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Research Article

FORMATION EVALUATION OF SIRP FIELD USING WIRELINE LOGS IN WESTERN DEPOBELT OF NIGER DELTA

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ABSTRACT

This interpretation is based on basic open hole logs. The essence is to evaluate porosity and litho-facie of SIRP in the Western Niger Delta Depobelt. Parameters of importance include Gamma Ray Log, Resistivity Log, Density Log and Neutron log The Formation Evaluation was performed to identify hydrocarbon bearing reservoir sand and study reservoir properties based on data from five wells imported to a software after proper scaling. Three out of the five wells contained sufficient data to allow detailed analysis such as porosity and lithofacie evaluation. In some of the sands that contains less feldspathic minerals, the porosity is good and probably viable for development.

Key Words: Formation Evaluation, Gamma ray, Resistivity, Density/Neutron logs, Porosity, Lithofacie, Niger Delta.

INTRODUCTION

The Niger Delta is a highly constructive resulting from plane jet inflow of less dense river water into denser Salt Ocean. The basin is deformed by large synsedimentary faults known as growth faults, antithetic and roll over anticlines and diapirs (Reyment, 1965). Formation Evaluation is based on logs. Petrophysical parameters like lithology, porosity and hydrocarbon saturation were derived from the log data. The field of study lies in the western Niger Delta between longitude 4° 49.86' E and latitude 5° 43.48' N. Three major lithostratigraphic units have been recognized in the Niger Delta. These are the Akata, Agbada and Benin Formation. The geology of Niger Delta in details has been discussed by several authors (Allen, 1965; Short and Stauble, 1967; Whiteman, 1982).

The Benin Formation is the shallowest part of the sequence and is composed almost entirely of non marine sand with occasional lignite and clays. They become thinner and disappear near the shelf edge. The Agbada Formation is made up of alternation sands, silts and shales. It forms the hydrocarbon prospective sequence and is a centre of overpressure. The alternation of fine and coarse clastic provides multiple reservoir seals. The Paralic Agbada Formation is thickest at the centre of the Delta, having sands mostly encountered at the upper part while shales mainly at the lower part. The Akata Formation (Marine Shales) is the zone of high over burden. It contains few streaks of sand possibly of turbitite origin. Marine Shales forms the base of the sequence in each depobelt. The mobile nature of the Akata Formation is the key factor in the development of growth faults (Short and Stauble, 1967). In the work of Archie (1942), it sets out fundamentals of rock type classification. Any porous network is related to its host rock fabric, therefore petrophysical parameters such as porosity, permeability, and saturation for any given type of rock are controlled by pore size, their distribution and interconnection. This paper is focused in computing and evaluating the petrophysical parameters of three offshore wells in the Niger Delta using Petrel Software.

MATERIALS AND METHODS

The major tool for this work is Petrel software. Evaluation analyses were carried out using wireline logs (Gamma Ray, Resistivity, Neutron and Density Logs). The depth of the log ranges from 5372.43 ft to 8603.00 ft. These logs obtained in ASCII format were imported into the petrel to generate continuous log and proper scaling of each of the logs was made to avoid errors. The reservoir top and base were also obtained using the petrel tool.

RESULTS AND DISCUSSION

The results of the analysis is shown on corresponding reservoirs within each of the wells SIRP 1, SIRP 3 & SIRP 4 were obtained as shown in Table 1-3 and Figures 1-6. The reservoir fluid was characterized using the interaction between Neutron and Density Logs. Edited input well logs data were used to generate rock properties with the aid of log calculator in the petrel. Some of the petrophysical results obtained include porosity log, V shale and lithofacies. The Gamma ray calculation was employed to determine the percentage of shale, hence the dominant lithology. These give the clean sand line from the Gamma Ray Log.

The evaluated sands showed little reduction with increase in depth. The porosity of the upper unit sand A has is higher than the lower unit sand B Table 1. This according to Schlumberger (1985), is due to the unconsolidated nature of the Niger Delta. Compaction and diagenetic processes therefore, seem to have very little or no effect on the porosity of the area. On Table 2 the porosity is variable low for sand A, moderate for sand B and moderate for sand C. It has been established that porosity and permeability of sandstones depend on grain size, sorting, cementation and compaction (Weber and Daukuro, 1975) Shlumberger, 1989; Etu-Efeotor, 1997 and Aigbedion, 2007). These variables are functions of the sedimentary environment and depositional processes in low and high energy environment. The porosities were estimated from the Density Log.

