LONGTOM-1 AND LONGTOM-1/ST1, VIC/P1

WELL COMPLETION REPORT

INTERPRETIVE VOLUME

PREPARED BY: A. Locke

71579.wcr

DATE: December, 1995

BHP PETROLEUM PTY. LTD.
A.C.N. 006 918 832

Acknowledgments

This report was completed with the help of the following:

Rob Cowley	Senior Petroleum Geophysicist
Barry Messent	Senior Petroleum Geologist
Cathy Ellis	Technical Assistant

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ENCLOSURE

1.0 WELL INDEX SHEET

Well Name:	LONGTOM-1
Basin(s):	Gippsland
Country:	Australia
State/District/Province:	Victoria
Permit:	VIC/P1
Well Type:	Wildcat
Current Well Status:	Gas Well - Abandoned

Total Depth:

Drillers:	2242m
Loggers:	2240m
Planned:	2285m

Surface Location:

Actual:	Lat:	38 deg 6 min .03 sec S
	Long:	148 deg 18 min 54.28 sec E
	Survey System:	Australian Geodetic Datum 1984
	Source of Location Data:	BHPE GPS Survey
Planned:	Lat:	38 deg 5 min 59.89 sec S
	Long:	148 deg 18 min 54.11 sec E
	Survey System:	Australian Geodetic Datum 1984
	Source of Location Data:	BHPP Drilling Program

Onshore/Ofshore:	Offshore - Marine
Seismic Reference:	Line: G91A-2004 SP: 2582
Sidetracked Hole:	N Related Sidetrack(s): Y

Elevations:	Log Ref.: RT,	25.0m above MSL
	Ground Level:	56.2m below MSL
	Water Depth:	56.0m

Operation Dates:	On Location:	12-MAY-1995, 02:30
	Spudded:	12-MAY-1995, 16:30
	Total Depth Reached:	24-MAY-1995, 20:00
	Kicked-off Sidetrack:	28-MAY-1995, 13:30
	Rig Released:	14-JUN-1995, 06:45

Operator: BHP Petroleum Interest: 100%

Objectives:

Primary Objectives: Judith Formation Sands

Secondary Objectives: Kipper Formation Sands

Drilling Summary:

Rig Name: Ocean Bounty
Rig Type: Semi-submersible
Drilling Contractor: Diamond Offshore

Bit Size	Interval	Casing	Shoe Depth
28 IN	81 - 117m	20 IN	117m
17.5 IN	117 - 1025m	13.375 IN	1012m
12.25 IN	1025 - 2242m		

Plugs:

Type	No.	Interval	Tagged	Sacks Cement
ABN	1	1965 - 1840 m	Y	335
ABN	2	1042 - 942 m	N	295
ABN	3	113 - 93 m	N	115
STK	1	1220 - 1155 m	Y	300

Conventional Cores: none

DST and Production Tests: none

Wireline Logs:

Suite	Run	Tool String	Interval	Date Run
1	1	DLL-SLS-CAL-GR-AMS	753 - 80m	16-MAY-95
2	2	AS-MSFL-GR-DLL-AMS	2237 - 700m	25-MAY-95
2	1	LDL-CNL-GR-AMS	2230 - 1011.6m	25-MAY-95
2	1	CST-GR	2213 - 1048m	26-MAY-95
2	1	MDT-GR-AMS	1930 - 1797m	26-MAY-95
2	1	FMS-GR-AMS	2239 - 1011.6m	25-MAY-95
2	1	MSD	2239 - 1011.6m	25-MAY-95
2	1	CSI	2225 - 100m	26-MAY-95
		DDP	2242 - 117m	24-MAY-95
		GAS/RAT	2242 - 117m	24-MAY-95
		FEWD	2242 - 117m	24-MAY-95
		PL	2242 - 117m	24-MAY-95

Well Name:	LONGTOM-1/ST1
Basin(s):	Gippsland
Country:	Australia
State/District/Province:	Victoria
Permit:	VIC/P1
Well Type:	Wildcat
Current Well Status:	Gas Show - Abandoned

Total Depth:

Drillers: 2445m

Surface Location:

Actual:	Lat:	38 deg 6 min .03 sec S
	Long:	148 deg 18 min 54.28 sec E
	Survey System:	Australian Geodetic Datum 1984
	Source of Location Data:	BHPE GPS Survey
Planned:	n/a	

Onshore/Ofshore:	Offshore - Marine		
Seismic Reference:	Line: G91A-2004 SP: 2582		
Sidetracked Hole:	Y	Related Sidetrack(s):	N
Elevations:	Log Ref.:	RT,	25.0m above MSL
	Ground Level:		56.2m below MSL
	Water Depth:		56.0m
Operation Dates:	On Location:		12-MAY-1995, 02:30
	Kicked-off Sidetrack:		28-MAY-1995, 13:30
	Total Depth Reached:		05-JUN-1995, 20:45
	Rig Released:		14-JUN-1995, 06:45
Operator:	BHP Petroleum	Interest:	100%

Objectives:

Primary Objectives: Judith Formation Sands

Secondary Objectives: Kipper Formation Sands

Drilling Summary:

Rig Name: Ocean Bounty
Rig Type: Semi-submersible
Drilling Contractor: Diamond Offshore

Bit Size	Interval	Casing	Shoe Depth
12.25 IN	1155 - 2445m	IN	

Plugs:

Type	No.	Interval	Tagged	Sacks Cement
ABN	1	2208 - 2080 m	Y	425

Conventional Cores: none

DST and Production Tests: none

Wireline Logs:

Suite	Run	Tool String	Interval	Date Run
3	3	AS-MSFL-GR-DLL-AMS	1779 - 1011.6m	06-JUN-95
		MD-CDR	2441 - 1715m	10-JUN-95
		TVD-CDR	2441 - 1715m	10-JUN-95
		DDP	2445 - 1100m	05-JUN-95
		GAS/RAT	2445 - 1100m	05-JUN-95
		FEL	2445 - 1100m	05-JUN-95
		PL	2445 - 1100m	05-JUN-95

2 WELL SUMMARY

Longtom-1 was drilled as an exploration well designed to test the hydrocarbon potential of the Longtom structure (Figure 1). Longtom-1 is located approximately 12km northwest of the Tuna oil/gas field and 7km northeast of the Sunfish oil discovery. The well was spudded on 12th May, 1995, in 56m of water, by the semi-submersible 'Ocean Bounty'. A 46m column of gas gave sufficient encouragement to sidetrack the well to evaluate downdip reservoir units. The Longtom-1/ST1 sidetrack began on 27th May, 1995 and reached a total depth of 2445mMDRT on 5th June.

The Judith Formation was the primary target of the well, with top seal expected to be provided by the overlying Kipper Formation. The sands of the Kipper Formation provide a secondary target with top seal provided by volcanics above the 80My Unconformity.

The Longtom structure has successfully trapped hydrocarbons but with poor reservoir quality. Although only gas was intersected in the wells, it is likely that an oil leg exists below the gas, however the volumes are likely to be small and uneconomic.

The well was plugged and abandoned on the 14th June, 1995.

3 HYDROCARBONS

3.1 Longtom-1

There were no visual hydrocarbon shows recorded in the Longtom-1 well. Recording of ditch gas commenced within the Gippsland Limestone at 350mRT, where background readings, consisting dominantly of C1, were recorded up to 0.06%. Background gas increased gradually throughout the Gippsland Limestone to between 0.1 and 0.3% with minor amounts of C2 and C3.

At 1272mRT a gas peak of 2% was recorded corresponding to coals within the Latrobe Group. No fluorescence was recorded in the adjacent sands which are interpreted to be water saturated.

At 1889mRT gas peaked at 9%, with significant quantities of C_1 - C_4. No fluorescence was recorded throughout these sands. Log interpretation (Appendix 1) indicates gas is present over the interval 1891-1933.4mRT. Using a Vsh cut-off of 50%, a total of 22.3m of net gas sand is interpreted over a gross 42.4m interval. Porosities range from 7-11%, with corresponding water saturations from 77-48%. The base of the gas zone corresponds to a major boundary fault to the field, therefore a gas/water contact (or gas/oil) cannot be determined from wireline logs.

An RFT program was conducted in the open-hole to confirm the presence of gas in the reservoir and to establish the depth of the gas-fluid contact. Interpretation of the pretest data (BHPP report, in prep., Appendix 2) suggests there is a gross gas column of 260m. Permeabilities of less than 1md have been interpreted from the pretest drawdown mobility.

Immediately below the fault at 1935mRT, Longtom-1 penetrated the clastic sediments of the Strzelecki Formation. The sands are interpreted from wireline logs to be entirely water saturated.

3.2 Longtom-1/ST1

The sidetrack kicked off at 1161m and drilled to a total depth of 2445mMD (2274mTVD) with a maximum hole deviation of 45.8^0.

Difficulties were experienced while attempting to log open hole, the DLL-MSFL-SDT-GR-SP-AMS tool string was unable to pass 1780mMD which then logged up to the casing shoe. As a result only MWD data consisting of a combination of dual resistivity and gamma ray is available to evaluate the hole from 1780-2445mMD (TD).

From the MWD data, the interval 2232-2410mMD (2046-2249mTVDRT) has approximately 41mTVT of net hydrocarbon bearing sand contained within two reservoir units. Unit 1 extends from 2056-2081mTVDRT and unit 2 extends from 2110-2249mTVDRT. Gas appears to be the only hydrocarbon phase present; no fluorescence was reported in the ditch cuttings during drilling. There is no evidence of a gas-oil or gas-water contact.

4 STRATIGRAPHY

The stratigraphic sequence penetrated at Longtom-1 was very similar to the anticipated section down to the 80My unconformity (Figure 2). A much thinner section of the Judith Formation was intersected than prognosed, due to the main bounding fault being intersected within the well at 1935mRT. Immediately below the fault the well intersected the clastic sediments of the Strzelecki Group. Longtom-1 reached a total depth of 2242mRT, terminating in the Strzelecki Group.

Due to the encouragement shown by the vertical well, a sidetrack was initiated to intersect a more complete reservoir section some 300m to the SSW of the vertical well. The tops came in close to prognosis (Figure 3), however the Judith Formation had far less reservoir than predicted.

The stratigraphic sections for both the vertical and sidetrack wells are shown in Figures 2 and 3. Delineation of age units is based on log correlation with nearby wells, together with palynology in the vertical well (Appendix 3) to further define the formations. Age, lithology, and drilling data are marked on the composite well logs accompanying this report. No ditch cuttings were obtained above 170m.

4.1 Tertiary

4.1.1 Gippsland Limestone

Depth: Seafloor to 1184mRT
Thickness: 1129m
Age: Recent - Middle Miocene

The Gippsland Limestone consists of 1184m of interbedded calcarenite, calcisiltite and calcilutite. The Gippsland Limestone lies conformably over the calcilutites and calcisiltites of the Lakes Entrance Formation. The base is reflected on wireline logs as a decrease in sonic and an increase in resistivity measurements.

The sequence consists dominantly of light grey to greenish grey calcarenites, which are friable to hard, fine to medium grained, with common fossil fragments including forams and bryozoans, traces of glauconite and poor visual porosity. The calcisiltites tend to be light olive grey to light medium grey, soft and sticky, with minor fossil fragments and traces of disseminated glauconite. Calcisiltite occurs in the interval 483 - 837mRT and consists of a medium to light grey calcisiltite which is soft, sticky and dispersive, with common fossil fragments and traces of glauconite and pyrite.

4.1.2 Lakes Entrance Formation

Depth:	1184 - 1245mRT
Thickness:	61m
Age:	Early Miocene

The Lakes Entrance Formation consists of 61m of carbonates which unconformably overlie the Late Cretaceous to Early Eocene Latrobe Group. The base of the Lakes Entrance Formation is marked lithologically from a carbonate sequence to a clastic sand/silt/coal sequence. The lithological change is reflected on wireline logs as an increase in gamma and a decrease in resistivity measurements. The Lakes Entrance Formation forms the seal for many of the Bass Straight oil/gas fields.

The Lakes Entrance Formation consists of interbedded calcarenite and calcisiltite with the calcisiltite grading to calcilutite. The sequence consists of light grey to translucent calcarenites, which are loose, fine to medium grained, subangular to subrounded, with common fossil fragments. The calcisiltite grades to calcilutite, and is generally medium dark grey, firm to moderately hard and slightly dispersive.

4.1.3 Latrobe Group

	Longtom-1	Longtom-1/1ST
Depth:	1245 - 1533mRT	1246 - 1533m(TVDRT)
Thickness:	288m	287m(TVT)
Age:	Early Eocene - Late Cretaceous (Maastrichtian)	

The Latrobe Formation consists of interbedded sandstone, siltstone and coal. The base of the Latrobe Group is marked by the 80My Unconformity, which in turn truncates the Judith Formation. The unconformity is recognised lithologically by the appearance of volcanics immediately above.

The top 11m of the Latrobe Group consists of the Middle Eocene aged Gurnard Formation, which comprises of greenish grey siltstones, which grade to very fine grained sandstone.

The remainder 277m of the Latrobe Group consist of undifferentiated coastal plain facies comprising of shales, coals and sands. The sands vary in thickness from 3 - 60m thick and are translucent, red brown, mottled, loose to friable, fine to medium grained, with porosity varying from poor to good. The interbedded siltstone is off white to light grey, soft to firm, with abundant argillaceous material. Coals are generally less than 1m thick and are dark red brown, black, firm to moderately hard, and grades to a carbonaceous claystone.

Volcanics are present immediately above the 80My Unconformity, at the base of the Latrobe Group.

4.2 Cretaceous

4.2.1 Judith Formation

	Longtom-1	Longtom-1/ST1
Depth:	1533 - 1935mRT	1533 - 2445m(TVDRT) - TD
Thickness:	402m	912(+)m (TVT)
Age:	Turonian	

The base of the Judith Formation was not observed in either the vertical or sidetrack wells. In the vertical well the basal section was truncated due to the main bounding fault being intersected at 1935mRT in the well. At the intersection point, the fault was some 200m SSW than expected. The sidetrack well was not drilled deep enough to intersect the base of the Judith Formation.

The Judith Formation consists of lacustrine shales and fluviatile sands, siltstones and shales. The sands are typically light grey to buff, with translucent, green and reddy brown grains. The sands tend to be fine to medium grained and have traces of quartz overgrowths and silica cement on grain boundaries. Visual porosity is fair.

Six sidewall core samples of sands from the Judith Formation were examined by petrology (Appendix 4). The study indicates that extensive compaction has affected the sands resulting 'overpacked' framework grains and causing significant reduction of interparticle porosity and destruction of pore throat apertures. Pore-filling kaolinite is abundant and occludes most remaining porosity.

4.2.2 Strzelecki Group

	Longtom-1
Depth:	1935 - 2242mRT (TD)
Thickness:	401m
Age:	Aptian - Barremian

The Strzelecki Group was only intersected in the vertical well and the base of the Strzelecki Group was not penetrated.

The Strzelecki Group consists of fluviatile sands and shales. The sands are off white to light grey aggregates with translucent to opaque quartz grains, and traces of green, black and browny red lithic grains. The sands contain abundant argillaceous matrix and have poor porosity.

5 STRUCTURE

The Longtom structure consists of three way dip closure against a sealing fault on the downthrown side of a major WNW-ESE basin terrace fault (Figure 4). The units above the 80My Unconformity dip down to the southwest into the basin. Considerable fault drag/folding beneath the unconformity cause the Golden Beach and Strzelecki Groups to dip down more steeply near the fault providing closure to the SSW. The Snapper/Barracouta anticlinal trend, resulting from Late Miocene to Middle Miocene compressional tectonism, provides closure along the strike direction.

The horizons down to the 80My Unconformity were intersected close to prognosis. The Longtom fault was intersected at 1935mRT, about 200m SSW than expected. The steeply dipping Kipper and Judith Formations were not migrated accurately, leading to a large fault location error. The well was planned to intersect the full Judith Formation thickness.

The sidetrack well intersected the Judith Formation 20m deeper than prognosed indicating a steeper average dip than originally mapped on this surface. The cross section in Figure 5 shows the well intersections with the gas reservoirs.

6 GEOPHYSICAL DISCUSSION

6.1 Seismic Coverage

A NNE-SSW trending grid of dip lines spaced from 700 to 1200m provides adequate dip line coverage of the Longtom structure. Most of these lines are of the G92D vintage shot in 1992 which infilled the sparser G91A grid shot in 1991. Only three strike lines with a 1km to 2km spacing cover the structure resulting in some uncertainty in the correlation of some Golden Beach horizons including the top Judith Formation. The main structure bounding fault becomes complex toward the NW end of the Longtom structure where smaller faults splay out from the main fault zone. The mapping becomes uncertain in this area. 3D seismic would be required to accurately image this region.

6.2 Pre-Drill Mapping

Horizon picking and mapping was completed on the Top of Latrobe Group, 80My Unconformity, Top Judith Formation and Top Strzelecki Group. The G91A and G92D seismic data were used in this mapping. Uncertainty in the location of the structure bounding fault resulted in difficulty in determining the optimum well location. The requirement that the well be drilled on the downthrown side of the fault to TD and also intersect the structure near the crest at the Top Judith Formation was difficult to satisfy. The steep structural dips within the Golden Beach Group would also tend to cause the well to deviate toward the fault.

A 244km aeromagnetic survey was acquired in 1992 and used as a guide to the distribution of volcanics overlying the 80My Unconformity. These volcanics form an effective seal where present and are required over the Longtom structure to seal the secondary target in the Kipper Formation. The magnetics data suggests the volcanics are thin over Longtom, increasing the seal risk for the Kipper Formation.

6.3 Time-Depth Conversion

Depth conversion of the Longtom structure was undertaken by ESSO. The Top Latrobe Formation was converted to depth using smoothed and calibrated stacking velocity data. The same method was used to convert the 80My Unconformity time map to depth. As a check, the interval velocity between these layers was back calculated to ensure there were no unusual trends.

To convert the Top Judith Formation to depth, an interval velocity between the 80MY Unconformity and the Top Judith Formation was derived using a linear velocity/depth relationship observed from well data. A similar method was used to obtain the Top Strzelecki depth map, but using a square root velocity/depth relationship. The Top Strzelecki depth map is considered less reliable.

6.4 Post Drill Mapping

The Longtom fault was intersected by the well, with a location about 200m further SSW than expected. The steep dips on the fault and Golden Beach Formation have resulted in inaccurate migration of the seismic data and incorrect location of the fault on the seismic data. The Top Judith Formation could not be identified with confidence on logs and may have been intersected deeper than expected. There was some uncertainty in the pick of the Top Judith Formation on seismic.

The sidetrack well intersected the Top Reservoir about 20m deeper than prognosed indicating a steeper dip than mapped. This may be caused by inaccurate migration of the steeply dipping seismic data.

7 GEOLOGICAL DISCUSSION

7.1 Previous Work

The Longtom prospect lies in VIC/P1, in the Gippsland Basin, offshore Victoria. The history of VIC/P1 can be summarised as follow:
- In 1960 BHPP acquired all offshore Gippsland acreage.
- During 1962-1963 seismic surveys were acquired and the major fields delineated.
- In 1964 ESSO farmed in bearing 100% exploration costs for 50% interest on production.
- After 30 years and numerous renewals and relinquishments of VIC/P1, 5 discontiguous blocks remain.
- ESSO withdrew from VIC/P1 in May 1994 prior to year 5 well commitment.

Longtom-1 is the first well to be drilled in this individual block of VIC/P1.

7.2 Regional Geology

7.2.1 Regional Setting

The Gippsland Basin is a Late Mesozoic/Tertiary Basin located mainly offshore between the mainland of Australia and Tasmania. The offshore basin can be generally divided into five structural elements. They are the Northern and Southern Platforms, the Northern and Southern Strzelecki Terraces and the Central Deep.

The Northern and Southern Platforms and the Northern and Southern Strzelecki Terraces are separated by the Lake Wellington and Foster Fault Systems. The Northern and Southern Strzelecki Terraces and the Central Deep are separated by the Rosedale and Darriman Fault Systems. A half graben known as the Pisces Sub-basin has been identified on the Southern Platform.

7.2.2 Basin Evolution and Tectonics

The evolution of the Gippsland Basin was the result of three tectonic events:

- Early Cretaceous rifting (120-97 Ma) associated with the opening of the Southern Ocean and deposition of the Strzelecki Group
- Mid-Late Cretaceous rifting (97-80Ma) associated with the opening of the Tasman Sea and deposition of the Golden Beach Group.
- Basin sag phase accompanied by deposition of the Latrobe Group sediments (80 Ma to c. 37 Ma) and later, by the Seaspray Group (37 Ma to present).

During the Early Eocene to Early Miocene, compression or wrenching occurred which resulted in the formation of the anticlinal and inversion features which form most of the structural traps within the basin. There is some evidence that the growth of these compressional anticlines may have commenced earlier, during Latrobe Group deposition.

7.2.3 Stratigraphy

A generalised stratigraphy of the Gippsland Basin is shown in Figure 6.

7.3 Contribution to Geological Concepts and Conclusions

Longtom-1 was drilled as an exploration well designed to test the hydrocarbon potential of the Longtom structure. The Longtom-1 well was drilled in the northeastern block of VIC/P1, which lies adjacent to the Tuna, Marlin and Snapper oil and gas fields.

Gas was intersected from 1891m to 1933.4mRT, with the well intersecting the main bounding fault of the structure at 1935mRT. As no fluid contacts were intersected in the vertical well, sufficient encouragement was provided to sidetrack the well to evaluate downdip reservoir units and hydrocarbon.

7.3.1 Hydrocarbons

A 42.4m gas column was intersected in Longtom-1, within the Judith Formation. Using a Vsh cut-off of 50%, a total of 22.3m of net gas sand is present, with porosity ranging from 7-11% and water saturation ranging from 77-48%. A gas-water/gas-oil contact was not intersected in the well.

An RFT program was conducted in the open hole of the vertical well to confirm the presence of gas and to establish the depth of the gas-fluid contact. Interpretation of the pretest data suggests that there is a gross column of 260m.

Difficulties were experienced while attempting to log open-hole in the sidetrack well. As a result only MWD data consisting of a combination of dual resistivity and gamma ray is available to evaluate the well. From the MWD data, the interval 2232-2410mMD (2046-2249mTVDRT) has approximately 41mTVT of net hydrocarbon sand contained within two units. Unit 1 extends from 2056-2081mTVDRT and unit 2 from 2110-2249mTVDRT. Gas appears to be the only phase present, no fluorescence was reported in the ditch cuttings. There is no evidence of a gas-oil or gas-water contact.

7.3.2 Trap

The horizons were encountered close to prognosis down to the 80My Unconformity. Below the unconformity a series of sand units overlayed a thick claystone sequence which formed a seal to the gas bearing sands intersected before passing into the Strzelecki Formation.

The Longtom fault was intersected at 1935mRT, about 200m SSW than expected. The steeply dipping Kipper and Judith Formations were not migrated accurately, leading to a large fault location error. The well was planned to intersect the full Judith Formation thickness.

The sidetrack well intersected the Judith Formation about 20m deeper than prognosed indicating a steeper average dip than originally mapped on this surface.

7.3.3 Reservoir

Reservoir properties are much poorer than prognosed. The actual net to gross ratio ranging from 30% (sidetrack) to 52% (vertical) is much lower than the 50% average expected. Porosity and permeability estimates are only available in the vertical well where extensive logs were run. Due to poor hole conditions, only a GR/resistivity LWD log could be recorded in the sidetrack well. The reservoir porosity of typically 10% is lower than the average 20% expected. The permeability estimate of 1md is much lower than expected and precludes the production of oil from the reservoir. The possible lack of lateral continuity and thinness of the sands would further reduce the productive capacity of the reservoir. There is an estimated 160m or more of unknown Judith Formation from the sidetrack TD to the top Strzelecki Group. There are potentially significant thicknesses of sand in this interval, however the reservoir properties are expected to degrade further with depth.

