ones considered in this work. The Catalanids are included in the latter unit.

During Cenomanian times, the area currently occupied by the Iberian Ranges was a SE-NW elongated intra-continental basin (Iberian Basin) developed between the Iberian and Ebro massifs, acting as a seaway between the Tethyan Ocean in the south-east and the Atlantic Ocean towards the north (Caus *et al.*, 2009 and the papers cited therein). In this basin, the development of shallow-water carbonate platforms with a tropical to subtropical climate and an oligotrophic to mesotrophic environmental regime favored the settlement of an abundant fauna of porcelaneous foraminifera with a high to moderate k-strategy, such as the

Alveolinoideans and the Soritoideans. The former group was widely studied in the 1930s by Reichel (1936-37), and updated later by Calonge *et al.* (2002) and Vicedo *et al.* (2011), but no new detailed studies have been made after the work of Calonge (1989, 1996) for the Soritaceans.

Thus, the aim of this work is to restudy the representatives of the Pseudorhapydioninae subfamily from the Iberian Ranges (E of Spain) in order to enhance their biostratigraphic and palaeogeographic distribution in this area of the western Tethys, in the context of the Cenomanian Soritoidean revision. The study has been based mainly on four sections from the Serranía de Cuenca (Castilian Branch, Cuenca province), although complementary samples have been also taken in the Maestrazgo (Puerto de Villarroya and Puerto del Remolcador sections, Teruel and Castellon provinces), and from the Catalanids outcrops (Prat de Compte, Llavèria and Tarragona, Tarragona province) (Fig. 1b). Moreover, material collected by Calonge (1989) and deposited in the University of Alcalá de Henares was also re-studied. The new material treated in this work has been deposited at the Department of Geology of the Universitat Autònoma de Barcelona. The figured specimens are deposited in the collection of Palaeontology under the acronym PUAB 82473-82479.

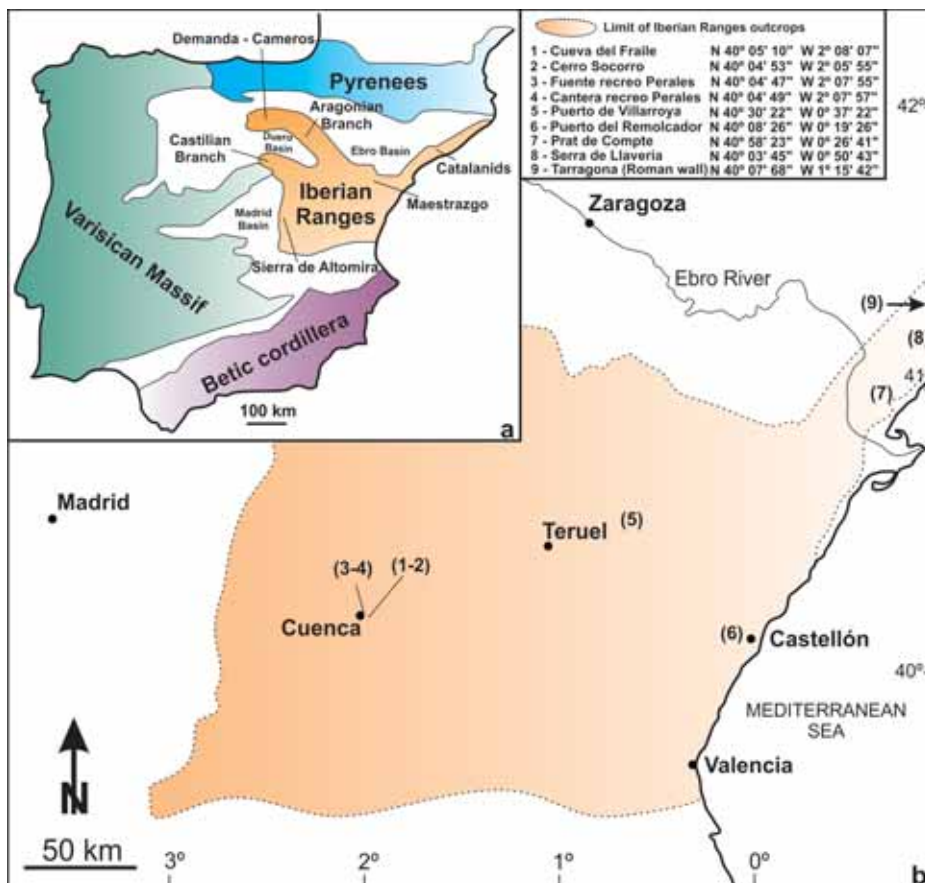


Figure 1. a) Location of the Iberian Ranges in the Iberian Peninsula. b) Position of the studied sections and outcrops. 1-4 Castilian Branch (Serranía de Cuenca): 1. Cueva del Fraile; 2. Cerro Socorro; 3. Fuente de Recreo Perales; 4. Cantera de Recreo Perales; 5-6 Maestrazgo: 5. Puerto de Villarroya (A-226 road); 6. Puerto del Remolcador (CV-190 road); 7-9 Catalanids: 7. Prat de Compte; 8. Serra de Llavèria; 9. Tarragona (Roman wall). See Calonge (1989) for further information.

2. CENOMANIAN STRATIGRAPHY

In the Iberian Ranges, the Cenomanian sequence is divided generally into five lithostratigraphic units (Vilas *et al.*, 1982). From bottom to top, they are (Fig. 2):

1. Chera Formation. This basal unit is constituted by green marls interbedded with partially dolomitized grey limestones. The unit contains a rich fauna of oysters and larger foraminifera; among this last group *Cuneolina pavonia* d'Orbigny, *Orbitolina (Conicorbitolina) cf. cuvillieri* (Moullade), *O. (C.) corbarica* Schroeder, *Peneroplis parvus* De Castro, *Ovalveolina maccagnoe* De Castro, *Sellialveolina quintanensis* Vicedo, Calonge & Caus (note that this species is generally named *Sellialveolina* gr. *vialli* in previous works), and rare small *Praealveolina iberica* Reichel. The age of this unit is earliest Cenomanian (Caus *et al.*, 2009). The Chera Formation, latest Albian in age (Caus *et al.*, 2009), overlays the Aras de Alpuente Formation.

