INTRODUCTION

1.1. Generalities:-

The Upper Cretaceous/Lower Tertiary (K/T) boundary is the most intensively studied interval by the most diverse teams of investigators ranging from Paleontologists to chemists and astrophysicists. For each team the presence of a continuous record of sedimentation is critical to reconstruct this time interval in Earth history.

High resolution centimeter-scale litho, bio- and chrono-stratigraphic analysis are carried out on many sections all over the world.

This international attention for this problem was reflected on the Stratigraphers and Paleontologists in Egypt. Therefore the problem of the K/T boundary have been the subject of much discussions in Egypt since 1947. Evidences for a depositional hiatus between the Maastrichtian and Danian sediments in the Nile Valley have been noticed by several workers (e.g. El-Naggar 1966, 1970; Faris 1982, 1984 and others).

Until very recently, the uppermost Maastrichtian and basal Danian biozones have not been recorded in the Late Cretaceous-Early Tertiary succession of Egypt. However, little recent works advocated the presence of Late Maastrichtian sediments as in Abu Roash, near Cairo (Faris & Abd El-Hameed, 1986).

The Late Cretaceous/Early Tertiary succession covered a wide area in Eastern Desert, Nile Valley and Western Desert, and has been one of the most controversial problems of Stratigraphy. Therefore, it is very useful to tackle this problem in an area which is considered to be the best locality representing the K/T succession. In this study, the Central and Southern Eastern Desert is chosen since it represents a wide variety of sediments belonging to the K/T succession which are very well developed and well exposed.

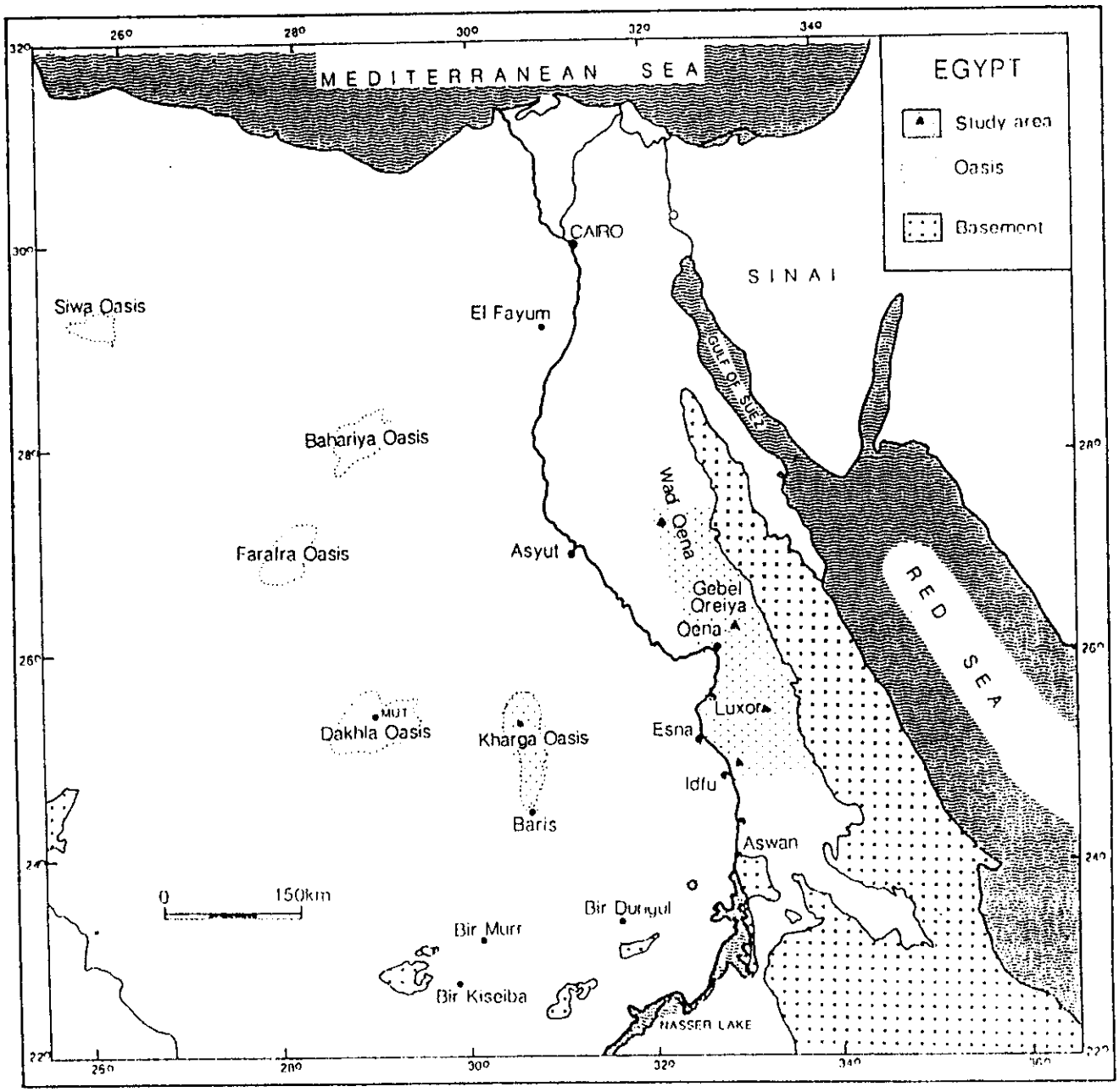

Fig. 1. General map of Egypt showing the area of study.

1.2. Scope of the present study:-

The present thesis is hoped to introduce a better understanding the condition of sedimentation that prevailed during the Upper Cretaceous to lower Tertiary in the Central and Southern Eastern Desert; and to introduce a new concept for understanding the nature of the K/T boundary in Egypt in the light of the almost complete section in the study area.