Parameter	**Sand A**	**Sand B**
Top MD (ft)	5372.43	6331.80
Base MD (ft)	5443.32	6420.56
Thickness (ft)	70.88	78.75
Total Porosity	0.31	

Table 1: Petrophysical Results for SIRP 1

Parameter	Sand A	Sand B	Sand C
Top MD (ft)	5425.94	6553.61	8543.30
Base MD (ft)	5425.94	6661.07	8603.00
Thickness (ft)	86.56	107.45	59.69
Total Porosity	0.21	0.30	0.26

Table 2: Petrophysical Results for SIRP 3

Parameter	Sand A
Top MD (ft)	5913.18
Base MD (ft)	6054.10
Thickness (ft)	140.9
Total Porosity	0.28

Table 3: Petrophysical Results for SIRP 4

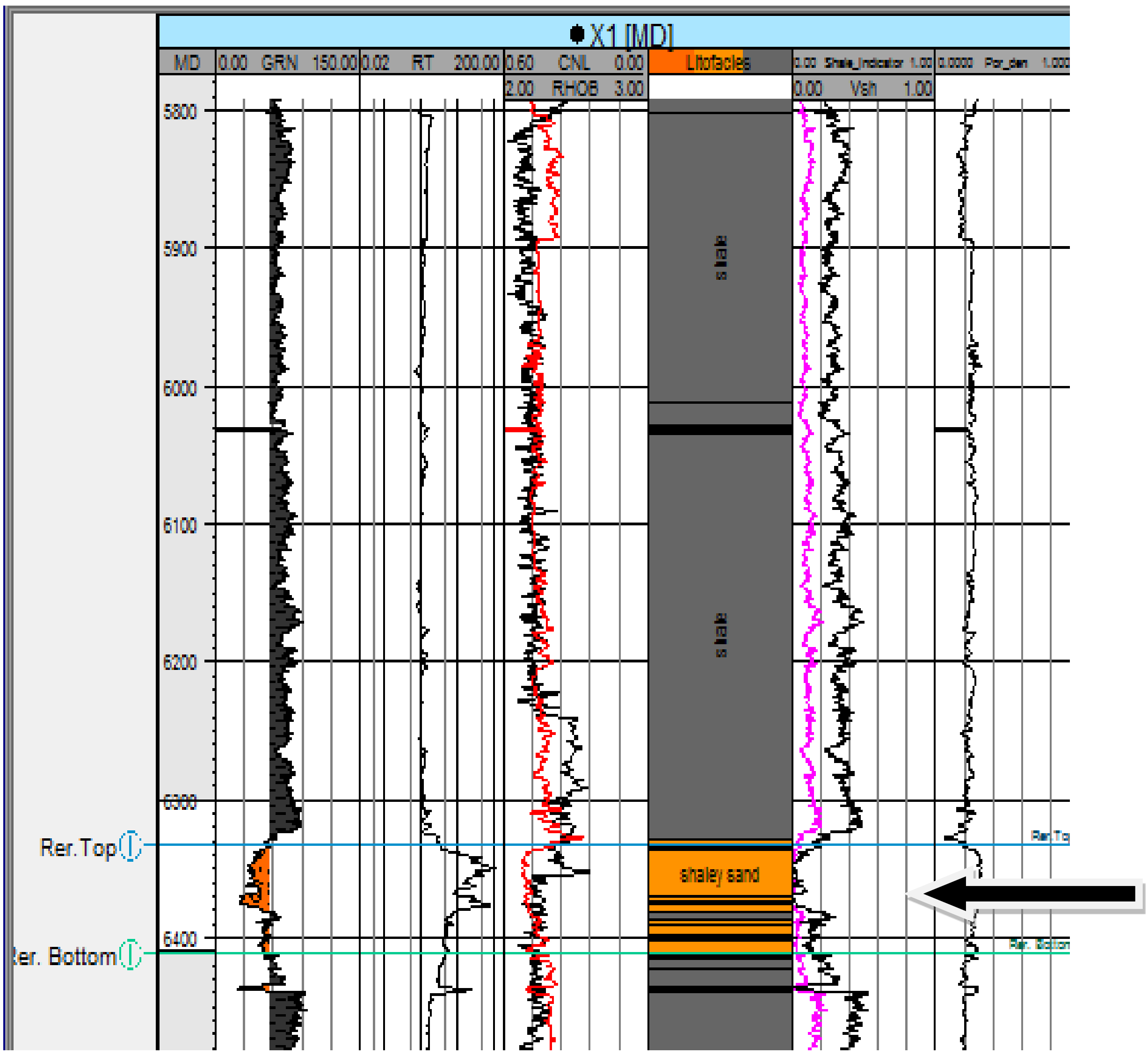

Figure 1: Display of First Reservoir zone thickness of well SIRP 1, (70.88ft)

