W787

W787

WCR
HELIOS - 1
(W787)

PHILLIPS PETROLEUM 66

PHILLIPS AUSTRALIAN OIL COMPANY
PERTH, WESTERN AUSTRALIA

WELL COMPLETION REPORT

HELIOS NO. 1

PERMIT VIC/P18

VICTORIA

By

PHILLIPS AUSTRALIAN OIL COMPANY

Perth, Australia

June, 1983

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1.0 ENCLOSURES

SUMMARY

Drilling

The Helios No. 1 well was drilled from the Semi-Submersible drilling unit Diamond M "Epoch" in a water depth of 87 metres. The well was drilled to a total depth of 3500 metres * in 64 days.

The Diamond M "Epoch" arrived on location at 2100 hours on October 23, 1982. The well was spudded at 2145 hours on October 28. After drilling a 36-inch hole to 142 metres, hole fill problems were encountered. The rig was moved 12 metres and the second hole was spudded at 1320 hours on the October 29. Hole fill problems were encountered again after drilling to 159 metres. The rig was moved 18 metres and the third hole was spudded at 1830 hours on October 30. A 36-inch hole was drilled to 159 metres. The 30-inch conductor was then run with the casing shoe at 159 metres. Due to the hole fill problems, the conductor was partially jetted down.

After the 30-inch conductor was cemented, the 18-5/8 inch marine riser was run. Due to the strong current, several unsuccessful attempts were made to latch the riser to the wellhead housing. The riser was laid down and a 12-1/4-inch pilot hole drilled to 354 metres. The hole was then opened to 26-inches. The 20-inch conductor was run and cemented with the casing shoe at 341 metres.

*All depths quoted are from rotary kelly bushing located 23 metres above sea level.

The 16-3/4-inch blowout preventer stack was run with the riser. After latching on the wellhead and successfully testing the stack, a 12-1/4-inch 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 9.9 ppg. Drilling of the 12-1/4-inch hole continued to 1341 metres and electric logs were run. The hole was then underreamed to 17-1/2-inches. The 13-3/8-inch casing was run and cemented with the casing shoe at 1179 metres. (The casing was set high due to a bridge in the hole).

A formation leak-off test was performed after drilling 3 metres of new 12-1/4-inch hole below the 13-3/8-inch casing shoe. The test indicated that formation leak-off occurred at an equivalent mud weight of 14.8 ppg. Drilling of the 12-1/4-inch hole continued to 2929 metres. Electric logs and a velocity survey were run. Sidewall cores were taken throughout the open hole. Drilling of the 12-1/4-inch hole continued to 3000 metres. At this point the drillpipe torqued up, back lashed and unscrewed. The drillpipe was fished out of the hole and electric logs were run over this new short section of hole.

After the logs were completed, a 9-5/8-inch liner was run and cemented with the casing shoe at 2995 metres and the liner hanger at 1030 metres. The liner lap was squeezed twice with a total of 800 sacks of cement before it was sealed off.

The cement and 3 metres of 8-1/2-inch hole below the 9-5/8-inch casing shoe were drilled out. A formation leak-off test was performed and indicated that formation leak-off occurred at an equivalent mud weight of 14.5 ppg. Drilling of the 8-1/2-inch hole continued to the total depth of 3500 metres which occurred on December 6, 1982. Electric logs and a velocity survey were run. Sidewall cores were taken throughout the open hole. Preparations were made to plug back the well.

An EZ-SV cement retainer was set at 2965 metres. After several unsuccessful attempts to establish injection below the retainer, a balanced cement plug was placed from 2820 metres to 2963 metres. Preparations were made to run Drillstem Test No. 1.

The 9-5/8-inch casing was perforated from 2592 metres to 2610 metres. Drillstem Test No. 1 was performed on December 12, 1982. Wellsite results indicated that the formation was very tight. Preparations were made to plug and abandon the well.

An EZ-SV cement retainer was set at 2583 metres. After determining that the retainer was leaking, a balanced plug was placed from 2435 metres to 2583 metres. Another balanced plug was placed from 994 metres to 1055 metres. A further balanced plug was placed from 866 metres to 990 metres to assure that the 9-5/8-inch liner lap was sealed off.

After setting these plugs the 13-3/8-inch casing would not pressure test. An RTTS tool which was run to find the casing leak determined that the leak was just below the wellhead. To assure that the 13-3/8 x 20-inch annulus was sealed off, preparations for a squeeze job were made. The 13-3/8-inch casing was perforated from 248.4 metres to 249 metres. An EZ SV cement retainer was set at 240 metres. Injection was established and 500 sacks of cement were pumped below the retainer. After the squeeze job was completed another balanced plug was placed from 144 metres to 237 metres.

The BOP stack and riser were pulled and recovered. An explosive charge was detonated 8 metres below the 16-3/4-inch wellhead. The 16-3/4-inch wellhead, a 30-inch stub and a 13-3/8-inch stub were recovered.

The anchors were pulled and the "Epoch" departed the Helios No. 1 location at 0030 hours on December 22, 1982.

GEOLOGICAL

Helios No. 1 was the first exploration well drilled in Permit Vic/P18 The well was drilled to test the hydrocarbon-bearing potential of sands sealed immediately below the Top Latrobe Unconformity, a proven trapping horizon in the Gippsland Basin. In addition, the well evaluated two potential intra-Latrobe traps, namely, a possible submarine fan deposit related to the Paleocene shelf progradation and an Upper Cretaceous unconformity horizon.

Helios No. 1 was drilled in 87 metres of water to a total depth of 3500 metres. The well confirmed the presence of an overall transgressive sedimentary sequence ranging from the paralic-continental deposits of the Latrobe Group, to the overlying marine sequences of the Lakes Entrance, Gippsland Limestone and Jemmy's Point Formations. Several thin condensed marginal-marine units referred to as the Flounder, Colquhoun and Lakes Entrance Marl Formations occurred at the boundary between these two major stratigraphic sequences. Each of these formations were separated from the others by extra- and intra-formatational unconformities.

No samples were collected prior to drilling out of the 20-inch casing shoe at 340.5 metres. Late Miocene/Pliocene sediments of the Jemmy's Point Formation, composed of shallow marine shelf sands, silts, shales and calcarenites were encountered over the interval 345 metres - 510 metres. Marine calcarenites and marls of the Gippsland Limestone Formation, ranging from Late Middle to Upper Miocene in age occurred from 510 metres - 1430 metres. The lower part of this sequence was composed of calcareous submarine debris slumps and slides, scouring into the underlying Lakes Entrance Formation which extends from 1332 metres - 2567 metres. The latter was composed predominantly of siltstones and silty claystones, and was separated from the underlying Lakes Entrance Marl by a 12-17 metre hiatus at the Oligo-Miocene boundary.

Condensed sequences of the Flounder, Colquhoun and Lakes Entrance Marl Formations (of Mid-Eocene, Late Eocene and Early Oligocene age respectively) occurred between 2567-2659 metres and were largely composed of estuarine silts and clays with some minor sands.

At Helios No. 1, the Latrobe clastics, senso stricto, range in age from Campanian (?) to Early Eocene and are composed of interbedded sands, silts, shales and coals laid down in an oscillating beach-barrier bar environment located seaward of extensive back-barrier lagoons and coal swamps. Generally speaking, the sedimentary section becomes more continental downhole, with the well terminating in paludal coal measures at 3500 metres.

Only minor indications of hydrocarbons were encountered in Helios No. 1. Pin-point fluorescence was detected in silty sands of the Flounder Formation and log analysis confirmed the presence of residual hydrocarbons at this level. The secondary intra-Latrobe objective, originally interpreted as a Paleocene fan deposit was found to be comprised of stacked barrier-beach sands and was not sealed.

INTRODUCTION

Helios No. 1 was the first well to be drilled in Permit Vic/P18, which was awarded to Phillips Australian Oil Company (Operator), Mount Isa Mines Limited, and Lend Lease Petroleum Limited on September 2, 1981. Helios No. 1 was located at Latitude 38°41'40.446" South and Longitude 148°16'34.057" East, placing it 96 km (60 miles) offshore (Figure 1). Drilling was performed from the Diamond M "Epoch" Semi-Submersible drilling-unit in 87 metres (285 feet) of water.

Permit Vic/P18 is located in the southeastern portion of the Gippsland Basin, an east-west trending graben which developed during rifting and breakup of Australia from Antarctica. The Helios No. 1 well tested a significant seismically-defined structural anomaly at the Top Latrobe unconformity level. This primary objective was a dip-closed feature trending northwest-southeast, overlying two separate anomalous zones developed within the intra-Latrobe Group. The upper zone was interpreted as a submarine fan deposit associated with a Paleocene depositional slope which was highlighted by prominent clinoforms on seismic data. The deeper zone was identified with an apparent intra-Latrobe unconformity, considered to represent the top of an early regressive sequence.

Figure 1 to follow

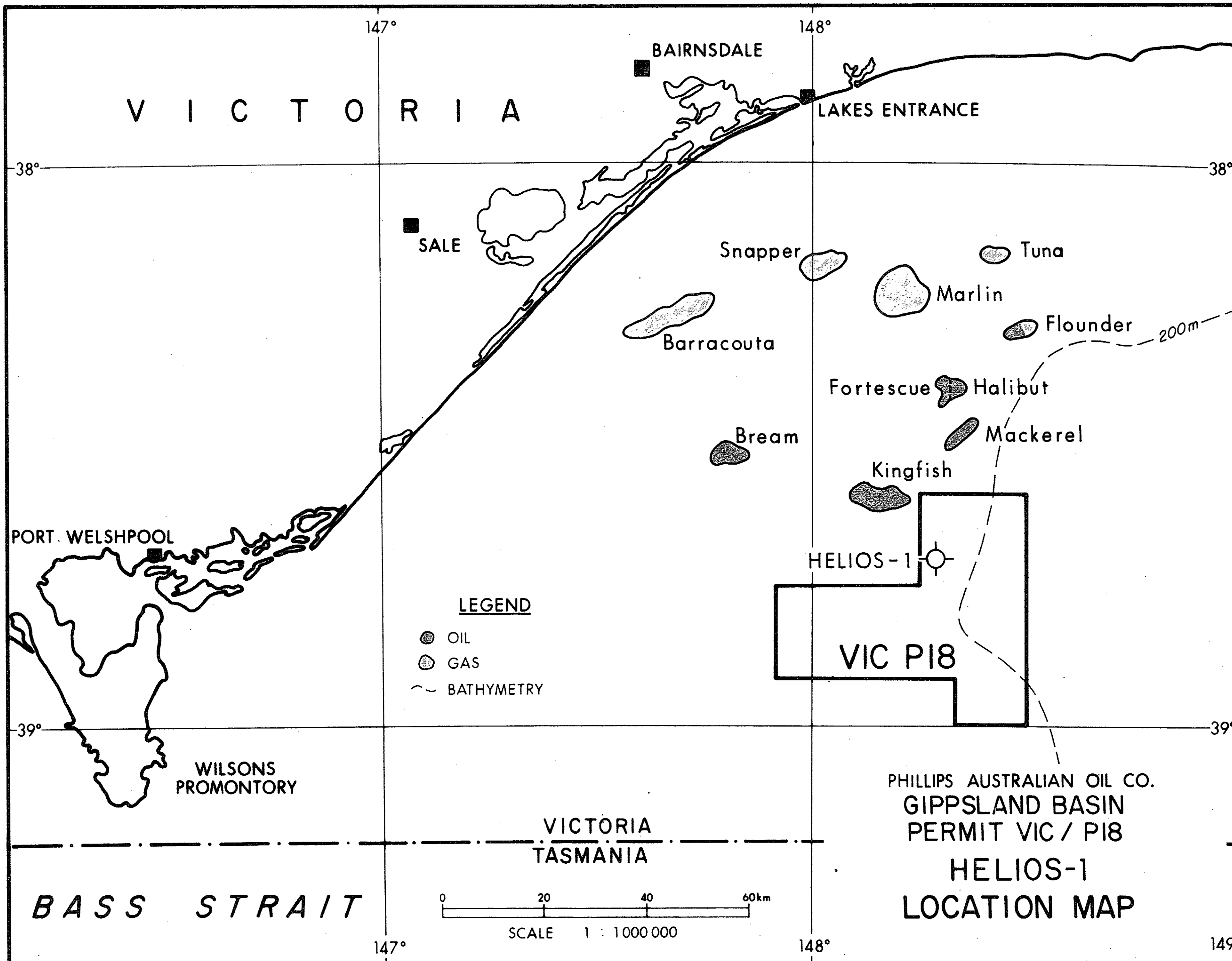
PE905100

This is an enclosure indicator page.
The enclosure PE905100 is enclosed within the container PE902616 at this location in this document.

The enclosure PE905100 has the following characteristics:

ITEM_BARCODE = PE905100
CONTAINER_BARCODE = PE902616
NAME = Location Map
BASIN = GIPPSLAND
ON_OFF = OFFSHORE
PERMIT = VIC/P18
TYPE = GENERAL
SUBTYPE = PROSPECT_MAP
DESCRIPTION = Helios 1 Location Map. Figure 1 of WCR.
REMARKS =
DATE_CREATED =
DATE_RECEIVED = 23/06/83
W_NO = W787
WELL_NAME = Helios 1
CONTRACTOR =
CLIENT_OP_CO = Phillips Australian Oil Company

(Inserted by DNRE - Vic Govt Mines Dept)



PHILLIPS AUSTRALIAN OIL CO.

GIPPSLAND BASIN
PERMIT VIC / P18

HELIOS-1
LOCATION MAP

FIGURE 1

A-5405-6A

WELL HISTORY

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

General Data

Well Name	:	Helios No. 1
Name and Address of Operator	:	Phillips Australian Oil Company 23rd floor, City Centre Tower 44 St. George's Terrace PERTH. W.A. 6000. (G.P.O. Box 2066W PERTH. W.A. 6001.)
Co-venturer Parties' Names and Addresses	:	Lend Lease Petroleum Limited Australia Square Tower, Level 36, SYDNEY. N.S.W. 2000 Mount Isa Mines Limited 15th floor, 160 Ann Street BRISBANE. QLD. 4000.
Exploration Permit	:	VIC/P18
District	:	Gippsland Basin, Victoria
Location	:	Lat. 38 degrees 41 min 40.446 sec South Long. 148 degrees 16 min 34.057 sec East
Elevations	:	Water depth 87 metres (285 feet) R/T to seabed 110 metres (358 feet)
Total Depth	:	3500 metres (11,482 feet) 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" Semi-Submersible 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	:	4 ea - 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 - H2S Trimmed/Vetco Ball Joint with MR-4B connector/C.I.W. Riser connector/Two hydrill annular preventers/Two-double "U" Cameron Ram preventors

B.O.P. Control System	:	Koomey with Acoustic Back-up
Choke Manifold	:	10,000 lbs working pressure - H2S 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 6E 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 Discovery Bay No. 1 location	0035	19th October, 1982
Arrived at Helios No. 1 Location	2100	23rd October, 1982
Spud No.1	2145	28th October, 1982
Spud No.2	1320	29th October, 1982
Spud No. 3	1830	30th October, 1982
TD	1630	6th December, 1982
Depart Location	0030	22nd December, 1982

Time Breakdown from transfer from Discovery Bay No. 1, till departure from Location

	Hours	%
Drilling	302.0	19.66
Reaming/Hole Opening	89.0	5.79
Cond. mud and circ.	76.5	4.98
Trips and making up BHA	372.0	24.22
Dev Survey	11.0	0.72
BOP Run/Retrieve	34.5	2.25
BOP Testing	17.0	1.10
Surface Equip. Test	3.5	0.23
Coring (Sidewall)	5.0	0.33
Logging	57.0	3.70
Cementing	25.5	1.66
DST/Leak off test	10.0	0.65
Repairs mechanical	28.5	1.86
Fishing	8.5	0.55
Delays	91.0	5.93
Weather delays	85.5	5.57
Move and positioning	75.5	4.91
Transit Respud move	5.0	0.33
Casing	41.5	2.70
Velocity survey	4.0	0.26
Anchoring	141.5	9.21
Other	52.0	3.39
	1536.0	100.00

WELL COMPLETION RECORDS

Included in Tables 1-10 are details concerning the drilling and testing of Helios No. 1. Enclosure No. 1 is the operational summary for Helios No. 1. A summary of daily operations is given in Appendix No. 2.

DRILLING FLUIDS

The hole was spudded using sea water, periodically flushing with high viscosity pills. Sea water-Drispac was used from 354 metres to 1341 metres. Brine-Baracarb was used from 1341 metres to Total Depth. Mud properties, materials and cost are given in Tables 11-13.

ABANDONMENT STATUS

Figure 2 shows the abandonment status for the Helios No. 1 well.

TABLE 1

HELIOS NO. 1

TOTCO SURVEY SUMMARY

Depth m (ft) RKB			Vertical Deviation - Degrees
119.5	(392)		0.5
143.9	(472)		Mis-run
143.9	(472)		Mis-run
143.9	(472)		1.0
158.8	(521)		0.0
248.5	(815)		0.5
353.7	(1160)	(12-1/4"-hole)	1.0
353.7	(1160)	(17-1/2"-hole)	0.5
608.5	(1996)		0.25
893.9	(2932)		0.75
1197.3	(3927)		0.5
1341.5	(4400)		0.75
1651.2	(5416)		0.75
1830.8	(6005)		0.5
1927.4	(6322)		Mis-run
2135.1	(7003)		0.5
2439.3	(8001)		2.0
2488.7	(8163)		1.0
2691.8	(8829)		0.5
2930.2	(9611)		1.0
3128.4	(10261)		1.5
3279.9	(10758)		2.0
3319.5	(10888)		2.25
3500.0	(11483)		2.25

TABLE 2

HELIOS NO. 1 CASING AND CEMENT

Permit VIC/P18

Elevations
RKB to MSL 23m (75 ft)
RKB to seabed 109m (358 ft)

Casing						Cement				
Date	Size	Weight	Grade & Coupling	Amount Run	Depth Set	Cuft Slurry	Class/Type	Slurry Weight	TOC	Additives
1.11.82	30"	1" wall	Vetco Squnch	52.69m	159.4m	1940	Class G/Neat mixed with seawater	14.04 PPG	seabed	1% CaCL
3.11.82	20"	133 lb/ft	X-56 Cameron JV Type LW	234.64m	340.6m	Lead 2910	Class G/Neat mixed with drillwater	13.1 PPG	seabed	2.5% gel-water
						Tail 575	Class G/Neat mixed with drillwater	15.8 PPG		
13.11.82	13-3/8"	72 lb/ft	N-80 Buttress	1071.14m	1178.8m	Lead 2134	Class G/Neat mixed with drillwater	12.4 PPG	188.0m	2.5% gel-water & 1.48% CFR-2L
						Tail 575	Class G/Neat mixed with drillwater	14.5 PPG		0.06% HR-6L
27.11.82	9-5/8"	47 lb/ft	S-95/L-80	1970.91m	2995.0m	Lead 2328	Class G/Neat mixed with drillwater	12.8 PPG	1570.0m	2.5% gel - water, 0.5% CFR-2 and 0.06% HR-6L

COMPANY [redacted] Oil Company	CONTRACTOR Diamond M	TABLE 3		COUNTY Victoria, Australia	STATE
LEASE Offshore	WELL NO Helios No. 1	SEC.	TOWNSHIP	RANGE	BLOCK Vic/P18 · FIELD Bass Strait

TOOL PUSHER	DRILL PIPE 5" Grade E & G			DRAW WORKS Oilwell E-3000	
DAY DRILLER	TOOL JOINT MAKE	SIZE 4½"	TYPE IF	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 1830 30 Oct. 1982
MORNING DRILLER	DRILL COLLAR NO 30	O D 6½	I D 2-13/16 · LENGTH 30'	PUMP NO 2 MAKE Oilwell · MODEL A1700 PT · STROKE 12"	T D DATE 1630 6 Dec. 1982

