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Reservoir Evaluation of Well A, Field Y, North-Eastern Niger Delta: A Case of a Problematic Sandstone

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ABSTRACT

The reservoir characteristics of well A, in field Y were evaluated using data derived from both wire line logs and cores. The wire line logs were used in delineating the lithostratigraphy, facies types and consequently the depositional environment. Porosity, permeability and hydrocarbon saturation were also determined from the wireline logs and compared with those from core analysis. The logs were environmentally corrected and normalized, porosity and permeability were calculated, water saturations were determined from which the fluid contents of the reservoirs were determined. Two economically viable reservoir horizons were delineated and analysed. The results showed alternation of sand-shale sequence, good porosity and permeability. This is generally the trend in the Niger Delta stratigraphy. The values obtained for water saturation have an inverse relationship with hydrocarbons, showing that there are hydrocarbons in both reservoir horizons which would make the two reservoirs to be of economic importance. However, the results from neutron logs (which are as high as 44.5%) indicate that there are clayey materials within these sands. These were thought to be a likely source of problem in the sandstone, if they occur as montimorrillonite clay minerals. This was looked into and recommendation made.

Key Words: Reservoir characteristics, Wireline logs, Core analysis, Porosity, Permeability, Water saturation.

INTRODUCTION

Literally, it is assumed that reservoirs are homogenous but in practical situation they are not. All sedimentary deposits however, have an inhomogeneity caused by distribution in time and space of sedimentary facies and by compaction, cementation and the nature of pore filling fluids. This study examines some of these characteristics using wireline logs signatures and data derived from them. These are then compared with those from core analyses results from which useful deductions were made.

MATERIALS AND METHODS

The materials that were available for this work include: wire line logs and conventional cores. The wire line logs include gamma ray (GR), neutron logs, sonic, density, Self potential (Sp), resistivity l (LLD, LLS & MSFL) and calliper logs. Cores were provided from one meter intervals of 3236-3237, 3245-3246 and 3253-3254. The base map showing location of the oil field Y, and the position of well A was drawn to scale of 1:25.00. These materials were provided by Elf Petroleum Nigeria Limited with the permission of the Department of Petroleum Resources (DPR), Lagos.

The Y field is the field under study and is located within concession OML58 block in the north-eastern Niger Delta (Fig 1). Geographically, the field lies between longitude 6^0 30'E and $7^0$00' and Latitude $5^0$00' and $5^0$30'N. Well A is located within field Y as indicated in Fig 1. The well was drilled by Elf Petroleum Nigeria limited. Initially, the well was producing at maximum capacity, but the productivity was reduced after sometime. This necessitated this research.

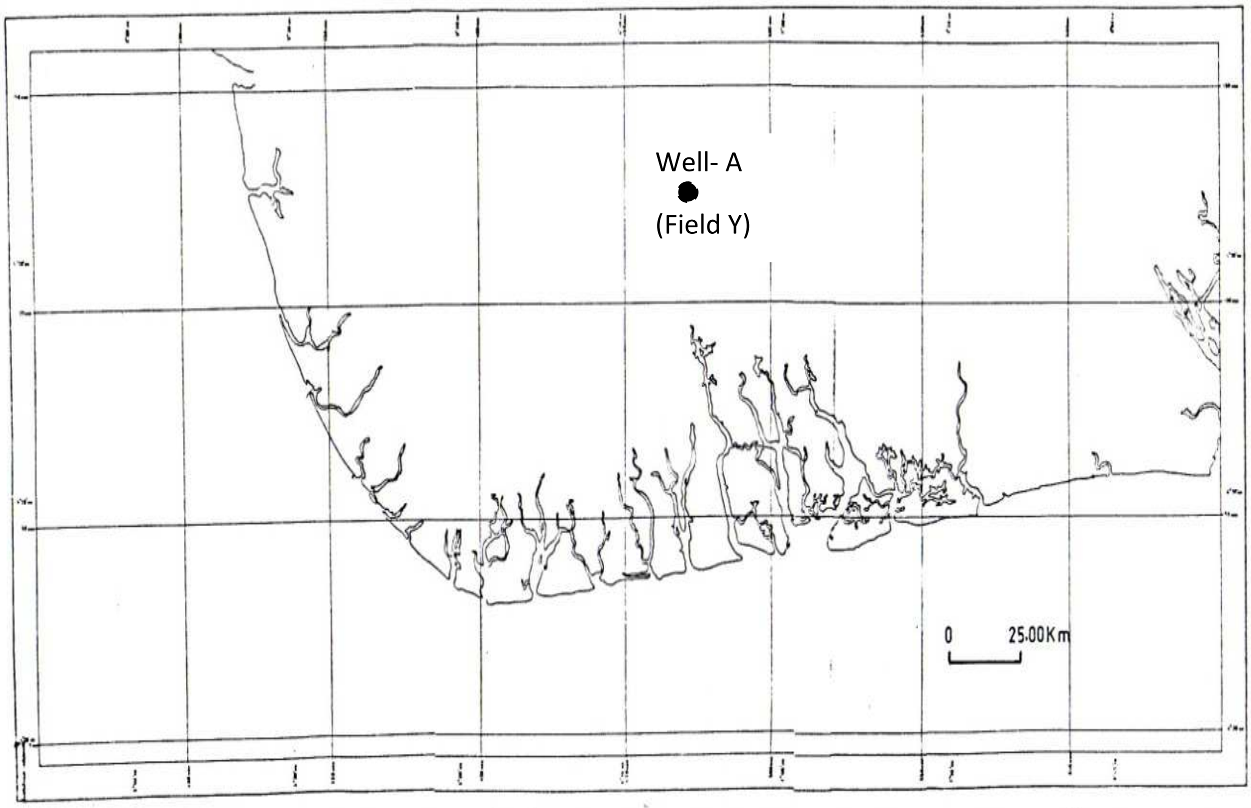


Fig 1: The Geographical Location of the study well relative to the coastline of Niger Delta (Elf,1997)

