Calcareous Nannofossils Biostratigraphy of Gulneri Formation in Sulaimaniya, Northeastern Iraq

Seham B. Al-Salmani1 and Omar A. Al-Badrani1,*

1 Department of Geology, College of Science, Mosul University, Mosul, Iraq

* Correspondence: omarbadrani@uomosul.edu.iq

Abstract

Investigations on the calcareous nannofossils of the Gulneri Formation are being done in the northern Iraqi of Dokan and Pushen areas, Sulimani, Northern Iraq. In this work, one biozone was established based on the results of a detailed examination used to identify fifty species of calcareous nannofossils; Quadrum gartneri Biozone (CC11) and Lucianorhabdus maleformis Biozone (CC12) in Dokan section, although in this study, three biozones were suggested; Microrhabdulus decoratus Biozone (CC10); Quadrum gartneri Biozone (CC11) and Lucianorhabdus maleformis Biozone (CC12) in Pushen section. According to correlations with other calcareous nannofossil biozones from local region we sagestion the Cenomanian to Turonian for Pushen section and Turonian for Dokan section.

Keywords: Calcareous nannofossils; Cretaceous; Cenomanian; Turonian; Iraq

1. Introduction

In its type section at Dokan Dam, Sulaimaniya, northeastern Iraq, (Bellen et al., 1959) provided the first description of the Gulneri Formation (Fig. 1). It is believed to be one of the early Turonian sequences in Iraq and is made up of fissile black shale and 1.2 meters thick greyish black marl and marly limestone.

According to Jassim and Goff (2006), the examined location is situated locally in the Low and High Folded Zones of the Western Zagros Fold-Thrust belt of Iraq and the modified tectonic subdivisions of that nation (Fouad, 2015). The three studied regions are located in the northeastern portion of the Arabian Plate and are a component of the long and broad northern passive margin of Gondwana, which borders the Paleo-Tethys Ocean (Sengör, 1990). The Gulneri Deposit is a significant Cretaceous shale formation located in Iraq's euxinic and minor relic basins (Buday, 1980). Numerous biostratigraphical investigations have been completed on the Gulneri Formation, both in subsurface sections and outcrops in northern Iraq, but no additional research has been done to combine paleontological data to show the impact of the OAE on the Gulneri Formation. Due to its presence of black layers rich in organic matter, dwarfed foraminiferal species, low oxygen-tolerance species, and calcareous nannofossils, the Gulneri Formation, which represents the Turonian and is found in northern Iraq, may have formed during an oceanic anoxic event, according to paleontological evidence. In Buday (1980); Abawi et al. (2006); Ameen and Gharib (2006).
The current work aims to age determination analyzing calcareous nannofossil data from the Gulneri Formation in two sections from northern Iraq.

The remains of the sea level coccolithophores algae are known as calcareous nannofossils. They float close to the water's top because they need sunlight to perform photosynthesis. These algae produce microscopic tests known as coccospheres, which are made up of platelets that sink to the ocean's floor. At this time, they are creating a lot of silt on the ocean floor, and their weight is sufficient to compress the lowest sediments into rocks.

![Fig. 1. Location map of the studied section](image)

![Fig. 2. Schematic regional rock unit correlation (After Haddad and Amin, 2007)](image)
2. Materials and Methods

Data for this study was generated from many samples of fresh outcrop samples from Gulneri Formation. Samples were collected at different interval which was obtained from section Lithologic mainly from shale.

(A) Nannofossil Slides preparation making by using the method (H) the procedure is as follows:

Each rock sample weighs about 5 grams, and it is crushed to the point where it can pass through a sieve with a mesh size of 45 m. To act as a dispersant, a tiny drop is introduced. A direct, low-heat source (hotplate) is used to thoroughly dry the slide and residue while keeping in mind that contamination should be avoided at all times. A thin cover slip that is free of contamination has been covered with an amorphous oleoresin known as Canada balsam. The sample is then turned over a dry drop of crushed sample solution that had been previously put, allowed to dry, and solidify before being ready for observation under a transmitted microscope.

(B) Observation Techniques

The slides were examined for calcareous nannofossil content under a light microscope in transmitted lights with cross-polarized and gypsum plate. Detailed investigation for the assemblages were made by using x1000 magnification. Identification of species was made by catalogue published from library and on the internet by various authors.

3. Results and Discussion

The Nannopaleontology of the calcareous nannofossils depending on many paleontological references (Bown and Young, 1997) and (Perch-Nielsen, 1985) to identify many species of calcareous nannofossils. The material and images are stored in the Department of Geology, college of science, University of Mosul, Mosul, Iraq.

