Core Sampling Report
Well: DD97WG002

McArthur Basin
Northern Territory, Australia


<table>
<thead>
<tr>
<th>Rev</th>
<th>Status</th>
<th>Prepared by</th>
<th>issued By</th>
<th>Date</th>
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<tr>
<td>0</td>
<td>Final</td>
<td>Geoff Hokin</td>
<td>Geoff Hokin</td>
<td>27-03-2015</td>
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Signature of approved person:

Geoffrey Hokin MSc(Hons) Geology
Principal Advisor Exploration & Operations
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Introduction

In accord with the Northern Territory petroleum exploration reporting and data submission guidelines Imperial Oil & Gas hereby submits this Core Sampling Report for nine samples taken from the core DD97WG002 stored at the Darwin Core Library.

This historical well DD97WG002 was drilled by Rio Tinto Exploration in July 1997 as a mineral exploration hole in the search for silver (Ag), lead (Pb) and zinc (Zn). This well was positioned approximately 11km north-west of Imperial’s BCFSC03 core hole and is in a similar geological setting. DD97WG002 was reported by Rio Tinto Exploration to have encountered black shales within the St Vidgeon Formation between 29 and 30m drill depth (dark grey carbonaceous shaly laminae within light grey dolomitic sandstone) and a further dolomitic carbonaceous zone from 30 to 55m.

The diamond core hole DD97WG002 was described to have been collared in the lower Nagi Formation. At 25.6 m the well went into the Saint Vidgeon Formation where it terminated at a depth of 179.2 m (measured depth) after 14 days of drilling.

The lithology of the Nagi Formation is dominated by a medium grained, quartz and feldspar-rich sandstone and quartz-lithic conglomerate. The main lithologies of the Saint Vidgeon Formation as described by Rio Tinto in the well lithology log (appendix 1) are shale and sandstone. The dominant colour in the top part is light to dark grey and changes to varieties of pink at around 55 m. Weathering is reported throughout the entire well with minor intervals described as fresh and/or silicified. Core loss occurred frequently.

The top 90m of the available core for this hole (stored in the Northern Territory Geological Survey core library) was located and re-logged (Table 2) by Imperial Oil & Gas in September 2014. A significant shale band from 28m to 53m was identified. Throughout this interval there exist numerous dark grey to black mudstone and carbonaceous shale bands with abundant tuffaceous bands and laminae.

Bore hole DD97WG002 was sampled as part of an exploration program undertaken by Imperial Oil & Gas Ltd (IOG) within the St Vidgeon region of EP184. This historical bore hole was drilled in proximity to a desired location for investigation by IOG. While originally drilled as a mineral exploration hole the bore penetrated the carbonaceous black organic shales of the St Vidgeon Formation predicted by IOG to have potential as a hydrocarbon generating source rock. The bore was selected to provide additional data in support of the shallow outcrop drilling undertaken by IOG within the region. These shales are a significant target of petroleum exploration within EP184 within the central portion of the McArthur Basin. Samples of this core were taken from the black shale zones for the purpose of testing the hydrocarbon generation potential of the target formation.

Nine samples (Table 1) were taken by IOG from the DD97WG002 core during the re-logging exercise and of these seven samples were provided to the Sprigg Research Laboratories at Adelaide University for geochemical, mineralogical and SRA analyses. The results of these analyses are presented in this report.

This report also provides a brief discussion of the data obtained from the analysis. Further interpretation of the results will be undertaken when the analysis of the remaining samples obtained from the 2014 drilling program are evaluated.
Sampling Summary and General Data

Sampler: Geoff Hokin
On behalf of: Imperial Oil & Gas Pty Ltd
Address: Level 7, 151 Macquarie Street, Sydney, NSW 2000
Main office number: +61 2 9251 1846

Current permit: EP184
Field: St. Vidgeon
Prospect/Location name: Mount Vizard

1:250K Map Sheet Name: Urapunga-Roper River Special SD5310
1:100K Map Sheet Name: Urapunga

Well name: DD97WG002
Well location: 0468 936 m E, 8364 903m N (GDA94 Zone 53L)

Coredat ID: 3422
Tenement at the time: EL 9185
Drilled by: Rio Tinto Drilling Co. Gorey & Cole

Spud date: 17-07-1997
TD date: 31-07-1997
Duration: 14 days
TD: 179.2 m
Inclination: -60
Azimuth: 245

Core Location: Darwin
Sampling allowed: Yes
Cutting available: No
Hylogged: No
Geochemical Analysis

Nine DD97WG002 core samples were taken from the core and of these seven samples were selected for source rock analysis and geochemical characterisation. A range of analyses were conducted on these seven samples. Sample preparation and analyses were conducted by the Sprigg Research Laboratories at the University of Adelaide. The sample preparation and analytical methods utilized by the lab is outlined below. This information is supplied by Dr Tony Hall of the Sprigg Research Laboratory at the University of Adelaide.

