*Ain Shams University*
*Faculty of Science*

# Application of Multi-dimensional Electrical Resistivity and Electromagnetic Induction Techniques to Explore the Groundwater Occurrences at El-Salloum Basin, Northwestern Coast, Egypt

*A Thesis Submitted by*

**Fardous Mohamed Abdel Hamid Mohamed Zarif**

**(M.Sc. in Geophysics–Faculty of Science–Suez Canal University, 2009)**

*For*
*The Doctor of Philosophy Degree (Ph.D.) of*
*Science in Geophysics*

**Geophysics Department**
**Faculty of Science**
**Ain Shams University**

**(2017)**

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*To*

**Geophysics Department**

**Faculty of Science**

**Ain Shams University**

*Supervised by*

**Prof.Dr. Salah El-Dien Abdel Wahab**
Professor of Geophysics
Faculty of Science
Ain Shams University

**Prof. Dr. Ahmed M. A. Youssef**
Professor of Geophysics,
Geophysics Department,
Desert Research Center
(DRC)

**Prof. Dr. Mohamed Abbas Mabrouk**
Emeritus Professor of Geophysics,
Geophysics Department
Desert Research Center

**Prof.Dr. Lee slater**
Professor of Geophysics,
Department of Earth&
Environment Sciences, Rutgers,
The state University of New Jersey,
USA

**Dr. Karam Samir Ibrahim Farag**
Lecturer of Geophysics at the Faculty
of Science, Ain Shams University

**Cairo – 2017**

*Ain Shams University*
*Faculty of Science*

# Approval Sheet
# Thesis Title

## Application of Multi-dimensional Electrical Resistivity and Electromagnetic Induction Techniques to Explore the Groundwater Occurrences at El-Salloum Basin, Northwestern Coast, Egypt

**Submitted by/ Fardous Mohamed Abdel Hamid Mohamed Zarif**
**M.Sc., Geophysics (2009)**

**For the Degree of Philosophy Doctor in Science (Geophysics)**

This thesis has been approved by Examiner committee

**Prof. Dr. Tharwat Ahmed Abdel-Fattah** ………………
Prof. of Geophysics
Alexandria University

**Prof. Dr. El Arabi Hendi Shendi** …………………
Prof. of Geophysics
Suez Canal University

**Prof. Dr. Mohamed Abbas Mabrouk** ……………….
Prof. of Geophysics
Desert Research Center

**Prof. Dr. Salah El-Dien Abdel Wahab** ………………….
Prof. of Geophysics
Ain Shams University

DATE OF EXAMINATION: / /2017

***Prof. Dr.***

Head of Geophysics Department

*Ain Shams University*
*Faculty of Science*

**Application of Multi-dimensional Electrical Resistivity and Electromagnetic Induction Techniques to Explore the Groundwater Occurrences at El-Salloum Basin, Northwestern Coast, Egypt**

By

**Fardous Mohamed Abdel Hamid Mohamed Zarif**

B.Sc., Geophysics (2003)
M.Sc., Geophysics (2009)

This thesis for Ph.D. degree has been approved by:

**Prof. Dr. Salah El-Dien Abdel Wahab Mousa**

**Prof. Dr. Mohamed Abbas Mabrouk**

**Prof. Dr. Ahmed M. A. Youssef**

**Prof. Dr. Lee slater**

**Dr. Karam Samir Ibrahim Farag**

DATE OF EXAMINATION: / / 2017

# *ACKNOWLEDGEMENT*

This thesis was completed with help and inspiration from glorification of Allah who guided and helped me. I would like to express gratitude to all who have helped me over the last years, but some people deserve special thanks. First of all I would like to thank my Egyptian supervisor Prof. Mohamed Abbas Mabrouk, Prof. Ahmed Youssef and my co-supervisors, Prof. Salah Abdel Wahab and Dr. Karam Samir. They have always helped in any way they could. I would like to think my foreign supervisor Prof. Lee Slater from Rutgers University, Newark, New Jersey, USA. Also my gratefulness for his critical and helpful review in writing the second paper. Prof. Ayman Al-temamy deserves to be acknowledged for taking time to help me in collecting the measurements in the study area. I thank Judy Robinson from Rutgers University of Earth and environmental sciences for introducing me to R2 Coding and helping me in applying the approach to my 2D ERI measurements to inverted the data sets. My gratefulness goes to those financing my Joint mission scholarship; Egyptian cultural affairs and missions sector, Desert Research center. My largest gratitude goes to Prof. Monteiro Santos who give us a permission to use his inv2DVLF code, which was developed recently by him et al (2006) for inverting the VLF tipper data of the single frequency to electrical resistivity .Also I have to thank Monteiro Santos for his critical and helpful reviews.

Special thanks go to prof. Mohamed Abas Mabrouk and prof. Ahmed Youssef who always were ready to answer questions and give valuable comments on my work. I would also like to thank former and present colleagues at Near Surface Geophysics group from Rutgers University for interesting discussions at the coffee breaks and seminars time. During the last years I have learned much about Electrical and Electromagnetic method, Depth of investigation and data analysis. Also Liz Morrin has been a great help taking care of the administrative issues and we have had many pleasant talks during my staying in Rutgers University. I thank all my supervisors for comments and language corrections of my thesis. My parents deserve special thanks. They have supported me in this last very hectic period. It feels good knowing that they always are prepared to help. The most important thanks go to my beloved husband Ahmed Elshenawy. Ahmed, he have read my work and supported me all the way. good knowing that they always are prepared to help. The most important thanks go to my beloved husband Ahmed Elshenawy. Ahmed, he have read my work and supported me all the way.

*Fardous zarif*

# ABSTRACT

Saltwater intrusion into shallow coastal aquifers, exacerbated by excessive groundwater withdrawals, is a major environmental problem along the coastal strip of the western desert of Egypt. This leads to a loss of freshwater resources, mandating alternative, costly water supply methods. Understanding and developing groundwater resources in El Salloum Basin along the northwestern coast of Egypt remains a challenging issue. Since groundwater cannot be easily located, a variety of scientific techniques are needed to provide information concerning its occurrence and location. Groundwater is considered as one of the main sources for both rural and agriculture water supplies in many areas in Egypt especially in the desert regions. Over recent years, increasing abstraction to meet rising demand for domestic supplies and expansion in reclamation in desert fringes has raised concerns for the sustainability of the groundwater resource and the livelihoods it supports. Near-surface electrical methods are a promising technology to evaluate groundwater resources as they are sensitive to physical and chemical variations of the subsurface associated with changing groundwater quality.Vertical Electrical Resistivity Sounding (VES), 2D Electrical Resistivity Imaging (ERI) and Very Low Frequency (VLF) electromagnetic have been applied, to investigate the hydrogeological framework of El Salloum basin with the aim of determining the potential of the review for providing potable water. A depth of investigation (DOI) index was used to constrain the information content of the images at depths up to 100 m. VLF- EM surveys identified major geological interfaces suspected to be faults/fractured zones across the study area. A combined analysis of the datasets suggests that the subsurface geology is related to four/five major resistivity layers. Resistivity tomographic images have shown a decrease of resistivity by going deeper (possibly representing clay rich limestone/ saline water impacted fractured limestone) and towards the coastal region where the sea water intrusion may take a place. The equivalent geologic layers suggest that the Oolitic Limestone (Pleistocene age) at the north and the underlain fractured limestone (Middle Miocene) southward areas of coastal plain as the aquifers layers. Sites that will provide appreciable volume of water were suggested base on vertical and lateral extent of the layers. The most promising locations for drilling productive wells
are in the south and southeastern parts of the region, where the potential for potable , groundwater increases substantially. The results from this research demonstrate the capability of integrated 1D-VES, 2D-ERI and VLF-EM techniques to understand and delineate the groundwater occurrence in heterogeneous/ karsts environments.

**Key words:** Coastal aquifers, Vertical Electrical Sounding (VES), VLF–EM, 2D resistivity imaging, Depth of investigation (DOI)

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