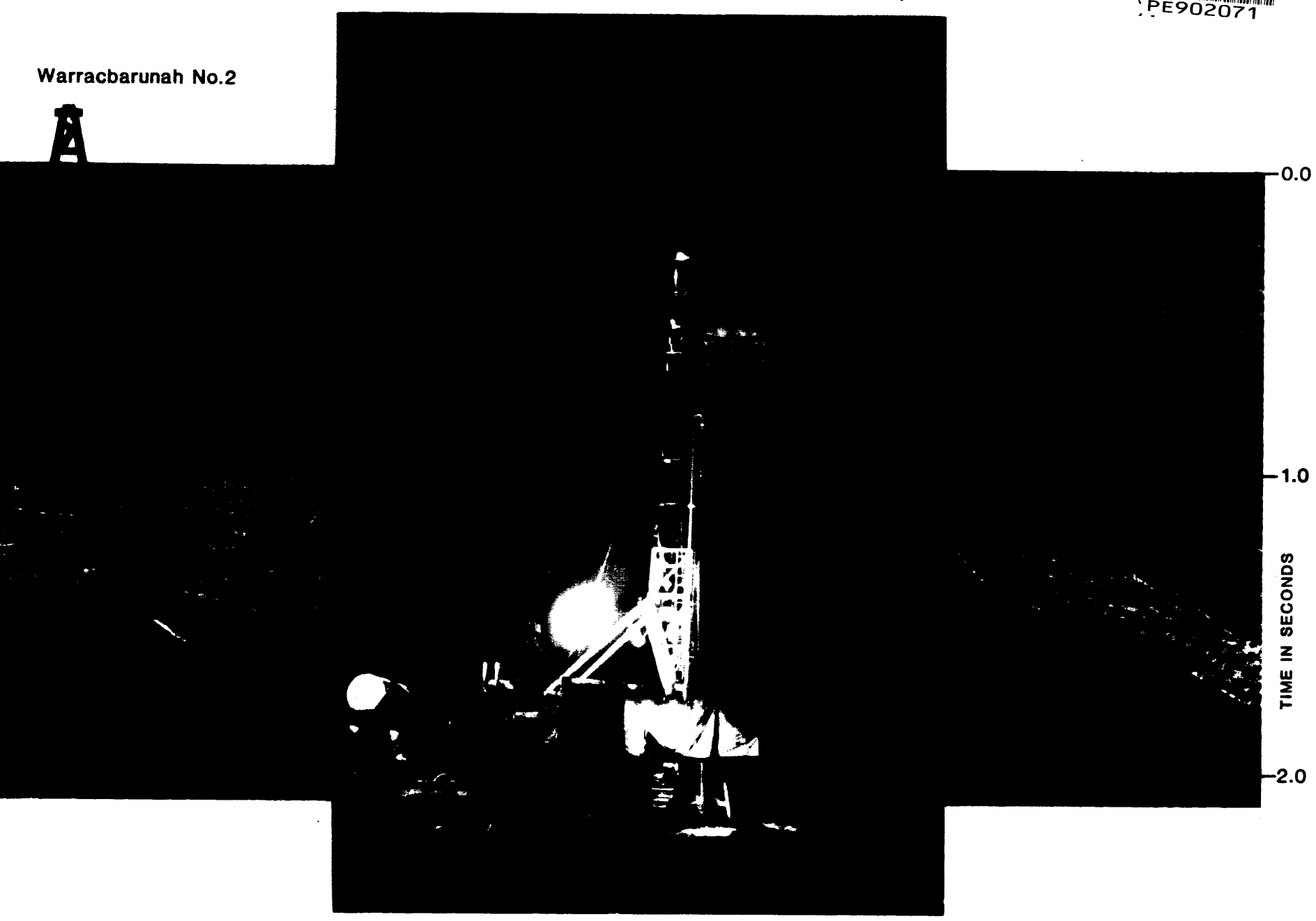
Warracbarunah No. 2

Well Completion Report

WCR vol. 1 Warracbarunah-2 (W1042)



Geological Survey of Victoria
Basin Studies

Department of Manufacturing and Industry Development

VOL. I: TEXT & APPENDICES

1991

GEOLOGICAL SURVEY OF VICTORIA

BASIN STUDIES

Warracbarunah 2

Well completion report

Unpublished report No.1991/66

Volume 1
Text and Appendices

Department of
Manufacturing
and Industry
Development

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PREFACE

APPENDICES

1. Details of Drilling Plant
2. Summary of Wellsite Operation
3. Drilling Fluid Recap
4. Cuttings and Core Descriptions
5. Velocity Survey Report
6. Petrological Report
7. Geochemistry Report
8. Palynological and Geochronological Reports
9. Core Analysis Report
10. Water Analysis Report

ENCLOSURES

		Scale
I.	Composite Well Log	1:1000
II.	Mud Log	1:500
III.	Wireline Logs	
	III.1. Dual Laterolog MLL MRS SP Sonic Gamma Ray Caliper	1:200
	III.2. Dual Laterolog MLL MRS SP Sonic Gamma Ray Caliper	1:500
IV.	Schematic Geological Cross-Section Through Warracbarunah No. 2	
V.	Log Interpretation	

PREFACE

Warracbarunah 2 was drilled as part of the Geological Survey of Victoria's (GSV) stratigraphic drilling programme in the Otway Basin.

The stratigraphic drilling programme is an important component of a major study being carried out by the Basin Studies branch of the GSV. The study involves a systematic review of all relevant data on the Otway Basin, including information held by government agencies and petroleum exploration companies. State of the art technologies, particularly in the area of geophysical interpretation, are a feature of the study. The study will increase the understanding of the evolution of the Otway Basin and will provide a better delineation of source and reservoir rocks in the basin. It will provide an up to date regional geological framework for use by petroleum explorers in developing hydrocarbon plays.

Warracbarunah 2 was drilled to confirm the presence of a trough on the northern margin of the Otway Basin. This trough was recognised on reinterpreted seismic lines during an Otway Basin margin definition project. The seismic lines were shot by Shell in 1972. The reinterpretation of existing gravity data, and the acquisition of two new gravity profiles by the Geophysics branch of the GSV further enhanced the delineation of the trough.

The well is located 500 metres inside the northern boundary of PEP 100. The well was jointly drilled by the GSV and Gas and Fuel Exploration N.L. as part of its licence committment in PEP 100.

Dr. John Foster, Operations Co-ordinator, Gas and Fuel Exploration N.L., is particularly thanked for his technical advice and comments.

Staff of Basin Studies are thanked for their contributions to the success of the project; Dr. Ahmad Tabassi co-ordinated the project; Cliff Menhennitt helped in planning the project and was in charge of the field operations and well site geology; Eddie Frankel worked at the well site and contributed significantly to the production of the composite well log; and Ben Hayes assisted in the preparation of the interpretative diagrams and compiled the report.

The well completion report was prepared by Ahmad Tabassi and Cliff Menhennitt.

The GSV is pleased with the acquired data and considers that Warracbarunah 2 was successful in meeting the project's objectives, and hopes that the results will stimulate increased exploration in this area of the Otway Basin. We look forward to participating in similar projects in the future.

JOHN LEONARD
Manager, Basin Studies

1 SUMMARY

Warracbarunah No. 2 was drilled as a stratigraphic well in PEP 100, Otway Basin Victoria.

The well was drilled by the Geological Survey of Victoria, a division of the Minerals Group of the Department of Manufacturing and Industry Development.

Warracbarunah No 2 was located 15 kilometres north west of the township of Winchelsea, and thirty kilometres north east of the City of Colac. The well was at vibration point number 170 of Gas and Fuel Exploration seismic line LM 91-03.

The objective of the well was to evaluate the lithology of the recently identified Gellibrand trough, located in the northern portion of PEP 100. This would potentially enhance the petroleum prospectivity of the eastern Otway Basin by extending the known basin margin and identifying the presence of previously unknown source and reservoir rocks in the area. The results of the well would also contribute to the understanding of the complex structural history of the basin as a whole.

Drilling commenced on November 25th 1990, and reached a total depth of 1527.46 metres on March 26th 1991.

At total depth the following suite of wireline logs were run;

Micro Laterolog, Shallow Laterolog, Deep Laterolog, Gamma Ray, Spontaneous Potential, Compensated sonic, Caliper.

The Neutron/Density tool combination became stuck in the hole while attempting to reach bottom. After successfully fishing this combination logging was abandoned.

A total of fifteen conventional cores were cut, no sidewall coring was attempted.

Hydrocarbon indications of varying intensities were commonly noted below 700 metres. The presence of hydrocarbon cut and crush cut fluorescence was most commonly noted in dried cuttings samples. Some hydrocarbon fluorescence was also noted in conventional core samples.

From surface to 477 metres the gas detection equipment used was the rig gas alarm, with a lower detection threshold of 1000ppm. No gas was detected with this equipment. Below 477 metres a hot wire total gas detector hired from Halliburton Geodata was used. A maximum gas reading of 4.2 units or 840ppm was recorded.

Warracbarunah No. 2 was completed as a groundwater observation bore in the Demons Bluff Formation.

BASIN STUDIES SECTION - DEEP STRATIGRAPHIC WELL - SUMMARY REPORT - DMID WELL

Well Name: Warracbarunah 2 | Basin: Otway | Conseq No.: 21/90/2

Status: Groundwater Observation | Rig: | Emsco GB 250 THB

Date Commenced: 25/11/90 | Completed: 26/3/91 | Total Depth: 1527.46m

Elevation (GL): ~~115m~~ 125m | Parish No.: 3745 | KB 128.7m

Location: AMG Sheet: Colac | Number 7621 | Zone: 54

Easting: 746725 | Northing: 5771290

Latitude: 38° 10' 21" Longitude: 143° 48' 39"

Seismic: LM 91-03 V.P.170

Engineering Data: (Casing, plugs, completion details)

Hole Size		Casing			Plugs and Grouting
349mm	0 - 142.41m	244mm	0 -	130.36m	130.36 - Surface
216mm	142.41 - 1527.46m	168mm	+0.5 -	129.07m	607 - 515.12m
		127mm	129.44 -	515.12m	
		Adaptor from	129.07 -	129.44m	

Geophysical Logs: Logged by BPB Wireline Services - 27/3/91

Gamma Ray
Spontaneous Potential
Laterolog Deep
Laterolog Shallow
Laterolog Micro
Compensated Sonic
Caliper

BHT: 75° C after 12 hrs

Cuttings: 3m intervals from surface to 1348m
Cores: 15 Conventional
Tests: Nil
Palynology See Appendix 9

Groundwater Data: (TDS, screened intervals, SL, drawdown, yield)

Screens	:	Pumping Test	:	
Outer Diameter	:135mm	SL	:	24.70m
Aperture	:0.02 inch	Interval	:	495.00 to 488.74m
		Formation	:	Demons Bluff
Screened interval	:495.00 to 488.74m	Yield	:	airlifting 12.6 l/s

TDS: 14100 mg/L

STRATIGRAPHY:	Depth (m) intersected	Thickness (m)	R.L. (m)
Newer volcanics	Surface	51	115
Heytesbury Group	51	347 -	64
Demons Bluff Formation	398	105	-283
Eastern View Formation	503	55	-388
Older Volcanics	588	122	-473
Eumeralla Formation	710	156	-595
Pretty Hill Formation	866	661+	-751
Sand/Shale Unit	866	615	-751
Sand Unit	1481	46+	-1366
OTHER DATA: Velocity survey and VSP carried out.			

2 WELL HISTORY

2.1 Location: (See Figs 1&2)

Co-ordinates:	Latitude	38° 10' 21"
	Longitude	143° 48' 39"
	Easting	746725
	Northing	5771290
Geophysical Control:	Vibration Point: 170 Seismic Line: LM 91-03	
Property: Description:	County of Greenville Parish of Warracbarunah Shire of Colac	
Property Owner:	Crown	

2.2 General Data

Well Name:	Warracbarunah #2
Operator:	Geological Survey of Victoria
Participants:	Gas and Fuel Exploration N.L.
Elevation:	Ground Level 115m ASL (Unless otherwise stated all depths refer to ground level)
Total Depth:	1527.46m Driller 1526.2m Logger
Drilling Commencement:	25th November 1990 @ 1300 hrs.
Total Depth Reached:	26th March 1991 @ 1700 hrs.
Status:	Completed as a groundwater observation bore in the Demons Bluff Formation

2.3 Drilling Data: (See also Appendix 1)

2.3.1 Drilling Contractor

Department of Manufacturing and Industry Development
Drilling Unit

2.3.2 Drilling Rig

DMID Rig 21

2.3.3 Casing and Cementing Details

A 16" Conductor pipe was set at 2m prior to rig up

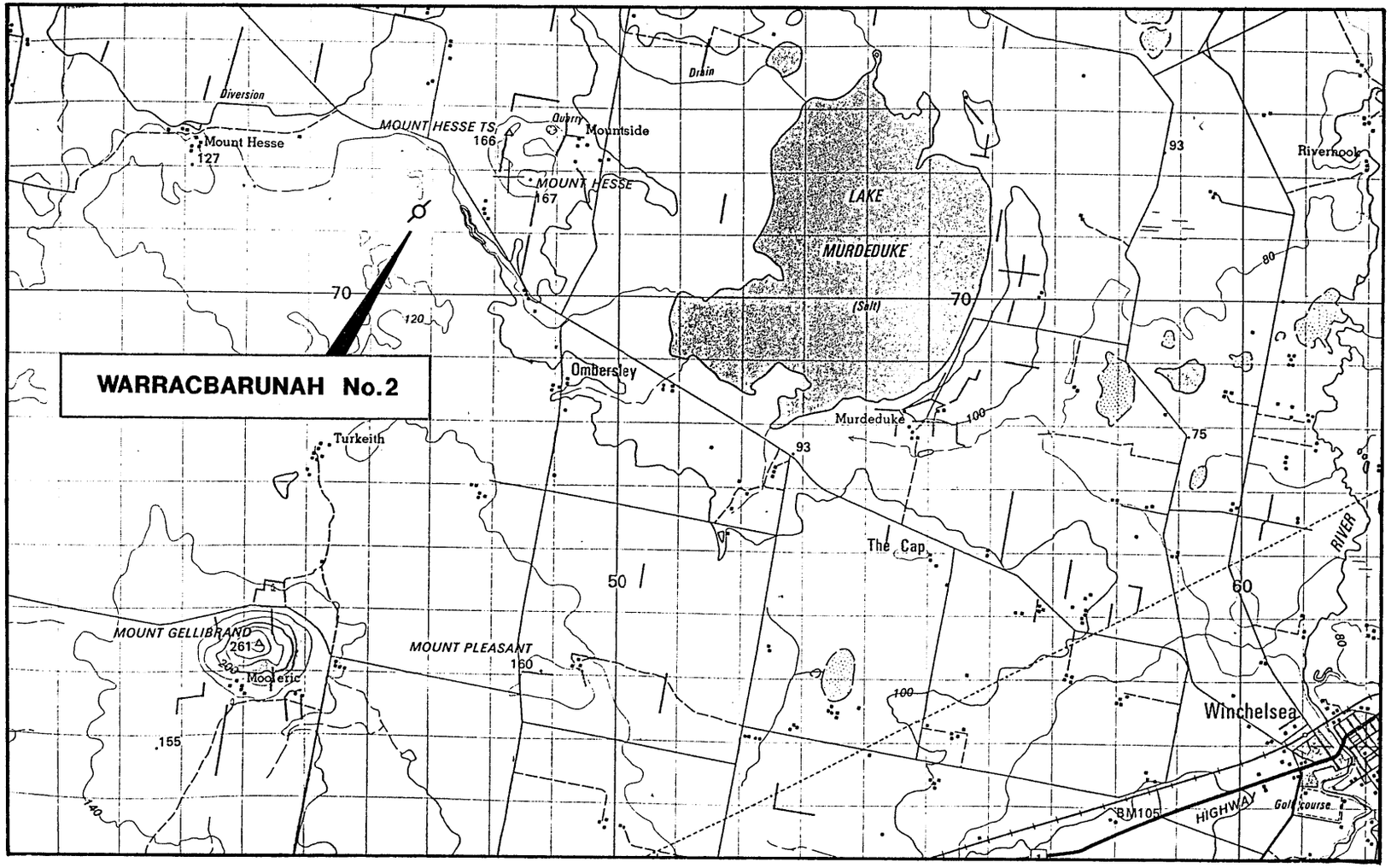

FIGURE 1 – TOPOGRAPHIC LOCATION MAP

WARRACBARUNAH No.2

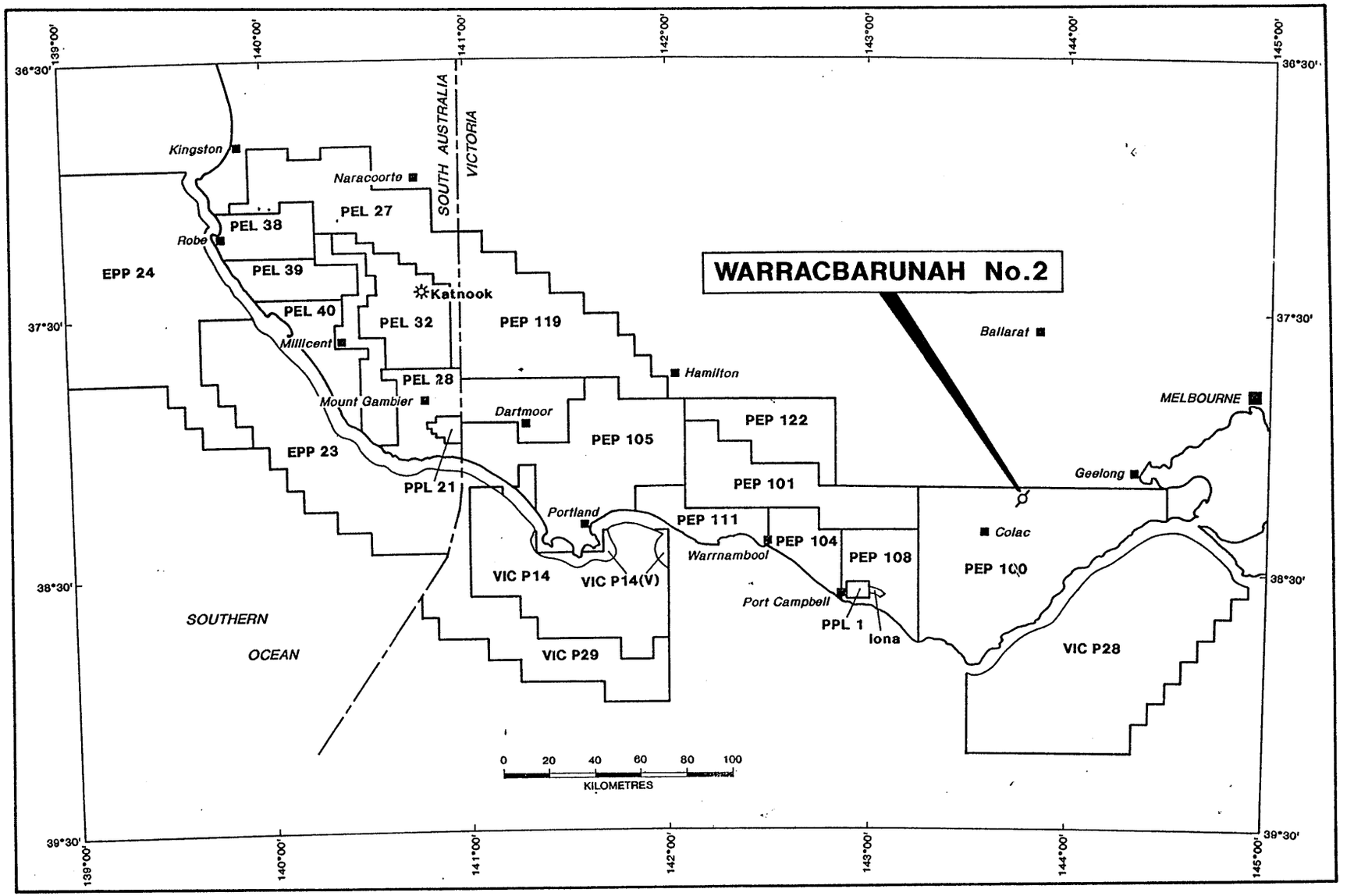

FIGURE 2 – PERMIT MAP

Surface Casing

Size:	$9^5/_8$"
Depth:	130.36m
Cement:	204 sacks Class "A" neat

Cement Plugs

Plug No 1

Interval	607 - 510m
Cement	124 sacks class "A" neat
Method	Balanced
Test	Tagged

2.3.4 Completion Casing

Warracbarunah 2 was completed as a groundwater observation bore in the Demons Bluff Formation. A PVC casing string incorporating screens was set atop a cement plug at 515m. A detailed water analysis is presented in Appendix 10.

Casing

Size:	168mm
Interval:	Surface + 0.5 - 129.07m
Size:	127mm
Interval:	129.44 - 515.12m
Adaptor from	129.07 - 129.44mm

Screens

Type:	Johnson
Aperture:	0.02inch
Outer Diameter:	136mm
Interval:	495 - 488.74m

2.3.5 Drilling Fluid

The drilling fluid program was designed by Baroid Australia Pty Ltd. The program was structured to accommodate the operating schedule of the rig and the anticipated long period of open hole conditions while being relatively easy to monitor and maintain by on site personnel.

The hole was spudded with an 11 inch down hole hammer which drilled to 49 metres. Conventional rotary drilling using a Potassium Chloride-Bentonite-CMC mud system was then used to total depth.

Casing point was reached without complication. After casing was set the hole was deepened to 476 metres with minor tight hole conditions around 200 metres. Operations were then suspended for six weeks for the Christmas break. Following the Christmas shut-down operations resumed. Drilling and coring were completed to the total depth. Tight hole conditions were common necessitating regular reaming back to bottom.

One successful wireline logging run was made. The caliper log indicated significant washout conditions and ledging over several intervals. An attempt to run the Neutron-Density tool combination was unsuccessful, becoming hung up around 735 metres. A wiper trip was then run, followed by the velocity survey. Another attempt to run the Neutron-Density tool combination resulted in the tool becoming stuck in the hole. The tools were successfully recovered. Poor hole conditions and ledging were thought to be responsible for the fishing operation.

2.3.6 Water Supply

Rig water was supplied from a service bore located approximately 20 metres from the rig. The supply was more than adequate for the operation.

2.4 Formation Sampling

2.4.1 Cuttings

Cuttings samples were collected at three metre intervals from surface to total depth. Each sample was washed dried and stored in labelled polythene bags. These samples are stored in the DMID core laboratory, Port Melbourne. Cuttings descriptions are included as Appendix 4.

2.4.2 Cores

Fifteen conventional cores were cut, the intervals and recoveries are listed below.

Core No.	Interval (M)	(Recovery %)
1	290.7 - 296.7	11
2	428.4 - 433.1	4
3	483.4 - 989.4	15
4	583.6 - 588.0	20
5	636.2 - 637.2	50
6	739.0 - 743.4	90
7	959.3 - 960.9	66
8	1032.1 - 1032.9	85
9	1151.8 - 1152.8	90
10	1252.7 - 1253.6	50
11	1343.0 - 1347.8	60
12	1389.2 - 1389.8	25
13	1442.8 - 1445.7	74
14	1497.4 - 1501.3	63
15	1524.9 - 1527.4	7

These cores are held in the DMID Core Laboratory, Port Melbourne. Core descriptions are included as appendix 4.

2.4.3 Testing

No formation testing was carried out on this well.

2.4.4 Sample Analyses

2.4.4.1 Palynology

A total of nineteen core and cuttings samples were submitted to Morgan Palaeo Associates for palynological determination. The results are included as Appendix 8. Sample intervals are presented in the following table.

WARRACBARUNAH 2

PALYNOLOGY SAMPLES

No.	Type	Interval (m)	Recovery%
(1)	Core No.13	1442.8 - 1445.7m	7 %
(2)	Core No.12	1389.2 - 1389.8m	25%
(3)	Core No.11	1343.0 - 1347.8m	60%
(4)	Core No.10	1252.7 - 1253.6m	50%
(5)	Cuttings	1212 - 1215m	
(6)	Core No.9	1151.8 - 1152.8m	90%
(7)	Cuttings	1107 - 1110m	
(8)	Core No.8	1032.1 - 1032.9m	85%
(9)	Cuttings	996 - 999m	
(10)	Core No.7	959.3 - 960.9m	66%
(11)	Cuttings	900 - 903m	
(12)	Cuttings	861 - 864m	
(13)	Cuttings	801 - 804m	
(14)	Cuttings	762 - 765m	
(15)	Core No.6	739.0 - 743.4m	90%
(16)	Core No.4	583.6 - 588.0m	20%
(17)	Cuttings	549 - 552m	
(18)	Core No.3	483.4 - 489.4m	15%
(19)	Cuttings	435 - 438m	
(20)	Core No.1	290.7 - 296.7m	11%

2.4.4.2 Source Rock Analysis

A Total of fifteen samples were submitted to Amdel for source rock analysis. The results are included as Appendix 7. The sample intervals are presented in the table below.

WARRACBARUNAH 2

SAMPLES FOR ANALYSIS

NO.	TYPE	INTERVAL (m)		RE	VR
(1)	Cuttings	1461 - 1464m		x	x
(2)	Core No.13	1442.8 - 1445.7m	Rec.74%	x	x
(3)	Core No.12	1389.2 - 1389.8m	Rec.25%	x	x
(4)	Core No.11	1343.0 - 1347.8m	Rec.60%	x	x
(5)	Cuttings	1296 - 1299m		x	x
(6)	Core No.10	1252.7 - 1253.6m	Rec.50%	x	x
(7)	Cuttings	1200 - 1203m		x	x
(8)	Cuttings	1176 - 1179m		x	x
(9)	Core No.9	1151.8 - 1152.8m	Rec.90%	x	x
(10)	Cuttings	1074 - 1077m		x	x
(11)	Core No.8	1032.1 - 1032.9m	Rec.85%	x	x
(12)	Core No.7	959.3 - 960.9m	Rec.66%	x	x
(13)	Cuttings	894 - 897m		x	x
(14)	Cuttings	810 - 813m		x	x
(15)	Cuttings	759 - 762m		x	x

RE: Rock Eval Pyrolysis

VR: Vitr inite Reflectance

2.4.4.3 Core Analysis

A total of nine sections of whole core were submitted to Amdel Core Services for porosity and permeability determination. The results are included as Appendix 9. The sample intervals are detailed below.

Sample No	Core No	Interval (m)
1	15	1524.88 - 1527.46
2	14	1497.36 - 1501.31
3	14	1497.36 - 1501.31
4	14	1497.36 - 1501.31
5	13	1442.77 - 1445.72
6	13	1442.77 - 1445.72
7	11	1342.99 - 1347.84
8	11	1342.99 - 1347.84
9	8	1032.12 - 1032.92

2.4.4.4. Petrology

A total of four core samples were submitted to Amdel core Services for detailed petrological analysis. The results are presented in Appendix 6. The sample intervals are detailed below.

Sample No	Core No	Interval (m)
1	15	1524.88 - 1527.46
4	14a	1497.36 - 1501.31
7	11d	1342.99 - 1347.84
8	11a	1342.99 - 1347.84

2.4.4.5 K - Ar Geochronology

One basalt sample from core No 5, 636.2 -637.2 metres, was submitted to Amdel Core Services for Potassium - Argon Geochronology. The result is included in appendix 8.

2.5 Logging & Surveys

2.5.1 Mud Logging

A DMID Mobile laboratory was used. The unit was equipped with a binocular microscope, a UV sample examination box and a sample drying oven. A hot wire total gas detector, hired from Halliburton Geodata, was also housed in the laboratory. The mud log is included as enclosure II.

2.5.2 Wire Line Logging

Wireline logging was carried out by BPB Wireline services using a standard truck mounted unit. The programmed suite of logs was abbreviated after the Neutron/Density tool combination became struck in the hole while attempting to reach bottom. Following a successful cut and thread fishing operation the proposed Neutron/Density and sidewall core operations were abandoned.

Suite 1

	Interval (m)
Dual laterolog/microlog	1515 - 130
Microlaterolog/Gamma Ray	
Compensated sonic/Caliper	

2.5.3 Deviation Surveys

Deviation surveys were conducted regularly with the following results.

Depth (m)	Deviation (deg)
672	1
900	$1^1/_4$
1140	$2^1/_4$
1251	3
1394	5

2.5.4 Velocity Survey

A velocity survey and vertical seismic profiling were carried out by Velocity Data Pty.Ltd. These data are included as appendix 5.

3. RESULTS OF DRILLING

3.1 Stratigraphy

The following stratigraphic intervals have been determined using wireline log interpretation, palynology, and core and cuttings analysis.

GROUP	FORMATION	DEPTH (m)	THICKNESS (m)	ELEVATION (m)
	Newer Volcanics	Surface	51	115
Heytesbury	Gellibrand Marl	51	347	64
Nirranda	Demons Bluff	398	105	-283
Wangerrip	Eastern View	503	55	-473
Otway	Eumeralla	710	156	-595
Otway	Pretty Hill	866	661+	-751
	Sand/shale Unit	866	615	-751
	Sand Unit	1481	46+	-1366

3.2 Lithological Description

3.2.1. Quaternary

Newer Volcanics **Surface - 51.0m**

Basalt, greyish black to black, occasionally brownish black and light reddish brown,.vesicular in parts, reddish brown weathering in parts, trace of medium to coarse quartz sand, common secondary carbonates, very hard, common Clay light brown, light reddish brown and light grey, trace of fine to medium quartz sand, soft non calcareous.

3.2.2 Tertiary

Heytesbury Group **51.0 - 398.0m**

51.0 - 63.0m
Limestone off white to greyish orange, abundant fine to very fine sand, occasional shell fragment, firm to moderately hard, very calcareous.

63.0 -398.0m
Marl olive grey to brownish grey, becoming medium light grey to medium dark grey with depth, trace to occasional fine to very fine sand, occasional fossil fragments, slightly silty in parts, trace of mica, trace of pyrite, dispersive, soft to moderately firm, sub blocky in parts, very calcareous.

WARRACBARUNAH No.2

PROGNOSED AND ACTUAL STRATIGRAPHY

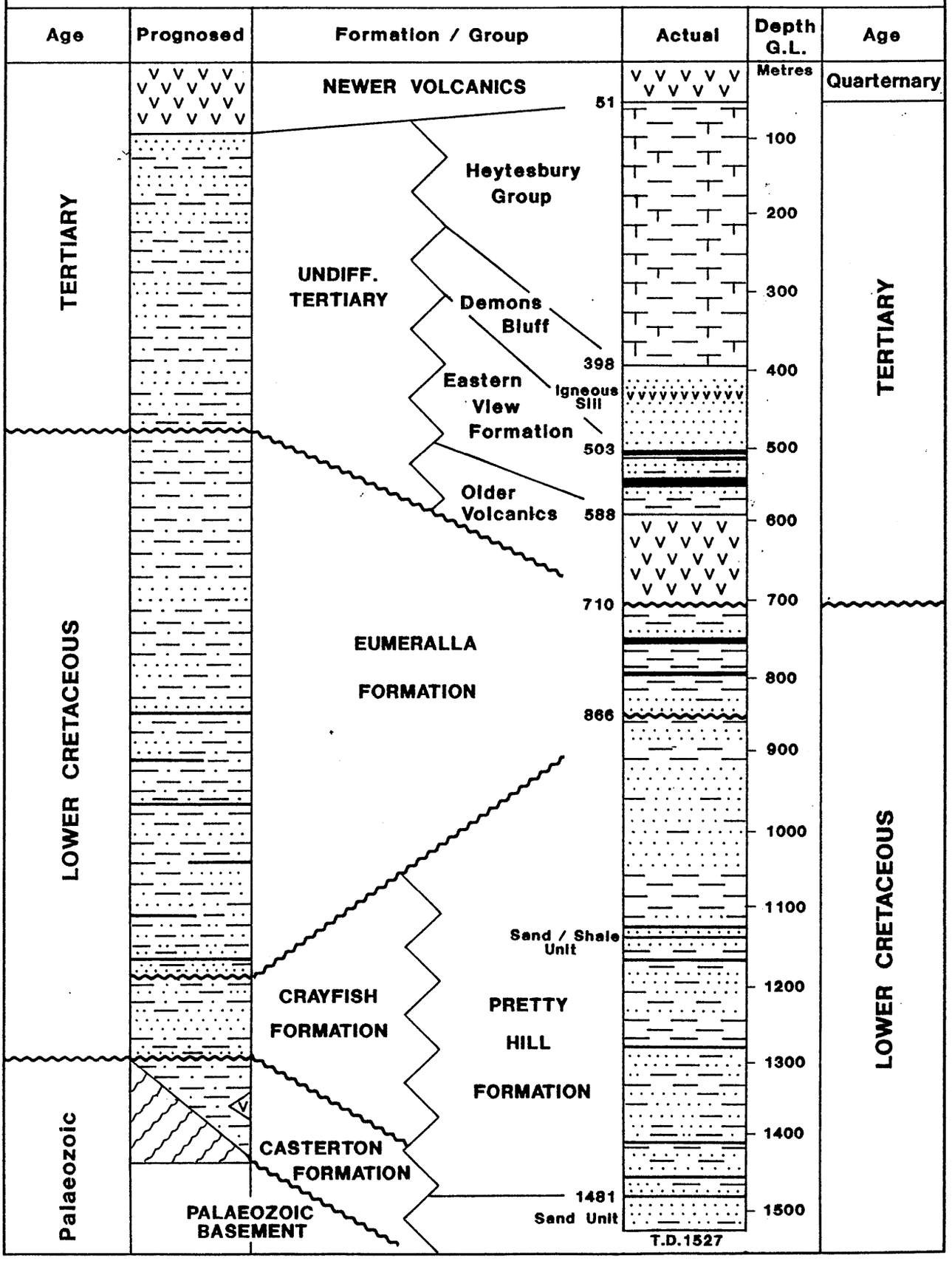

FIGURE No. 3

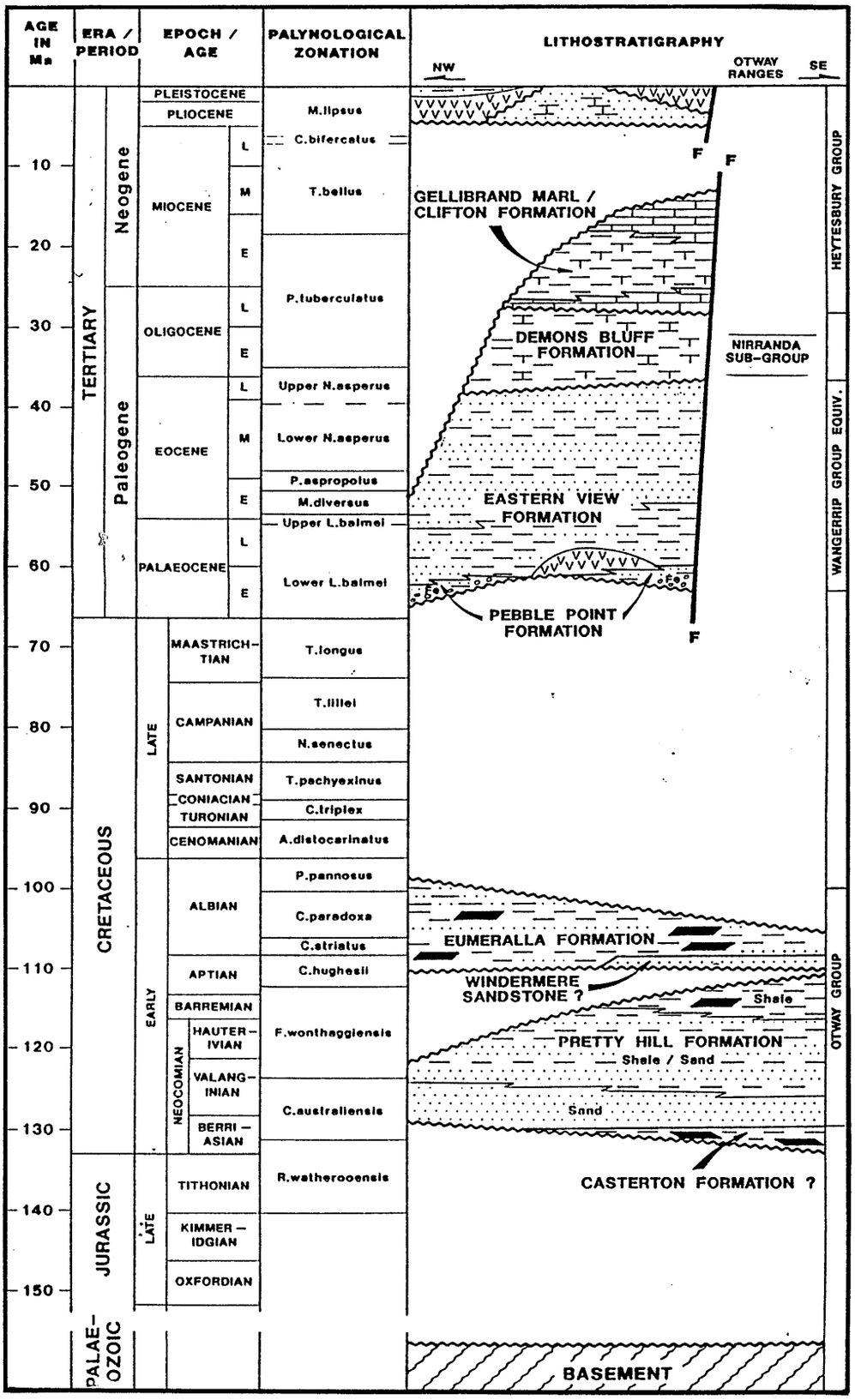

FIGURE 4 – STRATIGRAPHIC TABLE OF PEP 100 & ENVIRON

(After Gas & Fuel Exploration N.L., 1991)

3.2.3 **Tertiary**

Demons Bluff Formation **398.0 - 503.0m**

Sandstone clear to translucent quartz grains in a moderate brown to greyish brown matrix, predominantly very fine to fine grained with some medium and coarse grains, towards the bottom of the unit the grainsize becomes fine to medium and medium to coarse in parts, generally poorly sorted with occasional intervals showing bimodal grainsize distribution and other areas well sorted, sub angular to sub rounded occasionally angular and rounded, siliceous cement in parts, traces of pyrite cement, abundant argillaceous matrix which is slightly dispersive, commonly micaceous, occasional coal fragments, generally unconsolidated, underlain by a thin section of Coal greyish black to reddish brown, dull, soft to moderately firm, crumbly, trace of pyrite.

3.2.4 **Tertiary**

Eastern View Formation **503.0 - 588.0m**

Sandstone clear to translucent and occasionally milky quartz, fine to medium and occasionally very fine grained, occasional coarse grains in parts, well sorted, sub angular to sub rounded and occasionally angular, trace of silica cement, trace of calcite cement, light brown argillaceous matrix in parts, pyritic in parts, occasionally as cement, trace of mica, rare amber, predominantly unconsolidated, commonly interbedded with Claystone medium light grey to medium grey and occasionally brownish grey, sandy in parts, common pyrite, common coal fragments, trace of mica, trace of amber, trace of glauconite, soft to moderately firm, slightly calcareous, also present are seams of Coal brownish grey to brownish black, dull, soft to moderately firm, occasional webs and laminae of pyrite, trace of amber. In the lower 20 metres of the unit the Sandstone becomes reddish brown to medium grey, fine to medium and occasionally coarse grained, arkosic, poor to moderate sorting, angular to very angular, common silica cement, occasional calcite cement, common to abundant rock fragments, common to abundant pyrite, hard, abundant mineral fluorescence.

3.2.5 **Tertiary**

Older Volcanics **588.0 - 710.m**

Basalt greyish black to greenish black and occasionally bluish grey; non vesicular, occasional zeolites, weathered to reddish brown in parts, occasional green clay mineral inclusions, occasional calcite, moderately hard to hard, commonly weathered to Claystone brownish grey, bluish grey, greenish grey, occasionally greenish white and greyish white, commonly mottled, soft to moderately firm, occasional calcite.

3.2.6 **Lower Cretaceous**

Eumeralla Formation **710.0 - 866.0m**

Claystone light grey to medium dark grey, silty and occasionally sandy in parts, common carbonaceous flecks throughout, occasional coaly laminae, slightly dispersive in parts, soft to moderately firm, slightly calcareous in parts, interbedded with and grading to Siltstone light grey to light brownish grey, sandy in parts, moderately firm, slightly calcareous throughout, interbedded with and grading to Sandstone light grey to off white, very fine to occasionally fine grained, well sorted, sub angular to angular, abundant calcite cement throughout, slightly argillaceous matrix in parts, becoming silty in parts, occasional to common lithic grains, firm to friable in parts, poor visual porosity, throughout the unit there are minor bands of Coal grey black to black, sub vitreous lustre, firm, brittle, occasional sub conchoidal fracture.

3.2.7 **Lower Cretaceous**

Pretty Hill Formation **866.0m - T.D.**

Sand Shale Unit **866.0m - 1481.0m**

Sandstone off white to light grey with clear to translucent and occasionally milky quartz grains, predominantly very fine to fine grained with intervals of fine to medium grained and occasionally medium to coarse and very coarse grained, moderately to well sorted in the finer zones becoming poorly sorted in coarse grained areas, sub angular to sub rounded, occasionally angular and rounded, calcite cementation throughout ranging from weak to pervasive which obliterates all porosity, silty to argillaceous matrix in parts, light pink to red garnets below 900 metres and becoming more common in the coarser aggregates, occasional to common lithic and feldspathic grains, occasional coal, moderately firm to moderately hard where strongly cemented, generally poor visual porosity, occasionally moderate visual porosity in coarser aggregates, regularly interbedded with Claystone, light grey to medium grey and occasionally brownish grey, silty in parts, grading to very fine sand, common coaly flecks and laminae, slightly micaceous in parts, moderately firm to firm, sub blocky to blocky, non calcareous, grading to and interbedded with minor Siltstone medium grey to brownish grey, micaceous, occasional coaly and carbonaceous flecks, grading to very fine sandstone in parts, firm sub blocky to blocky, non calcareous. The unit has occasional bands of Coal greyish black to black, dull to sub vitreous lustre, firm, brittle, blocky to sub conchoidal fracture.

Sand Unit **1481.0m - 1527.4m**

Sandstone light grey to very light grey with clear to translucent and occasionally milky quartz grains, predominantly medium to coarse grained with common very coarse and occasional fine grains, predominantly well sorted, sub-angular to sub rounded, occasionally angular, trace to occasional calcite cement, common white argillaceous matrix, occasional light pink garnets, trace of coal, trace of pyrite, moderately firm, friable, moderate to good visual porosity, with minor interbeds of Siltstone medium light grey to medium grey, occasionally brownish grey, occasional carbonaceous wisps and laminae, moderately firm to firm, sub blocky, non calcareous grading in parts to Claystone medium light grey to medium grey, occasional carbonaceous flecks, silty in parts, moderately firm to firm, sub blocky to blocky, non calcareous with minor bands of Coal black, sub vitreous, firm , brittle, blocky to sub conchoidal fracture.

3.3 Hydrocarbon Indications

3.3.1 Drilling Fluid Gas Readings

From the surface to the pre Christmas break depth of 477 metres the gas detection equipment used was the rig gas alarm, which was mounted in the doghouse of the rig. This equipment has a lower detection threshold of 1000 parts per million. Sample was collected directly from the flow line without a conventional gas trap or agitator. No gas was detected with this equipment. Attempts to register a response on the detector with calcium carbide in the drilling fluid also proved to be unsuccessful.

Below 477 metres a Continental Laboratories hot wire total gas detector hired from Halliburton Geodata was used. The unit also had a conventional gas trap and agitator mounted in the possum belly of the shale shaker.

The gas detector was regularly checked to verify its operation and accuracy. Calcium carbide was placed in the drilling fluid during connections. This also verified lag estimates.

Over the interval 825.0 to 915.0 metres an average gas reading of 0.3 units with a maximum of 0.6 units was recorded.

From 1089.0 to 1110.0 metres an average gas reading of 0.3 units with a maximum of 0.4 units was recorded.

From 1350.0 to 1380.0 metres an average gas reading of 0.25 units with a maximum of 0.5 units was recorded.

From 1476.0 to 1497.0 metres an average gas reading of 0.5 units with a maximum of 1.1 units was recorded.

While cutting core No 15 a maximum gas reading of 3.0 units was recorded. While circulating bottoms up after reaming back to bottom a maximum of 4.2 units was recorded.

3.3.2 Sample Fluorescence

Core and cuttings samples were routinely checked for hydrocarbon fluorescence under ultra violet light. Samples were also tested for trichloroethane cut and crush cut fluorescence.

At this location wet cuttings samples initially exhibited no fluorescence. After drying however, cuttings samples from the lower third of the hole routinely exhibited cut and crush cut fluorescence. This fluorescence was weak to moderate yellowish and greenish white in trichloroethane, usually leaving a slightly stronger residue ring in the spot tray. This fluorescence was observed in several samples below 950 metres and almost all samples below 1100 metres. The occurrence of fluorescence is noted in the sample descriptions.

The testing of core samples also yielded some hydrocarbon fluorescence. Core samples from core no 7, 959.3 - 960.9 metres depth, onwards, exhibited some cut and crush cut fluorescence. Cores 7 and 8 showed weak to moderate greenish white crush cut fluorescence. Core samples 9 to 14 exhibited weak to moderate and occasionally moderate to strong yellowish white crush cut fluorescence. It is noted that fluorescence was derived from claystone or coaly samples only. No result was obtained from sandstone samples. The occurrence of fluorescence in these samples is also noted in the core descriptions.

4. GEOLOGY

4.1 Introduction

The Warracbarunah 2 stratigraphic well was drilled to confirm the presence of a trough on the northern margin of the Otway Basin. The trough, which is now called the Gellibrand Trough, was initially recognised during an Otway Basin margin definition project.

Reinterpretation of the regional gravity map indicated the presence of a gravity low, but a lack of additional information, including subsurface data, prevented confident definition of this low. The Cressy 2 well, drilled eleven kilometres to the northwest of Warracbarunah 2, was terminated after penetrating 114 m of volcanics below Tertiary sediments. It was then assumed that at this location there may be a granitic mass overlain by a thick interval of early Tertiary Older Volcanics.

The reinterpretation of two 1972 vintage seismic lines shot by Shell in this area revealed a major, down to the north, normal fault at the northern end of both lines (figures 5 and 6). The throw of the fault was up to 1.5 seconds (TWT). The fault is now recognised as marking the southern flank of the Gellibrand Trough.

The results of the seismic reinterpretation prompted a detailed investigation of the area. This was done by reinterpreting the existing gravity data and conducting two new gravity profiles over the trough. These investigations indicated a trough which is up to 10 km wide, more than 15 km long, and between 1200 and 1700 metres deep.

While the drilling of Warracbarunah 2 was in progress, Gas and Fuel Exploration N.L. conducted the Lake Murdeduke seismic survey, of which line LM-91-03 was shot over the well location (figure 10). Preliminary interpretation of this survey suggests a half graben configuration which is bounded by a major, down to the north, normal fault in the south, and several relatively minor, down to the south, step out faults to the north. This configuration matches that of the Ardonachie Trough and to some extent the Penola Trough.

The drilling of the Warracbarunah 2 stratigraphic well has confirmed the presence of the Gellibrand trough. Further, it has provided data beneficial to both the understanding of the tectonic evolution of the Otway Basin, and to the petroleum exploration industry.

4.2 TECTONICS

It is now believed that the development of the Otway Basin was initiated by an early rifting in the Late Jurassic - Early Cretaceous at the extreme northern flank of the present Otway Basin (Pettifer, Tabassi & Simons, 1991). This trough occupied the present location of the Penola Trough, Ardonachie Trough, and the Gellibrand Trough with at least one more small trough located between the Ardonachie and Gellibrand troughs.

