

Biostratigraphy of the Cretaceous Rocks of Central and North Wadi Araba-Jordan

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ABSTRACT

The biostratigraphy of the exposed Cretaceous rocks of the central and north Wadi Araba have been investigated by its lithological succession and microfaunas contents for the first time which are identified and figured. The succession is interrupted by several sedimentary hiatuses which are recognized for the first time.

KEYWORDS: Cretaceous rocks, central and north Wadi Araba, geological setting, stratigraphy, discussion and conclusion, paleoenvironment.

INTRODUCTION

The exposed Cretaceous rock units at the eastern side of the central and north Wadi Araba have been introduced briefly by BENDER(1974, Gharandal and Finan map sheets). The present paper is part of the investigations of the microfaunas of the Cretaceous and Tertiary sediments started by the author in 1997 on the Aqaba map sheet with the aim to reach a more detailed age attribution and biostratigraphic subdivisions. Different local stratigraphic subdivisions have been introduced by WOLFART(1959), MASRI (1963), McDONALD et al. (1965), BENDER(1968, 1974), and BASHA(1975).

Geological Setting

Six main sites of Cretaceous successions have been sampled and analysed for their litho and microfaunal content in the Central and north Wadi Araba resulted as follows:

Central Wadi Araba:

- Wadi es-Sik (SK), N:941.000, E:169,000
- Gharandal (X), N:940.000, E: 171,000
- Wadi Umm Sayyala (US), N: 975.000, E: 172.5000
- Bir: Madhkour (DM), N: 980.000, E: 185.000

North Wadi Araba:

- Dhahel – (DH), N: 165.000, E: 195.000
- North Dhahel- (NDH), N: 245.000, E: 190.0

Stratigraphy

The analysed samples of the Central Wadi Araba area reveal the dominance of the "Nodular limestone Member", overlain by the "Echinoid limestone Member" and underlain by the "Variegated Sandstones", where as the Northern area is dominated by a portion of the "Nodular Member" and is overlain by the "Massive white limestone, Member" (BENDER 1974), which all coincide with BASHA'S tentative suggestions (1975 and 1979) referring the item (A) to the typical Ajlun Group in north Jordan introduced by QUENNELL (1951) which is adopted herein (Fig.1).

The studied sequences of the Central and North areas consist of the following formations from base to top (Fig.2 and Fig. 3):

Naur Formations (A1 and A2) = Lower Nodular Limestone Member

It overlies the "variegated sandstones" Kurnub Sandstones(KB) and differentiated into:

Lower Naur Formation (A1) comprises of greenish sandy clay, argillaceous sandy limestone, interbedded with fibrous thin gypsum layers underlain by variegated sandstones =Kurnub Sandstone; of 20m,10m, 7m, and 20m. thick at Wadi es-sik,Wadi Umm Sayyala, Bir Madkour, and 20m at North Dhahel sites respectively, characterized by the foraminifera species; Trochamminoides parva SEIBOLD and SEIBOLD, Haplophragmoides rugosa CUSHMAN and WATERS Ammobaculites subcretacea CUSHMAN and

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ALEXANDER, *Flabellamina alexanderi* CUSHMAN, *Nezzazata* gp.(variables) BASHA, *Hedbergella gorbachikae* LONGORIA, H, *washitensis* (CARSEY), and the ostracodes *Amphicytherura antiqua*, *Neocythere ehrlichae* ROSENFELD and RAAB, *Centrocythere denticulata* MERTENS, *Eucytherura kokhavensis* ROSENFELD and RAAB, *Cythereis arabica houneesis*, *C. arabica diffusocostata*, *C. btaterensis*, and *C. cf. libanensis* BISCHOFF.

Upper Naur Formation(A2), composed of buff, medium sugar grained crystalline, partly cavernous, sandy dolomite about 8m., 10m., 5m., 15m, thick at Wadi es-sik, Gharandal Wadi Umm sayyala, Bir Madkour, and 16m. at North Dhahel sites, and barren. The Nodular Limestone Member is not reported from the Dhahel site.

Fuheis Formation(A3)=Upper Nodular Limestone Member

The formation is differentiated into three members from base to top as follows:

Lower member(A3-i) alternating layers of gypsiferous green-grey clay, sandy limestone and argillaceous dolomite, reported from all sites except Wadi umm sayyala site.

