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Timidonella? primitiva n. sp. (Foraminiferida) from the Middle Jurassic of the Eastern Taurides (Southern Turkey): Remarks on Evolutionary Steps of Hauraniids

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Abstract: A new species of complex benthic foraminifera, *Timidonella? primitiva* n.sp., has been identified from the Aalenian?–Bajocian of the eastern Taurides, Turkey. The new species, belonging to the family Hauraniidae SEPTFONTAINE, occurs in the lowermost beds of the Köroğlutepesi Formation and its test is composed of a planispirally coiled early stage followed by an uncoiled rectilinear portion. The internal structure is characterized by four different zones consisting of a subepidermal reticulate layer, a zone of subepidermal plates, a more internal empty zone in the chambers and a primitive interseptal pillar system in the most internal part of the chambers perforated by multiple apertures. Contrary to previous opinions, which considered that *Timidonella* had evolved from the *deserta* group, this study suggests instead that derivation of the *Timidonella* was from the *amiji* group of hauraniids. *Timidonella? primitiva* n.sp. was probably an early step derived from the *amiji* group and led to the evolution of the more advanced species, *Timidonella sarda*.

Key Words: Foraminifera, new species, evolution, taxonomy, Bajocian, Taurides, Turkey

Doğu Toroslar'ın Orta Jura İstifinden *Timidonella? primitiva* n. sp. (Foraminiferida): Hauraniidlerin Evrim Basamakları Üzerine Düşünceler

Özet: Doğu Toroslar'ın (Türkiye) Aaleniyen?–Bajosiyen'inde kompleks bentik foraminiferlerden *Timidonella? primitiva* yeni türü tanımlanmıştır. Hauraniidae familyasına ait olan yeni takson Köroğlutepesi Formasyonu'nun en alt tabakalarında bulunur ve formun kavkısı planispiral ilk evre ve bunu takip eden ve locaları bir eksen boyunca düz olarak gelişmiş bir kısımdan oluşmaktadır. Yeni türün iç yapısı dört farklı zon ile temsil edilir. Bunlar altepidermal gözenekli seviye, altepidermal plaka zonu, daha içte loca içi boş zon ve çoklu açıklıklarla delinmiş locaların en iç kısmında yer alan septumlar arası ilkel piliye sistemidir. Bu çalışma, *Timidonella* cinsinin, *deserta* grubundan türediğini ortaya koyan önceki çalışmaların aksine *amiji* grubundan ortaya çıktığını önermektedir. *Timidonella? primitiva* n.sp. olasılıkla *amiji* grubundan türemiş ve *Timidonella sarda*'nın bir önceki evrim basamağını oluşturmuştur.

Anahtar Sözcükler: Foraminifera, yeni tür, evrim, taksonomi, Bajosiyen, Toroslar, Türkiye.

Introduction

Based on complex benthic foraminifera, several studies describing the Jurassic biostratigraphy have been carried out in the Tethyan belt (Hottinger 1967; Crescenti 1969; Bernier & Neumann 1970; Bassoullet & Poisson 1975; Bassoullet *et al.* 1976, 1999; Altıner & Septfontaine 1979; Bassoullet & Fourcade 1979; Septfontaine *et al.* 1991; Chiocchini *et al.* 1994; Bassoullet & Lorenz 1995; Fourcade & Mouty 1995; Bucur *et al.* 1996; Bassoullet 1998; Septfontaine & de Matos 1998; Fugagnoli 1999, 2004; Taslı 2000; Peybernès *et al.* 2001; Bouaouda *et al.* 2004). Among these studies, some have also concentrated on the taxonomy and evolutionary relationships of taxa which evolved between the

Pliensbachian and the Malm. Although the biostratigraphic significance of the genus *Timidonella* has been emphasized in some studies (Bassoullet & Fourcade 1979; Pélissié *et al.* 1984; Septfontaine *et al.* 1991; Bassoullet 1998; Septfontaine & de Matos 1998) the evolutionary derivation of this taxon was only studied in detail by Bassoullet *et al.* (1974, 1976), Septfontaine (1988), Bassoullet & Boutakiout (1996).