This unit yields *Pseudorhapydionina* aff. *laurinensis*.

2. Alatoz Formation. This consists of laminated limestone and dolostone, characterized mainly by the occurrence of *Praealveolina iberica* associated to

O. (Orbitolina) concava (Lamark), *O. (O.) duranddelgai* Schroeder and *Charentia cuvillieri* Neumann, among others. The age is early Cenomanian (Caus *et al.*, 2009).

3. Villa de Ves Formation. This unit comprises thin-bedded to massive limestones intercalated with marly limestones passing upwards to dolostone. The larger foraminifera are represented by *Orbitolina (C.) conica* (d'Archiac), *Charentia cuvillieri*, *Praealveolina debilis* Reichel and *Sellialveolina gutzwilleri* Vicedo, Calonge & Caus. In addition, a rich association of nezzazatids (*Nezzazata simplex* Omara, *Merlingina cretacea* Hamaoui & Saint Marc, *Biplanata peneropliformis* Hamaoui & Saint Marc, *Biconcava bentori* Hamaoui & Saint Marc and *Coxites zubairensis* Smout) characterizes this unit. A middle Cenomanian age is given to this unit (Calonge *et al.*, 2002; Caus *et al.*, 2009).

4. Casa Medina Formation. Nodular limestone and dolomites with a rich fauna of porcelaneous foraminifera that include alveolinids (*Praealveolina tenuis* Reichel, *Praealveolina simplex* Reichel, *Ovalveolina ovum* (d'Orbigny) and *O. cf. crassa* De Castro) and pseudorhapydionines (*Pseudorhapydionina dubia* De Castro, *P. anglonensis* Cherchi & Schroeder,

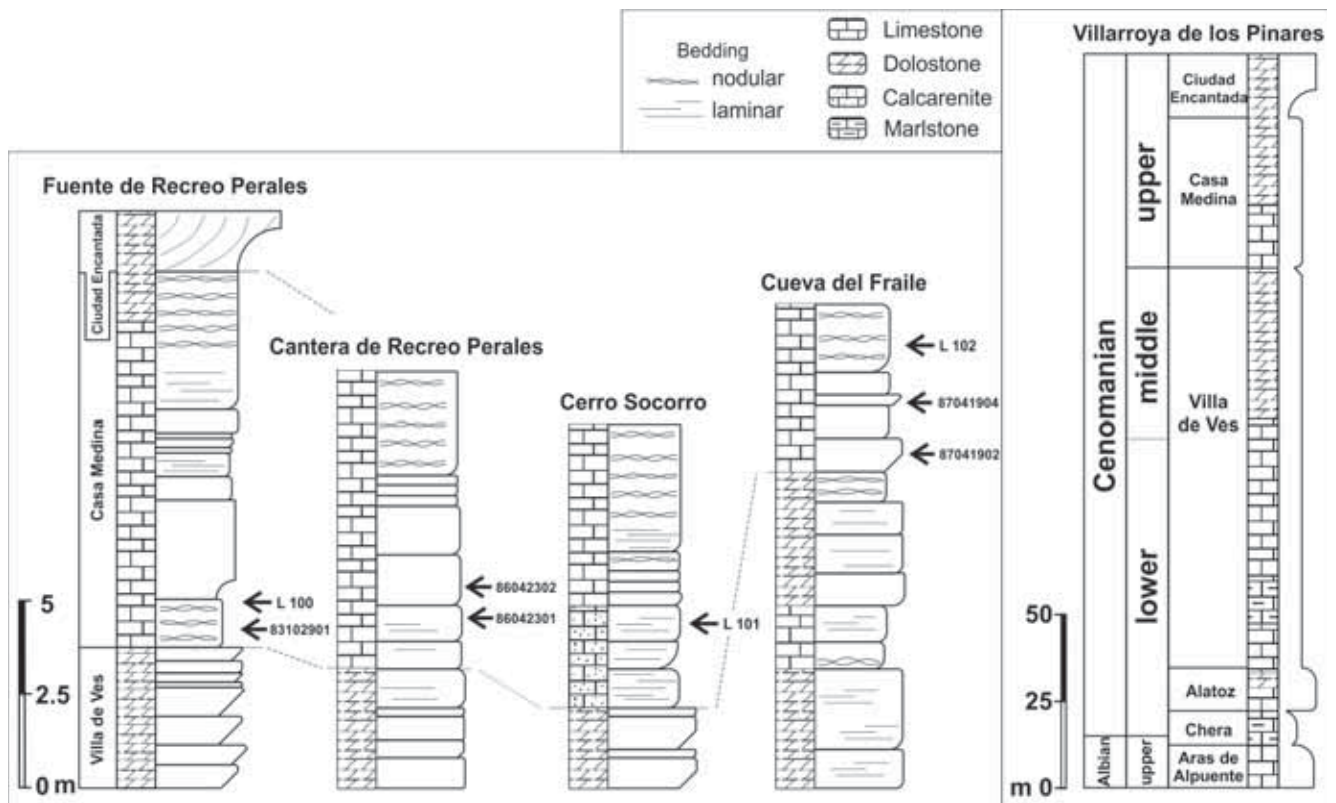


Figure 2. Schematic correlation of the Serranía de Cuenca sections (Castilian Branch) with the stratigraphic position of the samples containing *Pseudorhapydionines*. Note that the reference section is from Villarroya de los Pinares section (Maestrazgo) (redrawn from Caus *et al.*, 2009). See coordinates in Fig. 1B. Samples repository: L100 = PUAB 82475; L101 = PUAB 82476; L102 = PUAB 82478. Remaining samples have been taken from Calonge (1989).

P. laurinensis De Castro and *Pseudorhipidionina casertana* De Castro). No orbitolinids or rhyphydioninids are present in this unit, which is dated as late Cenomanian.

