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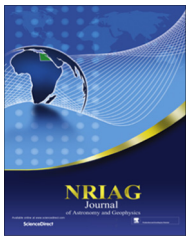

Application of high-pass filtering techniques on gravity and magnetic data of the eastern Qattara Depression area, Western Desert, Egypt

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Butterworth Filtering Utilization;
Butterworth high-pass filter techniques

Abstract In this work, a reconnaissance study is presented to delineate the subsurface tectonics and lithological inferences of the eastern area of Qattara Depression using the Bouguer gravity and aeromagnetic data. To achieve this goal, several transformation techniques and filtering processes are accomplished on these maps. At first, the total intensity aeromagnetic map is processed through the application of reduction to the magnetic north pole technique. The fast Fourier transform is carried out on the gravity and RTP magnetic data for establishing and defining the residual (shallow) sources. The frequency high-pass filtering is used to enhance the anomaly wavelengths associated with the shallow sources. The used processing techniques are the polynomial surface fitting enhancement, Laplacian, Strike Filtering, Enhancement Utilization, Suppression Utilization, Butterworth Filtering Utilization, Butterworth high-pass filter, Euler's deconvolution and forward modeling. The equivalent depths of the isolated short wavelength anomalies are 0.759 and 0.340 km below the flight surface, and the depths of the intermediate wavelength anomalies are 1.28 and 2.00 km for the gravity and magnetic data, respectively. Finally, the quantitative interpretations of the Bouguer gravity and RTP magnetic maps of the study area, reflect the occurrence of the various types of structures and their components. The main tectonic deformations of the study area have NNW–SSE, NNE–SSW, NE–SW, NW–SE and E–W trends.

1. Introduction

The investigated area lies in the northern part of the Western Desert of Egypt at a distance of about ten kilometers to the south of the Mediterranean Sea Coast, between latitudes 28°30′ and 30°00′N, and longitudes 27°30′ and 29°00′E (Fig. 1). The objective of gravity and magnetic interpretation was to recognize the geological characteristics of the

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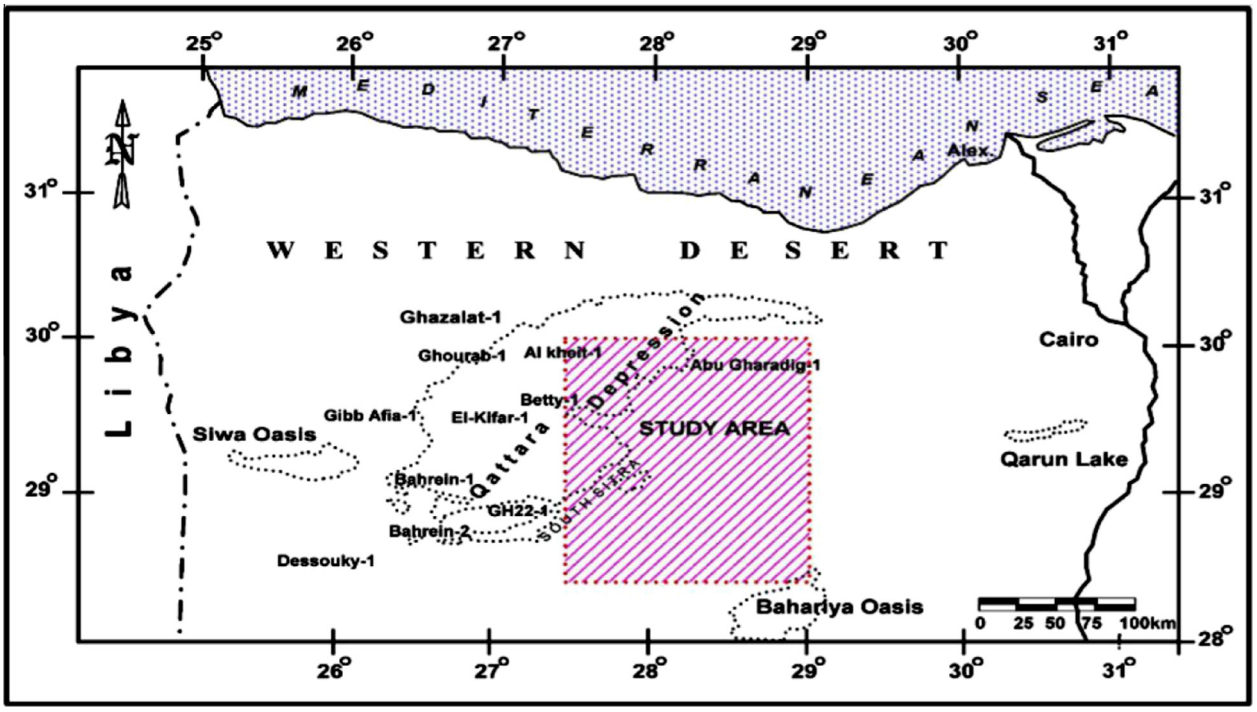

