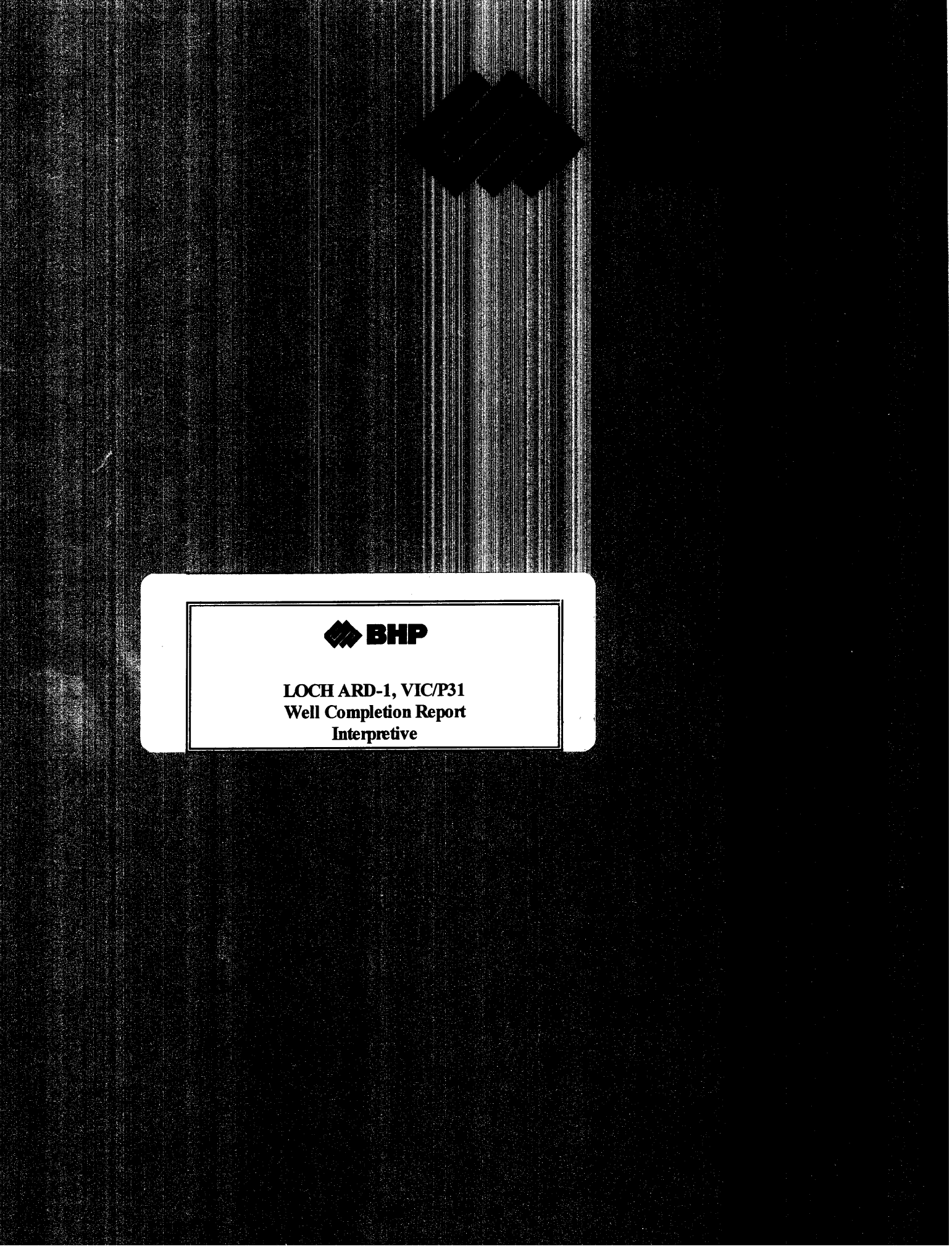


BHP

LOCH ARD-1, VIC/P31
Well Completion Report
Interpretive

OTWAY BASIN, VIC/P31

LOCH ARD-1

INTERPRETIVE DATA

PREPARED BY: A. MUSTICA
TECHNICAL ASSISTANT

70843_1.WCR

DATE: JUNE 1994

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

Acknowledgements

This report was compiled and written with the help of the following:

1 Simon Horan, Basin Explorationist,
2 Chris Luxton, Petroleum Geophysicist,
3 Mark Lemaire, Database Administrator.

TABLE OF CONTENTS

1 WELL INDEX SHEET

COMPANY:	BHP Petroleum Pty Ltd.				
SPUDDED:	18-Oct-1993	**WELL:**	Loch Ard-1	**TYPE:**	Exploration
COMPLETED:	1-Nov-1993		**BASIN:**	Otway Basin	
TD:	1397mRT	**ELEVATION**		**TENEMENT:**	VIC/P31
		W.D	**R.T**	**Lat.**	**Long.**
		74.7m	25.3m	38°55' 54.717" S	143°10' 55.156 E
STATUS:	Plugged and Abandoned, Dry Hole				

Group	**Seismic TWT**	**Tops (m)**		**Thickness (m)**	**Lithologic Summary/Remarks**
		RT	**Sub Sea**		
Sherbrook		393	368	191	Claystone with interbedded Sandstone
Upper Shipwreck	740	790	765	253	Sandstone with interbedded Claystone
Lower Shipwreck	980	1162	1137	43	Interbedded sandstone with claystone and minor coal interbeds
Otway	1007	1205	1180	192+	Interbedded Argillaceous lithic/quartzose sandstone and claystone
T.D.	1120	1397	1372		

LOGS		
SUITE 1	**SUITE 2**	**SUITE 3**
DLL-MSFL-AS-GR-SP-CAL-AMS	DLL-MSFL-SDT-GR-SP-CAL-AMS	
FMS-GR-AMS	LDL-CNL-GR-CAL-AMS	
CST-GR	VSP	
	CST-GR	

				STORED
DITCH CUTTINGS:				**KESTREL P/L**
FROM:	368m	**TO:**	1372m	**MT WAVERLEY VIC**

CONVENTIONAL CORE		
INTERVAL		**REC**
	No Conventional Cores taken	-

CASING			
SIZE	**30"**	**20"**	**9 5/8"**
LANDED AT (M)	133m	382m	930m

TEST RESULTS	
RFT:	None
DST:	None

2 WELL SUMMARY

Loch Ard-1 spudded on the 18th October 1993 and was drilled to a total depth of 1397m RT by the semi-submesible rig Byford Dolphin. The well is located in the Otway Basin, within permit VIC/P31, approximately 8km north of Eric the Red-1 well (refer to Figure 1). The water depth at this location was 74.7 metres.

The well was drilled to evaluate three targets in a faulted anticline structure:

1. Primary, Upper Shipwreck Group 'B' Sand
2. Secondary Upper Shipwreck Group 'A' Sand
3. Tertiary, Sherbrook Group 'B' Sand

No significant hydrocarbon zones were intersected by the well, consequently there were no RFT or DST's run.

As the well failed to intersect any significant hydrocarbon zones, the well was plugged and abandoned as a dry hole and the rig was released on the 1st November 1993.

3 HYDROCARBONS

3.1 Hydrocarbon Occurrences

No significant hydrocarbons were intersected during the drilling of the Loch Ard-1 well. The Petrophysical Interpretation Report (Appendix 1) indicates that all the sandstone units were water saturated. As a result no RFT's were conducted in the well.

4 STRUCTURE

The Loch Ard structure was defined as a faulted anticline with fault dependant closure. The trap first formed during a localised transpressional event during the late Campanian but was also influenced by episodic structural inversion occurring from late Campanian to Late Miocene. Pre-drill isopach mapping indicated that within the late Campanian sequence syndepositional faulting occurred resulting in a risk that cross-fault seal may be inadequate to trap hydrocarbons. Lateral seal across the faults was predicted to result from juxtaposition of sealing claystone intervals within the Shipwreck and Sherbrook Groups.

The prospect is located within a structurally complex area within the Mussel Terrace in the south-eastern part of the Otway Basin (Figure 2).

Post-drill analysis of the structure indicates that pre-drill interpretation was valid. The errors in the prognosed depths to key horizons (refer Figure 3 Predicted vs Actual) were due to seismic miscorrelations with nearby Eric The Red-1.

5 STRATIGRAPHY

5.1 Predicted vs Actual

The stratigraphic sequence penetrated at Loch Ard-1 is illustrated in Figure 3 (Predicted vs Actual), Enclosure 1 (Composite Log) and is summarised below. The well reached a total depth of 1397 mRT, terminating in the Early Cretaceous Otway Group. Delineation of age units is based primarily on log correlation with nearby wells, together with palynology (Appendix 2), to further define the formations.

A generalised stratigraphic column for the Otway Basin is presented in Figure 4.

No ditch cuttings were obtained obove 368 mRT.

5.2 Stratigraphic Summary

5.2.1 Cretaceous

Sherbrook Group

Depth:	393 - 790 mRT
Thickness:	397m
Age:	Santonian - Campanian
Depositional Environment:	Near Shore marine

Claystone interbedded with sandstone. The claystone is non calcareous and contains trace very fine to fine quartz and trace glauconite. The lower part of the section (584 - 790 mRT) represents the Sherbrook 'B' Sands and consists of predominately sandstone and claystone interbeds. The sands are clear to translucent, well sorted grains with good to excellent visual porosity and display a blocky log character.

Upper Shipwreck Group

Depth:	790 - 1162 mRT
Thickness:	372m
Age:	Coniacian - Turonian
Depositional Environment:	Nearshore marine to a non-marine slightly brackish

The top of the Upper Shipwreck Group is an unconformable surface. The section can be broken up into two units, the Upper Shipwreck Group 'A' Sands (790 - 1049 mRT) and the Upper Shipwreck Group 'B' Sands (1049 - 1162 mRT). The sediments consist of sandstone with claystone interbeds. The sands are clear to translucent, well sorted quartz grains with abundant strong calcite cement and have nil to poor visual porosity and display a blocky log character.

Lower Shipwreck Group

Depth:	1162 - 1203 mRT
Thickness:	41m
Age:	Cenomanian
Depositional Environment:	Non-marine lacustrine and marginally marine

The top of the Lower Shipwreck Group is an unconformable surface. The section consists of interbedded sandstone with claystone and minor coal interbeds. The sands are fine to coarse grained, dominately medium grained, moderately sorted clear quartz grains with poor to rarely fair visual porosity. The sands contain trace mica, light green lithics and trace medium brown, hard dolomite bands.

Otway Group

Depth:	1203 - 1397 mRT
Thickness:	194m
Age:	Late Albian
Depositional Environment:	Brackish

The top of the Otway Group is an unconformable surface. The section consists of interbedded Argillaceous lithic quartzose sandstone and claystone. The sands are fine to dominately medium grained, moderately well sorted with poor to very poor visual porosity.

6 GEOPHYSICAL DISCUSSION

6.1 Seismic Coverage

The Loch Ard structure is defined by a 1x1 kilometre grid of moderate to good quality seismic data acquired in 1991 by Western Geophysical's "Western Odyssey", designated "OH91". The seismic coverage did not optimally image the complex geology of the Loch Ard area. The close line spacing and the quality of the data, however did serve to relieve some of the interpretational uncertainty evoked by the structural complexity of the area. A complete history of previous seismic surveys conducted within the permit is given in Table 1.

TABLE 1

Survey	Operator	Year
OS	Shell	1967-1968
HO3	BHPP (Hematite)	1973
HO4	BHPP (Hematite)	1974
OE80A	ESSO	1980
OE81A	ESSO	1981
OMQ	Oil and Mineral Quest	1981-1982
OH91	BHPP	1991

6.2 Post Well Mapping

The primary and secondary targets both came in low to prognosis with the secondary target reservoir of poorer quality than first prognosed. The tertiary target also came in low to prognosis but was thicker than the prognosed. Errors in the prognosed depths to key horizons were mainly due to seismic miscorrelations from Eric The Red-1, as a result of the complex structure in the area.

6.3 Velocities

Pre-drill depth conversion of two-way time data in the Loch Ard area utilised the well velocity data acquired in Eric The Red-1. In the absence of any significant velocity problems in the well or noted in the section adjacent to Loch Ard, the calibrated sonic log (incorporating the VSP data) was used for depth conversion computations. Two-way times from the Landmark interpretation were extrapolated to the Eric The Red-1 calibrated time-depth curve and the corresponding sub-sea depths read off and tabulated for Loch Ard-1.

Despite differences in some of the prognosed versus actual formation tops the prognosed time-depth relationship was very close to the actual time-depth relationship in Loch Ard-1. Table 2 compares the prognosed interval velocities for four of the key horizons.

TABLE 2

HORIZON	PROGNOSED THICKNESS (m)	PROGNOSED INTERVAL VELOCITY (ms^{-1})	ACTUAL INTERVAL VELOCITY (ms^{-1})	DIFF (%)
Sherbrook 'B' Sands to Shipwreck 'A' Sands	168	2417	2374	-1.8
Shipwreck 'A' Sands to Shipwreck 'B' Sands	236	2538	2677	+5.5
Shipwreck 'B' Sands to Lower Shipwreck	201	2662	3126	+17.4
Lower Shipwreck to Otway Group	177	3000	3305	+10.2

7 GEOLOGICAL DISCUSSION

7.1 Summary of Previous Work

In the permit VIC/P31 (granted to BHPP on the 22nd February 1991) only three other wells have been drilled prior to Loch Ard-1, those being Mussel-1 (ESSO, 1969), Eric The Red-1 (BHPP, 1993) and Minerva-1 (BHPP, 1993).

Mussel-1 was drilled in the permit prior to it being granted to BHPP. The well was drilled to a total depth of 2450 mRT intersecting the Shipwreck Group (Primary Target) and the Dilwyn Formations (Secondary Target). The well encountered water bearing sandstones in the Mepunga and Dilwyn Formations and weak gas shows in the Waarre Sandstone. The well was plugged and abandoned.

Eric The Red-1 was designed primarily to test the hydrocarbon potential of the quartzose sandstones of the late Cretaceous Shipwreck Group within a faulted anticline. Eric The Red-1 was drilled to a total depth of 1875 mRT within the top of the Eumeralla Formation (Otway Group) without encountering any significant hydrocarbon flourescence and cuttings gas in the primary prospective sequence. The well was plugged and abandoned as a dry well.

Minerva-1 was drilled as an exploration well designed to test the hydrocarbon potential of the Minerva structure. The primary target was the sandstones of the Late Cretaceous Lower Shipwreck Group and the secondary target existed throughout the Late Cretaceous Sherbrook Group, Wangerrip Group and Nirranda Group. Gas bearing sands were encountered within both the Sherbrook Group and the Upper Shipwreck Sandstone. The lower sand was tested and flowed gas at up to 28.8 MMscf/d with 57.6 bbls of condensate per day before being suspended as a gas discovery.

7.2 Summary of Regional Geology

The Otway Basin, situated on the southeastern margin of Australia, is one of a series of basins formed in association with the breakup of Gondwana and Australia's separation from Antarctica.

Rifting within Gondwana was initiated at Late Jurassic to very Early Cretaceous time. Early Cretaceous sediments have only been penetrated offshore in Pecten-1A in the permit area. Rifting produced northwest-southeast oriented normal faulting which controlled the major structural style of the area. Sediments deposited within the Early Cretaceous rift and post-rift sequences thicken southwestwards across faults towards the basin centre.

From Valanginian to Barremian times, it is interpreted that the Pretty Hill Formation was deposited in the permit as alluvial fan sands, silts and clays in tilted half-graben settings. An ensuing sag phase due to thermal cooling and contraction of the crust led to a regional unconformity above the Pretty Hill Formation. The Eumeralla Formation was deposited from the Aptian to the latest Albian during the sag, comprising of both fluvial and lacustrine sands, silts and clays, with common coals deposited in a lake margin coal-swamp environment.

Reactivation of rift activity is interpreted at the earliest Cenomanian, which created a regional unconformity above the Eumeralla Formation. The rifting enhanced the structural style of the previous rifting episode, generating a series of northwest-southeast trending terraces, such as the Mussel Terrace, stepping down into the basin.

Rifting continued from the Cenomanian to the Santonian. During this time sediments of the Upper and Lower Shipwreck Groups were deposited, with the two separated by an unconformity dated approximately at 90 Ma. The sediments were deposited as a vast delta system changing regionally from non-marine/fluvial facies onshore in the north to nearshore and offshore/deltaic in the south.

The end of the second rifting episode, and the inception of sea-floor spreading, is suggested to occur in the permit area at 85Ma, which resulted in a compressive episode which gently folded the Shipwreck Group sediments. This resulted in a regional to occasionally parallel unconformity.

The Sherbrook Group sediments onlap and downlap the breakup unconformity. The sediments consist predominantly of distal clays and silts which grade vertically to more proximal delta sand-silt facies. During the deposition of the Sherbrook Group the basin underwent continued northeast-southwest extension along pre-existing normal faults, coincident with periods of northwest-southeast compression. The compression overprinted the previous minor regional folding.

Overlying the regional unconformity above the Sherbrook Group are Maastrichtian to Middle Eocene Wangerrip Group sediments. After a rapid marine transgression, which is often represented by a basal sand of the Pebble Point Formation, the Wangerrip Group prograded basinward, being deposited as a regressive sequence in deltaic settings represented by sands and silts of the Pember Mudstone and Dilwyn Formation.

The Nirranda Group, comprising of the Mepunga Formation shoreface sands overlain by marls and limestones of the Narrawaturk Marl, unconformably overlies the Wangerrip Group. The Nirranda Group represents a large marine transgression at Late Eocene time.

Northwest-southeast compressional tectonism was reactivated at earliest Oligocene time, with partial inversion of some faults, folding of strata and formation of a regional unconformity.

Open marine conditions since the Oligocene have produced the prograding, bioclastic carbonate sequence of the Heytesbury Group. Minor extension and some compressional tectonism have continued until present day, particularly in the northeast of the permit area, resulting in the partial erosion of the Heytesbury and Nirranda Group sediments.

7.3 Contributions to Geological Concepts and Conclusions

Loch Ard-1 was drilled to evaluate primary, secondary and tertiary targets within a faulted anticlinal structure. No significant hydrocarbons were intersected by the well. The primary target, the Upper Shipwreck Group 'B' sands were found to be water saturated and exhibit an average porosity of 14%. The secondary target, the Upper Shipwreck Group 'A' sand was also water saturated and is interpreted to have an average porosity of 19%. The Sherbrook Group 'B' sand constituting the tertiary target was also found to be water saturated and exhibit good reservoir properties with an average porosity of 30%. The Otway Group exhibited an average porosity of 10%.

