PETROPHYSICAL EVALUATION AND DEPOSITIONAL ENVIRONMENTS OF RESERVOIR SANDS OF X FIELD, OFFSHORE NIGER DELTA, NIGERIA

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ABSTRACT

This study involves the use of geophysical well logs to characterize four reservoir sand bodies contained in four wells offshore Western Niger Delta. The well logs include caliper, SP, gamma ray, resistivity, neutron (NPHI), density (RHOB) and sonic logs. The logs were obtained in digital data format and a Paradigm's petrophysical software, Geolog, was used to process the data into log images. This aided the visual identification of lithologies and potential reservoirs.

The reservoirs are contained in the Agbada Formation of the Niger Delta and are composed of sandstone and unconsolidated sands. The sands are predominantly medium to coarse grained with shale intercalations in some horizons. Thickness ranges between 33-60ft (10 to 18 metres). The reservoir characteristics are controlled by depositional environment and depth of burial.

From gamma ray log motifs, the reservoirs are inferred to be deep sea turbidite fans and tidal ridge sands. Porosity and permeability values are high with average values of 25% and 4500 millidarcies respectively. Shale content is generally low across the reservoir sands with average values of 15%. The sands are characterized by high relative permeability to oil, K_{ro}/K_{rw} is as high as 1.0 in some horizons. This suggests that oil can be produced relative to water. Generally, porosity and permeability are known to decrease with depth of burial in the Niger Delta. However, a situation of increased porosity and permeability with depth of burial was observed in one of the reservoirs. This can attributed to the preservation of secondary porosity in a mechanically stable, compaction resistant framework of quartz grains.

INTRODUCTION

Petrophysical evaluation of a reservoir for hydrocarbon content is essential in hydrocarbon exploration (Asquith and Gibson, 1982). The Niger Delta basin has been an important geological domain for several authors ever since its hydrocarbon potentials became apparent. The basin is situated in the Gulf of Guinea (Fig. 1a) and extends throughout the Niger Delta Province as defined by Klett *et.al.* (1997). The Gulf of Guinea formed at the culmination of Late Jurassic to Early Cretaceous tectonism that was characterized by both block and transform faulting superimposed across an extensive Paleozoic basin during the breakup of the African and American paleocontinents (Brownfield and Charpentier, 2006).

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The Niger delta is a passive margin basin that contains thick accumulations of deltaic terrigeneous sediments. The stratigraphic units thickens basinward across a series of normal, listric, down-to-basin syndepositional faults, with which are associated "rollover" anticlines which form traps (Curtis, 1985). From the Eocene to Recent, the delta has prograded southwestward, forming depobelts that represent the most active portion of the delta at each stage of its development (Doust and Omatsola, 1990).

These depobelts form one of the largest regressive deltas in the world with an area of some 300,000 km² (Kulke, 1995), having sediment volume of 500, 000 km³ (Hospers, 1965), and thickness of over 10km in the basin's depocenter (Kaplan *et.al.*, 1994). The reservoir sands under consideration in this study are believed to be the tidal ridge sands and deep sea turbidite fans of the Agbada Formation. The sand bodies are characterized by excellent porosity and permeability. This deduction is consistent with the works of earlier authors; Avbovbo, (1978); Kulke,

