BASS STRAIT OIL COMPANY LTD

GILBERT-1/1A

WELL COMPLETION REPORT

INTERPRETIVE DATA

OCTOBER 2006

VOLUME 1 OF 1

GILBERT-1/1A

WELL COMPLETION REPORT

VOLUME 1 OF 1

(INTERPRETIVE DATA)

VIC/P47
GIPPSLAND BASIN

OFFSHORE
VICTORIA

Date: October 2006
Compiled by: R. Fisher
Reviewed by: Ian Reid

Controlled Copy No: ____________

Volume 1 of 1

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DOCUMENT NO.:	BAS_WCR_004
TITLE:	BASS STRAIT OIL COMPANY PTY LTD WELL COMPLETION REPORT FOR GILBERT-1/1A (VIC/P47) *INTERPRETIVE DATA*

DOCUMENT REVISION RECORD					
Rev. No.	Date	Description	Prepared	Reviewed	Approved
0	October 2006	Well Completion Report-Interpretive Data	R Fisher	I. Reid	

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1. INTRODUCTION AND SUMMARY

The Gilbert-1/1A well is located in Commonwealth waters within Permit Vic/P47 approximately 350km east of Port Melbourne (Figure 1) and 8 km north northwest of the Patricia/Baleen producing gas field. This location is covered by the SJ 55 1:1,000,000 Melbourne Map Sheet; Graticular Block 1709. Vic/P47 is located offshore on the northern margin of the Gippsland Basin straddling the Northern Platform and Northern Terrace. The north-western portion of the permit that incorporates Gilbert-1/1A contains the Lake Wellington Fault System that separates the Northern Platform from the Northern Terrace.

Gilbert-1/1a was drilled in 51.3 metres (168') (MSL) of water by the DOGC 'Ocean Patriot' semi-submersible drilling unit and Gilbert-1 spudded on the 4th October 2005 at 07:30 hrs. The well was re-spudded as Gilbert-1A on the 4th October at 23:30 hrs. The well reached a total depth of 810 metres MD on the 9th October 2005 at 20:00 hrs in the Early Cretaceous Strzelecki Group. Wireline logs were acquired at this depth and the well was subsequently plugged and abandoned as a dry hole after encountering shows of hydrocarbon fluorescence with minor gas shows in the uppermost part of the Gurnard Formation. Despite wireline logs confirming the presence of moveable fluids in the pore space over the Gurnard Formation, wireline samples only recovered formation water. There were no lost time accidents and no environmental accidents during the drilling of Gilbert-1/1A.

The Well Card (Appendix 1) summarises pertinent data from the Gilbert-1/1A well.

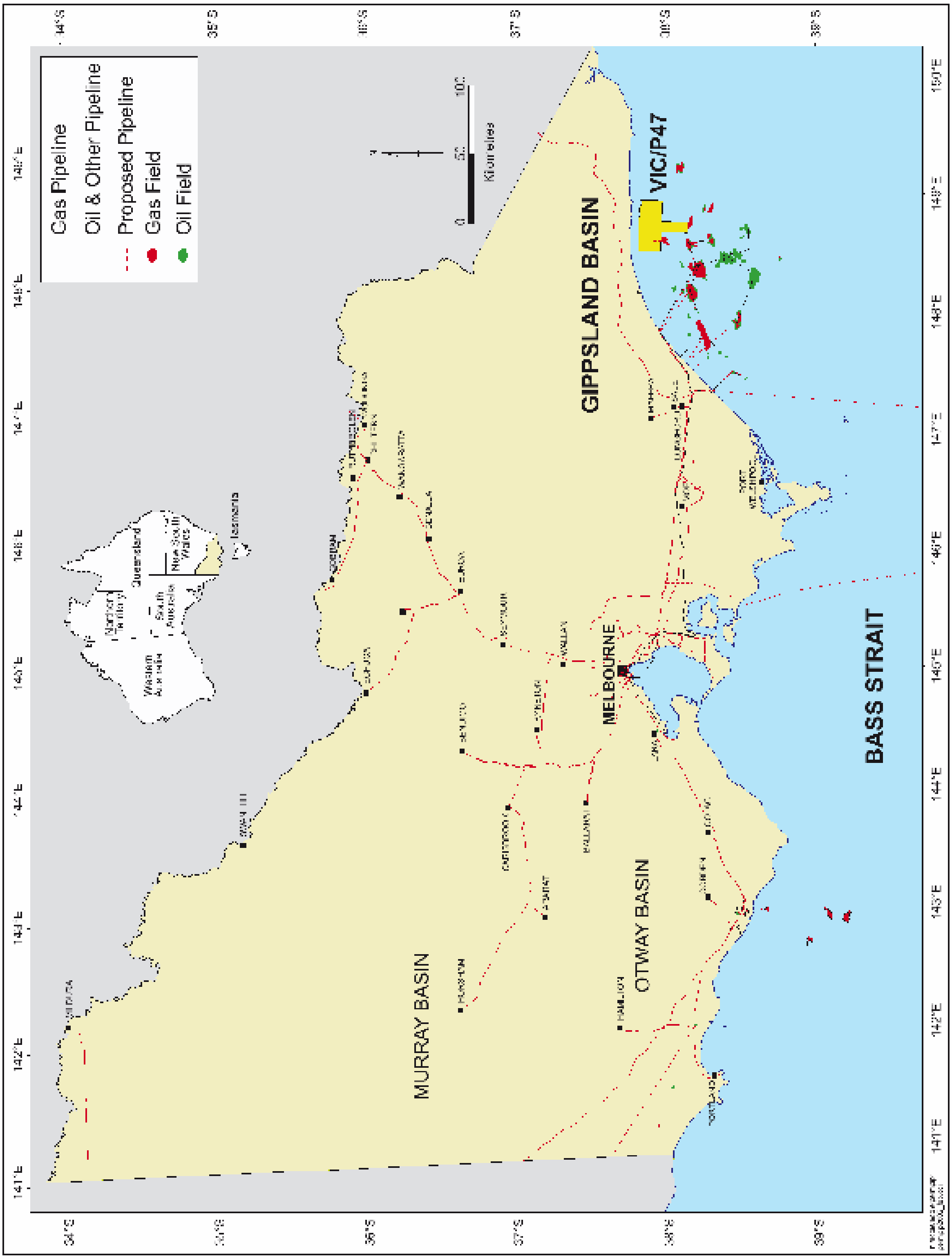

FIGURE-1: VIC/P47 LOCATION MAP

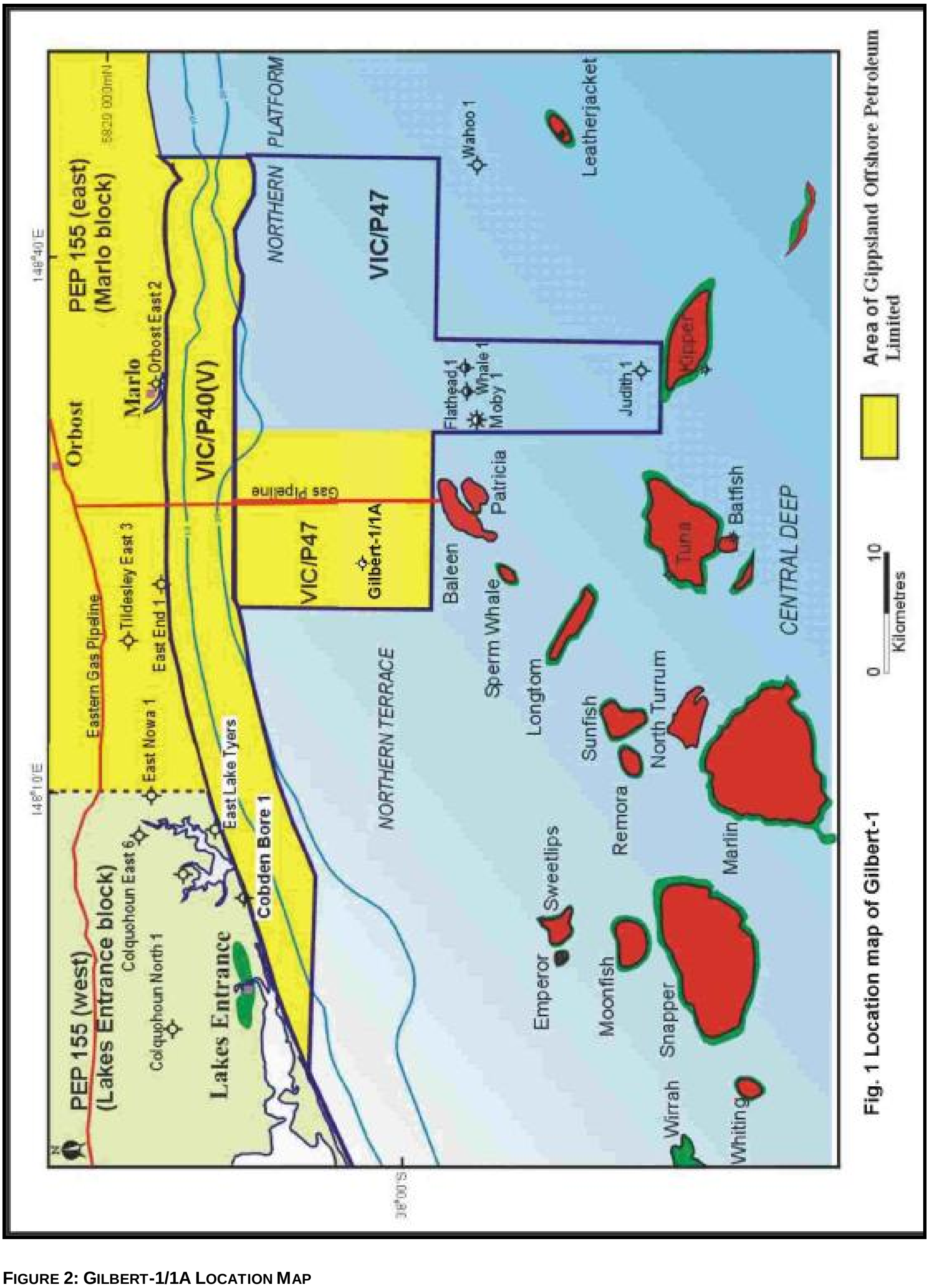

FIGURE 2: GILBERT-1/1A LOCATION MAP

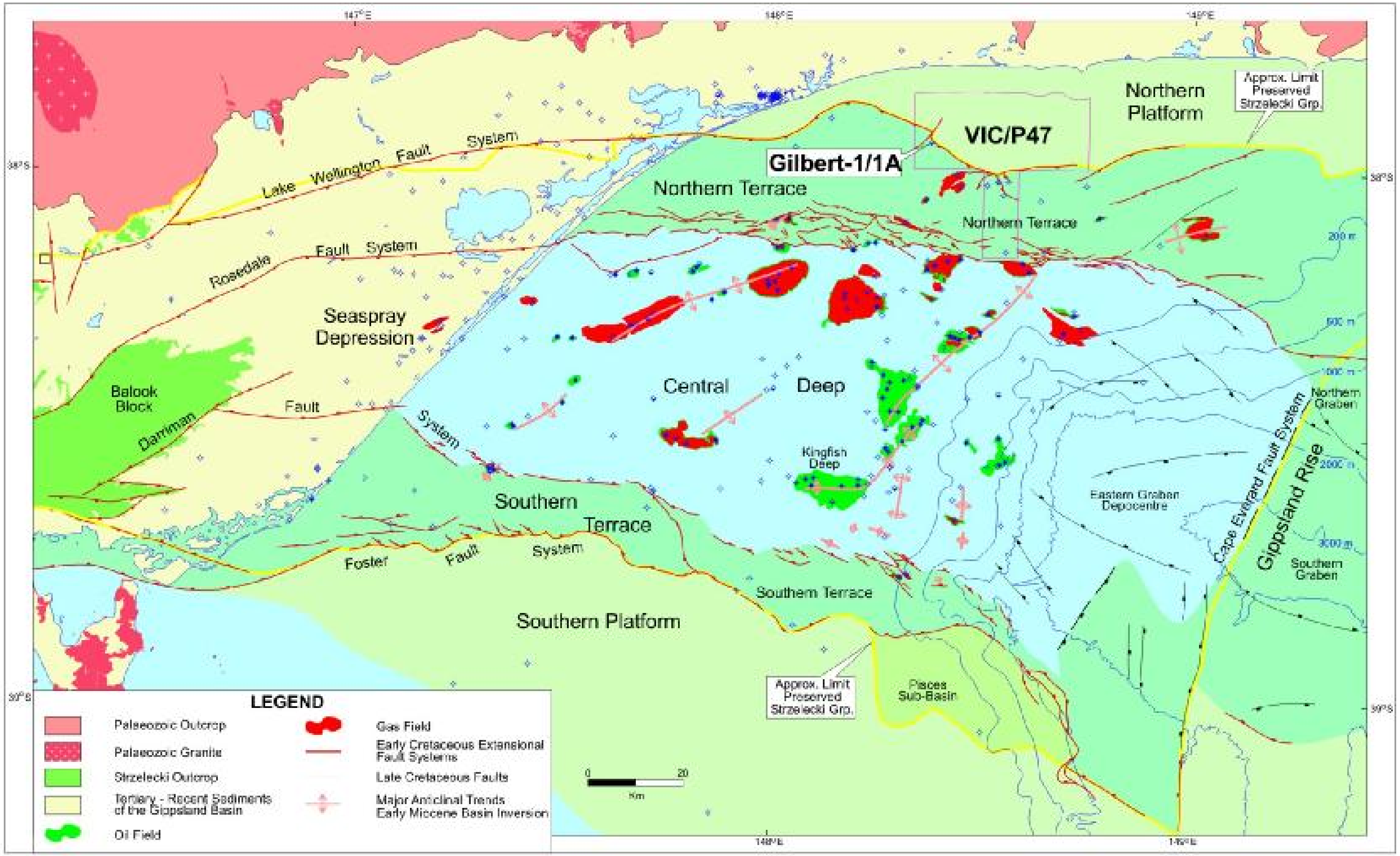

FIGURE 3: TECTONIC ELEMENTS MAP (MODIFIED AFTER WONG D., BERNECKER T. & MOORE D., 2001.)

1.1 GEOLOGICAL AND FORMATION EVALUATION SUMMARY

1.1.1 Prospect Summary

The Gilbert-1/1A exploratory well is located at SP 650 on seismic line GB79-136 and was proposed to be drilled to a Projected Total Depth of 910 metres TVD subsea. The Gilbert-1/1A well was designed to test the Gilbert Prospect, a low side fault trap in which the Gurnard Formation reservoir sands and Latrobe Group sands were interpreted to abut economic basement, which was expected to be a lateral seal. Marls of the Lakes Entrance Formation and Gippsland Limestone were expected to provide top seal for the Gilbert Prospect.

The main reservoir objective in the Gilbert Prospect was the Gurnard Formation, which has contributed more than 90% of the gas production in the nearby Patricia/Baleen fields. This reservoir comprises transgressive, glauconitic siltstone, sandstone and some greensand with porosity to 30% and permeabilities to 150md. It was expected that reservoir development at Gilbert would be similar to that at Baleen-1 well with relatively high net sand. The proximity to the basement high of the Gilbert Prospect was expected to have possibly provided coarser grained sandstone.

The top of the Latrobe “coarse clastics” or Kingfish Formation formed a secondary reservoir objective in the Gilbert Prospect. Similar rocks host 95% of the oil and 80% of the gas reserves in the Gippsland Basin. Porosities average 22% but in shallower areas closer to the basin margin, porosities are up to 30%, with permeabilities in excess of 1 darcy.

A third potential reservoir objective in the Gilbert Prospect was the top part of the Strzelecki Group. Weathered sandstones in Flathead-1 and Baleen-1 were apparently porous with permeabilities in the range of 10-500mD, although the development of a chloritic cement usually makes these sandstones tight and they are more typically a waste zone or seal.

There were two possibilities for the sourcing of an accumulation of hydrocarbons in the Gilbert Prospect.

The coaly lower coastal plain organic rich mudstones and coals of the Latrobe Group provided the source rocks for both oil and gas in the Gippsland basin. The mature source rocks for the Gilbert Prospect are interpreted to occur in the Central Deep to the southwest. Charge was expected to originate directly from the south of the structure and via spill from the Sunfish Oil Field to the southwest and other oil and gas fields to the south. Oil and gas charge is known to occur in the nearby Patricia/Baleen fields. Although dry gas was encountered in the Patricia/Baleen wells, the occurrence of oil in nearby wells e.g. Baleen-2, Flathead-1, Spermwhale-1 and Moby-1 indicate likely oil charge may also have occurred. A well on the Gilbert Prospect was interpreted to provide high vertical relief in excess of the interpreted gas-fluid contact in the nearby Patricia/Baleen wells, and thus was expected to allow retention of an oil leg.

From Lakes Oil NL’s recent experience in the onshore Gippsland Basin, the underlying Strzelecki Group is interpreted to offer oil source potential and to be within the oil maturity window. The Strzelecki Group has been considered primarily a gas source, but the Upper Strzelecki time and facies equivalent in the Otway Basin, the Eumeralla Formation, contains both gas and oil sources. Oil (40.9° API) generated from the Killara Coal sequence of the Eumeralla Formation was recovered from the intra-Eumeralla Heathfield Sandstone at Windermere-1 in the Otway Basin. In the Gippsland Basin, the Lakes Oil N.L. well Wombat-1 in PEP 157 recovered gas and light oil (47° API) from the Upper Strzelecki Group and Wombat-2 flowed gas with a condensate ratio of 3 bbl/mmcf from the same sequence. The Golden Beach Subgroup is currently considered the principal source of oil and gas in the offshore Gippsland fields (Bernecker et al in *Geology of Victoria*, Geological Society of Australia, 2003).

The key geological issues relating to the economic success of the Gilbert Prospect were:

1. the thickness of the primary objective Gurnard reservoir as determined from seismic, as it thins up-dip towards the basement block and:
2. the seal integrity of the Lake Wellington Fault which has propagated through to the shallow part of the Gippsland Limestone.

1.1.2 Geological and Formation Evaluation Summary

Gilbert-1/1A was spudded at 07:30 hrs on the 4th October 2005 and penetrated a sedimentary section ranging in age from Tertiary to Early Cretaceous. The stratigraphic section encountered was as predicted down to the Gurnard Formation. The Gurnard Formation was some 22 m thinner to prognosis and the Latrobe "Coarse Clastic" section was absent. The geological formations and data encountered for each hole section are discussed below.

The Miocene to Pliocene Gippsland Limestone was encountered at seafloor (covered by a veneer of Recent sediments) at 72.8 mMDRT (-51.3 mTVDSS). The upper part of this formation was drilled riserless in 914 mm (36") and 445 mm (17-½") hole sections down to a depth of 336.0 mMDRT. Intermediate 340 mm (13 ⅜") casing was subsequently run to 331.0 mMDRT where the BOPs and marine riser were run. Following displacement with drilling mud, 311mm (12 ¼") hole was drilled to a total depth of 810.0 mMDRT. Realtime geological control was provided while drilling using LWD Gamma-Ray/Resistivity logs. The hole section was wireline logged after reaching TD, providing depth control for the stratigraphic sub-division.

The lower part of the Gippsland Limestone below 336.0 mMDRT consists of argillaceous calcilutite with minor calcarenite and argillaceous calcisiltite. The base Gippsland Limestone/Top Lakes Entrance Formation is identified at 438.0 mMDRT (-416.5mTVDSS). It was encountered 12.5 metres low to prognosis, based upon the appearance of marl in the section. The Oligocene to early Miocene Lakes Entrance Formation consists of marl grading to, and interbedded with argillaceous calcilutite, calcisiltite and calcareous claystone. The basal part of the Lakes Entrance Formation is differentiated at 582.0 mMDRT (-560.5 mTVDSS) and defined as the Early Oligocene Wedge, which unconformably overlies the Gurnard Formation.

The primary objective Middle Eocene Gurnard Formation was intersected at 622.3 mMDRT (-600.8 mTVDSS), 5.8 metres low to prediction. The formation at Gilbert-1A consists of argillaceous and silty sandstone (lithic arkose) and siltstone with minor greensand and claystone. All lithologies contain at least trace amounts of glauconite. Sandstone cuttings over the gross interval 624.0-636.0 mMDRT within the Gurnard Formation exhibited 20% dull – moderately bright yellow fluorescence, with a slow to moderately fast blue-white cut and solid blue-white ring residue. Lithologies consistent with belonging to the Latrobe "Coarse Siliciclastics" were not intersected in the well, and the unit is interpreted to be absent. Consequently the Gurnard Formation rests unconformably on the Early Cretaceous (Barremian to Aptian) Strzelecki Group intersected at 656.5 mMDRT (-635.0 mTVDSS), 139.0 m high to prognosis. The Strzelecki Group consists predominantly of argillaceous lithic sandstone (litharenite).

The well reached total depth (TD) within the Strzelecki Group at 810.0 mMDRT (-788.5 mTVDSS) at 21:00 hrs on the 9th October 2005. This was 100 metres above the originally programmed total depth of the well. Schlumberger wireline logs were recorded in four runs at TD:

PEX(HALS)-DSI-LEHQT
CMR+-HNGS
MDT-GR
MSCT-GR

The primary wireline log recorded was the PEX (HALS)-DSI-LEHQT combo which was logged from 806.0 mMDRT to 331.0 mMDRT, after which the GR-DSI was logged up through casing to the seafloor, although the sonic signal deteriorated towards the seafloor. This log represents the primary depth control for Gilbert-1A. Logger's TD was shallow to Driller's TD by 4.0 m owing to possible fill on bottom. The 340mm (13 3/8") casing shoe at 331.0 mMD RT was found to be 1.0 m shallower than Driller's Depth.

The CMR+-HNGS was run from 802.0-580.0 mMDRT with a repeat pass carried out from 690.0-610.0 mMDRT and these logs confirmed the presence of moveable fluid in the pore spaces over the Gurnard Fm. This log was run specifically to better define effective porosity within the Gurnard Formation, a reservoir zone otherwise containing abundant, non-effective micro-porosity.

The MDT successfully recorded 13 valid formation pressures and 7 formation fluid samples were recovered to surface. The MDT samples were drained at surface and were shown to be formation water. Sample quality was good with low levels of contamination, ranging from 3.6-12.2 % filtrate concentration, as measured by Petrotech. The exception was the sample from 634.2 mMDRT which contained a scum of fluid with a filtrate concentration of 82.9 %. This sample had been taken with great difficulty due to the low mobility of the rock and could not even be overpressured due to the tightness of the formation. From 17 MSCT cores attempted, all 17 were successfully recovered. The seismic run was cancelled and Schlumberger wireline was rigged down at 17:15 hrs on the 11th October 2005.

Gilbert-1A was plugged and abandoned as a dry hole and the rig released at 14:00 Hrs on the 14th October 2005. A composite well log of the lithology intersected in Gilbert-1A is included as Enclosure 1.

1.2 DRILLING SUMMARY

The Diamond Offshore General Company MODU "Ocean Patriot" was mobilized from the ANZON Basker-2 location at 08:00 hrs on the 2nd October 2005. Operations commenced at the Gilbert-1 location at 15:30 hrs on the 2nd October 2005 when the first anchor (#5) was dropped. Positioning the rig on location was completed by 17:30 hrs 3rd October 2005 at which time the rig was ballasted down to drilling draft.

Gilbert-1 was spudded at 07:30 hrs on the 4th October 2005 and the 914 mm (36") hole was drilled to 107.0 mMDRT. An obstruction 6 m below the surface of the seabed, however, prevented the running of the conductor to bottom. This location was abandoned and the rig moved 9.5 m in a port forward direction hauling on anchors. The well was re-spudded as Gilbert-1A at 23:30 hrs on the 4th October 2005.

The Gilbert-1A well location was surveyed 3.7 m from the proposed Gilbert-1 location on a bearing of 231.3^{O} True. The final fix for Gilbert-1A is:

Latitude: 37^{O} 57' 10.72" S
Longitude: 148^{O} 22' 25.90" E
Easting: 620, 701.1mE
Northing: 5, 798, 512.1mN
DATUM: GDA 94

Gilbert-1A spudding operations commenced with the running of the TGB which was landed at 72.8 mMDRT (WD = 51.3 m BMSL). The well was spudded with a 914mm (36") hole-opener and drilled from 72.8 – 78 mMDRT with a low RPM, SPM and WOB through hard formation. At 78.0 mMDRT an Anderdrift survey was conducted which showed a hole deviation of 0.5 degrees. Drilling then proceeded from 78.0 -107.0 mMDRT. Drilling parameters were increased to full drilling capacity from 79.0-107.0 mMDRT. An Anderdrift survey at section TD recorded 0.5 degrees. At section TD, 100 PHG (gel) was swept around the hole. A short trip was made to the mudline spotting 220 bbl of PHG to fill up the hole prior to pulling out of hole to run the casing. After coming out of hole with the drill string and laying out the BHA, a double of 5" DP was made up with the running tool and connected to the 762 mm (30") casing housing. The 762 mm (30"/20") conductor was then run to sea level, attached to the landing string and then run into hole with the shoe set at 106.0 mMDRT. The bulls-eye reading was 1 degree stb/fwd.

Cement lines were rigged up and tested to 2000 psi. The low torque valve in the rig up assembly leaked. This was changed out and successfully re-tested to 2000 psi. Approximately 182 bbls of cement slurry (15.8 ppg) were mixed and pumped around the casing annulus and displaced with 26 bbl of sea water. The BHA for the next hole section was made up while waiting on cement. The well head running tool was released and the landing string was recovered.

The bulls-eye was re-measured at 1 degree stb/fwd. The 18 3/4" wellhead housing running tool was laid out. The Deep Sea Express cement head was racked back. A JSA was held and the 914 mm (36") BHA was laid down and the 445 mm (17 1/2") BHA was picked up. The MWD tools were initialized and the 445 mm (17 1/2") BHA was made up and stabbed into the wellhead with ROV assistance. The TOC was tagged at 101.0 mMDRT and the shoe was drilled out. The 445 mm (17 ½") hole was then drilled from 107.0-336.0 mMDRT. The hole was swept clean with 50 bbls of PHG and then displaced with 320 bbls of PHG. A Totco survey was dropped due to the MWD tool failure which resulted in no realtime surveys being acquired during drilling. LWD data was only recorded down to 268.0 mMDRT due to a battery failure in the tool. This was a separate problem and not related to the inability to take surveys. A wiper trip was performed from 336.0-105.0 mMDRT and the Totco was recovered at the shoe. The hole was swept again with 50 bbls of PHG and then displaced to PHG mud. The BHA was pulled out of hole and racked back and the MWD tools were laid down. A JSA was held and the casing handling gear was rigged up. The float and shoe joints were picked up and tested. The 340 mm (13 3/8") casing was run to 331.0 mMDRT and set there. The cement line was rigged up and the casing was set in place with 128.7 bbls of lead slurry (12.5 ppg) and 84 bbls of tail slurry (15.8 ppg). The plug was bumped with 1500 psi for 10 minutes. There were good returns to the mudline and dye returns were noted. The running tool was released and recovered. The launcher and cement head were laid down and the marine riser running equipment was rigged up at 04:00 hrs on the 7th October 2005.

The BOP and riser were run and the landing joint and tensioner were picked up and installed. The choke and kill goosenecks were installed and tested. The BOP was landed and latched and the connectors were tested. The landing joint was laid out and the diverter was installed. The riser handling equipment was laid out and the test plug was made up and run. The BOP and LMRP connector was tested to 3000 psi for 10 minutes. The test plug was recovered and laid down.

The 445 mm (17 ½”) BHA was laid down and the 311 mm (12 ¼”) BHA was picked up. The cement was tagged at 303.0 mMDRT and the shoe was drilled out. Three metres of new formation was drilled out and a FIT was performed giving an EMW of 1.44 sg. The mud was circulated and difficulty was experienced getting the polymers to shear. The 311 mm (12 ¼”) hole was drilled from 339.0-568.0 mMDRT. Controlled drilling commenced and the hole was drilled to 680.0 mMDRT at approximately 20 m/hr. Drilling continued from there to TD of 810.0 mMDRT at approximately 25 m/hr. A detailed geological summary for Gilbert-1A is described in a separate section below.

Bottoms up gas of 2.7% was recorded following circulation of the well. A wiper trip was performed and circulation stopped at 03:15 on the 10th October 2005. The BHA was pulled out of hole and the MWD was downloaded at 07:00 hrs. A JSA was held and Schlumberger wireline logging commenced at 07:25 hrs on the 10th October 2005. Four logging runs were completed and the wireline was rigged down at 17:15 hrs on the 11th October 2005.

The P&A program was started immediately and cement plugs were set as per the P&A completion details section at the top of this report from 810.0-270.0 mMDRT. Tubulars were laid down from the derrick while waiting on the cement to harden.

Riser pulling activities commenced and the rig was released at 14:00 Hrs on the 14th October 2005. The total time spent drilling and abandoning Gilbert-1A was 12 days.

A more comprehensive summary of the drilling may be found in the Gilbert-1/1A Well Completion Report –Basic Data issued under separate cover.

2. WELL HISTORY

2.1 WELL DATA SUMMARY

Well Name		Gilbert-1/1A
Operator		Bass Strait Oil Company Ltd
Equity Partners		Gippsland Offshore Petroleum Ltd 51% Lakes Oil NL 26% Eagle Bay Resources NL 10% Moby Oil & Gas Ltd 10% Stellar Resources 3%
Permit		Vic/P47 "Gilbert"
Basin		Gippsland Basin
Type of Well		Exploration
Well Status		Plugged & Abandoned
Surface Well Location	**Easting**	620,701.1m E
	Northing	5,798,512.1m N
	Latitude	37° 57' 10.72" S
	Longitude	148° 22' 25.90" E
	Datum	GDA94
Seismic Reference		GB79-136/SP-650
Map Reference		SJ 55 1:1,000,000 Melbourne Map Sheet; Graticular Block 1709
Objectives	***Primary***	Gurnard Formation
	Secondary	Latrobe and Strzelecki Groups
Total Depth	**mMD RT**	810.0
	mTVD SS	788.5
Elevations	**Water Depth**	51.3 m (MSL)
	Rotary Table	+21.5m
Rig on Contract		2nd October 2005; 08:00 hours
Spud Date		4th October 2005; 07:30 hours
Well Reach TD		9th October 2005; 20:00 hours
Rig Released		14th October 2005; 14:00 hours
Budget Well Cost	**AUD**	$6,049,486
Estimated Actual Well Cost	**AUD**	$6,548,248.07

2.2 OPERATIONS SUMMARY

Detailed information on drilling and engineering data may be found in the Gilbert-1/1A Final Well Report - Basic Data.

3. GEOLOGY

3.1 SUMMARY OF PREVIOUS EXPLORATION

Permit Vic/P47 which covers an area of 718 km^2 in water depths of 20-75 m in Bass Strait near the Patricia Baleen gas fields, was granted to Eagle Bay Resources NL (100%) pursuant to the PSLA by the Designated Authority for an initial six year period commencing on the 28th May 2001. On the 15th March 2004 Year 2 was suspended so that the Year 2 anniversary date was 27th February 2005. A suspension of the permit Year 3 was awarded for 10 months due to the acquisition of the Moby 3D which meant that the year now ends on 27th December 2005.

By a farm-in agreement made between Bass Strait Oil Company Ltd (BAS) and Eagle Bay Resources on the 13th June 2003 (pursuant to an option agreement between BAS and Eagle Bay dated 8th April 2002, as amended), BAS acquired a 75% interest in permit Vic/P47 and became operator. BAS agreed to earn the 75% farm-in interest by meeting the Year 2 work commitment by drilling Moby-1 which was undertaken in 2004. By a further farm-in agreement made between Moby Oil & Gas Limited (MOG) and BAS, MOG acquired a 35% interest in permit Vic/P47 by contributing to the cost of drilling Moby-1. Bass Strait Oil Company Ltd operated the drilling of Gilbert-1/1A, pursuant to an agreement made between the Vic/P47 Joint Venture and Lakes Oil NL (Lakes). By drilling the Gilbert-1 well, Lakes earned an interest in four graticular blocks on the northwest margin of Vic/P47 (the “Gilbert Blocks”). BAS did not retain any participating interest in these four Gilbert blocks. The Lakes agreement with Vic/P47 was conditional on Lakes successfully sponsoring the formation of a new company, Gippsland Offshore Petroleum Ltd (GOP). To this end, Lakes formed GOP and made other assignments of their interest as shown below. A Farmin and Co-ordination Agreement was later signed between Bass et al dated 20th January 2005. Pursuant to this later agreement, the participating interests in Vic/P47 “Gilbert Blocks” are now as follows:

Bass Strait Oil Company Ltd (BAS) - 0%; Moby Oil & Gas Limited (MOG) - 10.0%, Eagle Bay Resources NL - 10.0%, Gippsland Offshore Petroleum Ltd (GOP) 51%, Lakes Oil NL 26.0% and Stella Resources Ltd 3%.

3.1.1 Seismic Data

The Gilbert Prospect was defined on the GB seismic survey acquired in 1980 by Beach Petroleum and is defined as a low side fault trap in which the Gurnard Formation reservoir sands and Latrobe Group sands abut economic basement which was expected to be a lateral seal. Marls of the Lakes Entrance Formation and Gippsland Limestone were expected to seal the Gilbert Prospect. Seismic line GB79-136 illustrates the Gilbert Prospect through the Gilbert-1/1A location included herein as Figure 6. A two way time structure map to the top of the Latrobe Group illustrates the prospect and is included herein as Figure 5.

3.1.2 Well Data

To date, only four other wells have been drilled in the area now covered by permit Vic/P47 prior to Gilbert-1/1A, while a number of other key wells have been drilled immediately adjacent to the permit and are currently within Vic/L21.

Four wells were used in assessing the Gilbert-1/1A prospect. These are Flathead-1 and Whale-1 in Vic/P47 and Patricia-1 and Baleen-1 in Vic/L21. All wells intersected the Top Latrobe as their target and bottomed in sediments of the Strzelecki Group.

Flathead-1 which was drilled by Esso Australia in 1969, was drilled in a crestal position on the Moby Anticline, 16km SE of Gilbert-1/1A. The well reached a total depth of 1066 m MD in the Strzelecki Formation and it was plugged and abandoned as a potential oil discovery in the Kingfish Sandstone, with good gas shows in the Gurnard Formation siltstone. Oil was extracted from Kingfish Formation core with an API gravity of 14.6^{O} and 50 centipoise.

Whale-1 was drilled by Hudbay Oil (Australia) Ltd in 1981, also in a crestal position on the Moby Anticline, 18 km SE of Gilbert-1/1A. The well reached a total depth of 810 m MD in the Strzelecki Formation and it was plugged and abandoned with excellent oil shows in Latrobe Group sandstone and Gurnard Formation, with some minor gas shows, although testing failed to recover fluids. Oil extracted from a sidewall core sample from the Gurnard Formation had an API gravity of $19.9\text{-}22.3^{O}$.

Patricia-1 and Baleen-1 are located 11 km and 8 km SE of Gilbert-1/1A and were drilled in 1987 and 1981 respectively. These wells were drilled on closed structures and intersected gas-bearing sandstones in the Gurnard Formation. The Patricia Baleen gas project is now on stream through a pipeline which joins the fields extending through the western portion of Vic/P47 to the main trunkline to New South Wales.

3.2 REGIONAL STRUCTURE AND GEOLOGY

Vic/P47 is located offshore on the northern margin of the Gippsland Basin, straddling the Northern Platform and Northern Terrace, approximately 350 km east of Port Melbourne. The Gilbert Prospect lies to the south of the Lake Wellington Fault System that separates the platform from the terrace. The Generalised Stratigraphic Column reflecting the Early Cretaceous to Recent gross lithostratigraphic units of the Gippsland Basin (Figure 4) summarises much of the following discussion.

3.2.1 Geological Evolution

The east-west trending Gippsland Basin was formed as a consequence of Gondwana break-up (Rahmanian et al 1990; Willcox et al 1992; Willcox et al 2001; Norvik & Smith 2001; Norvick et al 2001) and the basin evolution is recorded by several depositional sequences that range from Early Cretaceous to Recent in age (Thomas et al 2003).

The profound tectonic control on sedimentary systems in the basin is exemplified by several basin-wide angular unconformities that are easily recognised on seismic sections. Other time-breaks are only recognised using biostratigraphic age determinations delineating missing sections. This is of particular relevance in the context of the upper Latrobe Group, where extensive channel incision and subsequent infill processes resulted in complex sedimentary sequences that developed at slightly different time intervals, the extent of which cannot be resolved by seismic mapping alone.

3.2.2 Tectonic History

The Gippsland Basin is an asymmetric graben formed by the incipient break-up of Australia and Antarctica (Otway Rift) during the earliest Cretaceous (130-96 Ma). As part of this Early Cretaceous rift system, the Gippsland Basin architecture initially featured a classic extensional geometry consisting of a depocentre (the Central Deep) flanked by platforms and terraces. These are defined by the Rosedale and Lake Wellington Fault systems on the northern basin margin and by the Darriman and Foster Fault systems on the southern margin. The Central Deep hosts most of the oil and gas fields and, to the east, is characterised by rapidly increasing water depths which exceed 3000m in the Bass Canyon (Hill et al 1998). The eastern boundary of the basin is defined by the Cape Everard Fault System, a prominent NNE-striking basement high clearly evident from the aeromagnetic data (Moore & Wong 2002). The western onshore extent of the basin is traditionally placed at the Mornington High, but for the units described in this report it is essentially represented by out-crops of Early Cretaceous Strzelecki Group sediments (Hocking 1988). A tectonic elements and basin setting map is included herein as Figure 3 (modified after Wong D., Bernecker T. & Moore D., 2001.).

Crystalline basement is formed by the low grade metamorphic and igneous rocks of the Palaeozoic Tasman Fold Belt that have a general north-south tectonic grain and are cross-cut by NE-SW trending basement-involved fault zones formed during the Cretaceous rift phase.

Australia commenced its separation from Antarctica during the Cenomanian. The plate suture did not extend into the Gippsland Basin, but instead continued down the western side of Tasmania. The break-up created an unconformity at the end of the Early Cretaceous, not only in those basins where new oceanic crust formed but also further east in the Bass and Gippsland Basins.

Initial rifling in the Early Cretaceous resulted in 30% crustal extension (Power et al 2001) and created a complex system of grabens and half-grabens. A compressional phase accompanied by uplift occurred between 100 and 95 Ma which has been linked to the separation of Australia from Antarctica (Duddy & Green, 1992). This produced a new basin configuration and provided the accommodation space for large volumes of basement derived sediments. A second phase of crustal extension, produced by rifting between Australia and the Lord Howe Rise (Tasman Rift), began at the end of the Early Cretaceous and produced northwest-southeast oriented basement-involved normal faults and established the Central Deep as the main depocentre. The first marine incursion is recorded by Late Santonian sediments in the eastern part of the basin (Partridge, 1999). Many: of the earlier generated faults were reactivated during this tectonic phase.

Rifting was followed by the development of a margin-sag basin characterised by rapid subsidence. Extensional tectonism prevailed until the Early Eocene and produced pervasive NW-SE trending normal faults. By the Middle Eocene, sea-floor spreading had ceased in the Tasman Sea and a period of compressional tectonism began to affect the Gippsland Basin, initiating a series of NE to ENE trending anticlines (Smith. 1988). Compression and structural growth peaked in the Middle Miocene and resulted in basin inversion. All the major fold structures at the top of the Latrobe Group which became the hosts for the large oil and. gas accumulations such as Barracouta, Tuna, Kingfish, Snapper and Halibut are all related to this tectonic episode.

A second regional event at this stage was a widespread mid-Eocene marine transgression that is recognised in the Gippsland, Taranaki and southern Australian margins (Norvik et al, 2001). Plate reorganisation occurred at this time leading to the onset of fast spreading south of Australia, obduction in New Caledonia and other movements in New Zealand. The Lakes Entrance Formation became a widespread depositional unit at this time and was succeeded by prograding carbonate wedge deposits of the Gippsland Limestone that continue to be deposited today.

Tectonism has continued to overprint the basin as documented by localised uplift during the Late Pliocene to Pleistocene. This is also reflected in the uplift of Pliocene sediments on the Barracouta, Snapper and Marlin anticlines as well as around the township of Lakes Entrance on the Victorian coastline. Ongoing tectonic activity is episodically recorded by seismic events around the major basin bounding faults.

The superposition of different age structures in the Gippsland Basin has produced a structural style characterised by multi-directional fault, fold and erosional patterns, allowing a range of trapping mechanisms, from large anticlines to complex, fault-controlled rotated blocks and truncation plays. The timing of the structuring, specifically the large compressional anticlines initiated in the Late Eocene, is particularly critical to the entrapment of most of the hydrocarbons in the basin, as the key geometry of the traps was in place prior to the generation of most of the oil and gas.

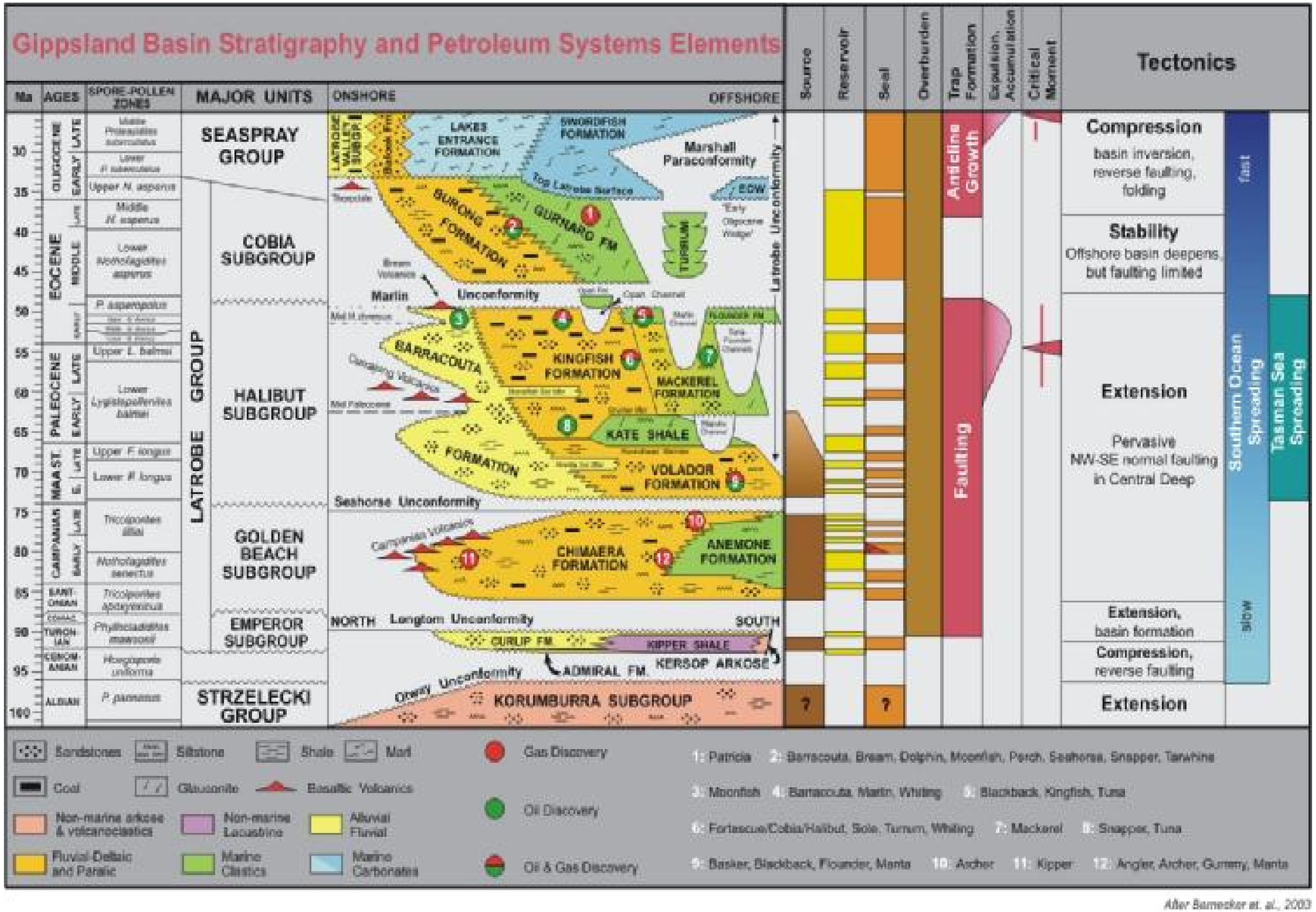

FIGURE 4: GENERALISED STRATIGRAPHIC COLUMN OF THE GIPPSLAND BASIN (AFTER BERNECKER, T., THOMAS, H. & DRISCOLL, J., 2003).

3.3 STRATIGRAPHY

Gilbert-1/1A penetrated a sedimentary section ranging in age from Early Cretaceous to Recent. The lithologies described herein follow the convention that the dominant lithology is mentioned first. Depths are measured depths (MD) in metres below the Drill Floor (DF) which was 21.5m above Mean Sea Level (MSL) and 72.8m above the seafloor, unless otherwise stated.

No ditch cuttings samples were collected over the 914mm (36") and 445mm (17 ½") hole sections drilled between the seabed (72.8mMD RT) and 336mMD RT in Gilbert-1/1A. Following installation of the marine riser, the well was drilled from 336mMD RT to 810 mMDRT (Total Depth) with full returns.

The wellsite lithological descriptions of the cuttings samples are contained in Appendix 1 of the Gilbert-1/1A Well Completion Report (Basic Data). A composite log of the lithology is provided in Enclosure 1, this volume. The lithology described hereunder is a synthesis of the lithological descriptions of cuttings, sidewall cores and petrophysical and petrological data. Table 1 below summarises the formations intersected and the relevant depths to the top of the formation.

Table 1. Gilbert-1/1A Stratigraphic Table. Drill Floor = 21.5m.

Formation/Age	Depth	Depth	True Thickness	Seismic Time TWT
	(mMD RTRT)	**(mTVDSS)**	**(m)**	**(msec)**
Miocene – Pliocene/Recent Gippsland Limestone (Seafloor)	72.8	51.3	365.2	70.7
Oligocene-Early Miocene Lakes Entrance Fm	438.0	416.5	144.0	513.5
Oligocene 'Early Oligocene Wedge'	582.0	560.5	40.3	557.0
Middle Eocene-Early Oligocene Gurnard Fm	622.3	600.8	34.2	559.0
Paleocene to Early Eocene Latrobe Coarse Siliciclastics	NP	NP		N/A
Early Cretaceous (Late Albian) Strzelecki Group	656.5	635.0	153.5+	592.6
TOTAL DEPTH	810.0	788.5		651.7

*** Subsea depths in metres below Mean Sea Level (MSL) and corrected for hole deviation where appropriate.**

The primary objective Gurnard Formation was encountered below base seal and 5.8m low to prognosis. The secondary Latrobe "Coarse Clastics" (Kingfish Formation) was not present. The well reached total depth in the Early Cretaceous (Late Albian) Strzelecki Group, which was encountered 139m shallow to prognosis. The sub-division of the sedimentary section of Gilbert-1/1A by formation boundaries and chronostratigraphic units as shown on the composite log (Enclosure 1) were determined primarily using a combination of wireline logs, lithological descriptions, drilling parameters and biostratigraphic data. A biostratigraphic report is included as Appendix 12 of the Gilbert-1/1A Well Completion Report (Basic Data) and included herein as Appendix 3. Log correlation with nearby offset wells was also used to define formation tops.

TERTIARY – RECENT

Seafloor – 656.5mMD RT (51.3 – 635mTVDSS)

GIPPSLAND LIMESTONE **Seafloor – 438mMD RT (51.3-416.5mTVDSS)**

True Vertical Thickness	365.2m
Age:	Miocene-Pliocene/Recent
Palynozone:	Not defined
Depositional Environment:	Marine
Seismic Time:	0.071 Sec TWT

No ditch cuttings were collected over the upper portion of the Gippsland Limestone above 336 mMDRT and no open hole wireline logs were recorded above 336 mMDRT. LWD gamma ray – resistivity was recorded while drilling below the surface conductor set at 106 mMDRT, to total depth at 810 mMDRT. A cased hole wireline gamma ray was recorded from 331 mMDRT to seafloor at 72.8 mMDRT, while a cased hole sonic (DSI) was also recorded to seafloor. The wireline gamma ray is the depth reference log in Gilbert-1/1A and the LWD logs have been depth adjusted as required to this gamma ray. Lithology above 336 mMDRT is interpreted from surrounding offset well data and ROP.

The Gippsland Limestone is interpreted to consist of calcarenite with interbedded and intergradational calcisiltite and calcilutite above 336 mMDRT. The lower part of the unit below 336 mMDRT consists predominantly of argillaceous calcilutite interbedded with rare to common argillaceous calcisiltite and calcarenite

The Gippsland Limestone unconformably overlies the Lakes Entrance Formation at 438 mMDRT (-416.5 mTVDSS), at a seismic time of approximately 432msec TWT. This interpretation is based on the first appearance of marl in the section and correlation with offset wells, although it is still not a definitive boundary.