Lateral seal across the faults was predicted to result from juxtaposition of sealing claystone intervals within the Shipwreck and Sherbrook Groups. The lithologies encountered in Loch Ard-1 were much sandier than predicted resulting in incompetant fault seal and loss of any migrated hydrocarbons. The potential for short distance leakage vertically along fault planes and into the overlying Shipwreck/Sherbrook Group also exists. Both the secondary and tertiary targets are similarly juxtaposed against sandy units that would have leaked any hydrocarbons which migrated into them.

The Lower and Middle Eumeralla Coal Measures were not penetrated in the well and hence no data is available to assess their source quality. A geothermal gardient of 2.8 °C/100m was measured from corrected bottom hole temperatures. This gradient was slightly lower than expected and may have affected maturation of the source intervals.

8 REFERENCES

BHPP, 1993
Loch Ard-1 well completion report, basic data. Unpublished BHPP inhouse report.

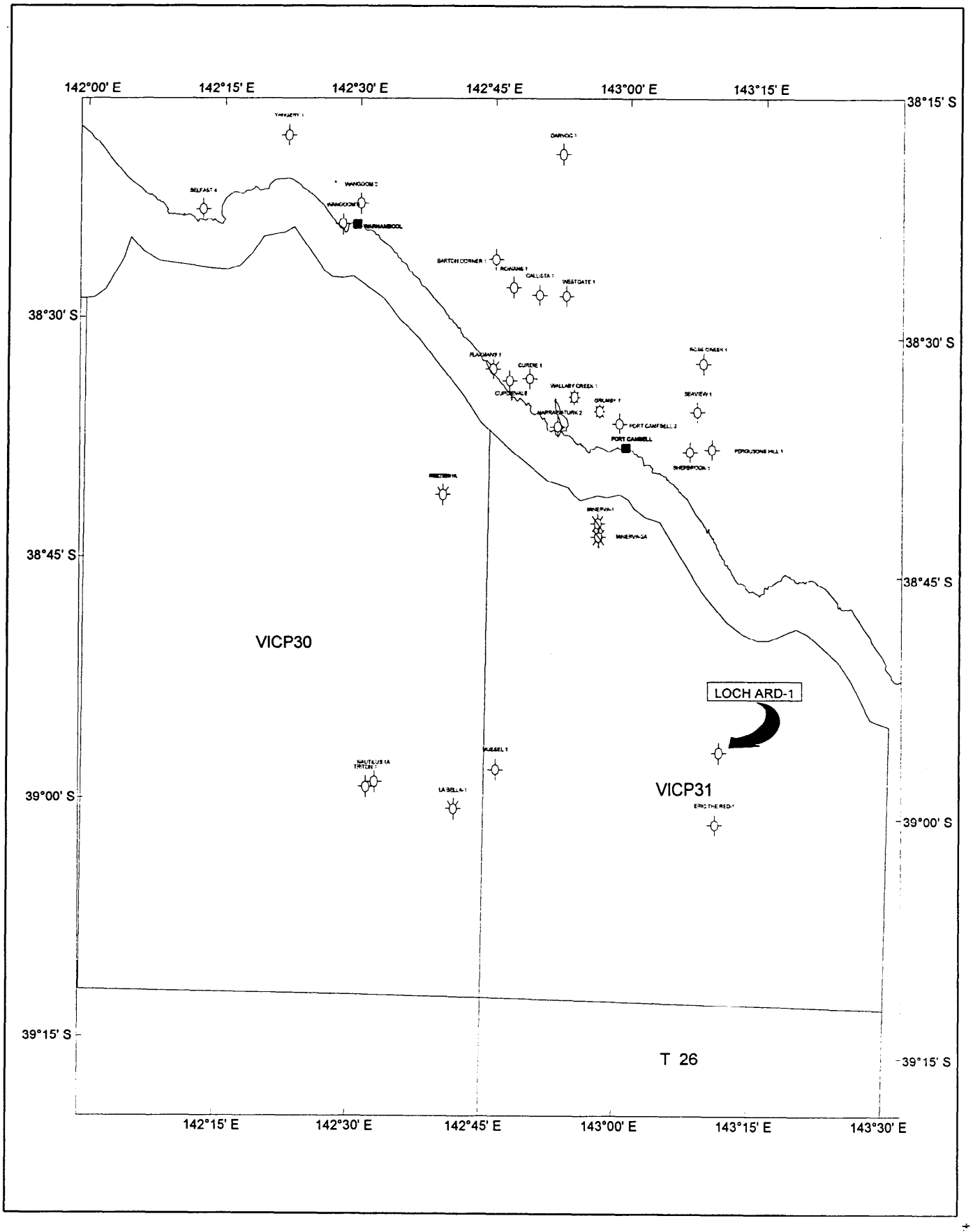
M. Durham, S. Horan and E. O'Callaghan, 1993
Loch Ard-1 Prospect File, Permit VIC/P31.
Unpublished BHPP inhouse report.

M. Durham, S. Horan, E. O'Callaghan, 1993
Loch Ard-1 Post Well Evaluation Report.
Unpublished BHPP inhouse report.

FIGURES

Loch Ard - 1
Location Map

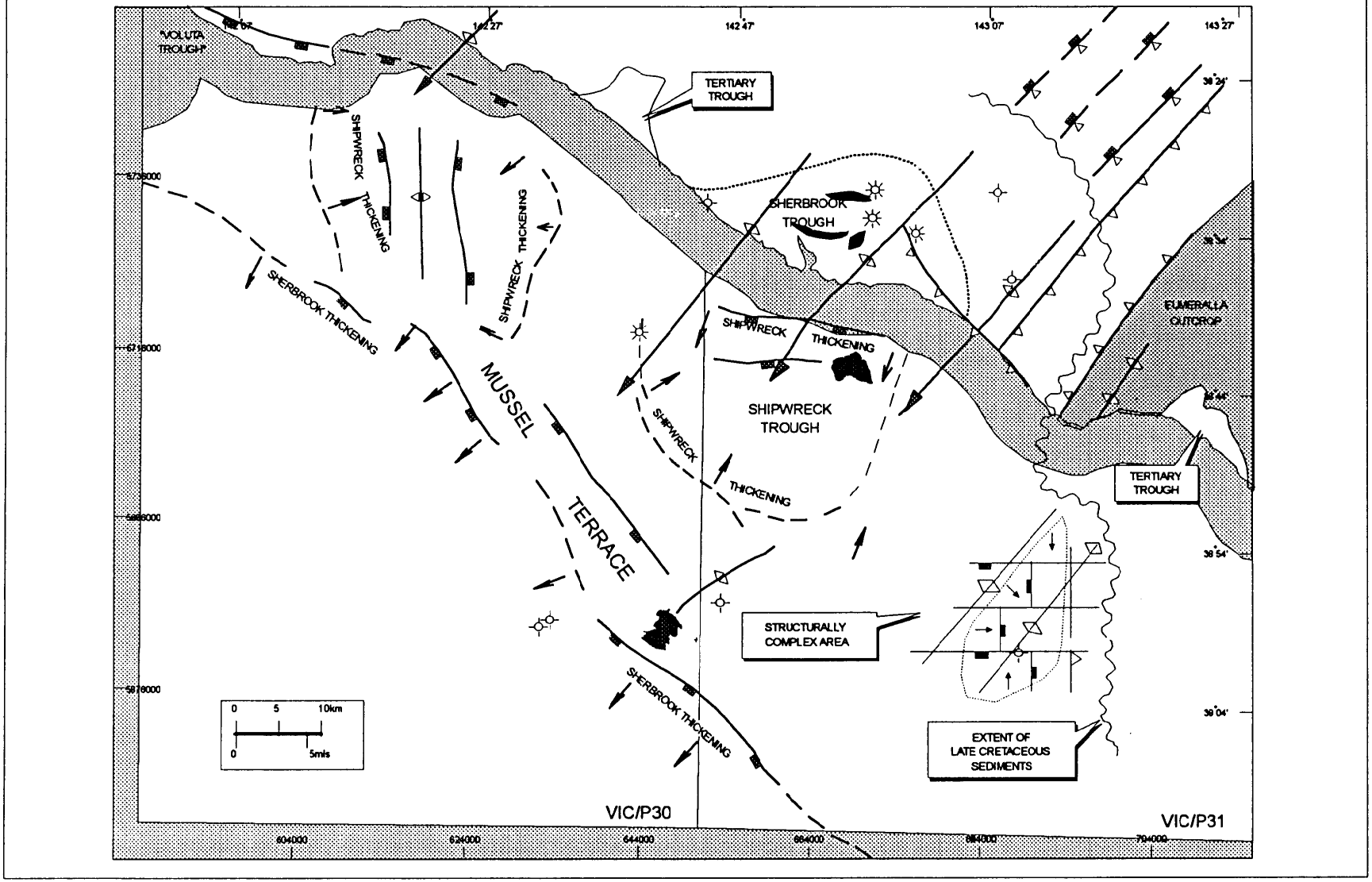
BHP

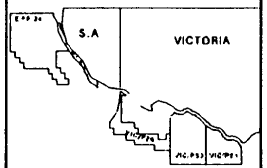


LOCHLOC.PRE
9-8-94

FIGURE 1

Australia Division
BHP Petroleum





VIC P30/P31
STRUCTURAL ELEMENTS MAP

FIGURE 2

BHP Petroleum

OTWAY BASIN

VIC/P30 & VIC/P31

FIGURE 6.0

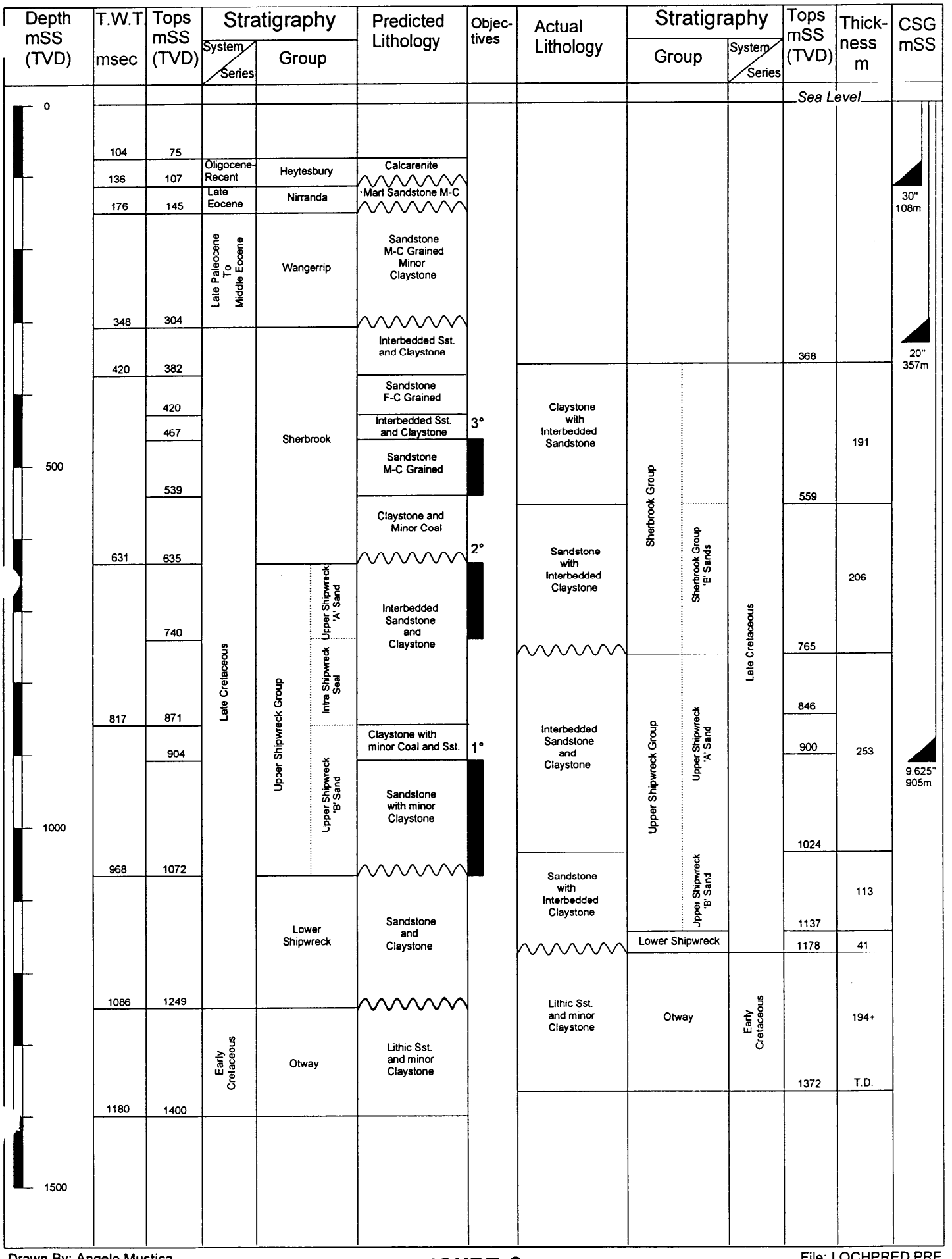
AUTHOR:	S.HORAN	DATE:	07/07/93
DRAWN BY:	T.DELPHIN	DWG NO:	042_FLW

LOCH ARD-1
PREDICTED v ACTUAL

PERMIT: VIC/P31

LINE: OH91-205 LAT: 38°55' 54.717" S ELEV: RT: 25m SPUD: 18-Oct-1993 STATUS: P & A Dry Hole

SP: 1490 LONG: 143°10' 55.156" E WATER DEPTH: 100m RIG RELEASE: 1-Nov-1993 RIG: Byford Dolphin



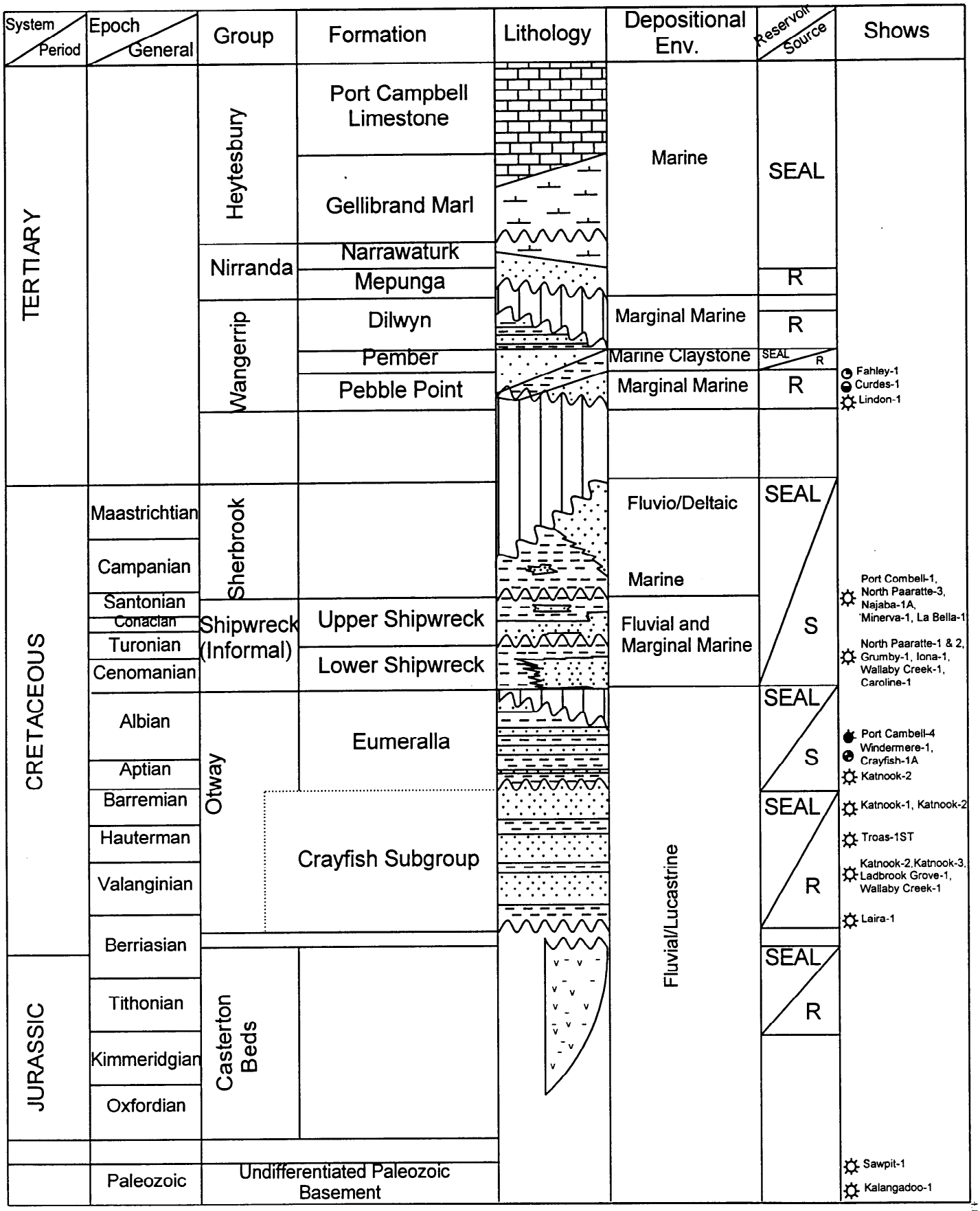
Drawn By: Angelo Mustica

FIGURE 3

File: LOCHPRED.PRE

OTWAY BASIN
STRATIGRAPHIC COLUMN

BHP



APPENDICES 1

BHP

LOCH ARD-1

PETROPHYSICAL INTERPRETATION

REPORT

PREPARED BY:

Mike Walker
Senior Petrophysicist

APPROVED BY:

Robert A. Hogarth
Reservoir Evaluation Manager

File No: Loc-1/PP/S01/R

DATE: 1st August, 1994

BHP PETROLEUM PTY. LTD.
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SUMMARY

Loch Ard-1 was interpreted using the all the available log data. The primary target, the Upper Shipwreck Group 'B' sands were found to be water filled and exhibit an average porosity of 14% and a net/gross of 73%. The secondary target, the Upper Shipwreck Group 'A' sand was also water filled and showed an average porosity of 19%. The Sherbrook Group 'B' sand, which constituted the tertiary target was also found to be water filled and exhibit an average porosities 30 %. The Otway Group exhibited an average porosity of 10%. Water salinities in the Sherbrook and Upper Shipwreck 'A' sands were quite low, in the order of 6000 ppm NaCl equivalent.

