MID-CRETACEOUS RADIOLARINS FROM THE BALAMBO FORMATION NE-IRAQ

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Abstract

The late Albian-Early Turonian Radiolarians of the Balambo Formation, which were recovered from well Jambur-18 (NE of Iraq) are characterized by their abundance and diversity. They show certain similarities to those from the Tethys and North Atlantic indicating the ongoing opening between the two basins.

Microfacies analysis for the Balambo rocks indicates a basinal depositional environment, where radiolarians thrived. The differences in depositional textures of the carbonate facies with presence of mudstone and shale units indicate relative changes in depth within the same environment. This can interpreted to the relative changes of sea-level, which exhibit transgressive and regressive cycles. Radiolarian-rich intervals correlate well with the transgressive cycles and their associated facies. The maximum flooding surfaces of these cycles are correlated with those identified in the Arabian plate. They represent global events causing the thrive of radiolarian in the study area and other parts of the Tethyan realm during Early Cenomanian-Early-Turonian.

الخلاصة

ان متحجرات الراديولاريا العائدة لتكوين البلامبو (الالبيان المتأخر– التوروني المبكر) والتي استخرجت من بئر جمبور–18 (شمال شرق العراق) تمتاز بغزارتها وتنوعها وهي تظهر تشابها خاصاً لتلك المعروفة في محيط التيثس وشمال الاطلسي دالة على الانفتاح بين الحوضين.

لقد دل تحليل السحنات المجهرية على بيئة ترسيبية حوضية لصخور تكوين البلامبو، حيث ازدهرت الراديولاريا. ان الاختلافات في الانسجة الترسيبية للسحنات الجيرية مع تواجد وحدات الصخور الطينية والسجيل يدل على التغيرات النسبية للعمق ضمن نفس بيئة الترسيب. يمكن ان يفسر ذلك للتغيرات النسبية لمستوى سطح البحر، والتي تظهر دورات تقدمية وسحناتها المصاحبة. ان سطوح الفيضان العليا لتلك الدورات يمكن مضاهاتها لتلك التي شخصت في الصفيحة العربية. وهي تمثل احداثا عالمية سببت ازدهار الراديولاريا في منطقة الدراسة واجزاء اخرى من محيط التيثس خلال السينوماني المبكر– التوروني المبكر.

Introduction

The Cretaceous radiolarians role has improved in many stratigraphic and taxonomic studies, as well as few ecological studies. This is due to their rapid evolution during this period, and many genera and species are short in range and quite distinctive.

In this study, the recovery of Cretaceous radiolarians from the Balambo Formation (Albian-Turonian) in NE Iraq provides new information on
the Stratigraphy and Biostratigraphy of the formation. The preliminary results may be interpreted in terms of eustatic seal-level changes and tectonics which played the main

role in the abundance and diversity of radiolarians in the Tethys.
The classification of (Erbacher, J., Pessagno. Jr. Campbell. A.S., Riedel, W.R., Forman. H.P. and Riedel, W.R., 1, 2, 3, 4, 5) have been adopted in this study. The studied thin sections are studied in the Department of Geology, College of Science, Unversity of Baghdad.

Methods and Study Area

In the present study, 19 cutting samples have been studied from well Jambur- 18 (in Jambur oilfield), which is located about 30 km to the southeast of Kirkuk (Figure1). According to tectonic subdivision of Iraq (6), the study area is located in the Himreen Subzone within the Foothill Zone. Thin sections were studied petrographically to identify the different radiolarian species, and interpret microfocies in terms of depositional environments. The Balamb

Stratigraphy

The Balambo Formation was first described by Wetzel in (8). The type section is located in Sirwan valley near Halabja in Northeastern Iraq Wheres.
The formation was divided lithologically into two units:
A- The Lower Balambo Formation which consists of thin bedded blue ammonitiferous limestones with intercalation of olive green marls and dark blue shales.
B- The Upper Balambo Formation is composed of a monotonous sequence of thin bedded globigerinal, passing downwards to radiolarian limestones.

