W783

WELL COMPLETION REPORT

DISCOVERY BAY NO.1 W783

PERMIT VIC/P14

VICTORIA

2 3 MAR 1983

OIL and GAS DIVISION

PHILLIPS PETROLEUM

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PHILLIPS AUSTRALIAN OIL COMPANY

PERTH, WESTERN AUSTRALIA

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PERMIT VIC/P14

VICTORIA

By

PHILLIPS AUSTRALIAN OIL COMPANY

Perth, Australia

February, 1983

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* Interpretive and confidential data

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* Interpretive and confidential data

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* Interpretive and confidential data

SUMMARY

DRILLING

The Discovery Bay No.1 well was drilled by the semisubmersible drilling unit Diamond M "Epoch" in a water depth of 97 metres. The well was drilled to a total depth of 2776 metres* in 36 days.

The Diamond M "Epoch" arrived on location at 0930 on 16th September, 1982 and the well was spudded the first time at 1200 on the 21st of September, 1982. A deviation survey indicated 3-1/2 degrees deviation at 141 metres which was too severe to set the surface conductor. The rig was moved 13 metres astern and the well was respudded at 1800 hours. The 36" hole was drilled to 172 metres. The 30" conductor was then run with the casing shoe set at 172 metres. A 12-1/4" hole was drilled to 435 metres and then opened to 26". The 20" conductor was run and cemented with the casing shoe set at 423 metres.

The 16-3/4" blowout preventer stack was run with 18-5/8" marine riser. After latching on to the wellhead and successfully testing the stack, a 12-1/4" hole was started. A formation leak-off test was performed after drilling 3 metres of new hole. The test indicated that formation leak-off occurred at an equivalent mud weight of 10.7 ppg. Drilling of the 12-1/4" hole continued to 1214 metres and electric logs were run. The hole was then underreamed to 17-1/2" and 13-3/8" casing was run and cemented with the casing shoe set at 1200 metres.

A formation leak-off test was performed after drilling 4 metres of new 12-1/4" hole below the 13-3/8" casing shoe. The test indicated that formation leak-off occurred at an equivalent mud weight of 12.1 ppg. Drilling continued to the total depth of 2776 metres which occurred on the 12th of October, 1982. Electric logs and velocity surveys were run. Sidewall cores were taken throughout the open hole. Preparations were made to plug the well.

*All depths quoted will be below rotary kelly bushing which was located 23 metres above mean sea level.

The first open hole balanced cement plug was set from 2445 metres to 2373 metres. The second plug was set from 1850 metres to 1779 metres. The third plug consisted of an EZ-SV cement retainer set at 1183 metres with 140 sacks of cement squeezed below the retainer and 40 sacks placed on top of the retainer. The surface plug was set from 200 metres to 150 metres.

The BOP stack and riser was pulled and recovered. The first explosive charge was set 7.3 metres below the wellhead assembly and detonated. The 20" wellhead with a 13-3/8" casing stub was recovered. A second explosive charge was set 4 metres below the 30" wellhead and detonated. The 30" wellhead was recovered.

The anchors were pulled and the "Epoch" departed the Discovery Bay No.1 location at 0035 hours on 19th October, 1982

GEOLOGICAL

Discovery Bay No.1 was the first exploration well drilled in Permit Vic/P14. The well was located to test the hydrocarbon potential of the Upper Cretaceous Curdies and Paaratte Formations contained within a complex fault-related closure developed on the top Cretaceous unconformity. A secondary target of sandstones within the underlying Belfast Formation was also anticipated within fault-related closure developed on an horizon correlated within the Belfast Formation. Deeply-buried Upper Cretaceous siltstones and mudstones of the Belfast Formation were expected to provide source potential for both oil and gas.

No samples were caught prior to drilling out of the 20" casing shoe at 423 metres. The interval 430 to 664 metres consisted of Pliocene limestone which was unconformably underlain by Oligocene limestone with minor calcareous mudstone and sandstone belonging to the Heytesbury Group (Gambier Limestone and Nelson Formation), down to 787 metres. A major unconformity at 787 metres separated Early Oligocene and Middle Eocene sediments. From 787 to 880 metres sandstone and calcareous claystone equivalent to the Middle Eocene Nirranda Group were encountered. An unconformity at 880 metres separated these sediments from the underlying Early Eocene Wangerrip Group (Dilwyn Formation and Pember Mudstone) which

consisted of interbedded sandstone and siltstone and which extended from 880 to 1279 metres.

A major unconformity at 1279 metres separated the Tertiary sediments from underlying sandstone and siltstone belonging to the Upper Cretaceous (Campanian) Curdies Formation. This section continued down to 1546 metres where it passed into a similar interbedded sandstone and siltstone sequence belonging to the Coniacian and Campanian Paaratte Formation, which extended to 2776 metres (TD). The Belfast Formation was not penetrated to TD of the well.

No indications of hydrocarbon were encountered in Discovery Bay No.1.

INTRODUCTION

Discovery Bay No.1 was the first well to be drilled in Exploration Permit Vic/P14 off the southwestern coast of Victoria, Australia. This permit is held by a group consisting of Phillips Australian Oil Company (Operator), Mount Isa Mines Investments Pty. Ltd., and Victoria Gas and Fuel Corporation N.L. Discovery Bay No.1 was located at Latitude 38°24'42.90" South and Longitude 141°04'21.10" East placing it 47 kilometres west-southwest of Portland (Figure 1). Drilling was performed from the semisubmersible drilling unit Diamond M "Epoch" in 97 metres of water.

The Discovery Bay No.1 well was located on the southern flank of the South Voluta High, a complex northwest-southeast anticlinal trend located in the northwestern portion of Permit Vic/P14. The well tested a complex closure mapped at the top Cretaceous horizon, related to faulting on the northern, western, and southern flanks, and to deep channelling on the eastern margin.

The primary exploration target was Upper Cretaceous fluvio-deltaic sandstone of the Curdies and Paaratte Formation, which was expected to be sealed by Lower Tertiary shale and siltstone overlying the Upper Cretaceous unconformity surface. The secondary target was deltaic sandstone within the Belfast Formation which was expected to be sealed by siltstone and shale interbeds.

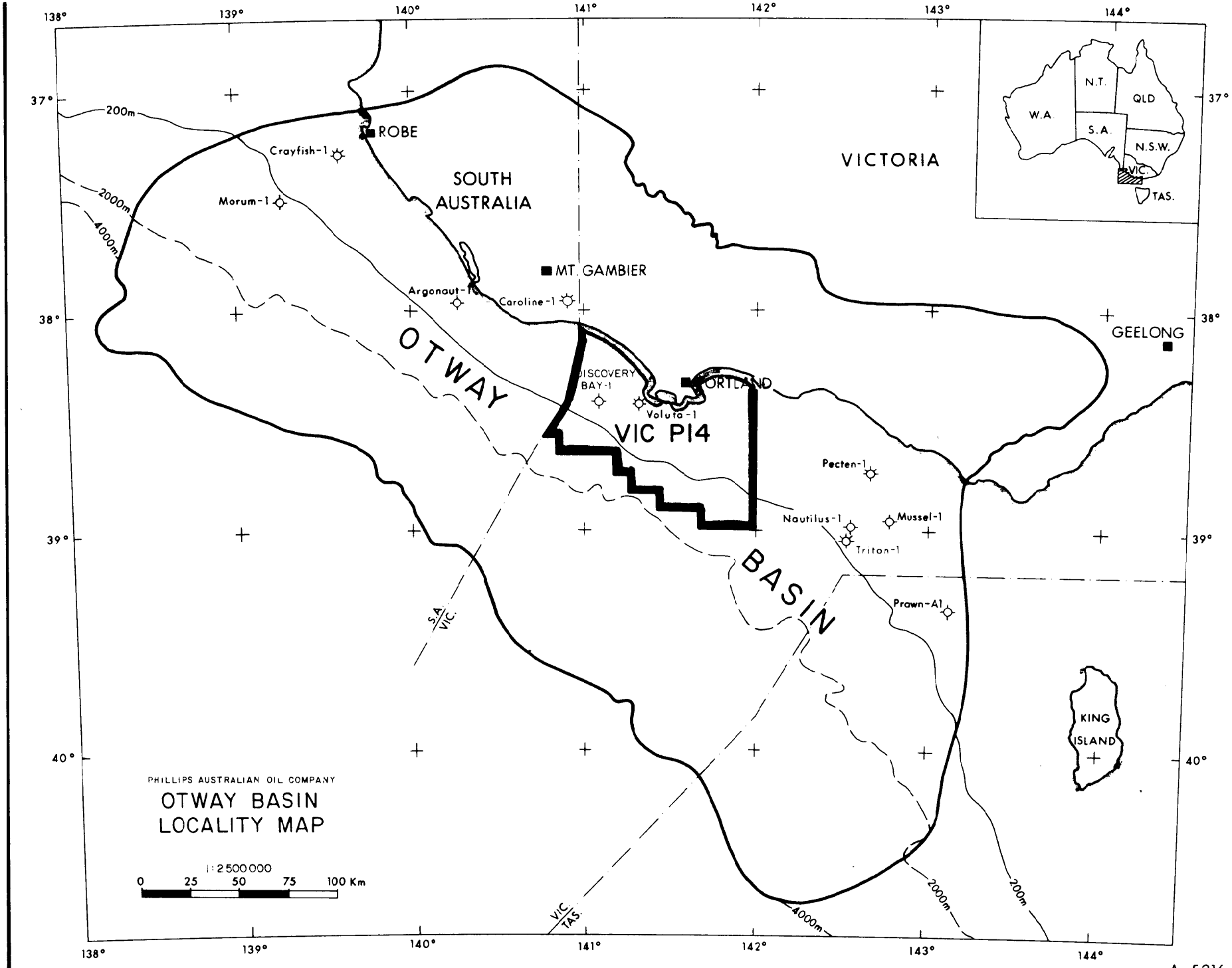

138°
139°
140°
141°
142°
143°
144°
37°
38°
39°
40°
200m
2000m
4000m
ROBE
Crayfish-1
Morum-1
SOUTH AUSTRALIA
VICTORIA
MT. GAMBIER
Argonaut-1
Caroline-1
OTWAY
BASIN
DISCOVERY BAY-1
PORTLAND
Voluta-1
VIC P14
GEELONG
Pecten-1
Nautilus-1
Mussel-1
Triton-1
Prawn-A1
KING ISLAND
S.A.
VIC.
VIC.
TAS.
N.T.
QLD
W.A.
S.A.
N.S.W.
VIC.
TAS.
PHILLIPS AUSTRALIAN OIL COMPANY
OTWAY BASIN
LOCALITY MAP
1:2500000
0 25 50 75 100 Km
A-5216

FIGURE 1

WELL HISTORY

The following provides details on the operational parameters of Discovery Bay No.1.

GENERAL DATA

Well Name	:	Discovery Bay No.1
Name and Address of Operator	:	Phillips Australian Oil Company, 23rd Floor, City Centre Tower, 44 St George's Terrace, (G.P.O. Box 2066W) PERTH W A 6000
Co-Venturer Parties' Names and Addresses	:	Gas and Fuel Exploration N.L., 171 Flinders Street, MELBOURNE VIC 3000 Mount Isa Mines Investments Pty. Ltd., 15th Floor, 160 Ann Street, BRISBANE QLD 4000
Exploration Permit	:	VIC/P14
District	:	Otway Basin, Victoria
Location	:	Lat. 38 degrees 24 min 42.9030 sec S Long. 141 degrees 04 min 21.1006 sec E
Elevations	:	Water depth 97m (319 ft) RKB to seabed 120m (394 ft)
Total Depth	:	2776m (9108 ft) RKB
Status	:	Plugged and Abandoned

DRILLING DATA

Name and Address of Drilling Contractor	:	Diamond "M" Marine Company, 2121 Sage Road, Suite 200, P.O. Box 22738, Houston, Texas 770727 U.S.A.
Drilling Vessel	:	Diamond M "Epoch" Semisubmersible Drilling Unit Length : 290 feet Beam : 200 feet Lower Hull Beam : 35 feet Lower Hull Depth : 25 feet Lightship Displacement :7754 long tons
Operating Depth	:	30,000 feet in 1,200 feet of water
Position System	:	Honeywell RS-505 Acoustic Position and Riser Angle indicator
Heave Compensator	:	Vetco 400-20D with 400,000 lbs capacity - 20' stroke
Riser Tensioning	:	6ea - Western Gear 80,000 lbs - 50' stroke
Guide Line Tensioning	:	4ea - Western Gear 16,000 lbs - 40' stroke
Slip Joint	:	Vetco X-52 with MR-4B connectors - 40' stroke
Riser	:	Vetco X-52 18-5/8" x 5/8" wall MR-4B connectors
Diverter	:	Regan Model KFDH-3
B.O.P.	:	16 3/4" - 10,000 lbs working pressure - H_2S Trimmed/Vetco Ball Joint with MR-4B connector/C.I.W. Riser connector/Two hydrill annular preventors/Two-double "U" Cameron Ram preventors
B.O.P. Control System	:	Coumine with Acoustic Back-up
Choke Manifold	:	10,000 lbs working pressure - H_2S trimmed with Cameron type F Gate valves/Two adjustable chokes and one remote operated Swaco Super Choke

Pumps	:	Two Oilwell 1700 PT Triplex pumps with pulsation dampeners. Each driven by two GE-752 DC motors. Mud Pumps to be charged by two 6 x 8 centrifugal pumps.
Drawworks	:	Oilwell E-3000 driven by two GE 752 DC motors, with Baylor 7838 electric brake and Crown-O-Matic.
Power	:	Two EMD 16E-9 Diesel Engines, 3070 Hp. Each driving EMD 2000 KW AC Generators. One EMD 16E-8 Diesel Engine, 2200 Hp, driving EMD 1500 KW AC Generator.
Storage	:	Sack Storage 3,500 sacks Bulk tanks 10,000 cu.ft. Mud tanks 1,594 BBLS Fuel 6,400 BBLS Drillwater 15,842 BBLS Potable water 755 BBLS Mud volume active 660 BBLS Mud volume reserve 681 BBLS Helifuel 2 ea 5,000 litres

TIME ANALYSIS

Significant Times and Dates

	Hours	Date
Departed Amoco location	2345	13th September, 1982
Arrived at Discovery Bay location	0930	16th September, 1982
Spud No.1	1200	21st September, 1982
Spud No.2	1800	21st September, 1982
TD	0800	12th October, 1982
Depart location	0035	19th October, 1982

Time Breakdown from takeover from Amoco, to departure from Location

	Hours	%
Drilling	216.5	25.75
Reaming/Hole Opening	37.0	4.40
Cond. mud and circ.	25.5	3.03
Trips and making up BHA	149.5	17.78
Dev Survey	9.0	1.07
BOP Run/Retrieve	23.0	2.74
BOP Testing	12.0	1.43
Surface Equip. Test	1.5	0.18
Coring (sidewall)	8.0	0.95
Logging	24.0	2.85
Cementing	12.5	1.49
DST/Leak off test	2.5	0.30
Repairs mechanical	2.0	0.24
Delays	34.0	4.04
Weather delays	72.5	8.62
Move and positioning	69.75	8.30
Transit Respud move	1.5	0.18
Casing	28.5	3.39
Velocity survey	6.0	0.71
Anchoring	66.0	7.85
Other	39.5	4.70
	840.75	100.00

WELL COMPLETION RECORDS

Included in Tables 1-4 are details concerning the drilling of Discovery Bay No.1. Enclosure No.1 is the operational summary for Discovery Bay No.1. A summary of daily drilling operations is given in Appendix No.2.

TABLE 1

DISCOVERY BAY No.1

TOTCO SURVEY SUMMARY

Depth m (ft) RKB	Vertical Deviation Degrees
142.6 (468)	1
161.2 (529)	1
172.2 (565)	1
310.3 (1018)	3/4
435.3 (1428)	1
608.4 (1996)	1
912.6 (2994)	3/4
1212.5 (3978)	Miss Run
1158.2 (3800) *	3
1460.6 (4792)	3 1/2
1674.6 (5494)	3 3/4
1885.5 (6186)	2
2138.5 (7016)	1
2349.4 (7708)	1 1/2
2613.4 (8574)	1 3/4
2776.1 (9108)	2°

* Gyro Survey - 3 degrees South 56 degrees West
closure 8.06m (26.43 ft) South

TABLE 2

DISCOVERY BAY NO.1 CASING AND CEMENT

Permit VIC/P14

Elevations
RKB to MSL 23m (75 ft)
RKB to seabed 120m (394 ft)

Casing						Cement				
Date	Size	Weight	Grade & Coupling	Amount Run	Depth Set	Cuft Slurry	Class/Type	Slurry Weight	TOC	Additives
22.9.82	30"	1" wall	Vetco Squnch	54.6m	172.3m	1345.5	Class G/Neat mixed with seawater	14.6 PPG	seabed	1% CaCL
24.9.82	20"	133 lb/ft	X-56 Cameron JV Type LW	306.2m	423.1m	Lead 2316	Class G/Neat mixed with seawater	12.8 PPG	seabed	2.5% gel-water
						Tail 585	Class G/Neat mixed with seawater	15.4 PPG		
2.10.82	13-3/8"	72 lb/ft	N-80 Buttress	1081.m	1199.5m	Lead 1940	Class G/Neat mixed with drillwater	12.8 PPG	190.5m	2.5% gel-water +0.5% CFR2
						Tail 575	Class G/Neat mixed with drillwater	15.8 PPG		1% HR-6L

Table 3

BIT RECORD

ANYF lips str n C Company	CON R Diamond M Marine Company	COUNTY Offshore	STATE Victoria, Australia
LEASE Vic/P14	WELL NO 1	SEC	TOWNSHIP
RANGE	BLOCK	FIELD Discovery Bay	
TOOL PUSHER	DRILL PIPE 5" Grade 'E' & 'G'	DRAW WORKS Oilwell E-3000	
DAY DRILLER	TOOL JOINT MAKE 4½" IF 18" SIZE 6 3/8 TYPE	POWER Electric H P	UNDER SURF
EVENING DRILLER	DRILL COLLAR NO 20 O D 7-3/4 I D 2-13/16 LENGTH 30'	PUMP NO 1 MAKE Oilwell MODEL A1700 PT STROKE 12"	INT DATE 21 Sept. 1982
MORNING DRILLER	DRILL COLLAR NO 6 O D 9½ I D 3.0 LENGTH 30'	PUMP NO 2 MAKE Oilwell MODEL A1700 PT STROKE 12"	T D DATE 12 Oct. 1982

BIT NO	BIT SIZE	BIT MFGR.	BIT TYPE	SERIAL NO. OF BIT	JET SIZE 1	2	3	DEPTH OUT	FTGE	HOURS RUN	ACC HOURS	FT/HR	WEIGHT 1000 LBS	ROTARY R.P.M	VERT DEV.	PUMP PRESS	PUMPS No.	Liner	SPM	MUD Wt	Vis	DULL CODE T	B	G	REMARKS FORMATION, CIRC. FLUID, ETC.	DATE
								(in)396																		
*1	26"	HTC	OSC 3AJ	109JL	Open			565	67/169	11	11	15	0/3	100	1°	700	½	6½	200	8.6		as	new			21/9
2	12¼"	Smith	SDS	CL6124	Open			1428	863	10	21	86	3/5	120	1°	400	"	"	130	8.6		as	new			23/9
RR1	26"	HTC	OSC 3AJ	109JL	Open			1428	863	9	30	96	2/6	100	1°	600	"	"	200	8.6		1/8	1/8	8/8		24/9
RR2	12¼"	Smith	SDS	CL6124	15	15	15	3981	2553	26.5	56.5	96	5/30	100	3°	2100	"	"	140	8.8		6/8	4/8	8/8	Gyro-3800	25/9
UR RR2	12¼"	Smith	SDS	CL6124	15	15	15	2249	821	20	84.5	41	5/15	95		1200	"	"	116	9.1	34	6/8	4/8	8/8	Under-reamer service	29/9
3	12¼"	Smith	SDS	CL6311	13	13	13	4792	811	11	95.5	74	10/35	80/110	3½°	2500	"	"	130	9.1	40	6/8	4/8	1/2	Snd-Claystone	3/10
4	12¼"	Smith	SDGH	CK2925	14	14	14	5494	702	12	107.5	58.5	20/35	100/130	3¾°	2600	"	"	133	9.3	40	6/8	3/8	1/4	" "	4/10
5	12¼"	Smith	SDGH	CK2817	14	14	14	6186	692	12.5	120.0	55	20/35	130	2°	2600	"	"	130	9.3	40	6/8	2/8	1/8	" "	5/10
6	12¼"	Smith	F-2	BZ1238	14	14	14	7016	830	23.5	143.5	35	35/45	65/70	1°	2700	"	"	130	9.5	39	4/8	2/8	1/8	Snd-Siltstone	6/10
7	12¼"	Smith	F-3	CK0894	14	14	14	7708	692	27	170.5	26	40/45	65/70	1½°	2700	"	"	130	9.7	41	5/8	4/8	1/8	" "	7/10
8	12¼"	Smith	F-2	CK4165	14	14	14	8574	866	36	206.5	25	40/45	65/80	1¾°	2550	"	"	130	9.75	41	3/8	2/8	1/8	" "	9/10
9	12¼"	Smith	F-3	XA2158	14	14	14	9108	534	39	245.5	14	45	70	2°	2550	"	"	125	9.8	37	6/8	8/8	1/4	" "	11/10

*Respud First hole 67'

SMITH REPRESENTATIVE PHONE

TABLE 4

SQUEEZE RECORD

Date	Size of Casing	Retainer			Cement			
		Type	Set	Slurry Cuft	Class/Type	Slurry wti	Additives	Company
15.10.82	13 3/8" 72lb N-80 Buttress	EZ-SV	1182.6m	157	Class G/Neat	15.8 PPG	None	Halli-burton

DRILLING FLUIDS

The hole was spudded using sea water, periodically flushing with high viscosity pills. Sea water-Drispac was used from 423 metres to 1213 metres. Brine-Barocarb was used from 1213 metres to TD. Mud properties, materials and cost are given in Tables 5-7.

ABANDONMENT STATUS

Figure 2 shows the abandonment status for the Discovery Bay No.1 well.

TABLE 5

MUD PROPERTIES

Depth	Hole Size	Temp	Weight	Viscosity	PV	YP	PH
(m)	(inches)	(°C)	(sg)	(sec)	-	-	-
172	36	-	1.03	100+	-	-	-
221	26	-	1.03	100+	-	-	-
435	26	-	1.03	100+	-	-	-
616	12 1/4	21	1.06	32	3	7	8.5
1213	12 1/4	-	1.08	38	7	4	9.0
677	17 1/2	33	1.08	33	6	5	9.0
810	17 1/2	19	1.08	35	5	4	9.0
1212	17 1/2	22	1.09	34	6	4	9.0
1187	12 1/4	-	1.08	30	6	3	8.5
1460	12 1/4	20	1.09	40	12	20	9.0
1674	12 1/4	31	1.12	40	12	18	9.5
1905	12 1/4	31	1.13	37	9	6	8.5
2138	12 1/4	37	1.16	39	10	9	9.0
2293	12 1/4	40	1.16	41	12	12	9.0
2395	12 1/4	37	1.18	40	12	12	9.5
2576	12 1/4	39	1.17	41	12	12	9.0
2591	12 1/4	35	1.16	40	11	10	9.0
2750	12 1/4	38	1.18	37	9	9	8.5
2776	12 1/4	40	1.18	39	10	11	8.3

TABLE 6

MUD MATERIALS

Type	Unit	Quantity
Aquagel	100 lb	840
Aluminium Stearate	25 kg	1
Bara Carb	35 kg	1376
Barade foam	20 ltr	22
Calcium chloride	25 kg	392
Caustic soda	50 kg	79
H.E.C.	25 kg	128
Lime	25 kg	27
Magnesium Oxide	20 kg	118
Monpac	50 lb	30
Potassium chloride	50 kg	1732
Q-Broxin	25 kg	29
Soda Ash	40 kg	63
XC Polymer	50 lb	81
Baroid (Bulk)	100 lb	360
Mud and Chemicals	BBL	796
Fresh water	BBL	3565
Sea water	BBL	8255
Total mud made	BBL	12,616

TABLE 7

MUD COST

Interval	Hole Size		Cost A$
Seabed to 172.2m	36"		3,247.14
172.2m to 435.2m	26"		4,876.74
435.2m to 1213.4m	17 1/2"		15,574.75
1213.4m to 2776.0m	12 1/4"		112,156.05
		TOTAL	$135,854.68

DISCOVERY BAY No.1 – ABANDONMENT STATUS

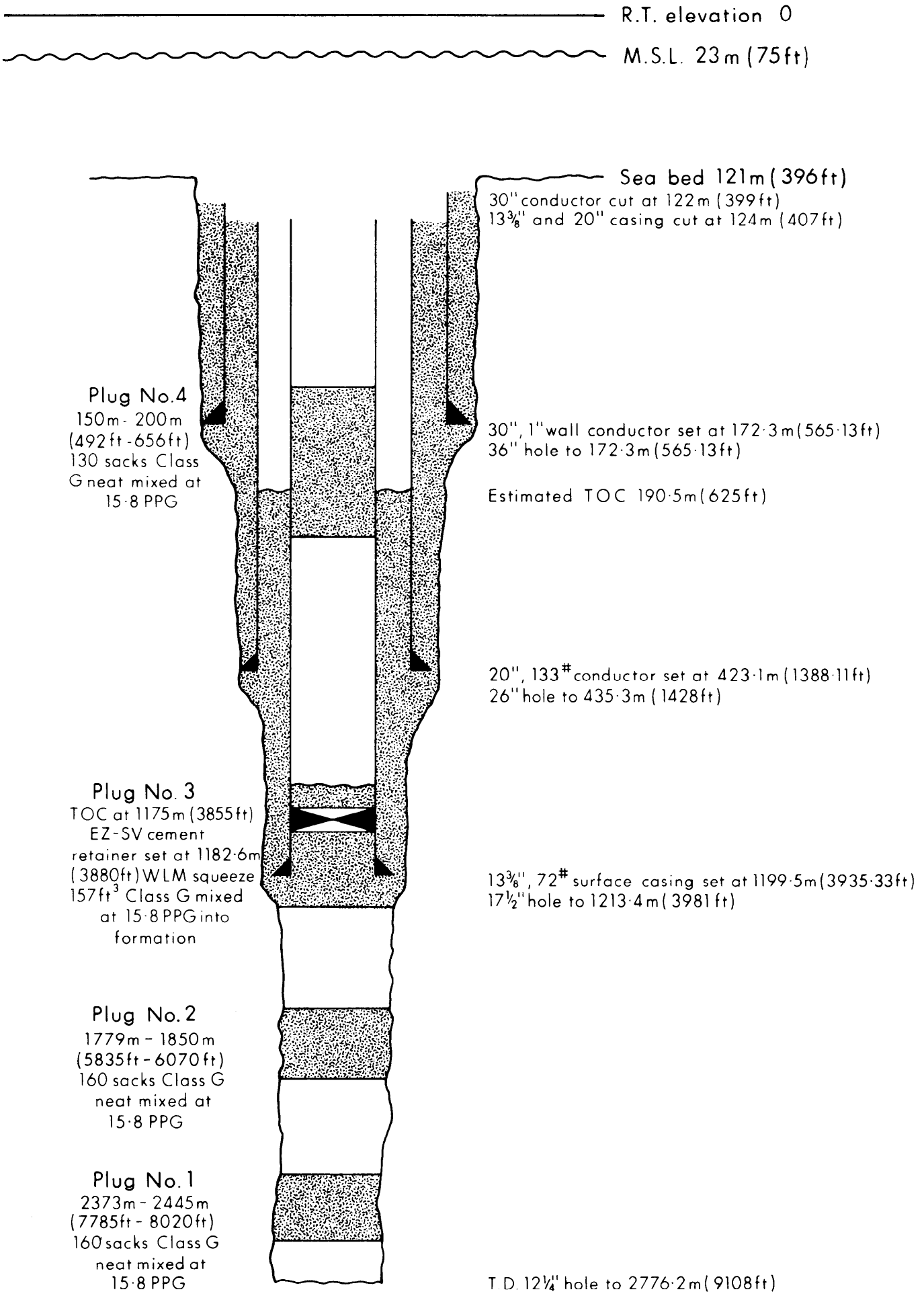


FIGURE 2 A-5695

GEOLOGY

SUMMARY OF PREVIOUS INVESTIGATIONS

Oil exploration in the Otway Basin began during the late 19th Century when several shallow wells were drilled without encountering hydrocarbons. Exploration using modern methods began in the early 1950's and 62 wells have been drilled since 1960. In the early 1960's Frome-Broken Hill, Alliance Oil Development, and Planet Oil became the major operators, and seismic surveys were conducted followed by drilling programmes. In the late 1960's to early 1970's Shell and Esso farmed into much of the onshore and offshore acreage and became the major operators, but were markedly unsuccessful. From 1975 to 1978 exploration was dormant throughout the basin. New onshore permits were issued in 1978, and three offshore permits were awarded in Victorian waters in 1980.

No commercial quantities of hydrocarbons have yet been discovered in the Otway Basin although a sub-commercial gas field was discovered onshore at North Paaratte No.1 in the eastern portion of the basin in 1979. To date some 21 wells in the basin have recorded hydrocarbon shows, four of which have been located offshore (i.e. Voluta No.1, Triton No.1, Pecten No.1, Crayfish No.1).

Exploration Permit Vic/P14 was awarded to the Phillips Group on 16th January, 1980. Structural interpretation of the Discovery Bay Prospect was based on geophysical mapping of the "OP80" seismic survey recorded by Geophysical Services International (G.S.I.) in 1980. Discovery Bay No.1 was the first well to be drilled in Permit Vic/P14. Permission to drill Discovery Bay No.1 was granted by the Victorian Department of Minerals and Energy on 6th August, 1982.

REGIONAL GEOLOGY

The Otway Basin is a passive continental rifted marginal basin and its development is controlled by three tectonic episodes, namely pre-rifting, rifting, and post-rifting. Actual rifting began during the uppermost Jurassic to Early Cretaceous following initial basin formation possibly

related to movement along a major right lateral strike-slip fault along the basin's northern margin. The downwarp of Early Paleozoic basement rocks associated with rifting, was infilled by fluvio-lacustrine volcanogenic sediments of the Otway Group. Volcanism ceased towards the end of the Lower Cretaceous rifting episode and passive infilling of the rifted margin by non-volcanic sediments of the Sherbrook Group commenced. A mid-Cretaceous unconformity between the Lower Cretaceous Otway Group and Upper Cretaceous Sherbrook Group sediments probably represents failed rifting between Australia and Antarctica, and also documents the opening of the Tasman Sea.

Sedimentation was predominantly from the west during Sherbrook Group deposition with a marine connection to the southeast. The basal trangressive Waarre Sandstone unit of the Sherbrook Group is representative of the localised weathering and reworking of the Otway Group sediments and is believed to be restricted in occurrence. The next depositional unit formed was the basinwide Belfast Formation, a prodelta shale deposited in front of a major prograding system that is thought to have entered from the western part of the basin. The prograding delta system contemporaneously laid down the Paaratte Formation, a fluvial, deltaic plain, and marginal marine clastic sequence, followed by fluvial and deltaic plain sandstone, shale and coal of the Curdies Formation.

A second phase of rifting, signified by a regional unconformity, commenced at the end of Upper Cretaceous time and culminated in the final separation of Australia and Antarctica. The Lower Tertiary Wangerrip Group, consisting of a basal transgressive sandstone conglomeratic unit (Pebble Point Formation) overlain by a deltaic-marine sandstone, siltstone, and shale sequence (Dilwyn Formation), was deposited during this second rifting phase.

Final separation of the continents occurred during Middle-Late Eocene times, and rapid continental separation caused by direct sea floor spreading westward of this basin resulted in strong downwarping throughout the southern basinal margin. Passive Late Tertiary infilling of the marine limestone, marl, and minor sandstone of the Nirranda and Heytesbury Groups has continued until recent times.

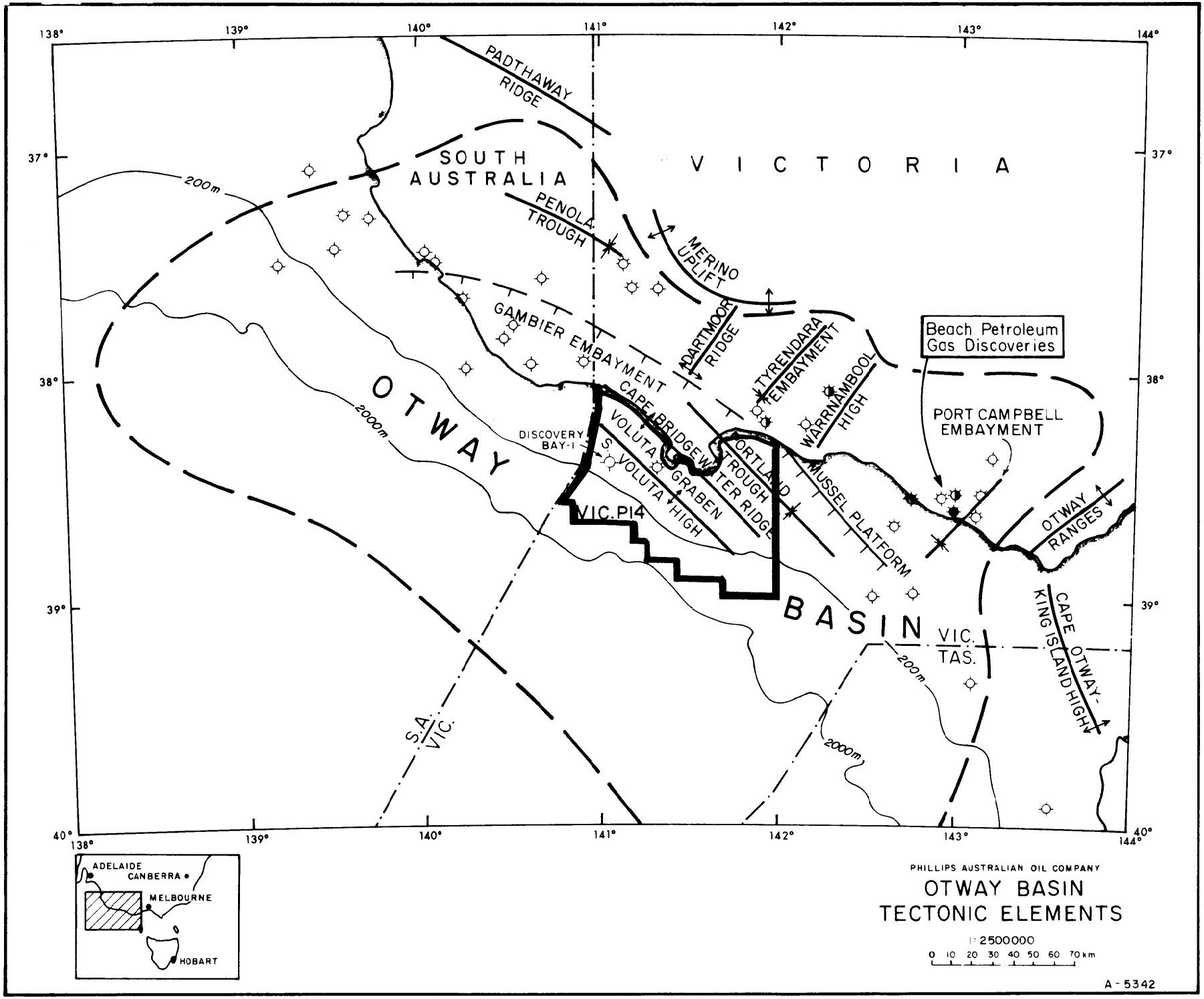

138°
139°
140°
141°
142°
143°
144°
37°
38°
39°
40°
PADTHAWAY RIDGE
SOUTH AUSTRALIA
VICTORIA
PENOLA TROUGH
MERINO UPLIFT
200m
GAMBIER EMBAYMENT
DARTMOOR RIDGE
TYRENDARA EMBAYMENT
WARRNAMBOOL HIGH
Beach Petroleum Gas Discoveries
PORT CAMPBELL EMBAYMENT
OTWAY
2000m
CAPE BRIDGEWATER TROUGH
DISCOVERY BAY-1
VOLUTA GRABEN
S. VOLUTA HIGH
PORTLAND TROUGH
CAPE BRIDGEWATER RIDGE
VIC.P14
MUSSEL PLATFORM
OTWAY RANGES
BASIN
VIC.
TAS.
CAPE OTWAY-KING ISLAND HIGH
S.A.
VIC.
ADELAIDE
CANBERRA
MELBOURNE
HOBART
PHILLIPS AUSTRALIAN OIL COMPANY
OTWAY BASIN
TECTONIC ELEMENTS
1:2500000
0 10 20 30 40 50 60 70 km
A-5342

FIGURE 3

STRATIGRAPHY

The stratigraphic section penetrated in Discovery Bay No.1 extends from Recent to Upper Cretaceous (Coniacian) in age. Anticipated versus actual stratigraphic sections are shown in Figure 4. Formation names, lithology and ages are shown in Figure 5.

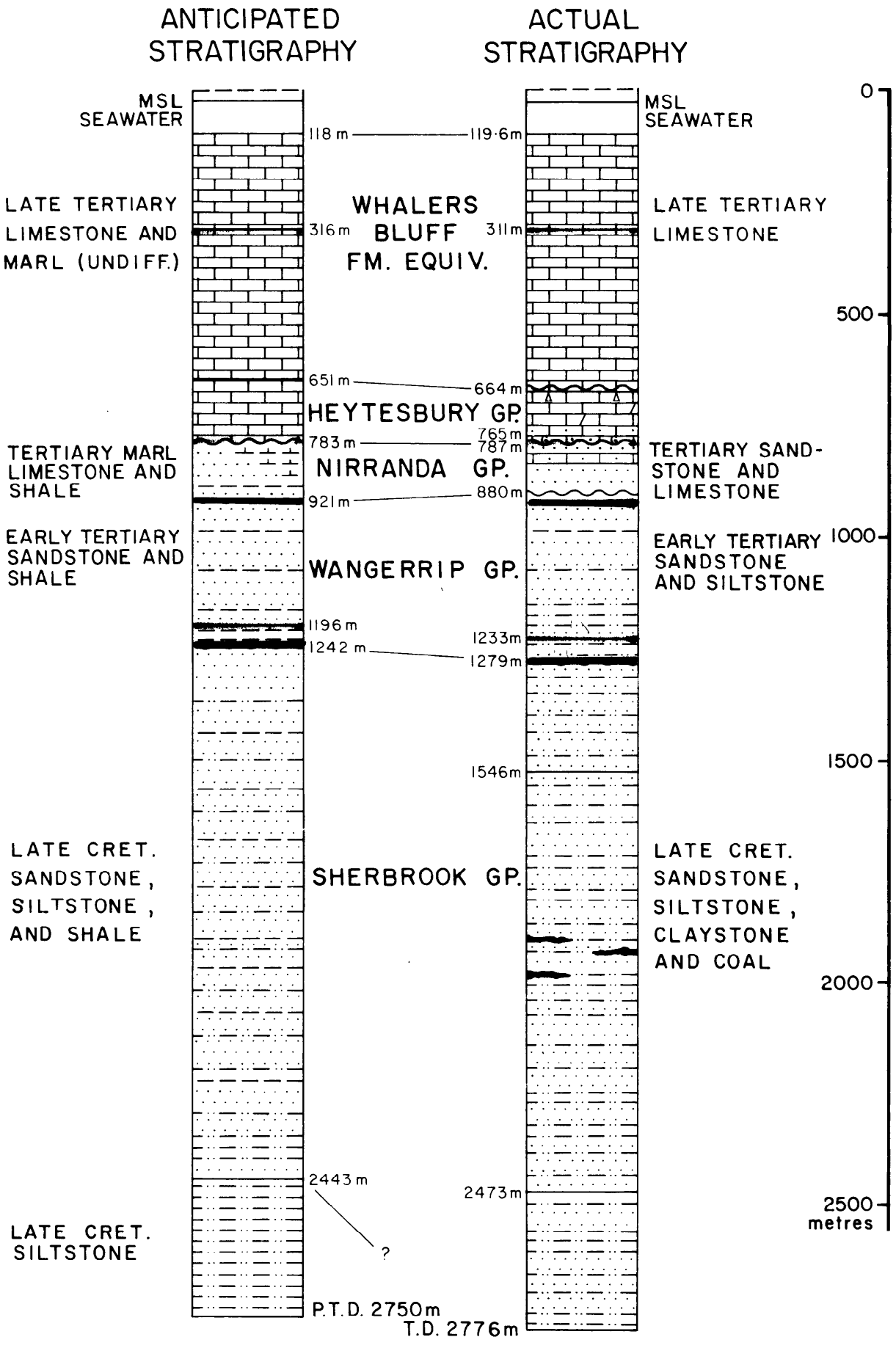
Formation tops and ages are based upon lithological, micropaleontological, and palynological study of sidewall cores and drill cuttings, in conjunction with wireline log characteristics and correlation with the nearby Voluta No.1 well (Figure 6). Ages for the Late Tertiary are based on micropaleontological data, whereas those for the Early Tertiary and Late Cretaceous are based on palynological (spore-pollen and dinoflagellate) data.