All depths in this report are in metres along hole below the Rotary Table of the drilling rig Byford Dolphin, which was 25.0 m above mean sea level.

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1 BASIC DATA

1.1 Wireline Logs

Wireline logs were run by Schlumberger on a Maxis 500 logging unit. Table 1 shows the available log data, with temperature information and time data.

Table 1: Wireline Logs & Temperatures

Time Circ Stopped / Circ Time Time log on bottom	TOOL STRING	Maximum Temperature	INTERVAL
24-Oct-93 @ 11:00 / 1.0	**Suite 1**		
25-Oct-93 @ 11:00	DLL-MSFL-SDT-GR-SP-GPIT-CAL-AMS	43°C	382 - 937m
25-Oct-93 @ 20:30	FMS-GR	44°C	382 - 937m
25-Oct-93 @ 23:15	CST (30 shot)		
27-Oct-93 @ 14:00 / 1.0	**Suite 2**		
27-Oct-93 @ 19:45	DLL-MSFL-AS-GR-SP-CAL	49°C	929 - 1395.0 m
27-Oct-93 @ 23:30	LDL-CNL-FMS-GR	52°C	929 - 1395.0 m
28-Oct-93 @ 05:00	CSI (VSP)		
28-Oct-93 @ 12:40	CST-GR [30 shot]		

The horner built-up temperatures were as follows, 45°C at 927 m and 57°C at 1395 m.

1.2 Conventional Cores

No conventional cores were cut.

1.3 Sidewall Cores

30 sidewall cores were shot in the 12-¼" open hole with 30 cores recovered, and 30 cores were shot in the 8½" hole with 30 cores recovered.

1.4 Wireline Formation Tests

No wireline formation tests were attempted.

1.5 Drill Stem/Production Tests

No production tests were carried out.

2 INTERPRETATION PROCEDURE

2.1 Data Preparation

Wireline log data was read from tapes and loaded into "Well Data System" (WDS), a log storage, manipulation, interpretation and presentation software package developed by Western Atlas International Inc. The suite 1 were used as delivered, whilst the 2 wireline data were prepared for interpretation by depth matching and by applying environmental corrections as per the Schlumberger chart book. The data from the density-neutron tools were adversely affected by a ribbed bore hole, which was presumed to have been generated by a bent drill collar. The resulting logs showed a "gas effect" due mainly to the density log reading low. A fourier transform run on the delta rho measurement revealed that the effect has a wavelength of exactly 2.4 m and inspection of the FMS calipers revealed an amplitude of less than ¼". A notch filter was designed to remove this effect using the WDS Filter program. The raw and filtered logs are shown in Enclosure 1. The filtered density and neutron logs were used in the interpretation.

2.2 Interpretation Model

The suite 1 data were processed using the gamma ray log for shale fraction, the sonic log for porosity and Rwa was calculated using the deep laterolog. The suite 2 data were interpreted using a shaly sand interpretation model which incorporated the Juhasz Water Saturation Model. Shale fraction was derived from the gamma ray and porosity was derived from the density and neutron logs.

2.3 Water Salinity

The SP log is well developed in Loch Ard-1. In suite 1 at 625 m the static SP was 70 mV, which suggests a values for R_w of 0.61Ω-m at 25°C, or about 9,000 ppm NaCl equivalent. The SP deflection decreases with depth, indicting a decrease in R_w. The Pickett plot for the suite 1 data is given in Figure 1 (and R_{wa} plot in Enclosure 2) and suggests a higher R_w , of 1 Ω-m at 36°C, or about 4000 ppm NaCl equivalent. These two values may be taken as end points, with the actual value expected in the middle at about 6000 ppm NaCl equivalent.

In the porous water sands encountered in suite 2 around 1075 m the maximum deflection recorded by the static SP was 38 mV. This suggests a value for R_w of 0.24Ω-m at 25°C, or about 25,000 ppm NaCl equivalent and agrees with the Pickett plot derived value shown in Figure 2.

2.4 Formation Electrical Properties

The electrical properties were assumed to be similar to the Shipwreck Formation encountered in Minerva-1 where electrical properties were measured on core plugs. The cementation exponent "m" was measured to be 1.77, "a" was taken to be 1.0 and the saturation exponent "n" was measured to be 1.90. These values are shown in Figure 2. Elsewhere these parameters were taken to be m=2.0, n=2.0 and a=1.0.

3 INTERPRETATION RESULTS

Table 3 contains a summary of the interpretation results using a porosity cut-off of 15% for the Sherbrook and Shipwreck 'A' sands. A porosity cut-off of 0% and a shale fraction cut-off of 50% was used for the Shipwreck 'B' and Otway group. It should be noted that the Otway Group is described as a siltstone and is likely to have very low permeability. The depths and thicknesses are given along hole. The results plot for the suite 2 data is given in Enclosure 3.

Table 2: Interpretation Results

Zone	Depth (mRT)	Gross (m)	Net (m)	N/G (%)	Por. (%)	Sw (%)
Sherbrook	585- 871	286	193.7	86	30	100
Shipwreck group 'A'	871 - 920	49	9.7	20	19	100
Shipwreck group 'B'	1049 - 1205	160	117.3	73	14	100
Otway Group	1205 - 1375	170	82.9	49	10	100

4 INTERPRETATION PARAMETERS

Table 4 contains the input parameters for the interpretation model.

Table 3: Interpretation parameters 1049 - 1205 m

Log	Matrix	Shale	Water	Filtrate	H/Carbon
Gamma Ray	30	140			
Sonic	55.5	102		189	
Density	2.65	2.56		1.0	1
Neutron	-.03	.30			1
Resistivity		8	.17	0.077	
Temperature	50		50	18	

Table 4: Interpretation parameters 1205 - 1375 m

Log	Matrix	Shale	Water	Filtrate	H/Carbon
Gamma Ray	40	130			
Sonic	55.5	92		189	
Density	2.65	2.56		1.01	1
Neutron	-.03	.40			1
Resistivity		9	.21	0.077	
Temperature	22		55	18	

Loch Ard-1 Pickett plot

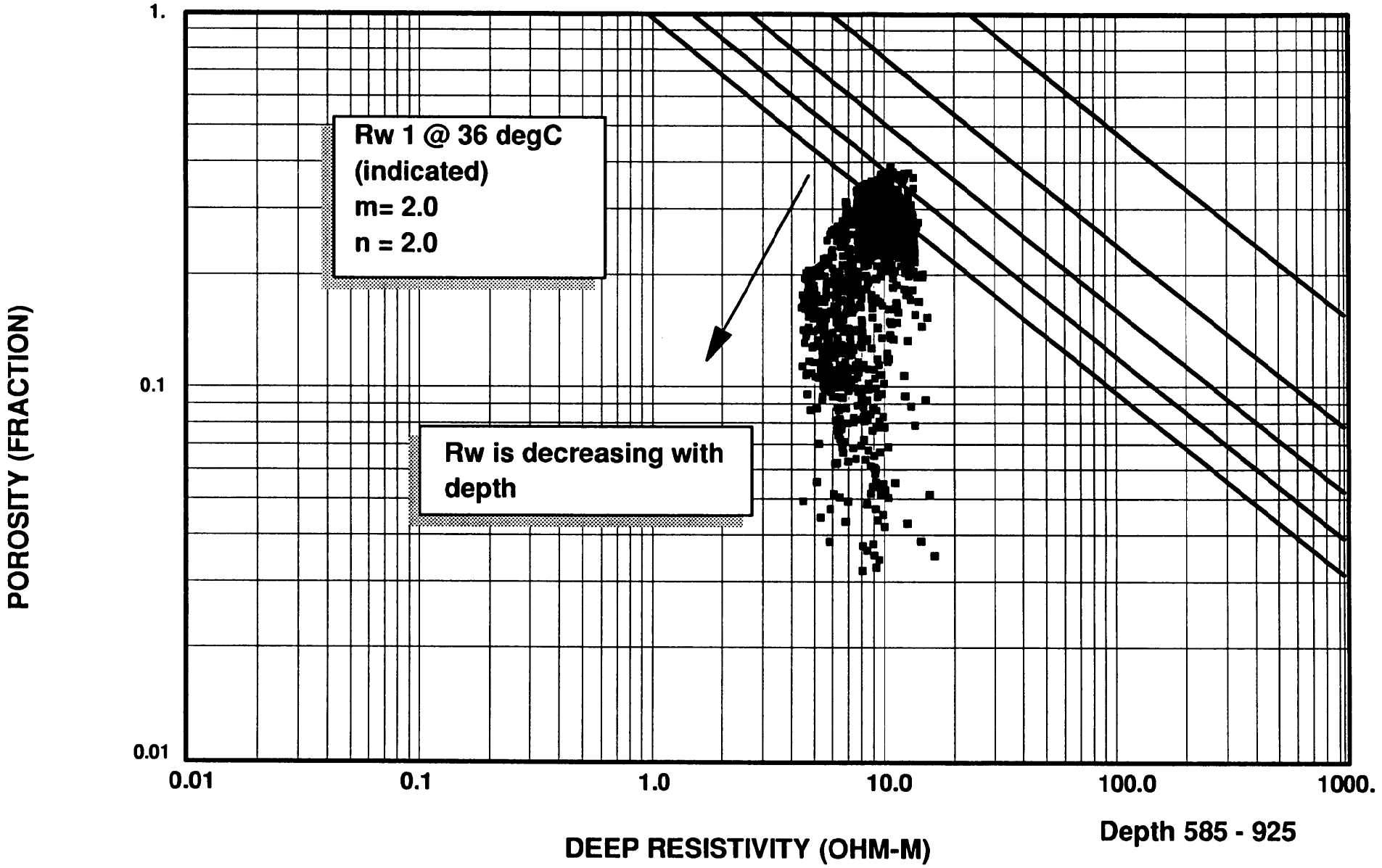

Figure 1

Loch Ard-1 Pickett Plot

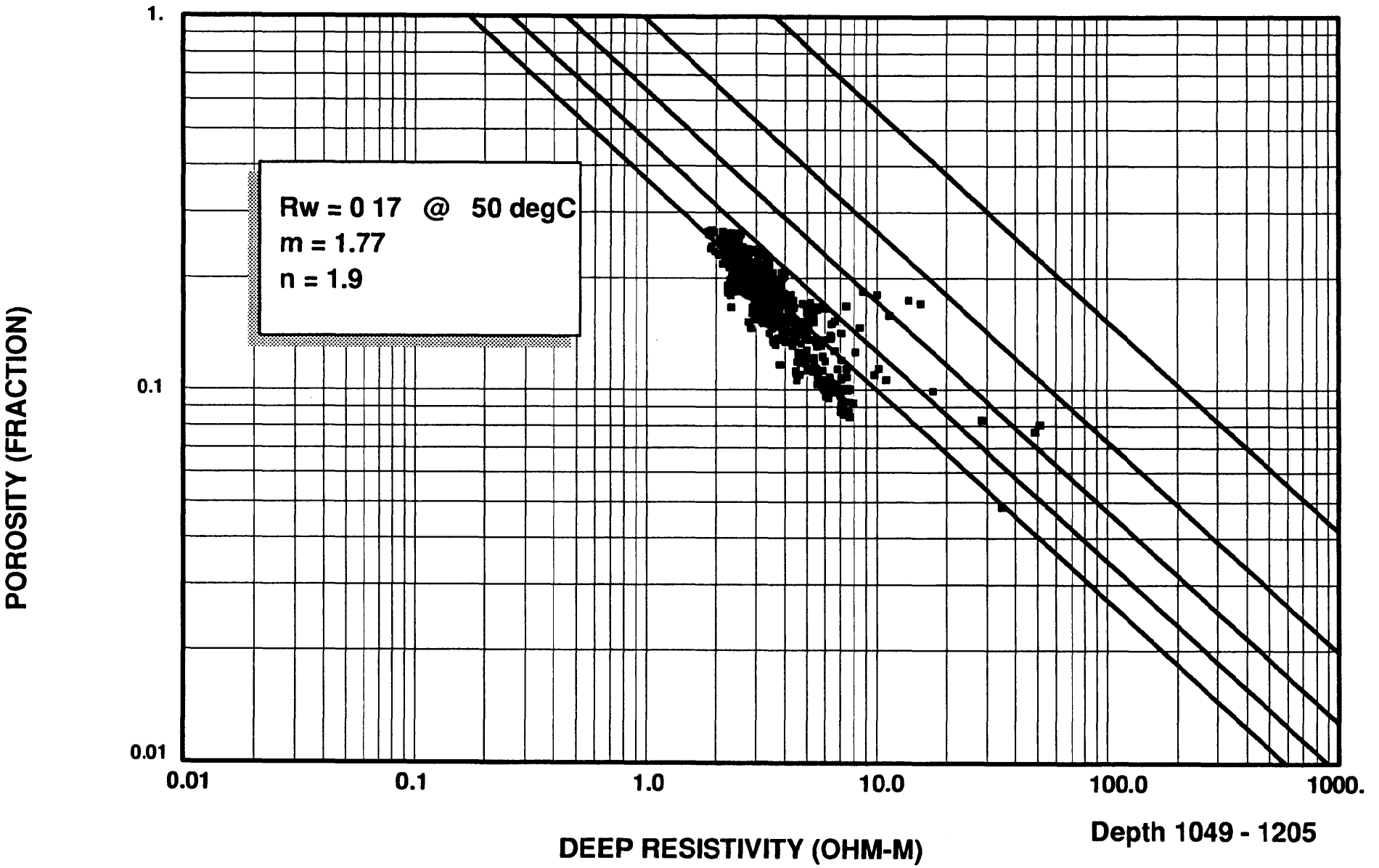

Figure 2

Loch Ard-1 Pickett Plot

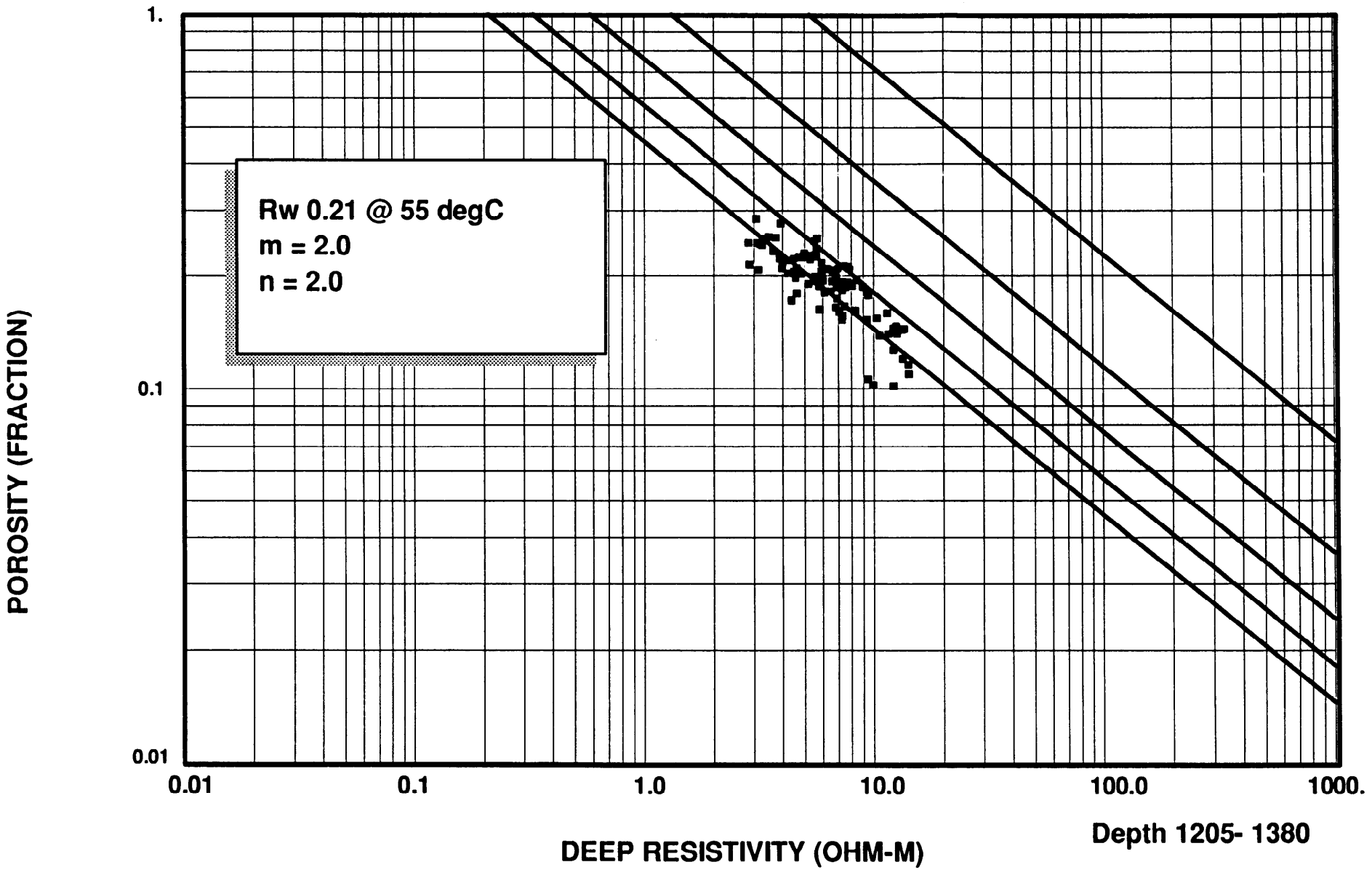

Figure 3

PE600347

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The enclosure PE600347 is enclosed within the container PE900439 at this location in this document.

