



RESEARCH ARTICLE

# New Five Southern Tethyan Agglutinated Foraminiferal Species

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## ABSTRACT

Benthic foraminifera was studied as part of an investigation of the Dababiya section (Egypt), which was undertaken to document a candidate section for the Global Stratotype Section and Point (GSSP) for the base of the Ypresian Stage, Thanetian/Ypresian boundary, Late Campanian Dokan and Azmer sections of Kurdistan (NE Iraq), and the type section of Khangiran Formation of Khangiran section (NE Iran). Five new species of the genera *Pseudogaudryina* and *Pseudogaudryinella* are proposed, from three countries Egypt, Iraq and Iran, and from Campanian and Ypresian sediments. Three species of *Pseudogaudryina*: *P. dababiyaensis* (from Egypt), *P. kurdistanensis* and *P. iraqensis* (from Iraq), two species from Iran: *Pseudogaudryinella iranica* and *Pseudoclavulina iranica*. The Tethyan continental shelf fauna Midway-Type Fauna (MTF) of deep middle neritic to the upper bathyal environment is interpreted.

## 1. Introduction

The present study aims at throwing light on: 1) the stratigraphy and taxonomy of new five members of the genera *Pseudogaudryina* (*dababiyaensis*, *kurdistanensis* and *iraqensis*), *Pseudogaudryinella iranica* and *Pseudoclavulina iranica*, 2) the paleogeographic distribution of them in many localities in the Southern Tethys: Iran, Iraq, Jordan and Egypt (Figure 1). This wide geographic distribution of these taxa indicates that the ancestral Tethys was open and connected with the ancestral Indian Ocean (e.g.,

Aubert, & Berggren <sup>[1]</sup>, Morsi et al. <sup>[2]</sup>, Salahi <sup>[3]</sup>).

## 2. Systematic Paleontology

The taxonomy of Kaminski <sup>[4]</sup> is followed in this study for three members of the genus *Pseudogaudryina* Cushman, another species of the genus *Pseudogaudryinella* Cushman, and one species of the genus *Pseudoclavulina* Cushman. The stratigraphic positions are also presented. Modern references have been added to complete the descriptions of the recorded species (Plate 1).

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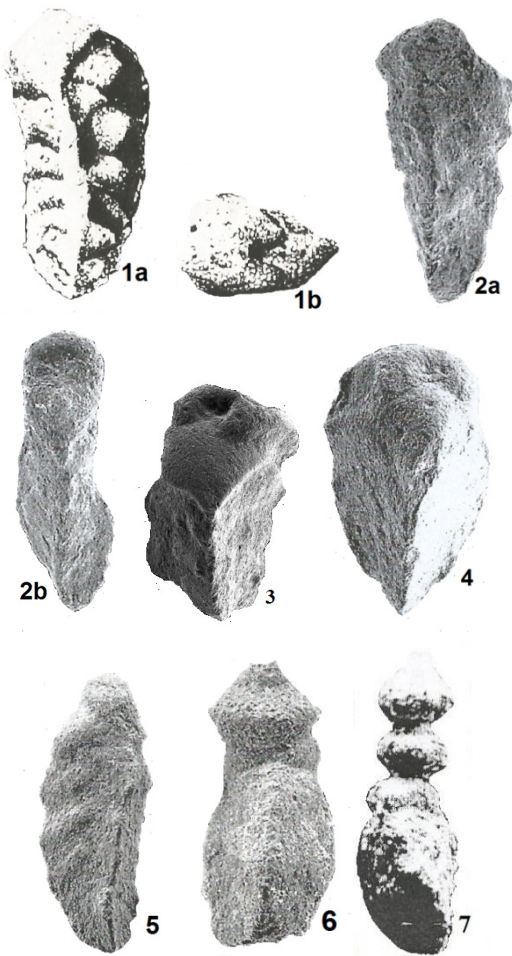
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**Figure 1.** Location map of the three countries (Egypt, Jordan, Iraq and Iran) in the Southern Tethys.



**Plate 1.** Figure 1a,b. *Pseudogaudryina atlantica* Bailey<sup>[5]</sup>, type species, 1a, side view, 1b, apertural view x 80; 2a,b. *P. dababiyaensis* Anan, n. sp., 2a, side view, 2b, side view x 85; 3. *P. kurdistanensis* Anan, n. sp., apertural view x 85; 4. *P. iraqensis* Anan, n. sp., side view x 85; 5. *Pseudogaudryinella iranica* Anan, n. sp., side view x 80; 6. *Pseudoclavulina iranica* Anan, n. sp., side view x 70; 7. *P. futyani* Anan<sup>[6]</sup>, side view x 40.

