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REVIEW ARTICLE

DIGITISATIZATION OF WELL CORELLATION AND PETROPHYSICAL ANALYSIS OF "OKPELLA" FIELD, NIGER DELTA

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ABSTRACT

The oil and gas industry is continuously evolving, with a growing emphasis on digital transformation to enhance exploration and production processes. This paper presents a detailed study on the digitization of well correlation and petrophysical analysis in the "Okpella" Field, located in the prolific Niger Delta basin. The Okpella Field represents a significant hydrocarbon reservoir with complex geological and petrophysical characteristics, making it an ideal case study for the implementation of advanced digitization techniques. This research presents the results of log suit analysis from the "OKPELLA" field, Niger Delta. The study aimed at locating the hydrocarbon potential of lithological units encountered during the drilling of the "OKPELLA" field. The primary objectives of this research are to improve well correlation accuracy, optimize reservoir characterization, and enhance reservoir management in the Okpella Field. To achieve the general objective, suites of wire-line logs from the "OKPELLA" field were used for the research. Based on wire-line logs, two types of lithology were identified, which include sand and shale. Five sand bodies are marked as reservoirs, and they are denoted as R1, R2, R3, R4, and R5. The sand bodies were identified with their tops and bases at a depth interval of 4880 m to 6050 m. Computed petrophysical parameters for the five reservoir zones gave an average total porosity of 8% to 28%, with low permeability in the range of 0.56 D to 0.95 D. The high permeability indicates that the reservoir sand bodies are permeable. The fluid type defined in the reservoir zones is hydrocarbon, with a high saturation greater than 75%, which indicates that the proportion of void space occupied by hydrocarbon is high, consequently low water saturation and production. Summarily, the good porosity, high permeability, and low water saturation obtained via petrophysical analysis of the "OKPELLA" field indicate that the quality of hydrocarbon within the five (5) reservoirs found in the field of study is prolific and of commercial use.

KEYWORDS

Lithology, Well log, Geo-correlation, Petrophysics, Seismic,Well digitization

1. INTRODUCTION

Geophysical well logging (GWL) is a mature technology comprising many separate systems. In GWL, many different physical properties can be used together to characterize the geology surrounding a borehole (Serra, 1988; Asquith, 2004; Bayode, 2018). These different types of information obtained reflect different aspects of geology and are often complementary in nature. GWL offers the opportunity to determine the composition, variability, and physical properties of the rocks around the borehole (Kaka et al., 2018). The actual volume of material sampled in this way varies from technique to technique and with the geological conditions, but it is invariably much larger than is represented by just the borehole. Precise determination of reservoir thickness is best obtained on well logs, especially using the gamma-ray and resistivity logs (Ofwona, 2010, Fagbemigun et al., 2021). Hydrocarbon play assessment in any field involves the evaluation of the production capacity of hydrocarbon reservoir units in the field. This involves a detailed study of the reservoir's petrophysical properties and the geological interpretation of structures suitable for hydrocarbon accumulation in the field as observed from seismic reflection images (Osisanya et. al., 2021). Almost all oil and gas produced today comes from accumulations in the pore spaces of lithologies like sandstones, limestone, or dolomites. The gamma-ray log can come in handy to help in lithology identification (Asquith, 2004). The resistivity log, on the other hand, can be used to determine the nature of the interstitial fluid, i.e., differentiating between saline water and hydrocarbons in the pore spaces of the reservoir rocks (Mondol, 2015).

The 3-D seismic data interpretation and reservoir mapping of ''Deejay Field'' have been carried out with the use of Schlumberger (PETRELTM) software. This research work is aimed at delineating the subsurface structure and deducing the trapping system of the study area that may aid hydrocarbon accumulation. Available wireline log signatures were employed to identify hydrocarbon-bearing sands and compute reservoir petrophysical parameters for hydrocarbon pore volume determination. The petrophysical parameters from the wells show that most of the reservoirs are good targets for hydrocarbon prospecting. The result shows that the three reservoirs in the field have high hydrocarbon potential and a good trapping mechanism for their productivity (Alabi et. al., 2021).

The FEMTOP Field offshore the Niger Delta was mapped in terms of its lithology and reservoirs, well correlation, petrophysical analysis, and structural mapping. A field base map, four wells with spontaneous

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potential (SP), GR logs, density logs, resistivity, and seismic data in SEG-Y format were used. Calculated petrophysical values of the reservoirs in each of the wells show that each formation has a varying degree of petrophysical parameters. The average water saturation in these reservoirs is low, ranging from 27% to 45%, with a corresponding hydrocarbon saturation ranging from 56% to 72%. Two major growth faults (F3 and F5) and three antithetic faults (F1, F2, and F4) were also mapped. Therefore, structural closures identified as rollover anticlines, which are displayed on the time and depth structure maps, suggest probable hydrocarbon accumulation at the downthrown side of the fault F3, attesting to the structural characteristics of identified reservoirs within the subsurface of the study area (Oyanameh et al., 2020).

