Sci. J. Fac. Sci., Minufiya Univ., Vol. XV, 2001, **209 - 235**

LITHOSTRATIGRAPHY AND SEDIMENTOLOGY OF THE LOWER CRETACEOUS SUCCESSION AT GABAL SHABRAWET, NORTH EASTERN DESERT, EGYPT.

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ABSTRACT

The Lower Cretaceous succession at Gabble Shabrawet is divided into three lithostratigraphic units: the lower clastic unit is equivalent to the Malha Formation (Barremian-Early Aptian), the middle carbonate/siliciclastic unit is equivalent to the Ras Al Ahmar Member of the Risan Aneiza Formation (Aptian), and the upper carbonate unit is equivalent to the Hamret Salma Member of the Risan Aneiza Formation (Albian). Stratigraphic relations and primary sedimentary structures were examined in the field and the microfacies were studied under the polarizing microscope using representative thin sections for samples from different rock units. The coarse clastic rocks of the Malha Formation were deposited in fluvial environment (braided stream) while the finer sediments represent overbank flood-plain deposits. The limestones of the Risan Aneiza Formation were deposited in restricted platform environment and/ or in an intertidal zone. The dolostone facies were produced from the dolomitization of the limestone at or near the surface during early diagenesis. The sandy dedolostone facies resulted from the replacement of dolomite by calcium carbonate during late diagenetic processes in vadose meteoric water environment. The contact between the Lower Cretaceous and the Upper Cretaceous rocks is unconformable as indicated by its irregularity, presence of basal conglomerate bed and authigenic glauconite grains which were formed diagenetically on the unconformity surface.

INTRODUCTION AND PREVIOUS WORK

Gabal Shabrawet lies close to the Suez Canal between Ismailia and Suez (about 40 km south of Ismailia) and about 137 km to the northeast of Cairo. It is located between latitudes 30° 13′-30° 19′ N and longitudes 32° 12′-32° 20′ E (Fig. 1). Structurally, the area is represented by two asymmetrical anticlines separated by a shallow syncline. The two anticlines are Gabal Shabrawet and Shabrawet west (Al-Ahwani, 1982). The area is also affected by both NE-SW and NW-SE faults. All these structures were resulted from the Syrian Arc movements as well as the movements resulted in the Gulf of Suez graben (Shukri, 1954; Al-Ahwani, 1982). The Lower Cretaceous succession, which represents the oldest exposed sedimentary rocks in the studied area, crops- out at the core of Gabal Shabrawet anticline.

The geology of Gabal Shabrawet was studied by many authors since the beginning of the last century. Among the most important studies are those carried out by Barron (1907), Blanckenhorn (1921), Barthoux (1922), Sadek (1926), Shukri (1954), Fawzi (1959; 1960), Faris and Abbas (1961), Said (1962), Fawzi and Naim (1964), Ismail et al. (1967), Ismail and El-Dakkak (1969), Soliman and Amer (1972), El-Shazly and Abdel Hady (1975), Al-Ahwani (1982), Mohammad and Omran (1991), and El-Azabi (1999). The majority of these works were concerned with different geological studies including structure, paleontology, stratigraphic classification and facies investigations. The present work deals with the lithostratigraphy and sedimentology of the Lower Cretaceous succession at Gabal Shabrawet, north Eastern Desert, Egypt.

LITHOSTRATIGRAPHY

The Cretaceous rocks has the widest distribution of all Mesozoic systems in the north Eastern Desert of Egypt. These rocks crop-out at southern and northern Galala plateaux, Gabal Ataqa and Gabal Shabrawet which represents the extreme northern Cretaceous outcrops in the Eastern Desert. Several studies concerning the stratigraphy of the Lower Cretaceous rocks at Gabal Shabrawet and adjacent areas were done. Among these studies are Faris and Abbas (1961) who gave the basal series of the sections at Gabal Shabrawet an Albian age on the basis of the presence of *Orbitolina subconcava*. Said (1962) stated that the Cretaceous strata which crop-out at the core of Gabal Shabrawet are the oldest exposed rocks in the Cairo – Suez district. He divided the Cretaceous succession into two rock units: the lower unit (250 m thick of variegated shales and marls) was considered as Cenomanian, except its lower part that contains Albian fossils; e.g., *Knemiceras syriacum,* and the upper unit (140 m thick of limestone) may belong to Turonian- Santonian. Abdallah et al. (1963) reported that the oldest Cretaceous rocks in central Sinai and in the Gulf of Suez are represented by alluvial- near shore sandstones which they named the Malha Formation at its type locality (Wadi Malha) in the northern Galala Plateau at the western side of the Gulf of Suez.The age of the Malha Formation is usually given as Early Cretaceous (mostly Albian) (Kerdany and Cherif, 1990). Fawzi and Naim (1964) studied the Lower Cretaceous strata (174 m thick) in Gabal Shabrawet and assigned an Albian age to the upper part of the section on the basis of the presence of *Knemiceras aff. spathi* and associated fauna. They gave an Aptian age to the lower part of the succession on the basis of the presence of Aptian fossils. They suggested a conformable relationship between this succession and the overlying Cenomanian rocks. Soliman and Amer (1972) reported that the Lower Cretaceous rocks crop-out in the Eastern Desert at Gabal Shabrawet, northern Galala and west of Ras Gharib area. They added that these rocks are mainly sandstones and shales with subordinate limestone northward. In addition, they concluded that the Cenomanian rocks conformably overlie the Lower Cretaceous rocks. Al-Ahwani (1982) recorded about 125 meters of Lower Cretaceous rocks at Gabal Shabrawet. He subdivided these rocks into four main rock units: two clastic units alternate with two carbonate units. The first two units (lower clastic unit and lower carbonate unit) belong to the Aptian age on the basis of lithological and paleontological similarity with the Aptian rocks studied by Abdine and Deibis (1972) in the north Western Desert and the absence of Albian fossils recorded by Ismail and Mansour (1969) from Gabal El-Maaza, northern Sinai. The other two units (upper clastic unit and upper carbonate unit) are of Albian age. He added that the four units are conformable with each other and the whole Lower Cretaceous succession is unconformable with the overlying Cenomanian rocks. Kerdany and Cherif (1990) called the whole Lower Cretaceous section at Gabal Shabrawet the Risan Aneiza Formation. This formation was originally proposed by Said (1971) for the Aptian-Albian section on the northern flanks of the Maghara structure at Bir Lagama in north Sinai. Darwish (1992) assigned Jurassic/Early Cretaceous age to the sandstones of the Malha Formation in the Northern Galala Plateau section. The most recent study of facies analysis and paleoenvironmental interpretation of Gabal Shabrawet Lower/Middle Cretaceous succession and its sequence stratigraphic applications was carried out by El-Azabi (1999). He measured the Lower Cretaceous-Cenomanian succession (325 m thick) and subdivided it into three main sequences: a lower regressive clastic, a middle carbonate/clastic and an upper carbonate-dominated facies on the basis of lithologic and environmental differences. He added that the lower regressive clastic sequence belongs to the Malha Formation of Abdallah et al. (1963) whereas the middle carbonate/clastic and the lower part of the upper carbonate- dominated sequences belong to the Risan Aneiza Formation of Said (1971).

