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PETROLOGY AND MINERALOGY OF THE MIOCENE ROCKS IN GEBEL GENEFFA, NORTH WEST OF SUEZ, EGYPT

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ABSTRACT

The present work aims to investigate the petrography , mineralogy and facies characteristics of the Micocene rocks exposed in Genbel Geneffa along Cairo - Suez road . To achieve this goal , thirty nine thin sections were made for petrographic and microfacies examination samples were subjected to heavy liquid separation of light and heavy mineral assemblages . From tis study , it has been concluded that :

1 - Sediments in the basal and upper parts of the Early Miocene represent platform deposits that were laid down under conditins of open circulation at or just below the wave base . Deposition of these sediments was occasionally slightly influenced by aeolian fluvial regime . Sediments in the middle part of this rock unit represent slightly deeper condition(Platrform margin) that prevailed as a consequence of a minor transgression of the sea . The progressive shallowness of the sea that commenced after deposition of the middle part led to the prevalence of beach conditions during accumulation of the upper most layers of the Early Miocene .

2 - Sediments at the basal part of the Middle Miocene unit (limestone) denote a perild of sea transgression as they represent platform margin and reef flank deposits . The clastic sediments which form the rest of this rock unit were laid down in a slightly shallower environment (platform) . The progressive shallowness of the sea resulted in dominant beach conditions under which the top part of the Middle Miocene was deposited .

INTRODUCTION

The area under investigation lies between longitudes 32° 15' and 32° 25' E and Latitudes 30° 8' and 30° 15' N (Fig. 1) . The study area generally has a moderate relief . The Miocene rocks are subdivided into two units , a lower unit of sandy facies and an upper unit mof carbonate facies.Structurally, the study area was affected by three main structural elements , these are afaults , unconformities and joints. Faults are normal having dips ranging between 65 and 85 . The main fault system have NW-SE direction of Clysmic or Erythrean trend (Al Ahwani , 1977) with down throw about 55 meters . Three unconformity surfaces were recognized in the study area by al Ahwani , (1977) . They belong to the time intervals ; Oligocene - Early Miocene , Early Miocene - Middle Miodene and Middle Miocene - Quaternary .

Several workers dealt in detail with the Miocene rocks exposed at some localities along Cairo - Suez road , e.g. the work published by Deperet and Fourtau (1900) , Sadek (1926) . Said and Yallouze (1955), Said (1962) , Abdallah and Abdel Hady (1966) , Aboul Ela (1968) and Al Ahwani (1977) .

The present study aims to investigate the detailed petrography . mineralogy and facies characteristics of the Micoene rocks exposed in Gebel Geneffa area . A sufficient number of thin sections representing rock sequence were prepared and examined with the petrographic microscope . Moreover , light and heavy minerals were separated from the 0.125 - 0.063 mm fractions by bromoform and counted under the microscope .

