

BASS STRAIT OIL COMPANY LTD



MACLEAN-1 WELL COMPLETION REPORT

INTERPRETIVE DATA

AUGUST 2006

VOLUME 1 OF 1

This Page is Left Blank Intentionally



MACLEAN-1

WELL COMPLETION REPORT

VOLUME 1 OF 1

(INTERPRETIVE DATA)

VIC/P47
GIPPSLAND BASIN

OFFSHORE
VICTORIA

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

Controlled Copy No: _____

This Page is Left Blank Intentionally

TABLE OF CONTENTS

Volume 1 of 1

1. INTRODUCTION AND SUMMARY	1
1.1 Geological and Formation Evaluation Summary	5
1.1.1 Prospect Summary	5
1.1.2 Geological and Formation Evaluation Summary	5
1.2 Drilling Summary	7
2. WELL HISTORY	9
2.1 Well Data Summary	9
2.2 Operations Summary	10
3. GEOLOGY	11
3.1 Summary of Previous Exploration	11
3.1.1 Seismic Data	11
3.1.2 Well Data	12
3.2 Regional Structure and Geology	13
3.2.1 Geological Evolution	13
3.2.2 Tectonic History	13
3.3 Stratigraphy	17
3.3.1 Gippsland Limestone/Recent Seafloor – 519.4mMD RT (57-497.9mTVDSS)	18
3.3.2 Lakes Entrance Formation 519.4 – 582.6mMD RT (497.9 – 561.1mTVDSS)	19
3.3.3 Gurnard Formation 582.6 – 626mMD RT (561.1 – 604.5mTVDSS)	20
3.3.4 Kingfish Formation 626 – 644.6mMD RT (565.5 – 568mTVDSS)	22
3.3.5 Grunter Member 644.6 – 667.2mMDRT (623.1 – 645.7mTVDSS)	23
3.3.6 Kate Shale 667.2 – 671.6mMDRT (645.7 – 650.1mTVDSS)	24
3.3.7 Volador Formation 671.6 – 692.3mMDRT (650.1 – 670.8mTVDSS)	24
3.3.8 Kipper Shale (Emperor Sub-Group) 692.3 - 766mMDRT (670.8 – 744.5mTVDSS)	25
3.4 Structure and Seal	26
3.5 Source and Migration	30
3.6 Relevance to the Occurrence of Hydrocarbons	30
3.6.1 Gas Readings	30
3.6.2 Hydrocarbon Shows Recorded in Ditch Cuttings	30
3.7 Formation Evaluation	31
3.7.1 Borehole Temperature Data	31
3.7.2 Wireline Testing	31
3.7.3 DST Testing	31
3.7.4 Porosity, Permeability and Formation Fluids	32
3.7.5 Geochemical Analysis	33
3.8 Conclusions and Contributions To Geological Knowledge	34
4. REFERENCES	34

Volume 1 of 1 (Continued)

TABLES

<i>Table 1: Maclean-1 Stratigraphic Table.....</i>	<i>17</i>
<i>Table 2. Summary of Gas Readings Recorded for All Lithology Intervals.....</i>	<i>30</i>

FIGURES:

<i>Figure-1 VIC/P47 Location Map.....</i>	<i>2</i>
<i>Figure 2 Maclean-1 Location Map.....</i>	<i>3</i>
<i>Figure 3 Tectonic Elements map (modified after Wong D., Bernecker T. & Moore D., 2001.).....</i>	<i>4</i>
<i>Figure 4 Generalised Stratigraphic Column of the gippsland basin (after Bernecker, T., Thomas, H. & Driscoll, J., 2003.....</i>	<i>16</i>
<i>Figure 5: Post-Drill Structural Interpretation of Maclean Fault Block at near Top Gurnard Formation.....</i>	<i>27</i>
<i>Figure 6: Post-Drill Structural Interpretation of Maclean Fault Block at Top Kingfish Formation</i>	<i>28</i>
<i>Figure 7: Post-drill Interpretation of 3D Seismic Line Inline 2466 Highlighting Maclean-1 Location.....</i>	<i>29</i>


APPENDICES:

<i>Appendix 1</i>	<i>Well Card (Bass Strait Oil Company Limited)</i>
<i>Appendix 2</i>	<i>Petrophysical Report – (The Saros Group Pty Ltd)</i>
<i>Appendix 3</i>	<i>Palynology Report: Sample Interval- 588-762m. – (Dr Alan Partridge)</i>

ENCLOSURES:

<i>Enclosure 1</i>	<i>Composite Well Log (1:500 Scale)</i>
--------------------	---

DOCUMENT NO.:	BAS_WCR_003
TITLE:	BASS STRAIT OIL COMPANY LTD WELL COMPLETION REPORT FOR MACLEAN-1 (VIC/P47) <i>INTERPRETIVE DATA</i>

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

CONTROLLED DISTRIBUTION LIST	
Copy No.	Recipient
001	Bass Strait Oil Company Ltd: Ian Reid – –Technical Advisor (Melbourne, Vic) Hard Copy + CD
002	Eagle Bay Resources NL: Tony Rechner – Director (Perth, WA) CD Only
003	Moby Oil & Gas Limited: Geoffrey Albers – Chairman (Melbourne, Vic) CD Only
004	Labrador Petro-Management Pty Ltd: Tom Brand -Project Advisor (Perth, WA) Hard Copy + CD
005	Victorian Department of Primary Industries; Minerals & Petroleum Division: Kourosh Mehin - Manager, Petroleum Resources (Melbourne, Vic) CD Only
006	GeoScience Australia: Trevor Powell – Chief Petroleum & Marine Division (Canberra, ACT) CD Only

1. INTRODUCTION AND SUMMARY

The Maclean-1 well is located in Commonwealth waters within Permit Vic/P47 approximately 350km east of Port Melbourne (Figure 1) and 8 km east southeast of the Patricia/Baleen producing gas field. This location is covered by the SJ 55 1:1,000,000 Melbourne Map Sheet; Graticular Block 1783. Vic/P47 is located offshore on the northern margin of the Gippsland Basin straddling the Northern Platform and Northern Terrace. The southern or 'neck' portion of the permit that incorporates Maclean-1 lies to the south of the Lake Wellington Fault System that separates the Northern Platform from the Northern Terrace.

The Maclean Prospect is formed as a downthrown fault closure on the southern flank of the Flathead Anticline, with a wedge of Halibut Subgroup reservoir developed on the downthrown side of the fault. The main reservoir target was the Kingfish Formation of the Halibut Subgroup, which was interpreted to thicken significantly southwards and eastwards over the Maclean Prospect on the southern flank of the Flathead Anticline. This sandstone reservoir has good porosity and permeability and is the main producing reservoir of the Gippsland Basin oil and gas fields. The Kingfish Formation reservoirs are now known to be predominantly absent on the shallow areas of the Flathead Anticline and in the Moby-1, Flathead-1 and Whale-1 wells. A secondary reservoir target was the deeper Volador Formation of the Halibut Subgroup, which is known to pinch out on the southeastern flank of the Flathead Anticline. This sandstone reservoir has good porosity and permeability. A significant thickening of the Volador Formation occurs eastwards across the Maclean structure and is the reason for locating Maclean-1 on the eastern culmination. The existence of an amplitude anomaly within the Gurnard Formation near the culmination of Maclean suggests it may be gas bearing there, although the anomaly is not present at the proposed well location. This is considered to be due to the Gurnard Formation being non-reservoir at the well location and therefore not an objective. The amplitude anomaly does not extend significantly laterally or downdip over Maclean, indicating any hydrocarbons that may be present within the deeper Halibut Subgroup sequence are likely to be oil.

Maclean-1 was drilled in 57 metres (187') (MSL) of water by the DOGC 'Ocean Patriot' semi-submersible drilling unit and spudded on the 16th October 2005 at 03:30 hrs. The well reached a total depth of 766 mMDRT (-744.5 mTVDSS) on the 20th October 2005 at 06:00 hrs in the Late Cretaceous (Turonian) Emperor Sub-Group (Kipper Shale). LWD gamma ray and resistivity logs were acquired while drilling and no wireline logs were acquired at total depth. The well was subsequently plugged and abandoned as a dry hole with no evidence of hydrocarbons detected and the rig released on the 22nd October 2005 at 18:30 hrs. There were no lost time accidents and no environmental accidents during the drilling of Maclean-1. Total time on the Maclean-1 location was 8.2 days.

The Well Card (Appendix 1) summarises pertinent data from the Maclean-1 well.

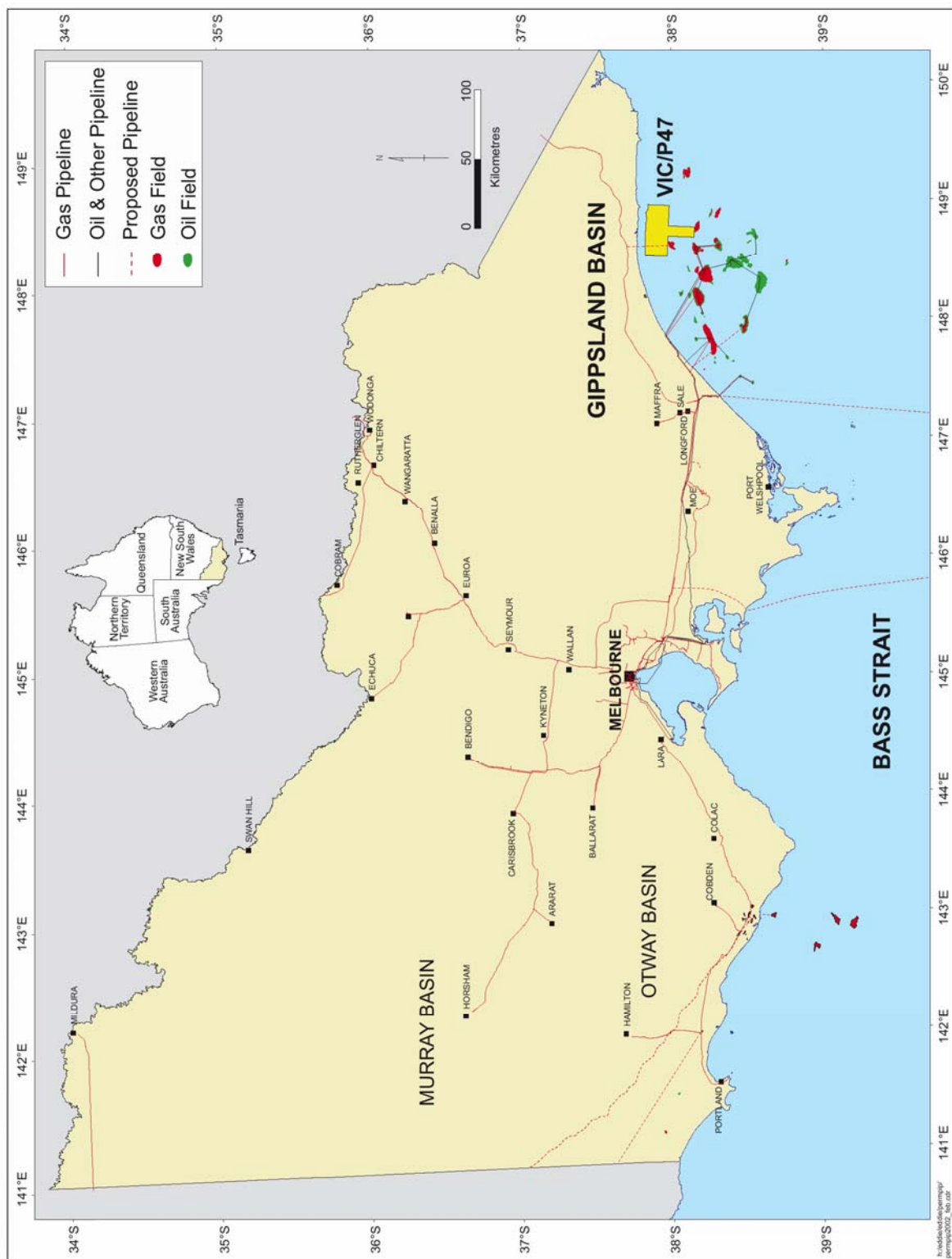


FIGURE-1 VIC/P47 LOCATION MAP

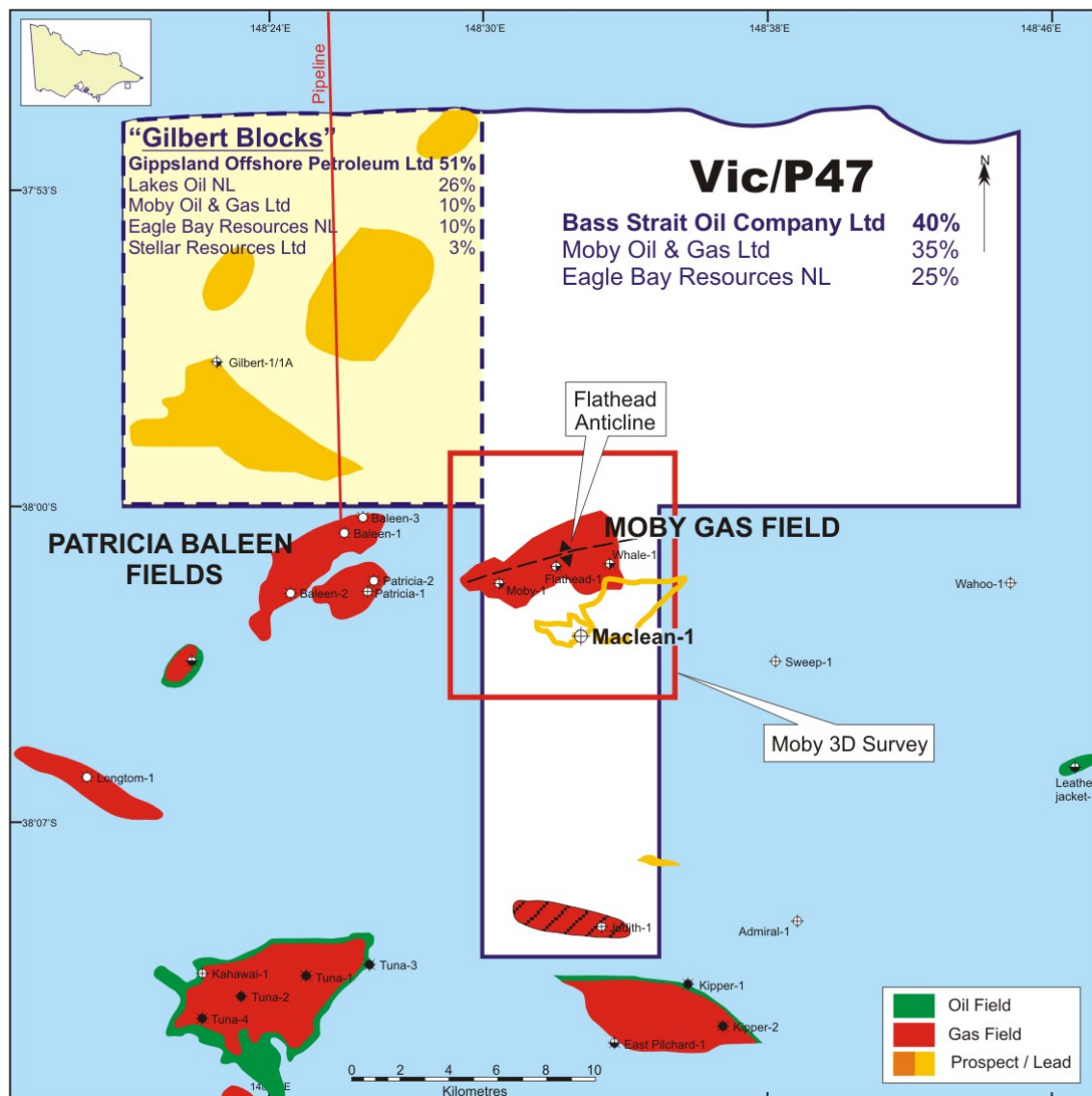
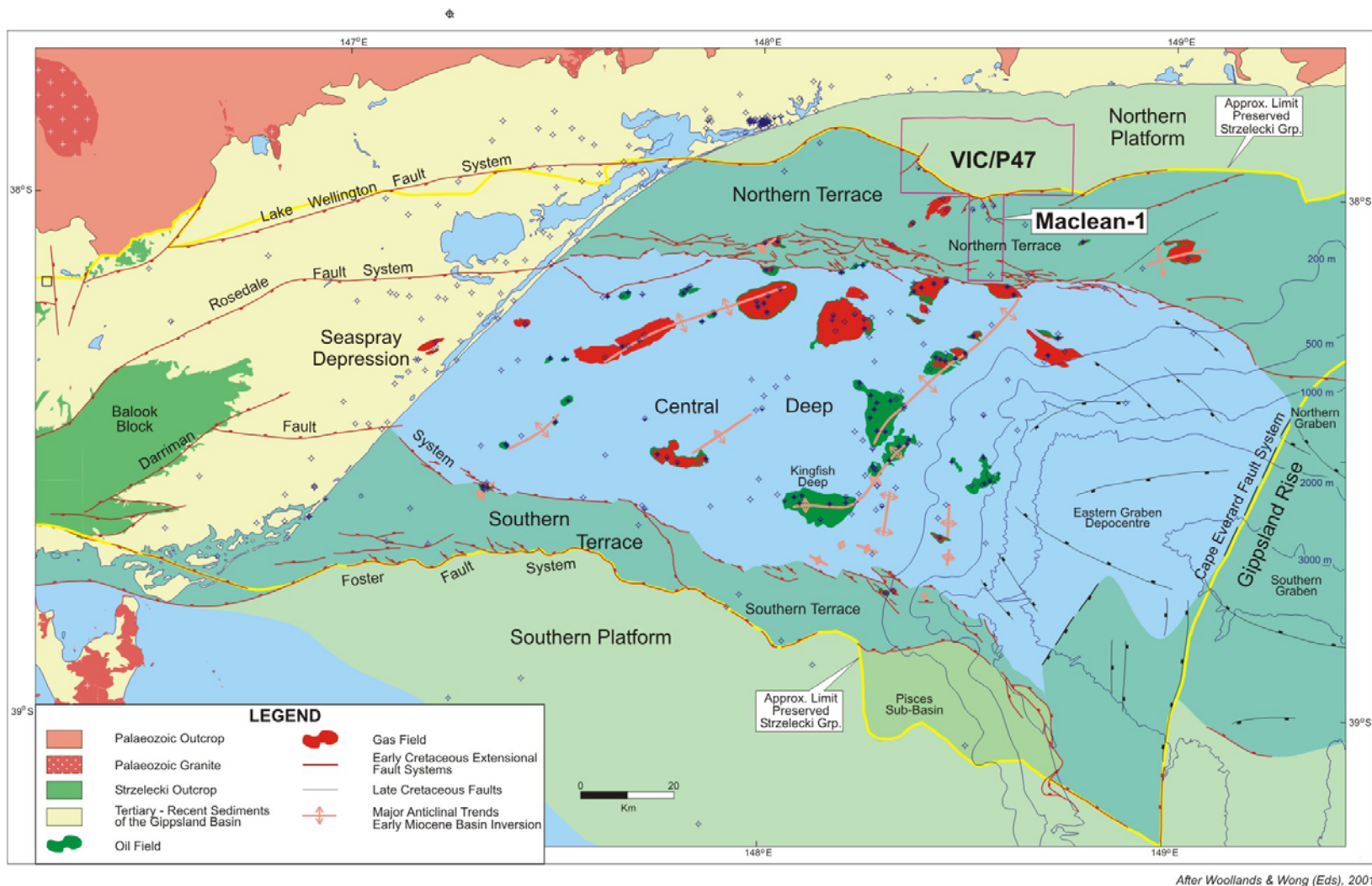


FIGURE 2 MACLEAN-1 LOCATION MAP



After Woollands & Wong (Eds), 2001

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 Maclean-1 exploration well is located at Inline 2466 Xline 1255 of the Moby (GAP04A) 3D Seismic Survey and proposed to be drilled to a Projected Total Depth of 750 metres TVD subsea. The Maclean-1 well was designed to test a downthrown fault closure on the southern flank of the Flathead Anticline, with a wedge of Halibut Subgroup reservoir intervals on the downthrown side of the fault.

