ANALYSIS OF OGOM-1 WELL USING MUD LOGGING EXPLORATION TOOL

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Abstract

A mud logging process was carried out on OGOM-1 well using its equipment. The well name is a hypothetical one (for security reasons). It is located in delta state and owned by the SPDC. The mud logging formation data was interpreted geologically, revealing their physical parameters such as depths, lithological tops, colour and description. Intervals 8900ft-9910ft of well shows strata of sand and shales, intervals 9910ft-10920ft of well consists mainly of thick columns of sand with occasional intercalation of shale which appears to be slightly sticky. While intervals 10920ft-11920ft of well consists of an alternating sequence of thick shale beds and sand beds. From the lithological analysis obtained, the reservoir could be concluded as a hydrocarbon bearing formation.

KEY WORDS: Lithological, Well, Ogom-1, Shales, Sands, Hydrocarbon Mudloging.

Introduction

Mud logging, also known as hydrocarbon well logging, is the creation of a detailed record (well log) of a borehole by examining the bits of rock or sediment brought to the surface by the circulating drilling medium (most commonly mud). Mud logging is usually performed by a third-party mud logging company. This provides well owners and producers with information about the lithology and fluid content of the borehole while drilling. Historically it is the earliest type of well log. Under some circumstances compressed air is employed as a circulating fluid, rather than mud. Although most commonly used in petroleum exploration, mud logging is also sometimes used when drilling water wells and in other mineral exploration, where drilling fluid is the circulating medium used to lift cuttings out of the hole. In hydrocarbon exploration, hydrocarbon surface gas detectors record the level of natural gas brought up in the mud. A mobile laboratory is situated by the mud logging company near the drilling rig or on deck of an offshore drilling rig, or on a drill ship. Mud logging includes observation and microscopic examination of drill cuttings (formation rock chips), and evaluation of gas hydrocarbon and its constituents, basic chemical and mechanical parameters of drilling fluid or drilling mud (such as chlorides and temperature), as well as compiling other information about the drilling parameters. Then data is plotted on a graphic log called a mud log.

Other real-time drilling parameters that may be compiled include, but are not limited to; rate of penetration (ROP) of the bit (sometimes called the drill rate), pump rate (quantity of fluid being pumped), pump pressure, weight on bit, drill string weight, rotary speed, rotary torque, RPM (Revolutions Per Minute), SPM (Strokes Per Minute) mud volumes, mud weight and mud viscosity. This information is usually obtained by attaching *monitoring devices* to the drilling rigs equipment with a few exceptions such as the mud weight and mud viscosity which are measured by the derrick hand or the mud engineer, (Aahestand, 1996).

Rate of drilling is affected by the pressure of the column of mud in the borehole and its relative counterbalance to the internal pore pressures of the encountered rock. A rock pressure greater than the mud fluid will tend to cause rock fragments to spall as it is cut and can increase the drilling rate. "D-exponents" are mathematical trend lines which estimate this internal pressure. Thus both visual evidence of spelling and mathematical plotting assist in formulating recommendations for optimum drilling mud densities for both safety (blowout prevention) and economics. (Faster drilling is generally preferred.)1" (every foot) mud log showing corrected d-Exponent trending into pressure above the sand

Mud logging is often written as a single word "mudlogging". The finished product can be called a "mud log" or "mudlog". The occupational description is "mud logger" or "mudlogger". In most cases, the two word usage seems to be more common. The mud log provides a reliable *time log* of drilled formations, (Purcell,1977).

Mud logging is a service that qualitatively and quantitatively obtains data from, and makes observations of, drilled rocks, drilling fluids and drilling parameters in order to formulate and display concepts of the optional, in situ characteristics of formations rocks with the primary goal of delineating hydrocarbon ñshowsò worthy of testing.

The mud logging unit is the information centre on the rig site to serve both exploration and drilling.

- Optimized drilling efficiency.
- Comprehensive formation evaluation.

Improved well site safety. The mud logging unit is considered the information centre of the rig site as the unit participates in the monitoring of each and every rig operation

Theory:

The mud logging theory is based on the mud cycle principal. The mud is sucked from the pits (Active Pit) and pumped via the drilling string down to the holeös bottom. The mud is then bumped against gravity through the annulus up to the shakers. The time necessary to get the drilled samples to the surface is exactly the time required to pump the mud volume through this passage. This is calculated and is known as Lag time or lag strokes

- Lag time is the time the mud takes to travel inside the hole between two specified depth points.
- The time taken between the surfaces to the bottom of the hole is called ñlag downò or ñLag inò.
- The time taken between the bottom of the hole to the surface is called ñlag-upò or ñbottoms upò.
- The surface to surface time is called ñComplete cycleò or ñIn/Out timeò.