Bassoullet *et al.* (1974, 1976), after describing for the first time the genus *Timidonella*, mentioned its presence in France, Iran, Madagascar, Italy and Morocco and compared it with several other complex foraminifera, mostly emphasizing the similarity between *Timidonella* and *Haurania*. Septfontaine (1988) proposed a refined taxonomy and described the overall phylogenetical schemes of complex Jurassic benthic foraminifera including valvulinids, mesoendothyrids, pfenderinids and hauraniids. He claimed that hauranids consist mainly of two groups, namely the *deserta* and *amiji* groups, distinguished by the absence or presence of interseptal pillars. The group *deserta* has a pillar system in the centre of chambers, whereas the *amiji* group lack pillars. In this scheme, *Timidonella sarda,* having a well-developed pillar system, has been considered to be related to the evolving *deserta* group. In addition, Septfontaine *et al.* (1991) interpreted the first appearance of *Timidonella* in certain carbonate platforms as an example of a sudden evolutionary step in larger foraminifera. In a relatively recent study, Bassoullet & Boutakiout (1996) described a new hauraniid subgenus, *Haurania (Platyhaurania)* (type species *Haurania (Platyhaurania) subcompressa*) by considering it to be the ancestor of the genus *Timidonella*.

This study focuses on a new taxon from the Eastern Taurides (Turkey) characterized by a shell architecture consisting of a more primitive interseptal pillar system within the lineage *Amijiella amiji-Timidonella sarda*. In the light of this, *Timidonella? primitiva* n. sp., is described in this study as an earlier evolutionary step of *Timidonella sarda.*

Systematic Description

Class FORAMINIFERIDA Eichwald, 1830

Order TEXTULARIINA Delage and Hérouard, 1896

Superfamily LITUOLACEA De Blainville, 1827

Family HAURANIIDAE Septfontaine, 1988

Genus *Timidonella* Bassoullet,

Chabrier and Fourcade, 1974

Timidonella? primitiva n.sp.

Diagnosis. A species probably belonging to *Timidonella* characterized by a coiled stage with $1^1/_2$ whorls and a more primitive interseptal pillar system than that of *Timidonella sarda.*

Holotype. The specimen in axial section is illustrated in Plate I, Figure 1. Holotype is from sample TP-4, thin section C. It is stored in the Laboratory of Paleontology Unit of the Geological Research Department, General Directorate of Mineral Research and Exploration (MTA), Turkey.

Derivation of Name. The species name has been used after the primitive aspect of the interseptal pillar system.

Type Locality. Taşpınardere measured section, 145 kilometers east of Kayseri (Figure 1A). The type material comes from 7 kilometers southwest of the town of Sarız (Figure 1B). The type locality lies within the Geyikdağı Unit (Özgül 1976, 1984; Özgül & Kozlu 2002), which is one of the major tectonic units, widely exposed in the eastern Taurides. The Geyikdağı Unit contains carbonate and clastic sediments ranging in age from Cambrian to Eocene. In the type locality Jurassic to Cretaceous carbonate deposits (Köroğlutepesi Formation) are widely exposed and rest unconformably on pre-Jurassic rocks. This study focuses on the lower part of the formation containing the new taxon (Figure 2).

Type Level. Sample TP-4, Aalenian?–Bajocian. The type level lies one meter above the unconformity separating the Jurassic units from the underlying Permian rocks (Figure 2). The measured section in the lower part of the Köroğlutepesi Formation has been divided into 3 main biostratigraphic zones, namely *Timidonella? primitiva* (Aalenian?–Bajocian), *Timidonella sarda-Selliporella donzelli* (Bajocian) and *Paleopfenderina trochoidea* (Bathonian-lower Callovian) zones, the latter including the *Satorina apuliensis* subzone (upper Bathonian). The type level belongs to the *Timidonella? primitiva* zone. This zone is defined as an interval zone between the first occurrences of *Timidonella? primitiva* n.sp. and *Selliporella donzelli*.