PE907639

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The enclosure PE907639 has the following characteristics:

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PERMIT	= PEP 100
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SUBTYPE	= SECTION
DESCRIPTION	= Shell Seismic Line 72-63 Showing the Southern Portion of the Gellibrand Trough(Figure 5 from Well Completion Report vol.1) for Warracbarunah-2
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	= 29/01/92
W_NO	= W1042
WELL_NAME	= Warracbarunah-2
CONTRACTOR	=
CLIENT_OP_CO	= Geological Survey of Victoria

(Inserted by DNRE - Vic Govt Mines Dept)

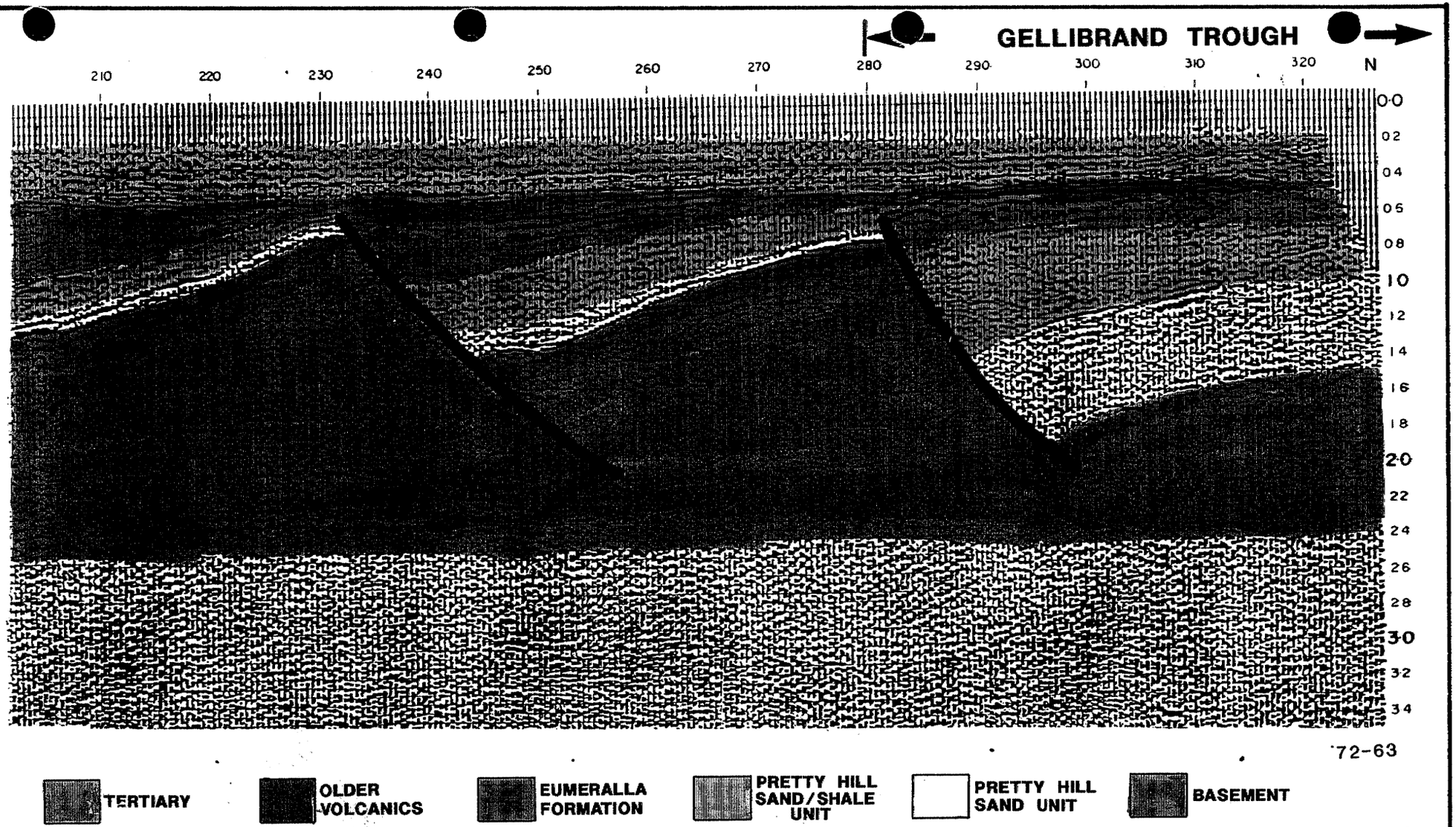

FIGURE 5 – SHELL SEISMIC LINE 72-63 SHOWING THE SOUTHERN PORTION OF THE GELLIBRAND TROUGH

PE907640

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TYPE	= SEISMIC
SUBTYPE	= SECTION
DESCRIPTION	= Shell Seismic Line 72-64 Showing the Southern Portion of the Gellibrand Trough(Figure 6 from Well Completion Report vol.1) for Warracbarunah-2
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	= 29/01/92
W_NO	= W1042
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CONTRACTOR	=
CLIENT_OP_CO	= Geological Survey of Victoria

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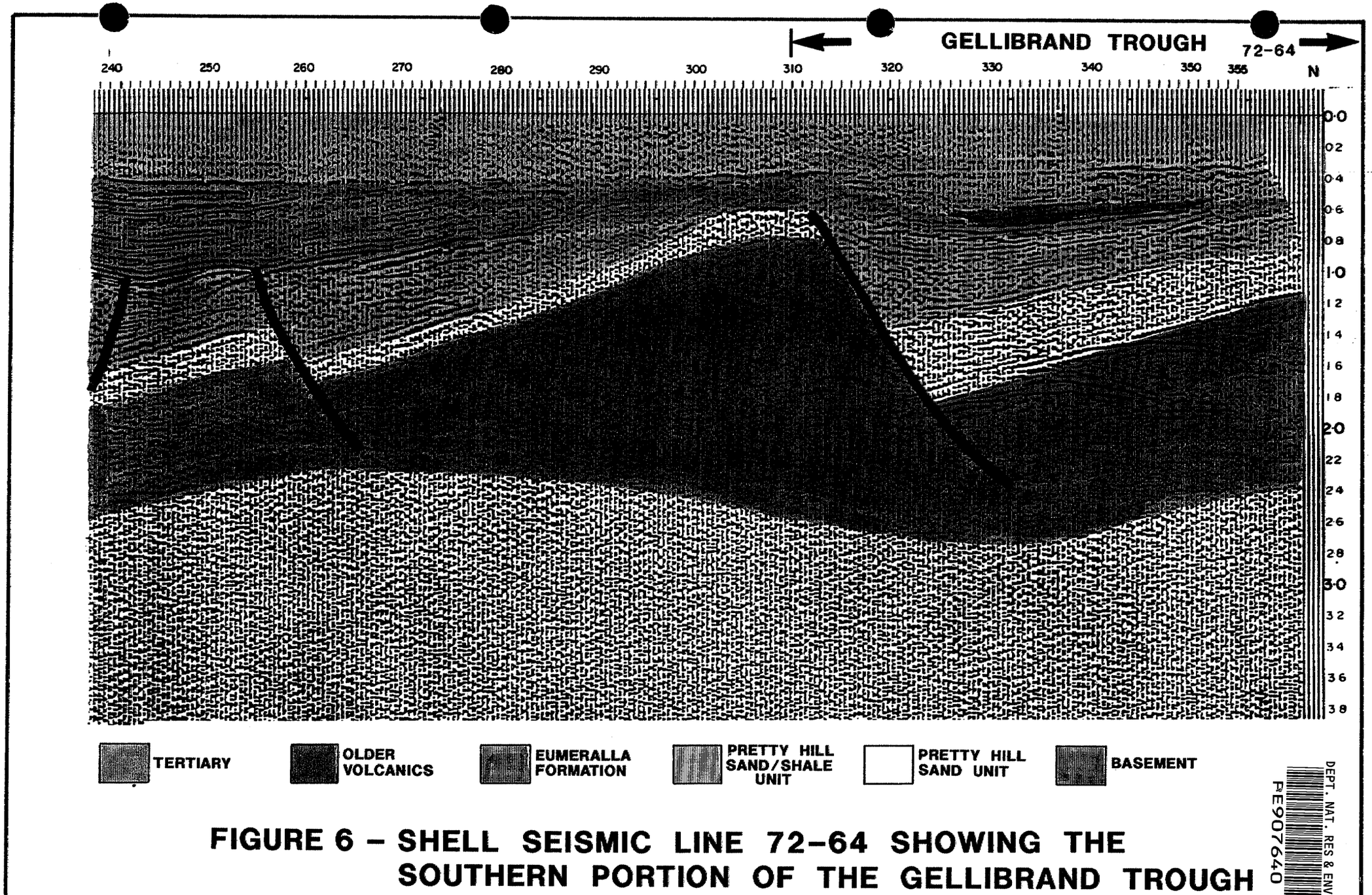

FIGURE 6 – SHELL SEISMIC LINE 72-64 SHOWING THE SOUTHERN PORTION OF THE GELLIBRAND TROUGH

The main Otway Basin rift developed, during the Early Cretaceous, parallel to and south of the earlier rift which was aborted. The mid-Cretaceous unconformity marks the boundary between the termination of rifting and the commencement of the break up of the Australia-Antarctica continent.

Until Mid-Cretaceous, the tectonic history of the Otway Basin was, with some minor variations, a uniform one. There is however, evidence to suggest that the eastern portion of the Otway Basin has gone through a completely different tectonic process. While the rest of the basin was, for the first time, being subjected to marine influence, by the beginning of upper Cretaceous time the Torquay Embayment, both off-shore and onshore, in the eastern portion of the basin was uplifted and subsequently peneplanated.

The Gellibrand Trough is considered to have undergone a similar history. This is indicated by the lack of Upper Cretaceous Sherbrook Group and a thin Eumeralla Formation in the well, and is confirmed by palynological studies (appendix 8).

The Tertiary tectonic history of the Gellibrand Trough is closely similar with that of the rest of the basin. The sedimentary sequence, however, resembles more that of the Torquay Embayment, and this is reflected by the stratigraphic nomenclature used.

A 122 metre thick section of volcanics was encountered at the base of the Tertiary sequence. These are believed to be Early Tertiary Older Volcanics similar to those intersected in Cressy 2. The possibility that the volcanics are Early Cretaceous cannot be ruled out. An attempt at K-Ar dating of this rock was unsuccessful due to the degree of weathering (appendix 8).

The Tertiary sequence of the Gellibrand Trough is capped by a relatively thick interval of Newer Volcanics.

Although there are insufficient data to discuss the structural elements within the Gellibrand Trough, a north-south schematic geological cross section has been prepared to highlight the structural grain of the area (enclosure IV).

4.3 POTENTIAL RESERVOIRS

The only potential reservoirs penetrated by Warracbarunah 2 are sandstones of the Pretty Hill Formation. The Sand/Shale unit of this formation contains a number of sandstone intervals with good reservoir characteristics. Five core samples of this unit were used for conventional core analysis (See appendix 10). These exhibited a range of porosity from 6.4% to 19.4%. Four of the five samples, however, have relatively low permeability.

Only a thin section (46 metres) of the Sand Unit of the Pretty Hill Formation was penetrated. Conventional core analysis results of four

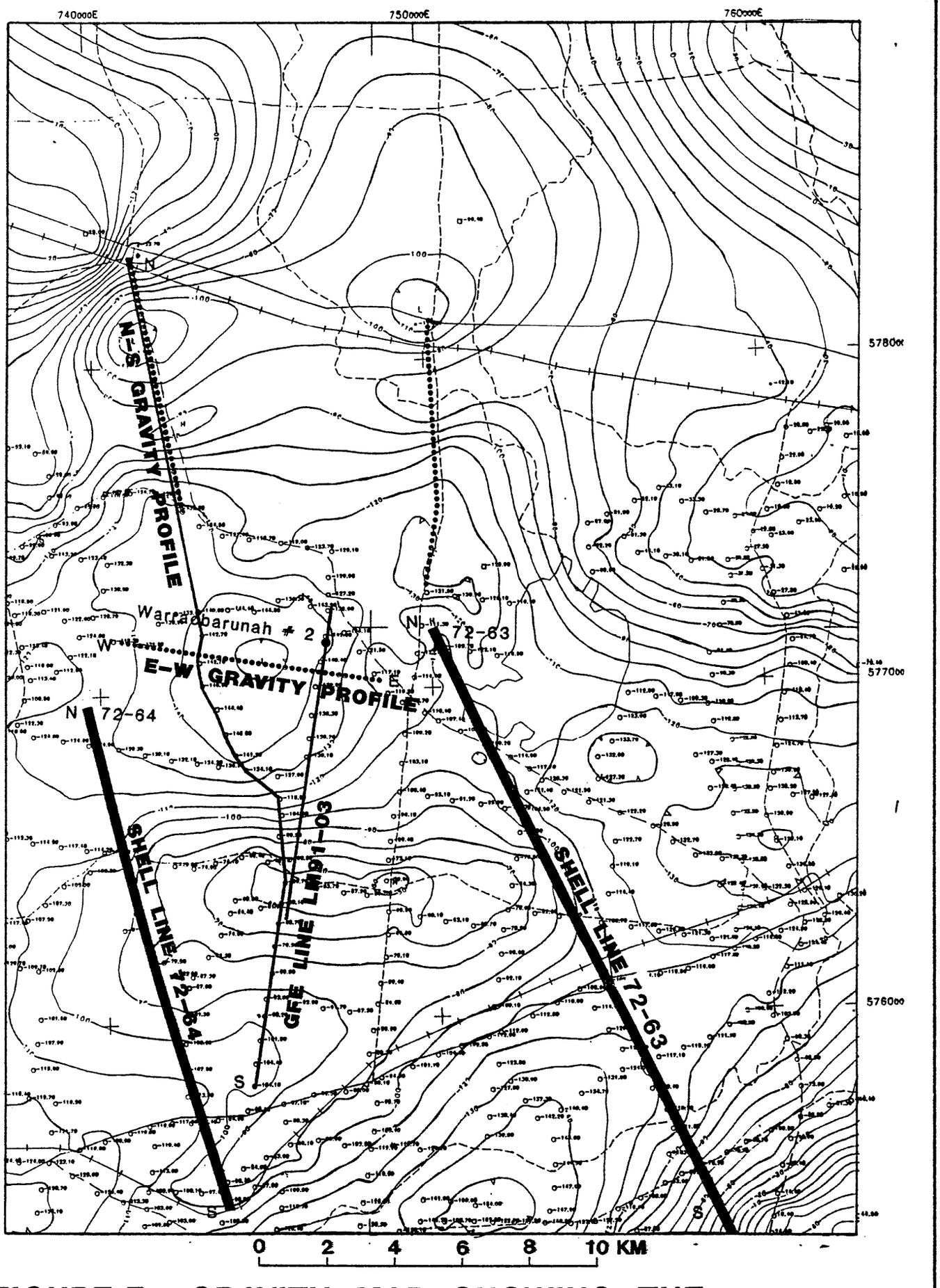

FIGURE 7 – GRAVITY MAP SHOWING THE GELLIBRAND TROUGH, WARRACBARUNAH No.2 LOCATION, SHELL SEISMIC LINES, GFE SEISMIC LINE & GRAVITY PROFILE

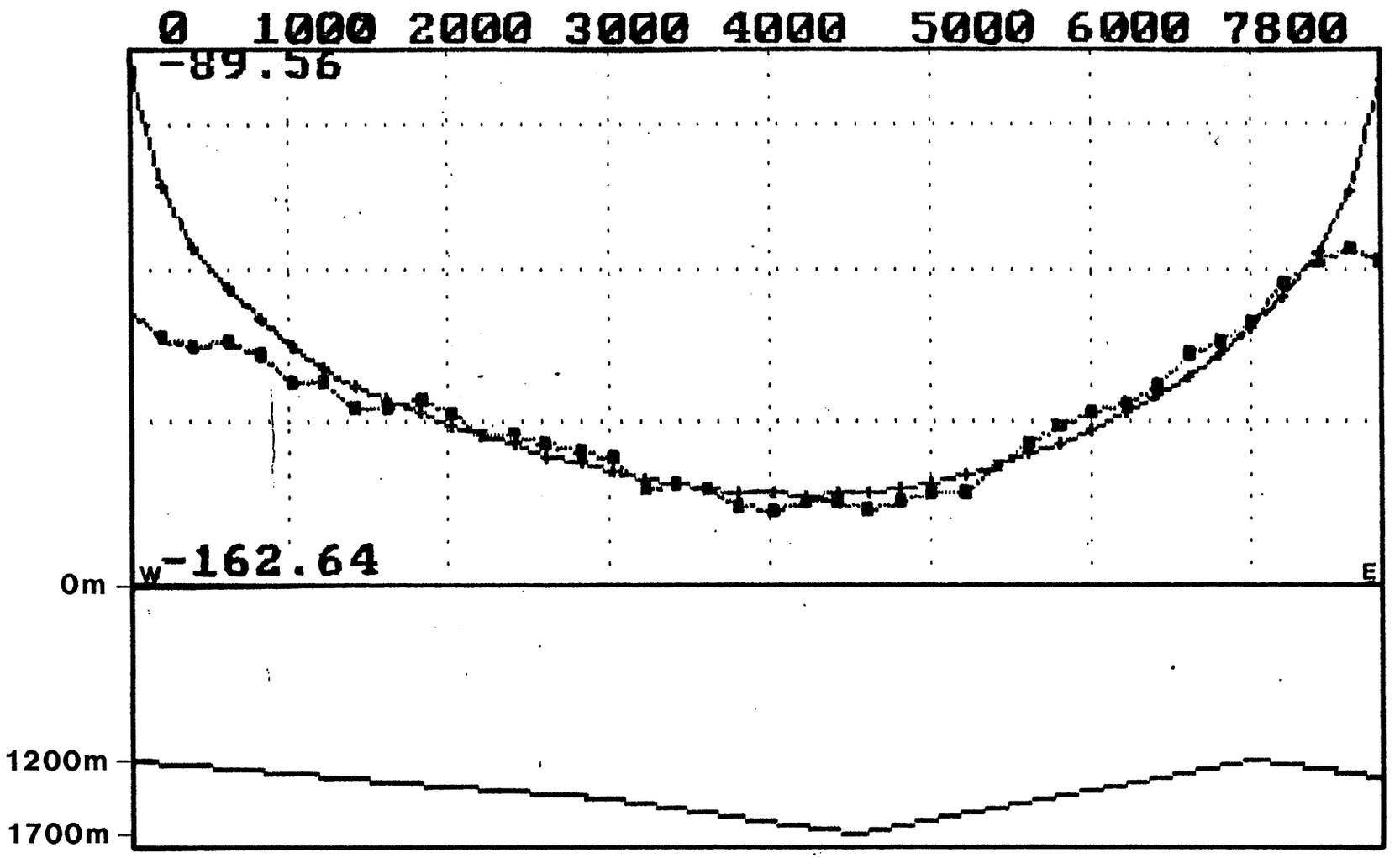

FIGURE 8 – GRAVITY MODEL OF THE GELLIBRAND TROUGH (W–E)
WITH SOIL DENSITY OF – 0.20tm^3

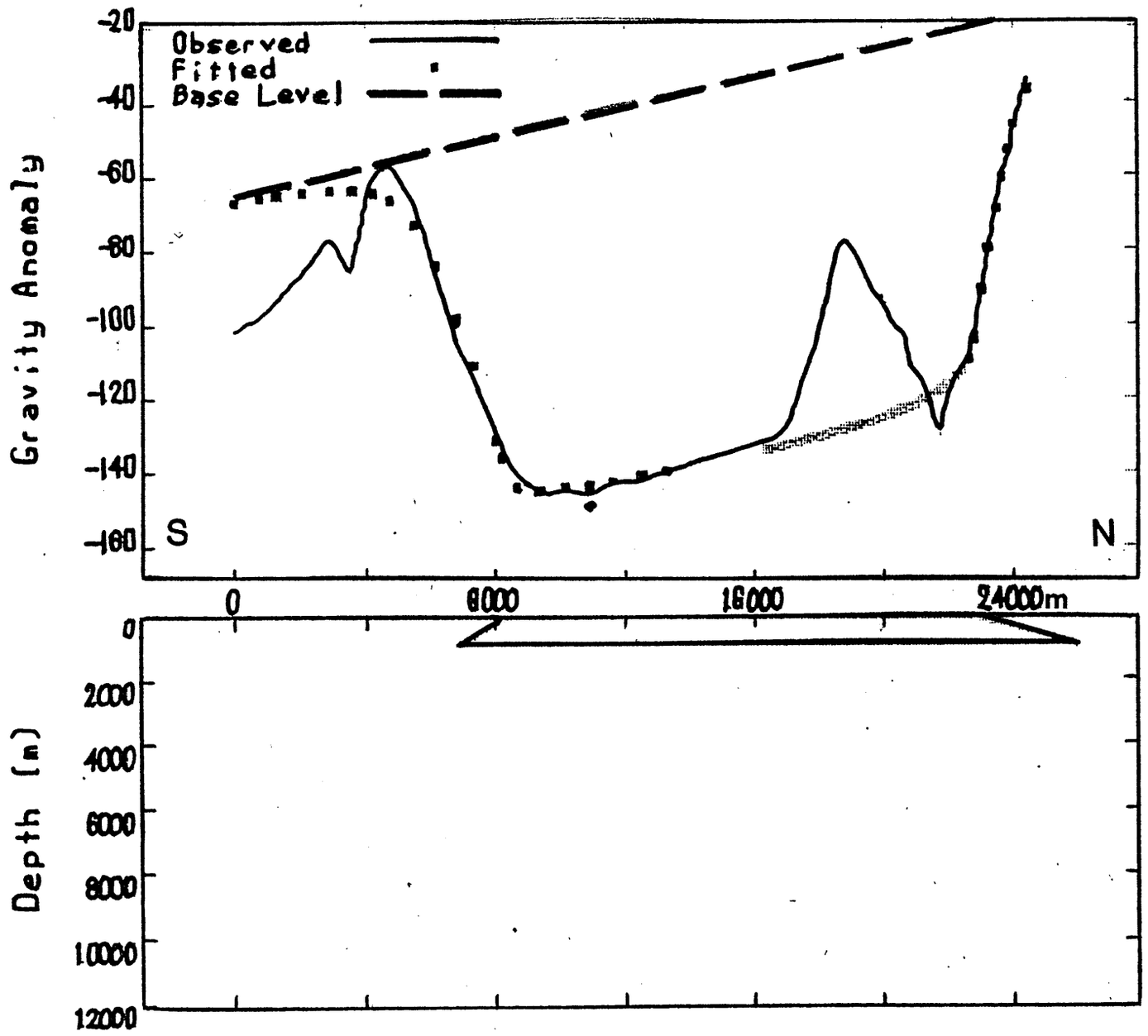

FIGURE 9 – GRAVITY MODEL OF THE GELLIBRAND TROUGH (S–N) WITH SOIL DENSITY OF – 0.20tm^3

core samples revealed porosities ranging from 10.2% to 15.2%, again with relatively low permeabilities.

Detailed petrological studies were carried out on these samples (appendix 10) in an attempt to understand the low permeability. Samples 1 and 8 exhibited the lowest permeability. Thin section analysis revealed that a combination of abundant carbonate cement and kaolin pore fill were responsible for the low permeability in these samples. Compaction effects may also have some influence.

As no Density/Neutron logs are available (logging tools were stuck in the hole and the logging programme was subsequently aborted), only a modified wireline log interpretation has been attempted (enclosure V).

4.4 SOURCE ROCK POTENTIAL

A total of twenty core and cuttings samples were analysed for:-

- Total Organic Carbon
- Rock-Eval Pyrolysis
- Organic Petrology

The results of these analyses are included as Appendix 7, and are discussed below.

The vitrinite reflectance profile (figure 11) shows that Rvmax=0.5% can be reached at a depth of approximately 1050 metres. Previous studies have revealed that in the Otway Basin this value is generally reached at an estimated 1700 metres or deeper. Similarly the Rvmax=0.6% value was reached above the total depth of the well at 1464 metres. The peak of liquid hydrocarbon generation (Rvmax=0.7%) is extrapolated to be approximately 1800 metres.

This clearly indicates that the Gellibrand Trough has had a distinctly higher geothermal gradient than elsewhere in the basin, even higher than that of the basement highs.

Considering the fact that the aborted rift usually has a higher geothermal gradient, due to the size of the trough and having basement as either flank, the higher Vitrinite Reflectance values in Warracbarunah 2 are not surprising.

The Total Organic Carbon (T.O.C) value of the samples vary greatly, ranging from a low of 0.19% to a high of 49.4%. Except for the sample from 583.6 - 588.0 metres, all samples yielded T.O.C. values higher than 0.5%, the nominated cut off point for potential source rock (figure 12).

The two best samples, with excellent organic and source richness, belong to the Eumeralla Formation and contain a better quality, i.e. more oil prone, Type II-III kerogen. One sample from the Pretty Hill Formation had similar properties, although with lesser T.O.C.

PE907641

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The enclosure PE907641 has the following characteristics:

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BASIN	= OTWAY
PERMIT	= PEP 100
TYPE	= SEISMIC
SUBTYPE	= SECTION
DESCRIPTION	= GSV Interpretation of Seismic Line Showing the Location of the Warracbarunah-2 Stratigraphic Well--seismic line courtesy of Gas and Fuel Ex. NL(Figure 10 from Well Completion Report vol.1) for Warracbarunah-2
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	= 29/01/92
W_NO	= W1042
WELL_NAME	= Warracbarunah-2
CONTRACTOR	=
CLIENT_OP_CO	= Geological Survey of Victoria

(Inserted by DNRE - Vic Govt Mines Dept)

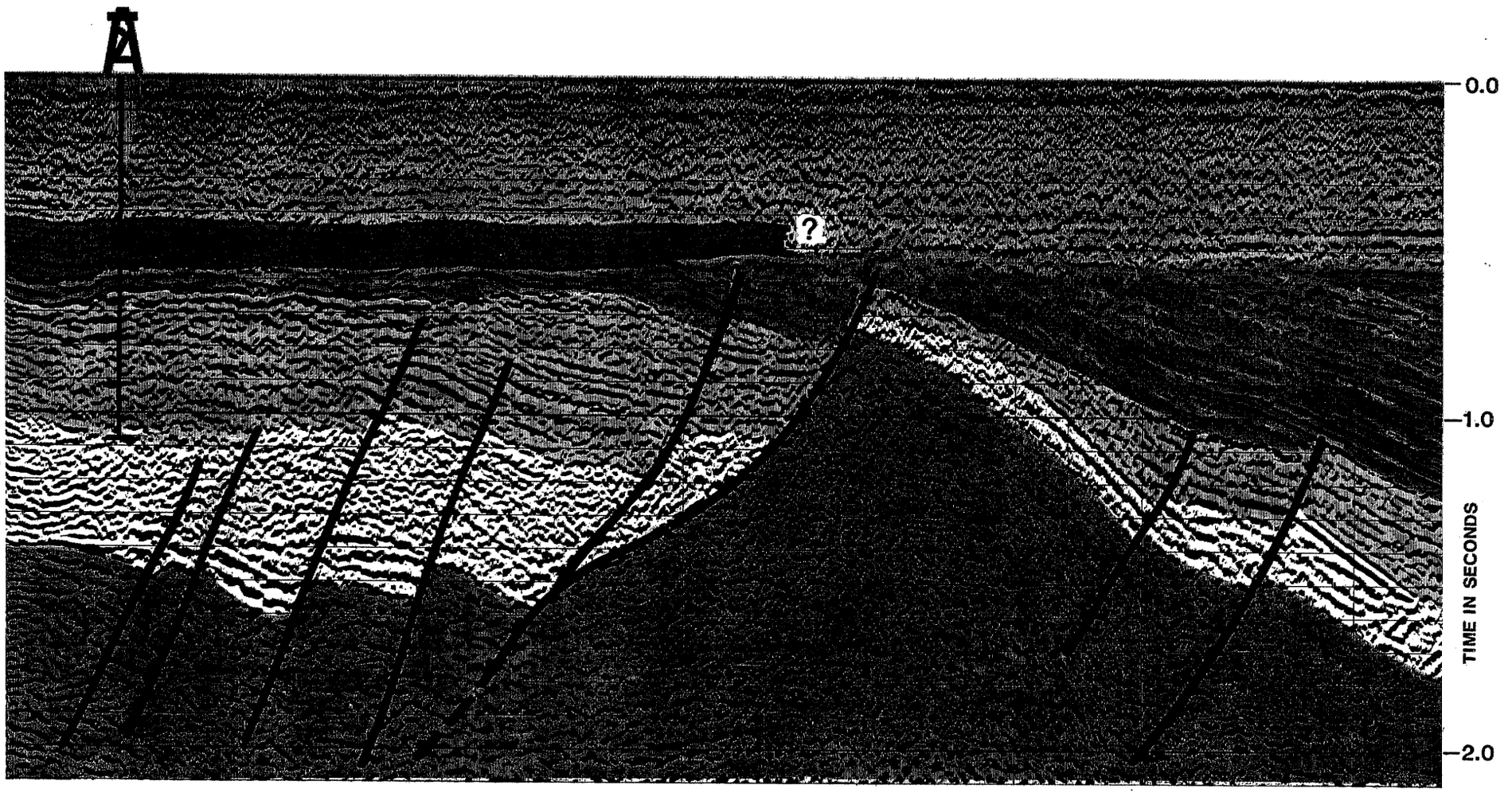

FIGURE 10 – GSV INTERPRETATION OF SEISMIC LINE SHOWING THE LOCATION OF WARRACBARUNAH No.2 STRATIGRAPHIC WELL (SEISMIC LINE COURTESY OF GAS & FUEL EX. N.L.)

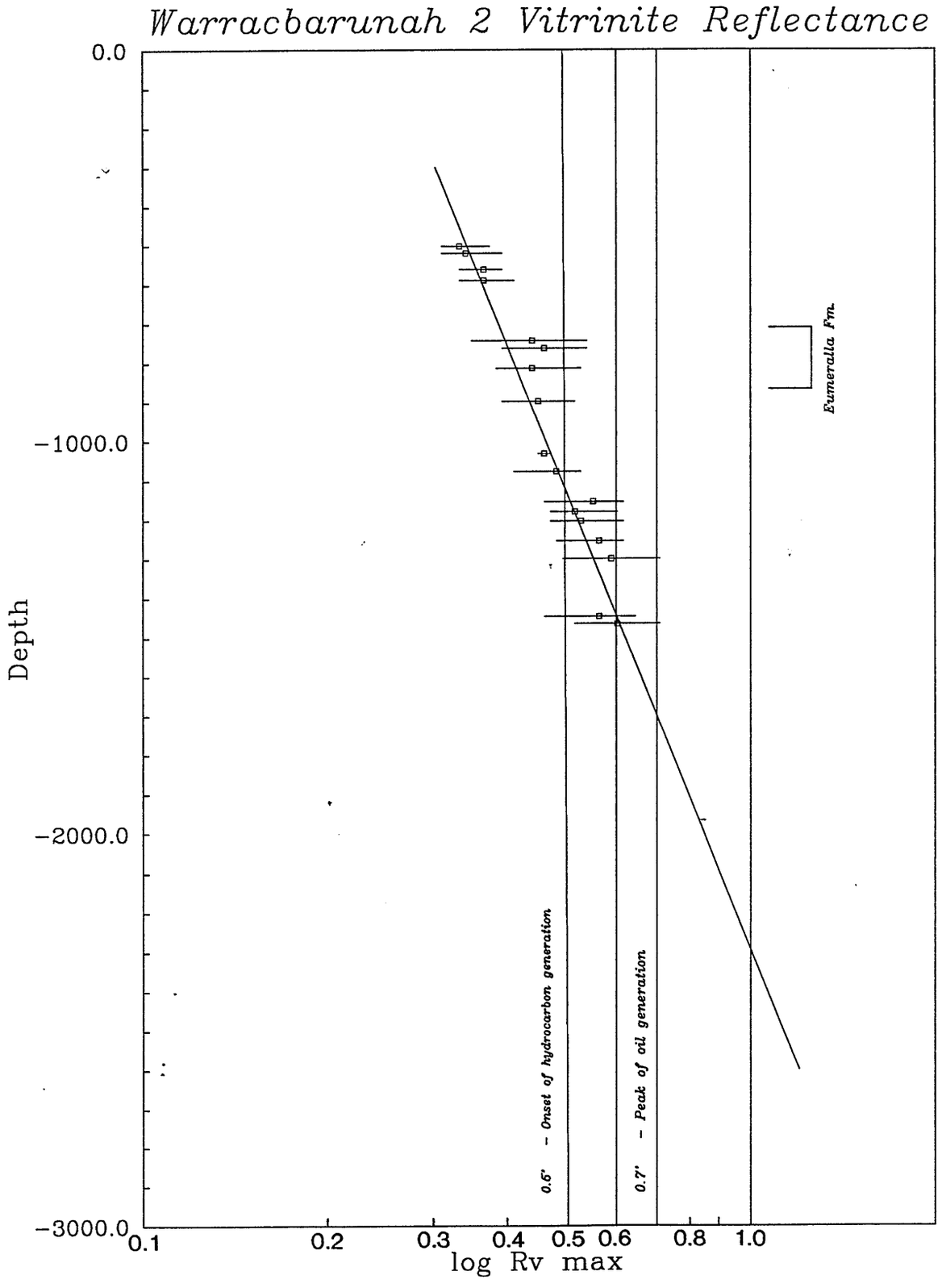

FIGURE 11 – VITRINITE REFLECTANCE PROFILE

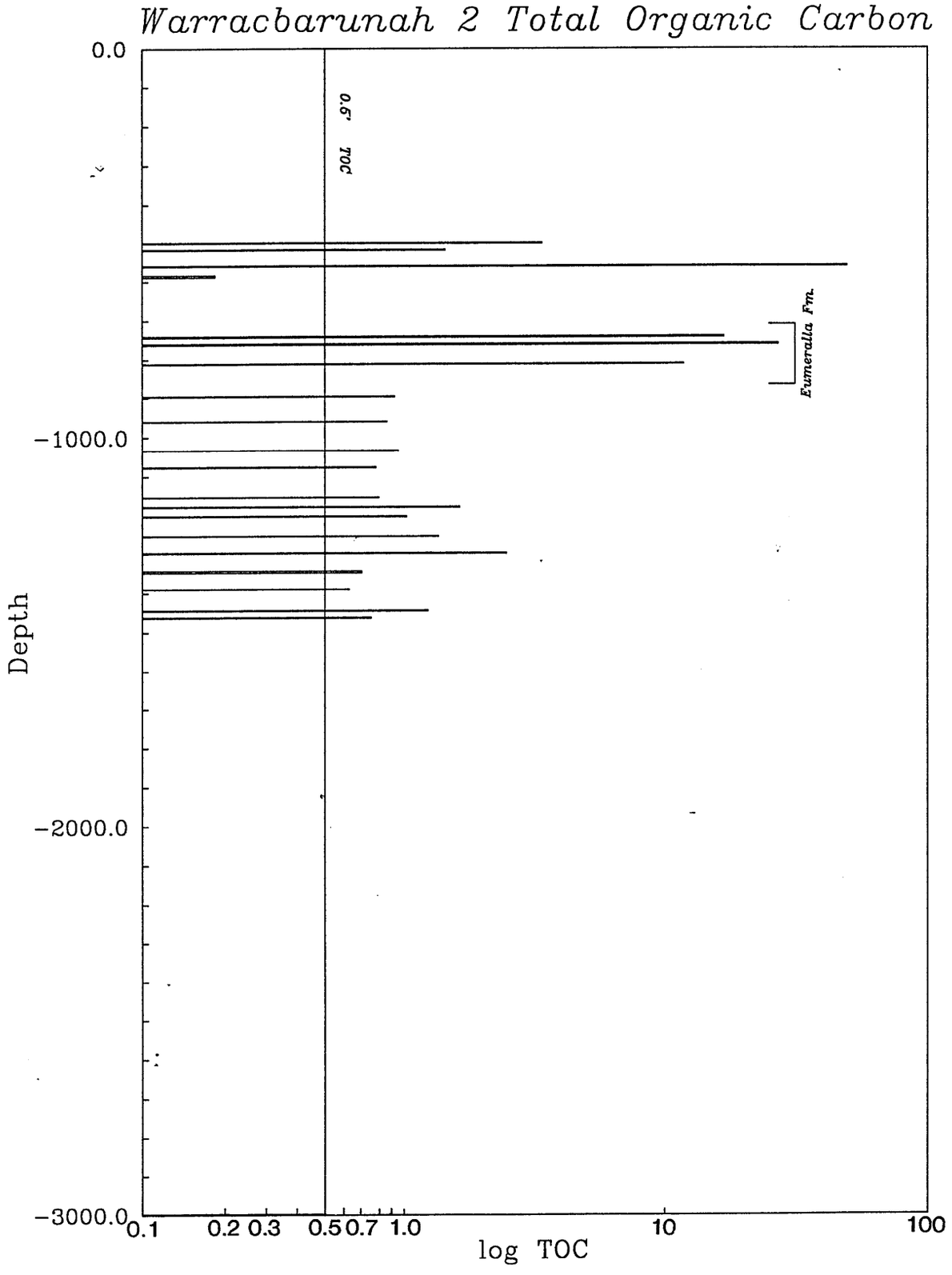

FIGURE 12 – TOTAL ORGANIC CARBON CONTENT (T.O.C.)

5. CONTRIBUTION TO HYDROCARBON PROSPECTIVITY OF THE AREA

The drilling of the Warracbarunah 2 well has provided invaluable data which has increased the understanding of the tectonic history of the basin in general, and the basin margin in particular. In addition, it has significantly increased the knowledge of the hydrocarbon prospectivity of a rather unusual frontier area.

It was previously considered that the northern limit of the prospective area was somewhere south of the major down to the north normal fault bounding the southern flank of the Gellibrand Trough.

The drilling results extend the exploration limit to the north, well beyond the location of Warracbarunah 2.

As was discussed in section 3.3.2, hydrocarbon fluorescence was noted from below 950 metres to almost total depth. The first incidence of fluorescence approximately coincides with the Rvmax=0.5%, indicating that the onset of hydrocarbon generation in this well is somewhere between 950 and 1050 metres.

Although the Rock-Eval production indices (PI) are low and suggest that the presence of migrated hydrocarbon can not be proved, the presence of in situ generation hydrocarbon is confirmed.

Seismic data suggest that the basement at the Warracbarunah 2 location could be up to 700 milliseconds below the well total depth, that is at approximately 2500 metres. As the well is located on the flank of the trough, the depocentre is probably deeper.

It is therefore reasonable to conclude that the Gellibrand Trough has the capacity to generate hydrocarbons in commercial quantities independently, and migration from the south is not critical.

Due to the relatively shallow depth of the well only a thin section of the Sand Unit of the Pretty Hill Formation was penetrated and a detailed discussion on the potential play in this unit is not attempted. There is probably a significant section of sandstone between the total depth of the well and the interpreted top of the basement.

Despite the fact that source rock studies suggest a lack of migrated hydrocarbon in this well, the presence of hydrocarbon envelopes surrounding a zircon in core sample No. 7 (1342.99 - 1347.84 metres), identified in the petrological study (appendix 6), could indicate migrated hydrocarbon within some section of the sandstone reservoir.

Limited available data suggest that excellent opportunities exist within the trough to provide different play types. The pinch out plays are anticipated to dominate the northern flank, while the roll overs and or faulted anticlines are believed to be present in the south.

In summary, the drilling of the Warracbarunah 2 stratigraphic well has,

for the first time, revealed the presence of all the necessary ingredients for a successful hydrocarbon prospect:

- The presence of a sedimentary trough.
- Mature source rock.
- Has generated and is generating hydrocarbon some of which has migrated to reservoirs.
- The presence of potential reservoir.
- The presence of potential plays.

Detailed seismic mapping will delineate mature plays.

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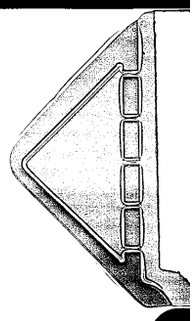


Appendix 1

INDEX A4

marbig

Ref. No. 35026
made in germany

APPENDIX 1

DETAILS OF DRILLING PLANT

Department of
Manufacturing
and Industry
Development

In reply
please quote
Reference No.

RIG 21

SPECIFICATIONS

An equal opportunity employer

Victoria
GROWING TOGETHER

Correspondence
PO Box 173
East Melbourne
Victoria 3002
Australia

Head Office
228 Victoria Parade
East Melbourne
Victoria 3002
Tel (03) 412 8000
Fax (03) 419 0770

Energy
151 Flinders Street
Melbourne
Victoria 3000
Tel (03) 412 8000
Fax (03) 650 9525

Minerals
115 Victoria Parade
Fitzroy
Victoria 3065
Tel (03) 412 8000
Fax (03) 412 7988

Overseas Offices
Frankfurt London
Los Angeles Tokyo
Hong Kong

Other Offices
Ballarat
Bendigo
Dandenong
Doncaster
Footscray
Geelong
Mildura
Shepparton
Traralgon
Wangaratta
Wodonga

RIG 21

SPECIFICATIONS

EMSCO GB-250-THB TRAILER MOUNTED DRILLING RIG AS DESCRIBED BELOW, COMPLETE WITH EMSCO GB CATHEADS, CATHEAD CONTROLS AND FLOOR MOUNTING TYPE ROPE ROLLER, HYDROMATIC BRAKE PACKAGE POWERED. BY -

ONE GENERAL MOTORS TWIN - 6-71 MODEL 12103 TORQUE CONVERTER DIESEL ENGINE
AND WITH 97 FT. L.C. MOORE DUAL TRAILER MOUNTED CANTILEVER DRILLING MAST.

DRAWWORKS

WINCH DRUM:	16" dia. x 40" long, plain
BRAKE RIMS:	7-3/4" face x 38" diameter Enclosed water cooling system
BRAKE:	Type "J" with 350 degree arc of contact
SHAFTS:	Drummshaft max. dia. 6-1/4" Cathead shaft max. dia. 4-13/16" Rotary Countershaft max. dia. 4-1/4"
CLUTCHES:	Drum disc type Emsco C-227 Rotary, disc type Emsco C-314 Transmission low, Spline, air controlled Transmission high, Spline, air controlled Transmission reverse, Spline, air controlled
CHAIN:	Drum drive 1-1/2" double Cathead Shaft Drive 1-1/2" double Engine, 1" quadruple Reverse 1-1/2" double Rotary 2" or No. 3 single Hydrotarder 1-1/2" double
CONTROLS:	Driller's control console includes all operating control except engine power take-off clutch.

Combination Air Clutch, Throttles and Speed Selector Controls, main Drum Brake is manual. Air actuated neutral brake.

TORQUE CONVERTER:

Twin Disc left hand series 11,500 mounted in Rigs.

CATHEADS:

LEFT Emsco GB air operated friction Spinning Cathead with rope separator and guard.

RIGHT Emsco GB air operated friction breakout Cathead with rope separator and guard.

SANDREEL:

GB-250, 5-11/16" max diameter shaft 12-3/4" x 40" long fee spooling drum,
7 1/2" wide 34" dia. brake rims capacity for 11,870' 1/2" or 9,520'9/16" Wireline, Emsco C218 disc type clutch

Hydrotarder No. 19635-X Parkersburg 22" type "BC" Single Rotor Hydromatic Brake with shaft extension, chain driven from drum shaft. Jaw type disconnect clutch on drum shaft.

General Motors Twin 6-71 Model 12103 Engine with Heavy Duty Power Transfer, Gear Ratio 1:1 and Standard Equipment Consisting of the following:

Heavy Duty Radiators
Lubricating Oil Coolers
Lubricating Oil Filters
Fuel Filters (Primary and Secondary)
Water Outlet Manifold and Thermostat Assemblies
Fuel Oil Circulating Pumps
Exhaust Manifold and Companion Flanges
Engine Water Circulating Pumps
Engine Disengaging Clutches

Battery Charging Generator
I Beam Front Supports and Base
Governor, includes Throttle
Control set at 1600 RPM full
load.
Fan.
Air Cleaner and Air Inlet Housing
without Shutdown
Wisconsin Gasoline starting Engine
600MM Injector

MAST

97' Lee C. Moore Dual Trailer
Mounted Cantilever Drilling Mast
No. 27217, static hook load
capacity 180,000lbs.(equivalent
to standard Derrick Capacity of
300,000 lbs.), 2'7-1/2" wide x 4'0"
top 8'5" clear width at base
between front legs, horizontally
retracting top section, reversible
crown block consisting of five
30" OD Manganese steel roller
bearing working sheaves grooved
for 1-1/8" diameter line and one 30"
OD Manganese steel roller bearing
sandline sheave grooved for 5/8"
diameter line, all on 5-1/2" diameter
shafts, and equipped with line
guards, racking finger capacity of
7200' of 4-1/2" diameter drill pipe;
15" diameter swinging catline sheave;
welded ladder; crown safety
platform; tong counterweights complete;
fifth wheel hoist and inverted fifth
wheel for adjusting mast elevation to enable
making connections; semi-trailer
mast base complete with two supporting
screw jacks.

ROTARY TABLE

Emsco Type P-17-1/2" -44" Rotary
Machine with completely enclosed
rectangular fabriform case,
manual locks, sealed rotary
mechanism, split table bushing
and hook for 6" conventional type
drill stem bushing. (LESS: Drive
sprocket and Drill Stem Bushing)

SWIVEL

Emsco type L-140 Swivel complete with female Thread gooseneck, cartridge type washpipe packing, sleeve or coupling thread protectors and bail bumper, including 2 1/4" ID Washpipe and 96387-C sleeve couplings, 6-5/8" API L.H.Pin 19".

KELLY

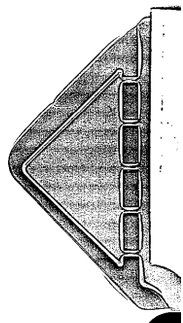
Emsco 4-1/4" x 40' overall length 37' working length 6-5/8" API Reg. L.H. box top and 3-1/2" API Reg. Pin bottom connection, steel kelly.

TRAVELLING BLOCK

Emsco type R-30-3-H100 Hydra-hook Travelling block with 3-30" dia. Roller Bearing Forged Sheaves. Sheaves grooved for 1-1/8" wire line. Sheaves Rolled Forged Steel, mounted on Double Race Tapered Bearings; Rope Grooves Flame-hardened; Roller Steel Side Plates; Reversible Sheave Bearing Lubrication Cartridge Oil-Bath Lubrication for Main Bearings, Main Springs and Plunger, Locking Mechanism (8 equally spaced positions). (Total rated capacity 100 tons).

MUD PUMP UNIT

Unitized Gardner Denver 7-1/4" x 12 Model FZ-FXZ Power Slush Pump driven by General Motors 6-71 Model 12107 Torque converter-Diesel Engine complete with standard accessories. Unit to be Trailer Mounted complete with necessary sprockets, chains, chain guards, 3 member light steel skid, and manifold fittings, including 0-3000lbs. pressure gauge, shear relief valve, 3" Cameron valves on mud lines, wing unions, suction hose. Trailer, Hobbsmodel 74105.



Appendix 2

APPENDIX 2

SUMMARY OF WELLSITE OPERATION

SUMMARY OF WELL SITE OPERATION

The well was spudded in hard basalt with an 11 inch down hole hammer. At 37 metres depth top hole caving necessitated pulling out of the hole and setting a conductor. Hammering continued to 49 metres where clay was encountered and hammering became ineffective. The hammer was then replaced with a $12^{1}/_{4}$ inch tri cone bit which reamed back to bottom before drilling ahead to 99 metres.

At 99 metres depth the $12^{1}/_{4}$ inch bit was pulled out and replaced with a $13^{3}/_{4}$ inch bit which reamed back to bottom before drilling ahead to the casing depth of 142.6m. Eleven lengths of $9^{5}/_{8}$ inch casing were then run. The casing shoe was set at 130.36 metres and the casing cemented with 204 sacks of cement.

The casing was drilled out with an $8^{1}/_{2}$ inch bit and drilling continued to 476 metres. Two cores were cut over this interval. The rig then shut down for the Christmas break.

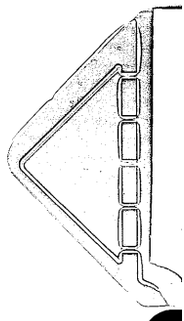
After the Christmas break drilling was resumed. The hole was deepened to a total depth of 1527.4 metres. A further thirteen cores were cut. Tight hole conditions were encountered regularly and necessitated regular reaming back to bottom after coring or tripping.

At total depth a wiper trip was performed and the first wireline logging run completed. The neutron-density logging tool combination became hung up while attempting to reach bottom and a further wiper trip was performed. Another attempt to run the neutron-density tool combination proved unsuccessful and the logging tools were pulled out in order to run the velocity survey.

A velocity survey including vertical seismic profiling was carried out without incident.

A further attempt to run the neutron-density tool combination resulted in the tools becoming stuck in the hole. Examination of the caliper log from the successful logging run indicated washout and ledging in the region where the tool was stuck. This factor, combined with the offset nature of the tools was considered responsible for the problem. The tools were successfully recovered using the cut and thread fishing method. The tools suffered only minor damage.

After the retrieval of the tools, further logging operations, including sidewall coring, were considered too dangerous. The logging program was then aborted and the hole plugged back for completion as a groundwater observation bore in the Demons Bluff Formation. A water sample from the screened section was analysed by the laboratories of the Rural Water Commission. The results of this analysis are presented in Appendix 10.



Appendix 3

APPENDIX 3

DRILLING FLUID RECAP

DRILLING FLUID RECAP

The drilling fluid programme for this well was provided by Baroid Australia Pty. Ltd. It was designed to provide an uncomplicated yet effective mud system while taking into account the anticipated geology, the likely well duration, the coring programme and the rig crew work practices.

The mud system was to be maintained and monitored by the rig crew since there would be no drilling fluid engineer at the site. Assistance was available from the site geologist who was also responsible for monitoring the chloride levels in the mud. Baroid Australia personnel were available for telephone consultation and visited the site on several occasions.

The programme proved effective and easy to operate. Minor problems were readily rectified. A copy of the drilling fluid programme is included in this appendix.

Due to the method of operation of this rig and the extended duration of the well, no conventional drilling fluid recap has been prepared.

W A R R A C B A R U N A H # 2

M U D P R O G R A M

INTRODUCTION

With the long open hole section, and an anticipated long shutdown over the Christmas holidays, a 3% Potassium Chloride mud system is recommended for the entire 8 1/2 inch hole of the well.

The CMC - Bentonite - Potassium Chloride formulation appeared to function adequately on the Mocamboro 11 well and rig personnel are familiar with the system. The only changes recommended from the previous well would be to possibly vary the mixing recipe being used more frequently to vary the mud viscosity with lithology changes. These lithology changes may be more frequent at this location. It should not be necessary to reduce the water loss very much before about 1000 metres as a much less sandy lower section is prognosed for this well.

8 1/2 inch Hole

Drill out the 9 1/2 inch casing using fresh water only. Treat out any cement contamination of the water with approximately 150 - 200 Kg of sodium bicarbonate, and then mix 1 ppb CMC - HV followed by 15 ppb of potassium chloride to produce basic potassium chloride mud. Note that this will have a very low viscosity initially as mud solids content and mud weight will be very low.

The general aim should be to keep the mud viscosity lower in the marl sections, and higher in the sandier sections, with an overall viscosity range between 34 to 42 seconds. While drilling marl or claystone a low viscosity is not a problem providing the potassium chloride content is maintained. The mud system should be maintained by adding premixed new mud according to the following recipe;

Fresh water
1 ppb CMC (Hi-vis)
15 ppb Potassium Chloride

Should a major sand section be anticipated or encountered it is preferable to have a viscosity of at least 36 seconds. To raise the viscosity it will be necessary to increase the mud bentonite content by including bentonite in the recipe to the following formula;

Fresh water
1/4 ppb Caustic soda
12 ppb bentonite

ALLOW TO MIX FOR 1 HOUR BEFORE ADDING

1 ppb CMC (Hi-vis)
15 ppb Potassium Chloride

NOTE: 1) When mixing bentonite it is advisable to give the mixing pit as much agitation as possible

2) As potassium chloride is a salt which retards bentonite mixing the tank should be drained as much as possible before being refilled with fresh water for the next mix.

By alternating between these two recipes where appropriate it should be possible to maintain the mud system viscosity within the desirable ranges of 34 to 37 seconds for marl/clay sections and 36 to 42 seconds for the sandier sections. Limit the mud weight to 9.3 ppg or 9.4 ppg and the viscosity to a maximum of 42 seconds by dumping excess mud and replacing it with new premixed mud.

