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Stratigraphical Position of Piran Limestone Unit in Piran Area, Erbil Governorate, Kurdistan Region, Iraq: Insights from Occurrence of Calcareous Nannofossils

Rzger A. Abdula[1*], Omar A. Al-Badrani [2]

[1] *Petroleum Geosciences Department, Faculty of Science, University of Soran, Soran, and Petroleum and Mining Engineering Department, Tishk International University, Erbil, KRG, Iraq.*

[2] *Department of Geology, College of Science, University of Mosul, Mosul, Iraq.*

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Correspondence:
Name: Rzger Abdulkarim Abdula

Email: rzger.abdulkarim@tiu.edu.iq

ABSTRACT

The Piran Limestone Unit in Kani Rash in Piran Sub-district is studied in order to determine the stratigraphical and palaeontological relationships. Based on the general geology and structural relations of the thrust units in the surroundings, the most representative layers are selected. The total number of the collected samples is 13. The same number of the thin sections are prepared and examined under the microscope. Biofacies assemblages are determined from thin sections using the polarized microscope. Based on the occurrence of *Fasciculithus tympaniformis* sp., *Heliolithus riedelii* sp., *Reticulofenestra* sp., *Prinsius* sp., *Sphenolithus anarrhopus* sp., and *Sphenolithus moriformis* sp., the age of this unit is determined to be Middle Thanetian.

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الوضع الطباقي لوحدة بيران الجيري في منطقة پيران، محافظة أربيل، إقليم كوردستان، العراق: استقراء من وجود متحجرات النانو الكلسية

رزگار عبدالكريم عبدالله[1]، عمر احمد البدراني [2]*

[1] قسم جيولوجيا النفط، كلية العلوم، جامعة سوران، سوران، اقليم كوردستان، وقسم هندسة النفط و المناجم، جامعة تيشك الدولية، اقليم كوردستان، اربيل، العراق.

[2] قسم علوم الارض، كليه العلوم، جامعة الموصل، الموصل، العراق.

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العراق

المراسلة:

الاسم: رزگار عبدالكريم عبدالله

Email: rzger.abdulkarim@tiu.edu.iq

الملخص

تمت دراسة وحدة بيران الجيرية في منطقة كاني رش في ناحية بيران لتحديد العلاقات الطباقية والباليونتولوجية. بناءً على الوضع الجيولوجي العام والعلاقات التركيبية للوحدات المنزلقة في المناطق المحيطة، تم اختيار الطبقات الأكثر تمثيلاً. العدد الإجمالي للعينات التي تم جمعها هو 13. نفس العدد من السلايدات تم تحضيرها وتحليلها تحت المجهر. تم تحديد تجمعات الأحياء الحيوية من السلايدات باستخدام المجهر المستقطب. بناءً على ظهور الانواع التالية:

Fasciculithus tympaniformis sp., *Heliolithus riedelii* sp., *Reticulofenestra* sp., *Prinzio* sp., *Sphenolithus anarrhopus* sp., and *Sphenolithus moriformis* sp.

تم تحديد الوحدة بعمر الثانيتيان الاوسط.

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Introduction

The Piran unit was defined by Cobbett (1957) in Kani Rash in Piran Sub-district as a unit of the Naopurdan shaly rock group, but including it in this group is incorrect according to Jassim et al. (2006). It is included in the Qandil group, and the limestone is considered a metamorphosed marble that meets the American Standard Test of marbles, ASTM C-503, 67, 1972 (Meala, 2005). Relatively, no complete work has been published concerning the stratigraphy, palaeontology, depositional environment and age determination of the Piran limestone in Iraq.

Aim of the Study

The objective of this study is to determine the stratigraphical and palaeontological relationships in detail for this unit throughout a detailed description of the selected section in terms of petrography, facies analysis and subdivisions of facies in Piran **Sub-district, northeast** of Erbil Governorate, Kurdistan Region, Iraq. This has been accomplished by determining and assigning relative age of Piran limestone based on occurrence of fossil

assemblages. To conclude that, the studies of the local stratigraphy, palaeogeography, and sedimentology will play a major role in the determination of the depositional environment of the units along the considered section. The study attempts to establish the sedimentologic characteristics and boundaries of the unit with both lower and upper contacts. Finally, the present study attempts also to propose a new stratigraphic rock formation in the stratigraphic column of Iraq.