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CONTAINER_BARCODE	= PE900439
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BASIN	= OTWAY
PERMIT	= VIC/P31
TYPE	= WELL
SUBTYPE	= WELL_LOG
DESCRIPTION	= Loch Ard 1 Raw & Filtered Data, Vol 2, Appendix 1 Enclosure 1
REMARKS	=
DATE_CREATED	= *
DATE_RECEIVED	= *
W_NO	= W1090
WELL_NAME	= Loch Ard 1
CONTRACTOR	= *
CLIENT_OP_CO	= BHP

(Inserted by DNRE - Vic Govt Mines Dept)

PE600348

This is an enclosure indicator page.
The enclosure PE600348 is enclosed within the container PE900439 at this location in this document.

The enclosure PE600348 has the following characteristics:

ITEM_BARCODE	= PE600348
CONTAINER_BARCODE	= PE900439
NAME	= Loch Ard 1 Log Interpretation, 1:500
BASIN	= OTWAY
PERMIT	= VIC/P31
TYPE	= WELL
SUBTYPE	= WELL_LOG
DESCRIPTION	= Loch Ard 1 Log Interpretation, 1:500, Vol 2, Appendix 1 Enclosure 2
REMARKS	=
DATE_CREATED	= *
DATE_RECEIVED	= *
W_NO	= W1090
WELL_NAME	= Loch Ard 1
CONTRACTOR	= Petrophysics Group
CLIENT_OP_CO	= BHP

(Inserted by DNRE - Vic Govt Mines Dept)

PE600349

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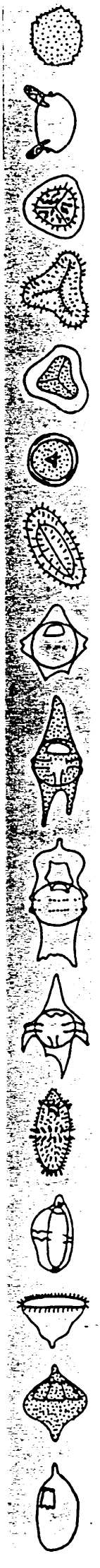
2

MORGAN PALAEO ASSOCIATES

PALYNOLOGICAL/PETROLEUM GEOLOGICAL CONSULTANTS

POSTAL ADDRESS: Box 161, Maitland, South Australia 5573
DELIVERIES: 1 Shannon Tce, Maitland, South Australia 5573
Phone (088) 32 2795 Fax (088) 32 2798



PALYNOLOGY OF BHPP LOCH ARD-1,

OFFSHORE OTWAY BASIN, VICTORIA, AUSTRALIA

BY

ROGER MORGAN

for **BHP PETROLEUM**

May 1994

REF:OTW.RPLOCHAR

PALYNOLOGY OF BHPP LOCH ARD-1

OFFSHORE OTWAY BASIN, VICTORIA, AUSTRALIA

BY

ROGER MORGAN

CONTENTS PAGE

I SUMMARY

402.5m(swc), 430.0m(swc) ; upper *senectus* Zone (lower *australis* Dino Zone) : Campanian : very nearshore marine : immature

451.0m(swc), 489.0m(swc) : middle *senectus* Zone (upper *aceras* Dino Zone) : Campanian : nearshore marine : immature

534.5m(swc) : lower *senectus* Zone (middle to lower *aceras* Dino Zone) : Campanian : nearshore marine : immature

575.0m(swc) : upper *apoxyexinus* Zone (upper *cretacea* Dino Zone) : Santonian : nearshore marine : immature

650-70m(cutts) : upper *apoxyexinus* Zone (lower *cretacea* Dino Zone) : Santonian : nearshore marine : immature

762.0m(swc), 788.0m(swc) mid *apoxyexinus* Zone (788.0m upper *porifera* Dino Zone) : Santonian : nearshore marine : immature

820.0m(swc), 837.0m(swc), 875-90m(cutts), 915-25m(cutts) : lower *apoxyexinus* Zone : Santonian : nearshore marine to very nearshore marine : immature

927.0m(swc) : indeterminate (almost barren)

954.0m(swc), 1022.0m(swc) : upper *mawsonii* Zone : Coniacian-Turonian : very nearshore marine with significant freshwater algae at 1022m : immature

1048.0m(swc) : *mawsonii* Zone : Turonian : possibly non-marine lake : immature

1107.0m(swc), 1150.0m(swc) : lower *mawsonii* Zone : Turonian : non-marine to slightly brackish : immature

1186.0m(swc), 1188.0m(swc), 1200.0m(swc) : *distocarinatus* Zone (*infusorioides* Dino Zone at 1200.0m) : Cenomanian : non-marine lacustrine and marginally marine : immature

1208.0m(swc), 1329.0m(swc) : indeterminate (almost barren)

1344-59m(cutts) : *paradoxa* Zone : late Albian : slightly brackish : marginally mature.

II INTRODUCTION

After well completion, twenty five samples (21 swcs, 4 cuttings) were submitted for detailed study. These results are summarised herein.

Palynomorph occurrence data are shown as Appendix I and form the basis for the assignment of the samples to twelve spore-pollen and dinoflagellate units of Campanian to Albian age.

Specimen counts were made on all assemblages and expressed in the raw data as percentages. In the running text, percentages from cuttings are always bracketed (5%) to show that they may be inaccurate due to caving.

The Cretaceous spore-pollen zonation is essentially that of Dettmann and Playford (1969), but has been significantly modified and improved by various authors since, and most recently discussed in Helby et al (1987), as shown on Figure 1. The Late Cretaceous zonation has been modified by Morgan (1992) in project work for BHPP (Figure 2). Tertiary zones are essentially those of Partridge (1976).

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

Sample processing usually involves the following steps. Extra techniques are only used if required:

(a) digest about 10gm of crushed rock in 50% HF overnight
(b) wash out several times over 10 micron polyester sieve. Acidify with conc HCl if flourosilicate gel forms
(c) heavy liquid separation used concentrated $ZnBr_2$ with SG of 2.0.
(d) wash out float fraction over 10 micron polyester sieve. Acidify if $Zn(OH)_2$ precipitate forms
(e) mount a sieved kerogen slide
(f) oxidise in Schutze Solution (conc 30% HNO_3 with crystalline $KClO_3$)

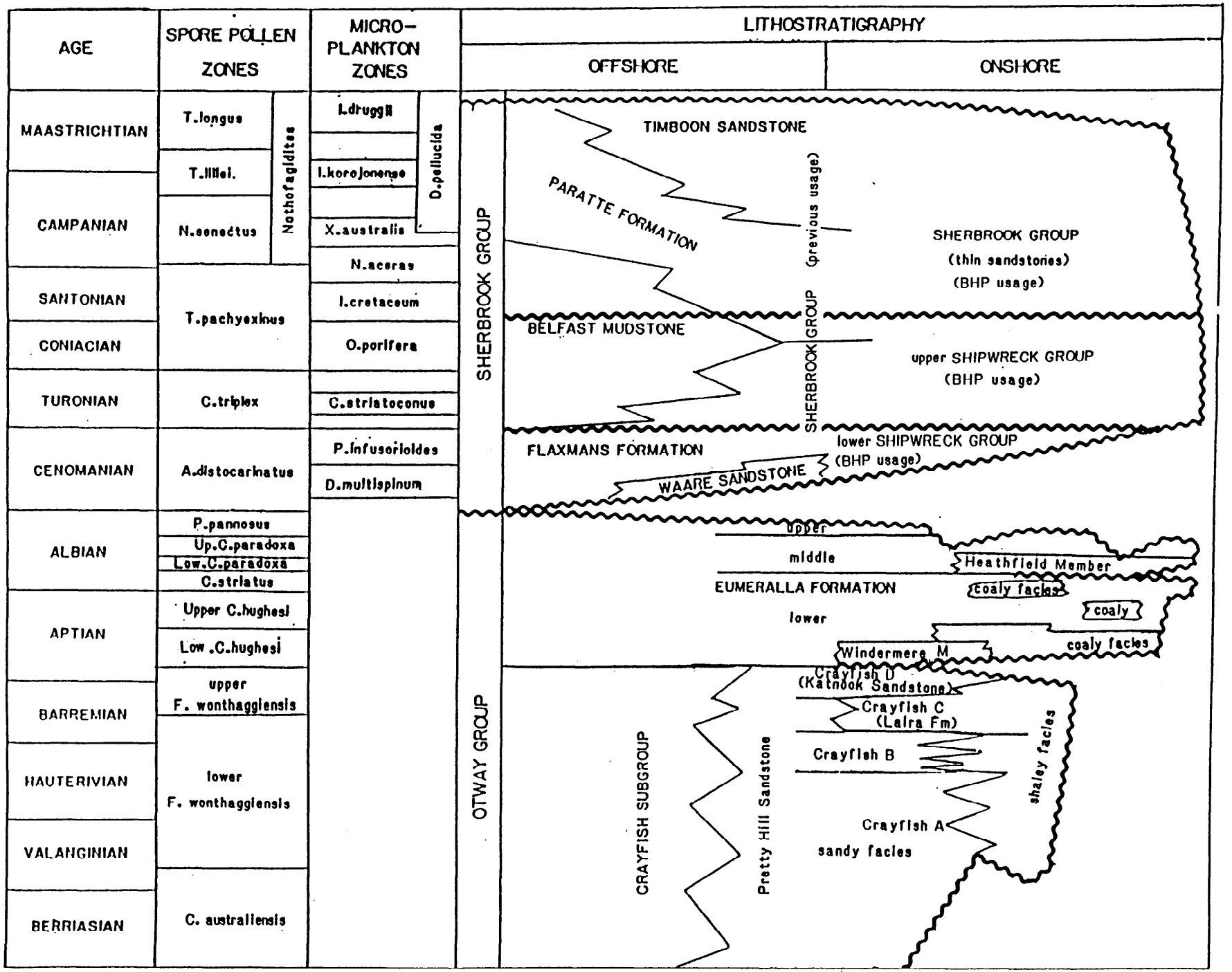


FIGURE 1. CRETACEOUS REGIONAL FRAMEWORK, OTWAY BASIN

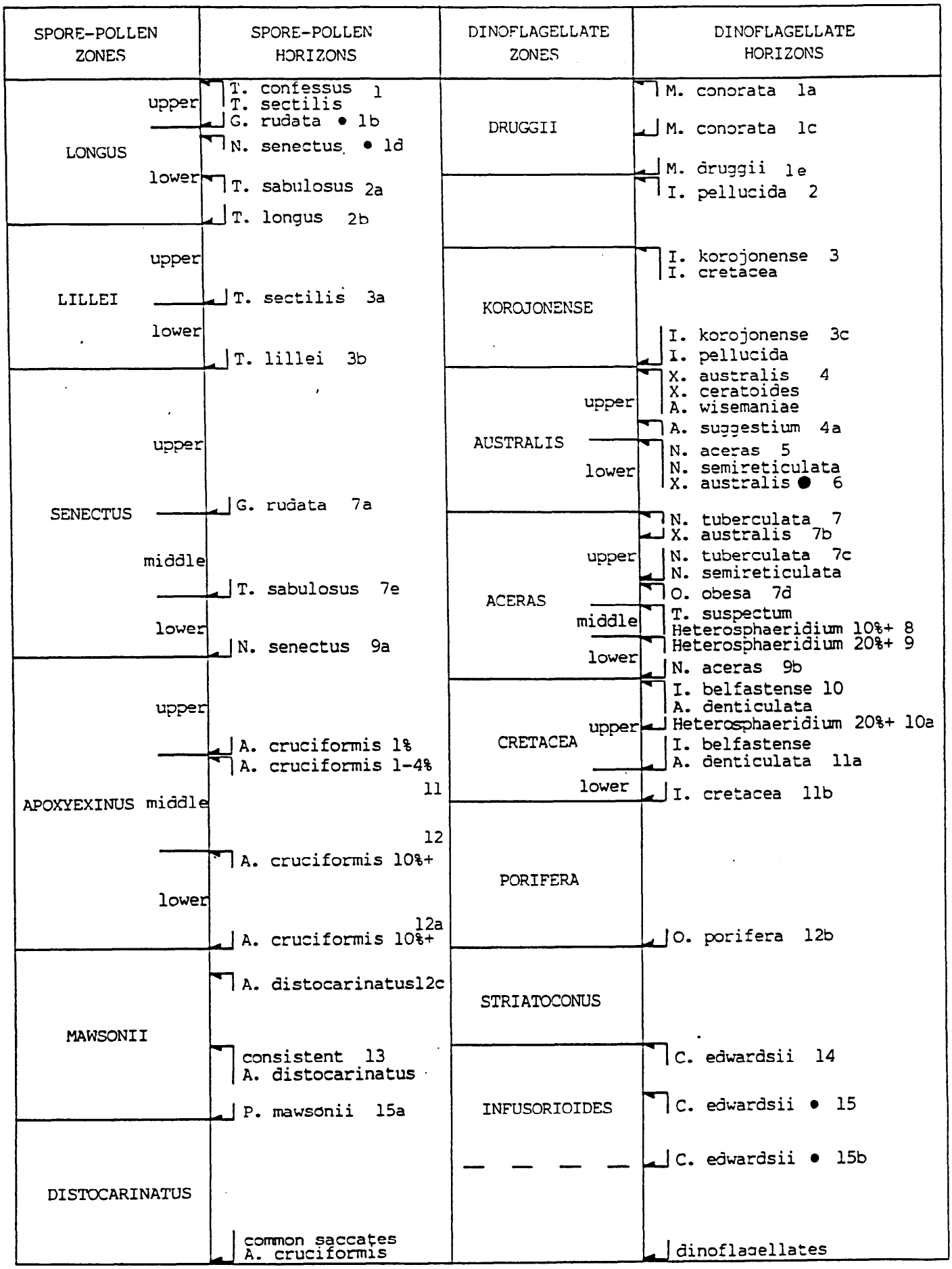


FIGURE 2 ZONATION USED HEREIN SHOWING THE NUMBERED HORIZONS AGAINST THE EXISTING FORMAL ZONATION.

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

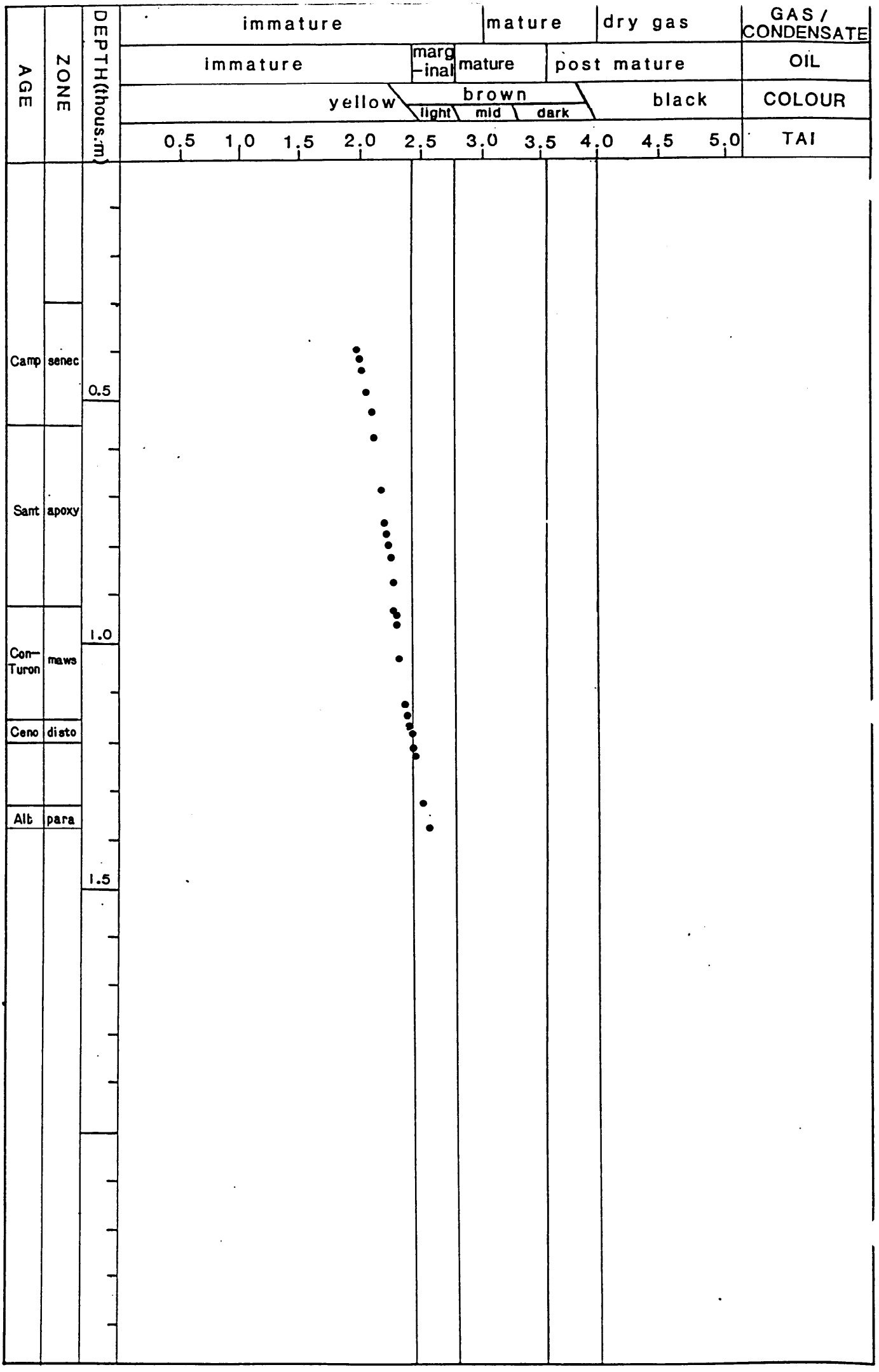


FIGURE 3 MATURITY PROFILE, BHPP : LOCH ARD-1

(g) wash out over 10 micron polyester sieve
(h) add 5% KOH to dissolve humic acids
(i) wash out over 10 micron polyester sieve
(j) examine under microscope for satisfactory oxidation. repeat steps f to g if required
(k) heavy liquid separation using $ZnBr_2$ solution (SG of 2.0)
(l) wash out float fraction using polyester sieve. Acidify if $Zn(OH)_2$ precipitate forms
(m) dehydrate onto coverslip
(n) mount microscope slides using Eukitt medium.

