

Findra-1 Petrophysical Analysis

Summary

The purpose of this study was to examine the reservoir characteristics of the sands encountered in the Findra-1. The wireline logs were quantitatively interpreted over the interval 290m to 850m to determine shale volume, porosity and water saturation.

Findra-1 was spudded on 26th June, 2004, by Essential Petroleum Pty Ltd and drilled to a total depth of 879m. No fluorescence associated with sands was recorded throughout the reservoir section and no significant gas shows were recorded. The well was plugged and abandoned as a dry well on 2nd July, 2004.

The Dilwyn Formation (332-416m) consisted of excellent quality reservoir sandstones interbedded with shale. The sands are described as clean, very fine to very coarse grained and quartzose. A total of 29.1m of net sand is interpreted over the gross interval 338.5-386.5m with an average porosity of 28.2%. There were no visual or significant gas shows observed during drilling and the high resistivity of 18 ohmm over this interval is indicative of fresh water. The sands are interpreted to be entirely water saturated.

The interval 469-482m, within the Pebble Point Formation is interpreted to consist of good quality reservoir sands interbedded with shales. A total of 8.2m of net reservoir sand is interpreted over the gross interval 469.0-482.0m with an average porosity 18.8%. There were no visual or gas shows observed during drilling and the interval is interpreted to be entirely water saturated. Resistivities are slightly lower (approximately 10 ohmm) which correspond to the slightly more saline formation waters as indicated by the SP response (+20mV)

The Paarrate Formation (498-565m) is interpreted to consist of good reservoir quality sandstones over the interval 500.0-513.5m. A total of 8.8m of net reservoir sand is interpreted with an average porosity of 30.3%. The entire Paarrate Formation is interpreted to be water saturated.

The Flaxman Formation (615-647m) consists of interbedded glauconitic sandstone and siltstone. The PEF varies between 2.5 and 3.8 reflecting the strong presence of glauconite. The sands are described as fine to medium grained with poor visual porosity. A total of 9.3m of net reservoir sand is interpreted over the interval 630.0-640.0m with an average porosity of 24.5% and is interpreted to be entirely water saturated. Resistivities have reduced further to 2-3ohmm over this interval, indicating an increase in formation water salinity.

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Introduction

A request was made by Essential Energy Resources Ltd to determine the porosity and water saturation of the sands encountered in the Findra-1 well. The wireline logs were analysed for these properties over the interval 290-850m.

Findra-1, operated by Essential Energy Resources Ltd, was spudded on 26th June 2004. It was drilled vertically to a total depth of 879m and plugged and abandoned. The interpreted section was drilled with an 8-1/2" bit and a KCl-polymer-PHPA mud system. A maximum bottom hole temperature of 48°C at 879m was measured during the final logging operations

The well did not encounter any significant hydrocarbon shows while drilling.

Available Data

The digital data-set was provided in LAS format by Essential Petroleum Resources. Both sonic and neutron/density logs were provided for the porosity determination. A list of the wireline logs run in the well is given as **Table 1**.

No conventional cores were cut in the Findra-1 well.

Hole Conditions

Hole conditions through the interpreted interval are good with mudcake buildup across permeable sands.

Interpretation Model

Based on the description of well cuttings, it has been assumed that the section of interest consists of quartzose sandstone with glauconite and shale. The volume of shale was calculated using the gamma ray log. A comparison was made with the shale volume determined from the neutron/density logs to confirm the consistency of the measurements.

Porosity was primarily calculated from the neutron-density logs. The Raymer-Hunt-Gardner equation was used to calculate porosity from the sonic log and used in zones with bad hole conditions.

Water saturation, S_w , was calculated using the Juhasz equation.

Input Parameters

A summary of the parameters used for this interpretation is given in **Table 2**. In the absence of special core analysis data a cementation exponent, m , of 2.00 was assumed with the coefficient, a , set to 1.00. A saturation exponent, n , of 2.00 was also used to calculate water saturation.

Water Salinity

The formation water salinity is extremely fresh as shown by the large positive SP deflection of +30mV. A Pickett Plot over the interval 332-416m (**Figure 1**) indicates an R_w of 1.75 ohmm at 26°C, which equates to a formation water salinity of 3,000 ppm NaCl equivalent.

The formation water salinity becomes more saline with depth as evidenced by a reduction of the positive SP deflection to +25mV. **Figure 2** is a Pickett plot within the Paarrate Formation (500-515m) and indicates an R_w of 0.55 ohmm at 33°C. This equates to a formation water salinity of 9,000 ppm NaCl equivalent.

Figure 3 is a Pickett plot within the Flaxman Formation and indicates an R_w of 0.290 ohmm at 38°C. This equates to a formation water salinity of 16,000 ppm NaCl equivalent. The further increase in formation water salinity is reflected by the +18mV SP deflection.

Reservoir Determination

For the purposes of this study a porosity cutoff of 10% and a V_{sh} cutoff of 40% were used to determine net reservoir. A summary of the results is given as **Table 3**. Permeability information would be needed to further refine appropriate cutoffs.