In the present study, the author measured the Lower Cretaceous succession in Gabal Shabrawet (about 110 m thick) and divided it into the following three lithostratigraphic units: lower clastic unit, middle carbonate/siliciclastic unit, and upper carbonate unit (Fig. 2).

1. Lower Clastic Unit

The lower clastic unit represents the oldest exposed Lower Cretaceous rocks in Gabal Shabrawet and adjacent areas. The rocks of this unit are easily recognized in the field by their multicolours (mottled, red, brown, purple, violet, black and white). It is equivalent to Malha Formation (Fig. 2) of Abdallah et al. (1963). It also includes the lower clastic unit of Al-Ahwani (1982) and the lower regressive clastic sequence of El-Azabi (1999). The age of the Malha Formation is disputed. It is commonly dated Aptian-Albian although Aboul Ela et al. (1991) gave the Berriasian-Barremian age to the lower beds of this formation. The author prefers the Barremian-Early Aptian age for the Malha Formation at Gabal Shabrawet due to its stratigraphic position below the Risan Aneiza Formation (middle carbonate/siliciclastic and upper carbonate units of the present work) of Aptian-Albian age. The base of this unit (Malha Formation) is not exposed and its upper contact with the middle carbonate/siliciclastic unit is unconformable. It attains a thickness of about 49 m and consists mainly of sandstones with sandy siltstone and claystone interbeds. Most of the sandstone beds are pebbly. The pebbles are more concentrated in the lower part of the succession. Iron oxide bands and nodules occur frequently in some sandstone and claystone beds. Gypsum bands characterize the uppermost part of the Malha Formation. The sandstones are poorly to moderately sorted and range in grain size from fine- to coarse-grained. They are friable to moderately hard and partly cemented by kaolinitic, calcareous and/or ferruginous materials. The Malha Formation here is generally nonfossiliferous except for some hazy plant remains. Some primary structures are preserved such as plane bedding, graded bedding, planar cross-bedding (Fig. 3-A) (with set thickness about10 to 30 cm, dip angle 22° and dip direction S75E) and scour features (Fig. 3-B). The succession is made up of six fining upward cycles; each of which consists of coarse clastics at its base followed upward by either claystone or finer sandstone, siltstone and claystone at its top; i.e., each cycle is truncated by pebbly coarse-grained sandstone of the succeeding cycle.

2. Middle Carbonate/Siliciclastic Unit

The rocks of this unit represent the lower part of the Risan Aneiza Formation of Said (1971). Hassaan et al. (1992) differentiated the Risan Aneiza Formation into two members: the lower member is Ras Al Ahmar Member (Aptian age) and the upper one is Hamret Salma Member (Albian age). At Gabal Shabrawet, the middle carbonate/ siliciclastic unit (Fig. 2) is equivalent to Ras Al Ahmar Member of Hassaan et al. (1992) on the basis of stratigraphic position and lithological similarity. It also includes the lower carbonate unit and the upper clastic unit of Al-Ahwani (1982) and the middle carbonate/clastic sequence of El-Azabi (1999). This unit is unconformably underlain by the lower clastic unit (Malha Formation) and conformably overlain by the upper carbonate unit. It reaches a thickness of about 38 m. It consists mainly of dolomite and limestone in the lowest 25 m and of thin green and grey fissile shale beds, dolomite and white limestone interbeds in the following 3 m. The topmost 10 meters consist of silty claystone. The dolostone is brownish, greenish, yellowish and sometimes brecciated. It contains vugs filled with calcite and black Mn dendroides in some beds. The contacts between different dolomite beds are sharp or undulating.

3. Upper Carbonate Unit

This unit (Fig. 2) represents the topmost part of the Lower Cretaceous succession at Gabal Shabrawet. It is equivalent to the Hamret Salma Member (Albian age) of Hassaan et al. (1992). It lies unconformably below the Cenomanian rocks. This unconformable relationship is represented by a 2 m thick basal conglomerate bed that consists of gravels and cobbles of limemudstone embedded in glauconite (Fig. 3-C). This unit attains a thickness of about 23 m and is mainly made up of limestone and dolostone with some interbeds of claystone. Echinoderm and molluscan shell fragments are so dominant that some beds consist mainly of shell fragments (coquina). The limestone is white, grey, massive and sometimes thinly bedded (Fig. 3-D) and fractured (Fig. 3-E), dolomitic, and mostly fossiliferous. The dolostone is yellow, brown, white, massive, fractured, silty and marly. The claystones are grey, green, and glauconitic. The contacts between carbonate beds are sharp or undulating with concentration of iron oxides with calcite filling vugs near the slope surface. Vertical burrows filled by glauconite (Fig. 3-F) are dominant in the limestone bed just below the unconformity surface that separates the Lower Cretaceous rocks from the Cenomanian rocks.

