

# New Insights on Stratigraphic Level and Record of the Nummulites Postfossulatus Sirel and Deveciler (Foraminiferida) in Safranbolu (NW Turkey) and Malatya Basins (E Turkey)

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## Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

## Article Information

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## ABSTRACT

A new species, postfossulatus, was originally described by Sirel and Deveciler in the middle Lutetian sediments in the Haymana region (Central Anatolia, Central Turkey).

The main purpose of this research is to reveal the new locations and new stratigraphic level of the new species. In this study, Nummulites postfossulatus was also reported for the first time in the early-middle Eocene sediments of the Safranbolu and Malatya Basins.

Safranbolu Basin is located on the Anatolian Plate, and Malatya Basin is located in the southern branch of Neo-Tethys. Safranbolu (Western Black Sea Region) and Malatya basins (SW Malatya, eastern Anatolia), which are important basins of Turkey in biostratigraphic research, have rich fossil content, especially benthic foraminifera, during the Eocene period.

The early-middle Eocene units of the Safranbolu Formation is widely exposed in the Safranbolu Basin-Karabuk (northwestern Turkey). This formation is composed of abundant macro-micro fossiliferous limestone.

The Yıldıztepe Formation outcropping in the Malatya Basin, represented by reefal limestones containing abundant foraminifera, algae, and coralline, is of middle-late Lutetian age.

This study determined that the stratigraphic level of N. postfossulatus went up to the Upper Lutetian because it was seen in the Nummulites aturicus zone representing late Lutetian in the Yıldıztepe Formation.

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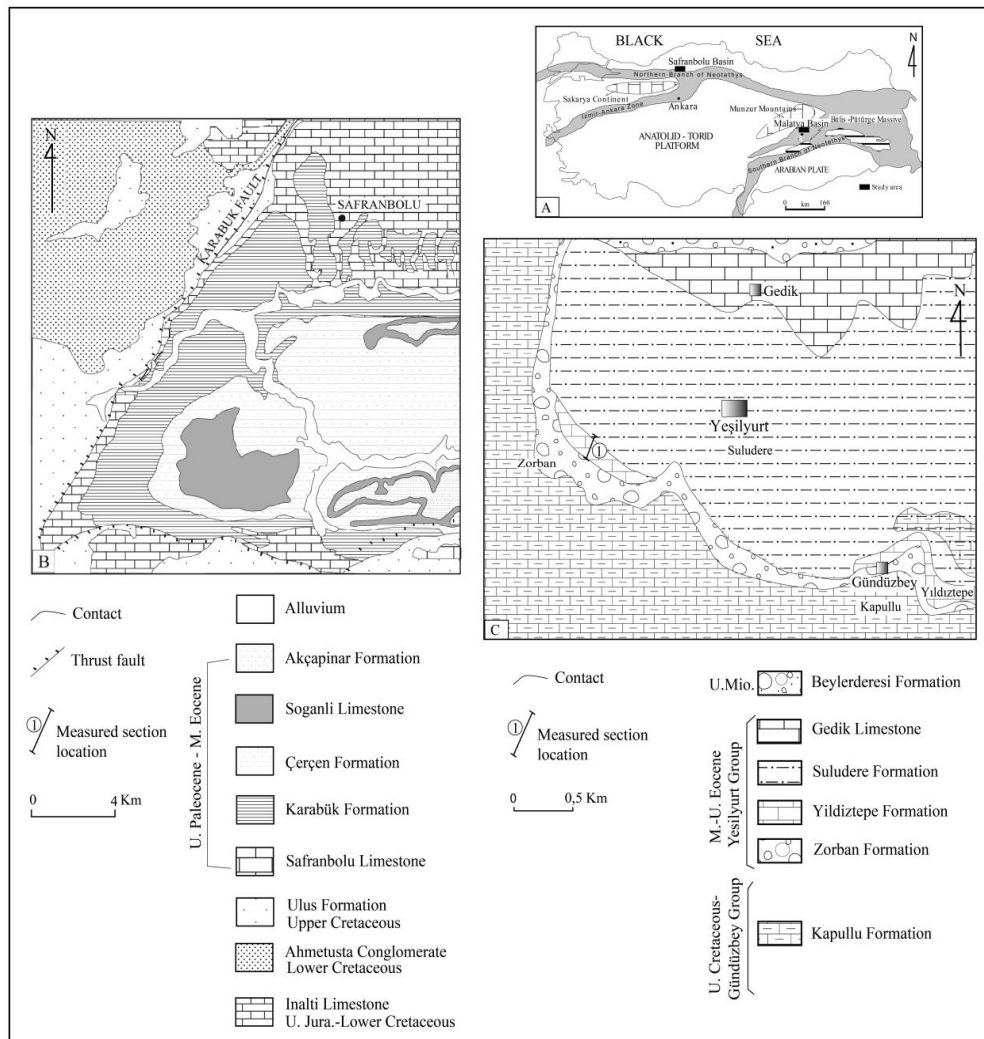
**Keywords:** *Postfossulatus*; early-middle Eocene; Safranbolu Basin; Malatya Basin.

