



**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

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**(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**

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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)

CONTENT

Subject	Page NO.
Acknowledgment	
Abstract	
Contents.....	i
List of Figures.....	iv
List of Tables.....	xi
Key of Words.....	x
 CHAPTER I: INTRUCTION 	
1.1. General outline	1
1.2. Site location	3
1.3. Literature Review.....	3
1.4. Problem statement.....	6
1.5. Objectives.....	7
 CHAPTER II: GEOMORPHOLOGICAL, GOLOGICAL ANDHYDROGEOLOGICAL SETTING 	
2.1. Geomorphological setting.....	9
2.1.1. The elevated tableland province.....	10
2.1.2. The low plain province.....	10
a. Piedmont plain.....	11
b. Coastal plain.....	11
i. Elongated parallel Ridges.....	12
i.1. The northern near-shore ridges.....	12
i.2. The southern inland ridges.....	12
ii. Lagoonal Depressions.....	12
ii.1. The Modern Beach.....	13
ii.2. A wave-cut cliff.....	13
ii.3. Lagoon.....	14
ii.4. Salt Marshes lakes.....	14
ii.5. Offshore islands.....	14
ii.6. Abrasion platform.....	14
ii.7. Fore-shore Dunes.....	15
iii. Hydrographic basins.....	15
iii.1. Basins of exterior drainage	15
iii.2. Basins of interior drainage.....	16
iv. Depressions.....	16
2.2. Geological aspects.....	16
2.2. 1. Lithostratigraphy.....	16
2.2 1.1. Miocene sediments.....	16
2.2. 1.2. Pliocene sediments.....	17
2.2.1.3. Pleistocene sediments.....	18

2.2.1.4. Holocene deposits.....	20
2.3. Geological structures.....	20
2.4. Hydrogeological setting.....	21
2.4.1. Quaternary aquifer.....	21
2.4.2. Middle Miocene (Marmarica limestone aquifer).....	22
2.4.3. Lower Miocene (Moghra aquifer).....	23

CHAPTER III: DATA ACQUISITION, PROCESSING AND INVERSION

3.1. Electrical Resistivity Method.....	24
3.1.1 Theory of Electrical Resistivity Method.....	24
3.1.2. Data acquisition, processing and inversion of Electrical Resistivity.....	28
3.1.2.1 1D-Vertical Electrical Sounding (VES).....	29
3.1.2.2. 2DElectrical Resistivity Imaging (ERI).....	34
a. Contact resistance.....	35
b. Stacking.....	35
c. Pulse duration.....	36
3.1.2.2.1. Data acquisition of 2D-Electrical Resistivity imaging (2D-ERI).....	36
3.1.2.2.2. Data Processing and Inversion of 2D-ERI.....	38
3.1.3. Strengths and Limitations of DC resistivity Method.....	42
3.1.4. Depth of investigation.....	43
3.1.4.1. Resolution matrix and Sensitivity.....	44
3.1.4.2. DOI index method.....	45
3.1.4.3. In-Situ Calibration.....	47
3.5. Very Low Frequency Electromagnetic (VLF-EM) Method.....	51
3.5.1. Operating Principles and conceptual background.....	51
3.5.2 Theory of VLF-EM method.....	52
3.5.3 VLF-EM Measured Parameters.....	55
3.5.4. Depth of Penetration of VLF-EM.....	56
3.5.5. VLF-EM Survey Procedure and Quality control.....	57
3.5.6. Methodology and data acquisition.....	58
3.5.7. VLF–EM Data treatment and Analysis.....	60
3.5.7.1 Fraser Filter.....	61
3.5.7.2. Karous-Hjelt Filter.....	62
3.5.8. Two-dimensional (2D) inversion of VLF–EM Data.....	64
3.5.8.1 Forward Modeling.....	64
3.5.8.2. Inverse Problem solving and solution.....	65

CHAPTER IV: RESULTS AND DISCUSSION:

4.1. Vertical Electrical Sounding (VES) Results.....	67
4.1.1 Presentation of Results.....	71
4.1.2 Geoelectrical cross sections.....	71
1. W-E cross sections.....	73