Sample examination usually involved the following steps:

(a) scan two traverses at x10 to log the bulk of the assemblage and get some idea of age
(b) scan at x40 and count the first 100 specimens to get percentage contents for each species. From this, saline "Microplankton Content" (%) can be developed to provide an index of marine influence. Where the sample is too lean to provide 100 specimens, frequency is estimated from the specimens seen with A=abundant, C=common, F=frequent, R=rare
(c) return to x10 to scan at least two large coverslips to log rare species, and finalise age conclusions. Log more slides if required.
(d) develop "Saline Microplankton Diversity" by counting up total species identified of dinoflagellates plus spiny acritarchs, as a second index of marine influence. This count includes species seen both inside and outside the court.
(e) develop "Freshwater Microplankton Content" by totally all freshwater algal elements (*Botryococcus*, *Schizosporis*, *Paralecaniella*, *Leiosphaeridia*, *Nummus*).
(f) examine sieved kerogen slide for specimens of *Cyathidites* to establish spore colour for Spore Colour Maturity Index.

III PALYNOSTRATIGRAPHY

A 402.5m(swc), 430.0m(swc) : upper *senectus* Zone (lower *australis* Dino Zone)

Assignment to the upper *Nothofagidites senectus* Spore Pollen Zone of Campanian age is indicated at the top by the absence of younger markers and at the base by oldest *Gambierina rudata*. Common forms are *Dilwynites granulatus*, *Falcisporites similis* and *Proteacidites* spp. Frequent are *Cyathidites* and *Microcachryidites*. Rare but significant are *Australopollis obscurus*, *Tricolpites sabulosus* and *Nothofagidites* spp. Very rare Permian reworking was seen.

Assignment to the lower *Xenikoon australis* dinoflagellate Zone is indicated at the top by youngest *Nelsoniella semireticulata* and *N. aceras*, and at the base by the continued presence of *X. australis*. All the dinoflagellate species are rare.

Very nearshore marine environments are indicated by the low dinoflagellate content (3% and 7% downhole) and their low diversity. Freshwater algae (*Botryococcus*) are significant at 402.5m suggesting lacustrine environments. Spores and pollen are abundant and diverse, with cuticle frequent at 402.5m.

Yellow spore colours indicate immaturity for hydrocarbons.

B 451.0m(swc), 489.0m(swc) : middle *senectus* Zone (upper *aceras* Dino Zone)

Assignment to the middle *N. senectus* Spore Pollen Zone of Campanian age is indicated at the top by the absence of younger markers and at the base by oldest *T. sabulosus*. Rare but significant are *Nothofagidites* spp, *Ornamentifera sentosa* and *Tricolpites gillii*. Common taxa are *F. similis* and *Proteacidites* spp. Frequent are *A. obscurus*, *Cyathidites minor*, *Dilwynites*, *M. antarcticus* and *Phyllocladidites mawsonii*. *T. sabulosus* is frequent at 430m and 451m. Minor Permian reworking was seen.

Assignment to the upper *Nelsoniella aceras* Dinoflagellate Zone is indicated at the top by youngest *Nelsoniella tuberculata* and at the base by oldest *X. australis*. Rare but significant species include *Areosphaeridium suggestium*,

Isabelidinium cretaceum and *N. aceras*. No dinoflagellate species are frequent, but *Heterosphaeridium* spp are consistent.

Nearshore marine environments are indicated by the low dinoflagellate content (11% and 6% downhole) and diversity. Spores and pollen are abundant and diverse and cuticle fragments are common at 489m.

Yellow spore colours indicate immaturity for hydrocarbons.

C 534.5m(swc) : lower *senectus* Zone (lower to middle *aceras* Dinoflagellate Zone)

Assignment to the lower *N. senectus* Spore Pollen Zone is indicated at the top by the absence of younger markers, and at the base by oldest *N. endurus*. Rare elements include *A. obscurus*, *O. sentosa* and *Tricolporites apoxyexinus*. Common taxa are *Cyathidites minor*, *Dilwynites*, *Falcisporites similis* and *Proteacidites*. Frequent is *M. antarcticus*. Minor Permian reworking was seen.

Assignment to the lower or middle *N. aceras* Dinoflagellate Zone is indicated at the top by youngest *Odontochitina obesa* and at the base by oldest *Nelsoniella aceras* in swcs. *Heterosphaeridium heteracanthum* is frequent with *Isabelidinium cretaceum* and *Odontochitina operculata* consistent. A single *Amphidiadema denticulata* is considered reworked and rare *Heterosphaeridium cf laterobrachius*, *Odontochitina porifera* and *N. aceras* are age significant.

Nearshore marine environments are indicated by the low dinoflagellate content (14%) and diversity. Spores and pollen are abundant and diverse.

Yellow spore colours indicate immaturity for hydrocarbons.

D 575.0m(swc), 650-70m(cutts) : upper *apoxyexinus* Zone (575m upper *cretacea* Dino Zone, 650-70m lower *cretacea* Dino Zone)

Assignment to the upper *Tricolporites apoxyexinus* Zone of Santonian age is indicated at top and base by the absence of younger and older markers respectively and confirmed by the dinoflagellate data. *T. apoxyexinus* occurs at 575m, and the single *Appendicisporites distocarinatus* at 670m is considered reworked. Common are *Cyathidites* spp, *Dilwynites*, *Falcisporites* and

Microcachryidites. *Proteacidites* spp are frequent here, but not below, confirming the subzone. *A. cruciformis* is very rare, as is Permian reworking.

At 575m, the presence of *Isabelidinium belfastense rotundata* and *Amphiadema denticulata* indicate the upper *Isabelidinium cretaceum* Dinoflagellate Zone. *Odontochitina porifera* and *Heterosphaeridium cf laterobrachius* are also present, but no dinoflagellates are frequent. At 670m, oldest *I. cretaceum* with *Isabelidinium rectangulare rectangulare* and without younger markers considered in place, indicates the lower *I. cretaceum* Zone. Again, no dinoflagellates are frequent, but *Heterosphaeridium heteracanthum* is the most consistent.

Nearshore marine environments are indicated by low dinoflagellate content (5% and 9% downhole) and diversity, with spores and pollen abundant and diverse.

Yellow spore colours indicate immaturity for hydrocarbons.

E 762.0m(swc), 788.0m(swc) : middle *apoxyexinus* Zone (788.0m upper *porifera* Dino Zone)

Assignment to the middle *T. apoxyexinus* Zone of Santonian age is indicated at the top by youngest frequent *A. cruciformis* (4%) and at the base by the absence of older markers. Common are *Cyathidites* and *Falcisporites*. Frequent are *A. cruciformis*, *Dilwynites*, *Microcachryidites* and *Osmundacidites*. *Proteacidites* are very rare here and below. Very rare Permian and Triassic reworking are seen. *T. apoxyexinus* was not seen.

Dinoflagellates are scarce but include *Isabelidinium rectangulare* at 788m without younger markers, indicating the upper *Odontochitina porifera* Zone. Rare taxa include *O. porifera* (788m) and *Odontochitina cribropoda* (762m), confirming the assignment. The most frequent dinoflagellate is *H. heteracanthum* in both samples. *Trithyrodinium marshalli* and *Circulodinium deflandrei* are consistent.

Nearshore marine environments are indicated by the low dinoflagellate content (7% and 13% downhole) and diversity with abundant and diverse spores and pollen.

F 820.0m(swc), 837.0m(swc), 875-90m(cutts), 915-25m(cutts) : lower *apoxyexinus* Zone

Assignment to the lower *T. apoxyexinus* Zone of Santonian age is indicated at the top by the downhole influx of *A. cruciformis* and at the base by the absence of older markers. At 837m, *A. cruciformis* is 16% of the assemblage and the lower *T. apoxyexinus* Zone has certainly been penetrated. At 820m however, *A. cruciformis* is only 7% of the assemblage, and so somewhat transitional from the middle *apoxyexinus* Zone. Common taxa are *Cyathidites*, and *Falcisporites*. Frequent to common are *A. cruciformis*, *Dilwynites* and *Microcachryidites*. Rare Permian and Triassic reworking was seen, and inertinite dominates several assemblages.

Dinoflagellates are rare and lack zonal markers. *Trithyrodinium marshalli* is persistent to the interval base but not below and may have future potential. *C. deflandrei* is consistent throughout. *Isabelidinium balmei* occurs at 837m only. *Heterosphaeridium* spp and *Botryococcus* are the most frequent microplankton.

Environments are nearshore to very nearshore marine, as shown by low dinoflagellate content (6%, 7%, 9%, 1% downhole) and diversity, and dominant and diverse spores and pollen. Significant lacustrine influence is seen at 820m, 890m, and 925m as shown by significant freshwater algal *Botryococcus* (4%, 3% and 8%).

Yellow spore colours indicate immaturity for hydrocarbons.

G 927.0m(swc) : indeterminate

This sample was virtually barren, with only minor inertinite and extremely rare spores and pollen recovered.

H 954.0m(swc), 1022.0m(swc) : upper *mawsonii* Zone

Assignment to the upper *Phyllocladidites mawsonii* Zone of Coniacian-Turonian age is indicated at the top by youngest *Appendicisporites distocarinatus* and at the base by the downhole decrease in *Amosopollis cruciformis* (4% and 7% within the subzone, 1% or less below it). At the zone top, *Dilwynites* becomes more frequent, and *A. cruciformis* becomes less frequent. Within the zone, *Cyathidites*, *Dilwynites*, *Falcisporites* and

Microcachryidites are common, with *A. cruciformis* and *Podosporites microsaccatus* frequent. *A. distocarinatus* is very rare but consistent. Very rare Permian reworking was seen.

Dinoflagellates are very rare and mostly longranging. Youngest *Aptea* sp occurs at 954m and may have future potential. *H. heteracanthum* and *Botryococcus* continue to be the most frequent forms.

Very nearshore marine environments are indicated by low dinoflagellate content (5% and 2% downhole) and diversity with significant lake influence suggested by freshwater algal *Botryococcus* (2% and 8% downhole). Spores and pollen are common and diverse.

Yellow spore colours indicate immaturity for hydrocarbons.

I 1048.0m(swc) : *mawsonii* Zone, subzone indeterminate

This sample was extremely lean with minor inertinite and very rare palynomorphs. The presence of *P. mawsonii* indicates that zone, but it cannot be assigned to either subzone. Microplankton are very rare but only freshwater algal taxa were seen (*Botryococcus* and *Shizosporis*) suggesting non-marine lacustrine environments.

J 1107.0m(swc), 1150.0m(swc): lower *mawsonii* Zone

Assignment to the lower *P. mawsonii* Zone is indicated at the top by a downhole decrease in *A. cruciformis* (from around 5% above, to <1% in this subzone), and at the base by oldest *P. mawsonii*. Common are *Cyathidites*, *Dilwynites* and *Falcisporites* with *Gleicheniidites* abundant at 1150m only. Frequent are *Microcachryidites*. *A. distocarinatus* is very rare but consistent. Very rare Permian reworking was seen.

Dinoflagellates are extremely rare and not age diagnostic.

Environments are non-marine to slightly brackish with only one or two dinoflagellate specimens seen in each sample. Freshwater algal *Botryococcus* is frequent at 1107m and rare at 1150m suggesting lacustrine influence. Spores and pollen are abundant and diverse, with large cuticle fragments very common at 1107m.

Yellow to light brown spore colours indicate immaturity for hydrocarbons, but approaching early marginal maturity for oil.

K 1186.0m(swc), 1188.0m(swc), 1200.0m(swc) : *distocarinatus* Zone (*infusorioides* Dino Zone at 1200m)

Assignment to the *Appendicisporites distocarinatus* Zone of Cenomanian age is indicated at the top by the absence of younger markers and at the base by oldest *A. distocarinatus* and the absence of older markers. *Falcisporites similis* is abundant with *Cyathidites*, *Dilwynites* and *Microcachryidites* frequent to common. *A. distocarinatus* is rare but consistent and *Liliacidites kaitangataensis* and *Senectotetradites varireticulatus* occur at 1186 only. Permian and Triassic reworking are consistent and some Early Cretaceous taxa are reworked, especially at 1188m.

Dinoflagellates are present only at 1200m and include *Cribroperidinium edwardsii*, indicating the *Palaeohystrichophora infusorioides* Dinoflagellate Zone. All species are extremely rare.

Environments are non-marine lacustrine at 1186 and 1188m, shown by the total absence of dinoflagellates, frequent freshwater *Botryococcus* (10% and 3%), and diverse spores and pollen. At 1200m, marginally marine to brackish environments are shown by very rare dinoflagellates (2%), their very low diversity (3 species) and *Botryococcus* content (3%). Pollen and spores are abundant and diverse.

Yellow to light brown spore colours indicate immaturity for hydrocarbons, approaching early maturity for oil.

L 1208.0m(swc), 1329.0m(swc) : indeterminate

These two samples are extremely lean, yielding rare inertinite and very rare spores and pollen. Some of the spore pollen are clearly caved (*T. sabulosus*). No microplankton were seen but two few palynomorphs were observed to consider this diagnostic of non-marine environments.

M 1344-59m(cutts) : *paradoxa* Zone

Assignment to the *Coptospora paradoxa* Zone of Albian age is indicated at the top by youngest *C. paradoxa* (coincident with the downhole influx of fern

spores including *Cicatricosisporites australiensis*, *Crybelosporites striatus*, *Foraminisporis asymmetricus*, *Trilobosporites trioreticulatus* and *Triporoletes bireticulatus)* and at the base on oldest *C. paradoxa*. Common are *Cyathidites minor*, *Falcisporites similis* and *Microcachryidites* while *C. australiensis* is frequent. *Senectotetradites varireticulatus* is also present.

Slightly brackish environments are favoured by very rare spiny acritarchs and a single dinoflagellate species. These could be caved in these cuttings, but the absence of other obvious caving suggests that they are probably in place. *Botryococcus* is very rare but spores and pollen are abundant and diverse.

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

IV CONCLUSIONS

The sampled section comprises the early Campanian to Albian (upper *senectus* to *paradoxa* Zones) in nearshore, marginally marine and non-marine environments. At the base, Albian Eumeralla Formation is securely dated in brackish environments. The Cenomanian *distocarinatus* Zone is marginally marine at the base, but shallows to freshwater lakes at the top. The Turonian lower *mawsonii* Zone is brackish while the Turonian-Coniacian upper *mawsonii* Zone deepens to become very nearshore marine. Further deepening occurs into the nearshore to very nearshore Santonian lower *apoxyexinus* Zone, then into the nearshore Santonian-Campanian middle *apoxyexinus* to middle *senectus* Zones. Above that, shallowing again occurs into the very nearshore marine Campanian upper *senectus* Zone. Younger section was not sampled.

At the base, the section is only marginally mature.

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Partridge AD (1976) The geological expression of eustacy in the early Tertiary of the Gippsland Basin **APEA J 16(1)** 73-79.

BASIN: OTWAY SPORE-POLLEN ZONES ELEVATION: KB: _____ GL: _____

WELL NAME: LOCH ARD-1 TOTAL DEPTH: _____

AGE		PALYNOLOGICAL ZONES	HIGHEST DATA				LOWEST DATA			
			Preferred Depth	Rtg	Alternate Depth	Rtg	Preferred Depth	Rtg	Alternate Depth	Rtg
NEOGENE	Plei	T. pleistocenicus								
	Plio	M. lipsus								
	Mio	C. bifurcatus								
		T. bellus								
		P. tuberculatus								
	Olig	upper N. asperus								
PALEOGENE	L.Eb	mid N. asperus								
	Mid Eb	lower N. asperus								
		P. asperopolus								
	Earl Eb	upper M. diversus								
		mid M. diversus								
		lower M. diversus								
	Pale	upper L. balmei								
		lower L. balmei								
LATE CRETACEOUS	Maas	upper T. longus								
		lower T. longus								
		T. lillei								
	Camp	N. senectus	403	1			535	0		
	Sant	up T. apoxyexinus	575	2			670	5		
		mid T. apoxyexinus	762	0			788	1		
	Con	low T. apoxyexinus	820	0			925	5		
	Tur	P. mawsonii	954	1			1150	0		
	Cen	A. distocarinatus	1186	2			1200	1		
EARLY CRETACEOUS	Alb	P. pannosus								
		upper C. paradoxa	1344	3						
		lower C. paradoxa					1395	4		
		C. striatus								
	Apt	upper C. hughesi								
		lower C. hughesi								
	l.Ne	F. wonthaggiensis								
	e.Ne	up C. australiensis								

Environments :

- o lacustrine (algal acritarchs).
- non-marine (no or very few 5% algal acritarchs).
- brackish (spiny acritarch, no or very few dinoflagellates 1%).
- marginal marine (1-5% very low diversity dinoflagellates).
- nearshore marine (6-30% low to medium diversity dinoflagellates).
- intermediate marine (31-60% medium diversity dinoflagellates).
- offshore marine (61%-80% medium to high diversity dinoflagellates).
- far offshore marine/oceanic (81%-100% high diversity dinoflagellates and/or planktonic forams).

Confidence Ratings :

0 : good to excellent with numerous zone fossils in core/swc.

1 : fair with rare zone fossils in core/swc.

2 : poor with non-diagnostic assemblage in core/swc. Often occurs next to a distinctive 0 to 1 rating, lacking the zone fossil seen adjacent.

3 : good with extinction event (top range) in cuttings.

4 : poor to fair with inception event (base range) in cuttings and therefore may be picked too low if caved or too high if swamped by cavings.

5 : poor with non-diagnostic assemblage in cuttings. Usually seen adjacent to a higher rating and picked on the absence of key zone fossil.

? : no confidence. Picked as a best guess in very poor data.

Data recorded by : Roger Morgan May 94

Data revised by : Roger Morgan May 94

PALYNOLOGICAL DATA SHEET

BASIN: OTWAY DINOFLAGELLATE ZONES ELEVATION: KB:_____ GL:_____

WELL NAME: LOCH ARD-1 TOTAL DEPTH:_____

AGE		PALYNOLOGICAL ZONES	HIGHEST DATA				LOWEST DATA			
			Preferred Depth	Rtg	Alternate Depth	Rtg	Preferred Depth	Rtg	Alternate Depth	Rtg
LATE CRETACEOUS	Maas	M. druggii								
	Camp	I. korojonense								
		upper X. australis								
		lower X. australis ☆/ᵹ	403	1			430	0		
	Sant	N. aceras ᵹ	451	1			534	0		
		I. cretaceum ᵹ	575	0			670	4		
	Con	O. porifera ᵹ	788	2			788	0		
	Turo	C. striatoconus								
	Ceno	P. infusorioides ☆	1200	1			1200	1		

Environments :

- o lacustrine (algal acritarchs).
- ℘ non-marine (no or very few 5% algal acritarchs).
- ☆ brackish (spiny acritarch, no or very few dinoflagellates 1%).
- ☆/ᵹ marginal marine (1-5% very low diversity dinoflagellates).
- ᵹ nearshore marine (6-30% low to medium diversity dinoflagellates).
- ᵹ/ᵹᵹ intermediate marine (31-60% medium diversity dinoflagellates).
- ᵹᵹ offshore marine (61%-80% medium to high diversity dinoflagellates).
- ⊖ far offshore marine/oceanic (81%-100% high diversity dinoflagellates and/or planktonic forams).