A major hiatus exists between Late Cretaceous and Early Eocene strata, coinciding with the final rifting phase between Australia and Antarctica preceding continental breakup and sea floor spreading. Large hiatii also exist between the late Early Eocene and earliest Middle Eocene, and between the Middle Eocene and Early Oligocene. This earlier hiatus is probably related to eustatic changes and/or erosion associated with continental breakup whilst the later depositional break signifies the final breakup event and onset of more-open marine circulation and carbonate sedimentation. An unconformity also occurs between the Oligocene and Middle Pliocene indicating a total absence of Miocene-aged sediments (Figure 5). The remainder of the interval penetrated appears to be conformable.

Brief descriptions of the stratigraphic units penetrated are presented below. Detailed lithologic descriptions of cuttings and sidewall cores are given in Appendices 3 and 4 respectively, and also on the Geologist's Litholog (Enclosure 3) and Geoservices Mud Log (Enclosure 2). A detailed summary of final stratigraphic interpretations for Discovery Bay No.1 is presented on the Well Composite Log (Enclosure 4). Petrographic descriptions of sediments from the Upper Cretaceous sequence are presented in Appendix 5.

Sampling commenced at 430 metres with the installation of the marine riser after setting 20" casing. All depths are recorded from the Rotary Kelly Bushing, 23 metres above mean sea level.

DISCOVERY BAY - 1

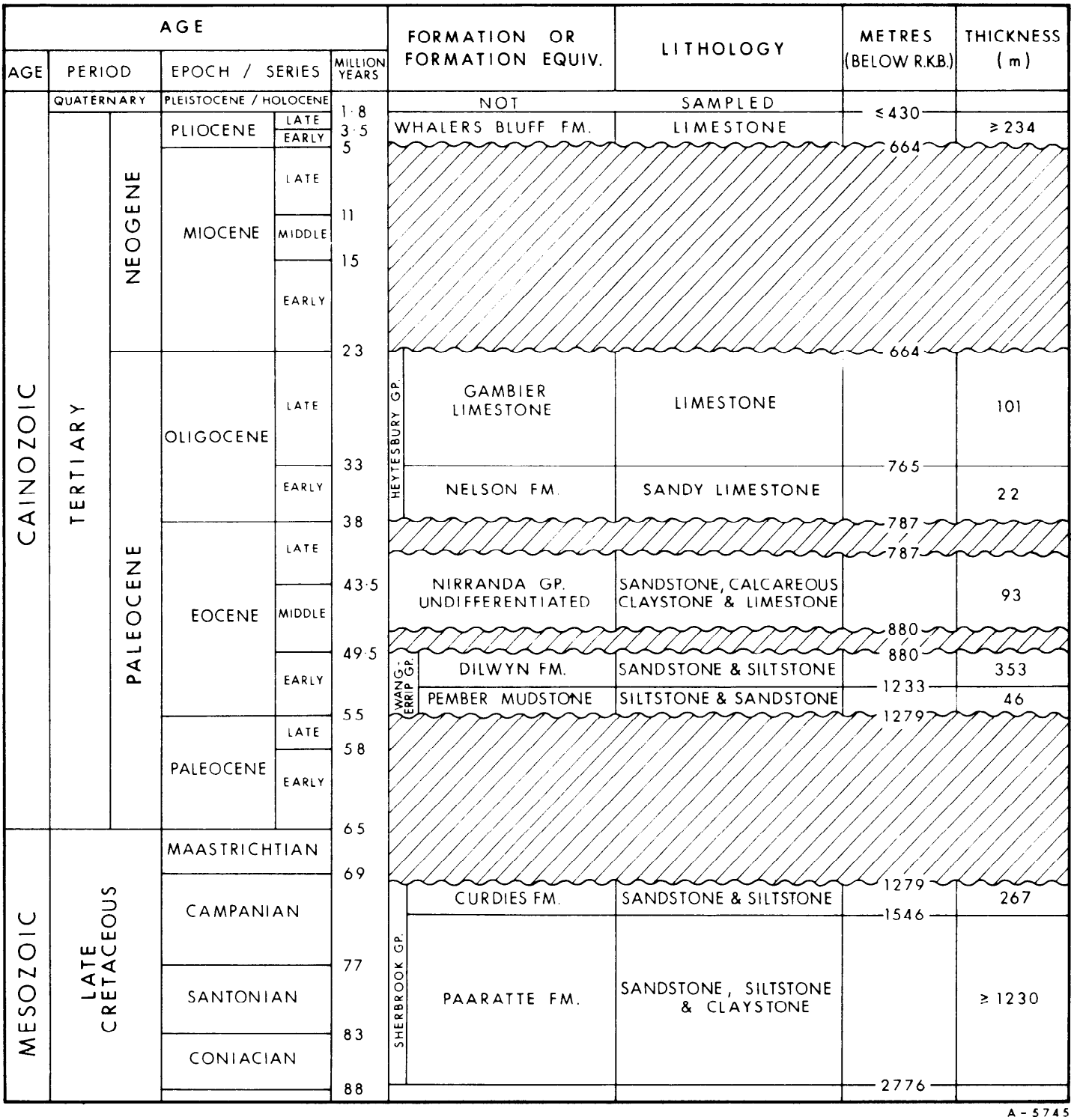


DEPTHS SUB R.K.B.

FIGURE 4

A-5673

STRATIGRAPHIC TABLE - DISCOVERY BAY - 1



A-5745

R.K.B. 23m ABOVE M.S.L.
WATER DEPTH 96·6m

FIGURE 5

Tertiary

Late Pliocene to Middle Pliocene: Whalers Bluff Formation Equivalent, 430 - 664 m (234m):

The naming of this unit is based tenuously on foraminiferal zonation and by correlation with the time equivalent Whalers Bluff Formation developed onshore at Portland. It consists of biogenic limestone, white to cream to light grey, moderately soft, homogeneous, highly fossiliferous with abundant bryozoan and coral fragments. There are traces of platy calcite crystals and medium sand-sized quartz grains. The limestone is indicative of open shelf carbonate sedimentation, and recent seismic studies suggest that the thick Pliocene sequence in Discovery Bay No.1 is part of a widespread fan-shaped wedge of sediment extending across Permit Vic/P14.

A hiatus of approximately 18 million years separates the Middle Pliocene from the Late Oligocene section. The entire Miocene section is not represented by the sedimentary sequence in Discovery Bay No.1 yet most of the Miocene is represented by limestone sediments onshore at Portland (Singleton et al., 1976), with at least the Early Miocene being present in the nearby Voluta No.1 well. This suggests that the absence of Miocene limestones at Discovery Bay No.1 is due to Late Miocene - Early Pliocene erosion, probably by submarine canyon cutting prior to infilling initiated in the mid-Pliocene.

Resistivity and sonic-transit time peaks at 664 metres indicates the base of the Pliocene Whalers Bluff Formation Equivalent which coincides with the yellow horizon within Permit Vic/P14 (Enclosures 4 and 5).

Late Oligocene: Gambier Limestone (Heytesbury Group), 664 - 765 m (101m):

Lower resistivity and high sonic-transit time log readings, and a slight increase in gamma-ray readings at 664 metres reflects a change in lithology to a moderately hard, dense, cream to white-grey, massive, microcrystalline limestone with abundant black, very hard, angular and flaked chert fragments. The limestone was deposited in a mid-continental shelf environment.

At 705 metres the limestone formation becomes strongly dolomitic in nature, coinciding with an increase in resistivity and slight decrease in sonic-transit time log readings. The dolomitic limestone is white to grey, very hard, massive, dense, and microcrystalline with a minor white, soft, massive limestone component. Occasional very hard, black, angular chert fragments are also apparent.

A decrease in dolomite is evident at 755 metres where the formation changes back to a white to light grey, soft, massive and homogeneous limestone. Medium to fine grained, black, angular to subangular quartz grains are present in minor amounts disseminated throughout the limestone.

Early Oligocene: Nelson Formation (Heytesbury Group), 765 - 787 m (22m):

At 765 metres a consistent decrease in gamma-ray and resistivity log readings coupled with a sharp increase in sonic-transit time log readings signals the boundary between the Early and Late Oligocene sections, although no sedimentary hiatus has been inferred. The lithology is dominantly a sandy limestone, grey to brown, soft, massive, granular, with common white to translucent, very coarse, well rounded, spherical quartz grains throughout. This thin sequence also contains abundant Foraminiferal fragments and glauconite pellets. The depositional environment appears to be in an inner continental shelf regime.

A hiatus of 5 to 7 million years exists at the base of this unit between the Early Oligocene and Middle Eocene. This is represented by a sharp increase in resistivity and gamma-ray log readings with a distinct decrease in sonic-transit time log readings, and coincides with a strong seismic reflector at 787 metres representing the green seismic horizon (Base Tertiary Carbonates; Enclosure 5) mapped throughout Permit Vic/P14. Late Eocene faunas are not widespread but do occur in the Otway Basin both to the west (McGowran, 1973) and east (Taylor, 1971). The absence of Late Eocene sediments is probably due to structural growth and/or regional uplift of the Dartmoor Ridge which prevented Late Eocene deposition or enhanced its erosion from the Discovery Bay No.1 sequence.

Middle Eocene: Nirranda Group (Undifferentiated), 787 - 880 m (93m):

A sharp increase in gamma-ray, resistivity, and a decrease in sonic-transit time responses reflects the unconformable boundary between sediments of the overlying Nelson Formation and the Nirranda Group. Sediments of the Nirranda Group are undifferentiated into formations as this unit consists of one major near-shore marine sand with minor claystone and limestone stringers.

The sandstone is quartzose, light grey to white, fine to very fine grained with common medium to coarse sized grains in part, subrounded to rounded, moderately sorted, moderate to high sphericity, non-carbonaceous, with minor calcareous cement and varying poor to good visual porosity. Thin calcareous claystone beds occur at the top of this unit immediately beneath the Nelson Formation. These beds are brown to light grey, massive, soft, glauconitic in part, with disseminated very fine grained and also granule-sized quartz grains throughout. Limestone stringers up to 2 metres thick are indicated on logs by distinct high resistivity and low sonic-transit time peak readings. They occur throughout the unit and probably represent selective diagenetic cementation of sandstones, forming a sandy limestone bed.

Palynological (spore-pollen and dinoflagellate) age dating indicates a hiatus of at least 2 million years and possibly up to 5 million years at the base of this unit between the early Middle and late Early Eocene.

Early Eocene: Dilwyn Formation (Wangerrip Group), 880 - 1233 m (353m):

A marked lithological change (emphasised by sharp changes in log character) separates this unit from the overlying Nirranda Group. The gamma-ray and resistivity curves vary consistently from high to low responses, indicative of the interbedded sandstone-siltstone lithologies that comprise the Dilwyn Formation.

The sandstones are deltaic-shallow marine in origin and occur in thick massive beds (up to 80 metres thick) separated by thinner siltstones (up to 30 metres thick). They are quartzose, light grey to white,

occasionally brown to grey-green with iron staining of the quartz grains, fine to coarse grained, subrounded to well rounded, moderately well sorted and occasionally poorly sorted, moderate to high sphericity, highly argillaceous with a common brown silty or clayey matrix, with minor siliceous cement, and rare pyrite and glauconite. Carbonaceous matter is abundant between 1035 and 1125 metres, but only scattered and in trace amounts elsewhere in the section. The siltstones are dark brown to grey brown, moderately hard to moderately soft, firm, massive, sandy in part, non-calcareous, with abundant carbonaceous material.

The dark blue seismic horizon mapped across Permit Vic/P14 occurs at 923 metres in Discovery Bay No.1 (Enclosures 4 and 5). This horizon (referred to as the Upper Intra-Wangerrip Group Marker) coincides with the top of a thick massive sandstone unit near the top of the Dilwyn Formation.

Early Eocene: Pember Mudstone (Wangerrip Group), 1233 - 1279 m (46m):

At 1233 metres a marked lithological change is shown by a decrease in gamma-ray and an increase in resistivity readings as the lowermost sandstone of the Dilwyn Formation passes into a conformable prodelta or marine siltstone and minor sandstone unit belonging to the Pember Mudstone. The light blue seismic horizon correlates with the top of this siltstone unit in Discovery Bay No.1 (Figures 4 and 5). The siltstone is dark brown, massive, homogeneous, moderately soft to moderately hard, plastic, argillaceous, non-calcareous, and carbonaceous with minor interbeds of sandstone, white to clear, very fine grained, subangular to subrounded, well sorted, high sphericity, occasional siliceous cement, slightly carbonaceous with a common silty and clayey matrix.

A marked hiatus of approximately 10 to 12 million years separates the Early Eocene from the Late Cretaceous sedimentary sections. The entire Paleocene section is absent in Discovery Bay No.1 yet most of the Early to Late Paleocene is represented by sandstones and shales of the Pebble Point Formation onshore at Portland and in the nearby Voluta No.1 well. The Pebble Point Formation is also present throughout most of the Otway Basin and its absence in the well possibly indicates either non-deposition on the Discovery Bay structural high at the end of the Cretaceous, or subsequent erosion of the unit from this location. A marked change in

dip direction on the dipmeter log indicates the unconformity to be angular.

Cretaceous

Maestrichtian to Campanian: Curdies Formation, 1279 - 1546 m (267m):

The boundary between this unit and the overlying Wangerrip Group is not distinct lithologically, although an increase in density and a decrease in sonic-transit time log readings marks the unconformity horizon which has been mapped as the pink seismic horizon throughout Permit Vic/P14 (Enclosure 5). Dipmeter readings also indicate a change in dip direction from south-southeast above the unconformity to westwards beneath it.

The lithology comprises dominantly sandstone with thinner interbeds of siltstone common throughout the section. The sandstones are typically quartzose, in beds from 5 up to 25 metres thick, and are brown to light-grey to white, fine grained with occasional coarse grained interbeds, subangular to subrounded, moderately well to well sorted, high sphericity, argillaceous with brown to grey clayey to silty matrix, common siliceous cement, highly carbonaceous to coaly in part, with common traces of pyrite. The sandstones are mainly marginal marine; delta plain point bar, crevasse splay, and sub-delta sands with fair to good visual intergranular porosity. The siltstone interbeds are dark brown, firm to moderately hard, homogeneous, argillaceous, non-calcareous, and carbonaceous in beds 2 to 10 metres thick. Very minor shales, brown, fissile, very hard, non-calcareous, and non-carbonaceous also occur in beds less than 2 metres thick.

The Curdies Formation was the prime reservoir target in the Discovery Bay No.1 well. Although no significant hydrocarbons were encountered its reservoir characteristics are described in the following section on Porosity and Permeability. A dipmeter analysis of the Curdies Formation is also given in Appendix 11.

Campanian to Coniacian: Paaratte Formation (Sherbrook Group), 1546 - 2776 m (1230m):

The boundary between the Paaratte Formation and the conformably overlying Curdies Formation is based tenuously on apparent variations in the gross lithologies of each unit. No distinct change in electric log character is evident, and because both formations are time-transgressive, palynological age dating does not define the exact boundary.

This unit comprises a sequence of delta plain-marginal marine siltstones and sandstones with minor coals and traces of claystones. The siltstones occur in beds 5 to 50 metres thick, and are dark brown to dark grey, homogeneous, moderately soft, carbonaceous to highly carbonaceous in part, mainly non-calcareous but calcareous in part, often subfissile, with common pyrite and very rare glauconite. Occasional loose, white, medium to coarse grained, subangular to subrounded quartz grains are disseminated throughout the siltstones. Quartzose sandstones generally occur in beds 2 to 25 metres thick and are white to light-dark grey, translucent to opaque, very fine to medium grained with occasional coarse grains, subangular to subrounded, well sorted, high sphericity, argillaceous with a silty matrix, occasional siliceous and calcitic cement, carbonaceous in part, with traces of pyrite. The coals are black, lignitic, brittle to hard, with a blocky to conchoidal fracture. The claystones are dark brown to black, massive, and carbonaceous.

Thin stringers of sandy limestone/dolomite up to a metre thick are apparent in the section down to 2250 metres. The stringers are indicated by high resistivity and neutron-density readings, and low sonic-transit time peaks, and represent the diagenetic alteration of initially clean and porous sandstones.

The brown seismic horizon lies within the Paaratte Formation at the base of a 12 metre sandstone bed at 2473 metres (Enclosures 4 and 5). Pre-drill geological analyses suggested that this horizon would occur within the Belfast Formation in Discovery Bay No.1, however its actual location suggests that it is a time-stratigraphic rather than a lithostratigraphic boundary.

Well Correlation

A comparison of the stratigraphy in Discovery Bay No.1 with the nearby Voluta No.1 well is given in Figure 6 and Table 8. Voluta No.1 is the closest well to the Discovery Bay No.1 location, being located 21 kilometres to the east. The next closest offshore well, Argonaut No.1, is located 134 kilometres to the northwest in South Australian waters.

A number of stratigraphic differences between the two wells are evident, although most of the units penetrated in Discovery Bay No.1 occur in Voluta No.1. These differences are:

a) The Paaratte Formation is significantly thicker in Discovery Bay No.1, (over 1230 metres) compared to Voluta No.1 (616 metres).

b) The Paleocene Pebble Point Formation is absent in Discovery Bay No.1, whereas 33 metres is present in the Voluta No.1 well. This absence is probably due to erosion, rather than to non-deposition of the formation at the Discovery Bay No.1 location.

c) The presence of 93 metres of Nirranda Group Equivaluent sediments in Discovery Bay No.1. These sediments are absent in Voluta No.1.

d) An increased thickness of the Oligo-Miocene Gambier Limestone in Voluta No.1 (over 522 metres) compared to Discovery Bay No.1 (101 metres). The entire Miocene limestone section in Voluta No.1 is absent in Discovery Bay No.1 indicating a widespread coastal erosion across the outer continental shelf.

e) The presence of over 234 metres of a Pliocene Limestone (Whalers Bluff Formation Equivalent) in Discovery Bay No.1, apparently absent in Voluta No.1.

TABLE 8: CORRELATION WITH VOLUTA NO.1

FORMATION	DISCOVERY BAY NO.1		VOLUTA NO.1 (21 km EAST)	
	Depth (m)	Thickness (m)	Depth (m)	Thickness (m)
Whalers Bluff Formation Equivalent	≤430	≥234	-	-
Gambier Limestone	664	101	≤294	≥522
Nelson Formation	765	22	730	86
Nirranda Group Equivalent	787	93	Absent	0
Dilwyn Formation	880	353	816	460
Pember Mudstone	1233	46	1276	27
Pebble Point Formation	Absent	0	1303	33
Curdies Formation	1279	267	1336	212
Paaratte Formation	1546 2776 TD	≥1230	1548	616
Belfast Formation			2164 3974 TD	≥1810

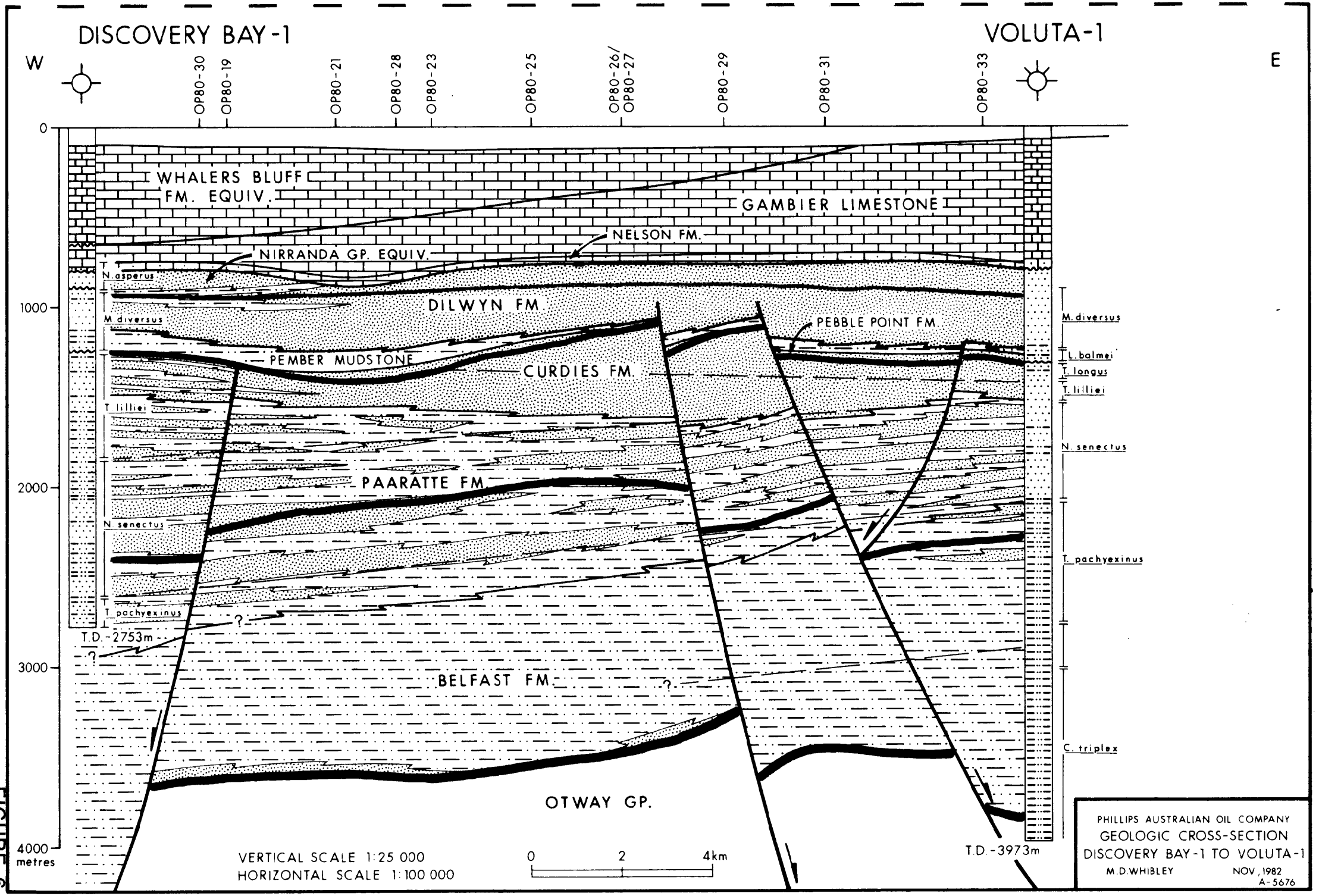

DISCOVERY BAY-1
VOLUTA-1
W
E
OP80-30
OP80-19
OP80-21
OP80-28
OP80-23
OP80-25
OP80-26/
OP80-27
OP80-29
OP80-31
OP80-33
0
1000
2000
3000
4000
metres
WHALERS BLUFF
FM. EQUIV.
GAMBIER LIMESTONE
NELSON FM.
NIRRANDA GP. EQUIV.
N. asperus
DILWYN FM
M. diversus
PEBBLE POINT FM.
PEMBER MUDSTONE
CURDIES FM.
T. lilliei
PAARATTE FM
N. senectus
T. pachyexinus
T.D.-2753m
BELFAST FM.
OTWAY GP.
T.D.-3973m
M. diversus
L. balmei
T. longus
T. lilliei
N. senectus
T. pachyexinus
C. triplex
VERTICAL SCALE 1:25 000
HORIZONTAL SCALE 1:100 000
0
2
4km
PHILLIPS AUSTRALIAN OIL COMPANY
GEOLOGIC CROSS-SECTION
DISCOVERY BAY-1 TO VOLUTA-1
M.D.WHIBLEY
NOV, 1982
A-5676

FIGURE 9

SEISMIC MARKER IDENTIFICATION

A well velocity survey was conducted at Discovery Bay No.1 on completion of drilling (Addendum 3). From the well velocity log, the three main seismic reflectors mapped within Permit Vic/P14 have been related to the stratigraphy of Discovery Bay No.1 as shown below, and in Enclosures 4 and 5:

SEISMIC EVENT	TWO-WAY TIME (secs)	DEPTH	STRATIGRAPHY
Green	0.720	787m (-764m)	Base Nelson Formation--Top Nirranda Group
Pink	1.118	1279m (-1256m)	Base Pember Mudstone--Top Sherbrook Group (Curdies Formation)
Brown	1.906	2473m (-2450m)	Intra-Paaratte Formation

The depths to the Green, Pink, and Brown seismic horizons are greater than those predicted prior to drilling. The pre-drill depths of the Green, Pink and Brown horizons were 783 metres, 1242 metres, and 2443 metres respectively, all too shallow since the initial time-to-depth conversion velocities were too slow.

Additional seismic reflectors within the Tertiary section mapped across Permit Vic/P14 have been related to the stratigraphy of Discovery Bay No.1 as shown below, and in Enclosures 4 and 5:

SEISMIC EVENT	TWO-WAY TIME (secs)	DEPTH	STRATIGRAPHY
Turquoise	0.153	311m (-288m)	Intra Heytesbury Group Marker
Yellow	0.630	664m (-641m)	Base Whalers Bluff Formation Equivalent--Top Gambier Limestone
Dark Blue	0.825	923m (-900m)	Upper Intra Wangerrip Group Marker (Near Top Wangerrip Group)
Light Blue	1.080	1233m (-1210m)	Lower Intra Wangerrip Group Marker (≡Top Pember Mudstone)

STRUCTURE

The Discovery Bay structure is a closure on a major complex northwest-southeast anticlinal trend in the northwestern portion of Permit Vic/P14, as mapped at the top Cretaceous unconformity pink seismic horizon (Top Sherbrook Group). This trend called the South Voluta High is separated by the fault-bounded Voluta Graben Depression from a similar-trending structure called the Cape Bridgewater Ridge (Figure 3).

The structure at the pink seismic horizon indicates a complex type of trap, related to faulting on the northern, western, and southern flanks and to deep channelling on the eastern margin (Figures 7, 9 and 10). Northern fault closure is related to a major listric fault with relief faulting providing closure to the east and dip into this listric fault providing closure to the west. A second listric fault down-drops the reservoir sequence on the southern side of the prospect to provide closure. East-west rollover is augmented to the east by a channel which cuts deeply into the Curdies Formation. The channel infill is believed to be composed of fine-grained sediment which would provide an effective lateral seal. The Discovery Bay structure is closed over an area of 59.7 square kilometres on the pink seismic horizon (Figure 7). Maximum vertical closure is 56 metres.

A closure was also mapped on the brown seismic horizon (Figures 8, 9 and 10), which represents a time-stratigraphic horizon within the Paaratte Formation in Discovery Bay No.1. Depth closure at this level occurs on the down-thrown side of a major curved fault, in part listric and in part strike-slip related. The trap is completely dependent on the integrity of the fault seal since there is no rollover into this fault. Areal closure at the brown level is 35.3 kilometres, with a maximum vertical closure of 108 metres.

Actual depth to the pink and brown levels at the Discovery Bay No.1 location were 36 metres and 30 metres respectively greater than predicted because the initial time-to-depth conversion velocities were too slow.

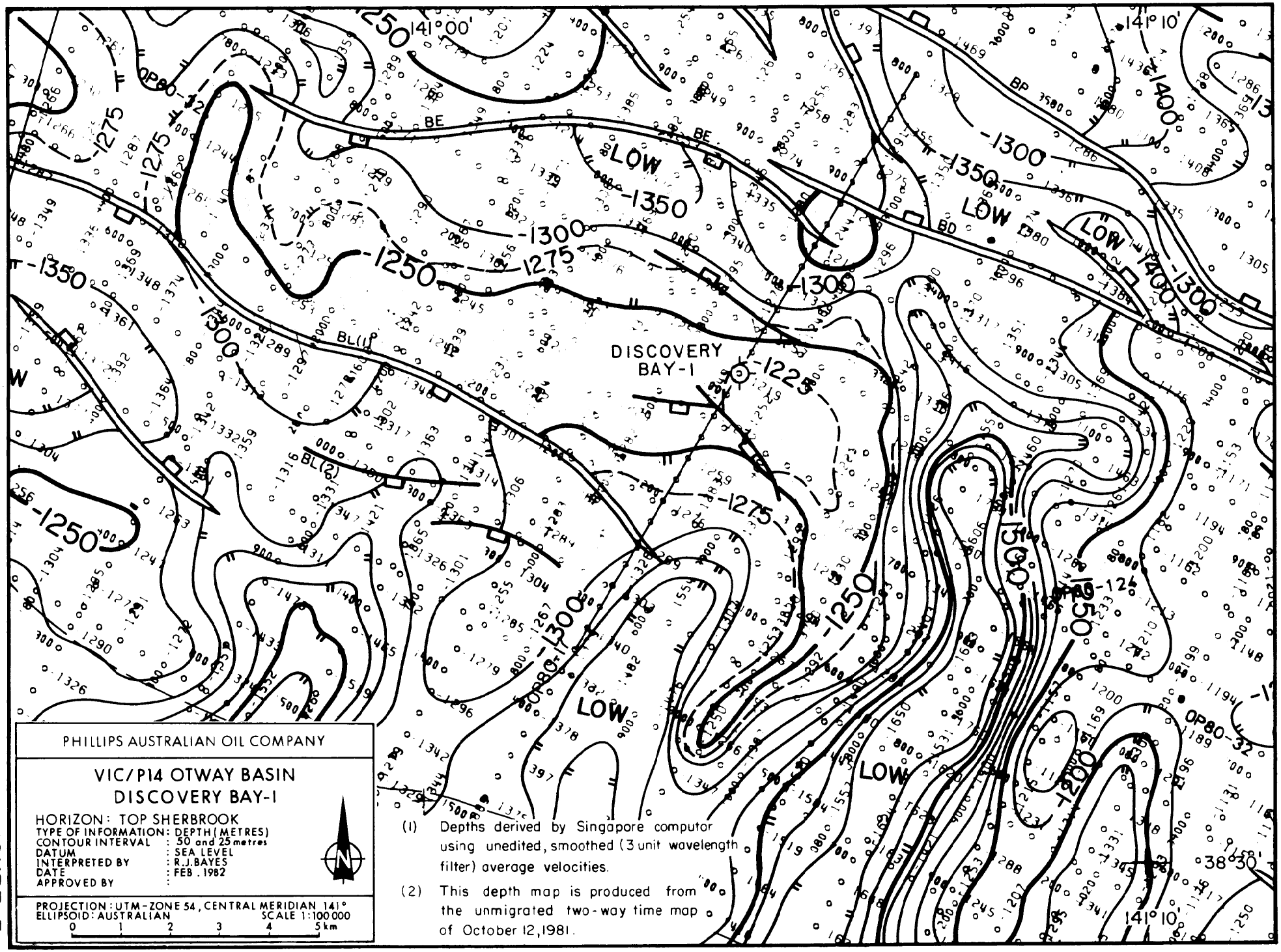

141°00'
141°10'
38°30'
DISCOVERY BAY-1
-1223
LOW
-1350
-1300
-1275
-1250
-1400
BE
BD
BP
BL(1)
BL(2)
OP80-12
OP80-17
OP80-32
PHILLIPS AUSTRALIAN OIL COMPANY
VIC/P14 OTWAY BASIN
DISCOVERY BAY-1
HORIZON: TOP SHERBROOK
TYPE OF INFORMATION: DEPTH (METRES)
CONTOUR INTERVAL : 50 and 25 metres
DATUM : SEA LEVEL
INTERPRETED BY : R.J.BAYES
DATE : FEB. 1982
APPROVED BY :
N
PROJECTION: UTM-ZONE 54, CENTRAL MERIDIAN 141°
ELLIPSOID: AUSTRALIAN
SCALE 1:100 000
0 1 2 3 4 5 km
(1) Depths derived by Singapore computor using unedited, smoothed (3 unit wavelength filter) average velocities.
(2) This depth map is produced from the unmigrated two-way time map of October 12, 1981.

FIGURE 7

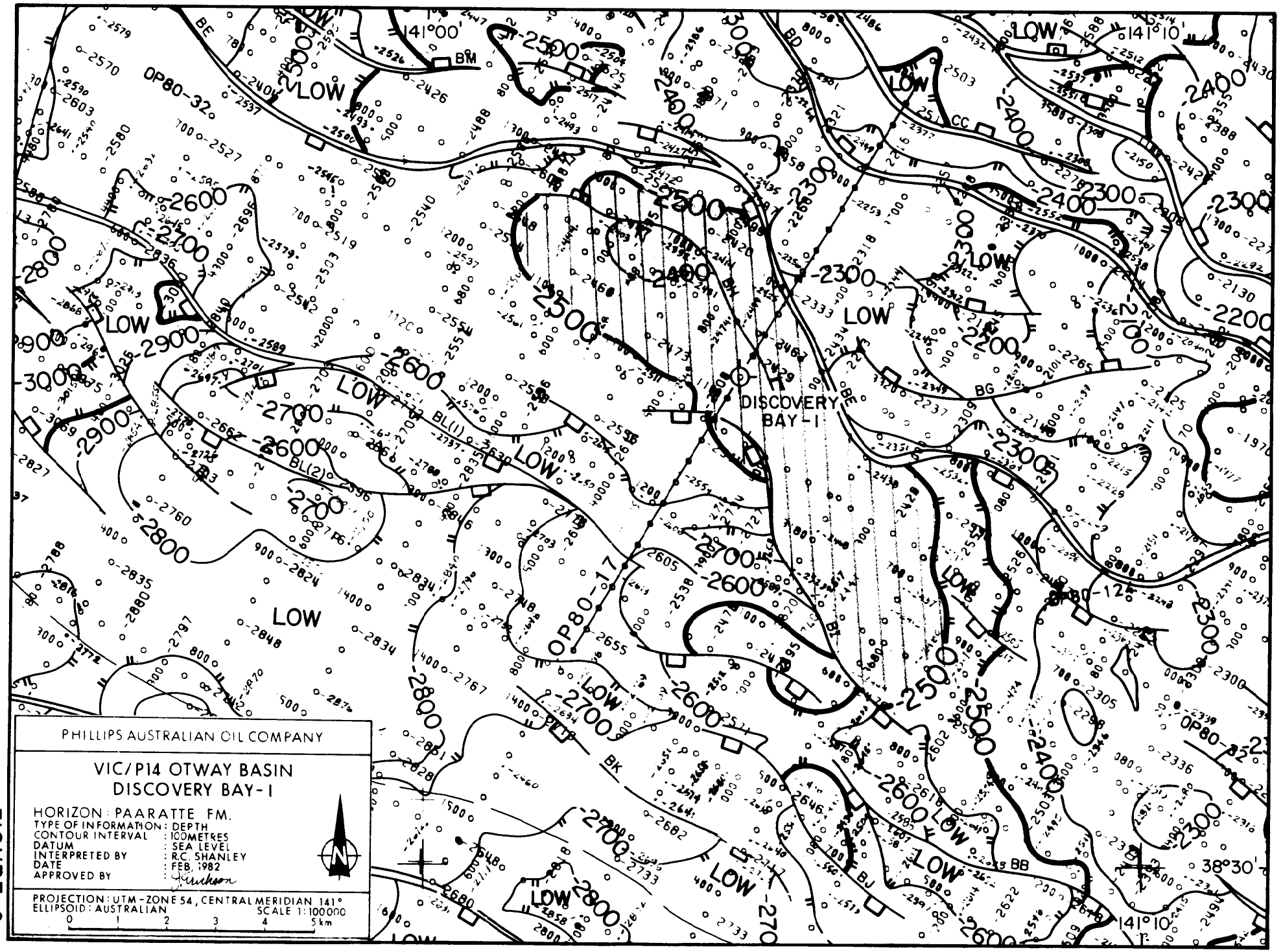

PHILLIPS AUSTRALIAN OIL COMPANY
VIC/P14 OTWAY BASIN
DISCOVERY BAY-1
HORIZON : PAARATTE FM.
TYPE OF INFORMATION : DEPTH
CONTOUR INTERVAL : 100METRES
DATUM : SEA LEVEL
INTERPRETED BY : R.C. SHANLEY
DATE : FEB, 1982
APPROVED BY :
PROJECTION : UTM - ZONE 54, CENTRAL MERIDIAN 141°
ELLIPSOID : AUSTRALIAN
SCALE 1:100000
0 1 2 3 4 5km
DISCOVERY BAY-1
LOW
141°00'
141°10'
38°30'
OP80-32
OP80-17
OP80-12
BE
BM
BD
CC
BG
BL(1)
BL(2)
BK
BJ
BB
PL

FIGURE 8

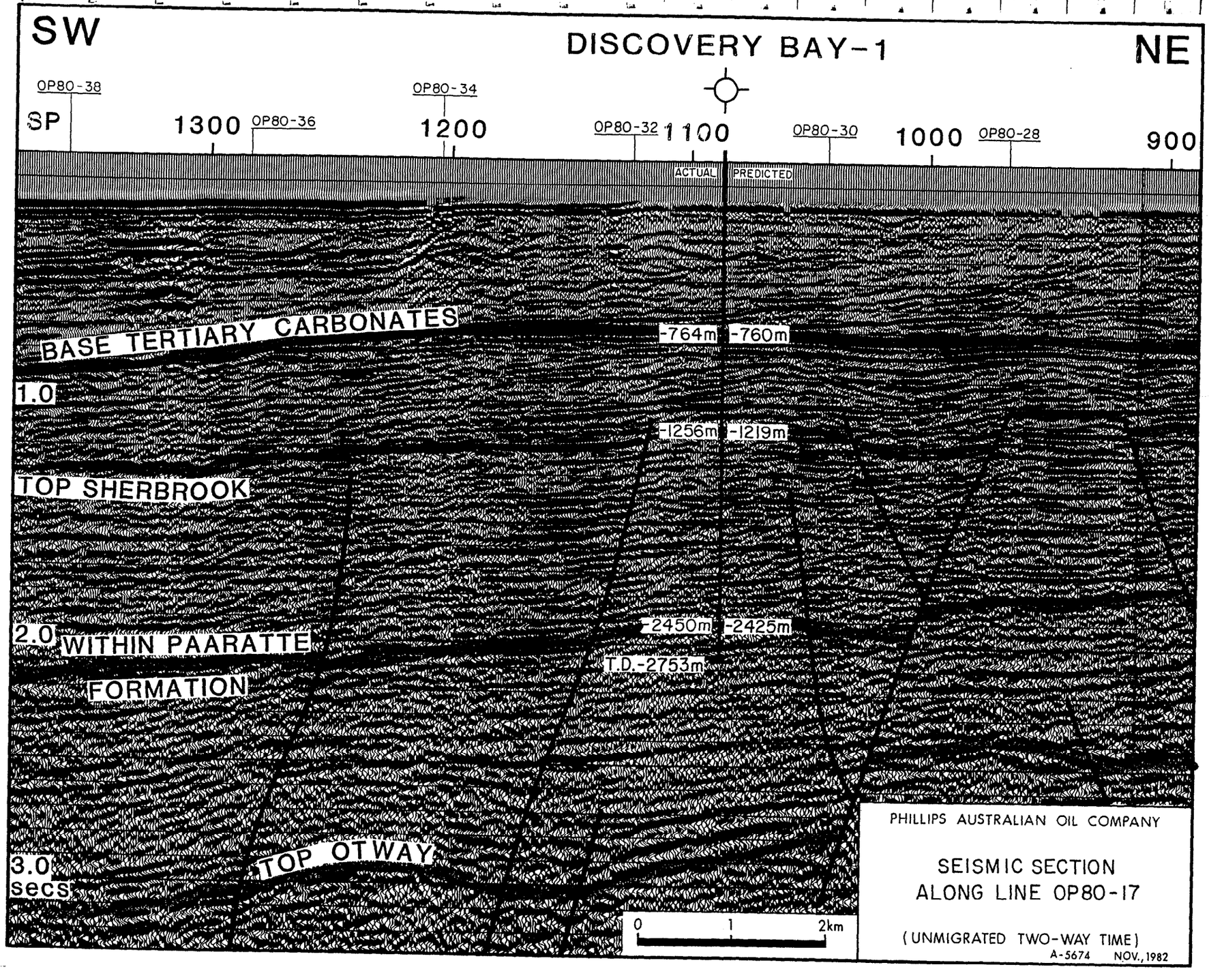


FIGURE 9

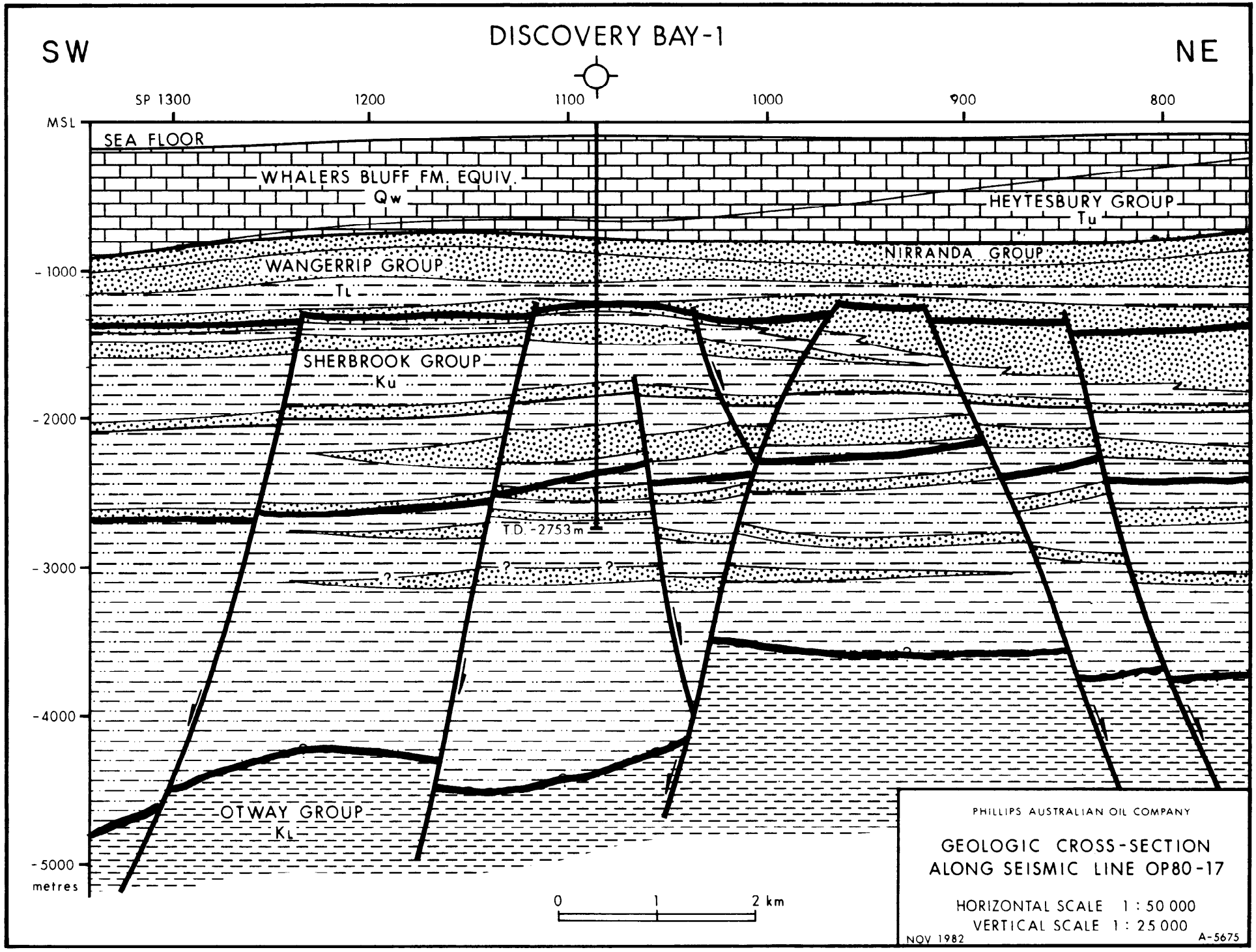

SW
DISCOVERY BAY-1
NE
SP 1300
1200
1100
1000
900
800
MSL
SEA FLOOR
WHALERS BLUFF FM. EQUIV.
Qw
HEYTESBURY GROUP
Tu
NIRRANDA GROUP
WANGERRIP GROUP
TL
-1000
SHERBROOK GROUP
Ku
-2000
T.D. -2753m
-3000
?
?
?
-4000
OTWAY GROUP
KL
-5000
metres
0
1
2 km
PHILLIPS AUSTRALIAN OIL COMPANY
GEOLOGIC CROSS-SECTION
ALONG SEISMIC LINE OP80-17
HORIZONTAL SCALE 1 : 50 000
VERTICAL SCALE 1 : 25 000
NOV 1982
A-5675

FIGURE 10

RELEVANCE TO THE OCCURRENCE OF HYDROCARBONS

Hydrocarbon Indicators

A continuous record of gas levels was maintained by Geoservices after drilling out of the 20" casing shoe at 423 metres in Discovery Bay No.1 (Addendum 2, Enclosures 2 and 3). Total gas determination and chromatographic analysis were conducted using a gas chromatograph (GAL Chromatograph Mod 78). No hydrocarbon indications were noted from cuttings or sidewall cores, or recorded from the mud returns by the gas detector. However, subsequent head space gas analyses (Appendix 8) carried out on canned geochemical samples over the 1235-1370 metre, 1715-1930 metre, and 2295-2770 metre intervals indicated minor amounts of methane, ethane, propane, n-butane and iso-butane.