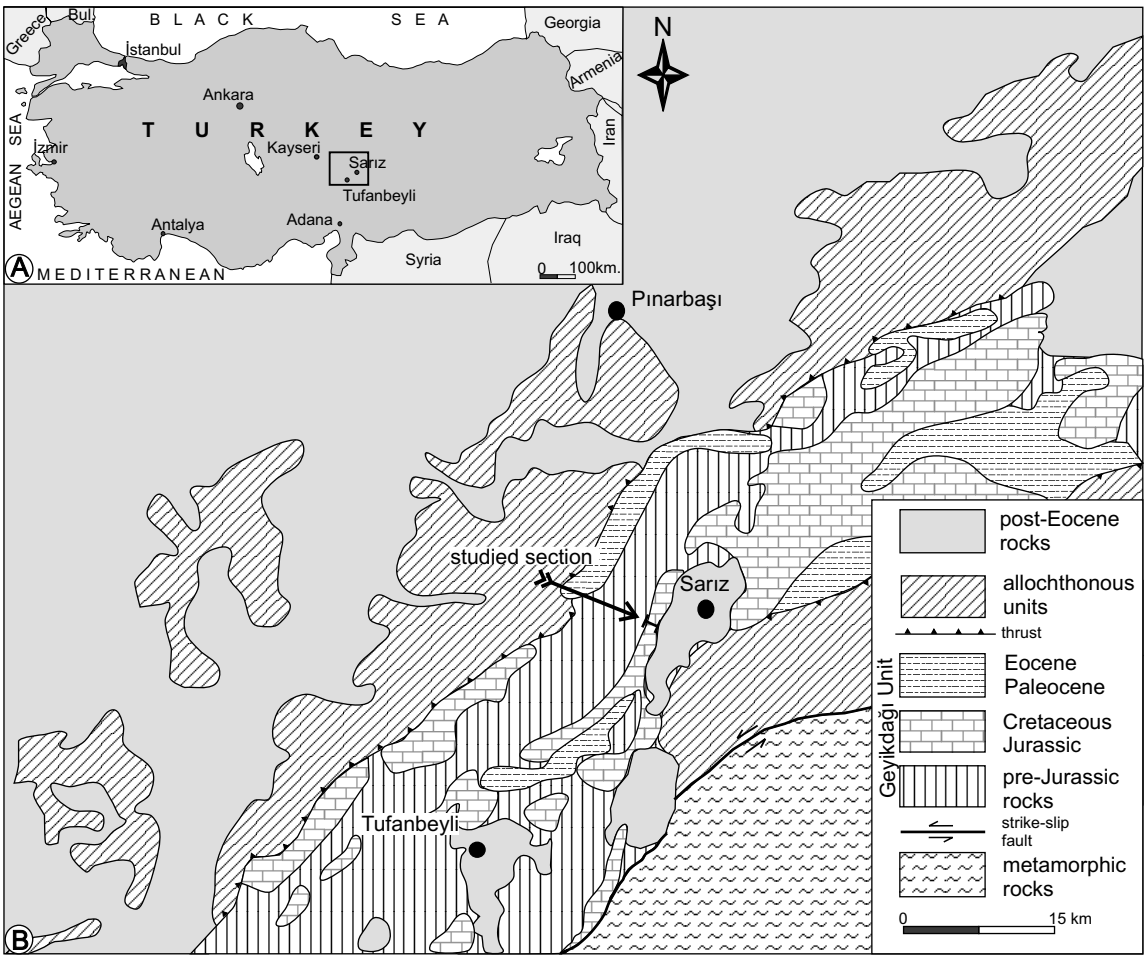

Figure 1. Location map (A) and the measured section in the Jurassic of the Geyikdağı Unit (B). The simplified geologic map is from the 1/500.000 scale map of the General Directorate of Mineral Research and Exploration (MTA 2002a, b).

Material. Hundreds of specimens have been examined in several samples (TP-3, 4, 5, 6, 7, 8, 9) collected along the measured stratigraphic section (Figure 2).

Microfossil Association. In the wackestones of the *Timidonella? primitiva* zone (Aalenian?–Bajocian) the new taxon is associated with *Haurania deserta* and several species of valvulinids (*Riyadhella* spp., *Redmondoides* sp., *Siphovalvulina variabilis*, *Siphovalvulina* sp.). The taxa associated with *Timidonella? primitiva* n.sp. are better diversified in the wackestones and grainstones of the lower part of the Bajocian *Timidonella sarda-Selliporella donzelli* zone. Besides foraminifera recognized in the *Timidonella? primitiva* zone, the following algae and foraminifers were identified in the samples: *Selliporella donzelli, Thaumatoporella parvovesiculifera, Timidonella sarda, Pseudomarssonella* sp., *Redmondoides lugeoni, Paravalvulina complicata, 'Paravalvulina'* sp., *Mesoendothyra croatica, Everticyclammina* sp., *Glomospira* sp., *'Earlandia'* sp. and *Trocholina* sp.

Description. The test of the new species is composed of two distinct stages in the megalospheric form. The first stage is planispirally coiled, and consists of $1^1/_2$ whorls. Following a relatively large proloculus measuring 90 to 125 microns in diameter (Plate I, Figures 1, 8, 12–14, 16; Plate II, Figures 2–4), the first whorl comprises 7 to 9 chambers (Plate I, Figures 12, 14; Plate II, Figure 3). The second whorl is incomplete and the number of chambers varies from 3 to 4 in this half whorl. The diameter of the coiled portion measures between 260–470 microns, the average diameter being 360

