The Role of Bouguer Data Analysis (Using 3D Euler Deconvolution) in Delineating Active Subsurface Structures in the Southeastern Mediterranean and Northeastern Egypt

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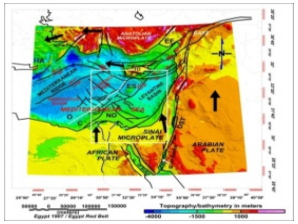

Figure 1: Present-day tectonic map of the Eastern Mediterranean region (after Harrison Panayides 2004; and Harrison et al 2004).

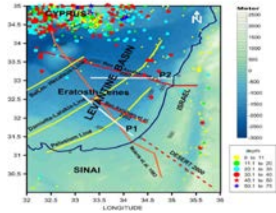

Fig.ure 2: seismicity, shear zones and previous refraction seismic lines (Red Lines) with map of the study area

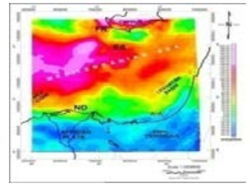

Figure 3: Bouguer anomaly map of the Study area.
(Contour interval is 5 mGal).

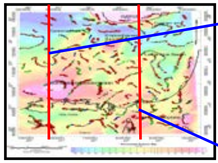

Figure 4: Maps shows Euler Solutions of structural Index (SI=0). The two solid red lines are locations of the 3D profiles.

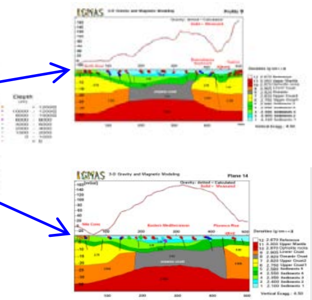

Figure 5: Locating Euler Solutions of gravity data with structural index (SI) = 0 (Sill, Dyke, Ribbon and/or Step). These solutions are actually concentrated, good clustered and well agreed with many shallow structures (active dykes and/or sills) estimated by the seismic and 3D density modeled profiles (Saleh, 2013). Thus the application of SI =0, for gravity data, is more ideal case along the study area than other used structural indexes (1, 2 and 3).

Introduction

The Eastern Mediterranean is a tectonically complex region located in the midst of the progressive Afro-Eurasian collision. The study area (Figure 1) has remarkably prominent geomorphic features such as the East Mediterranean Ridge, Levantine Basin, Eratosthenes Seamount, Nile cone, the northern part of the Sinai Peninsula and south Cyprus. Its geological-geophysical structure has been studied for years, but it is still not completely known. The present tectonics is driven by the collision of the African and Eurasian plates, the Arabian Eurasian convergence and the displacement of the Anatolian Aegean microplate. We present a case study of structural delineation by applying a 3D Euler deconvolution method to the Bouguer data (for Southeastern Mediterranean and Northeastern Egypt regions). Our results obtained with 3D Euler deconvolution gives an accurate- depth estimates, which are closer to the real position of sources. Moreover, the results presented here can be used to constrain depth to active crustal structures (fault system, magmatic activity and subduction zones) for the study area.

Bouguer Gravity data

The available Bouguer data of Eastern Mediterranean is interpreted using Eular deconvolution, Horizontal Gradient (HG) and Tilt Derivative (TDR) techniques, to estimated the depth of subsurface structures and the active faults and tectonic systems of the study area. The results are well confirmed and compared with the 3D deep seismic sounding and 3D density models to confirm the estimated depth values. Whereas, the expected structural systems are correlated with the seismicity data and the earthquake catalogues to trace the active tectonic boundary zones. Thus, the main goal of the present work is to The use of the present geophysical techniques are recommended to constrain the depth to the active structures (using Euler Deconvolution) with their predominant directions that are mostly controlling the seismic activity of the study area. Also, we could evaluate and classify the tectonic boundaries, contacts and faults, using horizontal gradient (HG) and tilt derivative (TDR) according to crustal structures consequently; the estimated results could be able to predict the tectonic processes (convergent) of the study area that originate these active boundaries.

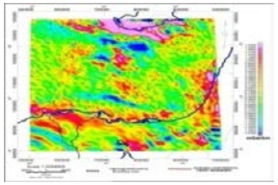

Figure 6: Horizontal-gradient amplitude map calculated from Bouguer gravity data of Southeastern Mediterranean

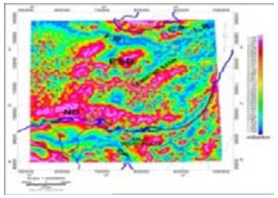

Figure 7: Tilt Derivative (TDR) of the Bouguer Gravity Anomaly of Southeastern Mediterranean.

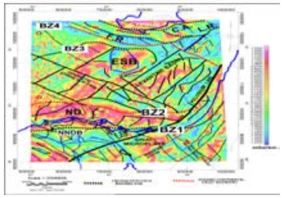

Figure 8: Tilt Derivative (TDR) of the Bouguer Gravity Anomaly. Narrow black discontinuous lines represent lithologic and structural boundaries. Black thick discontinuous lines show the boundaries of the sub-tectonic zones of the Eastern Mediterranean. Blue dotes line is approximate boundary between oceanic (O) and continental (C) crust derived from this

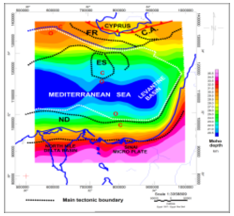

Figure 9: Moho depth Map of the study area (from Saleh, 2013)

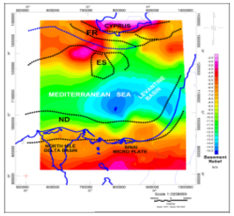

Figure 10: Basement Relief (sedimentary thickness) map (from *Saleh, 2012).*

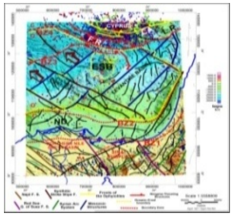

Figure 11: The resulted plate tectonic model and tectonic boundaries of the South Eastern Mediterranean with Levantine Basin.

Resulted active subsurface structural map

Plate boundaries were derived from Bouguer data analysis of this study. The estimated tectonic plate boundaries were correlated with Garfunkel (1988a), Bosworth et al. (2005), Robertson (1998a and 1998b), and Hall et al. (2005). CA, Cypriot Arc; LR, Larnaka Ridge FR, Florence Rise; ND, Nile Delta; ESB, Eratosthenes Seamount block; BZ1, BZ2, BZ3, BZ4 are boundary zones estimated from the present work. Heavy black dashed line represents the Pelusium megashear line. Narrow black lines represent lithologic and structural elements. Red thick discontinuous lines show the main boundaries of the sub-tectonic zones of the Eastern Mediterranean region. Other colored lines are represented below the map with their legends. The two big arrows represent the extension direction along the Late Triassic-Early Jurassic age (Meshref, 1990).

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