The investigation contributes to the more detailed stratigraphic, Paleontologic, and Paleoecologic studies of Qena region at the northern part of the study area and El-Mahamid region in the south. Beside El-Nezzi region at the middle which escaped the attention of workers, and not previously studied.

Using the Litho-Biostratigraphy in establishment the age assignment of the different exposed rock unit and a discussion the ages, their stages and its problems of the boundaries. comparison in the global stratotype section (GSSP) and according to the International Commission Group.

To use modern taxonomic classifications based on wall texture Olsson et al. (1992) and Pearson (1993) for the Planktonic Foraminifera of Tertiary (Paleocene-Early Eocene).

Using the identified Planktonic foraminifera in constructing the stratigraphic biozones and correlating with some other international standard zonal schemes. As well as using the calcareous nannoplankton for checked and matched with Planktonic foraminiferal biozones in order to confirm the nature of K/T boundary and to attain a higher biostratigraphic resolution.

To throw more light on Paleoecology and the Paleoenvironmental conditions which prevailed during the Maastrichtian through the Early Eocene in the area under investigation.

1.3. Delineation of the studied area:-

This study is a part of Special Research Project 69 "Geoscientific Problems in Arid Areas" which has financially been supported by the German Research Foundation.

The area under study in central and southern Eastern Desert is bounded by Lat. 25° 7`-27° 15` N and Long 32° 45`-33° 15` E (Fig. 1). Three regions have been chosen to carry out the detailed stratigraphic, Paleontologic (Foraminifera and Calcareous Nannoplankton) and Paleoecologic studies, these are Qena, El-Nezzi and El-Mahamid regions (Fig. 2).

Eleven sections (Fig. 3) were measured from these regions after taking into consideration the geologic structures and other field relations influencing the studied rock sequence. This is essential in order to have a reasonable coverage of the stratigraphic succession, and of the possible lateral variations.

The studied sections are sampled and graphically illustrated (Figs. 4-13). The following is a brief description of these sections from north to south:

1.3.1. Qena region:-

It lies at the northern part of the study area. Lat. 26° 15`-27° 15` N. Long. 32° 15`-33° 5` E. Five sections were measured from this region, these are:

1.3.1.1. Hammad section (section no. 1):

It lies at the central Wadi Qena Lat. 27° 15` N and Long. 32° 15` E. It comprises (20) samples representing the Maastrichtian deposits, Dakhla Formation (Hamama Member) and rests on a part of Rakhiyat Fm. It has a thick about 70 m. (Fig. 4)

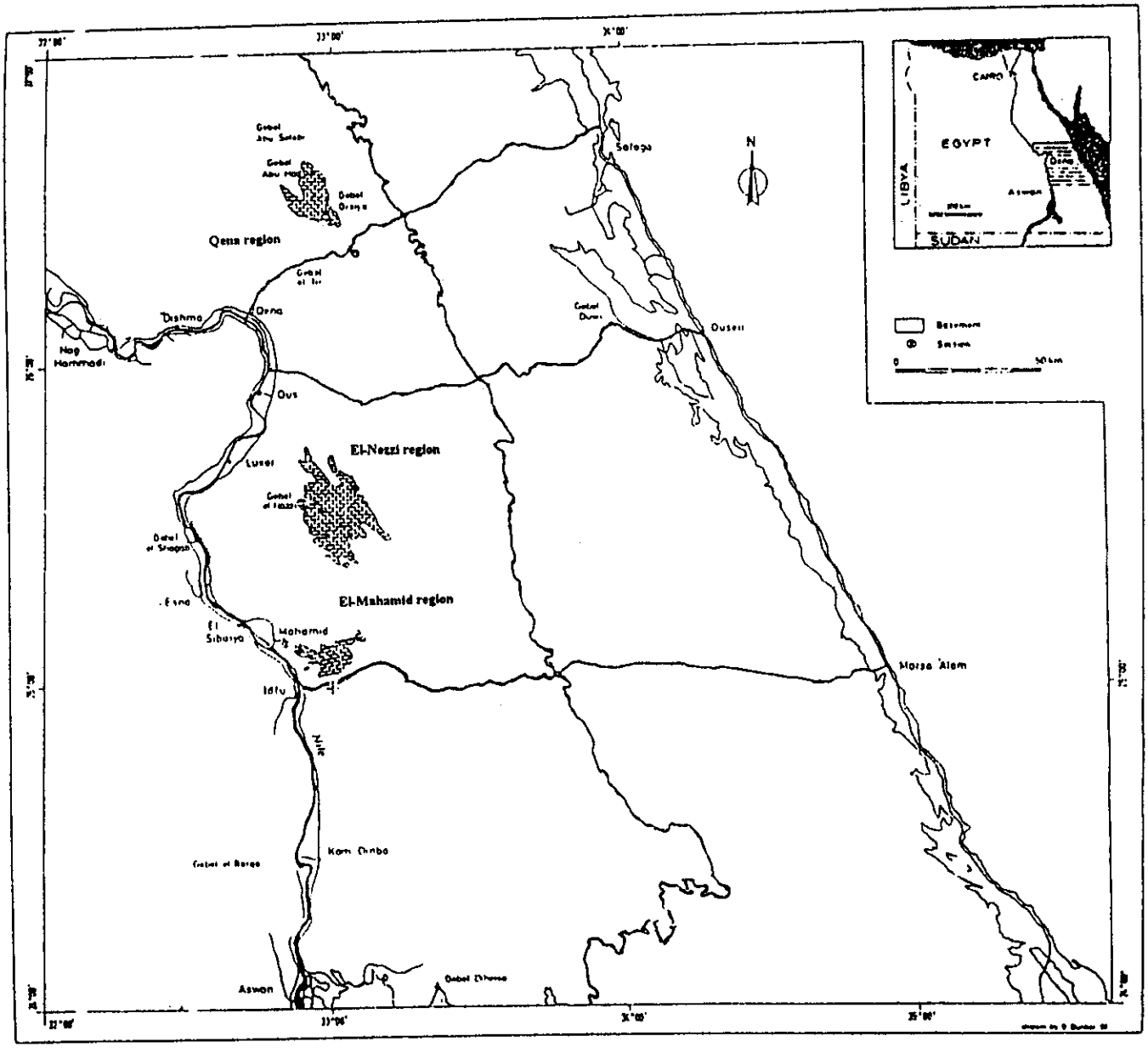

Fig. 2. Location map of the three studied regions, Qena, El-Nezzi and El-Mahmaid.