Porosity and Permeability

Potential reservoir sections in Discovery Bay No.1 are contained within the Lower Tertiary Dilwyn Formation, and within the Upper Cretaceous Curdies and Paaratte Formations. A log analysis is presented in Appendix 10 and a Computer Log Analysis Plot is presented in Enclosure 6.

The sandstones of the Dilwyn Formation vary in thickness from 15 to 80 metres and are typically medium-to-coarse grained, moderately sorted, subrounded-to-well rounded, and uncemented. They are mainly deltaic and shallow marine sands with a porosity range of 24 to 36 percent and an average porosity of about 30 percent.

Sandstones within the deltaic Curdies Formation are generally delta plain point bar, crevasse splay, and sub-delta sands and are usually fine grained, moderately sorted, subangular to subrounded, argillaceous, and cemented in part. Porosities vary from 20 to 32 percent, averaging around 27 percent. These sands range in thickness from 1 up to 25 metres with an average of about 8 metres.

Sandstones within the underlying deltaic-marginal marine Paaratte Formation are very similar to the sands of the Curdies Formation. They average

9 metres in thickness but can range up to 30 metres thick. Porosities vary between 20 and 32 percent, averaging 25 percent. The sandstones are usually point bar, crevasse splay and distributary mouth bar sands, and are very fine-to-fine grained, argillaceous, and heavily cemented in part with calcareous cement.

Figure 11 shows a general linear trend of decreasing porosity from the first clean Tertiary sand encountered at around 800 metres, to 2776 metres (TD). Clean uncemented sands were selected to show the effect of compaction.

Source Rock Potential

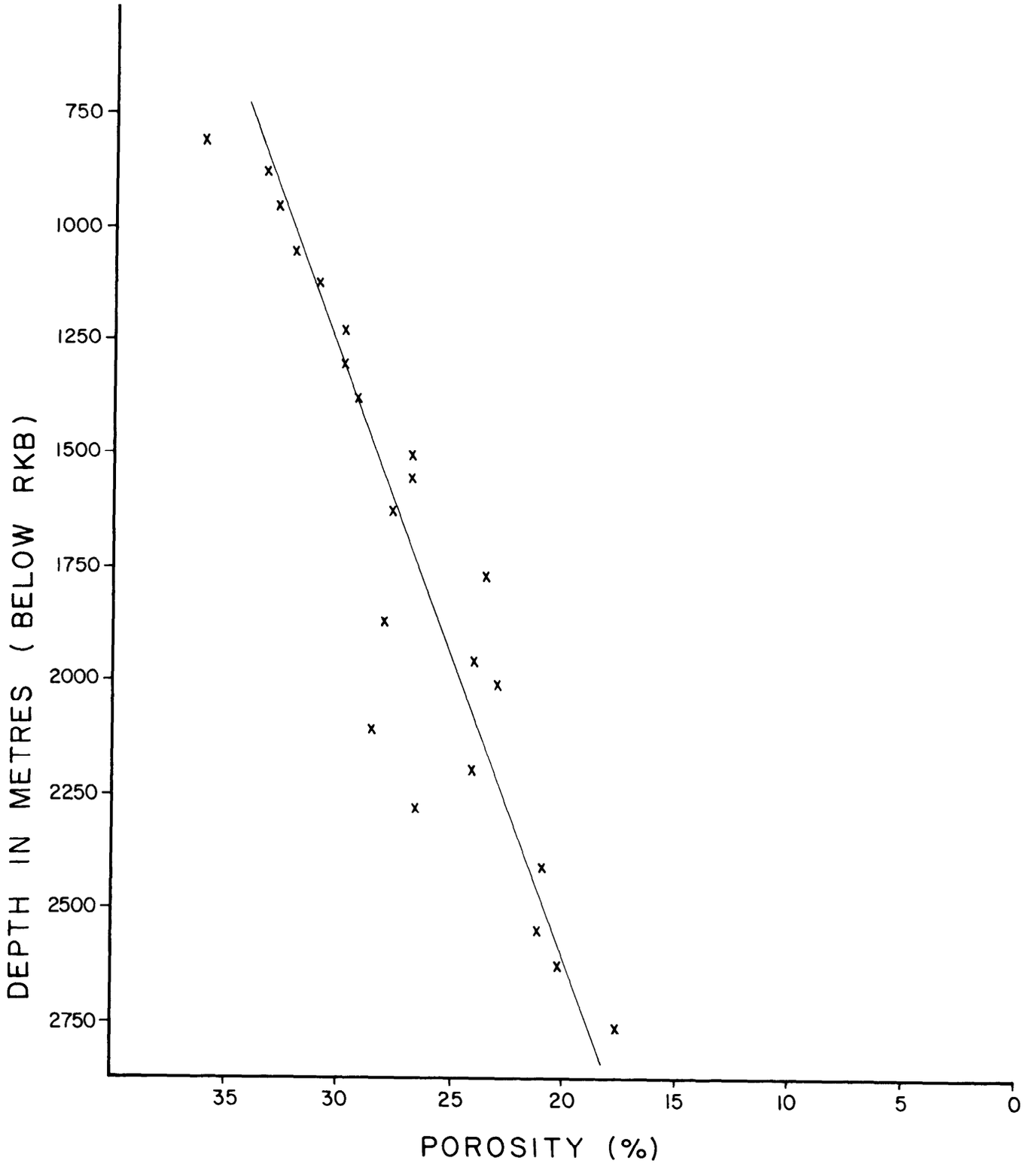
The hydrocarbon source rock potential of the sedimentary section encountered in Discovery Bay No.1 was evaluated using geochemical analysis, palynological and vitrinite reflectance data, and borehole temperature measurements.

Canned cuttings samples were taken over 15-metre composite intervals from 1200 metres at the near base of the Dilwyn Formation down to total depth within the Paaratte Formation. Thirty-five of the well cuttings samples were evaluated by Analabs for total organic carbon (TOC) content and were also analysed by gas chromatography and pyrolysis (Appendix 8). TOC determinations and pyrolysis, vitrinite reflectance, kerogen and spore colouration studies were also carried out on 16 sidewall cores and 10 well cuttings samples by the Exploration Projects Section of Phillips Petroleum Company (Appendix 9).

The Upper Cretaceous Belfast Formation, considered as the prime source for hydrocarbon generation throughout Permit Vic/P14, was not penetrated to total depth at the Discovery Bay No.1 location although it is thought to be present at a greater depth. Source rock and geochemical analyses were completed to determine the source rock potential of shales and siltstones penetrated within the Upper Cretaceous Paaratte and Curdies Formations.

Moderate (0.5-1.0 percent) to good (greater than 1.0 percent) levels of organic carbon are evident in all analysed samples throughout the Upper Cretaceous section (1279 to 2776 metres TD). Kerogen-type and pyrolysis

SANDSTONE POROSITY Vs DEPTH
DISCOVERY BAY - 1



A - 5672

FIGURE 11

studies indicate a dominance of gas prone kerogens and low hydrogen and moderately high oxygen indices respectively, which suggests that the organic matter is a poor hydrocarbon source.

Pyrolysis analysis by Phillips Petroleum Company indicates that minor oil kerogens present were probably subjected to oxidation prior to or during burial which destroyed any oil potential. However, similar analyses by Analabs on well cuttings from 2315 to 2370 metres and 2595 to 2630 metres respectively indicate higher hydrocarbon indices relative to lower oxygen indices interpreted as being more oil prone with the possibility of generation of minor amounts of liquid hydrocarbons.

Vitrinite reflectance (Ro) data (Appendix 9) suggest that the onset of petroleum generation (Ro=0.5%) occurs at about 825 metres in Discovery Bay No.1 according to the linear trend in Figure 12. At 2776 metres (TD), an Ro of 0.66 indicates only an early stage of thermal maturity which is supported by spore colouration index values. Consequently no significant source rock potential is indicated in any of these samples at their present level of thermal maturity. At higher levels of thermal maturity however, the samples could have generated and expelled moderate-to-good quantities of gas and possibly minor-to-moderate quantities of oil. The onset of the peak zone of liquid hydrocarbon generation (Ro=0.7 to 1.0%) is reached at 3250 metres by extrapolation from total depth.

The present day geothermal gradient at Discovery Bay No.1 is 3.17°C/100 metres (1.75°F/100 feet) as calculated from the bottom hole temperature at each logging run extrapolated to static equilibrium temperature (Figure 13).

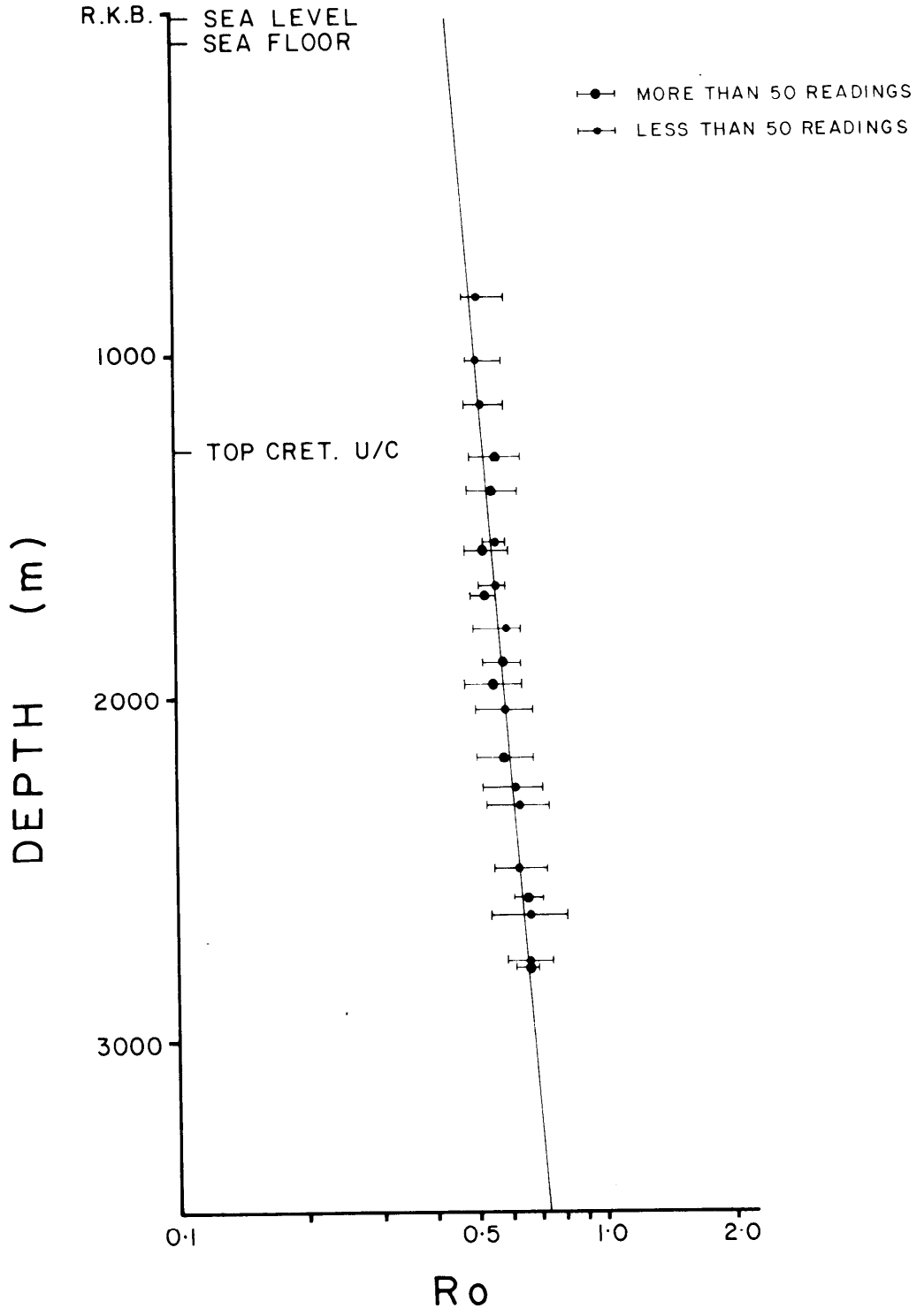
Summary of Hydrocarbon Significance

1. The lack of significant accumulations of hydrocarbons at Discovery Bay No.1 can be attributed to the following parameters:

   (i) The absence of a good sealing unit immediately above the Upper Cretaceous Curdies Formation.

   The Pember Mudstone immediately overlying the Curdies Formation comprises siltstone with thinly interbedded sandstones which

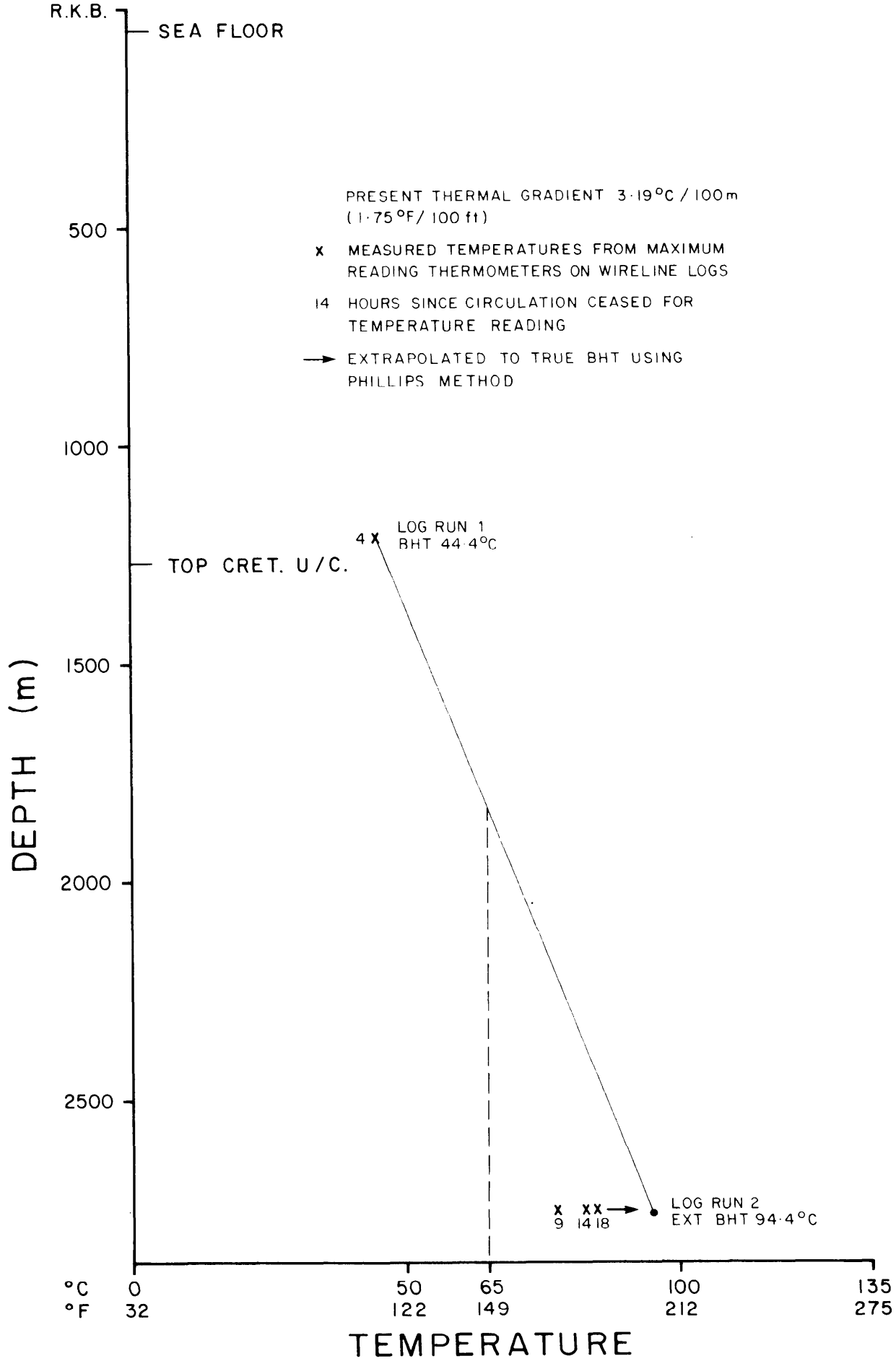
VITRINITE REFLECTANCE Vs DEPTH
DISCOVERY BAY - 1



A-5746

FIGURE 12

TEMPERATURE Vs DEPTH
DISCOVERY BAY-1



A-5759

FIGURE 13

would have allowed leakage of any hydrocarbons migrating to this level. Also, suitable regional seals are lacking for possible sandstone reservoirs developed within the Paaratte Formation at the Discovery Bay No.1 location.

(ii) Limited migratory movement of hydrocarbons from a possible deeper mature source into shallower Upper Cretaceous sandstone reservoirs in the Discovery Bay area.

2. Sandstone reservoirs with good porosities (greater than 25%) are present throughout the Upper Cretaceous section in Discovery Bay No.1. Permeabilities although not tested are also estimated to be moderate-to-good in these sandstones.

3. Thermally immature and dominantly gas-prone source rocks were penetrated to the total depth of the well. The Belfast Formation considered as the most favourable oil and gas source was not penetrated to total depth. Based on previous evidence this formation should occur at deeper and more suitable burial depths with a high enough thermal maturity for probable oil generation.

CONTRIBUTIONS TO GEOLOGICAL KNOWLEDGE

1. Discovery Bay No.1 indicated the existence of a thick (greater than 234 metres) Pliocene limestone wedge, equivalent to the Whalers Bluff Formation previously not penetrated in the offshore Otway Basin.

2. The absence of Miocene-aged strata in Discovery Bay No.1 indicates significant Late Miocene-Early Pliocene erosion across the outer continental shelf in the vicinity of the well preceding infilling and deposition of the later Pliocene limestone.

3. The absence of Upper Eocene-aged sediments is probably related to eustatic changes and erosion associated with final continental breakup of Australia and Antarctica.

4. The angular unconformity at the top of the Sherbrook Group represents a period of uplift and erosion related to the final rifting phase

between Australia and Antarctica at the end of Upper Cretaceous time. The absence of the Paleocene Pebble Point Formation and Maestrichtian-aged sediments indicates Late Paleocene erosion of these sediments from the Discovery Bay location.

5. The Upper Cretaceous Paaratte Formation is considerably thicker in Discovery Bay No.1 (greater than 1230 metres) than in Voluta No.1 (616 metres) located 21 kilometres to the east.

6. The Upper Cretaceous Curdies Formation or equivalent facies is considerably siltier than in Voluta No.1 or in other wells that have penetrated this unit. Its depositional environment as indicated by electric log, and dinoflagellate and foraminiferal data suggests more-marginal marine depositional conditions rather than the dominantly fluvial-upper delta plain environment indicated for this formation elsewhere in the basin.

7. Dipmeter analysis suggests an easterly and northeasterly source for Upper Cretaceous sediments in Discovery Bay No.1.

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APPENDIX NO.1

GOVERNMENT APPROVALS

DEPARTMENT OF MINERALS AND ENERGY

PRINCES GATE EAST 151 FLINDERS STREET MELBOURNE, VIC. 3000

TELEPHONE: (03) 653 9200 TELEX: MINERG AA 36595

Our Ref. IF:CF
Your Ref.
Contact
Ext.

14 October 1982

The Manager
Phillips Australian Oil Company
GPO Box 2066
PERTH WA 6001

Dear Sir,

It is hereby confirmed that, under Clause 2, Schedule 1 of the Direction as to Drilling Operations, Designated Authority approval has been granted to the plug and abandonment programme for Discovery Bay - 1 subject to the condition that the area surrounding the well shall be examined by an appropriate method to ensure that in the opinion of the Designated Authority the sea bed is clear of debris and obstructions.

A report on such survey is to be lodged with the Designated Authority within two months of the removal of the wellhead.

Yours faithfully

J L LePage
DIRECTOR, OIL AND GAS DIVISION

4-8-82 OK

DEPARTMENT OF MINERALS AND ENERGY

PRINCES GATE EAST 151 FLINDERS STREET MELBOURNE, VIC. 3000
TELEPHONE: (03) 653 9200 TELEX: MINERG AA 36595

1 5 10 1

Our Ref. IF/KW/ML
Your Ref.
Contact
Ext. 333

6 August 1982

Mr. O. J. Koop
Manager
Phillips Australian Oil Company
23rd Floor
City Centre Tower
44 St. Georges Terrace
PERTH WA.6000

Dear Sir

PETROLEUM (SUBMERGED LANDS) ACT 1967
CONSENT TO DRILL DISCOVERY BAY-1

You are advised that your application of 24 June 1982 to drill the wildcat well Discovery Bay-1 in VIC/P14 with the "Diamond M Epoch" has received Designated Authority approval under the provisions of Clause 3 of the Direction as to Drilling Operations subject to the conditions that your Company includes a well velocity survey in its logging programme and that complete adoption of metrication be undertaken in the reporting of all results.

Inspection of the sidescan sonar site specific study suggests a hard ocean floor that might provide some difficulty in anchor holding. Consequently, your Company's attention is drawn to the necessity of ensuring a stabilised drilling platform - perhaps via a piggy back anchoring capacity.

Yours faithfully

R. F. Hudson
ACTING DIRECTOR
OIL & GAS DIVISION

Copied to GFE, MIM, Spare + Baille 11/8/82

APPENDIX NO.2

DAILY DRILLING SUMMARY

DAILY DRILLING SUMMARY

(Covers previous 24 hour period to 0800 hours on report date)

Date	Total Depth (metres RKB)	Work Performed
13th Sept. 1982		The Diamond M Epoch was accepted from Amoco at 2345 hours.
14th Sept. 1982		Started towing Epoch to Discovery Bay No.1 Location.
15th Sept. 1982		Continued tow.
16th Sept. 1982		Epoch arrived at Discovery Bay No.1 location at 0930 hours. Anchor No.7 was dropped during the approach. The other primary anchors were dropped and tensional. Five anchors were slipping. The anchors were re-run and piggy backed. Three anchors with piggy backs held. The rig was 120 metres southwest of the intended location.
17th Sept. 1982		All anchors were pretensioned after letting them soak. Three anchors slipped.
18th Sept. 1982		Waited on weather.
19th Sept. 1982		The three anchors that slipped were re-run with piggy backs. Tension was applied and four anchors slipped. Two broken anchors were recovered and returned to the rig. It was determined that the anchors were apparently catching on rock outcrops and not digging into the seabed.
20th Sept. 1982		Two anchors were re-run with piggy backs. All anchors were pre-tensioned to 350,000-400,000 lbs and held. The rig was 165 metres at 202 degrees from the proposed location.

Date	Total Depth (metres RKB)	Work Performed
21st Sept. 1982	172	The well was spudded. A 36 inch hole was drilled to 141 metres RKB. A directional survey indicated that the hole was deviated by 3 1/2 degrees. The rig was moved 25 feet astern and the hole was re-spudded. A 36 inch hole was drilled to 172 metres RKB. The directional survey indicated one degree deviation.
22nd Sept. 1982	172	The 30 inch casing was run and set at 172 metres RKB. The casing was then cemented with 1150 sacks of Class G Neat cement.
23rd Sept. 1982	435	Drilling recommenced with a 12-1/4 inch bit. The hole was drilled to 435 metres. A directional survey indicated 3/4 of a degree deviation. The 12-1/4 inch hole was then opened to 26 inches and circulated clean in preparation to set the 20 inch casing.
24th Sept. 1982	435	The 20 inch casing was run and set at 423 metres RKB. The casing was then cemented with 1200 sacks of Class G Neat cement with 2.5% pre-hydrated gel water mixed at 12.8 ppg and 500 sacks of Class G Neat cement mixed at 15.4 ppg.
25th Sept. 1982	438	The BOP stack was run and tested to Phillips Australian Oil Company specifications. After testing was completed, a 12-1/4 inch hole was drilled to 438 metres.
26th Sept. 1982	1102	Drilling of the 12-1/4 inch hole continued to 1102 metres. A directional survey was taken and indicated 3/4 of a degree deviation. Drilling was shut down 2 hours during the day due to an oil leak on the compensator stand pipe.

Date	Total Depth (metres RKB)	Work Performed
27th Sept. 1982	1214	Drilling of the 12 1/4 inch hole continued to 1214 metres, the 13-3/8 inch casing point. The mud was circulated and conditioned in preparation to run logs. The gamma ray/dual induction log/sonic long space log was run from total depth to the 20 inch casing shoe. Several side wall cores were also taken.
28th Sept. 1982	1214	The 12-1/4 inch hole was underreamed to 17-1/2 inches to 741 metres.
29th Sept. 1982	1214	Underreaming continued on the 12-1/4" hole. The hole was opened to 17-1/2 inches to 884 metres RKB. Ten hours were lost due to waiting on weather.
30th Sept. 1982	1214	Underreaming of the hole to 17-1/2 inches to 1214 metres RKB was completed and preparations were made to run the 13-3/8" casing.
1st Oct. 1982	1214	The 13-3/8" casing was run and set at 1200 metres RKB. The casing was cemented with 1000 sacks of Class G Neat cement with 25% prehydrated gel mixed at 12.8 ppg, followed with 500 sacks of Class G Neat cement mixed at 15.8 ppg. Six and one half hours were lost due to waiting on weather.
2nd Oct. 1982	1214	Excess cement was washed from the well head and pressure tests were conducted on the BOP, wellhead and choke/kill manifolds while waiting on the cement to set. A gyro survey was run from T.D. to seabed. Cement inside the casing was tagged at 1195 metres RKB. The cement was drilled out to 1195 metres and the casing was pressure tested 200 psi.

Date	Total Depth (metres RKB)	Work Performed
3rd Oct. 1982	1461	Drilled 4 metres of new hole to 1218 metres RKB with a 12-1/4" bit and conducted a leak off test. The test indicated formation leak off at an equivalent mud weight of 12.1 ppg. Drilled the 12-1/4" hole to 1461 metres RKB.
4th Oct. 1982	1675	Drilled the 12-1/4" hole to 1675 metres RKB.
5th Oct. 1982	1903	Drilling of the 12-1/4" hole continued to 1903 metres RKB. A deviation survey at 1885 metres indicated 2 degrees deviation. An hour of drilling time during the day had been lost due to equipment problems.
6th Oct. 1982	1992	The 12-1/4" hole was drilled to 1993 metres RKB.
7th Oct. 1982	2165	Drilled 12-1/4" hole from 1993m to 2165m.
8th Oct. 1982	2349	Drilled 12-1/4" hole from 2165m to 2349m.
9th Oct. 1982	2449	Drilled 12-1/4" hold from 2349m to 2449m.
10th Oct. 1982	2614	Drilled 12-1/4" hole from 2449m to 2614m.
11th Oct. 1982	2700	Drilled 12-1/4 inch hole from 2614m to 2700m. Tested BOP stack to PAOC specs.
12th Oct. 1982	2776	Drilled 12-1/4 inch hole from 2700m to 2776m.

Date	Total Depth (metres RKB)	Work Performed
13th Oct. 1982	2776	The mud was circulated and conditioned in preparation to run logs. A directional survey was taken and indicated 2° deviation. Logs No.1 and 2 were run from TD (2776m) to the 13-3/8" casing shoe. These logs were the dual induction/gamma ray/long space sonic and the litho density/ compensated neutron/gamma ray. The third log (high resolution dipmeter tool) was started.
14th Oct. 1982	2776	The third log was completed. A velocity survey was run. Sidewall cores were taken and preparations were made to plug the well.
15th Oct. 1982	1175	An open hole plug was set from 2445 metres to 2373 metres. The plug consisted of 160 sacks of Class G Neat cement mixed at 15.8 ppg. A second open hole plug was set from 1850 metres to 1779 metres. It consisted of 160 sacks of class G Neat cement mixed at 15.8 ppg. An EZ drill cement retainer was set at 1183 metres (WLM). One hundred forty sacks of class G cement mixed at 15.8 ppg were squeezed below the retainer. Forty sacks of cement were placed on top of the retainer. This plug was set from 1230 metres to 1175 metres and was pressure tested to 1000 psi.
16th Oct. 1982	150	The surface plug was set from 200 metres to 150 metres. It consisted of 130 sacks of class G Neat cement mixed at 15.8 ppg. The riser was displaced with seawater and the BOP stack was pulled. The 20" wellhead was also recovered.

Date	Total Depth (metres RKB)	Work Performed
17th Oct. 1982	150	Recovered PGB, 30" wellhead and severed 30 inch joint. Inspected well site with Hydro ROV-TV. Prepared rig for tow. Shut down 14 hours - waiting on weather to pull anchors.
18th Oct. 1982		After 7 hours of waiting on weather, primary anchors 8-5-4-1 were pulled. The rig was ballasted up to transit draft.
19th Oct. 1982		The remaining anchors were retrieved (7-3-2-6). The final anchor was bolstered at 0035 hours. Final report for Discovery Bay 1. Rig released to move to Helios No.1 location.

APPENDIX NO.3

DETAILED CUTTINGS DESCRIPTIONS

APPENDIX No.3

DETAILED CUTTINGS DESCRIPTIONS

All depths quoted are below Rotary Kelly Bushing, which is 23 metres above Mean Sea Level and 119.6 metres above the sea bed. Drill cuttings were collected at 5 metre intervals, commencing at 434 metres after drilling out of the 20" casing shoe. No samples were collected while drilling top hole down to the 20" casing depth, with all returns to the sea floor.

438-475m (37m) : Limestone, white to cream, moderately soft, massive, homogeneous, very fine grained, fossiliferous, with abundant bryozoan and coral fragments, and traces of clear, platy, calcite.

475-664m (189m) : Limestone, cream-brown to grey, hard to moderately soft, massive, homogeneous, granular, very fine grained to microcrystalline, occasionally fossiliferous with traces of bryozoan fragments. Traces of platy calcite. Traces of medium grained quartz.

664-705m (41m) : Limestone, cream to white-grey, moderately hard, dense, massive, microcrystalline, with common black, very hard, angular and flaked chert fragments.

705-755m (50m) : Dolomitic Limestone, white to grey, very hard, massive, dense, microcrystalline, with minor Limestone, white, soft, massive, microcrystalline, and occasional black, angular chert fragments.

755m-765m (10m) : Limestone, white to light grey, soft, massive, homogeneous, with black medium to fine grained angular to sub-angular, quartz.

765-787m (22m) : Limestone, grey to brown, soft, massive, granular, with abundant glauconite pellets, and foraminifera fragments and common very coarse, well rounded, spherical, quartz grains and minor grey marl.

787-792m (5m) : Claystone, yellow, soft, massive, limonitic, with very coarse to granule size (3mm), well rounded, spherical, quartz grains. Traces of shale fragments, brown very hard, fissile, conchoidal fracture.

792-803m (11m) : Sandstone, quartz, light grey to white, fine grained with abundant very fine and coarse sized grains, subrounded to well rounded, very poorly to poorly sorted, moderate to high sphericity, common calcareous cement, traces of glauconite and carbonaceous matter. Thin limestone bed at 793.5 metres, light grey, soft, granular, massive, with minor silt sized quartz grains, carbonaceous matter, and rare very fine grained, nodular glauconite.

803-806m (3m)	:	Claystone, brown-light grey, calcareous, massive, with disseminated very fine grained quartz, and traces of glauconite and carbonaceous material.
806-839.5m (33.5m)	:	Sandstone, quartz, light grey to white, fine grained, with common medium to coarse sized grains, subrounded to well rounded, moderately sorted, moderate to high sphericity, minor calcarous cement, fluctuating visual intergranular porosity (poor to good), with traces of carbonaceous matter.
839.5-855m (15.5m)	:	Sandstone, quartz, brown with occasional clear grains, very fine to fine grained, subrounded to rounded, well sorted, argillaceous with abundant silt matrix, slightly calcareous to non-calcareous, minor carbonaceous matter, poor visual intergranular porosity.
855-880m (25m)	:	Sandstone, quartz, grey to dark grey, medium grained, rounded to well rounded, moderate sorting, high sphericity, very minor calcareous cement and trace carbonaceous matter, and iron stained grains. Hard streak of limestone, light grey, soft, granular, homogeneous, at 857 metres.
880-890m (10m)	:	Interbedded sandstone, and claystone. Sandstone, quartz, brown to grey-green, fine grained, well rounded, well sorted, high sphericity, with abundant silt or clay matrix, restricted porosity, with trace carbonaceous matter. Claystone, dark brown, soft, non-calcareous, homogeneous and massive.
890-902.5m (12.5m)	:	Sandstone, quartz, light to dark brown, fine grained, subrounded to well rounded, moderate sorting, with with abundant silt or clay matrix, low visual porosity, with trace carbonaceous matter.
902.5-927m (24.5m)	:	Sandstone, quartz, brown to grey-green, fine grained well rounded, well sorted, high sphericity, with abundant clay matrix, restricted porosity, with common Clay, interbeds, dark brown, homogeneous, soft, non-calcareous.
927-1009m (82m)	:	Sandstone, quartz, clear to brown-grey, medium to coarse grained, some fine grains, subrounded to well rounded, poorly to moderately sorted, high sphericity, with minor calcareous cement (calcite), and minor carbonaceous material. Good visual intergranular porosity with syntaxial overgrowths absent, and only a very slight silt or fine grained matrix.
1009-1027m (18m)	:	Siltstone, quartz, light to dark brown, homogeneous, carbonaceous, non-calcareous, with minor interbedded Sandstone, quartz, clear to brown, fine to medium grained, subrounded, moderately sorted, argillaceous, with minor carbonaceous or coaly matter.