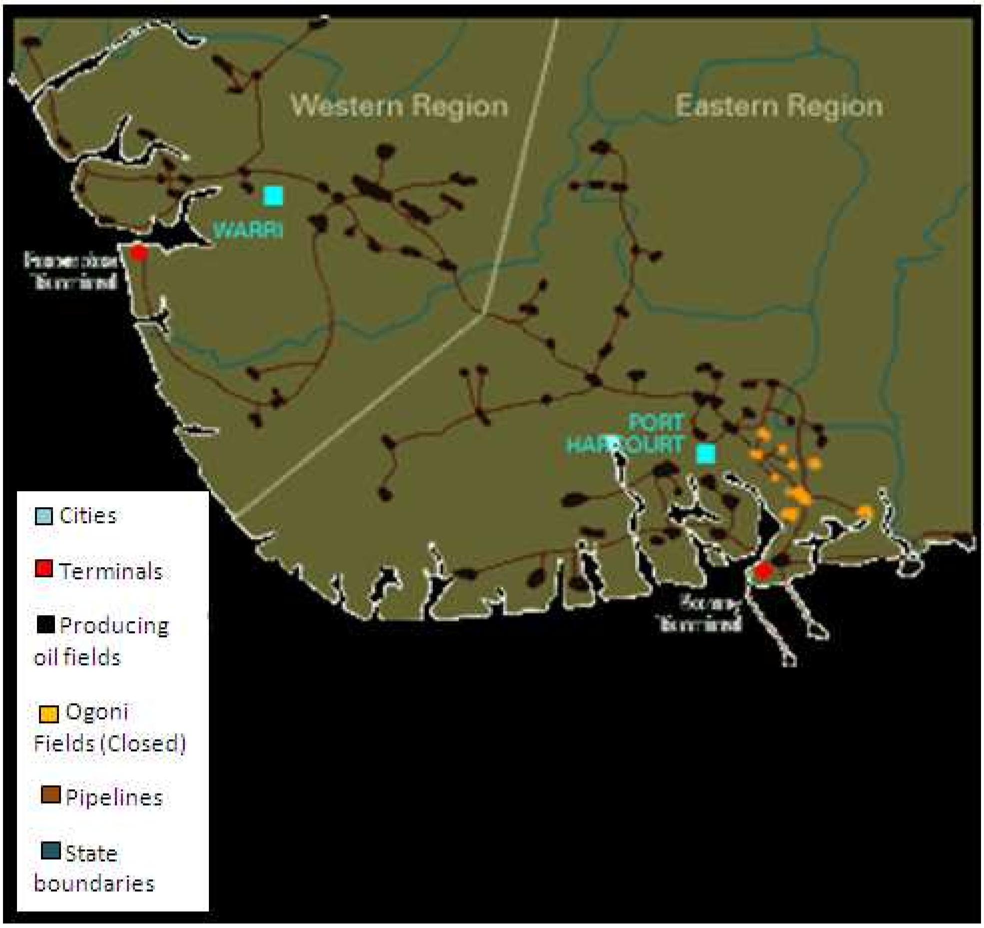


Fig 2: A Map of Niger Delta showing oil fields and pipelines (Source; Urhobo Historical Society,2008)

RESULTS AND DISCUSSION

The gamma ray log signatures complimented with those of Sp-log as well as resistivity readings were used to establish the lithology. The observed sequence in well A, consists of sand bodies with shale breaks on the upper part and intercalation of sand and shale bodies suggesting that logging started from the transition zone between the Benin and the Agbada Formation (figs. 3&4). This stratigraphic sequence is typical of Agbada Formation in the Niger Delta, which is the productive zone and has been the target of all drillings in the Niger Delta.
The sequence is characterized by point bars, barriers bars, barrier foot, marine clay and channel fills which are fine to coarse grained (fig. 4). The shale body is more abundant towards the base of well A, while the sand body is more abundant towards the upper part. This sand-shale zone is the productive zone of field Y.

In well A, two commercially viable reservoir horizons were selected for study i.e 2988m-3025m and 3200m3303m intervals (see Fig 3). This was determined from the wire line logs. In this well, the minimum porosity observed was 20.13% at a depth of 3261m in reservoir II, while the maximum value was 44.60% at a depth of 3215 also in reservoir II, with an average of 25.20%. Neutron porosity value was as high as 44.5% at some depth (e.g. 3228m) indicating the presence of shale in the sand, since neutron-porosity (N) log is also a measure of shaleness.