PETROGRAPHY AND FACIES ANALYSIS

Different representative samples of sandstones, limestones, dolomites and glauconite were thin sectioned and studied under the polarizing microscope. The following facies were identified and described:

A . Quartzarenite Facies

B. Limestone Facies

B-1 Limemudstone

B-2 Dolomitic molluscan packstone

B-3 Dolomitic molluscan echinoidal ostracode wackestone

C. Dolostone Facies

C-1 Sandy dolostone

C-2 Marly dolostone

C-3 Sandy dedolostone

D. Glauconitic Facies

A. Ouartzarenite Facies (Facies A)

The quartzarenite facies (Facies A) occurs dominantly in the lower clastic unit (Malha Formation). It is composed of multicoloured, pebbly, ferruginous and siliceous sandstone. It ranges in grain size from fine- to coarse-grained. Some units posses a planar cross-stratification. It is interbedded with multicoloured claystones and siltstones. Contacts between different units of the Malha Formation are either sharp or undulated (scoured).

Under the microscope, the quartzarenite facies contains mainly quartz grains (90-95%), most of which are monocrystalline and some of them are polycrystalline. They are poorly- to moderately sorted, subrounded to well rounded, and fine to coarse sand size (Fig. 4-A) . Most of the quartz grains exhibit straight extinction while others have undulose extinction. Syntaxial silica overgrowth occurs commonly (Fig. 4-B). There are no contacts between the quartz grains. Some rock fragments occur in addition to fine to coarse chert grains. Microcrystalline calcite, silica, iron oxides and gypsum are the main cementing materials.

B- Limestone Facies

The limestone facies occur in the middle carbonate/siliciclastic unit as well as in the upper carbonate unit with its dominance in the latter unit. The following three different limestone facies are recognized:

1. Limemudstone (Facies B-1)

This facies occurs in the middle unit above Facies C-1 and below Facies C-2 and in the upper unit it forms the cobbles of the basal conglomerate that separates the Lower Cretaceous rocks from Upper Cretaceous rocks (Fig. 2). The limemudstone of this facies is snow white, yellow and sometimes purple. Manganese dendroides occur in some units. Its contacts with adjacent facies is either sharp or undulated.

Microscopically, this facies consists of micrite (85%) with clear patches of microspar (5-10%). There is a little amount of clays. Echinoid osciles and molluscan shell debris occur in this facies (Fig. 4-C). The microspars show irregular contacts with the adjacent micrite. In some parts, the limemudstone is stained by brown patches of iron oxide.

2- Dolomitic molluscan packstone (Facies B-2)

This facies is represented only in sample 18 (Fig. 2) at the base of the upper carbonate unit (base of the upper member of Risan Aneiza Formation). Petrographically, this facies consists of micrite (about 50%), skeletal particles (40-50%) and scattered zoned dolomite rhombs (3%). Micrite occurs as microcrystalline to cryptocrystalline calcite which is stained by iron oxides. The dolomite rhombs consist of dark cores surrounded by clear outer rims. They are idiotopic to hypidiotopic in fabric. Skeletal particles are mostly mollusca, echinoids and ostracods. The molluscan fragments are elongated, subparallel to bedding planes and consist of lamellar structure. Some shell fragments have been replaced by sparry calcite, while other shell fragments suffer from degrading neomorphism due to the burrowing of fungi and algae in the lamellar structure of the shell fragments (Fig. 4-D).

3. Dolomitic molluscan echinoidal ostracode wackestone (Facies B-3)

This facies occurs only in the upper carbonate unit (Fig. 2). The rock of this facies is grey, yellow and white limestone with calcite filling vugs. It is sometimes fractured and highly fossiliferous with pelecypod, gastropod, ostracods and iron minerals (e.g., chlorite, siderite, and magnetite) are not common in fluvial deposits. He added that although deficency of a mineral is not an environmental indicator, it provides a supporting evidence in interpretation.

From the above discussion, it is suggested that the rocks of the Malha Formation indicate deposition in fluvial environment. The coarse pebbles and sandstones which are common in the lower part of each cycle may resemble the conglomerate-sandstone associations in braided stream interpreted by Long (1978). In addition, the coarse-grained sediments of the Malha Formation are similar to channel sediments of modern streams in terms of their textures, sedimentary structures and vertical sequences (Harms and Fahnestock, 1965; Sarkar and Basymallick, 1968). According to McKee et al. (1967), the enclosing finer-grained sediments (siltstone and claystone) are similar to contemporary overbank flood-plain deposits.

B. Risan Aneiza Formation

The Risan Aneiza Formation at Gabal Shabrawet includes the middle carbonate/siliciclastic and upper carbonate units. In its lower part (Ras Al Ahmar Member), it consists of dolomite and limestone which grades upward into green, grey fissile shale, dolomite and limestone interbeds. In the upper part of the formation (Hamret Salma Member), it is made up mainly of limestone and dolostone with interbeds of claystone. The limestones are usually white, grey, massive, fractured and dolomitic. They are highly fossiliferous, especially in the Hamret Salma Member. The dolostones are white, yellow, brown, silty, marly and usually massive and fractured. It contains vugs and vertical burrows. The claystones are grey, green and glauconitic. Six distinct carbonate facies have been recognized in the carbonates of the Risan Aneiza Formation at Gabal Shabrawet. Three limestone facies include limemudstone (B-1), dolomitic molluscan packstone (B-2), and dolomitic molluscan echinoidal ostracode wackestone (B-3) and three dolostone facies include sandy dolostone (C-1), marly dolostone (C-2), and sandy dedolostone (C-3).

