Ain Shams University
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EOCENE FORAMINIFERA OF WADI HITAN, FAYUM PROVINCE: SYSTEMATICS AND PALEOENVIRONMENTS

A thesis submitted in partial fulfillments of the requirements for the Master degree of science in Geology

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NOTE

This thesis is submitted to the Faculty of Science, Ain Shams University in partial fulfillment of the requirements for the Master degree of Science in Geology. Besides the research work materialized in this thesis, the author did attend eleven post-graduate courses for one academic year in the following topics:

1- Field Geology and Geostatistics.
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ABSTRACT

Wadi Hitan, Fayum Province, is characterized by its unique assemblage of fossil whales, which makes the area so scientifically and naturally important that it has been declared recently as a natural and heritage protectorate. Since then, the area attracted the attention of scientists in many geological fields. The present study shares this international attention and tries to contribute to the understanding of the Geology of Wadi Hitan. The stratigraphy and paleoecology of Wadi Hitan have been investigated based on its foraminiferal content. Planktic foraminifera show that Wadi Hitan succession ranges in age from middle to late Eocene based on the recognized zones; which, from base to top, are : *Turborotalia cerroazulensis possagnoensis* Zone, *Truncorotaloides rohri* Zone, *Turborotalia pseudoampliapertura* Zone and *Globigerinatheka semiinvoluta* Zone. Most of these zones belong to the Gehannam Formation. The overlying Qasr ElSagha Formation, on the other hand, is poor in foraminifera; yet its macro- invertebrate fossils assigned it to the upper Eocene comparable to other parts of Fayum and Egypt.

The benthic foraminifera of the succession are also identified, classified and analyzed. The results were integrated with the field lithofacies characteristics to envisage the paleoenvironment during which the studied succession was deposited. The outcome of this study shows that Wadi Hitan succession represents a gradually shallowing upward neritic sequence that was deposited during middle-late Eocene time. Eustatic sea level changes, overprinted occasionally with wet climatic episodes, controlled the facies and faunal distribution throughout the succession. Maximum shallowing occurred by the end of G. *semiinvoluta* zone of the upper Eocene; and hence the deposition of marginal marine facies of Qasr ElSagha Formation on top.

1. INTRODUCTION

The stratigraphy of Fayum province was extensively studied since the early part of last century (Mayer-Eymar 1883), Beadnell (1905). Foraminiferal stratigraphy in particular has been investigated by a number of workers such as Ansary (1955), Abdou & Abdel-Kireem (1975a), Haggag (1985,1990), Anan (1994), Haggag & Bolli (1995, 1996), Abdallah *et al.* (1997), Elewa *et al*. (1999), Omar (1999), Helal (2002), and Abd El-Azeam (2008).

Wadi Hitan area, a part of the Fayum province, drew a lot of attention as it contains a unique fossil association of whales, and has been declared as a natural and heritage protectorate since (1997). The present study shares the national interest in understanding the biostratigraphy of Wadi Hitan. The present study is directed mainly to investigate the Eocene biostratigraphy and paleoenvironment of Wadi Hitan succession.

Wadi Hitan (Figure1.1) is an elongated area opening in the western part of wadi El-Rayan at about 12km southwest of Garet Gehannam, about 80km west of Fayum city. The general stratigraphy of the study area in relation to the rest of Fayum governorate and other parts of Egypt is discussed in details in the next three chapters.

Sections were measured (Fig. 1.1), representative samples were collected and the major lithologic characteristics were described. Samples were washed and both planktic and benthic foraminifera were picked out, organized, identified and classified. Planktic assemblages were used to recognize the biozones in an attempt to date the different parts of the succession. Planktic/benthic ratios were calculated and graphically represented. Benthic foraminiferal distribution was investigated in an attempt to recognize their systematic positions as well as their depth habitat. The

genesis of the glauconitic intervals were briefly discussed. These results were used to trace any environmental change during the time of deposition of the Wadi Hitan succession.