7.3.4 Source/Migration/Timing

The reservoir sands intersected in both the vertical and sidetrack wells contained gas with a possible downdip oil leg. This proves the source, migration and timing conditions were adequate for trapping gas. Gas accumulations surrounding the Longtom structure have oil legs of various volumes below the gas column and the same is expected at Longtom.

7.3.5 Seal

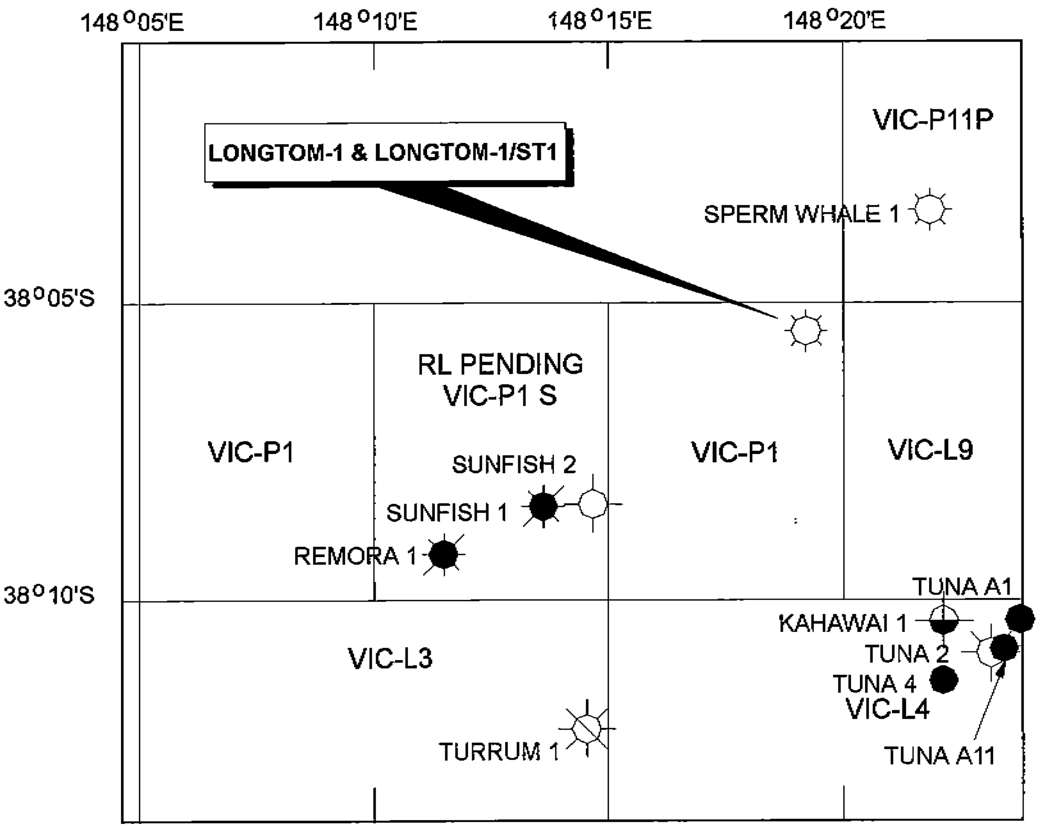
Top and cross-fault seal were identified as a major risk pre-drill. The well has proved the integrity of both the top seal and the cross fault seal. In addition it indicates that intra-formation seals are working and that stacked hydrocarbon accumulations are likely.

FIGURES

FIGURES

LONGTOM-1 & LONGTOM-1/ST1
Location Map

BHP



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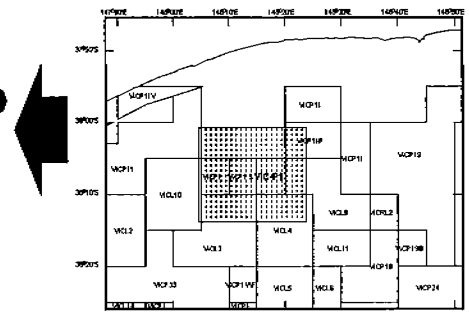
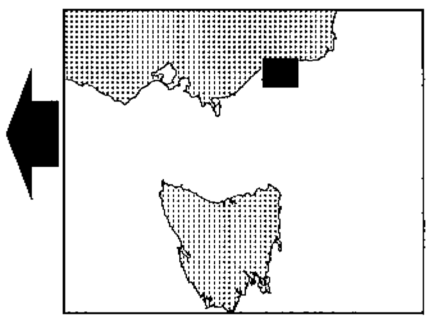
Rig	:	OCEAN BOUNTY
Latitude	:	38° 06' 00.03" S
Longitude	:	148° 18' 54.28" E





LONGTOM.PRE
December, 1995

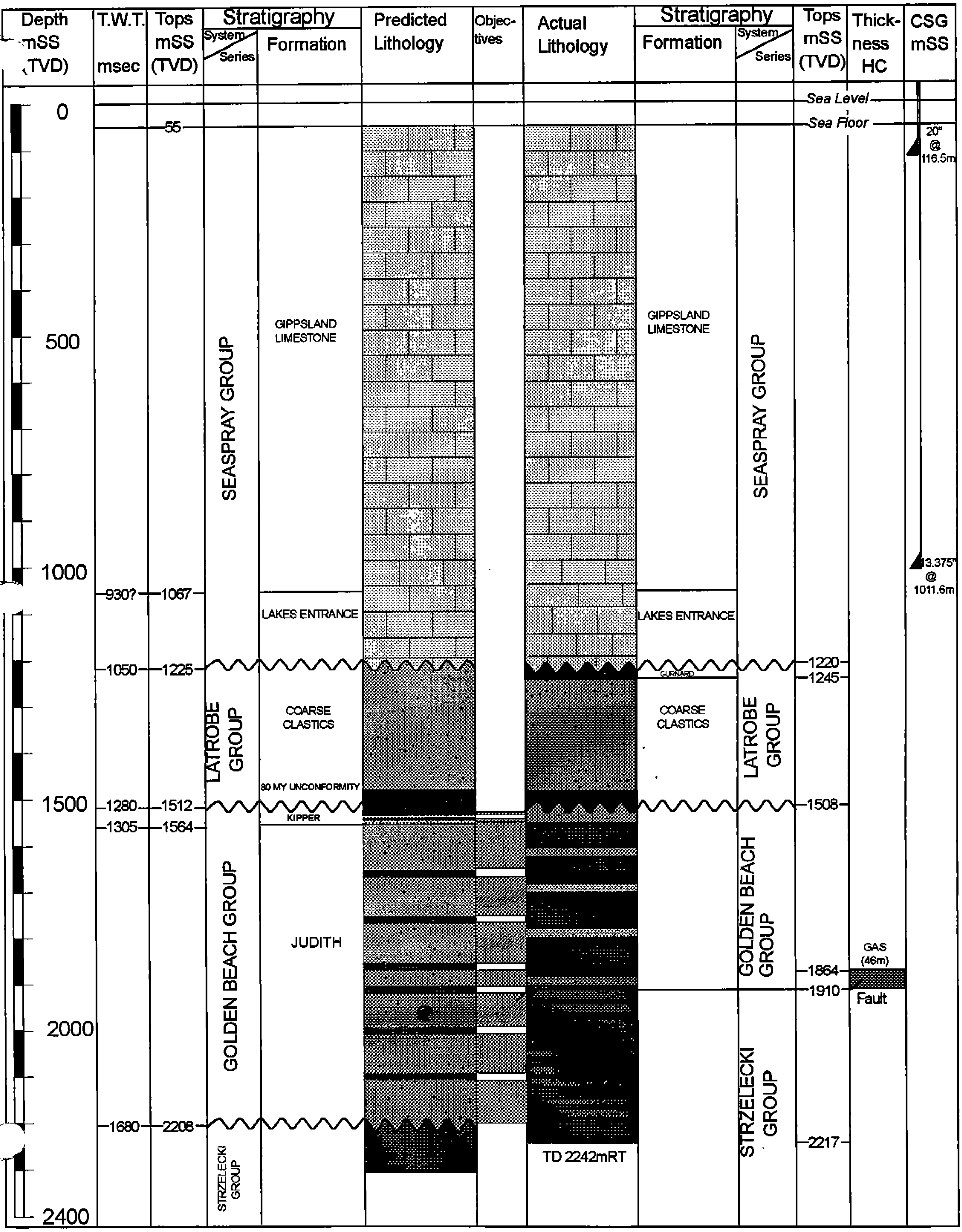
Figure 1

Australia Division
BHP Petroleum

LONGTOM-1 PREDICTED v ACTUAL

PERMIT: VIC/P1

LINE: G91A-2004	LAT: 38° 06' 0.03"S	ELEV: RT: 25m	SPUD: 12/5/95	STATUS: P&A
SP: 2582	LONG: 148° 18' 54.28"E	WATER DEPTH: 55.0m	RIG RELEASE: 14/6/95	RIG: Ocean Bounty



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MAY 1995

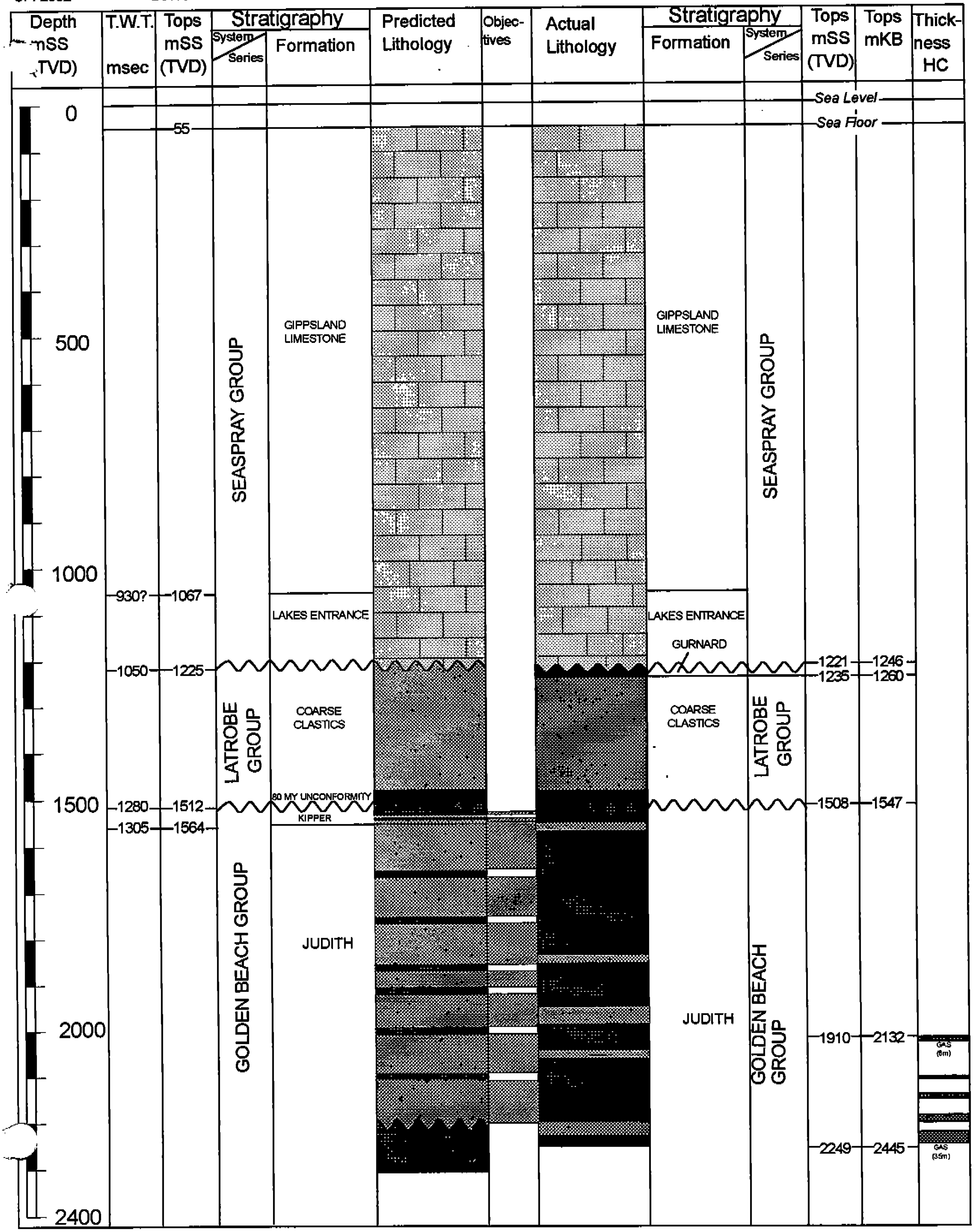
AUSTRALASIA DIVISION
BHP Petroleum

Figure 2

LONGTOM-1/ST1 PREDICTED v ACTUAL

PERMIT: VIC/P1

LINE: G91A-2004
SP: 2582
LAT: 38° 06' 0.03"S
LONG: 148° 18' 54.28"E
ELEV: RT: 25m
WATER DEPTH: 55.0m
SPUD: 12/5/95
RIG RELEASE: 14/6/95
STATUS: P&A
RIG: Ocean Bounty



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MAY 1995

AUSTRALASIA DIVISION
BHP Petroleum

Figure 3

PE904283

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BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = CONTOUR_MAP
DESCRIPTION = Structure Contour Map - Top Reservoir, for Longtom-1
REMARKS = PERMIT: VIC/P1PAGES: 1
DATE_WRITTEN = 19-JUN-1995
DATE_PROCESSED =
DATE_RECEIVED = 18-MAR-1996
RECEIVED_FROM = BHP Petroleum Pty Ltd
WELL_NAME = LONGTOM-1
CONTRACTOR =
AUTHOR =
ORIGINATOR = BHP Petroleum Pty Ltd
TOP_DEPTH =
BOTTOM_DEPTH =
ROW_CREATED_BY = xls_jc40

(Inserted by DNRE - Vic Govt Mines Dept)

PE901834

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   DATE_PROCESSED =
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        WELL_NAME = LONGTOM-1
       CONTRACTOR =
           AUTHOR =
       ORIGINATOR = BHP Petroleum Pty Ltd
        TOP_DEPTH =
     BOTTOM_DEPTH =
   ROW_CREATED_BY = xls_jc40
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(Inserted by DNRE - Vic Govt Mines Dept)

PE901835

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container PE904282 at this location in this
document.

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DESCRIPTION = Gippsland Basin Stratigraphy
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WELL_NAME = LONGTOM-1
CONTRACTOR =
AUTHOR =
ORIGINATOR = BHP Petroleum Pty Ltd
TOP_DEPTH =
BOTTOM_DEPTH =
ROW_CREATED_BY = xls_jc40

(Inserted by DNRE - Vic Govt Mines Dept)

APPENDICES

APPENDIX 1

BHP

LONGTOM-1 and LONGTOM-1/ST1

PERMIT VIC/P1

PETROPHYSICAL INTERPRETATION

REPORT

PREPARED BY:

Angie Cernovskis
Petrophysicist

APPROVED BY:

Robert A. Hogarth
Production Geoscience Manager

File No: Longtom

DATE: July, 1995

BHP PETROLEUM PTY. LTD.
A.C.N. 006 918 832

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1. EXECUTIVE SUMMARY

Longtom-1

The interval 1880-1935m has been quantitatively interpreted using all the log data available from Suite-2. Using a Vsh cut-off of 50%, from 1891-1933.4m, a total 22.3m net gas sand was intersected within a gross column of 42.4m. Porosity ranges from 7-11% with corresponding water saturation ranging from 77-48%. A gas-water/gas-oil contact is not recognisable on logs. There were no other hydrocarbon zones intersected by the well, all other sand units are interpreted to be water saturated.

The quality of the reservoir is poor, ie porosity and gas saturation's are low because of the high clay content (kaolinite) associated with the sand units. Although gas is present in the reservoir, the neutron and density logs do not exhibit any gas effect, the log display over the interval is typical of a "shaly gas-sand". The caliper log demonstrates the hole is consistently over gauge (0.5-1.0in) throughout the reservoir section, which is also consistent with the interpretation.

The Longtom feature lies within the freshwater influx zone, which has resulted in the underlying watersands being less saline than the hydrocarbon zone.

At 1935mRT the well passed through a fault which is evident on the dipmeter, coincident with the top of the Strzelecki Group. The proximity of the reservoir sequence to the fault was thought to be the main cause of poor reservoir quality.

An RFT program was conducted in the open-hole to confirm the presence of gas in the reservoir and to establish the depth of the gas-fluid contact. Interpretation of the pretest data suggests there is a gross gas column of 260m. Permeabilities of less than 1md have been interpreted from the pretest drawdown mobility.

The well was sidetracked away from the fault, to evaluate the quality of down-dip reservoir units, and assess the possibility of there being an oil-leg to the gas reservoir.

No MSCT or conventional cores were attempted in this well.

Longtom-1/ST1

The sidetrack kicked off at 1161m and drilled to a total depth of 2445mMD (2274mTVD) with a maximum hole deviation of 45.8^0.

Difficulties were experienced while attempting to log the open-hole, the DLL-MSFL-SDT-GR-SP-AMS tool string was unable to pass 1780mMD which then logged up to the casing shoe. Subsequent reaming operations failed to provide a suitable hole for open-hole logging to continue, and as a result only MWD data consisting of a combination of dual resistivity and gamma ray is available to evaluate the hole from 1780-2445mMD (TD).

From the MWD data, the interval 2232-2410mMD (2046-2249mTVDRT) has approximately 41mTVT of net hydrocarbon bearing sand contained within two reservoir units. Unit 1 extends from 2056-2081mTVDRT and unit 2 extends from 2110-2249mTVDRT. Gas appears to be the only hydrocarbon phase present, no fluorescence was reported in the ditch cuttings during drilling. There is no evidence of a gas-oil or gas-water contact.

The net hydrocarbon sand calculation has been corrected for steeply dipping beds (18^0 measured by the dipmeter) from a total of 72m of net hydrocarbon bearing sand estimated from the MWD TVD log plot.

2. BASIC DATA

All depths in this report are loggers' depths in metres along hole (mRT) below the Rotary Table of the drill rig "Ocean Bounty", measured at 25.3m (unless stated otherwise). The seabed was tagged at 56.25 below mean sea level.

Longtom-1 was drilled to total depth of 2242m and two conventional logging suites were run in the open hole, Suite-1: 80-760m, Suite-2: 700-2240m (refer section 2.2, Table 1).

Longtom-1/ST1 was drilled to a total depth of 2445mMD (2274mTVD) with a maximum hole deviation of 45.8^0. Logs consist of open-hole DLL-MSFL-SDT-GR-SP-AMS from 1011.6-1779m and MWD dual resistivity and gamma ray from 1715-2445m (refer section 2.2, Table 2).

2.1 Basic Stratigraphy

The well intersected a sedimentary sequence ranging in age from Recent to Cretaceous. The reservoir sands were intersected in the Cretaceous, Judith Formation of the Lower Golden Beach Group.

Longtom-1

The Judith Formation was intersected by the well from 1533-1935mRT. At 1935mRT the well passed through a fault, coincident with the top of the Strzelecki Group which was 298m high to prognosis. The well was expected to intersect a full thickness of Judith Formation, on the downthrown side of the fault.

The lithology of the hydrocarbon bearing reservoir sands, from 1885-1935mRT, was described from the sidewall cores as consisting of subangular, poorly sorted quartz grains of fine to medium grainsize, associated with abundant argillaceous matrix and minor to abundant lithics and feldspars. Visual porosity was described as fair to poor.

Gamma ray log character over the reservoir section has a variety of patterns ranging from blocky with reasonably abrupt contacts, to upward coarsening and upward fining.

Longtom-1/ST1

The sidetrack well was positioned to intersect the reservoir sands within the Judith Formation at a significant distance from the fault. The well intersected the Judith Formation 20m deeper than expected, indicating a steeper average stratigraphic dip than originally mapped on this surface.

The lithology of the Judith Formation reservoir sands (2132-2445mMDRT) was similar to that described for Longtom-1 indicating reservoir quality had not improved away from the fault. From the ditch cuttings as the reservoir sands consisted of angular to subround quartz grains with moderate sorting, very fine to medium grain size, combined with a kaolinite matrix and cemented with calcite and trace amounts of silica. Associate minerals described were minor amounts of altered feldspars, trace amounts of glauconite, also nodular and disseminated pyrite. Visual porosity was described as poor.

2.2 Wireline Logs

Wireline logs were run by Schlumberger on a CSU logging unit. Tables 1 and 2 show the available log data, with temperature and time data.

Table 1
Longtom-1
Wireline Logs & Temperatures

Time Circ Stopped / Time log on bottom	TOOL STRING	Maximum Temp	INTERVAL
Suite 1			
16-5-95 3:35 /16-5-95 11:55	DLL-SLS-CAL-GR-AMS	50^0C	80-753m
Suite 2			
24-5-95 20:25 /25-5-95 6:55	AS-MSFL-DLL-GR-AMS	85^0C	700-2237m
/25-5-95 13:50	LDL-CNL-GR-AMS-FMS	91^0C	1011.6-2239m
/26-5-95 12:15	CSI (CHECKSHOT)	99^0C	100-2225m
/26-5-95 19:00	CST	99^0C	1048-2213m

The horner buildup temperature at 2240m is 105^0C .

Table 2
Longtom-1/ST1
Wireline Logs & Temperatures

Time Circ Stopped / Time log on bottom	TOOL STRING	Maximum Temp	INTERVAL
5-5-95 22:10 /6-5-95 10:30	DLL-MSFL-SDT-GR-SP-AMS	79^0C	1011.6-1779m
---	LWD GR-RESIS (SHALLOW & DEEP)		1715-2241

2.3 MWD Data

MWD was run in the sidetrack well from 1715-2241mMD as difficulties were being experienced with hole conditions and open-hole wireline logs could not be run.

A qualitative interpretation of the reservoir section is presented table 4.

2.4 Hole Conditions

Longtom-1

The data appears to be reliable. Through most of the reservoir section (1885-1935mRT) the hole is over gauge, but there does not appear to be any evidence of caving.

Longtom-1/ST1

Data quality of the logged section is variable and at times is unreliable. The caliper indicates sever washout throughout most of the logged section, although there are some intervals where the hole is in gauge and the data appears to be reliable.

2.5 Conventional Cores

No conventional cores were cut in either well.

2.6 Sidewall Cores

Sixty sidewall cores were attempted in Longtom-1, resulting in 59 recovered. The minerals identified along with the rock descriptions were used to help constrain the log interpretation.

Sidewall cores were not attempted in Longtom-1/ST1 because of the poor hole conditions and operational difficulties with running open-hole logs. The minerals identified from the ditch cuttings were used to help constrain the log interpretation.

2.7 Mechanical Sidewall Cores

No mechanical sidewall cores were cut in either well.

2.8 Wireline Formation Tests

An RFT program consisting of pretests and sampling was conducted to obtain reservoir pressure data and recover formation fluid in Longtom-1 (refer RFT Interpretation Report, P. Mitchell, 1995)

Samples were recovered from:

1900m
Recovery: from 2 3/4 gallon chamber
400cc total liquids
trace oil/condensate
wellsite gas analysis: C1 81.43, C2 14.31, C3 3.18, iC4 0.5, nC4 0.19, C5+ 0.03, CO_2 0.7.
1 gallon chamber remained sealed for PVT analysis.

A total 10 pretests were attempted in the reservoir section from 1885-1935mRT, of which 6 failed to stabilise, and the formation has been described as being tight (permeability estimated to be < 1md).

