**AIN SHAMS UNIVERSITY**
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# 3D Structural Modeling and its Impact on Hydrocarbon Reservoirs utilizing 3D Seismic Data Interpretation at West Qarun Oil Field, Northwestern Desert, Egypt.

**By**

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# Dedication

This work is dedicated to my **family** who has been always supporting me. Especial dedication is to my **wife** whose support and devotion kept me going.

# ABSTRACT

West Qarun Oil Field is located in Abu Gharadig basin of the northern Western Desert, Egypt. It lies between latitudes 29º 36' N and 29º 39' N and longitudes 29º 16' E and 29º 22' E.

The main purpose of this study is to evaluate West Qarun oil field by studying the subsurface geologic structural features and the interested reservoir markers (Middle, Lower Abu Roash "G" Member and Bahariya Formation) which are considered the main primary potential reservoirs in the study field.

To achieve these objectives, the current study started with the description of the geological setting of the area, including the stratigraphic sequence and dominating structures through a review for the pervious geological studies.Then, 3D seismic data interpretation was carried out by using Petrel (2013) to provide detailed information about the subsurface structural geometry of West Qarun oil field. The 3D seismic interpretation step started by fault patterninterpretation through the original seismic data in order to delineate the subsurface structural features using conventional and unconventional seismic interpretation (seismic attributes) methods, then horizon interpretation process including the interested reservoirs markers. The depth structure maps which are constructed on the tops of Abu Roash "A", Middle Abu Roash "G", Lower Abu Roash "G", Bahariya and Alamein surfaces reveal that the West Qarun trap is an elongated NW-SE faulted anticline structural trap that constitutes over step-like fault pattern that has the same trend and downthrown towards the NE direction.

Then, comprehensive quantitative petrophysical review was carried out for the available wells in study area to determine the main petrophysical parameters for the main reservoir rocks like, net pay thickness, porosity, shale content, water and hydrocarbon saturation based on a number of equations and empirical formula.The well log data analysis has been done using Interactive Petrophysics (IP, 2013) Software.

Then, 3D structure model has been built through five processes (fault modeling, pillar gridding, make horizons, make zones and edit 3D grids).These processes should always be considered together and undergo several iterations to enhance the final structure model. The obtained 3D structure model confirms the interpreted structure from the seismic data.

Moreover, fault seal analysis has been done for the Middle and Lower Abu Roash "G" (A/R 'G') reservoirs, by using Allan's Diagram method across the main normal fault planes (F-1, F-2 and F-a). Allan's diagrams indicate that, the faults (F-1) and (F-a), which are located in the northern part of the study area are perfect seal in the Middle and Lower Abu Roash "G" reservoirs, while the fault (F-2), behaves as likely sealed in the Middle Abu Roash "G" and becomes a tranmissive (leak) fault where the sealing is unlikely in the Lower Abu Roash "G".

Evaluation parameters of a prospect which are the representative elements of petroleum system include essentially aerial extent and amplitude (thickness) of the structure, the source type and the reservoir facies, the seals and the entrapment mechanism to form an effective trap. These elements of petroleum system were evaluated and four new locations (A, B, C and D) were detected. The locations A, B, C and D proposed as plays for future exploration and development activities and drilling in West Qarun Oil field with respect to their seismic structural highs and suitability of petrophysical parameters in the Middle, Lower Abu Roash "G" Member and Bahariya Formation reservoirs.

**Key Words**: West Qarun Oil Field, Western Desert, Tectonic Trends, 3D Seismic interpretation, Petrophysical Properties, 3D Structure Model, Fault Seal Analysis, Locating Promising Prospects.

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# CHAPTER 1
# INTRODUCTION

## 1.1 LOCATION OF THE STUDY AREA

The West Qarun development concession is located in Abu Gharadig basin of the northern Western Desert, about 220 km southwest of Cairo city. The block comprises a gross area of 46.2 $km^2$. It is bounded from the south by Sitra platform and from the north by Ras Qattara uplift and from the east by Kattaniya high and from the west by Siwa platform. It lies between latitudes 29º 36' N and 29º 39' N and longitudes 29º 16' E and 29º 22' E (Figure 1-1). This part of Abu Gharadig basin is considered to be valuable for all petroleum companies due to the availability of petroleum system elements.

## 1.2 OBJECTIVES OF THE STUDY

The objectives of study is to evaluate West Qarun oil field by studying the subsurface geologic structural features through picking and identification of the horizon packages including interested reservoir markers (Bahariya Formation, Lower and Middle Abu Roash "G" Members) which are considered the main primary potential reservoirs in the study field. Then, petrophysical evaluation of the studied intervals for reservoir characterization, constructing of 3D structural model using 3D seismic data and fault seal analysis were carried out.

Finally, integrating the seismic and petrophysical results to obtain the detailed information about the field for the development stage to increase