The pH of the mud system should be maintained at about by adding caustic soda premixed in water and then trickled into the circulating system.

This approach should be sufficient to drill through the entire Tertiary and Eumeralla sections.

At around 1000 metres, prior to encountering the Crayfish Formation, the mud water loss should be reduced further by including an additional 2 ppb CMC (Lo-vis) in whichever premix recipe is being used. This should bring the water loss down to around 10 cc by logging depth and T.D. Should there be any tight hole problems it would be advisable to add this additional 2 ppb CMC (Lo-vis) earlier, and also to increase the potassium chloride content to about 20 ppb or 4%.

For logging the viscosity should be as close as possible to 40 seconds and the water loss 10 cc.

SUMMARY OF ANTICIPATED MUD PROPERTIES

8 1/2 Inch hole

a) Through Tertiary and Eumeralla Formation

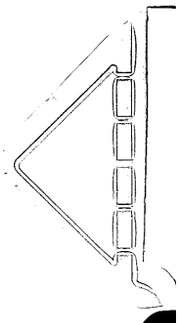
Mud weight	Less than 9.3 - 9.4 ppg
Viscosity	34 (Marls) to 42 (Sands)
Water loss	15 - 20 cc
pH	9.0
Chlorides	15000 - 17000 mg/l
Hardness	less than 200 mg/l

b) From 1000 metres to T.D.

Mud weight	Less than 9.3 - 9.4 ppg
Viscosity	34 - 42
Water loss	10 -12 cc
pH	9.0
Chlorides	15000 - 17000 mg/l
Hardness	less than 200 mg/l

Regular checks of mud weight, viscosity, and pH will form the basis of the mud maintenance program. A daily check on water loss and chlorides should be adequate. If it is found that the chloride level is either too low or too high by a significant margin the potassium additions should be correspondingly increased or reduced, until the concentration is within the desired range.

Appendix 4



APPENDIX 4

CUTTINGS & CORE DESCRIPTIONS

GEOLOGICAL SURVEY OF VICTORIA - BASIN STUDIES

Well: Warracbarunah No. 2 Date: 26/11/90 Geologist: C. Menhennitt Page: 1 of 45

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
0-3	100	Basalt: Greyish black to black, slightly weathered in parts, slightly vesicular in parts, very hard.		
3-6	100	Basalt: As for 0-3m		
6-9	100	Basalt: As for 0-3m		
9-12	100	Clay: Light brown, trace of fine to medium sand, soft, non calcareous.		
12-15	100	Basalt: Greyish black to black, brownish black in parts, trace of light grey clay, trace of anorthite, slightly weathered in parts, slightly vesicular, very hard.		
15-18	60	Clay: Light reddish brown and light grey, occasional fine to coarse quartz sand,		
	40	Basalt: As for 0-9m.		
18-21		Clay: As for 15-18		
21-24	100	Basalt: As for 0-9m		
24-27	100	Basalt: Greyish black to black with light reddish brown weathering in vesicules, reddish brown weathering in other parts, trace of anorthite trace of medium to coarse quartz sand, common (secondary) carbonates, very hard, clacareous in parts.		
27-30	100	Basalt: As for 24-27m		
30-33	100	Basalt: As for 24-27m		
33-36	100	Basalt: As for 24-27m		
36-39	100	Basalt: Greyish black to black, occasional vesicules, abundant light brownish grey clay, trace of carbonate, very hard.		
39-42	100	Basalt: As for 36-39m		
42-45	100	Basalt: As for 36-39m		
45-48	100	Basalt: As for 36-39m with reddish brown clay and sandstone. Sandstone: medium light grey to greenish grey, very fine to fine grained, well sorted, sub rounded, occasional coarse to very coarse grains, trace of argillaceous matrix, poorly conslidated, non calcareous.		
48-51	100	Basalt: Greyish black to black, occasional vesicules, trace of olivine reddish brown weathering in parts, common secondary carbonates, occasional greenish grey clay, common fine to very fine sand, occasional coarse sand, very hard.		
51-54	50	Basalt: as above.		
	50	Limestone: Greyish orange, abundant fine to very fine grained sand, occasional fossil fragment, firm to moderately hard, very calcareous.		

Depth (m)	%	Sample Description	Shows Gas	Fluor
54-57		Basalt and Limestone: As for 51-54m		
57-60	100	Limestone: Off white to greyish orange, abundant fine to very fine sand, common		
57-60	100	Limestone: Off white to greyish orange, abundant fine to very fine sand, common basalt cuttings, occasional shell fragment, firm to moderately hard, very calcareous.		
60-63	100	Limestone: As for 57-60		
63-66	100	Marl: Yellowish grey, abundant very fine sand throughout, occational limestone fragments, occasional greyish green clay, very soft, highly dispersive in fresh water, calcareous.		
66-69	100	Marl: Olive grey to brownish grey, trace of fine to very fine sand, occasional fossil fragment, very soft and sticky, dispersive, calcareous.		
69-72	100	Marl: As for 66-69		
72-75	100	Marl: As for 66-69		
75-78	100	Marl: As for 66-69		
78-81	100	Contaminated sample - mainly basalt cuttings from Possum Belly.		
81-84	100	Marl: Medium dark grey to brownish grey, trace of very fine to fine sand, occasional mica, rare fossil fragment, very soft and sticky, dispersive in fresh water, calcareous.		
84-87	100	Marl: As for 81-84m		
87-90	100	Marl: As for 81-84m		
90-93	100	Marl: As for 81-84m		
93-96	100	Marl: As for 81-84m		
96-99	100	Marl: As for 81-84m		
99-102	100	Marl: Medium light grey to medium grey, trace to common very fine to fine sand, occasional medium to coarse sand, abundant fossil fragments, very soft and sticky, dispersive, calcareous.		
102-105	100	Marl: As for 99-102m		
105-108	100	Marl: As for 99-102m		
108-111	100	Marl: Medium light grey to light brownish grey, trace of very fine to fine sand, occasional fossil fragments, very soft and sticky, dispersive, calcarous.		
111-114	100	Marl: Medium light grey to medium grey, rare fine to medium sand, rare fossil fragments, very soft and sticky, dispersive, calcareous.		
114-117	100	Marl: As for 111-114m		
117-120	100	Marl: Medium to light grey to medium grey, rare fine sand, rare fossil fragment, very soft and sticky, dispersive, calcareous.		
120-123	100	Marl: Medium light grey to light brownish grey, common very fine to fine sand, trace		

Depth (m)	%	Sample Description	Gas	Fluor
		of mica, rare fossil fragments, soft and sticky, dispersive, calcareous.		
123-126	100	Marl: As for 120-123m		
126-129	100	Marl: As for 120-123m		
129-132	100	Marl: As for 120-123m		
132-135	100	Marl: As for 120-123m		
135-138	100	Marl: As for 120-123m		
138-141	100	Marl: Medium light grey to light brownish grey, common fine to very fine sand, occasional medium sand, common mica, rare fossil fragments, soft and sticky, dispersive, calcareous.		
141-144	100	Marl: As for 138-141m		
144-147	100	Marl: As for 128-141m		
147-150	100	Marl: Medium grey to light brownish grey, common fine to very fine sand, common mica, common fossil fragments, soft, dispersive, very calcareous.		
150-153	100	Marl: As for 147-150m		
153-156	100	Marl: Medium light grey to medium grey, trace of fine to very fine sand, common mica, common fossil fragments, soft and sticky, dispersive, very calcareous.		
156-159	100	Marl: As for 153-156m		
159-162	100	Marl: As for 153-156m		
162-165	100	Marl: Medium grey to light brownish grey, trace of very fine sand, slightly silty, very soft and sticky, dispersive, moderately calcareous.		
165-168	100	Marl: As for 162-165m		
168-171	100	Marl: As for 162-165m		
171-174	100	Marl: Medium grey, light brownish grey in parts, trace of very fine sand, slightly silty, common mica, occasional fossil fragment, very soft and sticky, dispersive moderately calcareous.		
174-177	100	Marl: As for 171-174m		
177-180	100	Marl: As for 171-174m		
180-183	100	Marl: As for 171-174m		
183-186	100	Marl: Light grey to medium light grey, slightly silty, common mica, occasional fossil fragment, soft and sticky, dispersive, very calcareous.		
186-189	100	Marl: As for 183-186m		
189-192	100	Marl: As for 183-186m		
192-195	100	Marl: Light grey to medium light grey, common fossil fragments, occasional mica, slightly silty, rare very fine sand, soft and sticky, dispersive, calcareous.		
195-198	100	Marl: As for 192-195m		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
198-201	100	Marl: Medium dark grey to light olive grey, occasional fossil fragments, slightly silty, trace of pyrite, soft and sticky, dispersive, moderately calcareous.		
201-204	100	Marl: Medium dark grey to medium grey, common fossil fragments, slightly silty, occasional mica, soft to moderately firm, sub blocky in parts, dispersive, moderately calcareous.		
204-207	100	Marl: As for 201-203m		
207-210	100	Marl: As for 201-203m		
210-213	100	Marl: As for 201-203m		
213-216	100	Marl: As for 201-203m		
216-219	100	Marl: Medium dark grey to medium grey, occasional fossil fragments, trace of fine to medium sand, trace of mica, slightly silty, soft to moderately firm, sub blocky in parts, slightly dispersive, moderately calcareous.		
219-222	100	Marl: Medium Dark grey to moderate brownish grey, common fossil fragments, occasional fine to medium sand, trace of mica, soft to moderately firm, sub blocky in parts, slightly dispersive, strongly calcareous.		
222-225	100	Marl: As for 219-222m		
225-228	100	Marl: As for 219-222m		
228-231	100	Marl: As for 219-222m		
231-234	100	Marl: Medium dark grey to moderate brownish grey, common fossil fragments, trace of very fine sand and silt, trace of mica, soft to moderately firm, sub blocky in parts, slightly dispersive, moderately calcareous.		
234-237	100	Marl: As for 231-234m		
237-240	100	Marl: As for 231-234m		
240-243	100	Marl: As for 231-234m		
243-246	100	Marl: As for 231-234m		
246-249	100	Marl: As for 231-234m		
249-252	100	Marl: As for 231-234m		
252-255	100	Marl: As for 231-234m		
255-258	100	Marl: As for 231-234m		
258-261	100	Marl: As for 231-234m		
261-264	100	Marl: Medium grey to medium dark grey, occasional fossil fragments, trace of fine sand, slightly silty, trace of mica, moderately firm to soft in parts, dispersive, sub blocky, moderately calcareous.		
264-267	100	Marl: Medium light grey to light brownish grey, common fossil fragments, slightly silty, trace of mica, very soft and sticky, dispersive, moderately calcareous.		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
674-270	100	Marl:As for 264-276		
270-273	100	Marl: Medium grey, common fossil fragments, trace of very fine sand and silt, trace of mica, soft to moderately firm, dispersive, sub blocky, moderately calcareous.		
273-276	100	Marl: As for 270-273m		
276-279	100	Marl: As for 270-273m		
279-282	100	Marl: Medium dark grey to dark grey, abundant fossil fragments, slightly silty, trace of mica, moderately firm, dispersive, sub blocky, moderately calcareous.		
282-285	100	Marl: As for 279-282m		
285-288	100	Marl: As for 279-282m		
290.65-296.65	100	Core No. 1 Marl: as above		
297-300	100	Marl: As for 279-282m		
300-303	100	Marl: Medium dark grey to dark grey, common fossil fragments, occasional fine to very fine sand, trace of mica, slightly silty, soft to moderately firm, sub blocky, strongly calcareous.		
303-306	100	Marl: Medium grey to medium dark grey, common fossil fragments, occasional fine to very fine sand, trace of mica, slightly silty, dispersive, very soft and sticky, strongly calcareous.		
306-309	100	Marl: As for 303-306m		
309-312	100	Marl: As for 303-306m		
312-315	100	Marl: As for 303-306m		
315-318	100	Marl: As for 303-306m		
318-321	100	Marl: As for 303-306m		
321-324	100	Marl: As for 303-306m		
324-327	100	Marl: Medium dark grey to dark grey, occasional fossil fragment, occasional fine to very fine sand, trace of mica, slightly silty, soft to moderately firm, sub blocky in parts, strongly calcareous.		
327-330	100	Marl: As for 324-327m		
330-333	100	Marl: As for 324-327m		
333-336	100	Marl: As for 324-327m		
336-339	100	Marl: Medium dark grey to dark grey, common fossil fragments, trace of fine to very fine sand, slightly silty, trace of mica, moderately firm, moderately calcareous.		
339-342	100	Marl: As for 336-339m		
342-345	100	Marl: As for 336-339m		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat.	Shows Fluor Cut
345-348	100	Marl: As for 336-339m			
348-351	100	Marl: Medium grey, occasional fossil fragments, slightly silty, trace of mica, soft to moderately firm, moderately calcareous.			
351-354	100	Marl: As for 348-351m			
354-357	100	Marl: As for 348-351m			
357-360	100	Marl: Medium grey to medium dark grey, occasional fossil fragments, trace of very fine sand, trace of mica, slightly silty, dispersive, soft to soft and sticky, moderately calcareous.			
360-363	100	Marl: As for 357-360m			
363-366	100	Marl: As for 357-360m			
366-369	100	Marl: As for 357-360m			
369-372	100	Marl: As for 357-360m			
372-375	100	Marl: Medium dark grey to dark grey, occasional fossil fragments, trace of fine sand, trace of mica, slightly silty, dispersive, soft to moderately firm, strongly calcareous.			
375-378	100	Marl: As for 372-375m			
378-381	100	Marl: As for 372-375m			
381-384	100	Marl: As for 372-375m			
384-387	100	Marl: As for 372-375m			
387-390	100	Marl: Medium grey to medium dark grey, occasional fossil fragments, occasional fine sand, trace of mica, silty, dispersive, soft and sticky, moderately calcareous.			
390-393	100	Marl: As for 387-390m			
393-396	100	Marl: As for 387-390m			
396-399	100	Marl: As for 387-390m			
399-402	100	Marl: As for 387-390m			
402-405	100	Marl: As for 387-390m			
405-408	100	Marl: As for 387-390m			
408-411	100	Marl: As for 387-390m			
411-414	100	Argillaceous Sandstone: Greyish brown, predominantly fine to occasionally medium grained, rare coarse grains, well sorted, sub angular to sub rounded, 40% argillaceous matrix, common glauconite pellets, slightly calcareous, unconsolidated.			
414-417	100	Argillaceous Sandstone: As for 411-414m			

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
417-420	90	Sandstone: Moderate brown to greyish brown, bimodal aggregation of very fine to fine grained cemented sand and coarse to very coarse unconsolidated clear quartz grains, poorly sorted, finer grains are sub-angular to angular, coarser grains are sub rounded to rounded, siliceous cement, common argillaceous matrix, common marl fragments, occasional fragments indicating interbedding of marl and sandstone, common glauconite, trace of pyrite, moderately firm to firm where cemented, calcareous in parts.		
420-423	100	As for 417-420m		
423-426	100	As for 417-420m		
428.4-433.1	100	Core No. 2 Recovery 4% Basalt: Dark grey to greyish black, occasional vesicules very hard.		
432-435	100	Sandstone: Moderate brown to greyish brown, very fine to fine grained, occasional coarse grains, well sorted, sub angular to sub rounded, siliceous cement, occasional pyrite cement on coarser grains, no visual porosity. * Sample is heavily contaminated with marl cavings.		
435-438	100	As for 432-435m		
438-441	100	As for 432-435m		
441-444	100	As for 432-435m		
444-447	100	As for 432-435m * Sample is predominantly marl, apparently cavings, marl is light grey, medium grey, brownish grey, some fragments have abundant glauconite pellets.		
447-450	100	As for 432-435m		
450-453	100	As for 432-435m		
453-456	100	As for 432-435m		
456-459	100	Sandstone: Clear to translucent, common moderate brown, coarse to very coarse grained, abundant fine to very fine unconsolidated grains and fragments of fine sandstone as above, poorly sorted, sub rounded to rounded, occasionally angular, trace of pyrite cement, generally unconsolidated, occasional black lithic grains, traces of glauconite, abundant marl (cavings?).		
459-462	100	As for 456-459m		
462-465	100	As for 432-435m		
465-468	100	As for 432-435m		
468-471	100	Sandstone: Clear to translucent, very fine to fine grained, well sorted, angular to sub angular, unconsolidated, occasional black coal fragments, abundant mica (flakes up to 1.5mm diameter) common fragments of cemented brown sandstone as		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
		previously, minor marl contamination, trace of pyrite.		
471-474	100	Sandstone: Moderate brown, very fine to fine grained, well sorted, angular to sub angular, siliceous cement, common coaly fragments and coarse to very coarse translucent and clear grains, moderately firm (marl cavings).		
474-477	100	Sandstone: Predominantly clear and translucent with fragments of brown sandstone as in 471-474. Predominantly coarse to very coarse grained with abundant fine grains, angular to sub angular and occasionally rounded, unconsolidated, occasional coal fragment, occasional pyrite, trace of mica.		
477-480	90	Sandstone: Medium grey to medium brownish grey, fine to medium grained, occasional coarse grain, well sorted, sub rounded to rounded, trace of argillaceous matrix, unconsolidated, slightly calcareous.		
	10	Claytone: Medium brownish grey		
480-483		As for 477-470m		
483.4-489.4m		Core No. 3 Recovery 15%		
489-492	100	Sandstone: Clear to translucent, medium to coarse grained, occasional very coarse grains, abundant fine grains, well sorted, sub angular to sub rounded, occasionally angular, rare pyrite cement, unconsolidated, nil fluorescence	1.5	
492-495	100	Sandstone: As above		
495-498	100	Sandstone: Clear to translucent and occasional milky grains, predominantly medium grained, common coarse grains, common to abundant fine grains, well sorted, sub angular to sub rounded, occasionally angular, occasional to common pyrite cement, unconsolidated, nil fluorescence		
498-501	60	Sandstone: As above		
	40	Coal: Greyish black to black, dull, moderately firm, crumbly, trace of pyrite.		
501-504	100	Sandstone: Clear to translucent, occasionally milky grains medium to coarse grained, abundant fine grains, moderately to well sorted, angular to sub angular, occasionally sub rounded, common pyrite cement, trace of coal, marl cavings, unconsolidated, nil fluorescence		
504-507	60	Sandstone: Clear to translucent and occasionally milky quartz, fine to very fine grained, abundant medium grains, occasional coarse grains, poor to moderate sorting, sub angular to sub rounded, occasionally rounded, occasional silica cement, common pyrite, trace of black coal, unconsolidated, nil fluorescence		
	30	Coal: Moderate brown to reddish brown, dull, soft to moderately firm, crumbly.		
	10	Claystone: Medium light grey to light grey, slightly silty, moderately firm,		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
		slightly calcareous in parts.		
507-510	70	Claystone: Medium light grey and moderate brownish grey, silty in parts, common brown coal, occasional pyrite, soft to moderately firm, non calcareous.		
	30	Sandstone: Clear to translucent and occasionally milky quartz, very fine to coarse grained, poorly sorted, angular to sub angular, unconsolidated, occasional amber fragments, nil fluorescence		
510-513	50	Claystone: Medium light grey to light grey, slightly silty in parts, abundant pyrite, occasional amber, occasional fossil fragment, trace of glauconite, soft to moderately firm, slightly calcareous.	1.3	
	40	Sandstone: Clear to translucent quartz, medium to coarse grained, occasionally fine and very coarse, well sorted, angular to sub angular, occasional pyrite cement, trace of mica, unconsolidated, nil fluorescence		
	10	Coal: Brownish grey to brownish black, dull, soft to moderately firm, crumbly, occasional pyrite laminae and webs.		
513-516	50	As above		
	40	As above		
	10	As above		
516-519	80	Coal: Moderate brown to brownish grey, occasionally black, dull, predominantly soft (black is moderately firm), common pyrite, occasional amber, trace of white waxy substance, occasional medium light grey claystone, occasional fine to medium sand.	0.4	
	10	Sand: As above		
	10	Claystone: As above		
519-522	70	Claystone: Medium light grey to greenish grey, slightly silty in parts, abundant fine to occasionally medium sand, common coal, occasional pyrite, trace of amber, trace of glauconite, soft to occasionally moderately firm, slightly calcareous, occasional fossils.	1.4	
	20	Sand: As above		
	10	Coal: As above		
522-525	70	Sandstone: Opaque to milky, fine to medium grained, well sorted, angular to very angular, common silica cement, trace of calcite cement, common to abundant pyrite, abundant claystone, common coal, firm, trace of amber, nil vis por, nil fluorescence	1.0	
	20	Claystone: As above		
	10	Coal: As above		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
525-528	70	Sandstone: As above		
	20	Claystone: As above		
	10	Coal: As above		
528-531	70	Sandstone: As above		
	20	Claystone: As above		
	10	Coal: As above		
531-534	80	Sandstone: Clear to translucent and occasionally milky, fine to very fine grained occasional medium grains, well sorted, sub angular to sub rounded, occasionally angular, trace of silica cement, common medium grey and brown grey claystone, common coal, occasional pyrite, trace of mica, trace of amber, trace of glauconite, unconsolidated, nil fluorescence		
	10	Claystone: As above		
	10	Coal: As above		
534-537	60	Claystone: Medium light grey to medium grey, abundant, very fine to very coarse sand, common pyrite, common coal, trace of glauconite, trace of amber, soft to moderately, firm, slightly calcareous, occasional fossils.		
	30	Sand: As above		
	10	Coal: As above		
537-540	60	Claystone: As above		
	30	Sand: As above		
	10	Coal: As above		
540-543	100	Sandstone: Clear to translucent, occasionally milky quartz, medium grained, occasional coarse and fine grains, well sorted, sub angular to sub rounded, trace of silica cement, common pyrite, occasional mica, occasional claystone and coal, argillaceous matrix in parts, unconsolidated, nil fluorescence		
543-546	60	Sandstone: Clear to translucent, quartz, fine to occasionally medium grained, well sorted, sub angular to sub round, trace of silica cement, trace of calcite cement, light brown argillaceous matrix in parts, abundant medium grey claystone, common pyrite occasionally as cement, trace of mica, rare amber, unconsolidated, nil fluorescence		
	40	Claystone: As above		
546-549	100	Coal: Brownish grey to brownish black, dull, moderately firm, crumbly, occasional fine to medium sand, trace of pyrite, rare amber.	0.6	
549-552	90	Coal: As above	0.6	

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
	10	Sandstone: As above		
552-555	90	Coal: As above	1.1	
	10	Sandstone: As above		
555-558	100	Coal: Brownish grey to brownish black, dull, moderately firm, flaky to sub fissile, trace of fine to medium sand, trace of pyrite, rare amber.	1.5	
558-561	100	Coal: Brownish grey to brownish black, dull, moderately firm, blocky to sub blocky, sub fissile in parts, trace of amber.	0.2	
561-564	80	Sandstone: Reddish brown to medium grey, arkosic, fine to medium grained, moderately sorted, angular to very angular, common silica cement (silcrete), abundant feldspars, occasional to common pyrite, occasional siltstone and coal, moderately hard, abundant mineral fluorescence.	0.1	
	10	Siltstone: As above		
	10	Coal: As above		
564-567	80	Sandstone: As above		
	20	Siltstone: As above		
567-570	40	Sandstone: As above		
	20	Siltstone: As above		
	40	Claystone: Medium grey, slightly silty, soft to moderately firm, common pyrite, calcareous.		
570-573	40	Sandstone: As above		
	20	Siltstone: As above		
	40	Claystone: As above		
573-576	100	Claystone: Medium light grey to medium grey, slightly silty, common glauconite, occasional fossil fragments, soft to mainly moderately firm, calcareous.		
561-564	100	Sandstone: Reddish brown to medium grey, arkosic, fine to medium and occasionally coarse grained, poor to moderate sorting, angular to very angular, common silica cement, occasional calcite cement, common to abundant rock fragments, common to abundant pyrite, dolomitic?, hard, abundant mineral fluorescence	0.1	
564-567	100	Sandstone: As above		
567-570	60	Claystone: Very light grey, containing 40% sandstone as above, very soft, non dispersive, non calcareous.		
	40	Sandstone: As above		
570-573	80	Claystone: As above		
	20	Sandstone: As above		
573-576	80	Claystone: As above		
	20	Sandstone: As above		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
576-579	80	Claystone: As above	0.2	
	20	Sandstone: As above		
579-582	80	Sandstone: Light grey to very light grey, fine to medium and occasionally coarse grained, moderately sorted predominantly quartz, angular to very angular, common silica cement, trace of calcite cement, common feldspars and rock fragments, common mineral fluorescence, hard.	0.2	
	20	Claystone: As above		
583.59-588.04		Core No. 4 Recovery 20%		
588-591	80	Basalt: Greyish black and greenish black, trace to common soapy greenish mineral (chlorite), non vesicular, very hard.		
	20	Sand: translucent to light brown, very fine to coarse grains, aggregate of quartz, feldspar, lithic fragments, pyrite, abundant calcite, occasional fossil fragments (cavings).		
591-594	70	Claystone: Bluish grey to light bluish grey, slightly silty, occasional white claystone inclusions, firm to moderately hard, blocky		
	20	Sand: As above		
	10	Basalt: As above		
594-597	60	Claystone: As above		
	30	Sand: As above		
	10	Basalt: As above		
597-600	70	Claystone: Bluish grey and greenish grey, occasionally off white and brownish grey, soft and sticky to firm, blocky in parts		
	20	Sand: As above		
	10	Basalt: As above		
600-603	60	Claystone: As above		
	20	Sand: As above		
	20	Basalt: As above		
603-606	70	Basalt: As above		
	20	Claystone: As above		
	10	Sand: As above		
606-609	90	Basalt: Greyish black to greenish black, occasional green soapy clay mineral, non vesicular, hard to very hard		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
	10	Clay: Greyish white to greenish white, speckled appearance (ash) occasional greenish mineral, trace of calcite, trace of pyrite, moderately firm		
609-612	70	Basalt: As above		
	30	Claystone: Predominantly bluish and greenish grey, occasional light brown and reddish brown, abundant "fibrous" inclusions of light grey clay, occasional calcite, firm		
612-615	80	Claystone: As above rare pyrite		
	20	Basalt: Greyish black to greenish black, occasional green soapy clay mineral, occasional yellowish crystalline mineral, non vesicular, hard to very hard		
615-618	80	Basalt: As above		
	20	Claystone: As above		
618-621	80	Basalt: As above		
	20	Claystone: As above		
621-624	60	Basalt: As above		
	40	Claystone: As above		
624-627	90	Basalt: As above	0.2	
	10	Claystone: As above		
627-630	80	Basalt: As above		
	20	Claystone: As above		
630-633	90	Basalt: As above		
	10	Claystone: As above		
633-636	70	Basalt: As above		
	30	Claystone: As above		
636.17-637.27		Core No. 5 Recovery 50%		
639-642	60	Claystone: As above		
	40	Basalt: As above		
642-645	60	Claystone: As above		
	40	Basalt: As above		
645-648	60	Basalt: Grey black and brownish black, occasional green soapy clay mineral, occasional light bluish grey zeolite, hard to very hard.		
	40	Claystone: As above		
648-651	60	Basalt: As above		
	40	Claystone: As above		
651-654	80	Basalt: As above		
	20	Claystone: As above		
654-657	80	Basalt: As above		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
	20	Claystone: As above		
654-657	80	Basalt: As above		
	20	Claystone: As above		
657-660	60	Basalt: Grey black to brownish black weathered in parts occasional green clay mineral inclusions, moderately hard to hard, occasional calcite		
	40	Claystone: As above		
660-663	60	Basalt: As above		
	40	Claystone: As above		
663-666	80	Basalt: Grey black to greenish black, weathered to reddish brown in parts, trace of pyrite and calcite, common to abundant clays, soft to hard		
	20	Claystone: White, off white, green, brown, reddish brown, moderately firm		
666-669	80	Basalt: As above		
	20	Claystone: As above		
669-672	80	Basalt: As above		
	20	Claystone: As above		
672-675	60	Basalt: As above		
	40	Claystone: As above		
675-678	60	Basalt: As above		
	40	Claystone: As above		
678-681	80	Basalt: As above		
	20	Claystone: As above		
681-684	80	Basalt: As above		
	20	Claystone: As above		
684-687	50	Basalt: As above		
	50	Claystone: As above		
687-690	60	Basalt: As above		
	40	Claystone: As above		
690-693	60	Basalt: Grey black to greenish black, weathered to reddish brown in parts, occasional calcite, abundant to common clays, rare pyrite moderately firm to hard		
	40	Claystone: Green, reddish brown, moderate brown in parts, moderately firm, non calcareous.		
693-696	50	Basalt: As above		
	50	Claystone: As above		
696-699	80	Basalt: As above		
	20	Claystone: As above		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
699-702	90	Basalt: As above		
	10	Claystone: As above		
702-705	90	Basalt: As above		
	10	Claystone: As above		
705-708	80	Basalt: As above		
	20	Claystone: As above		
708-711	80	Basalt: As above		
	20	Claystone: As above		
711-714	90	Basalt: As above		
	10	Claystone: As above		
714-717	90	Basalt: Green, reddish brown, brown, white, grey, commonly mottled, common coarse to very coarse quartz grains which are clear and milky, occasional calcite, firm, clays calcareous in parts		
	10	Basalt: As above		
717-720	50	Basalt: Grey black to black weathered to reddish brown in parts, abundant clays, occasional calcite, trace of coarse sand, hard		
	50	Claystone: As above		
720-723	60	Basalt: As above		
	40	Claystone: As above		
723-726	60	Basalt: As above		
	40	Claystone: As above		
726-729	80	Claystone: Medium grey to medium dark grey, slightly silty, calcareous, moderately firm		
	20	Basalt and Weathered basalt as above		
729-732	100	Claystone: As above		
732-735	100	Claystone: As above		
735-738	100	Claystone: Medium grey to medium dark grey, slightly silty, occasional glauconite, occasional mica, moderately firm, calcareous.		
739.03-743.43		Core No. 6 Recovery 90%		
744-747	80	Claystone: Light grey to medium grey, slightly silty, sandy in parts, coaly laminae, moderately firm to firm, calcareous.		
	10	Sandstone: Clear to translucent quartz, very fine to fine grained, well sorted, sub rounded to rounded, unconsolidated.		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
	10	Coal: Greyish black to black, sub vitreous lustre, firm brittle, sub conchoidal fracture in parts.		
747-750	60	Sandstone: Light grey to off white, very fine grained, grading to siltstone in parts, well sorted, angular to sub-angular, abundant calcite cement, silty to argillaceous matrix in parts, friable, poor visual porosity.		
	30	Siltstone: Light grey to light brownish grey, sandy in parts, moderately firm, calcareous.		
	10	Coal: As above		
750-753	60	Claystone: Light grey to light brownish grey, occasionally medium dark grey, coaly flecks in parts, slightly silty and sandy in parts, moderately firm to firm, non calcareous		
	30	Sandstone: As above		
	10	Siltstone: As above		
753-756	60	Claystone: As above		
	30	Sandstone: As above		
	10	Siltstone: As above		
756-759	60	Sandstone: As above		
	20	Siltstone: As above		
	10	Claystone: As above		
	10	Coal: As above		
759-762	80	Coal: Brownish black to black, sub vitreous lustre, firm to moderately hard, sub conchoidal to conchoidal fracture		
	10	Sandstone: As above		
	10	Claystone: As above		
762-765	90	Coal: As for 759-762		
	10	Sandstone: As above		
	10	Claystone: As above		
765-768	70	Claystone: As for 750-753		
	20	Siltstone: As for 747-750		
	10	Sandstone: As for 747-750		
768-771	70	Claystone: Very light grey to very light grey, occasionally light brownish grey, occasional carbonaceous flecks, silty in parts, soft to moderately firm, slightly dispersive, calcareous in parts		
	20	Coal: As for 759-762		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
	10	Sandstone: As for 747-750		
771-774	100	Claystone: As above		
774-777	100	Claystone: As above		
777-780	80	Claystone: Light grey to medium light grey, occasional carbonaceous flecks, silty in parts, trace of coal, soft to moderately firm non calcareous		
	10	Sandstone: As for 747-750		
	10	Siltstone: As for 747-750		
780-783	60	Claystone: As above		
	20	Coal: As for 759-762		
	10	Sandstone: As above		
	10	Siltstone: As above		
783-786	70	Claystone: Light grey to medium light grey, occasionally very light grey, common carbonaceous flecks in parts, becoming silty in parts, soft to moderately firm, non calcareous		
	20	Sandstone: Very light grey to off white, very fine to occasionally fine grained, well sorted, sub angular to angular, abundant calcite cement, slightly argillaceous matrix in parts, silty in parts, occasional lithic grains, firm to friable, poor visual porosity		
	10	Coal: Grey black to black, sub vitreous lustre, firm, brittle, occasional sub conchoidal fracture		
786-789	60	Claystone: As above		
	30	Sandstone: As above		
	10	Coal: As above		
789-792	90	Claystone: As above		
	10	Sandstone: As above		
792-795	80	Claystone: As above		
	20	Sandstone: As above		
795-798	80	Coal: As above		
	10	Claystone: As above		
	10	Sandstone: As above		
798-801	70	Claystone: As above		
	20	Sandstone: As above		
	10	Coal: As above		
	TR	Siltstone: Light brownish grey, slightly carbonaceous, hard, non calcareous		

Depth (m)	%	Sample Description	Gas (total)	Fluor Nat.	Fluor Cut
801-804	80	Claystone: As above			
	10	Sandstone: As above			
	10	Coal: As above			
* NOTE:		occasional green chloritic clays and rare pyrite are noted in cuttings from 744m. There is no evidence of these minerals in the core and they are considered likely to be cavings.			
804-807	80	Claystone: As above			
	10	Sandstone: As above			
	10	Coal: As above			
807-810	60	Claystone: As above			
	30	Sandstone: As above			
	10	Siltstone: light grey to light brownish grey, grading to very fine sand, occasional carbonaceous flecks, moderately firm, slightly calcareous in parts			
810-813	50	Claystone: As above			
	20	Sandstone: As above			
	20	Coal: As above			
	10	Siltstone: As above			
813-816	60	Claystone: As above			
	20	Sandstone: As above			
	20	Siltstone: As above			
816-819	50	Claystone: As above			
	30	Sandstone: As above			
	20	Siltstone: As above			
819-822	50	Claystone: Light grey to medium light grey, occasionally medium grey, common carbonaceous flecks and occasional laminae, commonly silty, soft to moderately firm, non calcareous.			
	30	Sandstone: Very light grey to off white, medium light grey in parts, very fine grained, well sorted, angular to sub angular, abundant calcite cement, argillaceous matrix in parts, occasional lithics, moderately firm, friable, poor visual porosity			
	20	Siltstone: Medium light grey to light brownish grey, grading to very fine grained sand, occasional carbonaceous flecks, moderately firm, non calcareous.			
822-825	50	Claystone: As above	TR		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
	30	Sandstone: As above		
	20	Siltstone: As above		
825-828	50	Claystone: Medium light grey to medium grey, occasional light grey, common carbonaceous flecks and laminae, commonly silty, sandy in parts, moderately firm to firm non calcareous	0.1	
	30	Sandstone: Very light grey to medium light grey, fine to occasionally very fine grained quartz, occasional medium grained, abundant calcite cement, angular to sub angular, slightly argillaceous matrix in parts common lithic grains, moderately firm, friable poor visual porosity		
	20	Siltstone: Light brownish grey to moderate light brown, grading to very fine sandstone, common carbonaceous flecks, firm to moderately hard, non calcareous.		
828-831	70	Sandstone: light grey to medium light grey, fine to medium grained, occasional coarse and very coarse grains, moderately sorted, sub-angular to sub rounded, abundant calcite cement, argillaceous matrix in parts, occasional pyrite, trace of coal, firm, friable, poor visual porosity	0.2	
	20	Siltstone: As above		
	10	Claystone: As above		
831-834	80	Sandstone: As above	0.2	
	10	Siltstone: As above		
	10	Claystone: As above		
834-837	50	Sandstone: As above	0.2	
	30	Claystone: As above		
	20	Siltstone: As above		
837-840	70	Sandstone: As above	0.2	
	20	Claystone: As above		
	10	Siltstone: As above		
840-843	50	Sandstone: As above	0.1	
	40	Claystone: As above		
	10	Siltstone: As above		
843-846	90	Sandstone: Light grey to very light grey, very fine to fine grained, well sorted sub angular to sub rounded, abundant calcite cement, common brown coated grains, common chlorite coated grains, trace of pyrite, rare fossil fragment; (cavings?) unconsolidated, trace coal.	0.2	
	10	Claystone: As above		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
846-849	80	Sandstone: As above	0.2	
	20	Claystone: As above		
849-852	70	Sandstone: As above	0.2	
	20	Claystone: As above		
	10	Siltstone: As above		
852-855	80	Sandstone: As above	0.4	
	10	Siltstone: As above		
	10	Claystone: As above		
855-858	60	Claystone: Medium light grey to medium grey, occasionally greenish grey, commonly silty to occasionally sandy, carbonaceous flecks and laminae, marl cavings, trace coal, moderately firm, non calcareous.	0.3	
	30	Sandstone: As above		
	10	Siltstone: As above		
858-861	70	Claystone: As above	0.3	
	20	Sandstone: As above		
	10	Siltstone: As above		
861-864	40	Claystone: As above	0.4	
	40	Sandstone: As above		
	20	Siltstone: As above		
864-867	70	Sandstone: As above	0.3	
	20	Claystone: As above		
	10	Siltstone: As above		
867-870	60	Claystone: As above	0.5	
	30	Sandstone: Light grey to light brownish grey, very fine to fine grained, occasionally medium grained, rare coarse grains, moderately well sorted, sub angular to sub rounded, occasionally angular, abundant calcite cement, occasional brown stained fine to medium grains, moderately firm, friable, poor visual porosity		
	10	Siltstone: As above		
870-873	40	Claystone: As above	0.6	
	30	Sandstone: As above		
	20	Siltstone: As above		
873-876	70	Claystone: As above	0.4	
	20	Sandstone: As above		
	10	Siltstone: As above		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
876-879	100	Sandstone: Very light grey, predominantly medium grained, abundant fine and very fine grains, occasional coarse grains, poorly sorted, angular to sub angular, occasionally sub rounded, abundant calcite cement, trace Pyrite, unconsolidated.		
879-882	100	Sandstone: Clear to translucent, medium to coarse grained, common fine and very fine grains, poor to moderate sorting, angular to sub angular, occasionally sub rounded, abundant calcite cement, trace of pyrite, trace of coal, occasional chloritic clay matrix, unconsolidated, good visual porosity, nil fluorescence.	0.5	
882-885	90	Sandstone: As above with common granule sized grains	0.4	
	10	Claystone: Light grey to medium light grey, occasionally light brownish grey, occasionally light greenish grey, carbonaceous flecks, soft to moderately firm, non calcareous.		
885-888	90	Sandstone: As above		
	10	Claystone: As above		
888-891	80	Claystone: Very light grey to light brownish grey, minor carbonaceous flecks, silty in parts, very soft, dispersive, non calcareous.		
	20	Sandstone: As above		
891-894	80	Claystone: As above		
	20	Sandstone: As above		
894-897	70	Claystone: Light grey to medium light grey, occasionally very light grey, silty and sandy in parts, common carbonaceous flecks and laminae, soft to moderately firm, non calcareous.		
	20	Sandstone: As above		
	10	Siltstone: Light brownish grey, commonly sandy, grading to very fine grained sandstone, firm, non calcareous.		
897-900	50	Sandstone: Off white to very light grey, fine to very fine grained, occasional medium and coarse grains, moderately sorted, angular to sub angular, abundant calcite cement, commonly grading to sandy siltstone, trace of pyrite, trace of coal, firm, poor visual porosity.	0.1	
	30	Claystone: As above		
	20	Siltstone: As above		
900-903	70	Claystone: As above		
	20	Sandstone: As above		
	10	Siltstone: As above		
903-906	60	Sandstone: As above	0.2	

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
	20	Claystone: As above		
	20	Siltstone: As above		
906-909	70	Sandstone: As above	0.2	
	20	Siltstone: As above		
	10	Claystone: As above		
909-912	60	Sandstone: As above	0.3	
	30	Claystone: As above		
	10	Siltstone: As above		
912-915	70	Sandstone: As above	0.3	
	20	Claystone: As above		
	10	Siltstone: As above		
915-918	70	Sandstone: Light grey to very light grey, very fine to fine grained, occasional medium and coarse grains, well sorted, angular to sub angular, abundant calcite cement, commonly silty and argillaceous matrix, common coaly wisps and laminae, occasional lithic and feldspathic grains, grading to siltstone in parts, moderately firm, poor visual porosity.		
	30	Claystone: Medium light grey to medium grey, occasional coaly flecks and laminae silty in parts, soft to moderately firm, non calcareous		
918-921	90	Sandstone:		
	10	Claystone:		
921-924	60	Sandstone:		
	40	Claystone:		
924-927	90	Sandstone:		
	10	Claystone:		
927-930	100	Sandstone:		
930-933	80	Sandstone:		
	20	Claystone:		
933-936	100	Sandstone: Off white to very light grey, fine to very fine grained, common medium and coarse grains, moderately sorted, angular to sub angular, abundant calcite cement, common silty and argillaceous matrix, trace of coal, rare garnet, occasional lithic and feldspathic grains, unconsolidated, poor visual porosity.		
936-939	80	Sandstone: As above		
	20	Claystone: As above		
939-942	80	Claystone: As above		

Depth (m)	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
	20	Sandstone: As above			
942-945	60	Sandstone: Very light grey to off white, very fine to fine grained, well sorted, sub angular, to sub rounded, occasionally rounded, common calcite cement, silty to argillaceous matrix in parts, trace of pyrite, trace of coal, occasional, lithic grains, firm, poor visual porosity.			
	40	Claystone: Medium light grey to medium grey, silty throughout, occasional carbonaceous flecks, moderately firm to firm, non calcareous			
945-948	80	Sandstone: As above			
	20	Claystone: As above			
948-951	60	Sandstone: Very light grey to off white, fine to medium grained, abundant very fine grains, occasional coarse grains, moderately sorted, abundant calcite cement, slightly silty matrix in parts, trace of coal, occasional lithic grains, unconsolidated.			
	40	Claystone: As above			
951-954	80	Sandstone: As above			
	20	Claystone: As above			
954-957	90	Sandstone: As above			
	10	Claystone: As above			
957-960	70	Sandstone: Very light grey, fine to medium grained, common very fine and coarse to very coarse grains, common calcite cement, silty to argillaceous matrix in parts, trace of pyrite, trace of coal, occasional lithic and feldspathic grains, moderately firm, poor visual porosity, nil fluorescence.			
	30	Claystone: As above			
959.27-960.92		Core No. 7 Recovery 66%			x
960-963	80	Claystone: Medium light grey to medium dark grey, occasionally light grey, becoming silty in parts, occasional carbonaceous flecks and rare laminae, trace of pyrite, sub blocky, moderately hard, non calcareous			
	20	Sandstone: As above			
963-966	80	Claystone: As above			
	20	Sandstone: As above			
966-969	70	Sandstone: As above			
	30	Claystone: As above			
969-972	80	Sandstone: As above			
	20	Claystone: As above			

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
972-975	80	Sandstone: As above		
	20	Claystone: As above		
975-978	60	Sandstone: Very light grey, medium grained, common fine and coarse grains, well sorted, sub angular to sub rounded, occasionally rounded, abundant calcite cement, silty and argillaceous matrix in parts, trace of coal, poor visual porosity, no fluorescence.		
	40	Claystone: As above		
978-981	80	Sandstone: Very light grey to light grey, very fine to fine grained, common coarse to very coarse grains, poor to moderate sorting, angular to sub angular, abundant calcite cement, silty matrix in parts, common lithic grains in parts, firm, moderately friable, poor visual porosity, nil fluorescence.		
	20	Claystone: As above		
981-984	90	Sandstone: Very light grey to light grey, medium to coarse grained, abundant fine grains, moderately sorted, angular to sub angular, occasionally sub rounded, moderately sorted, abundant calcite cement, trace of argillaceous matrix, occasional lithic and feldspathic grains, moderately firm, friable, nil visual porosity, nil fluorescence.		
	10	Claystone: As above		
984-987	90	Sandstone: As above		
	10	Claystone: As above		
987-990	90	Sandstone: As above		
	10	Claystone: As above		
990-993	80	Sandstone: As above		
	20	Claystone: As above		
993-996	60	Sandstone: As above		
	40	Claystone: As above		
996-999	80	Sandstone: Light grey, to light brownish grey, fine to medium grained, abundant very fine grains, common coarse and very coarse grains, poorly sorted, sub angular to sub rounded, abundant calcite cement, light brownish grey, silty matrix in parts, trace of coal, trace of pyrite, common lithic and feldspathic grains, firm, poor visual porosity, nil fluorescence.		
	20	Claystone: As above		
999-1002	90	Sandstone: As above		
	10	Claystone: Medium light grey to medium dark grey, occasionally light grey, becoming		

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
		silty in parts, occasionally sandy, occasional carbonaceous flecks, sub blocky, moderately hard, non calcareous.		
1002-1005	90	Sandstone: As above		
	10	Claystone: As above		
1005-1008	60	Sandstone: As above		
	40	Claystone: As above		
1008-1011	70	Sandstone: As above		
	30	Claystone: As above		
1011-1014	60	Sandstone: Very light grey, medium to coarse grained, abundant fine grains, occasional very coarse grains, poorly sorted, common calcite cement, trace of silty matrix in parts, angular to sub angular, occasional garnets, occasional black coal, trace of pyrite, occasional lithic and feldspathic grains, firm, poor visual porosity, nil fluorescence.		
	40	Claystone: Medium light grey to brownish grey, silty in parts, occasional carbonaceous flecks, firm, sub blocky to blocky, non calcareous		
1014-1017	80	Sandstone: As above		
	20	Claystone: As above		
1017-1020	60	Sandstone: As above		
	40	Claystone: As above		
1020-1023	80	Sandstone: As above		
	20	Claystone: As above		
1023-1026	70	Claystone: As above		
	30	Sandstone: As above		
1026-1029	80	Sandstone: Very light grey to light grey, fine to occasionally medium grained, common coarse grains, moderately sorted, angular to sub angular, abundant calcite cement, silty to argillaceous matrix in parts, occasional garnets, rare coal, trace of pyrite, occasional lithic and feldspathic grains, firm in parts, poor visual porosity, nil fluorescence		
	20	Claystone: As above		
1029-1032	90	Sandstone: Very light grey, medium grained, abundant fine and coarse grains, poor to moderate sorting, sub angular to sub rounded, abundant calcite cement, common garnets, trace of coal, occasional lithic and feldspathic grains, unconsolidated poor to moderate visual porosity, nil fluorescence		
	10	Claystone: As above		

Depth (m)	%	Sample Description	Shows: Gas (total)	Fluor Nat.	Fluor Cut
1032.12-1032.92		Core No. 8 Recovery 85%			x
1032-1035	70	Claystone: Light grey to medium dark grey, occasionally light brownish grey, silty in parts, occasional carbonaceous laminae, trace of pyrite, moderately firm to firm, non calcareous.			
	30	Sandstone: As above			
1035-1038	60	Sandstone: Very light grey, fine to mediumn grained, abundant very fine grains, common coarse grains, poorly sorted, abundant calcite cement, abundant light pink to occasionally red garnets, trace of coal, occasional lithic and feldspathic grains, firm poor, visual porosity, nil fluorescence.			
	40	Claystone: As above			
1038-1041	80	Sandstone: As above			
	20	Claystone: As above			
1041-1044	80	Sandstone: Very light grey, predominantly medium grained, abundant fine, very fine and coarse grains, poorly sorted, very angular to sub angular, common calcite cement, occasional silty to argillaceous matrix, common light pink to red garnets, trace of coal, occasional lithic and feldspathic grains, moderately firm, friable, poor visual porosity, nil fluorescence.			
	20	Claystone: As above			
1044-1047	90	Claystone: As above			
	10	Sandstone: As above			
1047-1050	80	Claystone: As above			
	20	Sandstone: As above			
1050-1053	60	Claystone: Light grey to medium grey, occasionally medium dark grey and light brownish grey, commonly silty and grading to very fine sand in parts, common coaly flecks and laminae, moderately firm, sub blocky in parts, non calcareous.			
	40	Sandstone: Very light grey to white, very fine to fine grained, common calcite cement, common argillaceous matrix, trace of coal, occasional lithic and feldspathic grains, firm, poor visual porosity, nil fluorescence.			
1053-1056	80	Claystone: As above			
	20	Sandstone: As above			
1056-1059	80	Claystone: As above			
	20	Sandstone: As above			
1059-1062	90	Claystone: As above			
	10	Sandstone: As above			

Depth (m)	%	Sample Description	Shows Gas (total)	Shows Fluor Nat. Cut
1062-1065	80	Claystone: As above		
	20	Sandstone: Very light grey to white, fine to medium grained, abundant coarse to very coarse grains, occasionally granule sized, poorly sorted, abundant calcite cement, silty matrix in parts, occasional lithic and feldspathic grains, poor visual porosity, nil fluorescence.		
1065-1068	80	Sandstone: As above		
	20	Claystone: As above		
1068-1071	60	Claystone: Light grey to medium grey, occasionally olive grey, silty in parts and occasionally sandy, occasional carbonaceous flecks, moderately firm, sub blocky to blocky, non calcareous.		
	40	Sandstone: Clear to translucent, occasionally white, fine to medium grained, abundant coarse and very coarse grains, poorly sorted, sub angular to sub rounded, abundant calcite cement, occasional light pink to red garnets, trace of coal, moderately firm, friable, nil visual porosity, nil fluorescence.		
1071-1074	70	Claystone: As above		
	30	Sandstone: As above		
1074-1077	80	Claystone: As above		
	20	Sandstone: As above		
1077-1080	60	Claystone: As above		
	40	Sandstone: As above		
1080-1083	60	Claystone: Medium light grey to medium grey, occasionally light brownish grey, becoming silty to sandy in parts, occasional carbonaceous flecks, moderately firm to firm, sub blocky to blocky, non calcareous.		
	40	Sandstone: Light grey to very light grey, very fine to fine grained, common coarse grains, moderately sorted, angular to sub angular, abundant calcite cement, common silty to argillaceous matrix, trace of coal, moderately firm, friable, poor visual porosity, nil fluorescence.		
1083-1086	60	Claystone: As above		
	40	Sandstone: As above		
1086-1089	80	Sandstone: As above		
	20	Claystone: As above		
1089-1092	70	Claystone: As above		
	30	Sandstone: As above		