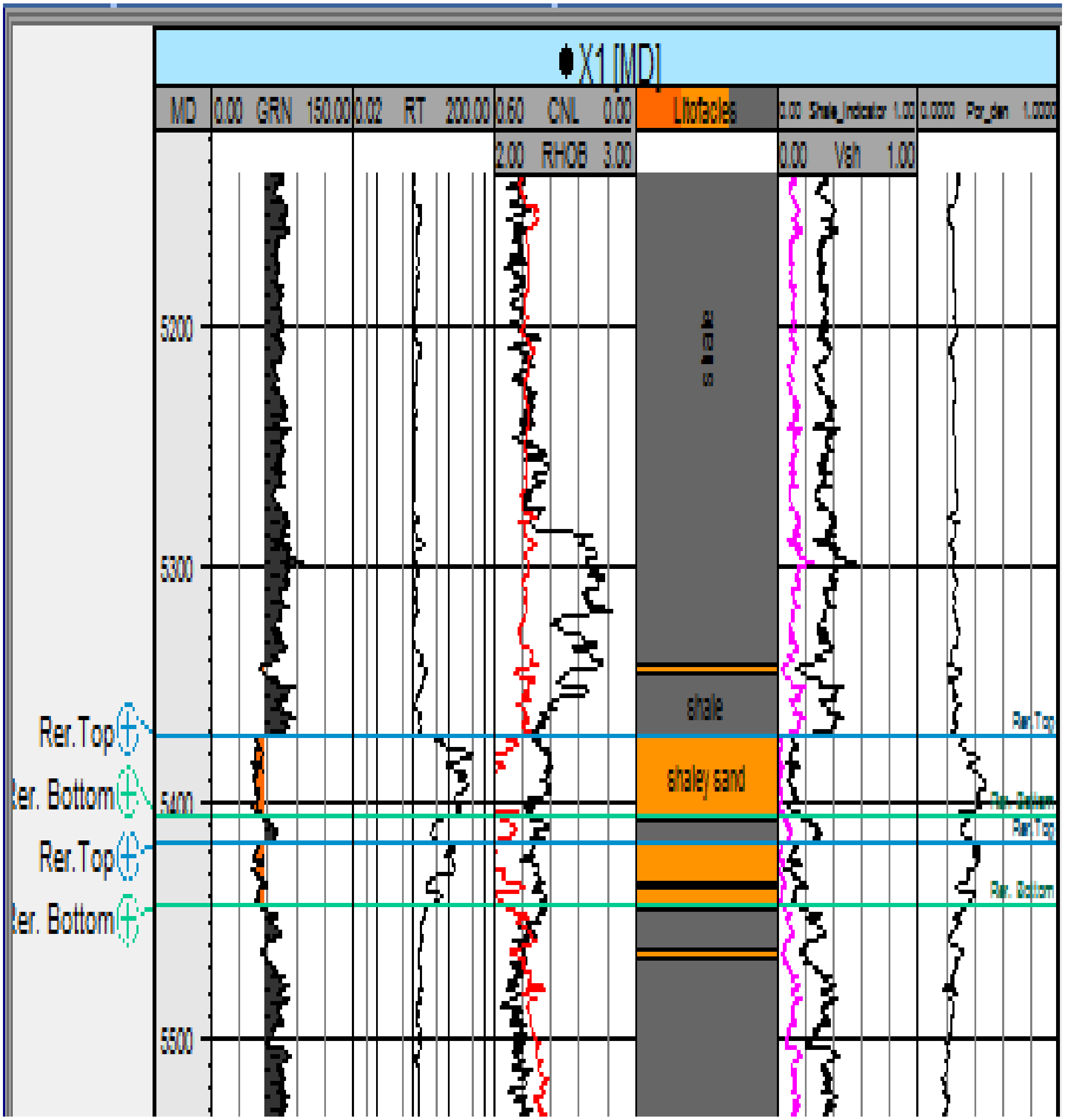

Figure 2: Second Reservoir Zone thickness of well SIRP 1, (78.75ft)