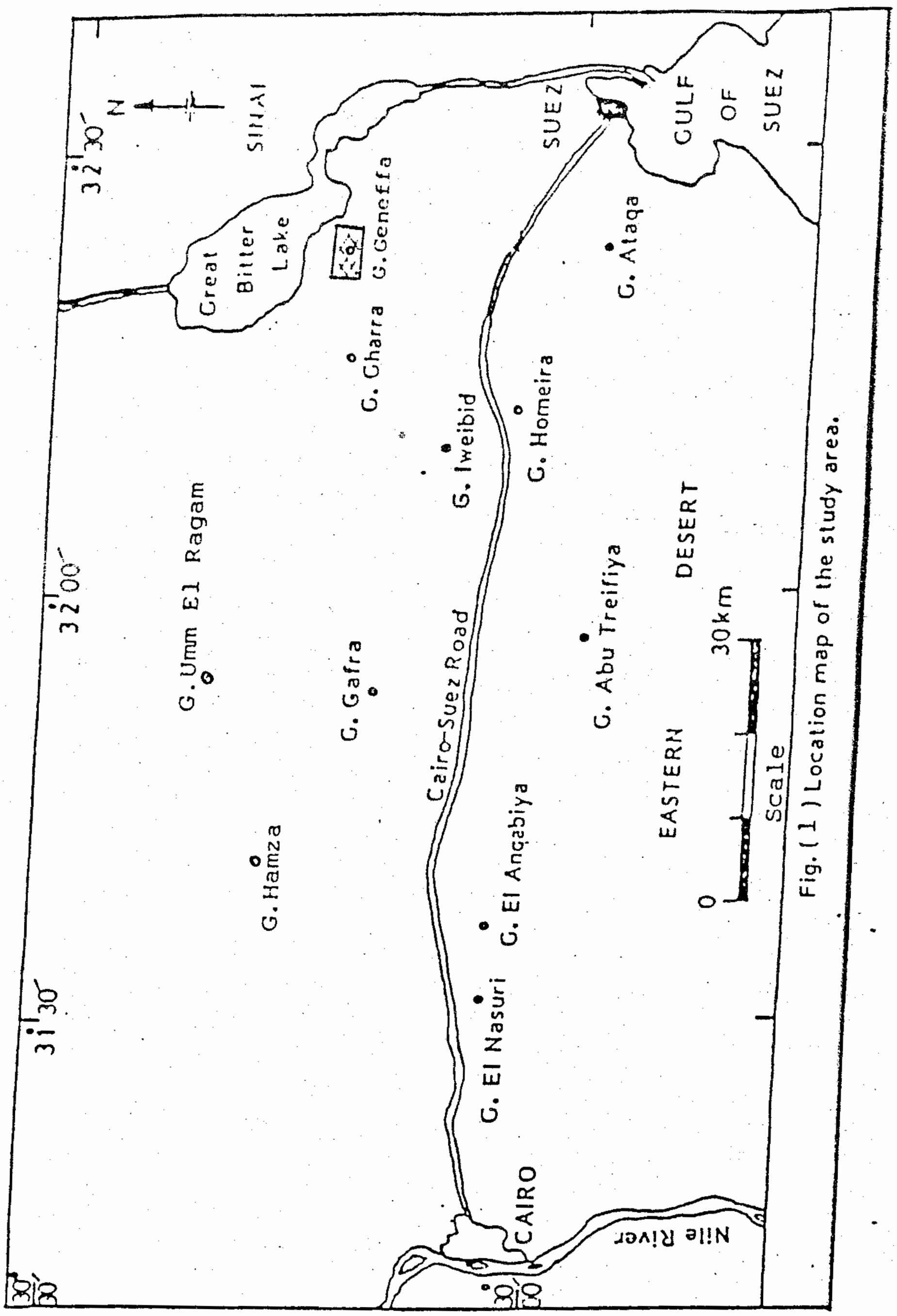

Fig. (1) Location map of the study area.

LITHOSTRATIGRAPHY

The sedimentary sequence exposed in Gebel Geneffa (Fig . 2) comprises the Oligocene (Gebel Ahmar Formatin of Shukri , 1954) overlain by the Miocene section . The exposed part of the Oligocene sequence consistsof vary colourd sandstones and gravels. the Miocene section is made up of two distinct rock units . The lowere rock unit (59 meters) unconformably intercalations of sandstone , mudstone and sandy limestone . This rock unit is fossiliferous and contains *Seutella sp.* , *Mioqypina sp.* and some tests of pelecypods and gastropods .

The second unit (77 meters) uncoformably overlies the lower one . The basal part of this unit is formed of chalky limestone highly fossiliferous and overlain by a biohermal limestone which contains calcareous algae and some foraminiferal tests . The upper part of this rockunit is made up of shales intercalated with sandstone .

The age assignment presented here is based on the previous studies . The lower unit is comparable with the Sadat Formation (Burdigalian age of Early Miocene) . The lithostratigraphic characteristics of the second rock unit is correlatable with the Hommath Formation of Al Ahwani (1977) which is considered as Middle Miocene .

PETROGRAPHY

The petrographic characteristics of the Miocene sediments in Gebel Geneffa are investigated through examination of thirty nine thin sectins of the clastic and nonclastic sediments . The aim of this study is to get information concerning the textural and composition-