BIT NO.	BIT SIZE	BIT MFGR.	BIT TYPE	SERIAL NO. OF BIT	JET SIZE 1	JET SIZE 2	JET SIZE 3	DEPTH OUT	FTGE	HOURS RUN	ACC. HOURS	FT/HR	WEIGHT 1000 LBS.	ROTARY R.P.M	VERT. DEV.	PUMP PRESS	PUMPS No.	PUMPS Liner	PUMPS SPM	MUD Wt	MUD Vis	DULL CODE T	DULL CODE B	DULL CODE G	REMARKS FORMATION, CIRC. FLUID, ETC.	DATE
RR1	26"	HTC	1-F-1 OSC 3AJ	JL 109	28	28	28	521	163	15.5	15.5	10.5	0/2	100	1°	1200	1/2	6.5	260	8.8	100+	OK for re-run			Bit used on previous well	1/11/82
2	12¼"	Smith	SDS	CL 6310	o	u	t	1160	637	6.0	21.5	10.6	0/5	110	1°	1000	1/2	6.5	190	8.8	105	Mint				2/11/82
RR1	26"	HTC	OSC 3AJ	JL 109	28	28	28	1160	637	19.0	40.5	19.3	10	120	.5°	1700	1/2	6.5	220	8.8	100+	OK for re-run				3/11/82
RR2	12¼"	Smith	SDS	CL 6310	15	15	15	3927	2767	32.5	73	85.1	25	110	3/4°	2700	1/2	6.5	154	9.15	40	3/8	3/8	In guage		7/11/82
3	12¼"	Smith	SDS	CH 3854	15	15	15	4400	473	8	81	59	30/45	120	3/4°	2600	1/2	6.5	150	9.0	40	2	2	I		8/11/82
RR2	12¼"	Smith	SDS	CL 6310	out		18	4400	3336	52.5	133.5	63.5	20/35	120	3/4°	1800	1/2	6.5	200	9.1	38	3/8	3/8	I	Run with under-reamer	12/11/82
UR1	17½"	Servco	DT	718468	-	-	-	2128	1064	12	12	88.6	5/12	115	3/4°	1800	1/2	6.5	200	9.0	40	1/8	5/8	I		10/11/82
UR2	17½"	Servco	DT	718468	-	-	-	3226	1098	15.5	27.5	70.8	10/15	115	3/4°	1550	1/2	6.5	200	9.0	40	1/8	6/8	I		11/11/82
UR3	17½"	Servco	DT	718468	-	-	-	4152	926	17	44.5	54.5	20/25	110	3/4°	1800	1/2	6.5	200	9.1	39	3/8	3/8	I	2 cones loose. Bearing of 1 cone left in hole	12/11/82
UR4	17½"	Servco	DT	718468	-	-	-	4400	248	8	52.5	31	20/35	120	3/4°	1800	1/2	6.5	200	9.1	38	2/8	6/8	I		12/11/82
RR3	12¼"	Smith	SDS	CH3854	14	14	14	6005	1605	24.5	158	65.5	35/45	110	½°	2850	1/2	6.5	280	8.9	44	5	3	I		15/11/82
4	12¼"	Reed	HS5 1J	634437	14	14	14	6322	317	9.5	167.5	33.4	45	100	-	2800	1/2	6.5	280	9.2	41	2	2	I		16/11/82
5	12¼"	Smith	SDS	AO 87L	14	14	14	8163	1841	30.5	198	60.4	35/40	120	½°	2900	1/2	6.5	300	9.4	40	2	4	I		18/11/82
6	12¼"	Smith	SDGH	XB 2715	14	14	14	8829	686	26.5	224.5	25.1	45	120	½°	3000	1/2	6.5	276	9.8	42	7	6	I		20/11/82
RR4	12¼"	Reed	HS 5 1J	634437	14	14	14	9611	782	16.5	241	47.4	50	100	1°	2800	1/2	6.5	250	9.9	41	1	3	I		22/11/82
7	12¼"	Smith	F3	CJ 0069	15	15	14	9843	232	12	253	19.3	30/50	60	1°	2800	1/2	6.5	129	10.0	40	Good			Twist off	24/11/82
RR7	12¼"	Smith	F3	CJ 0069	15	15	14	9843	0	- wiper		trip	after	log	run -		1/2	6.5	-	10.0	39	Good			Run on SWC	27/11/82
8	8½"	Smith	F3	XA 7725	Open			9057	0	-	-	-	0	0	-	2000	1/2	6.5	180	10.0	38	New			RIH and tag cmt plug	28/11/82
RR4	12¼"	Reed	HS 51J	634437	Open			-	-	-	-	-	10/15	70	-	440	1/2	6.5	90	9.9	38				Drilling cmt plug on liner lap	29/11/82
RR8	8½"	Smith	F3	XA7725	11	11	11	9899	56	2.5	255.5	22.4	30	60	1°	2750	1	6.5	93	9.2	40	2	1	I	3 teeth missing, POOH for washout in jet	1/12/82
9	8½"	Smith	F3	XA7763	12	12	12	10764	863	42.5	298	20.3	30	60	2°	2500	1	6.5	100	9.2	39	3	3	1/8		4/12/82

SMITH REPRESENTATIVE ______ PHONE ______

[redacted]

CONTRACTOR — TABLE 3 (continued) — COUNTY — STATE

LEASE [redacted] WELL NO. [redacted] SEC. [redacted] TOWNSHIP [redacted] RANGE [redacted] BLOCK [redacted] FIELD [redacted]

TOOL PUSHER	DRILL PIPE	DRAW WORKS	
DAY DRILLER	TOOL JOINT MAKE SIZE TYPE	POWER H P	UNDER SURF
EVENING DRILLER	DRILL COLLAR NO O.D I D LENGTH	PUMP NO 1 MAKE MODEL STROKE	INT DATE
MORNING DRILLER	DRILL COLLAR NO O D I D LENGTH	PUMP NO 2 MAKE MODEL STROKE	T.D. DATE

BIT NO	BIT SIZE	BIT MFGR.	BIT TYPE	SERIAL NO. OF BIT	JET SIZE			DEPTH OUT	FTGE	HOURS RUN	ACC. HOURS	FT/HR	WEIGHT 1000 LBS.	ROTARY R.P.M	VERT. DEV.	PUMP PRESS	PUMPS			MUD		DULL CODE			REMARKS FORMATION, CIRC. FLUID, ETC.	DATE
					1	2	3										No.	Liner	SPM	Wt	Vis	T	B	G		
10	8½	Smith	FDGH	CK 4934	12	12	12	10888	124	17.5	315.5	7.1	25/40	60/100	2°	2600	1	6.5	100	9.3	42	8	3	1/8	All teeth missing	5/12/82
11	8½	Smith	F2	XA 7169	12	12	12	Reamed	only	-	-	-	5/10	60	2¼°	2600	1	6.5	100	9.2	41	6	6	I	Never used in guage	6/12/82
12	8½	Smith	F2	CH 6742	12	12	12	11483	595	341	25.5	23.3	35	60	2¼°	2550	1	6.5	100	9.2	40	4	3	I	POOH at T.D.	7/12/82

SMITH REPRESENTATIVE ______ PHONE ______

TABLE 4

HELIOS NO. 1

SQUEEZE RECORD

Date	Size of Casing	Retainer		Cement				
		Type	Set	Slurry Cuft	Class/Type	Slurry wti	Additives	Company
28.11.82	9-5/8", 47 lb, S-95/L-80	None	1024.1m (squeezed liner lap)	575	Class G/Neat	15.8 PPG	None	Halli-burton
29.11.82	9-5/8", 47 lb, S-95/L-80	None	1024.1m (resqueezed liner lap)	345	Class G/Neat	16.0 PPG	None	Halli-burton
13.12.82	9-5/8", 47 lb, S-95/L-80	EZ-SV	2583.2m	112	Class G/Neat	15.8 PPG	None	Halli-burton
15.12.82	13-3/8", 72 lb, N-80/Buttress	EZ-SV	240.2m	575	Class G/Neat	15.8 PPG	None	Halli-burton

TABLE 5

PERFORATING RECORD

HELIOS NO. 1

Date	Size of Casing	Perforating		No. of Metres Perforated	No. of Holes/ft.	Gun Dia.	Gun Type	Company
		To	From					
11.12.82	9-5/8", 47 lb, L-80/S-95	2591.4m (8502 ft)	2609.4m (8561 ft)	18m (59 ft)	4	4"	Casing	Schlumberger
15.12.82	13-3/8", 72 lb, N-80, buttress	248.4m (815 ft)	249.0m (817 ft)	0.6m (2 ft)	4	4"	Casing	Schlumberger

TABLE 6

HELIOS NO. 1

DST # 1 FORMATION TEST DATA

FLUID SAMPLER DATA

Chloride Content:-	36,000 ppm

EQUIPMENT & HOLE DATA

Net Productive Interval	2591.4 - 2609.4m (8502 - 8561 ft.)
All Depths Measured from	RKB
Total Depth	2818.8m (9248 ft.) Plug Back T.D.
Main Hole/Casing Size	9-5/8"
Mud Weight/Viscosity	9.2 lb/gal/40 sec
Drill Collar Length	113.7m (373 ft.) 6.5" ID 2.813"
Drill Pipe Length	2432.9m (7982 ft.) 5" ID 4.276"
Packer Depth(s)	2582.9m (8474 ft.)
Depth Tester Valve	APR-N 2571m (8435 ft.)

Recovered 28m (92 ft) of mud

Note: 1.232 bbl∅stroke 100% efficiency

Remarks: Samples taken at choke manifold during reverse circulation period.

Temperature	Gauge No. 7982 Bottom Depth: 2589m (8494 ft.)	Gauge No. 7981 Top Depth: 2576m (8453 ft.)	Time
175°F at 8499 feet	48 hour clock	72 hour clock	Tool Opened 2155 hrs 11.12.82
	Blanked off: Yes	Blanked off: No	Tool Closed 0019 hrs 12.12.82

TABLE 7

HELIOS NO. 1

DST NO. 1 TEST READINGS (12th December, 1982)

Device No. : 7982
B.T. Gauge Depth : 2589 metres (8494 feet)
48 Hr Clock No. 10878
Guage Depth Temp 175°F

		THOUSANDS OF INCH	PRESSURE P.S.I.
Initial Hydro Mud Pressure		2.466	4093.7
1st	Initial Flow Pressure	0.367	612.0
	Final Flow Pressure	0.371	618.7
	First Closed In Pressure	1.836	3034.3
2nd	Initial Flow Pressure	0.384	642.1
	Final Flow Pressure	0.410	685.6
	Second Closed In Pressure	1.731	2878.6
Final Hydrostatic Mud Pressure		2.410	4001.5

Device No. : 7981
B.T. Gauge Depth : 2572.54m (8440 ft)
72 Hr Clock No. 26226
Est. Gauge Depth Temp 175°F

		THOUSANDS OF INCH	PRESSURE P.S.I.
Initial Hydrostatic Mud Pressure		2.432	4037.7
1st	Initial Flow Pressure	0.351	585.3
	Final Flow Pressure	0.359	598.7
	First Closed In Pressure	1.822	3031.2
2nd	Initial Flow Pressure	0.374	625.4
	Final Flow Pressure	0.400	668.9
	Second Closed In Pressure	1.731	2878.6
Final Hydrostatic Mud Pressure		2.413	4004.8

TABLE 8

HELIOS NO. 1

DST #1 PRODUCTION TEST DATA

Time	Choke Size	Surface Pressure PSI	Remarks
12.11.82 0200	0.5		Making up slip joints on doubles.
0300			Started making up tools.
0405			Loaded B.T. # 7981 - 72 hour clock # 26226
0445			Loaded B.T. # 7982 - 48 hour clock # 10878.
0605			Bottom slip joints in hole.
1720			Set packer @ 8474' with 20.000# of weight. Waiting on Flo-Petrol.
1940			Closed lower pipe rams - pressured annulus to 1400 psi. APR-N Open - Flo-Petrol surface manifold plugged
1955			Released annulus psi to close APR-N
2155			Opened APR-N with 1400# with a good blow - only bubble hose was open.
2200		2#	Good blow - only bubble hose open.
2205		2	"
2210		2	"
2215		2	"
2220		2	"
2225		2	Good blow-annulus psi dropping.
2230		2	Good blow - psi annulus to 1400#.
2300		2	Good blow - annulus psi dropping. 200 psi in 15 minutes - pressured annulus to 1400#.
2305		2	Good blow - no fluid to the surface - only bubble hose open.
2335		0	Opened choke - manifold to flow line - no choke.
2345		0	No blow - annulus psi continues to fall - 200# in 15 minutes.
12.12.82 0000		0	No blow - well was dead.
0018			Opened APR-M2 circulating safety valve with 2800#.
0218			Unseated the packer.
1330			Tools out of the hole.

TABLE 9

HELIOS NO. 1

DST #1 JOB LOG

Date	Time	Operation
		DST NO. 1 : 11-12-82 to 12-12-82
		PERFORATIONS : 8502 - 8561 ft.
		PACKER DEPTH : 8474 ft.
		Schlumberger RIH to perforate interval 8502' - 8561' RIH Halliburton test string
11-12-82	16 00	Function test EZ tree on rig floor
	16 10	EZ tree RIH
	16 40	Set RTTS Packer and pressure test surface lines
	19 40	Open APR test tool for initial flow
	19 55	Shut in for initial build up
	21 55	Open APR test tool to bubble hose for flowing period
	23 35	Switch flow through 3/8" fixed choke and 1-1/4" adjustable choke to flare
	23 44	Flow switched to burners and flare
12-12-84	00 05	Well shut in at choke manifold - flowing through bubble hose
	00 18	Close APR-N test tool
	00 25	Reverse circulate - collect samples at choke manifold
	05 00	POOH test string
	05 55	EZ tree on surface

TABLE 10

HELIOS NO. 1

DST #1 TOOLS DESCRIPTION

	O.D. in	I.D. in	LENGTH m (ft)	DEPTH m (ft)
Drill Pipe	5.000	4.276	430.1 (1411.2)	
Crossover	6.000	2.750	1.2 (1.4)	
Slip Joint	5.000	2.000	5.6 (18.5)	
Slip Joint	5.000	2.000	4.1 (13.5)	
Crossover	5.000	2.250	0.3 (1.0)	
Drill Pipe	5.000	4.276	2002.8 (6570.8)	
Crossover	6.500	2.000	0.24 (0.8)	
Slip Joint	5.000	2.000	5.6 (18.5)	
Slip Joint	5.000	2.000	4.1 (13.5)	
Crossover	6.000	2.000	0.67 (2.2)	
Drill Collars	6.500	2.813	85.3 (279.8)	
Crossover	6.000	2.250	0.3 (1.0)	
APR Circulating Valve	5.030	2.250	0.91 (3.0)	2536.8 (8322.7)
APR Circulating Valve	5.000	2.250	2.28 (7.5)	2537.7 (8325.7)
Crossover	6.000	2.250	0.3 (1.0)	
Drill Collars	6.500	2.813	28.4 (93.2)	
Crossover	6.500	2.000	0.61 (2.0)	
Handling Sub and choke assembly	3.500	2.250	1.83 (6.0)	
Crossover	4.800	2.000	0.52 (1.7)	
Drain Valve	5.000	2.000	0.3 (1.0)	
Crossover	4.800	2.000	0.21 (0.7)	
Apr-N Tester	5.000	2.250	3.9 (12.8)	2571.0 (8435.0)
Crossover	5.000	2.250	0.3 (1.0)	
AP Running Case	5.000	2.370	1.25 (4.1)	2453.9 (8051.0)
Crossover	5.000	2.250	0.3 (1.0)	
Jar	4.625	2.370	1.52 (5.0)	
Crossover	6.200	2.250	0.49 (1.6)	
RTTS Circulating Valve	6.120	3.000	0.98 (3.2)	2578.9 (8461.0)
RTTS Safety Joint	6.120	3.120	1.1 (3.6)	
Casing Packer	8.250	3.750	1.8 (5.9)	2582.9 (8474.0)
Crossover	6.000	1.500	0.34 (1.1)	
Perforated Tail Pipe	5.000	2.370	4.57 (15.0)	
Blanked-off Running Case	5.000	2.440	1.2 (4.1)	2589.2 (8494.5)
TOTAL DEPTH				2818.8 (9248.0)

TABLE 11

HELIOS NO. 1

MUD PROPERTIES

Depth (m)	Hole Size (inches)	Temp (°C)	Weight (ppg)	Viscosity (sec)	PV -	YP -	PH -
133	36	-	8.9	85	-	-	-
147	36	-	8.8	115	31	39	10.0
137	36	-	8.8	-	25	80	10.0
369	12-1/4	-	8.7	35	6	5	9.0
976	12-1/4	35	9.1	40	6	6	11.0
1209	12-1/4	39	9.0	38	5	6	10.0
1341	12-1/4	33	9.0	40	10	8	10.5
1341	12-1/4//17-1/2	28	8.9	38	9	7	9.5
674	17-1/2	27	9.0	39	8	11	10.5
1026	17-1/2	27	9.1	40	6	7	10.0
1320	17-1/2	31	9.1	38	6	7	10.0
1341	17-1/2	32	9.0	40	8	10	10.5
1393	12-1/4	28	8.9	46	12	14	10.0
1830	12-1/4	33	9.1	40	11	11	9.5
1970	12-1/4	32	9.3	40	9	10	10.0
2345	12-1/4	28	9.4	39	10	8	9.5
2510	12-1/4	32	9.6	42	11	13	10.0
2665	12-1/4	35	9.8	41	11	11	9.5
2733	12-1/4	37	9.9	44	20	15	10.0
2930	12-1/4	37	9.8	41	11	14	10.0
2930	12-1/4	32	9.9	42	12	14	10.0
2930	12-1/4	32	9.8	42	12	14	20.0
2982	12-1/4	33	10.0	40	9	9	9.0
3001	12-1/4	-	10.0	40	12	11	9.0
3001	12-1/4	32	10.0	38	9	8	8.3
3001	12-1/4	32	10.0	39	9	10	8.3
3001	12-1/4	-	10.0	39	9	10	8.3
3001	12-1/4	-	9.9	38	9	7	8.3
3012	8-1/2	30	9.2	38	9	8	9.0
3023	8-1/2	30	9.2	40	9	9	9.0
3107	8-1/2	32	9.2	40	11	11	8.5
3194	8-1/2	32	9.2	39	11	11	8.5
3280	8-1/2	-	9.3	42	14	15	8.3
3313	8-1/2	32	9.1	41	13	12	8.5
3319	8-1/2	32	9.2	40	13	15	8.3
3401	8-1/2	32	9.2	41	14	16	8.5
3500	8-1/2	-	9.2	42	18	17	9.5
2955	8-1/2	-	9.2	41	18	17	9.5
2820	-	-	9.2	40	17	15	9.5
2820	-	-	9.2	40	17	15	9.5
866	-	-	9.2	40	10	12	9.5

TABLE 12

HELIOS NO. 1

MUD MATERIALS

Type	Unit	Quantity
Aquagel (bulk)	100 lbs	1012
Aquagel (sacks)	100 lbs	878
Baracarb	25 kg	328
Baradefoam	20 ltr	10
Benex	2 lbs	11
Calcium chloride	25 kg	832
Caustic soda	70 kg	171
Dextrid	50 lbs	170
H.E.C.	25 kg	110
Desco	25 lbs	31
Lime	25 kg	10
Drispac	50 lbs	218
Potassium chloride	50 kg	1621
Q-Broxin	25 kg	61
Soda Ash	40 kg	74
Torq trim	55 gal	8
XC Plymer	50 lbs	123
Baroid (Bulk)	100 lbs	2325
Mud Chemicals	BBL	836
Fresh water	BBL	7635
Sea Water	BBL	8935
Total Mud made	BBL	17406

TABLE 13

HELIOS NO. 1

MUD COST

Interval	Hole Size	Cost A$
Seabed to 159m	36"	21,039.98
159m to 354m	26"	12,772.12
354m to 1341m	17-1/2"	37,356.88
1341m to 3000m	12-1/4"	89,248.30
3000m to 3500m	8-1/2"	32,154.10
	TOTAL	192,571.38

HELIOS No.1 – ABANDONMENT STATUS

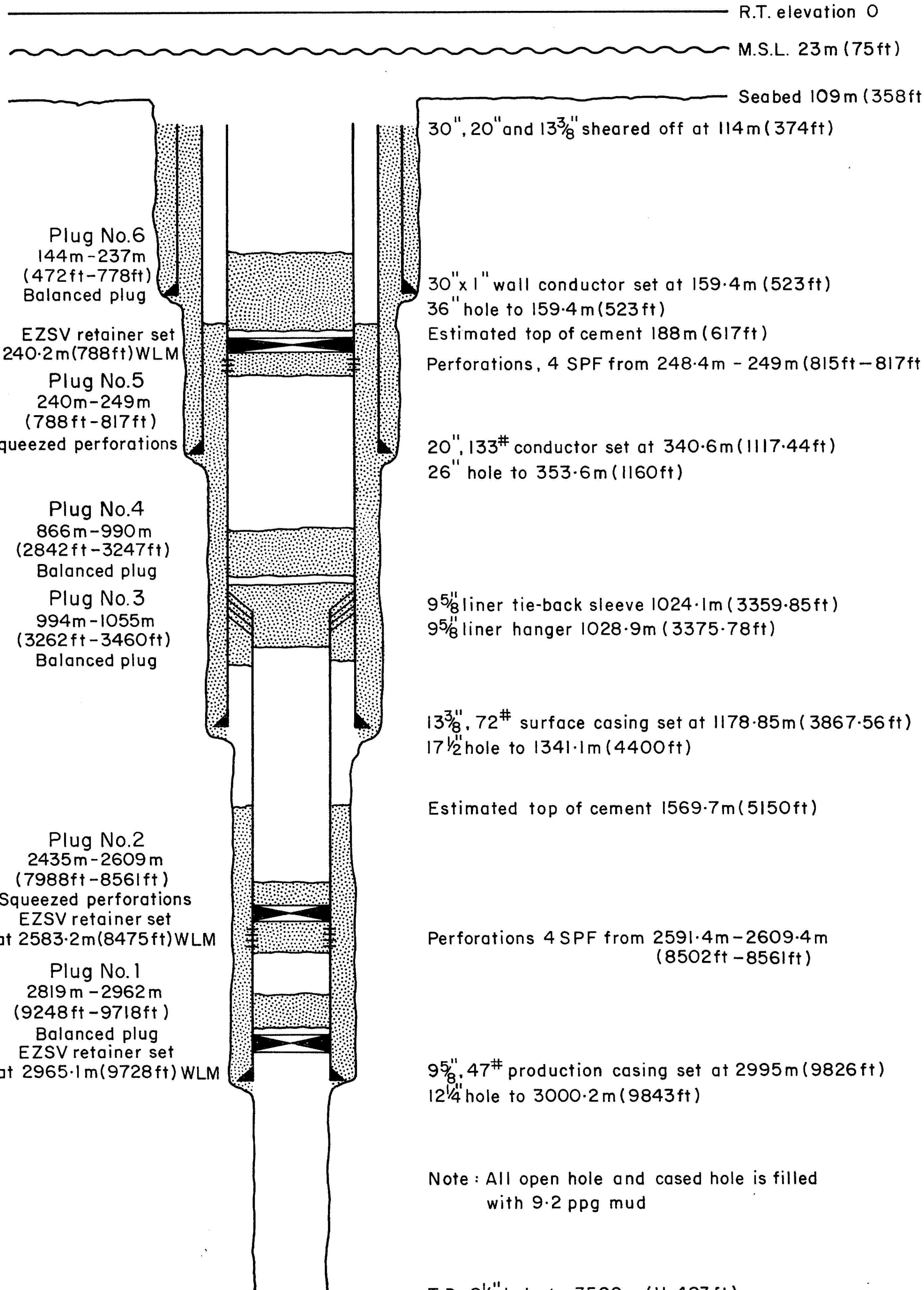


FIGURE 2
A-5778

GEOLOGY

SUMMARY OF PREVIOUS INVESTIGATIONS

Offshore exploration in the Gippsland Basin began in the 1950's when the Bureau of Mineral Resources conducted regional gravity and aeromagnetic surveys over limited onshore and offshore areas. The main exploration effort began in 1960 when Broken Hill Proprietary Ltd. (BHP) through their 100% owned subsidiary, Hematite Petroleum Ltd., applied for exploration permits over the major portion of the offshore Gippsland Basin. Results of regional aeromagnetic and reconnaissance seismic surveys were so encouraging that by May 1964, Esso Australia Ltd. and Hematite Petroleum Ltd. (BHP) had concluded an agreement for the joint exploration of the offshore Gippsland Basin.

