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Calcareous Nannofossils biostratigraphy of Mushorah Formation in (Bu15) well, Butmah oil field and (Sf41) well, Sfaia oil field, Northwestern Iraq

Basma Mohammed Al-Taaie, Omar Ahmed Al-Badrani

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

omarbadrani@uomosul.edu.iq

ABSTRACT

A Detailed calcareous nannofossils study for the Mushorah Formation from two subsurface sections in (Bu15) well, Butmah oil field and (Sf41) well, Sfaia oil field, Northwestern Iraq. This Paleontological classification of this flora led to determine many species. The nannobiostratigraphic analysis suggested three calcareous nannofossils biozones these are; *Calculites obscurus* Interval Biozone(CC17); *Broinsonia parca* Interval Biozone(CC18); *Misceomarginatus pleniporus* Interval Biozone(CC19). These biozones suggested that the age of studied section of the Mushorah Formation is Early to Middle Campanian.

Keywords: Campanian, Mushorah Formation, Calcareous Nannofossils, Iraq.

Introduction

The Mushorah Formation in its type section of Mushorah well (1), is consists of limestone and recrystallized alligostigonal limestone (Dunnington, 1953 in Bellen *et al.*, 1959). However, Hart (1962) determine the boundaries of the Mushorah Formation and confirmed the Wajna Formation underlies it in many wells in the northwestern Iraq regions (Buday, 1980).

Mushorah Formation belonging to Upper Turonian to Lower Campanian sedimentary cycle which studied by Haddad and Amin(2007) in northern Iraq (Fig.2). The biostratigraphy of Mushorah Formation was studied by Al-Shareefi *et al.* (2014) and the lithostratigraphy by Hassan *et al.*(2021).

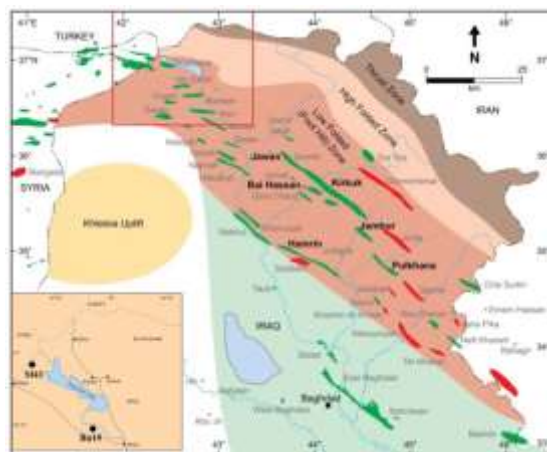


Fig. 1: Tectonic map showing the studied section (After Al-Qayim *et al.*,2010 and Al-Mutwali *et al.*,2008)

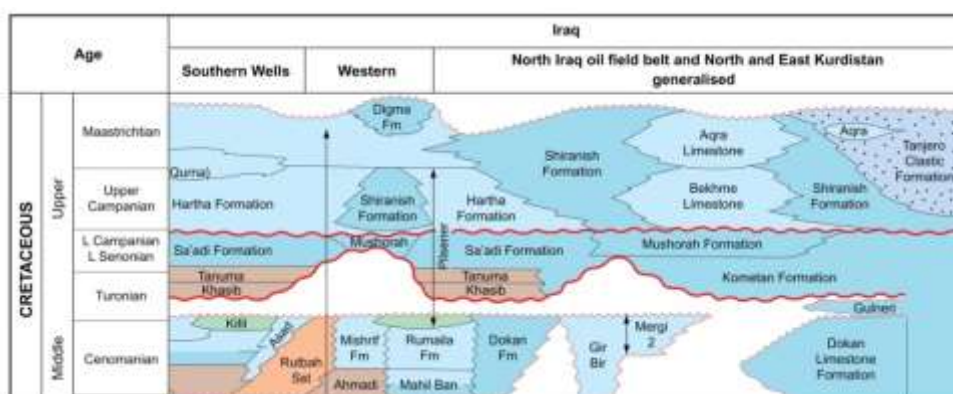


Fig. 2: Schematic regional rock unit correlation (After Haddad and Amin, 2007)