Confidence Ratings :

0 : good to excellent with numerous zone fossils in core/swc.

1 : fair with rare zone fossils in core/swc.

2 : poor with non-diagnostic assemblage in core/swc. Often occurs next to a distinctive 0 to 1 rating, lacking the zone fossil seen adjacent.

3 : good with extinction event (top range) in cuttings.

4 : poor to fair with inception event (base range) in cuttings and therefore may be picked too low if caved or too high if swamped by cavings.

5 : poor with non-diagnostic assemblage in cuttings. Usually seen adjacent to a higher rating and picked on the absence of key zone fossil.

? : no confidence. Picked as a best guess in very poor data.

Data recorded by : Roger Morgan May 94

Data revised by : Roger Morgan May 94

HYDROCARBON CHARACTERISATION STUDY:

LOCH ARD-1

Preface

Following the drilling of Loch Ard-1 in 1993, a program of geochemical analyses was performed on samples from the well by Geotechnical Services (Geotech) Pty. Ltd. The report which follows represents an interpretation of the Loch Ard-1 geochemical data. The text of the report was prepared by Geotech on behalf of BHP Petroleum.

The figures which follow the text were prepared by BHP Petroleum; whilst they are not referred to directly in the text, they are intended as an additional interpretative aid to the reader.

HYDROCARBON

CHARACTERISATION STUDY

LOCH ARD-1

Prepared for:

BHP Petroleum Pty Limited

July 1994

GEOTECH GEOTECHNICAL SERVICES PTY LTD
125 Burswood Road, Victoria Park, Western Australia 6100

Telephone (09) 362 5222
Facsimile (09) 362 5908

HYDROCARBON CHARACTERISATION STUDY LOCH ARD-1

1. Introduction and Analytical Procedures

Two sidewall cores (1050m, 1154m) from the well Loch Ard-1, drilled by BHP Petroleum in Vic/P31 in the Otway Basin, were solvent extracted and analysed by gas chromatography of the whole extract in an attempt to characterise the nature of their hydrocarbons.

Eleven SWCs between 548.5m and 1326m depth were submitted to vitrinite reflectance measurements and maceral characterisation.

The samples analysed are from the following formations:

Sample depth (m)	Formation	Age
548.5	Sherbrook	Late Cretaceous
668-1027	Upper Shipwreck	Late Cretaceous
1150-1128	Lower Shipwreck	Late Cretaceous
1326	Otway	Early Cretaceous

Analytical results are presented in the following figures and tables:

Type of Analysis	Figure	Table
Solvent extraction	1	1
Whole extract GC	2	2,3
Vitrinite reflectance/ maceral description	3	4,5

Analytical procedures applied are summarised in the Theory and Methods chapter in the back of this report.

2. General Information

One copy of this report has been sent to Jim Preston from BHP Petroleum Pty Limited. Any queries related to it may be directed to Dr. Birgitta Hartung-Kagi of Geotechnical Services Pty Ltd.

All data and information are proprietary to BHP Petroleum Pty Limited and regarded as highly confidential by all Geotech personnel.

Geotechnical Services Pty Ltd shall not be responsible or liable for the results of any actions taken on the basis of the information contained in this study, nor for any errors or omissions in it.

3. Results and Interpretation

3.1 Extraction and Gas Chromatography

Upon solvent extraction, only 66.9 ppm of total extract were obtained for sample 1050m and no further analysis was performed due to the low level of free hydrocarbons present.

For sample 1154m, solvent extraction yielded 414.4 ppm of total extract which was sufficient for gas chromatography of the whole extract.

The overall picture of its GC trace, however, was inconclusive and did not allow any meaningful characterisation of these hydrocarbons.

A pronounced baseline hump in the high molecular weight range may suggest a biodegraded residue. Alternatively this unresolved complex mixture of compounds under the hump may reflect a drilling additive.

3.2 Vitrinite Reflectance

Measured vitrinite reflectance values increase steadily from 0.35% at 548.5m to 0.54% at 1205m and characterise this section as immature to possibly just marginally mature in the deeper part.

No vitrinite is present at 1228m and the V_R value measured at 1326m is only 0.41%. The reason for the low reflectance in this sample is not clear. On the other hand it is possible that the value of 0.54% obtained for 1205m is anomalously high, as this sample contains high proportions of inertinite, compared with 1186m and 1326m.

TABLE 1

SUMMARY OF EXTRACTION AND LIQUID CHROMATOGRAPHY - SEDIMENTS

WELL NAME = LOCH ARD-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB =

DEPTH 1	DEPTH 2	WEIGHT OF ROCK EXTD (grams)	TOTAL EXTRACT (ppm)	LOSS ON COLUMN (ppm)	% REC.	SATURATES (ppm)	AROMATICS (ppm)	POLARS (ppm)	SATURATES (rel %)	AROMATICS (rel %)	POLARS (rel %)	EOM(mg)/ TOC(g)	SAT(mg)/ TOC(g)	SAT/ AROM	HC/ non-HC
1050.00	1050.00	13.50	66.9	-	-	-	-	-	-	-	-	-	-	-	-
1154.00	1154.00	14.50	414.4	-	-	-	-	-	-	-	-	-	-	-	-

EOM = Extractable organic matter
AROM = Aromatic compounds
POLARS = Polar (Asphaltenes + resins)
HC = Hydrocarbon
TOC = Total organic carbon
REC. = Recovered
SAT = Saturated compounds
- = no data

LOCH ARD-1
Total Extract Yield vs Depth

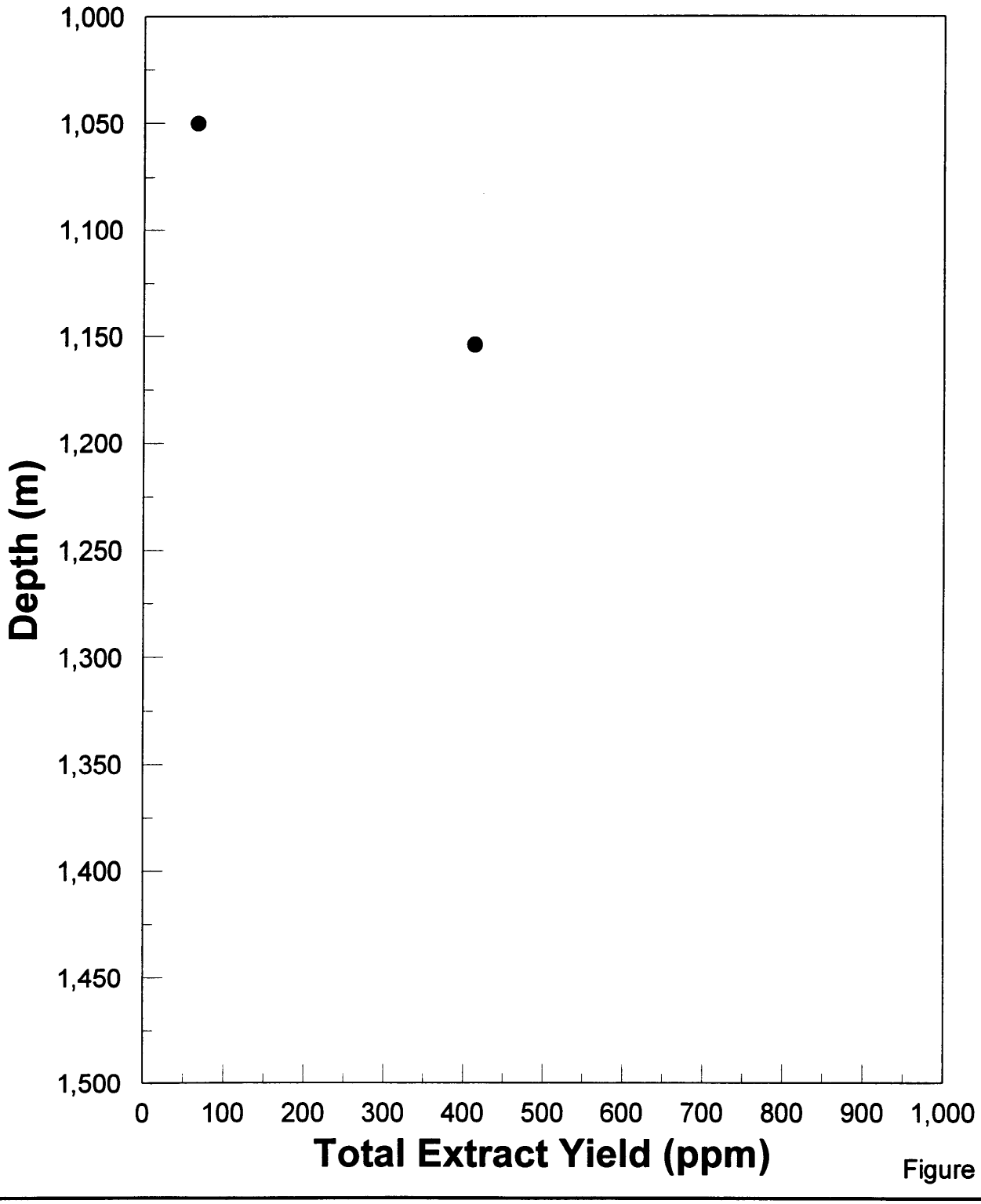


Figure 1

LCHD1 / PE900439 / P64

LOCH ARD 1, 1154.0m, SWC
Whole Extract
C12+ GLC

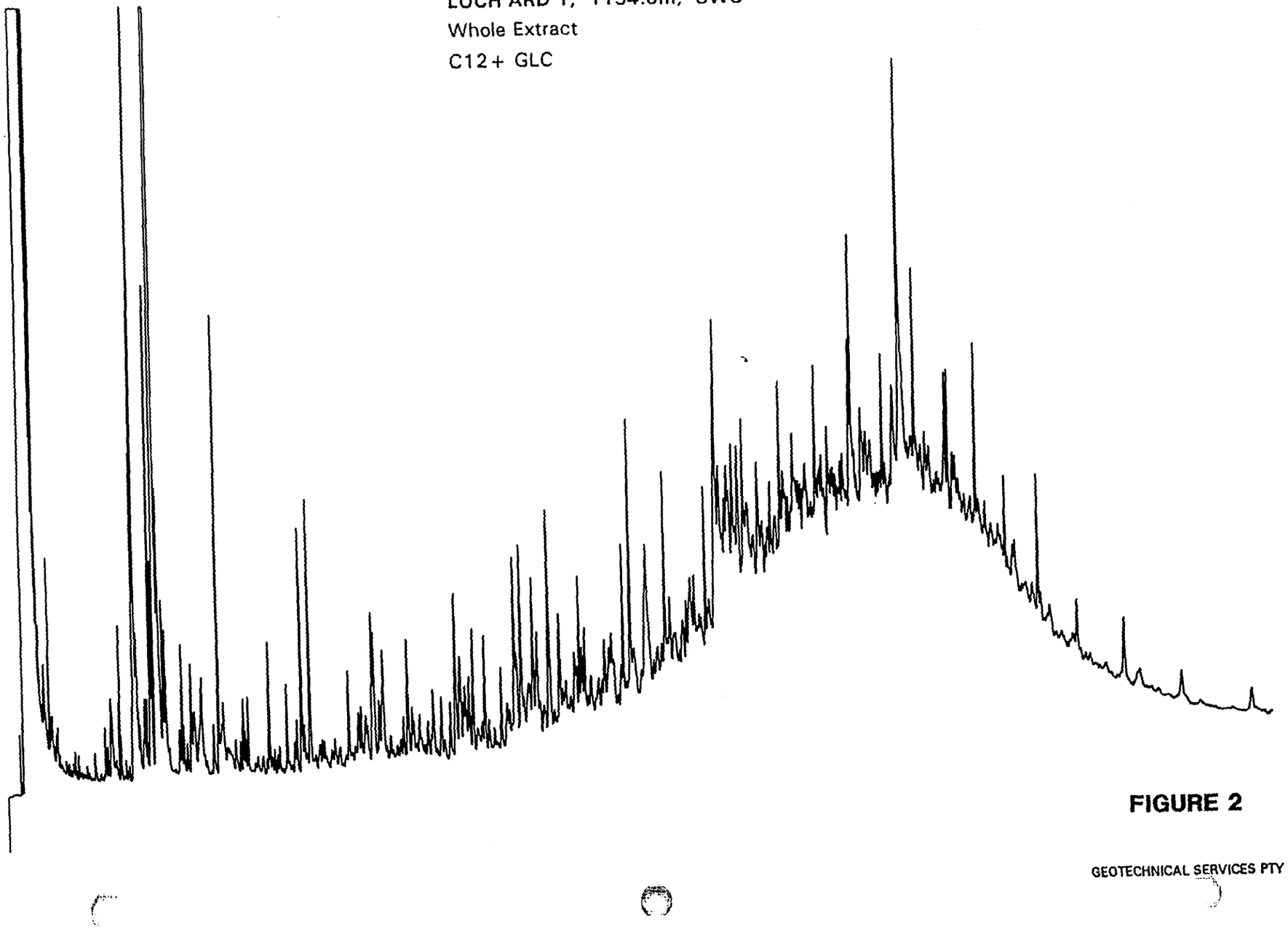


FIGURE 2

GEOTECHNICAL SERVICES PTY LTD

2030(D)1

TABLE 2

SUMMARY OF GAS CHROMATOGRAPHY DATA - SEDIMENTS
ALKANE DISTRIBUTIONS

WELL NAME = LOCH ARD-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB =

DEPTH 1	DEPTH 2	nC12	nC13	nC14	TMTD	nC15	nC16	iC18	nC17	iC19	nC18	iC20	nC19	nC20	nC21	nC22	nC23	nC24	nC25	nC26	nC27	nC28	nC29	nC30	nC31	nC32	nC33
1050.00	1050.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1154.00	1154.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

i = iso
- = no data
n = normal
TMTD = Trimethyltridecane
N.B. Values are relative %

TABLE 3

SUMMARY OF GAS CHROMATOGRAPHY DATA - SEDIMENTS
ALKANE COMPOSITIONAL DATA

WELL NAME = LOCH ARD-1
COUNTRY = Australia
BASIN = Otway

DEPTH UNIT = Metres
DATE OF JOB =

DEPTH 1	DEPTH 2	ANALYSIS TYPE	PRISTANE/PHYTANE	PRISTANE/n-C17	PHYTANE/n-C18	TMTD/PRISTANE	CPI(I)	CPI(II)	(C21+C22)/(C28+C29)
1050.00	1050.00		-	-	-	-	-	-	-
1154.00	1154.00		-	-	-	-	-	-	-

CPI = Carbon preference index TMTD = Trimethyltridecane - = no data
SF = Saturate fraction WE = Whole extract

LOCH ARD-1
Vitrinite Reflectance vs Depth

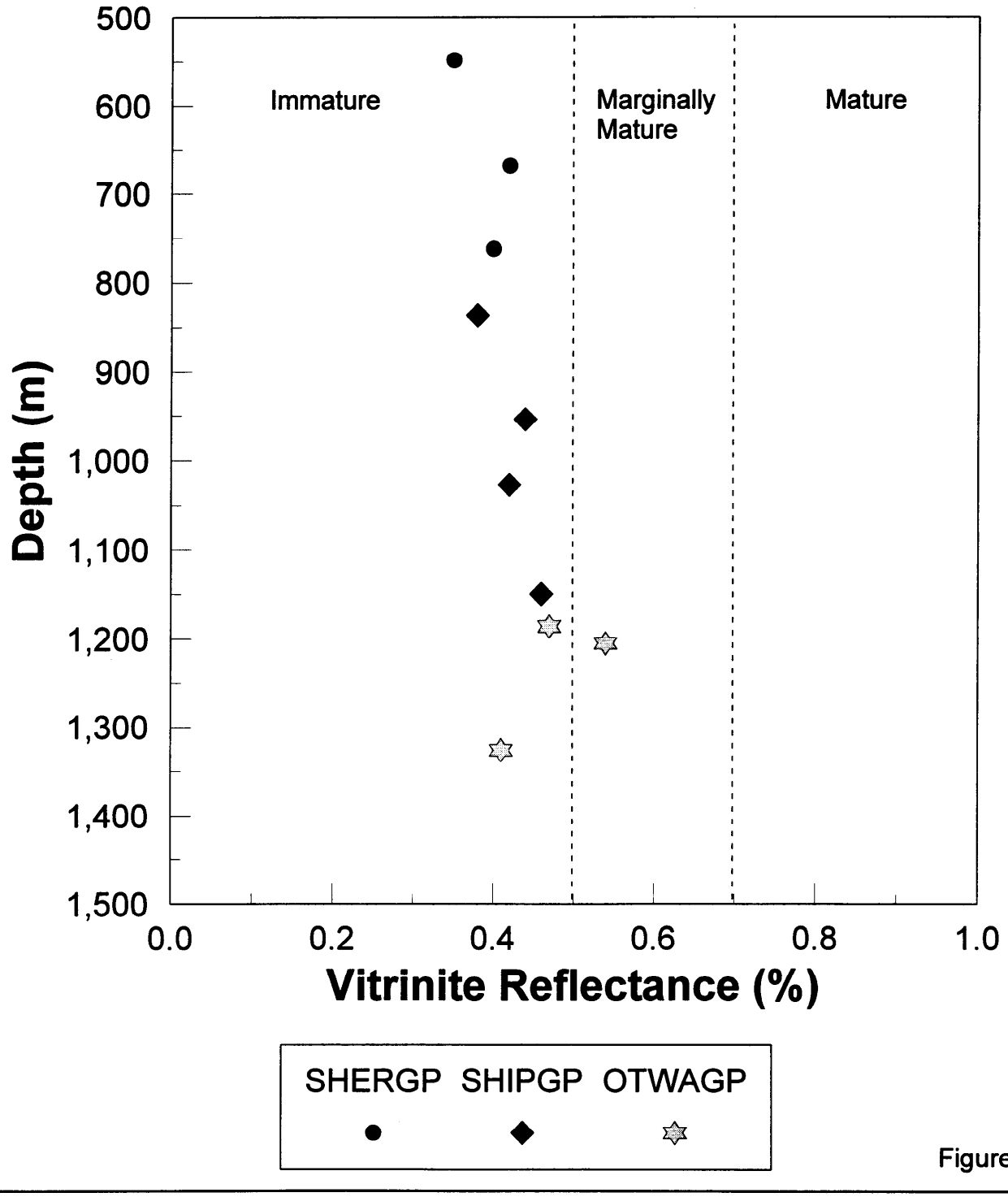


Figure 3

JOB No.# 2030A, LOCH ARD-1, OTWAY BASIN.

