

Killarney-1 Petrophysical Analysis

Summary

The purpose of this study was to examine the reservoir characteristics of the sands encountered in the Killarney-1 well. The wireline logs were quantitatively interpreted over the interval 1000m to 1637m to determine shale volume, porosity and water saturation.

Killarney-1 was spudded on 9th June 2004, by Essential Petroleum Pty Ltd and drilled to a total depth of 1604m. No fluorescence associated with sands was recorded throughout the reservoir section and no significant gas shows were recorded. The well was plugged and abandoned on 20th June 2004.

The sands of the Dilwyn Formation (1004.0-1038.7m) are of excellent reservoir quality. A total of 14.4m of net reservoir sand is interpreted with an average porosity of 22.0%. There were no visual or significant gas shows observed during drilling. The sands are interpreted to be water saturated.

The Paarate Formation (1114-1170m) consists of excellent reservoir quality sandstones interbedded with shale. A total of 23.7m of net reservoir sand is interpreted over the gross interval 1114.0-1168.7m, with an average porosity of 22.8%. There were no visual or significant gas shows observed during drilling. The sands are interpreted to be entirely water saturated.

The Skull Creek Mudstone (1170-1242m) is interpreted to consist of shale with some thin cemented sands. The exception is at 1194m where a 0.9m sand is interpreted to have 21.0% porosity and 100% water saturation.

The Nullawaare Formation (1242-1284m) consists of greensand interbedded with minor silt and claystone. The greensand is described as fine to medium grained, green-black glauconite with occasional grey/green aggregates. Poor visual porosity was described in the cuttings. The best sand was intersected over the interval 1242.5-1279.7m and consists of intervals with excellent reservoir properties interbedded with tightly cemented intervals. A total of 14.6m of net sand is interpreted with an average porosity of 17.2%. The section is interpreted to be entirely water saturated.

The Flaxman Formation (1393-1437m) consists of interbedded glauconitic sandstone and claystone. The PEF increases to over 7 indicating the strong presence of glauconite. The sands are described as fine to medium grained with good inferred porosity. A total of 0.3m of net reservoir sand is interpreted over the interval 1402.9-1404.5m, with an average porosity of 13.7%. The target interval was intersected over the interval 1413-1437m. The interval is seen on wireline logs as a very hard zone with a decrease in sonic slowness. The section is described as dark green to black glauconitic sandstone, with a weak silica cement. The PEF is over 10, reflecting the high concentration of glauconite. The section is interpreted to be tight with porosities less than 8%.

The Waarre Formation consists of interbedded claystone and argillaceous sandstone. Sands are interpreted over the intervals 1510-1523m and 1535-1548m, however the neutron/density crossplot indicates that they are argillaceous. A total of 4.7m of net reservoir sand is interpreted over these intervals with an average porosity of 9.3%. The higher resistivities within these sands are a response to the cemented zones. The interval is interpreted to be entirely water saturated.

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Introduction	<p>A request was made by Essential Energy Resources Ltd to determine the porosity and water saturation of the sands encountered in the Killarney-1 well. The wireline logs were analysed for these properties over the interval 1000-1637m.</p> <p>Killarney-1, operated by Essential Petroleum, was spudded on 9 June 2004. It was drilled vertically to a total depth of 1640m and plugged and abandoned. The interpreted section was drilled with an 8-1/2" bit and a KCl-PHPA mud system. A maximum bottom hole temperature of 63°C at 1640m was measured during the final logging operations</p> <p>The well did not encounter any significant hydrocarbon shows while drilling.</p>
Available Data	<p>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.</p> <p>No conventional cores were cut in the Killarney-1 well.</p>
Hole Conditions	<p>Hole conditions through the interpreted interval are good with mudcake buildup across permeable sands.</p>
Interpretation Model	<p>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.</p> <p>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.</p> <p>Water saturation, S_w, was calculated using the Juhasz equation.</p>
Input Parameters	<p>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.</p>
Water Salinity	<p>The formation water salinity over the top interval is relatively fresh as shown by the large positive SP deflection of +25mV. A Pickett Plot over the interval 1003-3142m (Figure 1) indicates an R_w of 0.26 ohmm at 43°C, which equates to a formation water salinity of 16,000 ppm NaCl equivalent.</p> <p>The formation water salinity becomes more saline with depth as evidenced by the reduction of the positive SP reflection to +13 mV. Figure 2 is a Pickett Plot within the Paarate Formation (1114-1169m) and indicates an R_w of 0.15 ohmm at 46°C. This equates to a water salinity of 28,000 ppm NaCl equivalent.</p> <p>Figure 3 is a Pickett Plot within the Nullawaare Formation (1242-1280m) and indicates an R_w of 0.11 ohmm at 51°C. This equates to a formation water salinity of 38,000 ppm NaCl equivalent. The further increase in formation water salinity is reflected by the +5 mV SP deflection</p>
Reservoir Determination	<p>For the purposes of this study a porosity cutoff of 8% and a V_{sh} cutoff of 50% 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.</p>
Discussion of Interpretation	<p>The purpose of this study is to interpret the porosity and saturation of sands in the Killarney-1 well over the interval 1000-1640m. The primary objective of the well was</p>