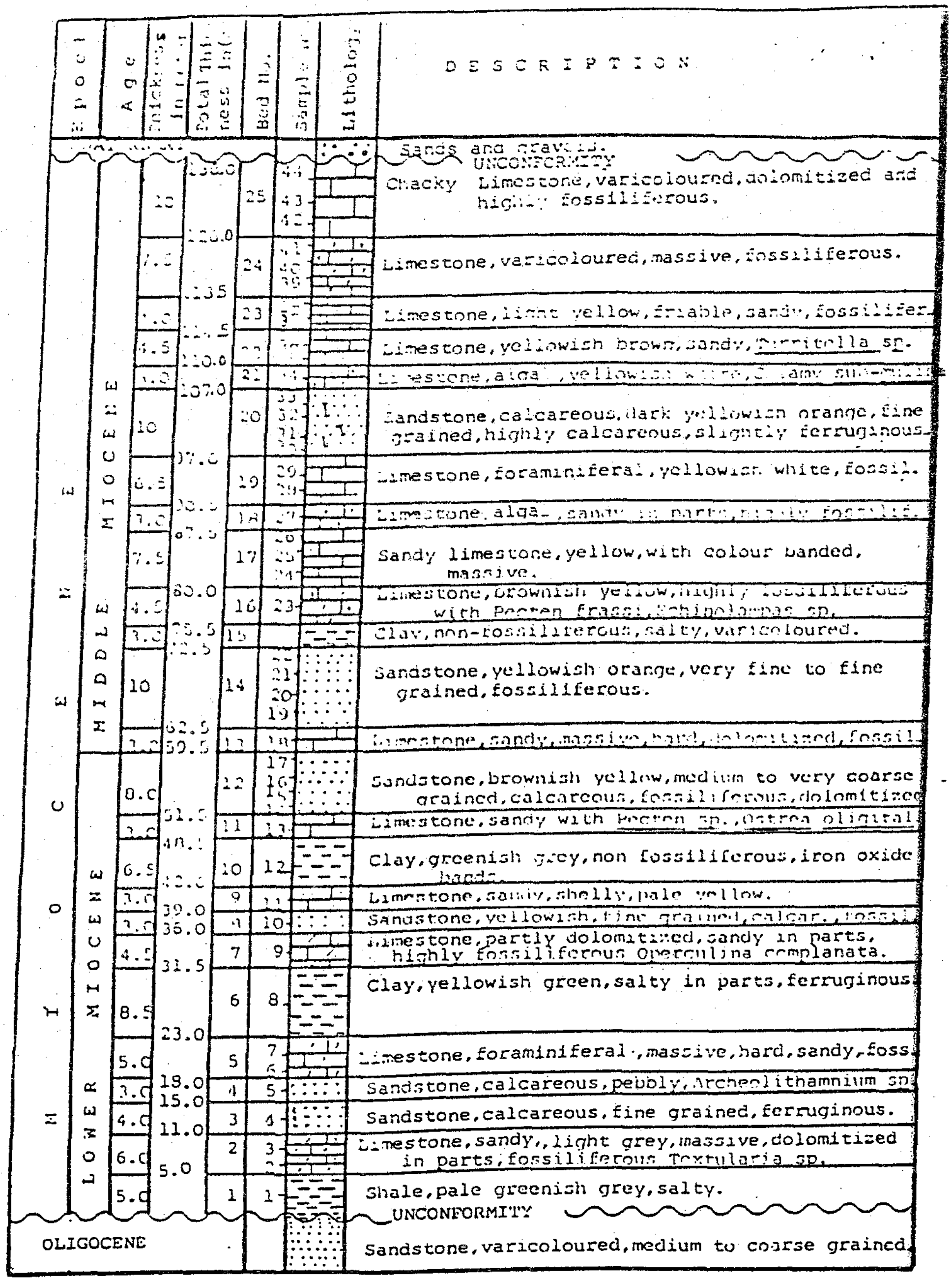

Fig.(2) The Stratigraphic Columnar Section of the Miocene Sequence in Gebel Geneffa .(Modifed after Aboul Ela,1968)

Fig. (2) The Stratigrphic columnar Section of the Miocene Sequence in Gebel Geneffa (Modifed after Aboul Ela, 1968) al aspects of these rocks, possible diagenetic features and the paleoenvironment .

A) The Petrography of the Clastic Rocks :

According to pettijohn et al . (1973) , the studied sandstones are petrographically classified as quartz arenites and quartz wackes .

1- Quartz arenite : (Sample Nos. 4,14,15,16 and 17)

This sandstone contains less than 15% matrix (mud) and more than 85% and may reach up to 95% or even more of quartz arenite .

This Petrographic class represents most sandstones in the Miocene rock units (Lower and Middle units), . the rocks are pale yellow to deep yellowish , calcareous, ferruginous and weakly fossiliferous with echinoid and molluscan shell fragment (Fig. 3) . Microscopically , the arenites are commonly composed of fine to medium sand grains . In the top of lower Miocene unit (samples Nos. 14,15,16 and 17), the sand grains are slightly of very coarse grade , poorly to moderately sorted and angular to subrounded . Roundness of grains increases slightly upwards in the sequence of Lower Miocene section , but it decreases in the same direction in the Middle Miocene sequence . In all the studied sampls , the effect of corrosion of quartz grains by carbonate cements is evident on their roundess . The sand grains , as well , are dominantly monocrystalline with uniform extinction (Fig . 4) although a few of coarser grains are polycrystalline . Some grains have overgrowths that are often replaced especially in the upper parts of the lower Miocene and Middle Miocene sequence . Grains coated with iron oxides are frequnetly recorded throughout the sequence especially at the top of Lower Miocene rock unit (sample Nos. 3 & 15) and the middle part of the Middle Miocene rock unit (Fig . 5) . Feldspars are generally rare and represented by microcline . Glauconite is frequently recorded and is concentrated mainly in the Upper part of the Lower Miocene unit and at the base of the overlying layers of the Middle Miocene rock unit . Glauconite gains are yellowish green with irregular outlines . Most of the grains are cracked , partly coated with reddish brown iron oxides .

Cement in quartz arenites is commonly carbonates and in a few cases iron oxide or silica . Carbonate cement is partly dolomitized in the lower and upper parts of the Lower Miocene unit and in the middle and upper parts of the Middle Miocene rock unit . In many samples , the carbonate cement (Fig . 6) partially corrods detrital quartz and feldspar grains at their peripheries . Silica cements are present as veinalets of filling pare cavities (Fig. 7) .

2) Quartz Wacke :

This type of sandstone is characterized by the presence of more than 15% argillaceous matrix and represents a transitional group between arenites and mud rocks .

It is present in the lower part of the Lower Miocene rock unit and in the lower and middle parts of Middle Miocene. Quartz is the major constituent reaching up to 80% of the rock components, while clay martix reaching up to 30%. Microscopically, the quartz wackes are composed mainly of quartz grains ranging between very fine to coarse. The grains are angular to subrounded and poorly to moderately sorted. The grains are characterized by an undulose extinction. Inclusions of opaques, tourmaline and zircon are recorded.

Feldspars are minor and represented essentially by microcline and plagioclases. Glauconite is rather common in quartz wackes of the lower part of the Middle Miocene unit.

B- Petrography of the Carbonate rocks in the Lower and Middle Miocene rock units:

The microfcies associations of the carbonate in the Lower and Middle Miocene rock units were studied according to the classifications of Folk (1962) and Dunham (1962).

