Journal of African Earth Sciences 105 (2015) 93–106

Contents lists available at ScienceDirect

Journal of African Earth Sciences

journal homepage: www.elsevier.com/locate/jafrearsci

Integrated geophysical interpretation for delineating the structural elements and groundwater aquifers at central part of Sinai Peninsula, Egypt

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ARTICLE INFO

Article history:
Received 10 August 2014
Received in revised form 10 January 2015
Accepted 27 February 2015
Available online 12 March 2015

Keywords:
Geophysics
Faults
Groundwater

ABSTRACT

The study area is inhabited by Bedouins, suffering from scarcity of water necessary for domestic use and agricultural activities. The study area is located at central part of Sinai between Nakhl area and El Thamed area. Magnetic, gravity and geoelectric methods were used in this investigation to determine the groundwater aquifers and delineate the structural elements in the study area. Two hundreds and eighty eight magnetic and gravity stations were acquired by the EnviMag and Autograv CG3 instruments respectively. The magnetic data were processed by using Oasis Montaj. Reductions to the pole and 2D magnetic modeling were established to construct basement relief map. The depth to the basement rocks in the study area is ranging from 1200 m to 7000 m. The regional–residual separation and Euler deconvolution techniques were applied to the gravity data. Nine deep Vertical Electrical Sounding stations were measured to estimate the deep groundwater aquifer in the study area (Nubian Sandstone aquifer). The depth of upper surface of Nubian Sandstone aquifer is ranging between 975 m and 1100 m and affected by two major fault trends in the NE–SW and NW–SE directions.

1. Introduction

The study area is located between latitudes 29°45′N and 30°00′N and longitudes 33°35′E and 34°15′E and represents an area of 1789.208 km^2 (Fig. 1). The groundwater aquifers in central Sinai are still ambiguous. The present study shows further efforts and attempts to reveal these ambiguities. The Vertical Electrical Soundings (VESes) together with the gravity and the magnetic methods could be integrated to provide reasonable results and clear picture about the subsurface formations. The electrical resistivity method is one of the most promising geophysical tools which is used for groundwater investigation due to its ability to provide useful information about the subsurface structure and lithology at reasonable depths (Jakosky, 1961; Keller, 1967). Gravity method is used in groundwater exploration and detection of structural trends controlling the regional geometry of the groundwater aquifers (Murty and Raghavan, 2002). Magnetic method is an important tool to detect the upper surface of the basement and the thickness of the sedimentary cover. Many geophysical investigations have been carried out in the study area and around it such as Hossein (1980), Shaaban (1980), Massoud (2005), Sultan et al. (2006) and Sultan et al. (2009), they concluded that the study area contains deep groundwater aquifer dissected by different structural elements of NE–SW and NW–SE trends,

The essential aims of the present study are the exploration of Nubian Sandstone aquifer, evaluating the structural elements dissecting the study area and controlling the geometry of the aquifers configuration, and determining the depth of the basement surface.

2. Geologic setting

The study area lies in the central part of Sinai at Egma plateau. The main surface geology was described from the geological map of Sinai with scale 1:500,000 (Fig. 2). The Study area was covered by wadi deposits and alluvial deposits of Quaternary age. These deposits were distributed in most of the wadies in the study area and namely wadi Eqapah and wadi El Arish. The Lower Eocene deposits are represented by Egma Formation which is composed of chalky limestone and covers most of the study area. Esna Shale Formation of Paleocene deposits is composed mainly of shale. This formation is shown as pockets at different parts of the study area. Sudr Formation of Upper Cretaceous (Maastrichtian

