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Petrophysical Characterization of AHO Field, Shallow Offshore Niger Delta, Nigeria

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ABSTRACT
This study presents the application of geophysical wireline logs for porosity and permeability characterization of “AHO” field, Eastern Niger Delta, Nigeria. The main objective of the study is to understand the effects of petrophysical parameters on reservoir quality of the field. A suite of wireline logs (gamma ray, resistivity, and density logs) from seven wells of “AHO” field were analyzed. Gamma ray log motif was used to delineate lithologies, delineate the top and base of reservoir units, and consequently determined petrophysical parameters using standard relations. The reservoir properties evaluated include porosity, permeability and fluid saturation. The study identified six (6) reservoir sand bodies (A, B, C, D, E, and F) delineated from their tops and bases at depth 3000ft – 5280ft. Petrophysical evaluation computed across the reservoir shows porosity ranging from 32.08 % to 37.47%; permeability 3067.72md to 4051.06md and average hydrocarbon saturation of 71.1% to 77.6% for reservoirs A-F. Plots of depth versus porosity shows that porosity decreases with increasing depth, and porosity versus permeability shows that permeability increases as porosity increases. From the analysis, the reservoirs show excellent porosity and permeability. The reservoirs in AHO field are of high quality to enhance hydrocarbon accumulation and production.

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Introduction

Petrophysics is the properties of rocks which are related to pore and fluid distributions particularly as they pertain to detection, estimation and evaluation of hydrocarbon bearing layers. (Rider, 2002). Petrophysics plays a basic role in the description, characterization and evaluation of reservoirs. The aim of the study is to evaluate the petrophysical characteristics of the reservoir sands using wireline logs, to qualify and quantify the reservoir potential of the “AHO” field with a view to determination of reservoir depth and thicknesses in the well, identify the reservoirs across the field, identify the various sand units and correlate them across the field, to discriminate the gas and oil bearing zones and their contact and interpretation of formation porosity, permeability, hydrocarbon saturation and hydrocarbon distribution within the field in the Eastern Niger Delta. The petrophysics of any oil field include reservoir rock and fluid properties that could affect oil recovery, amount of oil production and it is essential to integrate petrophysical data with data from geology and engineering. The development of techniques in characterization of reservoirs from logs is one of the most important existing and emerging challenges to geoscientists and engineers. Responses from logging tools (responses) and core data are usually used to determine lithology, fluid content and depositional environment. Post exploration and drilling studies have shown that a greater volume of oil can be recovered by studying the petrophysical and reservoir properties of a field.

The basic petrophysical properties encompass porosity, water of saturation, hydrocarbon saturation and permeability. The fundamental evaluations of these properties are necessary for determining the reservoir quality and hydrocarbon potential of a reservoir system performance. Although the physical properties of a small number of very common minerals such as feldspars, zircon, quartz etc are quite known, the vast majorities of minerals encountered in sedimentary formations pose a rather uncertain element for log interpretation.

Works which are mainly on evaluating porosity and permeability of reservoir sands and the geologic factors influencing production include those reported in the work of Archie (1942) who derived porosity equations and Weber (1971), who had attempted to derive permeability and porosity with wireline logs and grain size analysis. Mayer and Sibbit (1980) introduced a more universal and generalized approach to log analysis to determine petrophysical parameters for formation evaluation. Akaegbobi and Tegbe (2000) established that heterogeneity of reservoirs and evaluation of formation problems can make it difficult to characterize fluid distribution, estimate hydrocarbon in place and determine permeability. Ameloko A.A and Oseghe E. (2013) described the petrophysical evaluation of “Inda” Field in the eastern Niger Delta using well logs. Their report shows that the average porosity values are moderate and permeability values are very low within the field under study. Hence, the part of “Inda” field under study does not have good prospect for hydrocarbon production because of the high level of water saturation and low hydrocarbon saturation. Ekine A.S, and Iyabe P., (2009) examined the petrophysical characteristics of “Kwale” field reservoir sands from well logs. They showed that porosity ranges from 19.0 to 30% across the field and generally decrease with depth. They attributed the low porosity values to be mainly grain size and sorting effects within the reservoir sands. The permeability values ranges from 3.2 to 28.0md. This study was the first to attempt petrophysical evaluation of the “Kwale” field of the Niger Delta basin. Eze et al (2013) examined the Formation evaluation of X7 field in the Niger Delta, Nigeria. Their study shows that petrophysical characteristics of the reservoirs are good especially at the areas

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of interest (hydrocarbon zones). The average total porosity and effective porosity ranges from 13% to 34% and 12% to 31% respectively which is within the range for commercial accommodation of hydrocarbon. The water saturation in some zones is appreciably low (14% to 47%), this account for high hydrocarbon accumulation in those zones. This work tries to assess the quality of AHO field reservoirs using petrophysical properties.

Location of Study Area

The “AHO” field is located in the shallow offshore depobelt in the Eastern Niger Delta sedimentary basin. The locations of the wells in the field are shown in Fig. 1 below. The Niger Delta is located in southern part of Nigeria between latitudes 4 and 6^0N and longitudes 3 and 9^0E. It is bounded in the north by Anambra basin, in the south by Gulf of Guinea, in the east by Abakkaliki fold belt and in the west by Dahomey Basin.