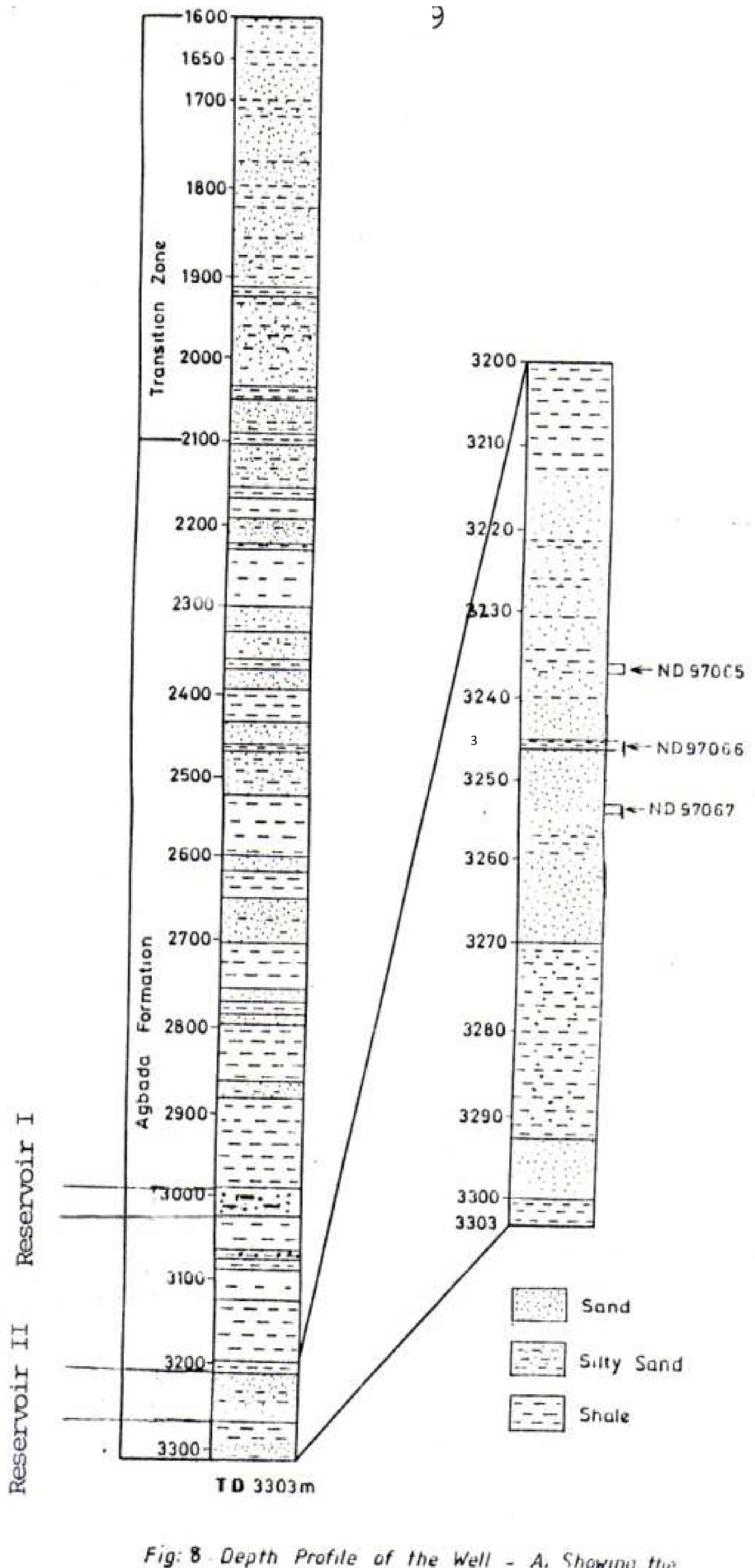


Fig 3. Depth Profile of Well-A. Showing the sampled intervals

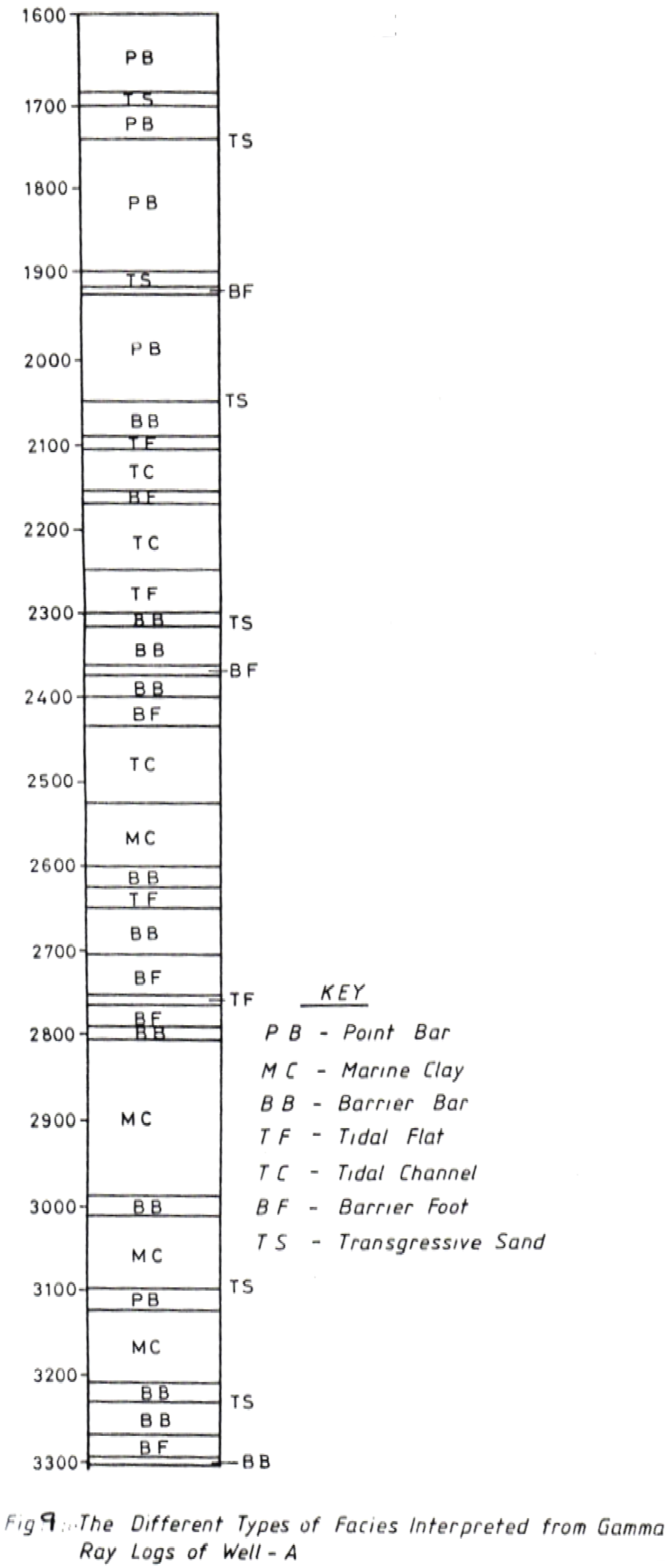
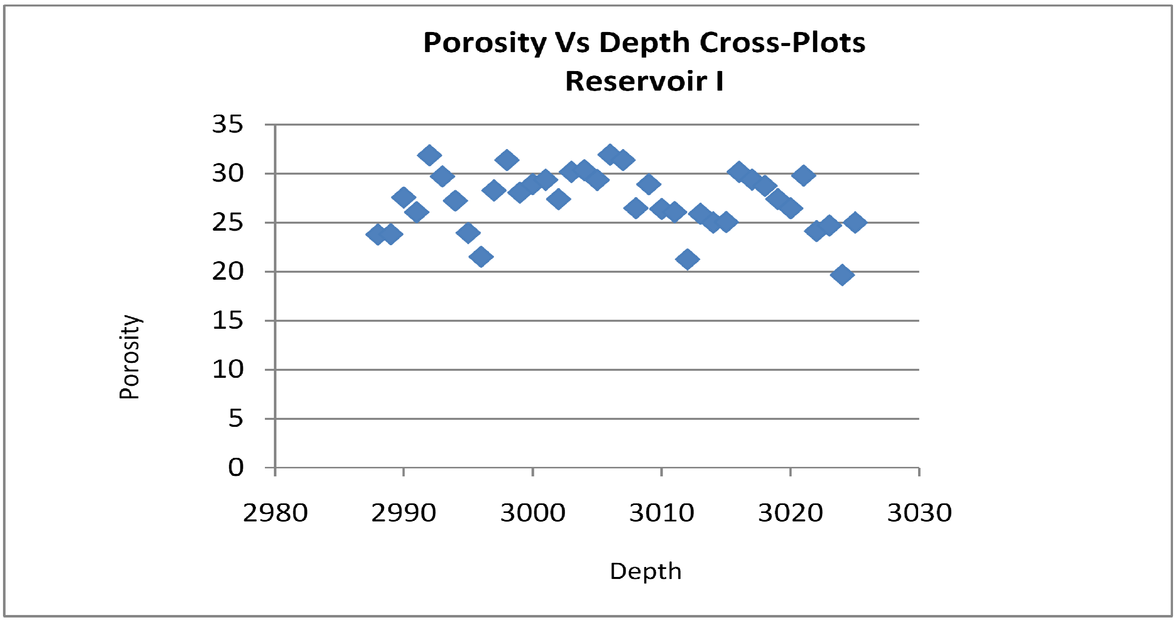
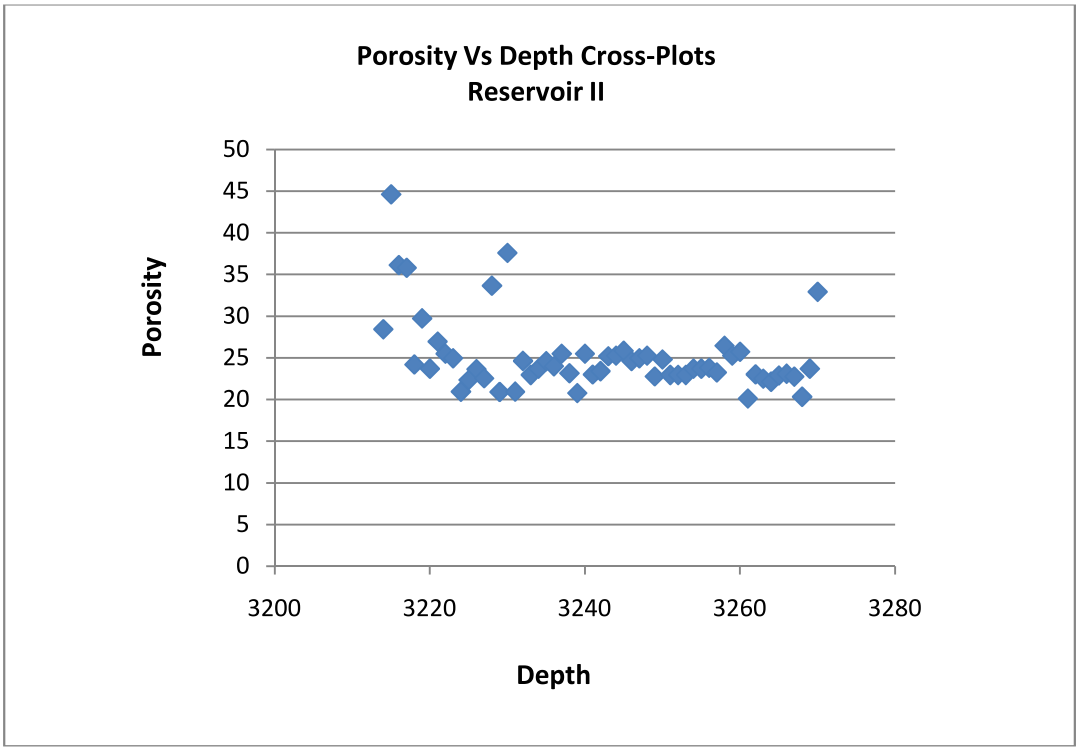