The main reservoir target was the Kingfish Formation of the Halibut Subgroup, which was interpreted to thicken significantly southwards and eastwards over the Maclean Prospect on the southern flank of the Flathead Anticline. This sandstone reservoir has good porosity and permeability and is the main producing reservoir of the Gippsland Basin oil and gas fields. The Kingfish Formation reservoirs are now known to be predominantly absent on the shallow areas of the Flathead Anticline and in the Moby-1, Flathead-1 and Whale-1 wells. A secondary reservoir target was the deeper Volador Formation of the Halibut Subgroup, which is known to pinch out on the southeastern flank of the Flathead Anticline. This sandstone reservoir has good porosity and permeability. A significant thickening of the Volador Formation occurs eastwards across the Maclean structure and was the reason for locating Maclean-1 on the eastern culmination. The existence of an amplitude anomaly within the Gurnard Formation near the culmination of Maclean suggests it may be gas bearing there, although the anomaly is not present at the proposed well location. This is considered to be due to the Gurnard Formation being non-reservoir at the well location and therefore not an objective. The amplitude anomaly does not extend significantly laterally or downdip over Maclean, indicating any hydrocarbons that may be present within the deeper Halibut Subgroup sequence are likely to be oil.

1.1.2 Geological and Formation Evaluation Summary

Maclean-1 was spudded at 03:30 hrs on the 16th October 2005 and penetrated a sedimentary section ranging in age from Tertiary to Late Cretaceous (Turonian). The stratigraphic section encountered was essentially as predicted with all of the formation tops slightly high to prognosis, with the exception of encountering Late Cretaceous sediments of the Emperor Sub-Group (Kipper Shale) sub-cropping the Volador Formation, not the Strzelecki Sub-Group as prognosed. The other major difference to prognosis was water bottom, 16m shallow to prediction. 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 78.5 mMDRT (-57.0 mTVDSS), the upper part of which down to a depth of 355.0 mMDRT was drilled riserless in the 914mm (36") and 445mm (17 1/2") hole sections. Intermediate 340mm (13 3/8") casing was subsequently run to 350.0 mMDRT and the BOPs and marine riser nipped up, below which 311mm (12 1/4") hole was drilled to 766.0 mMDRT (Total Depth) with LWD gamma ray and resistivity logs providing the primary evaluation tool. The main open hole section to total depth was not evaluated with wireline logs.

The lower part of the Gippsland Limestone below 355.0 mMDRT consists of argillaceous calcilutite with minor calcarenite, marl and argillaceous calcisiltite. The base Gippsland

Limestone/Top Lakes Entrance Formation is identified at 519.4 mMDRT (-497.9 mTVDSS). It was encountered 5.1 metres high to prognosis, based upon LWD logs. The Oligocene to early Miocene Lakes Entrance Formation consists of marl grading to and interbedded with argillaceous calcilutite, calcilutite and calcareous claystone.

The Middle Eocene Gurnard Formation was intersected at 582.6 mMDRT (-561.1 mTVDSS), 21.9 m high to prediction and consists of argillaceous and silty sandstone, siltstone with minor greensand and claystone. All lithologies contain trace to common glauconite.

The Early Eocene Kingfish Formation was intersected at 626.0 mMDRT (-604.5 mTVDSS), 12.5m high to prognosis. This interval which is 23.0 m thick consists of interbedded claystone, sandstone and rare, thin streaks of granular “conglomerate” with traces of coal. The Grunter Member of the Kingfish Formation, which was not prognosed, was intersected at 644.6 mMDRT (-623.1 mTVDSS) and consists of conglomerate with interbedded sandstone. The “conglomerate” produced extremely high and erratic readings on the LWD resistivity log which was very distinctive. This log response was seen to repeat in the memory data once the tools had been downloaded. It was predominantly loose and granular to gravel size and not very highly cemented suggesting the LWD tools were directly reading the quartz granules.

The Early Paleocene Kate Shale, which was also not prognosed, was intersected at 667.2 mMDRT (-645.7 mTVDSS) and consists predominantly of slightly silty and carbonaceous claystone. This formation rests unconformably on the Late Cretaceous (Late Maastrichtian) Volador Formation of the Halibut Subgroup which was intersected at 671.6 mMDRT (-650.1 mTVD SS), 6.9 m high to prognosis. This interval which is 20.7 m thick, consists of interbedded claystone, sandstone and “conglomerate”. This formation rests unconformably on the Late Cretaceous (Turonian) Emperor Subgroup (Kipper Shale) at 692.3 mMDRT (-670.8 mTVDSS). The Emperor Subgroup at Maclean-1 consists predominantly of claystone with very minor fine-medium grained sandstone stringers.

There were no hydrocarbon shows in the form of fluorescence, neither direct UV fluorescence nor solvent cut fluorescence recorded during the drilling of Maclean-1. Gas levels were low throughout, consisting dominantly of methane (C₁) only.

The well reached TD within the Emperor Subgroup (Kipper Shale) at 766 mMDRT (-744.5 mTVDSS) (not the anticipated Strzelecki Group), which was reached at 06:00 Hrs on the 20th October 2005. This is 5 metres above the originally programmed total depth of the well. No wireline logs were run and the well was plugged and abandoned as a dry hole. Evaluation of the LWD data in combination with the total absence of hydrocarbon shows while drilling indicates all potential reservoir sands are 100% water wet.

Maclean-1 was plugged and abandoned as a dry-hole and the rig released at 18:30 hrs on the 22nd October 2005. A composite well log of the lithology intersected in Maclean-1 is included as Enclosure 1

1.2 DRILLING SUMMARY

The Diamond Offshore General Company MODU 'Ocean Patriot' was mobilised from the Gilbert-1A location in the Gippsland Basin and towed to the Maclean-1 location by a single AHSV ("Far Grip"). Maclean-1 operations commenced at 14:00 on 14th October 2005 when the last anchor was racked back at the Gilbert-1A location. The 'Ocean Patriot' was on location at Maclean-1 at 21:30 on 14th October 2005. The seafloor was tagged at 78.5m MDRT, corrected to Mean Sea Level (MSL). The water depth at Mean Sea Level was recorded as 57.0m, significantly less than the 73.0m anticipated prior to drilling, with a drill floor elevation of 21.5m. Maclean-1 was spudded at 03:30 on 16th October 2005 and the 914mm (36") hole drilled to 112.0m MDRT. An Anderdrift survey was taken at section TD and showed 1.5° inclination so the hole was reamed three times. Another Anderdrift survey was taken and still showed 1.5° inclination at section TD. The 762 x 508mm (30 x 20") conductor was run and set at 110.9m MDRT and cemented with 855 sacks (180 bbl) cement slurry at 1.90 SG (15.8 ppg). The tension on the guidelines was adjusted to change the angle of the PGB from 2° to 1°. The final location for Maclean-1 was confirmed as being 4.1m from the proposed location on a True Bearing of 336.7°. The final fix for Maclean-1 was:

Latitude: 38° 02' 46.32" S
Longitude: 148° 32' 52.92" E
Easting: 635 831.9m
Northing: 5 787 927.9m
DATUM: GDA94

The 445mm (17 ½") BHA was made up and guide ropes were attached to it and the guidelines. The BHA was run in hole and cement was tagged at 107.0m MDRT. The cement and casing shoe were drilled from 107.0m MDRT to 112.0m MDRT and drilling continued to section TD at 355.0m MDRT, pumping PHG sweeps mid-stand and before every connection. At section TD, a 23.7 m³ (150 bbl) PHG sweep was pumped and the hole was displaced with 50.9 m³ (320 bbl) of PHG mud. A wiper trip to the 762 x 508mm (30" x 20") casing shoe was made to work tight spots clean. The string was run back to bottom with the hole in good condition. The hole was swept clean with 7.9 m³ (50 bbl) of PHG and then displaced to PHG mud. The BHA was pulled out of the hole, jetting the 762mm (30") housing on the way out.

The 340mm (13 ⅜") casing was run to 350.0m MDRT and cemented with a 20.7 m³ (130 bbl (459 sacks)) lead slurry of 1.50 SG (12.5 ppg) Class G cement, followed by a 16.1 m³ (101 bbl (356 sacks)) tail slurry of 1.90 SG (15.8 ppg) Class G cement. The top dart was released and chased with 1.6 m³ (10 bbl) of drillwater, then the cement was displaced with another 18.6 m³ (117 bbl), bumping the plug with 3447 kPa (500 psi) over the final circulating pressure to 6205 kPa (900 psi). The BOP's were run while testing the choke lines, kill lines and marine riser to 1724 kPa (250 psi) for 5 minutes and 20684 kPa (3000 psi) for 10 minutes. Once the BOP's were landed, the shear rams were closed and the connector to the casing was tested to 1724 kPa (250 psi) for 5 minutes and 20684 kPa (3000 psi) for 10 minutes. The middle pipe rams were then closed and the connector was tested with 1724 kPa (250 psi) for 5 minutes and 20684 kPa (3000 psi) for 10 minutes.

The 311mm (12 ¼") BHA was made up and run in hole, tagging the top of cement at 314.0m MDRT. The shoe track and cement were drilled out down to the bottom of the rat hole at 355.0m MDRT. New formation was drilled in 311mm (12 ¼") hole from 355.0m to 358.0m MDRT. The well was displaced to a 1.04 SG (8.7 ppg) KCl/PHPA mud system and the choke and kill lines were displaced as well. The cement unit lines were pressure tested to 6895 kPa (1000 psi) before performing a successful FIT to 1.65 SG (13.8 ppg). The hole section was then drilled ahead to 600.0m MDRT, from which depth the drilling rate was controlled at 25 m/hr until the well TD at 766.0m MDRT. The

well was circulated clean and the BHA was pulled out of the hole. Due to excessive drag, the hole was backreamed while pulling out from 622.0 to 350.0m MDRT. The hole was circulated clean and flow checked, then the BHA was pulled out of hole.

No wireline logs were required and so plug & abandonment operations were started.

The 73mm (2 $\frac{7}{8}$ ") tubing cement stinger was picked up and run in hole on 127mm (5") drill pipe to 766.0m MDRT and two plugs of 10.0 m³ (63 bbl) of 1.90 SG (15.8 ppg) Class G cement slurry were pumped. Plug #1a was set from 766.0m to 666.0m MDRT and Plug #1b was set from 666.0m to 530.0m MDRT. The cement stinger was pulled back to 400.0m MDRT and a 10.3 m³ (65.0 bbl) volume of 1.90 SG (15.8 ppg) Class G cement slurry was pumped, setting Plug #2 from 400.0m to 270.0m MDRT. Excess tubulars were laid out while waiting on cement. The cement stinger was picked up and run in hole to tag the top of cement Plug #2 at 274.0m MDRT and then the hole was displaced with 19.1 m³ (120 bbl) of 1.08 SG (9.0 ppg) inhibited mud. The stinger assembly was pulled out of the hole and the 73mm (2 $\frac{7}{8}$ ") tubing was laid out. The 340mm (13 $\frac{3}{8}$ ") bridge plug was picked up, run in hole and set at 148.0m MDRT. The bridge plug was pressure tested to 6895 kPa (1000 psi) and then the setting tool was pulled out of hole. Open-ended drill pipe was run in to 148.0m MDRT, where a final volume of 4.1 m³ (26 bbl) of 1.90 SG (15.8 ppg) Class G cement slurry was pumped, setting Plug #3 from 148.0m to 100.0m MDRT.

The BOP's were pulled and the ROV released the HAC. The 508mm (20") spear and cutting assembly was picked up, run in hole and stabbed into the 476mm (18 $\frac{3}{4}$ ") wellhead. The 508mm (20") casing was cut at 83.4m MDRT. The cutting assembly was then pulled out of hole along with the speared casing cut-off stub and PGB.

Anchor handling operations were started at 01:30 on 22nd October 2005. The last anchor was racked at 18:30 on 22nd October 2005 and the rig was released to Apache Energy Ltd. Total time on Maclean-1 location was 8.2 days.

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

2. WELL HISTORY

2.1 WELL DATA SUMMARY

Well name	Maclean-1		
Type of Well	Vertical Exploration		
Well Status	Plugged & Abandoned as a dryhole		
Permit	Vic/P47		
Operator	Bass Strait Oil Company Ltd		
Interests	Bass Strait Oil Company Ltd 40%		
	Eagle Bay Resources NL 25%		
	Moby Oil & Gas Ltd 35%		
Objectives	Primary	Kingfish Formation	
	Secondary	Volador Formation	
Seismic Reference	GAP04A Inline 2466 Xline 1255		
Geographical Location	Latitude	38° 02' 46.32" S	
	Longitude	148° 32' 52.92" E	
	Northing	5,787,927.9 mN	
	Easting	635,831.9 mE	
Elevation (RT)	+21.5m		
Water Depth	57.0m (MSL)		
General Reference Datum / CM	GDA 94 / 147°E		
Map Reference	SJ55 1:1,000,000 Melbourne Map Sheet		
	Graticular Block 1783		
Rig Heading	248.45° True		
Total Depth	mMDRT	766.0mMDRT	
	mSS	744.5mSS	
	mSSTVD	744.45mSSTVD	
Time to Drill	8.2 days		
Rig on Contract	14 th October 2005; 14:00 hours		
Spud Date	16 th October 2005; 03:30 hours		
Well Reach TD	20 th October 2005; 06:00 hours		
Rig Released	22 nd October 2005; 18:30 hours		
Approx. Well Cost	AUD\$3.685.666		

2.2 OPERATIONS SUMMARY

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

3. GEOLOGY

3.1 SUMMARY OF PREVIOUS EXPLORATION

Permit Vic/P47 which covers an area of 718 km² 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 is the 27th February 2005. Year 2 and Year 3 anniversary dates are now the common date of 27th February 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 a portion of permit Vic/P47 by contributing to the cost of drilling Moby-1. Pursuant to this later agreement, the participating interests in Vic/P47 are now as follows:

Bass Strait Oil Company Ltd (BAS) - 40.0%; Moby Oil & Gas Limited (MOG) - 35.0% and Eagle Bay Resources NL - 25.0%.

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.

3.1.1 Seismic Data

The Maclean Prospect is covered by the Moby 3D (GAP04A). This survey was conducted by WesternGeco, under client project number GAP04A by Apache Energy Northwest Pty Ltd for Bass Strait Oil Company Ltd. The objective of the survey was to delineate the extent of the gas accumulation encountered in Moby-1 drilled in October 2004 by Bass Strait Oil Company Ltd, east of the producing Patricia/Baleen fields. In addition, the survey was designed to delineate prospects on the southern flank of the Flathead Anticline including Maclean. The survey consists of approximately 148 CMP km² of data. The field data were acquired by WesternGeco (m/v Western Trident). The data were processed to pre-stack time migration by WesternGeco.

The key horizons, Top Gurnard Formation, Top Kingfish Formation, Top Volador Formation and Top Strzelecki Group were interpreted on every 10th inline and xline on the Moby 3D.

The interpretation of the Gurnard Formation reservoir became problematic towards the South into Judith-1, as the sequence diverges. A significant top Latrobe 'coarse clastics' event was not apparent on the crest of the Flathead Anticline due to the thin reservoir section encountered, and therefore could not be mapped on seismic. A large part of the Latrobe Group is interpreted to subcrop along the southern flank of the Flathead Anticline (at the Maclean Prospect). The top Volador Formation, tied to Judith-1, only exists in Vic/P47 south of Flathead- 1 towards the Central Deep and can be mapped with some difficulty through the Northern Fields 3D area. It was selected as it marks a major 'intra-

Latrobe' reservoir sequence, and is at base of the regional Kate Shale seal. The top Strzelecki Group seismic event is always recognisable due to the existence of a steep angular unconformity and resulting event terminations.

