DEEP STRUCTURES OF THE NILE CONTINENTAL MARGIN AS DEDUCED FROM COMBINED MULTI-CHANEL SEISMIC REFLECTION AND GRAVIMETRY DATA

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Abstract

The Egytian continental margin sedimentary cover include at least three main contrasted sequences. From top to bottom : a post Miocene, 2/3km thick on average, blanket which constitutes most of the Nile deep sea fan; a Messinian unit made of massive evaporites locally more than 2km thick, and submitted to important gravity gliding, and finally, a pre-mesinian, poorly known Mesozoic to Cenozoic cover which represents the pre, syn and most of the post-rift sequences of this segment of the african passive margin of Mesogea. Our results based on MCS and gravity data are a preliminary attempt to investigate this deep sedimentary and crustal sections of the Egytian margin.

Key words: Eastern Mediterranean/ Nile deep margin/ seismic-gravity

Most of the Egyptian continental margin is presently covered by the Nile deep-sea fan, a huge terrigenous construction of upper Cenozoic age resting on various Messinian deposits, including thick evaporites, themselves submitted to regional gravity tectonics [1]. It is generally agreed that the Egyptian continental margin represents a segment of a passive margin, the Mesogean margin of Africa, believed to have initiated in Mesozoic times (Jurassic to early Cretaceous, depending of the authors) in response to rifting processes leading to the opening of an oceanic space, whose remnants (the deep Eastern Mediterranean sea basins) [2, 3, 4] are now almost entirely consumed at the level of the Hellenic/Cyprus subduction zones. Despite considerable sets of geophysical data obtained by oil companies, but not yet available, little is still known on the deep structures of this passive margin which, moreover, may have been partly re-activated in Miocene times as a consequence of the the Red Sea/Gulf of Suez rifting. For example, the exact location of the transition zone between continental and oceanic crusts, or the tectonic fabrics, inherited from rifting and now deeply buried, are still pending questions. To our knowledge no seismic refraction data are yet available within this area of the Eastern Mediterranean, with the exception of an expanded seismic experiment recorded more than 10 year ago across the Herodotus abyssal plain [5]; Moreover the presence of massive, and unstable, Messinian evaporite layers [1], locally as thick as 3 km, and characterized by high seismic velocities, has considerably restricted sesimic imaging from academic seismic reflection surveys

This work is a preliminary attempt to better image, and constraint, the deep structures (sedimentary and crustal) of this passive margin segment. It is based on a combination of two sets of data: (1) Recently (2002) recorded deep penetrating (MCS) data [6]; (2) Marine gravity data, previously (1998) recorded on the entire deep sea fan, and themselves completed by Seasat derived data (Sandwell; 10).

In July 2002 about 1600 km of MCS data, using an array of 8 guns and a 5km long, 360 channels, digital streamer, have been recorded along seven regional lines, either perpendicular or parallel, to the present slope general trend (see Fig. 1). The use of standard processing packages (Geovecteur) has already allowed to better image several characteristics of the deep structures of the margin [6] and has particularly shown that, below spectacular thin-skin salt-related

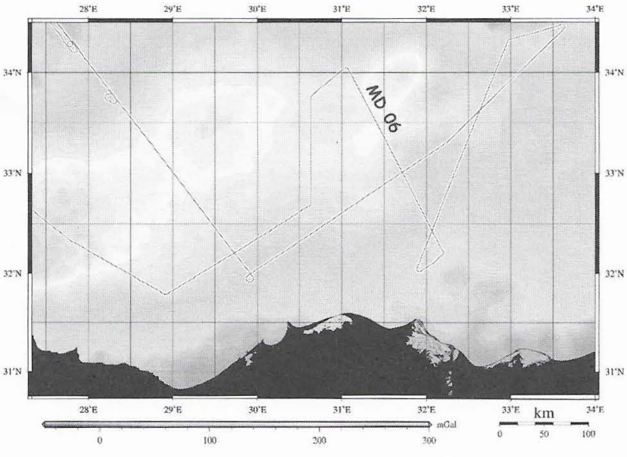

Fig. 1. Track line of Medisis survey over a Bouguer anomaly compilation.

shallow structures (particularly well-expressed in the Eastern margin area), deeply sedimented basins exist. These basins contain strong and well-layered, reflector sequences detected up to 10 stwt (see Fig. 2) and interpreted as indicative of Mesozoic and subsequent deposits [7]. Locally, deep reflectors (around 11/12 stwt) may indicate transitional zone to thin layered lower continental crust, or even to the Moho. Below the Herodotus abyssal plain, reflectors well correlated with ESP data [5]. are from top to bottom identified as indicative of the Plio-Quaternary cover, the thickened evaporites, the mesozoic to cenozoic sediments, the top of the oceanic crust and even the Moho. Different tests of pre-stack depth migration have been succesively performed on one of the MCS lines (Line MD 06) to better asses the sedimentary thickness and to better image the deep margin architecture.

The seismic data have then been used to constrain preliminary crustal models for the Egyptian margin based on gravimetry data.

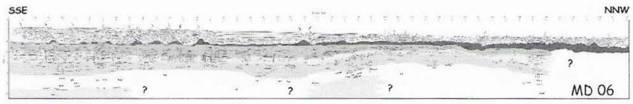

Fig. 2. Tracing of MD 06 line from preliminary Geovector processing. Below thin-skin salt-related tectonic features, deep sedimentary basins, characterized by strong and well-layered reflector packages (interpreted as Mesozoic to early Cenozoic sediments), are detected up to 10 stwt.

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