AIN SHAMS UNIVERSITY

GEOPHYSICS DEPARTMENT
FACULTY OF SCIENCE

RESERVOIR CHARACTERIZATION OF SANDSTONE RESERVOIRS, KHATATBA FORMATION, IN TUT OIL FIELD, WESTERN DESERT, EGYPT.

By

AHMED ABDEL AZIEM HASSAN MAHMOUD

(B.Sc., Geology-Geophysics, 2004).

A thesis submitted to
Geophysics Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.

For the partial fulfillment of the Requirements for the Degree of Master of Science.

UNDER THE SUPERVISION OF

Prof. Dr.
Abdel Moktader Abdel Aziz El-Sayed

Professor of reservoir geophysics,
Ain Shams University.

Dr.
Amir Maher Sayed Lala

Assistant professor of applied geophysics,
Ain Shams University.

Geophysicist.
Mahmoud Abdel Hamied Bahgat

Geophysical Operation General Manager,
Khalda Petroleum Company.

Cairo-2019

AIN SHAMS UNIVERSITY

GEOPHYSICS DEPARTMENT
FACULTY OF SCIENCE

APPROVAL SHEET

RESERVOIR CHARACTERIZATION OF SANDSTONE RESERVOIRS, KHATATBA FORMATION, IN TUT OIL FIELD, WESTERN DESERT, EGYPT.

A thesis submitted For the partial fulfillment of the
Requirements for the Degree of Master of Science.

By

AHMED ABDEL AZIEM HASSAN MAHMOUD

(B.Sc., Geology-Geophysics, 2004).

Advisor	**Approvd**
Prof. Dr. **Abdel Moktader Abdel Aziz El-Sayed** Professor of reservoir geophysics, Ain Shams University.	……
Dr. **Amir Maher Sayed Lala** Assistant professor of applied geophysics, Ain Shams University.	……
Geophysicist. Mahmoud Abdel Hamied Bahgat Geophysical Operation General Manger, Khalda Petroleum Company.	……

To
Geophysics Department,
Faculty of Science, Ain Shams University,
Cairo, Egypt.

Cairo - 2019

AIN SHAMS UNIVERSITY

GEOPHYSICS DEPARTMENT
FACULTY OF SCIENCE

QUALIFICATION

Name: Ahmed Adel Aziem Hassan Mahmoud.

Degree: The fulfillment of the Requirements for the Degree of Master of Science.

Department: Geophysics.

Faculty: science.

University: Ain Shams.

Year of graduate: B.Sc., Geology-Geophysics, 2004.

Recent job: Geologist at Khalda Petroleum Company.

Year Master's Scholarships: 2020.


بسم الله الرحمن الرحيم
قالوا
سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم
صدق الله العظيم
سورة البقرة الآية: ٣٢

Acknowledgments

Praise is to ALLAH, by whose grace this work has been completed.

I would like to express my gratitude to my supervisor Prof. Dr. ABD EL MOKTADER ABD EL AZIZ EL-SAYED; Professor of reservoir geophysics, Faculty of Science, Ain Shams University for the useful comments, remarks and engagement through, the learning process of this master thesis.

Furthermore, I like to thank Dr. AMIR MAHER SAYED LALA, Assistant professor of applied geophysics, Faculty of Science, Ain Shams University, for the expert and participants in my survey, who have willingly shared their precious time during the process of interviewing.

I am grateful to Dr. NAHLA ABD EL MOKTADER ABD EL AZIZ, Exploration Department, EPRI, Nasr City, Egypt, for the great help, valuable suggestions.

A special appreciation to Prof. Dr. SAMY HAMID; the head of geophysics department, and all the staff members in Geophysics Department, Faculty of Science, Ain Shams University, for their encouragement.

Also, I would like to thank MAHMOUD ABD EL HAMIED BAHGAT; Geophysical Operation General Manager, Khalda Petroleum Company, for introducing me to the topic as well for the support on the way.

I cannot express enough thanks to Dr. ABD EL MONEAM ABO SHADY; Geological Operation General Manager, Khalda Petroleum Company for his continued support and encouragement. My deep thanks for all Exploration and Department's Members in Khalda Petroleum Company for their help and encouragement.