On June 5 1965, Barracouta No. 1, the first offshore Gippsland Basin well was plugged and abandoned as a gas discovery. To date more than 90 exploration and step-out wells have been drilled in the offshore Gippsland Basin. Twelve oil and gas fields have been declared commercial by Esso/BHP since 1965 with recoverable reserves of approximately 3.6 billion barrels of oil and 8 trillion cubic feet of gas.

Following the second mandatory relinquishment of a portion of Permit Vic/P1, Phillips Australian Oil Company and co-venturers were granted Exploration Permit Vic/P18 on September 2, 1981. A 2,303 km seismic survey was recorded in November/December, 1981 with processing completed by early April, 1982. Permission to drill Helios No. 1 was granted by the Victorian Department of Minerals and Energy on October 14, 1982.

REGIONAL GEOLOGY

The development of the Gippsland Basin can be attributed to two separate phases of continental rifting and separation, firstly that of the Lord Howe Rise and New Zealand land mass from eastern Australia in Late Jurassic - Late Cretaceous time and secondly that of Antarctica from southern Australia in Late Cretaceous - Early Eocene time. Both phases are part of the fragmentation of Eastern Gondwanaland.

The Gippsland Basin developed as a consequence of a divergent wrench shear associated with early rifting, as did also the en-echelon Bass, Torquay and Otway Basins. These wrench shear zones developed in narrow linear rift basins linking the main extensional rift around the southern and eastern margins of the Australian continental plate. The first major unconformity in the Gippsland Basin is seen at the base Upper Jurassic and is related to the onset of rifting between south-eastern Australia and the Lord Howe Rise. The Tasman Sea breakup unconformity is the second major unconformity in the Gippsland Basin and can be correlated with the top of the Strzelecki Group sediments.

With continued divergent wrench motion between southeastern Australia and Tasmania during the Late Cretaceous to Eocene, second-order left-lateral wrench motion along northwest-southeast trending extensional faults (tension gashes) became the loci for wrench-induced anticlines along pre-existing faults. The wrench-induced anticlines were probably oriented in a northnorthwest-southsoutheast direction and may have been an early origin of the Helios structure. With continued opening of the Tasman Sea most of the extensional faults were downthrown to the northeast.

During this period, fluvial-paralic clastics and coals of the Latrobe Group were deposited in the Gippsland Basin. An unconformity and/or transgressive sequence at the top of the Late Cretaceous may be related to the onset of rifting in the Southern Ocean. An unconformity at the top of the Latrobe coarse clastic sequence is related to the breakup of Antarctica from Australia in latest Early Eocene time.

During Mid-Eocene time there was a change from divergent to convergent wrench motion along the Gippsland-Otway trend. The mechanisms of this change are not fully understood since the relative over-riding motion between Australia and Antarctica appears to be extensional. Divergent wrench motion between Tasmania and Australia at this time may, however, have been related to incipient movement along fracture zones in the Tasman Sea.

The consequences of the change from divergent to convergent wrench motion were expressed along the northern rift shoulder of the basin. A series of compressional wrench-induced anticlines developed on the northern rift shoulder at a new orientation to the pre-existing wrench anticlinal fabric. This new system developed in an eastnortheast-westsouthwest direction and largely grew where listric basin-bounding faults on the northern rift shoulder were able to move in a horizontal fashion. That is, they were reactivated to become wrench faults. Convergent wrenching has continued right up to the present day.

Figure 3 to follow

PE905101

This is an enclosure indicator page.
The enclosure PE905101 is enclosed within the container PE902616 at this location in this document.

The enclosure PE905101 has the following characteristics:

ITEM_BARCODE =	PE905101
CONTAINER_BARCODE =	PE902616
NAME =	Structural Trends
BASIN =	GIPPSLAND
ON_OFF =	OFFSHORE
PERMIT =	VIC/P18
TYPE =	GENERAL
SUBTYPE =	GEOL_MAP
DESCRIPTION =	Helios 1 Structural Trends Map. Figure 3 of WCR.
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	23/06/83
W_NO =	W787
WELL_NAME =	Helios 1
CONTRACTOR =	
CLIENT_OP_CO =	Phillips Australian Oil Company

(Inserted by DNRE - Vic Govt Mines Dept)

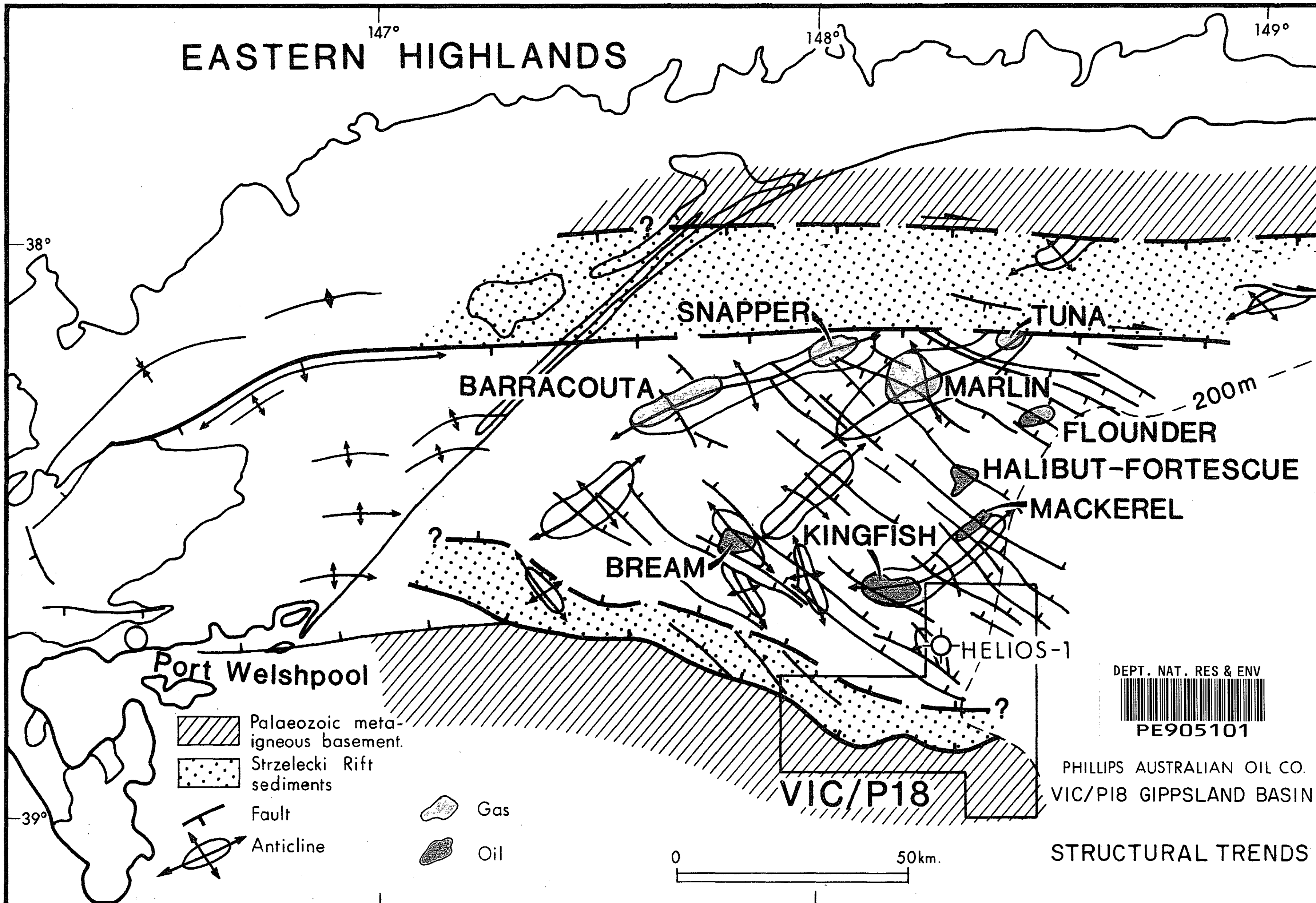


FIGURE 3

A-5588

STRATIGRAPHY

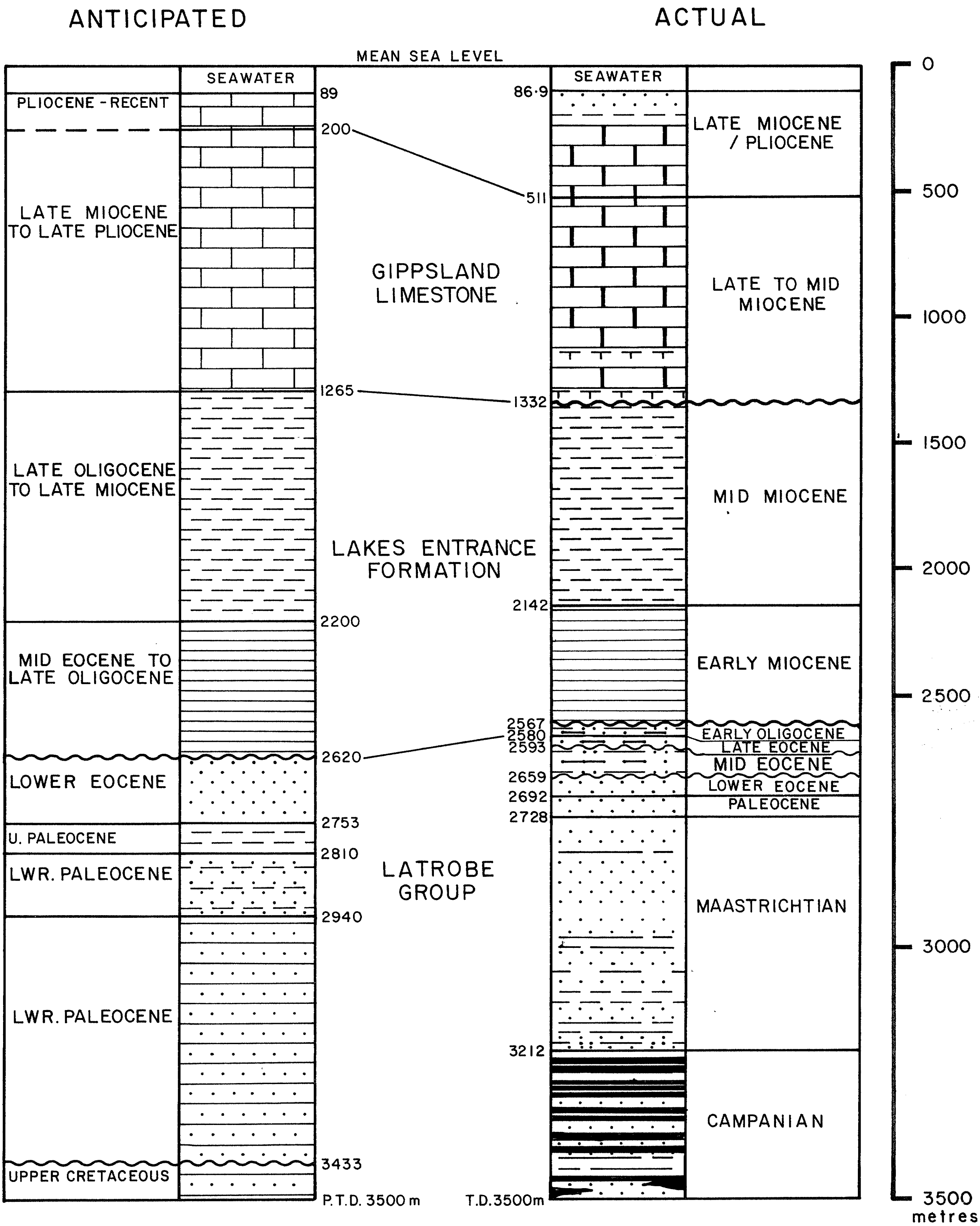
The stratigraphic section penetrated in Helios No. 1 extends in age from Recent to Upper Cretaceous (Campanian) time. Anticipated versus actual stratigraphic sections are shown in Figure 4 while nomenclature, lithology and respective ages are shown in Figure 5.

Formation tops and ages are based on lithological, micropaleontological and palynological study of sidewall cores and drill cuttings used in conjunction with wireline log characteristics and further backed by correlation with the nearby Bonita No. 1 well (Table 14). Ages for the Late Tertiary section are based on micropaleontological data, whereas those for the Early Tertiary and Late Cretaceous sections are based on palynological (spore-pollen and dinoflagellate) data.

A hiatus exists within the Oligocene where, over a time span of twelve to seventeen million years, no sediment is represented. This hiatus, or dislocation, is referred to as the Cobia Event and is related to the final opening of a deep sea way between Australia and Antarctica. This caused a major eustatic sea level drop, a sudden temperature decline and increase in the calcium carbonate budget of the Southern Ocean. Another large hiatus of approximately eight million years duration exists between the Mid Eocene and Late Eocene. This hiatus is probably related to episodic marine ingressions/regressions within the condensed sequences which were in response to eustatic sea-level and/or local tectonic adjustments. The sudden sea-level fall of one episode may have obliterated, by erosion, the evidence of a previous episode, as is shown by the fact that all condensed sequences are not represented in many portions of the Gippsland Basin.

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 Geoservices Mud Log and Geologist's Litholog (Enclosures 2 and 3 respectively). A detailed summary of final stratigraphic interpretations for Helios No. 1 is presented on the Well Composite Log (Enclosure 4). Petrographic descriptions of sediments from the Upper Eocene - Cretaceous Latrobe Group are presented in Appendix 5.

HELIOS-1 STRATIGRAPHY



DEPTHS (m) MEASURED FROM R.K.B.

A-5803

FIGURE 4

HELIOS-1 STRATIGRAPHIC TABLE

ERA	PERIOD	EPOCH / STAGE	M.Y.B.P.	FORMATION OR FM. EQUIV.	LITHOLOGY	DEPTH (m below R.K.B.)	THICKNESS (m)
CAINOZOIC	NEOGENE	PLEISTOCENE / HOLOCENE	1·5	NOT SAMPLED			
CAINOZOIC	NEOGENE	PLIOCENE (L / E)	2·5, 5	JEMMYS POINT FM.	SANDSTONE, SHALE SANDY CALC, CALC	≤ 345 – 511	166
CAINOZOIC	NEOGENE	MIOCENE – LATE / MID	10	GIPPSLAND LIMESTONE	CALCARENITE AND MARL	511 – 984	473
CAINOZOIC	NEOGENE	MIOCENE – MID		CANYON FILL MBR. OF GIPPSLAND LST. (MIOCENE CHANNEL)	MARL AND CALCARENITE	984 – 1332	348
CAINOZOIC	NEOGENE	MIOCENE – MID / EARLY	15	LAKES ENTRANCE FM. (TASMAN SEA CARBONATES WITH OOZES)	CLAYSTONE, SILTSTONE, SILTY CLAYSTONE; Intra-Lakes Entrance Marker	1332 – 2142	810
CAINOZOIC	NEOGENE	MIOCENE – EARLY			SILTSTONE	2142 – 2567	425
				12 - 17 M.Y.		2567 – 2567	
CAINOZOIC	PALEOGENE	OLIGOCENE – EARLY	24, 36·5	LAKES ENT. MARL (EQUIV)	SILTSTONE, SANDSTONE	2567 – 2580	13
CAINOZOIC	PALEOGENE	EOCENE – LATE		COLQUHOUN FM.	SANDSTONE	2580 – 2593	13
				8 M.Y.		2593 – 2593	
CAINOZOIC	PALEOGENE	EOCENE – MID	39·5	LATROBE GROUP: FLOUNDER FM. (Top Latrobe U/C)	INTERBEDDED SILTSTONE AND SANDSTONE	2593 – 2659	66
CAINOZOIC	PALEOGENE	EOCENE – EARLY		LATROBE GROUP: LATROBE CLASTICS	SANDSTONE	2659 – 2692	33
CAINOZOIC	PALEOGENE	PALEOCENE	53	LATROBE GROUP: LATROBE CLASTICS	SANDSTONE WITH VERY MINOR CLAYSTONE	2692 – 2728	36
MESOZOIC	CRETACEOUS	UPPER CRETACEOUS – MAASTRICHTIAN	64·5	LATROBE GROUP: LATROBE CLASTICS	SANDSTONE, CLAYSTONE, SILTY SANDSTONE, SILTSTONE, VERY MINOR SHALE	2728 – 3212	484
MESOZOIC	CRETACEOUS	UPPER CRETACEOUS – CAMP.	72	LATROBE GROUP: LATROBE CLASTICS	SANDSTONE, CLAYSTONE, SILTSTONE, COAL	3212 – 3500	288+

R.K.B. 23m ABOVE M.S.L.
WATER DEPTH : 86·86 m

A-5879

FIGURE 5

Tertiary

Late Miocene to Pliocene : Jemmy's Point Formation, 345m - 511m (166m):

This is an interbedded sequence of soft to moderately hard sands, silts, shales and calcarenites laid down in a high energy system with water depths of less than 100 metres. The sands are composed of dark grey, well-sorted, very fine grained quartz, grading to sandy calcarenite and silty sand with up to 50% clay matrix. Interbedded shales are dark grey, fissile to sub-fissile, with interspersed dolomitic and siliceous cement.

Late Middle Miocene to Late Miocene : Gippsland Limestone, (Massive Calcarenite) 511m - 984m (473m):

The naming of this unit is based tenuously on the echinoid Clypeaster gippslandicus which is commonly found near the top of the sequence. It consists of light grey to cream, dark grey calcarenite, with very fine-to-fine grained calcite grains held in calcareous clay matrix. It also exhibits a sucrosic texture, with minor amounts of very fine grained quartz grains. Throughout the sequence are a number of benthonic foraminifera and varying percentages of planktonic organisms. The sequence characteristically represents rapid filling of a submarine canyon topography by prograding calcareous shelf-slope deposits leading to gradual decrease in depositional depth towards the end of the Late Miocene.

<u>Mid Miocene : Canyon Fill Member of the Gippsland Limestone, (Miocene Channel), 984m - 1332m (348m):</u>

Most of the criteria for Gippsland Limestone submarine canyon fill are present in this interval. The E-log character change at 1332 metres is taken at the base of a slumped bed within the Gippsland Limestone, reflecting a sharp break from underlying pelagic claystone and marl to calcarenite and marl.

<u>Mid-Miocene : Lowermost Gippsland Limestone 1332m - 1430m (98m)</u>

The lowermost part of the Gippsland Limestone is an interlaminated sequence of marls and calcareous claystone increasing in carbonate content uphole. This sequence is conformable on the underlying clay-stones of the Lakes Entrance Formation and forms the basal part of the high velocity zone in the lowermost levels of the Gippsland Limestone. The abrupt change in facies up-section from claystone to calcareous claystone/marl at 1430 metres is reflected in the corresponding rapid increase in sonic velocity.

<u>Early Miocene to Middle Mid-Miocene : Upper Lakes Entrance Formation, 1430m - 2142m (712m):</u>

The upper part of the Lakes Entrance Formation as recorded in Helios No. 1 consists of interbedded siltstone and claystone. The entire sequence is calcareous, increasing in carbonate content up hole. This distinguishes the upper Lakes Entrance Formation from its lower counterpart which is largely non-calcareous.

The siltstone is varicoloured ranging from dark grey to light grey and brown, and contains very fine grained quartz detritals disseminated throughout the section. It also grades into a moderately soft to hard light grey-brown claystone.

A regional seismic event at the base of the upper part of the Lakes Entrance Formation corresponds to change in paleo-oxygen supply between the interval 2116 metres and 2145 metres. At and above 2116 metres, pyrite is generally abundant and benthonic distribution sporadic, while below 2145 metres pyrite is not present and faunas suggest reasonable oxygenation. Therefore, from E-log characteristics, the depositional surface below 2142 metres is regarded as having been oxic, while that above 2142 metres was anoxic. This was probably related to sudden changes in bottom water mass circulation during the Early Miocene.

Early Miocene : Lower Lakes Entrance Formation,
2142m - 2567m (425m):

This consists of a light grey-black to light brown homogeneous siltstone, which is moderately soft to hard, slightly calcareous, and argillaceous containing a clay matrix with moderate patches of very fine-occasional coarse grained quartz grains.

Although the lower part of the Lakes Entrance Formation differs only slightly lithologically from its upper counterpart, from a paleontological and depositional viewpoint the difference is decided. As stated previously, the depositional surface below 2142 metres is regarded as having been oxic, while that above 2142 metres was anoxic. Reasons for this change in oxygenation may have been related to sudden changes in bottom water mass characteristics during the Early Miocene. Sediment with Early Miocene planktonics deposited on the Gippsland Basin margins show indications of this oceanic warming by the presence of tropical, benthonic larger foraminifera such as Lepidocyclina spp. As reported in the paleontology report (Appendix 6) this was the only time in the foraminiferal sequence when warm water benthonic species inhabited Gippsland waters. The lowermost Lakes Entrance Formation has been referred to as the Tasman Sea Carbonates or microfaunal considerations by the paleontologists.

Early Oligocene : Lakes Entrance Marl Equivalent,
2567m - 2580m (13m):

The fine quartz sandy biogenic marls of this interval are very similar in lithofacies to the Lakes Entrance Marls of the Gippsland Basin margins. However, the benthonic foraminiferal faunas and high planktonic percentage indicate deeper paleo-depths of deposition. This sequence, as drilled in Helios No. 1 consists of a light-to-dark grey, homogeneous, soft, massive, calcareous siltstone, with occasional very fine grained quartz and glauconite pellets and interbedded silty sandstone containing quartz, light-to-dark grey and translucent white, very fine-to-fine grained, subangular to rounded, moderately well sorted, with an abundant silty matrix. It probably represents a rapidly-deepening marine shelf environment of deposition.