3.1.2 Well Data

To date, only five 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. Gilbert-1/1A was drilled in a farmout sub-area of Vic/P47 (the Gilbert Blocks) immediately prior to Maclean-1. It was drilled under BAS' operatorship and BAS retained no equity interest in the well.

Five wells were significant in assessing the Maclean-1 prospect. These are Moby-1, 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. In addition to these five wells, a well drilled in the south of Vic/P47 in 1989, Judith-1, is interpreted to have encountered gas in the Emperor Subgroup although it was never tested.

Flathead-1 which was drilled by Esso Australia in 1969, was drilled in a crestal position on the Moby Anticline, 2km NE of Maclean-1. The well reached a total depth of 1066 m MD in the Strzelecki Group 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° and 50 centipoise.

Whale-1 was drilled by Hudebay Oil (Australia) Ltd in 1981, also in a crestal position on the Moby Anticline, 5 km NE of Maclean-1. The well reached a total depth of 810 m MD in the Strzelecki Group 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 19.9-22.3°.

Moby-1 was drilled by Bass Strait Oil Company Ltd in 2004. It was designed to test the Moby Prospect, primarily to target a seismic amplitude anomaly identified on the Baleen 3D survey, interpreted to represent gas within reservoirs of the Gurnard Formation. Although the Moby-1 well was drilled on a significant anticline with over 70km² areal closure, the structure was previously drilled in a crestal location by Flathead-1 and Whale-1 which both failed to encounter suitable reservoirs within the Gurnard Formation. The well reached a TD of 660 m MD in the Strzelecki Group, and was plugged and abandoned as a gas discovery. Log evaluation, analysis of the RCI pressure and sampling data and core analysis confirms the likely presence of a 21m gross column of gas within the Gurnard Formation.

Patricia-1 and Baleen-1 are located 5 km and 7 km west of Maclean-1 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.

Judith-1 which was drilled by Shell Australia in 1989 is located 17.5 km south of Moby-1 and 12km south of Maclean-1. The well reached a total depth of 2958 m MD in the

Emperor Sub-Group. The well targeted Emperor Subgroup sediments within a rotated fault-block along the Rosedale Fault System. The well was plugged and abandoned as a gas discovery within Emperor Subgroup sediments. The well was also designed to test the updip extent of the Kipper Field's upper Golden Beach Subgroup reservoirs (post-drill re-assigned to the Golden Beach Subgroup – Chimaera Formation) with results indicating that the Kipper Fault bound them to the north. Strong gas shows were recorded whilst drilling, within multiple Kipper Shale and Admiral Formation sands. The onset of strong gas shows coincided with the well passing into the upthrown side of the Judith Fault at 2391m. Petrophysical re-interpretation interpreted the presence of six possible multiple stacked gas columns from pretest results; spread over four gross sand packages with a total of 171.4m net pay.

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 southern or 'neck' portion of the permit that incorporates the Maclean-1 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; Norvik 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 2001). 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 rifting 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 (Norvick 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.

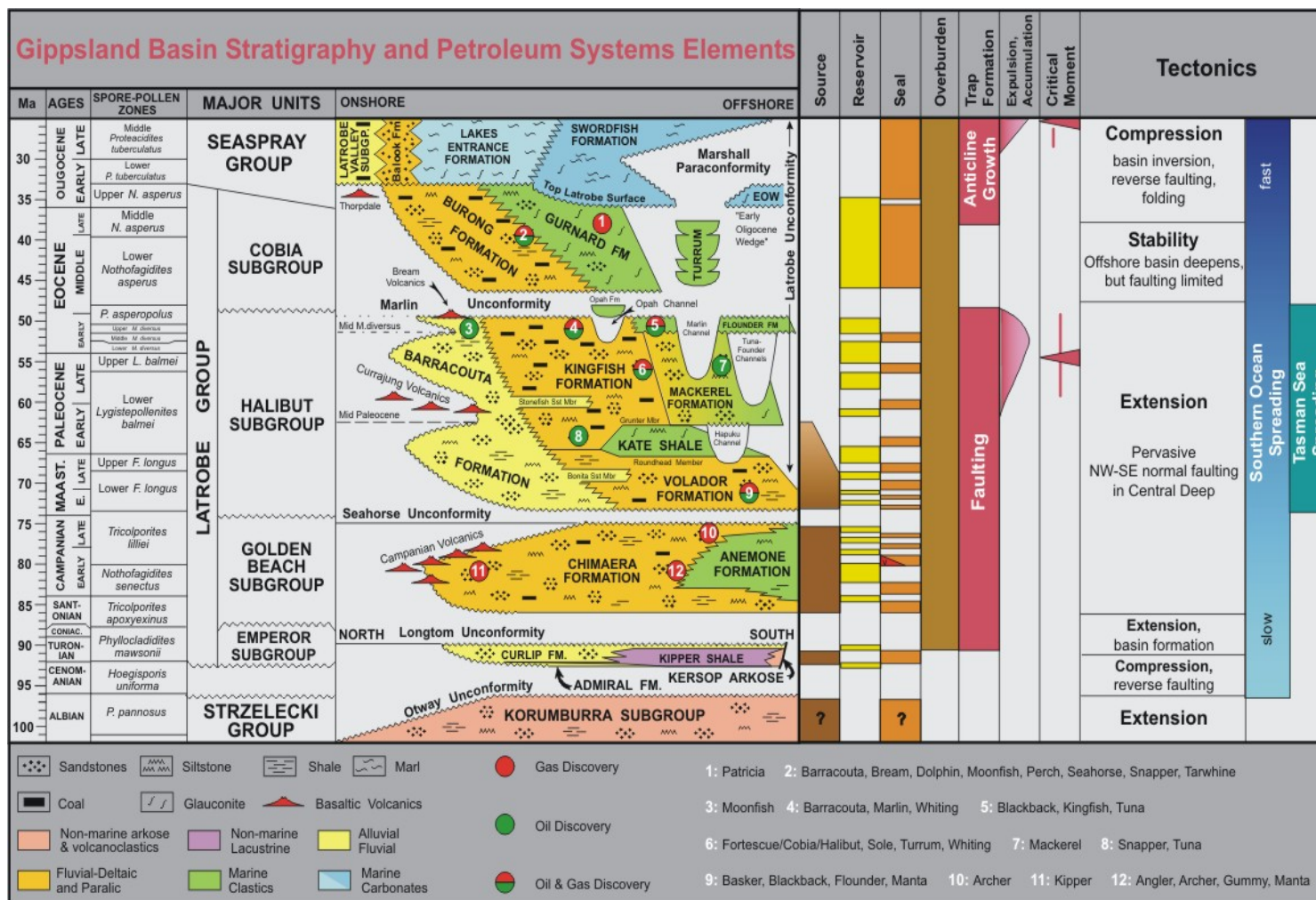


FIGURE 4 GENERALISED STRATIGRAPHIC COLUMN OF THE GIPPSLAND BASIN (AFTER BERNECKER, T., THOMAS, H. & DRISCOLL, J., 2003).

3.3 STRATIGRAPHY

Maclean-1 penetrated a sedimentary section ranging in age from Late 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 78.5m above the seafloor, unless otherwise stated.

No ditch cuttings samples were collected over the 914mm (36") and 445mm (17 1/2") hole sections drilled between the seabed (74.5mMD RT) and 355mMD RT in Maclean-1. Following installation of the marine riser, the well was drilled in a 311mm (12 1/4") hole from 355mMD RT to 766mMD RT (Total Depth) with full returns.

The wellsite lithological descriptions of the cuttings samples are contained in Appendix 1 of the Maclean-1 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.

Formation/Age	Depth	Depth	True Thickness	Seismic Time TWT
(Drill Floor = 21.5m)	(mMD RT)	(mTVDSS) *	(m)	(msec)
Miocene – Pliocene/Recent Gippsland Limestone (Seafloor)	78.5	57.0	440.9	76
Oligocene-Early Miocene Lakes Entrance Fm	519.4	497.9	63.2	513.
Middle Eocene-Early Oligocene Gurnard Fm	582.6	561.1	43.4	594
Paleocene to Early Eocene Kingfish Fm	626.0	604.5	18.6	625
Paleocene to Early Eocene Grunter Member	644.6	623.1	22.6	NP
Early Paleocene Kate Shale	667.2	645.7	4.4	NP
Late Cretaceous (Maastrichtian) Volador Formation	671.6	650.1	20.7	NP
Late Cretaceous (Turonian) Emperor S/G (Kipper Shale)	692.3	670.8	73.7+	695
TOTAL DEPTH	766.0	744.5		744

Table 1: Maclean-1 Stratigraphic Table.

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

The stratigraphy encountered was essentially as predicted with most of the formation tops slightly high to prognosis. The water bottom was significantly different to prognosis due to a seismic mis-pick. Seafloor was tagged at 78.5 mMDRT, resulting in a water depth of 57 metres corrected to MSL, significantly different to the 73 metre water column that was predicted. The primary objective Kingfish Formation was encountered below base seal inclusive of a non-reservoir facies of the overlying Gurnard Formation and 12.5m high to prognosis. Furthermore, Maclean-1 encountered a condensed sequence of Eocene to Paleocene age rocks and defined as the Grunter Member of the Kingfish Formation and Kate Shale. Neither of these units was prognosed. The well reached total depth in the Late Cretaceous (Turonian) Kipper Formation (Emperor Sub-Group) and not the Early Cretaceous (Mid-Late Albian) Strzelecki Group, which was prognosed to sub-crop the Kingfish Formation. The sub-division of the sedimentary section of Maclean-1 by formation boundaries and chronostratigraphic units as shown on the composite log (Enclosure 1) were determined primarily using a combination of LWD logs, lithological descriptions, drilling parameters and biostratigraphic data. A basic biostratigraphic report is included as Appendix 12 of the Maclean-1 Well Completion Report – Basic Data and an interpretive biostratigraphic report is included herein as Appendix 3. Log correlation with nearby offset wells was also used to define formation tops.

3.3.1 Gippsland Limestone/Recent Seafloor – 519.4mMD RT (57-497.9mTVDSS)

True Vertical Thickness	440.9m
Age:	Miocene-Pliocene/Recent
Palynozone:	Not defined
Depositional Environment:	Marine
Seismic Time:	0.076 Sec TWT

No ditch cuttings were collected over the upper portion of the Gippsland Limestone above 355mMD RT and no open hole wireline logs were recorded. However, LWD gamma ray and 4-phase resistivity was included in the BHA which was used to drill the interval below the surface conductor which was set at 110.9 mMDRT after drilling to 112 mMDRT. Lithology above 355mMD RT is interpreted from these logs and from surrounding offset well data and ROP.

The Gippsland Limestone is interpreted to consist of calcarenite with interbedded and intergradational calcisiltite and calcilutite above 355mMD RT. The lower part of the unit below 355mMD RT consists predominantly of calcilutite, argillaceous calcilutite and rare marl and calcarenite.

The Gippsland Limestone unconformably overlies the Lakes Entrance Formation at 519.4mMD RT (-497.9mTVDSS), at a seismic time of approximately 513 msec TWT. This interpretation is based on the first significant appearance of marl and calcareous claystone in the section and correlation with offset wells, although it is still not a definitive boundary.

The unconformable nature of the contact at 519.4mMD RT is based on regional evidence only and is not able to be documented directly in Maclean-1.

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

Lithology

78.5 – 355mMD RT (276.5m) *Calcarenite, Calcsiltite and Calcilutite*
ROP range (average): 9-350 (89) m/hr

No Samples – Returns to Seafloor

355 – 519.4mMD RT (164.4m) *Argillaceous Calcilutite and Calcilutite with minor Marl and Calcarenite*
ROP range (average): 9-80 (38) m/hr

Calcilutite (20-100%): argillaceous, very light to medium light grey, very soft, amorphous, dispersive, 20-35% argillaceous matrix, grading to *Calcilutite*, trace very fine dark green glauconite grains, trace fine dark green disseminated glauconite and nodular glauconite, trace fine pyrite & coarse nodular pyrite.

Calcilutite: medium to light grey, soft, amorphous, argillaceous in part, trace shell fragments, forams, bryozoan fragments.

Marl: medium dark grey, very soft, dispersive, amorphous, 35-45% argillaceous matrix grading to *Argillaceous Calcilutite*, trace calcsilt, trace very fine dark green disseminated glauconite, trace fossil fragments and forams.

Calcarenite: pale yellowish-brown, light grey, firm-hard, argillaceous, trace glauconite grains.

3.3.2 Lakes Entrance Formation 519.4 – 582.6mMD RT (497.9 – 561.1mTVDSS)

True Vertical Thickness	63.2m
Age:	Late Oligocene-Early Miocene
Palynozone:	Not Defined
Depositional Environment:	Open Marine
Seismic Time:	0.513 Sec. TWT

The Lakes Entrance Formation consists of argillaceous calcilutite with abundant interbedded and gradational marl and calcareous claystone.

The Lakes Entrance Formation unconformably overlies the Middle Eocene Gurnard Formation at 582.6 mMDRT (-561.1 mTVDSS) and at a seismic time of 594msec TWT. The contact is defined by an increase in gamma ray response from 85 API units above 582.6mMD RT to 120-125 API units below, while the deep resistivity log (SEDP curve) exhibits an increase from 2 ohm-m above 582.6mMD RT to 3-5 ohm-m below. The indicated log changes reflect a lithology change from argillaceous calcilutite above 582.6 mMDRT to a glauconite-rich sequence of gradational claystone, very fine grained lithic sandstone, siltstone and greensand.

The unconformable nature of the contact at 582.6mMD RT is not able to be documented directly in Maclean-1 and is based on regional evidence only and by correlation with offset wells.

No direct biostratigraphic age dating was attempted in Maclean-1 through the Lakes Entrance Formation, however based on regional evidence the sequence is defined as being Late Oligocene to Miocene in age.

Lithology

519.4 – 582.6m (63.2m)

Argillaceous Calcilutite interbedded with Marl and Calcareous Claystone

ROP range (average): 17-118 (41) m/hr

Calcilutite (20-40%): argillaceous, very light to medium light grey, very soft, amorphous, dispersive, 20-35% argillaceous matrix, grading to *Marl*, trace fine dark green disseminated glauconite and nodular glauconite, trace fine pyrite.

Marl: light medium grey, very soft, dispersive, amorphous, 35-45% clay matrix grading to *Calcareous Claystone*, trace very fine dark green disseminated glauconite and coarse nodules, trace fossil fragments and forams.

Claystone: calcareous, medium grey to medium dark grey, minor dark greenish grey, soft, amorphous, dispersive, 15-35% calcareous matrix grading to *Marl*, trace very fine dark green disseminated glauconite, trace fossil fragments and forams, trace fine pyrite & coarse nodular pyrite.

3.3.3 Gurnard Formation

582.6 – 626mMD RT (561.1 – 604.5mTVDSS)

True Vertical Thickness

43.4m

Age:

Middle-Late Eocene

Palynozone:

Lower to Middle *N. asperus*

Depositional Environment:

Shallow marine

Seismic Time:

0.594 Sec. TWT

The Gurnard Formation consists of a complex lithological mix of mainly non-reservoir intergradational claystone, silty/glauconitic sandstone, siltstone and greensand. The silty sandstone is defined as being a lithic arkose containing feldspar, lithic grains, glauconite and mica. The sands also contain an abundant mix of detrital clay (5-10%) and authigenic clay (10-15%) matrix.

The sequence consists of a number of depositional cycles characterised mainly by coarsening-upward trends as defined by funnel-shaped gamma ray motifs, generally in the range of 90-130 API units. The most distinctive feature of the Gurnard Formation is a 6.5m thick radioactive interval of feldspathic sandstone at the base of the unit characterised by a gamma ray response >200 API units. The radioactivity is thought to occur in response to accessory zircon, tourmaline and titanium oxide identified petrographically within the same stratigraphic zone which occurred in the nearby Moby-1 well.

The Gurnard Formation unconformably overlies the Kingfish Formation at 626mMD RT (-604.5mTVDSS), at a seismic time of approximately 0.625 seconds TWT. The contact is well defined by the gamma ray curve which exhibits a decrease from >200API units above 626mMD RT to 120 API units below. There is no apparent change in the LWD resistivity response at 626.0 mMDRT.

The unconformable nature of the contact at 626 mMDRT is indirectly based upon palynological evidence in Maclean-1 and regional evidence by correlation with offset wells and is referred to herein as the Early Eocene Unconformity. This unconformity is documented directly in Maclean-1, whereby marine rocks assigned to the Lower *N. asperus* palynozone of Middle Eocene age, directly overlie non-marine rocks arguably assigned to a mixed assemblage of Eocene, reworked Early Cretaceous and possibly reworked Triassic palynomorphs, but older than Lower *N. asperus*. The most likely correlation is with the Early Eocene *Proteacidites asperopolus* Zone which has been recorded from similar sandstones immediately beneath the Gurnard Formation in the offset Moby-1, Flathead-1 and Patricia-1 wells.

Palynological age dating of sidewall core samples and drilled ditch cuttings over the gross interval 588-624 mMDRT throughout the Gurnard Formation, places this unit within the Lower and Middle *N. asperus* palynozone of Middle and Late Eocene age respectively.

Lithology

582.6 – 626m (43.4m)

Claystone with interbedded Sandstone, Siltstone and Greensand

ROP range (average): 5-111 (36) m/hr

Claystone (20-50%): medium to dark yellowish brown and greyish brown, dark brown grey to brown black in part, soft to slightly firm, amorphous to blocky, hard in part, 5-20% silt to very fine sandstone (vfl-fL) grading to *Silty Claystone*, trace well-rounded fine to coarse grained weathered (dusky brown) glauconite pellets, generally firm to hard (“pisolitic” glauconite), trace-10% fine to medium nodular dark green glauconite, trace rounded cemented “pisolitic” glauconite, trace nodular pyrite and rounded concretions.