The field comprises two major lithologies, which are sand (yellow-filled curve) and shale (gray field curve) units. The gamma-ray and deep resistivity log responses showed that there were three hydrocarbon-bearing sand units. These were named R-1000, R-2000, and R-3000. Their high resistivity values made them stand out as possible hydrocarbon reservoirs, which were then studied. The reservoirs were also analyzed by taking into cognizance the resistivity log juxtaposed with the water saturation log (Sw) to identify the hydrocarbon fluid types present (Wasiu et al., 2023)

Seismic Structural interpretation of the subsurface system is a vital tool in mapping source rocks and a good trapping system, which enhances a good understanding of the subsurface system for productive drilling operations. This study is geared towards mapping the structural traps available within the hydrocarbon-bearing zones of the “high field” with the use of well logs and 3D seismic data. Seven horizons (H1, H2, H3, H4, H5, H6, and H7) were identified on well logs using gamma-ray logs and resistivity logs (Adebayo et al., 2021). Since these logs are recorded against depth, the hydrocarbon-bearing interval can be determined. If well logs are easy to find or direct hydrocarbon indicators are used, accurate mapping of the reservoir's lateral dimension can be made (Brown et al., 1984).

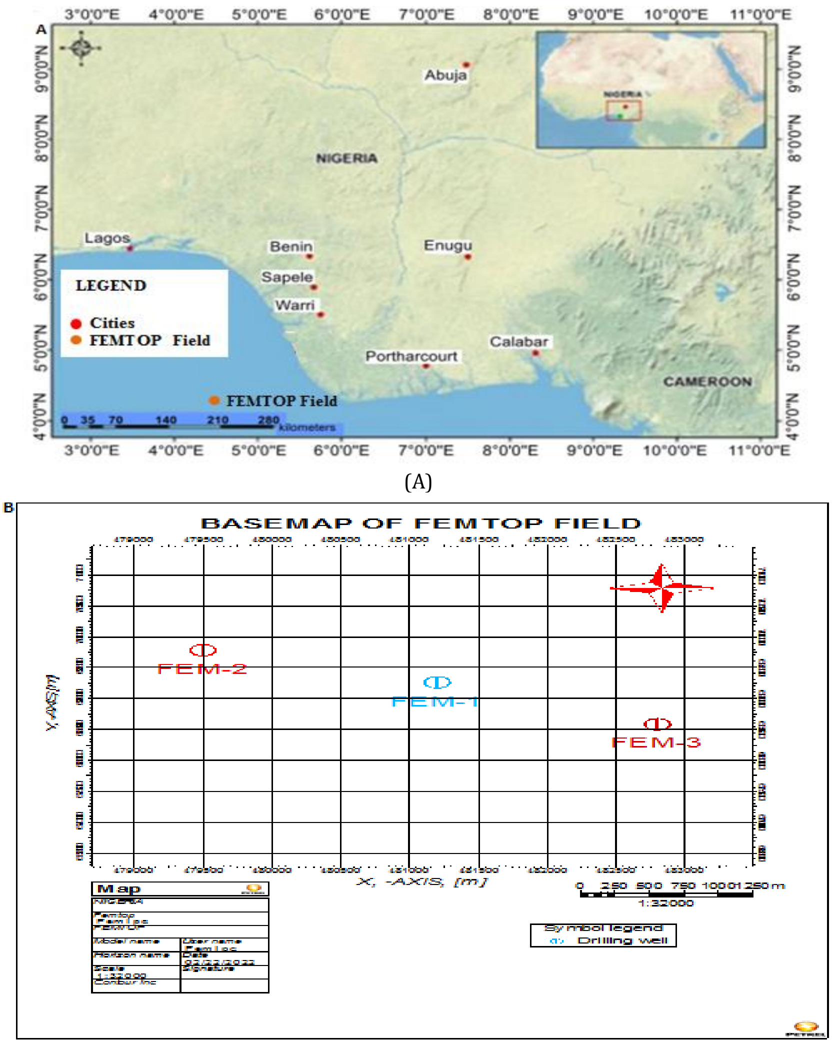
This work is aimed at correlating the wells and characterizing the subsurface of the study area by synchronizing the wells and deducing the lithology of the area.

2. Study Area and Regional Geology Setting

The onshore portion of the Niger Delta Province falls within 5° 19' 20.28"N, 6° 28' 9.12" (Fig. 1A) and is delineated by the geology of southern Nigeria and southwestern Cameroon (Whiteman, 1982; Doust and Omatsola 1990). The northern boundary is the Benin flank--an east-northeast trending hinge line south of the West Africa basement massif. The northeastern boundary is defined by outcrops of the Cretaceous on the Abakaliki High and further east-south-east by the Calabar flank, a hinge line bordering the adjacent Precambrian. The offshore boundary of the province is defined by the Cameroon volcanic line to the east, the eastern boundary of the Dahomey basin (the eastern-most West African transform-fault passive margin) to the west, and the two-kilometer sediment thickness contour or the 4000-meter bathymetric contour in areas where sediment thickness is greater than two kilometres to the south and southwest (Short and Stauble, 1967; Evamy et al., 1978). There are three Formations that make up the basin, which are Akata (about 7000 m sediment thickness), Agbada (about 4500 m sediment thickness) and Benin (>1820 m sediment thickness). Akata Formation is the source rock, while Agbada’s is the reservoir rock (Figure 2). The province covers 300,000 km² and includes the geologic extent of the Tertiary Niger Delta (Akata-Agbada) Petroleum System (Doust and Omatsola, 1990).