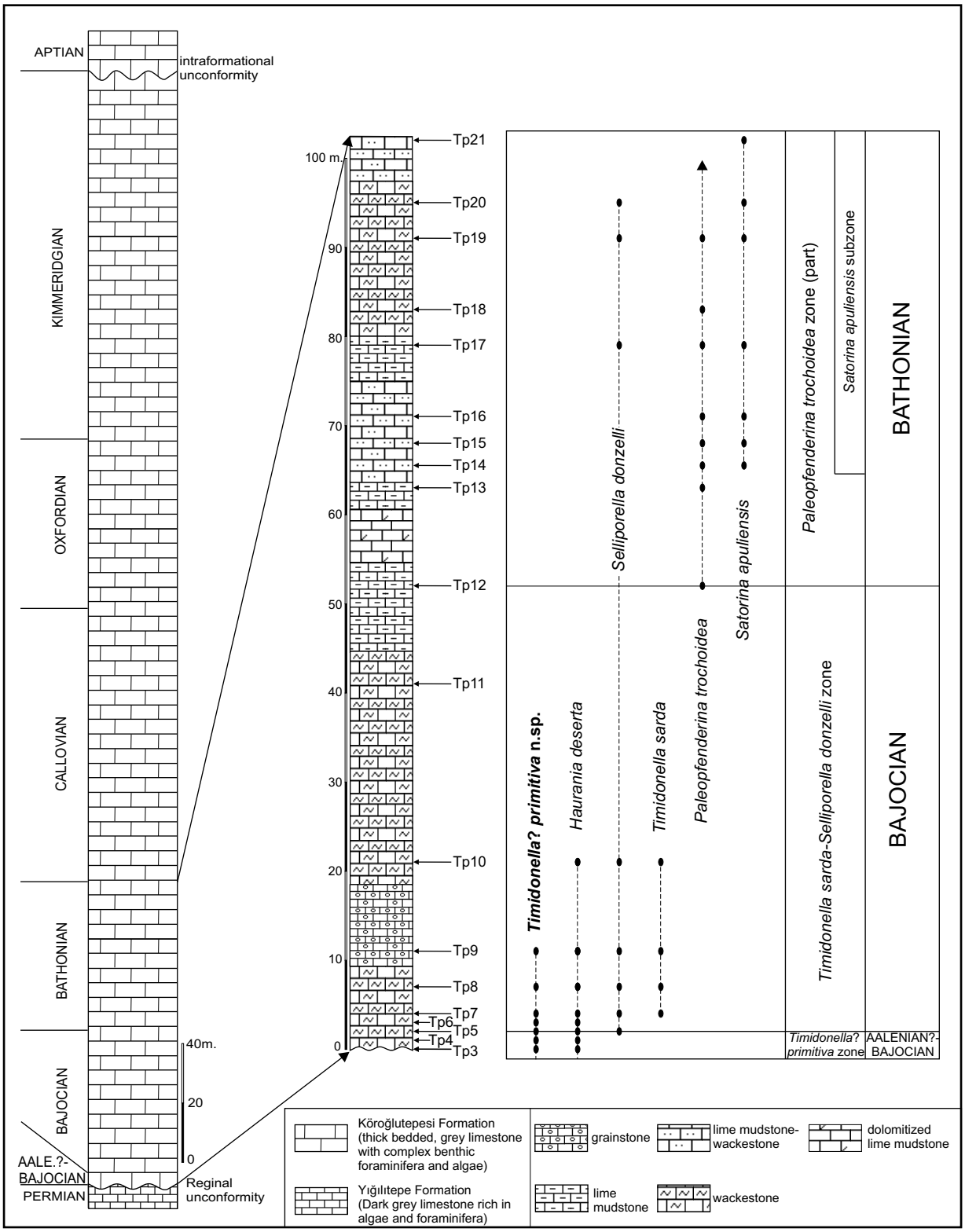

Figure 2. Detailed measured stratigraphic section (Taşpınardere) of the Aalenian? to Bathonian portion of the Köroğlutepesi Formation and the stratigraphic position of *Timidonella*? *primitiva* n.sp. Note the critical taxa associated with *Timidonella*? *primitiva* n.sp. and the biostratigraphical subdivision of the Aalenian?–Bathonian interval.

microns for 7 specimens (Plate I, Figures 1–2, 11–14; Plate II, Figure 2). The height of chambers in the coiled portion measures between 40 to 50 microns.

The second distinct stage, comprising 8 to 13 chambers, is the cylindrical and rectilinear portion of the test (Plate I, Figures 1–3, 14). The height at this uncoiled stage varies proportionally with the number of the chambers. For specimens having 8 to 9 chambers the height is around 700 microns, whereas for specimens composed of 13 chambers, the height reaches 1350 microns (Plate I, Figure 3). The growth rate of the height of chambers during the ontogenesis of the uncoiled portion is nearly constant in each individual. The maximum height measured is 60 microns (Plate I, Figure 11), in some specimens the height measures as low as 35 microns (Plate I, Figure 14).