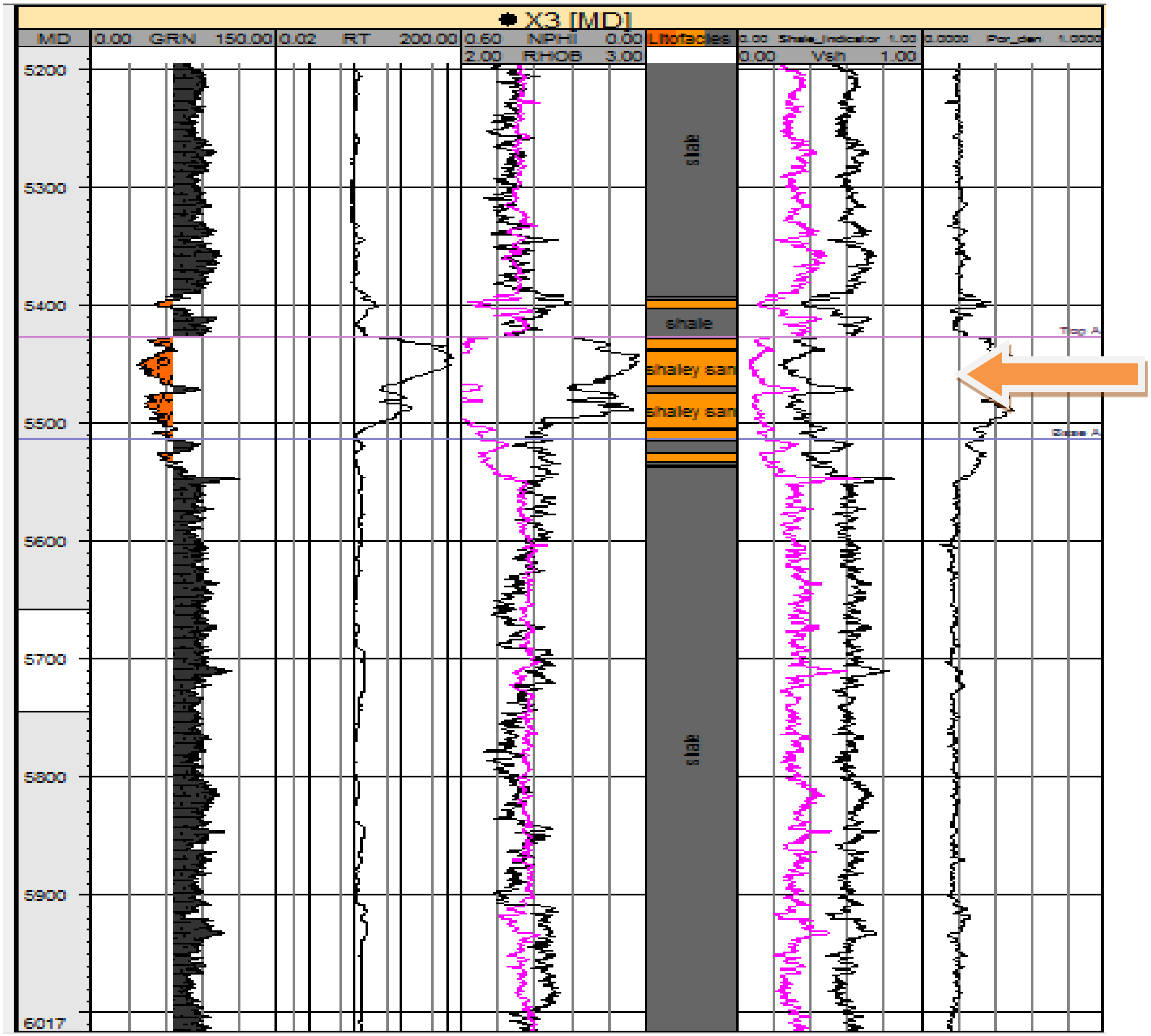

Figure 3: First Reservoir zone thickness of well SIRP 3, (86.56ft)