There was no RFT program for Longtom-1/ST1, because of the poor hole conditions.

2.9 Drill Stem/Production Tests

No drill stem tests or production tests were undertaken in either well.

2.10 Petrology

No cuttings or sidewall core material has been submitted for detailed petrographic analysis for either Longtom-1 or Longtom-1/ST1.

3. INTERPRETATION PROCEDURE

3.1 Data Preparation

Longtom-1

The Suite-2 open-hole wireline log data was read from tape and loaded into "Well Data System" (WDS), a log storage manipulation, interpretation and presentation software package developed by Western Atlas International Inc. The data was prepared for interpretation by depth-matching curves and by applying environmental corrections as per the Schlumberger chart book (1991).

3.2 Interpretation Model

The data was interpreted using a shaly sand interpretation model which incorporated the Juhaz Water Saturation Model. Shale fraction was derived from the gamma ray log and porosity from the density and neutron logs.

The interpretation parameters are given in Appendix 1.

3.3 Water Salinity

From 1890-1935mRT, a water salinity of 40,000ppm NaCl equivalent was used to estimate hydrocarbon saturations. This value is consistent with salinities used to estimate hydrocarbon saturations in offset wells and fields. It has been recognised (Kuttan et al., 1986) that quantitative evaluation of hydrocarbon zones in Gippsland Basin is complicated by the presence of a freshwater aquifer system, and that there is a 'background' salinity profile of 30,000-40,000ppm NaCl equivalent.

From 1935-2210mRT the salinity has been estimated to be 25,000ppm NaCl equivalent, significantly fresher than the overlying hydrocarbon zone.

3.4 Formation Electrical Properties

As no core data is available to measure the electrical properties of the reservoir units, the following default values were used:

$m=2$, $n=2$ and $a=1.0$

These values have been used consistently for interpretations in offset wells and fields.

Longtom-1/ST1

A qualitative review of the MWD data has been undertaken and the results are presented in section 4.2 Table 4.

4. INTERPRETATION RESULTS

4.1 Longtom-1

Table 3 contains a summary of the hydrocarbon zones intersected by the well. An analogue plot of the interpretation results is presented in Enclosure 1.

Table 3
Interpretation Results

Cut-offs
por > 0;Vsh < 50%

Zone	**Depth (mRT)**	**Gross (m)**	**Net (m)**	**N/G (%)**	**Por (%)**	**Sw (%)**	
Judith Fm	1891-1935	44.0	25.9	59	10	57	Gas
	1891-1895	4	3.0	76	9	56	Gas
	1899-1905.5	6.5	6.2	96	10	49	Gas
	1908-1917	9	5.5	61	11	48	Gas
	1922-1926	4	3.2	80	8	74	Gas
	1926-1931	5	3	61	7	77	Gas
	1931-1935	4	1.5	38	10	66	Gas
Strezelecki Fm	1935-2010	76.0				100	water

NB: All thicknesses are calculated using data recorded along hole.

REFERENCES

K. Kuttan, J.B. Kulla, R.G. Neumann 1986 - Freshwater Influx in the Gippsland Basin: Impact on Hydrocarbon Volumes and Hydrocarbon Migration. *APEA Journal*, 26, 242-249.

4.2 Longtom-1/ST1

Table 4 contains a summary of the hydrocarbon zones intersected by the well.

Table 4
Interpretation Results

Depth (mMDRT)	Depth (mTVDRT)	Net (m)		
Unit 1				
2132-2142	2046-2052	5	HKG	Caliper Poor Sig incr in ditch gas
2146-2149	2053-2058	2	Gas	Caliper Good
2178-2180	2080-2081	1	Gas	Caliper Good
Unit 2				
2217-2245	2110-2131	16	Gas	Caliper Variable Resis anomaly
2280-2296	2157-2169	12	Gas	Caliper Variable
2297-2307	2170-2175	5	Gas	Caliper Variable
2325-2375	2180-2225	25	Gas	Caliper Variable
2400-2408	2243-2249	6	LKG	Caliper Variable Sig resis anomaly

APPENDIX 1

LOG INTERPRETATION PARAMETERS

LONGTOM-1 BHP PETROLEUM

CURVE INPUTS

Porosity Density, Neutron

Vsh GR

Saturation Rt & Rxo

All input curve data have been corrected for environmental and borehole type effects.

INTERPRETATION PARAMETERS

DEPTH (mRT)	1880-1950	
Salinity (Rw) ppm NaCl Equiv	40,000	
Rsh	10	
GR API min	60	
GR API max	180	
DT sst shale filtrate	 55.6 80 189	
RHOB sst shale	 2.65 2.5	
CNL sst shale	 20 33	

a:1, m:2.0, n:2.0, BHT 105 °C Bit Size: 12.25"

PE600681

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DATE_RECEIVED =
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AUTHOR =
ORIGINATOR = BHP Petroleum Pty Ltd
TOP_DEPTH = 1889
BOTTOM_DEPTH = 1950
ROW_CREATED_BY = xls_kb00

(Inserted by DNRE - Vic Govt Mines Dept)

2

APPENDIX 2

BHP

LONGTOM-1 MDT REPORT

PREPARED BY : P. Mitchell
Petroleum Engineering
Consultant

APPROVED BY : [signature]

Y-S. Chow
Senior Petroleum Engineer

MANAGER'S APPROVAL : [signature]

M. Shircore
Development Planning Manager
ZOCA Asset Group

11mdtrpt.doc: Lgt-1/RE/F05/R

DATE: 4th July, 1996

BHP PETROLEUM PTY. LTD.
A.C.N. 006 918 832

EXECUTIVE SUMMARY

The Longtom-1 MDT gave the following results:

- A 1.50 psi/m water gradient was obtained from 1812.1 to 1829.1 mRT, and a gas gradient of 0.27 psi/m from two points at 1900.06 to 1904.58 mRT.

- One point in a water sand at 1797.1 mRT appeared to be in a lower pressure regime than the three deeper water points.

- The pressure in the gas zone was over 300 psi higher than the expected aquifer pressure at that depth. Assuming the gas is overlying an aquifer in the same pressure regime as that seen in the sands above, the possible gas water contact is at 2138.8 mRT.

- The formation permeability near the wellbore (based on the measured drawdown mobility and mud filtrate viscosity of 0.34 cp) ranged from 0.1 md to 15.9 md.

- One segregated gas sample was obtained from 1900.06 mRT.

- The aquifer was slightly overpressured relative to a fresh water gradient from surface.

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LIST OF FIGURES

1. OPERATIONS SUMMARY

The vertical exploration well, Longtom-1, was spudded on 12th May 1995 in permit VIC/P1 (Figure 1) to evaluate a three-way dip closure in the Judith Formation against a sealing fault on the downthrown side of a major WNW-ESE basin bounding terrace. The well reached a total depth of 2242 mRT on 24th May 1995. Appendix A summarises the basic well data.

A single MDT run was made commencing on 25th May 1995. Pretests were conducted over the interval 1797.1 mRT to 1930.1 mRT. A total of 23 pretests were attempted, of which one was a seal failure, 13 were tight and three were interpreted as supercharged. A segregated gas sample was taken at 1900.06 mRT

After completion of the logging program, the well was sidetracked to evaluate the downdip potential of the Judith Formation, but no MDT survey was conducted in the sidetrack due to poor hole conditions.

2. OBJECTIVES

The objectives of the Longtom-1 MDT program were as follows:

2.1 Determine formation pressures, fluid gradients and contacts (i.e. GOC, GWC, OWC) in each of the reservoir units intersected.

2.2 Obtain a representative segregated gas sample for compositional analysis onshore.

3. PRETEST INTERPRETATION

All pretest and sampling depth data are listed in Appendix B. The positions of the pretests and the sample point are shown on the log section presented in Figure 2.

3.1 Formation Pressures

Pretest pressures are plotted versus depth in Figure 3. The aquifer gradient from the three points at 1812.1 mRT, 1815.0 mRT and 1829.1 mRT was 1.50 psi/m; the gradient from surface was 1.48 psi/m, slightly overpressured relative to a fresh water gradient. The pretest pressure at 1797.1 mRT was 5.3 psi lower than predicted from the regression line through the three lower points. As the tool response indicates that all four points are valid tests, it appears that this sand is in a different pressure regime.

A plot of initial hydrostatic pressure versus depth (Figure 4) confirms that the CQG gauge is functioning properly during the pretests. The gradient of 1.63 psi/m from surface obtained with the CQG gauge (equivalent to 1.15 SG) was very close to that expected from the mud weight of 1.16 SG. The overbalance ranged from 24 psi in the gas zone at 1900.06 mRT to 327 psi in the upper water sand at 1797.1 mRT.

3.2 Fluid Gradients and Contacts

As discussed in Section 3.1, a water gradient of 1.50 psi/m was obtained from 1812.1 mRT to 1829.1 mRT. Also, a gas gradient of 0.27 psi/m was obtained from two points at 1900.1 mRT and 1904.6 mRT. There was no evidence of an oil gradient , and no fluid contacts were observed.

The pressures in the gas zone were over 300 psi higher than the expected aquifer pressure at this depth, based on the data from the sands above. This high pressure may be caused by communication with a deeper sand via the adjacent fault, or by a substantial hydrocarbon column.

An estimate was now made of the possible gas-water contact (GWC) depth, assuming the gas to be overlying an aquifer in the same pressure regime as the sands between 1812.1 and 1829.1 mRT. There was considerable uncertainty in the gas gradient from the pretests, as it was defined from two points only 4.5m apart. Accordingly, a gradient was derived (using Ref. 1) from the laboratory analysis of the gas sample (Ref. 2) - it was found to be 0.20 psi/m.

As can be seen in Figure 5, the possible GWC under these assumptions was estimated to be 2138.8 mRT. As the top of the gas reservoir is at 1891 mRT (Ref. 3), the possible gas column height is 247m. It is also possible that there may be an oil leg.

3.3 Formation Permeabilities

The permeability of the reservoir immediately adjacent to the wellbore ranges from 0.1 to 15.9 md. These values are based on the measured drawdown mobility of the valid tests, using a mud filtrate viscosity of 0.34cp (derived from the filtrate salinity and downhole conditions using Ref. 1).

A full listing of permeabilities is included in Appendix B.

4. SAMPLING RESULTS

One segregated gas sample was collected from 1900.06 mRT. The tool was released and reset by the Schlumberger engineer between the two samples, but this did not appear to compromise the quality of the sample in the one-gallon chamber (Ref. 2). On opening the 2¾ gallon chamber at surface, 400ml of filtrate and 62.1 scf of gas were recovered; the opening pressure was 2150 psig. The one gallon chamber was sealed for laboratory analysis.

The results of the sampling program are summarised in Appendix C.

5. SERVICE QUALITY

No problems were experienced with the MDT tool, but there was a power failure in the Maxus unit during the pretest program, which caused some delays. As mentioned in Section 4, while collecting the segregated sample the Schlumberger engineer released the tool after sealing the 2¾ gallon chamber, and then reset it before opening the one-gallon chamber. While this was done because of concerns about the tool sticking, it could have severely compromised the quality of the one-gallon sample. However, on this occasion, a good gas sample was still obtained for laboratory analysis.

The Schlumberger engineer did not appear to be familiar with the MDT tool, as he did not suggest that the pretest size be reduced when consistently low permeabilities were encountered.

6. RECOMMENDATIONS

6.1 Wellsite geologists should be given further training in the supervision of MDT and MDT surveys.

6.2 An MDT Procedures Manual should be in place on all BHPP-operated rigs.

6.3 The tool should not be released partway through collection of a segregated sample without the prior approval of the supervising BHPP engineer, except in an emergency.

7. REFERENCES

1. PanSystem Version 2.3, Fluid Parameters Module, Edinburgh Petroleum Services Ltd, October 1995.

2. Volant, M.: 'Longtom-1 Reservoir Fluid Study', Petrolab, 26th June 1995.

3. Cernovskis, A.: 'Longtom-1 Petrophysical Interpretation Report', BHPP, July 1995, BHPP File Ref. Lgt-1/PP/S01/R.

WELL DATA SHEET

Well:	**Longtom-1**
Permit:	VIC/P1
Location:	Lat: 38° 6' 0.03" South Long: 148° 18' 54.28" East
Rig:	Semi Submersible Ocean Bounty
Seismic Reference:	G91A-2004, SP 2582
RT Elevation:	25 m above MISLW
Water Depth:	56 m
Well TD (12.25" Hole):	2242 mRT
Spud Date:	12th May 1995
Date Reached TD:	24th May 1995
Well Status:	Plugged and Abandoned
Mud Weight during MDT:	1.16 SG
Casing Points:	20" 117 mRT $13^3/_8$" 1012 mRT

LONGTOM-1 MDT RAW PRETEST DATA

Well:	Longtom-1	Date:	25-May-95	BHP Engineer:	P Mitchell (not on location)
Rig:	Ocean Bounty	Run no.:	One	BHP Wellsite Geologists:	S Horan/K Haak
RT above MSL:	25 m	CQG No.	98	Schlumberger Engineers:	R Jonsson/S Hookway

Seat	Depth		Time	Initial Hydrostatic Pressure		Formation Pressure		CQG Temperature [°C]	Final Hydrostatic Pressure		Pretest Size [cm³]	Drawdown Mobility [md/cp]	Permeability (md) (mw= 0.34cp)	Comments
	[mRT]	[mSS]		Strain [psig]	CQG [psia]	Strain [psig]	CQG [psia]		Strain [psig]	CQG [psia]				
1	1797.06	1772.06	23:46	2951.5	2960.5	2624.5	2633.83	83	2951.4	2960.6	20	21.9	7.4	Valid Test
2	1812.05	1787.05	0:12	2976.1	2985.5	2652.1	2661.67	83	2975.8	2984.8	20	5.2	1.8	Valid Test
3	1815.00	1790.00	0:26	2980.8	2990.3	2656.5	2665.69	84	2980.8	2989.8	20	46.8	15.9	Valid Test
4	1829.07	1804.07	0:36	3003.5	3013.0	2677.0	2687.00	84	3003.3	3012.5	20	1.8	0.6	Valid Test
5	1892.87	1867.87	1:49	3107.0	3116.3			86	3107.0	3116.1	20			Tight
5A	1893.07	1868.07	8:21	3109.4	3118.4	3095.4	3104.48	89	3109.4	3118.4	5	1.0	0.3	Slightly Supercharged
6	1894.07	1869.07	1:58	3109.2	3118.4			86	3109.1	3118.4	20			Tight
6A	1894.58	1869.58	8:43	3111.8	3120.9			89	3111.6	3120.8	5			Tight
7	1900.06	1875.06	2:06	3119.1	3128.24	3094.6	3103.77	86	3119.4	3128.4	20	43.2	14.7	Valid Test: collected gas sample
8	1904.06	1879.06	5:25	3127.7	3136.9			88	3127.5	3136.6	20			Tight
8A	1904.58	1879.58	6:04	3128.4	3137.7	3095.7	3104.97	88	3128.5	3137.7	5	32.8	11.2	Valid Test
9	1908.46	1883.46	5:35	3134.7	3143.7	3108.3	3117.65	88	3134.6	3143.9	20	2.6	0.9	Supercharged
10	1911.07	1886.07	6:14	3138.8	3148.1			88	3138.6	3147.9	20			Tight
10A	1911.58	1886.58	6:26	3139.6	3148.77	3113.8	3123.0	88	3139.6	3148.7	10	0.3	0.1	Supercharged
11	1914.40	1889.40	6:54	3144.2	3153.5			88	3144.1	3153.3	5			Tight
11A	1914.47	1889.47	6:46	3144.2	3153.4			88	3144.2	3153.3	5			Tight
12	1916.55	1891.55	7:20	3147.5	3156.8			88	3147.3	3156.6	5			Tight
12A	1916.63	1891.63	7:07	3147.6	3156.9			88	3147.4	3156.8	5			Tight
13	1924.02	1899.02	7:28	3159.5	3168.7			88	3159.4	3168.7	5			Tight
14	1925.07	1900.07	7:35	3161.2	3170.4			88	3161.0	3170.3	5			Tight
15	1929.07	1904.07	7:44	3167.6	3176.7			89	3167.6	3176.6	5			Seal Failure
15A	1929.07	1904.07	7:49	3167.6	3176.6			89	3167.4	3176.5	5			Tight
16	1930.08	1905.08	8:10	3169.1	3178.1			89	3168.9	3178.0	5			Tight

Tool Configuration: AMS-GR-MDT

MDT Modules:

MRPC	Electric Power
MRSC-BB	1 gallon
MRSC-DB	2.75 gallon
MRSC-BA	1 gallon
MRHY	Hydraulics
MRPS	Single probe (standard packer, CQG and strain gauge)
MRSC-EB	6 gallon

Reference Log: DLL-MSFL-SDT-GR-AMS-SP-CAL
Suite 2 Run 1, 25 May 1995

LONGTOM-1 MDT S[illegible]LES

APPENDIX C

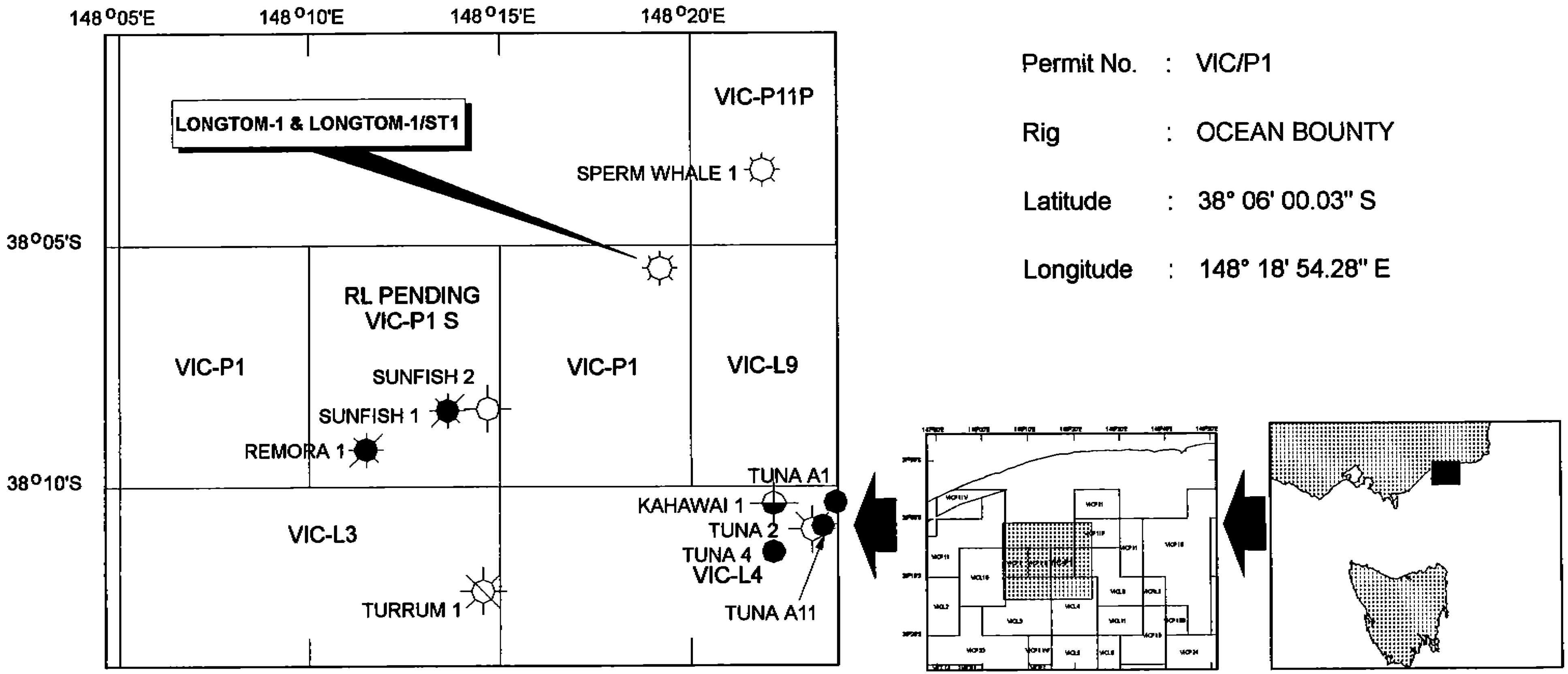
Well:	Gwydion-1	Date:	9th June 1995
Rig:	Sedco 702	Run No.:	One

BHP Engineer:	Philip Mitchell (not on location)
BHP Wellsite Geologist:	T Robertson/D Lockhart
Schlumberger Engineers:	A Fredheim/R Winata

	MUD SAMPLE	MDT SAMPLES						
Sampling Data								
Sample Depth [mRT]	-	**1900.1**		**1900.1**	-	-	-	-
Run No.	-	1		1	-	-	-	-
Chamber Number	-	DB-68		BA-21	-	-	-	-
Chamber Size	-	$2^3/_4$ gallon		1 gallon	-	-	-	-
Sample Type	**Mud**	**Gas**		**Gas**	-	-	-	-
Formation Pressure [psia]	-	3103.77		3103.77	-	-	-	-
Temperature [°C]	-	86		86	-	-	-	-
Sampling Pressure [psia]	-	Approx 1200		Approx 1000	-	-	-	-
Final Pressure (psia)		3099.14		3095.57	-	-	-	-
Time to Fill [mins]	-	103		54	-	-	-	-
Opening Pressure [psig]	-	2150		Sealed for lab	-	-	-	-
Gas Volume, [scf]	-	62.1			-	-	-	-
Total liquids [ml]	-	400			-	-	-	-
Oil/Condensate Volume [ml]	-	Trace			-	-	-	-
Filtrate/Water Volume [ml]	-	400			-	-	-	-
Gas Oil Ratio [scf/stb]	-	-			-	-	-	-
Condensate Gas Ratio [stb/MMscf]	-	-			-	-	-	-
Oil Analysis								
Specific Gravity	-	-		-	-	-	-	-
Colour	-	-		-	-	-	-	-
Wellsite Measurement of Gas Composition (Mol %)								
N2	-	-	-	-	-	-	-	-
CO2	-	0.70	0.70	-	-	-	-	-
C1	-	81.43	84.15	-	-	-	-	-
C2	-	14.31	12.26	-	-	-	-	-
C3	-	3.18	2.41	-	-	-	-	-
iC4	-	0.50	0.37	-	-	-	-	-
nC4	-	0.19	0.09	-	-	-	-	-
C5+	-	0.03	0.02	-	-	-	-	-
Water Analysis								
KCl [wt %]	7.5	7.0		-	-	-	-	-
Chlorides [mg/l]	56,000	62,000		-	-	-	-	-
Potassium [mg/l]	NA	NA		-	-	-	-	-
pH	10.0	6.8		-	-	-	-	-
Total hardness [mg/l]	NA	860		-	-	-	-	-

LONGTOM-1 & LONGTOM-1/ST1
Location Map

BHP



Permit No.	:	VIC/P1
Rig	:	OCEAN BOUNTY
Latitude	:	38° 06' 00.03" S
Longitude	:	148° 18' 54.28" E