2. S-N cross sections.....	78
3. NW-SE cross section.....	79
4.1.3. Contour maps.....	85
1. Surface layer	85
2. Chalky limestone (water bearing).....	85
3. Calcareous clay.....	88
4. Argillaceous limestone (water bearing).....	88
4.2. 2D-Electrical Resistivity Imaging results.....	95
4.2.1. 2D-ERI roll along profiles results.....	96
4.2.2. 2D-ERI on Coastal plain.....	105
4.2.3. 2D-ERI on Central part of the study area (El- Salloum Basin).....	113
4.2.4. 2D-ERI on the foot of the scarp of the plateau.....	121
4.2.5. 2D-ERI on Wadi Arkeet south of the study area (Case study).....	133
4.3. Very Low Frequency Electromagnetic (VLF-EM) results & interpretation.....	142
4.3.1. VLF-EM profiles results and interpretation at Coastal plain (North parts of the study area).....	149
4.3.1.1. Discussion the results of the Coastal plain VLF- EM profiles.....	151
4.3.2 VLF-EM profiles results and interpretation at the basin (central parts of the study area).....	159
4.3.2.1. Discussion the results of the central part (El Salloum basin) VLF- EM profiles.....	162
4.3.3. VLF-EM profiles results and interpretation at the foot of the plateau scarp (at the West and south parts of the study area).....	172
4.3.3.1. Discussion the results of the profile of the foot of the plateau scarp (at the West and south parts of the study area).....	175
4.3.4. Hydrogeological Implication through VLF-EM Data.....	185
 CHAPTER V: WATER POTENTIALITY IN THE STUDYAREA	
5.1. Groundwater occurrence throughout the Quaternary.....	188
5.1.1. Oolitic limestone water bearing layer (Pleistocene).....	188
5.2. Groundwater occurrence throughout Middle Miocene.....	189
 CHAPTERVI: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	
Summary, Conclusions	195
Recommendations	199
REFERENCES	200
APPENDIX	a
ARABIC SUMMARY	1

List of Figures	Page No.
Figure 1.1: The regional planning of the Northern Western Coastal Zone (NWCZ), (Attia A.A, 1999).....	2
Figure 1.2: (a) Key map of the study area at the Northwestern coastal plain, (b) Land sat image showing the location of the study area (El Salloum basin), south the Mediterranean Sea, Egypt in UTM at 35 N zone, Egypt.....	4
Figure 1.3: Surface elevation of the study area as extracted from the Shuttle Radar Topography Mission (SRTM) images.....	5
Figure 2.1: Simplified Geomorphologic map, El Salloum Depression area (After Salem et al., 2011).....	14
Figure 2.2: (Simplified Geologic map of the study area (Salem A. et al .2011).....	18
Figure 2.3: Composite stratigraphic sequence west Barrani area.....	19
Figure 2.4: Columnar section of El Salloum Well (After Salem et al., 2011).....	19
Figure 2.5: Geological Structure, El Salloum depression area, modified after (CONOCO, 1986).....	21
Figure 3.1: A sketch showing the applied Geophysical techniques.....	24
Figure 3.2: Illustration of a four-electrode station containing current and potential electrodes.....	26
Figure 3.3: Common arrays used in resistivity surveys and their geometric factors.....	28
Figure 3.4: Roll-along technique procedures to extend the covered area by a 2-D survey.....	28
Figure 3.5: location map of the study area within VES'S and cross-sections location.....	29
Figure 3.6: 1-D models obtained from resistivity data inversion at VES 14 and 8.....	33
Figure 3.7: Display the equivalence models analysis for VES No.6.....	34
Figure 3.8: Electrical Resistivity Imaging: Multi electrode technique.....	35
Figure 3.9: Location map of 2D-ERI sites of the study area.....	37
Figure 3.10: sketch showing standard and Roll along configuration of 2D-ERT Survey.....	38
Figure 3.11: Flow chart of the process used in geophysical data inversion and forward modeling.....	39
Figure 3.12 (a): Synthetic resistivity model used to compare the model obtained from Real field data of site well 10 (b): Forward model obtained from inversion synthetic data of site well 10.....	41
Figure 3.13: Inversion model obtained from inversion Real Field data of site well 10.....	41