## 1. INTRODUCTION

The investigation areas are located in the Safranbolu Basin, Karabük, NW Turkey and in the southern part of the Malatya Basin, East Anatolia as well as in the East of Turkey (Fig. 1A). A large number of studies have been conducted in these areas [1-7].

The focus of this research is to reveal the new stratigraphic position and locations of *Nummulites postfossulatus* Sirel and Deveciler detected in the Safranbolu and Yıldıztepe formations.

When I reviewed the article on *Nummulites postfossulatus* species described by Sirel and Deveciler (2018), I came to the conclusion that some of the specimens that I compiled in my previous studies [4,6] and, which I defined as *Nummulites fossulatus* are *postfossulatus*. In previous studies, this new species may have been described as *N. fossulatus*, just as my studies, before *N. postfossulatus* was described. Therefore, this information is valuable for determining the new locations and stratigraphic levels of the *postfossulatus* species.



**Fig. 1. A) Position of the Basins within Neo-Tethys realm (after [7]) B) Geological map of the Safranbolu Basin (modified from [1]) C) Geological map of the Malatya Basin (after [5])**

## 2. MATERIALS AND METHODS

Two measurement profiles were taken from the Safranbolu and Yıldıztepe groups, and 33 samples were systematically collected from these measurement profiles. Soft rock samples of the samples collected systematically from the measured sections were washed through a 63 µm sieve using a 17% hydrogen peroxide solution for 24 h, while the rest was oven-dried and sieved dry at 63 µm, 125 µm, and 250 µm. At the end of the binocular microscope examination, abundant planktonic and benthic foraminifera were identified [4,6]. In this study, the biozones were determined according to [8-10].

A total of 16 *Nummulites postfossulatus* were discovered and reported. The part representing the species under investigation is kept in the Faculty of Engineering of Ataturk University. The selected photos are shown in Fig. 4.

## 3. GEOLOGICAL SETTING

Safranbolu Basin consists of Eocene to post-Eocene sediments, mainly volcanoclastic, shallow marine and terrestrial sediments. The Eocene sediments (Safranbolu Formation) mainly consist of detritus and granite limestone [1,3].

Rock units in the Safranbolu Basin; Paleozoic units, Mesozoic units, Paleogene units, Neogene units and Subduction complex were classified by [1]. The Safranbolu Formation (Palaeogene units) consists of sandy limestone, calcareous sandstone and includes abundant benthic foraminifera and other micro and macrofossils. The formation overlies the shelf carbonates of the late Cretaceous Ulus Formation with angular unconformities. Middle Eocene Karabük Formation conformably sets above the Lower-middle Eocene Safranbolu Formation, which consists of abundant macro-micro fossiliferous limestone interlayered at times with dolomitic and sandy levels [1,3] (Figs. 1B, 2).

The Malatya Basin is an Upper Cretaceous to Tertiary graben developed in the southern branch of Neo-Tethys. It is composed of 4.5 kilometers of Upper Cretaceous-Tertiary volcanic-sedimentary rocks [5].

Gündüzbey Group is of Upper Cretaceous-Lower Paleocene aged and showing the transition from the terrestrial environments to the reef carbonate

and flysch-like sediments deposited in the fore-arc environment [5].