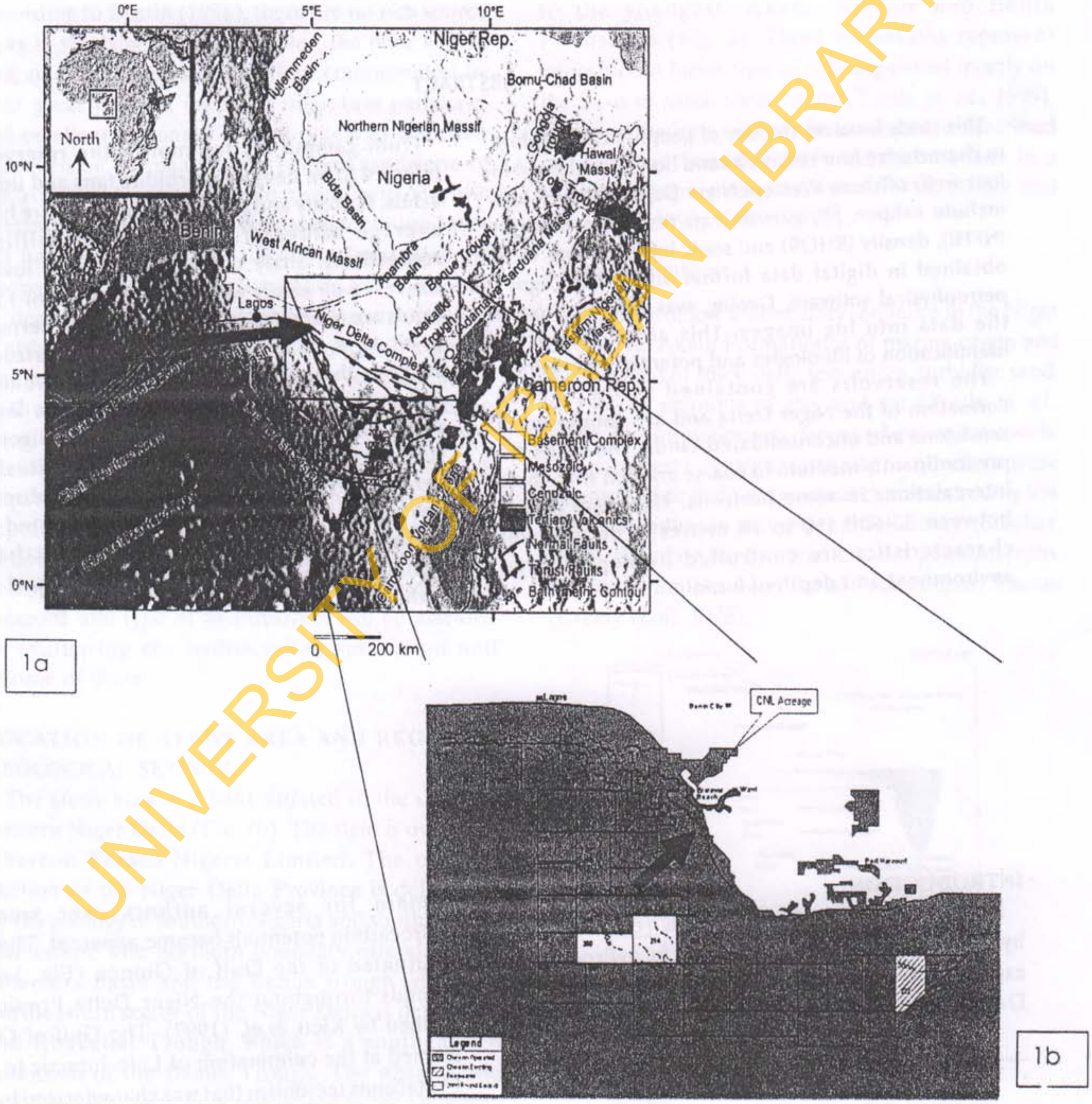

FIGURE 1: Fig 1a. *Modified geological map of Nigeria showing the position of Niger delta (After Onuoha, 1999). Inset is the map of Africa showing the position of Niger delta.*
Fig. 1b: *Location map of study area within Chevron Nigeria acreage.*

(1995); Edwards and Santogrossi, (1990); Beka and Oti, (1995); Ekweozor and Daukoru, (1992); and Tuttle et.al. (1999).

The works of several authors (Evamy *et.al.*, 1978; Doust and Omatsola, 1990) indicate that hydrocarbon is produced from sandstone and unconsolidated sands predominantly in the Agbada Formation, a paralic sequence of sandstone and marine shales. While the sandstones constitute the reservoirs, the marine shales are the hydrocarbon source rocks (Weber and Daukoru, 1975). According to Bustin (1988), there are no rich source rocks in the Niger delta. However, the poor source rock quality has been more than compensated by their great volume, excellent migration pathways, and excellent drainage. The oil potential is further enhanced by permeable interbedded sandstone of the Agbada Formation and rapid hydrocarbon generation resulting from high sedimentation rates.

It has been known that the characteristics of the reservoirs in the Agbada Formation are controlled by depositional environment and depth of burial (Tuttle *et.al.*, 1999). This study attempts to evaluate the petrophysical properties of some reservoir sands in the western offshore Niger Delta. It tries to identify and characterize the reservoirs and deduce the effects of depth on petrophysical properties such as porosity and permeability within the wells. The depositional environment of the reservoir sands will be deduced from available data and its influence on petrophysical properties will be examined. The presence and type of hydrocarbon will be assessed by evaluating the hydrocarbon saturation and volume of shale.

LOCATION OF STUDY AREA AND REGIONAL GEOLOGICAL SETTING

The study area is a field situated in the offshore western Niger Delta (Fig. 1b). The field is owned by Chevron Texaco Nigeria Limited. The onshore portion of the Niger Delta Province is delineated by the geology of southern Nigeria and southwestern Cameroon. The northern boundary extends to the Anambra basin and the Benue trough while the northeastern sector of the Niger Delta is defined by the Abakaliki Trough, which is a southeastern extension of the Benue Trough. The western and northwestern portions are delimited by the Dahomey basin, which rests on the West African Massif (Onuoha, 1999).

The province covers 300,000 km^2 and includes the geologic extent of the Tertiary Niger Delta petroleum systems (Tuttle *et. al.*, 1999).

STRATIGRAPHY OF NIGER DELTA

The Niger Delta Complex consists of thick sequences of Cenozoic rocks which rest on thinner and deeper water Cretaceous facies and older Mesozoic sedimentary rocks which in turn rest on oceanic, transitional and continental crust (Schlumberger, 1985). The Tertiary Niger Delta consists of three formations namely from the oldest to the youngest, Akata, Agbada and Benin Formations (Fig. 2). These formations represent depositional facies that are distinguished mostly on the basis of sand- shale ratios (Tuttle *et. al.*, 1999). The type sections of these formations are described in Short and Stauble (1967) and summarised in a variety of papers (e.g. Avbobvo, 1978; Doust and Omatsola, 1990; Kulke, 1995).

Akata Formation:

This is the oldest sedimentary sequence in the Niger Delta. The Akata Formation is of marine origin and is composed of thick shale sequences, turbidite sand, and minor amounts of clay and silt (Tuttle *et. al.*, 1999). The formation was deposited during lowstands, when terrestrial organic matter and clays were transported to deep water areas characterized by low energy conditions and oxygen deficiency (Stacher, 1995). Based on the foraminifera and palynomorphs, the formation has been dated Paleocene to Recent (Evamy *et.al.*, 1978).

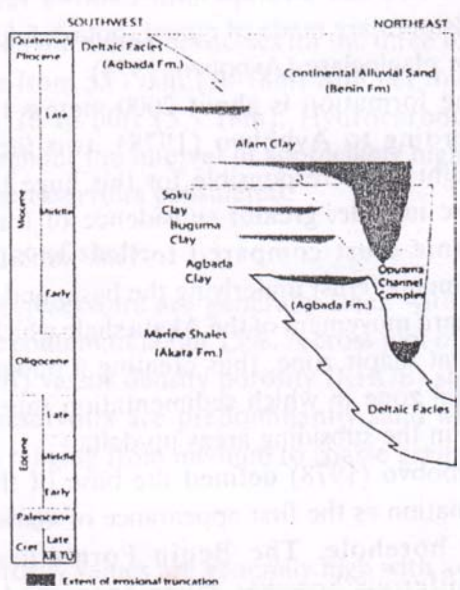

FIGURE 2: *Stratigraphic column showing the three formations of the Niger Delta (Doust and Omatsola, 1990).*

Agbada Formation:

The deposition of the Agbada Formation began in the Eocene and continues into the Recent. Tuttle *et.al.*, (1999) noted that the formation consists of paralic siliciclastics, over 3700 meters thick and represents the actual deltaic portion of the sequence. This formation forms the hydrocarbon - prospective sequence in the Niger Delta (Doust and Omatsola, 1990). The clastics accumulated in delta-front, delta-topset, and fluvio-deltaic environments. In the lower portion of the sequence, shale and sandstone beds were deposited in equal proportions; the upper portion is however, mostly sand with minor shale interbeds (Tuttle *et. al.*, 1999). Fossil flora and fauna recovered from the formation include palynomorphs, foraminifera, ostracods, gastropods, pelecypods and echinoid remains (Evamy *et.al.*, 1978).