3. Local Geology of The Study Area

The area of study, “Okpella” Field, is located within the western margin of offshore Niger Delta Basin. The seismic base map of the area originates from latitude 4.0°N and longitude 4.5°E, covering an area of 55 km² (Figure 1B). The study area comprises of thick sand at the upper part and alternation of sand and shale at the basal part, suggesting Benin and Agbada Formations (Doust and Omatsola, 1990).



(B)

Figure 1: (A) The Provinces of Niger Delta (Modifed Edigbue et al., 2015); (B) Base map of the study area showing Well Distribution

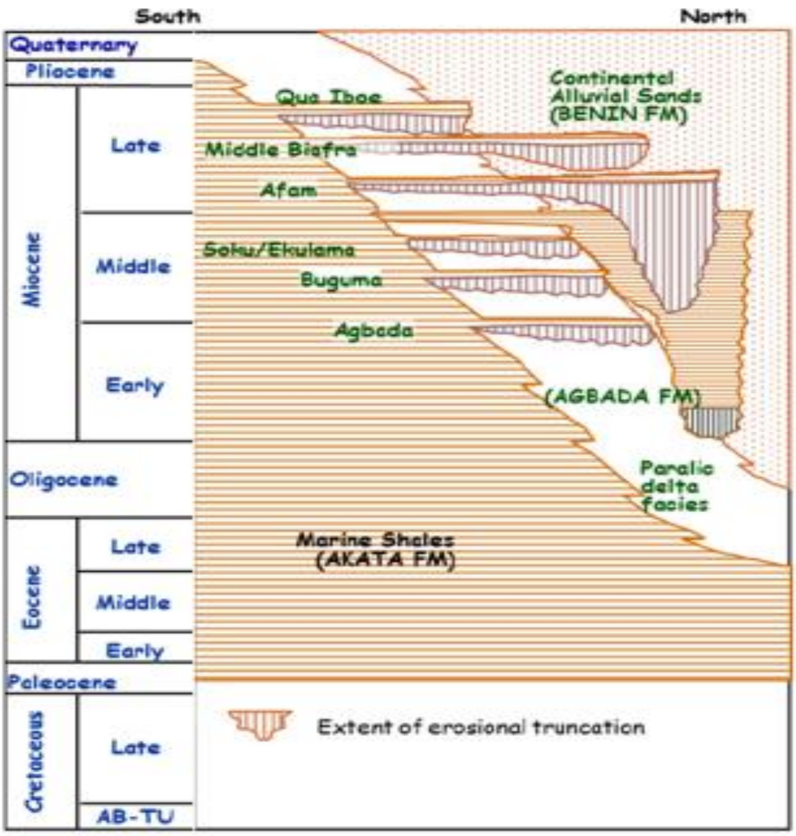


Figure 2: Regional stratigraphy of the Niger Delta displaying various formations (after Ozumba, 2013)

4. Methodology

4.1 Database and Materials

Well log data from three (3) wells were used for this work. The log data set comprise (sonic, density, gamma ray and resistivity). The materials for this study include field base map which was used to know the spatial location of wells in the field, SMT software and Petrel workstation was used for log data interpretation.

4.2 Lithology and Hydrocarbon Reservoir Delineation

The lithologies and reservoirs were delineated as described which involves using gamma ray and resistivity logs (Asquith and Krygowski 2004). Gamma ray log was used for lithology with left and right deflections indicate sand and shale respectively. Petroliferous zones (i.e. sand bodies with low gamma ray response) are associated with high resistivity response on resistivity log.

4.3 Correlation of Well Log

This involves the identification of various lithologic units penetrated by the wells. The gamma ray log was employed to study the lateral and geometric distribution of various shale and sand beds traversed by the wells. The maximum and minimum deflections on the gamma ray log were used to identify the shale and sand, thus, lithologic sections were produced from three available wells and it helps in proper analysis of the various wells at the area of study.

4.4 Petrophysical Evaluation

Standard equations were used for the estimation of reservoir properties, which involves calculation of reservoir parameters such as gross thickness, net thickness, volume of shale, formation factor estimation, porosity, water saturation and hydrocarbon saturation of the field etc. Equation 1 to 14 was used to estimate the petrophysical properties within the study area.