As for the depositional environment of the Risan Aneiza Formation, it displays different phases of deposition in shallow coastal zone. The first phase was resulted in the deposition of the sandy dolostone (C-1), marly dolostone (C-2), and sandy dedolostone (C-3) in the lower part of the formation. These rocks were formerly deposited as fine-grained limemudstone but after deposition they were subjected to the dolomitization processes. Dolomite was possibly resulted from an *in situ* replacement of limemud reacting with refluxed brines (Townson, 1975) or formed at or near the surface during early diagenesis (Taylor and Sibley, 1986). The absence of the fossils and the fine-grained dolomite rhombs indicate early dolomitization or shortly after deposition. The presence of clotted rock fragments in the sandy dolostone indicates that the deposition was interrupted. Several authors explained the process of dedolomitization and agreed that the process is late diagenetic (Schmidt, 1965). Other authors (e.g., Katz, 1968) stated that dedolomitization results due to changes in the parameters of the depositional environments which inhibited growth of dolomite crystals which were replaced by calcite during early diagenetic processes. Dedolomitization is common where dolomites have been washed by vadose meteoric waters rich in sulphate ions (Leeder, 1982). The vugs that are filled by blocky calcite and relics of dolomite rhombs in facies (C-3) may indicate intermittent subaerial exposure (Khalifa and Abu El-Hassan, 1993). Going upward in the section, there was a rising in sea level which resulted in the deposition of intercalation of dolomite, claystone, marly dolostone, and sandy dolostone. This reveals the presence of small pulses in sea level, each of which begins with deposition of claystone and capped by sandy or marly dolostone. The thick glauconitic claystone facies in the upper part of the Ras Al Ahmar Member suggests that this facies was settled out of suspension in a shallow marine, low-energy environment (James, 1983; Hendriks, 1986). The uppermost part of the formation consists of cyclic sequences. Each cycle consists of dolomitic molluscan packstone (B-2) or dolomitic molluscan echinoidal ostracode wackestone (B-3) capped by marly dolostone (C-2) or sandy dolostone (C-1). The carbonate facies in the basal parts of cycles that contain echinoids and mollusca points to the dominance of quiet marine conditions (Flugel, 1982), but the presence of the dolostone in the upper parts of cycles represents an intertidal zone, where there was shallowing of the sea that led to evaporation and increase in Mg ions needed for the dolomitization process (Khalifa and Abu El Hassan, 1993). Comparing the limestone facies in the present study with those of Wilson (1975) and Longman (1981), it is possible to suggest that the limemudstone facies (B-1), dolomitic molluscan packstone facies (B-2) and dolomitic molluscan echinoidal ostracode wackestone facies (B-3) were deposited in restricted platform environment Vertical burrows in facies (B-3) indicate deposition in an intertidal zone (Braun and Friedman, 1969).

C. Glauconite Facies

In the area of study, glauconite occurs in the middle and upper units of the Lower Cretaceous succession, but the main occurrence of this facies is in the basal conglomerate bed at the boundary between the Lower and Upper Cretaceous rocks. Glauconite is a good indicator of a specific depositional environment. Glauconite pellets and spherules form only in shallow marine environments (Odin and Matter, 1981; Prothero and Schwab, 1996). In his study on the glaucony from the middle Cambrian of Oland and Bornholm, southern Baltoscandia, Berg-Madsen (1983) suggested that the formation of the glaucony took place in shallow (less than 50m) and cool water. Harder (1974), in his experiments, obtained glauconite in the transition zone between oxidizing and reducing conditions. Glauconites must reside for 1000 to 10,000 years at the sediment-water interface to be formed and it takes much longer to develop highly complex glauconites (Odin and Matter, 1981). Working on the geochemistry and origin of glauconite of the El-Gedida mine and Bahariya Formation, Bahariya Oasis, Abu El-Hassan (1998) indicated that the glauconite of El-Gedida mine was formed in shallow marine environment whereas the glauconite of the Bahariya Formation was produced from the diagenetic processes of illite-smectite clay minerals. Green sands are found at the top of shallowing-upward marine sequences and just below unconformities (Prothero and Schwab, 1996). On the other hand, Goldman (1929) emphasized that glauconite zones may be associated with unconformities. They occur directly above the break or a foot or two above. Khalifa (1983) concluded that glauconite can be formed on unconformity surface as a result of replacement of calcite by glauconite during subaerial exposure.

In the present study, the glauconite of this facies is believed to be formed diagenetically on the unconformity surface since it can be generated from the diagenetic processes and its occurrence with the basal conglomerate supports this opinion. The glauconite that occur in other beds of the succession was formed in marine environment.

CONCLUSIONS

The oldest exposed sedimentary rocks at Gabal Shabrawet are those of the Early Cretaceous age. In this area, the Lower Cretaceous succession is divided into three lithostratigraphic units; lower clastic unit (equivalent to the Malha Formation of Abdallah et al., 1963), middle carbonate/siliciclastic unit (equivalent to Ras Al

Ahmar Member of the Risan Aneiza Formation of Hassaan et al., 1992), and upper carbonate unit (equivalent to Hamret Salma Member of the Risan Aneiza Formation of Hassaan et al., 1992). The Malha Formation is unconformably overlain by the Ras Al Ahmar Member which is conformably overlain by the Hamret Salma Member. The Lower/Upper Cretaceous contact is unconformable as indicated by the presence of a basal conglomerate bed. The Malha Formation, Ras Al Ahmar Member, and Hamret Salma Member were deposited during Barremian-Early Aptian, Aptian, and Albian, respectively. The rocks of the Malha Formation are mainly sandstone, siltstone and claystone interbeds arranged in the form of several fining upward cycles, each of which consists of coarse clastics at its base followed upward by either finer sandstone, siltstone or claystone and ended by claystone at its top. The sandstones of the Malha Formation are mainly multicolored quartzarenites. The coarse clastics were interpreted as braided stream deposits and the siltstones and claystones are overbank flood-plain deposits. The Lower Member of the Risan Aneiza Formation consists of dolomite, limestone and grey, green and glauconitic shale and silty claystone whereas the Upper Member consists of fossiliferous limestones and dolostones with interbeds of claystone. In Risan Aneiza Formation, three limestone facies, three dolostone facies and one glauconite facies were recognized, described and interpreted. The limemudstone facies (B-1), the dolomitic molluscan packstone facies (B-2) and dolomitic molluscan echinoidal ostracode facies (B-3) were deposited in restricted platform environment or in an intertidal zone. The sandy dolostone facies (C-1) and the marly dolostone facies (C-2) were probably resulted from the dolomitization of the limestones at or near the surface during early diagenesis. The sandy dedolostone facies (C-3) resulted from the replacement of dolomite by calcium carbonate during early diagenetic processes near the surface or due to the washing of dolomites by vadose meteoric waters. The glauconites which occur in the claystone beds of the Risan Aneiza Formation are believed to be formed in shallow marine environment but those occur with the basal conglomerate at the Lower/Upper Cretaceous boundary are authigenic and generated from the diagenetic processes on the unconformity surface.

