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Petrophysical analysis and hydrocarbon potentialities of the untested Middle Miocene Sidri and Baba sandstone of Belayim Formation, Badri field, Gulf of Suez, Egypt

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ABSTRACT

All over the Gulf of Suez, the Miocene sediments seem to have a very important role in oil accumulation. Badri field is one of the most prolific places in the Gulf of Suez which locates in the southern part of the gulf. Presence of sandstone streaks in the Sidri and Baba Members within Belayim Formation which belongs to the Middle Miocene (Serravallian) age in some wells within this field of relatively high resistivity signature in Electric logs is the main reason to investigate its petrophysical parameters to delineate the main characterization of these sands and to evaluate their ability for hydrocarbon accumulation and production. These members lie between two productive sandstone zones; Kareem Formation and Hammam Faraun Member. They can be a e good promising reservoir with hydrocarbon potentiality which will be added to the Egyptian oil production. A petrophysical analysis of these sandstone zones was undertaken using the electric logs and subsurface geologic data to obtain information about the main reservoir characteristics of the studied sandstones. This study revealed that six wells contain hydrocarbon accumulation within these two members. Petrophysical analysis of the electrical logs (Resistivity, Density-Neutron, Sonic and Gamma-Ray) of Sidri and Baba (S.S.) Members reveals that the shale volume, effective porosity, water saturation, hydrocarbon saturation, and net-pay thickness, are varying between 6 to 18%, 12 to 22%, 18 to 38%, 62 to 82%, and 17 to 37 feet respectively. The type of the present fluids in this reservoir are oil and gas. The hydrocarbon potential of the study area was evaluated through the vertical and the lateral distribution of the petrophysical parameters and hydrocarbon occurrence. The lateral distribution was studied and explained in the form of iso-parametric maps (effective thickness, shale content, effective porosity and hydrocarbon saturation), while the vertical distribution of petrophysical characteristics was studied and explained in the form of litho-saturation crossplots. Also, the hydrocarbon volume was calculated in these zones. All these analyses were performed for Sidri sandstone as one unit and for Baba Sandstone as another unit.

From the previously mentioned results the following recommendations should be noteworthy: 1 – BDR-A9 and BDR-A16 wells for the Baba (S.S.) Member and BDR-C14 and BDR-D8A wells for the Sidri Sandstones Member should be perforated, these zones were proved to be oil bearing formations. 2 – BDR (A8) well for the Baba sandstone and BDR (B9) for the Sidri sandstone should be perforated which were proven to be gas zones. 3 – Re-evaluation of all wells in Badri field that were correlated with these studied sandy facies should be performed.

1. Introduction

Petroleum exploration around Gulf of Suez began just over 100 years ago at Ras Gemsa, with commercial scale oil production starting in 1909. The Gulf is now a well-established oil province, presently ranked seventh in seam of production among the major grabens or rift basins of the world. All over the Gulf of Suez, the Miocene sediments seem to have a very important role in oil accumulation. More detailed and comprehensive studies are needed to achieve a better understanding for the new promising areas, in which awaited detailed examination all-over the Gulf of Suez. Alsharhan and Salah (1994) mentioned that, we must keep looking for stratigraphic traps in the southern Gulf of Suez.

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Badri field lies in the offshore part of the Gulf of Suez and covers a surface area of about 12 km^2. It is located 625 m northeast of Morgan Field in the southern province of the Gulf of Suez, approximately twenty kilometers northeast of Ras Shukheir area (Fig. 1). It is bounded by latitudes 33°22′ to 34°47′ N, and longitudes 28°24′ to 28°26′ E.

Six wells were chosen to perform the target of this work, these are BDR (A9, A16, A8) wells for Baba zone and BDR (C14, D8A, B9) wells for Sidri zone, all available logs were used in this study include (Gamma ray, Density, Neutron, Sonic and Resistivity logs).