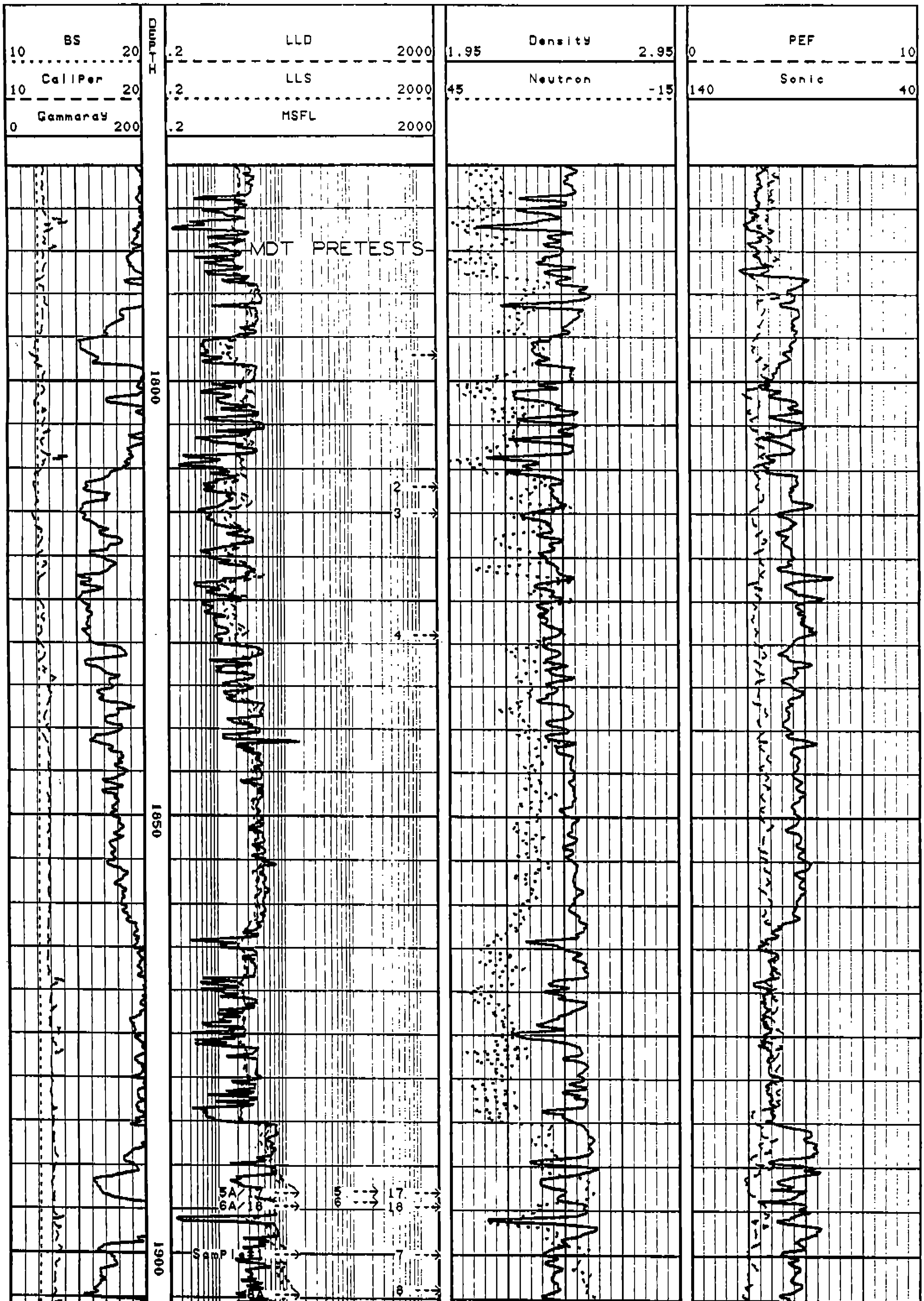
LONGTOM.PRE
December, 1995

Australia Division
BHP Petroleum

LONGTOM-1

Figure 2

Composite Log showing MDT Pretest and Sample Points



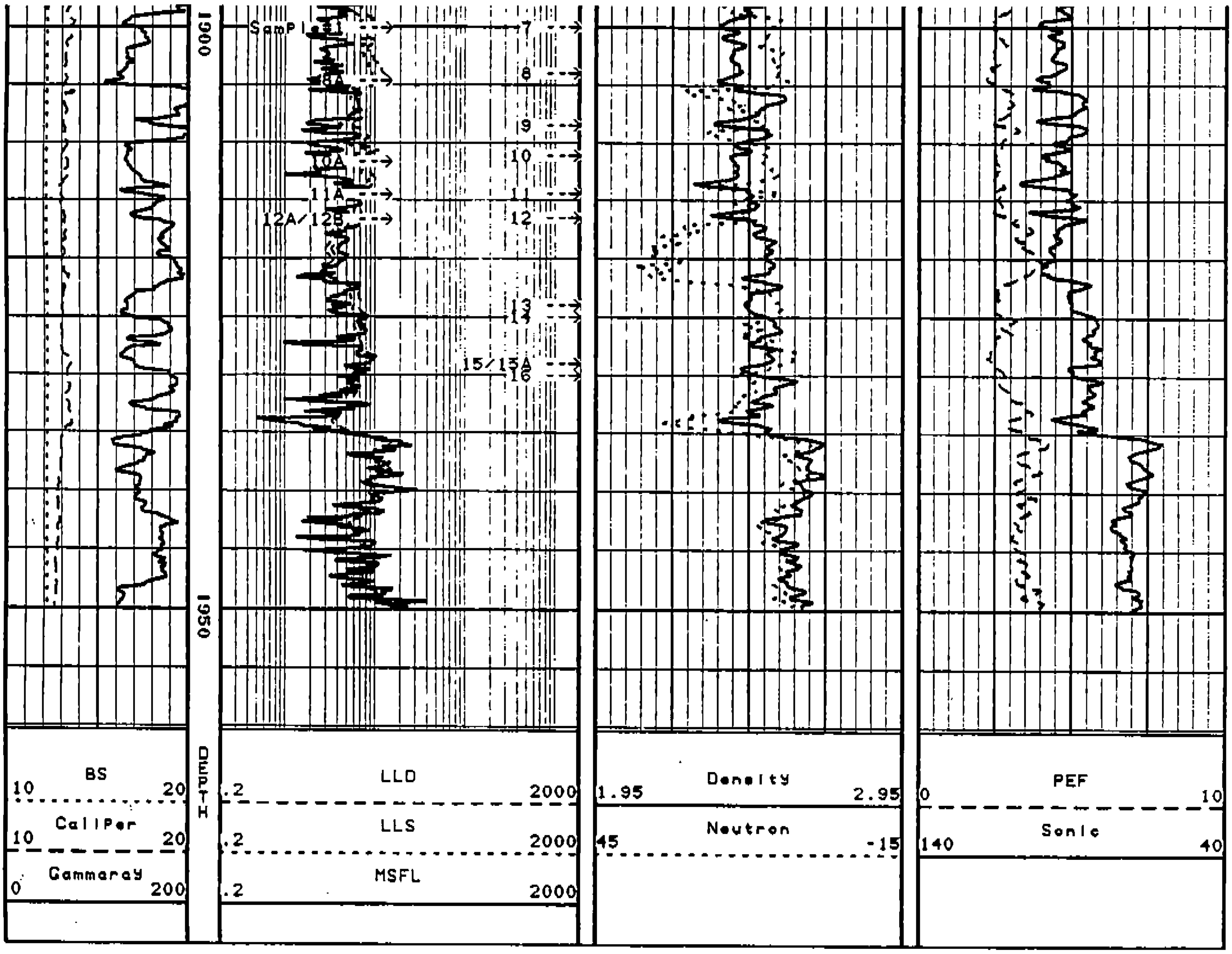
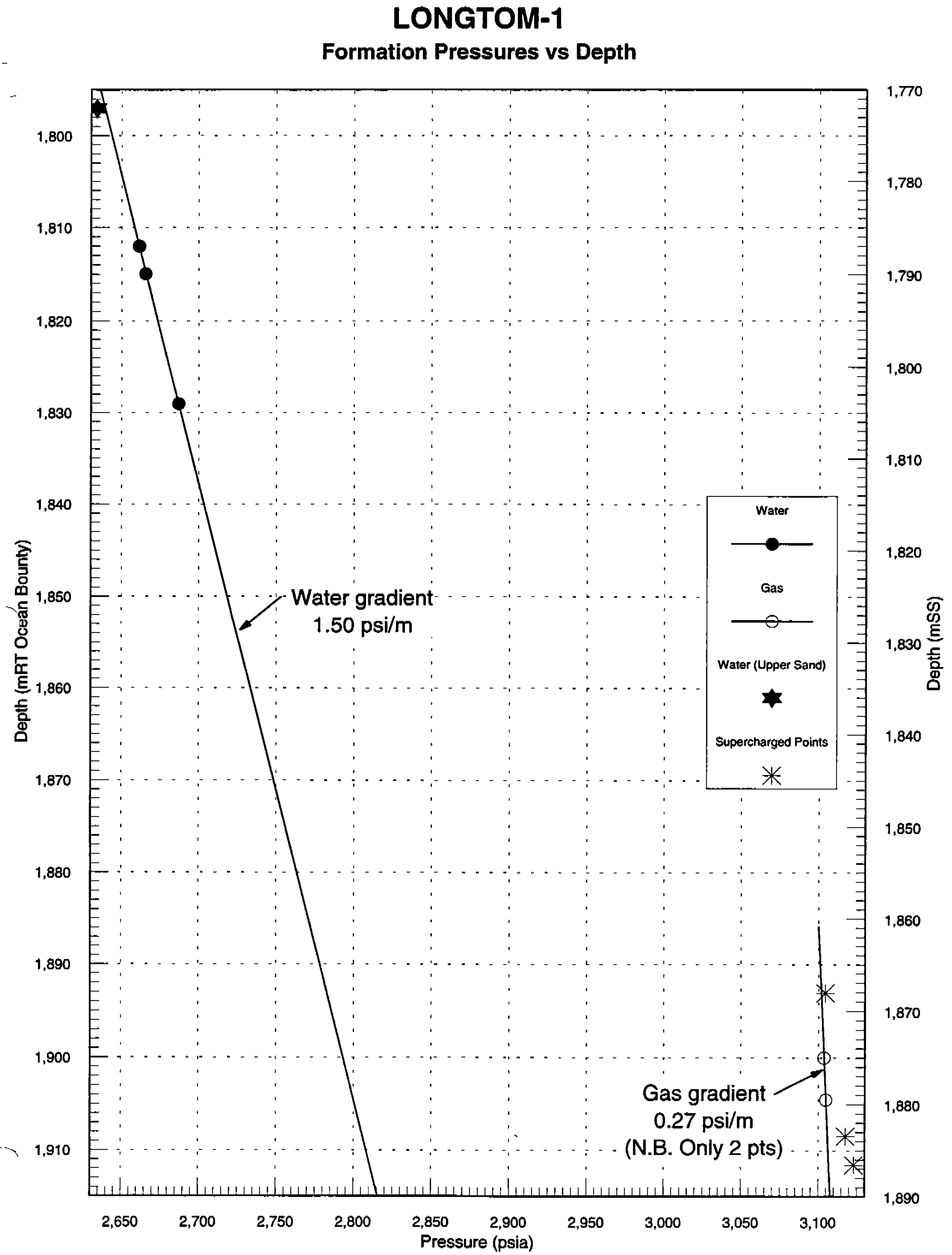
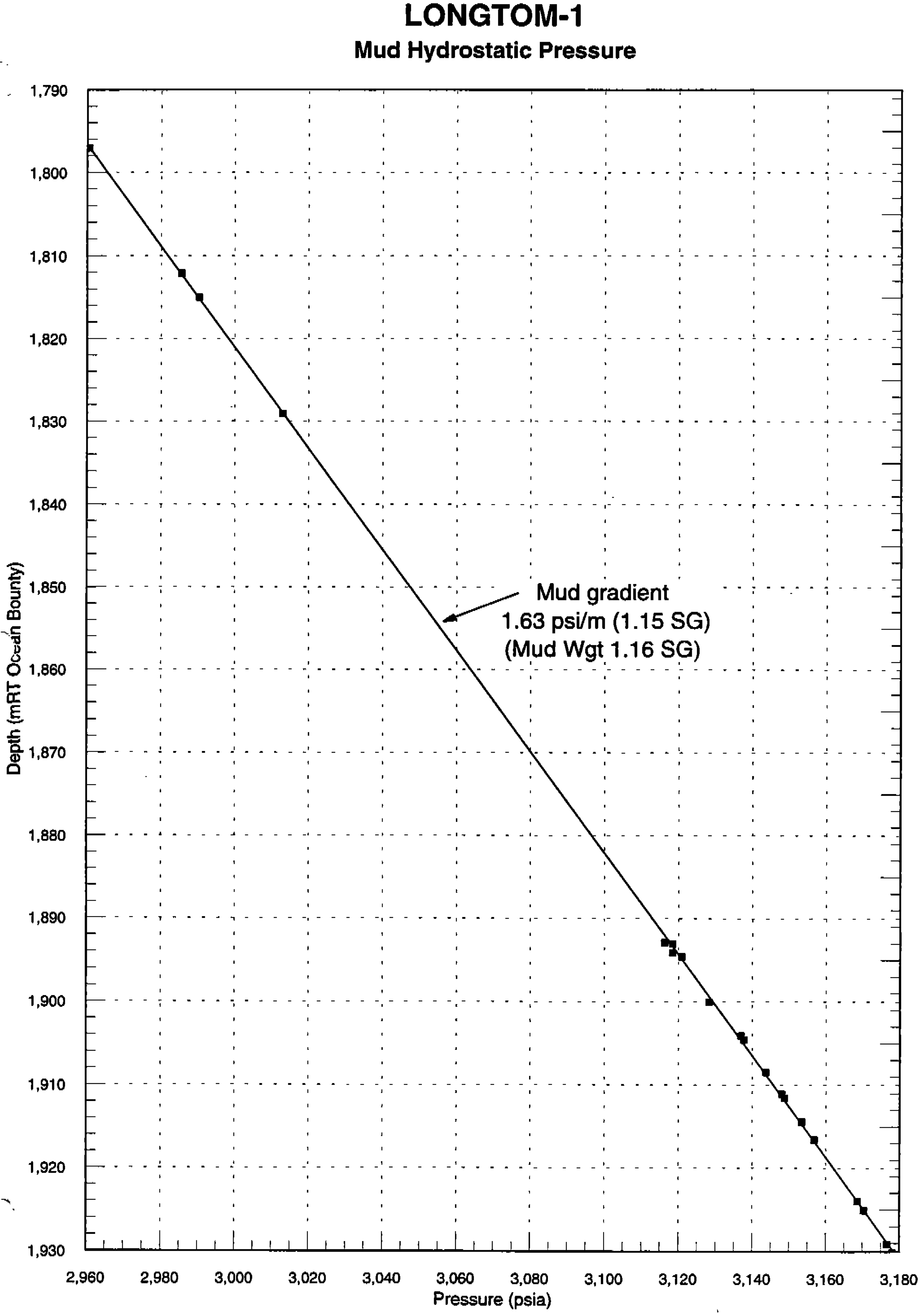

1900
1950
DEPTH
Samples
7
8
8A
9
10
10A
11
11A
12
12A/12B
13
14
15/15A
16
BS
10
20
Caliper
10
20
Gammaray
0
200
LLD
.2
2000
LLS
.2
2000
MSFL
.2
2000
Density
1.95
2.95
Neutron
45
-15
PEF
0
10
Sonic
140
40

Figure 3



LONGTOM-1
Formation Pressures vs Depth
Depth (mRT Ocean Bounty)
Depth (mSS)
Pressure (psia)
1,800
1,810
1,820
1,830
1,840
1,850
1,860
1,870
1,880
1,890
1,900
1,910
1,770
1,780
1,790
1,800
1,810
1,820
1,830
1,840
1,850
1,860
1,870
1,880
1,890
2,650
2,700
2,750
2,800
2,850
2,900
2,950
3,000
3,050
3,100
Water gradient
1.50 psi/m
Gas gradient
0.27 psi/m
(N.B. Only 2 pts)
Water
Gas
Water (Upper Sand)
Supercharged Points

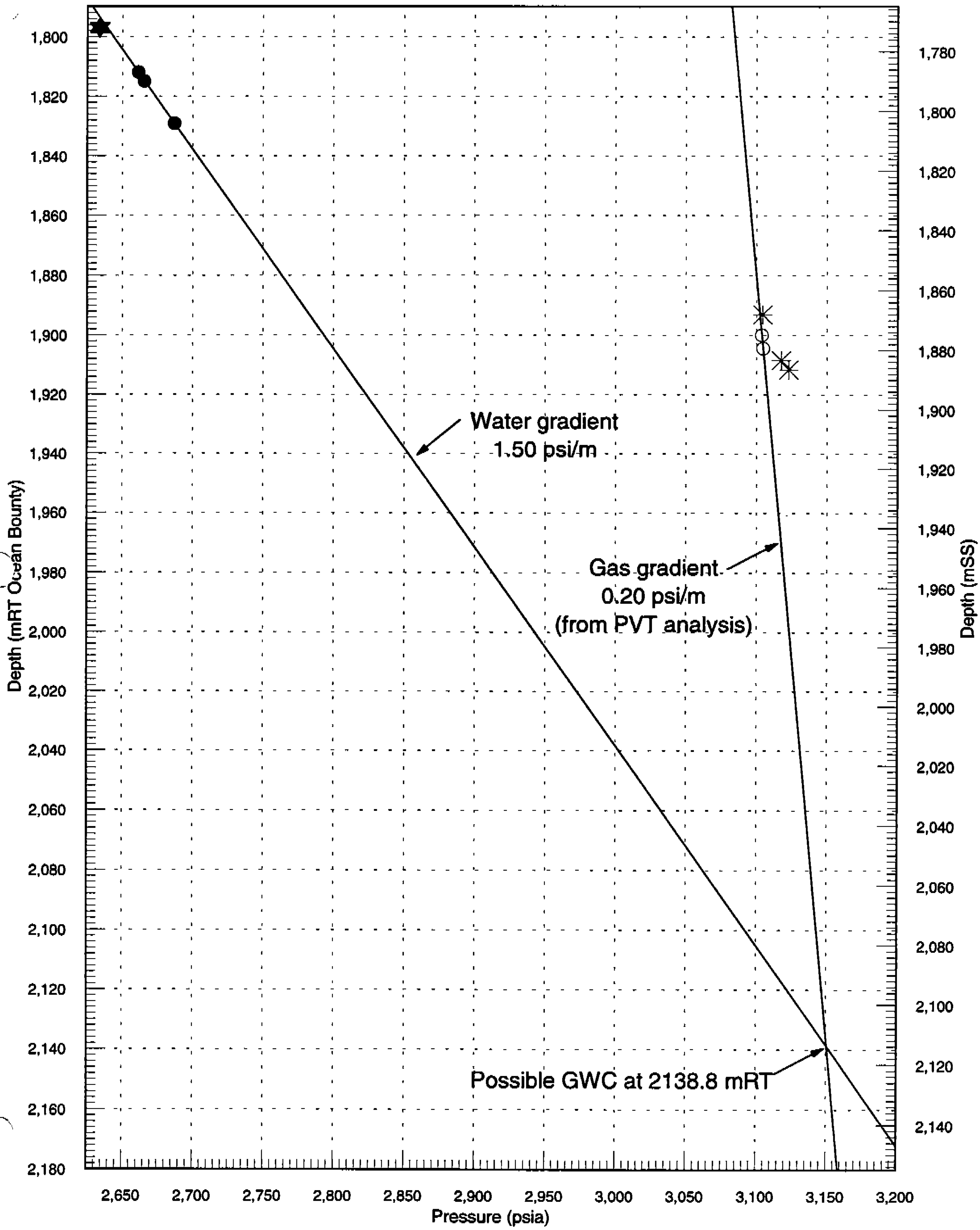
Figure 4



LONGTOM-1
Mud Hydrostatic Pressure
Depth (mRT Ocean Bounty)
Depth (mSS)
Pressure (psia)
Mud gradient
1.63 psi/m (1.15 SG)
(Mud Wgt 1.16 SG)
1,790
1,800
1,810
1,820
1,830
1,840
1,850
1,860
1,870
1,880
1,890
1,900
1,910
1,920
1,930
1,770
1,780
1,790
1,800
1,810
1,820
1,830
1,840
1,850
1,860
1,870
1,880
1,890
1,900
2,960
2,980
3,000
3,020
3,040
3,060
3,080
3,100
3,120
3,140
3,160
3,180

LONGTOM-1

Estimation of Possible GWC by Extrapolation of Pressure Gradient Data



3

APPENDIX 3

Palynological Analysis
of
Longtom-1 and Sidetrack
Gippsland Basin.

by

Alan D. Partridge

Biostrata Pty Ltd
A.C.N. 053 800 945

Biostrata Report 1995/13

31 August 1995

CONTENTS

INTERPRETATIVE DATA

BASIC DATA

INTERPRETATIVE DATA

Introduction

Thirty-five samples have been analysed from Longtom-1 comprising twenty-eight sidewall cores and five cuttings samples from the original hole and an additional two cuttings samples from the Sidetrack hole. Lithological units and palynological zones recognised are given in the following summary. The interpretative data with zone identification and Confidence Ratings are recorded in Tables 1A-B and basic data on residue yields, preservation and diversity are recorded on Tables 2A-B. All species which have been identified with binomial names are tabulated on separate palynomorph range charts for the Strzelecki and Golden Beach Groups and a combined chart for the Latrobe and Seaspray Groups. Relinquishment lists for palynological slides and residues from samples analysed in Longtom-1 are provided at the end of the report.

An average of 11 grams of the sidewall cores and 10 grams of the cuttings were processed for palynological analysis (Tables 2A-B). Residue yields were low to very low from the Seaspray Group but mainly high from the older Latrobe, Golden Beach and Strzelecki Groups. Palynomorph concentration were mostly moderate to high with mainly fair to good preservation from the Seaspray and Latrobe Groups but declined to mainly low to moderate concentrations in the deeper Golden Beach and Strzelecki Groups in line with a decline in overall preservation to poor to fair. Spore-pollen diversity averaged 24+ species/sample over all samples but was highest in the Latrobe Group at 37+ species/sample. Microplankton diversity was on average 10+ species/sample in the Seaspray Group, 3+ species/sample in the Latrobe and Golden Beach Groups but less than one species/sample in the Strzelecki Groups.

Palynological Summary of Longtom-1

AGE	UNIT/FACIES	SPORE-POLLEN ZONES (MICROPLANKTON ZONES)	DEPTHS (metres)
MIDDLE MIOCENE TO EARLY MIOCENE	SEASPRAY GROUP Gippsland Limestone 80-1184m Lakes Entrance Fm. 1184-1245m	*T. bellus* (*Operculodinium* Superzone) Middle *P. tuberculatus* (*Operculodinium* Superzone)	1048-1177 (1048-1177) 1242-1244 (1242-1244)
MIDDLE EOCENE	LATROBE GROUP Gurnard Formation 1245-1256m	Lower *N. asperus* *(A. australicum)*	1253 (1253)
EARLY EOCENE EARLY EOCENE LATE PALEOCENE PALEOCENE MAASTRICHTIAN	LATROBE GROUP Undifferentiated coastal plain facies of shales, coals and sands 1256-1533m	*P. asperopolus* Lower *M. diversus* (*A. hyperacanthum*) Upper *L. balmei* (*A. homomorphum*) Lower *L. balmei* Upper *T. longus*	1268 1308 (1308) 1358 (1358) 1428 1483-1510
CAMPANIAN	Unnamed Volcanics 1533-1568m	NOT ANALYSED	
TURONIAN	GOLDEN BEACH GROUP Lacustrine shales and fluviatile sands, siltstones and shales 1568-1935m	*P. mawsonii* and *H. trinalis* Subzone † (*Rimosicysta* Superzone)	1567-1934* (1567-1862)
APTIAN - BARREMIAN	STRZELECKI GROUP Fluviatile sands and shales 1935-2236m	*P. notensis* ‡	1986-2172

T.D. 2242m

NOTES:
- * Two cuttings samples analysed from Longtom-1 Sidetrack between 2316-2445m are both from *H. trinalis* Subzone† of *P. mawsonii* Zone.
- † *Hoegisporis trinalis* Subzone is a new zone used for the first time in the Gippsland Basin.
- ‡ The *Pilosisporites notensis* Zone is a new zone recently proposed by Morgan et al. (1995) as a partial replacement for the *Cyclosporites hughesii* Zone.

