Ain Shams UNIVERSITY
FACULTY OF SCIENCE
GEOLOGY DEPARTMENT

Structural Analysis and Petrophysical Evaluation of the Cretaceous Rocks, Shushan Basin , Western Desert, Egypt.

A Thesis Submitted for Master Degree of science in Geology
(Structural Geology)

By

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B. Sc. in Geology, Helwan University, 2005

Supervised by

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Approval Sheet

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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 degree of Master of Science in geology. Besides the research work materialized in this thesis, the candidate has attended ten post-graduate courses for one year in the following topics

1. Advanced Structural Geology
2. Geotectonics
3. Sequence Stratigraphy
4. Biostratigraphy
5. Photogeology
6. Geomorphology
7. Sedimentation
8. Sedimentary Petrology
9. Field Geology
10. Geostatistics

He successfully passed the final examination 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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LIST OF ABBREVIATIONS

Ft	: Feet
N	: North
E	: East
S	: South
W	: West
2D	: Two dimensional
3D	: Three dimensional
EGPC	: Egyptian General Petroleum Corporation
km2	: Square kilometer
m	: Meter
MMSCFD	: Million stander cubic feet per day
BCPD	: Barrel condensate per day
MBC	: Thousand barrel condensate
BCF	: Billion cubic feet
VSP	: Vertical seismic profile
ms	: Millisecond
Ft/ms	: Feet / Millisecond
TVDSS	: Total vertical depth subsea
U.Safa	: Upper Safa
L.Safa	: Lower Safa
E.Log	: Electric log
LWD	: Logging while drilling
LLS	: Laterolog shallow
LLD	: Laterolog deep
MSFL	: Microspherical focused log
Rt	: Resistivity of non-invaded zone
Rxo	: Resistivity of invaded zone
µsec/ft	: Microsecond per foot
µsec/m	: Microsecond per meter
TD	: Total depth
Rw	: Water resistivity
Vsh	: Shale volume
Δt	: Interval transit time
ϕS	: Sonic derived porosity
Δt log	: Sonic log reading
Δt ma	: Transit times in rock matrix
Δt f	: Transit time in the fluid
Sw	: Water saturation
Rw	: Formation water resistivity
Sh	: Hydrocarbon saturation
Shr	: Residual hydrocarbon saturation
API	: American Petroleum Institute .

ABSTRACT

The present study deals with evaluation of the Surface and Subsurface structural framework and reservoir characteristics. This is to evaluate the hydrocarbon potentialities of the study area Qasr oil Field (Shushan basin) which is located at the north Western Desert of Egypt, about 7.5 Km south of the Mediterranean coast.

The data include 2D and 3D seismic data, composite logs, electrical logs, cores and plugs results from the available exploration wells were utilized in this study. The AEB-3D rock unit is a part of the Lower Cretaceous Alam El Bueib Formation, and is considered as the main oil producing reservoir in the study area. The Lower Cretaceous Alam El Bueib sand (AEB) was interpreted, as stacked channel and point bar fluvio-deltaic sands, with interbedded shales and some limestones or dolomites. The oil is trapped in stratigraphic or structural three-way dip closures or a combination of both.

This work aims to find new drilling sites for further field development in the future, where the reservoir compartmentalization model can be updated, based on the data available from new wells. Furthermore, the analysis of electric well logs, reservoir pressure measurements and sedimentological core descriptions can help in the detection of sand channels and to predict their directions. Lithological interpretation showed two sand zones, with average thickness of 30-50 ft. in most wells. They are separated by inter-zones layers of about 10-50 ft. (distance). The interpretation of well logs, coupled with the core descriptions, showed that, Alam El Bueib-3D rock unit is subdivided laterally into two sand channels. Both are deposited in a high energy tidal environment. Well correlations, mapping and analysis of the pressure measurements showed that, the directions of these channels are most probably northeast to southwest. In addition, the effect of stratigraphy and structures led to a number of reservoir compartments with varying pressure values, either vertically or horizontally.

Picking and interpretation of the ten horizons from Lower Safa to Dabaa Formation which done by tying seismic data (time) with well data (depth). Seismic profiles illustrated the Surface and subsurface structural framework of the Lower Safa and Alam El Buieb reservoirs. It can be demonstrated that 3D structural modeling described the structural

compartments of the study area by displaying cross sections along any direction and through any well location of the model's data base. This can be used to propose locations for future exploration wells in the area.

Structurally, Qasr oil field is represented by horsts and grabens. Large accumulations of hydrocarbons have been trapped along the NE-SW elongated, narrow and asymmetrical tilted fault blocks.

The reservoir Petrophysics characteristics of the present study deals with the determination of the reservoir properties by using different log responses imply good reservoir quality. Petrophysical properties of Lower Safa and Alam El Buieb reservoirs are represented in the form of isoparametric maps which include shale volume (Vsh), gross sand, total porosity, effective porosity, water saturation (Sw), net pay, net/gross thickness, hydrocarbon saturation (Sh), residual hydrocarbon saturation (Shr) and movable hydrocarbon saturation (Shm) to show their horizontal distributions of the Lower Safa reservoir. The well log analysis of the Lower Safa and Alam El Buieb reservoirs using different types of the cross-plots such as density neutron that shows the Lower Safa reservoir is mainly sandstones with some calcareous cement. According to the pressure analysis, the hydrocarbon type of Lower Safa reservoir in Qasr oil Field field is mainly light hydrocarbon.

The source and reservoir rocks are all sandstones, while the seal rocks are the local intra-formational shales. The oil in sandstones is of 22-35 API. Porosity, permeability and water saturation ranges of the reservoir pay zones are 15-30%, 100-300 md and 20-50%, respectively

Data integration of all input data with each other by the Petrel TM , Schlumberger's software. The results of this study showed improve in the reservoir characterization of the Lower Safa and Alam El Buieb Formations, help to identify potential hydrocarbons present and hence will aid increasing the cumulative reserves in the concerning area. The integrated data has been used to support the exploration and development in the future field planning.