The unconformable nature of the contact at 438 mMDRT is based on regional evidence only and is not able to be documented directly in Gilbert-1/1A.

No direct biostratigraphic age dating was attempted in Gilbert-1/1A through the Gippsland Limestone, however based on regional evidence the sequence is defined as being Miocene to Pliocene in age with a probable thin veneer of Recent age sediments.

Lithology

72.8 – 336mMD RT (263.2m) *Calcarenite with interbedded and intergradational Calcisiltite and Calcilutite*
ROP range (average):3-111 (49) m/hr

336 – 438mMD RT (102m) *Argillaceous Calcilutite interbedded with rare to common Argillaceous Calcisiltite and Calcarenite*
ROP range (average): 30-191 (77) m/hr

Calcilutite (65-80%): argillaceous, white, off-white to medium grey, very soft to soft, amorphous, slightly firm in part, 10-35% argillaceous matrix, trace-15% fossil fragments (shell fragments, bryozoan, spicules, forams), trace-20% calcisilt, grading to *Calcisiltite* in part, trace fine to

occasionally very coarse dark green glauconite grains, trace fine disseminated through matrix, trace fine to coarse pyrite.
Calcisiltite: argillaceous, soft to slightly firm, very light to medium grey, 20-30% argillaceous matrix, grading to *Calcilutite* and *Calcarenite* in part, trace-10% fossil fragments (coral debris, bryozoan, spicules, shell fragments & forams), trace fine dark green glauconite and occasional nodules, trace fine pyrite, trace fine nodular pyrite.
Calcarenite: white, pale yellowish brown to dark yellowish brown, pale yellowish orange, firm to hard, partly recrystallised, coarse to very coarse calcareous fossil fragments (shell fragments, bryozoan, spicules & forams) with trace clay matrix, trace fine to occasionally very coarse dark green glauconite grains, trace pyrite.

LAKES ENTRANCE FORMATION 438.0 – 582.0mMD RT (416.5 – 560.5mTVDSS)

True Vertical Thickness	144m
Age:	Late Oligocene-Early Miocene
Palynozone:	*P. tuberculatus* / *Operculodinium*
Depositional Environment:	Open Marine
Seismic Time:	0.432 Sec. TWT

The Lakes Entrance Formation which consists of marl grading to argillaceous calcilutite and calcilutite with abundant interbedded calcareous claystone increasing with depth, was encountered 12.5 metres low to prognosis. The gamma ray displays a funnel-shaped motif, increasing from approximately 40 API units at the top of the sequence, to 80 API units at the base.

The Lakes Entrance Formation overlies a thin interval interpreted as the 'Early Oligocene Wedge' (EOW) at 582 mMDRT (-560.5 mTVDSS), at a seismic time of 563msec TWT. The contact is defined by an increase in gamma ray response from 65-70 API units above 582 mMDRT to 80-100 API units below, while the DLL log (R_D curve) exhibits no significant character change at this formation boundary.

The unconformable nature of the contact at 582 mMDRT is documented directly in Gilbert-/1A by biostratigraphic age dating, whereby rocks of Late Oligocene to Early Miocene age as defined by the *P tuberculatus* palynozone, directly overlie rocks of Early Oligocene age as defined by the Upper *N. asperus* palynozone, albeit based on data of low confidence. However it is also based on regional evidence and by correlation with offset wells.

Palynological age dating of a rotary sidewall core sample from 580 mMDRT within the basal part of the Lakes Entrance Formation places this part of the sequence within the *Proteacidites tuberculatus* Spore Pollen Zone of Late Oligocene to Early Miocene age.

Lithology

438 - 510m (72m) *Marl with common to abundant interbedded Calcareous Claystone and Argillaceous Calcilutite*
ROP range (average): 30-83 (47) m/hr

Marl (10-50%): very light to light medium grey, very soft - soft, dispersive in part, amorphous, clay matrix (30-40%) grading to *Argillaceous Calcilutite* in part, trace very fine dark green disseminated glauconite, trace fossil fragments and forams, interbedded with *calcilutite.*
Claystone: calcareous, light grey to brownish grey, trace light greenish grey, soft, amorphous to blocky, 15-25% micrite, trace – 5% calcisilt, trace light brownish yellow fossil fragments, trace fine

dark green disseminated glauconite and nodular glauconite, trace fine pyrite, trace coarse nodular pyrite.
Calcilutite: argillaceous, soft to slightly firm, massive, very light to medium grey and greenish grey, trace dark grey, argillaceous matrix (0-30%), grading to *Calcilutite* and *Argillaceous Calcisiltite* in part, trace fossil fragments including coral debris, bryozoan, spicules, shell fragments and forams, trace fine dark green disseminated glauconite and trace-5% medium to coarse nodular glauconite, trace fine pyrite, trace coarse nodular pyrite.

510-582m (72m): *Calcareous Claystone with rare to common interbedded Marl, and Calcilutite.*
ROP range (average): 15-54 (32) m/hr

Claystone (60-100%): calcareous, light grey to grey and brownish grey, trace to common light greenish grey, soft, amorphous to blocky, 15-25% micrite, trace-5% calcisilt, trace light brownish yellow fossil fragments (forams and spicules), trace fine dark green disseminated glauconite, trace fine pyrite, trace coarse nodular pyrite.
Marl: very light to light medium grey, very soft - soft, dispersive in part, amorphous, 35-45% clay matrix grading to *Argillaceous Calcilutite* in part, trace-5% calcisilt, trace fossil fragments and forams, interbedded with *Argillaceous Calcilutite.*
Calcilutite: soft to slightly firm, massive, very light to medium grey and greenish grey, trace dark grey, trace-30%, argillaceous matrix grading to *Calcilutite*, trace fossil fragments including coral debris, bryozoan, spicules, shell fragments and forams, trace fine dark green disseminated glauconite and trace-5% medium to coarse nodular glauconite, trace fine pyrite, trace coarse nodular pyrite.

'EARLY OLIGOCENE WEDGE' (EOW) 582 – 622.3mMD RT (560.5- 600.8mTVDSS)

True Vertical Thickness	40.3m
Age:	Early Oligocene
Palynozone:	Upper *N. asperus*
Depositional Environment:	marine
Seismic Time:	0.563 Sec. TWT

The 'Early Oligocene Wedge' (EOW), which was not prognosed, consists of a thick sequence of calcareous claystone with a gamma ray response that fluctuates between 80 and 120 API units (average 100 API units).

The 'Early Oligocene Wedge' (EOW) unconformably overlies the Gurnard Formation at 622.3 mMDRT (-600.8 mTVDSS), at a seismic time of approximately 0.595 seconds TWT. The contact is defined by correlation with offset wells and a marked change in LWD and wireline log response. The gamma ray is the only curve which displays undiagnostic change at this formation boundary, while the HALS log (R_D curve) exhibits an increase from 2 ohm-m above 622.3 mMDRT to 4-14 ohm-m below. There is a spike in the density at the formation boundary from 2.08-2.10g/cc above 622.3mMD RT to 2.15-2.50g/cc below, while the sonic log exhibits a significant decrease in interval transit time from >140µsec/ft above 622.3 mMDRT to a variable 95-140µsec/ft below. These wireline log changes occur in response to a marked lithological change from calcareous claystone above 622.3mMD RT to mainly thinly interbedded and intergradational silty/glauconitic sandstone, siltstone and claystone below.

The unconformable nature of the contact at 622.3 mMDRT is based on regional evidence and palynological age dating directly in Gilbert-1/1A. Rocks immediately above the unconformity are of Oligocene age, directly overlying rocks of Late Eocene age below the unconformity.

Recognition of this condensed interval as the 'Early Oligocene Wedge' (EOW) is based upon the assignment of two MSCT samples from 584.5 mMDRT and 621.8 mMDRT to the *Upper N. asperus* palynozone of Early Oligocene age, despite the documented assemblage from both samples exhibiting significant differences to equivalent zones in offset wells.

Lithology

582 – 622.3m (40.3m) — *Calcareous Claystone*
ROP range (average): 15-23 (20) m/hr

Claystone: calcareous, light grey to brownish grey, trace light greenish grey, soft, amorphous to blocky, 15-25% calcareous matrix, trace – 5% calcisilt, trace light brownish yellow fossil fragments, trace fine dark green disseminated glauconite and nodular glauconite, trace fine pyrite, trace coarse nodular pyrite.

GURNARD FORMATION — 622.3 – 656.5mMD RT (600.8-635.0mTVDSS)

True Vertical Thickness	34.2m
Age:	Middle-Late Eocene
Palynozone:	Lower to Middle *N. asperus*
Depositional Environment:	Shallow marine
Seismic Time:	0.595 Sec. TWT

The Gurnard Formation, which was the primary reservoir objective in Gilbert-1/1A, was intersected some 5.8m low to prognosis. It consists of a complex lithological mix of thinly interbedded and intergradational silty/glauconitic sandstone, siltstone, greensand and claystone. The sandstones are defined petrographically as lithic arkose containing 8-12% feldspar, 5-10% lithic grains and 10-15% glauconite and mica. The sands also contain an abundant mix of detrital clay (5-10%) and authigenic clay (10-15%) matrix. The sequence also includes rare greensand and claystone interbeds.

The sequence consists of a number of stacked depositional cycles characterised by slightly fining-upward and coarsening-upward trends as defined by subtle bell-shaped and funnel-shaped gamma ray motifs respectively, generally in the range of 70-160 API units.

The Gurnard Formation unconformably overlies the Strzelecki Group at 656.5 mMDRT (-635.0 mTVDSS), at a seismic time of approximately 0.636 seconds TWT. The contact is well defined by the gamma ray curve which exhibits a decrease from 100API units above 656.5 mMDRT to 75-80 API units below.

The unconformable nature of the contact at 656.5 mMDRT is directly based upon palynological evidence in Gilbert-1/1A and regional evidence by correlation with offset wells and is referred to herein as the Otway Unconformity. This unconformity is documented directly in Gilbert-1/1A, whereby marine rocks assigned to the Lower *N. asperus* palynozone of Middle Eocene age, directly overlie non-marine rocks assigned to the Lower *Pilosisporites notensis* palynozone of Early Cretaceous (Barremian to Aptian) age. This supports a depositional break and unconformity across the boundary at 656.5 mMDRT of some 75MM years.

Palynological age dating of an MSCT sample from a depth of 637.0 mMDRT within the middle of the Gurnard Formation is assigned to the Middle *N. asperus* palynozone of Middle/Late Eocene age, while a further two MSCT samples from 653.4m and 656 mMDRT at the base of the Gurnard Formation are both assigned to the Lower *N. asperus* palynozone of Middle Eocene age.

Lithology

622.3 – 639m (16.7m): *Sandstone with abundant interbedded and intergradational Siltstone and rare to common Claystone.*
ROP range (average): 11-38 (20) m/hr

Sandstone (20-80%): lithic arkose, medium yellowish brown to green, firm, friable to soft, loose in part, very fine - fine (dom vfU), subangular-subrounded, lithic with up to 40% lithic grains (chert, volcanic and feldspathic), moderately to very well sorted, 5-10% silt, 10-15% authigenic clay matrix (chlorite, kaolinite and minor illite/smectite), trace-10% detrital clay matrix, 5-10% mica (biotite and muscovite), trace-5% pyrite (framboidal in part), trace-10% dark lithics (titanium oxide with trace zircon and tourmaline), trace-10% fine glauconite, pelletal and nodular glauconite in part, poor – good inferred porosity.
Show: 20% dull to moderately bright yellow direct UV fluorescence, moderately fast blue-white cut fluorescence, solid yellowish-green ring residue.
Siltstone: medium to dark yellowish brown, dark brown grey to brown black, quartz silt to very fine quartz, soft to firm, occasionally hard, non-calcareous, 10-20% detrital clay matrix, grading to *Argillaceous Siltstone*, locally arenaceous with 10-20% very fine quartz, grading to *Arenaceous Siltstone*, trace-15% fine to coarse glauconite, locally in patches, trace-1% white mica, soft, nil to very poor visible porosity.
Claystone: light to medium greyish brown and light brownish yellow, soft – firm, hard in part, amorphous to blocky, rare-abundant (5-20%) quartz silt to fine quartz, grading to *Silty Claystone*, trace fine to medium dark green glauconite, trace nodular pyrite.

639-656.5m (17.5m): *Interbedded and intergradational Sandstone, Greensand, Siltstone and Claystone.*
ROP range (average): 10-27 (18) m/hr

Sandstone (30-80%): lithic arkose, medium yellowish brown-green, pale to dark yellowish brown and grey orange, quartz silt to fine quartz (dom vfU), sub-angular, low to medium sphericity, moderate to well sorted, trace - 20% quartz silt matrix, trace-5% detrital clay matrix, 5-15% authigenic clay (illite & smectite, chloritic & kaolinite) matrix, 5-15% coarse patchy and pelletal chlorite (chamosite) glauconite, trace-5% fine mica, 5-10% feldspar, trace-15% lithic fragments, firm to hard, nil to occasionally fair and good visible inter-granular porosity, no fluorescence.
Greensand: dark yellowish green to dusky green, soft – firm, loose grains in part, very fine to coarse grained, trace nodular glauconite, trace – 20% quartz sand, trace shell fragments.
Siltstone: medium to dark yellowish brown, firm-very firm, very soft in part, argillaceous, arenaceous with 5-10% very fine quartz sand, trace coarse chlorite, glauconite, trace large forams (?Amphistegina), corals, bryozoan fragments.
Claystone: “pisolitic”/glauconitic, pale yellowish brown to moderate brown, light grey, slightly calcareous, 20% well-rounded, medium to coarse dark brown, well-rounded fine-grained weathered glauconite pellets, generally firm, some soft, common reddish-brown areas which may be oxidized.

EARLY CRETACEOUS **656.5 – 810.0 mMD RT**

STRZELECKI GROUP **656.0 – 810.0mMDRT (635.0 – 788.5mTVDSS)**

True Vertical Thickness	153 m
Age:	Early Cretaceous (Barremian to Aptian)
Palynozone:	Lower *Pilosisporites notensis*
Depositional Environment:	Non-marine
Seismic Time:	0.636 Sec. TWT

The Strzelecki Group, which consists of a thick sequence of very fine to very coarse grained lithic arkoses with interbedded claystone and rare thin streaks of coal, was intersected 139 metres high to prognosis. Petrographic analysis of a "sandstone" from a depth of 662 mMDRT is defined as a feldspathic litharenite, characterized by the dominance of clay-rich rock fragments (32.2%), which are of both volcanic and sedimentary origin. Other grains include feldspars (22.4%), chert (5.2%) and quartz grains (9.6%). The framework grains are set within a matrix of clays that are defined by XRD analysis as constituting 43% of the total rock. The clays comprise chlorite (47%), illite/mica (36%), kaolinite (11%) and mixed-layer illite-smectite clays (6%), formed as a result of the deformation (compaction) and alteration of the volcanic lithoclasts.

The sequence is characterised by a variable gamma ray response between 60 and 140 API units, that occur in a series of slightly massive to fining-upward cycles defined by their uniform to bell-shaped gamma ray motif which suggest possible fluvial channel fill and abandonment deposits. A massive 'sandstone' that occurs above TD over the interval 770-810mMD RT may represent a stack of channel fill deposits. Thin coals streaks are associated with the lower energy, inter-distributary, claystone dominated deposits.

Palynological age dating of a sample from 672.5 mMDRT is confidently assigned to the Lower *Pilosisporites notensis* spore-pollen Zone of Barremian to Aptian (Early Cretaceous) age.

Gilbert-1/1A-1 reached a total depth within the Strzelecki Group at a depth of 810 mMDRT (-788.5 mTVDSS). This is some 100m above the original programmed total depth of the well, however it penetrated more than the prognosed 115 metres of Strzelecki Group.

Lithology

656 – 672m (16m): *Sandstone with rare to abundant interbedded Claystone and trace Coal.*
ROP range (average): 7-31 (16) m/hr

Sandstone (60-100%): lithic arkose, medium light grey, soft, friable, very fine to medium grained (vfL -mL), subrounded to angular, moderately sorted, variably quartzose, feldspathic & litharenitic, 40-65% lithic fragments (volcanic, sedimentary and chert), trace-15% authigenic clay matrix (illite & smectite, chloritic & kaolinite), trace detrital clay matrix, non-calcareous, trace-5% siderite and pyrite cement, nil - poor visible intergranular porosity, no fluorescence.
Claystone: white to light grey, light greenish-grey in part, soft, dispersive, to firm, blocky, trace – 10% silty/sandy in part, trace chloritic matrix, trace fine pyrite.
Coal: black, firm, brittle, fibrous, trace fine pyrite, large fragments.

672 – 711m (39m): *Claystone with rare to abundant interbedded Sandstone and trace Coal.*
ROP range (average): 10-41 (19) m/hr

Claystone (50-95%): white to light grey, light greenish-grey, light brownish-grey, soft, dispersive to firm - hard, blocky, trace – 10% silty/sandy in part, trace-10% chloritic matrix/cement in part, trace fine carbonaceous fragments in part, trace fine pyrite incl. pyritic lamination.
Sandstone: lithic arkose, argillaceous, medium light grey, soft, friable, dispersive, very fine to fine grained (vfL -fU), subrounded to angular, moderately sorted, variably quartzose, feldspathic & litharenitic, 40-65% lithic fragments (volcanic, sedimentary and chert), 10-25% authigenic clay matrix (illite & smectite, chloritic & kaolinite), trace detrital clay matrix, non-calcareous, trace-10% siderite and pyrite cement, trace very coarse pyrite nodules enclosing sand grains, nil - poor visible intergranular porosity, no fluorescence.
Coal: brownish black to black, firm to hard, blocky, brittle, dull lustre, interbedded with *Claystone* in part, trace fine pyrite, large fragments.

711 – 770m (59m): *Sandstone with rare to abundant interbedded Claystone, rare to common Carbonaceous Claystone and trace Coal.*
ROP range (average): 9-71 (20) m/hr

Sandstone (5-100%): lithic arkose, argillaceous, medium light grey greyish orange to dark yellowish orange, greenish grey, black, soft to firm, friable, loose in part, hard in part, blocky, very fine to coarse grained (vfL-cU), subrounded to angular, moderately to well sorted, variably quartzose with 40-65% feldspathic, litharenitic & lithic fragments (volcanic, sedimentary and chert), trace-25% authigenic clay matrix (illite & smectite, chloritic & kaolinite), trace detrital clay matrix, non-calcareous to slightly calcareous with trace-5% siderite, carbonate and trace pyrite cement, nil- poor visible intergranular porosity, no fluorescence.
Claystone: light to medium grey, light greenish-grey in part, soft, dispersive to firm - hard, blocky, splintery in part, trace-10% silty/sandy in part, trace-10% chloritic matrix/cement in part, trace-40% fine carbonaceous fragments in part, finely laminated in part with dark brown to black carbonaceous laminae and partings, grading to *Carbonaceous Claystone* in part, trace fine pyrite incl. pyritic lamination.
Claystone: carbonaceous, moderate brown to greyish-brown, firm, blocky, splintery in part, trace-10% silty/sandy in part, trace-40% fine carbonaceous fragments in part, finely laminated in part with dark brown to black carbonaceous laminae and partings, trace fine pyrite incl. pyritic lamination.
Coal: brownish black to black, firm to hard, blocky, brittle, dull lustre, interbedded with *Claystone* in part, trace fine pyrite, large fragments.

770-810m (40m): *Massive Sandstone*
ROP range (average): 6-29 (11) m/hr

Sandstone (100%): lithic arkose, light to medium-light grey and greenish grey, soft to firm, friable, hard in part, blocky, loose coarse to very coarse quartzose grains in part, very fine to very coarse grained grained (vfL-vcU, dom. fU-mL), subrounded to angular, poorly to well sorted, variably quartzose with 25-60% feldspathic, litharenitic & lithic fragments (volcanic, sedimentary and chert), trace-25% authigenic clay matrix (illite & smectite, chloritic & kaolinite), trace-10% detrital clay matrix, grading to *Argillaceous Sandstone* in part, slightly calcareous with trace-10% siderite, carbonate cement and trace-5% pyrite cement in part, trace carbonaceous grains, laminae and partings, nil visible intergranular porosity, no fluorescence.

3.4 STRUCTURE

The Gilbert-1/1A well was designed to test the Gilbert Prospect, a low side fault trap in which the Gurnard Formation reservoir sands and Latrobe Group sands were interpreted to abut economic basement, which was expected to be a lateral seal. Marls of the Lakes Entrance Formation and Gippsland Limestone were expected to provide top seal for the Gilbert Prospect.

A post-drilling structural interpretation of the Gilbert-1/1A fault block is included as Figure 5 and a post-drill interpretation of seismic line GB79-136 through the Gilbert-1/1A well is included as Figure 6. Gilbert-1/1A probably failed to encounter commercial hydrocarbons as a result of a lack of present day cross fault seal adjacent to the Gurnard Formation.

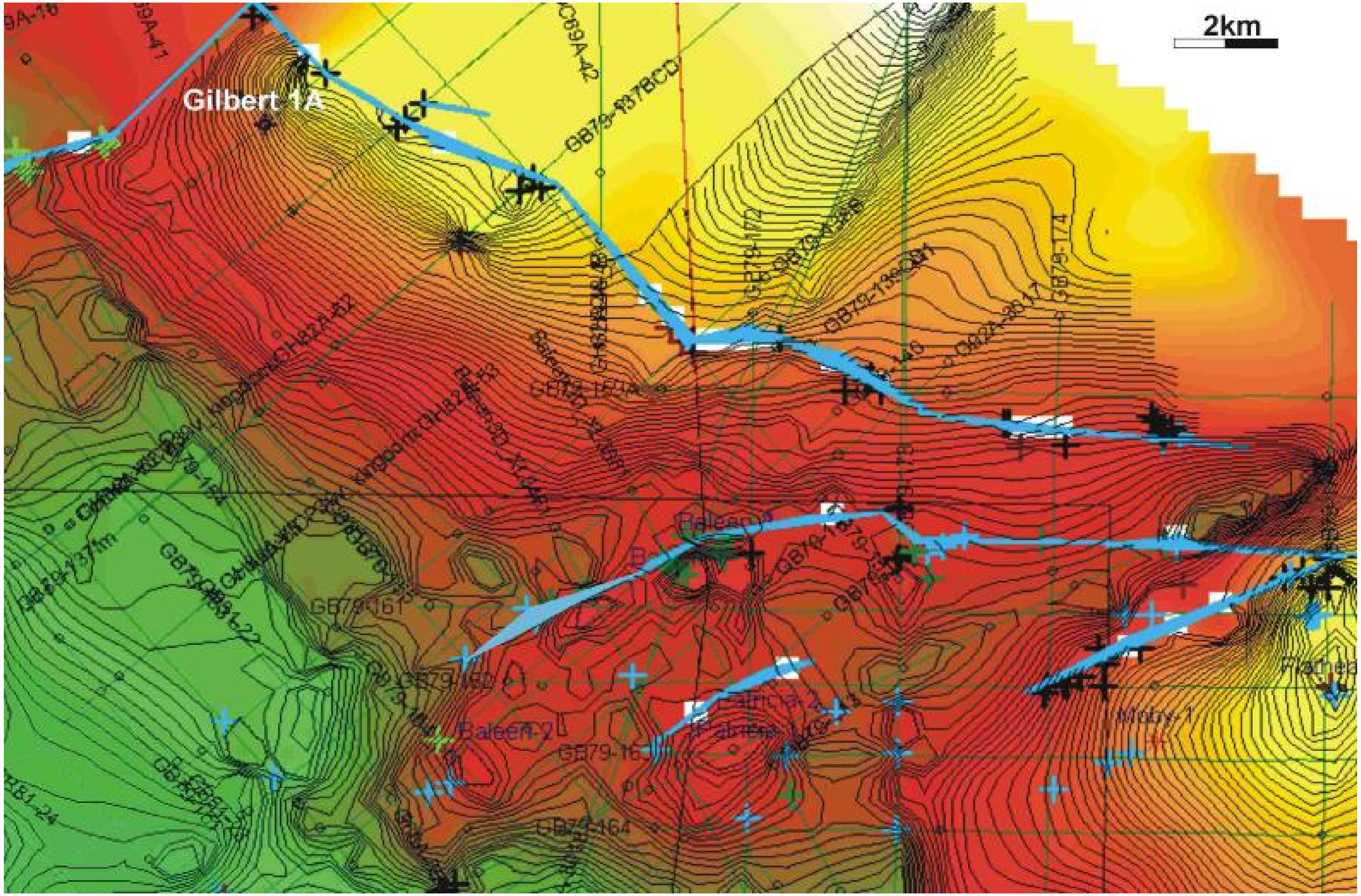

FIGURE 5: POST-DRILL STRUCTURAL INTERPRETATION OF GILBERT FAULT BLOCK

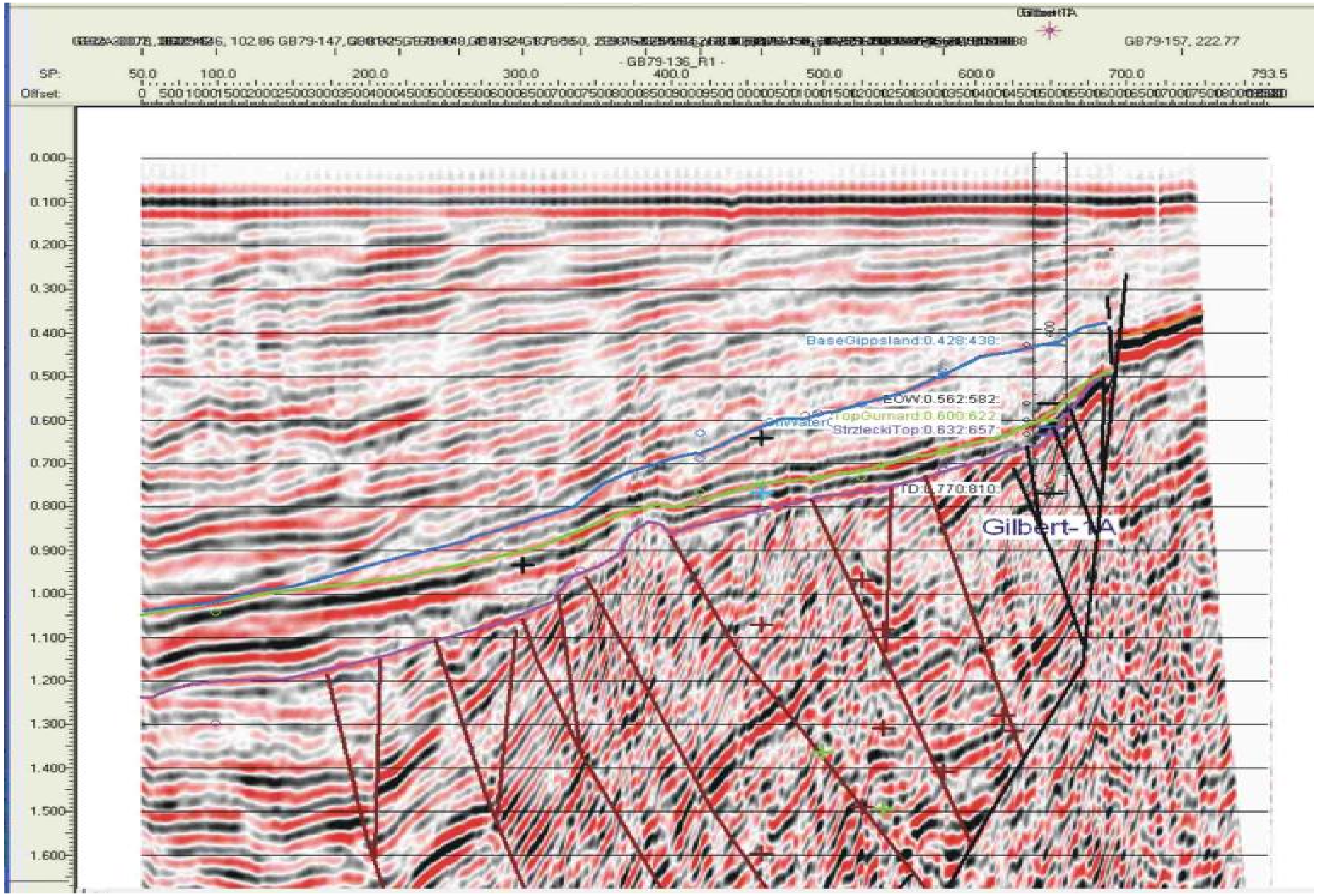

FIGURE 6: SEISMIC LINE GB79-136 DISPLAYING POST-DRILL INTERPRETATION

3.5 SOURCE AND MIGRATION

Gilbert-1/1A encountered slightly anomalous gas readings while drilling through the Gurnard Formation, while drilled ditch cuttings of sandstone over the gross interval 624.0–636.0 mMDRT also within the Gurnard Formation exhibited 20% dull to moderately bright yellow fluorescence, with a moderately fast blue-white cut fluorescence and a solid blue-white ring residue. No fluorescence was observed below 636.0mMD RT in Gilbert-1A. Furthermore, three (3) rotary sidewall core samples acquired over the gross interval 623.6-633.8 mMDRT also exhibited variable direct fluorescence and cut fluorescence.

Geochemical biomarker analysis of hydrocarbon extracts taken from MSCT#12 at a depth of 633.8 mMDRT within the Gurnard Formation indicate the hydrocarbons are characterised as severely biodegraded and mature in nature and thought to be sourced from strongly terrestrial organic matter, possibly with some resin input.

Gilbert-1/1A is located on a low side fault trap adjacent to and along strike from a structural closure on which earlier wells, Flathead-1 and Whale-1 were drilled and which also recorded anomalous hydrocarbon occurrences in the Gurnard Formation in particular. These data support there being evidence for Gilbert-1/1A being located on a migration pathway from a proven hydrocarbon kitchen to the south and southeast within the deeper parts of the Central Deep of the Gippsland Basin

3.6 RELEVANCE TO THE OCCURRENCE OF HYDROCARBONS

3.6.1 Gas Readings

Total gas, chromatographic breakdown of the ditch gas and trip gas was recorded from 336.0m to 810.0mMD RT throughout the 311mm (12 ¼") hole section using the GeoServices Reserval Gas System. Trace to minor amounts of total gas consisting of methane (C_1) and ethane (C_2) were recorded with the first drilling returns in the 311mm (12 ¼") hole section below 336.0mMD RT and which continued down to a depth of 436mMD RT. Trace amounts of propane (C_3), iso-butane (iC_4), n-butane (nC_4) and pentane (C_5) were recorded below approximately 436.0mMD RT, although this may be erroneous due to contamination or noise on the gas detection equipment as C_1 remained low. Background gas levels increased slightly below 585.0mMD RT, increasing further to become low to moderate levels of methane (C_1) and ethane (C_2) and propane (C_3) and with continuing trace butane (iC_4 and nC_4) and pentane (C_5) until TD was reached at 810.0mMD RT. A number of small gas peaks were recorded over the gross interval 585-810.0mMD RT and included 1.7% total gas at 632mMD RT, 2.01% total gas at 667mMD RT and 2.20% total gas at 738mMD RT. The maximum total gas recorded was 2.66% at 700.0mMD RT, consisting entirely of methane (C_1) with 26,319ppm and nil to trace amounts of C_2-C_5, although the latter again appears suspicious and may represent possible noise on the gas detection equipment.

Average ditch gas readings recorded throughout the drilling of Gilbert-1A are summarised below in Table 2.

Table2: Summary of Average Ditch Gas and Gas Peak Readings Recorded in Gilbert-1A

Depth Range (mMD RT)	Total Gas (%)	Methane (C1) ppm	Ethane (C2) ppm	Propane (C3) ppm	Iso-Butane (i-C4) ppm	Normal-Butane (n-C4) Ppm	Iso-Pentane (i-C5) ppm	Normal Pentane (n-C5) ppm
336-436	0.01	27	5	0	0	0	0	0
436-510	0.20	1586	6	2	7	3	1	1
510-585	0.56	5357	14	1	19	1	2	2
585-622	0.68	6483	17	1	26	1	2	2
622-632	0.93	8568	28	1	34	2	2	2
632	1.70	15790	67	0	59	3	1	2
632-647	0.93	8793	27	1	36	2	3	2
647-667	0.67	6357	17	2	26	1	2	2
667	2.01	18253	0	0	70	1	2	2
667-691	0.47	4426	8	2	15	1	2	2
691	1.34	12985	6	1	3	1	2	1
691-700	1.11	10679	2	1	10	1	3	2
700	2.66	26319	0	0	2	2	2	1
700-738	0.54	4880	3	2	12	1	4	2
738	2.20	17494	0	0	51	1	3	1
738-810	0.12	1164	3	1	10	1	1	2

3.6.2 Hydrocarbon Shows Recorded in Ditch Cuttings

All ditch cuttings were examined for direct, cut and crush cut fluorescence and residues while drilling Gilbert-1A. Sandstone over the gross interval 624.0–636.0 mMDRT exhibited 20% dull to moderately bright yellow fluorescence, with a moderately fast blue-white cut fluorescence and a solid blue-white ring residue. No fluorescence was observed below 636.0mMD RT in Gilbert-1A.

3.6.3 Hydrocarbon Shows recorded in Mechanical Sidewall Core (MSCT) Samples

A total of three (3) of the seventeen (17) mechanical sidewall cores collected in Gilbert-1A exhibited fluorescence attributable to hydrocarbons within the Gurnard Formation over the gross interval 623.6-633.8 mMDRT, coinciding with the sample fluorescence exhibited in ditch cuttings within the Gurnard Formation. These are listed below in Table 3.

The direct indications of hydrocarbons recorded in ditch cuttings and rotary sidewall cores as discussed above in Sections 3.6.2 and 3.6.3 respectively are thought to represent possible residual hydrocarbons within the reservoir rocks of the Gurnard Formation, following a breach of the Gilbert trap. Geochemical characterization (refer discussion in Section 3.7.5) defines the sediment extract as being heavily biodegraded.

Table 3: Hydrocarbon Shows Recorded in MSCT Samples

SWC NO.	DEPTH (mRT)	Actual Lithology	Hydrocarbon Show
1	682.0	Sandstone	Nil
2	677.0	Claystone	Nil
3	672.5	Claystone	Nil
4	662.0	Sandstone	Nil
5	656.0	Sandstone/Claystone	Nil
6	653.4	Sandstone	Nil
7	649.5	Sandstone	Nil
8	647.4	Sandstone	Nil
9	642.6	Sandstone	Nil
10	639.5	Sandstone	Nil
11	637.0	Sandstone	Nil
12	633.8	Sandstone	Mottled Bright Yellow Direct Fluorescence; Cut Fluorescence Not Recorded
13	627.5	Siltstone	Very Patchy Dull Yellow Direct Fluorescence; Cut Fluorescence Not Recorded
14	623.6	Sandstone	Trace Dull Yellow Direct Fluorescence; Cut Fluorescence Not Recorded
15	621.8	Claystone	Nil
16	584.5	Claystone	Nil
17	580.0	Claystone	Nil

3.7 FORMATION EVALUATION

3.7.1 Borehole Temperature Data

There were no temperature surveys run in Gilbert-1A. Three maximum recording thermometers were used on all wireline logging runs to record the borehole temperature. The following temperatures were recorded on all four open hole logging runs conducted at final TD (810 mMDRT).

Table 4: Wireline Recorded Temperature Data

Run No.	Wireline Log	Max. Recorded Temperature (°C)	Depth (mTVDSS) (corrected to top of tool string	Hours Since Last Circulation	t/(Tx+t)
1	PEX (HALS)-DSI	43.0°C	775.0m	7.0 hrs	0.8235
2	CMR+-HNGS	46.0°C	777.0m	10.78 hrs	0.8778
3	MDT-GR	46.7°C	700.0m	22.83 hrs	0.9383
4	MSCT-GR	46.0°C	720.0m	35.4 hrs	0.9593

Note: t = Time Since Circulation Stopped; Tx=Last Circulation

There is a growing database of evidence to suggest that the standard Horner calculated derivation for a static bottom hole temperature (SBHT) underestimates the SBHT in many Australian offshore basins. Consequently, the Horner derived SBHT is herein modified by a factor of 1.09 which was established by Doug Waples (pers. comm.), so something of the order of 10% above Horner has been a conventional rule of thumb commonly used. This is herein referred to as the Modified Horner Technique.

Another method of calculating SBHT is the Shell Technique. This technique utilises a simple relationship that involves the proportional addition of 15^{O}C, 30^{O}C or 35^{O}C to the BHT recorded on the first logging run only when measured as 50^{O}C, 100^{O}C or 150^{O}C. This technique approximately coincides with a modified Horner technique (ie 1.09 x Horner) calculated temperature, however data suggests that use of this technique may slightly over-estimate the SBHT.

In Gilbert-1A, the Horner derived SBHT is calculated as 47.6^{O}C (Figure 7), the Modified Horner SBHT is 51.9^{O}C and the Shell Technique derived SBHT is 55.9^{O}C. Assuming a seabed measured temperature of 15^{O}C, the present day geothermal gradient using the Horner SBHT is 4.45^{O}C/100m, using the Modified Horner SBHT is 5.03^{O}C/100m and using the Shell derived SBHT is 5.58^{O}C/100m (Figure 8). The average gradient is 5.02^{O}C/100m.

GILBERT-1A - WIRELINE HORNER PLOT

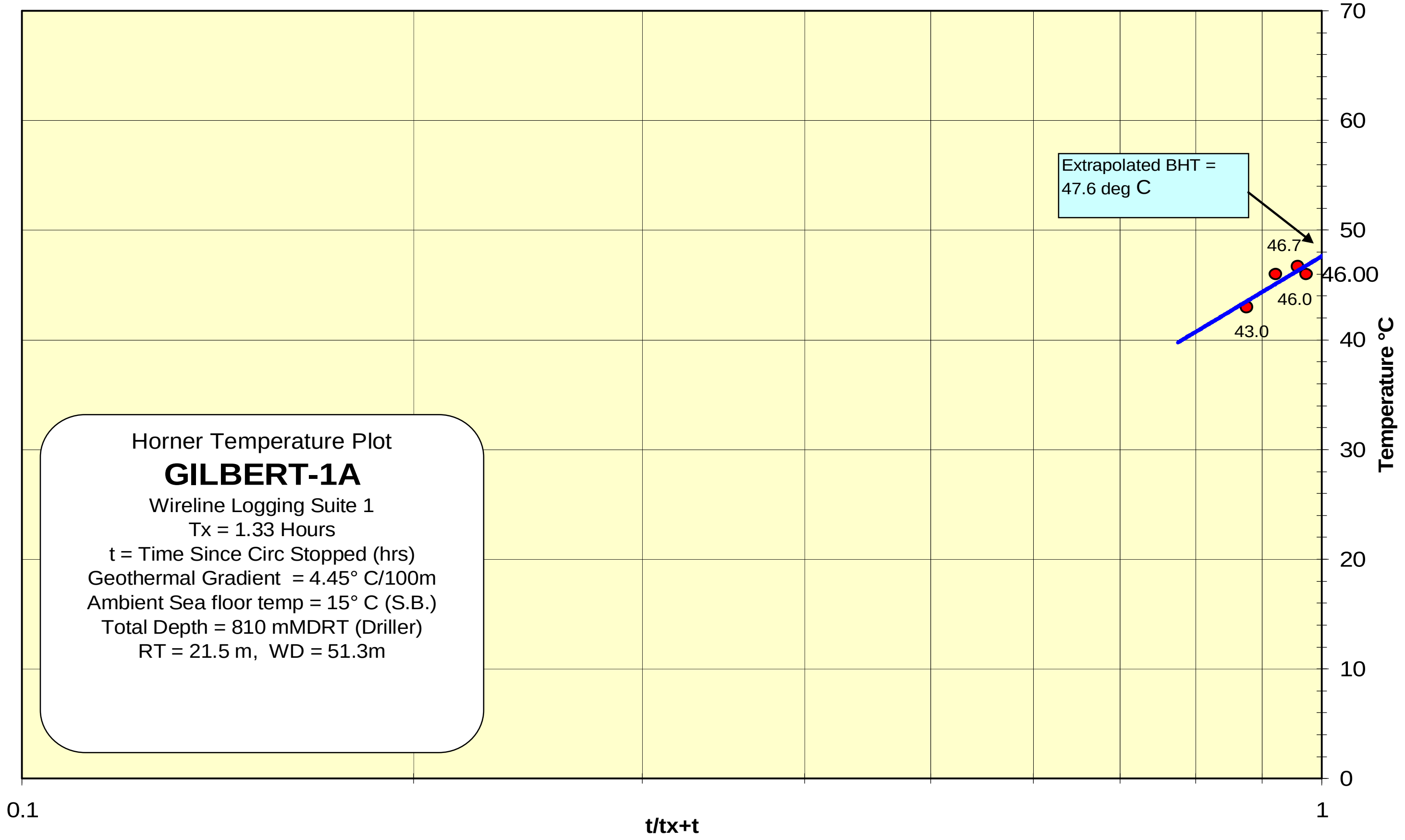

FIGURE 7: GILBERT-1/1A HORNER EXTRAPOLATED BHT

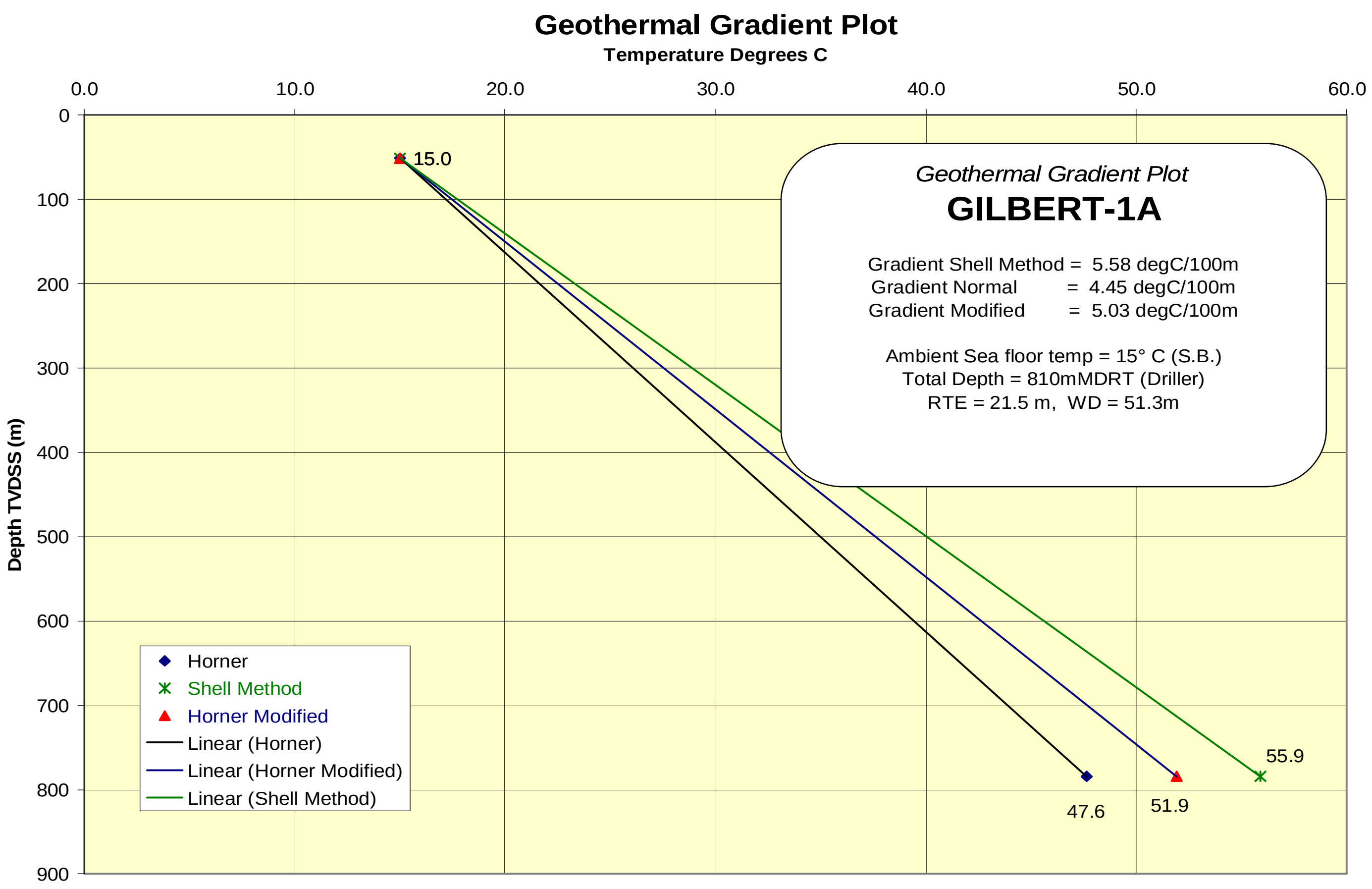

FIGURE 8: GILBERT-1/1A GEOTHERMAL GRADIENT PLOT

3.7.2 Wireline Testing

One run was made with Schlumberger's Modular Formation Dynamic Tester (MDT) tool in Gilbert-1/1A, the results of which are presented in Section 2.2.8 of the Gilbert-1/1A Well Completion Report – Basic Data issued under separate cover. Pressure data was acquired over the gross interval 627.8 - 725.7 mMDRT across potential reservoir zones, the majority of which were concentrated in the Gurnard Formation in an attempt to evaluate formation fluids in zones with associated direct hydrocarbon shows and anomalous wireline zones. A total of 37 pre-tests were attempted; 14 were successful and 6 with lost seal, 13 tight tests and 4 curtailed or unrecognizable tests. All of the tight tests were conducted in the Strzelecki Formation.

From 'good' quality formation pressure test data in the Gurnard Formation, formation mobility ranged from 0.8 mD/cp at 643.6 mRT to 445.9 mD/cp at 654.8 mRT. Based on the available data, two interpretations of the MDT pressure data are possible. One possible interpretation (Figure 9) is that Gilbert-1A intersected the base of an oil column, with a free water level at approximately 617.8 mTVDSS. An alternative interpretation is that there are two water pressure gradients (Figure 10) in the Gurnard Formation, which would imply some geological compartmentalisation.

For further detailed discussion and analysis of the MDT data, refer to the Petrophysical Evaluation included herein as Appendix 2.

Six (6) x 450cc samples and 1 x 2 ¾ gallon sample were collected with the MDT wireline test tool in Gilbert-1/1A. The following samples were collected from anomalous zones of interest within the Gurnard Formation.

- 634.2m - 1 x 450cc sample: recovered filtrate
- 636.6m – 1 x 450cc and 2 ¾ gallon samples: recovered slightly contaminated formation water
- 648.5m – 2 x 450cc samples: recovered slightly contaminated formation water
- 654.8m – 2 x 450cc samples: recovered slightly contaminated formation water

Water analyses are included in Appendix 8 of the Gilbert-1/1A Well Completion Report – Basic Data issued under separate cover.

3.7.3 DST Testing

No drill stem test was performed on Gilbert-1/1A.