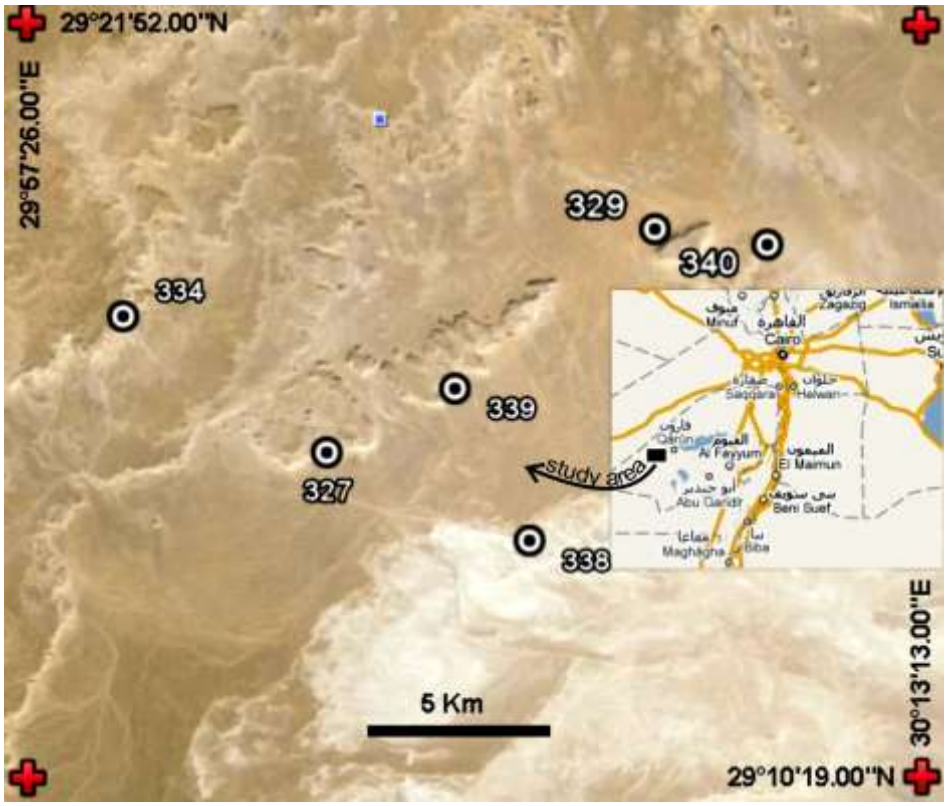

Figure 1.1: Location map of Wadi Hitan, showing the measured sections.

2. GENERAL STRATIGRAPHY OF THE MIDDLE AND UPPER EOCENE ROCKS OF EGYPT

2.1. HISTORY OF STUDY

The modern geology of Egypt is usually considered to coincide with the Rholf's Expedition of 1873-1874. Zittel, the geologist of the expedition, published in 1883 the results of his exploration of the Eastern and Western Deserts. Zittel (1883) divided the Eocene into three stratigraphic intervals: the *Libysche Stufe* or Libyan Stage, the *Mokattam Stufe* or Mokattamian Stage, and the *Ober Eocaen*. He equated the Libyan with the lower Eocene and the Mokattamian with the middle Eocene. In his table of interregional correlation, Zittel drew the upper boundary of the Mokattamian at the base of the beds with *Nummulites fichteli* and *N. intermedius* ("Obereocaene Sch. von Siuah mit *Num. Fichteli, N. intermedia, N. rütimeyeri, Orbitoides papyracea"*). Above these he questionably placed the "Schichten von Birket-el-Qurûn" of the Fayum which he correlated with the Ligurian Stage of Western Europe. Later on, Fourtau (1899b), Blanckenhorn (1900) and Beadnell (1905) will show that the Birket-el-Qurûn beds of Zittel are, in fact, correlatable with the upper part of the Gebel Mokattam succession.