Genus *Pseudogaudryina* Cushman, 1936

Remarks: The type species (Plate 1, Figure 1) is triangular throughout the agglutinated test with an early tri-serial stage and later biserial. The two series of angular biserial chambers are dissimilar, one series being roughly triangular in section and the other quadrangular in section maintaining the triangular test shape, aperture an interior-marginal arch (Leoblich & Tappan<sup>[7]</sup>).

*Pseudogaudryina dababiyaensis* Anan, n. sp. (Plate 1, Figure 2a,b (= *Gaudryina* sp. Alegret & Ortiz<sup>[8]</sup>, p. 442, Plate 1, Figure 2a,b).

Holotype: Illustrated specimen in Plate 1, Figure 2a,b.

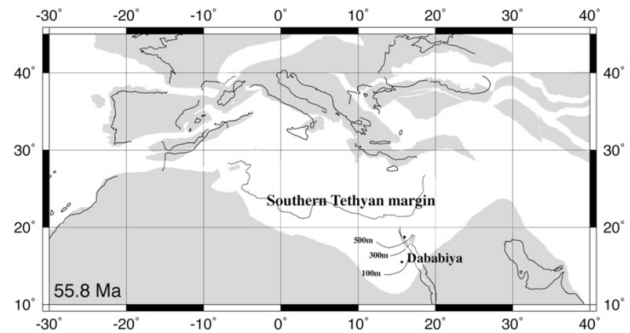
Diameter of the holotype: Length 0.88 mm, width 0.44 mm.

Etymology: After the site of the Paleocene/Eocene Boundary Global Stratotype (Egypt).

Type locality: Dababiya section, south Luxor (Figure 2).

Age: Early Ypresian, *P. wilcoxensis* Zone (E2).

Diagnosis: This species has a triangular agglutinated test with tri-serial early stage and later biserial, one end of the biserial has a pointed end, while the periphery of the other end is rounded, aperture wide interior-marginal arch. It has a wide triangular tri-serial portion, while the biserial has parallel edges.



**Figure 2.** Location map of the Dababiya section (Egypt) in the Southern Tethys (after Alegret & Ortiz<sup>[8]</sup>).

*Pseudogaudryina iraqensis* Anan, n. sp. (Plate 1, Figure 4) (= *Gaudryina pyramidata* Cushman - Jaff & Lawa<sup>[9]</sup>, p. 14, Plate 2, Figure 7, non Figures 5,6.

Holotype: Illustrated specimen in Plate 1, Figure 4.

Diameter of the holotype: Length 0.96 mm, width 0.48 mm.

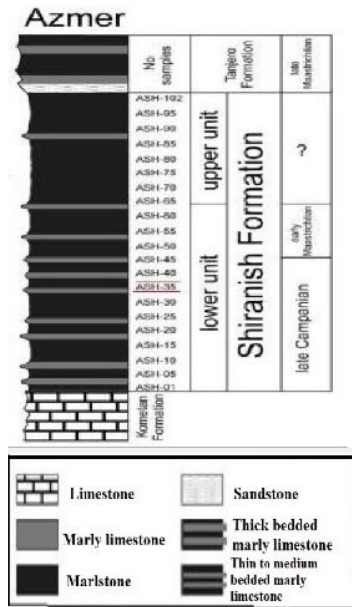
Etymology: After the Republic of Iraq.

Type locality: Shiranish Formation, Dokan section (Figure 4).

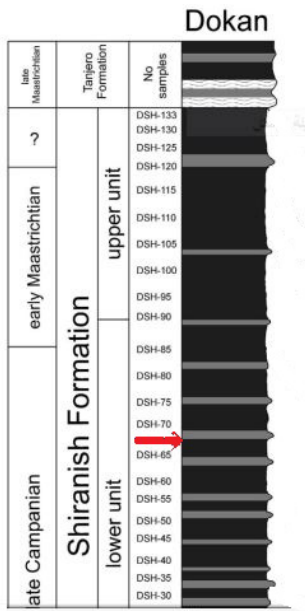
Age: Late Campanian.

Diagnosis: This species has a triangular throughout the fine-grained agglutinated test with tri-serial early stage and later biserial, and one end of the biserial has a pointed

end, while the outline of the other end is rounded, regular edges of the test, aperture wide interiomarginal arch. This species differs from the *P. iraqensis* in its wider width of the test, regular periphery than irregular, and less tapering pointed end of the prefinal biserial chamber.



**Figure 3.** Stratigraphic log of the Azmer section, Kurdistan region (NE Iraq) including the position of the sample-ASH-35, the type locality of *P. kurdistanensis*, (for the lithological description see the next figure 4, after Jaff & Lawa [9]).



**Figure 4.** Stratigraphic log of the Dokan section, Kurdistan region (NE Iraq) including the position of the sample-DSH-68, the type locality of *Pseudogaudryina iraqensis* (after Jaff & Lawa [9]).

