STRUCTURAL – TECTONIC DEVELOPMENT OF AL-AMAL FIELD, GULF OF SUEZ –EGYPT, AND ITS IMPLICATIONS ON THE HYDROCARBON PROSPECTIVITY

A THESIS
SUBMITTED TO AWARD THE DEGREE OF DOCTOR OF PHILOSOPHY OF SCIENCE IN GEOPHYSICS (SEISMIC)

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ABSTRACT

The Gulf of Suez covers an area of about 25000 sq km. It extends along a Northwest trends from latitude 27˚ 30` N to 30˚ 00' N. Its wide varies from 30 to slightly over 50 km at the central part. Both the eastern and western coastal belts exhibit a sedimentary sequence, which is also present offshore. Thus, originally the gulf must have been much wider than at present.

The Amal concession area is about 27 sq km in the offshore, southern province of the Gulf of Suez basin. It is located some 55 km from Ras Gharib city, about 15 km southwest from Morgan Oil field and about 15 km offshore from the western Gulf of Suez shore line. Amal field is located on a NW-SE faulted monocline, which has a SW dip, plunging NW and SE, sealed by clysmic faults and capped by Middle–Upper Miocene evaporites.

In view of the Amal field history, the main reservoir is the Miocene sandstone of Kareem and Rudies formations, while the oil shows are encountered in the Pre-Miocene reservoirs, which are not yet well explored. In addition, the area reveals certain differences in oil gravity within both production reservoirs and different formation pressure regimes. These facts implying that, the Amal field productive reservoirs are controlled by either structural or stratigraphic barriers or both.

In the study area, the relation between average and interval velocities, with the depth was calculated for ten wells. Eighteen average and interval velocities contour maps of Zeit, South Gharib, Belayim, Feiran, Kareem, Rudies, Nukhul, Eocene, and Senonian were drawn. These velocities maps were used for establishing the structure contour and isopach maps

Thirteen 2D seismic lines were interpreted with the help of well velocity and time-depth trace conversion to construct the structure-tectonic maps characterizing the different stratigraphic tops of the concerned area, as well as to confirm the validity of the proposed structural model. Most of the available seismic data in the Amal area were investigated and reviewed to select the best quality set. The used thirteen seismic lines, in the present study, are TAL-82-1, TAL-82-102, TAL-80-

104, TAL-80-105, TAL-82-106, TAL-82-108, TAL-82-109, TAL-82-110, TAL-82-111, TAL-82-112, TAL-82-118, TAL-82-122A and TAL-82-124.

In order to study the larger structural features based on the 2D seismic lines, four depth structure contour maps were constructed on the top of the mentioned formations; South Gharib, Belayim, Kareem and Rudeis, from top downward using depth data. They show that, structures are very clear through the studied maps. Faults like strike-slip, Dip-slip and oblique-slip faults are obvious. Folds are conspicuous as anticlines and synclines at some parts of the study area, while at the middle part there is a big salt intrusion between two downlifted features located at the northwestern and southeastern parts.

In order to study the detailed structural elements based on the 3D seismic lines ; six depth structure contour maps were constructed on the tops of Zeit, South Gharib, Belayim, and Kareem, Nukhul, and Matulla formations from top downward. Interpretation was aided by the missing sections detected from the well tops and dip-meter data. These maps indicate that, the Miocene and Pre- Miocene formations of the Amal field form an elongated tilted greben block trending in the NW-SE direction and bounded by two sets of faults, which are down throwing toward the west and east directions.

Six 3D seismic lines were illustrated in the northeast-southwest direction, according to the available wells data. The structural features along these lines are some faults affecting this area making grabens, horsts and step-like blocks. Some of them are of NW-SE trend, while, others are of SE-NW trend.

In the study area, the sediments deposited are mainly marls, shale, limestone and some sandstone .Some of these deposits could act as source rocks, others act as reservoir rocks. Evaporites prevailing in the Gulf of Suez act as an excellent cap rock for the Miocene reservoirs. The prevailing physico-chemical conditions were suitable enough for generating hydrocarbons. Petrophysical parameters and fault conduits played an important role for the hydrocarbon migration from the source to the reservoirs, where they are accumulated and preserved in adequate stratigraphic (where the facies carried laterally), structural (where the folds, faults and faulted folds are occurred) and combined traps (where the stratigraphic and structural elements are conjugated) . The adaptability of the foregoing elements in a proper merging way reflects the Amal area as an excellent petroleum system model.

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