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MICROFACIES ANALYSIS OF THE MIDDLE EOCENE SEDIMENTS IN SOUTH EL-FAYOUM DEPRESSION, WESTERN, DESERT, EGYPT.

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ABSTRACT

Microfacies study of four Middle Eocene outcrops at Gabal El-Qalamun, G.Mungar El-Shinnara, G. Sath El-Hadid and G.Elwe El Breg, south El- Fayoum Province, has resulted in the recognition of 17 micofacies association.

Analysis of the microfacies characters suggest that the base of studied succession El-Midawarah Formation (Middle Lutetian) was deposited in the lower to upper shelf and continental shelf edge to outer shelf in environment. Then Sath El-Hadid Formation (Late Lutetian) are deposited under lower and upper shelf to outer shelf environment. The El-Gharaq Formation, which represented the sommet of succession (Terminal Late Lutetian), depositional environment as Bank margin.

INTRODUCTION

In the south El-Fayoum four surface section were measured from, G.El Qalamun, G.Mungar El-shinnara, Gssath El-Hadid and G.Elwe El-Breg,(Fig.1) to Study in detail the microfacies of the Middle Eocene sediments, in this area to obtain the depositionol environment.

The Middle Eocene (Lutetian rock units. El-Midawarh Formation (Terminal Late Lutetian) and El-Gharaq Formation (Terminal Late Lutetian) cover an extensive area in the south El-Fayoum and also south wadi El-Rayan. Their are detailed thin sections study of about 315 samples from the measured section, has shown that the Middle Eocene sediments are fairly rich in various organisms, and accordingly to several microfacies associations. This resulted in recognition of 17 association of Microfacies.

The stratigraphic study of the three Formation are discussed in detail in separated note by Shamah et al. (sous press).

The Microfacies studies carried out in this work aim to emphasize and demonstrate the different types of lithofacies in each lithostratigraphic unit, based on the type and amount of skeletal and nonskeletal particles, texture and the cementing material.

The classification of limestone texture used in the present study is that of Folk 1962 and Dunham (1962).

