CHAPTER III

STRATIGRAPHY

This chapter deals with the lithostratigraphy in the study area, which ranging in age from Carboniferous to Quaternary. The Carboniferous, Jurassic, Cretaceous and Paleocene rocks have a limited distribution, while the Lower-Middle Eocene deposits cap the plateau surface of the study area. On the other hand the Upper Eocene, Oligocene, and Miocene rocks are preserved in the structurally and topographically low areas, which separate these plateaux Fig. (16).

The succession in the study area is represented by different types of lithofacies, which composed mainly of clastic/carbonate deposits. The following is a brief description of the stratigraphic succession between the southern Ataqa and the northern Galala area according to Abdallah (1993).

III.1. Pre-Cretaceous deposits.

III.1.1 Carboniferous rocks.

The Carboniferous rocks are the oldest exposed rock units in the studied area. The marine Carboniferous of Aheimer Formation was described by Abdallah et al (1963) along the east coast of the Gulf of Suez.

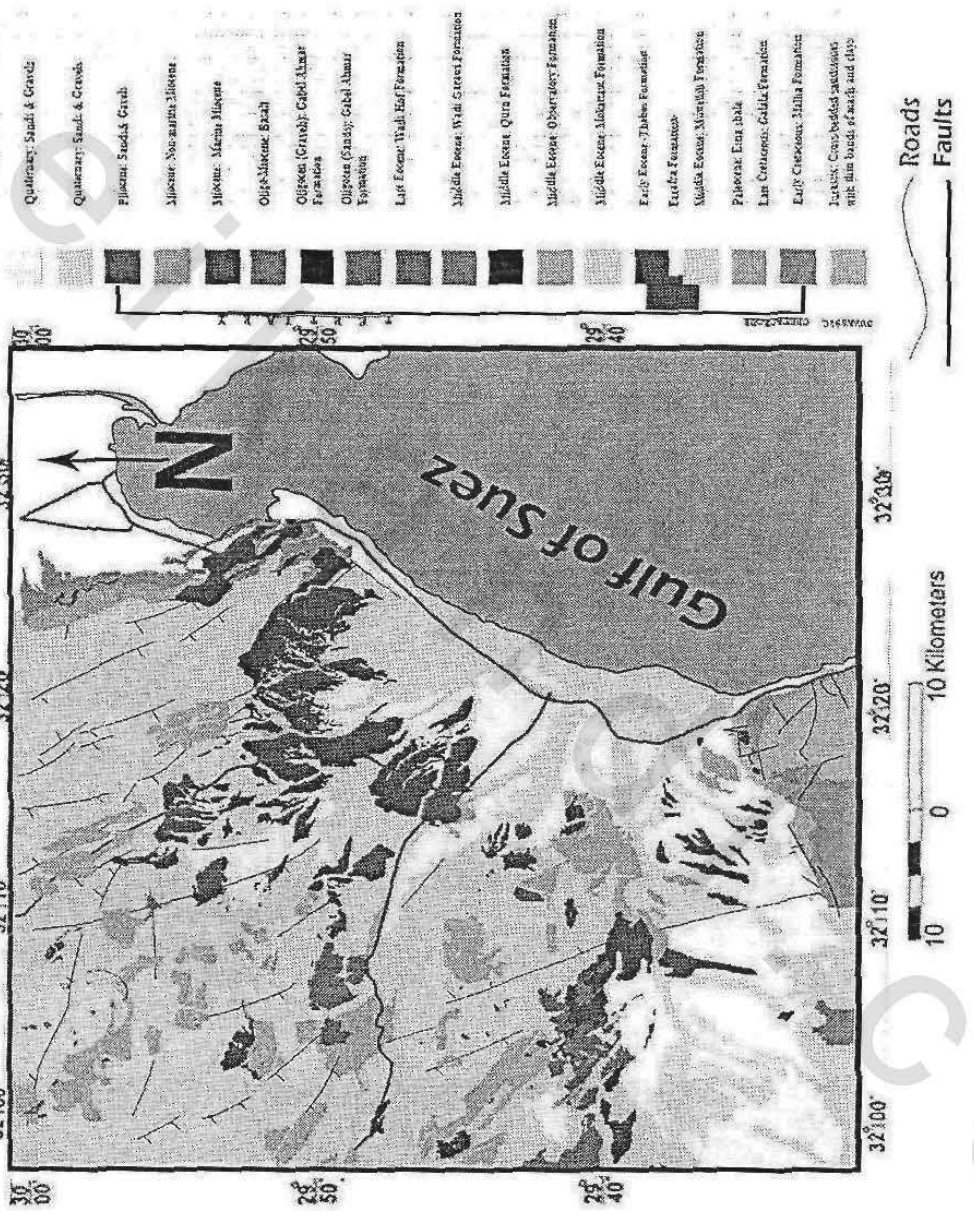

Figure (16) Geological map of the study area (after Hassan, 2008).

Aheimer Formation