Fig 4. The Different Types of Facies Interpreted from Gamma Ray Logs of Well-A

The presence of shale would have reduced the porosity further but the contrary observed here is due to the type of clay minerals that make up the shales. GOCON (1988) suggested that the minimum porosity for a hydrocarbon-bearing rock to be of economic importance is 10%-20%. From the studied well the average porosity is 25.20% which is very good (Tissot and Welte, 1984). This was also corroborated by the average porosity values from the core analyses which are 20.55% and 23.72% for ND97065 and ND97067 respectively. This shows that the two reservoirs are of economic significance.





In order to determine the fluid content of the two reservoirs, water saturation (S_w) values from the the wireline logs were used and compared with those from core analyses. A zone or sand level where the water saturation is higher than 0.50 means that the zone is water bearing whereas if it is less than 0.50, then it is hydrocarbon bearing. Water saturation at 0.50 implies that the zones have equal amount of water and hydrocarbon (Schlumberger,1989). Reservoir I was found to contain entirely of hydrocarbon while reservoir II was found to contain hydrocarbon and water (Tables 1.0, 2.0 & 2.1). Oil-water contact gas-oil contact was read from the logs for reservoir II and they were at 3250m and 3232m respectively (Fig 5)

Permeability is seldom the same in all directions within a rock. Vertical permeability is generally less than horizontal permeability, this is the case for heterogeneous reservoirs (Bryant et al, 1993). A look at the (average) permeability results from core analysis of reservoir II (Table 1, ND97065) generally agree with this assertion (except in a few intervals) suggesting that the reservoir II is heterogeneous. The permeability values from wireline logs for well A ranges from 647.76md to 72320.21md for reservoir I and 757.1md-106691.5md for reservoir II suggesting that these are good (exploitable) reservoir horizon (Tables 2.0). For a rock to be considered as an exploitable hydrocarbon reservoir without stimulation, its permeability must be greater than approximately 100 md (however, depending on the nature of the hydrocarbon - gas reservoirs with lower permeabilities are still exploitable because of the lower viscosity of gas with respect to oil). The good exploitable characteristics of these reservoirs are confirmed by the core analysis of ND 97065 and ND 97067 permeability results (Table 1).

Table 1 Evaluation Parameters from core analysis

ND97065

		Permeability					
Nos	**Depth**	**Horizontal md**	**Vertical md**	**Total k md**	**Porosity Helium %**	**Sw**	**Fluid Indicated**
1	3236	334	37.9	371.9	17.4	0.27	Hc
2	3236.25	2020	2050	4070	22.3	0.3	Hc
3	336.5	2550	3160	5710	21.3	0.36	Hc
4	3237	8730	3960	12690	21.2	0.35	Hc
Average		**3408.5**	**2301.975**	**5710.475**	**20.55**	**0.32**	

ND97067

		Permeability					
Nos	**Depth**	**Horizontal md**	**Vertical md**	**Total k md**	**Porosity Helium %**	**Sw**	**Fluid Indicated**
5	3253	4950	3780	87309	25	0.66	H_20
6	3253.25	5750	5500	11260	23.7	0.5	$Hc=H_2O$
7	3253.5	5000	4110	9110	22.9	0.63	H_2O
8	3253.75	6510	9210	15720	24.5	0.25	Hc
9	3254	4580	9160	13740	22.5	0.19	Hc
Average		5358	6352	27427.8	23.72	0.446	

The facies and depositional environment of the sequence cross-cut by well **A** are discussed in the light of the knowledge of depositional facies so recognised from gamma ray logs. The gamma ray log is best used for facies delineation, because their curves give greater variety of shapes; show greater details and have more characteristics than other logs (Schlumberger,1998). Facies delineation using well-logs is generally based on recognition of log-patterns

Seven basic facies types were delineated (fig 4). These include (i) Point bars (PB) (ii) Barrier bar (BB) (iii) Barrier foot (BF) (iv) Marine clay (MC) (v) Tidal channel (TC) (vi) Tidal flat (TF) (vii) Transgressive sand facies (TS). All these facies were deposited in different depositional environments. Marine clay facies for example is characteristic of the basin plain environment unit which is found in the deep sea environment.