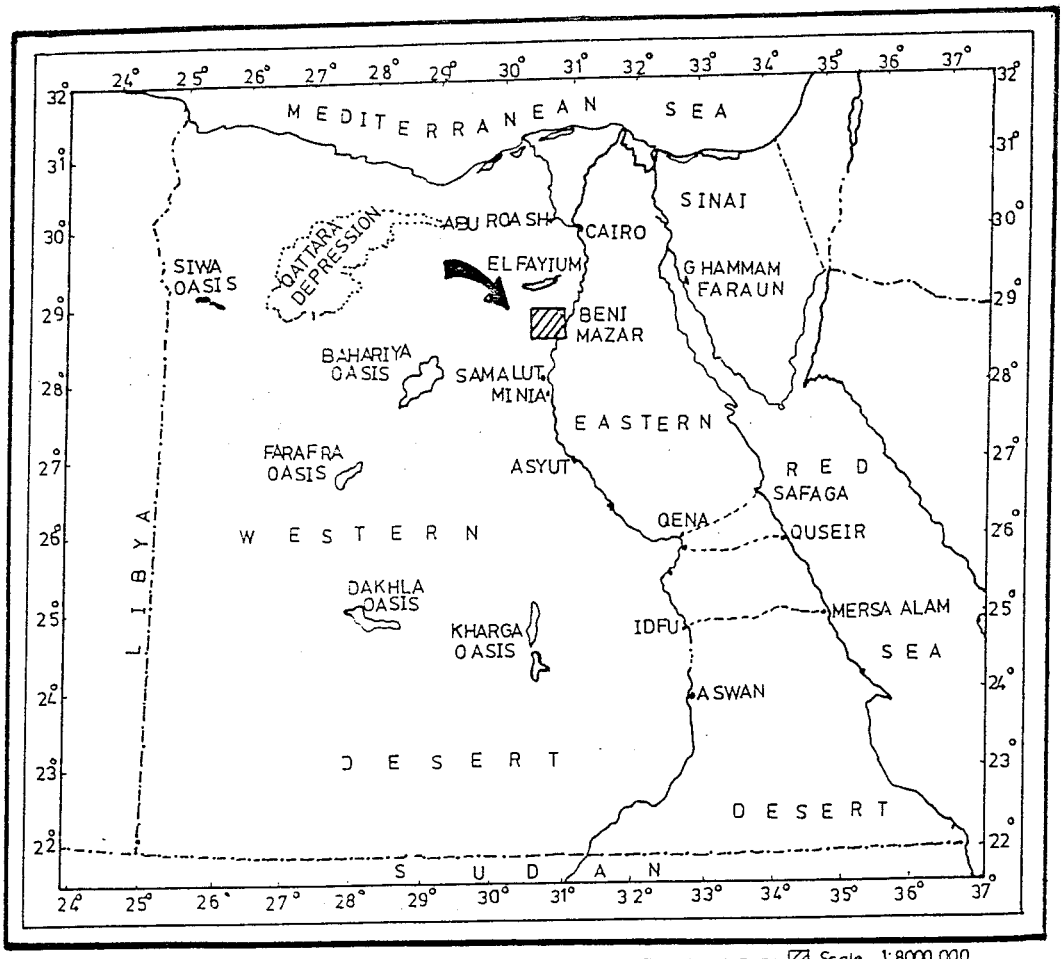

FIG. (1) LOCATION MAP OF THE STUDIED AREA Scale 1:8000,000

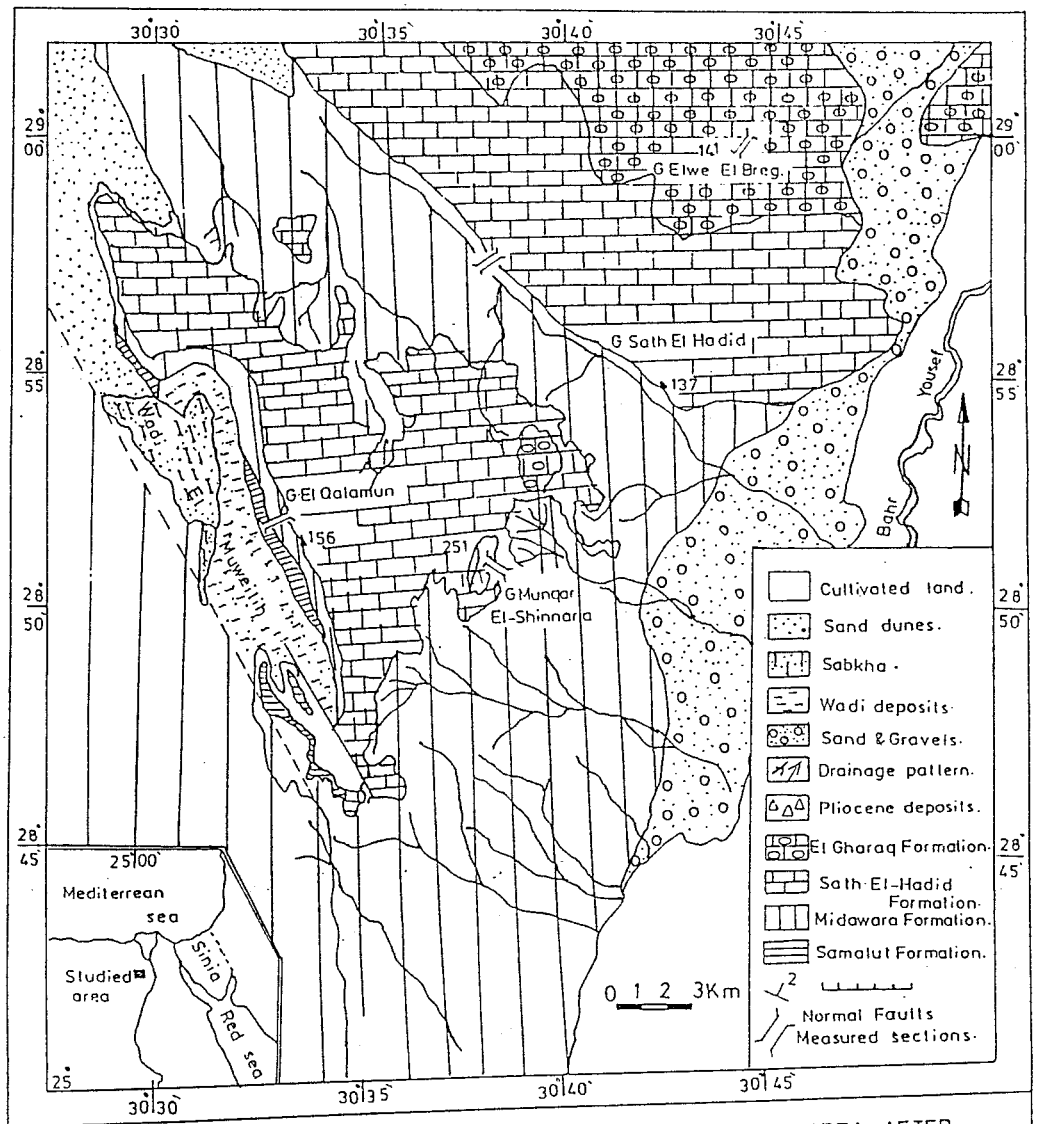

Fig (2) LOCATION AND GEOLOGICAL MAP OF SOUTH EL FAYOUM AREA AFTER GEOLOGICAL SURVEY (1981), WITH MODIFICATIONS .

The carbonate components include particles and matrix. Particles were designed by earlier workers as "Organic and inorganic components. Illing (1954) changed the above terms and proposed the terms "skeletal and nonskeletal" particles to replace the term "Organic and in organic component respectively.

Skeletal particles are dervied from organisms, the complete particles are mostly of forminifera, bryozoa, ostracoda, while the fragmented particles, added to the echinoderms, mollusca and corals. The skeletal remains derived from the above organisms are used in the present study as bioclasts.

In this work, non skeletal particles are mainly intraclasts. Ecological and depositional condition prevailing during the deposition of these sediments has been attepted on the basis of their Microfacies characters.

The distribution and the abundance of the different microfacies associations represented as approximate percentage with respect to the thickness of the corresponding rocl units are tabulated in table No. 1

CARBONATE MICROFACIES :

Carbonate lithofacies are mostly of limestones and dolostones. Thses lithofacies are described in the following:

1- DOLOSTONE MICROFACIES:-

- Siliceous bryozoan dolostone (SiBrD)

Table (1): Show the distribution of different Microfacies throughout the rock units.

Microfacies and symbols / Formations	Wackestone Microfacies								Packstone Microfacies						Grainstone Microfacies		Dolostone Microfacies
	STbW	SFW	NEBrW	NW	SNMW	NDiW	SNW	SNEW	bP	NbP	BrNP	SbP	SgNP	SNbP	NbG	bG	SiBrD
El-Gharaq				*		*			*	*	*				*	*	
Sath El-Hadid		*	*	*	*					*		*					
Midawara	*	*		*	*		*	*	*	*			*	*			

Si : Siliceous
Br : Bryzoa
D : Dolomite
I : Intraclasts
b : Bioclasts

F : Foraminifera
N : Nummulites
S : Sandy
M : Mollusca
Di : Discocyclina

P : Packstone
g : Glauconite
G : Grainstone
E : Echinoids
W: Wackstone

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2-LIMESTONE MICROFACIES:-

A)Wackestone Microfacies:-

- Sandy intraclastic bioclastic wackestone (SIbW).
- Sandy foraminiferal wackestone (SFW).
- Nummulitic echinoidal bryozoan wackestone (NEBrW).
- Sandy wachestone (NW).
- Sandy nummulitic molluscan wackestone (SNMW).
- Nummulitic discocycline wackestone (NDiW).
- Sandy nummulitic waskestone (SNW).
- Sandy nummulitic echinoidal wackestone (SNEW).

B) Packstone Microfacies:-

- Bioclastic packstone (bp).
- Nummulitic bioclastic packstone (NbP).
- Bryozoan nummulitic packstone (BrNP).
- Sandy bioclastic packstone (SbP).
- Sandy nummulitic bioclastic wackestone (SNbP).

C) Grainstone Microfacies :-

- Nummulitic bioclastic grainstone (NbG).
- Bioclastic grainstone (bG).

The distribution of these Microfacies throughout the different rock units are showed in Table (3).

1- DOLOSTONE Microfacies:

Siliceous bryozoan dolostone (SiBrD)(pl. 1, fig. 1):

Siliceous bryozoan dolostone lithofacies occurs only in one bed at the top of Sath El-Hadid Formation at El-Qalamun section, sample No.

This microfacies occurs as lenticular beds embedded within the now white limestone.

The bed is reddish brown to pale brown in colour, fine grained, hard, silicified with some chert noduls. Some small sized *Nummulites sp.* can also be present in this lithofacies.

In thin section the rock is made up of dolomite rhombs (65%), with some skeletal particles (15%) and bioclasts (13%). Dolomite rhombs have fine sand-sized (0.05-0.1 mm)
Most of the rhombs are ideotopic in fabric and inequigranular in texture. They occur in lime mud, in echinoid and in the zooecia of bryozoa. Most of the dolomite rhombs are unzonned, few rhombs show dark core of iron oxide with clear outer rim.

The skeletal particles are represented by *Bryozoa* sp. and *Nummulites sp.* Bryozoa have medium to coarse sand-sized (0.3-1.0 mm), in which the zooecia are rounded to elongated and filled with dolomite rhombs. Nummulites are oblitrated, distorted and have radial and have radial fibrous structures, the fibrous is aligned at right angles with the wall test.

The Bioclasts are variable in size ranging from medium to very coarse sand-sized. Bioclasts are usually angular, elongated, rectangular in shape. They are derived from bryozoa, echinoids (spines, stems and osccles) and pelecypoda shell fragments.

Most sand grains are monocrystaline and wavey extinction.

2- LIMESTONE MICROFACIES:

A. Wackestone Microfacies:

Sandy intraclastic bioclastic wackestone (SIBW):(p1.1, fig.2)

Sandy intraclastic bioclastic wackestone is common at Gebal Sath El-Hadid. Section, sample No. it is recorded in the Lower, Middel and uppermost parts of the Midawara Formation attaining a thickness of about 1.8m, and 0.7m, respectively .

The rock is grey in colour , moderately hard to hard, fine grained, with gypsum veinlets.

The wackestone consists mostly of bioclasts, intraclasts, quartz and lime mud matrix . Bioclasts form about 30 % of the rock. They have fine sand-sized (0.1-0.2 mm) , and are drived from echinoid spines, osciles and stems and pelecypoda shell fragments. They are usually angular to subangular and randomly distributed in the lime mud.

