SUMMARY AND CONCLUSION

This work is an attempt to better understand the conditions of sedimentation that prevailed during the uppermost Cretaceous (Maastrichtian) to the Lower Eocene (Ypresian), especially at the K/T boundary in Central and Southern Eastern Desert, Egypt. The study concentrates mainly on the Stratigraphic, Paleontologic and Paleoecologic investigations on eleven sections from three regions, Qena, El-Nezzi and El-Mahamid regions.

* **Lithostratigraphically,** the Cretaceous/Tertiary succession in the area under investigation is divisible into four main rock units that unconformably overlies the Rakhiyat/Duwi Fm.:

4- Thebes Fm.

3- Esna Fm.

2- Tarawan Fm.

1- Dakhla Fm.

Rakhiyat/Duwi Fm.

The Dakhla Fm. unconformably overlies the Rakhiyat Fm. in the north (Qena and El-Nezzi regions) and Duwi Fm. in the south (El-Mahamid region). In Qena region, the Dakhla Fm. is subdivided from base to top into:

- Hamama Member
- Beida Member

While in the south (El-Mahamid region) it is subdivided into:

- Sharawna Member
- Oweina Member

In the central part of the study area (El-Nezzi region) an intermediate facies between the northern and southern regions dominates. The Hamama Member and Sharawna Member comprise the Maastrichtian sediments of Dakhla Fm., the overlying

Beida Member as well as the Oweina Member represent the Early to middle Late Paleocene deposits.

The Tarawan Fm. is represented in the three regions and is assigned to late Late Paleocene.

The Esna Fm. which was deposited during the late Late Paleocene and Early Eocene is represented in Qena and El-Nezzi regions, while it is absent in El-Mahamid region where the section is terminated at the top of the Tarawan Fm.

The Thebes Fm. conformably overlies the Esna Fm. and terminates the stratigraphic sequence and it was deposited during Early Eocene (Ypresian).

* **Paleontologically,** the rock samples which have been collected from the studied sections are treated and microscopically investigated for their microfaunal content. The microfauna includes Planktonic Foraminifera and calcareous nannoplankton which are used for the biostratigraphy investigation, beside the benthonic Foraminifera which is used for the Paleoecologic investigation.

One hundred sixty one Planktonic Foraminifera species belonging to thirty six genera are identified, scanned, taxonomically treated and illustrated on twenty eight plates and ten range charts, whereas twenty calcareous nannoplankton species are identified from G. Qreiya section, Qena region and illustrated on two plates and one distribution chart.

Fifteen planktonic foraminiferal species of Late Maastrichtian and Earliest Paleocene are recorded here for the first time from Egypt. These are *Glo'la piramidalis, Ab. asteroidalis, Ru. spinosa, K. falsocalcarata trigonocamerata, K. hangi, K. sp., Psg. hariaensis, H. labellosa* (Latest Maastrichtian); *P. longiapertura, Planorotalites zargounii, Eo. anconitana, Pr. polycamera, Gu. irregularis, Woodringina hornerstownensis, Pr. taurica* (Earliest Paleocene).

* **Biostratigraphically,** using the Planktonic Foraminifera, four modified Planktonic foraminiferal biozones are proposed for Maastrichtian. Four nannoplankton biozones are recognized for the K/T boundary and eleven Planktonic foraminiferal biozones for the Paleogene (Paleocene; Early Eocene) are recognized. The calcareous nannoplankton investigation are carried out to confirm the results obtained from the Planktonic Foraminifera at the K/T boundary. The achieved biostratigraphy is comprehensively discussed considering the global biostratigraphy of the stratotypes at the K/T and P/E. boundaries.

The main result of this investigation is the record of an almost complete stratigraphical section (G. Qreiya, Qena region) from late Early Maastrichtian to Early Eocene from this Egyptian part of the southern Tethyan shelf.

In this section, the *K. falsocalcarata* Zone which represents the latest Maastrichtian is recorded here for the first time in Egypt after the extinction of the *Ab. mayaroensis*. The calcareous nannoplankton has yield results, which also allow the recognition of the latest Maastrichtian represented by *Micula prinsii* Zone. As well the foraminiferal *P. eugubina* Zone which represents the Earliest Paleocene is recorded.

