بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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التوثيق الإلكتروني والميكروفيلم

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التوثيق الإلكتروني والميكروفيلم

قسم

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MONA MAGHRABY

Ain Shams University
Faculty of Science

Impact of Cenozoic Structural Deformation on Hydrocarbon Preservation in South Alamein Block (northern Western Desert, Egypt)

A Dissertation Submitted for

the Degree of Doctor of Philosophy in Science

(Geology)

By

Mohamed AbdElhady Farag Hassan

(M.Sc. in Geology)

To

Geology Department
Faculty of Science
Ain Shams University

2021

AIN SHAMS UNIVERSITY

GEOLOGY DEPARTMENT
FACULTY OF SCIENCE

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Chapter I

Validity of Ph.D. of Science Thesis in Geology

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To my father

– to whom I promised to contribute this dissertation before he passed this world, always in my heart.

Your Son

ABSTRACT

Oil and gas reservoirs in the northern Western Desert have Mesozoic age and later phases of deformation during the Cenozoic affected some areas of the northern Western Desert and may have positive or negative impact on hydrocarbon preservation in these fields. This thesis deals with this issue in one of the hydrocarbon exploration areas in the northern Western Desert (South Alamein area) with detailed surface study of Cenozoic deformation at Gebel Qattamia area (northern Eastern Desert). 3D seismic and borehole data were used for subsurface study of the South Alamein area whereas the surface study of Gebel Qattamia area is based on detailed surface geological mapping of the exposed structures and study of the faults and the nature of their fault rock material.

The deep stratigraphic levels in the South Alamein area (Masajid to Abu Roash Formation) are dissected mainly by ENE-WSW and NW-SE oriented faults. These faults become discontinuous and less dominant at the top Khoman Formation. At the top Apollonia and top Dabaa Formations, NNW-SSE oriented normal faults are well developed and an E-W belt of left-stepped en echelon faults is obvious at the northernmost part of the area.

The main ENE-WSW oriented faults had normal slip during the early and late Cretaceous (till end of Coniacian) and were inverted in the Santonian and during the Paleocene, Eocene, and Oligocene times. The WNW-ESE oriented faults had continued normal slip from Jurassic to post-Oligocene times with largest slip during the Campanian- Maastrichtian.

Detailed surface geological mapping of Gebel Qattamia area indicates three main fault sets oriented NNW-SSE, WNW-ESE, and E-W. The E-W and WNW-ESE oriented faults form one en echelon fault belt in the

northern part of Gebel Qattamia area whereas the NNW-SSE oriented faults are the most dominant and form narrow linear grabens. Field measurements of fault damage zones indicate that they are dominated by fractures parallel to the faults in two conjugate sets. The width of the fault damage zones ranges from 15–20 meters (on each side of the fault) and the fault core material is mostly made up of breccia and/or gouge indicating deformation at shallow depth.

Comparison of the subsurface structures of the South Alamein area with those mapped at the surface at Gebel Qattamia area shows an identical structural pattern at the top Oligocene represented by NNW-SSE oriented narrow linear grabens abutted at the north by an E-W elongated belt of left-stepped en echelon normal faults. One of the narrow linear grabens in the South Alamein area is underlain by a 23 Ma basalt dike where the volcanic activity triggered the normal faulting. Rapid withdrawal of magma led to the formation of circular axial depressions at the top Apollonia Formation. The same subsurface structural features have also been identified at the surface in Gebel Qattamia.

The identical structural patterns in the South Alamein and Gebel Qattamia area indicates that the Cenozoic structures were formed at shallow structural levels and they do not reach the deep (Jurassic and Cretaceous) stratigraphic levels. For this reason, the Cenozoic deformation of the northern Western Desert does not have a negative effect on trap integrity at the deeper structural levels.

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