Figure 3.14: Workflow of the proposed 5-steps modified DOI-based methodology to statistically estimate the depth of investigation.....	48
Figure 3.15: Shows the global distribution of the common world VLF–EM radio-stations.....	53
Figure 3.16: Schematic diagram shows the horizontal orientation of the primary VLF–EM radio-wave field with enlargement of secondary magnetic field (Hutchinson, et al., 2010).....	54
Figure 3.17: Schematic diagram shows the tilt angle surveying profile over a vertical subsurface conductive anomaly (Hutchinson, et al., 2010).....	55
Figure 3.18: Field setup of the VLF–EM system, at each measuring azimuth, over a horizontally-layered earth (redrawn after Farag and Tezkan, 2007).....	58
Figure 3.19: Location map of the VLF-EM surveying profiles	59
Figure 3.20: Field photograph shows the ABEM WADITM VLF–EM measuring system, along with other connections.....	60
Figure 3.21: Typical finite-element mesh (Santos, 2007).....	66
Figure 4.1: Zonation map derived from digital elevation model and locations of sounding points.....	68
Figure 4.2: Shows Geological logs determined from drilling information obtained for the water supply wells in the study area.	69
Figure 4.3: Examples for VES Curves, (a) showing VES curves at the Coastal plain (b), showing VES Curves at the Central part and (c) showing the VES curves on the south part of the study area	70
Figure 4.4: Frequency distribution chart of observed curve types in the Study Area.....	71
Figure 4.5: location map of the study area within VES'S and cross-sections location.....	72
Figure 4.6: Geoelectrical cross-section A – A\ along W-E direction of the study area.....	75
Figure 4.7: Geoelectrical cross-section B-B\ along W-E direction of the study area.....	76
Figure 4.8: Geoelectrical cross-section C-C\ along W-E direction of the study area.....	77
Figure 4.9: Geoelectrical cross-section F-A\ along S-N direction of the study area.....	81
Figure 4.10: Geoelectrical cross-section D-D\ along S-N direction of the study area.....	82
Figure 4.11: Geoelectrical cross-section C-E along S-N direction of the study area.....	83
Figure 4.12: Geoelectrical cross-section A -D along NW- SE direction of the study area.....	84
Figure 4.13: Iso-resistivity contour map for surface layer.....	86
Figure 4.14: Isopach contour map for surface layer.....	86

Figure 4.15: Iso-resistivity contour map for chalky limestone layer.....	87
Figure 4.16: Isopach contour map for chalky limestone layer.....	87
Figure 4.17 Upper surface level map of Chalky limestone layer.....	88
Figure 4.18: Iso-resistivity contour map for Calcareous clay layer.....	89
Figure 4.19: Isopach contour map for Calcareous clay layer.....	90
Figure 4.20 Upper surface level map of calcareous clay layer.....	90
Figure 4.21: Iso-resistivity contour map for argillaceous limestone (Water bearing) layer.....	91
Figure 4.22: Isopach contour map for argillaceous limestone layer.....	91
Figure 4.23: Upper surface level map for argillaceous limestone layer.....	92
Figure 4.24: Shows the Inferred structural elements obtained from integration of the results of VES surveys.	95
Figure 4.25: Overview of 2D-ERI lines collected overall the study area.....	96
Figure 4.26 (a) Roll along electrical resistivity profiles conducted from south to north	98
Figure 4.27 Results of step 1 applied to 2D-ERI profile of Site 7.	102
Figure 4.28 Step2: (a): Histogram of the scaled DOI index values estimated for 2D-ERI profile of site7, the cumulative distribution of the scaled DOI is plotted in red line. (b): is step3: fitting of the mixture of the two Gaussian distribution on the cumulative distribution function computed in step 2.	103
Figure 4.29 shows the interpretability index cross-section computed in step 4 for (site7) 2D-ERI profile.....	104
Figure 4.30 Results of step 5 applied to the site 7.	104
Figure 4.31 inverted resistivity models obtained in the north part of the study area.	106
Figure 4.32 Results of step 1 applied to Site 2 2D-ERI profile.	109
Figure 4.33 Step 2: (a): Histogram of the scaled DOI index values estimated for 2D-ERI profile of site 2, the cumulative distribution of the scaled DOI is plotted in red line. (b): Results of step 3	110
Figure 4.34: Cross-section shows the interpretability index cross-section computed in step 4 for (site 2) 2D-ERI profile.....	111
Figure 4.35 Results of step 5 applied to the site 2. A: ERI image obtained when using the reference model q_c . B: ERI image obtained after using II as alpha blending values.....	112
Figure 4.36: 2D-ERI profiles obtained in central part of the study area.	115
Figure 4.37 Results of step 1 applied to 2D-ERI profile of Site 4.	117
Figure 4.38: Step2: (a): Histogram of the scaled DOI index values estimated for 2D-ERI profile of site 4, the cumulative distribution of the scaled DOI is plotted in red line. (b): Results of step3.....	118