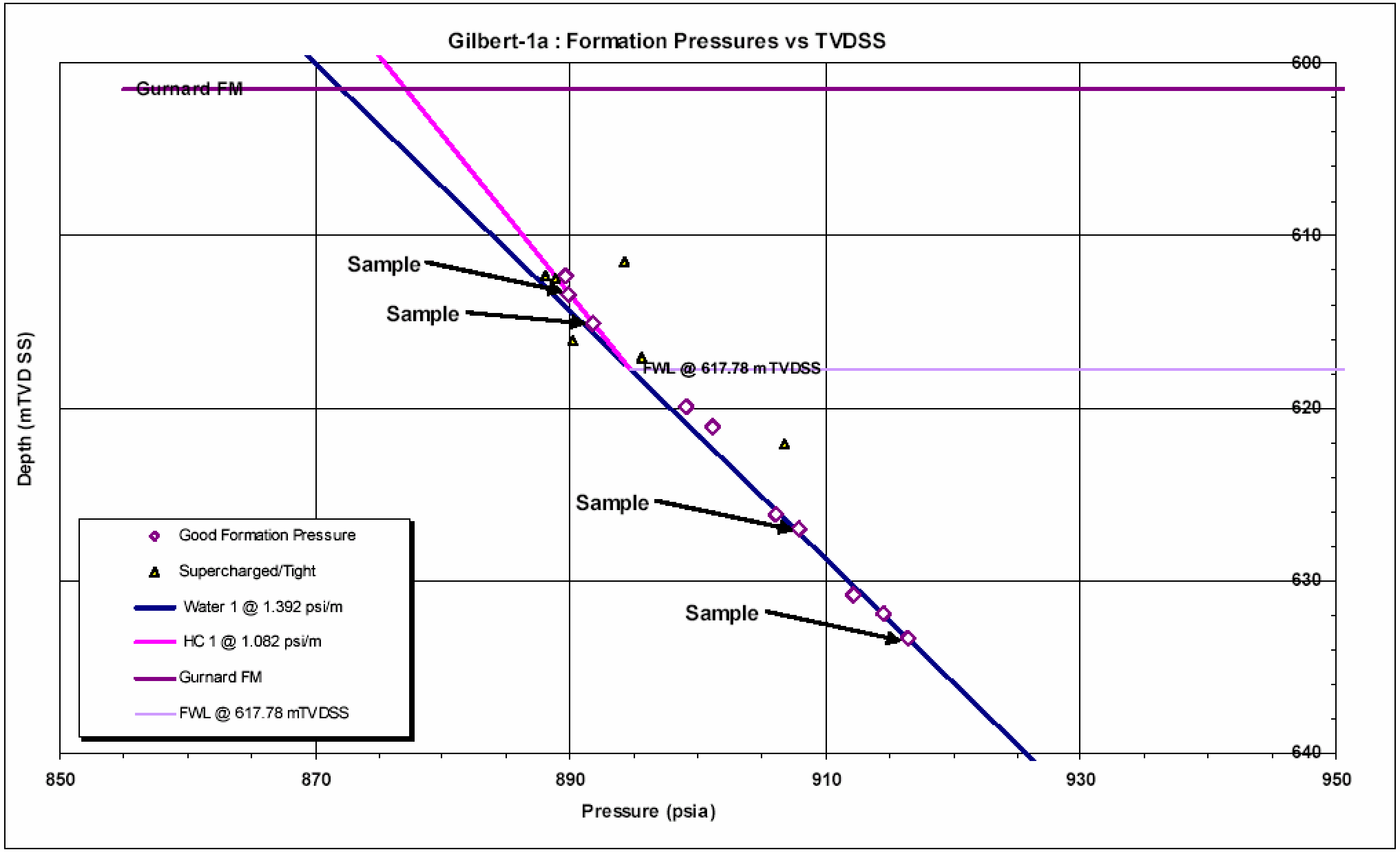

FIGURE 9: GILBERT-1/1A MDT PRESSURE DATA HIGHLIGHTING POSSIBLE HYDROCARBON – WATER FLUID CONTACT

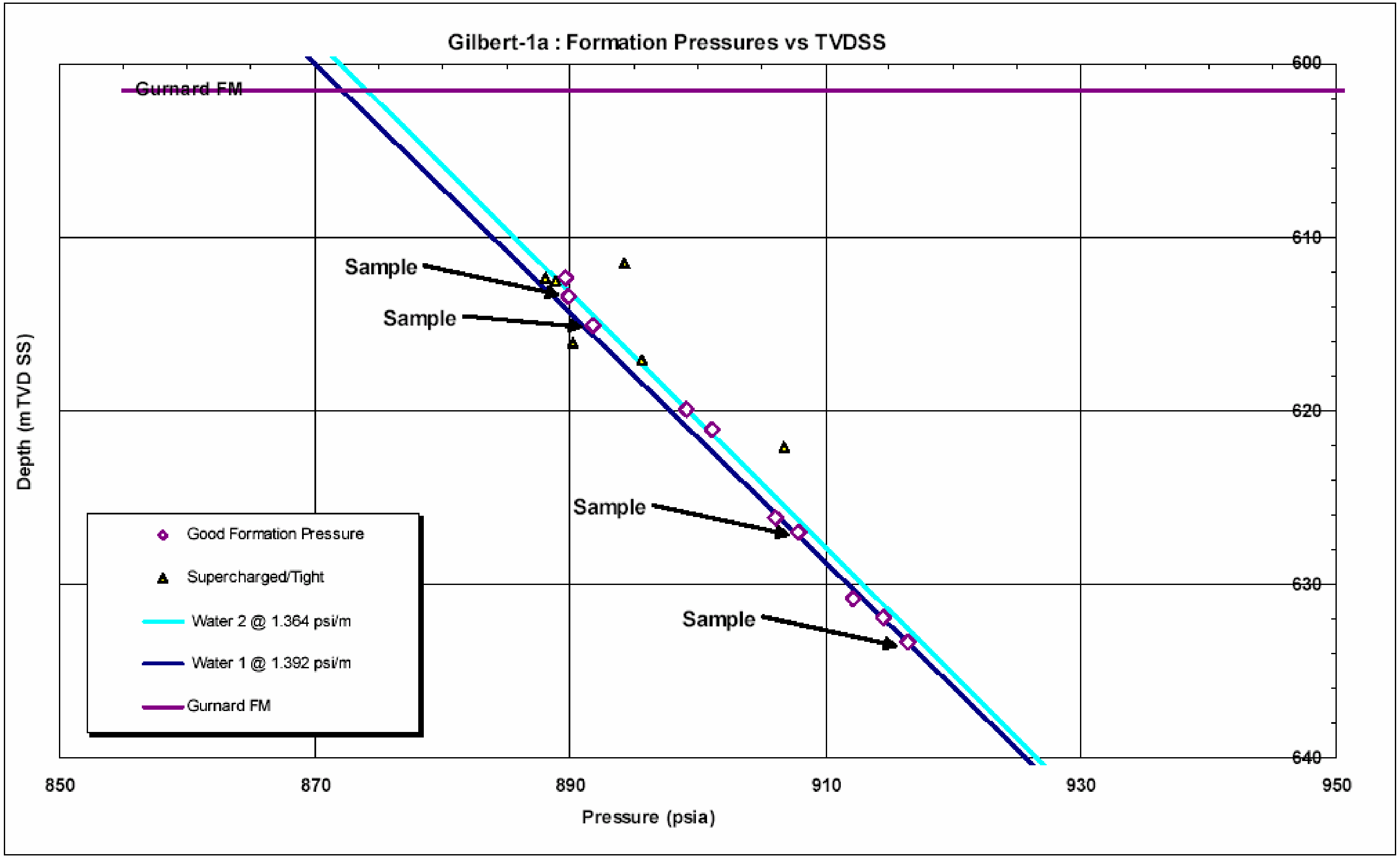

FIGURE 10: GILBERT-1A MDT PRESSURE DATA HIGHLIGHTING POSSIBLE INTERPRETATION OF TWO WATER GRADIENTS IN THE GURNARD FORMATION

3.7.4 Porosity, Permeability and Formation Fluids

Reservoir properties (porosity and permeability) and formation fluids were evaluated with wireline logs, routine core analysis of rotary sidewall core samples, petrographic analysis of selected rotary sidewall core samples and geochemical analysis (hydrocarbon characterization) of sediment extract in zones of anomalous hydrocarbon shows (refer Section 3.7.5). The integrated results of these analyses are discussed in detail in the Petrophysical Report by the Saros Group, included herein as Appendix 2.

A total of 7 of 10 rotary sidewall core samples acquired in the Gurnard Formation and 1 core from the Strzelecki Formation had basic ambient routine core analysis (RCA) performed on them which consisted of He-injection porosity, permeability and grain density. The results of these analyses are included in Table 5 below.

Four (4) rotary sidewall core (MSCT) samples were submitted to Core Laboratories Pty Ltd for petrographic and point count analysis, the results of which are summarised below in Table 6. Details of the petrographic analysis of the main lithologies within the Gurnard Formation and Strzelecki Formation are included in the petrology report by Core Laboratories Australia, included in this report as Appendix 4.

The Gurnard Formation (622.3-656.5 m MDRT) which was the primary reservoir objective in Gilbert-1/1A consists of a complex lithological mix of thinly interbedded and intergradational sandstone, silty sandstone, siltstone, greensand and claystone. Mineralogical analysis of samples from the Gurnard Formation revealed that the framework grains of the sandstones are dominated by quartz and feldspars, with rock fragments and chamositic, partly oolitic pellets and are defined as quartzose feldspathic litharenites. The sandstones are dominantly fine grained (fL) in the range of 125-180µ, moderately well to very well sorted, and tend to become slightly finer grained with increasing depth; ie appear slightly coarsening-upward or prograding, a feature which is not readily apparent from wireline log response. Diagenetic products are persistently represented by chamositic chlorite, in part displaying several stages of growth. Expandable mixed-layer illite-smectite clays, determined by XRD, are present in all sandstones. It should be noted that wellsite descriptions of sediments within the Gurnard Formation described glauconite throughout, however petrological analysis (Appendix 4) defines the mainly green to brown mineral accessory as chamosite. Chamosite is a member of the chlorite group of minerals in which iron (Fe) is the dominant divalent cation.

Visible porosity in the Gurnard Formation sandstones is good (17.8 – 20.4%) as defined by petrographic analysis (Table 6). Both depositional porosity and permeability have considerably been reduced by the presence of clays, mainly detrital. Pore connectivity, in particular, has suffered more considering the mode of occurrence of clays, which tend to be present as grain coating. Authigenic clays have been instrumental in the further reduction of permeability as they tend to block pore throats. Depositional porosity and permeability, however, have significantly improved as a result of mineral leaching, which was conducive to the generation of a sizable solutional pore component.

These porosities differ significantly from those porosities documented by routine core analysis as shown below in Table 5, which also measures a significant component of micro-porosity.

Permeability of sandstones in the Gurnard Formation were measured by RCA as being in the range of 12.1-165mD (average 59mD).

Petrophysical evaluation of the Gurnard Formation concludes an absence of any hydrocarbon net pay, due primarily to the high interpreted water saturation. However, the high water saturations are based largely on shale-rich complex mineralogy which does inhibit the estimation of true water saturations from resistivity measurements, and may result in the under estimate of hydrocarbon volumes. The recovery of formation water (albeit slightly contaminated) on all wireline tests suggests that all potential reservoir zones are presently water saturated, despite the occurrence of possible residual, biodegraded hydrocarbon.

Petrographic analysis and XRD of a sandstone from 633.8 mMDRT within the Gurnard Formation is illustrated below in Figures 11 to 15.

FIGURE 11: THIN SECTION OF MSCT#12 FROM A DEPTH OF 633.8 MMDRT

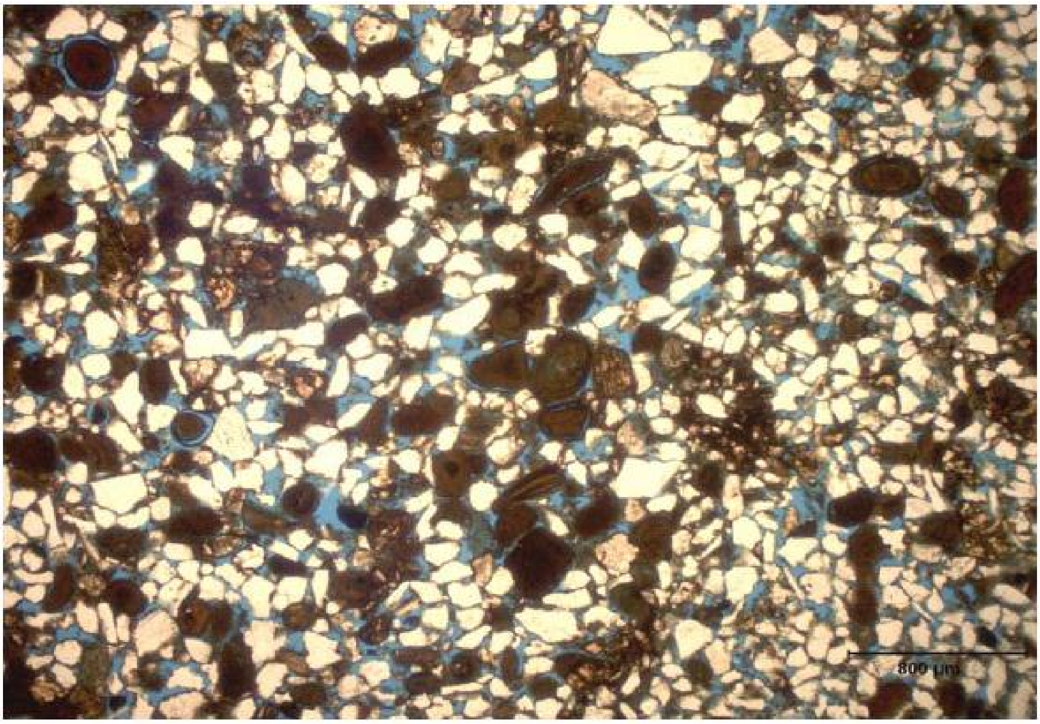

FIGURE 12: MSCT#12-MODERATELY TO WELL SORTED, FINE GRAINED SANDSTONE, WITH ABUNDANT CLAY-DOMINATED 'PELLETS' (BROWN). GOOD INTERGRANULAR POROSITY (BLUE). SOME PARTS OF THIS SAMPLE ARE RICH IN DOLOMITE (MAGNIFICATION X 32)

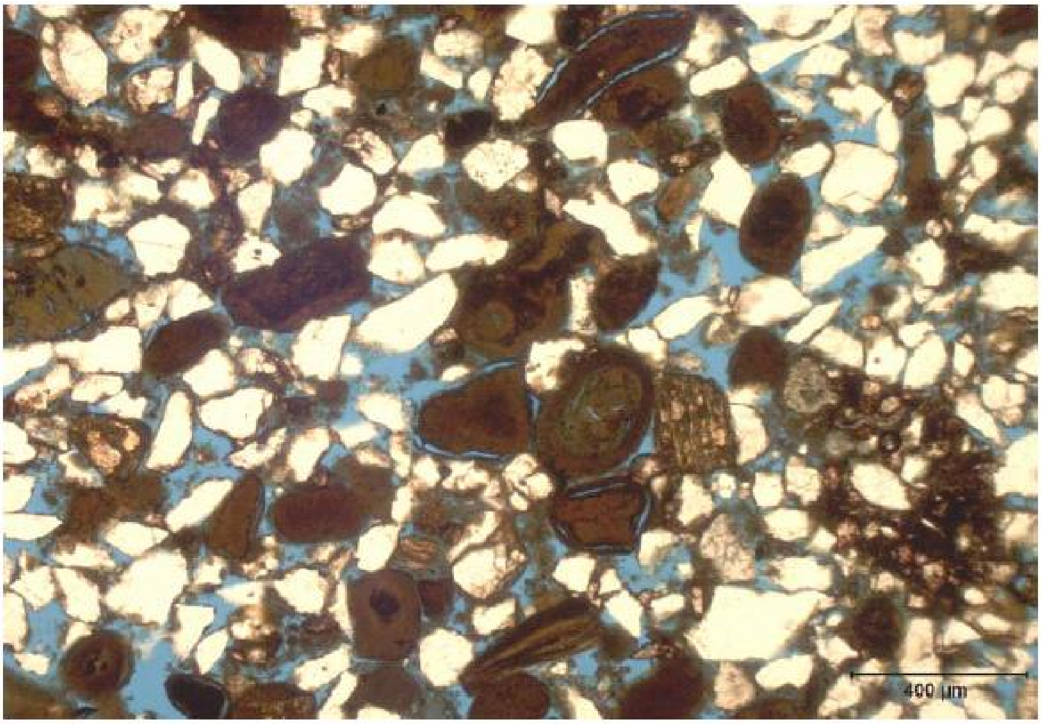

FIGURE 13: MSCT#12-MAGNIFICATION OF THE SAMPLE, REFLECTING THE RELATIVE ABUNDANCE OF 'PELLETS' AND OOLITHS (BROWN), WHICH ARE DOMINANTLY COMPOSED OF CHAMOSITE (MAGNIFICATION X 63)

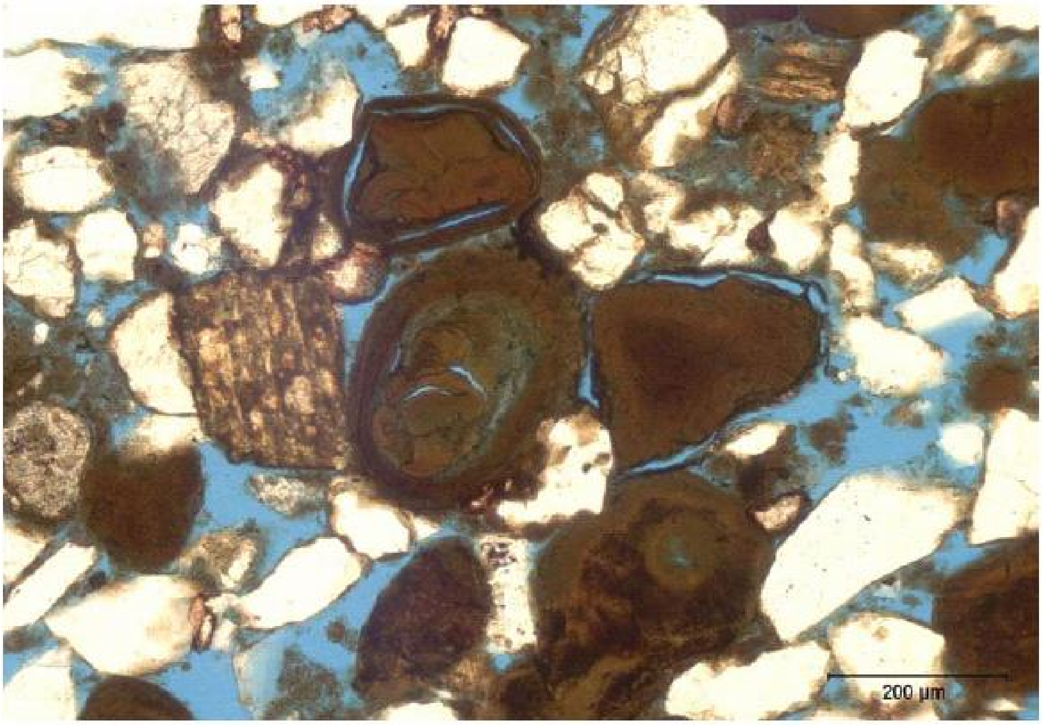

FIGURE 14: MSCT#12-DETAIL OF CHAMOSITE PELLETS (BROWN), SHOWING SHRINKAGE RELATED OPEN SPACE. THE PORE SYSTEM IS OF INTERGRANULAR TYPE, ENHANCED BY MINERAL DISSOLUTION. INCOMPLETE LEACHING WAS CONDUCIVE TO THE FORMATION OF MINERAL FINES, WHICH CAN BECOME MIGRATABLE. (MAGNIFICATION X 125)

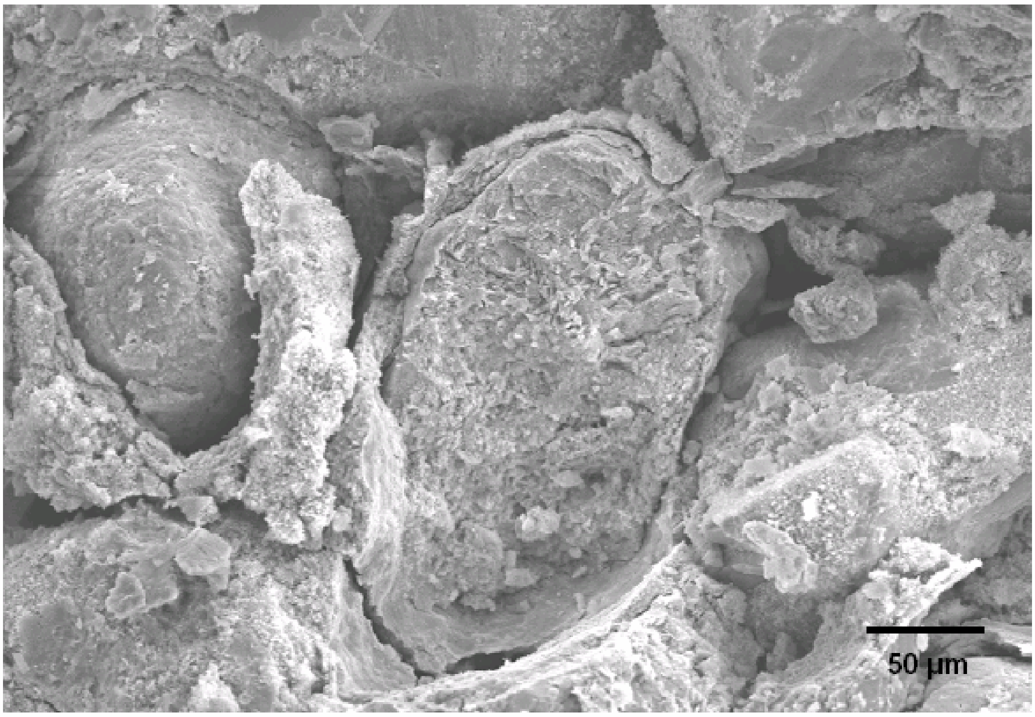

FIGURE 15: MSCT#12: MAGNIFICATION OF CHAMOSITIC OOLITHS; NOTE THE OUTER LAYERING (UPPER CENTER). THESE CLAYS ARE RECRYSTALLIZED. REMNANT INTERGRANULAR POROSITY IS STILL PRESERVED. XRD ANALYSIS OF THESE LAYERS INDICATES IRON-RICH CHLORITE, IDENTIFIED AS CHAMOSITE. PORES ARE REDUCED BY AUTHIGENIC CLAY

The Strzelecki Group (656.5-810.0 mMDRT) consists of a thick sequence of very fine to very coarse grained (dominantly mL with an average grain size of 270µ) lithic arkoses with interbedded claystone and rare thin streaks of coal. Framework grains are subangular to subround and display mainly point-to-long grain contacts. Petrographic analysis of a “sandstone” from a depth of 662 mMDRT is defined as a feldspathic litharenite, characterized by the dominance of clay-rich rock fragments (32.2%), which are of both volcanic and sedimentary origin. Other grains include feldspars (22.4%), chert (5.2%) and quartz grains (9.6%). The framework grains are set within a matrix of clays that are defined by XRD analysis as constituting 43% of the total rock. The clays comprise chlorite (47%), illite/mica (36%), kaolinite (11%) and mixed-layer **illite-smectite** clays (6%), formed as a result of the deformation (compaction) and alteration of the volcanic lithoclasts.

Porosity of the Strzelecki sandstone is mediocre (3.2%) and secondary solutional in type, with a considerable micropore component. Porosity from RCA is measured as 19.5% with a permeability of 0.219mD.

Petrographic analysis and XRD of a sandstone from 662.0 mMDRT within the Strzelecki Group is illustrated below in Figures 16 and 17.

All reservoir zones are interpreted to be 100% water-wet with no evidence of hydrocarbons in the Strzelecki Group.

Table 5: Summary of Basic Core Analysis Results

SAMPLE NUMBER	DEPTH (m)	AMBIENT CONDITIONS			GRAIN DENSITY (g/cc)	COMMENTS
		PERMEABILITY		POROSITY (%)		
		Kinf (md)	Kair (md)			
1	682.0	0.135	0.219	19.5	2.652	
2	677.0	-	-	-	-	Claystone
3	672.5	-	-	-	-	Claystone
4	662.0	-	-	-	-	Not suitable for analysis
5	656.0	-	99.4	33.1	2.768	
6	653.4	34.1	40.2	34.5	2.697	
7	649.5	10.7	12.1	34.6	2.760	
8	647.4	59.9	64.4	36.8	2.709	
9	642.6	18.1	20.2	33.5	2.822	
10	639.5	-	-	-	-	Not suitable for analysis
11	637.0	-	165	38.1	2.714	
12	633.8	12.8	14.3	34.8	2.774	
13	627.5	-	-	-	-	Not suitable for analysis
14	623.6	-	-	-	-	Not suitable for analysis
15	621.8	-	-	-	-	Not suitable for analysis
16	584.5	-	-	-	-	Not suitable for analysis
17	580.0	-	-	-	-	Not suitable for analysis

FIGURE 16: THIN SECTION OF MSCT#4 FROM A DEPTH OF 662.0 MMDRT

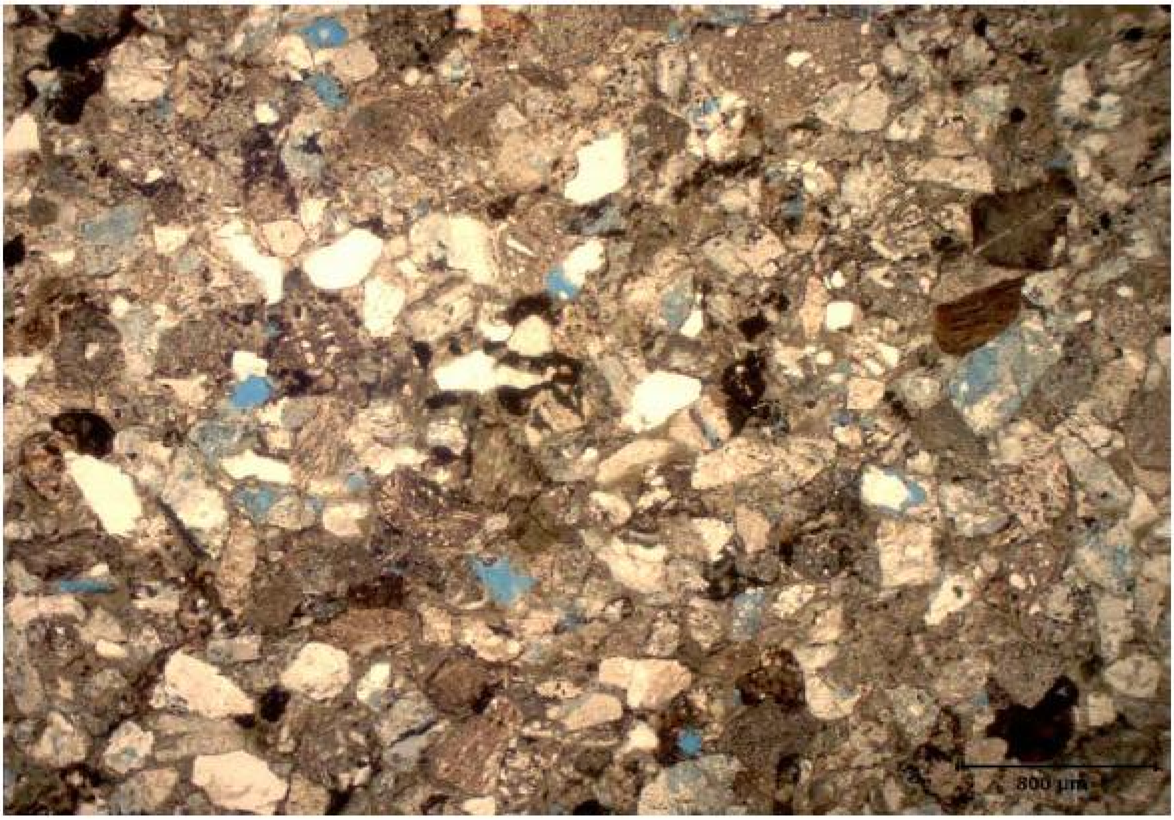

FIGURE 17: MSCT 4: OVERVIEW AND MAGNIFICATION OF A MODERATELY SORTED, MEDIUM GRAINED SANDSTONE, WITH ABUNDANT MAINLY VOLCANIC ROCK FRAGMENTS. THESE FRAGMENTS HAVE BEEN EXTENSIVELY CHLORITIZED. POROSITY (BLUE), LOCALLY OBSERVED, IS DOMINANTLY SOLUTIONAL, RESULTING FROM MINERAL LEACHING (MAGNIFICATION X 3)

Table 6: Petrographic Summary/Point Count of Four (4) Rotary Sidewall Core (MSCT) Samples from Gilbert-1A

SAMPLE		12	8	6	4
DEPTH (m)		633.8	647.4	653.4	662.0
ROCK TYPE		SANDSTONE	SANDSTONE	SANDSTONE	SANDSTONE
CLASSIFICATION (Folk, '80)		Feldspathic litharenite	Feldspathic litharenite	Feldspathic litharenite	Feldspathic litharenite
FRAMEWORK GRAINS					
Quartz	Monocrystalline	30.6	26.8	29.0	9.6
	Polycrystalline	-	-	-	-
Rock Fragments	Chert	3.6	4.2	3.6	5.2
	Sedimentary	5.2	7.2	10.2	10.2
	Volcanic	1.2	< 1.0	1.2	22.0
Feldspars	Potassium feldspar	6.2	6.0	4.2	7.6
	Plagioclase feldspar	2.4	3.6	2.4	14.8
Accessory Grains	Pellets/ooliths	12.6	8.6	3.6	-
	Micas (biotite)	2.0	3.2	4.2	0.8
	Heavy minerals	2.4	2.0	2.6	0.8
MATRIX					
Detrital clays	Pseudo-matrix	-	2.8	-	-
AUTHIGENIC MINERALS					
Clays	Chlorite	8.6	8.0	10.0	16.8
	Kaolinite	-	-	3.2	1.2
	Illite	-	-	-	-
Non-Clay Cements	Dolomite	-	2.4	2.0	-
	Siderite (spindle-shaped)	5.2	3.6	3.6	4.2
	Quartz overgrowth	-	-	-	-
	Pyrite	1.2	1.2	2.4	3.6
	Bitumen	-	-	-	-
POROSITY					
Primary intergranular		16.0	18.0	15.0	-
Secondary solutional / micropore		2.8	2.4	2.8	3.2
Total visible porosity		18.8	20.4	17.8	3.2
TEXTURE					
Average Grain Size (mm)		0.180 (fU)	0.140 (fL)	0.125 (fL)	0.270 (mL)
Sorting		Moderately-well	Very well	Very well	Moderate
Roundness		Sa-Sr	Sa-Sr	Sa-Sr	Sa-Sr
Grain Contacts		Point to long	Loose to point	Point to long	Point to long
RESERVOIR CHARACTERISTICS					
Thin Section Porosity (%)		18.8	20.4	17.8	3.2
Core Porosity (%)		N/A	N/A	N/A	N/A
Permeability (md)		N/A	N/A	N/A	N/A
Grain Density (g/cm³)		N/A	N/A	N/A	N/A

3.7.5 Geochemical Analysis

One (1) MSCT sample (#12) from a depth of 633.8mMD RT within the Gurnard Formation was submitted to Geotechnical Services Pty Ltd for geochemical analysis. The MSCT sample selected for analysis was associated with mottled bright yellow direct fluorescence. The geochemical programme was undertaken to evaluate the thermal maturity, source and depositional environment. The sample was submitted for solvent extraction and characterisation of the hydrocarbon extract. The whole extract was initially analysed via GCMS and then subjected to liquid chromatographic separation to afford the saturate, aromatic and polar fractions. The saturate and aromatic fractions were analysed via GC-MS. The saturate fraction was treated with ZSM5 molecular sieves to isolate the branched/cyclic components which were subsequently analysed via GC-MS.

The analytical results are included as Appendix 11 in the Gilbert-1/1A Well Completion Report –Basic Data, while a full analysis and interpretation of these results are included herein as Appendix 5.

The MSCT-12 sample from 633.8m displays evidence of being severely biodegraded to the extent that neither n-alkanes nor isoprenoidal components are visible in the saturate chromatogram (Figure 16). The aromatic fraction similarly shows severe biodegradation. Little information regarding maturity, source and depositional environment could be obtained from the biodegraded saturate or aromatic fractions. Calculated maturity parameters derived from the high molecular weight hopane and sterane biomarkers, which are more resistant to biodegradation, indicate a high level of thermal maturity. Biomarker analysis supports derivation of organic matter primarily from terrigenous sources, with C29 steranes and land plant resin indicators being in high relative abundance. Isosterane analysis indicates deposition of organic matter in a near shore river or delta system.

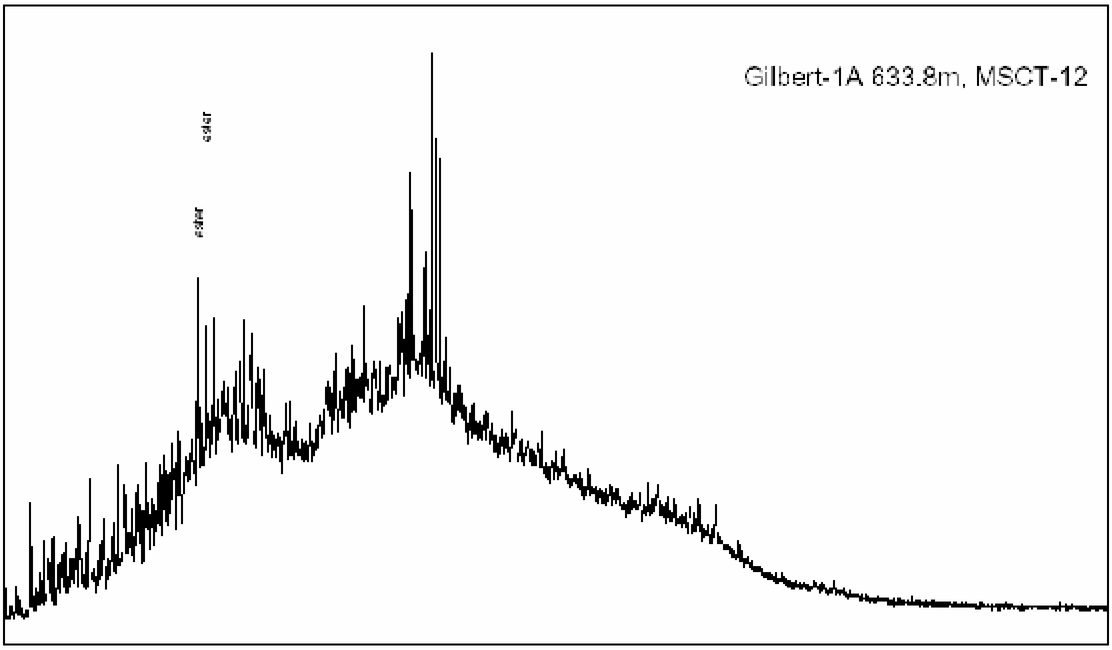

FIGURE 18: MASS CHROMATOGRAM OBTAINED FROM WHOLE EXTRACT GC-MS ANALYSIS OF GILBERT-1A (MSCT-12: 633.8M)

Correlation of the Gilbert-1A MSCT-12 extract with fluids from Sperm Whale-1 indicate a comparable level of biodegradation. Whilst the saturate profiles from GC analysis of the Sperm Whale-1 fluids, do not show strong correlation with the Gilbert-1A extract, it is difficult to ascertain whether the organic matter extracted from the Gilbert-1A sandstone is genetically related to the Sperm Whale-1 hydrocarbons, since different analytical instruments and techniques were used to analyse the samples.

3.8 CONCLUSIONS AND CONTRIBUTIONS TO GEOLOGICAL KNOWLEDGE

- The stratigraphic section encountered in Gilbert-1/1A was essentially as predicted with all of the formation tops including the primary reservoir objectives intersected slightly low to prognosis. The only exception to prognosis was:
  - The presence of a 40.3 m thick sequence of calcareous claystone occurs at the base of the Lakes Entrance Formation and is documented as the "Early Oligocene Wedge" at 582.0 mMDRT.
  - An absence of the secondary reservoir objective Kingfish Formation (Latrobe Coarse Clastics) sequence.
- The primary objective Middle to Late Eocene Gurnard Formation was intersected at 622.3 mMDRT (-600.8 mTVDSS), 5.8m low to prediction and consists of complex lithological mix of thinly interbedded and intergradational sandstone, silty sandstone, siltstone, greensand and claystone. The sandstones are defined primarily as quartzose feldspathic litharenites.
- The tertiary objective Early Cretaceous Strzelecki Group was intersected at 656.5 mMDRT (600.8 mTVDSS), 139 metres high to prognosis. The Strzelecki Group consists of mainly lithic arkose composed of mainly volcanic rock fragments and contains nil to very poor effective porosity.
- Gilbert-1/1A recorded poor visible hydrocarbon shows in ditch cuttings and rotary sidewall core samples accompanied by a slight increase in background gas over the gross interval 623.6-636 mMDRT within the Gurnard Formation, associated with quartzose feldspathic litharenites.
- Petrophysical analysis of wireline data results in nil net hydrocarbon pay due to the high water saturations interpreted. Formation fluid sampling resulted in the interpreted recovery of formation water at 648.5, 654.8 and 636.6 mMDRT from the Gurnard Formation and mud filtrate recovery at 634.2 mMDRT.
- One possible interpretation of MDT data is that Gilbert-1A intersected the base of an oil column, with a free water level at approximately 617.8 mTVDSS within the Gurnard Formation. An alternative interpretation is that there are two water pressure gradients in the Gurnard Formation, which would imply some geological compartmentalisation.
- Geochemical characterization of sediment extract of MSCT#12 from a depth of 633.8 mMDRT within the Gurnard Formation displays evidence of being severely biodegraded to the extent that neither n-alkanes nor isoprenoidal components are visible in the saturate chromatogram. The aromatic fraction similarly shows severe biodegradation
- Gilbert-1/1A probably failed to encounter commercial hydrocarbons as a result of a lack of present day cross fault seal adjacent to the Gurnard Formation.
- The well reached TD within the Early Cretaceous Strzelecki Group at 810.0 mMD RT (-788.5 mTVDSS), 100 metres above the originally programmed total depth of the well. The well was subsequently plugged and abandoned as a dry hole.
- The stabilised formation temperature at the TD of the well is estimated to be 47.6°C using the Horner method and 51.9°C using the modified Horner method. This indicates a present day geothermal gradient of 4.45°C/100m and 5.03°C respectively at the Gilbert-1/1A location.

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APPENDIX 1

Well Card

Well Card: Gilbert-1/1A

Location	Latitude	37° 57' 10.72" S		**Participating Interests**		
	Longitude	148° 22' 25.90" E		Bass Strait Oil Company Ltd (Operator)	0%	
	UTM Co-ordinates	620,701.1m E 5,798,512.1m N		Gippsland Offshore Petroleum Ltd	51%	
	Datum	GDA 94		Lakes Oil NL	26%	
	Elevation	+21.5 m		Eagle Bay Resources NL	10%	
	Water Depth	51.3 m (MSL)		Moby Oil & Gas Gravity Capital Ltd	10% 3%	
Permit	VIC/P-47			Primary Objective	Gurnard Fm	
Rig on Contract	08:00 hrs 2nd October 2005			Secondary Objective	Latrobe Fm & Strzelecki Fm	
Spudded	07:30 Hrs 4th October 2005 (G-1) 23:30 Hrs 4th October 2005 (G-1A)					
Reached T.D.	20:00 Hrs 9th October 2005			**Completion Details/Plugs**		
Rig Released	14:00 Hrs 14th October 2005			Plug # 1	810.0-690.0 mMDRT	74.6 bbls of 15.8 ppg Class G
Structure Type		Low side fault trap		Plug # 1b	690.0-570.0 mMDRT	74.6 bbls of 15.8 ppg Class G
Rig	DOGC Semi-Submersible	"Ocean Patriot"		Plug # 2	370.0-270.0 mMDRT	54.2 bbls of 15.8 ppg Class G
Status	P & A	Dry Hole		**Casing Details**		
Hole Size (mm)	914	445	311	Size (mm)	Wt (ppf)	Depth (m)
Depth (m)	107.0	336.0	810.0	508 x 762	133 x 330	106
Hole Size (mm				340	68	331
Depth (m)						
Total Depth	810.0 mMDRT	788.5 mTVDSS				

Formation	**Depth (mMD RT)**	**Depth (mTVD SS)**	**Thickness (m)**	**TWT (ms)**	**Remarks**
Gippsland Limestone (Seafloor)	72.8	51.3	365.2	71	
Lakes Entrance Fm	438.0	416.5	144.0	432	
Early Oligocene Wedge	582.0	560.5	40.3	563	
Gurnard Fm	622.3	600.8	34.2	595	
Latrobe Coarse Siliciclastics	NP	NP			Not present
Strzelecki Group	656.5	635.0	153.5+	636	
TOTAL DEPTH	810.0	788.5		693	

WIRELINE LOGGING SUMMARY

RUN	TOOL STRING	INTERVAL (M)	BHT (C)/TIME SINCE CIRC.	PLAYBACK SCALES
1	PEX(HALS)-DSI-LEHQT	806.0 – 332.0 m (GR-DT to 72.5 m)	43.0 °C @ 775.0m/7.00 hrs	1:200 1:500
2	CMR-HNGS	802.0 – 580.0 m	46.0 °C @ 777.0m/11.75 hrs	1:200 1:500
3	MDT-GR	725.7 – 624.0 m (13 valid pressures acquired out of 29 attempts and 7 samples recovered to surface)	46.7 °C @ 700.0m/23.00 hrs	N/A
4	MSCT-GR	682.0 – 580.0 m (Cored 17-Recovered 17)	46.0 °C @ 720.0m/35.5 hrs	N/A

CORE SUMMARY

Core	Interval	Cut	Recovered	%
NO CONVENTIONAL CORES WERE CUT				

MSCT CORES

MSCT No.	DEPTH (mRT)	REC (cm)	Actual Lithology	MSCT No.	DEPTH (mRT)	REC (cm)	Actual Lithology
1	682.0	3.8	Sandstone	10	639.5	2.0	Sandstone
2	677.0	4.0	Claystone	11	637.0	4.2	Sandstone
3	672.5	1.8	Claystone	12	633.8	3.8	Sandstone
4	662.0	1.5	Sandstone	13	627.5	1.0	Siltstone
5	656.0	4.4	Sandstone/ Claystone	14	623.6	2.5	Sandstone
6	653.4	4.2	Sandstone	15	621.8	1.0	Claystone
7	649.5	4.5	Sandstone	16	584.5	2.0	Claystone
8	647.4	4.4	Sandstone	17	580.0	2.0	Claystone
9	642.6	4.4	Sandstone				

WELL TESTING SUMMARY

DRILL STEM TESTS (DSTs) **No DSTs were conducted**

Test No.	Formation	Perforation Interval (m)	Flow Min	Shut Min	Ship Psig	Fthp Psig	Chokes	Remarks

DRILLING SUMMARY

The Diamond Offshore General Company MODU "Ocean Patriot" was mobilized from the ANZON Basker-2 location at 08:00 hrs on the 2nd October 2005. Operations commenced at the Gilbert-1 location at 15:30 hrs on the 2nd October 2005 when the first anchor (#5) was dropped. Positioning the rig on location was completed by 17:30 hrs 3rd October 2005 at which time the rig was ballasted down to drilling draft.

Gilbert-1 was spudded at 07:30 hrs on the 4th October 2005 and the 914 mm (36") hole was drilled to 107.0 mMDRT. An obstruction 6 m below the surface of the seabed, however, prevented the running of the conductor to bottom. This location was abandoned and the rig moved 9.5 m in a port forward direction hauling on anchors. The well was re-spudded as Gilbert-1A at 23:30 hrs on the 4th October 2005.

The Gilbert-1A well location was surveyed 3.7 m from the proposed Gilbert-1 location on a bearing of 231.3^O True. The final fix for Gilbert-1A is:

Latitude: 37^O 57' 10.72" S

Longitude: 148^O 22' 25.90" E

Easting: 620, 701.1mE

Northing: 5, 798, 512.1mN

DATUM: GDA 94

Gilbert-1A spudding operations commenced with the running of the TGB which was landed at 72.8 mMDRT (WD = 51.3 m BMSL). The well was spudded with a 914mm (36") hole-opener and drilled from 72.8 – 78 mMDRT with a low RPM, SPM and WOB through hard formation. At 78.0 mMDRT an Anderdrift survey was conducted which showed a hole deviation of 0.5 degrees. Drilling then proceeded from 78.0 -107.0 mMDRT. Drilling parameters were increased to full drilling capacity from 79.0-107.0 mMDRT. An Anderdrift survey at section TD recorded 0.5 degrees. At section TD, 100 PHG (gel) was swept around the hole. A short trip was made to the mudline spotting 220 bbl of PHG to fill up the hole prior to pulling out of hole to run the casing. After coming out of hole with the drill string and laying out the BHA, a double of 5" DP was made up with the running tool and connected to the 762 mm (30") casing housing. The 762 mm (30"/20") conductor was then run to sea level, attached to the landing string and then run into hole with the shoe set at 106.0 mMDRT. The bulls-eye reading was 1 degree stb/fwd.

Cement lines were rigged up and tested to 2000 psi. The low torque valve in the rig up assembly leaked. This was changed out and successfully re-tested to 2000 psi. Approximately 182 bbls of cement slurry (15.8 ppg) were mixed and pumped around the casing annulus and displaced with 26 bbl of sea water. The BHA for the next hole section was made up while waiting on cement. The well head running tool was released and the landing string was recovered.

The bulls-eye was re-measured at 1 degree stb/fwd. The 18 3/4" wellhead housing running tool was laid out. The Deep Sea Express cement head was racked back. A JSA was held and the 914 mm (36") BHA was laid down and the 445 mm (17 1/2") BHA was picked up. The MWD tools were initialized and the 445 mm (17 1/2") BHA was made up and stabbed into the wellhead with ROV assistance. The TOC was tagged at 101.0 mMDRT and the shoe was drilled out. The 445 mm (17 ½") hole was then drilled from 107.0-336.0 mMDRT. The hole was swept clean with 50 bbls of PHG and then displaced with 320 bbls of PHG. A Totco survey was dropped due to the MWD tool failure which resulted in no realtime surveys being acquired during drilling. LWD data was only recorded down to 268.0 mMDRT due to a battery failure in the tool. This was a separate problem and not related to the inability to take surveys. A wiper trip was performed from 336.0-105.0 mMDRT and the Totco was recovered at the shoe. The hole was swept again with 50 bbls of PHG and then displaced to PHG mud. The BHA was pulled out of hole and racked back and the MWD tools were laid down. A JSA was held and the casing handling gear was rigged up. The float and shoe joints were picked up and tested. The 340 mm (13 3/8") casing was run to 331.0 mMDRT and set there. The cement line was rigged up and the casing was set in place with 128.7 bbls of lead slurry (12.5 ppg) and 84 bbls of tail slurry (15.8 ppg). The plug was bumped with 1500 psi for 10 minutes. There were good returns to the mudline and dye returns were noted. The running tool was released and recovered. The launcher and cement head were laid down and the marine riser running equipment was rigged up at 04:00 hrs on the 7th October 2005.

The BOP and riser were run and the landing joint and tensioner were picked up and installed. The choke and kill goosenecks were installed and tested. The BOP was landed and latched and the connectors were tested. The landing joint was laid out and the diverter was installed. The riser handling equipment was laid out and the test plug was made up and run. The BOP and LMRP connector was tested to 3000 psi for 10 minutes. The test plug was recovered and laid down.

The 445 mm (17 ½") BHA was laid down and the 311 mm (12 ¼") BHA was picked up. The cement was tagged at 303.0 mMDRT and the shoe was drilled out. Three metres of new formation was drilled out and a FIT was performed giving an EMW of 1.44 sg. The mud was circulated and difficulty was experienced getting the polymers to shear. The 311 mm (12 ¼") hole was drilled from 339.0-568.0 mMDRT. Controlled drilling commenced and the hole was drilled to 680.0 mMDRT at approximately 20 m/hr. Drilling continued from there to TD of 810.0 mMDRT at approximately 25 m/hr..

Bottoms up gas of 2.7% was recorded following circulation of the well. A wiper trip was performed and circulation stopped at 03:15 on the 10th October 2005. The BHA was pulled out of hole and the MWD was downloaded at 07:00 hrs. A JSA was held and Schlumberger wireline logging commenced at 07:25 hrs on the 10th October 2005. Four logging runs were completed and the wireline was rigged down at 17:15 hrs on the 11th October 2005.

The P&A program was started immediately and cement plugs were set as per the P&A completion details section at the top of this report from 810.0-270.0 mMDRT. Tubulars were laid down from the derrick while waiting on the cement to harden.

Riser pulling activities commenced and the rig was released at 14:00 Hrs on the 14nd October 2005. The total time spent drilling and abandoning Gilbert-1A was 12 days.

GEOLOGICAL SUMMARY

Gilbert-1/1A was spudded at 07:30 hrs on the 4th October 2005 and penetrated a sedimentary section ranging in age from Tertiary to Early Cretaceous. The stratigraphic section encountered was as predicted down to the Gurnard Formation. The Gurnard Formation was some 22 m thinner to prognosis and the Latrobe "Coarse Clastic" section was absent. The geological formations and data encountered for each hole section are discussed below.

The Miocene to Pliocene Gippsland Limestone was encountered at seafloor (covered by a veneer of Recent sediments) at 72.8 mMDRT (-51.3 mTVDSS). The upper part of this formation was drilled riserless in 914 mm (36”) and 445 mm (17-½”) hole sections down to a depth of 336.0 mMDRT. Intermediate 340 mm (13 ⅜”) casing was subsequently run to 331.0 mMDRT where the BOPs and marine riser were run. Following displacement with drilling mud, 311mm (12 ¼”) hole was drilled to a total depth of 810.0 mMDRT. Realtime geological control was provided while drilling using LWD Gamma-Ray/Resistivity logs. The hole section was wireline logged after reaching TD, providing depth control for the stratigraphic sub-division.