Discussion of Interpretation Results

The purpose of this study is to interpret the porosity and saturation of sands in the Findra-1 well over the interval 290-850m. The primary objective of the well was sands within the Flaxman Formation intersected at 631m.

The Dilwyn Formation (332-416m) consisted of excellent quality reservoir sandstones interbedded with shale. The sands are described as clean, very fine to very coarse grained and quartzose. A total of 29.1m of net sand is interpreted over the gross interval 338.5-386.5m, with an average porosity of 28.2%. There were no visual or significant gas shows observed during drilling and the high resistivity of 18 ohmm over the interval is indicative of fresh water. The sands are interpreted to be entirely water saturated.

The interval 469-482m, within the Pebble Point Formation, is interpreted to consist of good quality reservoir sands interbedded with shales. A total of 8.2m of net reservoir sand is interpreted over the gross interval 469.0-482.0m, with an average porosity of 18.8%. There were no visual or gas shows observed during drilling and the interval is interpreted to be entirely water saturated.

The Paarrate Formation (498-565m) is interpreted to consist of good reservoir quality sandstones over the interval 500.0-513.5m. Below 513.5m the section becomes more shaly with only thin, tight sands present. A total of 8.8m of net reservoir sand is interpreted over the gross interval 500.0-513.5m, with an average porosity of 30.3%. The entire Paarrate Formation is interpreted to be water saturated.

The Skull Creek Mudstone (565-580m) consists essentially of shale with some minor interbeds of thin sands. A total of 2.9m of net sand is interpreted over the interval 569.5-579.0m with an average porosity of 21.3%. The sand has a high clay content with an average of 31.4%.

The Nullawarre Greensand (580-598m) consists of a tight argillaceous glauconitic siltstone, which grades to claystone. No visual porosity was described in the cuttings.

The Flaxman Formation (615-647m) consists of interbedded glauconitic sandstone and siltstone. The PEF varies between 2.5 and 3.8 reflecting the strong presence of glauconite. The sands are described as fine to medium grained with poor visual porosity. A total of 9.3m of net reservoir sand is interpreted over the interval 630-640m with an average porosity of 24.5% and is interpreted to be entirely water saturated.

The Waare (A) Formation (666-744m) consists of interbedded claystone and argillaceous sandstone. The sands are described as medium grained with abundant lithic fragments and traces of pyrite and mica. The neutron and density logs indicate that the sands are argillaceous.

The Eumeralla Formation was intersected over the interval 744m-TD and consists of a quartz litharenite. The section is described as fine to medium grained, clear to translucent, light green, greenish grey and orange, with a very pale grey silty matrix. The neutron/density log indicates an argillaceous sandstone, with very poor reservoir characteristics.

Table 1 : Wireline Logs Run (Schlumberger)

Date	Hole Size (inches)	Interval (mRT)	Logs Run	Comments
30/6/04	8-½	876.7 - 150.0	HALS/BHC/PEX/HNG	Run OK GR to surface
n/a	n/a	n/a	MDT/GR	n/a

Table 2 : Input Parameters

Interval (mRT)	290-465	465-498	498-615	615-744	744-850
GRmin (api)	20	25	25	30	30
GTmax (api)	90	130	130	120	120
DTsh (usec/ft)	145	145	145	140	145
DTma (usec/ft)	55.5	55.5	55.5	55.5	55.5
RHOsh (g/cc)	2.00	2.15	2.15	2.10	2.15
NPHIsh (lst)	0.53	0.51	0.51	0.55	0.55
Rsh (ohmm)	8	7	3	3	1.5

Table 3 : Reservoir Summary

Formation	Gross Interval (mRT)	Net Thickness (m)	Average Porosity (%)	Average Vsh (%)	Average Sw (%)
Dilwyn	338.5 - 386.5	29.1	28.2	14.0	98.6
Pebble Point	469.0 - 482.0	8.2	18.8	33.6	99.3
Paarrate	500.0 - 513.5	8.8	30.3	14.3	95.9
Skull Creek	569.5 - 579.0	2.9	21.3	31.4	99.5
Nullawarre Greensand	585.0 - 592.0	0.3	21.2	36.5	100.0
Flaxman	630.0 - 640.0	9.3	24.5	19.0	98.0
Eumeralla	780.5 - 786.5	0.8	15.2	37.8	97.2

Note: Cutoffs used: Vsh <= 40% and Porosity >=10%.

