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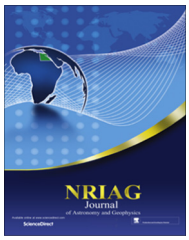

Geophysical contribution to evaluate the subsurface structural setting using magnetic and geothermal data in El-Bahariya Oasis, Western Desert, Egypt

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Abstract The future development of agriculture, industry, and civil activity is planned to be in the Western Desert, Egypt. El-Bahariya Oasis is located in the heart of the Western Desert at a distance of about 370 km to the southwest of Cairo. The area under investigation is located between latitudes 28°06′N & 28°16′N and longitudes 28°54′E & 29°04. The Bahariya depression comprises a total area of approximately 2250 km^2. The main target of the present study is to delineate the shallow and deep subsurface structures of the study area. To achieve this, two geophysical methods (magnetic and geothermal) have been used. A detailed land magnetic survey has been acquired. Fifty three land magnetic stations have been measured in a mesh like area with 500 m spacing interval. The necessary corrections concerning daily variation, the regional gradient and time variations have been applied. Then, the total magnetic intensity anomaly map (TMI) has been constructed and reduced to the pole magnetic map (RTP). The Euler deconvolution has been applied to the TMI anomaly data as well as the analytical signal technique. Also, the magnetic interpretation has been carried out using the high-pass filtering technique and spectral frequency analysis. The analysis of the magnetic data shows that the dominant tectonic trends are NW–SE and E–W. The results show that, the average calculated depth ranges between 0.1 km and 0.32 km, while the depth to the basement intrusion is 0.4 km, below the measuring level.

The geothermal studies in EL Bahariya-Oasis comprise subsurface temperature contour map which illustrates that the study area has geothermal groundwater reservoirs. The measurements of the geothermal properties for measured rock samples show that the rocks of the study area have moderate values of geothermal properties. This may be due to the seasonal variation in soil temperatures. These soil thermal properties depend on soil porosity and moisture content.

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1. Introduction

The Western Desert covers the west of the Nile River and extends to the border with Libya. A number of diverse basins and structural features make up this province. The Bahariya Oasis is a large oval shaped NE-oriented depression located

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in the north-central part of Western Desert of Egypt (Fig. 1). The Bahariya depression comprises a total area of approximately 2250 km^2 and is one of the five large oases in the Western Desert. The area falls under the arid condition as the total rainfall ranges from 3 to 6 mm/year. Springs and wells are the main two-groundwater resources for irrigation and civic purposes (Salem, 1987). Egypt is facing greatly increasing demands for water due to a rapidly growing population. Surface water resources originating from the Nile are now fully exploited (Hvidt, 1999). Recently, there has been a development program of progressive reclamation and urbanization of the desert including the investigated northern Bahariya Oasis. The main objective for this study is to delineate the shallow and deep subsurface structures of the studied area. To achieve this target, two geophysical methods are used (magnetic and geothermal investigations).

1.1. Geology of EL-Bahariya Oasis

The Bahariya Oasis is a large Syrian Arc age (Upper Cretaceous through late Eocene) anticline that forms the southern termination of the basins of the Western Desert. Upper Cretaceous reservoirs of the Bahariya Formation are well exposed, as are some of the transpersonal structural features typical of the Syrian Arc orogenic event (Said, 1962). Oligocene basalts unconformably overlie the Bahariya Formation over most of the oasis. The oasis was an exposed landmass from Paleocene through Eocene time, when carbonate and anoxic lagoonal shale deposition dominated in the flanking lows. The Bahariya is a large natural excavation, surrounded by escarpments and has a large number of isolated hills within the depression. The general shape of the depression is oval with its major axis running northeast and with a narrow blunt-pointed extension at each end. The most striking features in the topography of the Bahariya Oasis are large number of hills within the depression (Said, 1962). Small separate parts of the depression are occupied by local people, while the rest are uninhabited. More than 100 flowing springs and 21 deep drilled wells are developed in the Bahariya depression. The regional section shown in Fig. 2 illustrates major differences between the Western Desert and the Nile Delta. Eocene and Oligocene strata seal the Western Desert petroleum system. At Bahariya Oasis, the stratigraphic section is dominantly clastic, reflecting proximity to Upper Egypt highlands that have long shed sediment northward into the Western Desert and Nile Delta. All sequences become sandy southward toward these highlands.

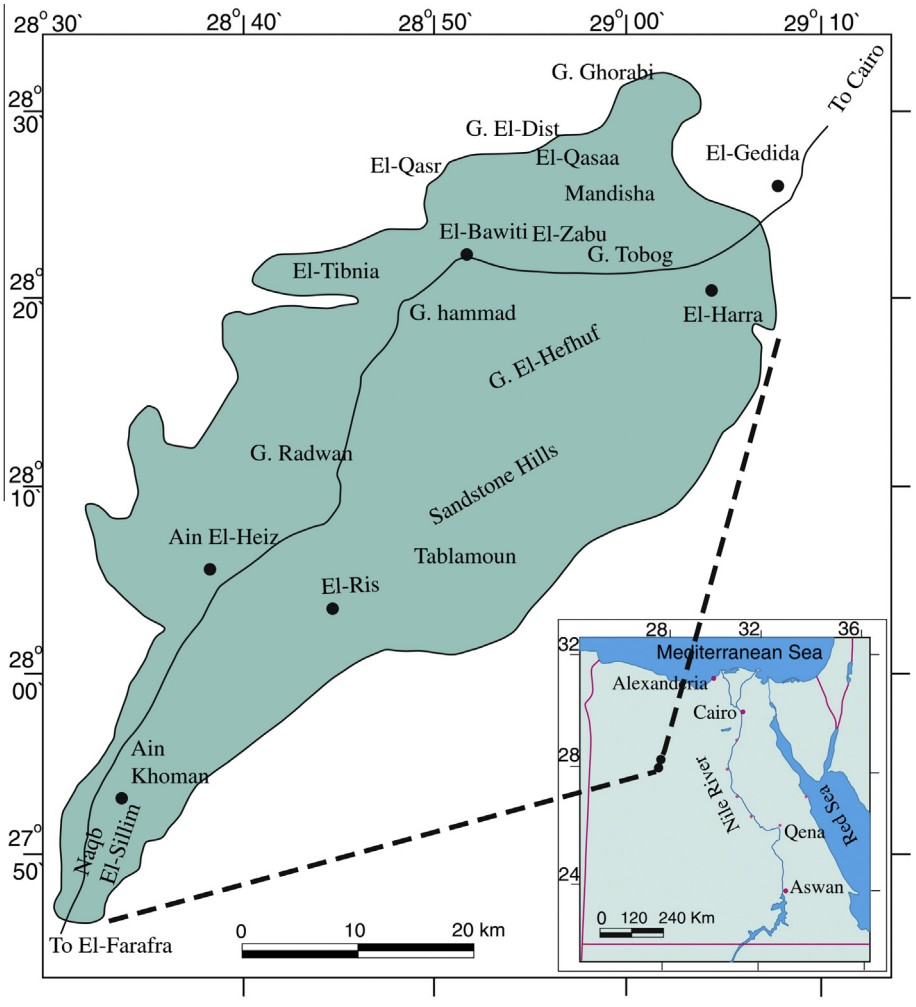

Figure 1 Location map of the El-Bahariya Oasis area.