"Paleontological studies and sedimentological evolution in Wadi El-Hitan District, Fayoum Governorate, Egypt"

A Thesis
Submitted to the Faculty of Science
Cairo University

By

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Partial Fulfillment of the Requirement for
Master of Science in Geology

Cairo 2010

Approval sheet

Title of the MSc. Thesis

"Paleontological studies and sedimentological evolution in Wadi El-Hitan District, Fayoum Governorate, Egypt"

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To My Father

To My Dear Mother's Soul

To My Wife

To My Children

Note:

The present thesis is submitted to the faculty of science, Cairo University in the partial fulfillment of the requirement for the degree of Master of Science in (Geology).

Beside the research work materialized in this thesis, the author has attended eleven post-graduate courses for one year and successfully passed the final examination of Msc. Courses in the following topics:

1. Lithostratigraphy
2. Biostratigraphy
3. Macropaleontology
4. Micropaleontology
5. Paleoecology
6. Sedimentary Rocks
7. Sedimentation
8. Structure Geology
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Note:

All the referred Figures in the text are located at the end of each chapter of this thesis. The appendices are given at the end of the thesis.

ACKNOWLEDGMENTS

First thanks to God for the continuous and persistent supply with patience to produce this study. The author wishes to express his thanks to Prof. Dr. Adel Sehim, Head of Geology Department, Faculty of Science, Cairo University for the facilities offered from the Department. The author wishes to express his deep gratitude and his sincere appreciation to the main supervisor **Prof. Dr. Mohammed El Anbaawy**, prof. of sedimentology and environmental Geology, Geology Department, Cairo University who suggested the problem of this study, and helped very much in the fieldwork and critical reviewing the thesis. His sympathy and variable scientific discussion during the study is greatly appreciated and unforgettable. The author is greatly indebted to **Dr. Mohsen Abdul Fattah**, Geology Department, Cairo University for his great help for supervision and guidance during the fieldwork and also for the available discussion during the study.

The author is greatly indebted to **Prof**. **Dr. Mohammed Gameil**, Geology Department, Cairo University for his supervision, valuable advice, discussion, help and guidance.

The author wishes to to express his deep gratitude to **Mr. Mohammed El Hakeem**, the director of the Egyptian Geological Museum for the great help in during the preparation of the whale skull specimen and studying it. In addition, I thank very much Mr. **Magdi Zakarya**, the general manager of the vertebrate department in the Geological Museum for his distinctive help. In addition, I thank very much Mr**. Medhat Said, Mr. Afifi Hassan, Mr. Yaser abdulrazik** the geologists in the Egyptian Geological Museum for their great help.

The author thanks very much **Mr. Mohammed Magdy**, the technician in the Egyptian geological museum for his great help during the preparation of the whale specimens. The author also thanks very much **Dr/ Sayed Abdel Aziz**- Fayoum University- Geology Department for his help during the study.

The author thanks very much **Mr. Khaled Dieb**, my friend for his help during the study. The author thanks very Much **Mr. Ahmed Awad**, the geologist in Wadi El Rayan protected area. In addition, I thank very much **Mr. Taha Abdulaaty**, the driver of Qaroun protected area for his great help and guiding in the desert.

Finally, I thank very much Mrs. **Faten Mohammed** (Azhar University) for her assist in preparing maps by GIS Program.

Abstract

The present thesis aims to study the geological, geomorphological, and structural setting of the **Wadi El-Hitan area**, which represents the UNESCO world heritage site in the Western Desert, Fayoum, Egypt. The present study also aims to integrate the paleontological, sedimentological and sequence stratigraphical factors govern **the plaeoenvironment framework** of the Bartonian- Priabonian succession and their fossil contents in the Wadi El-Hitan area. **The taxonomic composition a**nd sequence stratigraphical position of the whale fossils were emphasized in this work. Rock and fossils samples were collected from four stratigraphic sections, namely; Qaret Gehannam, Minqar El Hut, Sandouk El Bornitta and North Wadi El-Hitan sections that representing the Middle – Late Eocene formations. These samples were petrographically and paleontologically investigated to reveal their composition, microfacies and **diagenetic characteristics**.

