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Facies and sequence stratigraphy of some Miocene sediments in the Cairo–Suez District, Egypt

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ABSTRACT

The shallow-water siliciclastics and carbonates of the Miocene sediments in the Cairo–Suez District, Egypt represent an epiric ramp. The facies are characterized by stacked high-frequency cycles with restricted ramp to shoal margin sequences. Based on an extensive micro- and biofacies documentation, six lithofacies associations were defined and their respective depositional environments were interpreted. A sequence-stratigraphic analysis was carried out by integrating lithostratigraphic marker beds, facies relationships, stratigraphic cycles, and biostratigraphy. The investigated sections were subdivided into three third-order sequences, named S1, S2 and S3. S1, is interpreted to correspond to the Late Burdigalian stage (18–16.38 My), S2 corresponds to the Late Burdigalian–Early Langhian stage (16.38–14.78 My), and S3 represents the Late Langhain–Early Serravallian stage (14.78–13.66 My). Each of the three sequences was further subdivided into fourth order cycle sets and fifth-order cycles.

1. Introduction

The overall sedimentary nature of the Miocene sediments in the Cairo–Suez District, Egypt tends to be dominated by epiric ramp deposits. The Cairo–Suez area lays East of Cairo and extends about 120 km to the city of Suez. It lies between Latitudes 29°55′–30°20′N and Longitudes 31°15′–32°35′E (Fig. 1). The topography of the area is largely controlled by its structure and the relief is generally low except for few hills and small mountains. Topographically, the area is subdivided into three ridges crossing the district in a more or less E–W alignment; between these ridges there are two depressions. The Cairo–Suez asphaltic road passes through the southern one, while Gabal Ataqa, Gabal Abou Treifiya, Gabal Qattamiya, Gabal Anqabiaya, Gabal Nasuri and Gabal Mokattam form an elongated ridge running parallel to Cairo–Suez high way depression from East to West and to the South of it (Abou Khadrah et al., 1993). The oldest exposed rocks in the area are of Early Cretaceous age while the youngest rocks are of Quaternary age of sy-nrift sedimentary sequence (Bruce and Hotzl, 1988). The Miocene rocks of the Cairo–Suez area were the subject of many studies since the last quarter of the 19th century.

The regional stratigraphy of the Miocene in the Cairo–Suez area has been studied by different authors (e.g. Fuchs, 1883; Depéret and Fourtau, 1900; Blanckenhorn, 1901; Barron, 1907; Shukri and Akmal, 1953; Sadek, 1959; Said, 1962, 1971, 1990; Said and Metwalli, 1963; Ghorab and Marzouk, 1965; Abdallah and Abd El-Hady, 1966; Barakat and Aboul Ela, 1970; Stratigraphic Sub-Committee, 1974; Abbass, 1977; El-Heiny, 1982; Abdel Wahab and El-Belassy, 1987; Szczechura and Abd-Elshafy, 1988; Abd-Elshafy and Abd-Elmoneim, 1992; Hamza, 1992; Abou Khadrah et al., 1993; El-Sorogy and Ziko, 1999; El-Shazly and Saber, 1999; Abdelghany, 2002; Elattar, 2003; Mowafi, 2006). The lithostratigraphic classification of the Miocene in the Cairo–Suez area is illustrated in Table 1.

The main two aims of the present study are: (1) Identifying facies types of the Miocene sediments in the Cairo–Suez area in Egypt, as well as make an acceptable interpretation by integrates micro- and biofacies analysis to construct a 2D siliciclastic–carbonate model. (2) Estimating the studied successions in the view of sequence stratigraphic analysis by subdividing the studied sections into sequences, cycle sets, and cycles. Three stratigraphic sections have been chosen to fulfill these aims of study. These are Gabal Geneifa, Gabal Gharra and Gabal Homeira sections (Fig. 1).

1.1. Methodology

A standardized logging sheet was developed and used to log the studied sections of the Cairo–Suez District, Egypt. The main

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properties recorded in these sections are: texture, biota, grain type and size, sorting, bedding style, sedimentary features of the rocks and facies. 450 representative samples were collected from the field to produce 162 thin sections, which were examined under polarizing microscope to integrate lithological, paleontological and diagenetic data for facies characterization, and sequence stratigraphy. The nomenclature of limestone in the present study follows that system introduced by Dunham (1962) and Embry and Klovan (1972).

2. Results and discussion

2.1. Facies analysis and interpretation

14 Lithofacies types (LFT) were distinguished in the Miocene studied sections on the Cairo–Suez District (Table 2, Figs. 2 and 3). The description and classification of these lithofacies types depend on the following: textures, mineralogy, rock color, grain size, sorting, components (skeletal or non skeletal), thickness of different rock unit, bedding style, sedimentary features, interpretation of depositional setting and the appearance according to lithofacies code (Fig. 4). In general, the studied sections are divided into two lithostratigraphic units namely, the Gharra Formation and the Genefe Formation in ascending order, according to Ghorab and Marzouk (1965).