2. Geologic setting

The Gulf of Suez is a Neogene continental rift system that developed by the separation of the African and Arabian plates in Late Oligocene – Early Miocene time. Geomorphologically, it represents a rejuvenated, slightly arcuate NW–SE topographic depression, known as the Clysmic Gulf. It extends northwestward from 27°30′N to 30°00′N. Its width varies from about 50 km at its northern end to about 90 km at its southern end where it merges with the Red Sea (El-Naby et al., 2010; Lashin and Abd El-Aal, 2004; Bosworth and McClay, 2001). The Gulf of Suez is dissected by a complex pattern of faults: N-S to NNE–SSW as well as E-W trending normal faults at the rift borders and within the rift basin, and NE-trending strike-slip faults crossing the Gulf basin (El-Naby et al., 2009). The interaction of these major fault systems resulted in a complex structural pattern consisting of numerous horsts and grabens with variable relief and dimensions. The Gulf of Suez is subdivided into three structural provinces according to their structural settings and regional dip directions: the northern Araba dip province (SW dips), the central Belayim dip province (NE dips), and the southern Amal-Zeit dip province (SW dips,). These provinces are separated by two NE-trending accommodation zones: the Galala-Abu Zenima Accommodation zone (GAZAZ) in the north, and the Morgan Accommodation zone (MAZ) in the south. Based on surface and subsurface data, the stratigraphic succession of the Gulf of Suez can be subdivided into three depositional units (Fig. 2), (El-Naby et al., 2009). The pre-rift units include Proterozoic basement rocks and Paleozoic to Upper Eocene sediments. These formations are important as source and reservoir rocks. The Upper Oligocene and Miocene syn-rift units contain source, reservoir and seal lithologies, as well as volcanic rocks. The post-rift units are of Pliocene to Pleistocene age.

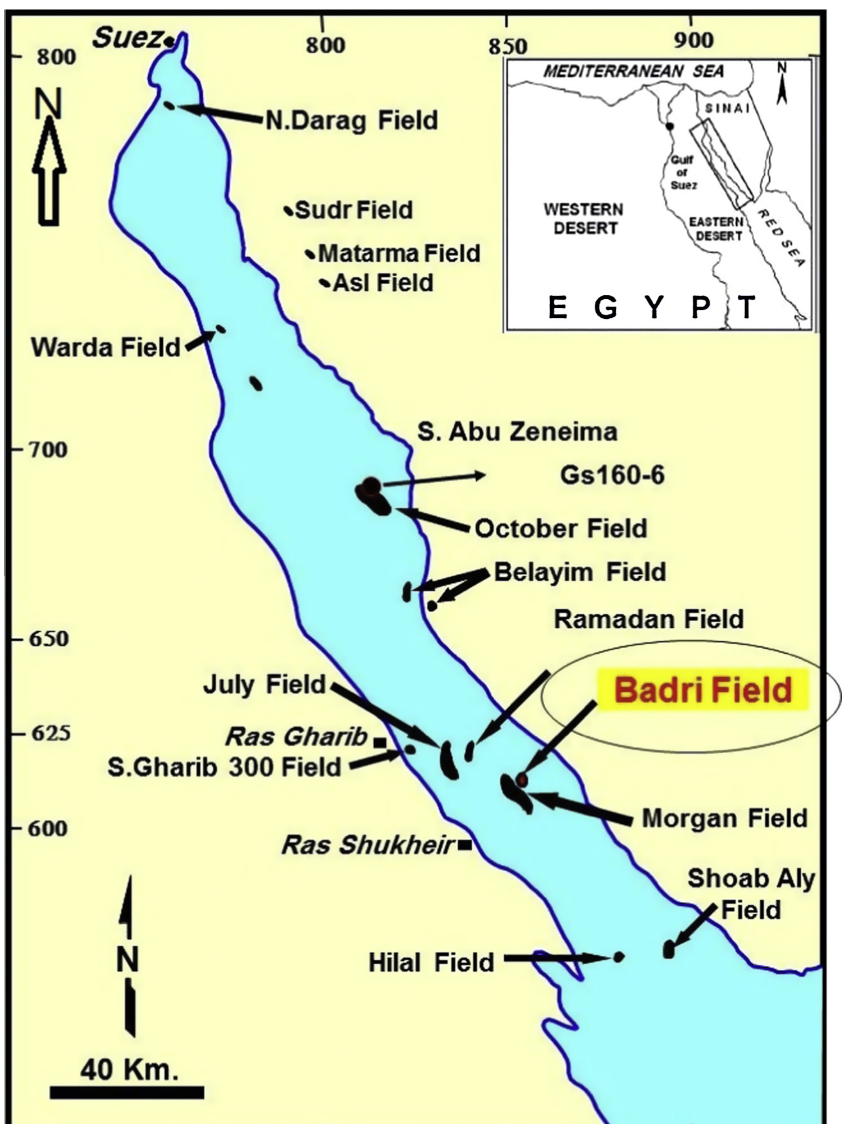

Fig. 1. Location map of the study area where the main Gulf of Suez oil fields are illustrated.