INTEGRATION FORMATION - SUBSURFACE EVALUATION OF WADI EL-NATRUN AREA, NORTHERN WESTERN DESERT, EGYPT, USING WELL LOGGING DATA.

THESIS
Submitted to Faculty of Science
Ain Shams University

BY
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(B. Sc.)

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In Partial Fulfilment of the Requirements for
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بسم الله الرحمن الرحيم

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NOTE

The present thesis is submitted from Mohamed Ahmed Reda Mohamed to Ain Shams University in partial fulfilment of the requirements for the degree of Master of Science in Geophysics.

Beside the research work materialized in this thesis, the candidate has attended eleven graduate courses for one year in the following topics.

Well Logging

Petrophysics

Biostratigraphy

Lithostratigraphy

Sedimentation

Sedimentary Petrology

Geotectonics

Structure Geology

Statistics & Computer Science

Field Geology

English Language

He has successfully passed the final examinations of these courses in September 1987.

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ABSTRACT

The present study deals with the evaluation of hydrocarbon potentialities of the Abu-Roash and Bahariya formations using six wells (BIRIGAT-1,NATRUN GHIBLI-1,T-56-1,ZEBEIDA-1X, WEST HALLIF-1 and FAYAD-1) scattered in Wadi El-Natrun area, northern Western Desert. This study is accomplished using different types of open-hole well logs such as Resistivity, Neutron, Density , Sonic and Gamma-Ray for the determination of the included petrophysical parameters and the evaluation of the inherited source rocks.

However, the petrophysical parameters calculated are the rock components (sandstone,shale, Limestone and porosity) and the fluid saturations (water, movable and residual hydrocarbons). These parameters were presented zone-wise, in the form of litho-saturation cross plots to show their vertical variations within the wells,and also in the form of iso-parametric maps, to illustrate their lateral changes across the study area. The isopach maps of Abu-Roash and Bahariya Formations reveal a northwestward increase in thickness. The lithofacies conditions of Abu-Roash Formation show an increase of the sandstones and limestones northward reflecting oscillatory shallow to intermediate marine environments. Those of Bahariya Formation exhibit an increase of shales southwestward with the increase of the sandstones and limestones northward and eastward reflecting steadier shallower marine environment. The structural elements complicating the studied interval imply folding features as well as faulting elements (dip-slip).

Moreover, the source rock indicators were defined, as the organic content (vol%), the total organic carbon (wt%) and the discriminant function to differentiate between the source rocks and non-source rocks of the shales and shaly units of the Abu -Roash and Bahariya Formations in the investigated area. Their results were presented in organo- source logs and gradient maps to show the distribution of the implicated organic materials vertically and laterally.

Regarding the hydrocarbon potentialities of the study area, the evaluated sequence reflects inadequate source rocks with suitable reservoir and cap rocks. Transformation cycle of hydrocarbons seems to be sufficient for the considerable depth of burial and temperature needed for oil and gas maturation and generation, with the presence of primary and secondary migration paths needed for transporting the synthesized hydrocarbons to the final accumulation places.

Traps are existed with nearly the various structural, stratigraphic and miscellaneous types. The hydrocarbons of Abu-Roash Formation shows outward increase, while those of Bahariya Formation exhibit northward increase. But, the comparison between the trends of variation of the movable and residual hydrocarbons indicates that, most of the initiated hydrocarbons are from the residual type.

The mathematical sequential steps followed in the accomplishment of this work were done through eight computer programs listed at the end of this thesis.

LIST OF SYMBOLS

Symbol	Meaning
Rmc	Resistivity of Mud Cake corrected at Formation Temp.
Rt	Resistivity of the uninvaded zone.
Rxo	Resistivity of the Flushed zone.
Rw	Resistivity of the Formation Water.
Ro	Resistivity of the Formation When 100% water-saturation.
F	Formation Resistivity Factor.
m	Cementation Factor.
Sw	Water Saturation.
Sxo	Water Saturation in the Flushed zone.
Sh	Hydrocarbon Saturation.
Shr	Residual Hydrocarbon Saturation.
Shm	Movable Hydrocarbon Saturation.
ϕ_N	Porosity derived from the Neutron Log.
ϕ_D	Porosity derived from the Density Log.
ϕ_S	Porosity derived from the Sonic Log.
ϕ_T	Total Corrected Porosity.
ϕ_E	Effective Porosity.
Vsh	Volume of shale content.
$(Vsh)_{GR}$	Volume of shale derived from Gamma-Ray Log.
$(Vsh)_{\phi N}$	Volume of shale derived from Neutron Porosity Log.
$(sh)_R$	Volume of shale derived from Resistivity Log.
$(Vsh)_{sp}$	Volume of shale derived from Spontaneous Potential Log.
ρ_b	Bulk Density in grams per Cubic Centimeter.
ρ_{bma}	Bulk Density for the Matrix.
ρ_f	Fluid Density.
ρ_{sh}	Density Reading Opposite Thick Shale Bed.
ΔT	Sonic Transit Time in Microsecond Per Foot.
ΔT_{ma}	Sonic Transit Time for te Matrix.
ΔT_f	Sonic Transit Time for the fluid.
ΔT_{sh}	Sonic Transit Time Opposite Thick Shale Bed.
CAl	Caliper Log.

DIL	Dual Induction log.
GR	Gamma-Ray Log.
BHC	Bore-Hole Compensated Log.
CNL	Compensated Neutron Log.
FDC	Formation Density Compensted Log.
SNP	Side-Wall Neutron Porosity Log.
sp	Spontaneous Potential Log.
Hmc	Mud Cake Thickness.
ORG	Organic Contant.
TOC	Total organic carbon.

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CHAPTER I

GEOLOGIC SETTING