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The impact of the Syrian Arc Orogeny on the Early Paleogene rocks, western shoulder of the Gulf of Suez, Egypt

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ABSTRACT

Integrated biostratigraphical and sedimentological studies on the Early Paleogene rocks (Thebes Formation) at four localities along the western shoulder of the Gulf of Suez, have provided an opportunity to evaluate the stratigraphy and the geological evolution of the sedimentary basins. The carbonate succession of the Thebes Formation represents a general regressive trend, which rests conformably to unconformably on the shales and marls of the Dakhla and Esna formations. The vertical facies change records a transition from deep- to mid-shelf to shoal, to lagoon, into a peritidal zone forming southwest gently-dipping slope to basin transect. Based on the study of the planktonic foraminiferal fossils; four zones have been defined according to the important planktonic foraminiferal taxa: *Morozovella aragonensis/Morozovella subbotinae*, *Acarinina pentacamerata*, *Acarinina cuneicamerata* of Ypresian age and *Globigerinatheka kugleri/M. aragonensis* of Early Lutetian age. The stratigraphy of the studied rocks is punctuated by three regional syn-depositional tectonic phases. The ages of these phases, have been determined chrono-stratigraphically as: Danian/Early Ypresian, Middle–Late Ypresian and Early Lutetian. Globally, these phases are three pronounced tectonic episodes in the tectonic history of the Syrian Arc Orogeny. The results suggest that the sedimentation regime was mainly controlled by external as well as internal parameters, which formulated the sedimentary basins.

1. Introduction

The Early Paleogene in Tethys realm is characterized by tectonism that caused paleogeographic and sea level changes linked with climatic fluctuations. These changes have had impacts on the depositional history in northern Egypt which is a part of the Syrian Arc Orogeny (SAO). The SAO is related to the northward movement of the African craton towards Eurasia in the Late Turonian (Scheibner et al., 2003) as well as the reactivation of Mesozoic fault systems (Hussein and Abd-Allah, 2001). The history of the SAO conditioned the times and intensity of the terrigenous input, the location of the main depocenters and the facies framework modulated by global eustatic sea level changes (Haq et al., 1987).

Throughout the Phanerozoic, the importance of tectonically controlled carbonate platform evolution has been described for various environments (Bosence, 2005). Recently, several local circum-Tethyan studies on the evolution of carbonate platform systems during the Early Paleogene have been carried out with special emphasis on environmental conditions (Özgen-Erdem et al., 2005; Adabi et al., 2008; El Ayyat and Obaidalla, 2013), biostratigraphy (Schaub, 1992) and the response to palaeoclimatic change (Pujalte et al., 2009).

The Southern Galala, along the western side of the Gulf of Suez (Fig. 1), represents a playground area for Paleogene carbonate research. The geological evolution of the carbonate platform there is tied strongly to the activity of the SAO, which demonstrates a northeast-southwest striking framework of horsts and grabens at the southern Tethyan shelf. The emergence of the Galala platform has been documented for the Campanian/Maastrichtian (Scheibner et al., 2003). Multiple pulses of tectonic uplift, which are related to the temporarily reactivation of Cretaceous fault systems, caused the repeated reconfiguration of the platform morphology. Although, the focus area represents only a relatively small part of the whole tectonic history of the SAO in northern Egypt, it greatly contributes to the knowledge of the different tectonic mechanisms and associated sea level oscillations in this folding belt.

The Early Paleogene sediments have been extensively studied in the north Eastern Desert. Most of the previous studies focused on their lithological and paleontological aspects. In contrast, the impacts of tectonism and sea level oscillations on the stratigraphy and pattern of sedimentation have been only briefly outlined. Basic previous studies include the works of Mazhar et al. (1979), Abu Khadra et al. (1994), Strougo and Faris (1993), Boukhary et al. (1998), Kuss et al. (2000), Morsi and Scheibner (2009) and Höntzsch et al. (2011).

The present study focuses on the Thebes Formation since it is highly confused with other rock units with respect to its age and nomenclature as shown in Table 1. The present study is devoted mainly to: 1) provide