Sample preparation

The study used cored cutting samples collected from the DD97WG002 core held at the Darwin NTGS library. This core was recovered from the well drilled in the ST Vidgeon region within the central McArthur Basin in the Urapunga Roper River area of the Northern Territory.

Samples were taken of the prospective carbonaceous shales recovered within the core and identified as samples S31 to S39. While all samples were lithologically logged (Table 1) not all samples were sent for analysis. The samples sent for analysis were chosen to investigate the St Vidgeon Formation. All samples were selected to be representative of the differing zones of interest exhibited through the core sections. Prior to analysis all samples selected for further investigation were cleaned, dried for ≥ 24 hrs at 40°C and ground using a tungsten carbide ring mill to <120um. Samples were washed, dried and cut into appropriate sections for SEM stub mounting preparation.

Analytical Methodology (TOC, SRA, GC-MS)

Total carbon (TC) content for each sample was measured in a Perkin Elmer 2400 Series II CHNS analyzer. Inorganic carbon (IC) content was determined using the pressure-calcmeter acidification method of Sherrod et al. (Sherrod et al., 2002). TOC content was calculated by difference (TOC=TC-IC).

Total petroleum hydrocarbon analyses (TPH) were conducted using a Source Rock Analyser (SRA TPH) Workstation, (Weatherford Laboratories Instruments Division), this is equivalent to the ‘Rock-eval’ analytical instrumentation. The sample is purged in Helium prior to being raised into a desorption furnace at 300°C for 3 minutes which releases the free hydrocarbon, or S1, fraction. The sample is then pyrolysed by heating at a 25°C/minute ramp to 600°C to generate the potential hydrocarbon, or S2, fraction. Detection of released hydrocarbons is conducted by flame ionization detection(FID) and quantification is conducted by calibration against a certified reference material of known S1 & S2 response.

Thermal maturity and hydrocarbon potential (S1 & S2) of each sample was determined by pyrolysis using a Weatherford Instruments Source Rock Analyser. Thermal maturity was estimated using the method of Jarvie et al. (2005), which relates measured Tmax to calculated vitrinite reflectance using the following relationship: calculated %Ro =0.0180×Tmax −7.16. Based on the TPH data collected by SRA a sub-suite of samples were identified for further characterization of the organic matter (OM) fractions by mass spectrometry. Both the S1 & S2 fractions of each sample were evolved by thermal and pyrolytic extraction respectively.

Thermal extraction gas chromatography mass spectrometry(GC-MS) screening was conducted using micro scale sealed vessels (MSSV) to characterize OM present within the samples. Between 5 & 10mg of sample was transferred to the MSSV reaction vessel and extracted at 300°C for 1 hour. GC-MS was run with a temperature program of 50°C held for 1 min ramped at 8°C/Min to 300°C and held for 17 mins. Analysis was undertaken using a Quantum MSSV injector fitted to a Hewlett Packard 6890/5973 GC-MS system and was analysed under standard extraction parameters,(see Hall et al.,(1999) and Hall et al.(2011).

Mineralogy was determined by XRD analysis conducted qualitatively using a Bruker D8 ADVANCE Powder X-ray Diffractometer with a Cu-radiation source. Data was processed using Bruker
DIFFRAC.EVA software and Crystallography Open Database reference patterns for identifying mineral phases. Major component quantification was conducted by XRF with quantification reported following ignition. Trace & REE quantification was conducted by whole rock digestion and ICPMS elemental detection using an Agilent 7500cs with ORS for Solution ICP Analysis.

**Inorganic sediment analyses**

Mineralogy was determined from randomly orientated bulk powder samples, using X-ray diffraction (XRD; Bruker D8 Advance XRD with Cu source). Samples were scanned between 3.5° - 50°2θ using a 0.02 step size and 1s dwell time. Mineral phases were identified in the Difrac.Eva software package using reference patterns from the Open Crystallography Database. Clay mineralogy was determined on orientated preparations of the <5μm fraction and prepared as per Moore and Reynolds (1997).

**Results and discussion**

Bore hole DD97WG002 Total organic carbon (TOC) analysis results (Table 3) and the (figure 1) geochemical log of organic richness indicate that samples S32, S33, S34 and S35 all have good levels of organic matter. The TOC levels of these samples range from 2.45% to 0.91% with an average of 1.54%. These samples sit in the depth range of 29.6m to 37m. Samples S36 and S37 have marginal TOC levels at 0.54 and 0.78%. While the results are marginal they sit above the minimum acceptable level of organic carbon for prospective hydrocarbon generation of 0.5% TOC. Sample S31 has poor values of TOC at 0.09%.

The figure 2 Kerogen quality plot indicates that the kerogen is type IV which is to be expected of these types of highly weathered samples of palaeo-proterozoic age. Given the estimated age of the formation at 1.64GA (Crick, I. H., Boreham, C. J., Cook, A. C., & Powell, T. G. 1988) it is indicated that the organic material source would be lamalginite (Adelaide Research & Innovation Pty Ltd. 2013.; Holman A. I., Grice K., Jaraula C. M. B., Schimmelmann A. (2014); Korth j. 1987; Page, R. W. and Sweet, I. P. 1998.).