1-Microfacies associations in Lower Miocene rock unit:

The microfacies investigation of these rocks revealed the presence of three associations:

a- Sandy Micrite Microfacies. (Sample No. 2 and Fig. 8)

This microfacies formed of detrital quartz grains scattered in a matrix consists of lime-mud and microcrystalline calcite. It is characterized by its rarity of fossils (echinoid and foraminiferal tests). The detrital sand grains are composed of fine to midum quartz sand grains, poorly to moderately sorted and angular to subrounded. Ferruginous clusters and glauconitic grains are rarely recorded.

The main constituents of sandy micrite microfacies are:

Foraminiferal tests	Echinoid fragmenst	Micrite	Sparite	Tirrigenous Materials	Iron oxide	Glauconite
3.1%	1.9%	48.3%	17.6%	21.4%	4.8%	2.9%

From above and in correlation with the microfacies types of wilson (1975)., This microfacies deposited in wshallow water with open circulation or Just below wave base.

b-Sandy Biosparite Microfacies:(Sample No.5 and Fig.9)

This microfacies is recorded in the middle and upper parts of Lower Miocene unit. It is characterized by its relatively high sand content. The matrix consists of sparry calcite, partially dolomitized in upper part. It characterized by richness of fossils (molluscan shell fragments, algae and echinoid fragments). Some of these fossil fragments are filled with either sparry calcite or dark brown ferruginous material (Fig. 9). Sand grains are fine quartz grains, poorly to moderately sorted and angular to subangular. Glauconite is commonly recorded in the middle part of the Lower Miocene Unit.

The main constituents of sandy biosparite microfacies are:

Molluscan shell fragments	Algae	Echinoid Fragments	Sparite	Dolomite	Terrigenous Materials
2.8%	1.9%	1.4%	60.8%	4.6%	28.5%

Comparison of this facies with the standard microfacies types of wilson (1975) indicates the infuencee of aeolian and / or fluvial regime in the sedimentation of these rocks and the shallowness of the marine depositonal environment.

C) Foraminiferal Algal Biospoarite: (Sample No.11 and Fig. 10)

This microfacies is composed of alfgal fragments and foraminiferal tests embedded in sparry calcite cement changed in some parts to micrite. The foramineferal tests are commonly filled with either ferruginous micrite or sparry calcite. Sandy grains represent very small fraction and are composed of fine to mdeium quartz sand grains with angular to subangular edges.

The main constituents of the foramineferal algal biosparite microfacies are:

Foraminiferal tests	Algae	Micrite	Dolomite	Sparite	Terrigenous Materials
10.8%	12.6%	6.10%	7.9%	60.20%	2.4%

This type of associationd indicates deposition in a shallow marine environment of platform margin, (Wilson 1975).

2) Microfacies Associations in Middle Miocene Rock Unit :

The Carbonate rocks in this unit rpresent limestone with a few sandy limestone intercalations. The microfacies analysis of these limestones revealed the presence of three facies.

1) Biocrite: (Sample Nos. 18,37 and 38).

This microfacies represents the chalky limestone. It also contains foraminferal tests, algal and molluscan fragments embedded in micritic matrix and include some patches of sparry calcite crystals.

The main constituents of the biomicrite microfacies are:

Foraminiferal tests	Algal fragments	Molluscan fragments	Micrite	Sparite	Terrigenous Materials
12.1%	10.9%	10.3%	51.3%	14.2%	1.2%

According to Wilson (1975), This microfacies was possibly deposited in a platfom margin.

2- Sandy Biosparite: (Sample Nos., 25 26 and Fig. 11)

This microfacies type is identified in the limestone layers encountered in the uppper part of the Middle Miocene rock unit. It is characterized by the presence of some algal fragements, foraminiferal tests embedded in sparray calcite cement. The foraminiferal tests are commonly recrystallized and filled with sparry calcite cement, while some of algal fragments are partially coated by redddish brown ferruginous material. The sand grains are composed of fine to medium grade, poorly sorted and angular to subangular quartz grains.

The main costituents of the sandy biosparite microfacies are:

Foraminiferal tests	Algal fragments	Sparite	Micrite	Terrigenous Materials	Iron oxide
3.7%	4.2%	59.4%	6.2%	24.7%	1.8%

This facies indicates deposition in the foreslope under mormal wave base (Wilson, 1975). The lack of sorting of the quartz grains indicates rapid deposition.

3- Sandy Biomicrite: (Sample No. 27 and Fig. 12).

This facies is characterized by the presence of quartz sands and the dominance of micrite as a carbonate matrix. Foaminiferal tests and algal fragments are embedded in a ferruginous micrite. The sands are composed of fine to medium, poorly sorted and subangular to subrounded quartz grains.

The main constituents of the sandy biomicrite microfacies are:

Foraminiferal tests	Algal fragments	Micrite	Sparite	Terrigenous Materials	Iron oxide
9.4%	10.3%	52.4%	5.3%	20.4%	2.2%

This afcies is redorded in the lower part of the Middle Miocene rock unit. It indicates deposition in an open platform shallow marine environment (wilson 1975).