ACKNOWLEDGEMENTS

The author thanks Prof. Dr. M. A. Khalifa for reading the manuscript and his constructive criticism and valuable suggestions. Thanks are also due Dr. H. A. Wanas for his great aid in the field and thin section data.

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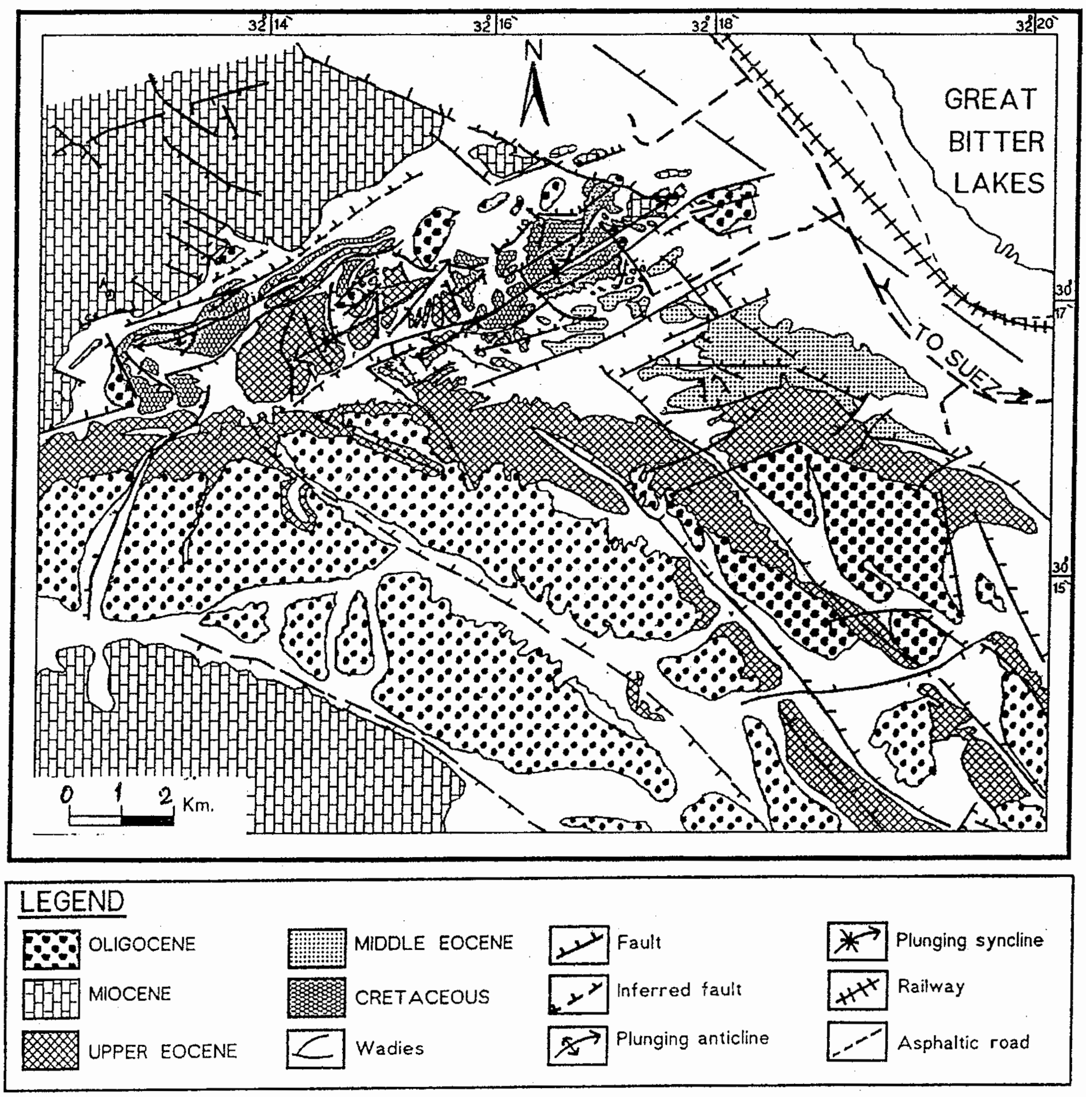

Fig. (1): Geological map of Shabrawet area (After Al-Ahwani, 1982).