Sandstone: lithic arkose, medium yellowish brown, dark brown grey, light grey, greyish green to brown black in part, firm, friable to soft, loose, very hard in part, very fine - fine (vfl-fL, dom. vfl), subangular-subrounded, lithic with up to 30% 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), non-calcareous, trace -10% sideritic and pyritic cement, variably glauconitic with trace-30% coarse patchy and pelletal glauconite, grading to *Glauconitic Sandstone*, poor inferred porosity, no fluorescence or cut.

Siltstone: medium to dark yellowish brown and greyish brown, dark brown grey to brown black, soft to firm, occasionally hard, quartz silt to very fine sand (silt-vfl), grading to *Arenaceous Siltstone*, non-calcareous, 10-25% detrital clay matrix grading to *Argillaceous Siltstone*, trace-10% fine to coarse glauconite, locally occurring in patches, trace-1% white mica.

Greensand: olive brown, dark yellowish green to dusky green, soft -firm, loose grains in part, very fine to coarse grained, trace nodular glauconite, trace -20% quartz sand and silt.

3.3.4 Kingfish Formation 626 – 644.6mMD RT (565.5 - 568mTVDSS)

True Vertical Thickness	20.6m
Age:	Late Paleocene to Early Eocene?
Palynozone:	L. balmei to P. asperopolus?
Depositional Environment:	Non-marine to shallow coastal marine
Seismic Time:	0.625 Sec. TWT

The Kingfish Formation, which formed the primary reservoir objective in Maclean-1, was interpreted to thicken significantly southwards and eastwards over the Maclean Prospect on the southern flank of the Flathead Anticline where good porosity and permeability with high net:gross was expected. The sequence encountered in Maclean-1 consists of interbedded claystone and sandstone with rare thin streaks of conglomerate and coal. The sandstone consisted of loose, coarse to very coarse and granular quartz, locally conglomeratic, poorly sorted with trace detrital clay matrix with very good inferred porosity. The sandstone interbed is 6m thick and defined by a fining-upward gamma ray motif within the middle part of the interval.

The Kingfish Formation conformably overlies the Grunter Member of the Kingfish Formation at 644.6 mMDRT (-623.1mTVDSS). The contact is well defined on LWD logs, with the gamma ray exhibiting a decrease from 140 API units above 644.6 mMDRT, to a variable 80-45 API units below, while the resistivity log (SEDP) curve exhibits no significant change at this depth.

Palynological analysis of drilled ditch cuttings from the interval 630-633 mMDRT, a zone of moderately high gamma ray, contained a poor assemblage of spore pollens and given their absence in the shallower samples down to 624 mMDRT. Consequently they are interpreted to represent a latest Early Eocene sequence. Based on comparison with similar sections from offset wells, the species identified in Maclean-1 is therefore assigned to the *P. asperopolus* Zone, although an older assignment to the Upper *Malvacipollis diversus* Zone cannot be excluded.

Lithology

626 – 644.6 (20.6m)

Interbedded Claystone and Sandstone with rare thin streaks of Conglomerate and Coal

ROP range (average): 6-53 (19) m/hr

Claystone (0-95%): white to very light grey, soft, dispersive, washing out in drilling mud, 5-10% silt to very fine sand dispersed through matrix, trace very fine carbonaceous grains.

Sandstone: clear-frosted, translucent, white and light to medium dark grey, loose, coarse to very coarse and granular (dom cU), conglomeratic in part, quartzose, angular (broken fragments) to well rounded, poorly sorted, trace argillaceous matrix coating grains, trace nodular pyrite and pyritic cement, trace lithics, trace rounded carbonaceous fragments, very good inferred porosity, no fluorescence or cut.

Conglomerate: clear-frosted, translucent, white and light to medium dark grey, loose, granular, quartzose, angular (broken fragments) to well rounded, poorly sorted, trace white argillaceous matrix coating grains, very good inferred porosity, no fluorescence or cut.

Coal: brownish black to black, soft to firm, brittle, fibrous, very fine to large fragments.

3.3.5 Grunter Member 644.6 – 667.2mMDRT (623.1 – 645.7mTVDSS)

True Vertical Thickness	22.6m
Age:	Paleocene
Palynozone:	Not defined
Depositional Environment:	Non-marine
Seismic Time:	Not defined

The Grunter Member of the Kingfish Formation consists of a sequence of conglomerate and interbedded sandstone. The sequence is characterised by a relatively uniform gamma ray response between 45 and 80 API units, while the resistivity response is high, erratic and variable which was very distinctive. This log response was seen to repeat between realtime and memory LWD data. It was predominantly loose and granular to gravel size and not very highly cemented suggesting the LWD resistivity tools were directly reading the quartz granules.

Recognition of this sequence as being equivalent to the Grunter Member of the Kingfish Formation is based on a similarity of log profile to the Grunter Member identified in Judith-1 and Admiral-1.

The Grunter Member of the Kingfish Formation overlies the Kate Shale with apparent conformity at 667.2 mMDRT (-645.7 mTVDSS). The formation boundary is well documented by a sharp increase in the gamma ray response from an average 60 API units above 667.2 mMDRT to 120-140 API units below. This log response is coincident with a lithology change from conglomerate above 667.2 mMDRT to silty claystone below.

No direct biostratigraphic age dating was attempted in Maclean-1, however it is considered to be Paleocene in age by correlation with offset wells.

Lithology

644.6 – 667.2m (22.6m) *Conglomerate with common to abundant interbedded Sandstone*
ROP range (average): 10-130 (28) m/hr

Conglomerate (40-80%): clear-frosted, translucent, white and light to medium dark grey, loose, granular, quartzose, angular (broken fragments) to well rounded, poorly sorted, trace white argillaceous matrix coating grains, very good inferred porosity, no fluorescence or cut.

Sandstone: clear-frosted, translucent, white and light to medium dark grey, loose, coarse to very coarse and granular (dom cU), conglomeratic in part, quartzose, angular (broken fragments) to well rounded, poorly sorted, trace argillaceous matrix coating grains, trace nodular pyrite and pyritic cement, trace lithics, trace rounded carbonaceous fragments, very good inferred porosity, no fluorescence or cut.

3.3.6 Kate Shale 667.2 – 671.6mMDRT (645.7 – 650.1mTVDSS)

True Vertical Thickness	4.4m
Age:	Paleocene
Palynozone:	Not defined
Depositional Environment:	Marine?
Seismic Time:	Not defined

The Kate Shale is identified solely on the basis of its stratigraphic position and by comparison of its LWD log character and profile with offset wells. The unit consists of white to very light grey claystone, but lacked the distinctive marine indicators such as glauconite which may have better supported the definition of this thin bed as the Kate Shale. Discussion by Partridge (Appendix 3) notes that the documentation of this thin bed in Maclean-1 represents the northern most occurrence of this marine transgression in the Gippsland Basin, yet seaward of the palaeoshoreline at the time of deposition.

The Kate Shale overlies the Volador Formation at 671.6 mMDRT (650.1 mTVDSS) with apparent conformity. The contact is well defined on LWD logs, with the GR exhibiting a decrease from 140 API units above 671.6 mMDRT to 50 API units below, while there is only a subtle change on the LWD resistivity curves.

There is no direct palynological age dating of samples from the Kate Shale in Maclean-1, however by virtue of stratigraphic correlation with offset wells, it directly overlies rocks of Late Cretaceous (Maastrichtian) age at 671.6 m MDRT. This is documented in Maclean-1 whereby drilled ditch cuttings from the interval 675-678 m MDRT immediately below the formation boundary in the uppermost part of the Volador Formation, are documented as belonging to the Upper *F. longus* palynozone of Late Maastrichtian age.

Lithology

667.2 – 671.6m (4.4m)	<i>Claystone</i> ROP range (average): 10-17 (13) m/hr
------------------------------	---

Claystone (100%): white to very light grey, soft, dispersive, washing out in drilling mud, 5-10% silt to very fine sand dispersed through matrix, trace very fine carbonaceous grains.

3.3.7 Volador Formation 671.6 – 692.3mMDRT (650.1 – 670.8mTVDSS)

True Vertical Thickness	20.7m
Age:	Late Cretaceous (Late Maastrichtian)
Palynozone:	Upper <i>F. longus</i>
Depositional Environment:	Non-Marine
Seismic Time:	Not defined

The Volador Formation consists of sandstone with rare thinly interbedded claystones and conglomerates. The sandstone is dominantly coarse grained quartzose, locally conglomeratic and occurs in a stacked sequence of both fining-upward and coarsening-upward depositional cycles with bell-shaped and funnel-shaped gamma ray motifs respectively. The sandstone units are separated by thin streaks of claystone.

The Volador Formation unconformably overlies the Late Cretaceous Kipper Formation (Emperor Sub-Group) at 692.3 mMDRT (-670.8 mTVDSS), at a seismic time of 0.695 seconds TWT. The contact is well defined on the LWD logs, with the gamma ray exhibiting an increase from 80 API units above 692.3 mMDRT to 110 API units below, while the resistivity curves (SEDP) exhibits a decrease from 10-20 ohm-m above 692.3 mMDRT to 3-4 ohm-m below. These log changes reflect a lithology change from dominantly quartzose sandstone above 692.3 mMDRT to a claystone dominant sequence below.

Recognition of the boundary at 692.3 mMDRT as an unconformity is directly based upon palynological evidence in Maclean-1 and regional evidence by correlation with offset wells and is referred to herein as the Seahorse/Longtom Unconformity of Late Cretaceous age. This unconformity is documented directly in Maclean-1, whereby rocks assigned to the Upper F. longus palynozone of Late Maastrichtian age, directly overlie rocks assigned to the P. mawsonii spore pollen zone of Turonian age.

Palynological analysis of drilled ditch cuttings from the interval 675-768 mMDRT, was dominated by the angiosperm pollen assemblage and is confidently assigned to the Upper F. longus Zone.

Lithology

671.6-692.3m (20.7m): *Sandstone with rare to common interbedded Claystone and Conglomerate*
ROP range (average): 8-104 (30) m/hr

Sandstone (10-40%): clear-frosted, translucent, white and light to medium dark grey, loose, coarse to very coarse and granular (dom cU), conglomeratic in part, quartzose, angular (broken fragments) to well rounded, poorly sorted, trace argillaceous matrix coating grains, trace nodular pyrite and pyritic cement, trace lithics, trace rounded carbonaceous fragments, very good inferred porosity, no fluorescence or cut.

Claystone: white to very light grey, soft, dispersive, washing out in drilling mud, 5-10% silt to very fine sand dispersed through matrix, trace very fine carbonaceous grains.

Conglomerate: clear-frosted, translucent, white and light to medium dark grey, loose, granular, quartzose, angular (broken fragments) to well rounded, poorly sorted, trace white argillaceous matrix coating grains, very good inferred porosity, no fluorescence or cut.

3.3.8 Kipper Shale (Emperor Sub-Group) 692.3 - 766mMDRT (670.8 - 744.5mTVDSS)

True Vertical Thickness	73.7m+
Age:	Late Cretaceous (Turonian)
Palynozone:	P. mawsonii
Depositional Environment:	Non-Marine
Seismic Time:	0.695 Sec TWT

Penetration of the Kipper Shale was not predicted or expected based upon the location of the well in proximity to other wells that had intersected the otherwise prognosed Strzelecki Group of sediments. The Kipper Shale consists of claystone with rare thin interbedded

sandstone and trace coal. The sequence is characterised by a relatively uniform GR response, varying between 95 and 150 API units (average 110 API units).

Palynological age dating of drilled ditch cuttings over the gross interval 699-762m contained a spore dominated assemblage that are assigned to the *P. mawsonii* Zone of Late Cretaceous (Turonian) age.

Maclean-1 reached a total depth within the Kipper Shale (Emperor Sub-Group) at a depth of 766 mMDRT (-744.5 mTVDSS). This is just 5m above the original programmed total depth of the well.

Lithology

692.3-766m (73.7m): *Massive Claystone with rare interbedded Sandstone and trace Coal*
ROP range (average): 8-97 (26) m/hr

Claystone (90-100%): light grey to brownish-grey, soft, dispersive, washing out in drilling mud, 5-10% quartz silt to very fine quartz, dispersed through matrix, trace very fine carbonaceous grains.

Sandstone: clear-frosted, translucent, white and light to medium dark grey, loose to very rarely cemented fragments, fine to medium (fU-mL), poorly sorted, trace argillaceous matrix cementing grains, trace nodular pyrite and pyritic cement, trace lithics, no fluorescence or cut.

Coal: brownish black to black, soft to firm, brittle, fibrous, very fine to small fragments.

3.4 STRUCTURE AND SEAL

The Maclean-1 exploration well is located at GAP04A Inline 2466 Xline 1255 of the Moby 3D Seismic Survey. It was designed to test a downthrown fault closure on the southern flank of the Flathead Anticline, with a wedge of Halibut Subgroup reservoir on the downthrown side of the fault.

The existence of an amplitude anomaly within the Gurnard Formation near the culmination of Maclean suggests it may be gas bearing there, although the anomaly is not present at the well location. This is considered to be due to the Gurnard Formation being non-reservoir at the well location. The amplitude anomaly does not extend significantly laterally or downdip over Maclean.

The stratigraphic section encountered in Maclean-1 was essentially as predicted pre-drill, with all of the formation tops encountered slightly high to prognosis, except for the penetration of Late Cretaceous (Turonian) rocks assigned to the Emperor Sub-Group (Kipper Shale), sub-cropping the Volador Formation.

Faulting is clearly evident cutting the primary objective Kingfish Formation level (Figure 6), which may provide the only viable explanation of why no hydrocarbons were trapped in Maclean-1. The Maclean-1 well is located on a migration pathway from the deeper parts of

the Gippsland Basin as supported by the occurrence of hydrocarbons higher on the Flathead Anticline.

A post-drill structural interpretation of the Maclean-1 fault block is included as Figures 5 and 6 and a post-drill interpretation of the 3D seismic Inline 2466 through the Maclean-1 well is included as Figure 7.

