IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 4 Issue 5, May 2017
ISSN (Online) 2348 – 7968 | Impact Factor (2016) – 5.264
www.ijiset.com

Geoelectrical Survey For Engineering Uses, Madinaty City, Egypt.

Thabet H. S.*,Abdel Hafeez Th. H.* , Diaa Hamed*,Azab M.A.*
Basheer.A.A. And Abdel Qawi S.R.***.**
*Geology Department, Faculty of Science, Al-Azhar University, Cairo, Egypt.
** Geology Department, Faculty of Science, Helwan University, Cairo, Egypt.
***Aloqbi Cosultant Engineering Office,Jeddah.KSA.
saeednajm64@yahoo.com
saeednajm2014@yahoo.com

Abstract

Near Surface Geophysical Techniques such as electrical resistivity tomography (ERT) is useful technique for delineating subsurface configurations such as stratigraphy, structural elements. The ERT technique is used to delineate the contamination, and buried objects, as well as to quantify some aquifer properties. Twenty -four 2-D electrical resistivity sections were measured using Wenner configurations. The spread length is about 100 m and the electrodes spacing are 1m, respectively, to reach about 30 m. The results indicate that, the subsurface section is divided into main three geo-electrical units, the first geoelectrical is highly weathered (loose sediments composed of sand and gravels)., which exhibits low resistivity values ranging from 280 to 550 ohm m. The second geoelectrical unit is corresponding to loose sand with small rounded flint pebbles and fossil woo of moderate resistivity values from 500 to 1100 ohm m. The third geoelectrical unit, which is the lower bed, exhibits high resistivity values from 1100 to 2050 ohm m and corresponding to Sands and gravels with some basalt flows. Also, the interpretation results of the obtained data for Wenner array were represented in the 2-D view to delineate the layer of low or very low resistivity values these values are corresponding to loose sediments have direct effect on the constructions and may cause cracks and fractures.

Keywords: 2D Electrical Imaging and Withered limestone

IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 4 Issue 5, May 2017
ISSN (Online) 2348 – 7968 | Impact Factor (2016) – 5.264
www.ijiset.com

1. Introduction

The new urban regions around the Greater Cairo usually sited on bedrocks that run into many problems and reported construction damage. It became inevitable that high resolution near surface geophysical techniques be applied to discover and help delineate and assessing these hazardous problems. At highly developed countries, the application of geophysical techniques is constrained for solving the engineering and Geo-technical problems, thus, this study of 2D geoelectrical survay introduces is a one of different instruments which has used for solving and giving a clear characterization of these troubles to be constrained by the engineering viewpoint in Egypt.

The study area is a part of Greater Cairo, east of the River Nile (Fig.1).