Benin Formation:

The Benin Formation is the youngest stratigraphic sequence in the Niger Delta and is a continental latest Eocene to Recent deposit of alluvial and Upper Coastal Plain Sands. The formation consists of predominantly massive, highly porous, freshwater-bearing sandstones with local thin shale beds. The sands and sandstones, ranging from very coarse to fine are poorly sorted and show little lateral continuity. The sandstones were deposited as point bars deposited as point bars by braided streams, while the shales and finer grained deposits were laid down in back swamps and oxbows lakes. The sandstones are made of quartz, potash feldspar and some plagioclase (Avbobvo, 1978).

The formation is about 2000 meters thick and according to Avbobvo (1978), two factors are thought to be responsible for this huge thickness. These include, greater subsidence of transitional oceanic crust compared to less subsidence of continental crust underlying the basin and the mass seaward movement of the Akata shale which formed a great diapir zone, thus creating a buoyant delta frontal zone in which sedimentation rate was less than in the subsiding areas up-delta.

Avbobvo (1978) defined the base of the Benin Formation as the first appearance of marine shales in a borehole. The Benin Formation is less fossiliferous however fauna recovered include gastropod and echinoid remains while foraminifera are rare (Evamy *et.al.*, 1978).

DATA ACQUISITION AND METHODOLOGY

The data for this study were acquired from Chevron Texaco Nigeria Limited, Lagos, Nigeria, in digital log format. Data acquired include gamma ray, spontaneous potential, resistivity (Deep Resistivity Log (LLD), Shallow Resistivity Log (LLS) and Micro spherically focused log (MSFL), neutron porosity, caliper, density and sonic logs. The digital logs were processed into log images using GEOLOG, a Paradigm Company petrophysical software.

Lithologies were identified with the aid of gamma ray, spontaneous potential log, caliper log and neutron-density combination. Gamma ray log indicates the degree of shaliness while spontaneous potential and caliper logs were used to distinguish between porous and permeable rocks (reservoir) from non-permeable rocks.

Porous and permeable sections show negative SP deflections. Positive deflections indicate shaly, non-permeable beds. Permeable formations (sands) were inferred at intervals where caliper readings (hole size) is smaller than bit size. Larger hole diameter indicates caving or washout which is typically of shales especially when unconsolidated.

Shale was identified on the neutron-density combination where the neutron value is high relative to the density value. It gives a large positive separation to the logs, the neutron well to the left of the density. This separation is typically diagnostic and is due to the high hydrogen index of shale matrix material. When used properly, the neutron-density combination is the best lithology indication than the gamma ray log and, at least quantitatively, can be used to evaluate the degree of shaliness (Goetz*et.al.*, 1977).

The concentration of radioactive elements in shales and clays form the basis for using GR as shale indicator (Dypvik and Eriksen, 1983). Shale tends to give high GR reading, while low GR reading is characteristic of clean formations such as sandstone. However, care was taken not to misinterpret radioactive sands for shales. In doing this, GR log was combined with other logs such as SP, Caliper, and neutron-density.

Hydrocarbon bearing intervals were identified with the aid of resistivity log (LLD) and porosity logs (i.e. density and neutron logs). Hydrocarbon was inferred at intervals with peak resistivity values. The type of hydrocarbon (gas or oil) was determined from neutron-density log. Gas was inferred at intervals with large separation between neutron and density logs while the tracking of the two logs indicates oil.

Shale content, or volume of shale, is an important quantitative result of log analysis. It is needed for correcting porosity and water saturation results for the effects of shale, and is an indicator of reservoir quality. Lower shale content usually indicates a better reservoir (Crain, 2000).

Several methods such as calculation from SP, GR, neutron-density cross plot, and sonic-density cross plot can be used to calculate the volume of shale. The GR method was used in this study from the formula;

$$I_{GR} = (GR_{log} - GR_{min}) / (GR_{max} - GR_{min})$$

Where,

I_{GR} - gamma ray index
GR_{log} - gamma ray reading of formation.
GR_{min} - gamma ray reading in clean sand.
GR_{max} - gamma ray reading in shale.

Volume of shale was then calculated from the Gamma ray index, I_{GR} using Dresser Atlas (1979) formula as applied to both older and Tertiary rocks.

For older rocks

$$V_{sh} = 0.33\,(2^{(2.0 \times I_{GR})} - 1.0)$$

For Tertiary rocks

$$V_{sh} = 0.083\,(2^{(3.7 \times I_{GR})} - 1.0)$$

Where,

V_{sh} = volume of shale.

Niger Delta Formation are Tertiary Rocks, hence the later equation was used in calculating shale volume of the reservoirs.

Shale volumes obtained for the reservoirs were used to correct porosity and water saturation values.

Porosity values were obtained from both density (RHOB) log and neutron (NPHI) logs. The neutron porosity values were read directly from NPHI log. Bulk density was read from density log in gm/cm³. Equivalent porosity values in sandstone unit for bulk density values were obtained from Schlumberger chart CP-IC.

Permeability values were determined from Schlumberger chart Perm-3.

The charts are based on empirical observations and are similar in form to a general expression proposed by Wyllie and Rose (1950):

$$K^{1/2} = (c\Phi/S_{wi}) + c'$$

Values of porosity, Φ and water saturation, S_{wi} were entered into the chart, their intersection defines the intrinsic (absolute) rock permeability.

The following relationships:

$$K_{rw} = \{(S_w - S_{wi}) / (1 - S_{wi})\}^3$$

and,

$$K_{ro} = (1 - S_w)^{2.1} / (1 - S_{wi})^2$$

were used to calculate the relative permeabilities of water and oil respectively.

K_{rw} - relative permeability to water
K_{ro} - relative permeability to oil
S_w - water saturation (%)
S_{wi} - irreducible water saturation (%).

Detailed procedures for the different aspects of this study can be obtained in Adebambo, (2007).

RESULTS AND DISCUSSION

The reservoirs of X - Field located in the western Niger Delta, Nigeria consist predominantly of medium to coarse grained sands. Minor shale intercalations occur within sand bodies. The sands are characterized by excellent porosity and permeability which allow for storage and transmission of fluid. In this study, the sands are designated reservoir sands A, B and C (Fig. 3, 4 & 5). Detailed individual characteristics of the reservoirs and the generating parameters are discussed in Adebambo (2007).