Results

the hard zone within the Flaxman Formation intersected at 1413m.

The sands within the Dilwyn Formation (1004.0-1038.7m) are of excellent reservoir quality. A total of 14.4m of net reservoir sand is interpreted with an average porosity of 22.0%. There were no visual or significant gas shows observed during drilling. The sands are interpreted to be water saturated.

The Paarate Formation (1114-1170m) consists of excellent reservoir quality sandstones interbedded with shale. The sands are described as clean, fine to medium grained and quartzose. A total of 23.7m of net reservoir sand is interpreted over the gross interval 1114.0-1168.7m, with an average porosity of 22.8%. There were no visual or significant gas shows observed during drilling. The sands are interpreted to be entirely water saturated.

The Skull Creek Mudstone (1170-1242m) is interpreted to consist of shale with some thin cemented sands. The exception is at 1194m where a 0.9m sand is interpreted to have 21.0% porosity and 100% water saturation.

The Nullawaare Formation (1242-1284m) consists of greensand interbedded with minor silt and claystone. The greensand is described as fine to medium grained, green-black glauconite with occasional grey/green aggregates. Poor visual porosity was described in the cuttings. The best sand was intersected over the interval 1242.5-1279.7m and consists of intervals with excellent reservoir properties interbedded with tightly cemented intervals. A total of 14.6m of net sand is interpreted with an average porosity of 17.2%. The section is interpreted to be entirely water saturated.

The Belfast Formation (1284-1393m) consists mainly of claystone with some minor siltstone. Below 1340m minor quantities of glauconitic sandstone with poor visual porosity were recovered in the cuttings. Below 1370m the PEF increases to over 5, reflecting the increase in glauconite in the section.

The Flaxman Formation (1393-1437m) consists of interbedded glauconitic sandstone and claystone. The PEF increases to over 7 indicating the strong presence of glauconite. The sands are described as fine to medium grained with good inferred porosity. A total of 0.3m of net reservoir sand is interpreted over the interval 1402.9-1404.5m, with an average porosity of 13.7%. The target interval was intersected over the interval 1413-1437m. The interval is seen on wireline logs as a very hard zone with a decrease in sonic slowness. The section is described as dark green to black glauconitic sandstone, with a weak silica cement. The PEF is over 10, reflecting the high concentration of glauconite. The section is interpreted to be tight with porosities less than 8%.

The Waarre Formation consists of interbedded claystone and argillaceous sandstone. The sandstones are described as white-clear, dark green and black, very fine to fine grained with poor to occasionally fair visual porosity. The PEF has decreased to between 3-3.5, indicating a decrease in the amount of glauconite. Sands are interpreted over the intervals 1510-1523m and 1535-1548m, however the neutron/density crossplot indicates that they are argillaceous. A total of 4.7m of net reservoir sand is interpreted over these intervals with an average porosity of 9.3%. The higher resistivities within these sands are a response to the cemented zones. The interval is interpreted to be entirely water saturated.

The Eumeralla Formation (1569-TD) consists of massive quartz litharenites, which are described in cuttings as fine to medium grained, clear, translucent, light green, yellow and red, with a grey silty matrix. The neutron/density logs indicate an argillaceous sandstone. The higher resistivities are again associated with cemented zones and the interval is again interpreted to be water saturated.