Intraclasts are the only nonskeletal particles forming about 7 % of the rock. They are well rounded and are variable in size ranging from 0.4-0.6 mm. Most of them consists of dark grey to cloudy black lime mud enclosing some skeletal debris. Subrounded to subangular quartz grains are observed in the rock, forming about 15% of the rock. They have fine sand-sized and most of the grains are monocrystalline and give wavy extention.

Ostracods, benthenic and planktonic foraminifera are recorded with lesser amount. Subrounded glauconites are recorded forming about 3%.

The Lime mud matrix has undergone aggrading recrystallization into irregular patches of equigranular microspars.

Sandy foraminiferal wackestone (SFW) :(pl.1, Fig.3)

Sandy foraminiferal wackestone is common in the Midawara and Sath El-Hadid Formations. It is recorded in the middle parts of Sath El-Hadid Formation at Sath El-Hadid with average thickness of 7m. It occurs in the middle part of the Midawara Formation at Munqar El-Shinnara with thickness of 0.7m. Also, it occurs in the lower, middle and upper parts of the Midawara Formation at Sath El-Hadid with an average thickness of 8m. Moreover, it occurs in the lower part of the Midawara Formation at Elwe El-Breg below the sandy nummulitic echinoidal wackestone with average thickness of 9m. Rocks belonging to this lithofacies is usually marly to argillaceous, greyish in colour, compact, hard, saliferous and with gypsum veinlets.

The wackestone is fine-grained consisting mostly of skeletal particles, bioclasts, quartz and lime mud matrix. The skeletal particles form about 15% of the rock. Such particles include benthonic and planktonic foraminifera. Benthonic foraminifera form about 8% of the rock. They have fine sand-sized (0.1-0.2mm). Biserial forms are represented by *Textularia* sp., *Gumbline* sp. and planispiral form which may be *Anomalina* sp. Other species such as *Nonion acutidorsatum* and *Uvigerina* sp., can be recorded. Most of chambers contain some microsparite may be resulted from the aggrading neomorphism. The planktonic foraminifera form about 3% of the rock. Their chambers filled with microsparite. Nummulites are fragmented, highly oblitrated and distorted

indicating that they may be transported from other places. Angular to subangular quartz grains are less abundant forming about 11% of the rock. They have fine sand-sized and are monocrystalline and wavy extinction. Bioclasts are recorded with low percentage. They are derived from foraminifera, echinoid spine or stems and nummulites debris. The cement in this lithofacies is lime mud which is stained with yellow patches may be due to the association of clay matrix. Some evaporites can be recorded replacing the microspars as a result of diagenesis. Some parts of the lime mud matrix was changed to microspars by the aggrading neomorphism.

Nummulitic echinoidal bryozoan wackestone (NEBrW) :(p1.1, fig.5)

Nummulitic echinoidal bryozoan wackestone is more common in the Sath El-Hadid Formation, where, it constitutes the bulk of the Formation at El-Qalamun and Munqar El-Shinnara. This lithofacies decreases in thickness northeastwards being it measures 12.3m. and 10m. at El-Qalamun and munqar El-Shinnara, respectively. It wedges out farther northwards where, it is not recorded at Sath El-Hadid, and even in Elwe El-Breg.

The rock is snow white, massive, enriched with bryozoa and echinoids. Petrographically; the rock is made up of skeletal particles, bioclasts and micrite matrix. Skeletal particles account for about 20% of the rock. They involve bryozoa, nummulites and benthonic foraminifera. Their sizes range from medium to coarse sand-sized (0.11-1.2mm). Most of the particles are reworked and their chambers are filled with microspars. Bryozoa are represented by *Nellia tenella, Tremogastrina fourtaui* and *Vincularia davisi* in

which the zooecia are usually elongated or oval in shape and are filled with sparry calcite, others are filled with lime mud. The skeleton of bryozoa are usually micritized into fine dense dark grey lime mud.

Nummulitic wackestone (NW) :(pl.1, fig.6)

The minimum thickness of the nummulitic wackestone is recorded in the topmost part of the Midawara Formation at Munqar El-Shinnara (3m. thick.), and the lower part of Sath El-Hadid Formation at Elwe El-Breg (1.5m.), but its maximum thickness (7m. and 5.6m. thick.) is recorded at the basal part of El-Gharaq Formation at Munqar El-Shinnara and Sath El-Hadid, respectively.

The rock is greyish-yellow in colour, fossiliferous with small and medium-sized nummulites. This lithofacies consists mostly of skeletal particles, bioclasts and lime mud matrix. Nummulites are the ccommon skeletal particles forming about 20% of the rock. They have coarse to very coarse sand-sized (0.5-10.0mm.). The core of nummulites have been recrystallized to sparry calcite as a result of aggrading neomorphism, while the rest of the particles still consist of original fibrous calcite. Sometimes, some nummulites show micritization, where, some parts of them have been changed to dull dark grey apearance. Bioclasts are less abundant (10%), and have two modes of sizes. The finer mode ranges in size from fine to medium sand-sized. Most of them have been derived from nummulites, echinoid spines, stems and osciles. The coarser mode ranges from coarse to very coarse sand-sized, they differ in composition from the finer mode, because they were derived from pelecypods which are recrystallized into microspars. Some quartz

grains are recorded in the basal part of El-Gharaq Formation. The lime mud matrix is the binding material, some parts have been recystallized into microspars and sparry calcite due to the effect of aggrading neomorphism.

Sandy nummulitic molluscan wackestone (SMNW) :(p1.2, fig.7)

Sandy nummulitic molluscan wackestone is encountered in the basal part of the Sath El-Hadid Formation at El-Qalamun and Munqar El-Shinnara. The thickness of this lithofacies decreases from 8m. at SW to 3m. at NE. Also, it is recorded in the upper part of the Midawara Formation and shows decrease in thickness towards the northeast direct from 4m. at El-Qalamun to 3m. at Munqar El-Shinnara.

The rock is yellowish-brown in colour, fossiliferous with small nummulites, *Wackulina* sp., *Ostrea* sp., *Spondylus* sp., *Echinolampas* sp. and is burrowed with horizontal and oblique burrows.

The rocck is made up of skeletal particles, quartz, glauconites and lime mud matrix. Molluscs are the main particles type represented by pelecypoda and gastrpoda. They are variable in size (coarse sand to granule size), and are susceptible to aggrading neomorphism. Nummulites are less abundant forming about 9% of the rock, and are usually elongated and show a preferred orientation parallel to the bedding planes. Bryozoa represented by *Nellia tenella* and *Tremogastrina fourtaui* are recorded at Munqar El-Shinnara forming about 6% of the rock. They have coarse

granules range from 2-4mm. The zooecia of bryozoa are filled willed with quartz grains.

Bioclasts are derived mainly from pelecypoda forming about 8% of the rock. They are usually elongated or curvec ranging in length from 2.5 to 4.2mm. Most of the bioclast are micritized and are aligned in one direction. This may indicate the direction of current.

Fine quartz grains are less abundant forming about 7% of the rock. They scattered with random distribution in the rock. Most of the grains are monocrystalline and parallel extinction. Glauconites are rarely recorded with less than 3%. They show sharp contact with the cement indicating a detrital origin. The lime mud matrix is abundant throughout the rocck which consisits mostly of micrite.