5. Ciudad Encantada Formation. The unit is constituted mainly by dolomites, and the larger foraminifera occur only sporadically when the dolomitization is less intense.

In the Catalanids, the deposits of Cenomanian age are represented only by a few meters of limestone and dolomites attributed to the Serra de Llaveria Formation (Robles, 1982), which are contemporaneous with the Casa Medina and Ciudad Encantada Formations. In this area the Cenomanian deposits lie on the terrigenous Utrillas Formation. The limestones of the Serra de Llaveria Formation contain *Pseudorhapydionina dubia*, *P. anglonensis*, *P. laurinensis* and *Pseudorhipidionina casertana*.

From a depositional point of view, the Cenomanian deposits of the Iberian Basin belong to two consecutive cycles, separated by a major unconformity occurring at the middle Cenomanian. At that time an important sea-level drop caused a regional episode of subaerial exposure across most Iberian shallow marine areas (Giménez, 1987; Martín-Chivelet & Giménez, 1993). The deposits of the lower cycle are represented by Chera, Alatoz, and Villa de Ves, while those of the upper cycle are constituted by the Casa Medina and Ciudad Encantada formations or their contemporaneously equivalent deposits in the Catalanids.

3. SYSTEMATICS

Phylum FORAMINIFERA d'Orbigny, 1826 Pawlowski *et al.*, 2013

Class TUBOTHALAMEA Pawlowski *et al.*, 2013

Order MILIOLIDA (Delage & Hérouard, 1896) Pawlowski *et al.*, 2013

Remarks. In this paper the classification used for high-level categories, such as phylum, class, and order categories, is from Pawlowski *et al.* (2013).

Superfamily Soritoidea Ehrenberg, 1839

Remarks. Following Consorti *et al.* (2016) the Superfamily Soritoidea should be restricted to porcelaneous foraminifera with planispiral early arrangement of the chambers in A and B generations that may later become uncoiled, flabelliform, or annular, in the adult stage.

Family **Praerhapydioninidae** Hamaoui & Fourcade, 1973

Remarks. See Consorti *et al.* (2015, 2016) for discussion about the Praerhapydioninidae family.

Subfamily Pseudorhapydionininae Consorti *et al.*, 2016

Type Genus *Pseudorhapydionina* De Castro, 1972

Genus *Pseudorhapydionina* De Castro, 1972

Type species *Rhapydionina laurinensis* De Castro, 1965

Description. Globular to subcylindrical porcelaneous foraminifer with planispiral-involute chamber arrangement in the early stage of growth, becoming generally uncoiled in the adult stage. The aperture is cribrate. The marginal chamber lumen is partially subdivided by radial septula. For further details see De Castro in Schroeder & Neumann (1985).

Pseudorhapydionina dubia (De Castro, 1965)
(Figs 3a-3g)

Description. Porcelaneous shell with subglobular-to-cylindrical morphology. The chambers in the early stage of growth are arranged in one and a half to two whorls. The specimens of the Iberian Ranges show four chambers in the first whorl and six or seven in the second one. The uncoiled adult stage consists generally of five cylindrical chambers. The globular early stage reaches a maximum diameter of 0.35 mm with an average of 0.29 mm. The seriate adult stage has an average length of 0.6 mm and the height of the chambers is approximately 0.06 mm. The scarce centered sections show a proloculus of about 40 µm in diameter. The apertural face is convex and the aperture cribrate. The intercameral foramina are regularly disposed, forming a circular pattern with three concentric stipple rings in the septa. The chamber lumen is partially divided by radial septula, which number approximately 5-6 per quadrant in the seriate adult stage of growth. Septula are short and their thickness is less than 10 µm.

Remarks. The concentric ring pattern of the foramina observed in the *P. dubia* from the Iberian Ranges can be also observed in De Castro (1985; Pl. 41, Figs 2-6). The circular outline of foraminiferal disposition is referred always to the seriate chambers. Their presence in the spirally arranged chambers has not been observed.

Stratigraphical and geographical distribution. *Pseudorhapydionina dubia* is a common species in the late Cenomanian of the Iberian Ranges. It frequently occurs in the Serranía de Cuenca (Casa Medina Formation) and in Prat de Compte (Serra de Llaveria Formation).

Pseudorhapydionina anglonensis Cherchi & Schroeder, 1985
(Fig. 3h)