Late Eocene : Colquhoun Formation (Top Latrobe Group),
2580m - 2593m (13m):

The Colquhoun Formation represents the top of the marginal marine condensed sequences and is taken to be the top of the Latrobe Group. This was the final stage of continental-paralic nearshore marine sedimentation prior to the basinwide marine transgression in post-Eocene time.

A calcareous clayey polymodal quartz sandstone at 2593 metres contained an abundance of glauconite and pyrite with a very sparse foraminiferal fauna with an uppermost Eocene planktonic association. This represents the acme stage of the widespread Late Eocene-Early Oligocene transgression onto the Gippsland Basin margins. Deposition from this interval was in a very shallow inner-continental shelf environment, possibly under littoral conditions.

Facies equivalents of either the Turrum or the Gurnard Formations condensed sequences as found elsewhere in the Gippsland Basin were not identified in the Helios No. 1 well. These units were most likely removed as a consequence of the succeeding Late Eocene transgression, and are represented by a hiatus of some eight million years.

Mid-Eocene : Flounder Formation,
2593m - 2659m (66m)

This interval consists of dark brown siltstone with abundant very fine, clear to translucent, subangular to subrounded quartz grains throughout the matrix which is very clayey and calcareous. There is abundant glauconite and occasional mica. The silts are interbedded with a silty sandstone which is light grey and dark grey to dark brown, clear to translucent, very fine grained, angular to subangular, minor subrounded grains, moderately well sorted, very silty matrix, abundant glauconite and sporadic pyrite.

The entire interval, with the exception of the very basal portion, is faunally dominated by the arenaceous benthonic foraminifera Haplophragmoides spp., which can withstand fluctuations in salinity. Fish fragments, worm tubes, and evidence of bioturbation are frequent throughout the unit. This benthonic association supports an estuarine environment of deposition with possible tidal delta conditions in the lower portion of the interval. Porosity and permeability values within the Flounder Formation in Helios No. 1 are very low and can be attributed to low energy silt-choked sands deposited within the estuarine environment.

Latrobe Clastics

The Latrobe 'coarse clastics' occur in the sedimentary sequence from the top of the Lower Eocene at 2659 metres to total depth in the well. This term is used to loosely describe the thick sequences of interbedded sands, silts, shales and coals laid down in a coastal-paralic environment backed by huge paludal swamps occasionally crossed by ephemeral streams. The beach-barrier bar system oscillated seaward or landward according to the governing global eustatic sea level at each particular time interval. Consequently, each facies unit is diachronous and does not readily fall into accepted time-stratigraphic definitions. The Latrobe clastics have therefore been subdivided on the basis of lithostratigraphic and not time-stratigraphic units. For convenience in reporting, a time-stratigraphic system will be adhered to, but it should be remembered that the facies described are diachronous.

Paleocene - Lower Eocene,
2659m - 2728 (69m)

The interval from 2659 metres to 2728 metres is composed of fairly clean sands and minor silts and is indicative of a lagoonal-washover environment of deposition heralding a gradual regressive phase prior to the onset of subaerial erosional conditions at the Top Latrobe unconformity. The sands are composed of white, clear-to-transulcent quartz grains and are very fine-to-fine grained and coarsen toward the base including pebbles, subangular to subrounded, well sorted, moderate to high sphericity, with non-calcareous cement, abundant glauconite and pyrite, occasional muscovite, kaolinitic matrix.

There is good porosity towards the top and middle of the interval becoming fair porosity towards the base. The beach barrier sands are very fine-to-fine grained and are reasonably well sorted. They can be distinguished from the overlying lagoonal-washover sands by high dip angles of up to 20°-30°. The basal part of the barrier sands are frequently of marginal marine origin, possibly representing an offshore bar sand as indicated by the presence of a clayey and glauconitic matrix.

Cretaceous

Upper Cretaceous : Maastrichtian
2728m - 3212m (484m)

This interval is largely composed of an alternating sequence of beach-barrier, nearshore-marine and washover sands and silts. It can be subdivided into four main sequences: namely, stacked beach barrier (2728 metres - 2770 metres), nearshore marine (2770 metres - 2900 metres), stacked beach-barrier (2900 metres - 3090 metres) and washover (3090 metres - 3212 metres). Lithologically these sequences are represented by a host of interbedded sands, silts, clays and occasional coals, the latter increasing in frequency towards the base. The stacked beach-barrier from 2900 metres - 3090 metres was originally thought to be a subaqueous sand body of possible Paleocene age because of its stratigraphic position at the base of an aggrading clinoformal sequence on seismic profiles. It was a secondary objective in the well but was found to have no top seal.

The clays are black, moderately soft to hard, very silty, homogeneous, massive, non-calcareous with occasional well-rounded fine-grained quartz grains throughout. The sands are white, light-to-dark grey and translucent, fine-to-coarse grained with occasional irregular prismatic and lath fragments, angular to rounded, very poorly sorted, low sphericity, kaolinitic matrix with mica and carbonaceous material. These are interbedded with siltstone: blue, moderately soft to moderately hard, homogeneous, non-calcareous, massive, and silt matrix. The sands continue as described to the base of the interval, however the siltstone stringers are replaced by claystones, dark grey to brown, very soft, homogeneous, massive, very plastic to ductile with kaolinitic or volcanic clay. A shale bed is developed at the very base of the interval and is dark brown, non-calcareous, silty, and contains abundant organic debris and coal along bedding planes.

Upper Cretaceous : Campanian (?),
3212m - 3500m (T.D.) (288m)

The section is more carbonaceous downhole with a paludal marsh swamp environment becoming more prevalent. The top of the Campanian is probably indicated by the arrival of the first major coal band. Lithologically the sandstones within these coal measures are dark grey, white to clear/translucent, with very fine grained to medium-coarse grained quartz detritals, subangular to subrounded, moderate sorting, moderate sphericity, argillaceous, silty matrix, with fair-to-poor porosity. The interbedded claystones are dark brown, massive, homogeneous, plastic, very soft, slightly calcareous, very argillaceous with thin lamina or partings of siltstone. The siltstone is black to dark grey, massive, sub-fissile, non-calcareous, argillaceous, highly carbonaceous. Coal bands which occur throughout the sequence are black to very dark brown, hard, brittle, conchoidal fracture, lignitic.

Well Correlation

A comparison of the stratigraphy of Helios No. 1 with that of the Bonita No. 1 well is given in Figure 6 and Table 14. The Bonita No. 1 well is the closest well to the Helios No. 1 location, being located 14 km (8.7 miles) to the north.

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

a) The submarine erosional channel towards the base of the Gippsland Limestone was penetrated at a shallower depth in Helios No. 1 and contains an appreciably thinner calcareous submarine canyon fill (446 metres) as opposed to Bonita No. 1 (746 metres).

b) Due to submarine scouring by the Miocene channel, the upper part of the underlying Lakes Entrance unit is thinner in Bonita No. 1 (74 metres thick) although at a shallower depth than in Helios No. 1 (712 metres thick).

c) The lower part of the Lakes Entrance sequence is also thinner in Bonita No. 1 (14 metres) in comparison with that of Helios No. 1 (438 metres).

d) Although the Colquhoun Formation, lying at the top of the Latrobe Group is virtually the same thickness in both wells, it was penetrated almost 400 metres deeper in Helios No. 1.

TABLE 14: CORRELATION WITH BONITA NO.1

HORIZONS	HELIOS NO. 1		BONITA NO.1	
	DEPTH	THICKNESS	DEPTH	THICKNESS
Gippsland Limestone	511m (1677')	473m (1551')	N/A	N/A
Base Massive Calcarenite	984m (3229')	446m (1463')	1342m (4403')	746m (2447')
Upper Lakes Entrance	1430m (4692')	712m (2336')	2088m (6850')	74m (243')
Lower Lakes Entrance	2142m (7028')	438m (1437')	2162m (7093')	273m (896')
Colquhoun Formation	2580m (8422')	13m (85')		
Flounder	2593m (8507')	66m (216.5')	2435m (7989')	22m (172')
Top Latrobe Clastics (Lower Eocene)	2659m (8724')	33m (108')	2457m (8060')	604m (1982')
Top Paleocene	2692m (8052')	36m (119')	Unknown	
Top Cretaceous	2728m (8950')	484m (1588')	3061m (10,043')	119m (390')
Top Campanian	3212m (10538')	288m+ (945')	Absent	
T.D.	3500m (11483')		3180m (10433')	

e) The Flounder Formation, like the units above, was penetrated at a greater depth in the Helios No. 1. It was, however, considerably thicker in the Helios No. 1 (66 metres) compared to the Bonita No. 1 (22 metres).

f) The Latrobe Clastics were encountered at 2659 metres in the Helios No. 1, and at 2457 metres in the Bonita No. 1.

g) The Upper Cretaceous Unconformity (Top Maastrichtian) was encountered at a shallower depth in the Helios No. 1 (2728 metres) compared to the Bonita No. 1 (3061 metres). The Maastrichtian was also appreciably thicker (484 metres) compared to the Bonita No. 1 (119 metres).

h) Although Bonita No. 1 reached a total depth of 3180 metres, still above the Campanian; the latter was encountered at 3205 metres in Helios No. 1, where 288 metres of Campanian was penetrated to total depth at 3500 metres. Probably at least 1000 metres - 1600 metres of Campanian can be expected in this part of the basin, based on seismic time-depth conversion of potential top and base Campanian seismic markers.

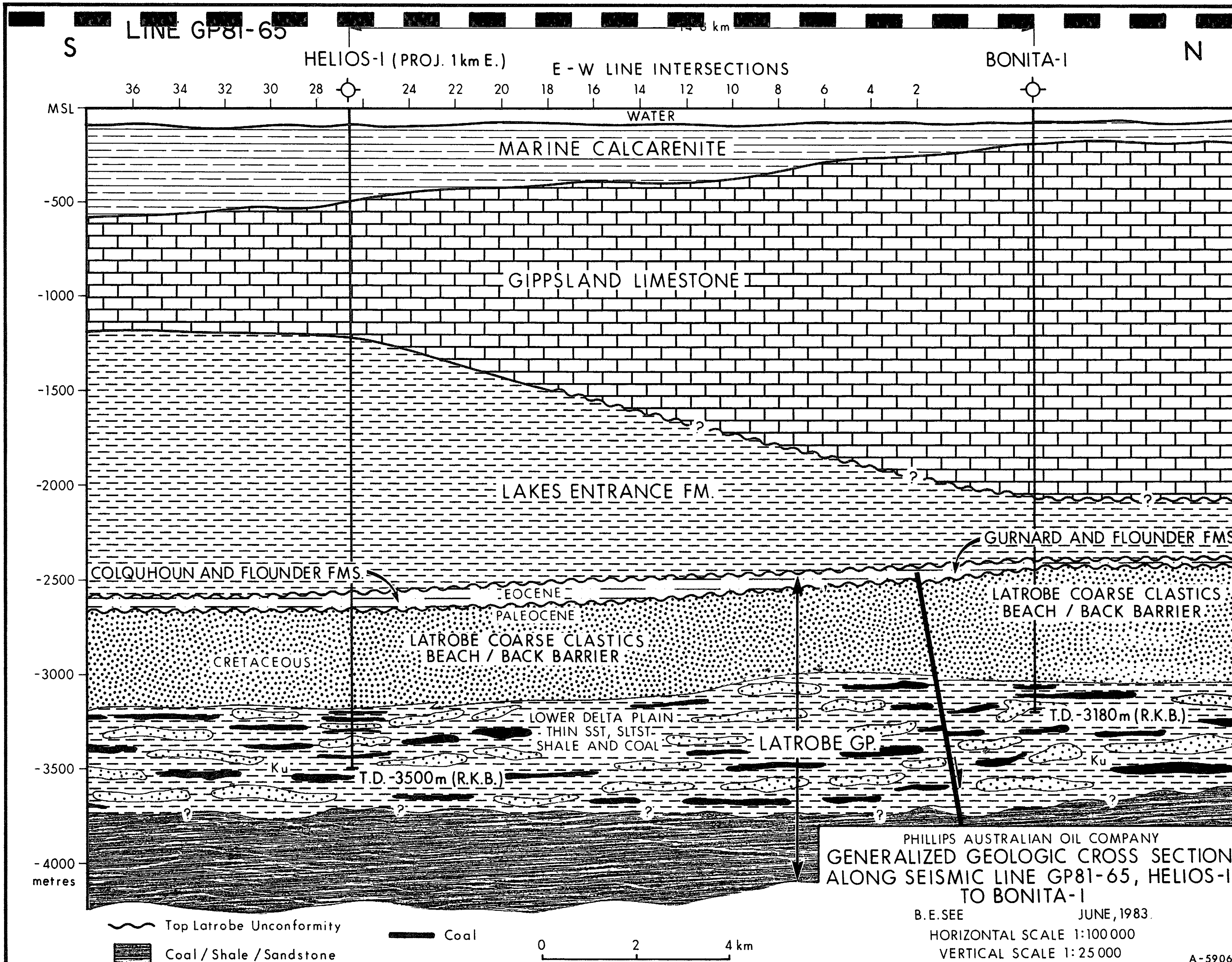

LINE GP81-65
S
N
HELIOS-1 (PROJ. 1km E.)
BONITA-1
E-W LINE INTERSECTIONS
36 34 32 30 28 24 22 20 18 16 14 12 10 8 6 4 2
MSL
-500
-1000
-1500
-2000
-2500
-3000
-3500
-4000
metres
WATER
MARINE CALCARENITE
GIPPSLAND LIMESTONE
LAKES ENTRANCE FM.
GURNARD AND FLOUNDER FMS.
COLQUHOUN AND FLOUNDER FMS.
EOCENE
PALEOCENE
LATROBE COARSE CLASTICS
BEACH / BACK BARRIER
CRETACEOUS
LATROBE COARSE CLASTICS
BEACH / BACK BARRIER
LOWER DELTA PLAIN
THIN SST, SLTST-
SHALE AND COAL
LATROBE GP.
Ku
T.D. -3500m (R.K.B.)
T.D. -3180m (R.K.B.)
Top Latrobe Unconformity
Coal / Shale / Sandstone
Coal
0 2 4 km
PHILLIPS AUSTRALIAN OIL COMPANY
GENERALIZED GEOLOGIC CROSS SECTION
ALONG SEISMIC LINE GP81-65, HELIOS-1
TO BONITA-1
B.E.SEE
JUNE, 1983
HORIZONTAL SCALE 1:100 000
VERTICAL SCALE 1:25 000
A-5906

FIGURE 6

STRUCTURE

The Helios No. 1 well tested a structural anomaly oriented at a 25°-30° strain-ellipsoid angle to a northwest-southeast trending wrench fault bounding the southern flank of the Kingfish structure. The east-west orientation of the Kingfish anticline fits a wrench-induced strain ellipsoid for right lateral motion along the northwest-southeast trending fault which separates a southern zone of relatively thin Latrobe Group sediments from a northern zone containing thick Latrobe Group sediments. The northwest-southeast trending normal fault is believed to have undergone intermittent right lateral wrench motion during Latrobe Group deposition.

Seismic mapping at the Top Latrobe unconformity level (orange seismic horizon) defined a simple dip-closed anticlinal structure in time (Figure 7). Because of apparent channelling in the overlying Gippsland Limestone, a depth map (Figure 8) was constructed using a contoured smoothed velocity overlay. The depth map delineated a closed area of 18.6 sq. km with maximum vertical closure of 67 metres. Two discrete culminations were defined within the gross area of closure - one to the northwest coincident with the time closure, and the other to the south-east independent of closure in time.

The velocity overlay indicated that the "channel" was filled with low rather than high velocity material, and that the structure had been distorted by velocity "pulldown". In order to confirm the velocity relationship and to verify the validity of the structure, an isochron between the Intra-Lakes Entrance Formation (purple seismic marker) and Top Latrobe (orange seismic marker) horizons was constructed. The results indicated thinning over the structure, showing that some structuring had already occurred by Lakes Entrance time (Figures 9 and 10).

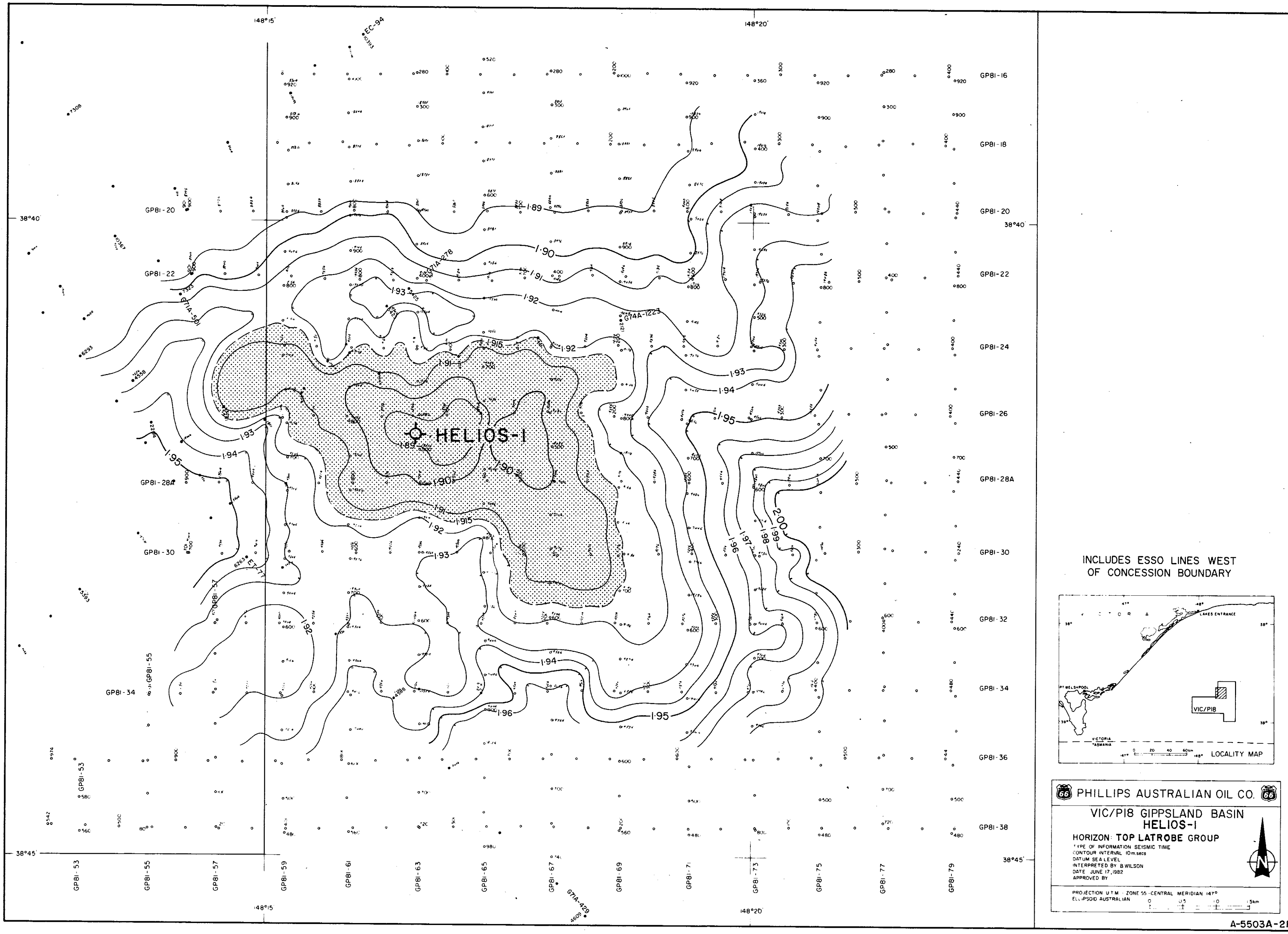
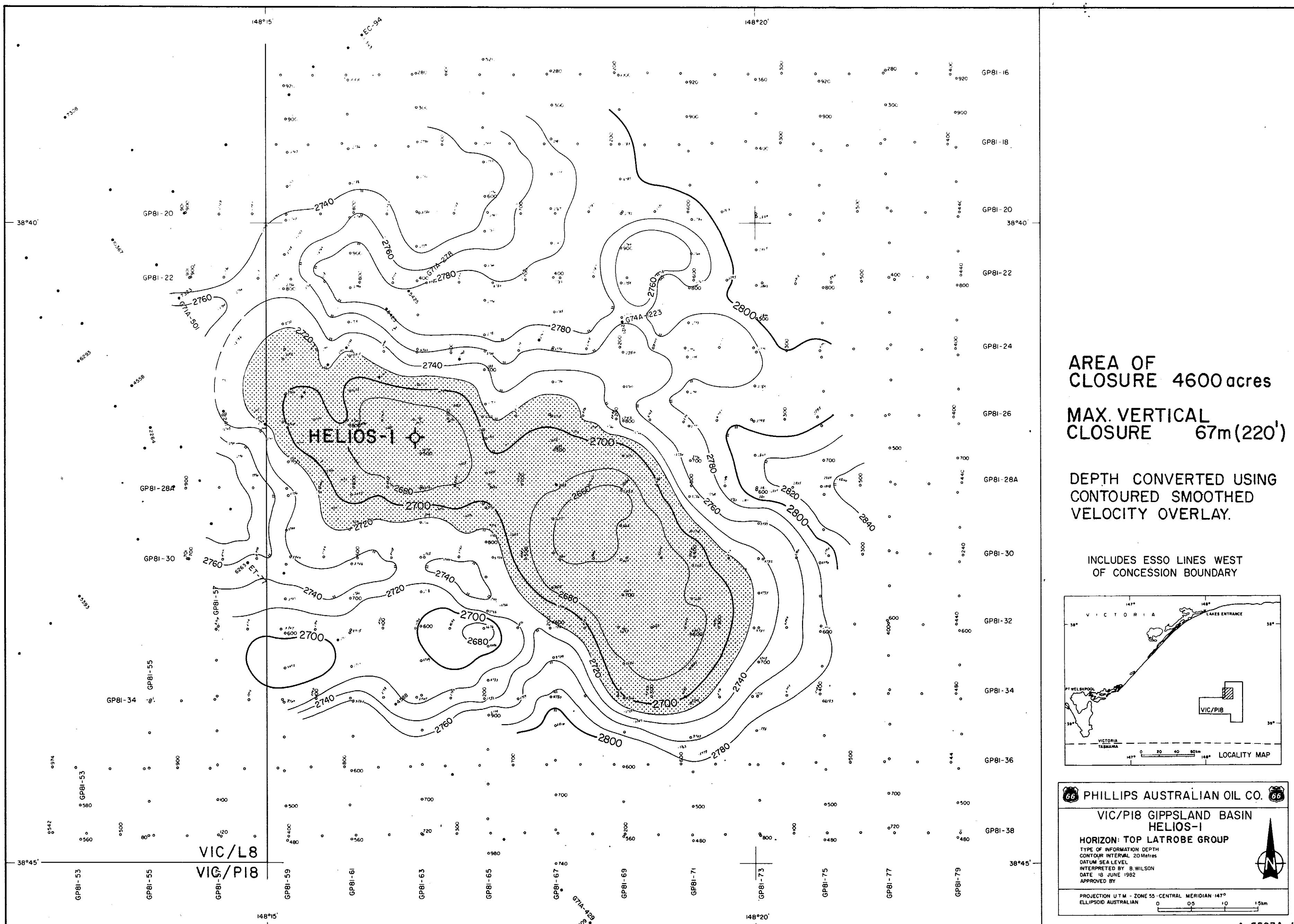