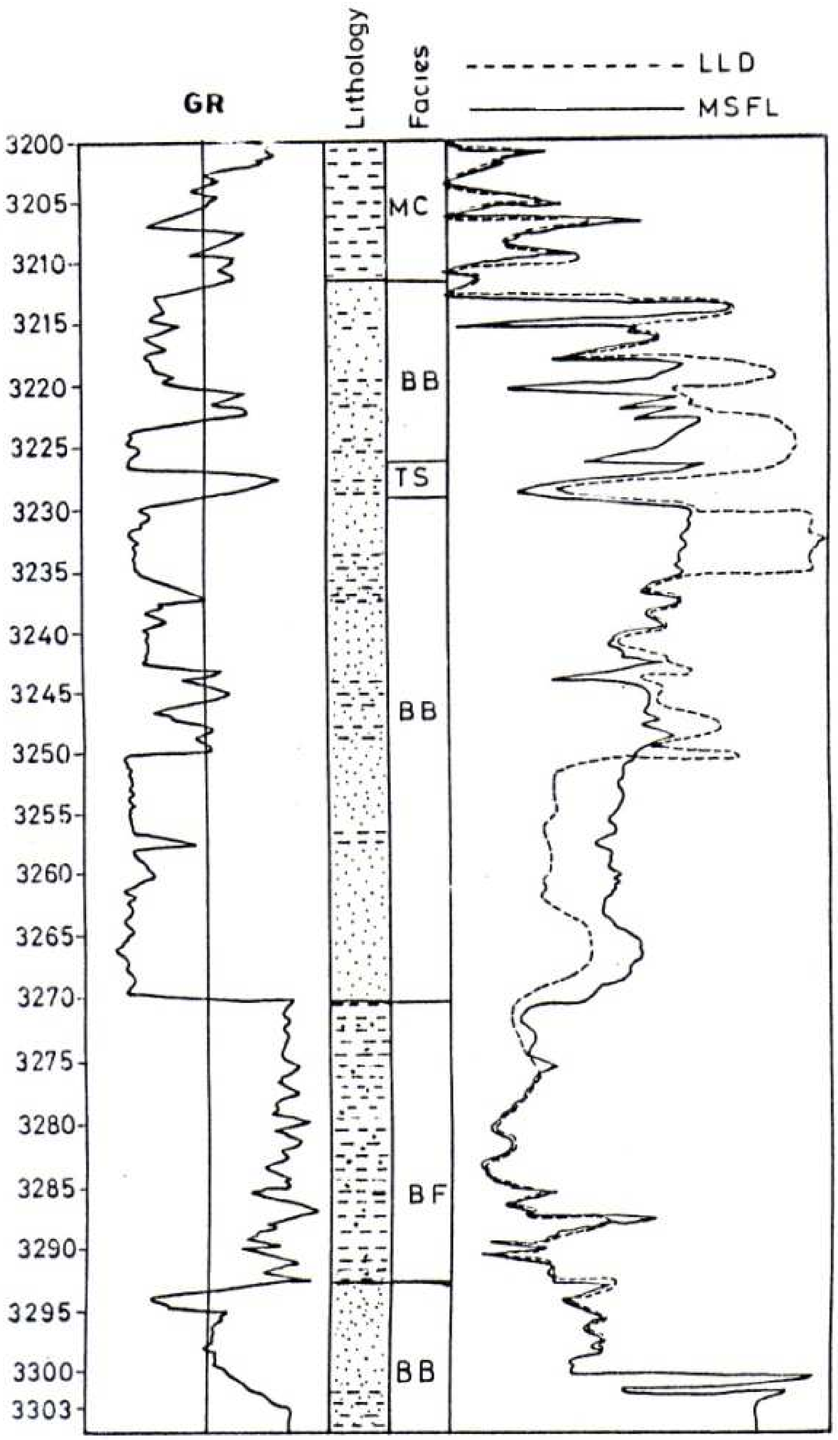


Fig. 5: Log Responses of Well - A at Depth Interval of 3200 - 3303m, Showing Lithology and Facies.

Marine clay may contain significant amount of montmorrillonite. Marine clays are of great importance with respect to the hydrocarbon accumulations because they form the seal over the top of the reservoirs as is the case in the two reservoirs in well **A** (fig 5)**.** Barrier bars are characterised by a coarsening upward sequence of sands; these are deposits of the inner fan-channel environment unit which form the sedimentary off-lap cycles in the Niger Delta. They are usually coarse and clean enough to be regarded as potential reservoir beds (Coleman and Prior,1980).