The age of the formation was subdivided into two units. The lower unit corresponds to the Valangian-Middle Albian, and the upper unit belongs to the Late Albian-Turonian (9) (10) suggested the Albian –Lower Turonian as an age for the Balambo Formation according to planktonic foraminifera

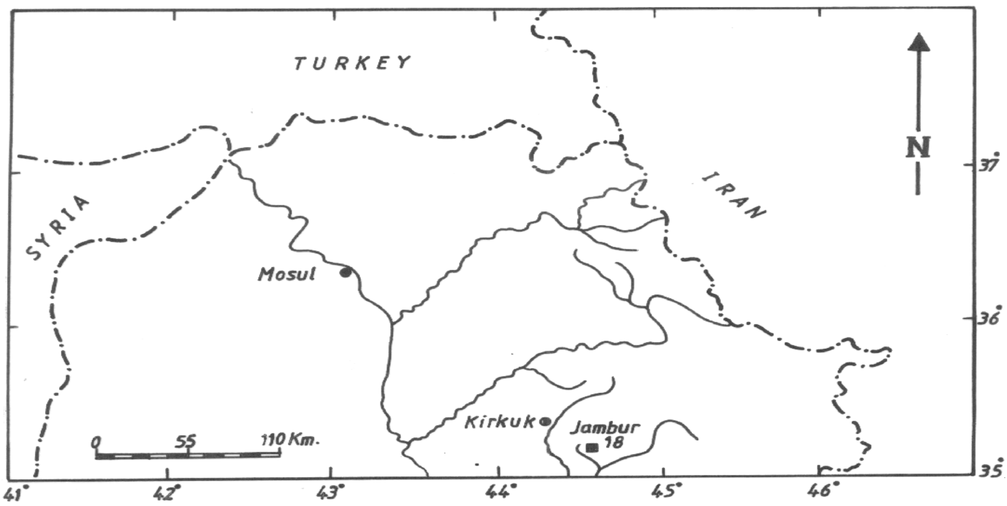

Figure (1): Location map of the study area.

SYSTIMATIC DESCRIPTION
Phylum: PROTOZOA
Subphylum: SARCODINA
Class: RETICULARIA
Subclass: RADIOLARIA
Order: POLYSTIDA
Suborder: SPUMELLARINA
***Crucella messinae* Pessagno 1971**
(Plt.2, Figure. 6)
1971, *Crucella messinae,* Pessagno, pl.6, Figure.1-3.
Erbacher, 1998, Pl.2, fig.26
Range-Early to Late Cenomanian (1).Late Jurassic to Late Cretaceous world wide (2)
***Paronaella ewingi* 1971**
(Plt.2, Figure. 1)
1971, *Paromaella ewingi*, pessagno, pl. 19, fig. 2-5)
Range-late Jurassic of Blacke-Bahama Basin. In this study *Paronaella ewingi* occur in L-To Earlt-M-Cretaceous (Figure.3)
***Patulibracchium* sp.**

(Plt.2, Figure.5)
1998, *Patulibracchium* sp., Erbacher, pl.2, figure.25. As only one to two rays are preserved in the forms examined
Range.- Late Cretaceous? Early Cretaceous ? Late Jurassic (2)

Cryptamphorella conara **(Foreman)**
(Plt. 2, Figure.2)
1970. *C.conara* Dumitrica, P.80, Pl.11, Figures. 66a-c; 1972, Pl.1, Fig. 2-5; 1975, Fig. 2. No. 28.
1994. *C.conara* Erbacher, P. 97, Pl.5, Fig. 7, 1998, Pl. 2, Figs. 10-11.
1998.Hemicryptocapsa conara Foeman, Pl.4, Figures. 11a, b.
Range.- L- Albian-Cenomanian.

Hagiastrum plenum **Rust, 1885**
(Plt, 2, Figure.4)
Range.-Jurassic to Late Cretaceous (3)

***Rhopalosyringium hispidum*, O'Dorgherty 1994**
(Plt. 2, Figure, 3)
1994. *R. hispidum*, O'Dorgherty, P.167, pl.23, Figures.7-11.
1998. *R.hispidum* Erbacher, P. 370, Pl.1, Figure.6.
Range.-*R.hispidum* has been described from the early Turonian of centeral Italy.