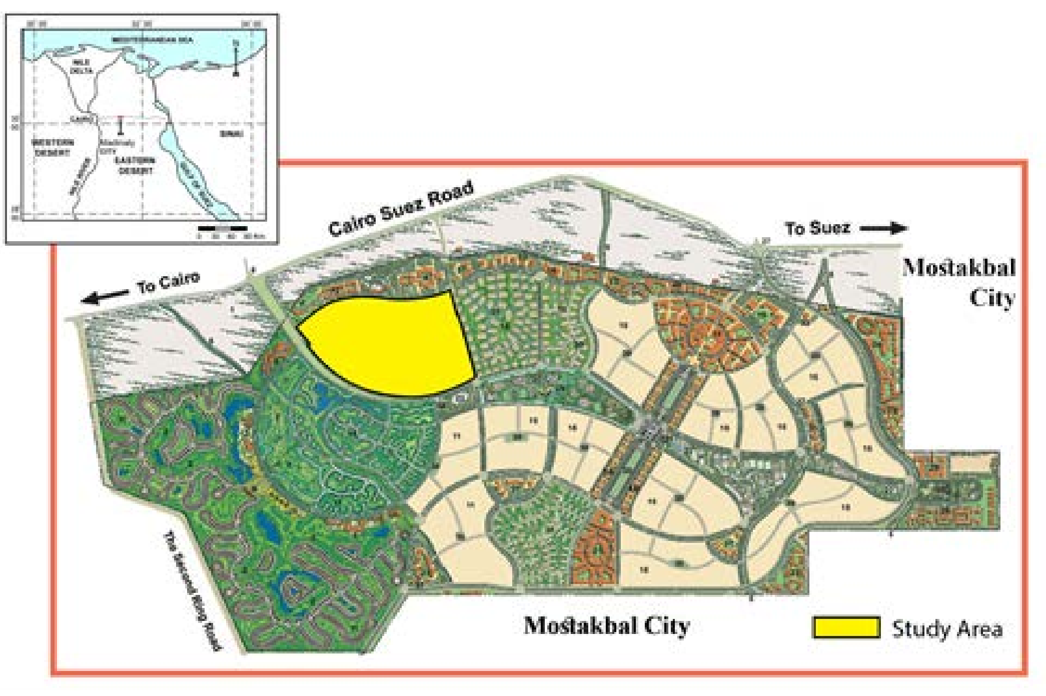

Figure 1: Location map of the study area at Madinaty City.

IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 4 Issue 5, May 2017
ISSN (Online) 2348 – 7968 | Impact Factor (2016) – 5.264
www.ijiset.com

2. Geological setting:

The surface geology in and around the studied area Figure (2) reveals that, the older rocks are have been subdivided into two main rock units by (Said, 1962). The oldest unit is made up of sands and gravels and was named by (Shukri, 1954) as the “Gebel Ahmar Formation” to refer to the Early Oligocene period. The youngest rock unit is composed of basalt flows and referred to Late Oligocene-Early Miocene period.

The younger rocks are the Upper Miocene beds at the southern side of Wadi Hagul along the Gulf of Suez (Abdullah and Abdelhady, 1966). In the study area, the Hagul Formation is made up of loose sand with small rounded flint pebbles and fossil wood.