The lower part of the Gippsland Limestone below 336.0 mMDRT consists of argillaceous calcilutite with minor calcarenite and argillaceous calcisiltite. The base Gippsland Limestone/Top Lakes Entrance Formation is identified at 438.0 mMDRT (-416.5mTVDSS). It was encountered 12.5 metres low to prognosis, based upon the appearance of marl in the section. The Oligocene to early Miocene Lakes Entrance Formation consists of marl grading to, and interbedded with argillaceous calcilutite, calcisiltite and calcareous claystone. The basal part of the Lakes Entrance Formation is differentiated at 582.0 mMDRT (-560.5 mTVDSS) and defined as the Early Oligocene Wedge, which unconformably overlies the Gurnard Formation.

The primary objective Middle Eocene Gurnard Formation was intersected at 622.3 mMDRT (-600.8 mTVDSS), 5.8 metres low to prediction. The formation at Gilbert-1A consists of argillaceous and silty sandstone (lithic arkose) and siltstone with minor greensand and claystone. All lithologies contain at least trace amounts of glauconite. Sandstone cuttings over the gross interval 633.0-636.0 mMDRT within the Gurnard Formation exhibited poor hydrocarbon shows of 20% dull – moderately bright yellow fluorescence, with a slow to moderately fast blue-white cut and solid blue-white ring residue. Lithologies consistent with belonging to the Latrobe “Coarse Siliciclastics” were not intersected in the well, and the unit is interpreted to be absent. Consequently the Gurnard Formation rests unconformably on the Early Cretaceous (Barremian to Aptian) Strzelecki Group intersected at 656.5 mMDRT (-635.0 mTVDSS), 139.0 m high to prognosis. The Strzelecki Group consists predominantly of argillaceous lithic sandstone (litharenite).

Final total depth was 810.0 mMDRT (-788.5 mTVDSS). This was 100 metres above the originally programmed total depth of the well. The well reached TD within the Strzelecki Group at 810.0 mMDRT (-788.5 mTVDSS) at 21:00 hrs on the 9th October 2005. Schlumberger wireline logs were recorded in four runs:

(1) PEX(HALS)-DSI-LEHQT

(2) CMR-HNGS

(3) MDT-GR

(4) MSCT-GR

The primary wireline log recorded was the PEX(HALS)-DSI-LEHQT combo which was logged from 806.0 mMDRT to 331.0 mMDRT, after which the GR-DSI was logged up through casing to the seafloor, although the sonic signal deteriorated towards the seafloor. This log represents the primary depth control for Gilbert-1A. Logger’s TD was shallow to Driller's TD by 4.0 m owing to possible fill on bottom. The 340mm (13 3/8") casing shoe at 331.0 mMD RT was found to be 1.0 m shallower than Driller's Depth.

The CMR-HNGS was run from 802.0-580.0 mMDRT with a repeat pass carried out from 690.0-610.0 mMDRT and these logs confirmed the presence of moveable fluid in the pore spaces over the Gurnard Fm.

The MDT successfully recorded 13 valid formation pressures and 7 formation fluid samples were recovered to surface. The MDT samples were drained at surface and were shown to be formation water. Sample quality was good with low levels of contamination, ranging from 3.6-12.2 % filtrate concentration, as measured by Petrotech. The exception was the sample from 634.2 mMDRT which contained 50 cc of fluid with a filtrate concentration of 82.9 %. This sample had been taken with great difficulty due to the low mobility of the rock and could not even be overpressured due to the tightness of the formation. Of 17 MSCT cores attempted, all 17 were successfully recovered. The seismic run was cancelled and the wireline was rigged down at 17:15 hrs on the 11th October 2005. Petrophysical analysis of wireline data results in nil net hydrocarbon pay due to the high water saturations interpreted. Formation fluid sampling resulted in the interpreted recovery of formation water at 648.5, 654.8 and 636.6 mMDRT from the Gurnard Formation and mud filtrate recovery at 634.2 mMDRT.

One possible interpretation of MDT data is that Gilbert-1A intersected the base of an oil column, with a free water level at approximately 617.8 mTVDSS within the Gurnard Formation. An alternative interpretation is that there are two water pressure gradients in the Gurnard Formation, which would imply some geological compartmentalisation.

Geochemical characterization of sediment extract of MSCT#12 from a depth of 633.8 mMDRT within the Gurnard Formation displays evidence of being severely biodegraded to the extent that neither n-alkanes nor isoprenoidal components are visible in the saturate chromatogram. The aromatic fraction similarly shows severe biodegradation.

Gilbert-1/1A probably failed to encounter commercial hydrocarbons as a result of a lack of present day cross fault seal adjacent to the Gurnard Formation. Gilbert-1A was plugged and abandoned as a dry hole and the rig released at 14:00 Hrs on the 14th October 2005. A composite well log of the lithology intersected in Gilbert-1A is included as Enclosure 1.

APPENDIX 2

Petrophysical Report

By The Saros Group Pty Ltd

Petrophysics
Gilbert-1a

Prepared for:

Bass Strait Oil Company Ltd

CONFIDENTIAL

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April, 2006

the saros group
Our experts. Your results.

DOCUMENT ISSUE APPROVAL

Project and Document No:	BSO04
Document Version	FINAL
Date	26-06-06
Title	Petrophysics Gilbert-1a
Client	Bass Strait Oil Company Ltd
Document Name	Gilbert-1a Petrophysics FINAL.doc

	Name	**Position**	**Signature**	**Date**
Prepared by:	Paul Theologou	Petrophysicist		26th April 2006
Reviewed by:	Ian Reid	Technical Advisor		

DISTRIBUTION

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ABSTRACT

Gilbert-1a was drilled as a wildcat exploration well in the Vic/P47 permit offshore Victoria, Australia. The well is located approximately 350km east of Port Melbourne and 8 km NNW of the Patricia/Baleen producing gas field. The main petrophysical objectives of the well were to determine reservoir quality in the Gurnard Formation, the underlying Latrobe Group "Coarse Clastics" (Kingfish Formation) and the upper part of the Strzelecki Group, and to sample and identify any oil pay in the Gurnard Formation, Kingfish Formation or Strzelecki Groups and measure its characteristics.

The well reached TD on the 9th October, 2005. Cuttings were recovered and described from the top of the 12 ¼" hole section at 336m mRT until TD. Slightly elevated mud gas and 20% dull to moderate bright yellow fluorescence, with a moderate to fast bluish white cut, and solid yellow residual ring, was recorded near the top of the Gurnard Formation 624 – 639 mRT. The logging suite included PEX with HALS and DSI, CMR with spectral gamma ray, MDT for pressures and sampling, and mechanical sidewall cores.

From 'good' quality formation pressure test data, formation mobility ranged from 0.8 mD/cp at 643.6 mRT to 445.9 mD/cp at 654.8 mRT. All of the 'good' tests were completed within the Gurnard Formation, and all of the tests attempted in the Strzelecki Group were tight. Based on the available data, two interpretations of the MDT pressure data are possible. One possible interpretation, is that the Gilbert-1a intersected the base of an oil column, with a free water level at approximately 617.8 mSS. An alternative interpretation is that there are two water pressure gradients in the Gurnard Formation, which would imply some geological compartmentalisation.

Mineralogical analysis of samples from the Gurnard Formation and the Strzelecki Group revealed that the framework grains of the Gurnard Formation sandstones are dominated by quartz and feldspars, with rock fragments and chamositic, partly oolitic, pellets; these sandstones are quartzose feldspathic litharenites. The deepest Strzelecki Group sandstone is mainly composed of volcanic rock fragments, corresponding to feldspathic litharenite. Diagenetic products are persistently represented by chamositic chlorite, in part displaying several stages of growth. Visible porosity in the Gurnard Formation sandstones is good (17.8 – 20.4%), and mainly modified intergranular, but with a significant solutional pore component. Porosity of the Strzelecki sandstone is mediocre (3.2%) and secondary solutional in type, with a considerable micropore component.

High resolution wireline data from Gilbert-1a was interpreted using MULTIMIN software, which is an optimising petrophysical module within GEOLOG6. Optimising petrophysics relies on obtaining the best match between a model, the measured data and the predicted results. For each logging tool, response equations are used to define the influence of each of the mineral and fluid volumes. The mineral and fluid parameters and the response equations are then used to reconstruct the actual wireline measurements and predict the volumes of minerals and fluids present within the reservoir.

Water samples from Gilbert-1a were not preserved, however a pump-through module with downhole resistivity measurement was used. The recovered MDT water samples were analysed by PetroTech on site and the results of these analyses used to verify the parameters used. For the lowermost sample at 654.8 mRT a final resistivity of approximately 0.47 ohm.m @ 45 degC or 0.7 ohm.m @ 25degC was recorded. This resistivity has been used for this analysis, and is in reasonable agreement with the water sample analysis data. A variable *m* approach, and a value of 2.1 for *n* was used for interpretation for water saturation using the Dual-Water equation.

Indications of hydrocarbons were recorded in the form of slightly increased mud gas and fluorescence in cuttings whilst drilling through the top of the Gurnard Formation. Fluorescence was also observed in mechanical sidewall cores cut from the upper Gurnard Formation. However, no net hydrocarbon pay has been interpreted from wireline log analysis in Gilbert-1a, due to the high water saturations interpreted. Formation fluid sampling resulted in the interpreted recovery of formation water at 648.5, 654.8 and 636.6 mRT, and mud filtrate recovery at 634.2 mRT.

In general a good quality petrophysical interpretation was accomplished based on the extensive suite of wireline logs acquired. However the presence of a shale-rich complex mineralogy does inhibit the estimation of water saturations from resistivity measurements, and may result in the under estimate of hydrocarbon volumes. There is a reasonable to good match between measured core porosity and wireline derived porosity, as well as core and MDT permeability with wireline derived permeability estimates. Sufficient data was available to fully interpret the well, despite the fact that a small amount of ambiguity remains in the interpretation of the formation pressure data. The only way to remove that uncertainty would be to drill up dip.

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FIGURES

INTRODUCTION

Gilbert-1a was drilled as a wildcat exploration well in the Vic/P47 permit in Victoria, Australia. The well is located in Commonwealth waters approximately 350km east of Port Melbourne and 8 km NNW of the Patricia/Baleen producing gas field. The objectives of the well were to:

- Determine reservoir quality in the Gurnard Formation, the underlying Latrobe Group "Coarse Clastics" (Kingfish Formation) and the upper part of the Strzelecki Group.
- Determine if a seal exists between the Gurnard Formation, Kingfish Formation and Strzelecki Group and extent of cross fault seal provided by basement rocks of probable Ordovician meta-sediments.
- Sample and identify any oil pay in the Gurnard Formation, Kingfish Formation or Strzelecki Groups and measure its characteristics.

DATA AVAILABILITY AND QUALITY

Drilling & Mudlog Data

Gilbert-1a was spudded on the 4th October 2005 and was drilled with an 12¼ " bit over the reservoir intervals to a total depth of 810 mRT within the Strzelecki Formation. The well reached TD on the 9th October, 2005. Cuttings were recovered and described from the top of the 12 ¼" hole section at 336m mRT until TD. Slightly elevated mud gas and 20% dull to moderate bright yellow fluorescence, with a moderate to fast bluish white cut, and solid yellow residual ring, was recorded near the top of the Gurnard Formation 624 – 639 mRT (Figure 1).

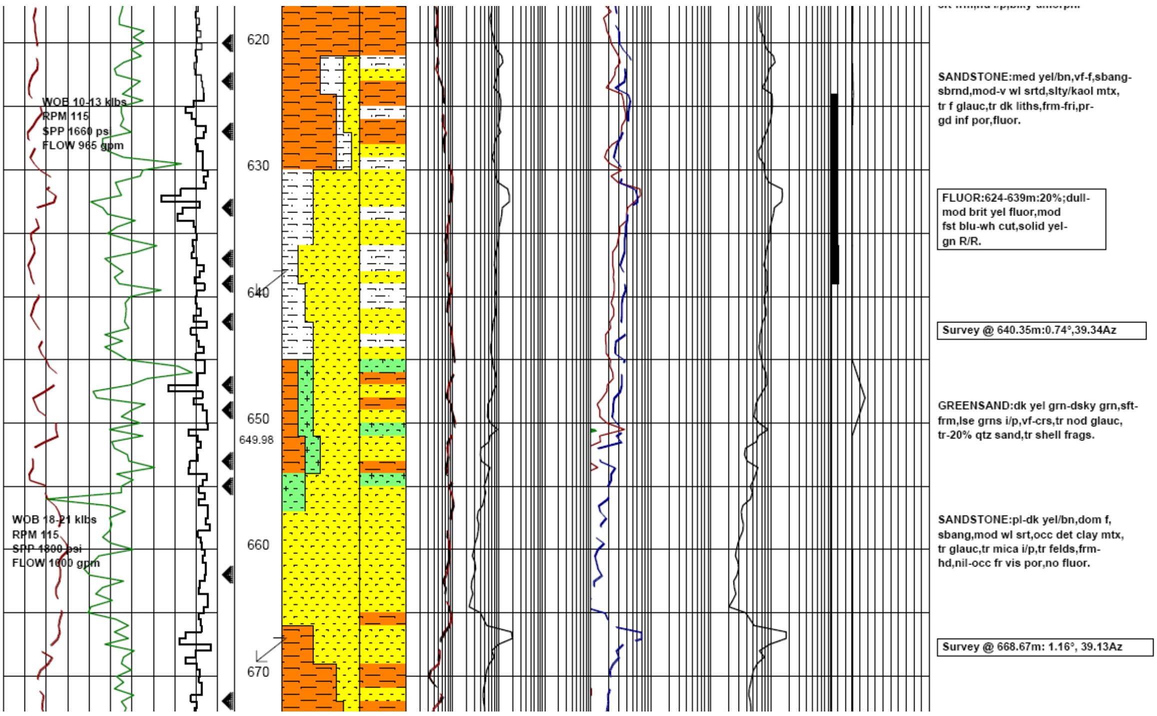

Figure 1. Mudlog over the Gurnard Formation showing zone of hydrocarbon indications.

MWD/LWD Data

Measure while drilling (MWD) and log while drilling (LWD) data was acquired in the 17 ½" and 12 ¼" hole sections in Gilbert-1a (Table 1).

Suite	Tool String	Interval (mRT)	Hole Size
1	DGR-EWR_P4-PM	106 – 331	17 ½"
2	DGR-EWR_P4-PM	331-810	12 ¼"

Table 1. Summary of MWD and LWD data acquired in Gilbert-1a.

Wireline Log Data

Wireline logging of Gilbert-1a was performed by Schlumberger. The logging suite included PEX with HALS and DSI, CMR with spectral gamma ray, MDT for pressures and sampling, and mechanical sidewall cores. Table 1 summarises the logs acquired.

Suite/Run	Tool String	Interval (mRT)	BHT (degC)
1 / 1	PEX-(HASLS)-DSI	332 – 806	43
1 / 2	CMR-HNGS	585 – 806	46
1 / 3	MDT-GR	29 pretests, 14 good tests, 4 unrecognisable, 13 tight, and 6	46.7
1 / 4	MSCT-GR	17 cores attempted and recovered	

Table 2. Summary of wireline log data acquired in Gilbert-1a.

Formation Test Data

Formation fluid pressure data was acquired in Run-3 using Schlumberger's MDT tool. A total of 29 pretests were completed with 14 good tests, 4 unrecognisable tests, 13 tight tests, and 6 lost seals. From the good test data, formation mobility ranged from 0.8 mD/cp at 643.6 mRT to 445.9 mD/cp at 654.8 mRT. All of the good tests were completed within the Gurnard Formation, and all of the tests attempted in the Strzelecki Group were tight.

If all of the good pressure points are used to estimate a fluid gradient through the Gurnard formation, a light value of less than 1.3 psi/m is calculated. This is too light to represent a water gradient, and an alternative interpretation has been investigated. Based on the available data, two interpretations of the MDT pressure data are possible.

One possible interpretation, is that the Gilbert-1a interpreted the base of an oil column, with a free water level at approximately 617.8 mSS (Figure 2). This interpretation is supported by the presence of fluorescence in cuttings and in rotary sidewall core samples from the Gurnard above that depth. However sampling attempts at 613 and 615 mSS were interpreted to recover only water. An alternative interpretation is that there are two water pressure gradients in the Gurnard Formation, which would imply some geological compartmentalization. Figure 3 shows the interpretation for this scenario.

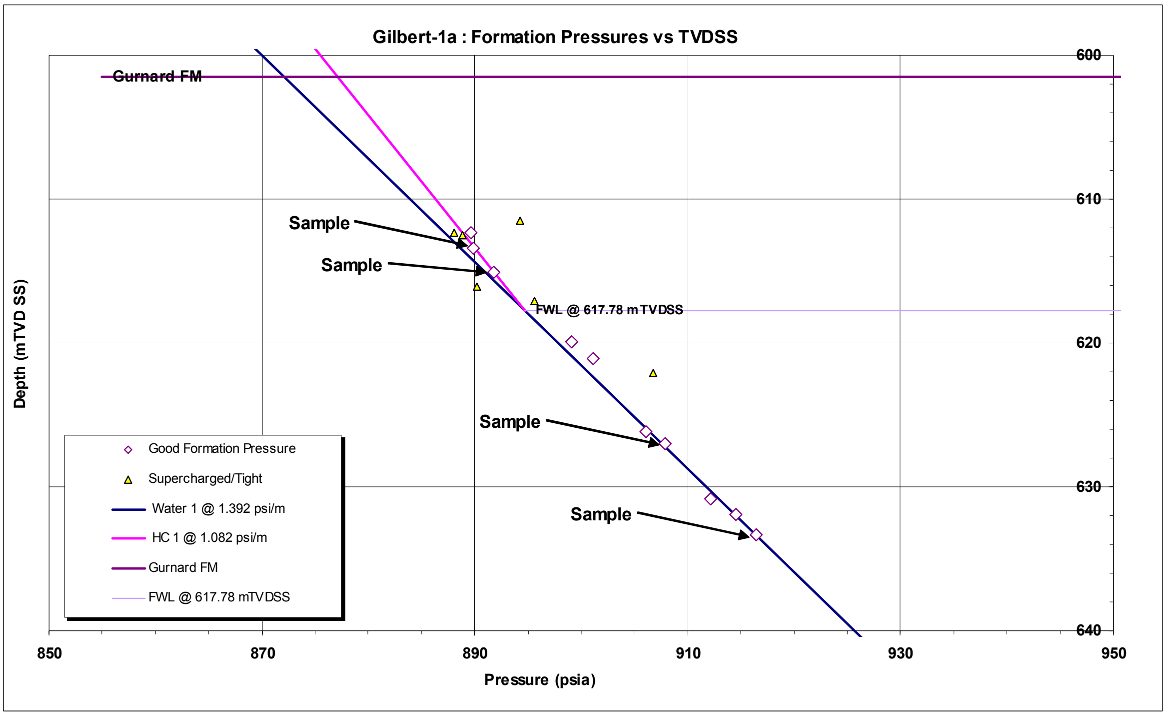

Figure 2. Possible interpretation of a hydrocarbon – water fluid contact in Gilbert-1a.

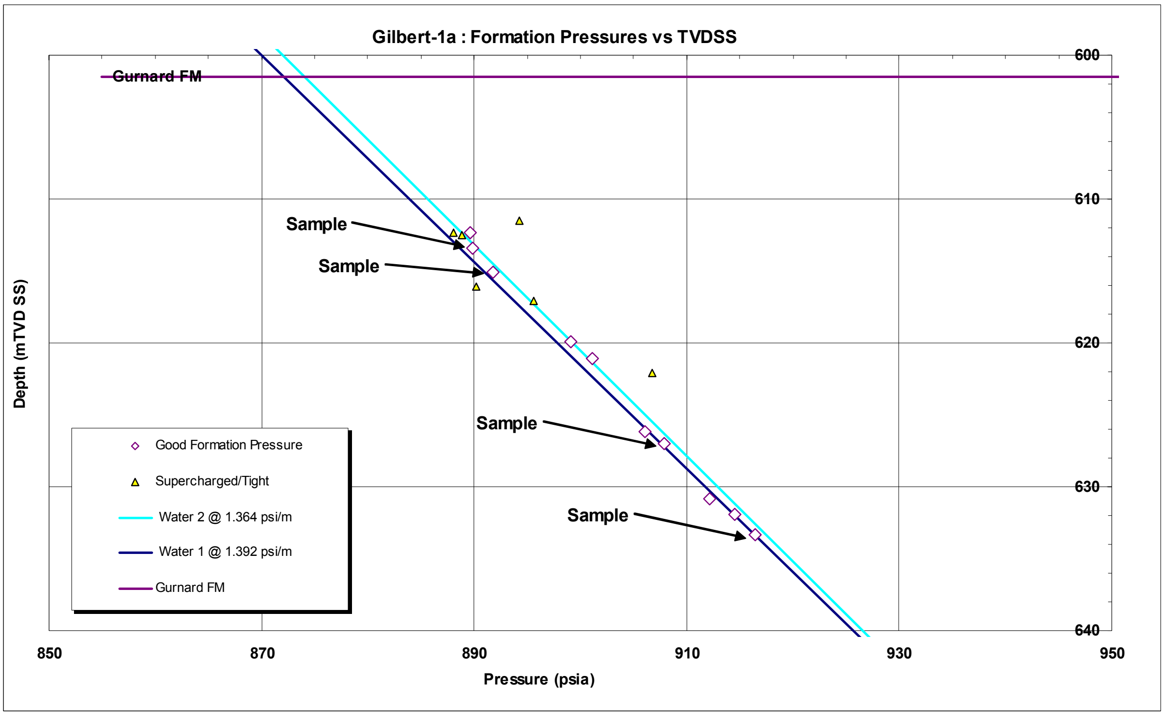

Figure 3. Possible interpretation of two water gradients in Gilbert-1a, Gurnard Formation.

Core Data

Seventeen mechanical sidewall cores were recovered from Gilbert-1a from the Gurnard Formation and the Strzelecki Formation. These samples were used for porosity and permeability estimation, geochemistry and mineralogical analysis.

Porosity & Permeability Data

Table 3 summarises the porosity and permeability data acquired at ambient conditions from mechanical sidewall cores from Gilbert-1a. The core data has also been plotted on the formation evaluation plot (Enclosure-1) for comparison with the wireline interpretation.

Mineralogical Data

Core laboratories undertook mineralogical analysis (petrology, XRD and SEM) of selected MSCT samples in order to determine the mineralogical composition of the intersected objective units (see shaded samples in table 3, Core Laboratories, 2006). The results are summarized from the report as follows:

The shallower three clastics (633.8 – 653.4m) are texturally and mineralogically comparable; these samples are homogeneous, well to very well sorted, fine grained sandstones. The deepest sample (662.0m), also sandstone, is moderately sorted and medium grained.

- The framework grains of the shallowest three sandstones are dominated by quartz and feldspars, with rock fragments and chamositic, partly oolitic, pellets; these sandstones are quartzose feldspathic litharenites. The deepest sandstone is mainly composed of volcanic rock fragments, corresponding to feldspathic litharenite.
- Diagenetic products are persistently represented by chamositic chlorite, in part displaying several stages of growth. Rather small amounts of dolomite and significant quantities of siderite were recognized in thin-section. Small amounts of authigenic pyrite are present, as well.
- Expandable mixed-layer illite-smectite clays, determined by XRD, are present in all samples, increasing significantly in the deepest sandstone (662.0m); these clays are dominantly composed of smectite.
- Visible porosity in the shallower three sandstones (633.8 – 653.4m) is good (17.8 – 20.4%), and mainly modified intergranular, but with a significant solutional pore component. Porosity of the deepest sandstone (662.0m) is mediocre (3.2%) and secondary solutional in type, with a considerable micropore component.

SAMPLE NUMBER	DEPTH	AMBIENT CONDITIONS			GRAIN DENSITY	COMMENTS	FORMATION
		PERMEABILITY		POROSITY			
		Kinf	Kair				
	(m)	(md)	(md)	(%)	(g/cc)		
17	580.0	-	-	-	-	Not suitable for analysis	Early Eocene
16	584.5	-	-	-	-	Not suitable for analysis	Early Eocene
15	621.8	-	-	-	-	Not suitable for analysis	Early Eocene
14	623.6	-	-	-	-	Not suitable for analysis	Gurnard Formation
13	627.5	-	-	-	-	Not suitable for analysis	Gurnard Formation
12	633.8	12.8	14.3	34.8	2.774		Gurnard Formation
11	637.0	-	165	38.1	2.714		Gurnard Formation
10	639.5	-	-	-	-	Not suitable for analysis	Gurnard Formation
9	642.6	18.1	20.2	33.5	2.822		Gurnard Formation
8	647.4	59.9	64.4	36.8	2.709		Gurnard Formation
7	649.5	10.7	12.1	34.6	2.760		Gurnard Formation
6	653.4	34.1	40.2	34.5	2.697		Gurnard Formation
5	656.0	-	99.4	33.1	2.768		Gurnard Formation
4	662.0	-	-	-	-	Not suitable for analysis	Strzelecki Group
3	672.5	-	-	-	-	Claystone	Strzelecki Group
2	677.0	-	-	-	-	Claystone	Strzelecki Group
1	682.0	0.135	0.219	19.5	2.652		Strzelecki Group

Table 3. Summary of porosity and permeability data from Gilbert-1a. Shaded samples have undergone mineralogical analysis.

LOG ANALYSIS METHODOLOGY

Preparation

Wireline data were loaded from DLIS files into Geolog6 software. The logs were checked for depth-matching and general acquisition quality.

Log QC and Environmental Corrections

Environmental corrections were applied as required using the *Geolog* software. In general however, data from the PEX tool is provided fully environmentally corrected. The gamma logs were borehole corrected before further correction for KCl % using the BPB correction charts as Schlumberger do not provide algorithms for that correction.

Interpretation Technique

High resolution wireline data from Gilbert-1a was interpreted using MULTIMIN software, which is an optimising petrophysical module within GEOLOG6. Optimising petrophysics relies on obtaining the best match between a model, the measured data and the predicted results. For each logging tool, response equations are used to define the influence of each of the mineral and fluid volumes. The mineral and fluid parameters and the response equations are then used to reconstruct the actual wireline measurements and predict the volumes of minerals and fluids present within the reservoir. For example we can define the response of the density tool to the formation if we know the response (or endpoint parameters) of each of the components that make up the formation e.g. the following would be the density response of a formation containing oil and water in the pore space, and having a matrix of quartz and albite.

$$\hat{\rho}_b = \rho_{oil} v_{oil} + \rho_{fw} v_{fw} + \rho_{qtz} v_{qtz} + \rho_{alb} v_{alb}$$

Such equations can be written for each of the wireline measurements. These equations are then solved simultaneously to define the best combination of various volumes, such that the original log measurements are as closely matched as possible. An extensive suite of wireline log data meant that a suitably complex mineral model could be built to attempt to characterize the complex mineralogy of this reservoir. The following logs were incorporated into the model:

RHOB, TNPH, DT, U, GR, POTA, CT, CXO, TCMR*, BFV* and CBW*

* these logs were derived from the CMR tool – TCME – total porosity, BFV – capillary + clay bound fluid volume, CBW – clay bound fluid volume

Lithology

MULTIMIN relies on the knowledge of the logging response of the various known minerals and fluids that may occur within the formation under investigation. These responses are generally constant from basin to basin (with some exceptions) and are fairly well identified through the publication of research into the topic.

Based on the mineralogical analysis provided of the Gurnard Formation and the Strzelecki Group in Gilbert-1a, the following is a list of the volume components that were integrated into the models used in this study (details supplied in Appendix 2).

Framework:	*Clays:*	*Fluids:*
Quartz	Chlorite	Formation Brine
Siderite	Kaolinite	Oil
Orthoclase	Smectite	
Heavy Mineral		

It is important to note that Multimin estimates the volume of mineral components (clays and framework grains) which means that a Vsh is not actually calculated as defined by typical deterministic analyses. If you look at typical shales across the world, they contain on average around 40% quartz, and 60% clay minerals, which surprises many people.

Fluid parameters

Formation Brine

Some uncertainty exists in the value of formation salinity, due to regional variations in water salinity. Water samples from Gilbert-1a were not preserved, however a pump-through module with downhole resistivity measurement was used. The recovered MDT water samples were analysed by PetroTech on site and the results of these analyses used to verify the parameters used. For the lowermost sample at 654.8 mRT a final resistivity of approximately 0.47 ohm.m @ 45 degC or 0.7 ohm.m @ 25degC was recorded. This resistivity has been used for this analysis, and is in reasonable agreement with the water sample analysis data, which gave a tds of approximately 6-7kppm.

A variable *m* approach, and a value of 2.1 for *n* was used for interpretation for water saturation using the Dual-Water equation.

Porosity Determination

From MULTIMIN Analysis

Total porosity is calculated from the MULTIMIN analysis from a combination of the individual fluid components, which in the unflushed zone corresponds to:

$$\phi_t = V_{freewat} + V_{hc} + V_{bndwat}$$

Where;

$V_{freewat}$ = *volume of free water*

V_{bndwat} = *volume of bound water*

V_{hc} = *volume of hydrocarbons.*

Saturation Evaluation

The interpretation presented in this report has utilised MULTIMIN for all results, including water saturations. The following is a description of the conductivity model used in MULTIMIN for the estimation of water saturation. It is worth noting that in the Permian section of Gilbert-1a the intervening shales are very resistive which complicates the prediction of Sw and can result in artificially high gas saturations being predicted in shales.

Dual-Water Equation

Water saturation in this study has been determined within the MULTIMIN package using the Dual Water equation. The Dual water model uses the concept of cation exchange capacity to explain shaly sand conductivity. This model assumes that the waters in a formation can be considered to be of two kinds – a free water of normal salinity and clay bound water of altered salinity and increased conductivity. The dual-water equation is as follows:

$$C_t = \phi_t^{m_0} S_{wt}^{n_0} \left[C_{fw} + \frac{\alpha v_q^h Q_v}{S_w^t} \left(C_{bw} - C_{fw} \right) \right]$$

Where;

C_t = *total conductivity (mho/m)*

C_{bw} = *clay bound water conductivity (mho/m)*

C_{fw} = *free water conductivity (mho/m)*

m_0 = *dual-water cementation exponent*

n_0 = *dual-water saturation exponent*

Q_v = *concentration of cations (meq/cm^3)*

V_q^h = *volume of clay bound water (cm^3/meq)*

S_{wt} = *water saturation of total porosity (v/v)*

α = *expansion factor for diffuse layer*

ϕ_t = *total porosity (v/v)*

Parameters for the dual-water equation have been calculated using the following relationships;

$$\alpha = \sqrt{\frac{0.35}{<n>}} \qquad C_{wb} = \frac{\beta}{\alpha v_q^H}$$

$$\beta = 2.05\frac{(T+8.5)}{(22+8.5)} \qquad v_q^H = 0.3\frac{96}{(T+25)}$$

Where;

T = *temperature (^{0}C)*

β = *equivalent conductivity of Na counter ions @ 22^{0}C (S/m)*

$<n>$ = *brine salt concentration (mol/dm^3)*

Saturation equation parameters

Electrical properties special core analysis data was not available at the time of this analysis, therefore a variable cementation exponent (*m*) of 1.8 + VCLAY was used together with a saturation exponent (*n*) of 2.1.

Permeability Evaluation

In the absence of representative core data an intrinsic permeability logs was derived using the Coates free fluid index (FFI) was used as the model for permeability prediction. The basic equation takes on the following form;

$$K_{FFI} = C\left[\phi_e^2 \frac{(\phi_t - BV_{irr})}{BV_{irr}}\right]^X$$

Where;

ϕ_e = *log analysis effective porosity*

ϕ_t = *log analysis total porosity*

BV_{irr} = *bulk volume irreducible water*

C = *constant multiplier*

X = *exponent*

The values for C and X of 75 and 2 respectively were used for this analysis as this resulted in a reasonable match to the mobility derived and core plug derived permeability measurements.

RESULTS

Lumping was performed to define average reservoir and pay properties through the primary objective zones. No net pay has been interpreted win this well. Porosity and permeability is interpreted to be significantly higher in the Gurnard Formation than in the Strzelecki Group, where the CMR data supports the mineralogical interpretation that porosity is dominated by micro-porosity.

DISCUSSION AND RECOMMENDATIONS

Indications of hydrocarbons were recorded in the form of slightly increased mud gas and fluorescence in cuttings whilst drilling through the top of the Gurnard Formation. Fluorescence was also observed in mechanical sidewall cores cut from the upper Gurnard Formation. However, no net hydrocarbon pay has been interpreted from wireline log analysis in Gilbert-1a, due to the high water saturations that have been interpreted. Formation fluid sampling resulted in the interpreted recover of formation water at 648.5, 654.8 and 636.6 mRT, and mud filtrate recovery at 634.2 mRT.

MDT pressure data is consistent with two possible interpretations. One possible interpretation is that the Gilbert-1a intersected the base of an oil column, with a free water level at approximately 617.8 mSS (Figure 2). This interpretation is supported by the presence of fluorescence in cuttings and in rotary sidewall core samples from the Gurnard above that depth. However sampling attempts at 613 and 615mSS (634.2 &636.6 mRT) were interpreted to recover only mud filtrate or water. This interpretation also necessitates the exclusion of a few interpreted good pressure measurements.

An alternative interpretation is that there are two water pressure gradients in the Gurnard Formation, which would imply some geological compartmentalisation. Figure 3 shows the interpretation for this scenario. Only a small amount of pressure difference would be required to fit the two gradients. This interpretation does seem to fit the data slightly better than the alternative presented above.

In general a good quality petrophysical interpretation was accomplished based on the extensive suite of wireline logs acquired. However the presence of a shale-rich complex mineralogy does inhibit the estimation of water saturations from resistivity measurements, and may result in the under estimate of hydrocarbon volumes. There is a reasonable to good match between measured core porosity and wireline derived porosity, as well as core and MDT permeability with wireline derived permeability estimates. Sufficient data was available to fully interpret the well, despite the fact that a small amount of ambiguity remains in the interpretation of the formation pressure data. The only way to remove that uncertainty would be to drill up dip.

APPENDIX 1: PAY SUMMARY REPORTS

Pay Summary Specification: gurnard
Primary reference for reporting and sample control: DEPTH
Cutoff details:-
VOL_WETCLAY <= .4 V/V
Lumping details:-
Standalone Minimum Thickness: 0.25 METRES
Include Minimum Thickness: 0.25 METRES
Maximum Separation: 0.25 METRES

Well	Interval	DEPTH_TOP METRES	DEPTH_BASE METRES	GROSS METRES	NET METRES	NET_TO_GROSS M/M	PHITH (V/V)M	KINTH MDM	PHIT_AV V/V	KINT_AM MD	PHIE_AM V/V	VOL_WETCLAY_AM V/V
GILBERT-1A	GURNARD_FM	622.3	656.5	34.2	23.851	0.697	8.693	240.107	0.364	10.067	0.259	0.268
GILBERT-1A	STRZELECKI_GP	656.5	778.9	122.4	51.723	0.423	9.535	2.47	0.184	0.048	0.048	0.325
GILBERT-1A	-	622.3	778.9	156.6	75.574	0.483	18.228	242.577	0.241	3.21	0.115	0.307

Pay Summary Specification: gurnard
Primary reference for reporting and sample control: DEPTH
Cutoff details:-
PHIE >= .10 V/V
VOL_WETCLAY <= .4 V/V
Lumping details:-
Standalone Minimum Thickness: 0.25 METRES
Include Minimum Thickness: 0.25 METRES
Maximum Separation: 0.25 METRES

Well	Interval	DEPTH_TOP METRES	DEPTH_BASE METRES	GROSS METRES	NET METRES	NET_TO_GROSS M/M	PHITH (V/V)M	KINTH MDM	PHIT_AV V/V	KINT_AM MD	PHIE_AM V/V	VOL_WETCLAY_AM V/V
GILBERT-1A	GURNARD_FM	622.3	656.5	34.2	23.851	0.697	8.693	240.107	0.364	10.067	0.259	0.268
GILBERT-1A	STRZELECKI_GP	656.5	778.9	122.4	6.706	0.055	1.864	2.4	0.278	0.358	0.135	0.325
GILBERT-1A	-	622.3	778.9	156.6	30.556	0.195	10.557	242.507	0.345	7.936	0.232	0.281

APPENDIX 2: MULTIMIN REPORT

ENCLOSURE 1: FORMATION EVALUATION PLOT (1:200)

APPENDIX 3

Palynology Report

By Dr Alan Partridge

INTERPRETATIVE DATA.
Palynological analysis of interval from 580 to 672.5 metres in Gilbert-1A, offshore Gippsland Basin.

by

Alan D. Partridge

Biostrata Pty Ltd
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Biostrata Report 2005/32A

12th December 2005

INTERPRETATIVE DATA.
Palynological analysis of interval from 580 to 672.5 metres in Gilbert-1A, offshore Gippsland Basin.

by Alan D. Partridge

Summary

Palynological analyses have been performed nine mechanical sidewall core samples between 580 and 672.5m in Gilbert-1A. The section investigated consists of the basal 42 metres of the Seaspray Group, overlying a thin 35 metre section of the Gurnard Formation of the Latrobe Group. These Tertiary units in turn unconformably overlie the Strzelecki Group. The 153 metres of the latter group penetrated before TD has a relatively old Barremian to early Aptian age indicating substantial erosion of the group at this location. Results of the analyses are summarised in Tables 1 and 2.

Table 1. Stratigraphic and Palynological Summary of Gilbert–1A.

AGE	STRATIGRAPHY	PALYNOLOGY	DEPTHS (mKB)
Recent to Late Oligocene	**SEASPRAY GROUP** Undifferentiated Seafloor to 585m	*P. tuberculatus* SP Zone	580m
Early Oligocene	"Early Oligocene Wedge" 585 to 622m	Upper *N. asperus* SP Zone	584.5 to 621.8m
Late to Middle Eocene	**LATROBE GROUP** **Cobia Subgroup** Gurnard Formation 622 to 657m	Middle *N. asperus* SP Zone Lower *N. asperus* SP Zone *Deflandrea. heterophlycta* MP Zone	637.0m 653.4 to 656.0m 653.4 to ?656.0m
Barremian to early Aptian	**STRZELECKI GROUP** 657 to 810mTD	Lower *Pilosisporites notensis* SP Zone	672.5m

SP = Spore-Pollen; MP = Microplankton

Introduction

Nine mechanical sidewall core samples (MSCTs) have been analysed from the Gilbert-1A well drilled by the Bass Strait Oil Company Ltd in the Gilbert Block of permit VIC/P47 in the offshore Gippsland Basin. All samples have been processed in the palynological laboratory facilities of Core Laboratories Australia Pty Ltd in Perth. Palynological slides from the nine samples were received on 8th November 2005, and the initial results of microscope analysis of these samples were provided in a Provisional Report issued on 11th November 2005. The final zones and ages assigned to the samples, zone confidence ratings, and zone identification criteria for each of the samples are summarised on Table 2.

The basic sample data comprising the lithologies and weights of sample processed are provided in Table 3. The basic assemblage data comprising the visual organic residues yields, palynomorph concentrations and preservation, and number of species of spore-pollen and microplankton recorded from individual samples are provided in Table 4. The palynological slides prepared and examined are listed in Table 5. No palynological residues were left from any of the samples after the preparation of the slides.

Between 0.6 and 10.2 grams (average 7.1 grams) of the MSCTs were processed to give visual yields from negligible to high, although most were low. The concentration of palynomorphs on the slides is mostly low, while the preservation of the palynomorph is mostly fair. The recorded spore-pollen diversity varies from very low to high, whereas the recorded microplankton diversity is consistently low.

The palynomorphs identified in the samples are documented on the accompanying StrataBugs™ range chart which displays the recorded palynomorph species in the samples proportional to their depth in the well and in terms of their relative abundance (as a percentage). The palynomorphs recorded are split between different categories. The terrestrial spore-pollen are divided between spores, gymnosperm pollen and angiosperm pollen, which are plotted in separate panels as percentages of just the spore-pollen count. This is followed by a panel showing the total count of marine microplankton as a percentage relative to the sum of the spore-pollen and microplankton counts. Next the distribution of individual microplankton species are displayed in the panel labelled Microplankton. Finally plotted are Other palynomorphs, with their abundances expressed as a percentage of the sum of the total Spore-Pollen plus Other palynomorphs counted. Within the panels the species are plotted according to their oldest occurrences or in alphabetical order.

The following codes or abbreviations apply to the individual species occurrences and abundances on the range chart:

Numbers	=	Abundances expressed as percentage
+	=	Species outside of count
C	=	Caved species
R	=	Reworked species
?	=	Questionable identification of species.

Author citations for most of the recorded spore-pollen species can be sourced from the papers by Dettmann (1963), Helby *et al.* (1987), Stover & Partridge (1973) or Macphail (1999), while the author citations for the microplankton species can be sourced from the indexes for dinocysts and other organic-walled microplankton prepared by Fensome *et al.* (1990) and Williams *et al.* (1998). Manuscript species names and combinations are indicated by “sp. nov.” or “comb. nov.” on the range chart, and “ms” after their binomials names in the text and tables.

Geological Discussion.

The section investigated by palynology in Gilbert-1A covers the basal 42 metres of the Seaspray Group, a thin 35 metre section of the Gurnard Formation of the Latrobe Group, and a 153 metre section of the Strzelecki Group. Stratigraphic nomenclature is after Bernecker & Partridge (2001; fig.2).

Seaspray Group**:** The shallowest three sidewall cores analysed are from the Seaspray Group but unfortunately all gave poor or atypical assemblages. The shallowest sample from a non-calcareous claystone at 580m gave a meagre palynological yield with very few diagnostic species which is overall broadly consistent with the Lakes Entrance Formation. The immediately underlying sample at 584.5m, of the same lithology, gave an assemblage equally dominated by spore-pollen and marine dinocysts. Most conspicuous was the high abundance of the dinocyst *Cooksonidium capricornum* (>20% of total count and >40% of MP count). Such a high abundances of the this species has not previously been observed in the Gippsland Basin by the author so a direct comparison of this assemblage with other assemblages is not possible. It is nevertheless more comparable to dinocyst assemblages from the enigmatic “Early Oligocene Wedge” rather than the normal calcareous lithologies of the Seaspray Group. The deepest sample at 621.6m, just above the

Gurnard Formation also yielded a poor assemblage dominated by long ranging palynomorphs. Although nondescript it is also consistent with the "Early Oligocene Wedge."

Latrobe Group**:** The thin section of Latrobe Group encountered in Gilbert-1A is interpreted to consist solely of the Gurnard Formation of the Cobia Subgroup. The older Halibut, Golden Beach and Emperor subgroups are missing in the well at the unconformity with the Strzelecki Group.

Gurnard Formation**:** This 35 metre thick formation identified between 622 and 657m consists predominantly of lithic and glauconitic sandstones. It is most clearly defined by elevated readings on the SP log. In contrast the gamma ray log displays spiky high and low log readings suggesting that the unit is thinly bedded and more sandy compared to wells to the south of Gilbert-1A. Only three of the four MSCTs samples analysed gave datable assemblages and all are from the bottom 20 metres of the unit. The palynological analyses confirms that the formation is a marine unit despite the low diversity and abundance of the microplankton (range <1% to 9%). Both the spore-pollen and dinocysts also confirm an age range of late Middle to Late Eocene. However, based on the tentative assignment of the sample at 656m, immediately above the base of the formation, to the *Deflandrea heterophlycta* Zone the next older *Enneadocysta partridgei* Zone is interpreted to be missing at Gilbert-1A. The base of the Gurnard Formation is therefore younger than recorded from the Baleen and Patricia fields to the south where at least seven metres of the *E. partridgei* Zone are recorded from the basal Gurnard Formation in Patricia-1 (Partridge, 2000).

Strzelecki Group**:** Only 153 metres of the Strzelecki Group is penetrated in Gilbert–1A below a major unconformity where as much as 75 million years of stratigraphic section is missing. The one sample analysed from this section gave a very good assemblage that is confidently assigned to the Lower *Pilosisporites notensis* Zone. This zone has an age range of Barremian to early Aptian (see Partridge & Dettmann, 2003; table 22.9), which is a significantly older age than found at the top of the Strzelecki Group wells in the Baleen and Patricia fields located just 7 km to the south. In the latter area the Strzelecki Group is no older than the mid to late Albian *Coptospora paradoxa* Zone. As the Upper *Pilosisporites notensis*, *Crybelosporites striatus* and *Coptospora paradoxa* zones are clearly all missing at the Gilbert-1A location the well is interpreted to have penetrated the hanging wall of a major fault. Further west in the basin the three missing zones have a recorded thickness of >2000 metres. Although the Gilbert-1A well was situated closer to the basin margin during deposition of the Strzelecki Group, and therefore the overall succession likely thinner, a substantial thickness of the group is nevertheless interpreted to have been eroded at this location.

Biostratigraphy.

In Gilbert-1A the Tertiary samples analysed are classified according to the spore-pollen zonation scheme original proposed by Stover & Partridge (1973, 1982), and updated and refined by Partridge (1999), while the Cretaceous sample is classified according to the revised scheme of Morgan *et al.* (1995). Those samples containing diagnostic marine dinocysts are also classified according to the parallel microplankton scheme originally proposed by Partridge (1975, 1976), and subsequently refined and modified by Partridge (1999). A recent published summary of these zonation schemes can also be found in the contribution by Partridge & Dettmann (2003) to the latest 2003 edition of the *Geology of Victoria*.

Proteacidites tuberculatus **spore-pollen Zone**
Sample at: 580.0 metres
Age: Oligocene to Early Miocene

Unfortunately only a low number of palynomorphs were recovered from the shallowest MSCT analysed. The assemblage is dominated by long-ranging spore-pollen species and is only assigned to the *P. tuberculatus* Zone based on a single poorly preserved specimen of *Cyatheacidites annulatus*. The few dinocysts recorded are also long-ranging and although consistent with the broad *Operculodinium* Superzone the number of specimens recovered was too low to determine the relative abundance of species or provide further refinement.

Upper *Nothofagidites asperus* spore-pollen Zone or younger,
Interval: 584.5 to 621.8 metres
Age: Early Oligocene

The two samples conform to the original zone concept of Stover & Partridge (1973) in that they lack index species of either the younger *P. tuberculatus* Zone or older Middle *N. asperus* Zone. However, this negative evidence is potentially an artefact of the limited yields and poor quality of the assemblages and therefore the confidence in the zone assignment must be considered low. The shallower sample at 584.5m is about equally dominated by spore-pollen and marine dinocysts. The spore-pollen assemblage is dominated by *Nothofagidites* pollen (44%) and the alete gymnosperm pollen of *Araucariacites australis* and *Dilwynites granulatus* which have a combined abundance of 24%. The latter abundance spike is indicative of a strong *Neves effect*[1] and a distal offshore marine environment of deposition. In the deeper sample at 621.8m the spore-pollen (88%) dominate over the microplankton (12%) in the combined count. The spore-pollen assemblage also has a reduced dominance of *Nothofagidites* pollen (24%), with secondary abundances of *Cyathidites* spores (18%), and bisaccate pollen referred to *Podocarpidites* spp. (16%), while the abundance of the alete pollen of *Araucariacites australis* and *Dilwynites* spp. falls to 13%, which is indicative of only a weak *Neves effect* and probably a more inshore environment of deposition.

The microplankton assemblage at 584.5m highly unusual and nothing similar has previously been documented in the Gippsland Basin by the author. The assemblage is dominated by *Cooksonidium capricornum* (>40% of MP count), with common *Enneadocysta* sp. cf. *E. pectiniformis* (8%) and rare *Selenopemphix nephroides* (<1%). The assemblage is interpreted to form part of the broad *Operculodinium* Superzone based on the abundance of *Spiniferites* spp. (32%) and questionable presence of *Protoellipsodinium simplex* ms. The limited microplankton assemblage recorded from the deeper sample at 621.8m is less distinctive but as *Spiniferites* spp. and *Operculodinium centrocarpum* are the two most prominent species it too is probably best referred to the *Operculodinium* Superzone.