Study Area

The study area is located 1040 m a.s.l., about 5 km to the west of the Piran Sub-district, which is located far away in northeast of Iraqi territory close to the borders with Turkey, about 15 km to northeast of Mirga Sur Town, Erbil Governorate. The studied section is located approximately on latitude 36° 54' 07.53" N and longitude 44° 19' 36.68" E. The area is studied in details for the first time (Fig. 1).

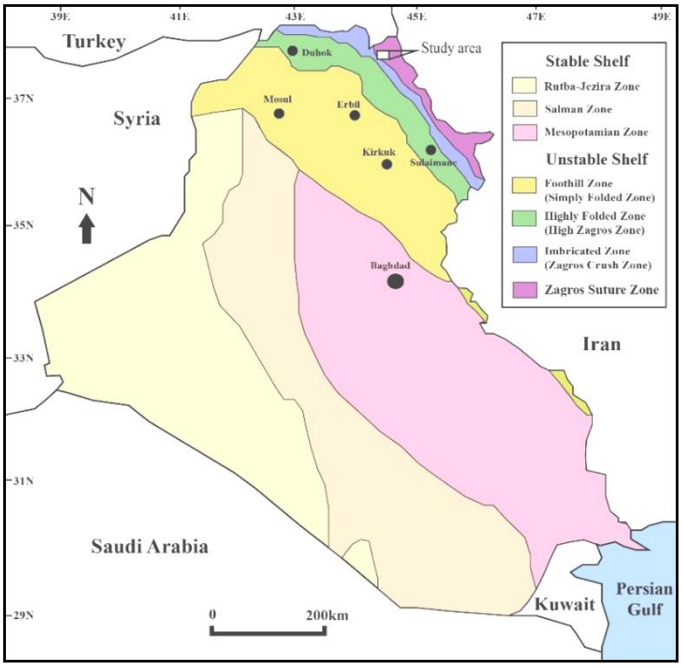

Fig.1.Tectonic map of Iraq showing the Study Area (redrawn after Sorkhabi, 2008).

Materials and Methods

During the field survey, the general geology and structural relations of the thrust units in the surroundings were observed. This has been accomplished after selecting the most appropriate locality for the study. Sampling focused on the main lithology (limestones). The total number of the collected samples is 13. The same number of the thin sections were prepared and analyzed under the microscope.

The field work of Piran outcrop was performed during the winter of 2021. The outcrop section was measured from the base of the Piran limestone to the top by using a Jacob's staff and Brunton compass. The thickness, mineral composition, color, and sedimentary structures were documented by hand lens. The samples are collected at an interval of approximately every 1 m for the whole unit. Lithofacies and biofacies assemblages are determined from thin sections using the polarized microscope. Each sample is subjected for a bulk analysis at the Soran Scientific Research Center (SSRC) and Geology Department at University of Mosul. Two

different methods are chosen for the preparation and extraction of fossils: (1)- acetic acid technique; and (2)- hydrogen peroxide technique.

Geologic Overview

Geologically, northern Iraq is located at the conversion flanked by the Arabian Plate in the southwest and the extremely suture zone in north and northeast of the Arabian Plate. The development of the Arabian shelf has been prejudiced by the movement of the Precambrian units and by the tectonism lengthways the Neo-Tethyan edge (Jassim and Buday, 2006a). During Palaeocene-Eocene times, in which Piran limestone is supposed to be deposited, the north eastern area was raised, and deposition was hosted by the down warping of a broad linear northwest-southeast trough, crossing the region to the southwest (Ziegler, 2001; Khoshnaw et al., 2021), and the sediments were dropped within an earlier foredeep-setting (Dunnington, 1955; Karim et al., 2022). In Palaeocene-Eocene times, most of Iraq was covered by several isolated basins (Fig. 2).