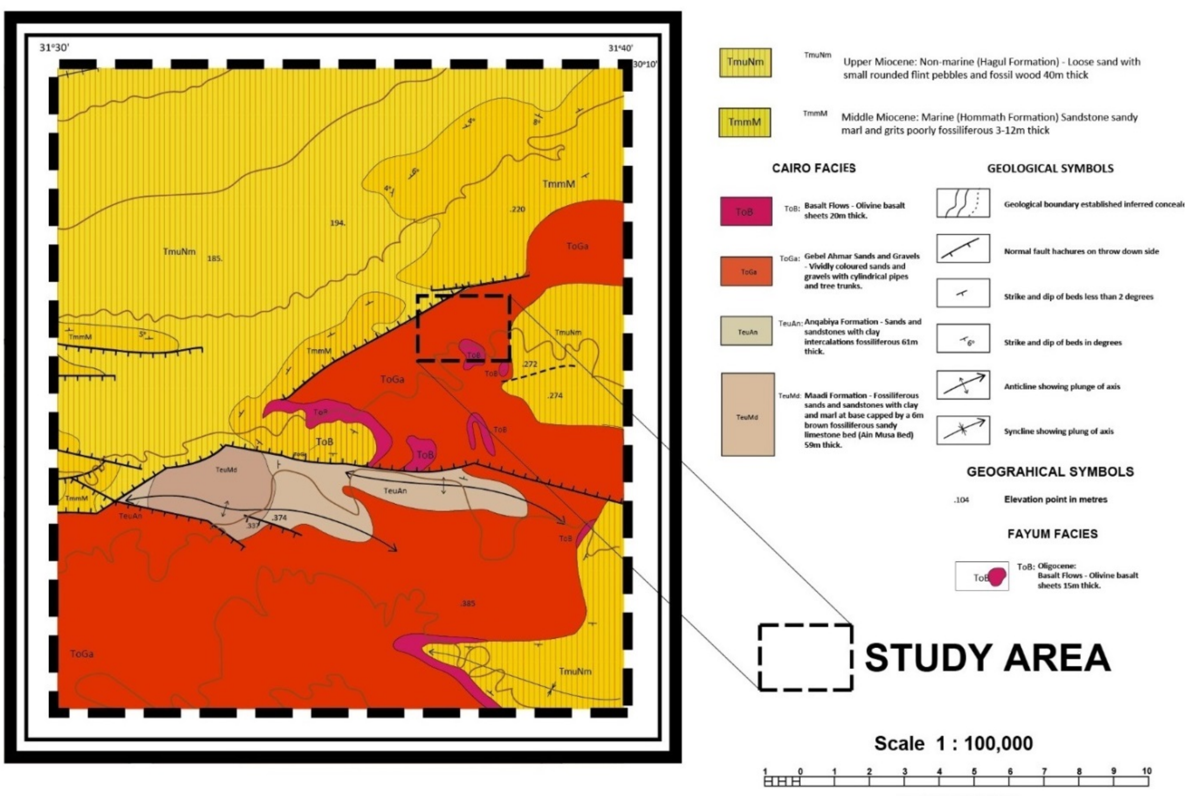

Fig. 2: Geological map of the New Cairo City and the study area (after EGSMA,1983)

3. Methodology

Geophysical surveys can play an important role in defining the subsurface geology. The 2D resistivity survey was carried out in the present work to outline the thicknesses and electrical resistivities of the encountered geoelectric units.

3.1 Geoelectric method:

The utmost constraint of the resistivity sounding method is that it does not take into description horizontal changes in the subsurface resistivity. The 2-D imaging survey conquers this problem, where the resistivity changes in the horizontal direction as well as in the vertical direction along the survey line. Therefore, the 2-D geo-electrical imaging techniques was selected for the survey. The Wenner array gives the smallest number of possible measurements compared to the other common arrays (Griffiths and Barker, 1993), also it competent to work in noisy fields and when good vertical resolution is required. The Wenner array was used in the present work. The geo-electrical data obtained along twenty -four profiles, of 100 m length, distributed over the study area. The survey has been accomplished using a 99 multi-electrodes system connected to the SYSCAL R2 resistivity meter through a multicore cable (Fig. 3). A built-in microcomputer with an electronic switching unit was used to automatically select the relevant four electrodes for each measurement. In geoelectrical survey, the digital computer–operated high–resolution resistivity meter (Syscal–R2), was used to acquire the field resistivity data The geoelectric survey was carried out 2-D geoclectrical resistivity imaging. In the 2-D geoelectrical resistivity imaging, twenty -four profiles, of Wenner resistivity imaging were conducted in the Madinaty area with a spacing of 1 m and to depth about 30 m show fig. (4).