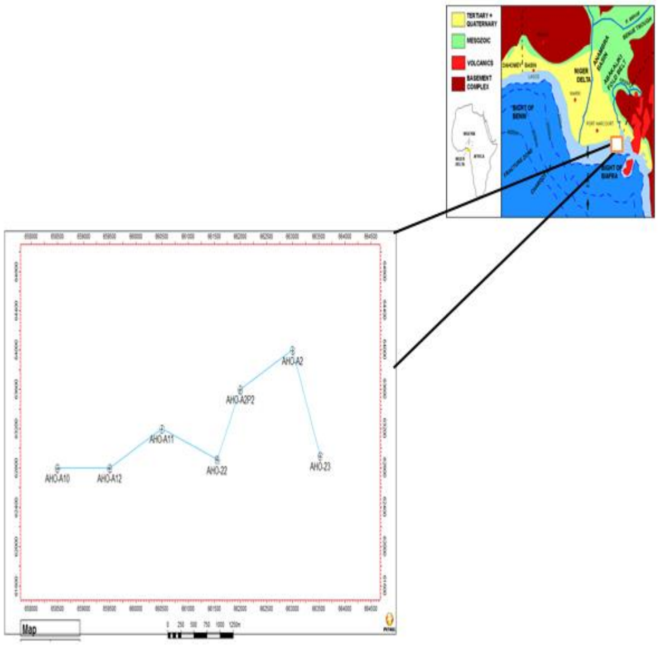

Figure 1. Map Showing the Study Area and Well Locations

Materials and methods

Wireline logs of seven wells containing gamma ray, resistivity and density logs for three out of the seven wells, base map of the area, and well coordinates were provided for this study. The data was loaded into the Schlumberger Petrel software version 2010 for analysis and interpretation. Petrophysical parameters were determined using relevant equations and inputted into Microsoft Excel 2010 to generate plots. Fundamentally, three types of logs were used in the analysis. They include; Gamma Ray log (lithogic log), Resistivity log (electrical log) and Bulk density log (Porosity log).

Gamma Ray (GR) Log

Gamma ray log measures natural radioactivity in formations. The radiation comes essentially from naturally occurring Thorium, Uranium and Potassium. It is used for identifying lithologies, correlate zones (suggest facies and sequences) and to calculate shale volume quantitatively. It is measured in API (American Petroleum Institute) unit; an API is defined as 1/200 of the response generated by a calibration standard, which is the artificial formation containing precisely known quantity of the three radioactive elements maintained by American Petroleum Institute. The gamma ray log is recorded in track 2 along with the caliper.

Scales are chosen locally but 0 to 100 or 0 to 150 API is common. A deflection of GR log to the right indicates shale and a deflection of GR log to the left indicates sand, while the maximum and recorded radioactivity to the right shows shale line and the minimum and recorded radioactivity to the left shows sand line. Shale free sandstones (free from shales) gives low gamma ray reading and low concentration of radioactive materials. In petroleum borehole logging, the greatest amount of natural radioactivity (by volume) is found in shales. A high gamma ray value frequently means shale while a low gamma ray value means sand.

Based on the suites of logs used for this research, the fundamental parameters include Gamma ray Index (I_{GR}), of Shale (V_{Sh}), Formation Factor (F), Porosity (ϕ), Water of Saturation, Hydrocarbon saturation, irreducible water of saturation, bulk volume water BVW and permeability K.

Volume of Shale

Before computing the volume of shales, the I_{GR} (gamma ray index) was first calculated as shown in equation 1.

I_{GR}=(GRlog - GRmin)/GRmax – GRmin eq. 1

Where: I_{GR}= Gamma Gay Index, GRlog =Gamma Ray reading of the formation, Gamma ray minimum (clean sands or carbonate) and GRmax = Gamma ray maximum (in shales). The volume of shales in the reservoir was estimated using equation (2) below which is valid for tertiary sediments in the Niger Delta.

V_{sh}= 0.083*($2^{3.7*IGR}$) -1) eq. 2

Dresser Atlas 1979

Porosity

Density logs were used in determining porosity. Density porosity was read directly from the log without any mathematical calculation. The formula for calculating density porosity is shown in equation 3:

$(\phi_{den}) = \frac{\rho ma - \rho b}{\rho ma - \rho f}$ *eq.* 3

(ϕ_{den}) = density derived porosity, ρ_{ma} = density of matrix (2.65g/cm^3 for sandstone), ρ_b = formation bulk density

ρ_f = density of the fluid (1.0 for fresh mud)

Formation Factor

Formation factor is a function of porosity and rock type. The formation factor within the target depth interval was calculated using Humble's formula of best averages for sandstones for unconsolidated formations, typical of Niger Delta. This is shown in equation 4 below:

$F = \frac{0.62}{\phi^{2.15}}$ (best average for sandstones) eq. 4

Bulk Volume Water

It is a function of water of saturation and porosity. The equation of BVW is given below in equation 5:

BVW=Sw*ϕ eq. 5

Where Sw= water of saturation and ϕ= Porosity

Permeability

Permeability is the property a rock has to transmit fluids. It is controlled by the size of the connecting passages (pore throats or capillaries) between pores. It is represented by the symbol K and measured in darcies or millidarcies and its equation is shown in equation 6 below. Qualitative interpretation of porosity and permeability in this study is after Rider, 2002 (table 8 and 9).

