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FULL LENGTH ARTICLE

Reservoir characteristics of some Cretaceous sandstones, North Western Desert, Egypt

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Abstract The present study aims to reveal diagenetic processes and reservoir characteristics of the subsurface Cretaceous (Upper and Lower) sandstones at the North Western Desert of Egypt at four wells namely Gibb Afia-1, Betty-1, Salam-1X and Mersa Matruh-1.

Petrographic observations and statistical analysis of petrophysical data of forty-five subsurface Cretaceous sandstone samples reflect good reservoir characteristics in some intervals due to high porosity (varies up to more than 27%) and permeability (varies up to more than 826 mD). In other intervals, they reflect fair to bad reservoir characteristics due to low porosity (reaches a value of 6.25%) and permeability (reaches a value of 0.01 mD), caused by matrix and diagenesis processes.

FZI (flow zone indicator) and R35 (pore aperture corresponding to the mercury saturation of 35% pore volume) were calculated from the measured porosity and permeability, by defining FZI and R35, four hydraulic flow units (HFU1, HFU2, HFU3 and HFU4) in a reservoir have been identified. HFU1 is distinguished by FZI values that lie between 3.71and 8.11 μm, meanwhile, the values of R35 are greater than 10 μm. HFU2 is marked where the FZI values are between 1.32 and 3.70 μm, while the values of R35 are between 2 and 10 μm. HFU3 is noticed where FZI shows values between 0.40 and 1.31 μm, while the values of R35 are between 0.5 and 2 μm. The HFU4 is evaluated where FZI values are between 0.06 and 0.39 μm, and the R35 values are less than 0.5 μm.

1. Introduction

The North Western Desert of Egypt has been recognized as a region of simple surface geological features, which conceal beneath it more complicated geological structures, in addition to different basins and sub-basins [1]. Many geological, as well as mineralogical and sedimentological researches

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have been carried out on the North Western Desert, [26,11,22,9,12,24,7,15].

The Cretaceous rocks in the study area (Fig. 2A and B) are divided into lower and upper units. The lower unit is made up of Lower Cretaceous clastics rocks, while the upper unit is composed mainly of carbonates rocks [24]. These rock units from base to top are Alam El Bueib Formation (Neocomian – Early Aptian), Alamein Formation (Early Cretaceous – Middle Aptian), Dahab Formation (Aptian – Early Albian), Kharita Formation (Early Cretaceous – Albian), Bahariya Formation (Early Cenomanian), Abu Roash Formation (Late Cenomanian – Santonian), and Khoman Formation (Santonian – Maestrichtian). A brief description of these units was mentioned by Kassab et al. [15].

The Cretaceous rocks (Aptian and Cenomanian–Turonian) deposited on Palaeo-highs under relatively high energy conditions are the main hydrocarbon reservoirs of the Western Desert [24]. The study of the subsurface Cretaceous sandstone rock samples at the northern part of the Western Desert is most interesting due to their high hydrocarbon potentiality. The present study aims to reveal the diagenetic processes and the reservoir characteristics of the subsurface Lower and the Upper Cretaceous sandstones at the North Western Desert, in terms of evaluate their hydrocarbon potentiality. The present work has been carried out for 45 samples belonging to four wells namely; Gibb Afia-1, Betty-1, Salam-1X and Mersa Matruh-1, which are located between latitudes 29° 37′ 59″ N & 31° 19′ 43″ N and longitudes 26° 20′ 12″ E & 27° 26′ 45″ E, (Fig. 1).

2. Samples and methods

Forty-five (45) sandstone samples were collected from the studied two Cretaceous rock units (20 samples from the Upper Cretaceous and 25 from the Lower Cretaceous). Petrographic and petrophysical investigations have been conducted on these samples. Thin sections and scanning electron microscope of core samples are used to identify the mineralogical composition, diagenetic processes and depositional environments. Thin section preparation involved vacuum impregnation with blue epoxy to facilitate the recognition of porosity types. The petrographical study is based mainly on the microscopic examination of thin sections of the studied Cretaceous sandstone rock samples. The scanning electron microscopic analysis was performed on selected fifteen (15) samples by the scanning electron microscope (SEM) model (JEOL JSM – 5300) at the Egyptian Petroleum Research Institute.