Middle member(A3-ii): the lower argillaceous dolomitic horizon is reported from the Gharandal and Bir Madkour sites of 15m, and 2m thick, respectively, whereas the upper limestone horizon is only reported from Wadi es-sik 6m, Gharandal 12m, and Wadi umm sayyala 7m sites.

Upper member(A3-iii) of alternating layers of gypsiferous clay, creamy argillaceous limestone, and sandstones, reported from Wadi es-sik, 25m, Bir Madkour, 43m and North Dhahel 26m sites while it is eroded from all other sites.

Generally the sequences are very rich with microfossil assemblages of which selected the foraminiferal species: *Haplophragmoides rugosa* CUSHMAN and WATERS, *Flabellamina aegyptiaca* SAID and BARAKAT, *Flabellaminopsis barnardia*, *F. jordanensis* *F. hasaensis* BASHA, *Marssonella gaugeri* GAUGER, *M. trochus* (d' ORBIGNY), *Tetraplasia quadrata* BARTENSTEIN and BRAND, *Thomassinella aegyptia* and *fragmentaria* OMARA, , *Nezzazata gyra* SMOUT, *N. spp.*, *Biconcava bentori* HAMAOU, *Atoxiphragmium aegyptiacum* SAID and BARAKAT, *Ophthalmidium*

amplectans LOEBLICH and TAPPAN, *Pseudolitonella mariae* CECIL P. reicheli MARIE, *Pseudodomia droimensis* REISS et al., *Raphidionina dubbai* and *R. laurinsensis* De CASTRO, *Ovalvulina ovum* REICHEL, *Pseudoalveolina cretacea* (ARCHIAC), *Lenticulina subaalata* (REUSS), *Hedbergella delrioensis* (CARSEY), *H. gorbachikae* LONGORIA *H. washitensis* (CARSEY), and the ostracoda species, *Cytherelloidea bicostata* CRANE, , *Amphicytherura sexta* VAN DEN BOLD, *A. sp.*, and *A. antiqua* ROSENFELD and RAAB, *Bythocytherina tamarae* ROSENFELD, *Cytherelloidea sp.*, *Cythereis zoumoffenni* BISCHOFF, *Metacytheroptern berbericum* (BSSOULET and DAMOTTE), *Neocythere bisulcata* ROSENFELD, *Neocythere sp.1* and *sp. 2*, *Veenniacythereis jezzineensis* (BISCHOFF), *Eucythereura kokhavensis* ROSENFELD, and, *C. oertlii* BISCHOFF, *Damontia cenomaana* DAMOTTE, *Loeynella sohni* ROSENFELD, *Plainleberis zirgensis* BASSOULET and DAMOTTE, *Spinoleberis yotvataensis* ROSENFELD and *Metacytheropteron berbericum* BASSOULET and DAMOTTE.

Hummer Formation(A4)=Lower Echinoid Limestone Member

It is represented by the Lower horizon of the Lower dolomitic limestone member which is estimated 25m thick at Wadi es-sik site and 13m at Gharandal, Wadi umm sayyala, and Bir Madkour sites approximately.

The Upper Fuheis microfaunas extends to this level in addition to the foraminifera; *Discorbis cf. minima* SAID and KENAWY, *Gabonella obesa* & *G. levis* De KLASZ et al, *Hedbergella planispira* TAPPAN, *Charantia cuvilliri* NEUMANN, *Ch. rummanensis* BASHA, *Thomassinella punica* SCHLUMBERGER, *Mayncina d' orbigny* (CUVILLIER and SZAKALL), *Pseudodomia drorimensis* REISS et al, *Conorboides hofkeri* BARTESTEIN and BRAND, *Cuneolina pavonia parva* HENSON, *Dicyclina schlumbereri* MUNIER-CHALMAS, and the ostracodes *Cythereis rawashensis* *kanaanensis* ROSENFELD. The formation is not reported from the Dhahel and North Dhahel sites.