4.5 Volume of Shale (V_{sh})

The data obtained from gamma ray log was used to achieve this. The volume of shale (Vsh) was mathematically computed using Eq. 1 (Asquith and Krygowski 2004):

$$V_{sh} = 0.083[2^{(3.7xI_{GR})} - 1.0] \quad (1)$$

$$I_{GR} = \frac{GR_{log} - GR_{min}}{GR_{max} - GR_{min}} \quad (2)$$

where I_{GR} is the gamma ray index; GR_{min} is gamma ray minimum from clean sand; GR_{max} is gamma ray maximum (shaly sand); GR_{log} is gamma ray log (shaly-sand).

4.6 Porosity (Ø)

Based on the available data, density derived porosity $Ø_{DEN}$ is computed using Eq. 3 and corrected for shale effect using the Dresser Atlas, (1979) equation (Eq. 4).

The density derived porosity, $Ø_{DEN}$ is given by;

$$Ø_{DEN} = \left(\frac{\rho_{ma} - \rho_b}{\rho_{ma} - \rho_f}\right) \quad (3)$$

The corrected density porosity, after Dresser Atlas, (1979) is given by;

$$Ø = \left(\frac{\rho_{ma} - \rho_b}{\rho_{ma} - \rho_f}\right) - V_{sh}\left(\frac{\rho_{ma} - \rho_{sh}}{\rho_{ma} - \rho_f}\right) \quad (4)$$

Where; V_{sh} = Volume of shale. $Ø_{DEN}$ = Density derived porosity; Ø = Corrected density porosity for shale effect; ρ_{ma} = Matrix density of formation. This is given to be 2.68g/cc in the log header; ρ_b = Bulk density of formation. It is obtained as the log response in each reservoir; ρ_f = Fluid density. This is given as 1.0g/cc in the log header; and ρ_{sh} = Bulk density of adjacent shale. This is the density log response in the adjacent shale zone to each reservoir formation.

4.6 Formation Factor Estimation (F)

This fundamentally expresses the ratio of the resistivity of a formation to the resistivity of the water with which it is saturated. In borehole geophysics, the formation factor F was estimated using Eq. 5.

$$F = \frac{a}{Ø^m} \quad (5)$$

Where; a = Tortuosity factor; m = Cementation factor; and Ø = Porosity. Where, a = 1 and m = 1.8.

4.7 Water Saturation Estimation (S_w)

The water saturation in each of the reservoir formation is computed using the Archie formula in Eq. 6 (Archie, 1942). It is given by:

$$S_w = \left(F \times \frac{R_w}{R_t}\right)^{1/n} \quad (6)$$

Where; F = Formation Factor; R_w = Formation water resistivity at formation temperature; R_t = True formation resistivity; n = Saturation exponent. n is usually two.

4.8 Hydrocarbon Saturation (S_h)

This was estimated using Eqs. 7, S_h is given by:

$$S_h = 1 - S_w \quad (7)$$

4.9 Irreducible Water Saturation ($S_{w\,Irr}$)

Water saturation at irreducible water $S_{w\,irr}$ was estimated using Eq. 8.

$$S_{w\,irr} = \sqrt{\frac{F}{2000}} \quad (8)$$

Where; F is the formation factor.

4.10 Absolute Permeability (K)

It is measured in millidarcy (mD)

The absolute permeability K was estimated using Eq. 9.

$$K^{1/2} = \frac{100 \times Ø^{2.25}}{S_{w\,irr}} \quad (9)$$

This is called the Timur relationship.

$$K^{1/2} = \frac{250 \times Ø^{3}}{S_{w\,irr}} \quad (10)$$

This is the Tixier relationship. This is applied in this study to compute the permeability for each reservoir rock.

4.11 Irreducible Water Saturation ($S_{w\,irr}$)

Water saturation at irreducible water $S_{w\,irr}$ is given by;

$$S_{w\,irr} = \sqrt{\frac{F}{2000}}$$
(11)

Where; F is the formation factor.

The significance of $S_{w\,irr}$ is that the log-derived permeability formulas will only be valid for estimating permeability at irreducible water saturation (Schlumberger, 1977).

4.12 Relative Permeability (K_r)

The relative permeability K_r is the ratio between effective permeability of fluid at partial saturation, and the permeability at 100% saturation (absolute permeability).

The relative permeability to water K_{rw} is given by;

$$K_{rw} = \left[\frac{(S_w - S_{w\,irr})}{(1 - S_{w\,irr})}\right]^3 \quad (12a)$$

The relative permeability to oil K_{ro} is given by;

$$K_{ro} = \left[\frac{S_h}{(1 - S_{w\,irr})}\right]^{2.1} \quad (12b)$$

4.13 Effective Permeability (K_w and K_o)

The effective permeability to water K_w is given by;

$$K_w = K_{rw} \times K \quad (13a)$$

The effective permeability to oil K_o is given thus;

$$K_o = K_{ro} \times K \quad (13b)$$

4.14 Hydrocarbon Pore Volume (HCPV)

This is the fraction or the percentage of bulk reservoir volume that is occupied by hydrocarbon. It is given by;

$$HCPV = Ø \times (1 - S_W) = Ø \times S_h \quad (14)$$

Where;

Ø: is the porosity.