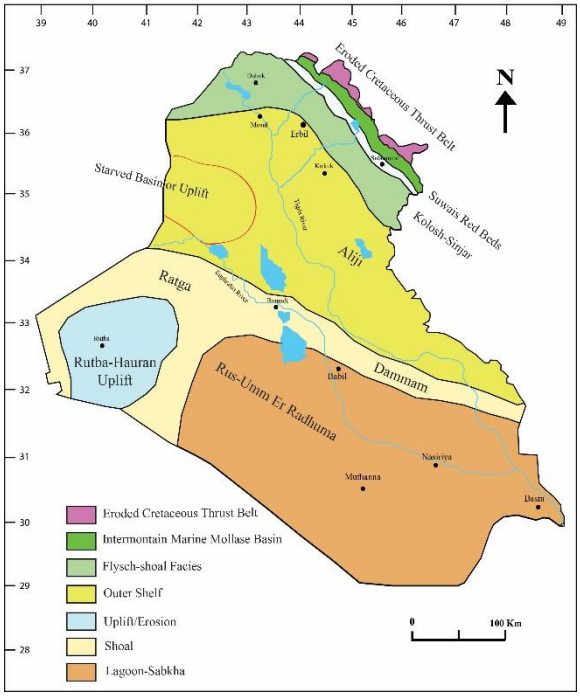

Fig. 2. Palaeogeographic map of Iraq during Palaeocene-Middle Eocene time (redrawn after Jassim and Buday, 2006b).

The Naopurdan (shaly) rock group is widely distributed in the northwestern parts of the Zagros thrust zone, occupying its external (western and southwestern) parts. At the same time, the Naopurdan (shaly) rock group is the single, or at least prevalent component of the lowermost tectonic unit of the Zagros zone (Buday, 1980). At this locality, the Naopurdan shaly rocks crop out with the main thrusted rock units. Additionally, the area is characterized by the presence of formations containing numerous faults and secondary folds. In respect to stratigraphy, the investigated section includes stratigraphic successions shown in figure (3).

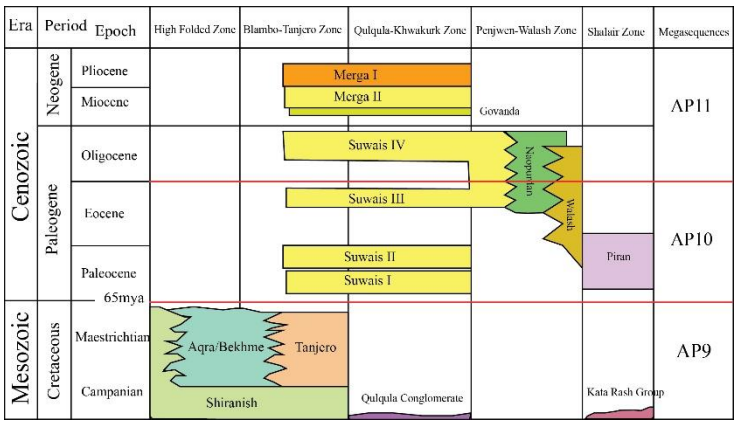

Fig. 3. Tectonostratigraphic column for the Zagros Suture Zone in Iraq. Red lines represent tectonic contacts (redrawn after Jassim et al., 2006; Abdula et al., 2018).

Results and Discussion

The studied unit (Fig. 4) comprises of massive, rosy clayey limestones (Fig. 5) rich in calcareous nannofossils. The unit rises as a block of mountain in the west of Piran Sub-district. Tectonically, the outcrop is located in the Zagros thrust zone. In the bottom part, Palaeogene fossils are found, and in the top part, Maastrichtian fossils are found (Cobbett, 1957). The limestones overlie dark flysch sequence of early Middle Eocene age. The flysch belongs doubtless to the Sidekan Subgroup of the Naopurdan shaly rock group. The contact between the two units is evidently tectonic.

Fig. 4. Field image of Piran Limestone in Piran Town, Iraq.