Lag Equations:

- Converting Barrels ➔ Gallons:
- Gallons (gal) = Barrels Î 42
- Converting Gallons ➔ Barrels:
- Barrels (bbl) = Gallons ¸ 42
- Calculating Pipe Volume:

$$\text{Pipe. Volume (bbl)} = \frac{(\text{Pipe / Collar ID}^2) \times \text{Length(ft)}}{1029}$$

Calculating Annular volume

$$\text{Ann. Volume (bbl)} = \frac{(\text{Hole / Casing ID}^2 - \text{Pipe / Collar OD}^2) \times \text{Length(ft)}}{1029}$$

Calculating Lag in Strokes

$$\text{Lag - in strokes} = \frac{\text{Annular Volume (bbl)}}{\text{Pump Output (bbl / stk)}}$$

Calculating Lag in minutes

$$Lag - in \min utes = \frac{Lag - in\ strokes}{Pump\ Rate\ (spm)}$$

- Converting Meter ➔ Foot:
- Feet (ft) = Meter x 3.281
- Converting Cu. in ➔ Barrels:
- Barrel (bbl) =9702 cu. in
- Converting g/cc ➔ ppg:
- ppg = g/cc x 8.33

Lag Correction:

- The number of strokes from the surface to the bit inside the pipe.
- The total number of strokes from starting up the pump until the gas arrives at the surface.

The resulting number of strokes is the actual lag time. From this it is possible to estimate the amount of washout in the hole, (Bariod, 1995).

Stratigraphy of the Studied Area

The Niger Delta occur at the southern end of Nigeria bordering the Atlantic Ocean and extends from about longitude 3o.9 E and latitude 4$^{o.}$30ôï 5^{o}.20ôN. The proto delta developed in the northern part of the basin during the capanian transgression and ended with the Paleocene transgression.

It has been suggested that the formation of the modern delta basin which enhanced and controlled the development of the present day Niger delta, developed by rift faulting during the Precambrian. Sediment logical and faunal data suggest that the modern Niger delta has a configuration similar to that of the past. (Molua and Ujuanbi, 2006)

Methodology / Materials

Role played by Mud Logging Unit

- The collection of the rock cuttings which is geologically described examined for any oil shows and then packed.
- The hydrocarbon & some non hydrocarbon gas monitoring while drilling.
- The monitoring of the drill fluid volume and to immediately inform the personnel in charge about any change in that volume

Confirming with the Driller about any Drilling Breaks

1. The generation of mud logs and graphs during the drilling of the well, acquisition of the data and producing a final well report.
2. The monitoring of the drilling parameters & informing the personnel in charge about any anomalies.
3. Monitoring the trips and updating a trip sheet at a five-stand basis

The detection and evaluation of the formation pressure, the hydraulics optimization and the well control.

Results and Analysis

Sample collection
Unwashed samples: - Two (2) sets at 30ft interval.
Washed and Wet samples: - One (1) sets at 30ft interval.
Washed and Dried: - Two (2) sets at 30ft interval.
All samples were collected from 4,150ft casing shoe to total depth (TD)
Mudlogging operation on OGOM-1 started from 8900ft to 11930ft (TD).

Table 1: Below Represent Log and lithological Interpretation from the Mudlog.

Depth(feet)	Lithology	Colour	Description
8900-9195	Predominantly sand with Shale intercalation	White to dark Gray colonizing action	Sand is very fine, well sorted, rounded, porous and poorly cemented while shale is moderately hard to hard having a salty sub surface. Yellow fluorescence milk to white cut fluorescence.
9195-9500	Predominantly sand	White to Gray coloration	Sand is very fine, well sorted, rounded, porous and poorly cemented while shale is moderately hard sticky and occasionally plat translucent white translucent white cut fluorescence.
9500-9800	Predominantly sand with Shale intercalation	White to dark Gray coloration	Sand: medium moderately well sorted, rounded, porous and poorly cemented while shale is moderately hard, occasionally platy fluorescence yellow with not cut
9800-10070	Predominantly Shale	Light Gray to Gray	moderately hard to soft slightly salty and sticky
10070-10320	Predominantly sand with Shale intercalation	White to Gray coloration	Sand: fine to medium moderately well sorted, sub rounded to rounded porous and poorly cemented while shale is moderately hard to soft, silky and slightly sticky light fluorescence, light brown milk to white cut fluorescence.
10320-10600	Predominantly sand	White	Fine to medium, moderately sorted well sorted, rounded to very rounded, porous and poorly cemented light yellow fluorescence, translucent light yellow cut milk, white cut fluorescence.
10600-10900	Predominantly Shale with sand Intercalation	Gray to Light Gray coloration	Shale moderately hard to soft sticky and salty Sand: fine to medium moderately well sorted to well sorted sand grain, sub rounded to rounded, porous and poorly cemented yellow spot fluorescence, no viscous cut, light yellow cut fluorescence.