Depth (m)	%	Sample Description	Gas (total)	Shows Fluor Nat.	Shows Cut
1092-1095	80	Sandstone: Clear to translucent and common milky grains, predominantly coarse grains, abundant medium and very coarse grains, common fine grains, moderately sorted, sub angular to sub rounded, commonly rounded, common calcite cement among finer grains, trace of coal, moderately firm, moderate visual porosity, nil fluorescence.	.3		
	20	Claystone: As above			
1095-1098	90	Claystone: Medium light grey to medium grey, occasionally light brownish grey, grading to siltstone in parts, occasional to common carbonaceous flecks, sub blocky to blocky, moderately firm to firm, slightly calcareous in silty sections.	.4		
	10	Sandstone: As above			
1098-1101	90	Sandstone: As above	.3		
	10	Claystone: As above			
1101-1104	70	Sandstone: Clear to translucent and occasionally milky grains, fine to medium grained, abundant very fine to fine grains, common coarse grains, moderately sorted, common calcite cement, angular to sub angular, trace of coal, occasional lithic grains, rare light pink garnet, moderately firm, moderate visual porosity, nil fluorescence.	.2		
	30	Claystone: As above			
1104-1107	80	Sandstone: Clear to translucent and occasionally milky, medium to coarse grained, abundant fine and very fine coarse grains, poorly sorted, sub angular to sub rounded, occasionally rounded, common calcite cement, trace of coal occasional light pink garnet, occasional lithic grain, moderately firm, moderate visual porosity, nil fluorescence.	.2		x
	20	Claystone: As above			
1107-1110	80	Sandstone: As above	.2		
	20	Claystone: As above			
1110-1113	90	Claystone: As above			x
	10	Sandstone: As above			
1113-1116	70	Claystone: Medium light grey to medium grey, occasionally greenish grey, grading to siltstone in parts, occasional carbonaceous flecks and laminae, trace of coal, firm, blocky to sub blocky, non calcareous.			
	30	Sandstone: Clear to translucent and occasionally milky, fine to very fine grained, abundant coarse and medium grains, poorly sorted, sub angular to sub rounded, common calcite cement, silty matrix in parts, trace of coal, occasional lithic			

Depth (m)	%	Sample Description	Gas (total)	Shows Fluor Nat.	Shows Fluor Cut
		fragments, moderately firm, poor to moderate visual porosity, nil fluorescence.			
1116-1119	60	Sandstone: As above			x
	40	Claystone: As above			
1119-1122	90	Sandstone: Clear to translucent, very fine to fine grained, common medium and occasional coarse grains, moderately sorted, sub angular to sub rounded, abundant calcite cement, occasional lithic and feldspathic grains, rare light pink garnet, trace of coal, moderately firm, poor visual porosity, nil fluorescence.			x
	10	Claystone: As above			
1122-1125	80	Sandstone: Clear to translucent and occasionally milky, fine to medium grained, common very fine and coarse grains, poor to moderate sorting, sub angular to sub rounded, common calcite cement, occasional light pink to red garnets, trace of coal, moderately firm, slightly friable, poor visual porosity, nil fluorescence.			x
	20	Claystone: As above			
1125-1128	60	Sandstone: As above			
	40	Claystone: As above			
1128-1131	70	Claystone: Clear to translucent and occasionally milky, fine to occasionally very fine grained, occasional medium and coarse grains, well sorted, sub angular to sub rounded, occasionally angular, common calcite cement, trace of coal, trace of pyrite, occasional lithic and feldspathic grain, occasional light pink to red garnet, poor visual porosity, nil fluorescence.			x
	30	Claystone: As above			
1131-1134	100	Sandstone: Clear to translucent and occasionally white, medium grained, occasional fine and coarse grains, well sorted, angular to sub angular, occasionally sub rounded, abundant calcite cement, trace of coal, moderately firm, poor visual porosity, nil fluorescence.			x
1134-1137	90	Sandstone: As above			x
	10	Coal: Greyish black to black, sub vitreous to vitreous lustre, moderately firm, brittle, sub conchoidal fracture, conchoidal in parts.			
1137-1140	100	Sandstone: Clear to translucent and occasionally milky, coarse to very coarse grained, abundant medium and occasional fine grains, poor to moderate sorting, sub angular to sub round, occasionally angular, abundant calcite cement, trace of coal, trace of pyrite, occasional feldspathic and lithic grains, moderately firm, moderate to poor visual porosity, nil fluorescence.			
1140-1143	80	Sandstone: As above			x

Depth (m)	%	Sample Description	Shows Gas (total)	Fluor Nat.	Fluor Cut
	10	Coal: As above			
	10	Claystone: As above			
1143-1146	90	Sandstone: Clear to translucent and occasionally milky, fine to medium grained abundant coarse grains, poorly sorted , sub angular to sub round, occasionally angular, abundant calcite cement, trace of coal moderately firm, slightly friable, poor to moderate visual porosity, nil fluorescence.			x
	10	Claystone: As above			
1146-1149	90	Sandstone: As above			
	10	Claystone: As above			x
1151.84-1152.8	4	Core No. 9 Recovery 90%			
1152-1155	70	Sandstone: Very light grey to light grey, very fine to fine grained, abundant coarse to very coarse grains, poorly sorted, angular to sub angular, occasionally sub rounded, abundant calcite cement, common silty to argillaceous matrix, grading to siltstone in parts, occasional coal, occasional lithic grain, rare garnet, moderately firm to firm, friable, nil visual porosity, nil fluorescence.			x x
	30	Claystone: Medium light grey to medium grey, occasionally light brownish grey, occasional carbonaceous flecks, silty in parts, moderately firm, sub blocky to blocky, non calcareous.			
1155-1158	80	Sandstone: Light grey to light brownish grey, fine to occasionally medium grained, occasional coarse grains, well sorted, sub angular to sub rounded, occasionally angular, abundant calcite cement, silty to argillaceous matrix in parts, abundant pink to light red garnets, common lithic and feldspathic grains, trace of coal, moderately firm, friable, poor visual porosity, nil fluorescence.			x
	20	Claystone: As above			
1158-1161	80	Sandstone: Clear to translucent, occasionally light grey, medium to occasionally coarse grained, abundant fine grains, well to moderately sorted, angular to sub angular, abundant calcite cement, common pink to red garnets, trace of coal, occasional lithic and feldspathic grains, moderately firm, friable, moderate visual porosity, nil fluorescence.			x
	20	Claystone: As above			
1161-1164	60	Claystone: Light grey to medium light grey, occasionally medium grey, silty in parts, common carbonaceous flecks, soft to moderately firm, sub blocky in parts, non calcareous.			x
1164-1167	90	Claystone: As above			x

Depth (m)	%	Sample Description	Shows: Gas (total)	Fluor: Nat.	Fluor: Cut
	10	Sandstone: As above			
1167-1170	80	Claystone: Medium dark grey to dark grey, occasionally medium grey, slightly silty, trace of coal, moderately firm, sub blocky to blocky, non calcareous.			x
	20	Sandstone: As above			
1170-1173	80	Claystone: As above			x
	20	Sandstone: As above			
1173-1176	60	Claystone: As above			x
	40	Sandstone: As above			
1176-1179	50	Claystone: As above			x
	50	Sandstone: Clear to translucent, occasionally light grey, fine to occasional medium grained, occasional coarse grains, moderately to poorly sorted, angular to sub angular, common calcite cement, slightly silty matrix, common lithic and feldspathic grains, occasional pink and red garnets, poor visual porosity, nil fluorescence.			
1179-1182	70	Sandstone: Clear to translucent, medium to coarse grained, occasional fine and very coarse grains, moderately to well sorted, sub rounded to rounded, occasionally sub angular, occasional calcite cement, rare garnet, unconsolidated, moderate visual porosity, nil fluorescence.			x
	20	Claystone: As above			
	10	Coal: Greyish Black to black, vitreous lustre, brittle, blocky to occasionally sub conchoidal fracture			
1182-1185	60	Sandstone: Clear to translucent and occasionally light grey, bimodal; fine to very fine and coarse to very coarse, poorly sorted, angular to rounded, common calcite cement, occasional lithic grains, rare garnet, rare chloritic grain, moderately firm and friable, poor to moderate visual porosity, nil fluorescence.			x
	40	Sandstone: Medium grey to medium dark grey, occasionally medium light grey and brownish grey, silty in parts, occasional carbonaceous flecks, moderately firm, non calcareous.			
1185-1188	80	Sandstone: As above			x
	20	Claystone: As above			
1188-1191	80	Sandstone: Clear to translucent and occasionally milky, predominantly coarse grained, to occasionally very coarse grained, occasional fine and medium grains, well sorted, sub angular to sub rounded and occasionally rounded, common calcite cement among fine fraction, trace of coal, rare garnet, unconsolidated,			x

Depth (m)	%	Sample Description	Shows Gas (total)	Fluor Nat.	Fluor Cut
		good visual porosity, nil fluorescence.			
	20	Claystone: medium dark grey to dark grey, occasionally brownish grey and medium grey, slightly silty in parts, occasional carbonaceous flecks and laminae, moderately firm, sub blocky, non calcareous.			
1191-1194	90	Sandstone: As above			x
	10	Claystone: As above			
1194-1197	90	Sandstone: As above			x
	10	Claystone: As above			
1197-1200	70	Sandstone: As above			x
	30	Claystone: As above			
1200-1203	60	Sandstone: As above			x
	40	Claystone: As above			
1203-1206	50	Sandstone: As above			x
	50	Claystone: As above			
1206-1209	50	Sandstone: Clear to translucent and occasionally milky, coarse to very coarse grained with abundant fine and medium grains, moderately sorted, sub angular to sub rounded, common calcite cement, especially among finer fraction, occasional silty matrix, occasional coal, rare light pink garnets, moderately firm in parts poor to moderate visual porosity, nil fluorescence.			x
	50	Claystone: As above			
1209-1212	70	Claystone: medium dark grey to dark grey, occasionally light grey, silty and micaceous in parts, common coaly flecks and laminae, commonly firm to occasionally moderately firm, sub blocky, non calcareous.			x
	30	Sandstone: Clear to translucent and occasionally milky, fine to medium grains with abundant coarse and very coarse grains, poorly sorted, sub angular to rounded, common calcite cement, occasional coal, rare light pink garnets, moderately firm, slightly friable, poor visual porosity, nil fluorescence.			
1212-1215	60	Claystone: As above			x
	40	Sandstone: As above			
1215-1218	70	Claystone: As above			x
	30	Sandstone: As above			
1218-1221	80	Claystone: As above			x
	20	Sandstone: As above			
1221-1224	90	Claystone: As above			x

Depth (m)	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
	10	Sandstone: As above			
1224-1227	60	Claystone: As above			x
	40	Sandstone: As above			
1227-1230	70	Sandstone: As above			x
	30	Claystone: As above			
1230-1233	50	Sandstone: As above			x
	50	Claystone: As above			
1233-1236	60	Sandstone: Clear to translucent and occasionally milky, fine grained, common medium and occasional coarse and very coarse grains, well sorted, sub angular to sub rounded, common calcite cement, light grey silty matrix in parts, trace of red garnet, moderately firm, friable, poor visual porosity, nil fluorescence.			x
	30	Claystone: Medium grey to medium dark grey, occasionally dark grey, rare carbonaceous flecks, silty in parts, firm, non calcareous, sub blocky to blocky.			
	10	Siltstone: Medium grey to brownish grey, grading to very fine sandstone in parts, micaceous, occasional coaly and carbonaceous flecks, firm, sub blocky to blocky, non calcareous.			
1236-1239	50	Sandstone: As above			x
	30	Claystone: As above			
	20	Siltstone: As above			
1239-1242	80	Sandstone: Very light grey to off white, fine grained, occasional medium and coarse grains, very well sorted, abundant calcite cement, angular to sub angular, slightly silty in parts, trace of coal, trace of pyrite, rare garnet, firm, slightly friable, nil visual porosity, nil fluorescence.			x
	10	Claystone: As above			
	10	Siltstone: As above			
1242-1245	80	Sandstone: Clear to translucent and occasionally milky, coarse to very coarse grains, abundant fine grains, moderately sorted, sub angular to sub rounded, common calcite cement, trace of coal, rare garnet, occasional lithic fragments in finer fraction, moderately firm, friable, moderate to good visual porosity, nil fluorescence.			x
	10	Claystone: As above			
	10	Siltstone: As above			
1245-1248	40	Sandstone: As above			x
	30	Siltstone: As above			

Depth (m)	%	Sample Description	Shows Gas (total)	Fluor Nat.	Fluor Cut
	30	Claystone: As above			
1248-1251	80	Claystone: Medium grey to brownish grey, occasionally medium dark grey, occasional carbonaceous flecks, silty and micaceous in parts, moderately firm to firm, sub blocky to blocky, non calcareous.			x
	10	Siltstone: As above			
	10	Sandstone: As above			
1252.7-1253.6		Core No. 10 Recovery 50%			x
1251-1254	80	Claystone: As above			x
	10	Sandstone: As above			
	10	Siltstone: As above			
1254-1257	60	Claystone: As above			x
	40	Sandstone: Very light grey to light grey, very fine to fine grained, well sorted; sub angular to sub rounded, occasional to common calcite cement, silty to argillaceous matrix in parts, trace of coal, common lithic and feldspathic grains, moderately firm, nil visual porosity, nil fluorescence.			
1257-1260	100	Claystone: Medium grey to dark grey, brownish grey to brownish black in parts, silty in parts, trace to occasional very fine sand, micromicaceous in parts, firm, sub blocky to blocky, non calcareous			x
1260-1263	100	Claystone: As above			x
1263-1266	70	Claystone: As above			x
	20	Sandstone: Very light grey to medium light grey, very fine to fine grained, well sorted, sub angular to sub rounded, common calcite cement, common silty to argillaceous matrix in parts, slightly micaceous, trace of coal, lithic fragments in parts, moderately firm, poor visual porosity, nil fluorescence.			
	10	Silstone: Medium grey to medium dark grey, grading to very fine sandstone, occasional carbonaceous flecks, slightly micaceous, moderately firm, sub blocky to blocky, non calcareous.			
1266-1269	60	Claystone: As above			x
	30	Sandstone: As above			
	10	Siltstone: As above			
1269-1272	70	Claystone: As above			x
	20	Sandstone: As above			
	10	Siltstone: As above			
1272-1275	50	Claystone: As above			x

Depth (m)	%	Sample Description	Shows Gas (total)	Fluor Nat.	Fluor Cut
	30	Sandstone: As above			
	20	Siltstone: As above			
1275-1278	60	Claystone: As above			x
	30	Sandstone: As above			
	10	Siltstone: As above			
1278-1281	70	Claystone: As above			x
	20	Sandstone: As above			
	10	Siltstone: As above			
1281-1284	50	Claystone: As above			x
	30	Siltstone: As above			
	20	Sandstone: As above			
1284-1287	50	Claystone: As above			x
	30	Sandstone: As above			
	20	Siltstone: As above			
1287-1290	60	Claystone: As above			x
	30	Sandstone: As above			
	20	Siltstone: As above			
1290-1293	50	Sandstone: As above			x
	30	Claystone: As above			
	20	Siltstone: As above			
1293-1296	60	Sandstone: As above			x
	20	Claystone: As above			
	20	Siltstone: As above			
1296-1299	50	Sandstone: Light grey to medium light grey, very fine to fine grained, well sorted, sub angular to sub rounded, abundant calcite cement, abundant silty and argillaceous matrix, common lithic grains, micaceous in parts, trace of interbedded coal, moderately firm, friable, poor visual porosity, nil fluorescence.			x
	20	Claystone: Medium dark grey to dark grey, occasionally brownish grey, silty in parts slightly micaceous, firm, sub blocky to blocky, non calcareous.			
	20	Siltstone: Medium dark grey to brownish grey, commonly argillaceous, occasional carbonaceous flecks, slightly micaceous, firm, sub blocky to blocky, non calcareous.			
	10	Coal: Greyish black to black, sub vitreous lustre, moderately firm, brittle, sub conchoidal fracture.			
1299-1302	60	Sandstone: As above			x

Depth (m)	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
	20	Claystone: As above			
	20	Siltstone: As above			
1302-1305	80	Sandstone: As above			x
	10	Claystone: As above			
	10	Siltstone: As above			
1305-1308	70	Sandstone: As above			x
	20	Siltstone: As above			
	10	Claystone: As above			
1308-1311	70	Sandstone: As above			x
	30	Siltstone: As above			
1311-1314	50	Sandstone: As above			x
	30	Siltstone: As above			
	20	Claystone: As above			
1314-1317	40	Sandstone: As above			x
	40	Siltstone: As above			
	20	Claystone: As above			
1317-1320	50	Sandstone: As above			x
	30	Siltstone: As above			
	20	Claystone: As above			
1320-1323	50	Sandstone: As above			x
	30	Claystone: As above			
	20	Siltstone: As above			
1323-1326	60	Claystone: Medium dark grey to dark grey, occasionally brownish grey, silty in parts, occasional carbonaceous flecks, rare coal, moderately firm, blocky, non calcareous.			x
	30	Siltstone: Medium grey to medium dark grey, grading to very fine sand in parts, micromicaceous, occasional carbonaceous flecks, moderately firm, sub blocky non calcareous			
	10	Sandstone: Very light grey to medium light grey, fine to very fine grained, occasional coarse grains, well sorted, sub angular to sub rounded, abundant calcite cement, occasional lithic grains and coaly fragments, moderately firm to firm, nil visual porosity, nil fluorescence.			
1326-1329	50	Claystone: As above			x
	40	Siltstone: As above			

Depth (m)	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
	10	Sandstone: As above			
1329-1332	40	Claystone: As above			x
	40	Siltstone: As above			
	20	Sandstone: As above			
1332-1335	60	Sandstone: Very light grey to medium light grey, very fine to fine grained, occasional medium and coarse grains, well sorted, sub angular to sub rounded, occasional to common calcite cement, silty to argillaceous matrix in parts, occasional lithic and feldspathic grains, rare mica, trace of coal, moderately firm to firm, nil to poor visual porosity, nil fluorescence.			x
	20	Claystone: As above			
	20	Siltstone: As above			
1335-1338	70	Sandstone: As above			x
	20	Siltstone: As above			
	10	Claystone: As above			
1338-1341	70	Sandstone: As above			x
	20	Siltstone: As above			
	10	Claystone: As above			
1342.99-1347.84		Core No. 11 Recovery 60%			x
1347-1350	60	Sandstone: Very light grey to medium light grey, very fine to fine grained, occasional medium and coarse grains, well sorted, sub angular to sub rounded, occasional calcite cement common very light grey argillaceous matrix, trace of coal, rare pyrite, occasional lithic grains, moderately firm, friable, poor visual porosity, nil fluorescence.			
	20	Siltstone: Medium light grey to medium grey, slightly sandy in parts, rare carbonaceous flecks, moderately firm, sub blocky to blocky, non calcareous.			
	20	Claystone: Medium dark grey to dark grey, rare carbonaceous flecks, moderately firm, sub blocky to blocky, non calcareous.			
1350-1353	70	Sandstone: As above	TR		x
	20	Siltstone: As above			
	10	Claystone: As above			
1353-1356	60	Sandstone: As above	0.1		
	20	Siltstone: As above			
	20	Claystone: As above			
1356-1359	70	Sandstone: As above	0.2		x

Depth (m)	%	Sample Description	Shows Gas (total)	Floor Nat.	Floor Cut
	20	Siltstone: As above			
	10	Claystone: As above			
1359-1362	40	Sandstone: As above	0.2		x
	30	Siltstone: As above			
	30	Claystone: As above			
1362-1365	80	Sandstone: As above			x
	10	Siltstone: As above			
	10	Claystone: As above			
1365-1368	70	Sandstone: Very light grey to white, fine grained, occasionally very fine and medium grained, common coarse grains, moderately sorted, sub angular to sub rounded, occasionally rounded, abundant calcite cement, trace of argillaceous matrix, occasional coaly laminae in parts, rare red garnet, rare pyrite and chloritic grains, moderately firm, friable in parts, poor visual porosity, nil fluorescence.	0.5		x
	20	Siltstone: Medium grey to medium dark grey, occasional coaly laminae, grading to sandstone in parts, moderately firm to firm, sub blocky to blocky, non calcareous.			
	10	Claystone: Medium dark grey to dark grey, occasionally silty, trace of carbonaceous material, moderately firm, sub blocky, non calcareous.			
1368-1371	40	Sandstone: As above	0.3		x
	30	Siltstone: As above			
	30	Claystone: As above			
1371-1374	60	Sandstone: As above	0.3		x
	20	Siltstone: As above			
	20	Claystone: As above			
1374-1377	60	Sandstone: As above	0.2		x
	20	Siltstone: As above			
	20	Claystone: As above			
		Connection Gas @ 1379.5m 0.9 unit			
1377-1380	40	Sandstone: As above	0.3		x
	40	Siltstone: As above			
	20	Claystone: As above			
1380-1383	40	Siltstone: As above	-		x
	40	Claystone: As above			

Depth (m)	%	Sample Description	Shows Gas (total)	Fluor Nat.	Fluor Cut
	20	Sandstone: As above			
1383-1386	70	Sandstone: As above	0.2		x
	20	Siltstone: As above			
	10	Claystone: As above			
1386-1389	60	Sandstone: As above			x
	30	Siltstone: Medium light grey to medium dark grey, very micaceous in parts, grading to very fine sand, common carbonaceous flecks, fragments and occasional laminae, moderately firm, sub blocky in parts, non calcareous.			
	10	Claystone: As above			
1389.2-1389.8		Core No. 12 Recovery 25%			x
1389-1392	60	Claystone: Medium grey to medium dark grey, slightly silty, micaceous in parts, occasional carbonaceous flecks, moderately firm to firm, sub blocky, non calcareous.			x
	30	Siltstone: As above			
	10	Sandstone: As above			
1392-1395	50	Claystone: As above			x
	30	Siltstone: As above			
	20	Sandstone: Very light grey to white, fine to occasionally medium grained, occasional coarse grain, well sorted, sub angular to sub rounded, abundant calcite cement, common white argillaceous matrix, occasional micaceous laminae, occasional coaly laminae, rare garnet, common lithic grains and coaly fragments, moderately firm, friable in parts, nil visual porosity, nil fluorescence.			
1395-1398	50	Claystone: As above			x
	30	Siltstone: As above			
	20	Sandstone: As above			
1398-1401	60	Claystone: Medium grey to medium dark grey, occasionally dark grey to greyish black, occasionally light brownish grey, slightly silty in parts, occasional carbonaceous flecks and laminae, moderately firm to firm, blocky, non calcareous			x
	20	Siltstone: As above			
	15	Sandstone: As above			
	5	Coal: Greyish black to black, dull to sub vitreous, firm brittle, blocky to sub conchoidal fracture			
1401-1404	50	Claystone: As above			x
	30	Sandstone: As above			

Depth (m)	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
	20	Siltstone: As above			
1404-1407	50	Siltstone: As above			x
	30	Sandstone: As above			
	20	Claystone: As above			
1407-1410	70	Sandstone: White to very light grey, medium grained, occasional fine and coarse grains, well sorted, sub angular to sub rounded, abundant calcite cement, common lithic and feldspathic grains, rare garnet, occasional mica, trace of coal, moderately firm, friable, poor visual porosity, nil fluorescence.			x
	20	Siltstone: As above			
	10	Claystone: As above			
1410-1413	60	Sandstone: White to very light occasionally light brown, predominantly fine to medium grained, abundant coarse grains, occasional very coarse angular grains, poorly sorted, sub angular to sub rounded, occasionally very angular, abundant calcite cement, common lithic grains, trace of coal, moderately firm to firm, friable in parts, poor visual porosity, nil fluorescence.			x
	20	Siltstone: As above			
	20	Claystone: As above			
1413-1416	60	Claystone: Medium grey to medium dark grey, silty in parts, occasional carbonaceous flecks, moderately firm to firm, sub blocky to blocky, non calcareous.			x
	20	Siltstone: Medium light grey to medium grey, occasionally medium dark grey, common fine to very fine sand in parts, occasional coaly fragment, moderately firm, sub blocky, non calcareous.			
	20	Sandstone: As above			
1416-1419	60	Claystone: As above			x
	20	Siltstone: As above			
	10	Sandstone: As above			
	10	Coal: Dark grey to greyish black, dull to sub vitreous, firm, brittle, blocky to occasionally fissile.			
1419-1422	40	Claystone: As above			x
	40	Siltstone: As above			
	20	Sandstone: As above			
1422-1425	50	Siltstone: As above			x
	30	Claystone: As above			

Depth (m)	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
	20	Sandstone: As above			
1425-1428	80	Sandstone: Very light grey to white, very fine to fine grained, well sorted, sub angular to sub rounded, common calcite cement, argillaceous matrix in parts, common lithic and feldspathic grains, trace of mica, occasional coal fragments, trace of pyrite, moderately firm to firm, friable in parts, poor visual porosity, nil fluorescence.			
	10	Claystone: As above			
	10	Siltstone: As above			
1428-1431	50	Sandstone: As above			x
	30	Siltstone: As above			
	20	Claystone: As above			
1431-1434	50	Siltstone: Light grey to medium light grey, occasionally medium grey and dark grey, occasional carbonaceous flecks and coaly laminae, moderately firm, sub blocky, non calcareous.			x
	30	Sandstone: Light grey to very light grey, occasionally light brownish grey, fine to medium grained, common to occasional coarse grains, moderately to well sorted, sub angular to sub rounded, abundant calcite cement, occasional lithic and feldspathic grains, occasional mica, moderately firm, friable in parts, poor visual porosity, nil fluorescence.			
	15	Claystone: Medium dark grey to dark grey, occasionally brownish grey, silty in parts, moderately firm to firm, sub blocky to blocky.			
	5	Coal: Dark grey to greyish black, sub vitreous to vitreous lustre, firm, brittle blocky to sub conchoidal fracture.			
1434-1437	40	Siltstone: As above			x
	40	Claystone: As above			
	20	Sandstone: As above			
1437-1440	40	Siltstone: As above			x
	40	Claystone: As above			
	20	Sandstone: As above			
1442.8-1445.7		Core No. 13 Recovery 74%			x
1446-1449	70	Claystone: Medium dark grey, occasionally medium grey and dark grey, slightly silty in parts, occasional carbonaceous flecks, moderately firm to firm, non calcareous, sub blocky to blocky.			x
	20	Sandstone: white to very light grey, fine to occasionally medium grained, occasional coarse grains, moderately sorted, sub angular to sub rounded, common			

Depth (m)	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		calcite cement, argillaceous matrix in parts, occasional light pink to red garnets, trace of pyrite, moderately firm, friable in parts, occasional lithic grains, nil visual porosity, nil fluorescence.			
	10	Siltstone: Medium light grey, micaceous, common carbonaceous flecks, grading to very fine sand in parts, moderately firm, sub blocky, slightly calcareous in parts			
1449-1452	60	Sandstone: White to very light grey, very fine to fine grained, well sorted, sub angular to sub rounded, abundant calcite cement, argillaceous matrix in parts, common lithic and occasional feldspathic grains, occasional mica, occasional coaly fragments, moderately firm, friable, poor visual porosity, nil fluorescence.			x
	30	Claystone: As above			
	10	Siltstone: As above			
1452-1455	40	Sandstone: As above			x
	40	Claystone: As above			
	20	Siltstone: As above			
1455-1458	80	Sandstone: White to very light grey, predominantly fine grained, occasional very fine and medium to coarse grains, abundant calcite cement, trace of pyrite cement, occasional light pink garnets, common coaly fragments, occasional lithic fragments, moderately firm, slightly friable, nil visual porosity, nil fluorescence.			x
	10	Claystone: As above			
	10	Siltstone: As above			
1458-1461	70	Sandstone: As above			x
	20	Siltstone: As above			
	10	Claystone: As above			
1461-1464	40	Sandstone: As above			x
	40	Siltstone: As above			
	20	Claystone: As above			
1464-1467	60	Siltstone: As above			x
	30	Sandstone: As above			
	10	Claystone: As above			
1467-1470	60	Siltstone: As above			x
	30	Sandstone: As above			
	10	Claystone: As above			
1470-1473	60	Sandstone: Very light grey to light grey, very fine to occasionally fine grained,			x

Depth (m)	%	Sample Description	Shows Gas (total)	Fluor Nat.	Fluor Cut
		well sorted, sub angular to sub rounded, occasionally angular, abundant calcite cement, argillaceous matrix in parts, common coaly fragments, occasional lithic and feldspathic grains, occasional light pink garnets, trace of pyrite, firm, friable in parts, poor visual porosity, nil fluorescence.			
	30	Siltstone: Medium light grey to medium grey, clayey in parts, micaceous in parts, occasional carbonaceous flecks, grading to fine sand in parts with occasional pink garnets, moderately firm to firm, sub blocky, non calcareous.			
	10	Claystone: Medium dark grey to dark grey, silty in parts, occasional carbonaceous flecks, moderately firm to firm, sub blocky, non calcareous			
1473-1476	70	Sandstone: As above			x
	20	Siltstone: As above			
	10	Claystone: As above			
1476-1479	70	Sandstone: As above	0.2		x
	20	Claystone: As above			
	10	Siltstone: As above			
1479-1482	60	Sandstone: Very light grey to light grey, very fine to fine grained, occasional medium and coarse grains, well sorted, abundant calcite cement, argillaceous matrix in parts, common coaly fragments, occasional mica, common lithic grains, firm, friable in parts, poor visual porosity, nil fluorescence.	0.9		x
	20	Siltstone: As above			
	10	Claystone: As above			
	10	Coal: Black, sub vitreous, firm, brittle, blocky to sub conchoidal fracture.			
1482-1485	60	Sandstone: As above	0.4		x
	30	Siltstone: As above			
	10	Claystone: As above			
1485-1488	70	Sandstone: Very light grey to white, fine to medium grained, occasional coarse and very coarse grains, well sorted, sub angular to sub rounded, common to abundant calcite cement, trace of argillaceous matrix, occasional coal fragments, occasional lithic and feldspathic grains, trace of mica, moderately firm, friable poor visual porosity, patchy mineral fluorescence	0.2		x
	20	Siltstone: Medium light grey to medium grey, occasionally brownish grey, grading to claystone in parts, occasional carbonaceous wisps and laminae, moderately firm to firm, sub blocky, non calcareous.			
	10	Claystone: Medium light grey to medium grey, silty in parts, moderately firm to			

Depth (m)	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		firm, sub blocky to blocky, non calcareous.			
1488-1491	80	Sandstone: As above	0.3		x
	10	Siltstone: As above			
	10	Claystone: As above			
1491-1494	80	Sandstone: Very light grey to white, medium to occasionally fine grained, common coarse grains, well sorted, sub angular to sub rounded, common calcite cement, occasional lithic grains, occasional light pink garnets, trace of mica, moderately firm, friable, moderate visual porosity, nil fluorescence.			x
	10	Siltstone: As above			
	5	Claystone: As above			
	5	Coal: As above			
1494-1497	80	Sandstone: As above			x
	10	Siltstone: As above			
	5	Claystone: As above			
	5	Coal: As above			
1497.4-1501.3		Core No. 14 Recovery 63%			x
1501-1503	70	Sandstone: As above			x
	20	Siltstone: As above			
	10	Claystone: As above			
1503-1506	80	Sandstone: Clear to translucent, medium to coarse grained quartz, well sorted, sub angular to sub rounded, occasionally angular, occasional calcite cement, common white argillaceous matrix, occasional light pink garnets, trace of coal, moderately firm, friable, good visual porosity, nil fluorescence.			x
	10	Siltstone: As above			
	10	Claystone: As above			
1506-1509	90	Sandstone: Clear to translucent, medium to predominantly coarse grained, occasional fine and very coarse grains, well sorted, sub angular to sub rounded, trace of calcite cement, occasional argillaceous matrix, trace of coal, trace of pyrite, occasional light pink garnets, moderately firm friable, good visual porosity, nil fluorescence.			x
	5	Siltstone: As above			
	5	Claystone: As above			
1509-1512	90	Sandstone: Clear to translucent, fine to coarse and common very coarse grains, poorly sorted, sub angular to sub rounded, occasionally angular, rare calcite			x

Well: Warracbarunah No. 2 Date: 19/3/91 Geologist: C. Menhennitt Page: 45 of 45

Depth (m)	%	Sample Description	Shows: Gas (total)	Shows: Fluor Nat.	Shows: Fluor Cut
		cement, common white argillaceous matrix, trace of coal, trace of pyrite, rare pink garnets, moderately firm, friable, moderate to good visual porosity, nil fluorescence.			
	5	Siltstone: As above			
	5	Claystone: As above			
1512-1515	90	Sandstone: As above			x
	5	Siltstone: As above			
	5	Claystone: As above			
1515-1518	70	Sandstone: As above			x
	20	Siltstone: As above			
	10	Claystone: As above			
1518-1521	90	Sandstone: Clear to translucent, medium to coarse grained, occasional fine and very coarse grains, moderately to well sorted, sub angular to sub rounded, occasionally angular, rare calcite cement, common white argillaceous matrix, trace of coal, trace of pyrite, occasional light pink garnet, moderately firm, friable, good visual porosity, nil fluorescence.			x
	5	Siltstone: As above			
	5	Claystone: As above			
1524.88-1527.41		Core No. 15 Recovery 7%			x

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WARRACBARUNAH #2

Core No 1 290.65 - 296.65 metres Recovery 11%

Poor recovery of medium light grey to medium grey marl, abundant very fine sand grading to silt throughout, common fossil fragments and mica. The rock is very dispersive in fresh water, soft to moderately firm and strongly calcareous. There is no apparent bedding or structure in the recovered sample.

WARRACBARUNAH #2

Core No 2 **428.44 - 433.09 metres** **Recovery 4%**

Basalt, dark grey to greyish black, occasional millimetre scale vesicules, very hard. The driller reported that a twenty centimetre section of the cored interval took 1.5 hours to drill, and the rest was very soft and easy to drill. This corresponds with the recovered core. The bulk of the section cored has obviously washed away. The thin section of basalt can be identified on the wireline logs.

WARRACBARUNAH #2

Core No 3 483.40 - 489.25 metres Recovery 15%

Poor recovery of medium grey to medium brownish grey quartzose sandstone which is generally fine grained with occasional very fine and medium grains. The grains are well sorted and sub rounded to rounded with no apparent cement and a supportive brownish grey argillaceous matrix. There is a trace of mica and the rock is slightly silty and very soft. There is no apparent bedding or structure in the recovered core.

WARRACBARUNAH #2

Core No 4 **583.59 - 588.04 metres** **Recovery 20%**

Approximately half of the recovery from the core barrel appears to be hole fill rather than fresh formation. Predominantly light greenish grey to occasionally light grey claystone with common arkosic sand throughout which consists of quartz, feldspars, and lithics. There is crystalline calcite up to pebble size in parts and a possible slickenside surface and chlorite. The core is very soft and sticky to firm. The softer zones are slightly to strongly calcareous while the firmer zones are non calcareous. The core has an overall weathered appearance.

WARRACBARUNAH #2

Core No 5 636.17 - 632.27 metres Recovery 50%

The bottom ten centimetres of the core is grey black to brownish black basalt which has occasional zeolites, vesicles and traces of calcite. It is hard to very hard and has a slightly weathered appearance.

The remainder of the recovered core is an aggregate of pebble size angular basalt gravel in a matrix of various coloured clays. The clays are bluish grey, brownish grey, reddish brown and white and there is common calcite throughout. The clays are generally soft and sticky and occasionally firm.

A thin section description of this rock is part of the Geochronology report in Appendix 8.

WARRACBARUNAH #2

CORE #6 739 - 743.3m RECOVERY 90%

Bottom 13cm is a medium grey claystone, silty in parts, with occasional carbonaceous material, hard, strongly calcareous.

Overlying 77cm is a light grey to medium grey silty claystone with common interbeds and laminae of siltstone and fine grained calcareous sandstone. Dominant sandstone lithology is quartz with accessory feldspar and lithics. Carbonaceous flecks and wisps occur throughout. Coaly fragments and leaf remnants are visible on some fracture surfaces. Apparent bedding dip 15°. This section is very firm to moderately hard and predominantly non calcareous.

Overlying 2m is medium light grey to medium grey silty claystone which becomes clayey siltstone in parts, occasional traces of very fine quartz sand, abundant coaly flecks and wisps. Apparent bedding dip 15°. Moderately hard to hard and non calcareous.

Overlying 60cm is dark grey to greyish black carbonaceous claystone which is topped by a 10cm black bituminous coal band. This section is silt and sand free. The coal is grey black to black, dull lustre with abundant laminae with bright lustre. The brighter layers have a conchoidal fracture. The claystone has abundant carbonaceous flecks throughout and is non calcareous. No apparent bedding. Core is broken up but there are several vertical to near vertical slickensided surfaces.

Remaining core is a light grey to medium light grey arenaceous siltstone, possibly slightly weathered. Sand is quartz with feldspars and lithics and minor carbonaceous flecks. Soft to moderately firm, non calcareous.

WARRACBARUNAH #2

Core No 7 959.27 - 960.92 metres Recovery 66%

Predominantly sandstone with interbeds of claystone and minor coal. The sandstone is very light grey, predominantly very fine to fine grained quartz with occasional coarse grains. The grains are angular to sub angular and moderately to well sorted with abundant calcite cement and silty matrix in parts. There are common coaly wisps and laminae, no visual porosity and no apparent fluorescence. Within the sandstone cross bedding is common but contacts with interbedded claystones tend to be laminar. There is some load deformation of bedding.

The claystones are uniformly medium light grey to medium grey with minor carbonaceous and occasional carbonaceous laminae. They are moderately firm and non calcareous. A dried sample of the claystone yielded a weak to moderate greenish which crush cut fluorescent residue in the spot tray.

WARRACBARUNAH #2

Core No 8 1032.12 - 1032.92 metres Recovery 85%

The Upper 49cm is a white to very light grey sandstone of predominantly quartz grains in a silty to argillaceous matrix. Throughout there are abundant grains and clasts of feldspars, lithics, claystones, and coal fragments. Garnets are also abundant throughout. Grain size ranges from silt to up to 10mm. There is abundant calcite cement. A full range of grain shape is noted. Two broadly fining upward cycles are evident. A bedding angle of approximately 10° is apparent. The bottom of this section is predominantly coarse grained and abruptly overlies a thinly laminated unit of interbedded claystone and siltstone with common carbonaceous laminae. The contact shows some scouring. Unit is slightly calcareous in parts.

A dried sample of the claystone yielded a weak to moderate greenish white crush cut fluorescent residue ring in the spot tray.

WARRACBARUNAH #2

Core No 9 1151.84 - 1152.84 metres Recovery 90%

Predominantly fine to very fine grained sandstone which grades to siltstone interbedded with medium grey to medium dark grey claystone. Abundant cross bedding throughout with flaser bedding towards the base of the core. The sandstone is predominantly quartz with common lithic and feldspathic grains, and coaly fragments throughout with silty and argillaceous matrix and abundant calcite cement. The claystone is commonly silty and grades to siltstone in parts with common very fine carbonaceous fragments. Claystone is now calcareous.

A dried claystone sample from the core yielded a weak to moderate yellowish white crush cut fluorescent residue ring in the spot tray.

WARRACBARUNAH #2

Core No 10 1252.7 - 1253.6 metres Recovery 50%

Predominantly claystone with finely interbedded siltstone and very fine grained sandstone. The claystone is dark grey to brownish grey with occasional carbonaceous flecks and mica. It is silty and commonly grades to siltstone, and is firm to very firm and non calcareous.

The siltstone is medium grey to brownish grey, micaceous with occasional coaly and carbonaceous flecks. There is common very fine sand and the rock grades to sandstone in parts. It is firm and non calcareous.

The sandstone is very light grey to light grey, very fine to fine grained and dominantly quartzose with common lithic and feldspathic grains. The grains are sub angular to sub rounded and well sorted with abundant calcite cement and occasional silty to argillaceous matrix. There is a trace of coal and no visual porosity.

Contacts between the different lithologies are commonly gradational although some laminar instances are also apparent. Laminar bedding within the siltstone and claystone indicate a bedding angle of 25° - 30°. Cross bedding and occasional laminar bedding is noted the sandstone.

A fresh piece of claystone from this core yielded a moderate to strong yellowish white crush cut fluorescent residue in a spot tray.

WARRACBARUNAH #2

CORE #11 1343 - 1347.8m RECOVERY 60%

The lower 1.1m is an interbedded sequence of sandstone, siltstone and claystone. The sandstone is very light grey to light grey, predominantly quartzose, fine grained to occasionally very fine and medium grained. Very well sorted, sub-rounded to rounded. The consolidating agent is a very light grey to white argillaceous matrix. Calcite cement is absent except for one instance of calcite fracture fill. There are common thin (< 2mm) coaly laminae. Rare garnets are present. The rock is firm and friable. Visual porosity is poor and there is no fluorescence. The siltstone is medium light grey to light brownish grey, commonly sandy and grading to claystone in parts. It has common flecks and occasional laminae of carbonaceous material. It is firm and non calcareous. The claystone is medium grey to medium dark grey and commonly silty and occasionally sandy with rare carbonaceous material. The rock is firm and non calcareous.

The sand beds dominate and are up to 15cm thick, with the siltstones and claystones not exceeding 5cm. Some post depositional bedding deformation is noted and apparent bedding angles range from 10° to 40°. Coaly laminae are confined to the sandy beds and rare leaf fragments are noted.

The remainder of the recovered core is sandstone with occasional fine silty and carbonaceous laminae. The sandstone is very light to light grey, very fine to fine grained, well sorted and sub-angular to sub-rounded. The upper 45cm is strongly calcite-cemented but the remainder is calcite free except for occasional fracture fill. Argillaceous matrix is common throughout. The rock is predominantly quartzose with occasional to common lithic grains and coaly fragments. Rare garnets are present. It is moderately firm to firm, friable with poor visual porosity and no fluorescence. Apparent bedding angles of 10° to 20° are noted. Throughout the core bedding in dominantly laminar with minor cross bedding noted in the sandstones towards the base.

WARRACBARUNAH #2

Core No 12 1389.21-1389.81 metres Recovery 25%

Three hours coring with a roller bit resulted in the recovery of 15 centimetres of core. The core recovered is a medium dark grey to dark grey claystone which is slightly micaceous and slightly calcareous but otherwise featureless. It is firm to very firm with no apparent bedding or structure.

WARRACBARUNAH #2

CORE #13 1442.8 - 1445.7m RECOVERY 74%

The lower 74cm is a medium dark grey to dark grey silty claystone which commonly grades into a medium grey siltstone. Under the microscope very fine carbonaceous flecks can be seen throughout and appear to make up 5-10% of rock volume. A brownish mica is also common throughout the siltier sections. There are several intervals of sandier siltstone that grade into very fine grained silty sandstone.

Samples from this interval exhibit moderate to strong, yellowish white crush cut fluorescent residue rings and weak patchy fluorescence.

Abruptly overlying the claystone is a 7cm interval of a fine to coarse grained clayey sandstone. The rock is a very poorly sorted assemblage of quartz grains, garnets, and clayey clasts in a silty to argillaceous matrix. There is minor carbonaceous matter. It is commonly medium grey but there are also common patches of light brown argillaceous matrix. Contact with the overlying unit is abrupt and sub-horizontal with a deep scour and fill feature. It has patchy calcite cement and also exhibits moderate to strong, yellowish white crush fluorescence and residue ring.

The remainder of the core is a predominantly very fine to fine grained sandstone which has abundant calcite cement and argillaceous matrix. There are common silty and clayey laminae throughout and several fining upward cycles. Cross-bedding is common and occasional flaser bedding is noted. Throughout the finer sections very fine carbonaceous material is abundant, and there are occasional flecks and wispy laminae of coal throughout the core. This section also yields a moderate to strong, yellowish white crush cut fluorescent residue ring.

WARRACBARUNAH #2

CORE #14 1497.4 - 1501.3M RECOVERY 63%

The recovered core is 100% very light grey to white sandstone. It is predominantly medium to coarse grained with occasional very coarse and larger grains, and is occasionally fine grained.

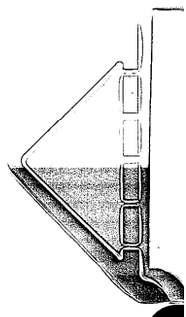
The sandstone is quartzose with occasional lithic grains and common light pink to light red garnets. It is well sorted and sub-angular to sub-rounded with white argillaceous matrix throughout. There is minor patchy calcite cement and one 5cm interval containing irregular coal laminae which are approximately horizontal. No other structure is apparent in the core. The rock is firm, competent, and moderately friable and has good visual porosity. The coaly interval yields instant strong yellowish green crush cut fluorescence and weak cut fluorescence. Several sand samples tested yielded no fluorescence.

WARRACBARUNAH #2

Core No 15 1524.88 - 1527.46 metres Recovery 7%

Recovered 18 centimetres of sandstone which is somewhat worn from the rotation of the core barrel. The sandstone is very light grey, medium to coarse grained with occasional very coarse grains. The rock is quartzose with occasional lithic grains and common light pink to light red garnets. The grains are sub angular to sub rounded and generally well sorted. There is patchy calcite cement and white argillaceous matrix material throughout. The rock is moderately firm and friable with fair to good visual porosity. There is no apparent bedding or structure.

Appendix 5



APPENDIX 5

VELOCITY SURVEY REPORT

Velocity Data

WELL VELOCITY SURVEY

WARRACBARUNAH #2

PEP 100

Victoria

for

GEOLOGICAL SURVEY OF VICTORIA

recorded by

VELOCITY DATA PTY. LTD.

processed by

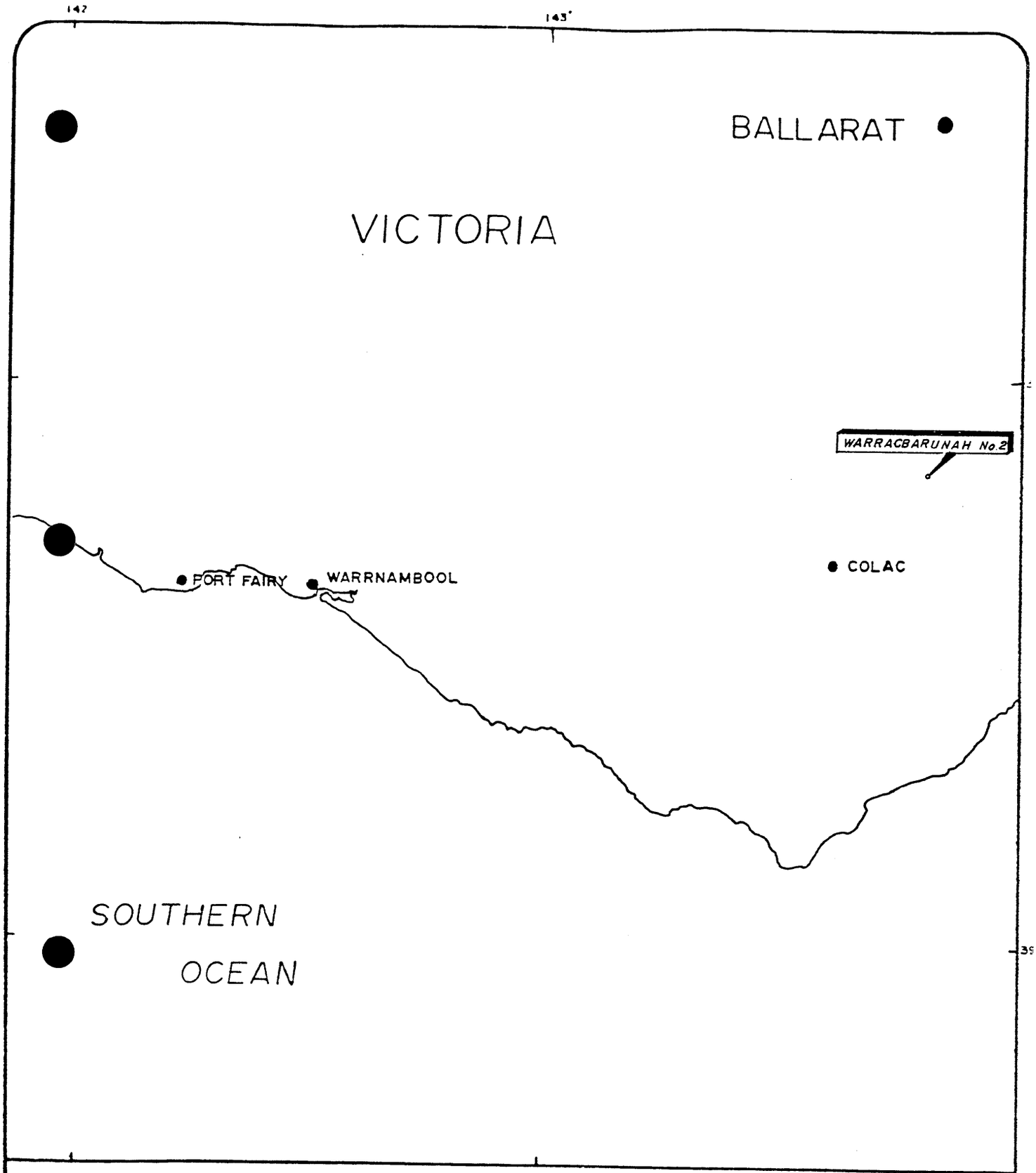
VELSEIS PTY LTD

Integrated Seismic Technologies

Brisbane, Australia

May 28, 1991

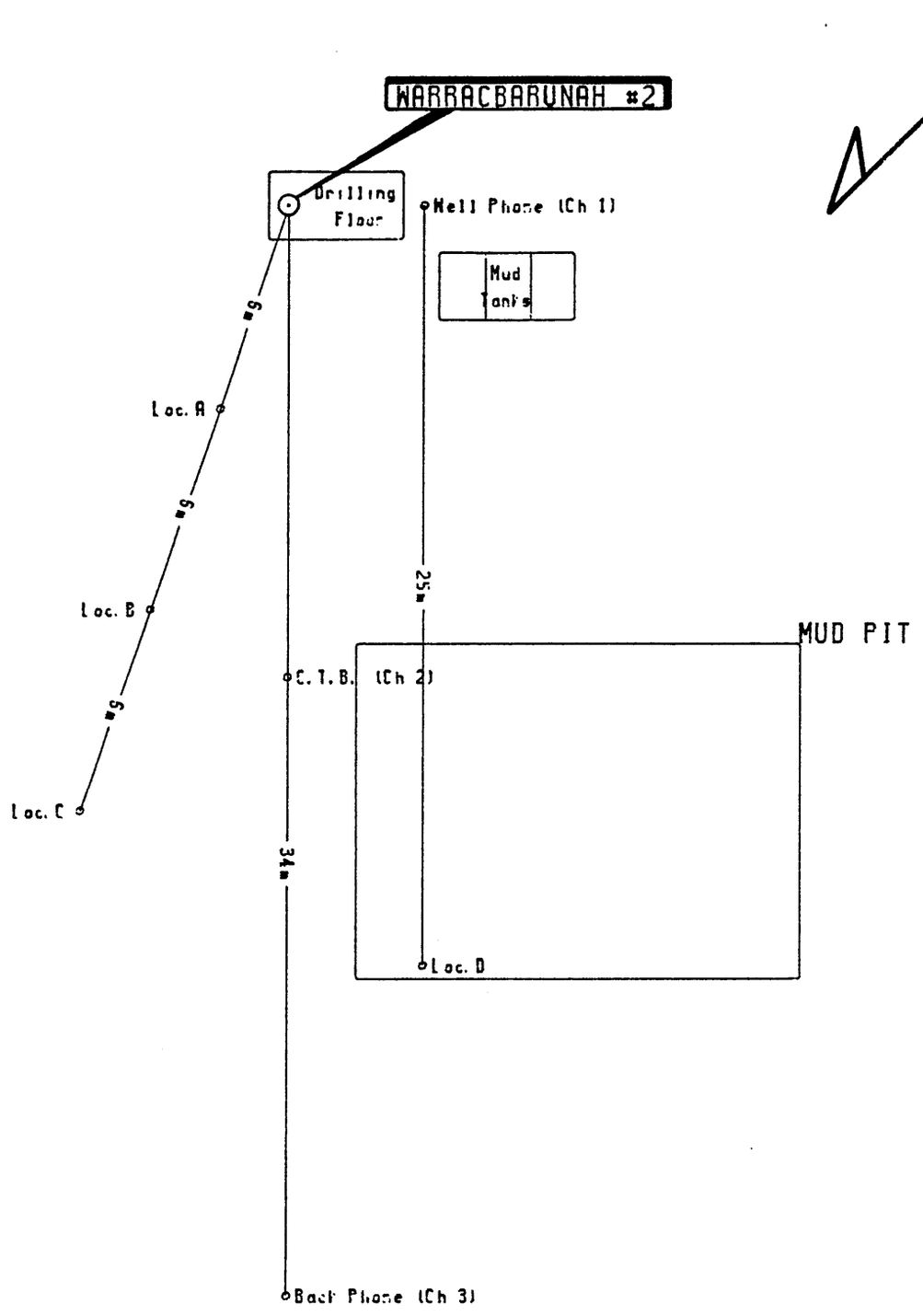
CONTENTS



WARRACBARUNAH # 2
GEOLOGICAL SURVEY OF AUSTRALIA
WELL LOCATION MAP

Scale 1:1000 000

Figure 1



WARRACBARUNAH #2

GEOLOGICAL SURVEY OF VICTORIA

SHOT POINT LOCATION SKETCH

Figure 2

SUMMARY

Velocity Data Pty Ltd conducted a velocity survey for Geological Survey of Victoria in the Warracbarunah No 2 well , PEP 100, Otway Basin, Victoria.