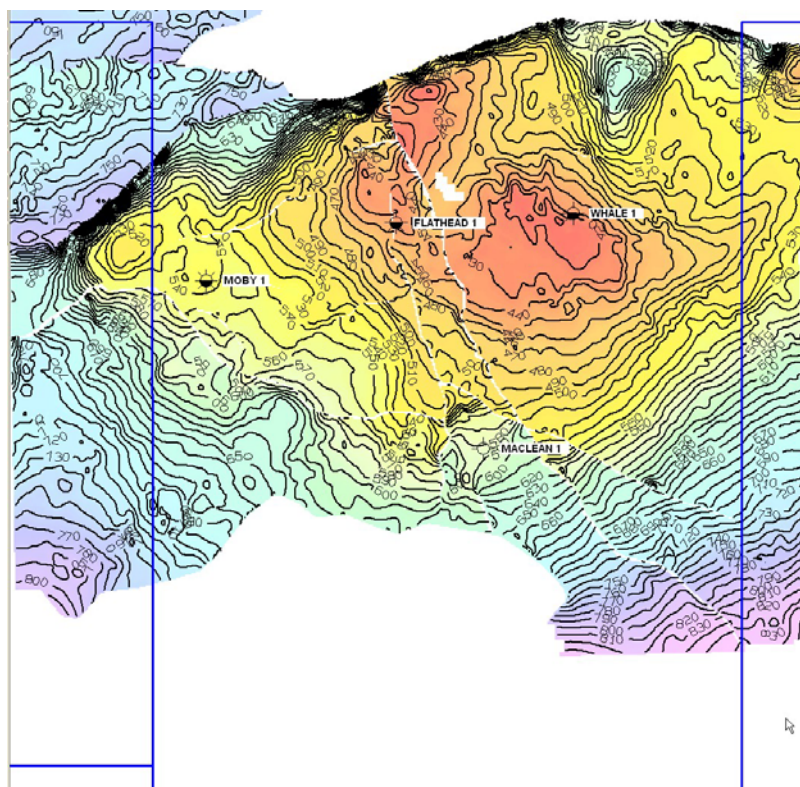


FIGURE 5: POST-DRILL STRUCTURAL INTERPRETATION OF MACLEAN FAULT BLOCK AT NEAR TOP GURNARD FORMATION

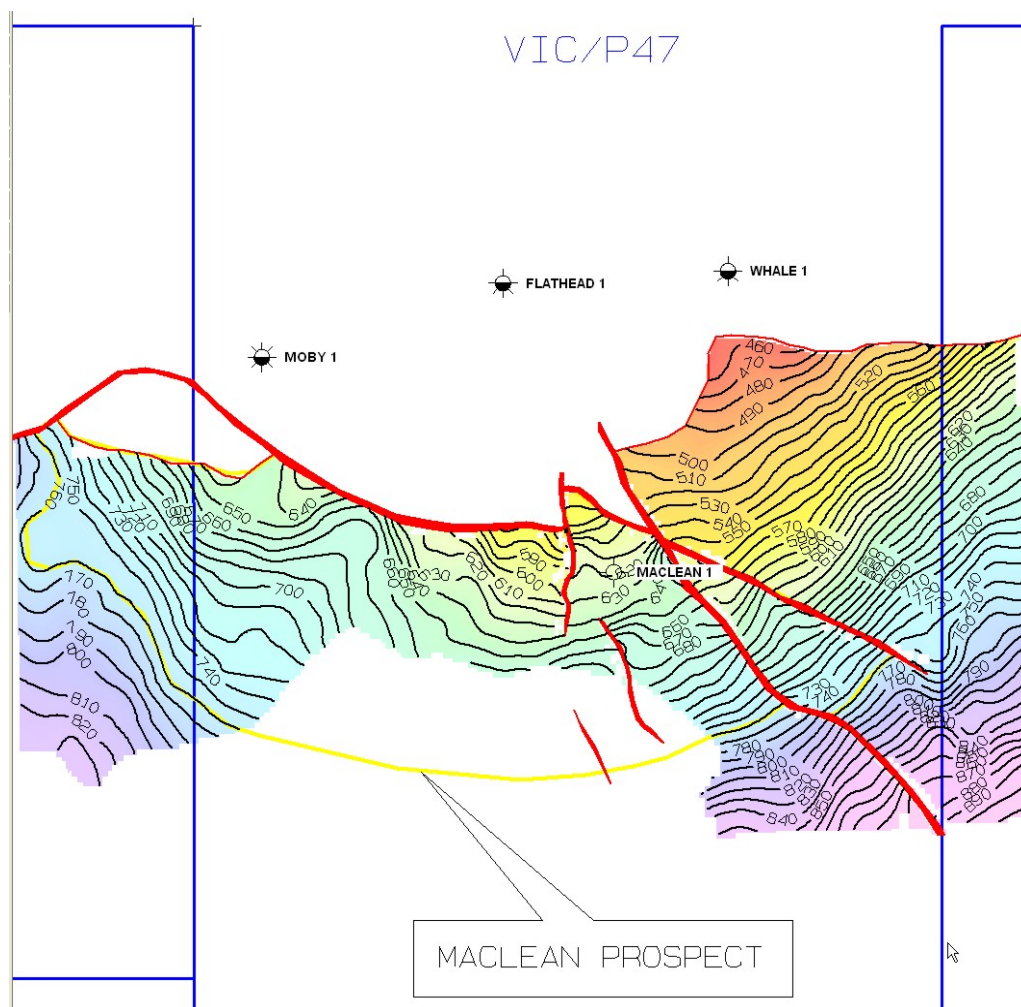


FIGURE 6: POST-DRILL STRUCTURAL INTERPRETATION OF MACLEAN FAULT BLOCK AT TOP KINGFISH FORMATION

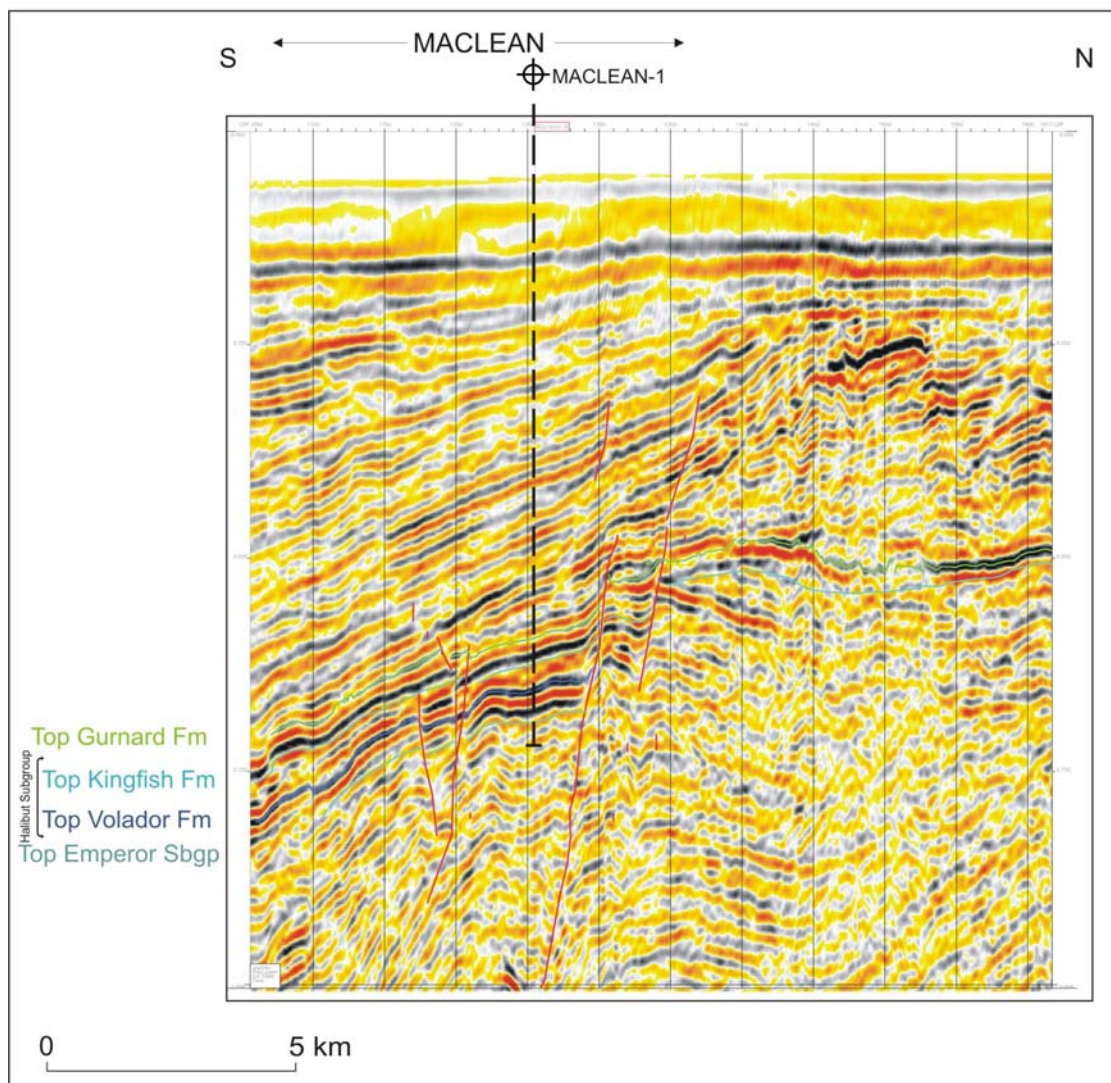


FIGURE 7: POST-DRILL INTERPRETATION OF 3D SEISMIC LINE INLINE 2466 HIGHLIGHTING MACLEAN-1 LOCATION

3.5 SOURCE AND MIGRATION

Maclean-1 failed to encounter any evidence of hydrocarbons.

Maclean-1 is located on the flank of a structural closure on which three earlier wells, namely Flathead-1, Whale-1 and Moby-1 were drilled on the crest of the same structure, and which also recorded hydrocarbons. Maclean-1 is interpreted to have been well located to receive hydrocarbons from deeper kitchens to the south.

3.6 RELEVANCE TO THE OCCURRENCE OF HYDROCARBONS

3.6.1 Gas Readings

During the drilling of Maclean-1, a continuous record of ditch gas was made using an automatic FID total gas and chromatograph detector. Ditch gas readings are summarised in Table 3 below. No cuttings gas analyses or headspace gas analyses were undertaken.

Total gas, chromatographic breakdown of the ditch gas and trip gas was recorded from 355.0m to 766.0m MDRT throughout the 311mm (12 1/4") hole section using the GeoServices Reserval Gas System. Trace to minor amounts of total gas, consisting of minor amounts of methane (C₁) and trace amounts of ethane (C₂), propane (C₃), iso-butane (iC₄) and n-butane (nC₄), were recorded with the first drilling returns in the 311mm (12 1/4") hole section, starting at 355.0m MDRT and continuing to 520.0m MDRT. Average background gas through this interval was 0.08% total gas with a maximum of 0.2% total gas. Background gas levels increased slightly below 520.0m MDRT, fluctuating between 0.11% and 0.82% total gas until total depth was reached at 766.0m MDRT. The readings on this deeper gas showed minor amounts of C₁ with trace amounts of C₂ to C₅. The maximum total gas recorded in Maclean-1 was 1.88% at 590.5m MDRT in the Gurnard Formation, consisting of 13,598ppm C₁, 1ppm C₂, 1ppm C₃, 12ppm iC₄, 4ppm nC₄ and 3ppm iC₅ and 1ppm nC₅.

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

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
355-520	0.08	686	2	1	1	1	0	0
520-584	0.37	3695	2	2	2	0	0	0
584-630	0.82	6419	1	1	4	2	2	2
630-672	0.28	2298	2	2	7	0	0	0
672-708	0.13	1333	5	1	6	2	4	0
708-766	0.16	1411	1	1	6	1	6	0

Table 2. Summary of Gas Readings Recorded for All Lithology Intervals

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 Maclean-1. No sample shows were recorded in cuttings in Maclean-1.

3.7 FORMATION EVALUATION

3.7.1 Borehole Temperature Data

There were no temperature surveys run in Maclean-1 and no wireline logs were run at total depth to record borehole temperature. Circulating temperatures were measured by the LWD tools used while drilling, the details of which are included in Appendix 4 of the Maclean-1 Well Completion Report (Basic Data).

LWD Run	End Depth (mMD)	BHT Circ. Temp °C
1	355	20
1	766	45

Based on these figures, there is an apparent 25°C increase in circulating temperature between the two bit runs as recorded by LWD tools over an interval of 411mMD. It may be valid to equate this temperature increase to the present day geothermal gradient, which results in a calculated gradient of 6.08°C/100m, a figure which is consistent with data from offset wells.

3.7.2 Wireline Testing

No wireline testing was performed in Maclean-1

3.7.3 DST Testing

No drill stem test was performed on Maclean-1.

3.7.4 Porosity, Permeability and Formation Fluids

No wireline or LWD porosity logs were acquired in Maclean-1, consequently any evaluation of porosity and permeability is qualitative only based on rate of penetration (ROP), resistivity separation on the LWD resistivity curves and evaluation of ditch cuttings through potential reservoir intervals.

The Gurnard Formation (582.6-626 m MDRT) was not a reservoir objective in Maclean-1, despite being a gas-bearing reservoir in the nearby Moby-1 well and in the adjacent Patricia-Baleen Gas Field. The absence of any seismic amplitude anomaly occurring within the Gurnard Formation at the well location itself was interpreted to be a result of poor reservoir potential and the likelihood of a clay-prone facies. The Gurnard Formation in Maclean-1 consists of a complex lithological mix of mainly non-reservoir intergradational claystone, silty/glauconitic sandstone, siltstone and greensand. The maximum total gas recorded in Maclean-1 was 1.88% at 590.5m MDRT in the upper part of the Gurnard Formation associated with siltstone and consisting of 13,598ppm C₁, 1ppm C₂, 1ppm C₃, 12ppm iC₄, 4ppm nC₄ and 3ppm iC₅ and 1ppm nC₅. However there was no resistivity anomaly associated with this measurement, suggesting that the interval is water-bearing, although minor gas saturation may occur.

The Kingfish Formation (626.0 – 667.2 m MDRT) formed the primary reservoir objective in Maclean-1 which was interpreted to thicken significantly southwards and eastwards over the Maclean Prospect on the southern flank of the Flathead Anticline. This sandstone reservoir has good porosity and permeability and is the main producing reservoir of the Gippsland Basin oil and gas fields. The Kingfish Formation reservoirs, which are now known to be predominantly absent on the shallow areas of the Flathead Anticline and in the Moby-1, Flathead-1 and Whale-1 wells, was found to consist of quartzose sandstone with interbedded claystone and rare thin streaks of conglomerate over the interval 626.0-644.6 mMDRT. The sandstone is coarse to very coarse and slightly conglomeratic with inferred good porosity. Net to gross of apparent porous sandstone over this interval is approximately 30%. Some invasion (permeability) is indicated at 635-639 mMDRT from a large resistivity separation, but which actually has low resistivity (~ 5ohm.m).

The lower part of the Kingfish Formation (644.6 – 667.2 mMDRT) is herein defined as the Grunter Member. The interval consists almost entirely of poorly to weakly cemented conglomerate with inferred fair to good porosity. The conglomerate produced extremely high and erratic readings on the LWD resistivity log which was very distinctive. This log response was seen to repeat in the memory data once the tools had been downloaded. It was predominantly loose and granular to gravel size and not very highly cemented suggesting the LWD tools were directly reading the quartz granules. The absence of anomalous gas readings while drilling suggests that the entire Kingfish Formation is 100% water-wet.

The Volador Formation (671.6 – 692.3 mMDRT) was a secondary objective in Maclean-1 which is known to pinch out on the southeastern flank of the Flathead Anticline. This sandstone reservoir has known good porosity and permeability in offset wells. A significant thickening of the Volador Formation occurs eastwards across the Maclean structure and was the reason for locating Maclean-1. The sequence consists predominantly of coarse to very coarse and conglomeratic quartzose sandstone, with rare thin streaks of conglomerate and interbedded claystone. The sandstone has fair to very good inferred porosity, however there was no evidence of anomalous hydrocarbons detected while drilling and no resistivity

anomalies are evident on the LWD logs except for apparent spikes associated with the thin conglomerate bands. Consequently, the Volador Formation is interpreted to be 100% water-wet.

The Emperor Sub-Group (Kipper Shale) (692.3 - 766 mMDRT) consists of a thick sequence of claystone with rare thin streaks of sandstone and coal. The interval is interpreted to be 100% water saturated.

A Petrophysical Evaluation of Maclean-1 is included herein as Appendix 2.

3.7.5 Geochemical Analysis

No geochemical analyses were performed on samples from Maclean-1.

3.8 CONCLUSIONS AND CONTRIBUTIONS TO GEOLOGICAL KNOWLEDGE

- ❖ The stratigraphic section encountered in Maclean-1 was essentially as predicted with all of the formation tops including the primary and secondary reservoir objectives intersected slightly high to prognosis. The only exceptions to prognosis were:
 - Difference in water column; 57m compared to 73m predicted and;
 - Recognition of the Grunter Member of the Kingfish Formation and;
 - Recognition of the Kate Shale and;
 - Penetration of the Emperor Sub-Group (Kipper Shale) in place of the Strzelecki Group, sub-cropping the Volador Formation.
- ❖ The primary objective Paleocene to Early Eocene Kingfish Formation was intersected at 626.0 mMDRT (-604.5 mTVDSS), 13.5m high to prediction and consists of quartzose sandstone with interbedded claystone and thin streaks of conglomerate.
- ❖ Documentation of the Kate Shale occurring over the interval 667.2-671.6 mMDRT represents the northern most occurrence of this thin marine unit in the offshore Gippsland Basin
- ❖ The secondary objective Late Maastrichtian Volador Formation was intersected at 671.6 mMDRT (-650.1 mTVDSS), 7m high to prediction and consists of coarse grained quartzose sandstone with interbedded claystone and rare thin streaks of conglomerate.
- ❖ The evaluation of LWD gamma ray/resistivity logs, ditch cuttings and absence of anomalous hydrocarbon shows while drilling, indicated all potential reservoir zones within the primary and secondary targets are 100% water-wet.
- ❖ Maclean-1 probably failed to encounter hydrocarbons as a result of a lack of fault seal.
- ❖ The well reached TD within the Late Cretaceous Emperor Sub-Group (Kipper Shale) at 766 mMD RT (-744.5 mTVDSS), 5 metres above the originally programmed total depth of the well. The well was subsequently plugged and abandoned as a dry hole with no evidence of hydrocarbons.

4. REFERENCES

- Duddy, I.R. & Green, P.F., 1992.** Tectonic development of Gippsland Basin and environs: identification of key episodes using Apatite Fission Track Analysis (AFTA). In C.M. Barton, K. Hill, C. Abele, J. Foster & N. Kempton (Eds) *Energy, Economics and Environment – Gippsland Basin Symposium*, Australian Institute of Mining and Metallurgy, pp. 111-120.
- Hill, P.J., Exon, N.F., Keene, J.B. & Smith, S.M., 1998.** The continental margin off east Tasmania and Gippsland: structure and development using new multibeam sonar data, *Exploration Geophysics*, 29, pp. 410-419.
- Hocking, J.B., 1998.** Gippsland Basin. In Douglas, J. G. & Ferguson, J. A. (Eds) *Geology of Victoria*, Victorian Division Geological Survey Australia Inc., Melbourne, pp. 322-347.
- Megallaa, M., Bernecker, T. And Frankel, E., 1998.** Hydrocarbon prospectivity of the Northern Terrace, offshore Gippsland Basin, for the 1998 Acreage Release. Victorian Initiative for Minerals and Petroleum Report 56. Department of Natural Resources and Environment.
- Moore, D.H. & Wong, D., 2001.** Down and out in Gippsland: Using potential fields to look deeper and wider for new hydrocarbons. In Hill, K.C. & Bernecker, T. (Eds) *Eastern Australian Basins Symposium, A Refocused Energy Perspective for the Future*, Petroleum Exploration Society of Australia, Special Publication, pp. 363-371.

Norvick, M. & Smith, M.A., 2001. Mapping the plate tectonic reconstructions of southern and southeastern Australia and implications for petroleum systems. *The Australian Petroleum Production and Exploration Association Journal*, **41 (1)**, pp. 15-35.

Norvick, M.S., Smith, M.A. & Power, M.R., 2001. The plate tectonic evolution of eastern Australasia guided by the stratigraphy of the Gippsland Basin. In Hill, K.C. & Bernecker, T. (Eds) *Eastern Australasian Basins Symposium, A Refocused Energy Perspective for the Future*, Petroleum Exploration Society of Australia, Special Publication, pp. 15-23.

Partridge, A.D., 1999. Late Cretaceous to Tertiary geological evolution of the Gippsland Basin, Victoria. PhD-thesis, *La Trobe University, Bundoora, Victoria*, 439p (unpublished).

Power, M.R., Hill, K.C., Hoffman, N., Bernecker, T. & Norvick, M., 2001. The structural and tectonic evolution of the Gippsland Basin: Results from 2D section balancing and 3D structural modelling. In Hill, K.C. & Bernecker, T. (Eds) *Eastern Australasian Basins Symposium, A Refocused Energy Perspective for the Future*, Petroleum Exploration Society of Australia, Special Publication, pp. 373-384.

Rahmanian, V.D., Moore, P.S., Mudge, W.J. & Spring, D.E., 1990. Sequence stratigraphy and the habitat of hydrocarbons, Gippsland Basin. In: Brook S, J. (ed.), *Classic Petroleum Provinces*, Geological Society Special Publication No. 50, pp. 525-541.

Thomas, H., Bernecker, T. & Driscoll, J., 2003. Hydrocarbon Prospectivity of Areas V03-3, V03-4 - Offshore Gippsland Basin, Victoria, Australia. 2003 Acreage Release. *Victorian Initiative for Minerals and Petroleum Report 80*. Department of Primary Industries.