1027-1122m (95m)	:	Sandstone, quartz, clear to brown-grey, translucent, medium to coarse grained, subrounded to well rounded, moderately sorted, high sphericity trace calcite cement in parts, argillaceous (silty matrix) in part, generally high apparent intergranular porosity, with fissile coal and carbonaceous stringers. Minor Siltstone, interbeds, brown, argillaceous, moderately soft homogeneous.
1122-1135m (13m)	:	Siltstone, dark brown, massive, homogeneous, non-calcareous, plastic, argillaceous, with abundant carbonaceous material, and minor clear, medium sized, subangular, quartz grains.
1135-1157m (22m)	:	Siltstone, as above, with occasional scattered shell fragments (unidentifiable), and minor sandstone interbeds, quartz clear to translucent, fine to very fine grained, subrounded to well rounded, well sorted.
1157-1200m (43m)	:	Siltstone, dark brown, massive, homogeneous, non-calcareous plastic, argillaceous, with abundant carbonaceous matter, and occasional shell fragments (unidentifiable), and traces of clear medium grained, subangular quartz.
1200-1233m (33m)	:	Sandstone, quartz, light grey-white, very fine to fine grained, subangular to rounded, well sorted, high sphericity, slightly silty matrix, non-calcareous cement, abundant carbonaceous matter, good visible intergranular porosity, with traces of glauconite.
1233-1259 (26m)	:	Siltstone, dark brown, homogeneous, moderately soft to moderately hard, non-calcareous, argillaceous, with common carbonaceous matter throughout, and occasional clear, fine grained, well rounded quartz grains in part.
1259-1279m (20m)	:	Siltstone, as above, with minor Sandstone, interbeds, quartz, white to clear, very fine grained, subangular to subrounded, well sorted, high sphericity, non-calcareous cement, carbonaceous, silty, and clayey matrix in part.
1279-1298m (19m)	:	Sandstone, quartz, brown to light grey, medium to coarse grained, subangular to subrounded, moderately well to well sorted, non-calcareous cement, moderate sphericity, with minor carbonaceous matter, and traces of Pyrite. Minor Siltstone, interbeds, dark brown to dark grey, moderately hard, non-calcareous, homogeneous, argillaceous, with traces of quartz grains, clear, coarse to very coarse grained, subangular.
1298-1373m (75m)	:	Interbedded Siltstone and Sandstone. Siltstone, dark brown, homogeneous, argillaceous, carbonaceous, non-calcareous. Sandstone, quartz, white to brown to grey, fine grained with coarse grained interbeds, subangular to subrounded, well sorted, high sphericity, non-calcareous cement, very silty matrix in part, with trace pyrite and carbonaceous matter. Also very minor shale, brown, fissile, very hard, thin laminations or streaks less than two metres thick.

1373-1394m (21m)	:	Sandstone, quartz, light-grey to white, clear, coarse to very coarse grained, subangular to subrounded, occasionally angular, moderate sorting, high sphericity, argillaceous, with non-calcareous, dark brown, silty, matrix in part, non-calcareous cement, with traces of pyrite, and stringers of coal, black, shiny, hard, conchoidal fracture.
1394-1406m (12m)	:	Siltstone, dark brown, moderately hard, homogeneous, non-calcareous, very carbonaceous with traces of plant fragments.
1406-1546m (140m)	:	Sandstone, quartz, light-grey to white to pink, fine grained with some coarse to very coarse grained sand beds in part, subangular to rounded, moderately well sorted, high sphericity, non-calcareous cement, brown, silty, argillaceous matrix in part, very carbonaceous to coaly in part, with trace pyrite and iron staining. Minor siltstone, interbeds and streaks, light to dark brown, moderately hard, homogeneous, non-calcareous.
1546-1555.5m (9.5m)	:	Siltstone, dark brown, moderately hard, non-calcareous, homogeneous, with minor dolomite, dark grey, hard, microcrystalline.
1555.5-1565m (9.5m)	:	Sandstone, quartz, grey, fine to medium grained, subangular to subrounded, poorly sorted, silt matrix, non-calcareous cement, carbonaceous with traces of pyrite.
1565-1574m (9m)	:	Siltstone, dark brown, moderately hard, non-calcareous, homogeneous, with minor sandstone, quartz, fine to medium grained, subangular to subrounded, poorly sorted, high sphericity, minor calcareous cement.
1574-1615m (41m)	:	Sandstone, quartz, light grey to white to clear, coarse grained, subrounded to well rounded, moderate sorting, high sphericity, with occasional calcareous cement and interbeds of hard, heavily cemented calcareous sandstone streaks. Minor interbedded siltstone, dark brown, non-calcareous, homogeneous, carbonaceous in places.
1615-1660m (45m)	:	Siltstone, dark brown to dark grey, non-calcareous, homogeneous, highly carbonaceous, moderately soft to moderately hard, minor pyrite, with sandstone, grey, very fine to fine grained, subrounded to rounded, moderately sorted, carbonaceous, with minor calcareous cemented hard streaks.
1660-1688m (28m)	:	Siltstone, dark brown, very slightly calcareous to non-calcareous, moderately soft, homogeneous, with minor interbeds of sandstone, white to grey, medium to fine grained, angular to subrounded, moderate sorting, calcareous cement, and occasional hard calcareous streaks.

1688-1705m (17m) : Sandstone, quartz, white to translucent, medium to coarse grained, subangular to subrounded, moderate sorting, with common calcareous cement (dolomite and limestone), white, hard, dense, homogeneous, low visual porosity.

1705-1730m (25m) : Siltstone, dark brown, homogeneous, moderately soft, non-calcareous.

1730-1797m (67m) : Thinly interbedded Siltstone, and Sandstone.
Siltstone, dark brown to grey, homogeneous, soft, non-calcareous, common carbonaceous matter, with traces of loose medium to coarse grained, subangular quartz apparent.
Sandstone, quartz, white to grey, fine to very fine grained, subangular to subrounded, moderate sorting, occasional calcareous cement, and traces of carbonaceous matter. Minor limestone/dolomite cementing the sandstone producing thin hard streaks.

1797-1821m (24m) : Sandstone, quartz, white to light grey, fine grained although coarse grained in part, subangular to rounded, well sorted, argillaceous with common silty matrix, with non-calcareous cement, minor carbonaceous matter, pyrite traces, and coal, black, splintery. Very minor siltstone, dark brown, non-calcareous, homogeneous, moderately hard, interbed.

1821-1933m (112m) : Siltstone, dark brown to light grey, homogeneous, soft, non-calcareous, with abundant carbonaceous matter in part, and coal stringers, black, hard, conchoidal fracture, trace pyrite. Minor thinly interbedded sandstone, quartz, white to translucent to clear, fine to medium grained, although very fine and coarse grained in part, subangular to subrounded, poorly sorted, varying high to low sphericity, heavily cemented in part, both non-calcareous and calcareous cement, with traces of pyrite.

1933-1957m (24m) Sandstone, quartz, white to translucent to clear, medium grained, subangular to subrounded, well sorted, high sphericity, with minor calcareous and non-calcareous cement, and traces of pyrite, and stringers of coal, black, fissile, conchoidal fracture.

1957-2068m (111m) : Interbedded Siltstone, and Sandstone.
Siltstone, dark brown to dark grey, non-calcareous, homogeneous, carbonaceous, with pyrite, and common quartz, clear, coarse to very coarse grained, loose subangular to subrounded, disseminated throughout.
Sandstone, quartz, white to grey, medium to very fine grained, subangular to rounded, well sorted, high sphericity, calcareous cement in part, (minor hard streaks of calcareous cemented sandstone) non-calcareous cement, carbonaceous, with traces of pyrite.

2068-2082m (14m) : Siltstone, dark brown, carbonaceous, homogenous, firm, non-calcareous, with pyrite, and minor quartz grains, clear to translucent, medium grained, angular.

2082-2153m (71m) : Sandstone, quartz, white to light grey, medium to coarse grained, subangular to subrounded, moderate sphericity, moderate to well sorted, friable, argillaceous, with minimal calcareous cement, minor calcareous stringers, and traces of pyrite. Minor siltstone, interbeds, dark brown to grey, homogeneous, subfissile, moderately soft, non-calcareous.

2153-2165m (12m) : Siltstone, dark brown to grey, homogeneous, firm, slightly calcareous, argillaceous, with trace pyrite.

2165-2301m (136m) : Interbedded Sandstone, and Siltstone.
Sandstone, quartz, white to light grey and translucent, medium to coarse grained, very coarse grained in part, in the uppermost beds of this interval, firm to friable, subangular to subrounded, moderately well sorted, argillaceous, with dark brown silty matrix, calcareous (dolomite/calcite) cement in part, common carbonaceous matter, and traces of pyrite.
Minor siltstone, interbeds, dark brown to grey, homogeneous, moderately soft to hard, firm, subfissile, non-calcareous, argillaceous, carbonaceous, with minor disseminated fine grained quartz grains in part, angular to subrounded, and minor clay.

2301-2324m (23m) : Sandstone, quartz, white to clear and translucent, medium grained, subangular to subrounded, moderate sorting, calcareous (dolomitic) cement apparent, with carbonaceous specks and streaks throughout, poor visual porosity, and minor pyrite.

2324-2473m (149m) : Interbedded Siltstone, and Sandstone.
Siltstone, dark brown to grey to black, hard, firm, carbonaceous argillaceous, homogeneous, non-calcareous, with occasional white clay laminatiqns (kaolinite?), sandy in part.
Sandstone, interbeds up to 15 metres thick, quartz, white to light grey, fine to very fine grained, with medium to coarse loose grains in the upper beds of the interval, subangular to subrounded, moderately well to well sorted, common carbonaceous material, silty matrix, non-calcareous and slightly calcareous cement, poor visual porosity, with traces of pyrite and glauconite.

2473-2509m (36m) : Siltstone, dark brown to light grey, homogeneous hard to very hard, carbonaceous, non-calcareous, subfissile, with occasional trace white, clay, kaolinite? Minor sandstone, quartz, white to translucent, fine to very fine grained, subrounded to subangular, well sorted, very hard, non-calcareous cement, carbonaceous matter.

2509-2595m (86m) : Sandstone, quartz, light grey to brown to white, sucrosic texture, fine to very fine grained, subangular to subrounded, well sorted, argillaceous, abundant carbonaceous material, well cemented, with common calcitic cement and minor dolomitic cement, and traces of glauconite and pyrite. Minor siltstone, dark brown to black, homogeneous, non-calcareous, very carbonaceous, soft to moderately hard, sandy in part. Minor sand, quartz, clear to translucent, coarse to very coarse grained, subangular to subrounded, well sorted.

2595-2656m (61m) : Siltstone, black to very dark brown, homogeneous, subfissile, moderately soft to moderately hard, containing abundant carbonaceous matter, minor calcareous cement, trace glauconite, sandy in part, grading to a sandy siltstone. Minor sandstone, quartz, white to dark grey, medium to fine grained, with occasional coarse quartz grains, subangular to subrounded, well sorted, argillaceous, very silty matrix, with minor calcareous cement and carbonaceous matter and traces of glauconite.

2656-2697m (41m) : Sandstone, quartz, white to light pink to light brown, fine to very fine grained, coarse grained in part, subangular to subrounded, well sorted, high sphericity, non-calcareous and non-carbonaceous, with little silt/clay matrix and cement, with trace pyrite, and rare glauconite. Minor siltstone, dark grey to grey, moderately soft, plastic, very carbonaceous, subfissile in part.

2697-2757m (60m) : Interbedded siltstone and sandstone.
Siltstone, dark grey to black, moderately hard to moderately soft, highly carbonaceous, argillaceous, non-calcareous, subfissile in part, with minor clay.
Sandstone, quartz, white to dark grey, fine to very fine grained, subangular to subrounded, well sorted, highly carbonaceous, with minor calcareous cement, traces of dolomitic cement, poor visual intergranular porosity, common glauconite pellets, and pyrite traces.

2757-2770m (13m) : Sandstone, quartz, white, coarse to very coarse grained, subangular to subrounded, moderately well sorted, no apparent cement, good visual porosity, with common interstitial pyrite.

2770-2776m (6m) : Thinly interbedded sandstone, and siltstone.
Sandstone, quartz, dark grey to white, fine to very fine grained, subangular to subrounded, well sorted, high sphericity, with carbonaceous matter, and traces of glauconite and pyrite.
Siltstone, dark grey homogeneous, non-calcareous, very carbonaceous, moderately hard, with white clay, kaolinite?

APPENDIX NO.4

SIDEWALL CORE DESCRIPTIONS

PHILLIPS AUSTRALIAN OIL COMPANY

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 790 m - 1210 m DATE 28/9/82 PAGE 1

SWC ATTEMPTED 51 RECEIVED 33 MISSFIRES 15 NO RECOVERY 3

RUN No. 1 GEOLOGIST B. See

DEPTH in metres	LENGTH RECV'D	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
790	-	No recovery	-	-	-	-
795	1-1/4"	Limestone: Soft, granular in appearance, light grey, includes minor silt size quartz grains, silt size carbonaceous material; rare very fine grained nodular glauconite.	-	-	-	-
800	1/2"	Sandstone: Light grey to white, poorly sorted ranging from silt to coarse grained, mainly very fine grained, well rounded, generally high sphericity; calcareous cement; trace glauconite, trace carbonaceous material, rare mica (muscovite?).	-	-	-	-
803.5	1-1/4"	Limestone: Light grey, soft and granular includes silt to very fine grained quartz throughout limestone matrix; trace glauconite and carbonaceous material.	-	-	-	-
810	-	No recovery	-	-	-	-
815	1/2"	Sandstone: Light grey to white, poorly sorted, mainly fine grained with abundant moderate well to well rounded coarse to granule size grains, moderate sphericity, calcareous cement.	-	-	-	-
830	3/4"	Sandstone: White, moderate sorted, mainly fine grained with occasional medium to coarse grains; moderate well rounded to well rounded. Moderate to high sphericity especially on larger grains, calcareous cement abundant; trace carbonaceous material; this sandstone and those described above have too much calcareous cement to allow for good porosity.	-	-	-	-
835	1-1/4"	Sandstone: Grey, fine grained with occasional medium grains, sub-rounded to rounded; fair sorting; calcareous cement; high sphericity; all sandstone described above is quartz; may have slight porosity but still very choked with calcareous cement.	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 790 m - 1210 m DATE 28/9/82 PAGE 2

SWC ATTEMPTED 51 RECEIVED 33 MISSFIRES 15 NO RECOVERY 3

RUN No. 1 GEOLOGIST B. See

DEPTH in metres	LENGTH RECV'D	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
839.5	2"	Sandstone: Quartz, brown, fine grained with abundant medium to coarse grains, subrounded to rounded, larger grains clear quartz, poorly sorted; matrix mainly dirty looking silt, very slightly calcareous; moderate amount of carbonaceous specks and mica flakes; porosity poor to moderate.	-	-	-	-
844	2"	Sandstone: Quartz, brown, very fine grained, rounded, good sorting, grains clear quartz; non-calcareous silty cement; abundant carbonaceous specks, minor mica; may have fair porosity but dirty appearance casts doubt.	-	-	-	-
858	-	No recovery	-	-	-	-
862	1-3/4"	Sandstone: Dark grey, quartz, medium grained, rounded, high sphericity, poor sorting, abundant coarse grains, larger grains tend to be subrounded, some opaque and loose. Some sphericity; calcareous cement; this core appears much different to the two previous. The dirty look is gone, replaced by a more clay looking cement. Carbonaceous specks absent.	-	-	-	-
865	2"	Sandstone: Dark grey; quartz; coarse grained, rounded to well rounded, clear, fair sorting, high sphericity; calcareous cement. This core similar to 862 m except more coarse grained and minor carbonaceous material.	-	-	-	-
875	1-1/4"	Sandstone: Grey, quartz, medium grained, rounded to well rounded, fair sorting, high sphericity; calcareous cement, abundant coarse grains which are opaque, occasional iron stained grains, abundant grains which have what appear to be carbonaceous inclusions in clear quartz. Minor carbonaceous material.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 790 m - 1210 m DATE 28/9/82 PAGE 3

SWC ATTEMPTED 51 RECEIVED 33 MISSFIRES 15 NO RECOVERY 3

RUN No. 1 GEOLOGIST B. See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
880	2"	Sandstone: Quartz, light - dark brown, fine grained, subrounded to rounded, fair sorting; silty dirty cement, abundant carbonaceous material, abundant mica; thin (less than 1mm) beds of dark brown clay occur randomly.	-	-	-	-
885	2"	Sandstone: As above (880 m), sands vary in colour from brown to tan. Colour variation gives core a mottled appearance. Bedding appears horizontal in relation to long axis of core.	-	-	-	-
891	2"	Sandstone: As in 880 m core. This core displays distinct laiminations or thin bedding alternating between fine sandstone and dark brown clay layers. Bedding is reminiscent of varves and probably represents over-bank or lake deposits.	-	-	-	-
906	2"	Sandstone: Same as core at 891 m.	-	-	-	-
910	1-3/4"	Sandstone: Quartz, grey-green, fine grained, rounded to well rounded, well sorted, high sphericity, grains mostly clear, includes small dark grains of magnetite?; sedimentary structures absent in this core, sand appears massive; could have excellent porosity.	-	-	-	-
920	2"	Sandstone: Core represents laminated beds as described in core at 891 m. The silty clay layers are more abundant in this core and predominate. These laminated cores give every indication of fresh water deposition. Probably lake deposits.	-	-	-	-
928	2"	Sandstone: Dark brown, quartz, coarse to very coarse; subrounded to rounded, spherical, poorly sorted, has a dirty mud matrix; trace carbonaceous; due to muddy nature of matrix porosity probably poor.	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 790 m - 1210 m DATE 28/9/82 PAGE 4

SWC ATTEMPTED 51 RECEIVED 33 MISSFIRES 15 NO RECOVERY 3

RUN No. 1 GEOLOGIST B. See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
958.5	1-3/4"	Sandstone: Brown-grey; quartz; fine grained with abundant medium to coarse grains, rounded to well rounded, generally clear occasional opaque, high sphericity, poorly sorted; cement slightly calcareous, abundant carbonaceous specks. Good visible porosity.	-	-	-	-
1013.5	2"	Claystone: Brown; has abundant medium to coarse quartz grains, rounded to well rounded; could almost be called a very dirty coarse grained sandstone.	-	-	-	-
1020	2"	Sandstone: Quartz, brown, fine grained, abundant medium grains, clear, rounded fair sorting; very muddy matrix, mica.	-	-	-	-
1026	2"	Siltstone: Quartz, brown, very muddy appearing; abundant mica and carbonaceous material; poor porosity.	-	-	-	-
1050	1-3/4"	Sandstone: Quartz, brown, medium grained, subrounded to rounded; fair sorting, spherical; silty, dirty matrix; may have good porosity.	-	-	-	-
1123	1-3/4"	Siltstone: Same as 1026 m core.	-	-	-	-
1130	1-1/4"	Siltstone: Same as 1026 m core.	-	-	-	-
1135	2"	Siltstone: Same as 1026 m core but with abundant medium grained, clear, subangular quartz; trace magnetite?	-	-	-	-
1150	2"	Siltstone: Same as 1026 m core but with very fine grained quartz, rounded, clear, spherical, scattered through matrix. Occasional shell fragments.	-	-	-	-
1160	2"	Siltstone: Same as core at 1150 m.	-	-	-	-
1180	2"	Siltstone: Same as core at 1150 m.	-	-	-	-
1190	2"	Siltstone: Same as core at 1150 m but with increasing unidentifiable shell fragments.	-	-	-	-
1200	2"	Siltstone: Same as core at 1150 m.	-	-	-	-

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SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 790 m - 1210 m DATE 28/9/82 PAGE 5

SWC ATTEMPTED 51 RECEIVED 33 MISSFIRES 15 NO RECOVERY 3

RUN No. 1 GEOLOGIST B. See

DEPTH in metres	LENGTH REC'VD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
1210	1-1/4"	Sandstone: Quartz, light grey-white, fine grained, rounded to well rounded, spherical, well sorted, friable, abundant glauconite, good visible porosity.	-	-	-	-
854.5	2"	Sandstone: Quartz, brown; very fine grained, subrounded, good sorting, grains clear, non calcareous silty cement, very similar to core at 844 m.	-	-	-	-

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SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 434m - 852m DATE 28/9/82 PAGE 1

SWC ATTEMPTED 20 RECEIVED 20 MISSFIRES 0 NO RECOVERY 0

RUN No. 2 GEOLOGIST M.Whibley/B.See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
434	4.3cm	Marl: Light grey, calcareous, massive consolidated, homogeneous; very fine grained with trace coarser silt sized grains.	-	-	-	-
484	4.3cm	Limestone: Cream, brown, massive, consolidated, homogeneous, soft, microcrystalline.	-	-	-	-
525	4.5cm	Limestone: Cream, brown, grey, massive, homogeneous, granular, moderately soft, consolidated, minor hard limestone streaks throughout.	-	-	-	-
570	5 cm	Limestone: Cream, brown, grey, massive, homogeneous, granular, moderately soft, consolidated as above (525 m).	-	-	-	-
580	4 cm	Limestone: Cream, brown, grey, massive, homogeneous, granular, moderately hard, consolidated with calcite, angular platy, transparent grains, disseminated throughout.	-	-	-	-
625	5.4cm	Limestone: Cream, brown, massive, homogeneous, moderately hard, consolidated with black chert, angular fragments present, minor quantity throughout, very coarse grained.	-	-	-	-
650	3.5cm	Limestone: Cream, brown, massive, homogeneous, moderately hard, consolidated; no quartz grains apparent, as above (525 m).	-	-	-	-
660	5 cm	Limestone: Cream, brown, massive, homogeneous, as above (525 m).	-	-	-	-
675	4.5cm	Limestone: Cream, white, brown, massive, homogeneous, moderately hard, consolidated.	-	-	-	-
725	4.5cm	Limestone: Light white grey, massive homogeneous, hard, consolidated, granular.	-	-	-	-
750	2.3cm	Limestone: Light white grey, massive homogeneous, hard, consolidated grain as above (725 m) with trace fine grained quartz.	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 434m - 852m DATE 28/9/82 PAGE 2

SWC ATTEMPTED 20 RECEIVED 20 MISSFIRES 0 NO RECOVERY 0

RUN No. 2 GEOLOGIST M. Whibley/B. See

DEPTH in metres	LENGTH RECV'D	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
758	2.3cm	Limestone: White, moderately soft to moderately hard, consolidated, massive, homogeneous, with disseminated, argillaceous grains, white calcite.	-	-	-	-
766	4 cm	Limestone: Whtie, moderately soft to moderately hard, consolidated, massive, homogeneous with disseminated coarse grained quartz grains, subrounded to subangular.	-	-	-	-
774	1-3/4"	Limestone: Grey; granular in appearance, soft, abundant glauconite pellets, abundant foram tests.	-	-	-	-
778	2"	Limestone: As in 774 m core.	-	-	-	-
782	2"	Limestone: Brown to dark grey; granular, soft, abundant glauconite both in pellets and shards.	-	-	-	-
786	2"	Limestone: Same as core at 782 but very glauconitic.	-	-	-	-
790	1-3/4"	Mudstone: Yellow; limonitic?; calcareous. Includes from very coarse to granule size (3 mm), well rounded, spherical, quartz and shale. Shale is very hard and breaks with conchoidal fracture. Quartz and shale spheres are very common in the mud matrix, rare mica, gives appearance of subaerial exposure, very different from previous cores. Very calcareous cement.	-	-	-	-
810	1"	Sandstone: Light grey-white, quartz; medium grain with occasional granules larger than 3 mm, granules are well rounded and lack sphericity. Appear almost platy, sand grains are rounded to well rounded, spherical and clear; calcareous matrix; trace carbonaceous material, trace glauconite, good visible porosity.	-	-	-	-
852	5 cm	Sandstone: Dark brown to grey; quartz fine to very fine grained; moderately well sorted; moderate sphericity; argillaceous with very silty matrix; non-calcareous, carbonaceous; no cement.	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 2164m to 2776m DATE 13/10/82 PAGE 1

SWC ATTEMPTED 51 RECEIVED 29 MISSFIRES 19 NO RECOVERY 3

RUN No. 3 GEOLOGIST Sec/Garrity

DEPTH in metres	LENGTH RECV'D cm	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2776	1.5	Sandstone: Light grey to white, quartz, fine grained to very fine grained, glauconite pellets, carbonaceous, well sorted, subangular, friable, clay cement, no calcareous/dolomite cement	-	-	-	-
2772	2.5	Sandstone: Dark grey - light grey, quartz, very fine grained, very carbonaceous glauconitic, moderately good sorting, muscovite, firm-hard, subangular - subrounded, calcareous/dolomitic cement.	-	-	-	-
2753	1.0	Silty Sandstone: Dark grey quartz, very fine grained, very carbonaceous, glauconitic, non-calcareous cement, firm, good sorting of quartz grains, subangular, occasional fine grained light grey to white quartz grains.	-	-	-	-
2738	2.0	Siltstone: Very dark grey - black, very carbonaceous, glauconitic, firm - soft, non-calcareous cement micaceous. Sandstone: White, quartz, very fine grained, well sorted, subangular to subrounded, occurs as thin beds in siltstone, only minor.	-	-	-	-
2702	1.0	Interbedded Siltstone and Sandstone. Siltstone: Dark grey to black, soft - firm, very carbonaceous, subfissile, in part, non-calcareous, contorted bedding in part, 70% of sample. Sandstone: White quartz, very fine grained glauconitic, well sorted, subrounded, non-calcareous, carbonaceous in part, 30% of sample.	-	-	-	-
2670	1.0	Interbedded Siltstone and Sandstone. Siltstone: Dark grey - grey, soft - firm, plastic, very carbonaceous, subfissile in part, 90% of sample. Sandstone: White quartz, very fine grained, very well sorted, subrounded to rounded. Very clean, non-calcareous, non-carbonaceous - 10%.	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 2164m to 2776m DATE 13/10/82 PAGE 2

SWC ATTEMPTED 51 RECEIVED 29 MISSFIRES 19 NO RECOVERY 3

RUN No. 3 GEOLOGIST See/Garrity

DEPTH in metres	LENGTH RECVD cm	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2649	2.0	Sandstone: Dark grey to light grey quartz, fine to medium grained with occasional very coarse grained quartz, very silty, carbonaceous, subangular. Very coarse grained quartz is subrounded to rounded. Friable, calcareous cement, poorly sorted.	-	-	-	-
2633.5	1.5	Siltstone: Black to very dark brown, well sorted, very carbonaceous, sub-fissile, firm - soft, minor calcareous material. No sand size particles.	-	-	-	-
2621.5	0.75	Interbedded Siltstone and Sandstone. Siltstone: Dark grey to black, very carbonaceous, soft, minor calcareous/dolomitic cement, sandy in part.	-	-	-	-
		Sandstone: White quartz, fine grained glauconitic, well sorted, subangular to subrounded, sucrosic texture, minor calcareous/dolomitic cement, silty in part, carbonaceous in part, some mica.	-	-	-	-
2612.5	-	No recovery	-	-	-	-
2590	1.0	Sandstone: Light grey to grey quartz, fine grained, silty, carbonaceous in part, quartz grains well sorted, trace glauconite, subrounded, calcareous/dolomitic cement. ?Tar? Very black, with high lustre. Soft to plastic.	-	-	-	-
2565	1.5	Sandstone: Dark grey to brown quartz, very fine to fine grained, very silty, very carbonaceous, trace glauconite, calcareous cement. Quartz grains moderately well sorted, subangular. ?Tar? Very black, high lustre, soft, no reaction with HCl. Minor interbeds of dark brown siltstone.	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 2164m to 2776m DATE 13/10/82 PAGE 3

SWC ATTEMPTED 51 RECEIVED 29 MISSFIRES 19 NO RECOVERY 3

RUN No. 3 GEOLOGIST See/Garrity

DEPTH in metres	LENGTH RECVD cm	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2534	75 1.5	Sandstone: Dark grey quartz, fine grained, well sorted quartz grains, very carbonaceous, subangular to subrounded, very silty. ?Tar? Common? Minor interbeds of white, fine grained, clean, well sorted quartz sand.	-	-	-	-
2505	2.0	Siltstone: Dark brown, very hard, well sorted, very carbonaceous, subfissile, non-calcareous, well cemented.	-	-	-	-
2489.5	1.5	Sandstone: Dark grey quartz, very fine grained, very silty, very carbonaceous, poor sorting, very hard, non-calcareous cement, abundant clay, well cemented.	-	-	-	-
2475.5	1.2	Siltstone: Dark brown, non-calcareous , homogeneous, occasional white clay - ?kaolinite? trace glauconite, very thin laminations, with very fine white sand, subangular to subrounded, well sorted, high sphericity, trace porosity.	-	-	-	-
2458.5	1.0	Interbedded Siltstone and Sandstone. Siltstone: Dark brown, non-calcareous, trace glauconite, very carbonaceous. Sandstone: White quartz, very fine grained, subangular to subrounded, clear to opaque, well sorted, non-calcareous cement, abundant glauconite, carbonaceous specks throughout, trace mica in sandstone and siltstone. Trace porosity.	-	-	-	-
2433	1.5	Siltstone: Dark brown, non-calcareous, homogeneous in part, trace glauconite; interbedded with sandstone: white, quartz, very fine grained, subangular to subrounded, clear - opaque, well sorted, non-calcareous cement, abundant glauconite, carbonaceous specks throughout, trace mica, carbonaceous streaks throughout, sandstone interbeds 1mm or less. Trace porosity.	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 2164m to 2776m DATE 13/10/82 PAGE 4

SWC ATTEMPTED 51 RECEIVED 29 MISSFIRES 19 NO RECOVERY 3

RUN No. 3 GEOLOGIST See/Garrity

DEPTH in metres	LENGTH RECVD cm	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2418	2.5	Siltstone: Dark brown, non-calcareous, homogeneous, occasional mica - muscovite?, occasional carbonaceous specks; trace porosity.	-	-	-	-
2399	2.5	Siltstone: Dark brown, non-calcareous, homogeneous, mica, carbonaceous specks, rare coarse grained quartz, subrounded, floating in matrix, trace porosity.	-	-	-	-
2381.5	3.0	Siltstone: Dark brown, non-calcareous, occasional mica, with interbedded sandstone: white, quartz, very fine grained, subangular to subrounded. Well sorted, non-calcareous cement, occasional glauconite, carbonaceous specks throughout, bedding seldom exceeds 1mm of sandstone. Poor porosity.	-	-	-	-
2357	3.5	Siltstone: Dark brown, non-calcareous, carbonaceous specks, trace mica. Trace porosity, homogeneous throughout.	-	-	-	-
2345	1.5	Sandstone: White, quartz, very fine grained, subangular to subrounded, well sorted, high sphericity, abundant glauconite, non-calcareous cement, carbonaceous specks and streaks throughout. With minor siltstone interbeds, dark brown, non-calcareous, carbonaceous specks, trace mica, poor porosity.	-	-	-	-
2316	2.0	Sandstone: White, quartz, fine grained, subangular to subrounded, moderately well sorted, calcareous cement, carbonaceous specks throughout, occasional glauconite, with minor siltstone: dark brown, non-calcareous, carbonaceous specks, trace mica, trace - poor porosity.	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 2104m to 2776m DATE 13/10/82 PAGE 5

SWC ATTEMPTED 51 RECEIVED 29 MISSFIRES 19 NO RECOVERY 3

RUN No. 3 GEOLOGIST See/Garrity

DEPTH in metres	LENGTH RECVD cm	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2293	2.0	Siltstone: Dark brown, non-calcareous, carbonaceous specks throughout, trace mica, trace pyrite, homogeneous, very fine sand floating in matrix, plant fragments - spores throughout. On fresh fractures very clay looking; trace porosity.	-	-	-	-
2268.5	3.0	Siltstone: Dark brown, non-calcareous, carbonaceous specks throughout, trace mica, with occasional coarse sand floating in matrix, very fine sand: subangular to subrounded; coarse grained sand; subangular, trace porosity.	-	-	-	-
2260	2.0	Siltstone: Dark brown, minor calcareous cement, very carbonaceous, subfissile, micaceous, firm, well sorted, occasional fine grained sandstone, quartz; no porosity.	-	-	-	-
2235.5	2.0	Interbedded Sandstone and Siltstone. Sandstone: Light grey - white, quartz, fine grained, moderate to well sorted, subangular, non-calcareous, firm, carbonaceous specks, trace glauconite, some clay matrix. Siltstone: Dark grey - black, sandy in part, moderately good sorting, very carbonaceous, minor calcareous/ dolomitic cement.	-	-	-	-
2196	-	No recovery				
2166	-	No recovery				
2164	2.0	Siltstone: Dark grey, well sorted, sandy, very fine grained quartz, very cabonaceous, firm to hard, non-calcareous cement, trace glauconite, very poor porosity.	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 2095m DATE 13/10/82 PAGE 6

SWC ATTEMPTED 51 RECEIVED 29 MISSFIRES 19 NO RECOVERY 3

RUN No. 3 GEOLOGIST Sog/Garrity

DEPTH in metres	LENGTH RECVD cm	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2095	2.5	Interbedded Siltstone and Silty Sandstone. Siltstone: Black, excessive silt, very carbonaceous, non-calcareous, subfissile, very poor porosity. Sandstone: Dark grey - light grey, fine grained with occasional very coarse grain quartz, very well rounded, carbonaceous, firm to hard, moderately well sorted, very coarse grains floating in matrix.	-	-	-	-

[redacted] COMPANY

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 1220 m to 2047.5 m DATE 13/10/82 PAGE 1

SWC ATTEMPTED 30 RECEIVED 26 MISSFIRES 0 NO RECOVERY 4

RUN No. 4 GEOLOGIST Sec/Carrity

DEPTH in metres	LENGTH RECVD cm	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2047.5	2.5	Siltstone: Dark brown, non-calcareous, very fine grained quartz sand dispersed through the matrix, carbonaceous, trace glauconite, trace porosity.	-	-	-	-
1974.5	3.0	Interbedded Silstone and Sandstone. Siltstone: Dark brown, non-calcareous, carbonaceous throughout, trace glauconite. Sandstone: White, quartz, very fine grained, subangular to subrounded, well sorted, high sphericity, non-calcareous cement, carbonaceous, trace glauconite, trace porosity.	-	-	-	-
1908	3.5	Siltstone: Dark brown, non-calcareous, carbonaceous, trace glauconite; minor interbedded Sandstone: white, quartz, very fine grained, subangular to subrounded, well sorted, high sphericity, non-calcareous cement, carbonaceous, trace glauconite, trace porosity.	-	-	-	-
1846.5	3.5	Siltstone: Dark brown, non-calcareous, carbonaceous, trace glauconite; with very fine sand grains, subangular to subrounded, high sphericity throughout the matrix, trace porosity.	-	-	-	-
1838.5	3.5	Sandstone: White, quartz, very fine grained, subangular to subrounded, well sorted, high sphericity, non-calcareous cement, carbonaceous laminations, glauconite, trace mica; with 5mm band of very carbonaceous material through centre of core; coal laminations, black shiny, poor porosity.	-	-	-	-
1796.75	4.5	Claystone: Dark brown, carbonaceous, rare coarse grained quartz floating in matrix, trace glauconite, no visible porosity.	-	-	-	-

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SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 1220 m to 2047.5 m DATE 13/10/82 PAGE 2

SWC ATTEMPTED 30 RECEIVED 26 MISSFIRES 0 NO RECOVERY 4

RUN No. 4 GEOLOGIST See/Garrity

DEPTH in metres	LENGTH RECVD cm	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
1749	3.0	Siltstone: Dark brown to grey, non-calcareous, carbonaceous, trace glauconite; with interbedded Sandstone: very fine grained, subangular to subrounded, non-calcareous cement, carbonaceous specks throughout, glauconite, trace porosity.	-	-	-	-
1719.5	5.0	Siltstone: Grey, homogeneous, non-calcareous, carbonaceous specks throughout, trace glauconite, moderately hard, trace glauconite, trace porosity.	-	-	-	-
1687	5.0	Siltstone: Dark brown, non-calcareous, carbonaceous, trace pyrite, trace mica, moderately hard, trace porosity.	-	-	-	-
1662	-	No recovery	-	-	-	-
1618	4.5	Siltstone: Dark brown, non-calcareous, carbonaceous specks throughout, trace mica, very fine grained sand dispersed throughout, moderately hard, trace porosity.	-	-	-	-
1594.5	5.5	Siltstone: Dark brown, non-calcareous, carbonaceous specks throughout; with interbedded Sandstone: White, quartz, very fine grained, subangular to subrounded, well sorted, high sphericity, non-calcareous cement, carbonaceous specks, trace porosity.	-	-	-	-
1565.5	4.5	Interbedded Siltstone and Sandstone. Siltstone: Dark brown, non-calcareous, very carbonaceous, very pyritic; Sandstone: White, quartz, very fine grained, subangular to subrounded, well sorted, carbonaceous, pyritic, trace porosity.	-	-	-	-
1527.5	5.0	Sandstone: Light grey to white, quartz, very fine grained, sub-angular to subrounded, well sorted, high sphericity, non-calcareous, very silty cement, carbonaceous, fair porosity.	-	-	-	-
1474	-	No recovery	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 1220 m to 2047.5 m DATE 13/10/82 PAGE 3

SWC ATTEMPTED 30 RECEIVED 26 MISSFIRES 0 NO RECOVERY 4

RUN No. 4 GEOLOGIST See/Garrity

DEPTH in metres	LENGTH RECV'D cm	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
1420	75 5.0	Interbedded Sandstone and Siltstone. Sandstone: White, quartz, very fine to fine grained, subangular to subrounded, well sorted, high sphericity, non-calcareous cement, very carbonaceous, trace glauconite. Siltstone: Dark brown, non-calcareous, very carbonaceous to coaly in part, layers of pyrite, trace mica, trace porosity.	-	-	-	-
1400	5 5.0	Siltstone: Dark brown, homogeneous non-calcareous, very carbonaceous with plant fragments, trace porosity.	-	-	-	-
1369	5 5.0	Sandstone: Dark grey, quartz, very fine grained almost silt, subangular to subrounded, well sorted, high sphericity, carbonaceous specks throughout, non-calcareous, silty matrix, fair porosity.	-	-	-	-
1344	5 5.0	Siltstone: Dark brown, non-calcareous, very carbonaceous, trace mica; with interbedded sandstone, white, very fine grained, subangular to subrounded, well sorted, high sphericity, non-calcareous cement, carbonaceous specks, trace porosity.	-	-	-	-
1320	-	No recovery	-	-	-	-
1306	5 4.5	Sandstone: Brown - grey, quartz, very fine grained, subangular to subrounded, well sorted, high sphericity, non-calcareous cement, very silty in part, very carbonaceous, trace mica, trace porosity.	-	-	-	-
1297	5 5.0	Siltstone: Brown, non-calcareous abundant coarse to very coarse, subangular to subrounded, quartz grains floating in matrix, quartz clear to opaque; carbonaceous, trace porosity.	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 1220 m to 2047.5 m DATE 13/10/82 PAGE 4

SWC ATTEMPTED 30 RECEIVED 26 MISSFIRES 0 NO RECOVERY 4

RUN No. 4 GEOLOGIST Soc/Garrity

DEPTH in metres	LENGTH RECVD cm	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
1290	5.0	Sandstone: Brown - grey, quartz, clear to opaque, medium to coarse grained, subangular to subrounded, moderately well sorted, non-calcareous cement, moderate high sphericity; with intermixed minor sandstone, fine grained, brown, well sorted, translucent, good porosity.	-	-	-	-
1283	-	No recovery	-	-	-	-
1279.5	1.5	Siltstone: Dark brown to dark grey, non-calcareous cement, with abundant coarse quartz grains floating in matrix, subangular to subrounded, moderate sphericity, carbonaceous in part, appears to have been weathered in part, trace porosity.	-	-	-	-
1275.5	5.0	Interbedded Siltstone and Sandstone. Siltstone: Dark brown, non-calcareous. Sandstone: White, quartz, sub-angular to subrounded, very fine grained, well sorted, high sphericity, non-calcareous cement, carbonaceous specks, trace porosity.	-	-	-	-
1270.5	5.5	Interbedded Siltstone and Sandstone. Siltstone: Dark brown, non-calcareous. Sandstone: White, quartz, sub-angular to subrounded, very fine grained, well sorted, high sphericity, non-calcareous cement, carbonaceous specks; burrow filled with white clay 90° to siltstone bedding, trace porosity.	-	-	-	-
1240	1.5	Silstone: Dark brown, homogeneous, carbonaceous specks throughout, occasional round fine grained quartz floating in matrix, poorly preserved shell fragments. Bivalves? Trace porosity.	-	-	-	-
1230	5.0	Sandstone: Grey, quartz, very fine to fine grained, subangular to sub-rounded, well sorted, high sphericity, occasional coarse to very coarse, round to well rounded quartz grains, occasional carbonaceous specks, good porosity.	-	-	-	-

SIDEWALL CORE DESCRIPTION

WELL DISCOVERY BAY-1 INTERVAL 1220 m to 2047.5 m DATE 13/10/82 PAGE 5

SWC ATTEMPTED 30 RECEIVED 26 MISSFIRES 0 NO RECOVERY 4

RUN No. 4 GEOLOGIST Sue/Garrity

DEPTH in metres	LENGTH RECVD cm	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
1220	5.0	Sandstone: Light grey, quartz, very fine to fine grained, subangular to subrounded, well sorted, high sphericity, non-calcareous cement, abundant carbonaceous specks, good porosity.	-	-	-	-

APPENDIX NO.5

PETROGRAPHIC DESCRIPTIONS

APPENDIX NO.6

MICROPALEONTOLOGICAL REPORT

PETROLOGY AND DIAGENESIS OF DISCOVERY BAY NO. 1 SAMPLES, OTWAY BASIN

BY

LINDSAY B. COLLINS

REPORT TO PHILLIPS AUSTRALIAN OIL COMPANY

MARCH, 1983.

