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Sea-level changes in the Paleocene (Danian–Thanetian) succession at the Dakhla Oasis, Western Desert, Egypt: implications from benthic foraminifera

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ABSTRACT

The Danian–Thanetian benthic foraminiferal assemblages at the Gharb El-Mawohb section in the Dakhla Oasis of Western Desert (Egypt) are inferred in combination with characteristic species, genera distribution, Benthic Foraminifera Numbers (BFN), species diversity, and abundance of high flux-species to infer prevailing paleoenvironment, paleoproductivity and paleobathymetry vis-à-vis sequence stratigraphy, regional tectonics, climate and changes in sea-level. The response of benthic foraminiferal assemblages to sea-level changes during boundary successions, namely the Danian/Selandian (D/S) and the Selandian/Thanetian (S/Th) is also analyzed. Data suggests a remarkably highly equitable environment throughout the studied interval. Eighty eight percent of the data plot in the restricted littoral environment (mostly in brackish and some in normal lagoons) suggesting that the fauna are not stressed despite a largely shallow depositional setting (middle to outer neritic, at places upper bathyal). The dominance of calcareous taxa indicates a largely open marine condition, in a largely oxic and oligotrophic environment, except in the late Paleocene where high-organic-flux species suggest increased paleoproductivity possibly due to local upwelling. The end of Zone P2 marks the deepest part of the studied section (outer neritic to upper bathyal) followed by gradual shallowing across the section (inner to middle neritic), with intermittent deepening in the middle of Zone P3a and P3b (middle neritic). There is shallowing at the transitions of Zones P3a, P3b and P4 (inner neritic). The changes in the vertical facies and benthic foraminiferal assemblage at the D/S and S/Th boundaries are analyzed.

1. Introduction

The southern Tethyan margin represents an important area for studying processes on the Paleocene continental margin, as it provides numerous well-exposed outcrops, yielding well-preserved microfossils and representing a wide variety of paleoenvironmental settings (Farouk, 2016). Climatically, the Paleogene was a highly dynamic period, transitioning from a near ice-free world of the Cretaceous to the glacially dominated world of the Neogene, marked by important biotic and environmental changes (Zachos et al., 2001; Speijer, 1994, 2003; Speijer and Schmitz, 1998; Speijer et al., 2000; Arenillas, 2011; Schmitz et al., 2011; Liebrand et al., 2017). Along the continental margin, Egypt (Fig. 1a) occupies a prominent place to study biotic changes, where the southern and central parts of the Western Desert have received much attention for stratigraphic, paleontological and sedimentological studies (see Luger, 1985; Bassiouni et al., 1991; El-Azabi and El-Araby, 2000; Tantawy et al., 2001; Hewaidy et al., 2006; El-Azabi and Farouk, 2011; Boukhary et al., 2013; El Nady and Hammad, 2015; Hewaidy and Ayyad, 2015; Farouk and El-Sorogy, 2015; Farouk, 2016). However, benthic foraminiferal paleoenvironmental and paleobathymetric studies in the Dakhla Oasis remain scarce (Schnack, 2000; Hewaidy et al., 2014; Farouk and Jain, 2016).

The present study is an attempt to bridge this gap and uses the presence and distribution of benthic foraminiferal species, genera and assemblage, BFN (Benthic Foraminiferal Number), species diversity, and abundance of high flux-species to infer the prevailing paleoenvironment, paleoproductivity, paleooxygenation and paleobathymetry of the Danian–Thanetian interval at the Gharb El-Mawohb section (Dakhla Oasis, Western Desert, Egypt). The study also attempts to document the response of benthic foraminiferal assemblages to sea-level changes during boundary successions,

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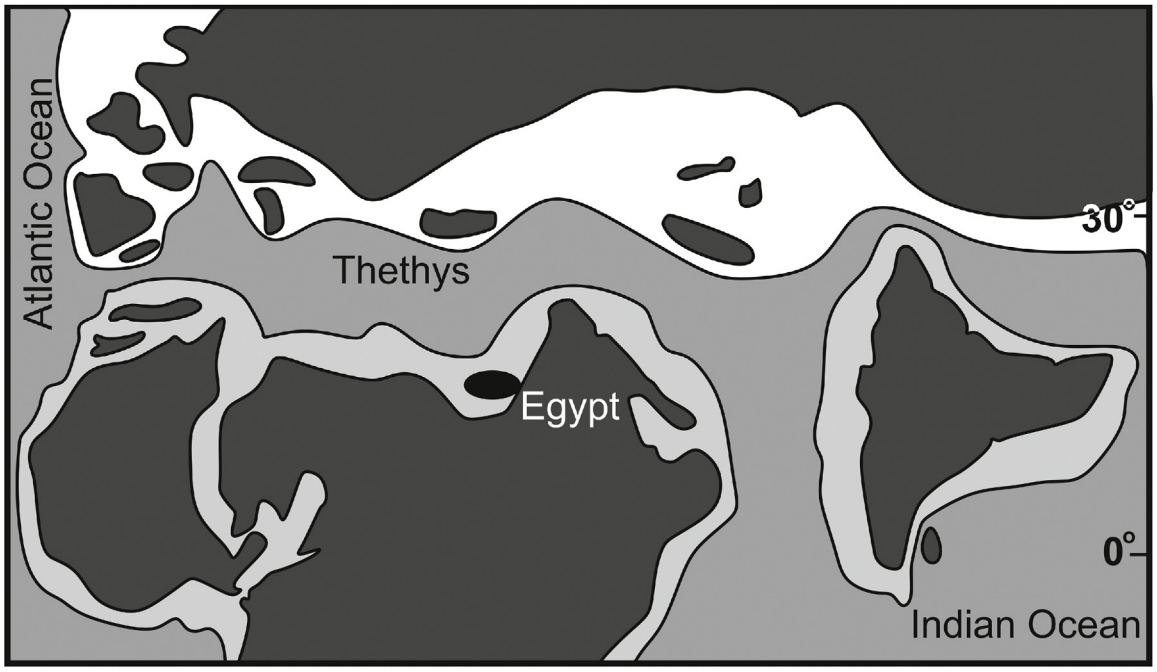