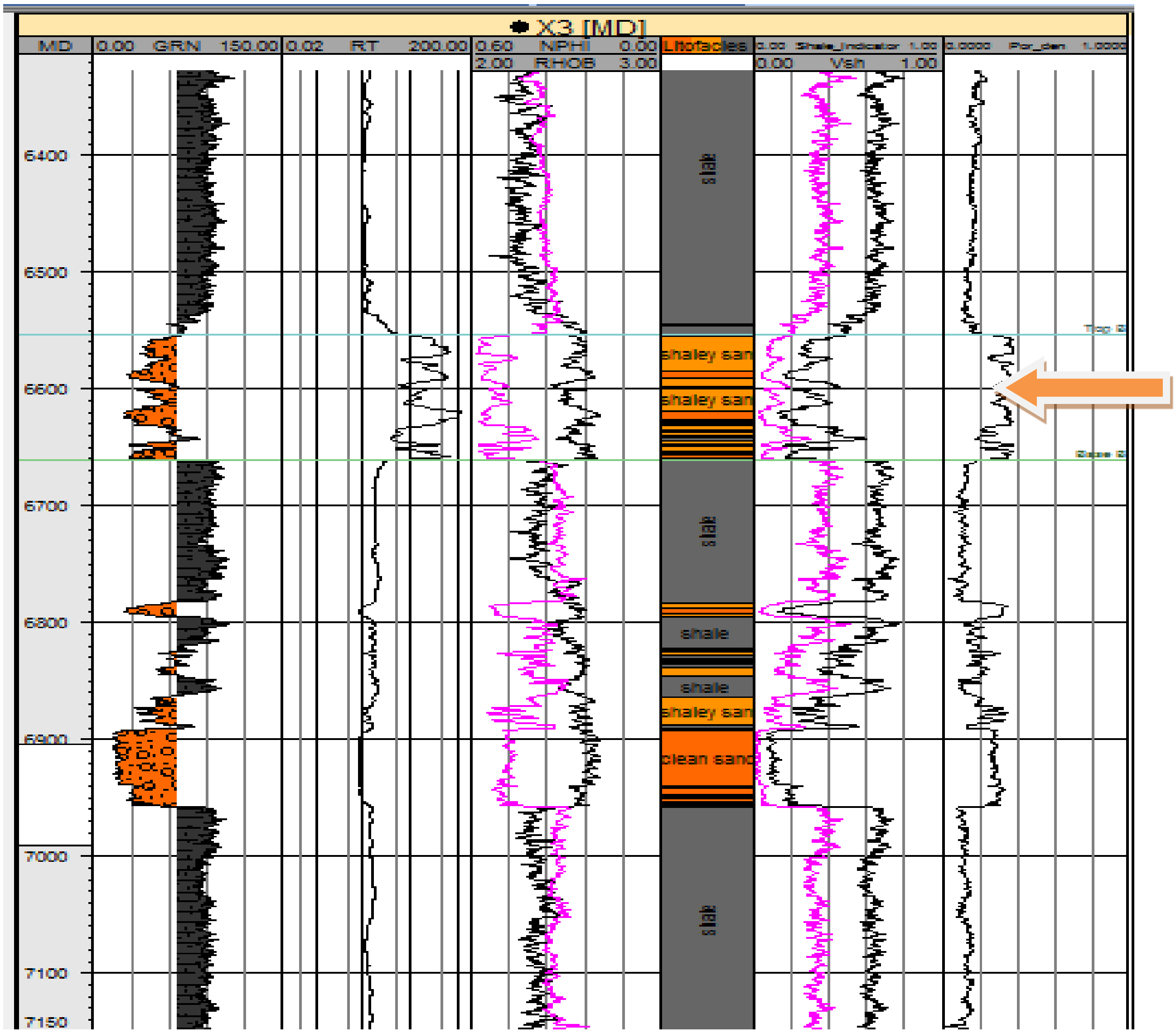

Figure 4: Second Reservoir zone thickness of well SIRP 3, (107.45ft)

Figure 5: Third Reservoir zone thickness of Well SIRP 3, (59.69ft)