CONTENTS

INTRODUCTION

Samples from five sidewall cores (SWC) from the Discovery Bay No. 1 well were examined by petrography, SEM, and X-ray diffraction analysis, as follows:

DISCOVERY BAY NO. 1

SWC # 10 , 1050 m (petrography only)

SWC # 63 , 1220 m (petrography only)

SWC # 56 , 1290 m

SWC # 38 , 1838.5 m

SWC # 24 , 2316 m

Splits of sidewall cores were plastic impregnated and thin sectioned for petrographic study. The silt-clay fraction was separated from three samples and analysed by X-ray diffraction to determine mineralogy. Coated samples were examined by SEM. Results are described in this report.

PETROGRAPHY

Sample:

Discovery Bay - 1, SWC # 10 , 1050 m.

Hand Specimen:

Dusky yellowish brown (10 YR 2/2) friable, silty fine-medium sand; detrital grains subrounded.

Log:

Dilwyn Formation (Upper Palaeocene-Lower-Middle Eocene); 787-1232 m; sandstone (338 m) overlying shale (75 m); SWC from within sandstone sequence which contains minor coal.

Thin Section:

Abstract: Predominantly medium-fine sand with voids filled by very fine sand, silt, clay and organic matter; contains brown 2.5 mm thick siltstone laminae overlain by 1 mm thick, organic-rich fine sand laminae.

Texture: Coarser grains (0.5-0.75 mm) are subrounded; fine particles (< 0.25 mm) are subangular to angular; grain contacts are generally tangential. Voids are filled with fine sand, silt, clay, and brown organic matter. Angular, 0.1 mm quartz grains "float" within siltstone laminae. Laminae of very fine sand with matrix-filled voids overlie siltstone laminae. The sediment is texturally immature.

Mineralogy:

Quartz, monocrystalline grains	70%
Quartz, polycrystalline	5%
Feldspar	10%
Quartzite	trace
Matrix: clays and organic matter	15%
Cement: calcite crystals in matrix fraction	trace

Siltstone laminae are composed predominantly of silt-size detritus, organic matter, and calcite cement.

Interpretation:

Source area: Monocrystalline quartz grains are probably from a sedimentary source; the small amounts of quartzite present were derived from a metamorphic source.

Depositional basin: Textural immaturity, abundant matrix and organics, and rapid grain size variations between laminae suggest an environment of low energy, undirectional traction currents, such that traction and suspended load were deposited. No marine indicator minerals or biotic constituents are present. Deposition within a low energy, delta plain environment is suggested.

Diagenesis: Diagenetic effects are minor. Small (10 μm) crystals of calcite have been sporadically precipitated within the matrix fraction of the sand laminae. Similar calcite crystals are abundant within siltstone laminae.

Sample:

Discovery Bay - 1, SWC # 63 , 1220 m.

Hand Specimen:

Very light grey (N8), friable moderately well sorted fine sand, with rare mica flakes and medium sand size quartz grains.

Log:

Dilwyn Formation (Upper Palaeocene-Lower-Middle Eocene); 787-1232 m; from 30 m thick basal sandstone with minor coal, carbonaceous partings and glauconite; overlies Pember Mudstone.

Thin Section:

Abstract: Subrounded to subangular fine quartz sand with common medium sand grains and minor matrix.

Texture: Sunrounded to subangular fine sand, (diameter 0.125-0.25 mm) and medium subrounded sand (diameter 0.5 mm) are in grain support; grain contacts are point to long. Matrix is lacking, and primary voids are generally empty.

Mineralogy:

Quartz, monocrystalline	98%
Chert	trace
Micas	trace
Feldspar	trace
Amphibole	trace
Zircon	trace
Matrix	2%

Interpretation:

Source area: Quartz-dominated rocks were the major source material. The presence of amphibole suggests little chemical weathering in the source area, and relatively short term transport.

Depositional basin: Lack of significant matrix and moderate sorting suggests moderate energy traction currents were active. Carbonaceous partings, glauconite and coal are recorded from logs but are not present in the side-wall core material. Delta front or shoreface sand are probable depositional facies.

Diagenesis: Diagenetic changes are minor. Compaction has caused warping of mica laminae during reorientation of the quartz grain frame. Most voids are empty, but a few are filled by diagenetic clay minerals with a platy habit.

Sample:

Discovery Bay - 1, SWC # 56 , 1290 m.

Hand Specimen:

Yellowish grey to light olive grey (5 Y 7/2 - 5 Y 5/2) friable, poorly sorted subangular medium to coarse sand; contains granules and pebbles 5 - 10 mm diameter, and minor silt-size detritus.

Log:

Curdies Formation (Upper Cretaceous), from 10 m below an unconformity at 1280 m; interbedded sandstone and siltstone with carbonaceous partings and pyrite, from 10 m thick sandstone interval.

Thin Section:

Abstract: Poorly sorted, pebbly sandstone, with matrix - filled voids. Matrix contains organic matter and minor calcite cement.

Texture: Subangular to subrounded quartz and minor feldspar grains, poorly sorted, 0.5-2 mm diameter (occasionally up to 5 mm) with tangential grain contacts. Finer (0.25-0.5 mm) sand size quartz grains partly fill the coarser grain framework. Intergranular voids are filled by silt-size angular quartz, detrital clays and organic matter; equant calcite crystals are common in the organic fraction of the matrix. Glauconite is present but rare in the matrix fraction.

Mineralogy:

Quartz, 0.5-2 mm (rarely 5 mm)	75%
Feldspar, 0.5-1 mm (rarely 5 mm) untwinned	10%
Clays, unindentified (matrix)	10%
Organic matter (matrix fraction)	3%
Calcite spar (within matrix)	2%
Glauconite	trace

Interpretation:

Source area: Quartz (mainly monocrystalline) and feldspar of variable sand to granule size were derived from the felsic terrain; feldspar weathering is minor.

Depositional basin: The abundance of poorly sorted sand to granule size quartz and feldspar, deposited with interstitial detrital clays and organics, suggests traction currents of moderate but variable and periodically low energy. The codeposition of matrix organics and very poorly sorted sand, and presence of glauconite suggest that the sediment may have been deposited by grainflow from a delta front environment (Reading, 1978, Fig. 12.53).

Diagenesis: Minor development of equant calcite crystals (up to 10 μm diameter) has occurred within the matrix.

Sample:

Discovery Bay - 1, SWC # 38 , 1838.5 m.

Hand Specimen:

Very light grey - dary grey (N8 - N3), friable, laminated, carbonaceous shale. Carbonaceous laminae are thin (0.2 mm) or are up to 5 mm thick.

Log:

Paaratte Formation (Upper Cretaceous); 1550 m+; sandstone and siltstone with marl, coal and pyrite; sandstone from within 12 m sandstone section which contains minor coal, carbonaceous partings and pyrite; overlain and underlain by siltstone.

Thin Section:

Abstract: Alternating cm-scale clastic and carbonaceous laminae comprise the rock. Clastic laminae are composed of alternating 2 mm thick laminae of quartz (0.05-0.1 mm) and 0.05 mm carbonaceous laminae.

Texture: Clastic laminae are composed predominantly of subangular quartz (also micas, organics, clays) of 0.05-0.1 mm diameter; particles are in grain support, and grain contacts are long; intergranular void space has been destroyed. Organic matter and platy micas, generally 0.05-0.1 mm diameter, are dispersed throughout the quartz grain frame. Diagenetic clay minerals occlude some primary voids.

Carbonaceous laminae have well developed partings, and are composed of dark brown-black coalified organic material; detrital quartz (0.1 mm diameter) and micas are concentrated along partings.

Mineralogy:

Coalified organic matter	30%
Detrital quartz (0.05-0.1 mm diameter)	55%
Micas	10%
Diagenetic clays	5%
Feldspar, amphibole	trace

Interpretation:

Source area: Rare amphiboles may represent an igneous or metamorphic source for detritus; also a lack of source rock chemical weathering, and relatively short term transport. Quartz and micas are possibly from an acid igneous or sedimentary source.

Depositional basin: Deposition took place in a non-marine environment characterised by low energy traction currents and abundant organic matter. Periods of clastic influx (very fine sand deposition) alternated with periods of organic sedimentation to generate the lamination described. A delta plain swamp or marsh environment is suggested.

Diagenesis: Significant post-depositional burial would have been required to generate coalified organic residue, and to develop long grain contacts between quartz grains. Diagenetic clays (? chlorite) were precipitated in remnant void spaces.

Sample:

Discovery Bay - 1, Core # 24 , 2316 m.

Hand Specimen:

Very light grey (N8), friable, clayey fine sand; poorly sorted.

Log:

Paaratte Formation (Upper Cretaceous) 1550+ m; sandstone and siltstone with marl, pyrite and coal; sample from within 6 m thick sandstone interval containing pyrite, marl and coal.

Thin Section:

Abstract: A laminated, organic-rich siltstone with abundant calcite cementation.

Texture: Angular, silt-size quartz grains (0.02 mm) and silt size organic matter set in a matrix of sub-silt-size organic matter. Lamination is due to oriented, elongate mica, quartz and organic matter. Sand size (0.25 mm) quartz grains are scattered throughout the siltstone.

Mineralogy:

Quartz, silt size, angular	50%
Mica, silt size	10%
Organic matter, predominantly silt size	40%

Interpretation:

Source area: Silt-size monocrystalline quartz and muscovite, also clays, plus one lithoclast of calcite-cemented silty sandstone were shed from the source area.

Depositional basin: Low velocity traction and suspension currents deposited the silt size detritus and organic matter which forms the bulk of the rock. Variations in grain size, shape, orientation and organic content between laminae, on a mm scale, reflect subtle variations in the depositing currents. No biotic constituents or lebensspuren are present. Deposition in a low energy, organic-rich, delta plain environment is suggested.

Diagenesis: Calcite spar crystals 10-30 μm diameter have developed throughout the rock. Small spar crystals (diameter = 4 μm) are abundant within organic matter and matrix.

X-RAY DIFFRACTION ANALYSIS

SWC # 56 , 1290 m (Curdies Formation):

Both quartz and kaolinite are common in the silt/clay fraction. Illite and a montmorillonite group clay are present but less common.

SWC # 38 , 1838.5 m (Paaratte Formation):

Quartz, kaolinite and illite are common in the silt/clay fraction. Dolomite is present in trace amounts.

SWC # 24 , 2316 m (Paaratte Formation):

Illite, kaolinite and quartz are all common in the silt/clay fraction.

Primary detrital matrix is abundant in all three samples above and the minerals identified probably comprise this matrix. The Curdies Formation (SWC # 56) is distinguished by kaolinite and minor montmorillonite-type clay, whereas the Paaratte Formation (SWC # 38; 24) has both kaolinite and illite in the matrix fraction.

SEM STUDIES

Discovery Bay - 1, SWC # 56 , 1290 m; 0002; (Fig. 1):

Poorly sorted subangular sand of the Curdies Formation is shown in Fig. 1. The smaller quartz grains (upper part of field) have overgrowths of diagenetic clays of irregular habit.

Discovery Bay - 1, SWC # 38 , 1838.5 m; 0003; (Fig. 2):

Laminated carbonaceous shale of the Paaratte Formation is shown in Fig. 2. Blocky carbonaceous laminae with subvertical orientation are present in the central part of the field of view. Fine grained detrital laminae are composed of silt-size quartz, and detrital clays and organic material.

Discovery Bay - 1, SWC # 24 , 2316 m; 0004; 0005; (Figs. 3-4):

Laminated, organic-rich siltstone of the Paaratte Formation is shown in Fig. 3. Intergranular void space (lower and left part of field of view, Fig. 3) is filled by matrix, detrital clays and calcite cement. Crystals of calcite cement of diameter commonly less than 10 μm are shown in Fig. 4. These are developed throughout the organic-rich matrix fraction.

Fig. 1. Electron micrograph, Discovery Bay - 1, SWC # 56 , 1290 m.

Fig. 2. Electron micrograph, Discovery Bay - 1, SWC # 38 , 1838.5 m.

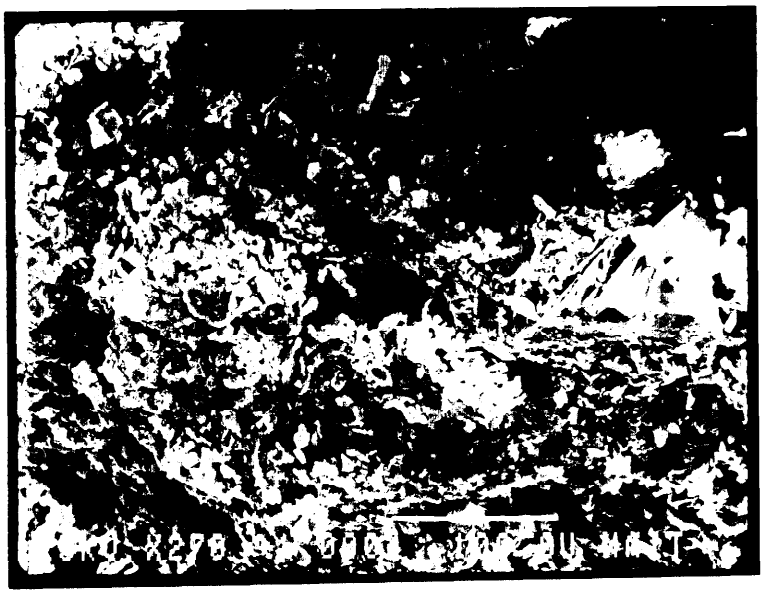

Fig. 3. Electron micrograph, Discovery Bay - 1, SWC # 24 , 2316 m.

Fig. 4. Electron micrograph, Discovery Bay - 1, SWC # 24 , 2316 m; central portion of Fig. 3.

CONCLUSIONS

The Discovery Bay - 1 well was drilled in the Voluta Trough of the Otway Basin. Upper Cretaceous clastic sediments were deposited in an intracratonic basin with a maximum thickness of 6000 m approximately; increased movement along down-to-basin faults along the north-east flank of the basin, combined with tilting, gave a marginal basin in Tertiary time, which has a section composed of prograding sedimentary wedges (Denham and Brown, 1976). The sidewall cores studied from the Dilwyn, Curdies and Paaratte Formations, are described within their stratigraphic setting. Stratigraphic terminology used is that adopted by Denham and Brown (1976).

DILWYN FORMATION

Description:

The Dilwyn Formation (Upper Palaeocene - Lower-Middle Eocene) is part of the Wangerrip Group, a sand - shale sequence. The type section, described from outcrop, consists of carbonaceous sandy clay and silt which is burrowed, micaceous and pyritic; with interbedded fossiliferous and glauconitic units. The sequence becomes less clayey, coarser grained and more carbonaceous upwards in the subsurface in several wells (Abele et al., 1976). In Discovery Bay - 1, the Dilwyn Formation, intersected from 787-1232 m, consists of sandstone and minor siltstone which contains coal and marl (338 m), overlying shale with minor sandstone and coal (75 m), and sandstone with coal, glauconite and carbonaceous partings (32 m). The basal sand section conformably overlies the Pember Mudstone, composed of interbedded siltstone and sandstone.

SWC # 10 , 1050 m:

Lithology: This core, located within the 338 m thick sandstone and coal section at the top of the Dilwyn Formation, consists of friable, subrounded silty fine-medium sand which contains siltstone laminae. Primary detrital matrix and organic matter are common.

Diagenesis: Diagenetic effects are minor; small (10 μm diameter) crystals of calcite have been precipitated sporadically within the organic-rich matrix fraction of sand and silt laminae, probably during burial diagenesis.

Depositional Environment: Textural immaturity, abundant matrix, organics and poor sorting, millimetre scale sand-silt lamination, together with the stratigraphic setting (sand section with abundant coal) suggest a delta plain environment.

SWC # 63 , 1220 m:

Lithology: This core, located within the basal 32 m sand section which contains glauconite and carbonaceous partings, consists of moderately well sorted, micaceous fine quartz sand with a low matrix content.

Diagenesis: The minor diagenetic effects present are warping of mica flakes during reorientation of the grain frame, and small amounts of diagenetic clays precipitated within some voids.

Depositional Environment: Lack of significant matrix and moderate sorting suggest that traction currents of moderate energy were active during deposition. The presence of glauconite in the well log suggests marine conditions; delta front, shoreface or above wave-base shelf are probable depositional environments.

CURDIES AND PAARATTE FORMATIONS

Description:

The Curdies and Paaratte Formations are the uppermost formations of the Sherbrook Group (Upper Cretaceous) which overlies the Otway Group (Lower Cretaceous). An Upper Cretaceous unconformity is developed at the top of the Curdies Formation, and sometimes cuts the underlying Paaratte Formation;

these two formations have been considered seismically as one unit. The Sherbrook Group has a thickness of about 5000 m in the Voluta Trough. Upper Cretaceous deposition probably occurred along an open southern margin to the basin in relatively shallow water when a narrow gulf, subject to marine incursions, may have been present between the Antarctic and Australian continents (Denham and Brown, 1976; Figs. 14C, 15C).

In the Discovery Bay - 1 well the Curdies Formation consists of a 265 m thick section of sandstone and interbedded siltstone in which coal and carbonaceous partings and pyrite are common. The Paaratte Formation, present below 1545 m, consists of a thick sequence of sandstone and interbedded siltstone with coal, carbonaceous partings, marl, pyrite, and 1 m thick sandy limestone and dolomite units.

SWC # 56 , 1290 m; Curdies Formation:

Lithology: This core, located 10 m below an unconformity at 1280 m at the top of the formation, is from within a 10 m thick sandstone (and minor interbedded siltstone) interval; the siltstone contains carbonaceous partings and pyrite. The core consists of poorly sorted, friable pebbly sand with matrix - filled voids and minor glauconite.

Diagenesis: Diagenetic effects are restricted to minor development of equant calcite crystals within the matrix fraction.

Depositional Environment: High matrix content, extremely poor sorting and the presence of glauconite suggest that the sand may have been supplied by grain flow from a delta front, to be deposited on the adjacent low energy shelf.

SWC # 38 , 1838.5 m; Paaratte Formation:

Lithology: This core, from within a 15 m thick sand section, consists of friable, laminated carbonaceous shale and sand.

Diagenesis: The coalified organic matter present in carbonaceous laminae, long grain contacts and destruction of primary void space in quartz-rich laminae, and development of diagenetic clays have occurred during post-burial compaction and diagenesis.

Depositional Environment: A non-marine environment, with low energy traction currents and organic sedimentation alternating with clastic influx was required to generate the fine-scale lamination and organic matter present; thus a delta plain swamp or marsh environment is suggested.

SWC # 24 , 2316 m; Paaratte Formation:

Lithology: This core, from within a 6 m thick sand section containing coal, carbonaceous partings and pyrite, consists of laminated clayey fine sand and calcite-cemented carbonaceous siltstone.

Diagenesis: Calcite cementation, probably developed during burial diagenesis, is present throughout the rock, as 10-30 μm crystals in siltstone laminae, and as smaller (4 μm) crystals within organic matter and matrix in sandy laminae.

Depositional Environment: Low velocity traction and suspension currents deposited the sand and silt-size detritus and organic matter which forms the bulk of the rock. The sand section and interbedded carbonaceous siltstone were probably deposited in a delta plain environment.

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FORAMINIFERAL SEQUENCE

in

DISCOVERY BAY # 1.

for:- PHILLIPS AUSTRALIAN OIL COMPANY

November 17th, 1982.

DAVID TAYLOR,
23 Ballast Point Road, BIRCHGROVE, 2041.
AUSTRALIA. *(02) 82.5643.*

CONTENTS

SUMMARY.

The Phillips Australia Otway Basin Well, DISCOVERY BAY # 1 can be divided into four broad units on microfaunal and residue grain evidence.

UNIT 4 - 795m to 434m - MID EOCENE, OLIGOCENE and PLIOCENE marine sediments. The late Eocene/early Oligocene and the entire Miocene periods were not represented in the sedimentary sequence.

UNIT 3 - 1013.5m to 1594m - BARREN INTERVAL (No foraminifera found). Grain analysis suggests marginal marine, lagoona/ deltaic complex shoreward of barrier/dune system.

UNIT 2 - 1618m to 2399.5m - LATE CRETACEOUS marginal marine; salt marsh/pro-delta environments.

UNIT 1 - 2458.5m to 2772m - BARREN INTERVAL (No foraminifera found). Marginal marine deltaic complex.

Arrangement of Report.

Units 1 and 2 are discussed on pages 3 to 4, and pertinent results shown on Table 1 at back of report.

Unit 3 - briefly discussed on page 4 with grain analysis summarised on Table 2 (2 sheets) at back of report.

Unit 4 - Described with biostratigraphic correlations and environmental interpretations on pages 5 to 9, with summary on page 5. Planktonic foraminiferal distribution is given on Table 3, with significant benthonic foraminifera and other grains present tabulated on Table 4. Reliability of zonal determinations given on the Data Sheet - Table 5.

UNIT 1 - 2458.5 to 2772m - probably CRETACEOUS.

Represented in sidewall cores by carbonaceous and clayey, fine, angular quartz sandstone. No foraminifera were found in this sediment, although it was lithologically similar to the fossiliferous, late Cretaceous sediment at and above 2399.5m. This unit was probably deposited in a deltaic/marginal marine environment, in water less saline (<5°/oo) than those present in Unit 2, above 2400m.

UNIT 2 - 1618m to 2399.5 - LATE CRETACEOUS.

This unit can be divided on both lithological and faunal grounds into two formations:-

1618-1846.5m = CURDIES FORMATION
E-Log change at ?1851m?
1974-2399.5m = PAARATE FORMATION

The interval between 1974 and 2399.5m contains a heterogeneous admixture of sandstone types (refer Table 1) with carbonaceous material in some samples. The foraminifera are all arenaceous benthonic forms, typical of the late Cretaceous Paarate Formation (Taylor, 1964). On biofacies evidence, the interval is equated with that between 1590 and 2165m in Voluta # 1 (S.D.A., 1967). Absence of any calcareous foraminifera as well as the heterogenity of sediment types precludes any correlation of this interval with the Belfast Mudstone.

The Paarate Formation was deposited in salt marsh and/or lagoonal environments, with salinities less than that of normal seawater (= 35°/oo), though in all the waters were polyhaline with seasonal fluctuations as in the modern Gippsland Lakes (Apthorpe, 1980). Note is made of presence of the thick shelled pelecypod (mollusca) *Inoceramus* at 2047.5m in Discovery Bay # 1. Sporadic occurrences of *Inoceramus* have been reported within the Paarate Formation in a number of drilled sequences. The existence of this molluscan type, plus the complete dominance of arenaceous foraminifera indicates that the sediment/water interface was deplete in oxygen; that is anaerobic.

The interval between 1618 and 1846.5m contains a suite of arenaceous foraminifera dominated by the arenaceous benthonic foraminifera *Haplophragmoides* spp. The morphometric nature of these forms would suggest that they were early Tertiary rather than late Cretaceous (refer Taylor, 1965). However, a similar

association was described from Voluta # 1 between 1412 and 1551m; an interval considered as being late Cretaceous on palynological evidence (S.D.A. 1967). The sedimentary sequence was fairly homogenous, being predominantly a quartz sandy siltstone. In most samples, very little residue (>.075mm) remained after processing. In the sample at 1687m, only 50 grains were in the residue and of these, 48 were arenaceous foraminifera.

The interval is regarded as representing the Curdies Formation, deposited in the margins of a deltaic fan. Water salinity and oxygenation were similar to these deduced for the Paarate Formation interval.

UNIT 3 - 1013.5m to 1594.5m.

An interval barren of fauna. Although the sedimentary sequence is heterogenous, a broad subdivision can be made of presence or absence of carbonaceous material and/or pitted and impact fractured quartz grains (refer Table 2).

1013.5m to 1400.5m - high percentages of pitted and impact fractured quartz grains.

1426.75 - oxidized pyritic/limonitic clayey, quartz sandstone with high percentage of pitted quartz.

1525 to 1594.5 - carbonaceous, silty fine quartz sandstone with varying percentages of pyrite.

No statement can be made regarding age or other correlations, because of absence of foraminifera. However, all samples contained pitted and/or impact fractured quartz grains, suggesting aeolian transport mechanisms, with the possibility that the depositional area was lagoonal; enclosed on the shoreward side of a barrier/dune system.

UNIT 4 - 434m to 795m - MID EOCENE to PLIOCENE SEQUENCE.

The tabulation below summarises the biostratigraphy and paleoenvironment from nineteen sidewall cores. The interval was divisible into three discrete biostratigraphic units with an unconformity bounding the top and bottom of the middle unit. Cutting samples were examined at 5 metre intervals between 650 and 680 metres.

Sidewall Cores depth (m)	Approx. E-Log Pick	AGE*	ZONE*	PALEOENVIRONMENT¶	LITHO-UNIT
434 to 660		LATE to MID PLIOCENE	A-3 to A-4	Canyon fill or outer shelf fan (<200m)	WHALERS BLUFF FORMATION equivalent
	664				
675 to 758		LATE OLIGOCENE	I-1 to I-2	MID SHELF (<100m)	Chert horizon in cuttings between 665 & 675. GAMBIER LIMESTONE
	765				
766 to 786		EARLY OLIGOCENE	J-1	INNER SHELF (<40m)	CLIFTON FORMATION
	788				
790 to 795		MID EOCENE		INNER SHELF (<40m)	NIRANDA GROUP equivalent
	795				

*Biostratigraphy is based on Taylor (in prep.); see also comments on next page regarding correlations. Planktonic foraminiferal distribution for Discovery Bay # 1 is presented on Table 3 of this report with reliability of zonal determinations on the Data Sheet - Table 5.

¶Interpretation based on distribution of selected benthonic foraminiferal species and other sediment grains (<.075mm) as shown on Table 4 (Paleo-depth estimates are in parentheses).

MIDDLE EOCENE, Inner Shelf Carbonate; interval from 795m to 790m.

The planktonic foraminifera associations were typical of those representing the upper part of the Middle Eocene westward from Portland along the southern Australian Margin. Similar faunas were listed by McGowran (1973) from bores onshore, in the Gambier Embayment of the Otway Basin. This assemblage, here designated as Zone N, can be correlated on a worldwide basis with Blow Zone Pl4 (refer also McGowran, 1973).

The benthonic foraminiferal faunas are dominated by *Cibicides* spp. Group 1 (including *C. perforatus* and *C. brevoralis*) with *Elphidium* sp. and *Notorotalia* in a muddy bryozoal calcarenite, indicating medium energy conditions on an inner continental shelf sea floor with water depths in the vicinity of 40 metres. Sediments containing the same planktonic association in the Gambier Embayment were non calcareous, with carbonaceous material, suggesting a shallower, more shoreward position than in Discovery Bay # 1. For these reasons, the term Niranda Group is applied rather than the Gambier Embayment term Lacepede Formation (refer McGowran, 1973).

Both the Discovery Bay # 1 and Gambier Embayment mid Eocene sediments contain evidence of open marine influence with planktonic foraminifera being present, but east of the Gambier Embayment, no open marine mid Eocene has been reported (Taylor, 1971). This west to east trend from marine to marginal marine, was no doubt related to the opening of the Southern Ocean (Deighton et al, 1976).

A HIATUS from mid Eocene into the early Oligocene is apparent from the foraminiferal associations between 790m and 786m, with a period of some 5 to 7 million years not represented by sediment. Late Eocene, open marine carbonates were absent from the sequence, although they were present both to the west (McGowran, 1973) and in the east (Taylor, 1971). It is assumed that structural growth and/or regional uplift of the "Portland/Dartmoor High" prevented late Eocene deposition or removed it from the Discovery Bay # 1 sequence.

EARLY OLIGOCENE - inner shelf detritus; interval 786m to 766m.

The basal Oligocene, J-2 association with *Globigerina brevis* and *Globorotalia gemma* was not found in this sequence. The planktonic

association at 782m represented the Zone J-1 assemblage which was present up to 766m, which contains the highest appearance of *Globigerina angiporoides angiporoides*. This biostratigraphic event correlates with the Blow Zones P20/P21 of the pan tropical belt.
The lowest sample of this unit, at 786m was unfossiliferous, however the sedimentary grain characters are typical of the basal unit of the heterogeneous, detritus rich, Clifton Formation. As elsewhere in the Otway Basin, the Clifton Formation lithological and paleontological sequence in Discovery Bay represents the record of the Early Oligocene transgression onto an exposed shelf platform with water depth increasing from intertidal at 786m to around 40 metres at 766m.

LATE OLIGOCENE - mid shelf bryozoal calcarenite; interval 758m to 665m.

The litho and biofacies of this sedimentary interval is characteristic of the Gambier Limestone. Biostratigraphically, the top of the interval approximates the top of Blow Zone N3, at around 25 million years ago, although in the type area the Gambier Limestone deposition continued to the base of the Miocene at 22.5 million years (refer McGowran, 1973).

A HIATUS from late Oligocene to mid Pliocene is apparent from the dramatic change in planktonic foraminiferal associations between sidewall core at 675m (= Late Oligocene) and that at 660m (= Mid Pliocene). Examination of ditch cuttings revealed the existence of considerable chert in the interval between 665m and 680m; with the highest appearance of Oligocene planktonic foraminifera in the interval 665m to 670m. Abundance of chert is a feature of the upper part of the Gambier Limestone (McGowran, l.c., p.45). This chert horizon no doubt arrested post-Oligocene erosion of the Limestone unit, as well as providing a prominent seismic reflector.

The Oligocene/Pliocene unconformity is placed at 665m on microfossil and lithological changes in the ditch cutting sequence, which corresponds with an E-log character change at 664m. A time span of some 20 million years is estimated for the period *not represented* by sediment in Discovery Bay. Such a span includes the entire Miocene; yet most of the Miocene is represented by sediment onshore at Portland (Singleton et al, 1976) with at least the early Miocene (22.5 to 17.5 m.y.) being present in Voluta # 1 (S.D.A., 1967).

MID to LATE PLIOCENE - turbo-carbonate wedge; interval 434m to 665m.

This is a sedimentary interval of polymodal, biogenic carbonates with sporadic concentrations of quartz grains. The basal sidewall core at 660m contains remainié grains; both chert from the underlying Gambier Limestone, as well as quartz from another source. Table 3 demonstrates the Oligocene to Pliocene abrupt faunal change, although recycled Oligo/ Miocene planktonic species were present in the basal samples. The sidewall core at 650m contains a typical mid Pliocene Zone A-4 fauna which can be correlated with Blow Zone N19, as well as with planktonic foraminiferal species listed by Mallett (in Singleton et al, 1976) from Whalers Bluff, onshore at Portland. The highest sidewall core (at 434m) examined was no younger than late Pliocene, thus the Discovery Bay # 1 sampled interval of Pliocene corresponds with the 2 million year time span allotted to the onshore Whalers Bluff Formation by Singleton et al (l.c.) in their interpretation of radiometric dating and planktonic foraminiferal biostratigraphy. Base of the Pliocene in both sections approximates 4.5 m.y.

Comparison between the Whalers Bluff Pliocene and that in Discovery Bay # 1 illustrates thickening seaward, with an increase in accumulation rate by some 30 times.

	Whalers Bluff	Discovery Bay # 1
Paleowater Depth	<20m	100m to 200m
Sedimentary time span	2×10^6	2×10^6
Thickness (not compensated for compaction)	8m	+231m
Accumulation rate per 1000 years	4 millimetres	12 centimetres

The characteristics of this biogenic carbonate suggests transport was by gravity flow, at first along the compact surface of the chert enriched Gambier Limestone. The Pliocene sediments could be described as limestone *turbidites* or *"turbo-carbonates"*. There are close

similarities between the Discovery Bay Pliocene turbo-carbonates and the mid Miocene canyon fill carbonates of the Gippsland Basin. Furthermore, seismic surveys showed a thick, late Tertiary canyon fill deposit offshore from Portland (Hopkins, 1966). However, recent seismic extrapolation suggests that this thick Pliocene sequence in Discovery Bay # 1 was part of a widespread fan shaped, wedge of sediment rather than fill restricted within a deeply incised canyon. A single vertical sample sequence does not permit any comment regarding the geometric form of the sediment packet; however, the high accumulation rate denotes amazingly high biological productivity. This conclusion, together with high plankton percentages and other grain characters indicates that nutrient enriched, deep oceanic waters, upwelled onto the continental shelf; a phonomena explained by Diester-Haas (1978). Submarine canyons act as pathways for such upwellings. Therefore, adjacent canyons may have generated this prolific organic growth, thus indirectly contributing to this rapid and massive accumulation of biogenic carbonates.

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AGE	Depth of lowest sample	ENVIRONMENT and LITHOLOGICAL CORRELATION	E-LOG CHARACTER CHANGE	RESIDUE LITHOLOGY: MINOR COMPONENTS (pyrite spheres (? biogenic) glauconite pellets; pyrite; mica; limonite staining; c ang rock frags.; c-m ang-subrd qtz.)	RESIDUE LITHOLOGY: MAJOR COMPONENTS (f = foraminifera; q = f ang qtz silty sdst.; Q = f-c ang subrd qtz.; c.sdst. = carbonaceous clayey f. qtz. sandstone)	ARENACEOUS BENTHONIC FORAMINIFERA & MOLLUSCA (*Haplo. sp. A.*; *Haplo. sp. B.*; *Haplo. sp. C.*; *Ammobac. goodlandensis*; *A. subcretacea*; *A. cf. fragmentaria*; *Hyperammina elongata*; *Trochammina cf. bubinflata*; *INOCERAMUS* moulds; *INOCERAMUS* prisms; *Haplo. pauperata*; *Haplo. complanata*; *Haplo. rotundata*; *Bathysiphon spp.*)	SIDEWALL CORE Depth in metres
? — ?	? — ?	? — ?	?				
		Delta fan CURDIES FORMATION		A A A	QQQ qqqqqqqqqqqqq	°	←1618
				A A	fffffffffffffff	° ° ° x °	←1687
				A A	qqqqqqqqqqqqqqq	°	←1719
				A	qqqqq fffffffffff	° ? °	←1796.75
	1846.5		?1851?	A	qqqqq fffffffffff	° ° ° x °	←1846.5
LATE CRETACEOUS		Salt Marsh/ lagoonal PAARATE FORMATION			c.sdst c.sdst	N.F.F.	←1974.5
				A	QQ c.sdst c.sdst	x ° ° ° °	←2047.5
					QQ c.sdst c.sdst	N.F.F.	←2097
				A	qqqqqqqqqqqqqqq	° °	←2164
					qqqqqqqqqqqqqqq	° °	←2260
				A A A	QQQQQQQQQQQQQQQ	° °	←2268.5
				A	c.sdst c.sdst	° °	←2293
					c.sdst c.sdst	x ° °	←2357
				A	c.sdst c.sdst	x	←2381.5
? — ?	2399.5	? — ?	?2400?	A	c.sdst c.sdst	° ° ° ° °	←2399.5
				A	c.sdst c.sdst	N.F.F.	←2458.5
				r	c.sdst c.sdst	N.F.F.	←2633.5
				A A A	c.sdst c.sdst	N.F.F.	←2772

A = abundant 1-5% total grains
r = rare

KEY: ° = <20 specimens
x = >20 specimens
N.F.F.= no foraminifera found

TABLE 1: LATE CRETACEOUS FORAMINIFERA, MOLLUSCA & RESIDUE LITHOLOGY - DISCOVERY BAY # 1.
David Taylor, November 9, 1982.

TABLE 2 - Sheet 1 of 2.

DISCOVERY BAY # 1

UNIT 3 - Interval 1013.5 to 1594.5 metres

Residue grain analysis of samples devoid of foraminifera.

DEPTH	*SAMPLE TYPE*	*ZONE & AGE*	*LITHO. INFORMATION*
1013.5	SWC	? N.F.F.	40% f ang qtz 40$ m-c ang subrd qtz 20% py siltst matrix
1020	SWC	? N.F.F.	60% f ang qtz 30% m-c ang subrd qtz rock frags. pitted
1026	SWC	? N.F.F.	70% f. ang qtz 20% m-c ang subrd qtz rock frags. pitted
1123	SWC	? N.F.F.	f ang qtz, pitted A rock frags.
1130	SWC	? N.F.F.	50% f ang qtz 40% m-c ang subrd qtz A py, A rock frags. pitted
1135	SWC	? N.F.F.	50% f ang qtz 30% m-c ang subrd qtz 10% py siltst rock frags - A py spheres pitted
1150	SWC	? N.F.F.	70% f ang qtz) 30% c ang qtz) pitted py rock frags glauc.
1160	SWC	? N.F.F.	70% f ang-subrd qtz, pitted 30% biogenic pyr. Moll. frags. V. small res.
1180	SWC	? N.F.F.	90% ang-subang f qtz, pitted 10% f rock frags moll.
1190	SWC	? N.F.F.	f ang qtz, pitted r py shell frags, rock frags Mollusca. VERY SMALL RES.
1200	SWC	? N.F.F.	f-m ang subrd qtz, pitted & 10% glauc clay + rock frags Mollusca frag.
1210	SWC	? N.F.F.	95% f ang qtz sd, pitted c glauc py rock frags Note Macro descrip A-glauc
1270.5	SWC	? N.F.F.	80% g-m ang-subrd qtz - pitted 20% clay & gy siltst matrix.
1275.5	SWC	? N.F.F.	80% f ang qtz 20% m ang-subrd qtz. & rock frags. pitted
1400.5	SWC	? N.F.F.	90% f-c ang-subrd qtz - pitted 10% py. siltst.

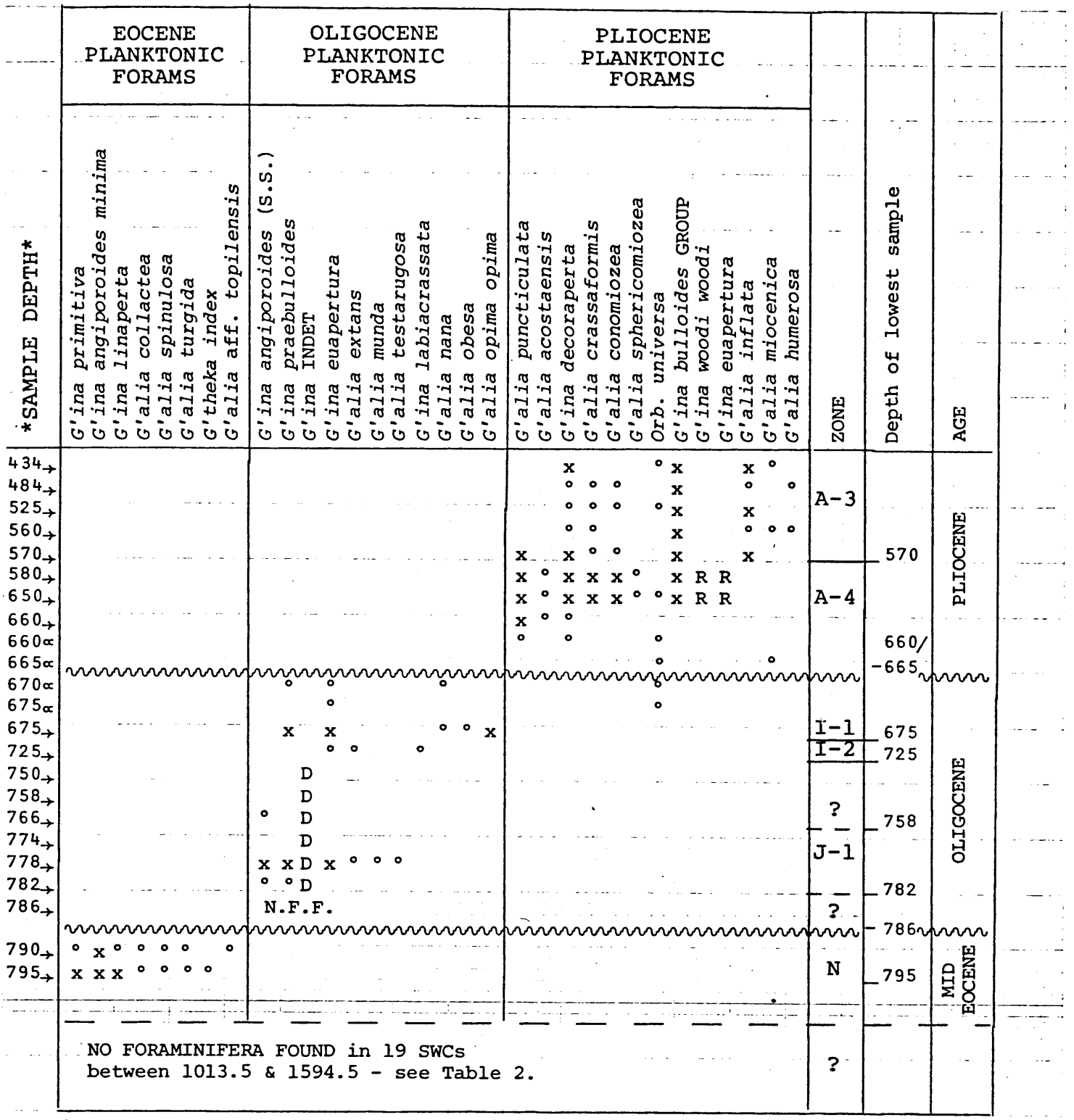
TABLE 2 - Sheet 2 of 2.