The Yeşilyurt Group in the Malatya Basin is composed of the Middle-Upper Eocene Yıldıztepe, Suludere and Gedik formations (Fig. 1C, 3). The Yeşilyurt Group consists of conglomerate interbedded with sandstone and mudstone, reefal limestone containing *Nummulites*, and a flysch-like succession with features of a long erosion period. There is an angular unconformity between the Yeşilyurt Group and the Gündüzbey Group. The Pliocene Beylerderesi Formation started as a basement conglomerate and continued in the form of alternating conglomerate-sandstone-mudstone [5] (Fig. 1C).

### 3.1 Safranbolu Formation

The early-middle Eocene units of the Safranbolu Formation is widely exposed in the Safranbolu Basin-Karabük (northwestern Turkey). This formation is composed of the abundant macro-micro fossil limestone, sometimes containing dolomite and sand. Samples were collected systematically along the stratigraphic section measured along the Safranbolu formation (Figs. 1B, 2). According to [1], Safranbolu, Karabük, Çerçen, Soğanlı and Akçapınar formations are late Paleocene-middle Eocene in age. However, [3] obtained new fossil data and concluded that these formations are early-middle Eocene in age.

According to the identified benthic foraminiferae, the age of the Safranbolu Formation is the early-middle Eocene, namely: *Coskinolina douvillé*, *Pfendericonus aff. makarskae*, *Alveolina cremae*, *A. rütimeyeri*, *A. sp.*, *Orbitolites complanatus*, *Bulimina alazaensis*, *Mississippina sp.*, *Eorupertia manga*, *Asterigerina rotula*, *Linderina brugesi*, *Fabiania cassis*, *Sphaerogypsina globula*, *Silvestriella tetraedra*, *Assilina exponens*, *Nummulites fossulatus*, *N. postfossulatus*, *N. sp.*, *Asterocyclina stellata*, *Discocyclina sp.*, Textulariidae, Hauerinidae, Rotaliidae. In addition, some corals, algae, ostracods and gastropods were also found in these sediments [4] (Fig. 2). The data obtained all indicate that the Safranbolu Formation was deposited in the lower-middle Eocene.

In this research, I identified the SBZ 11 and SBZ 16 biozones in the Safranbolu section (Fig. 2). Since *N. postfossulatus* is between these two biozones, I determined that its stratigraphic level is the early-middle Eocene.