Nummulitic discocycline wackestone (NDiW) :(p1.2, fig.8)

Nummulitic discocycline wackestone occurs in two beds in El-Gharaq Formation at Elwe El-Breg. The lower bed occurs in the basal part of the sequence attaining a thickness of 2.5m, while the other bed occurs in the middle part of the sequence with an average thickness of 2.5m.

The rock is pale grey in colour, compact, hard, fine grained, fossiliferous with discocyclines and nummulites.

The rock consists mostly of skeletal particcles, bioclasts and lime mud matrix. Skeletal particles form about 25% of the rock. They are represented by discocyclines, nummulites, operculines and

benthonic foraminifera. Discocyclines form about 16% of the rock and have 0.5-10.0mm. in length and 0.1-0.22mm. in width. They have preferred orientation parallel to the bedding planes. most of them have been micritized and their chamber are filled with microsparite. Nummulites from about 6% of the rock. They have fine to medium sand-sized (0.1-0.6mm). They have a radial fibrous structre aligned at right angle to the wall test. Other benthonic foraminifera such as operculines can also be recorded. Ostracods which recorded in the lower bed appear as complete form or fragmented valves.

Bioclasts is recorded with low percentages. They are mainly derived from discocycline, nummulites and benthonic foraminifera. Glauconites grains are rarely distributed forming about 2% of the rock. The binding material is lime mud matrix which consists mostly of micrite.

Sandy nummulitic wackestone (SNW) :(p1.2, fig.9)

Sandy nummulitic wackestone occurs only at the upper part of the Midawara Formation at El-Qalamun attaining a thickness of about 6.6m. The rock is greenish-yellow in colour due to the presence of glauconite grains. It is fossiliferous with nummulites, bryozoa and echinoids.

In thin section, the rocck is made up of skeletal particles, quartz, glauconite and lime mud matrix. Nummulites are the main skeletal particles forming of about 13% of the rock. They have medium sand-sized ranging from 0.2-0.4mm. They show usually

parallel orientation to the bedding plane,. Some benthonic and planktonic foraminifera are rarely recorded.

Rounded to subrounded fine grained quartz grains form of about 10% of the rock. Most of the grains are replaced by the calcite cement. The replacement is partial so that the outer periphery of the quartz grains are irrigular.

Glauconite grains are less abundant than quartz forming about 4% of the rock. The grains have fine sand-sized (0.1-0.2 mm.). The binding material is lime mud matrix which consists mainly of micrite.

Sandy nummlitic echinoidal wackestone (SNEW):(p1.1, fig.5)

Sandy nummulitic echinoidal wackestone is recorded in the middle parts of the Midawara Formation at both El-Qalamun and Elwe El-Breg. In the firest locality, the lithofacies is represented by one bed (2.1 m. thickness), while in the secone locality, the lithofacies is represented by two beds which ha an average thickness of 0.6 m.

The rocks are marly limestone, grey in colour, hard and crystalline. It is fossilierous with *Turretella* sp. and *nummulites* and is burrowed in its upper part.

In thin section, the wackestone consists of bioclasts, nummulites, quartz and lime mud matrix. Bioclasts are abundant forming about 20% of the rock. They have fine to medium sand-sized ranging from 0.1-0.3 mm. They are probably derived from echinoids, nummulites and mollusca.

The skeletal particles are less abundant than biocclasts forming about 10% of the rock. They are represented only by nummulites, which have medium to very coarse sandsized ranging from 0.3-1.9 mm. Most of particles are reworked, some of them are filled with micrite, while other show aggrading neomorphism.

Subround to subangular fine grained quartz form about 8% of the rock. Most of the grains are monocrystalline, wavy extincction and show sharp contact with the matrix.

The lime mud matrix is the binding material of this lithofacies. It has undergone aggrading recrystallization into micosparite in some parts of the rocks.

B) Packstone lithofacies :

Bioclastic packstone (bp):p1.2, figs,11,12)

Bioclastic packstone lithofacies is mor common in the Midawara Formation especially at Elwe El-Breg, where, it bulids up the upper two thirds of the Midawara Formation.

This lithofacies is interclated with claystone and has an average total thickness of about 7.3 m. Also, it is recorded at the Sath El-Hadid Formation and at the middle part of the El-Gharaq Formation at Elwe El-Breg attaining a thickness of about 4 m. and 2 m., respectively. The rock is usually, greyish-white in colour, fossiliferous with small-sized of nummulites and other shall debris.

The rock consists exclusively of bioclasts, rare skelal particles and lime mud matrix. Bioclasts are the fundemental allocheme forming about 70% of the rock. The size of bioclasts vary from area to another. In the Midawara Formation at Elwe El-

Breg, their sizes are fine sand-sized. While in the El-Gharaq formation at Elwe El-Breg, their are of medium sand-sized (0.2-0.5 mm). These bioclasts are most probably derived from nummulites, pelecypoda shell fragments and echinoid, spines and stems. The bioclasts are usually well sorted angular to subangular, rounded and are distributed with random variation in the rock.

The skeletal particles are rarely recorded(6%), they are heavily oblitrated, distorted and are represented by nummulites, benthonic and plankonic forminifera and bryozoa Fine to medium grained glauconite grains and quartz are observed in the El-Gharaq Formation forming about 5% of the rock. Most of the glauconite grains are subrounded to angular, cracked and show sharp contact with the matrix. This indicates that the glauconite grains are of detrital origin.

Medium sand-sized nonskeletal particles are recorded at Elwe El-Breg and are represented by intraclasts grains accounting for about 5% of the rock. They are rounded to subrounded and contains quartz grains and lime mud.

The bioclasts are cemented by micrite which has been changed by recrystallization into pseudospars and microspars. The recrystallization occurs in the fissures and cracks through which the micrite has been subjected to aggrading recrystallization.

Nummulitic bioclastic packstone (NbP) :(p1.3, fig.13)

This lithofacies is more common in El-Gharaq Formation, as it occurs in the form of four beds measuring a total thickness of 3.8m. at Munqar El-Shinnara. It also forms the upper part of this

formation at Sath El-Hadid with average thickness of 3m. Further northwest it wedges out, where, it is represented by one bed (2m.) at Elwe El-Breg. Such lithofacies is also encountered at the base and top of the Sath El-Hadid Formation at Gebel Sath El-Hadid and at the top of the Midawara Formation at Elwe El-Breg.

The rock is yellowish-grey in colour fossiliferous with different sizes of nummulites, echinoids, mollusca and crystalline.

Also, the rock consists mostly of bioclasts, skeletal particles, and lime mud matrix. Bioclastic are abundant accounting about 35% of the rock, especially in Sath El-Hadid Formation. They form the main bulk of the rock (40-60%) at El-Gharaq Formation. They have two modes of sizes, the first is fine sand-sized (0.05-0.15mm) while the second one is of coarse sand-sized (0.5-1.5mm). Both modes are derived from nummulites, discocyclines and echinoidal spines, stems and osciles and pelecypoda shells. They are subangular and moderately stored.

The skeletal particles which form about 20% of the rock are represented by nummulites, discocylina, ostracoda, and benthonic foraminifera. Nummulites are the main abundant particles. They have medium to very coarse sand-sized (0.5-2.0mm), and have radial fibrous structures. The fibrous are aligned at right angles with the wall test. The shell fossils have been subjected to aggrading neomorphism towards their center producing coarse sparry calcite, some chambers are filled with microspars. Discocyclines, ostracods and benthonic foraminifera are also rarely recorded in this lithofacies.