The Aheimer Formation was described by Swedan and Kandil (1989) at the mouth of Wadi Um Reseis in the north face of El Galala El Bahariya Fig (17). These formations are quite similar to those exposed in the type locality at Wadi Aheimer. So, it is subdivided into three units:

3- Upper unit, 40m thick, of alternating thick beds of pale yellowish brown, grey and white sandstone and dark greenish grey to black shales and silts.

2- Middle unit, 83m thick, of brownish yellow, fine grained cross-bedded sandstone.

1- Lower unit, 42.9m thick, made up of dark grey to green shale and clay intercalated with reddish sandstone.

III.1.2. Jurassic rocks

The Jurassic rocks were recorded first by Sadek (1926), at Khasm - El Galala area, which attain a thickness of 220 meters and consists of varicolored, cross-bedded sandstones with mudstone and siltstone interbeds. Lithostratigr-aphically, the Jurassic succession divided into three members: the lower basal clastic, the middle shale-limestone and the upper sand-shale member according to Darwish et al. (1984).

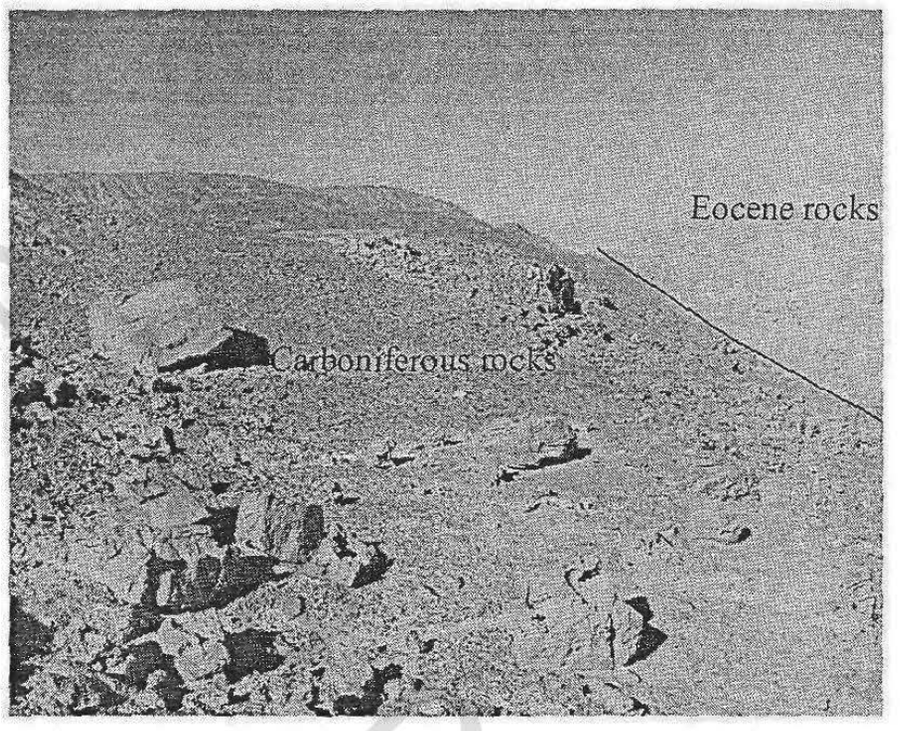

Figure (17): Photograph showing the fault plane between the Carboniferous and Eocene rocks.