Zittel (1883) placed the lower boundary of the Mokattamian at the first appearance of *Nummulites gizehensis* as seen in the area between Assiut and Minia. The upper boundary of the stage most probably corresponds with the top of the Eocene succession at Gebel Mokattam, below the Gebel Ahmar (now called Gebel Akhdar) sands and gravels, presumably of Oligocene age. Zittel examined a sectionropping out behind the Citadel in the northern part of Gebel Mokattam and gave the following description of it:

1) *Baustein* (or building stone). Made up of limestones quarried at several places and containing abundant *Nummulites gizehensis*, large molluscs (cerithiids, naticids, nautiloids), large echinoids (*Echinolampas africana, E. fraasi*), and crabs (*Lobocarcinus*),
2) Limestones similar to (1) with *N. gizehensis* still abundant in the lower part, replaced in the upper part by *Operculina pyramidum, Orbitoides papyracea, Nummulites beaumonti,* and echinoids (*Echinolampas africana, E. fraasi, Porocidaris schimedi, Eupatagus formosus*).
3) Clastic complex made of shales interbedded with dark ferruginous sandy limestones. Fossils include *Ostrea clotbeyi* (bank-forming) and abundant spatangoids (*Schizaster, Linthia, Anisaster*).

Following the monumental monograph of Zittel, several attempts have been made to divide the Mokattamian into subunits that could be correlated across the Egyptian territory and with the west European stages.

Blanckenhorn (1900) divided the Mokattamian into lower Mokattamian (white limestones = units 1 and 2 of Zittel) and upper Mokattamian (unit 3 of Zittel). He called the lower Mokattamian *Gizehensis-Stufe* and divided it into 5 units (I-1 to I-5), and the upper Mokattamian *Carolia-Stufe* and divided it into 8 units (II-1 to II-8). Blanckenhorn regarded the entire Mokattamian sequence as being equivalent to the Parisian (Lutetian, middle Eocene) of Europe.

In a comprehensive study of the topography and geology of the Fayum, Beadnell (1905) classified the Paleogene stratigraphic succession exposed in the area into five units. From top to base, these are:

5) Fluvio-marine Series (Jebel el Qatrani beds)
4) Qasr el Sagha Series (*Carolia* beds).
3) Birket el Qurûn Series (*Operculina-Nummulites* beds).
2) Ravine Beds.
1) Wadi Rayan Series (*Nummulites gizehensis* beds).

Beadnell correlated units (1) to (3) with the lower Mokattamian and unit (4) with the upper Mokattamian. Like Blanckenhorn (1900), he regarded the entire Mokattamian succession as being equivalent to the Parisian (Lutetian) of Europe, while the Fluvio-marine Series (unit 5) was considered as equivalent to the upper Eocene (Bartonian) and lower Oligocene (Tongrian) of Europe.

Hume (1911), summarizing his personal observations on the Eocene succession of the Western Desert, wrote (p. 141): «Further study will probably indicate a triple division of the Middle Eocene as being the most convenient; the Middle Moqattam Beds in such a case would be characterized by the abundance of the *Exogyra fraasi* bands, and a great development of the smaller nummulites (*Nummulites schweinfurthi, N. beaumonti*, etc.)». He illustrated his point of view in a table (2.1) in which he compared his results with the works of his predecessors– Beadnell (1905) in the Fayum and Blanckenhorn (1900), among others. It should be noted that Hume was not totally convinced that the Mokattamian belonged entirely in the middle Eocene. Thus he wrote (p. 142): «I have purposely refrained from comparing these strata more closely with the Eocene formations of Europe, as this would require a more careful palaeontological analysis than time has permitted me to undertake. Only such a study will finally decide whether the Upper Moqattam as above defined should be regarded as Upper Eocene, instead of being considered, as it was originally, the uppermost member of the Middle Eocene. ». This was the first hint at the possible younger age of the upper part of the Mokattamian.