Middle *Nothofagidites asperus* spore-pollen Zone
Sample at: 637 metres
Age: Late Eocene

The sample gave a low residue yield, which contains a highly diverse spore-pollen suite and a low abundance (<2%) and low diversity microplankton suite, and is clearly no older than the broad parent *N. asperus* Zone based on the abundance of *Nothofagidites* pollen (28%), and no younger than the Middle *N. asperus* subzone based on presence of numerous Eocene species including *Dryptopollenites semilunatus, Proteacidites crassus* and *Santalumidites cainozoicus*. Short ranging index species are unfortunately rare and consist of the spore *Foveotriletes palaequetrus* and single poorly preserved and questionable specimens of the pollen *Triorites magnificus* and the dinocyst *Gippslandica extensa*. The latter two species are respectively diagnostic of the Middle *N. asperus*

[1] **Neves effects** are the tendency for certain fossil gymnosperm pollen to occur in greater abundance in distal marine environments. In the Australian Late Cretaceous and Cenozoic palynological succession Neves effects have empirically been found to be displayed by the species *Araucariacites australis* and the various species of the genus *Dilwynites*. When the combined abundance of these two pollen types exceeds 20% of the total count of the terrestrial spores and pollen a strong Neves effect is indicated.

and *G. extensa* zones. After *Nothofagidites* pollen the next most abundant palynomorphs in the spore-pollen assemblage are the three gymnosperm pollen *Phyllocladidites mawsonii* (19%), *Podocarpidites* spp. (17%) and *Lygistepollenites florinii* (9%). All other species recorded in the assemblage have abundances of <4%. The commonest microplankton is *Paralecaniella indentata*.

Lower *Nothofagidites asperus* spore-pollen Zone, and
***Deflandrea heterophlycta* microplankton Zone**
Interval: 653.4 to 656 metres
Age: Middle Eocene

The two MSCT samples from the bottom four metres of the Gurnard Formation both contain high diversity spore-pollen assemblages and low diversity microplankton assemblages. With the exception of *Paralecaniella indentata* which represents 7% of combined SP + MP count in the top sample at 653.4m, the abundances of microplankton are low (<2%). Both samples are confidently assigned to the Lower *N. asperus* Zone based on the combination of common *Nothofagidites* pollen (average 18%), and presence of the *Nothofagidites falcatus* and *Proteacidites pachypolus*. The former species is the key individual index species for the base of the broader *N. asperus* Zone, while the latter species is generally rare and inconsistent in the younger Middle *N. asperus* Zone in the Gippsland Basin, even though the species tends to remains more prominent and consistent in this younger subzone in the Bass and Otway basins. Other index species recorded that occur no older than this zone are *Tricolpites simatus*, *Tricolporites leuros* and *Proteacidites reflexus.* The shallower sample 653.4m is assigned to the *Deflandrea heterophlycta* Zone based on the presence of the eponymous species, while the deeper sample at 656m is assigned to same zone based on the presence of the manuscript species *Corrudinium corrugatum.*

Lower *Pilosisporites notensis* spore-pollen Zone
Sample at: 672.5 metres
Age: Barremian to early Aptian

The claystone sample from near the top of the Strzelecki Group in Gilbert-1A gave a diverse and well-preserved spore-pollen assemblage which is confidently assigned to the basal part of the *P. notensis* Zone based on the presence of the eponymous species *Pilosisporites notensis* in association with *Cyclosporites hughesii* and *Cooksonites variabilis*, and the absence of the younger index species *Foraminisporis asymmetricus*, *Pilosisporites parvispinosus* and *Crybelosporites striatus*. The use of the local southern margin *Pilosisporites notensis* Zone of Morgan *et al.* (1995) is preferred over the partly equivalent Australian standard *Cyclosporites hughesii* Zone of Helby *et al.* (1987) as it better expresses the palynological succession in the Gippsland Basin.

The *P. notensis* Zone is defined as the biostratigraphic interval from the first or oldest occurrence of *Pilosisporites notensis* to the first or oldest occurrence of *Crybelosporites striatus*. The species *Foraminisporis asymmetricus* followed by *Pilosisporites parvispinosus* first occur in the formal Lower subzone, whose top is defined by the subsequent last or youngest occurrence of *Cooksonites variabilis* (Morgan *et al*., 1995; fig.6.1). The *C. hughesii* Zone of Helby *et al.* (1987) is defined slightly differently as the biostratigraphic interval from the first occurrence of *F. asymmetricus* to the first occurrence of *C. striatus*. The sample from Gilbert-1A lacks *F. asymmetricus* and therefore lies in the basal part of the Lower *P. notensis* Zone, and would be equivalent to the uppermost part of the *Foraminisporis wonthaggiensis* Zone of Helby *et al.* (1987). According to the review by Partridge & Dettmann (2003; table 22.9) the most likely age for the assemblage would be Barremian, although a basal Aptian cannot be entirely excluded.

The composition of the assemblage is slightly richer in gymnosperm pollen (55%) than spores (45%) with the most abundant species being the bisaccate pollen of *Podocarpidites* spp. (28%), the trisaccate pollen of *Microcachryidites antarcticus* (17%), and spores of *Cyathidites* spp. (21%). The next most commonest species are spores of *Foraminisporis wonthaggiensis* (6%) and *Leptolepidites verrucatus* (5%). All other species in the assemblages have abundances of <5%. As no acritarchs or algal microplankton were recorded the sample is interpreted as non-marine and probably deposited in a fluvial environment.

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Table 2. Interpretative data for Gilbert-1A, offshore Gippsland Basin.

Sample Type	Depth (metres)	Palynology Zones STAGE/AGE	CR*	Comments and Key Species Present
MSCT 17	580.0	*P. tuberculatus* SP Zone **Oligocene/Early Miocene**	B5	Very low recovery with <40 specimens. Assigned to zone on poor specimen of *Cyatheacidites annulatus*. MP est. <15%.
MSCT 16	584.5	*P. tuberculatus* to Upper *N. asperus* SP Zones and *C. capricornum* MP Acme **Early? Oligocene**	B5	SP assemblage nondescript and lacking diagnostic index species. Marine MP ~50%, dominated by *Cooksonidium capricornum*. Unusual assemblage not seen before.
MSCT 15	621.8	Upper *N. asperus* SP Zones **Early? Oligocene**	B5	Moderate yielding SP assemblage lacking index species. Assigned to Upper *N. asperus* Zone by default. MP 12%; not diagnostic.
MSCT 13	627.5	Indeterminate		Very low yield with <20 specimens recovered, from just 0.6 grams of sample analysed. Species identified not zone diagnostic.
MSCT 11	637.0	Middle *N. asperus* SP Zone and possible *G. extensa* MP Zone **late Middle to Late Eocene**	B4 B5	Moderate yield gave richly diverse assemblage containing good *Foveotriletes palaequetrus* and questionable *Triorites magnificus*. Microplankton <2%, including questionable *Gippslandica extensa*.
MSCT 8	647.4	Indeterminate		Sample effectively BARREN with only one specimen recovered.
MSCT 6	653.4	Lower *N. asperus* SP Zone *D. heterophlycta* MP Zone **late Middle Eocene**	B1 B3	Low yield gave good SP assemblage containing common *Nothofagidites* 18%. MP 9% and including zone index *Deflandrea heterophlycta*.
MSCT 5	656.0	Lower *N. asperus* SP Zone *D. heterophlycta* MP Zone **late Middle Eocene**	B1 B5	Low yield gave richly diverse assemblage with abundant *Nothofagidites* 23%. MP <1%; with *Corrudinium corrugatum* ms diagnostic.
MSCT 3	672.5	Lower *P. notensis* SP Zone **Barremian to early Aptian**	B1	High yield with high concentration of spores and pollen including frequent specimens of index species *Pilosisporites notensis* and *Cooksonites variabilis*.

SP & MP = Spore-Pollen & Microplankton;

*Confidence Ratings used in STRATDAT database and applied to Table 2.

Alpha codes: Linked to sample		**Numeric codes:** Linked to fossil assemblage		
A	Core	**1**	**Excellent confidence:**	High diversity assemblage recorded with key zone species.
B	Sidewall core	**2**	**Good confidence:**	Moderately diverse assemblage with key zone species.
C	Coal cuttings	**3**	**Fair confidence:**	Low diversity assemblage recorded with key zone species.
D	Ditch cuttings	**4**	**Poor confidence:**	Moderate to high diversity assemblage without key zone species.
E	Junk basket	**5**	**Very low confidence:**	Low diversity assemblage without key zone species.

Table 3. Basic sample data for Gilbert-1A, offshore Gippsland Basin.

Sample Type	Depth metres	Lithology	Wt grams
MSCT 17	580.0	Claystone: non-calcareous, light to medium grey, trace light brownish yellow fossil fragments.	9.1
MSCT 16	584.5	Claystone: non-calcareous, light to medium grey, trace light brownish yellow fossil fragments.	9.0
MSCT 15	621.8	Claystone: light grey to brownish grey, trace dark green disseminated glauconite and nodular glauconite.	3.7
MSCT 13	627.5	Siltstone: medium to dark yellowish-greenish brown, trace coarse glauconite and common fine green glauconite grains.	0.6
MSCT 11	637.0	Sandstone: lithic arkose, argillaceous, medium dark grey, 5% glauconite.	8.3
MSCT 8	647.4	Sandstone: lithic arkose, argillaceous, dark greenish grey, 5% glauconite.	6.0
MSCT 6	653.4	Sandstone: lithic arkose, argillaceous, medium dark greenish grey, trace –5% glauconite.	7.9
MSCT 5	656.0	Sandstone: lithic arkose, argillaceous, dark greenish-grey, trace–5% glauconite, Claystone: grayish black hard, trace carbonaceous flecks.	9.2
MSCT 3	672.5	Claystone: dark greenish grey olive brown, splintery fracture, massive.	10.2
		Average:	**7.1**

Wt = Weight of sample processed in grams.

Table 4. Basic assemblage data for Gilbert-1A, offshore Gippsland Basin.

Sample Type	Depth metres	Visual Yield	Palynomorph Concentration	Preservation	No. SP Species	No. MP Species
MSCT 17	580.0	Low	Low	Fair	12+ (1+)	2+
MSCT 16	584.5	Low	Low	Poor	19+	9+
MSCT 15	621.8	Moderate	Moderate	Poor	28+ (1+)	5+
MSCT 13	627.5	Very low	Very Low	Fair	9+	2+
MSCT 11	637.0	Low	Moderate	Fair-poor	57+	8+
MSCT 8	647.4	Very low	Negligible	Fair	1+	NR
MSCT 6	653.4	Low	Moderate	Fair-good	49+	8+
MSCT 5	656.0	Low	Moderate	Fair-good	72+	5+
MSCT 3	672.5	High	Very high	Poor-fair	40+	NR
				Average:	**32+**	**4+**

Notes:
NR = Not Recorded
Species numbers in brackets refer to number of reworked species identified in assemblage.

Table 5. Palynological slides from Gilbert-1A, offshore Gippsland Basin.

No.	Sample Type	Depth Metres	Catalogue Number	Core Lab Prep. No.	Description
1	MSCT 17	580	P218662	2236	Oxidised slide 1: 10µm filter
2	MSCT 16	584.5	P218663	2237	Oxidised slide 1: 10µm filter
3	MSCT 16	584.5	P218664	2237	Oxidised slide 2: 10µm filter
4	MSCT 16	584.5	P218665	2237	Oxidised slide 3: 10µm filter
5	MSCT 15	621.8	P218666	2238	Oxidised slide 1: 10µm filter
6	MSCT 15	621.8	P218667	2238	Oxidised slide 2: 10µm filter
7	MSCT 15	621.8	P218668	2238	Oxidised slide 3: 10µm filter
8	MSCT 13	627.5	P218669	2239	Oxidised slide 1: 10µm filter 1/2 cover slip
9	MSCT 11	637	P218670	2240	Oxidised slide 1: 10µm filter
10	MSCT 11	637	P218671	2240	Oxidised slide 2: 10µm filter
11	MSCT 8	647.4	P218672	2241	Oxidised slide 1: 10µm filter
12	MSCT 6	653.4	P218673	2242	Oxidised slide 1: 10µm filter
13	MSCT 5	656	P218674	2243	Oxidised slide 1: 10µm filter
14	MSCT 5	656	P218675	2243	Oxidised slide 2: 10µm filter
15	MSCT 3	672.5	P218676	2244	Oxidised slide 1: 10µm filter
16	MSCT 3	672.5	P218677	2244	Oxidised slide 2: 10µm filter

Well Name : Gilbert-1A

Operator : Bass Strait Oil Co Ltd — Spudded : 04 October 2005
Well Code : GILBERT-1A — Completed : 09 October 2005
Lat/Long : 37°57' 10.72"S 148°22' 25.90"E
Interval : 570m - 815m — INTERPRETATIVE Palynomorph Range Chart
Scale : 1:600 — Sample interval 580 to 672.5m
Chart date: 11 December 2005 — Microscope analysis by Alan D. Partridge

Gilbert-1A

Biostrata Pty Ltd
AUSTRALIA

Attachment to Biostrata Report 2002/32A

APPENDIX 4

Petrographic Analysis of Four Samples Selected from Well Gilbert-1A

By Core laboratories Australia Pty Ltd

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PETROGRAPHIC ANALYSIS OF FOUR CLASTIC SAMPLES FROM WELL GILBERT-1A

Prepared for

BASS STRAIT OIL COMPANY LTD

Job No. 52135-05-3466 / PRP-05132

CONFIDENTIAL

Core Laboratories Canada Ltd.
Petroleum Services
2810 12th Street NE
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January 2006

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EXECUTIVE SUMMARY

GENERAL

- Four **clastic** samples, retrieved from **Well Gilbert-1A**, have been petrographically analyzed. All were analyzed by X-ray diffraction (XRD) and examined with the scanning electron microscope (SEM), as well.

LITHOLOGIC AND PETROGRAPHIC CHARACTERISTICS

- The shallower three clastics (633.8 – 653.4m) are texturally and mineralogically comparable; these samples are homogeneous, well to very well sorted, fine grained **sandstones**. The deepest sample (662.0m), also sandstone, is moderately sorted and medium grained.

- The framework grains of the shallowest three sandstones are dominated by quartz and feldspars, with rock fragments and chamositic, partly oolitic, pellets; these sandstones are quartzose **feldspathic litharenites**. The deepest sandstone is mainly composed of volcanic rock fragments, corresponding to **feldspathic litharenite**.

DETRITAL CLAY MATRIX

- The shallower sandstones (633.8 – 653.4m) are devoid, or contain small quantities, of recrystallized detrital matrix clays. Detrital clay is often in the form of pseudo-matrix.

CEMENTS AND OTHER AUTHIGENIC PRODUCTS

- Diagenetic products are persistently represented by **chamositic chlorite**, in part displaying several stages of growth. Rather small amounts of **dolomite** and significant quantities of **siderite** were recognized in thin-section. Small amounts of authigenic pyrite are present, as well.

- Expandable mixed-layer **illite-smectite** clays, determined by XRD, are present in all samples, increasing significantly in the deepest sandstone (662.0m); these clays are dominantly composed of **smectite**.

POROSITY AND RESERVOIR QUALITY

- **Visible porosity** in the shallower three sandstones (633.8 – 653.4m) is **good** (17.8 – 20.4%), and mainly **modified intergranular**, but with a significant solutional pore component. Porosity of the deepest sandstone (662.0m) is mediocre (3.2%) and secondary **solutional** in type, with a considerable **micropore** component**.**

- Parts of these clastics display evidence of **leaching** effects, resulting in secondary porosity.

- **Depositional porosity** and particularly pore **connectivity** have mainly been reduced by clays.

- Presence of relatively small amounts of dolomite indicates ‘minor’ potential for precipitation of **fluoride scales**, if hydrofluoric (HF) acid is used.

- **Iron**, present in chamosite, ferroan dolomite, siderite and pyrite would likely be reflected on the resistivity-log response.

- If dissolved, iron in these iron-bearing minerals might re-precipitate as **iron gels**, thereby compounding the detrimental effects of clays on pore connectivity.

PETROGRAPHIC ANALYSIS OF FOUR CLASTIC SAMPLES FROM WELL GILBERT-1A

INTRODUCTION

This report presents petrographic data of clastic samples, retrieved from the depth interval: 633.8 - 662.0m in Well **GILBERT-1A**. The present report provides descriptions of:

a) **Rock type** and constituents.
b) **Diagenetic** products.
c) The **pore system**.
d) **Reservoir quality** of the sampled intersections.

PROCEDURES AND DATA BASE

SAMPLE PREPARATION AND ANALYTICAL PROCEDURE

This report is based on four samples (Table 1). Thin-sections were prepared by impregnating the rock samples with blue dyed epoxy to identify porosity, and to prevent delicate mineral constituents (e.g. authigenic clays) from being destroyed during grinding. Thin-sections of the samples were stained for both dual carbonates (non-ferroan calcite: pink; ferroan calcite: purple; non-ferroan dolomite: colorless; and ferroan dolomite: turquoise) and potassic feldspars (yellow).

Point count analyses (based on 250 points) were conducted to provide the relative proportions of framework grains, detrital clay matrix and cements, in addition to pore volume. Folk's (1980) classification has been used to categorize the mineralogical composition of these clastics. All samples were analyzed by X-ray diffraction (XRD) and examined with the scanning electron microscope (SEM); the latter was aimed at pore system categorization, including pore geometry and contained authigenic, and/or recrystallized detrital clays (particularly expandable mixed-layer illite-smectite clays).

REPORT AND COPIES

An original and two copies, with a CD, of this report are provided. Core Laboratories retains another copy of this report for reference in any future discussions regarding this study. These samples have been illustrated with a macroview and three photomicrographs each, for details. All data and interpretations related to this study are considered strictly confidential, and the sole property of BASS STRAIT OIL COMPANY LTD.

LITHOLOGIC FEATURES

The shallower three clastics, retrieved from the depth interval 633.8 – 653.4m, are comparable in terms of texture and mineralogical composition.

These samples are relatively undercompacted, homogeneous, moderately well to very well sorted, fine grained **sandstones**. Framework-grain average of these sandstones falls within a range of 125 - 180μ-across (Table 2), corresponding to fine grain sand size; these sandstones become coarser grained in an upward direction. Framework grains of these clastics are subangular to subrounded, and display loose-to-point and point-to-long contacts.

The deepest sample (662.0m), also sandstone, is by contrast, compacted, moderately sorted and lower medium grained (average grain 270μ-across). Framework grains of this sandstone are subangular to subrounded, and display mainly point-to-long contacts.

PETROGRAPHIC ANALYSIS

ROCK TYPES AND FRAMEWORK CONSTITUENTS

Clastics, making up the sampled intersection (633.8 – 662.0m) in this well, are represented by four sandstones; their depth positions are shown on Table 2. Of these, the shallower three sandstones (633.8 – 653.4m) exhibit remarkable similarity in both textural and mineralogical composition; this sample suite, taken as a whole, differs from the deepest sample (662.0m).

The Shallower Part of the Intersection: 633.8 – 653.4m

Petrographic analysis of the three shallower sandstone samples (633.8 – 653.4m) indicates dominance of monocrystalline quartz grains (26.8% - 30.6%), feldspars (6.6% - 9.6%) and rock fragments (6.4% – 11.4%), with smaller quantities of chert (3.6% – 4.2%), biotite-mica (2.0 – 4.2%) and chamosite (3.6 – 12.6%), increasing towards the top of the sampled interval (Table 2).

Chamosite occurs as rounded/ellipsoidal '**pellet**'-like particles, some of which are coated with several very thin layers of this mineral, indicating **oolitic** mode of occurrence. Often, however, there is a gap(s) of open space in between these layers, or between these layers and particle substrate, suggesting drying and possible shrinkage of these chamosite-dominated substrates and layers. These pellets/ooliths are most common in the shallowest sandstone; their distribution in that sample suggests moderate relative preferential concentration along certain laminae.

Feldspars are of both potassic and plagioclase attributes (4.2 – 6.2% and 2.4 – 3.6%, respectively, by point count analysis). Rock fragments include those of sedimentary and volcanic attributes, with the former being significantly more common.

Based on their mineralogical composition, characterized by common quartz and feldspars, these sandstones have been classified as quartzose **feldspathic litharenite** (Fig. 1).

The Deeper Part of the Intersection: 662.0m

The deepest sandstone (662.0m), by glaring contrast, is characterized by the dominance of clay-rich rock fragments (32.2%), which are of both volcanic (volcanoclasts) and sedimentary origin. Other grains include feldspars (22.4%; Table 2), chert (5.2%) and quartz grains (9.6%). This mineralogical composition indicates that this sandstone corresponds to **feldspathic litharenite** rock type (Fig. 1).

Outstanding textural and mineralogical disparity between these two intervals, represented by the shallower three samples (633.8 – 653.4m) and the deepest (662.0m) indicates the presence of two discrete and widely diverse (both in terms of texture and mineralogy) sandstone units. The latter has dominantly been influenced by a volcanic source.

DETRITAL CLAY MATRIX

<u>The Shallower Part of the Intersection: 633.8 – 653.4m</u>

The shallower sandstones are devoid, or contain small quantities (2.8%, in one sample), of detrital matrix clays that have been recrystallized.

In thin-section, these clays are green and display very low first-order birefringence. These clays are not pervasively distributed and, therefore, do not fill the pore system completely; rather, they tend to be present as framework-grain coating.

Bulk sample X-ray diffraction (XRD) analyses of these three sandstones (Table 3) indicate the presence of 17 – 23% total clays. These clays are mainly composed of chlorite (40 – 44%), with smaller amounts of other clay minerals, including illite/mica (23 - 31%), kaolinite (21 – 27%) and mixed layer **illite-smectite** clays (4 – 14%); smectite makes up most of the illite-smectite mixed-layer clays; chlorite is mainly chamosite.

<u>The Deeper Part of the Intersection: 662.0m</u>

The deepest sandstone also lacks detrital clays. However, significant quantities of clays have been generated by the argillization of volcanoclasts, followed by their redistribution within this sandstone, due to compactional effects.

Bulk sample X-ray diffraction (XRD) analysis of this sample indicates the presence of 43% total clays. These clays comprise chlorite (47%), illite/mica (36%), kaolinite (11%) and mixed-layer **illite-smectite** clays (6%).

CEMENTS AND OTHER AUTHIGENIC PRODUCTS

The Shallower Part of the Intersection: 633.8 – 653.4m

Diagenesis of the **shallower** quartzose feldspathic litharenite-dominated **interval** (633.8 – 653.4m) is characterized by ubiquitous **chloritization**, followed by mineral leaching. In addition to chlorite (dominantly chamosite), several other diagenetic products are present, as well; these include ferroan dolomite, siderite, pyrite and authigenic clays.

Rather small quantities of dolomite (2.0 – 2.4%; Table 2) tend to form pinpoint concentrations. Dolomite crystals often show a degree of corrosion; some dolomite crystals contain molds of previously existing less stable dolomite. Spindle-shaped siderite is relatively more common, forming 3.6 – 5.2% of these clastics.

Precipitation of authigenic quartz was totally inhibited by the common coating of detrital quartz grains by clays.

Authigenic pyrite, forming 1.2% – 2.4% of these rocks, occurs as fairly well distributed framboids.

Authigenic chlorite (8.0% and 10.0%) has been recognized in all samples. In addition to being dominantly represented as recrystallization product, chlorite forms discrete isopachous layers.

X-ray diffraction analysis of the less-than-2micron fractions (Table 3), representing authigenic clays in the pore system of this shallower interval, indicates that these clays are mainly composed of kaolinite (60 – 77%), with smaller quantities of chlorite (14 – 21%), illite (6 – 15%) and expandable mixed-layer **illite-smectite** (1 – 4%). Mixed-layer illite-smectite clays are **80 – 100%** composed of **expandable smectite**.

The Deeper Part of the Intersection: 662.0m

Diagenesis of the deeper part of the sampled intersection, represented by the sandstone from 662.0m, is mainly reflected by:

a) Argillization of feldspars.
b) Chloritization of commonly volcanic fragments.
c) Precipitation of abundant chlorite cement.
d) Extensive mineral dissolution, particularly of feldspars.

Identified by XRD (Table 3), diagenetic clays within the less-than-2micron fraction are dominantly composed of chlorite (49%) and **mixed-layer illite-smectite (29%)**; other clays, present, include illite (15%) and kaolinite (7%). Mixed-layer illite-smectite clays are **80 – 100%** composed of **expandable smectite**.

Based on XRD analysis, chlorite is chamositic in type. This diagenetic product is present as isopachous grain coating, precipitating during several contemporaneous diagenetic events; this occurrence (repeated isopachous enrichment), albeit discernible locally, is indicated by the presence of several layers of ordered chlorite platelet assemblages.

THE PORE SYSTEM

The Shallower Part of the Intersection: 633.8 – 653.4m

Total visible thin-section point count porosity of the quartzose feldspathic litharenite-dominated **interval** varies from 17.8% to 20.4% (Table 2), increasing marginally in the middle of the sampled interval. Most of the visible porosity is of **intergranular** type (15.0 – 18.0%), modified by authigenic/recrystallized clays and other diagenetic products. In addition to this pore type, mineral leaching has been conducive to the creation of secondary **solution-**enhanced **porosity**; the latter pore type ranges between 2.4% and 2.8%. This pore component is evidenced by the presence of:

a) Open spaces that are as large as framework grains.
b) Oversized intergranular pore space.

c) Abnormally large pore throats.
d) Relict, partly dissolved, material within pores.
e) Corroded and partly leached dolomite.
f) Partly dissolved chamositic grains.

Microporosity is mostly present within clays, but also has been created by incipient mineral dissolution.

<u>The Deeper Part of the Intersection: 662.0m</u>

The sandstone retrieved from this depth exhibits mediocre porosity (3.2%), which is dominated by micropore type; this pore component is mostly contained within partly leached grains. If core analysis porosity is available, most of it would be considered 'ineffective' for liquid hydrocarbons.

RESERVOIR CHARACTERISTICS

<u>The Shallower Part of the Intersection: 633.8 – 653.4m</u>

This sandstone-dominated interval exhibits moderate to good readily discernible visible porosity, which is evenly distributed throughout the samples.

Both depositional porosity and permeability have considerably been reduced by the presence of clays, mainly detrital. Pore connectivity, in particular, has suffered more considering the mode of occurrence of clays, which tend to be present as grain coating. Authigenic clays have been instrumental in the further reduction of permeability as they tend to block pore throats.

Depositional porosity and permeability, however, have significantly improved as a result of mineral leaching, which was conducive to the generation of a sizable solutional pore component.

A rather small quantity of authigenic kaolinite has been visibly identified in the deepest sample of this interval.

The use of HF acid in the presence of dolomite (in the deeper two samples) could be conducive to the precipitation of insoluble and irremovable fluoride precipitates.

These samples contain significant amounts of iron-rich chamosite; the presence of iron in this mineral could affect the resistivity-log response; this factor has to be taken into account during interpretation. Also, if dissolved, the released iron could re-precipitate as iron gels.

The Deeper Part of the Intersection: 662.0m

The sandstone representing the formation at this depth exhibits minor to mediocre porosity, which is dominated by microporosity.

Expandable mixed-layer illite-smectite clays are common at this depth; these clays are dominantly composed of smectite (80 – 100%). If exposed to fresh water, these clays would swell, causing formation damage.

Chamositic clays are rich in iron; this iron will show on the resistivity-log response. If these clays are dissolved, the released iron could re-precipitate as iron gels.

REFERENCES

Folk, R.L. (1980) Petrology of Sedimentary Rocks. Hemphill Publishing Company, Austin, Texas, 184p.

Table 1. Sample Data

Well	Sample #	Depth (m)	TS	XRD	SEM
Gilbert - 1A	12	633.8	*	*	*
	8	647.4	*	*	*
	6	653.4	*	*	*
	4	662.0	*	*	*

Company: Bass Strait Oil Company Ltd
Well: Gilbert - 1A

C.L. File No. 52135-05-3466
Date: January, 2006
Petrologist: Simona Vari

Table 2. Petrographic Summary / Point Count

SAMPLE		12	8	6	4
DEPTH (m)		633.8	647.4	653.4	662.0
ROCK TYPE		SANDSTONE	SANDSTONE	SANDSTONE	SANDSTONE
CLASSIFICATION (Folk, '80)		Feldspathic litharenite	Feldspathic litharenite	Feldspathic litharenite	Feldspathic litharenite
FRAMEWORK GRAINS					
Quartz	Monocrystalline	30.6	26.8	29.0	9.6
	Polycrystalline	-	-	-	-
Rock Fragments	Chert	3.6	4.2	3.6	5.2
	Sedimentary	5.2	7.2	10.2	10.2
	Volcanic	1.2	< 1.0	1.2	22.0
Feldspars	Potassium feldspar	6.2	6.0	4.2	7.6
	Plagioclase feldspar	2.4	3.6	2.4	14.8
Accessory Grains	Pellets/ooliths	12.6	8.6	3.6	-
	Micas (biotite)	2.0	3.2	4.2	0.8
	Heavy minerals	2.4	2.0	2.6	0.8
MATRIX					
Detrital clays	Pseudo-matrix	-	2.8	-	-
AUTHIGENIC MINERALS					
Clays	Chlorite	8.6	8.0	10.0	16.8
	Kaolinite	-	-	3.2	1.2
	Illite	-	-	-	-
Non-Clay Cements	Dolomite	-	2.4	2.0	-
	Siderite (spindle-shaped)	5.2	3.6	3.6	4.2
	Quartz overgrowth	-	-	-	-
	Pyrite	1.2	1.2	2.4	3.6
	Bitumen	-	-	-	-
POROSITY					
Primary intergranular		16.0	18.0	15.0	-
Secondary solutional / micropore		2.8	2.4	2.8	3.2
Total visible porosity		18.8	20.4	17.8	3.2
TEXTURE					
Average Grain Size (mm)		0.180 (fU)	0.140 (fL)	0.125 (fL)	0.270 (mL)
Sorting		Moderately-well	Very well	Very well	Moderate
Roundness		Sa-Sr	Sa-Sr	Sa-Sr	Sa-Sr
Grain Contacts		Point to long	Loose to point	Point to long	Point to long
RESERVOIR CHARACTERISTICS					
Thin Section Porosity (%)		**18.8**	**20.4**	**17.8**	**3.2**
Core Porosity (%)		N/A	N/A	N/A	N/A
Permeability (md)		N/A	N/A	N/A	N/A
Grain Density (g/cm^3)		N/A	N/A	N/A	N/A

Table 3. X-Ray Diffraction Analysis (Combined Whole Rock and Clay)

Company: Bass Strait Oil Company Ltd
Well: Gilbert-1A
File No: 52135-05-3466

Sample ID	12	8	6	4
Depth (m)	633.8	647.4	653.4	662.0
Mineral	Whole Rock Weight %			
Quartz	73	80	72	33
K-Feldspar	3	2	3	8
Plagioclase	Trace	Trace	1	15
Anhydrite	0	0	0	0
Calcite	0	0	0	0
Ferroan Dolomite	0	1	Trace	0
Dolomite	0	0	0	0
Gypsum	0	0	0	0
Halite	0	0	0	0
Siderite	6	0	0	0
Pyrite	1	Trace	1	1
Fluorapatite	0	0	0	0
Total Clay	17	17	23	43
Total	100	100	100	100

Clay Mineral	Relative Clay % (in Bulk)			
Smectite	0	0	0	0
Illite / Smectite *	14	8	4	6
Illite & Mica	24	23	31	36
Kaolinite	22	27	21	11
Chlorite **	40	42	44	47
Total	100	100	100	100

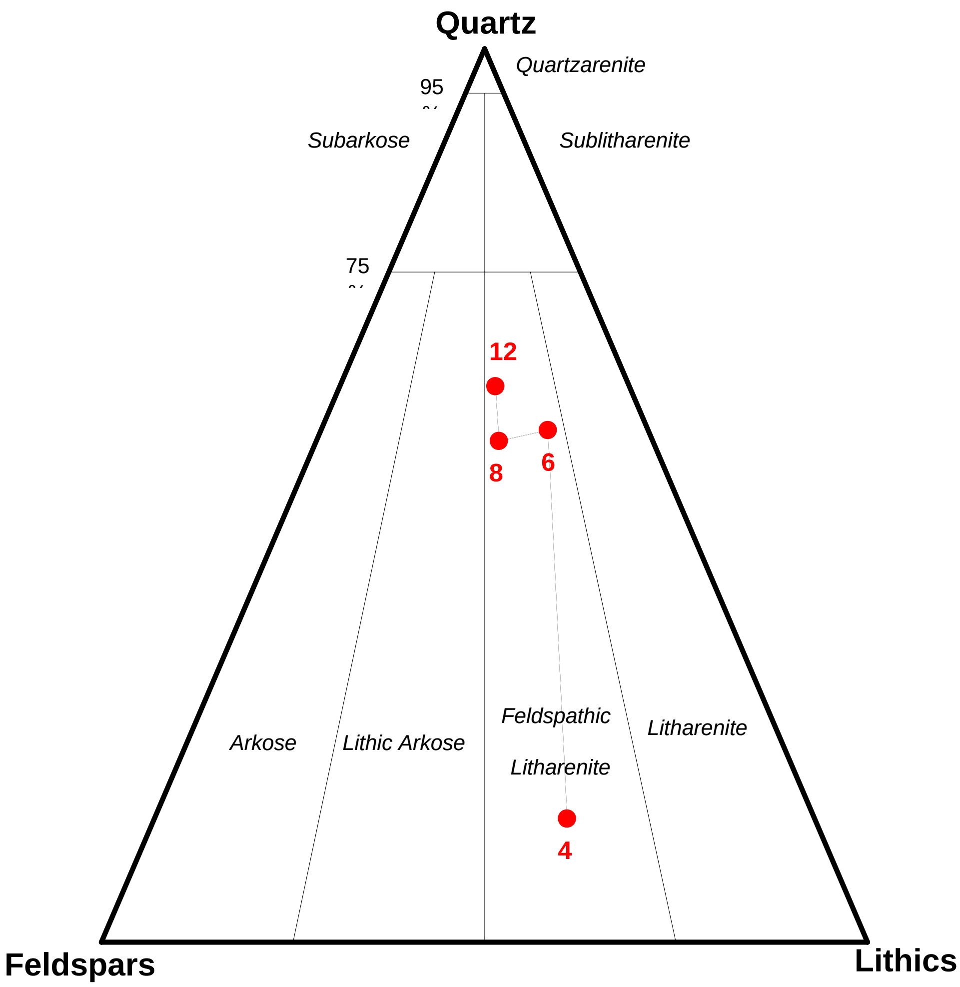
Clay Mineral	Relative Clay % (<2 Micron Fraction)			
Smectite	0	0	0	0
Illite / Smectite *	4	1	1	29
Illite	15	8	6	15
Kaolinite	60	77	76	7
Chlorite **	21	14	17	49
Total	100	100	100	100

*** Illite / Smectite Mixed-Layer Clay**
**** Chlorite in these samples is chamosite (Fe-rich chlorite).**

The percentage of smectite layers in illite / smectite clay	80%-100%	80%-100%	80%-100%	80%-100%

Figure 1. Ternary diagram (Folk's 1980 Classification)

Well Gilbert - 1A



Company: Bass Strait Oil Company Ltd

52135-05-3466

Well: Gilbert - 1A

Plate: 1A

4mm

Sample:	12
Depth (m):	633.8
Porosity (%):	N/A
Permeability (mD):	N/A

Company: Bass Strait Oil Company Ltd
Well: Gilbert-1A
Depth (m): 633.80
Sample 12: Sandstone

Plate 1B (x32): Moderately to well sorted, fine grained sandstone, with abundant clay-dominated 'pellets' (brown). Good intergranular porosity (blue). Some parts of this sample are rich in dolomite.

Plates 1C (x63): Magnification of the sample, reflecting the relative abundance of 'pellets' and ooliths (brown), which are dominantly composed of chamosite.

Plates 1D (x125): Detail of chamosite pellets (brown), showing shrinkage-related open space.The pore system is of intergranular type, enhanced by mineral dissolution. Incomplete leaching was conducive to the formation of mineral fines, which can become migratable.

Plate 1B

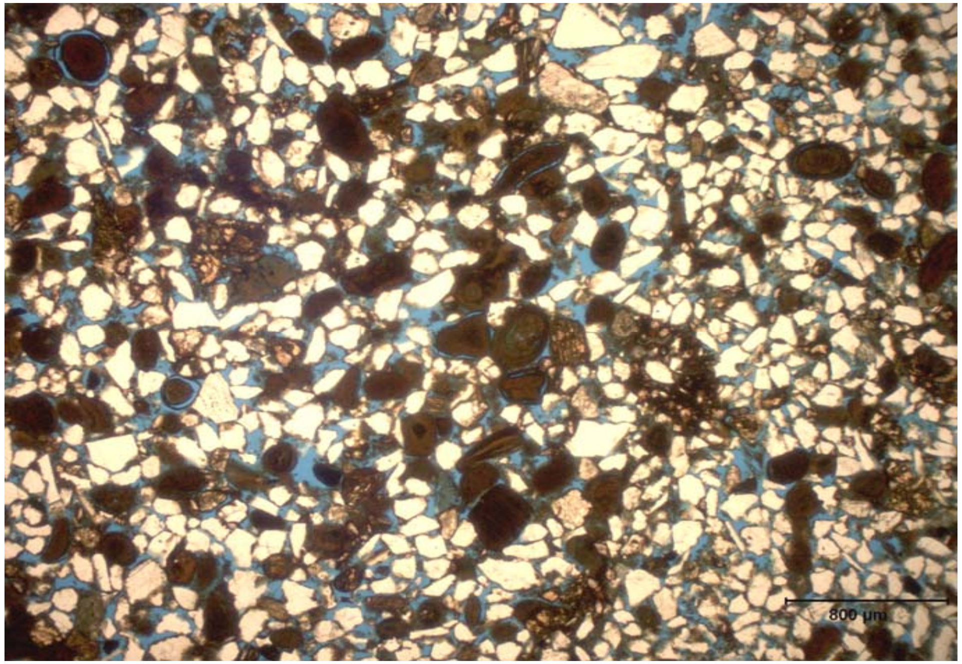


Plate 1C

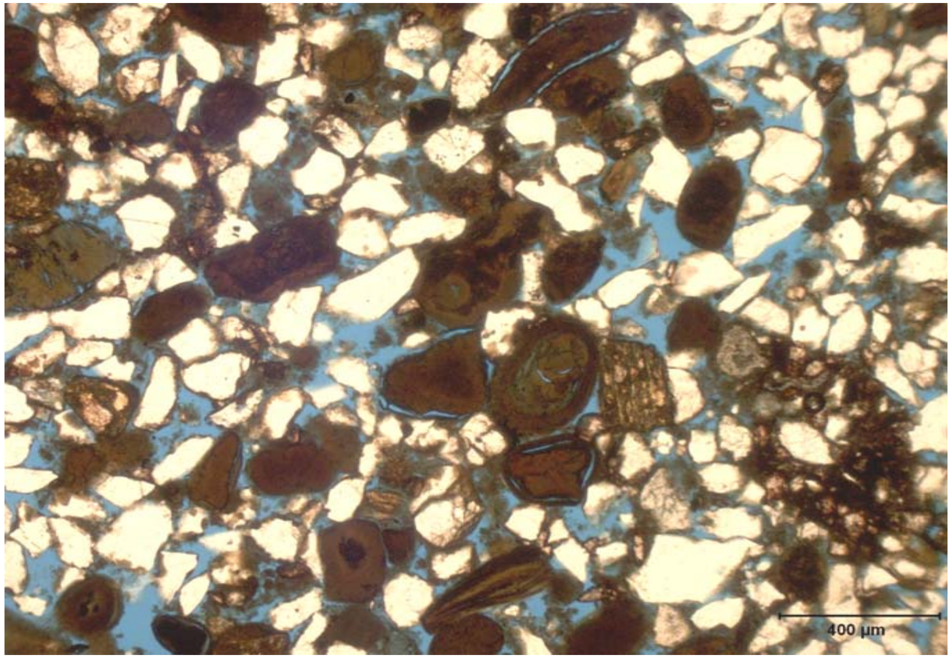
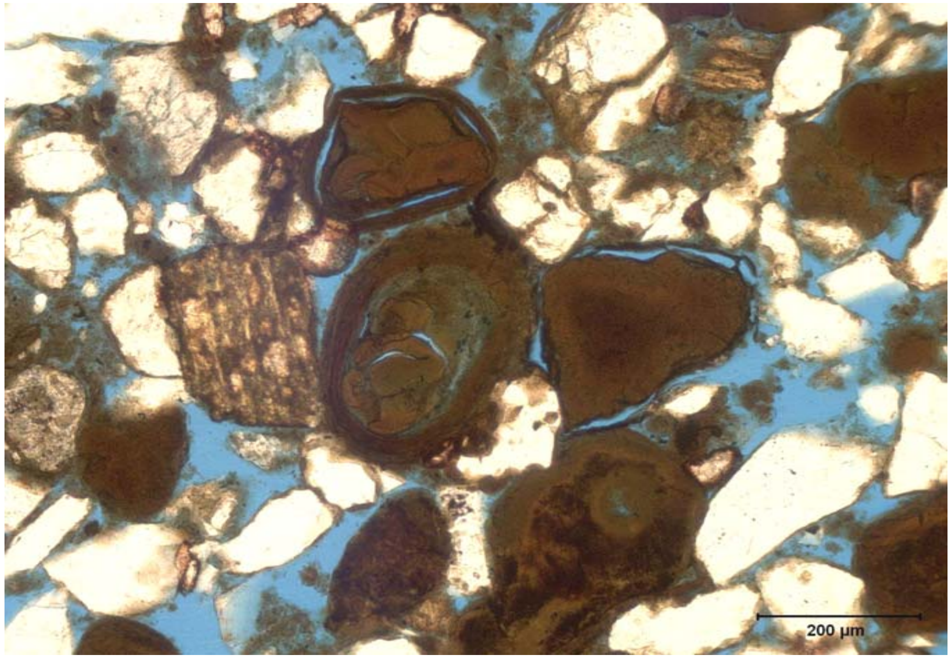


Plate 1D



Company: Bass Strait Oil Company Ltd
Well: Gilbert-1A
Depth (m): 633.8
Sample 12: Sandstone

Plate 1E (x350): Magnification of chamositic ooliths; note the outer layering (upper center). These clays are recrystallized. Remnant intergranular porosity is still preserved. XRD analysis of these layers indicates iron-rich chlorite, identified as chamosite.

Plates 1F and 1G (x1000/X1500): Details of intergranular pore spaces, which are considerably reduced by authigenic clays; these clays, however, are much more detrimental to pore connectivity. Micropores are associated with these clays. These clays have filamentous ends (illite), which can become migratable fines, if broken.

Plate 1E

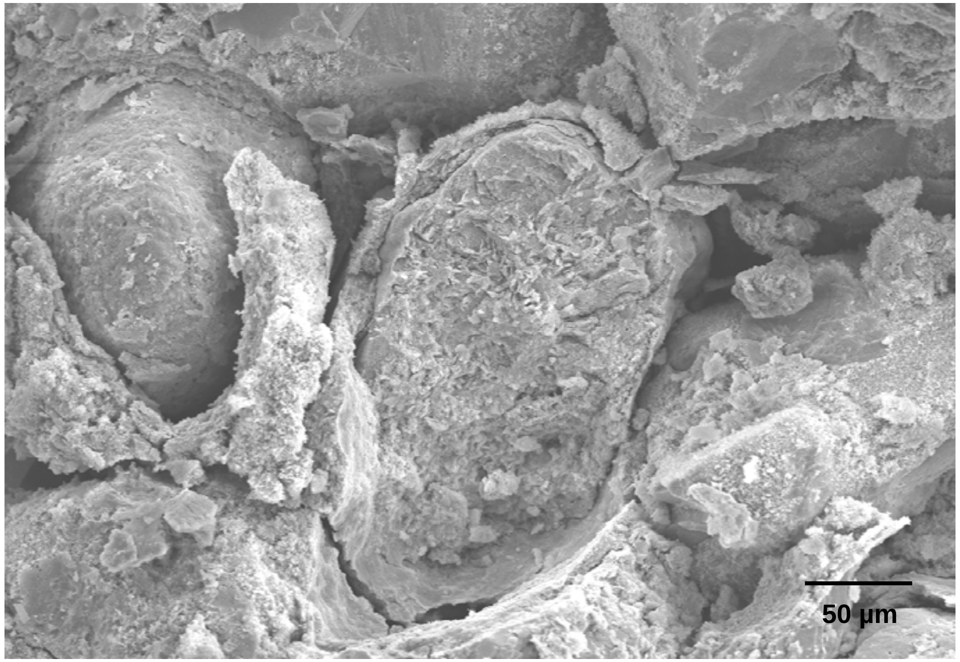


Plate 1F

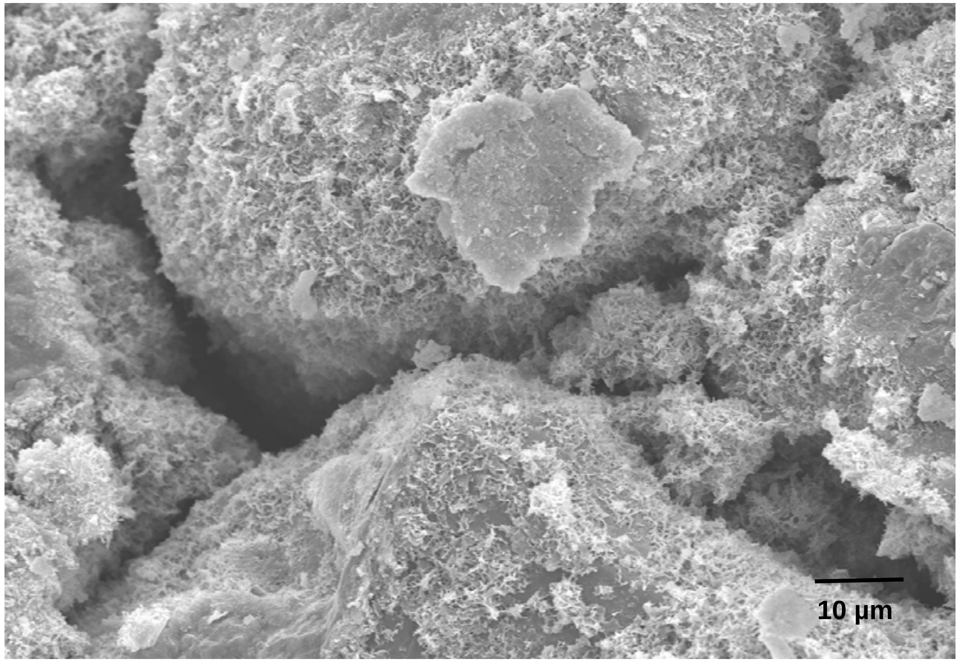
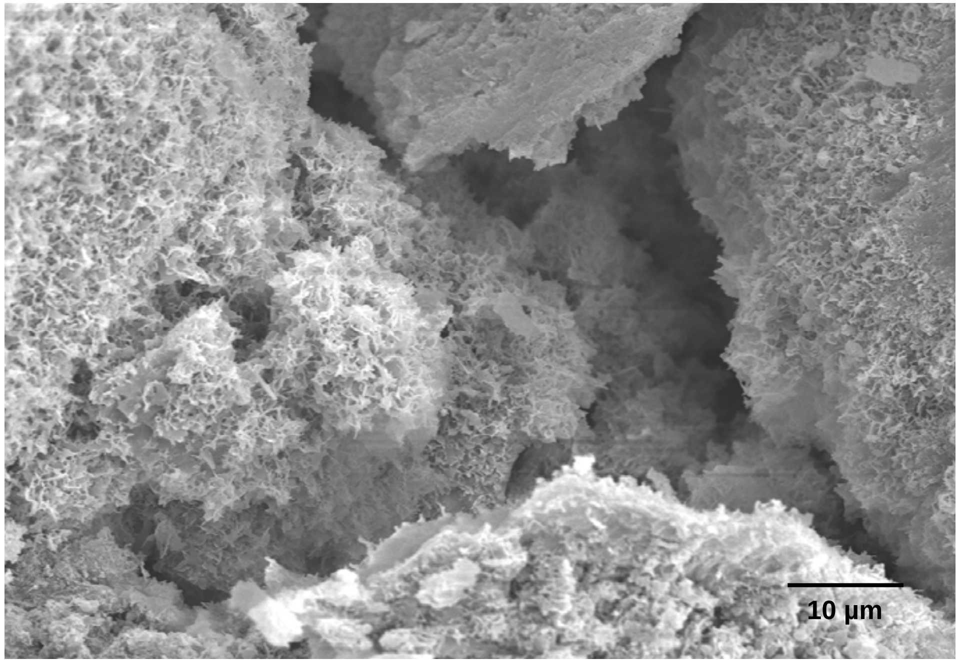


Plate 1G

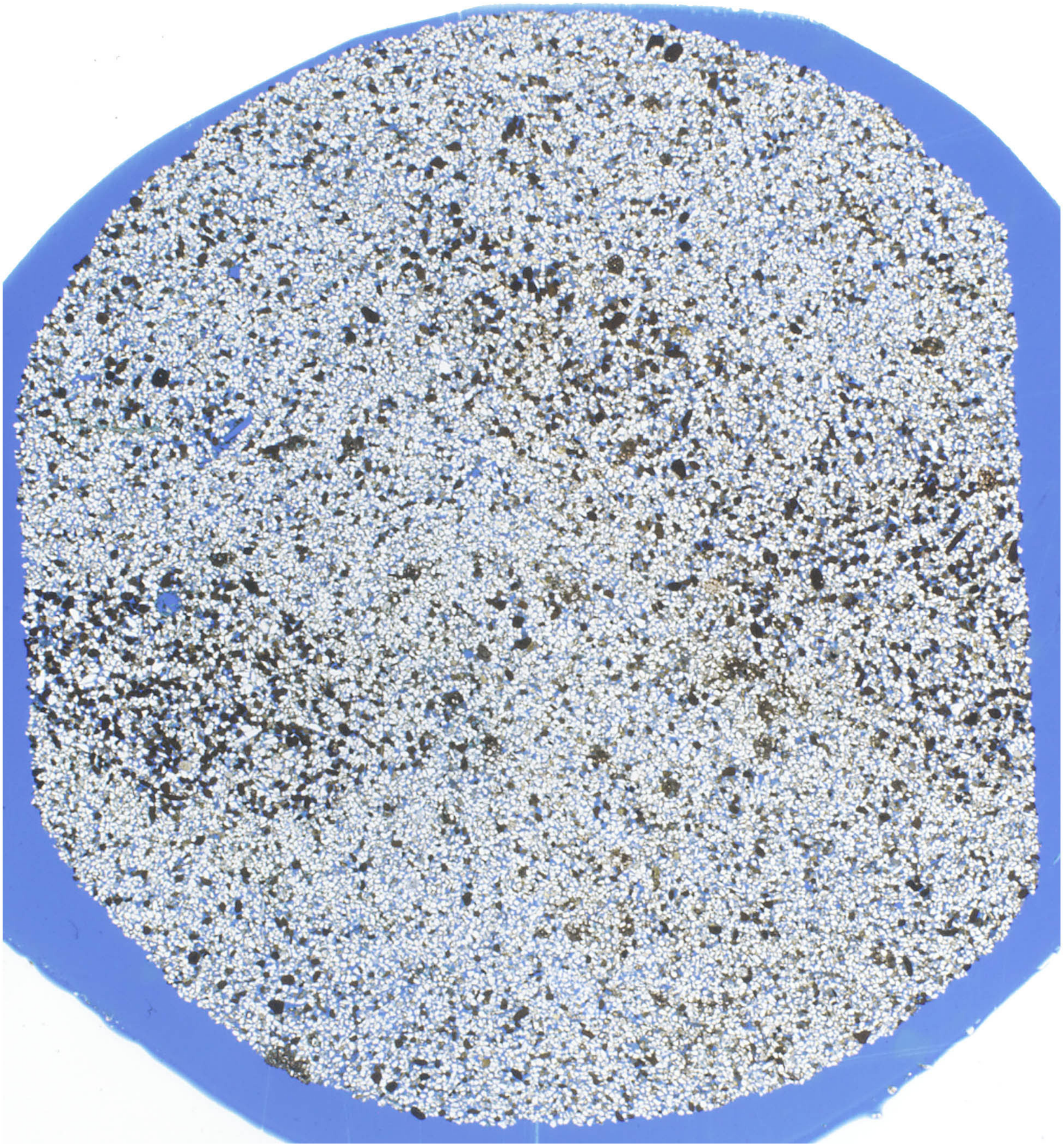


Company: Bass Strait Oil Company Ltd

52135-05-3466

Well: Gilbert - 1A

Plate: 2A



Sample:	8	4mm
Depth (m):	647.4	
Porosity (%):	N/A	
Permeability (mD):	N/A	

Core Lab
RESERVOIR OPTIMIZATION

Company: Bass Strait Oil Company Ltd
Well: Gilbert-1A
Depth (m): 647.4
Sample 8: Sandstone

Plates 2B (x32) and **Plate 2C** (x63): Overview and magnification of this sandstone. The non-pelletal component of this sandstone is very well sorted and fine grained. Porosity (blue) is evenly distributed and intergranular. Note, however, the presence of an elongated grain-mold, reflecting mineral dissolution and creation of secondary porosity. This field of view contains a small amount of ferroan dolomite; some dolomite crystals show signs of leaching.