1.3.1.2. Abu Had section (section no. 2):

It lies to the north of G. Qreiya, northeast Qena Lat. 26° 45` N and Long. 32° 75` E. It comprises (31) samples of the Maastrichtian and Early Paleocene deposits (Dakhla Fm.). It has a thick about 56 m. (Fig. 5).

1.3.1.3. G. Qreiya sections (sections no. 3,4):

Two sections are studied in the G. Qreiya Lat. 26° 30` N and Long. 32° 90` E. They are considered to be the most complete succession where they comprise the Maastrichtian to Early Eocene deposits (Dakhla, Tarawan, Esna and Thebes Formations). These situated in the central part of Eastern Desert, northeast Qena.

The section no. 3 in G. Qreiya has a thickness about 95 m. and comprises (50) samples (Fig. 6). The interval from sample no. 28 and no. 30 about (2.5 m) are returned in measuring, continuous sampling in 5 to 10 cm intervals for more detailed description where it represents the K/T boundary, it comprises (26) samples (Fig. 7).

The section no. 4 has about 80 m. thick and comprises (38) samples (Fig. 8).

1.3.1.4. Hamama section (section no. 5):

It lies opposite to G. Qreiya to the south of Qena-Safaga distinct, Lat. 26° 15` N and Long 33° 5` E. It comprises the Maastrichtian and Early Paleocene deposits (Dakhla Fm.) representing by (34) samples and 53 m. thick (Fig. 9).

1.3.2. El-Nezzi region:-

El-Nezzi region lies 45 km. southeast of Luxor town, Lat. 25° 30`-25° 50` N. and Long. 32° 80`-33° 15` E. It covers the middle portion of the area under investigation between Qena and El-Mahamid regions. It comprises four sections (no. 6, 7, 8, 9). The sediments of this region belong to Dakhla, Tarawan, Esna and Thebes Formations representing the Maastrichtian to Early Eocene.

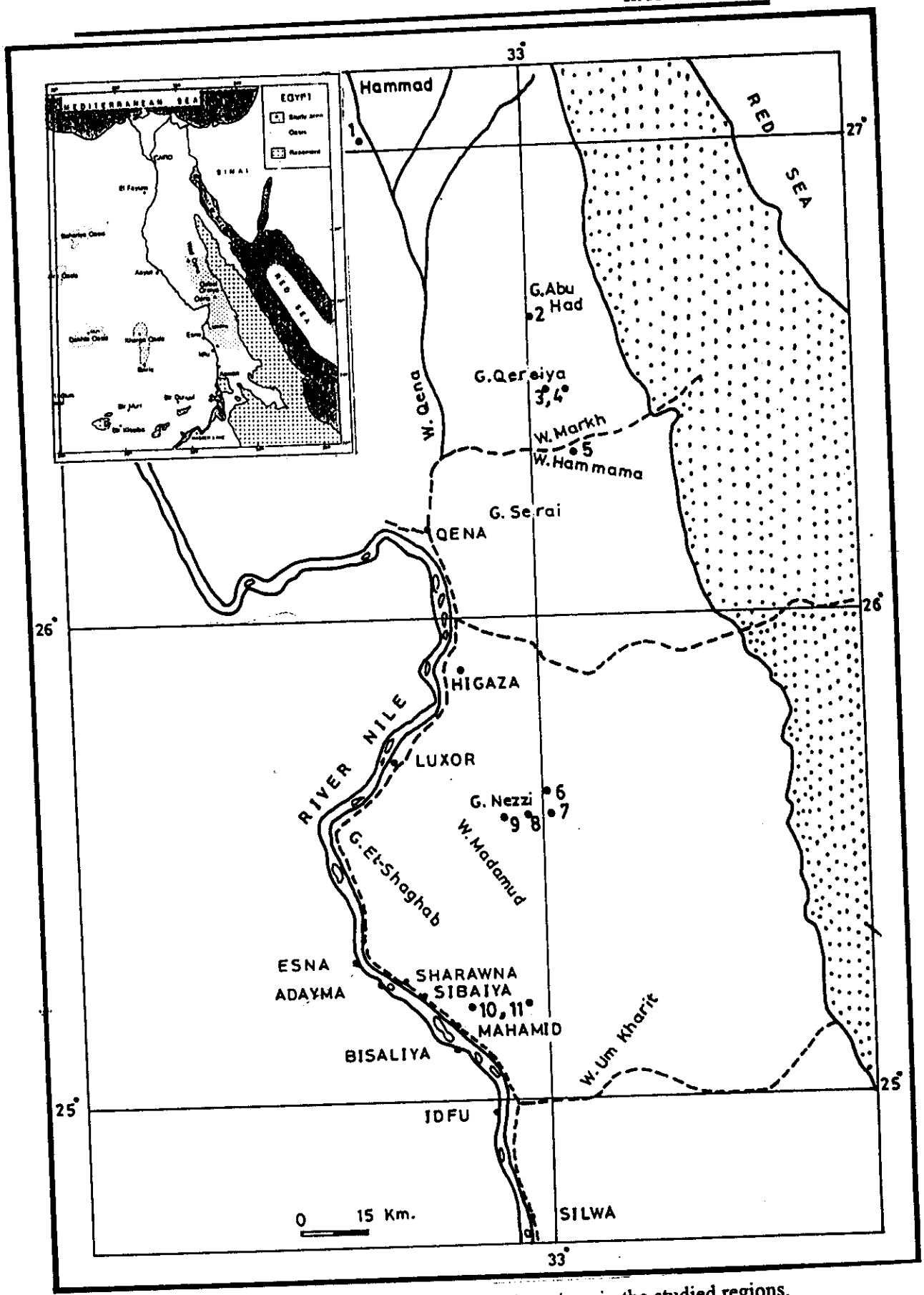

Fig. 3 Location map of the measured sections in the studied regions.