Shuib Formation (A5-6) = Echinoid Limestone Formation

Only 20m thick of light grey dense slightly argillaceous limestone was allocated in the Wadi es-sik (A5) whereas the (A6) member was not reported from all

sites. However it corresponds to 10m. thick of gypsiferous greenish clay interbedded with thin ostracodal limestone bands at Dhahel site, characterized by the foraminifera *Ammotium hasaensis* BASHA, *Flabellaminopsis omaria* (KOCH), *Frankeina djaffaensis* SIGAL, *Valvulammina picardi* HENSON, and the ostracodes; *Cytherella* gr. *C.ovata*(ROEMER), *C.pararella*(REUSS), *Paracypris mdaouerensis* BISCHOFF, *Amphicytherura distincta* GERRY and ROSENFELD, *Cythereis namousensis*, *C.algeriana*, and *Planileberis ziregensis* BASSOULET and DAMOTTE.

Wadi Es –Sir Formation(A7)= Echinoid Limestone and Massive White Limestone Members

The Formation is reported from the Wadi umm sayyala 60m, Dhahel 72m, and at North Dhahel 5m thick of thick massive limestone partly dolomitic and marly. It is characterized by the foraminiferal species; *Haplophragmoides gracilis*, *Ammomarginuluna aburoashensis*, and *ammobaculites turonicus* SAID&KEAWY, *Flabellamina aegyptia* OMARA, *Praebulimia proluxa* CUSHMAN and Parker, *Discorbis minutus*, *Nonion beadnelli*, and *Gavelinopsi pseudobaccata* SAID and BARAKAT, *Heterohelix globulosa* (EHRENBERG), *Hedbergella delrioensis* (CARSEY), *elvatoglobotruncana praehelvetica* (TRUJILLO), and the ostracodes *Cythereis rawaschensis* kanaanensis ROSENFELD, *C.mdaourensis* BASSOULET and DAMOTTE, and *Pterygocythere raabi* ROSENFELD.

Discussion and Conclusions

The studied microfaunas of the cretaceous rocks exposed at the Central and North Wadi Araba show a close affinities with those described from other countries of the Fertile Crescent and Egypt ;(Jordan : McDONALD et al., 1965, KOCH, 1968, BASHA, 1975; 1978a; 1978b;1979; 1997; BASHA and MIQBEL 1987-Israel: REISS, HAMAOU and EKER;1964; ROSENFELD and RAAB, 1974, HONIGSTEIN, RAAB and ROSENFELD, 1985. Lebanon: BISCHOFF, 1963;1964-Iraq:HENSON, 1948; SMOUT1955) but also with north Africa (Egypt:OMARA, 1956; OMARA and STRAUCH, 1965; SAID and KENAWY, 1957; SAID and BARAKAT, 1957; VAN DEN BOLD, 1964; Tunisia: SCHLUMBERGER, 1893; Algeria: SIGAL, 1952; Gabon: KLASZ and RERAT, 1961; BASSOULET and DAMOTTE, 1969) and other some near by European countries from where similar nearshore - supratidal to

intertidal microfaunas have been identified.. The Turonian microfaunas of the Wadi umm sayyala site are strikingly similar to those of the same age identified from the Sinai and Abu-Roash areas (Northern Egypt).

Consequently, the base of the studied sections which is represented by the Kurnub Sandstones(KB)is barren, whereas the Lower Naur (A1) is attributed to the Aptian-Albian for the first time on foraminiferal and ostracoda species evidence ,the Upper Naur (A2) well as the Fuhies Formation (A3) is related to the Early Cenomanian; the Hummer Formation (A4) together with the Lower Shuieb(A5) to Late Cenomanian; while the Upper Shuieb (A 6) and the Wadi Es-Sir Formation (A7) are ascribed to the Turonian on the base of their facies changes and the microfaunal co-existence, which are illustrated in plates(1&2), respectively.

Accordingly, upon analysing the microfauna line ages and the lithologies of the different sites, the following facts have been observed:

None of the studied sites are sedimentary complete since they are accompanied by several unconformities which is not the case in North and Central Jordan as it could be observed below between:

- a. Upper middle Fuhies horizon(A-ii) and the Naur Formation (A2), where as the Lower Fuhies(A-i) as well as the Lower middle Fuhies(A-ii) horizons are eroded and unconformably overlain the Naur Formations(A1-2) at the the Wadi es-sik and Wadi umm sayyala sites while they are retained at Gharandal and Bir Madkour sites.
- b. The upper Hummer and the Upper Fuhies Formation.
- c. The Upper middle Hummer horizon and the overlying either Shuieb or the Wadi Es-Sir Formations only outcropping at Wad es-sik&Wadi Umm Sayyala sites.
- d. An normal fault is detected between Dhahel and North Dhahel where the Naur and the Fuhies Formations are omitted from Dhahel site since it has been confirmed by lithologies and microfauna analysis.