Plate 2D (X125): Detail of the pore system (blue), showing the presence of both intergranular and solutional pore spaces. The latter pore component (mostly occupying the left side of this view) appears more associated with the chamositic component of this sample. Incomplete mineral dissolution has created fines, which have the potential to become migratable.

Plate 2B

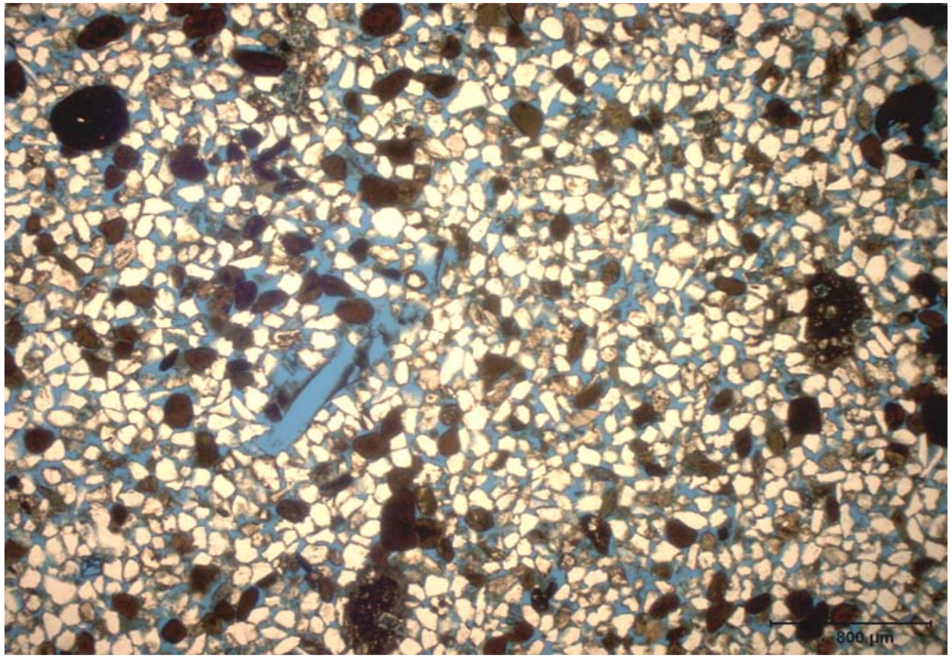


Plate 2C

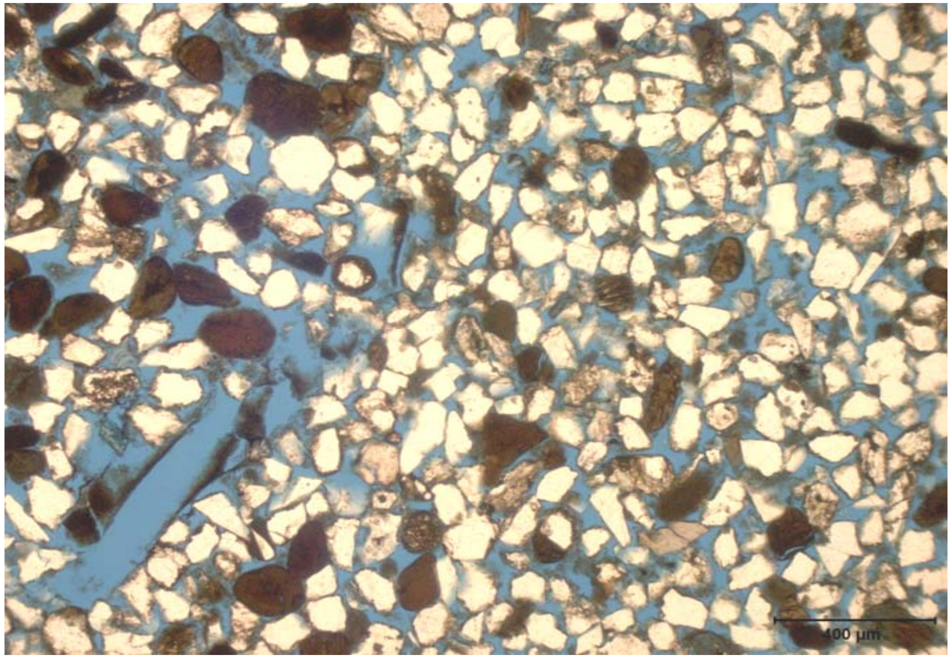
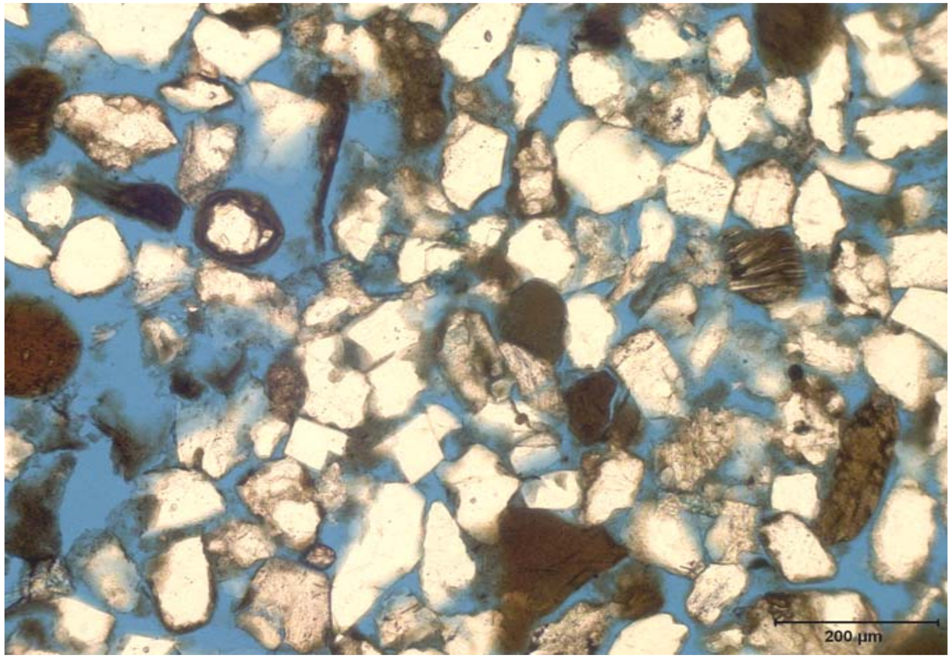


Plate 2D



Company: Bass Strait Oil Company Ltd
Well: Gilbert-1A
Depth (m): 647.4
Sample 8: Sandstone

Plate 2E (x500): Isopachous layering of grains, representing ooliths, coated with authigenic clays. Although remnant intergranular porosity is still observed, pore connectivity has been greatly reduced.

Plates 2F and 2G (x1000/X2000): Details of pore throat closure due to the precipitation of isopachous clays, which show strong tendencies to pore throat bridging; these clays are chamositic, as indicated by abundant iron (EDX analysis). Micropores are associated with these authigenic/recrystallized clays.

Plate 2E

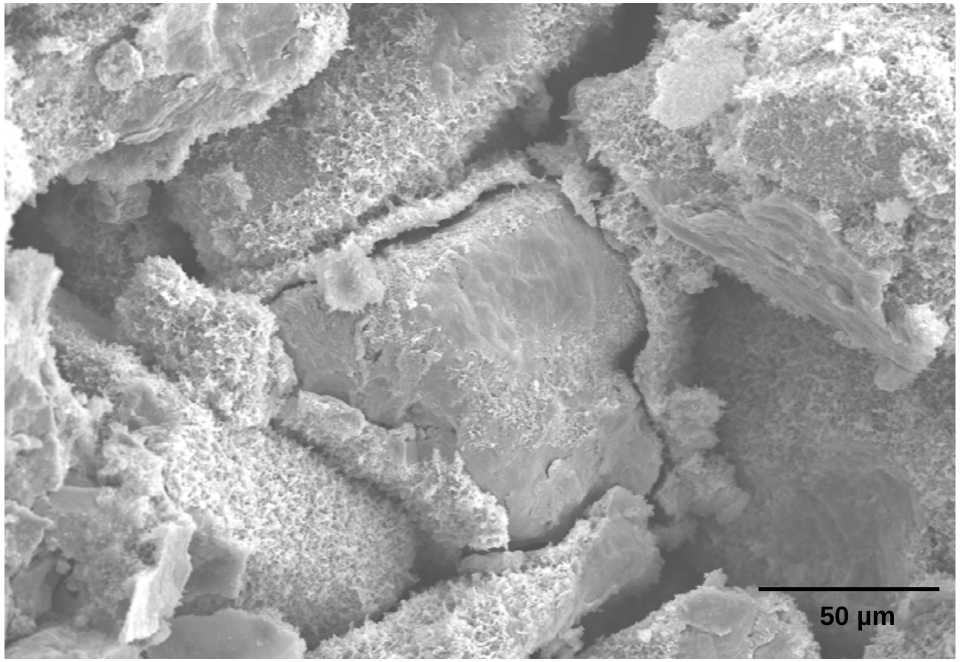


Plate 2F

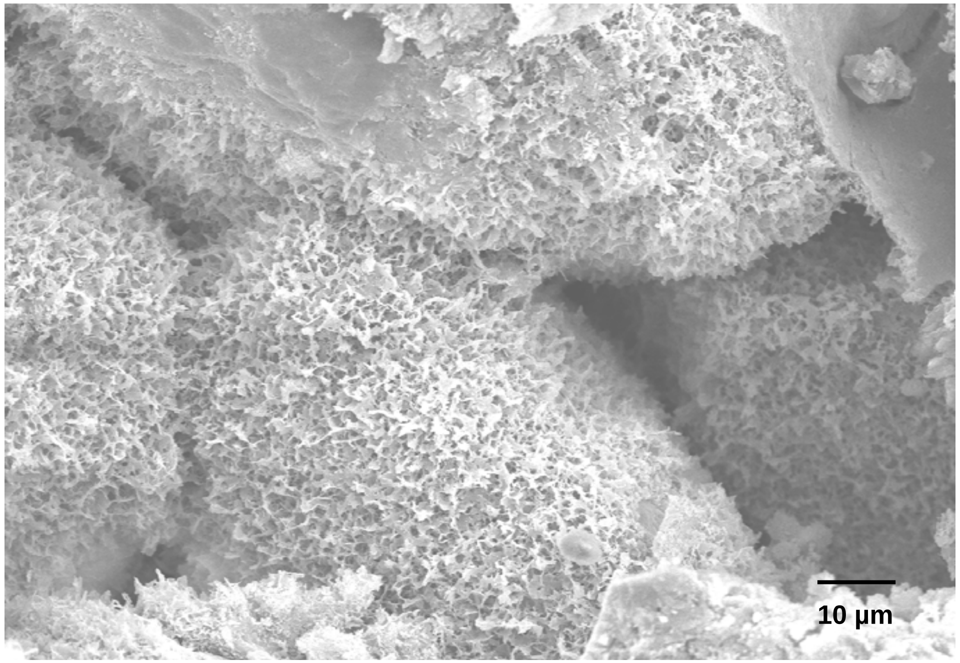
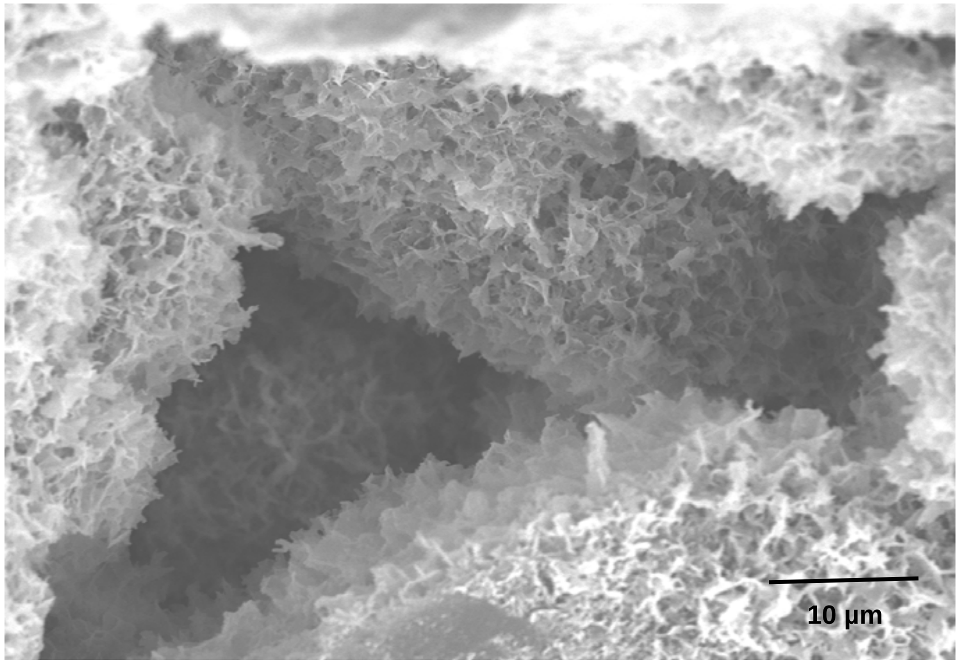


Plate 2G

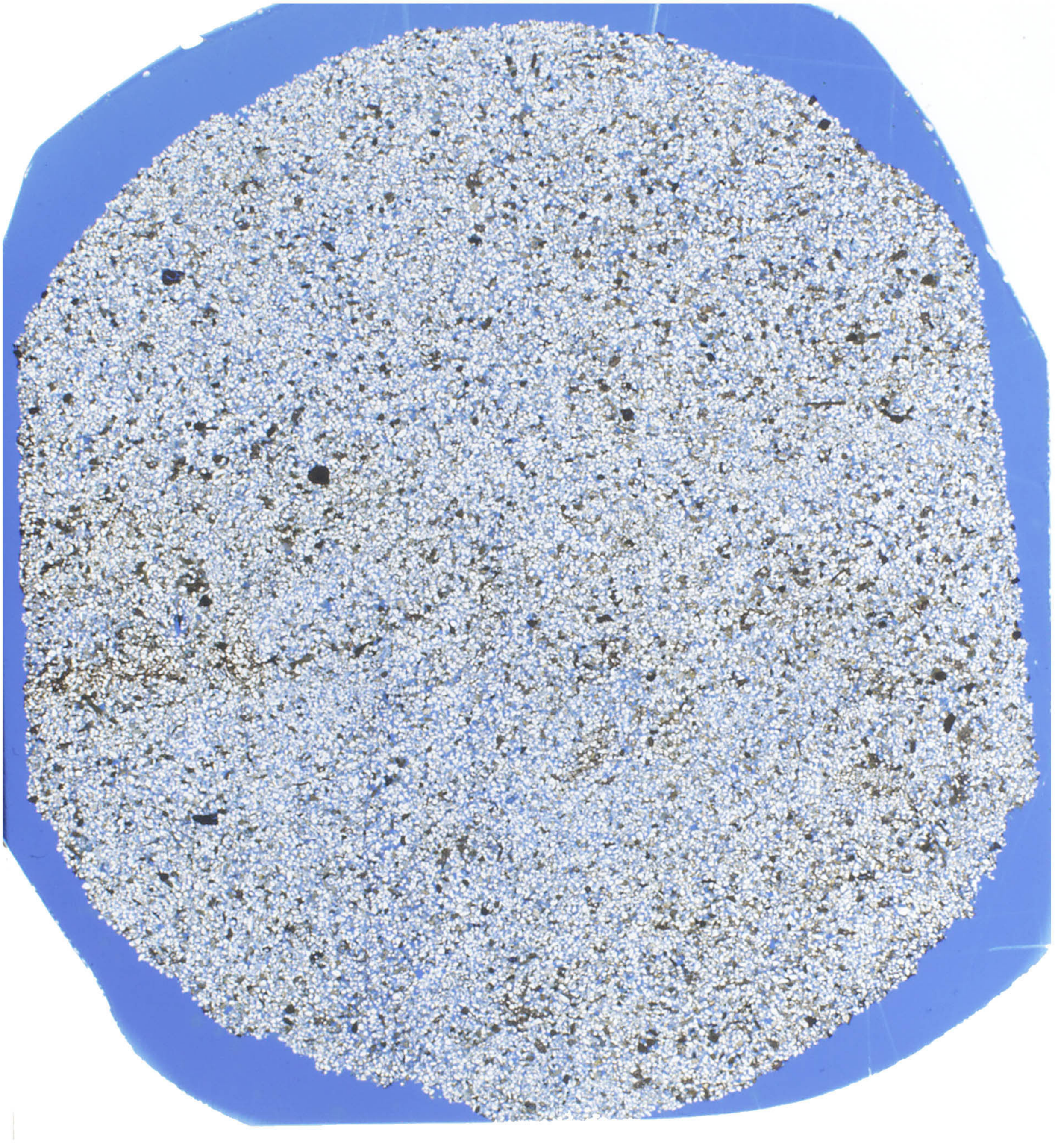


Company: Bass Strait Oil Company Ltd

52135-05-3466

Well: Gilbert - 1A

Plate: 3A



Sample:	6
Depth (m):	653.4
Porosity (%):	N/A
Permeability (mD):	N/A

4mm

Company: Bass Strait Oil Company Ltd
Well: Gilbert-1A
Depth (m): 653.4
Sample 6: Sandstone

Plate 3B (x32): Very well sorted, fine grained sandstone, with chamositic pellets (brown). Good, commonly intergranular and evenly distributed, porosity is observed (blue).

Plates 3C and **3D** (x63/X125): Magnification and detail of the sample illustrating the pore system (blue), which mainly comprises intergranular pore spaces. The pore system has been enhanced by mineral dissolution, resulting in grain molds and abnormally large intergranular pores.

Plate 3B

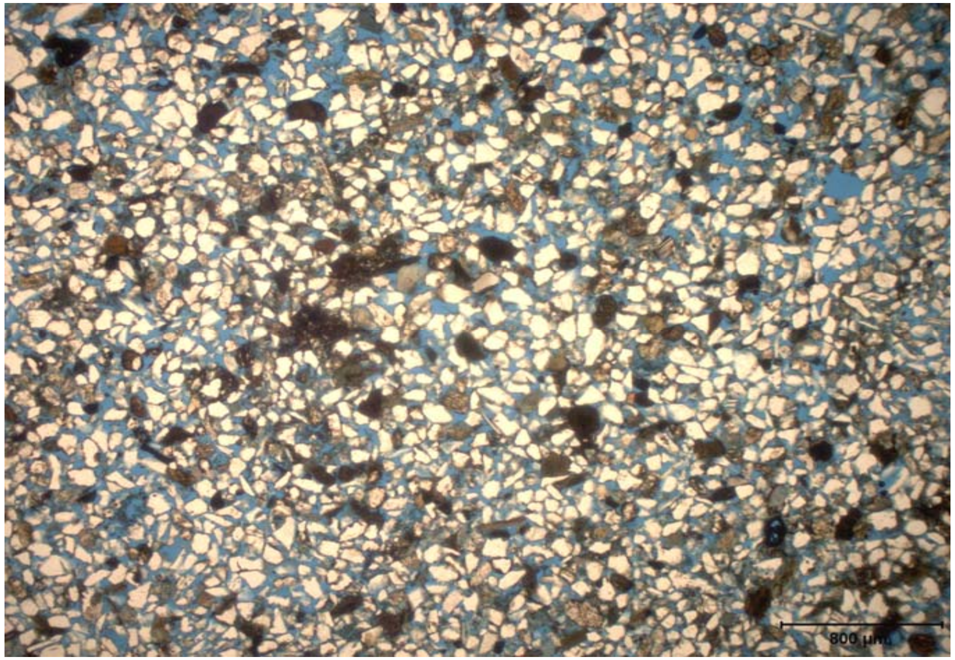


Plate 3C

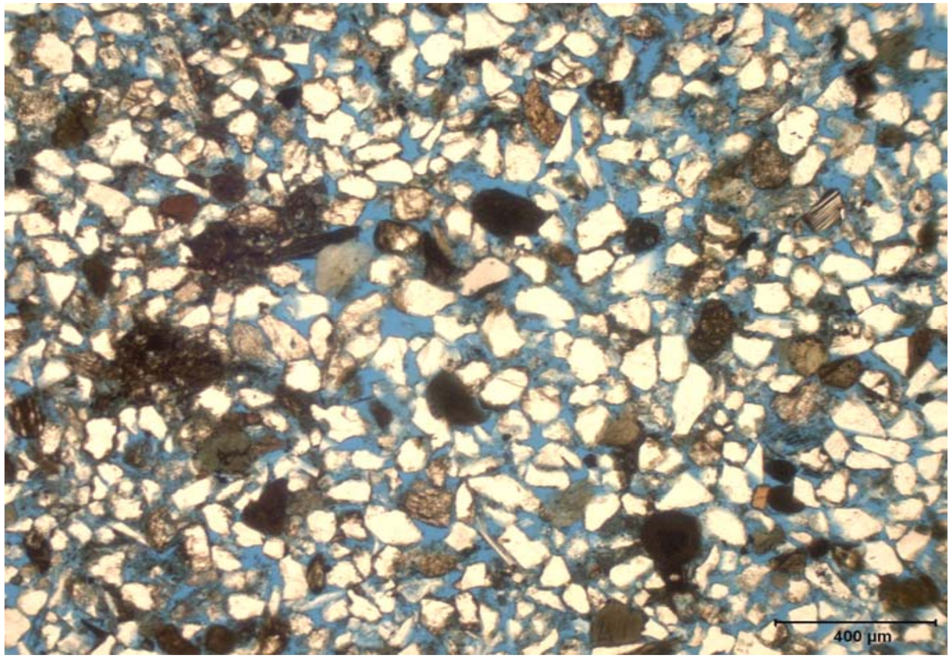
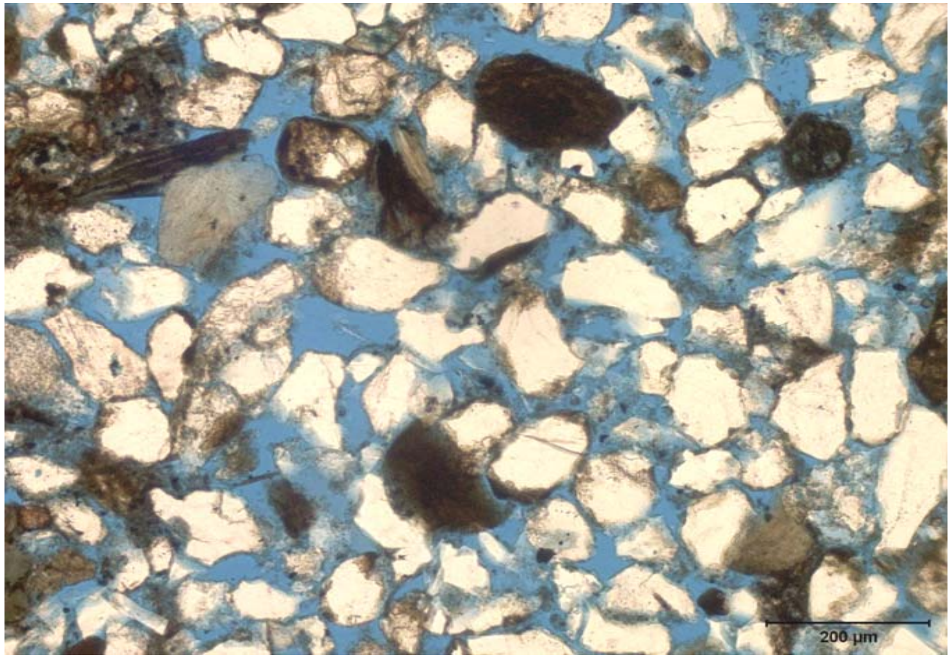


Plate 3D



Company: Bass Strait Oil Company Ltd
Well: Gilbert-1A
Depth (m): 653.4
Sample 6: Sandstone

Plate 3E (x700): Close-up of the pore system which has been reduced by clays and compaction. Pore connectivity has suffered more than porosity.

Plate 3F (x1000): Contorted illitic platelets (centre) occupying an intergranular pore space.

Plate 3G (X1500): Detail of authigenic clays, with filamentous ends indicating illitic clays. These filaments have the potential of migration, if broken. Note the bridging of pore throats, which effectively reduces pore connectivity. These clays exhibit micropores.

Plate 3E

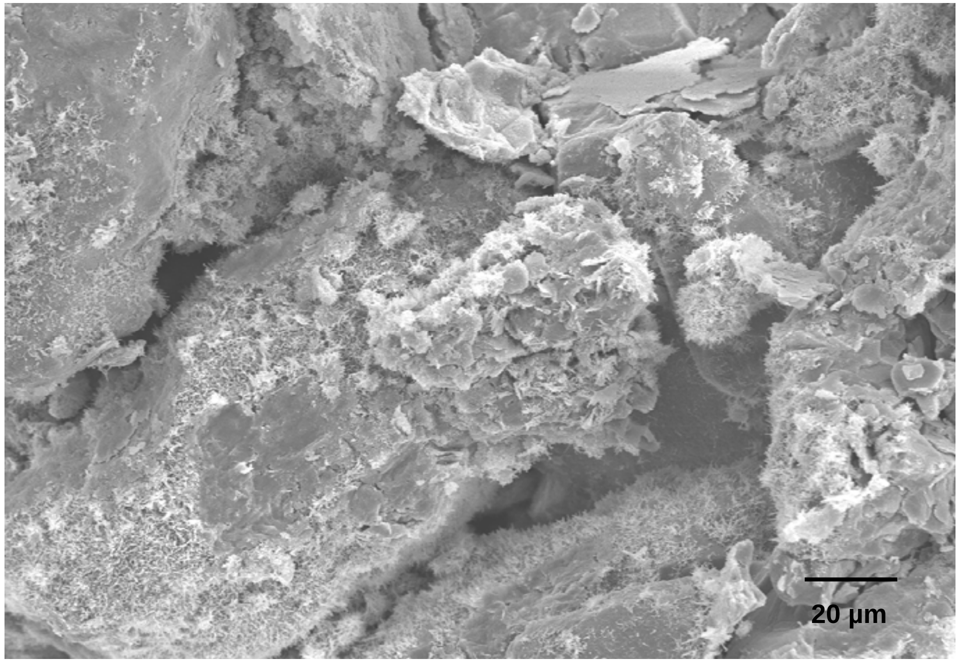


Plate 3F

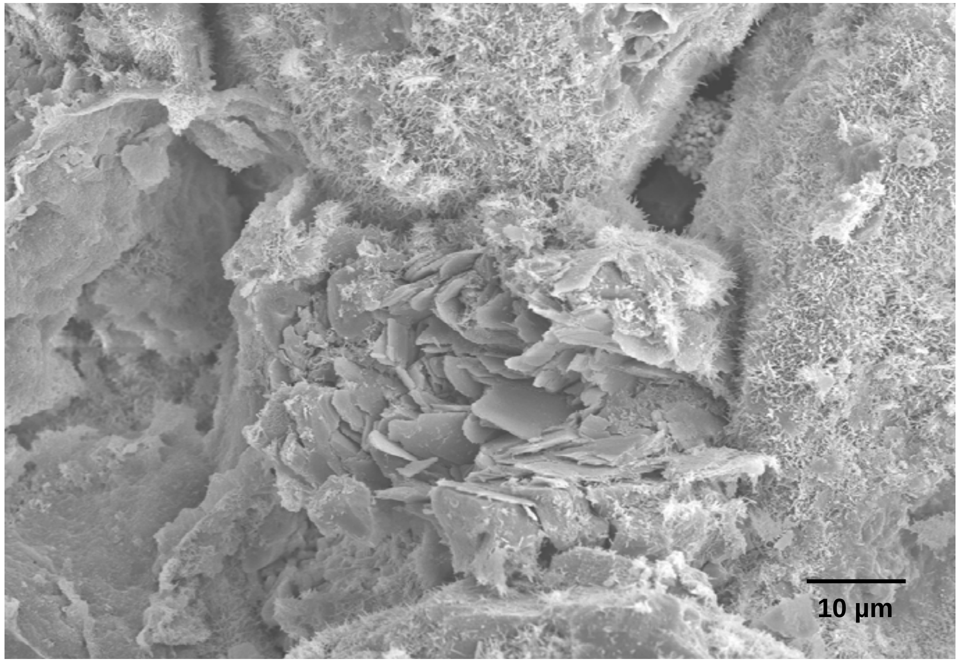
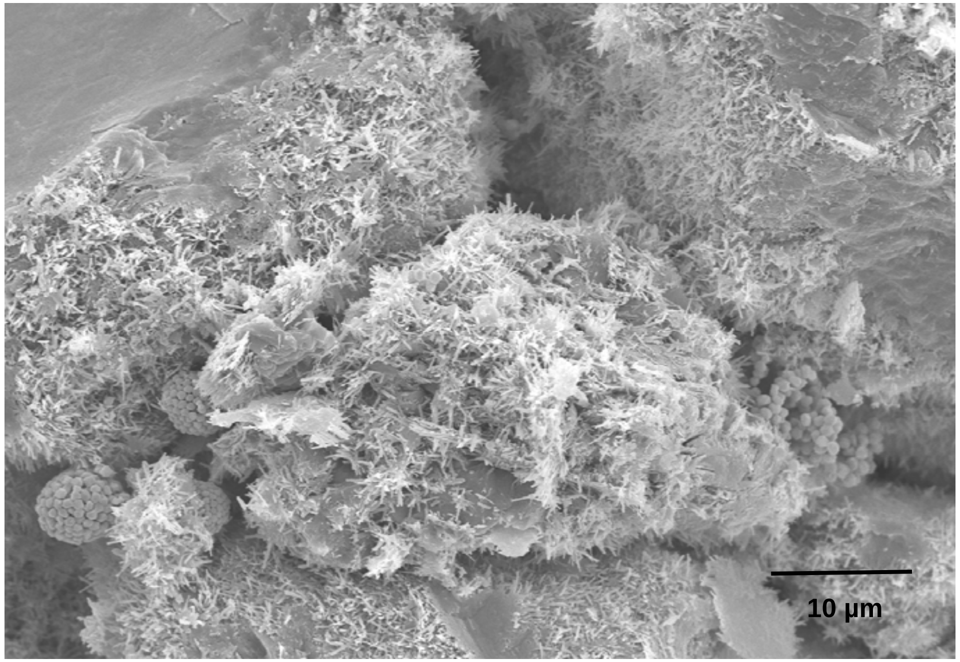


Plate 3G



Company: Bass Strait Oil Company Ltd

Well: Gilbert - 1A

Plate: 4A

52135-05-3466

Sample:	4
Depth (m):	662.0
Porosity (%):	N/A
Permeability (mD):	N/A

4mm

Core Lab
RESERVOIR OPTIMIZATION

Company: Bass Strait Oil Company Ltd
Well: Gilbert-1A
Depth (m): 662.0
Sample 4: Sandstone

Plates 4B (x32) and **Plate 4C** (x63): Overview and magnification of a moderately sorted, medium grained sandstone, with abundant mainly volcanic rock fragments. These fragments have been extensively chloritized. Porosity (blue), locally observed, is dominantly solutional, resulting from mineral leaching.

Plate 4D (X125): Detail of the pore system, illustrating the dominance of microporosity. This pore component is associated with clays and partly dissolved rock fragments.

Plate 4B

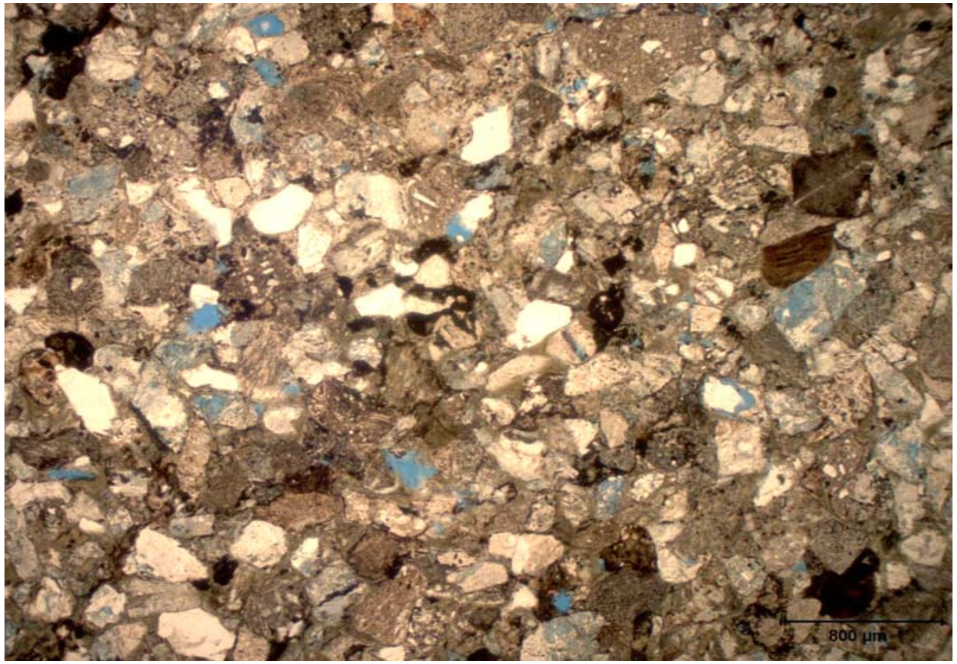


Plate 4C

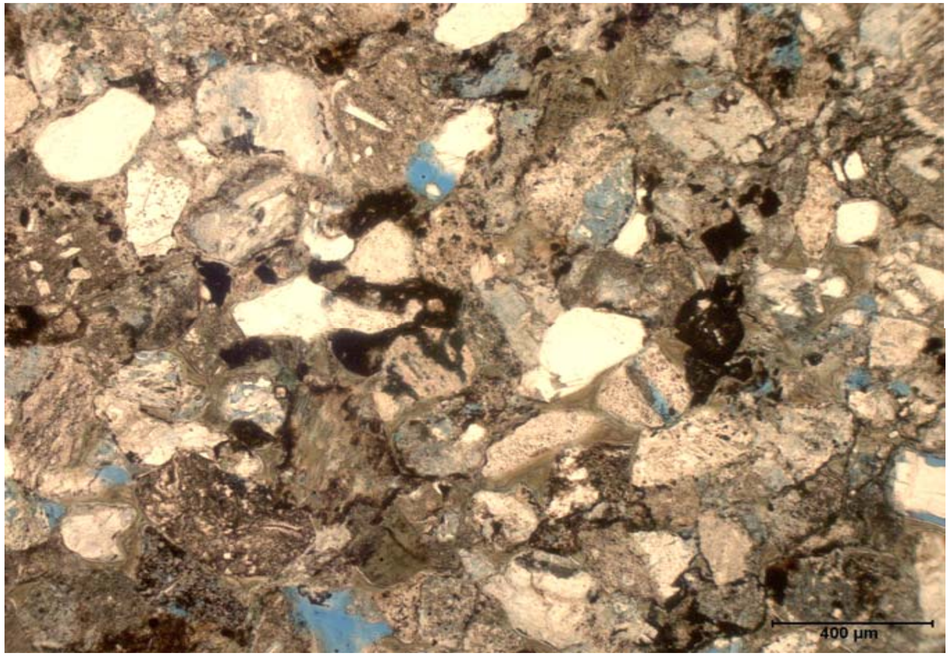
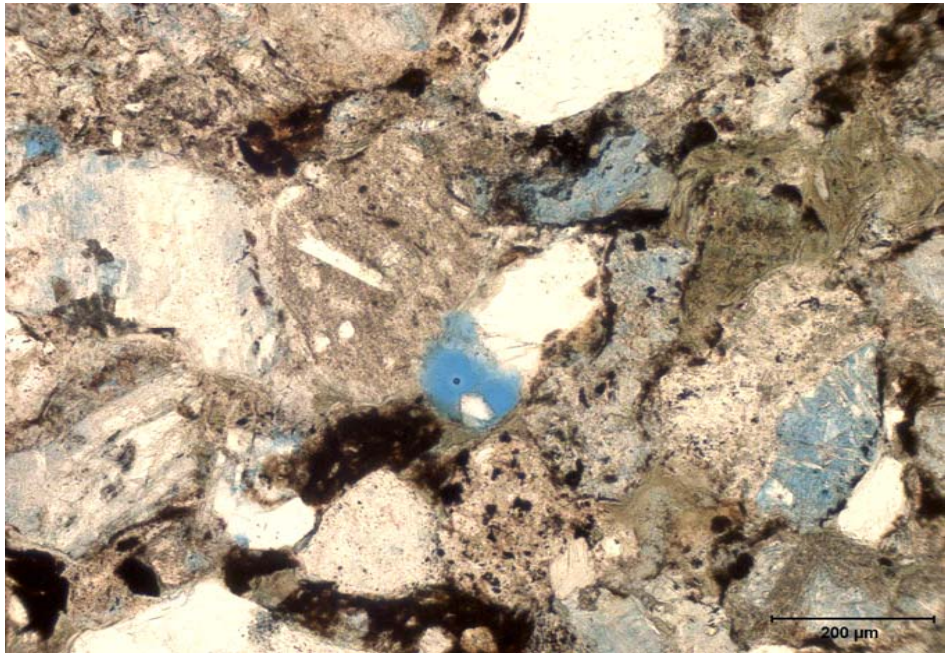


Plate 4D



Company: Bass Strait Oil Company Ltd
Well: Gilbert-1A
Depth (m): 662.0
Sample 4: Sandstone

Plate 4E (x1000): EDX analysis of the contorted platy clay at left indicates the presence of illite, with chlorite.

Plates 4F and 4G (x1000/X1200): Detail of intergranular pore spaces, which are completely lined by authigenic clays. These clays, dominantly composed of mixed-layer illite-smectite, contain a significant micropore component. The abundance of these clays in this sample indicates a high damage potential due to swelling, if these clays are exposed to fresh water.

Plate 4E

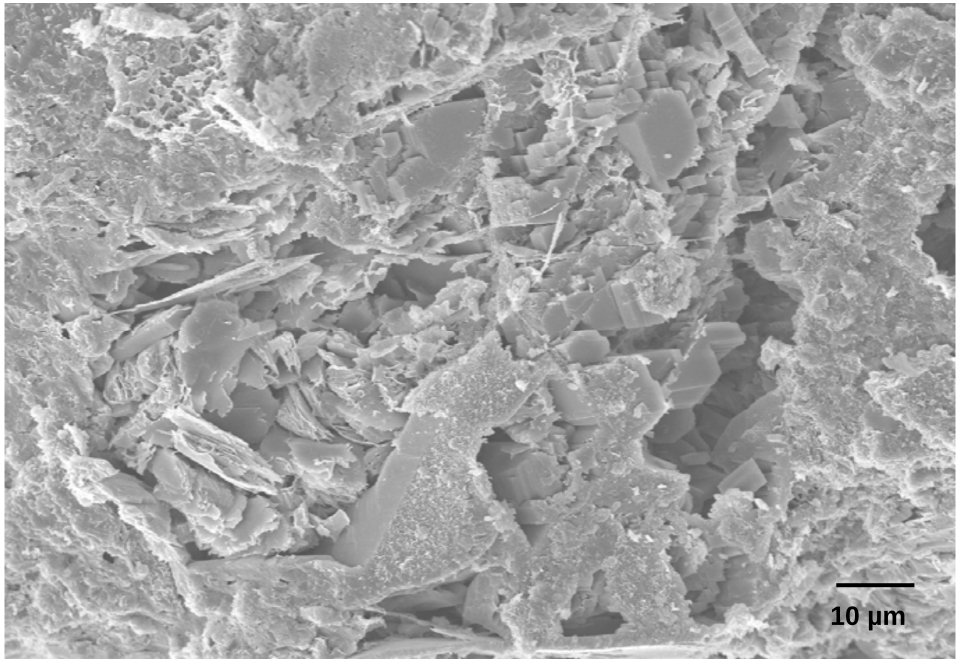


Plate 4F

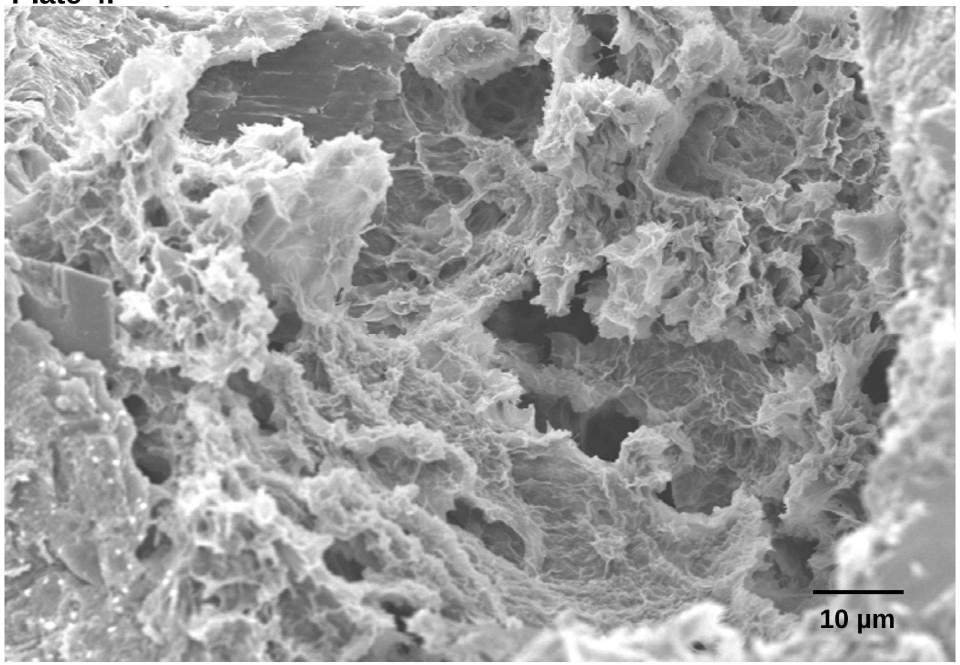
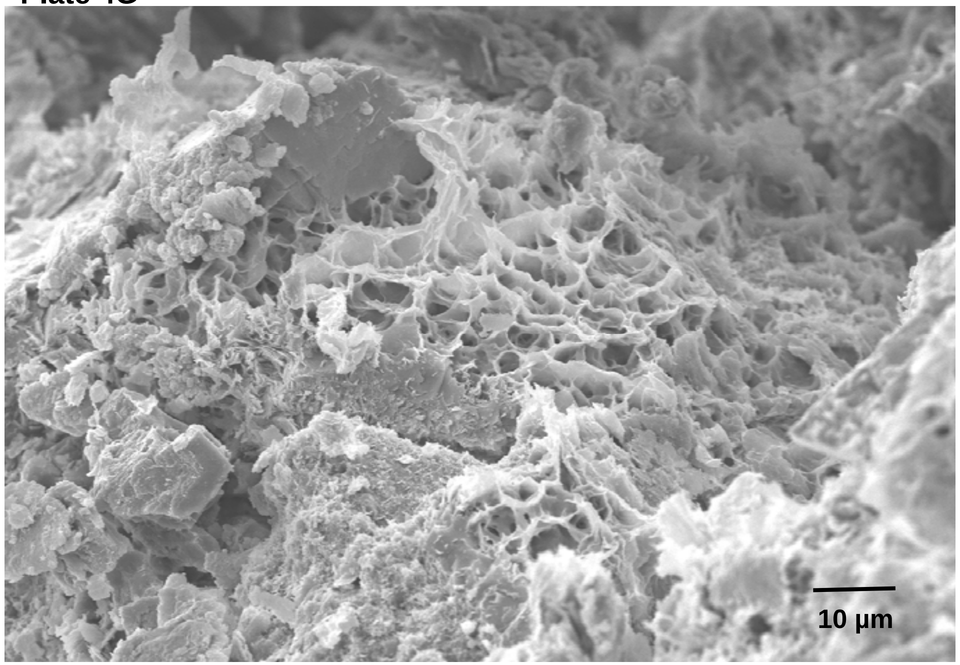


Plate 4G



APPENDIX 5

Hydrocarbon Characterisation Study
Gilbert-1A

By Geotechnical Services Pty Ltd

HYDROCARBON CHARACTERISATION STUDY

GILBERT-1A

PROFESSIONAL OPINION

Prepared by:
Cindy Barber

Prepared for:
Bass Strait Oil Company Ltd

December 2005

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EXECUTIVE SUMMARY

Two samples from Gilbert-1A, drilled by Bass Strait Oil Company Ltd, were submitted for geochemical analyses. The sample suite comprised the following:

- One mud sample from 631m
- One MSCT sample (no. 12) from 633.8m

A geochemical program was undertaken to evaluate the thermal maturity, source and depositional environment. This report provides a compilation of geochemical data obtained from analysis of hydrocarbons together with an interpretation of these data.

A Gilbert-1A mud sample from 631m was analysed by GC-MS. The mud does not appear to contain hydrocarbons that could interfere with biomarker analysis of the Gilbert-1A MSCT-12 extract.