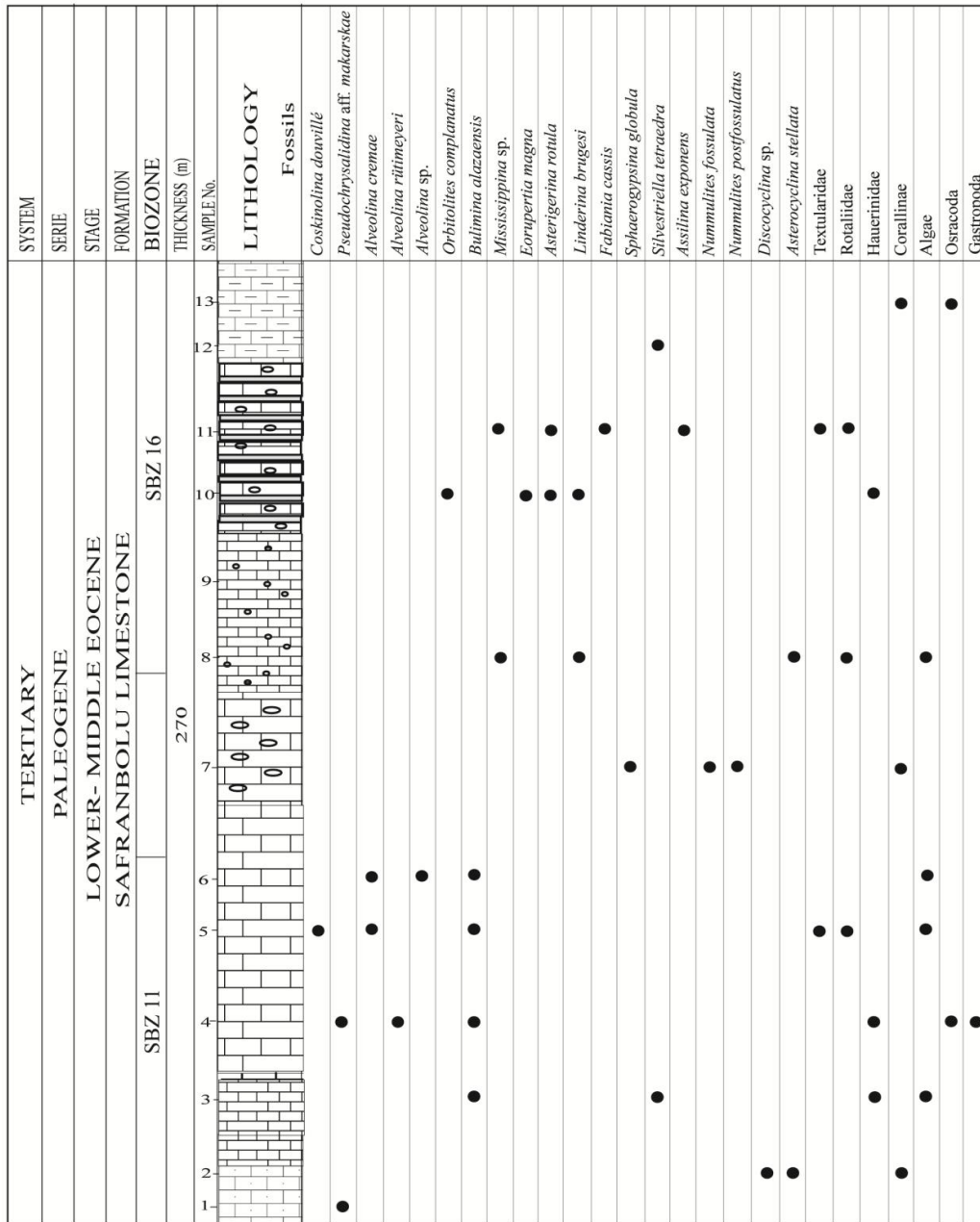


Fig. 2. Safranbolu measured stratigraphical section (modified from [4]).

### 3.2 Yıldıztepe Formation

The Yıldıztepe Formation is characterized by foraminifera, algae, corallinae-bearing reef-like limestones, with the mudstone, calcareous sandstone, claystone and sandy limestone interbeds. The thickness of the unit in the type section is up to 120 m (Figs. 1C, 3). According to benthic foraminifera assemblage, Lutetian age was suggested for the formation [5,6].

Sixteen species representing 13 genera benthic foraminifera in Yıldıztepe Formation were recorded and a brief explanation is given for their biostratigraphic value [6]- namely, *Clavulina* sp., *Globotextularia* sp., *Textularia* sp., *Miliola saxorum*, *Alveolina* sp., *Orbitolites complanatus*, *Baggatella* cf. *inconspicua*, *Cibicides blanpiedi*, *Sphaerogypsina globula*, *Asterigerina rotula*, *Assilina exponens*, *Nummulites aturicus*, *N. beamonti*, *N. cf. cuvillieri*, *N. fossulatus*, *N.*



**Description:** Megalospheric forms are not found.

**Microspheric Forms.** The two sides of the shell are swollen and the edges are sharp, with a pit in the center (Fig. 4 A). This appears to be “dumb bell-shaped” in the axial section with a central depression (Fig. 4 D).

The diameter of the test ranges from 1.45 mm to 1.90 mm and the thickness from 0.60 mm to 1 mm. (Table 1). Proloculus very small, spherical and between 0.040-0.050 mm in diameter. There are 3-5 whorls in the equatorial sections and the number of chambers in the whorls is seen as 9-29. Spire is regular, showing opening after the second or third whorl; chambers are slightly curved, usually isometric and about 1.5 times higher than their length. Septa straight to slightly curved (Fig. 4 B, C).

**Remarks:** Sirel and Deveciler named this new species *postfossulatus* because it is similar to the Cuisian species *Nummulites fossulatus* Cizencourt.