Vitorfus morini Empson-Morini 1981
(plt.1, Figure.5)
1981.*V.morini* Empson-Morini, P. 261 pl.4, Figures. 7a-8d.
1994. *V.morimi* O'Dogherty, P.267-268, pl. 47, Figures. 12-15.
1998. *V.norini* Erbacher, P.371, P1. 1, Figure.9.
Range.- *V.morini* has been described from the early Turonian to Campanian of centeral Italy, the Pacific, and Japan (1)

Suborder NASSELLARINA

Archaeodictyomitra simplex **Pessagno 1977**
(Plt. 1, Figure. 3,4)
1977.*A.Simplex*, Pessagno, P34, Pl.6, Figure 1, 24, 28, pl. 12, Figure 12.
1988, *A.simples* Thurow, P. 398, Pl.3, Figure.9.
1994. *Dictyomitra montisseri* (Sqyinabol) O'Dogherty P.77, Pl.3, Figure. 1-29.
1998. A. simplex Erbacher, P.368, Pl1.1, Figure, 11.

Novixitus mclaughlini **Pessagno 1977**
(Plt. 1, Figure.1, 2)
1977. *N.mclaughlini*, Pessagno, P. 54, Pl.9, Figure17.
1988.*N.mclaughlini* Thurow, P. 404, Pl.3, Figure, 21.
1994. *N.mclaughlini* Erbacher, P. 104, Pl.6, **Figure**. 4)
1998. *N.mclaughlini* Erbacher, Pl.2, Figure.6.
Range.- This species has been recorded frome the Albian to Cenomanian of California, North Atlantic and west Tethys.

Xitus spinosus **(Squinabol) 1994**
(Plt. 1, Figure.6)
1994.*X.spinosus*(Squinabol), O'Dogherty, P.129-130, Pl. 12, Figures. 1-13
1998. *X.spinosus* Erbacher, Pl,2, Figure.3.
Range.-Late Turonian to Santonian.

Biostratigraphy

Radiolarians from well Jambur-18 are characterized by their abundance (Figure.2) and diversity (Figure.3, pls.1&2) Also, they have different degrees of preservation.

The use of radiolarians as an age indicator for the lower and upper parts of the Balambo Formation is problematic due to the lack of index morphotypes. However, based on present information and compared to the well-known radiolarian assemblages of the Tethys, North Atlantic and Eastern Equatorial Atlantic, some of the observed forms seems to be an age indicator and dominated through Late Albian to Early Turonian, For example, the lower unit is characterized by high abundance and diversity (figures 2&3), which is one of the most remarkable feature for the radiolarians during the Late Albian (11). This is paralleled by the presence of Middle Albian-Cenomanian taxa such as *Novixitus mclaughlini* (Pl.1- Figures. 1&2) and absence of the index taxa of the Cenomanian, which suggest a Late Albian age of the lower unit. As little knowledge exists about radiolarians of Turonion age (1) a clearer age assignment of the uppermost unit of the Balambo Formation was easy. This is due to the presence of *Vitorfus morini* (Pl. 1 Figures. 5), which is known only from the Turonian age and younger (1). The restriction of this species in the uppermost unit suggests an Early Turonian age.