The date of the survey was the 28th March 1991.

The results of the survey, which are considered to be reliable, have been used to calibrate the sonic log.

Explosives were used as an energy source with shots being fired in the mud pit in the majority of instances.

GENERAL INFORMATION

Name of Well	:	Warracbarunah #2
Location (Figure 1)	:	PEP 100, Otway Basin
Coordinates	:	Latitude 038 10 21
	:	Longitude 143 48 39
Date of Survey	:	March 28th, 1991.
Wireline Logging	:	BPB Unit V1030
Weather	:	Fine
Operational Base	:	Brisbane
Operator	:	N. Delfos
Shooter	:	J. Brown
Client Representative	:	Mr. C Menhennitt

EQUIPMENT

Downhole Tool

Veldata Camlock 100 (90 mm)

Sensors:

6 HSI 4.5 Hz 215 ohm, high temperature (300 degrees F) detectors connected in series parallel. Frequency response 8-300 Hz within 3 dB.

Preamplifier:

48 dB fixed gain.
Frequency response 5-200 Hz within 3 dB.

Reference Geophone

Mark Products L1 4.5 Hz

Recording Instrument

VDLS 11/10 software controlled digital recording system utilising SIE OPA-10 floating point amplifiers for digital recording and SIE OPA-4 amplifiers for analog presentation. The system includes a DEC LSI-11 CPU,twin cassette tape unit and printer.

RECORDING

Energy Source	:	Explosive, AN-60
Shot Location	:	Mud pit
Charge Size	:	0.5 / 1.0 (125grm) sticks
Average Shot Depth	:	1.0 metre
Average Shot Offset	:	25.0 metres
Recording Geometry	:	Figure 2

Shots were recorded on digital cassette tape. Printouts of the shots used are included with this report.(Enclosure 2)

The sample rate was 1 ms with 0.5 ms sampling over a 200ms window encompassing the first arrivals. The scale of the graphic display varies with signal strength and is noted on each playout.

During the survey the A/D board was known to have a timing error, therefore the times were picked from the printouts using the numerical value of the signal strength and then multiplied by 1.024 to reflect this problem. (Enclosure 2)

PROCESSING

Elevation Data

Elevation of KB	:	128.7m above sea level
Elevation of Ground	:	125.0m above sea level
Elevation of Seismic Datum	:	0.0m above sea level
Depth Surveyed	:	1524.0m below KB
Total Depth	:	1527.4m below KB
Depth of Casing	:	130.2m below KB
Sonic Log Interval	:	20.0 to 1525.0m below KB

PROCESSING

Recorded Data

Number of Shots Used	:	25
Number of Levels Recorded	:	21
Data Quality	:	Excellent
Noise Level	:	Low
Rejected Shots	:	9

Correction for Instrument Delay and Shot Offset

The 'corrected' times shown on the calculation sheet have been obtained by:

(i) Subtraction of the instrument delay (4msec) from the recorded arrival times
(ii) geometric correction for non-verticality of ray paths resulting from shot offset.
(iii) shot static correction to correct for the depth of shot below ground level at the well head using a correction velocity of 1400 metres/sec
(iv) readdition of the instrument delay (4msec).

Correction to Datum

The datum chosen was 0.0 metres ASL that is 128.7 metres below kelly. This level was shot three times during the survey. Using these shots an average time has been computed of 70.6msecs for the effective datum correction, please note that this time includes an instrumentation delay of 4msecs.

PROCESSING

Calibration of Sonic Log - Method

Sonic times were adjusted to checkshot times using a polynomial derived least squares fit correction of the sonic transient times.

These differences arise as the sonic tool measures the local velocity characteristics of the formation with a high frequency signal, whereas the downhole geophone records the bulk velocity character using a signal of significantly lower frequency.

Calibration of Sonic Log - Results (Enclosure 1)

The discrepancies between shot and sonic interval velocities were generally large at the top of the hole. The largest adjustment was 100.0 μsecs/m on the interval 392.0m and 411m below KB.

In aggregate, the shot and sonic interval times differed by 12.6 msec over the logged portion of the well.

A paper copy of the sonic log was provided and on examination of this it was found that the large discrepancies between sonic and interval velocities are likely to be a product of poor borehole conditions.

PROCESSING

Trace Playouts (Figure 4)

Figure 4A is a plot of all traces used. No filter or gain recovery has been applied.

Figure 4B is a plot to scale in depth and time of selected traces. No filter or gain recovery has been applied.

Figure 4C is a plot to scale in depth and time of selected traces with a 5 Hz - 40 Hz filter and a gain recovery function of t^2 applied.

Figure 4D is a plot of selected surface traces. No filter or gain recovery has been applied.

Troy Peters
Geophysical Analyst.

TABLE 1. Time-Depth curve values Page 1.

Well : WARRACBARUNAH #2 Client : GEOLOGICAL SURVEY OF VICTORI
Survey units : METRES Datum : 0.0
Calibrated sonic interval velocities used from 22.5 to 1350.0

Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval	Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interva
2.5	1.1	2370	2370	2370	102.5	58.3	1757	1801	1750
5.0	2.1	2334	2334	2298	105.0	59.7	1758	1801	1811
7.5	3.3	2305	2306	2251	107.5	61.1	1761	1803	1868
10.0	4.4	2281	2282	2213	110.0	62.3	1765	1806	1954
12.5	5.5	2259	2260	2175	112.5	63.7	1765	1805	1770
15.0	6.7	2236	2238	2127	115.0	65.1	1765	1805	1794
17.5	7.9	2209	2211	2059	117.5	66.6	1765	1804	1765
20.0	9.2	2174	2178	1958	120.0	68.0	1765	1803	1771
22.5	11.6	1941	2108	1816	122.5	69.3	1768	1805	1918
25.0	13.3	1882	2039	1481	125.0	70.6	1771	1808	1931
27.5	15.0	1831	1979	1436	127.5	72.0	1771	1807	1777
30.0	16.5	1814	1951	1651	130.0	73.5	1768	1803	1616
32.5	18.0	1808	1935	1743	132.5	75.1	1765	1800	1626
35.0	19.4	1802	1920	1723	135.0	76.3	1768	1803	1948
37.5	20.9	1795	1905	1701	137.5	77.8	1768	1802	1759
40.0	22.3	1790	1894	1723	140.0	79.0	1771	1805	1966
42.5	23.8	1788	1886	1753	142.5	80.2	1778	1811	2213
45.0	25.3	1780	1873	1658	145.0	81.3	1783	1816	2154
47.5	26.9	1768	1857	1571	147.5	82.5	1789	1822	2220
50.0	28.3	1765	1850	1717	150.0	83.6	1795	1828	2220
52.5	29.9	1757	1838	1614	152.5	84.6	1802	1836	2339
55.0	31.3	1759	1836	1787	155.0	85.7	1808	1843	2329
57.5	32.7	1760	1834	1796	157.5	86.9	1813	1847	2138
60.0	34.1	1759	1830	1719	160.0	88.0	1818	1852	2212
62.5	35.6	1757	1825	1723	162.5	89.1	1823	1858	2244
65.0	37.1	1752	1818	1633	165.0	90.3	1827	1861	2094
67.5	38.6	1748	1811	1639	167.5	91.7	1827	1861	1884
70.0	40.1	1744	1805	1642	170.0	93.1	1827	1860	1787
72.5	41.7	1740	1799	1646	172.5	94.2	1830	1863	2101
75.0	43.2	1737	1794	1652	175.0	95.4	1835	1868	2223
77.5	44.7	1734	1790	1658	177.5	96.5	1839	1872	2202
80.0	46.2	1733	1787	1691	180.0	97.6	1844	1877	2233
82.5	47.5	1737	1790	1885	182.5	98.7	1850	1883	2396
85.0	49.0	1734	1785	1626	185.0	99.8	1854	1887	2227
87.5	50.4	1736	1786	1841	187.5	100.9	1858	1891	2181
90.0	51.7	1742	1790	1940	190.0	102.2	1859	1892	1971
92.5	52.9	1747	1795	1979	192.5	103.4	1862	1895	2128
95.0	54.2	1752	1799	1946	195.0	104.6	1864	1896	2045
97.5	55.5	1757	1803	1995	197.5	106.1	1862	1894	1679
100.0	56.9	1757	1802	1747	200.0	107.5	1861	1892	1781

TABLE 1. Time-Depth curve values

Well : WARRACBARUNAH #2 Client : GEOLOGICAL SURVEY OF VICTORIA
Survey units : METRES Datum : 0.0
Calibrated sonic interval velocities used from 22.5 to 1350.0

Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval	Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval
202.5	108.9	1859	1891	1770	302.5	160.8	1882	1909	2000
205.0	110.3	1858	1889	1770	305.0	162.1	1882	1909	1885
207.5	111.7	1857	1888	1773	307.5	163.4	1882	1909	1872
210.0	113.1	1856	1887	1788	310.0	164.6	1883	1910	2137
212.5	114.5	1855	1885	1790	312.5	165.9	1883	1910	1886
215.0	116.0	1853	1883	1690	315.0	167.2	1884	1910	1918
217.5	117.4	1852	1882	1769	317.5	168.3	1887	1913	2338
220.0	118.8	1851	1880	1769	320.0	169.6	1887	1914	1965
222.5	120.2	1850	1879	1772	322.5	170.8	1888	1915	2037
225.0	121.6	1850	1878	1777	325.0	172.0	1890	1916	2159
227.5	123.1	1849	1877	1781	327.5	173.2	1891	1917	2022
230.0	124.5	1848	1876	1776	330.0	174.3	1893	1919	2163
232.5	125.9	1847	1875	1767	332.5	175.6	1894	1920	2018
235.0	127.3	1846	1874	1771	335.0	176.9	1894	1919	1881
237.5	128.7	1846	1873	1785	337.5	178.4	1892	1918	1699
240.0	130.1	1844	1871	1716	340.0	179.5	1895	1920	2350
242.5	131.6	1843	1870	1744	342.5	180.6	1896	1922	2085
245.0	133.0	1842	1868	1767	345.0	181.8	1898	1923	2143
247.5	134.4	1841	1867	1767	347.5	183.0	1899	1925	2204
250.0	135.8	1841	1866	1760	350.0	184.1	1901	1927	2233
252.5	137.2	1840	1865	1764	352.5	185.2	1903	1929	2153
255.0	138.7	1839	1864	1766	355.0	186.4	1905	1930	2181
257.5	140.1	1838	1863	1751	357.5	187.7	1905	1930	1898
260.0	141.5	1837	1862	1762	360.0	188.9	1906	1931	2102
262.5	143.0	1836	1860	1674	362.5	190.1	1907	1932	2135
265.0	144.4	1836	1860	1839	365.0	191.3	1908	1933	2082
267.5	145.6	1837	1861	1968	367.5	192.5	1909	1934	2000
270.0	146.9	1838	1862	1983	370.0	193.8	1910	1934	1984
272.5	148.0	1841	1865	2254	372.5	194.8	1912	1937	2334
275.0	149.1	1845	1869	2360	375.0	196.0	1913	1938	2088
277.5	150.1	1849	1874	2426	377.5	197.2	1914	1939	2164
280.0	151.2	1852	1877	2248	380.0	198.2	1917	1942	2468
282.5	152.2	1856	1882	2581	382.5	199.6	1916	1941	1741
285.0	153.4	1857	1883	1976	385.0	201.1	1914	1939	1712
287.5	154.5	1861	1887	2454	387.5	202.5	1914	1938	1776
290.0	155.5	1865	1891	2435	390.0	203.7	1915	1939	2169
292.5	156.5	1869	1895	2412	392.5	204.8	1916	1941	2156
295.0	157.5	1872	1899	2429	395.0	205.7	1920	1945	2687
297.5	158.5	1877	1904	2586	397.5	206.9	1922	1946	2259
300.0	159.5	1881	1909	2491	400.0	207.9	1924	1949	2311

TABLE 1. Time-Depth curve values

Well : WARRACBARUNAH #2 Client : GEOLOGICAL SURVEY OF VICTORIA
Survey units : METRES Datum : 0.0
Calibrated sonic interval velocities used from 22.5 to 1350.0

Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval	Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval
402.5	209.2	1924	1949	1971	502.5	249.3	2016	2074	3737
405.0	210.6	1923	1948	1800	505.0	249.9	2021	2081	4083
407.5	211.8	1924	1949	2160	507.5	251.2	2021	2080	1953
410.0	213.0	1925	1950	2074	510.0	252.2	2022	2081	2308
412.5	213.9	1928	1953	2539	512.5	253.1	2025	2084	2837
415.0	214.9	1931	1957	2710	515.0	254.0	2028	2088	2897
417.5	215.8	1934	1960	2559	517.5	254.6	2032	2094	3915
420.0	217.1	1935	1960	1990	520.0	255.2	2037	2101	4071
422.5	218.4	1935	1960	1978	522.5	255.9	2041	2107	3538
425.0	219.6	1935	1960	1986	525.0	256.5	2046	2114	4173
427.5	220.9	1935	1960	1964	527.5	257.8	2046	2113	1938
430.0	222.1	1936	1961	2127	530.0	259.4	2043	2110	1605
432.5	222.9	1940	1966	2859	532.5	260.8	2042	2109	1820
435.0	223.9	1943	1969	2755	535.0	261.4	2047	2116	4215
437.5	224.9	1945	1972	2414	537.5	261.9	2053	2125	5049
440.0	225.9	1948	1974	2446	540.0	262.4	2058	2134	4925
442.5	227.0	1949	1976	2320	542.5	263.2	2061	2138	3003
445.0	228.0	1952	1979	2534	545.0	263.8	2066	2145	4243
447.5	228.9	1955	1982	2616	547.5	264.3	2071	2153	4605
450.0	230.0	1957	1984	2374	550.0	264.8	2077	2162	5189
452.5	231.4	1955	1982	1738	552.5	265.3	2082	2171	4924
455.0	232.8	1954	1981	1807	555.0	266.1	2086	2175	3310
457.5	233.7	1958	1985	2922	557.5	267.2	2087	2175	2283
460.0	234.6	1961	1988	2599	560.0	268.3	2087	2175	2241
462.5	236.1	1959	1986	1644	562.5	269.2	2090	2178	2772
465.0	237.7	1957	1984	1643	565.0	269.7	2095	2185	4627
467.5	239.2	1955	1982	1643	567.5	270.2	2100	2195	5382
470.0	240.1	1958	1986	2755	570.0	270.7	2106	2204	5333
472.5	240.6	1964	1998	5437	572.5	271.1	2111	2213	5253
475.0	241.0	1971	2010	5386	575.0	271.6	2117	2222	5041
477.5	242.2	1972	2011	2121	577.5	272.1	2122	2230	5207
480.0	243.3	1973	2012	2352	580.0	272.9	2125	2234	3172
482.5	244.1	1976	2016	2871	582.5	274.1	2125	2233	2046
485.0	244.8	1981	2022	3579	585.0	275.3	2125	2233	2216
487.5	245.3	1987	2033	5094	587.5	276.5	2125	2232	1964
490.0	246.0	1992	2040	3805	590.0	277.8	2124	2231	2036
492.5	246.6	1997	2047	3860	592.5	278.9	2124	2231	2149
495.0	247.1	2003	2056	4762	595.0	280.0	2125	2231	2381
497.5	248.0	2006	2060	3013	597.5	281.2	2125	2231	2084
500.0	248.6	2011	2067	4009	600.0	282.2	2126	2231	2360

TABLE 1. Time-Depth curve values

Well : WARRACBARUNAH #2 Client : GEOLOGICAL SURVEY OF VICTORI
Survey units : METRES Datum : 0.0
Calibrated sonic interval velocities used from 22.5 to 1350.0

Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval	Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interva
602.5	283.3	2127	2231	2338	702.5	323.9	2169	2263	2704
605.0	284.3	2128	2233	2587	705.0	324.9	2170	2264	2555
607.5	285.3	2129	2233	2414	707.5	325.8	2171	2265	2694
610.0	286.3	2131	2234	2490	710.0	326.8	2173	2266	2629
612.5	287.2	2132	2236	2683	712.5	327.7	2174	2267	2694
615.0	288.2	2134	2237	2496	715.0	328.7	2176	2269	2602
617.5	289.2	2136	2239	2700	717.5	329.6	2177	2270	2686
620.0	290.2	2137	2240	2493	720.0	330.5	2178	2271	2697
622.5	291.2	2138	2241	2519	722.5	331.4	2180	2273	2730
625.0	292.1	2139	2242	2544	725.0	332.4	2181	2274	2603
627.5	293.4	2139	2241	2038	727.5	333.3	2182	2275	2624
630.0	294.6	2139	2240	2093	730.0	334.3	2184	2276	2652
632.5	295.7	2139	2240	2270	732.5	335.3	2185	2276	2502
635.0	296.7	2140	2241	2467	735.0	336.3	2186	2277	2531
637.5	297.8	2141	2241	2287	737.5	337.1	2188	2280	3080
640.0	298.8	2142	2242	2345	740.0	338.0	2189	2281	2781
642.5	299.9	2142	2242	2320	742.5	338.9	2191	2282	2735
645.0	301.0	2143	2242	2341	745.0	339.7	2193	2285	3209
647.5	302.3	2142	2241	1935	747.5	340.6	2195	2287	2842
650.0	303.3	2143	2242	2389	750.0	341.5	2196	2288	2732
652.5	304.3	2144	2243	2502	752.5	342.4	2198	2289	2798
655.0	305.3	2145	2243	2430	755.0	343.2	2200	2291	2886
657.5	306.4	2146	2244	2332	757.5	344.1	2201	2293	2906
660.0	307.4	2147	2244	2521	760.0	345.0	2203	2294	2633
662.5	308.4	2148	2245	2487	762.5	346.0	2204	2295	2681
665.0	309.5	2149	2246	2333	765.0	346.9	2206	2296	2839
667.5	310.5	2150	2246	2438	767.5	347.8	2207	2298	2742
670.0	311.6	2150	2247	2346	770.0	348.6	2209	2299	2875
672.5	312.6	2151	2247	2439	772.5	349.6	2210	2300	2677
675.0	313.6	2153	2248	2549	775.0	350.5	2211	2302	2781
677.5	314.6	2154	2249	2575	777.5	351.4	2213	2303	2797
680.0	315.5	2155	2250	2573	780.0	352.2	2214	2305	2897
682.5	316.5	2157	2252	2621	782.5	353.1	2216	2306	2760
685.0	317.4	2158	2253	2676	785.0	354.0	2217	2307	2783
687.5	318.3	2160	2255	2764	787.5	354.9	2219	2309	2795
690.0	319.3	2161	2256	2531	790.0	355.8	2220	2310	2782
692.5	320.3	2162	2256	2501	792.5	356.7	2222	2312	2809
695.0	321.2	2164	2258	2895	795.0	357.5	2223	2313	2999
697.5	322.1	2166	2260	2761	797.5	358.4	2225	2315	2926
700.0	323.0	2167	2261	2732	800.0	359.3	2227	2317	2871

TABLE 1. Time-Depth curve values

Well : WARRACBARUNAH #2 Client : GEOLOGICAL SURVEY OF VICTORI
Survey units : METRES Datum : 0.0
Calibrated sonic interval velocities used from 22.5 to 1350.0

Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval	Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interva
802.5	360.1	2228	2318	2955	902.5	395.1	2284	2372	3066
805.0	361.0	2230	2320	2914	905.0	396.0	2285	2373	2859
807.5	361.8	2232	2321	2870	907.5	396.8	2287	2375	3103
810.0	362.9	2232	2322	2395	910.0	397.6	2288	2376	2943
812.5	363.8	2233	2322	2675	912.5	398.5	2290	2378	2983
815.0	364.7	2235	2324	2886	915.0	399.3	2291	2379	2969
817.5	365.6	2236	2325	2761	917.5	400.2	2292	2380	2712
820.0	366.5	2238	2327	2882	920.0	401.2	2293	2381	2747
822.5	367.4	2239	2328	2785	922.5	402.2	2293	2381	2314
825.0	368.2	2240	2329	2911	925.0	403.1	2295	2382	2877
827.5	369.2	2241	2330	2554	927.5	403.9	2296	2383	3006
830.0	370.0	2243	2332	3072	930.0	404.9	2297	2384	2620
832.5	370.9	2245	2333	2941	932.5	405.9	2297	2384	2398
835.0	371.7	2246	2335	2848	935.0	406.8	2298	2385	2915
837.5	372.6	2248	2337	2999	937.5	407.6	2300	2387	3002
840.0	373.4	2249	2338	2948	940.0	408.5	2301	2388	2967
842.5	374.6	2249	2337	2097	942.5	409.3	2303	2389	2920
845.0	375.6	2250	2338	2618	945.0	410.2	2304	2390	2896
847.5	376.4	2252	2340	3169	947.5	411.0	2306	2392	3178
850.0	377.2	2253	2342	2860	950.0	411.8	2307	2393	2955
852.5	378.0	2255	2344	3420	952.5	412.7	2308	2394	2833
855.0	378.8	2257	2346	3044	955.0	413.5	2309	2396	2952
857.5	379.6	2259	2347	3009	957.5	414.3	2311	2397	3191
860.0	380.4	2261	2349	3053	960.0	415.2	2312	2399	2959
862.5	381.3	2262	2351	3021	962.5	416.0	2314	2400	3013
865.0	382.1	2264	2352	2901	965.0	416.8	2315	2401	2975
867.5	383.0	2265	2354	2922	967.5	417.6	2317	2403	3154
870.0	383.8	2267	2355	2965	970.0	418.4	2318	2405	3146
872.5	384.8	2268	2356	2671	972.5	419.2	2320	2406	3157
875.0	385.7	2269	2357	2658	975.0	420.0	2321	2408	3070
877.5	386.6	2270	2358	2843	977.5	420.8	2323	2409	3152
880.0	387.5	2271	2359	2842	980.0	421.7	2324	2410	2844
882.5	388.3	2273	2361	2930	982.5	422.7	2324	2411	2504
885.0	389.2	2274	2362	2754	985.0	423.6	2326	2412	2928
887.5	390.1	2275	2363	2750	987.5	424.3	2327	2414	3344
890.0	390.9	2277	2365	3164	990.0	425.0	2329	2416	3440
892.5	391.7	2278	2366	3099	992.5	425.8	2331	2417	3217
895.0	392.6	2280	2368	2878	995.0	426.6	2332	2419	3129
897.5	393.5	2281	2369	2835	997.5	427.4	2334	2421	3293
900.0	394.3	2283	2370	3051	1000.0	428.0	2336	2423	3712

TABLE 1. Time-Depth curve values

Well : WARRACBARUNAH #2 Client : GEOLOGICAL SURVEY OF VICTORIA
Survey units : METRES Datum : 0.0
Calibrated sonic interval velocities used from 22.5 to 1350.0

Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval	Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval
1002.5	428.8	2338	2426	3492	1102.5	458.8	2403	2496	3475
1005.0	429.5	2340	2428	3435	1105.0	459.5	2405	2498	3643
1007.5	430.2	2342	2430	3758	1107.5	460.2	2407	2500	3632
1010.0	430.9	2344	2432	3408	1110.0	460.9	2409	2502	3615
1012.5	431.6	2346	2434	3431	1112.5	461.5	2410	2504	3661
1015.0	432.4	2347	2436	3220	1115.0	462.2	2412	2506	3787
1017.5	433.2	2349	2437	3089	1117.5	463.1	2413	2507	2937
1020.0	434.0	2350	2439	3092	1120.0	463.8	2415	2509	3522
1022.5	434.8	2352	2440	3105	1122.5	464.5	2417	2511	3358
1025.0	435.6	2353	2442	3340	1125.0	465.2	2418	2512	3460
1027.5	436.3	2355	2444	3603	1127.5	466.0	2420	2514	3394
1030.0	437.0	2357	2446	3219	1130.0	466.7	2421	2516	3432
1032.5	437.9	2358	2447	3014	1132.5	467.4	2423	2518	3544
1035.0	438.7	2359	2448	3052	1135.0	468.1	2425	2519	3629
1037.5	439.5	2360	2449	2924	1137.5	468.9	2426	2521	3244
1040.0	440.4	2362	2451	3070	1140.0	469.6	2428	2522	3308
1042.5	441.0	2364	2453	3665	1142.5	470.4	2429	2524	3275
1045.0	441.8	2365	2455	3364	1145.0	471.1	2430	2525	3419
1047.5	442.5	2367	2457	3634	1147.5	471.9	2432	2527	3331
1050.0	443.1	2369	2459	3716	1150.0	472.6	2433	2529	3469
1052.5	443.8	2371	2462	3606	1152.5	473.3	2435	2530	3408
1055.0	444.5	2373	2464	3607	1155.0	474.0	2437	2532	3447
1057.5	445.2	2375	2466	3681	1157.5	474.8	2438	2533	3432
1060.0	446.0	2377	2468	3250	1160.0	475.5	2439	2535	3230
1062.5	446.9	2378	2469	2836	1162.5	476.3	2441	2536	3407
1065.0	447.6	2379	2470	3491	1165.0	476.9	2443	2538	3776
1067.5	448.3	2381	2472	3458	1167.5	477.6	2444	2540	3526
1070.0	449.1	2383	2474	3215	1170.0	478.3	2446	2542	3563
1072.5	449.9	2384	2475	2970	1172.5	479.0	2448	2544	3581
1075.0	450.7	2385	2477	3302	1175.0	479.7	2449	2546	3647
1077.5	451.4	2387	2478	3370	1177.5	480.5	2451	2547	3413
1080.0	452.2	2388	2480	3155	1180.0	481.2	2452	2549	3278
1082.5	453.0	2390	2481	3109	1182.5	482.0	2453	2550	3387
1085.0	453.7	2391	2483	3496	1185.0	482.7	2455	2552	3437
1087.5	454.4	2393	2485	3514	1187.5	483.4	2456	2553	3382
1090.0	455.1	2395	2487	3526	1190.0	484.1	2458	2555	3762
1092.5	455.9	2397	2489	3466	1192.5	484.8	2460	2557	3544
1095.0	456.6	2398	2490	3391	1195.0	485.5	2461	2558	3398
1097.5	457.4	2400	2492	3305	1197.5	486.3	2463	2560	3387
1100.0	458.1	2401	2494	3512	1200.0	487.0	2464	2561	3406

TABLE 1. Time-Depth curve values

Well : WARRACBARUNAH #2 Client : GEOLOGICAL SURVEY OF VICTORI
Survey units : METRES Datum : 0.0
Calibrated sonic interval velocities used from 22.5 to 1350.0

Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interval	Datum Depth	One-way time(ms)	-----VELOCITIES----- Average	RMS	Interva
1202.5	487.7	2466	2563	3561	1300.0	517.2	2514	2612	3269
1205.0	488.4	2467	2565	3458	1302.5	518.0	2514	2612	2968
1207.5	489.2	2468	2566	3428	1305.0	518.8	2515	2613	3069
1210.0	489.9	2470	2568	3440	1307.5	519.7	2516	2614	3016
1212.5	490.6	2471	2569	3444	1310.0	520.5	2517	2614	2917
1215.0	491.3	2473	2571	3686	1312.5	521.3	2518	2615	3024
1217.5	492.0	2475	2573	3475	1315.0	522.2	2518	2616	3043
1220.0	492.8	2476	2574	3387	1317.5	523.0	2519	2616	2917
1222.5	493.5	2477	2575	3328	1320.0	523.9	2520	2617	2983
1225.0	494.2	2479	2577	3632	1322.5	524.7	2521	2618	3065
1227.5	494.9	2480	2579	3649	1325.0	525.5	2521	2618	3116
1230.0	495.6	2482	2580	3415	1327.5	526.3	2522	2619	2894
1232.5	496.3	2483	2582	3551	1330.0	527.2	2523	2619	2875
1235.0	497.0	2485	2584	3573	1332.5	528.1	2523	2620	2942
1237.5	497.8	2486	2585	3358	1335.0	528.9	2524	2620	2857
1240.0	498.5	2488	2586	3440	1337.5	529.8	2525	2621	2898
1242.5	499.2	2489	2588	3327	1340.0	530.7	2525	2621	2856
1245.0	500.0	2490	2589	3265	1342.5	531.6	2526	2622	2844
1247.5	500.8	2491	2590	3337	1345.0	532.5	2526	2622	2745
1250.0	501.5	2493	2592	3449	1347.5	533.4	2526	2622	2813
1252.5	502.2	2494	2593	3403	1350.0	534.3	2527	2622	2782
1255.0	502.9	2495	2594	3491	1352.5	535.0	2528	2624	3664
1257.5	503.8	2496	2595	3010	1355.0	535.7	2530	2626	3908
1260.0	504.6	2497	2596	3149	1357.5	536.3	2531	2628	4074
1262.5	505.3	2498	2597	3139	1360.0	536.9	2533	2630	4182
1265.0	506.1	2499	2598	3300	1362.5	537.5	2535	2633	4249
1267.5	506.9	2501	2599	3304	1365.0	538.0	2537	2635	4292
1270.0	507.7	2502	2600	3139	1367.5	538.6	2539	2638	4317
1272.5	508.5	2503	2601	3133	1370.0	539.2	2541	2640	4333
1275.0	509.2	2504	2603	3422	1372.5	539.8	2543	2642	4344
1277.5	510.0	2505	2604	3118	1375.0	540.3	2545	2645	4351
1280.0	510.8	2506	2605	3160	1377.5	540.9	2547	2647	4359
1282.5	511.6	2507	2606	3226	1380.0	541.5	2548	2650	4366
1285.0	512.4	2508	2606	3104	1382.5	542.1	2550	2652	4378
1287.5	513.2	2509	2607	3081	1385.0	542.6	2552	2654	4396
1290.0	514.0	2510	2608	3022	1387.5	543.2	2554	2657	4426
1292.5	514.8	2511	2609	3007	1390.0	543.8	2556	2659	4475
1295.0	515.6	2512	2610	3163	1392.5	544.3	2558	2662	4560
1297.5	516.4	2513	2611	3149	1395.0	544.8	2560	2665	4708

PE907642

This is an enclosure indicator page.
The enclosure PE907642 is enclosed within the container PE902071 at this location in this document.

The enclosure PE907642 has the following characteristics:

ITEM_BARCODE	= PE907642
CONTAINER_BARCODE	= PE902071
NAME	= One Way Time Graph
BASIN	= OTWAY
PERMIT	= PEP 100
TYPE	= WELL
SUBTYPE	= VELOCITY_CHART
DESCRIPTION	= One Way Time Graph, m/sec, Time Depth & Velocity Curves by Velocity Data Pty Ltd(figure 3 from appendix 5 -Velocity Survey Report- from Well Completion Report vol.1) for Warracbarunah-2
REMARKS	=
DATE_CREATED	= 23/03/90
DATE_RECEIVED	= 29/01/92
W_NO	= W1042
WELL_NAME	= Warracbarunah-2
CONTRACTOR	=
CLIENT_OP_CO	= Geological Survey of Victoria

(Inserted by DNRE - Vic Govt Mines Dept)

FIGURE 3a

+ SONIC POINT
O CHECK SHOT

ONE-WAY TIME (MSEC)

100 200 300 400 500 600 700 800 900 1000

128.7 — DATUM — 0

411.0 — DILWYN FM — 160

430.0 — OLDER VOLCANICS — 320

432.0 — EASTERN VIEW FM EQV

588.0 — VOLCANICS — 480

729.0 — EUMERALLA FM — 640

933.0 — CRAYFISH FM — 800

960

1120

1280

1491.0 — CRAYFISH FM SANDY — 1440

1600

DEPTH BELOW DATUM (METRES)

Average velocity

RMS velocity

Interval velocity

GEOLOGICAL SURVEY OF VICTORIA

WARRACBARUNAH #2

TIME-DEPTH & VELOCITY CURVES

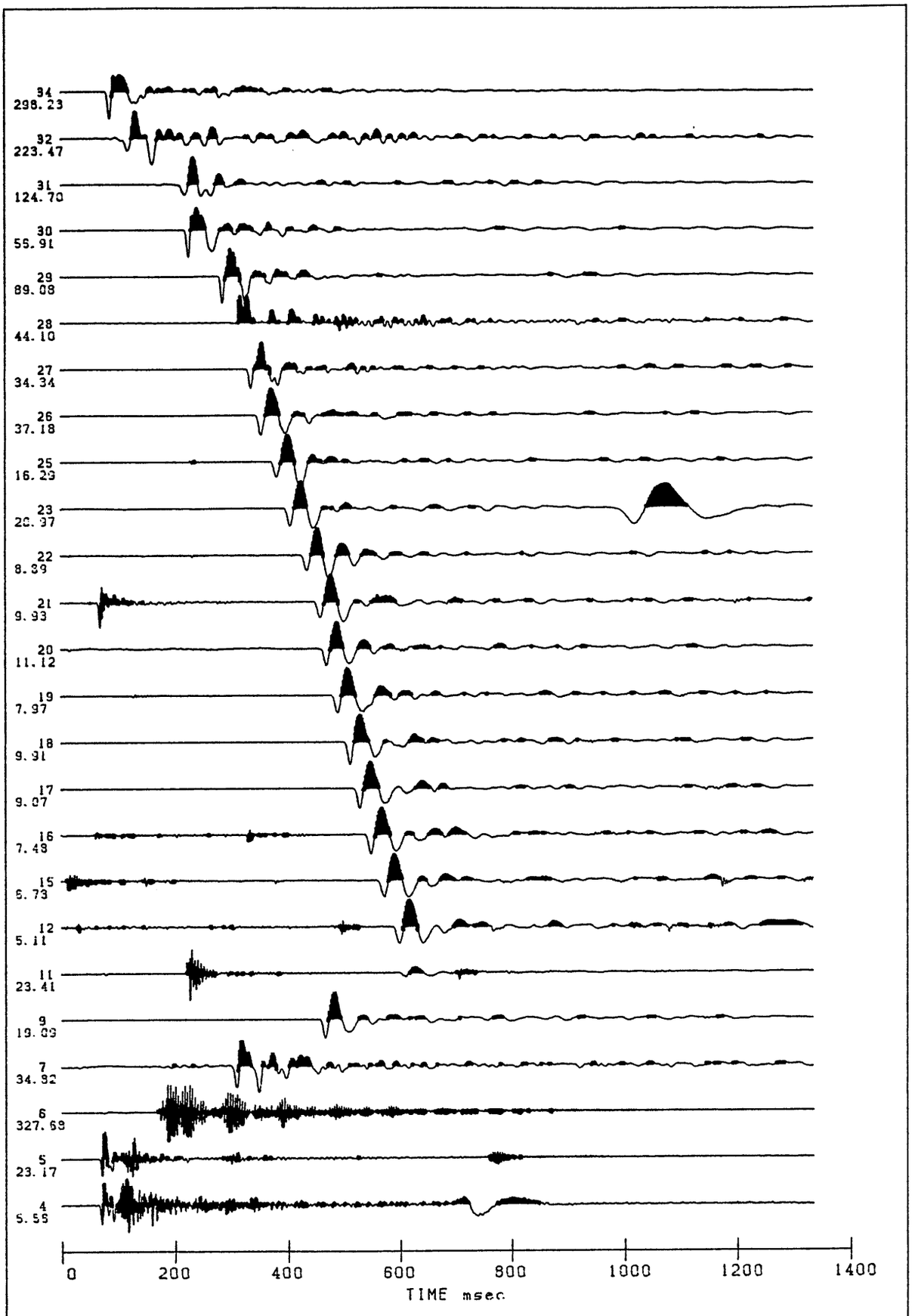
BY
VELOCITY DATA PTY LTD

23 MARCH 1990

1500 3000 1000 4500

AVERAGE & RMS VELOCITY (m/sec)

INTERVAL VELOCITY (m/sec)



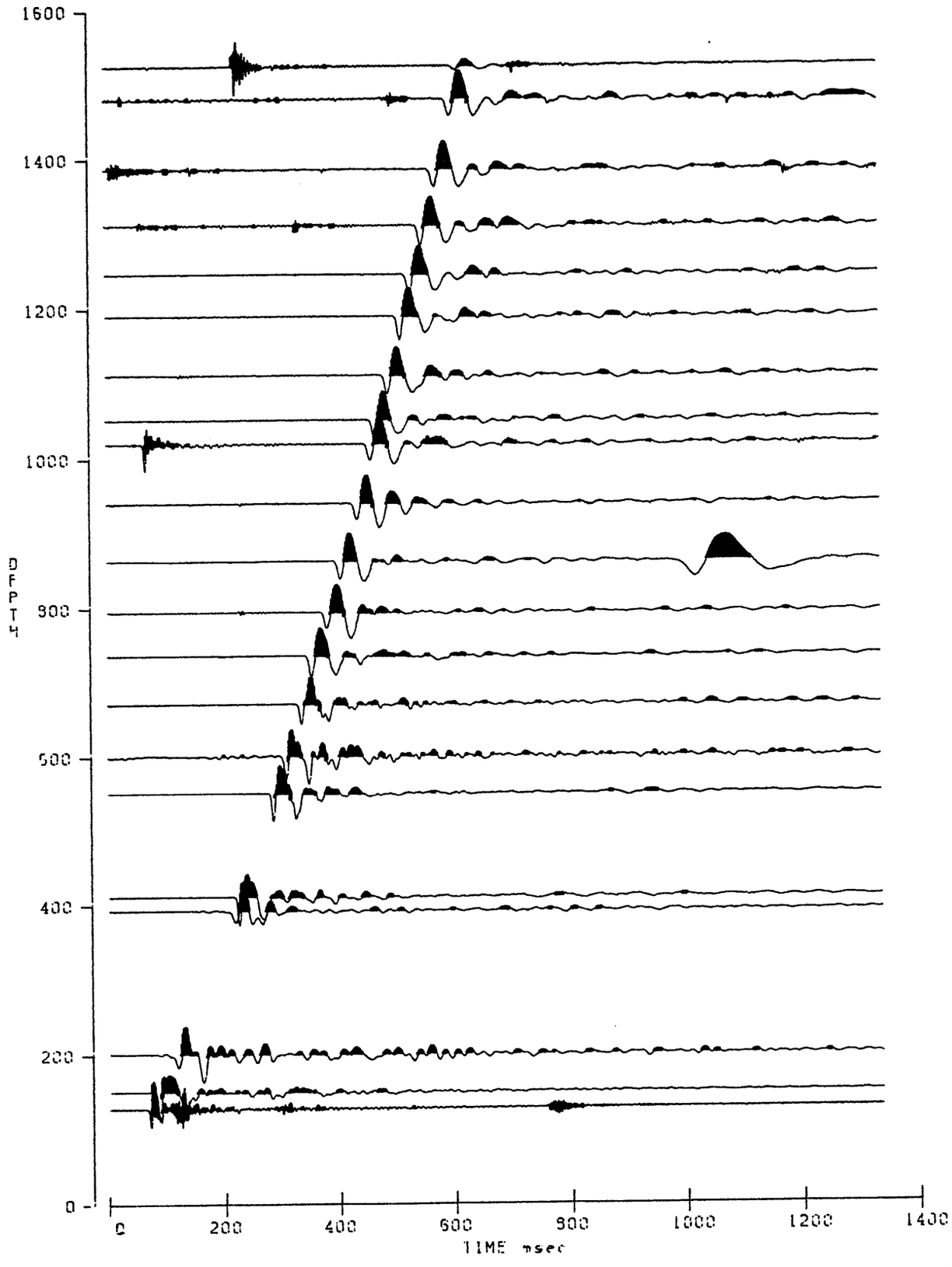
WARRACBARUNAH #2

VELOCITY SURVEY TRACE DISPLAY

Filter OUT - OUT

No gain recovery

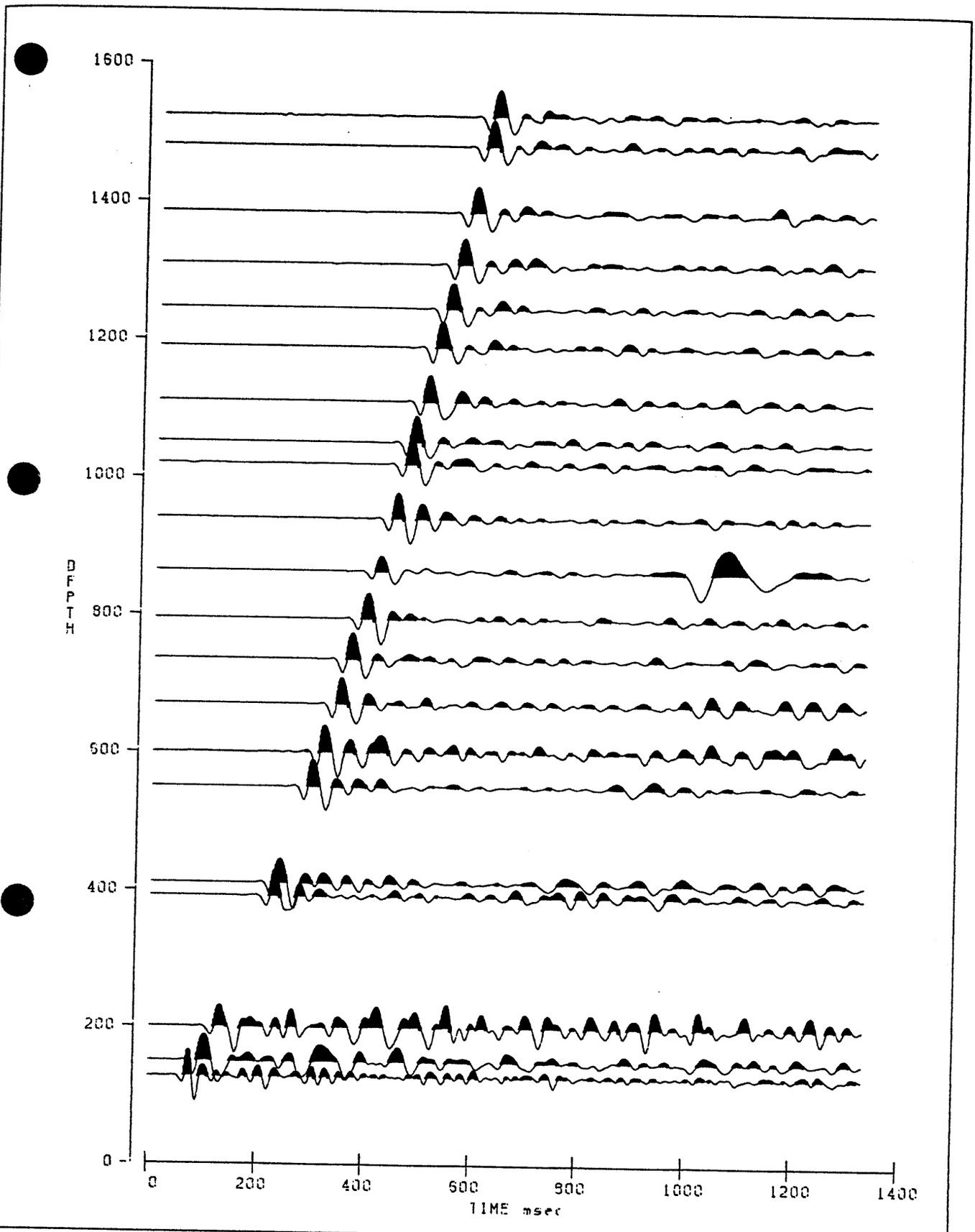
Figure 4A



WARRACBARUNAH #2

VELOCITY SURVEY TRACE DISPLAY
Filter OUT - OUT
No gain recovery

Figure 46



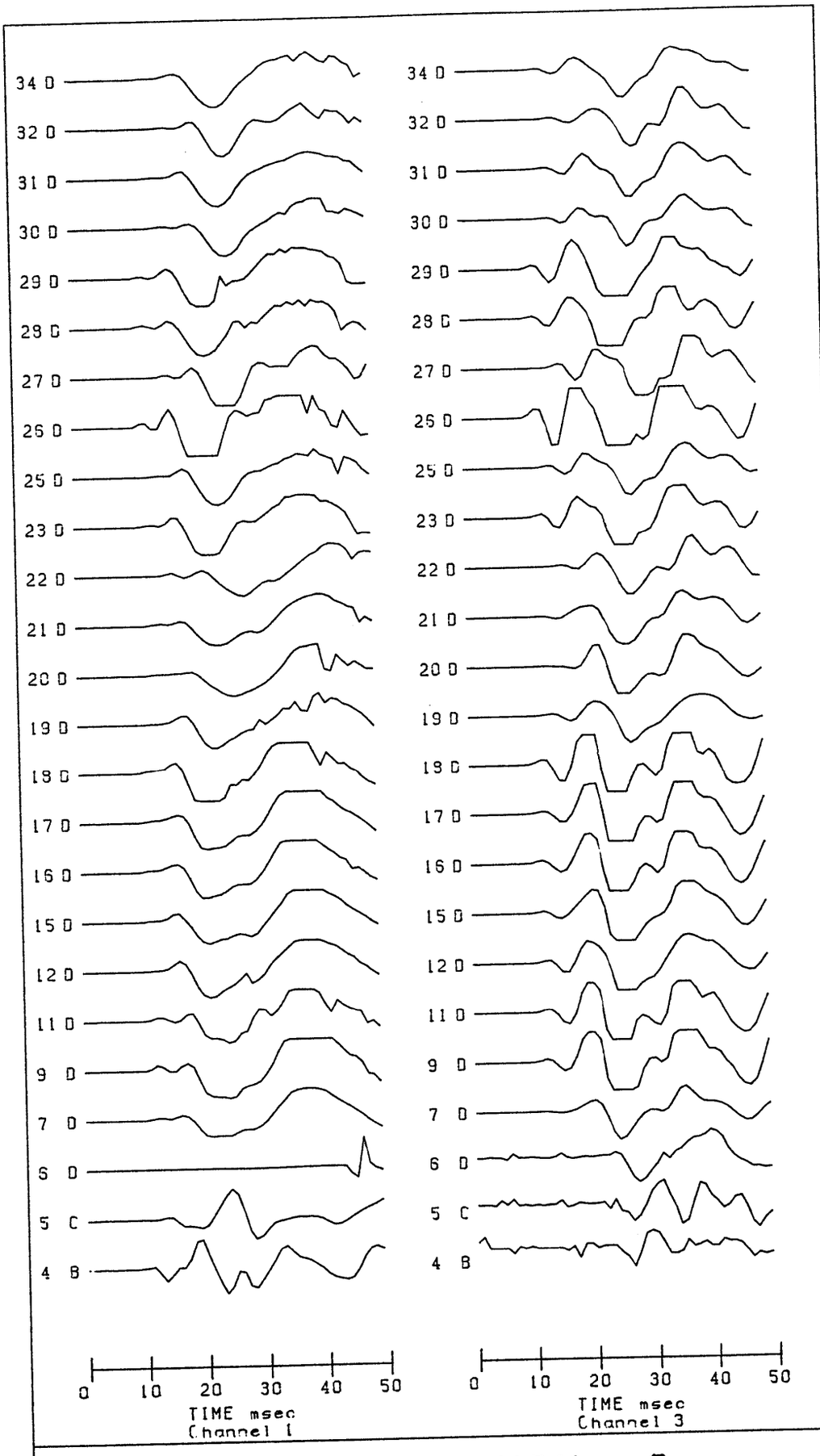
WARRACBARUNAH #2

VELOCITY SURVEY TRACE DISPLAY

Filter 5-40

Gain $T^{2.0}$

Figure 40



WARRACBARUNAH #2

VELOCITY SURVEY TRACE DISPLAY
Auxiliary channels
Filter OUT-OUT

Figure 40

Company : GEOLOGICAL SURVEY OF VICTORIA
Well : WARRACBARUNAH #2
Elevations : Datum : 0.0 Ground : 125.0 Kelly : 128.7
Shot data : Location Elevation Offset

A	125.0	6.0
B	125.0	12.0
C	125.0	18.0
D	125.0	25.0

Latitude : 038 10
Longitude : 143 48 39
Rig identification :
Energy source : AN60
Logger : BPB V1030
Near surface velocity for shot statics: 1400
Instrument delay: 4.0 ms

Survey date : 28-MAR-
Survey units : METRES
Times in milliseconds.