Table 1 : Wireline Logs Run (Schlumberger)

Date	Hole Size (inches)	Interval (mRT)	Logs Run	Comments
18/6/04	8-½	1632.4 - 255.5	HALS/BHC/PEX/HNGS	Run OK GR to surface
n/a	8-½	n/a	MDT/GR	n/a

Table 2 : Input Parameters

Interval (mRT)	1000-1170	1170-1242	1242-1284	1284-1413	1413-1437	1437-1569	1569-1637
GRmin (api)	30	30	30	30	30	30	30
GTmax (api)	115	115	115	120	110	110	125
DTsh (usec/ft)	110	110	105	110	90	105	93
DTma (usec/ft)	55.5	55.5	55.5	55.5	55.5	55.5	55.5
RHOsh (g/cc)	2.35	2.25	2.35	2.42	2.45	2.35	2.35
NPHIsh (lst)	0.40	0.42	0.41	0.45	0.58	0.35	0.30
Rsh (ohmm)	3	3	3	3	3	2.5	3.5

Table 3 : Reservoir Summary

Killarney-1				
Interval (mRT)	Thickness (m)	Average Porosity (%)	Average Shale Volume (%)	Average Sw (%)
1004.0 - 1038.7	14.4	22.0	27.4	95.8
1114.0 - 1168.7	23.7	22.8	29.6	99.1
1193.4 - 1194.4	0.91	21.0	33.8	100.0
1242.5 - 1279.7	14.6	17.2	30.2	96.3
1402.9 - 1404.5	0.30	13.7	49.8	100.0
1509.5 - 1547.2	4.71	9.3	44.4	91.2

Note: Cutoffs used: Vsh ≤ 50% and Porosity ≥ 8%.

Figure 1 : Pickett Plot 1003-1039m

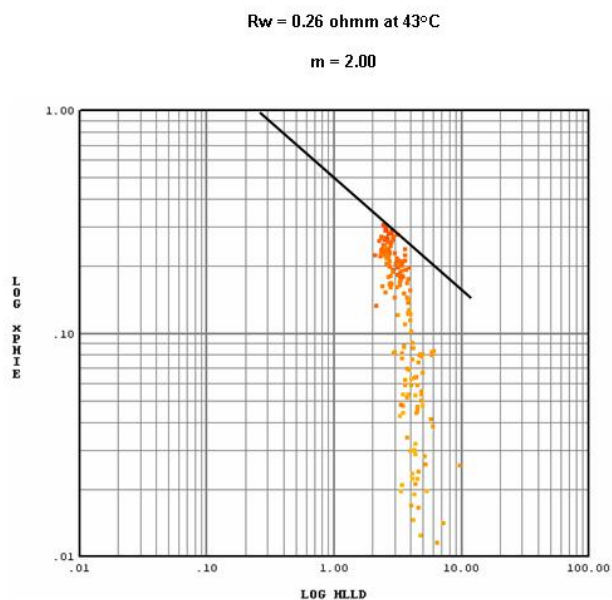


Figure 2 : Pickett Plot 1114-1169m

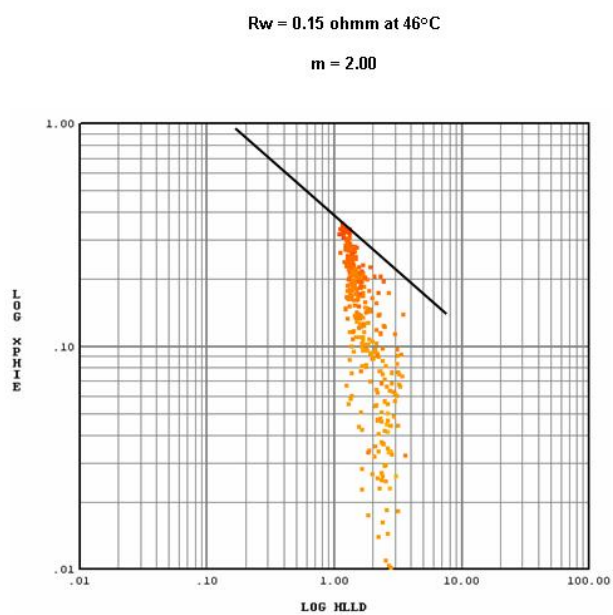


Figure 3 : Pickett Plot 1242-1280m