10900-11200	Predominantly sand with Shale Intercalation	White	Sand: medium, moderately sorted to well sorted grains, sub rounded to rounded, porous, and poorly cemented shale is moderately hard to soft sticky Dull yellow fluorescence, No viscous cut, translucent milky to white cut fluorescence.

11200-11400	Predominantly sand with Shale Intercalation	White	Sand: Fine- medium, moderately well sorted grains, rounded to very rounded, porous, and poorly cemented. Shale: moderately hard to soft, occasionally platy, slight sticky. Dull yellow fluorescence, light yellow cut fluorescence.
11400-11800	Predominantly Shale	Gray to dark gray colouration	Moderately hard to hard platy and subsurface is salty.
11800-11900	Predominantly sand with Shale Intercalation	White to dark gray colouration	Sand: Fine to medium, moderately well sorted grains, sub rounded to rounded, porous, and poorly cemented. Shale: moderately hard to hard, platy, sub surface is silty. Yellow spots fluorescence, light yellow cut, milky ï white cut fluorescence.

The Lithological analysis of zones interest from the Mudlog is summarized into three groups between 8900ft to 11,930ft where the mudlogging terminated. These are (A) 8900ft to 9910ft (B) 9,910ft to 10,920ft and (C) 10,920ft to 11,930ft.

For 8900 to 9910 the Sand is very fine, well sorted, rounded, porous and poorly cemented while shale is moderately hard to hard having a salty sub surface. Yellow fluorescence milk and white cut fluorescence. The hydrocarbon shows indicates that the background gas recorded was between 6units (0.12%) and 8 unit (0.17%) with a maximum gas reading of 177units (3.55%) at 8980ft, 52 units (1.14%) at 9126ft and 72 units (1.45%) at 9490ft. The chromatograph analyses for this interval are:

C_1= 23320 ppm	C_1= 8820 ppm
C_2 = 4966 ppm	C_3 = 1486 ppm
C_2 = 4966 ppm	C_3 = 484 ppm

For the interval 9910ft to 10,920ft, the Sand is fine to medium moderately well sorted, sub rounded to rounded porous and poorly cemented while shale is moderately hard to soft, silty and slightly sticky light fluorescence, light brown milk to white cut fluorescence. The hydrocarbon shows indicates that the background gas recorded was between 16units (0.32%) and 19 unit (0.40%) with a maximum gas reading of 997units (13.8%) at 10,060ft, 352 units (8.64%) at 10,360ft, and 768 units (19.45%) at 10,786ft. With chromatograph analyses for this interval are:

C_1= 82810 ppm	C_1= 51300 ppm
C_2 = 31100 ppm	C_2 = 21970 ppm
C_3 = 10,136 ppm	C_3 = 1,311 ppm
IC_4 = 13,560 ppm	NC_4 = 10,140 ppm

For the interval 10,920ft to 11,920ft, it consists of alternating sequence of thick shale beds and sand beds. The hydrocarbon shows indicates that the background gas recorded was about 26units (0.5%) in this section with a maximum gas reading of 55.4units (10.81%) at 11,218ft, 212 units (4. 4%) at 11,370ft, 304 units (9.2%) at 11, 820ft. With chromatograph analyses for this interval are:

C_1= 47,994 ppm	C_1= 11970 ppm
C_2 = 17281 ppm	C_2 = 1308 ppm
C_3 = 7578 ppm	C_3 = 1890 ppm
IC_4 = 5894 ppm	

Conclusion

The general review of the above analysis proved evidence of the presence of hydrocarbon with the aid of log analysis parameters, obtained, such as fluorescence, visible stains, and cuts etc, exhibited by the show samples. The reservoir could be concluded as a hydrocarbon bearing formation.

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