Characteristics of the reservoir sands:

Reservoir sand thicknesses for the three reservoirs range from 33 - 60ft (10-18m) with net thicknesses from 16 to 60ft (5 - 18m). Hydrocarbon occurs throughout the interval in appreciably high ratio in all the reservoirs considered.

Volume of shale:

The reservoirs are generally clean with average shale content of about 15%. A cross plot of neutron (NPHI) versus density porosity (RHOB) shows that the reservoirs are predominantly sand with grain sizes ranging from medium to coarse grain (Fig. 6).

Porosity:

Porosity values are generally high with average of about 25%. The reservoirs owe their excellent porosity values to low shale contents. In most reservoirs, porosity tends to decrease with depth of

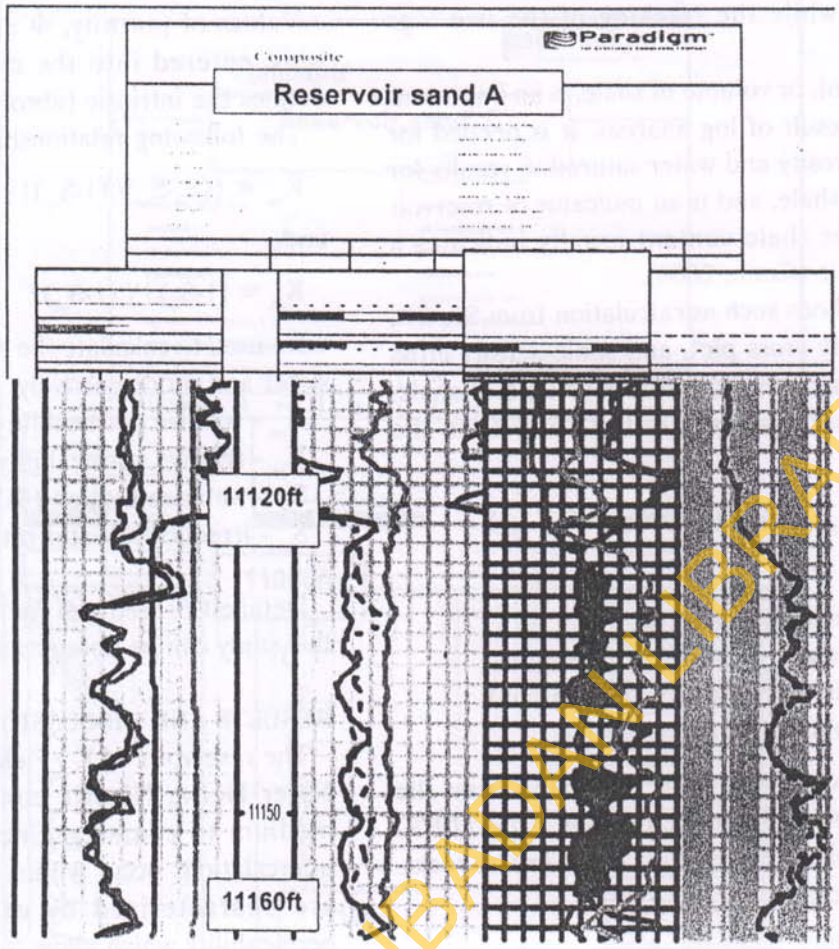

FIGURE 3: Log image *of reservoir sand A (red loop indicates hydrocarbon): Gamma ray log (track 1) between interval 11120 and 11160ft (3390-3402m) is characteristic of deep sea turbidite fan.*

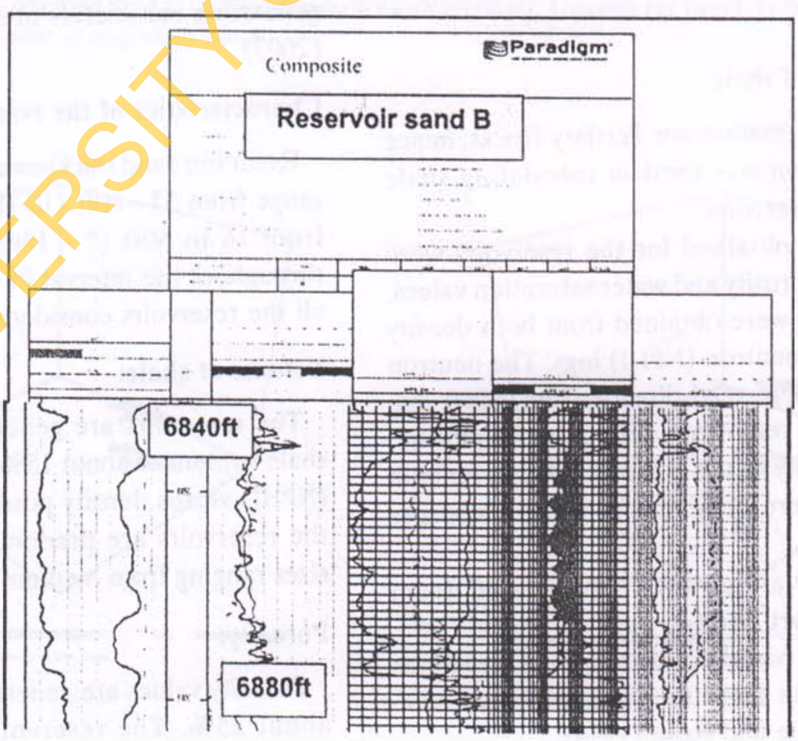

FIGURE 4: *Log image of reservoir sand B(red loop indicates hydrocarbon): Gamma ray log (track 1) between 6840 and 6880ft (2085-2098m) is characteristic of tidal ridge sand.*