KK/Ref. No.	Depth(m) Type	$\bar{R}_v$ max	Range	N	Description Including Liptinite (Exinite) Fluorescence
v9199 SWC23	548.5	0.35	0.29-0.43	26	Sparse cutinite, resinite and liptodetrinite, yellow to orange, rare sporinite, yellow to orange. (Sandstone>>Coal. Coal sparse, I>V>>L, inertite>vitrite. Dom abundant, I>V>>L. Inertinite abundant, vitrinite common, liptinite sparse. Mineral fluorescence pervasive, faint green to weak orange. Iron oxides common. Pyrite abundant.)
v9200 SWC18	668.0	0.42	0.31-0.52	26	Sparse sporinite, yellow to orange, rare cutinite, resinite, lamalginite and liptodetrinite, yellow to orange. (Clayey siltstone>sandstone>>carbonate. Dom abundant, I>>V>L. Inertinite common, vitrinite and liptinite sparse. Mineral fluorescence pervasive, faint green to weak orange. Iron oxides common. Glauconite abundant. Pyrite abundant.)
v9201 SWC15	762	0.40	0.30-0.52	26	Sparse cutinite and liptodetrinite, yellow to dull orange, rare sporinite, resinite and lamalginite, yellow to dull orange. (Calcareous siltstone>carbonate>coal. Coal rare, V>>I>L, vitrite. Dom abundant, I>V>L. Inertinite abundant, vitrinite common, liptinite sparse. Shell fragments sparse. Mineral fluorescence pervasive, faint green. Iron oxides abundant. Pyrite abundant.)
v9202 SWC10	837	0.38	0.31-0.48	25	Sparse cutinite and liptodetrinite, yellow to dull orange, rare resinite, sporinite and lamalginite, yellow to dull orange. (Sandstone>carbonate>>coal. Coal rare, V>I>>L, vitrite>inertite. Dom abundant, I>V>>L. Inertinite abundant, vitrinite common, liptinite sparse. Shell fragments rare. Mineral fluorescence pervasive, faint green. Iron oxide common. Glauconite rare. Pyrite abundant.)
v9203	954 SWC60	0.44	0.36-0.50	28	Sparse lamalginite, bright yellow to orange, rare liptodetrinite yellow to orange. (Calcareous clayey siltstone>>coal. Coal sparse, V only. Vitrite. Texturally, the coal is immature to moderately mature ulminite with cell structures and some remnant cell lumens. Dom common, V>L>I. All three maceral groups sparse. Oil drops rare, bright greenish yellow. Mineral fluorescence pervasive, dull orange. Iron oxides common. Pyrite rare.)
v9204	1027 SWC55	0.42	0.36-0.48	26	Common cutinite, yellow to dull orange, sparse lamalginite, and liptodetrinite, yellow to orange, rare resinite, greenish yellow, rare sporinite, yellow to orange. (Calcareous clayey siltstone>>coal. Coal rare, V>>I. Inertite>vitrite. Dom abundant, I>V>L. Inertinite and vitrinite abundant, liptinite common. Bitumen rare, orange. Mineral fluorescence pervasive, dull orange. Iron oxides abundant. Pyrite sparse.)

TABLE 4

JOB # 2030A, LOCH ARD-1, OTWAY BASIN

KK/Ref. No.	Depth(m) Type	$\bar{R}_v$ max	Range	N	Description Including Liptinite (Exinite) Fluorescence
v9205	1150 SWC48	0.46	0.42-0.52	25	Common cutinite, yellow to orange, sparse sporinite and liptodetrinite, yellow to orange, sparse resinite, yellow, sparse suberinite, weak brown. (Clayey siltstone>>coal. Coal common, V>I>L. Vitrite>inertite. Dom abundant, V>I>L. Vitrinite abundant, inertinite and liptinite common. Mineral fluorescence pervasive, dull orange. Iron oxides common. Pyrite sparse.)
v9206	1186 SWC44	0.47	0.42-0.53	26	Abundant cutinite and liptodetrinite, yellow to dull orange, abundant resinite, greenish yellow, abundant sporinite, yellow to orange. (Coal>shaly coal. Coal dominant, V>L>>I. Vitrite>clarite. Mineral-free maceral group composition of the coal: vitrinite - 89.5%, inertinite - <0.1%, liptinite - 10.5%. Shaly coal dominant, V>L>>I. Clarite. Some open lumens present within telovitrinite, but coal is early mature in textural terms. Mineral-free maceral group composition of the shaly coal: vitrinite - 53.8%, inertinite - <0.1%, liptinite - 46.2%. Exsudatinite rare, yellow to orange. Iron oxides sparse. Pyrite sparse.)
v9207	1205 SWC40	0.54	0.48-0.65	28	Common cutinite, yellow to dull orange, common sporinite, yellow to orange, sparse resinite, greenish yellow, sparse liptodetrinite, greenish yellow to dull orange. (Clayey siltstone>>coal. Coal common, V>>I>L. Vitrite>clarite. Dom abundant, I>V>L. All three maceral groups abundant. Bitumen sparse, dull orange. Mineral fluorescence pervasive, weak brown. Iron oxides sparse. Pyrite abundant.)
v9208	1228 SWC38	- $\bar{R}_I$ max 1.51	- 1.07-2.02	- 5	Fluorescing liptinite absent. (Sandstone. Dom rare, I only. Mineral fluorescence patchy, weak orange. Iron oxides common. Pyrite sparse.)
v9209	1326 SWC32	0.41	0.35-0.48	28	Rare cutinite, sporinite and liptodetrinite, yellow to orange, rare resinite, greenish yellow. (Sandstone>>coal. Coal sparse, V only. Vitrite. Dom sparse, V>L>I. Vitrinite sparse, liptinite and inertinite rare. Mineral fluorescence pervasive, dull green. Iron oxides abundant. Pyrite sparse.)

The causes for low reflectances from SWC 32 are not clear. The vitrinite populations in samples v9207 and v9209 are both well defined. v9207 contains leaf tissue that would be expected to yield below average reflectances. Some leaf tissue is present in v9209 but the presence of mesophyll does not seem to be the cause of the low values for v9209. If a sample has been incorrectly labelled, this may be clear from the lithology as SWC 32 is a much more sandy lithology than most of the other SWC samples. It is also possible that v9207 is anomalously high, the sample containing a high proportion of inertinite compared with v9209 and v9206.

TABLE 4 (contd)

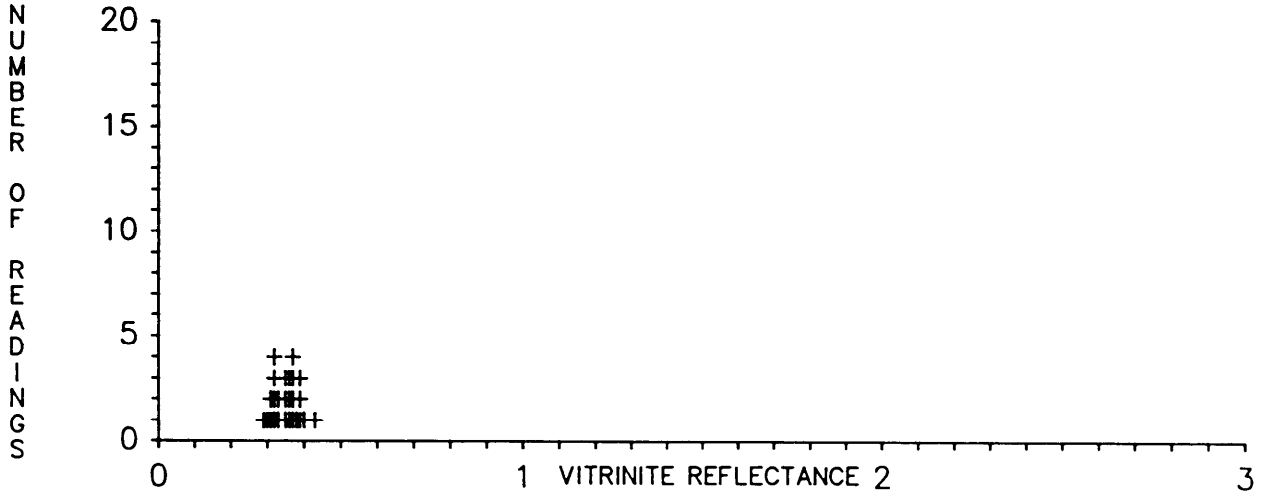
TABLE 5

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: LOCH ARD-1 CLIENT: BHP PETROLEUM PTY LTD SAMPLE TYPE: SWC
SAMPLE ID: 548.5 METRES DATE: APRIL 1994

(Total No. of Readings=26) 0.29 0.30 0.31 0.31 0.32 0.32 0.32 0.32 0.33 0.33 0.35 0.35 0.35 0.36 0.36 0.36 0.37 0.37 0.37 0.37 0.38 0.39 0.39 0.39 0.40 0.43

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.35	0.29	0.43	0.03	INDIGENOUS(+)	32.88	63.01	4.11	0.00



SAMPLE ID: 668.0 METRES SAMPLE TYPE: SWC

(Total No. of Readings=26) 0.31 0.33 0.34 0.36 0.37 0.38 0.39 0.39 0.39 0.39 0.40 0.41 0.41 0.43 0.43 0.43 0.44 0.45 0.45 0.45 0.46 0.47 0.47 0.48 0.48 0.52

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.42	0.31	0.52	0.05	INDIGENOUS(+)	9.52	85.72	4.76	0.00

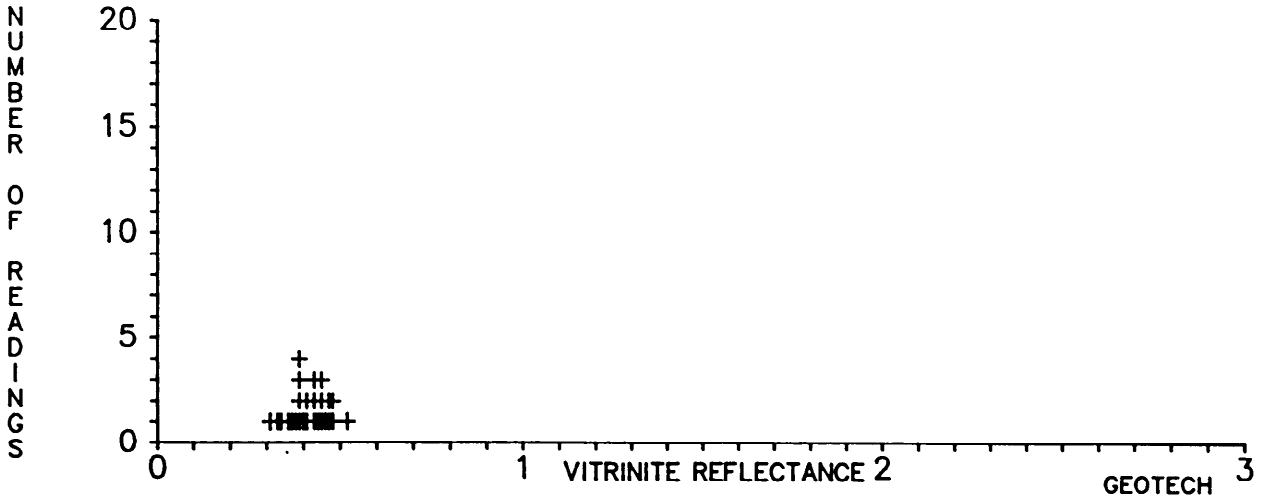


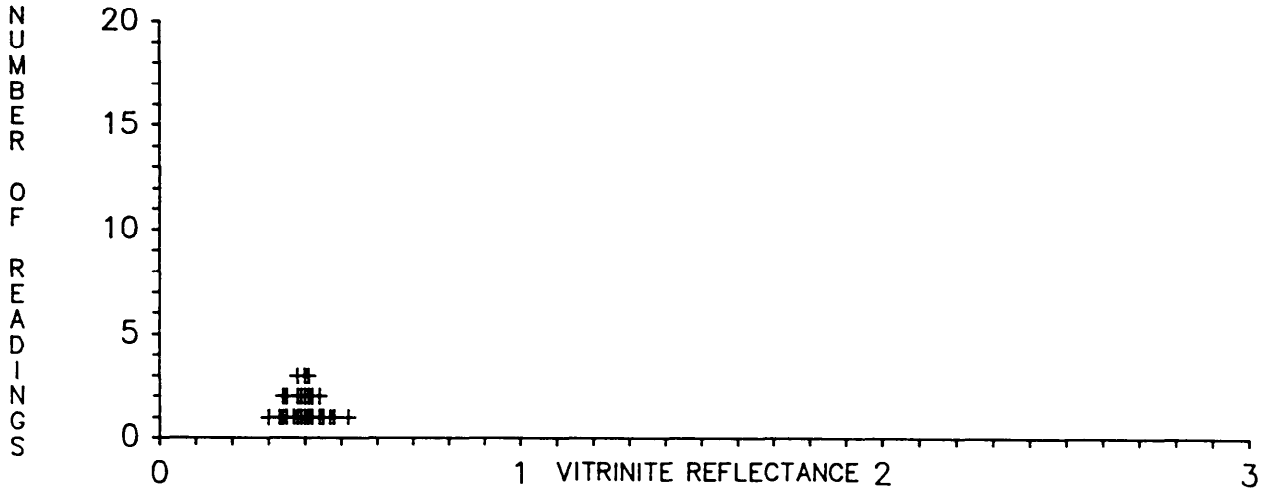
TABLE 5 (contd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: LOCH ARD-1 CLIENT: BHP PETROLEUM PTY LTD SAMPLE TYPE: SWC
SAMPLE ID: 762.0 METRES DATE: APRIL 1994

(Total No. of Readings=26) 0.30 0.33 0.34 0.34 0.35 0.35 0.37 0.38 0.38 0.38 0.39 0.39 0.40 0.40 0.40 0.41 0.41 0.41 0.42 0.42 0.44 0.44 0.45 0.47 0.48 0.52

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.40	0.30	0.52	0.05	INDIGENOUS(+)	21.88	68.74	9.38	0.00



SAMPLE ID: 837.0 METRES SAMPLE TYPE: SWC

(Total No. of Readings=25) 0.31 0.31 0.32 0.34 0.34 0.35 0.36 0.37 0.37 0.38 0.38 0.39 0.39 0.40 0.40 0.40 0.40 0.41 0.41 0.41 0.41 0.41 0.43 0.45 0.48

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	25	0.38	0.31	0.48	0.04	INDIGENOUS(+)	40.00	55.56	4.44	0.00

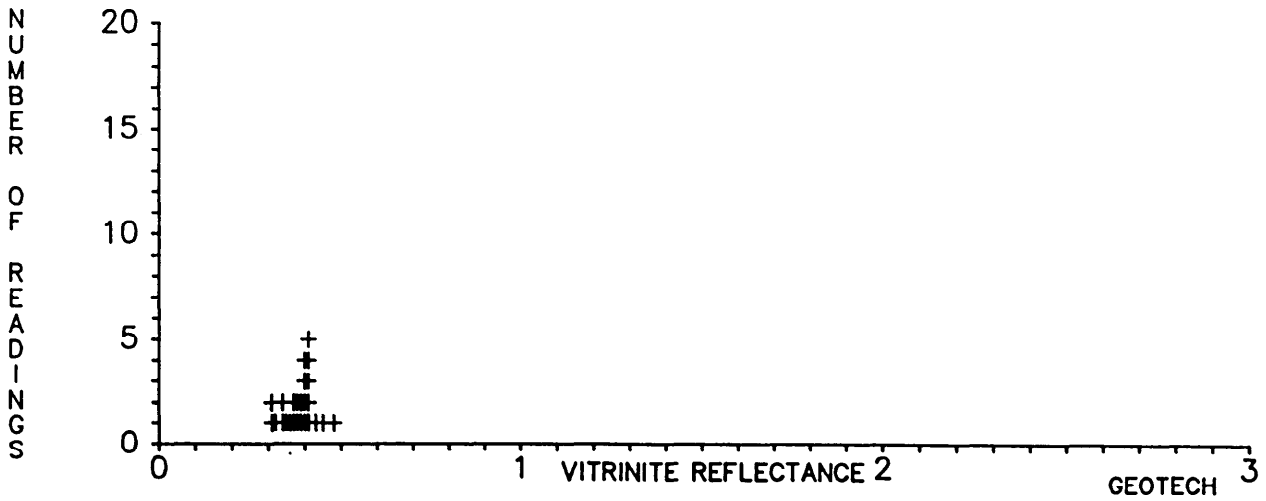


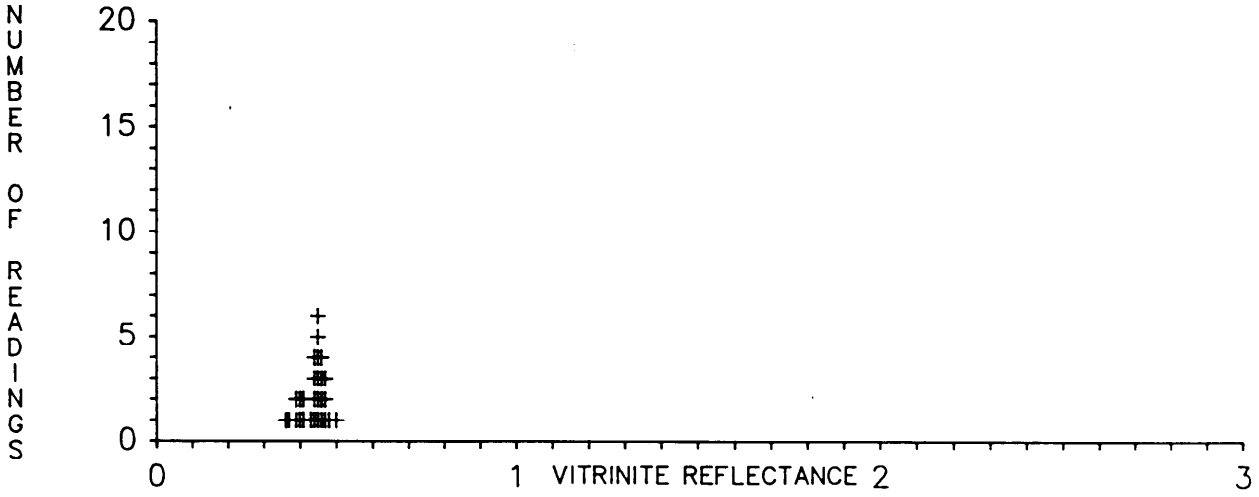
TABLE 5 (contd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: LOCH ARD-1 CLIENT: BHP PETROLEUM PTY LTD SAMPLE TYPE: SWC
SAMPLE ID: 954.0 METRES DATE: APRIL 1994