Figure 1 : Pickett Plot 338-385m

Rw = 1.750 ohmm at 26°C

m = 2.00

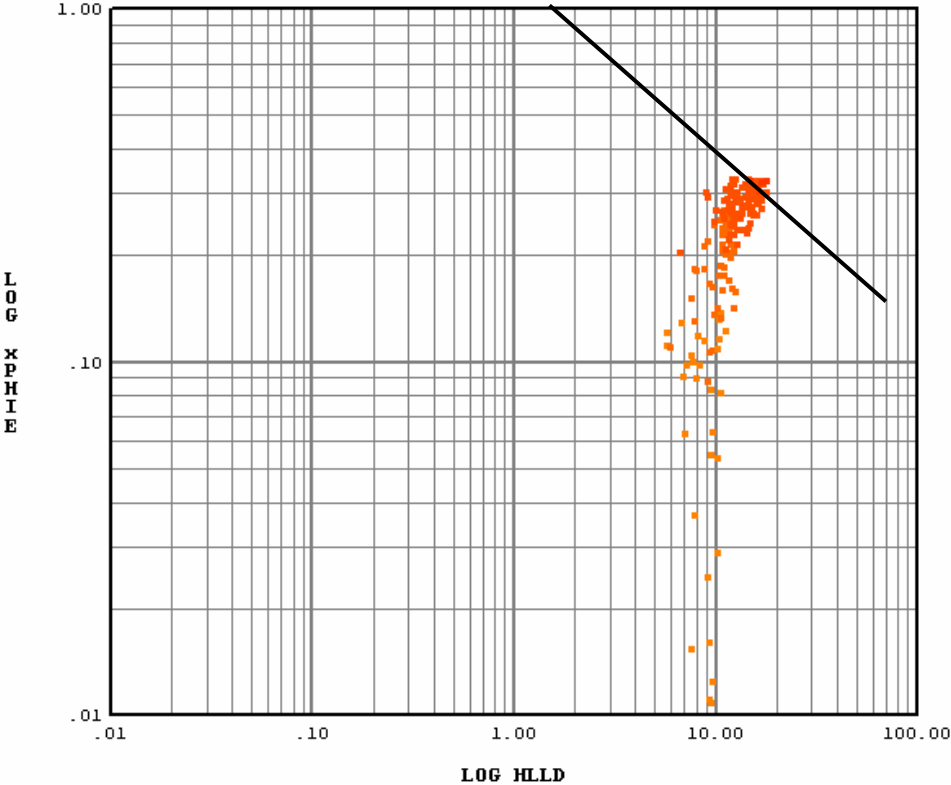


Figure 2 : Pickett Plot 500-515m

Rw = 0.550 ohmm at 33°C

m = 2.00

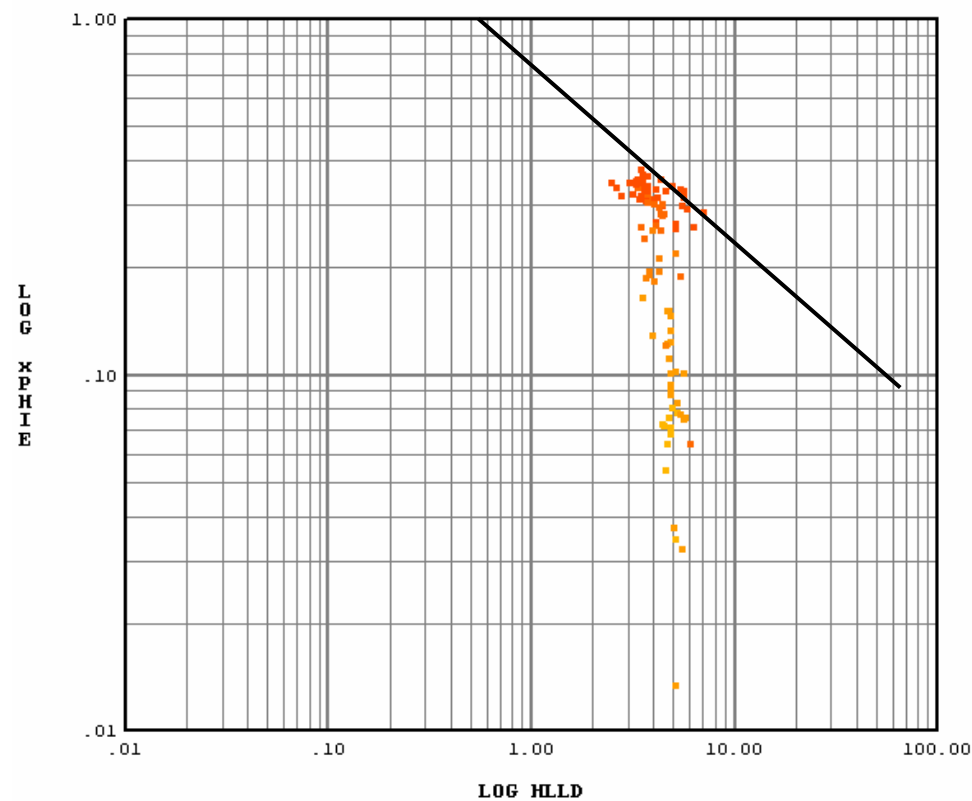


Figure 3 : Pickett Plot 630-640m

Rw = 0.290 ohmm at 33°C

m = 2.00