Owolabi et al (1994) equation was used in determining permeability in this research and it is shown in eq. 4.5

$K = 307 + 26,552\ (\phi)^2 - 34540\ (\phi\text{-Swirr})^2$ *eq. 6*

Where K = Permeability (millidarcies), Swirr = irreducible water saturation, ϕ = porosity

Water Saturation (Sw)

It is the percentage of pore volume in a rock occupied by formation water. It is represented by symbol Sw and is measured in percent. Water saturation is an important log interpretation tool because you can determine the hydrocarbon saturation of a reservoir by subtracting water saturation from the 1(one). Archie equation for water of saturation was used in this research and this is shown in eq. 7 below.

$$Sw = \left(\frac{F\ c\ Rw}{Rte}\right)^{1/n} \qquad eq.\ 7$$

where Sw = water saturation, F= formation factor, c= constant (usually 20), Rte= Resistivity of uninvaded zone (true resistivity), Rw = resistivity of formation water, n = saturation exponent (usually 2).

Hydrocarbon Saturation

It is the percentage or fraction of pore volume occupied by hydrocarbons. It is represented by symbol Sh. The equation is shown in equation 8

$$Sh = 1 - Sw \qquad eq.\ 8$$

Where Sh = hydrocarbon saturation,
Sw = water saturation, 1 = unity

The petrophysical evaluation of an area is dependent on a number of factors including the geophysics and geology of the area. Correlation panel was made available to show the subsurface geometry and general stratigraphy of the area. In his research, seven wells were evaluated with three out of the seven having density data.

Across the wells, the porosity of the reservoirs ranges from 32.08% to 37.40% with an average value of 34.63% from reservoir A to F (fig. 2, table 1). The water saturation values range from 22.24% to 22.80% with an average water saturation value of 22.42% across reservoir A to F. The permeability value ranges from 3774.78md to 4051.06md with an average value of 3933.8md. Therefore, the reservoir quality ranges from very good to excellent.

The deepest reservoir top depth was encountered at 3135.2ft in AHO 12 well and the shallowest reservoir top at 2909.9ft in AHO A2 well. The evaluation of sand/shale ratios showed that the reservoir is predominantly sand with an average net/gross sand ratio of 0.99. Crossplots (Fig 2 to 4) of depth versus porosity shows that porosity decreases with increasing depth. Plots of permeability versus porosity show that permeability increases as porosity increases and vice versa. The reservoir shows a high quality reservoir with a perfect linear relationship. Lateral distribution of the reservoir shows that the reservoirs are similar with almost the same values and minor differences for each of the reservoirs (table 2-5).

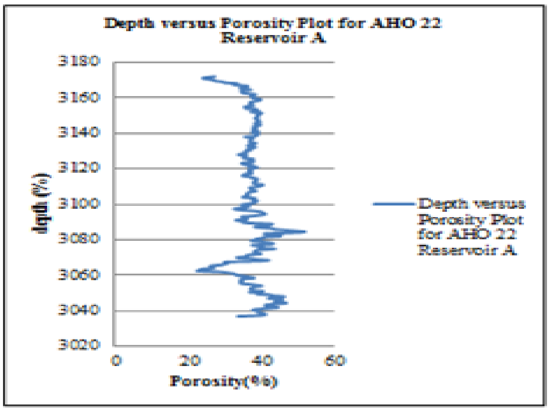

Fig.2; Cross plot of depth versus porosity showing Reservoir A for AHO A22 well

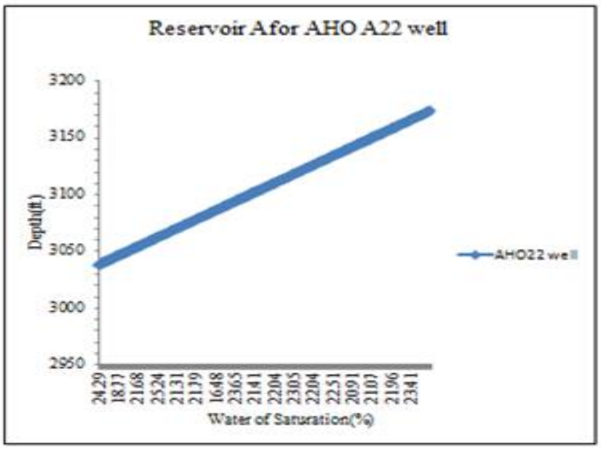

Fig. 3: Cross plot of depth versus water of saturation for Reservoir A for AHO A22 well

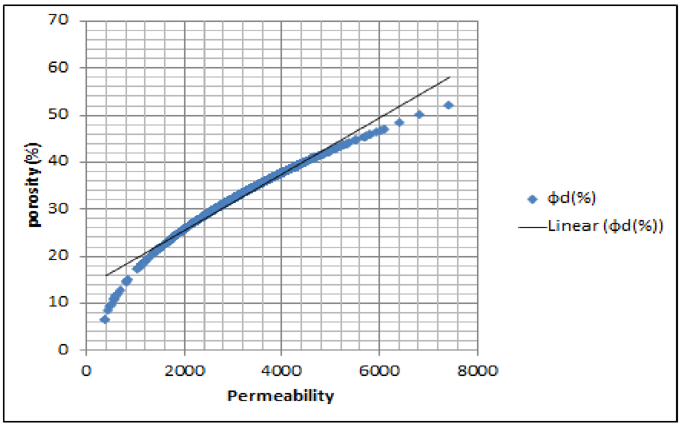

Figure 4. Cross plot of permeability versus porosity showing reservoir A for well AHO A22

