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Well Log Analysis for Oil and Gas Formation Evaluation of Hawaz Formation in Murzuq Basin, Southwest Libya

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Abstract

The well logs are one of the main tools applied to identify the important subsurface information. The main objective of this study is to evaluate Hawaz reservoir in purpose of estimating the hydrocarbon in place, rather than completions to increase the production and to enhance oil recovery from the study area. This will be carried out through predicting the deposition environment and its relation to the petrophysical model deduced from well logs. Well logs are the main tool to confirm the core and cutting sample description (lithology and type of fluid or gas) and correct the depth of these samples of each drilled well. Consequentially, the well logs considered in this study were used to give the detail and accuracy of rock properties at any depth. Also petrophysical characteristics such as from well logs are: volume of shale, porosity, hydrocarbon saturation, permeability, pressure and temperature at any depth, were calculate these properties give indications on rock type, rock properties and type of fluid. Where might be construction petrophysical model, this model gives us indication lateral distribution of Hawaz Formation in Murzuq basin.

Keywords: Well log analysis; Murzuq basin; gas, oil.

1. Introduction

Borehole logging, as defined here, is the science of recording and analyzing measurements in boreholes or wells, for determining physical and chemical properties of soils or rocks and fluids. The purpose of this section is to provide the basic information necessary to apply the most useful geophysical well logs to provide the best understanding on the groundwater, environmental and petroleum engineering applications.

1.1. Area of study

The location of Murzuq Basin is in the south western part of Libya, it covers an area of over 350 000 km^2. The area is located within Murzuq basin southwestern Libya. Where located it between Longitude 11 50^o -12 40^o and latitude 26 10^o- 27^o.

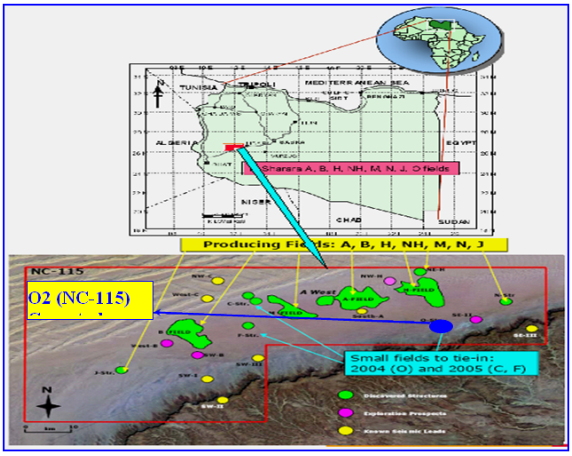

Figure 1.1: Study area

Table 1.1: Petrophysical parameters

Rmf 0.15 Oh.m at 81F°	SSP = 63.64 mV	Φdshale = 0.03854 %
Ts = 81F°	Bed thick = 13 Feet	Φnshale = 0.2567%
B.H .T = 184F°	GRmin = 19 API	Φclay = 0.24%
Rm = 0.156 at 81F°	GRmax = 135.5API	Φaverage = 0.133 %
Rm = 0.072 at 184 F°	Rw = 0.335 Oh.m	Faverage = 30.6465
Rmc = 0.179 at 81 F°	Pbma = 2.65 g/c3	Rw/Rb = 0.54086 Oh.m
Ri = 13.5 Oh.m	Pbf = 1 g/c3	Rb = 0.61938 Oh.m
Ri/Rm = 187.5 Oh.m	Δtma = 52.6 us/ft	Pw = 1 g/c3
GG = 0.018	Δtf = 189 us/ft	C = 250
SP = 43 mV	Δtshale = 85	Ph = 0.4 g/c3
Correction factor = 1.48	Rshale = 10.75 Oh.m	-