The section no. 6 comprises (36) samples and has about 45 m. thick, the sections no. 7,8 have 70 m. thick and comprises (35) samples, and the section no. 9 comprises (31) samples and has 85 m. thick.

1.3.3. El-Mahamid region:-

It lies about 20 km. south of Esna town, it covers the southern portion of the studied area, Lat. 25° 7`-25° 15` N. and Long. 32° 65`-32° 80` E. Two sections are measured in this region (no. 10, 11). Two main lithological units, Dakhla and Tarawan Formation are clearly recognizable in the field, and constitute the Maastrichtian and Paleocene, and overlie unconformably the Duwi Fm.

These sections comprises (60) samples and have about 180 m. thick.

Haslett (1994) mentioned that by far the most suitable K/T boundary section in south-west France in terms of accessibility and sedimentological completeness is that situated on the coast near Bidart, south of Biarritz.

2.3. Stratigraphical and Paleontological works on the Late Cretaceous-Early Tertiary of some important localities in Egypt:-

The Late Cretaceous-Early Tertiary succession in Egypt had been studied by different authors since a long time. Some authors (Barron, 1907; Boussac, 1913; Cuviller, 1930; Ball, 1939) believed that a break in sedimentation occurred between the two systems (Upper Cretaceous-Lower Tertiary) but others (Zittel, 1883; Beadnell, 1927; Picard, 1943; Tromp, 1942 and 1949; Faris, 1947) observed that with rare exceptions no unconformities exist between these two systems.

Nakkady in 1950 published the first work on the foraminiferal fauna of the Esna shale and the Upper Cretaceous chalk of Egypt. He mentioned that strata of the Cretaceous-Tertiary boundary are conformable in the five locations: Wadi Danili, Abu Durba, Wadi Mellaha, Gebel Duwi and Luxor. He considered the chalk and the overlying Esna shale as two phases of continuous sedimentation in the Upper Cretaceous and the Lower Tertiary, where he noted that the Esna Shale fauna is transitional, with Cretaceous affinities below and Eocene affinities above. His conclusion was that the results of his microfaunal study favour Zittel's contention (1883) regarding continuous sedimentation between Cretaceous and Eocene, as the physical evidence was supported paleontologically.

Tromp (1952) reviewed the micropaleontology of Egypt and by using his quantitative generic method, he concluded that in the Middle East, the uppermost Cretaceous and Lower Eocene are transitional. His results were corroborated by the work of Omara (1951) who studied the quantitative generic distribution of

Foraminifera in the Upper Cretaceous to Lower Tertiary succession of Gebel Nezzezzat, Sinai.

Le Roy (1953), studied the foraminiferal content of the Maqfi section, Western Desert. He divided the section into five units: unit "A" lies within the chalk and was given a Maastrichtian age. The Lower Tertiary units (IV, III, II and I) comprise the upper part of the chalk and the Esna shale. He noted a disconformity between his unit "A" and the Lower Tertiary, unit IV due to the faunal changes which reflect a major Paleontologic hiatus.

Osman (1954), studied two sections, the Raha Scarp and Gebel Qabeliate, Sinai. He attempted to zone the Cretaceous chalk to correlate the two sections, but with limited success. Many of the zones found in one section were missing in the other, and no explanation for this discrepancy was given.

Said and Kenawy (1956), identified 275 foraminiferal species from the Upper Cretaceous and the Lower Tertiary of Nekhl and Giddi sections in Northern Sinai. They concluded that the boundary between the Maastrichtian and the Lower Tertiary coincides with the chalk contact in Nekhl section, but it lies within the Esna shale in Giddi section, where he divided the Upper Cretaceous-Lower Tertiary sequence into three mappable rock units:

1 - The chalk: It was dated as Campanian and/or Maastrichtian.

2- The Esna Shale: It was dated as Danian/Paleocene.

3 - A massive Limestone: Its age is Early Eocene.

Nakkady (1957), examined five sections from different localities in Western and Eastern Desert, Nile Valley, and Sinai with an aim to define the biostratigraphic character of the Upper Cretaceous and Lower Tertiary and to correlate the boundaries of these ages in Egypt and outside Egypt. He considered the Danian in Egypt to include the section lying between the upper surface of the "Globotruncana zone"

(Nakkady 1951 and 1955) and the first appearance of Mountain fauna with Nummulites deserti and operculina Lybica etc.

In most parts of the stable shelf of Egypt Said (1962) classified the Late Cretaceous-Early Tertiary succession into the following formations from top to base:

7- Thebes Formation

6- Esna Shale

5- Chalk

4- Dakhla Shale

3- Phosphate

2- Variegated Shale

1- Nubia Sandstone

Issawi (1972) subdivided the Upper Cretaceous-Lower Tertiary sequence in Central and Southern Egypt into three facies types: Farafra, Garra-El Arbain and Nile Valley Facies. Anan et al. (1985) described an "intermediate facies" between the latter two facies at Ain Amur area, Abu Tartur plateau, and Western Desert.

Omran (1973) studied the Late Cretaceous-Lower Tertiary sequence in Umm El-Glanayem section, Kharga Oasis and classified it, based on Planktonic and larger foraminifera, from the top to bottom into the following zones:

8- *Alveolina oblonga/totundata* zone	Late Ypresian
7- *Assilina granulosa/Operculina canalifera*	Early Ypresian
6- *Nummulites planulatus* zone	Late Landenian
5- *Globorotalia aequa/esnaensis* zone	Middle Landenian
4- *Globorotalia velascoensis* zone	Early Landenian
3- *Globorotalia uncinata* zone	Late Danian
2- *Globigerina pseudobulloides* zone	Early Danian
1- *Globotruncana heterohelix* zone	Maastrichtian

Abd El-Malik et al. (1974) dealt with the classification, and illustration of fifty five Planktonic foraminiferal species separated from 37 samples collected from Late Cretaceous-Early Tertiary rocks at Bir El-Markha, West Central Sinai.