SHOT CALCULATIONS

Shot No	Geophone depth Kelly	Geophone depth Datum	Shot Locn	Shot Depth	TIMES Record	TIMES Corr.	TIMES Avg.	TIMES Below datum	Check shot interval Distance	Check shot interval Time	Velocities Average	Velocities RMS	Velocities Interval
DATUM													
4	128.7	0.0	B	1.0	69.6	70.0							
5	128.7	0.0	C	1.0	70.7	70.7							
6	128.7	0.0	D	1.0	71.7	71.1	70.6	0.0					
									21.3	9.9			2151.5
34	150.0	21.3	D	1.0	80.9	80.5	80.5	9.9			2151.5	2151.5	
									50.0	31.9			1567.4
32	200.0	71.3	D	1.0	112.6	112.4	112.4	41.8			1705.7	1723.7	
									192.0	102.9			1865.9
31	392.0	263.3	D	1.0	215.0	215.3	215.3	144.7			1819.6	1826.0	
									19.0	8.2			2317.1
DILWYN FM													
30	411.0	282.3	D	1.0	223.2	223.5	223.5	152.9			1846.3	1855.6	
									139.0	61.6			2256.5
29	550.0	421.3	D	1.0	284.7	285.1	285.1	214.5			1964.1	1979.1	
									50.0	22.8			2193.0
7	600.0	471.3	D	1.0	308.2	308.6							
28	600.0	471.3	D	1.0	306.7	307.1	307.9	237.3			1986.1	2000.6	
									70.0	29.0			2413.8
27	670.0	541.3	D	1.0	336.4	336.9	336.9	266.3			2032.7	2049.6	
									124.0	44.0			2818.2
26	735.0	606.3	D	1.0	353.3	353.8	N/U						
25	794.0	665.3	D	1.0	380.4	380.9	380.9	310.3			2144.1	2175.2	
									69.0	25.1			2749.0
23	863.0	734.3	D	1.0	405.5	406.0	406.0	335.4			2189.3	2223.3	
									77.0	30.3			2541.3
22	940.0	811.3	D	1.0	435.7	436.3	436.3	365.7			2218.5	2251.3	
									79.0	24.1			3278.0
21	1019.0	890.3	D	1.0	459.8	460.4	460.4	389.8			2284.0	2328.0	
									32.0	9.7			3299.0
9	1051.0	922.3	D	1.0	469.0	469.6							
20	1051.0	922.3	D	1.0	470.0	470.6	470.1	399.5			2308.6	2356.3	
									59.0	21.5			2744.2
19	1110.0	981.3	D	1.0	491.0	491.6	491.6	421.0			2330.9	2377.6	
									79.0	24.1			3278.0
18	1189.0	1060.3	D	1.0	515.1	515.7	515.7	445.1			2382.2	2434.9	

Company : GEOLOGICAL SURVEY OF VICTORIA
Well : WARRACBARUNAH #2
Elevations : Datum : 0.0 Ground : 125.0 Kelly : 128.7
Shot data : Location Elevation Offset

Location	Elevation	Offset
A	125.0	6.0
B	125.0	12.0
C	125.0	18.0
D	125.0	25.0

Latitude : 038 10 21
Longitude : 143 48 39
Rig identification :
Energy source : AN60
Logger : BPB V1030
Near surface velocity
for shot statics: 1400
Instrument delay: 4.0 ms

Survey date : 28-MAR-[illegible]
Survey units : METRES
Times in milliseconds.

SHOT CALCULATIONS

Shot No	Geophone depth Kelly	Geophone depth Datum	Shot Locn	Shot Depth	TIMES Record	TIMES - Corr.	TIMES Avg.	TIMES - Below datum	Check shot interval Distance	Check shot interval Time	Velocities Average	Velocities RMS	Velocities Interval
18	1189.0	1060.3	D	1.0	515.1	515.7	515.7	445.1			2382.2	2434.9	
									56.0	17.4			3218.4
17	1245.0	1116.3	D	1.0	532.5	533.1	533.1	462.5			2413.6	2468.9	
									65.0	20.5			3170.7
16	1310.0	1181.3	D	1.0	553.0	553.6	553.6	483.0			2445.8	2502.7	
									75.0	22.0			3409.1
15	1385.0	1256.3	D	1.0	575.0	575.6	575.6	505.0			2487.7	2548.9	
									95.0	29.7			3198.7
12	1480.0	1351.3	D	1.0	604.7	605.3	605.3	534.7			2527.2	2589.3	
									44.0	10.2			4313.7
11	1524.0	1395.3	D	1.0	614.9	615.5	615.5	544.9			2560.7	2632.0	

Company : GEOLOGICAL SURVEY OF VICTORIA
Well : WARRACBARUNAH #2
Elevations : Datum : 0.0 Ground : 129.0 Kelly : 128.7

Latitude : 038 10 21
Longitude : 143 4[illegible]

Survey date : 28-MAR-[illegible]
Survey units : METRES
Times in milliseconds.

SONIC DRIFT

	Geophone depth Kelly	Datum	Check shot times Average	Below datum	Check shot interval Distance	Time	Sonic Int. time	Interval sonic drift usec/m	msec	Cumulative drift msec
DATUM										
	128.7	0.0	70.6	0.0						
	150.0	21.3	80.5	9.9	21.3	9.9	10.5	-28.17	-0.6	-0.6
	200.0	71.3	112.4	41.8	50.0	31.9	31.3	12.00	0.6	0.0
	392.0	263.3	215.3	144.7	192.0	102.9	116.1	-68.75	-13.2	-13.2
DILWYN FM					19.0	8.2	10.1	-100.00	-1.9	-15.1
	411.0	282.3	223.5	152.9						
	550.0	421.3	285.1	214.5	139.0	61.6	73.2	-83.45	-11.6	-26.7
	600.0	471.3	307.9	237.3	50.0	22.8	23.9	-22.00	-1.1	-27.8
	670.0	541.3	336.9	266.3	70.0	29.0	22.8	88.57	6.2	-21.6
	794.0	665.3	380.9	310.3	124.0	44.0	44.7	-5.65	-0.7	-22.3
	863.0	734.3	406.0	335.4	69.0	25.1	24.3	11.59	0.8	-21.5
	940.0	811.3	436.3	365.7	77.0	30.3	24.9	70.13	5.4	-16.1
	1019.0	890.3	460.4	389.8	79.0	24.1	25.6	-18.99	-1.5	-17.6
	1051.0	922.3	470.1	399.5	32.0	9.7	10.6	-28.12	-0.9	-18.5
	1110.0	981.3	491.6	421.0	59.0	21.5	19.6	32.20	1.9	-16.6
	1189.0	1060.3	515.7	445.1	79.0	24.1	24.0	1.27	0.1	-16.5
	1245.0	1116.3	533.1	462.5	56.0	17.4	17.1	5.36	0.3	-16.2
	1310.0	1181.3	553.6	483.0	65.0	20.5	19.7	12.31	0.8	-15.4
	1385.0	1256.3	575.6	505.0	75.0	22.0	21.8	2.67	0.2	-15.2
	1480.0	1351.3	605.3	534.7	95.0	29.7	27.1	27.37	2.6	-12.6
	1524.0	1395.3	615.5	544.9	44.0	10.2				

Company : GEOLOGICAL SURVEY OF VICTORIA
Well : WARRACBARUNAH #2
Elevations : Datum : 0.0 Ground : [illegible] Kelly : 128.7

Latitude : 038 10 21
Longitude : 143 48 [illegible]

Survey date : 28-MAR-90
Survey units : METRES
Times in milliseconds

SONIC CALIBRATION

Geophone depth Kelly	Geophone depth Datum	Interval Distance	Original sonic times Interval	Original sonic times Cumulative	Adjusted sonic times Interval	Adjusted sonic times Calibrated	Velocities Average	Velocities RMS	Velocities Interval
DATUM									
128.7	0.0								
		21.3	10.5		9.9				2151.5
150.0	21.3			10.5		9.9	2151.5	2151.5	
		50.0	31.3		31.9				1567.4
200.0	71.3			41.8		41.8	1705.7	1723.7	
		192.0	116.1		102.9				1865.9
392.0	263.3			157.9		144.7	1819.6	1826.0	
		19.0	10.1		8.2				2317.1
DILWYN FM									
411.0	282.3			168.0		152.9	1846.3	1855.6	
		19.0	9.4		7.8				2431.4
OLDER VOLCANICS									
430.0	301.3			177.4		160.7	1874.8	1887.7	
		2.0	1.2		1.0				1935.9
EASTERN VIEW FM EQV									
432.0	303.3			178.6		161.7	1875.1	1888.0	
		118.0	62.6		52.8				2236.9
550.0	421.3			241.2		214.5	1964.1	1979.5	
		38.0	17.5		16.7				2280.4
VOLCANICS									
588.0	459.3			258.7		231.2	1986.9	2002.7	
		12.0	6.4		6.1				1955.7
600.0	471.3			265.1		237.3	1986.1	2001.5	
		70.0	22.8		29.0				2413.8
670.0	541.3			287.9		266.3	2032.7	2050.4	
		59.0	18.9		18.6				3177.7
EUMERALLA FM									
729.0	600.3			306.8		284.9	2107.3	2142.0	
		65.0	25.8		25.4				2555.7
794.0	665.3			332.6		310.3	2144.1	2178.9	
		69.0	24.3		25.1				2749.0
863.0	734.3			356.9		335.4	2189.3	2226.6	
		70.0	22.5		27.4				2553.9
CRAYFISH FM									
933.0	804.3			379.4		362.8	2216.9	2253.0	
		7.0	2.4		2.9				2421.4
940.0	811.3			381.8		365.7	2218.5	2254.4	
		79.0	25.6		24.1				3278.0
1019.0	890.3			407.4		389.8	2284.0	2330.8	
		32.0	10.6		9.7				3299.0
1051.0	922.3			418.0		399.5	2308.6	2359.0	
		59.0	19.6		21.5				2744.2
1110.0	981.3			437.6		421.0	2330.9	2380.2	

Company : GEOLOGICAL SURVEY OF VICTORIA
Well : WARRACBARUNAH #2
Elevations : Datum : 0.0 Ground : 128.0 Kelly : 128.7

Latitude : 038 10 21
Longitude : 143 48

Survey date : 28-MAR-90
Survey units : METRES
Times in milliseconds.

SONIC CALIBRATION

Geophone depth Kelly	Geophone depth Datum	Interval Distance	Original sonic times Interval	Original sonic times Cumulative	Adjusted sonic times Interval	Adjusted sonic times Calibrated	Velocities Average	Velocities RMS	Velocities Interval
1110.0	981.3			437.6		421.0	2330.9	2380.2	
		79.0	24.0		24.1				3278.0
1189.0	1060.3			461.6		445.1	2382.2	2437.3	
		56.0	17.1		17.4				3218.4
1245.0	1116.3			478.7		462.5	2413.6	2471.1	
		65.0	19.7		20.5				3170.7
1310.0	1181.3			498.4		483.0	2445.8	2504.8	
		75.0	21.8		22.0				3409.1
1385.0	1256.3			520.2		505.0	2487.7	2550.9	
		95.0	27.1		29.7				3198.7
1480.0	1351.3			547.3		534.7	2527.2	2591.1	
		11.0	3.0		3.0				3666.7
CRAYFISH FM SANDY									
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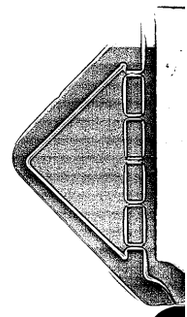
		33.0							
1524.0	1395.3								

Appendix 6



APPENDIX 6

PETROLOGICAL REPORT

AMDEL
CORE
SERVICES

PETROLOGY REPORT

WARRACBARUNAH #5

OTWAY BASIN

Report prepared for

The Department of Manufacturing and Industry Development

Geological Survey of Victoria

by

S E PHILLIPS & D L CATHRO

Amdel Core Services
PO Box 109
Eastwood
SA 5063

August 1991

INDEX

1. SUMMARY

The Department of Manufacturing and Industry Development requested petrological descriptions of 4 core plugs from Warracbarunah #5 (formerly Warracbarunah #2) in the Otway Basin. The primary aim of this study was to determine why samples 1 and 8 have much lower permeabilities than samples 4 and 7.

Routine core analysis indicated that porosity and permeability are variable in these four samples, with porosity ranging from 6.4% to 15.9% and permeability ranging from 0.01md to 174.0md. The lower measurements were detected in samples 1 and 8. Porosity and permeability were reduced in sample 1 by compaction and the presence of cements, matrix and deformed lithics. Intergranular pore throats were typically choked by either kaolin booklets, matrix or deformed lithic fragments and secondary dissolution pores were not interconnected. Porosity and permeability was low in sample 8, due to the abundant carbonate cement. Samples 4 and 7 both have higher porosity and permeability. Quartz cementation prior to compaction has preserved intergranular pores in both samples, thus enhancing permeability. Bedding limited porosity and permeability in Sample 7 where most of the sample is composed of a matrix rich litharenite with only traces of porosity and permeability. Lack of matrix and cements in sample 4 has resulted in increased porosity and permeability. Permeability and porosity is further enhanced in sample 7 by the presence of fractures associated with the organic stringers. These fractures are thought to have been induced by the release of pressure after drilling and therefore porosity and permeability is artificially enhanced in this sample.

Core samples from Warracbarunah #5 are composed of muddy and clean sublitharenites, a litharenite and a carbonate cemented sublitharenite. Grain size varies from silt to very coarse sand and they range from well to poorly sorted.

Quartz is predominantly of the granitic/plutonic variety with minor polycrystalline quartz indicating a metamorphic contribution. Lithics of igneous, metamorphic and sedimentary provenance are represented in all samples.

No definitive evidence is present to suggest a particular depositional environment. Variable textural maturity and mineralogical immaturity, and angularity of framework grains, suggest the samples were deposited after only short distances of transport from the provenance region. Bedding was noted in three samples, which indicates the influence of current activity. The lack of marine indicators, combined with the sedimentological features noted, may suggest a fluvial/alluvial depositional environment.

Diagenetic alteration in the litharenites and sublitharenites is a major factor in the preservation, occlusion and development of porosity and permeability. Although the paragenetic sequence is uncertain, the following diagenetic events have been identified:

Sericitisation of feldspars
Micritic carbonate
Early pyrite
Dissolution of labiles and kaolinisation
Silicification
Mechanical compaction
Carbonate cementation
Chloritisation

Fe oxide precipitation
?Zeolites
Hydrocarbon migration

The above events are not recognised in all samples and should not to be regarded as discrete, rather they probably overlap in time.

2. INTRODUCTION

The Department of Manufacturing and Industry Development of the Geological Survey of Victoria, requested petrological descriptions of 4 core plugs from Warracbarunah #5 (formerly Warracbarunah #2) in the Otway Basin. The primary aim of this study was to determine why samples 1 and 8 have much lower permeabilities than samples 4 and 7 as documented in the conventional core analysis report (008/096 dated 20th May 1991) from Amdel Core Services.

Core plugs cut from the following core samples were examined in thin section:

Sample Number	Core Number	Depth (m)	*Porosity (%)	*Permeability (md)
1	15	1524.88-1527.46	11.5	0.79
4	14a	1497.36-1501.31	15.2	25.00
7	11d	1342.99-1347.84	15.9	174.00
8	11a	1342.99-1347.84	6.4	0.01

* Results from Conventional Core Analysis Report 008/096 (20 May 1991)

3. METHODS

Samples were described in hand specimen, then impregnated with araldite prior to thin section preparation. Blue dye was used in the araldite to facilitate description of porosity and permeability. Thin sections were systematically scanned to determine lithology, composition, porosity and textural relationships. All percentages given in thin section descriptions are based on visual estimates, not point counts.

4. CORE PLUG PETROLOGY

4.1 Warracbarunah #5, Sample 1, Core 15, 1524.88 - 1527.46m

Hand specimen description
Sample received consisted of two pieces of full diameter core plug approximately 1cm thick. It was a fine to coarse grained (average medium), moderately sorted, well cemented, olive grey (5Y 4/1) sandstone. There was an immediate slight reaction with 10% HCl in isolated zones, suggesting the presence of carbonate. Porosity/permeability was slight and no sedimentary features were evident. Trace amounts of opaques and feldspars were noted.

Thin section description
This sample is a very fine to coarse grained (average medium), poorly sorted, carbonate and kaolin cemented, texturally submature, mineralogically immature sublitharenite (Fig. 1). Rare discontinuous opaque stringers are evident. Grains are subangular to angular (rarely rounded) and moderately to poorly spherical.

Framework grains are composed of quartz, feldspar, lithics, mica, tourmaline and zircon. Monocrystalline quartz is predominant, it contains rare fluid and mineral (rutile needles) inclusions, Boehm lamellae, and has straight to slightly undulose extinction. Rare polycrystalline quartz exhibits both stressed and unstressed characteristics. Plagioclase, microcline, perthite and K-feldspar, in varying proportions and stages of alteration are evident. Plagioclase is the most abundant and possibly has a composition of sanidine. Microcline grains are typically fresh, whereas both fresh and partially dissolved examples of perthite are evident. Honeycomb porosity has resulted from extensive dissolution of untwinned K-feldspars (Fig. 1). Lithics are variable in provenance and relatively abundant. They are composed of igneous (volcanic), sedimentary (chert) and deformed schistose metamorphic rock fragments. The lithics are predominantly of metamorphic origin. Mica (muscovite) is up to 0.55mm long and is commonly slightly splayed. Green and brown tourmaline is fine grained, well rounded and unzoned. Zircon grains are up to very fine sand sized and are commonly rounded.

Matrix is evident as illite coating grains. The alignment of the illite plates parallel to grain boundaries suggests the clay is detrital. Opaque material (?organic matter) and associated pyrite occurs in stringers within the matrix.

Authigenic minerals and cements include carbonate, kaolin, glaucony, quartz and pyrite. Carbonate occurs as clear anhedral spar (Fig. 1) and iron stained microspar which fills intergranular pores and partially replaces framework grains. The clear spar is also commonly intermixed with kaolin and rarely takes the form of dogtooth spar. The iron rich microspar commonly forms in patches where it coats and replaces grains and only partially occludes porosity. Kaolin booklets that are rarely vermiform, fill intergranular pores (Fig. 1) and replace labile grains. Commonly the kaolin is associated with ?glaucony in the form of chlorite, this results in the kaolin appearing cloudy. The chlorite - kaolin mixtures are probably altered lithics. Generally the ?chlorite has formed by the alteration of micas and thus has a fibrous nature. Quartz overgrowths are a minor component in this sample and are indicated by dust rims and rare euhedral terminations on the margins of intergranular pores. Pyrite is associated with ?organic matter in the stringers and forms isolated patches throughout the sample.

Texturally, the sample is framework grain supported with common tangential and

concavo-convex contacts, and minor sutured contacts. The presence of sutured and concavo-convex contacts, splayed mica flakes and deformed lithics, suggests compaction has been quite significant. Minor amounts of primary intergranular porosity is preserved despite the abundance of cement and matrix. Secondary dissolution porosity in the feldspars is also common and microporosity is associated with the kaolin.

Visually estimates of porosity are minor, primary (4%), secondary dissolution (2%) and microporosity (tr). The higher porosity reported from core analysis is attributed to the proportion of kaolin which would contain micropores that are not visible. Permeability has been reduced in this sample by the presence of matrix and cement choking pore throats, grain rotation and presence of sutured contacts. Rare intergranular pores are interconnected, unlike the secondary dissolution pores which are spatially isolated.

Composition	%
Quartz	52
Feldspar	3
Mica	tr
Lithics	13
Tourmaline	tr
Zircon	1
Matrix	
Clay	1
Organic matter	2
Authigenic minerals and cements	
Quartz	tr
Kaolin	10
Glaucony - Chlorite	2
Pyrite	1
Carbonate	8
Porosity	
Primary	4
Secondary	2
Microporosity	tr

4.2 Warracbarunah #5, Sample 4, Core 14a, 1497.36 - 1501.31m

Hand specimen description
Sample received consisted of 4.0cm of well indurated, full diameter core plug. It was an interbedded, well sorted, fine to medium grained (average medium) sandstone with a moderately sorted medium to very coarse grained (average medium) sandstone. The boundary between the two beds was sharp and planar. The entire sample was yellowish grey (5Y 8/1) and well cemented. There was no reaction with 10% HCl in either bed and porosity/permeability was slight. Trace to minor amounts of opaques, lithics and feldspar were noted. Quartz overgrowths were evident by the euhedral terminations present.

Thin section description
This sample is composed of an interbedded fine to medium grained (average medium), well sorted sublitharenite and a fine to very coarse grained (average coarse), moderately sorted sublitharenite. Both sublitharenites are mineralogically immature and texturally mature. The moderately sorted sublitharenite is graded with the coarser grains at the boundary between the two beds. The boundary is irregular and sharp and the grains are angular to subrounded and typically poorly spherical. The composition of the two beds is essentially the same and therefore will be described together with variations noted.

Framework grains are composed of quartz, lithics, feldspars, micas, zircon and tourmaline. Quartz is typically monocrystalline and contains minor fluid and mineral (rutile needles, ?sillimanite and zircon) inclusions and has straight to slightly undulose extinction. The fluid inclusions rarely form Boehm lamellae. Polycrystalline quartz is typically unstrained with undulose extinction and minor fluid inclusions. A variety of lithics are evident with examples from igneous, metamorphic and sedimentary terrains. Fine grained volcanics and schistose metamorphics are the most common, with lesser proportions of sedimentary chert (partially replaced by pyrite). Other lithics are highly altered by an iron oxide, masking the original composition. Micas that are composed of muscovite are highly deformed and commonly splayed with carbonate along the cleavage. The flakes are up to 0.90mm long. Untwinned feldspars are partially dissolved resulting in secondary honeycomb porosity (Fig. 2). Dissolution is rarely so extensive that only skeletal grains remain and the composition of the original labile is unknown. Sericitised plagioclase (?sanidine) and microcline partially replaced by carbonate are evident. Altered perthites (dissolved and sericitised) are also present. Zircon and zoned tourmaline are fine grained and well rounded.

Trace amounts of ?illitic matrix coats framework grains.

Diagenetic minerals and cements include carbonate, kaolin, quartz and glaucony. Carbonate ranges in crystal size from spar and microspar to micrite. Microspar is dominant as anhedral to subhedral rhombs coating grains, replacing quartz dust rims and partially replacing framework grains. Rare examples of what were probably microspar coatings on grains that were subsequently dissolved are present. Spar and micrite are minor carbonate components. The spar is clear, anhedral to rarely euhedral and partially occludes intergranular pores. Fe-rich micritic carbonate, similar to that in sample 1 is evident rimming and partially replacing grains. The proportion of kaolin is much less in this sample. It fills intergranular pores with stacks of booklets that are rarely vermiform. Well developed quartz overgrowths are indicated by dust rims and euhedral terminations. Although the quartz overgrowths partially occlude pores, they have also limited mechanical compaction, and thus preserved pores. Fibrous glaucony composed of chlorite is an alteration product of micas.

The sample is framework grain supported with dominantly concavo-convex and tangential contacts. Rare sutured contacts are evident in those areas where quartz overgrowths are not as significant. Primary intergranular porosity accounts for between 8 and 12% of the total rock composition and is supplemented by minor proportions (2%) of secondary porosity and traces of microporosity.

Porosity and permeability are higher in this sample due to the reduced proportions of cements and matrix and the presence of quartz overgrowths preserving intergranular pores (Fig. 2). The visual estimate of porosity is probably less than that measured due to an underestimation of micropores in the kaolin. Slightly coarser grain size and better sorting are responsible for the higher proportion of primary porosity.

Composition	%
Quartz	63 - 59
Feldspar	3
Mica	1
Lithics	14
Tourmaline	tr
Zircon	tr
Matrix	2
Authigenic minerals and cements	
Quartz	1
Kaolin	4
Glaucony - Chlorite	tr
Carbonate	1
Porosity	
Primary	8 - 12
Secondary	2
Microporosity	tr

The second number in the range refers to the coarser grained bed.

4.3 Warracbarunah #5, Sample 7, Core 11d, 1342.99 - 1347.84m

Hand specimen description
Sample received consisted of 4cm of well indurated, full diameter core plug. It was an interbedded medium grey (N5), well sorted, fine grained sandstone with a pinkish grey (5YR 8/1), well sorted, medium to coarse grained (average medium) sandstone. A graded contact and a sharp, planar contact marked by the concentration of opaque material (?organic matter) are evident between the beds. Irregularly distributed opaque stringers are also present. There was no reaction with 10% HCl. Porosity and permeability is less in the finer grained bed and is moderate in the coarser bed. Permeability is high along the fracture defining and parallel with the two beds.

Thin section description
This sample is a poorly sorted, muddy silt to medium sand sized (average fine grained), texturally and mineralogically immature litharenite (Fig. 3a) with one bed of fine to medium grained (average medium), moderately sorted, texturally mature, mineralogically immature sublitharenite (Fig. 3b). The boundaries between the beds are irregular and gradational. Discontinuous opaque (organic matter) stringers parallel bedding and are commonly associated with fractures.

a) Muddy Litharenite
Angular to subrounded framework grains are composed of quartz, lithics, feldspar, mica, tourmaline and zircon. Quartz is predominantly monocrystalline and contains minor fluid and mineral (rutile needles) inclusions and has straight to slightly undulose extinction. Most of the lithics are highly altered and therefore are difficult to identify. Lithics are composed of igneous varieties (possibly volcanic), deformed schistose metamorphic fragments with abundant aligned micas and chert that is rarely chalcedonic and commonly partially replaced by pyrite. Partially sericitised plagioclase and lesser proportions of fresh microcline are evident with dissolution of untwinned K-feldspars resulting in honeycomb porosity. Micas (muscovite) are up to 0.40mm long and are commonly bent. Green tourmaline and zircon grains are very fine grained and the zircons are commonly surrounded by hydrocarbon envelopes.

Matrix is abundant (Fig. 3a), it is composed of aligned (?illitic) and non aligned clays and silt sized quartz. Opaque material concentrated in irregular discontinuous stringers is possibly organic matter and rarely has a reddish colour.

Authigenic minerals and cements include glaucony and pyrite. Glaucony composed of chlorite occurs in patches within the matrix. The chlorite is an alteration product of micas and is commonly fibrous and iron rich. Pyrite is difficult to distinguish from the ?organic matter with which it is commonly associated, and pyrite partially replaces chert.

The litharenite is framework grain supported with rare point contacts due to the abundant clays. Rare preserved intergranular and secondary pores are evident.

b) Sublitharenite
Framework grains are composed of quartz, lithics, feldspars, opaques, mica, tourmaline and zircon. Quartz is similar in nature to that in the litharenite. Lithics are composed of volcanic rock fragments, deformed micaceous schist and chert. Plagioclase and K-feldspar are commonly partially sericitised and dissolved, resulting in honeycomb porosity. Opaque grains of

unknown composition are subangular and randomly distributed throughout the bed. Micas (muscovite) are up to 0.45mm long and are commonly bent. Brown tourmaline is elongate and zoned. Zircon is commonly elongated and is typically surrounded by opaque material (hydrocarbon envelopes - Fig. 3b). The proportion of zircon is higher in this bed.

Opaque material (?organic matter) lines pores.

Authigenic minerals and cements include kaolin, glaucony, ?zeolite and quartz. Kaolin booklets rarely fill intergranular pore spaces. Chlorite is typically fibrous and is an alteration product of micas. A possible zeolite is present that varies in habit from euhedral laths to tabular colourless crystals. The laths are rarely radial in distribution. The crystals range from clear to opaque, possibly due to variable staining with hydrocarbons and they concentrate on the margins of pores. Quartz overgrowths are indicated by dust rims and euhedral terminations.

This bed is framework grain supported with common tangential and concavo-convex contacts. Porosity is predominantly secondary dissolution, with minor proportions of micropores and relatively well interconnected intergranular pores. Compaction is indicated by the presence of concavo-convex contacts and deformed micas.

The measured porosity and permeability is artificially high in this sample due to the presence of induced fractures associated with and parallel to the organic matter. Differences in lithology further restrict porosity and permeability in a directional sense. The sublitharenite (Fig. 3b) with comparatively less clay and more pores (secondary) has slightly higher porosity.

Composition		%	
		(A)	(B)
Quartz		52	70
Feldspar		2	1
Mica		tr	tr
Lithics		25	12
Opaques		-	3
Tourmaline		tr	tr
Zircon		tr	1
Matrix			
Clays		10	-
Opaques	- Organic matter	5	3
Authigenic minerals and cements			
Quartz		-	1
Kaolin		-	2
Glaucony	- Chlorite	5	2
?Zeolites		-	tr
Pyrite		tr	-
Porosity			
Primary		tr	1
Secondary		tr	3
Microporosity		-	tr

(A) = muddy litharenite
(B) = sublitharenite

4.4 Warracbarunah #5, Sample 8, Core 11a, 1342.99 - 1347.84m

Hand specimen description
Sample received consisted of two pieces of full diameter, well preserved core plug, approximately 1cm thick. It was a very fine to fine grained (average very fine), well sorted, olive grey (5Y 4/1) sandstone with discontinuous and indistinct light brown (5YR 5/6) cross beds. The cement/matrix had an immediate vigorous reaction with 10% HCl, indicating the presence of carbonate. Porosity/permeability was slight and there were trace amounts of opaques.

Thin section description
The sample is a very fine to fine grained (average fine), well sorted, carbonate cemented sublitharenite (Fig. 4) which is crossbedded. Beds are outlined by an increase in the dirty nature of the carbonate. This could indicate that the cross beds originally contained a higher proportion of muddy material prior to carbonate cementation. Grains are typically subangular to angular with moderate sphericity. Their morphology is governed by carbonate embayment.

Framework grains are composed of quartz, lithics, feldspar, mica, tourmaline and zircon. Quartz is monocrystalline and contains trace amounts of fluid inclusions and has straight to slightly undulose extinction. Lithics are of variable composition and provenance. Volcanic, schistose metamorphic and sedimentary chert (rarely chalcedonic and commonly partially replaced by pyrite) fragments are noted. Sericitised feldspars are composed of plagioclase and microcline, with secondary porosity the result of dissolution. Micas (muscovite) up to 0.45mm long are commonly bent. Tourmaline is brown, silt to very fine sand sized and unzoned. Zircon is silt sized, well rounded and slightly elongate.

Minor anhedral matrix is present in the cross beds associated with the dirty carbonates.

Authigenic minerals and cements include carbonate, iron oxide, glaucony, ?zeolites and quartz. Carbonate (Fig. 4) is the dominant cement and has embayed and replaced lithics and other framework grains. Anhedral spar ranges from clear to dusty in the cross beds and is rarely poikilotopic. Trace amounts of dogtooth spar are also evident. Iron rich micritic cement similar to that in Samples 1 and 4, coats grains and forms blotches. Iron oxide (?limonite) is anhedral and associated with the carbonate cement. Glaucony composed of chlorite rarely replaces micas and is fibrous. The possible zeolites are similar to those described in the previous sample although no hydrocarbon staining is evident. Trace amounts of quartz overgrowths are suggested by the presence of dust rims with terminations disguised by carbonate embayment.

The sample is framework grain supported with typically point contacts due to extensive carbonate cement. Rare intergranular and secondary dissolution pores are preserved.

Measured porosity and permeability is relatively low in this sample. Carbonate cementation has occluded a large proportion of the intergranular pores and thus also reduced permeability. The minor secondary porosity evident is not interconnected and does not contribute to the permeability.

Composition		%
Quartz		54
Feldspar		3
Mica		tr
Lithics		10
Tourmaline		tr
Zircon		tr
Matrix		1
Authigenic minerals and cements		
Carbonate		25
Glaucony	- Chlorite	2
Iron oxide		1
?Zeolites		tr
Quartz		tr
Porosity		
Primary		2
Secondary		1

5. DISCUSSION AND CONCLUSIONS

a) Controls on porosity and permeability

Routine core analyses indicate that porosity and permeability are variable in these four samples, with porosity ranging from 6.4% to 15.9% and permeability ranging from 0.01md to 174.0md. The lower measurements were detected in samples 1 and 8. Porosity and permeability were reduced in sample 1 by compaction and the presence of cements, matrix and deformed lithics. Intergranular pore throats were typically choked by either kaolin booklets or matrix and secondary dissolution pores were not interconnected. Porosity and permeability was low in sample 8, due to the abundant carbonate cement.

Samples 4 and 7 both have higher porosity and permeability. Quartz cementation prior to compaction has preserved intergranular pores in both samples, thus enhancing permeability. Bedding limited porosity and permeability in Sample 7 where most of the sample is composed of a matrix rich litharenite with only traces of porosity and permeability. Lack of matrix and cements in sample 4 has resulted in increased porosity and permeability. Permeability and porosity is further enhanced in sample 7 by the presence of fractures associated with the organic stringers. These fractures are thought to have been induced by the release of pressure after drilling and therefore porosity and permeability is artificially high in this sample.

b) Lithology and sediment provenance

Core samples from Warracbarunah #5 are composed of muddy and clean sublitharenites, a litharenite and a carbonate cemented sublitharenite. They range from texturally immature to mature and are all mineralogically immature. Mineralogical immaturity possibly reflects short distances of sediment transport or instability in the source regions. Grain size varies from silt to very coarse sand and they range from well to poorly sorted.

Quartz is predominantly of the granitic/plutonic variety with minor polycrystalline quartz indicating a metamorphic contribution. Lithics of igneous, metamorphic and sedimentary provenance are represented in all samples with fragments of metamorphic provenance the most abundant.

c) Depositional Environment

Variable textural maturity and mineralogical immaturity, and angularity of framework grains, suggest the samples were deposited after only short distances of transport from the provenance region.

No definitive evidence is present to suggest a particular depositional environment. However, certain conclusions can be drawn from the sedimentary features. Bedding was noted in three samples, this indicates the influence of current activity. Gradational bedding in sample 7 and mud in the crossbeds of sample 8 suggests varying speeds of sediment laden currents. The lack of marine indicators, combined with these sedimentological features, may suggest a fluvial/alluvial depositional environment. This hypothesis is supported by the relative abundance of micritic ?siderite blotches that are typical of terrestrial environments.

d) Diagenetic alteration

Diagenetic alteration in the litharenites and sublitharenites is a major factor in the preservation, occlusion and development of porosity and permeability. Pyrite is associated with organic matter and therefore is likely to be an early diagenetic event. In clay and cement poor samples (sample 4 and part of sample 7), the development of quartz overgrowths prior to compaction has allowed partial preservation of intergranular pores. Silica for these overgrowths may have been derived from compaction or the release of

excess silica during kaolinisation of feldspars. This suggests that dissolution of feldspars, kaolinisation and quartz overgrowth precipitation may have been synchronous. Carbonate spar cementation postdated quartz overgrowths and in sample 8, significantly occludes porosity. Several phases of carbonate are suggested by the presence of iron rich micrite in addition to the predominantly clear microspar and spar. The latter is more typical of a burial cement, whereas the micrite probably formed in a vadose environment. Relative timing of the chloritisation of micas, precipitation of ?zeolites, hydrocarbon migration and development of iron oxide is uncertain. However, it is clear that most diagenetic events were completed prior to hydrocarbon migration. There is some evidence in the literature that ?zeolites can form as diagenetic minerals rather than as indicators of low grade metamorphism. The fact that the laths in these samples are probably stained with bitumen, lends support to this hypothesis.

Although the paragenetic sequence is uncertain, the following diagenetic events have been identified:

Sericitisation
Micritic carbonate
Early pyrite
Dissolution of labiles and kaolinisation
Silicification
Mechanical compaction
Carbonate cementation
Chloritisation
Fe oxide
?Zeolites
Hydrocarbon migration

The above events are not recognised in all samples and should not to be regarded as discrete, rather they probably overlap in time.

PE907643

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PERMIT	= PEP 100
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SUBTYPE	= CORE_PHOTO
DESCRIPTION	= Thinsection Core Photographs(figure 1a & 1b from appendix 6 -Petrological Report- from Well Completion Report vol.1) for Warracbarunah-2
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	= 29/01/92
W_NO	= W1042
WELL_NAME	= Warracbarunah-2
CONTRACTOR	=
CLIENT_OP_CO	= Geological Survey of Victoria

(Inserted by DNRE - Vic Govt Mines Dept)

6. FIGURES AND CAPTIONS

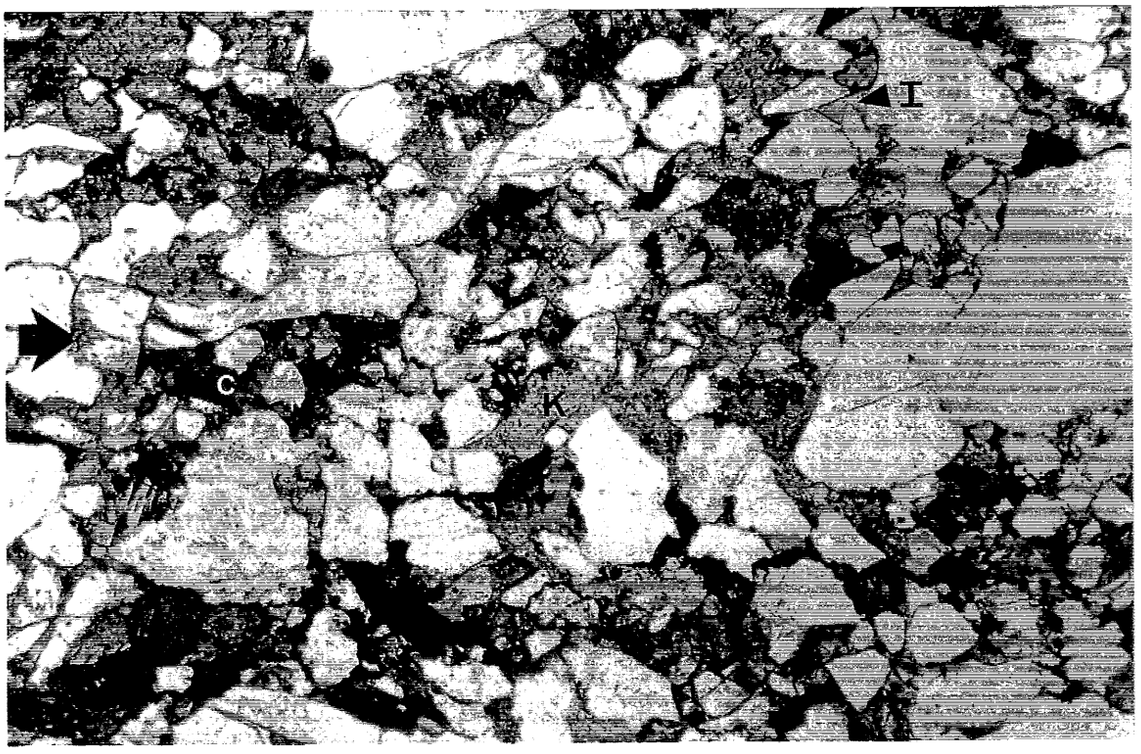

Figure 1a. Thin section photomicrograph illustrating porosity occlusion by kaolin (K) and carbonate (C). Intergranular (I) and dissolution (arrow) porosity are evident. Warracbarunah #5, Sample 1, core 15, depth 1524.88-1527.46m. Plane light. Field of view 2.72mm

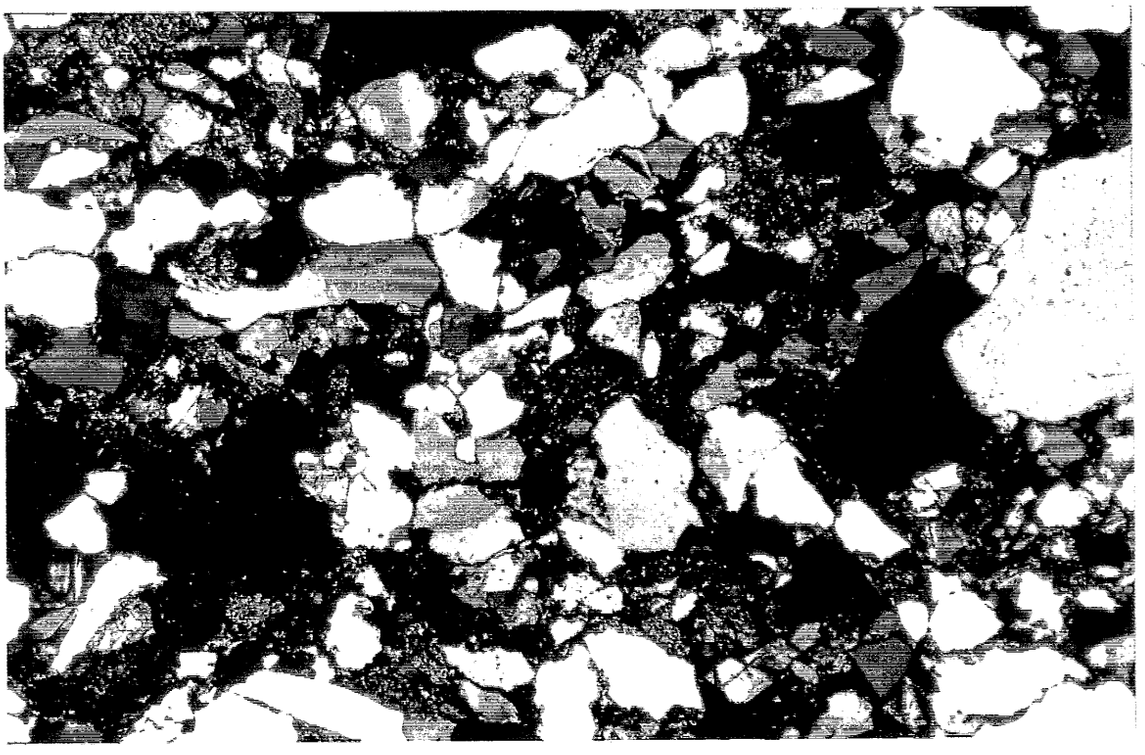

Figure 1b. Same field of view as Figure 1a in crossed nicols.

PE907644

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NAME	= Thinsection Core Photographs
BASIN	= OTWAY
PERMIT	= PEP 100
TYPE	= WELL
SUBTYPE	= CORE_PHOTO
DESCRIPTION	= Thinsection Core Photographs(figure 2a & 2b from appendix 6 -Petrological Report- from Well Completion Report vol.1) for Warracbarunah-2
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	= 29/01/92
W_NO	= W1042
WELL_NAME	= Warracbarunah-2
CONTRACTOR	=
CLIENT_OP_CO	= Geological Survey of Victoria

(Inserted by DNRE - Vic Govt Mines Dept)

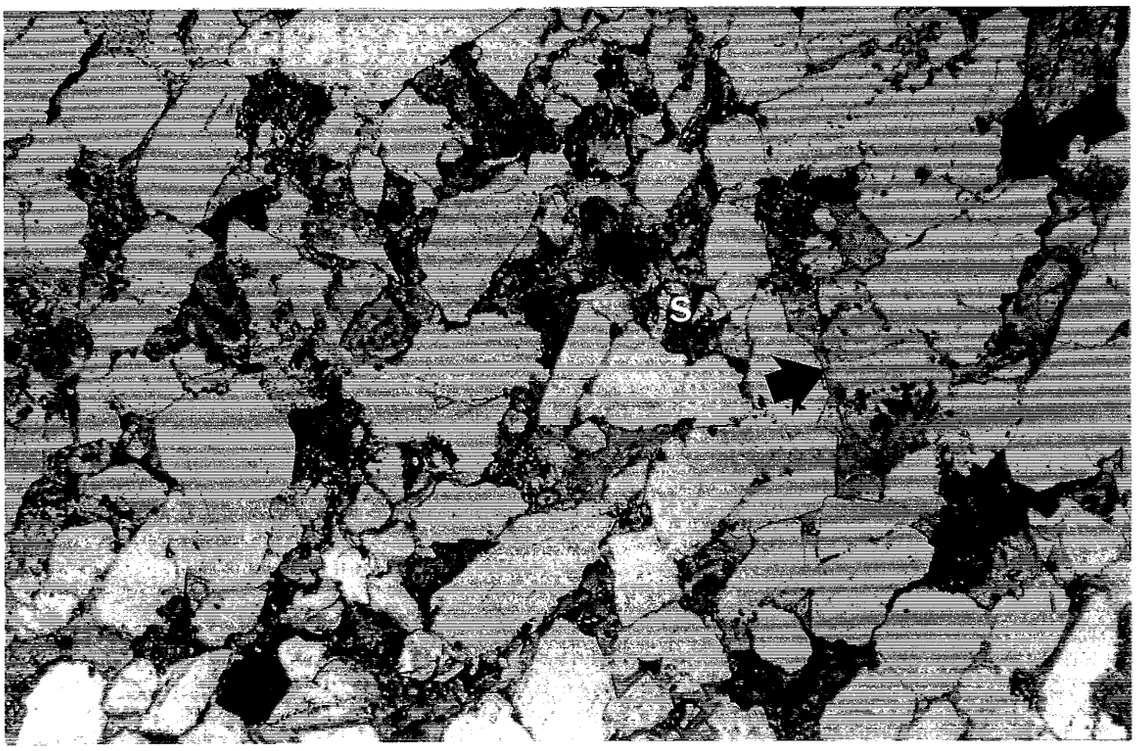


Figure 2a. Thin section photomicrograph of interconnected intergranular (arrow) and secondary pores (S) in this sublitharenite. Dusty grains are commonly the lithics or feldspars. Warracbarunah #5, Sample 4, core 14a, depth 1497.36-1501.31m. Plane light. Field of view 2.72mm

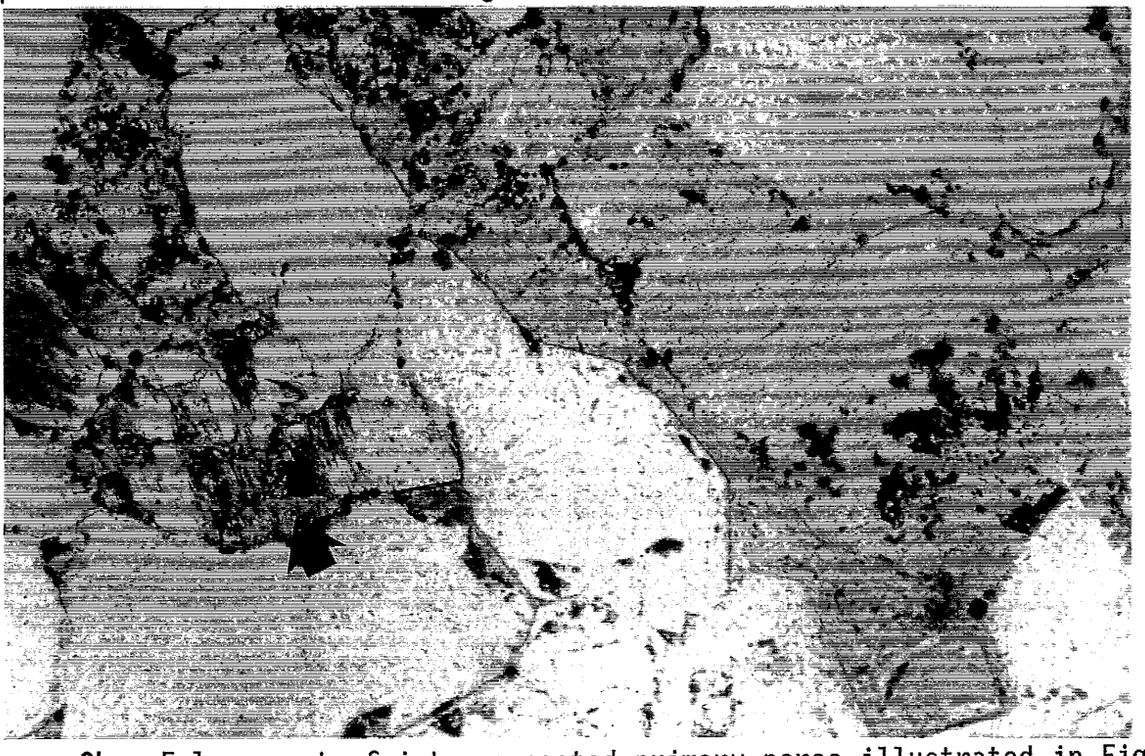


Figure 2b. Enlargement of interconnected primary pores illustrated in Figure 2a. Note the secondary honeycomb porosity associated with the feldspar (arrow) and the euhedral quartz overgrowths. Plane light. Field of view 0.83mm.