MINERALOGY OF CLASTIC ROCKS

The mineral compositeion of the clastic rocks was carried out to distinguish the mineral characteristics of sediments in the various rock units, to determine the Prouenance of sediments and evaluate their sedimentary history. 12 Miocene rock samples were analyzed according to Doeglas (1940) technique. The heavy and lighy fractions were mounted on slides in Canada Balsam for identification. More than 500 heavy mineral grains were counted according to Chayes stystem (1956) from random fields in each slide , and the relative frequencies of the different minerals were calcualted (Table 1).

1- Minerals of the Light Fraction:

The light fraction of the studiedsamples consists mainly of quartz which mostly forms 90.4% and 95.7% of the light fraction. In the Lower Miocene Unit, the quartz grains increase in the grain roundness upwards in the sequence and are partially coated with iron oxied. Traces of feldspar minerals in almost samples are re

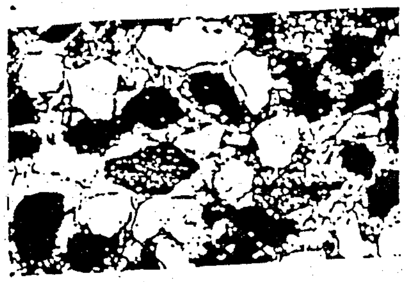

Fig.(3)

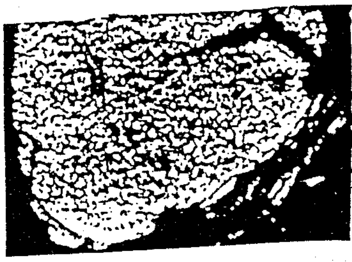

Fig.(4)

Fig.(5)

Fig.(6)

Fig.(7)

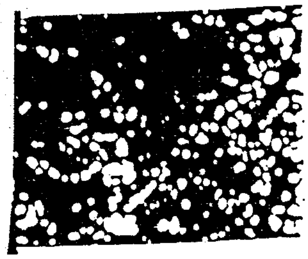

Fig.(8)

Fig. (3) photomicrograph showing quartx arenite, Quartz arenite, Quartx grains arc fine to meium grained, subangular to subrounded. Sample No. 16. C.N. X.40

Fig.(4) photomicrograph showing a moderately rounded monocrystalline quartx grain and showing an eroded overgrowth indicate of recycling of sedimentation. sample No.4. C.N. X.40.

Fig. (5) photomicrograph showing the iron oxide cement in quartz arenite. Sample No. 17. P.P.1. X. 40.

Fig. (6) photomicrograph showing carbonate sparry calcite cement in quartz arenite and the effect of etching of quartx grains by carbonate cement. Sample No. 32. C.N. x.40.

Fig. (7) photomicrograph showing silica cement which is present as veinlets or filling small cavities. Sample No. 21. C.N. x.40

Fig. (8) photomicrograph showing sandy mierite micrite cicrofacies, Lowermiocene rock unit, Sample No. 2.C.N. x.40.

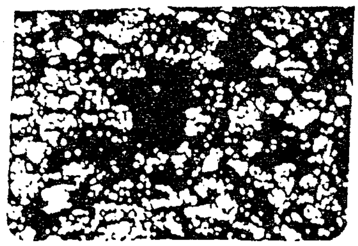

Fig. (9)

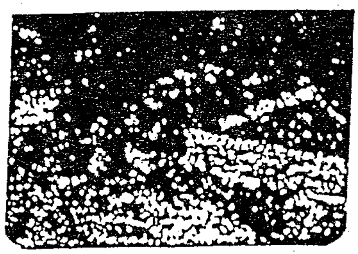

Fig. (10)

Fig. (11)

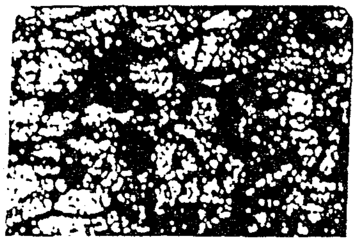

Fig (12)

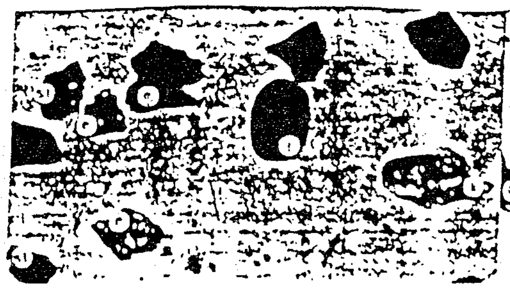

Fig. (13)

Fig. (14)

Fig. (9) photcmicrograph showing sandy biosparite microfacies, Lower Miocene rock unit, Sample No. 5.C.N.X.40 .

Fig. (10) photmicograph showing foraminiferal algal biosparite microfacies, Lower Miocene rock unit.

Fig. (11) photomicrograph showing sandy biosparite microfacies, Middle Miocene rock unit, sample No. 26. C.N. X. 40.

Fig. (12) photomicrograph showing sandy biomicrite microfacies, Middle Miocene rock unit, sample No 27, C.N. X.40.

Fig. (13) photomicrograph showing tourmaline (t) together with angglar grains of kyanite (k) and stauolite (st) in Lower Miocene rook unit. Sample No. 14. C.N. X.40.

Fig. (14) photomicrograph showing grains of hornblende (h), epidote (e) and garnet (g) in Lower Miocene rock unit. Sample No. 15, C.N. X.40 .