Reservoir B

The following inferences can be deduced from the interpretation: Reservoir B has depth range of 3058.9ft-3363.48ft across the field. Reservoir B occurs between the interval of 3281.28-3314.9ft in AHO 10 well, 3322.14-3363.48ft in AHO 12 well, 3283.45-3327.49ft in AHO 11, 3210.9-3323.76ft in AHO 22 well, 3088.03-3198.48ft in AHO A2P2 well, 3058.9-3156.45ft in AHO A2 and 3130.38-3265.46ft in AHO 23 well. Three wells (AHO A22, A2P2, and A23) out of the seven wells have density logs which were used for calculating the petrophysical parameters. The porosity of the reservoirs ranges from 34.49% to 37.47% with an average value of 36.06%. The water saturation values range from 21.99% to 23.98% with an average water saturation value of 22.93%. The permeability value ranges from 3471.12md to 4033.49md with an average value of 3767.78md. Therefore, the reservoir has an excellent porosity and an excellent permeability. The deepest top of the reservoir was encountered at 3210.9 in AHO 22 well and the shallowest top was encountered at 3088.03m in AHO A2P2 well. The evaluation of sand/shale ratios showed that the reservoir is predominantly shaly sand with an average net/gross sand ratio of 0.99. Crossplots (Fig. 5 to 7) of depth versus porosity shows that depth increases with decreasing porosity due to compaction and burial of the sediment. Plot of permeability versus porosity shows permeability increases with porosity and vice versa and shows a strong linear relationship. Lateral distribution of water of saturation shows similar values or nearly constant in all the reservoirs.

Table 1. Summary of Petrophysical Characteristics values of AHO A22 well

Reservoir	Depth to Reservoir(ft)	Average Porosity (Φ)	Average Permeability K (md)	Average Water Saturation Sw (%)	Average Hydrocarbon Saturation Sh (%)	Average Net Thickness	Average Gross Thickness	Net to Gross Ratio NTG
A	3037.09-3172.44	37.40	4051.06	22.24	77.76	133	135	0.99
B	3210.90-3323.76	36.23	3798.74	22.82	77.18	109	112	0.97
C	3397.86-3513.72	35.74	3731.81	23.59	76.41	113	115	0.98
D	3562.12-3681.19	32.08	3067.72	26.09	73.91	118	119	0.99
E	3780.97-4115.91	33.02	3245.6	25.92	74.08	333	335	0.99
F	4344.54-4853.50	33.29	3255.39	24.9	75.1	508	509	0.99
		34.63	3523.55	24.26	75.74	219	221	0.99

Table 2. Lateral distribution of porosity values in the reservoirs

Reservoirs	AHO A22	AHO A2P2	AHO A23
A	37.40	37.14	36.15
B	36.23	37.47	34.49
C	35.74	35.28	34.47
D	32.08	34.76	32.69
E	33.02	36.38	32.08
F	33.29	33.79	32.28

Table 3. Lateral distribution of permeability values in the reservoirs

Reservoirs	AHO A22	AHO A2P2	AHO A23
A	4051.06	3975.78	3774.78
B	3798.74	4033.49	3471.12
C	3731.81	3690.89	3476.01
D	3067.72	3535.79	3152.30
E	3245.6	3968.16	3080.80
F	3255.39	3373.60	3096.45

Table 4. Lateral distribution of water of saturation values in the reservoirs

Reservoirs	AHO A22 (%)	AHO A2P2 (%)	AHO A23 (%)
A	22.24	22.24	22.80
B	22.82	21.99	23.98
C	23.59	24.21	24.11
D	26.09	23.88	25.32
E	25.92	23.51	26.70
F	24.9	25.03	25.88

Table 5. Lateral distribution of hydrocarbon saturation values in the reservoirs

Reservoirs	AHO A22 v	AHO A2P2 (%)	AHO A23 (%)
A	77.76	77.76	77.20
B	77.18	78.01	76.02
C	76.41	75.79	75.89
D	73.91	76.12	74.68
E	74.08	76.49	73.30
F	75.1	74.97	74.12

Table 6. Summary of Petrophysical Characteristics values of AHO A2P2 Well

Reservoir	Depth to Reservoir (ft)	Average Porosity (Φ)	Average Permeability K (md)	Average Water Saturation Sw (%)	Average Hydrocarbon Saturation Sh (%)	Average Net Thickness (ft)	Average Gross Thickness (ft)	Net to Gross Ratio (NTG)
A	2922.69-3059.22	37.14	3975.78	22.24	77.76	134.5	136.5	0.98
B	3088.03-3198.48	37.47	4033.49	21.99	78.01	108	110.1	0.98
C	3270.22-3402.14	35.28	3690.89	24.21	75.79	130	131.9	0.99
D	3469.94-3583.93	34.76	3535.79	23.88	76.12	113	114.0	0.99
E	3668.02-4039.46	36.38	3968.16	23.51	76.49	369	371.4	.0.99
F	4255.47-4723.36	33.79	3373.60	25.03	74.97	465	467.9	0.99
		35.80	3762.95	23.48	76.52	219.9	222.0	0.99