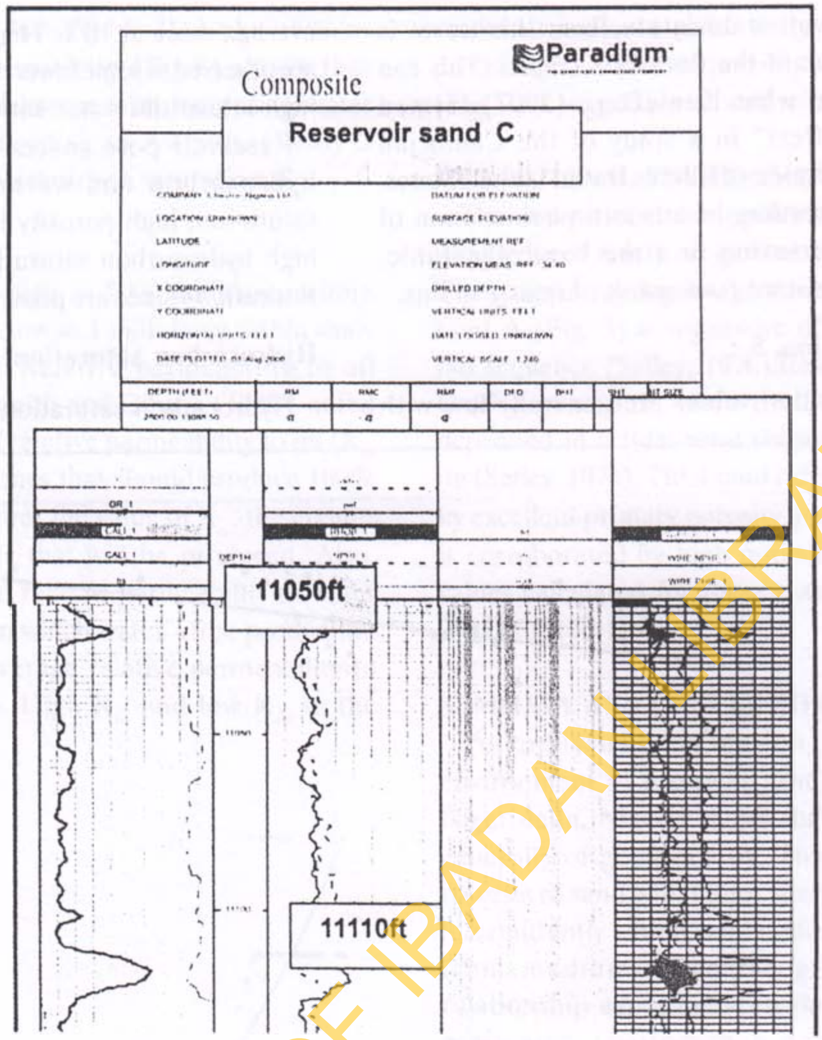

FIGURE 5: *Log image of reservoir sand C (red loop indicates hydrocarbon): Gamma ray (track 1) between 11050-11110ft (3369-3387m) is characteristic of tidal ridge sand*

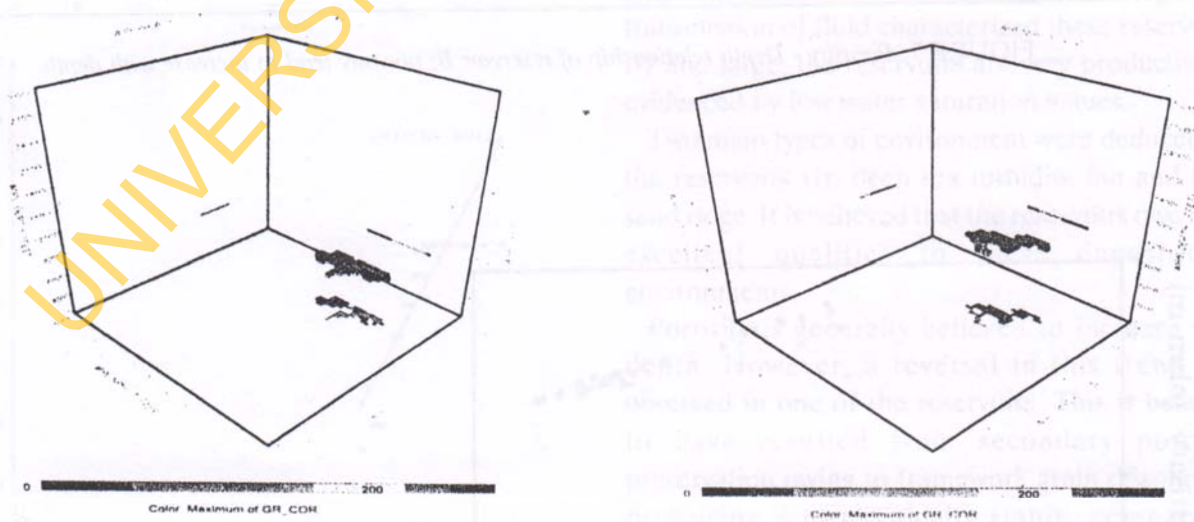

FIGURE 6: *Density - Neutron cross plots for the reservoirs: shale content and porosity are determined from the plot (Paradigm Geophysical).*

burial. However, a deviation from this norm is observed in one of the reservoirs (Fig.7). This can be ascribed to what KunleDare (2007) termed "Buckyball Effect" in a study of the Cambrian Galesville sandstone of Illinois Basin, United States. This effect according to him is a phenomenon of porosity preservation in a mechanically stable, compaction resistant framework of quartz grains.

Water Saturation, S_w:

Water saturation values are generally low with average value at 18%. High water saturation values are observed at some lower porosity horizons suggesting high interstitial water within clay (Shaw, 1980).

Reservoir pore spaces are usually occupied by hydrocarbon and water, therefore, low water saturation, high porosity intervals are indicative of high hydrocarbon saturation and vice versa. Fluid saturation values are presented in the Table 2 below.