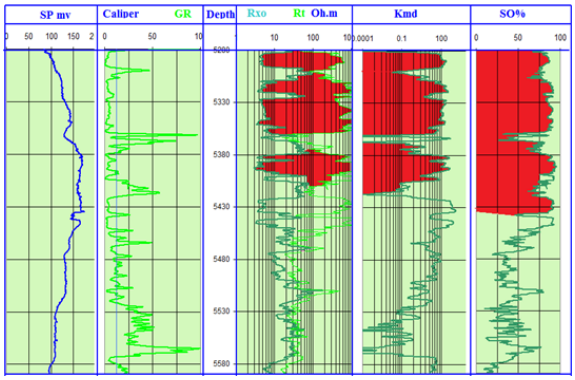

Figure 1.2: Differences between physical properties

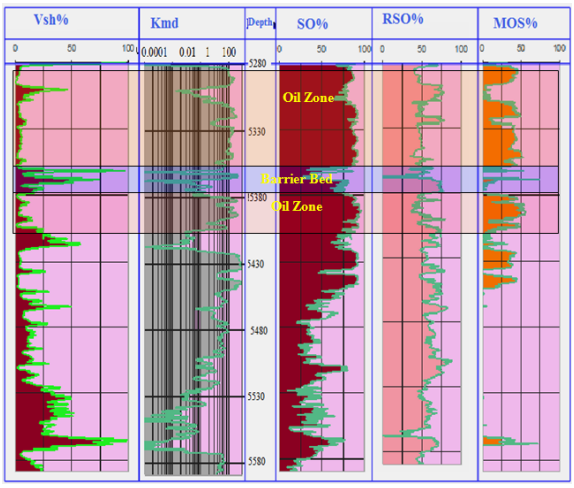

Figure 1.3: Reservoir quality

1.2. Petrophysical Parameters (NC-115)

1.3. Vertical Distribution of Petrophysical Analysis of NC-115 (Murzuq Basin)

From figure 1.2 increase in values of true resistivity, permeability, oil saturation is high, on the other hand, the values of shale decreases at depth between 5280 ft to 5430 ft. however there is existence of barrier beds in this reservoir.

1.4. Petrophysical Properties Estimation

Figure 1.3, give us indication of reservoir quality, where the values of oil saturation, movable oil saturation, and residual saturation are high at a depth from 5280 ft to 5430 ft, and it is also noticed that the permeability is high, while the volume of shale is low at the same depth. These petrophysical characteristics indicate the quality and important of this reservoir.

1.5. Field Zonation

The field of study can be divided into four zones figure 1.4 based zone on the petrophysical characteristics, where zone one is characterized by high oil saturation (oil zone) with existence barrier bed of shale, while zone two is indicated by high volume of shale (shale zone). However zone three is clearly noticed we note high oil saturation also. The last zone is water barrier zone.

2. Analytical Formation Evaluation

2.1. Lithology Identification

From relationship bulk density and porosity the type of lithology is sandstone.