III. 2.Cretaceous rocks.

The Cretaceous rocks crop out at the footslopes of El Galala El Bahariya scarps and consist of green marls, shales, dolomites, sandstones and limestone's. Also the Cretaceous rocks crop out at Gabal Ataqa in the northeastern corner of the study area. The Upper Cretaceous rocks overlie the succession belonging to the Paleozoic and Early Cretaceous at Gabal Um Reseis, the Jurassic and Early Cretaceous at Khashm – El Galala.

Abdallah (1993), classified the Cretaceous succession in the study area is into three rock units, which are (from base to top) the Malha, Galala, and chalky limestone unit.

A - Malha Formation

The term Malha Formation was originally used by Abdallah and Adindani (1963) to define the white, light violet, fine grained sandstone succession of Wadi Malha in the southeastern corner of El Galala El Bahariya massif.

Malha Formation is exposed at the foot slopes and traces of eastern and northern edges of the El Galala El Bahariya plateau. This formation composed of about 70 m of varicoloured sandstone beds with thin clay and marl bands. Also includes kaolinitic and conglomeratic layers. Its age is Aptain-Albian according to Abdallah and Adindani (1963).

B - El Galala Formation

El Galala Formation was described by Abdallah and Adindani (1963) from the eastern side of El Galala El Bahariya plateau. In the study area, this formation

consists of green shales and marls with dolomitic ledges (Fig. 18). The age of the Galala Formation is Late Cenomanian and its thickness reaches 100 m at Gabal Khashm El Galala, according to it is faunal content Hewaidy et al (2003).

Akaad and Abdallah (1971), mentaioned that The Galala Formation is exposed at Gabal Ataqa in the northeasteren corner of the study area. The Galala Formation can be divided into two member; upper carbonat unit and lower yellow and green marl unit.

C - Chalky limestone and dolomite unit

This unit consists of hard grey massive limestone. It is exposed on the eastern side of the El Galala El Bahariya plateau. It is a cliff-forming unit underlying the Esna Shale with an erosional contact (Bandel and Kuss,1987).

III.3. Eocene rocks

The Eocene rocks are the nummulitic limestones which form the main parts of the Gabal Ataqa and El Galal plateau as well as the faulted blocks of Akheider-Rammlyia and Um Zeita-Kahallya.

According to Abdallah (1993) the Eocene succession is subdivided into from base to top; the upper part of the Esna shale, Farafra , Thebes, Muweilih, Mokattam , Observatory , Qurn , Wadi Garawi and Wadi Hof Formation.

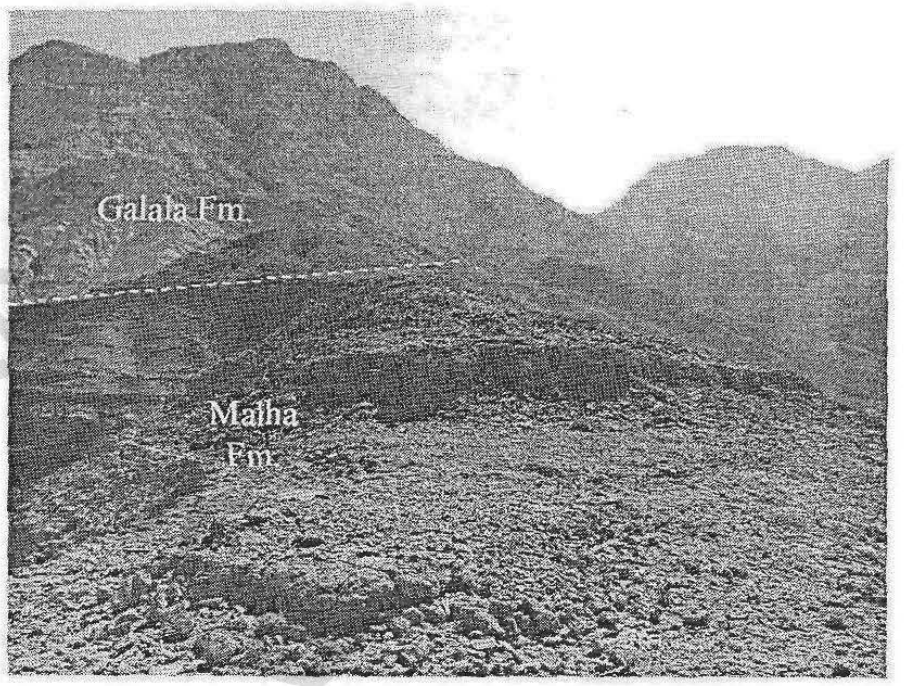

Figure (18): Photograph showing the contact between Malha and Galala formations.