Willcox, J.B., Colwell, J.B., & Constantine, A.E., 1992. New ideas on Gippsland Basin regional tectonics. In Barton C.M., Hill, K., Abele, C. Foster, J. & Kempton, N. (Eds) *Energy, Economics and Environment – Gippsland Basin Symposium*, Australasian Institute of Mining and Metallurgy, pp. 93-110.

Willcox, J.B., Sayers, J., Stagg, H.M.J. & Van De Beuque, S., 2001. Geological framework of the Lord Howe Rise and adjacent ocean basins. In Hill, K.C. & Bernecker, T. (Eds) *Eastern Australasian Basins Symposium, A Refocused Energy Perspective for the Future*, Petroleum Exploration Society of Australia, Special Publication, pp. 211-225.

Wong D., Bernecker T. & Moore D., 2001. Otway Basin. In: Woollands, M.A. & Wong, D., (eds.), *Petroleum Atlas of Victoria, Australia*. Department of Natural Resources and Environment

APPENDIX 1

Well Card

Well Card: Maclean-1

Location	Latitude	38 ^o 02' 46.32" S		Participating Interests		
	Longitude	148 ^o 32' 52.92" E		Bass Strait Oil Company Ltd (Operator)		40%
	UTM Co-ordinates	635,831.9 mE 5,787,927.9 mN		Eagle Bay Resources NL		25%
	Datum	MGA 94		Moby Oil & Gas Limited		35%
	Elevation	+21.5 m				
	Water Depth	57.0 m (MSL)				
Permit	VIC/P47			Primary Objective		Kingfish Fm
Rig on Contract	14:00 Hrs 14 th October 2005			Secondary Objective		Volador Fm
Spudded	03:30 Hrs 16 th October 2005					
Reached T.D.	06:00 Hrs 20 th October 2005			Completion Details/Plugs		
Rig Released	18:30 Hrs 22 nd October 2005			Plug # 1a	766 – 666 m	62.4 bbls of 15.8 ppg Class G
Structure Type		Dowthrown Fault Closure		Plug # 1b	666 – 566 m	62.4 bbls of 15.8 ppg Class G
Rig	DOGC Semi-Submersible	"Ocean Patriot"		Plug # 2	400 – 300 m	65 bbls of 15.8 ppg Class G
				Plug# 3	150 – 100 m	26 bbls of 15.8 ppg Class G
Status	P & A			Casing Details		
Hole Size (mm)	914	445	311	Size (mm)	Wt (ppf)	Depth (m)
Depth (m)	112.0	355.0	766	508 x 762	133 x 330	110.9
Hole Size (mm)				340	68	350.0
Depth (m)						
Total Depth	766.0mMD		744.5 mTVDSS			

Formation	Depth (mMDRT)	Depth (mTVDSS)	Thickness (m)	TWT (ms)	Remarks
Gippsland Limestone (Seafloor)	78.5	57.0	440.9	76	Seafloor
Lakes Entrance Fm	519.4	497.9	63.2	513	LWD
Gurnard Fm	582.6	561.1	43.4	594	LWD
Kingfish Fm	626.0	604.5	18.6	625	LWD
Grunter Mbr	644.6	623.1	22.6		LWD/Palynology
Kate Shale	667.2	645.7	4.4		LWD/Palynology
Volador Fm	671.6	650.1	20.7	-	LWD/Palynology
Emperor S/G (Kipper Shale)	692.3	670.8	73.7+	695	LWD/Palynology
TOTAL DEPTH	766.0	744.5	-	744	TD

WIRELINE LOGGING SUMMARY

RUN	TOOL STRING	INTERVAL (M)	BHT (C)/TIME SINCE CIRC.	PLAYBACK SCALES
NO WIRELINE LOGGING WAS CARRIED OUT				

CORE SUMMARY

Core	Interval	Cut	Recovered	%
NO CONVENTIONAL CORES WERE CUT				

SIDEWALL CORES

SWC No.	DEPTH (mRT)	REC (cm)	Actual Lithology	SWC No.	DEPTH (mRT)	REC (cm)	Actual Lithology
NO SIDEWALL CORES WERE TAKEN							

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 Gilbert-1A location by two AHSVs ("Far Grip" & "Pacific Wrangler"). Maclean-1 operations commenced at 14:00 Hrs on the 14th October 2005. Positioning the rig on location was completed and the rig was ballasted down to drilling draft. The final location for Maclean-1 was confirmed as being 4.1m from the proposed location on a bearing of 336.7° True. The final fix for Maclean-1 was:

Latitude: 38° 02' 46.32" S

Longitude: 148° 32' 52.92" E

Easting: 635,831.9 mE

Northing: 5,787,927.9 mN

DATUM: MGA 94

The TGB was run and landed at 78.5 mMDRT. The 914 mm (36") BHA was made up and run in hole with the ROV assisting through the TGB and tagged the seafloor at 78.5 mMDRT corrected to Mean Sea Level (MSL). The water depth at Mean Sea Level was recorded as 57.0 m, with a drill floor elevation of 21.5m. The well was spudded at 03:30 Hrs on the 16th October 2005 with a 914 mm (36") hole drilled from seafloor (78.5 mMDRT) to a depth of 112.0 mMDRT. The 762 mm (30") casing was run and cemented with 758.8 sacks (160.8 bbls) of cement slurry (15.8 ppg).

The 445mm (17 ½") BHA was made up and run in hole. This BHA included 203mm (8") MWD/LWD tools that consisted of directional-DGR-EWR_P4-PM sensors. The cement and shoetrack were drilled out and the 445 mm (17 ½") hole was drilled to 355.0 mMDRT. A wiper trip was carried out to the shoe and the BHA was pulled out from TD once the hole was circulated clean. The casing handling equipment was rigged up and the 340 mm (13 3/8") casing was run and set at 350.0 mMDRT. The BOP handling equipment was prepared and the BOP's and riser were run and landed and pressure tested.

The 445 mm (17 ½") BHA was laid down and the 311mm (12 ¼") bit and BHA were made up and run in hole. This BHA also included 203mm (8") MWD/LWD tools that consisted of directional-DGR-EWR_P4-PM sensors. The top of cement was tagged at 314.0 mMDRT and the cement and shoetrack were drilled out down to 358.0 mMDRT. The well was displaced to KCL/PHPA mud and a FIT was conducted to 1.66 sg EMW @ 358.0 mMDRT.

The 311 mm (12 ¼") hole was drilled ahead to 766.0 mMDRT. TD was reached at 06:00 hrs on the 20th October 2005. The well was determined to be a dry-hole and wireline logging was cancelled. Pulling out of hole with the

BHA commenced immediately and following some circulation at the casing shoe the BHA was pulled out of hole to surface and the LWD tools downloaded on the deck.

The P & A program began at 06:30 hrs on the 20th October 2005.

Open-ended 127mm (5") drill pipe was picked up and run in hole to 766 mMDRT and 62.4 bbls of 15.8 ppg Class G cement slurry was pumped, setting Plug#1a from 766.0 mMDRT to 666.0 mMDRT. The pipe was pulled out of hole slowly to 666 mMDRT and 62.4 bbls of 15.8 ppg Class G cement slurry was pumped setting Plug#1b from 666.0 mMDRT to 566.0 mMDRT. The pipe was pulled out slowly and 65 bbls of 15.8 ppg Class G cement slurry was pumped, setting cement Plug#2 from 400.0 mMDRT to 300.0 mMDRT.

A 340 mm (13 3/8") bridge plug was picked up and run in hole to set at 150 mMDRT as per Dowell instructions. The bridge-plug was then pressure-tested to 1000 psi. The pipe was pulled out of hole and then 26.0 bbls of 15.8 ppg Class G cement slurry was pumped, setting cement Plug#3 from 150.0 mMDRT to 100.0 mMDRT.

The wellhead jetting tool and wear bushing retrieval tool were picked up and run in hole to jet the stack and wellhead. The wear bushing retrieval tool was landed and pulled out of hole. The riser and BOPs were pulled and secured. The 508 mm x 762 mm (20" x 30") spear and cutting assembly was picked up and run in hole stabbing into 18 3/4" wellhead to cut the 508 mm (20") casing. This was pulled out of hole with the casing stub and housing. The spear was re-dressed and RIH, stabbing into the 762mm (30") housing and cutting it.

Anchor handling operations commenced at 05:00 Hrs on the 22nd October 2005. The last anchor was racked at 18:30 Hrs on the 22nd October 2005 and the rig released to Apache. Total time on the Maclean-1 location was 8.2 days.

GEOLOGICAL SUMMARY

Maclean-1 was spudded at 03:30 hrs on the 16th October 2005 and penetrated a sedimentary section ranging in age from Tertiary to Late Cretaceous (Turonian). The stratigraphic section encountered was essentially as predicted with all of the formation tops slightly high to prognosis. A comparison of the Actual and Predicted section drilled in Maclean-1, including a brief summary of drilling and formation evaluation data is included in Enclosure 2. 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 78.5 mMDRT (-57.0 mTVDSS), the upper part of which down to a depth of 355.0 mMDRT was drilled riserless in the 914mm (36") and 445mm (17 1/2") hole sections. Intermediate 340mm (13 3/8") casing was subsequently run to 350.0 mMDRT and the BOPs and marine riser nipped up, below which 311mm (12 1/4") hole was drilled to 766.0 mMDRT. The main hole sections to total depth were not wireline logged after reaching TD.

The lower part of the Gippsland Limestone below 355.0 mMDRT consists of argillaceous calcilutite with minor calcarenite, marl and argillaceous calcisiltite. The base Gippsland Limestone/Top Lakes Entrance Formation is identified at 519.4 mMDRT (-497.9 mTVDSS). It was encountered 4.5 metres high to prognosis, based upon LWD logs. The Oligocene to early Miocene Lakes Entrance Formation consists of argillaceous calcilutite with interbedded and gradational marl and calcareous claystone.

The Middle Eocene Gurnard Formation was intersected at 582.6 mMDRT (-561.1 mTVDSS), 21.9 m high to prediction and consists of argillaceous and silty sandstone, siltstone with minor greensand and claystone. All lithologies contain trace to common glauconite.

The Early Eocene Kingfish Formation was intersected at 626.0 mMDRT (-604.5 mTVDSS), 12.5m high to prognosis. This interval which is 23.0 m thick consists of interbedded claystone, sandstone and rare, thin streaks of granular "conglomerate" with traces of coal. The Grunter Member of the Kingfish Formation, which was not prognosed, was intersected at 644.6 mMDRT (-623.1 mTVDSS) and consists of conglomerate with interbedded sandstone. The "conglomerate" produced extremely high and erratic readings on the LWD resistivity log which was very distinctive. This log response was seen to repeat in the memory data once the tools had been downloaded. It was predominantly loose and granular to gravel size and not very highly cemented suggesting the LWD tools were directly reading the quartz granules.

The Early Paleocene Kate Shale, which was also not prognosed, was intersected at 667.2 mMDRT (-645.7 mTVDSS) and consists predominantly of slightly silty and carbonaceous claystone. This formation rests unconformably on the Late Cretaceous (Late Maastrichtian) Volador Formation of the Halibut Subgroup which was intersected at 671.6 mMDRT (-650.1 mTVD SS), 6.9 m high to prognosis. This interval which is 20.7 m thick, consists of interbedded claystone, sandstone and "conglomerate", rests unconformably on the Late Cretaceous (Turonian) Emperor Subgroup (Kipper Shale) at 692.3 mMDRT (-670.8 mTVDSS). The Emperor Subgroup at

Maclean-1 consists of predominantly claystone with very minor fine-medium grained sandstone stringers.

There were no hydrocarbon shows in the form of fluorescence, neither direct UV fluorescence nor solvent cut fluorescence recorded during the drilling of Maclean-1. Gas levels were low throughout and dominantly C₁.

The well reached TD within the Emperor Subgroup (Kipper Shale), not the anticipated Strzelecki Group at 766 mMDRT (-744.5 mTVDSS), which was reached at 06:00 Hrs on the 20th October 2005. No wireline logs were run and the well was plugged and abandoned as a dry hole. Evaluation of the LWD data in combination with the total absence of hydrocarbon shows while drilling indicates all potential reservoir sands are 100% water wet.

Final total depth was 766.0 mMDRT (-744.5 mTVDSS). This is 5 metres above the originally programmed total depth of the well.

Maclean-1 was plugged and abandoned as a dry-hole and the rig released at 18:30 hrs on the 22nd October 2005. A composite well log of the lithology intersected in Maclean-1 is included as Enclosure 1.

APPENDIX 2

Petrophysical Report

By The Saros Group Pty Ltd

Petrophysics

Maclean-1

Prepared for:

Bass Strait Oil Company Ltd

CONFIDENTIAL

The Saros Group Pty Ltd
Petroleum Services
46 Princess Rd.
CLAREMONT WA 6010


Dr. Paul Theologou
April, 2006



All interpretations are opinions based on inferences from electrical, core, fluid or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretations, and we shall not except in the case of gross or willful negligence on our part be liable or responsible for any loss costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by the authors of this report.

DOCUMENT ISSUE APPROVAL

Project and Document No:	BSO04
Document Version	Version 1
Date	19/09/2006
Title	Petrophysics Maclean-1
Client	Bass Strait Oil Company Ltd
Document Name	Maclean-1 Petrophysics FINAL.doc

	Name	Position	Signature	Date
Prepared by:	Paul Theologou	Petrophysicist		13th April 2006
Reviewed by:	Ian Reid	Technical Advisor		

DISTRIBUTION

Organisation	Attention	Copy Nos.	Comment	Actioned
Bass Strait Oil Company Ltd	Ian Reid	1	Draft	16/4/06

TABLE OF CONTENTS

INTRODUCTION4

DATA AVAILABILITY AND QUALITY4

Drilling & Mudlog Data 4

MWD/LWD Data 5

Wireline Log Data 5

Formation Test Data 5

Core Data 5

DISCUSSION5

TABLES

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

FIGURES

Figure 1. Mudlog over the Gurnard Formation and Kingfish Formations showing lack of hydrocarbon shows.

Figure 2. Comparison of LWD GR-RES data and Mudlog data from Maclean-1.

INTRODUCTION

Maclean-1 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.

- Determine reservoir quality in the Kingfish and Volador formations.
- Sample and identify any oil pay in the Kingfish Formation and Volador Formation and measure its characteristics in order to determine likely well initials.

DATA AVAILABILITY AND QUALITY

Drilling & Mudlog Data

Maclean-1 was spudded on the 16th October 2005 and was drilled with an 12¼" bit over the reservoir intervals to a total depth of 766 mRT within the Emperor Sub-Group. Cuttings were recovered and described from the top of the 12 ¼" hole section at 355m mRT until TD. No shows were observed whilst drilling, and recorded gas readings were at background levels (Figure 1).

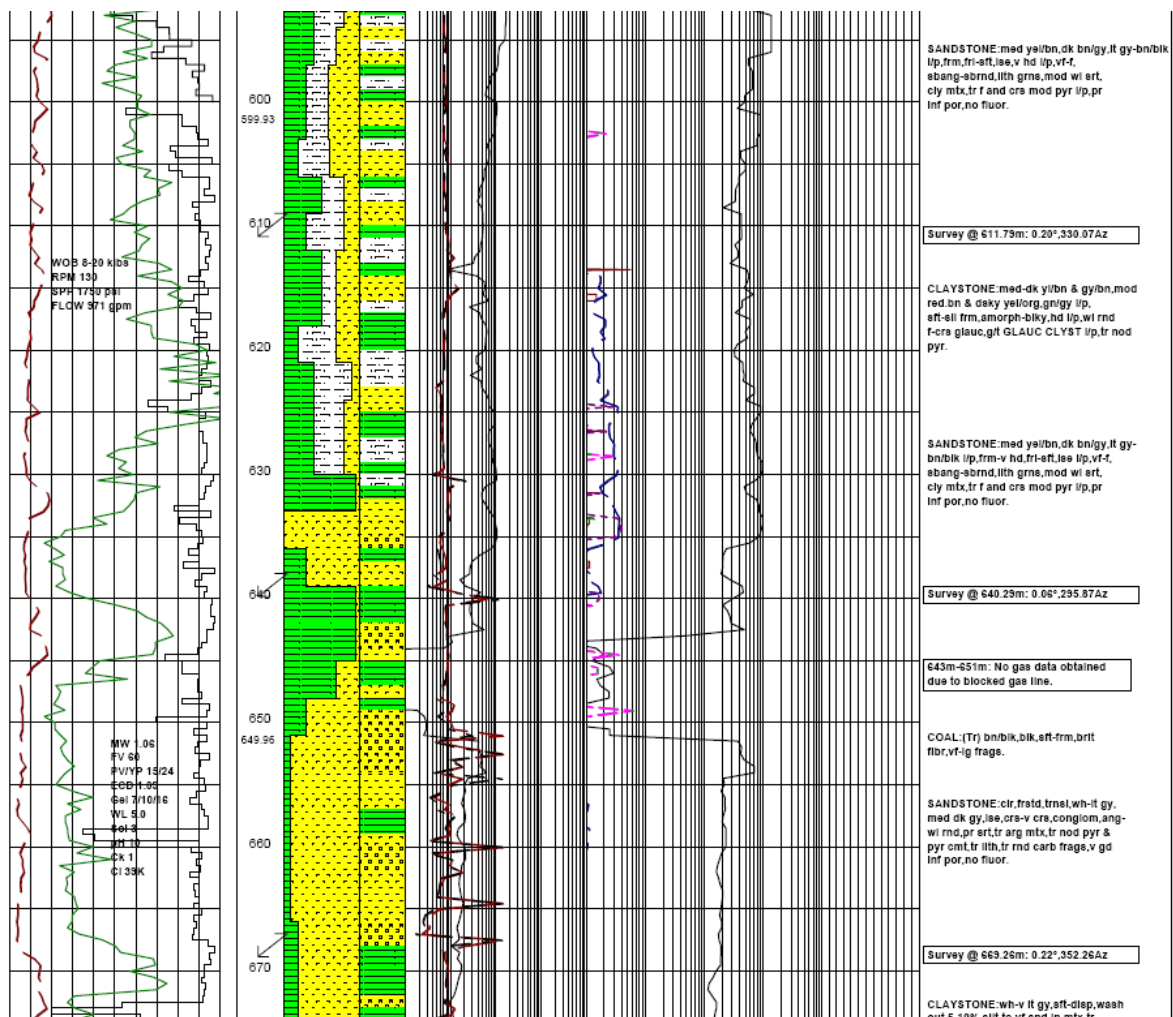


Figure 1. Mudlog over the Gurnard Formation and Kingfish Formations showing lack of hydrocarbon shows.