Paleoenvironment

It is clear that the studied sequences are generally composed of gypsiferous clays, fibrous gypsum, sandy carbonates partly dolomitic, recrystallized dolomites, biomicritic limestones; characterized by arenaceous , and calcareous foraminifera as well as thick walled ostracodes which reflect altogether lagoonal-nearshore-backreef

supratidal and intertidal environments. This could be due to the transgression and retrogression of the sea on the unstable shelf of the southern Jordan during the historical geology and the evolution of Jordan territory, which led to the tilting of the sediments towards the East and Northeast during the connecting of Jordan with Egypt.

Plate I

Typical representative Lower Cretaceous (Aptian-Albian) micro fossils :

Foraminiferal species

- 1- Hedbergella gorbachikae LONGORIA. X224
- 2- Hedbergella washitensis(CARSEY). X195
- 3- Amphicytherura antiqua ROSENFELD and RAA'B. X172 Ostracoda species
- 4- Centrocythere denticulata MERTENS.X104
- 5- Cythereis arabica houneensis BISCHOFF. X108
- 6- Cyth. arabica diffusocostata BISCHOFF.X104
- 7- Cyth. btaterensis intersticta BISCHOFF.X212
- 8- Cyth. cf. libanensis BISCHOFF.x132
- 9- Eucytherura kohkayensis BOSENFELD&RAA'B. X170
- 10- Neocythere ehrlichae ROSENFELD.X152

Typical representative Early Cenomanian microfaunas; Foraminiferal species;

- 11- Flabellaminopsis barnardia BASHA.X52
- 12- Flabellaminopsis jordanensis BASHA.x84
- 13- Frankeina djaffaensis SIGAL.X84
- 14- Tetraplasia quadrata BARTENSTEIN&BRAND.X132
- 15- Pseudolituonella mariae CECILE.X92
- 16- Pseudolituonella reicheli MARIE.X47
- 17- Ovalveolina ovum REICHEL.X100 Ostracoda species:
- 18- -Cytherelloidea bisulcata CRANE.X148
- 19- Amphicytherura sexta BOLD.X220
- 20- Bythoceratina tamarae ROSENFELD
- 21- Cytherelloidea sp.1.X204
- 22- Cythereis zoumoffenni BISCHOFF.X104

Plate II

Typical representative Early Cenomanian microfossils, continued,

- 1- Metacytheropteron berbericum (BASSOULET&DAMOTTE).X171
- 2- -Neocythere sp.1
- 3- Neocythere sp.2
- 4- Veeniacythereis jezzineensis (BISCHOFF).X156

Typical representative Late Cenomanian microfossils :

Foraminiferal species:

- 5- Ammotium hasaensis BASHA.X64
- 6- Charantia cuvillieri NEUMANN.X51
- 7- Charantia rummanensis BASHA.X52
- 8- Thomassinella punica SCHLUMBERGER.X32
- 9- Mayncina d'orbigny(CUVILLIER and SZAKALL).x84
- 10- Pseudedomia drorimensis REISS et al. X49
- 11- Amphicytherura distincta GERRYand ROSENFELD.X208 Ostracoda species:
- 12- Cythereis algeriana BASSOULET&DAMOTTE.X128
- 13- Planileberis ziregensis BASSOULETand DAMOTTE. X184

Typical representative Turonian microfossil :

Foraminifera species:

- 14- Gavelinopsis pseudobaccata SA'ID and KENAWY.X223
- 15- Discorbis minutus SA'ID &KENAWY.X180
- 16- Praebulimina proluxa CUSHMAN&PARKER.X168
- 17- Gabonella parva KLASZ&RERAT. X152
- 18- Gabonella sumaya BASHA.X202
- 19- Helvatoglobotruncana praehelvetca (TRUJILLO).X216 Ostracoda species:
- 20- Cythereis rawashensis kanaanensis ROSENFELD.X108
- 21- Cythereis mdaouerensis BISCHOFF.X188
- 22- Pterygocythere raabi ROSENFELD.X165.

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