III.3.1. Early Eocene:

Abdallah (1993) subdivided the lower Eocene rocks into the following formation:

A - Esna Shale

Only the upper part of the formation is included in the present study. It is reported from Wadi Naaot and measures about 7m Abu El-enain et al (1995), composed of grey argillaceous limestone. The Esna Shale spans the late Paleocene-Early Eocene time (Abdallah 1993).

B – Farafra and Thebes Formation

The Farafra and Thebes Formations were originally introduced by Said (1962). These formations are widespread in the eastern part of the El Galala El Bahariya plateau. The Thebes Formation measures 185m of yellowish, grayish white chalky limestone with chert nodules and bands (Abu El-enain et al 1995).

III.3.2. Middle Eocene:

The mountains in the study area consist of the Middle Eocene rocks. Abdallah (1993) subdivided the Middle Eocene rocks into the following formation:

A - Muweilih Formation

The name Muweilih Formation was proposed by Iskander (1943) to describe matl-limestone complex at Wadi Rayan depression in Fayum. The Muweilih Formation consists of interbedded marl and limestone; it is early to middle Lutetian age Abdallah, (1993).

B -Mokattam Formation

The Mokattam Formation was introduced by Said (1962) from Gabal Mokattam near the Cairo. It consists of white to yellow nummulitic limestones,dolomitic limestones and marls. The limestone beds of this formation are highly enriched in Nummulites gizehensis (Fig. 19). In the study area the maximum measured thickness of the Mokattam Formation is about 122m at Gabal Akheider and 78m at Gabal Um Zeita Abu El-enain et al (1995). The age of this formation is assigned to the Late Lutetian Middle Eocene Abdallah (1993).

C -Observatory Formation

The Observatory Formation was described by Farag and Ismail (1959) from Observatory plateau east of Helwan. This formation consists of white to golden-tan marly limestones with nodular limestones at its top, its age is Lutetian (Farag and Ismail, 1959a; Said, 1962; and Strougo (1985 a,b).

The Observatory Formation in the study area designates a sequence of biogenic and bioclastic, frequently cross-bedded, white limestones and chalky limestones with some dolomitic ledges in the middle and upper parts, (Fig. 20). It underlies the Qurn Formation and overlies the Mokattam Formation.

In the study area the maximum measured thickness of the Observatory Formation, is about 203 m at Gabal Akheider, about 33.5m at Wadi Akheider and reaches 168 m at Gabal El Ramliya. The age of this formation is assigned to the Middle Eocene.

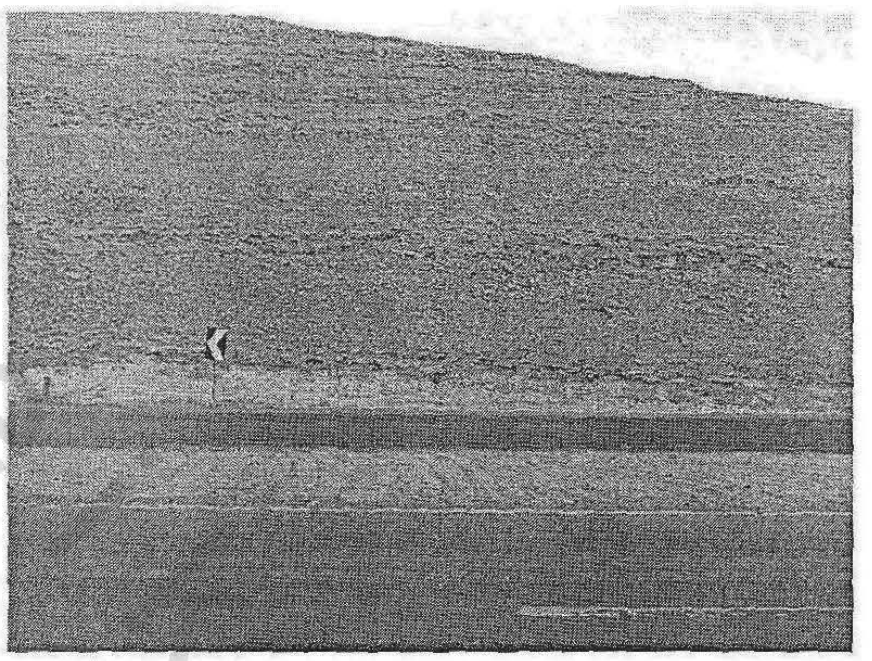

Figure (19): Photograph showing the Middle Eocene Mokattem Formation.

