AIN SHAMS UNIVERSITY
FACULTY OF SCIENCE
GEOPHYSICS DEPARTMENT

An Integrative Petrophysical and Geo-Electrical Investigations for Evaluating the Shallow Subsurface Section, East of 15th May City, South Cairo, Egypt

A Thesis Submitted for Partial Fulfillment for the Requirements of the Degree of Master of Science (M.Sc.) in Geophysics

By

Mohamed Abd El-Dayem Mohamed Badr Mosa

(B.Sc. in Geophysics – Faculty of Science – Ain Shams University – 2012)

To

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Note

The present thesis is submitted to the Faculty of Science, Ain Shams University in partial fulfillment for the requirements of the Master degree of Science in Geophysics.

Beside the research work materialized in this thesis, the candidate has attended ten post-graduate courses for one year in the following topics:

1) Geophysical field measurements.
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3) Advanced Well Logging.
4) Formation Evaluation.
5) Physical properties of rocks.
6) Basin analysis.
7) Subsurface geology.
8) Geophysical exploration.
9) Reservoir evaluation.
10) Fluid dynamics.

He successfully passed the final examinations in these courses.

In fulfillment of the language requirement of the degree, he also passed the final examination of a course in the English language.

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جامعة عين شمس
كلية العلوم
قسم الجيوفيزياء

دراسة تكاملية بين القياسات البتروفيزيقية و الجيوكهربية لتقييم القطاع التحت سطحى الضحل, شرق مدينة ١٥ مايو, جنوب القاهرة, مصر

رسالة مقدمة لاستكمال متطلبات الحصول على درجة الماجستير فى العلوم

فى الجيوفيزياء

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Head of Geophysics Department

Prof. Dr. Salah Eldin Abd Elwahab Mousa

……

وَيَوْمَ يُنفَخُ فِي الصُّورِ فَفَزِعَ مَن فِي السَّمَاوَاتِ
وَمَن فِي الْأَرْضِ إِلَّا مَن شَاءَ اللَّهُ وَكُلٌّ أَتَوْهُ
دَاخِرِينَ {87} وَتَرَى الْجِبَالَ تَحْسَبُهَا جَامِدَةً وَهِيَ
تَمُرُّ مَرَّ السَّحَابِ صُنْعَ اللَّهِ الَّذِي أَتْقَنَ كُلَّ شَيْءٍ
إِنَّهُ خَبِيرٌ بِمَا تَفْعَلُونَ { 88}مَن جَاء بِالْحَسَنَةِ فَلَهُ
خَيْرٌ مِّنْهَا وَهُم مِّن فَزَعٍ يَوْمَئِذٍ آمِنُونَ { 89} وَمَن
جَاء بِالسَّيِّئَةِ فَكُبَّتْ وُجُوهُهُمْ فِي النَّارِ هَلْ تُجْزَوْنَ
إِلَّا مَا كُنتُمْ تَعْمَلُونَ {90} إِنَّمَا أُمِرْتُ أَنْ أَعْبُدَ رَبَّ
هَذِهِ الْبَلْدَةِ الَّذِي حَرَّمَهَا وَلَهُ كُلُّ شَيْءٍ وَأُمِرْتُ أَنْ
أَكُونَ مِنَ الْمُسْلِمِينَ { 91} وَأَنْ أَتْلُوَ الْقُرْآنَ فَمَنِ
اهْتَدَى فَإِنَّمَا يَهْتَدِي لِنَفْسِهِ وَمَن ضَلَّ فَقُلْ إِنَّمَا أَنَا
مِنَ الْمُنذِرِينَ {92} وَقُلِ الْحَمْدُ لِلَّهِ سَيُرِيكُمْ آيَاتِهِ
فَتَعْرِفُونَهَا وَمَا رَبُّكَ بِغَافِلٍ عَمَّا تَعْمَلُونَ {93}

سورة النمل (الأيات 87 – 93)

DEDICATION

This thesis work is dedicated to my wife, Hadeer, who has been a constant source of support and encouragement during the challenges of this work and life. I am truly thankful for having you in my life. This work is also dedicated to the spirit of my dear father "May Allah forgave him, I ask Allah to him the mercy and high Paradise", to my dear mother, my son, my brother, and my sister who have always loved me unconditionally and whose good examples have taught me to work hard for the things that I aspire to achieve.

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Mohamed Abd El-Dayem Mohamed

ABSTRACT

The 15th of May city is a distinctive suburban area at the southeastern Greater Cairo established in 1978. The Egyptian New Urban Communities Authority (NUCA) has been targeting to solve the Cairo's insufficient accommodation problem by expanding the surrounding residential areas connected to Cairo.

The study area represents the southern part of the proposed eastern extensional area of the 15th of May city. It is roughly centered at latitude 29° 49' 1.75" N and longitude 31° 24' 40.20" E, covering an area of some 7.7 km2. It has an uneven topography, comprising several terraces reaching about 350.0 m above the sea level. Existing relative elevation differences within the area are ranged between 10 and 50 m. The area also has many limestone quarries.

The aim of the present work is to study the geotechnical properties of the Eocene limestone and emphasis the possibilities of these carbonate rocks for their economic utilization as building material and for chemical industry.

The area's bedrock geology is made up, from the top (recent) to bottom (old) of the followings; (1) the surficial Late Quaternary Wadi deposits, (2) the Upper Eocene Qurn Formation, (3) the Middle Eocene Observatory Formation.

A joint of 6 multi-spacing electromagnetic–terrain conductivity meter surveying profiles, 6 very low frequency electromagnetic surveying profiles, and 7 DC–resistivity horizontal profiling surveys were conducted

in the study area. The main objective of these surveys was to highlight the applicability, efficiency and reliability of utilizing such non-invasive surface techniques in a field like geologic mapping, and hence to image both the vertical and lateral electrical resistivity structures of the subsurface bedrock.

Field sampling has been carried out to study the physical and mechanical properties of the foundation bedrocks include the natural moisture content, bulk density, specific gravity and effective porosity, while their mechanical properties include the uniaxial compressive strength. The samples also have been analyzed to measure the compressional wave velocity (V_P) and shear wave velocity (V_S) using commercially available OYO - Sonic Viewer 170 (Model – 5228) and further leads to the calculations of the dynamic elastic properties of the different samples.

Complete chemical analysis was carried out for 238 borehole samples of limestone from 34 boreholes for the determination of L.O.I, SiO2, Al2O3, Fe2O3, CaO, MgO, K2O, Na2O, TiO2, Mn2O3, P2O5 and Cl^-. The results of the chemical analysis (oxides and elements) were plotted and mapped every six meters for the 34 drilled boreholes to study the chemical characteristics of limestone of the area under investigation.

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CHAPTER 3

PHYSICAL AND MECHANICAL PROPERTIES OF ROCKS