The internal part of the new species is rather complex and consists of four distinct zones. Immediately below the surface of the test, the first zone is represented by the subepidermal reticulate layer consisting of quite regularly distributed small vertical and horizontal plates forming an alveolar structure (**se** in Plate I, Figure 11; Plate II, Figures 5, 6). Diameter of the alveoles varies between 20 and 30 microns.

The second zone is characterized by rather regularly spaced vertical subepidermal plates varying in number from 3 to 5 with a length of 250 microns. These plates divide the chambers entirely into chamberlets (**sp** in Plate I, Figure 14). They extend into the inner part of chambers decreasing in length gradually and leaving an open space at the bottom of the chamber cavity. This case is visible in some sections (Plate I, Figure 12) where septa are perforated by a multiple aperture system.

The third zone in the test of *Timidonella*? *primitiva* n.sp. is represented by a layer where neither the subepidermal plates nor the interseptal pillars are observed. This zone, whenever seen in sections, is also characterized by the presence of multiple apertures perforating the septa (**ez** in Plate I, Figures 3 & 11; Plate II, Figure 6)

The fourth zone of *Timidonella*? *primitiva* n. sp. is the interseptal pillar system (**pi**) which never forms a continuity in the chambers. It is visible in elongated axial (Plate I, Figure 1, 2), axial (Plate I, Figures 8, 13) oblique (Plate I, Figures 4, 5, 7 & 10) and transversal sections (Plate II, Figure 1). In some sections, although it appears as a dark micritic mass (Plate I, Figures 1, 4, 8 & 13) this massive appearance is probably due to the fusion of individual pillars (Plate II, Figures 1 & 6). In some other sections individual pillars are seen as isolated and slender structures crossing the septa (Plate I, Figures 2, 3 & 7).

Figures 6, 7 and 8 illustrated in Plate II are probably microspheric individuals of *Timidonella*? *primitiva* n.sp. characterized by annular chambers . Particularly in figure 6, all layers reflecting the morphologic character of *Timidonella*? *primitiva* n.sp. are visible, consisting of the subepidermal reticule layer, subepidermal plates, the empty zone in the chambers and the interseptal pillar system.

The wall of the new species is calcareous and probably finely agglutinated. Its thickness is 30–35 microns in the coiled stage, 15–20 microns in the uncoiled stage.

Remarks. Timidonella? *primitiva* n.sp. differs from the type species of the genus *Timidonella* (*T. sarda*) in having a more primitive pillar system and a marked coiled stage composed of $1^{1}/_{2}$ whorls. In specimens of *Timidonella sarda* BASSOULLET, CHABRIER & FOURCADE the interseptal pillars are located in the central part of the chambers and extend as a continuous rod-like structure crossing the chambers. The number of subepidermal plates in a given length in *Timidonella*? *primitiva* n.sp. is much less than the number of plates in *Timidonella sarda* BASSOULLET, CHABRIER & FOURCADE. In addition, the size of the proloculus of the new species is much smaller than the size of the proloculus of *Timidonella sarda* BASSOULLET, CHABRIER & FOURCADE. Although we assign this new population to the genus *Timidonella* and compare it with the type species of the genus, the primitive aspect of the pillar system makes us approach the genus *Timidonella* with some reservations.

Certain sections of the *Timidonella*? *primitiva* n.sp. might be thought to resemble *Haurania (Platyhaurania) subcompressa* BASSOULLET & BOUTAKIOUT. However, the latter differs from the new species in having a regular pillar system and a rather compressed test.

Phylogenetic Considerations

In his comprehensive study of the classification and evolution of the Jurassic lituolid foraminifers, Septfontaine (1988) proposed that the genus *Timidonella* was derived from the plexus *Haurania* (*H. deserta*). This view has been approved by Bassoullet & Boutakiout

