HYDROGEOLOGIC AND HYDRODYNAMIC STUDIES OF THE OIL TRAPS IN THE NORTHERN PART OF THE GULF OF SUEZ, EGYPT.

Thesis Submitted In Partial Fulfillment of the Requirements of the Degree of M.Sc in Geology (Hydrogeology)

BY

WAEL AHMED SHOKRY

(B.Sc. in Geology)

To

Ain Shams University

Faculty of Science

Geology Department

SUPERVISORS

Prof. Dr. EZZAT ALI KORANY
Geology Department,
Faculty of Science,
Ain Shams University

Dr. MOHAMED NASHAT M.YOUSSEF
Rashpetco Exploration
General Manager

Cairo, Egypt, 2009

AIN SHAMS UNIVERSITY
FACULTY OF SCIENCE

APPROVAL SHEET

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Head of geology Department
Prof Dr.Adel Ramadan Mustafa

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ABSTRACT

The Gulf of Suez is considered to the most oil province in Egypt. This study covering the Northern part of the Gulf of Suez which bounded by

longitudes 32° 20` and 33° 20`E and latitudes 28° 45` and 29° 45` N. It comprises the twenty four oil wells representing a group of oil fields, both Onshore and Offshore (North Darage, Ayon Musa, Matarma, Sudr, Asal, Zafarana and October).

Compiled hydrogeological and geophysical technique were successfully applied in order to identify the systems of flow dynamics and hydro-geochemistry of the groundwater, which encountered in the northern part of the Gulf of Suez as well as geologic setting factors , the reservoir characteristics and formation processes.

The lithostratigraphic sequence is formed of units belonging to Pliocene, Lower, Middle and Upper Miocene, Eocene, Cretaceous and Precambrian Basement Complex. The types, thickness and Stratigraphic setting of the different sedimentary sequences have been affected by complicated tectonic history.

Hydrogeologically, the Gulf of Suez can be considered as an artesian basin of the first order and can be further subdivided into other secondary basins. In the general hydrogeological studies of that region (Ayon Musa area), the following water pressure systems are considered:

1. The Post-Miocene water system.
2. The Miocene water pressure system.
3. The Eocene water pressure system.
4. The Cretaceous water pressure system.
5. The Jurassic water pressure system.

Three main hydrogeological systems are distinguished in the Northern part of the Gulf of Suez, namely:

A) A closed system in which the Hydrogeochemical composition is characterized by a very high water salinity with anionic composition, mainly chloride which indicated a limited migration of oil from the nearby source rocks and non-mixing of the groundwaters with the meteoric water.

B) Semiclosed system, is represented by the on-shore oil fields, the water salinity is lower than that in the closed system and the hydrochemical composition variable. Hence, a longer migration extent of oil from source rocks and mixing of different water genesis are expected in this system.

C) Open system where the groundwater is discharged upwards and mixed with magnesium and sulphate.

The hydrochemical compositions of groundwater in the oil fields of the northern part of the Gulf of Suez reflect the following results:

To the north of the Gulf of Suez (North Darage, Sudr and Asal fields) the following characteristics are recorded:

Low water salinity, high water resistivity, low water specific gravity, alkaline phase is dominant. Most north wells have the ratio (Na+/Cl- >0.853) ,which indicate poor zone for hydrocarbon preservation, The ratio of (rMg++/rCl-) generally less than the value of the standard sea water (0.198). The decrease in the concentration of magnesium ions in the groundwater is due to the deep reducing conditions.

To the south of the Gulf of Suez (October field and Zafarana field) .The following characteristic features are recorded:

High water salinity, low water resistivity, high water specific gravity, acidic phase is dominant. Most of groundwater in these south wells has the ratio (Na+/Cl- < 0.853) (the standard ratio for sea water) .This indicates a good zone for hydrocarbon preservation.

The ratio of (rSO4--/rCl-) is generally less than the value of the standard sea water (0.103). The decrease of sulphate ions in the groundwater is attributed to the consumption of sulphate ions during reduction processes. The ratio of (rCa++/rCl-) is higher than the value of the standard sea water (0.385). They are decreased due to North of the Gulf of Suez. The rise of the concentration of Calcium ions in all groundwater is due to reducing environment for a long geological time of continuous marine sedimentation.

The salinity model is suggested to explain the lateral and vertical salinity changes within the different reservoirs and the different hydrogeological systems in the northern part of the Gulf of Suez. The salinity increases with depth. The salinity trends increase from North to South of the Gulf of Suez, where similar trends of hydrodynamic movements of groundwater from North to South are investigated meteoric water entering the basin and the fluids move along the open system to semi-closed system and discharge the fluids upward to the surface of the North of the Gulf of Suez.

The pressure model is suggested to explain the pressure change with depth in each denser phase (oil, gas, water) and the hydrodynamic concept through the pressure –depth curves and cross sections in the north of the Gulf of Suez along different reservoirs .The methods used to construct regional potentiometric surfaces are based on groundwater heads calculation . They are which can be used to determine flow velocity and flow pattern used for the development of a concept of hydrodynamic models of the flow systems.

All the data are pointed to the fresh water coming from Ayon Musa area at northeast to offshore area (North Darage area) at southwest and may be displaced part of the hydrocarbon reservoir in the north region.

The present study suggested several recommendations for further assessment for the improvements and development of new techniques for exploration and production of oil and gas based on the hydrogeological and hydrodynamic studies to solve some of the scientific and technical problems arises through these activities in the northern part of the Gulf of Suez or other parts in Egypt .

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