The analysis of the major elements presented in table 5 when compared to the average shale (AS) values of Wedepohl (1971, 1991a, 1991b) and Condie (1993) and to the post Archean Australian shale standard (PAAS) averages indicates a significant number of differences in the DD97WG002 shale composition. When the DD97WG002 results are compared against the averages found in the IOG drilling of the St Vidgeon Formation shale averages (Table 7) and those of the Barney Creek Formation further significant differences are identified.

While silica contents of the DD97WG002 shales are generally in line with the AS and the PAAS they are significantly lower than those levels found in the 2014 St Vidgeon drilling analysis results. The differences are strongest within the zone of good TOC levels of samples S33, S34, S35 between 32.6m measured depth (MD) and 37m MD. Similarly the titanium oxide values are highest in these same samples and include the marginal TOC samples of S36 and S37. These values are between 25% to 80% higher than the values found in the IOG drilling program for the exploration core holes BCSC01 to BCFSC04a. [The average values of these samples comprise the St Vidgeon average shale results presented in table 7.] Significantly these titanium oxide samples are also considerably higher than the values found in the Barney Creek Formation. The Barney Creek formation is considered to be a chrono-stratigraphic equivalent to the St Vidgeon Formation, albeit the St Vidgeon is considered to be a shelf peritidal facies against the deeper basin Barney Creek Formation (Rawlings 1999; Hokin G. 2014).

Aluminium trioxide present is also substantially higher in the DD97WG002 S34, S35, S36 & S37 samples than that found in the St Vidgeon (SV) averages. These same samples are lower than those values found in the Barney Creek Formation (BCF) average value. The exception is the shallow samples of S31 and S32 that are in line with the BCF values while all are considerably lower than the AS and the PAAS.
Ferric oxide analysis results are highly variable across the samples and in the order of approximately one seventh of the PAAS values and closer to the AS values. The samples iron oxide values range from one quarter to one half of the AS values and are comparable to the SV and BCF averages. The iron oxide analysis indicates that the iron levels of samples S33, S34 and S35 is at least twice that of the SV average and five times that of the BCF avg. There are no reported average levels for the AS or the PAAS with which to compare.

The pattern of results consistently indicates that samples S33, S34 and S35 (all carbonaceous shale siltstones – table 1) all fall outside the established SV and the BCF averages as well as outside the AS and the PAAS. The association of these elements with carbonaceous material appears to be coincidental as these samples all fall in the good OM range. However the S32 sample with the highest TOC does not follow this pattern. While the results may suggest in part an association of these elements with the OM there are insufficient samples on which to draw such a conclusion.

Additionally the elements of manganese oxide, magnesium oxide, calcium oxide, sodium oxide, potassium oxide, and phosphorous pentoxide all fall well outside the averages established for the SV and BCF. Nonetheless many of these same elements are consistent with either the AS and or the PAAS.

The spread of results appears to suggest that there is a different environment of deposition in play, and perhaps a differential in post deposition evolution of the black carbonaceous sediments encountered within the bore hole DD97WG002. The sediments major element analysis of DD97WG002 differs significantly to that encountered within the carbonaceous shales sampled within the IOG 2014 exploration core program of the same formation.

As previously mentioned, Hokin (2014) and Rawlings (1999) reported that the SV formation has the characteristics of a shelf facies; while Hokin (2014) suggested that the initial data analysis interpretation of the core samples obtained from the IOG St Vidgeon 2014 exploration core drilling program (11km SSW of DD97) indicated a high potential for the SV to be a peritidal facies. The presence of chamosite [an hydrous aluminium silicate iron end member of the chlorite group] in sample S31 (table 6) according to Deer, Howie, and Zussman (1992) is produced in an environment of low to moderate grade metamorphism as a product of hydrothermal alteration of pyroxenes, amphiboles and biotite in igneous rocks. According to Deer et al such iron rich chlorites can be replacements of iron rich ferro-magnesium minerals. This is consistent with the anomalous very high values of magnesium oxide found in the samples in relation to the SV, BCF averages and the AS and PAAS. However, the maximum temperature calculated by the analysis (table 3) does not support a theory of hydrothermal alteration. No other samples tested contain this mineral. Conversely the S31 sample is the only sample that does not contain pyrite. However, in support of the possible source of the chamosite as hydrothermal, Hokin (2014) indicated in his report on the results of the sample analysis of the 2014 drilling program within the SV that there did exist strong evidence of hydrothermal fluid movement within the SV.

Shen, Canfield and Knoll (2002) cite research by Raiswell and Berner (1985) that the presence of pyrite in marine sediments depositing from oxic bottom waters is only formed during diagenesis when anoxic conditions are established within the sediments. Shen et al state that iron speciation patterns in the McArthur Basin black shales strongly indicate an euxinic depositional environment. In euxinic environments, pyrite can form both within the sediments and within the anoxic water column. And Shen et al (2002) argue that the McArthur Basin of which the SV is considered to be a shelf facies was in fact an euxinic, intracratonic basin with open connection to the sea.