Table 7. Summary of Petrophysical Characteristics values of AHO A23 Well

Reservoir	Depth to Reservoir(ft)	Average Porosity (Φ)	Average Permeability K (md)	Average Water Saturation Sw (%)	Average Hydrocarbon Saturation Sh (%)	Average Net Thickness	Average Gross Thickness	Net to Gross Ratio NTG
A	2966.21-3095.13	36.15	3774.78	22.80	77.20	126	128.92	0.98
B	3130.38-3265.73	34.49	3471.12	23.98	76.02	134.0	135.35	0.99
C	3349.46-3494.45	34.47	3476.01	24.11	75.89	143	144.99	0.98
D	3555.69-3687.61	32.69	3152.30	25.32	74.68	129.5	131.92	0.98
E	3816.3-4322.14	32.08	3080.80	26.70	73.30	504	505.84	0.99
F	4615.23-5365.76	32.28	3096.45	25.88	74.12	745	750.53	0.99
		33.69	3341.90	24.79	75.12	296.9	299.64	0.99

Table 8.Qualitative evaluation of porosity (Adopted after Rider 2002)

Qualitative Description	Percentage Porosity (%)
0 - 5	Negligible
5 - 10	Poor
15 - 20	Good
20 – 30	Very Good
> 30	Excellent

Table 9. Qualitative evaluation of permeability (Adopted after Rider 2002)

Average K Value (md)	Qualitative Description
<10.5	Poor to fair
15 – 50	Moderate
50 – 250	Good
250 – 1000	Very Good
> 1000	Excellent

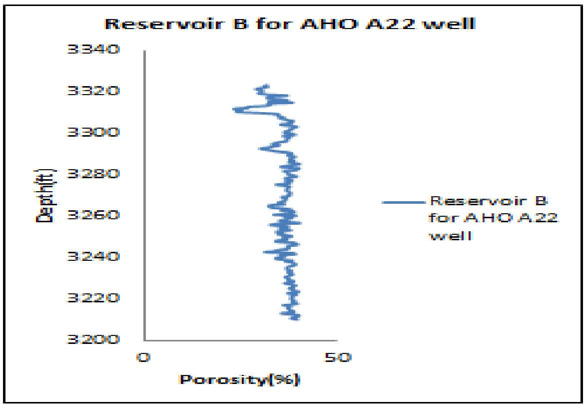

Figure 5. Cross plot of depth versus porosity showing reservoir B for AHO A22 well

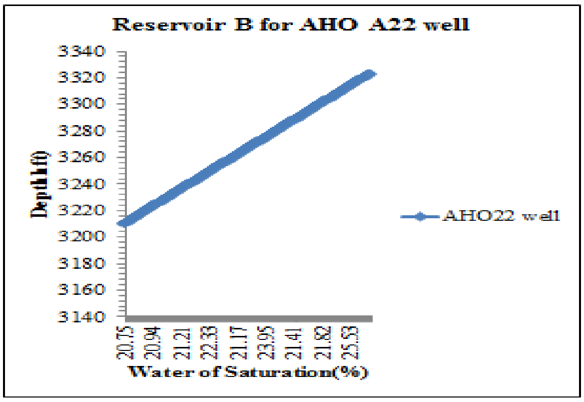

Figure 6. Cross plot of depth versus water saturation showing reservoir B for AHO A22 well

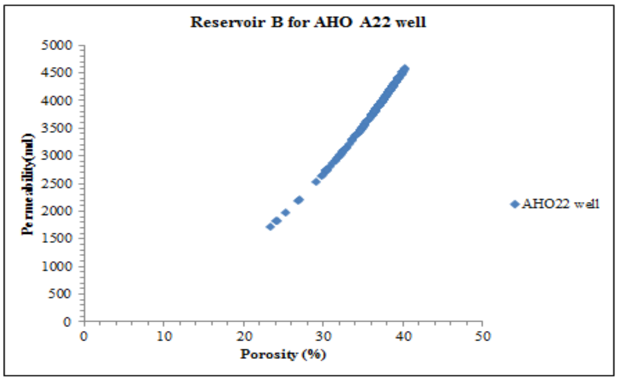

Figure 7. Cross plot of permeability versus porosity showing reservoir B for AHO A22 well

Reservoir C

Reservoir C has depth range of 3236.47-3552.94ft across the field. Reservoir C occurs between the depth interval of 338569-3501.43ft AHO 10 well, 3418.19355294ft in AHO 12 well, 3388.89-3495.1ftin AHO 11, 3397.86-3513.72ft in AHO 22 well, 3270.22-3013.18ft in AHO A2 and 2966.21-3095.13ft in AHO 23 well. Three wells (AHO A22, A2P2, A23) out of the seven wells had density logs which were used for calculating the petrophysical parameters. The porosity of the reservoirs ranges from 34.47% to 35.74% with an average value of 35.16%. The water saturation values ranges from 23.59% to 24.21% with an average water saturation value of 23.87%. The permeability value ranges from 3476.01md to 3731.81md with an average value of 3632.90md. Therefore, the reservoir has an excellent porosity and an excellent permeability. The deepest top of the reservoir was encountered at 3397.86 in AHO 22 well and the shallowest top was encountered at 3270.22m in AHO A2P2 well. The evaluation of sand/shale ratios showed that the reservoir is predominantly sand with an average net/gross sand ratio of 0.99. Crossplot (Fig 8 to 10) of depth versus porosity shows that depth increases as porosity decreases. The grain size is predominantly fine-medium grained. Permeability versus porosity plots show that permeability increases as porosity increases and vice versa.