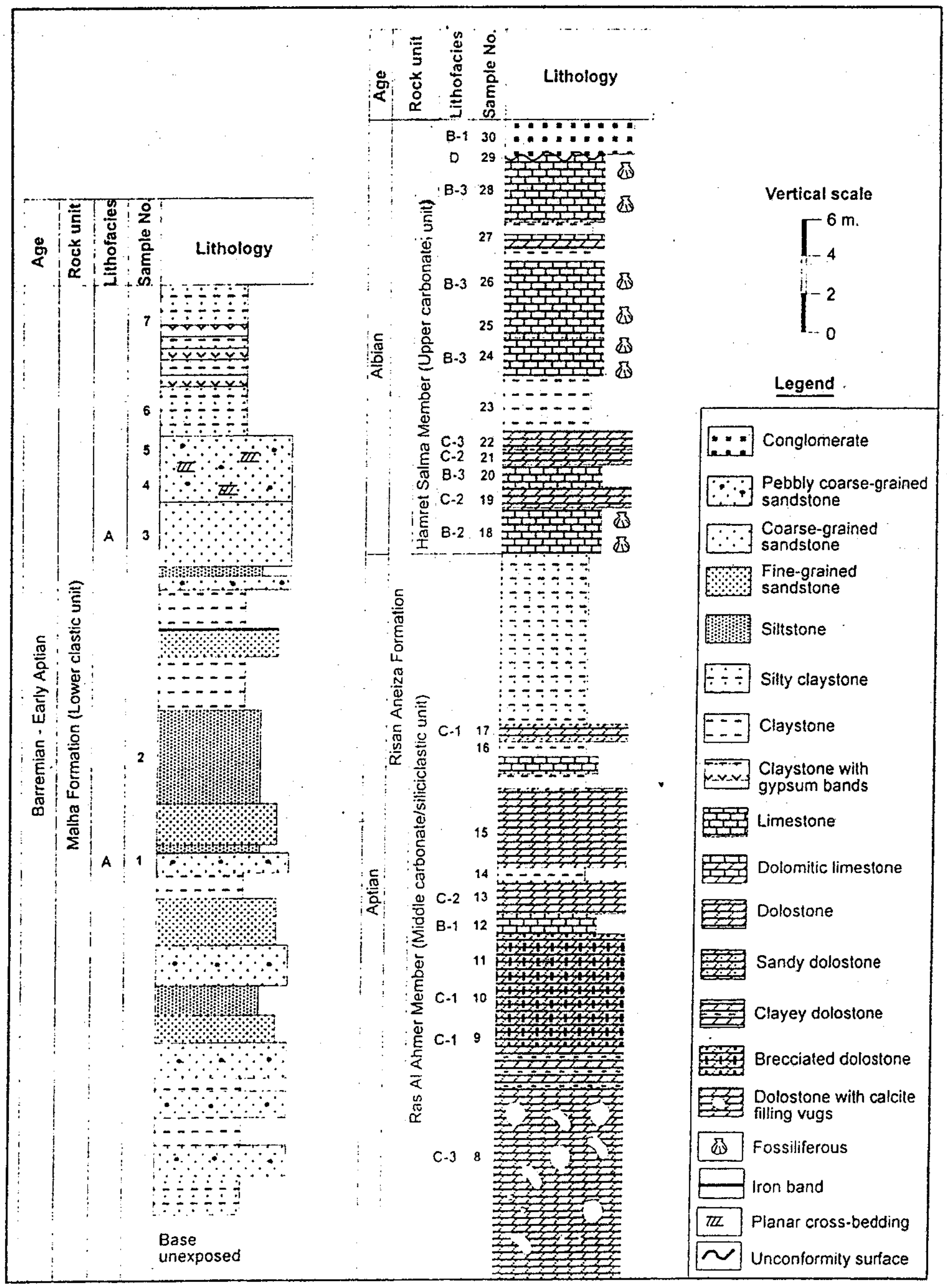

Fig. (2) : Lithostratigraphic succession of the Lower Cretaceous rocks at Gabal Shabrawet.

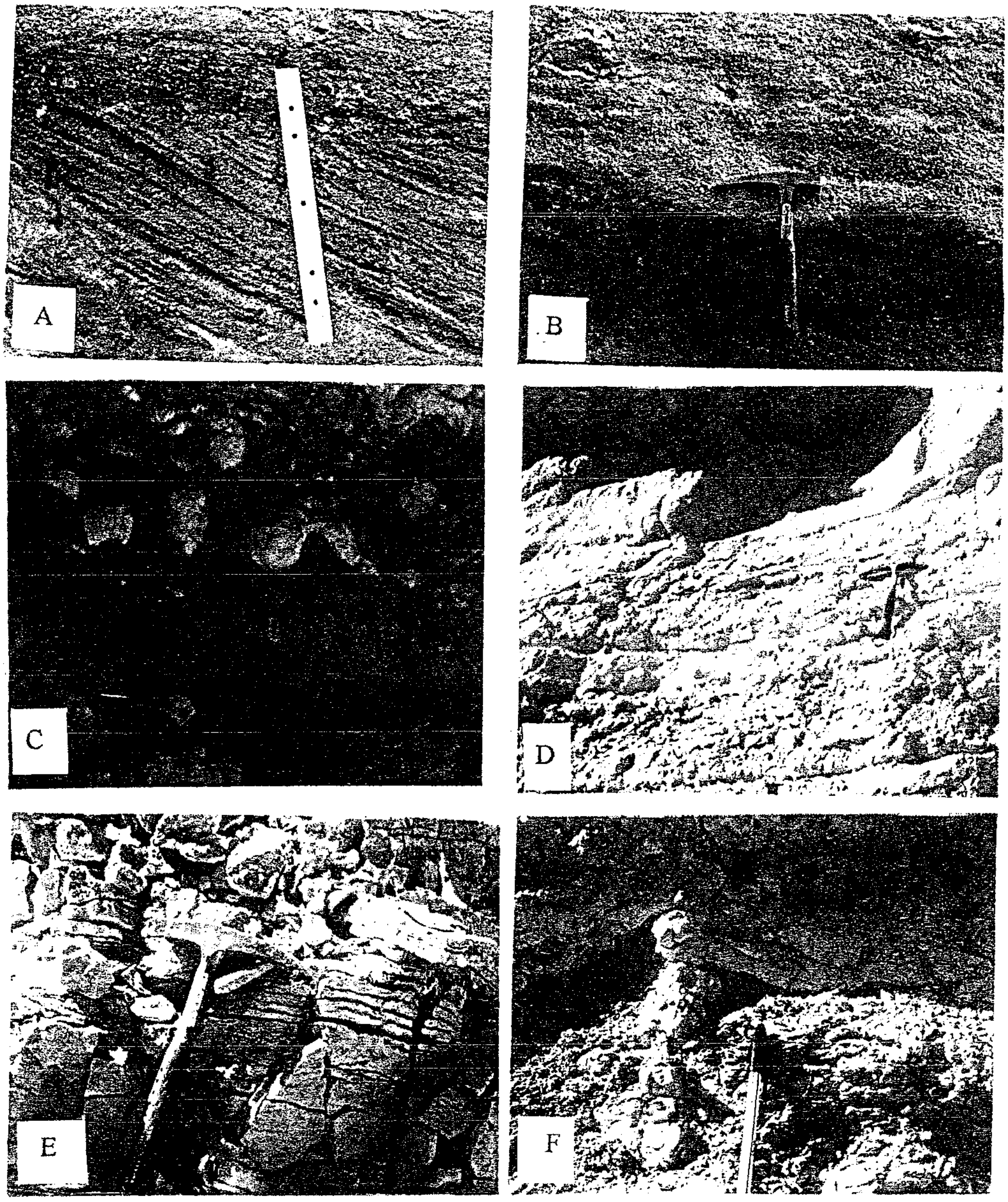

Fig. (3). Outcrop photographs showing: (A) Planar cross-bedding in the quartzarenites of the Malha Formation. (B) Small-scale scouring of the coarse pebbly sandstone into the sandy claystone in Malha Formation., (C) Basal conglomerate associated with glauconite on the unconformity surface between Lower and Upper Cretaceous rocks., (D) Thinly-bedded and flat lying limestone of the upper carbonate-dominated unit., (E) Fractured limestone of the upper carbonate-dominated unit.,(F) Vertical burrows filled by glauconite in the limestone bed just below the unconformity surface which separates the Lower Cretaceous rocks from the Cenomanian rocks.

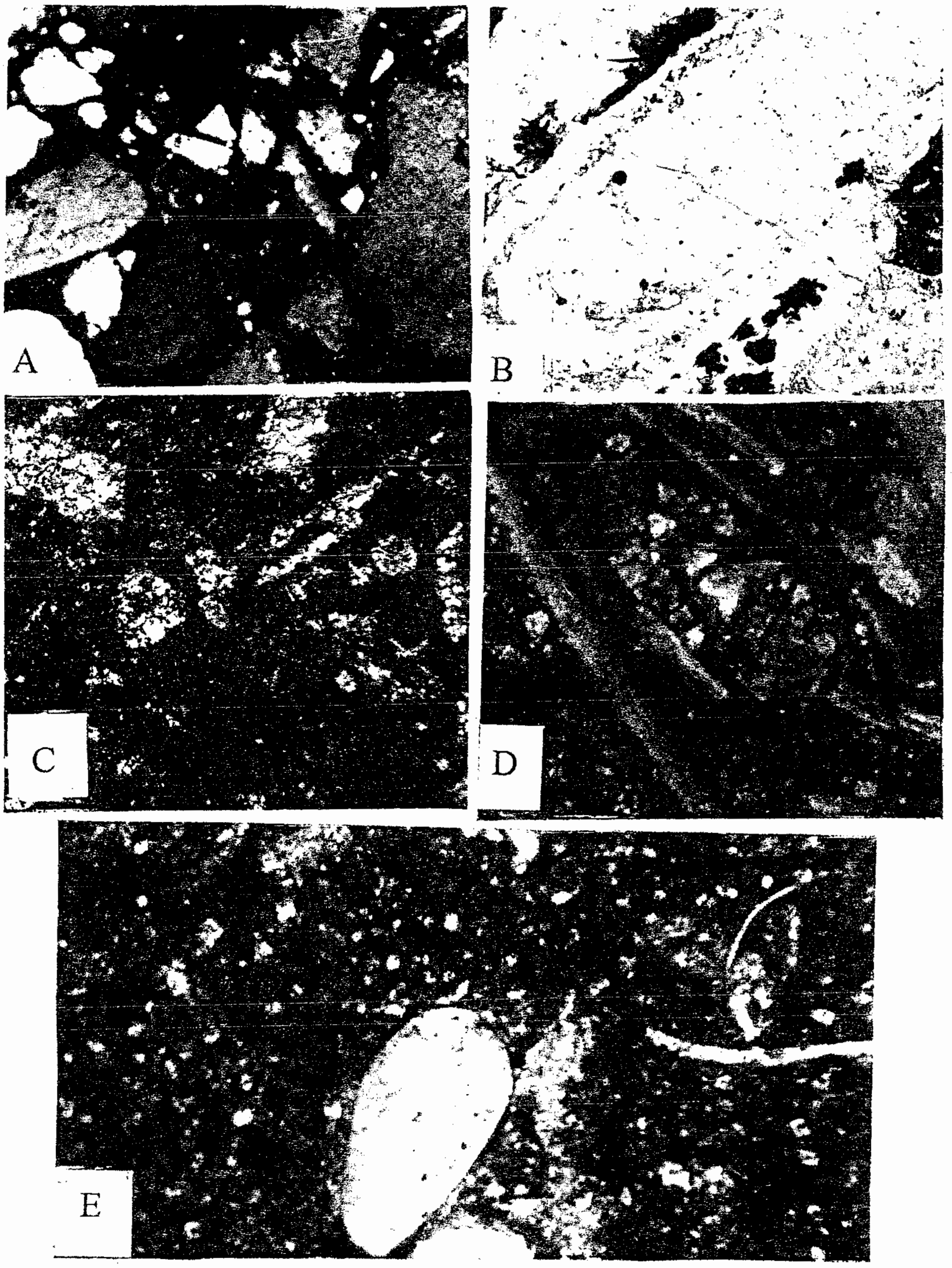

Fig. (4): Photomicrographs showing: (A) Ferruginous quartzarenite facies (Malha Formation) in which the quartz grains are rounded to subrounded. And moderately sorted, (B) Quartzarenite facies (Malha Formation) showing silica overgrowth which is common in this facies., (C) Limemudstone facies (B-1) showing the aggrading neomorphism along the cracks, shell debris occur in this facies., (D) Dolomitic molluscan packstone facies (B-3) showing different skeletal particles; mollusca, echinoids and ostracods and fine dolomite rhombs., (E) Dolomitic molluscan echinoidal ostracode facies (B-3).

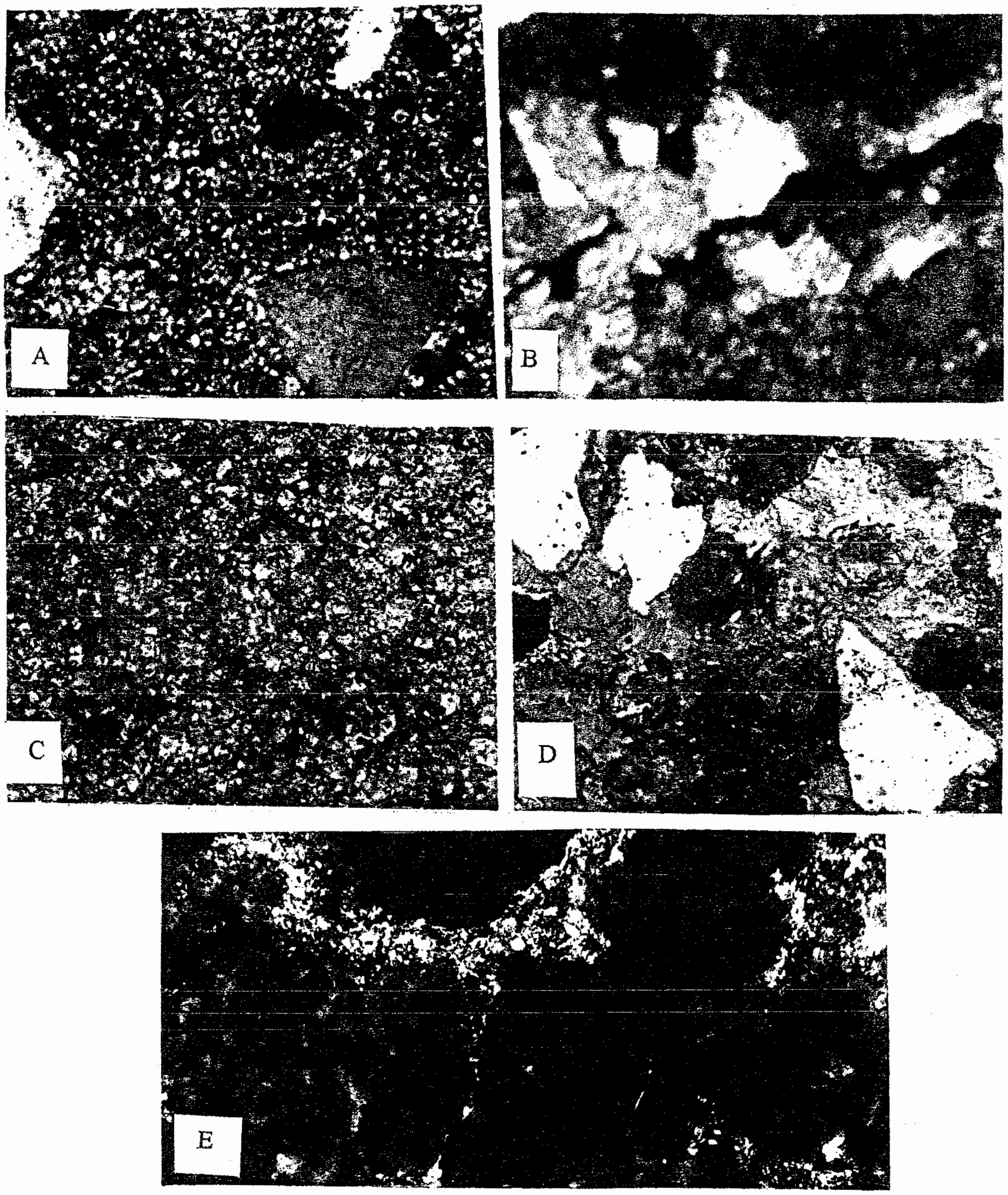

Fig. (5): Photomicrographs showing: (A) Sandy dolostone facies (C-1) showing fine to medium grained dolomite rhombs and partial replacement of quartz by dolomite. (B) Sandy dolostone facies showing replacement of dolomite by calcite along the stylolites., (C) Marly dolostone facies (C-2) showing the dolostone rhombs in the marl., (D) Sandy dedolostone facies (C-3) showing replacement of dolomite by calcite., (E) Glauconite facies (D) at the unconformity surface on the top of the Risan Aneiza Formation.

دراسات استراتجرافية و ترسيبية لتتابع الطباشيرى السفلى فى جبل شبراويت ، شمال الصحراء الشرقية، مصر.

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الملخص العربى

يمكن تقسيم تتابع الطباشيرى السفلى فى جبل شبراويت الى ثلاث وحدات استراتجرافية : الوحدة السفلى (متكون المالحا؛ عبد الله واخرون ، ١٩٦٣) ، الوحدة الوسطى (عضو راس الاحمر؛ حسان واخرون ،١٩٩٢) و الوحدة العليا (عضو حمرة سلمى ؛ حسان و اخرون ،١٩٩٢). الوحدة الوسطى و العليا تنتميان الى متكون ريسان عنيزة (سعيد، ١٩٧١). تفصل صخور الطباشيرى السفلى من صخور السينومانى بسطح عدم التوافق الذى يمكن الاستدلال عليه بواسطة عدم انتظامه ، وجود طبقة الكونجلوميرات القاعدية عليه بالاضافة الى الجلوكونيت الذى تكون عليه من عمليات ما بعد الترسيب.

تتكون صخور متكون المالحا من رواسب فتاتية تتراوح احجام حبيباتها بين الحصى والطين و امكن الاستدلال على انها قد ترسبت فى بيئة قارية نهرية بينما تتكون صخور متكون ريسان عنيزة من رواسب فتاتية و كربوناتية فى جزئها االسفلى و تسود الرواسب الكربوناتية فى جزئها العلوى . و قد امكن التعرف على ست سحنات رسوبية كربوناتية فى متكون ريسان عنيزة: ثلاث سحنات حجر جيرى و ثلاث سحنات دولوميت و توجد سحنة الجلوكونيت فى الصخور الطينية و على سطح عدم التوافق الفاصل بين صخور الطباشيرى السفلى و الطباشيرى العلوى . من دراسة هذه السحنات تم الاستدلال على ان صخور متكون ريسان عنيزة قد ترسبت فى بيئة بحرية ضحلة او فى منطقة المد و الجزر.