This suggest that it is possible therefore that sample S31 has been subjected to a different energy and diagenetic environment and that there is a boundary between S31 and S32 not previously identified. The lithology log (table 2) does not support this theory of an unreported boundary. The lithology description of a dolarenaceous lutite for S31 is lithologically consistent with the description of S32 as a “carbonaceous shale dark grey to black with carbonaceous mudstone”. In support, the calcium and
magnesium levels are high across all samples. Magnesium oxide levels are two to five times higher than the SV, AS and PAAS average and the calcium oxide levels are also two to five times higher than the SV, AS and PAAS averages. According to Guppy (1964) citing Pettijohn (1957) a lutite is generally termed a siltstone, mudstone or claystone, also correlating with the lithology descriptions. Guppy also states that these may contain clay minerals and chlorite. The term shale applies to these sediments when the rocks demonstrate a laminated or fissile nature.

The presence of the chlorite and the available analytical evidence would therefore suggest that the presence of the chamosite and the absence of pyrite in S31 is therefore a chemical alteration possibly induced by an oxidation effect rather than a hydrothermal induced one. And, according to Shen et al (2002) the highly available ferric oxide and iron oxide within the samples S32 to S37 could still be incorporated into pyrite during continued early diagenesis. The presence of high residual levels of OM in S32 sample would suggest that the intervening ~2m of lithology between S31 and S32 has provided some high level of initial oxidation barrier to the S32 sample. The lithology above S31 is dominated by siltstones and sandstones which are considerably more permeable and porous than the intervening muddy siltstones and muddy shales between the two samples. This could allow for a partial oxidation of the iron aluminium rich sediment to the chamosite while protecting the conversion of the iron to pyrite in deeper sediments.

With limited exception the major element analysis presented in table 7 for the DD97WG002 samples does not match either the SV nor the BCF profile. At this time no conclusion is drawn from this.

Table 1: Overview of DD97WG002 sample lithology

<table>
<thead>
<tr>
<th>Sample number</th>
<th>depth [mMD]</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td>S31</td>
<td>27.40</td>
<td>Dolostone (dolarenaceous lutite)</td>
</tr>
<tr>
<td>S32</td>
<td>29.65</td>
<td>Carbonaceous shale</td>
</tr>
<tr>
<td>S33</td>
<td>32.65</td>
<td>Interbedded carbonaceous shale and dolomitic siltstone</td>
</tr>
<tr>
<td>S34</td>
<td>35.10</td>
<td>Carbonaceous siltstone</td>
</tr>
<tr>
<td>S35</td>
<td>37.00</td>
<td>Carbonaceous shaly siltstone</td>
</tr>
<tr>
<td>S36</td>
<td>40.70</td>
<td>Carbonaceous shaly siltstone</td>
</tr>
<tr>
<td>S37</td>
<td>45.40</td>
<td>Carbonaceous siltstone</td>
</tr>
<tr>
<td>S38</td>
<td>50.80</td>
<td>Carbonaceous shale dark grey to black with minor calcite veins</td>
</tr>
<tr>
<td>S39</td>
<td>54.00</td>
<td>Shale grey to dark grey with pink tuffaceous laminae throughout</td>
</tr>
</tbody>
</table>

Note: Samples S38 and S39 were lithologically described by the geologist in the core library but were not further analysed. Sample depths reported have not been corrected for inclination of the drill hole.
Table 2: Lithology Log of DD97WG002 17.5m To 90.0m

