THE MINERALOGY AND GEOCHEMISTRY OF CARBONATE ROCKS BETWEEN IDFU AND ASSUIT, EGYPT.

THESIS

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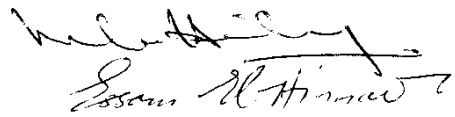

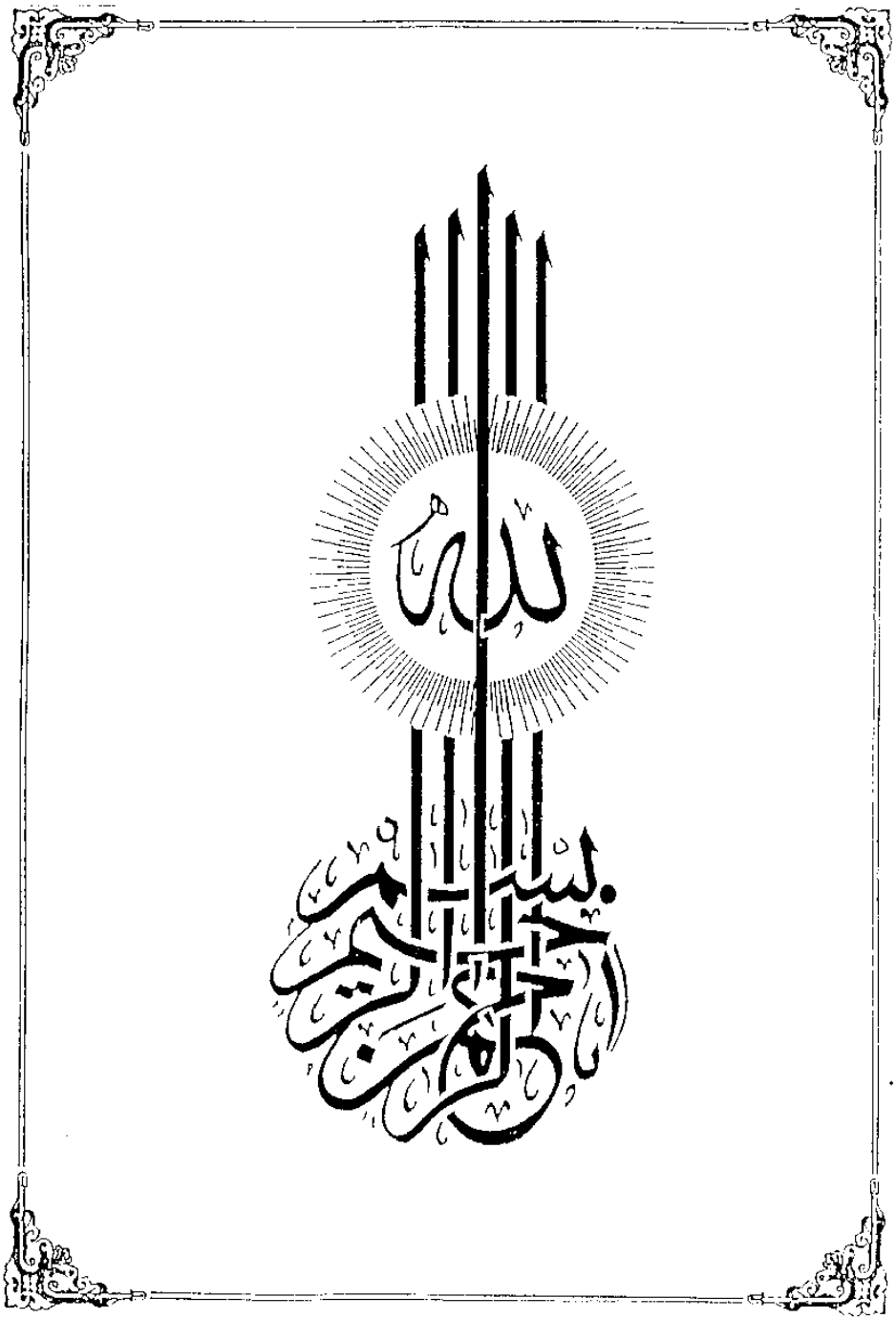

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CONTENTS

CHAPTER VI

CHAPTER VII

CHAPTER I

INTRODUCTION

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INTRODUCTION

The area between Idfu and Assuit (between latitudes 25° and 27°N and longitudes 31° and 33°E) is mostly covered by Early Eocene carbonate rocks. In the neighbourhood of Idfu, Luxor and Qena, however, Cretaceous beds (Nubian sandstone and shale) crop out in limited locations. The Nile Valley itself is composed of sediments of post-Pliocene age (Fig. 1). Within these sediments a number of early Pleistocene carbonates (referred to as travertine) are known to overlie Pliocene sediments in several Wadis, especially between Qena and Sohag. The following is a brief review of previous work carried out on the carbonate rocks occurring on both sides of the Nile Valley between Idfu and Assuit.

I. The Early Eocene

The Early Eocene rocks between Idfu and Assuit have been studied by a number of authors. Boukhary and Abdelmalik (1983) and Said (1990) summarized the stratigraphy of Early Eocene deposits as follows:

(1) The earliest Eocene Formation comprises the uppermost part of the Esna shale which carries the Early Eocene planktonic foraminiferal zones: Morozovella subbotinae and M. formosa.

(2) The Thebes Formation, overlies the uppermost part of the Esna shale, and is composed of massive limestones with flint