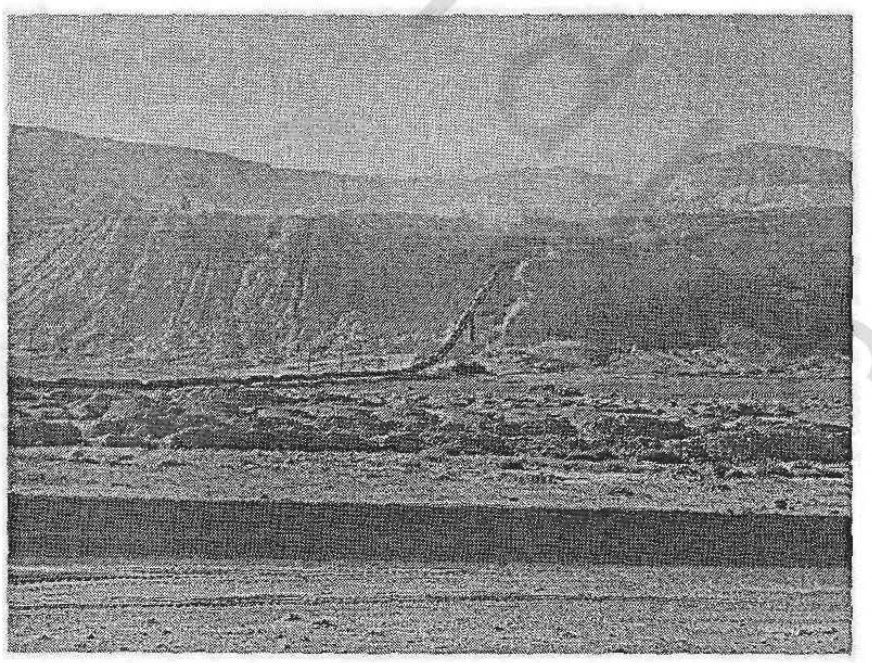

Figure (20): Photograph showing the quarry limestone in Observatory Formation using for cement manufactur.

D -Qurn Formation

The Qurn Formation was originally defined by Farag and Ismail (1959) in the Qurn height, east of Helwan and assigned to the Late Eocene. It consists of chalky and marly limestones alternating with sandy marls and attains a thickness of about 97 meters.

Strougo (1985a, b) and Strougo and Boukhary (1987) gave a Middle Eocene age to the Qurn Formation on the basis of the nummulite assemblage. The Qurn Formation has been divided into three units in its type locality but in the present study, it could be classified into the following two parts:

1. The lower part is highly fossiliferous, soft, yellow, marly limestones and marls.

2. The upper part is made up of chalky limestones throughout the study area. The thickness of the Qurn Formation as measured in Wadi Akheider is about 12 m. The age of this formation is assigned to the Middle Eocene (Bartonian).

E - Wadi Garawi Formation

The name Wadi Garawi Formation was originally used by Farag and Ismail (1959a) to describe about 25 m of brown limestones, marls, and shales in Wadi Garawi, east of Helwan.

Farag and Ismail (1959), and Ismail and Farag (1960) assigned a Late Eocene age to this formation. Strougo (1958a, b.) and Strougo and Boukhary (1987), the Wadi Garawi Formation assigned the Middle Eocene

age on the basis of *Nummulites pukhiani and N. vicaryi*. The Wadi Garawi Formation underlies the Wadi Hof Formation and overlies the Qurn Formation.

The Wadi Garawi Formation in the study area starts at the base with a thick light green marl bed in the western part and changes to an orange marl bed in the east. The upper part of this formation is made up of yellow to orange marls and marly limestones throughout the study area.

The thickness of the Wadi Garawi Formation is 7 m in Wadi Akheider. The age of this formation is assigned to the Middle Eocene (Bartonian) (Abu El-enain et al 1995).