Faris (1985) studied the K/T biostratigraphy of the Ghanima and Ain Amur sections in the Kharga area, on the basis of the Planktonic and benthic larger Foraminifera and Calcareous nannoplankton, he stated that the K/T boundary interval is marked by a hiatus concerning the Latest Maastrichtian and Early Danian, while no lithologic changes occur in this boundary interval.

Luger (1985) studied the Upper Cretaceous-Lower Tertiary succession in Southern Egypt, including the two diagnostic sedimentary facies, the Nile Valley and Garra El-Arbain Facies. The biostratigraphic classification of this succession of sediments is achieved by making use of Planktonic and larger foraminifera in samples from 13 locations in the area between Kharga-Bir Abu El-Hussein-Dungul. Considering the biostratigraphical, bio- and lithofacial characteristics, he subdivided the Maastrichtian to early Eocene sedimentary sequence into four almost complete transgressive/regressive cycles with isochronous sediments differentiated into basinal (N) and marginal facies (S). The basinal facies comprises the mainly pelitic deposits of the Duwi (Campanian to Early Maastrichtian), Dakhla (Middle Maastrichtian, *Gn. gansseri* zone to early Middle Paleocene, *Mo. trinidadensis* to *Mo. angulata* zone), Tarawan (Late Paleocene, *G. pseudomenardii* zone), Esna (Late Paleocene, *Mo. velascoensis* zone to Early Eocene, *Mo. edgari* zone) and Thebes Fm. (Early Eocene, *Mo. edgari* zone to *Mo. subbotinae* zone).

The marginal facies is represented by the mainly psamitic sediments of the Shab Member of Kiseiba Fm. (Middle Maastrichtian, *Gn. gansseri* zone at base), of Kurkur (late Early to early Late Paleocene), Garra (Late Paleocene, *G. pseudomenardii, Mo. velascoensis* zone to? Early Eocene, *Mo. edgari* zone) and Dungul Fm. (Early Eocene, *Mo. edgari* to *Mo. subbotinae* zone). The two lithofacies interfringer, depending on the

stage of transgression and regression in different times at different latitudes in the area between Baris and Bir Murr.

Haggag (1986) studied the Late Cretaceous and Paleocene Planktonic Foraminifera from Abu Roash, West of Cairo, she recognized two unconformities, the lower unconformity lies between the Upper Maastrichtian and the Paleocene and the upper one is intra-Paleocene.

Abd El-Aziez (1988) identified 48 Planktonic and 83 benthonic species and subspecies of foraminifera from the Late Cretaceous-Early Tertiary succession of 3 subsurface wells in north-western Desert. He recognized two major unconformities in the succession. The first lies at the Mesozoic-Cenozoic contact and is accompanied by a major Paleontologic break. The second lies between the Late Paleocene and the Early Eocene and is of much smaller magnitude. This reflects the instability of the region during the Late Cretaceous-Early Paleocene time as well as between the Paleocene and the Eocene.

Orabi (1988) mentioned that the Latest Maastrichtian and Early Paleocene were not recorded from four stratigraphic sections (Gebel Nezzazat, Mukattab, Ekma and Qabeliat) in an area lying to the south-east of Abu Rudies in west-central Sinai.

Shahein (1988) deduced that there is no unconformity between the Late Cretaceous and Early Tertiary in Gebel Nezzazat, Sinai.

Bassiouni and Luger (1990) studied the Maastrichtian to Early Eocene marine ostraceda faunas of the Kharga-Bir Abu El-Hussein-Dungul stretch in the Western Desert of Egypt and concluded that there is high similarity of the Late Paleocene to Early Eocene ostracod faunas of West Africa and the Southern Tethys (Afro-Tethyan Type) is emphasized.

El-Sheikh & El-Beshtawy (1992) studied the K/T boundary in two measured sections in west-central Sinai (South-East Nezzazat and Mouth Wither). Seven

formations are recognized from base to top as follows: Sudr Chalk, Esna Shale, Thebes, Darat, Khaboba, Tanka and Red Beds including the equivalent rock unit (Qarara Formation). Based on foraminifera 17 biozones could be established ranging in age from Maastrichtian to Middle Eocene. From these results they concluded the presence of Lacuna in sedimentation during the Uppermost Maastrichtian and Lowermost Paleocene sediments due to the absence of *Abathomphalus mayaroensis* and *Morozovella eugibina* Zones.

Ismail (1992) studied the Maastrichtian-Early Eocene benthonic foraminiferal biostratigraphy and Paleoecology of west-central Sinai (Gindi, Matulla and Qabeliat sections) and he summarized the rock units as Sudr Chalk and Esna Shale and recorded that these units ranges in age from Maastrichtian to Early Eocene according to their Planktonic foraminiferal content.

2.4. Stratigraphical and Paleontological works on the Late Cretaceous-Early Tertiary of the study area (Eastern Desert and Nile Valley):-

Regarding the nature of the Late Cretaceous-Early Tertiary in the region under present consideration, the earlier authors who have worked on that area are Zittel (1883), Newton (1898), Blanckenhorn (1900), Wanner (1902) and others. The geological results and informations of that period included the identification of certain faunal elements and the age determination of Cretaceous and Tertiary rocks.

Barron and Hume (1902), Beadnell (1905), Ball (1909, 1913), Hume (1910, 1927) and others were the first investigators who published rather fundamental papers on the geology of the area.

The most important and detailed recent works on the Eastern Desert and Nile Valley in general and the study area in particular are discussed here.