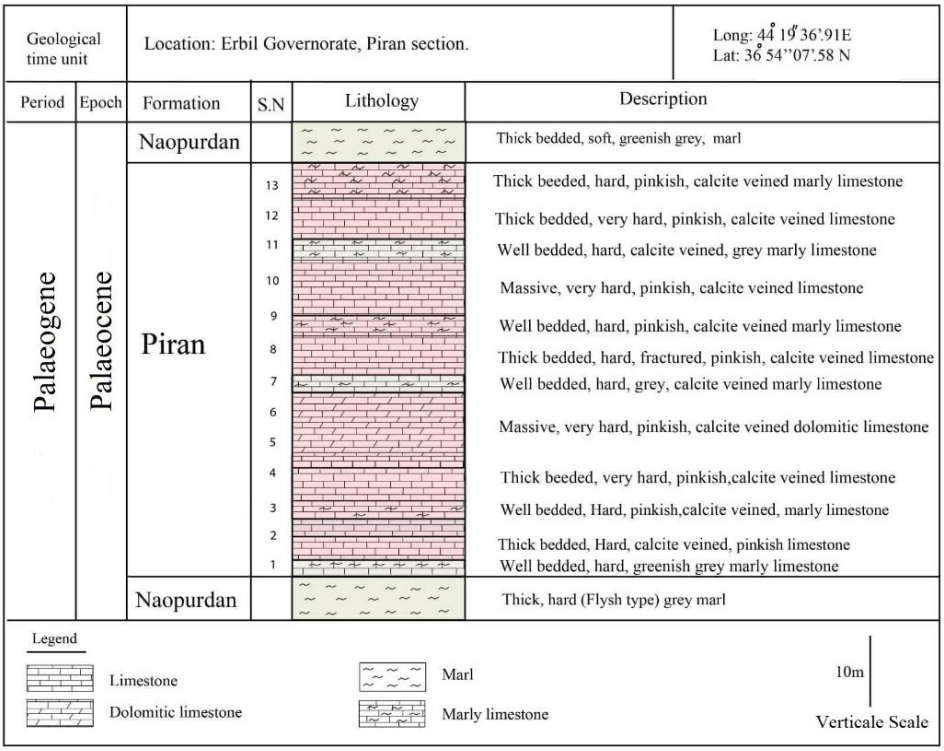

Fig. 5. Stratigraphic section shows the lithology of Piran Limestone.

The beds mentioned above are considered by Cobbett (1957) as part of the Naopurdan shaly rock group and correlated with the coralline limestone horizon of that group. This stratigraphic and tectonic position of the Piran limestone is of course dubious. First of all, the coralline limestone is of Palaeocene-Lower Eocene age and do not contain Cretaceous fossils. Furthermore, the contact of the limestones with the underlying flysch beds is tectonic. These are reasons for why the Piran limestone cannot be considered as a normal member of the Naopurdan sequence. On the other hand, it is possible to correlate them with the non-metamorphosed limestone members of the Qandil Serginil sequence (Buday, 1980). The Piran limestone contain Maastrichtian fossils as well according to Stevenson (1957, in Buday, 1980). Their tectonic position; however, indicates that these limestones are apart from the fact that they contain beds of different age belonging to different tectonic units, e.g., to some remnants of the thrust over Qandil, too. The Cretaceous fossils found in these limestones cannot be; therefore, considered as a proof for the possible Cretaceous age of the lowermost beds of the Naopurdan (shaly) rock group (Buday, 1980).

There is no exact idea about the depositional environment of this unit except that of Jassim et al. (2006), who proposed the depositional environment of this unit as carbonate shelf of Sanandaj-Sirajan Zone. According to Buday (1980), both upper and lower contacts of the unit are structural not stratigraphic. Excellent outcrops of Piran limestone are exposed in the west of Piran Sub-district and also from Sakran Mountain at the south of Choman Town within the Zagros thrust zone of Kurdistan Region, Iraq. Only Cobbett (1957) had mentioned this unit from the type area.

Based on the following Calcareous Nannofossils (Fig. 6) that are recognized within the Piran limestone unit in Kani Rash locality in Piran Sub-district, the age of this unit is determined to be *Heliolithus riedelii* biozone of the age Middle Thanetian (Fig. 7).