HELIOS-1
INCLUDES ESSO LINES WEST OF CONCESSION BOUNDARY
LOCALITY MAP
VIC/P18
VICTORIA
TASMANIA
PHILLIPS AUSTRALIAN OIL CO.
VIC/P18 GIPPSLAND BASIN
HELIOS-1
HORIZON: TOP LATROBE GROUP
TYPE OF INFORMATION SEISMIC TIME
CONTOUR INTERVAL 10m.secs
DATUM SEA LEVEL
INTERPRETED BY B.WILSON
DATE JUNE 17, 1982
APPROVED BY
PROJECTION U.T.M. - ZONE 55 - CENTRAL MERIDIAN 147°
ELLIPSOID AUSTRALIAN
A-5503A-2R
148°15'
148°20'
38°40'
38°45'
GP81-16
GP81-18
GP81-20
GP81-22
GP81-24
GP81-26
GP81-28A
GP81-30
GP81-32
GP81-34
GP81-36
GP81-38
GP81-53
GP81-55
GP81-57
GP81-59
GP81-61
GP81-63
GP81-65
GP81-67
GP81-69
GP81-71
GP81-73
GP81-75
GP81-77
GP81-79
EC-94
G71A-278
G71A-501
G74A-1223
G71A-429

FIGURE 7



148°15'
148°20'
38°40'
38°45'
HELIOS-1
2680
2700
2720
2740
2760
2780
2800
2820
2840
GP81-16
GP81-18
GP81-20
GP81-22
GP81-24
GP81-26
GP81-28A
GP81-30
GP81-32
GP81-34
GP81-36
GP81-38
GP81-53
GP81-55
GP81-59
GP81-61
GP81-63
GP81-65
GP81-67
GP81-69
GP81-71
GP81-73
GP81-75
GP81-77
GP81-79
VIC/L8
VIC/P18
AREA OF CLOSURE 4600 acres
MAX. VERTICAL CLOSURE 67m (220')
DEPTH CONVERTED USING CONTOURED SMOOTHED VELOCITY OVERLAY.
INCLUDES ESSO LINES WEST OF CONCESSION BOUNDARY
VICTORIA
LAKES ENTRANCE
VIC/P18
VICTORIA
TASMANIA
LOCALITY MAP
PHILLIPS AUSTRALIAN OIL CO.
VIC/P18 GIPPSLAND BASIN
HELIOS-1
HORIZON: TOP LATROBE GROUP
TYPE OF INFORMATION DEPTH
CONTOUR INTERVAL 20 Metres
DATUM SEA LEVEL
INTERPRETED BY B. WILSON
DATE 18 JUNE 1982
APPROVED BY
PROJECTION U T M - ZONE 55 - CENTRAL MERIDIAN 147°
ELLIPSOID AUSTRALIAN
0 0.5 1.0 1.5km
A-5503A-1R

FIGURE 8

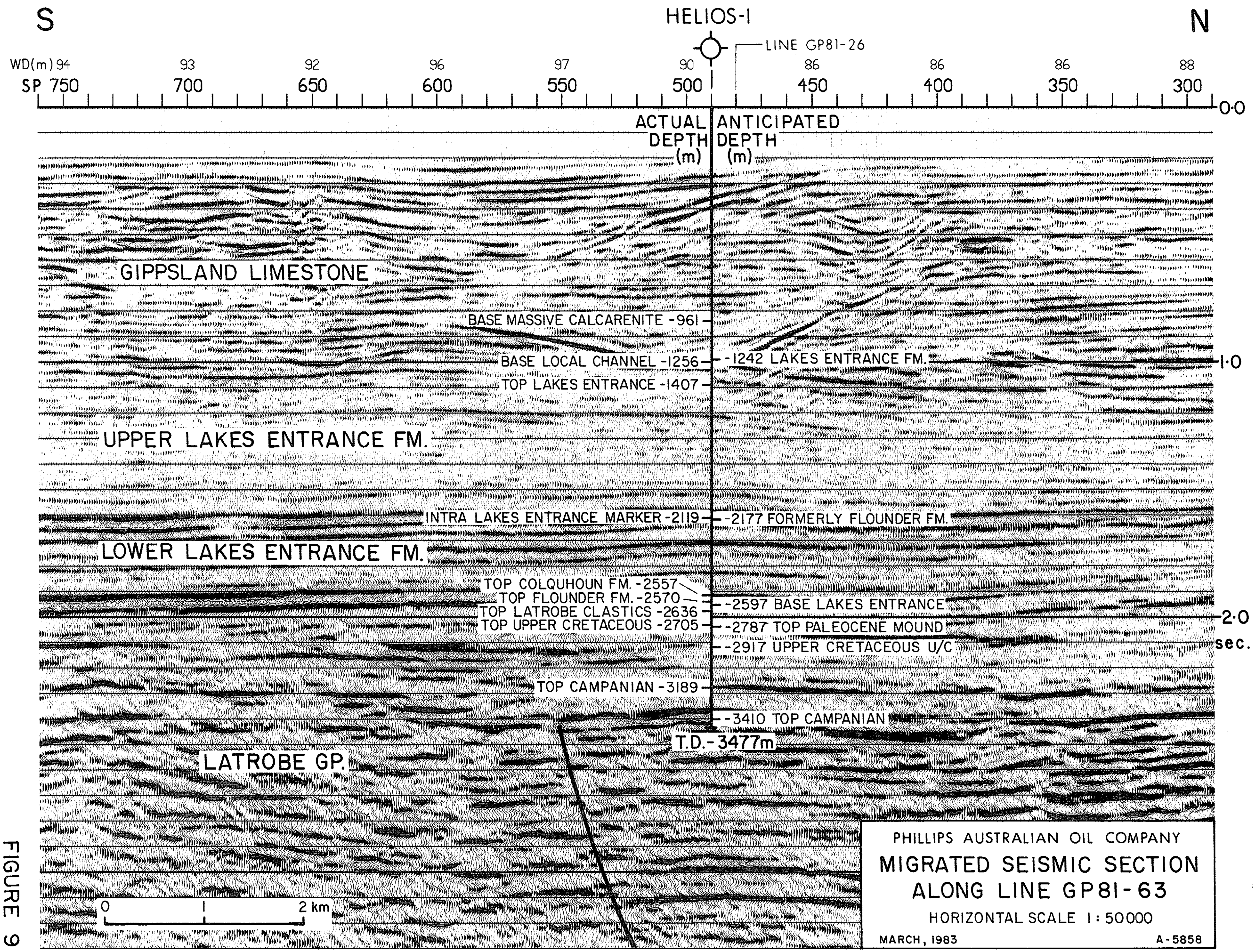
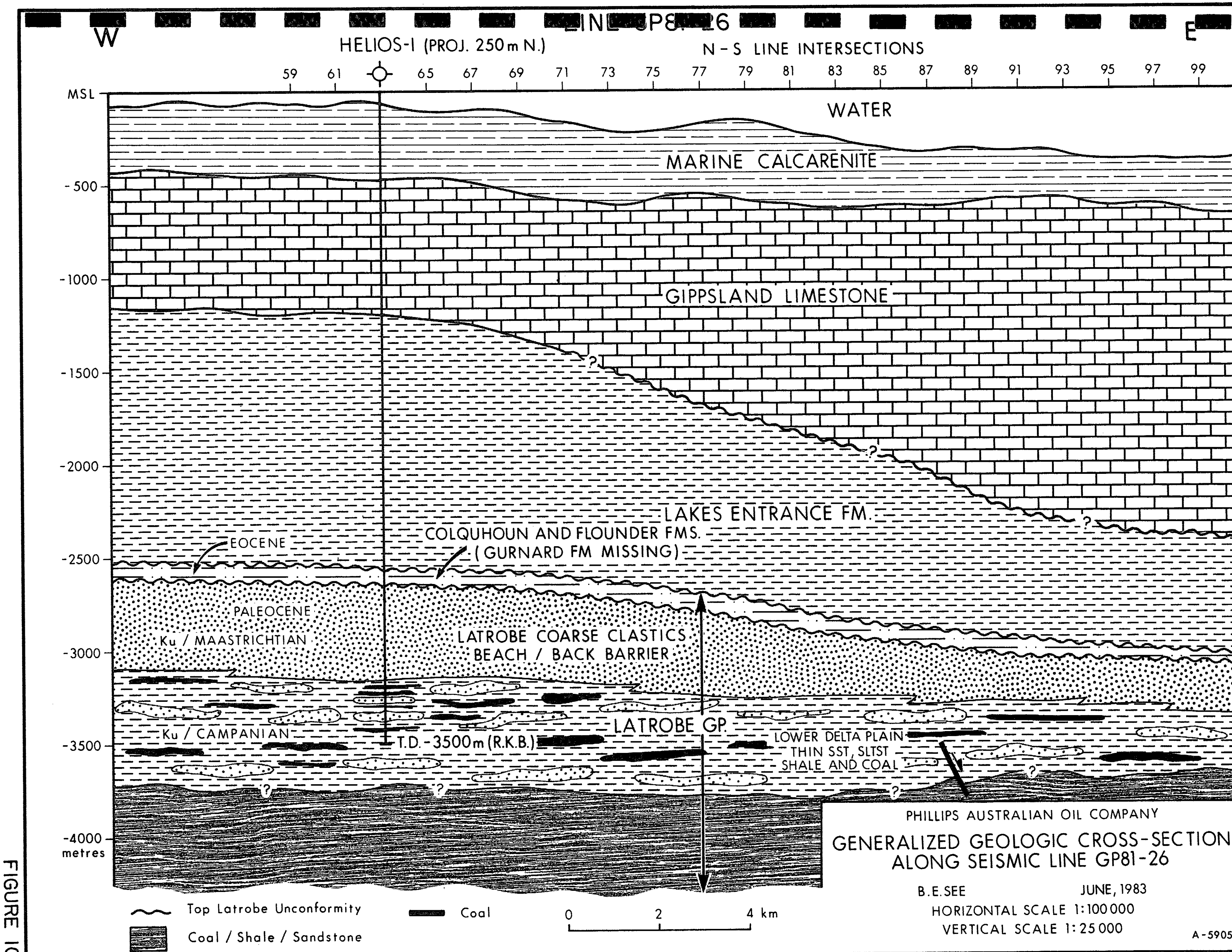

S
HELIOS-1
N
LINE GP81-26
WD(m) 94
93
92
96
97
90
86
86
86
88
SP 750
700
650
600
550
500
450
400
350
300
0·0
ACTUAL DEPTH (m)
ANTICIPATED DEPTH (m)
GIPPSLAND LIMESTONE
BASE MASSIVE CALCARENITE -961
BASE LOCAL CHANNEL -1256
-1242 LAKES ENTRANCE FM.
1·0
TOP LAKES ENTRANCE -1407
UPPER LAKES ENTRANCE FM.
INTRA LAKES ENTRANCE MARKER -2119
-2177 FORMERLY FLOUNDER FM.
LOWER LAKES ENTRANCE FM.
TOP COLQUHOUN FM. -2557
TOP FLOUNDER FM. -2570
-2597 BASE LAKES ENTRANCE
TOP LATROBE CLASTICS -2636
2·0
TOP UPPER CRETACEOUS -2705
-2787 TOP PALEOCENE MOUND
sec.
-2917 UPPER CRETACEOUS U/C
TOP CAMPANIAN -3189
-3410 TOP CAMPANIAN
T.D. - 3477m
LATROBE GP.
0
1
2 km
PHILLIPS AUSTRALIAN OIL COMPANY
MIGRATED SEISMIC SECTION
ALONG LINE GP81-63
HORIZONTAL SCALE 1 : 50000
MARCH, 1983
A-5858

FIGURE 9



LINE GP81-26
W
E
HELIOS-1 (PROJ. 250 m N.)
N - S LINE INTERSECTIONS
59 61 65 67 69 71 73 75 77 79 81 83 85 87 89 91 93 95 97 99
MSL
-500
-1000
-1500
-2000
-2500
-3000
-3500
-4000
metres
WATER
MARINE CALCARENITE
GIPPSLAND LIMESTONE
LAKES ENTRANCE FM.
EOCENE
COLQUHOUN AND FLOUNDER FMS.
(GURNARD FM MISSING)
PALEOCENE
Ku / MAASTRICHTIAN
LATROBE COARSE CLASTICS
BEACH / BACK BARRIER
LATROBE GP.
Ku / CAMPANIAN
T.D. -3500 m (R.K.B.)
LOWER DELTA PLAIN
THIN SST, SLTST
SHALE AND COAL
PHILLIPS AUSTRALIAN OIL COMPANY
GENERALIZED GEOLOGIC CROSS-SECTION
ALONG SEISMIC LINE GP81-26
B.E.SEE
JUNE, 1983
HORIZONTAL SCALE 1:100 000
VERTICAL SCALE 1:25 000
A-5905
Top Latrobe Unconformity
Coal / Shale / Sandstone
Coal
0 2 4 km

FIGURE 10

Although mapping at the top of the "Paleocene Mound", now identified as a stacked beach barrier sequence, did not define structural closure, it was considered that updip pinchout of the sands may have provided a lateral sealing mechanism. However, this secondary stratigraphic objective was invalidated because of the absence of a top seal.

Significant closure deeper within the Latrobe Group, as mapped by the green seismic horizon, has been mapped elsewhere in Permit Vic/P18. Although no closure was mapped at this level in the Helios area (Figure 11), important stratigraphic information was obtained through drilling to below this horizon.

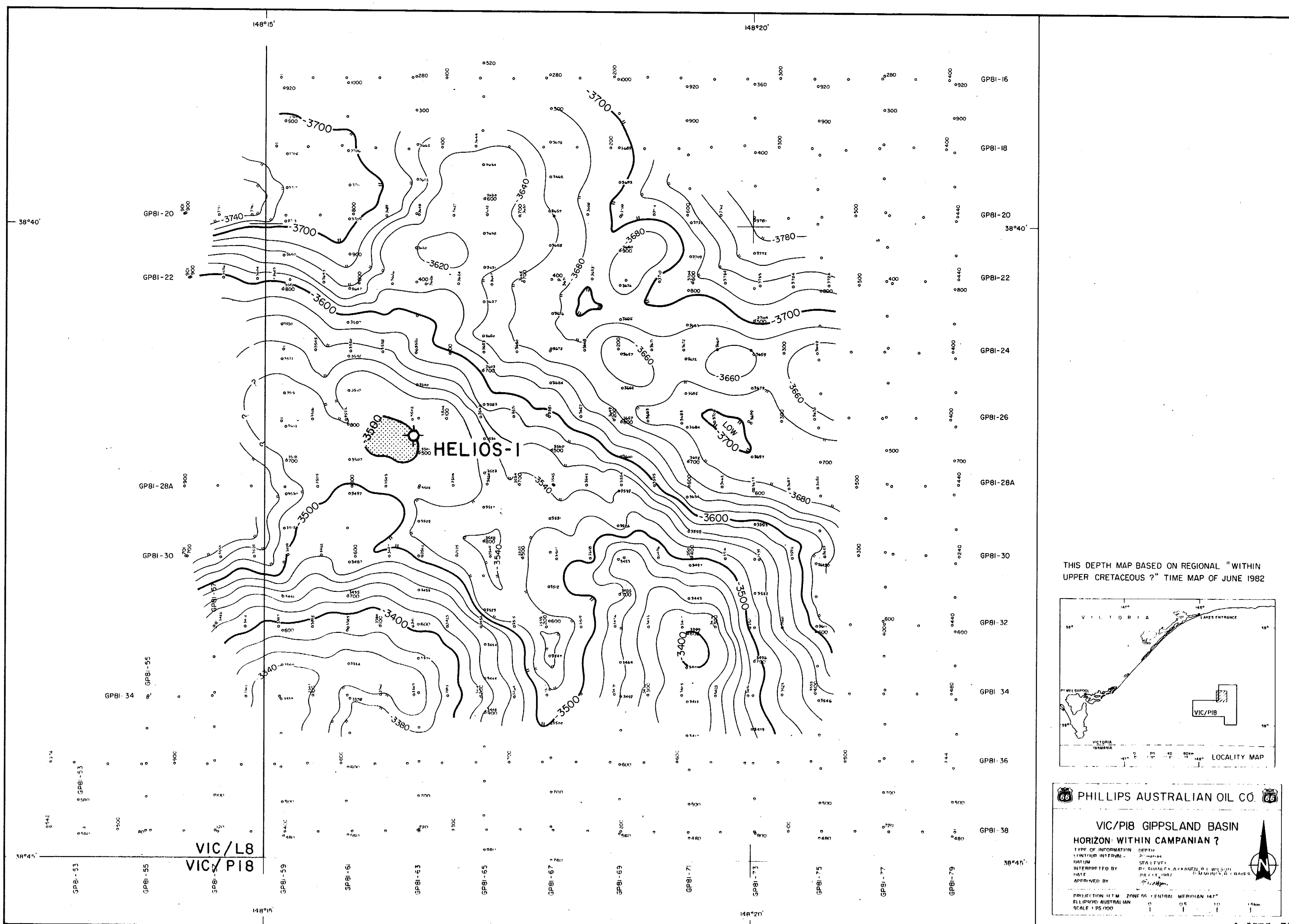

HELIOS-1
VIC/L8
VIC/P18
THIS DEPTH MAP BASED ON REGIONAL "WITHIN UPPER CRETACEOUS ?" TIME MAP OF JUNE 1982
VICTORIA
LAKES ENTRANCE
PT WELSHPOOL
VIC/P18
VICTORIA
TASMANIA
LOCALITY MAP
PHILLIPS AUSTRALIAN OIL CO.
VIC/P18 GIPPSLAND BASIN
HORIZON: WITHIN CAMPANIAN ?
TYPE OF INFORMATION DEPTH
DATUM SEA LEVEL
INTERPRETED BY
DATE
APPROVED BY
ELLIPSOID AUSTRALIAN
SCALE 1:25 000
A-5503-7R

FIGURE 11

SEISMIC MARKER IDENTIFICATION

A well velocity survey was conducted at Helios No. 1 on completion of drilling (Addendum 3). From the well velocity log, the five main seismic reflectors mapped within Permit Vic/P18 have been related to the stratigraphy of Helios No. 1 as shown below, and as described in Enclosures 4 and 5.

HORIZON MARKER	TWO-WAY TIME (SEC)	DEPTH
BASE GIPPSLAND LIMESTONE/ TOP LAKES ENTRANCE FORMATION	1.022	1332 metres (-1309 metres)
INTRA-LAKES ENTRANCE MARKER	1.610	2142 metres (-2119 metres)
BASE LAKES ENTRANCE/TOP COLQUHOUN FORMATION	1.907	2580 metres (-2557 metres)
UPPER CRETACEOUS UNCONFORMITY	2.000	2728 metres (-2705 metres)
TOP CAMPANIAN	2.274	3212 metres (-3189 metres)

The depth to the Base Gippsland Limestone/Top Lakes Entrance Formation seismic horizon was greater than the predicted depth because of slower than actual interval velocities being used in depth conversions. However, the computed pre-drill depths of the Intra-Lakes Entrance Marker, Base Lakes Entrance/Top Colquhoun Formation, Upper Cretaceous Unconformity, and Top Campanian horizons were 2200 metres, 2620 metres, 2940 metres and 3433 metres respectively and these were all deeper than predicted because faster than actual interval velocities were used in depth conversion.

RELEVANCE TO THE OCCURRENCE OF HYDROCARBONS

Hydrocarbon Indicators

A continuous record of gas levels was maintained by Geoservices after drilling out of the 20-inch casing shoe at 340.5 metres in Helios No. 1 (Addendum 2, Enclosure 2). Total gas determination and analysis were conducted using a Geoservices Flame Ionization Detector (FID).

With the exception of Item 4 below significant hydrocarbon indications were not noted from cuttings or sidewall cores. Minor shows, however, were recorded from the mud returns by the Flame Ionization Detector as follows:

1) Background gas of 1-3% was detected between 1340 metres and 1670 metres, reaching a peak of 3.5% between 1600 metres and 1650 metres in the Upper Lakes Entrance Formation.

2) Traces of C_2 gas were detected in the trip gas from approximately 2487 metres within the basal part of the Lower Lakes Entrance Formation.

3) Between 2565 metres and 2595 metres, traces of C_2 and C_3 were detected within the Lakes Entrance Marl and Colquhoun Formation. There were also weak shows at 2565 metres and 2575 metres.

4) Between 2597 metres and 2635 metres in the Flounder Formation, traces of C_2, C_3 and C_4 were detected along with very slight pinpoint fluorescence in sample cuttings. This was tested by DST 1.

5) Insignificant gas readings were recorded from the primary target below the top of the Latrobe coarse clastics at 2659 metres, through the secondary target zone in the Intra-Latrobe to the total depth of the well.