II1.3.3. Late Eocene:

The Upper Eocene rocks consist of Wadi Hof Formation (Abdallah 1993).

A - Wadi Hof Formation:

The Wadi Hof Formation was established for the first time in the Wadi Hof area, east of Helwan by Farag and Ismail (1959a). It is made up of brown sandy limestones, shales, and sandstones. The Wadi Hof Formation is of Late Eocene age.The Wadi Hof Formation is used here according to Strougo's concept (1958a, b), i.e. it includes the Anqabiya Formation of Shukri and Akmal (1953) at its top.

The Wadi Hof Formation in the study area consists of marly and sandy limestones, marls, shales and

sandstones. The upper contact of the Wadi Hof Formation is unconformable with the Oligocene rocks or the Miocene rocks.

III.4. Oligocene Units:

An unconformity separates the Upper Eocene rocks from the Oligocene sediments, which were deposited in a fluviatile environment (Said, 1962).

The Oligocene rocks are differentiated into two units; the lower unit is varicolored, unstratified sands, gravels, and sedimentary quartzites; the upper unit consists of basalt sheets capping the lower unit. Uprising of silica and iron bearing solutions along the fault zones caused the formation of the sedimentary quartzite layer (about 5 meters thick) capping the Qurn or Wadi Garawi Formation in the area northeast of Wadi El Abraq. The lower sands and gravels unit contains abundant silicified wood fragments. On a lithologic basis, the Oligocene sands and gravels in the study area are equivalent to those of the Gabal Ahmar Formation in Gabal Ahmar, east of Cairo.

The Oligocene basaltic sheets are petrographically and stratigraphically similar to other basalts in the Cairo-Suez District. K-Ar age dating of the basalts of the district shows that they are of Late Oligocene to Early Miocene age (Meneisy and Kreuzer, 1974), Meneisy and Abdel Aal (1984), Meneisy (1990). Basalts of the same age and petrography were also reported in the Gulf of Suez rift (Steen, 1982) and were attributed to the early stages of rifting (Garfunkel and

Bartov, 1977; Steen, 1982).

The basaltic flows are cropped out to the east of Cairo extending along the Cairo- Suez road and seem along the faults that affected the area during the Oligocene time

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III.5. Miocene Units:

Miocene rocks lie unconformably over the Oligocene rocks in the central part of the study area, and over the Middle and Upper Eocene rocks in Wadi Akheider.

According to Sadek (1926) Miocene rocks classified into three series; lower series or M1, middle series or M2 and upper series or M3. M1 and M2 are marine to coastal deposits, while M3 is mostly of terrestial origin. The marine Miocene unit consists of bioturbated marls, shales, sandstones, and marly limestones.

The Miocene rocks of the Cairo- Suez district attracted the attention of many geologists e.g. Sadek (1926,1959), Abdallah and Abd-El Hady (1966), Cherif (1966), National sub-Committee (1974), Cherif and Yehia (1977), El-Azabi (2000), Abou El-Anwar and El-Gohary (2003).

According to Abdallah and Abd-El Hady (1966) the Miocene succession exposed in the Sadat area that lays 30 km to the south west of Suez city, is subdivided as follows from base to top: Sadat Formation (Early Miocene), Hommath Formation (Middle Miocene) and Hagul Formation (late Miocene).

A - Sadat Formation

The term of Sadat Formation was frist used by Abdallah and Abdel-Hady (1966) to describe the Early Miocene rocks at Sadat area, 30km to southwest of Suez city. There are three wadis that dissect the Sadat Formation from north to south: Wadi El Ramiya-Wadi El Mahagar and Wadi Tweirig. The type section of Sadat Formation is Sadat quarry where the thickness attains 52m.

It consists mainly of elastics calcareous sandstone at the base, followed upward by carbonates. This formation unconformably overlies either the Middle or Upper Eocene rocks, with distinct conglomeratic bed between them, and unconmformably overlained by the Hommath Formation.

The age of the Sadat Formation was assigned to the Early Miocene (Burdigalian) by El Heiny (1982), Early Miocene (late Burdigalian) Abdallah and Abd - El Hady (1966), El Azabi (2000) and Abu El Anwar and El Gohary (2003), Early Middle Miocene (Burdigalian-Langhian) by Youssef et al (1971), Cherif and Yahia (1977), Said (1990) and Abd El Shafy and Abd El Moneim (1992).