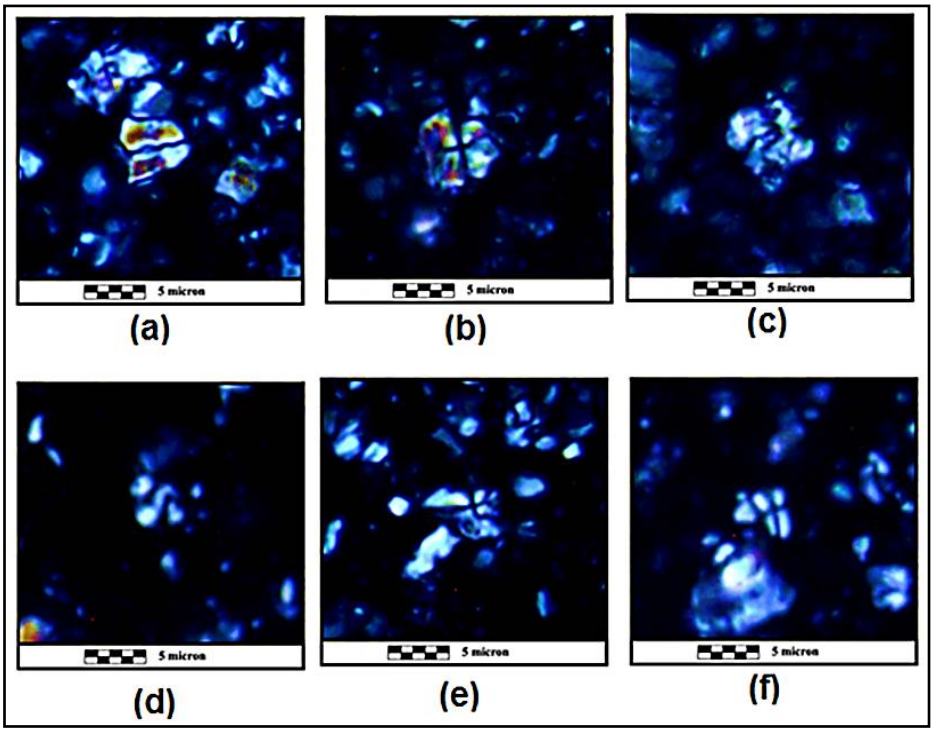

Fig. 6. Cross-polarized images of calcareous nannofossil taxa from Piran Limestone Unit within sample number 4. (a) *Fasciculithus tympaniformis* sp.; (b) *Heliolithus riedelii* sp.; (c) *Reticulofenestra* sp.; (d) *Prinsius* sp.; (e) *Sphenolithus anarrhopus* sp.; (f) *Sphenolithus moriformis* sp.

Fasciculithus tympaniformis

Family Fasciculithaceae Hay and Mohler, 1967

Genus *Fsciculithus* Bramlette and Sullivan, 1961

Fasciculithus tympaniformis sp. Hay and Mohler, 1967 in Hay et al., 1967 (Pl.1, Fig. 6a)

Heliolithus riedelii

Family Heliolithceae Hay and Mohler, 1967

Genus *Heliolithus* Bramlette and Sullivan, 1961

Heliolithus riedelii sp. Bramlette and Sullivan, 1961 (Pl.1, Fig. 6b)

Reticulofenestra

Family Noelaerhabdaceae Jerkovic, 1970

Genus *Reticulofenestra* Hay, Mohler and Wade, 1966

Reticulofenestra sp. (Pl.1, Fig. 6c)

Prinsius

Family Prinsiaceae Hay and Mohler, 1967 emend

Genus *Prinsius* Hay and Mohler, 1967

Prinsius sp. (Pl.1, Fig. 6d)

Sphenolithus anarrhopus

Family Sphenolithaceae Deflandre, 1952 in Grasse´, 1952

Genus *Sphenolithus* Deflandre in Grasse´, 1952

Sphenolithus anarrhopus sp. Bukry and Bramlette, 1969 (Pl.1, Fig. 6e)

Sphenolithus moriformis

Family Sphenolithaceae Deflandre, 1952 in Grasse´, 1952

Genus *Sphenolithus* Deflandre in Grasse´, 1952

Sphenolithus moriformis sp. Brönnimann and Stradner, 1960; Bramlette and Wilcoxon, 1967 (Pl.1, Fig. 6f)