(Total No. of Readings=28) 0.36 0.37 0.39 0.39 0.40 0.40 0.41 0.41 0.43 0.44 0.44 0.44 0.44 0.45 0.45 0.45 0.45 0.45 0.45 0.46 0.46 0.46 0.46 0.47 0.47 0.47 0.48 0.50

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Oil Drops
1	100.0	28	0.44	0.36	0.50	0.03	INDIGENOUS(+)	50.00	16.67	25.00	8.33



SAMPLE ID: 1027.0 METRES SAMPLE TYPE: SWC

(Total No. of Readings=26) 0.36 0.36 0.38 0.38 0.38 0.40 0.40 0.40 0.40 0.40 0.42 0.42 0.42 0.42 0.42 0.42 0.42 0.42 0.43 0.43 0.45 0.45 0.45 0.46 0.47 0.48

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.42	0.36	0.48	0.03	INDIGENOUS(+)	35.21	42.25	21.13	1.41

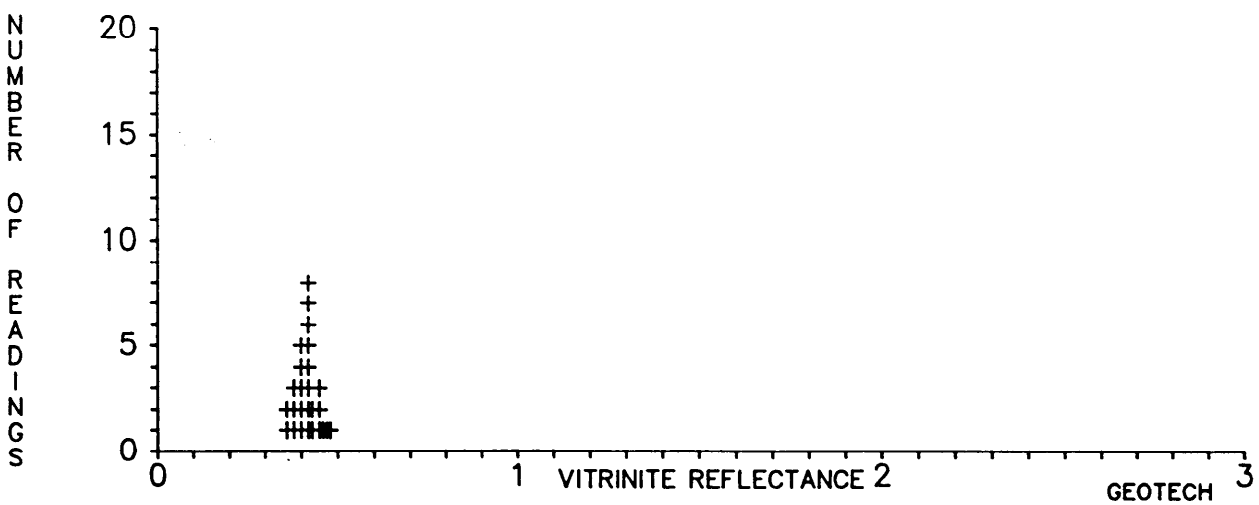


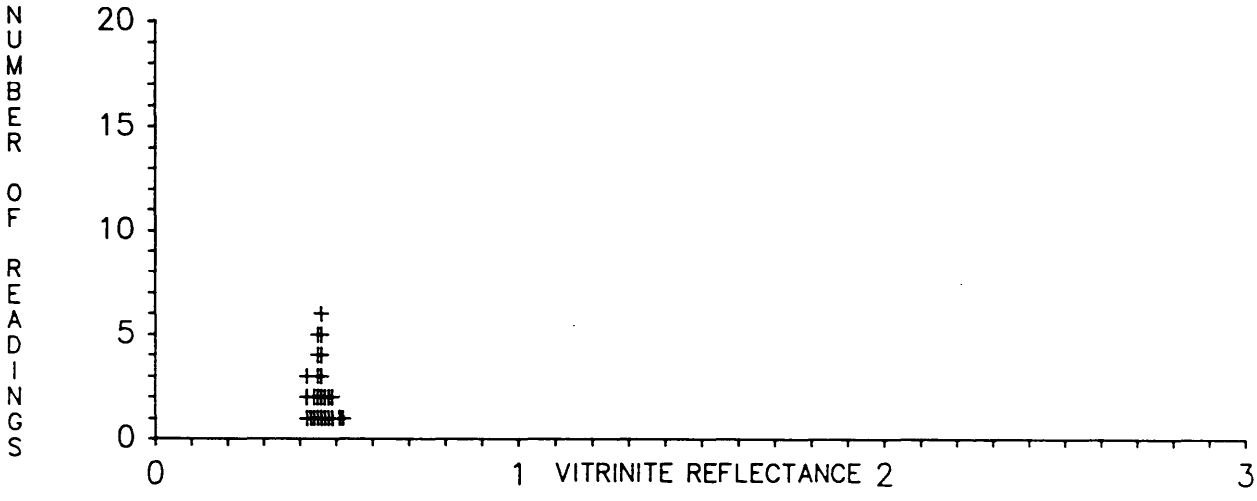
TABLE 5 (contd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: LOCH ARD-1 CLIENT: BHP PETROLEUM PTY LTD SAMPLE TYPE: SWC
SAMPLE ID: 1150.0 METRES DATE: APRIL 1994

(Total No. of Readings=25) 0.42 0.42 0.42 0.43 0.44 0.44 0.45 0.45 0.45 0.45 0.45 0.46 0.46 0.46 0.46 0.46 0.46 0.47 0.47 0.48 0.48 0.49 0.49 0.51 0.52

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	25	0.46	0.42	0.52	0.03	INDIGENOUS(+)	50.00	27.94	22.06	0.00



SAMPLE ID: 1186.0 METRES SAMPLE TYPE: SWC

(Total No. of Readings=26) 0.42 0.42 0.43 0.43 0.44 0.44 0.44 0.45 0.45 0.45 0.46 0.46 0.47 0.47 0.48 0.48 0.48 0.49 0.49 0.49 0.50 0.50 0.51 0.52 0.52 0.53

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	26	0.47	0.42	0.53	0.03	INDIGENOUS(+)	82.77	0.11	17.12	0.00

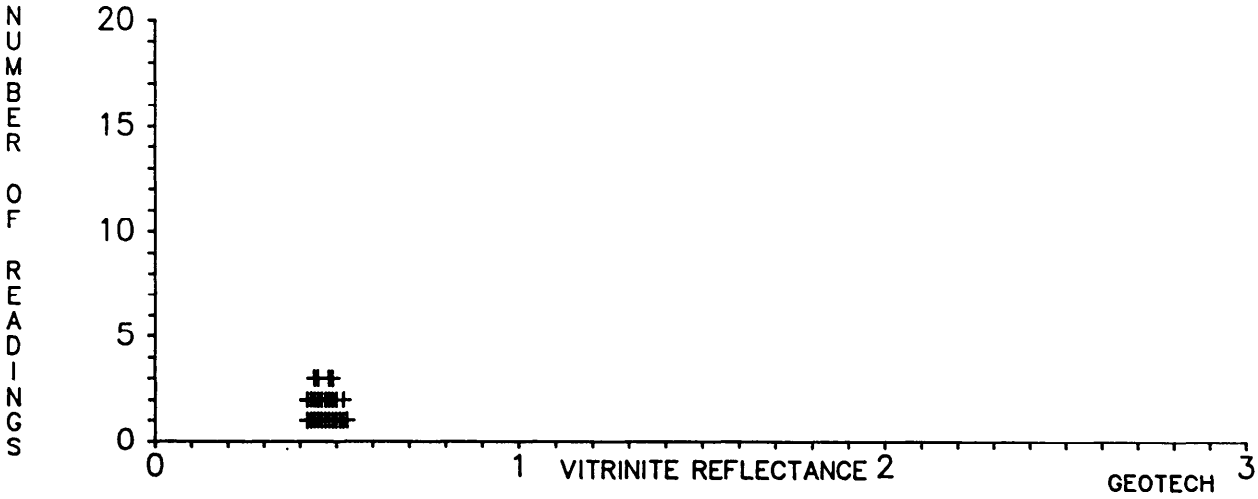


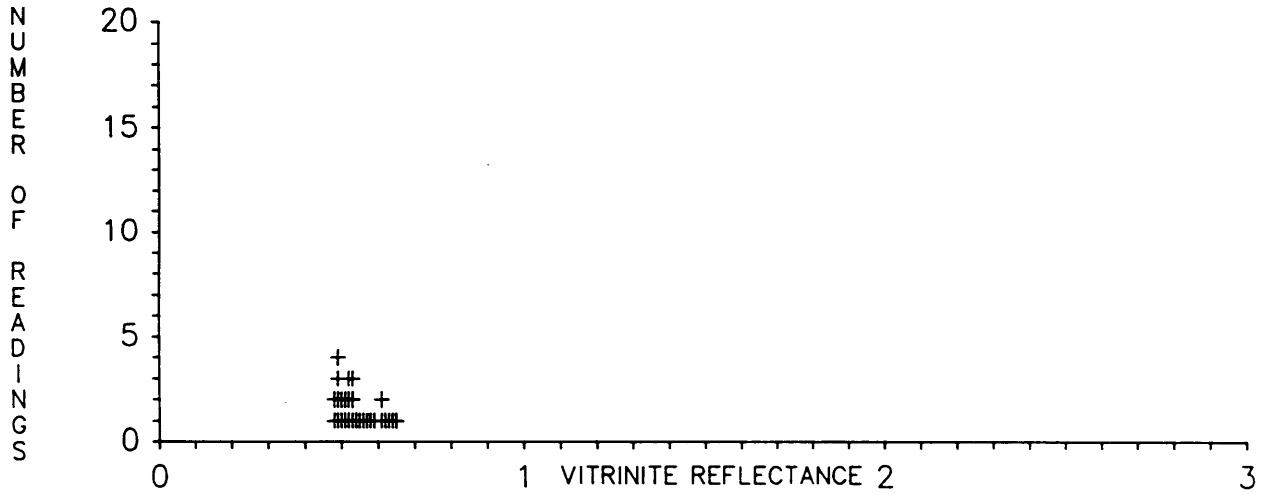
TABLE 5 (contd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: LOCH ARD-1 CLIENT: BHP PETROLEUM PTY LTD SAMPLE TYPE: SWC
SAMPLE ID: 1205.0 METRES DATE: APRIL 1994

(Total No. of Readings=28) 0.48 0.48 0.49 0.49 0.49 0.49 0.50 0.50 0.51 0.51 0.52 0.52 0.52 0.53 0.53 0.53 0.54 0.55 0.56 0.57 0.58 0.59 0.61 0.61 0.62 0.63 0.64 0.65

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	28	0.54	0.48	0.65	0.05	INDIGENOUS(+)	34.40	36.80	28.00	0.80



SAMPLE ID: 1228.0 METRES SAMPLE TYPE: SWC

(Total No. of Readings=5) 1.07 1.10 1.67 1.69 2.02

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	5	1.51	1.07	2.02	0.41	INERTINITE(X)	0.00	100.00	0.00	0.00

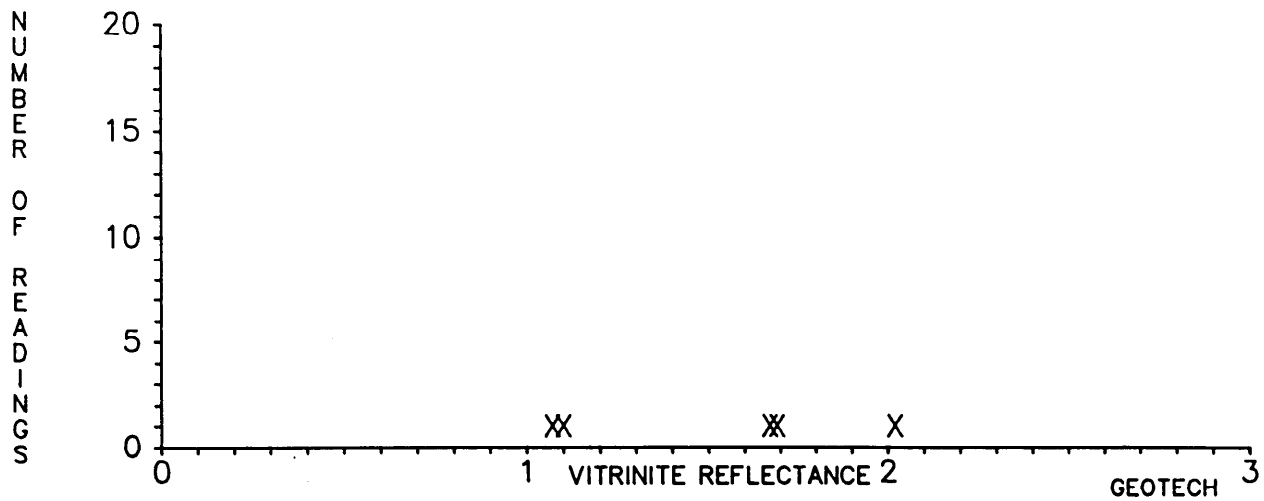


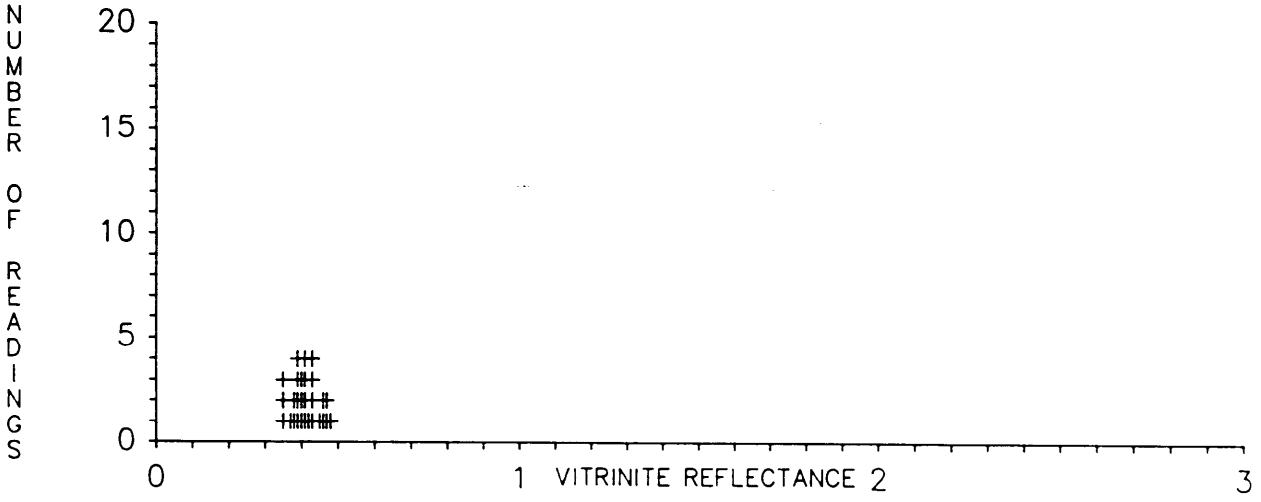
Table 5 (contd)

VITRINITE REFLECTANCE AND COAL MACERAL INDENTIFICATION

WELL: LOCH ARD-1 CLIENT: BHP PETROLEUM PTY LTD SAMPLE TYPE: SWC
SAMPLE ID: 1326.0 METRES DATE: APRIL 1994

(Total No. of Readings=28) 0.35 0.35 0.35 0.37 0.38 0.38 0.39 0.39 0.39 0.39 0.40 0.40 0.40 0.41 0.41 0.41 0.41 0.42 0.43 0.43 0.43 0.43 0.45 0.46 0.46 0.47 0.47 0.48

VITRINITE REFLECTANCE								MACERAL IDENTIFICATION			
POPULATION Number	%	No. of Readings	Mean Ro (%)	Min Ro (%)	Max Ro (%)	STD Dev (%)	Comments	% Vitrinite	% Inertinite	% Liptinite	% Bitumen
1	100.0	28	0.41	0.35	0.48	0.04	INDIGENOUS(+)	60.00	20.00	20.00	0.00



ENCLOSURES

PE602827

This is an enclosure indicator page.
The enclosure PE602827 is enclosed within the container PE900439 at this location in this document.

The enclosure PE602827 has the following characteristics:

ITEM_BARCODE	PE602827
CONTAINER_BARCODE	PE900439
NAME	Loch Ard 1 Well Summary Log
BASIN	Otway
PERMIT	VIC/P31
TYPE	WELL
SUBTYPE	COMPOSITE_LOG
DESCRIPTION	Loch Ard 1 Well Summary Log
REMARKS	Written as Composite Log in WCR Table of Content
DATE_CREATED	27/10/93
DATE_RECEIVED	*
W_NO	W1091
WELL_NAME	Loch Ard 1
CONTRACTOR	BHP
CLIENT_OP_CO	BHP

(Inserted by DNRE - Vic Govt Mines Dept)