DISCOVERY BAY # 1.

UNIT 3 - INTERVAL 1013.5 to 1594 metres

Residue grain analysis of samples devoid of foraminifera.

DEPTH	*SAMPLE TYPE*	*ZONE & AGE*	*LITHO.INFORMATION*
1426.75	SWC	? N.F.F.	70% f-m ang-subrd qtz - pitted 20% orange limonitic clayey f-m ang. qtz. sdst. 10% py. A-carbonaceous matter.
1525	SWC	? N.F.F.	80% silty carbonaceous f ang qtz sdst. 20% py.
1562	SWC	? N.F.F.	as for 1525.
1594.5	SWC	? N.F.F.	as for 1525 & 1562.



→ = sidewall cores ∝ = cutting samples

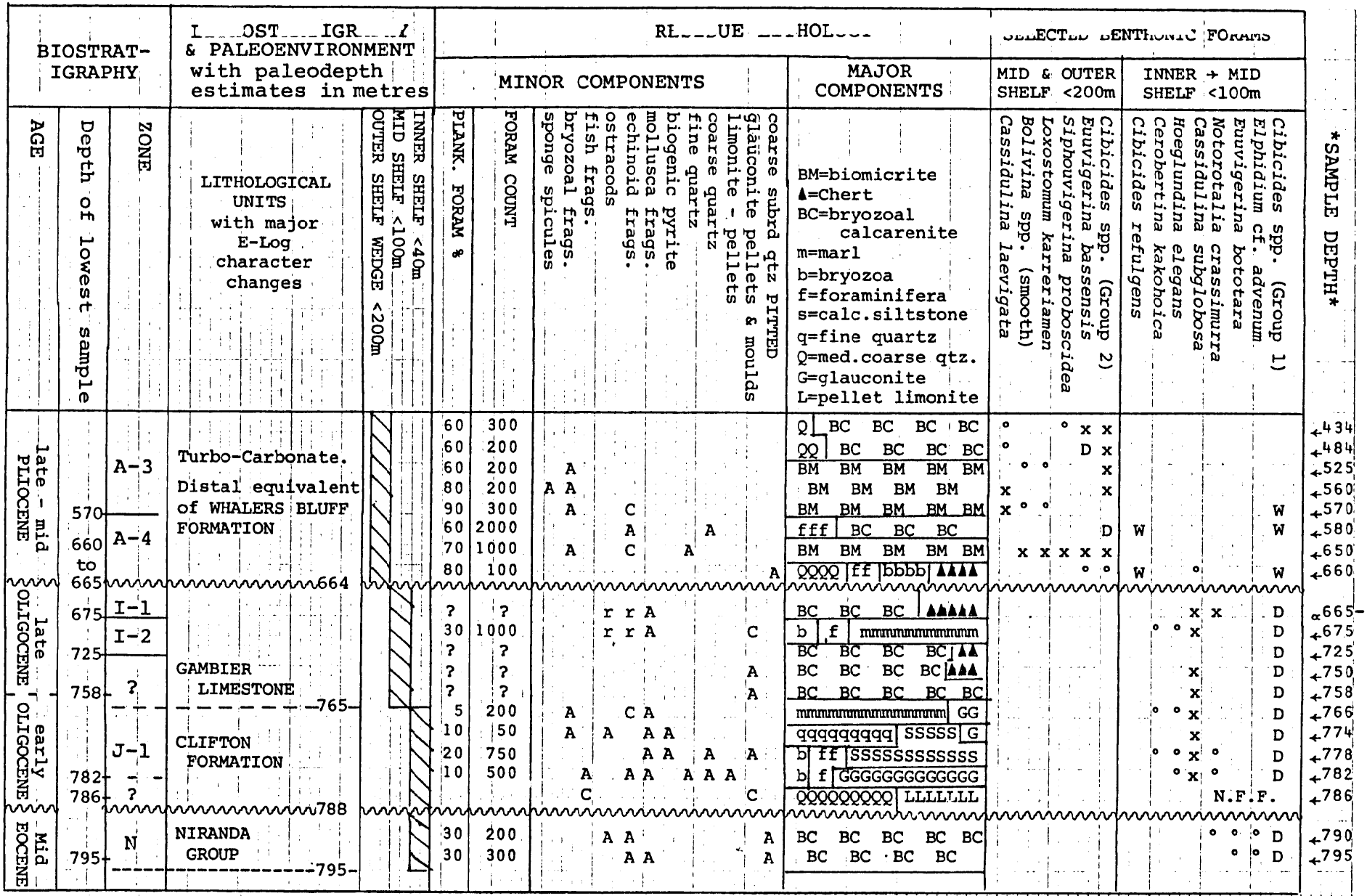
Key: ° = <20 specimens
x = >20 specimens
D = >60% specimens
R = recycled Oliog/Miocene species
N.F.F.= no foraminifera found

Form generic abbreviations

G'ina = Globigerina
G'alia = Globorotalia
G'theka = Globigerinatheka
Orb = Orbulina

TABLE 3: TERTIARY PLANKTONIC FORAMINIFERAL DISTRIBUTION - DISCOVERY BAY # 1.

David Taylor, November 9, 1982.



→ = sidewall core; ∝ = cutting samples

A = abundant 1-5% total grains
C = common <20 grains
r = rare

KEY: ° = <20 specimens
x = >20 specimens
D = >60% specimens
W = worn specimens

TABLE 4: TERTIARY BENTHONIC FORAMINIFERA & RESIDUE LITHOLOGY - DISCOVERY BAY # 1; 795 to 434 metres.

David Taylor, November 9, 1982.

TABLE 5.

M I C R O P A L E O N T O L O G I C A L D A T A S H E E T

B A S I N: OTWAY ELEVATION: KB: 23.0m GL: -96.0m

WELL NAME: DISCOVERY BAY # 1 TOTAL DEPTH: 2777m

AGE		FORAM. ZONULES	HIGHEST DATA					LOWEST DATA				
			Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time	Preferred Depth	Rtg	Alternate Depth	Rtg	Two Way Time
PLEISTOCENE		A_1										
		A_2										
PLIOCENE		A_3	434	1				570	1			
		A_4	580	0				665	3	650	0	
MIOCENE	LATE	B_1										
		B_2										
		C										
	MIDDLE	D_1										
		D_2										
		E_1										
		E_2										
	EARLY	F										
		G										
		H_1										
OLIGOCENE	LATE	H_2										
		I_1	665	3	675	1		775	1			
		I_2	725	1				725	1			
	EARLY	J_1	766	2	778	0		782	2	778	0	
		J_2										
EOCENE		K										
		Pre-K *	790*	0				795*	0			

COMMENTS: *The Pre-K Unit was ZONULE N representing the top of the mid Eocene.

No foraminifera were found in 19 SWCs examined between 1013.5 & 1594.5m.

Late Cretaceous arenaceous benthonic foraminiferal assemblages in SWCs between 1618 and 2399.5m assigned lowest confidence rating re. age, but high confidence re local correlation to Voluta # 1.

CONFIDENCE RATING:

- 0: SWC or Core - Complete assemblage (very high confidence).
- 1: SWC or Core - Almost complete assemblage (high confidence).
- 2: SWC or Core - Close to zonule change but able to interpret (low confidence).
- 3: Cuttings - Complete assemblage (low confidence).
- 4: Cuttings - Incomplete assemblage, next to uninterpretable or SWC with depth suspicion (very low confidence).

NOTE: If an entry is given a 3 or 4 confidence rating, an alternative depth with a better confidence rating should be entered, if possible. If a sample cannot be assigned to one particular zone, then no entry should be made, unless a range of zones is given where the highest possible limit will appear in one zone and the lowest possible limit in another.

DATA RECORDED BY: David Taylor DATE: November 16, 1982.

DATA REVISED BY: _____ DATE: _____

APPENDIX NO.7

PALYNOLOGICAL REPORT

DISCOVERY BAY NO. 1 WELL

OTWAY BASIN

Palynological Examination and Kerogen Typing of Sidewall Cores

by

W.K. Harris

PALYNOLOGICAL REPORT

Client : Phillips Australian Oil Company

Study : Discovery Bay No. 1 Well, Otway Basin

Aims : Determination of age and distribution of kerogen types

SUMMARY

Palynological analysis of seventy five sidewall cores from Discovery Bay No. 1 Well provide the basis for the following subdivisions:

Spore/pollen Zones

Nothofagidites asperus - 774-880m
Malvacipollis diversus - 885-1275.5m
Tricolporites lilliei - 1279.5-1838.5m
Nothofagidites senectus - 1846.5-2590m
Tricolpites pachyexinus - 2621.5-2776m

Dinoflagellate Zones

Spiniferites Assemblage - 774-786m
Apectodinium Assemblage - 891-1275.5m
Isabelidinium pellucidum - 1279.25-1719.5m
Xenikoon australis - 1749-2260m
Nelsoniella aceras - 2268.5-2738m
Isabelidinium cretaceum - 2753-2776m

A major hiatus is present between the Cretaceous and Tertiary sediments and another smaller break occurs in the early to middle Eocene.

Most of the sediments were deposited in near shore or marginal marine environments.

Kerogen analysis of the samples indicates immaturity for the entire section.

INTRODUCTION

Seventy five sidewall cores from Discovery Bay No. 1 Well drilled in the Otway Basin at Lat. 38°24'43"S, Long. 141°04'21"E in Vic. P-14 were processed by normal palynological procedures.

The basis for the biostratigraphy and consequent age determinations are based on Stover & Partridge (1973) and Partridge (1976) for the Tertiary sediments; and principally on Dettmann (1963), Dettmann & Playford (1969), with the modifications of Dettmann & Douglas (1976) and Burger (1973), for the Cretaceous sequence.

TABLE 1

DISCOVERY BAY NO. 1 WELL

SUMMARY OF PALYNOLOGICAL DATA

DEPTH	SWC NO.	PRESERVATION	DIVERSITY	SPORE POLLEN ZONE	DINOFLAGELLATES ZONE	CONFIDENCE LEVEL	ENVIRONMENT
774	41	good	low	N. asperus	Spiniferites	4	Nearshore marine
778	40	fair	low	N. asperus	Spiniferites	4	Nearshore marine
782	39	good	low	N. asperus	Spiniferites	4	Nearshore marine
786	38	good	low	N. asperus	Spiniferites	4	Nearshore marine
790	37	good	moderate	N. asperus	Spiniferites	5	Nearshore marine
854.5	26	good	moderate	N. asperus	indeterminate	5	Marginal marine
860	21	good	moderate	N. asperus	-	5	Non marine
855	20	good	moderate	M. diversus	? Apectodinium	5	Marginal marine
891	19	good	moderate	M. diversus	? Apectodinium	5	Marginal marine
906	18	good	moderate	M. diversus	? Apectodinium	5	Marginal marine
920	16	good	moderate	M. diversus	? Apectodinium	5	Marginal marine
928	15	good	moderate	M. diversus	? Apectodinium	5	Marginal marine
1013.5	13	good	moderate	M. diversus	? Apectodinium	5	Marginal marine
1026	11	good	moderate	M. diversus	? Apectodinium	5	Marginal marine
1123	9	good	moderate	M. diversus	Apectodinium	5	Marginal marine
1130	8	good	low	M. diversus	Apectodinium	4	Marginal marine
1135	7	good	moderate	M. diversus	-	5	Non marine
1150	6	good	moderate	M. diversus	-	5	Non marine
1160	5	good	moderate	M. diversus	Apectodinium	5	Marginal marine
1180	4	good	low	M. diversus	Apectodinium	4	Marginal marine
1190	3	good	moderate	M. diversus	Apectodinium	5	Marginal marine
1200	2	fair	moderate	M. diversus	Apectodinium	5	Marginal marine
1220	63	good	moderate	M. diversus	Apectodinium	5	Marginal marine
1230	62	good	moderate	M. diversus	Apectodinium	5	Marginal marine
1240	61	good	moderate	M. diversus	Apectodinium	5	Marginal marine
1270.5	60	good	moderate	M. diversus	Apectodinium	5	Marginal marine
1275.5	59	good	moderate	M. diversus	Apectodinium	5	Marginal marine
1279.5	38	fair	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1297.5	55	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1306.5	54	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1344.5	52	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1369.5	51	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1400.5	50	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1426.75	49	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1525	47	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1562	46	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1594.5	45	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1618	44	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1687	42	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1719.5	41	good	moderate	T. lilliei	I. pellucidum	5	Marginal marine
1749	40	good	moderate	T. lilliei	X. australis	5	Marginal marine
1796.75	39	fair	moderate	T. lilliei	X. australis	5	Marginal marine
1838.5	38	good	moderate	T. lilliei	-	5	Non-marine
1846.5	37	-	moderate	N. senectus	-	5	Non-marine
1908	36	fair	moderate	N. senectus	-	5	Non-marine
1974.5	35	-	moderate	N. senectus	X. australis	5	Marginal marine
2047.5	34	-	moderate	N. senectus	X. australis	5	Marginal marine

TABLE 1 (cont)

DEPTH	SWC NO.	PRESERVATION	DIVERSITY	SPORE POLLEN ZONE	DINOFLAGELLATES ZONE	CONFIDENCE LEVEL	ENVIRONMENT
2095	33	fair	moderate	N. senectus	X. australis	5	Marginal marine
2164	31	fair	moderate	N. senectus	X. australis	5	Marginal marine
2235.5	28	fair	moderate	N. senectus	X. australis	5	Marginal marine
2260	27	fair	moderate	N. senectus	X. australis	5	Marginal marine
2268.5	26	fair	moderate	N. senectus	N. aceras	5	Marginal marine
2293	25	fair	moderate	N. senectus	N. aceras	5	Marginal marine
2345	23	fair	moderate	N. senectus	N. aceras	5	Marginal marine
2357	22	fair	moderate	N. senectus	N. aceras	5	Marginal marine
2381.5	21	fair	moderate	N. senectus	N. aceras	5	Marginal marine
2399	20	fair	moderate	N. senectus	N. aceras	5	Marginal marine
2418	19	fair	moderate	N. senectus	N. aceras	5	Marginal marine
2433	18	fair	moderate	N. senectus	N. aceras	5	Marginal marine
2485.5	17	poor	moderate	N. senectus	N. aceras	5	Marginal marine
2474.5	16	fair	moderate	N. senectus	N. aceras	5	Marginal marine
2489.5	15	fair	moderate	N. senectus	N. aceras	5	Marginal marine
2505	14	fair	moderate	N. senectus	N. aceras	5	Marginal marine
2534.75	13	fair	low	N. senectus	N. aceras	4	Marginal marine
2565	12	good	moderate	N. senectus	N. aceras	5	Marginal marine
2590	11	poor	moderate	N. senectus	N. aceras	5	Marginal marine
2621.5	9	poor	moderate	T. pachyexinus	N. aceras	5	Marginal marine
2633.5	8	poor	moderate	T. pachyexinus	N. aceras	5	Marginal marine
2649	7	good	moderate	T. pachyexinus	N. aceras	5	Marginal marine
2670	6	good	moderate	T. pachyexinus	N. aceras	5	Marginal marine
2702	5	poor	low	T. pachyexinus	N. aceras	4	Marginal marine
2738	4	poor	moderate	T. pachyexinus	N. aceras	5	Marginal marine
2753	3	poor	moderate	T. pachyexinus	I. cretaceum	5	Marginal marine
2772	2	good	moderate	T. pachyexinus	I. cretaceum	5	Marginal marine
2776	1	good	moderate	T. pachyexinus	I. cretaceum	5	Marginal marine

Confidence Levels:

1. cuttings sample, low diversity ± contaminants
2. cuttings sample, good assemblage
3. core or sidewall core, low diversity ± contaminants
4. core or sidewall core, low diversity
5. core of sidewall core, good assemblage

OBSERVATIONS AND INTERPRETATION

A. Biostratigraphy

Table I summarises the biostratigraphy and age determinations for the samples studied. Tables II to IV indicate the distribution of species identified in the Late Cretaceous and Tertiary sequences.

Preservation of the assemblages ranged from poor to good with a general improvement up sequence. All samples yielded identifiable microfossils and only few were of low diversity.

1. Late Cretaceous Spore/Pollen Zones

a. Tricolpites pachyexinus Zone: 2621.5 - 2776m

This zone is identified at T.D. by the presence of the nominate species, together with Proteacidites amolosexinus and P. scaboratus. Common species include Phimopollenites pannosus, Stereisporites viriosus and Amosopollis cruciformis.

All samples from this unit yielded marine dinoflagellates and their presence in low frequencies in a dominantly terrestrially derived assemblage indicates deposition in a marginal marine environment. The age of this zone is Coniacian to Santonian.

b. Nothofagidites senectus Zone: 1846.5 - 2590m

The initial appearance of N. senectus marks the base of this zone at 1846.5m. Stover & Partridge (1973) list several other species: viz. Gambierina rudata Tricolpites gillii and T. sabulosus in this zone in the Gippsland Basin. However in this sequence these species appear much higher in the sequence and are therefore not reliable indicators of the base of the zone. These authors also list P. amolosexinus as a species first appearing in this zone but as noted in 1(a) this species apparently occurs earlier in this Otway Basin section.

Marine dinoflagellates are persistent throughout this zone except at 1846.5 and 1908m. They indicate deposition in a marginal marine environment. The top two samples are essentially non-marine.

The age of the N. senectus Zone is largely Campanian.

c. Tricolporites lilliei Zone: 1279.5 - 1838.5m

In the Gippsland Basin the base of this zone is marked by the initial appearance of the following species:

Gephyrapollonites wahooensis
* Latroposporites amplus
* L. ohaiensis
Lygistepollenites balmei
Nothofagidites endurus
* Ornamentifera sentosa

Proteacidites palisadus
* P. scaboratus
* Tricolpites confessus
T. lilliei
Triporopollenites sectilis

The species marked * have a demonstrably longer range in this Otway Basin sequence and are therefore not reliable indicators of the base of this zone. Proteacidites palisadus has not been recognised in this section. In this well the first appearance of L. balmei and N. endurus is taken as the base of the zone. These species are then succeeded up section by G. wahooensis at 1719.5m, T. sectilis at 1618m, T. lilliei at 1562m.

The top sample in this zone contains a mixed Late Cretaceous and Early Tertiary assemblage but the latter are very rare. This can be explained by stratigraphic leakage at the unconformity surface at the top of the Late Cretaceous section. "Leaked" species are:

Haloragacidites harrisii
Nothofagidites flemingii
Sparganiaceaepollenites sp.
Herkosporites elliottii

Dinoflagellates throughout this zone, except in the bottom sample, indicate deposition in a marginal marine environment. The age of the zone is Maastrichtian.

2. Late Cretaceous Dinoflagellate Zones

The zonation adopted here is based on Evans (1966, 1971) and as adopted by Dettmann & Playford (1969).

a. Isabelidinium cretaceum Zone: 2753-2776m

This zone is defined by the first appearance of the nominate species and extends upwards to the first appearance of N. aceras. Other species which are prominent in this zone include Isabelidinium belfastensis, Hexagonifera vermiculata and Gillinia hymenophora. The age of this zone is Coniacian.

b. Nelsoniella aceras Zone: 2268.5-2738m

The base of this zone is defined by the first appearance of the nominate species and its top by the first appearance of Xenikoon australis.

However in this well there are two distinct zone where X. australis is present. The lowest is between 2663.5-2670m within the T. pachyexinus Zone and the younger assemblage begins at 2260m. Therefore, the top of the N. aceras zone as used in this report is taken at the base of the upper X. australis occurrence where it is associated with Nelsoniella tuberculata. Thus the N. aceras zone as used here includes some occurrences of X. australis. There appears to be nothing

in the samples to indicate contamination and sidewall cores in this interval had very good recoveries.

The age of this zone is Campanian-Maastrichtian.

c. Xenikoon australis Zone: 1749-2260m

The definition of the base of this zone has been discussed in the foregoing section. Its top is marked by the first appearance of Isabelidinium pellucidum. Nelsoniella tuberculata and Spiniferites crassipellis are characteristic species in this zone.

d. Isabelidinium pellucidum Zone: 1279.25-1719.5m

The base of this zone is marked by the initial appearance of the nominate species. In the Otway Basin the top of the zone remains undefined. Species which may have stratigraphic significance towards the top of the zone include Alterbia cf. A. acuminata and A. acutula.

3. Early Tertiary Spore/pollen Zones

The zonal scheme adopted in this report is that used in the Gippsland Basin (Stover & Partridge 1973). An alternative scheme was proposed by Harris (1971) and a comparison of the two is presented in the following table.

TABLE VI

Comparison between Early Tertiary Spore/pollen Zones
Gippsland and Otway Basins

GIPPSLAND BASIN	OTWAY BASIN
Upper Nothofagidites asperus	Sparganiaceaepollenites barungensis
Middle Nothofagidites asperus	Triorites magnificus
Lower Nothofagidites asperus	Proteacidites pachypolus
Proteacidites asperopolus	Proteacidites confragosus
Upper Malvacipollis diversus Lower Malvacipollis diversus	Cupanieidites orthoteichus
Lygistepollenites balmei	Gambierina edwardsii

a. Malvacipollis diversus Zone: 885 - 1275.5m

The base of this zone in this well is marked by the first appearance of the nominate species together with Cupanieidites orthoteichus, Dryptopollenites semilunatus and a diverse suite of Proteacidites spp. The present of D. semilunatus and Periporopollenite demarcatus would suggest that the Upper M. diversus Zone is represented. The assemblages contain a low diversity of dinoflagellates indicating deposition in a marginal marine environment. The age is Early Eocene.

b. Nothofagites asperus Zone: 774 - 880m

The base of this zone is placed at the first appearance of Nothofagidites falcatus and is succeeded in the next sample by N. asperus. The assemblages are not very diverse but are probably equivalent to the Middle N. asperus sub-zone. Dinoflagellates are prominent except in the lowest two samples and indicate deposition in a near-shore marine environment. The sequence is transgressive and is of Middle to Late Eocene age.

4. Early Tertiary Dinoflagellate Zones

There are no formal zonal schemes described from the Otway Basin and those proposed by Partridge (1976) for the Gippsland Basin are not readily identified on the data given in that paper. In addition there are problems of provincialism between the two regions. Thus two informal assemblages are recognised here.

a. Apectodinium Assemblage: 891 - 1275.5m

This assemblage is characterised by the presence of Apectodinium homomorphum, Deflandroea flounderensis, Kenleyia lophophora Deflandrea pachyceros and Muratodinium fimbriatum. Higher in the section Cassidium fragile and Rottnestia borusicca appear.

b. Spiniferites Assemblage: 774 - 786m

Species characteristic of this assemblage are Alisocysta ornata, Dyphes airiensis, Emmetrocysta urnaformis, Schemetophora speciosus, Systematophora placacantha and Deflandrea heterophlycta.

A higher subdivision of the assemblage is marked by the appearance of Dapsilidinium pseudocolligierum, Hystrichokopolma poculum and Pentadinium laticinctum. These species would suggest, in comparison with assemblages elsewhere in South Australia, that the age of these samples is latest Eocene.

TABLE II

DISCOVERY BAY NO. 1 WELL
DISTRIBUTION OF SPORES AND POLLEN

Spore/Pollen — Depth in metres	2776	2772	2753	2738	2702	2670	2649	2633.5	2621.5	2590	2565	2534.75	2505	2489.5	2474.5	2458.5	2433	2418	2399	2381.5	2357	2345	2293	2268.5	2260	2235.5	2164	2095	2047.5	1974.5	1908	1846.5	1838.5	1796.75	1749	1719.5	1687	1618	1594.5	1562	1525	1426.75	1400.5	1369.5	1344.5	1306.5	1297.25	1279.5
Appendicisporites distocarinatus	X																																															
Australopollis obscurus	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X				X				X										X
Baculatisporites comaumensis	X	X	X		X	X	X			X	X		X	X		X			X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X		X	X	X	
Latrobosporites amplus	X	X	X	X	X	X	X	X		X	X	X	X	X				X			X	X				X		X			X	X		X	X	X	X		X	X	X	X	X		X		X	X
Camerozonosporites sp.	X									X	X		X							X	X										X	X						X	X				X			X	X	
Ceratosporites equalis	X	X	X	X	X		X			X	X	X	X	X	X			X	X			X			X	X		X				X		X		X	X	X	X	X	X		X		X		X	
Cicatricosisporites australiensis	X	X		X			X				X	X	X	X					X	X	X											X	X	X	X	X	X						X					
Clavifera triplex	X	X	X	X		X	X	X		X	X	X	X	X				X	X	X	X	X	X		X	X	X	X				X		X		X	X	X				X	X		X	X	X	
Clavatipollenites hughesi cf.	X																																														
Cyathidites australis	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
Leptolepidites major	X	X																																													
L. verrucatus	X				X															X			X	X																							
Lycopodiumsporites spp.	X	X	X		X	X	X				X		X	X	X				X		X	X	X	X	X	X			X	X	X			X		X	X	X	X	X	X	X	X		X		X	
Microcachryidites antarcticus	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X		X	X			X			X		X	X	X	X	X	X				X	X
Myrtaceidites sp.	X		X																																												
Phimipollenites pannosus	X	X	X	X	X		X	X	X	X	X								X	X	X	X	X			X		X					X	X										X				X
Phylocladidites mawsonii	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X			X	X	X		X		X
P. paleogenicus	X	X																																													
Podocarpidites sp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Podosporites sp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Proteacidites amolosexinus	X					X	X	X	X	X	X		X	X				X	X	X	X	X	X	X	X	X	X		X	X							X		X	X	X	X						X
P. scaboratus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			X	X		X	X	X				X		X
Tricolpites pachyexinus	X			X				X		X	X		X			X										X	X								X	X		X									
Balmeisporites holodictyus	X																																														
Amosopollis cruciformis		X	X				X		X				X	X				X																													
Callialasporites dampieri		X	X																																												
Dictyophyllidites sp.		X										X																																			
Falcisporites grandis		X	X	X			X			X					X								X		X		X			X	X	X		X	X	X		X	X			X	X			X		X
Gleicheniidites sp.		X	X	X	X	X	X	X	X	X	X			X		X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X									
Polyodiisporites sp.		X	X				X		X																																						
Stereisporites antiquasporites		X	X	X		X	X	X		X		X							X	X	X					X				X	X	X				X	X	X	X	X	X	X				X		X
S. variosus		X			X	X	X				X	X	X	X			X	X	X	X	X	X	X		X	X	X					X		X		X						X						X
Tricolpites sp.		X				X												X							X								X	X													
Densosporites velatus			X																							X												X									
Vitreisporites pallidus			X											X																																	
Camerozonosporites bullatus				X						X																		X										X									
Cicatricosisporites cuneiformis				X									X																				X	X				X	X								
Corollina sp.				X		X							X	X	X																																
Ischyosporites punctatus				X																										X																		X
Kraeuselisporites papillatus				X	X																X													X				X		X	X				X			X
Kuylisporites lunaris						X																																									
Lycopodiacidites asperatus						X																																									
Simplicepollis sp.						X																							X																		
Tricolpites gillii aff.						X			X	X									X	X								X	X			X		X	X	X		X		X	X				X		X	
Aequitriradites spinulosus							X	X																																							
Dictyotosporites complex							X																													X												
Klukisporites sp.							X																																								
Neoraistrickia truncata							X	X			X																																				

Depth in metres	Reticulatisporites pudens	Velosporites triquetrus	Latrobosporites ohaiensis	Cicatricosisporites sp.	Contignisporites sp.	Nothofagidites senectus	Triorites minor	Crybelosporites striatus	Laevigatosporites major	Laevigatosporites ovatus	Ornamentifera sentosa	aff. Ilexipollenites sp.	Ephedripites sp.	Perotriletes jubatus	Kraeuselisporites sp.	Proteacidites spp.	Pilosisporites sp.	Cyathidites aff. splendens	Tricolpites sp. aff. longus	Lygistepollenites florinii
1279.5			x			x			x	x						x		x	x	
1297.25																x			x	
1306.5			x															x	x	
1344.5			x						x							x			x	x
1369.5			x						x							x		x		
1400.5			x						x							x			x	x
1426.75			x													x				
1525			x													x			x	x
1562			x													x			x	x
1594.5												x				x				x
1618			x			x			x							x			x	x
1687			x			x				x						x			x	x
1719.5			x			x			x		x					x			x	x
1749			x			x					x					x				
1796.75			x			x				x	x					x		x	x	x
1838.5			x			x										x				x
1846.5			x			x	x		x							x		x		x
1908			x			x			x							x				
1974.5			x			x			x							x		x		
2047.5			x			x														
2095			x			x										x				
2164			x			x										x				x
2235.5			x								x							x		x
2260			x							x						x				
2268.5			x				x									x				
2293				x							x					x		x		
2345										x									x	x
2357			x									x				x			x	
2381.5										x						x		x		
2399										x	x	x			x		x			
2418			x									x								
2433										x		x								
2458.5																x				
2474.5							x			x		x			x					
2489.5			x			x						x	x	x						x
2505	x		x							x	x	x								
2534.75			x						x											x
2565						x		x	x											
2590			x	x	x	x	x													
2621.5			x																	
2633.5																				
2649	x	x																		
2670																x				
2702																				
2738																				
2753																				
2772																				
2776																				

Depth in metres	Falcisporites similis	Tricolpites pachyexinus cf.	Araucariacites australis	Lycopodiumsporites circolumenus	Tricolpites sabulosus	Cingutriletes clavus	Kraeuselisporites majus	Proteacidites parvus	Tricolpites cf. confessus	Rousseisporites reticulatus	aff. Balmeisporites sp.	Ericipites sp.	Proteacidites aff. similis	Lygistepollenites balmei	Nothofagidites endurus	Matonisporites sp.	Cyclosporites hughesi	Gambierina rudata	Gephyrapollenites wahooensis	Liliacidites sp.
1279.5								x						x	x			x		
1297.25								x						x	x			x	x	
1306.5								x							x			x		
1344.5								x						x	x			x		
1369.5															x			x		
1400.5								x	x									x		
1426.75	x								x						x			x		
1525					x				x				x		x			x		
1562					x				x				x		x			x		
1594.5	x		x					x						x	x			x		
1618	x								x					x	x			x		
1687					x				x					x	x			x	x	x
1719.5									x						x		x	x	x	x
1749	x				x		x	x	x					x	x	x				
1796.75	x				x		x		x			x		x	x					
1838.5					x								x							
1846.5	x				x		x				x	x								
1908					x				x	x										
1974.5					x															
2047.5					x		x		x											
2095	x				x	x	x	x												
2164					x															
2235.5					x															
2260			x	x	x															
2268.5	x	x																		
2293																				
2345																				
2357																				
2381.5																				
2399																				
2418																				
2433																				
2458.5																				
2474.5																				
2489.5																				
2505																				
2534.75																				
2565																				
2590																				
2621.5																				
2633.5																				
2649																				
2670																				
2702																				
2738																				
2753																				
2772																				
2776																				

Depth in metres	Triporopollenites spp.	Gambierina edwardsii	Stereisporites regium	Proteacidites aff. incurvatus	Proteacidites cf. fromensis	Ephedripites notensis	Ilexpollenites anguloclavatus	Latrobosporites crassus cf.	Nothofagidites emarcidus	Phylocladidites verrucosus	Proteacidites kopiensis	Proteacidites aff. leightonii	Triporopollenites sectilis	Tricolpites ieuros	Gleicheniidites circinidites	Simplicepollis meridianus	Tricolpites lilliei	aff. Beaupreaidites sp.	Periporopollenites polyoratus	Proteacidites latrobensis
1279.5		x							x				x		x	x			x	
1297.25		x							x				x		x				x	x
1306.5		x							x				x		x				x	x
1344.5		x							x				x						x	x
1369.5		x																	x	x
1400.5	x	x						x	x							x				
1426.75		x													x			x	x	
1525	x	x													x	x				
1562	x	x													x	x	x			
1594.5		x			x										x					
1618		x	x			x	x	x	x	x	x	x	x	x						
1687		x	x	x	x															
1719.5	x																			
1749																				
1796.75																				
1838.5																				
1846.5																				
1908																				
1974.5																				
2047.5																				
2095																				
2164																				
2235.5																				
2260																				
2268.5																				
2293																				
2345																				
2357																				
2381.5																				
2399																				
2418																				
2433																				
2458.5																				
2474.5																				
2489.5																				
2505																				
2534.75																				
2565																				
2590																				
2621.5																				
2633.5																				
2649																				
2670																				
2702																				
2738																				
2753																				
2772																				
2776																				

Depth in metres	Proteacidites cf. angulatus	Dilwynites granulatus	Proteacidites aff. reticuloscabratus	P. palisadus	Tricolpites reticulatus	Haloragacidites harrisii	Nothofagidites flemingii	Sparganiaceaepollenites sp.	Herkosporites elliottii	Reworked Permian and other spores	Granulatisporites trisinus	Plicatipollenites sp.	Horriditriletes ramosus	Limitisporites sp.	Protohaploxypinus limpidus	Apiculatisporis morbosis (Devonian)	Convolutispora sp.	Striatoabietes multistriatus	Verrucosisporites pseudoreticulatus	Didecitriletes ericianus	Protohaploxypinus sp.	Verrucosisporites sp.	Punctatisporites sp.	Microbaculispora tentula	Microbaculispora sp.	Marsupipollenites triradiatus	Indotriradites sp.	Striate bisaccates indet.
1279.5				x				x	x	x																		
1297.25			x	x																								
1306.5			x	x																								
1344.5			x	x	x	x	x																					
1369.5			x																									
1400.5																												
1426.75																												
1525																												
1562																												
1594.5																												
1618																												
1687																												
1719.5																												
1749																												
1796.75																												
1838.5																												
1846.5																												
1908																												
1974.5																												
2047.5																												
2095																												
2164																												
2235.5																												
2260																												
2268.5																												
2293																												
2345																												
2357																												
2381.5																												
2399																												
2418																												
2433																												
2458.5																												
2474.5																												
2489.5																												
2505																												
2534.75																												
2565																												
2590																												
2621.5																												
2633.5																												
2649																												
2670																												
2702																												
2738																												
2753																												
2772																												
2776																												

TABLE II

DISCOVERY BAY NO. 1 WELL
DISTRIBUTION OF CRETACEOUS DINOFLAGELLATE SPECIES

Depth in metres	2776	2772	2753	2738	2702	2670	2649	2633.5	2621.5	2590	2565	2534.75	2505	2489.5	2474.5	2458.5	2433	2418	2399	2381.5	2357	2345	2293	2268.5	2260	2235.5	2164	2095	2047.5	1974.5	1908	1846.5	1838.5	1796.75	1749	1719.5	1687	1618	1594.5	1562	1525	1426.75	1400.5	1369.5	1344.5	1306.5	1297.25	1279.5
Chatangiella aff. multispinosa	X																																														
Cleistosphaeridium sp.	X	X												X																				X														
Cyclopsiella sp.	X																																														
Gillinia hymenophora	X	X																																													
Heterosphaeridium heteracanthum	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X																		?
Hexagonifera chlamydata	X	X																																													
H. glabra	X					X																																									
H. vermiculata	X		X		X	X	X	X																																							
Isabelidinium belfastensis	X	X	X																																												
I. cretacea	X	X	X			X	X	X		X																																					
Odontochitina porifera	X							X			X		X	X										X									X													
O. striatoperforata	X	X											X	X																																	
Spiniferites sp.	X																																														
Amphidiadema denticulata		X	X																																												
Chatangiella sp.		X					X																																								
Dinogymnium westralium		X																																													
Hystrichodinium sp.		X	X			X		X						X																																	
Odontochitina cribropoda		X																																													
Isabelidinium thomasii			X	X		X	X																																								
Pterospermopsis sp.			X																																												
Nelsoniella aceras				X		X		X	X	X	X	X	X	X	X	X	X	X										X		X																	
Xenikoon australis						X	X	X																	X	X	X	X	X	X																	
Gonyaulacysta sp.							X															X																										
Oligosphaeridium sp.							X																																									
Trichodinium sp.							X													X																												
Spiniferites ramosus										X																												X	X								
Dino. indet.												X	X						X																												X	
Deflandrea sp. (indet).														X					X																X	X	X	X			X	X					?
Cribroperidinium cf. edwardsii														X																																		
Odontochitina sp. nov. - aff. O. perforata														X																																		
Chatangiella cf. C. tripartita														X																																		
Hystrichosphaeridium sp.															X														X										?	?							
Microhystridium sp.																		X																														
Isabelidinium cf. korojonense																								X	X																							
Nelsoniella tuberculata									•																X	X																						
Operculodinium sp.																											X	X		X																		
Spiniferites crassipellis																																		X														
Xenascus sp.																																		X														
Paralecaniella indentata																																				X	X							X				
Isabelidinium pellucidum																																				X							X	X	X	X	X	X
Impletosphaeridium sp.																																					X		X		?	?	X	?		X			
Florentinia sp.																																									?	?							
Isabelidinium sp.																																									X	X							
Oligosphaeridium sp.																																											X					
Spinidinium sp.																																																
Isabelidinium sp. aff. cretacea																																															
Valensiella sp.																																															
Impagidinium sp.																																															
Alterbia acutula																																															
Alterbia acuminata cf.																																															
Spinidinium aff. macmurdoense																																															