Beadnell (1905) described Gebel Aweina section in detail and assigned the Esna Shale to the "passage beds" between the well dated Lower Eocene Limestone with flint and the underlying Upper Cretaceous (Danian) Chalk bed. The Lower Dakhla Shale beds were given a Danian age by Beadnell, while the oyster limestone and the associated phosphatic rocks (Said's phosphate Formation) were given a Campanian age.

He concluded that in the southern part of the country, where Upper Cretaceous and Lower Eocene occur in their fullest developments, there is no sharp line of demarcation between the Cretaceous and Tertiary and no disturbance in the stratigraphic succession. He added that the unconformity between the Eocene and the Cretaceous in the southern part of country is not proven.

Hume, in his pioneering work (1911) recognized his so-called "the Wadi Qena type" in the upper reaches of Wadi Qena. He agreed with the age assignments given by Beadnell (op. cit).

Beadnell (1924) worked out the geology of the Red Sea coast between Qusseir and Wadi Ranga. He gave a summarized section of Cretaceous and Eocene rocks. He considered the phosphate beds with the underlying shales and sandstones as upper Senonian (Campanian), the lower part of "Esna Shales" to be of Maastrichtian or Danian, the upper part as passage beds and the overlying limestones as lower Eocene.

Faris (1947) mentioned the occurrence of some species of Foraminifera in his study of Cretaceous-Eocene contact in the Tramsa-Tukh area (Nile Valley, Qena).

Youssef (1949, 1957) studied the Late Cretaceous-Early Paleogene succession in the Qusseir area and regarded the Esna Shale Formation, the succession overlying the Duwi Formation and underlying the Thebes Formation, as representing most of the Maastrichtian-Paleocene age.

In Gebel Aweina section, Nile Valley, Nakkady (1958) has referred the Dakhla Shale and the chalk to the Danian age and the Esna Shale and the overlying Thebes Formation to the (Montian) age.

Faris and Hassan (1959) studied the Stratigraphy and fauna of the Upper Cretaceous-Paleocene rocks of Um-El Huetat, Safaga area and they mentioned that the fossiliferous succession in Um El-Huetat starts with a horizon that is definitely older in age than the oldest fossiliferious horizon in Qusseir area.

Said (1961 & 1962) also described the succession at Gabal Oweina agreeing with the absence of unconformity between the Cretaceous and Tertiary.

Said and Sabry (1964) studied the Planktonic Foraminifera of Upper Cretaceous-Lower Tertiary of Gebel Aweina. They divided this section into different Planktonic zones. The bulk of the Dakhla Shale is of Maastrichtian age, for it contains the characteristic *Globotruncana-Heterohelix* assemblage. The upper layers of the Dakhla Shale are of Danian age (*Globigerina daubjergensis - Globorotalia pseudobulloides* Zone), of lower Landenian age, (*Globorotalia uncinata* Zone), and of lower Middle Landenian age (*Globorotalia pusilla pusilla* Zone), the chalk is of upper Middle Landenian age (*Globorotalia pseudomenardii* Zone) in its lower part, of Lower Upper Landenian (lower levels of the *Globorotalia velascoensis* zone) in its upper part. The Esna Shale belongs to the *Globorotalia velascoensis* Zone in its lower part to the *Globorotalia rex* Zone in its upper part.

Ismail and Abdalla (1966) studied the biostratigraphy of St. Paul Monstary area by means of microfacies. They recognized a thick conglomerate series indicating a major unconformity between the Upper Paleocene (Landenian) foraminiferal marls and the Lower Lutetian calcareous grits and marly limestone. They found that the Lower Tertiary unconformably overlies the Campanian strata and explained the occurrence of reefal shallow facies and the deep water facies deposits to be due to oscillation of the sea floor during the Lower Lutetian age.

El-Naggar (1963, 1966 and 1968) classified the Late Cretaceous/Early Tertiary succession in the region from Esna to Idfu Nile Valley, into the following groups starting by the younger:

C- Libya Group:

5- Thebes Limestone and calcareous shale:

b- Thebes Limestone Member

a- Calcareous Shale Member

B- Esna Group:

4- Oweina Shale:

c- Upper Oweina Shale Member

b- Middle Oweina Shale Member

a- Lower Oweina Shale Member

---------- Disconformity ----------

3- Sharawna Shale:

c- Upper Sharawna Shale Member

b- Middle Sharawna Shale Member

a- Lower Sharawna Shale Member

A- Nubia Group:

2- Sibaiya (phosphate) Formation

1- Nubia Sandstone and Variegated Shale

Later on, El-Naggar (1970) subdivided the rocks of the Late Cretaceous-Early Paleogene succession in the Nile Valley into four groups; these are from top to base as follows:

4- The Mokattam Group

3- The Libyan Desert Group

2- The Esna Group

1- The Nubia Group

The same author (op. cit.) described the Planktonic Foraminifera in that region and used it in assigning the succession age. According to El-Naggar the age of the Upper Cretaceous/Lower Tertiary succession in Esna-Idfu region, Nile Valley are divided into the following zones and subzones from top to base:

7- *Globorotalia willcoexensis* Zone	L. Eocene (Ypresian)
6- *Globorotalia velascoensis* Zone:-	
b- *Globorotalia aequa/Globorotalia esnaensis* subzone	(Landenian)
a- *Globorotalia pseudomenardii* subzone	U. Paleocene
5- *Globorotalia angulata* Zone:-	
b- *Globorotalia pusilla* subzone	(Montian)
a- *Globorotalia uncinata* subzone	M. Paleocene
4- *Globorotalia compressa/Globigerina daubjergensis* Zone	L. Paleocene
3- *Globotruncana esnehensis* Zone	U. Maastrichtian
2- *Globotruncana gansseri* Zone	M. Maastrichtian
1- *Globotruncana fornicata* Zone	L. Maastrichtian

In his study, El-Naggar (op. cit.) regarded the presence of the Upper Maastrichtian represented by the *Globotruncana esnehensis* Zone overlain by the Danian represented by *Globorotalia compressa/Globigerina daubjergensis* Zone to indicate a minor hiatus between K/T.