Geological Comments

1. Longtom-1 located on the Northern Strzelecki Terrace penetrates an abridged sections of the four major groups recognised in the Gippsland Basin. The boundaries between the Seaspray, Latrobe and Golden Beach Groups are major unconformities, while the boundary between the Golden Beach Group and underlying Strzelecki Group intersected in the original Longtom-1 hole is interpreted as a faulted contact.

2. The Longtom-1 Sidetrack diverted to the downthrown side of the fault intersected more section of the Golden Beach Group and terminated whilst still within this unit according to the palynological analysis of cuttings.

3. Only the basal 208 metres of Seaspray Group below the 13.375 inch casing point at 1037m was analysed. The section is subdivided into the Lakes Entrance Formation overlain by the Gippsland Limestone by a good log break at 1184m which is well expressed on the gamma, sonic and density/porosity logs. The largely Middle Miocene *T. bellus* Zone was identified in four samples distributed through the Gippsland Limestone while only two samples were analysed from the basal five metres of the Lakes Entrance Formation. These gave a Middle *P. tuberculatus* Zone or younger age suggesting that most if not all of the Oligocene is missing at the base of the Seaspray Group. In this the palynology is consistent with the foraminiferal ages in the adjacent wells Sunfish-2 and Sperm Whale-1 where the Early Miocene zonule G is the oldest foraminiferal zone identified.

4. The one sample analysed from the 11 metres thick Gurnard Formation between 1245-1256m at the top of the Latrobe Group provides a good Middle Eocene date near the base of the unit. The thinness of the unit suggests that it may represent only the Middle Eocene and if so the unconformity at the top of the Latrobe would include Late Eocene as well as Oligocene and have a duration of up to 11 million years according to current correlations to the time scale of Haq *et al.* (1987, 1988).

5. The sedimentary package from the base of the Gurnard Formation at 1256m to the top of a massive sandstone at 1270.5m is unusual and unexpected in this part of the basin. The unit from its base consists of a shale interbedded and overlain by two coal seams (at 1263-1265m and 1267-1267.8m), in turn overlain by a fining up sand (1256-1263m). The Early Eocene *P. asperopolus* Zone age from the shale immediately below the coals makes these coals the most easterly coals in the basin assigned to either the *P. asperopolus* or

N. asperus Zones, and the only coals of this age found east of the Marlin Channel. These sediments which are clearly deposited in a coastal plain environment are also facies equivalent of the youngest part of the Flounder Formation in the Tuna field 10 kms to the southeast of Longtom-1.

6. The massive sand between 1270.5-1294.5m is also most likely a facies equivalent of the Flounder Formation and the major sequence boundary corresponding to the cutting of the Tuna-Flounder Channel probably lies within or at the base of this sand. The sand is most likely to be *P. asperopolus* or Upper *M. diversus* Zone in age, with the older Middle *M. diversus* and most of the Lower *M. diversus* Zones removed by erosion.

7. The discovery of the *A. hyperacanthum* microplankton Zone at 1308m in Longtom-1 together with an equivalent occurrence in Sweetlips-1 at 1559m (Partridge 1990a) represents the two most northern records of this marine incursion into the Gippsland Basin. The zone was recorded in Longtom-1 interbedded with and immediately above a coal but is not distinguished by any particularly signature on the electric logs. This is consistent with most other wells in the basin. The *A. hyperacanthum* Zone marine incursion appears to have been a very short duration event which did not allow time for deposition of a lithologically distinctive marker bed.

8. The interval from 1294.5m to top of volcanics at 1533m is a relatively homogenous sequence of interbedded sands, shales and coals typical of the coastal plains facies in the Gippsland Basin. The Early Eocene and two Paleocene sample all contain marine dinoflagellates indicating consistent marine influence while the two Maastrichtian samples are both non-marine. The thickest sand in this interval at 1434-1463m conveniently separates the marine and non-marine samples and based on available age dating probably is approximately at the level of the Mid-Paleocene seismic marker. The Cretaceous/Tertiary boundary is poorly constrained by the available samples in Longtom-1 but if the latter interpretation is correct it should lie below this sand. The most likely position is within the thin shale bed between 1462-1474m.

9. The volcanics between 1533-1568m lie on the unconformity surface between the Golden Beach and Latrobe Groups. The duration of the unconformity from the palynological dating, extends from probable early Turonian to latest Maastrichtian, a period in excess of 20 million years. As the extrusion of volcanics would only represent a fraction of this time regional correlation across the basin suggests they are most likely Campanian in age. As such

they are closer in age to the Latrobe Group sediments and are best included in that group.

10. The 375+ metres thick Golden Beach Group deposited between 1568-1935m is interpreted to represent alternating episodes of lacustrine and fluviatile deposition. The lacustrine environments can be subdivided into "deep" and "shallow" lakes based on combined log and palynological analysis. The "deep" lakes are characterised by the more diverse microplankton assemblages with microplankton relative to spore-pollen abundances typically between 5% to 30%. The "shallow" lakes are characterised by monotypic or nearly monotypic microplankton assemblages with variable microplankton abundances from <1% to 20%.

    Three episodes of "deep" lakes are interpreted to occur in Longtom-1 from combined log and palynological analysis. The most distinctive is at the top of the sequence between 1564-1617m. It is characterised by a constant or slightly coarsening-up gamma ray log; a broad separation on the density/neutron porosity logs and a sonic log which shows a sharp break to slower sediments at the base and then gradually increases in velocity up section. In the two sidewall cores analysed from this lacustrine shale episode the basal sample at 1615m has a microplankton diversity of eight species and abundance of 26% relative to the spore-pollen. The sample at 1567m near the top of the shale has a recorded microplankton diversity of just three species and abundance of only 5%. A distal offshore environment of deposition is also favoured by the spore-pollen assemblages which show a distinct "Neves effect" with high abundances of gymnosperm pollen. This effect is most extreme in the bottom sample where gymnosperm pollen comprise 85% of the pollen count and gymnosperm pollen of the *Araucariacites/Dilwynites* complex an exceptionally high 75%. The "Neves effect" is a tendency for bisaccate pollen, and other buoyant spores and pollen with "comparatively greater transportability" to have greater relative abundance the further offshore you go in any depositional basin (Traverse 1988, p.413). This feature has previously been recognised and commented on in Admiral-1 (Partridge 1990b). The other two "deep" lake episodes are interpreted on log character and limited palynological sampling to lie between 1759-1788m and 1861-1885m. Most notable for both episodes is the slow sonic log.

    The "shallow" lakes are characterised by thinner shale beds and hence are undoubtedly more ephemeral. Only the sidewall cores at 1721m and 1922m clearly belong to this category, and of these the deeper sample provides a more distinctive log signature. A "shallow" lake is interpreted for the interval 1917-1923m which is characterised by a broad separation on the density/neutron porosity logs but without any particular characteristic signature on either the gamma or sonic logs. The palynological assemblage at 1922m within this shale contain a microplankton abundance of 21% comprised of a single fresh water algal species. The spore-pollen assemblage is dominated by spores 61% with *Cyathidites minor* at 30% and *Gleicheniidites circinidites* at 20% the dominate species. Unlike the "deep" lakes there was no "Neves effect" and gymnosperm pollen of the *Araucariacites/Dilwynites* complex comprised only 6% of the total pollen count.

11. Another "shallow" lake environment may be represented by the shale between 1885-1889m as it does not have a broad separation of the density/porosity logs nor a slow sonic. This shale is moreover of particular interest as it immediately overlies the gas column in Longtom-1 between 1889-1935mKB yet underlies, with quite a sharp break on the logs, the oldest identified "deep" lake episode between 1861-1889m.

    The following environmental interpretation can be applied to the deposition of these two shales. The older shale between 1885-1889m starts out as a shallow lake which following a sudden deepening of the basin, perhaps as the result of a tectonic event, is replaced by a deep lake depositing finer more distal lake facies between 1861-1889m. As the lake fills up it returns to mixed "shallow" lake and fluviatile facies over the interval 1788-1861m which is in turn replaced by the next "deep" lake episode.

    In terms of sequence stratigraphy analysis the shale between 1885-1889m would be equivalent to the last part of a Transgressive Systems Tract, the sharp log break at 1885m would be a Downlap Surface and the overlying shale between 1861-1885m part of a Highstand System Tract with a probable condensed section at its base.

12. Considering the stratigraphic nomenclature applied to the Golden Beach Group the "deep" lake facies would be equivalent to the Kipper Shale while the mixed "shallow" lake and fluviatile facies would be equivalent to the Judith Formation. The palaeogeographic location of Longtom-1 along the probable northern margin of the purported "Kipper lake" makes it much more likely to have a higher percentage of the shallow facies typical of the Judith Formation. Because the base of the oldest "deep" lake facies approximates the top of the gas column in Longtom-1 it is speculated that the base of this facies is an effective regional seal within the Golden Beach Group. For this to be true the fluviatile sands and siltstones interbedded with the three "deep" lake episodes in Longtom-1 would need to pinch out to the south and the three "deep" lake episodes merge to form a thick unbroken

"deep" lake facies. Based on the above speculation the preferred choice for the boundary between the Judith and Kipper Formations is at the base of the oldest "deep" shale facies at 1885m.

13. Palynological correlation of the Golden Beach Group in Longtom-1 to specific intervals of the thick sections of this group penetrated in other wells is currently not possible with any confidence because the key species used to define the new *Hoegisporis trinalis* Subzone of the *P. mawsonii* Zone have not been reported (or not consistently recorded) in palynological studies prior to 1990. Presently the in *H. trinalis* Subzone can only be recognised in Admiral-1 between 1912-2103.5m (Partridge 1990b), and in the adjacent Sweetlips-1 and Emperor-1 wells based on the recent review by Partridge (1993). Unfortunately, confident correlation is not possible to either of the thick sections of the Golden Beach Group penetrated in Kipper-1 and Judith-1 because of the lack of key species in the recorded assemblages. Both these wells require additional microscope examination of existing material.

14. The Strzelecki Group in Longtom-1 is assigned to the *Pilosisporites notensis* Zone recently established by Morgan *et al.* (1995) as a replacement for the *C. hughesii* Zone. This change is desirable because the *C. hughesii* Zone is being applied to sections in the Bass Strait basins using different criteria which have created confusion and/or ambiguity.

Biostratigraphy

Zone and age determinations are based on the spore-pollen zonation scheme proposed by Stover & Partridge (1973), partially modified by Stover & Partridge (1982) and Helby *et al.* (1987). The Tertiary microplankton zones identified are based on a scheme developed but only published in outline by Partridge (1975, 1976), while the *Rimosicysta* Superzone identified in the Golden Beach Group is a name applied to the unusual algal cyst assemblages described by Marshall (1989).

Author citations for most spore-pollen species identified and discussed can be sourced from Stover & Partridge (1973, 1982), Helby *et al.* (1987) or references quoted in those papers. Dinoflagellates can be found in the index of Lentin & Williams (1993) and acritarchs and other organic walled algae can be found in the index of Fensome *et al.* (1990). Species names followed by "ms" are unpublished manuscript names.

***Triporopollenites bellus* spore-pollen Zone.**
Interval: 1048.0 to 1177.0 metres (129+ metres)
Age: Latest Early Miocene to Middle Miocene.
The four shallowest sidewall cores analysed in Longtom-1 gave low residue yields with generally high palynomorph concentration overwhelmingly dominated by dinoflagellates (>85%). Although the recorded spore-pollen assemblages are limited by the low yields, the rare occurrence of *Tubulifloridites antipodica* at 1140m and the rare to frequent occurrence of *Rugulatisporites cowrensis* (formerly *Rugulatisporites micraulaxus* Partridge *in* Stover & Partridge 1973) in the other three samples provides a confident identification of the *T. bellus* Zone. Unfortunately other index species including the eponymous species were not recorded. Further, because of relatively low spore-pollen concentrations on the palynological slides, counts of the spore-pollen assemblages did not provide meaningful supporting data.

Other noteworthy species in the top sample include the species *Acaciapollenites myriosporites, Monoporites media, Myrtaceidites eucalyptoides* and *Chenopodipollis chenopodiaceoides*. All these species are known to have their oldest occurrences as rare species in the underlying *P. tuberculatus* Zone.

The microplankton which dominate these four samples can as yet only be assigned to the broad *Operculodinium* Superzone flora. The assemblages are dominated by dinoflagellates belonging to the *Spiniferites* species complex (>55% of microplankton) with the presence of *Tuberculodinium vancampoae* a potential index species for subdividing this superzone and supporting a younger Miocene age.

Middle *Proteacidites tuberculatus* spore-pollen Zone.
Interval: 1242.0 to 1244.0 metres (>3m but <68m)
Age: Late Oligocene to Early Miocene.
The two closely spaced sidewall cores from the base of the Seaspray Group, gave very low yields and as a consequence only limited assemblages were recorded. The occurrence of *Cyathidites subtilis* in the deepest sample is diagnostic of the Middle subzone of the *P. tuberculatus* Zone. Other key species recorded are *Cyatheacidites annulatus* and *Proteacidites truncatus* at 1242m and *Cyathidites porospora* and *Proteacidites rectomarginis* at 1244m.

The associated microplankton assemblages are dominated by the *Spiniferites* species complex. The rest of the recorded species are all relatively long ranging. Lacking from assemblages are key species considered diagnostic of Early Oligocene.

Lower *Nothofagidites asperus* spore-pollen Zone
and
***Areosphaeridium australicum* microplankton Zone**
Interval: 1253.0 metres (<11 metres from logs)
Age: Middle Eocene.
The single sample analysed from the Gurnard Formation gave a high diversity spore-pollen assemblage dominated by *Nothofagidites* spp. (>37%) associated with a low abundance and low diversity dinoflagellate assemblage dominated by the zone index *Areosphaeridium australicum* ms. Total microplankton were <7% of the composite spore-pollen and microplankton count. The spore-pollen zone assignment is based solely on the abundance of *Nothofagidites* pollen relative to *Haloragacidites harrisii* (= modern *Casuarina* pollen) at <12%, as all the other recorded species can be considered long ranging extending into older zones.

Amongst the other microplankton recorded the acritarch *Tritonites tricornus* is the most important as it is restricted to *A. australicum* Zone (Marshall & Partridge, 1988).

***Proteacidites asperopolus* spore-pollen Zone.**
Interval: 1268.0 (~14 metres)
Age: Early Eocene.
The highest sidewall core analysed from the "coarse clastic" portion of the Latrobe Group is located immediately below the two shallowest coal seams in Longtom-1 at 1263-1265m and 1267-1267.8m, and therefore it not surprisingly contained a non-marine assemblage.

The highly diverse assemblage of 52+ species is considered no older than the *P. asperopolus* Zone based on the FADs in the sample of *Conbaculites apiculatus* ms and *Sapotaceoidaepollenites rotundus*, and no younger than this zone on the LAD in the sample of *Intratriporopollenites notabilis*, and a questionably identified specimen of *Myrtaceidites tenuis*. Unexpectedly the eponymous species was not recorded although *Proteacidites pachypolus* is prominent in the assemblage but rare (<1%) in pollen count.

The assemblage upon counting was found to be dominated by *Proteacidites* spp. at 26% and tricolp(or)ate pollen at 19% and contained surprisingly abundant *Nothofagidites* spp. also at 19%, but a very low *Haloragacidites harrisii* abundance of 5%. The ratio of the last two species is anomalous for the *P. asperopolus* Zone but very typical of the overlying Lower *N. asperus* Zone, which suggests this sample may comes from very high in the former zone. The absence of key species such as *Nothofagidites falcatus* and *Tricolpites simatus* precludes assignment to the Lower *N. asperus* Zone.

Lower *Malvacipollis diversus* spore-pollen Zone
and
***Apectodinium hyperacanthum* microplankton Zone**
Interval: 1308.0 metres
Age: Early Eocene.

Although relatively poorly preserved this sample contains most of the key species characteristic of the *A. hyperacanthum* Zone incursion at the base of the Lower *M. diversus* Zone (Partridge, 1976).

The spore-pollen assemblage is dominated by *Malvacipollis* spp. (mostly *M. diversus*) at 26% of spore-pollen count with the next most abundant species in order are *Gleicheniidites circinidites* (22%); *Tricolp(or)ites* spp. (~11%); with *Laevigatosporites* spp. and *Spinizonocolpites prominatus* each ~5%.

Additional diagnostic species are *Lygistepollenites balmei* still present and 1.3% in count, and the spores *Crassiretitriletes vanraadshoovenii* and *Polypodiaceoisporites varus* ms.

Microplankton are surprisingly abundant at 33% of the combined spore-pollen and microplankton, especially as Longtom-1 is palaeogeographically located at or near the maximum landward penetration of this marine incursion. The *A. hyperacanthum* Zone is not found in any wells north of Longtom-1 but is recorded from Sweetlips-1 approximately 25 kms to the west (Partridge 1990a).

The most abundant microplankton identified in the assemblage are *A. hyperacanthum* at 33% of microplankton count, followed by *Fibrocysta bipolare* at 8% and *Kenleyia* spp. at 5%. Considerable taxonomic work needs to be undertaken to fully document this assemblage as >40% of the assemblage was categorised as undifferentiated dinoflagellates which could not be identified to species level.

Upper *Lygistepollenites balmei* spore-pollen Zone
and
***Apectodinium homomorphum* microplankton Zone**
Interval: 1358.0 metres
Age: Paleocene.

Although over 40 spore-pollen species were recorded from this zone, key index species are rare being restricted to *Malvacipollis subtilis* and questionable *Proteacidites annularis*. Both species are taken to indicate an age no older than the Upper *L. balmei* Zone. The diversity and abundance of the assemblages reinforces this younger age by absence of older index species such as *Proteacidites angulatus* and *Tetracolporites verrucosus*. An age no younger than the Upper

L. balmei Zone is clearly indicated by frequent occurrence of *Lygistepollenites balmei* and rare *Polycolpites langstonii.*

The *A. homomorphum* Zone is identified solely on the rare occurrence of the eponymous species.

Lower *Lygistepollenites balmei* spore-pollen Zone
Interval: 1428.0 metres
Age: Early Paleocene.

The youngest occurrence of *Tetracolporites verrucosus* in absence of older index species provides a confident assignment of this sample to the Lower *L. balmei* Zone. Other index species for the broader *L. balmei* Zone include the eponymous species, *Gambierina rudata, Latrobosporites amplus, L. ohiaensis* and the frequent occurrence of *Peninsulapollis gillii* in a moderate diversity assemblage of 25 species

The limited microplankton assemblage of four species in the sample unfortunately is not zone diagnostic.

Upper *Tricolpites longus* spore-pollen Zone
Interval: 1483.0-1510.0 metres (27+ metres)
Age: Maastrichtian

The deepest two sidewall cores from the Latrobe Group gave non-marine assemblages dominated by the extinct angiosperm pollen *Gambierina rudata* (>28%) whose abundance indicates an age no older than the Upper *T. longus* Zone. The presence of the FAD of *Stereisporites (Tripunctisporis)* spp. at 1483m confirms this pick. The absence of this latter species from the deeper sample is not considered particularly anomalous but is reflected in the confidence rating assigned to the zone.

Eleven species or 21% of total species list for both samples are considered diagnostic for picking the top of the zone as they are not considered to range above the top of the Cretaceous. In the following the first column were not recorded above 1510m while the second column were not recorded above 1483m.

Battenipollis sectilis
Camarozonosporites horrenudus ms
Densoisporites velatus
Nothofagidites senectus
Proteacidites clinei ms
Pseudowinterapollis wahooensis
Tetradopollis securus ms
Tricolpites confessus

Proteacidites otwayensis ms
Proteacidites pallidus
Proteacidites reticuloconcavus ms

***Phyllocladidites mawsonii* spore-pollen Zone**
and
***Hoegisporis trinalis* Subzone**

Interval: Longtom-1 - 1567.0-1934.0 metres (367+ metres)
Sidetrack - 2316.0-2445.0 metres MDKB (129+ mMD)

Age: Early Turonian

The ten sidewall cores and four cuttings samples are confidently assigned to the *P. mawsonii* Zone of Helby *et al.* (1987) even though the eponymous species *Phyllocladidites mawsonii* was only recorded from sidewall cores at 1778m and 1922m and the closely related *P. eunuchus* ms only recorded from the deepest sidewall core at 1934m and deepest cutting in the Sidetrack hole. Instead, the zone is mainly recognised from the confident identification of the new *Hoegisporis trinalis* Subzone, based on the consistent, to at times abundant, presence of the new species *Hoegisporis trinalis* ms, *Dilwynites pusillus* ms, *Laevigatosporites musa* ms and *Rugulatisporites admirabilis* ms. The importance of these species has been established firstly, in the detailed study of the Golden Beach Group intersected in Admiral-1 (Partridge 1990b) and secondly, from more recent work in the Port Campbell Embayment of the Otway Basin where these zones are associated with marine microplankton assemblages. *Hoegisporis trinalis* ms is particularly important as it can now be demonstrated to be restricted to the lower part of the *P. mawsonii* Zone and is considered to be diagnostic of the Early Turonian.

An age no younger than the *P. mawsonii* Zone is also indicated by the species *Appendicisporites distocarinatus*, *Interulobites intraverrucatus*, *Foraminisporis asymmetricus* and *Cyatheacidites tectifera* (only at 1615m) which range no higher than this zone according to ranges in Helby *et al.* (1987, fig.33).

There are also a number of other species which, although rare and usually inconsistent, combine to make the assemblages distinctive. These species are:

Balmeisporites glenelgensis
Cicatricosisporites pseudotripartitus
Crybelosporites brennerii
Densoisporites muratus ms
Dilwynites echinatus ms
Senectotetradites varireticulatus
Striatopollis paraneus
Tricolpites variverrucatus ms

Counts of the assemblages reveal two characteristic end members. Most samples are dominated by gymnosperm pollen assigned to the *Araucariacites/Dilwynites* complex with the new species *Dilwynites pusillus* ms by far the most abundant individual species. A maximum abundance of 55% was recorded for this species at 1615m, which is also the sample with the maximum abundance and diversity of non-marine microplankton. The abundance of these pollen types is interpreted to be a manifestation of the "Neves effect", and this end member type relates to distal (and probable deep water) lacustrine environments. The other end member is characterised by abundances of individual spore species. Typical are abundances of *Cyathidites minor* (30%) and *Gleicheniidites circinidites* (20%) at 1922m; and *Laevigatosporites ovatus* (37%) at 1933.8m. These latter assemblages are reflecting more local and fluctuating environments which is considered to be more typical of fluviatile environments.

***Rimosicysta* microplankton Superzone**
Interval: Longtom-1 - 1567.0-1862.0 metres (295+ metres)
Sidetrack - 2445.0 metres MDKB
Age: Early Turonian

The presence of abundant or diverse *Rimosicysta* spp. or *Wuroia* spp. in the Golden Beach Group is taken as being diagnostic of the *Rimosicysta* Superzone which is used as a general term to broadly cover the unusual algal cyst flora described by Marshall (1989). It is anticipated that interval zones will be established within this superzone once the ranges of individual species is better understood. Only five out of ten sidewall cores analysed in Longtom-1 contain *Rimosicysta* with only the species *R. kipperii* and the new species *R. robustus* ms identified, whilst of the three described *Wuroia* species only *W. tubiformis* was identified in deepest cuttings in the Sidetrack hole. Notably absent are the distinctly shaped *Rimosicysta cucullata* diagnostic of the *Rimosicysta* Superzone in the nearby Sunfish-1 between 2480.7-2485m, and representatives of the genus *Limbicysta* diagnostic of the *Rimosicysta* Superzone from the dredge sample in the Bass Canyon (Marshall 1989). Instead the assemblages are most similar to those recorded from Admiral-1 and Kipper-1 (Partridge 1990b, Marshall 1989). These differences highlight the lack of understanding of both species ranges within the superzone and the correlation of the different sections of the Golden Beach Formation found in the different wells.