TABLE IV

DISCOVERY BAY NO. 1 WELL
DISTRIBUTION OF EARLY TERTIARY SPORES POLLEN AND DINOFLAGELLATES

Depth in metres	1275.5	1270.5	1240	1220	1200	1190	1180	1160	1150	1135	1130	1123	1026	1013.5	928	920	906	891	885	880	854.5	786	782	778	774
Baculatisporites comaumensis	X						X					X						X							
Cupanieidites orthoteichus	X	X	X		X	X	X	X			X	X	X	X	X		X	X	X		X				
Cyathidites australis	X	X	X	X										X	X	X	X			X					
Dilwynites granulatus	X	X	X	X	X	X	X	X	X	X	X	X								X					
Dryptopollenites semilunatus	X							X	X		X								X						
Haloragacidites harrisii	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Lygistepollenites florinii	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X		X						
Laevigatosporites ovatus	X											X													
Malvacipollis diversus	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X		X	X					
Myrtaceidites parvus/mesonesus	X				X	X		X	X		X	X		X	X	X		X	X						X
Nothofagidites brachyspinulosus	X	X	X	X	X	X	X	X	X	X	X		X		X	X		X	X	X	X	X		X	
Parvisaccites catastus	X															X									
Periporopollenites polyoratus	X	X	X			X												X	X						
Podosporites sp.	X	X	X	X	X	X	X	X	X		X	X	X	X				X	X		X				
Peromonolites densus	X											X													
Phyllocladidites mawsonii	X														X	X							X		
Podocarpidites spp.	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X			X	X
Polycolpites esobalteus	X				X	X							X						X		X				
Polypodiidites sp.	X	X		X																					
Proteacidites incurvatus	X				X	X		X											X						
P. leightonii	X	X	X		X	X		X				X						X		X	X				
P. ornatus	X																								
P. reticuloscabratus	X										X	X	X	X	X	X									
P. tuberculiformis	X	X																							
Stereisporites (Tripunctisporis) punctatus	X	X																							
Tricolporites scabratus	X				X	X		X	X		X	X		X											
T. microreticulatus	X		X		X	X		X																	
Araucariacites australis		X	X	X	X	X	X	X									X	X							
Alisporites similis		X																							
Clavifera triplex		X			X	X		X			X								X						
Cyathidites splendens		X																							
Microcachyridites antarcticus		X	X		X	X	X			X	X	X	X					X	X	X	X				
Proteacidites kopiensis		X	X		X	X			X			X	X	X			X	X	X		X				
P. spp.		X																		X					
Rugulatisporites mallatus		X	X									X	X												
Sapotaceoidaepollenites rotundus		X																							
Simplicepollis meridianus		X	X		X	X	X	X	X		X	X			X	X		X	X		X		X		
Tricolporites leuros		X																							
Triporopollenites gemmatus		X			X	X																			
Verrucosisporites kopukuensis		X																							
Ischyosporites gremius			X					X								X									
Myrtaceidites tenuis					X	X			X		X	X	X	X	X	X	X	X	X		X				
Proteacidites annularis			X		X	X			X	X	X	X	X						X	X	X			X	
P. crassus			X		X	X	X	X			X	X	X							X					
P. parvus			X	X							X	X											X		
Tricolpites phillipsii			X		X	X		X				X							X		X				
Tricolporites spp.			X																						

Depth in metres	1275.5	1270.5	1240	1220	1200	1190	1180	1160	1150	1135	1130	1123	1026	1013.5	928	920	906	891	885	880	854.5	786	782	778	774
T. paenestriatus			X				X	X										X							
Dacrycarpites australiensis				X																			X		
Cyathidites splendens cf.					X	X																			
Elphedripites notensis					X	X			X		X	X							X						
Ericipites crassiexinus					X	X																			
Ilexpollenites anguloclavatus					X	X	X	X	X		X		X	X											
Krauselisporites papillatus					X	X																			
Nothofagidites emaridus/heterus					X	X		X	X		X	X	X				X	X	X	X	X	X		X	
N. flemingii					X	X			X		X	X	X						X		X				
Periporopollenites demarcatus					X	X		X			X	X	X	X			X	X	X		X				
P. vesicus					X	X		X				X	X	X											
Proteacidites concretus					X		X				X		X												
P. latrobensis					X	X	X		X		X	X	X	X											
Tricolporites adelaidensis					X	X		X			X	X		X					X		X				
Beaupreaidites elegansiformis cf.						X																			
Proteacidites grandis						X																			
Falcisporites grandis							X																		
Gleicheniidites circinidites							X							X	X	X									
Anisotricolporites triplaxis								X																	
Camerozonosporites sp.								X					X												
Disulcites sp.								X																	
Intratriporopollenites notabilis								X							X	X	X				X				
I. sp. nov.								X																	
Margocolporites sp.								X				X													
Periporopollenites magnus								X					X												
Proteacidites fromensis								X					X					X						
P. obscurus														X											
Stereisporites antiquasporites								X						X											
Tricolporites prolata								X																	
T. sphaerica								X	X		X				X	X				X					
Anacolosidites luteoides											X	X													
Australopollis obscurus											X	X													
Diporate sp. nov.											X														
Gothanipollis bassensis											X														
Polypodiidites speciosus							X				X														
Proteacidites cf. rhynthius											X														
Helciporites astrus												X									X				
Herkosporites elliottii												X													
Ovoidites sp.												X													
Proteacidites tenuiexinus												X	X	X		X									
Tricolporites (sp. nov., striate)												X													
Crassiretitriletes vanraadshoovenii													X												
Polypodiaceoisporites varus													X												
P. pachypolus													X			X		X			X				
P. recavus													X												
Tricolporites geranoides													X						X						
Proteacidites tripartitus														X											
Laevigatosporites major																	X								
Proteacidites pseudomoides																		X	X	X	X				
Banksieaeidites arcuatus																			X						
Falcisporites sp.																			X						
Milfordia hypolaenoides																			X						
cf. Oenothera sp.																			X						
Peromonolites vellosus																			X						
Tricolpites incisus																			X						
T. angurium																			X	X	X				

Depth in metres	1275.5	1270.5	1240	1220	1200	1190	1180	1160	1150	1135	1130	1123	1026	1013.5	928	920	906	891	885	880	854.5	786	782	773	774
Triporopollenites delicatus																			X						
Nothofagidites falcatus																				X	X				X
Clavatipollenites sp.																					X				
Nothofagidites asperus																					X				X
Proteacidites angulatus																					X				
Tricolporites valvatus																					X				
Triporopollenites scabratus																					X				
Nothofagidites deminutus																						X			
Dinoflagellates																									
Apectodinium homomorphum	X	X				X	X				X	X													
Deflandrea flounderensis	X																								
Kenleyia lophophora	X															X									
Muratodinium fimbriatum	X																								
Operculodinium centrocarpum	X										X											X	X	X	X
Spiniferites ramosus	X					X	X	X			X											X	X	X	X
Thalassiphora pelagica	X	X																				X		X	
Deflandrea truncata aff.		X																							
Spiniferites sp.		X																							
Deflandrea pachyceros			X			X		X																	
Spinidinium essoi			X																						
Lingulodinium machaerophorum			X		X			X																	
Dyphes colligerum						X																			
Achomosphaera ramulifera						X	X	X														X	X		
Impletosphaeridium sp.						X		?																	
Deflandrea dilwynensis							X																		
Cordosphaeridium fibrospinosum							X																		
Rottnestia borussica							X																		
Deflandrea obliquipes								X											X						
Cleistosphaeridium sp.												X													
Cassidium fragile													X												
aff. Microdinium sp.														X											
Areosphaeridium sp.																X						X			
Hystrichokolpoma rigaudae																	X					X	X	X	
Acritarch indet.	X	X																			X				
Alisocysta ornatum																						X	X	X	
Dyphes airiensis																						X			X
Emmetrocysta urnaformis																						X	X	X	
Schematophora speciosus																						X			
Systematophora placacantha																						X	X	X	X
Deflandrea heterophlycta																						X		X	
D. leptodermata																						X			
D. phosphoritica																						X	X	X	
Phthanoperidinium comatum																						X	X	X	
Achomosphaera crassipellis																						X	X		
Impagidinium cingulatum																						X	X	X	
I. victorianum																						X			
Tectatodinium sp.																						X	X	X	
Dapsilidinium pseudocolligerum																							X		
Hystrichokolpoma poculum																							X		
Pentadinium laticinctum																							X		
Spiniferites pseudofurcatus																							X		
Cordosphaeridium inodes																								X	
Impagidinium sp.																									X

DISCUSSION

Late Cretaceous sediments in Discovery Bay No. 1 well are essentially complete from the T. pachyexinus zone through to the T. lilliei and were deposited mostly in a marginal marine environment. They correlate with the Paaratte Formation. The top of the Cretaceous is marked by an obvious unconformity with reworking and stratigraphic leakage of microfossils. Neither the Tricolpites longus nor the Paleocene Lygistepollenites balmei zones are present. The interval of uncertainty is less than 4 metres (1275.5 - 1279.5m) and strongly argues for the unconformity.

The Early Tertiary sequence represented by the marginal marine M. diversus zone correlates with the onshore Dilwyn Formation at about the level of the Princetown Member.

No Proteacidites asperopolus zone was recognised and the interval of uncertainty is less than 5m (880 - 885m). Therefore another signifant break is present in this section.

The N. asperus zone sediments are transgressive and are correlated with the Nirranda Sub-Group - Mepunga Formation and Narrawaturk Marl.

B. Kerogen Types and Spore Colouration

During routine palynological processing of sidewall cores an unoxidised kerogen sample was taken and the nature of the kerogens and spore colouration are documented in Table VII. Spore colour is expressed as the "Thermal Alteration Index" (TAI) of Staplin (1969) according to the scale in Table VI.

Total organic matter (TOM) is expressed semi-quantitatively in the scale- abundant, moderate, low, very low, barren. Samples classed as having abundant or moderate amounts of TOM would be expected to have TOC's (total organic content) greater than 1%.

In this report four classes of organic matter are recognised - amorphogen, phrogen, hylogen and melanogen and these terms are more or less synonymous with amorphous, herbaceous, woody, and coaly. For reasons as outlined by Bujak et al. (1977) the former terms are preferred because they do not have a botanical connotation. The thermal alteration index scale follows that of Staplin (1969) and as outlined by Bujak et al. (1977). At a TAI of 2+ all four types of organic material contributed to hydrocarbon generation whereas at a TAI of 2, only amorphogen forms liquid hydrocarbons. The upper boundary defining the oil window is at a TAI of approximately 3 but varies according to the organic type. Above TAI 3+ all organic types only have a potential for thermally derived methane.

Spore colouration in Discovery Bay No. 1 well ranges from values of 1 to 2 at T.D. The Tertiary sequence shows very little evidence of alteration and below the Tertiary - Cretaceous unconformity there is a very gradual increase in maturity. However all values indicate that the entire section is immature for the generation of hydrocarbons.

TABLE VI

MATURATION LEVELS, Bujak et al. 1977

CATEGORIES	ORGANIC COMPONENTS	OIL	GAS CONDENSATE	THERMALLY DERIVED METHANE
HYLOGEN	NON-OPAQUE FIBROUS PLANT MATERIAL OF WOODY ORIGIN } TRACHEIDS VESSELS	TAI >2→3 (2.5-2.9)	TAI >2→≥3 (2.3-3.2)	TAI 2→4
PHYROGEN	NON-OPAQUE NON-WOODY ORIGIN } SPORES POLLEN ALGAE ACRITARCHS CUTICLES	>2→3 (2.2→3)	2→<3+	>2⁻→4
AMORPHOGEN	STRUCTURELESS ORGANIC MATTER } FINELY DISSEMINATED or COAGULATED FLUFFY MASSES	2→<3+	2→3+	3+→5
MELANOGEN	OPAQUE ORGANIC DEBRIS	-	2+→<3	2.5-4

Notes: (1) Hylogen, Phyrogen, Melanogen 4→5: Traces of Dry Gas and Co_2

(2) Hylogen, Phyrogen, Melanogen 1→2: Biogenic methane (Marsh gas).

TAI (Thermal Alteration Index):

1+, 2-, 2 - YELLOWS
2, 2+, 3, 4 - BROWNS
4-, 5 - BLACK

TABLE VII

DISCOVERY BAY NO. 1 WELL
SUMMARY OF KEROGEN AND SPORE COLOURATION DATA

Depth	TAI	TOM	PHYRO.	AMORPHO.	HYLO.	MELANO
774	1	v. low	5	80	-	15
778	1+	v. low	10	70	-	20
782	1+	v. low	Tr.	95	-	5
786	1+	v. low	20	50	Tr.	30
790	1+	barren	-	-	-	-
854.5	1+	low	Tr.	70	Tr.	30
880	1+	moderate	10	50	10	30
885	1+	moderate	5	65	Tr.	30
891	1+	moderate	30	50	Tr.	20
906	1+	moderate	30	50	-	20
920	1	moderate	20	60	10	10
928	1+	moderate	Tr.	90	-	10
1013.5	1+	moderate	30	60	Tr.	10
1026	1+	moderate	5	85	-	10
1123	1+	low	10	80	-	10
1130	1+	moderate	5	90	-	5
1135	N.D.	moderate	20	80	Tr.	Tr.
1150	1+	moderate	10	80	10	Tr.
1160	1+	moderate	15	75	-	10
1180	1+	moderate	10	80	Tr.	10
1190	1+	moderate	10	80	Tr.	10
1200	1+	moderate	10	80	Tr.	10
1220	1+	v. low	20	10	-	70
1230	N.D.	v. low	10	-	10	80
1240	1+	low	40	40	Tr.	20
1270.5	1+	moderate	30	50	10	10
1275.5	1+	moderate	50	30	10	10
1279.5	2-	v. low	10	40	10	40
1297.25	2-	low	30	-	15	55
1306.5	2-	low	40	10	10	40
1344.5	2-	low	40	10	10	40
1369.5	2-	low	20	10	10	60
1400.5	2-	low	30	5	5	60
1426.75	2-	moderate	30	10	10	50
1525	2-	moderate	20	5	5	70
1562	2-	moderate	30	20	10	40
1594.5	2-	moderate	30	20	10	40
1618	2-	moderate	40	10	10	40
1687	2-	moderate	30	10	Tr.	60
1719.5	2-	moderate	20	5	5	70
1749	2-	moderate	20	20	10	50
1796.75	2-	moderate	30	20	Tr	4
1838.5	2	abundant	20	-	20	60
1846.5	2	moderate	30	20	10	40
1908	2	low	35	5	10	50
1974.5	2	moderate	30	10	10	50
2047.5	2	moderate	20	20	10	50
2095	2	moderate	30	10	10	50
2164	2	moderate	15	30	5	50

TABLE VII cont.

Depth	TAI	TOM	PHYRO.	AMORPHO.	HYLO.	MELANO.
2235.5	2	abundant	20	30	10	40
2260	2	moderate	20	30	15	35
2268.5	2	moderate	15	10	5	70
2293	2	moderate	20	40	10	30
2345	2	moderate	20	40	10	30
2357	2	abundant	20	30	20	30
2381.5	2	moderate	20	30	20	30
2399	2	moderate	10	30	20	40
2418	2	moderate	20	20	20	40
2433	2	moderate	20	10	10	60
2458.5	2	abundant	20	-	10	70
2474.5	2	moderate	30	-	10	60
2489.5	2	moderate	10	50	-	40
2505	2	moderate	10	50	10	20
2534.75	2	low	10	30	5	55
2565	2	low	20	15	15	20
2590	2	moderate	20	10	10	60
2621.5	2	low	30	20	20	30
2633.5	2	low	30	20	20	30
2649	2	low	30	10	20	40
2670	2	moderate	20	40	10	20
2702	2	low	30	20	10	40
2738	2	low	30	20	25	25
2753	2	moderate	15	20	Tr.	65
2772	2	low	15	10	15	60
2776	2	low	30	-	10	60

Kerogen is dominated in the Early Tertiary sequence by amorphogen which is a potential source for liquid hydrocarbons whereas the Late Cretaceous section is dominated by melanogen. The potential in this section is for the generation of gaseous hydrocarbons with some liquid fraction.

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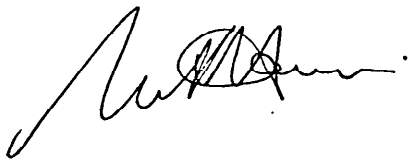

W.K. Harris
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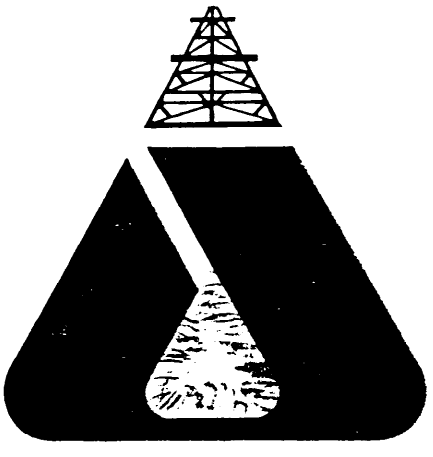
APPENDIX NO.8

PETROLEUM GEOCHEMISTRY EVALUATION

PETROLEUM GEOCHEMISTRY

DISCOVERY BAY No. 1



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PHILLIPS AUSTRALIAN OIL CO.

DISCOVERY BAY NO. 1

SUMMARY

Organic geochemical analyses carried out on cutting samples from well intervals 1215m to 1370m, 1655m to 1930m and 2295m to 2770m in the Phillips Australian Oil Co. Discovery Bay No. 1 Well have indicated the following:

- The fine grain rocks contained within well intervals 1215m to 1370m and 1655m to 1930m have an immature, poor hydrocarbon source character. At a more mature thermal maturity these sediments may have generated good amounts of gaseous hydrocarbons.

- The fine grain rocks within well interval 2295m to 2770m have attained marginal thermal maturity and have generated minor amounts of liquid hydrocarbon at zones 2315m to 2370m and 2595m to 2630m.

This study focuses exploration attention on encountering these organic rich sediments at a more mature position within the basin. At a higher level of thermal maturity, moderate to good quantities of gas and minor to moderate quantities of oil could have been generated and expelled into available reservoirs.

Paul Tybor

Paul Tybor
Analabs

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INTRODUCTION

Organic geochemical analyses have been carried out on thirty five (35) well cuttings samples from the Phillips Australian Oil Co. Discovery Bay No. 1 Well.

The purpose of this study is to evaluate the hydrocarbon generating capability of the sediments penetrated by the Discovery Bay No. 1 Well.

Analytical

Upon receiving the samples, the following analytical program was implemented.

Type of Analyses	Table	Figure
C_1 - C_4 light hydrocarbon gas chromatography	I	
% Total organic carbon screen analysis	II	I
Pyrolysis	II	I

General Information

All data and interpretations given herein by Analabs are proprietary to the Phillips Australian Oil Co. Two (2) copies of this report have been sent to Mr. Gale Yarrow of Phillips at their Perth Office.

Any questions related to this study may be directed to Paul Tybor or Gary Woodhouse at Analabs in Perth W.A.

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DISCUSSION OF THE RESULTS

A. Hydrocarbon Source Rock Evaluation

Within the sedimentary section penetrated by this well, three (3) intervals were evaluated geochemically and are as follows:

1. 1215m to 1370m
2. 1670m to 1930m
3. 2310m to 2770m

1. 1215m to 1370m

The rocks within well interval 1215m to 1370m have an apparent immature thermal maturity with poor hydrocarbon source characteristics. These rocks at a more mature level of maturation may have generated moderate amounts of predominantly gaseous hydrocarbon.

The apparent immature thermal maturity placed on this interval is based solely on the low Tmax and Production Index (Figure I, Table II) values obtained from the samples from this interval. It should be noted that Tmax and Production Index data are not as difinitive measurements of thermal maturity as are Thermal Alteration Index (TAI) or Vitrinite Reflectance (%Ro) data, hence the apparent immature rating has been given.

The poor hydrocarbon source character given to these sediments is based on the poor volumes of gas (Table I) and poor free hydrocarbon yields (S_1; Figure I Table II) obtained from the samples, even though good amounts of organic matter (% TOC Figure I Table II) were analysed from these samples. This is probably due to the immature nature of these rocks which have not experienced sufficient time and temperature to generate any significant quantities of hydrocarbon.

The organic matter contained in these rocks is probably the gas-prone variety, due to the low hydrogen indices and high oxygen indices calculated for the samples (Table II). Consequently at a more mature position within the basin this interval would be expected to have generated fair to good amounts of predominantly gas. Here also, there are analyses available which provide better insight into the types of organic matter present in rocks (visual kerogen and coal maceral identification) than does the hydrogen and oxygen index.

2/-.....

2. 1670m to 1930m

Well interval 1670m to 1930m contain rocks which have good amounts of organic matter (1.31% mean TOC, Figure I, Table II), however, this interval also yielded low Tmax and Production Index values, which suggest thermal immaturity. Low S_1 (Figure I, Table II) values were recorded from the samples comprising this interval. As a result this unit is characterised as an apparent immature, poor hydrocarbon source unit, which has the potential of generating good amounts of predominantly gaseous hydrocarbons at a more mature geothermal regime. These rocks are also gas-prone due to the low hydrogen indices and moderately high oxygen indices (Figure I, Table III).

3. 2310m to 2770m

The rocks comprising well interval 2310m to 2770m have apparently experienced a slightly higher geothermal history, than the sediments contained in the two overlying intervals. This is evidenced by the slightly higher Tmax values obtained from the samples from this lower zone. Consequently, minor to moderate hydrocarbon generation has occurred from the good amounts of organic matter (% TOC, Figure I, Table II) contained in these rocks. This hydrocarbon generation is evidenced by the fair S_1 peak values obtained from the samples from intervals 2315m to 2330m, 2355m to 2370m, 2595m to 2610m and 2615m to 2630m. At these intervals, the hydrogen indices are slightly higher than the hydrogen indices of the other samples, and are approaching a hydrogen index value of 100 (Figure I, Table II). Also, the oxygen indices of the samples from this lower most interval are generally lower than those of the samples from the two overlying intervals. This suggests that the rocks encountered within the lower portion of this well are more oil-prone than the overlying sediments

As a result, the rocks comprising well interval 2310m to 2770m are marginally mature, based on Tmax values, which have generated minor to moderate amounts of hydrocarbon at intervals 2315m to 2330m, 2355m to 2370m, 2595m to 2610m and 2615m to 2630.

B. Exploration Significance

In the general vicinity of this well, the reservoir traps in communication with the fair hydrocarbon source rocks of intervals 2315m to 2330m, 2355m to 2370m, 2595m to 2610m and 2615m to 2630m, may contain minor amounts of liquid and gaseous hydrocarbons.

The remaining sediments analysed contain good amounts of organic matter. However, the type is apparently gas-prone, which has not given off significant quantities of gas at the apparent low thermal maturities analysed in the bulk of the sediments, sampled from this well.

On a regional basis, the explorationist should attempt to define where in the basin these sediments have attained thermal maturity. At a more mature position in the basin, the organic rich sediments in intervals 1 (1215m to 1370m) and 2 (1655m to 1630m) would be expected to have generated good amounts of gas. Furthermore the rocks in interval 3 (2295m to 2770m) could have generated moderate amounts of oil and good amounts of gas at mature levels of thermal maturation.

****

TABLE I

LIGHT HYDROCARBON DATA

DEPTH(m)	%METHANE	%ETHANE	%PROPANE	%ISOBUTANE	%BUTANE	i-C4/n-C4	VOL. GAS(ul/Kg)	C2+/C1	C2/C1	C3+/C1
1235.0-1250.0	92.8	4.6	1.8	0.6	0.3	2.02	50.1	.078	.049	.029
1355.0-1370.0	91.5	6.2	1.5	0.5	0.2	2.00	41.9	.092	.068	.025
1715.0-1730.0	71.4	20.0	7.4	0.7	0.5	1.35	11.9	.401	.281	.120
1815.0-1330.0	72.9	10.9	10.8	2.9	2.5	1.16	11.3	.372	.150	.222
1835.0-1350.0	68.0	14.4	9.8	4.2	3.6	1.16	9.8	.470	.211	.258
1855.0-1370.0	53.1	27.0	14.3	3.1	2.6	1.21	11.3	.883	.508	.375
1875.0-1390.0	42.8	29.3	18.8	5.2	3.9	1.33	7.5	1.334	.685	.649
1895.0-1910.0	35.5	40.8	15.5	4.5	3.7	1.21	9.1	1.816	1.150	.666
1915.0-1930.0	30.8	48.1	14.6	3.7	2.9	1.27	12.4	2.249	1.562	.686
2295.0-2310.0	64.2	17.5	13.8	3.2	1.4	2.33	23.4	.557	.272	.285
2315.0-2330.0	65.4	19.4	11.3	2.7	1.2	2.28	15.8	.529	.296	.232
2335.0-2350.0	58.6	24.0	13.4	2.8	1.2	2.37	19.8	.706	.409	.296
2355.0-2370.0	61.4	22.6	8.8	4.8	2.4	2.03	26.4	.629	.368	.261
2375.0-2390.0	68.5	20.6	8.1	2.0	0.8	2.63	48.6	.459	.300	.159
2395.0-2410.0	70.2	19.0	6.7	2.7	1.3	2.05	90.3	.424	.271	.153
2475.0-2490.0	66.2	23.5	6.4	2.6	1.2	2.07	103.6	.510	.355	.155
2495.0-2510.0	69.6	21.6	5.7	2.1	1.0	2.09	158.3	.437	.310	.127
2595.0-2610.0	53.3	26.7	12.8	5.1	2.1	2.36	232.5	.875	.500	.375
2615.0-2630.0	61.6	24.3	7.3	4.3	2.4	1.77	193.2	.622	.395	.228
2635.0-2650.0	54.3	23.9	10.8	7.6	3.5	2.16	177.4	.841	.439	.401
2655.0-2670.0	50.3	21.1	14.9	9.5	4.1	2.31	76.7	.988	.420	.567
2675.0-2690.0	49.4	22.2	15.2	9.3	3.9	2.41	57.6	1.025	.450	.574
2695.0-2710.0	59.1	18.0	12.6	6.9	3.3	2.08	124.0	.692	.305	.386
2715.0-2730.0	65.5	15.2	10.4	5.4	3.5	1.53	146.7	.526	.231	.295
2735.0-2750.0	46.0	19.1	17.9	11.1	5.9	1.90	70.8	1.173	.414	.759
2755.0-2770.0	56.1	13.2	15.3	9.7	5.7	1.70	65.1	.784	.235	.549

TABLE II

WELLNAME = DISCOVERY BAY NO.1

DATE OF JOB = NOVEMBER 1982

ROCK-EVAL PYROLYSIS DATA

DEPTH(M)	TMAX	S1	S2	S3	S1+S2	S2/S3	PI	PC	TOC	HI	OI
1215.0-1230.0	nd	nd	nd	nd	nd	nd	nd	nd	0.69	nd	nd
1235.0-1250.0	419	0.09	0.88	1.59	0.97	0.55	0.09	0.08	1.23	71	129
1255.0-1270.0	421	0.11	1.03	1.40	1.14	0.74	0.10	0.09	1.33	77	105
1355.0-1370.0	413	0.08	0.51	0.89	0.59	0.57	0.14	0.05	1.04	49	85
1655.0-1670.0	425	0.11	0.76	0.81	0.87	0.94	0.13	0.07	1.04	73	77
1675.0-1690.0	422	0.18	1.13	1.22	1.31	0.93	0.14	0.11	1.33	84	91
1695.0-1710.0	426	0.10	0.82	0.80	0.92	1.03	0.11	0.08	1.01	81	79
1715.0-1730.0	428	0.13	1.07	0.95	1.20	1.13	0.11	0.10	1.24	86	76
1735.0-1750.0	430	0.13	1.03	1.10	1.16	0.94	0.11	0.10	1.42	72	77
1755.0-1770.0	425	0.12	1.02	1.23	1.14	0.83	0.11	0.09	1.47	69	83
1775.0-1790.0	427	0.12	0.95	1.05	1.07	0.90	0.11	0.09	1.38	68	76
1795.0-1810.0	nd	nd	nd	nd	nd	nd	nd	nd	0.85	nd	nd
1815.0-1830.0	426	0.16	0.84	0.67	1.00	1.25	0.16	0.08	1.10	76	60
1835.0-1850.0	425	0.14	1.13	1.07	1.27	1.06	0.11	0.11	1.58	71	67
1855.0-1870.0	427	0.13	1.21	1.20	1.34	1.01	0.10	0.11	1.57	77	76
1875.0-1890.0	422	0.22	1.51	1.53	1.73	0.99	0.13	0.14	1.62	93	94
1895.0-1910.0	426	0.13	1.25	1.19	1.38	1.05	0.09	0.11	1.43	87	83
1915.0-1930.0	428	0.10	1.10	0.97	1.20	1.13	0.08	0.10	1.34	82	72
2295.0-2310.0	429	0.17	1.02	0.89	1.19	1.15	0.14	0.10	1.31	77	67
2315.0-2330.0	425	0.25	1.13	0.81	1.38	1.40	0.18	0.11	1.28	88	63
2335.0-2350.0	nd	nd	nd	nd	nd	nd	nd	nd	0.91	nd	nd
2355.0-2370.0	423	0.32	1.77	1.01	2.09	1.75	0.15	0.17	1.74	101	58
2375.0-2390.0	430	0.17	1.51	1.13	1.68	1.34	0.10	0.14	1.88	80	60
2395.0-2410.0	428	0.16	1.18	0.83	1.34	1.42	0.12	0.11	1.51	78	54
2475.0-2490.0	428	0.17	0.97	0.76	1.14	1.28	0.15	0.09	1.17	82	64
2495.0-2510.0	431	0.16	1.40	0.87	1.56	1.61	0.10	0.13	1.45	96	60
2595.0-2610.0	427	0.30	1.33	1.15	1.63	1.16	0.18	0.14	1.39	95	82
2615.0-2630.0	426	0.24	1.57	1.19	1.81	1.32	0.13	0.15	1.78	88	66
2635.0-2650.0	428	0.14	1.03	0.65	1.17	1.58	0.12	0.10	1.39	74	46
2655.0-2670.0	nd	nd	nd	nd	nd	nd	nd	nd	0.95	nd	nd
2675.0-2690.0	nd	nd	nd	nd	nd	nd	nd	nd	0.55	nd	nd
2695.0-2710.0	431	0.13	1.07	0.63	1.20	1.70	0.11	0.10	1.41	75	44
2715.0-2730.0	430	0.14	1.04	0.51	1.18	2.04	0.12	0.10	1.41	73	36
2735.0-2750.0	430	0.13	0.84	0.41	0.97	2.05	0.13	0.08	1.14	73	35
2755.0-2770.0	nd	nd	nd	nd	nd	nd	nd	nd	0.67	nd	nd

LOG ANALYSIS

Table 1 lists all the wireline logs run at Discovery Bay No.1. The final Computer Well Log Plot (CPI), a composite of log analyses for Runs 1 (450-1190m) and Run 2 (1199-2766m) respectively, indicates no potential hydrocarbon productive zones (Enclosure 6).

The primary water saturation parameters for this analysis are:

aRw = 0.38 ohm/m at 82°C (180°F),
where 'a' is the Formation Resistivity Factory Constant = 1
Cementation Exponent (m) = 1.8 (Sandstones), 2 (Limestones)
Saturation Exponent (n) = 2.0

Lithological descriptions from several sources were used to choose the appropriate coding. However, the mud log, the litholog, the daily reports, and the sidewall core descriptions are not entirely consistent. Consequently, the lithology portrayed on the Well Log Print may not exactly match the final interpretation on the Composite Log.

Thin hydrocarbon-bearing zones are apparent on the Computer Well Log Plot between 750-768 metres, 792-802 metres, and 855-874 metres respectively, with water saturations in the 80-90% range. These zones exhibit a false hydrocarbon content probably caused by the presence of freshwater or the difference in lithology between these zones and the average sandstone zones which were used to determine the basic saturation parameters.

TABLE NO.1

DISCOVERY BAY NO.1 WIRELINE LOGS

TYPE	INTERVAL	SCALE
Run 1		
DIL-SLS-GR	435-1210m	1:200, 1:500
Run 2		
DIL-SLS-GR	1199-2776m	1:200, 1:500
LDL-CNL-GR	1199-2776m	1:200, 1:500
HDT	1199-2776m	1:200, 1:500

THEORY AND METHOD

1. PREPARATION OF SAMPLES

The samples provided for geochemical studies are firstly, where necessary, carefully air dried. Then they are crushed to 1/8" chips using a van Gelder jaw crusher, and finally they are crushed to 0.1mm using an NV Tema grinder.

2. TOC DETERMINATIONS

The total organic carbon value (TOC) was determined on the unextracted sediment sample. The value was determined by treating a known weight of sediment with dilute HCl to remove carbonate minerals, and then heating the residue to approximately 1700 ^{o}C (Leco Induction Furnace) in an atmosphere of pure oxygen. The carbon dioxide produced was absorbed on a "Carbosorb" tower. The weight of carbon dioxide produced was then used to calculate %TOC in the sediment.

3. ROCK-EVAL PYROLYSIS

Rock-Eval pyrolysis is carried out by placing approximately 100mg of the crushed sample into a crucible and then subjecting it to the following pyrolysis cycle:

Stage (i) - Sample purged with helium for 3.5 minutes outside of heated part of pyrolysis furnace;

Stage (ii) - Sample heated at 300^{o}C for 3 minutes to liberate free petroleum (S_1 peak);

Stage (iii)- Sample heated from 300^{o}C to 550^{o}C at 25^{o}C/minute to produce petroleum from kerogen (S_2 peak). The furnace is maintained at 550^{o}C for one minute. Carbon dioxide produced during this pyrolysis up to 390^{o}C (550^{o}C in the case of the carbonate-free sediment) is absorbed on a special column;

Stage (iv) - During cool-down period the carbon dioxide produced during pyrolysis is measured (S_3 peak).

The units used for Rock-Eval data are as follows:

S_1, S_2, S_3 = kg/tonne of rock
T_{max} = ^{o}C
Hydrogen Index = mg HC/g TOC
Oxygen Index = mg CO_2/g TOC

Rock-Eval data is most commonly used in the following manner:

(i) S_1 - indicates the level of oil and/or gas already generated by the sample.

(ii) S_1+S_2 - referred to as the genetic potential this parameter is used for source rock evaluation according to the following criteria:

<2	kg/tonne	Poor
2-6	kg/tonne	Moderate
>6	kg/tonne	Good

(iii) $S_1/(S_1+S_2)$ - this parameter is the production index which is a measure of the level of maturity of the sample.

(iv) T_{max} - the temperature corresponding to the S_2 maxima. This temperature increases with increasingly mature sediments.

(v) HI, OI - the hydrogen ($[S_2 x 100]/TOC$) and oxygen ($[S_3 x 100]/TOC$) indices when plotted against one another provide information about the type of kerogen contained in the sample and the maturity of the sample.

4. HEADSPACE ANALYSIS

Headspace analysis is carried out on sealed containers (usually tinned cans) of wet cuttings. The containers are approximately three quarters filled with the cuttings to leave an appreciable headspace into which volatile hydrocarbons contained in the cuttings diffuse.

The analysis involves placing a small hole (1/16" diamter) in the container lid, sampling 1 ml of the headspace gas with a gas injection syringe, and finally gas chromatographing this sample of gas under the following conditions: instrument = Varian Aerograph 1440 equipped with an FID; column = 3 m x 1/8" Chromosorb 102; temperature program = 70°C for 1.5 mins then up to 140°C at 15°C/min; carrier gas = nitrogen at 23 mls/min; injector temperature = 50°C; detector temperature = 200°C. After each analysis the gas chromatograph is heated at 200°C for 8 minutes to remove the C_5 + components from the column.

The integrated areas of peaks representing each of the C_1-C_4 components of the headspace gas are corrected for their relative weight and

volume detector responses, and their concentrations are reported as volume (or molar) %. If requested a semi-quantitative estimate of the amount of gas in the headspace is determined by comparison of the data for the sample gas to that for a known volume of a standard gas of known composition and accounting for the approximate volume of the headspace.

Data from headspace analysis is commonly used to identify the zone of oil generation by plotting the proportion of C_2 + components (either C_2+/C_1 or % C_2+) against sediment burial depth. Gas containing appreciable quantities of C_2+ components, termed wet gas (Fuex, 1977), is generally considered to be gas associated with oil generation. In addition, the the ratio of isomeric butanes can sometimes be used for assessment of sediment maturity (Alexander et al., 1981). The amount of gas in sediments can be used to identify zones of significant gas generation and out-of-place gas.

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APPENDIX NO.9

BASIC HYDROCARBON SOURCE ROCK POTENTIAL

AND

VITRINITE REFLECTANCE ANALYSIS

PHILLIPS 66

INTER-OFFICE CORRESPONDENCE / SUBJECT:
BARTLESVILLE, OKLAHOMA

December 2, 1982

Basic Hydrocarbon Source Rock Potential Analysis of the PPCo Discovery Bay No. 1 Well, Otway Basin, Offshore Australia.
Charge No. RA4053
EPS Report No. 2368L

BVP-215-82

O. J. Koop (r) N. C. Tallis
Perth Office

N. C. Tallis' letter to H. A. Kuehnert dated Oct. 19, 1982 requested source rock analyses of the PPCo. Discovery Bay No. 1 well, offshore Australia. The study of 16 sidewall core samples and 10 ditch cutting samples from this well is complete. The results indicate that there is no significant source rock potential in any of these samples at their present level of thermal maturity.

A summary of these results was reported by telex on Nov. 11, 1982. Included in this report are a source rock plot and a pyrolysis data chart which help to display the various source rock potential parameters. Kerogen and pyrolysis printouts on all samples are also included.

Although 18 of these samples have rich levels of organic carbon (TOC > 1.0% by weight) and 6 others have fair levels (0.5 to 1.0%), only 6 samples have a dominantly oil prone kerogen content. Sixteen samples have dominantly gas prone kerogen, whereas 4 samples have approximately equal amounts of oil and gas prone kerogen (see printout). Vitrinite reflectance values on these samples range from Ro 0.51 at 844 meters to Ro 0.66 at 2776 meters T.D. These values indicate only an early stage thermal maturity; i.e., not yet into the peak range for oil generation. Spore coloration index values (TAI) ranging from 2 to 3- support this maturity level.

Given the above data alone, secondary liquid hydrocarbon source rock potential is indicated. However, the pyrolysis data do not support this interpretation. The hydrogen index values of these samples indicate that the oil prone kerogen present was apparently subjected to oxidation prior to or during burial which destroyed its oil potential. This conclusion would seem to relate well to the sandstone/siltstone lithologies described in the sidewall core descriptions and well logs.

All things considered, therefore, no significant source rock potential is indicated in any of these samples at their present level of thermal maturity. Given greater depth of burial, and consequent greater thermal maturity, only dry gas source rock potential of questionable significance could be expected.

As of this date we have not received samples from our second well in this area. When received, it will also be assigned a high priority status.