Kenawy (1967, 1972) studied the Taramsa section, west of Qena on the basis of Planktonic and Larger Foraminifera. He regarded the Dakhla Shale to be of Danian-Landenian age, the Esna Shale to be of Landenian age, while the Thebes Formation belongs to the Yperesian.

The Stratigraphy of the K/T succession at Gebel Duwi and Gebel Anz, Qusseir area, had been studied by Krasheninnikov and Abd El-Razik (1969). The result of their studies is that, in Gebel Duwi the deposition of the succession is continuous i.e. the

Danian is almost complete. Further, Barakat and El-Dawoody (1973), investigated the microlitho- and microbiofacies assemblages from the K/T sediments at Gebel Duwi, they concluded that there is a slight faunal break without any facies changes in the Lower Tertiary.

The geology of the Upper Cretaceous-Lower Eocene rocks was described in detail at the East Qena area, Nile Valley by Abd El-Razik (1970). The following is a lithostratigraphic classification in a scending order:-

1- Thebes Formation:
   - a- Serei Limestone Member — Lower Eocene
   - b- Abu Had (chalk) Member
2- Esna Shale Formation:
   - a- El-Shaghab Member
   - b- El-Hanadi Member — Landenian
3- Tarawan chalk Formation.
4- Dakhla Shale Formation
   - a- Beida Shale Member — Heerisian-Danian
   - b- Hamama marl Member — Maastrichtian
5- Duwi phosphate Formation
6- The Nubia Formation

He recognized ten Planktonic foraminiferal biozones represented the Upper Cretaceous-Lower Tertiary.

Issawi et al. (1971) introduced a valuable discussion for the rock units in the Safaga-Qusseir coastal plain. They recorded a break in the sedimentary sequence between the Maastrichtian and the Danian. The change in lithology between the Lower Marl Member and the Upper Shale Member of the Dakhla Formation is the reason behind that break in the sedimentary sequence. Continuous sedimentation took place during the span of time from the Danian to the Ypresian.

Issawi (1972) in his review of Upper Cretaceous-Lower Tertiary in Wadi Qena assembled the following section as a result of their work taking into consideration Said's (1962), and Akaad and Issawi's (1963) rock units.

Ypresian Thebes Formation-Limestone with flint concretion Landanian.

Chalk-white to grey chalky limestone Paleocene at top-Maastrichtian at base.

Dakhla Shale, Shale with carbonate bands Maastrichtian.

Duwi Formation-alternating phosphate shale Lower Maastrichtian-Campanian.

Nubia Formation.

On both two sides of Qena, East and West of the Nile Valley, Faris (1974) described two sections Gebel Abu Had and Gebel El-Gir. The author used the agglutinated and Planktonic Foraminifera to subdivide the Upper Cretaceous-Lower Tertiary succession in Abu Had section. He recognized these zones in the different formations from top to base as follows:

6- Thebes Formation:	
b- *Globorotalia pentacamerata* Zone	U. Ypresian
a- *Globorotalia rex* Zone	L. Ypresian
5- Esna Shale:	
b- *Globorotalia rex* Zone	L. Ypresian
a- *Globorotalia velascensis* Zone	Landenian
4- Tarawan chalk:	
Planorotalites pseudomenardii Zone	Landenian
3- Dakhla Shale:	
e- *Globorotalia angulata* Zone	U. Danian
d- *Globorotalia uncinata* Zone	U. Danian
c- *Globigerina pseudobulloides* Zone	Lower Danian
b- *Globotruncana gansseri* Zone	Maastrichtian
a- *Globotruncana fornicata* Zone	Maastrichtian

2- Duwi Formation:

Baculites anceps Zone — Maastrichtian

1- Qusseir Shale:

c- *Ammobaculites khargensis* Zone — Campanian

b- *Lituola difformis/taylorensis* Zone — Campanian

a- *Trochamina undulosa* Zone — Campanian

He noticed that the presence of *Globorotalia pseudobulloides* the Lower Danian zone indicates that the Lower Tertiary lies conformably over the Late Cretaceous (Maastrichtian).

According to Haggag (1975) the Dakhla Shale Formation and Esna Shale Formation at Gebel Duwi can be subdivided into the following zones and subzones from top to base:

6- *Globorotalia rex* Zone — L. Eocene

5- *Globorotalia velascoensis* Zone — U. Paleocene (Landenian)

a- *Globorotalia acuta* subzone — U. Paleocene (Landenian)

b- *Globorotalia pseudomenardii* subzone — U. Paleocene (Landenian)

4- *Globorotalia agnulata* Zone — M. Paleocene Montian

a- *Globorotalia pusilla pusilla* subzone — M. Paleocene Montian

b- *Globorotalia uncinata* subzone — M. Paleocene Montian

3- *Globigerina daubjergensis* Zone — L. Paleocene

2- *Abathomphalus mayroensis* Zone — U. Maastrichtian

1- *Globotruncana gansseri* Zone — M. Maastrichtian

Arif (1976) studied the biostratigraphy of Late Cretaceous-Early Tertiary succession in the Eastern Desert, Nile Valley and Western Desert and correlated between 3 sections; Gebel Duwi, in Qusseir area, Gebel Serei in Qena region, and Ezab El-Mawhoob in Dakhla Oasis. He noticed that there is a faunal break which marks the top of the Maastrichtian (detected by the disappearance of the Upper Maastrichtian, *Abathomphalus mayaroensis* zone), and the base of Danian (defined by the absence of the Lower Danian, *Eoglobigerina euboloides* Zone.

Later on, Faris (1982) classified the Upper Cretaceous/Lower Tertiary sequence in central Egypt (Duwi region, Nile Valley, Kharga and Dakhla Oases) on the basis of Planktonic Foraminifera and calcareous nannofossils.