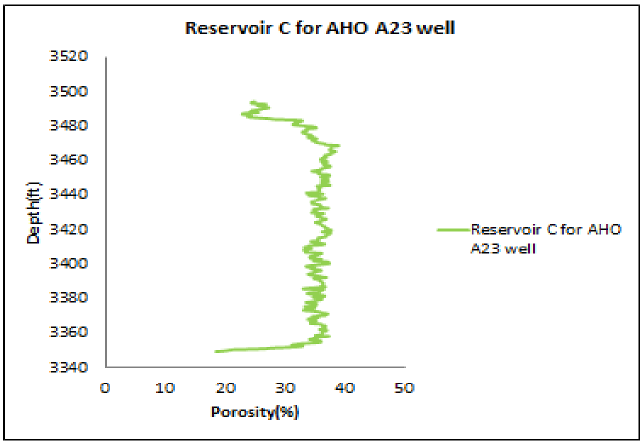

Fig 8. Cross plot of Depth versus Porosity showing Reservoir C across the field

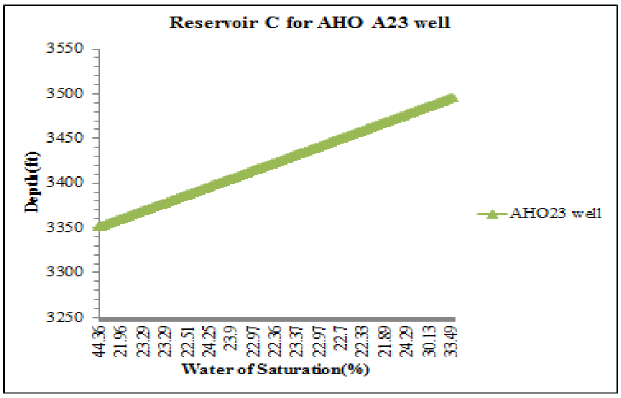

Fig 9. Cross plot of Depth versus Water of Saturation showing Reservoir C across the field

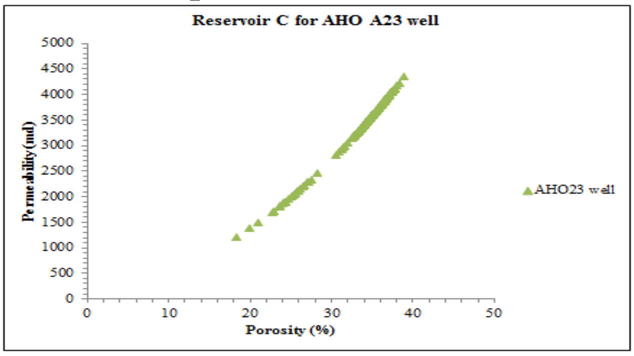

Fig 10. Cross plot of Permeability versus Porosity showing Reservoir C across the field

Reservoir D

The reservoir has a gross sand thickness of 119.1m in AHO 22 well, 114.0m in AHO A2P2 well, 103.3m in AHO A2 well and 131.9m in AHO 23 well. Three wells (AHO A22, A2P2, and A23) out of the seven wells had density logs which were used for calculating the petrophysical parameters. The porosity of the reservoirs ranges from 32.08% to 105.30% with an average value of 51.2%. The water saturation values ranges from 7.88% to 26.09% with an average water saturation value of 20.79%. The permeability value ranges from 3067.72md to 30027.82md with an average value of 9945.91md. Therefore, the reservoir has an excellent porosity and an excellent permeability. The deepest top of the reservoir was encountered at 3562.12 in AHO 22 well and the shallowest top was encountered at 3417.36m in AHO A2 well. The evaluation of sand/shale ratios showed that the reservoir is predominantly shaly sand with an average net/gross sand ratio of 0.99. Crossplots (Fig. 11 to 13) of depth versus porosity shows that porosity decreases with increasing depth. The grain size is predominantly fine-medium grained. Plot of permeability shows permeability increases as porosity increases and vice versa.

