

***Integrated Geophysical, Geological and Petrophysical data to Study the Middle Devonian Aouinet Ouenine F3 Sand Reservoir in ALWafa Field Ghadames Basin, North-West Libya.**

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Abstract

The Middle Devonian Eifelian-Givetian age, Aouinet Ouenine F3 Sandston member represent the main reservoir in Al Wafa Oil and Gas Field, which is located in southwestern part of Ghadames Basin near the Algerian border. This reservoir rock in Al Wafa Oil and Gas Field is considered as a basal portion of Aouinet Ouenine Formation deposited in a shallow marine barrier bar environments and characterized by a typical coarsening upward sequence. The quality and distribution of the reservoir Facies in the area is not well understood, which is negatively effects the performance of the reservoir. Geophysical, Geological and Petrophysical Analysis carried out to understand this reservoir quality, distribution thickness across Al Wafa Field. Seismic interpretation techniques used to map the reservoir as a result of delineate the sand limit in the area; In addition, 3D seismic volume cube data for seismic attribute technique was used. Well logs from 29 wells in conjunction with core analysis results data from previous studies have been used. The results suggested that the reservoir has lateral changes interm of lithology and thickness, the sand map F3 was confidently mapped in the northern and part of the southern areas and as a result, the reservoir was divided into two parts north and south based on sand Pinchout, due to the sea level changes. The petrophysical analysis results show that Aouinet-Ouenine F3 Sandston reservoir quality is variable, where net pay thickness is ranges from one foot in well A11 in south of the northern area to 101 feet in well A47 feet, average porosity is about 12.5 % and average water saturation is 16 %, due to the facies changes. The study area is classified to high, moderate and low risk in terms of the reservoir quality and Facies distribution.

Introduction

The Ghadames Basin is a large intracratonic basin Figure 1, covering portions of Algeria, Tunisia and Libya, extending over 350000 km², the basin contains up to 6000 m of Paleozoic and Mesozoic sediments (Hallett, D, 2002).

The Palaeozoic sections separated from the overlying Mesozoic deposits by a major regional unconformity of Hercynian (Permian-Carboniferous) age. The erosion pattern and topography developed on this unconformity has a major control on petroleum systems within the basin (Echikh, 1998) affecting the preservation of Palaeozoic hydrocarbons, communication between source and higher reservoirs, and patterns of long-distance migration within the Triassic reservoir.

The south-eastern part of the Zamzam Trough is cut by the SE-NW trending Tertiary Hon Graben. The area is characterized by the presence of varying land forms as sand/gravel plains, Sabka and small sand dunes. Since the first exploratory wells (1959) around 300 exploratory wells were drilled, the most of which have been located in the structurally highest part of the basin. (Underdown & Redfern, 2008).

During the Late Silurian and Early Devonian, Laurasia separated from the Gondwanaland ensuing uplift and limited erosion of some formations on and near the Amguid-Hassi Touareg structural axis (Klett, 2000).

The Middle Devonian Eifelian-Givetian age, Aouinet Ouenine F3 Sandston member represent the main reservoir in Al Wafa Oil and Gas Field, this reservoir rock in the Field is considered as a basal portion of Aouinet Ouenine Formation deposited in a shallow marine barrier bar environments and characterized by a typical coarsening upward sequence.

The area of study Al Wafa Field as shown in Figure 1, is located in Block NC169a, close to the Libyan-Algerian border at the south western part of Ghadames Basin about 100 Km of Ghadames city (unpublished report Mellitah Gas Report).

The main aims of this study are :

1. Evaluate the reservoir quality of Aouinet Ouenine F3 Sand Member by using seismic interpretation techniques and petrophysical analysis for selected wells to determine porosity, permeability, Net Pay.
2. Geological analysis by using wells information and formation Tops to generate geological cross sections and isopach maps.
3. By combined all above help us to understand the variable of reservoir quality of Aouinet Ouenine F3 Sand Member in Al Wafa Field.