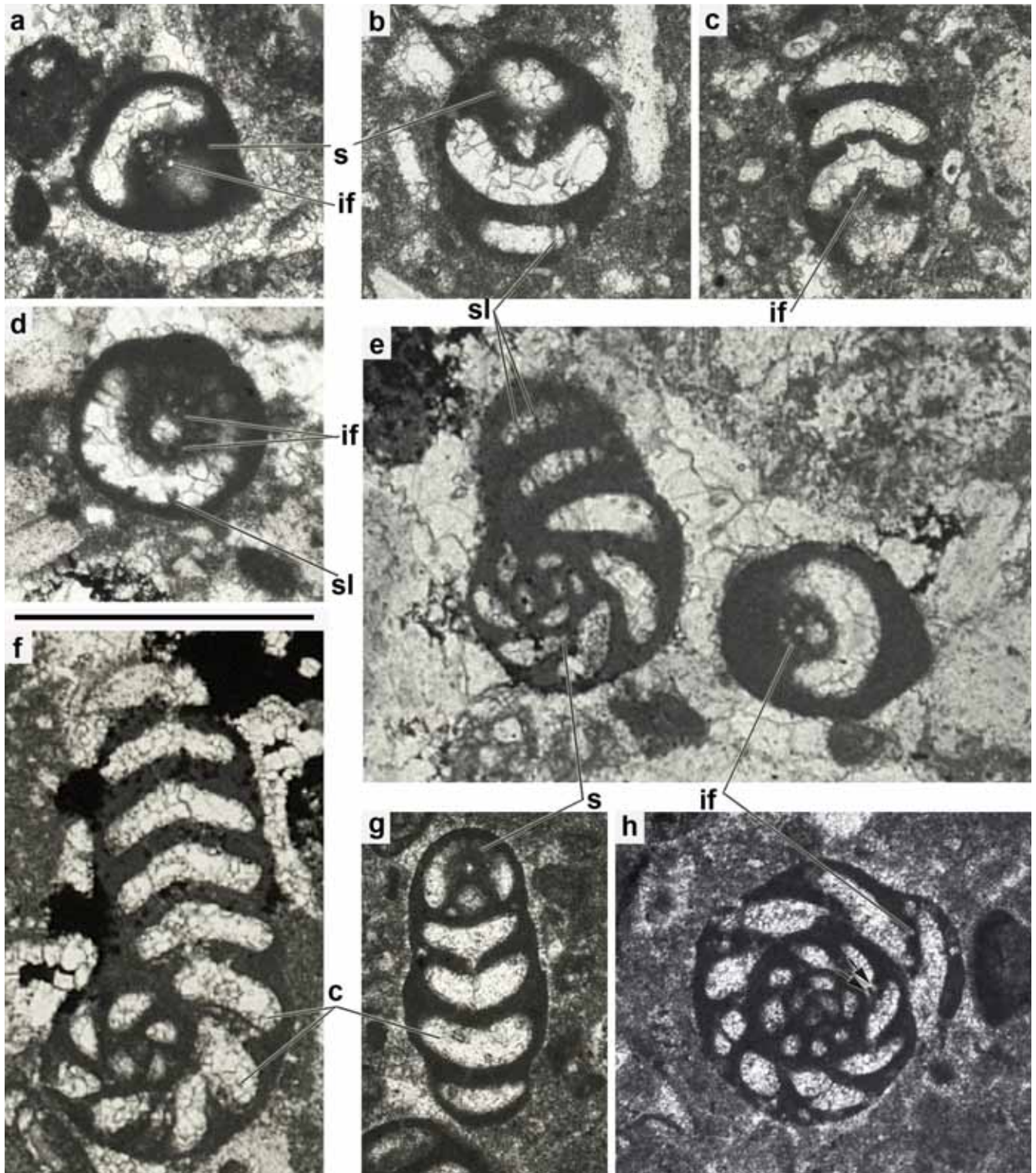


Figure 3. Scale bar 0.5 mm for all specimens. **(a-f)** *Pseudorhapydionina dubia* from Prat de Compte (PUAB 82473 LP01 and LP02). **a)** Transverse slightly oblique section. Note intercameral foramina piercing septum. **b)** Oblique section. Intercameral foramina and septula are visible. **c)** Badly preserved longitudinal section. **d)** Transverse section. The cut show septulae and intercameral foramina piercing septum. **e)** Close to the equatorial (left side) and transverse slightly oblique (right side) sections. **f)** Close to the equatorial section. Four seriate chambers are visible. **(g)** *P. dubia* from Serra de Llaveria (sample 80092401 of Calonge, 1989). Longitudinal section. In the upper part, the convexity of the septum simulates the presence of a simple unique aperture. This also happens in a, b, d. **(h)** Equatorial section of *Pseudorhapydionina anglonensis* from Serra de Llaveria (sample 80092401 of Calonge, 1989). The section shows few septula (lower part) and intercameral foramina in interiomarginal position (lasts chambers). Apertures in interiomarginal position are also visible in earlier growth stage (arrows). **c:** chamber; **if:** intercameral foramina; **s:** septum; **sl:** septulum.

Description. Porcelaneous globular shell lacking the seriate stage of growth typical of the other species of the genus *Pseudorhapydionina*. The chambers are arranged in 2.5 planispiral whorls. The first whorl consists of seven chambers, the second of eight, while the last incomplete whorl is composed of five chambers. The shells have an average diameter of 0.48 mm, while their proloculi are around 30 μm . The septa are convex and cribbed by foramina located in the interiomarginal position. *Pseudorhapydionina anglonensis* has few and short radial septula subdividing the chamber lumen.

Remarks. Cherchi & Schroeder (1985) state that cribrate aperture is present just in the last chambers, while a simple aperture is present in the early ontogenetic stage of growth. However, in the Iberian material at our disposition, the cribrate aperture is also observed in the early steps of growth (see the arrows in Fig. 3h).

Stratigraphical and geographical distribution. *Pseudorhapydionina anglonensis* has been only found in the Serra de Llaveria Formation (Catalanids).

Pseudorhapydionina laurinensis (De Castro, 1965)
(Figs 4a-4b)

Description. Porcelaneous, subglobular-to-cylindrical shell. The subglobular early stage, with a size of about 0.33 mm of diameter, consists of two whorls of planispiral chambers. The first whorl hosts six chambers, while the second one has ten. The diameter of the proloculus is approximately 30 μm . The height of the cylindrical chambers is approximately 0.05 mm. The chamber lumen is partially divided by long radial septula, which number approximately 5-6 per quadrant in the seriate stage of growth. Septula thickness is around 15 μm . For further information see De Castro (1985) and Consorti *et al.* (2016).

Remarks. In the deposits of the Chera Formation (early Cenomanian) of the Puerto del Remolcador section (see Calonge, 1989 for details), some specimens of a small *Pseudorhapydionina* (*P.* aff. *laurinensis* in this work) have been observed (Fig. 4a). These specimens differ from *P. laurinensis* type by the smaller size of their adult shells and proloculi. However, the material at our disposal is not enough to prove if it is a new species characterizing the older deposits than those containing *P. laurinensis*. It is worth noting that De Castro (1985) also mentioned "*P. laurinensis*" in association with *S. vialli* in the deposits of early Cenomanian of southern Italy, although the author does not figure it.

Stratigraphical and geographical distribution. *Pseudorhapydionina laurinensis* is rare in the studied samples. It has only been found in the deposits of the

Serra de Llaveria Formation, although Calonge (1996) mentioned this species in the deposits of the Castilian branch (Puerto de Villarroja and Morrón de Pinarueco sections). The late Cenomanian age of the specimens of the Iberian Ranges coincides with the age of the *P. laurinensis* type (De Castro, 1985).