The *Rimosicysta* Superzone is only considered to be fully developed in Longtom-1 in the sidewall cores between 1567-1862m corresponding to the presence of "deep lakes" facies discussed under the Geological Comments. The assemblages over this interval have microplankton abundances ranging from < 1% to 30% (average ~8%) and a composite diversity of 10+ species. Each sample shows a different species dominance with *Micrhystridium* sp. A, dominant at 1567m; *Luxadinium* sp. B, (50%) and *Amosopollis cruciformis* (32%) dominant at 1615m; *Sigmopollis* spp. at 1778m and *Rimosicysta* spp. (>80%) at 1862m.

Although *Rimosicysta* and other microplankton are recorded from the cutting it is possible that many of them are caved and therefore these samples may not be truly representative of the distribution of the algal cysts. This is relevant to the four sidewall cores over the interval 1922-1934m where only the deepest contained very rare *Rimosicysta* which may perhaps be contamination. This interval is not considered to be part of "deep lake" facies of the *Rimosicysta* Superzone.

An unusual or unexpected occurrence amongst the microplankton was a fragment recorded from the sidewall core at 1615m which was tentatively identified as the marine dinoflagellate species *Cribroperidinium edwardsii*. The fragmented specimen was identified by characteristic paratabulation and an ornament of verrucae within the paraplate boundaries. The discovery was unexpected because this is the first time a purported marine dinoflagellate has been recorded from the Golden Beach Group. The possibility of contamination is considered unlikely because of its similar preservation style to other palynomorphs in the assemblage, whilst reworking is discounted.

Although all slides were examined only one specimen was observed. The occurrence, if it can be confirmed by future work, of *Cribroperidinium edwardsii* is important as this species forms a distinct acme in middle part of Waarre Formation in the Port Campbell Embayment, Otway Basin and may therefore provide a correlation between the basins.

Pilosisporites notensis **spore-pollen Zone**
Interval: 1986.0-2213.0 metres (227+ metres)
Age: Barremian to Aptian

The *Pilosisporites notensis* Interval Zone has recently been proposed by Morgan *et al*. (1995) to replace the *C. hughesii* Zone of Helby *et al*. (1987, p.37) to avoid ambiguity and confusion with the concept of the *C. hughesii* Zone, as originally defined by Dettmann & Playford (1969), which continues to have currency in the Otway Basin.

Morgan *et al*. (1995, appendix 6.1) define the zone as the interval from the oldest occurrence of *Pilosisporites notensis* to the oldest occurrence of *Crybelosporites striatus* and claim in their comments that the zone **".....is identical in concept to the *C. hughesii* Zone as modified by Helby *et al*. (1987)"**. This statement is wrong as in their original definition Helby *et al*. (*loc. cit*) define the base by the oldest occurrence of *Foraminisporis asymmetricus* which Morgan *et al*. (1995, fig.6.1) show as having its oldest occurrence in the middle of their new *P. notensis* Zone, and approximately at the base of the Aptian in accordance with Helby *et al.* (*loc. cit*).

In Longtom-1 both index species are rare with *P. notensis* recorded from sidewall core at 2078m and *F. asymmetricus* in the picked fraction of cuttings at 2125-50m and both occurring together in the deepest cuttings at 2172m. The occurrence of the diagnostic index species in only 3 of the 8 samples analysed is a typical but frustrating feature of palynological analysis of the Strzelecki Group. The rarity of both index species is considered to reflect the high deposition rates of accumulation of the unit which tends to dilute the diversity of the palynomorphs recorded resulting in bland assemblage of mainly long ranging species.

Considering that only ~300 metres of Strzelecki Group was penetrated, and in light of its probable high depositional rates, it is most likely that only the *P. notensis* Zone is represented in Longtom-1. The absence of *Crybelosporites striatus* in all samples including the cuttings precludes a younger age while the presence of *P. notensis* and *F. asymmetricus* although inconsistent in the samples is taken to infer an age no older than the *P. notensis* Zone for the whole section.

The assemblages from the Strzelecki Group in Longtom-1 are typically dominated by *Podocarpidites* spp. and spores of *Baculatisporites/Osmundacidites* spp. Next most common are spores of *Cyathidites* spp. and *Stereisporites antiquisporites* with occasional frequent occurrences of the spore *Cicatricosisporites australiensis*. The assemblages are distinctly composition different from the assemblages of the overlying Golden Beach Group by lacking common to abundant occurrences of *Dilwynites* spp., *Gleicheniidites circinidites* and *Laevigatosporites* spp.

Microplankton are restricted to the four species *Sigmopollis carbonis, S. hispidus, Schizosporis reticulatus* and *Lecaniella dictyota* (1 specimen). This is a similar suite to that recorded by Dettmann (1986) from the Koonwarra Fossil Bed from the onshore Gippsland Basin and interpreted as fresh water (lacustrine) in origin.

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Table-1A: Interpretative Palynological Data for Longtom-1.

Sample	Depth (m)	Spore-pollen Zone and Subzones	*CR	Microplankton Zones	*CR	Comments and Key Species Present
SWC 60	1048.0	*T. bellus*	B1	*Operculodinium* Sz	B1	Microplankton 86% with *Tuberculodinium vancampoae*. S-P include *Acaciapollenites myriosporites*, *Rugulatisporites cowrensis*.
SWC 59	1107.0	*T. bellus*	B2	*Operculodinium* Sz	B1	Frequent *R. cowrensis*.
SWC 58	1140.0	*T. bellus*	B1	*Operculodinium* Sz	B1	Microplankton 89% with FADs of *T. vancampoae*. FAD of pollen *Tubulifloridites antipodica*,
SWC 57	1177.0	*T. bellus*	B1	*Operculodinium* Sz	B1	FAD of spore *Rugulatisporites cowrensis*.
SWC 56	1242.0	*P. tuberculatus*	B2	*Operculodinium* Sz	B1	FAD of spore *Cyatheacidites annulatus*.
SWC 55	1244.0	Middle *P. tuberculatus*	B2	*Operculodinium* Sz	B1	Microplankton 63% dominated by *Spiniferites* spp. at 59% of MP. FAD of spore *Cyathidites subtilis*.
SWC 53	1253.0	Lower *N. asperus*	B1	*A. australicum*	B2	Microplankton < 7% with FADs of *Tritonites tricornus* and *Areosphaeridium australicum* ms. S-P dominated by *Nothofagidites* spp. 37%.
SWC 51	1268.0	Lower *N. asperus*	B1			S-P dominated by *Nothofagidites* spp. 20%. LAD for *Intratriporopollenites notabilis*. FADs for *Conbaculites apiculatus* ms, *Sapotaceoidaepollenites rotundus*.
SWC 49	1308.0	Lower *M. diversus*	B1	*A. hyperacanthum*	B2	Microplankton 33% with FAD of *Apectodinium hyperacanthum*. S-P dominated by *Malvacipollis* spp. 26% with FAD of *Spinozonocolpites prominatus*.
SWC 48	1358.0	Upper *L. balmei*	B4	*A. homomorphum*	B3	FAD *Malvacipollis subtilis*.
SWC 45	1428.0	Lower *L. balmei*	B1			LAD *Tetracolporites verrucosus*.
SWC 42	1483	Upper *T. longus*	B1			*Gambierina rudata* 33% with *Stereisporites (Tripunctisporis)* sp.
SWC 41	1510	Upper *T. longus*	B4			*Gambierina rudata* 24% without *Stereisporites (Tripunctisporis)* sp.
SWC 37	1567	*P. mawsonii* *H. trinalis* Subz	B1	*Rimosicysta* Sz	B3	Microplankton ~5%. LADs of *Rimosicysta* spp. and pollen *Hoegisporis trinalis* ms.
SWC 36	1615.0	*P. mawsonii* *H. trinalis* Subz	B1	*Rimosicysta* Sz	B3	Microplankton ~26% dominated by *Luxadinium* sp. B, Marshall 1989. S-P dominated by *Dilwynites pusilus* ms at 55%.
SWC 34	1721.0	*P. mawsonii*	B3			Microplankton <1%. *Laevigatosporites musa* ms present assemblage.
SWC 32	1778.0	*P. mawsonii* *H. trinalis* Subz	B1			Microplankton ~4%, mostly *Sigmopollis carbonis*. *Dilwynites* spp. ~50%.
SWC 30	1860.0	*P. mawsonii*	B2			*Densoisporites muratus* ms present Microplankton << 1%.

Table-1A: Interpretative Palynological Data for Longtom-1 cont...

Sample	Depth (m)	Spore-pollen Zone and Subzones	*CR	Microplankton Zones	*CR	Comments and Key Species Present
SWC 29	1862	*P. mawsonii* *H. trinalis* Subz	B1	*Rimosicysta* Sz	B3	Microplankton ~11% dominated by *Rimosicysta kipperii*. *Dilwynites* spp. ~52%. FAD of *D. muratus* ms.
SWC 24	1922.0	*P. mawsonii*	B1			Microplankton ~21% almost exclusively *Circulosporites parvus*. FAD *Phyllocladidites mawsonii*.
Cuttings A1	1925-50	*P. mawsonii*	D2	*Rimosicysta* Sz	D3	Unpicked cuttings / mixed lithologies. Common *Dilwynites granulatus* and *D. pusillus* ms with *Senectotetradites varireticulatus*. *Rimosicysta kipperii* present.
Cuttings A2	1925-50	*P. mawsonii* *H. trinalis* Subz	D2	*Rimosicysta* Sz	D3	Picked dark grey claystone with most chips over 5mm diameter. Common *Luxadinium* sp. B and rare *Rimosicysta* spp. Pollen *Hoegisporis trinalis* ms present.
SWC 21	1931	*P. mawsonii*	B1			*Appendicisporites distocarinatus* present.
SWC 20	1933.8	*P. mawsonii* *H. trinalis* Subz	B2			Microplankton ~2%. All *Circulosporites parvus*. S-P dominated by *Laevigatesporites* spp. 45% with *H. trinalis* ms and *Laevigatosporites musa* ms present.
SWC 19	1934	*P. mawsonii* *H. trinalis* Subz	B1			FADs of *H. trinalis* ms, *Rugulatisporites admirabilis* ms, *Senectotetradites varireticulatus* and *Dilwynites pusillus* ms.
SWC 12	1986	*P. notensis*	B4			Assemblage dominated by *Podocarpidites* spp. at 33% and *Baculatisporites/Osmundacidites* at 32%, without zone index species.
SWC 10	2056	Indeterminate				Sample essentially barren. Only kerogen slide available with less than 10 specimens.
SWC 9	2078	*P. notensis*	B2			Frequent *Pilosisporites notensis* in assemblage dominated by *Podocarpidites* spp. at 40%.
Cuttings B1	2125-50	*P. notensis*	D4			Unpicked cuttings / mixed lithologies with spore dominated assemblage typical of Strzelecki Group. *Foraminisporis wonthaggiensis* present.
Cuttings B2	2125-50	*P. notensis*	D2			Picked lithology of medium grey claystone to siltstone with common *Cyathidites australis* and *Cicatricosisporites australiensis* considered typical of Strzelecki. *Foraminisporis asymmetricus* present.
SWC 5	2131.0	*P. notensis*	B4			Frequent *Cicatricosisporites australiensis*.
Cuttings	2172	*P. notensis*	D2			Frequent *Pilosisporites notensis*.
SWC 1	2213.0	*F. wonthaggiensis* or *P. notensis*	B4			Assemblage dominated by *Podocarpidites* spp. 22% and *Baculatisporites/Osmundacidites* at 20%, with FAD of *Foraminisporis wonthaggiensis*.

Table-1B: Interpretative Palynological Data for Longtom-1 Sidetrack.

Sample	Depth (m)	Spore-pollen Zone and Subzones	*CR	Microplankton Zones	*CR	Comments and Key Species Present
Cuttings	2316	*P. mawsonii* *H. trinalis* Subz	D2			
Cuttings	2445	*P. mawsonii* *H. trinalis* Subz	D1	*Rimosicysta* Sz	D4	Microplankton ~3%. *Hoegisporis trinalis* ms frequent. *Wuroia tubiformis* present. Fragments of insect chitin are common in palynology preparation.

Subz. = Subzone
Sz. = Superzone
LAD = Last Appearance Datum
FAD = First Appearance Datum

Confidence Ratings

The Confidence Ratings assigned to the zone identifications on Table-2A-B are quality codes used in the STRATDAT relational database being developed by the Australian Geological Survey Organisation (AGSO) as a National Database for interpretive biostratigraphic data. Their purpose is to provide a simple relative comparison of the quality of the zone assignments. The alpha and numeric components of the codes have been assigned the following meanings:

Alpha codes: Linked to sample type

A	Core
B	Sidewall core
C	Coal cuttings
D	Ditch cuttings
E	Junk basket
F	Miscellaneous/unknown
G	Outcrop

Numeric codes: Linked to fossil assemblage

1	**Excellent confidence:**	High diversity assemblage recorded with key zone species.
2	**Good confidence:**	Moderately diverse assemblage recorded with key zone species.
3	**Fair confidence:**	Low diversity assemblage recorded with key zone species.
4	**Poor confidence:**	Moderate to high diversity assemblage recorded without key zone species.
5	**Very low confidence:**	Low diversity assemblage recorded without key zone species.

Table-2A: Basic Data for Longtom-1, Gippsland Basin.

Sample	Depth (m)	Sample Wt (g)	Yield	Palynomoprh Concentration	Palynomorph Preservation	No. S-P species	No. MP species
SWC 60	1048.0	12.4	Low	High	Good	27+	9+
SWC 59	1107.0	12.4	Low	High	Good	15+	13+
SWC 58	1140.0	15.7	Low	High	Good	19+	10+
SWC 57	1177.0	8.9	Low	Low	Fair-good	26+	14+
SWC 56	1242.0	12.7	Very low	High	Good	15+	14+
SWC 55	1244.0	15.0	Very low	Moderate	Fair	12+	10+
SWC 53	1253.0	13.7	Moderate	Low	Poor-fair	41+	6+
SWC 51	1268.0	9.0	High	Moderate	Fair-good	52+	
SWC 49	1308.0	11.8	High	High	Poor-fair	33+	8+
SWC 48	1358.0	16.3	High	Moderate	Poor	41+	1
SWC 45	1428.0	10.7	High	Low	Poor-fair	25+	5+
SWC 42	1483.0	13.2	High	High	Good	29+	2
SWC 41	1510.0	8.3	High	High	Poor-fair	40+	
SWC 37	1567.0	11.7	High	Moderate	Poor-fair	32+	4+
SWC 36	1615.0	10.9	High	High	Poor-fair	38+	7+
SWC 34	1721.0	12.8	Moderate	Very low	Poor	9+	2+
SWC 32	1778.0	8.6	High	High	Fair	33+	6+
SWC 30	1860.0	6.1	High	Low	Poor	19+	1
SWC 29	1862.0	9.2	Moderate	High	Poor-fair	29+	5+
SWC 24	1922.0	15.6	High	Moderate	Poor	26+	2+
Cuttings A1	1925-50	>10	High	Low	Poor	11+	2+
Cuttings A2	1925-50	7.8	High	Low	Poor-fair	18+	7+
SWC 21	1931.0	11.0	High	Low	Poor	26+	
SWC 20	1933.8	14.5	High	Low	Poor	20+	1
SWC 19	1934.0	13.9	Moderate	Moderate	Poor	26+	1+
SWC 12	1986.0	11.2	High	Moderate	Poor-fair	30+	
SWC 10	2056.0	6.3	Very low	Very low	Poor	3+	1
SWC 9	2078.0	11.3	High	High	Poor	23+	1
Cuttings B1	2125-50	>10	High	Low	Poor	16+	
Cuttings B2	2125-50	2.5	Moderate	Low	Poor-fair	15+	1
SWC 5	2131.0	7.6	High	Moderate	Poor	19+	1
Cuttings	2172	13.9	High	Moderate	Poor	18+	
SWC 1	2213.0	11.9	High	Moderate	Poor	30+	

Table-2B: Basic Data for Longtom-1 Sidetrack, Gippsland Basin.

Sample	Depth (m)	Sample Wt (g)	Yield	Palynomoprh Concentration	Palynomorph Preservation	No. S-P species	No. MP species
Cuttings	2316	11.8	High	Moderate	Poor-fair	24+	3+
Cuttings	2445	11.4	High	High	Poor-good	29+	5+

RELINQUISHMENT LIST - PALYNOLOGY SLIDES

WELL NAME & NO: LONGTOM-1
PREPARED BY: A.D. PARTRIDGE
DATE: 16 AUGUST 1995

Sheet 1 of 5

SAMPLE	DEPTH (M)	CATALOGUE NUMBER	DESCRIPTION
SWC 60	1048.0	P196942	Kerogen slide: filtered/unfiltered
SWC 60	1048.0	P196943	Oxidised slide 2: 8μm filter
SWC 59	1107.0	P196944	Kerogen slide: filtered/unfiltered
SWC 59	1107.0	P196945	Oxidised slide 2: 8μm filter
SWC 58	1140.0	P196946	Kerogen slide: filtered/unfiltered
SWC 58	1140.0	P196947	Oxidised slide 2: 8μm filter
SWC 57	1177.0	P196948	Kerogen slide: filtered/unfiltered
SWC 57	1177.0	P196949	Oxidised slide 2: 8μm filter
SWC 56	1242.0	P196950	Kerogen slide: filtered/unfiltered
SWC 56	1242.0	P196951	Oxidised slide 2: 8μm filter - 1/2 cover slip
SWC 55	1244.0	P196952	Kerogen slide: filtered/unfiltered
SWC 55	1244.0	P196953	Oxidised slide 2: 8μm filter - 1/2 cover slip
SWC 53	1253.0	P196954	Kerogen slide: filtered/unfiltered
SWC 53	1253.0	P196955	Oxidised slide 2: 8μm filter
SWC 53	1253.0	P196956	Oxidised slide 3: 8μm filter
SWC 53	1253.0	P196957	Oxidised slide 4: 15μm filter
SWC 51	1268.0	P196958	Kerogen slide: filtered/unfiltered
SWC 51	1268.0	P196959	Oxidised slide 2: 8μm filter
SWC 51	1268.0	P196960	Oxidised slide 3: 8μm filter
SWC 51	1268.0	P196961	Oxidised slide 4: 15μm filter
SWC 51	1268.0	P196962	Oxidised slide 5: 15μm filter
SWC 49	1308.0	P196963	Kerogen slide: filtered/unfiltered
SWC 49	1308.0	P196964	Oxidised slide 2: 8μm filter
SWC 49	1308.0	P196965	Oxidised slide 3: 8μm filter
SWC 49	1308.0	P196966	Oxidised slide 4: 15μm filter
SWC 49	1308.0	P196967	Oxidised slide 5: 15μm filter
SWC 48	1358.0	P196968	Kerogen slide: filtered/unfiltered
SWC 48	1358.0	P196969	Oxidised slide 2: 8μm filter
SWC 48	1358.0	P196970	Oxidised slide 3: 8μm filter
SWC 48	1358.0	P196971	Oxidised slide 4: 15μm filter
SWC 48	1358.0	P196972	Oxidised slide 5: 15μm filter
SWC 45	1428.0	P196973	Kerogen slide: filtered/unfiltered
SWC 45	1428.0	P196974	Oxidised slide 2: 8μm filter
SWC 45	1428.0	P196975	Oxidised slide 3: 8μm filter
SWC 45	1428.0	P196976	Oxidised slide 5: 15μm filter
SWC 45	1428.0	P196977	Oxidised slide 4: 15μm filter
SWC 42	1483.0	P196978	Kerogen slide: filtered/unfiltered
SWC 42	1483.0	P196979	Oxidised slide 2: 8μm filter
SWC 42	1483.0	P196980	Oxidised slide 3: 8μm filter

RELINQUISHMENT LIST - PALYNOLOGY SLIDES

WELL NAME & NO: LONGTOM-1
PREPARED BY: A.D. PARTRIDGE
DATE: 16 AUGUST 1995

Sheet 2 of 5

SAMPLE	DEPTH (M)	CATALOGUE NUMBER	DESCRIPTION
SWC 42	1483.0	P196981	Oxidised slide 4: 15μm filter
SWC 42	1483.0	P196982	Oxidised slide 5: 15μm filter - 1/2 cover slip
SWC 41	1510.0	P196983	Kerogen slide: filtered/unfiltered
SWC 41	1510.0	P196984	Oxidised slide 2: 8μm filter
SWC 41	1510.0	P196985	Oxidised slide 3: 8μm filter
SWC 41	1510.0	P196986	Oxidised slide 4: 15μm filter
SWC 41	1510.0	P196987	Oxidised slide 5: 15μm filter
SWC 37	1567.0	P196988	Kerogen slide: filtered/unfiltered
SWC 37	1567.0	P196989	Oxidised slide 2: 8μm filter
SWC 37	1567.0	P196990	Oxidised slide 3: 8μm filter
SWC 37	1567.0	P196991	Oxidised slide 4: 15μm filter
SWC 37	1567.0	P196992	Oxidised slide 5: 15μm filter
SWC 36	1615.0	P196993	Kerogen slide: filtered/unfiltered
SWC 36	1615.0	P196994	Oxidised slide 2: 8μm filter
SWC 36	1615.0	P196995	Oxidised slide 3: 8μm filter
SWC 36	1615.0	P196996	Oxidised slide 4: 15μm filter
SWC 36	1615.0	P196997	Oxidised slide 5: 15μm filter
SWC 34	1721.0	P196998	Kerogen slide: filtered/unfiltered
SWC 34	1721.0	P196999	Oxidised slide 2: 8μm filter
SWC 34	1721.0	P197000	Oxidised slide 3: 8μm filter
SWC 32	1778.0	P197001	Kerogen slide: filtered/unfiltered
SWC 32	1778.0	P197002	Oxidised slide 2: 8μm filter
SWC 32	1778.0	P197003	Oxidised slide 3: 8μm filter
SWC 32	1778.0	P197004	Oxidised slide 4: 15μm filter
SWC 32	1778.0	P197005	Oxidised slide 5: 15μm filter
SWC 30	1860.0	P197006	Kerogen slide: filtered/unfiltered
SWC 30	1860.0	P197007	Oxidised slide 2: 8μm filter
SWC 30	1860.0	P197008	Oxidised slide 3: 8μm filter
SWC 30	1860.0	P197009	Oxidised slide 4: 15μm filter
SWC 30	1860.0	P197010	Oxidised slide 5: 15μm filter
SWC 29	1862.0	P197011	Kerogen slide: filtered/unfiltered
SWC 29	1862.0	P197012	Oxidised slide 2: 8μm filter
SWC 29	1862.0	P197013	Oxidised slide 3: 8μm filter
SWC 29	1862.0	P197014	Oxidised slide 4: 15μm filter
SWC 24	1922.0	P197015	Kerogen slide: filtered/unfiltered
SWC 24	1922.0	P197016	Oxidised slide 2: 8μm filter
SWC 24	1922.0	P197017	Oxidised slide 3: 8μm filter
SWC 24	1922.0	P197018	Oxidised slide 4: 15μm filter