Methods

3D seismic interpretation applied to define the F3 reservoir limit as either a pinch-out or facies change. A number of attribute volumes were generated and used to help confirm this reservoir limit. It was also compared to previous interpretations of the reservoir limit from 2D seismic data, horizontal seismic time slice data, seismic attribute and velocity model were generated by using petrel software to depth convert time to depth map.

The petrophysical analysis study generated by using 30 wells including Electric logs (Gamma Ray, Sonic, Neutron, Density, Spontaneous potential, Resistivity etc.) were also provided for the majority of the wells. The key wells also had time/depth data (Check shots) to allow us to calibrate the wells.

By calculate the volume of shale, effective porosity, permeability, water saturation, net pay, net to gross ratio. etc., to evaluate the reservoir quality within the study area, also a dry hole analysis acquired to investigate the reason of failed in some wells.

The study uses a wide variety of technique, Petrel platform is powerful software for seismic interpretation, seismic attribute, generate structure map, thickness map well interpretation, well to well correlation, identified stratigraphic sequences, facies ,geological interpretation .

Results

The reservoir is mapped using seismic interpretation techniques, and the sand limit is shown. Data from prior research, well logs from 30 wells calibrated with the results of core analysis, and several seismic attribute techniques retrieved from a 3D seismic volume cube were also employed. The findings imply that the reservoir has lateral lithological and thickness changes. Figure 1 illustrates how the F3 sand was confidently mapped. Due to fluctuations in sea level, the region was split into two portions, north and south, depending on sand pinch-out. The Aouinet Ouenine F3 Sandston reservoir quality is variable, according to the results of the petrophysical analysis, with net pay thickness varying from one foot in well A11 in the southern region to 101 feet in well A47, with an average porosity of 12.5 % and a water saturation of 16.1 % because of facies changes.

Conclusion

Over Al Wafa field the F3 sand mapped with confident by using the Attribute volume in conjunction with the seismic stack volume.

Based on the results of seismic interpretation, seismic attributes and petrophysical properties suggested that Aouinet Ouenine F3 sand exist between the Well A11 and Well A13.

To the far north area the Aouinet Ouenine F3 sand is picked by seismic interpretation and seismic attributes, therefore the exploration program can extended.

The petrophysical analysis results show that Aouinet-Ouenine F3 sand reservoir quality is variable, net pay thickness is ranges from one foot to 101 feet, Average porosity is 12.5 % and average water saturation is 16 %, due to the facies changes.

The Results show that through study area can be classified to high, moderate and low risk in terms of the reservoir quality

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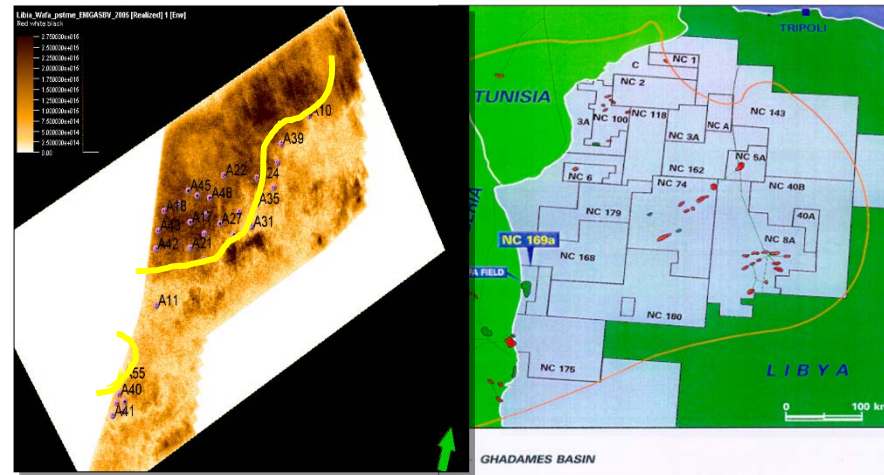


Figure 1. shows the location of Al wafa Field sand limit on the area by using Envelops Attribute.