Genus *Pseudorhipidionina* De Castro, 1972

Type species *Rhipidionina casertana* De Castro, 1965

Description. Flat, porcelaneous foraminifer with planispiral-involute chamber arrangement in the early stage of growth, becoming uncoiled and flabelliform in the adult stage. The elongate apertural face is pierced by multiple non-aligned openings (cribrate aperture). The marginal chamber lumen is partially subdivided by radial septula. See De Castro in Schroeder and Neumann (1985) for further details.

Pseudorhipidionina casertana De Castro, 1972
(Figs 4d-4e, 4h, 5a-5j)

Description. Porcelaneous flabelliform shell with an acute periphery. The early planispiral-involute stage of growth consists of elongated chambers arranged in one and a half to two whorls, reaching a diameter of 0.55 mm, approximately. The seriate stage is composed, at least, of 10 wide and short chambers averaging 0.04 mm in height. The septa are markedly convex and cribbed by numerous intercameral foramina. The external part of the chamber lumen is partially divided by radial septula. The septula, which has a thickness of around 15-18 μm , may bifurcate at their inner end. They occupy one-third of the chamber lumen.

Remarks. The presence of bifurcate septula has never been highlighted in this taxon, although the character seems to be present with high frequency, especially in the seriate stage of growth. Bifurcate septula are visible in our material and in the specimens figured by De Castro (1985; Pl. 45, Fig. 6).

De Castro (2006) transferred a foraminifer to the genus *Pseudorhipidionina* that was previously described by Crescenti (1964) as *Praerhapydionina murgiana*. However, the small biometrical differences between *P. murgiana* (Crescenti) and *P. casertana* De Castro (see Table 2 in De Castro, 2006) may suggest they are synonyms, although further studies should be done.

Stratigraphical and geographical distribution. This species is widely distributed in the upper Cenomanian samples of the Casa Medina and Serra de Llaveria Formations. It has also been found in the Cenomanian clasts reworked in the Tertiary foreland conglomerates of the Ebro Basin.