The Miocene rocks of the Sadat Formation are rich in macrofauna, especially Echinoids. In the study area, the Sadat Formation covers the area occupying the Wadi Tweirig and the center of Wadi Hagul. The Sadat Formation represented by two main facies, clastics in the lower part and carbonate in the upper part (El Attar 2003).

B - Hommath Formation

The name of Hommath Formation was first used by Abdallah and Abd-El Hady (1966) to describe the Middle Miocene rocks at the Eastern part of Wadi Hommath along the Gulf of Suez. The thickness of this formation is about 75 m. It composed of green shale, reefal limestone, interbedded with yellow sandy, yellow friable sandstone and Calcareous sandstone Fig. (21).

In the studied area the Hommath Formation is found in the southern part of Gabal Akheider, north of Cairo Suez road. This formation lies unconformably over the underlying basaltic flows, and Gabal Ahmer Formation of Oligocene age. However, the Oligocene- Miocene contact was not easily defined at some localities, where it is masked by gravel wash from the Oligocene.

The type section of the Hommath Formation has been traditionally assigned to Middle Miocene. (Strougo et al 2006) suggested that the lower part of Hommath Formation at the type-locality belonges to the late (but not the latest) Burdigulian (Lower Miocene).

C - Hagul Formation

The Hagul Formation was described by Abdallah and Abd-El Hady (1966) to refer to the upper Miocene beds. This formation consists of 21 m of coarse white calcareous sandstone with quartz grains and bands of flint pebbles with green shale interbeds and chalky sandy limestone bed occurring at top. This is covered

by a layer of large flint gravels in sandy matrix. El–Azabi (2000) concluded that the Hagul Formation of Abdallah and Abd-El Hady (1966) are of Early Pliocene age. The type section was measured at the southern Sid hill of wadi Hagul. In the studied area the Hagul Formation covers a wide area, between Wadi Hagul and Wadi Bada (Fig. 22) where the thickness is 24 m. East Bir Bada, south Wadi Bada and East Gabal Akheider the thickness increases to 62 m.

II1.6. Quaternary deposits

The Holocene wadi deposits and aeolian sand deposits are widely distributed over a large portion of the study area. These deposits are formed of sands, gravels, clays, aeolian sand and sand accumulation.

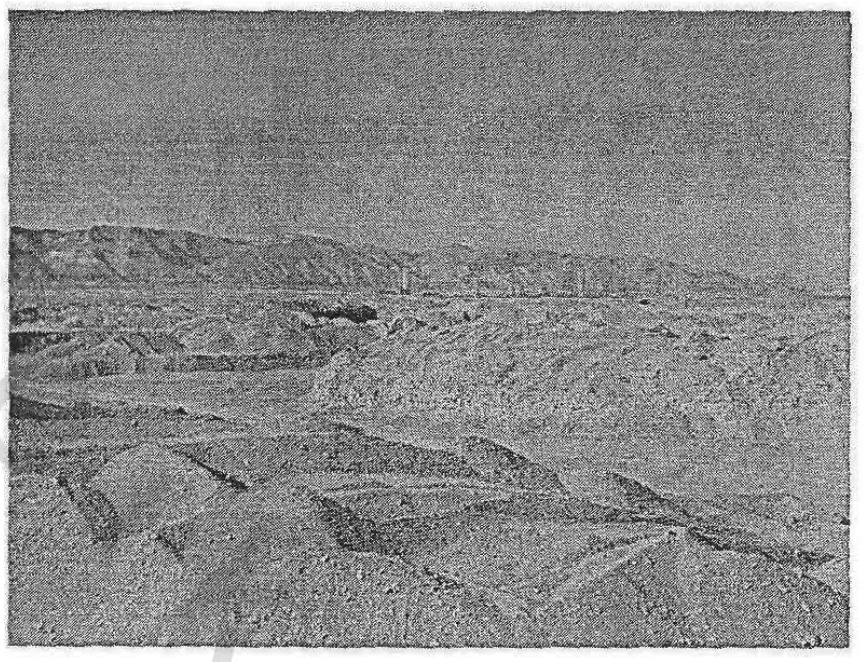

Figure (21): Photograph showing green shale of Middle Miocene Hommath Formation.