The MSCT-12 sample from 633.1m is severely biodegraded to the extent that neither n-alkanes nor isoprenoidal components are visible in the saturate chromatogram. The aromatic fraction similarly shows severe biodegradation. Little information regarding maturity, source and depositional environment could be obtained from the biodegraded saturate or aromatic fractions. Calculated maturity parameters derived from the high molecular weight hopane and sterane biomarkers, which are more resistant to biodegradation, indicate a high level of thermal maturity. Biomarker analysis supports derivation of organic matter primarily from terrigenous sources, with C_{29} steranes and land plant resin indicators being in high relative abundance. Isosterane analysis indicates deposition of organic matter in a near shore river or delta system.

Correlation of the Gilbert-1A MSCT-12 extract with fluids from Sperm Whale-1 indicate a comparable level of biodegradation. Whilst the saturate profiles from GC analysis of the Sperm Whale-1 fluids, provided by the client, do not show strong correlation with the Gilbert-1A extract, it is difficult to ascertain whether the organic matter extracted from the Gilbert-1A sandstone is genetically related to the Sperm Whale-1 hydrocarbons, since different analytical instruments and techniques were used to analyse the samples.

HYDROCARBON CHARACTERISATION STUDY

GILBERT-1A

TABLE OF CONTENTS

1 INTRODUCTION

Two samples from Gilbert-1A, drilled by Bass Strait Oil Company Ltd, were submitted for geochemical analyses. The sample suite comprised the following:

- ❖ One mud sample from 631m
- ❖ One MSCT sample (no. 12) from 633.8m

A geochemical program was undertaken to evaluate the thermal maturity, source and depositional environment. This report provides a compilation of geochemical data obtained from analysis of hydrocarbons together with an interpretation of these data.

One hardcopy and one electronic copy of this report have been sent to Bob Fisher at Bass Strait Oil Company Ltd. Any queries related to it may be directed to Cindy Barber or Dr Birgitta Hartung-Kagi at Geotechnical Services Pty Ltd.

All data and information are proprietary to Bass Strait Oil Company Ltd and regarded as highly confidential by all Geotech personnel.

Geotechnical Services has endeavoured to use techniques and equipment to achieve results and information as accurately as it possibly can. However, such equipment and techniques are not necessarily perfect. Therefore, Geotechnical Services shall not be held responsible or liable for the results of any actions taken on the basis of the information contained in this document. Moreover, this report should not be the sole reference when considering issues that may have commercial implications.

2 ANALYTICAL PROCEDURES

2.1 MUD SAMPLE

A mud sample from 631m was solvent extracted and the extract analysed via GC-MS. No further analyses were required to be conducted on this sample.

2.2 SEDIMENT

An MSCT sample (Gilbert-1A 633.1m MSCT-12) was submitted for solvent extraction and characterisation of the hydrocarbon extract. The whole extract was initially analysed via GC-MS and then subjected to liquid chromatographic separation to afford the saturate, aromatic and polar fractions. The saturate and aromatic fractions were analysed via GC-MS. The saturate fraction was treated with ZSM5 molecular sieves to isolate the branched/cyclic components which were subsequently analysed via GC-MS.

3 RESULTS AND INTERPRETATION

3.1 MUD SAMPLE

Gilbert-1A was drilled using a KCL/polymer mud system containing a synthetic flocculant known as Magnafloc®. The mud sample taken from 631m yielded a low amount of extractable material (26ppm) consistent with a KCL/polymer mud system. GC-MS analysis of the whole extract (Figure 1) indicates the mud consists primarily of organic esters, acids and alcohols. Due to the low extract yield and the absence of any visible hydrocarbons in the whole extract chromatogram, no further analyses were conducted on the mud sample.

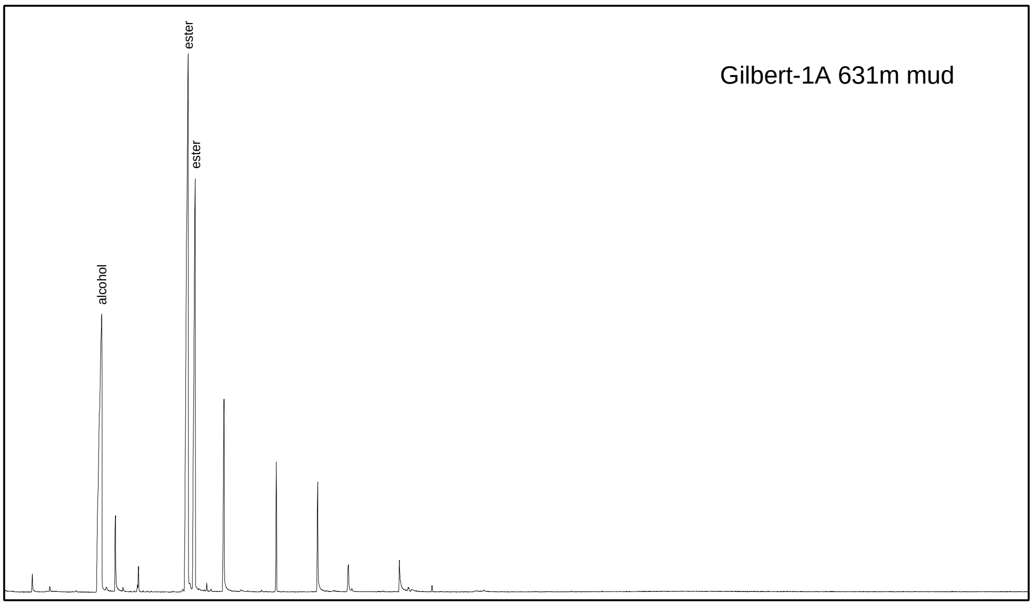

Figure 1. Mass chromatogram obtained from whole extract GC-MS analysis of Gilbert-1A 631m mud sample

3.2 SEDIMENT

One MSCT sample (Gilbert-1A 633.8m, MSCT-12) was submitted for soxhlet extraction and GC-MS analysis in order to characterise the hydrocarbon shows in the reservoir section. An excellent yield of extractable organic matter was obtained from the sandstone (5129ppm). Whole extract GC-MS (Figure 2) analysis showed the sample to be severely biodegraded, to the extent that neither n-alkanes nor isoprenoidal components are visible in the chromatogram. There is no indication of significant contamination from drilling mud additives, such as alkenes or glycols, although some minor contamination from organic esters/acids, identified as components of the KCL/polymer mud system (see Figure 1), are apparent.

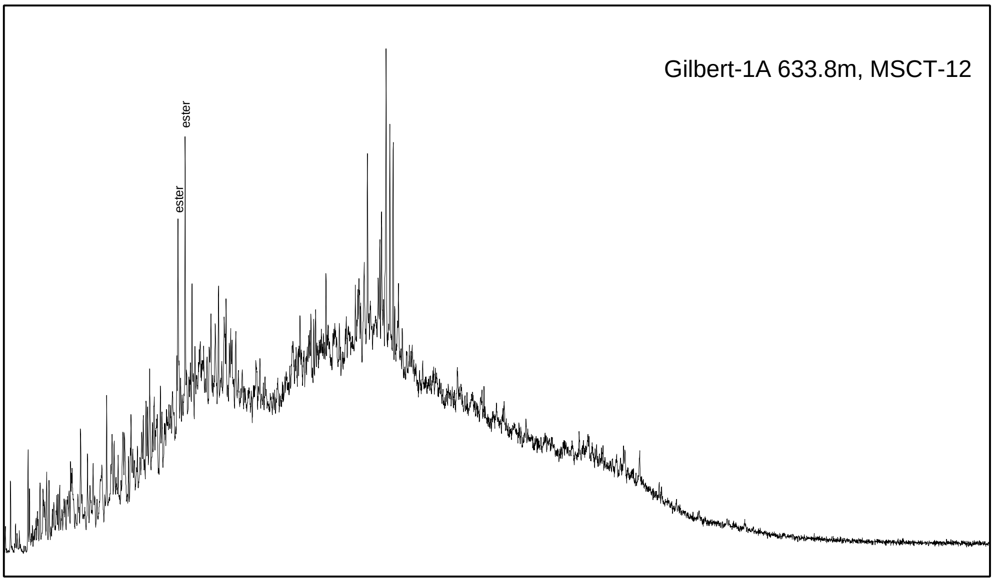

Figure 2. Mass chromatogram obtained from whole extract GC-MS analysis of Gilbert-1A 633.8m MSCT-12

The Gilbert-1A 633.8m MSCT-12 extract was subjected to liquid chromatographic separation to afford the saturate, aromatic and polar fractions. Whilst the saturate plus aromatic hydrocarbon yield was 3435ppm, and the saturate yield alone was 2117ppm, the saturate components have been severely biodegraded. Figure 3 shows the mass chromatogram obtained from GC-MS analysis of the saturate fraction. Almost the entire suite of n-alkanes has been removed, as have the isoprenoids including pristane and phytane, and as a result, little information regarding maturity, source or depositional environment can be gained from the saturate hydrocarbon profile.

The sediment extract was subsequently submitted for aromatic and branched/cyclic GC-MS analysis in order to characterise the biomarker content of the sample. Figure 4 presents the total ion chromatogram obtained from analysis of the aromatic fraction of Gilbert-1A 633.8m MSCT-12. Like the saturate fraction, the aromatic fraction is similarly biodegraded to the extent that little information can be gained. A dimethylnaphthalene ratio (DNR-1) of only 0.87 is generally considered to be indicative of very low maturity however given the level of biodegradation, this value is not believed to be a true indication of the level of thermal maturity of the sample.

Calculated maturity parameters derived from hopane and sterane data are believed to be more reliable than those derived from aromatic data since branched/cyclic components are more resistant to microbial degradation. A C_{29} 20S/20R sterane ratio of 1.17 characterises the sample as being of very high maturity, equivalent to around 1.1% VR, although a C_{32} 22S/22R hopane ratio of 1.27 suggests a somewhat lower maturity level, approaching the onset of oil generation.

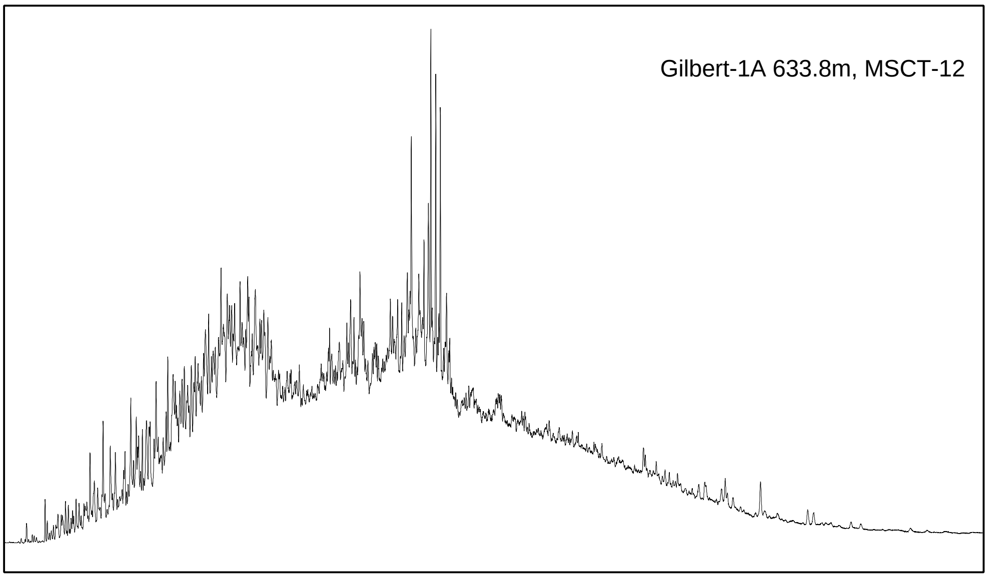

Figure 3. Mass chromatogram of the saturate fraction from the Gilbert-1A 633.1m MSCT-12 extract

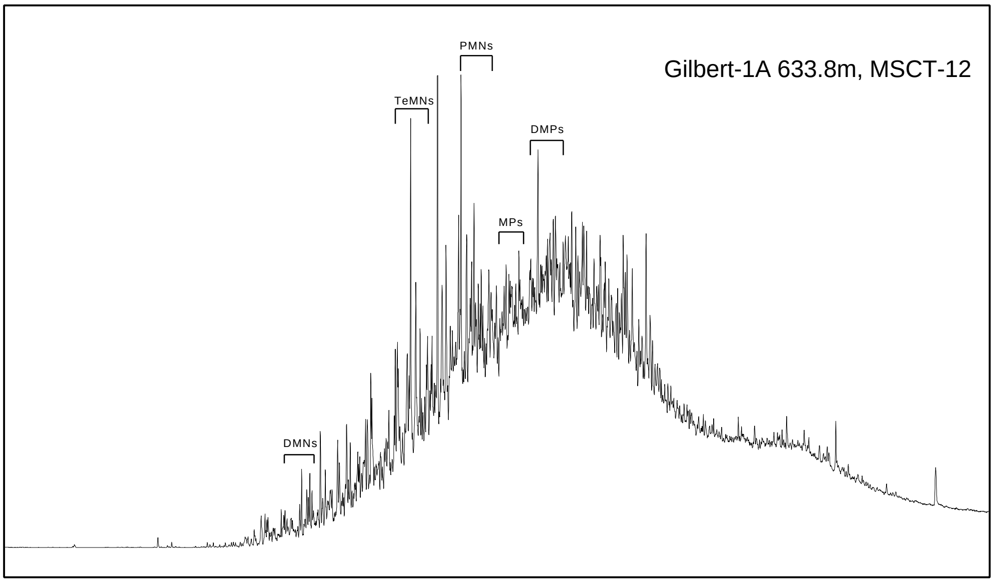

Figure 4. Total ion chromatogram obtained from GC-MS analysis of the aromatic fraction of Gilbert-1A 633.1m MSCT-12 extract

Biomarker analysis of the Gilbert-1A 633.1m MSCT-12 extract indicates derivation of organic matter from terrigenous sources. Figure 5 presents a partial m/z 217 mass chromatogram showing the distribution of steranes which is dominated by C_{29} components derived predominantly from land plant material. The C_{27} counterparts, which largely derive from marine organic matter, are present in significantly reduced abundances, suggesting only a minor contribution of organic matter from planktonic material. C_{27}/C_{29} sterane and diasterane ratios are consequently low (0.39 and 0.08, respectively). Analysis of the m/z 123 mass chromatogram (Figure 6) similarly attests to a significant contribution of terrigenous organic matter, since diterpane components, including isopimarane and phyllocladane, are reported to derive from land plant resin material.

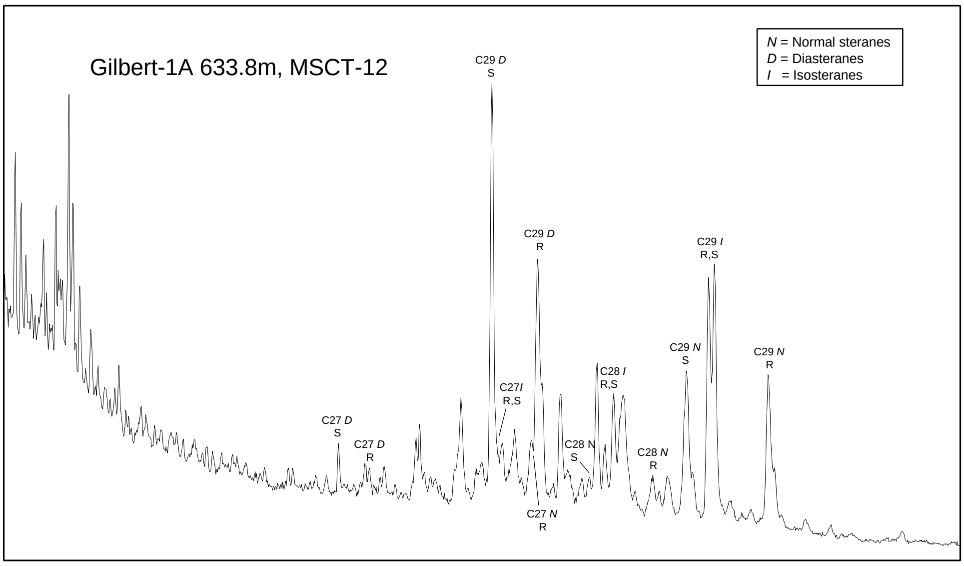

Figure 5. Partial m/z 217 mass chromatogram showing the distribution of steranes in the Gilbert-1A 633.1m MSCT-12 extract

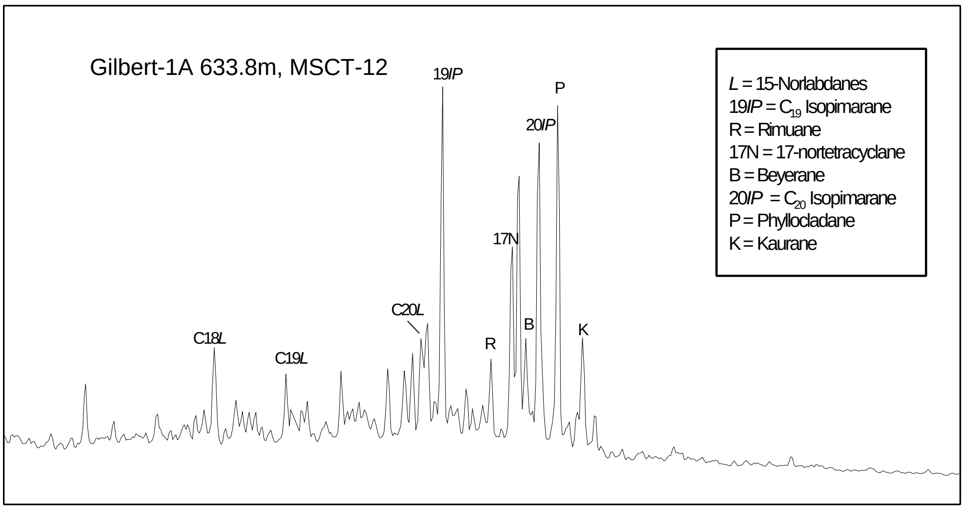

Figure 6. Partial m/z 123 mass chromatogram showing the presence of diterpanes in the Gilbert-1A 633.1m MSCT-12 extract

Figure 7 shows a ternary plot of isosterane components in the extract which characterise the original depositional environment as 'higher plant', suggesting proximity to a river or delta system.

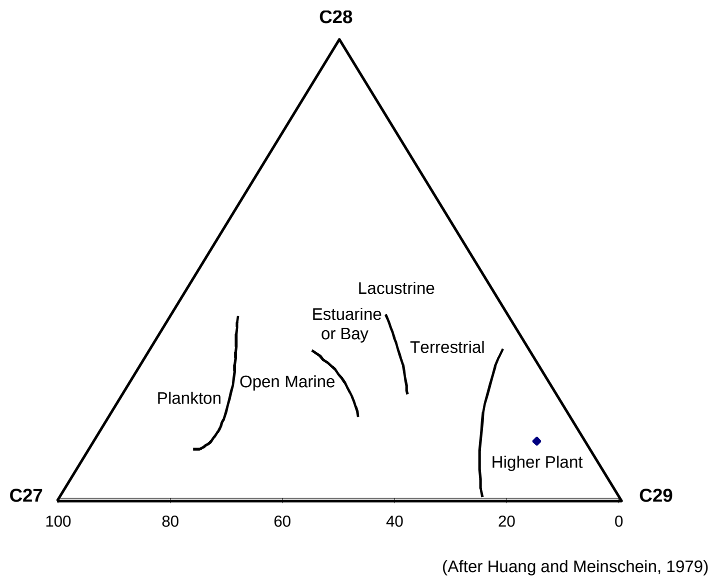

Figure 7. Ternary plot showing the distribution of isosteranes in the Gilbert-1A 633.1m MSCT-12 extract

3.3. CORRELATION WITH SPERM WHALE-1

Gas chromatography data obtained from previous analyses of nearby fluid samples from Sperm Whale-1 were provided by the client for correlation with the Gilbert-1A hydrocarbon shows extracted from the MSCT-12 sandstone.

The saturate fraction from three RFT samples (#1, #2, #21) and two DST samples (#1B, #2) were analysed from Sperm Whale-1. With the exception of Sperm Whale-1 DST-1B, which showed an anomalous n-alkane profile consistent with severe diesel contamination, all Sperm Whale-1 fluids were found to have been altered by biodegradation. The saturate GC profiles showed that the n-alkanes had been almost completely removed, indicating a biodegradation ranking of at least 3 or 4. The extent of biodegradation of the Gilbert-1A MSCT-12 extract is similarly ranked as level 3 or 4 since only traces of n-alkanes and isoprenoidal components are observed in the saturate GC-MS profile. The Sperm Whale-1 oils and the Gilbert-1A MSCT-12 extract thus appear to have been altered to a similar extent by biodegradation.

In the absence of aromatic and GC-MS data for the Sperm Whale-1 fluids it is however difficult to ascertain whether the hydrocarbon shows extracted from the Gilbert-1A MSCT-12 sample could be genetically related to the Sperm Whale-1 samples. The saturate GC-MS profiles from the Sperm Whale-1 fluids show little similarity to that obtained from Gilbert-1A extract. This may, however, be due to differences in analytical techniques rather than differences in source of organic matter, since the samples were analysed on different instruments and are likely to have been analysed under very different conditions.

4 CONCLUSION

The MSCT-12 sample from 633.1m is severely biodegraded to the extent that neither n-alkanes nor isoprenoidal components are visible in the saturate chromatogram. The aromatic fraction similarly shows severe biodegradation. Little information at all regarding maturity, source and depositional environment could be obtained from the saturate or aromatic fractions. Calculated maturity parameters derived from the high molecular weight hopane and sterane biomarkers, which are more resistant to biodegradation, indicate a high level of thermal maturity. Biomarker analysis supports derivation of organic matter primarily from terrigenous sources, with C_{29} steranes and land plant resin indicators being in high relative abundance. Isosterane analysis indicates deposition of organic matter in a near shore river or delta system.

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5 REFERENCES

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APPENDIX A

DATA AND TABLES

DATA AND TABLES

GILBERT-1A

TABLE OF CONTENTS

TABLE 1

SOLVENT EXTRACTION DATA

GILBERT-1A

GEOTECH

DEPTH	Sample Type	Weight of Material Extd. (g)	Total Extract (mg)	Total Extract (ppm)
631m	Mud	100.0	2.6	26
633.8m	MSCT-12	31.8	163.0	5129

nd = no data
12/12/2005

FIGURE 1-1

Sample : **GILBERT-1A, 631m, Mud**
File ID : **353302X**

Chromatogram obtained from analysis of the whole extract by GC-MS

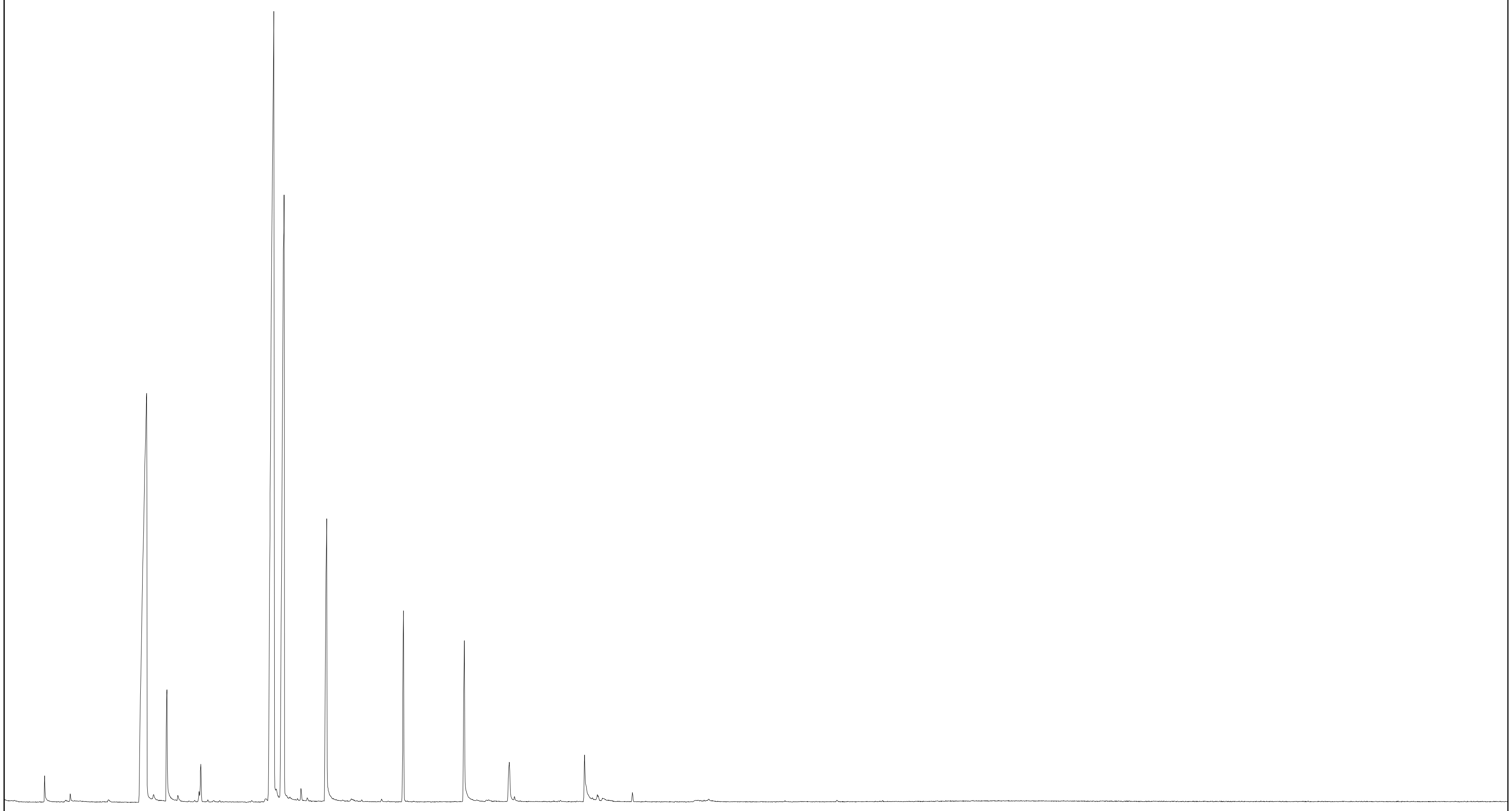

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FIGURE 1-2

Sample : **GILBERT-1A, 633.8m, MSCT-12**
File ID : **353301X**

Chromatogram obtained from analysis of the whole extract by GC-MS

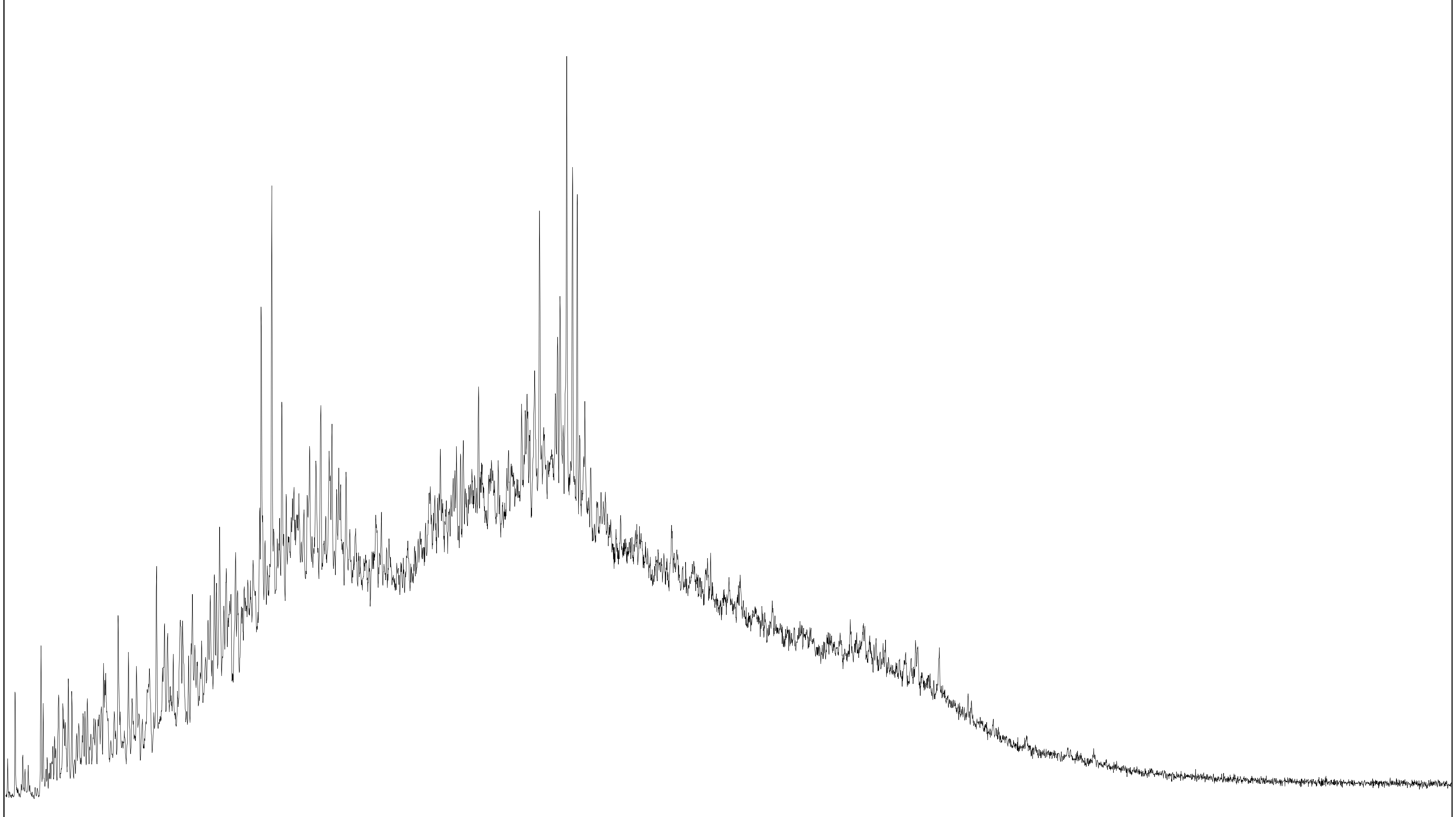

TABLE 2

LIQUID CHROMATOGRAPHY DATA

EXTRACT

GILBERT-1A

A. Yields (ppm)

		-------Hydrocarbons-------			------Non-hydrocarbons------			Loss
DEPTH	Sample Type	Sats	Aros	HC's	NSOs	Asph.	Non HC's	on column
633.8m	MSCT-12	2117	1318	3435	623	nd	623	1071

GILBERT-1A

B. Yields (%) and Selected Ratios

		------Hydrocarbons------			------Non-hydrocarbons------			Sats	Asph.	HC
DEPTH	Sample Type	Sats	Aros	HC's	NSOs	Asph.	Non HC's	Aros	NSO	Non HC
633.8m	MSCT-12	52.2	32.5	85	15.4	nd	15	1.6	nd	5.5

12/12/2005
nd = no data

TABLE 3

ANALYSIS OF SATURATED HYDROCARBONS BY GC-MS

EXTRACT

GILBERT-1A

A. Selected Ratios

DEPTH	Sample Type	Prist./Phyt.	Prist./n-C17	Phyt./n-C18	CPI(1)	CPI(2)	(C21+C22)/(C28+C29)
633.8m	MSCT-12	nd	nd	nd	nd	nd	nd

GILBERT-1A

B. n-Alkane Distributions

DEPTH	nC12	nC13	nC14	nC15	nC16	nC17	Pr	nC18	Ph	nC19	nC20	nC21	nC22	nC23	nC24	nC25	nC26	nC27	nC28	nC29	nC30	nC31
633.8m	7.8	10.9	19.2	7.2	8.1	2.3	nd	6.4	nd	10.1	28.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

12/12/2005

nd = no data

$$CPI(1) = \frac{(C23+C25+C27+C29)+(C25+C27+C29+C31)}{2x(C24+C26+C28+C30)}$$

$$CPI(2) = \frac{(C23+C25+C27)+(C25+C27+C29)}{2x(C24+C26+C28)}$$

FIGURE 2

Sample : **GILBERT-1A, 633.8m, MSCT-12**
File ID : 353301S

Chromatogram obtained from the analysis of saturated hydrocarbons by GC-MS

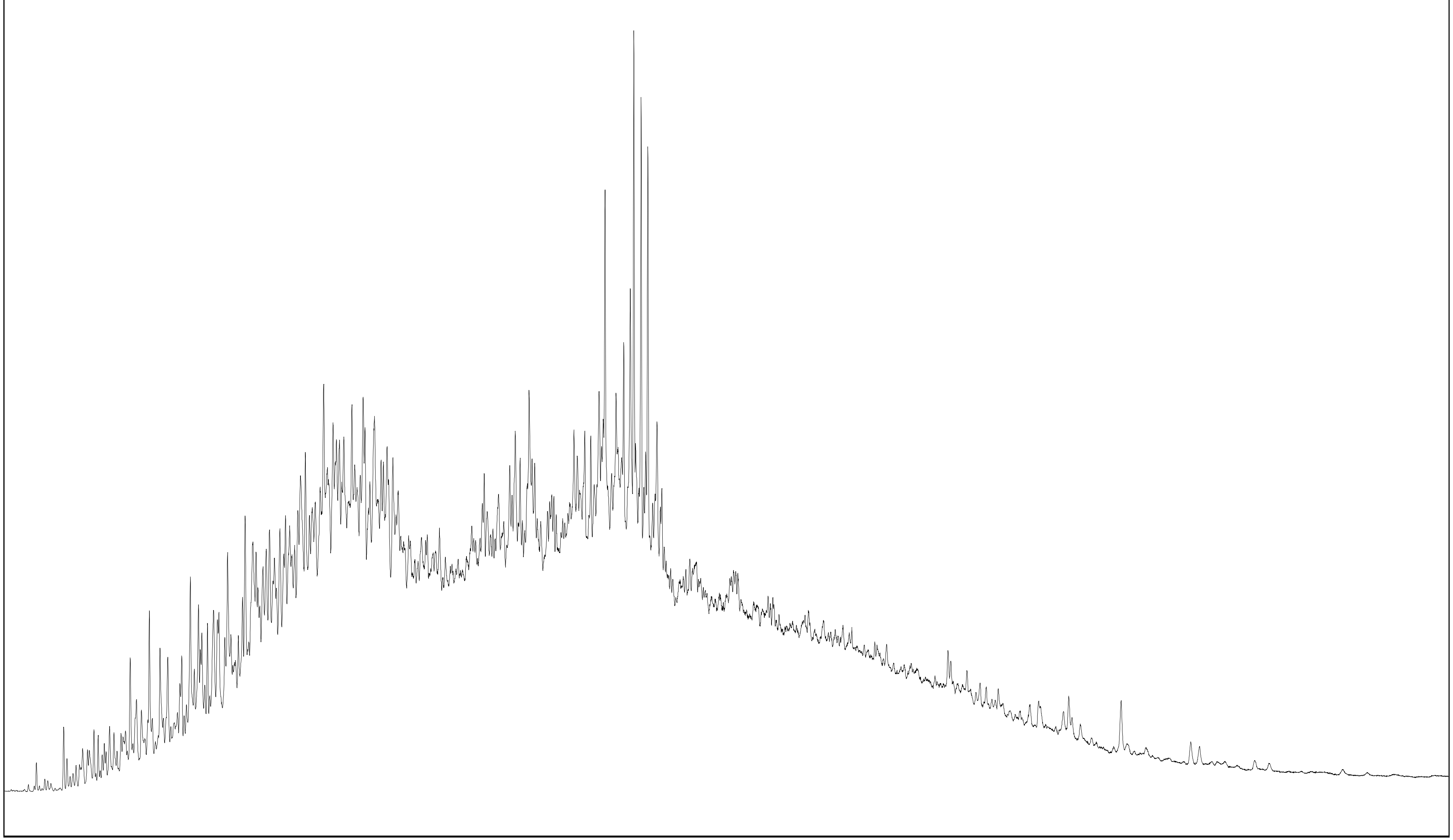

TABLE 4

ANALYSIS OF AROMATIC HYDROCARBONS BY GC-MS

GILBERT-1A

DEPTH	TYPE	DNR-1	DNR-5	DNR-6	TNR-1	TNR-5	TNR-6	MPR-1	MPI-1	MPI-2	Rc(a)	Rc(b)
633.8m	MSCT-12	0.87	nd	0.25	nd	nd	nd	nd	nd	nd	nd	nd

response factors have not been applied to these ratios

GILBERT-1A

DEPTH	TYPE	1,7-DMP/X (m/z 206)	RETENE/9-MP (m/z 219,192)	1MP/9MP	HPI
633.8m	MSCT-12	nd	nd	nd	nd

HPI = Higher Plant Index (i.e (retene + cadalene + iHMN-IV)/1,3,6,7-TeMN))

12/12/2005
nd = no data

iHMN-IV = RODB

FIGURE 3A

Sample: **GILBERT-1A, 633.8m, MSCT-12**

File ID: **353301A**

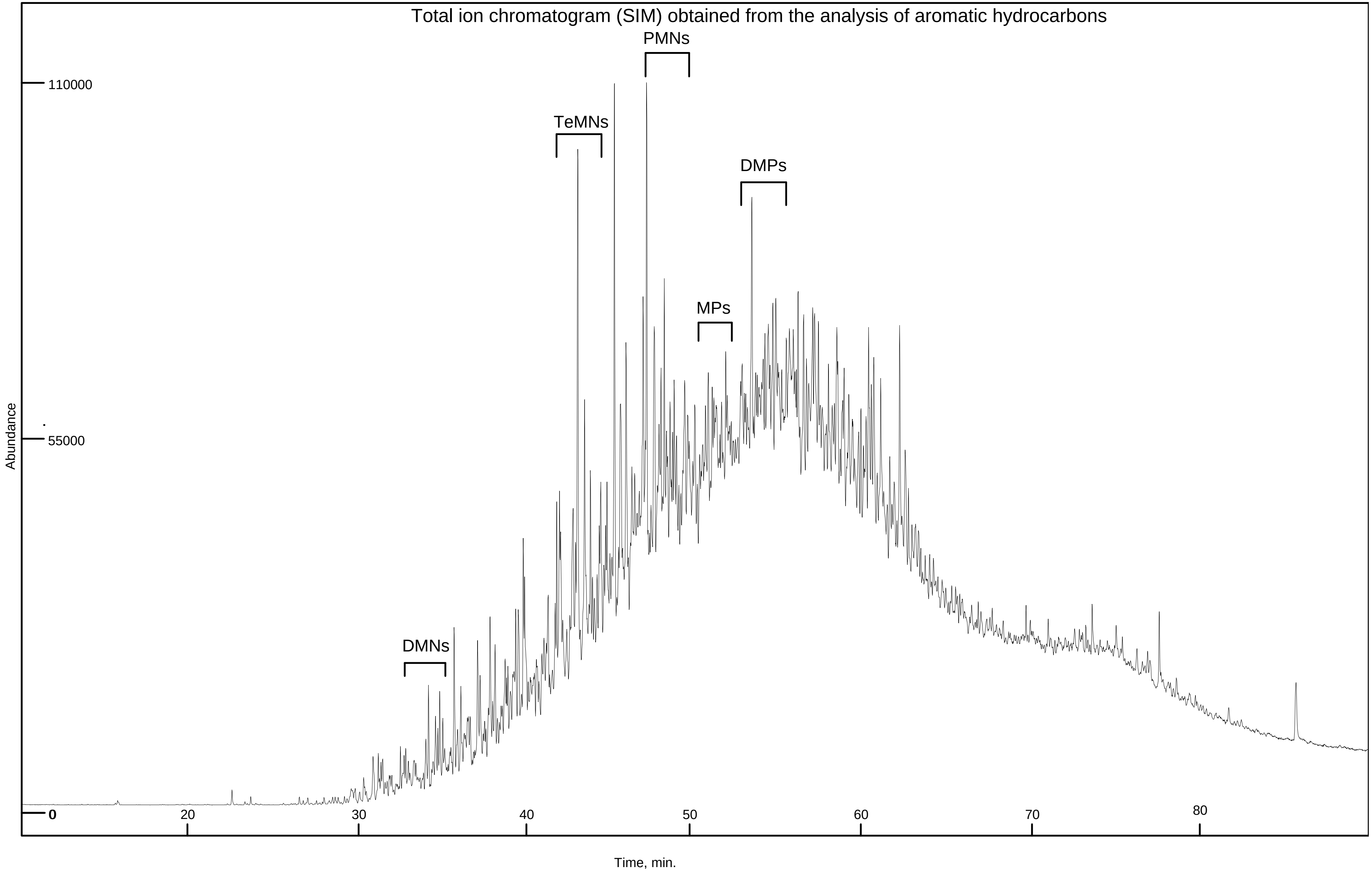

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FIGURE 3B

Sample: **GILBERT-1A, 633.8m, MSCT-12**

File ID: **353301A**

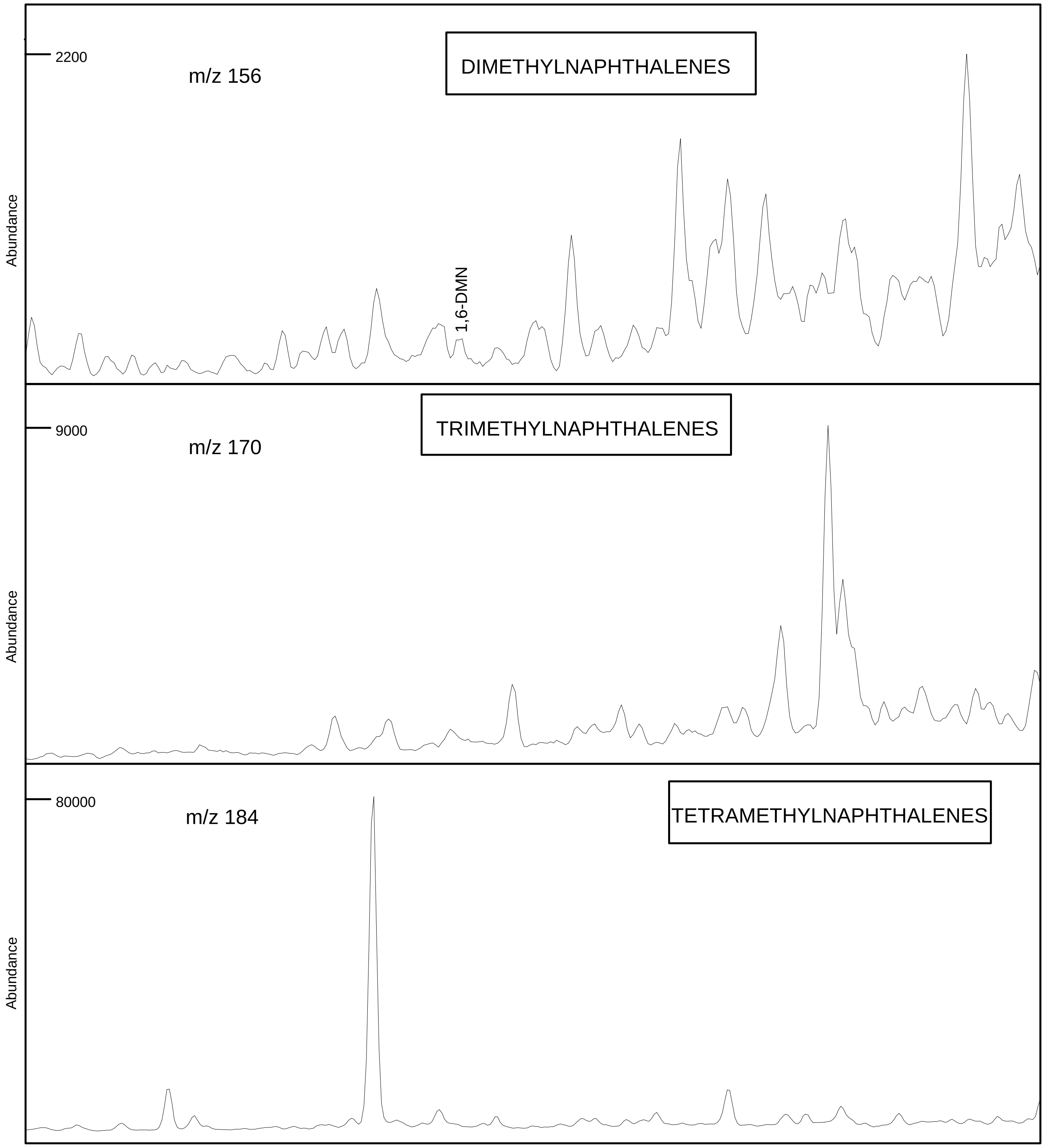

FIGURE 3C

Sample: **GILBERT-1A, 633.8m, MSCT-12**

File ID: **353301A**

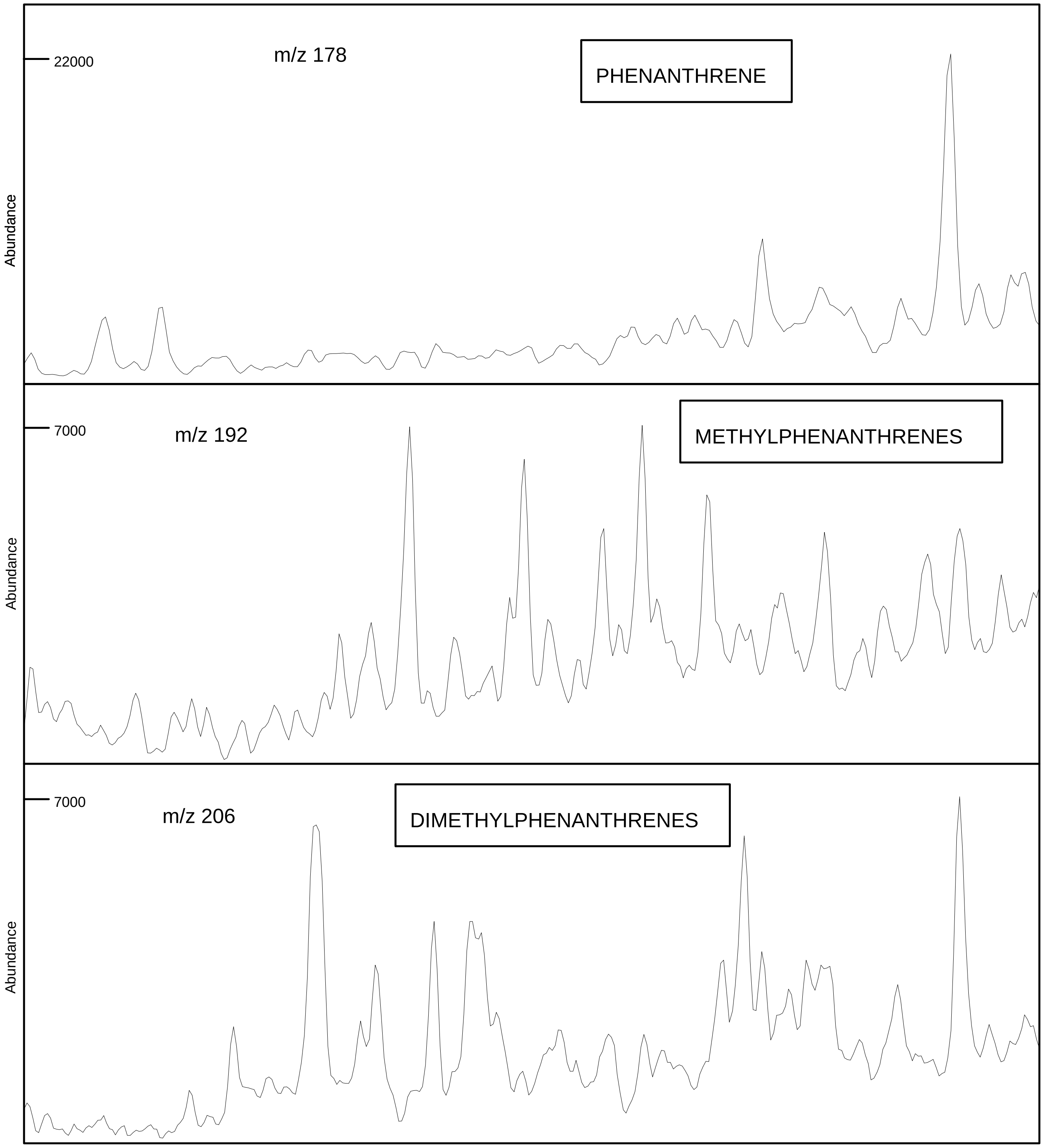

FIGURE 3D

Sample: **GILBERT-1A, 633.8m, MSCT-12**

File ID: **353301A**

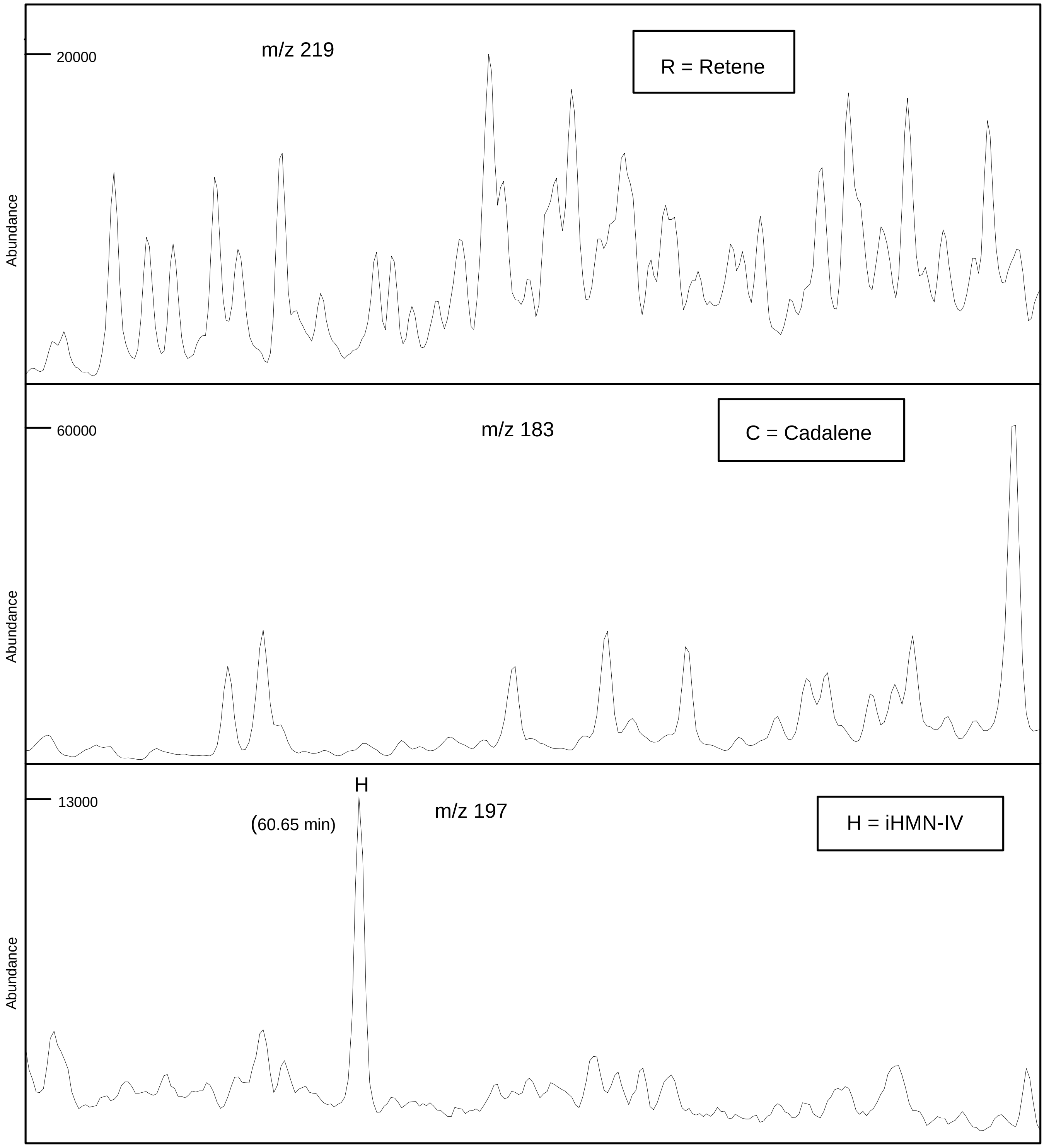

FIGURE 3E

Sample: **GILBERT-1A, 633.8m, MSCT-12**

File ID: **353301A**

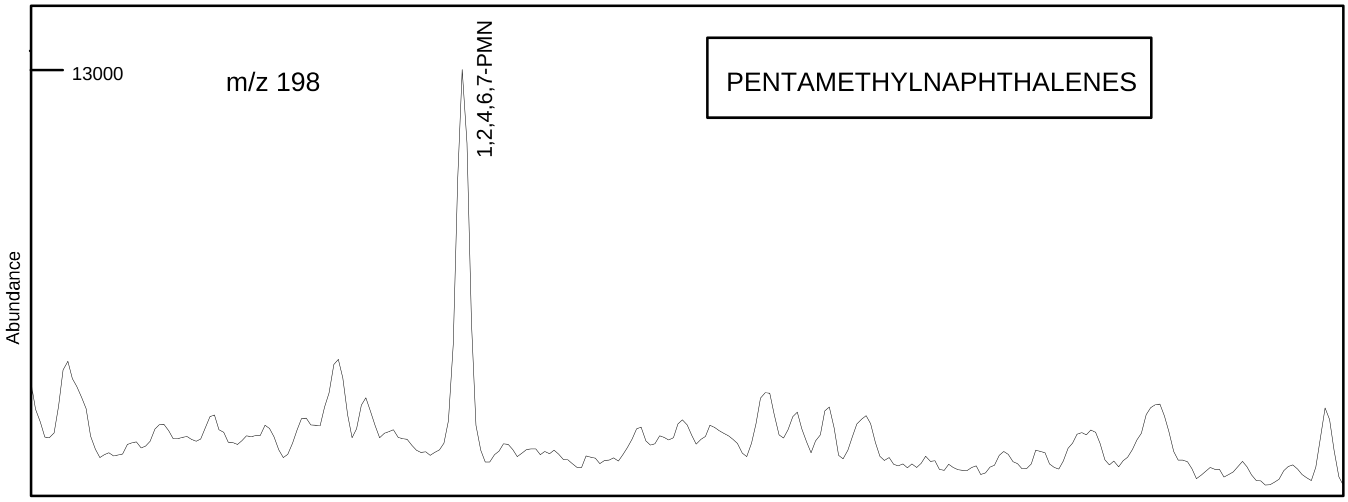

TABLE 5

ANALYSIS OF BRANCHED AND CYCLIC SATURATED HYDROCARBONS BY GC-MS

GILBERT-1A, 633.8m, MSCT-12

GEOTECH

	Selected Parameters	*Ion(s)*	*Value*
1.	18α(H)-hopane/17α(H)-hopane (Ts/Tm)	191	0.66
2.	C30 hopane/C30 moretane	191	9.14
3.	C31 22S hopane/C31 22R hopane	191	1.36
4.	C32 22S hopane/C32 22R hopane	191	1.27
5.	C29 20S ααα sterane/C29 20R ααα sterane	217	1.17
6.	C29 ααα steranes (20S / 20S+20R)	217	0.54
7.	C29 αββ steranes / (C29 ααα steranes + C29 αββ steranes)	217	0.58
8.	C27/C29 diasteranes	259	0.08
9.	C27/C29 steranes	217	0.39
10.	18α(H)-oleanane/C30 hopane	191	nd
11.	C29 diasteranes / (C29 ααα steranes + C29 αββ steranes)	217	0.78
12.	C30 (hopane + moretane) / C29 (steranes + diasteranes)	191/217	1.24
13.	C15 drimane/C16 homodrimane	123	1.70
14.	Rearranged drimanes/normal drimanes	123	1.03