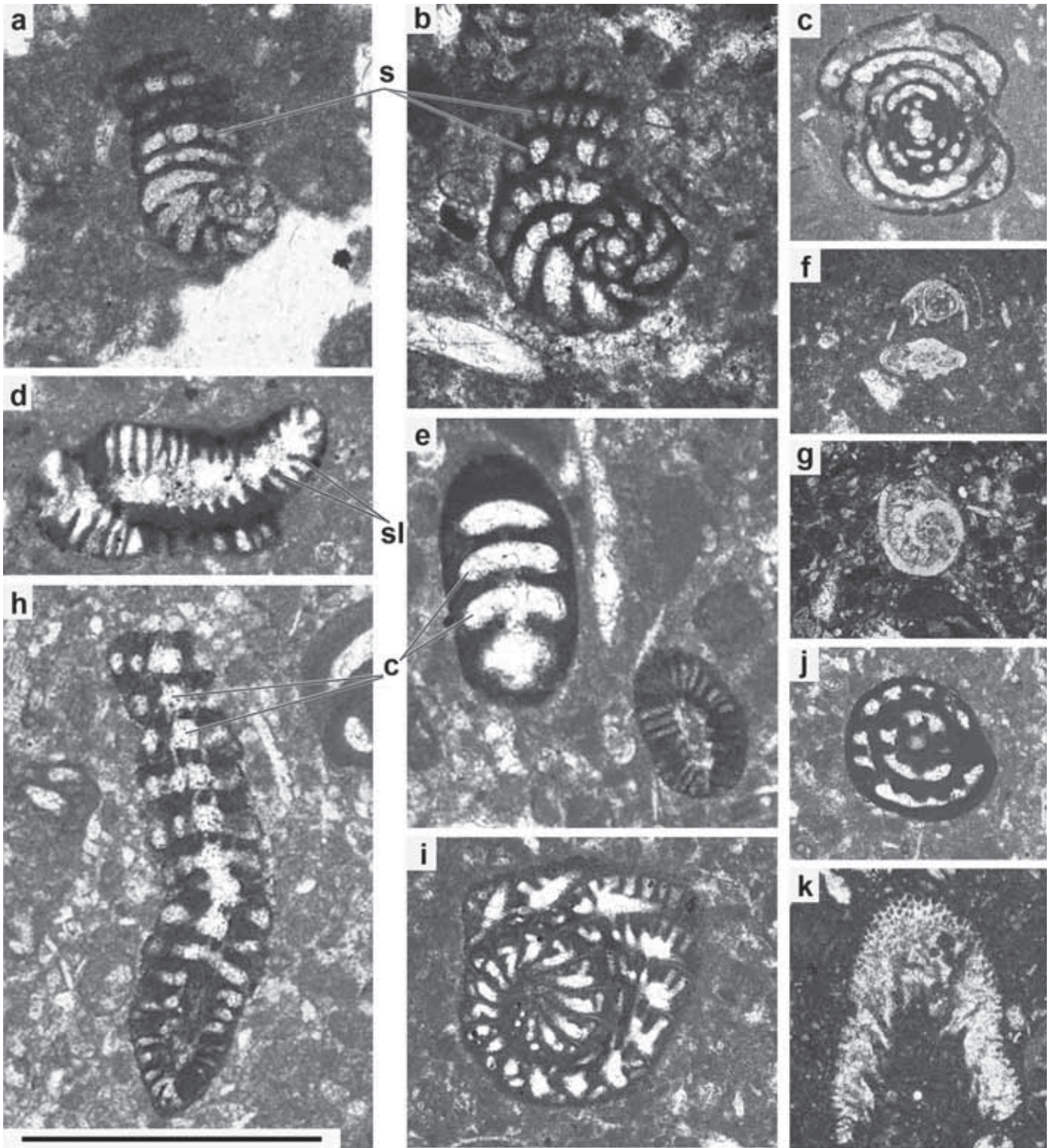


Figure 4. Scale bar 0.5 mm for figures a, b, d, e, h. **a)** Equatorial section of *P. aff. laurinensis* from Chera Formation in Puerto del Remolcador (PUAB 82479 LP01). **b)** Equatorial section of *P. laurinensis* from Serra de Llaveria (sample 80092401 of Calonge, 1989). **d)** *Pseudorhipidionina casertana* from Serra de Llaveria (sample 80092401 of Calonge, 1989). Oblique-transverse section of seriate chambers. Note bifurcation at the inner end of a septulum. **e)** Oblique-longitudinal section of a *P. dubia* (left side) and *P. casertana* in transverse section (right side). Specimens from Fuente de Recreo Perale (PUAB 82475 LP02). **h)** *P. casertana* in longitudinal section. Cut also shows the preceding whorl in the spiral stage of growth (lower side of the picture). Specimens from Fuente de Recreo Perale (PUAB 82475 LP02). Scale bar 1 mm for associate fauna in figures c, f, g, i, j, k. **(c, f, i, j, k)** Specimens from Cerro Socorro (PUAB 82476 LP02-03); **(g)** from Fuente de Recreo Perales (PUAB 82475 LP03). **c)** *Cisalveolina cf. lehneri*. **f, g)** Axial and equatorial section respectively of *Rotorbinella mesogeensis*. **(i)** *Coxites zubairensis* in transverse section **j)** *Ovalveolina* sp. **k)** Green algae. c: chamber; s: septum; sl: septula.

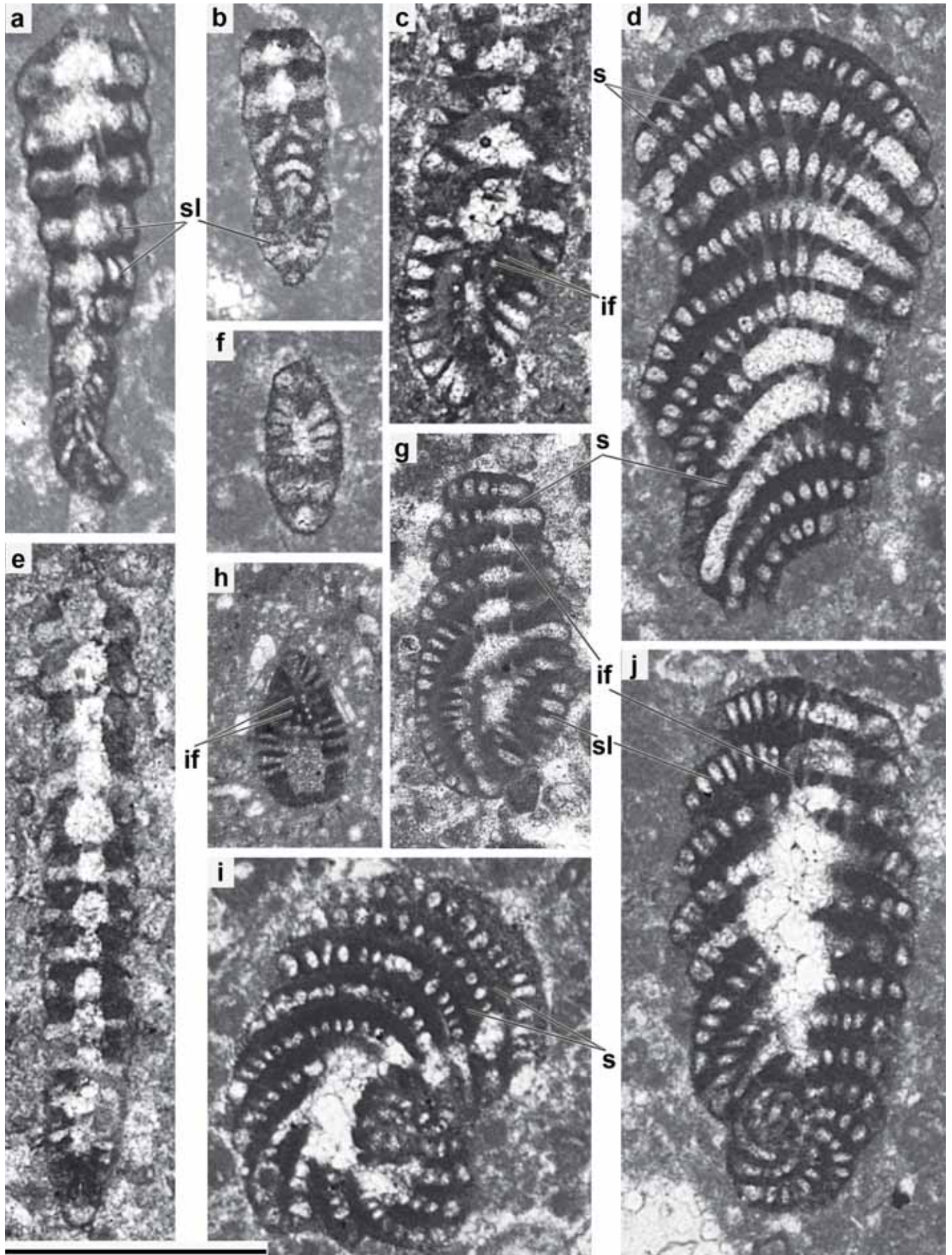


Figure 5. *Pseudorhipidionina casertana*. Scale bar 0.5. **(a, c, e)** Specimens from Cueva del Fraile section; **(b, f)** from a clast in Tertiary deposits near Prat de Compte; **(d, g, i, j)** from Fuente de Recreo Perales section; **(h)** from Serra de Llavèria section. **a)** Longitudinal section showing septula (PUAB 82473 LP01). **b)** Near to the axial section, septula are shown in the lower part of the specimen (PUAB 82474 LP01). **c)** Longitudinal section, septum cut tangentially shows intercameral foramina (sample 87041904). **d)** Oblique-tangential section of the seriate stage of growth. Septula are absent where cut intercept inner cameral spaces (PUAB 82475 LP01). **e)** Longitudinal section of a badly preserved specimen (sample 87041904). **f)** Transverse slightly oblique section of a small chamber (PUAB 82474 LP01). **g)** Oblique section of several seriate chambers (sample 83102901). **h)** Transverse section showing intercameral foramina (sample 80092401-2 of Calonge, 1989). **i)** Close to the equatorial section of a badly preserved specimen (PUAB 82475 LP02). **j)** Oblique-longitudinal section, seriate chambers are partially dissolved in their central part (PUAB 82475 LP02). **if:** intercameral foramina; **s:** septum; **sl:** septulum.