S_W: Water saturation S_h: Hydrocarbon saturation.

5. Results and Discussion

The results obtained from the wells in "OKPELLA" oil field were qualitatively and quantitatively interpreted. Petrophysical data were computed and presented in tabular and statistical forms. Gamma ray logs were used for lithology correlation. The results obtained provided a good understanding of the formation, which helped to determine economic viability of the wells within the area.

5.1 Correlation of Hydrocarbon Reservoirs

Five (5) hydrocarbon reservoirs were delineated and designated as reservoirs R_A, R_B, R_C, R_D, and R_E. Reservoirs R_A, R_B, R_C, R_D, and R_E cuts across the three wells at the depth intervals of 4920 – 4950 ft, 5030 – 5150 ft, 5420 – 5660 ft, 5780 – 5850 ft and 5930 – 6080 ft respectively (Figures 2 – 4). The well correlation carried out reveals that the subsurface geology is faulted across the "OKPELLA" field. This structure (fault) inferred from the well correlation can aid accumulation and production of oil and gas within the subsurface.

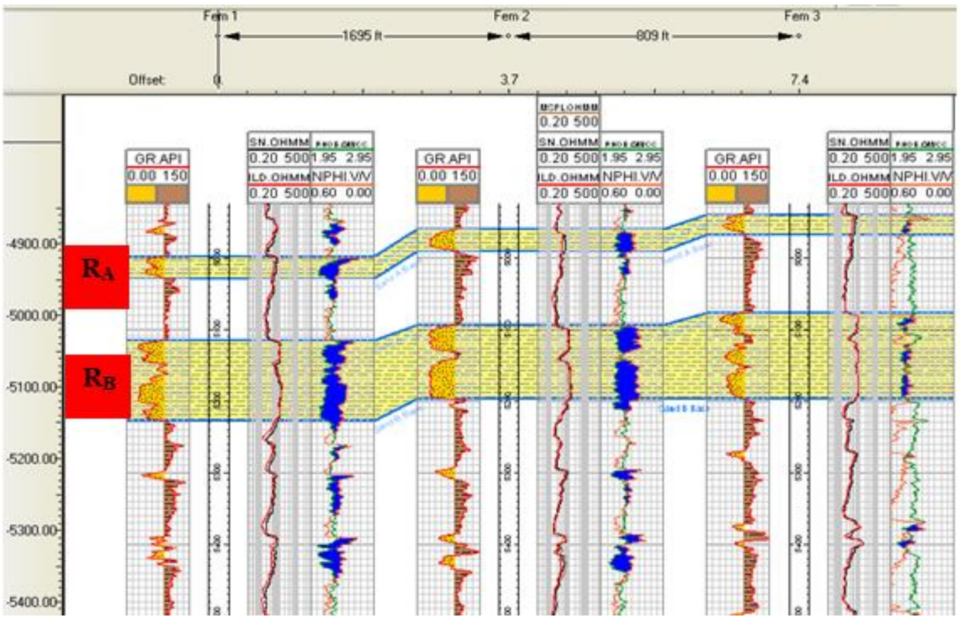


Figure 2: Lithostratigraphic correlation section across Reservoir A and B.

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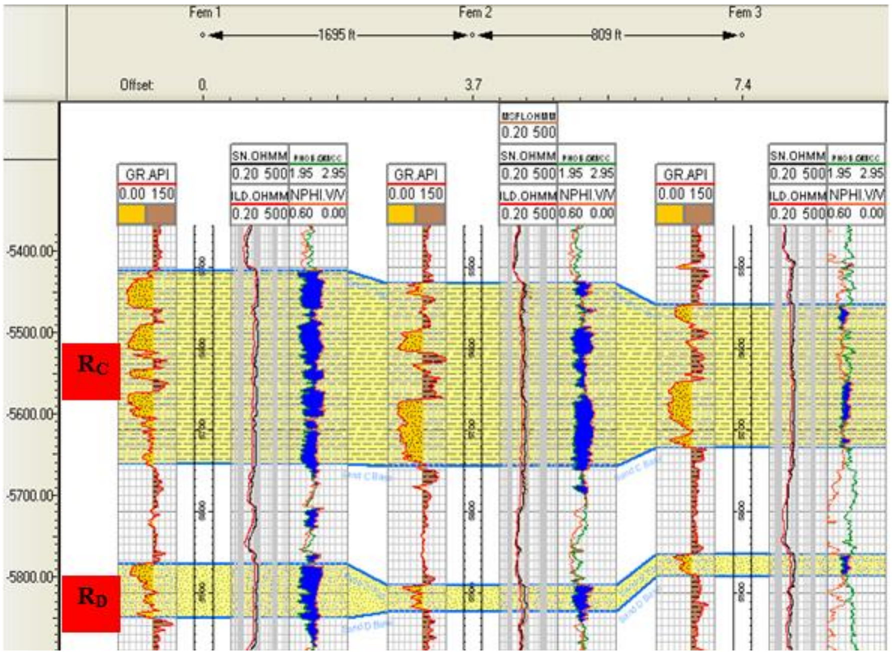

Figure 3: Lithostratigraphic correlation section across Reservoir C & D.