The upper Turonian-Early Campanian cycle was deposited in a relatively restricted seaway region, specifically the High Folded and Foothill zones. The Rutba-Jezira zone of the Stable Shelf was emerging while neritic to deep water carbonates predominated in the region of the submerged Mosul High, which was bordered on the west and east by deep water basins where oligosteginal basinal limestones (Mushorah facies) were deposited after the Early Turonian activities. The lower stage of the sedimentary cycle is represented by the formations of the Khasib, Tanuma, Sa'di, Mushorah, and Kometan. The formations in the Hartha, Tayarat, Digma, Aqra, Bekhme, Shiranish, Tanjero, and Hadiena formations make up the megasequence's top portion.

The first section from Btmah oil field (Bu15), and the second section from Sfaia oil field (Sf41), North West of Mosul city, northern Iraq (Fig.1), the study area belonging to the Foothill Zone of the Unstable Shelf of the Arabian platform (Buday and Jassim, 1987).

Calcareous nannofossils are the remains of coccolithophores algae, that live in the sea surface. They require sunlight to make the photosynthesis, so they float near the surface of the water. These algae make tiny test called coccosphere consist of platelets which fall off to the bottom of the ocean. At this point they are make many sediments on the ocean bottom, and their weight is enough so that the lowest sediments are squeezed enough to become rocks. The purpose of this study is to classified the calcareous nannofossils and make a zonation and correlation of the studied well age determination.

Methodology

Materials

Data for this study was generated from many samples of cutting samples from Mushorah Formation. Samples were collected at different interval which was obtained from one well namely (Bu15) and (Sf41), with Lithologic mainly from Limestone.

Laboratory Analysis

(A) Nannofossil Slides preparation making by using the method (H) (Armstrong and Brasier, 2005), the procedure is as follows:

Each rock sample, which weighs about 5 grams, is broken down until it can pass through a sieve. A little drop is added to act as a dispersant. The slide and residue are dried completely using a direct, low-heat source (hotplate), although contamination must always be avoided. An amorphous oleoresin known as has been used to coat a thin cover slip that is free of contamination (Canada balsam). After being placed over a dry drop of previously dried and solidified sample solution, the sample is then prepared for examination using a transmitted microscope.

(B) Observation Techniques

The slides were investigated for the presence of calcareous nannofossils using a light microscope, cross-polarized transmitted lights, and gypsum plate.

x1000 magnification was used to conduct a thorough analysis of the assemblages. By using a catalog that multiple writers had published online and in libraries, species were identified.

Results and discussions

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 are stored in the Dept. of Geology, Science College, University of Mosul, Mosul, Iraq.

Nannobiostratigraphy

1 - *Calculites obscurus* Interval Biozone (CC17)

Definition: This biozone is an Interval biozone for the species *Calculites obscurus*. Boundaries: The lower boundary is determine by the first occurrence for the species *Calculites obscurus* and the upper boundary is determine by the first occurrence the species *Broinsonia parca*.

Author: Sissingh, 1977.

Age: Lte Santonian to Early Campanian.

Thickness: The thickness of this biozone is meter.

Discussions: This zone is compared with the zone called CC17 (*Calculites obscurus* zone) by Sissingh (1977) that aged early Campanian and Al-Badrani et al. (2021c). After update the age of zone by Gradstein (2012), We hypothesize that these geologic successions date back to the early Campanian (Fig.3,4).

2 - *Broinsonia parca* Interval Biozone (CC18)

Definition: This zone is an Interval zone of the species *Broinsonia parca*.

Boundaries: The lower boundary is determine by first occurrence the sepcies *Broinsonia parca*, and the upper boundary is determine by the first occurrence for the species *Misceomarginatus pleniporus*.