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Lithology</th>
<th>Weathering</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.50</td>
<td>19.60</td>
<td>siltstone brown</td>
<td>Weathered (w)</td>
</tr>
<tr>
<td>19.60</td>
<td>21.55</td>
<td>sandstone brown very fine grained</td>
<td>w</td>
</tr>
<tr>
<td>21.55</td>
<td>21.80</td>
<td>sandstone clayey brown vuggy in part, quartzose lithic</td>
<td>w</td>
</tr>
<tr>
<td>21.80</td>
<td>23.15</td>
<td>sandstone white clayey, quartzose lithic</td>
<td>w</td>
</tr>
<tr>
<td>23.15</td>
<td>24.00</td>
<td>sandstone brown fine , quartzose lithic</td>
<td>w</td>
</tr>
<tr>
<td>24.00</td>
<td>24.90</td>
<td>clay brown sandy matrix vuggy</td>
<td>w</td>
</tr>
<tr>
<td>24.90</td>
<td>25.30</td>
<td>clay brown sandy matrix vuggy</td>
<td>w</td>
</tr>
<tr>
<td>25.30</td>
<td>26.60</td>
<td>sandstone light brown to brown dolomitic</td>
<td>w</td>
</tr>
<tr>
<td>26.60</td>
<td>26.90</td>
<td>siltstone brown to grey brown coarsening upwards dolomitic</td>
<td>w</td>
</tr>
<tr>
<td>26.90</td>
<td>27.40</td>
<td>siltstone dark grey very fine to muddy</td>
<td>w</td>
</tr>
<tr>
<td>27.40</td>
<td>27.40</td>
<td>[S31] - Dolostone (dolarenaceous lutite)</td>
<td>w</td>
</tr>
<tr>
<td>27.40</td>
<td>27.90</td>
<td>siltstone dark grey very fine to muddy</td>
<td>w</td>
</tr>
<tr>
<td>27.90</td>
<td>29.60</td>
<td>mudstone dark grey to black shaly in part</td>
<td>w</td>
</tr>
<tr>
<td>29.60</td>
<td>29.61</td>
<td>[S32]- Carbonaceous shale dark grey to black with carbonaceous mudstone</td>
<td>W</td>
</tr>
<tr>
<td>29.61</td>
<td>30.30</td>
<td>shale dark grey to black with carbonaceous mudstone lenses</td>
<td>W</td>
</tr>
<tr>
<td>30.30</td>
<td>30.40</td>
<td>shale grey silty in part</td>
<td>W</td>
</tr>
<tr>
<td>30.40</td>
<td>32.40</td>
<td>shale brown tuffaceous laminae sandy in part</td>
<td>W</td>
</tr>
<tr>
<td>32.40</td>
<td>32.60</td>
<td>shale dark grey to black sandy in part minor carbonaceous in part</td>
<td>W</td>
</tr>
<tr>
<td>32.60</td>
<td>32.61</td>
<td>[S 33]- Interbedded carbonaceous shale and dolomitic siltstone. Shale dark grey to black sandy in part minor carbonaceous in part</td>
<td>W</td>
</tr>
<tr>
<td>32.61</td>
<td>32.90</td>
<td>shale grey brown to dark grey with tuffaceous mudstone bands base of unit silty in part</td>
<td>W</td>
</tr>
<tr>
<td>32.90</td>
<td>33.50</td>
<td>shale dark grey to black common tuffaceous laminae</td>
<td>W</td>
</tr>
<tr>
<td>33.50</td>
<td>33.10</td>
<td>[S 34] - Carbonaceous siltstone with minor carbonaceous shale dark grey to black</td>
<td>W</td>
</tr>
<tr>
<td>33.10</td>
<td>36.12</td>
<td>carbonaceous shale dark grey to black with tuffaceous laminae base of unit, bedding 10 deg</td>
<td>W</td>
</tr>
<tr>
<td>36.12</td>
<td>36.60</td>
<td>tuffaceous shale brownish grey</td>
<td>W</td>
</tr>
<tr>
<td>36.60</td>
<td>37.00</td>
<td>shale grey to dark grey carbonaceous in part and minor sandy</td>
<td>W</td>
</tr>
<tr>
<td>37.00</td>
<td>37.00</td>
<td>[S35] Carbonaceous shaly siltstone</td>
<td>W</td>
</tr>
<tr>
<td>37.00</td>
<td>38.10</td>
<td>shale grey to dark grey carbonaceous in part and minor sandy</td>
<td>W</td>
</tr>
<tr>
<td>38.10</td>
<td>40.35</td>
<td>shale dark grey with minor tuffaceous mudstone laminae, sandy in part with sharp oblique base</td>
<td>W</td>
</tr>
<tr>
<td>40.35</td>
<td>40.39</td>
<td>tuff white, appears siliceous, irregular base</td>
<td>W</td>
</tr>
<tr>
<td>40.39</td>
<td>40.70</td>
<td>shale dark grey to grey finely laminated sandy in part</td>
<td>W</td>
</tr>
<tr>
<td>40.70</td>
<td>40.70</td>
<td>[S36] - Carbonaceous shaly siltstone. Shale dark grey to grey finely laminated sandy in part</td>
<td>W</td>
</tr>
<tr>
<td>40.70</td>
<td>40.80</td>
<td>shale dark grey to grey finely laminated sandy in part</td>
<td>W</td>
</tr>
<tr>
<td>40.80</td>
<td>43.40</td>
<td>shale grey to dark grey finely laminated minor carbonaceous in part and sandy in part</td>
<td>W</td>
</tr>
<tr>
<td>43.40</td>
<td>45.40</td>
<td>shale grey to dark grey finely laminated with calcite veins base of unit, iron staining an sandy in part</td>
<td>W</td>
</tr>
<tr>
<td>45.40</td>
<td>45.40</td>
<td>[S37] dark grey carbonaceous siltstone – shaly in part</td>
<td>W</td>
</tr>
</tbody>
</table>
45.40  46.00  shale grey to dark grey finely laminated with calcite veins base of unit, iron staining an sandy in part  w
46.00  48.80  shale dark grey to grey minor carbonaceous in part with minor calcite middle of unit and minor carbonaceous bands throughout  W
48.80  50.80  Carbonaceous shale dark grey to black with minor calcite veins and minor pyrite granules with fine laminae, bedding 15 deg  W
50.80  50.80  [S38] Carbonaceous shale dark grey to black with minor calcite veins  W
50.80  51.10  Carbonaceous shale dark grey to black with minor calcite veins and minor pyrite granules with fine laminae, bedding 15 deg  W
51.10  52.40  shale grey to dark grey finely laminated with carbonate bands  W
52.40  53.07  shale grey silty siliceous with calcite veins, irregular base  W
53.07  53.60  shale grey brown silty with iron staining  W
53.07  54.00  shale brown silty, abundant dendrites  W
54.00  54.00  [S39] Shale grey to dark grey with pink tuffaceous laminae  W
54.00  54.18  shale brown silty, abundant dendrites  W
54.18  54.70  shale grey brown gradational base (fining upwards) finely laminated at 15deg  W
54.70  56.00  sandstone light reddish brown very fine quartzose  W
56.00  56.90  sandstone light brown very fine quartzose, abundant dendrites  W
56.90  60.80  silstone brown, dolomitic vuggy towards base of unit  W
60.80  62.80  shaly sandstone brown, vuggy to base of unit  W
62.80  65.50  shaly sandstone brown, vuggy to base of unit  W
65.50  86.40  not logged  Slight W
86.40  90.50  sandstone light grey dolomitic silicified  Slight W
90.50  end of logging  Slight W