Some fine-grained glauconite and quartz grains have been recorded at Elwe El-Breg, while rounded to subrounded medium sand-sized intraclasts have been recognized at Gebel Sath El-Hadid. The lime mud matrix which form the binding material in this lithofacies have been undergone recrystallization into sparry calcite due to aggrading neomorphism. In some parts, the lime mud is stained with reddish colour.

Bryozoan nummulitic packstone (BrNP) :(p1.3, fig.14)

Bryozoan nummulitic packstone lithofacies is recorded in the middle part of El-Gharaq Formation at Munqar El-Shinnara attaining a thickness of about 1.5m. The rock is greyish-yellow in colour, fossiliferous with different sizes of nummulites and bryozoa.

In thin section, the rock is made up of bioclasts, skeletal particles and lime mud matrix. The skeletal particles which form about 40% of the rock framework, are represented by nummulites and bryozoa. The particles have very coars sand-sized to pebble sized (1.0-4.0mm). They are usually oblitrated, distorted and reworked. Most of the chambers are micritized, others are filled with sparry calcite. Bioclasts are less abundant than particles forming about 12% of the rock. They have two modes of size, the first mode is medium to coarse sand-sized (0.2-0.5mm), while the second one is very coarse sand-sized to pebble size (1.6-4.0mm). Both modes are derived from nummulites, bryozoa, molluscan debris and echinoidal spines, stems and osciles. They are usually rectangular, angular to subangular in shape. The molluscan bioclasts are usually replaced by sparry calcite while echinoids bioclasts have been micritized.

The lime and matrix which is the main binding material have been undergone recrystallization in some parts to sparry calcite due to aggrading neomophism.

Sandy bioclastic packstone (Sbp):(p1.3, fig.15)

Sandy bioclastic packstone Lithofacies constitutes the middle part of Sath El-Hadid Formation with average thickness of 5.4 m. at Gebel Sath El-Hadid. The rock is marl limestone, grey,Fine-grained, compact, massive with some chernodules.

The rock is made up of bioclasts skeletal particles, quartz and lime mud matrix. Bioclasts from about one third of the at Sath El-Hadid. They have very fine to fine sand-sized (0.05-0.15 mm), angular to subangular, and are derived from echinoids, however, some nummulites or miliolids debris are rarely scattered within the matrix.

Skeletal particles represented by benthonic and planktonic foraminifera are rerely observed (▪4%) of the rock.

Subangular to angular fine sand-sized quartz grains from about 10% of the rock. The majority of grains are monocrystalline, wavy extinction and show sharp contact with the matrix.

The lime mud matrix consists mostly of micrite and is stained with red iron oxides oxides, som parts have been undergone to microspars as a result of recrystallization.

Sandy glauconitic nummulitic packstone (SgNP):(p1.3, fig.16)

Sandy glauconitic nummulitic packstone is recorded only at the topmost part of the Midawara Formation at El-Qalamun. It attains a thickness of about 2.5 m. The rock is yellowish-green in colour due to the presence of glauconites. The rock is yellowish-green in colour, massive, hard and fossiliferous with small-sized nummulites.

Under microscope, the rock is made up of skeletal particles, bioclasts, glauconites, quartz grains and lime mud matrix. Skeletal particles are relatively abundant forming about 23% of the rock. Nummulites are the most common particles type. They have coarse to very coarse sand-sized ranging from 1.0-2.0 mm. They are distributed with random orientation in the lime mud. Some particles show complete forms, while others are oblitrated and fragmented. Benthonic foraminifera represented by *Nonion acutedorsata* and *cibicides* sp. can also be recorded.

Bioclasts derived from nummulites and echinoids are less abundant forming about 11% of the rock. Their sized vary from coarse to fine sand-sized, nummulite bioclasts have usually angular and rectangular shape.

Fine to medium sand-sized glauconite grains are concentrated in this lithofacies forming about 20% of the rock.

Most of the glauconites replaced the quartz grains, shell fragments and nummlites. The presence of relics of quartz and shall fragment within within the glauconites indicate that the glauconites are of anthigenic origin.

Subangular to angular fine-grained quartz grains are also abundant accounting about 15% of the rock. Most of these grains are monocrystalline and show partial replacement by glauconites on their borders. The lime mud matrix consists of micrite.

Sandy nummlitic bioclastic packstone (SNbP):(p1.2, fig.10)

Sandy nummlitic bioclastic packstone is common in the midawara Formation. It occurs in the upper and basal parts of this formation at El-Qalamun (4 m. thick.) and occurs at Munqar El-Shinnara measuring 6.6 m. in thickess.

The rock is marly-limestone, yellowish white in colour and is fossiliferous with nummulites, and shell fragments. The rock consists mostly of bioclasts skeletal particles quartz and lime mud matrix.

Bioclasts from about 60% of the rock. They are derived mainly from corals, nummuites and echinoides spines, stems and osciles. They are fine to medium sand-sized ranging from 0.1-0.3 mm. The coral bioclasts from about 50% of the total bioclasts. They show rectangular individual laths scattered with random orientation.

Each individual coral laths has an elongation of 0.4 mm with average width of 0.2 mm. and exhibites wavy extiction. Sometimes, aggregates of the coral laths attached together parallel to each other in one plate can be observed. The other bioclasts consists of echinoids, nummulites and some ostracoda.

Skeletal particles represented by nummlites, algae and ostracoda form about 10% of the rock. Nummulites are oblitrated, fractured and their chambers are filled with sand and lime mud.

Fine to medium grained quartz grains account about 10% of the rock. Most of the grains are angular to subangular in shape and show monocrystalline and wavy extinction. The lime mud matrix which consists mostly of micrite form the binding material in this rock.

C) Grainstone lithofacies :

Nummulitic bioclastic grainstone (NbG)(p1.3, fig.17)

Nummulitic bioclastic grainstone occurs near the top of El-Gharrq formation at Munqar El-Shinnara interclated with the nummulitic bioclastic packstone lithofacies. The average thickness of each bed belonging to this lithofacies is about 4.3m.

The rock is grey in clour, fossiliferous with some *Nummulites lyelli* but it contains appreciable amount of different type of shell debris.

In thin section, the grainstone consists mostly of bioclasts, skeletal particles and glauconites. Bioclasts are the main constituent in this rock, comprising about 55% of the rock framework. They have two modes of size, the first mode is abundant and are of subrounded to subangular medium sand-sized (0.1-0.3 mm), the second mode is less abundant and show coarse to very coarse sand-sized (0.5-1.2 mm), with angular to rectangular in shape.

Both modes are derived from nummlites, echinoids, (spines,stems and osciles) and discocyclines. They are distibuted with random orientation in the sparry calcite.

Skeletal partal particles are represented by nummulites and some discyclina. Discocyclines have an elongation and micritized. Nummulites particles are oblitrated and can be identified, e.g. *Nummulites solitarous* and *Nummulites atacicus*. Some, *Gumblina* sp. and *Textularia* sp. of benthonic foraminifera can be often recorded.

Medium sand-sized glauconite grains are encounted in this lithofacies. Most of the grains are cracked and show sharp contact with the bioclasts and even with the binding material.

The binding material is granular psanular pseudospars and microspars. Some blocky calcite crystals have been precipitated around the echinoid partivcle in the form of syntaxial overgrowths. This may result from the percolation of meteoric water on this lithofacies during subaerial exposure.