New **geomorphological and geological maps** were constructed. **Parasequences and sequence boundaries** were recognized based on the distribution of the lithostratigraphical, biostratigraphical and facies sequence characteristics of the Gehannam (Bartonian – early Priabonian), Birket Qaroun (Priabonian) and Qaser El Sagha (Priabonian) formations.

The Gehannam Formation includes mudstone – fossiliferous sandstone (MFS) indicating open marine shelf in initial regressive system tract, limestone– bioclastic sandstone (LBS) indicating shallow open shoreface in a regressive system tract and mangrove limy sandstone – mudstone sequence boundary (MSM) indicating lowstand system tract with limited subareial exposure and a restricted lagoonal local environment where it was subjected to paleometeoric diagenesis and weathering. The mangrove sequence boundary can be correlatable with the nearly Pr1 of the global eustatic sea level curve.

The Birket Qaroun Formation includes bioclastic mudstone- fine sandstone (BMS) indicating open marine shelf with storm deposits, thick mudstone – thin friable sandstone (TMS) indicating time of maximum marine sediment accommodation, burrowed limy – bioclastic sandstone – mudstone (BBS) indicating initial transgression with submarine barrier sand bars complex on shallow shelf to shallow

embayment environment with occasionally storm events, conglomeratic skeletal sandstone sequence boundary (CSS) indicating river system near shoreline where it was subjected to subaerial exposure with paleo-meteoric diagenesis and it can correlatable with Pr2, cross bedded rippled friable sandstone- interbedded mudstone (CSM) indicating mixed fluviomarine system during the initial transegressive phase of sequence TA4.2, and bioclastic conglomerate sandstone – mudstone (BCS) indicating early transgressive tract with initial reworked nearshore over muddy embayment.

The lower part of the **Qaser El Sagha Formation** includes limestone- mudstone-marl parasequence (LMM) which indicating nomal marine shallow shelf condition during early to moderate transegressive tract. Generally, the microfacies paleoecological invistegations support the revealed the above paleoenvironment interpretation.

Adynamic paleogeographic model was developed in a sedimentlogical evolutionary steps, which related to eustatic global sea level change. However, this change is supported by tectonic subsidence and uplifting along WSW- ENE fault trend that divide the study area into northern sector including the North Wadi El-Hitan section, and southern sector including the rest of the sections. The observed shift between the local curves that representing the sea level cycles of the southern sections and those of the northern one, may reflect tectonic activity. The northern section depositional cycles are basically consistent with the global eustatic sea level while the southern ones are not.

It was found that most **vertebrate remains** of the Birket Qaroun Formation in the study sections, particularly those of the North Wadi El-Hitan section, occur in condensed stratigraphic intervals where the taxonomic composition changes with sequence position. Eight types of stratigraphic horizons (I, II, III, IV, V, VI, VII, VIII horizons) were recognized within the parasequence and sequence boundaries: MFS, LBS, MSM and CLM. It is documented that complete, partially articulated skeletons of *Basilosaurus isis*, *Dorudon atrox* and dugongs are abundant in IV, V and VII horizons respectively. The vertebrate contents in the rest of the horizons are not directly related to the sequence stratigrarphic architecture or sea level change

controlling factors; however, other factors e.g. local coastal or embayment geomorphology and shallow shelf environment conditions between the transegressive and regressive phases that representing the sequence boundaries (e,g. MFS) may be involved. It was found that the most common whale types nearly in the all stratigraphic horizons are ***Basilosaurus isis*** **and** ***Dorudon atrox***, for this reason, their taxonomic composition and skeletal structure were described in some details.

The most important **diagenetic processes** that took place during multi stages of **diagenetic history** of the study limy- siliciclastic – carbonate stratigraphic intervals are: compaction, carbonate and iron oxide cementation, neomorphism and celesitization. These processes could be choronologically arranged as eodiagenetic stage (including marine diagenesis and hardground synsedimentary sea- floor cementation), mesodiagenetic stage during burial history and finally telediagenetic stage during uplifting and meteoric water intrusion the exposed sediments and vertebrate fossils. The celecitization process is very common in mangrove and bone fossils beds, which seems to be formed during eodiagenetic and paleoexposed stage.

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