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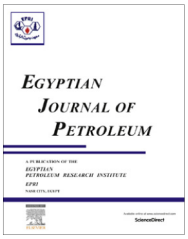

FULL LENGTH ARTICLE

Groundwater exploration using resistivity and magnetic data at the northwestern part of the Gulf of Suez, Egypt

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Abstract The present study aims to investigate the ground water accumulations present in the area located west of the Gulf of Suez, to face the new urbanization settlements of industrial national projects in the study area using geoelectrical and magnetic measurements. Magnetic data interpretation was carried out using the RTP magnetic data (or, through analyzing the RTP aeromagnetic map) to determine the depth to the surface of basement rocks and delineate the trends of structural elements. The results of magnetic interpretation indicated that the depth to the basement surface is ranging from 1200 to 3500 m and the trends of encountered structural elements are mainly NE–SW, NW–SE, NNW–SSE and E–W directions. Seventeen vertical electrical soundings of Schlumberger configuration were measured with AB/2 ranging from 1.5 m to 1500 m at the southern part of the study area. The results of quantitative interpretation of geoelectrical data indicated that the subsurface section consists of six different geoelectrical units; the first unit represents the Quaternary gravel and sand of high resistivity values and thickness of about a few meters. The second geoelectrical unit exhibits moderate resistivity values ranging from 23 to 100 ohm m and thickness ranging from 4.5 to 67 m which represents the fresh water aquifer in the study area, while the lithology of this layer consists of sandstone and limestone which belongs to the Upper Miocene. The third geoelectrical unit is composed of sandy clay and limestone which belongs to the Middle Miocene deposits and shows low resistivity values ranging from 6 to 7 ohm m and thickness ranging from 44.5 m to 66 m. This third layer represents the second aquifer (brackish water). The fourth geoelectrical unit consists of limestone and clayey limestone which belongs to the Lower Miocene deposits and exhibits moderate resistivity values ranging from 16 to 33 ohm m, while the thickness of this unit ranges from 47–102 m. This layer represents the third aquifer (brackish water). The fifth geoelectrical unit reveals very low resistivity values of about 2–5 ohm m and

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consists of clay and sandstone of the Oligocene and Upper Eocene deposits. The sixth geoelectrical unit is the bottommost unit in the studied subsurface section and exhibits moderate resistivity values in a range of about 22–35 ohm m and consists of limestone of the Middle Eocene deposits.

1. Introduction

Different authors used different geophysical tools such as resistivity and magnetism for ground water exploration [1–3]. [1] studied the ground water potentiality at the southern part of the study area; and they concluded that; the ground water in this area is accumulated in the Upper Miocene, Middle Miocene and Lower Miocene deposits. The study area is located between latitudes 29° 30′ to 30° 00′ N and longitudes 32° 00′ & 32° 30′ E (Fig. 1).

The western side of the Gulf of Suez is one of the proposed promising sites for new urbanization programs of industrial national projects. The present study aims to investigate the ground water occurrences to face the increasing new water demands of the industrial national projects as the cement, fertilizers, ceramics and steel factories in the study area, using geoelectrical measurements.

1.1. Geology of the study area

In the study area, different rock units were identified. They range in age from the Jurassic to Quaternary. Eocene, Oligocene and Miocene are the most widespread rock units in this area (Fig. 2) according to [4]. The Jurassic section consists of varicolored and cross-bedded sandstones, with mudstone and siltstone interbeds. The Cretaceous succession in the study area is classified by [5] into three rock units, which are (from base to top) the Malha, Galala and chalky limestone units. The Eocene rocks are the nummulitic limestones, which form the main part of Gabal Ataqa and Gabal El-Galala El-Baharyia as well as the faulted blocks of Akheider-Rammlyia and Um Zeita-Kahallya. The Eocene succession is subdivided from base to top into the upper part of Esna Shale Formation, Farafra Formation, Thebes Formation, Muweilih Formation, Mokattam Formation, Observatory Formation, Qurn Formation, Wadi Garawi Formation and Wadi Hof Formation. The Oligocene rocks are differentiated into two units; the lower unit is varicolored, consisting of unstratified sands, gravels, and sedimentary quartzites; the upper unit crops out in the central part of the study area and consists of basalt sheets of Gabal El Ahmer Formation. The Miocene succession that is exposed in the Sadat area lies 30 km to the southwest of Suez city and is subdivided from base to top as follows: Sadat Formation (Early Miocene), Hommath Formation (Middle Miocene) and Hagul Formation (Late Miocene). Sands, gravels, clays, sabkhas and sand accumulations represent the recent deposits in the study area.

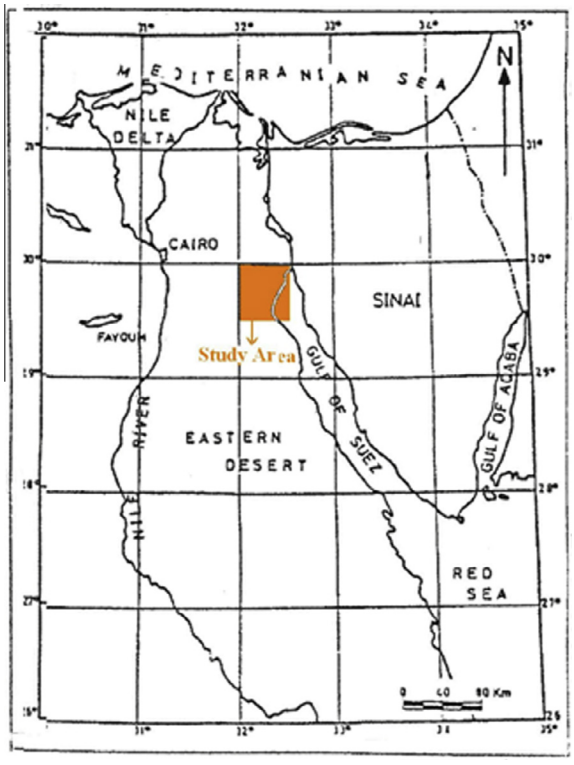

Figure 1 Location map of the study area.

2. Methodology

2.1. Magnetic data and interpretation

2.1.1. Acquisition and enhancement of magnetic data

The airborne geophysical magnetic surveys for the study area were carried out by [6]. The obtained airborne magnetic data were reduced to the north magnetic pole (RTP), compiled and finally presented in the form of RTP aeromagnetic map reduced to the pole (Fig. 3). The map reveals a high magnetic anomaly occupying the northeastern, northwestern and eastern parts of the study area, while the low magnetic anomaly occupys the southwestern part.

2.1.2. Interpretation of magnetic data

2.1.2.1. Magnetic filtering. The high and low pass filter technique based on wave number was applied on the RTP aeromagnetic map reduced to the pole data (Fig. 3) to separate the residual and regional magnetic anomalies. The separation was carried out at a wave number cut-off of 0.0000287 (1/km) through the power spectrum technique (Fig. 4), RTP aeromagnetic producing two maps representing the residual (Fig. 5) and regional magnetic anomaly maps using [7]. The qualitative interpretation of the RTP map shows that, the zones of high gradient with closely spaced contour lines are indicators of probable major fault zones. Also, the direction