Figure 1 Location map of the study area.

subsurface lithologies and structures from the anomaly maps. This is to deduce, from the various characteristics (amplitude, shape, sharpness and frequency) of the gravity anomalies, the locations and structures that produce the gravity pattern. Gravity measurements have been used to follow many types of lithological and geological structures, ranging in depth and size from very deep crustal blocks to near-surface sedimentary elements. In addition, the magnetic prospecting is utilized to delineation of the intra-sedimentary and supra-basement magnetic sources, such as the shallow dykes and intrusives, that disrupt the normal continuity of the overlying sedimentary sequence.

2. Geological setting

Geomorphologically, the study area is a part of the northern Western Desert of Egypt and it may be regarded as a rocky platform of low altitude. In general, the Western Desert is essentially a plateau desert with vast expanses of rocky ground and numerous extensive and closed-in depressions (Said, 1990). The region exhibits a vast peneplain, which is covered in many places by wind-blown sand, sheets and gravels.

The main topographic features of the northern Western Desert are large plateaus slopping northwards closed-in depressions, oases and dunes (Abdine, 1974). The rocks and loose sediments cropping out on the investigated area belong to the Paleocene, Early Eocene, Middle Eocene, Late Eocene, Oligocene, Early Miocene, Middle Miocene, Late Miocene and Quaternary. All rocks are of sedimentary nature, although signs of volcanicity and hydrothermal activity are manifested, especially along fault lines. According to El Shazly et al. (1976), the outcrops of the study area are composed of rocks and loose sediments belonging to the Paleocene, Eocene, Oligocene, Miocene and Quaternary ages.

Stratigraphically, the Western Desert, with the exception of small outliner of Abu Roash, is a plateau covered with Neogene sediments (Hantar, 1990). Many recent activities of oil exploration works including drilling, seismic, gravity and magnetic measurements have reviled the presence of subsurface stratigraphic column, which ranges in age from Paleozoic to Recent. The generalized stratigraphic column of the northern Western Desert (Fig. 2) shows that the subsurface stratigraphic sequence is ranging in age from Cambro–Ordovician to Recent, resting unconformably over the crystalline basement rocks.

Tectonically, the northern Western Desert represents a part of the unstable belt of the tectonic framework of the Egyptian Territory. This area has been subjected to different tectonic regimes since the Paleozoic time, which resulted in the construction of many sub-basins, ridges, troughs and platforms.

3. Potential field data

The available gravity and magnetic data of the study area are as follows:

3.1. Gravity data

The Bouguer gravity anomaly map (G.P.C., 1985) with a scale of 1:100,000 and 1 mGal contour interval (Fig. 3), shows two strong positive anomalies shown at the central part, and a third steep positive gradient at the northern part of the map. The first one is exhibited as a closure trending ENE–WSW and extended to moderate positive anomaly toward the eastern border with E–W trend. The second positive anomaly extends to the north from the first one and shows more circular closure taking the WNW–ESE trend of 13 mGal amplitude. The last