nd = no data

FIGURE 4A

Sample : **GILBERT-1A, 633.8m, MSCT-12**

File ID : 353301B

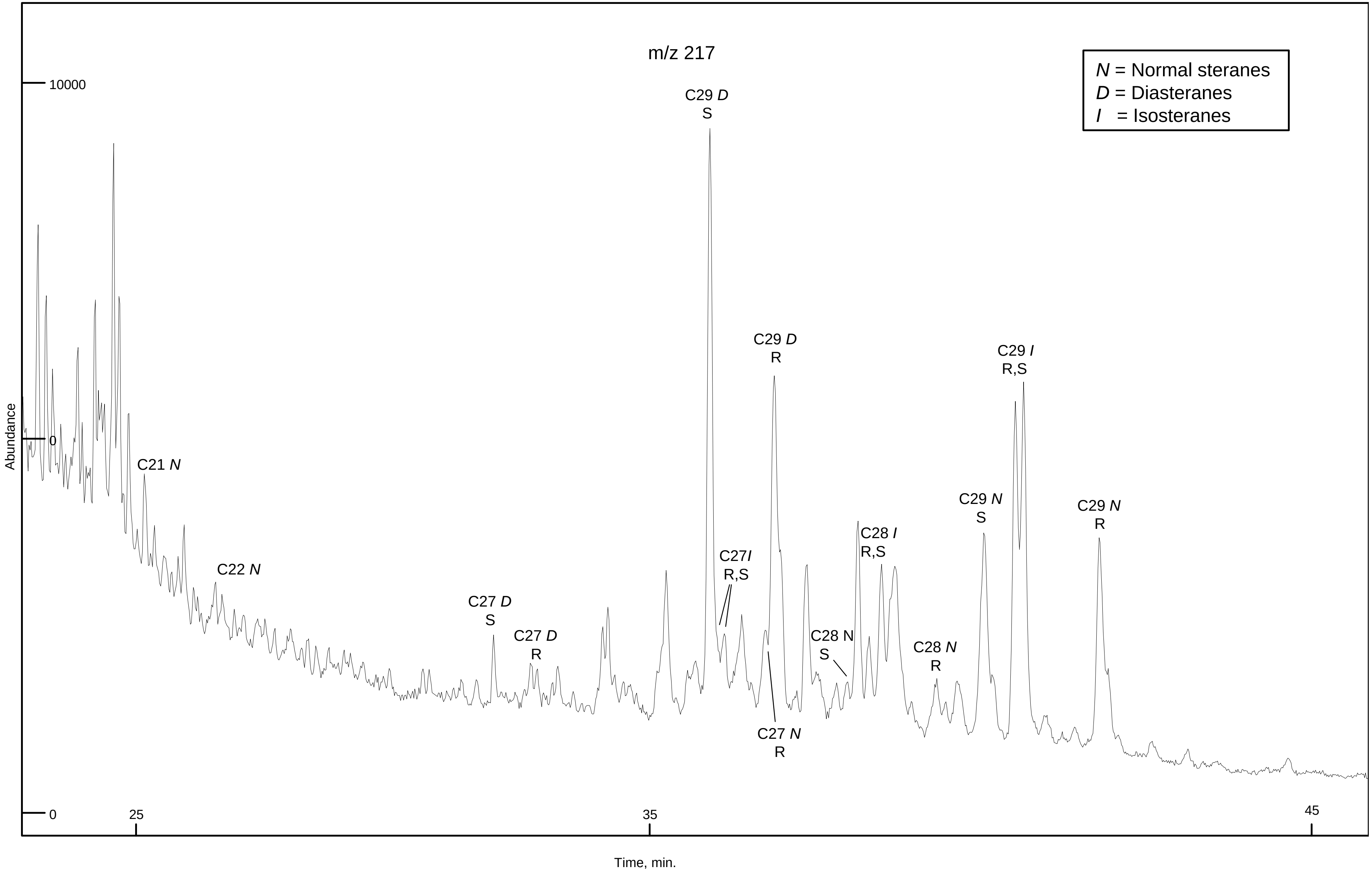

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FIGURE 4B

Sample : **GILBERT-1A, 633.8m, MSCT-12**

File ID : 353301B

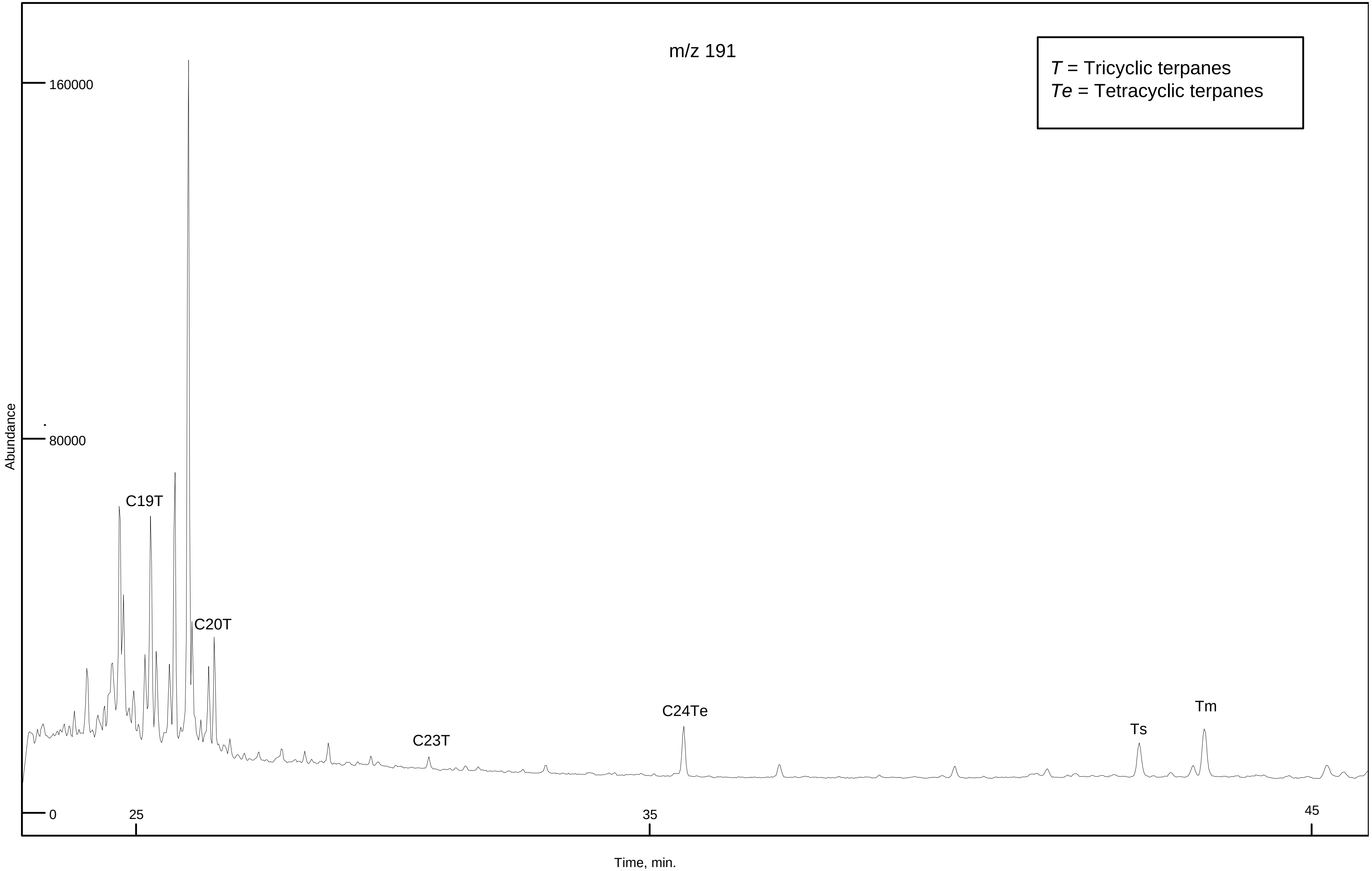

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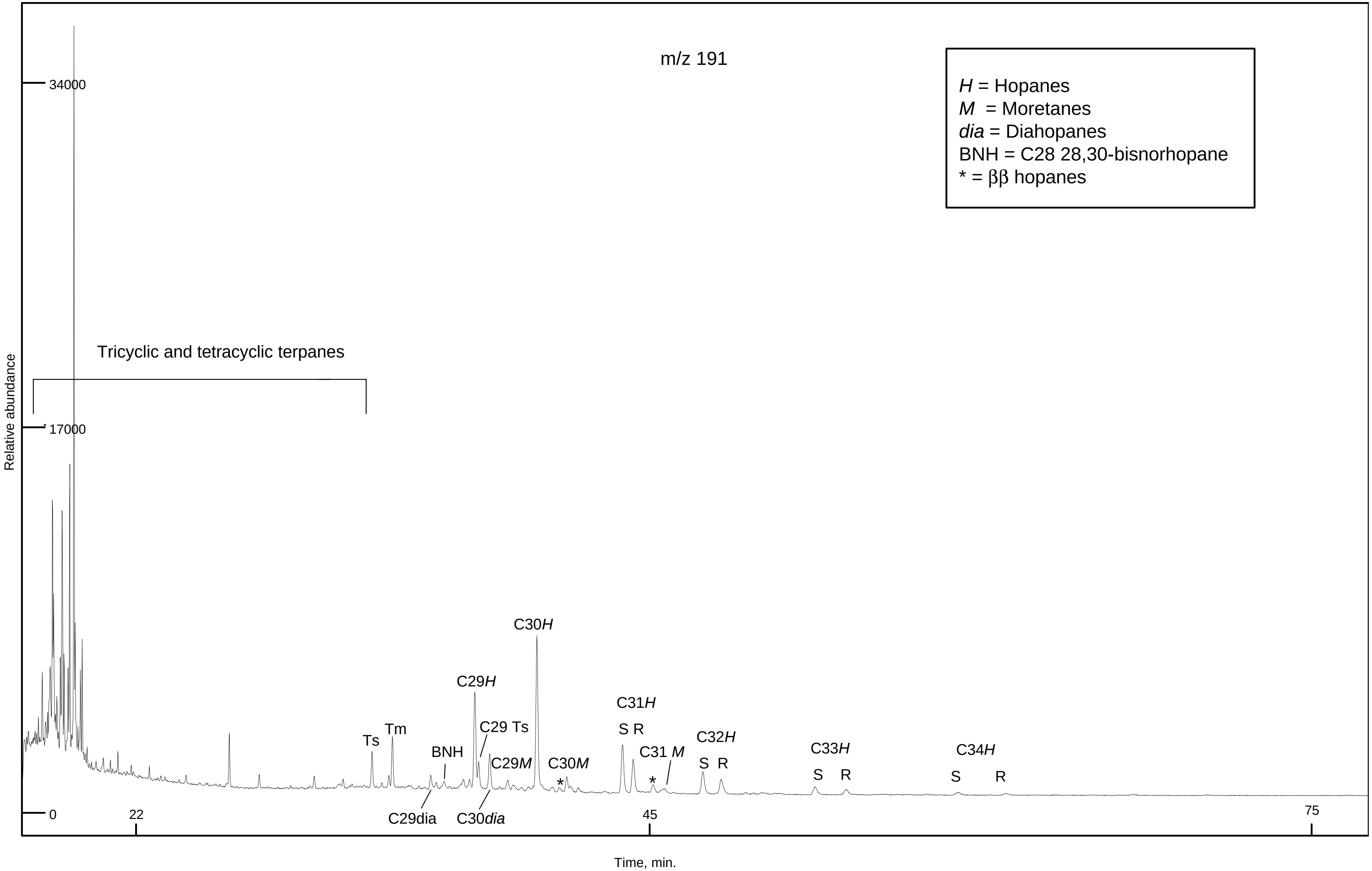
FIGURE 4C

Sample : **GILBERT-1A, 633.8m, MSCT-12**

File ID : 353301B



GEOTECHNICAL SERVICES PTY LTD

FIGURE 4D

Sample : **GILBERT-1A, 633.8m, MSCT-12**

File ID : 353301B

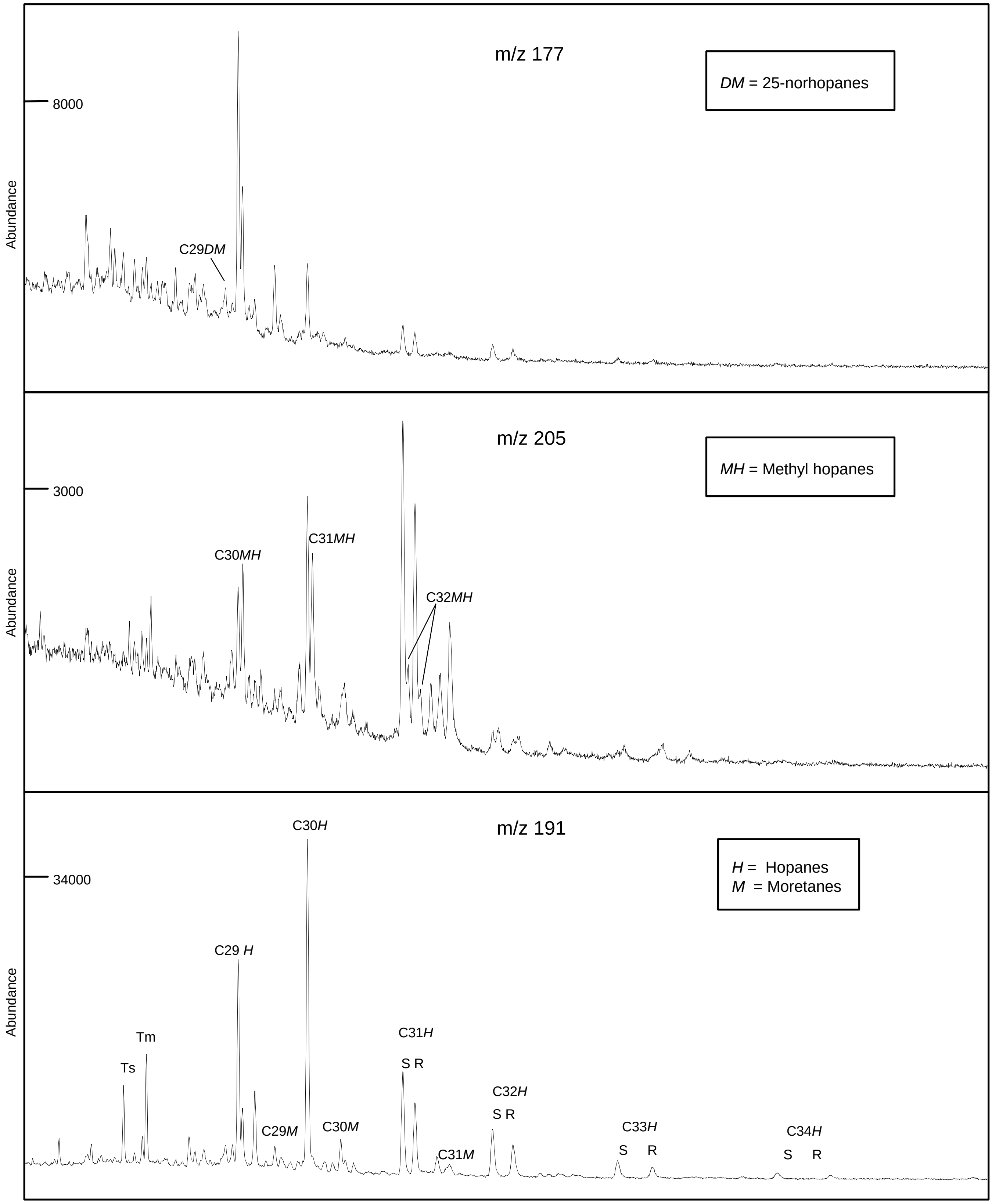


FIGURE 4E

Sample : **GILBERT-1A, 633.8m, MSCT-12**

File ID : 353301B

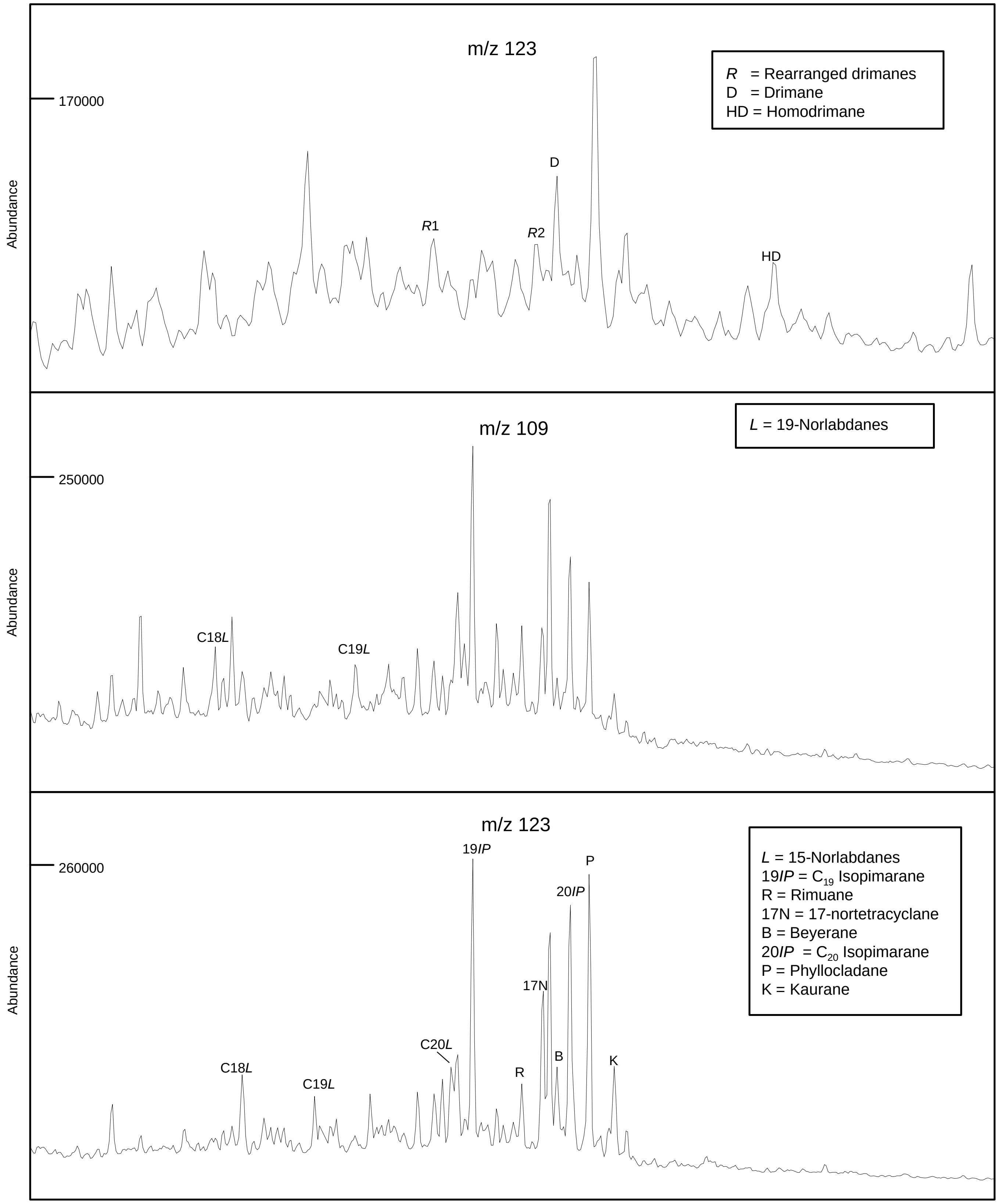
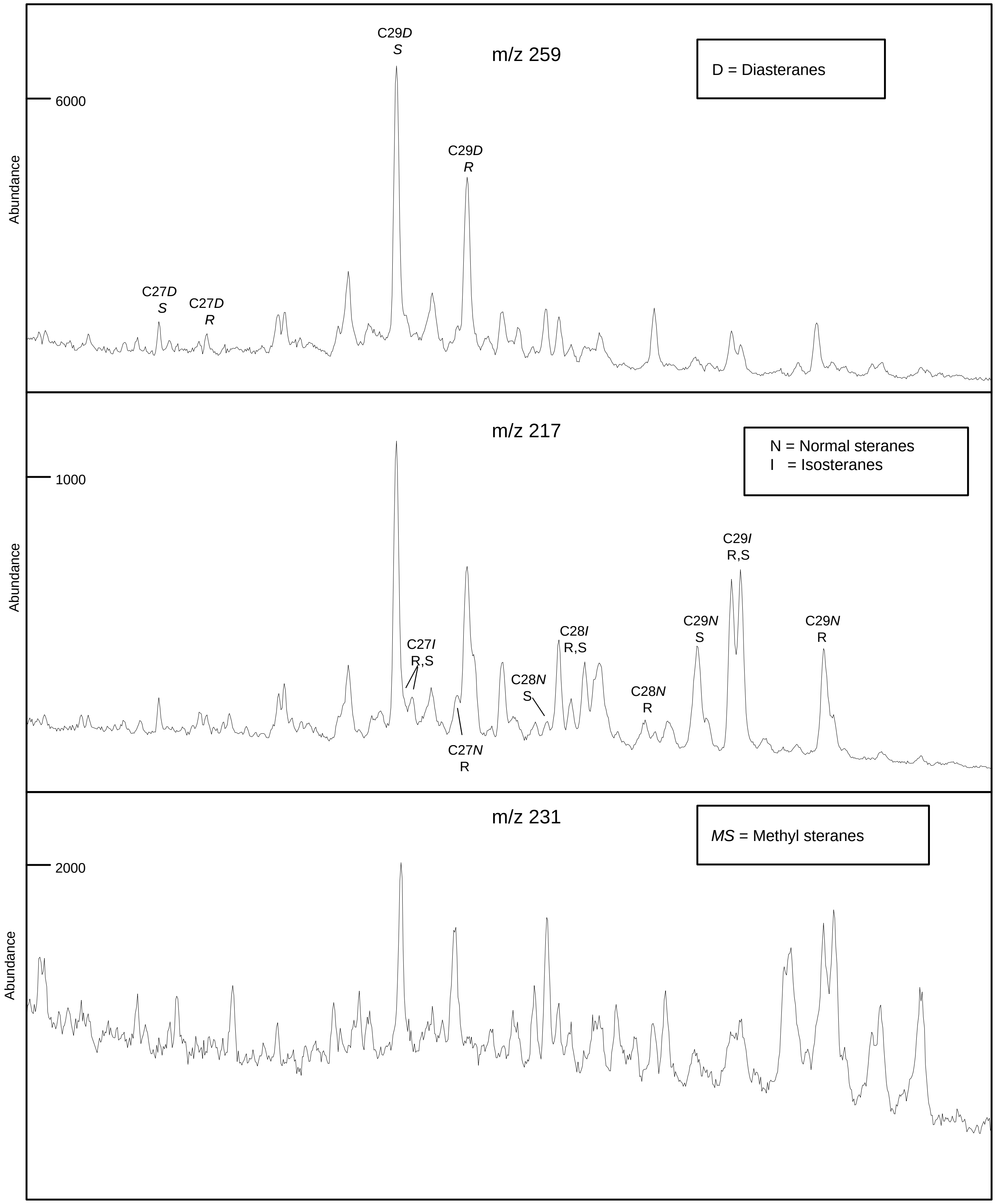


FIGURE 4F

Sample : **GILBERT-1A, 633.8m, MSCT-12**

File ID : 353301B



APPENDIX B

THEORY AND METHODS

INSTRUMENT CONDITIONS

SOURCE ROCK ANALYSES

A.1 Total Organic Carbon (TOC)

Samples were finely crushed and digested in acid (HCl) to remove the carbonate minerals. The remaining sample was heated to 1700^{o}C using a Leco CS-444 system (CS-444 Determinator; HF-400 Induction Furnace) in an atmosphere of pure oxygen. The CO_2 produced was measured with an infra-red detector, and values calculated according to standard calibration.

TOC values generated for the products in this study have been categorised according to the following classification scheme, based on their perceived effect on geological data:

Classification	**%TOC**
Low	0.00 - 0.20
Moderate	0.20 - 0.50
High	0.50 - 1.00
Very High	> 1.00

A.2 Rock-Eval Pyrolysis

Samples were pyrolysed on a Rock-Eval II instrument under an inert atmosphere of helium. The samples were heated to 300^{o}C (held for 3 mins) in order to thermally distill free or adsorbed hydrocarbons (S1) which were then measured by a flame ionisation detector (FID). The oven temperature was ramped from 300^{o}C to 550^{o}C at 25^{o}C/min and held at 550^{o}C for 1 minute, in order to crack the kerogen and generate hydrocarbons (S2). These hydrocarbons were measured by a FID. CO_2 released during the kerogen cracking process (S_3) is trapped and subsequently measured by a thermal conductivity detector (TCD). The temperature at which the maximum amount of S_2 hydrocarbons is generated is referred to as the T_{MAX}.

S1 and S2 values generated for the products in this study have been described according to the following classification schemes, based on their perceived effect on geological data.

Characterisation	**S_1 (mg/g)**
Low	0.00 - 0.20
Moderate	0.20 - 0.80
High	0.80 - 3.00
Very High	> 3.00

Characterisation	**S_2 (mg/g)**
Low	0.00 - 0.50
Moderate	0.50 - 2.00
High	2.00 - 4.00
Very High	> 4.00

A.3 Pyrolysis Gas Chromatography (Pyrolysis GC)

Pyrolysis GC was performed on solvent extracted samples. The samples were pyrolysed by a GHM pyrojector which was coupled directly to a Varian 3400 Series gas chromatograph. The operating conditions were:

Column:	ZB-1 (30 m x 0.25 mm i.d; 0.25 μm film thickness)
Pyrolysis programme:	*Thermal extract (S1): 155^{o}C to 330^{o}C @ 60^{o}C/min (3mins);
	*Pyrolysis GC (S2): 330^{o}C to 530^{o}C @ 25^{o}C/min (5.8mins)
Oven conditions:	40^{o} (22mins) to 300^{o}C @ 4^{o}/min (17.50mins)
	(A liquid nitrogen trap was used from 0-22mins)
Carrier gas:	Helium

HYDROCARBON CHARACTERISATION ANALYSES

A.4 Solvent Extraction of Solid Products

Solid products were finely crushed and extracted with dichloromethane using sonic vibration. After filtration, a small quantity of magnesium sulphate was added to the extract to remove any water. The extract was then filtrated and passed through activated copper powder to remove elemental sulphur. The extractable organic matter (EOM) was collected by evaporation of the solvent by fractional distillation.

A.5 Whole Extract or 'Hexane' Solubles GC-MS

Fluid samples and extracts (from solid products) were analysed by GC-MS in scan mode producing a chromatogram of the compounds present from C_9 to C_{36}. These analyses were performed under the following conditions:

Instrument:	Hewlett-Packard 5890 Series II GC/5971 MSD
Column:	ZB-1 (30 m x 0.25 mm i.d; 0.25 µm film thickness)
Mode:	Split
Oven conditions:	60^{o}C (1min) to 300^{o}C @ 5^{o}C/min (13mins)
Carrier Gas:	Helium

A.6 Liquid Chromatographic Separation

Fluid products and extracts (from solid products) were separated into saturate, aromatic and NSO (polars) fractions.

This separation was achieved by liquid column chromatography using activated silica gel adsorbent and eluting solvents of varying polarity (pentane, pentane/dichloromethane and dichloromethane/methanol). The saturate, aromatic and NSO fractions were recovered by evaporation of the solvent by fractional distillation.

A.7 Saturate GC-MS

The saturate fraction obtained from liquid chromatographic separation was analysed by GC-MS in scan mode producing a chromatogram of the compounds present from C_9 to C_{34}. The analyses were performed under the following conditions:

Instrument:	Hewlett Packard 6890 GC/5973 MSD
Column:	ZB-1 (60 m x 0.25 mm i.d; 0.25 µm film thickness)
Mode:	Pulsed splitless
Oven conditions:	60^{o}C to 300^{o}C @ 6^o/min (22mins)
Carrier Gas:	Helium

A.8 Aromatic GC-MS

The aromatic fraction obtained from liquid chromatographic separation was analysed by GC-MS in selected ion monitoring (SIM) mode under the following conditions:

Instrument:	Hewlett Packard 6890 GC/5973 MSD
Column:	ZB-5 (60 m x 0.25 mm i.d; 0.25 µm film thickness)
Mode:	Pulsed splitless
Oven conditions:	50^{o}C to 300^{o}C @ 3^o/min (17min)
Carrier Gas:	Helium

A.9 Branched/cyclic GC-MS

The saturate fractions were treated with ZSM-5 in order to isolate the branched/cyclic compounds, which were then analysed by GC-MS. In those cases where insufficient saturate material was obtained to perform the separation, the entire saturate fraction was analysed by the branched/cyclic GC-MS method.

Analysis was carried out in SIM mode under the following operating conditions:

Instrument:	Hewlett Packard 6890 GC/5973 MSD
Column:	ZB-1 (60 m x 0.25 mm i.d; 0.25 µm film thickness)
Mode:	Pulsed splitless
Oven conditions:	70^{o}C(1min) to 270^{o}C @ 8^o/min; 270^{o}C to 285^{o}C @ 1^o/min (49 mins)
Carrier Gas:	Helium

BASS STRAIT Oil
Oil for Australians

GILBERT-1/1A

COMPOSITE WELL LOG
(1:500 scale)

Surface Location:	37deg 57' 10.72"S 148deg 22' 25.90"E	**Permit:**	Vic-P/47	**Region:**	Gippsland Basin
		Map Reference:	SJ55 1:1,000,000 Melbourne Map Sheet Graticular Block 1709	**Well Status:**	P & A as Dry Hole
Easting:	620,701.1mE				
Northing:	5,798,512.1mN				
		Total Depth (Driller's):	810.0m		
UTM Zone:	GDA 94	**Total Depth (Logger's):**	806.0m		
Seismic Location:	GB79-136/SP-650				
		Plugged Back to:	100mMD RT		
Datum:	MSL	**Perforations:**	NIL	**Wellsite Geologists:**	G. Geary/R. Blackmore
Elevations (RT):	21.5m				
Water Depth:	51.3m	**Drilling Contractor:**	DOGC		
		Rig:	MODU "Ocean Patriot"		
Date Commenced:	2/10/2005; 08:00 Hrs	**Wireline Logging By:**	Schlumberger	**Log Compilation:**	R.W. Fisher
Date Spudded:	4/10/2004; 07:30 Hrs	**Cementing:**	Dowell		
Date Re-Spudded:	4/10/2004: 23:30 Hrs	**Mud Logging By:**	GeoServices	**Drafting:**	P. Charlebois (Crocker Data Processing Pty Ltd)
Date at Total Depth:	9/10/2005; 20:00 Hrs	**MWD/LWD Logging By:**	Halliburton-SperrySun		
Date Rig Released:	14/10/2004: 14:00 Hrs				

LWD LOG DATA

LOG SUITE/RUN NUMBER	1	2
LOG TYPE/COMBINATION	MWD-DGR-EWR_P4-PM	MWD-DGR-EWR_P4-PM
DATE	6-Oct-2005	10-Oct-2005
INTERVAL RECORDED	107-336m	336-810m
BIT SIZE	445mm	311mm
MUD TYPE	Seawater/PHG	KCl/PHPA
MUD DENSITY	1.05	1.08
MUD VISCOSITY	N/A	56
FLUID LOSS	N/A	5.6
PH	10	8
Rm @ TEMP MEAS.	N/A	0.06ohmm @ 25.0degC
Rmf @ TEMP MEAS.	N/A	0.04ohmm @ 25.0degC
Rmc @ TEMP MEAS.	N/A	0.08ohmm @ 25.0degC
MAXIMUM TOOL TEMP.	20.0degC	52.0degC
Rm @ Max. Tool Temp.	N/A	0.04ohmm @ 52.0degC

HOLE SIZE

SIZE (mm)	FROM (m)	TO (m)	MUD SYSTEM & COMMENTS
914mm	73	107	Seawater with PHG Sweeps
445mm	107	336	Seawater with PHG Sweeps
311mm	336	810	KCL-PHPA

CASING

SIZE (mm)	WEIGHT (kg/m)	INTERVAL (m)	COMMENTS
508 x 762mm	461	106	
340mm	101	331	

CEMENT

PLUG NUMBER	FROM (mRT)	TO (mRT)	COMMENTS
1a	810	690	
1b	690	570	
2	370	270	

WIRELINE LOGS

LOG SUITE/RUN NUMBER	RUN 1	RUN 2	RUN 3	RUN 4
LOG TYPE/COMBINATION	PEX (HALS)-DSI-LEHQT	CMR-HNGS	MDT-GR	MSCT-GR
DATE	10/10/2005	10/10/2005	10/10/2005	11-Oct-05
INTERVAL RECORDED	806.0-332.0m	802.0-580.0m	757.7-624.0m	682.0-580.0m
CASING DRILLER	13.375" @ 331.0m	13.375" @ 331.0m	13.375" @ 331.0m	
CASING LOGGER	13.375" @ 332.0m	13.375" @ 332.0m	13.375" @ 332.0m	
BIT SIZE	12.25"	12.25"	12.25"	
MUD TYPE	KCL/PHPA			
MUD DENSITY	1.06g/cc			
MUD VISCOSITY	45s			
FLUID LOSS	7.2cm2			
PH	8.7			
SAMPLE SOURCE	FLOWLINE			
Rm @ TEMP MEAS.	0.126ohmm @ 30degC			
Rmf @ TEMP MEAS.	0.111ohmm @ 21degC			
Rmc @ TEMP MEAS.	0.139ohmm @ 19degC			
MEASURED BHT	43.0degC @ 775.0mMDRT	46.0degC @ 777.0mMDRT	46.7degC @ 700.0mMDRT	46.0degC @ 720.0mMDRT
Rm @ BHT	0.100ohmm @ 43.0degC			
Rmf @ BHT	0.073ohmm @ 43.0degC			
TIME CIRCULATION STOPPED	10/10/2005 3:15			
TIME LOGGER ON BOTTOM	10/10/2005 9:42			
COMMENTS:	GR -DT to 72.5m		13 valid pressures; 29 attempted and 7 samples	CUT 17; REC 17

LITHOLOGY SYMBOLS

ROCK TYPE

SANDSTONE (coarse)
SANDSTONE (fine)
CALCAREOUS SANDSTONE
CONGLOMERATE
GREENSAND
SILTY SANDSTONE
SILTSTONE
LIMESTONE
CALCARENITE
CALCISILTITE
ARGILLACEOUS CALCISILTITE
CALCILUTITE
ARGILLACEOUS CALCILUTITE
CLAYSTONE
CALCAREOUS CLAYSTONE
HALITE
GYPSUM
ANHYDRITE
VOLCANICS
CEMENT
MARL
COAL

OTHER CONSTITUENTS

ARGILLACEOUS
GLAUCONITIC
FELDSPATHIC
MICACEOUS
CARBONACEOUS
PYRITE
SILTY
CALCAREOUS
SIDERITIC
CHERT
SKELETAL FRAGMENTS
SILICEOUS
CEMENT
LITHICS

ENGINEERING SYMBOLS

CASING SEAT
PLUGGED INTERVAL
DRILL STEM TEST
PERFORATED INTERVAL
CORE No. AND INTERVAL
MSCT CORE
MSCT CORE (Not recovered)
Formation Test (MDT)
MDT Sample Recovered

SHOW LEGEND

MODERATE TO STRONG OIL SHOW
MODERATE TO STRONG GAS SHOW
MINOR OIL SHOW
MINOR GAS SHOW

LOG DESCRIPTION

GR	Gamma-Ray
CALI	Caliper Log
RHOZ	Nuclear Formation Density
NPHI	Thermal Neutron Porosity (Ratio Method)
PEFZ	HRDD Standard Resolution Formation Photoelectric Factor
DTCO	Delta-T Compressional
HDRA	HRDD Density Correction
HLLD	HALS Laterolog Deep Resistivity
HLLS	HALS Laterolog Shallow Resistivity
RXOZ	MCFL Standard Resolution Invaded Zone Resistivity
ROP	Rate of Penetration
SEXP	Smoothed Extra Shallow Phase-Shift Derived Resistivity (Sperry)
SESP	Smoothed Shallow Phase-Shift Derived Resistivity (Sperry)
SEMP	Smoothed Medium Phase-Shift Derived Resistivity (Sperry)
SEDP	Smoothed Deep Phase-Shift Derived Resistivity (Sperry)
SP	SP Shifted
SGRC	Smoothed Gamma Ray Combined (Sperry)

MDT TABLE

No.	DEPTH (mMDRT)	DEPTH (mTVDRT	DEPTH (mSS)	Time (hr:mi	IHP (PSIA)	FFP (PSIA)	(EMW)	FHP (PSIA)	(EMW)	VOL (CC)	D. MOB (mD/cp)	Temp (degC	Comments
1	627.80	627.80	606.30	20:58	1008.63	997.70		1008.90		10.0	N/A	44.9	Test - Supercharged?
2	628.00	628.00	606.50	20:51						10.0			No seal.
3	633.80	633.80	612.30	19:32	1019.60	889.64		1018.99		10.0	8.4	44.5	Test
4	634.90	634.90	613.40	19:56	1020.65	889.89		1020.24		10.0	2.9	44.6	Test
5	636.60	636.60	615.10	20:10	1022.76	891.73		1022.39		20.0	35.7	44.8	Repeat Test. High perm.
6	637.60	637.60	616.10	20:40	1024.36	890.18		1024.05		10.0	23.4	45.0	Test
7	638.60	638.60	617.10	20:14	1026.33	895.63		1025.59		10.0	6.5	45.1	Test. Long wait to stabilize.
8	641.40	641.40	619.90	21:46	1030.26	899.1		1029.99		10.0	13.5	45.2	Test
9	642.60	642.60	621.10	22:00	1031.99	901.08		1031.74		10.0	4.6	45.3	Test
10	643.60	643.60	622.10	22:15	1033.51	906.77		1032.77		10.0	0.8	45.3	Test
11	647.70	647.70	626.20	22:32	1039.40	906.13		1039.82		10.0	52.3	45.4	Test
12	648.50	648.50	627.00	22:52	1041.41	907.89		1041.66		10.0	73.7	45.4	Test
13	651.30	651.30	629.80	23:08	1046.68			1046.95		10.0		45.4	Tight
14	652.30	652.30	630.80	23:15	1049.02	912.19		1049.80		10.0	44.4	45.5	Test
15	653.40	653.40	631.90	23:30	1051.26	914.48		1051.02		10.0	28.7	45.6	Test
16	654.40	654.40	632.90	23:52									No seal.
17	654.30	654.30	632.80										No seal.
18	654.80	654.80	633.30	0:28	1051.95	916.39		1051.96		2x10	445.9	46.1	Test
19	670.70	670.70	649.20	0:45									Tight
20	673.80	673.80	652.30	0:54	1082.63							46	Tight
21	678.20	678.20	656.70	1:07	1088.90							46.1	Tight
22	679.00	679.00	657.50	1:15	1090.25					2x10		46.1	Tight
23	691.00	691.00	669.50	1:21						10.0		46.2	Tight
24	715.00	715.00	693.50	1:34	1147.95					10.0		46.3	Tight
25	725.70	725.70	704.20	1:45	1164.38			1163.71		2x10		46.5	Tight (curtailed after 15 mins)
26	665.00	665.00	643.50	2:17	1067.38			1067.88		10.0		46.9	Tight
27	658.50	658.50	637.00	2:29						10.0		46.6	Tight
28	632.50	632.50	611.00	2:35						10.0			Tight
29	633.00	633.00	611.50	2:45	1017.23	894.24		1017.36		10.0	1.7	46.2	Test (Supercharged?)
30	629.00	629.00	607.50	3:00	1010.93							45.9	No seal.
31	629.00	629.00	607.50	3:15								45.8	No seal.
32	627.00	627.00	605.50	3:27	1007.62					10.0	N/A	45.8	Test-Supercharged?
33	624.00	624.00	602.50	3:33	1002.89							45.6	Tight
34	636.60	636.60	615.10	3:49	1023.69	891.55	Chamber # 33 & 123	1024.68		74 LITRES		45.6	PUMPOUT & SAMPLE (2 3/4 GAL & 1X450CC)
35	648.50	648.50	627.00	6:00	1043.34	907.73	Chamber # 192 & 316	1043.77		93 LITRES		45.7	PUMPOUT & SAMPLE (2X450CC)
36	654.80	654.80	633.30	8:16	1053.35	916.31	Chamber # 485 & 487	1053.83		55 LITRES		45.8	PUMPOUT & SAMPLE (2X450CC)
37	633.80	633.80	612.30	10:00	1019.34	888.10						45.3	TIGHT-ABORTED
38	634.00	634.00	612.50	10:17	1019.01	888.82						45.3	TIGHT-ABORTED
39	633.60	633.60	612.10	10:26	1018.20	888.57						45.3	TIGHT-ABORTED
40	634.20	634.20	612.70	3:07	1018.86	888.09	Chamber # 501	1018.46		11.8 LITRES		45.7	PUMPOUT & SAMPLE (1x450cc)

MSCT TABLE

MSCT No.	DEPTH (mMDRT)	REC (cm)	Actual Lithology	MSCT No.	DEPTH (mMDRT)	REC (cm)	Actual Lithology
1	682	3.8	Sandstone	10	639.5	2	Sandstone
2	677	4	Claystone	11	637	4.2	Sandstone
3	672.5	1.8	Claystone	12	633.8	3.8	Sandstone
4	662	1.5	Sandstone	13	627.5	1	Siltstone
5	656	4.4	Sandstone/ Claystone	14	623.6	2.5	Sandstone
6	653.4	4.2	Sandstone	15	621.8	1	Claystone
7	649.5	4.5	Sandstone	16	584.5	2	Claystone
8	647.4	4.4	Sandstone	17	580	2	Claystone
9	642.6	4.4	Sandstone				