PE907645

This is an enclosure indicator page.
The enclosure PE907645 is enclosed within the container PE902071 at this location in this document.

The enclosure PE907645 has the following characteristics:

ITEM_BARCODE	= PE907645
CONTAINER_BARCODE	= PE902071
NAME	= Thinsection Core Photographs
BASIN	= OTWAY
PERMIT	= PEP 100
TYPE	= WELL
SUBTYPE	= CORE_PHOTO
DESCRIPTION	= Thinsection Core Photographs(figure 3a & 3b from appendix 6 -Petrological Report- from Well Completion Report vol.1) for Warracbarunah-2
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	= 29/01/92
W_NO	= W1042
WELL_NAME	= Warracbarunah-2
CONTRACTOR	=
CLIENT_OP_CO	= Geological Survey of Victoria

(Inserted by DNRE - Vic Govt Mines Dept)

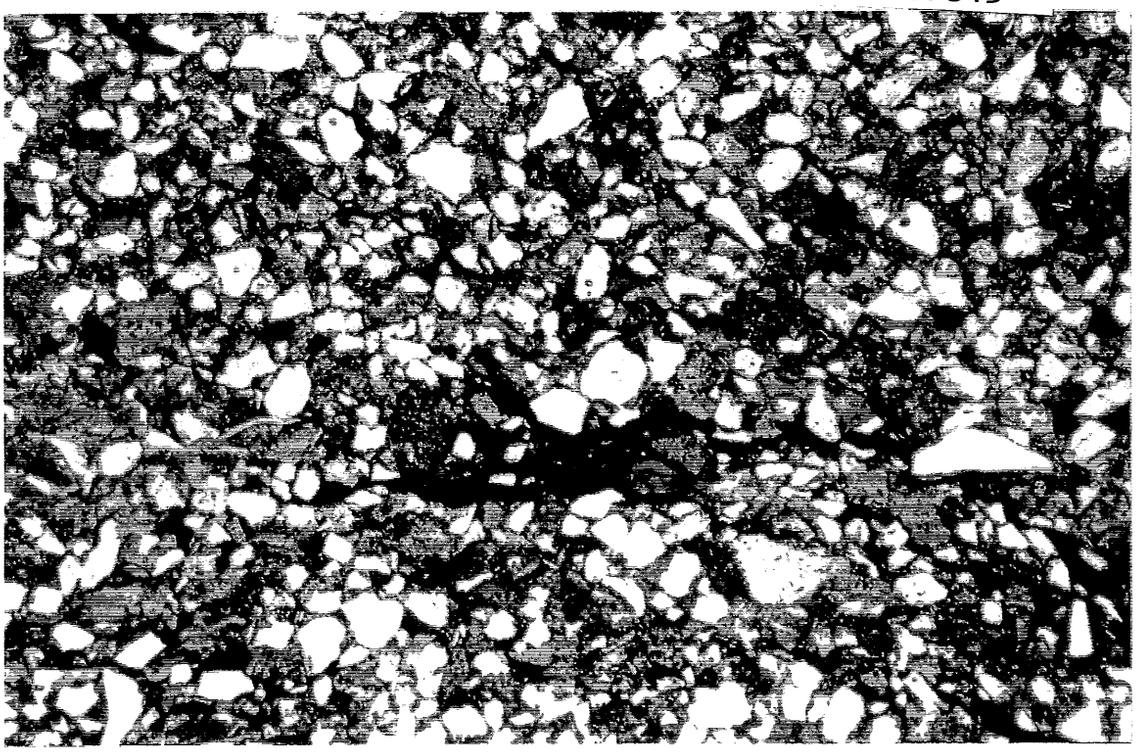


Figure 3a. Thin section photomicrograph of muddy litharenite displaying only minor intergranular pores (blue). A discontinuous opaque stringer is present in the centre of the photograph. Warracbarunah #5, Sample 7, core 11d, depth 1342.99-1347.84m. Plane light. Field of view 2.72mm

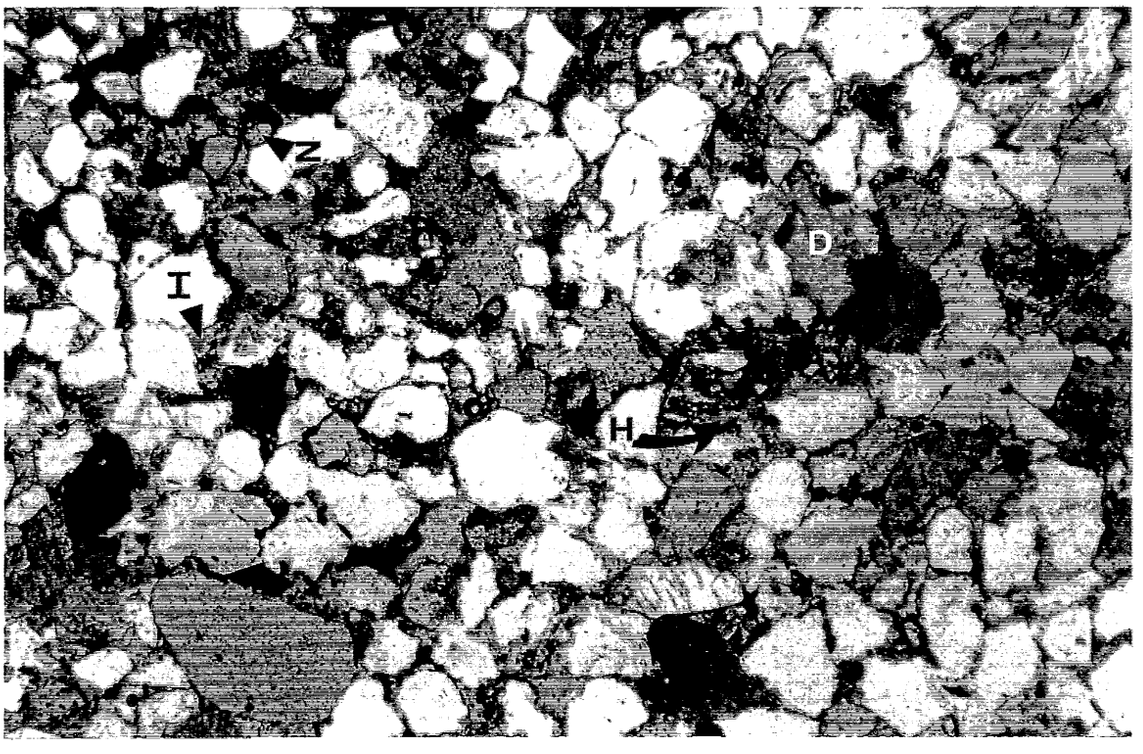


Figure 3b. Thin section photomicrograph of sublitharenite in same section as Figure 3a. Over sized pores are probably the result of dissolution (D), with minor intergranular pores (I) present. Note honeycomb porosity (H) and zircon grain (Z) with hydrocarbon envelope. Warracbarunah #5, Sample 7, core 11d, depth 1342.99-1347.84. Plane light. Field of view 2.72mm

PE907646

This is an enclosure indicator page.
The enclosure PE907646 is enclosed within the container PE902071 at this location in this document.

The enclosure PE907646 has the following characteristics:

ITEM_BARCODE	= PE907646
CONTAINER_BARCODE	= PE902071
NAME	= Thinsection Core Photographs
BASIN	= OTWAY
PERMIT	= PEP 100
TYPE	= WELL
SUBTYPE	= CORE_PHOTO
DESCRIPTION	= Thinsection Core Photographs(figure 4a & 4b from appendix 6 -Petrological Report- from Well Completion Report vol.1) for Warracbarunah-2
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	= 29/01/92
W_NO	= W1042
WELL_NAME	= Warracbarunah-2
CONTRACTOR	=
CLIENT_OP_CO	= Geological Survey of Victoria

(Inserted by DNRE - Vic Govt Mines Dept)

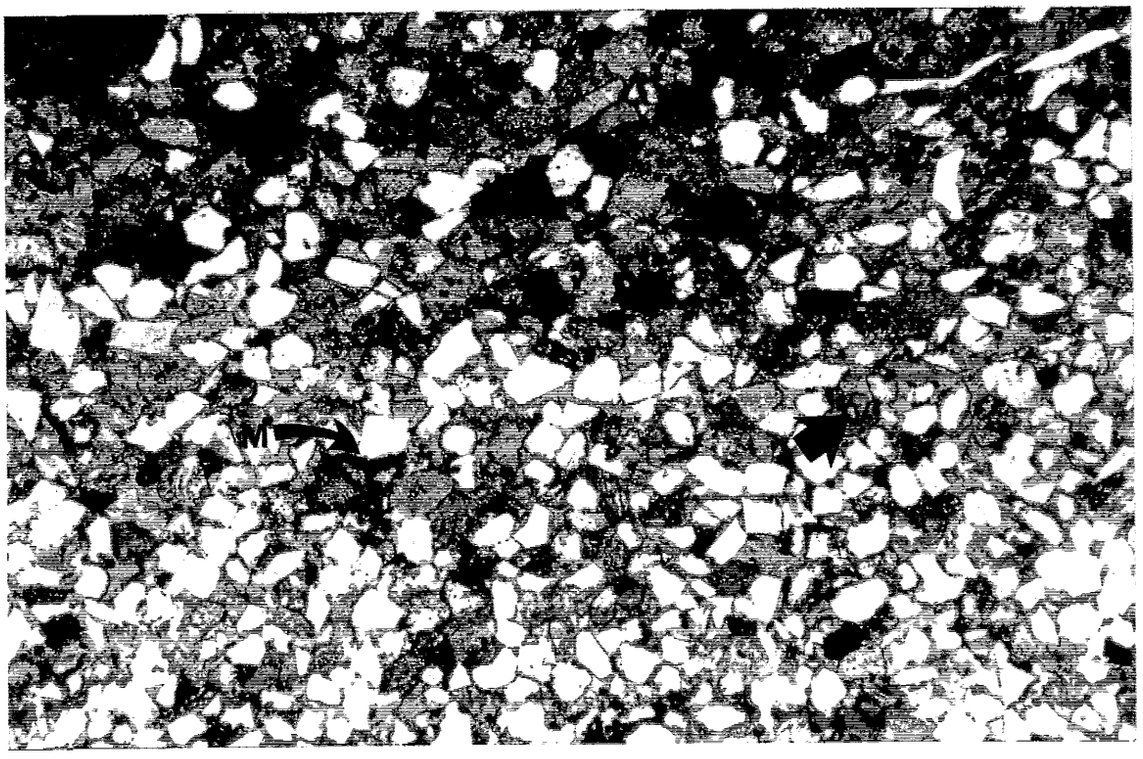


Figure 4a. Thin section photomicrograph of carbonate cemented sublitharenite. Clear (bottom) and dirty (top) carbonate are present. Opaque patches are iron rich carbonate which also coats framework grains (M). Rare porosity (arrow) is evident. Warracbarunah #5, Sample 8, core 11a, depth 1342.99-1347.84m. Plane light. Field of view 2.72mm

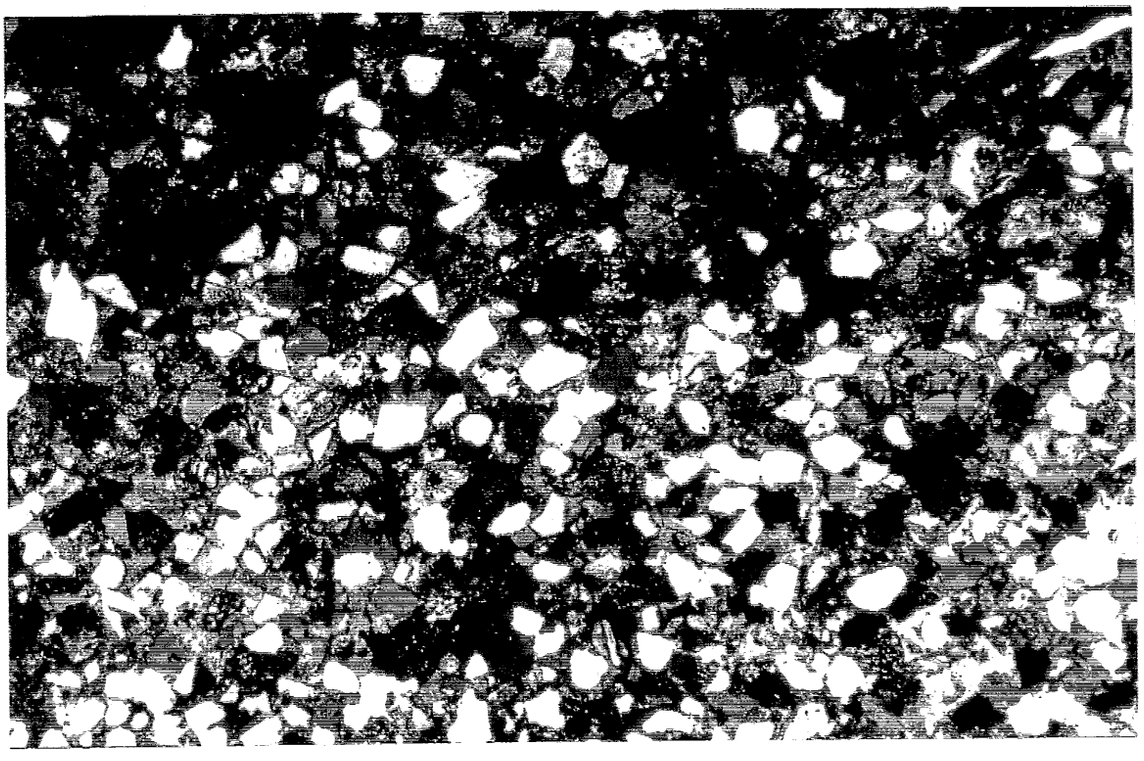
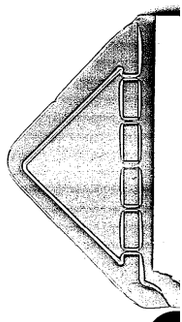


Figure 4b. Same field of view as Figure 4a in crossed nicols.

Appendix 7



APPENDIX 7

GEOCHEMISTRY REPORT

AMDEL
CORE
SERVICES

9 August 1991

Department of Manufacturing and
Industry and Development
PO Box 173
EAST MELBOURNE VIC 3002

Attention: John Leonard (Basin Studies Manager)

REPORT: 009/999

CLIENT REFERENCE:	Fax from Tabassi and Associates
MATERIAL:	SWC, Core and Cuttings
LOCALITY:	Warracbarunah-5
WORK REQUIRED:	Geochemistry

Please direct technical enquiries regarding this work to the signatory below under whose supervision the work was carried out.

BRIAN L WATSON
Laboratory Supervisor
on behalf of Amdel Core Services Pty Ltd

1. INTRODUCTION

Twenty (20) core and cuttings samples were received for vitrinite reflectance analysis and TOC and Rock-Eval pyrolysis. This report is a formal presentation of the results of these analyses.

2. ANALYTICAL PROCEDURE

2.1 Sample Preparation

Samples (as received) were ground in a Siebtechnik mill for 20-30 seconds.

2.2 Total Organic Carbon (TOC)

Total organic carbon was determined by digestion of a known weight (approximately 0.2 g) of powdered rock in HCl to remove carbonates, followed by combustion in oxygen in the induction furnace of a Leco IR-12 Carbon Determinator and measurement of the resultant CO_2 by infra-red detection.

2.3 Rock-Eval Pyrolysis

A 100 mg portion of powdered rock was analysed by the Rock-Eval pyrolysis technique (Girdel IFP-Fina Mark 2 instrument; operating mode, Cycle 1).

2.4 Organic Petrology

Representative portions of each sample (crushed to -14+35 BSS mesh) were obtained with a sample splitter and then mounted in cold setting Glasscraft resin using a 2.5 cm diameter mould. Each block was ground flat using diamond impregnated laps and carborundum paper. The surface was then polished with aluminium oxide and finally magnesium oxide.

Reflectance measurements were made with a Leitz MPV1.1 microphotometer fitted to a Leitz Ortholux microscope and calibrated against synthetic standards. All measurements were taken using oil immersion (n = 1.518) and incident monochromatic light (wavelength 546 nm) at a temperature of 23±1°C.

3. RESULTS

Vitrinite reflectance data are presented in Table 1 and are displayed graphically versus depth in Figure 1. Table 2 is a summary of TOC and Rock-Eval pyrolysis data. Figure 2 is a plot of Hydrogen Index versus T_{max} illustrating kerogen Type and maturity. Histogram plots of measured vitrinite reflectance data are presented on Appendix 1.

4. INTERPRETATION

4.1 Maturity

Vitrinite reflectance determinations (Table 1, Figure 1) indicate that the sediments intersected in this location have maturities ranging from immature to marginally mature. This data suggests that the sedimentary section is sufficiently mature for the generation of light oil/condensate from sediments rich in resinite and bituminite below approximately 900 m depth (VR threshold = 0.45%).

Extrapolation of this data indicates that significant gas generation should occur below approximately 1500 m depth (VR $\geq$ 0.6%) while oil generation from sediments rich in exinites other than resinite and bituminite should commence below approximately 1800 m depth (VR $\geq$ 0.7%). Rock-Eval Hydrogen Index and T_{max} data (Table 2, Figure 2) show maturites similar to those indicated by the measured vitrinite reflectance data.

Samples from depths 1343.0 - 1347.8 m and 1389.2 - 1389.8 m have low T_{max} values due to their small and ill-defined S_2 peaks.

Rock-Eval Production Indices are consistently low for these sample (PI $\leq$ 0.14; Table 2) which suggests that migrated hydrocarbons are not present in significant quantities in the samples analysed from this location.

4.2 Source Richness

Organic richness ranges from poor to excellent (TOC = 0.19 - 49.40%) in the samples studied. Source richness for the generation of hydrocarbons also ranges from poor to excellent ($S_1 + S_2$ = 0.49 - 76.39 kg of hydrocarbons/tonne). Samples which have excellent organic and source richness fall within the interval 558 to 813 metres depth and with the exception of the sample from 583.6 - 588 metres depth, all of these samples from this interval have both excellent organic and source richness. Samples from 498-501, 1176-1179 and 1296-1299 metres depth have both fair source richness and organic richness.

4.3 Kerogen Type and Source Quality

Rock-Eval Hydrogen Index and T_{max} data (Table 2, Figure 2) indicates that the samples examined contain organic matter which has bulk compositions ranging from Type II-III to Type IV kerogen. The samples which contain better quality (more oil-prone) Type II-III kerogen occur at the following depths:

Depth (m)	T_{max}	HI
739.0 - 743.4	430	234
810 - 813	431	196
1176 - 1179	439	174

TABLE 1

SUMMARY OF VITRINITE REFLECTANCE MEASUREMENTS

WARRACBARUNAH-5

Depth (m)	Mean Maximum Reflectance (%)	Standard Deviation	Range	Number of Determinations
498.0 - 501.0	0.33	0.01	0.31-0.37	30
516.0 - 519.0	0.34	0.02	0.31-0.39	14
558.0 - 561.0	0.36	0.02	0.33-0.39	25
583.6 - 588.0	0.36	0.03	0.33-0.41	7
739.0 - 743.4	0.44	0.05	0.35-0.54	30
759.0 - 762.0	0.46	0.04	0.39-0.54	30
810.0 - 813.0	0.44	0.03	0.38-0.52	30
894.0 - 897.0	0.45	0.04	0.39-0.51	21
959.3 - 960.9	-	-	-	-
1032.1 - 1032.9	0.46	0.01	0.45-0.47	4
1074.0 - 1077.0	0.48	0.04	0.41-0.52	9
1151.8 - 1152.8	0.55	0.05	0.46-0.61	11
1176.0 - 1179.0	0.51	0.03	0.47-0.60	30
1200.0 - 1203.0	0.53	0.05	0.47-0.61	14
1252.7 - 1253.6	0.56	0.05	0.48-0.62	12
1296.0 - 1299.0	0.59	0.05	0.49-0.70	30
1343.0 - 1347.8	-	-	-	-
1389.2 - 1389.8	-	-	-	-
1442.8 - 1445.7	0.56	0.05	0.46-0.65	20
1461.0 - 1464.0	0.60	0.05	0.51-0.71	24

TABLE 2

AMDEL CORE SERVICES

Rock-Eval Pyrolysis

12/07/91

Client: Department of Manufacturing and Industry Development

Well: Warracbarunah-5

Depth (m)	T Max	S1	S2	S3	S1+S2	PI	S2/S3	PC	TOC	HI	OI
498-501	430	0.13	1.96	2.58	2.09	0.06	0.75	0.17	3.39	58	76
516-519	431	0.14	1.61	2.57	1.75	0.08	0.62	0.14	1.44	111	178
558-561	418	2.09	74.30	23.25	76.39	0.03	3.19	6.36	49.40	150	47
583.6-588									0.19		
739.0-743.4	430	0.45	39.69	2.55	40.14	0.01	15.56	3.34	16.90	234	15
759-762	429	0.37	44.44	4.44	44.81	0.01	10.00	3.73	27.30	162	16
810-813	431	0.24	23.14	1.83	23.38	0.01	12.64	1.94	11.80	196	15
894-897	437	0.03	0.56	1.20	0.59	0.05	0.46	0.04	0.92	60	130
959.3-960.9	440	0.01	0.57	1.06	0.58	0.02	0.53	0.04	0.86	66	123
1032.1-1032.9	441	0.05	0.53	1.15	0.58	0.09	0.46	0.04	0.95	55	121
1074-1077	435	0.04	0.45	0.81	0.49	0.08	0.55	0.04	0.78	57	103
1151.8-1152.8	439	0.05	0.48	0.61	0.53	0.10	0.78	0.04	0.80	60	76
1176-1179	439	0.09	2.85	2.16	2.94	0.03	1.31	0.24	1.63	174	132
1200-1203	438	0.07	1.28	1.10	1.35	0.05	1.16	0.11	1.02	125	107
1252.7-1253.6	440	0.06	0.68	0.13	0.74	0.08	5.23	0.06	1.35	50	9
1296-1299	439	0.15	2.82	1.05	2.97	0.05	2.68	0.24	2.48	113	42
1343.0-1347.8	387	0.05	0.32	0.13	0.37	0.14	2.46	0.03	0.69	46	18
1389.2-1389.8	362	0.03	0.19	0.19	0.22	0.14	1.00	0.01	0.62	30	30
1442.8-1445.7	440	0.04	1.16	0.10	1.20	0.03	11.60	0.1	1.23	94	8
1461-1464	441	0.07	0.71	0.34	0.78	0.09	2.08	0.06	0.75	94	45

FIGURE 1

VITRINITE REFLECTANCE VERSUS DEPTH
WARRACBARUNAH-5

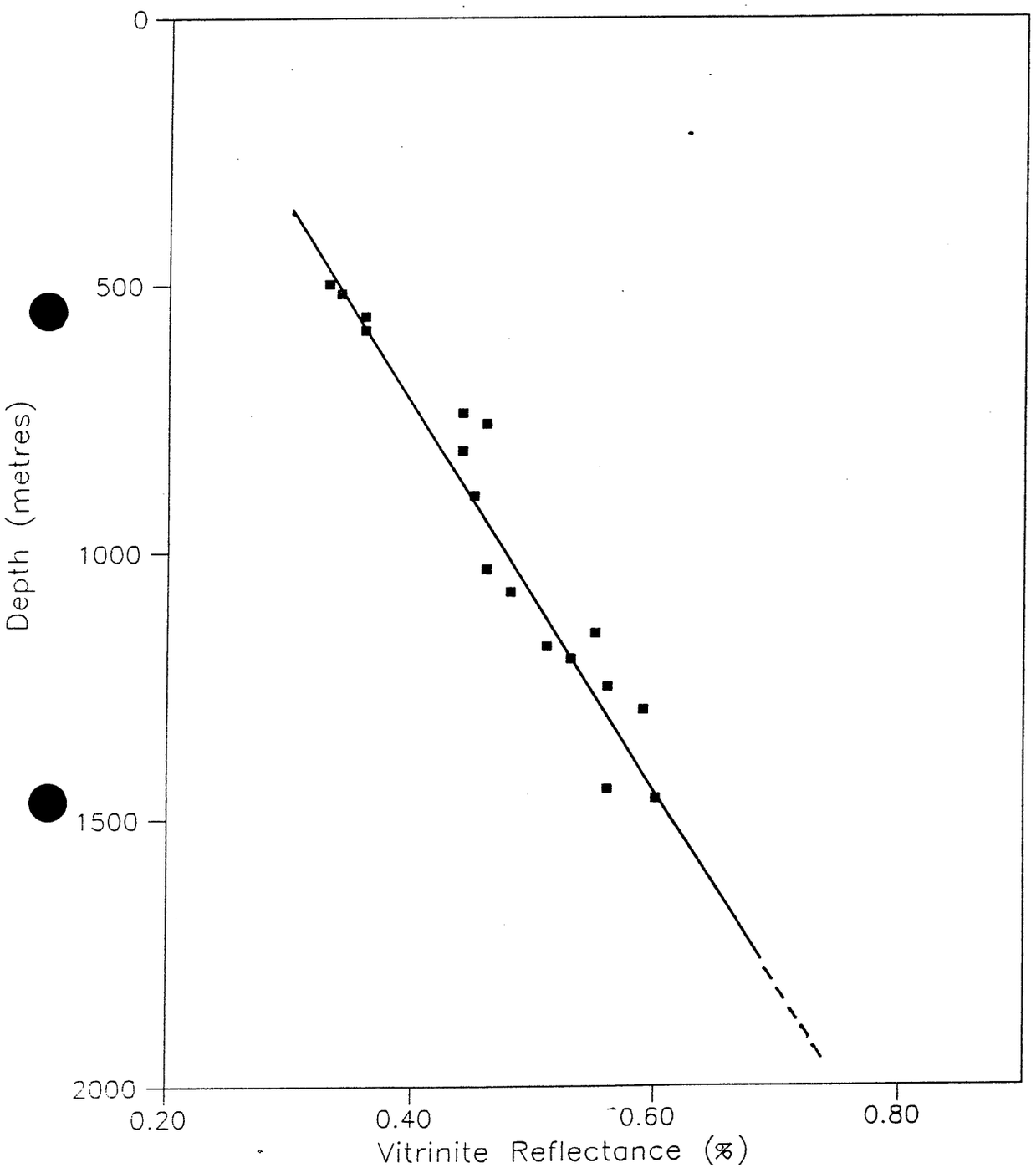
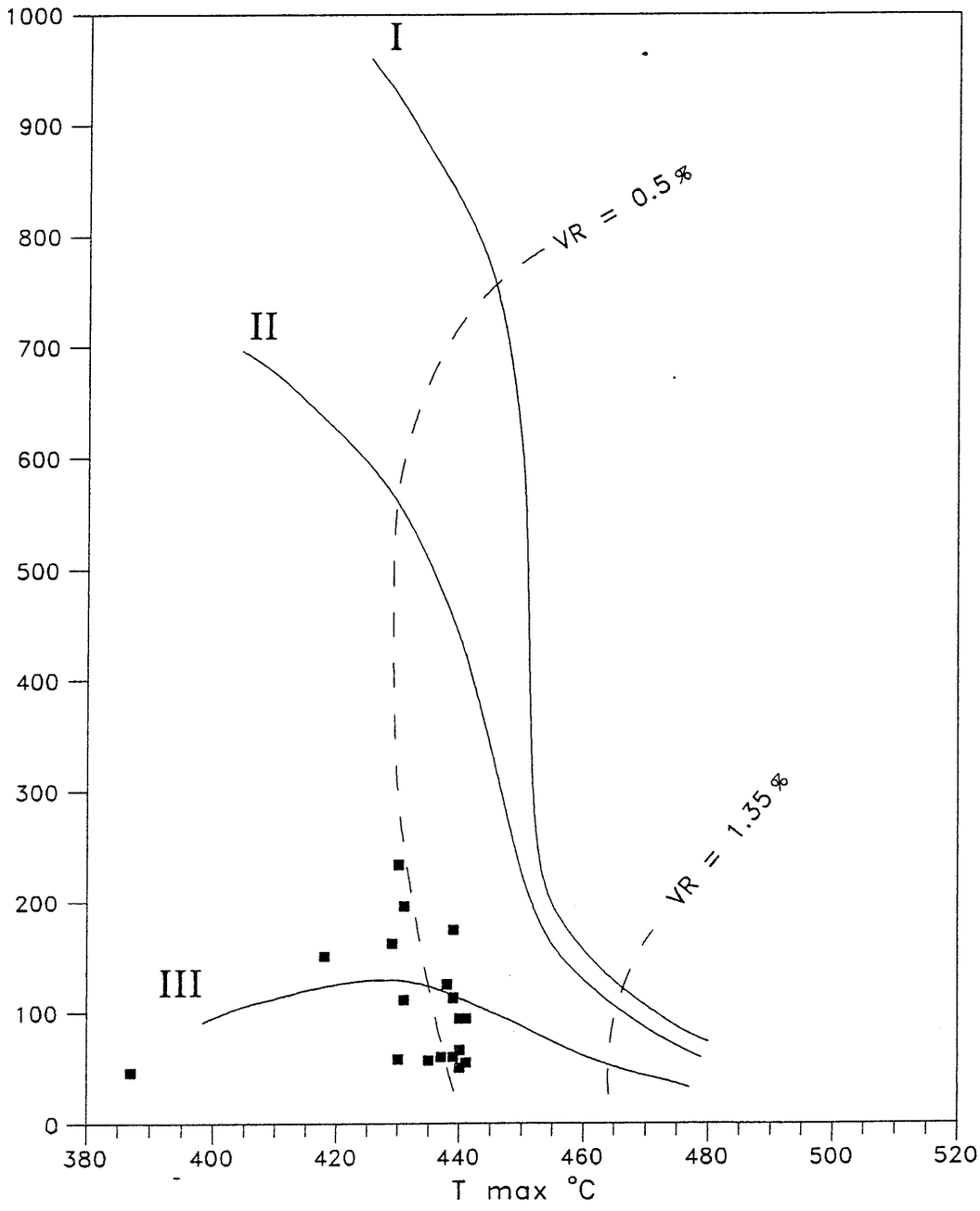


FIGURE 2

HYDROGEN INDEX vs T max

Company : DEPARTMENT OF MANUFACTURING AND INDUSTRY DEVELOPMENT
Well : WARRACBARUNAH-2



APPENDIX 1

HISTOGRAM PLOTS OF VITRINITE REFLECTANCE DATA

WARRACBARUNAH-5

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 498-501m

Sorted List

0.31	0.33	0.34
0.31	0.33	0.34
0.32	0.33	0.34
0.32	0.33	0.34
0.32	0.33	0.34
0.32	0.33	0.35
0.32	0.33	0.35
0.32	0.33	0.35
0.33	0.33	0.37
0.33	0.33	0.37

Number of values= 30

Mean of values 0.33
Standard Deviation 0.01

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

31-33	**********
34-36	********
37-39	**

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 516-519m

Sorted List

0.31	0.36
0.32	0.36
0.32	0.38
0.33	0.39
0.33	
0.33	
0.34	
0.34	
0.34	
0.35	

Number of values= 14

Mean of values 0.34
Standard Deviation 0.02

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

31-33	******
34-36	******
37-39	**

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 558-561m

Sorted List

0.33	0.35	0.37
0.33	0.35	0.37
0.34	0.36	0.38
0.34	0.36	0.39
0.34	0.36	0.39
0.34	0.36	
0.35	0.36	
0.35	0.36	
0.35	0.36	
0.35	0.37	

Number of values= 25

Mean of values 0.36
Standard Deviation 0.02

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

33-35 **********
36-38 **********
39-41 **

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 583.6-588.0m

Sorted List

0.33
0.33
0.34
0.35
0.38
0.41
0.41

Number of values= 7

Mean of values 0.36
Standard Deviation 0.03

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

33-35 ****
36-38 *
39-41 **

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 739.0-743.4m

Sorted List

0.35	0.42	0.48
0.35	0.42	0.48
0.37	0.42	0.48
0.38	0.43	0.48
0.38	0.44	0.49
0.39	0.45	0.49
0.39	0.46	0.51
0.40	0.46	0.51
0.41	0.47	0.51
0.41	0.48	0.54

Number of values= 30

Mean of values 0.44
Standard Deviation 0.05

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

35-37	***
38-40	*****
41-43	******
44-46	****
47-49	********
50-52	***
53-55	*

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 759-762m

Sorted List

0.39	0.44	0.48
0.40	0.44	0.49
0.41	0.45	0.49
0.41	0.46	0.49
0.42	0.46	0.50
0.42	0.46	0.50
0.42	0.47	0.51
0.43	0.47	0.52
0.43	0.47	0.52
0.44	0.48	0.54

Number of values= 30

Mean of values 0.46
Standard Deviation 0.04

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

39-41	****
42-44	********
45-47	*******
48-50	*******
51-53	***
54-56	*

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 810-813m

Sorted List

0.38	0.42	0.44
0.39	0.43	0.45
0.39	0.43	0.45
0.40	0.43	0.46
0.40	0.43	0.46
0.41	0.44	0.47
0.41	0.44	0.47
0.42	0.44	0.47
0.42	0.44	0.48
0.42	0.44	0.52

Number of values= 30

Mean of values 0.44
Standard Deviation 0.03

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

38-40	*****
41-43	**********
44-46	**********
47-49	****
50-52	*

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 894-897m

Sorted List

0.39	0.45	0.51
0.39	0.46	
0.40	0.47	
0.40	0.47	
0.41	0.47	
0.41	0.47	
0.41	0.49	
0.42	0.49	
0.43	0.49	
0.44	0.50	

Number of values= 21

Mean of values 0.45
Standard Deviation 0.04

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

39-41	*******
42-44	***
45-47	******
48-50	****
51-53	*

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 1032.1-1032.9m

Sorted List

0.45
0.45
0.46
0.47

Number of values= 4

Mean of values 0.46
Standard Deviation 0.01

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

45-47 ****

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 1074-1077m

Sorted List

0.41
0.44
0.45
0.47
0.49
0.50
0.50
0.52
0.52

Number of values= 9

Mean of values 0.48
Standard Deviation 0.04

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

41-43 *
44-46 **
47-49 **
50-52 ****

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 1151.8-1152.8m

Sorted List

0.46	0.61
0.48	
0.53	
0.54	
0.55	
0.57	
0.58	
0.58	
0.59	
0.60	

Number of values= 11

Mean of values 0.55
Standard Deviation 0.05

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

46-48	**
49-51	
52-54	*
55-57	***
58-60	****
61-63	*

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 1176-1179m

Sorted List

0.47	0.49	0.52
0.48	0.50	0.53
0.48	0.50	0.53
0.48	0.51	0.53
0.48	0.51	0.54
0.49	0.51	0.54
0.49	0.51	0.55
0.49	0.51	0.56
0.49	0.52	0.57
0.49	0.52	0.60

Number of values= 30

Mean of values 0.51
Standard Deviation 0.03

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

47-49	**********
50-52	**********
53-55	*****
56-58	***
59-61	*

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 1200-1203m

Sorted List

0.47	0.56
0.47	0.61
0.48	0.61
0.49	0.61
0.50	
0.53	
0.53	
0.53	
0.54	
0.55	

Number of values= 14

Mean of values 0.53
Standard Deviation 0.05

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

47-49	****
50-52	*
53-55	****
56-58	**
59-61	***

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 1252.7-1253.6m

Sorted List

0.48	0.62
0.48	0.62
0.51	
0.54	
0.55	
0.56	
0.57	
0.57	
0.57	
0.62	

Number of values= 12

Mean of values 0.56
Standard Deviation 0.05

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

48-50	**
51-53	*
54-56	**
57-59	****
60-62	***

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 1296-1299m

Sorted List

0.49	0.57	0.61
0.50	0.57	0.61
0.51	0.57	0.61
0.51	0.57	0.63
0.53	0.58	0.64
0.54	0.58	0.65
0.54	0.59	0.65
0.55	0.60	0.66
0.56	0.60	0.67
0.56	0.60	0.70

Number of values= 30

Mean of values 0.59
Standard Deviation 0.05

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

49-51	****
52-54	*
55-57	*********
58-60	******
61-63	****
64-66	****
67-69	*
70-72	*

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 1442.8-1445.7m

Sorted List

0.46	0.57
0.48	0.57
0.51	0.58
0.53	0.58
0.53	0.60
0.54	0.60
0.54	0.61
0.55	0.62
0.55	0.63
0.56	0.65

Number of values= 20

Mean of values 0.56
Standard Deviation 0.05

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

46-48	**
49-51	*
52-54	**
55-57	*******
58-60	****
61-63	***
64-66	*

VITRINITE REFLECTANCE VALUES

Well Name: WARRACBARUNAH-5
Depth: 1461-1464m

Sorted List

0.51	0.59	0.66
0.52	0.59	0.67
0.53	0.60	0.69
0.56	0.61	0.71
0.56	0.62	
0.56	0.62	
0.57	0.63	
0.58	0.63	
0.58	0.64	
0.58	0.66	

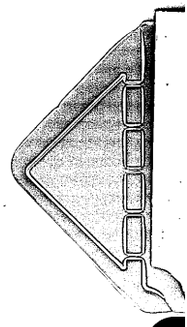
Number of values= 24

Mean of values 0.60
Standard Deviation 0.05

HISTOGRAM OF VALUES
Reflectance values multiplied by 100

51-53	***
54-56	
57-59	*********
60-62	****
63-65	***
66-68	***
69-71	**

Appendix 8



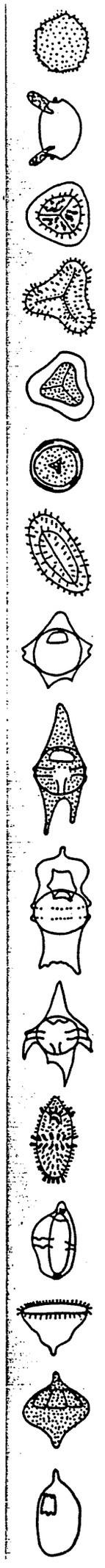
APPENDIX 8

PALYNOLOGICAL & GEOCHRONOLOGICAL REPORTS

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 VICTORIAN GEOLOGICAL SURVEY

WARRACBARUNAH-2, OTWAY BASIN, VICTORIA

BY

ROGER MORGAN
BOX 161
MAITLAND SA 5573

PHONE: (088) 322795
FAX: (088) 322798
REF: DW.OTW.WARRACBA

FOR VICTORIAN GEOLOGICAL SURVEY

OCTOBER, 1991.

PALYNOLOGY OF VICTORIAN GEOLOGICAL SURVEY

WARRACBARUNAH-2, OTWAY BASIN, VICTORIA

BY

ROGER MORGAN

CONTENTS PAGE

I SUMMARY

The studied sample set yielded the following breakdown

438m (cutts) : lower P. tuberculatus zone : Early Oligocene nearshore marine : immature for hydrocarbons

489.4m (CORE) : middle N. asperus zone : Late Eocene : marginally marine : immature

552m (cutts) : upper L. balmei zone : late Paleocene : apparently non-marine : immature

583.6m (CORE) indeterminate

743.4m (CORE) - 864m (cutts) : C. hughesi zone : Aptian : non-marine : usually lower Eumeralla Formation including Windermere Member : immature

903m (cutts) - 1032.9m (CORE) : upper F. wonthaggiensis zone : latest Neocomian : non-marine with algal M. evansii bloom at 999m suggesting lacustrine maximum : usually upper Crayfish D-C of Kopsen and Scholefield : marginal mature for oil

1110m (cutts) - 1445.7m (CORE) : lower F. wonthaggiensis zone : late Neocomian : non-marine : marginal mature for oil

1) Top Pretty Hill unconformity therefore expected in the gap 864m to 903m.

2) Volcanics 580m - 710m, if extrusive, must be post Aptian and pre late Paleocene and therefore possible correlatives of the Pentland Hill Volcanics in the Ballan Graben.

II INTRODUCTION:

Nineteen core and cuttings samples were processed, to provide information on age, environment and maturity.

Palynomorph occurence data are shown as Appendix I and form the basis for the assignment of the samples to six spore-pollen units of Oligocene to late Neocomian age. 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 and modified by Morgan (1985) for application in the Otway Basin. The Tertiary zonation is that of Stover and Partridge (1973) and Stover and Evans (1973) as modified by Partridge (1976).

Maturity data was generated in the form of Spore Colour Index, and is plotted on figure 2 Maturity profile of Warracbarunah-2. The oil and gas windows in figure 2 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%.

	AGE		SPORE - POLLEN ZONES	DINOFLAGELLATE ZONES
Early Tertiary	Early Oligocene		P. tuberculatus	
	Late Eocene		upper N. asperus	P. comatum
			middle N. asperus	V. extensa
	Middle Eocene		lower N. asperus	D. heterophlycta
			P. asperopolus	W. echinosuturata
				W. edwardsii
				W. thompsonae
	Early Eocene		upper M. diversus	W. ornata
				W. waipawaensis
			middle M. diversus	
			lower M. diversus	W. hyperacantha
	Paleocene		upper L. balmei	A. homomorpha
			lower L. balmei	E. crassitabulata
				T. evittii
Late Cretaceous	Maastrichtian		T. longus	M. druggii
	Campanian		T. lillei	I.korojonense
			N. senectus	X. australis
	Santonian		T. pachyexinus	N. aceras
				I. cretaceum
				O. porifera
	Coniacian		C. triplex	
	Turonian			C. striatoconus
	Cenomanian		A. distocarinatus	P. infusorioides
Early Cretaceous	Albian	Late	P. pannosus	
		Middle	upper C. paradoxa	
			lower C. paradoxa	
		Early	C. striatus	
	Aptian		upper C. hughesi	
			lower C. hughesi	
	Barremian		F. wonthaggiensis	
	Hauterivian			
	Valanginian		upper C. australiensis	
	Berriasian		lower C. australiensis	
Juras.	Tithonian		R. watherooensis	

FIGURE 1 ZONATION FRAMEWORK

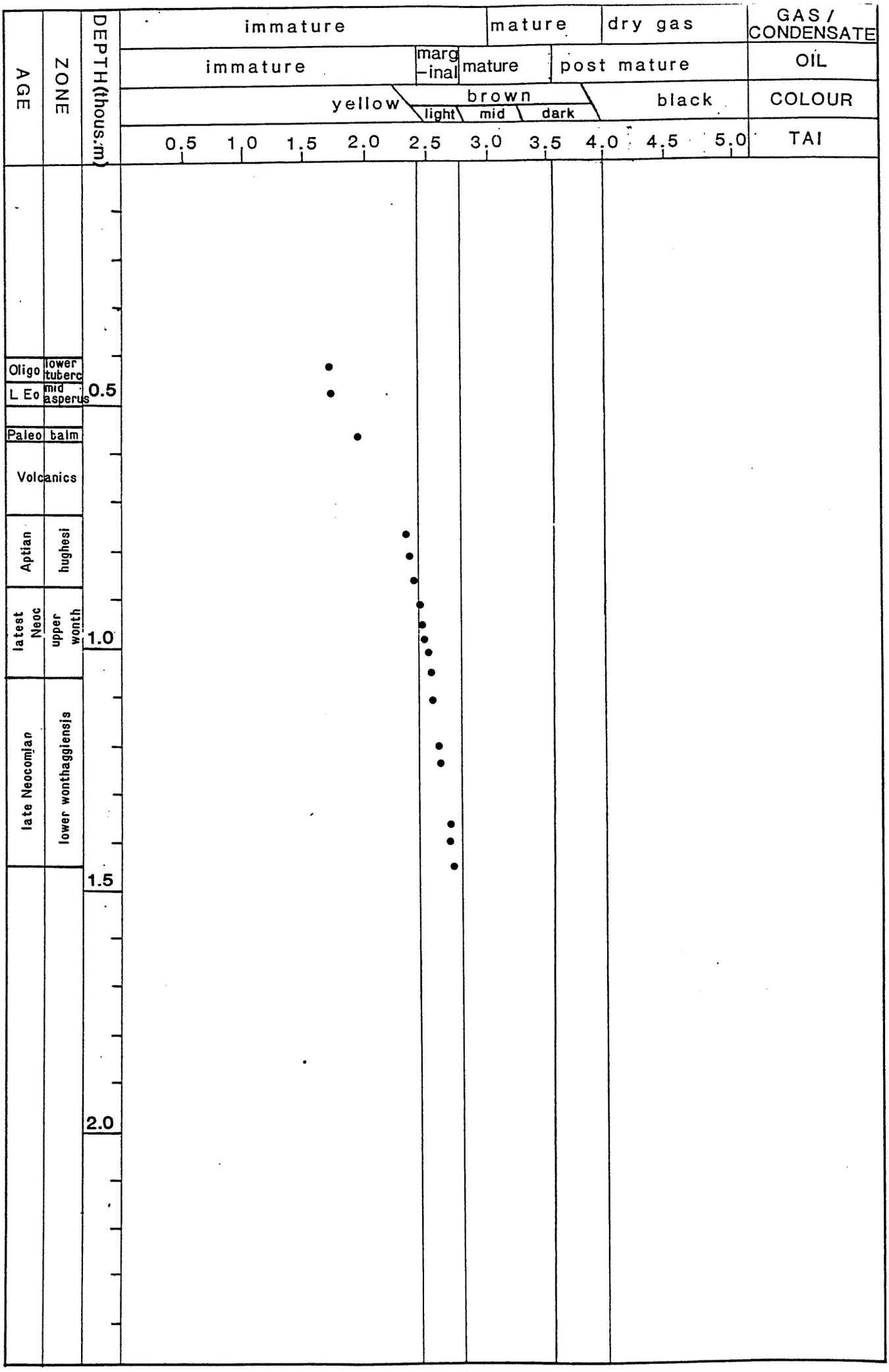


FIGURE 2 MATURITY PROFILE WARRACBARUNAH 2

III PALYNOSTRATIGRAPHY

A 438m (cutts) : lower P. tuberculatus zone

Assignment to the lower subzone ofthe Proteacidites tuberculatus zone is indicated at the top on youngest Beaupreadites verrucosus, Periporopollenites vesicus and Nothofagidites flemingii, and at the base on oldest Cyatheacidites annulatus. Nothofagidites spp. dominate the assemblage and comprise 60% of palynomorphs, with Haloragacidites harrisii, and Cyathidites frequent. Proteacidites rectomarginus and Nothofagidites asperus are rare. The rare dinoflagellates are not age distinctive, but include common Operculodinium spp.

Very nearshore marine environments are suggested by the total dominance of the spores and pollen and the rare low diversity dinoflagellates.

Colourless palynomorphs indicate immaturity for hydrocarbon generation.

B 489.4m (CORE) : middle N. asperus zone

Assignment to the middle subzone of the Nothofagidites asperus zone is indicated by Proteacidites reticulatus and Triorites magnificus, both of which are confined to the subzone. Nothofagidites spp. again dominate with 70% of the assemblage. Minor Cretaceous reworking includes Coptospora paradoxa and Cicatricosisporites australiensis. The very lean dinoflagellate asssemblage is not zone distinctive, but the presence of Deflandrea phosphoritica is consistent with the spore-pollen zonal assignment.

Very nearshore marine environments are indicated by the dominance of spore-pollen and the rare low diversity dinoflagellates. Frequent Paralecaniella indentata suggests lacustrine influence.

Colourless palynomorphs indicate immaturity for hydrocarbon generation.

C 552m (cutts) : upper L. balmei zone

This rich sample is assigned to the upper Lygistepollenites balmei zone at the top on youngest Gambierina rudata and G. edwardsii and at the base on oldest Proteacidites grandis and the absence of other indicators. Clavifera triplex is common, with frequent Australopollis obscurus, Nothofagidites brachyspinulosus and Periporopollenites polyoratus. Dinoflagellates are absent.

Non-marine environments are indicated by the dominance of diverse spores and pollen and total absence of dinoflagellates.

Yellow spore colours indicate immaturity for hydrocarbon generation.

D 583.6m (CORE) : indeterminate

This sample is extremely lean and contains only trace quantities of longranging taxa of late Cretaceous to Tertiary age including C. triplex, Phyllocladidites mawsonii and Nothofagidites emarcidus. These are considered most likely mud contamination given the volcanic lithologies.

E 743.4m (CORE) - 864 (cutts) : C. hughesi zone

This group of four samples is assigned to the Cyclosporites hughesi spore pollen zone at the top on youngest C. hughesi without younger indicators, and at the base on oldest Pilosisporites notensis. Dictyotosporites speciosus and Cicatricosisporites australiensis occur consistently with the latter very rare beneath the interval. Common species include Cyathidites minor, Falcisporites similis and Stercieporites antiquasporites. Cooksonites variabilis occurs at 864m (cutts) only.

Non-marine environments are indicated by the common and diverse spores and pollen and total absence of cuticle.

Yellow to light brown spore colours indicate immaturity for hydrocarbon generation.

These features are normally seen in the lower Eumeralla Formation and correlatives of Kopsen and Scholefield (1989).

F 903m (cutts) - 1032.9m (CORE) : upper F. wonthaggiensis zone

Assignment to the upper part of the Foraminisporis wonthaggiensis zone is indicated at the top by the absence of younger indicators and the downhole influx of Contignisporites cooksoniae, and at the base by oldest C. australiensis, F. wonthaggiensis and Triporoletes reticulatus. Common forms are Cyathidites spp, Osmundacidites spp and Falcisporites similis.

Non-marine mostly fluvial environments are indicated by common and diverse spores and pollen and virtual absence

of acritarchs of any kind down to 960.9m. Microfasta evansii occurs at 999m (cutts) only as 2% of palynomorphs and represents a lacustrine maximum.

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

These features are normally seen in the upper part of the Crayfish Formation (D-C members of Kopsen and Scholfield) and correlatives.

G 1110m (cutts) - 1445.7m (CORE) : lower F. wonthaggiensis zone

Assignment to the lower subzone is indicated at the top by the absence of younger indicators and at the base by oldest D. speciosus. C. hughesi also occurs to the interval base. Common taxa include Cyathidites spp and O. wellmanii with F. similis intermittently frequent.

Non-marine environments are indicated throughout by common and diverse spores and pollen and the absence of saline indicators. Some lacustrine influence is suggested in most samples however by the rare presence of algal acritarchs (Schizospiris spp).

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

These features are normally seen in the mid Crayfish Formation B-C units of Kopsen and Scholefield.