NB: [S] numbers denote sample location and identifier. Reported log depth is measured depth and not corrected for hole inclination.

Table 3: Preliminary results of TOC/SRA analysis

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Sample Depth (m MD)</th>
<th>TOC %</th>
<th>S1</th>
<th>S2</th>
<th>Tmax°C</th>
<th>Calc %Rn (Tmax)</th>
<th>Lab ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD-S31</td>
<td>27.4</td>
<td>0.09</td>
<td>0.03</td>
<td>0.05</td>
<td>425.6</td>
<td>0.5</td>
<td>DD-531</td>
</tr>
<tr>
<td>DD-S32</td>
<td>29.6</td>
<td>2.45</td>
<td>0.08</td>
<td>0.08</td>
<td>413</td>
<td>0.27</td>
<td>DD-532</td>
</tr>
<tr>
<td>DD-S33</td>
<td>32.6</td>
<td>0.91</td>
<td>0.07</td>
<td>0.06</td>
<td>403.6</td>
<td>0.1</td>
<td>DD-533</td>
</tr>
<tr>
<td>DD-S34</td>
<td>35.1</td>
<td>1.05</td>
<td>0.06</td>
<td>0.05</td>
<td>402.1</td>
<td>0.08</td>
<td>DD-534</td>
</tr>
<tr>
<td>DD-S35</td>
<td>37</td>
<td>1.73</td>
<td>0.06</td>
<td>0.08</td>
<td>426.4</td>
<td>0.52</td>
<td>DD-535</td>
</tr>
<tr>
<td>DD-S36</td>
<td>40.7</td>
<td>0.54</td>
<td>0.05</td>
<td>0.07</td>
<td>401</td>
<td>0.06</td>
<td>DD-537</td>
</tr>
<tr>
<td>DD-S37</td>
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<td>0.06</td>
<td>320.1</td>
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<td>DD-536</td>
</tr>
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</table>

1 % Rn is calculated using the formulae %Rn = 0.0180 x Tmax – 7.16 (Jarvie et al 2005). Note that the values may be unreliable due to the low SRA results.
Table 4: Calculation of petroleum potential using hydrocarbon index and production index from source rock analysis results presented in Table 3 for core samples from well DD97WG002.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Sample Depth (m MD)</th>
<th>HI</th>
<th>PI</th>
<th>PP (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD-S31</td>
<td>27.40</td>
<td>54</td>
<td>0.38</td>
<td>0.08</td>
</tr>
<tr>
<td>DD-S32</td>
<td>29.60</td>
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<td>0.50</td>
<td>0.16</td>
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<tr>
<td>DD-S33</td>
<td>32.60</td>
<td>7</td>
<td>0.54</td>
<td>0.13</td>
</tr>
<tr>
<td>DD-S34</td>
<td>35.1</td>
<td>5</td>
<td>0.55</td>
<td>0.11</td>
</tr>
<tr>
<td>DD-S35</td>
<td>37.0</td>
<td>5</td>
<td>0.43</td>
<td>0.14</td>
</tr>
<tr>
<td>DD-S36</td>
<td>40.70</td>
<td>13</td>
<td>0.42</td>
<td>0.12</td>
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<td>DD-S37</td>
<td>45.40</td>
<td>8</td>
<td>0.45</td>
<td>0.11</td>
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Table 5: XRF analysis results

