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Sequence stratigraphy of the Maastrichtian-Paleocene succession at the Dakhla Oasis, Western Desert, Egypt

Abdel Galil A. Hewaidy [a, *], Sherif Farouk [b], Youssef S. Bazeen [a]

[a] Geology Department, Faculty of Science, Al-Azhar University, Cairo, Egypt
[b] Exploration Department, Egyptian, Petroleum Research Institute, Cairo, Egypt

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ABSTRACT

The Maastrichtian-Paleocene succession at the Dakhla Oasis is marked by the presence of a typical Nile Valley Facies represented by the Dakhla and Tarawan formations in Edmonstone and Qur El Malik sections in the central and western parts of the oasis, while a mixed Nile Valley and Garra Al-Arbain facies represented by Dakhla, Kurkur and Tarawan formations in Teneida section in the eastern part of the oasis adjacent to the Abu Tartur Plateau. These sections were examined for their foraminiferal contents, lithologic characters and stratigraphic boundaries. The distribution of foraminifera in the studied sections is variable and inconstant, as the planktonics are concentrated only at certain levels, which may be considered as a time intervals of transgression and maximum flooding surfaces. Eight planktonic biozones are distinguished in this work; of theses two are of Maastrichtain age and six are of Paleocene age. Eight 3rd order depositional sequences are recognized in the studied Maastrichtian-Paleocene succession based on the time stratigraphic boundaries released from the planktonic foraminifera and sea level changes which are released from the paleoecologic interpretations. The distinguished sequences are subdivided into their systems tracts based on the paleobathymetric interpretations of P/B% and benthic biofacies analysis. These sequences are bounded by eight sequence boundaries (SB A - SB H) represented by unconformity surfaces and depositional hiatuses. The correlation of the sequence boundaries of the established depositional sequences with the eustatic sea level curve, suggesting that these depositional sequences were resulted from the interplay of eustatic sea-level changes and local tectonic activities.

1. Introduction

The Dakhla Oasis lies about 300 km west of the Nile, between longitudes 28°15′- 29°40′ E and latitudes 25°00′ - 26°00′ N (Fig. 1). The oasis and adjacent areas were subjected to many geological investigations since 1883 when Zittel gave the first geological information about the south Western Desert. This is followed by several paleontological and stratigraphical studies (e.g., LeRoy, 1953; Hermina et al., 1961; Awad and Ghobrial, 1965; El-Naggar, 1966; Abbass and Habib, 1969; Issawi, 1972; Barthel and Herrmann-Degen, 1981; Lüger, 1985, 1988; Anan and Sharabi, 1988; Hermina, 1990; Hewaidy, 1990; El-Azabi and El-Araby, 2000; Schnack, 2000; Tantawy et al., 2001; Hewaidy et al., 2006, 2014; El-Azabi and Farouk, 2011; Farouk and El-Sorogy, 2015; El Nady and Hammad, 2015). Few of these studies were concerned with the sequence stratigraphy of this area (e.g., El-Azabi and El-Araby, 2000; Schnack, 2000; Hewaidy et al., 2006; El-Azabi and Farouk, 2011).

The main objectives of this study are: 1- Establishing a biostratigraphic framework for the Maastrichtian-Paleocene succession exposed at Dakhla Oasis based on planktonic foraminiferal zonation. 2- Study the environments of deposition of the studied successions based on foraminiferal content and lithological characters. 3- Interpretation of the studied succession in terms of sequence stratigraphy.

2. Material and methods

Three sections representing the Maastrichtian-Paleocene successions in the Dakhla Oasis were measured, sampled, and studied at Edmonstone, Qur El Malik, and Teneida. A total of 749 rock

* Corresponding author.
E-mail addresses: ahewaidy50@yahoo.com, ahewaidy@hotmail.com (A.G.A. Hewaidy).

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samples were collected from the three studied sections. The studied samples were prepared for foraminiferal studies following the normal techniques.

The foraminiferal species were picked and the different planktonic and benthonic foraminiferal species were identified and counted. The different foraminiferal parameters as planktonic/benthic ratios (P/B %) and diversity were calculated. The benthic foraminiferal species are subjected to cluster analysis using Minitab computer program in order to figure out the relation between the different associated groups and subdivide them into biofacies assemblages. Bathymetric range for the different benthic foraminiferal species and assemblages, planktonic/benthic ratio (P/B %) and diversity, expressed by the total number of the species, were employed to establish the paleodepth curve. The distribution of the identified planktonic foraminiferal species was utilized in planktonic foraminiferal biostratigraphic classification of the studied succession based on the schemes of Li et al., 1999 and Huber et al., 2008 for the Maastrichtian and that of Keller et al., 1995; Keller et al., 2002; Berggren and Pearson, 2005; Wade et al., 2011 for the Paleocene. The biostratigraphic studies, biofacies analysis, and detailed field study are integrated to build a sequence stratigraphic framework for the studied succession.