Late Albian-Early Turonian radiolarians of the Balombo Formation are of a remarkably similar to those of time-equivalent assemblages from the Tethys, North Atlantic, and Pacific. The dominance of elongated nasselarians (e.g.,*Novixitus*, *Xitus*) (Pl.1-Figures.1&2& 6) and hagiastrid spumellarians (e.g. *Paronella*) (Pl.2- Figures.1) supports this idea. This can be interpreted as a result of an ongoing opening of the gateway through the Tethys, and North and South Atlantic

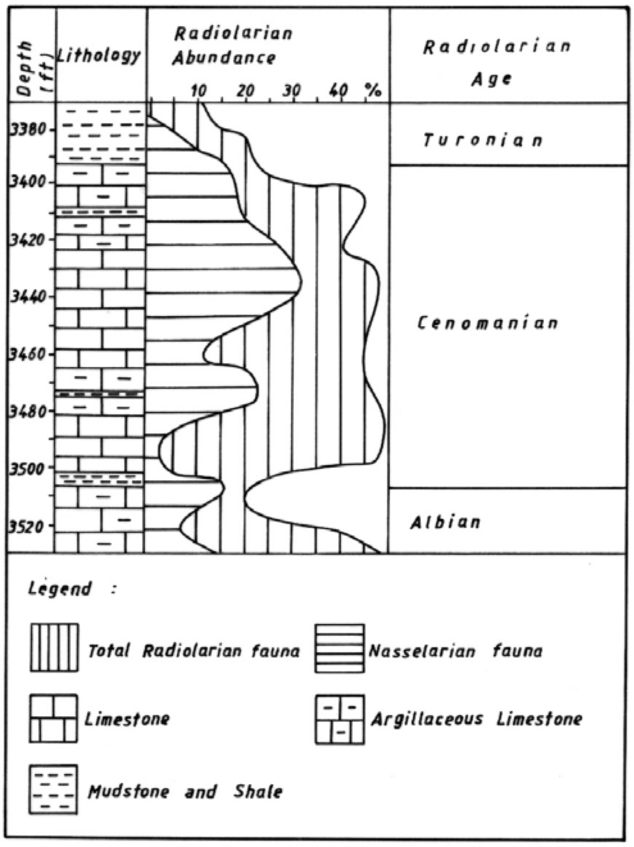

Figure (2): The Radiolarian abundance of the Balanbo Formation (Albian - Turonian) in Jambur -18 well.

Microfacies Analysis and Depositional Cycles

In Jambur-18 well the Balambo Formation consists of about of light coloured limestones and marls, with intercalation of dark blue shales and mudstones in the lower and upper parts.

The petrographic study of these rocks revealed distinct microfacies, which can tell much more about the depositional history that affected the distribution of radiolarian through time.

The identified microfacies include pelagic forminiferal and Radiolarian Mudstones and Wackestones, which some of them are argillaceous. Also, shale units occur at the bottom and uppermost part of the formation (Figure.3).

These microfacies reflect the deposition in a basinal environment (12, 13). However, relative differences in water depth within the same environment exist throughout the succession. These differences are reflected in several properties including : the Argillaceous and organic matter content , colour, radiolarian abundance , and sedimentary structures (e.g. lamination) , and they reflect relative changes in sea level within the same depositional environment .

Thus, the Balambo Formation succession can be subdivided into transgressive and early regressive cycles, which were caused by tectonism and or eustatic sea-level changes.

The transgressive cycles consists of radiolarian rich mudstones wakestones, which are argillaceous and have dark brown color.

Also, they include parts from these events. In addition, the early Turonian interval shows high radiolarians abundance (Figure.3), which can be related to the global early Turonian sea-level rise (14).