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<th>S32</th>
<th>S33</th>
<th>S34</th>
<th>S35</th>
<th>S36</th>
<th>S37</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>57.41</td>
<td>58.85</td>
<td>48.20</td>
<td>53.16</td>
<td>51.40</td>
<td>56.81</td>
<td>63.19</td>
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<td>TiO₂</td>
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<td>0.72</td>
<td>0.40</td>
<td>0.50</td>
<td>0.47</td>
<td>0.54</td>
<td>0.47</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>12.35</td>
<td>13.64</td>
<td>9.50</td>
<td>11.18</td>
<td>11.14</td>
<td>10.50</td>
<td>11.90</td>
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<td>2.36</td>
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<td>MnO</td>
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<td>0.11</td>
<td>0.08</td>
<td>0.10</td>
<td>0.08</td>
<td>0.06</td>
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<tr>
<td>MgO</td>
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<td>6.08</td>
<td>12.29</td>
<td>9.29</td>
<td>10.14</td>
<td>8.68</td>
<td>5.61</td>
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<tr>
<td>CaO</td>
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<td>8.39</td>
<td>18.55</td>
<td>13.91</td>
<td>15.17</td>
<td>12.67</td>
<td>7.93</td>
</tr>
<tr>
<td>Na₂O</td>
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<td>0.14</td>
<td>0.11</td>
<td>0.08</td>
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<tr>
<td>K₂O</td>
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<td>9.33</td>
<td>6.75</td>
<td>8.30</td>
<td>8.08</td>
<td>7.70</td>
<td>8.70</td>
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<tr>
<td>P₂O₅</td>
<td>0.19</td>
<td>0.13</td>
<td>0.17</td>
<td>0.17</td>
<td>0.16</td>
<td>0.12</td>
<td>0.15</td>
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<tr>
<td>LOI</td>
<td>16.06</td>
<td>14.34</td>
<td>23.10</td>
<td>18.24</td>
<td>20.50</td>
<td>16.63</td>
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<tr>
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<td>99.86</td>
<td>100.21</td>
<td>99.91</td>
<td>99.97</td>
<td>100.12</td>
<td>100.15</td>
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<tr>
<td>Fe₂O₃T</td>
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<td>2.47</td>
<td>4.08</td>
<td>3.11</td>
<td>3.17</td>
<td>2.85</td>
<td>1.93</td>
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Table 6: XRD Mineralogy Summary

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<tr>
<th>Sample</th>
<th>Depth (m)</th>
<th>Quartz</th>
<th>Dolomite</th>
<th>K Feldspar</th>
<th>Mica</th>
<th>Chlorite (Chamosite)</th>
<th>Pyrite</th>
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<tr>
<td>DD-S31</td>
<td>27.4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>X</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>DD-S32</td>
<td>29.6</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>X</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>DD-S33</td>
<td>32.6</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>X</td>
<td>x</td>
<td>x</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td>X</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>DD-S35</td>
<td>37</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>X</td>
<td>x</td>
<td>x</td>
</tr>
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<td>DD-S36</td>
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<td>x</td>
<td>x</td>
<td>X</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>DD-S37</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td>X</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
Table 7: Concentration of major elements (as %) of the samples sourced from the DD97WG002 core hole showing comparison of the shale averages of the St Vizard and the Barney Creek Formation samples to the Average Shale composition determined by Wedepohl (1971, 1991) (sourced from Ross et al 2009) and the PAAS*. Barney Ck. and St Vizard averages drawn from correlation of samples obtained through the Imperial Oil & Gas ltd 2014 drilling program.

<table>
<thead>
<tr>
<th>Specimen</th>
<th>DD97WG002</th>
<th>St Vidgeon</th>
<th>Barney Ck. (1971, 1991)</th>
<th>PAAS*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S31</td>
<td>S32</td>
<td>S33</td>
<td>S34</td>
</tr>
<tr>
<td>SiO₂</td>
<td>57.41</td>
<td>58.85</td>
<td>48.2</td>
<td>53.16</td>
</tr>
<tr>
<td>TiO₂</td>
<td>0.57</td>
<td>0.72</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>12.35</td>
<td>13.64</td>
<td>9.5</td>
<td>11.18</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.76</td>
<td>1.58</td>
<td>1.67</td>
<td>0.49</td>
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<tr>
<td>FeO</td>
<td>1.11</td>
<td>0.8</td>
<td>2.17</td>
<td>2.36</td>
</tr>
<tr>
<td>MnO</td>
<td>0.07</td>
<td>0.05</td>
<td>0.11</td>
<td>0.08</td>
</tr>
<tr>
<td>MgO</td>
<td>8.48</td>
<td>6.08</td>
<td>12.29</td>
<td>9.29</td>
</tr>
<tr>
<td>CaO</td>
<td>11.29</td>
<td>8.39</td>
<td>18.55</td>
<td>13.91</td>
</tr>
<tr>
<td>Na₂O</td>
<td>0.08</td>
<td>0.14</td>
<td>0.11</td>
<td>0.08</td>
</tr>
<tr>
<td>K₂O</td>
<td>7.42</td>
<td>9.33</td>
<td>6.75</td>
<td>8.3</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>0.19</td>
<td>0.13</td>
<td>0.17</td>
<td>0.17</td>
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<tr>
<td>LOI</td>
<td>16.06</td>
<td>14.34</td>
<td>23.1</td>
<td>18.24</td>
</tr>
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<td>Total</td>
<td>99.91</td>
<td>99.86</td>
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<td>99.91</td>
</tr>
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<td>TOC %</td>
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<td>Fe₂O₃T</td>
<td>1.99</td>
<td>2.47</td>
<td>4.08</td>
<td>3.11</td>
</tr>
<tr>
<td>Fe₂O₃T/K₂O</td>
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<td>0.60</td>
<td>0.37</td>
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<tr>
<td>Fe₂O₃T/Al₂O₃</td>
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<td>0.18</td>
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<td>5.07</td>
<td>4.75</td>
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<tr>
<td>CaO/K₂O</td>
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<td>2.75</td>
<td>1.68</td>
</tr>
<tr>
<td>K₂O/Al₂O₃</td>
<td>0.60</td>
<td>0.68</td>
<td>0.71</td>
<td>0.74</td>
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<tr>
<td>MgO/Al₂O₃</td>
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<td>1.29</td>
<td>0.83</td>
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<tr>
<td>TiO₂/Al₂O₃</td>
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<td>0.05</td>
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<td>0.04</td>
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<tr>
<td>SO₃%</td>
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<td></td>
<td></td>
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<tr>
<td>Total Carbon %</td>
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<td></td>
</tr>
<tr>
<td>CaCO₃ %</td>
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</tr>
<tr>
<td>inorganic carbon %</td>
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* PAAS = Post Archean Australian Shale standard
Table 8: ICP element results