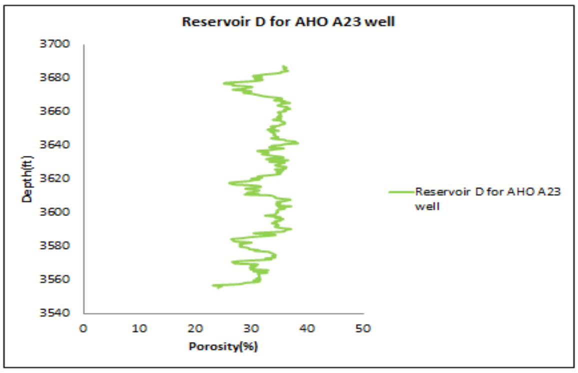

Fig 11. Cross plot of Depth versus Porosity showing Reservoir D across the field

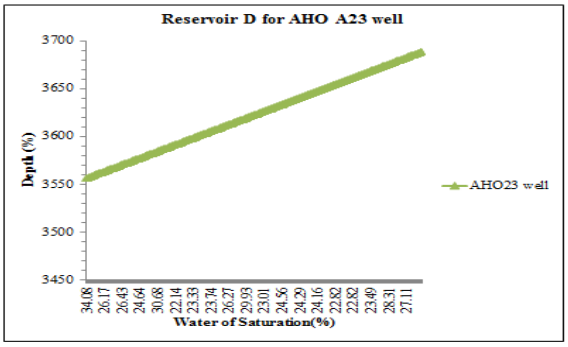

Fig 12. Cross plot of Depth versus Water of Saturation showing Reservoir D across the field

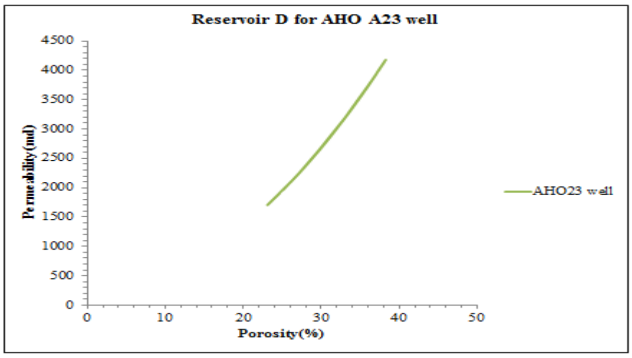

Fig 13. Cross plot of Permeability versus Porosity showing Reservoir D across the field

Reservoir E

The reservoir has a gross sand thickness of 334.9m in AHO 22 well, 371.4m in AHO A2P2 well, 303.69m in AHO A2 well and 505.84m in AHO 23 well. Three wells (AHO A22, A2P2, and A23) out of the seven wells had density logs which were used for calculating the petrophysical parameters. The porosity of the reservoirs ranges from 33.08% to 111.44% with an average value of 53.28%. The water saturation values ranges from 7.40% to 26.70% with an average water saturation value of 20.88%. The permeability value ranges from 3080.8md to 33412.04md with an average value of 10926.65md. Therefore, the reservoir has an excellent porosity and an excellent permeability. The deepest top of the reservoir was encountered at 3562.12 in AHO 22 well and the shallowest top was encountered at 3417.36m in AHO A2 well. Cross plots (Fig 14 to 16) of depth versus porosity shows that porosity decreases with increasing depth. The evaluation of sand/shale ratios showed that the reservoir is predominantly sand with an average net/gross sand ratio of 0.99. The grain size is predominantly fine to medium grained. Plot of permeability versus porosity showed that permeability increases as porosity increases.

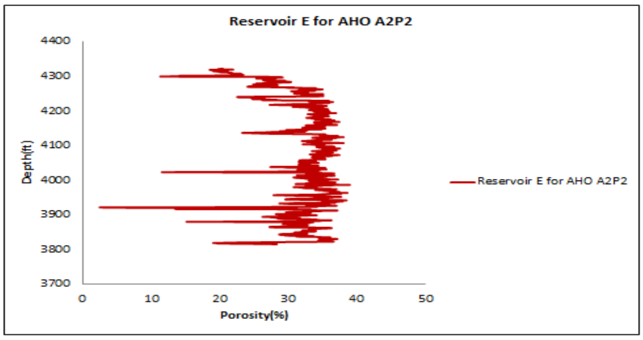

Fig 14. Cross plot of Depth versus Porosity showing Reservoir E across the field

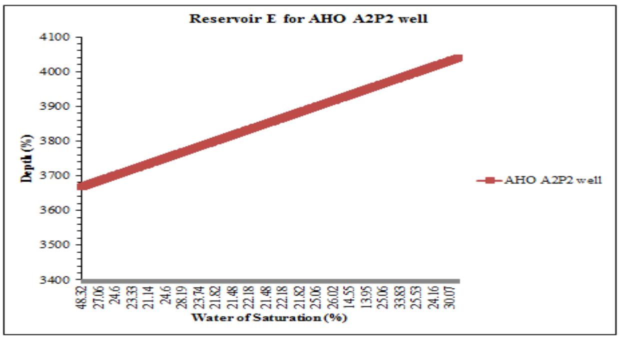

Fig 15. Cross plot of Depth versus Water of Saturation showing Reservoir E across the field

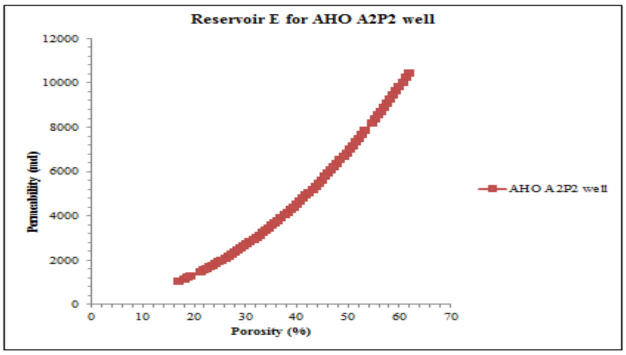

Fig 16. Cross plot of Permeability versus Porosity showing Reservoir E across the field