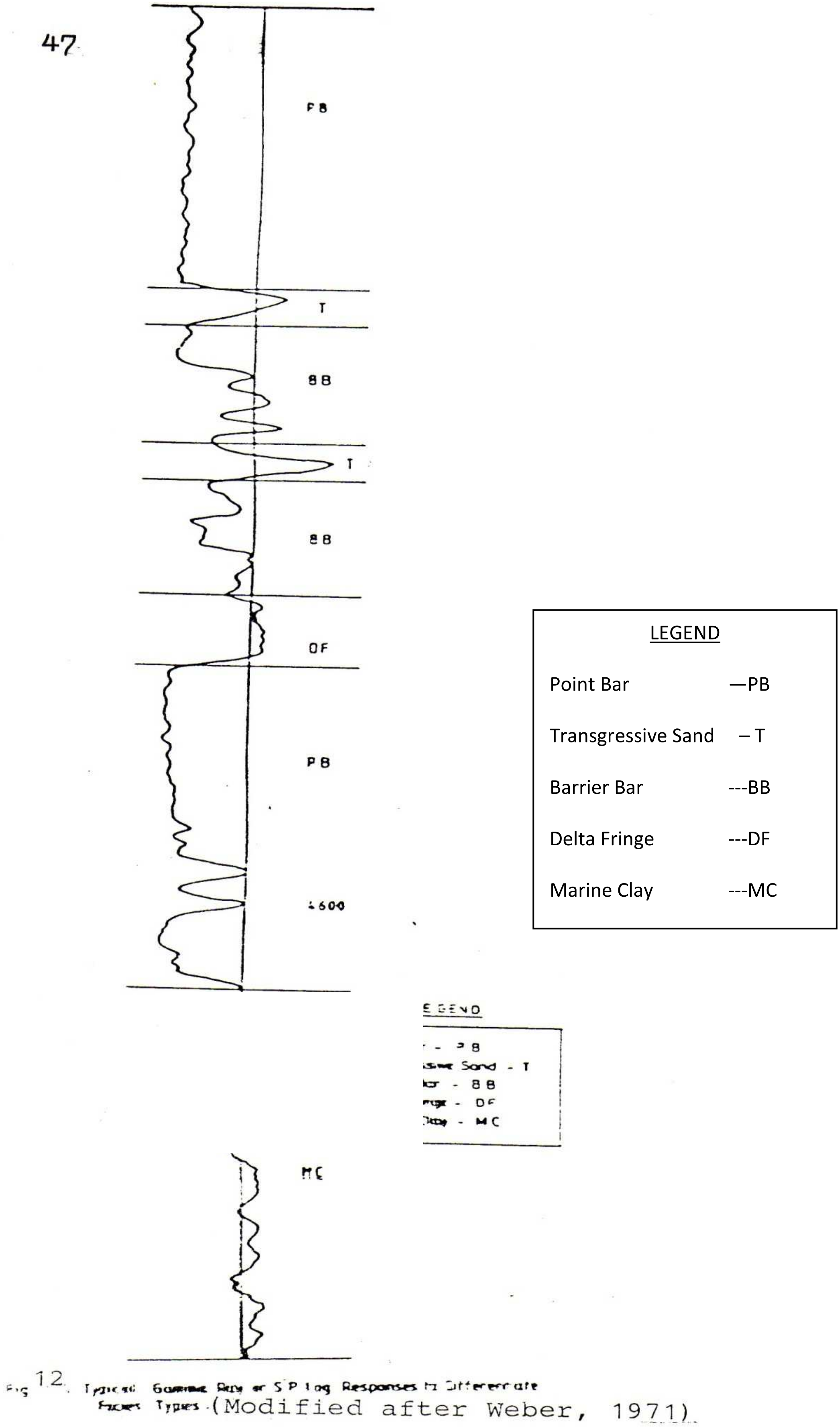


Fig 6 Typical Gamma Ray or SP Log Responses for Different Facies Types (Modified after Weber, 1971)

Tabble 2 Evaluation Parameters From Wireline Logs
RESERVOIR I

Depth	ÓN	ÓN corrected	ÓD	ÓN.D	F	Swirr	K	Rt	Rwa	Sw	Fluid Indicated	Sp-log values	R_o
2988	27.0	30	15.2	23.78	13.33	8.16	72320.21	12	0.9	0.31	Hc	18	1.2
2989	24.6	28	18.7	23.81	13.57	8.24	2291.1	40	2.9	0.17	Hc	-54	1.2
2990	12.6	17	35.1	27.57	9.95	7.05	5958.05	80	8.0	0.10	Hc	-56	0.84
2991	12.6	17	32.7	26.06	11.13	7.40	4152.99	200	18.0	0.08	Hc	-56	0.96
2992	27.0	31	32.7	31.86	7.28	6.01	15490.75	160	22.0	0.06	Hc	-56	0.65
2993	35.8	29	30.4	29.71	8.43	6.49	9768.37	80	9.5	0.10	Hc	-56	0.73
2994	18.8	22	31.6	27.23	10.19	7.14	5499.82	60	5.9	0.12	Hc	-56	0.84
2995	21.0	24	23.9	23.95	13.45	8.2	2370.58	40	3.0	0.17	Hc	-56	1.2
2996	18.8	22	21.0	21.51	16.89	9.19	1176.40	20	1.2	0.27	Hc	-52	1.48
2997	34.2	37	15.2	28.28	9.35	6.84	7079.26	12	1.3	0.26	Hc	-38	0.80
2998	27.0	30	32.7	31.38	7.48	6.11	14020.18	40	5.3	0.13	Hc	-50	0.68
2999	21.0	24	31.8	28.06	9.50	6.89	6740.71	40	4.2	0.14	Hc	-55	0.80
3000	18.6	20	35.7	28.93	8.94	6.68	8202.43	160	17.8	0.07	Hc	-55	0.75
3001	21.0	24	33.9	29.37	8.64	6.57	9062.22	40	4.6	0.14	Hc	-60	0.75
3002	21.0	24	30.4	27.39	10.03	7.08	5740.27	40	4.0	0.15	Hc	-64	0.84
3003	5.4	7	42.1	30.18	12.52	7.91	7045.91	120	9.6	0.77	H_2O	-62	0.71
3004	6.0	8.4	42.1	30.35	8.08	6.35	11207.70	1000	123.8	0.02	Hc	-60	0.71
3005	5.0	7.4	40.9	29.35	8.62	6.56	9116.87	1000	116.0	0.02	Hc	-60	0.75
3006	24.0	27	36.2	31.93	7.23	6.01	15641.07	160	22.1	0.06	Hc	-55	0.65
3007	24.0	30	32.7	31.38	7.48	6.11	14020.19	180	24.1	0.06	Hc	-52	0.68
3008	27.0	1.3	35.1	26.47	10.77	7.35	4595.25	14	1..3	0.25	Hc	-54	0.90
3009	9	19	36.2	28.91	8.94	6.68	8177.51	12	1.3	0.26	Hc	-52	0.80
3010	15.0	30	22.2	26.39	10.86	7.37	4497.72	12	1.1	0.28	Hc	-50	0.95
3011	27.0	26	24.0	26.07	11.13	7.46	4160.01	16	1.4	0.24	Hc	-54	0.95
3012	24.6	24	18.1	21.25	17.23	9.23	1093.48	16	0.9	09.31	Hc	-46	1.56
3013	21.0	30	21.0	25.89	11.32	7.52	3970.88	14	1.2	0.26	Hc	-48	0.95
3014	27.0	30	18.7	25.00	12.21	7.81	3156.57	12	0.9	0.29	Hc	-42	1.04
3015	27.0	32	15.2	25.05	12.11	7.78	3208.65	10	0.82	0.32	Hc	-42	1.04
3016	29.4	30	31.5	30.18	7.80	6.24	12398.99	40	5.1	0.13	Hc	-59	0.68
3017	27.0	27	31.6	29.39	8.62	6.56	9116.87	80	9.2	0.10	Hc	-62	0.75
3018	24.0	27	30.4	28.75	9.08	6.73	7862.18	100	11.0	0.09	Hc	-64	0.80
3019	25.8	29	25.7	27.40	10.03	7.03	5748.35	60	6.0	0.12	Hc	-64	0.84
3020	23.4	26	26.9	26.45	10.86	7.37	4592.05	40	3.7	0.15	Hc	-65	0.90
3021	24.6	28	31.5	29.80	8.37	6.47	9960.73	40	4.8	0.13	Hc	-63	0.71
3022	18.0	21	26.9	24.13	13.21	8.13	2492.24	38	2.9	0.17	Hc	-62	1.04
3023	19.8	23	26.3	24.70	12.53	7.91	2912.69	12	1.0	0.29	Hc	-48	1.04
3024	21.0	24	14.0	19.65	20.61	10.15	647.76	10	0.5	0.47	Hc	-42	2.2
3025	27.0	30	18.7	25.00	12.21	6.78	4187.93	10	0.8	0.32	Hc	-40	1.04

Point bars which are characteristic of fluviatile-channel environment unit commonly consist of clean well sorted sands and thus obvious potential reservoir for hydrocarbon. This environment show fining upward sequence.