Bioclastic grainstone (bG):(p1.3, fig.18)

Bioclastic grainstone lithofacies is only recognized in the topmost part of El-Gharaq formation at Elee El-Breg section. It attains a thickness of about 4.4 m.

The rock is gryish-white to pale pink in colour, compact, hard, crystalline, fossiliferous with small and large size nummulites, such as Nummulites lyelli.

The grainstone is made up of bioclasts, skeletal particles and glauconites. Bioclasts are the main components in the rock. They form of about 45% of the total rock. They are most probably from nummulites, discocyclines and echinoid spines and stems. Their size range from fine to medium sand-sized (0.1-0.35 mm). Most of the bioclasts are rectangular in shape, subrounded to subangular and distributed with random distribution in the rock. Skeletal particles are rarely abundant and represented by discocyclines, nummulites and operculines.

Glauconites grains grains from of about 5% of the rock. Most grains have fine to medium sand-sized and show aharp contact with sparry calcite. The cement is sparry calcite which are deposited between the bioclasts. Some of them have been formed by the aggrading recrystallization of limemud.

CONCLUSION

Microfacial properties of the Middle Eocene sediments in the south El-Fayoum Province at the Gabal El-Qalamun, G. Mungar El-Shinnara, G.Sath El-Hadid and G. ElweEl Breq has resulted in recognition 17 microfacies association. This microfacies associatians are represented by Dolostone microfacies, Packstone microfacies and Grainstone Microfacies.

Throughout the stratigraphic sections examined dolomitisation took place especial at sath El-Hadid Formation, as a result of metasomatic replacement of the original carbonate rocks in

shallow, warm, magnesium-rich environments that prevailed as a result of local uplift movements of the sea floor.

The microfacies characters suggest that the Midawarh Formation (Middle Lutetian) which are represented the base of studied succession, was deposited in the to upper shelf and continental shelf edge to out shelf in environment. The sath El-Hadid Formation (Late Lutetian) which overlies El Midawarah Formation are deposited under lower and upper shelf to outer shelf environment. The El Gharaq Formation which represented the sommet of suecession (Terminal Late Lutetian) depositional environment as Bang margin.

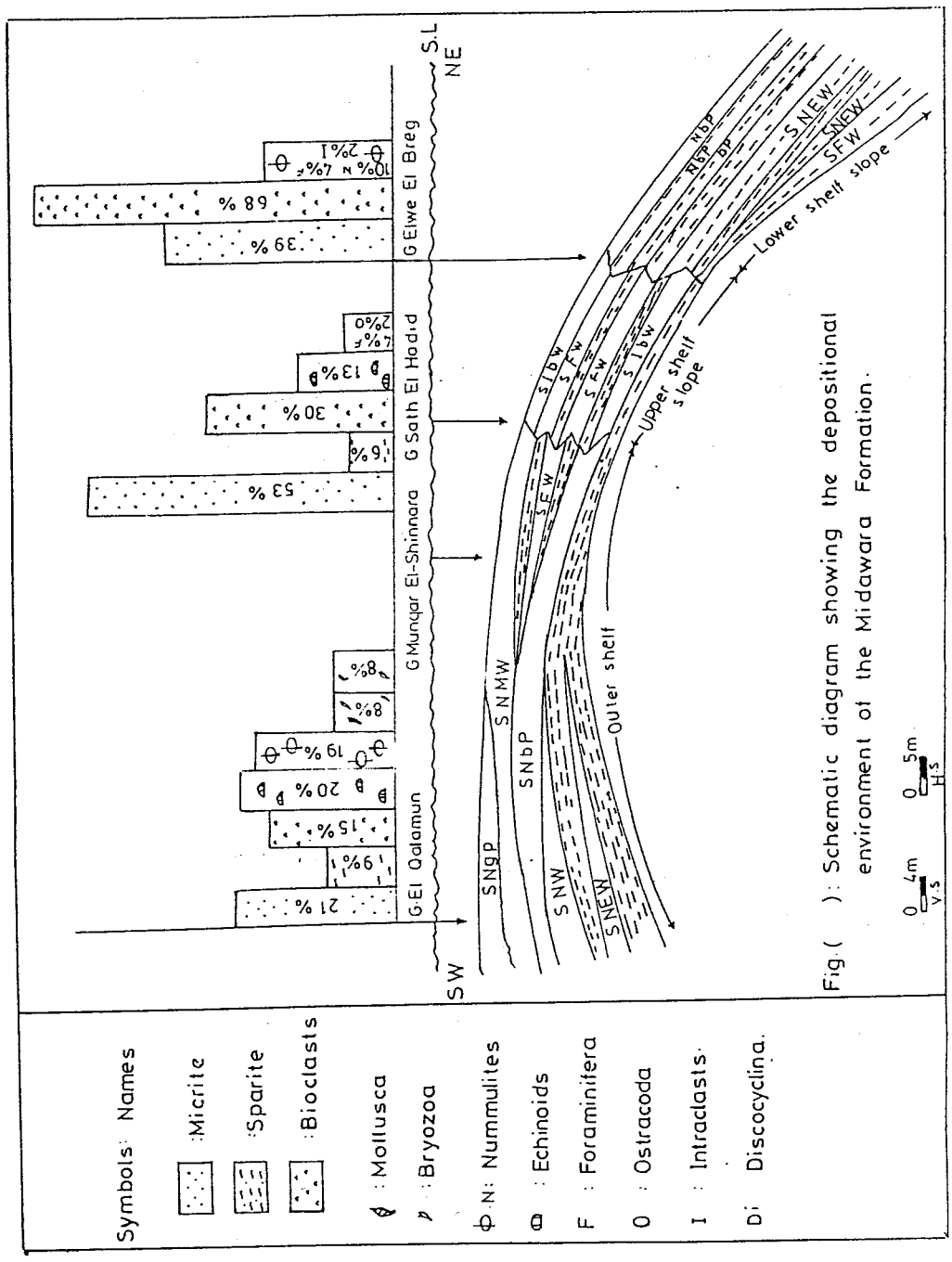


Fig. ( ): Schematic diagram showing the depositional environment of the Midawara Formation.