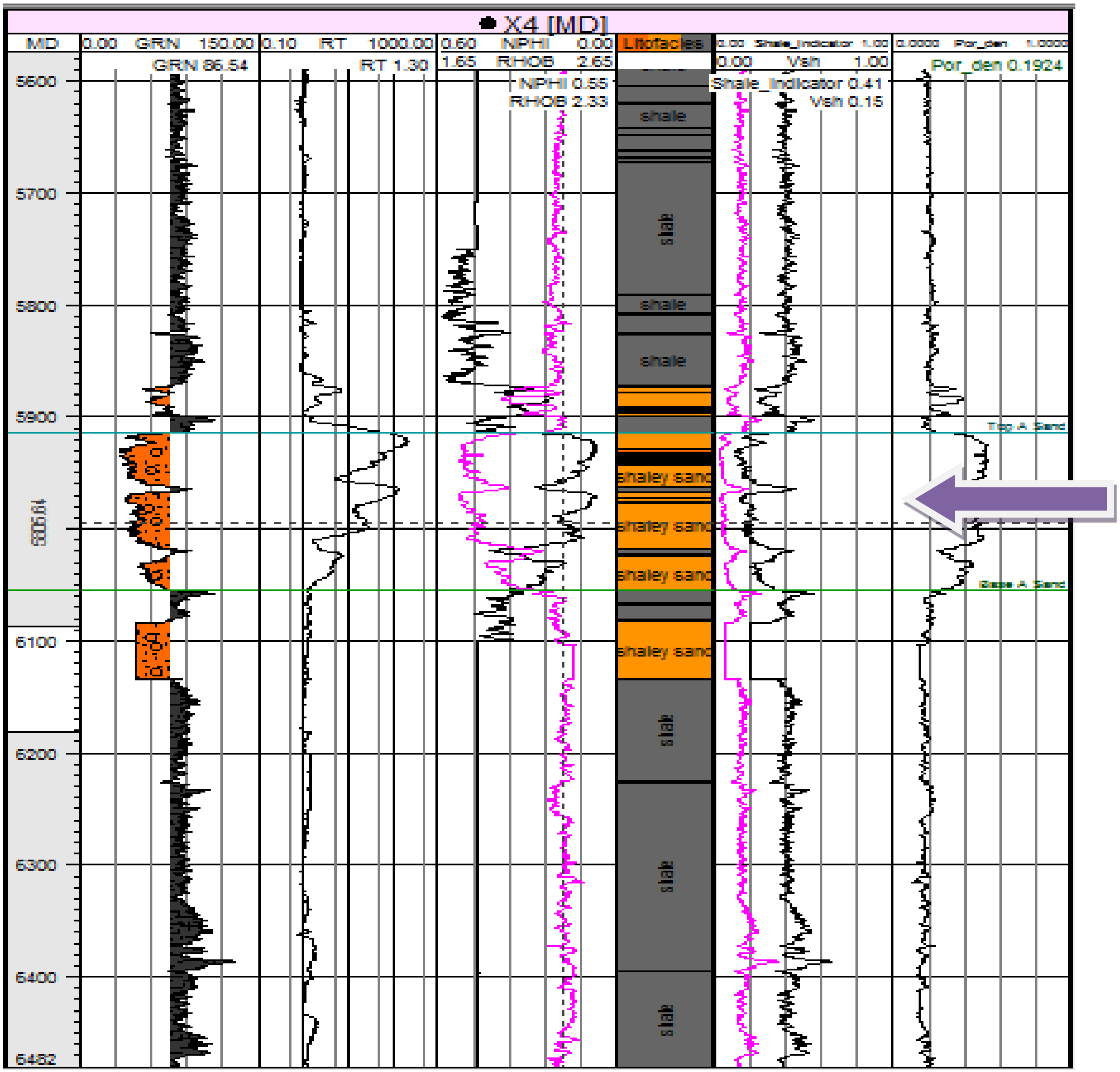

Figure 6: Reservoir zone thickness of well SIRP 4, (140.9ft)

Equations for parametres:

I_{GR} = (GR – GRMin)/(GrMax – GrMin)

Shale_Indicator=(GR-GR.Min)/(GR.Max-GR.Min)

Vsh=0.083*(Pow(2,(3.7*Shale_Indicator))-1)

Por_den=(2.65-RHOB)/(2.65-1)

Litofacies = If(GR<=25,0 ,If(GR>25 And GR<50, 1, If(GR>50,2 ,2)))

Where, I_{GR} = Gamma Ray Index

G_r Max = Maximum value of Gamma Ray

G_r Min = Minimum value of Gamma Ray

V_{sh} = Volume of shale

RHOB = Density log

GR < 50 = shale cutoff

GR > 25 = Half of shale cutoff

CONCLUSION

Generally, all the reservoir sand within the three wells has good porosity and are viable for further development. The lithologies are fairly homogeneous and the lithofacies description across the reservoir sand presents a shaly sand alternation implying that wells in the reservoir are in communication. If the permeability of the reservoir sand is good from core data, in those reservoirs of interest, then the sands have potential for development.

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