IV CONCLUSIONS

A At the base of the well, an apparently conformable Otway Basin Early Cretaceous sequence occurs, spanning the lower wonthaggiensis to hughesi zones (equivalent to the mid Crayfish to lower Eumeralla Formations. Within this interval, the basal Eumeralla unconformity is most likely to lie in the sample gap 864m to 903m. The sequence is therefore strongly truncated at the top with all of the Albian missing.

B Above this truncated Eumeralla Formation, a sequence of Volcanics 580m - 710m occur which are barren of palynomorphs.

C Above volcanics, a thin Paleocene interval occurs, age equivalent to the upper Pebble Point and lower Dilwyn Formation, and places a younger age limit to the Volcanics.

D Apparently unconformably above the Paleocene, Late Eocene and Early Oligocene very nearshore marine section occurs up to 438m at least. Younger section was not sampled.

V REFERENCES:

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WARRACBARANAH #2

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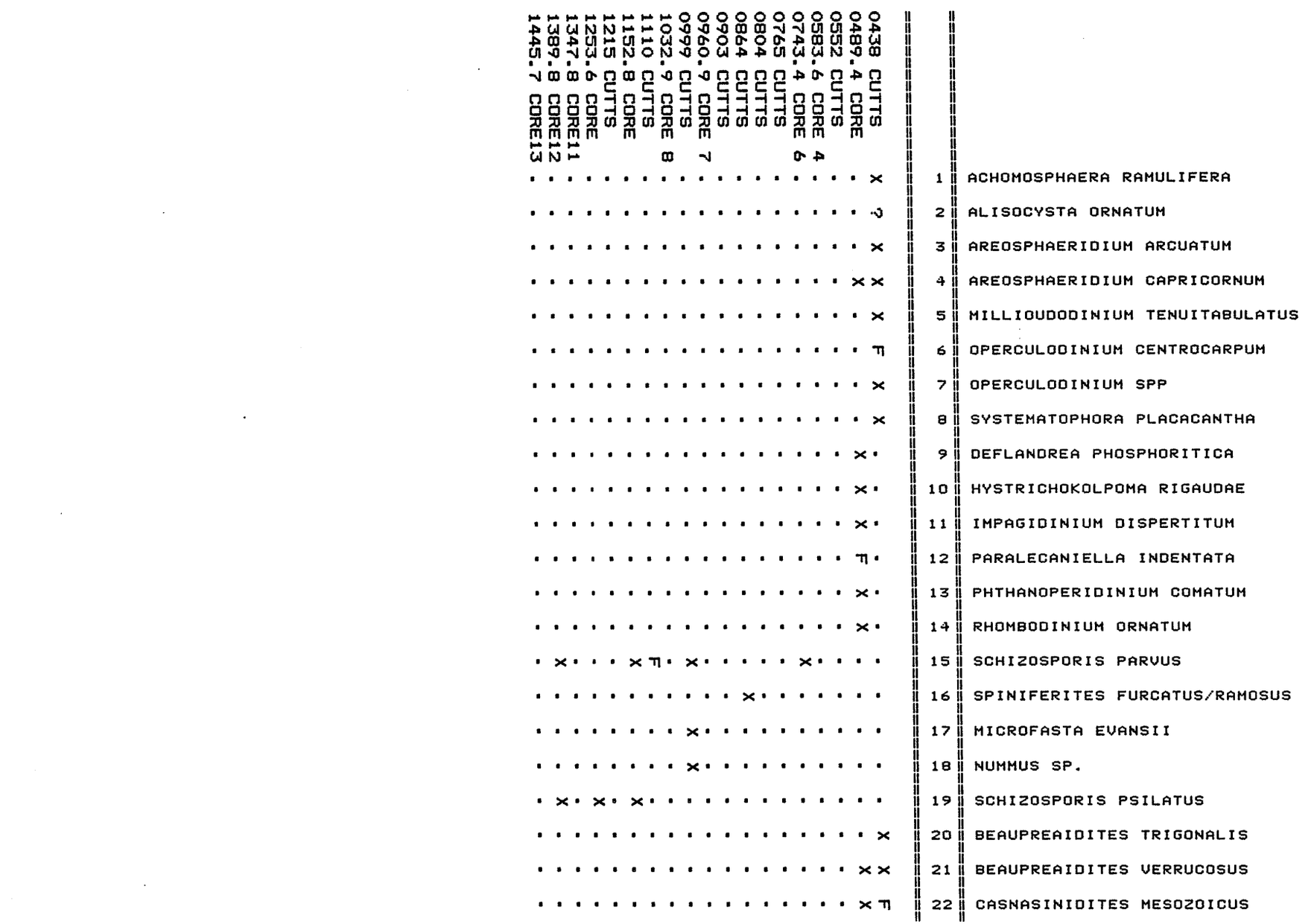
C L I E N T: VICTORIAN MINES DEPARTMENT / GAS AND FUEL
W E L L: WARRACBARUNAH #2
F I E L D / A R E A: OTWAY BASIN

A N A L Y S T: ROGER MORGAN D A T E : JULY 1991
N O T E S: ALL DEPTHS IN METRES

RANGE CHART OF OCCURRENCES BY HIGHEST APPEARANCE (by group)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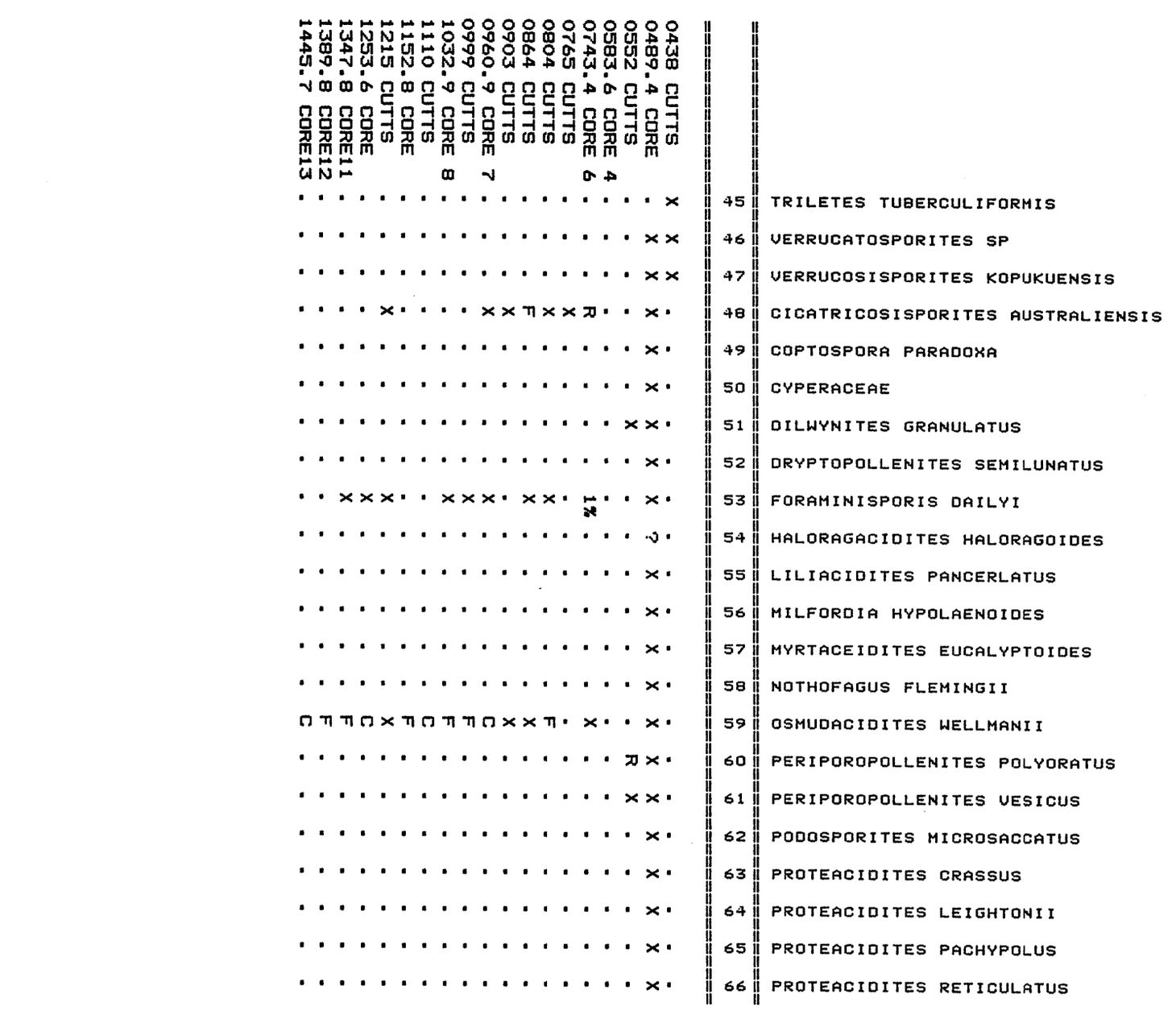
0489.4 CORE
0552 CUTTS
0583.6 CORE 4
0743.4 CORE 6
0765 CUTTS
0804 CUTTS
0864 CUTTS
0903 CUTTS
0960.9 CORE 7
0999 CUTTS
1032.9 CORE 8
1110 CUTTS
1152.8 CORE
1215 CUTTS
1253.6 CORE
1347.8 CORE11
1389.8 CORE12
1445.7 CORE13
1 ACHOMOSPHAERA RAMULIFERA
2 ALISOCYSTA ORNATUM
3 AREOSPHAERIDIUM ARCUATUM
4 AREOSPHAERIDIUM CAPRICORNUM
5 MILLIOUDODINIUM TENUITABULATUS
6 OPERCULODINIUM CENTROCARPUM
7 OPERCULODINIUM SPP
8 SYSTEMATOPHORA PLACACANTHA
9 DEFLANDREA PHOSPHORITICA
10 HYSTRICHOKOLPOMA RIGAUDAE
11 IMPAGIDINIUM DISPERTITUM
12 PARALECANIELLA INDENTATA
13 PHTHANOPERIDINIUM COMATUM
14 RHOMBODINIUM ORNATUM
15 SCHIZOSPORIS PARVUS
16 SPINIFERITES FURCATUS/RAMOSUS
17 MICROFASTA EVANSII
18 NUMMUS SP.
19 SCHIZOSPORIS PSILATUS
20 BEAUPREAIDITES TRIGONALIS
21 BEAUPREAIDITES VERRUCOSUS
22 CASNASINIDITES MESOZOICUS

0438 CUTTS	0489.4 CORE	0552 CUTTS	0583.6 CORE 4	0743.4 CORE 6	0765 CUTTS	0804 CUTTS	0864 CUTTS	0903 CUTTS	0960.9 CORE 7	0999 CUTTS	1032.9 CORE 8	1110 CUTTS	1152.8 CORE	1215 CUTTS	1253.6 CORE	1347.8 CORE11	1389.8 CORE12	1445.7 CORE13		
.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	23	CORRUDINIUM SP
.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	24	CUPANIEIDITES ORTHOTEICHUS
.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25	CYATHEACIDITES ANNULATUS
.	X	F	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	26	CYATHIDITES SPP
.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	27	DACRYCARPITES AUSTRALIENSIS
.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	EOXLADOPYXIS PENICULATA
.	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	29	GLEICHENIIDITES CIRCINIDITES
.	X	.	F	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	30	HALORAGACIDITES HARRISII
.	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31	LYGISTEPOLLENITES FLORINII
.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	32	MALVACIPOLLIS SUBTILIS
.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	33	MYRTACEIDITES PARVUS/MESONESUS
.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	34	NOTHOFAGUS ASPERUS
.	R	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	35	NOTHOFAGUS BRACHYSPINULOSUS
.	X	F	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	36	NOTHOFAGUS DEMINUTUS
.	X	C	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	37	NOTHOFAGUS EMARCIDUS/HETERUS
.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	38	NOTHOFAGUS FALCATUS
.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	39	PEROMONOLITES VELLOSUS
X	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	40	PHYLLOCLADIDITES MAWSONII
.	X	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	41	PROTEACIDITES ANNULARIS
.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	42	PROTEACIDITES INCURVATUS
.	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	43	PROTEACIDITES RECTOMARGINIS
C	.	.	X	X	F	F	X	.	X	.	X	.	.	.	.	.	.	.	44	STEREISPORITES ANTIQUISPORITES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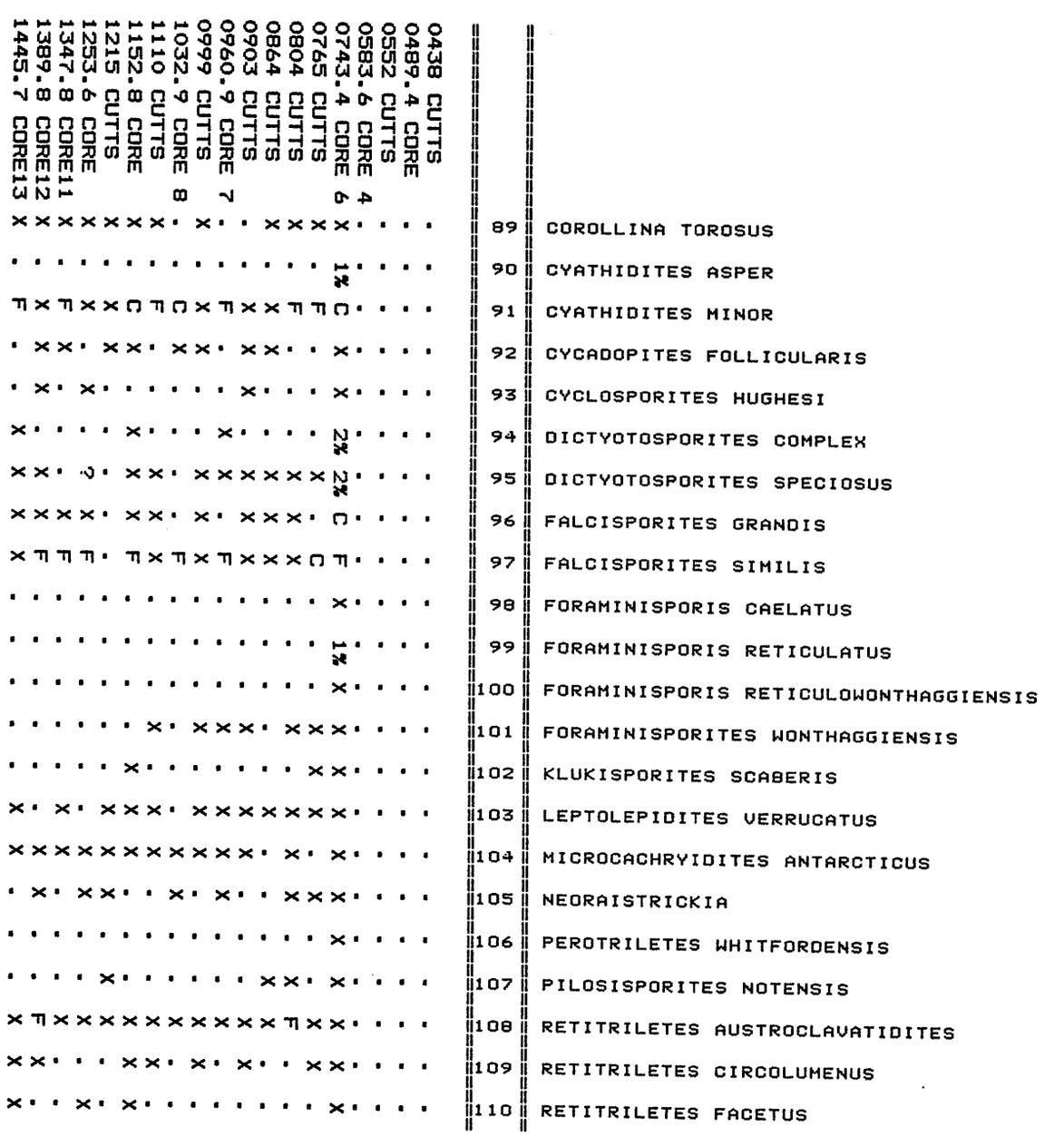
1032.9 CORE 8
1110 CUTTS
1152.8 CORE
1215 CUTTS
1253.6 CORE
1347.8 CORE11
1389.8 CORE12
1445.7 CORE13
45 TRILETES TUBERCULIFORMIS
46 VERRUCATOSPORITES SP
47 VERRUCOSISPORITES KOPUKUENSIS
48 CICATRICOSISPORITES AUSTRALIENSIS
49 COPTOSPORA PARADOXA
50 CYPERACEAE
51 DILWYNITES GRANULATUS
52 DRYPTOPOLLENITES SEMILUNATUS
53 FORAMINISPORIS DAILYI
54 HALORAGACIDITES HALORAGOIDES
55 LILIACIDITES PANCERLATUS
56 MILFORDIA HYPOLAENOIDES
57 MYRTACEIDITES EUCALYPTOIDES
58 NOTHOFAGUS FLEMINGII
59 OSMUDACIDITES WELLMANII
60 PERIPOROPOLLENITES POLYORATUS
61 PERIPOROPOLLENITES VESICUS
62 PODOSPORITES MICROSACCATUS
63 PROTEACIDITES CRASSUS
64 PROTEACIDITES LEIGHTONII
65 PROTEACIDITES PACHYPOLUS
66 PROTEACIDITES RETICULATUS
1%

0438 CUTTS	0489.4 CORE	0552 CUTTS	0583.6 CORE 4	0743.4 CORE 6	0765 CUTTS	0804 CUTTS	0864 CUTTS	0903 CUTTS	0960.7 CORE 7	0999 CUTTS	1032.9 CORE 8	1110 CUTTS	1152.8 CORE	1215 CUTTS	1253.6 CORE	1347.8 CORE11	1389.8 CORE12	1445.7 CORE13		
·	·	X	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	67	PROTEACIDITES SP
·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	68	TRIORITES MAGNIFICUS
·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	69	TRIPOROPOLLENITES BELLUS
·	·	R	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	70	AUSTRALOPOLLIS OBSCURUS
·	·	C	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	71	CLAVIFERA TRIPLEX
·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	72	ERICIPITES SCABRATUS
·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	73	GAMBIERINA EDWARDSII
·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	74	GAMBIERINA RUDATA
·	·	C	·	X	·	·	·	·	·	X	·	·	·	·	·	·	X	·	75	GLEICHENIIDITES
·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	76	LATROBOSPORITES
·	·	R	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	77	LATROBOSPORITES AMPLUS
·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	78	PHYLLOCLADIDITES VERRUCATUS
·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	79	PROTEACIDITES GRANDIS
·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	80	TETRACOLPORITES SP
·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	81	TRICOLPORITES LEUROS
·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	82	NOTHOFAGIDITES EMAREIDUS
·	·	·	X	·	X	X	X	·	·	X	·	X	·	·	·	·	·	·	83	AEQUITRIRADITES SPINULOSUS
·	·	·	X	·	X	·	X	·	·	X	·	·	X	·	·	·	·	·	84	AEQUITRIRADITES VERRUCOSUS
·	X	·	X	·	X	·	·	X	·	X	·	·	X	·	·	·	·	·	85	ARAUCARIACITES AUSTRALIS
·	X	·	·	1%	X	X	X	·	F	X	X	·	·	X	X	X	X	X	86	CERATOSPORITES EQUALIS
·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	87	CICATRICOSISPORITES CRUCIFORMIS
·	·	·	·	1%	·	·	·	·	·	·	·	·	·	·	·	·	·	·	88	CICATRICOSISPORITES LUDBROOKIAE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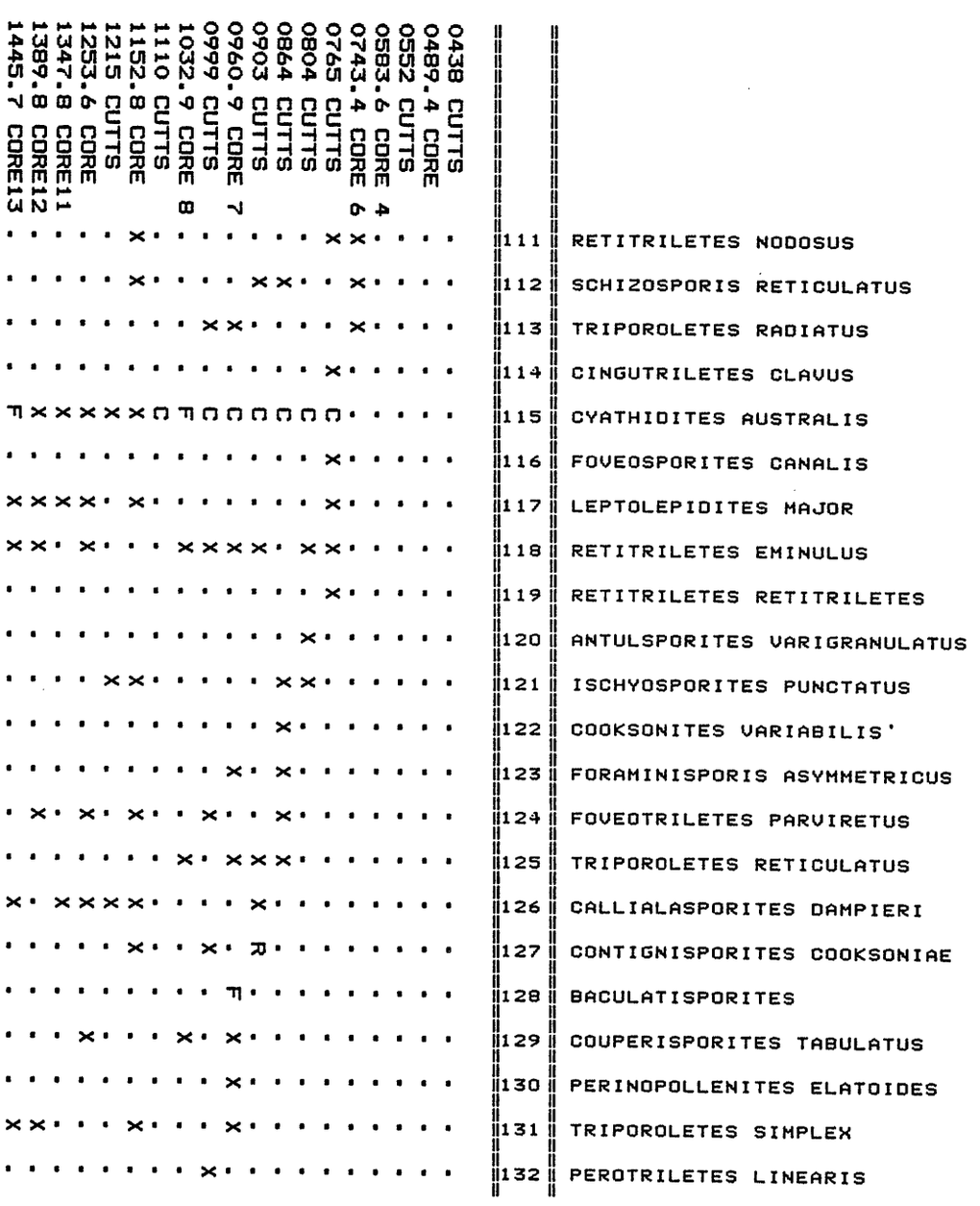
0552 CUTTS
0583.6 CORE 4
0743.4 CORE 6
0765 CUTTS
0804 CUTTS
0864 CUTTS
0903 CUTTS
0960.9 CORE 7
0999 CUTTS
1032.9 CORE 8
1110 CUTTS
1152.8 CORE
1215 CUTTS
1253.6 CORE
1347.8 CORE11
1389.8 CORE12
1445.7 CORE13
89 COROLLINA TOROSUS
90 CYATHIDITES ASPER
91 CYATHIDITES MINOR
92 CYCADOPITES FOLLICULARIS
93 CYCLOSPORITES HUGHESI
94 DICTYOTOSPORITES COMPLEX
95 DICTYOTOSPORITES SPECIOSUS
96 FALCISPORITES GRANDIS
97 FALCISPORITES SIMILIS
98 FORAMINISPORIS CAELATUS
99 FORAMINISPORIS RETICULATUS
100 FORAMINISPORIS RETICULOWONTHAGGIENSIS
101 FORAMINISPORITES WONTHAGGIENSIS
102 KLUKISPORITES SCABERIS
103 LEPTOLEPIDITES VERRUCATUS
104 MICROCACHRYIDITES ANTARCTICUS
105 NEORAISTRICKIA
106 PEROTRILETES WHITFORDENSIS
107 PILOSISPORITES NOTENSIS
108 RETITRILETES AUSTROCLAVATIDITES
109 RETITRILETES CIRCOLUMENUS
110 RETITRILETES FACETUS


0438 CUTTS
0489.4 CORE
0552 CUTTS
0583.6 CORE 4
0743.4 CORE 6
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0864 CUTTS
0903 CUTTS
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1152.8 CORE
1215 CUTTS
1253.6 CORE
1347.8 CORE11
1389.8 CORE12
1445.7 CORE13
111 RETITRILETES NODOSUS
112 SCHIZOSPORIS RETICULATUS
113 TRIPOROLETES RADIATUS
114 CINGUTRILETES CLAVUS
115 CYATHIDITES AUSTRALIS
116 FOVEOSPORITES CANALIS
117 LEPTOLEPIDITES MAJOR
118 RETITRILETES EMINULUS
119 RETITRILETES RETITRILETES
120 ANTULSPORITES VARIGRANULATUS
121 ISCHYOSPORITES PUNCTATUS
122 COOKSONITES VARIABILIS'
123 FORAMINISPORIS ASYMMETRICUS
124 FOVEOTRILETES PARVIRETUS
125 TRIPOROLETES RETICULATUS
126 CALLIALASPORITES DAMPIERI
127 CONTIGNISPORITES COOKSONIAE
128 BACULATISPORITES
129 COUPERISPORITES TABULATUS
130 PERINOPOLLENITES ELATOIDES
131 TRIPOROLETES SIMPLEX
132 PEROTRILETES LINEARIS

	CRYBELOSPORITES STYLOSUS	MUROSPORA FLORIDA	SESTROSPORITES PSEUDOALVEOLATUS	LYCOPODIACIDITES ASPERATUS	NEVESISPORITES VALLATUS	RETITRILETES WATHAROOENSIS	STOVERISPORITES LUNARIS	CALLIALASPORITES TURBATUS	CORONATISPORA PERFORATA	FOVEOTRILETES MAETONENSIS	DICTYOTOSPORITES COARSE	STAPLINISPORITES MANIFESTUS	BOTRYOCOCCUS	
	133	134	135	136	137	138	139	140	141	142	143	144	145	
0438 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	0438 CUTTS
0489.4 CORE	.	.	.	.	.	.	.	.	.	.	.	.	.	0489.4 CORE
0552 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	0552 CUTTS
0583.6 CORE 4	.	.	.	.	.	.	.	.	.	.	.	.	.	0583.6 CORE 4
0743.4 CORE 6	.	.	.	.	.	.	.	.	.	.	.	.	.	0743.4 CORE 6
0765 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	0765 CUTTS
0804 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	0804 CUTTS
0864 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	0864 CUTTS
0903 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	0903 CUTTS
0960.9 CORE 7	.	.	.	.	.	.	.	.	.	.	.	.	.	0960.9 CORE 7
0999 CUTTS	.	.	.	.	.	.	.	.	.	.	.	.	.	0999 CUTTS
1032.9 CORE 8	X	X	X	.	.	.	.	.	.	.	.	.	.	1032.9 CORE 8
1110 CUTTS	.	.	.	X	X	X	.	.	.	.	.	.	.	1110 CUTTS
1152.8 CORE	.	.	.	.	.	X	.	.	.	.	.	.	.	1152.8 CORE
1215 CUTTS	.	.	.	X	.	.	X	.	.	.	.	.	.	1215 CUTTS
1253.6 CORE	.	.	.	.	.	.	.	X	X	.	.	.	.	1253.6 CORE
1347.8 CORE11	.	.	.	.	.	X	.	.	.	.	.	.	X	1347.8 CORE11
1389.8 CORE12	.	.	.	X	.	X	.	.	X	X	.	.	.	1389.8 CORE12
1445.7 CORE13	.	X	.	.	.	.	.	.	X	X	X	X	.	1445.7 CORE13

SPECIES LOCATION INDEX

Index numbers are the columns in which species appear.

INDEX NUMBER	SPECIES
1	ACHOMOSPHAERA RAMULIFERA
83	AEQUITRIRADITES SPINULOSUS
84	AEQUITRIRADITES VERRUCOSUS
2	ALISOCYSTA ORNATUM
120	ANTULSPORITES VARIGRANULATUS
85	ARAUCARIACITES AUSTRALIS
3	AREOSPHAERIDIUM ARCUATUM
4	AREOSPHAERIDIUM CAPRICORNUM
70	AUSTRALOPOLLIS OBSCURUS
128	BACULATISPORITES
20	BEAUPREAIDITES TRIGONALIS
21	BEAUPREAIDITES VERRUCOSUS
145	BOTRYOCOCCUS
126	CALLIALASPORITES DAMPIERI
140	CALLIALASPORITES TURBATUS
22	CASNASINIDITES MESOZOICUS
86	CERATOSPORITES EQUALIS
48	CICATRICOSISPORITES AUSTRALIENSIS
87	CICATRICOSISPORITES CRUCIFORMIS
88	CICATRICOSISPORITES LUDBROOKIAE
114	CINGUTRILETES CLAVUS
71	CLAVIFERA TRIPLEX
127	CONTIGNISPORITES COOKSONIAE
122	COOKSONITES VARIABILIS
49	COPTOSPORA PARADOXA
89	COROLLINA TOROSUS
141	CORONATISPORA PERFORATA
23	CORRUDINIUM SP
129	COUPERISPORITES TABULATUS
133	CRYBELOSPORITES STYLOSUS
24	CUPANIEIDITES ORTHOTEICHUS
25	CYATHEACIDITES ANNULATUS
90	CYATHIDITES ASPER
115	CYATHIDITES AUSTRALIS
91	CYATHIDITES MINOR
26	CYATHIDITES SPP
92	CYCADOPITES FOLLICULARIS
93	CYCLOSPORITES HUGHESI
50	CYPERACEAE
27	DACRYCARPITES AUSTRALIENSIS
9	DEFLANDREA PHOSPHORITICA
143	DICTYOTOSPORITES COARSE
94	DICTYOTOSPORITES COMPLEX
95	DICTYOTOSPORITES SPECIOSUS
51	DILWYNITES GRANULATUS
52	DRYPTOPOLLENITES SEMILUNATUS
28	EOXLADOPYXIS PENICULATA
72	ERICIPITES SCABRATUS
96	FALCISPORITES GRANDIS
97	FALCISPORITES SIMILIS
123	FORAMINISPORIS ASYMMETRICUS
98	FORAMINISPORIS CAELATUS
53	FORAMINISPORIS DAILYI
99	FORAMINISPORIS RETICULATUS
100	FORAMINISPORIS RETICULOWONTHAGGIENSIS
101	FORAMINISPORITES WONTHAGGIENSIS
116	FOVEOSPORITES CANALIS
142	FOVEOTRILETES MAETONENSIS
124	FOVEOTRILETES PARVIRETUS
73	GAMBIERINA EDWARDSII
74	GAMBIERINA RUDATA
75	GLEICHENIIDITES
29	GLEICHENIIDITES CIRCINIDITES
54	HALORAGACIDITES HALORAGOIDES
30	HALORAGACIDITES HARRISII
10	HYSTRICHOKOLPOMA RIGAUDAE
11	IMPAGIDINIUM DISPERTITUM
121	ISCHYOSPORITES PUNCTATUS
102	KLUKISPORITES SCABERIS
76	LATROBOSPORITES
77	LATROBOSPORITES AMPLUS
117	LEPTOLEPIDITES MAJOR
103	LEPTOLEPIDITES VERRUCATUS
55	LILIACIDITES PANCERLATUS
136	LYCOPODIACIDITES ASPERATUS

102	KLUKISPORITES SCABERIS
76	LATROBOSPORITES
77	LATROBOSPORITES AMPLUS
117	LEPTOLEPIDITES MAJOR
103	LEPTOLEPIDITES VERRUCATUS
55	LILIACIDITES PANCERLATUS
136	LYCOPODIACIDITES ASPERATUS
31	LYGISTEPOLLENITES FLORINII
32	MALVACIPOLLIS SUBTILIS
104	MICROCACHRYIDITES ANTARCTICUS
17	MICROFASTA EVANSII
56	MILFORDIA HYPOLAENOIDES
5	MILLIOUDODINIUM TENUITABULATUS
134	MUROSPORA FLORIDA
57	MYRTACEIDITES EUCALYPTOIDES
33	MYRTACEIDITES PARVUS/MESONESUS
105	NEORAISTRICKIA
137	NEVESISPORITES VALLATUS
82	NOTHOFAGIDITES EMAREIDUS
34	NOTHOFAGUS ASPERUS
35	NOTHOFAGUS BRACHYSPINULOSUS
36	NOTHOFAGUS DEMINUTUS
37	NOTHOFAGUS EMARCIDUS/HETERUS
38	NOTHOFAGUS FALCATUS
58	NOTHOFAGUS FLEMINGII
18	NUMMUS SP.
6	OPERCULODINIUM CENTROCARPUM
7	OPERCULODINIUM SPP
59	OSMUDACIDITES WELLMANII
12	PARALECANIELLA INDENTATA
130	PERINOPOLLENITES ELATOIDES
60	PERIPOROPOLLENITES POLYORATUS
61	PERIPOROPOLLENITES VESICUS
39	PEROMONOLITES VELLOSUS
132	PEROTRILETES LINEARIS
106	PEROTRILETES WHITFORDENSIS
13	PHTHANOPERIDINIUM COMATUM
40	PHYLLOCLADIDITES MAWSONII
78	PHYLLOCLADIDITES VERRUCATUS
107	PILOSISPORITES NOTENSIS
62	PODOSPORITES MICROSACCATUS
41	PROTEACIDITES ANNULARIS
63	PROTEACIDITES CRASSUS
79	PROTEACIDITES GRANDIS
42	PROTEACIDITES INCURVATUS
64	PROTEACIDITES LEIGHTONII
65	PROTEACIDITES PACHYPOLUS
43	PROTEACIDITES RECTOMARGINIS
66	PROTEACIDITES RETICULATUS
67	PROTEACIDITES SP
108	RETITRILETES AUSTROCLAVATIDITES
109	RETITRILETES CIRCOLUMENUS
118	RETITRILETES EMINULUS
110	RETITRILETES FACETUS
111	RETITRILETES NODOSUS
119	RETITRILETES RETITRILETES
138	RETITRILETES WATHAROOENSIS
14	RHOMBODINIUM ORNATUM
15	SCHIZOSPORIS PARVUS
19	SCHIZOSPORIS PSILATUS
112	SCHIZOSPORIS RETICULATUS
135	SESTROSPORITES PSEUDOALVEOLATUS
16	SPINIFERITES FURCATUS/RAMOSUS
144	STAPLINISPORITES MANIFESTUS
44	STEREISPORITES ANTIQUISPORITES
139	STOVERISPORITES LUNARIS
8	SYSTEMATOPHORA PLACACANTHA
80	TETRACOLPORITES SP
81	TRICOLPORITES LEUROS
45	TRILETES TUBERCULIFORMIS
68	TRIORITES MAGNIFICUS
113	TRIPOROLETES RADIATUS
125	TRIPOROLETES RETICULATUS
131	TRIPOROLETES SIMPLEX
69	TRIPOROPOLLENITES BELLUS
46	VERRUCATOSPORITES SP
47	VERRUCOSISPORITES KOPUKUENSIS

AMDEL
CORE
SERVICES

5th March 1991

Geological Survey of Victoria
115 Victoria Parade
FITZROY VICTORIA 3065

Attention: Ahmad Tabassi

REPORT: 001/101

CLIENT REFERENCE:	Fax
MATERIAL:	Drill Core
LOCALITY:	Warracbarunah No. 2
WORK REQUIRED:	K-Ar Geochronology

Please direct technical enquiries regarding this work to the signatory below under whose supervision the work was carried out.

DR SALLY E PHILLIPS
Laboratory Supervisor
on behalf of Amdel Core Services Pty Ltd

EVALUATION OF SUITABILITY FOR K-Ar DATING

1. INTRODUCTION

One sample of basalt drill core from Warracbarunah No. 2 was received from the Geological Survey of Victoria, with a request to carry out a K-Ar age determination.

2. EVALUATION

A thin section of the basalt was prepared and examined to determine the suitability of the rock for K-Ar dating. To obtain reliable K-Ar dates from total rock samples, all primary mineral phases in the rock should be fresh. The presence of abundant secondary minerals or veining are usually signs that the rock is not suitable and that a date determined on the rock may be significantly younger than the true age of crystallisation. The present sample falls into this category and a K-Ar date would be of doubtful value for accurate stratigraphic positioning or correlation.

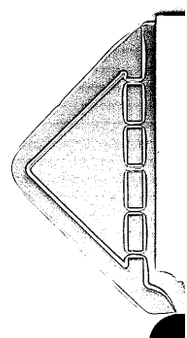
Warracbarunah #2: TSC54976

This is a fine grained basalt that in hand specimen can be seen to contain numerous ovoid ?vesicles filled with pale to dark green secondary minerals.

In thin section, the rock is a fine grained basalt with altered mafic phenocrysts. From their outlines, these phenocrysts appear to have been olivine, but they are totally replaced by green chlorite minerals rimmed with red-brown ?iddingsite. These grade down to groundmass grain size and make up about 10-15% of the rock.

The groundmass is made up of fine plagioclase laths and tiny granules of pyroxene and Fe oxide (all of which are fresh) and widespread patches of almost colourless, structureless, isotropic to weakly anisotropic material. The secondary material appears to be filling the round to ovoid vesicles. This widespread alteration makes the rock unsuitable for dating.

Appendix 9



APPENDIX 9

CORE ANALYSIS REPORT

AMDEL
CORE
SERVICES

20th May 1991

Department of Manufacturing and Industry Development
PO Box 173
EAST MELBOURNE VIC 3002

Attention: Mr C Menhennitt

REPORT: 008/096

CLIENT REFERENCE:	cm.ge.L1
MATERIAL:	Whole Core Samples
LOCALITY:	Warracbarunah No.2
WORK REQUIRED:	Conventional Core Analysis

Please direct technical enquiries regarding this work to the signatory below under whose supervision the work was carried out.

RUSSELL R MARTIN
Laboratory Supervisor
Core Analysis/Special Core Analysis
on behalf of Amdel Core Services

CONTENTS:

LIST OF TABLES:

LIST OF FIGURES:

1. INTRODUCTION

Nine (9) small sections of whole core sample arrived at Amdel Core Services (ACS) Adelaide laboratories for conventional core analysis and petrological analysis on the 13 May 1991.

The following report includes conventional core analysis data: helium injection porosity, permeability to air and calculated grain density determinations. Data presented graphically in this Report includes a porosity versus permeability to air cross-plot.

Off-cuts of samples 1 and 8 were dispatched to the Petrology Department of ACS for analysis and results will be issued in a separate report.

The data contained in this report has been derived by the following methods:

2. PLUG PREPARATION

1½" diameter plugs were taken from the core sections provided. Tap water was used as the bit lubricant. The plug samples were cut along the strike of the bedding as appearing in the core sections, therefore determining a maximimum permeability into the well bore. Samples were trimmed square and the offcuts retained. Offcuts of samples 1 and 8 were delivered to the ACS Petrology Department for analysis as requested.

Residual hydrocarbons and salts are extracted from the plugs using a 3:1 chloroform methanol mixture in a Soxhlet extractor. The solvent is recycled in the Soxhlet until the samples are free of soluble hydrocarbons and salts.

After cleaning, the plugs are dried in a dry oven at temperatures not exceeding 80°C and are then stored in a desicator and allowed to cool to room temperature.

3. PERMEABILITY TO AIR

A plug sample is used for this measurement and is placed in a Hassler cell to which a confining pressure of 200 psig (1380 kpa) is applied; this pressure is used to prevent bypassing of air around the sides of the sample when the measurement is made. A known pressure is then applied to the upstream sample face and the differential pressure (between the upstream and downstream faces) is monitored at the downstream face. Permeability is then calculated using Darcy's Law.

4. HELIUM INJECTION POROSITY

The porosity of a clean dry core plug is determined as follows: it is first placed in a matrix cup; a known volume of helium at a known pressure is expanded into the matrix cup which contains the core plug; the resulting pressure is recorded and the unknown volume (that is, the volume of the grains) is determined using Boyle's Law. The bulk volume is determined by mercury immersion. The difference between the grain volume and the bulk volume is the pore volume and from this the porosity is calculated as the volume percentage of pores with respect to the bulk volume.

5. APPARENT GRAIN DENSITY

The apparent grain density is derived from the measurements described in Section 4, above, and is the ratio of the weight of the core plug divided by the grain volume.

BLE 1

CONVENTIONAL CORE ANALYSIS

Company: Department of Manufacturing and Industry Development
Report: 008/096 Well: Warracbarunah No.2
Date: 20 May 1991 Field:
State: Victoria Country: Australia

Sample Number	Depth (m)	Porosity (%)		Density		Permeability (md)		Summation of Fluids			Remarks
		He Inj	Roll Av	Nat	Grain	Ka	Roll Av Ka	Por %	Oil %	Water %	
1		11.5		2.70		0.79					
2		10.2		2.68		0.62					
3		11.7		2.68		1.4					
4		15.2		2.66		25					
5		14.3		2.68		0.23					
6		15.2		2.68		0.20					
7		15.9		2.68		174					VF
8		6.4		2.71		0.01					
9		19.0		2.67		5.6					

VF = Vertical Fracture; HF = Horizontal Fracture; MP = Mounted Plug; SP = Short Plug;
C# = Top of Core; B# = Bottom of Core; OWC = Probable Oil/Water Contact;
Tr = Probable Transition Zone; GC = Probable Gas Cap;

TAB 2

CORE PLUG DESCRIPTION

Company: Department of Manufacturing and Industry Development

Report: 008/096 Well: Warracbarunah No.2

Date: 20 May 1991 Field:

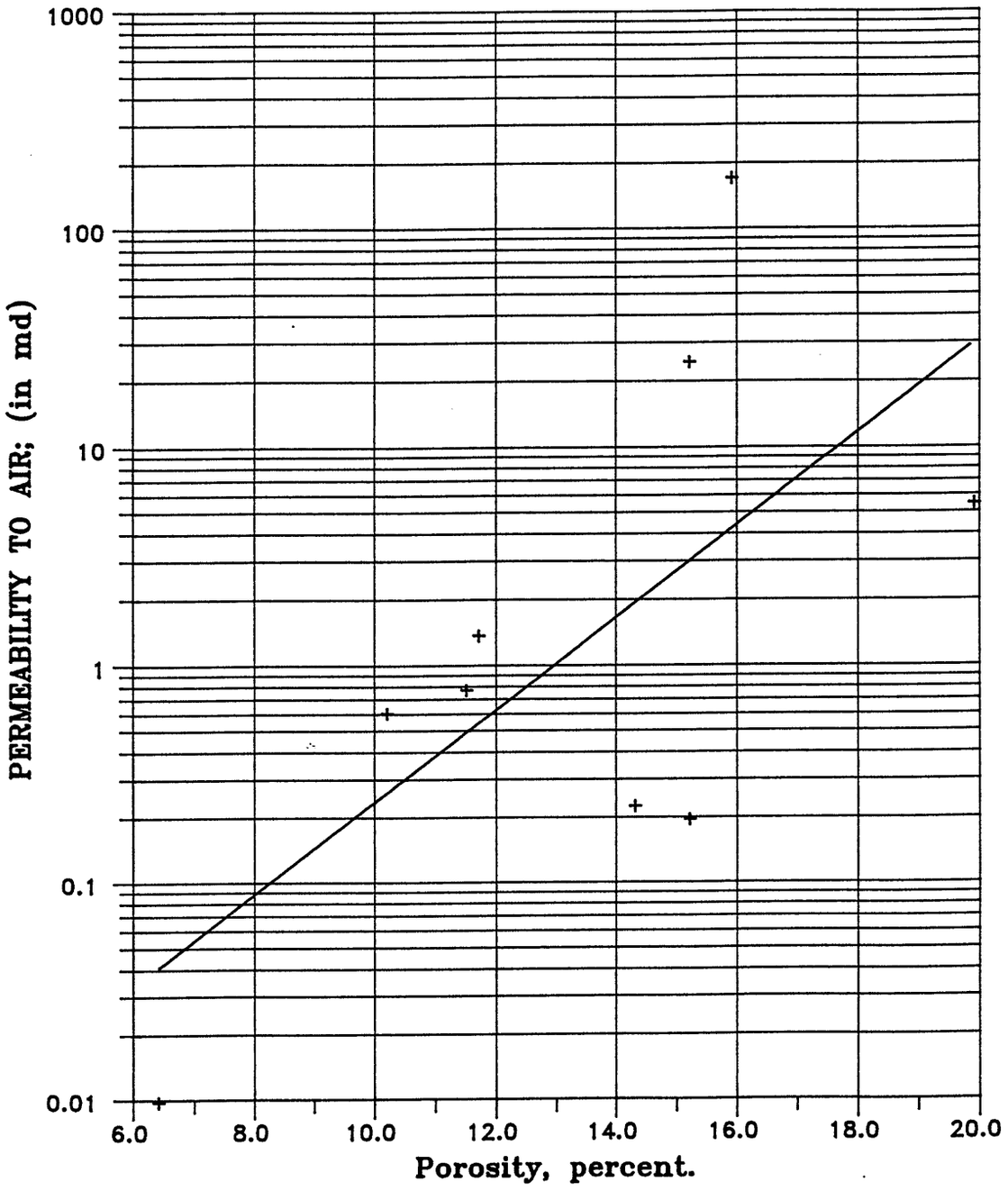
State: Victoria Country: Australia

Sample Number	Depth (m)	Description
1	1524.88-1527.46	Sst: med gry, wl srt, f-med gr, mod wl rndd to sbang, Qtz w/ Cl Cmt.
2	1497.36-1501.31	Sst: med-lt gry, wl srt, f-med gr, sbrndd to slily ang, Qtz w/ Fspr, Cl Cmt, occ carb clasts.
3	1497.36-1501.31	Sst: as in 2.
4	1497.36-1504.31	Sst: slily gnsh gry, mod wl srt, f-crs gr, sbrndd to sbang, Qtz w/ Fspr, occ Rk Frag & Mic, r carb clasts.
5	1442.77-1445.72	Sst: slily brnsh gry, mod-wl srt, f-vf gr, rndd to sbrndd, Qtz & Fspr w/ Cl & Mic, r Rk Frag, carb Bnd, slily turb, v wl cmt.
6	1442.77-1445.72	Sst: slily tn gry, mod srt, f-vf gr, wl rndd to sbrndd, Qtz & Fspr w/ Mic & Cl, carb Bnd & r sml carb clasts, wl cmt.
7	1342.99-1347.84	Sst: gry-bu, wl srt, f-med gr, wl rndd to sbang, Qtz & Fspr w/ Mic & Cl, occ Rk Frag, crs gr qtz Bnd, carb Lam w/ sl Frac, slily turb.
8	1342.99-1347.84	Sst: tn gry, v wl srt, vf gr, sbrndd to sbang, Qtz w/ Fspr Mic & Cl, r Rk Frag, v wl cmt.
9	1032.12-1032.92	Sst: gnsh tn gry, mod srt, crs-f gr, mod rndd to sbang, Qtz w/ Fspr & Cl, occ Mic & sml carb clasts, fri.

Figure 1

POROSITY Vs PERMEABILITY

Company: Department of Manufacturing and Industry Development
Well : Warracburunah No.2



$$K_{md} = 0.002 \times \exp^{(0.489 \times \text{Porosity})}$$

APPENDIX 10

WATER ANALYSIS REPORT

A BRANCH OF THE RURAL WATER COMMISSION OF VICTORIA

ANALYSIS REPORT

LAB-NO 3134
DATE RCD 25/06/91

AUTHORITY: Rural Water Commission - State Groundwater Monitoring
PROJECT : G00 - Miscellaneous Projects

SAMPLER: G. Kingwell

SITE-DESCRIPTION	SITE-NO	SAMPLED DATE	SAMPLED TIME
1 Mooleric Rd, 1.1Km South of Mt Hese Estate Rd Parish: Warracbarunah	S34141143	09/04/91	

DETERMINATION	1
pH, units	7.8
EC 25C, microS/cm	23000
Hardness, as CaCO3 (calc.)	2200
Total Alkalinity, as CaCO3	590
Chloride, as Cl	8000
Sulphate, as SO4	400
Calcium, as Ca	350
Magnesium, as Mg	310
Sodium, as Na	4200
Potassium, as K	110
Iron (Undigested), as Fe	0.64
Nitrate & Nitrite, as N	<0.15
Silica, total as SiO2	1.7
Total Soluble Salts (Sum.)	14100

<< Results in MILLIGRAM per LITRE (mg/l) unless otherwise stated.>>
<< The above analyses were performed on the samples as received. >>
<< Where applicable, comments on the analyses are attached. >>

P. TeHennepe
Reported 16/07/91

DISTRIBUTION
Sampler(MIV),File(MIV),File

A BRANCH OF THE RURAL WATER COMMISSION OF VICTORIA

ANALYSIS REPORT

LAB-NO 3134
DATE RCD 25/06/91

AUTHORITY: Rural Water Commission - State Groundwater Monitoring
PROJECT : G00 - Miscellaneous Projects

SAMPLER: G. Kingwell

SITE-DESCRIPTION	SITE-NO	SAMPLED DATE	SAMPLED TIME
1 Mooleric Rd, 1.1Km South of Mt Hese Estate Rd Parish: Warracbarunah	S3414114	3109/04/91	

FIELD RESULTS	1
Aquifer Level tapped from (m)	488.74
Aquifer Level tapped to (m)	495.00
Bore Sampling Method	Airlift
Static Level, m	24.70
Lab Number	1386

<< Results in MILLIGRAM per LITRE (mg/l) unless otherwise stated.>>
<< The above analyses were performed on the samples as received. >>
<< Where applicable, comments on the analyses are attached. >>

P. TeHennepe
Reported 16/07/91