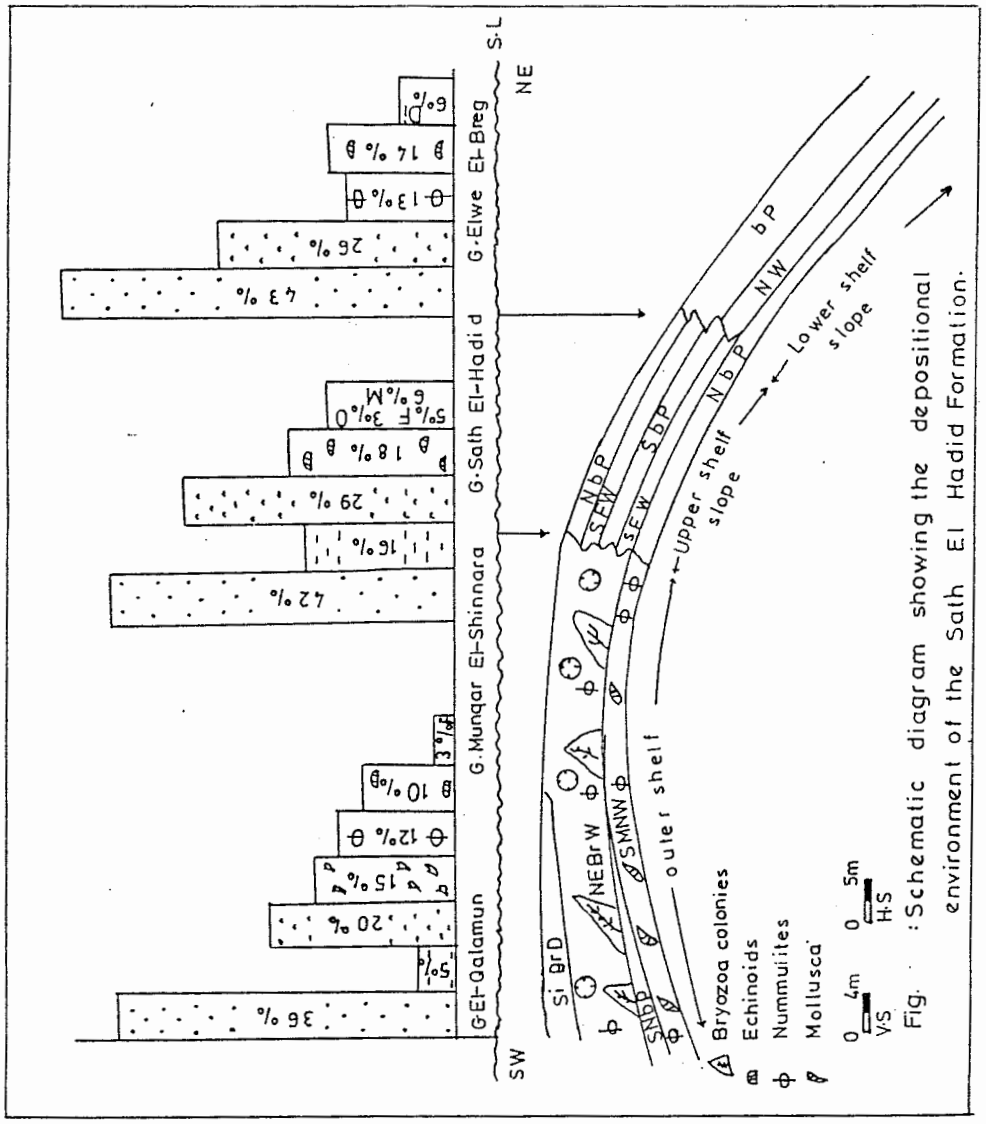
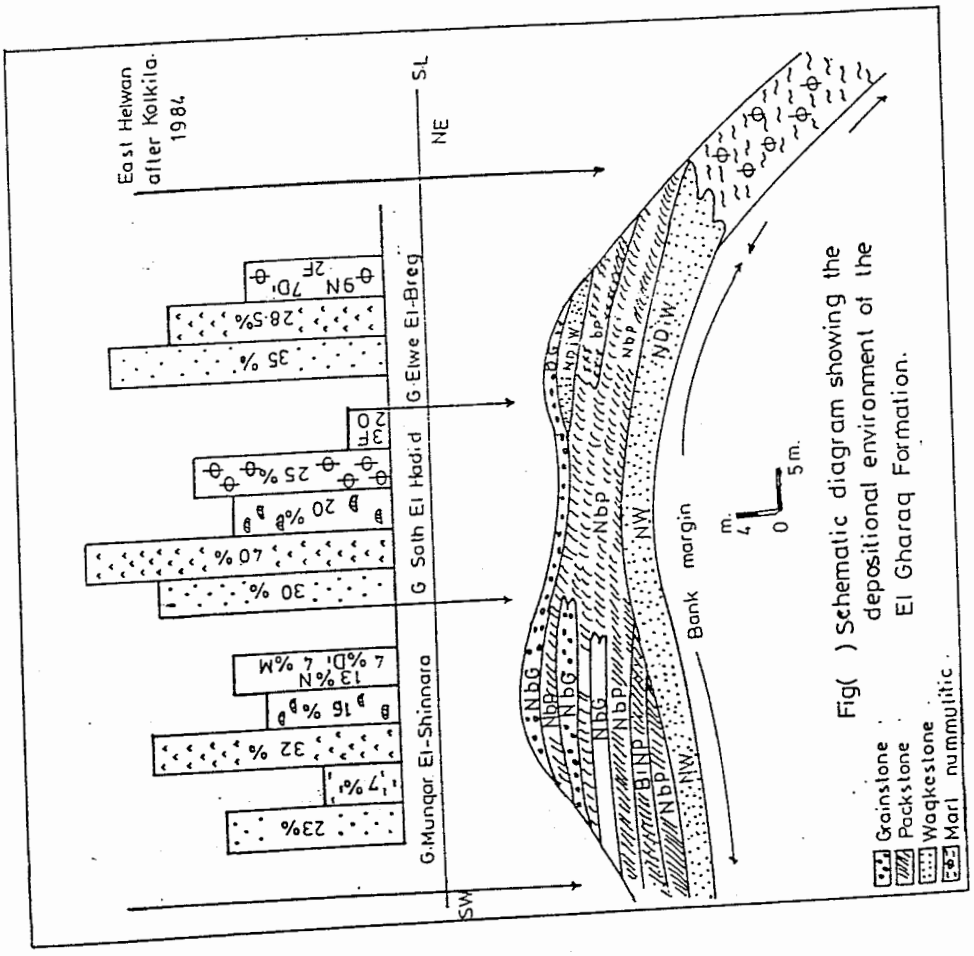


Fig. : Schematic diagram showing the depositional environment of the Sath El Hadid Formation.



Fig( ) Schematic diagram showing the depositional environment of the El Gharaq Formation.

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Plate 1

Fig. 1;. Siliceous bryozoan Dolostone (Si Br D)
El-Qalamun section, Sath El-Hadid Formation, X.40.

Fig.2;. Sandy intraclastic bioclastic Wackestone (SIbW).
Sath El-Hadid section, Midawara Formation, X.40.

Fig.3;. Sandy foraminiferal Wackestone (SFW).
Elwe El-Breg section, Midawara Formation, X.40.

Fig.4;. Sandy nummulitic echinoidal Wackestone (SNEW)
Elwe El-Breg section, Midawara Formation, X.40

Fig.5;. Nummulitic echinoidal bryozoan Wackestone (NE Br W).
Munqar El-Shinnara El-Shinnara section, Sath El-Hadid Formation, X.40.

Fig.6;. Nummulitic Wackestone (NW).
Elwe El-Breg section, Sath El-Hadid Formation, X.40.