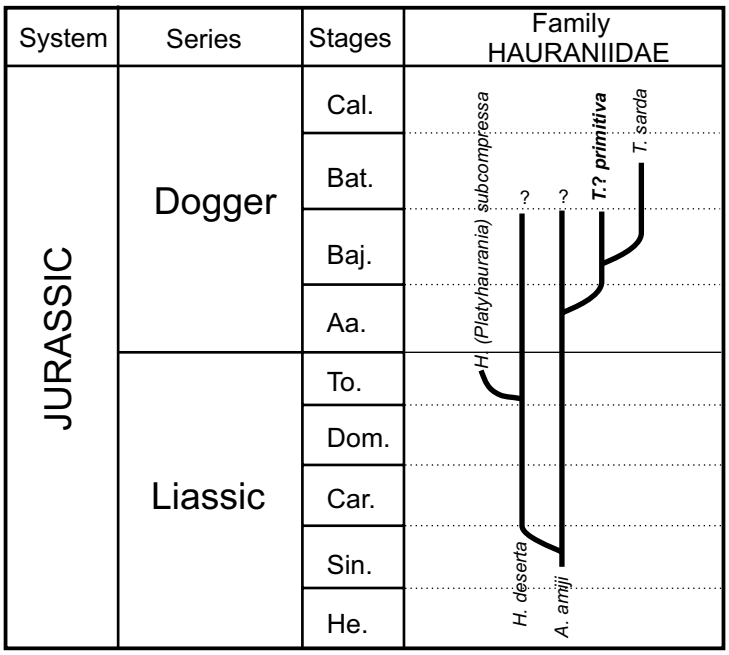

Figure 3. Evolutionary scheme of Hauraniidae in the Liassic and Dogger and the position of *Timidonella*? *primitiva* n.sp. in this scheme.

(1996) who introduced *Haurania (Platyhaurania)* as another evolutionary step derived from the same plexus and considered *Haurania (Platyhaurania)* to be the ancestor of *Timidonella*. However, the new population described in this study suggests that this evolutionary model might not be correct and should be reinterpreted with care within the evolutionary scheme of hauranids. *Timidonella*? *primitiva* n.sp. with a primitive pillar system should be considered as an intermediate stage in the evolution of the genus *Timidonella* from the plexus *Amijiella* which is basically characterized by the absence of a pillar system in the central portion of the test. In their test architecture, both *Amijiella amiji* and *Timidonella*? *primitiva* n.sp. are characterized by the presence of a zone of subepidermal reticulate layer, subepidermal plates and a zone of empty chambers, except for the presence of a primitive pillar system in *Timidonella*? *primitiva* n.sp. In this study, we propose as the first stage of this evolution the appearance of primitive pillars in the macrospheric population of *Amijiella amiji* with cylindrical adult chambers leading to the derivation of *Timidonella*? *primitiva*. In the next stage, the megalospheric specimens of *Timidonella*? *primitiva* should have led to the appearance of *Timidonella sarda,* characterized by a well-developed and continuous rod-like pillar system. Therefore, we suggest, as illustrated in figure 3, the derivation of the genus *Timidonella* from the plexus *Amijiella* in two steps consisting of *Timidonella*? *primitiva* n.sp. and *Timidonella sarda* BASSOULLET, CHABRIER & FOURCADE. This interpretation also differs from the claim of Septfontaine *et al.* (1991) that the appearance of *Timidonella* in carbonate platforms of Tethys was a sudden evolutionary step suggesting a punctual evolution mode. We also find that it is very unlikely that the macrospheric population of *Haurania (Platyhaurania)* with compressed tests was the ancestor of *Timidonella sarda,* which displays no sign of compression in macrospheric tests (Figure 3).

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PLATE I

Figure 1–17. *Timidonella? primitiva* n.sp.

1. Holotype. Axial section showing the coiled portion and the uncoiled stage with the discontinuous interseptal pillar system (pi) seen as dark micritic masses in the centre of chambers. Sample TP-4, thin section C.

2–5, 7, 10. Axial, subaxial and oblique sections showing the primitive interseptal pillar system (pi) in the uncoiled stage. 2: Sample TP-4, thin section D; 3: Sample TP-4, thin section C; 4: Sample TP-3, thin section C; 5: Sample TP-3, thin section A, 7: Sample TP-5, thin section A; 10: Sample TP-3, thin section D.