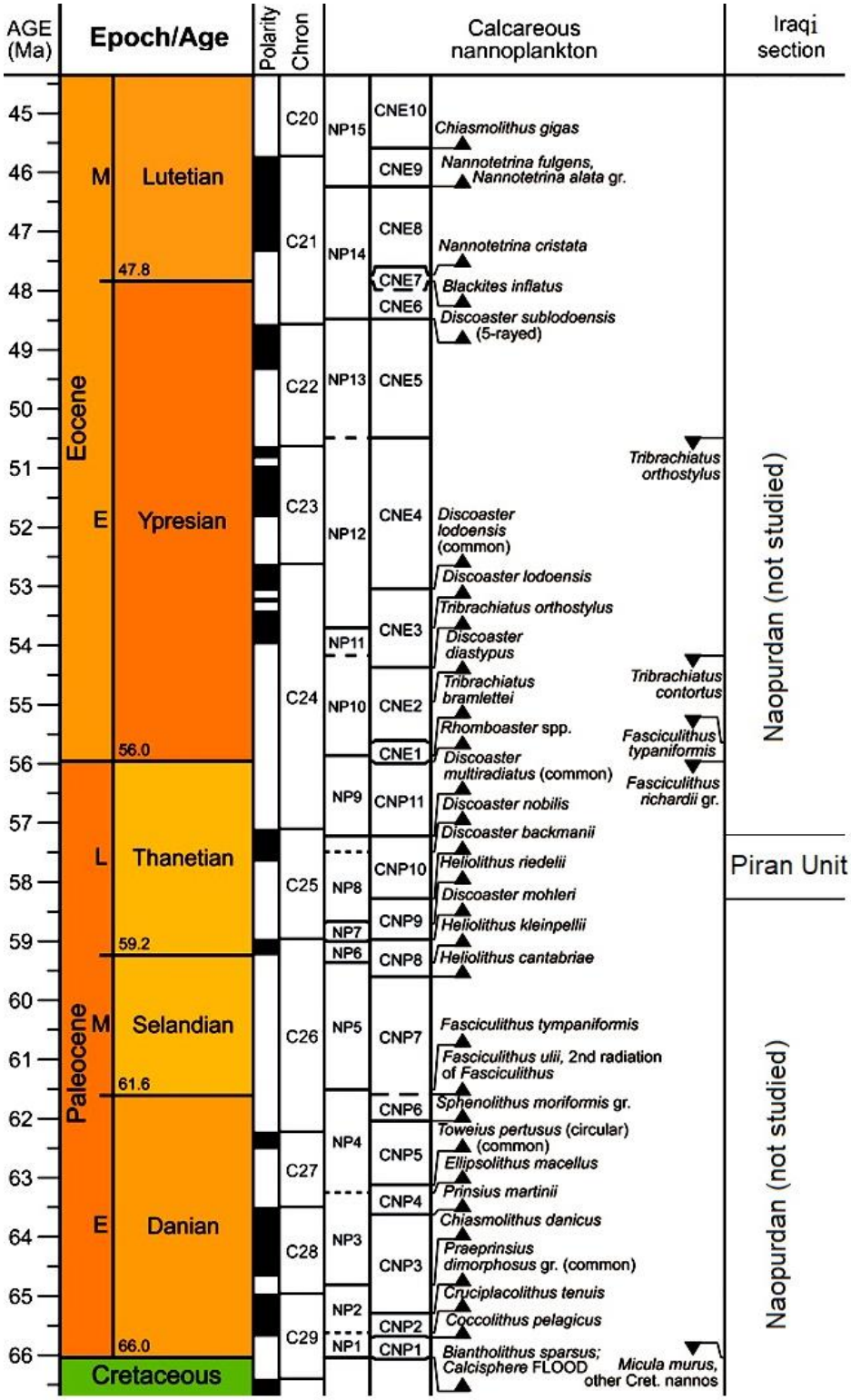

Fig. 7. Correlation chart of significant calcareous nannofossil biozones showing the age of Piran Limestone Unit (Ogg et al., 2016).

Conclusions

- The Cretaceous fossils found in the Piran unit cannot be considered as a proof for the possible Cretaceous age of the lowermost beds of the Naopurdan rock group.

- The Piran limestone cannot be considered as a normal member of the Naopurdan sequence due to the nature of the contact with the underlying flysch beds which is tectonic.

- Based on the occurrence of *Fasciculithus tympaniformis* sp., *Heliolithus riedelii* sp., *Reticulofenestra* sp., *Prinsius* sp., *Sphenolithus anarrhopus* sp. and *Sphenolithus moriformis* sp., the age of this unit is determined to be Middle Thanetian.

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