شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

HANAA ALY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

HANAA ALY

AIN SHAMS UNIVERSITY
FACULTY OF SCIENCE
GEOPHYSICS DEPARTMENT

Joint Use of Electromagnetic Induction and Magnetic Techniques for Subsurface Imaging at Ain Sokhna–Galala Sector, Gulf-of-Suez, Egypt

A Thesis Submitted in Partial Fulfillment of the Requirement

for the Degree of Master Science (M.Sc.) in Geophysics

By

Mahmoud Yahia Abd El-Hamid

B.Sc. in Geophysics, 2012

To

Geophysics Department

Faculty of Science

Ain Shams University

Supervised by

Prof. Dr. Sami Hamed Abd El-Nabi

Professor of Geophysics

Geophysics Department – Faculty of Science Ain Shams University – Cairo – Egypt

Prof. Dr. Mahmoud Mohamed Mahmoud Mekkawi

Professor of Geophysics at the National Research Institute of Astronomy and Geophysics (NRIAG) Geomagnetism and Geoelectricity Department, Cairo, Egypt.

Ass. Prof. Karam Samir Ibrahim Farag

Associate Professor of Geophysics

Geophysics Department – Faculty of Science Ain Shams University – Cairo – Egypt

Cairo – 2021

ACKNOWLEDGEMENT

I would like to thank geophysics department, especially Prof. Dr. Abdel-khalek El-Werr, Professor and Head of Geophysics at the Faculty of Science, Ain Shams University, for his cooperation and facilitation. In addition I'm so thankful to my supervisors Prof. Dr. Mahmoud Mekkawi, Professor of Geophysics at the National Research Institute of Astronomy and Geophysics (NRIAG) Geomagnetism and Geoelectricity Department, Prof. Dr Sami Hamed Abd El-Nabi Professor of Geophysics, Head of Petroleum Geophysics Program, Faculty of Science, Ain Shams University and Dr. Karam Samir Farag, Associate professor of Geophysics, Geophysics Department, Faculty of Science, Ain Shams University, for their guidance and great help in making this work perfect.

ABSTRACT

Recently, several urban and service development projects were carried out at the "City of Al-Galala Mountain", along the Egyptian Gulf of Suez, between Ain Sokhna and El Galala El Bahariya Plateau. This region is adjacent to the Gulf of Suez rift, which is an active geothermal area, as indicated by the geothermal surface manifestations, such as: thermal hot springs. It is a zone between two tectonic plates, which is expected to have a several geothermal reservoirs; consequently, it represents a potential area for geothermal prospecting. Aeromagnetic data interpretation was performed to define the deep and shallow structures in the study area and their distribution to select the most probable site to represent a geothermal reservoir suitable to construct a geothermal power system. Consequently, two sites were chosen to conduct a detailed study, with ground magnetic and (1D MT) to discover variations in conductivity (resistivity) and fix the depth of predicted geothermal reservoir as well as the distribution of deep and shallow faults which can facilitate geothermal solutions flow and injection to exploit the geothermal source energy. The obtained results showed that, the study area is intensely faulted with major NW-SE trend and minor E-W trend. Meanwhile the (MT) results show several conductive and resistive zones at different depths, which could be correlated with faulting zones, suitable to predict geothermal sources and aquifers.

List of Contents

Chapter 1: Introduction

Chapter 2: Geological and Geophysical Background

Chapter 3: Airborne Magnetic Data Interpretation

Chapter 4: Ground Magnetic Survey

Chapter 5: Magnetotelluric Survey

Chapter 6: Integration Between Magnetic and Magnetotelluric Results

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Overview

Nowadays, the government is keen on the development of the Eastern Desert, Gulf of Suez and Gulf of Aqaba. These areas are selected for applying the present work to assess the sites; namely, define the agricultural plan in due to the ideal water usability, define the residence and housing zone in due to the geotechnical assessments, and define the other activities such as industry and tourism zones in due to the accessibility of their elements. Ain Sokhna area is located in the Suez Governorate and lies on the western side of Gulf of Suez, Egypt (Figure 1.1). It is represented by low lands that occur between Gulf of Suez to the east and a hilly and mountain terrain to the west.

It became important place and its surroundings due to the urban expansion and construction of New Galala City. Many researches and studies have been done concerning that there are some factors might be affect the distribution of population there such as ground water resources, geologic hazard due to faults and karstification, weathering and pollution. The area has some geothermal resources with the potential for development of other renewable energy sources. An active geothermal area (Red Sea and its two branches of Gulfs of Suez and Aqaba) indicated by geothermal surface manifestations such as thermal water wells and hot springs (Figure 1.1). Many hot springs (Table 1) are distributed along the coasts of the Gulf of Suez (Ayun Musa 37°C, Ain Hammam Faraun 71°C, Hammam Musa 48 °C, and Ain Sokhna 33°C). These hot springs are natural indicators of heat transportation through the Earth and geothermal activity (Abdelzaher et al, 2018).

1.2 Climate Conditions

Climate conditions of the study area were obtained from Suez climate station. The average minimum air temperature in January (15.20°C) whiles the average maximum air temperature in July (30°C), Rainfall rate is (17.2mm/year), and the maximum value of rain in one day is 3.2mm. Evaporation ranges between (5.6 to12.5mm/day). There are three principal directions of wind-blown NW, N and W having, general ratios of 36.7%, 29.1% and 7.4%.

The wind speed range between 11.5 and 19.2 km/hour (Egyptian Meteorological Authority, 1998-2004).

1.3 Sources of Hazards

Gulf of Suez is considered unstable area, frequent and large earthquakes might affect the coastal plain of the Red Sea and the Gulf of Suez (Sultan, 1993), which did not reach to destructive level, beside that the existence of carbonate rocks at the Northern Galala Plateau which contains palaeo-karst surfaces, caves, fissures, and fault zones represents geological hazard. Study area contains several wadis and deltas, average annual rainfall is 17.2 mm/year, and rainstorms occur at least once every year which indicate that the area is subjected to the risk of flash flood. Because of climate conditions, soil nature, and coastal location of study area, the area is subjected to salt weathering which must be taken in to consideration while constructing roads and buildings. Additionally the industrial areas at the west of Ain Sokhna add significant hazards of environmental pollution.

1.4 Scope of Study

The study area is tectonically active and large geothermal reservoirs are expected. Understanding the tectonic framework of the Gulf of Suez region, will help defining the mechanism, thermal state (future energy) and can give a real alarm to the decision makers for any near-future development. The present field investigations comprise regional aeromagnetics (AEROMAG), accessible broadband magnetotellurics (MT), and ground magnetics (GRMAG) located near the Gulf of Suez (Figure 1.3). The expected results will show clearly the subsurface structures and variations in conductivity (resistivities) which can be used to locate the groundwater, and high heat sources. Later, suggested suitable locations of drilling boreholes can give the evolution of ground water or hydrothermal reservoir and subsurface geology.