6. Oblique section displaying subepidermal plates (sp). Sample TP-4, thin section D.

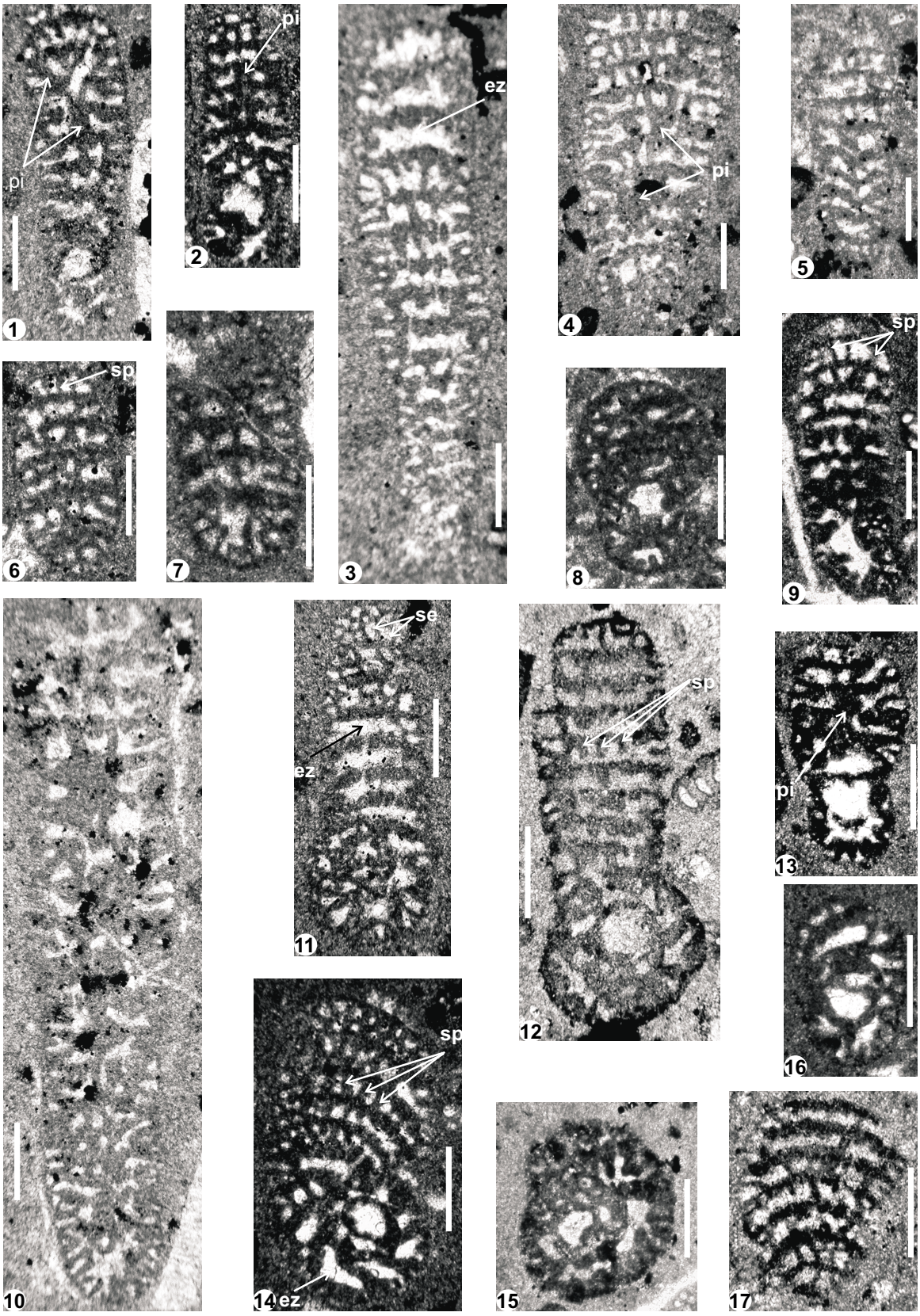
8, 13. Axial sections illustrating subepidermal plates (sp) and the centrally located pillars appearing as dark masses (pi). 8: Sample TP-7, thin section A; 13: Sample TP-3, thin section D

9, 11. Oblique sections showing the subepidermal reticulate layer (se), subepidermal plates (sp), the zone with empty chambers and the multiple aperture system perforating the septa (ez). 9: Sample TP-4, thin section A; Sample TP-4, thin section C.

12, 14–15, 17. Specimens illustrating the coiled and the uncoiled stages of the test. Note the subepidermal reticulate layer, subepidermal plates (sp) and the zone with empty chambers in Figure 14 and incomplete subepidermal plates in Figure 12 reaching the central part of the chambers perforated by the multiple aperture system. 12: Sample TP-3, thin section B; 14: Sample TP-4, thin section A; 15: Sample TP-3, thin section A; 17: Sample TP-4, thin section D.

16. Oblique section of the coiled portion. Sample TP-5, thin section C.

Vertical bar scale is 250 microns.


pi
1
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17

PLATE II

1. *Timidonella*? *primitiva* n. sp. Oblique transversal section of the uncoiled stage of the test displaying subepidermal plates (sp) and central pillars (pi). Sample TP-4, thin section D.

2–4. *Timidonella*? *primitiva* n. sp. Specimens showing coiled and uncoiled stages of the test. Note subepidermal plates (sp) in all figures. 2: Sample TP-7, thin section B; 3: Sample TP-7, thin section C; 4: Sample TP-7, thin section A.

5. *Timidonella sarda* BASSOULLET, CHABRIER & FOURCADE. Equatorial section of the coiled stage and part of the uncoiled stage. Note the regular distribution of subepidermal plates (sp) and the zone of pillars (pi). Sample TP-8, thin section B.