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 Maclean-1 (Table 1).

Suite	Tool String	Interval (mRT)	Hole Size
1	MWD-DGR-EWR_P4-PM	112-355	17 ½"
2	MWD-DGR-EWR_P4-PM	355-766	12 ¼"

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

Wireline Log Data

No wireline log data was acquired in Maclean-1, as this was contingent on the presence of hydrocarbon shows.

Formation Test Data

No formation test data was acquired in Maclean-1 as these were contingent on the presence of hydrocarbon shows.

Core Data

No who core or sidewall core samples were obtained in Maclean-1 as these were contingent on the presence of hydrocarbon shows.

DISCUSSION

A petrophysical analysis was not completed for Maclean-1 due to the lack of suitable porosity logs. The existing LWD, gas chromatograph and hydrocarbon shows data was assessed immediately after drilling to determine the need for the contingent wireline run. Based on this data, it was concluded that no hydrocarbons were intersected in this well, and the contingent wireline runs were not acquired. The following specific observations were made:

- No fluorescence recorded
- no significant gas shows over background
- High resistivity spikes (A in Figure 2) are associated with conglomerates
- Some thin zones of higher ROP are not associated with higher gas show, and are associated with low resistivity (B in Figure 2)
- Some invasion (permeability) indicated at 635-639m from large resistivity separation, but has low resistivity (~ 5ohm.m) (C in Figure 2)

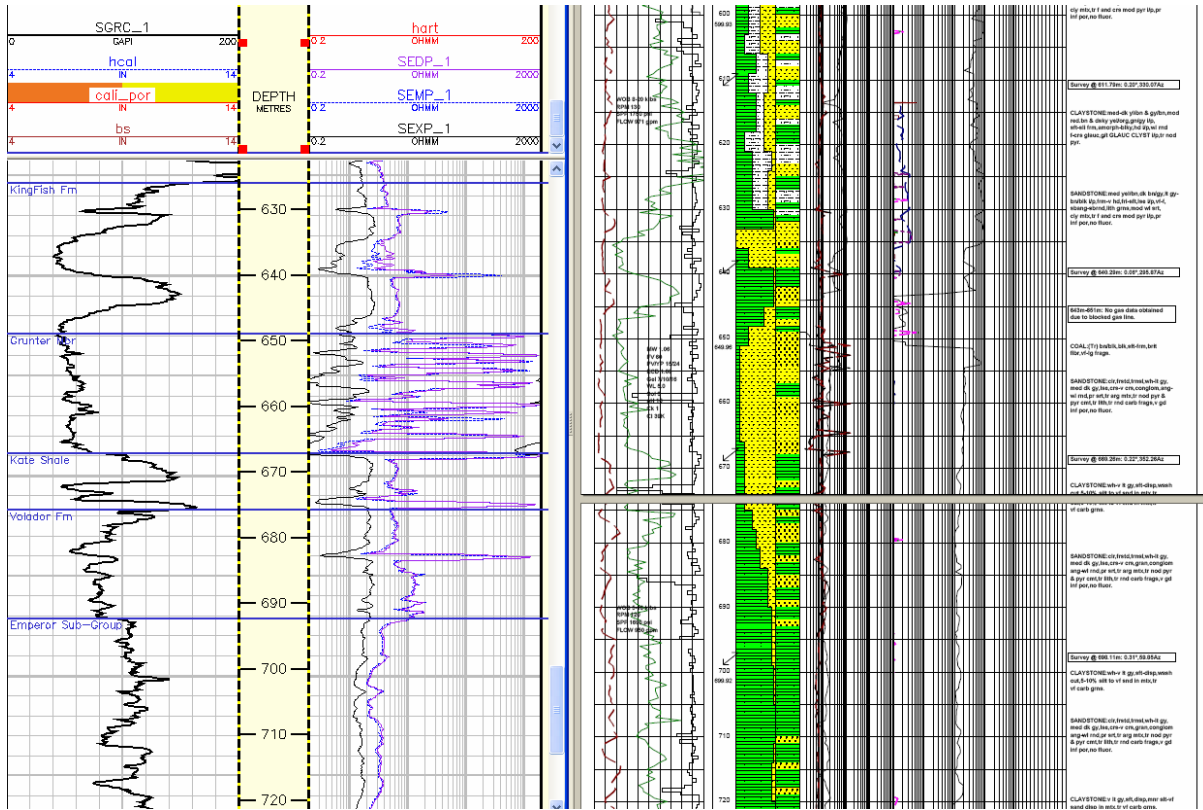


Figure 2. Comparison of LWD GR-RES data and Mudlog data from Maclean-1.

APPENDIX 3

Palynology Report

By Dr Alan Partridge

INTERPRETATIVE DATA.
Palynological analysis of interval
from 591 to 762 metres in Maclean-1,
offshore Gippsland Basin.

by

Alan D. Partridge

Biostrata Pty Ltd

A.B.N. 39 053 800 945

Biostrata Report 2006/03A

21st February 2006

INTERPRETATIVE DATA.
Palynological analysis of interval from 591 to 762 metres
in Maclean-1, offshore Gippsland Basin.

by Alan D. Partridge

Summary

Palynological analyses have been performed nine cuttings samples between 591 and 762m in Maclean-1. The spore-pollen assemblages recorded indicate that the well reached TD within Turonian age sediments of the Emperor Subgroup. The unconformably overlying section contains Late Maastrichtian to Early Eocene spore-pollen assemblages characteristic of the Halibut Subgroup, which is in turn overlain by a marine interval containing Middle to Late Eocene spore-pollen and microplankton assemblages diagnostic of the Gurnard Formation of the Cobia Subgroup. When combined with the available electric logs and the cuttings lithologies the palynological zones allow the Latrobe Group to be further subdivided as summarised in Table 1.

Table 1. Stratigraphic and Palynological Summary of Maclean-1.

AGE	STRATIGRAPHY	PALYNOLOGY	DEPTHS (mKB)
Recent to Late Oligocene	SEASPRAY GROUP Undifferentiated Seafloor to 582.6m	Not analysed by palynology	
Late to Middle Eocene	Cobia Subgroup Gurnard Formation 582.6 to 626m	Middle <i>Nothofagidites asperus</i> SP Zone <i>Gippslandica extensa</i> MP Zone Lower <i>Nothofagidites asperus</i> SP Zone <i>Deflandrea heterophlycta</i> MP Zone <i>Enneadocysta partridgei</i> MP Zone	591m 591m 609 to 624m 609m 618 to 624m
Early Eocene to Paleocene basal Paleocene to latest Maastrichtian Late Maastrichtian	LATROBE GROUP Halibut Subgroup Kingfish Formation 626 to 667.2m Kate Shale 667.2 to 671.6m Volador Formation 671.6 to 692.3m	<i>Proteacidites asperopolus</i> SP Zone <i>Lygistepollenites balmei</i> SP Zone Not analysed Upper <i>Forcipites longus</i> SP Zone	Caved at 633m 633 to 645m 678m
Turonian	Emperor Subgroup Kipper Shale 692.3 to 766mTD	<i>Phyllocladidites mawsonii</i> SP Zone <i>Hoegisporis trinalis</i> SP Subzone	720 to 762m 762m

SP = Spore-Pollen; MP = Microplankton

Introduction

Nine cuttings samples have been analysed from the Maclean-1 well drilled by the Bass Strait Oil Company Ltd in permit VIC/P47 in the offshore Gippsland Basin. The samples were selected by the author from a set of washed and dried cuttings and were sent to Core Laboratories Australia Pty Ltd in Perth for processing. The palynological slides were returned on 4th January 2006, and the initial results of the microscope analysis were provided in a Provisional Report issued on 9th January 2006. The final zones and ages assigned to the samples, zone confidence ratings, and zone identification criteria for each of the samples are summarised in 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 on the slides and palynomorph 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.

A standard 15 grams of the cuttings were processed to give moderate organic yields containing mostly moderate to high concentrations of palynomorphs. Preservation of the palynomorphs is mostly fair, and the recorded spore-pollen diversity is generally high, whereas significant abundances and diversities of microplankton were only recorded from the Gurnard Formation.

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 and non-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. The final two columns are Other palynomorphs, expressed as a percentage of the sum of the total Spore-Pollen plus Other palynomorphs counted, and Reworked (RW) palynomorphs. Within the panels the species are plotted according to their youngest 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, 1982) 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 nine cuttings samples all gave good recoveries of well-preserved and generally diverse spore-pollen assemblages, which are only associated with frequent to common marine dinocysts in the shallowest four samples. The palynological ages obtained from these assemblages indicate that the Maclean-1 well has penetrated 183 metres into the Latrobe Group and is represented by zones diagnostic of Eocene, Paleocene, Late Maastrichtian and Turonian ages. Based on the palynological ages, cuttings lithologies and the gamma ray log the Cobia Subgroup is identified between 582.6 and 626m, the Halibut Subgroup between 626 and 692.3m and the Emperor Subgroup between 692.3 and 766mTD. Stratigraphic nomenclature of the Latrobe Group is after Partridge (1999) and Bernecker & Partridge (1999).

The Cobia Subgroup is assigned entirely to the Gurnard Formation, which is distinguished by the high readings on the gamma ray log between 582.6 and 626m. The interval appears to contain all zones normally found in the Gurnard Formation in this part of the basin. The oldest *Enneadocysta partridgei* microplankton Zone is identified at 618m based on the index species *Paucilobimorpha tripus* (= senior synonym of the acritarch *Tritonites tricornus*) and probably encompasses the two oldest shaly spikes on the gamma log at 613-617m and 619-626m. The next younger *Deflandrea heterophlycta* microplankton Zone is recorded at least to 609m, but most likely ranges higher. The shallowest sample analysed at 591m contains the *Gippslandica extensa* microplankton Zone which is consistent with the youngest Late Eocene part of the Gurnard Formation.

The presence of the Halibut Subgroup is confirmed by assemblages recovered in the three samples at 633m, 643-45m and 678m, which contain spore-pollen species diagnostic of the *P. asperopolus*, *L. balmei* and Upper *F. longus* Zones. These appear to be non-marine assemblages as the few dinocysts recorded in the samples are interpreted to be caved. Based on these palynological ages and a comparison of the gamma log profile in Maclean-1 with those recorded in the Judith-1 well (12 km to the S) and the Admiral-1 well (15 km to the SSE) it is suggested that the subgroup can be divided between the Volador Formation (from 671.6 to 692.3m), the Kate Shale (from 667.2 to 671.6m) and the Kingfish Formation (from 626 to 667.2m). Within the last formation the conglomeratic sandstone section between 644.5 and 667.2m shows a similar log profile to the Grunter Member of the Kingfish Formation identified in both Judith-1 (between 1715 and 1745m) and Admiral-1 (between 1389 and 1423m). Identification of the underlying Kate Shale is solely on comparison of the electric log profiles as a palynological sample has not been analysed from the shale spike between 667.2 to 671.6m. The absence of dinocysts diagnostic of the Kate Shale from the next deepest sample at 678m does not preclude this interpretation as most samples are relatively clear of downhole cavings. In terms of the palaeogeographic reconstruction of the Kate Shale provided by Bernecker & Partridge (2005) the record in Maclean-1 is the northernmost occurrence of this marine transgression, yet is still lies seaward of the palaeoshoreline at the time of deposition.

The penetration of the Emperor Subgroup by Maclean-1 was not predicted nor expected from the location of the well. However, the two deepest cuttings recovered good spore-pollen assemblages diagnostic of the *Phyllocladidites mawsonii* Zone and oldest *Hoegisporis trinalis* Subzone which are characteristic of this subgroup. Based on these palynological assemblages and the “shaly” gamma ray log character (and lack of any significant sandstones) the interval penetrated is best correlated with the Kipper Shale according to the diagnosis provided by Bernecker & Partridge (2001). Somewhat surprisingly however, none of the distinctive non-marine algal cysts described from the Kipper Shale by Marshall (1989), which are considered diagnostic of deposition in large and deep palaeolakes, were found in the two cuttings assemblages. How much significance can be assigned to their absence is uncertain as other wells contain samples and interval from the Kipper Shale which lack these non-marine algal cysts diagnostic of the *Rimosicysta* Superzone. It is expected that these microplankton would be found with more detailed sampling of the Kipper Shale in Maclean-1, and that their current absence just reflects the vagaries of limited sampling.

Biostratigraphy.

In Maclean-1 the samples analysed are classified according to the spore-pollen zonation scheme originally proposed by Stover & Partridge (1973, 1982) and Helby *et al.* (1987), which have been updated for the Gippsland Basin by Partridge (1999). 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). The most recently published summary of these zonation schemes is to be found in the contribution by Partridge & Dettmann (2003) to the latest 2003 edition of the *Geology of Victoria*.

Middle *Nothofagidites asperus* spore-pollen Zone***Gippslandica extensa* microplankton Zone****Cuttings at: 591 metres****Age: Late Eocene**

The shallowest sample analysed, from near the top of the Gurnard Formation, gave a moderate organic residue yield, containing a moderate to high diversity spore-pollen suite and a moderately abundant (8% of SP + MP count) but low diversity microplankton suite. The spore-pollen are dominated by *Nothofagidites* pollen (38% of SP count), and are no younger than the Middle *N. asperus* Zone based on presence of *Proteacidites adenanthoides*, *P. pachypolus* and *P. recavus* which do not range above this zone. The microplankton are comprised mainly of long-ranging species, many of which are caved from the overlying Seaspray Group, but can be confidently assigned to the *Gippslandica extensa* Zone based on the presence of the eponymous species.

Lower *Nothofagidites asperus* spore-pollen Zone, and***Deflandrea heterophlycta* microplankton Zone****Cuttings at: 609 metres****Age: late Middle Eocene**

This sample analysed from the middle of the Gurnard Formation gave a high diversity spore-pollen assemblage and a moderately diverse microplankton assemblage of low abundance (5%). The spore-pollen are dominated by pollen of *Haloragacidites harrisii* (27%) while *Nothofagidites* pollen conspicuously decline in abundance to just 15%. Notwithstanding the latter the sample is confidently assigned the Lower *N. asperus* Zone based on the presence of *Nothofagidites falcatus* and *Tricolpites simatus* which range no older than this zone, and *Proteacidites asperopolus* and *P. reflexus* which range no younger than the zone. The associated microplankton are assigned to the *D. heterophlycta* Zone based on the presence of the eponymous species *Deflandrea heterophlycta* and the acritarch *Paucilobimorpha* (al. *Tritonites*) *inaequalis*.

Lower *Nothofagidites asperus* spore-pollen Zone, and***Enneadocysta partridgei* microplankton Zone****Cuttings at: 618 metres and probably extending to 624 metres****Age: Middle Eocene**

The sample at 618m with *Nothofagidites* pollen abundance of 30%, compared to *Haloragacidites harrisii* abundance of 10%, and the occurrence of *Nothofagidites falcatus* and *Tricolpites simatus* is considered typical of the Lower *N. asperus* Zone. In contrast, the deeper sample at 624m, which contains low abundance of *Nothofagidites* pollen (8%) and moderate abundance of *H. harrisii* (15%), could be considered to have greater affinity with the next older *Proteacidites asperopolus* Zone. However, the key index species marking the top of the latter zone (eg. *Myrtaceidites tenuis*, *Proteacidites ornatus* and *Intratroporopollenites notabilis*) were not found and therefore the samples is placed by default into the Lower *N. asperus* Zone. The associated microplankton are assigned to the *E. partridgei* Zone based on the presence of the acritarch *Paucilobimorpha tripus* (= senior synonym of *Tritonites tricornus*) at 618m and the occurrence of *Deflandrea flounderensis* in both samples. Unfortunately, the principal index species *Enneadocysta partridgei* was not recorded in these two low diversity and low abundance microplankton assemblages.

P. asperopolus* spore-pollen Zone*Caved in cuttings at: 633 metres****Age: late Early Eocene**

The occurrence of angiosperm pollen species *Intratroporopollenites notabilis*, *Proteacidites tuberculiformis*, *Santalumidites cainozoicus* and *Tricolporites paenestriatus* in the cuttings at 633m,

and their rarity or absence in the shallower cuttings samples suggests the presence of some latest Early Eocene section in the well. The cuttings at 633m were specifically selected to sample the shale spike on the gamma ray log at 630.5 to 632.5m, and as the bulk of the spore-pollen assemblage recovered from this cuttings belong to the *L. balmei* Zone the Early Eocene component is most likely derived from the probable argillaceous sandstone interval identified on the gamma ray log between 626 and 630.5m. This interval lies directly below the Gurnard Formation and above the *L. balmei* Zone shale spike. Based on comparison with similar sections penetrated in the nearby Flathead-1 and Patricia-1 wells the Early Eocene species recorded in Maclean-1 most likely come from the *P. asperopolus* Zone, although an older Upper *Malvacipollis diversus* Zone assignment cannot be completely excluded.

***Lygistepollenites balmei* spore-pollen Zone**

Interval: 633 to 645 metres

Age: Paleocene

The next two cuttings which sample distinctive shaly spikes on the gamma ray log contain gymnosperm pollen dominated assemblages (average 50%), which are assigned to the *L. balmei* Zone based on the frequent to abundant occurrence of the eponymous species *Lygistepollenites balmei* (4% at 633m and 18% at 643-45m). Supporting the broad zone assignment are the presence of *Tetracolporites textus* ms at 633m and *Phyllocladidites reticulosaccatus*, *P. verrucosus* and *Podocarpidites exiguus* at 643-55m, but somewhat surprisingly none of the more important secondary index species were found (eg. *Australopollis obscurus*, *Gambierina rudata* and *Polycolpites langstonii*). The shallower sample may belong to the Upper subzone based on the presence of *Proteacidites annularis*. The few microplankton species recorded from these two samples are considered to be caved.