Porosity and Permeability

Potential reservoir sections in Helios No. 1 were penetrated in the upper part of the Latrobe clastics including the mounded stacked beach barrier sequence, and also interbedded within the coal measure sequence.

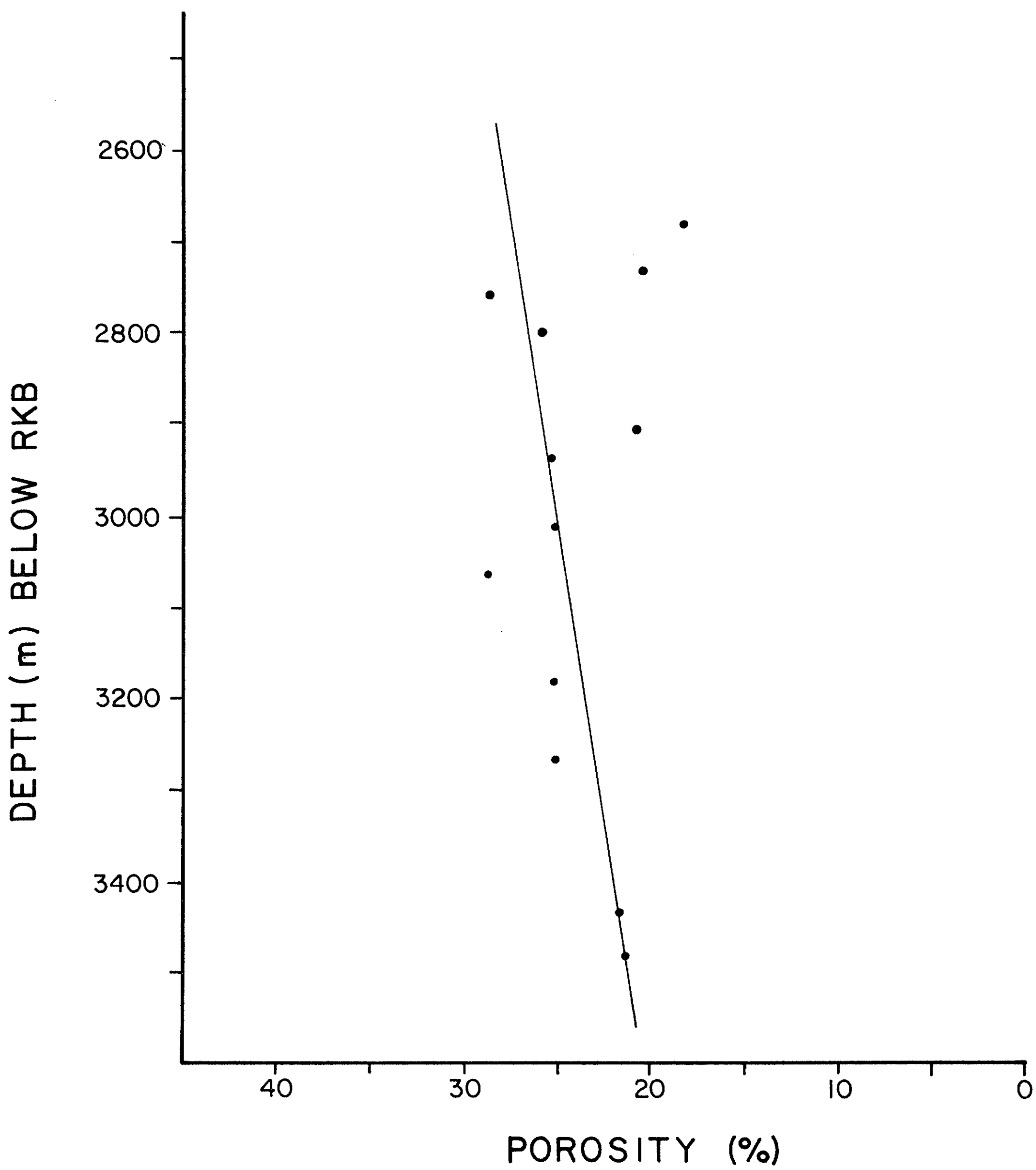
Published basinwide reservoir porosities in the Latrobe Group range from 18 percent to 21 percent with permeabilities ranging from 50 to 1000 millidarcies. The reservoir porosities in the Helios No. 1 well range to almost 29 percent with an average porosity of slightly greater than 25 percent. The sands are found in multiple zones (Enclosure 6).

Sandstones within the stacked beach barrier sequences (2728 metres - 2770 metres and 2900 metres - 3090 metres) have porosities varying up to more than 29 percent, averaging around 23 percent.

Sandstones within the underlying paludal marsh facies of the Campanian are of channel and point bar origin, averaging 11 metres in thickness but occasionally ranging up to 35 metres thick. Porosities range to slightly greater than 28 percent, averaging almost 15 percent.

Figure 12 shows a general linear trend of slightly decreasing porosity with increasing depth from the first clean Tertiary sand encountered at around 2675 metres to the deepest sand at 3490 metres (T.D. 3500 metres). Clean, uncemented sands were selected to show the effect of compaction.

SANDSTONE POROSITY Vs DEPTH
HELIOS-1



A-5819

FIGURE 12

Source Rock Potential

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

Organic geochemical analyses were performed by Analabs on fifty two 10 metre drill cuttings samples taken over the intervals 2550 metres to 2670 metres and 3020 metres to 3500 metres. The samples were analysed for total organic carbon (TOC) content and by gas chromotography and pyrolysis (Appendix 8). Additional TOC determinations and pyrolysis, vitrinite reflectance, kerogen and spore coloration studies were also performed on fifteen sidewall cores by the Exploration Projects Section of Phillips Petroleum Company (Appendix 9).

Light hydrocarbon (C_2 and C_7) gas chromatography (headspace analysis: Appendix 8) was also performed by Analabs on cuttings samples over the interval 2550 metres to 2670 metres. These results indicate that sands within the interval are lean in gas and condensate, and consequently are considered to be non-prospective for any significant quantities of indigenously generated hydrocarbon.

The rock samples between 3020 metres and 3160 metres contain fair to good amounts of organic matter. Pyrolysis results show moderate to good S_2 values, however, volatile hydrocarbon (S_1) values are low and indicate that the sediments are thermally immature and have not commenced hydrocarbon generation. These data are supported by the low Production Index and Tmax values obtained during analysis.

Sediments within the interval 3170 metres to 3500 metres contain very good to excellent amounts of organic matter, with corresponding very good to excellent hydrocarbon generating potential yields. The volatile hydrocarbon yields (S_1) of these rocks, reach moderate to good values, however, this amounts to only 3% to 5% of the total pyrolyzed hydrocarbons from the samples. This low hydrocarbon conversion percentage probably reflects an immature thermal maturation for these organic-rich rocks. Consequently, these sediments are analysed to contain moderate to good amounts of free hydrocarbons due to the high concentrations of organic carbon present.

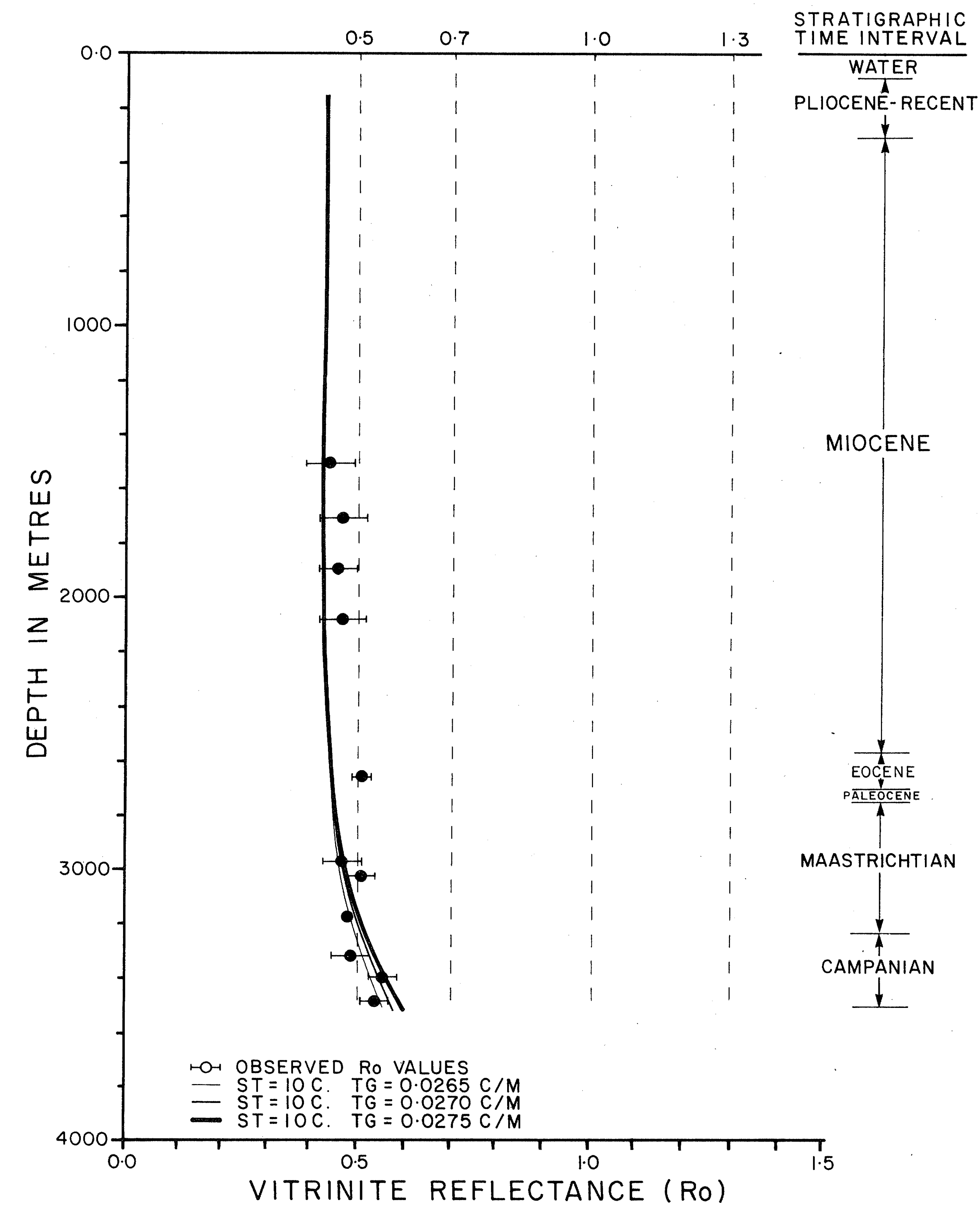
Pyrolysis analysis performed by Phillips Petroleum Company on fifteen sidewall cores indicates that no significant liquid hydrocarbon source rock potential exists, at present maturity levels in the well to total depth. However, coal samples near total depth are believed to have generated, and are probably presently generating biogenic gas to some degree. Given greater depth of burial and subsequent higher thermal maturity, excellent to secondary source rock potential for oil generation would be expected.

No significant hydrocarbon source rock potential was indicated from the interval 1500 metres to 2565 metres in the post-Latrobe sedimentary section. Although four of the seven samples analysed were in the "fair" range of total organic carbon content, vitrinite reflectance (Ro) and spore coloration index (TAI) indicate that this interval is thermally immature for liquid hydrocarbon generation. All of the seven samples submitted for analysis from this interval have dominant abundances (>50%) of the oil prone kerogens, alginite and exinite. However, even if it were in the peak oil generation window under optimum conditions of thermal maturity (Ro values $\pm$ .65 to 1.0) the interval probably would not have significant hydrocarbon source rock potential. This is inferred from low hydrogen index values associated with immature oil prone kerogen and suggests oxidation of the organics prior to, or during, burial. Therefore, the oil potential has probably been destroyed.

Six sidewall core samples were analysed from the interval 2652 metres to 3311 metres within the Latrobe Group. No significant hydrocarbon source rock potential was indicated at existing maturity levels of Ro .47 to .51. These maturity values are marginal, being at best barely within earliest stage of oil generation. Given greater depth of burial, however, three of the samples analysed would have significant liquid hydrocarbon source rock potential. Because of a favourable oil prone kerogen content, "rich" TOC levels, and higher hydrogen index values a sample at 2965.2 metres would have excellent oil source rock potential, a sample at 3167 metres might have somewhat less potential, while the third sample at 3311 metres could have secondary source rock potential for oil generation.

Vitrinite reflectance (Ro) data (Appendix 9) suggest that the onset of petroleum generation (Ro = 0.5%) occurs at about 2652 metres in Helios No. 1 according to the linear trend in Figure 13. Although the vitrinite reflectance values range from Ro 0.51 to 0.56 over the interval 2652 metres to 3481.5 metres, they correspond with the earliest stage maturity for oil generation, not yet approaching the peak range. Vitrinite reflectance values ranging from Ro 0.44 to 0.47 in the interval 1500 metres to 2565 metres are indicative of thermal immaturity in terms of oil generation. The two deepest samples, at 3390.5 metres and 3481.5 metres, are both coals and should have generated biogenic gas to some degree. These latter data are supported by spore coloration index values and fluorescence from ditch cuttings samples. Consequently, no significant source rock potential is indicated in any of these samples at their present level of thermal maturity.

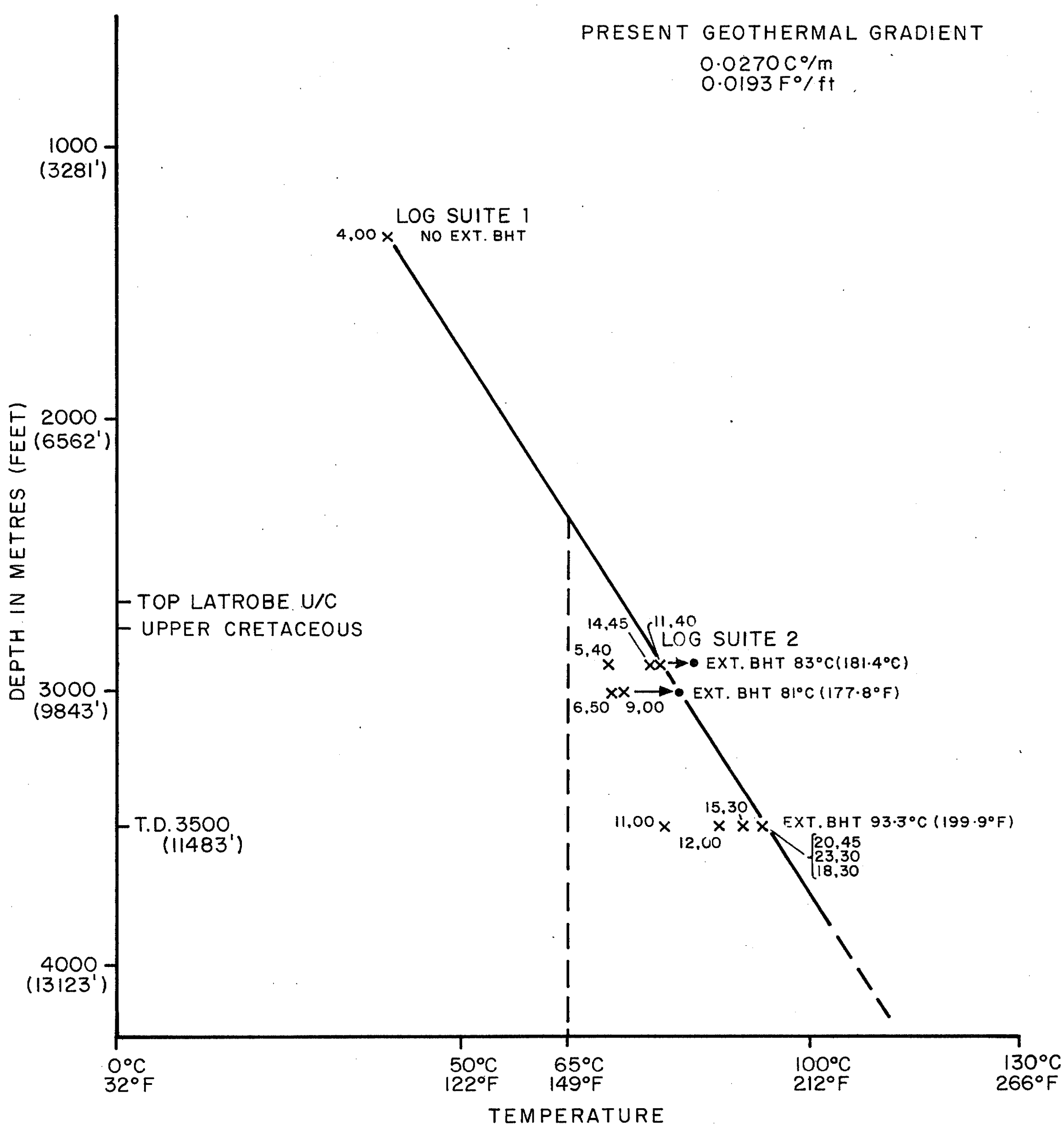
VITRINITE REFLECTANCE vs DEPTH
HELIOS-1



A-5847

FIGURE 13

TEMPERATURE vs DEPTH
HELIOS No.1



× : Measured temperatures from maximum reading thermometers on wireline logs

14,45 : Hours and minutes since circulation ceased for temperature reading

⟶ : Extrapolated to true BHT using Phillips method

A-5794

FIGURE 14

The present day geothermal gradient at Helios No. 1 is 2.70°C/100 metres (1.93°F/100 feet) as calculated from the bottom hole temperature at each logging run extrapolated to static equilibrium temperature (Figure 14). This gradient reflects the immature burial history for the Gippsland Basin, currently at its maximum historical temperature. This has resulted in vitrinite values lagging behind the present day temperature regime, indicating rapid post-Eocene subsidence and burial of the objective sedimentary section.

Summary of Hydrocarbon Significance

1. Geochemical

The lack of significant accumulations of hydrocarbons at Helios No. 1 can be directly attributed to the following geochemical parameters:

a) Sediments from 3020 metres to 3160 metres within the Latrobe Group contain fair to good amounts of organic matter with corresponding favourable S_2 values. However, they gave low free hydrocarbon yields, and as a result these rocks have probably only generated biogenic methane gas due to thermal immaturity.

b) Sediments from 3170 metres to 3500 metres are very organic rich with high S_2 values and occasional favourable S_1 values. However, the percentage of this volatile hydrocarbon (S_1) to the total pyrolysed hydrocarbon (S_1 + S_2) is very low. This suggests that these rocks have not experienced sufficient time and temperature to have generated and effectively expelled significant quantities of hydrocarbon.

c) None of the samples analysed indicated any significant migration of hydrocarbons from a deeper, more mature source.

2. Reservoir

Sandstone reservoirs with porosities greater than 25% are present near the top of, and within the Latrobe Group in Helios No. 1. Although only low porosities are present in the Flounder Formation interval, a drillstem test was performed within this interval to evaluate possibly significant hydrocarbon shows observed during drilling, and to determine whether the Flounder/Colquhoun Formations contained seal or reservoir capability. However, the test obtained no fluid recovery, and permeability was measured at less than 0.10 millidarcies.

3. Seal

The Flounder Formation provides a good potential seal at the top of the Latrobe clastics objective as borne out by the lack of permeability measured from the drillstem test. The lack of hydrocarbons in the sands immediately below the Flounder Formation can in part be attributed to the fact that the closure upon which the well was located was mapped on the top of the Colquhoun Formation, some 79 metres above the top of the reservoir sequence.

Potential seals are not developed within the upper portion of the Latrobe clastics. Consequently, the intra-Latrobe mound or stacked barrier bar sequence was not effectively sealed. Although the thick coal measure sequence contains significant sand members, these are believed to be of point bar origin and therefore may have only a limited areal extent. The sequence contains thick coal, siltstone and shale interbeds and may therefore provide a semi-regional sealing capability. This is supported by the lack of migrated hydrocarbons within the sequence.

CONTRIBUTIONS TO GEOLOGICAL KNOWLEDGE

1. The series of condensed sequences deposited in the Helios area during Lower Eocene-Oligocene time above the top of the Latrobe clastics are thicker than in nearby wells, being up to 92 metres thick. This anomalous thickness confirms the presence of a minor depocentre in the Helios area towards the end of Latrobe time.

2. Unlike the hydrocarbon-bearing reservoir potential of the Flounder Formation in the Flounder field, this formation in Helios No. 1, was extremely tight and impermeable.

3. A study of the sedimentology of the Latrobe Group suggests a depositional environment highlighted by a series of paludal-coal forming swamps dammed behind an extensive beach barrier bar system. Occasional river channels flowed across the swamps towards lagoons trapped behind the beach-bar system. The gradual replacement of the coal measures upsection by washover-lagoonal sediments and finally the beach-nearshore marine interface in Helios No. 1, indicates that Late Cretaceous-Early Tertiary sediments in the Gippsland Basin were laid down essentially under a transgressive regime, finally culminating in a regressive phase towards the top of the Latrobe clastic sequence.

4. Consequently the coal measures are largely impervious and, if thermally mature, will generate and migrate hydrocarbons either up fault planes to the Top Latrobe unconformity surface, or to interbedded point bar sands of possibly limited areal extent. In this context the development of thicker, semi-regional sand bodies appears to be essential to the trapping of significant hydrocarbon accumulations within the Latrobe sequence.

5. There are no major unconformities within the Latrobe section penetratd by the Helios No. 1 well; all boundaries noticed on seismic profiles are facies boundaries representing a change from one facies environment to another. The only unconformities that may be expected are those of a transgressive nature related to reworking by a landward-migrating beach front, such as that which may have occurred at the base of each major stacked beach-barrier bar sequence.

APPENDIX NO. 1

GOVERNMENT APPROVALS

11·10·82

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/ML
Your Ref.
Contact
Ext. 333

6 October 1982

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

Dear Sir

PETROLEUM (SUBMERGED LANDS) ACT 1967
CONSENT TO DRILL HELIOS NO.1

You are advised that under Clause 3 of the Direction as to Drilling Operations, Designated Authority approval has been granted to your request to drill the new field wildcat well Helios No.1 in VIC/P18 using the semi-submersible "Diamond M Epoch".