The Gharra Formation rests unconformably on sediments of Oligocene age (sands and gravels) with silicified woods in both Gabal Gharra and Gabal Homeira sections, while in Gabal Geneifa one the base of the formation is unexposed. In all the three sections, the Gharra Formation is conformably overlained by the Genefe Formation, and consists mainly of clastics (shale, claystone, marl and sandstone) with sandy limestone interbeds. The limestones are low or moderate fossiliferous to highly fossiliferous, containing rich assemblages of macrofossils.

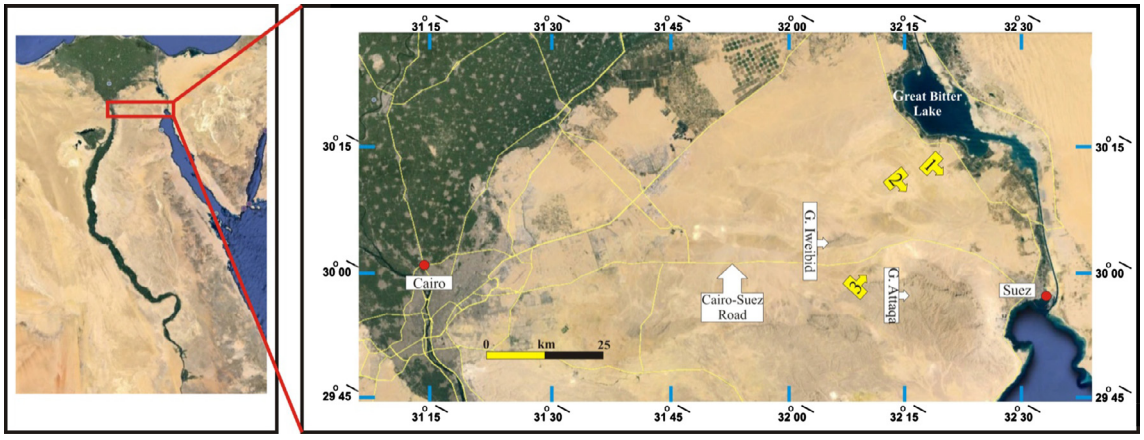

Fig. 1. Location map of the studied sections, 1. Gabal Geneifa section, 2. Gabal Gharra section, 3. Gabal Homeira section.

Table 1
Different rock units proposed by different authors for the Miocene rocks in the Cairo–Suez District.

Shukry & Akmal (1953) Shukri & Ayouti (1956)	Said (1962)	Ghorab & Marzouk (1965)	Farag & Sadek (1966)	Stratigraphic Sub Committee (1974)	Abbass (1977)	El-Heiny (1982)	Said (1990)	El Shazly & Saber (1999)	Elattar (2003)	Mowafi (2006)	Present work
Non marine Miocene	Upper Miocene / Non marine Miocene	Iweibid Fm: El-Bahhara Member, El-Hamza Member	Upper Miocene / Non marine Miocene	Upper Miocene: Hagul Formation		Plioc: Hamzi Formation; Messinian: Hagul Formation	Late Pliocene: Hamzi Formation, Hagul Formation	Late Miocene (?)		Post Middle Miocene	Post Middle Miocene
Marine Miocene	Middle Miocene / Marine Miocene / Calcerous unit	Gharra Formation (Fm): Genefe Member, Gafra Member, Abbasia Member, Reishi Member, Sukhna Member	Helvetian / Marine Miocene	Middle Miocene: Genefe Member; Hommath Formation: Gafra Member, Abbasia Member, Reishi Member; Lower Miocene: Sadat Formation	Gharra Formation: Genefe Chalky Limestone Member, Hommath Sady Limestone Member, Sadat reefal LST Member, Agrud S.s Member	Middle Miocene: Genefe Formation, Hommath Formation, Sadat Formation	Langhian: Genefe Formation; Aquitanian-Burdigalian: Gharra Formation	Middle Miocene: Genefe Formation; Early Miocene: Gharra Formation	Middle Miocene: Sadat Formation; Early Miocene	Middle Miocene: Genefe Formation; Early Miocene: Gharra Formation	Serravalian: Sequence 3; Laghiann: Sequence 2; Burdigalian: Sequence 1
Oligocene	Lower Miocene / Sandy unit / Oligocene	Oligocene	Burdigalian / Oligocene	Upper Eocene	Oligocene	Burdigalian / Oligocene	Oligocene	Oligocene	Eocene	Oligocene	Oligocene