PL.1

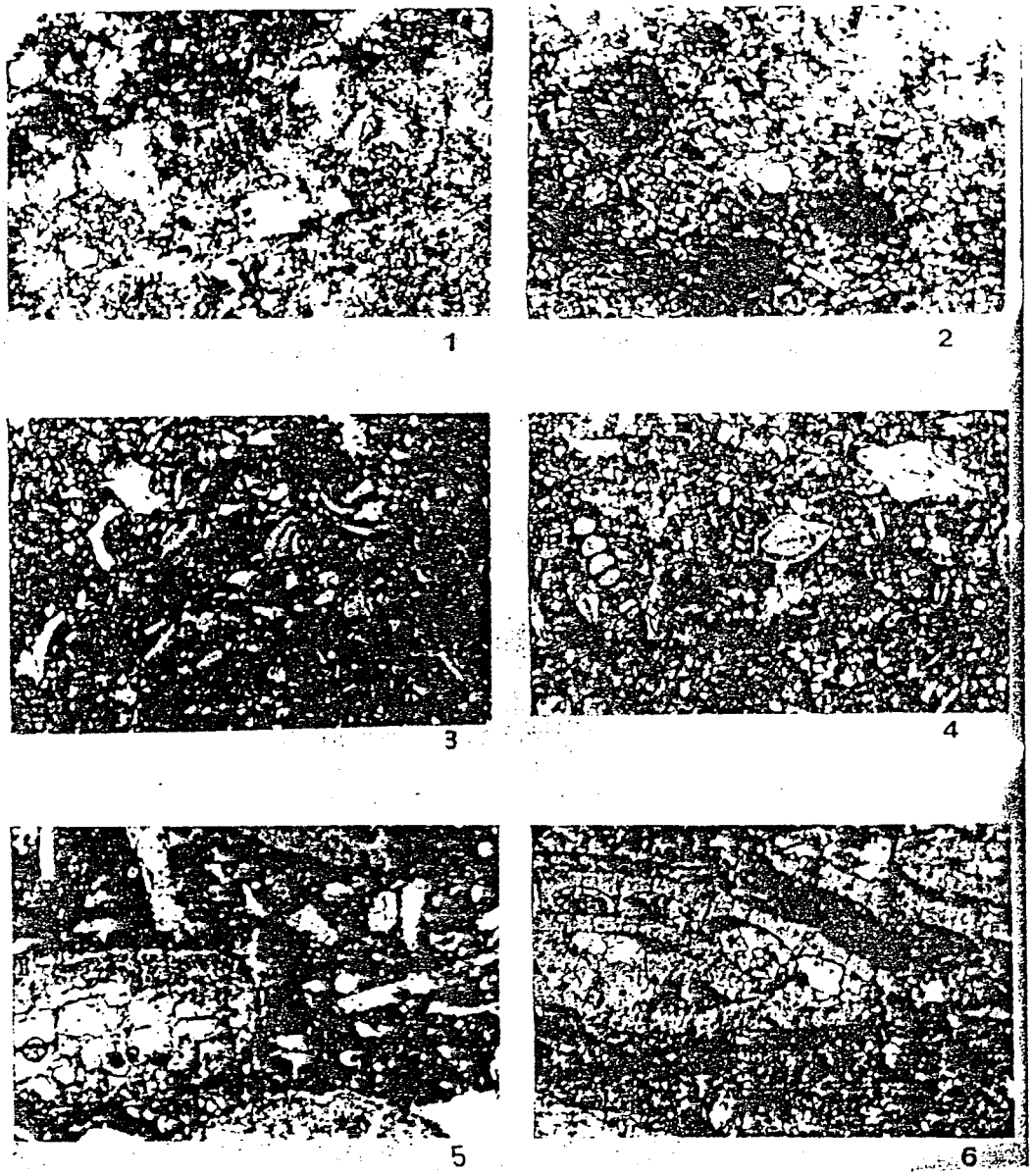

Plate 2

Fig.7;. Sandy nummulitic molluscan Wackestone (S N M W).
El-Qalamun section, Sath El-Hadid Formation, X.40.

Fig.8.;. Nummulitic discocycline Wackestone (N Di W).
Elwe El-Breg section, El-Gharaq Formation, X.40.

Fig.9;. Sandy nummulitic Wackestone (S N W).
El-Qalamun section, Midawara Formation, X.40.

Fig.10;. Sandy nummulitic bioclastic Packstone (S N b p).
El-Qalamun section, Midawara Formation, X.40.

Fig.11;. Bioclastic packstone (bp).
Elwe El-Breg section, Midawara Formation, X.40.

Fig.12;. Bioclastic packstone (bp).
Elwe El-Breg section, Sath El-Hadid Formation, X.40.

PL.2

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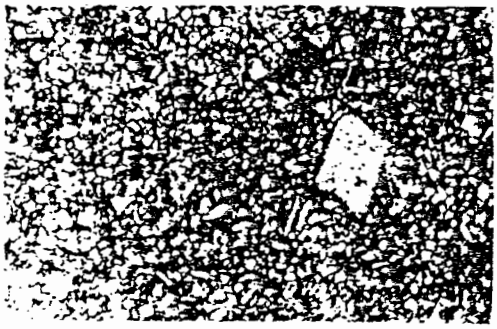

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Plate 3

Fig.13;. Nummulitic bioclastic Packstone (N b p).
Elwe El-Breg section, Sath El-Hadid Formation, X.40.

Fig.14;. Bryozoan nummulitic Packstone (Br N P)
Munqar El-Shinnara section, El-Gharaq Formation, X.40.

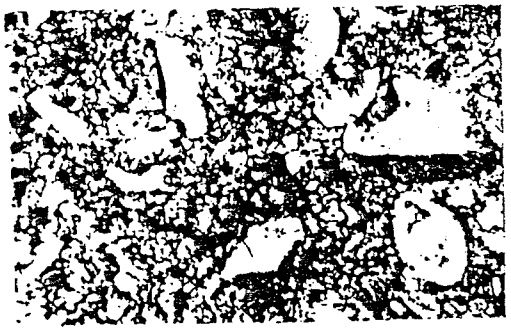
Fig.15;. Sandy bioclastic Packstone (S b p).
Sath El-Hadid section, Sath El-Hadid Formation, X.40.

Fig.16;. Sandy glauconitic nummulitic Packstone (S g N p).
El-Qalamun section, Midawara Formation, X.40.

Fig.17;. Nummulitic bioclastic Grainstone (N b G).
Munqar El-Shinnara section, El-Gharaq Formation, X.40.

Fig.18;. Bioclastic Grainstone (bG).
Munqar El-Shinnara section, El-Gharaq Formation, X.40.

PL. 3



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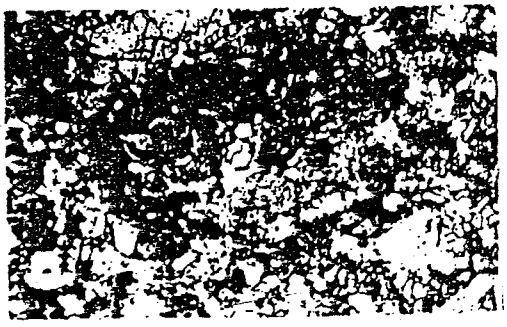

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تحليل السحنات الدقيقة لرواسب الأيوسين المتوسط في جنوب الفيوم – الصحراء الغربية، مصر

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أدت دراسة أربعة مكاشف للأيوسين المتوسط (جبل القلمون، جبل منقار، الشنارة، جبل سطح الحديد، جبل علوة البرج) فى جنوب الفيوم إلى التعرف على ١٧ نوع من السحنات الدقيقة وقد أدى تحليل خصائص هذه السحنات إلى استنتاج أن قاعدة التتابع المدروس، تكوين المدورة (اللوتيسى المتوسط) قد ترسبت فى الرصيف السفلى إلى الرصيف العلوى وكذلك حافة الرصيف القارى إلى الرصيف الخارجى. بعد ذلك وجد أن تكوين سطح الحديد (اللوتيسى العلوى) قد ترسب فى الرصيف من السفلى إلى العلوى إلى الرصيف الخارجى، أما تكوين الغرق الذى يمثل قمة التتابع (نهاية اللوتيسى العلوى) فإنه يمثل حافة البنك (أى المناطق التى تنمو الكائنات الحية فيها بغزارة ويزيد حجمها).