Figure 4.39: The interpretability index cross-section computed in step 4 for 2D-ERI profile of Site 4.....	119
Figure 4.40: Shows Results of step 5 applied to the 2D-ERI of site 4.	120
Figure 4.41: 2D-ERI profiles obtained in the foot of the plateau scarp.	122
Figure 4.42: shows the 2D- inverted resistivity model of Site 12.	124
Figure 4.43: shows the 2D- inverted resistivity model of Site 10	125
Figure 4.44: shows the 2D- inverted resistivity model of Site 14	126
Figure 4.45: shows the 2D- inverted resistivity model of Site 9	127
Figure 4.46: shows the 2D- inverted resistivity model of Site 8	128
Figure 4.47: Results of the step 1 applied to 2DERI- profile of Site 12.	130
Figure 4.48: Step 2 (b): Results of step3 of site 12.....	131
Figure 4.49: The interpretability index cross-section computed in step 4 for 2D-ERI profile of Site 12.....	132
Figure 4.50: Shows Results of step 5 applied to the 2D-ERI profile of site 12. A: 2D-ERI image obtained from using the reference model q_c . B: ERI image obtained after using Π as alpha blending values.....	133
Figure 4.51: 2D-ERI obtained in Wadi Arkeet.	135
Figure 4.52: Results of the step 1 applied to 2D-ERI profile of Site 15.	137
Figure 4.53: Step 2 (b): Results of step3 of site 15.....	138
Figure 4.54: The interpretability index cross-section computed in step 4 for 2D-ERI profile of Site 15.....	139
Figure 4.55: Shows Results of step 5 applied to the 2D-ERI profile of site 15.	140
Figure 4.56: Location of the VLF–EM surveying profiles within the study area... ..	144
Figure 4.67: VLF-EM response along VLF-2 profile on the coastal plain.....	145
Figure 4.58: VLF-EM response along VLF-12 profile on the basin (central part)	146
Figure 4.59: VLF-EM response along VLF-23 profile on the basin (central part).....	147
Figure 4.60: Scatter plot of VLF-2 profile of Coastal plain	148
Figure 4.61: Scatter plot of VLF-12 profile of the basin (central part) shows the degree of correlation between the observed and calculated in-phase and out-phase VLF-EM data.....	148
Figure 4.62: Scatter plot of VLF-23 profile of plateau (south part) shows the degree of correlation between the observed and calculated in-phase and out-phase VLF-EM data.....	149
Figure 4.63 (a): Observed and Fraser filtered real and imaginary VLF data of profile VLF -2.....	152
Figure 4.64: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF -6.	153
Figure 4.65: (a) Observed and Fraser filtered real and imaginary VLF data profile VLF-7.....	154

Figure 4.66: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 8.	155
Figure 4.67: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF-19	156
Figure 4.68: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF-14.	157
Figure 4.69: (a) Observed and Fraser filtered real and imaginary VLF data for profiles VLF-27.....	158
Figure 4.70: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 1.....	164
Figure 4.71: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 4.....	165
Figure 4.72: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF-	166
Figure 4.73: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 10	167
Figure 4.74: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 26	168
Figure 4.75: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 18	169
Figure 4.76: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 20	170
Figure 4.77: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 11	171
Figure 4.78: (a) Observed and Fraser filtered real and imaginary VLF data of profiles VLF- 28	178
Figure 4.79: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 13	179
Figure 4.80: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 15	180
Figure 4.81: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 25	181
Figure 4.82: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 17	182
Figure 4.83: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 22	183
Figure 4.84: (a) Observed and Fraser filtered real and imaginary VLF data of profile VLF- 24	184
Figure 4.85: 3D-surface map of Fraser-filtered in-phase of the VLF-EM data with colored scale the red and Orange color means high real response but the green and yellow color mean low real response.....	186
Figure 5.1: Groundwater occurrence in limestone aquifers.....	187

Figure 5.2 shows the white ridges of Oolitic limestone along shore line (Oolitic limestone aquifer).....	189
Figure 5.3 a collection of pictures captured in the study area to show the highly fractured chalky at the southern parts of the study area (Middle Miocene aquifer).....	190
Figure 5.4: Depth to water contour map of the Middle Miocene aquifer overall the study area from the available water wells and points.....	191
Figure 5.5 Expected water level contour map of the Middle Miocene aquifer which is inferred from the available water point over all the study area.....	191
Figure 5.6:(a) Iso- Resistivity contour map obtained from geoelectrical resistivity measurements While,(b)Iso-Salinity contour map obtained from the available water point	192
Figure 5.7: Isopach contour map of the water bearing formation which is obtained from geoelectrical resistivity measurements.....	193
Figure 5.8: Sketch shows the conceptual model with the Inferred structural elements obtained from integration of the results of VES and 2D-ERI surveys.	194

List of tables

Page No

Table 4.1 Values of the fitted parameters of the Gaussian distributions computed in step 3 for the three roll along profiles.....	102
Table 4.2 Values of the fitted parameters of the Gaussian distributions computed in step 3 for the all profiles over the study area.....	108