While recognising the necessity for exploration drilling in shipping lanes and avoidance of temporary amendments to the Traffic Separation Scheme and Area to be Avoided in the Bass Strait, this requisite authority carries the following conditions -

1. Rig anchor marker buoys, if deployed, shall carry warning lights the characteristics of which satisfy the Commonwealth Department of Transport and Construction. Alternatively, your Company shall avoid the use of pennant lines and anchor buoys and rely on chain chaser techniques for anchor retrieval.

2. A preliminary abandonment programme shall be submitted to the Designated Authority at least one week prior to submission of the detailed (post final logs) abandonment programme.

3. The master of the Diamond M Epoch shall be advised that westbound maritime vessels may pass within one nautical mile of the drilling platform instead of maintaining the recommended 2.5 nautical miles as laid down by the Commonwealth Department of Transport and Construction.

4. The Masters of all work boats shall be cognizant of the International Maritime Organisation rules relating to traffic separation schemes.

Although it is not a condition of this approval, favourable consideration would be given to the utilisation of the work boats to watch for or monitor either by radio, radar or visual means, maritime traffic approaching the westbound traffic separation lane. While the DOT will sustain daily radio warnings to all ships in the area defining the location of the Diamond M Epoch in respect of the lightships marking the traffic separation zone, the Diamond M Epoch should initiate some form of watch or early warning system.

The Designated Authority is encouraged by Phillips Australian Oil Company's adherence to its exploration and drilling programme and wishes good luck with Helios No.1.

Yours faithfully

J. L. LePage
DIRECTOR
OIL & GAS DIVISION

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
19th Oct. 1982		The rig was under tow 7-1/2 hours to the Helios No. 1 location.
20th Oct. 1982		The rig was under tow 15 hours to the Helios No. 1 location. The tow line broke at 2305 hours and anchor No. 7 was dropped. The rig was holding the following position. Long. 143° 35' east Lat. 38° 57' south
21st Oct. 1982		A new tow line was connected and the tow re-commenced to Rabbit Island (15-1/2 hours under tow).
22nd Oct. 1982		The rig was under tow for 19-1/2 hours. Rig arrived at Rabbit Island at 0315 hours. Anchor No. 7 was dropped and the installation of anchor chain rings began.
23rd Oct. 1982		Completed installation of chain chaser rings on anchors and continued tow to Helios No. 1 location. Rig departed Rabbit Island at 0245 hours.
24th Oct. 1982		Completed tow to Helios No. 1 location. Rig arrived at Helios No. 1 location at 2100 hours. Anchoring operations commenced.

Date	Total Depth (metres RKB)	Work Performed
25th Oct. 1982		Continued running anchors. Pre-tension anchors. Anchors 1-6-8 slipped. Let anchors soak 9-1/2 hours. Pre-tension anchors 6 and 7. Both slipped.
26th Oct. 1982		All anchors slipping above 200,000 lbs. Recovered anchor No. 6 and re-ran with piggy back. Tensioned up on anchors No. 6 and 5 holding 300,000 lbs. All others slipping above 200,000 lbs. Started chasing No. 7 anchor.
27th Oct. 1982		Recovered anchor No. 7 and re-ran same with piggy back. Pulled in anchor No. 3 with rig. Re-ran No. 3 anchor with piggy back. Bolstered anchors No. 8 and No. 4. At present, 4 x 15 ton anchors are being offloaded from workboat to the rig and are being assembled on the pipe deck. Piggy backing operations will continue.
28th Oct. 1982		Assembled and ran piggy back anchors on anchors No. 1, 4, & 8. Bolstered anchor No. 2. Shut down 10 hours waiting on weather.
29th Oct. 1982	142 metres	Ran piggy back anchor on anchor No. 2. Pre-tensioned all anchors to over 300,000 lbs. Ballasted down rig and spud in at 2145 hours. Drilled and reamed 36-inch hole to 142 metres RKB and encountered hole fill problems again.

Date	Total Depth (metres RKB)	Work Performed
30th Oct. 1982	159 metres	Relocated rig 12 metres and spud hole No. 2. Drilled and reamed 36-inch hole to 159 metres RKB and encountered hole fill problems again.
31st Oct. 1982	144 metres	Relocated rig 18 metres and spud hole No. 3. Drilled and reamed 36-inch hole to 144 metres RKB.
1st Nov. 1982	159 metres	Drilled and reamed 36-inch hole to 159 metres RKB. Conditioned hole and ran 30-inch casing to 159 metres. Casing was cemented with 1000 sacks class "G" cement mixed with 1% $CaCl_2$ in seawater at 14 ppg. Rigged up to run riser.
2nd Nov. 1982	354 metres	Ran and attempted to latch riser. Several attempts were unsuccessful due to strong current at location. Laid down riser and made up 12-1/4-inch B.H.A. Drilled 12-1/4-inch pilot hole to 354 metres RKB.
3rd Nov. 1982	354 metres	Opened 12-1/4-inch hole to 26-inches to 354 metres RKB. Made wiper trip to 30-inch shoe and hit bridge at 222 metres. Reamed and circulated to T.D. at 354 metres.
4th Nov. 1982	354 metres	Conditioned 26-inch hole and ran 20-inch casing to 341 metres RKB. Casing was cemented with 1500 sacks of class "G" cement mixed with 2.5% gel in freshwater at 13.1 ppg followed with 500 sacks of class "G" neat cement at 15.8 ppg. Rigged up and ran BOP stack.

Date	Total Depth (metres RKB)	Work Performed
5th Nov. 1982	537 metres	Completed running the BOP assembly and tested same to PAOC specs. Drilled cement and 3 metres on new hole. Conducted a leak-off test which indicated leak-off began at an equivalent mud weight of 9.9 ppg. Drilled 12-1/4-inch hole to 537 metres RKB.
6th Nov. 1982	1170 metres	Drilled 12-1/4-inch hole to 1170 metres RKB.
7th Nov. 1982	1209 metres	Drilled 12-1/4-inch hole to 1209 metres RKB. Operations were shut down 15-1/2 hours due to mechanical problems.
8th Nov. 1982	1341 metres	Operations were shut down 8 hours due to mechanical problems. Drilled 12-1/4-inch hole to casing depth of 1341 metres RKB. Made a wiper trip and rigged up to run electric logs.
9th Nov. 1982	1341 metres	Ran electric logs and took sidewall cores. Made up 17-1/2-inch under-reaming BHA and opened hole to 595 metres RKB.
10th Nov. 1982	1341 metres	Ran 17-1/2-inch under-reamer to 649 metres RKB. Operations were shut down 7 hours to repair drilling line. Under-reamed 12-1/4-inch hole to 17-1/2-inches at 848 metres RKB.
11th Nov. 1982	1341 metres	Under-reamed 12-1/4-inch hole to 17-1/2-inches from 848 metres to 1192 metres.

Date	Total Depth (metres RKB)	Work Performed
12th Nov. 1982	1341 metres	Continued under-reaming from 1192 metres to 1341 metres (casing point). Conditioned hole for 13-3/8-inch casing.
13th Nov. 1982	1341 metres	Ran 13-3/8-inch, N-80, 72 lb casing. Hit a bridge at 1186 metres and were unable to pass bridge. Layed down 10 joints of casing, ran hanger and landed casing with shoe at 1179 metres. Cemented casing with 1100 sacks Class "G" cement mixed at 12.4 ppg with 2.5% pre hydrated gel and 1.48% CFR2L. Followed with 500 sacks Class "G" cement mixed at 14.5 ppg with 0.06% HR6L and fresh water. Estimated top of cement at 188 metres. Tested BOPs and surface equipment to PAOC specs.
14th Nov. 1982	1573 metres	Performed well kill drill. Drilled out plugs and cement. Performed formation leak-off test. Leak-off was indicated at an equivalent mud weight of 14.8 ppg. Drilled 12-1/4-inch hole from 1341 metres to 1573 metres. Ran RCV in water to check riser angle. Found that the 30-inch casing had separated from the 20-inch and was sitting on the seabed. Slope indicators on riser and stack showed a 2 degree angle to port.
15th Nov. 1982	1861 metres	Drilled 12-1/4-inch hole from 1573 metres to 1861 metres. (Hole deviation at 1830 metres was 0.5 degrees).

Date	Total Depth (metres RKB)	Work Performed
16th Nov. 1982	2135 metres	Drilled 12-1/4-inch hole from 1861 metres to 2135 metres. (Hole deviation at 2135 metres was 0.5 degrees).
17th Nov. 1982	2445 metres	Drilled 12-1/4-inch hole from 2135 metres to 2445 metres. (Hole deviation at 2439 metres was 2 degrees).
18th Nov. 1982	2571 metres	Drilled 12-1/4-inch hole from 2445 metres to 2571 metres. (Hole deviation at 2488 metres was 1 degree).
19th Nov. 1982	2691 metres	Drilled 12-1/4-inch hole from 2571 metres to 2691 metres.
20th Nov. 1982	2819 metres	Drilled 12-1/4-inch hole from 2691 metres to 2819 metres. (Hole deviation at 2691 metres was 0.5 degrees).
21st Nov. 1982	2929 metres	Drilled 12-1/4-inch hole from 2819 metres to 2929 metres. Conditioned hole and pulled out for logs.
22nd Nov. 1982	2929 metres	Finished pulling out of hole and ran logs.
23rd Nov. 1982	2998 metres	Finished sidewall cores and drilled 12-1/4-inch hole from 2929 metres to 2998 metres.
24th Nov. 1982	3000 metres	Drilled 12-1/4-inch hole from 2998 metres to 3000 metres. Lost all string weight except 6000 lbs. Drillpipe unscrewed. Made up overshot and fished drill pipe out of hole.

Date	Total Depth (metres RKB)	Work Performed
25th Nov. 1982	3000 metres	Finished pulling fish out of hole. Ran back in hole with new bottom hole assembly and reamed from 2974 metres to 3000 metres.
26th Nov. 1982	3000 metres	Pulled out of hole and ran logs. Ran in hole and reamed from 2991 metres to 3000 metres.
27th Nov. 1982	3000 metres	Ran 9-5/8-inch liner (shoe at 2995 metres). Cemented with 1200 sacks of Class "G" cement mixed at 12.8 ppg with 2.5% pre-hydrated gel, 0.5% CFR2 and 0.06% HR6L. Tested BOP stack and surface equipment to PAOC specs.
28th Nov. 1982	3000 metres	Ran in hole with 12-1/4-inch bit and tagged top of liner at 1025 metres. Performed pump in test. Formation took fluid at a rate of 6.1 BPM at 900 psi. Pulled out of hole and went in hole with 8-1/2-inch bottom hole assembly. Tagged cement plug at 2761 metres. Pulled out of hole and ran in hole with open end drill pipe to 1006 metres.

Date	Total Depth (metres RKB)	Work Performed
29th Nov. 1982	3000 metres	Squeeze cemented liner lap with 500 sacks Class "G" cement mixed with fresh water at 15.8 ppg. Final squeeze pressure was 600 psi at 4 BPM. Pulled out of hole with open end drillpipe and ran in hole with 12-1/4-inch bit. Drilled cement from 960 metres to 1024 metres. Pressured up on casing to 1500 psi and squeeze job leaked. Pulled out of hole and ran in hole with open end drillpipe to 1006 metres. Re-squeezed liner lap with 300 sacks Class G cement mixed with sea water at 16 ppg. Final squeeze pressure 2000 psi.
30th Nov. 1982	3000 metres	Pulled out of hole with open end drillpipe and ran in hole with 12-1/4-inch bit. Drilled cement from 1024 metres to 1025 metres. Pressure tested casing to 3300 psi. Pressure held. Pulled out of hole with 12-1/4-inch bit and ran in hole with 8-1/2-inch bit. Drilled cement from 1025 metres to 1033 metres. Ran in hole and tagged cement at 2761 metres. Drilled cement to 2967 metres.

Date	Total Depth (metres RKB)	Work Performed
1st Dec. 1982	3046 metres	Drilled to 3003 metres and performed leak-off test. Test indicated that leak-off occurred at an equivalent mud weight of 14.5 ppg. Drilled from 3003 metres to 3017 metres. Lost 200 psi pump pressure. Pulled out of hole and found washout in jet nozzel cavity. Ran in hole with new bottom hole assembly and drilled from 3017 metres to 3046 metres.
2nd Dec. 1982	3211 metres	Drilled an 8-1/2-inch hole from 3046 metres to 3211 metres.
3rd Dec. 1982	3280 metres	Drilled from 3211 metres to 3280 metres.
4th Dec. 1982	3317 metres	Drilled from 3280 metres to 3317 metres.
5th Dec. 1982	3319 metres	Drilled from 3317 metres to 3319 metres. Pipe stuck at 3032 metres while going in hole with new bit. Pulled free with 125,000 lbs over pull. Reamed undergauge hole to 3064 metres and pulled out of hole for bit change.
6th Dec. 1982	3447 metres	Drilled from 3319 metres to 3447 metres.
7th Dec. 1982	3500 metres	Drilled from 3447 metres to 3500 metres. Conditioned hole for logs. Made one logging run
8th Dec. 1982	3500 metres	Made three logging runs, took sidewall cores and ran velocity survey.

Date	Total Depth (metres RKB)	Work Performed
9th Dec. 1982	2820 metres	Ran and set an EZ-SV cement retainer at 2965 metres. Stung into retainer and made several unsuccessful attempts to establish injection rate. Pulled out of retainer and set a balanced plug from 2963 - 2820 metres with 168 sacks of Class "G" cement mixed at 15.8 ppg.
10th Dec. 1982	2820 metres	Tested casing to 3300 psi for 15 minutes. Ran casing scraper in 9-5/8-inch casing to 2649 metres. Tested BOP stack to PAOC specifications. Laid down old bottom hole assembly and picked up a new bottom hole assembly.
11th Dec. 1982	2820 metres	Perforated well from 2592 to 2610 metres. (due to gun mis-firing repeatedly, seven runs were required). Made up and ran drillstem test tools.
12th Dec. 1982	2820 metres	Performed DST No. 1, perforations 2592 - 2610 metres. Formation very tight. Pulled out of hole.
13th Dec. 1982	2583 metres	Ran and set an EZ-SV cement retainer at 2583 metres. Tested retainer to 1000 psi - a leak was indicated. Pulled out of hole and picked up squeeze stinger and ran in hole.
14th Dec. 1982	994 metres	Stung into retainer to establish injection rate. A leak around packer was indicated. Pulled out of retainer/

Date	Total Depth (metres RKB)	Work Performed
		/retainer and set a balanced plug from 2435 to 2583 metres with 200 sacks of Class "G" cement mixed at 15.8 ppg. Pulled up hole and set another balanced plug from 1055 to 994 metres with 130 sacks of Class "G" cement mixed at 15.8 ppg.
15th Dec. 1982	866 metres	Set a balanced plug from 866 to 990 metres. Pressure tested 13-3/8-inch casing - lost pressure. Ran in hole with RTTS tool to find the casing leak. Determined that the 13-3/8-inch casing leak was just below the wellhead.
16th Dec. 1982	144 metres	Perforated 13-3/8-inch casing from 248.4 metres to 249 metres with 4 shots per foot. Set EZSV cement retainer at 240 metres. Pumped 500 sacks of Class "G" cement mixed at 15.8 ppg below retainer. Pulled out of retainer and pumped 200 more sacks of cement. Estimated TOC at 144 metres. Pulled riser and BOP stack.
17th Dec. 1982	144 metres	Detonated an explosive charge 8 metres below the wellhead. Recovered 20-inch wellhead, 30-inch stub and permanent guide base. Started pulling anchors. (Operations were shut down 6-1/2 hours due to mass meeting in Sale.)
18th Dec. 1982	144 metres	Pulled No. 8, 7, 6 and 3 piggy backs. (Operations shut down 14 hours due to weather).

Date	Total Depth (metres RKB)	Work Performed
19th Dec. 1982	144 metres	Recovered remaining piggy backs. Heaved and bolstered No. 1 and 5 primary anchors. (Operations shut down 13-1/2 hours due to weather).
20th Dec. 1982	144 metres	Waited on weather.
21st Dec. 1982	144 metres	Started ballasting rig up to bolster anchors. (Operations shut down 22 hours due to weather).
22nd Dec. 1982	144 metres	Ballasted up to 7.3 metres. Heaved and bolstered remaining anchors. Rig released from Helios No. 1 location at 0030 hours 22nd December, 1982.

APPENDIX NO. 3

DETAILED CUTTINGS DESCRIPTIONS

APPENDIX NO.3

DETAILED CUTTINGS DESCRIPTIONS

All depths quoted are below Rotary Kelly Bushing (RKB), which is 23 metres (75.5 feet) above Mean Sea Level and 109.86 metres (360.4 feet) above the sea bed. Drill cuttings were collected at 10 metre intervals between 350 metres (1148 feet) and 2400 metres (7874 feet), thence at 5 metre intervals between 2400 metres (7874 feet) and 3500 metres (11,484 feet), 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, all returns being circulated to the sea floor.

350 - 370 m : (20 m)

Calcarenite, white, yellow, grey, dark grey, coarse grained to medium grained, well rounded to moderately well rounded, high sphericity of abundant coarse fossil fragments, foraminifera common, minor fine grained white, grey Limestone material, minor platy, grey Calcite as cementing material, Quartz grains, clear to white, coarse grained to very coarse grained, well sorted, high sphericity, well rounded. No fluorescence.

370 - 400 m : (30 m)

Calcarenite, white to light grey, medium grained, well sorted, friable, calcite cement, abundant fossil fragments, abundant platy Calcite, minor Quartz grains, clear to white, coarse to very coarse grained, well sorted, high sphericity, well rounded. Silty Sandstone, dark grey, very fine grained, very silty, carbonaceous, firm, non calcite cement, very poor porosity, minor amount of round minerals reacting slowly with hydrochloric acid could be mud additive or quartzitic dolomite. The Silty Sandstone grades to Siltstone towards base of interval. No fluorescence.

400 - 410 m : (10 m)	Calcarenite, white to light grey, medium grained, well sorted, friable, calcite cement, fewer fossil fragments, abundant platy Calcite. Siltstone, dark grey, carbonaceous, well sorted, non calcite cement, firm to hard, no porosity. No fluorescence.
410 - 425 m : (15 m)	Calcarenite, white to light grey, firm to hard, calcite (15 m) cement, fine to medium grained, calcite fragments and fossil fragments common and cemented together, well sorted, poor porosity, abundant platy calcite, minor glauconite, Siltstone, almost a Sandstone, dark grey, carbonaceous, non calcite cement, poor porosity, well sorted, firm to hard. Glauconite disappears toward base of interval. No fluorescence.
425 - 450 m : (25 m)	Marl, light grey, very calcareous claystone, sticky. Calcarenite, white to light grey, firm to hard, calcite cement, fine to medium grained, calcite fragments and fossil fragments common and cemented together, well sorted, poor porosity, abundant platy calcite, glauconite grades out at top of interval. Siltstone, very minor amount, possibly cavings, dark grey, carbonaceous, non calcite cement, well sorted, firm to hard.
450 - 535 m : (85 m)	Marl, light grey, very calcareous claystone, sticky. Calcarenite, white to light grey, very hard, calcite cement, fine to medium grained, calcite fragments, abundant large fossil fragments, well sorted, poor porosity, abundant platy calcite. Toward bottom of interval the Marl grains become clay size and the Calcarenite matrix becomes calcareous clay along with minor amounts of very fine grained quartz grains. No fluorescence.

535 - 1100 m : (565 m)	Calcarenite, light grey, firm to hard, very calcareous, calcareous clay matrix, minor very fine grained quartz grains, fine grained calcite grains, large and small fossil fragments common, forams common. Marl, light grey, very calcareous, clay size grains, very sticky, increase in plasticity of Marl in lower portion of interval. No fluorescence.
1100 - 1175 m : (75 m)	Marl, major constituent, light grey, sticky, very plasticky, clay size grains, very calcareous. Calcarenite, probably cavings, light grey, fine grained calcite grains, soft to firm, forams and fossil fragments common. No fluorescence.
1175 - 1385 m : (210 m)	Marl and Calcarenite, interbedded, Marl, light grey to medium grey, sticky, plasticky, clay size grains, very calcareous, Calcarenite, light grey to medium grey, very fine grained to fine grained, minor calcite in matrix plus carbonaceous material, abundant glauconite pellets, medium firm to firm, fossil fragments and forams common. No fluorescence.
1385 - 1500 m : (115 m)	Marl, light grey to medium grey, sticky, plasticky, clay size grains, slightly firm to firm, very calcareous, glauconite pellets, trace pyrite(?), grading to silt size grains with very fine grained quartz grains toward base of interval. No fluorescence.
1500 - 1510 m : (10 m)	Marl/Siltstone, dark grey to light grey, clay to silt size grains grading to Siltstone over last 2 metres, soft to hard, sub fissile in part, abundant very fine grained quartz grains, calcite cement, no fossils. No fluorescence.

1510 - 1560 m : (50 m) — Siltstone, light grey to dark grey, clay to silt size grains, predominantly silt size grains, soft to hard, sub-fissile in part, calcite cement, abundant very fine grained quartz grains, no fossils. No fluorescence.

1560 - 1590 m : (30 m) — Sandy Siltstone, light grey to dark grey, very fine grained quartz grains in silt matrix, calcite cement, quartz becoming predominant, sub fissile, no fossils, very low porosity. No fluorescence.

1590 - 1715 m : (125 m) — Siltstone/Sandy Siltstone, interbedded, Siltstone, light grey to dark grey, silt to clay size grains, silt size grains predominantly, very fine grained quartz grains, calcite cement, very low porosity, Sandy Siltstone, light grey to dark grey, very fine grained to medium grained quartz grains in silt matrix, calcite cement, sub fissile in part, quartz predominant, well sorted, well rounded, homogeneous, occasional fossil fragments and forams. No fluorescence.