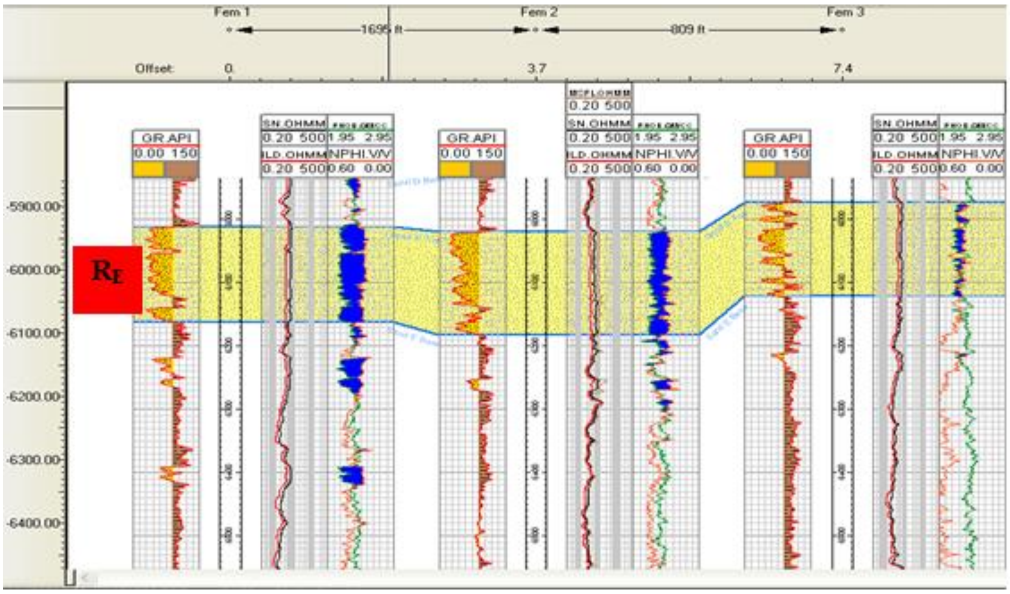

Figure 4: Lithostratigraphic correlation section across Reservoir E.

Table 1: Computed Petrophysical Parameters of Reservoirs in Fem-1

RESEVOIRS	GROSS (ft)	Net/Gross (%)	I_{GR}	V_{sh} (%)	$Ø_D$	K (mD)	K_{rw}	K_w (mD)	K_{ro}	K_o (mD)	S_h (%)	S_w (%)	BVO_{MO} (%)	HCPV (%)
A	30.8	79	0.332	11.17	0.297	952	0.04	42.84	0.397	378	59	41	13	17
B	112.3	90	0.356	12.38	0.303	1097	0.01	15.56	0.559	613	70	30	15	21
C	236.8	89	0.386	14.04	0.290	825	0.06	46.82	0.361	298	56	44	12	16
D	66	74	0.442	17.50	0.310	525	0.07	84.59	0.334	421	55	45	12	17
E	150.8	78	0.303	9.79		1259	0.09	115.94	0.283	357	51	49	12	16

Table 2: Computed Petrophysical Parameters of Reservoirs in Fem-2

RESEVOIRS	GROSS (ft)	Net/Gross (%)	I_{GR}	V_{sh} (%)	$Ø_D$	K (mD)	K_{rw}	K_w (mD)	K_{ro}	K_o (mD)	S_h (%)	S_w (%)	BVO_{MO} (%)	HCPV (%)
A	30.7	79	0.29	9.13	0.277	600	0.05	29.6	0.39	236	58	42	12	16.1
B	103	80	0.24	6.89	0.277	600	0.01	5.4	0.61	376	72	28	14	20.0
C	224.5	87	0.40	14.6	0.245	300	0.03	8.3	0.46	124	72	38	11	15.2
D	32.3	79	0.48	20	0.271	500	0.05	28.9	0.36	192	56	44	11	15.3
E	163	81	0.29	9.35	0.271	500	0.06	31.2	0.35	186	55	45	11	15.0

Table 3: Computed Petrophysical Parameters of Reservoirs in Fem-3

RESEVOIRS	GROSS (ft)	Net/Gross (%)	I_{GR}	V_{sh} (%)	$Ø_D$	K (mD)	K_{rw}	K_w (mD)	K_{ro}	K_o (mD)	S_h (%)	S_w (%)	BVO_{MO} (%)	HCPV (%)
A	27.6	87	0.39	14.47	0.27	612	0.04	17	0.47	289	64	36	12	18
B	120	78	0.43	17.07	0.30	1096	0.02	16	0.56	613	70	30	14	21
C	175.2	79	0.43	16.71	0.27	525	0.03	16	0.46	241	63	37	12	17
D	27.7	85	0.38	13.57	0.28	712	0.04	29	0.41	294	60	40	12	17
E	147.7	76	0.41	15.26	0.27	525	0.03	15	0.47	245	63	37	12	17