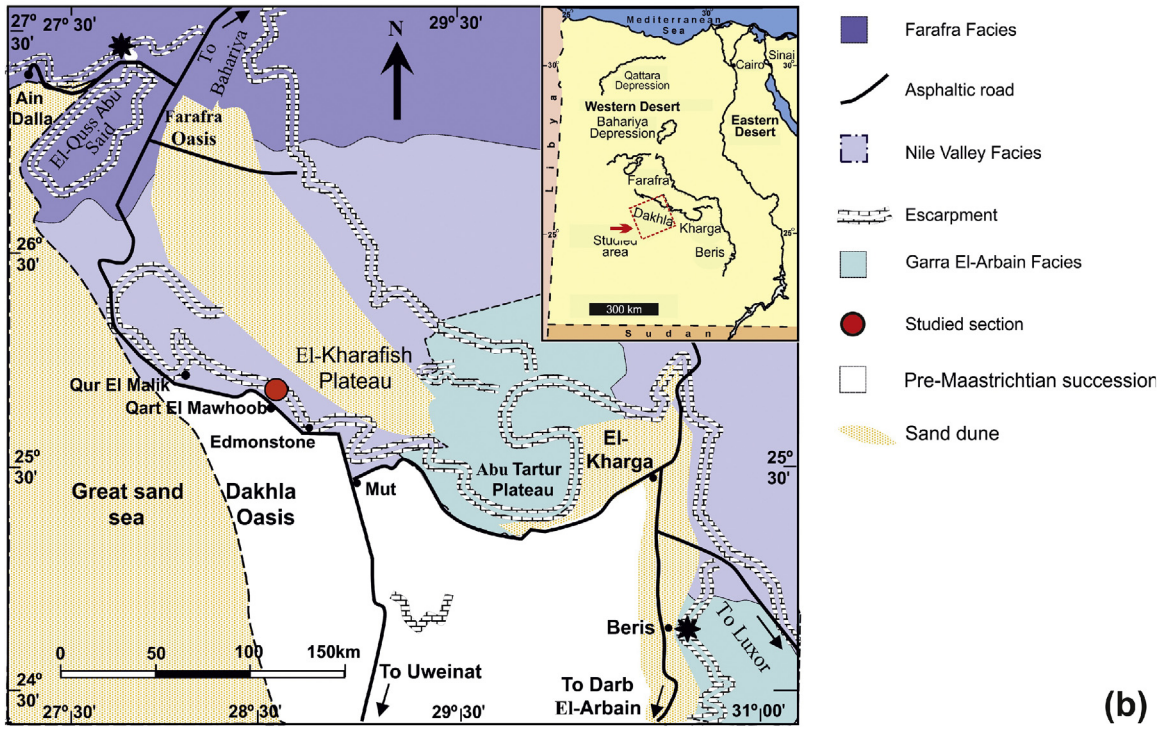

Fig. 1. Location map. (a) Paleobiogeographic map showing the position of Egypt (study area) along the continental margin. (b) Detailed map of the study area (inset: map of Western Desert, Egypt, mentioning the studied locality).

namely the Danian/Selandian (D/S) and the Selandian/Thanetian (S/Th) of the Dakhla Oasis vis-à-vis sequence stratigraphy, regional tectonics, climate and sea-level changes.

The five proxies are used in this study namely benthic foraminiferal species, genera and assemblage, Benthic Foraminiferal Number, species diversity and abundance of high flux-species. These are briefed first along with a note on the relevance of benthic foraminifers as a bathymetric proxy.

Several Recent benthic foraminiferal studies have demonstrated that some species or assemblages exhibit preferences for specific oxygen and/or trophic levels, whereas others are tolerant to a wider range of oxygen availability and of many types of food (see Murray, 1991; Gooday, 2003). It has been well demonstrated that benthic foraminiferal distribution is largely limited by a combination of food availability and oxygenation (the TROX model of Jorissen et al., 1995; see Speijer, 1994; Jain and Collins, 2007; Jain

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