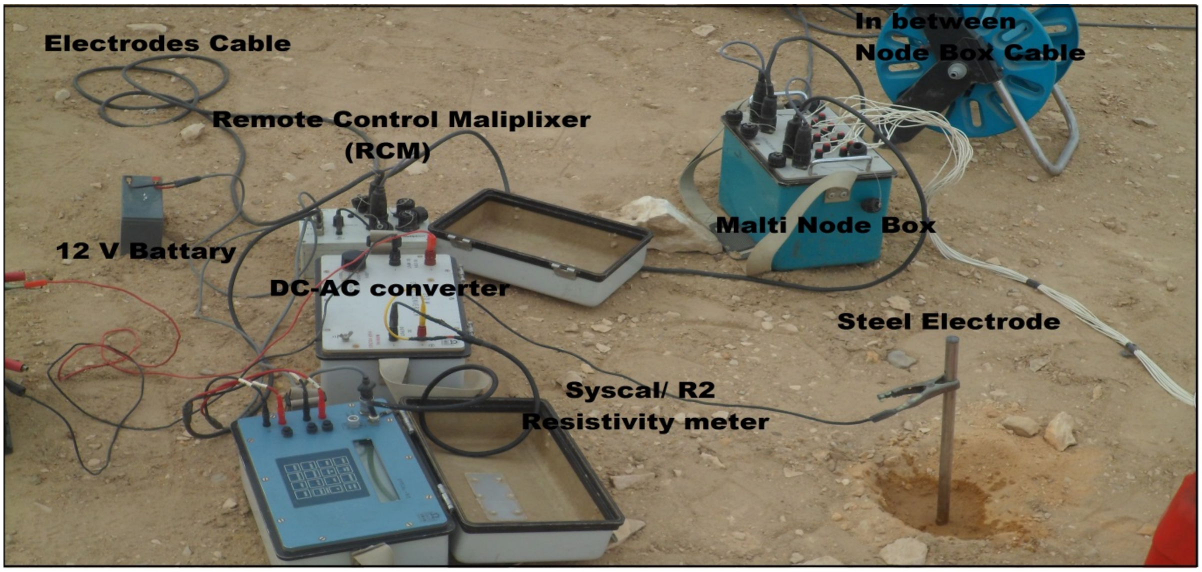

Figure 3: Instruments used in the geoelectrical surveying and 2–D geoclectrical resistivity imaging

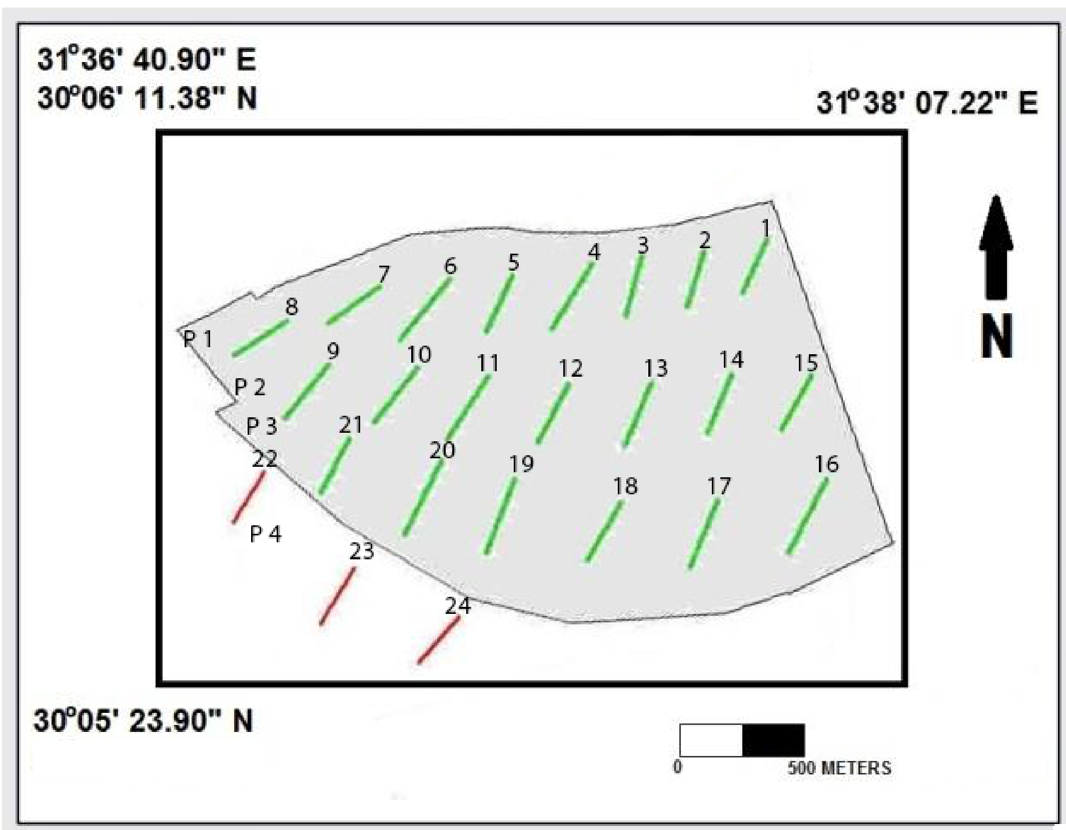

Figure 4: 2D Geoelectric location map of the study area.