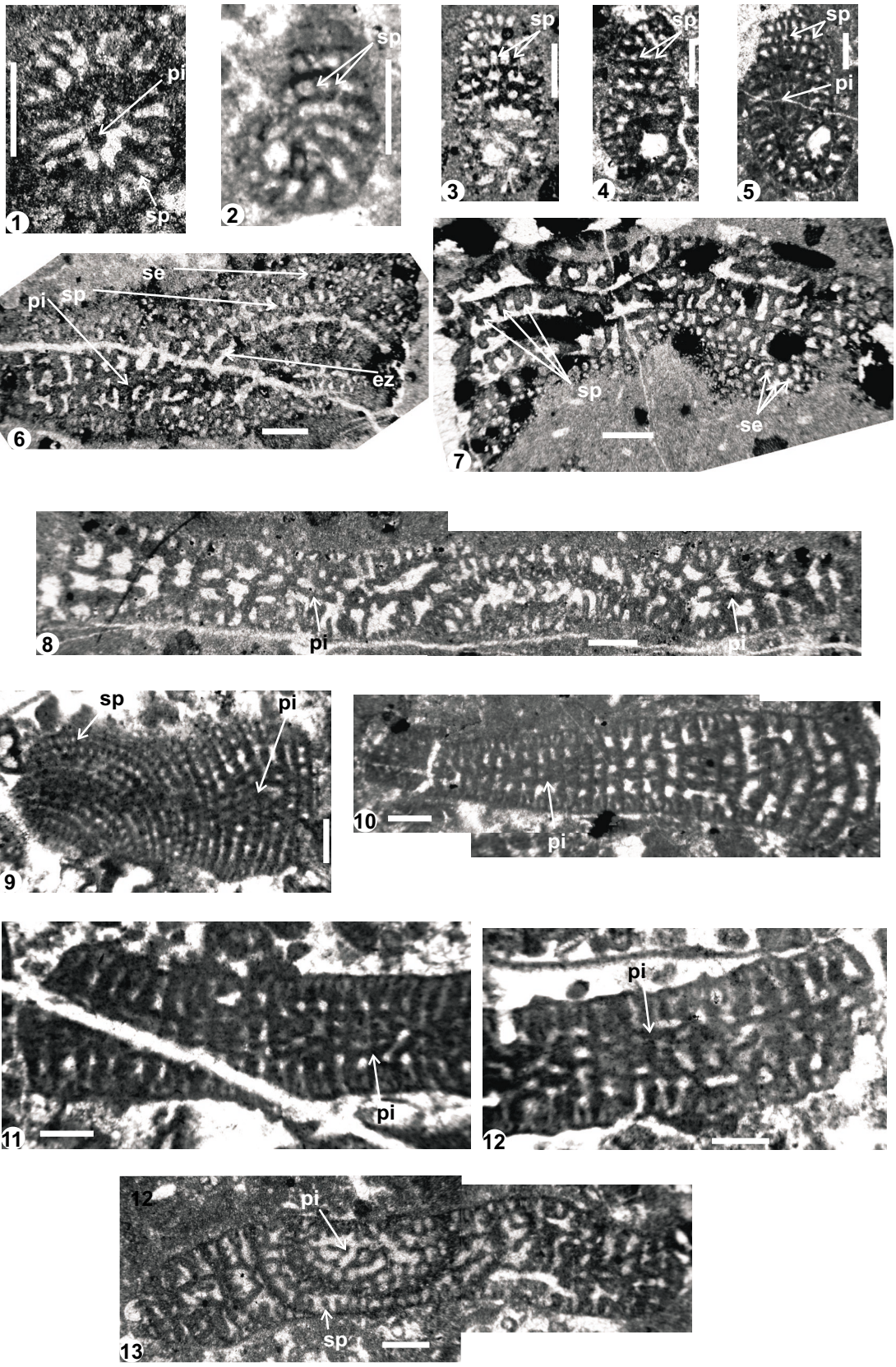
6–8. *Timidonella*? *primitiva* n. sp. Oblique sections of microspheric forms. The discontinuous interseptal pillar system (pi) is visible in Figure 6 and 8. 6: Sample TP-3, thin section D. 7: Sample TP-3, thin section E; 8: Sample TP-4, thin section A.

9. *Timidonella sarda* BASSOULLET, CHABRIER & FOURCADE. Oblique section of the microspheric form showing densely spaced subepidermal plates (sp) and the pillar system (se). Sample TP-9, thin section F

10–12. *Timidonella sarda* BASSOULLET, CHABRIER & FOURCADE. Subaxial sections of microspheric forms displaying the continuous rod-like pillar system (pi). 10: Sample TP-6, thin section B, 11-12: Sample TP-9, thin section F.

13. *Timidonella sarda* BASSOULLET, CHABRIER & FOURCADE. Oblique section of the microspheric form. Note the anastomosing pillar system (pi) and subepidermal plates (sp). Sample TP-6, thin section C

Scale bar is 250 microns.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