Author: Sissingh, 1977.

Age: Early Campanian.

Thickness: The thickness of this zone is meter.

Discussions: This zone is compared with the zone called CC18 (*Broinsonia parca* zone) by the Sissingh (1977) that aged of the early Campanian, also compared with Al-Badrani et al.(2012) and Al-Badrani et al.(2021c).After update the age of zone by Gradstein (2012), We hypothesize that these geologic successions date back to the early Campanian (Fig.3,4).

3 - *Misceomarginatus pleniporus* Interval Biozone (CC19)

Definition: This zone is an Interval zone for the species *Misceomarginatus pleniporus*.

Boundaries: The lower boundary of this zone determine by first occurrence of the species *Misceomarginatus pleniporus*, and the upper boundary is determine by first occurrence of the species *Ceratolithoides aculeus*.

Author: Sissingh, 1977.

Age: late Early Campanian.

Thickness: The thickness of this zone is meter.

Discussions: This zone is compared with the zone called CC19 (*Calculites ovalis* zone) by the Sissingh (1977) that aged of the early Campanian, also compared with Al-Badrani et al.(2012) and Al-Badrani et al.(2021a) and Al-Badrani et al.(2021b). After update the age of zone by Gradstein (2012), We hypothesize that these geologic successions date back to the middle Campanian (Fig.3,4).

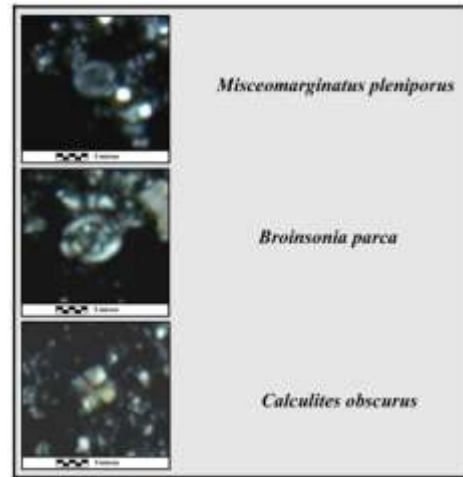


Fig. 3: Index calcareous nannofossils species for The Mushorah Formation, Northwestern Iraq

Ma	Period	Epoch	Age	Gradstein et al, 2020	Age	Sissingh, 1977	Perch-Nielsen, 1985	Bown, 1998	Age	Present study		
71	Cretaceous	Late Cretaceous	Maastr.	CC 24	Maastr.	CC 24	CC 24	UC17	Maastr.			
72			L	CC23		CC23	CC23	UC16				
73												
74			Campanian	CC22		CC22	CC22	UC15				
75				CC21		CC21	CC21					
76				CC20		CC20	CC20					
77				CC19		CC19	CC19	UC14				
78				CC18		CC18	CC18					
79				CC17		CC17	CC17					
80			Santonian	CC16		CC16	CC16	UC12			Santonian	
81				CC15		CC15	CC15	UC11				
82				CC14		CC14	CC14	UC10				
83				CC13		CC13	CC13	UC9				
84			Cretaceous	Early Cretaceous		Coniacian	CC12	Coniacian			CC12	CC12
85												
86	Turonian	CC11			CC11	CC11	UC7		Turonian			
87												
88	Cenoman.	CC10			Cenoman.	CC10	CC10	UC6	Cenoman.			
89								UC5				
90						UC4						

Fig. 4: Age correlation chart of calcareous nannofossils for The Mushorah Formation, Northwestern Iraq

Conclusions

According to the results of this study, the Mushorah Formation contains several species of Cretaceous nannofossils. Three biozones have been identified for this formation, and they are as follows:

Calculites obscurus Interval Biozone(CC17)

Broinsonia parca Interval Biozone (CC18)

Misceomarginatus pleniporus Interval Biozone (CC19)

The calcareous nannofossils biozones suggest the Early to Middle Campanian age for studied section.

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