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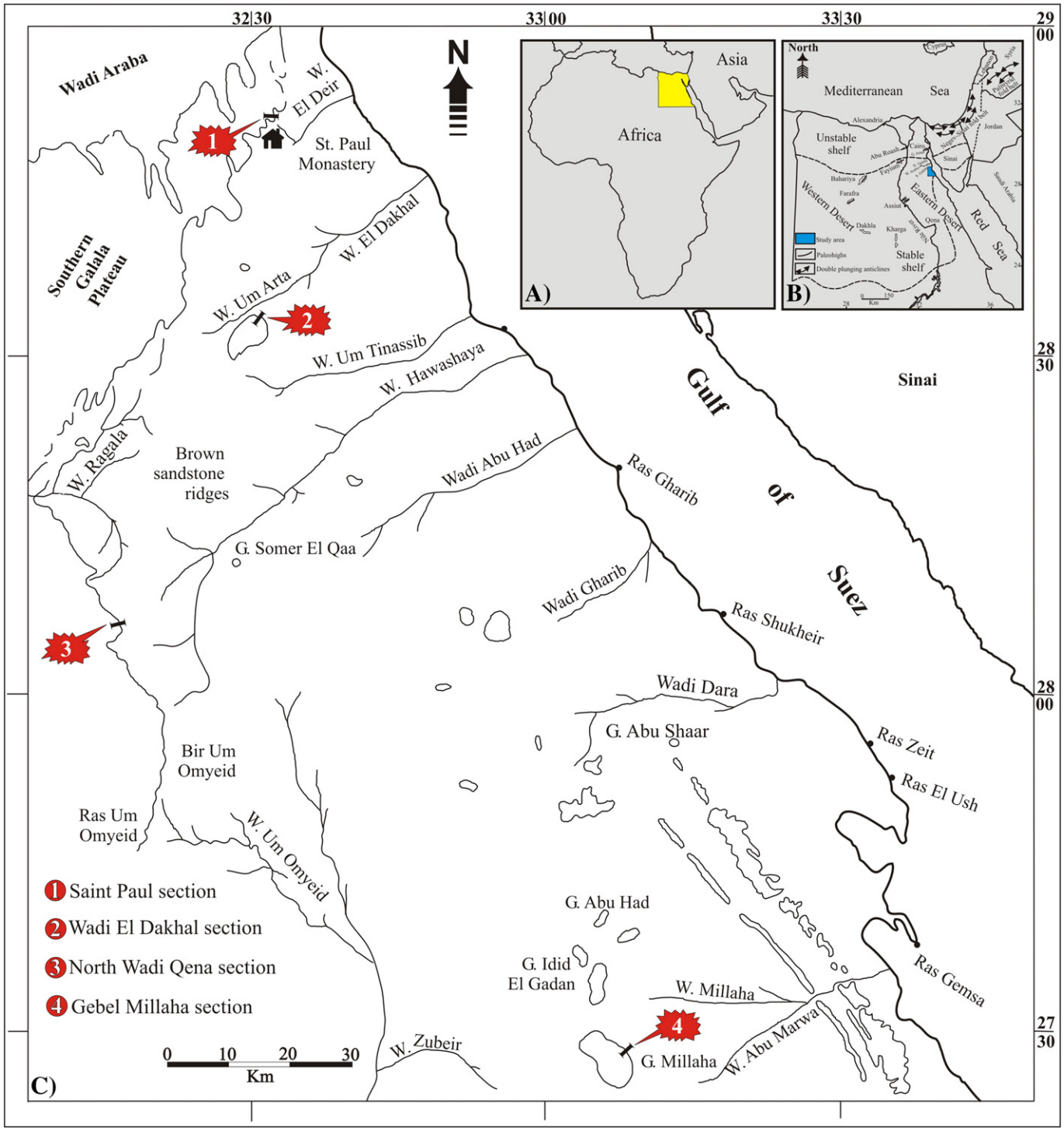

Fig. 1. (A) Location of Egypt in Africa, (B) location of the study area in Egypt and (C) the distribution of the measured sections in the study area. Modified from El Ayyat and Obaidalla (2013).

age determination for the studied sequence, aiming to construct an accurate biostratigraphical zonal scheme. This scheme is used to detect the syn-depositional tectonism of the Early Paleogene; 2) redefine and correlate the Early Paleogene lithostratigraphic subdivisions in northeastern Egypt from Saint Paul Monastery in the north to Gebel Millaha in the south; 3) provide a general view of the sedimentological model as well as reconstruct the depositional history of the slope to basin transect for the study area; and 4) discuss the relationship between the tectonic events identified and the development of the basin, its tectonic history and global events.

2. Materials and methods

An area extending between 32° 00′, 33° 30′ East and 27° 30′, 29° 00′ North, west of the Gulf of Suez in Egypt has been chosen and subjected to detailed stratigraphical and sedimentological studies. Four stratigraphical sections have been measured and described in detail bed by bed (Fig. 1). The vertical sample distance varies between 20 cm in shales to more than 1 m in carbonates, depending on the general condition of the outcrop and the degree of alteration. About 200 samples have been taken mainly for detailed thin section analysis. Extra polished cut slabs