Delta border progradation environment typified by delta fringe facies has thickened sand laminae and in some cases they form the barrier foot, tidal flat and tidal channel. The transgressive marine shelf environment on the other hand are characterized by Transgressive sand facies, inferred by the high gamma radiation emitted due to high percentage of potassium rich glauconite. The sands in this type of environment are derived from reworking and winnowing of eroded beds.

Table 2.0 (continuation) Evaluation Parameters from Wireline Logs
RESERVOIR II

Depth	ÓN	ÓN corrected	ÓD	ÓN.D	F	S_{wirr}	K	R_t	R_{wa}	S_w	Fluid Indicated	Sp-log values	Φfrom sonic log	R_o
3212.55	212.0	30.0	26.9	28.5	9.2	6.7	7633.2	25	0.35	0.25	Hc	-55	43.5	5.9
3213.0	15.0	19.0	0.21	28..31	9.3	6.8	7195.4	45	0.26	0.38	Hc	-9	42.9	5.6
3214.0	13.8	18.0	0.22	28.43	9.3	6.8	7330.6	80	0.37	0.07	Hc	-4	29.0	5.6
3215	27.0	30.0	0.33	44.60	3.5	4.8	106691.5	20	0.29	0.14	Hc	-5	24.5	2.8
3216	21.0	42.0	0.27	36.12	5.5	5.2	35943.7	45	0.33	0.30	Hc	-5	35.8	3.75
3217	17.4	21.0	0.29	35.80	5.6	5.3	33271.5	35	0.22	0.26	Hc	-5	29.0	3.8
3218	11.4	15.0	0.19	24.20	13.1	8.1	2543.1	180	0.51	0.35	Hc	-2	24.5	8.4
3219	16.2	20.0	0.22	29.73	8.4	6.5	9767.2	40		0.44	Hc	-2	24.5	10.3
3220	17.0	20.0	26.6	23.7	13.7	8.3	2209.4	40	2.9	0.49	Hc	-10	22.5	9.5
3221	24.0	17	26.9	26.95	10.4	7.2	5168.1	60	5.7	0.35	Hc	-2	25.0	7.5
3222	21.0	42	26.9	25.49	11.7	7.6	3630.3	45	3.9	0.42	Hc	0	24.5	7.5
3223	12.5	16.5	32.16	24.95	12.3	7.8	3136.6	350	28.5	0.15	Hc	0	24.5	8.0
3224	12.5	16.5	24.6	20.95	17.9	9.5	980.2	350	19.6	0.19	Hc	-1	19.5	12.5
3225	14.5	17.5	26.32	22.35	15.5	8.8	1518.4	160	10.3	0.28	Hc	0	27.5	10.5
3226	16.0	19.0	27.49	23.63	13.8	8.3	2180.8	140	10.1	0.27	Hc	-1	27.5	10.0
3227	15.0	18.0	26.32	22.55	15.2	8.7	1615.6	40	2.6	0.51	Hc=H_2O	-1	24	10.5
3228	44.5	44.5	18.13	33.65	6.44	5.7	21704.0	11	1.7	0.62	H_2O	-20	24.0	4.4
3229	22.0	25.0	15.79	20.91	17.9	9.5	972.0	14	0.9	0.94	H_2O	-10	28.0	12.5
3230	45.5	45.5	27.49	37.59	5.1	5.0	46335.8	200	39.2	0.13	Hc	0	24.5	3.4
3231	7.0	11.0	27.49	20.94	17.9	9.5	980.2	300	16.8	0.20	Hc	0	24.5	12.5
3232	15.0	18.0	29.82	24.63	12.6	7.9	2888.9	400	31.7	0.14	Hc	0	25.0	8.3
3233	16.0	19.0	26.32	22.95	14.7	8.6	1786.4	300	20.4	0.18	Hc	0	24.5	10.0
3234	17.0	20.0	26.90	23.70	13.7	8.3	2209.4	350	25.5	0.16	Hc	0	24.0	9.5
3235	17.5	20.5	26.07	24.59	12.7	8.0	2797.0	300	23.6	0.17	Hc	-1	24.0	8.5
3236	21.0	24.0	23.97	23.99	13.3	8.2	2388.1	45	3.4	0.47	Hc	-1	27.5	9.8
3237	21.0	24.0	26.90	25.49	11.7	7.6	3630.3	100	8.5	0.28	Hc	-1	24.5	8.0
3238	15.5	19.5	26.32	23.16	14.4	8.5	1903.5	80	5.6	0.34	Hc	-1	22.0	9.5
3239	14.0	18.5	22.81	20.77	18.2	9.5	943.7	40	2.2	0.55	Hc=H_2O	-2	24.5	12.0
3240	21.0	24.0	26.90	25.49	11.7	7.6	3630.3	33	2.8	0.49	Hc	-1	24.0	8.0
3241	19.0	22.0	23.91	23.0	14.6	8.5	1846.3	30	2.1	0.56	Hc-H_2O	-2	28.5	9.5
3242	18.5	21.5	25.15	23.40	14.1	8.4	2039.5	50	3.5	0.43	Hc	-1	26.5	9.4
3243	21.0	24.0	26.32	25.19	12.0	7.7	3357.1	35	2.9	0.48	Hc	-1	31.0	8.0
3244	20.5	23.5	26.90	25.26	11.9	7.7	3398.3	40	3.4	0.45	Hc	-1	28.0	8.0
3245	23.0	26.0	25.70	25.85	11.4	7.5	3965.6	40	3.5	0.44	Hc	-1	25.5	7.8
3246	20.5	23.5	25.70	24.62	12.6	7.9	2883.7	50	4.0	0.41	Hc	-1	28.5	8.5
3247	20.5	23.5	26.33	24.95	12.3	7.8	3136.6	80	6.5	0.32	Hc	-1	29.5	8.2
3248	20.5	23.5	26.90	25.26	11.9	7.7	3398.3	55	4.6	0.38	Hc	0	26.0	8.0
3249	18.5	21.5	23.97	22.77	14.9	8.6	1725.6	50	3.4	0.44	Hc	0	24.0	10.0
3250	14.5	18.5	29.82	24.81	12.4	7.9	2982.9	140	11.3	0.24	Hc	0	18.0	8.3
3251	16.0	19.0	26.32	22.95	14.7	8.6	1786.4	18	1.2	0.74	Hc	0	23.0	9.8
3252	16.0	19.0	26.32	22.95	14.7	8.6	1786	12	0.8	0.90	H_2O	0	22.0	9.8
3253	16.0	19.0	26.32	22.95	14.7	8.6	1786.4	10	0.6	1.0	H_2O	0	21.5	10.0
3254	17.6	20.5	26.90	23.70	13.7	8.3	2209.4	12	0.9	0.89	H_2O	0	23.0	9.5
3255	17.0	20.0	26.90	23.70	13.7	8.3	2310.4	12	0.9	0.89	H_2O	0	21.5	9.5
3256	18.5	21.0	26.32	23.81	13.6	8.2	1936.3	12	0.8	0.89	H_2O	0	21.5	9.4
3257	17.5	20.5	25.70	23.25	14.3	8.5	1936.3	10	0.9	0.88	H_2O	0	23.0	9.5
3258	23.0	26.0	26.90	26.45	10.8	7.3	4629.8	10	0.9	0.88	H_2O	0	24.0	7.8
3259	20.5	23.5	26.90	25.26	11.9	7.7	3398.3	11	0.9	0.86	H_2O	0	22.0	8.1
3260	21.5	24.5	26.90	25.73	11.5	7.6	3783.1	11	1.0	0.85	H_2O	0	20.0	8.0
3261	14.5	18.5	21.64	20.13	19.5	9.9	757.1	12	0.6	1.0	H_2O	0	21.5	12.5
3262	16.5	19.5	28.07	23.02	14.5	8.5	1853.4	9	0.6	1.0	H_2O	0	21.5	9.5
3263	17.0	20.0	26.90	22.50	15.3	8.7	1599.9	11	0.7	0.9	H_2O	0	21.0	10.5
3264	16.0	19.0	26.90	22.13	15.9	8.9	1421.3	18	11	0.78	H_2O	0	21.5	11.0