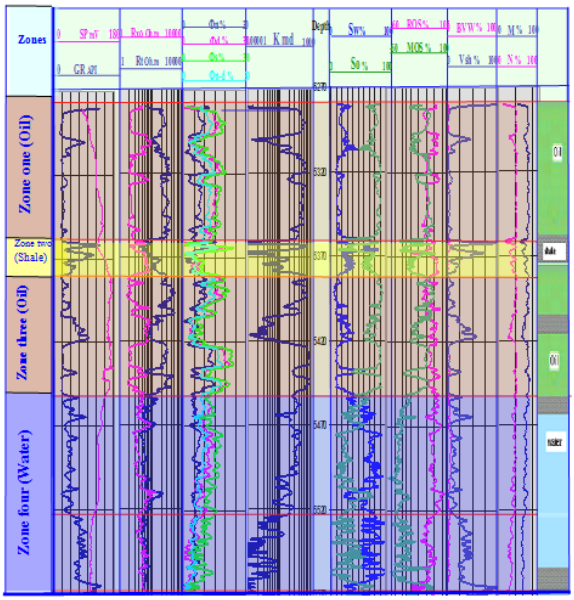

Figure 1.4: Zonations

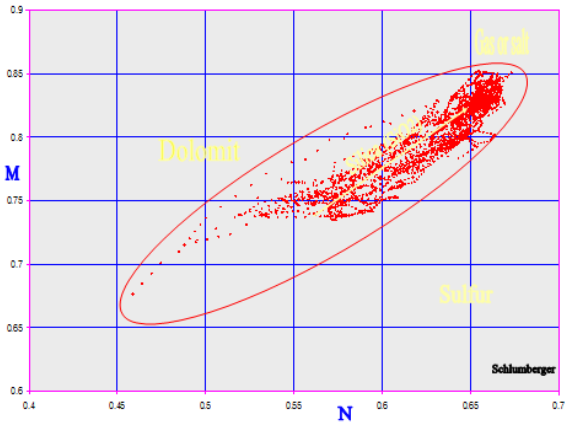

Figure 2.2: Relationship between M-N

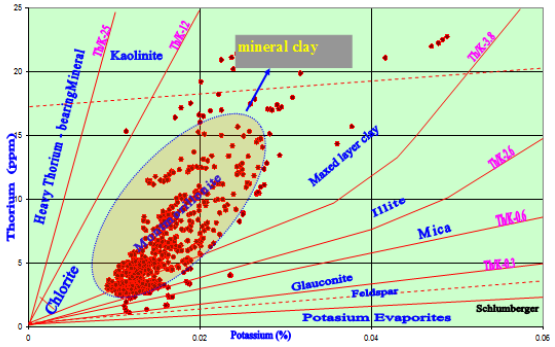

Figure 2.3: Mineral clay

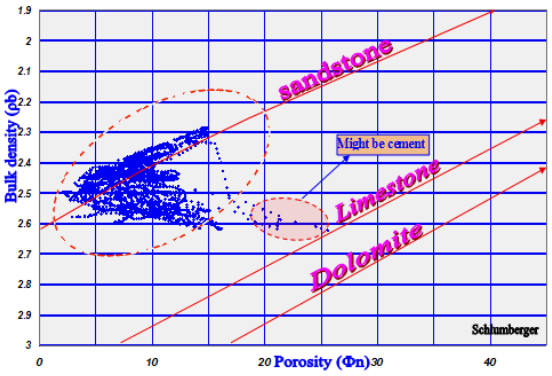

Figure 2.1: Lithology estimation

Lithology can also be determined through M-N plot, which clarifies the type of rocks for this formation which appears in form of sand, where this relationship gives an indication of the presence of sand only figure 2.2. The M-N plots indicate also minerals type which is silica (Sio_2).
The depositional environment of Hawaz Formation might be deduced by using since when well logs, where the shale (Montmorillonite) indicates the stable deposition environment (Open-marine), it is deposited, it take the heavy mineral with it. This deposition environment can be indicated through the measurement Gamma rat spectrometry (NGS) which discriminate between thorium, uranium, and potassium.
The sand indicates the deposition environment of Open- Shallow marine for this formation at that time figures 2.3 and 2.4.
The Hawaz Formation is mainly made of fine-grained, clean quartzitic sandstones with interbed-

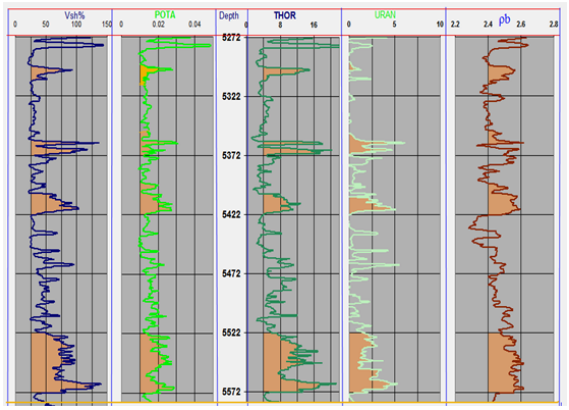

Figure 2.4: Radioactive

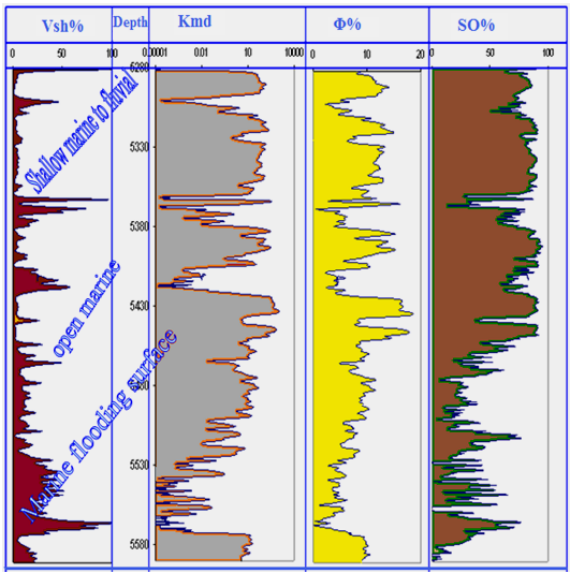

Figure 2.5: Deposition environment

ded thin beds of silty sandstones and siltstones. The vertical facies arrangement shows an upward evolution from clastic deposition in an open and shallow marine environment to a nearshore, tidal- and storm-influenced environment. The open marine deposits are represented by the lower third of the succession and consist of tabular beds of massive, quartzitic sandstones, highly bioturbated by Skolithos. Tidal and storm facies associations along with shoreface to beach facies associations characterize the nearshore deposits figure 2.5.

3. Conclusion

The basin is considered one of the high petroliferous attractive areas in Libya with two main reservoirs (Mamuniyat and Hawaz), sourced and caped by Tanezzuft shale. This research studied the secondary reservoir target of Murzuq basin Hawaz Formation-Middle Ordovician of this study can be categorized in the following items:-

1. 1. The logs gives clear indication on types of minerals which forming the rocks.
2. The volume of shale illustrates the presence of wide range of shale percentage which between 15-75%.This might be due to the change of water level.
3. The porosity is wobbling between 5-20%, this range reflect the change of lithology and genesis of reservoir rocks.
4. There is a very wide range of permeability values. These changes resulted from the shale content (lithological change), genesis and structural condition (faults &fractures), where the range of permeability is between 0.0001 and 1000 mD.
5. The middle and lower part of the reservoir has better reservoir quality compared with the upper part of Hawaz reservoir.
6. Hawaz formation deposited in stable deposition environment, where it has wide vertical reservoir changes and limited lateral change.
7. Analysis of well logging records might indicate the deposition environment.

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