From its comparison with El-Kef section, Tunisia which is considered the global stratotype section all over the world we observed the simillarity between them, therefore, the G. Qreiya section is considered the best and most complete section during the Upper Cretaceous-Lower Tertiary

* **Chronostratigraphically;** from the previous investigation, we distinguished the late Early and Late Maastrichtian ages, and the Danian, Selandian, Thanetian and Ypresian ages representing the Upper Cretaceous-Paleogene sequence.

The interpretation of the stratigraphic situation of the studied rock units and the established ages for the identified taxa and biozones revealed the following conclusions:-

* The Maastrichtian is subdivided into late Early and Late Maastrichtian ages, it comprises the lower member of Dakhla Fm. in the three studied regions.

The Paleocene is subdivided into Early (Danian) and Late (Selandian, Thanetian), it comprises the upper member of Dakhla Fm., Tarawan Fm. and the lower part of Esna Fm.

The Early Eocene (Ypresian) comprises the upper part of Esna Fm. and Thebes Fm.

* Qena region represents the almost continuous sedimentation without facies changes from the late Early Maastrichtian through Early Eocene. The K/T boundary in the south (El-Mahamid region) is marked by a distinct break documented by a conglomeratic horizon which is due to a regressive phase which decreased northwards. El-Nezzi region is considered as intermediate and the K/T boundary is marked by a hiatus represented by the missing of Earliest Paleocene only.

* The Paleocene/Eocene boundary in the area under investigation is continuous within Esna Fm.

Finally, the Paleoecological Parameters, Total foraminiferal number, Heterohelicid/Globotruncanid ratio, keeled and non-keeled Morozovella forms, Test size distribution, Species diversity, Planktonic/Benthonic ratio and Plaeobathymetric curves, are used in the reconstruction of the Paleoecologic conditions of the studied area.

An open marine, inner-to outer shelf deposits accumulated in the area under investigation (Rakhiyat/Duwi; Dakhla; Tarawan; Esna and Thebes Formations). These deposits indicate several transgressive and regressive events due to sea-level fluctuations as well as to tectonic movements. These events are as follows:

- A very short regressive period during the earliest Maastrichtian is indicated by a hiatus (missing of *Globotruncanella havanensis* Zone). This regressive phase is also documented in the study area by the existence of shallow water deposits in the three studied region (Qena, El-Nezzi and El-Mahamid).

- During the late Early Maastrichtian (*Glt. aegyptiaca* Zone), the major transgression started; Transgressive peaks which affected most of the study area are documented at the end of *Glt. aegyptiaca, Ru. hexacamerata* and *Rac. fructicosa* Zones. This phase includes the Lower Member of Dakhla Fm. and is characterized by a foraminiferal assemblage that points to deposition on middle to outer shelf environment.

- This transgressive phase was interrupted by a minor regressive instances that began in the Late Maastrichtian in the southern region and continued to cross K/T boundary.

The maximum of regression, which caused extensive reworking of sediments in southern Egypt, occurred to northwards close to the K/T boundary, probably in *P. eugubina* Zone and *Par. pseudobulloides* zone, where the Maastrichtian forms are recorded in these Zones.

- After the regression of the Early Paleocene which affected the study area, open marine conditions were re-established rapidly in Beida/Oweina Member of Dakhla Fm. and a deeper shelf facies developed during the late *Par. pseudobulloides* Zone. The trangressive peak is attributed to the *Pr. trinidadensis* and *Mo. angulata* Zone (late Early Paleocene-early Late Paleocene).

- By the beginning of the deposition of Tarawan Fm. (*"Ac." pusilla/G. pseudomenardii* Zone boundary, middle Late Paleocene, a thin interval of reworking in the study area is observed indicating erosional activity (Luger, 1988).

The new transgression during the late Late Paleocene (*G. pseudomenardii* Zone) was accompanied by tectonic activity (Strugo, 1986 "Velascoensis event") in G. Qreiya section.

During the *G. pseudomenardii* and the *Mo. velascoensis* Zones almost all regions underwent strong subsidence and open, deep marine conditions were established (Tarawan Fm., lower part of Esna Fm.).

- The upward shift of sediments of Esna type, deposited in outer-to middle-shelf environment by deposits of middle-to inner shelf environment indicates a gradual shallowing of the sea.

- The sedimentary succession which has been deposited during the Early Eocene (Thebes Fm.) accumulated in an open marine middle-to inner-shelf environment.