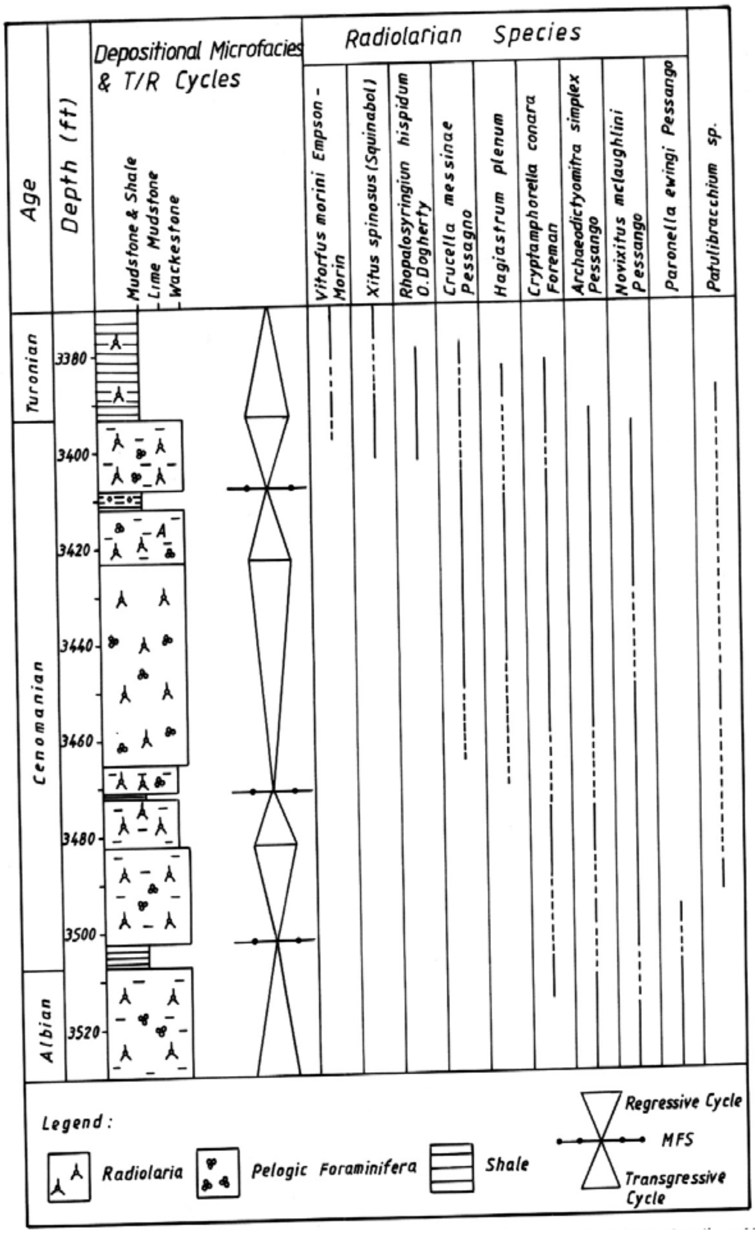

Figure (3): The Radiolarian biostratigraphy, Microfacies, and Sequence Stratigraphic interpretation of the Balambo Formation in well Jambur- 18

Conclusions

The radiolarians of the Balambo Formation (Late Albian-Early Turonian) are characterized by their abundance and diversity. They show signs of Tethyan and North Atlantic influences Some of the observed forms are age indicators, Their age is date1d to late Albian-Early Turonian, which is characterized by periods of global sea-level rise providing the suitable conditions for the radiolarian to thrive. Radiolarian-bearing intervals of the Balambo Formation can be correlated with global radiolarian-rich intervals, which were deposited through transgressive cycles. The evidence for this fact was supported by the sequence stratigraphic analysis of the formation.

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All figures are from Balambo Formation, Jambur well No.18

Plate 1

Figure 1: *Novixtus mclaughlini* Pessagno; Axial section; depth 3395 ft; X 100.
Figure 2: *Novixtus mclaughlini* Pessagno; Axial section; depth 3425 ft; X 75.
Figure 3: *Archaeodictyomitra* simplex Pessagno; Axial section; depth 3490 ft; X 70.
Figure 4: *Archaeodictyomitra* simplex Pessagno; Axial section; depth 3425 ft; X 85.
Figure 5: *Vitorfus morini Empson*-Morin; Axial section; depth 3385 ft; X 80.
Figure 6: *Xitus spinosus* (Squinabol); Axial section; depth 3380 ft; X 100.

Plate -2

Figure 1: *Paronella ewingi* Pessagno; Axial section; depth 3430 ft; X 70.
Figure 2: *Cryptamphorella conara* (Foreman); Axial section; depth 3460 ft; X 50.
Figure 3: *Rhopalosyringium hispidum* O'Dogherty; Axial section; depth 3390 ft; X 70.
Figure 4: *Hagiastrum plenum* Rust; Axial section; depth 3430 ft; X 120.
Figure 5: *Patulibracchium* sp., ; Axial section; depth 3500 ft; X 100.
Figure 6: *Crucella messinae* Pessagno; Axial section; depth 3395 ft; X 90.