They stated that it is an intermediate form between *Nummulites pinfoldi* Davies and *Nummulites fossulatus* Cizencourt. But *Nummulites postfossulatus* is different from *Nummulites pinfoldi* Davies in that they have smaller tests and loosely coiled whorls with larger chambers. *Nummulites fossulatus* also differs from the new species in that it has a larger test and loosely coiled whorls.

I agree with Sirel and Deveciler's [15] suggest of *Nummulites postfossulatus* as an intermediate form between *Nummulites pinfoldi* Davies and *Nummulites fossulatus* Cizencourt.

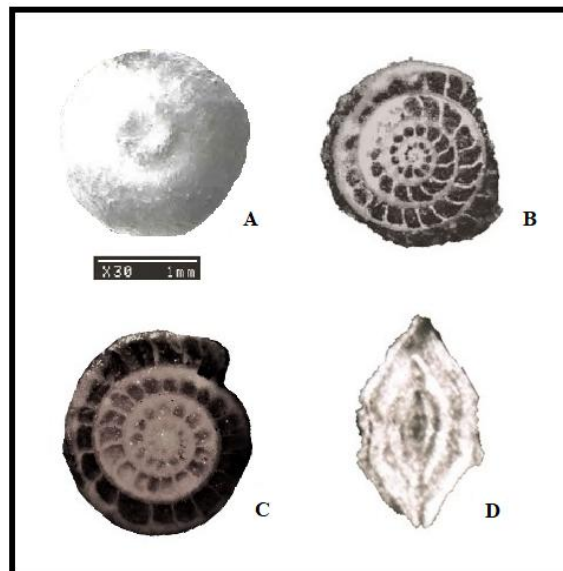
**Localities:** Safranbolu and Malatya basins.

**Age:** Early-middle Eocene (Safranbolu Basin), late Lutetian (Malatya Basin).

Sirel and Deveciler [15] discovered *Nummulites postfossulatus*, which they described in their research around Haymana (Ankara, Central Turkey), as well as *N. lehneri* Schaub, *Assilina exponens* (Sowerby), and *A. spira* (de Roissy). Therefore, they determined the age of *N. postfossulatus* as middle Lutetian (SBZ 14-15).

In this study, *Nummulites postfossulatus* was found in the Malatya Basin along with *Assilina exponens* (Sowerby), *Nummulites aturicus* (Joly and Leymerie), *Nummulites fossulatus* Cizencourt, *Baggatella* cf. *inconspicua* Howe. The stratigraphic level of *N. postfossulatus* is late Lutetian, since it is located in the *Nummulites aturicus* zone.

In the Safranbolu Basin, this species was discovered together with *Nummulites fossulatus* Cizencourt, *Nummulites* sp. and *Sphaerogypsina globula* (Reuss). According to the fossil assemblage of the Safranbolu Formation, the stratigraphical level of *N. postfossulatus* is of the early-middle Eocene age.



**Fig. 4. *Nummulites postfossulatus* Sirel and Deveciler. (A) External view, Safranbolu basin (B, C) Equatorial sections, Safranbolu and Malatya basins; (D) Axial section, Malatya basin**

**Table 1. Dimensions in mm (measured external view of twenty-five specimens).**

Diameter (mm)	Thickness (mm)	D/T	Dump-bell diameter (mm)
1.90	1.00	1.90	0.50
1.65	0.80	2.06	0.35
1.60	0.80	2.00	0.35
1.55	0.70	2.21	0.35
1.50	0.65	2.31	0.35
1.45	0.60	2.42	0.30

## 5. CONCLUSION

Sirel and Deveciler, who first described this new species, identified it in the Lutetian unit at Haymana. This study determined that the stratigraphic level of *N. postfossulatus* went up to the Upper Lutetian because it was seen in the *Nummulites aturicus* zone representing late Lutetian in the Yıldıztepe Formation. The stratigraphic level of *N. postfossulatus* in the Safranbolu Formation is of early-middle Eocene age because it is observed between the SBZ11 zone representing the early Eocene and the SBZ 16 zone representing the late Lutetian. These data are important in terms of contributing to the creation of records of new locations and new stratigraphic levels of the *postfossulatus* species.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

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