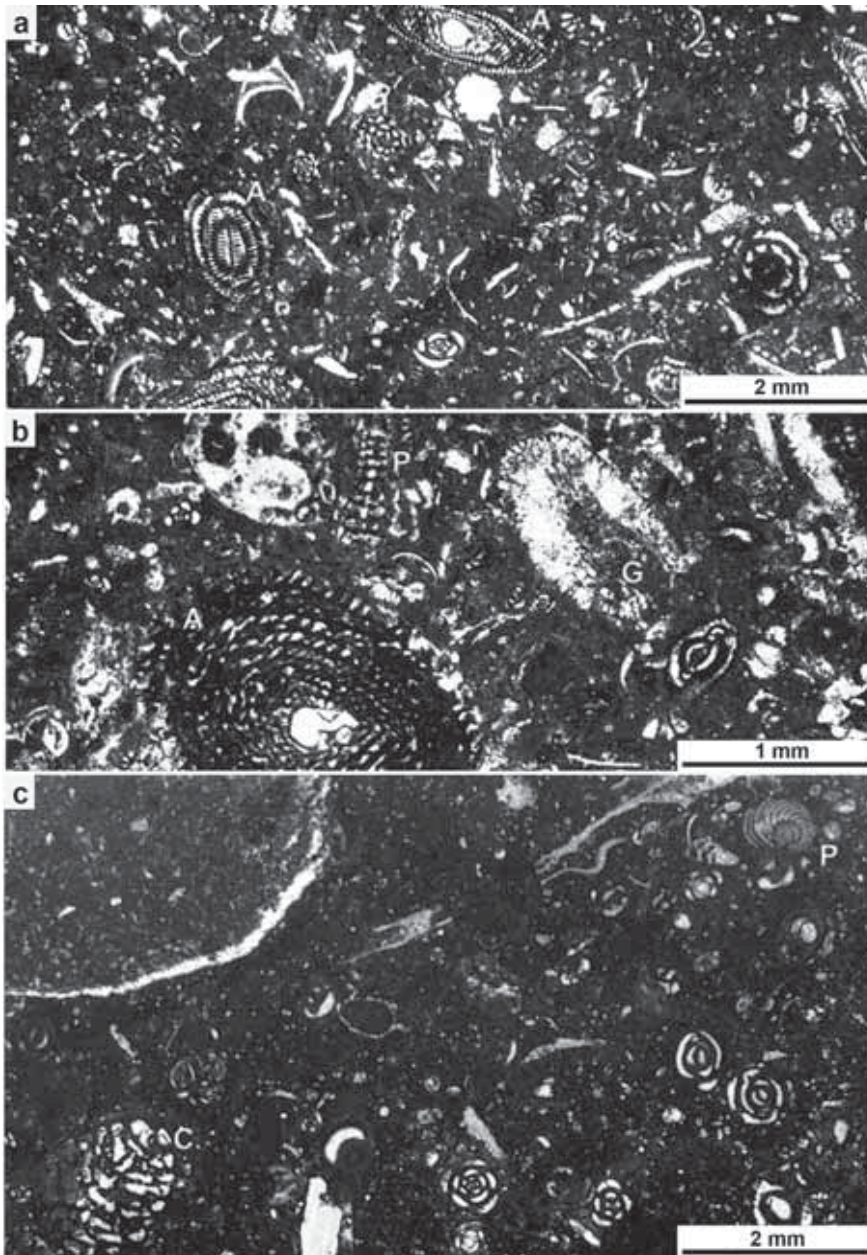


Figure 6. **a)** Facies from Cerro Socorro section, Serranía de Cuenca (sample L101). Wackestone-packstone with alveolinids (A). The microfacies also contains *Cuneolina* sp., *Pseudorhipidionina casertana*, *Rotorbinella mesogeensis*, *Coxites zubairensis*, nezzazatids, miliolids, green algae and rudist fragments. **b)** Facies from the Cueva del Fraile section, Serranía de Cuenca (sample L102). Wackestone-packstone with *Pseudorhipidionina casertana* (P), green algae (G) and alveolinids (A). The microfacies contains also few miliolids, nezzazatids, green algae and rudist fragments. **c)** Facies from Parco-Peragine (near Bari, SE of Italy), sampled in the same locality of De Castro (2006). Wackestone-packstone with *Pseudorhipidionina 'murgiana'* (P), *Craspedidina gradata* (C), miliolids and echinoderm fragments. In the same sample *Coxites zubairensis*, *Cisalveolina fraasi*, *Pseudolituonella reicheli*, *Dicyclina schlumbergeri*, nezzazatids and trocholinids are also present.

4. PALAEOENVIRONMENT, AGE AND PALAEOBIOGEOGRAPHY

The facies bearing Pseudorhapydionines from Iberian Ranges are interpreted as shallow-water carbonate platform deposits, ranging from lagoonal to littoral facies. They consist of packstone-wackestones with abundant porcelaneous foraminifera, mainly *Praealveolina*, small rotaliids, some agglutinating forms, green algae, and rudist fragments (Figs 6a-6b). The Iberian facies differ from most of the contemporaneous facies from southern Italy (type localities of *P. dubia*, *P. laurinensis* and *P. casertana*) because the latter contain miliolids and *Cisalveolina* (Fig. 6c).