RELINQUISHMENT LIST - PALYNOLOGY SLIDES

WELL NAME & NO: LONGTOM-1
PREPARED BY: A.D. PARTRIDGE
DATE: 16 AUGUST 1995

Sheet 3 of 5

SAMPLE	DEPTH (M)	CATALOGUE NUMBER	DESCRIPTION
Cuttings A1	1925-50	P197019	Oxidised slide - rushed
Cuttings A1	1925-50	P197020	Oxidised slide A
Cuttings A1	1925-50	P197021	Oxidised slide B
Cuttings A2	1925-50	P197022	Oxidised slide - rushed
Cuttings A2	1925-50	P197023	Oxidised slide A
Cuttings A2	1925-50	P197024	Oxidised slide B
SWC 21	1931.0	P197025	Kerogen slide: filtered/unfiltered
SWC 21	1931.0	P197026	Oxidised slide 2: 8μm filter
SWC 21	1931.0	P197027	Oxidised slide 3: 8μm filter
SWC 21	1931.0	P197028	Oxidised slide 4: 15μm filter
SWC 21	1931.0	P197029	Oxidised slide 5: 15μm filter
SWC 20	1933.8	P197030	Kerogen slide: filtered/unfiltered
SWC 20	1933.8	P197031	Oxidised slide 2: 8μm filter
SWC 20	1933.8	P197032	Oxidised slide 3: 8μm filter
SWC 20	1933.8	P197033	Oxidised slide 4: 15μm filter
SWC 20	1933.8	P197034	Oxidised slide 5: 15μm filter
SWC 19	1934.0	P197035	Kerogen slide: filtered/unfiltered
SWC 19	1934.0	P197036	Oxidised slide 2: 8μm filter
SWC 19	1934.0	P197037	Oxidised slide 3: 8μm filter
SWC 19	1934.0	P197038	Oxidised slide 4: 15μm filter
SWC 12	1986.0	P197039	Kerogen slide: filtered/unfiltered
SWC 12	1986.0	P197040	Oxidised slide 2: 8μm filter
SWC 12	1986.0	P197041	Oxidised slide 3: 8μm filter
SWC 12	1986.0	P197042	Oxidised slide 5: 15μm filter
SWC 12	1986.0	P197043	Oxidised slide 4: 15μm filter
SWC 10	2056.0	P197044	Kerogen slide: filtered/unfiltered
SWC 9	2078.0	P197045	Kerogen slide: filtered/unfiltered
SWC 9	2078.0	P197046	Oxidised slide 2: 8μm filter
SWC 9	2078.0	P197047	Oxidised slide 3: 8μm filter
SWC 9	2078.0	P197048	Oxidised slide 4: 15μm filter
SWC 9	2078.0	P197049	Oxidised slide 5: 15μm filter
Cuttings B1	2125-50	P197050	Oxidised slide - rushed
Cuttings B1	2125-50	P197051	Oxidised slide - rushed
Cuttings B1	2125-50	P197052	Oxidised slide - A
Cuttings B1	2125-50	P197053	Oxidised slide - B
Cuttings B2	2125-50	P197054	Oxidised slide - X
Cuttings B2	2125-50	P197055	Oxidised slide - A
Cuttings B2	2125-50	P197056	Oxidised slide - B

RELINQUISHMENT LIST - PALYNOLOGY SLIDES

WELL NAME & NO: LONGTOM-1
PREPARED BY: A.D. PARTRIDGE
DATE: 16 AUGUST 1995

Sheet 4 of 5

SAMPLE	DEPTH (M)	CATALOGUE NUMBER	DESCRIPTION
SWC 5	2131.0	P197057	Kerogen slide: filtered/unfiltered
SWC 5	2131.0	P197058	Oxidised slide 2: 8μm filter
SWC 5	2131.0	P197059	Oxidised slide 3: 8μm filter
SWC 5	2131.0	P197060	Oxidised slide 4: 15μm filter
SWC 5	2131.0	P197061	Oxidised slide 5: 15μm filter
Cuttings	2172.0	P197062	Kerogen slide: filtered/unfiltered
Cuttings	2172.0	P197063	Oxidised slide 2: 8μm filter
Cuttings	2172.0	P197064	Oxidised slide 4: 15μm filter
Cuttings	2172.0	P197065	Oxidised slide 5 15μm filter
Cuttings	2172.0	P197066	Oxidised slide 3: 8μm filter
SWC 1	2213.0	P197067	Kerogen slide: filtered/unfiltered
SWC 1	2213.0	P197068	Oxidised slide 2: 8μm filter
SWC 1	2213.0	P197069	Oxidised slide 3: 8μm filter
SWC 1	2213.0	P197070	Oxidised slide 4: 15μm filter
SWC 1	2213.0	P197071	Oxidised slide 5: 15μm filter

RELINQUISHMENT LIST - PALYNOLOGY SLIDES

WELL NAME & NO: LONGTOM-1 SIDETRACK
PREPARED BY: A.D. PARTRIDGE
DATE: 16 AUGUST 1995

Sheet 5 of 5

SAMPLE	DEPTH (M)	CATALOGUE NUMBER	DESCRIPTION
Cuttings	2316.0	P197072	Kerogen slide: filtered/unfiltered
Cuttings	2316.0	P197073	Oxidised slide 2: 8μm filter
Cuttings	2316.0	P197074	Oxidised slide 3: 8μm filter
Cuttings	2316.0	P197075	Oxidised slide 4: 15μm filter
Cuttings	2316.0	P197076	Oxidised slide 5: 15μm filter
Cuttings	2445.0	P197077	Kerogen slide: filtered/unfiltered
Cuttings	2445.0	P197078	Oxidised slide 2: 8μm filter
Cuttings	2445.0	P197079	Oxidised slide 3: 8μm filter
Cuttings	2445.0	P197080	Oxidised slide 4: 15μm filter
Cuttings	2445.0	P197081	Oxidised slide 5: 15μm filter

RELINQUISHMENT LIST - PALYNOLOGY RESIDUES

WELL NAME & NO: LONGTOM-1
PREPARED BY: A.D. PARTRIDGE
DATE: 14 AUGUST 1995

Sheet 1 of 1

SAMPLE	DEPTH (M)	DESCRIPTION
SWC 53	1253.0	Kerogen residue
SWC 51	1268.0	Kerogen residue
SWC 51	1268.0	Oxidised residue
SWC 49	1308.0	Kerogen residue
SWC 48	1358.0	Kerogen residue
SWC 48	1358.0	Oxidised residue
SWC 45	1428.0	Kerogen residue
SWC 45	1428.0	Oxidised residue
SWC 41	1510.0	Kerogen residue
SWC 41	1510.0	Oxidised residue
SWC 37	1567.0	Kerogen residue
SWC 37	1567.0	Oxidised residue
SWC 36	1615.0	Kerogen residue
SWC 32	1778.0	Kerogen residue
SWC 32	1778.0	Oxidised residue
SWC 30	1860.0	Oxidised residue
SWC 29	1862.0	Kerogen residue
SWC 29	1862.0	Oxidised residue
Cuttings A1	1925-50	Mixed residue
Cuttings A2	1925-50	Mixed residue
SWC 21	1931.0	Kerogen residue
SWC 21	1931.0	Oxidised residue
SWC 20	1933.8	Oxidised residue
SWC 12	1986.0	Oxidised residue
SWC 9	2078.0	Oxidised residue
Cuttings B1	2125-50	Mixed residue
Cuttings B2	2125-50	Mixed residue
SWC 5	2131.0	Oxidised residue
Cuttings	2172.0	Oxidised residue
Cuttings	2316.0	Oxidised residue
Cuttings	2445.0	Kerogen residue
Cuttings	2445.0	Oxidised residue

PE900475

This is an enclosure indicator page.
The enclosure PE900475 is enclosed within the container PE904282 at this location in this document.

The enclosure PE900475 has the following characteristics:

ITEM_BARCODE =	PE900475
CONTAINER_BARCODE =	PE904282
NAME =	Palynmorph Range Chart, 1 of 3
BASIN =	GIPPSLAND
ONSHORE? =	N
DATA_TYPE =	WELL
DATA_SUB_TYPE =	BIOSTRAT
DESCRIPTION =	Palynmorph Range Chart, 1 of 3, Longtom-1
REMARKS =	PERMIT: VIC/P1PAGES: 1
DATE_WRITTEN =	23-AUG-1995
DATE_PROCESSED =	
DATE_RECEIVED =	
RECEIVED_FROM =	BHP Petroleum Pty Ltd
WELL_NAME =	LONGTOM-1
CONTRACTOR =	Biostrata Pty Ltd
AUTHOR =	A.D.Partridge
ORIGINATOR =	BHP Petroleum Pty Ltd
TOP_DEPTH =	1048
BOTTOM_DEPTH =	1510
ROW_CREATED_BY =	xls_jc40

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PE900476

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The enclosure PE900476 has the following characteristics:

ITEM_BARCODE = PE900476
CONTAINER_BARCODE = PE904282
NAME = Palynmorph Range Chart, 2 of 3
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = BIOSTRAT
DESCRIPTION = Palynmorph Range Chart, 2 of 3, Longtom-1
REMARKS = PERMIT: VIC/P1PAGES: 1
DATE_WRITTEN = 23-AUG-1995
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = BHP Petroleum Pty Ltd
WELL_NAME = LONGTOM-1
CONTRACTOR = Biostrata Pty Ltd
AUTHOR = A.D.Partridge
ORIGINATOR = BHP Petroleum Pty Ltd
TOP_DEPTH = 1567
BOTTOM_DEPTH = 1934
ROW_CREATED_BY = xls_jc40

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PE900477

This is an enclosure indicator page.
The enclosure PE900477 is enclosed within the container PE904282 at this location in this document.

The enclosure PE900477 has the following characteristics:

ITEM_BARCODE = PE900477
CONTAINER_BARCODE = PE904282
NAME = Palynmorph Range Chart, 3 of 3
BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = BIOSTRAT
DESCRIPTION = Palynmorph Range Chart, 3 of 3, Longtom-1
REMARKS = PERMIT: VIC/P1PAGES: 1
DATE_WRITTEN = 23-AUG-1995
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = BHP Petroleum Pty Ltd
WELL_NAME = LONGTOM-1
CONTRACTOR = Biostrata Pty Ltd
AUTHOR = A.D.Partridge
ORIGINATOR = BHP Petroleum Pty Ltd
TOP_DEPTH = 1986
BOTTOM_DEPTH = 2213
ROW_CREATED_BY = xls_jc40

(Inserted by DNRE - Vic Govt Mines Dept)

4

APPENDIX 4

ACS LABORATORIES PTY. LTD.

PETROLOGY REPORT

of

LONGTOM-1 SIDEWALL CORES

for

BHP PETROLEUM

by

ACS LABORATORIES PTY LTD

PETROLOGY REPORT

of

LONGTOM-1 SIDEWALL CORES

A report prepared for

BHP PETROLEUM

by

DR CHRISTOPHER WILSON
and KENRICK VAN NOORD

July 1995

Brisbane Laboratory | PO Box 396, Chermside, Qld. 4032, Australia | ACS Laboratories Pty Ltd
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This report is divided into two parts:

Part A presents an executive summary (Chapter 1), introduces this investigation (Chapter 2), discusses methodology (Chapter 3), summarises the main results (Chapter 4) and presents an integrated model of sediment provenance, environment of deposition and reservoir potential (Chapter 5). Photomicrographs referenced in the text are located at the end of Part A.

Part B presents detailed thin section descriptions (Appendix 1) and traces of XRD spectra (Appendix 2).

CONTENTS

PART A

PART B

PART A

1. EXECUTIVE SUMMARY

- BHP Petroleum Pty Ltd submitted six sidewall cores from Longtom-1 for detailed petrographic analysis involving thin section description and X-ray diffraction. These samples are from the Judith Formation.

- The Judith formation is dominated by very fine- to medium- and rarely coarse-grained, moderately to poorly sorted, angular to subrounded litharenites. Sample 25 (1911.0 m) is slightly finer and comprises a silt-sized to medium-grained detrital fraction. Sample 22 (1928.5 m) is slightly coarser and is silt-sized to medium grained. Minor detrital matrix is present in some samples.

- The framework component of all samples is dominated by monocrystalline quartz and micaceous phyllitic and schistose lithic grains. Monocrystalline quartz displays straight to strongly undulose extinction and some grains contain boehm lamellae, rare to common microscopic vacuoles, and rare rutile and zircon inclusions. Polycrystalline quartz, and chert, metaquartzite, altered volcanic and argillaceous sedimentary fragments are a minor component. Polycrystalline quartz displays strongly undulose extinction and comprises equant to foliated crystals with polygonal to sutured crystal boundaries. Mica and accessory minerals (zircon and opaque grains) are minor to trace components. The above composition suggests a recycled orogenic provenance of continental affinity.

- The authigenic mineralogy of samples 28 (1892.5 m) to 23 (1923.5 m) is dominated by pore-filling kaolinite. Illite and possibly illite/smectite is present as finely disseminated flecks within altered lithic grains and appears to have formed by alteration of the micaceous component. Chlorite is a minor to trace component of all samples and has also formed by alteration of some lithic grains. Sample 22 (1928.5 m) is different to other samples in that it is pervasively cemented by poikilotopic calcite.

- Visible porosity is very poorly preserved and is difficult to estimate due to pervasive impact-damage and associated sample disaggregation. Nevertheless, a very poorly interconnected, small mesoscopic porosity (ca. 5-10%) is present in some samples and is dominated by a primary interparticle type. A small mesoscopic, secondary moldic and microscopic intercrystal porosity is a minor component.

- Extensive compaction has affected all samples and resulted in 'overpacked' framework grains with long to concavo-convex grain contacts. Ductily-deformed lithic grains are abundant. Finely disseminated illite and possibly illite/smectite is associated with lithic grains and has probably formed by alteration of the micaceous component. Similarly, traces of chlorite are associated with altered lithic grains. Patchy to pervasively developed pore-filling kaolinite occludes remaining porosity in all samples. Poikilotopic calcite is pervasive in sample 22.

- Porosity is very poorly preserved and the reservoir potential of all samples is extremely poor. This is due to extensive compaction which has resulted in grain 'overpacking' and caused significant reduction of interparticle porosity and destruction of pore throat apertures. Pore-filling kaolinite is abundant and occludes most remaining porosity. Pervasive poikilotopic calcite occludes all traces of porosity in sample 22.

2. INTRODUCTION

BHP Petroleum Pty Ltd submitted six sidewall cores from Longtom-1 for petrographic study (Table 1). This involved detailed thin section description of all samples and XRD analysis of one sample. A summary of the major aims follows:-

- Undertake thin section descriptions to include sediment classification, description of texture and composition, diagenesis, reservoir potential and environment of deposition.
- Confirm clay identification and relative abundance using XRD analysis of the extracted clay fraction.
- Present an integrated model detailing lithology, sediment provenance and environment of deposition, style and extent of diagenetic modification, and reservoir potential.

Sample Details			Analysis	
Sample	Depth (meters)	Formation	TS (detailed)	XRD
28	1892.50	Judith	*	
27	1899.50	"	*	
26	1904.50	"	*	
25	1911.00	"	*	*
23	1923.50	"	*	
22	1928.50	"	*	

Table 1: Summary of petrographic analyses performed on Longtom-1 samples. Thin sections were stained for K-feldspar identification with sodium cobaltinitrate. All samples are variably impact-damaged sidewall cores.

3. METHODS

Thin section preparation

A portion of each side wall core was impregnated with blue-stained araldite prior to thin section preparation in order to facilitate description of porosity and permeability. Thin sections were made using standard techniques and stained with sodium cobaltinitrate for K-feldspar identification.

Thin section description

Clastic rock classification is based on Folk (1974). Description of porosity size and type follows a modified version of Scmidt, McDonald and Platt (1977) and Choquette and Pray (1970). Stylolite description is based on Wanless (1979).

The abundance of all components was estimated by comparison with the grain abundance charts of Flugel (1982). The term glauconite is used to describe a green mineral whose optical properties indicate true glauconite. In cases where an authigenic green mineral cannot be identified with certainty the term glaucony is used.

X-ray Diffraction

A portion of each sample was disaggregated in an agate mortar and pestle in a small amount of distilled water. The coarse material was allowed to settle and a few mLs of the remaining suspension was pipetted onto glass discs and allowed to dry overnight. The oriented fine particle thin-films were examined in a Phillips vertical diffractometer using copper $K\alpha$ radiation.

The procedure for clay analysis comprised a scan of the air-dried sample from 2° - 36° 2-theta and a scan of the glycolated sample (75°C for 1 hour in ethylene glycol) from 2° - 22°.

4. RESULTS

This investigation studied six sidewall cores from Longtom-1. These samples spanned an interval of 1892 m to 1928.5 m and are part of the Judith Formation. A summary of the main lithological characteristics of each sample is given in Table 2 and the estimated framework composition in Table 3. Photomicrographs referenced in the text below are presented at the end of Section A. A representative photomicrograph set of each sample is also given with the relevant thin section description in Appendix 1.

Lithology
The Judith Formation is dominated by litharenites (Fig. 1). Samples 28 (1892.0 m) to 23 (1923.5 m) are kaolinite-cemented (Fig. 2). Sample 22 (1928.5 m) is pervasively cemented by poikilotopic calcite (Fig. 3).

Texture
Most samples comprise a very fine- to medium- and rarely coarse-grained, moderately to poorly sorted, angular to subrounded detrital component (Figs. 2 and 3). Sample 25 (1911.0 m) is slightly finer and comprises a silt-sized to medium-grained detrital fraction. Sample 22 (1928.5 m) is slightly coarser and comprises a fine- to very coarse-grained, poorly sorted detrital component (Fig. 3). Minor detrital matrix is present in some samples (i.e. sample 25: 1911.0 m). However, the presence of detrital matrix is difficult to quantify due to the formation of 'pseudomatrix' formed by ductile deformation and alteration of lithic grains.

Composition
The framework component of all samples is dominated by monocrystalline quartz and lithic grains (Table 3). Monocrystalline quartz displays slight to strong undulose extinction, and some grains contain common boehm lamellae, rare to common microscopic vacuoles, and rare rutile and zircon inclusions. Lithic grains are dominated by strongly foliated phyllites and mica schists (Figs. 3 and 4). Chert, metaquartzite, argillaceous sediments and altered volcanics are minor components. Polycrystalline quartz comprising equant to strongly foliated crystals with polygonal to sutured crystal boundaries is a minor component of samples 28 (1892.5 m) to 23 (1923.5 m) and a major component of sample 22 (1928.5 m) (Table 3). Feldspar is a trace component of samples 23 (1923.5 m) and 22 (1928.5 m). Mica and accessory minerals (zircon and opaque minerals) are trace components of most samples.

Detrital matrix is a minor component of some samples (i.e. 25: 1911.0 m) and is difficult to distinguish from altered and deformed lithic grains which form a 'pseudomatrix'.

The authigenic mineralogy of samples 28 (1892.5 m) to 23 (1923.5 m) is dominated by kaolinite. This pervasively occludes porosity and comprises fine- to coarsely-crystalline booklets with a variably developed interbooklet microporosity. Minor kaolinite may have formed by alteration of detrital grains. Illite and possibly illite/smectite mixed layer clay is present as finely disseminated flecks within altered lithic grains and appears to have formed by alteration of the micaceous component. Chlorite is a minor to trace component of all samples and has also formed by alteration of lithic grains. Sample 22 is significantly different to other samples in that it is pervasively cemented by calcite (Fig. 3).

Judith Formation		
Sample	Depth (m)	Lithology
28	1892.50	Litharenite: Massive, grain-supported, very fine- to medium- and rarely coarse-grained, moderately sorted, angular to subrounded sandstone.
27	1899.50	Litharenite: Very fine- to medium-grained, moderately sorted, angular to rounded sandstone. Poorly defined lamination marked by parallel alignment of lithic grains. Deformed and altered lithic grains form 'pseudomatrix'.
26	1904.50	Litharenite: Severely impact-damaged, grain-supported, very fine- to medium- and rarely coarse-grained, poorly to moderately sorted, angular to subrounded sandstone.
25	1911.00	Litharenite: Silt-sized to medium-grained, poorly to moderately sorted, subangular to subrounded sandstone. Minor detrital matrix may be present.
23	1923.50	Litharenite: Very fine- to medium-grained, poorly to moderately sorted, subangular to subrounded sandstone. Weak lamination is marked by parallel alignment of grain long axis. Deformed and altered lithic grains form 'pseudomatrix'.
22	1928.50	Calcite-cemented litharenite: Fine- to very coarse-grained, poorly sorted, subangular to subrounded sandstone. Development of pervasive calcite precludes identification of possible matrix.

Table 2: Brief lithological descriptions of Longtom-1 samples. Detailed descriptions are given in Appendix 1.

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Formation	JUDITH FORMATION					
Sample Depth (m)	28 1892.50	27 1899.50	26 1904.50	25 1911.00	23 1923.50	22 1928.50
Lithology Grain size Sorting	Lithar F-M Mod.	Lithar VF-M Mod.	Lithar F-C Mod.	Lithar F-M Mod.	Lithar VF-M Mod.	lithar C-VC Mod.
Framework Grains						
Quartz (mono.)	25-35	45-55	25-35	40-45	25-35	25-35
Quartz (poly.)	5-10	5-10	5-10	2-3	1-2	10-20
Feldspar (K)						tr
Feldspar (plag.)					tr	
Lithic (undif.)	25-35	15-25	35-45	40-45	40-50	20-30
Mica	tr	tr		tr	tr	tr
Accessory		tr	tr	tr	tr	
Matrix						
Detrital matrix	tr	tr				1-2
Organic matter						
Authigenic minerals						
Pyrite			tr			
Kaolinite	15-20	5-15	5-15	10-15	10-20	2-3
Illite/smectite MLC	5-10	5-10	5-10	5-10	5-10	5-10
Chlorite	3-5	1-2	tr	2-3	1-2	2-3
Calcite						15-20
Quartz					tr	tr
Porosity						
Prim. Interparticle	5-10	5-10	?	?	<5	tr
Sec. Dissolution	tr	tr				
Fracture						
Unidentified	3-5	<3	1-2	<3	3-5	1-2

Table 2: Composition of Longtom-1 samples. All values are per cent volume. Values were estimated by visual estimation in thin section using the grain abundance charts of Flugel (1982).

Visible porosity is very poorly preserved in all samples and is difficult to estimate due to pervasive impact-damage and sample disaggregation. Nevertheless, a poorly interconnected, small mesoscopic porosity (ca. 5-10%) is developed in some samples and is dominated by a primary interparticle type. A secondary moldic and microscopic intercrystal porosity is a minor component.

XRD data
XRD analysis of the extracted clay fraction in sample 25 (1911.0 m) indicates (Fig. 11) that kaolinite is the dominant clay. Illite is a minor component of the clay fraction and chlorite a trace component.

Diagenesis
A summary of the main diagenetic events is presented below and the reader is referred to the thin section descriptions in Appendix 1 for a more detailed discussion. As far as possible diagenetic events are discussed in approximate chronological order. However, it is likely that some processes overlap and that the timing of others is poorly constrained.

- Extensive compaction has affected all samples as indicated by 'overpacked' framework grains comprising long to concavo-convex grain contacts (Fig. 3), and ductily-deformed micaceous lithic grains which have partly 'flowed' between more resistant detrital grains. Compaction has caused significant reduction of porosity and destruction of pore throat apertures.

- Finely disseminated illite and possibly illite/smectite is associated with lithic grains and has probably formed by alteration of the micaceous component. The timing of formation is poorly constrained. Traces of chlorite have formed by alteration of some lithic grains.

- Patchy to pervasive formation of medium to coarsely crystalline (booklets to 5 μm dia.) pore-filling kaolinite. This has caused significant reduction of any remaining interparticle porosity and effectively transforms mesoscopic pores into microscopic. Minor kaolinite has also formed by alteration of some lithic grains.