Hydrocarbon saturation:

Hydrocarbon saturation in the reservoir is fairly

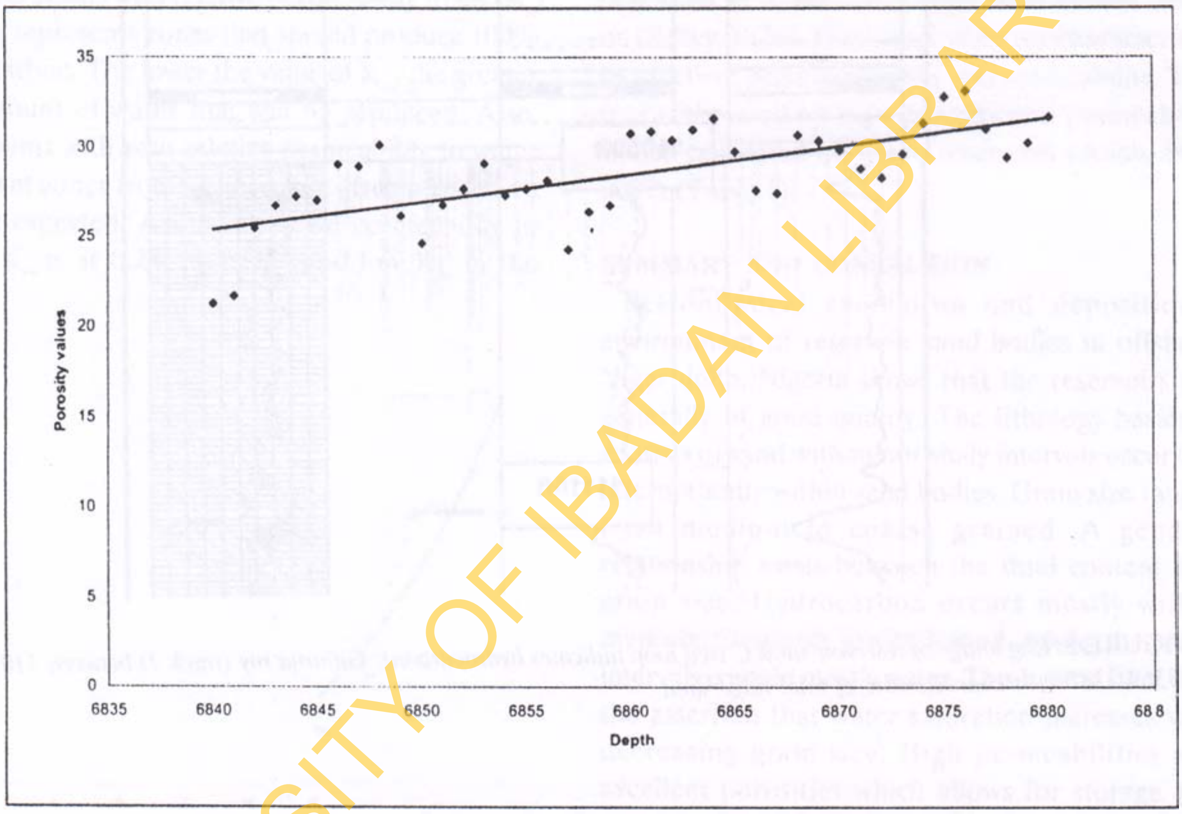

FIGURE 7: *Porosity - Depth relationship of reservoir B; porosity tend to increase with depth.*

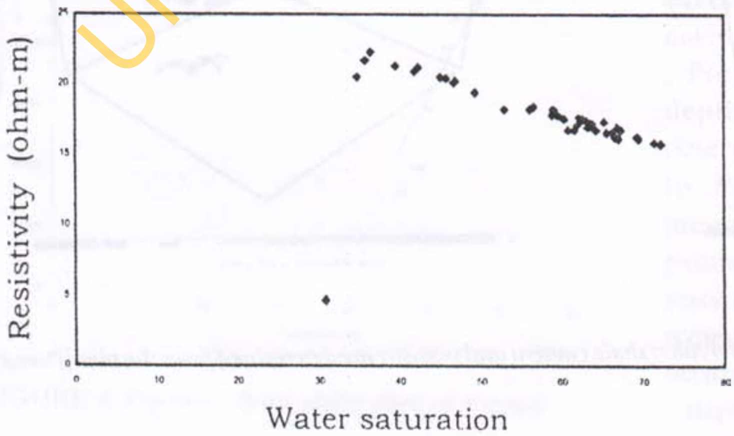

FIGURE 8: *Resistivity - water saturation cross plot of reservoir: resistivity values tend to increase with decreasing water saturation.*

high with average at 78% (Table 2). A plot of water saturation versus resistivity (Fig.8) shows that resistivity tends to decrease with increasing water saturation. This according to Asquith, (1990) is suggestive of high hydrocarbon saturation, S_h.

Permeability:

Permeability is as high as 5000 millidarcy within sand intervals and as low as 1 millidarcy within shaly intervals (Table 1). Relative permeability to oil averages at 0.75. Asquith and Gibson (1982), noted that data points with relative permeability to oil (K_{ro} of 1.0), represents zones that should produce 100% hydrocarbon. The lower the value of K_{ro}, the greater the amount of water that will be produced. Also, data points with zero relative permeability to water represent zones from which water - free production can be expected. Average relative permeability to water K_{rw} is at 0.28. High K_{ro} and low K_{rw} in the reservoir indicate potentially high hydrocarbon production. A plot of porosity versus permeability (Fig. 9) is suggestive of well sorted sands.