Figure (22): Photograph showing sandstone quarry in Upper Miocene Hagul Formation.

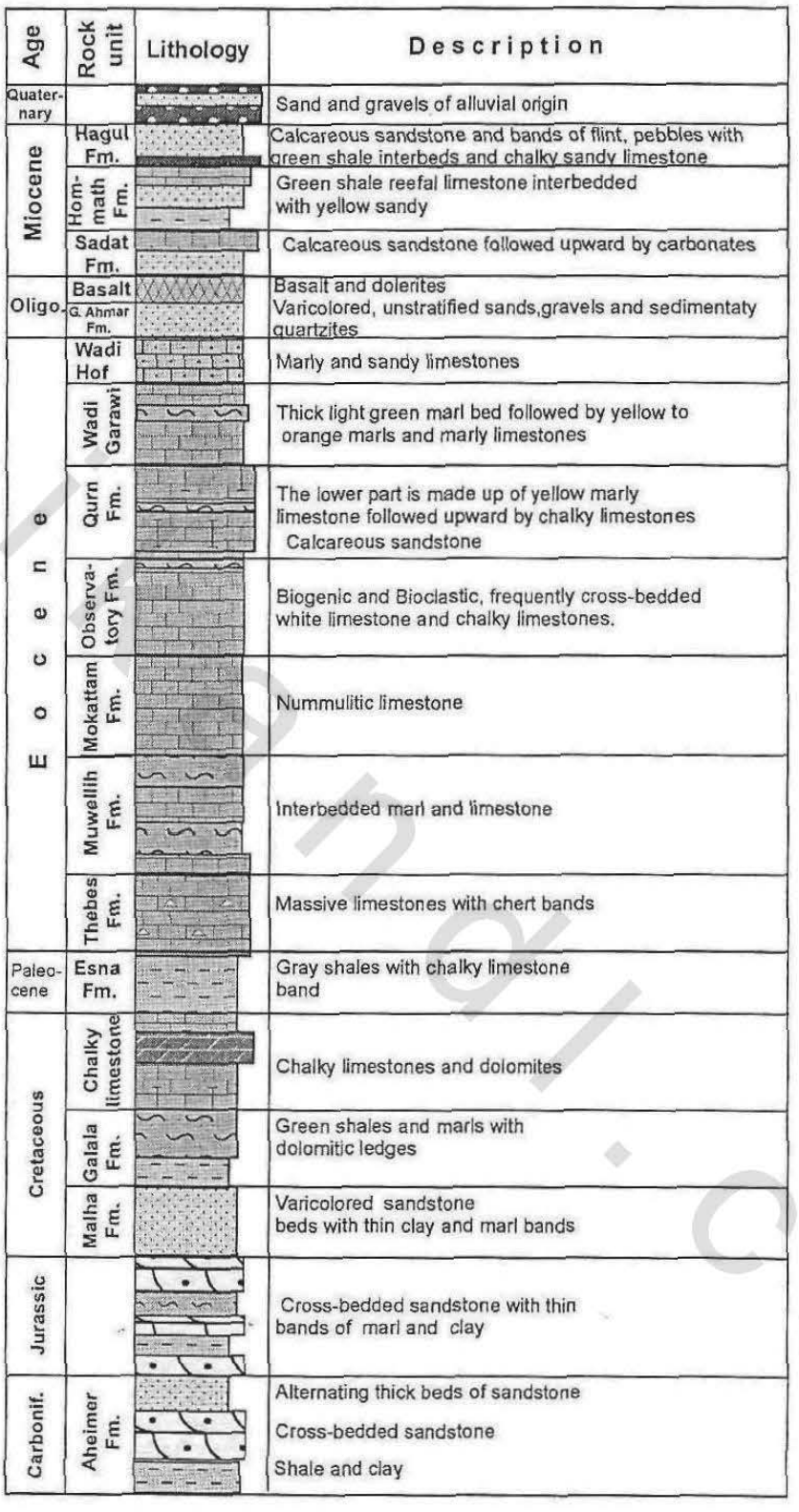

Figure (23): Composite section in the studied area without vertical scale.