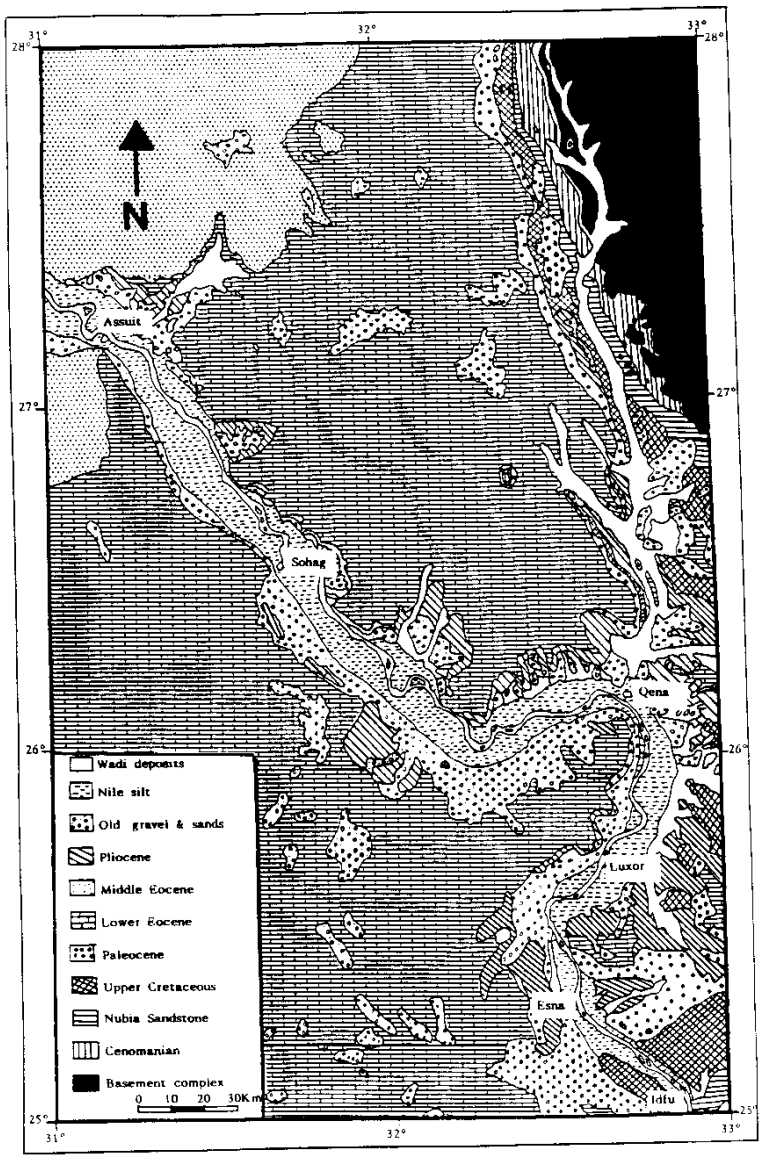

Fig. 1 Geological map of the area around the Nile Valley between Assuit and Idfu (Geological survey of Egypt, 1979).

bands and nodules and sometimes with varying amounts of thin shale and marl intercalations.

(3) The Minia Formation follows on top of the Thebes Formation. The formation consists of thick snow-white limestone and was considered by Said (1960) of Middle Eocene age. However, Boukhary and Abdelmalik (1983) considered it of late Early Eocene age.

Said (1960) introduced the new term "Thebes Formation" to describe a 290 metres section of limestones in Gebel Gurnah on the western side of the Nile facing Luxor. He pointed out that the Thebes Formation overlies conformably the Esna shale which is represented at Gebel Gurnah by some 55 metres of green laminated shales.

Bishay (1961), Labib et al (1968), Abdel Razik (1969, 1972), Ismail and Abdel Razik (1969) and Amr et al. (1970) studied the Thebes Formation and suggested several stratigraphic subdivisions for it. Snavely et al. (1979) pointed out that the Thebes Formation in the Nile Valley can be divided into three informal "members":

(1) The Lower Thebes Member: This member rests conformably on the Esna shale and consists primarily of laminated to thinly-bedded fine-grained limestone and chalk. The limestone tends to be quite indurated and is rhythmically interbedded with the chalky carbonate rock. Scattered nodules or concretions of chert (flint) can be found throughout the member, but tend to be most common in its upper portion. The characteristics of the lower Thebes Member

indicate that it was deposited in a very low-energy environment. This, coupled with the scarcity of benthonic fossils suggests that the member was formed as a pelagic deposit in deep quiet water.

