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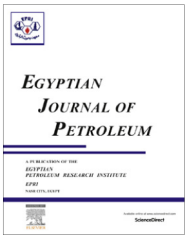

FULL LENGTH ARTICLE

Geophysical investigation in the Northwestern part of the Gulf of Suez, Egypt

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Abstract Vertical Electrical Soundings (VES) and shallow seismic refraction data interpretation have been used to delineate groundwater aquifer and fault elements which are dissecting the northwestern part of Gulf of Suez. Thirty-five Vertical Electrical Soundings (VES) were carried out and inverted through 3-D VES inversion to determine the subsurface stratigraphy, structures and groundwater aquifer potentialities. The results of VES inversion indicate that the study area consists of four geoelectrical units interpreted as surficial dry sand and gravels deposits, underlain by fresh water bearing zone, salt water bearing unit and limestone layer, at the bottom. The 3-D VES inversion indicates that the area is dissected by normal fault of NE-SW direction. Thirty-four shallow seismic refraction profiles of 94 m spread length have been used to delineate the geotechnical characteristics of surface layers, subsurface structures and subsurface lithology. The results of shallow seismic refraction indicate that the shallow part of the subsurface section consists of three layers, the first soil layer (dry gravels and sands of the recent deposits) underlain by the second soil layer (sands and gravels of the Pleistocene) while the third layer is the bedrock layer of sandstone and shale belonging to the Middle Miocene.

1. Introduction

The study area lies near the shore line of the Gulf of Suez, occupying an area of 548,000 m^2 in the northwestern part of the Gulf of Suez. It is bounded by latitudes 29° 44′ 10″ – 29° 44′ 20″N and longitudes 32° 21′ 30″ – 32° 22′ 20″E. It lies near two roads, the first is the Cairo-Sokhna road and the second is the Suez-Sokhna paved road along the Gulf of Suez coast and is surrounded by many mountains such as Ataqa Mountain, Kaheilyia Mountain, Abou Treifiya Mountain, Akheider Mountain and El Galala El Bahariya plateau. The main wadis near the study area are streaming into the coastal plain and the Gulf of Suez. These Wadis are, from north to south, Wadi Hagoul, Wadi Beda, Wadi Akheider, Wadi Hammamat and Wadi Ghuweiba (Fig. 1). Many authors have carried out valuable geological, geophysical and structural works around the study area as [1–8].

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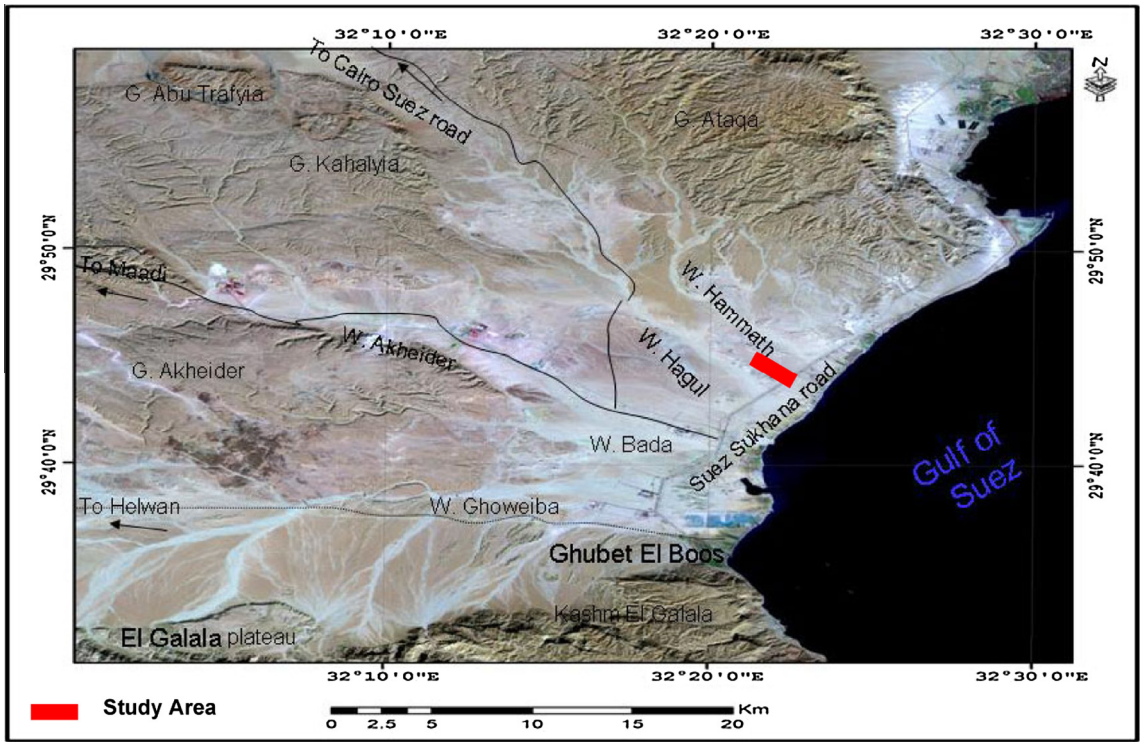