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<tr>
<th>Sample Name</th>
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<th>Be</th>
<th>B</th>
<th>Sc</th>
<th>V</th>
<th>Cr</th>
<th>Co</th>
<th>Ni</th>
<th>Cu</th>
<th>Zn</th>
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<td>&lt;1</td>
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<td>9.2</td>
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<th>As</th>
<th>Rb</th>
<th>Sr</th>
<th>Zr</th>
<th>Nb</th>
<th>Mo</th>
<th>Ag</th>
<th>Cd</th>
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<td>46.9</td>
<td>103.9</td>
<td>11.5</td>
<td>4.8</td>
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<td>&lt;1</td>
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<td>113.5</td>
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<td>&lt;1</td>
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<td>10.7</td>
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<th>Ba</th>
<th>Hf</th>
<th>Ta</th>
<th>W</th>
<th>Ti</th>
<th>Pb</th>
<th>Bi</th>
<th>Th</th>
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Figure 1: Geochemical logs
Figure 2: Kerogen quality plot
Figure 3: Kerogen type and maturity
Figure 4: kerogen conversion and maturity
Appendix 1: DD97WG002 drill hole ledger

### Drill Hole Ledger

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- Silicified Breccia
- Abundant Tarn Weathering Alvars
- Fractures
- Silicified Zone Starts 64.00m
- Leached and Bleached Bce?
- Leached and Bleached Bce?
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- Leached and Bleached Bce?
- Pyt in Breccia Veins
- Pyrite Zone 78.0-80.0m
- Millet-Seed Gypsum
- Voids
- Pyrite in Breccia Veins
- HPZ and Cal Veins X-cutting Silicified Bst
- Re-crystallized and Silicified Bcee
- Gassy
- Y Small Amounts of Sulphide Associated with Abundant Calcite Veining
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- INTENSE BRECCIATION 109.5-111.5M
- RECRYSTALISED
- DOLOMITIC SILTSTONE
- RECRYSTALISED
- DOLOMITIC SILTSTONE
- BRECCIA ZONE 118.5-121.5M
- ONLY ECM OF SS (WSI) RECOVERED FOR INTERVAL (SAMPLED WITH ABOVE INTERVAL CONTAINED A FEW FRAGMENTS OF CHALKY BUFF SSTR CONTAINED A FEW FRAGMENTS OF CHALKY BUFF SST
- HIGHLY SILICIFIED
- HIGHLY SILICIFIED
- HIGHLY SILICIFIED
- THINLY BEDDED SILTSTONE
- THINLY BEDDED SILTSTONE
- THINLY BEDDED SILTSTONE
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ONLY 10cm RECOVERED - OB SST - SAMPLED WITH ABOVE INTERVAL

VERY FERUGINOUS

VERY FERUGINOUS

ECHAN / VERY FERUGINOUS
Appendix 2: XRD analysis

DD531 (Coupled TwoTheta/Theta)
DD536 (Coupled TwoTheta/Theta)

Counts

2Theta (Coupled TwoTheta/Theta) WL=1.54060
Appendix 3: Pyrolysis data

![Graph of Pyrolysis Data]

**DD-531**

- **X-Axis:** Time (Minutes)
- **Y-Axis:** Temperature
- **Graph Lines:**
  - Pink: TEMP
  - Blue: SAMPLE

The graph illustrates the temperature response of the sample over time, with distinct peaks and trends indicating the pyrolysis process.
DD-533

Time (Minutes)

Temperature

FID Response

DD-533

TEMP

SAMPLE
References:


