WELL COMPLETION REPORT
INTERPRETATIVE

GEOGRAPHE NORTH-1

VIC/P43

OFFSHORE OTWAY BASIN

MAY 2004

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1. WELL INDEX SHEET

Permit Interests:	Origin Energy Resources Ltd (30%) - OPERATOR Woodside Energy Ltd (55%) CalEnergy Gas (UK) Ltd (15%)
Rig on Location:	28/09/2001
Spud:	29/09/2001
Reached TD:	8/10/2001
Rig Released:	14/10/2001
Total Rig Days:	17.08
Rig Name:	Ocean Bounty
Drilling Contractor:	Diamond Offshore General Co.
Total Depth:	2156.0m MDRT (D)
Well Status:	Plugged and Abandoned

Well Name:	Geographe North-1
Basin:	Offshore Otway
Permit:	VIC/P43
Type:	Vertical Exploration Well
Water Depth:	82.0m (MSL to seabed)
Elevation:	25m (RT-sealevel)
Latitude:	39° 04' 39.928"S
Longitude:	142° 54' 57.647"E
Easting:	665 736.2 metres
Northing:	5 672 832.3 metres
(AGD 84; AMG Zone 54, Central Meridian 141° East). Deviation from intended location = 5.6m toward 240°	
Seismic Reference:	Inline 870/CDP 2640: Investigator 3D survey
Actual Well Cost:	A$ 11,262,986

Formation Tops:

FORMATION / *SEISMIC MARKER*	**TOPS (m)**				**REMARKS/SHOWS**
	MDRT	SUBSEA	THICK	TWT(ms)	
Port Campbell Limestone	107.0	82.0	136.1	-	No Returns 107.0 – 565.0 mMDRT
Gellibrand Marl			410.0		No Returns 107.0 – 565.0 mMDRT
Upper Gellibrand Marl	243.1	218.1	342.9	-	No Returns 107.0 – 565.0 mMDRT
Middle Miocene Seismic Marker				286	
Lower Gellibrand Marl *Base Miocene Seismic Marker*	586.0	561.0	67.1	-	No Returns 107.0 – 565.0 mMDRT. Below 565.0 mMDRT, argillaceous calcilutite with minor interbedded calcareous claystone
Narrawaturk Marl	653.1	628.1	77.7	-	argillaceous calcilutite with minor interbedded calcareous claystone and argillaceous calcarenite
Mepunga Formation	730.8	705.8	153.0	-	sandstone with minor silty sandstone
Dilwyn Formation	883.8	858.8	203.4	800	sandstone with lesser argillaceous siltstone and rare claystone
Paaratte Formation	1087.2	1062.0	335.7	931	argillaceous siltstone with minor interbedded sandstone and silty sandstone
Belfast Formation	1422.9	1397.9	423.4	1161	silty claystone grading to argillaceous siltstone
Thylacine Member	1846.3	1821.3	21.5	1428	silty claystone with minor argillaceous sandstone
Flaxman Formation	1867.8	1842.8	116.2	1440	interbedded silty claystone and sandstone
Waarre Formation			172.0+	1509	
Upper Waarre Formation	1984.0	1959.0	172.0+		sandstone with minor siltstone.
TOTAL DEPTH	2156.0	2131.0		1609	

Formation Evaluation While Drilling:

Suite #	Run #	Interval (mDRT)	Logs Acquired
1	1	558.0 – 1790.0	PowerPulse/MVC/CDR
1	2	1784.0 – 2156.0	PowerPulse/MVC/CDR

Wireline Logs:

Suite #	Run #	Interval (mMDRT)	Logs Acquired
1	1	2155.0 – 1787.5	PEx(HLRA)-DSI-GPIT
1	2	2153.0 – 800.0	CSAT-GR Checkshot
1	3	2126.0 – 1794.0	CST-GR

Cores:

Conventional: None

Sidewall:

Suite #	Run #	Type	Interval (mMDRT)	Bullets	Misfired	Empty	Lost	Recovered
1	3	Percussion (CST)	1794.0 – 2126.0	30	0	0	1	29

Pressure Testing and Fluid Sampling:

No MDT tests were run.

Hole & Casing Details:

Hole Size	Interval (mMDRT)	Casing Size	Shoe Setting Depth (mMDRT)
36"	107.0 – 162.0	30"/20"	162.0
17 ½ "	162.0 – 558.0	13 $^{3}/_{8}$ "	558.0
12 ¼ "	558.0 – 1790.0	9 $^{5}/_{8}$ "	1784.0
8 ½ "	1790.0 – 2156.0 (TD)		

Abandonment Plugs:

Abandonment Plug #	Interval (mMDRT)
1	1729 – 1935
2	114 - 189

2. WELL SUMMARY

Geographe North-1 (Heaps, 2001) is a vertical exploration well located in the Victorian part of the offshore Otway Basin in the southwest corner of petroleum exploration permit VIC/P43, approximately 227 km southwest of Melbourne, 141 km southeast of Portland, and 52 km south of Port Campbell (Figure 1). The objective of the well was to test the northern crest of a large bi-crestal closure at the Late Cretaceous (Turonian) level (Figure 2) located on a prominent southwest plunging anticline in the axis of the Shipwreck Trough. The well was designed as a follow-up to Geographe-1, which had successfully tested the southern crest of the closure 4.2 km to the south four months earlier.

Geographe North-1 spudded on the 29th September 2001 in 82 m of water. The well was drilled by the semi-submersible drilling rig 'Ocean Bounty' and reached a total depth of 2156 mMDRT. The primary objective was the Waarre Formation, with the overlying Flaxman Formation a secondary objective. Prior to drilling, seismic mapping indicated the Geographe and Geographe North prospects should be in communication at the Top Turonian level via a narrow saddle. However, the bright seismic amplitudes observed on seismic above the GWC contact in Geographe-1 did not appear to extend northwards into the Geographe North closure, which raised the possibility the northern closure had either been by-passed by hydrocarbons or had leaked.

On the 8th October 2001, Geographe North-1 reached its primary and secondary objectives but no significant shows were reported. The well was then logged and plugged and abandoned. The rig was released on 14th October 2001.

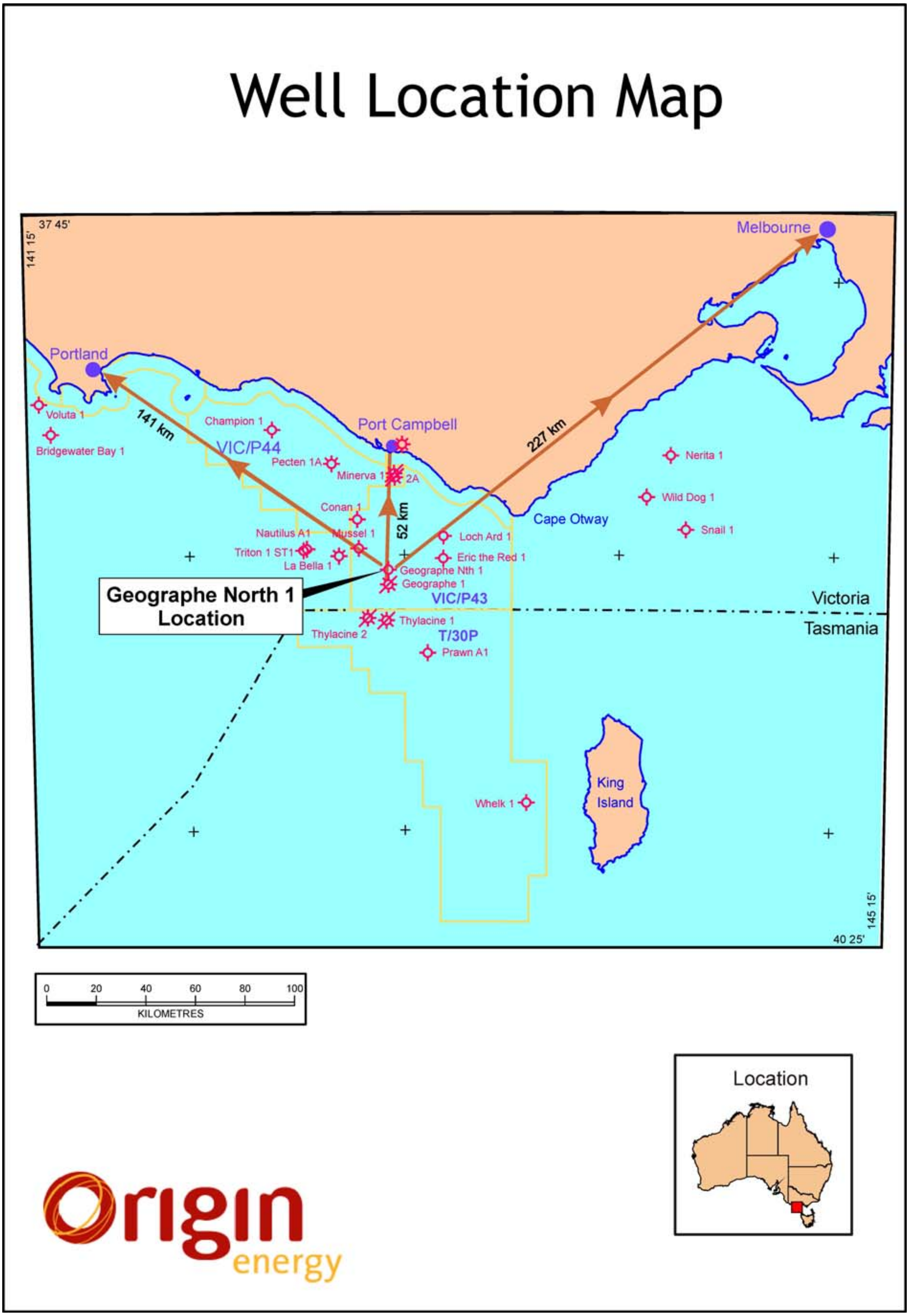

Figure 1 - Geographe North-1 location map

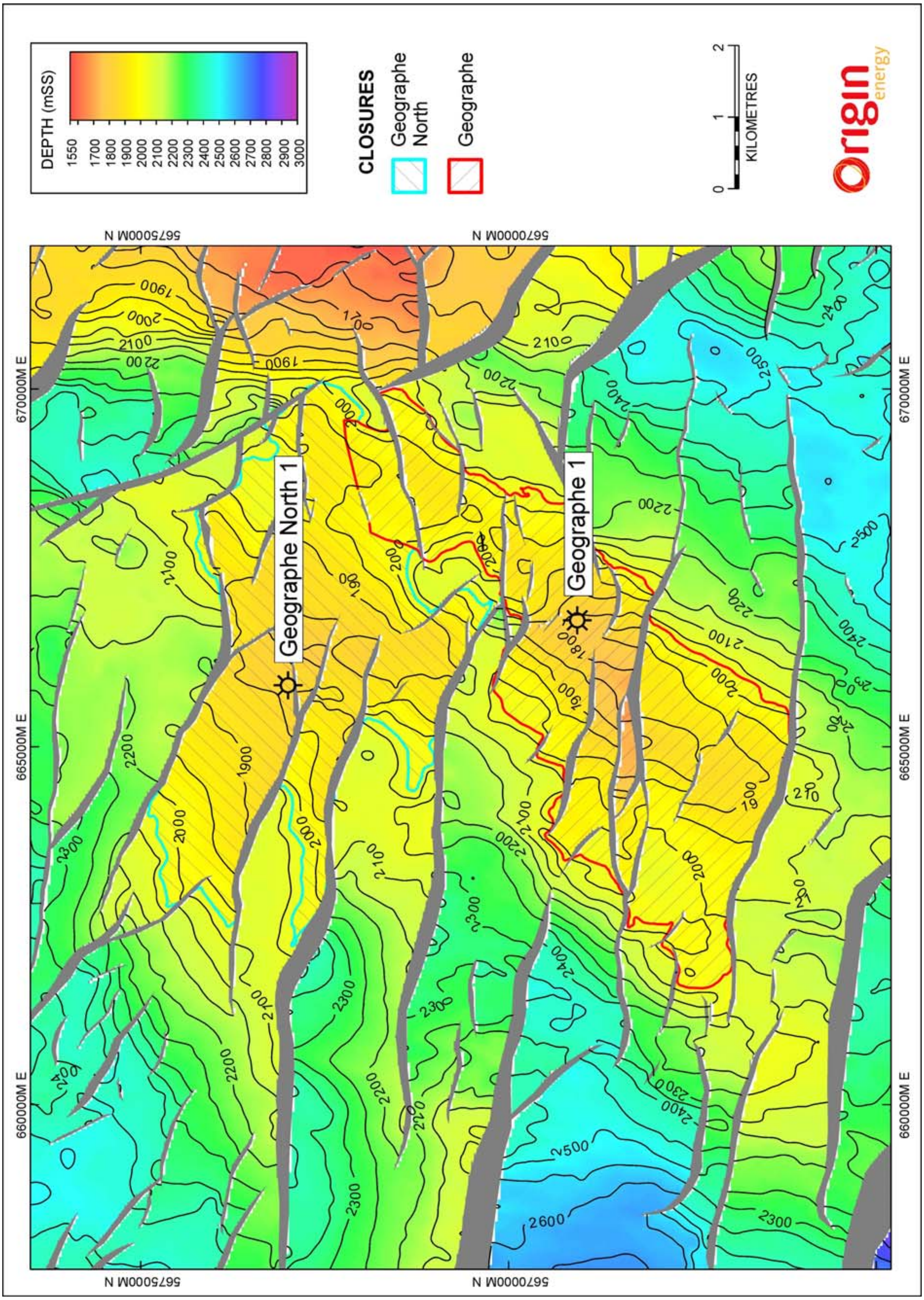

Figure 2 - Top Porosity depth structure map over Geographe and Geographe North prospects

3. HYDROCARBONS

Background gas readings in Geographe North-1 remained relatively steady (0.01 - 0.14%) down to the base of the Tertiary. No significant gas peaks were recorded and no fluorescence was observed.

The low gas readings continued down into the Late Cretaceous as far as the Belfast Formation (1422.5 – 1846.3 mMDRT) and Thylacine Member (1846.3 – 1867.8 mMDRT). Again, no significant gas peaks were recorded and no fluorescence was observed. However, most of the sidewall cores recovered from the basal part of the Belfast Formation and Thylacine Member did display a weak diffuse blue-white fluorescence cut with a trace blue-white ring residue. Contamination from the glycol-based mud filtrate is considered to be the most likely cause of this fluorescence.

Upon entering the Flaxman Formation (1867.8 – 1984 mMDRT), gas readings in the well rose slightly over an interval of a few metres from less than 0.1% at 1885 mMDRT to a maximum of 3.0% at 1888 mMDRT. They then dropped back to below 0.1% at 1892 mMDRT before peaking again at 0.8% at 1902 mMDRT. The gas readings then dropped back to about 0.1% and remained fairly steady down to the Upper Waarre Formation (1984 – 2156 mMDRT TD), when at about 2018 mMDRT they started to fluctuate between 0.02 and 0.22% until TD.

Although no direct fluorescence was observed, the majority of sidewall cores recovered from the Flaxman Formation also displayed a weak to strong blue-white fluorescent cut with a moderate blue-white ring residue. In the Upper Waarre Formation, several of the sidewall cores displayed 5 - 10% (80% in SWC#5) dull white / bluish fluorescence with a weak blue-white fluorescent cut and thin blue-white ring residue, while the rest typically had only a weak blue-white fluorescent cut with a thin blue-white ring residue. At the bottom of the well, the two deepest sidewall cores were reported to have 10 – 30% patchy bright blue-white patchy fluorescence with a weak blue-white diffuse fluorescent cut with a thin blue-white ring residue. Again, contamination from the glycol-based mud filtrate is considered to be the most likely cause of the fluorescence.

Log analysis (Appendix 1) indicates the Thylacine Member, Flaxman Formation and Upper Waarre Formation sands in Geographe North-1 are all water-saturated.

4. STRATIGRAPHY

The generalised stratigraphy of the eastern offshore Otway Basin is illustrated in Figure 3 and the stratigraphic section intersected by Geographe North-1 in Figure 4. As can be seen in Figure 4, the actual stratigraphy differs from the prognosed stratigraphy in a number of areas. These include: 1) a thicker-than-expected Dilwyn Formation; 2) the absence of the Pember Mudstone and Pebble Point Formation; and 3) the penetration of a thin, previously unknown sequence of interbedded silty claystone and very fine- to fine-grained sandstone at the base of the Belfast Formation.

A report by Dr Roger Morgan on the age of the sediments penetrated in Geographe North-1 is included in Appendix 2. The detailed palynological sampling programme conducted during the drilling of Geographe North-1 (25 side wall core samples) has, in co-ordination with the Thylacine-1, Thylacine-2 and Geographe-1 sampling programmes, allowed Dr Morgan to significantly refine the existing Late Cretaceous spore-pollen and dinoflagellate zonation schemes for the Otway Basin, thereby dramatically increasing its resolution. Consequently, it is now possible correlate units between wells inside the Shipwreck Trough more accurately than before.

Lithological descriptions from ditch cuttings and SWC's, together with the MWD and wireline log interpretation, provide the basis for the stratigraphic breakdown in Enclosure 1.

HEYTESBURY GROUP

Port Campbell Limestone (107.0 – 243.1 mMDRT)

The Port Campbell Limestone in Geographe North-1 is approximately 136 m thick. Its presence is inferred from seismic ties to nearby wells including La Bella-1, Mussel-1 and Conan-1, as first returns in Geographe North-1 were not established until 565.0 mMDRT. To the north, onshore, the Port Campbell Limestone is a light grey to white, medium-hard, poorly sorted, shallow marine calcarenite with abundant fossils (corals, bryozoans, foraminifera) and is Miocene in age.

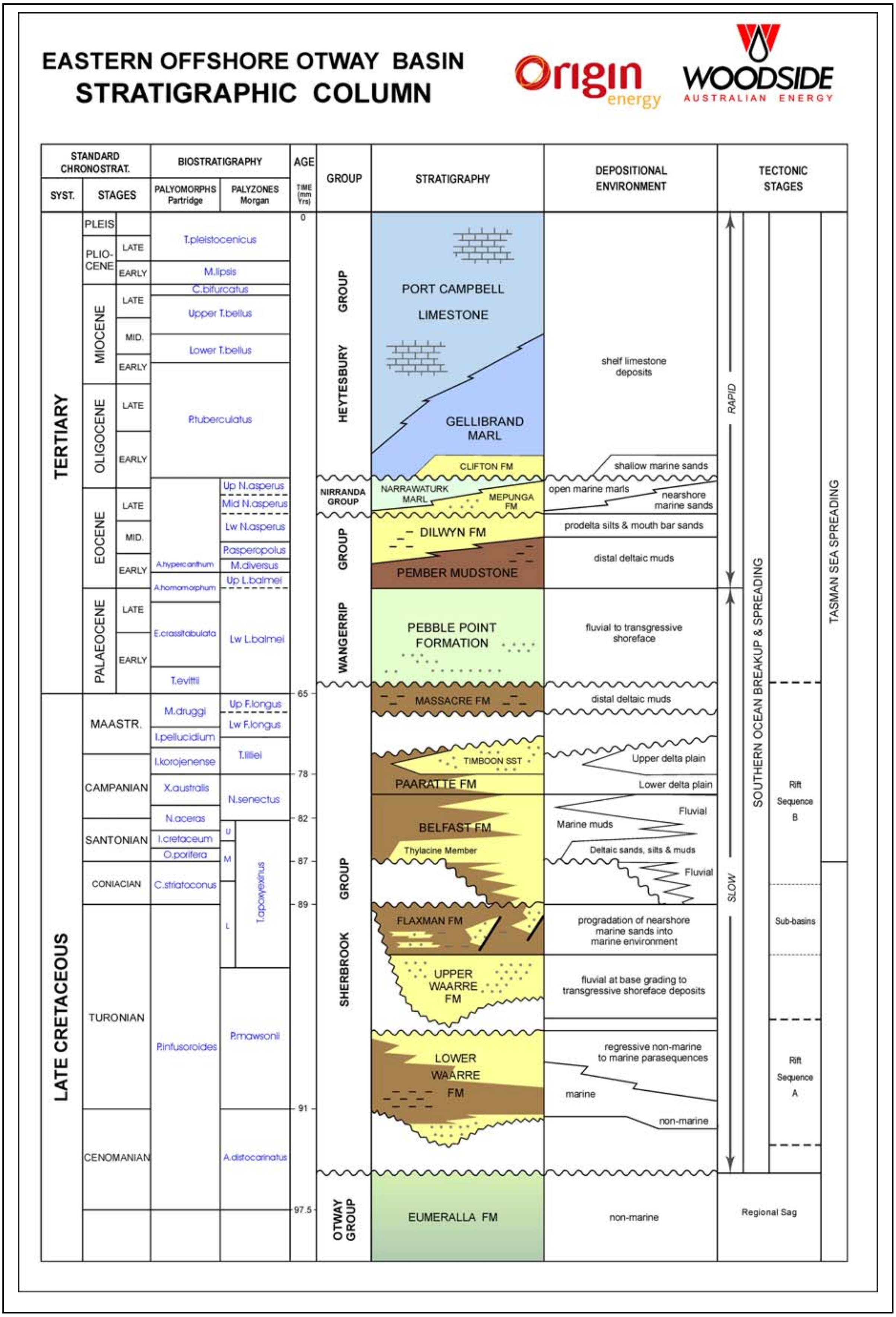

Figure 3 – Offshore Otway Stratigraphic Section

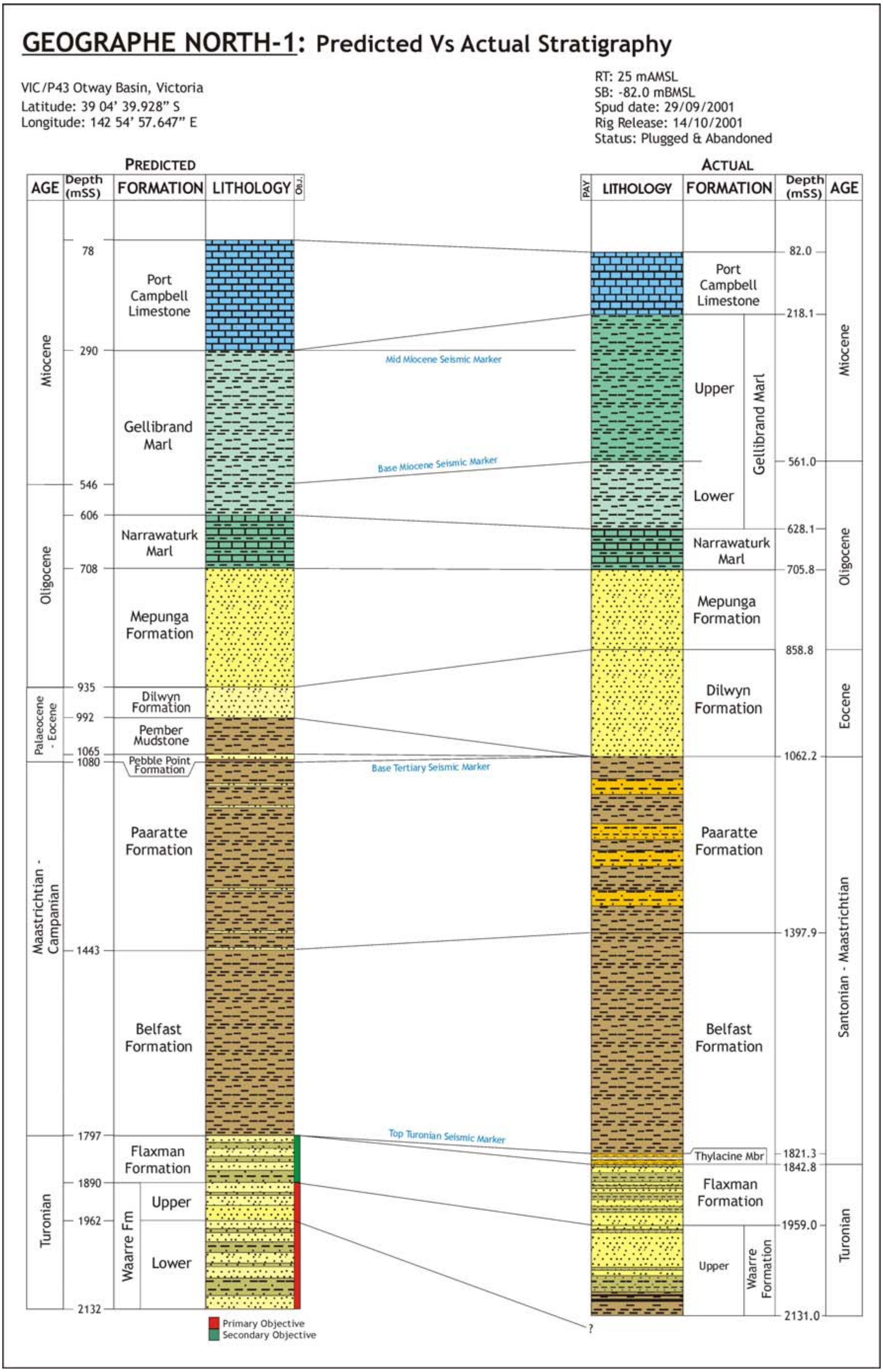

Figure 4 – Predicted versus Actual Stratigraphy

Gellibrand Marl (243.1 – 653.1 mMDRT)

The Gellibrand Marl is a shallow marine calcareous claystone that gradationally underlies the Port Campbell Limestone. In the Shipwreck Trough, the Gellibrand Marl can be seismically divided into two units separated by a prominent seismic marker. Both units are present in Geographe North-1 where they have a combined thickness of 410.0 m.

Upper Gellibrand Marl / Mid Miocene Seismic Marker (243.1 – 586.0 mMDRT)

The Upper Gellibrand Marl in Geographe North-1 is approximately 343 m thick. Prior to drilling, the top of the Gellibrand Marl in the Shipwreck Trough was correlated with a prominent seismic marker called the 'Mid Miocene Seismic Marker'. This event is an unconformity surface with local canyon development that is mappable across the entire Shipwreck Trough area. In this report, the top of the Upper Gellibrand Marl in Thylacine-2 is tied to a drop in ROP as it is in Geographe-1 and Thylacine-1 to the south. The drop in ROP occurs approximately 70 m stratigraphically above the predrill depth estimate (290 mMDRT), which was calculated using the Geographe-1 time-depth curve.

The lithology of the Upper Gellibrand Marl in Geographe North-1 is largely unknown since first returns in the well were not established until 565.0 mMDRT, approximately 20 m above the base of the unit. Elsewhere in the basin, the Upper Gellibrand Marl is a calcareous silty-clay and clayey-silt, with minor fine- to coarse-grained calcarenite beds. They are typically light grey in colour, soft, fossiliferous, glauconitic, pyritic, and carbonaceous.

Lower Gellibrand Marl/Base Miocene Seismic Marker (586.0 – 653.1 mMDRT)

The 'Base Miocene' seismic event defines the top of the Lower Gellibrand Marl in Geographe North-1. This event is another unconformity surface with local canyon development that is mappable across the entire Shipwreck Trough area.

In Geographe North-1, the top of the Lower Gellibrand Marl is difficult to pick because first returns in the well do not appear until 565 mMDRT, which is just above the pre-drill depth estimate for the top of the unit (571 mMDRT), and there is little difference in cuttings lithology over the first 100 m of cuttings. In this report, the top of the Lower Gellibrand Marl (586 mMDRT) is picked on a subtle character change in the GR log (the only log acquired above 695 mMDRT) that coincides with a slight increase in ROP.

The above pick makes the Lower Gellibrand Marl in Geographe North-1 approximately 67 m thick. The cuttings descriptions suggest the formation is composed largely of argillaceous calcilutite with minor interbedded calcilutite. The argillaceous calcilutite is light olive-grey to green-grey in colour, soft to firm, sub-blocky, with abundant grey argillaceous material, trace calcite cement, and rare siliceous silt. Foraminifera, crinoid and coral fragments are also present in trace amounts. Glauconite is rare. The interbedded calcilutite is white to very light grey, soft to firm, amorphous, with rare calcareous silt and light grey argillaceous material, and trace glauconite.

The age of the Lower Gellibrand Marl in Geographe North-1 is not known as no samples were collected for dating purposes.

NIRRANDA GROUP

Narrawaturk Marl (653.1 - 730.8 mMDRT)

The Narrawaturk Marl in Geographe North-1 is represented by 77.7 m of argillaceous calcilutite with minor interbedded calcarenite and calcareous claystone. The top of the formation is picked on a subtle character change on the GR log (the only log acquired above 695 mMDRT).

The argillaceous calcilutite, which comprises the bulk of the Narrawaturk Marl, is light grey to green grey in colour, firm, sub-blocky, with abundant grey argillaceous material, trace calcite cement and rare siliceous silt. Foraminifera, crinoid and coral fragments are also present in trace amounts, along with rare glauconite. The interbedded calcarenites are light yellowish-brown to very light grey in colour, friable to moderately hard, and composed largely of skeletal and calcilutite fragments, with abundant calcilutite and calcisiltite matrix and minor calcite cement. The calcareous claystones, in comparison, are very light grey to light grey in colour, soft to firm, amorphous, with common calcareous silt and trace glauconite.

The age of the Narrawaturk Marl in Geographe North-1 is not known as the formation was not sampled for dating purposes. However, the close proximity of the well to Geographe-1 where the Narrawaturk Marl has been dated suggests it is at least in part late Early to early Late Oligocene in age.

Mepunga Formation (730.8 – 883.8 mMDRT)
The Mepunga Formation in Geographe North-1 is represented by 153 m of yellowish-brown to greyish-brown, very fine to very coarse-grained, poorly to moderately sorted, friable sandstone with occasional interbedded silty sandstone. The sands are weakly cemented and display very good visual porosity. Framework grains range from sub-angular to well rounded with a yellow to dark brown stain. The majority of quartz grains are clear with some pitting evident. Frosting is rare. The silty sandstone interbeds are predominately brownish-black in colour, firm, dispersive, with very fine- to fine-grained, sub-angular to well rounded quartz grains.

The age of the Mepunga Formation in Geographe North-1 is not known as the formation was not sampled for dating purposes. However, the close proximity of the well to Geographe-1 where the Mepunga Formation has been dated suggests it is probably Early to Middle Eocene in age.

WANGERRIP GROUP

Dilwyn Formation (883.8 – 1087.2 mMDRT)
The Dilwyn Formation in Geographe North-1 is represented by 203.4 m of moderately sorted very fine- to very coarse-grained sandstone with minor interbedded siltstone and argillaceous siltstone. The top of the formation is difficult to pick in Geographe North-1 because the Dilwyn Formation and overlying Mepunga Formation are almost identical in lithology and there is no age data in the well to separate the two units. In this report, the top of the Dilwyn is picked on a DT break that coincides with the current preferred seismic pick.

The Dilwyn Formation sandstones in Geographe North-1 are pale yellowish orange in colour with a light grey stain. The sands are loose with individual grains ranging from sub-rounded to rounded and elongate to spherical in shape. Jasper and siderite are present in trace amounts. Visual porosity is described as fair. The interbedded siltstones and argillaceous siltstones range from greyish-black to olive-black and olive-grey in colour, and are relatively plastic, sticky and amorphous. Carbonaceous matter and disseminated pyrite are present in trace amounts.

SHERBROOK GROUP

Paaratte Formation (1087.2 – 1422.9 mMDRT)

The Paaratte Formation in Geographe North-1 is represented by 335.7 m of argillaceous siltstone with minor interbedded very fine to medium-grained sandstone above 1380 mMDRT and very fine to fine-grained silty sandstone below. The argillaceous siltstones are grey-brown to olive-grey in colour, very soft to soft, amorphous to dispersive, with abundant argillaceous material and trace carbonaceous matter, glauconite, lithics and mica. The interbedded very fine to fine-grained sandstones are white to olive-grey in colour and typically poorly to moderately sorted, with minor argillaceous matrix, trace calcite cement, glauconite and lithics, rare coarse to very coarse grains of quartz, and 0 - 10% visual porosity. The very fine to medium-grained silty sandstones, in comparison, are very light grey to very light greenish grey to olive grey in colour, very soft to soft, rarely friable to loose, poorly to moderately sorted, with minor argillaceous matrix, trace glauconite and lithics, and no visible porosity.

The age of the Paaratte Formation in Geographe North-1 is not known as the formation was not sampled in the well.

Belfast Formation (1422.9 – 1846.3 mMDRT)

The Belfast Formation in Geographe North-1 is represented by 423.4 m of silty claystone with argillaceous siltstone common in the upper half of the unit. The formation is undifferentiated except for a thin (21.5 m) sequence of interbedded silty claystone and argillaceous sandstone at the base of the unit called the Thylacine Member (see below).

The silty claystones that make up the Belfast Formation range from olive black to dusky yellowish-brown, dusky brown and brownish-grey in colour, and are soft to moderately hard, dispersive, with trace amounts of very fine quartz grains, carbonaceous matter, lithics, mica and disseminated pyrite, and minor to trace amounts of glauconite. The interbedded argillaceous siltstones vary in colour from dark yellowish brown to reddish brown, greenish grey and olive grey in colour. The siltstones, in comparison, are very soft to soft, sticky and dispersive, with trace amounts of carbonaceous matter, lithics, mica and disseminated pyrite, trace to rare grains of very fine quartz. Carbonaceous matter is rare.

Palynological analysis of sidewall cores from between 1842.5 - 1794.0 mMDRT (Appendix 2) indicate the base of the Belfast Formation spans the *upper O.porifera - I.cretaceum (lower b)* dinoflagellate zones and Middle *T.apoxyexinus* spore-pollen zone, and is Santonian in age. The predominance of spore-pollen over dinoflagellate, and the moderate diversities of both, suggest the basal Belfast sediments were deposited in a nearshore marine environment. The age of the formation above 1794.0 mMDRT is not known as no samples were collected for dating purposes.

Thylacine Member (1846.3 – 1867.8 mMDRT)

The Thylacine Member in Geographe North-1 is represented by 21.5 m of silty claystone and minor argillaceous very-fine to fine-grained sandstone. The silty claystone is brown grey to medium grey in colour, soft to rarely firm, sticky to dispersive, with abundant quartz silt, trace carbonaceous matter, mica and disseminated pyrite, and trace to rare glauconite. The argillaceous sandstones, in contrast, are very light to medium grey in colour, friable, well-sorted, with abundant light grey matrix, minor quartz silt, and trace siliceous cement, very fine carbonaceous matter and glauconite. Visual porosity is about 5%.

Palynological analysis of sidewall cores from between 1854.8 mMDRT and 1866.8 mMDRT indicates the lower half of the unit contains *lower O.porifera* Zone dinoflagellate and Middle *T.apoxyexinus* Zone spore-pollen, and is Coniacian in age. The age of the upper half of the Thylacine Member is not known as it was not sampled, but it cannot be younger than Early Santonian based on the presence of *upper O.porifera* Zone dinoflagellate and Middle *T.apoxyexinus* Zone spore-pollen at the base of the overlying Belfast Formation in sidewall cores between 1842.5 mMDRT and 1821.5 mMDRT (see Enclosure 1).

Flaxman Formation (1867.8 – 1984.0 mMDRT)

The Flaxman Formation in Geographe North-1 is represented by 116.2 m of interbedded silty claystone and very-fine to coarse-grained sandstone with rare very coarse grains. The silty claystone is brown grey to medium grey in colour, soft to rarely firm, sticky to dispersive, with abundant quartz silt, trace carbonaceous matter, mica and disseminated pyrite, and trace to rare glauconite. The sandstones are very light grey in colour, friable to loose, poorly-sorted, with minor to rare light grey argillaceous matrix, trace quartz silt, trace to rare pyritic cement, trace siliceous cement, trace lithics, carbonaceous matter and disseminated pyrite, and 10 to 20% visual porosity.

Palynological dating (Appendix 2) indicates the Flaxman Formation in Geographe North-1 spans the *P.infusorioides upper 'a'* to *P.infusorioides upper 'c'* dinoflagellate zones and *lower T.apoxyexinus* spore-pollen Zone, and is Turonian in age. Apart from right near the top, the bulk of the formation appears to have been deposited in a nearshore to very nearshore environment based on the predominance of spore-pollen over dinoflagellate and the low diversity of the latter. The top of the unit, in contrast, appears to have been deposited in a shelfal marine environment based on the presence of subequal proportions of spore-pollen and dinoflagellate in the three sidewall cores between 1869.9 mMDRT and 1890.5 mMDRT.

Waarre Formation (1984.0 – 2156.0 mMDRT [TD])

The Waarre Formation in the Shipwreck Trough can be divided into two units separated by a major sequence boundary. The two units are here called the Upper Waarre Formation and Lower Waarre Formation. Only the Upper Waarre unit was penetrated in Geographe North-1.

Upper Waarre Formation (1984.0 – 2156.0 mMDRT [TD])

The Upper Waarre Formation intersected in Geographe North-1 is represented by 172 m of very fine to very-coarse (predominantly medium to coarse) grained sandstone and minor interbedded siltstone. This is a minimum thickness as the base of the unit was not intersected. The sandstones are very light grey to very light brownish grey in colour, largely loose with minor friable aggregates, poorly sorted, with trace to rare silt matrix, rare light grey argillaceous matrix, trace to rare pyritic cement, rare siliceous cement, and trace carbonaceous matter, mica, glauconite and fluorescent amber. Inferred intergranular porosity is very good, ranging from 10 to 25 %. The interbedded siltstones are light brownish grey to medium grey in colour, soft to moderately hard, predominantly quartzose, with abundant clay matrix, minor disseminated grains of very fine quartz, minor to common carbonaceous streaks, and trace mica, glauconite and fluorescent amber.

Palynological dating (Appendix 2) suggests the Upper Waarre in Geographe North-1 spans the *P.infusorioides middle 'c'* and *upper 'a'* dinoflagellate Zones and *upper P.mawsonii* and *lower T.apoxyexinus* spore-pollen Zones (see Enclosure 1). A very nearshore marine to possibly nonmarine environment of deposition is inferred for these sediments based on the extremely rare low diversity dinoflagellate assemblages observed in the three sidewall cores recovered from between 2083.0 mMDRT and 2103.0 mMDRT and the total absence of saline markers in the single sidewall core from 2101.0 mMDRT.

5. PETROPHYSICAL SUMMARY

A full report on the reservoir quality and hydrocarbon saturation of the Thylacine Member, Flaxman Formation and Upper Waarre Formation in Geographe North-1 is included in Appendix-1 and summarised in Table 1.

The Thylacine Member (1846.3-1867.8 mMDRT) is interpreted to have minimal to nil reservoir quality, with a net to gross of less than 2%. Reviewing average reservoir parameters when such a small thickness of reservoir (0.4 metres) exists is quantitatively invalid and misleading. The average parameters are reported in Table 8 of Appendix 1, but should not be utilised as inputs into any geological or reservoir modelling.

The underlying Flaxman Formation (1867.8-1984.0 mMDRT) has moderately good reservoir development in part, although the overall net to gross ratio is low. The sandstones present, on average, have an average clay volume of 19.9%. The average effective porosity is 16.2%, and the average gas permeability averages 1.13mD. This unit has a net reservoir to gross of 32.0%.

The deeper Upper Waarre Formation (1984.0-2128.0 mMDRT) displays average clay volumes of only 9.7%, average effective porosities of 19.3%, and an average net to gross ratio of 82.7%

All of the Thylacine Member, Flaxman Formation, and upper Waarre Formation reservoirs within the interpreted interval are water-saturated. There is no indication from either the wireline logs or the mudlog of significant hydrocarbons being present.

Based upon the learning from the petrophysical analysis of both Thylacine-1 and Geographe-1, only an Indonesian water saturation equation was applied in this well. It was originally thought that with the benefit of detailed special core analysis data, the Waxman-Smits equation should result in more realistic values. Unfortunately, this was not the case, as the Waxman-Smits equation encountered problems in argillaceous reservoirs, and under-estimated the gas saturation in comparison with the Indonesian equation. The Indonesian Equation is therefore applied in all reported values.

FORMATION NAME	TOP FROM mMDRT	BASE TO mMDRT	GROSS INTERVAL mMDRT	NET RESERV INTERVAL mMDRT	AVERAGE VCL %	AVERAGE PHIE %	AVERAGE AIR PERM mD	AVERAGE GAS PERM mD	AVERAGE H_2O PERM mD	AVERAGE SWE %	NET RES / GROSS %
Thylacine Member	1846.30	1867.80	21.50	0.41	29.15	22.48	11.55	9.14	3.37	98.61	1.91
Flaxman Formation	1867.80	1984.00	116.20	37.21	19.89	16.21	1.48	1.13	0.41	95.64	32.02
Upper Waarre Fm	1984.00	2128.00	144.00	119.08	9.74	19.33	2.97	2.29	0.83	99.67	82.69

Cut-offs Applied		
Net Pay	K_gas >	0.1mD
	VCl <	40.0%

Table 1 - Geographe North-1 Petrophysical Summary

6. GEOPHYSICAL DISCUSSION

6.1 Seismic Data

The Investigator 3D seismic survey, which was acquired in 2000, covers an area of 986.4 km^2 spanning permits VIC/P43 and T/30P in the central Shipwreck Trough (Figure 5). The Geographe North Prospect is located in the center of the Investigator 3D. Seismic data quality over the prospect is considered good to very good (Figure 6).

6.2 Structure

The Geographe North Prospect is the northern lobe of a large bi-crestal closure located on the axis of a prominent southwest plunging anticline adjacent to the Sorrell Transfer Fault in the Shipwreck Trough (see Figure 2). The southern closure, called the Geographe Prospect, was successfully tested four months earlier by Geographe-1. The two closures are connected by a narrow saddle about 1 km wide; the floor of which lies about 100m above the GWC in Geographe-1. This saddle, however, does not mark the boundary between the two prospects. Instead, the boundary is represented by an abrupt termination in amplitudes at the Top Porosity level approximately 1.6 km north of the saddle (see Figure 7). The significance of this cut-off is discussed below in Section 6.3.

The Geographe North Prospect covers an area of approximately 16 sq km and has a relief of about 225 m. The structure is dominated by WNW-ESE striking normal faults and pitches to the west and east. The structural spill-point is a small saddle located on the eastern side of the prospect. The floor of the saddle is approximately 30 m shallower than the GWC in Geographe-1.

The faulting history at Geographe North is complex due to its proximity to the Sorrell Transfer Fault. This complexity is clearly visible in the Variance Cube™ time slice shown in Figure 8.

6.3 Seismic Amplitudes

Initially, the absence of amplitudes at the Top Porosity level within the Geographe North closure was, based on the success of Geographe-1, attributed to pinch-out of the basal Belfast sands (Thylacine Member) onto the Geographe North structure. The absence of amplitudes is now thought to be fault-related, because the cut-off is knife-sharp on seismic, both in profile and plan view (see Figures 7 and 9). However, only a small section of the fault is actually visible on 3D, which suggests the amount of throw on the fault is relatively small (ie. near to below seismic resolution).

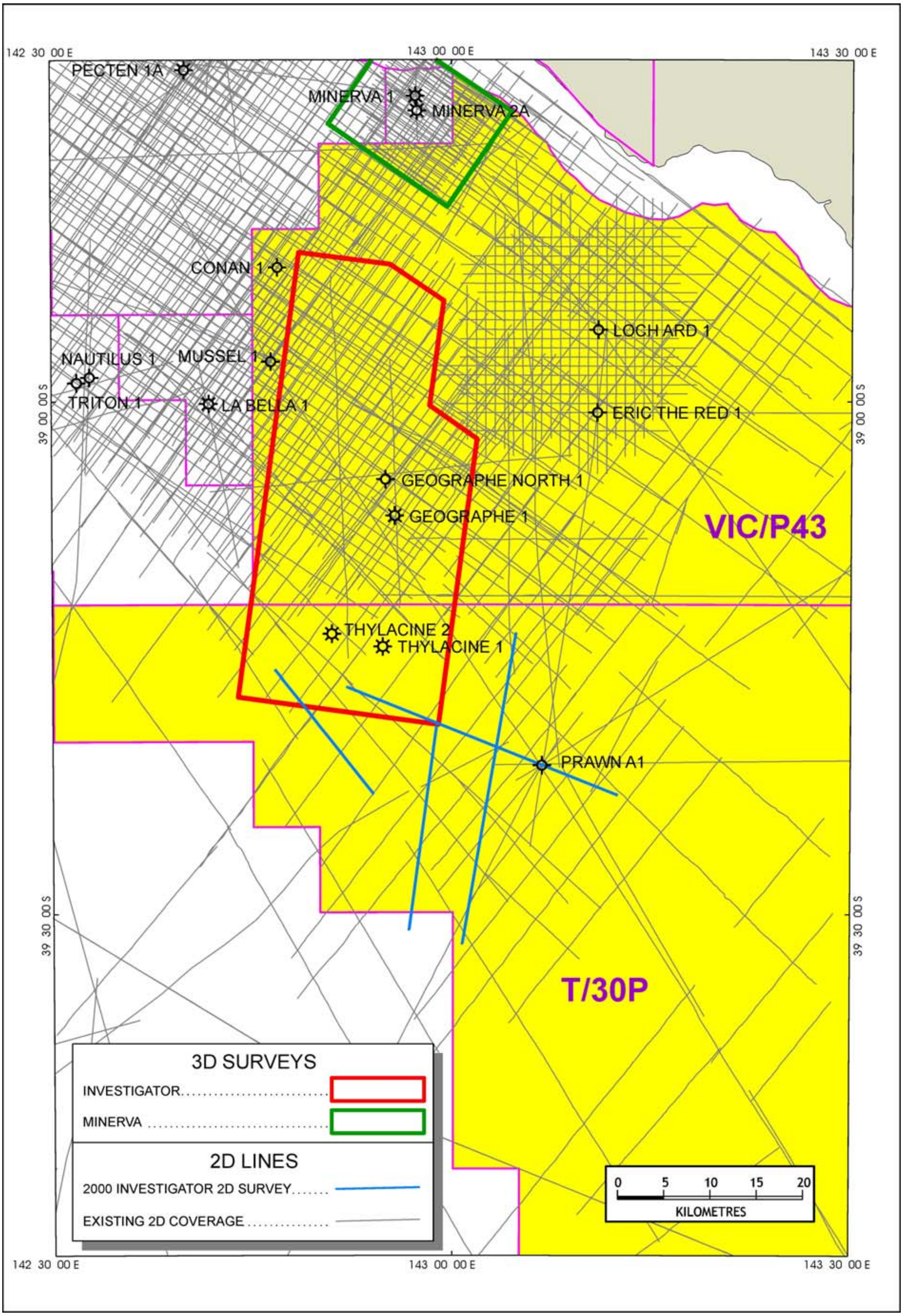

Figure 5 – Investigator 3D and 2D Seismic Survey Location Map

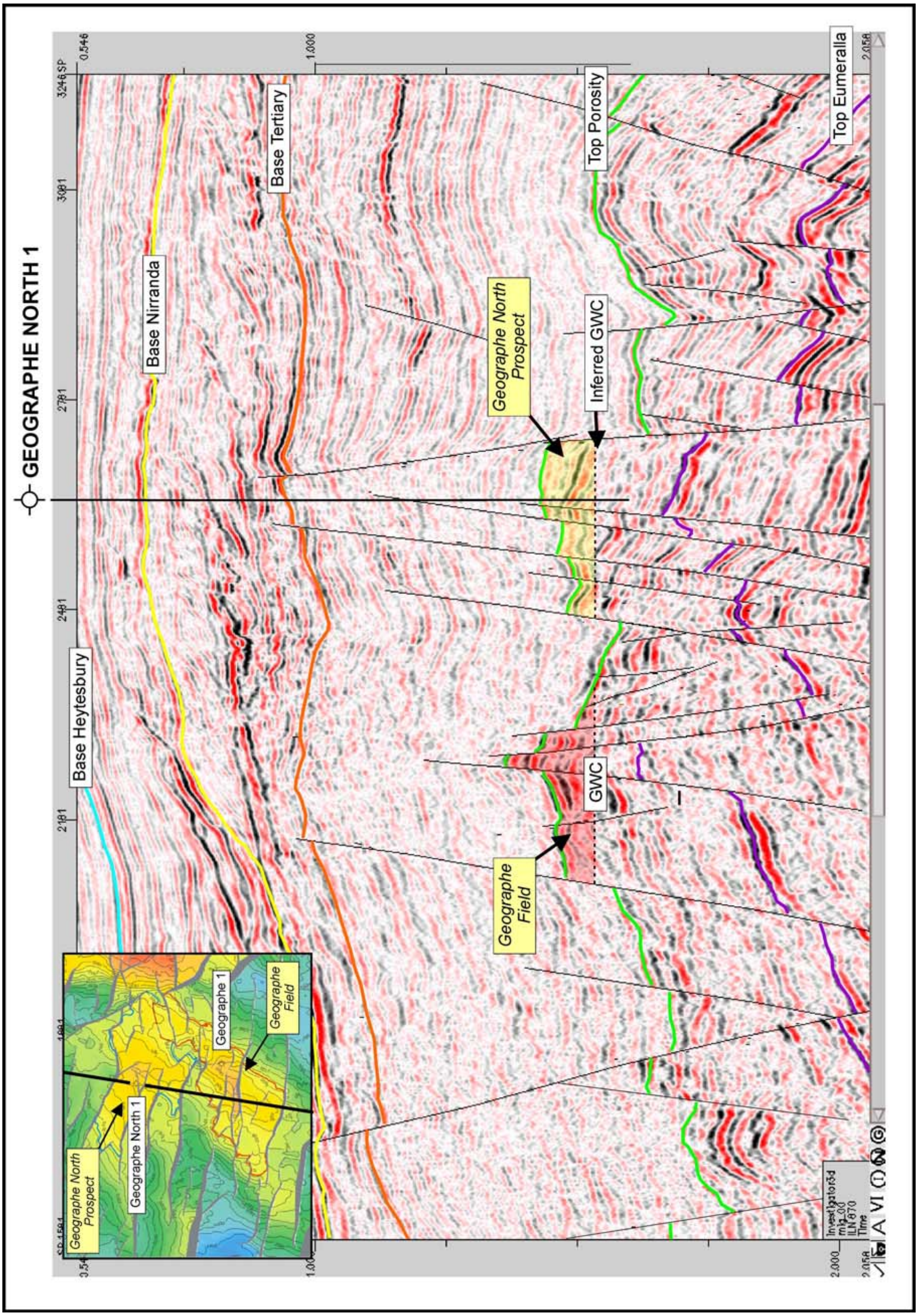

Figure 6 – 3D Inline 870 through Geographe North 1

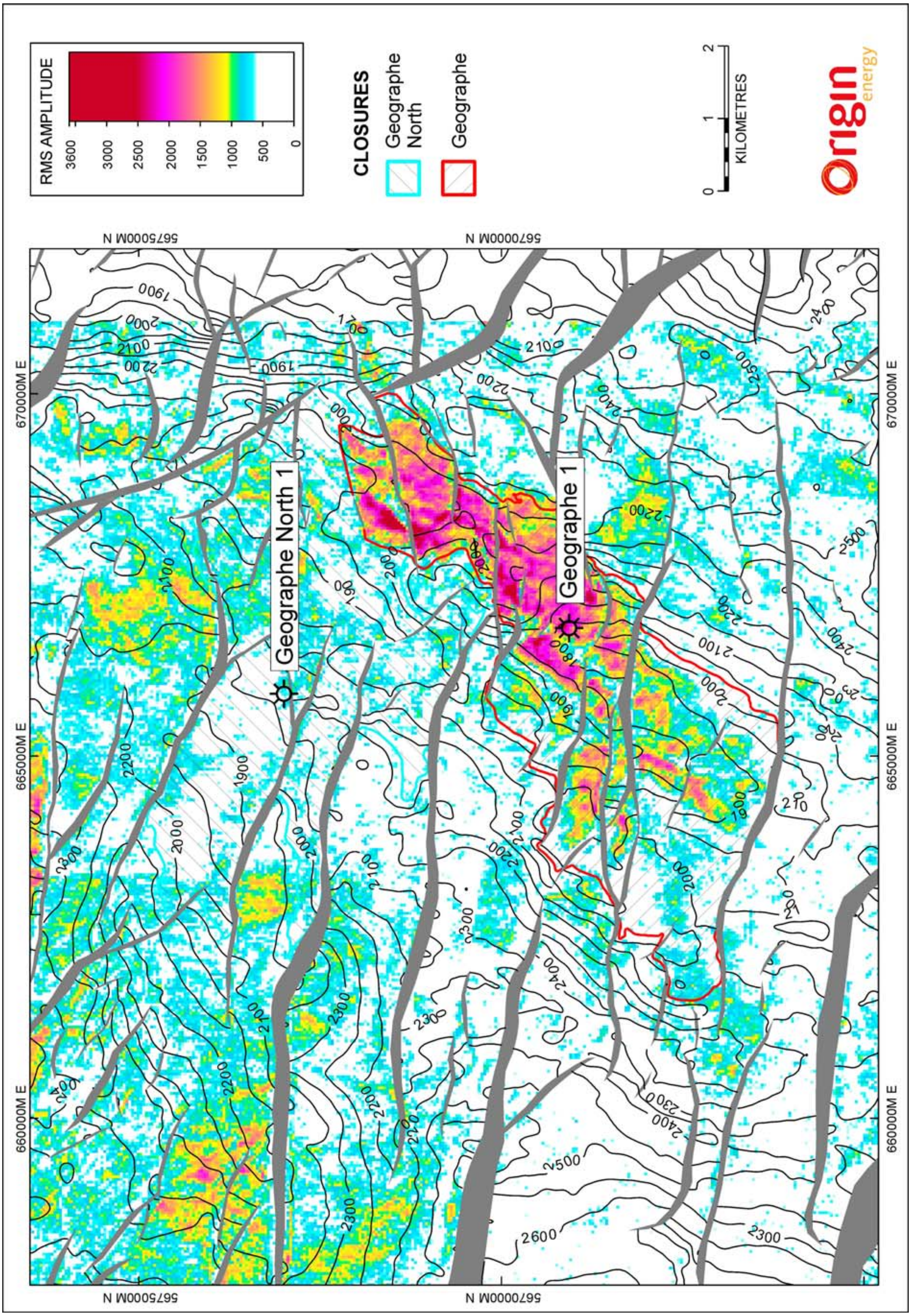

Figure 7 – Amplitude map over Geographe and Geographe North prospects

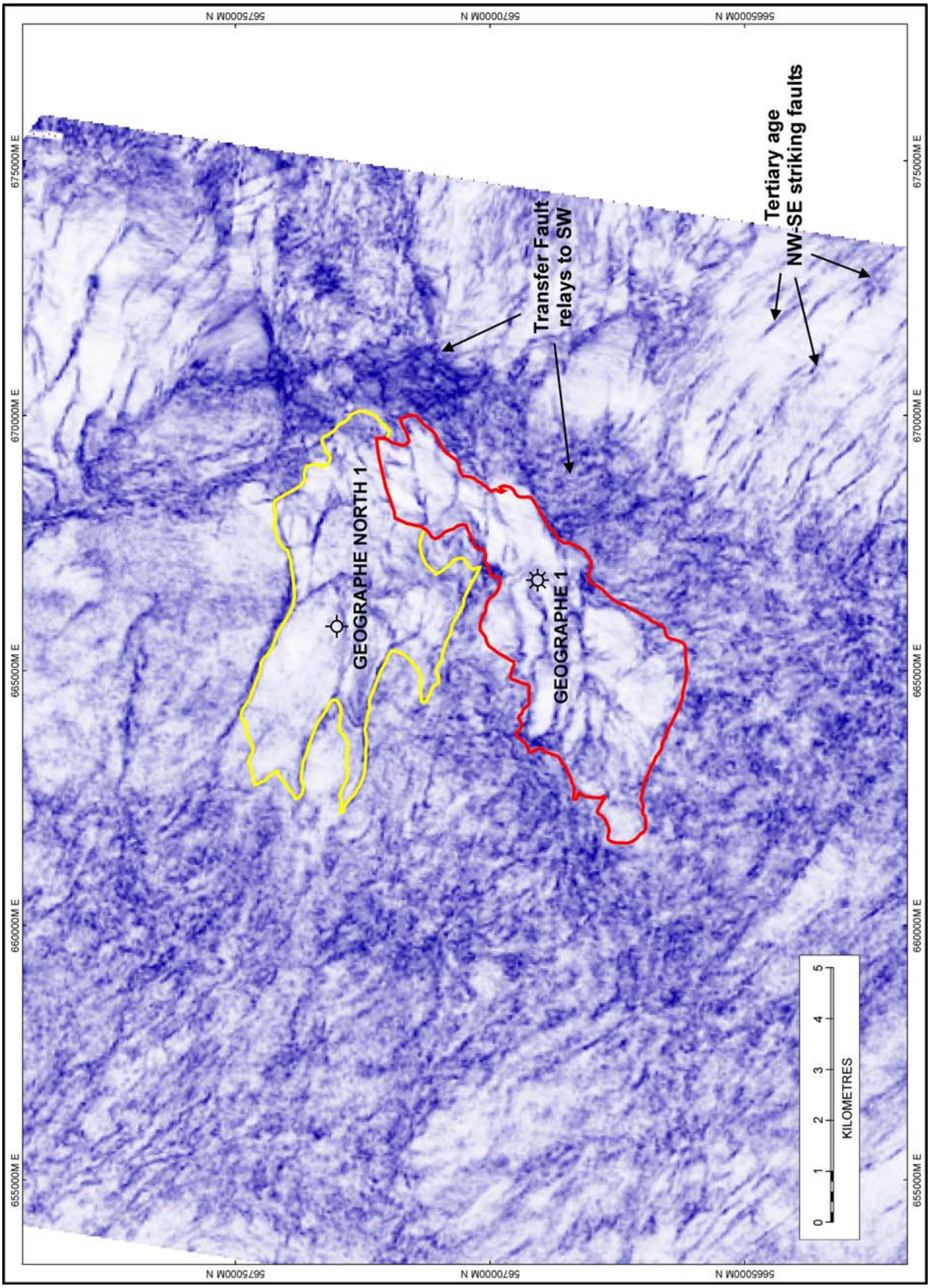

Figure 8 – Variance Cube Time Slice through Geographe Field and Geographe North Prospect

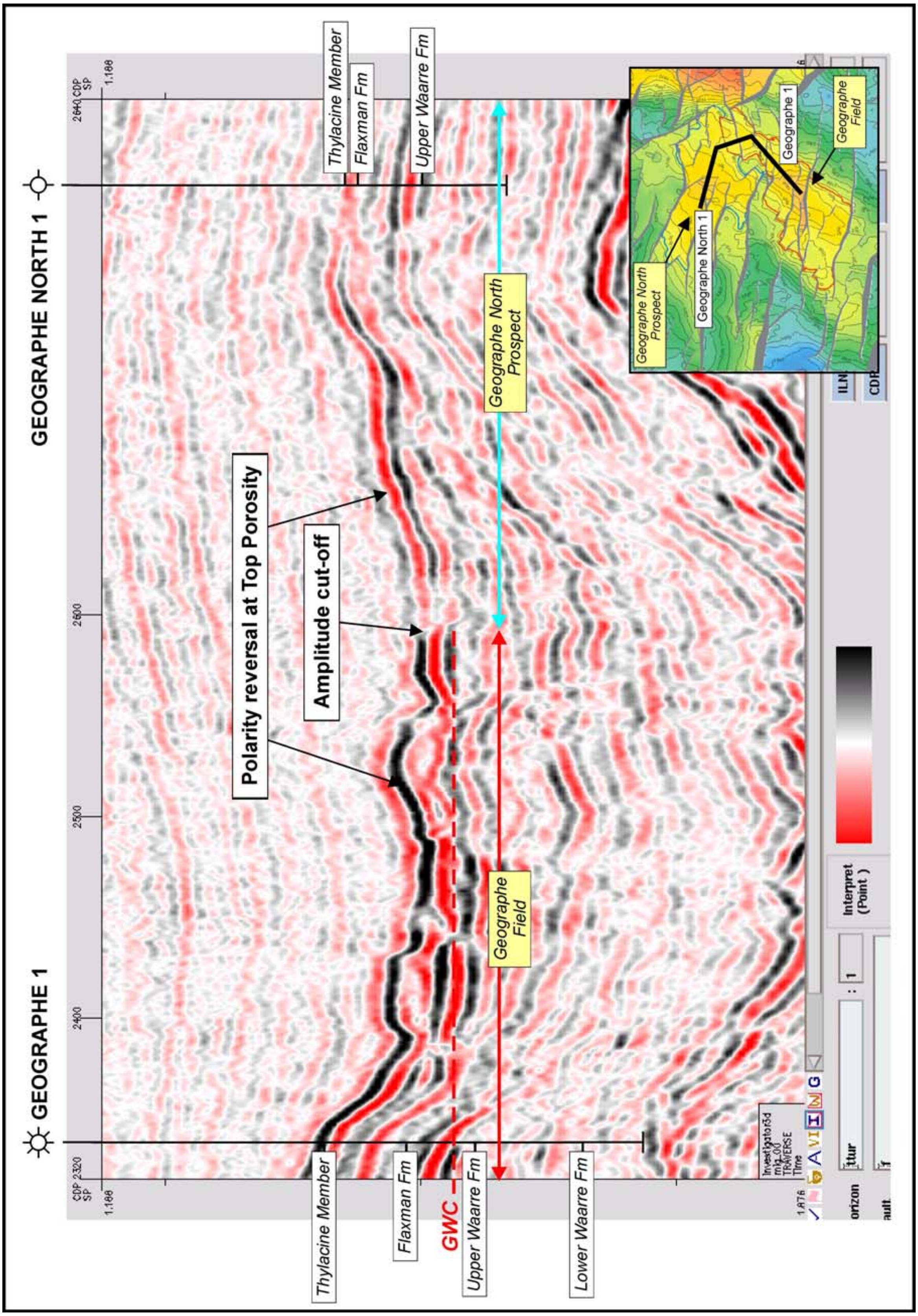

Figure 9 – Amplitude comparison between Geographe Field and Geographe North Prospect (Inline 800)

More importantly, this fault must be sealing Geographe from Geographe North, otherwise Geographe North would not be dry.

6.4 Predicted versus Actual Depths

The depth prognosis for Geographe North-1 was based on the time-depth curve from Geographe-1. Time picks for each formation were determined by correlating the events on the 3D seismic from Geographe-1. The uncertainty in the depth estimates was estimated to be in the order of +/- 30 m, based on the T-D curves from nearby wells.

The predicted versus actual depths for the formations intersected in Geographe North-1 are shown in Table 2. All tops were within the predicted range of error except the Dilwyn Formation and Upper Waarre Formation. These horizons are difficult to correlate on seismic, hence the error in depth prediction was mostly a result of uncertain seismic picks and not poor velocity estimation. Time depth curves based on the check-shot surveys of Geographe-1 and Geographe North-1 shows that the velocity trend is very similar in each well and close to the trend in nearby wells (Figure 10). Details of the velocity survey can be found in Appendix 6 of the Geographe North-1 Basic Data Report.

Table 2. Predicted vs Actual Formation Tops

Geographe North 1 (Inline 870 CDP 2640)
RT = 25 m ASL
Water Depth = 82.0 m

	Formation / *Seismic Marker*	**Predrill TWT (ms)**	**Predicted Depth (mKB)**	**Actual Depth (mKB)**	**Actual Depth (mSS)**	**Thickness (m)**	**High/Low (-ve = high)**
TERTIARY	Port Campbell Lst / *Seabed*	94	103.0	107.0	82.0	136.1	4.0
	Upper Gellibrand Marl	286	315.0	243.1	218.1	342.9	-71.9
	Mid Miocene Seismic Marker	286	315.0	-	-	-	-
	Lower Gellibrand Marl / *Base Miocene Seismic Marker*	521	571.0	586.0	561.0	67.1	15.0
	Narrawaturk Marl	576	631.0	653.1	628.1	77.7	22.1
	Mepunga Formation	662	733.0	730.8	705.8	153.0	-2.2
	Dilwyn Formation	836	960.0	883.8	858.8	203.4	-76.2
	Pember Mudstone	880	1017.0	Not Intersected	Not Intersected	-	-
	Pebble Point Formation	930	1090.0	Not Intersected	Not Intersected	-	-
CRETACEOUS	Paaratte Formation / *Base Tertiary*	940	1105.0	1087.2	1062.2	335.7	-17.8
	Belfast Formation	1180	1468.0	1422.9	1397.9	423.4	-45.1
	Thylacine Member	Not Prognosed		1846.3	1821.3	21.5	-
	Flaxmans Formation	1410	1822.0	1867.8	1842.8	116.2	45.8
	Waarre Formation	-	-	-	-	172.0+	-
	Upper Waarre Formation	1462	1915.0	1984.0	1959.0	(172.0)	69.0
	Lower Waarre Formation	1500	1987.0	Not Intersected	Not Intersected	-	-
	GWC (predicted from flat spot)	1670	2057.0	-	-	-	-
	TD		**2157.0**	**2156.0**	**2131.0**		

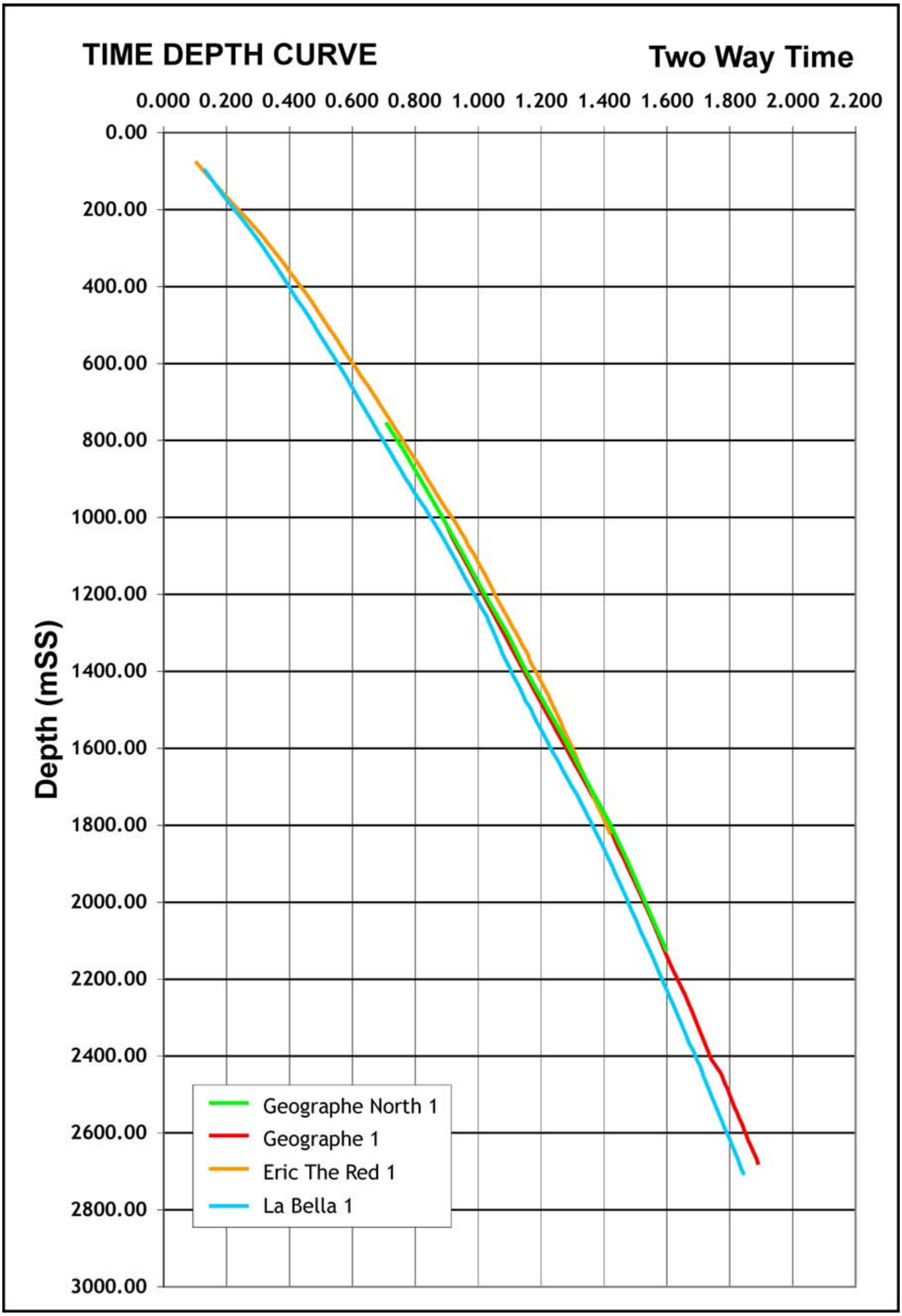

Figure 10 - Geographe North-1 Time-Depth Curve

7. GEOLOGICAL DISCUSSION

7.1 Previous Exploration

The drilling history in the eastern offshore Otway Basin is summarized in Table 3. Five wells had been drilled in VIC/P43 prior to Geographe North-1: Mussel-1 (1969), Eric the Red-1 (1993), Loch Ard-1 (1993), Conan-1 (1995) and Geographe-1 (2001). The first four wells were all plugged and abandoned as dry holes. Geographe-1 was a gas discovery.

Well	Year	Operator	TD (m)	Status	Result
Pecten 1A	1967	Shell	2850	P&A	Gas show, 145 mcf from 17 m of tight Waarre
Prawn A1	1967	Esso	3193	P&A	No valid closure, good reservoir, poor seal
Nautilus 1A	1968	Esso	2011	P&A	Tertiary wedge play, no reservoir found
Mussel 1	1969	Esso	2450	P&A	Not drilled in crestal location
Whelk 1	1970	Esso	1466	P&A	No seal
Triton 1	1982	Esso	3545	P&A	Poor reservoir, no closure mapped to date
La Bella 1	1993	BHP	2710	GAS	Estimated 210 bcf OGIP
Minerva 1	1993	BHP	2425	GAS	Estimated 575 bcf OGIP
Eric the Red 1	1993	BHP	1875	P&A	No cross fault seal
Minerva 2A	1993	BHP	2170	GAS	Thick Waarre sand development
Loch Ard 1	1993	BHP	1397	P&A	No Top Seal for Waarre reservoir
Conan 1	1995	BHP	2175	P&A	Ineffective fault seal
Champion 1	1995	BHP	1882	P&A	Upper Waarre absent, no cross fault seal
Thylacine 1	2001	Origin	2710	GAS	Estimated 1255 bcf OGIP
Geographe 1	2001	Origin	2430	GAS	Estimated 600 bcf OGIP
Thylacine 2	2001	Origin	2525	GAS	Appraisal well

Table 3 - Previous drilling history, eastern offshore Otway Basin.

7.2 Regional Geology

The Otway Basin formed in response to rifting between Australia and Antarctica during the Late Jurassic - Late Cretaceous. The basin has a two-stage rift history. The first stage occurred during the Late Jurassic and Early Cretaceous, followed by the second in the Late Cretaceous. The second event was responsible for the formation of the Shipwreck Trough, which is where all the known gas discoveries in the offshore Otway Basin are located (see Figure 11).

The Shipwreck Trough formed in response to sinistral transtension along the Sorell Transfer Fault during the Late Cretaceous, with significant thickening of Late Cretaceous sediments centred along the axis of the trough. Initial sedimentation commenced in the Cenomanian with the deposition of axially-dispersed marginal marine to fluvial-dominated sediments of the Waarre Formation. This section thickens significantly into the trough and deposition and preservation is dependant on the palaeotopography of the basin, which in turn was dependent upon accommodation created by transpression adjacent to the Sorell Fault.

During the mid Turonian, an increase in rifting resulted in significant growth basinward of the Mussel Fault Zone and Tartwaup Hingeline. This was followed by a major transgression culminating in the deposition of the Flaxman Formation in the late Turonian. A significant increase in structural activity during the Coniacian and Santonian resulted in marked relative uplift east of the Sorell Fault and significant fault movement within the trough itself. This change in structural style resulted in a complete reorganization of sedimentation patterns within the Shipwreck Trough. On high parts of fault blocks, this period of structural reorganisation is marked by a depositional hiatus recorded by the absence of the *C.striatoconus* dinoflagellate zone concomitant with bathyl sedimentation in low areas. Subsequent progradation from the east during the middle and late Santonian resulted in the deposition of deltaic sediments within the trough such as those intersected at the Thylacine and Geographe Fields (i.e. the Thylacine Member of the Belfast Formation). A final widespread regional transgression in the Late Santonian (lower *I.cretaceum* dinoflagellate zone) resulted in the blanket deposition of thick mudstone (Belfast Formation) throughout most areas of the basin west of the Sorell Fault Zone. This mudstone forms the regional seal to the reservoir section in the Thylacine and Geographe Fields, and is also the top seal at other gas fields within the Shipwreck Trough (i.e. La Bella, Minerva).

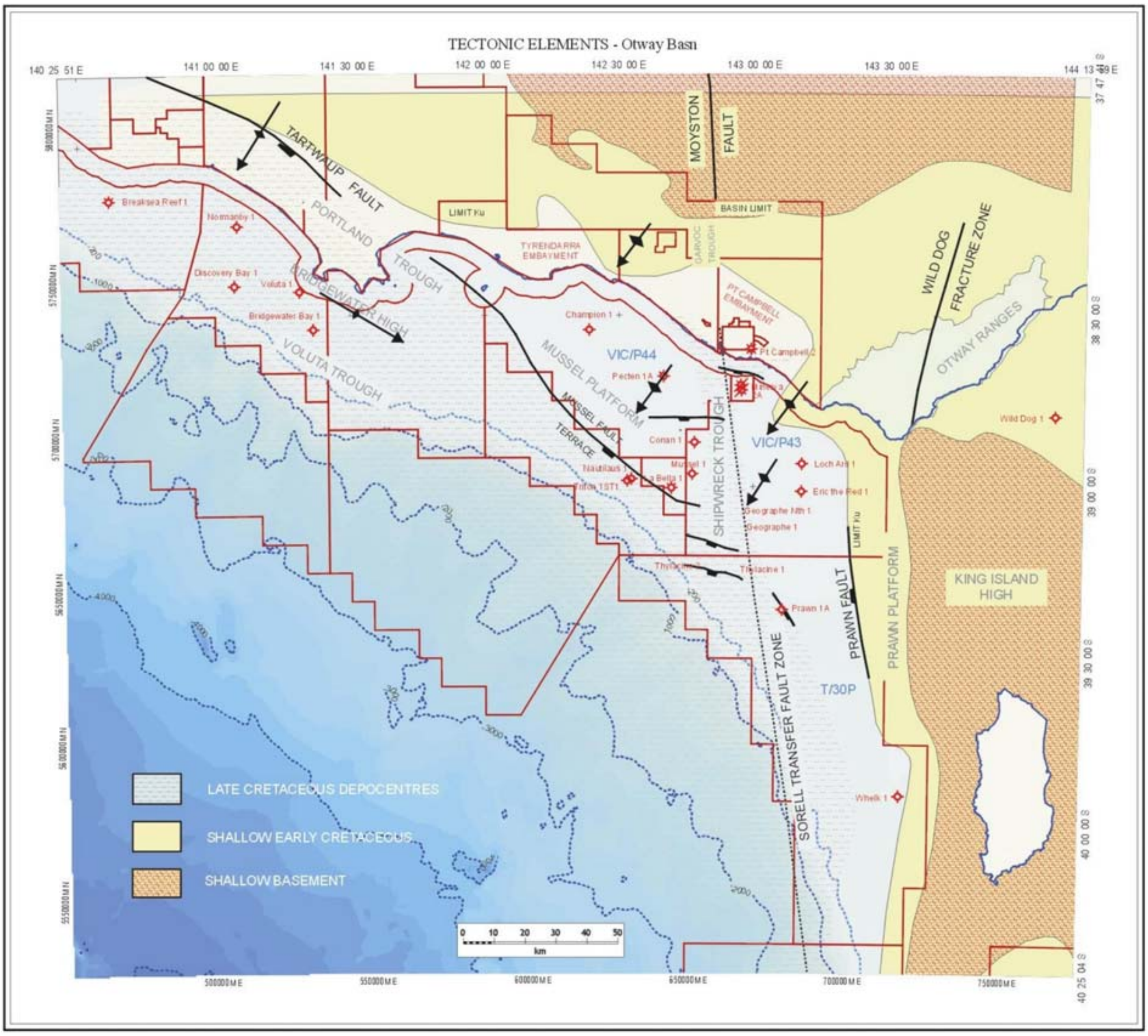

Figure 11 – Tectonic Elements of the Otway Basin

Directly adjacent to, and to the east of the Sorell Fault Zone, the Cenomanian through to the base Tertiary was dominated by continental and nearshore sedimentation reflecting higher palaeotopography and proximity to sediment source areas. These areas provided vast volumes of sediment into the low area adjacent to the Sorell Fault Zone. This is particularly evident within the Late Cretaceous (Santonian to Campanian) sedimentary sections intersected in Prawn-A1 and Whelk-1, which are sandstone-dominated fluvial sequences. Within T/30P, these sand-dominated depositional sequences are clearly evident on seismic data and extend westward off the Prawn Platform and into the Shipwreck Trough.

Regional fold trends that plunge to the southwest are essential to defining prospectivity within the Shipwreck Trough. The Investigator 3D covers three such fold trends within the Shipwreck Trough play fairway. The 'Geographe Anticline', which plunges to the southwest, underlies the Geographe and Thylacine prospects, and is interpreted to control the migration of hydrocarbons from source kitchens to the southwest. The folding and stress field orientations are a composite of at least three different phases of deformation. The first phase began in the Albian/Cenomanian with the initial uplift of the Otway Ranges (crustal kink) in response to rift propagation from the west. This was followed by a second episode of folding and uplift in the Santonian associated with the opening of the Tasman Sea, and a third during the Mid to Late Miocene in response to sea floor spreading inertia following the collision of the Australian northern plate margin with the Banda Arc.

Major east-west trending rift faults occur along the Shipwreck Trough together with the transfer fault deformations. The Albian to Turonian east-west striking rift faults are inferred to be perpendicular to the direction of extension. The rift and post rift deformations mean there are three main fault sets that dominate the Shipwreck Trough, with extensional tectonics accentuated towards the shelf margin by gravitational effects.

The northwest-southeast striking listric normal faulting commenced in the middle of the Late Cretaceous and terminated at the end of the Cretaceous with very little penetration above the Base Tertiary unconformity. These faults commonly sole out on the earlier fault sets. Secondary synthetic and antithetic faulting and rollover anticline development is also present. Inversion due to north-northwest transpression is inferred to have affected most structures in the eastern Otway, especially at Minerva.

A degraded north-south oriented wrench zone is present in the east of the Investigator 3D and is best shown on the Variance Cube data (see Figure 8). This wrenching, which is the result of crustal transtension, is manifest as a prominent north-south striking fault that splays vertically with keystone development.

The rift climax of this sequence was associated with growth along the Mussel Fault Zone and Tartwaup Hingeline and resulted in a shallow marine transgression across low areas of the basin in the Early-Mid Turonian. The base of the intra-Waarre marine sequence marks a change from a dominantly lithic to a more quartzose sediment provenance, which continued throughout the rest of the Late Cretaceous section.

A significant mid-Turonian unconformity occurs within the Waarre Formation separating the upper and lower sequences. The best reservoir facies are intersected in the lower part of the Upper Waarre Formation. Sedimentological analysis of core recovered from Minerva 2A shows this section to comprise high-energy fluvial facies. Palaeotopography within the Shipwreck Trough is interpreted to be the primary control upon deposition of the Upper Waarre Formation, with sediment sourced from the north and possibly east.

7.3 Contributions to Geological Concepts and Conclusions

Geographe North-1 was drilled as a vertical exploration well designed to test the hydrocarbon prospectivity of the northern crest of the greater Geographe structure. Prior to drilling, it was anticipated Geographe North-1 would intersect gas-bearing reservoirs at the Late Cretaceous Flaxman Formation and underlying Upper Waarre Formation levels. Instead, the Flaxman and Upper Waarre Formations in Geographe North-1 both proved water saturated, while the stratigraphically younger Thylacine Member, which is a gas reservoir in Geographe-1 4.2 km to the south, had virtually no reservoir development.

Despite the failure of Geographe North-1, the well demonstrated the importance of both fault and intraformational seals within the Shipwreck Trough. Fluid Inclusion Screening analysis of cuttings from the well (Appendix 3) detected a strong gas signal in the Upper Waarre Formation, but no gas signal in the overlying Flaxman Formation, Thylacine Member or Belfast Formation. The presence of gas inclusions in the Upper Waarre Formation suggests this formation probably contained hydrocarbons at some stage in the past, but that they had leaked, possibly up breached faults. The absence of gas inclusions in the overlying Flaxman Formation suggests the shale at the base of the unit must be acting as an effective top seal against the underlying Upper Waarre Formation over the entire Geographe North structure.

The absence of hydrocarbons in Geographe North-1 is also consistent with the absence of amplitudes within the Geographe North Prospect itself. This was recognized as a significant risk prior to drilling and confirms the presence of a WNW-ESE striking sealing fault along the southeastern flank of the structure just north of the saddle connecting Geographe and Geographe North.

8. REFERENCES

Heaps, T. (Origin Energy)	Geographe North-1 Basic Data Report, VIC/P43, December 2001.

APPENDIX 1
PETROPHYSICS REPORT

VIC/P43, OTWAY BASIN, VICTORIA

GEOGRAPHE NORTH - 1

PETROPHYSICAL REPORT

THYLACINE MEMBER, FLAXMAN FORMATION, AND WAARRE FORMATION

1820-2128 mMDRT

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339 Coronation Drive
MILTON QLD 4064

Chris Shield, February 2004
N:\chris\otway\geographe\geographe_north_1\reports\petrophysics_2004-02\geographe_north_1_petro_report.doc

EXECUTIVE SUMMARY

This report details a review of the reservoir quality and hydrocarbon saturation of three Late Cretaceous formations intersected whilst drilling the exploration well, Geographe North-1 in VIC/P43 in the Otway Basin, offshore Victoria. The study entails an analysis of all available lithological data, and a complete petrophysical analysis (Table 1).

The Thylacine Member (1846.3-1867.8 mMDRT) encountered at Geographe North-1 is interpreted to have minimal to nil reservoir quality. The unit has a net to gross of less than 2%. Reviewing average reservoir parameters when such a small thickness of reservoir (0.4 metres) exists is quantitatively invalid and misleading. The average parameters are reported in Table 8, but should not be utilised as inputs into any geological or reservoir modelling.

The Flaxman Formation (1867.8-1984.0 mMDRT) has moderately good reservoir development in part, although the overall net to gross ratio is low. The sandstones present, on average, have an average clay volume of 19.9%. The average effective porosity is 16.2%, and the average gas permeability averages 1.13mD. This unit has a net reservoir to gross of 32.0%.

All Thylacine Member, Flaxman Formation, and upper Waarre Formation reservoirs included in the interpreted interval are water-saturated. There is no indication from either the wireline logs or the mudlog of significant hydrocarbons being present

Based upon the learning from the petrophysical analysis of both Thylacine-1 and Geographe-1, only an Indonesian water saturation equation was applied in this well. It was originally thought that with the benefit of detailed special core analysis data, the Waxman-Smits equation should result in more realistic values. Unfortunately, this was not the case, as the Waxman-Smits equation encountered problems in argillaceous reservoirs, and under-estimated the gas saturation in comparison with the Indonesian equation. The Indonesian Equation is therefore applied in all reported values.

FORMATION NAME	TOP FROM mMDRT	BASE TO mMDRT	GROSS INTERVAL mMDRT	NET RESERV INTERVAL mMDRT	AVERAGE VCL %	AVERAGE PHIE %	AVERAGE AIR PERM mD	AVERAGE GAS PERM mD	AVERAGE H_2O PERM mD	AVERAGE SWE %	NET RES / GROSS %
Thylacine Member	1846.30	1867.80	21.50	0.41	29.15	22.48	11.55	9.14	3.37	98.61	1.91
Flaxman Formation	1867.80	1984.00	116.20	37.21	19.89	16.21	1.48	1.13	0.41	95.64	32.02
Upper Waarre Fm	1984.00	2128.00	144.00	119.08	9.74	19.33	2.97	2.29	0.83	99.67	82.69

Cut-offs Applied		
Net Pay	K_gas >	0.1mD
	VCl <	40.0%

Table-1. Petrophysical Reservoir Summary

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INTRODUCTION

Geographe North-1 is an appraisal well drilled in 2001, and is located within the current VIC/P43 permit (Figure-1).

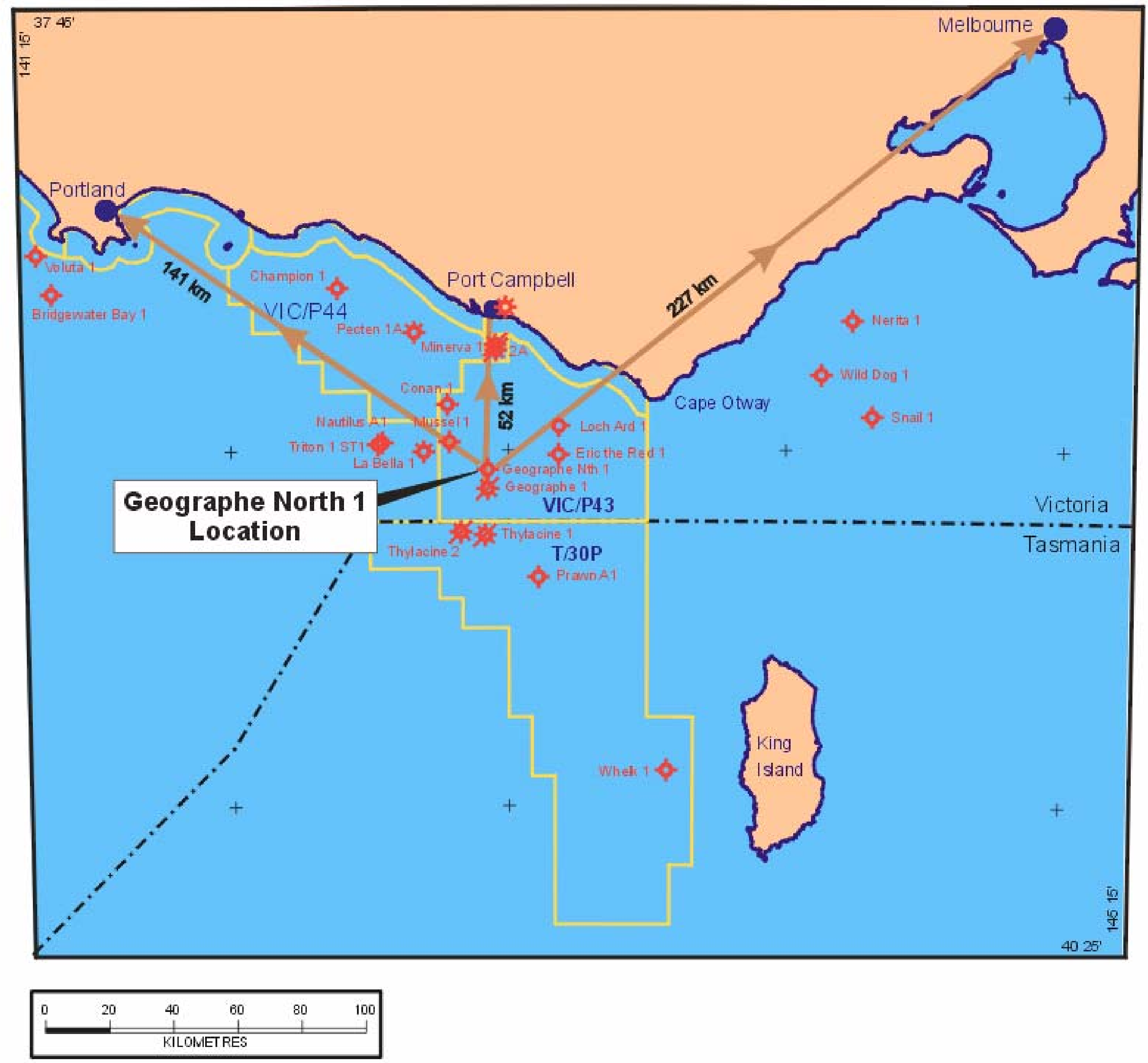


Figure 1. Location Map

The well intersected interbedded claystones, siltstones, and poor to excellent quality sandstones displaying nil hydrocarbon shows within the Thylacine Member, and Flaxman and Waarre Formations (Table-2). This report addresses the reservoir and hydrocarbon-producing potential of all strata intersected between 1820.0 metres and the base of complete log coverage at 2128.0 mMDRT.

FORMATION / *SEISMIC MARKER*	TOPS (m)				REMARKS/SHOWS
	MDRT	SUBSEA	THICK	TWT(ms)	
Port Campbell Limestone	107.0	82.0	136.1	-	No Returns 107.0 – 565.0 mMDRT
Gellibrand Marl			410.0		No Returns 107.0 – 565.0 mMDRT
Upper Gellibrand Marl	243.1	218.1	342.9	-	No Returns 107.0 – 565.0 mMDRT
Middle Miocene Seismic Marker				286	
Lower Gellibrand Marl *Base Miocene Seismic Marker*	586.0	561.0	67.1	-	No Returns 107.0 – 565.0 mMDRT. Below 565.0 mMDRT, argillaceous calcilutite with minor interbedded calcareous claystone
Narrawaturk Marl	653.1	628.1	77.7	-	argillaceous calcilutite with minor interbedded calcareous claystone and argillaceous calcarenite
Mepunga Formation	730.8	705.8	153.0	-	sandstone with minor silty sandstone
Dilwyn Formation	883.8	858.8	203.4	800	sandstone with lesser argillaceous siltstone and rare claystone
Paaratte Formation	1087.2	1062.0	335.7	931	argillaceous siltstone with minor interbedded sandstone and silty sandstone
Belfast Formation	1422.9	1397.9	423.4	1161	silty claystone grading to argillaceous siltstone
Thylacine Member	1846.3	1821.3	21.5	1428	silty claystone with minor argillaceous sandstone
Flaxman Formation	1867.8	1842.8	116.2	1440	interbedded silty claystone and sandstone
Waarre Formation			172.0+	1509	
Upper Waarre Formation	1984.0	1959.0	172.0+		sandstone with minor siltstone.
TOTAL DEPTH	2156.0	2131.0		1609	

Table 2. Stratigraphic Table

DATA AVAILABILITY AND QUALITY

Lithological Data

Lithological information is provided by sidewall core and cuttings description summaries. There were no cores cut in Geographe North-1.

Mudlog Data

Baker Hughes Inteq were contracted to provide mudlogging services. A variable depth match was applied to this mudlog data to conform to wireline log depths. The ROP and total gas curves were used as the seed to depth match the mudlog data to the wireline gamma ray and density curve data. The depth match applied varied between –1.8 and 3.2 metres. A listing of the depth shifts applied is included in Appendix-A. The raw and depth-shifted data are available in LAS ASCII format on a CD-ROM adjoining this report. Appendix-B contains a copy of the mudlog encompassing the potential reservoir intervals discussed herein.

Electric Log Data

MWD and LWD services were provided by Anadrill. These data were matched to wireline depths. The LWD gamma ray was variably depth matched to the wireline gamma ray, which varied between –0.6 and 3.7 metres. The LWD data was not utilised in this interpretation. A summary of the tools and intervals acquired is in Table-3, and a listing of the depth shifts applied is included in Appendix-A. The raw and depth-shifted data are available in LAS ASCII format on a CD-ROM adjoining this report.

Schlumberger, which provided wireline services, logged the well in one suite while in 8.5-inch hole. Table-3 contains a summary of the logging tools run. Comments upon log quality, herein discussed, are limited to the first run in the hole as this is the super-combo run. The raw, edited, and merged data are available in LAS ASCII format on a CD-ROM adjoining this report.

Suite/Run	Tool String	Interval (mMDRT)	BHT (degC)
1/1	DGR-CDR (LWD)	558.0-1790.0	
2/1	DGR-ARC5 (LWD)	1784.0-2156.0	
1/1	PEx(HRLA)-DSI-HNGS-SP-GPIT	1787.5-2155.0	89.2
2/4	CSI-GR	800.0-2155.3.0	93.0
2/4	CST-GR	1794.0-2126.0	

Table-3. Log Data Acquired

Copies of all sections of the Schlumberger field prints relevant to a petrophysical evaluation are included as Appendix-C. This appendix includes the log header details, remarks, results, and a complete parameter listing that provides the settings, constants, and environmental corrections applied at the wellsite.

Overall, the data is of a high quality, although the PEF log must be considered to have a lesser quality. This hole was drilled with a mud containing barite. Barite settles out as a solid, and therefore tends to concentrate in the mudcake. In a hole displaying limited wash out, such as this one, the thickness of the mudcake build-up opposite porous sandstones can be estimated by the difference between the bit size and the caliper, although there is always a degree of uncertainty in the environmental barite concentration correction applied. The optimal method of correcting the PEF log for the variable affects of barite is to calibrate and bulk shift the PEF to ensure that the clean quartzose sandstones coincide with the quartz point on a Rhomaa-Umaa cross plot. For the PEF log acquired in Geographe North-1, this required a –0.50 bulk shift.

Formation Test Data

No wireline of drill-stem tests were conducted on Geographe North-1.

BOREHOLE DATA

Hole Conditions

Apart from the upper 6 metres directly beneath the 9.625-inch casing shoe, the hole condition within 8.5-inch hole section is excellent. The caliper generally does not exceed the bitsize by any more than 0.5 inch, mudcake build-up is limited to less than 0.2 inch. The hole does display rugosity, as evident upon the Delta-Rho curve, between the casing shoe and 1878 mMDRT.

Mud Properties

The section encompassing the Thylacine Member, Flaxman and Waarre Formations reservoirs was drilled with a KCl-PHPA-Glycol-barite mud. The mud and logging details are summarised in Table-4.

Bottom Hole Temperature

A Horner temperature plot generated for Suite-1 (Figure-2) yielded an extrapolated bottom hole temperature of 96.9 degree Celsius at 2155.0 mMDRT. The maximum-recorded temperatures from the individual logging runs were used to environmentally correct the wireline log data.

RESERVOIR QUALITY

The upper part of the interpreted interval (2115-2143.3 mMDRT) is described as argillaceous grey-olive brown, moderately hard to hard, sub-blocky, non-calcareous siltstone interbedded with rare siliceous cement and carbonaceous material, and forms part of the Belfast Formation.

	1
Log date	8-Sep-2001
Depth-Driller	2525
Depth-Logger	2529
Bottom log interval	2530
Top log interval	2103.5
Casing-Driller	2101
Casing-Logger	2103.5
Casing Diameter	9.625
Bit Size	8.5
Hole Fluid type	KCl PHPA Glycol
Fluid Density	1.16
Fluid Viscosity	16
Fluid PH	9
Fluid Loss	3.7
Mud Sample Source	Active Pit
RM @ Surface	0.103
Mud temp Surface	15.0
RMF @ Surface	0.09
MF temp Surface	15.0
RMC @ Surface	0.24
MC Temp Surface	15.0
Source of RMF/RMC	PRESS
Time circ. stopped	13:15
Date circ. stopped	8-Sep-2001
Time logger at btm	00:15
Date logger at btm	9-Sep-2001
Surface hole temp	26.67
Surface temperature	15
Max recorded temp	109
Recorded by	F.Marcano,M.Van
Witness	M.Bilek,G.Weste
Filtrate Cl	43,000 ppm
PV	16
YP	20
% Solids	8
% Sand	Trace
% Oil	0
% KCl	KCl: 6.0%
% NaCl	NaCl: 2.9%
% Barite	Barite: 1.5%

Table-4. Mud Properties

HORNER TEMPERATURE PLOT

Geographe North-1 Suite-1

WELL:	Geographe North-1	**LOG SUITE:**	Suite-1
PERMIT:	VIC/P43	**LOG DATE:**	09-Oct-01
NOTES:	Sensor measure points estimated.	**T.D.:**	2155.0 (Logger)
		Geologist:	Chris Shield

LOG TYPE	BOTTOM DEPTH OF LOGGED INTERVAL mRT {Sensor Measure Point}	Tx (hrs)	T (hrs)	T/(Tx+T)	Max. TEMP Deg C	Eq. Max TEMP Deg C
PEx(HRLA)-DSI-HNGS	2113.3	1.50	11.17	0.882	89.2	89.20
CSAT-GR	2129.4	1.50	21.33	0.934	93	92.30

Where: Tx = CIRCULATION TIME
T = TIME SINCE CIRCULATION STOPPED

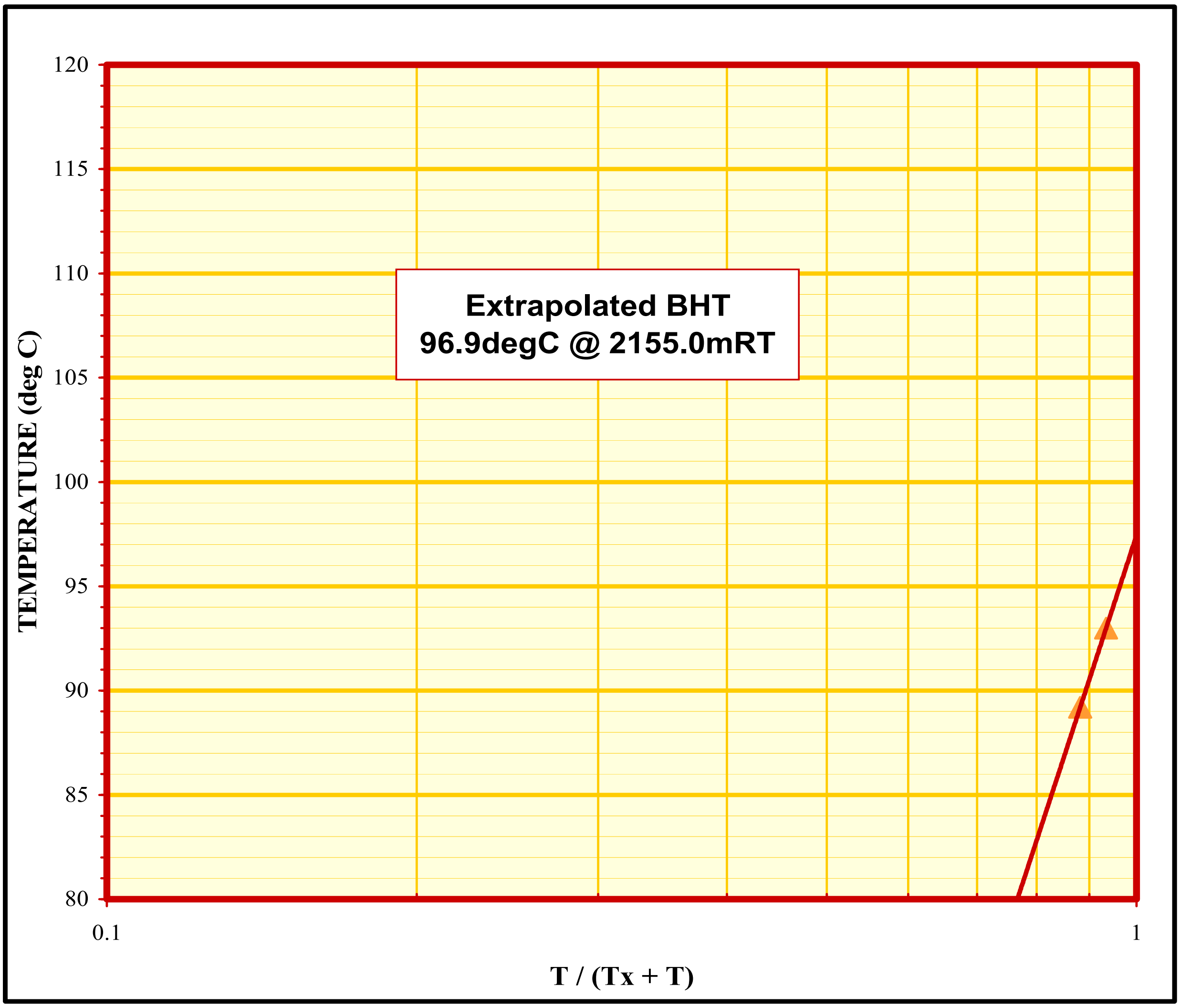


Figure-2. Suite-1 Extrapolated Borehole Temperature Plot

The Thylacine Member (1846.3–1867.8mMDRT) is described as brown-grey to medium grey, soft, sticky, silty claystone, with minor interbeds of argillaceous sandstone.

Between 1867.8 and 1984.0mMDRT, the Flaxman Formation is described as brown-grey to medium grey, soft, sticky, silty claystone; interbedded with very light grey, very fine to fine-grained, well sorted quartzose sandstone with trace siliceous and pyritic cement, carbonaceous material and poor to fair visual porosity.

The upper Waarre Formation between 1984.0 and 2156.0mMDRT is described as colourless to very light grey, very fine to coarse-grained, dominantly medium-coarse-grained, poorly sorted quartzose sandstone with trace siliceous cement and carbonaceous material, and exhibiting good to excellent visual porosity, and is interbedded with siltstone.

LOG ANALYSIS METHODOLOGY

A complete listing of all reservoir zonations, petrophysical models, constants, and parameters applied in the interpretation are included in Appendix-D.

Preparation

The final Schlumberger wireline data were loaded from Origin Energy's master digital well log database into the Crocker Data Processing (CDP) Petrolog v9.2 software. As there were data of various resolutions, wireline data at 2.5, 5, and 15cm, and mudlog data at 50cm spacings, all available data were re-sampled to the finest 2.54cm resolution.

Environmental Corrections

With the Platform Express tool, many environmental corrections are applied at the wellsite. The field prints (Appendix-C) contain a parameter listing, that details which environmental corrections that have been applied by the wireline engineer. This section summarises which corrections were applied, and whether they were applied at the wellsite, or in the Petrolog software in the office.

The gamma ray (GR) curve was corrected for borehole size using the density, caliper, and KCl concentration at the wellsite. For the purposes of creating a composite log suite, the GR was corrected for casing thickness, where necessary, in the Petrolog software.

The borehole size and bed thickness corrections were applied to the laterolog data via inverse resistivity modelling at the wellsite. Invasion corrections were also applied at the wellsite, resulting in a true formation resistivity (Rt) and invaded zone resistivity (Rxo) curve provided by Schlumberger. Mudcake thickness corrections were applied to the microlaterolog data at the wellsite.

The density (RHOB) log data were corrected for borehole size and mud density at the wellsite. The compensated neutron (NPHI) log was also corrected for borehole size and salinity, formation temperature and pressure, mudcake thickness, and mud density at the wellsite. Formation salinity and barite corrections were applied in the Petrolog software.

Zonation

The well was zoned according to the formation tops in Table-1. These formational zones were further subdivided into petrophysical facies, thus enabling the recognition of sand, silt, and clay-rich rock types. Figure-3 displays an example of how these data were subdivided on a density neutron cross plot.

This subdivision enabled different inputs and constants to be applied to the different petrological facies within each formational unit. The identification of clay volume parameters and of clay resistivity values was made more accurate as these parameters were determined from only those points dominated by clay. In a similar fashion, the identification of formation water resistivity and hydrocarbon density could now be evaluated using only sandstone dominated petrophysical facies.

Clay Volume and Porosity

Clay volume (VCl) was defined by application of a linear GR, RHOB-NPHI cross-plot, RHOB-DT cross-plot, and sonic (DT) models (Figure-4). The minimum VCl calculated from all techniques was applied as the final VCl in this interpretation. VCl parameters were set to ensure that the average values calculated from logs matched the sidewall cores and cuttings descriptions.

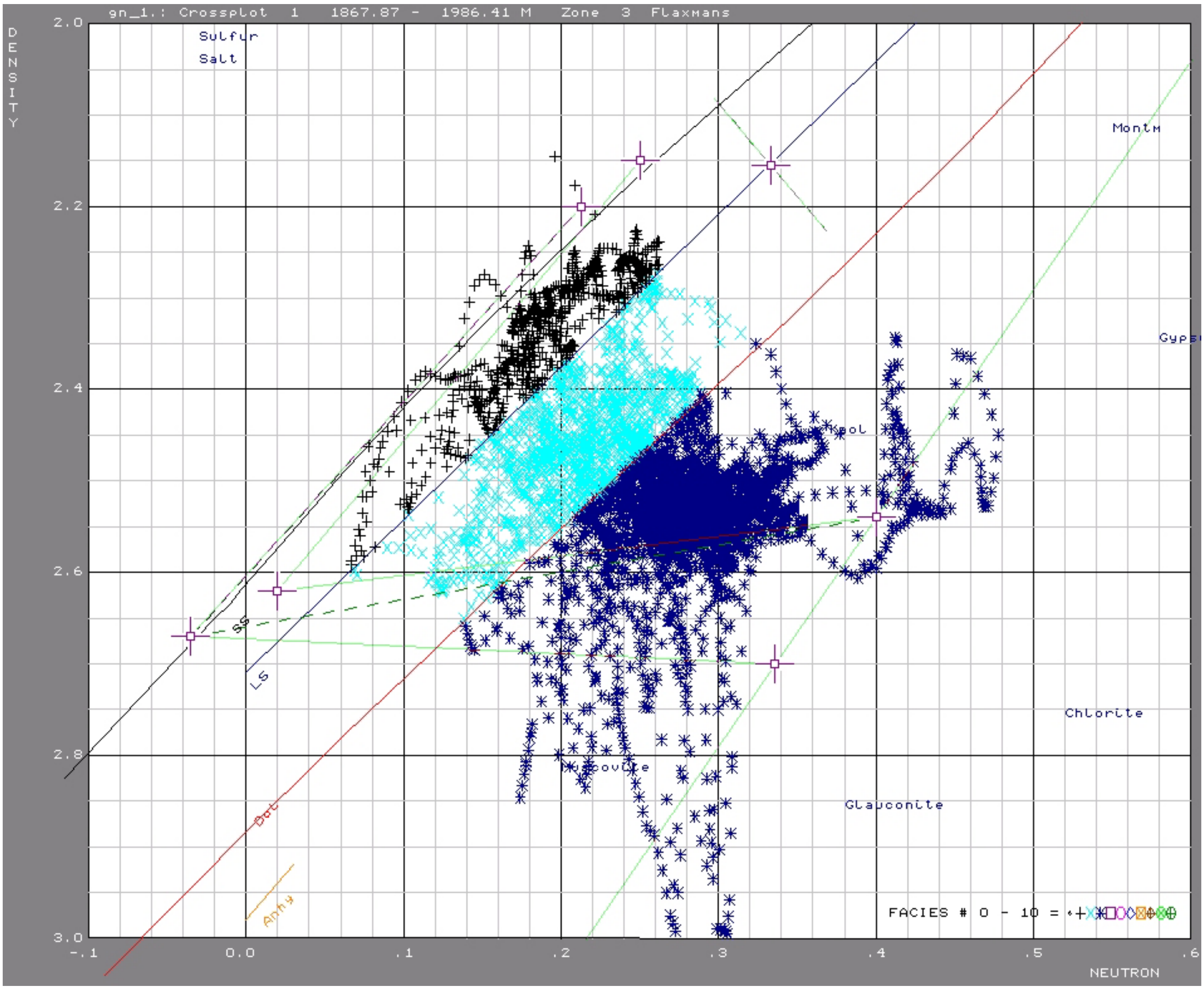


Figure-3. Petrophysical facies sub-division of lithostratigraphic zones.

A linear density-neutron model was applied to derive total porosity (PHIT), with a Wyllie sonic porosity model being applied in badhole areas. Badhole was defined using cut-offs for differential caliper, DRHO, and hole rugosity. The density and neutron data were corrected for hydrocarbon density prior to determining the log-derived total porosity. The total porosity was then matched to the overburden helium core porosity, prior to the correction for clay volume and the subsequent derivation of effective porosity.

$$PHIT = \frac{((\rho_{ma} - \rho_b)/(\rho_{ma} - \rho_f)) + \varphi_N}{2}$$

Lithology

Petrological studies, detailed in Appendix-6 of the Interpretive Well Completion Report, and conducted on core and sidewall core samples from Thylacine-1 and Geographe-1, indicate that some of the sandstone reservoirs contained significant amounts of carbonate cements and argillaceous matter. To allow for this variable mineralogy, particularly the carbonate cementation, a complex lithology petrophysical model was applied in preference to a silty sand petrophysical model. The application of this complex lithology model aims to optimise the calculation of total porosity for subtle changes in the matrix density as a result of changing concentration in carbonate cement.

This model however, does have its drawbacks. As previously discussed, the PEF log, which is an essential component of the complex lithology model, required a bulk correction of –0.50 to the PEF data in order to optimise the distinction between quartz and carbonate cements.

Formation Water Resistivity

The formation water resistivity was defined using the Rwa technique by the application of Hingle (Figure-5) and Pickett (Figure-6) crossplots of sandstone-dominated zones.

A review of offset well data with reliable formation water chemistries was conducted prior to the drilling of Geographe North-1. The results of this study are compared with formation water resistivity data from nearby offset wells in Table-5.

Water Saturation

Based upon the results of the petrophysical analyses of both Thylacine-1 and Geographe-1, where more realistic results were obtained by application of an Indonesian equation than a Waxman-Smits equation, only an Indonesian equation hydrocarbon saturation was calculated for Geographe North-1.

The tortuosity factor (a) was kept constant at one. Values for the cementation exponent (m) and the saturation factor (n) were determined from the results of the special core analysis study. These values remained constant for each petrophysical facies, and across the various lithostratigraphic units (Table-6).

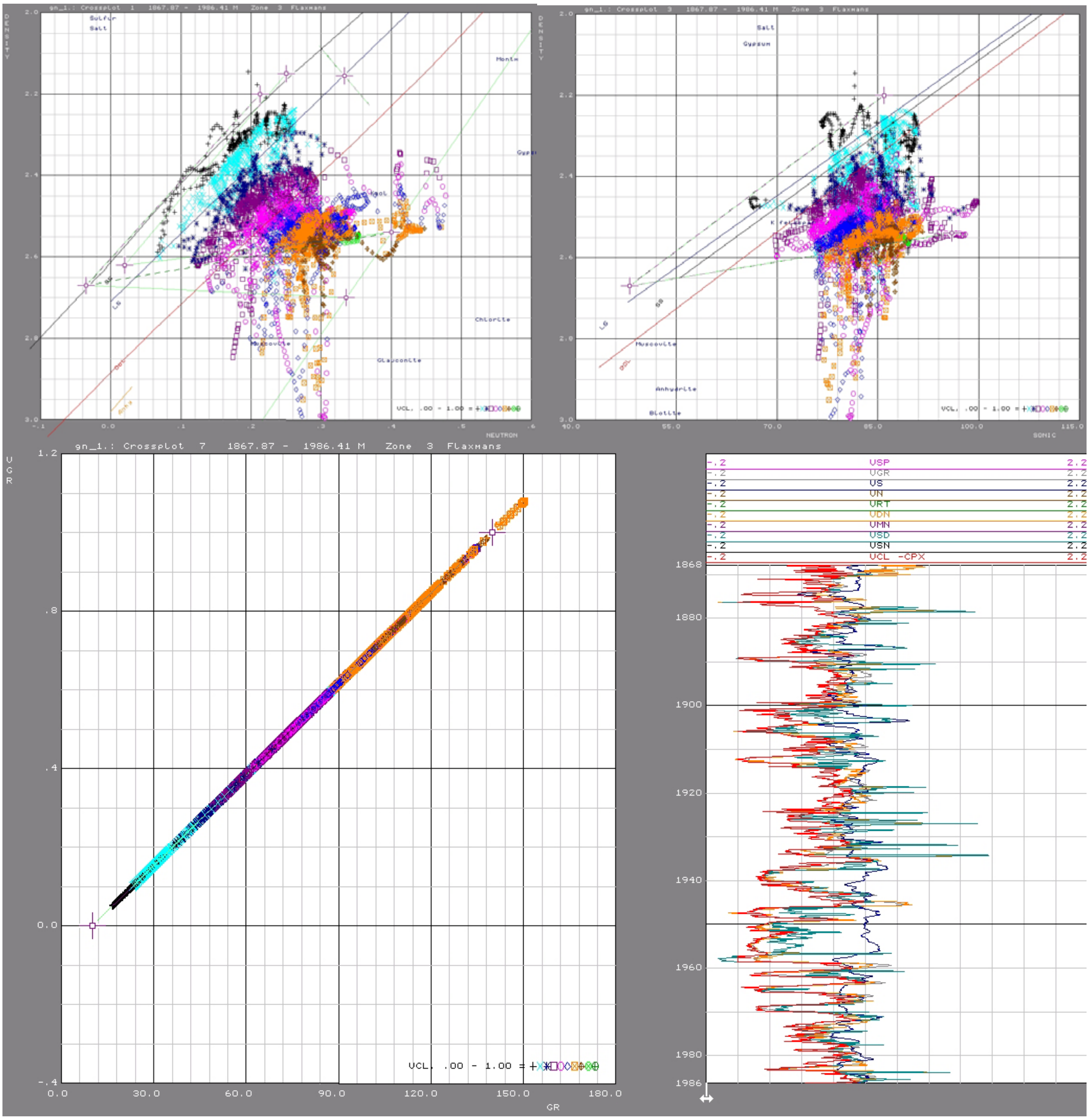


Figure 4. Clay volume determination. Comparison of results from the RHOB-NPHI, RHOB-DT, and GR techniques for the Flaxman Formation, 1867.8-1984.0 mMDRT.

The Indonesian equation, which is an effective porosity system that calculates an effective water saturation, derives its shale conductivity factor from the resistivity log-derived Rt. A log-derived clay resistivity (RCl) is defined by cross-plotting the apparent formation water resistivity (Rwa) versus GR for the clay-rich petrophysical facies (Figure-7). This RCl value remains a constant across all zones that are deemed to contain similar clay properties.

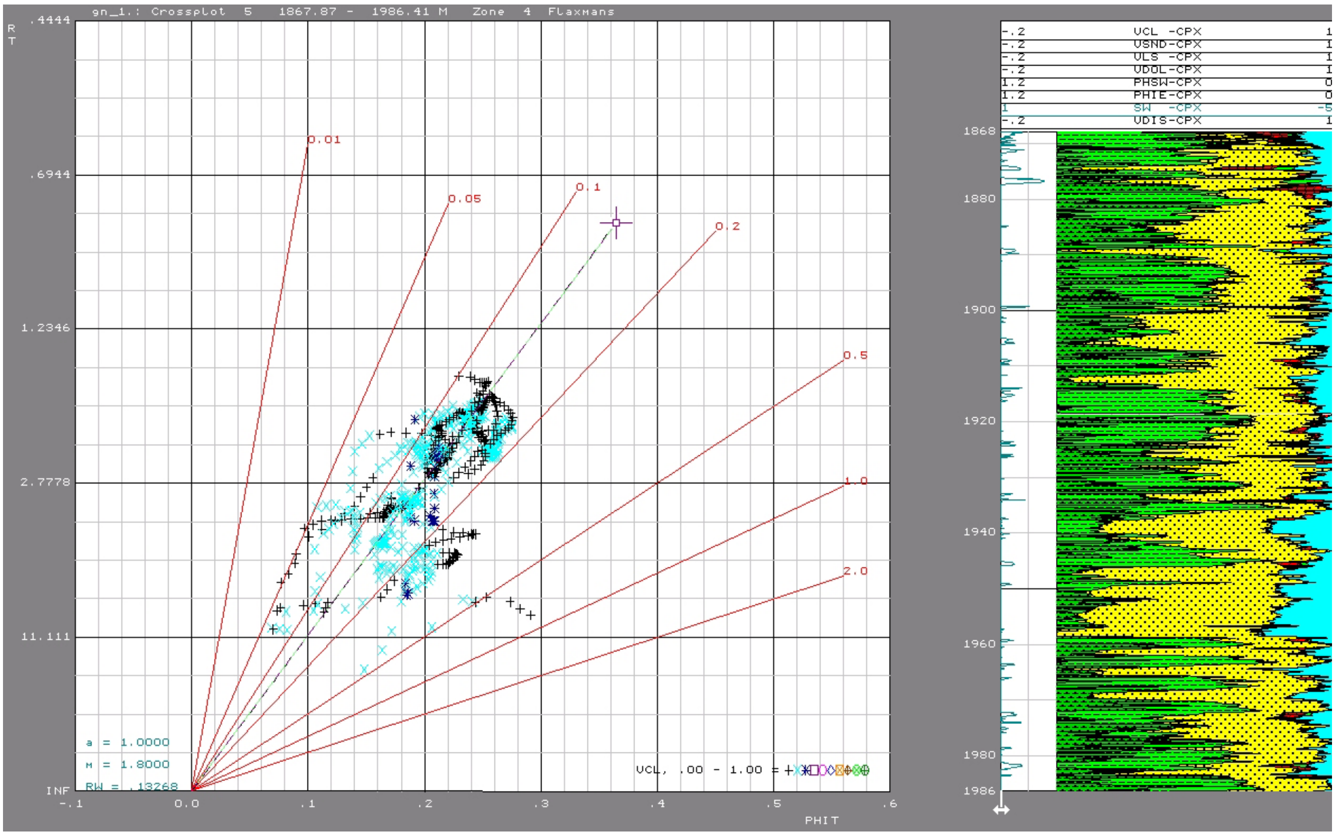


Figure 5. Hingle cross-plot defining formation water resistivity from Flaxman Formation. Sand petrofacies displayed.

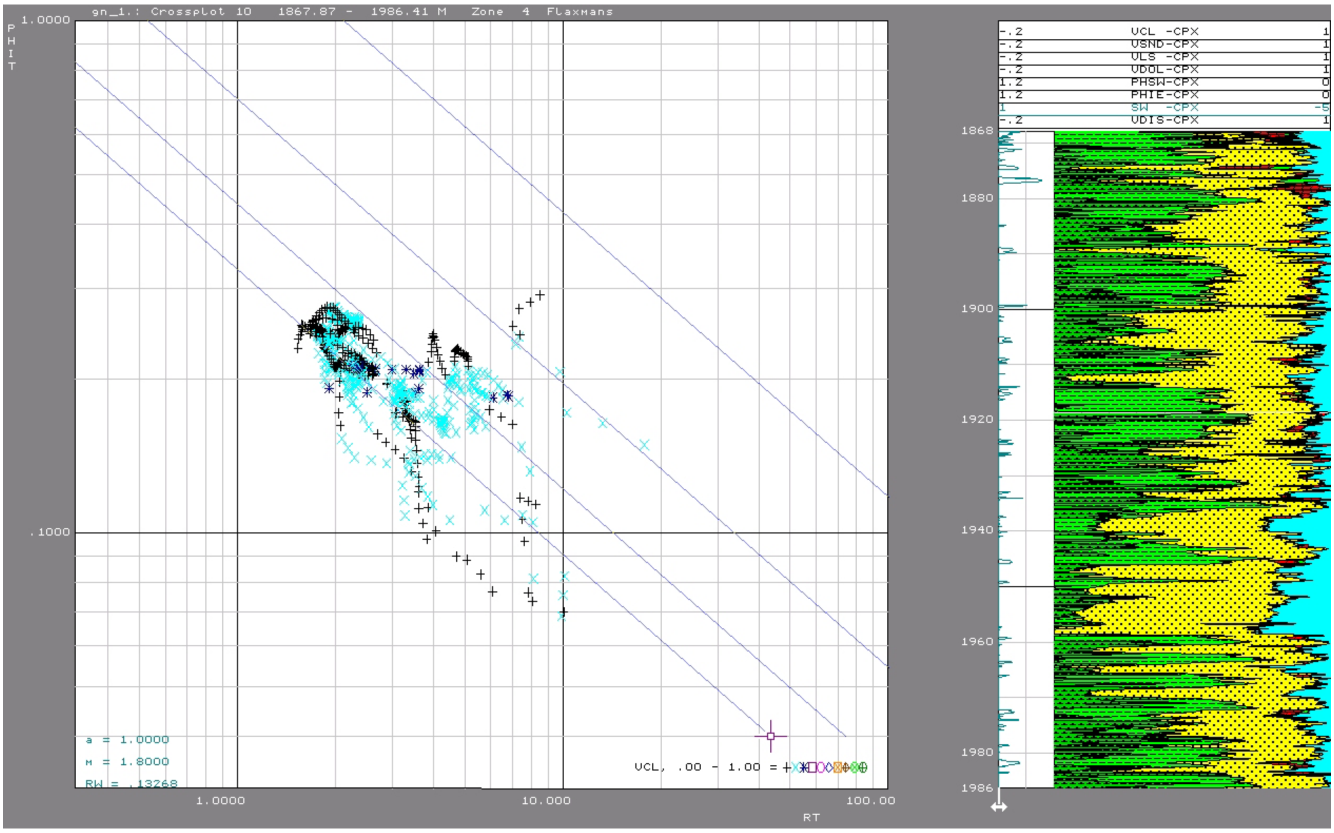


Figure 6. Pickett cross-plot defining formation water resistivity from Flaxman Formation . Sand petrofacies displayed.

Well	Depth (m)	Rw@ Temp (Ωm @ °C)	Salinity (ppm NaCl Eq)	Source
Geo North-1	1984-2128	0.31 @ 25	20,000	Rwa derived from logs
Thylacine-2	2115-2530	0.46 @ 25	13,000	Rwa derived from logs
Geographe-1	2050-2403	0.42 @ 25	14,280	Rwa derived from logs
Thylacine-1	2335-2613	0.46 @ 25	13,000	Rwa derived from logs
Minerva-1	1816-1838	0.48 @ 25	13,800	DST-1 fluid recovery
Pecten-1A	1771-1784	0.32 @ 25	20,700	Production test fluid recovery
Conan-1	1830-1950	0.50 @ 25	11,700	Rwa derived from logs

Table-5. Waarre Formation water chemistry data

Petro-facies	Tortuosity Factor (a)	Cementation Exponent (m)	Saturation Exponent (n)	Clay Resistivity (RCl)
Sandstone	1.00	1.80	1.75	17.0 ohmm
Siltstone	1.00	2.00	1.95	17.0 ohmm
Claystone	1.00	2.35	2.15	17.0 ohmm

Table-6. Summary of electrical properties applied in the Indonesian Equation

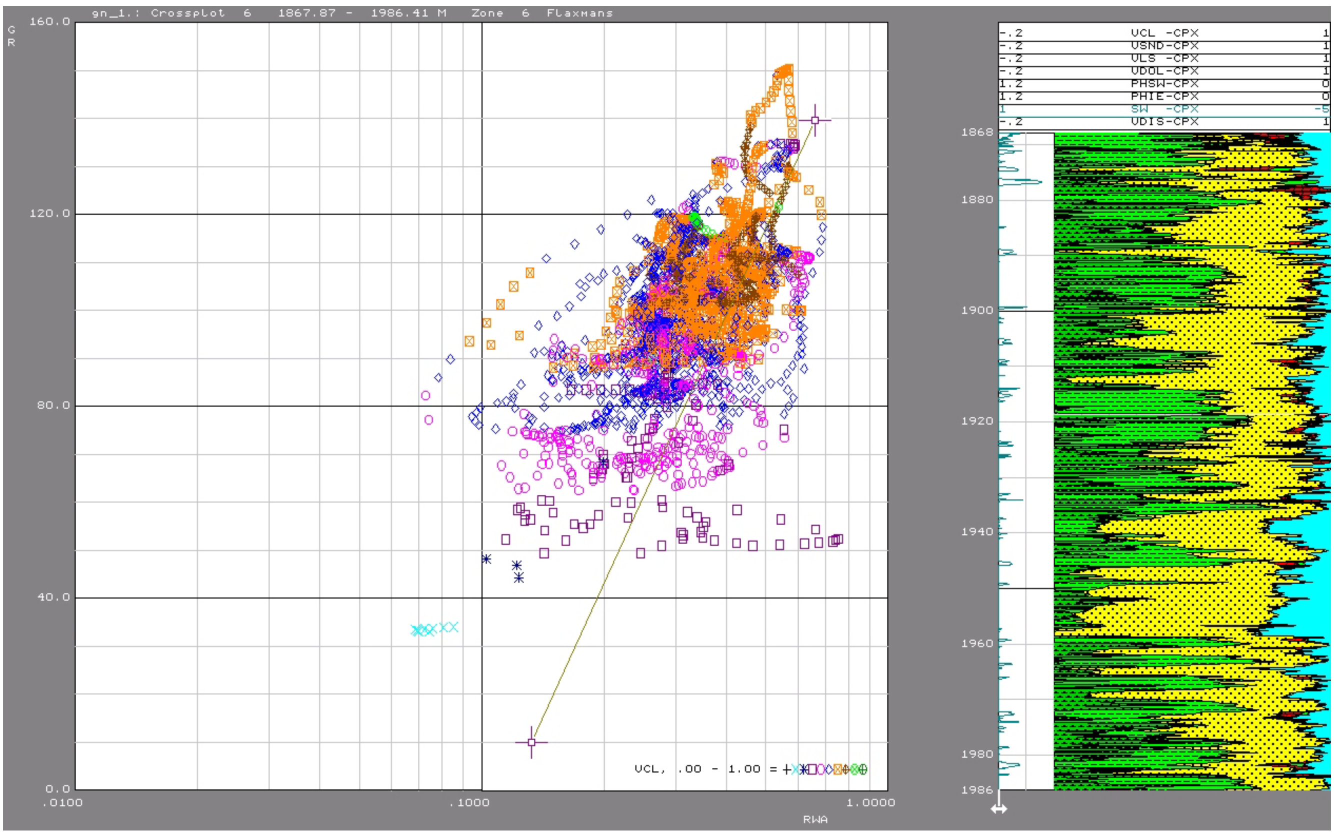


Figure 7. Clay resistivity derivation as applied in the Indonesian water saturation equation. Clay petrofacies displayed.

Permeability

As a component of the special core analysis study on Thylacine-1, Thylacine-2, and Geographe-1, gas-slippage and Klinkenburg-corrected overburden permeabilities were measured from both horizontal and vertical core plugs. These data act as a reference for any log-derived permeability equation. Permeability is often correlated to porosity alone, but this correlation is fraught with inaccuracy, as there are other rock parameters that can affect permeability. The intrinsic permeability of a rock is affected by its clay content, as increasing clay content in the pore space will decrease the flow rate at which a fluid can pass, and also increase the pressure gradient required to make the fluid flow. A useful qualitative indicator of the distance which a fluid has been able to flow into a formation is given by the difference between the true formation resistivity and the invaded zone resistivity (Rt-Rxo). With decreasing flow rates of mud filtrate into a formation, the difference between these values diminishes to the point that in a claystone, the Rt and Rxo have the same value as the mud filtrate cannot enter the formation as there is no permeability.

As the core analysis data in these three wells had been accurately depth-matched to wireline depths, it was possible to conduct a multiple linear regression of VCl, PHIT, and Rt-Rxo to derive an effective overburden air permeability curve. This log-derived permeability is displayed on Enclosures-1and 2, and is derived as

$$K_{Air} = 10\hat{\ }(13.824 \times PHIT - 1.240 \times VCl + 0.638 \times \log(Rt - Rxo) - 2.281)$$

This technique produces a 77% correlation co-efficient between the measured overburden Klinkenburg-corrected permeabilities and the log-derived air permeabilities (Figure-8). This equation incorporates all available routine and special core analysis data for all four wells drilled on the Thylacine and Geographe structures drilled to date. This equation is only quantitatively valid for reservoirs above a gas water contact (GWC), as the values for Rt and Rxo are affected by the nature of the fluid in the pore space. This is especially relevant in the case of Geographe North-1, where all reservoirs are water-saturated, and therefore all reservoirs are below any potential GWC. Although average permeabilities have been quoted for the rocks intersected in Geographe North-1, it should be remembered that any reported average log-derived permeabilities should be considered qualitatively and would be expected to under-estimate true values.

The SCAL data from Thylacine-1, Thylacine-2, and Geographe-1 were used to derive a correlation between the overburden air, and both gas and water permeabilities (Figures-9, 10). These relationships were used to generate gas and water permeability curves, which are also only quantitative above any GWC.

MULTIPLE LINEAR REGRESSION SUMMARY REPORT

Regression of Klinkenburg-corrected overburden horizontal core permeability on log-derived clay volume, total porosity, and the log of the difference between the true and invaded zone resistivities

Regression Statistics	
Multiple R	0.772056876
R Square	0.596071819
Adjusted R Square	0.590538557
Standard Error	1.101583172
Observations	223

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	392.168889	130.722963	107.725197	7.12729E-43
Residual	219	265.7533214	1.213485486		
Total	222	657.9222104			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	**-2.2809176**	0.539612414	-4.226955382	3.47826E-05	-3.344416412	-1.217418788	-3.344416412	-1.217418788
PHIT	**13.82472431**	1.475470793	9.369703812	9.27803E-18	10.91678263	16.732666	10.91678263	16.732666
VCL	**-1.240288555**	0.575542414	-2.154990711	0.032253536	-2.374600252	-0.105976859	-2.374600252	-0.105976859
log(Rt-Rxo)	**0.638622873**	0.200012483	3.192915074	0.001615589	0.244426904	1.032818842	0.244426904	1.032818842

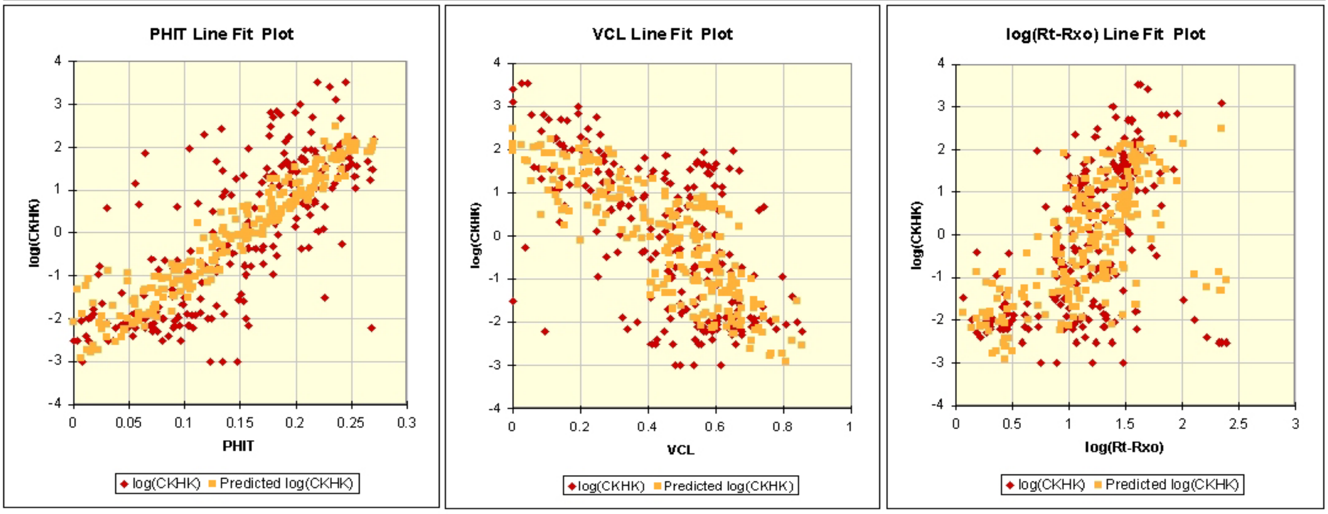


Figure-8. Log-derived permeability derivation via multiple linear regression.

Reservoir Summary Parameters

The cut-off limits for petrophysical parameters are detailed in Table-7. A maximum clay volume of 40% is the basis of the net rock calculation. Net reservoir is defined as those net rocks having a log-derived overburden Klinkenburg-corrected horizontal gas permeability of greater than 0.1mD. Average effective water saturations are reported for zones above the gas-water contact. The petrophysical results are summarised in Table-8.

Reservoir	VCl < (%)	Kgas > (mD)
Thylacine Member, Flaxman Formation, Waarre Formation	40	0.1

Table-7. Cut Off Parameters

Fluid Contacts

All Thylacine Member, Flaxman Formation, and upper Waarre Formation reservoirs included in the interpreted interval are water-saturated. There is no indication from either the wireline logs or the mudlog of significant hydrocarbons being present

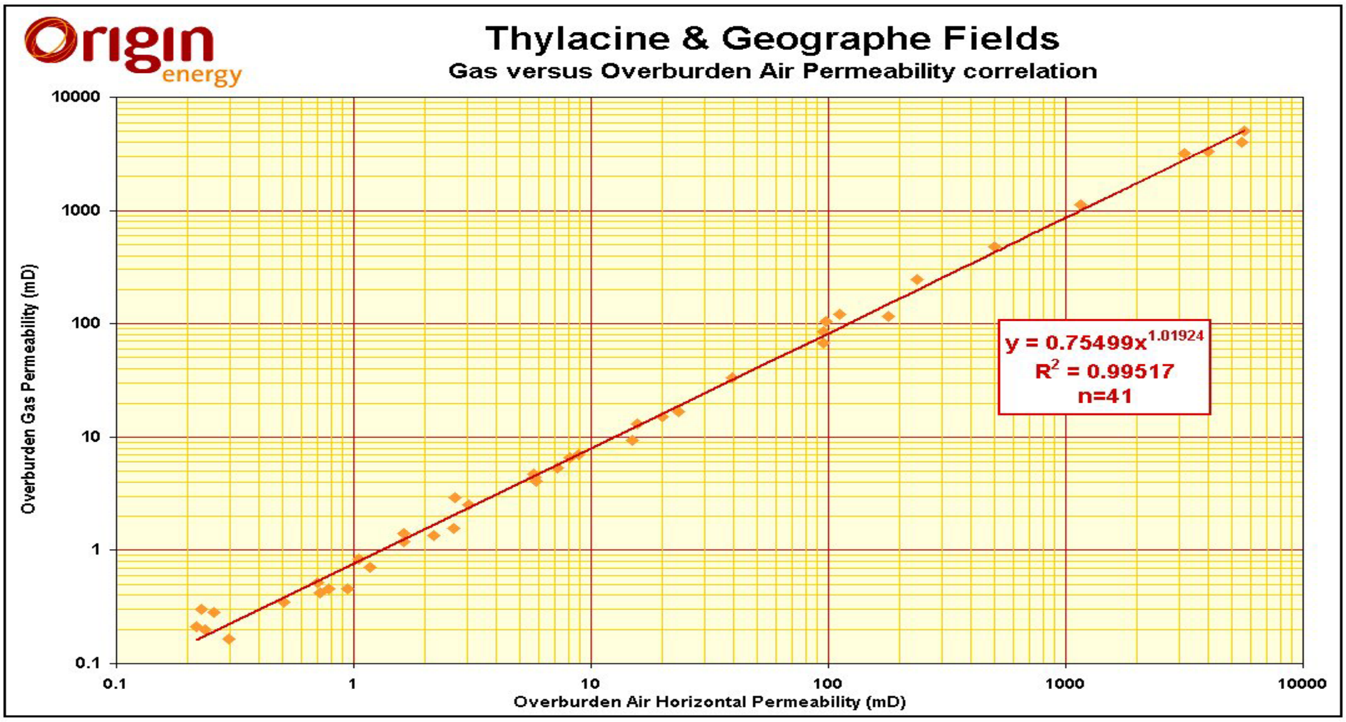


Figure-9. Relationship between core-derived overburden air permeability and gas permeability.

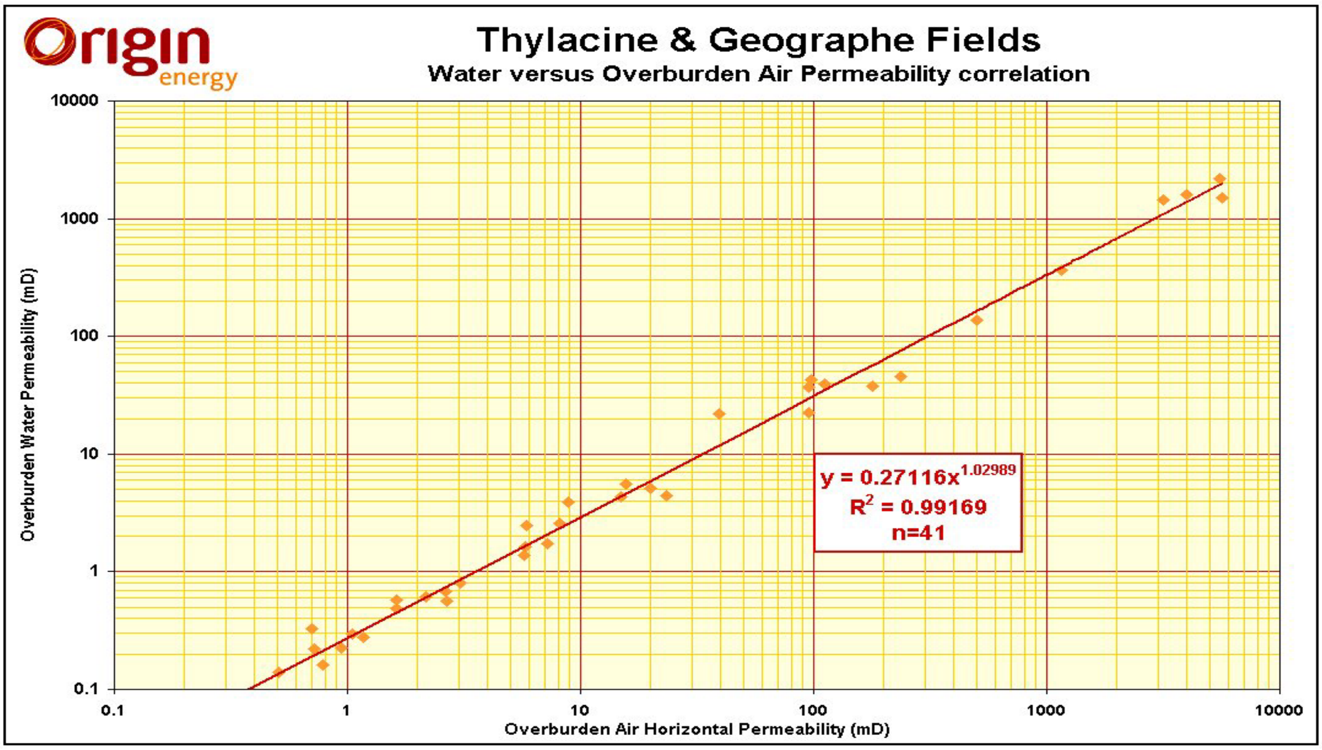


Figure-10. Relationship between core-derived overburden air permeability and water permeability.

FORMATION NAME	TOP FROM mMDRT	BASE TO mMDRT	GROSS INTERVAL mMDRT	NET RESERV INTERVAL mMDRT	AVERAGE VCL %	AVERAGE PHIE %	AVERAGE AIR PERM mD	AVERAGE GAS PERM mD	AVERAGE H_2O PERM mD	AVERAGE SWE %	NET RES / GROSS %
Thylacine Member	1846.30	1867.80	21.50	0.41	29.15	22.48	11.55	9.14	3.37	98.61	1.91
Flaxman Formation	1867.80	1984.00	116.20	37.21	19.89	16.21	1.48	1.13	0.41	95.64	32.02
Upper Waarre Fm	1984.00	2128.00	144.00	119.08	9.74	19.33	2.97	2.29	0.83	99.67	82.69

Cut-offs Applied		
Net Pay	K_gas >	0.1mD
	VCl <	40.0%

Table-8. Petrophysical Reservoir Summary

DISCUSSION

The Thylacine Member (1846.3-1867.8 mMDRT) encountered at Geographe North-1 is interpreted to have minimal to nil reservoir quality. The unit has a net to gross of less than 2%. Reviewing average reservoir parameters when such a small thickness of reservoir (0.4 metres) exists is quantitatively invalid and misleading. The average parameters are reported in Table 8, but should not be utilised as inputs into any geological or reservoir modelling.

The Flaxman Formation (1867.8-1984.0 mMDRT) has moderately good reservoir development in part, although the overall net to gross ratio is low. The sandstones present, on average, have an average clay volume of 19.9%. The average effective porosity is 16.2%, and the average gas permeability averages 1.13mD. This unit has a net reservoir to gross of 32.0%.

The Upper Waarre Formation (1984.0-2128.0 mMDRT) displays average clay volumes of only 9.7%, average effective porosities of 19.3%, and an average net to gross ratio of 82.7%

Between the four wells now present on the Thylacine and Geographe fields, sufficient core analysis data are present to calibrate the log responses, and no more core analysis is considered necessary, except for the measurement of CEC on very clean sandstone plugs, to aid in the future application of the Waxman-Smits saturation equation.

Given the thinly-bedded nature of the Thylacine Member and Flaxman Formation, it is recommended that all wireline logs are acquired in high resolution mode. To enable consistency in logging responses, and avoid subtle variations in the measurement of different company's logging tools, it is recommended that the same principle logging suite (PEx(HRLA)-DSI-SP) be run in subsequent wells.

CONCLUSIONS / RECOMMENDATIONS

- All reservoirs in the interpreted interval and including the Thylacine Member, Flaxman Formation, and upper Waarre Formation are water-saturated.
- The Thylacine Member (1846.3-1867.8 mMDRT) does not contain any significant reservoir potential at Geographe North-1.
- The Flaxman Formation (1867.8-1984.0 mMDRT) has a poor net to gross ratio, but contains some clean, porous, and permeable sandstones that would be expected to achieve moderate to high gas production rates.
- The Upper Waarre Formation (1984.0-2128.0 mMDRT) displays average clay volumes of only 9.7%, average effective porosities of 19.3%, and an average net to gross ratio of 82.7%
- Core-to-log correlations of porosity and permeability are adequate to suggest that the acquisition of further core and core analysis data would not significantly increase the confidence level applied to the petrophysical analysis.
- The addition of barite to the mud should be limited or eradicated if possible, in order to improve the quality of density and PEF data in future wells.
- There is no petrophysical requirement to acquire LWD data in future wells, as the wireline resistivity data is considered a more reliable indicator of the nature and volume of the fluids in the pore space.

Appendix – A
Log Depth-matching Summary

LWD TO SURFACE WIRELINE PASS

DEPTH MATCH LOG MNEMONICS
GR_CDR_C, GR_CDR, GR_CDR_R, ROP5_RM, BS, ATR, CATR, PSR, PSHF

REFERENCE LOG MNEMONIC
GR
DEPTH UNITS = M

551.155	553.187
559.689	559.994
574.802	575.716
581.025	581.355
596.138	597.713
613.537	615.671
637.616	638.531
647.294	648.360

WIRELINE SONIC INSIDE CASING TO LWD OVER WIRELINE GAP

DEPTH MATCH LOG MNEMONICS
GR, BS, CS, TENS, ETIM, HAZI, P1AZ, RB, SDEV, DF, CVEL, IHV, SCD, CDF, QCPOR, HCAL, ECGR, HTHO, HURA, HFK, HSGR, HCGR, HTPR, HTUR, HUPR, RGR, HBHK, EHGR, RHGR, HGR, NPHI, TNPH, CFTC, CNTC, NPOR, HTNP, HNPO, TNRA, HCFT, HCNT, ITT, DTCO, DTSM, DT4P, DT4S, DT5, PR, VPVS, DTRP, DTRS, DTTP, DTTS, SVEL, SSVE

REFERENCE LOG MNEMONIC
GR_CDR
DEPTH UNITS = M

670.154	670.255
676.580	676.173
696.062	695.477

LWD TO SONIC INSIDE CASING PASS

DEPTH MATCH LOG MNEMONICS
GR_CDR_C, GR_CDR, GR_CDR_R, ROP5_RM, BS, ATR, CATR, PSR, PSHF

REFERENCE LOG MNEMONIC
GR
DEPTH UNITS = M

1671.117	1674.800
1681.124	1685.849
1696.085	1699.057
1719.936	1722.247
1746.504	1749.527

LWD_2 TO OPEN-HOLE WIRELINE

DEPTH MATCH LOG MNEMONICS
GR_ARC_F, GR_ARC_R, GR_ARC_C, GR_ARC, A22H_UNC, A28H_UNC, A34H_UNC, A40H_UNC, P16H_UNC, P22H_UNC, P28H_UNC, P34H_UNC, P40H_UNC, A16L_UNC, A22L_UNC, A28L_UNC, A34L_UNC, A40L_UNC, P16L_UNC, P22L_UNC, P28L_UNC, P34L_UNC, P40L_UNC

```
REFERENCE LOG MNEMONIC
GR
DEPTH UNITS = M
  1823.237  1826.260
  2102.993  2104.924
  2117.369  2119.478
```

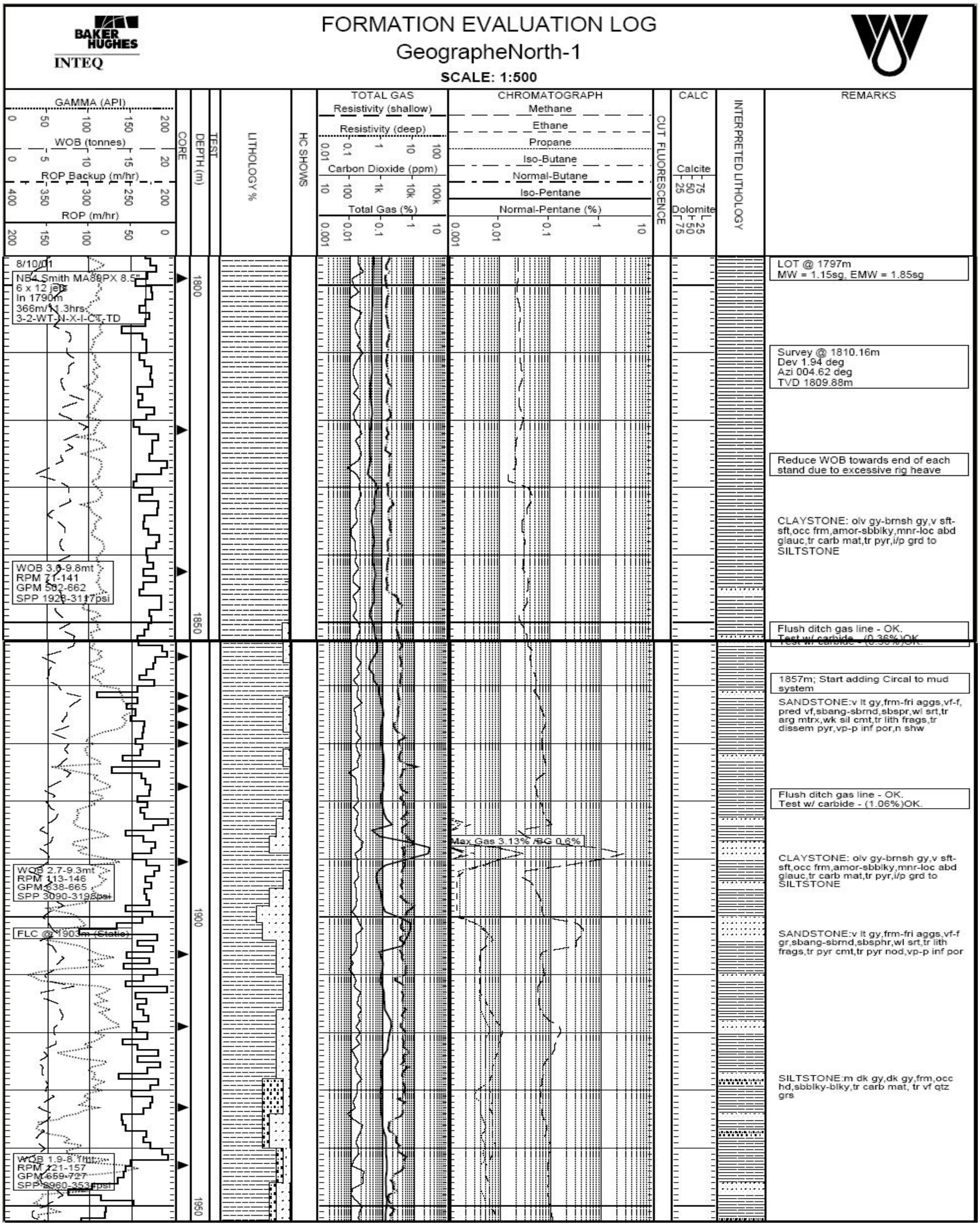
MUDLOG TO WIRELINE

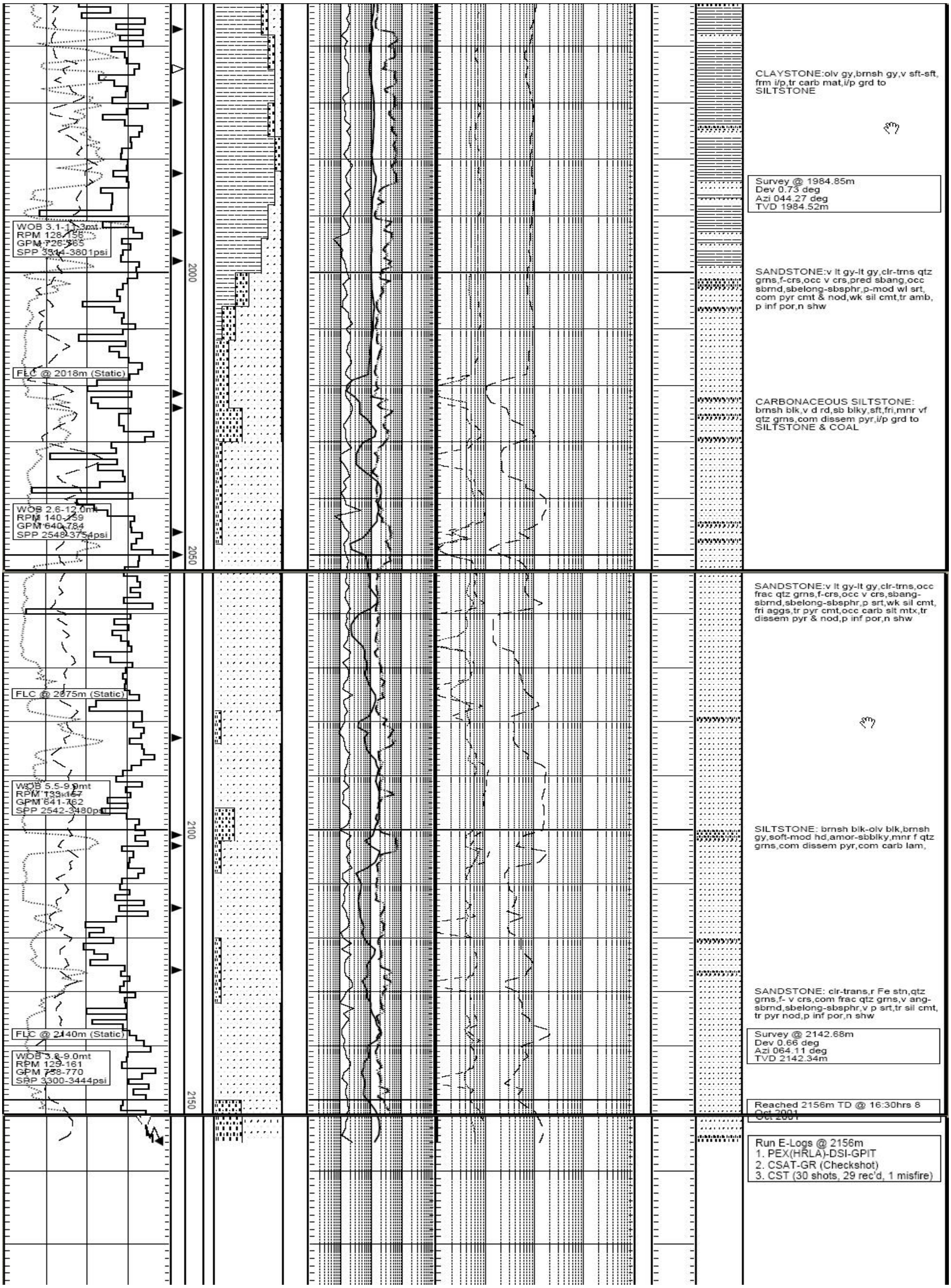
```
DEPTH MATCH LOG MNEMONICS
ROPA, TGAS, WOBA, RPMA, MFIA, TQA, TQX, MDIA, MDOA, MTIA, MTOA, BDDI, BDTI, DXC,
CO2, HAS, METH, ETH, PRP, IBUT, NBUT, IPEN, NPEN, C5, C4, GWR, LHR, CH

REFERENCE LOG MNEMONICS
GRCC, DTCO, RESD
DEPTH UNITS = M
   305.029   307.061
   372.339   374.802
   419.659   422.021
   529.895   531.571
   707.390   709.981
   798.424   800.837
   843.026   848.335
   930.123   932.053
   978.332   979.500
   996.493   998.118
  1019.531  1018.515
  1058.291  1057.173
  1073.506  1071.905
  1120.597  1119.632
  1141.400  1141.095
  1197.788  1196.721
  1220.495  1220.165
  1305.255  1304.239
  1336.421  1334.592
  1417.269  1415.821
  1475.461  1474.318
  1545.387  1543.888
  1638.503  1638.605
  1661.490  1661.008
  1684.807  1685.087
  1716.278  1716.405
  1742.567  1741.932
  1772.514  1772.717
  1847.952  1848.130
  1889.430  1890.243
  1903.222  1904.975
  1940.763  1943.456
  1964.792  1967.992
  1991.665  1993.265
  2025.726  2026.844
  2078.355  2078.838
  2092.503  2094.992
  2101.571  2103.831
  2125.650  2127.530
  2152.802  2154.047
```

Appendix – B

Mudlog Summary – 1800-2156 mMDRT




WOB 3.1-11.3mt
RPM 128-156
GPM 726-765
SPP 3514-3801psi
2000
FLC @ 2018m (Static)
WOB 2.6-12.0mt
RPM 140-159
GPM 640-784
SPP 2548-3754psi
2050
FLC @ 2075m (Static)
WOB 5.5-9.9mt
GPM 641-762
SPP 2542-3480psi
2100
FLC @ 2140m (Static)
RPM 125-161
GPM 758-770
SPP 3300-3444psi
2150
CLAYSTONE:olv gy,brnsh gy,v sft-sft, frm i/p,tr carb mat,i/p grd to SILTSTONE
Survey @ 1984.85m
Dev 0.73 deg
Azi 044.27 deg
TVD 1984.52m
SANDSTONE:v lt gy-lt gy,clr-trns qtz grns,f-crs,occ v crs,pred sbang,occ sbrnd,sbelong-sbsphr,p-mod wl srt, com pyr cmt & nod,wk sil cmt,tr amb, p inf por,n shw
CARBONACEOUS SILTSTONE: brnsh blk,v d rd,sb blky,sft,fri,mnr vf qtz grns,com dissem pyr,i/p grd to SILTSTONE & COAL
SANDSTONE:v lt gy-lt gy,clr-trns,occ frac qtz grns,f-crs,occ v crs,sbang-sbrnd,sbelong-sbsphr,p srt,wk sil cmt, fri aggs,tr pyr cmt,occ carb slt mtx,tr dissem pyr & nod,p inf por,n shw
SILTSTONE: brnsh blk-olv blk,brnsh gy,soft-mod hd,amor-sbblky,mnr f qtz grns,com dissem pyr,com carb lam,
SANDSTONE: clr-trans,r Fe stn,qtz grns,f- v crs,com frac qtz grns,v ang-sbrnd,sbelong-sbsphr,v p srt,tr sil cmt, tr pyr nod,p inf por,n shw
Survey @ 2142.68m
Dev 0.66 deg
Azi 064.11 deg
TVD 2142.34m
Reached 2156m TD @ 16:30hrs 8 Oct 2001
Run E-Logs @ 2156m
1. PEX(HRLA)-DSI-GPIT
2. CSAT-GR (Checkshot)
3. CST (30 shots, 29 rec'd, 1 misfire)

Appendix – C

Field Print Header Summary

Company:	Woodside Energy Limited
Well:	Geographe North-1 — 12 1/4 in. Hole
Field:	Permit VIC/P43
Rig:	Ocean Bounty — State: Victoria

Schlumberger

CDR - Resistivity
1:500 Measured Depth
Recorded Mode

Rig:	Ocean Bounty
Field:	Permit VIC/P43
Location:	Otway Basin
Well:	Geographe North-1
Company:	Woodside Energy Limited

		Elevation	
Total depth:	2156 m	K.B.	Top Drive
Spud date:	29 September 2001	G.L.	-107 m
Runs:	1 To 2	D.F.	25 m
Permanent datum:	L.A.T.	Elev.:	0.0 m
Log measured from:	Drill Floor	25 m	above Perm. datum
Depth reference:	Driller's Depth		

Location

API serial no.	Longitude	Latitude
	E 142 54' 57.647	S 39 04' 39.928

Depth logged:	565 m To 1,775 m	Mag decl:	11.034
Date logged:	01-Oct-01 To 05-Oct-01	Mag dip:	-70.256

Other services: Directional Surveys

Bore hole record			Casing record			
Hole size	from	to	Size	Density	from	to
12.25 in	565 m	1,790 m	13.375 in	61 lb/ft	165 m	558 m

Mud record			Borehole deviation record			
Type	from	to	Min	Max	from	to
Aquadrill	565 m	1,790 m	0.5 deg	1.94 deg	565 m	1,790 m

Surface equipment		Software record	
Unit	TWIS - EA	IDEAL Wis	6.1c_03
Depth system	Geolograph	SPM	6.1c_03
		LWD	6.3
		MWD	6.1

IDEAL services from Anadrill

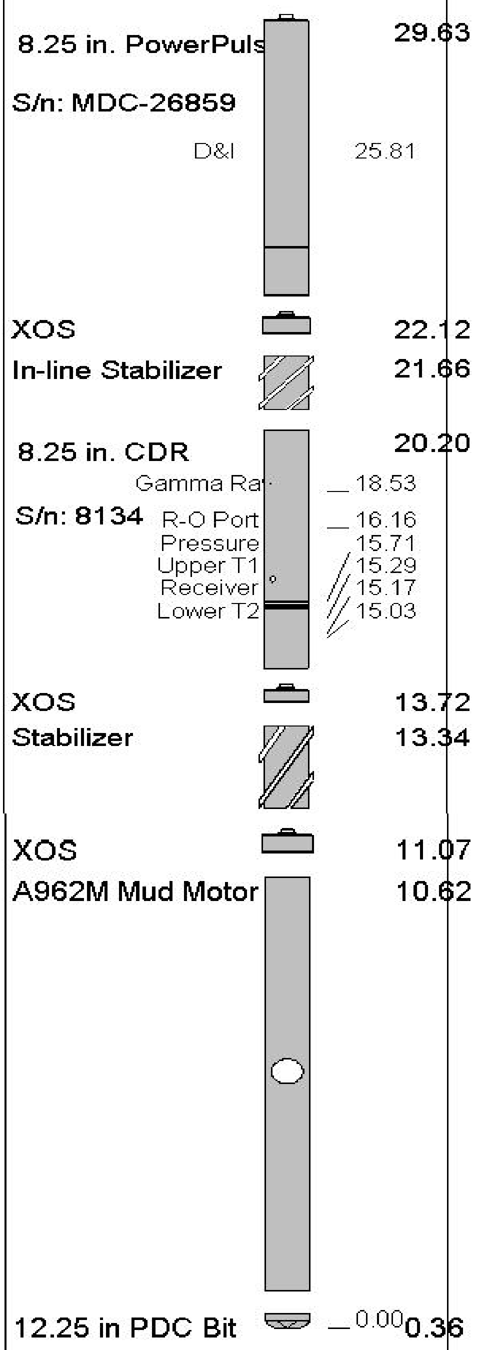
OTHER SERVICES FOR RUN 1	OTHER SERVICES FOR RUN	OTHER SERVICES FOR RUN
Directional Surveys Drilling Mechanics (DWOB, DTORQ, 4-axis vibration monitoring)		

REMARKS: RUN NUMBER 1	REMARKS: RUN NUMBER	REMARKS: RUN NUMBER
CDR GR is corrected for bit size and mud weight. CDR Resistivity is borehole compensated but not environmentally corrected. Rotary Drilled from 565 1790 m Depth logged: 565 - 1775 m		

EQUIPMENT DESCRIPTION

RUN 1	RUN	RUN

DOWNHOLE EQUIPMENT



MAXIMUM STRING DIAMETER 12.25 IN

ALL LENGTHS IN METERS

Bit Run Summary

Run number		1		
Bit size	in.	12.25		
Bit start depth	m	565 m		
Bit end depth	m	1790 m		
Top interval logged	m	558 m		
Bottom interval logged	m	1775 m		
Begin log: time		21:29 hrs		
Begin log: date		01 Oct 01		
End log: time		10:00 hrs		
End log: date		05 Oct 01		
Mud data				
Depth	m	1790		
Type		Aquadrill		
Mud weight	sg	1.15		
Solids	%vol	12.0		
Chlorides	mg/l	45000		
Rm	ohm.m@degC	0.123@22		
Rmf	ohm.m@degC	0.081@22		
Rmc	ohm.m@degC	0.248@22		
Potassium	mg/l	33450		
Environmental data				
GR				
Mud weight	sg	1.15		
Bit size	in.	12.25		
Resistivity				
Neutron porosity				
Hole Size		n/a		
Mud weight		n/a		
Temperature		n/a		
Mud salinity		n/a		
Formation salinity		n/a		
Recording rate 1	SEC	6 sec	GR	
Recording rate 2	SEC	6 sec	RES	
Filtering GR		3 point		
Filtering density				
Filtering Neutron				
Company representative		D. Bell	M. Bilek	G.Westle
Anadrill personnel		A. Abad	M. Saicic	

ANADRILL

SCHLUMBERGER

Survey report 8-Oct-2001 21:45:01 Page 1 of 2

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Client....................: Woodside Energy Ltd.
Field.....................: Permit VIC/P43

Well......................: Geograph North-1          Spud date.................: 29 Sep 01
API number................:                           Last survey date..........: 08-Oct-01
Engineer..................: A.Abad, M.Saicic          Total accepted surveys....: 17
                                                      MD of first survey........:  561.00 m
Rig:......................: Ocean Bounty              MD of last survey.........: 2142.68 m
STATE:....................: Victoria

----- Survey calculation methods-------------         ----- Geomagnetic data ----------------------
Method for positions.....: Minimum curvature          Magnetic model............: BGGM version 2000
Method for DLS...........: Mason & Taylor             Magnetic date.............: 01-Oct-2001
                                                      Magnetic field strength..:    1222.77 HCNT
----- Depth reference -----------------------         Magnetic dec (+E/W-).....:      11.03 degrees
Permanent datum..........: L.A.T.                     Magnetic dip.............:     -70.26 degrees
Depth reference..........: Driller's Depth
GL above permanent.......:    107.00 m                ----- MWD survey Reference Criteria ---------
KB above permanent.......:     82.00 m                Reference G..............:    1000.10 mGal
DF above permanent.......:     25.00 m                Reference H..............:    1222.77 HCNT
                                                      Reference Dip............:     -70.26 degrees
----- Vertical section origin----------------         Tolerance of G...........: (+/-) 2.50 mGal
Latitude (+N/S-).........:      0.00 m                Tolerance of H...........: (+/-) 6.00 HCNT
Departure (+E/W-)........:      0.00 m                Tolerance of Dip.........: (+/-) 0.45 degrees

----- Platform reference point---------------         ----- Corrections ---------------------------
Latitude (+N/S-).........:      0.00 m                Magnetic dec (+E/W-).....:      11.03 degrees
Departure (+E/W-)........:      0.00 m                Grid convergence (+E/W-).:      -1.17 degrees
                                                      Total az corr (+E/W-)....:      12.20 degrees
Azimuth from rotary table to target:    0.00 degrees    (Total az corr = magnetic dec - grid conv)
                                                      Sag applied (Y/N).........: No    degree: 0.00
```

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ANADRILL SCHLUMBERGER Survey Report 8-Oct-2001 21:45:01 Page 2 of 2

Seq # -	Measured depth (m)	Incl angle (deg)	Azimuth angle (deg)	Course length (m)	TVD depth (m)	Vertical section (m)	Displ +N/S- (m)	Displ +E/W- (m)	Total displ (m)	At Azim (deg)	DLS (deg/ 10m)	Srvy tool type	Tool qual type
1	561.00	0.50	0.00	0.00	561.00	0.00	0.00	0.00	0.00	0.00	0.00	TIP	-
2	582.93	0.14	140.00	21.93	582.93	0.08	0.08	0.02	0.08	12.91	0.28	MWD	6-axis
3	787.44	0.24	327.54	204.51	787.44	0.25	0.25	-0.05	0.25	348.01	0.02	MWD	6-axis
4	1045.27	1.06	176.39	257.83	1045.26	-1.68	-1.68	-0.19	1.69	186.51	0.05	MWD	6-axis
5	1134.01	1.32	323.02	88.74	1133.99	-1.68	-1.68	-0.75	1.84	204.17	0.26	MWD	6-axis
6	1221.07	1.31	340.49	87.06	1221.03	0.06	0.06	-1.69	1.69	271.93	0.05	MWD	6-axis
7	1308.98	1.44	340.75	87.91	1308.91	2.05	2.05	-2.39	3.15	310.58	0.01	MWD	6-axis
8	1395.89	1.48	355.28	86.91	1395.79	4.08	4.08	-3.21	5.20	321.80	0.02	MWD	6-axis
9	1510.17	1.39	334.24	114.28	1510.04	6.65	6.65	-4.42	7.99	326.38	0.01	MWD	6-axis
10	1568.32	1.65	336.38	58.15	1568.17	8.06	8.06	-5.07	9.52	327.84	0.05	MWD	6-axis
11	1656.23	1.91	353.24	87.91	1656.04	10.67	10.67	-5.75	12.12	331.70	0.07	MWD	6-axis
12	1713.58	1.95	1.23	57.35	1713.35	12.60	12.60	-5.84	13.88	335.13	0.05	MWD	6-axis
13	1762.43	1.84	357.96	48.85	1762.18	14.21	14.21	-5.85	15.37	337.63	0.03	MWD	6-axis
14	1810.16	1.94	4.62	47.73	1809.88	15.78	15.78	-5.81	16.82	339.79	0.05	MWD	6-axis
15	1984.85	0.73	44.27	174.69	1984.52	19.53	19.53	-4.79	20.11	346.20	0.08	MWD	6-axis
16	2142.68	0.66	64.11	157.83	2142.34	20.64	20.64	-3.28	20.90	350.98	0.02	MWD	6-axis
17	2170.70	0.65	64.11	157.83	2170.01	20.86	20.86	-3.26	20.98	351.01	0.02	projection	

|(c)2001 Anadrill IDEAL ID6_1C_03|

COMPANY: Woodside Energy Ltd.

WELL: GEOGRAPHE NORTH-1

FIELD: EXPLORATION

RIG: Ocean Bounty **COUNTRY:** AUSTRALIA

RIG:	Ocean Bounty
Field:	EXPLORATION
Location:	OTWAY BASIN
Well:	GEOGRAPHE NORTH-1
Company:	Woodside Energy Ltd.

Schlumberger

SP-HRLA-DSI-PEX-HNGS
RESISTIVITY - NUCLEAR LOG
SCALE 1:200

LOCATION				
OTWAY BASIN EASTING: 665736.2 M NORTHING: 5672832.2 M			Elev.: R.T. 25 m G.L. 82 m	
Permanent Datum:	LAT		Elev.: 0 m	
Log Measured From:	R.T.		25.0 m above Perm. Datum	
Drilling Measured From:	R.T.			
STATE: VICTORIA	Max. Well Deviation 1.95 deg		Longitude 142 54' 57.647" E	Latitude 39 04' 39.928" S

Logging Date		9-Oct-2001			
Run Number		1A			
Depth Driller		2156 m			
Schlumberger Depth		2155 m			
Bottom Log Interval		2155 m			
Top Log Interval		1787.5 m			
Casing Driller Size @ Depth		9.625 in @ 1784 m		@	
Casing Schlumberger		1787.5 m			
Bit Size		8.500 in			
Type Fluid In Hole		KCl-PHPA-GLYCOL			
MUD Density	Viscosity	1.16 g/cm3	54 s		
MUD Fluid Loss	PH	4 cm3	9.5		
MUD Source Of Sample		FLOWLINE			
RM @ Measured Temperature		0.113 ohm.m @ 22 degC		@	
RMF @ Measured Temperature		0.100 ohm.m @ 22 degC		@	
RMC @ Measured Temperature		0.200 ohm.m @ 22 degC		@	
Source RMF	RMC	PRESSED	PRESSED		
RM @ MRT	RMF @ MRT	0.044 @ 90	0.039 @ 90	@	@
Maximum Recorded Temperatures		89 degC	89	90	
Circulation Stopped	Time	8-Oct-2001	17:00		
Logger On Bottom	Time	9-Oct-2001	4:10		
Unit Number	Location	25	VEA-APG		
Recorded By		F. Marcano / M. Van Steene			
Witnessed By		M. Bilek / G. Weste			

OTHER SERVICES1
OS1: CSI-GR
OS2: CST-GR
OS3:
OS4:
OS5:

REMARKS: RUN NUMBER 1

1. First run in hole. Schlumberger depth procedures observed.
2. Borehole correction applied to logs.
3. Limestone matrix-model used in computation of neutron porosity.
4. Bottom hole temperature 89.2 degC at 4:10 on 9-Oct-01.
5. Data aquired in high resolution mode for the entire interval as per client request.
6. Well sketch shows driller's depth.
7. Caliper check in casing reading 8.43in. ID expected 8.75 in.
8. Tools run as per tool sketch.
9. Circulation started 16:15 on 8-Oct-01, stopped at 17:00 on 08-Oct-01.

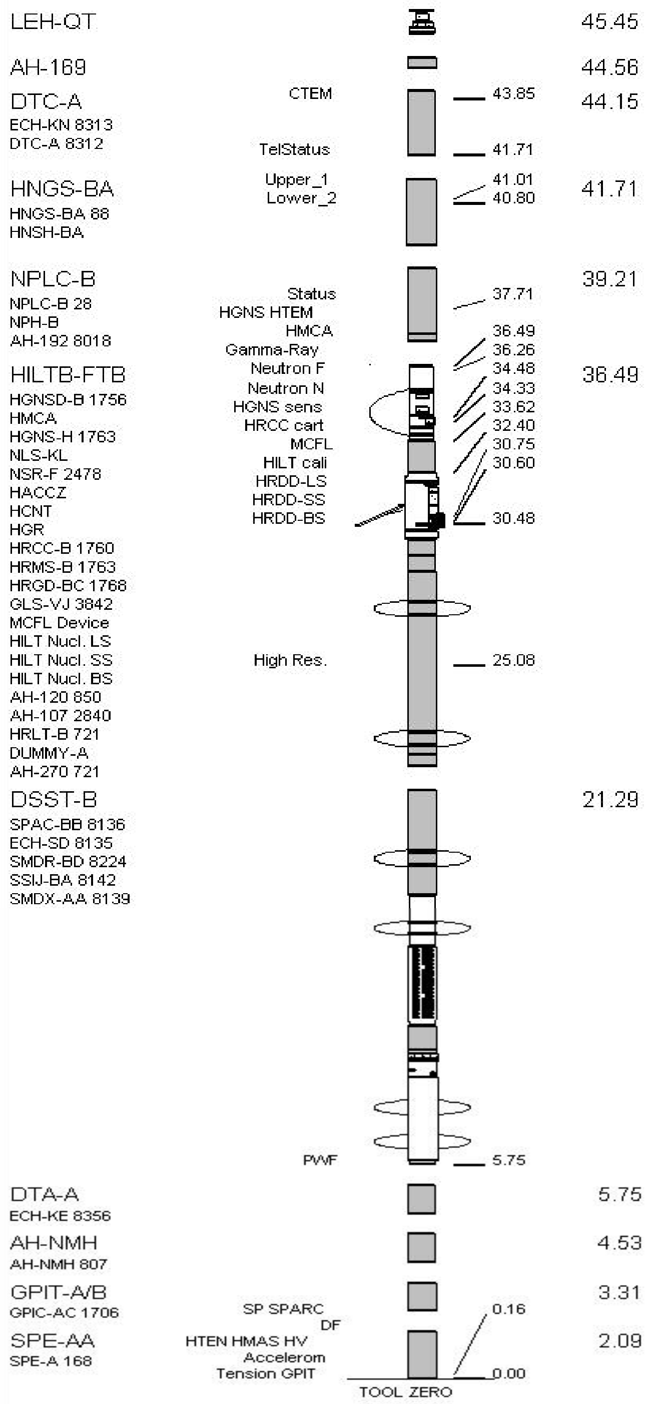
Thank you for using Schlumberger

Mud Properties:
Barite conc = 1.55%, Chloride conc. = 42000 mg/l, Potassium conc. = 30569 mg/l
Water content = 89 %, Solids content = 8 %, Corr. Solids content = 5.71 %
Glycol conc. = 3 %, Calcium conc. = 280 mg/l

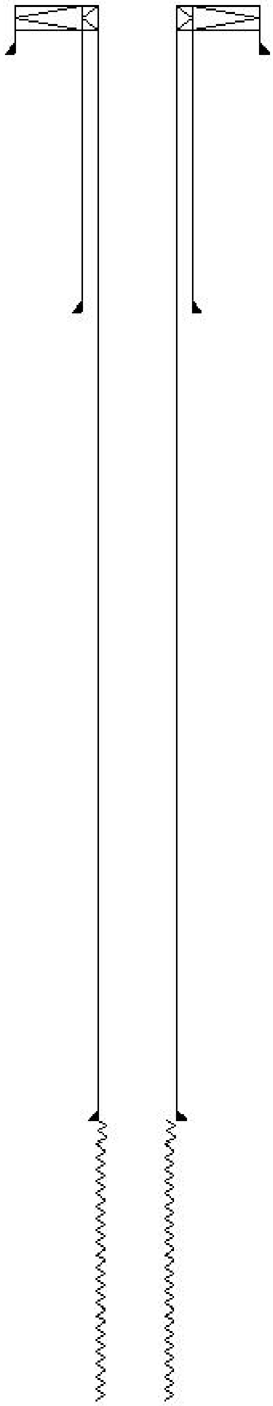
RUN 1			RUN 2		
SERVICE ORDER #: PROGRAM VERSION: 9C2-303 FLUID LEVEL:			SERVICE ORDER #: PROGRAM VERSION: FLUID LEVEL:		
LOGGED INTERVAL	START	STOP	LOGGED INTERVAL	START	STOP

EQUIPMENT DESCRIPTION

RUN 1	RUN 2
SURFACE EQUIPMENT WITM (DTS)-A NCS-VB GSR-U/Y 607 GSR-U NCT-B CNB-AB	
DOWNHOLE EQUIPMENT	



MAXIMUM STRING DIAMETER 4.63 IN
MEASUREMENTS RELATIVE TO TOOL ZERO
ALL LENGTHS IN METERS

Production String	OD (in)	ID	MD (m)	Well Schematic	MD (m)	OD (in)	ID	Casing String
					107.0	30.000		Casing String
					165.0	30.000		Casing Shoe
					558.0	13.375		Casing Shoe
					1784.0	9.625		Casing Shoe
					1784.0	8.500		Borehole Segment
					2156.0	8.500		Borehole Segment Bottom

Parameters

DLIS Name	Description	Value	
ACPP	Accelerometer PROM Presence	PRESENT	
AFMO	Accelerometer Filtering Mode	MOVING_AVERAGE	
ALTDPCHAN	Name of alternate depth channel	MeasuredDepth	
ART	Accelerometer Reference Temperature	20	DEGC
BAR1	HNGS Detector 1 Barite Constant	0.953902	
BAR2	HNGS Detector 2 Barite Constant	0.97118	
BARS_MTR1	Length for Monopole Transmitter to Receiver 1	2.7432	M
BHFL	Borehole Fluid Type	WATER	
BHK	HNGS Borehole Potassium Correction Concentration	0.0279146	
BHS	Borehole Status	OPEN	
BHT	Bottom Hole Temperature (used in calculations)	89	DEGC
BILI	Bond Index Level for Zone Isolation	0.8	
BS	Bit Size	8.500	IN
BSAL	Borehole Salinity	42000.00	PPM
BSCO	Borehole Salinity Correction Option	YES	
CALSTAT	HRLTB Calibration Status	SHALLOW_DONE	
CALTEMP	HRLTB Calibration Temperature	10.6916	DEGC
CASF	Label Casing Function - Monopole P&S	50	
CCCO	Casing & Cement Thickness Correction Option	NO	
CDTS	C-Delta-T Shale	100	US/F
COLL	Label Slowness Lower Limit - Monopole P&S Compressional	60	US/F
COUL	Label Slowness Upper Limit - Monopole P&S Compressional	180	US/F
CSD1	Inner Casing Outer Diameter	0	IN
CSD2	Outer Casing Outer Diameter	0	IN
CSIZ	Current Casing Size	9.625	IN
CSTR	Compressive Strength of Cement	0	KPAA
CSW1	Inner Casing Weight	0	LB/F
CSW2	Outer Casing Weight	0	LB/F
CWEI	Casing Weight	47.00	LB/F
DBCC	HNGS Barite Constant Correction Flag	USER	
DDE1	Digitizing Delay 1	0	US
DDE2	Digitizing Delay 2	0	US
DDE3	Digitizing Delay 3	0	US
DDE4	Digitizing Delay 4	0	US
DDE5	Digitizing Delay 5	0	US
DDEX	Digitizing Delay X	0	US
DFD	Drilling Fluid Density	1.16	G/C3
DHC	Density Hole Correction	BS	
DLCS	Label Compressional Source - Dipole Shear	USE	
DLHS	Label Hole Diameter Source for SOBS Channel	AUTO	
DO	Depth Offset for Playback	-2.5	M
DPPM	Density Porosity Processing Mode	HIRS	
DSHL	Label Slowness Lower Limit - Dipole Shear	75	US/F
DSHU	Label Slowness Upper Limit - Dipole Shear	475	US/F
DSI1	Digitizer Sample Interval 1	10	US
DSI2	Digitizer Sample Interval 2	40	US
DSI3	Digitizer Sample Interval 3	40	US
DSI4	Digitizer Sample Interval 4	10	US
DSI5	Digitizer Sample Interval 5	10	US
DSIX	Digitizer Sample Interval X	40	US
DTCS	Compressional Delta-T Source for DTCO Channel	PS_COMP	
DTF	Delta-T Fluid	189	US/F
DTM	Delta-T Matrix	56	US/F
DTF	Delta-T Fluid	189	US/F
DTM	Delta-T Matrix	56	US/F
DTSS	Shear Delta-T Source for DTSM Channel	UPPER_DIPOLE	
DWC1	Digitizer Word Count 1	512	
DWC2	Digitizer Word Count 2	512	
DWC3	Digitizer Word Count 3	512	
DWC4	Digitizer Word Count 4	512	
DWC5	Digitizer Word Count 5	512	
DWCX	Digitizer Word Count X	512	
EXSICL	External Shale Indicator Clean Value	20	
EXSISH	External Shale Indicator Shale Value	150	
FCD	Future Casing (Outer) Diameter	7	IN
FCF	CBL Fluid Compensation Factor	1	
FD	Fluid Density	1	G/C3
FEXP	Form Factor Exponent	2	
FGM5	First Motion Gate Moveout 5	40	US/F
FILG	Label Fill Gap Control - Monopole P&S	COMP_SHEAR	
FMG5	First Motion Minimum Gate 5	500	US
FMLL	Slowness Lower Limit - FMD	40	US/F
FMRC	Restart Control - FMD	CONTINUE	
FMT5	First Motion Threshold 5	UP	
FMUL	Slowness Upper Limit - FMD	180	US/F
FNUM	Form Factor Numerator	1	
FPHI	Form Factor Porosity Source	PXND_HILT	
FPM	Processing Mode - FMD	DFMD	
FREQ0	HRLT Frequency Index for Mode 0	32	
FREQ1	HRLT Frequency Index for Mode 1	128	
FREQ2	HRLT Frequency Index for Mode 2	104	
FREQ3	HRLT Frequency Index for Mode 3	86	
FREQ4	HRLT Frequency Index for Mode 4	56	
FREQ5	HRLT Frequency Index for Mode 5	44	
FREQ6	HRLT Frequency Index for Mode 6	116	
FSAL	Formation Salinity	-50000	PPM
FSCO	Formation Salinity Correction Option	NO	
GCSE	Generalized Caliper Selection	HCAL	
GDEV	Average Angular Deviation of Borehole from Normal	0	DEG
GDT1	Gain Delta-T 1	800	US/F
GDT2	Gain Delta-T 2	800	US/F
GDT3	Gain Delta-T 3	800	US/F
GDT4	Gain Delta-T 4	160	US/F
GDT5	Gain Delta-T 5	160	US/F
GDTX	Gain Delta-T X	800	US/F
GGRD	Geothermal Gradient	0.018227	DC/M
GIN1	Gain Interval 1	15360	US
GIN2	Gain Interval 2	15360	US
GIN3	Gain Interval 3	15360	US
GIN4	Gain Interval 4	2560	US
GIN5	Gain Interval 5	1600	US
GINX	Gain Interval X	15360	US
GLM	GPIT Logging Mode	DIPM	
GOBO	Good Bond	2	MV
GRSE	Generalized Mud Resistivity Selection	CHART_GEN_9	
GTSE	Generalized Temperature Selection	LINEAR_ESTIMATE	
H1P	HNGS Detector 1 Allow/Disallow In Processing	ALLOW	
H2P	HNGS Detector 2 Allow/Disallow In Processing	ALLOW	
HABK	HNGS Borehole Potassium Running Average	0.0350803	
HACPP	Accelerometer PROM Presence	PRESENT_FILE	
HALF	HNGS Alpha Filter Length	60	IN
HART	Accelerometer Reference Temperature	20	DEGC
HCRB	HNGS Apply Borehole Potassium Correction	USER	
HDCOD	HILT Density Coal detection	2	G/C3
HDSAD	HILT Density Salt detection	2.1	G/C3
HILT_GAS_DENSITY	HILT Gas Downhole Density	0	G/C3

HILT_GAS_OPTION	HILT Gas Computation Option	OFF	
HMWM	Mud Weighting Material	BARI	
HNCOD	HILT Neutron Coal detection	45	PU
HNPE	HNGS Processing Enable	YES	
HNSAD	HILT Neutron Salt detection	5	PU
HPHIECUT	HILT effective Porosity Cutoff	5	PU
HSCO	Hole Size Correction Option	YES	
HSIS	HILT Shale Indicator Selection	GR	
HSWCUT	HILT Water Saturation from AITH cutoff	50	%
HVCS	Integrated Hole Volume Caliper Selection	HCAL	
ICMO	Inclinometry Computation Mode	AUTOMATIC_SELECTION	
ITTS	Integrated Transit Time Source	DTCO	
KFAC_HRLT	HRLT K Factor Option	SONDE	
LFC	Label Formation Character - Monopole P&S	DYNAMIC	
LOOPCOEF_S	HRLT Loop Coefficient for Shallow Modes	LOW	
LOOPMOD0	HRLT Mode 0 Loop Mode	OFF	
LOOPMOD1	HRLT Mode 1 Loop Mode	OFF	
LOOPMOD2	HRLT Mode 2 Loop Mode	OFF	
LOOPMOD3	HRLT Mode 3 Loop Mode	OFF	
LOOPMOD4	HRLT Mode 4 Loop Mode	OFF	
LOOPMOD5	HRLT Mode 5 Loop Mode	OFF	
LOOPMOD6	HRLT Mode 6 Loop Mode	OFF	
LTXG	Lower Dipole Transmitter Geometry	156	IN
MAI5	Slowness Averaging Interval - FMD	42	IN
MAPP	Magnetometer PROM Presence	PRESENT	
MATR	Rock Matrix for Neutron Porosity Corrections	LIMESTONE	
MCCO	Mud Cake Correction Option	YES	
MCI	Minimum Cemented Interval	4.51523	M
MCOR	Mud Correction	BARI	
MCS	Mean Casing Slowness	57	US/F
MDEC	Magnetic Field Declination	11.0346	DEG
MDEN	Matrix Density	2.71	G/C3
MDS5	Multishot Delta-T Scatter - FMD	20	US
MHC0	MCFL B0 Contrast Correction Coefficient	2.2e-005	OHMS
MHC1	MCFL B1 Contrast Correction Coefficient	3.2e-005	OHMS
MHCC	MCFL High Contrast Correction Switch	NO	
MPOF	MCFL Processing Operation Mode	ON	
MRTE	Magneto Reference Temperature	21	DEGC
MSA	Minimum Sonic Amplitude	19.7824	MV
MST	Mud Sample Temperature	22.00	DEGC
MTXG	Monopole Transmitter Geometry	186	IN
MWCO	Mud Weight Correction Option	YES	
NAAC	HRDD APS Activation Correction	OFF	
NMT	HILT Nuclear Mud Type	BARITE	
NOTS	NPLC Old Temperature Sensor	NO	
NPRM	HRDD Processing Mode	HiRes	
NSAR	HRDD Depth Sampling Rate	1	IN
NWS1	Number Waveforms Stacked 1	1	
NWS2	Number Waveforms Stacked 2	1	
NWS3	Number Waveforms Stacked 3	1	
NWS4	Number Waveforms Stacked 4	1	
NWS5	Number Waveforms Stacked 5	1	
NWSX	Number Waveforms Stacked X	1	
PBVSADP	Use alternate depth channel for playback	NO	
PHIMAX	HILT max porosity	35	PU
PP	Playback Processing	RECOMPUTE	
PROCINV	Inversion Selection	ON	
PROCMFL	Inversion Micro-Resistivity Selection	NO_EXTERNAL_RXO	
PROCMSO	Mechanical Standoff Fin Size	1.5	IN
PROCRM	Processing Mud Resistivity Select	HRLT_Compute	
PROCSPO	Sonde Position	Centered	
PTCO	Pressure/Temperature Correction Option	YES	
RATE	Firing Rate	R3	
RMFS	Resistivity of Mud Filtrate Sample	0.1000	OHMM
RSMN	Label Shear/Compressional Minimum Ratio - Monopole P&S	1.4	
RSMX	Label Shear/Compressional Maximum Ratio - Monopole P&S	2.12	
RW	Resistivity of Connate Water	1.0000	OHMM
RX1G	Receiver 1 Geometry	294	IN
RX2G	Receiver 2 Geometry	300	IN
RX3G	Receiver 3 Geometry	306	IN
RX4G	Receiver 4 Geometry	312	IN
RX5G	Receiver 5 Geometry	318	IN
RX6G	Receiver 6 Geometry	324	IN
RX7G	Receiver 7 Geometry	330	IN
RX8G	Receiver 8 Geometry	336	IN
S1BI	HNGS Detector 1 Calibration Bismuth Count Rate	1.3	CPS
S2BI	HNGS Detector 2 Calibration Bismuth Count Rate	1.3	CPS
SAM1	DSST Sonic Acquisition Mode 1 - Lower Dipole Mode	OFF	
SAM2	DSST Sonic Acquisition Mode 2 - Upper Dipole Mode	ODD	
SAM3	DSST Sonic Acquisition Mode 3 - Low Frequency Monopole Mode for Stoneley	OFF	
SAM4	DSST Sonic Acquisition Mode 4 - High Frequency Monopole Mode for P&S	EVEN	
SAM5	DSST Sonic Acquisition Mode 5 - High Frequency Monopole Mode for FMD	ODD	
SAMX	DSST Sonic Acquisition Mode X - Both Dipoles or Monopole Mode for Expert	BCR	
SAS1	STC Sonic Array Status - Lower Dipole	255	
SAS2	STC Sonic Array Status - Upper Dipole	255	
SAS3	STC Sonic Array Status - Monopole Stoneley	255	
SAS4	STC Sonic Array Status - Monopole P&S	255	
SAS5	Sonic Array Status - FMD	255	
SBO1	STC Search Band Offset - Lower Dipole	3000	US
SBO2	STC Search Band Offset - Upper Dipole	3000	US
SBO3	STC Search Band Offset - Monopole Stoneley	3000	US
SBO4	STC Search Band Offset - Monopole P&S	500	US
SBR4	STC Baseline Removal - Monopole P&S	ON	
SBW1	STC Search Bandwidth - Lower Dipole	8000	US
SBW2	STC Search Bandwidth - Upper Dipole	8000	US
SBW3	STC Search Bandwidth - Monopole Stoneley	8000	US
SBW4	STC Search Bandwidth - Monopole P&S	2000	US
SDAT	Standoff Data Source	SOCN	
SEXP_HILT	HILT Saturation Exponent	2	
SFC1	STC Formation Character - Lower Dipole	SELECTABLE	
SFC2	STC Formation Character - Upper Dipole	SELECTABLE	
SFC3	STC Formation Character - Monopole Stoneley	SELECTABLE	
SFC4	STC Formation Character - Monopole P&S	SELECTABLE	
SFM1	STC Filter - Lower Dipole	B1-3K	
SFM2	STC Filter - Upper Dipole	B1-3K	
SFM3	STC Filter - Monopole Stoneley	B.5-1.5K	
SFM4	STC Filter - Monopole P&S	B3-20K	
SGRC	HNGS Standard Gamma-Ray Correction Flag	YES	
SHLL	Label Slowness Lower Limit - Monopole P&S Shear	75	US/F
SHT	Surface Hole Temperature	20	DEGC
SHUL	Label Slowness Upper Limit - Monopole P&S Shear	180	US/F
SLL1	STC Slowness Lower Limit - Lower Dipole	75	US/F
SLL2	STC Slowness Lower Limit - Upper Dipole	75	US/F
SLL3	STC Slowness Lower Limit - Monopole Stoneley	180	US/F
SLL4	STC Slowness Lower Limit - Monopole P&S	40	US/F

SOCN	Standoff Distance	0.125	IN
SOCO	Standoff Correction Option	NO	
SPFS	Sonic Porosity Formula	RAYMER_HUNT	
SPNV	SP Next Value	0	MV
SPSO	Sonic Porosity Source	DTCO	
SST1	STC Slowness Step - Lower Dipole	4	US/F
SST2	STC Slowness Step - Upper Dipole	4	US/F
SST3	STC Slowness Step - Monopole Stoneley	4	US/F
SST4	STC Slowness Step - Monopole P&S	2	US/F
SSW1	STC Source Waveform - Lower Dipole	WF_SAM1	
SSW2	STC Source Waveform - Upper Dipole	WF_SAM2	
SSW4	STC Source Waveform - Monopole P&S	WF_SAM4	
STLL	Label Slowness Lower Limit - Monopole Stoneley	180	US/F
STUL	Label Slowness Upper Limit - Monopole Stoneley	780	US/F
SUL1	STC Slowness Upper Limit - Lower Dipole	475	US/F
SUL2	STC Slowness Upper Limit - Upper Dipole	475	US/F
SUL3	STC Slowness Upper Limit - Monopole Stoneley	780	US/F
SUL4	STC Slowness Upper Limit - Monopole P&S	240	US/F
SWD1	STC Slowness Width - Lower Dipole	40	US/F
SWD2	STC Slowness Width - Upper Dipole	40	US/F
SWD3	STC Slowness Width - Monopole Stoneley	40	US/F
SWD4	STC Slowness Width - Monopole P&S	10	US/F
TBF1	STC Time for Baseline Fill - Lower Dipole	0	US
TBF2	STC Time for Baseline Fill - Upper Dipole	0	US
TBF3	STC Time for Baseline Fill - Monopole Stoneley	0	US
TBF4	STC Time for Baseline Fill - Monopole P&S	300	US
TD	Total Depth	2156	M
TDD	Total Depth - Driller	2156.00	M
TDL	Total Depth - Logger	2155.00	M
TEMS	GPIT Temperature Sensor Used	BOTH	
TLL1	STC Time Lower Limit - Lower Dipole	600	US
TLL2	STC Time Lower Limit - Upper Dipole	600	US
TLL3	STC Time Lower Limit - Monopole Stoneley	600	US
TLL4	STC Time Lower Limit - Monopole P&S	150	US
TPOS	Tool Position	ECCE	
TST1	STC Time Step - Lower Dipole	200	US
TST2	STC Time Step - Upper Dipole	200	US
TST3	STC Time Step - Monopole Stoneley	200	US
TST4	STC Time Step - Monopole P&S	50	US
TUL1	STC Time Upper Limit - Lower Dipole	12462.5	US
TUL2	STC Time Upper Limit - Upper Dipole	12225	US
TUL3	STC Time Upper Limit - Monopole Stoneley	12000	US
TUL4	STC Time Upper Limit - Monopole P&S	3660	US
TWD1	STC Time Width - Lower Dipole	2000	US
TWD2	STC Time Width - Upper Dipole	2000	US
TWD3	STC Time Width - Monopole Stoneley	2000	US
TWD4	STC Time Width - Monopole P&S	1000	US
TWI1	STC Integration Time Window - Lower Dipole	1600	US
TWI2	STC Integration Time Window - Upper Dipole	1600	US
TWI3	STC Integration Time Window - Monopole Stoneley	2400	US
TWI4	STC Integration Time Window - Monopole P&S	500	US
TWRX	Transmitter Waveform Sample Rate X	5	US
TWS	Temperature of Connate Water Sample	37.78	DEGC
TWSX	Transmitter Waveform Select X	0	
UTXG	Upper Dipole Transmitter Geometry	162	IN
VBA1	HNGS Detector 1 Variable Barite Factor Running Average	0.92799	
VBA2	HNGS Detector 2 Variable Barite Factor Running Average	0.949717	
WFDTSP1	SAM1 Waveform Delta for Spectrum	0	US/F
WFDTSP2	SAM2 Waveform Delta for Spectrum	0	US/F
WFDTSP3	SAM3 Waveform Delta for Spectrum	0	US/F
WFDTSP4	SAM4 Waveform Delta for Spectrum	0	US/F
WFDTSPX	SAMX Waveform Delta for Spectrum	0	US/F
WFLLSP1	SAM1 Waveform Lower Limit for Spectrum	0	US
WFLLSP2	SAM2 Waveform Lower Limit for Spectrum	0	US
WFLLSP3	SAM3 Waveform Lower Limit for Spectrum	0	US
WFLLSP4	SAM4 Waveform Lower Limit for Spectrum	0	US
WFLLSPX	SAMX Waveform Lower Limit for Spectrum	0	US
WFM1	Waveform Mode 1	W1	
WFM2	Waveform Mode 2	W1	
WFM3	Waveform Mode 3	W1	
WFM4	Waveform Mode 4	W1	
WFM5	Waveform Mode 5	W1	
WFMX	Waveform Mode X	W1	
WFULSP1	SAM1 Waveform Upper Limit for Spectrum	20000	US
WFULSP2	SAM2 Waveform Upper Limit for Spectrum	20000	US
WFULSP3	SAM3 Waveform Upper Limit for Spectrum	20000	US
WFULSP4	SAM4 Waveform Upper Limit for Spectrum	5000	US
WFULSPX	SAMX Waveform Upper Limit for Spectrum	20000	US

Format: COM_200_NUC Vertical Scale: 1:200 Graphics File Created: 10-Oct-2001 05:40

OP System Version: 9C2-303

MCM

SPE-AA	9C2-303	GPIT-A/B	9C2-303
DTA-A	OP92-KP2	DSST-B	OP92-KP2
HILTB-FTB	OP92-KP2	NPLC-B	OP92-KP2
HNGS-BA	OP92-KP2	DTC-A	OP92-KP2

Input DLIS Files

DEFAULT	DSI_TLD_MCFL_CNL_022LUP	FN:31	PRODUCER	09-Oct-2001 04:07	2160.3 M	1780.2 M

Output DLIS Files

DEFAULT	DSI_TLD_MCFL_CNL_063PUP	FN:92	PRODUCER	10-Oct-2001 05:40

COMPANY: Woodside Energy Ltd.

WELL: GEOGRAPHE NORTH-1

FIELD: EXPLORATION

RIG: Ocean Bounty **COUNTRY:** AUSTRALIA

Schlumberger

CSI-GR SEISMIC SURVEY CHECKSHOTS

RIG: Ocean Bounty
Field: EXPLORATION
Location: OTWAY BASIN
Well: GEOGRAPHE NORTH-1
Company: Woodside Energy Ltd.

LOCATION

OTWAY BASIN
EASTING: 665736.2 M
NORTHING: 5672832.2 M

Elev.: R.T. 25 m
G.L. 82 m

Permanent Datum: LAT — Elev.: 0 m
Log Measured From: R.T. — 25.0 m above Perm. Datum
Drilling Measured From: R.T.

STATE:	Max. Well Deviation	Longitude	Latitude
VICTORIA	1.95 deg	142 54' 57.647" E	39 04' 39.928" S

Logging Date		9-Oct-2001			
Run Number		1B			
Depth Driller		2156 m			
Schlumberger Depth		2155 m			
Bottom Log Interval		2153 m			
Top Log Interval		800 m			
Casing Driller Size @ Depth		9.625 in @ 1784 m		@	
Casing Schlumberger		1787.5 m			
Bit Size		8.500 in			
Type Fluid In Hole		KCl-PHPA-GLYCOL			
MUD Density	Viscosity	1.16 g/cm3	54 s		
MUD Fluid Loss	PH	4 cm3	9.5		
MUD Source Of Sample		FLOWLINE			
RM @ Measured Temperature		0.113 ohm.m @ 22 degC		@	
RMF @ Measured Temperature		0.100 ohm.m @ 22 degC		@	
RMC @ Measured Temperature		0.200 ohm.m @ 22 degC		@	
Source RMF	RMC	PRESSED	PRESSED		
RM @ MRT	RMF @ MRT	0.043 @ 93	0.038 @ 93	@	@
Maximum Recorded Temperatures		93 degC	93 / 93		
Circulation Stopped	Time	8-Oct-2001	17:00		
Logger On Bottom	Time	9-Oct-2001	14:20		
Unit Number	Location	25	VEA-APG		
Recorded By		F. Marcano / M. Van Steene			
Witnessed By		M. Bilek / G. Weste			

OTHER SERVICES1
OS1: SP-HRLA-DSI-PEX-HNGS
OS2: CST-GR
OS3:
OS4:
OS5:

REMARKS: RUN NUMBER 1
1. Log correlated to SP-HRLA-DSI-PEX-HNGS log dated 9-Oct-01.
2. Bottom hole temperature 93 degC at 14:00 on 9-Oct-01.
3. Circulation started 16:15 on 8-Oct-01, stopped at 17:00 on 08-Oct-01.
4. Well sketch shows driller's depth.
5. Tools run as per tool sketch.
6. Gun offset = 45 m, gun azimuth = 115 degc, gun depth = 30 mRT.
7. Hydrophone at 5 m below guns.
8. 3 x 150 cu in. compressed air guns operating at 1900 psi used for acquisition

Thank you for using Schlumberger

Mud Properties:
Barite conc = 1.55%, Chloride conc. = 42000 mg/l, Potassium conc. = 30569 mg/l
Water content = 89 %, Solids content = 8 %, Corr. Solids content = 5.71 %
Glycol conc. = 3 %, Calcium conc. = 280 mg/l

RUN 1			RUN 2		
SERVICE ORDER #:			SERVICE ORDER #:		
PROGRAM VERSION:	9C2-303		PROGRAM VERSION:		
FLUID LEVEL:	0 m		FLUID LEVEL:		
LOGGED INTERVAL	START	STOP	LOGGED INTERVAL	START	STOP

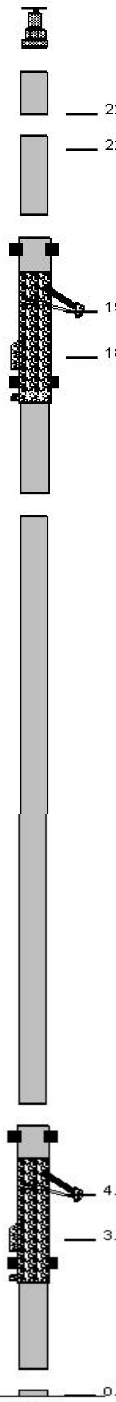
EQUIPMENT DESCRIPTION

RUN 1	RUN 2

SURFACE EQUIPMENT

WSAM
GSR-U/Y
WITM (CTS)-A

DOWNHOLE EQUIPMENT

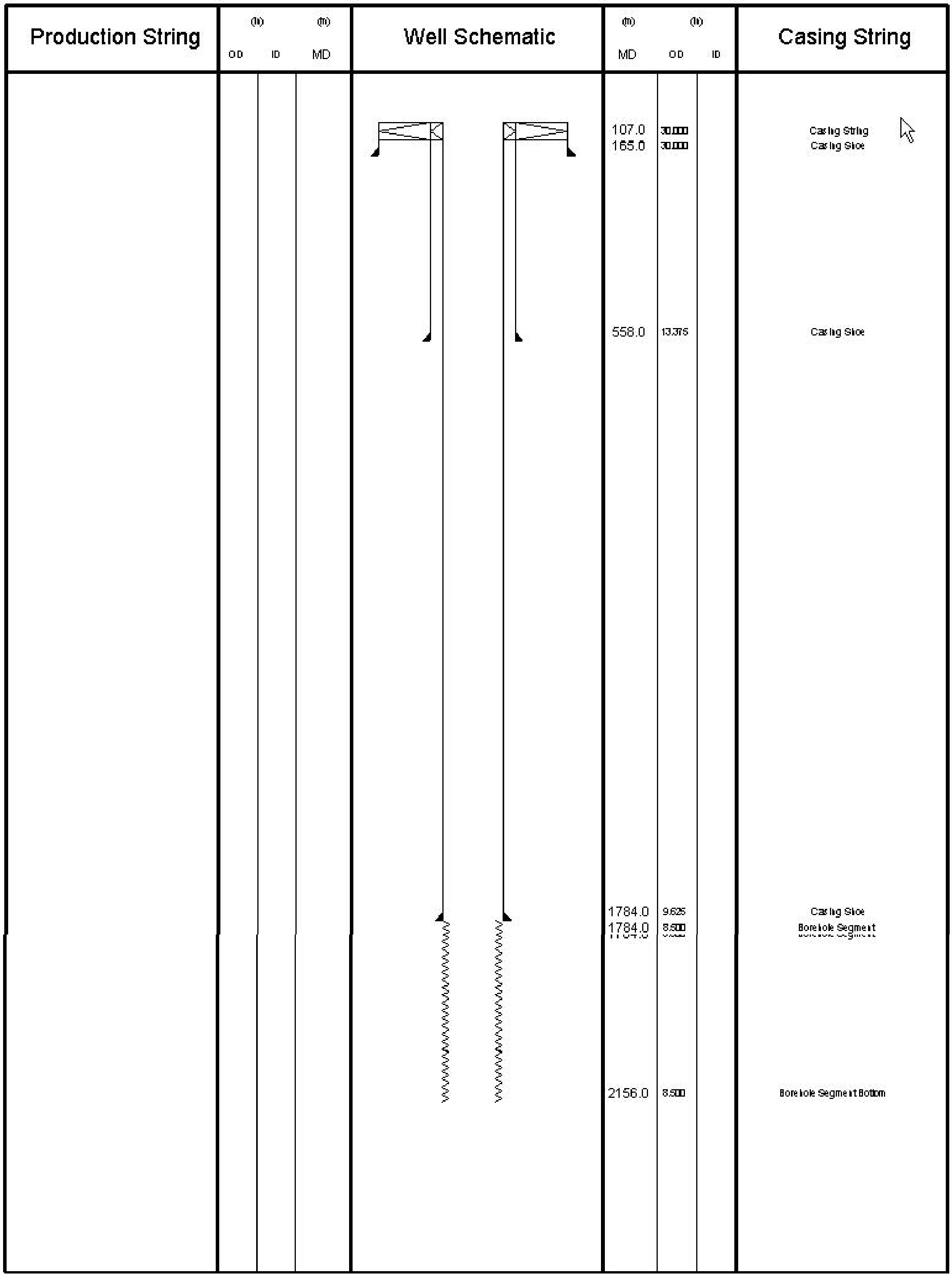


Tool	Components	Sensor	Sensor offset	Length
LEH-QT	LEH-QT 1519			24.50
TCC-BF	ECH-KC 299, TCC-BF 258	TelStatus	22.70	23.61
SGT-L	SGH-K 1510, SGC-SA 1191, SGD-TAA 4152	Gamma Ray	22.42	22.70
CSAT-B2	CSSH, CSSC-A 715, CSAS-A 709, Shaker, CSAH-A 767, CSAC-A 715, STAND-LO, STAND-HI, CSAD-B 709	CSAT-2 Ar; CSAT-2 Su	19.45; 18.46	21.02
AH-spacer	AH-spacer			15.56
CSAT-B1	CSSH, CSSC-A 757, CSAS-A 758, Shaker, CSAH-A 764, CSAC-A 757, STAND-LO, STAND-HI, CSAD-B 725	CSAT-1 Ar; CSAT-1 Su	4.03; 3.04	5.59
BNS-CCS		DF Tension HV	0.00	0.14

TOOL ZERO

MAXIMUM STRING DIAMETER 4.63 IN
MEASUREMENTS RELATIVE TO TOOL ZERO
ALL LENGTHS IN METERS

Geographe North-1



COMPANY: Woodside Energy Ltd.
WELL: GEOGRAPHE NORTH-1
FIELD: EXPLORATION
RIG: Ocean Bounty COUNTRY: AUSTRALIA

Schlumberger

CST-GR
SIDE WALL CORES

RIG:	Ocean Bounty
Field:	EXPLORATION
Location:	OTWAY BASIN
Well:	GEOGRAPHE NORTH-1
Company:	Woodside Energy Ltd.

LOCATION

OTWAY BASIN
EASTING: 665736.2 M
NORTHING: 5672832.2 M

Elev.: R.T. 25 m
G.L. 82 m

Permanent Datum:	LAT	Elev.:	0 m
Log Measured From:	R.T.	25.0 m above Perm. Datum	
Drilling Measured From:	R.T.		

STATE: VICTORIA	Max. Well Deviation 1.95 deg	Longitude 142 54' 57.647" E	Latitude 39 04' 39.928" S

Logging Date		9-Oct-2001				
Run Number		1C				
Depth Driller		2156 m				
Schlumberger Depth		2155 m				
Bottom Log Interval		2126 m				
Top Log Interval		1794 m				
Casing Driller Size @ Depth		9.625 in	@ 1784 m		@	
Casing Schlumberger		1787.5 m				
Bit Size		8.500 in				
Type Fluid In Hole		KCl-PHPA-GLYCOL				
MUD Density	Viscosity	1.16 g/cm3	54 s			
Fluid Loss	PH	4 cm3	9.5			
Source Of Sample		FLOWLINE				
RM @ Measured Temperature		0.113 ohm.m	@ 22 degC		@	
RMF @ Measured Temperature		0.100 ohm.m	@ 22 degC		@	
RMC @ Measured Temperature		0.200 ohm.m	@ 22 degC		@	
Source RMF	RMC	PRESSED	PRESSED			
RM @ MRT	RMF @ MRT	0.043 @ 93	0.038 @ 93	@		@
Maximum Recorded Temperatures						
Circulation Stopped	Time	8-Oct-2001	17:00			
Logger On Bottom	Time	9-Oct-2001	23:20			
Unit Number	Location	25	VEA-APG			
Recorded By		F. Marcano / M. Van Steene				
Witnessed By		M. Bilek / G. Weste				

OTHER SERVICES1	OTHER SERVICES2
OS1: SP-HRLA-DSI-PEX-HNGS	OS1:
OS2: CSI-GR	OS2:
OS3:	OS3:
OS4:	OS4:
OS5:	OS5:
REMARKS: RUN NUMBER 1	REMARKS: RUN NUMBER 2
1. Log correlated to SP-HRLA-DSI-PEX-HNGS log dated 9-Oct-01.	
2. Temperatures not available on this run. Thermometer broke during sampling.	
3. Circulation started 16:15 on 8-Oct-01, stopped at 17:00 on 08-Oct-01.	
4. Well sketch shows driller's depth.	
5. Tools run as per tool sketch.	
6. All bullets used were type new combo 42 mm.	
7. Sampling not shot on the run.	
8. Sample #14 missfired.	
9. CST-D type of gun were used.	
Thank you for using Schlumberger	
Mud Properties:	
Barite conc = 1.55%, Chloride conc. = 42000 ppm, Potassium conc. = 30569 ppm	
Water content = 89 %, Solids content = 8 %, Corr. Solids content = 5.71 %	
Glycol conc. = 3 %, Calcium conc. = 280 mg/l	

RUN 1			RUN 2		
SERVICE ORDER #:			SERVICE ORDER #:		
PROGRAM VERSION:	9C2-303		PROGRAM VERSION:		
FLUID LEVEL:	0 m		FLUID LEVEL:		
LOGGED INTERVAL	START	STOP	LOGGED INTERVAL	START	STOP

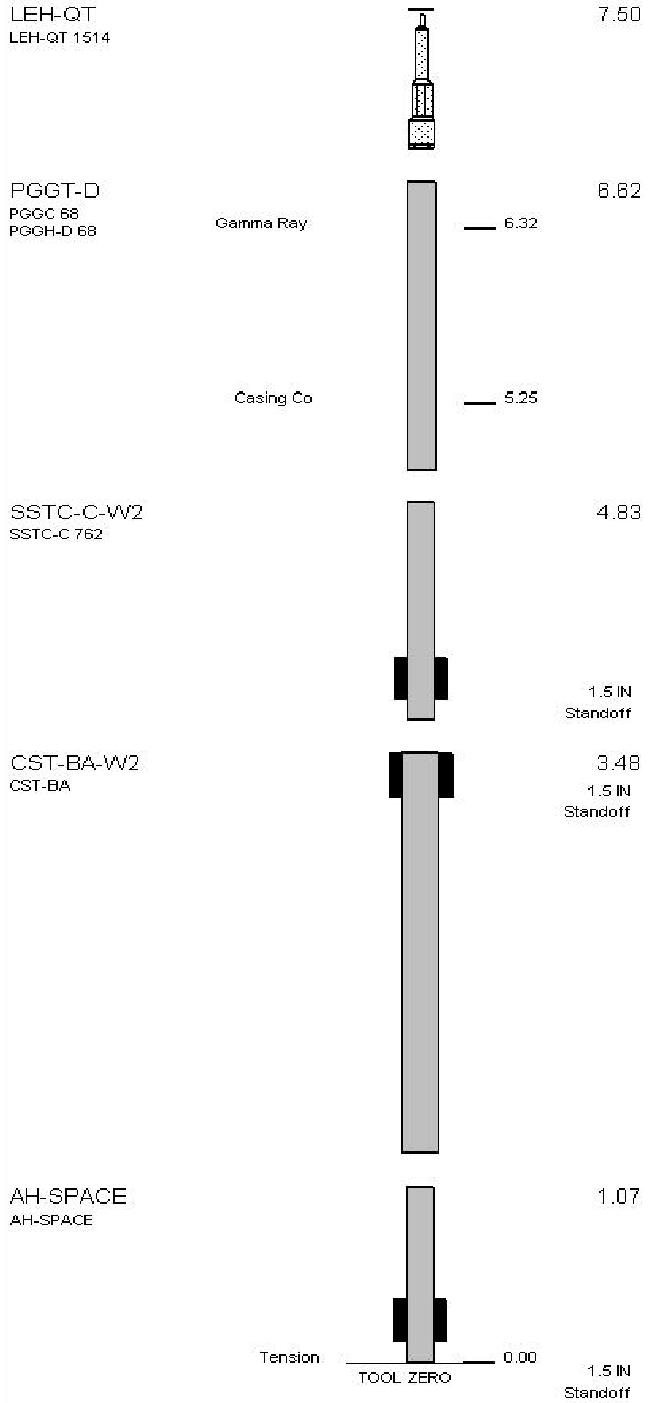
EQUIPMENT DESCRIPTION

RUN 1	RUN 2

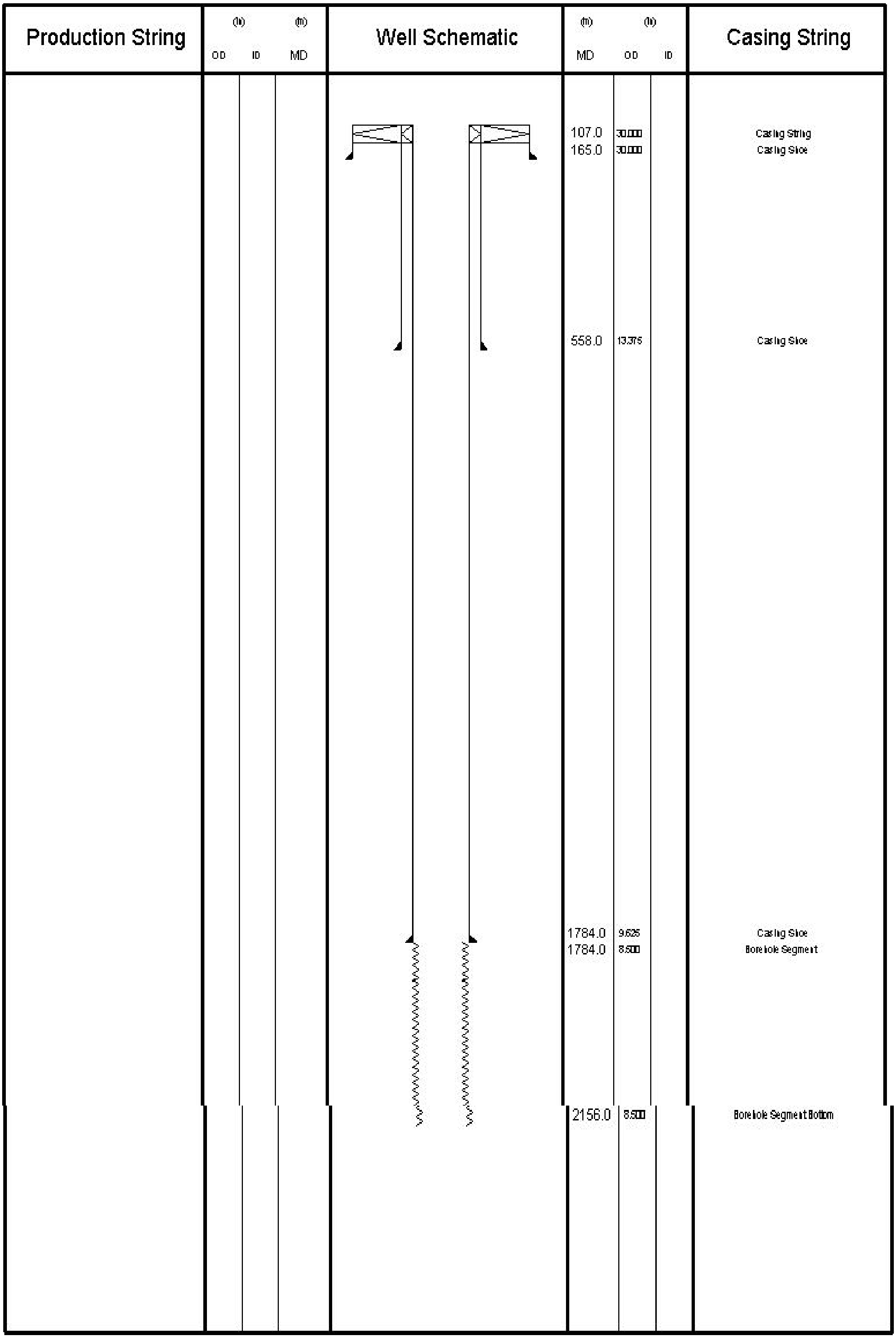
SURFACE EQUIPMENT

SSTM-E

DOWNHOLE EQUIPMENT



MAXIMUM STRING DIAMETER 7.50 IN
MEASUREMENTS RELATIVE TO TOOL ZERO
ALL LENGTHS IN METERS


Production String
(in) (m)
OD ID MD
Well Schematic
(m) (in)
MD OD ID
Casing String
107.0 30.000 Casing String
165.0 30.000 Casing Shoe
558.0 13.375 Casing Shoe
1784.0 9.625 Casing Shoe
1784.0 8.500 Borehole Segment
2156.0 8.500 Borehole Segment Bottom

Schlumberger

Sidewall Core Summary

Date	Engineer	Company	Field	Well	Rig	Run
9-Oct-2001	F. Marcano / M. Van Steene	Woodside Energy Ltd.	EXPLORATION	GEOGRAPHE NOR	Ocean Bounty	1C

Correlation Tools
AH-SPACE SSTC-C-W2 PGGT-D LEH

Page 1 of 1

Bullet No.	Sample Depth (M)	Req. Depth (M)	Status	Bullet Type	Powder Load (G)
1	2126.0	2126.0	Recovered	Combo	8.0
2	2114.6	2114.5	Recovered	Combo	8.0
3	2103.0	2103.0	Recovered	Combo	10.0
4	2101.0	2101.0	Recovered	Combo	10.0
5	2083.0	2083.0	Recovered	Combo	10.0
6	2050.0	2050.0	Recovered	Combo	10.0
7	2046.0	2046.0	Recovered	Combo	8.0
8	2023.9	2024.0	Recovered	Combo	8.0
9	2021.5	2021.5	Recovered	Combo	8.0
10	1998.0	1998.0	Recovered	Combo	8.0
11	1992.9	1993.0	Recovered	Combo	8.0
12	1982.5	1982.5	Recovered	Combo	10.0
13	1970.1	1970.0	Recovered	Combo	8.0
14	1964.0	1964.0	Missfired	Combo	10.0
15	1957.0	1957.0	Recovered	Combo	8.0
16	1942.9	1943.0	Recovered	Combo	8.0
17	1932.9	1933.0	Recovered	Combo	8.0
18	1919.0	1919.0	Recovered	Combo	8.0
19	1906.5	1906.5	Recovered	Combo	8.0
20	1890.5	1890.5	Recovered	Combo	8.0
21	1877.6	1877.5	Recovered	Combo	8.0
22	1869.9	1870.0	Recovered	Combo	8.0
23	1866.8	1866.8	Recovered	Combo	8.0
24	1864.1	1864.0	Recovered	Combo	8.0
25	1861.7	1861.8	Recovered	Combo	8.0
26	1854.9	1855.0	Recovered	Combo	8.0
27	1842.5	1842.5	Recovered	Combo	8.0
28	1821.5	1821.5	Recovered	Combo	8.0
29	1799.0	1799.0	Recovered	Combo	8.0
30	1794.0	1794.0	Recovered	Combo	8.0

% Recovered	Number Recovered	Number Empty	Number Lost	Number Misfired
96	29	0	0	0

Number Attempted
30

Format: CORRELATION Vertical Scale: 1:200 Graphics File Created: 09-Oct-2001 23:05

OP System Version: 9C2-303

MCM

CST-BA-W2	OP92-KP2	SSTC-C-W2	OP92-KP2
PGGT-D	9C2-303		

Output DLIS Files

DEFAULT ST_051LUP FN:80 PRODUCER 09-Oct-2001 23:05

COMPANY:	Woodside Energy Ltd.	BOTTOM LOG INTERVAL	2126 m
		SCHLUMBERGER DEPTH	2155 m
WELL:	GEOGRAPHE NORTH-1	DEPTH DRILLER	2156 m
FIELD:	EXPLORATION	ROTARY TABLE	25 m
RIG:	Ocean Bounty		
COUNTRY:	AUSTRALIA	GROUND LEVEL	82 m

Schlumberger

CST-GR
SIDE WALL CORES

Appendix – D
Petrophysical Model and Constant Report

```
Company          : Origin Energy
Well Name        : GEOGRAPHE NORTH-1
Field            : GEOGRAPHE
Country          : Australia
State            : Tasmania
Field Location   : Otway Basin
Latitude         : 039 04' 39.928" S    DMS
Longitude        : 142 54' 57.647" E    DMS
Permanent Datum  : LAT
Elevation of PD  :        .00 M

Hole depth M     Temperature C     Gradient Deg C / 100 M
    2155.0           90.00          2.9389
        .0           26.67

Log data
Column     Logs       Logs
Position   Available  Used
    1      DEPT       DEPT
    2      GRCC       GR
    3      GR
    4      BS
    5      CS
    6      TENS
    7      HDAR
    8      HAZI
    9      P1AZ
   10      RB
   11      SDEV       DEVI
   12      DF
   13      CVEL
   14      QCBS
   15      QCMC
   16      QCPO
   17      SPDC       SP
   18      SP
   19      SPAR
   20      RSP
   21      HCAL       CALI
   22      ECGR
   23      HTHO       THOR
   24      HURA       URAN
   25      HFK        POTA
   26      HSGR
   27      HCGR
   28      HTPR
   29      HTUR
   30      HUPR
   31      RGR
   32      HBHK
   33      EHGR
   34      HGR
   35      RHGR
   36      RESD
   37      RESS
   38      RESX
   39      RT_H       ERT
   40      RXO_       MSFL
   41      RM_H
   42      DI_H
   43      MODE
   44      NITE
   45      RLA5       LLD
   46      RLA4       LLS
   47      RLA3
   48      RLA2
   49      RLA1
   50      RLA0
   51      RXOI
   52      RXOZ
   53      RSOZ
   54      RXO8
   55      RSO8
   56      HMIN
   57      HMNO
   58      RHO8       RHOB
   59      DSO8
   60      RHOZ
   61      DSOZ
   62      HDRA       DRHO
   63      PEF8       PEF
   64      PEFZ
   65      HPRA
   66      NPHI       NPHI
   67      TNPH
```

68	NPOR	
69	HTNP	
70	HNPO	
71	TNRA	
72	CFTC	
73	CNTC	
74	HCFT	
75	HCNT	
76	DTCO	DT
77	DTSM	DTS
78	DT2	
79	DT4P	
80	DT4S	
81	DT5	
82	PR	
83	VPVS	
84	DTRP	
85	DTRS	
86	DTTP	
87	DTTS	
88	SVEL	
89	SSVE	
90	DTCO	
91	DTCO	
92	DTSM	
93	DTSM	
94	ROPA	
95	TGAS	
96	WOBA	
97	RPMA	
98	MFIA	
99	TQA	
100	TQX	
101	MDIA	
102	MDOA	
103	MTIA	
104	MTOA	
105	BDDI	
106	BDTI	
107	DXC	
108	CO2	
109	HSA	
110	METH	
111	ETH	
112	PRP	
113	IBUT	
114	NBUT	
115	IPEN	
116	NPEN	
117	C5	
118	C4	
119	GWR	
120	LHR	
121	CH	
122	FLAG	FLAG
123	Kair	
124	Kgas	
125	Kwat	
126	log(	
127	Rt-R	
128	NET	
129	NET	
130	NET	

```
Caliper recorded in : Inches
Mud weight units    : g/cc
Density log units   : g/cc
DRHO    log units   : g/cc
Sonic   log units   : Us/ft
Neutron log units   : LS POR
Density tool type   : LDT
RHO (H,MA,f)  units : g/cc
Dens. X-plots units : g/cc
GRV units           : Mbbl
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Log scaling data

Log Mnemonic	Scaling Option	Coeff. A	Coeff. B
PEF	1	-.50000	1.00000

Mineral table

Zone no.	1	2	3	4	5	6	7	8	9	10
Formation Name	BelfastM	Thylacin	Flaxmans	Flaxmans	Flaxmans	Flaxmans	UpperWaa	UpperWaa	UpperWaa	UpperWaa
Top depth M	1820.012	1848.620	1867.870	1867.870	1867.870	1867.870	1986.410	1986.410	1986.410	1986.410
Bottom depth M	1848.620	1867.870	1986.410	1986.410	1986.410	1986.410	2128.012	2128.012	2128.012	2128.012
USER Log type	RHO8	RHO8	RHO8	RHO8	RHO8	RHO8	RHO8	RHO8	RHO8	RHO8
Coal RHOB min	-INF	-INF	-INF	-INF	-INF	-INF	-INF	-INF	-INF	-INF
Coal RHOB max	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Coal PHIN min	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500
Coal PHIN max	+INF	+INF	+INF	+INF	+INF	+INF	+INF	+INF	+INF	+INF
Coal GR min	-INF	-INF	-INF	-INF	-INF	-INF	-INF	-INF	-INF	-INF
Coal GR max	+INF	+INF	+INF	+INF	+INF	+INF	+INF	+INF	+INF	+INF

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     Coal   t    min     100.000   100.000   100.000   100.000   100.000   100.000   100.000   100.000   100.000   100.000
     Coal   t    max        +INF      +INF      +INF      +INF      +INF      +INF      +INF      +INF      +INF      +INF
     Coal   RT   min      20.000    20.000    20.000    20.000    20.000    20.000    20.000    20.000    20.000    20.000
     Coal   RT   max        +INF      +INF      +INF      +INF      +INF      +INF      +INF      +INF      +INF      +INF
     Coal   USER min        .000      .000      .000      .000      .000      .000      .000      .000      .000      .000
     Coal   USER max       2.000     2.000     2.000     2.000     2.000     2.000     2.000     2.000     2.000     2.000

Lithology models
   1.   Sand-Dolomite              2.64 to     2.89
   2.   Sand-Limestone             2.64 to     2.75
   3.   Sand                       2.64 to     2.69
   4.   Limestone                  2.67 to     2.75
   5.   Dolomite                   2.75 to     2.89
   6.   Limestone-Dolomite         2.68 to     2.89

CPX flag values
   1.  VCL greater than 0.95
   2.  VN  greater than 0.75
   3.  VS  greater than 0.75
   4.  Bad hole condition
   5.  Matrix density greater than Lithological model
   6.  Matrix density less than Lithological model
   7.  Porosity derived from Sonic Log
   8.  Porosity derived from or limited by PHIMAX
   9.  Porosity derived from Density Log
   $.  Pay zone

Water saturation equations
   1.  Indonesia
   2.  Simandoux
   3.  Fertl & Hammock
   4.  Laminar
   5.  Bussian
   6.  Charlebois
   7.  Single Sonic

VGRTYPE :Vclay from GR Equations used
   0.  Not Used
                          IGR=(GR-GRmin)/(GRmax-GRmin)
   1.  Linear             VGR=IGR
   2.  Asymmetric (S shaped)
           Defined by 2 sets of intermediate points
           through which the S bend passes through.
           GR1, VGR1 and GR2, VGR2.
       Steiber equation:  VGR= IGR/(A + (A-1.0)*IGR)
   3.  Steiber 1  A = 2.0
   4.  Steiber 2  A = 3.0
   5.  Steiber 3  A = 4.0
   6.  Steiber 50%
        A is computed to give VGR= 0.5 when GR = GR50%)
   7.  Larinov Old Rocks: VGR= (2**(2*IGR)-1.0)/3.0
   8.  Larinov Tertiary : VGR= 0.083*(2.0*(3.7058*IGR)-1.0)
   9.  Clavier          : VGR= 1.7-SQRT(3.38-(IGR+0.7)**2.0)

Cementation factor m
   1.  Linear       m = m
   2.  Shell formula m = 1.87 + 0.019/PHI
   3.  Borai formula m = 2.2 -0.035/(PHI+0.042)

              GEOGRAPHE NORTH-1                 Complex Lithology Results
              Origin Energy                     11-02-2004
                               Neutron           RT Determination
Logging Company   Mud type     log type          Flags by priority
0. Schlumberger   0. NaCl      0. CNL CORR       23. ERT (external RT)
1. HLS            1. KCl %     1. TNPH            1. Dual Laterolog - RXO
2. Dresser        2. Oil-base  2. SNP            20. PHASOR-SFL
3. BPB/Reeves     3. Barite    3. N              21. PHASOR-RXO
4. Sperry MWD                  4. HLS DSN2        2. Dual Induction - LL8
5. Baker MWD                   5. CNL PRE 86      3. ILD-SFL-RXO
6. Anadril MWD                 6. APLU           10. DIL-SFL
7. Computalog                  7. FPLU           11. DIL-LL3
8. Probe                       8. CDN 6.5"        8. ILD & 16 inch Normal
9. Tucker                      9. CDN 8.0"       17. LLD-LLS
Formation                     10. ADN 6.75       18. ID PHASOR
Water                         11. ATLAS 2435 CN   4. ILD
0=NaCl                        12. ATLAS 2420 CN   5. LLD
1=NaHCO3                      13. ATLAS SNP       6. LL3 or LL7
                              14. BPB/Reeves      7. Dual Laterolog
                              15. HLS G          13. LLS
                              16. Tucker_SNP     19. IM PHASOR
                              17. Tucker_CNL     14. ILM
                                                 15. LL8
                                                  9. 64 inch Normal Log
                                                 12. SFL
                                                 22. N16
                                                 16. RXO
                                                  0. No RT logs

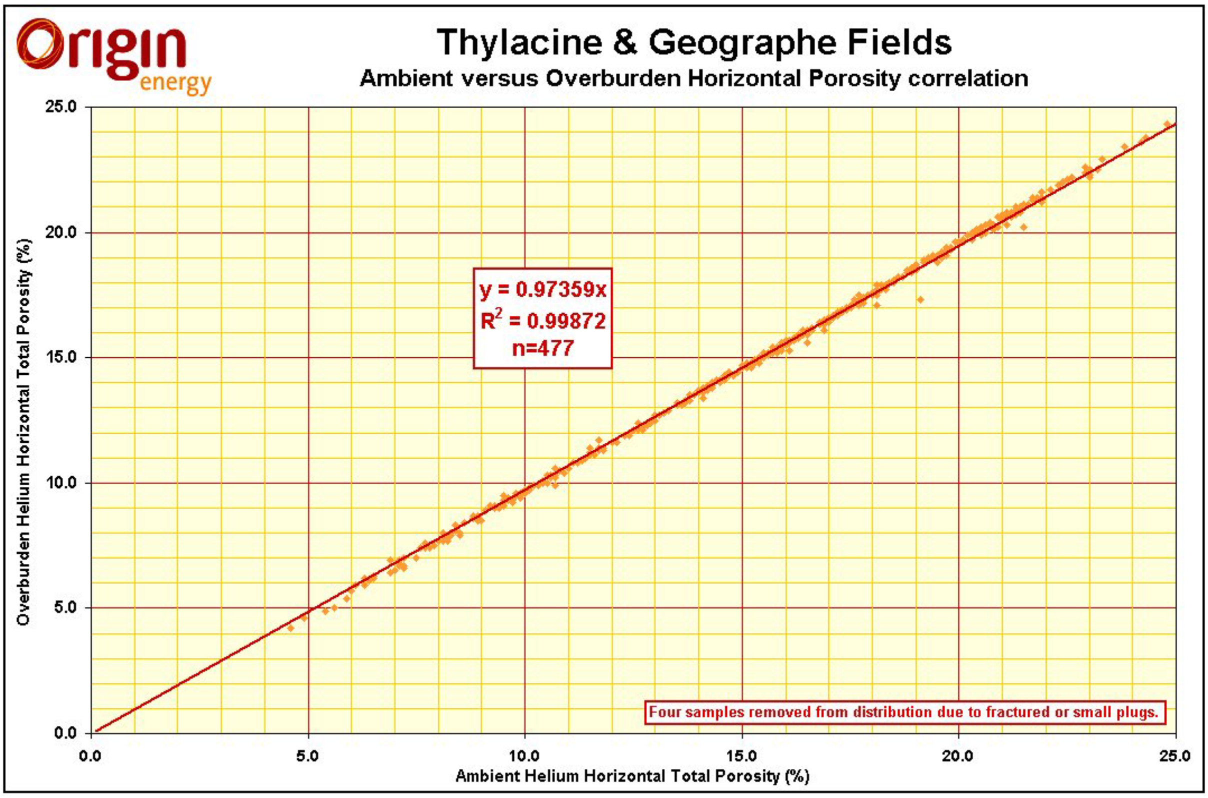
        Zone no.           1         2         3         4         5         6         7         8         9        10
  Formation Name      BelfastM  Thylacin  Flaxmans  Flaxmans  Flaxmans  Flaxmans  UpperWaa  UpperWaa  UpperWaa  UpperWaa
  Top depth    M      1820.012  1848.620  1867.870  1867.870  1867.870  1867.870  1986.410  1986.410  1986.410  1986.410
  Bottom depth M      1848.620  1867.870  1986.410  1986.410  1986.410  1986.410  2128.012  2128.012  2128.012  2128.012
  Logging Company            0         0         0         0         0         0         0         0         0         0
```

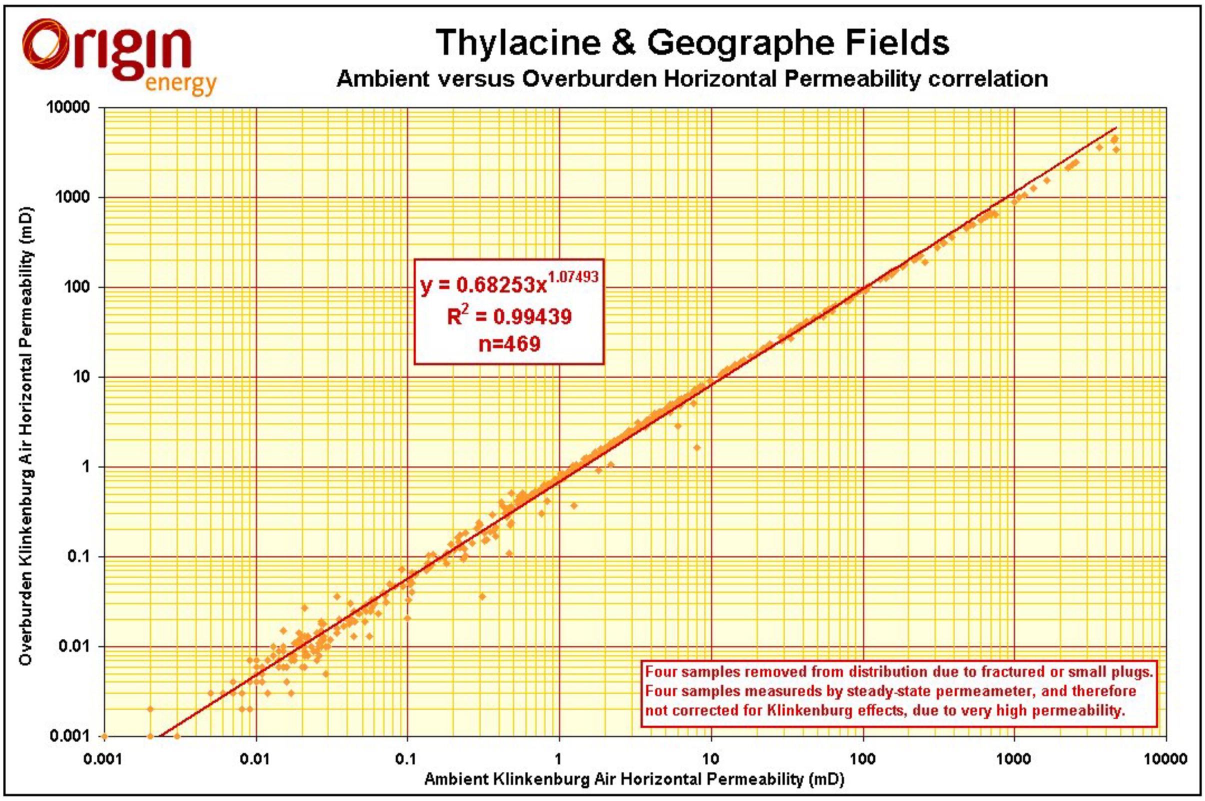
Mud type	4	4	4	4	4	4	4	4	4	4
Formation Water Type	0	0	0	0	0	0	0	0	0	0
Neutron Log Type	0	0	0	0	0	0	0	0	0	0

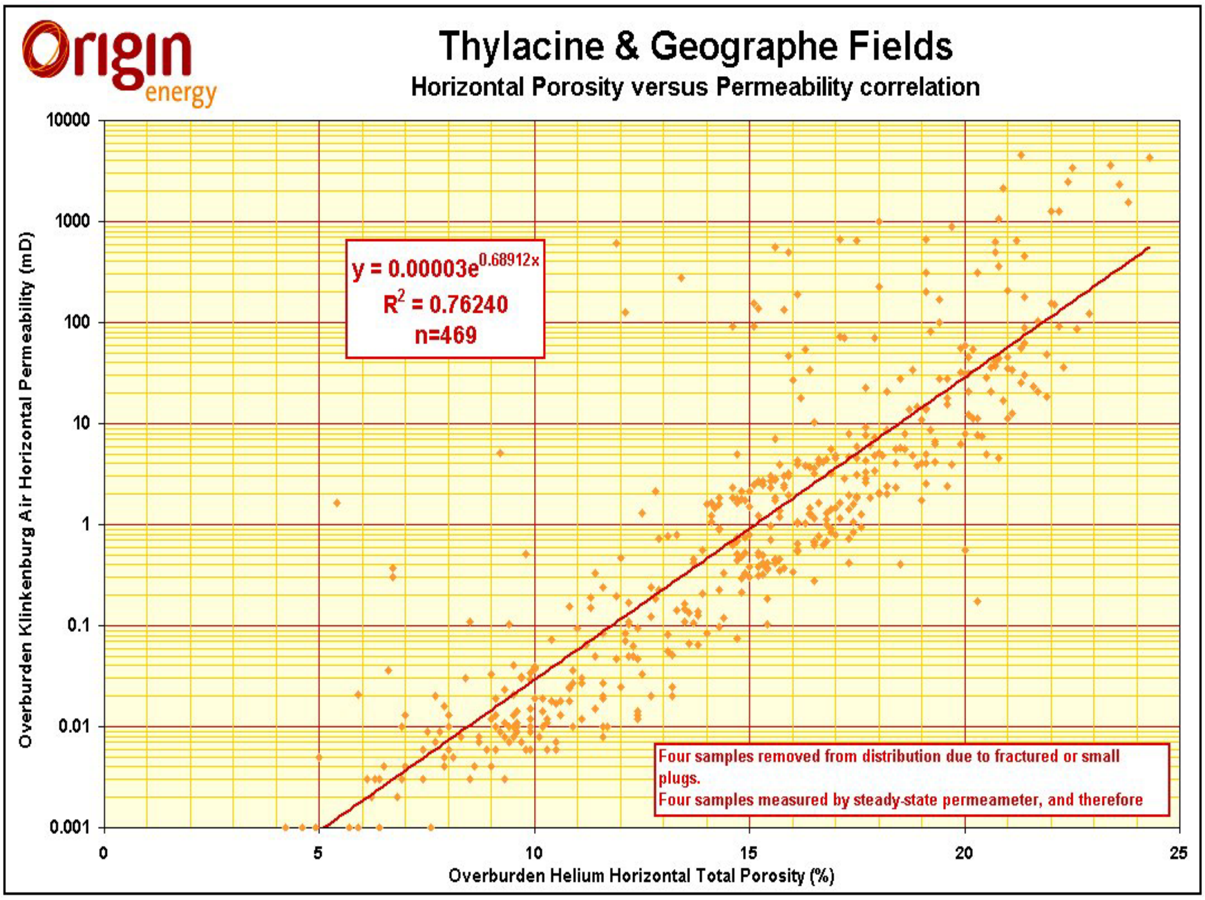
Zone no.	1	2	3	4	5	6	7	8	9	10
Formation	BelfastM	Thylacin	Flaxmans	Flaxmans	Flaxmans	Flaxmans	UpperWaa	UpperWaa	UpperWaa	UpperWaa
1. Top depth	1820.012	1848.620	1867.870	1867.870	1867.870	1867.870	1986.410	1986.410	1986.410	1986.410
2. Bottom depth	1848.620	1867.870	1986.410	1986.410	1986.410	1986.410	2128.012	2128.012	2128.012	2128.012
3. No logs										
4. No logs	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
5. RM	.113	.113	.113	.113	.113	.113	.113	.113	.113	.113
6. Temp. RM	22.000	22.000	22.000	22.000	22.000	22.000	22.000	22.000	22.000	22.000
7. RMF	.100	.100	.100	.100	.100	.100	.100	.100	.100	.100
8. Temp. RMF	22.000	22.000	22.000	22.000	22.000	22.000	22.000	22.000	22.000	22.000
9. RMC	.200	.200	.200	.200	.200	.200	.200	.200	.200	.200
10. Temp. RMC	22.000	22.000	22.000	22.000	22.000	22.000	22.000	22.000	22.000	22.000
11. Bit size	8.500	8.500	8.500	8.500	8.500	8.500	8.500	8.500	8.500	8.500
12. Mud wt	1.160	1.160	1.160	1.160	1.160	1.160	1.160	1.160	1.160	1.160
13. SSP	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
14. RW (SP)	.0426374	.0423458	.0415280	.0415280	.0415280	.0415280	.0400671	.0400671	.0400671	.0400671
15. Temperature	80.575	81.279	83.303	83.303	83.303	83.303	87.126	87.126	87.126	87.126
16. RW @ FT	.136	.135	.133	.133	.133	.133	.128	.128	.128	.128
17. RW@75F(23.9C	.306	.306	.306	.306	.306	.306	.306	.306	.306	.306
18. RW salinity	20000.000	20000.000	20000.000	20000.000	20000.000	20000.000	20000.000	20000.000	20000.000	20000.000
19. RMF @ FT	.0426374	.0423458	.0415280	.0415280	.0415280	.0415280	.0400671	.0400671	.0400671	.0400671
20. RMF salinity	.0748804	.0748804	.0748804	.0748804	.0748804	.0748804	.0748804	.0748804	.0748804	.0748804
21. RM @ FT	.0481803	.0478507	.0469266	.0469266	.0469266	.0469266	.0452758	.0452758	.0452758	.0452758
22. RHO H	.510	.510	.510	.510	.510	.510	.510	.510	.510	.510
23. Gas Flag	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
24. RHO F	1.042	1.041	1.041	1.041	1.041	1.041	1.040	1.040	1.040	1.040
25. t F	188.980	188.980	188.980	188.980	188.980	188.980	188.980	188.980	188.980	188.980
26. RHOMA	2.670	2.670	2.670	2.670	2.670	2.670	2.670	2.670	2.670	2.670
27. PHIN min	-.0350000	-.0350000	-.0350000	-.0350000	-.0350000	-.0350000	-.0350000	-.0350000	-.0350000	-.0350000
28. t MA	55.500	55.500	55.500	55.500	55.500	55.500	55.500	55.500	55.500	55.500
29. t MA min	48.000	48.000	48.000	48.000	48.000	48.000	48.000	48.000	48.000	48.000
30. Sonic option	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
31. Compact/Ovrt	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
32. CAL cut off	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000
33. RUGO.cut off	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
34. DRHO cut off	.150	.150	.150	.150	.150	.150	.150	.150	.150	.150
35. Bad Hole	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
36. No clay	SP	SP	SP	SP	SP	SP	SP	SP	SP	SP
	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
	N	N	N	N	N	N	N	N	N	N
	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN
	SN	SN	SN	SN	SN	SN	SN	SN	SN	SN
37. Vclay Flag	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
38. Vclay type	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
39. Vclay inp1	.200	.200	.200	.200	.200	.200	.200	.200	.200	.200
40. Vclay out1	.150	.150	.150	.150	.150	.150	.150	.150	.150	.150
41. Vclay inp2	.800	.800	.800	.800	.800	.800	.800	.800	.800	.800
42. Vclay out2	.800	.800	.800	.800	.800	.800	.800	.800	.800	.800
43. Vclay 50%	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500
44. VclayGR type	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
45. GR clean	10.000	10.000	10.000	10.165	10.000	10.000	10.000	9.076	10.000	10.000
46. GR clay	102.460	140.031	139.896	140.211	140.211	139.621	140.211	140.211	140.211	140.170
47. GR1	36.000	36.000	36.000	36.000	36.000	36.000	36.000	36.000	36.000	36.000
48. VGR1	.100	.100	.100	.100	.100	.100	.100	.100	.100	.100
49. GR2	81.000	84.000	84.000	84.000	84.000	84.000	84.000	84.000	84.000	84.000
50. VGR2	.800	.800	.800	.800	.800	.800	.800	.800	.800	.800
51. GR50%	70.000	70.000	70.000	70.000	70.000	70.000	70.000	70.000	70.000	70.000
52. R clay	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000
53. R limit	1000.000	1000.000	1000.000	1000.000	1000.000	1000.000	1000.000	1000.000	1000.000	1000.000
54. Rclay1 flag	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
55. Rclay1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
56. Vcl @ Rclay1	.150	.150	.150	.150	.150	.150	.150	.150	.150	.150
57. RHOB sand	2.150	2.150	2.150	2.150	2.150	2.150	2.150	2.150	2.150	2.150
58. RHOB silt	2.620	2.620	2.620	2.620	2.620	2.620	2.620	2.620	2.620	2.620
59. RHOB clay	2.540	2.540	2.540	2.540	2.540	2.540	2.540	2.540	2.540	2.540
60. RHO Dry Clay	2.700	2.700	2.700	2.700	2.700	2.700	2.700	2.700	2.700	2.700
61. Rhob Calcite	2.850	2.850	2.850	2.850	2.850	2.850	2.850	2.850	2.850	2.850
62. PHIN Sand	.250	.250	.250	.250	.250	.250	.250	.250	.250	.250
63. PHIN silt	.0200000	.0200000	.0200000	.0200000	.0200000	.0200000	.0200000	.0200000	.0200000	.0200000
64. PHIN clay	.411	.400	.400	.400	.400	.400	.400	.400	.400	.400
65. Phin Calcite	.100	.100	.100	.100	.100	.100	.100	.100	.100	.100
66. PHISILT	.0307056	.0307029	.0306953	.0306953	.0306953	.0306953	.0306809	.0306809	.0306809	.0306809
67. Calcite Flag	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
68. t clay	96.000	96.000	96.000	96.000	96.000	96.000	96.000	96.000	96.000	96.000
69. M clay	.621	.620	.620	.620	.620	.620	.620	.620	.620	.620
70. N clay	.393	.400	.400	.400	.400	.400	.400	.400	.400	.400
71. PHIN 2.2	.235	.213	.213	.213	.213	.213	.213	.213	.213	.213
72. t 2.2	90.000	90.000	85.900	85.900	85.900	85.900	85.900	85.900	85.900	85.900
73. a	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
74. A1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
75. m	2.350	2.350	2.000	1.800	2.000	2.350	2.000	1.800	2.000	2.350
76. m1	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
77. m Function	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
78. n	2.150	2.150	2.000	1.750	1.950	2.150	2.000	1.750	1.950	2.150
79. n1	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
80. B from BQV	11.027	11.112	11.354	11.354	11.354	11.354	11.804	11.804	11.804	11.804
81. A(QV)	.0003050	.0003050	.0003050	.0003050	.0003050	.0003050	.0003050	.0003050	.0003050	.0003050
82. B(QV)	-3.450	-3.450	-3.450	-3.450	-3.450	-3.450	-3.450	-3.450	-3.450	-3.450
83. Lithomod	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

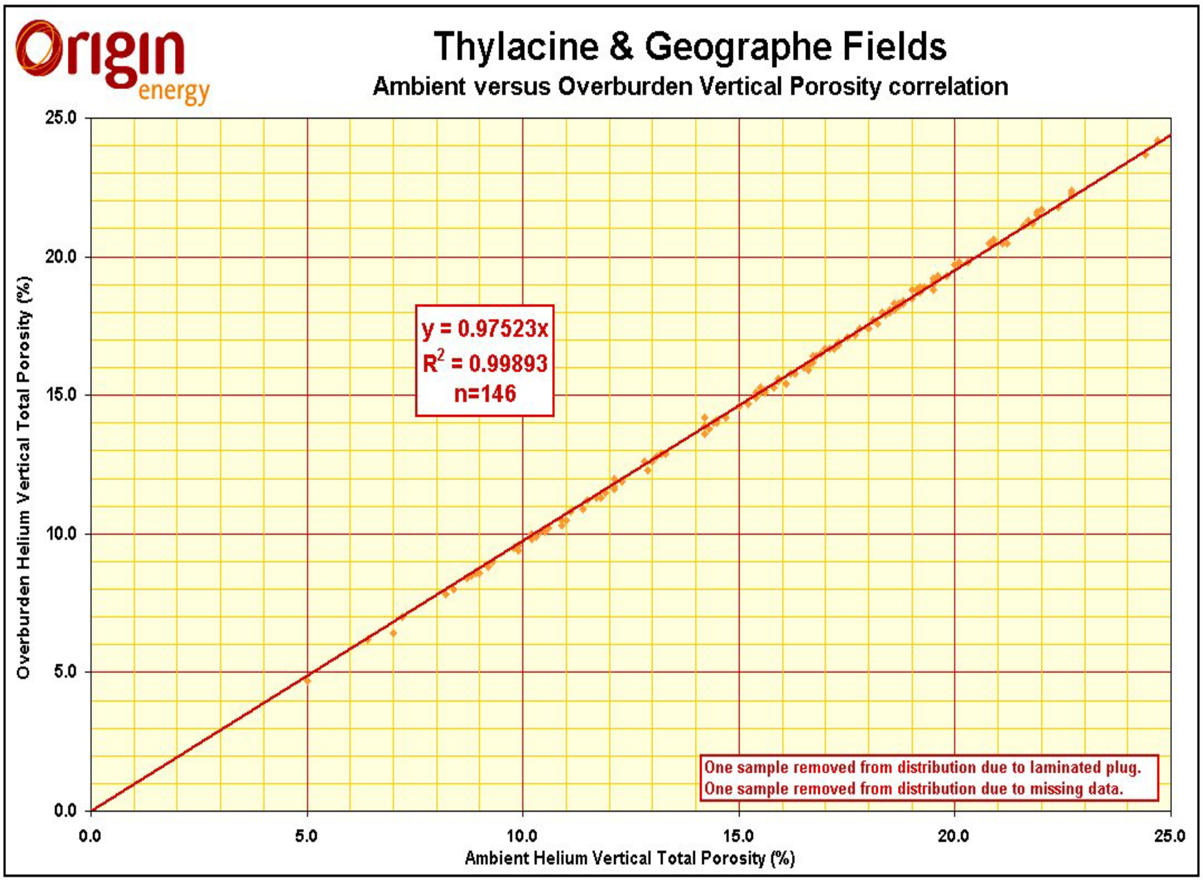
84. SXO limit	.200	.200	.200	.200	.200	.200	.200	.200	.200	.200
85. PHI max	.341	.310	.333	.333	.333	.333	.283	.283	.283	.283
86. PHI min c.o.	.0010000	.0010000	.0010000	.0010000	.0010000	.0010000	.0010000	.0010000	.0010000	.0010000
87. EXPX	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500
88. Pay Flag typ	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
89. Clay cut off	.400	.400	.400	.400	.400	.400	.400	.400	.400	.400
90. PHIe cut off	.0500000	.0500000	.0500000	.0500000	.0500000	.0500000	.0500000	.0500000	.0500000	.0500000
91. PHIt cut off	.100	.100	.100	.100	.100	.100	.100	.100	.100	.100
92. SWe cut off	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500
93. SWt cut off	.600	.600	.600	.600	.600	.600	.600	.600	.600	.600
94. GrossRockVol	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
95. Oil Exp.Fact	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200
96. FormGeom.Fac	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
97. RecoveryFact	.200	.200	.200	.200	.200	.200	.200	.200	.200	.200
98. SWB max	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
99. RWB	.203	.301	.349	.100	.100	.660	.100	.100	.100	.620
100. SWB cut off	.300	.300	.300	.300	.300	.300	.300	.300	.300	.300
101. RWF	.136	.135	.133	.133	.133	.133	.128	.128	.128	.128
102. RMFF	.0426374	.0423458	.0415280	.0415280	.0415280	.0415280	.0400671	.0400671	.0400671	.0400671
103. Sw Eq. CPX	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
104. Sw Eq. SSS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
105. Glauconite	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
106. SWirr.cutoff	.300	.300	.300	.300	.300	.300	.300	.300	.300	.300
107. Perm Expon.	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
108. PERM K coef	62500.000	62500.000	62500.000	62500.000	62500.000	62500.000	62500.000	62500.000	62500.000	62500.000
109. RHOMA 1	2.670	2.670	2.670	2.670	2.670	2.670	2.670	2.670	2.670	2.670
110. RHOMA 2	2.710	2.710	2.710	2.710	2.710	2.710	2.710	2.710	2.710	2.710
111. RHOMA 3	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200
112. UMA 1	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800
113. UMA 2	27.950	27.950	27.950	27.950	27.950	27.950	27.950	27.950	27.950	27.950
114. UMA 3	14.300	14.300	14.300	14.300	14.300	14.300	14.300	14.300	14.300	14.300
115. UF	.400	.400	.400	.400	.400	.400	.400	.400	.400	.400
116. UMACL	12.100	12.100	12.100	12.100	12.100	12.100	12.100	12.100	12.100	12.100
117. GR Dispersed	78.000	78.000	78.000	78.000	78.000	78.000	78.000	78.000	78.000	78.000
118. PHIT Dispers	.0570000	.0570000	.0570000	.0570000	.0570000	.0570000	.0570000	.0570000	.0570000	.0570000
119. PHIT Laminat	.107	.0650000	.0650000	.0650000	.0650000	.0650000	.0650000	.0650000	.0650000	.0650000
120. PHIT Sand	.248	.248	.248	.248	.248	.248	.248	.248	.248	.248
121. Vp/Vs Sand	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500
122. Vp/Vs LS	1.900	1.900	1.900	1.900	1.900	1.900	1.900	1.900	1.900	1.900
123. Vp/Vs DOL	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800
124. Vp/Vs VCL	1.700	1.700	1.700	1.700	1.700	1.700	1.700	1.700	1.700	1.700
125. Vp/Vs Salt	1.810	1.810	1.810	1.810	1.810	1.810	1.810	1.810	1.810	1.810
126. Vp/Vs Trona	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250
127. Vp/Vs Anhyd	1.840	1.840	1.840	1.840	1.840	1.840	1.840	1.840	1.840	1.840
128. Vp/Vs Gypsum	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450	2.450
129. Vp/Vs Coal	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
93. PHINmat1	.200	.200	.200	.200	.200	.200	.200	.200	.200	.200
94. PHIDmat1	.240	.240	.240	.240	.240	.240	.240	.240	.240	.240
95. PHINmat2	.350	.350	.350	.350	.350	.350	.350	.350	.350	.350
96. PHIDmat2	.200	.200	.200	.200	.200	.200	.200	.200	.200	.200
97. PHINmat3	.050	.050	.050	.050	.050	.050	.050	.050	.050	.050
98. PHIDmat3	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
99. PHINmat4	.200	.200	.200	.200	.200	.200	.200	.200	.200	.200
100. PHIDmat4	-.100	-.100	-.100	-.100	-.100	-.100	-.100	-.100	-.100	-.100

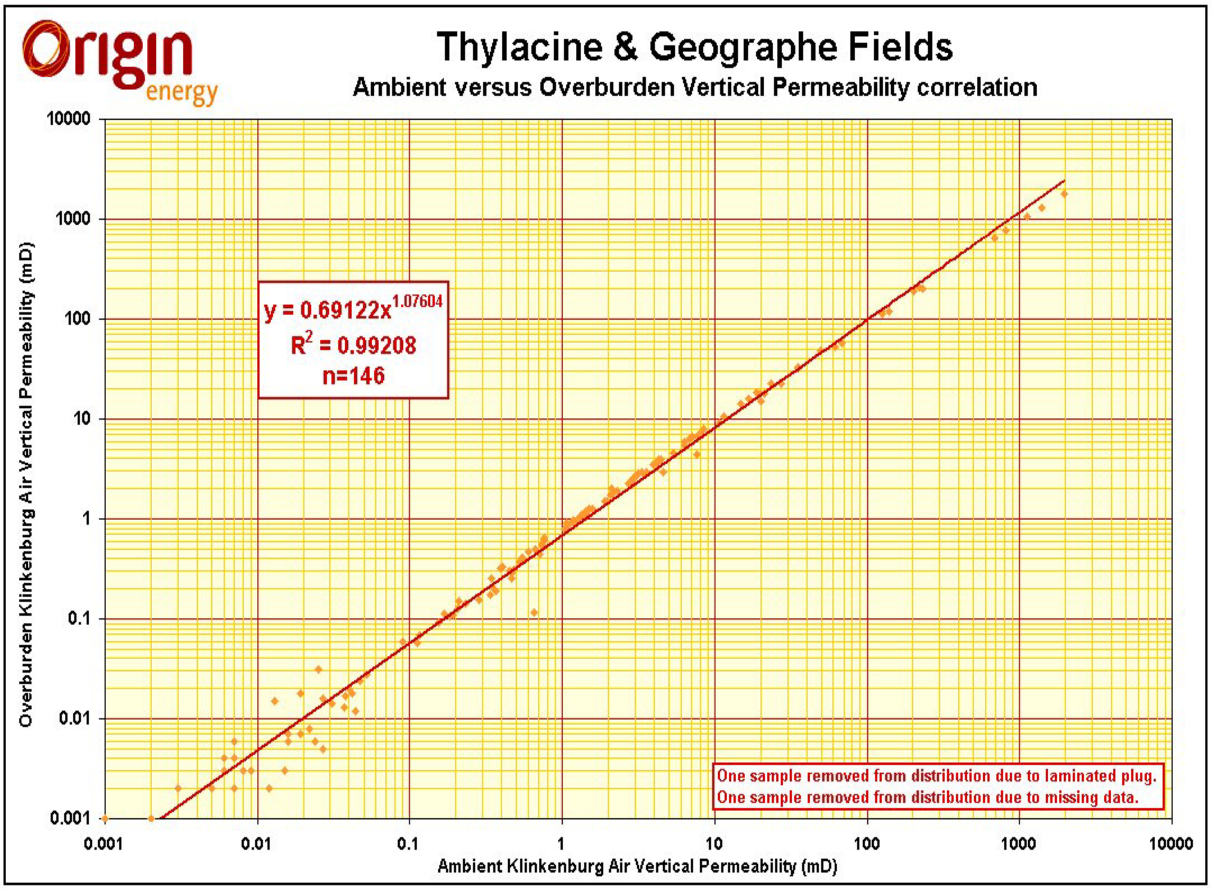
Appendix – E
Core Analysis Cross-plots

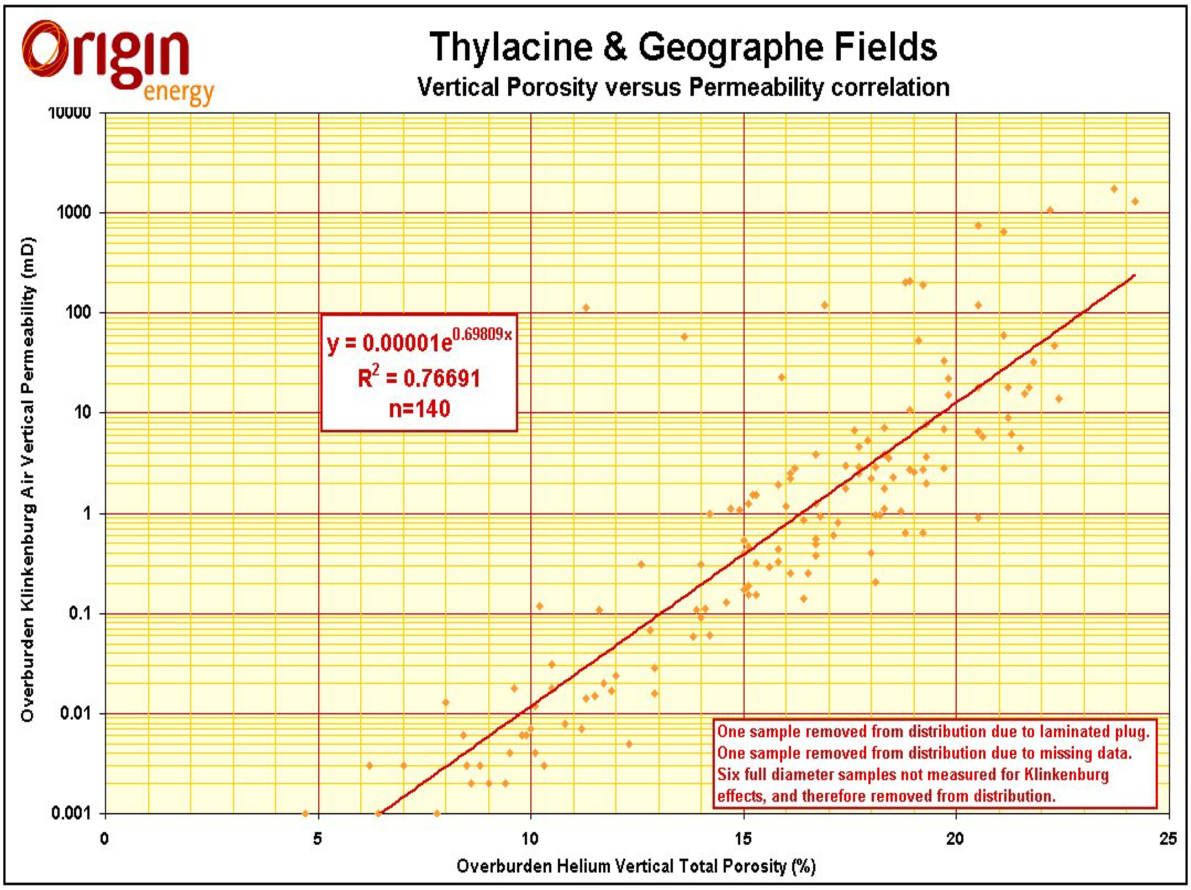


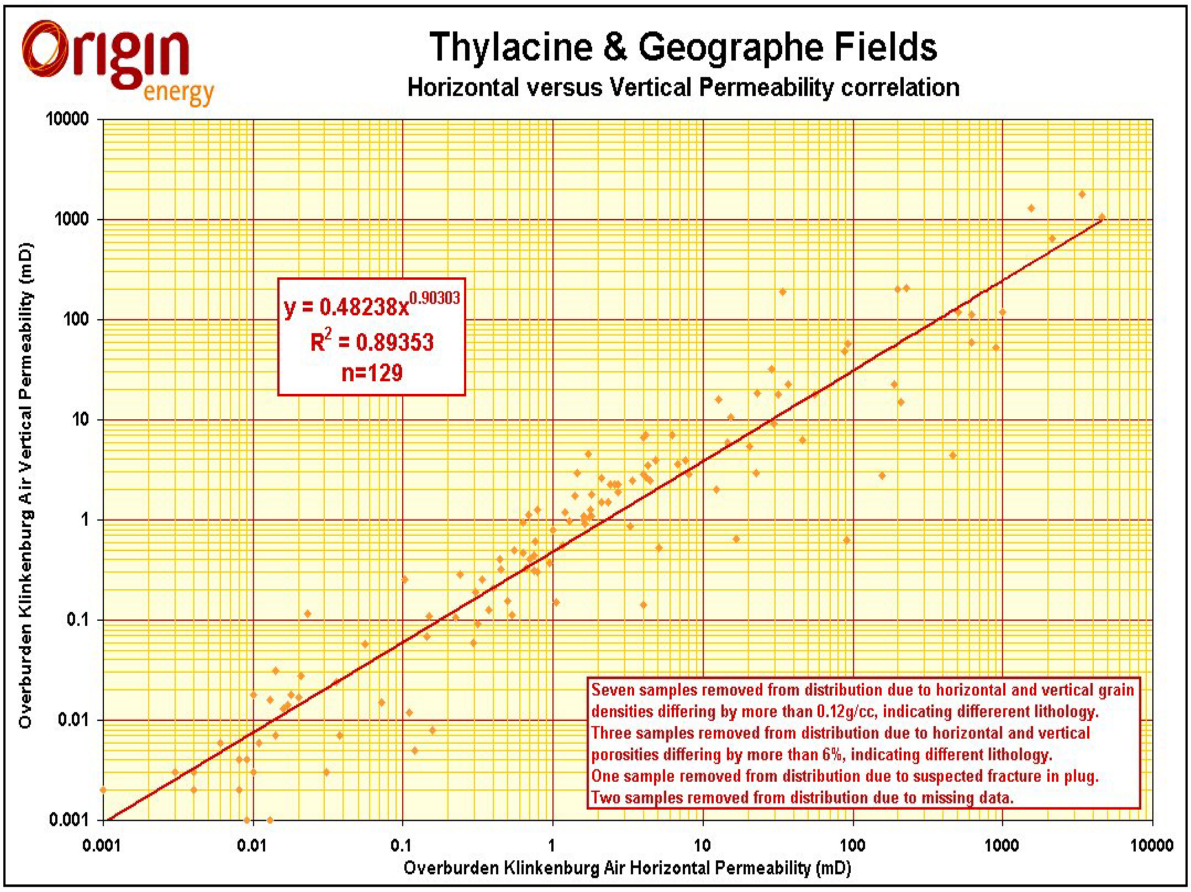



Origin energy
Thylacine & Geographe Fields
Horizontal Porosity versus Permeability correlation
y = 0.00003e^0.68912x
R^2 = 0.76240
n=469
Four samples removed from distribution due to fractured or small plugs.
Four samples measured by steady-state permeameter, and therefore
Overburden Klinkenburg Air Horizontal Permeability (mD)
Overburden Helium Horizontal Total Porosity (%)
10000
1000
100
10
1
0.1
0.01
0.001
0
5
10
15
20
25


Origin energy
Thylacine & Geographe Fields
Ambient versus Overburden Vertical Porosity correlation
y = 0.97523x
R^2 = 0.99893
n=146
One sample removed from distribution due to laminated plug.
One sample removed from distribution due to missing data.
Overburden Helium Vertical Total Porosity (%)
Ambient Helium Vertical Total Porosity (%)
25.0
20.0
15.0
10.0
5.0
0.0
0.0
5.0
10.0
15.0
20.0
25.0


Origin energy
Thylacine & Geographe Fields
Ambient versus Overburden Vertical Permeability correlation
y = 0.69122x^1.07604
R² = 0.99208
n=146
One sample removed from distribution due to laminated plug.
One sample removed from distribution due to missing data.
Overburden Klinkenburg Air Vertical Permeability (mD)
Ambient Klinkenburg Air Vertical Permeability (mD)
0.001
0.01
0.1
1
10
100
1000
10000


Origin energy
Thylacine & Geographe Fields
Vertical Porosity versus Permeability correlation
y = 0.00001e^0.69809x
R² = 0.76691
n=140
One sample removed from distribution due to laminated plug.
One sample removed from distribution due to missing data.
Six full diameter samples not measured for Klinkenburg effects, and therefore removed from distribution.
Overburden Klinkenburg Air Vertical Permeability (mD)
Overburden Helium Vertical Total Porosity (%)
0
5
10
15
20
25


Thylacine & Geographe Fields
Horizontal versus Vertical Permeability correlation
y = 0.48238x^0.90303
R^2 = 0.89353
n=129
Overburden Klinkenburg Air Vertical Permeability (mD)
Overburden Klinkenburg Air Horizontal Permeability (mD)
0.001
0.01
0.1
1
10
100
1000
10000
Seven samples removed from distribution due to horizontal and vertical grain densities differing by more than 0.12g/cc, indicating differerent lithology.
Three samples removed from distribution due to horizontal and vertical porosities differing by more than 6%, indicating different lithology.
One sample removed from distribution due to suspected fracture in plug.
Two samples removed from distribution due to missing data.

ENCLOSURE-1
Petrophysical and Composite Plot
1818-2132mMDRT (1:500)

Origin Energy

GEOGRAPHE NORTH-1

COMPOSITE AND PETROPHYSICAL SUMMARY

Company	Origin Energy
Well Name	GEOGRAPHE NORTH-1
Field	GEOGRAPHE
Country	Australia
Nation	Australia
State	Tasmania
County or Rig name	Ocean Bounty
Field Location	Otway Basin
Field Locn. Line 1	Easting: 665736.2 m
Field Locn. Line 2	Northing: 5672832.2 m
Latitude	039 04' 39.928" S DMS
Longitude	142 54' 57.647" E DMS
Permanent Datum	LAT
Elevation of PD	.00 M
Elevation of KB	25.00 M
Elevation Ground lv	107.00 M
Elevation Log Zero	25.00 M
Above Perm. Datum	7.62 M
Log measured from	RT
Drill measured from	RT
Services	PEx(HRLA)-DSI-HNGS-SP
Other Services Ln 1	CSI-GR
Other Services Ln 2	CST-GR
Other Services Ln 3	DGR-ARC5
Service company	Schlumberger
Number of runs	1
Well class	Appraisal
Basin	Otway
Tenement/Concession	T/30P
On-Shore Flag	Offshore
Log date	8-OCT-2001
Date computed	11-02-04
Date plotted	11-02-2004
Time plotted	10:37:31

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CROCKER
DATA PROCESSING

RUN INFORMATION

Run number	1
Log date	8-OCT-2001
Depth-Driller	2156.00 M
Depth-Logger	2155.00 M
Bottom log interval	2155.00 M
Top log interval	119.80 M
Casing-Driller	1784.00 M
Casing-Logger	1787.50 M
Casing Diameter	9.6250 inch
Casing Weight	47.0000 lb/ft
Casing Depth	1784.00 M
Bit Size	8.5000 inch
Hole Fluid type	KCl-PHPA-Glycol
Fluid Density	1.1600 gm/cc
Fluid Viscosity	54.0000 s
Fluid PH	9.500000
Fluid Loss	4.0000 C3
Mud Sample Source	Flowline
RM @ Surface	.1130 Ohmm
Mud temp Surface	22.00 degC
RMF @ Surface	.1000 Ohmm
MF temp Surface	22.00 degC
RMC @ Surface	.2000 Ohmm
MC Temp Surface	22.00 degC
Source of RMF/RMC	Pressed
Mud Sample Temp	90.00 degC
Mud Filt.SampleTemp	90.00 degC
MudCakeSample Sourc	Pressed
Time circ. stopped	17:00
Date circ. stopped	8-OCT-2001
Time logger at btm	04:10
Date logger at btm	9-OCT-2001
Surface hole temp	26.00 degC
Bottom hole temp	90.00 degC
Surface temperature	22.00 degC
Max recorded temp	90.00 degC
Logging unit No	25
Logging unit Loc	VEA-APG
Logging Company ID	440
Recorded by	F.Marcano/M.VanSte
Witness	M.Bilek / G.Weste
Program Version	9C2-303
Bore Hole Status	Open
Avg Angular Deviat	.0000000
General.Temp Select	TEMP
Maximum Hole Deviat	1.9400 deg
Total depth	2156.00 M
Temp Conn.WaterSamp	37.78 degC
Filtrate Cl	41,000 ppm
PV	17
YP	31
% Solids	8
% Sand	0.5

FIELD REMARKS

1. First run in hole. Schlumberger depth procedures observed.
2. Borehole correction applied to logs.
3. Limestone matrix-model used in computation of neutron porosity.
4. Bottom hole temperature degC at h on 9-Oct-01.
5. Data aquired in high resolution mode for the entire interval as per client request.
6. Well sketch show driller's depth.
7. Caliper check in casing reading in. ID expected 8.68 in.
8. Tools run as per tool sketch.
9. Circulation started 16:00 on 8-Oct-01, stopped at 17:00 on 08-Oct-01.

Thank you for using Schlumberger

Mud Properties:
Barite conc = 1.55%, Chloride conc. = 42000 ppm, Potassium conc. = 30569 ppm
Water content = 89 %, Solids content = 8 %, Corr. Solids content = 5.71 %
Glycol conc. = 3 %, Calcium conc. = 280 mg/l

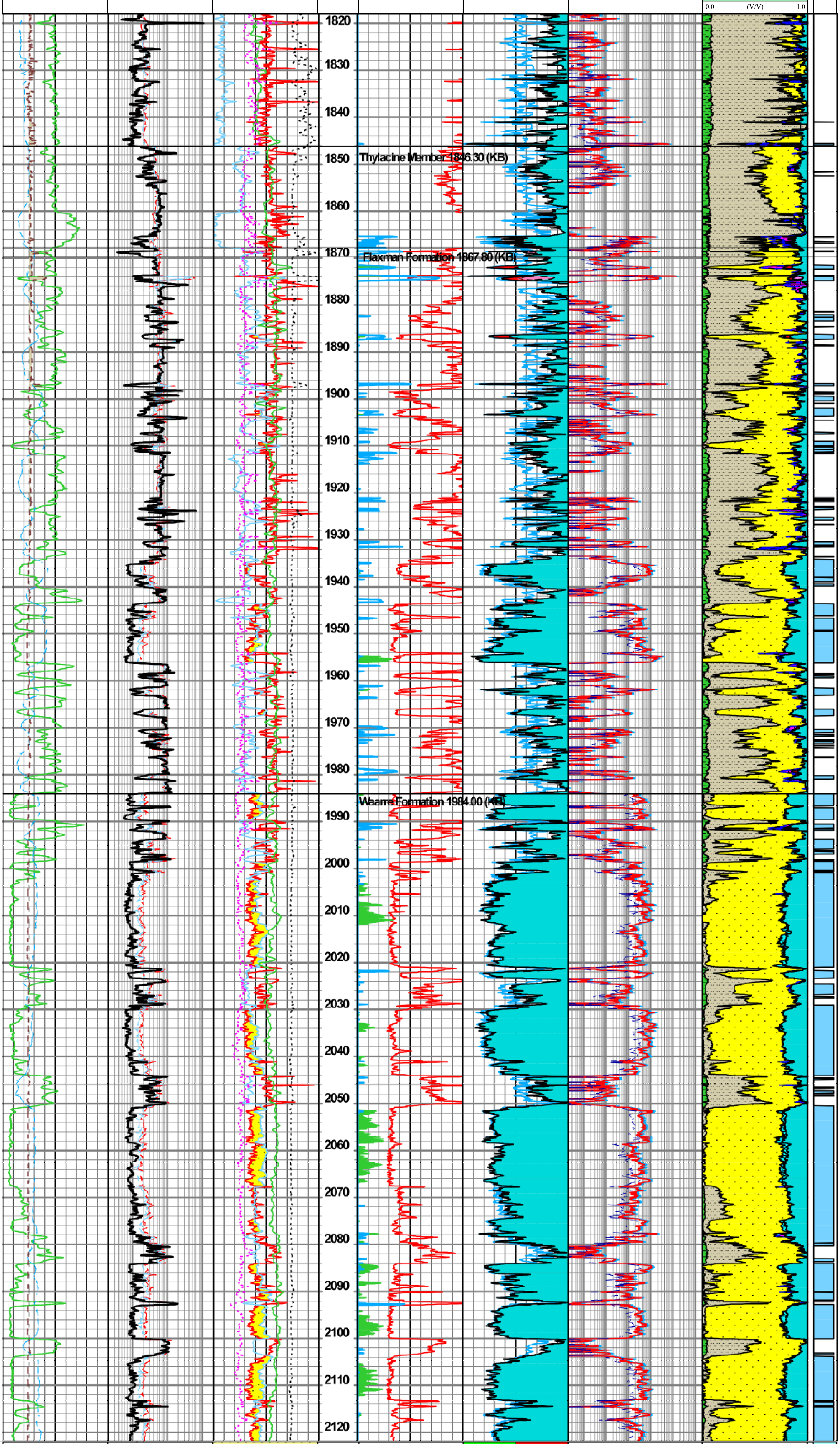
COMPUTATION PARAMETERS

DEPTH INTERVAL	RW PPM	RW OHMM	TEMP C	GR MIN	GR MAX	R CLAY	RHOB CLAY	PHIN CLAY	t CLAY	RHOH	a	m
1820.0 - 1848.6	20000	.136	80.6	10	102	17	2.54	.411	96	.51	1.00	2.35
1848.6 - 1867.9	20000	.135	81.3	10	140	17	2.54	.400	96	.51	1.00	2.35
1867.9 - 1986.4	20000	.133	83.3	10	140	17	2.54	.400	96	.51	1.00	2.00
1867.9 - 1986.4	20000	.133	83.3	10	140	17	2.54	.400	96	.51	1.00	1.80
1867.9 - 1986.4	20000	.133	83.3	10	140	17	2.54	.400	96	.51	1.00	2.00
1867.9 - 1986.4	20000	.133	83.3	10	140	17	2.54	.400	96	.51	1.00	2.35
1986.4 - 2128.0	20000	.128	87.1	10	140	17	2.54	.400	96	.51	1.00	2.00
1986.4 - 2128.0	20000	.128	87.1	9	140	17	2.54	.400	96	.51	1.00	1.80
1986.4 - 2128.0	20000	.128	87.1	10	140	17	2.54	.400	96	.51	1.00	2.00
1986.4 - 2128.0	20000	.128	87.1	10	140	17	2.54	.400	96	.51	1.00	2.35

LOG DESCRIPTION

ROMA-CPX	Apparent Matrix Density (Complex Litho Model)
SPI -CPX	Secondary Porosity Indicator = PHIT-PHIS >=0 (Complex Litho Model)
SW -CPX	Formation Water Saturation <=1.0 (Complex Litho Model)
PHIE-CPX	Effective Porosity (Complex Litho Model)
PHXO-CPX	Product (PHIE * SXO) (Complex Litho Model)
PHSW-CPX	Product (PHIE * SW) (Complex Litho Model)
MINERAL	Special Mineral Table output flag (Salt,Trona,Anhydrite,Gypsum,Coal)
VCL -CPX	Volume of clay (Complex Litho Model)
VSND-CPX	Volume of Sand (Complex Litho Model)
VLS -CPX	Volume of Limestone (Complex Litho Model)
VDOL-CPX	Volume of Dolomite (Complex Litho Model)
PHIE-CPX	Effective Porosity (Complex Litho Model)
PHXO-CPX	Product (PHIE * SXO) (Complex Litho Model)
PHSW-CPX	Product (PHIE * SW) (Complex Litho Model)
VBW -CPX	Volume of bound water (Complex Litho Model)
GRCC	Gamma-Ray - casing corrected
SPDC	SP Drift corrected
BS	Bit Size
HCAL	HRCC Cal. Caliper
RHO8	HRDD High Resolution Formation Density
NPHI	Thermal Neutron Porosity (Ratio Method)
DTCO	Delta-T Compressional
PEF8	HRDD High Resolution Formation Photoelectric Factor
HDRA	HRDD Density Correction
PHIT-CPX	Total porosity from CPX model after hydrocarbon correction (Complex Litho Model)
RT_HRLT	HRLT Computed True Resistivity
RLA3	HRLT Borehole Corrected Resistivity 3
RXO_HRLT	HRLT Computed Invaded Zone Resistivity
NET -RES	
Kair_log	Air Permeability - log derived
Kgas_log	Gas Permeability - log derived
Kwat_log	Water Permeability - log derived

GAMMA RAY 0.0 (API) 200.0; SP -10.0 (MV) 90.0; BITSIZE 6.0 (INCH) 16.0; CALIPER 6.0 (INCH) 16.0
RT_HRLT 0.2 (OHMM) 2000.0; RLA3 0.2 (OHMM) 2000.0; RXO_HRLT 0.2 (OHMM) 2000.0
DENSITY 1.95 (G/CC) 2.95; COMP. NEUTRON 0.45 (PU) -0.15; COMP. SONIC 140.0 (US/F) 40.0; P.E. ABSORPTION 0.0 (B/E) 10.0; DELTA rHO -0.75 (G/CC) 0.25
DEPTH M 1:500
RHOMA 2.5 (G/CC) 3.0; SEC. POROSITY 0.0 (PU) 0.25; WATER SATURATION 1.0 (PU) 0.0
OIL & GAS 0.3 (PU) 0.0; MOVED OIL&GAS 0.3 ( ) 0.0; PHIE*SW 0.3 ( ) 0.0; TOTAL POROSITY 0.3 (PU) 0.0
Kair_log 0.002 ( ) 2000.0; Kgas_log 0.002 ( ) 2000.0; Kwat_log 0.002 ( ) 2000.0
COAL 0.0 ( ) 1.0; CLAY 0.0 (PU) 1.0; SANDSTONE 0.0 (PU) 1.0; LIMESTONE 0.0 (PU) 1.0; DOLOMITE 0.0 (PU) 1.0; OIL & GAS 1.0 (PU) 0.0; MOVED OIL&GAS 1.0 ( ) 0.0; PHIE*SW 1.0 ( ) 0.0; BOUND WATER VOLUME 0.0 (V/V) 1.0
Res 0.0( )1.2



GAMMA RAY 0.0 (API) 200.0; SP -10.0 (MV) 90.0; BITSIZE 6.0 (INCH) 16.0; CALIPER 6.0 (INCH) 16.0
RT_HRLT 0.2 (OHMM) 2000.0; RLA3 0.2 (OHMM) 2000.0; RXO_HRLT 0.2 (OHMM) 2000.0
DENSITY 1.95 (G/CC) 2.95; COMP. NEUTRON 0.45 (PU) -0.15; COMP. SONIC 140.0 (US/F) 40.0; P.E. ABSORPTION 0.0 (B/E) 10.0; DELTA rHO -0.75 (G/CC) 0.25
RHOMA 2.5 (G/CC) 3.0; SEC. POROSITY 0.0 (PU) 0.25; WATER SATURATION 1.0 (PU) 0.0
OIL & GAS 0.3 (PU) 0.0; MOVED OIL&GAS 0.3 ( ) 0.0; PHIE*SW 0.3 ( ) 0.0; TOTAL POROSITY 0.3 (PU) 0.0
Kair_log 0.002 ( ) 2000.0; Kgas_log 0.002 ( ) 2000.0; Kwat_log 0.002 ( ) 2000.0
COAL 0.0 ( ) 1.0; CLAY 0.0 (PU) 1.0; SANDSTONE 0.0 (PU) 1.0; LIMESTONE 0.0 (PU) 1.0; DOLOMITE 0.0 (PU) 1.0; OIL & GAS 1.0 (PU) 0.0; MOVED OIL&GAS 1.0 ( ) 0.0; PHIE*SW 1.0 ( ) 0.0; BOUND WATER VOLUME 0.0 (V/V) 1.0
Res 0.0( )1.2

ENCLOSURE-2
Petrophysical and Composite Plot
1828-2052mMDRT (1:200)

GEOGRAPHE NORTH-1

COMPOSITE AND PETROPHYSICAL SUMMARY

Company	Origin Energy
Well Name	GEOGRAPHE NORTH-1
Field	GEOGRAPHE
Country	Australia
Nation	Australia
State	Tasmania
County or Rig name	Ocean Bounty
Field Location	Otway Basin
Field Locn. Line 1	Easting: 665736.2 m
Field Locn. Line 2	Northing: 5672832.2 m
Latitude	039 04' 39.928" S DMS
Longitude	142 54' 57.647" E DMS
Permanent Datum	LAT
Elevation of PD	.00 M
Elevation of KB	25.00 M
Elevation Ground lv	107.00 M
Elevation Log Zero	25.00 M
Above Perm. Datum	7.62 M
Log measured from	RT
Drill measured from	RT
Services	PEx(HRLA)-DSI-HNGS-SP
Other Services Ln 1	CSI-GR
Other Services Ln 2	CST-GR
Other Services Ln 3	DGR-ARC5
Service company	Schlumberger
Number of runs	1
Well class	Appraisal
Basin	Otway
Tenement/Concession	T/30P
On-Shore Flag	Offshore
Log date	8-OCT-2001
Date computed	11-02-04
Date plotted	11-02-2004
Time plotted	10:37:31

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CROCKER
DATA PROCESSING

RUN INFORMATION

Run number	1
Log date	8-OCT-2001
Depth-Driller	2156.00 M
Depth-Logger	2155.00 M
Bottom log interval	2155.00 M
Top log interval	119.80 M
Casing-Driller	1784.00 M
Casing-Logger	1787.50 M
Casing Diameter	9.6250 inch
Casing Weight	47.0000 lb/ft
Casing Depth	1784.00 M
Bit Size	8.5000 inch
Hole Fluid type	KCl-PHPA-Glycol
Fluid Density	1.1600 gm/cc
Fluid Viscosity	54.0000 s
Fluid PH	9.500000
Fluid Loss	4.0000 C3
Mud Sample Source	Flowline
RM @ Surface	.1130 Ohmm
Mud temp Surface	22.00 degC
RMF @ Surface	.1000 Ohmm
MF temp Surface	22.00 degC
RMC @ Surface	.2000 Ohmm
MC Temp Surface	22.00 degC
Source of RMF/RMC	Pressed
Mud Sample Temp	90.00 degC
Mud Filt.SampleTemp	90.00 degC
MudCakeSample Sourc	Pressed
Time circ. stopped	17:00
Date circ. stopped	8-OCT-2001
Time logger at btm	04:10
Date logger at btm	9-OCT-2001
Surface hole temp	26.00 degC
Bottom hole temp	90.00 degC
Surface temperature	22.00 degC
Max recorded temp	90.00 degC
Logging unit No	25
Logging unit Loc	VEA-APG
Logging Company ID	440
Recorded by	F.Marcano/M.VanSte
Witness	M.Bilek / G.Weste
Program Version	9C2-303
Bore Hole Status	Open
Avg Angular Deviat	.0000000
General.Temp Select	TEMP
Maximum Hole Deviat	1.9400 deg
Total depth	2156.00 M
Temp Conn.WaterSamp	37.78 degC
Filtrate Cl	41,000 ppm
PV	17
YP	31
% Solids	8
% Sand	0.5

FIELD REMARKS

1. First run in hole. Schlumberger depth procedures observed.
2. Borehole correction applied to logs.
3. Limestone matrix-model used in computation of neutron porosity.
4. Bottom hole temperature degC at h on 9-Oct-01.
5. Data aquired in high resolution mode for the entire interval as per client request.
6. Well sketch show driller's depth.
7. Caliper check in casing reading in. ID expected 8.68 in.
8. Tools run as per tool sketch.
9. Circulation started 16:00 on 8-Oct-01, stopped at 17:00 on 08-Oct-01.

Thank you for using Schlumberger

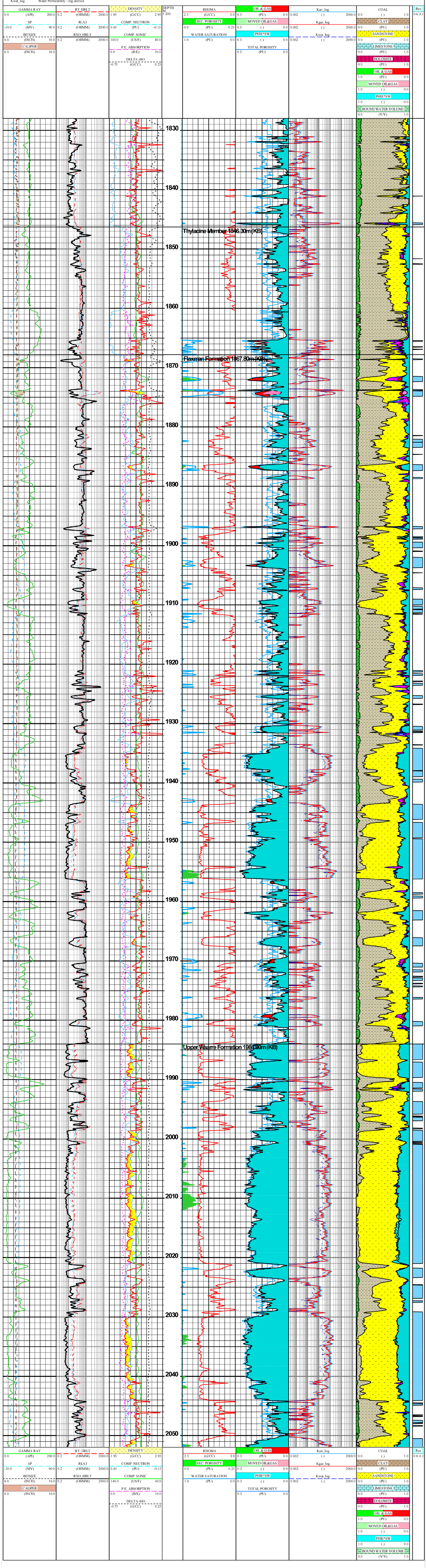
Mud Properties:
Barite conc = 1.55%, Chloride conc. = 42000 ppm, Potassium conc. = 30569 ppm
Water content = 89 %, Solids content = 8 %, Corr. Solids content = 5.71 %
Glycol conc. = 3 %, Calcium conc. = 280 mg/l

COMPUTATION PARAMETERS

DEPTH INTERVAL	RW PPM	RW OHMM	TEMP C	GR MIN	GR MAX	R CLAY	RHOB CLAY	PHIN CLAY	t CLAY	RHOH	a	m
1820.0 - 1848.6	20000	.136	80.6	10	102	17	2.54	.411	96	.51	1.00	2.35
1848.6 - 1867.9	20000	.135	81.3	10	140	17	2.54	.400	96	.51	1.00	2.35
1867.9 - 1986.4	20000	.133	83.3	10	140	17	2.54	.400	96	.51	1.00	2.00
1867.9 - 1986.4	20000	.133	83.3	10	140	17	2.54	.400	96	.51	1.00	1.80
1867.9 - 1986.4	20000	.133	83.3	10	140	17	2.54	.400	96	.51	1.00	2.00
1867.9 - 1986.4	20000	.133	83.3	10	140	17	2.54	.400	96	.51	1.00	2.35
1986.4 - 2128.0	20000	.128	87.1	10	140	17	2.54	.400	96	.51	1.00	2.00
1986.4 - 2128.0	20000	.128	87.1	9	140	17	2.54	.400	96	.51	1.00	1.80
1986.4 - 2128.0	20000	.128	87.1	10	140	17	2.54	.400	96	.51	1.00	2.00
1986.4 - 2128.0	20000	.128	87.1	10	140	17	2.54	.400	96	.51	1.00	2.35

LOG DESCRIPTION

ROMA-CPX	Apparent Matrix Density (Complex Litho Model)
SPI -CPX	Secondary Porosity Indicator = PHIT-PHIS >=0 (Complex Litho Model)
SW -CPX	Formation Water Saturation <=1.0 (Complex Litho Model)
PHIE-CPX	Effective Porosity (Complex Litho Model)
PHXO-CPX	Product (PHIE * SXO) (Complex Litho Model)
PHSW-CPX	Product (PHIE * SW) (Complex Litho Model)
MINERAL	Special Mineral Table output flag (Salt,Trona,Anhydrite,Gypsum,Coal)
VCL -CPX	Volume of clay (Complex Litho Model)
VSND-CPX	Volume of Sand (Complex Litho Model)
VLS -CPX	Volume of Limestone (Complex Litho Model)
VDOL-CPX	Volume of Dolomite (Complex Litho Model)
PHIE-CPX	Effective Porosity (Complex Litho Model)
PHXO-CPX	Product (PHIE * SXO) (Complex Litho Model)
PHSW-CPX	Product (PHIE * SW) (Complex Litho Model)
VBW -CPX	Volume of bound water (Complex Litho Model)
GRCC	Gamma-Ray - casing corrected
SPDC	SP Drift corrected
BS	Bit Size
HCAL	HRCC Cal. Caliper
RHO8	HRDD High Resolution Formation Density
NPHI	Thermal Neutron Porosity (Ratio Method)
DTCO	Delta-T Compressional
PEF8	HRDD High Resolution Formation Photoelectric Factor
HDRA	HRDD Density Correction
PHIT-CPX	Total porosity from CPX model after hydrocarbon correction (Complex Litho Model)
RT_HRLT	HRLT Computed True Resistivity
RLA3	HRLT Borehole Corrected Resistivity 3
RXO_HRLT	HRLT Computed Invaded Zone Resistivity
NET -RES	
Kair_log	Air Permeability - log derived
Kgas_log	Gas Permeability - log derived
Kwat_log	Water Permeability - log derived



APPENDIX 2
PALYNOLOGICAL REPORT

PALYNOLOGY OF

GEOGRAPHE NORTH-1

OFFSHORE OTWAY BASIN, AUSTRALIA

BY

ROGER MORGAN

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PALYNOLOGY OF

GEOGRAPHE NORTH-1

OFFSHORE OTWAY BASIN, AUSTRALIA

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1 SUMMARY

1794.0 m (swc) – 1799.0 m (swc) : ***I. cretaceum* (lower b) Zone**; *T. apoxyexinus* (middle) Zone : Santonian : nearshore marine : marginally mature

1821.5 m (swc) – 1842.5 m (swc) : ***O. porifera* (upper) Zone**; *T. apoxyexinus* (middle) Zone : Santonian : nearshore marine : marginally mature

1854.9 m (swc) – 1866.8 m (swc) : ***O. porifera* (lower) Zone**; *T. apoxyexinus* (middle) Zone : Santonian : nearshore marine : marginally mature

1869.9 m (swc) – 1998.0 m (swc) : ***P. infusorioides* (upper) Zone** (1869.9 m – 1906.5 m upper c, 1919.0 m upper b, 1932.9 m – 1998.0 m upper a); *T. apoxyexinus* (lower) Zone : Turonian : very nearshore to shelfal marine : marginally mature

2023.9 m (swc) – 2050.0 m (swc) : ***P. infusorioides* (?middle c) Zone**; *P. mawsonii* (upper) Zone: Turonian : marginal marine to non-marine : marginally mature

2083.0 m (swc) – 2103.0 m (swc) **: *P. infusorioides* (middle c) Zone**; *P. mawsonii* (lower) Zone : Turonian : very nearshore marine to ?non-marine : marginally mature

2 INTRODUCTION

A total of 25 samples (all sidewall cores) have been studied from **Geographe North-1** for Woodside Energy Ltd. The zonation used for the Cretaceous is based on the scheme of Helby, Morgan and Partridge (1987), revised and refined using Otway Basin cuttings by Morgan (1992, 1994, 2001), and summarised in Figure 1. Alan Partridge has also revised this zonation in unpublished studies and published it as an outline table in Partridge (1997). The two schemes are easily reconciled. The main difference being in the definition of the base of the *T. apoxyexinus* Zone and his belief that the Cenomanian is entirely missing in the Otway Basin. A summary of the palynological details for each sample is presented on Table 1.

All informal species names are shown in quotation marks and listed in Section 5 with informal authorship. Names are given in full when first mentioned in the text, but only the genus initial and full species name is given when subsequently mentioned.

Maturity data were generated in the form of Spore Colour Index, and are plotted on Figure 2 Maturity Profile: Geographe-1. The oil and gas windows on Figure 3 follow the general consensus of geochemical literature. The oil window corresponds to spore colours of light-mid brown (Staplin Spore Colour Index of 2.7) to dark brown (3.6), equivalent to vitrinite reflectance values of 0.6% to 1.3%. Geochemists argue variations on kerogen type, basin type and basin history. The maturity interpretation is thus open to reinterpretation using the basic colour observations as raw data. However, the range of interpretation philosophies is not great, and probably would not move the oil window by more than 200 m.

Raw palynological data are included in Appendix 1. The data are based on a 250+ specimen count in swcs and core from which an indication of marine microplankton to terrestrial palynomorph proportions can be derived. The microplankton percentages are listed in Table 1, which also summarizes other palynological details. Environmental assessments are derived from the palynomorph counts using content and diversity of saline taxa (dinoflagellates and spiny acritarchs), other microplankton (mostly freshwater algae), and terrestrial spores and pollen. The criteria for these assessments are defined in Table 1. However, dinoflagellate content and diversity in the Otway Basin are lower than might be expected from other data sources, especially sedimentology in the offshore marine shales. It may be that dinoflagellate productivity is suppressed by lowered salinity or restricted oceanic circulation caused by the enclosed nature of a long narrow marine gulf. Environments interpreted here may therefore underestimate marine influence in this section with environments really being more marine than interpreted here. In running text, frequency of taxa is discussed in the following intervals: Very rare = <1%, Rare = 1-3%, Frequent = 4-10%, Common = 11-29%, Abundant = 30-49%, Super-abundant = 50-100%.

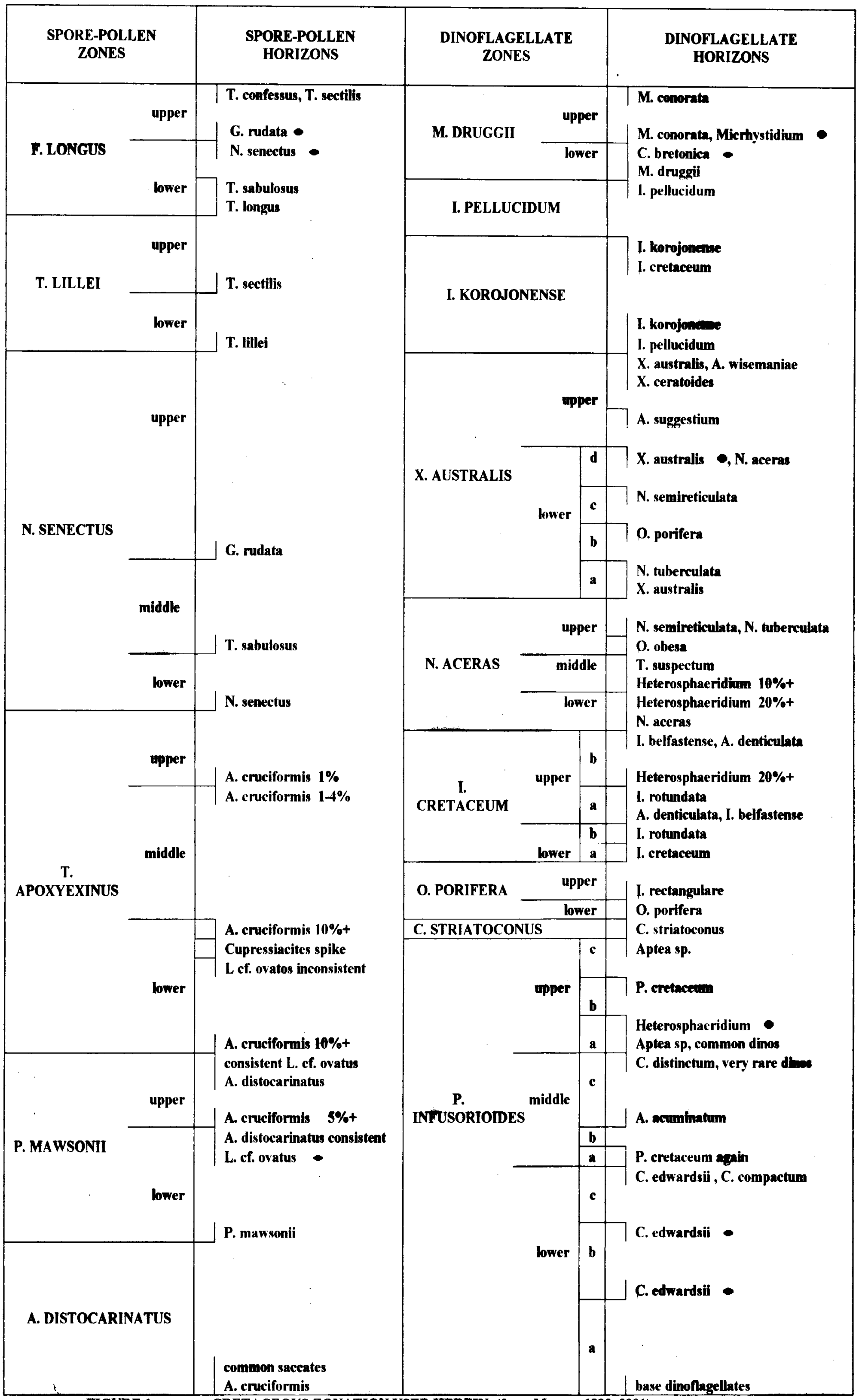
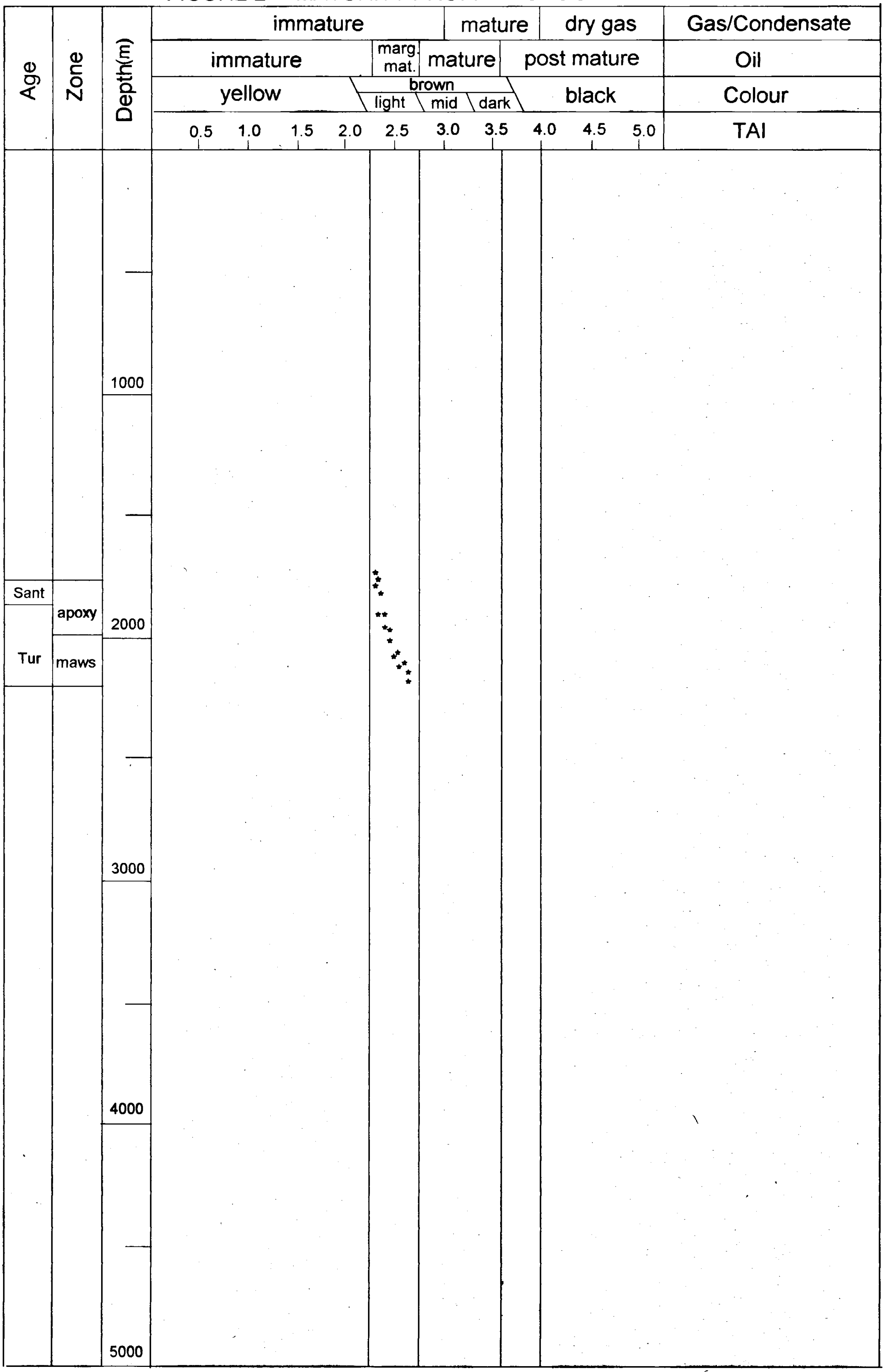


FIGURE 1 CRETACEOUS ZONATION USED HEREIN (from Morgan 1992, 2001)

● = frequent (4-10%) ● = common (11-30%)

FIGURE 2 MATURITY PROFILE : GEOGRAPHE NORTH-1



3 PALYNOSTRATIGRAPHY

3.1 1794.0 m (swc) – 1799.0 m (swc) : *I. cretaceum* (lower b) Zone, *T. apoxyexinus* (middle) Zone, nearshore to shelfal marine

Inertinite is dominant. Spore-pollen assignment is based on *Amosopollis cruciformis* at 0-4%, with frequent *Proteacidites* spp. (near 5%). *Tricolporites apoxyexinus* occurs at 1794.0 m (swc) only. The dinoflagellate zones offer more precise correlation. Common are *Cyathidites minor* and *Falcisporites similis* with frequent *Dilwynites granulatus,Dilwynites "pusillum", Microcachryidites antarcticus,Vitreisporites pallidus* and *Osmundacidites wellmanii*. Rare elements include *A. cruciformis, Australopollis obscurus, Clavifera triplex* and *Phyllocladidites mawsonii*.

Dinoflagellate zonal assignment is indicated at the top by the absence of younger markers and at the base by oldest *I. cretaceum* in place and the absence of older markers.

Within the interval, the following subzones can be recognised:

lower b subzone = base *I. belfastense "rotundata"* in place beneath younger markers (1794.0 m swc – 1799.0 m swc)
lower a subzone = base *I. cretaceum* beneath younger markers (not seen here, presumed present in the sample gap 1799.0 m – 1821.5 m)

Within the interval, the following markers have high potential for detailed correlation and possible further subdivision and several have been seen in nearby wells. Those marked with an asterisk are considered almost certain to provide new subzones in closely sampled sections. Data from nearby wells suggests these samples are in the upper part of the *I. cretaceum* (lower) zone.

1794.0 m (swc)	: acme *Isabelidinium belfastense "rotundata"* (12%)
	: top *Occisucysta "septata"**
1799.0 m (swc)	: base *I. belfastense "rotundata"*
	: base thick *Trithyrodinium* spp.
	: base *Occisucysta "septata"**
not seen	: top *Aptea "gigantis"**
not seen	: top *Hystrichodinium furcatum*
1799.0 m (swc)	: base *I. cretaceum* in place

Frequent to common are *Heterosphaeridium* spp., mostly *H. "solida"* and *I. belfastense "rotundata"*. Frequent are *Odontochitina* spp., especially *O. cribropoda* at 1799.0 m. Rare is *I. cretaceum* with the elongated variant *I. cretaceum "elongatum"* present at 1799.0 m. Rare but persistent elements throughout include *Alterbidinium acuminatum, Canningia "scabrate", O. "septata", Odontochitina costata*, thick *Trithrodinium* spp. and *Trithyrodinium "marshallii"*.

Nearshore marine environments are indicated by the subordinate moderately diverse dinoflagellates and dominant moderately diverse spore-pollen.

Light brown spore colours indicate marginal maturity for oil but immaturity for gas/condensate.

3.2 1821.5 m (swc) – 1842.5 m (swc) : *O. porifera* (upper) Zone, *T. apoxyexinus* (middle) Zone, nearshore to shelfal marine

Inertinite is dominant. Spore-pollen zonal assignment is based on *A. cruciformis* at 2-5% throughout. *Proteacidites* spp. are extremely rare, in contrast with the overlying section. These critera are consistent with those used in the inshore previously BHP acreage and appear to work consistently. Minor inconsistency in the *A. cruciformis* content seen in a nearby well may be related to its closer proximity to a major distributary, increasing the content of the freshwater algae *A. cruciformis* flushed into the depositional system. Common are *M. antarcticus*, *C. minor* and *F. similis* with intermittently frequent *D. "pusillum", D. granulatus, P. mawsonii,* and *V. pallidus*. Rare elements include *Proteacidites* spp. which are virtually not seen below this interval.

Dinoflagellate zonal assignment is indicated at the top by the absence of younger markers concident with top *Isabelidinium rectangulare* and at the base by oldest *I. rectangulare.* Top *I. retangulare "diversum"* is seen at 1842.5 m (swc) suggesting the lower part of the interval. Minor mud contamination is considered responsible for the anomolous specimens of *I. cretaceum* at 1821.5 m. No dinoflagellate species are common. Frequent are *Heterosphaeridium heteracanthum* and *H. "solida"*. At 1821.5 m only, *Aptea "gigantis"* and *T. "marshallii"* are frequent. Consistent to frequent are *I. rectangulare* "*rectangulare", S. ramosus* and *Botryococcus* sp. Very rare elements include *Aptea* sp. cf. *gryphus, O. porifera* and *Prolixosphaeridium "pandora"*. Dinoflagellates are more common near the top (1821.5 m). The following events have potential for event stratigraphy and detailed intra-reservoir correlation. Those marked with an asterisk are almost certain to provide new subzones in closely sampled sections and have been seen in nearby wells.

1821.5 m (swc)	: top *I. rectangulare “rectangulare”, I. rectangulare “contractum”*
	: acme *A. “gigantus”, T. “marshallii”*
	: top richer dinos
1842.5 m (swc)	: top *P. “pandora”*
not seen	: top influx *H. heteracanthum**
1842.5 m (swc)	: top *I. rectangulare “diversum”**
	: base *I. rectangulare*

Nearshore to shelfal marine environments are indicated by the dominant and diverse spores and pollen and subordinate moderately diverse dinoflagellates.

Light brown spore colours indicate marginal maturity for oil but immaturity for gas/condensate.

3.3 1854.9 m (swc) – 1866.8 m (swc) : *O. porifera* (lower) Zone : *T. apoxyexinus* (middle) Zone : nearshore marine

Inertinite and cuticle are dominant. Assignment to the spore pollen zone is indicated by the continued presence of *A. cruciformis* near 1-10%. Distinctive in this interval is common to abundant *M. antarcticus* (especially at 1861.7 m and 1864.1 m), not seen anywhere else in this well but seen in nearby wells at this level. Very common to abundant is *M. antarcticus* with common *C. minor* and *F. similis* and frequent to common *D. “pusillum”, D. granulatus* and *V. pallidus*. Consistent taxa include *A. cruciformis, Cupressiacites* spp. and *P. mawsonii*. Very rare taxa include *Cicatricosisporites “radialis”, Foraminisporis caelatus* and Permian and Triassic reworking.

Dinoflagellate zonal assignment is indicated at the top by the absence of younger markers (coincident with youngest *Cribroperidinium “distincta”* and *Hystrichodinium pulchrum “short”*) and at the base by oldest *T. “marshallii”* (coincident with oldest *C. “distincta”* and *H. pulchrum “short”*). No dinoflagellate species are common. Frequent are *Circulodinium “solida”, H. heteracanthum, H. “solida”* and *C. “distinctum”* near the base with other elements rare. *Aptea* sp. (= cf. *gryphus*) is intermittent and is considered reworked. *Aptea “gigantis”* is a very rare component.

Nearshore marine environments are indicated by the dominant and diverse spores and pollen and subordinate moderately diverse dinoflagellates.

Light brown spore colours indicate marginal maturity for oil but immaturity for gas/condensate.

3.4 1869.9 m (swc) – 1998.0 m (swc) : *P. infusorioides* (upper) Zone, *T. apoxyexinus* (lower) Zone, nearshore to marginal marine

Vitrinite, cuticle and inertinite are all very common, in contrast to the inertinite dominated assemblages above. Assignment to the spore-pollen zone is indicated by near 10%+ content of *A. cruciformis*, in contrast to lower contents immediately above and below. At the top (1869.9 m – 1877.6 m) , the *Cupressiacites* spp. spike (12%) is seen and is normally associated with the Banoon Member at the top of the Flaxmans Formation, in the sense of Partridge (1998). Frequent to common at the top (1869.9 m – 1890.5 m) are *A. cruciformis, C. minor, D. granulatus, F. similis* and *M. antarcticus*. In the middle (1906.5 m – 1919.0 m), *D. "pusillum"* becomes common and has been seen in other wells nearby. At the bottom (1932.9 m – 1998.0 m), *A. cruciformis* and *M. antarcticus* become common to abundant. Rare elements throughout include inconsistent *Laevigatosporites* cf. sp. *L. ovatus* (=*L. musa* of Partridge) and *Gleicheniidites* sp. (thick). Occasional specimens of *Appendicisporites distocarinatus* seen in 6 out of 12 samples are considered reworked but may be just inconsistent. Permian and occasionally Triassic reworking are mostly minor, but peak at 3-4% at 1890.5 m – 1906.5 m and again at 1982.5 m – 1992.9 m.

Dinoflagellate zonal assignment is indicated at the top by youngest consistent/frequent *Aptea* sp. (cf. *gryphus*) coincident with youngest *Kiokansium polypes* and *Chlamydophorella nyei* and at the base by oldest *Aptea* spp. and common dinoflagellates (20%+) The upper part (1869.9 m – 1919.0 m) is dominated by plant debris with minor dinoflagellates. *K. polypes, Circulodinium "solida", Aptea* sp. (cf. *gryphus*) and *Heterosphaeridium* spp. are frequent to consistent. The lower part (1932.9 m – 1998.0 m) is dominated by plant debris and is more marine, with common to very common *H. heteracanthum* and frequent *Botryococcus* sp. and *C. "solida"*. Consistent are *Aptea* spp., *Cribroperidinium* sp., *K. polypes, O. operculata* and *O. complex*. The following dinoflagellate subdivisions can be recognised.

upper c subzone = consistent *Aptea* sp. (cf. *gryphus*) above youngest *P. cretaceum* (1869.9 m – 1906.5 m swc)

upper b subzone = *P. cretaceum* above *Heterosphaeridium* spp. acme (1919.0 m)

upper a subzone = *Heterosphaeridium* spp. acme above base *Aptea* spp. (1932.9 m – 1998.0 m)

Within the interval, the following events have further potential for event stratigraphy and detailed local intra-reservoir correlation.

1869.9 m (swc)	: top consistent *Aptea* sp. (cf. *gryphus*), *K. polpes, C. nyei*
	: Cupressiacites acme (12%)
1890.5 m (swc)	: *Aptea* sp. (cf. *gryphus*) acme (15%)
	: top inconsistent *L.* cf. *ovatus*
1877.6 m (swc)	: base part range consistent *A. acuminatum*
1906.5 m (swc)	: less dinoflagellates
	: top *D." pusillum"* acme (15%+)
	: *Dilwynites* acme (25%)
	: base frequent *H. "solida"*
	: base *Aptea "gigantis"*
1919.0 m (swc)	: top *P. cretaceum*
1932.9 m (swc)	: top *H. heteracanthum* acme (25%), *A. cruciformis* acme (30%)
	: base consistent *Aptea* sp. (cf. *gryphus*), *P. cretaceum*
1970.0 m (swc)	: repeat top *A. acuminatum, Spinidinium* sp.
1998.0 m (swc)	: base common dinoflagellates (20%+), base *Aptea* spp.
	: base *Spinidinium* sp.

Environments are marine throughout, but are mostly nearshore to very nearshore. This is indicated by low to moderate dinoflagellate content and diversity. In only two samples towards the top, shelfal marine environments are indicated by subequal proportions of dinoflagellates and spore-pollen. Overall transgressian is suggested to a marine maximum near 1932.9 m, then regressian above (by the changing dinoflagellate contents).

Light brown spore colours indicate marginal maturity for oil but immaturity for gas/condensate.

3.5 2023.9 m (swc) – 2050.0 m (swc) : *P. infusorioides* (?middle c) Zone, *P. mawsonii* (upper) Zone, marginal marine

These samples are either extremely lean or dominated by cuticle and inertinite. The 2023.9 m sample is almost barren with minor inertinite and palynomorphs comprising mostly freshwater algae (*Paraleaniella indentata*) with very few spore-pollen. Spore-pollen zonal assignment is indicated at 2050.0 m by consistent *L.* cf. *ovatus,* inconsistent *A. distocarinatus* and a downhole decrease of *A. cruciformis.* The base is defined on consistent *P. mawsonii* above older markers (especially consistent *A. distocarinatus*, and a downhole influx of *L.* cf. *ovatus)* and on a further downhole decrease of *A. cruciformis.* Common pollen include *C. minor, D. granulatus, D. "pusillum", F. similis* and *M. antarcticus* with spores relatively rare. In this interval, *A. distocarinatus* is very rare (1 specimen in 3 slides). Permian reworking is rare.

Dinoflagellate zonal assignment of this interval is negatively based, on the absence of distinctive markers seen both above and below. However, the presence of *A. acuminatum* in samples beneath indicate that this interval is equivalent to the middle c subzone. Dinoflagellates are absent from 2023.9 m and are extremely rare at 2050.0 m with a very limited assemblage including not much more than *C. "solida", H. heterocanthum, O. complex* and *P. infusorioides*. Freshwater algae are totally dominant at 2023.9 m (superabundant *P. indentata*, rare *Nummus* spp.) and common at 2050.0 m (frequent *Botryococcus* sp., diaphanous leiospheres, *Nummus* spp. and *P. indentata*).

The *P. infusorioides* (middle) Zone can be subdivided into:

middle c subzone = base *Aptea* spp. and common dinoflagellates down to base *Alterbidinium acuminatum*
middle b subzone = base *A. acuminatum* down to top *P. cretaceum* re-appearance
middle a subzone = top *P. cretaceum* re-appearance down to top *Cribroperidinium edwardsii*

Marginally marine environments are indicated at 2050.0 m by the totally dominant and highly diverse spores and pollen and extremely rare low diversity dinoflagellates. Non-marine lacustrine environments are indicated at 2023.9 m by the total dominance of freshwater algae, absence of dinoflagellates and few spores and pollen.

Light brown spore colours indicate marginal maturity for oil but immaturity for gas/condensate.

3.6 2083.0 m (swc) – 2103.0 m (swc) : *P. infusorioides* (middle c) Zone, *P. mawsonii* (lower) Zone, marginal marine to non-marine

Plant debris is dominant, comprising mostly cuticle and inertinite. Spore-pollen zonal assignment is indicated at the top by a downhole decrease of *A. cruciformis* (absent herein) and a downhole influx of *A. distocarinatus* (consistent, from very rare above) and *L.* cf. *ovatus* (consistent, from inconsistent above), and a marked downhole influx of *Dictyophyllidites harrisii.* The base is assigned by having *P. mawsonii* to the interval base. Spore diversity appears higher in this interval with heavy spores like *Convolutispora "magnifica", Foraminisporis asymmetricus, Foraminisporis "limatulus", Lycopodiacidites asperatus, Perotriletes "baldii"* and *Sestrosporites pseudoalveolatus* swelling spore diversity. Very common is *D. harrisii* at 2083.0 m, with common taxa including *C. minor, D. granulatus, F. similis, O. microsaccatus,M. antarcticus* and *V. pallidus*. The 2101.0 m sample is extremely lean, lacks any dinoflagellates and may be non-marine.

Events with possible significance for detailed correlation include:

2083.0 m (swc)	: top common *D. harrisii*, spore influx
	: top consistent *L.* cf. *ovatus, A. distocarinatus*
2101.0 m (swc)	: ?non-marine
2103.0 m (swc)	: base *A. acuminatum*

Dinoflagellate zonal assignment is based at the top on the absence of younger markers and at the base on oldest *A. acuminatum*. At 2083.0 m (swc) anomolous dinoflagellates include *Chatangiella victoriensis* and *Aptea* spp. and are presumed to be mud contamination. The sample at 2101.0 m may be non-marine and may have correlative potential. The renewed top-range of *P. cretaceum* was not seen and is presumed present in undrilled section beneath TD. These data indicate the following subzonal assignment.

middle c subzone = non-descript or no dinoflagellates below *Aptea* sp. and above oldest *I. acuminatum* (2083.0 m – 2103.0 m)

middle b subzone = beneath base *I. acuminatum* and above top *P. cretaceum* re-appearance (not seen)

middle a subzone = top *P. cretaceum* re-appearance above youngest *C. edwardsii* (not seen)

Environments are very nearshore marine to possibly non-marine with extremely rare (or no) low diversity dinoflagellates amongst abundant and diverse spores and pollen. At 2101.0 m (swc) non-marine environments are suggested by the total absence of saline markers, but is not conclusive in such a lean assemblage. This horizon may correlate with non-marine horizons seen at the top of the *P. mawsonii* (lower) Zone elsewhere.

Light brown spore colours indicate marginal maturity for oil but immaturity for gas/condensate.

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5 UNPUBLISHED NAMES

Dinoflagellates

Aptea "gigantis"	Morgan
Aptea sp. (cf. *gryphus*)	Morgan (=*V. gryphus* sensu Partridge)
Aptea "spiny"	Morgan
Canningia "scabrata"	Morgan
Circulodinium "solida"	Morgan
Cribroperidinium "distincta"	Morgan
Cribroperidinium sp.	Morgan
Florentinia "ingramii"	Marshall (1984)
Heterosphaeridium "minutum"	Morgan
Heterosphaeridium "solida"	Morgan
Isabelidinium cretaceum "elongatum"	Marshall (1984)
Isabelidinium belfastense "rotundata"	Marshall (1984)
Isabelidinium rectangulare "contractum"	Marshall (1984)
Isabelidinium rectangulare "diversum"	Marshall (1984)
Isabelidinium rectangulare "rectangulare"	Marshall (1984)
Occisucysta "septata"	Marshall (1984)
Odontochitina "triangulata"	Marshall (1984)
Prolixosphaeridium "pandora"	Morgan
Trithyrodinium "thick reticulate"	Morgan
Trithyrodinium "marshallii"	Morgan

Spores and Pollen

Cicatricosisporites "radialis"	Morgan
Coptospora "porthole"	Morgan (herein)
Dilwynites "pusillum"	Partridge
Gleicheniidites sp. "(thick)"	Morgan (?=*G. "ancorus"* Partridge)
Hoegisporis "trinalis"	Morgan (=*H. "trinalis"* Partridge)
Laevigatosporites cf. *ovatus*	Morgan (=*L. musa* Partridge)
Perotriletes "baldii"	Morgan
Phyllocladidites "eunuchus"	Morgan

TABLE 1: SUMMARY PALYNOLOGICAL DATA, GEOGRAPHE NORTH-1

RT= 25 m

LOG DEPTH [mbRT]	CORE DEPTH [mbRT]	SAMPLE TYPE	ORGANIC YIELD *1	MICROFOSSIL YIELD	PRESERVATION *2	PERCENTAGE				DIVERSITY *3		DINOFLAGELLATE ZONE/SUBZONE	SPORE-POLLEN ZONE/SUBZONE	ENVIRONMENT *4
						MICROPLANKTON			SPORE-POLLEN	MICROPLANKTON	SPORE-POLLEN			
						DINOFLAG.	SPINY AC.	OTHER						
1794.00		SWC 30	0.053	HIGH	3 = GOOD	23	0	4	73	MODERATE	HIGH	I. CRETACEUM, LOWER b	T. APOXYEXINUS, MID	NEARSHORE
1799.00		SWC 29	0.061	HIGH	3 = GOOD	25	0	1	74	MODERATE	HIGH	I. CRETACEUM, LOWER b	T. APOXYEXINUS, MID	NEARSHORE
1821.50		SWC 28	0.075	MODERATE	3 = GOOD	38	0	5	57	VERY HIGH	HIGH	O. PORIFERA, UPPER	T. APOXYEXINUS, MID	SHELFAL
1842.50		SWC 27	0.055	MODERATE	3 = GOOD	28	0	8	64	HIGH	HIGH	O. PORIFERA, UPPER	T. APOXYEXINUS, MID	NEARSHORE
1854.90		SWC 26	0.052	MODERATE	3 = GOOD	17	0	13	70	MODERATE	HIGH	O. PORIFERA, LOWER	T. APOXYEXINUS, MID	NEARSHORE
1861.70		SWC 25	0.093	MODERATE	3 = GOOD	15	0	5	80	MODERATE	HIGH	O. PORIFERA, LOWER	T. APOXYEXINUS, MID	NEARSHORE
1864.10		SWC 24	0.098	MODERATE	3 = GOOD	17	1	5	77	HIGH	HIGH	O. PORIFERA, LOWER	T. APOXYEXINUS, MID	NEARSHORE
1866.80		SWC 23	0.066	MODERATE	3 = GOOD	21	<1	13	66	MODERATE	MODERATE	O. PORIFERA, LOWER	T. APOXYEXINUS, MID	NEARSHORE
1869.90		SWC 22	0.034	HIGH	3 = GOOD	30	0	12	58	MODERATE	MODERATE	P. INFUSORIOIDES, UPPER c	T. APOXYEXINUS, LOW	NEARSHORE
1877.60		SWC 21	0.057	HIGH	3 = GOOD	41	3	11	45	HIGH	HIGH	P. INFUSORIOIDES, UPPER c	T. APOXYEXINUS, LOW	SHELFAL
1890.50		SWC 20	0.071	HIGH	3 = GOOD	27	0	22	51	MODERATE	HIGH	P. INFUSORIOIDES, UPPER c	T. APOXYEXINUS, LOW	NEARSHORE
1906.50		SWC 19	0.063	MODERATE	3 = GOOD	21	0	9	70	MODERATE	HIGH	P. INFUSORIOIDES, UPPER c	T. APOXYEXINUS, LOW	NEARSHORE
1919.00		SWC 18	0.098	MODERATE	3 = GOOD	15	0	7	78	MODERATE	HIGH	P. INFUSORIOIDES, UPPER b	T. APOXYEXINUS, LOW	NEARSHORE
1932.90		SWC 17	0.114	MODERATE	3 = GOOD	41	0	24	35	HIGH	HIGH	P. INFUSORIOIDES, UPPER a	T. APOXYEXINUS, LOW	SHELFAL
1942.90		SWC 16	0.140	MODERATE	3 = GOOD	10	0	14	76	MODERATE	HIGH	P. INFUSORIOIDES, UPPER a	T. APOXYEXINUS, LOW	VERY NEARSHORE
1957.00		SWC 15	0.158	MODERATE	3 = GOOD	6	0	26	67	LOW	HIGH	P. INFUSORIOIDES, UPPER a	T. APOXYEXINUS, LOW	VERY NEARSHORE
1970.00		SWC 13	0.131	MODERATE	3 = GOOD	28	0	30	42	MODERATE	HIGH	P. INFUSORIOIDES, UPPER a	T. APOXYEXINUS, LOW	NEARSHORE
1982.50		SWC 12	0.057	MODERATE	3 = GOOD	19	3	16	62	MODERATE	HIGH	P. INFUSORIOIDES, UPPER a	T. APOXYEXINUS, LOW	NEARSHORE
1992.90		SWC 11	0.043	MODERATE	3 = GOOD	16	0	17	67	MODERATE	HIGH	P. INFUSORIOIDES, UPPER a	T. APOXYEXINUS, LOW	NEARSHORE
1998.00		SWC 10	0.032	MODERATE	3 = GOOD	5	<1	8	87	MODERATE	HIGH	P. INFUSORIOIDES, UPPER a	T. APOXYEXINUS, LOW	VERY NEARSHORE
2023.90		SWC 8	0.001	VERY LOW	3 = GOOD	0	0	95	5	EX LOW	LOW	P. INFUSORIOIDES, ?MIDDLE c	P. MAWSONII, UPPER	NON-MARINE LAKE
2050.00		SWC 6	0.040	MODERATE	3 = GOOD	1	0	22	77	MODERATE	HIGH	P. INFUSORIOIDES, ?MIDDLE c	P. MAWSONII, UPPER	MARGINAL MARINE
2083.00		SWC 5	0.050	MODERATE	3 = GOOD	5	0	5	90	(MODERATE)	VERY HIGH	P. INFUSORIOIDES, MIDDLE c	P. MAWSONII, LOWER	VERY NEARSHORE
2101.00		SWC 4	0.006	EX LOW	3 = GOOD	0	0	9	91	(EX LOW)	(MODERATE)		P. MAWSONII, LOWER	?NON-MARINE
2103.00		SWC 3	0.085	MODERATE	3 = GOOD	4	0	3	93	MODERATE	HIGH	P. INFUSORIOIDES, MIDDLE c	P. MAWSONII, LOWER	MARGINAL MARINE

*1 ORGANIC YLD=VOL(cc)/WGHT(g)
<0.01 : EXTREMELY LOW
0.01 - 0.10 : LOW
0.1 - 0.5 : MODERATE
>0.5 : HIGH

*2 NOTE:PRESERVATION (FRAGMENTATION INDEX)
1 = SUPERB
2 = EXCELLENT
3 = GOOD
4 = FAIR
5 = POOR

*3 DIVERSITY	
V HIGH	30+ SPECIES
HIGH	20-29 SPECIES
MOD	10-19 SPECIES
LOW	5-9 SPECIES
EX LOW	1-4 SPECIES

*4 ENVIRONMENTS	DINOFLAGELLATE CONTENT %	DINOFLAGELLATE DIVERSITY	FRESHWATER ALGAE CONTENT%
OFFSHORE MARINE	67 to 100	VERY HIGH	LOW
SHELFAL MARINE	34 to 66	HIGH	"
NEARSHORE MARINE	11 to 33	MODERATE	"
VERY NEARSHORE MARINE	5 to 10	MODERATE-LOW	"
MARGINAL MARINE	<1 to 4	LOW-VERY LOW	"
BRACKISH	0, SPINY ACRITARCHS ONLY	EXTREMELY LOW	"
NON-MARINE (UNDIFF)	0, NO SPINY ACRITARCHS	NIL	LOW <3
NON-MARINE (LACUSTRINE)	0, NO SPINY ACRITARCHS	NIL	MODERATE 3-10+

TABLE 2: SUMMARY OF SAMPLE LITHOLOGIES, GEOGRAPHE NORTH-1
RT= 25 m

LOG DEPTH [mbRT]	CORE DEPTH [mbRT]	SAMPLE TYPE	RECOVERY [mm]	LITHOLOGY
1794.00		SWC 30	36	DK GY CLYST, TR GLAUC
1799.00		SWC 29	52	DK GY CLYST, RARE GLAUC
1821.50		SWC 28	37	DK GY CLYST, TR GLAUC
1842.50		SWC 27	43	DK GY CLYST, RARE GLAUC
1854.90		SWC 26	22	DK GY CLYST, TR CARB, TR GLAUC, V MINOR LT GY SST LAM
1861.70		SWC 25	18	DK GY CLYST, TR CARB, V MINOR LT GY SST LAM
1864.10		SWC 24	17	DK GY CLYST, TR CARB
1866.80		SWC 23	20	MED-DK GY SLTY CLYST, TR CARB, TR GLAUC
1869.90		SWC 22	17	LT-MED GY SLTY SST, TR CARB
1877.60		SWC 21	20	MED-DK GY SLTY CLYST, TR CARB
1890.50		SWC 20	15	MED-DK GY SLTY CLYST, TR CARB
1906.50		SWC 19	17	MED-DK GY ARG SLTST, TR CARB, MINOR LT-MED GY SST LAMS
1919.00		SWC 18	15	MED-DK GY SLTY CLYST, TR CARB
1932.90		SWC 17	22	MED-DK GY SLTY CLYST, TR CARB
1942.90		SWC 16	18	MED-DK GY SLTY CLYST, TR CARB, MINOR LT-MED GY SST LAMS
1957.00		SWC 15	10	LT GY SST & DK GY SLTST LAMS, TR-COMMON CARB
1970.00		SWC 13	20	MED GY SDY SLTST, COMMON DK GY CLYST I/BEDS, TR CARB
1982.50		SWC 12	25	DK GY CLYST, MINOR LT-MED GY SST I/BEDS, TR CARB
1992.90		SWC 11	18	LT-MED GY SST, COMMON MED GY SLTST I/BEDS, TR CARB
1998.00		SWC 10	12	LT-MED GY SST, COMMON DK GY CLYST I/BEDS, TR CARB
2023.90		SWC 8	20	LT-MED GY SST, TR CARB
2050.00		SWC 6	15	LT GY SST, TR CARB, V MINOR SLTST LAMS
2083.00		SWC 5	20	DK GY-BRN ARG SLTST, TR CARB, COMMON SST LAMS.
2101.00		SWC 4	15	LT GY SST, TR CARB
2103.00		SWC 3	20	DK GY-BRN SDY SLTST, TR CARB, MINOR THIN SST LAMS

Well Name	: GEOGRAPHE NORTH-1
Operator	: WOODSIDE ENERGY LTD
Interval	: 1794.00m - 2103.00m
Scale	: 1:2000

GEOGRAPHE NORTH-1 Interpretive Data
Style : % Abundance Histogram
Author : Roger Morgan
Date : 7-February-2002
Palynology Distribution Chart

Morgan Palaeo Associates
South Australia

APPENDIX 3
GEOCHEMISTRY REPORT

GEOGRAPHE NORTH-1
GEOCHEMISTRY REPORT
OTWAY BASIN

WOODSIDE
AUSTRALIAN ENERGY

CONFIDENTIAL

Revision: 1
Date: 25/11/02
David Cliff

GEOCHEMISTRY REPORT

1 Introduction

Following the completion of the Geographe North-1 well, a limited program was undertaken to evaluate the source rock character of the drilled sequence.

This report provides a compilation of the petroleum geochemistry data from Geographe North-1 well, together with an interpretation of these data.

The evaluation consisted of the following analyses:

DESCRIPTION	TYPE	QUANTITY
Bulk Volatile Chemistry from Fluid Inclusions (FIS analysis)	SED	180
Lithological description	SED	3
Total organic carbon (TOC)	SED	3
Rock-Eval pyrolysis	SED	3

Table 1 : Analytical program

Geotechnical Services Pty in Perth performed the source rock analyses and Fluid Inclusion Technologies (FIT) in Oklahoma, the fluid inclusion screening.

2 Fluid Inclusion Screening (FIS)

- Fluid Inclusion Screening is a rapid and relatively cheap tool used to:
  - Check for the presence of paleocolumns and migration zones
  - Assess seal effectiveness
  - Detect the presence of live hydrocarbons near a dry well bore (proximity to pay or PTP signal)
- It is unaffected by drilling mud contamination, and can be applied to all cuttings samples
- It needs to be calibrated for each basin

180 cuttings samples from Geographe North-1 were selected for Fluid Inclusion Screening from 570 m to 2156 m. The Fluid Inclusion Screening hydrocarbon response is displayed in Figure 1. There is a strong dry gas signal in the Upper Waarre Formation, which is similar in strength and character to that in nearby gas wells. This suggests that similar gas saturations have existed in the past, even though the Geographe North structure is now dry. Gas signals also appear in inclusions in the shallower Tertiary sands at Geographe North-1, which did not appear in the nearby gas wells. This may be good evidence to show that the trap has recently been breached, perhaps by fault movement to allow the gas to escape. However, gas trapping within inclusions will be more efficient in the shallower carbonate cemented sandstones than in the deeper quartz cemented sandstones.

The lack of gas in inclusions through the regional seal in Geographe North-1, the Belfast Formation, indicates this unit is an effective top seal, even if the trap has been breached by fault movement. Furthermore the intra-formational shales in the Flaxman Formation have apparently provided effective seals, preventing hydrocarbons accumulating in sandstones within this unit (Figure 2).

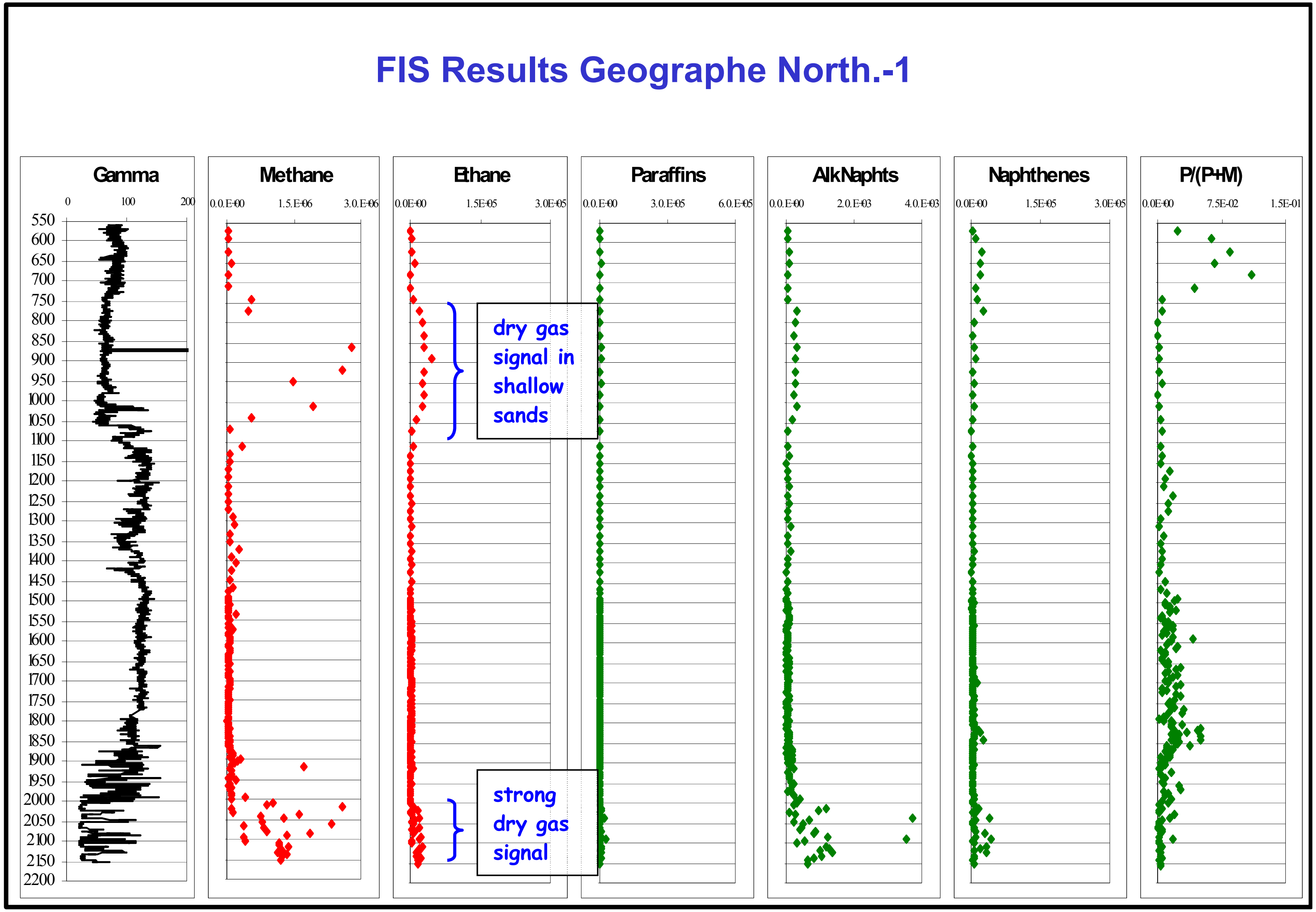


Figure 1 : Fluid inclusion screening (hydrocarbon indicators)

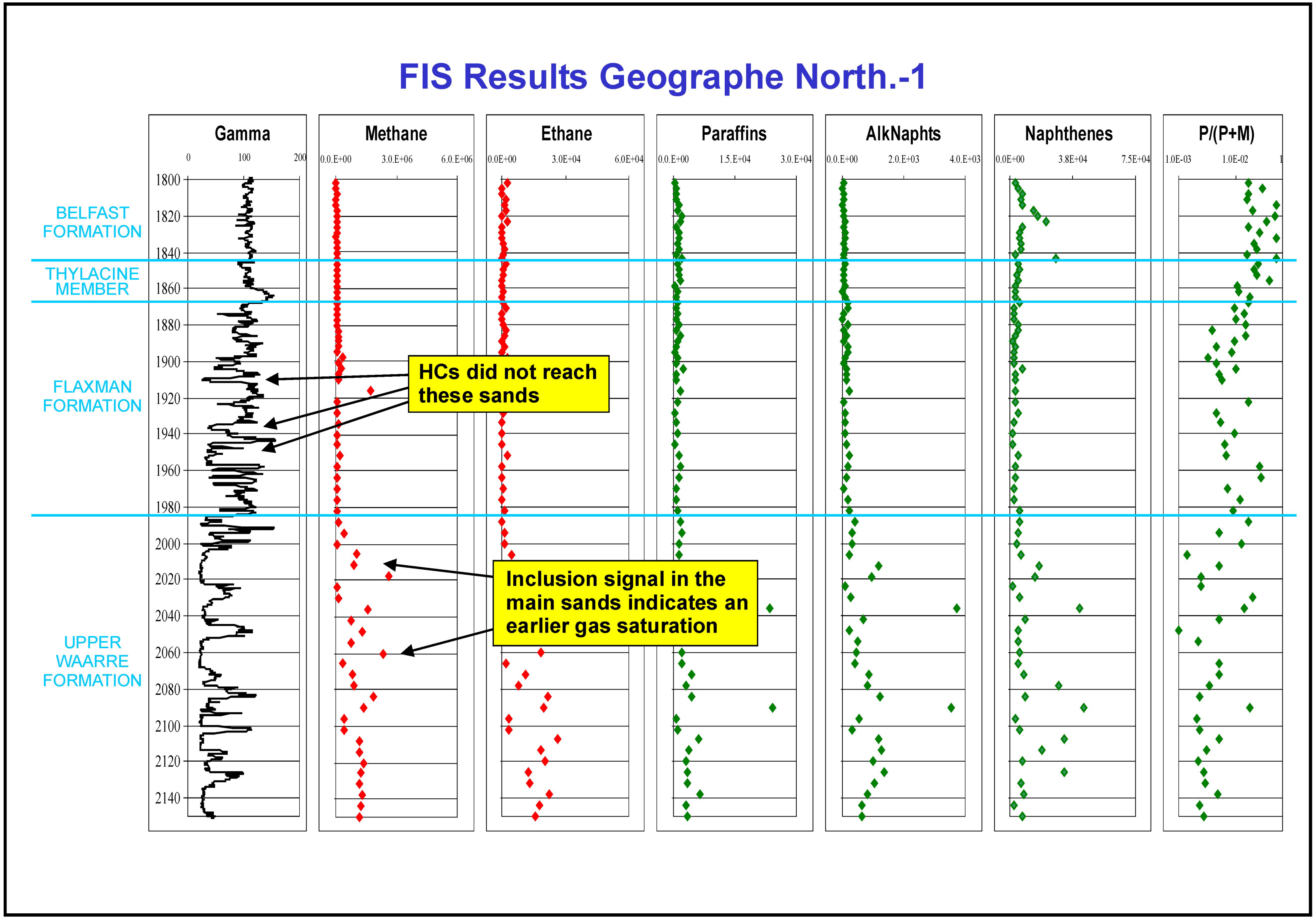


Figure 2: Fluid inclusion screening reservoir interval expanded)

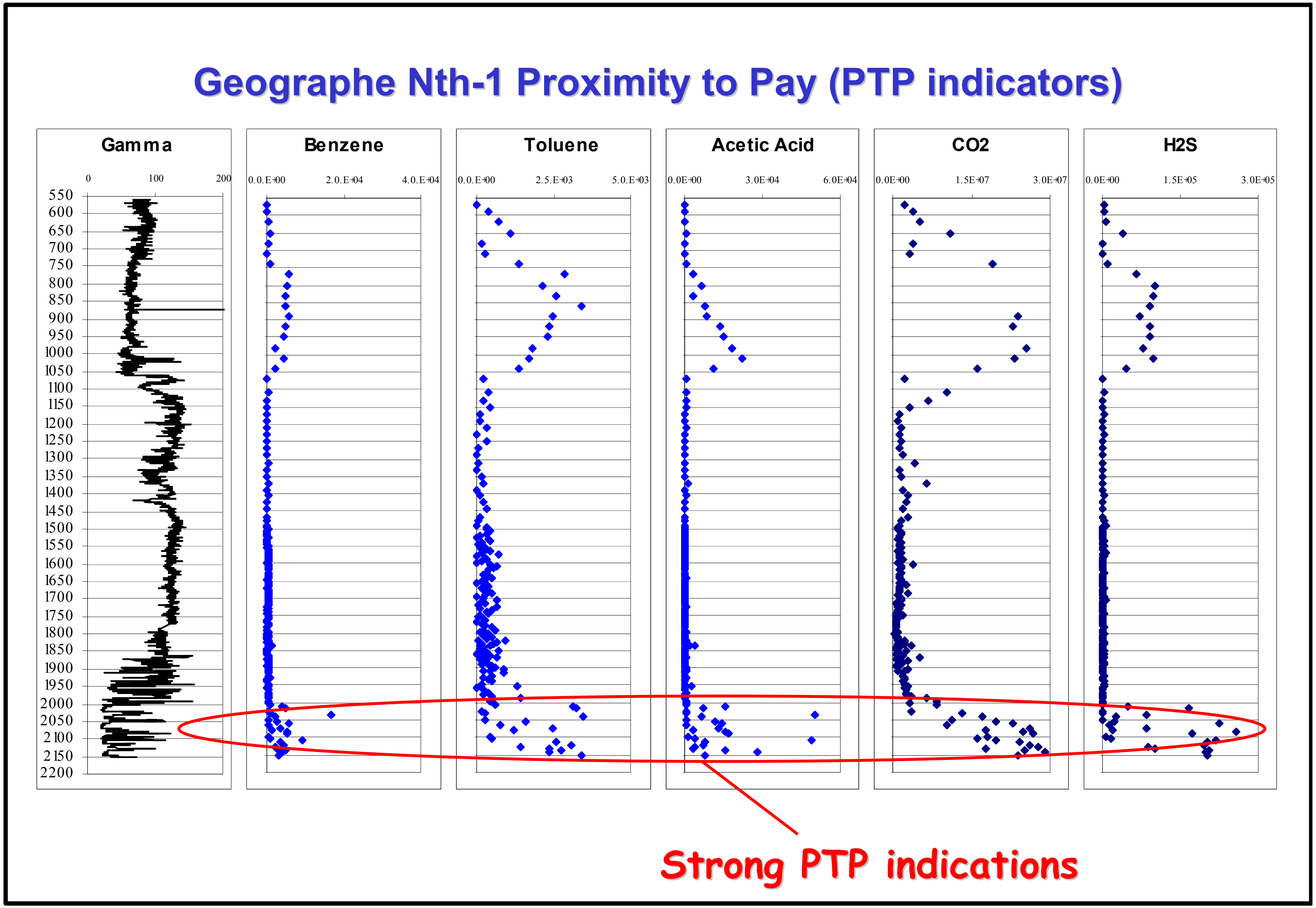


Figure 3: Fluid inclusion screening (proximity to pay indicators)

In the Upper Waarre Formation, there is only a minor liquids signal, which is consistent with the low CGR gas currently reservoired in the nearby Geographe Field. There is no indication of an early oil migration/trapping phase, which is consistent with our understanding of the poor capacity of the coaly terrigenous source rocks in the Lower Waarre and the Eumeralla Formations to source liquids.

Sands below 2000m show a strong proximity-to-pay (PTP) response, with relatively high concentrations of water soluble hydrocarbons and related species (Figure 3). Although PTP has not been calibrated for this basin, this suggests communication of the sands with a HC bearing zone.

3 Source Rock Potential

After a fairly comprehensive source rock study in Geographe-1, only one high gamma ray Santonian aged shale was sampled (sidewall cores from 1861.7 m to 1942.9 m) for TOC and Rock Eval Pyrolysis in Geographe North-1. In view of the mud contamination detected in samples from other wells in the same drilling program, sediments were subjected to solvent and water extraction before analysis. The results are summarised in Table 2. A graph of Hydrogen index vs TOC (Figure 4) shows that the source rock potential of the Santonian shale is fair, and strongly gas-prone. TOC ranges from 1.2 to 2.0% while HI are significantly lower than 100. In general the kerogen appears to be oxidised Type III/IV.

ANALYSIS OF ORGANIC MATTER BY ROCK-EVAL PYROLYSIS

GEOGRAPHE NORTH-1 GEOTECH

Depth (m)		Tmax	S1	S2	S3	S1+S2	S2/S3	PI	TOC	HI	OI
1861.7	swc, ext	435	0.07	1.35	0.63	1.42	2.14	0.05	2.01	67	31
1864.1	swc, ext	434	0.16	0.53	0.76	0.69	0.70	0.23	1.20	44	63
1866.8	swc, ext	427	0.04	0.66	0.80	0.70	0.83	0.06	1.26	52	63
1942.9	swc, ext	432	0.09	1.08	1.49	1.17	0.72	0.08	1.42	76	105

ext = Solvent and water extracted sediment
A TMAX value is not reported if the S2 is <0.2mg/g
TMAX = Max. temperature S2 | S1 = Volatile hydrocarbons (HC) | S2 = HC generating potential
S1+S2 = Potential yield | S3 = Organic carbon dioxide | PI = Production index
OI = Oxygen Index | TOC = Total organic carbon | HI = Hydrogen index
nd = no data
GEOTECHNICAL SERVICES PTY LTD

Table 2: TOC and Rock-Eval data

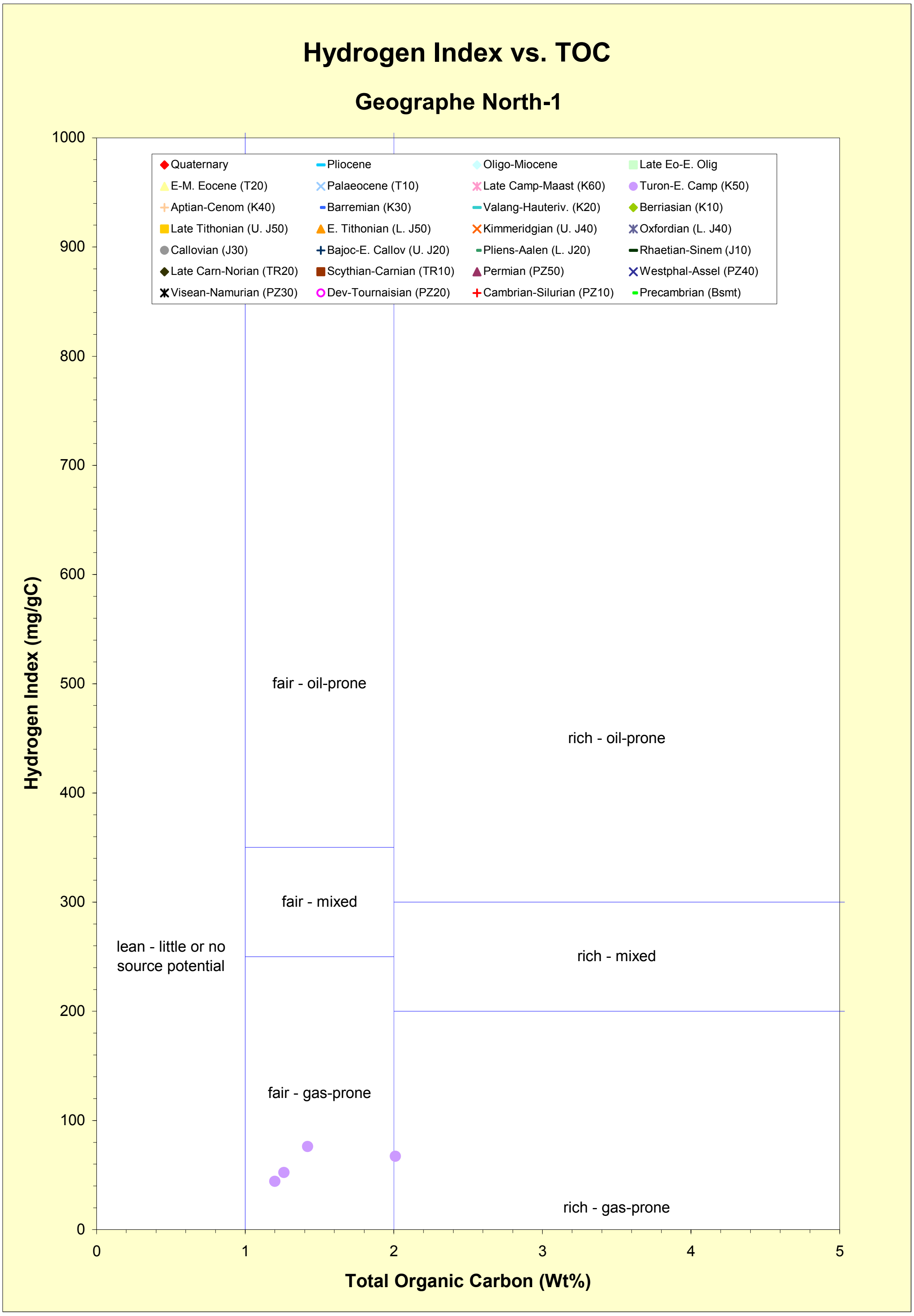
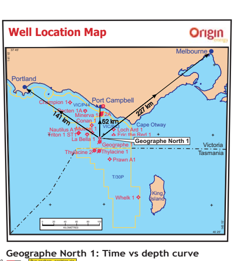


Figure 4: TOC vs. Hydrogen Index

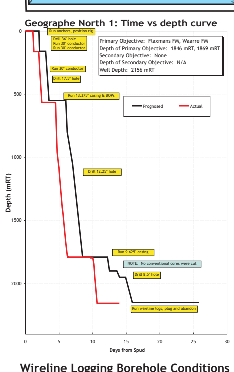
GEOGRAPHE NORTH-1
COMPOSITE WELL LOG

Origin energy

Well Location Map



Geographe North 1: Time vs depth curve



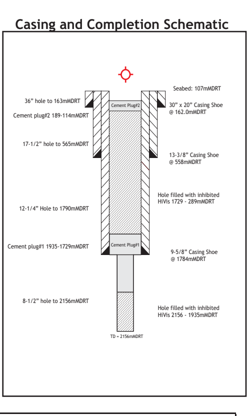
Well Data Card

Well:	Geographe North-1
Well Type:	Vertical Exploration Well
Well Status:	Plugged and Abandoned
Tenement:	VIC/P43
State:	Victoria
Basin:	Otway
Location:	

Latitude: 39°04'39.928" South Easting: 665 736.2 mE
Longitude: 142°54'57.647" East Northing: 5 672 832.3 mN
(AGD 84; AMG Zone 54, Central Meridian 141° East). Well positioned 5.6 metres on a bearing of 240.0° (G) from intended location.

Seismic Reference:	Inline 870/CDP 2640: Investigator 3D survey	
Elevation:	25m (RT-AMSL)	
Water Depth:	82.0m (LAT to seabed)	
Total Depth (Drillers):	2156 mMDRT	
Rig on Location:	16:30hrs 28/09/2001	
Spud:	04:00hrs 29/09/2001	
TD Reached:	16:30hrs 08/10/2001	
Rig Released:	18:30hrs 14/10/2001	
Permit Operator:	Origin Energy Resources Limited	
Permit Interests:	Origin Energy Resources Limited (Operator)	30%
	Woodside Energy Ltd	55%
	CalEnergy Gas (UK) Ltd	15%
Rig Name:	Ocean Bounty	
Rig Type:	Semi-submersible MODU	
Drilling Contractor:	Diamond Offshore General Co.	
Well Cost:	A$ 11,262,986	
Service Company:	Schlumberger	

Casing and Completion Schematic



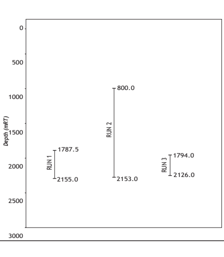
Formation	Tops mMDRT	Tops mSS	Tops Thickness (m)	Lithological Summary
Port Campbell Limestone	107.0	82.0	136.1	No Returns 107.0 - 565.0 mMDRT
Gellibrand Marl			370.9	
Upper Gellibrand Marl	243.1	218.1	(342.9)	No Returns 107.0 - 565.0 mMDRT
Lower Gellibrand Marl	586.0	561.0	(67.1)	No Returns 107.0 - 565.0 mMDRT; Below 565.0 mMDRT, argillaceous calcilutite with minor interbedded calcareous claystone
Narrawaturk Marl	653.1	628.1	77.7	argillaceous calcilutite with minor interbedded calcareous claystone and argillaceous calcarenite
Mepunga Formation	730.8	705.8	153.0	sandstone with minorl silty sandstone
Dilwyn Formation	883.8	858.8	203.4	sandstone with lesser argillaceous siltstone and rare claystone
Paaratte Formation	1087.2	1062.2	335.7	argillaceous siltstone with minor interbedded sandstone and silty sandstone
Belfast Formation	1422.9	1397.9	423.4	silty claystone grading to argillaceous siltstone
Thylacine Member	1846.3	1821.3	21.5	silty claystone and minor argillaceous sandstone
Flaxmans Formation	1867.8	1842.8	116.2	interbedded silty claystone and sandstone
Waarre Formation			172.0+	
Upper Waarre Formation	1984.0	1959.0	(172.0+)	sandstone with minor siltstone
TD	2156.0	2131.0		

Wireline Logging Borehole Conditions

Suite-1

Run	1	2	3
First Reading (m)	2155.0	2153.3	2126.0
Last Reading (m)	1787.5	800.0	1794.0
Bit Size (in)	8.5	8.5	8.5
Fluid Type	KCl/PHPA/Glycol	KCl/PHPA/Glycol	KCl/PHPA/Glycol
Density (g/cc)	1.16	1.16	1.16
Viscosity (s)	54	54	54
Fluid Loss (cm3)	4	4	4
pH	9.5	9.5	9.5
RM @ measured Temp (ohm.m @ oC)	0.113 @ 22	0.113 @ 22	0.113 @ 22
RMF @ measured Temp (ohm.m @ oC)	0.100 @ 22	0.100 @ 22	0.100 @ 22
RMC @ measured Temp (ohm.m @ oC)	0.200 @ 22	0.200 @ 22	0.200 @ 22
Max. Recorded Temp (°C) @ Depth (m)	89.2 @ 2110.9	93.0 @ 2131.4	Thermometer broken, no data
Circulation Stopped	08/10/01 1700	08/10/01 1700	08/10/01 1700
Logger on Bottom	09/10/01 0410	09/10/01 1425	09/10/01 2320

Suite - 1
Run 1: Pex(HRLA)-DSI-GPIT
Run 2: CSAT-GR Checkshot
Run 3: CST-GR



LITHOLOGIES

Mudcake, Washout, Limestone, Marl, Calcareous Sandstone, Claystone, Carbonate, Sandstone, Siltstone

LEGEND

Cement Plug; Casing shoe; Palynological Data; CST: Full Sample; CST: Partial Sample; CST: No Sample

FORMATION	ENGINEERING	DEPTH (m) 1:500	LITHOLOGY					CST's/ SAMPLES	LITHOLOGY REMARKS
	Total Gas (TGAS) 0.0 (%) 5.0; Rate of Penetratio 300.0 (M/H) 0.0			Caliper (HCAL) 6.0 (INCH) 16.0; SP Drift-corrected (SPDC) -20.0 (MV) 80.0; Gamma Ray Casing-corrected (GRCC) 0.0 (API) 200.0; Bitsize (BS) 6.0 (INCH) 16.0	Shall. Laterolog (RLA3) 0.2 (OHMM) 2000.0; Deep Laterolog (RT) 0.2 (OHMM) 2000.0; Micro Laterolog (Rxo) 0.2 (OHMM) 2000.0	Delta-Rho (HDRA) -0.75 (G/CC) 0.25; Thermal Neutron (HTNP) 0.45 (V/V) -0.15; Density (RHO8) 1.95 (G/CC) 2.95	Compressional Sonic (DTCO) 140.0 (US/F) 40.0; Photoelectric Factor (PEF8) 0.0 (B/E) 10.0