4. Interpretation of geoelectric method:

Wenner Resistivity Imaging System:

Two-dimensional (2-D) electrical imaging surveys are now widely used in areas with complex geology (Griffiths and Barker 1993). In the Wenner array, the spacing between the current electrodes (and potential electrodes) are equal (a). The depth of penetration is a function of (a) spacing and the dipole separation factor (n). Measurements were carried out with (a) values; 1, where Wenner section along profiles. The inversion problem is to find the resistivity of the cells that will minimize the difference between the calculated and measured apparent resistivity values (Loke and Dahlin 2002). The regularized least-squares optimization method with cell-based model is sufficiently flexible to represent almost any subsurface structures with an arbitrarily resistivity distribution (Loke et al. 2003). The processing and interpretation of the obtained data were carried out using the RES2DINV (2003) program, which produced an image of the electrical resistivity distribution in the subsurface based on a regularization algorithm (Loke and Barker 1996). The 2-D inversion model consists of a number of rectangular cells. The arrangement of the cells approximately follows the distribution of the data points in the apparent resistivity pseudosection. In the present study, the obtained data have undergone several processing steps through the RES2DINV software to produce a smooth model. An initial damping factor of 0.14 and minimum damping factor 0.010 were used where the quality of data is good and not too noisy. The width of the interior model cells is the same as the unit electrode spacing. The Wenner array 2-D surveys were carried out along profile 1as shown in (Fig.5). The Wenner sections exhibit large variation of resistivity values corresponding to lateral variation in the subsurface lithological units (Fig.5,6,7,8). In addition to the surface layer composed of Highly weathered (loose sediments composed of sand and gravels), which exhibits low resistivity values ranging from 280 to 550 ohm m, while the inverted sections demonstrate that, the deduced subsurface section is classified into two main geoelectrical units. The first unit is loose sand with small rounded flint pebbles and fossil wood of moderate resistivity values. The second unit is corresponding to sands and gravels with some basalt flows is the deeper unit and exhibits high resistivity values corresponding to Sands and gravels with some basalt flows.

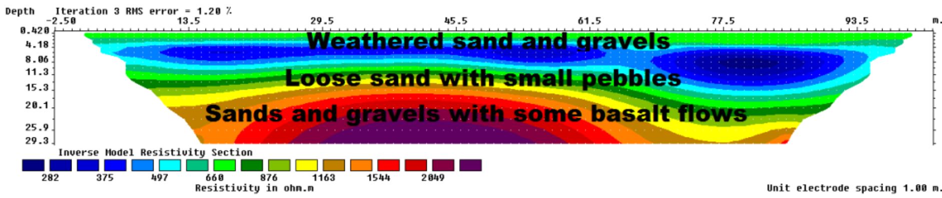

Fig. (III –5): 2-D electrical resistivity sections No.1 along profile P1.

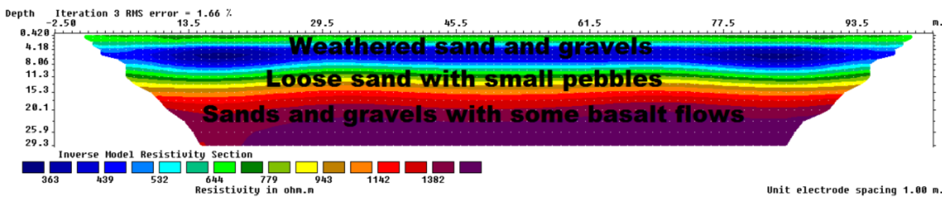

Fig. (III –6): 2-D electrical resistivity sections No.12 along profile P2.

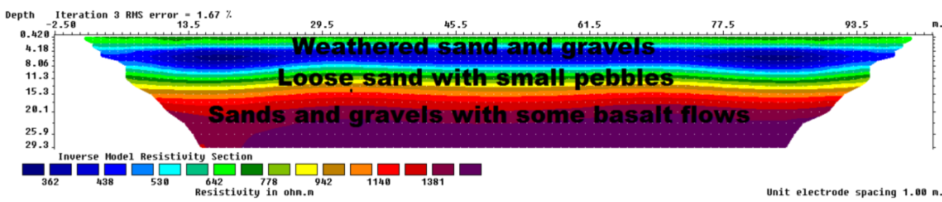

Fig. (III –7): 2-D electrical resistivity sections No.19 along profile P3.

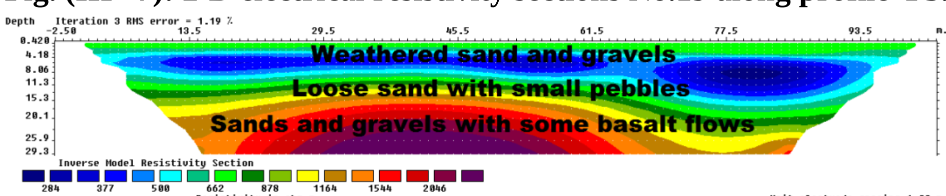

Fig. (III –8): 2-D electrical resistivity sections No.24 along profiles P4.

Summary and conclusion

A geophysical investigation was carried out at Madinaty city, passing through the study area to evaluate the effectiveness of one from geophysical methods for assisting the site characterization and determination the problems which may be found., Madinaty area is one of the new urban sites which is suffering from engineering and geological problems for urbanization projects. Therefore, geological and geophysical studies are necessary to be carried out in this area to identify and characterize bedrock layers and to characterize the site from an engineering viewpoint.

This regularity in the values of the apparent resistivity and depth for 2D imaging geoelectric sections are confirmed by the information obtained from previous geological studies; this cross-section shows three-geoelectrical layers. The first geoelectrical layer shows resistivity ranging (280 – 660 Ohm.m) in the upper part of the section extended along the all profile, and its depth is ranging from 0.5m to 1m depth, which reveals the surface layer corresponding to (weathered sand and gravels). The second geoelectrical layer shows resistivity ranging from (282 - 1544 Ohm.m), this layer has a thickness ranging from 9 meters at west of the study area to 14 meters at north and east of the area, which may be represented for layer of (loose sand with small pebbles). The third geoelectrical layer has higher resistivity than the previous layers with values range from (1318 to 2053 Ohm.m), this layer refers to presence sands and gravels with some basalt flows, and this layer considered deeper unit in the cross-section.

From the previous we can note that:

1-The interpreted Geoelectrical cross-sections suggest two-layers at all positions in addition to surface layer.

2- The Geoelectrical layers were converted from the resistivity values into the following lithologic layers (according to lithostratigraphic column of Abd El-Aal, 1982) as follows:

A – Surface layer:

Highly weathered (loose sediments composed of sand and gravels).

B – Second layer:

Loose sand with small rounded flint pebbles and fossil wood.

C – Third layer:

Sands and gravels with some basalt flows.

References:

1. Abdallah, A.M., Abdelhady, F.M., (1966): Geology of Sadat area, Gulf of Suez. Journal Geology United Arab Republic. Vol. 10 (l), pp. l-22.
2. GRIFFITHS DH, BARKER RD (1993): Two-dimensional resistivity imaging and modeling in areas of complex geology. J Appl Geophys:29 .
3. LOKE MH, ACWORTH I, DAHLIN T (2003): A comparison of smooth and blocky inversion methods in 2D electrical imaging surveys. Explor Geophys 34:82–187.
4. EGSMA, (1983): Geological map of Egypt 1:500 000. NH 36 NW. Cairo sheet.
5. LOKE MH, BARKER RD (1996): Rapid least-squares inversion of apparent resistivity pseudosections by a quasi-Newton method. Geophys Prospect 44:131–152.
6. LOKE MH, BARKER RD (1996): Rapid least-squares inversion of apparent resistivity pseudosections by a quasi-Newton method. Geophys Prospect 44:131–152.
7. RES2DINV VER. 3.4 (2003): Rapid 2-D Resistivity & IP inversion using the least-Squares method, Geoelectric Imaging 2-D & 3D, Geotomo software, Malaysia.
8. SAID, R. (1962): The geology of Egypt. Elsevier, Amsterdam Pub. Co., P. 377.
9. Shukri, N. M., (1953): The geology of the desert east of Cairo, Bull. Inst. Desert, Egypt, 3, 2: pp. 89-105.

Acknowledgments

The authors express their deep thanks to the members of the geoelectric and geothermic Lab., National Research Institute of Astronomy and Geophysics (NRIAG) due to their kind help during the field work.