AHMED ABD EL AZIEM HASSAN MAHMOUD

DEDICATION

This work is dedicated

To Allah and I hope to accept it from me

To my parents,

To my sister,

To my wife,

And to my daughters

Salma, Rodyna and Mariam

For their continuous encouragement and kind patience.

ABSTRACT

The Western Desert is considered one of the most prolific petroleum provinces in Egypt. The TUT field represented one of the main oil fields in the North Western Desert region due to its high production from many reservoirs. The study area lies between latitudes 30° 44' 15" – 30° 46' 03" N and longitudes 26° 57' 18"- 27° 00' E. The investigated stratigraphic section of the study area ranges in age from Middle Jurassic.

The penetrated section consists of thick clastic beds. The aim of this study is directed, to evaluate the important reservoirs in Khatatba Formation (Upper and Lower Safa Members) which subdivided into three units: Khatatba (Upper Safa- Top, Upper Safa- Bottom & Lower Safa- Top reservoirs)), in TUT oil field, at the North Western Desert, Egypt and to evaluate the reservoir of Khatatba rocks through the analysis of lithofacies types. In addition, determine the different reservoir parameters characterizing the pay zone utilizing well log data using the available data to spot lighting on the promising locations for further exploration.

The materials used in this study include complete log sets of four (4) wells and twenty (20) 2D seismic lines covered study area.

The interpretation of twenty seismic lines are shooted in the study area led to identify the most important seismic reflectors throughout Khatatba reservoirs. Seismic interpretation showed four reflection horizons; top Masajid, top Zahra, top Khatatba (Upper Safa-Bottom), and top Ras Qattara. Moreover seismic interpretation revealed two sets of faults forming TUT field horst block. The trend of these two sets of faults is northeast– southwest direction. These two sets of faults represent the structural control for the hydrocarbon accumulation in TUT field.

To illustrate the subsurface structural configurations of the study area, four time and depth structure contour maps are constructed for the selected stratigraphic horizons: Masajid, Zahra, Khatatba (Upper Safa-Bottom), Ras Qattara. The constructed structure time and depth contour maps have showed that, the study area dissected by sets of normal faults trending northeast – southwest forming horst block.

The 3D structure model of Masajid, Zahra, Khatatba (Upper Safa Bottom), Ras Qattara horizons shows the same configuration and the same structural elements. This concordance indicates that, the Khatatba horizons conformably deposited in the same basin and subjected to the same movements with approximately the same degree of tectonic events after their deposition (Post Depositional Environment).

The subsurface geological studies were achieved for Khatatba (Safa) reservoirs through constructing subsurface maps (isopach, sandstone isolith, siltstone isolith, shale isolith, total clay isolith, triangle facies and sand/shale ratio maps). The correlations are used to reveal the subsurface geological conditions, and to study lithostratigraphy, trends of lateral change in thickness and lithofacies of the studied reservoirs to delineate the environment of deposition.

The well log analysis of the Khatatba (Safa) reservoirs includes data base editing, data correction, and determination of lithology from logs using some types of cross plots such as (density-neutron and M-N cross plots) as well as identification of reservoir fluids type by using available pressure data (Repeat Formation Tester; RFT).

Petrophysical data are illustrated on vertically Litho-Saturation Crossplots and Isoparametric maps: (total thickness, shale volume, net or gross sand, net sand or net pay/ Gross sand, total porosity, effective porosity, water saturation, hydrocarbon saturation, residual hydrocarbon saturation and

movable hydrocarbon saturation) to indicate the lateral variation, reservoir thickness, and good places for new productive wells.

The need to understand the dominated environment of deposition through the clay elements and lithofacies distribution study in order to predict the reservoir heterogeneity in terms of sandstone quality using Gamma Ray log analysis.

From the results, it can be stated that the study area may be considered containing hydrocarbon accumulation in other new locations, and there is a good opportunity to drill another development wells to enhancement the productivity from the area of study.

CONTENTS