Table 1. Frequency distribution of the non- Opaque heavy minerals in the Miocene Sediments in the study area.

Rock unit	Sample No.	Average ZTR indez%	Zircona %	Rutile %	Tourmaline %	Epidotes %	Staurolite %	Kyanite %	Garnets %	Amphibole %
Middle Miocene	38	20.3	11.0	3.0	6.3	51.4	7.9	9.2	8.5	2.7
	35	22.4	10.8	10.2	1.4	45.3	8.3	7.4	13.8	2.8
	32	27.3	10.5	9.2	7.6	33.4	8.1	18.7	8.5	4.0
	30	30.5	9.8	7.8	12.9	29.1	6.5	7.9	7.8	18.2
	21	34.2	10.2	11.0	13.0	34.6	4.6	5.3	5.6	15.7
	19	23.7	0.8	10.4	12.5	46.3	6.8	3.4	6.4	13.4
	Average	26.4	8.95	8.6	8.59	40.02	7.03	8.65	8.43	9.47
Lower Miocene	17	30.0	12.0	5.0	13.0	39.6	2.7	5.6	4.6	17.5
	16	29.4	12.1	4.9	12.4	24.9	4.3	5.4	9.4	26.6
	14	37.3	14.5	8.6	14.2	25.1	10.4	5.7	4.8	16.7
	10	47.1	17.4	13.3	16.4	24.8	3.9	6.1	4.7	13.4
	5	50.1	17.2	11.3	21.6	25.1	4.1	5.4	4.6	10.7
	4	51.5	12.0	27.1	12.4	25.8	2.5	5.6	4.9	9.7
	Average	40.9	14.2	11.7	15.0	27.55	4.65	5.63	5.5	15.77

corded ranging between 3.3% to 8.7% Feldspars are rpresent-ed by potash feldspar (orthoclase and / or microcline).

In the Middle Miocene, the quartz grains range between 93.8% to 97.6%. The grains are mainly angular to subrounded and are commonly coated with iron oxides. Feldspars are commonly orthoclase with rare grains of microcline and plagioclase.

2- Minerals of the Heavy Fraction: (Figs. 13 and 14).

The opaque minerals identified in this work are mostly iron-oxides (magnetite, ilmenite, hematite, limonite, in addition to a group of undefferentiated opaques). The nonopaque minerals are zircon, ruitle, tourmaline, staurolite, epidotes, garnet, kyanite and amphibloes.

Opaque minerals constitute more than 68% of the heavy fractions of all samples.

Zircon: Zircon grains are recorded in all examined samples and is represented mostly by small prismatic grains. The mineral is present usually in colourless variety surrounded by dark rim. Zonation is observed in few grains but the non-zoned grains are the most abundant variety of zircon. In the Lower Miocene unit, it varied from 12.0% to 17.4% and decreases upwards in this rock unit. On the other hand, in the Middle Miocene unit zircon varies from 0.8% to 11% and its concentration shows a slight increase upwards in the succession.

Ruitle: Rutile is commonly represented in all examined samples as elongated pink to dark reddish brown varieties. It is present in the form of rounded, prismatic grains and contains opaque inclusions. In the Lower Miocene unit, the concentration of rutile is ranging from 4.9% to 27.1% . It shows a decrease upwardes in the sequence. In the Middle Miocene unit, the concentration of rutile ranges from 3.0% to 11% with no obvious variation throughout the rock unit.

Tourmaline: It is strongly pleochroic from bluish green to intense golden or brownish yellow. Inclusions were recorded in all these varieties of which gas bubbles are common and mostly oriented either parallel to the long axis of the crystal or parallel to the peripheries. The toumaline content in the Lower Miocene Unit is ranging from 12.4% to 21.6% while in the Middle Miocene rock unit, it is ranging from 1.4% to 13.0%. In both rock units. the average percentages show a gradual decrease upwards in the sequence.

Staurolite: Staurolite is recorded in all studied samples, and is represcented by a golden to molasse yellow, pleochroic variety thaty is mostly present as flaky grains. Some staurolite grains are platy or of irrgular shape and very rarly rounded. In Lower Miocene rock unit, the content of staurolite varies from 2.5% to 10.4% and shows no remarkable variation throughout the sequence. In the Middle Miocene unit, staurolite is ranging in content from 4.6% to 8.3% and their is a slight increase upward in the squence.

Epidotes: Epidote grains are colourless, green and elongated in shape. Inclusions are fornd in all identified grains. In the lower Miocene rock unit, the content of epidote varies from 24.8% to 39.6%. Its percentage shows a relative increase at the base and top of this rock unit. In the Middle Miocene rock unit, the concentration of epidotes range from 29.1% to 51.4% and their percentages show a slight increase in the upper part of its sequence.

Garnet: Garnet grains are mainly colourless in addition to few pale pink grains. The mineral grains are rounded to subrounded and contain opaque inclusions. The content of garnet in the Lower Miocene rock unit ranges from 4.6% to 9.4% with no remarkable variations throughout this rock unit. On the other hand, the concentration of garnet in the Middle Miocene rock unit ranges from 5.6% to 13.8% and shows a slight increase upwards in the sequence of the Miocene rock.

Kyanite: Kyanite is represented by long prismatic colouress grains, with pale blue and yellow, non-pleochroci rims, in addition to few rounded types. In Lower Miocene rock unit, the content of Kyanite is more or less consistent truoughout the rock unit (5.4% to 6.1%) while its content in the Middle Mocene unit ranges from 3.4% to 18.7% with a slight increase upwards in the sequence.

Amphiboles: The amaphiboles are represented by different varieties of pleochroic hornblende which have dark brownish green, light bluish green, dark brown and dark green colours. Some grains are angular and with gas inclusions. The content of amphiboles ranges in the Lower Miocene, unit from 9.7% to 2,6% while the Middle Miocene rock unit it ranges from 2.7% to 18.2% and shows a remarkable decrease upwards in its succession.

Maturity of Sandstone: In general, the studied Miocene sands and sandstones have a coniderable mineral maturity. This maturity is detrmined by 1) the dominance of stable quartz mineral in the light fraction (more than 90%) 2) The presence of the ultra-stable heavy minerals (zircon, toumaline and rutile) in higher proportions relative to those of the less stable minerals. 3) The predominance of monocrystalline quartz grains with uniform extinction (Blatt 1967).

Hubert (1962) reported that the maturity of the heavy mineral assemblage of a sandstone can be quantitively defined by a zircon tourmaline-rutile (ZTR) index. By calculation of ZTR index for the studied succession, it is found that sands of Lower Miocene unit have ZTR 40.9%. It is rmarkably more mature than the sand of the Middle Miocene unit of ZTR 26.4%

DIAGENESIS

The studied Lower and Middle Miocene clastic and non clastic sedimnts appear subjected to several diagenetic processes which resulted in remarkable changes in their original textrue and mineral characteristics.

1- Diagenesis of the clastic sediments:

Clastic sediments in the studied area were affected by compaction, cementation, replacement and solution:

a- Compaction: The clastic sediments were affected by compaction due to burial which is evident by fracturing of some quartz grains (Fig. 3).

b- Iron oxide cementation: Cementation with iron oxides (mainly hematite) is relatively more noticeable in the stuedied clastic sediment. It is revealed by predominance of dark red and brown colouration. Walker (1967) emphasized that most of the diagenetic hematite in clastic rock owes its origin to in-place alteration of iron rich mineral in hot, dry region (Fig. 4,5, 6 & 7).

c- Carbonate cement is presented as equigranular crystals forming a groundmass in which sand grains appear to be floating.This type of cement was possibly the product of chemical precipitaion and filling from groundwater saturated with bicarbonates (Blatt 1980). Carbonat cement appeared as corrosion and replacement of deterital grains (Figs, 9 & 11).

d- Silica cement is present in the form of microcrystalline crystals filling voids of as overgrowth on detrital quartz grains. Some quartz grains show eroded overgrowth which indicates their derivation from older sedimentary rocks (Tucker, 1983). (Fig. 7) e- Replacement and dolomitization: Carbonate cement in sandstone occasionally corrodes the detrital quartz grains at their margins. It is believed that this corrosion process was the result of mobilization of calcite cements. Dolomitization of the calcitic matrix is a rather common replacement process in the calcareous sandstone.

2- Diagensis of the Non-clastic Sediments:

The petrographic study of the Miocene limestone reflects the effect of several diagenetic processes. The most important of these processes are compaction, cementation, recrystallization and solution (Fig. 9, 10, 11 and12).

a- Compaction and Cementation:

Compaction resulted in the reorientation of elongate shell fragments to become more or less paralles to the bedding planes (Figs. 9, 10& 12).

Calcite is the most common cementing material. It is most probably that the sparitic calcite cement was precipitated from intrastratal solutions rich in bicarbonates. Micritic carbonate cements are relatively rare and are observed in limestone of lower and middle parts of Lower Miocene rock unit and in the middle part od Middle Miocene rock unit. Bathurst (1971) emphasized that secretion of lime mud by algae is one of the most important lithification processes in shallow water environment.

b-Recrystallization and Dolomitization

The matrix and allochems in the limestones of the upper parts of both Lower and Middle Miocene rock units show evidence of re-crystsllization both aggrading (sparitization) and degrading (micritization). Calcitization of the originally aragonitic skeletal grains is a rather common process in the studied limestones. It involves the solution of aragonite grains and the partial or complete filling of their molds with sparry calcite at a later diagenetic stage.

Dolomitiztion is a common diagentic process in the Middle Miocene limestone. It affecte both the rock matrix and allochems.

ENVIRONMENT OF DEPOSITION

The litho-and biofacies characters of the Miocene clastic and non clastic sediments suggest deposition under predominantly shallow marine conditions that were occasionally slightly influenced by aeolian / or fouvial regimes (Reineck and Singh 1980). On hte other hand, the litho- and biofacies characters of the Miocene limestone resemble those described by Wilson (1975) for platform and platform margin environments. This implies that deposition of Lower Miocene sand was followed by progressive transgression of the sea that was occasionally interrupted by minor regression esepecially at the boundaries between Lower and Middle Miocene rock units.

The intercalations of sandstone, mudstone and sandy limestone which form the basal and upper parts of the Lower Miocene rock unit probalbly represent platform deposits that were laid down under conditions of open circulation at or just below the wave base. The facies characteristics of the limstone interbeds of the Lower Miocene rock unit indicate occasional minor influences of aeoline or fluvial regime. Sediments in the middle part of this rock unit were deposited under slightly deeper marine conditions that prevalied as a result of minor transgression of the sea.

In the Middle Miocene, these rocks deposited under slightly deeper marine conditions than those of the Lower Mocene rock unit. The limestones are purer and contain relatively higher proportions of clay and lower concentrations of sand. The litho- and biofacies characteristics of these limestone indicate that they represnt platform margin and reef flank deposits. However, the shales that intercalate with sandstones which form the rest of the Middle Miocene rock unit were laid down probably under slightly shallower conditions.

CONCLUSIONS

1-The sedimentary sequence exposed in Gebel Geneffa comprised the upper part of the Oligocene section (Gebel Ahmar Formation) overlain by the Miocene sequence . The Miocene rocks are subdivided into two time units (136 meters thickness), a lower unit of sandy facies and belong to the Lower Miocene age and an upper unit of carboante facies of Middle Miocene age.

2- The Petrographic characteristics of the rocks were studied through the examination of thin sections of the clastic and non clastic sediments and concluded that:

a- Sandstones in the studied sequence are quartz arenite. Qrartz wackes are rarely encountered in the lower part of the Lower Miocene rock unit and in the lower and middle parts of Middle Miocene rock unit.

b- The Miocene arenites are commonly composed of fine to medium sand-sized, poorly to moderately sorted and angular to sdubrounded quartz grains. These grains are often monocrystalline and have uniform extinction. Some quartz grains have overgrowths which are occasionally eroded especially in the upper parts of both Lower and Middle Miocene rock units. Feldspars are rare and are represented by orthoclase and microcline.

c- Cements in the Miocene arenites are commonly carbonates, partly dolomitized in the lower and upper parts of Lower Miocene rock unit and in the middle and upper parts of the Middle Miocene rock unit. In a few cases, iron oxides and silica are present as cements.

d- Fossils in the Miocene are nites are rare and include molluscan, algae and foraminiferal tests.

3- Detailed quantitative mineral studies have been carried out on the Miocene arenaceous sediments. These studies comprised the separation and microscopic examination of the light and heavy mineral components of the Miocene sandstone.

a- The light fractions of the Miocene sands consist of quartz (> 90%) and minor feldspars. Quartz grains are mainly angular to subrounded, monocrystalline with mainly angular to subrounded, monocrystalline with uniform extinction.

b-The heavy minerals recorded in the Miocene sands contain of opaques, zircon, tourmaline, rutile Kyanite, garnets and amphiboles. Comparison between sands of Lower and Middle Miocene rock units reveals that the Lower Miocene rock unit contain higher concentrations of opaques, zircon, tourmaline and rutile and lower proportions of staurolite, Kyanite and amphibloes.

4- The microfacies analysis of the carbonate rocks in the lower Miocene rock unit rvealed the presence of sandy micrite, sandy biosparite and foraminiferal algal biosparite microfacies associations which are coparable with the standard types 7,8 and 9 of Wilson (1975) for deposition under conditions of open circulation in a shallow-water environment at or just below the wave zone.

5- The microfacies types in the Middle Miocene unit are biomicrite, sandy biosparite and sandy biomicrite. These microfacies types are comparable with the standard types 4 and 5 of Wilson (1975) are typical of reef flank facies and / or slightly deeper shelf margin.

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بتروجرافية ومعدنية صخور الميوسين فى منطقة جبل جنيفه - شمال غرب السويس - مصر

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تهدف هذه الدراسة الى التعرف على الخصائص السحنية والتاريخ الترسيبى والعمليات اللاحقة لترسيب التتابع السطحى بمنطقة جبل جنيفه. ويشتمل هذا التتابع على جزء يمثل صخور الاوليجوسين والمكون من الرمال ويتبع (متكون الجبل الأحمر) والذى يعلوه وحدتين صخريتين تابعتين لعصر الميوسين المبكر الأوسط بسمك نقداره ١٣٦ متراً. وقد تم قياس هذا القطاع الاستراجرافى وتم جمع ٣٩ عينة صخرية. وقد تم إجراء مجموعة من الدراسات على هذه العينات تشمل دراسة الخصائص البتروجرافية والمعدنية لهذه الصخور من خلال فحص الشرائح الصخرية وكذلك دراسة مكوناتها من المعادن الخفيفة والثقيلة.

وتشير نتائج الدراسة الى أن صخور عصر الميوسين المبكر قد ترسب فى ظروف بحرية ضحلة تخللتها بعض التقهقرات المتقطعة والبسيطة للبحر مما غلب عليها بسحنتها الرميلة. بينما صخور عصر الميوسين الأوسط قد ترسبت فى بيئة أكثر عمقاً مما غلب عليها السحنة الكلسية. .

وبدراسة العمليات اللاحقة للترسيب وجد أنها قد لعبت دوراً هاماً فى تغير الخصائص النسيجية والمعدنية والكيميائية لهذه الصخور وأن هذه العمليات اشتملت على الإنضغاط وترسيب المواد اللاحقة والإحلال وإعادة التبلور والذوبان.