Upper *Forcipites longus* spore-pollen Zone

Cuttings at: 678 metres

Age: Late Maastrichtian

The angiosperm pollen dominated assemblage (41% of count) with abundant *Proteacidites* pollen (29%) recorded from the cuttings at 678m can be confidently assigned to the Upper *F. longus* Zone based on the youngest occurrence in the sample of the species *Battenipollis sectilis*, *Densoisporites velatus*, *Ornamentifera sentosa*, *Proteacidites reticuloconcavus* ms, *P. clinei* ms and *P. (Propylipollis) crotonoides*, which do not range younger than this zone or the Late Maastrichtian, and frequent occurrence of the spore *Tripunctisporis maastrichtiensis* which does not range older than the Upper *F. longus* subzone. The next most abundant species in the assemblage after small generalised *Proteacidites* specimens is the spore *Stereisporites antiquasporites* at 12%.

***Phyllocladidites mawsonii* spore-pollen Zone, and**

***Hoegisporis trinalis* spore-pollen Subzone**

Interval: 702 to 762 metres

Age: Turonian

The two deepest cuttings analysed contain spore dominated assemblages (average 58%), principally *Cyathidites* spp. (average of 28%), with secondary gymnosperm pollen (average >38%) and only rare *in situ* angiosperm pollen (<2%). The samples are assigned to the broad *P. mawsonii* Zone based on the presence in both samples of *Verrucosisporites admirabilis* ms and a variety of other index species from the deeper sample. The latter comprise frequent spores of *Appendicisporites distocarinatus*, the megaspores *Balmeisporites glenelgensis* and *B. holodictyus*, rare spores of *Cicatricosisporites cuneiformis*, *Crybelosporites brennerii* and *Densoisporites muratus* ms and the angiosperm pollen tetrads of *Senectotetradites fistulosus* and *S. varireticulosus*. This sample also contains the overlap in the ranges of the subzone index species *Laevigatosporites musa* ms and

Hoegisporis trinalis ms which is considered to be indicative of the upper part of the *H. trinalis* Subzone. The only microplankton recorded in both samples is the algal cyst *Sigmopollis carbonis* which is not age significant and is found widely distributed in most early to mid Cretaceous depositional environments.

References

- BERNECKER, T., & PARTRIDGE, A.D., 2001. Emperor and Golden Beach Subgroups: The onset of Late Cretaceous sedimentation in the Gippsland Basin, SE Australia. **In** *Eastern Australian Basins Symposium. A Refocused Energy Perspective for the Future*, K.C. Hill & T. Bernecker, editors, *Petroleum Exploration of Australia, Special Publication*, p.391-402.
- BERNECKER, T. & PARTRIDGE, A.D., 2005. Approaches to palaeogeographic reconstructions of the Latrobe Group, Gippsland Basin, Southeastern Australia. *APPEA Journal*, vol.45, pt.1, p.581-598.
- DETTMANN, M.E., 1963. Upper Mesozoic microfloras from southeastern Australia. *Proceedings Royal Society Victoria*, vol.77, pt.1, p.1-148.
- FENSOME, R.A., WILLIAMS, G.L., BARSS, M.S., FREEMAN, J.M. & HILL, J.M., 1990. Acritarchs and fossil Prasinophytes: An index to genera, species and infraspecific taxa. *AASP Contribution Series No. 25*, p.1-771.
- HELBY, R., MORGAN, R. & PARTRIDGE, A.D., 1987. A palynological zonation of the Australian Mesozoic. **In** *Studies in Australian Mesozoic Palynology*, P.A. Jell, editor, *Memoir Association Australasian Palaeontologists 4*, p.1-94.
- MACPHAIL, M.K., 1999. Palynostratigraphy of the Murray Basin, inland Southeastern Australia. *Palynology* vol.23, p.197-240.
- MARSHALL, N.G., 1989. An unusual assemblage of algal cysts from the late Cretaceous, Gippsland Basin, Southeastern Australia. *Palynology* 13, p.21-56.
- PARTRIDGE, A.D., 1975. Palynological zonal scheme for the Tertiary of the Bass Strait Basin (Introducing Paleogene Dinoflagellate Zones and Late Neogene Spore-Pollen Zones). *Geological Society of Australia (Victorian Division) Symposium on the Geology of Bass Strait and Environs, Melbourne, November, 1975. Esso Australia Ltd Palaeontological Report 1975/17* (unpubl.).
- PARTRIDGE, A.D., 1976. The geological expression of eustasy in the early Tertiary of the Gippsland Basin. *The APEA Journal*, vol.16, pt.1, p.73-79.
- PARTRIDGE, A.D., 1999. Late Cretaceous to Tertiary geological evolution of the Gippsland Basin, Victoria. PhD thesis, La Trobe University, Bundoora, Victoria, p.i-xxix, p.1-439, 165 figs, 9 pls (unpubl.).
- PARTRIDGE, A.D. & DETTMANN, M.E., 2003. Chapter 22.4.2 Plant microfossils. **In** *Geology of Victoria*, W.D. Birch, editor, *Geological Society of Australia Special Publication 23*, p.639-652.
- STOVER, L.E. & PARTRIDGE, A.D., 1973. Tertiary and late Cretaceous spores and pollen from the Gippsland Basin, southeastern Australia. *Proceedings Royal Society of Victoria*, vol.85, pt.2, p.237-286.
- STOVER, L.E. & PARTRIDGE, A.D., 1982. Eocene spore-pollen from the Werillup Formation, Western Australia. *Palynology* 6, p.69-95.
- WILLIAMS, G.L., LENTIN, J.K. & FENSOME, R.A., 1998. The Lentin and Williams index of fossil dinoflagellates 1998 edition. *American Association of Stratigraphic Palynologists, Contributions Series, no. 34*, p.1-817.

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

Sample Type	Depths (metres)	Palynology Zones STAGE/AGE	CR*	Comments and Key Species Present
Cuttings	591m	Middle <i>N. asperus</i> SP Zone <i>G. extensa</i> MP Zone Late Eocene	D4 D3	Marine MP 8%, with zone species <i>Gippslandica extensa</i> . SP assemblage with <i>Nothofagidites</i> 38% > <i>Haloragacidites harrisii</i> 7% and containing LADs of <i>Proteacidites adenanthoides</i> and <i>P. pachypolus</i> .
Cuttings	609m	Lower <i>N. asperus</i> SP Zone <i>D. heterophlycta</i> MP Zone late Middle Eocene	D1 D3	Marine MP 5%, with LADs of <i>Deflandrea heterophlycta</i> and <i>Paucilobimorpha inaequalis</i> . SP assemblage with <i>Haloragacidites harrisii</i> 27% > <i>Nothofagidites</i> 15% and containing LADs of <i>Proteacidites asperopolus</i> and <i>P. reflexus</i> .
Cuttings	618m	Lower <i>N. asperus</i> SP Zone <i>E. partridgei</i> MP Zone Middle Eocene	D1 D3	Marine MP 3%, with zone assignment based on LAD of <i>Paucilobimorpha tripus</i> . SP assemblage with <i>Nothofagidites</i> 30% > <i>Haloragacidites harrisii</i> 27% and containing <i>Proteacidites pachypolus</i> .
Cuttings	624m	Lower <i>N. asperus</i> SP Zone <i>E. partridgei</i> MP Zone Middle Eocene	D4 D5	Marine MP 5%, with <i>Deflandrea flounderensis</i> but otherwise not diagnostic. SP assemblage with <i>Haloragacidites harrisii</i> 15% > <i>Nothofagidites</i> 8% and containing FADs of <i>Tricolpites simatus</i> , <i>Proteacidites asperopolus</i> and <i>P. pachypolus</i> .
Cuttings	633m	Mixed <i>P. asperopolus</i> and <i>L. balmei</i> SP Zones, Early Eocene and Paleocene	D5 D1	Marine MP <1%, probably all caved. SP mixed with LADs of <i>Intratropipollenites notabilis</i> and <i>Lygistipollenites balmei</i> (4%). indicative of zone assignments. <i>Nothofagidites</i> declines to <8%.
Composite Cuttings	643-645m	Lower <i>L. balmei</i> SP Zones Early Paleocene	D2	LAD of <i>Camarozonosporites apiculatus</i> ms with common <i>L. balmei</i> (18%) favours Lower subzone
Cuttings	678m	Upper <i>F. longus</i> SP Zone Late Maastrichtian	D1	SP assemblage with abundant <i>Proteacidites</i> 29% including LADs of <i>P. reticuloconcavus</i> ms and <i>P. clinei</i> ms, plus FAD of <i>Tripunctisporis maastrichtiensis</i>
Cuttings	702m	<i>P. mawsonii</i> SP Zone Turonian	D4	SP dominated by <i>Cyathidites</i> spores 34%, with LAD of <i>Verrucosisporites admirabilis</i> ms.
Cuttings	762m	<i>P. mawsonii</i> SP Zone and <i>H. trinalis</i> Subzone Turonian	D4 D1	LAD of <i>Hoegisporis trinalis</i> ms and FAD of <i>Laevigatosporites musa</i> ms in assemblage with frequent <i>Appendicisporites distocarínatus</i> and common <i>Cyathidites</i> spores.

SP & MP = Spore-Pollen & Microplankton;

FAD and LAD = First and Last Appearance Datums

***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 Maclean-1, offshore Gippsland Basin.

Sample Type	Depth metres	Lithology	Wt grams
Cuttings	591m	Medium brown-grey siltstone to mudstone with trace glauconite.	15.0
Cuttings	609m	Medium greenish brown-grey mudstone to siltstone.	15.0
Cuttings	618m	Medium brown-grey mudstone to siltstone with trace glauconite.	15.0
Cuttings	624m	Medium brownish grey mudstone to siltstone with trace glauconite.	15.0
Cuttings	633m	Light to medium brown-grey sandy claystone.	15.0
Composite Cuttings	643-645m	Light brown-grey claystone (largest pieces selected for processing)	15.0
Cuttings	678m	Medium grey mudstone and black carbonaceous mudstone to coal.	15.0
Cuttings	702m	Medium grey mudstone selected in preference to conglomerate pebbles	15.0
Cuttings	762m	Medium grey mudstone (clumped lumps selected for processing).	15.0

Average: 15.0

Wt = Weight of sample processed in grams.

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

Sample Type	Depth metres	Visual Yield	Palynomorph Concentration	Preservation	No. SP Species	No. MP Species
Cuttings	591m	Moderate	Moderate	Poor-fair	43+ (1+)	11+ (2+)
Cuttings	609m	Moderate	High	Fair-good	59+ (3+)	13+ (4+)
Cuttings	618m	Moderate	Moderate	Poor	52+ (2+)	9+ (1+)
Cuttings	624m	Low	Low-Moderate	Fair	42+	5+ (4+)
Cuttings	633m	Moderate	Moderate	Poor-good	48+ (5+)	(3+)
Composite Cuttings	643-645m	Moderate	Moderate	Poor-fair	32+ (3+)	(2+)
Cuttings	678m	Moderate	High	Fair	38+ (1+)	1
Cuttings	702m	Moderate	Low	Poor-fair	19+ (6+)	1
Cuttings	762m	Moderate	High	Poor-good	36+ (2+)	1

Average: 43+ 6+**Notes:**

NR = Not Recorded

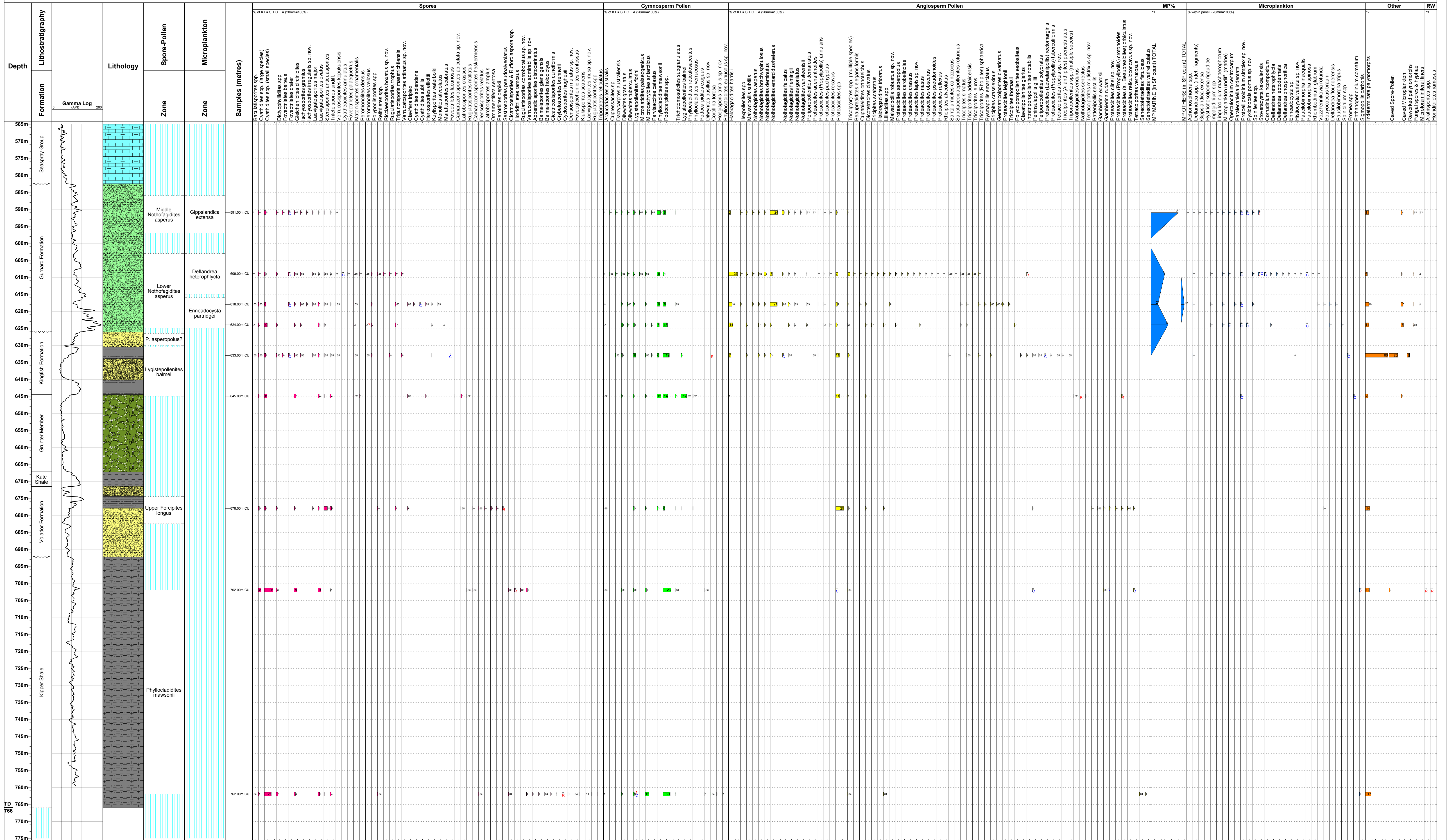
Species numbers in brackets refer to number of reworked and/or caved species identified.

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

No.	Sample Type	Depth Metres	Catalogue Number	Core Lab Prep. No.	Description
1	Cuttings	591.0	P218678	2373	Oxidised slide 1: 10µm filter
2	Cuttings	591.0	P218679	2373	Oxidised slide 2: 10µm filter
3	Cuttings	591.0	P218680	2373	Oxidised slide 3: 10µm filter
4	Cuttings	609.0	P218681	2374	Oxidised slide 1: 10µm filter
5	Cuttings	609.0	P218682	2374	Oxidised slide 2: 10µm filter
6	Cuttings	609.0	P218683	2374	Oxidised slide 3: 10µm filter
7	Cuttings	618.0	P218684	2375	Oxidised slide 1: 10µm filter
8	Cuttings	618.0	P218685	2375	Oxidised slide 2: 10µm filter
9	Cuttings	618.0	P218686	2375	Oxidised slide 3: 10µm filter
10	Cuttings	624.0	P218687	2376	Oxidised slide 1: 10µm filter
11	Cuttings	624.0	P218688	2376	Oxidised slide 2: 10µm filter
12	Cuttings	624.0	P218689	2376	Oxidised slide 3: 10µm filter
13	Cuttings	633.0	P218690	2377	Oxidised slide 1: 10µm filter
14	Cuttings	633.0	P218691	2377	Oxidised slide 2: 10µm filter
15	Cuttings	633.0	P218692	2377	Oxidised slide 3: 10µm filter
16	Cuttings	643-645	P218693	2378	Oxidised slide 1: 10µm filter
17	Cuttings	643-645	P218694	2378	Oxidised slide 2: 10µm filter
18	Cuttings	643-645	P218695	2378	Oxidised slide 3: 10µm filter
19	Cuttings	678.0	P218696	2379	Oxidised slide 1: 10µm filter
20	Cuttings	678.0	P218697	2379	Oxidised slide 2: 10µm filter
21	Cuttings	678.0	P218698	2379	Oxidised slide 3: 10µm filter
22	Cuttings	702.0	P218699	2380	Oxidised slide 1: 10µm filter
23	Cuttings	702.0	P218700	2380	Oxidised slide 2: 10µm filter
24	Cuttings	702.0	P218701	2380	Oxidised slide 3: 10µm filter
25	Cuttings	762.0	P218702	2381	Oxidised slide 1: 10µm filter
26	Cuttings	762.0	P218703	2381	Oxidised slide 2: 10µm filter
27	Cuttings	762.0	P218704	2381	Oxidised slide 3: 10µm filter

Maclean-1

INTERPRETATIVE chart for Biostrata Report 2006/03A



ENCLOSURES