3. Lithostratigraphy

The stratigraphic successions exposed in the study area are represented by two main facies types: Nile Valley Facies and Garra El-Arbain Facies (Issawi, 1972). These facies are described in detail below within the context of their corresponding Maastrichtian-Paleocene rock units.

3.1. Nile Valley facies

This facies is widely distributed in the study area and subdivided into two formations: Dakhla Formation at the base and Tarawan Formation at the top.

3.1.1. Dakhla Formation

The term Dakhla Shale was first introduced by Said, 1962 to describe 230 m thick of shales and mudstones overlying the Duwi Formation and underlying the Tarawan Formation. According to Awad and Ghobrial, 1965, the Dakhla Formation is subdivided into three formal members the Mawhoob Shale Member at base, the Beris Oyster Mudstone Member at middle, and the Kharga Shale Member at top.

The Mawhoob Shale Member describes the basal fissile black shales overlying the Duwi Formation and underlying the Beris Oyster Mudstone Member of the same formation. It consists of grey to black fissile calcareous silty shales inerbedded with siltstone. It is assigned to the early Maastrichtian age based on its foraminiferal content (CF7 Zone).

The Beris Oyster Mudstone Member represents the middle subdivision of the Dakhla Formation. It consists of grey to reddish grey shale intercalated with argillaceous limestone, sandstone, and siltstone enriched in *Exogyra overwegi* of the middle Maastrichtian age.

The Kharga Shale Member is overlain by the Tarawan Formation. It consists of pale to dark grey to green calcareous, partly glauconitic, and phosphatic shale intercalated with siltstone, sandstone, and limestone. At the middle part of the Kharga Shale Member, a phosphatic conglomeratic band with 20–30 cm thick, represents

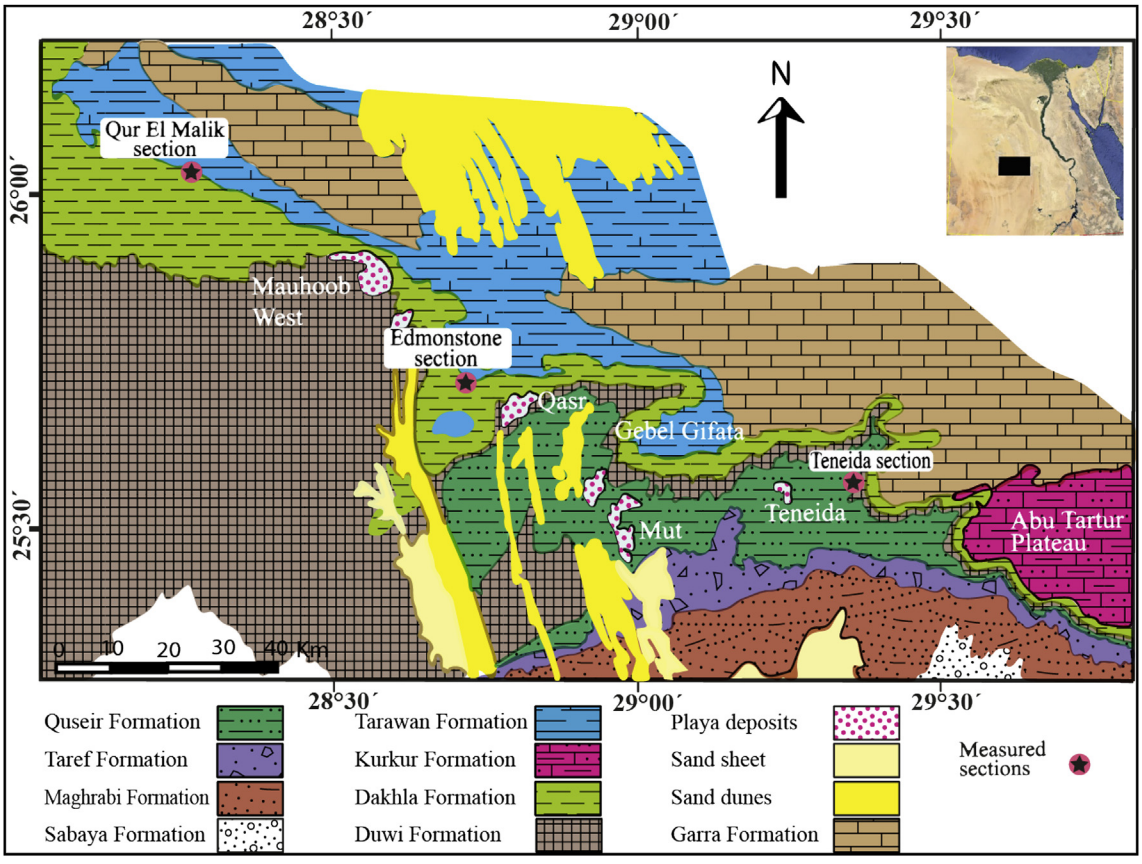

Fig. 1. Geological map of the Dakhla Oasis with location of the three studied sections. After Conoco, 1987.