Faris (1984) concluded that the K/T boundary in central Egypt (Duwi region, Nile Valley) is characterized by abrupt changes, extinctions and appearances of microfaunas and floras and he recorded that in most sections, the uppermost Maastrichtian and the basal Danian are missing.

Amstutz et al. (1984) studied the phosphorites of Wadi Qena. they mentioned that the Duwi Formation decreases northwards from 8 m. at Wadi Hamama to 4.5 m. at Gebel Abu Had.

Ezzat (1985) studied the mineralogy and behaviour of some trace elements in the clay fraction of the Late Cretaceous-Early Tertiary shaley succession at Gebel Qreyia, Wadi Qena. He mentioned that the Late Cretaceous-Early Tertiary shales at Wadi Qena area have been deposited in fluvial, deltaic nearshore and pelagic environments.

Akmal (1985) studied the sedimentology and the Stratigraphy of the Upper Cretaceous-Lower Tertiary succession near Qena (Gebel Abu Had, Gebel El-Serai and Gebel El-Gir (Taramsa section). He mentioned that the marked change in faunal and nannofloral assemblages at the K/T boundary is in good harmony with the observations of many authors in different parts of the world. The gradual replacement of the Cretaceous faunas and floras by Tertiary ones suggests a transitional character of the K/T boundary, although it is not clear whether these species crossed the boundary or whether their presence is the result of reworking and he recorded that the basal Danian was missing.

Anan & Hewaidy (1986) studied and identified the Paleocene benthonic foraminiferal assemblages of five sections in the Nile Valley facies in central Egypt, one section from the Eastern Desert (Um El-Huetat section), two sections from the Nile

Valley (Gebel Gurnah opposite Luxor and Gebel Dandara opposite Qena and two sections in the Western Desert (Gebel Ghanima and G. Teir/Tarawan).

They used the benthonic Foraminifera to define two benthonic biostratigraphic zones:

1- *Cibicidoides vulgaris* Zone (Early, Middle Paleocene) [from *Morozovella pseudobulloides* to *Planorotalites pusilla pusilla* Zones].
2- *Loxostomoides applinae* Zone (Late Paleocene) [*Planorotalites pseudomenardii* and *Morozovella velascoensis* Zones].

They mentioned that the Tarawan Chalk and the lower part of the Esna Shale successions in Gebel Dandara section are missing. This stratigraphic gap may be due to mistake in sampling causing this unexpected stratigraphic result in comparison with the stratigraphic data that were published on the neighbouring areas.

Soliman et al. (1986) mentioned that the Upper Cretaceous-Lower Tertiary rocks around Wadi Qena, Egypt, represent a mixed siliciclastic-carbonate-phosphorite succession including (from base to top) the Nubia Sandstone, Qusseir Shale, Duwi Formation, Dakhla Shale, Tarawan Chalk, Esna Shale and Thebes Formation. He recorded that the sedimentation of the Upper Cretaceous-Lower Tertiary rocks were affected by regional and local tectonics.

Faris (1986) examined the K/T boundary in Taramsa section, west of Qena, he concluded that the sedimentation is continuous or contain a hiatus at the K/T boundary. In case of the latter, he concluded that this hiatus probably includes some of the early Danian which is not recorded in this section, where the Uppermost Cretaceous is represented by *Micula prinsii* Zone (nannofossil).

Hendriks and Luger (1987) recorded Amonites in two horizons within the stratigraphic sequence of the Rakhiyat Formation of the Gebel Qreiya area together with the foraminiferal assemblages in the uppermost deposits of the underlying

Hawashya Formation and the lowermost sediments of the overlying Dakhla Formation and this allowed, for the first time, a more accurate dating of the accumulation of the phosphate-bearing strata in Egypt.

Hendriks et al. (1987) studied the evolution of the depositional environments of SE-Egypt during the Cretaceous and Lower Tertiary.

Abu Khadra et al. (1987) studied the Late Cretaceous/Tertiary sequences exposed in the Gulf of Suez area and correlated theserock units with other localities in Eastern Desert. They subdivided the Late Cretaceous-Paleocene succession into six formations and noticed that the lower part of the Esna Shale Formation (Paleocene-Early Eocene) rests paraconformably over the Campanian rocks.

Luger (1988) summarized the sedimentary history and facies development of southern Egypt during the latest Cretaceous and Early Paleogene. He (op. cit.) recorded the eugubina Zone which represents the basal Paleocene.

Ismail (1989) studied the Stratigraphy of the Cretaceous-Lower Tertiary rocks in the southwestern part of the Gulf of Suez region. He discussed in detail the Cretaceous rock units (Nubia Sandstone-Raha Formation, Abu Qada Formation, Wata Formation, Taref Sandstone, Qusseir Formation, Duwi Formation and Suder Chalk) and the Lower Tertiary rock units (Esna Shale and Thebes Formation). His study emphasized that there is no continuous sedimentation between K/T boundary his studied area.

Dabous & Mohammed (1989) studied the Peterographical and Litho-Stratigraphical characteristics as well as depositional environments and lateral variation of facies of the Thebes and Esna Formation in Esna-Qena district.

Kuss's (1992) studies are the stratigraphic and macro-/microfacies investigations of the Cretaceous and Early Tertiary carbonate dominated strata of the Eastern Desert, Sinai and Jordan allow for an interpretation of the Paleogeographic development of the

Northeast African Continental Margin, particularly the growth and destruction of carbonate platforms.

Frank (1996) measured 24 stratigraphic sections from northern surroundings of the Gulf of Suez covering Campanian to Early Eocene clastic and calcareous sediments and he used the Planktonic and benthonic Foraminifera to established a biostratigraphic frame and to interpret the facies development with respect to sequence Stratigraphy and he concluded the Tectonic processes, related to the Syrian Arc system, were active from Campanian to Early Eocene.