In the Iberian Ranges, *Pseudorhapydionina laurinensis*, *P. dubia*, *P. anglonensis* and *Pseudorhipidionina casertana* occur only in the deposits of the upper sedimentary cycle (Casa Medina and Serra de Llaveria Formations), attributed to the late Cenomanian (*Praealveolina brevis* and *P. tenuis* biozones, Calonge *et al.*, 2002). They are mainly associated with alveolinids (*Praealveolina brevis* and *P. tenuis*) and nezzatids. *Rotorbinella mesogeensis* is also present. This age is concordant with that attributed to this association in other areas of the Mediterranean Sea and Middle East (De Castro in Schroeder & Neumann, 1985

and the papers cited therein; Whittaker *et al.*, 1998; Parente *et al.*, 2008; Chiocchini *et al.*, 2012; Consorti *et al.*, 2015 among others). Outside the Iberian Ranges, the above-mentioned taxa are in the same strata as *Cisalveolina fraasi*, a marker for the late Cenomanian (De Castro, 1983; Frijia *et al.*, 2015).

However, the presence of small forms (*P. aff. laurinensis* in this paper) associated with *Sellialveolina quintanensis* in the deposits of the Chera Formation suggests that the first representatives of the Pseudorhapydioninae appear in the Iberian Ranges at least at the base of the Cenomanian.

From a palaeogeographical point of view, *Pseudorhapydionina dubia*, *P. laurinensis* and *Pseudorhipidionina casertana* showed a broader distribution along the Cenomanian Tethyan shallow-water deposits, from the eastern shores of the Iberian Peninsula and Sardinia at the northwest to the Zagros Mountains in Iran, and probably Oman at the southeast (Fig. 7). *Pseudorhapydionina anglonensis* has been only mentioned in the Iberian Peninsula (this work), Sardinia (Cherchi & Schroeder, 1985), and central Italy (Chiocchini *et al.*, 2012). However, the lack of references from this species in the Middle East may be due to a mistake in its identification due to the difficulties to distinguish the juvenile tests of *P. anglonensis* and *P. dubia*.

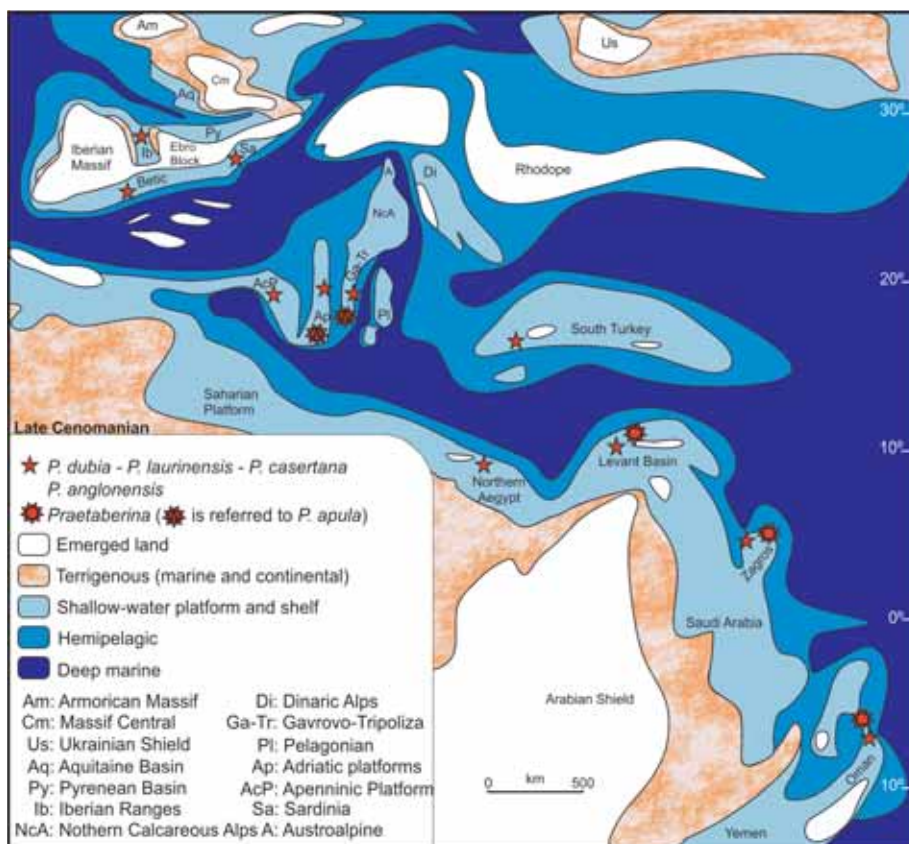


Figure 7. Palaeogeographic reconstruction of central and eastern Tethys during late Cenomanian. Redrawn and simplified after Dercourt *et al.* (2000), Caus *et al.* (2009), and Zarcone *et al.* (2010). References for each locality: Iberian Ranges (Calonge, 1989, 1996 and this work); Greece (Fleury, 1980); Sardinia (Cherchi & Schroeder, 1985); Adriatic platforms (De Castro, 2006; Velić, 2007; Spalluto, 2012); Apenninic Platform (De Castro, 1965; Chiocchini *et al.*, 2012); north of Egypt (Bauer *et al.*, 2002); south of Turkey (Bignot & Poisson, 1974); Lebanon, Levant Basin (Saint-Marc, 1974); Iran and Oman (Smith *et al.*, 1990; Afghah & Fadei, 2014; Consorti *et al.*, 2015).

5. CONCLUSIONS

In the Iberian Ranges, the subfamily Pseudorhapydionininae is represented by *Pseudorhapydionina laurinensis*, *P. dubia*, *P. anglonensis* and *Pseudorhipidionina casertana*. These species characterize the shallow-water carbonate deposits of the Cenomanian upper sedimentary cycle (Casa Medina and Ciudad Encantada Formations), late Cenomanian in age. However, in the deposits of the lowermost lower sedimentary cycle (Chera Formation), a small *Pseudorhapydionina*, named here as *P. aff. laurinensis*, occurs. Its age is early Cenomanian, which places the origin of the group, at least, in the earliest Cenomanian.

ACKNOWLEDGMENTS

The program “Ayuda a la Investigación de la Sociedad Española de Paleontología” is gratefully acknowledged. We thank the project of the Spanish Ministry of Economía y Competitividad (project CGL2012-33160) for providing supplementary financial support. We thank M. Reolid for reviewing the manuscript and J. Aguirre for his careful editorial handling.

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