5.2 Evaluation of Hydrocarbon Bearing Reservoirs

5.2.1 Reservoir A

Reservoir A is located within a depth range of 4880 – 4950 ft and extends across Fem1, 2, and 3. It has an average porosity of 28%, hydrocarbon saturation of 60%, volume of shale of 12%, (net to gross sand ratio of 0.79) and water saturation of 39.7%. The reservoir is thin in the NW and thickens toward the SE); this probably could be attributed to deformation (Tables 1 – 3).

The reservoir has an average porosity of 28% and permeability of 721 mD, which are good and significant characteristics of sand stone reservoirs. The reservoir is also characterized by good permeability ranging from 612 md, 600 md, 952 md, in Fem 1, Fem 2, and Fem 3 respectively (Tables 1-3). The hydrocarbon saturation in the reservoir are 59%, 58%, 64% in Fem 1- Fem 3, which are good indication of oil.

5.2.2 Reservoir B

The reservoir in sand B was delineated within the depths 5040 – 5150 ft for Fem 1, 5020 – 5120 ft for Fem 2, 5010 – 5130 ft. Gross reservoir thickness averagely is 29.67 ftof 31 ft, 30 ft, 28 ft, in Fem1, Fem 2, and Fem 3 respectively (Figures 1 – 3). It was characterized by gross thickness of 120 ft, 103 ft, 112 ft, Net to gross ratio are 100% in Fem 1, Fem 2, Fem 3 respectively. The average volume of shale is 8%, as a result of this the reservoir has a maximum porosity of 28 % which is a clear indication that the reservoir has a large volume of sand deposit than shale, therefore due to this there will be good hydrocarbon saturation in the reservoir and it is also an indication of reducing of shaliness on pore space. The hydrocarbon saturation in the reservoir are 70%, 72%, 70% for Fem 1, Fem 2, Fem 3 respectively (Tables 1-3). The estimation of effective and relative permeability to oil hydrocarbon of Fem 1, Fem 2 and Fem 3 are 0.559, 0.61 and 0.56 respectively. The estimation of resistivity index of reservoir B is 1 all through, which implies that the reservoir is 100% saturated with water.

5.2.3 Reservoir C

Reservoir in sand C with thickness ranging from depths of 5420 – 5660 ft for Fem 1, 5430 – 5660 ft for Fem 2, 5460 – 5640 ft for Fem 3, Gross reservoir thickness of 236 ft, 225 ft, 175 ft, in Fem1, Fem 2, and Fem 3 respectively (Figures 1 – 3). It was characterized by an average gross thickness and Net to gross ratio are 212 ft, with net to gross ratio of 100% in Fem 1, Fem 2, Fem 3 respectively. In Fem1, Fem 2, the resistivity log gives a little increase which is an indication of gas and oil contact, while in Fem 3 the resistivity log yields a minute increase which is an indication of an oil and water contact. The average volume of shale in reservoir C is 15% (Tables 1 – 3).

5.2.4 Reservoir D

Reservoir in sand C was penetrated with thickness ranging from depths of 5780 – 5850 ft for Fem 1, 5810 – 5840 ft for Fem 2, 5770 – 5810 ft for Fem 3, Gross reservoir thickness of 66 ft, 32 ft, 27 ft, in Fem1, Fem 2, and Fem 3 respectively (Figures 1-3). It was characterized by an average gross thickness of 99% Fem 1, Fem 2, Fem 3 respectively. In reservoir D there is a little trace of oil due to slight increase in density log and decrease in neutron log, thereby causing a slight density-neutron separation (Tables 1 – 3).

5.2.5 Reservoir E

The reservoir is laterally extensive which is been penetrated at depths of 5930 – 6080 ft for Fem 1, 5940 – 6100 ft for Fem 2, 5890 – 6050 ft, Average gross reservoir thickness of 154 ft with the net sand to gross reservoir thickness of 100% in Fem1, Fem 2, and Fem 3 respectively (Figures 1 – 3). The porosity values which ranges from 31% at Fem 1 to 27% at Fem 3 which are good and significant characteristics of sandy shale reservoirs which means it may contain some amount of gas due to its content of shale.

Due to the presence of gas oil in the reservoir, the gas in the formation cause the apparent porosity from density log to increase and porosity from neutron log to decrease, thereby causing a slight increase density-neutron separation in Fem 1 and Fem 2 but minima or little trace in Fem 3 at this reservoir (Tables 1 – 3).