(2) The Middle Thebes Member: This member is less homogeneous than the lower member. While the dominant lithology consists of laminated and thinly-bedded limestone and chalk as in the lower member, interbeds of nodular limestones are common and skeletal limestone horizons are often observed. The deposition of the middle member of the Thebes Formation took place within a marine basin of primarily neritic depth. The relative abundance of the large benthonic foraminifera Nummulites and Operculina suggests moderately shallow, tropical water depths.

(3) The Upper Thebes Member: This member consists mainly of skeletal limestone (oyster limestone and oyster shell debris), and was deposited under shallow-water conditions. The abundance of oysters and their apparent primary accumulation as lenticular, organic build-ups, is due to this shallower water depth.

Hassanein et al. (1983) subdivided the Thebes Formation in the Eastern Desert into three members:

(1) The lower member (Hamadat Member) composed of yellowish-white, chalky limestone with brownish flint nodules. The limestone consists of fine-grained micritic calcite; occasionally dolomitic and with argillaceous material in the lower parts. This member was deposited in a relatively deeper part of the neritic zone.

(2) The middle member (Beida Member) composed of whitish-grey limestone, interbedded with light-brown flint bands. The limestone is partially nodular, fossiliferous, dolomitic and finely crystalline. This member was deposited in a shallower part of the neritic zone.

(3) The upper member (Al-Geer Member) composed of grey, compact, finely crystalline limestones with abundant oyster shells and devoid of any flint. This member was deposited under shallow marine conditions.

Hassaan et al. (1985) identified 10 microfacies in the Thebes Formation at 8 localities in the Eastern Desert. These are: Globigerina foraminiferal biomicrite, dolomitized micrite, nummulitic foraminiferal biomicrite, Operculina foraminiferal biomicrite, algal biomicrite, micrite, microsparite, phosphatic micrite, and sparite. They concluded that the Thebes Formation was deposited in an open marine environment of low oxidation potential; the lower parts of the Thebes Formation were deposited in a deep neritic zone, whereas the upper parts were deposited under shallower conditions.