Figure 1 Location map of the study area.

Several algorithms have been developed to perform 3-D resistivity modeling and inversion. 3-D forward algorithms based on the finite-difference, finite-element and integral methods have been presented by several authors [9–14], just to refer to some of the papers published in the last decade. 3-D VES inversion can be used to distinguish between the various rock units and structures at different depth levels. [15] used 3-D VES inversion to delineate structural as well as some geological parameters at Cairo-Ismailia desert road. [16] applied 3-D VES inversion with gravity and magnetic interpretation to delineate groundwater occurrences and structural elements at Insha area near Cairo. [17] applied integrated interpretation of geological, geoelectrical, shallow seismic and geotechnical data to delineate the subsurface stratigraphy and structures at May15th City located in south Cairo. [18] delineated the structural elements around Greater Cairo using gravity and magnetic data. In the present work, we used the results of 3-D VES and shallow seismic refraction data to delineate the fresh groundwater aquifer to be used in developing the industrial area which contains many factories and national projects. Another objective in this study is to delineate the subsurface structural elements (faults) which dissect the area and evaluate the suitable sites for any infrastructural purposes.

2. Geology of the area

Geomorphologically, the study area is characterized by plenty of hills and wadis, which are covered by calcareous boulders and gravels. Their sources are the near and surrounding mountains such as Ataqa Mountain in the north and Kaheilia and Um Zieta Mountains in the northwest. Although El Galala El Bahariya plateau lies in the south of the study area, its effect appears in the drainage form, which descends from the northern face of the plateau. Most of the wadis descend from Ataqa Mountain, Akheider Mountain and El Galala El Bahariya plateau.

The subsurface stratigraphy of the area under investigation is exposed at the surface in two locations around the study area. The first is at Akheider Mountain in the western side of the region and completed by the faulted sections below. The layers of these faulted sections are dipping to the east until they are covered by recent alluvium at the coastal plain. The second location is at Ataqa Mountain, where the old rocks at the low southern margins of Ataqa Mountain and their layers are dipping at this part to the south and southwest. Also the old rocks are exposed on the surface below the series of the western mountains, which include Kaheilia and Um Zieta Mountains with layers dipping toward the eastern and southeastern directions. Fig. 2 shows the geological map of the study area. The surface geology was discussed in [19,20] and the subsurface stratigraphy was described by [21] (Fig. 3). The surface geological map indicates that the study area and its surrounding regions are covered by rock units extending from Middle Eocene to Quaternary deposits. The Middle Eocene rocks (E2) covering the northern part of the area under investigation, exist in two successions, one at Ataqa Mountain area (Ramia Formation) and the other in the western part (Hof Formation). The Middle Eocene rocks are represented by a succession of limestone in Akheider Mountain. Upper Eocene units (E3) are exposed at the low southern margins of Ataqa Mountain and represented by Hof Formation which consists of clay, marl and fossiliferous calcareous sandstone. Middle Miocene (M2) rock units are of shallow marine origin, consisting of a succession of marl, coarse sand and clay, and occupying the greatest part cropped out in the area and correspond to the

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