Genus *Pseudogaudryinella* Cushman, 1936

***Pseudogaudryinella iranica* Anan, n. sp.** (Plate 1, Figure 5) (= *Gaudryina* sp. Salahi [3], p. 314, Plate 4, Figure 23, non Figure 28.

Holotype: Illustrated specimen in Plate 1, Figure 5.

Diameter of the holotype: Length 0.92 mm, width 0.34 mm.

Etymology: After the Islamic Republic of Iran (Figure 5).

Type locality: Ypresian.

Diagnosis: Test elongate, early-stage tri-serial triangular in section, followed by biserial, and finally uniserial rounded in section, aperture rounded terminal on the short neck in the last chamber. This species differs from *Pseudogaudryinella iraqensis* Anan [6], by its longer and irregular tri-serial portion, and lesser size of the uniserial final chamber.



**Figure 5.** The type section of Khangiran Formation, Kopet-Dagh Basin, NE Iran (after Salahi [3]).

Genus *Pseudoclavulina* Cushman, 1936

***Pseudoclavulina iranica* Anan (n. sp.)** (Plate 1, Figure 6) (= *Gaudryina* sp. Salahi [3], p. 314, Plate 4, Figure 28, non Figures 14,23.

Holotype: Illustrated specimen in Plate 1, Figure 6.

Diameter of the holotype: Length 0.80 mm, width 0.34 mm.

Etymology: After the Islamic Republic of Iran.

Type locality: The Islamic Republic of Iran.

Age: Late Campanian.

Diagnosis: This species has a large tri-serial part and comprise 2/3 of the fine-grained agglutinated test, followed by two chambers of the flask-shaped uniserial portion, rounded terminal aperture on a short neck, and deep sutures. This Iranian species differs from the Jordanian species *P. futyani* Anan in its larger tri-serial part and lesser numbers of the uniserial part.

***Pseudoclavulina futyani* Anan [6]** (Plate 1, Figure 7)



(= *Clavulina barnardi* Futyan <sup>[10]</sup>, p. 522, Plate 81, Figure 4, non Figure 3.

Remarks: This Paleocene species has a large tri-serial part and comprise one-half of the test, the uniserial part has slightly irregular rectilinear three flask-shaped inflated chambers, a rounded terminal aperture at the end of the tubular neck, and deeply excavated sutures. *Pseudoclavulina futyani* differs from *P. barnardi* (Futyan) in its larger tri-serial portion of *futyani* of ½ of the entire test instead of ¼ in *barnardi*, and also three uniserial chambers in the former instead of five to eight chambers in the latter. *P. futyani* is, so far endemic to Jordan.

### 3. Paleogeography

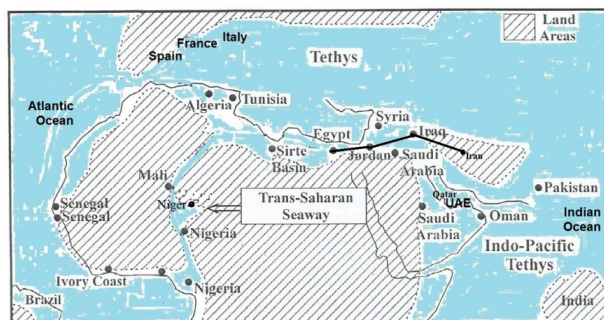
The five new agglutinated benthic foraminiferal species were originally identified and erected in three countries in the Southern Tethys: Egypt, Iraq and Iran. The Tethys Ocean had connected with the Atlantic Ocean in the west and extended across the modern Mediterranean Sea to the Indian Ocean in the east, during the Campanian through Paleogene times (Figure 6).



**Figure 6.** The Tethys Ocean in the Early Paleogene, showing the location of Africa, India, Asia and Europe (after Salahi <sup>[3]</sup>).

### 4. Paleoenvironment

The five recorded species are endemic to their original localities from Egypt, Iraq and Iran. Most of the identified species in the Southern Tethys (Tunisia, Egypt, Jordan, UAE, Pakistan, Figure 7) by many authors are related largely to Midway Type Fauna “MTF” (deep middle neritic to the upper bathyal environment). The Middle East basins show possible migration routes during the Campanian-Ypresian times (LeRoy <sup>[11]</sup>, Haque <sup>[12]</sup>, Berggren & Aubert <sup>[13]</sup>, Futyan <sup>[10]</sup>, Anan <sup>[14]</sup>). On the other hand, the Shiranish Formation has been classically interpreted as a succession of deep-water deposits (Jaff & Lawa <sup>[9]</sup>).



**Figure 7.** The paleogeographic map of the Southern Tethys around the KPg boundary: Egypt, Jordan, Iraq and Iran (after Morsi et al. <sup>[2]</sup>).

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### Conflict of Interest

There is no conflict of interest.

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