5.3 Statistical Analysis of Volume of Shale, Hydrocarbon Saturation and Water Saturation in Each of the Well

It was observed that all the mapped reservoirs are good petroliferous zones with high oil saturation at irreducible water saturation, because water saturation values are low, it follows that the reservoir must have high oil saturation (Tables 4). Therefore, the volume of shale in all the reservoirs are generally low ranging from 11.5% to 17.2%, (Figure 5a and b), which means that the sand body in all the reservoirs are high, and there will be high rate of free flow of hydrocarbon in all the reservoirs. Due to the high hydrocarbon saturation, low water saturation, and volume of shale that is low in Fem 3, therefore Fem 3 will be prolific or good for hydrocarbon exploration.

Table 4: Hydrocarbon Saturation, Water Saturation and Volume of Shale Profile

WELL	S_H, S_W, AND V_{SH} IN EACH OF THE RESERVOIRS																	
	A			B			C			D			E			TOTAL		
	S_H	S_W	V_{SH}	S_H	S_W	V_{SH}	S_H	S_W	V_{SH}	S_H	S_W	V_{SH}	S_H	S_W	V_{SH}	S_H	S_W	V_{SH}
FEM 1	54	41	11.7	70	30	12.38	56	44	14.04	55	45	17.50	51	49	9.79	58.2	41.8	12.98
FEM 2	57.93	42.07	9.13	72.26	27.7	6.89	61.82	38.18	14.6	56.33	43.67	20	55.43	44.57	9.35	60.8	39.25	12
FEM 3	64	36	14.47	70	30	17.07	63	37	16.71	60	40	13.57	63	37	15.26	64	36	15.4
TOTAL	60.3	39.7	11.7	70.8	29.2	12.1	60.2	39.7	15.12	57.11	42.89	17.2	56.48	43.5	11.5			

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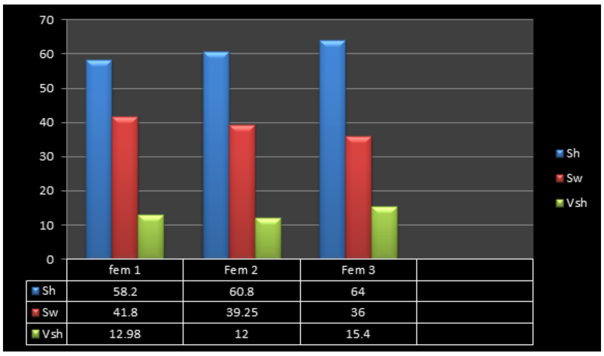

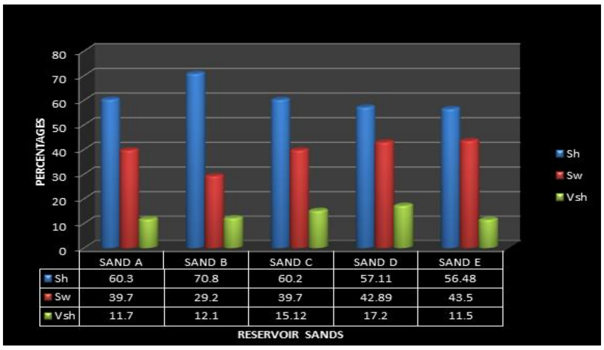

(A) **(B)**

Figure 5: (a) Comparison Bar chart of total volume of shale, hydrocarbon shale, and water saturation in each of the wells (b) Comparison Bar chart of total volume of shale, hydrocarbon shale, and water saturation in each of the reservoirs.

6. Conclusion

Computed petrophysical parameters of ”OKPELLA” Field have revealed that the field is composed of sand and shale, and sometimes some traces of shale are found within the sand Formation, Petrophysical analysis of ”OKPELLA” Field shows that each formation has varying degree of petrophysical properties. The average effective porosity are good over the reservoirs ranging from 27% – 29%, This shows that the reservoir average absolute permeability ranges from 300 md – 1259 md which revealed that hydrocarbon can be readily extracted from the wells, while the average effective permeability for both oil and water over the reservoir ranges from 5.0 md – 115 md which reveals that the reservoirs are permeable, porous and contain some desirable hydrocarbon.

By taking a critical look at the correlation section of the hydrocarbon bearing reservoirs using the well logs in the study area, it was observed and established that the gross reservoir thickness of each reservoirs varies from one well location to the other and it is been vividly seen that ”Okpella” Field composed of alternation of sand and shale, and some traces of shale are found within the sand formation with the integrated use of gamma-ray log and resistivity logs, while using the S.M.T. to correlate all the wells that is been analysed petrophysically in this project.

In conclusion, it can be seen that the petrophysical estimation obtained from the delineated reservoirs show that there is hydrocarbon in the reservoirs. Also the hydrocarbon pore volume for both oil and gas shows that the reservoirs have good hydrocarbon potential. However, based on the fact that there are many other factors that affect the permeability of the well, it can not be fully concluded that the well will produced in commercial quantity.

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Competing Interest Statement

The authors declare no conflict of interest.

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