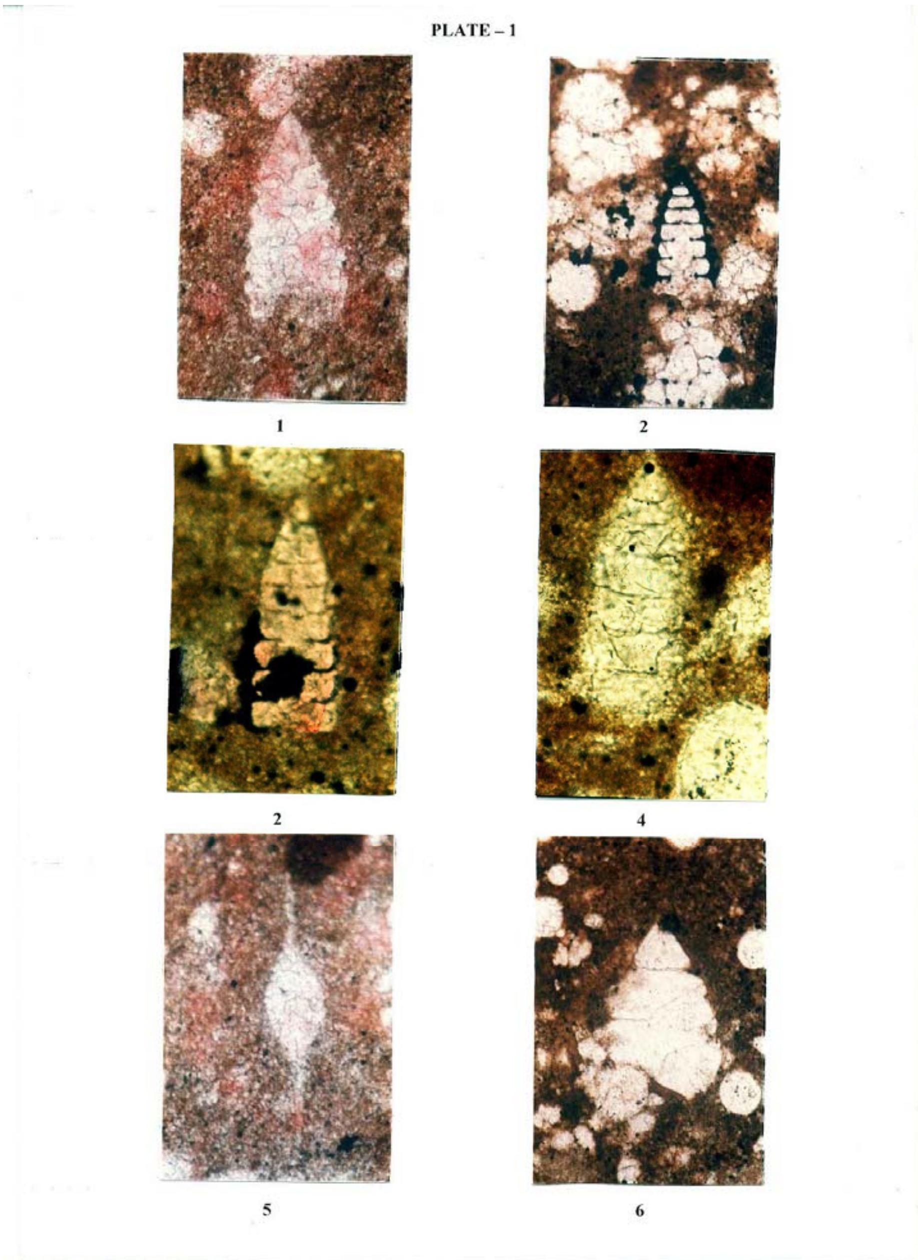

PLATE – 2