- Incipiently formed non-sutured stylolites are a minor component of sample 26 (1904.5 m). They are marked by an accumulation of insoluble opaque material and sutured grain contacts and represent vertical permeability barriers.

<u>Note</u>: The diagenesis of sample 22 (1928.5 m) is also characterised by pervasive development of poikilotopic calcite. The presence of abundant occlusions suggests that calcite may replace depositional matrix. Detrital grains entrapped within calcite are less compacted than in other samples and indicate that calcitization occurred during early diagenesis.

5. SUMMARY AND CONCLUSIONS

5.1. SEDIMENT PROVENANCE

The framework component of all samples is dominated by monocrystalline quartz and micaceous lithic grains of phyllitic and mica schist origin. Most monocrystalline quartz display straight to undulose extinction and some grains contain boehm lamellae and annealed fractures marked by lines of inclusions. This suggests a metamorphic origin. Occasional quartz grains with abundant vacuoles are probably of vein origin. Polycrystalline quartz, and chert, metaquartzite, altered volcanic and argillaceous sedimentary fragments are also present. Polycrystalline quartz displays undulose extinction and comprises equant to foliated crystals with polygonal to sutured crystal boundaries. These grains are likely of a medium grade metamorphic origin. Zircon is the dominant accessory mineral and is typical of plutonic igneous rocks. However, the resistance of zircon to abrasion suggests that it may also have been reworked from an existing sediment or metasediment.

The above composition plots on the quartz/lithic axis of the Folk (1974) classification scheme and suggests a recycled orogenic provenance of dominantly continental affinity.

5.2. ENVIRONMENT OF DEPOSITION

All samples are variably impact damaged and lack diagnostic environmental indicators. However, the following is noted:-

The dominance of a very fine- to medium- and rarely coarse-grained, moderately to poorly sorted detrital component and possible presence of minor matrix suggests deposition under moderate energy conditions. Sample 22 contains a slightly coarser detrital component and was probably deposited under moderate to high energy conditions. The abundance of unstable lithic fragments indicates proximity to source and may indicate a marginal marine environment.

5.3. RESERVOIR POTENTIAL

Visible porosity is poorly preserved and the reservoir potential of all samples is very poor. This reflects primarily extensive compaction which has resulted in grain 'overpacking' through the development of long to concavo-convex grain contacts and ductily-deformed lithic grains. This has caused significant reduction of interparticle porosity. More importantly, pervasive development of long grain contacts has caused the closure of most pore throats and exerts the major control on permeability destruction. Pore-filling kaolinite is abundant and occludes most remaining interparticle porosity. Pervasive poikilotopic calcite occludes all traces of porosity in sample 22 (1928.5 m).

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PART B

APPENDIX 1

Thin Section Description

Sample No. 28 (1892.5m)

Lithology: Kaolinite-cemented litharenite

Texture: Massive, grain-supported, very fine- to medium- and rarely coarse-grained, moderately sorted, angular to subrounded.

Composition: Dominantly monocrystalline quartz and micaceous lithics; minor polycrystalline quartz, chert and opaques; trace mica. Authigenic minerals comprise dominantly kaolinite and quartz; chlorite is a minor component. Visible porosity is poorly preserved and difficult to estimate due to sampling-induced damage. It comprises ca. 5-10%, microscopic to small mesoscopic, relict interparticle, plus minor moldic and microscopic intercrystal.

Monocrystalline quartz displays straight to slightly undulose extinction, minor boehm lamellae and rarely microscopic vacuoles. Polycrystalline quartz is dominantly of recrystallized metamorphic variety comprising equant to flattened crystals with sutured to polygonal subgrain boundaries. Lithic grains comprise dominantly compacted mica schist, plus minor chert, felsic volcanics and quartz-rich arenites.

Diagenesis:

- Extensive compaction is indicated by 'overpacked' framework grains with long to concavo-convex grain contacts, and ductily-deformed lithic grains which have occasionally 'flowed' between more resistant detrital grains. This has resulted in significant reduction of interparticle porosity and destruction of pore throat apertures.
- Pervasive alteration of micaceous lithics and detrital mica to illite and ?illite/smectite. Minor patchy replacement of micaceous lithics and illite by chlorite was also noted. In both cases the timing of formation is poorly constrained.
- Patchily developed of medium to coarsely crystalline pore-filling and grain-replacing kaolinite resulting in significant occlusion of remaining interparticle porosity.

Env. Deposition: The fine- to coarse-grained nature of the detrital component and probable absence of matrix suggests deposition under moderate energy conditions. The abundance of micaceous lithics indicates proximity to source.

Reservoir Pot.: Extensive compaction involving ductile deformation of micaceous lithics has resulted in 'overpacking' of framework grains. This has caused a significant reduction of interparticle porosity and destruction of pore throat apertures. Consequently permeability is likely extremely poor and the reservoir potential of this sample is not good. Authigenic kaolinite is pervasive and effectively transforms remaining interparticle porosity from mesoscopic to microscopic.

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Sample No. 27 (1899.5)

<u>Note</u>: This sample is moderately impact-damaged especially at its margins and there has likely been some alteration to grain packing. This makes it difficult to estimate porosity.

Lithology: Kaolinite-cemented litharenite

Texture: Grain-supported, very fine- to medium-grained, moderately sorted, angular to rounded sandstone. Poorly defined lamination marked by parallel alignment of deformed lithic grains. Compaction and alteration of lithic grains has resulted in the formation of a 'pseudomatrix' which makes it difficult to determine if detrital matrix is present.

Composition: Dominantly monocrystalline quartz is the dominant framework grain; subdominant micaceous lithics; minor chert, polycrystalline quartz, opaques; trace muscovite and accessory minerals. Authigenic minerals are dominated by kaolinite and illite; chlorite is a minor component. Porosity is poorly preserved and comprises ca. 5-10%, microscopic to small mesoscopic, relict interparticle and ?minor dissolution types.

Monocrystalline quartz is slightly undulose and most grains contain common boehm lamellae and occasional microscopic vacuoles. Polycrystalline quartz is of a recrystallized metamorphic origin and comprises equant to flattened crystals with sutured crystal boundaries. Lithic grains are dominated by phyllite and mica schist lithologies; unidentified volcanic fragments are a minor component.

Diagenesis:

- Extensive compaction is indicated by 'overpacked' framework grains displaying long to concavo-convex grain contacts, and ductily-deformed lithic grains which have partly 'flowed' between the more detrital quartz. Sutured grain contacts are relatively common.
- Pervasive alteration of micaceous lithics and detrital micas to illite and possibly traces of illite/smectite. Minor chlorite is also present and appears to have formed by replacement of some lithic grains.
- Patchy albeit pervasive formation of pore-filling kaolinite resulting in occlusion of relict interparticle porosity.

Env. Deposition: The very fine- to medium-grained nature of the detrital component and probable absence of matrix suggests deposition under moderate energy conditions. An abundant micaceous lithic component indicates proximity to a metamorphic source.

Reservoir Pot.: A microscopic to small mesoscopic interparticle porosity is poorly preserved and very poorly interconnected and the reservoir potential of this sample is extremely poor. This primarily reflects the abundance of ductily deformed lithic grains which have 'flowed' between more resistant detrital grains (quartz, chert and metaquartzite). Grain 'overpacking' associated with the development of long to concavo-convex grain contacts is pervasive and has resulted in a significant reduction of interparticle porosity. More importantly, the pervasive development of long contacts has caused a major restriction of pore throats and probably exerts the major control on reservoir quality. Kaolinite occludes relict porosity and effectively transforms mesoporosity into micrporosity.

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Sample No. 26 (1904.5m)

Note: This sample was severely damaged during sampling and is extensively disaggregated. Consequently, primary and secondary porosity could not be estimated.

Lithology: Litharenite

Texture: Severely sampling-damaged, very fine- to medium- and rarely coarse-grained, poorly to moderately sorted, angular to subrounded sandstone. Original fabric was probably grain-supported.

Composition: Dominantly monocrystalline quartz and micaceous lithics; minor polycrystalline quartz; trace accessory minerals. Authigenic minerals are dominated by kaolinite; illite and chlorite are minor components. Excessive sample disaggregation during sampling precludes accurate estimation of visible porosity. However, the compacted nature of the lithic component suggests that porosity will have been largely obliterated.

Monocrystalline quartz displays slight to undulose extinction, common boehm lamellae and occasional vacuoles (some in bubble trains). Polycrystalline quartz comprises equant to stretched crystals with sutured to polygonal boundaries. This indicates a metamorphic origin. Lithic grains are dominated by phyllite and mica schist; intermediate composition volcanic fragments, chert and metaquartzite are minor components. Accessory minerals include opaques grains and zircon.

Diagenesis:

- Extensive compaction is indicated by common long to occasionally sutured grain contacts and ductily-deformed micaceous lithic grains.
- Formation of finely disseminated illite by alteration of the micaceous component of some lithic grains. The timing of formation is poorly constrained. Traces of finely disseminated chlorite have also formed by alteration of some lithic grains.
- Patchy formation of coarsely crystalline, pore-filling kaolinite, resulting in significant reduction of any remaining interparticle porosity. Kaolinite encloses deformed lithic grains suggesting that it is late diagenetic.
- Incipiently developed, non sutured stylolites are marked by an accumulation insoluble opaque material.

Env. Deposition: The very fine- to medium-grained nature of the detrital component and probable absence of matrix suggests deposition under moderate to possibly high energy conditions. Abundant micaceous lithic grains suggest proximity to source.

Reservoir Pot.: Grain disaggregation during sampling precludes accurate estimation of visible porosity. However, abundant remnants of ductily-deformed micaceous lithic grains suggest that compaction has been extensive and caused both reduction of porosity and restriction of pore throats. Patchily-developed kaolinite appears to partly occlude relict pores and will have further reduced permeability. Minor dissolution was noted but is unlikely to be volumetrically significant.

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Sample No. 25 (1911m)

Note: This sample was severely damaged during sampling and is extensively disaggregated. Consequently, primary and secondary porosity could not be estimated.

Lithology: Kaolinite-cemented litharenite

Texture: Silt-sized to medium-grained, poorly to moderately sorted, subangular to subrounded sandstone. Minor detrital matrix is present. A possible matrix-lined burrow may be present, although this may also be an artefact of sampling.

Composition: Dominantly monocrystalline quartz and micaceous lithics; minor to trace polycrystalline quartz, muscovite and accessory minerals. Kaolinite is the major authigenic mineral which fills most of the relict porosity not destroyed by compaction. Minor finely disseminated chlorite and rare authigenic illite/smectite are also noted. Porosity could not be quantified due to sampling-induced damage. However, porosity is largely absent in the larger more cohesive fragments.

Monocrystalline quartz grains are slightly undulose and some grains contain microscopic vacuoles and rare zircon inclusions. Polycrystalline quartz is of metamorphic variety with slight undulose extinction, few vacuoles and sutured to rare polygonal subgrain boundaries. Micaceous lithics have been extensively deformed and probably constituted muscovite-rich phyllite and/or schist lithologies. Chert and mataquartzite are trace components. Accessory minerals include zircon.

Diagenesis:

- Compaction is indicated by 'overpacked' framework grains with long to concavo-convex grain contacts, and ductily deformed lithic grains. This has resulted in significant reduction of interparticle porosity.
- Finely disseminated illite and traces of chlorite have formed by alteration of the micaceous component of some lithic grains.
- Patchy formation of coarsely crystalline pore-filling and possibly grain-replacing kaolinite. This probably resulted in occlusion of remaining interparticle not destroyed by compaction.

Env. Deposition: The silt-sized to medium-grained nature of the detrital component, relatively poor sorting and presence of minor matrix, suggests deposition under moderate to low energy conditions. Abundant micaceous lithic suggest proximity to a metamorphic source.

Res. Potential: Visible, microscopic to small scale mesoscopic, interparticle porosity is absent to very poorly preserved in the larger and more cohesive sample fragments. This indicates that the reservoir potential of this sample is extremely poor. Compaction has been extensive and resulted in grain 'overpacking' through development of long to concavo-convex grain contacts, and ductily-deformed lithic grains. This has resulted in significant reduction of porosity and destruction of pore throat apertures. Pore-filling kaolinite occludes most remaining porosity and effectively mesoporosity into microporosity.

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Sample No. 23 (1923.5m)

Lithology: Litharenite

Texture: Very fine- to medium-grained, poorly to moderately sorted, subangular to subrounded sandstone. Weak lamination is defined by parallel alignment of grain long axis. Compaction and alteration of lithic grains has resulted in the formation of a 'pseudomatrix' which makes it difficult to determine if detrital matrix is present.

Composition: Dominantly monocrystalline quartz and micaceous lithics, minor polycrystalline quartz; trace plagioclase (albite) and accessory minerals. Detrital matrix may be present but is difficult to distinguish from compacted detrital grains. Kaolinite is the main authigenic mineral and occludes interparticle porosity; illite and chlorite are minor components. A microscopic interparticle porosity is a minor component.

Monocrystalline quartz is slightly to strongly undulose. Polycrystalline quartz is comprised of metamorphic quartz with sutured subgrain boundaries, equant crystals and rare zircon inclusions. Lithic grains are dominated by phyllite and mica schist; metaquartzite, argillaceous sediments and possible altered felsic volcanics are minor components. Accessory minerals include zircon and opaques.

Diagenesis:

- Compaction is indicated by abundant long to concavo-convex grain contacts and ductily deformed micaceous lithic grains. This has resulted in 'overpacking' of framework grains and significant reduction of interparticle porosity.
- Pervasive alteration of the micaceous component of lithic grains to illite, possibly illite/smectite and traces of chlorite. The timing of formation is poorly constrained.
- Traces of quartz overgrowths are developed at the contact of some quartz grains.
- Formation of patchily developed coarsely crystalline pore-filling kaolinite. This has caused occlusion of remaining interparticle porosity. An interbooklet microporosity is moderately developed.

Env. Deposition: The very fine- to medium-grained nature of the detrital component and probable presence of minor matrix suggests deposition under moderate to possibly low energy conditions. Abundant micaceous lithics indicate proximity to a metamorphic source.

Reservoir Pot.: Porosity is largely absent in this sample and the reservoir potential extremely poor. Pervasive compaction involving ductile deformation of lithic grains has resulted in destruction of most porosity and closure of pore throats. Remaining porosity is largely occluded by pore-filling kaolinite.

PE906536

This is an enclosure indicator page.
The enclosure PE906536 is enclosed within the container PE904282 at this location in this document.

The enclosure PE906536 has the following characteristics:

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CONTAINER_BARCODE = PE904282
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BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = PHOTOMICROGRAPH
DESCRIPTION = Photomicrograph, Figure 9, Appendix 4, Longtom-1
REMARKS = PERMIT: VIC/P1PAGES: 1
DATE_WRITTEN = 31-JUL-1995
DATE_PROCESSED =
DATE_RECEIVED =
RECEIVED_FROM = BHP Petroleum Pty Ltd
WELL_NAME = LONGTOM-1
CONTRACTOR = BHP Petroleum Pty Ltd
AUTHOR =
ORIGINATOR = BHP Petroleum Pty Ltd
TOP_DEPTH =
BOTTOM_DEPTH =
ROW_CREATED_BY = xls_jc40

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Sample No. 22 (1928.5m)

Lithology: Calcite-cemented litharenite

Texture: Grain-supported, fine- to very coarse-grained, poorly sorted, subangular to subrounded sandstone. Development of pervasive calcite precludes identification of possible matrix.

Composition: Dominantly monocrystalline quartz and micaceous lithics; major polycrystalline quartz; trace mica, accessory minerals and orthoclase feldspar. Detrital matrix may be present but could not be quantified due to pervasive calcite. Authigenic minerals comprise dominantly monocrystalline quartz; minor kaolinite; trace illite, possible illite/smectite and chlorite. Visible porosity is largely absent.

Monocrystalline quartz displays straight to slightly undulose extinction. Polycrystalline quartz displays undulose extinction and comprises equant to elongate subgrains with polygonal and sutured crystal boundaries. Lithic grains are dominated by mica schist; chert, metaquartzite, argillaceous sediments and altered volcanic fragments are minor to trace components.

Diagenesis:

- Onset of compaction as indicated by long to concavo-convex grain contacts and deformed lithic grains.
- Pervasive development of poikilotopic calcite resulting in almost complete occlusion of porosity. The dusty appearance of calcite crystals suggest that they may replace an earlier matrix. Detrital grains entrapped in calcite are less compacted than other samples and suggest that calcitisation occurred during early diagenesis.
- Illite, possible illite/smectite and traces of chlorite have formed by alteration of the micaceous component of lithic grains. The timing of formation is poorly constrained.
- Pore-filling kaolinite is a minor component and appears to both occlude porosity and replace detrital grains. Its timing of formation relative to calcite development is unknown.

Env. Deposition: The very fine- to very coarse-grained nature of the detrital component and possible presence of matrix suggests deposition under moderate to high energy conditions. The absence of sorting suggests that bioturbation may have been extensive (viz. the higher energy events needed to transport the coarser fraction should occur as discrete lamellae in an undisturbed sediment).

Reservoir Pot.: Visible porosity is largely absent and the reservoir potential of this sample is extremely poor. This reflects both early compaction resulting in 'overpacking' of grains and pervasive development of poikilotopic calcite which has resulted in complete occlusion of porosity.

PE906537

This is an enclosure indicator page.
The enclosure PE906537 is enclosed within the container PE904282 at this location in this document.

The enclosure PE906537 has the following characteristics:

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                    Longtom-1
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        WELL_NAME = LONGTOM-1
       CONTRACTOR = BHP Petroleum Pty Ltd
           AUTHOR =
       ORIGINATOR = BHP Petroleum Pty Ltd
        TOP_DEPTH =
     BOTTOM_DEPTH =
   ROW_CREATED_BY = xls_jc40
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APPENDIX 1

Traces of XRD Spectra

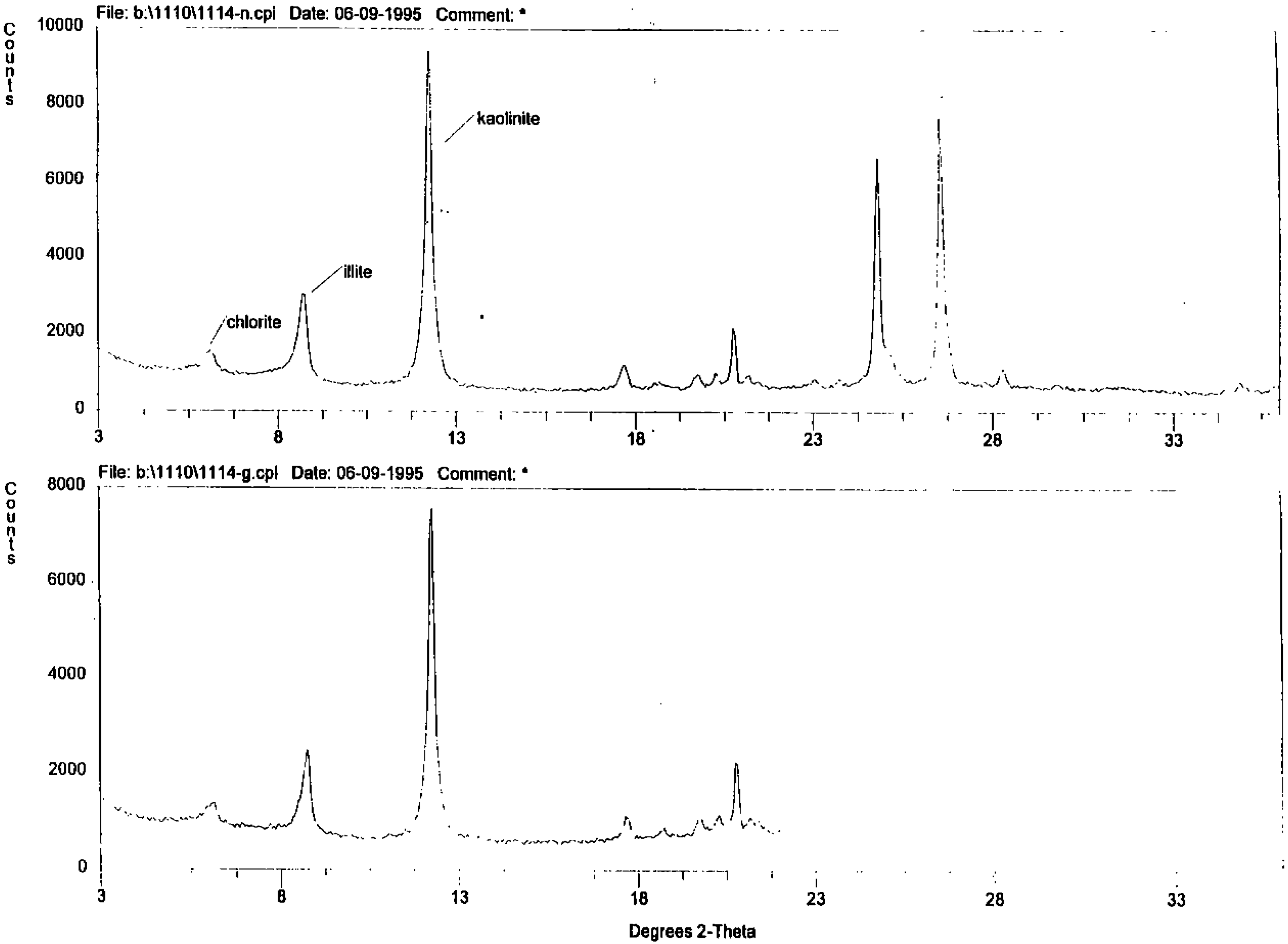

Figure 11: **Sample 25 (1911.0 m)**: Air dried (upper) and glycolated (lower) traces of XRD spectra. Kaolinite is the dominant clay. Illite and chlorite are minor to trace components. Note that all peaks are unaffected by glycolation.

ENCLOSURES

ENCLOSURES

PE600682

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The enclosure PE600682 is enclosed within the container PE904282 at this location in this document.

The enclosure PE600682 has the following characteristics:

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CONTAINER_BARCODE = PE904282
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BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
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DESCRIPTION = Composite Well Log, 1 of 2, (enclosure from WCR vol.2) for Longtom-1
REMARKS = PAGES: 1
DATE_WRITTEN = 25-MAY-1995
DATE_PROCESSED =
DATE_RECEIVED = 23-JAN-1995
RECEIVED_FROM = BHP Petroleum Pty Ltd
WELL_NAME = Longtom -1
CONTRACTOR = BHP Petroleum Pty Ltd
AUTHOR =
ORIGINATOR = BHP Petroleum Pty Ltd
TOP_DEPTH = 82
BOTTOM_DEPTH = 2240
ROW_CREATED_BY = xls_kb00

(Inserted by DNRE - Vic Govt Mines Dept)

PE600683

This is an enclosure indicator page.
The enclosure PE600683 is enclosed within the container PE904282 at this location in this document.

The enclosure PE600683 has the following characteristics:

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CONTAINER_BARCODE = PE904282
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BASIN = GIPPSLAND
ONSHORE? = N
DATA_TYPE = WELL
DATA_SUB_TYPE = COMPOSITE_LOG
DESCRIPTION = Composite Well Log, 2 of 2, (enclosure from WCR vol.2) for Longtom-1
REMARKS = PAGES: 1
DATE_WRITTEN = 06-JUN-1995
DATE_PROCESSED =
DATE_RECEIVED = 23-JAN-1995
RECEIVED_FROM = BHP Petroleum Pty Ltd
WELL_NAME = Longtom -1
CONTRACTOR = BHP Petroleum Pty Ltd
AUTHOR =
ORIGINATOR = BHP Petroleum Pty Ltd
TOP_DEPTH = 1011
BOTTOM_DEPTH = 1780
ROW_CREATED_BY = xls_kb00

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