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The hydrogeological conditions in Sahel Hasheesh, Eastern Desert, Egypt

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Abstract The groundwater development in Egypt in the present time is of a vital importance than in past few years. A comprehensive plan for new land reclamation projects has been recently established. To achieve these plans new sources of water must be available. This has been done by conducting a number of VES'S where interpreted by a comparison with the existing drilled borehole soil samples. The optimum resistivity model is obtained by matching method using "IPI2Win" Moscow State University 2000 software computer programs for resistivity interpretation. The results of the quantitative interpretation of the resistivity curves has been represented as geoelectric sections, showing the thickness and true electric resistivity values of the different geoelectric layers. The results of quantitative interpretation of the vertical electrical soundings show subsurface five geoelectric units and the aquifer system belongs to lower Miocene and the total salinity of 2451.2 ppm. The depth to water surface is 88.05 m and the total dissolved solids are 2451.2 ppm (Mekhemer well). The salt assemblages in Sahel Hasheesh are $NaCl$, $MgCl_2$, $MgSO_4$, $CaSO_4$, $Ca(HCO_3)_2$. This marine water is of brackish sodium chloride water type ($NaCl$).

1. Introduction

Development of the Eastern Desert of Egypt is a main target to strengthen the National Economy plan in Egypt. This is being emphasized in the Eastern Desert by developing the water resources.

The area of study is located in the western part of the Red Sea in the Eastern Desert, south of Hurghada by about 25 km between latitude 26°56′00″, 27°07′00″N and longitude 33°36′00″, 33°55′00″E (Fig. 1).

The present study deals with the exploration and evaluation of the groundwater potentiality by using geological, geophysical, hydrogeological and chemical tools. This work started in the summer of 2006 and continued until the summer of 2008. This area covers an area of about 1200 km^2. Development of Sahel Hasheesh was the topic of several research works

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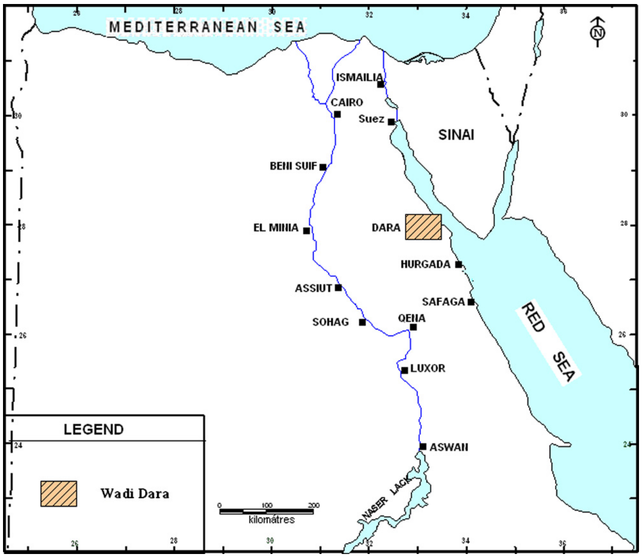

Figure 1 Location map of the study area.

including the construction of storage dams or and drilling boreholes. Previous studies showed that a relatively large amount of flood water is lost every year to the Red Sea. Therefore, the operational objectives of the current project are to utilize this flood water for ground water recharge. Twenty vertical electrical sounding (VES) were measured by using Schlumberger configuration in the study area.

2. Previous work

The areas of study, western side of the Red Sea Coastal plain were studied by several authors; Hume (1921), El Ramly (1972), Issawi (1983), Said (1990), El Sharabi (1993), (1983), Aggur and Sadek (2001).

2.1. Aim of the study

The main objectives of the study are as follows:

1. Study the surface and subsurface lithological.
2. Studying the subsurface structural setting and its effect on movement and accumulation of the groundwater.
3. Delineating the aquifer configuration and the subsurface structural complex in the study area. and
4. To calculate the hydraulic parameters of the aquifer.
5. The chemical analysis of the available groundwater samples to evaluate their suitability for the different use purposes.

3. Geomorphology and geology in the study area

The investigated area is subdivided into three geomorphologic units, Said (1962) as shown in Fig. 2. The high lands are represented by Red Sea mountainous shield (Basement Complex). These high lands are Shayieb El Banat (2185 m), Umm ‘Anab (1660 m), Abu Dalf (1235 m), Loman (1122 m), Umm Araka (1310 m), Umm Nife’I (1735 m), Abu ’Abid (1900 m), Umm Gidri (1070 m), Abu Bidun (755), Umm Fahm (375) and represent the main watershed areas.

The low land is represented by sedimentary tablelands and widespread along the sides of wadis and low lands. It consists of relatively thick section of loose sands and gravels. The area is intersected by a number of wadis draining from the high lands. The tributaries of these wadis spread westwards and collecting rain water down to the main streams and eastward to the Red Sea. The main wide wadis included in the catchments of the study area are Wadi Faliq El-Sahl, Wadi Nakhra, Wadi Abu Makhadiq and Wadi Umm Enab. The coastal plain occupies the eastern part of the study area with a low topographic feature of an irregular longitudinal strip of land running parallel to the Red Sea Coast. The lowermost area bounding the sea shore form narrow strip of sabkha lands as shown in Fig. 2 which are dominated by salt tolerant plants cover including Nitraia Retusa, Zyophyllum album and Tamarix mannifera (El Sharabi, 1993). The emerged shoreline is locally represented by the soft sandy shore such as in Sharm el-’Arab, Marsa Abu Makhadiq, and Dishet El Dhaba.

3.1. The geology of the study area

The sedimentary sequence overlies the Precambrian basement rocks and extends to recent sands and gravels. The geology of Sahel Hasheesh is dominated by a sedimentary succession ranging in age from lower Miocene (Ranga formation) to Recent (post-rift succession) as shown in Fig. 3. Post-Rift Succession (Post-Miocene units): Pliocene (Shagra F.) to Recent and Syn-Rift Succession (Miocene units The Upper Miocene (Umm Gheig Formation) – The Middle Miocene (Umm Mahara Formation) – The Lower Miocene Ranga Formation).

4. Measurements and interpretation of vertical electrical soundings

Schlumberger array is the most widely used technique in electrical prospecting. Four electrodes are placed along a straight line on the earth’s surface. The outer electrodes are for the current and the in-between electrodes are for the potential. The separating distance between the potential electrodes is small compared with the total length of the array, usually less than one fifth of total length.

4.1. Data acquisition

The field geoelectric survey comprises 20 VES in Sahel Hasheesh using Schlumberger electrode configuration. The centers of these spreads are shown in Fig. 4. At each VES location, the distance between the potential electrodes (MN) was increased only few times (0.5–200 m) while the current electrode separation (AB) was increased from 1 up to 1000 m.

4.2. The qualitative interpretation of electrical resistivity data

The main purpose of the qualitative interpretation of the geoelectric resistivity sounding is to determine the number of geoelectric layers in terms of thicknesses (or depth) and relative resistivity. This is done by plotting the field measured apparent