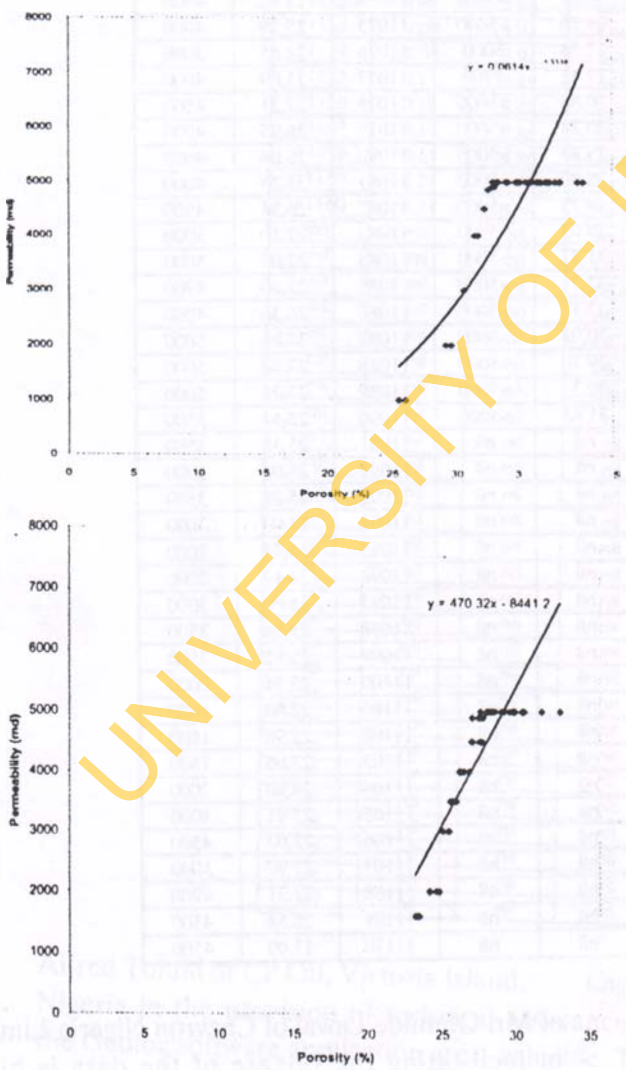

FIGURE 9: *Porosity - Permeability plots of reservoir.*

DEPOSITIONAL ENVIRONMENT

The depositional environment for the reservoirs was deduced solely on gamma ray log signatures. The gamma ray log image (track 1) over reservoir sand A (Fig. 3) is suggestive of deep sea turbidite fan sequence (Selley, 1976).Reservoir sands B and C (Fig. 4 and 5) were deduced to have been deposited in a tidal sand ridge environment based on (Selley, 1976). Tidal sand ridges are characterized by excellent primary porosity and permeability. This is corroborated by high porosity and permeability values calculated for these reservoirs (Adebambo, 2007) (Table 1).

SUMMARY AND CONCLUSION

Petrophysical evaluation and depositional environment of reservoir sand bodies in offshore Niger delta, Nigeria shows that the reservoirs are generally of good quality. The lithology basically consists of sand with minor shaly intervals occurring intermittently within sand bodies. Grain size ranges from medium to coarse grained. A general relationship exists between the fluid content and grain size. Hydrocarbon occurs mostly within medium to coarse grained sand, while the shale intervals contain mostly water. This is consistent with the assertion that water saturation increases with decreasing grain size. High permeabilities and excellent porosities which allows for storage and transmission of fluid characterized these reservoirs. By and large, the reservoirs are very productive as evidenced by low water saturation values.

Two main types of environment were deduced for the reservoirs viz: deep sea turbidite fan and tidal sand ridge. It is believed that the reservoirs owe their excellent qualities to these depositional environments.

Porosity is generally believed to increase with depth. However, a reversal in this trend was observed in one of the reservoirs. This is believed to have resulted from secondary porosity preservation owing to framework grain dissolution, producing a mechanically stable, compaction resistant framework of quartz grains. Dissimilar temperature and pressure histories of sandstones occurring at similar depths can also affect porosity – depth relationship.

TABLE 1: Reservoir porosity and permeability values

RESERVOIR SAND A			RESERVOIR SAND B			RESERVOIR SAND C		
DEPTH	φND	K (md)	DEPTH	φND	K (md)	DEPTH	φND	K (md)
11127	20.83	800	6840	21.20	1000	11050	26.51	4500
11128	23.30	1600	6841	21.62	1000	11051	27.54	5000
11129	20.23	750	6842	25.42	3000	11052	28.47	>5000
11130	14.19	80	6843	26.72	4500	11053	29.91	>5000
11131	18.92	500	6844	27.23	4900	11054	32.36	>5000
11132	20.21	750	6845	27.00	4850	11055	31.15	>5000
11133	15.36	150	6846	29.03	>5000	11056	29.39	>5000
11134	12.69	40	6847	28.91	>5000	11057	30.02	>5000
11135	20.68	800	6848	30.11	>5000	11058	29.85	>5000
11136	25.42	3000	6849	26.11	4000	11059	29.02	5000
11137	25.76	3500	6850	24.57	2000	11060	28.68	>5000
11138	21.10	790	6851	26.75	4500	11061	29.20	>5000
11139	15.38	120	6852	27.67	5000	11062	28.60	>5000
11140	10.88	15.0	6853	29.08	>5000	11063	29.28	>5000
11141	7.09	1.000	6854	27.30	5000	11064	27.77	5000
11142	8.80	4.00	6855	27.65	5000	11065	27.50	5000
11143	10.56	15.00	6856	28.15	5000	11066	27.59	5000
11144	16.59	220	6857	24.22	2000	11067	27.60	5000
11145	21.03	800	6858	26.35	4000	11068	27.01	4900
11146	24.47	2000	6859	26.74	4500	11069	27.79	5000
11147	24.48	2050	6860	30.76	>5000	11070	27.93	5000
11148	22.17	1050	6861	30.89	>5000	11071	28.66	>5000
11149	16.58	210	6862	30.39	>5000	11072	27.87	5000
11150	17.88	400	6863	30.97	>5000	11073	28.08	>5000
11151	20.00	750	6864	31.61	>5000	11074	27.12	4900
11152	22.33	1100	6865	29.76	>5000	11075	25.79	4000
11153	23.14	1600	6866	27.58	5000	11076	24.65	3000
11154	23.99	2000	6867	27.42	4900	11077	25.69	4000
11155	25.60	3500	6868	30.68	>5000	11078	27.21	4500
11156	23.16	1600	6869	30.34	>5000	11079	26.95	4900
11157	18.18	500	6870	29.83	>5000	11080	26.04	4000
11158	21.79	1100	6871	28.80	>5000	11081	25.73	4000
11159	20.25	750	6872	28.28	>5000	11082	26.54	4900
11160	16.42	200	6873	29.62	>5000	11083	27.10	5000
nil	nil	nil	6874	31.32	>5000	11084	27.93	5000
nil	nil	nil	6875	32.77	>5000	11085	27.00	4900
nil	nil	nil	6876	33.11	>5000	11086	26.36	4000
nil	nil	nil	6877	30.98	>5000	11087	27.66	5000
nil	nil	nil	6878	29.40	>5000	11088	27.92	5000
nil	nil	nil	6879	30.23	>5000	11089	27.75	5000
nil	nil	nil	6880	31.65	>5000	11090	25.51	3500
nil	nil	nil	nil	nil	nil	11091	25.35	3500
nil	nil	nil	nil	nil	nil	11092	25.06	3000
nil	nil	nil	nil	nil	nil	11093	25.28	3500
nil	nil	nil	nil	nil	nil	11094	25.03	3000
nil	nil	nil	nil	nil	nil	11095	23.75	2000
nil	nil	nil	nil	nil	nil	11096	24.17	2000
nil	nil	nil	nil	nil	nil	11097	25.00	3000
nil	nil	nil	nil	nil	nil	11098	25.54	3500
nil	nil	nil	nil	nil	nil	11099	25.12	3500
nil	nil	nil	nil	nil	nil	11100	23.74	2000
nil	nil	nil	nil	nil	nil	11101	22.80	1600
nil	nil	nil	nil	nil	nil	11102	22.96	1600
nil	nil	nil	nil	nil	nil	11103	23.06	1600
nil	nil	nil	nil	nil	nil	11104	24.40	2000
nil	nil	nil	nil	nil	nil	11105	25.91	4000
nil	nil	nil	nil	nil	nil	11106	27.03	4500
nil	nil	nil	nil	nil	nil	11107	27.90	5000
nil	nil	nil	nil	nil	nil	11108	27.31	4900
nil	nil	nil	nil	nil	nil	11109	26.58	4500
nil	nil	nil	nil	nil	nil	11110	27.09	4500