Reservoir F

The reservoir depth intervals are 4256.81 to 4657.38ft in AHO 10 well, 4333.16 to 4657.38ft in AHO 11, 4297.2 to 4601.75ft for AHO 12, 4094.09 to 4581.06ft for AHO 2, AHO 22 well, 467.9m in AHO A2P2 well, 487.0m in AHO A2 well and 750,5m in AHO 23 well. Three wells (AHO A22, A2P2, A23) out of the seven wells had density logs which were used for calculating the petrophysical parameters. The porosity of the reservoirs ranges from 32.28% to 109.26% with an average value of 52.12%. The water saturation values ranges from 7.93% to 25.88% with an average water saturation value of 20.94%. The permeability value ranges from 3096.5md to 32657.5md with an average value of 10595.74md. Therefore, the reservoir has an excellent porosity and an excellent permeability. The deepest top of the reservoir was encountered at 4615.23 in AHO 23 well and the shallowest top was encountered at 4094.09m in

AHO A2 well. The evaluation of sand/shale ratios showed that the reservoir is predominantly sand with an average net/gross sand ratio of 0.99. Crossplots (Fig 17 to 18) of depth versus porosity shows that porosity decreases with increasing depth. The grain size is predominantly medium to coarse grained. Plot of permeability versus porosity showed that permeability increases as porosity increases and vice versa.

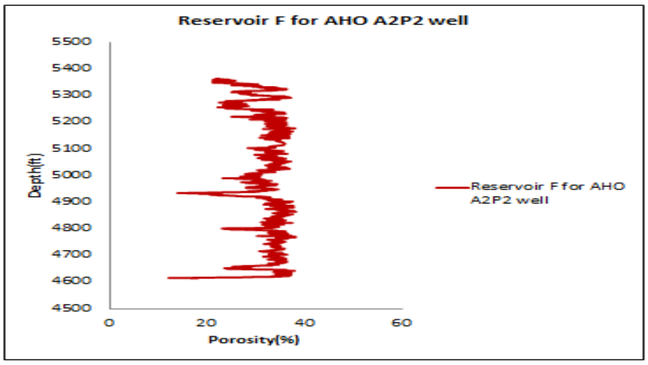

Fig 17. Cross plot of Depth versus Porosity showing Reservoir F across the field

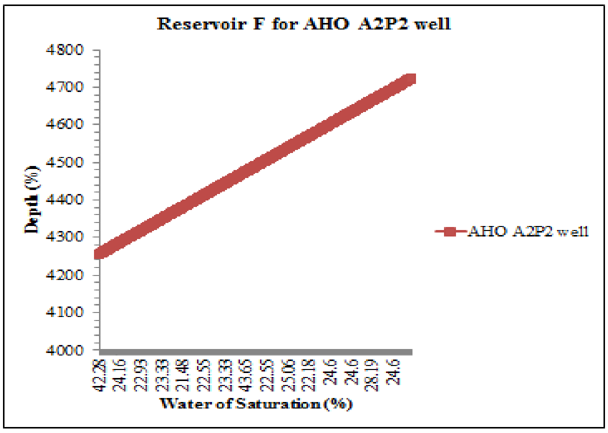

Fig 18. Cross plot of Depth versus Water of Saturation showing Reservoir F across the field

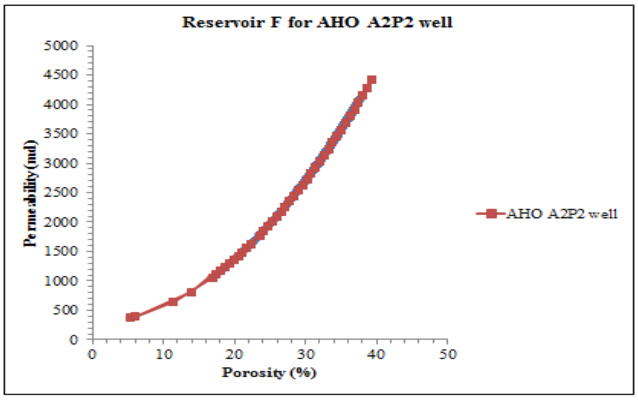

Fig 19. Cross plot of Depth versus Water of Saturation showing Reservoir F across the field

Conclusions

Petrophysical evaluation of AHO field shows that the reservoirs have excellent porosity and permeability with values above 30 percent and 1000md respectively. Crossplots of depth versus porosity shows that porosity decreases with increasing depth while porosity increases as permeability increases. Reservoirs A to F are inferred to be predominantly medium to coarse grained. This can be interpreted to result from an increase in energy of the depositing medium. In practice, coarse sands sometimes have higher porosities than finer sands. The average water saturation values range from 7.4 to 26 percent whereas the average hydrocarbon saturation values ranges from 73.3 to 92.6 percent. The bulk volume water values of all the reservoirs is constant or nearly constant and can be interpreted to be homogenous and at irreducible water saturation. The reservoirs are prospective and of high quality when compared with Rider (2002) standard (tables 8 and 9), and may represent sediments deposited within high energy-wave dominated environments. The reservoirs in AHO field are of high quality to enhance hydrocarbon accumulation and production.

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