Ain Shams University
Faculty of Science
Geology Department
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HYDROGEOLOGIC AND HYDRODYNAMIC ASSESSMENT OF NUBIA AQUIFER AND IMPACTS ON OIL POTENTIALITY IN ALAMEIN AREA ,NORTH WESTERN DESERT,EGYPT

Thesis Submitted for the Degree of Ph.D. in Geology (Hydrogeology)

BY

WAEL AHMED SHUKRY

(B. Sc. in Geology, Ain Shams University, 1984)

(M. Sc. in Geology/Hydrogeology, Ain Shams University, 2009)

To

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Cairo, Egypt, 2015

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APPROVAL SHEET

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ABSTRACT

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The hydrocarbon occurrences in the Western Desert are closely linked with the tectonic, the stratigraphic history of the area and the hydrodynamic potential of the groundwater in the regional Nubia Sandstone Aquifer System in the Western Desert and in the local Nubia Sandstone Aquifer System in the Northern section of the Western Desert. The north of Western Desert province has a significant hydrocarbon potential as recent oil and gas discoveries.

The present work aims to identify the systems of flow dynamics and hydro-geochemistry of the groundwater, which encountered in the North Western Desert as well as geologic setting, the reservoir characteristics and formation processes. The hydrogeochemistry of the groundwater (formation water) represents one of the main topics aiming to understand the connate groundwater behavior in relation to oil, as the base for further investigations.

The flow systems and the hydrogeochemical regime of the groundwater in the Nubia Sandstone Aquifer in the regional and local systems in the Western Desert of Egypt have a great impacts on the generation, migration and accumulations processes of the hydrocarbons.

The development of oil traps in the North Western Desert depends mainly upon structures. They are highly controlled by the potential of the hydrodynamic conditions of the groundwater flow system in both the regional and local flow systems of the Nubia Sandstone Aquifer.

Flow trends of groundwater match with the trends of salinity variations. They flow from NE and NW towards the Qattara Depression. Opposite trends

were developed due to uplift structers and exerting discharge areas favorable for oil accumulation. The Qattara Depression represents the great discharge area in the North Western Desert of Egypt.

The aquifer framework of North Western Desert is classified into two main aquifer systems, the Post Nubia Aquifer System along the Mediterranean and assigned to Late Tertiary ,Lower Miocene (Moghra Formation) and Quaternary the Nubia Sandstone Aquifer system which assigned to the Jurassic - Upper Cretaceous time (Khatatba, Alam El Bueib, Kharita and Bahariya Formations). The Nubia Sandstone Aquifer is built of multilayered system.

The hydrodynamic concept through the pressure –depth curves and cross sections in the North Western Desert along different reservoirs are investigated. The Middle and Lower Cretaceous Reservoirs (Bahariya, Kharita, Alamein and Alam El Bueib Formations) and Jurassic Reservoir (Khatatba Formation) are described. The potentiometric surfaces as based on groundwater heads are compiled. The hydraulic gradients of groundwater match with the trends of salinity variations.

Fourteen formation water samples were collected from three oil fields (Alamein, Yidema and Horus fields) they are collected from ten oil wells penetrating aquifers and different pay zones .They are selected to represent the hydrocarbon pay zones belonging to different geological times, and chemically analyzed. Variation of salinity and hydrogeochemical characteristics of the connate groundwater are investigated. They match the flow trends reflecting the hydrodynamic potentials in the Nubia Sandstone Aquifer System.

The salinity has a trend of increase northward forming a fresh /salt water boundary coinciding with the Qattara Depression. It divides the Western Desert into a northern area with salt water, low bacterial degradation and active oil generation and southern area with fresh water and high bacterial degradation with active water flushing and non-active oil generation. The permeability barrier between the Latitudes 29° and 30° N as a result of Jurassic orogeny is expected to prevent the fresh water flushing toward the North.

The groundwaters (formation water) in the multilayered Nubia Aquifer System in the North Western Desert have a marine water origin and act as active hydrodynamics zone. It reflects a favorable zone for hydrocarbon accumulation.

The hydrodynamic conditions of the Nubia Sandstone Aquifer System have great effect on the occurrence and distribution of oil accumulations in the North Western Desert. The oil possibilities in the North Western Desert and the best locations for oil potentiality exist around Abu Gharadig and Shushan- Matruh Basins.

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