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TABLE 2: Reservoir fluid saturation values

RESERVOIR SAND A			RESERVOIR SAND B			RESERVOIR SAND C		
DEPTH	S_w	S_h	DEPTH	S_w	S_h	DEPTH	S_w	S_h
11127	0.17	0.83	6840	0.05	0.95	11050	0.95	0.05
11128	0.11	0.89	6841	0.2	0.8	11051	0.91	0.09
11129	0.18	0.82	6842	0.22	0.78	11052	0.91	0.09
11130	0.18	0.82	6843	0.22	0.78	11053	0.89	0.11
11131	0.15	0.85	6844	0.21	0.79	11054	0.86	0.14
11132	0.17	0.84	6845	0.21	0.79	11055	0.84	0.16
11133	0.22	0.78	6846	0.19	0.81	11056	0.86	0.14
11134	0.23	0.77	6847	0.17	0.83	11057	0.83	0.17
11135	0.16	0.84	6848	0.16	0.84	11058	0.83	0.17
11136	0.11	0.89	6849	0.16	0.84	11059	0.85	0.15
11137	0.11	0.89	6850	0.16	0.84	11060	0.88	0.12
11138	0.18	0.82	6851	0.17	0.83	11061	0.88	0.12
11139	0.23	0.77	6852	0.18	0.82	11062	0.86	0.14
11140	0.27	0.73	6853	0.18	0.82	11063	0.85	0.15
11141	0.32	0.68	6854	0.17	0.83	11064	0.89	0.11
11142	0.34	0.66	6855	0.16	0.84	11065	0.92	0.08
11143	0.30	0.70	6856	0.17	0.83	11066	0.94	0.06
11144	0.25	0.75	6857	0.17	0.83	11067	0.98	0.02
11145	0.18	0.82	6858	0.17	0.83	11068	0.99	0.01
11146	0.10	0.90	6859	0.17	0.83	11069	0.93	0.07
11147	0.09	0.91	6860	0.17	0.83	11070	0.92	0.08
11148	0.12	0.88	6861	'.0.17	0.83	11071	0.93	0.07
11149	0.16	0.85	6862	0.18	0.82	11072	0.94	0.06
11150	0.15	0.85	6863	0.20	0.80	11073	0.95	0.05
11151	0.10	0.90	6864	0.20	0.80	11074	0.96	0.04
11152	0.08	0.92	6865	0.18	0.82	11075	0.97	0.03
11153	0.09	0.91	6866	0.18	0.82	11076	0.96	0.04
11154	0.08	0.92	6867	0.20	0.80	11077	0.93	0.07
11155	0.11	0.89	6868	0.20	0.80	11078	0.92	0.08
11156	0.14	0.86	6869	0.18	0.82	11079	0.91	0.09
11157	0.14	0.86	6870	0.17	0.83	11080	0.93	0.07
11158	0.15	0.85	6871	0.16	0.84	11081	0.96	0.04
11159	0.21	0.79	6872	0.16	0.84	11082	0.97	0.03
11160	0.31	0.69	6873	0.17	0.83	11083	0.98	0.02
nil	nil	nil	6874	0.17	0.83	11084	0.96	0.04
nil	nil	nil	6875	0.18	0.82	11085	0.96	0.04
nil	nil	nil	6876	0.18	0.82	11086	0.96	0.04
nil	nil	nil	6877	0.17	0.83	11087	0.94	0.06
nil	nil	nil	6878	0.16	0.84	11088	0.95	0.05
nil	nil	nil	6879	0.17	0.83	11089	0.95	0.05
nil	nil	nil	6880	0.21	0.79	11090	0.91	0.09
nil	nil	nil	nil	nil	nil	11091	0.92	0.08
nil	nil	nil	nil	nil	nil	11092	0.94	0.06
nil	nil	nil	nil	nil	nil	11093	0.93	0.07
nil	nil	nil	nil	nil	nil	11094	0.94	0.06
nil	nil	nil	nil	nil	nil	11095	0.95	0.05
nil	nil	nil	nil	nil	nil	11096	0.92	0.08
nil	nil	nil	nil	nil	nil	11097	0.89	0.11
nil	nil	nil	nil	nil	nil	11098	0.89	0.11
nil	nil	nil	nil	nil	nil	11099	0.91	0.09
nil	nil	nil	nil	nil	nil	11100	0.94	0.06
nil	nil	nil	nil	nil	nil	11101	0.99	0.01
nil	nil	nil	nil	nil	nil	11102	1.00	0.00
nil	nil	nil	nil	nil	nil	11103	1.00	0.00
nil	nil	nil	nil	nil	nil	11104	0.96	0.04
nil	nil	nil	nil	nil	nil	11105	0.92	0.08
nil	nil	nil	nil	nil	nil	11106	0.91	0.09
nil	nil	nil	nil	nil	nil	11107	0.87	0.13
nil	nil	nil	nil	nil	nil	11108	0.86	0.14
nil	nil	nil	nil	nil	nil	11109	0.9	0.1
nil	nil	nil	nil	nil	nil	11110	0.88	0.12

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