![Fig. 3. Polarized micrographs of calcareous nannofossil from the Gulneri Formation. (a) Zeugrhabdotus blowii; (b) Cribrocorona echinus; (c) Cribrocorona; (d) Cribrocorona sp.; (e) Eiffellithus collis Hoffmann, 1970; (f) Eiffellithus eximius, 1968; (g) Eiffellithus gorkae Reinhardt, 1965; (h) Eiffellithus primus Applegate & Bergen, 1988; (i) Helicolithus trabeculatus (Górka, 1957) Verbeek, 1977; (j) Cretarhabdus striatus; (k) Miravetesina bergenii; (l) Miravetesina favula Grün in Grün and Allemann, 1975.](image-url)
Fig. 4. Polarized micrographs of calcareous nannofossil from the Gulneri Formation. (a) *Miravetesina* sp.; (b) *Retecapsa ficula*; (c) *Retecapsa crenulata* Grün in Grün and Allemann, 1975; (d) *Cyclagelosphaera wiedmannii*; (e) *Watznaueria barnesiae*; (f) *Watznaueria biporta*; (g) *Watznaueria britannica*; (h) *Watznaueria bayackii*; (i) *Watznaueria fossacincta*; (j) *Watznaueria quadriradiata*; (k) *Arkhangelskiella cymbiformis*; (l) *Broinsonia* sp.

Fig. 5. Polarized micrographs of calcareous nannofossil from the Gulneri Formation. (a) *Calculites obscurus*; (b) *Calculites sp.*; (c) *Lucianorhabdus maleformis*; (d) *Lucianorhabdus sp.*; (e) *Lithraphidites houghtonii*; (f) *Lithraphidites magnus*; (g) *Lithraphidites praequadratus*; (h) *Microrhabdulus decorates*; (i) *Nannoconus circularis*; (j) *Eprolithus antiquus*; (k) *Eprolithus apertior*; (l) *Eprolithus floralis*.
Fig. 6. Polarized micrographs of calcareous nannofossil from the Gulneri Formation. (a) *Eprolithus* sp.; (b) *Lithastrinus grillii*; (c) *Lithastrinus septenarius* Forchheimer, 1972; (d) *Lithastrinus* sp.; (e) *Micula staurophora*; (f) *Micula* sp.; (g) *Radiolithus laingii* Varol, 1992; (h) *Radiolithus planus* (i) *Uniplanarius clarkei*; (j) *Uniplanarius* sp.; (k) *Quadrum gartneri*; (l) *Ceratolithoides amplector*; (m) *Ceratolithoides sagittatus*; (n) *Ceratolithoides cf. verbeekii*.

3.1. Nannobiostratigraphy

3.1.1. *Microrhabdulus decoratus* interval biozone (CC10)

Definition: Interval from FO of *Microrhabdulus decoratus* to FO of *Quadrum gartneri*.

Author: Sissingh, 1977.

Age: Late Cenomanian.

Discussion: The biozone is compared with the biozone called CC10 (*Microrhabdulus decoratus* biozone) by the Sissingh (1977) that aged of the Late Cenomanian. After update the age of zone by Gradstein (2012), we suggest the age of this stratigraphic successions is early to Late Cenomanian (Figs.3 and 4).

3.1.2. *Quadrum gartneri* interval biozone (CC11)

Definition: Interval from FO of *Quadrum gartneri* to FO of *Lucianorhabdus maleformis*.


Age: Early to Middle Turonian.

Discussion: The biozone is compared with the biozone called CC11 (*Quadrum gartneri* biozone) that aged of the Early to Middle Turonian. After update the age of zone by Gradstein (2012), we suggest the age of this stratigraphic successions is early to Early to Middle Turonian (Fig.3,4).
3.1.3. Lucianorhabdus maleformis interval biozone (CC13)

Definition: Interval from FO of Lucianorhabdus maleformis to FO of Marthastrites furcatus.

Author:

Age: Late Turonian.

Discussion: The biozone is compared with the biozone called CC12 (Lucianorhabdus maleformis biozone) by the that aged of the Late Turonian, we suggest the age of this stratigraphic successions is early to Late Turonian (Figs. 3, 4).

Fig. 7. Range chart for calcareous nannofossils for the Dokan section
Fig. 8. Range chart for calcareous nannofossils for the Pushen section
4. Conclusions

This study are concluded that the formation have about many species belonging to calcareous nannofossils, and It is determine three biozones for the Gulneri Formation:

In the Dokan section:

- *Microrhabdulus decoratus* Biozone
- *Quadrum gartneri* Biozone
- *Lucianorhabdus maleformis* Biozone

In the Pushen section:

- *Quadrum gartneri* Biozone
- *Lucianorhabdus maleformis* Biozone

**Fig. 9.** Age correlation chart of calcareous nannofossils for the Gulneri Formation, Northern Iraq
According to correlations with other calcareous nannofossil biozones from local region we suggest the Cenomanian to Turonian for Pushen section and Turonian for the Dokan section.

Acknowledgements

The facilities offered by the College of Science and University of Mosul, which contributed to enhance the caliber of this study, are greatly appreciated by the writers.

References