Dennis R. Logan

Approved: E. A. Stanley

DRL/sjv

Attachments

cc: W. E. Ryker
K. Lyons (r) B. W. Knuth
L. H. Hoelscher (r) J. A. Standridge
H. A. Kuehnert (r) D. W. Dalrymple

DISCOVERY BAY #1, OFFSHORE VICTORIA, AUSTRALIA

PYROLYSIS DATA

DEPTH RANGE METERS	TOTAL ORGANIC CARBON WEIGHT %	S1 PEAK MG.HC/ G.ROCK	S2 PEAK MG.HC/ G.ROCK	PRODUCTION INDEX S1/(S1+S2)	TEH/TOC MG.HC/ G.ORG.C	HYDROGEN INDEX MG.HC/G.ORG.C		
644- 644	1.16	0.080	0.320	0.20	6.8	27.1	SWC	GI82ECM
1126- 1126	2.72	0.120	2.130	0.05	4.4	78.9	SWC	GI82ECN
1150- 1150	2.15	0.100	1.550	0.06	4.7	72.1	SWC	GI82ECO
1243- 1243 —	1.41	0.020	0.760	0.10	5.7	53.9	SWC	GI82ECP
1306- 1306 —	0.96	0.050	0.270	0.16	5.1	27.6	SWC	GI82ECQ
1400- 1400	1.42	0.060	0.470	0.11	4.2	33.1	SWC	GI82ECR
1562- 1562	1.68	0.110	0.680	0.11	5.9	46.8	SWC	GI82ECS
1687- 1687 —	2.35	0.180	1.490	0.11	7.6	62.6	SWC	GI82ECT
1797- 1797 —	1.99	0.320	1.160	0.22	16.1	58.3	SWC	GI82ECU
1908- 1908 —	1.27	0.080	0.610	0.12	6.3	48.0	SWC	GI82ECV
2047- 2047	2.97	0.070	1.680	0.04	2.4	56.6	SWC	GI82ECW
2263- 2263	2.72	0.070	1.340	0.05	2.6	49.3	SWC	GI82EC
2418- 2418 —	2.04	0.090	0.780	0.10	4.4	38.2	SWC	GI82ECY
2505- 2505 —	2.13	0.100	1.340	0.07	4.7	62.9	SWC	GI82ECZ
2633- 2633 —	2.56	0.090	1.420	0.06	3.5	55.5	SWC	GI82EDA
2772- 2772 —	2.11	0.160	1.360	0.11	7.6	64.5	SWC	GI82EDB
1410- 1410	0.33	0.040	0.100	0.29	12.1	30.3	CUT	GI82EDC
1565- 1565	0.71	0.070	0.180	0.28	9.9	25.4	CUT	GI82EDD
1715- 1715	1.27	0.070	0.690	0.09	5.5	54.3	CUT	GI82EDE
1970- 1970	2.13	0.070	1.940	0.03	3.3	91.1	CUT	GI82EDF
2060- 2060	0.57	0.070	0.200	0.26	12.3	35.1	CUT	GI82EDG
2175- 2175	0.76	0.050	0.410	0.11	6.4	52.6	CUT	GI82EDH
2305- 2305	1.39	0.080	1.290	0.06	5.8	92.8	CUT	GI82EDI
2475- 2475	0.71	0.120	0.470	0.20	16.9	66.2	CUT	GI82EDJ
2590- 2590	0.44	0.050	0.250	0.17	11.4	56.8	CUT	GI82EDK
2770- 2770	0.82	0.090	0.560	0.14	11.0	68.3	CUT	GI82EDL

[illegible] LIT[illegible] PPCO DISCOVERY BAY NO 1 OTWAY BASIN
EFS REPORT # 2368L

[illegible]ALIZED TO 10[illegible] BY VOLUME

[illegible] (METRES)	[illegible]	TYPE	TAI	EXINITE (OIL PRONE)	ALGINITE (OIL PRONE)	VITRINITE (GAS PRONE)	INERTINITE (GAS PRONE)	RO MEAN	STND. DEV	MODE	RANGE LOW	RANGE HIGH	NO. OF VIT. READINGS	TOTAL ORGANIC CARBON (WT %)	EXTR ORG MAT (PP[illegible]
[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	20.	0.51	0.04	0.50	0.45	0.59	84	1.16	
[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	10.	0.51	0.03	0.52	0.46	0.58	83	2.70	
[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	20.	0.52	0.03	0.50	0.45	0.59	94	2.15	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	20.							1.41	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	50.	0.56	0.04	0.50	0.48	0.64	42	0.97	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	30.	45.	0.55	0.05	0.54	0.47	0.63	43	1.42	
[illegible]	[illegible]	CC	[illegible]	[illegible]	[illegible]	[illegible]	30.							0.33	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	30.	0.56	0.02	0.56	0.52	0.59	35	1.88	
[illegible]	[illegible]	CC	[illegible]	[illegible]	[illegible]	[illegible]	30.	0.52	0.04	0.49	0.45	0.60	92	0.71	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	30.	30.	0.56	0.05	0.54	0.51	0.59	37	2.38	
[illegible]	[illegible]	CC	[illegible]	[illegible]	[illegible]	35.	40.	0.52	0.02	0.53	0.49	0.56	48	1.27	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	25.	0.59	0.03	0.60	0.50	0.64	54	1.99	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	35.	0.58	0.04	0.60	0.52	0.64	38	1.27	
[illegible]	[illegible]	CC	[illegible]	[illegible]	[illegible]	[illegible]	35.	0.55	0.05	0.52	0.45	0.65	23	2.13	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	25.	0.59	0.04	0.58	0.50	0.68	74	2.97	
[illegible]	[illegible]	CC	[illegible]	[illegible]	[illegible]	45.	30.							0.57	
[illegible]	[illegible]	CC	[illegible]	[illegible]	[illegible]	[illegible]	30.	0.59	0.04	0.55	0.52	0.67	47	0.78	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	30.	40.	0.62	0.05	0.60	0.52	0.71	71	2.72	
[illegible]	[illegible]	CC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.63	0.05	0.60	0.53	0.74	61	1.39	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	30.	30.							2.04	
[illegible]	[illegible]	CC	[illegible]	[illegible]	[illegible]	[illegible]	30.							0.71	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	20.	0.63	0.04	0.59	0.55	0.73	79	2.13	
[illegible]	[illegible]	CC	[illegible]	[illegible]	[illegible]	45.	40.	0.66	0.03	0.69	0.61	0.71	17	0.44	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	20.	30.	0.67	0.06	0.66	0.54	0.81	63	2.56	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.66	0.05	0.60	0.59	0.75	61	2.11	
[illegible]	[illegible]	CC	[illegible]	[illegible]	[illegible]	40.	35.	0.66	0.02	0.67	0.62	0.69	8	0.82	

[illegible] USED FOR SOURCE ROCK PLOT

[illegible] = [illegible] (SPORE COLOR) (1-2 YELLOW) (2-3 BROWN) (3-4 DARK BROWN) (5 BLACK)
[illegible] = [illegible] + PLANT CUTICLES + RESINS + OTHER STRONGLY FLUORESCENT ORGANIC MATERIALS + [illegible] (IF RECOGNIZABLE AS FROM TERRESTRIAL SOURCE - IF NOT IT IS RECORDED [illegible])
[illegible] = [illegible] - CYST[illegible] AND BODIES) + AMORPHOUS SAPROPEL
[illegible] = [illegible] TISSUE ([illegible] HUMIC COMPOUNDS) + NONFLUORESCENT STRUCTURED TRANSLUCENT MATERIAL
[illegible] = [illegible] INCLUDING FUSINITE, SEMIFUSINITE, PSEUDOVITRINITE, MACRINITE, & INERTODETRINITE
[illegible] = [illegible] / ([illegible] TOC)

LEGEND

CUTTINGS

CORE

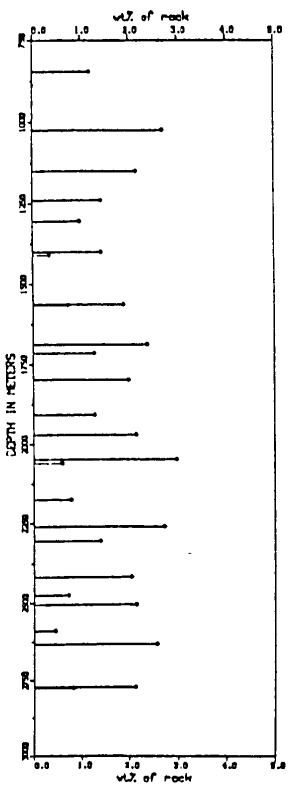
VERTICAL SCALE:
1 INCH = 125 METERS

DISCOVERY BAY #1, OFFSHORE VICTORIA, AUSTRALIA

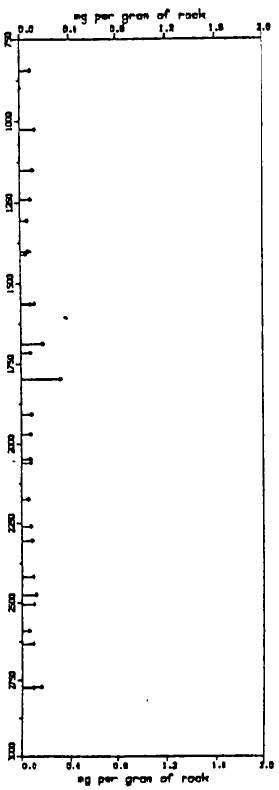
PYROLYSIS DATA

EPS REPORT = 2368L

TOTAL ORGANIC CARBON (TOC)



S1 PEAK (TEH)



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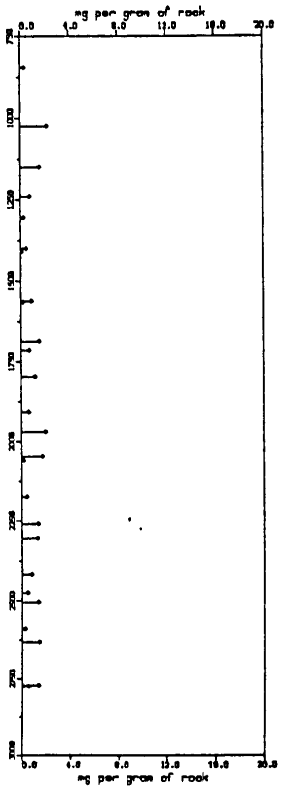
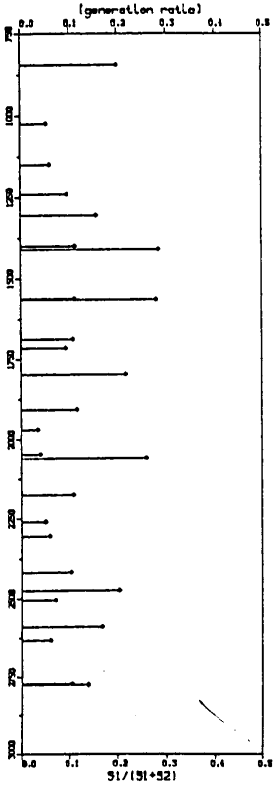
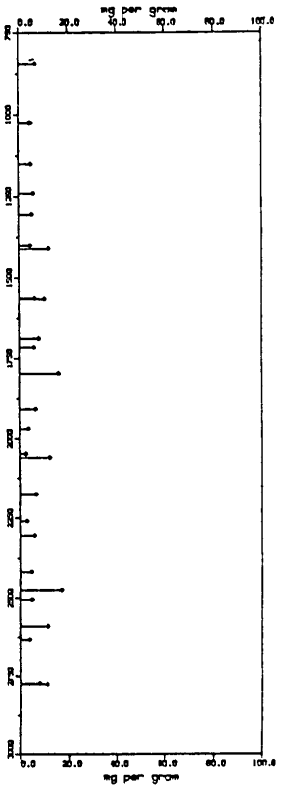


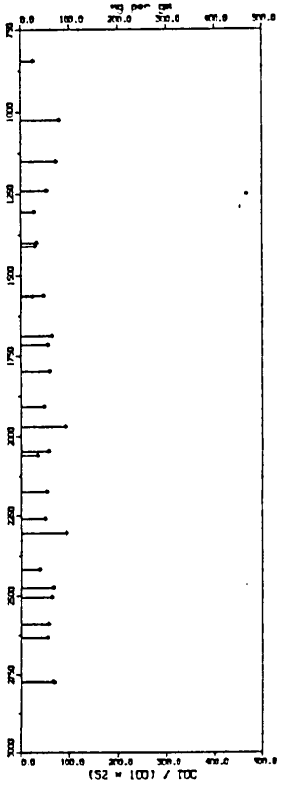
PRODUCTION INDEX



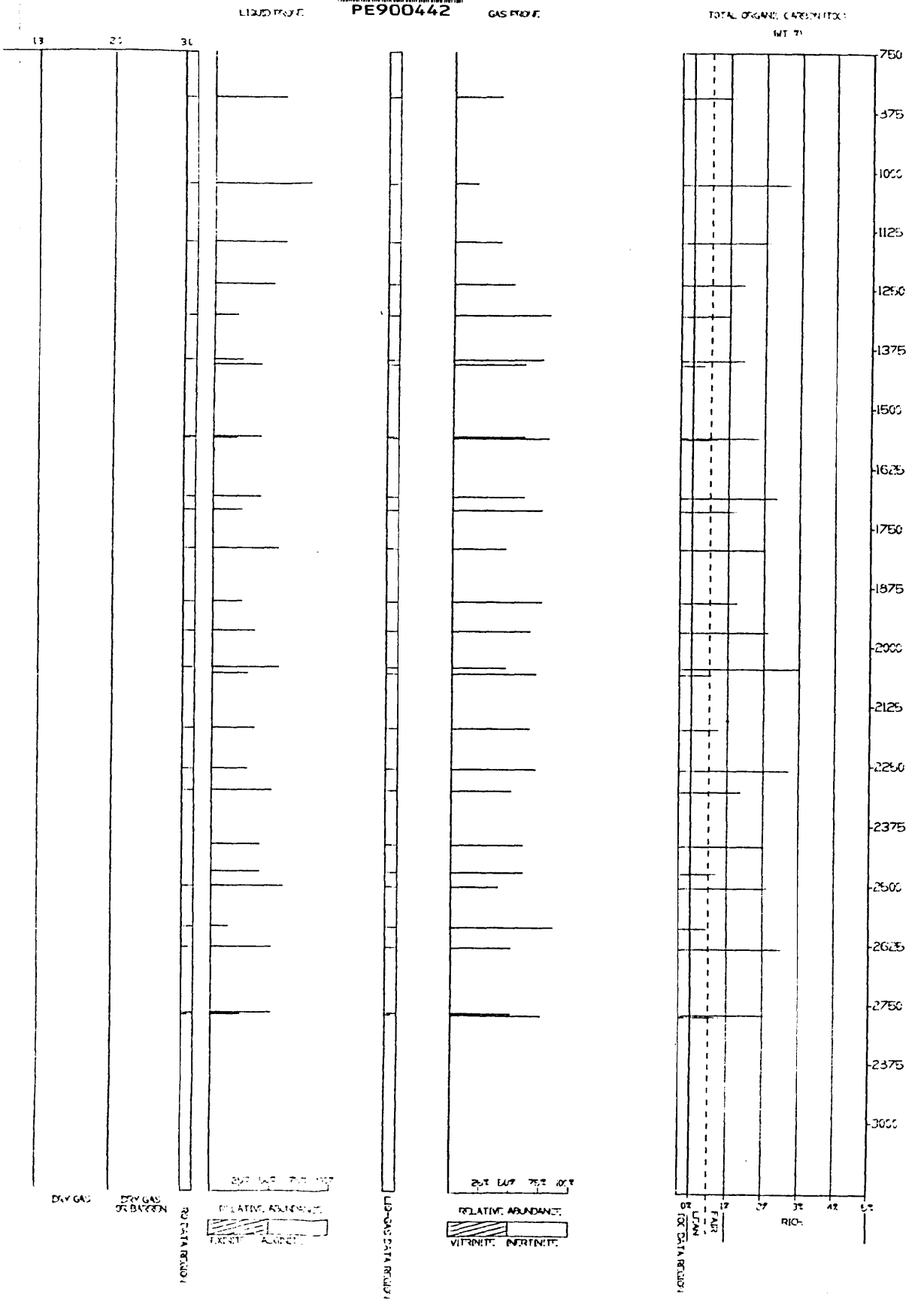
TEH/TOC



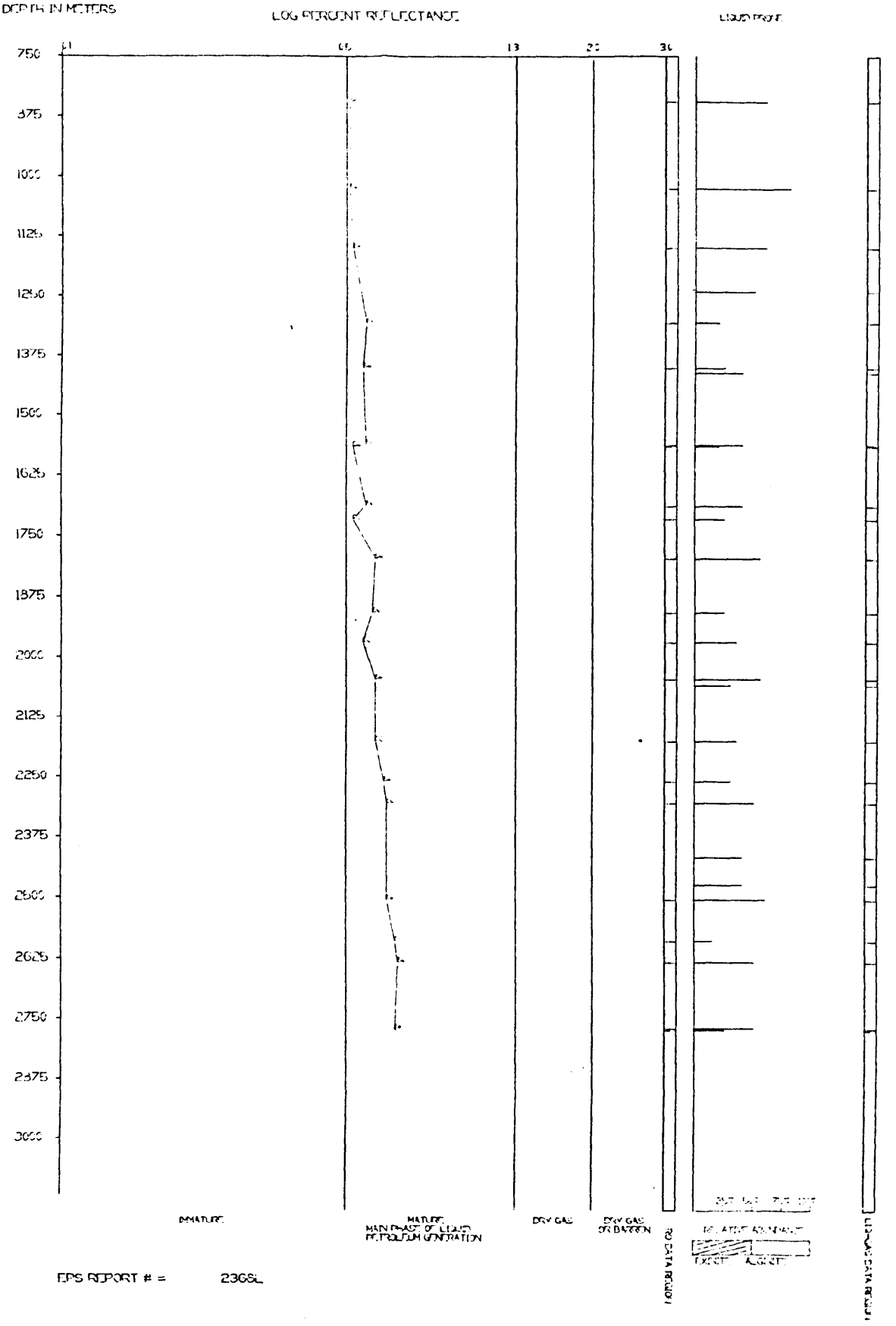
HYDROGEN INDEX



SOURCE ROCK POTENTIAL OF PPCO DISCOVERY BAY NO 1 OTWAY BASIN



THERMAL ALTERATION AND SOURCE ROCK POTENTIAL OF PPCO [



EPS REPORT # = 2368L

APPENDIX NO.10

LOG ANALYSIS

APPENDIX NO.11

DIPMETER INTERPRETATION

DIPMETER ANALYSIS, DISCOVERY BAY NO.1

The dipmeter log was run over the 1199 to 2776 metre interval at Discovery Bay No.1 which includes the objective Upper Cretaceous sedimentary section and also the lowermost 80 metres of the Lower Tertiary sequence. Dipmeter analysis of sandstones within the section aids in determining the main paleocurrent directions of each formation and their respective depositional environments. The three formations studied are the Coniacian to Campanian Paaratte Formation, the Campanian Curdies Formation, and the Early Eocene Dilwyn Formation. Although only 80 metres of Lower Tertiary section above the top Cretaceous unconformity was covered by the dipmeter log, sandstones within this section were analysed to highlight the change in dip direction above and below the major unconformity.

After obtaining the raw dipmeter log, computer results in Geodip form were produced using a correlation interval of 4 metres, a step distance of 1 metre, and a 35 degree search angle. In order to study the sedimentary dips of the penetrated section more readings were obtained by reducing the correlation interval to 1 metre, the step distance to 0.5 metres, whilst the search angle remained at 35 degrees. The standard removal of structural dip was not necessary as it remains at less than 2 degrees at an azimuth varying from south to southwest throughout the sedimentary section.

Polar plots were constructed for sandstone beds in each of the three formations each of which was determined as a separate entity in Discovery Bay No.1 by lithological and logging characteristics, and from palynological data. For each formation two plots have been made; one including all dip values and another plotting only dip values greater than or equal to 5 degrees. This is done to determine the general sedimentary dip direction of each formation and also to assess any trend in larger dip values which may be particularly relevant in fluvio-deltaic environments. Dip azimuths have been grouped into 10 degree intervals for plotting purposes.

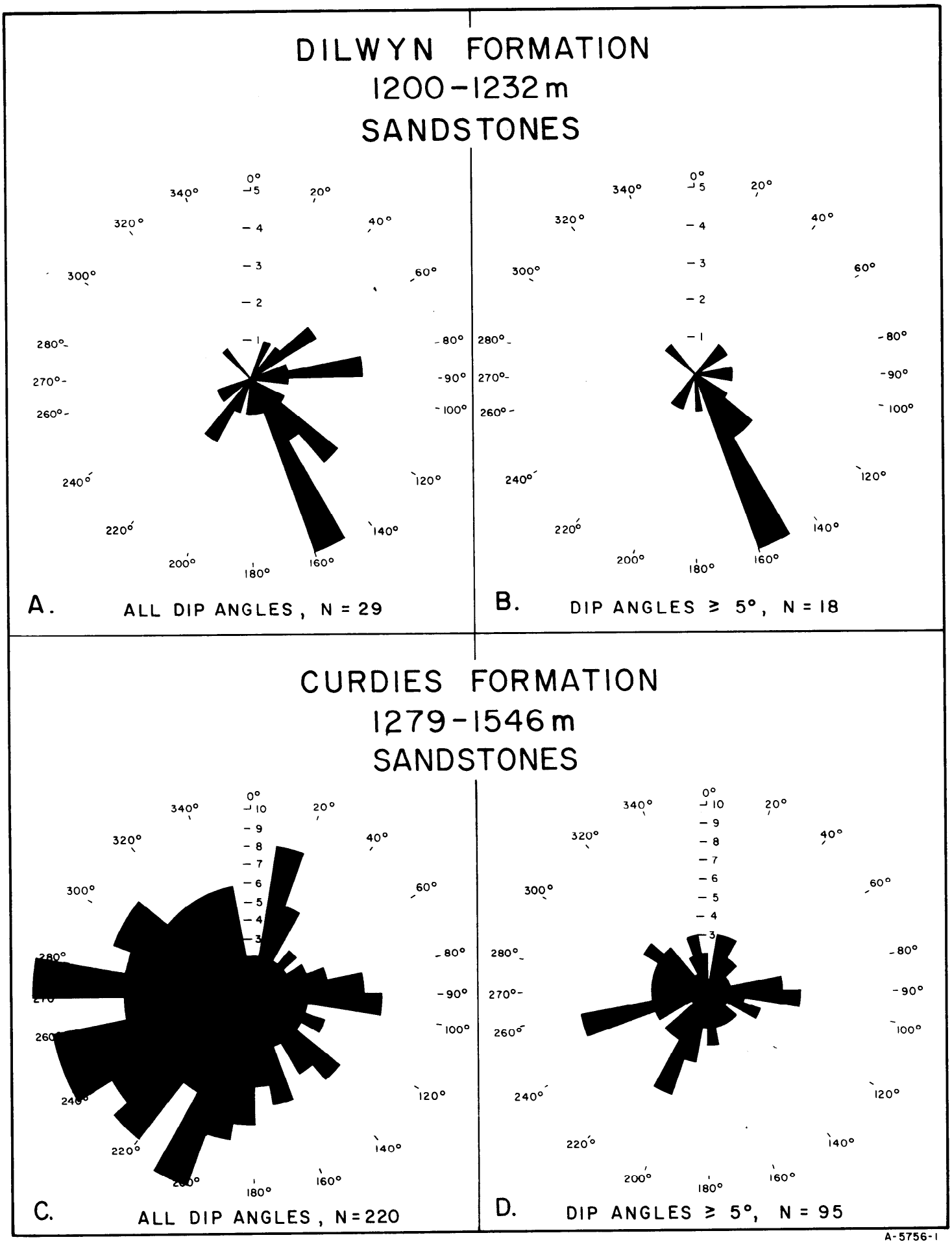
The Early Eocene Dilwyn Formation is a deltaic-shallow marine unit extending over the interval 880 to 1233 metres in Discovery Bay No.1 and consists of thick massive sandstones with interbedded siltstones. The

dipmeter log was only run across the basal 34 metres of this unit, and includes a 32 metre thick sandstone which was analysed to obtain the general direction of sedimentation. Both polar plots for this sandstone (Figures 1A and 1B) show the same pronounced sedimentary dip direction to the south-southeast indicating that major Early Tertiary sedimentation was from the north-northwest.

The Campanian Curdies Formation extends over the interval 1279 to 1546 metres in Discovery Bay No.1 and consists of a dominantly deltaic plain interbedded sandstone-siltstone sequence. The sandstones are up to 25 metres thick, typically fine grained, moderately well sorted, and of good intergranular porosity. The two polar plots (Figures 1C and 1D) show a similar trend of pronounced sedimentary dip to the west and south-west, with a minor component to the east. The distinct change in dip direction (or paleocurrent direction) between this Upper Cretaceous unit and the overlying Dilwyn Formation highlights the major unconformity at the top of the Curdies Formation, and indicates that two different sedimentological systems were active in late Upper Cretaceous and Lower Tertiary times respectively.

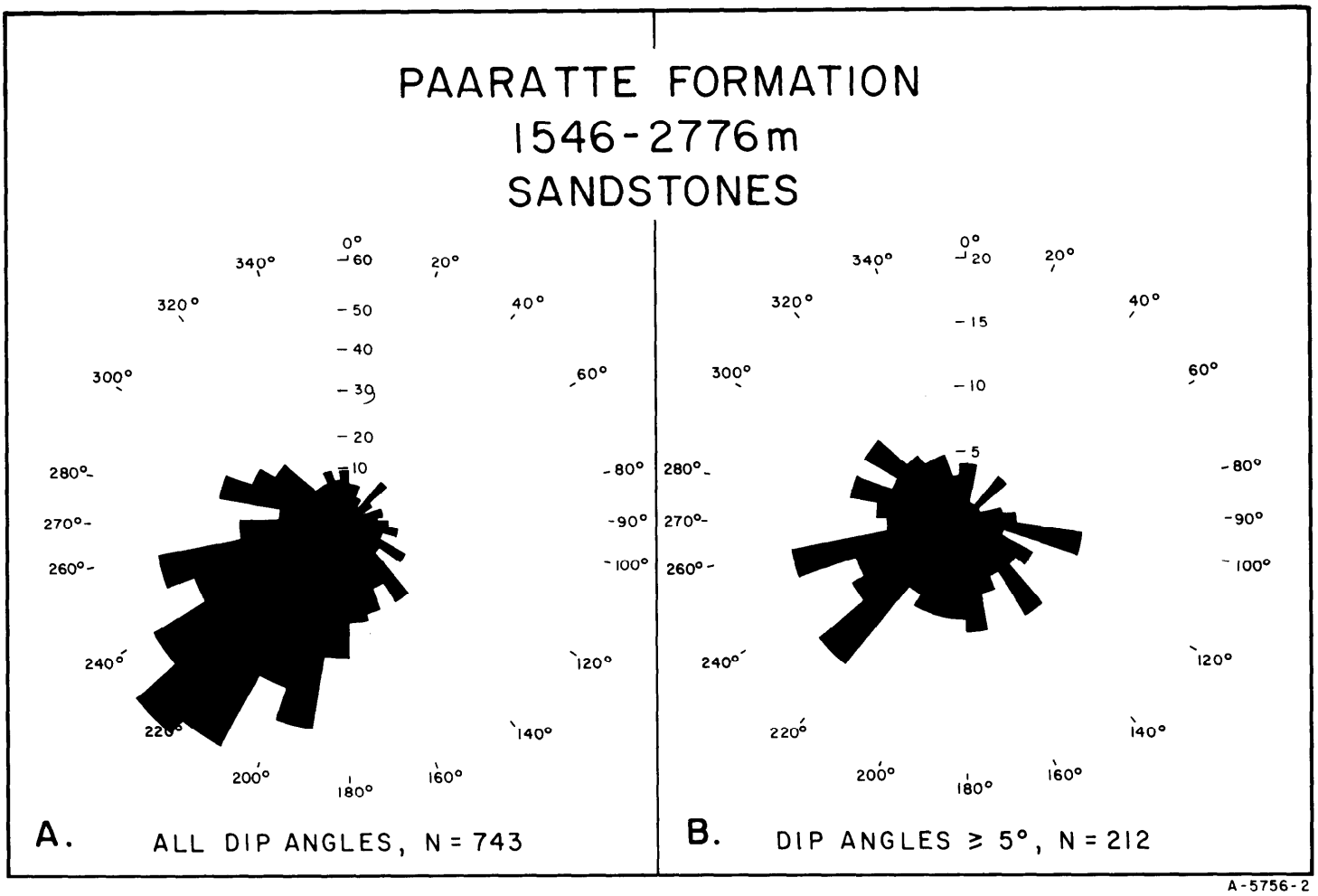
The Coniacian to Campanian Paaratte Formation conformably underlies the Curdies Formation in Discovery Bay No.1 and occurs over the interval 1546 to 2776 metres (TD). It comprises of an interbedded siltstone, sandstone, claystone, and minor coal sequence. Individual sandstones are similar to those of the Curdies Formation ranging up to 30 metres thick, very fine to fine grained, non-calcareous, with moderate intergranular porosity. Log characteristics, lithological, and palynological data show the environment of deposition to be predominantly deltaic plain with an increasing marine influence towards the lower section of the formation. Both polar plots indicate sedimentary dips to the southwest with no other component of dip direction apparent (Figures 2A and 2B). The paleocurrent direction generally agrees with that apparent in the overlying Curdies Formation, although a minor paleocurrent shift to the west is evident during deposition of this younger formation.

Previous regional studies of the Otway Basin and Permit Vic/P14 have suggested that during Upper Cretaceous times sedimentation was from the west with progradation towards the east. This conflicts with the present results from the Discovery Bay No.1 dipmeter log which indicates that the major source of sediment supply was to the northeast and east.



POLAR PLOT OF PALEOCURRENTS MEASURED FROM DIPMETER DATA, DISCOVERY BAY-1

FIGURE 1



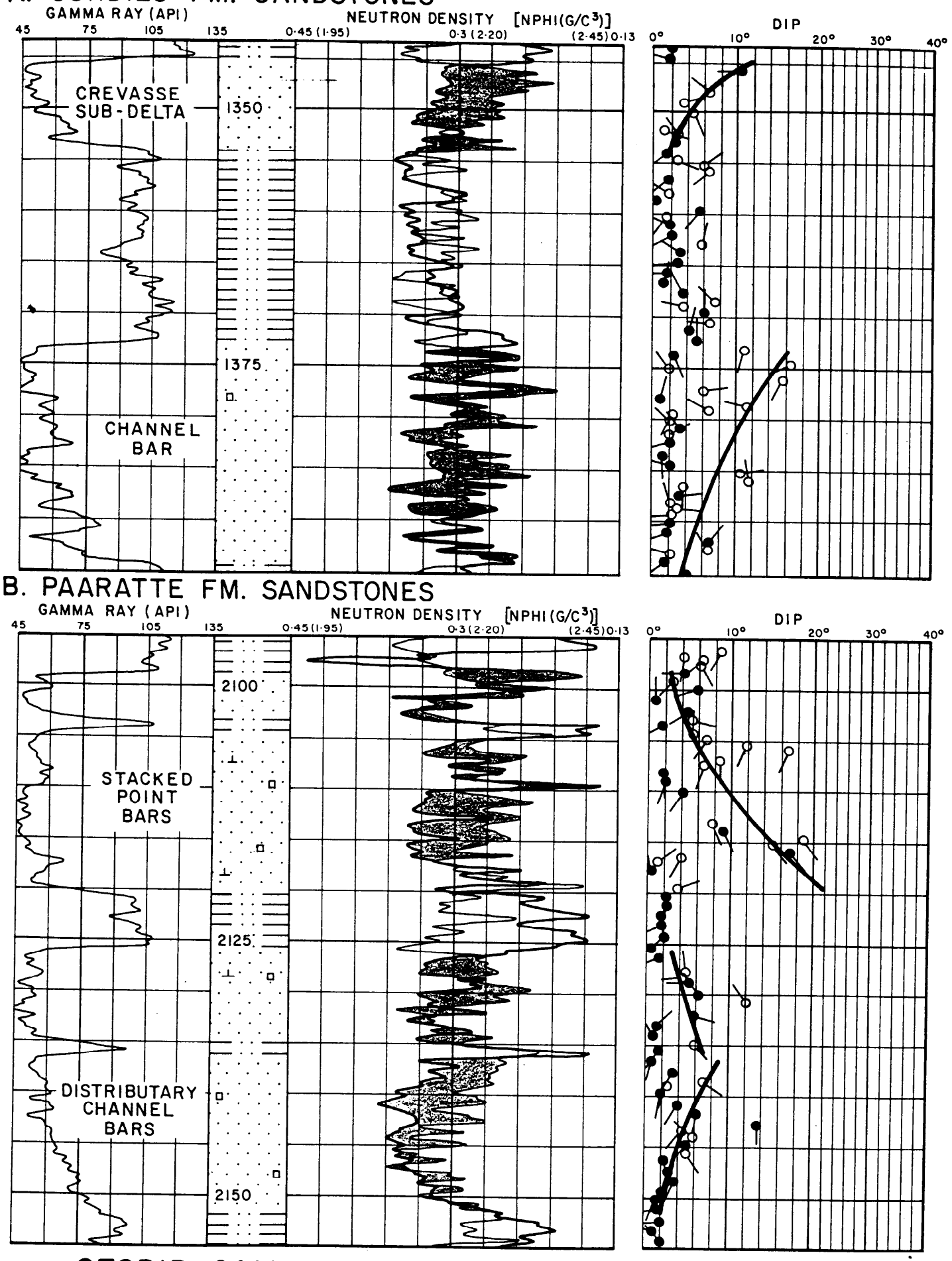
POLAR PLOT OF PALEOCURRENTS MEASURED FROM DIPMETER DATA, DISCOVERY BAY-1

FIGURE 2

Dip magnitudes within the sandstones are generally consistent, usually less than 20 degrees in the Curdies Formation and less than 15 degrees in the Paaratte Formation. Dips of up to 40 degrees reflecting a higher energy of deposition of coarser grained sandstones are rarely present. The sandstones at Discovery Bay No.1 are mainly slightly serrated to smooth cylindrical and occasionally bell shaped on the gamma-ray log, with common sharp basal contact (Figure 3A and 3B). Most of the sandstones are of moderate porosity and are moderately to well sorted as shown by the separation on the neutron-density combination logs.

Figure 3A shows a delta plain or delta front channel bar sandstone separated from a possible crevasse sub-delta, by a thick bay siltstone unit. Both sandstones are from within the Curdies Formation. The channel bar shows a smooth to slightly serrated funnel-cylindrical shape on the gamma-ray log, good porosity on the neutron-density combination logs, and low dip magnitudes with scattered dip azimuths on the Geodip log. The slight funnel influence on the gamma-ray trace indicating a coarsening upwards sand body agrees with the increase in dip magnitude apparent on the Geodip log. The overlying crevasse sub-delta displays similar characteristics to the thicker channel bar sandstone.

Figure 3B shows a distributary channel sandstone overlain by a stacked point bar sequence from within the deltaic-marginal marine Paaratte Formation. The lower channel sandstone displays a smooth funnel shaped gamma-ray trace indicative of a coarsening upwards sandstone, associated with an increase in dip magnitude and depositional energy. Low to moderate dip azimuth scatter implies a constant direction of channel flow. The series of stacked point bars with smooth to slightly serrated gamma-ray log traces are separated by thin bay siltstones. Dip magnitudes decrease upwards within the point bars, and the scattered dip azimuths imply continuous changes in current direction.



GEODIP, GAMMA RAY LOG SHAPE AND POROSITY RELATIONSHIPS, DISCOVERY BAY - I

A-5764

FIGURE 3

PE600095

This is an enclosure indicator page.
The enclosure PE600095 is enclosed within the container PE900181 at this location in this document.

The enclosure PE600095 has the following characteristics:

ITEM-BARCODE	**PE600095**
CONTAINER_BARCODE	**PE900181**
NAME	**Discovery Bay 1 Seismic Section with Stratigraphy, Enclosure 5**
BASIN	**Otway**
PERMIT	VIC/P14
TYPE	**SEISMIC**
SUBTYPE	**SECTION**
DESCRIPTION	**Discovery Bay 1 Seismic Section with Stratigraphy, Enclosure 5**
REMARKS	**Seismic Section with clear plastic overlay of Strat at the well and coloured annotation of the horizons**
DATE-CREATED	16/09/82
DATE-RECEIVED	23/03/83
W_NO	**W783**
WELL-NAME	**Discovery Bay 1**
CONTRACTOR	**PHILLIPS AUSTRALIAN OIL COMPANY**
CLIENT_OP_CO	

(Inserted by DNRE - Vic Govt Mines Dept)

PE600097

This is an enclosure indicator page.
The enclosure PE600097 is enclosed within the container PE900181 at this location in this document.

The enclosure PE600097 has the following characteristics:

ITEM-BARCODE	**PE600097**
CONTAINER_BARCODE	**PE900181**
NAME	**Discovery Bay 1 Operation Summary, Enclosure 1**
BASIN	**Otway**
PERMIT	VIC/P14
TYPE	**WELL**
SUBTYPE	**DIAGRAM**
DESCRIPTION	**Discovery Bay 1 Operation Summary, Enclosure 1**
REMARKS	
DATE-CREATED	30/11/82
DATE-RECEIVED	23/03/83
W_NO	**W783**
WELL-NAME	**Discovery Bay 1**
CONTRACTOR	**PHILLIPS AUSTRALIAN OIL COMPANY**
CLIENT_OP_CO	

(Inserted by DNRE – Vic **Govt Mines Dept)**

PE600098

This is an enclosure indicator page.
The enclosure PE600098 **is enclosed within the container PE900181 at this location in this document.**

The enclosure PE600098 has the following characteristics:

ITEM-BARCODE = PE600098
CONTAINER_BARCODE = PE900181
NAME = Discovery Bay 1 Master Log, Enclosure 2
BASIN = Otway
PERMIT = VIC/P14
TYPE = WELL
SUBTYPE = MUD-LOG
DESCRIPTION = Discovery Bay 1 Master Log
REMARKS =
DATE-CREATED = *
DATE-RECEIVED = 23/03/83
W_NO = W783
WELL-NAME = Discovery Bay 1
CONTRACTOR = PHILLIPS AUSTRALIAN OIL COMPANY
CLIENT_OP_CO =

(Inserted by DNRE - Vic **Govt Mines Dept)**

PE600101

This is an enclosure indicator page.
The enclosure PE600101 is enclosed within the container PE900181 at this location in this document.

The enclosure PE600101 has the following characteristics:

ITEM-BARCODE	**PE600101**
CONTAINER_BARCODE	PE900181
NAME	**Discovery Bay 1 Lithologic Log, Enclosure 3**
BASIN	**Otway**
PERMIT	VIC/P14
TYPE	**WELL**
SUBTYPE	**WELL-LOG**
DESCRIPTION	**Discovery Bay 1 Lithologic Log, Enclosure 3**
REMARKS	
DATE-CREATED	*
DATE-RECEIVED	23/03/83
W_NO	**W783**
WELL-NAME	**Discovery Bay 1**
CONTRACTOR	**PHILLIPS AUSTRALIAN OIL COMPANY**
CLIENT_OP_CO	

(Inserted by DNRE - Vic **Govt Mines Dept)**

PE600102

This is an enclosure indicator page.
The enclosure PE600102 **is enclosed within the container PE900181 at this location in this document.**

The enclosure PE600102 has the following characteristics:

ITEM-BARCODE	**PE600102**
CONTAINER_BARCODE	**PE900181**
NAME	**Discovery Bay 1 Well Log Plot, Enclosure** 6
BASIN	**Otway**
PERMIT	VIC/P14
TYPE	**WELL**
SUBTYPE	**WELL-LOG**
DESCRIPTION	**Discovery Bay 1 Well Log Plot, Enclosure** 6
REMARKS	
DATE-CREATED	9/02/83
DATE-RECEIVED	23/03/83
W_NO	**W783**
WELL-NAME	**Discovery Bay 1**
CONTRACTOR	**PHILLIPS AUSTRALIAN OIL COMPANY**
CLIENT_OP_CO	

(Inserted by DNRE – Vic **Govt Mines Dept)**

PE600112

This is an enclosure indicator page.
The enclosure PE600112 is enclosed within the container PE900181 at this location in this document.

The enclosure PE600112 has the following characteristics:

ITEM-BARCODE	**= PE600112**
CONTAINER_BARCODE	**= PE900181**
NAME	**= Discovery Bay 1 Composite Log, Enclosure 4**
BASIN	**= Otway**
PERMIT	**= VIC/P14**
TYPE	**= WELL**
SUBTYPE	**= COMPOSITE_LOG**
DESCRIPTION	**= Discovery Bay 1 Composite Log, Enclosure 4**
REMARKS	**=**
DATE-CREATED	**= ***
DATE-RECEIVED	**= 23/03/83**
W_NO	**= W783**
WELL-NAME	**= Discovery Bay 1**
CONTRACTOR	**= PHILLIPS AUSTRALIAN OIL COMPANY**
CLIENT_OP_CO	**=**

(Inserted by DNRE - Vic **Govt Mines** Dept)