Mohammad (1984) studied the Thebes Formation at Gebel El-Shagab near Esna and at El Zawida near Qena. He found that the rocks are essentially micritic and biomicritic and were subjected to dolomitization and recrystallization processes. Mohammad (op. cit.) found that the micritic limestone contains higher strontium than other limestone varieties such as dolomitized micrite, dolomitized biomicrite and biomicrite. In other

words, the strontium content of the carbonate rocks was found to decrease by diagenetic processes.

El-Kammar et al. (1988) studied the mineralogy and geochemistry of the Thebes Formation at Mualla, near Esna; Gebel Gurnah near Luxor; and Gebel Nour near Qena. They concluded that the sediments are mainly composed of irregularly dolomitized limestones, and that the chert nodules present in the sediments are composed of diagenetically crystallized quartz together with occasional calcite, dolomite and clay admixture. El-Kammar et al. (op. cit.) pointed out that the distribution of trace elements in the carbonate rocks is controlled by lithology. The heavy metals are strongly correlated with MgO in dolomitic limestones and with Al_2O_3 in argillaceous limestones. They found that the Sr content decreases towards the upper member of the Thebes Formation (Al Geer member) and indicated that this decrease in Sr is due to increasing diagenesis as a result of surfacial processes.

II. The Pliocene and Pleistocene

The Early Eocene between Idfu and Assuit is not followed by Middle and Late Eocene and Miocene strata. It is followed directly by Pliocene and more recent sediments.

The Pliocene sediments of the Nile Valley consist of a lower marine sequence of Early Pliocene age and an upper fluviatile sequence of Late Pliocene age. The rising sea level of the Early Pliocene brought

the Mediterranean into the exacavated Nile canyon transforming it into a narrow gulf reaching as far south as Aswan. The marine Pliocene of this Eonile canyon is made up of montmorillonitic clay and sandy loam (Said, 1981, 1990). The onset of more humid conditions in Late Pliocene time converted the marine gulf of the Nile into a river channel to which Said (1981) gave the name Paleonile. The sediments belonging to this river system consist of a long series of interbedded red-brown clays and thin fine-grained sand and silt laminae which crop out along the banks of the Nile. This was followed by a long episode of aridity in Early Pleistocene in which the Paleonile stopped flowing into Egypt. This long episode of aridity was interrupted by the intrusion of the Protonile, the deposits of which are made up of cobble and gravel-sized sediments. At a later time during the Early Pleistocene a short pluvial occurred during which conglomerates were deposited (the Armant Formation). The composition of the rock fragments that make up the deposits of the Armant Formation differs from place to place, being on the whole of calcareous nature owing to the derivation of most of them from the Eocene limestone plateaus that tower the valley along most of its middle course; but in some areas the fine-grained rock is made up of the products derived from the disintegration of the Cretaceous to Paleocene Dakhla and Esna shales.

The end of the Early Pleistocene pluvial period was marked by the deposition of travertines and tuffaceous rocks (Said, 1981). The best-known of these travertines are those which occur in Issawia along the east bank of the Nile in the vicinity of Akhmim. The travertine is hard

and is almost exclusively made up of pure calcium carbonate which also deposited in thin imbricating laminae around algae and plants which thrived in pools formed during the Armant pluvial. Mineralogically, the travertine is made up of fine-grained microcrystalline calcite and few scattered quartz grains.

Aim of the Present Thesis

The aim of the present Thesis is to give a detailed petrographical, mineralogical and geochemical analysis of the carbonate rocks between Idfu and Assuit, in particular the Thebes Formation of Early Eocene age and the Early Pleistocene "travertine" deposits east of the Nile. A detailed discussion of the mode of formation of these rocks is given in the light of the results obtained.