3265	15.0	18.0	26.90	22.89	14.8	8.6	1766.0	20	1.4	0.71	H_2O	0	20.8	10.0
3266	15.5	18.5	26.90	23.09	14.5	8.5	1834.9	20	1.4	0.69	H_2O	0	28.8	9.5
3267	15.0	18.5	26.32	22.75	15.0	8.7	1679.6	18	1.2	0.71	H_2O	0	17.0	9.0
3268	14.5	17.5	22.81	20.33	19.1	9.8	807.0	10	0.5	1.0	H_2O	-2	20.8	12.5
3269	17.0	20.0	26.90	23.70	13.7	8.3	2209.4	9	0.7	1.0	H_2O	-2	22.0	9.0
3270	44.0	44.0	15.20	32.92	6.8	5.8	19209.1	8	1.2	0.75	H_2O	-2	30.0	4.5

Table 2.1 Evaluation Parameters from Wireline Logs (corresponding to ND97350 & ND97065 respectively)

Depth	ǾN	ǾN corrected	ǾD	ǾN-D	F	Swirr	k	Rt	Rwa	Sw	Fluid Indicated	Sp-Log values
3236.00	21.0	24.0	23.97	23.99	13.3	8.2	2388.1	45	3.45	0.27	Hc	-1
3236.25	22.0	25.0	22.2	23.61	13.8	8.3	2168.7	40	2.96	0.31	Hc	-1
3236..50	23.0	26.0	24.0	25.03	12.2	7.8	3164.4	55	4.57	0.36	Hc	-1
3236.75	22.0	25.0	26.3	25.60	11.6	7.6	3699.75	80	6.99	0.34	Hc	-1
3237.00	21.0	24.0	26.9	25.44	11.6	7.6	3237	100	8.53	0.35	Hc	-1

Depth	ǾN	ǾN corrected	ǾD	ǾN-D	F	Swirr	k	R_t	Rwa	Sw	Fluid Indicated	Sp-Log values
3263.0	16.0	19.0	26.32	22.95	14.7	8.6	1786.4	10	0.5	0.68	H_2O	0
3253.25	14.0	18.0	26.3	22.5	15.3	8.7	1599.9	11	0.7	0.50	Hc=H_2O	0
3253.50	18.0	21.0	26.9	24.1	13.2	8.1	2497.1	12	0.9	0.63	H_2O	0
3253.75	17.0	20.0	26.9	23.70	13.7	8.3	2209.4	12	0.9	0.25	Hc	0
3254.00	17.6	20.5	29.9	23.70	13.7	8.3	2209.4	12	0.93	0.56	H_2O	0

CONCLUSION

One of the essential potentials for commercial accumulation of hydrocarbon is the existence of a reservoir. Prediction of reservoir parameters is an integral part of petroleum exploration geology. Such estimates are especially critical in evaluating prospects and potentials where reserves and productivity are considered for economic success.

From well A in field Y, two economically viable reservoir horizons were delineated and evaluated. It was found that the reservoirs have good porosity ranging from 19% to 31.93% in reservoir I and 20.91% to 44.60% in reservoir II from neutron density log combination. These results were confirmed for reservoir II from the result of core analysis of ND97065 and ND 97067. ND 97066 was not analysed because it was a shale break within the reservoir. The permeability of these reservoirs is high and good, ranging from 647.76md to 106691.5md for both reservoir horizons.Since, the porosity and permeability were high, and there was a drop in production of hydrocarbon after some time, the high neutron porosity log which indicates the presence of shale in the reservoir sand was suspected to be as a result of the clay content of the shale being montmorrilonite. Montmorillonite does not have significant effect on permeability in the presence of hydrocarbon but has the ability to swell and greatly reduce permeability when saturated with water (Selley,1998). If this is the case of this reservoir, then the montmorrillonite clay could pose a problem during production in that during production, high recovery rate may be experienced initially and after a while, productivity will decline due to formation damage. The principle is that when production begins, water displaces the crude hydrocarbon, causing the montmorrillonite clay to expand and destroy the permeability of the lower part of the reservoir (Selley, 1998). This was the case in well A. Hence during drilling of other wells within the same field the use of oil-based mud is advised rather than the conventional water-based mud.

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REFERENCES

[1] Bryant, S., Cade, S and Mellor, D, **1993**, *The Amer. Assoc. of Petrol. Geol. Bull*. Vol. 77, No. 8, P. 1338-1350.
[2] Coleman, J.M and Prior, D.B, Deltaic sand bodies. A 1980 short education course, **1980**, Note series #15, *The Amer. Assoc. of Petrol. Geol*. 195p
[3] Gocon, Porosity Gradient Studies in Niger delta, **1988**, P. 1-7.
[4] Schlumberger: Log Interpretation Charts: Schlumberger Well Serv. Inc., Houston, Texas, U.S.A,**1989**, P.3-8 – 3,11, A3.
[5] Selley R.C, Elements of Petroleum Geology, Academic Press Limited, London,**1998** P. 37-131, 239-299
[6] Tissot, B.P and Welte, D.H, Petroleum formation and Occurrence, Springer-Verlag, Berlin,**1984,** P. 356-361.