Petrophysical measurements were carried out for forty-five (45) core samples at room temperature and ambient pressure at the Egyptian Petroleum Research Institute. The studied samples have been drilled into cylinders of about 2.54 cm in diameter and up to 3.00 cm length for the petrophysical measurements. These cylindrical samples were cleaned and then dried at a temperature of 85 °C for 10 h.

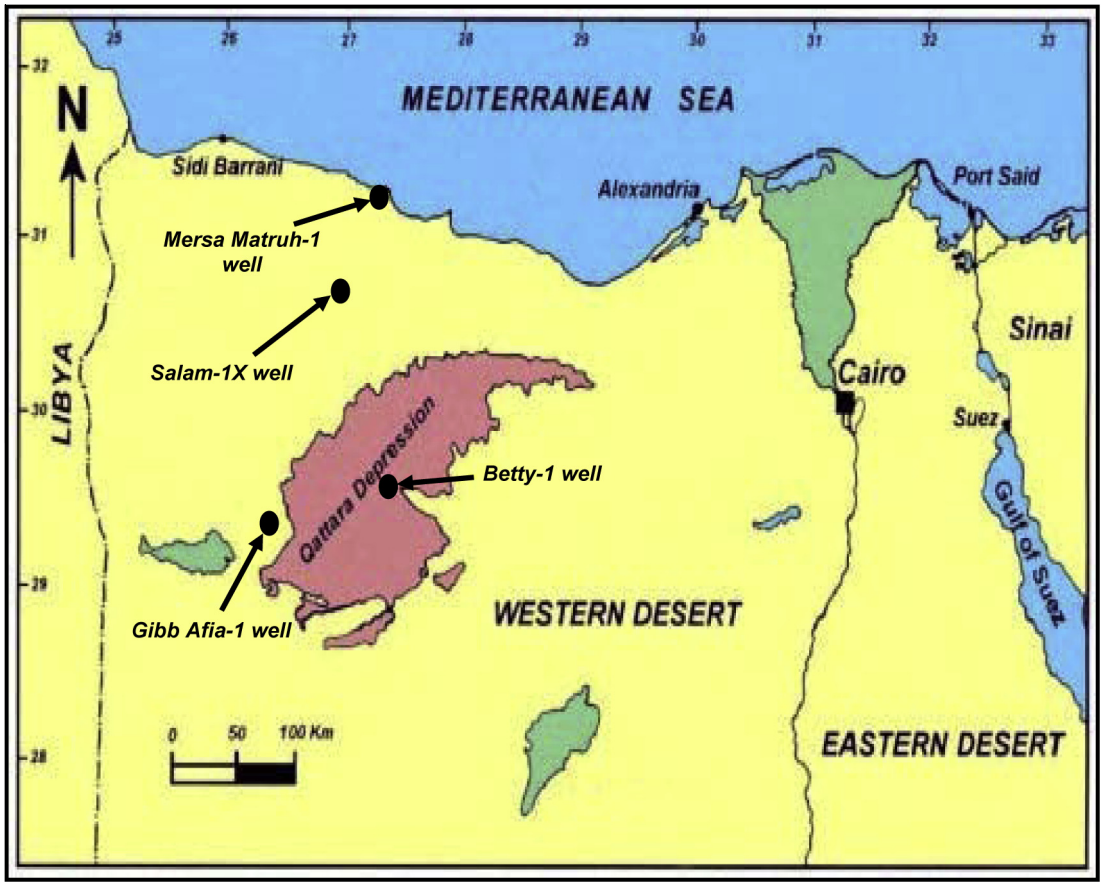

Figure 1 Location map of the studied wells.