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http://dx.doi.org/10.1016/j.jafrearsci.2015.02.011
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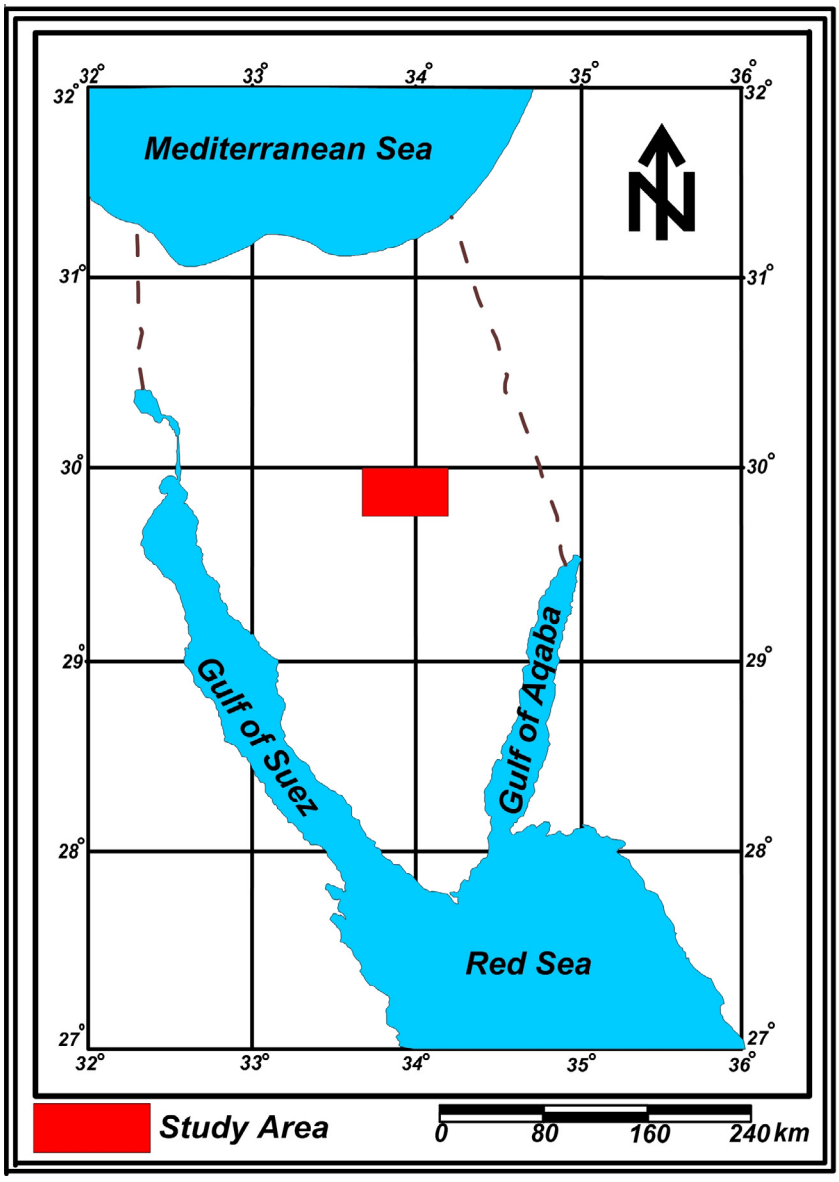

Fig. 1. Location map of the study area.

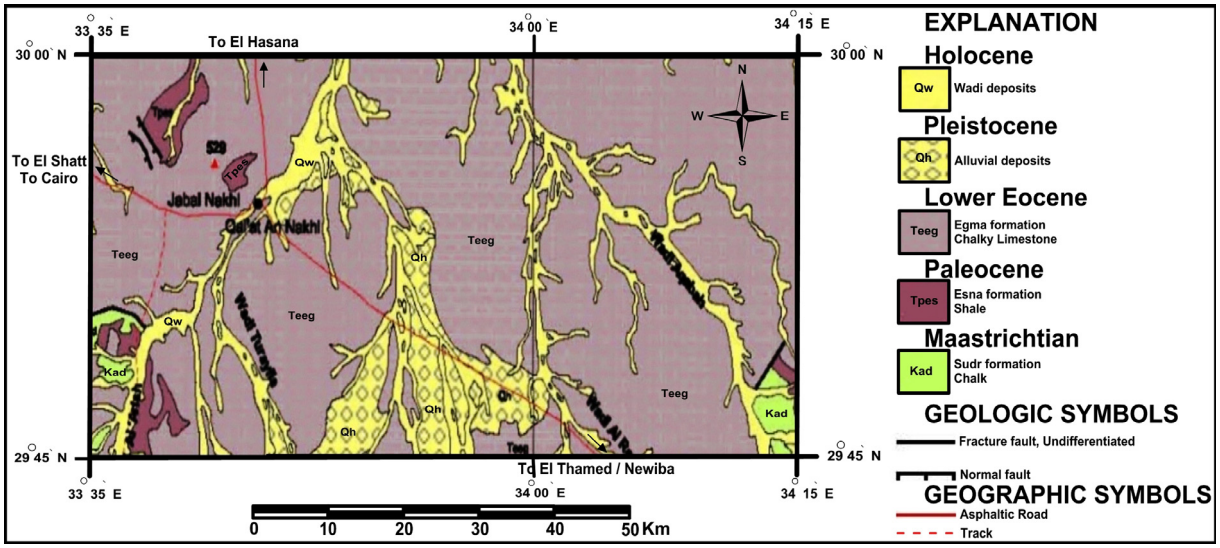

Fig. 2. Geological map of the study area (executed by UNSECO Cairo Office, 2005).