1715 - 1755 m : (40 m) — Siltstone, light grey to dark grey, silt to clay size grains, predominantly clay size grains towards bottom of interval, very fine grained quartz grains floating in matrix, calcite cemnet, soft to hard, fossils rare but where present have been replaced by silica, homogeneous. No fluorescence.

1755 - 1840 m : (85 m) — Claystone, light to dark grey, very silty with predominantly clay, very calcareous, homogeneous, fossil fragments replaced by silica, occasional coarse grained to very coarse grained, well rounded quartz grains floating in matrix, calcite cement, sub-fissile in part, rare plant fossils(?). No fluorescence.

1840 - 1925 m : (85 m)	Claystone/Siltstone, interbedded, Claystone, light to dark grey, very silty with predominantly clay, very calcareous, homogeneous, fossil fragments replaced by silica, occasional coarse grained to very coarse grained, well rounded quartz grains floating in matrix, calcite cement, sub-fissile in part, rare plant fossils(?), abundant forams, large pyrite grains, clay content increases toward bottom of interval, Siltstone, light grey to dark grey, very fine grained quartz grains, calcite cement, decrease of Siltstone toward base of interval. No fluorescence.
1925 - 2070 m : (145 m)	Claystone, light grey to dark grey, silty with predominantly clay size grains, very calcareous, occasional fossil fragments replaced by silica, rare plant fossils(?), abundant clear quartz grains floating in matrix, calcite cement, occasional pyrite, rare glauconite pellets. No fluorescence.
2020 - 2275 m : (205 m)	Claystone/Siltstone, interbedded, Claystone, light grey to dark grey, soft to hard, silty, abundant very fine grained quartz grains floating in matrix, calcite, calcite cement, sub-fissile in part, abundant forams, pyrite, Siltstone, light grey to dark grey, firm to very hard, sub-fissile to platy, micaceous, calcareous, well sorted silt size grains in part, forams, trace of limonite, pyrite and glauconite present, becomes siltier toward base of interval. No fluorescence.
2275 - 2405 m : (130 m)	Siltstone, light grey to dark grey to dark green, very clayey, carbonaceous material in matrix, firm to moderately hard, becoming platy in part, very calcareous, trace of pyrite and glauconite. No fluorescence.

2405 - 2485 m : (80 m)	Siltstone/Claystone, interbedded, Siltstone, light grey to dark grey, firm to hard, sub fissile to platy, black carbonaceous material floating in matrix, very fine grained quartz grains floating in matrix, calcareous, forams common, pyrite common, increase in carbonaceous material, pyrite, and forams toward base of interval, poor porosity, Claystone, light grey, sticky, calcareous, silty, soft, abundant very fine grained quartz grains, decreases rapidly towards base of interval. No fluorescence.
2485 - 2565 m : (80 m)	Siltstone, light grey to dark grey, very clayey, very calcareous, firm to moderately hard, platy to sub fissile, black carbonaceous material in matrix, occasional pyrite, rare glauconite pellets, occasional fossil forams and striated plant fragments, very fine grained quartz grains common in matrix and increases throughout toward base of interval, increase in glauconite content toward base of interval, trace of porosity. No fluorescence.
2565 - 2570 m : (5 m)	Sandstone, light grey to grey, white, firm, very fine grained to fine grained, silty, clayey in part, well rounded, very glauconitic, calcareous cement, trace of porosity. Light blue fluorescence.
2570 - 2575 m : (5 m)	Sandstone, light grey to grey to white, firm, very fine grained to fine grained, well rounded calcareous cement, very silty, very clayey, very glauconitic, abundant dispersed pyrite, trace of porosity. Minor crush fluorescence.

2575 - 2595 m : (20 m)

Sandstone, light grey to white, firm, very fine grained to fine grained, well rounded to subrounded, moderately well sorted, increase in silt and clay content after sharp decrease, calcareous cement, abundant pyrite, increase in glauconitic pellets, trace of porosity. No fluorescence.

2595 - 2600 m : (5 m)

Sandstone, light grey to white, firm, abundant coarse grained to very coarse grained clayey quartz grains, subangular to well rounded, abundant very fine grained to fine grained clayey quartz grains, angular to subangular common on desilter, calcareous cement, abundant pyrite and glauconite. Pin-point fluorescence.

2600 - 2615 m : (15 m)

Sandstone, dark grey to white, very fine grained to fine grained quartz grains, silty to very clayey, calcareous cement, firm to hard, abundant forams, abundant pyrite, very glauconitic, abundant fossils, abundant medium grained to very coarse grained clay quartz, well sorted, subangular to rounded, trace of porosity. No fluorescence.

2615 - 2620 m : (5 m)

Sandstone, light grey to dark grey, very fine grained to fine grained, silty, clayey, slightly calcareous, firm to hard, very glauconitic, forams, fossil fragments, abundant medium grained to very coarse grained clay quartz, subangular to rounded. Yellow pin-point fluorescence with light blue crush cut.

2620 - 2625 m : (5 m)

Sandstone, light grey to white, very fine grained quartz, very silty, very clayey, firm to moderately hard, very glauconitic, occasional fossil fragments, occasional plant fragments, trace feldspar(?), very calcareous, occasional medium to coarse grained quartz, subangular to subrounded. No fluorescence.

2625 - 2635 m : (10 m)	No recovery
2635 - 2655 m : (20 m)	Siltstone, light grey to white, abundant very fine grained quartz in matrix, very clayey in part, firm to moderately hard, glauconite spheres less than 1 mm in size, occasional pyrite, occasional fossil fragments, occasional plant fragments, very calcareous, occasional medium to coarse quartz, subangular to subrounded, minor amount of Sandstone, light brown, very fine grained, subrounded to rounded, very glauconitic, non calcareous cement. No fluorescence.
2655 - 2730 m : (75 m)	Sandstone, light grey, brown, clear, white, opaque, very fine grained to coarse grained quartz grains, subangular to round, very pyritic, very glauconitic, abundant medium to coarse loose grains of quartz, slightly to non calcareous, trace of carbonaceous material(?), very argillaceous, minor cement. No fluorescence but minor light blue to white crush cut.
2730 - 2735 m : (5 m)	Sandstone, clear to white to light grey, medium to coarse grained, subangular to subrounded, well sorted, moderate sphericity, silty, argillaceous grains, clay matrix (glauconitic?), minor amount pyrite, non calcareous. Minor amount Siltstone, brown, non calcareous, moderately hard. Pin-point fluorescence (light yellow).

2735 - 2965 m : (230 m)

Sandstone, clear to white quartz conglomerate, very fine grained to coarse grained, angular to rounded grains throughout, poor to well sorted throughout, moderately spherical, range from calcareous to non calcareous to no cement, clayey calcareous matrix, carbonaceous material noted throughout interval, traces of pyrite and glauconite, Siltstone, interbedded in part, light grey to grey, moderately soft, silty, calcareous masses, firm, homogeneous, trace of mica. No fluorescence.

2965 - 2970 m : (5 m)

Sandstone, clear to white, medium to coarse grained, subangular to subrounded, well sorted, highly spherical, argillaceous, silty matrix, non calcareous, with carbonaceous material, trace pyrite, minor Siltstone, grey, moderately soft, silty, calcareous masses, firm, homogeneous, calcareous cement. Very minor yellow pin-point fluorescence.

2970 - 2990 m : (20 m)

Sandstone, quartz, clear, white, light grey, opaque, coarse to very coarse grained, subangular to rounded, well sorted, highly spherical, non calcareous cement, silty argillaceous silt matrix, trace of pyrite, glauconite pellets, occasional black carbonaceous material, trace kaolinite(?). No fluorescence.

2990 - 3000 m : (10 m)

No recovery

3000 - 3060 m : (60 m)

Sandstone, clear to translucent, white, fine to coarse grained, subangular to rounded, well sorted to moderately sorted, moderate sphericity, argillaceous, non calcareous, carbonaceous material common, pyrite common, no apparent cement, minor interbedded Siltstone, black to white, moderately soft to moderately hard, massive to sub-fissile, non calcareous. No fluorescence.

3060 - 3065 m (5 m)

No recovery

3065 - 3115 m (50 m)	Sandstone, grey to light white, clear to translucent, medium grained to coarse grained, subangular to subrounded, moderately sorted, moderate sphericity, argillaceous with non calcareous brown to white clay matrix, trace pyrite, carbonaceous material common, minor interbedded Siltstone, white to brown, homogeneous, non calcareous masses. No fluorescence.
3115 - 3120 m : (5 m)	No recovery
3120 - 3125 m : (5 m)	Siltstone, grey, soft, calcareous cement, argillaceous matrix, pyrite, with Sandstone interbedded, white to clear, coarse grained, angular to subrounded, low to moderate sphericity, silty clay matrix. No fluorescence.
3125 - 3135 m : (10 m)	Sandstone, white to clear, medium to coarse grained, angular to subrounded, silty cement, argillaceous matrix, trace pyrite, with Siltstone interbedded, grey to dark grey, silt cement, very argillaceous, plus interbedded Coal. No fluorescence.
3135 - 3140 m : (5 m)	Siltstone, dark grey to black, hard, silt cement, carbonaceous, argillaceous matrix, with Sandstone interbedded, white to clear, medium to coarse grained, angular to subrounded, silt cement, argillaceous matrix, trace pyrite, with interbedded Coal.
3140 - 3145 m : (5 m)	Sandstone, clear to translucent, medium to coarse grains, angular to subrounded, low to moderate sphericity, argillaceous matrix(?), with Siltstone interbedded, light to dark grey, silty, argillaceous matrix, pyritic in part, Coal throughout. No fluorescence.
3145 - 3150 m : (5 m)	Claystone, grey, soft, silty, with Siltstone interbedded, medium to dark grey, hard, silica cement, argillaceous matrix, pyrite, with minor amount Sandstone, clear to translucent, medium to coarse grains, angular to subrounded, low to moderate sphericity, argillaceous matrix(?). No fluorescence.

3150 - 3165 m : (15 m)	Sandstone, white to translucent, medium to coarse grains, well sorted, subangular to subrounded, argillaceous matrix(?), trace pyrite, with Claystone interbedded, grey, soft, silty, with Siltstone interbedded, medium to dark grey, hard, silica cement, argillaceous matrix, with minor amount of Coal.
3165 - 3170 m : (5 m)	Claystone, dark grey to brown, soft, silty, silica, with interbedded carbonaceous Shale, Siltstone, medium to dark grey, hard, silica cement, argillaceous matrix, pyrite, minor amount Coal. No fluorescence.
3170 - 3190 m : (20 m)	Sandstone, white to clear, coarse grained, subangular to subrounded, fair sorting, silica cement, clay matrix(?), with Siltstone interbedded, grey, silty, and Coal. No fluorescence.
3190 - 3200 m : (10 m)	Siltstone, dark grey to brown, moderately soft, non calcareous, homogeneous with Claystone, light grey to white, very soft and plasticky, non calcareous, argillaceous, homogeneous, trace pyrite, Coal, black, hard, vitreous, and minor amount very coarse grained, white to translucent quartz Sandstone grains, subangular to subrounded. No fluorescence.
3200 - 3215 m : (15 m)	Sandstone, quartz, light grey to white, clear to translucent, medium to very coarse grained with granular/pebble size grains, angular to subrounded, moderately well sorted to poorly sorted, low to moderate sphericity, slightly argillaceous, clay matrix, silica cement, non calcareous, trace of pyrite, with Siltstone, light grey, hard, carbonaceous, argillaceous, homogeneous, non calcareous, trace pyrite, minor Coal. No fluorescence.

3215 - 3245 m : (30 m)

Siltstone, light grey to black, moderately soft to hard, slightly carbonaceous to carbonaceous, argillaceous, non calcareous, homogeneous, with minor Sandstone, light grey to white, medium to very coarse grained, angular to subrounded, moderately well sorted to poorly sorted, low to moderate sphericity, clay matrix, silica cement, Claystone, light grey to cream, soft, non calcareous, slightly carbonaceous in part, plasticky, Coal. No fluorescence.

3245 - 3250 m : (5 m)

Claystone, light grey to cream, soft, non calcareous, slightly carbonaceous in part, plasticky, with Siltstone, light grey to black, moderately soft to hard, slightly carbonaceous to carbonaceous, argillaceous, non calcareous, homogeneous, and Coal, with minor amount of interbedded Sandstone, white, very fine grained, argillaceous matrix, non calcareous. No fluorescence.

3250 - 3270 m : (20 m)

Sandstone, white, opaque, coarse to very coarse grained, angular to subrounded, low to moderate sphericity, poorly sorted, minor pyrite with interbedded Siltstone, light grey to black moderately soft to hard, carbonaceous, argillaceous, homogeneous, Claystone, light grey to cream, soft, non calcareous, plasticky, Coal. No fluorescence.

3270 - 3285 m : (15 m)

Siltstone, dark grey, black, brown, hard, siliceous, carbonaceous to coaly in part, with minor interbedded Sandstone, white to clear, coarse grains, subangular to subrounded, moderately well sorted, pyrite, and interbedded Shale toward base of interval, black, hard, siliceous, Coal. No fluorescence.

3285 - 3290 m : (5 m)

Shale, brown to black, generally soft, non calcareous, silty, carbonaceous, only slightly fissile, borders on Claystone, with minor Coal. No fluorescence.

3290 - 3305 m : (15 m)

Sandstone, white to opaque, very coarse to coarse grains, angular to subrounded, moderately sorted, includes igneous clasts of feldspars welded with quartz, trace muscovite, abundant feldspathic clay, weathered micas, moderate to abundant kaolinite, minor Shale, brown to black, soft, non calcareous, silty, carbonaceous, slightly fissile. Coal. No fluorescence.

3305 - 3315 m : (10 m)

Claystone, dark brown, soft, non calcareous, silty, carbonaceous, with interbedded Shale, black, hard, non calcareous, carbonaceous to lignitic and Coal, minor interbedded Sandstone, white to opaque, very coarse to coarse grains, angular to subrounded, moderately sorted, weathered arkose. No fluorescence.

3315 - 3325 m : (10 m)

Shale, dark brown to black, non calcareous, carbonaceous to lignitic, with minor interbedded Siltstone, dark grey to black, hard, siliceous, carbonaceous. Trace of minor fluorescence.

3325 - 3350 m : (25 m)

Sandstone, quartz, milky to clear, medium grained to coarse grained, angular to rounded, low to high sphericity, poorly sorted, trace of pyrite, minor Shale, dark brown to black, non calcareous, carbonaceous to lignitic, with interbedded Siltstone, dark brown, argillaceous, non calcareous, carbonaceous to lignitic in part. No fluorescence.

3350 - 3370 m : (20 m)	Siltstone, dark brown, argillaceous, non calcareous, abundant reworked carbonaceous debris, including Coal debris, pyrite, Siltstone borders on very fine grained Sandstone, with interbedded Claystone, dark brown, soft, non calcareous, silty, carbonaceous. No fluorescence.
3370 - 3380 m : (10 m)	Coal, black, hard, conchoidal fractures, combustible, with minor Siltstone, grey, non calcareous, soft, argillaceous. No fluorescence.
3380 - 3385 m : (5 m)	Sandstone, quartz, grey, very fine grained, non calcareous, silty matrix, subrounded, well sorted(?), with abundant interbedded Shale, black, carbonaceous, hard, silty, and Claystone, dark brown, soft. No fluorescence.
3385 - 3400 m : (15 m)	Shale and Claystone, dark brown, soft, non calcareous, carbonaceous to lignitic, with interbedded Coal and Sandstone, grey, fine grained, subrounded, well sorted, non calcareous, trace pyrite, abundant white Clay, diagenetic Kaolinite(?), blebs, very soft. No fluorescence.
3400 - 3410 m : (10 m)	Sandstone, quartz, white, fine grained to very coarse grained, subangular to subrounded, well sorted, with interbedded brown to black carbonaceous Siltstone and Shale. No fluorescence.
3410 - 3415 m : (5 m)	Claystone, brown to cream, very soft, massive, non calcareous, plasticky, tacky, non carbonaceous, with siltstone, brown to black, hard, non calcareous, carbonaceous, argillaceous, sub fissile, massive, with Coal, minor amount only, black, hard, conchoidal fracturing, and Sandstone, quartz, white to translucent, fine grained, rounded, moderate sphericity, no cement. No fluorescence.

3415 - 3420 m : (5 m)

Coal, black, hard, conchoidal fracturing, with interbedded Claystone, brown to cream, very soft, massive, non calcareous, plasticky, tacky, non carbonaceous, Siltstone, brown to black, hard, non calcareous, carbonaceous, argillaceous, sub fissile, massive, and minor quartz Sandstone, white to translucent, fine grained, rounded, moderate sphericity, no cement. No fluorescence.

3420 - 3435 m : (15 m)

Sandstone, quartz, white to light grey, translucent, coarse to very coarse grains with occasional granular/pebble size grains, angular to subrounded, moderately sorted, poorly cemented, non carbonaceous, pyrite common, with minor amounts of Coal, black, hard, conchoidal fracturing, Siltstone, brown to black, hard, non calcareous, carbonaceous, argillaceous, sub fissile, massive, and Claystone, brown to cream, very soft, massive, non calcareous, plasticky, tacky, non carbonaceous. No fluorescence.

3435 - 3485 m : (50 m)

Siltstone, brown to light grey, moderately hard, massive, non calcareous, carbonaceous, argillaceous, with interbedded Sandstone, quartz, light to dark grey, very fine grained to fine grained, subangular to subrounded, moderately sorted, silica cement, non calcareous, with Coal, very common, and Claystone, brown to cream, very soft, massive, non calcareous, plasticky, tacky, non carbonaceous. No fluorescence.

3485 - 3500 m : (15 m)

Sandstone, quartz, white to light grey, coarse grains, subangular to subrounded, moderate sorting, high sphericity, non calcareous, slightly argillaceous, trace of carbonaceous material, trace of pyrite, with interbedded Claystone, brown to cream, very soft, massive, non calcareous, plasticky, tacky, non carbonaceous, Siltstone, brown to light grey, moderately hard, massive, non calcareous, carbonaceous, argillaceous and Coal, black, hard, conchoidal fracturing. No fluorescence.

APPENDIX NO. 4

SIDEWALL CORE DESCRIPTIONS

APPENDIX NO. 4

Sidewall Core Descriptions

Four sidewall core suites were performed at Helios No. 1:

Suite No. 1	Interval cored: 345 metres - 1330 metres
	Shots attempted: 51
	Cores recovered: 51
Suite No. 2	Interval cored: 1345 metres - 2900 metres
	Shots attempted: 51
	Cores recovered: 48
Suite No. 3	Interval cored: 1400 metres - 2998 metres
	Shots attempted: 30
	Cores recovered: 27
Suite No. 4	
Run No. 1	Interval cored: 3020.5 metres - 3497 metres
	Shots attempted: 30
	Cores recovered: 22 (only 12 of acceptable size)
Run No. 2	Interval cored: 3020.5 metres - 3497 metres
	Shots attempted: 20
	Cores recovered: 18

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 350 m to 1330 m DATE 8/11/82 PAGE 1

SWC ATTEMPTED 51 RECEIVED 51 MISSFIRES ______ NO RECOVERY ______

RUN No. 1 GEOLOGIST Murray/Garrity

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
345	2.0	Sandstone: Dark grey, very fine grained quartz grains, silica cement, hard, homogeneous, no sedimentary structure, no fossils, very well sorted.	-	-	-	-
350	2.25	Shale: Dark grey, fissile to sub-fissile, very hard dolomite cement plus silica cement, homogeneous, no fossils.	-	-	-	-
366	1.5	Sandy Calcarenite: very light grey, about 50% fine grained calcite grains and 50% fine grained quartz grains - subrounded, calcite and quartz clay size matrix, no fossils, no sedimentary structure.	-	-	-	-
400	2.0	Calcarenite: Dark grey to light grey, fine grained calcite grains, minor calcareous clay matrix, friable to soft, minor very fine grained quartz grains, fossil fragments common, no sedimentary structure, homogeneous.	-	-	-	-
408	2.5	Calcarenite: Dark grey, fine grained calcite grains, calcareous clay matrix is minor, abundant large fossil fragments probably pelecypods, no sedimentary structure, homogeneous,	-	-	-	-
469.5	2.5	Calcarenite: Dark grey, very fine grained calcite grains, calcareous clay matrix, friable, minor very fine grained quartz grains, occasional fossil fragments, no sedimentary structure, homogeneous.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 350 to 1330 m DATE 8/11/82 PAGE 2
SWC ATTEMPTED 51 RECEIVED 51 MISSFIRES ______ NO RECOVERY ______
RUN No. 1 GEOLOGIST Murray/Garrity

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
511	2.0	Calcarenite: Dark grey to light grey, very fine grained calcite grains, calcareous clay matrix, friable, minor very fine grained quartz grains, no fossils, no sedimentary structure, homogeneous.	-	-	-	-
547	2.5	Calcarenite: Dark grey to light grey, very fine grained calcite grains, calcareous clay matrix, friable, minor very fine grained quartz grains, occasional medium grained calcite grains, horizontal laminations, fossils present - molluscs and pelecypods.	-	-	-	-
603.5	2.25	Calcarenite: Dark grey to light grey, very fine grained calcite grains, calcareous clay matrix, minor very fine grained quartz grains, no fossils, no sedimentary structure, homogenous.	-	-	-	-
636	2.5	Calcarenite: Dark grey to light grey, very fine grained calcite grains, calcareous clay matrix, matrix is 15 to 20% of sample, friable, occasional coarse grained calcite grains, platy, minor very fine grained quartz grains, no fossils, no sedimentary structure, homogeneous.	-	-	-	-
645	2.5	Calcarenite: Dark grey to light grey, very fine grained calcite rains, calcareous clay matrix, matrix is 10% of sample, friable, minor very fine grained quartz grains, no fossils, no sedimentary structure, homogeneous.	-	-	-	-
708	2.25	Calcarenite: Light grey, very fine grained calcite grains, calcareous lay size matrix, matrix is less than 10% of sample, friable, minor very fine grained quartz grains, no fossils, no sedimentary structure, homogeneous, minor glauconite.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 350 m to 1350 m DATE 8/11/82 PAGE 3

SWC ATTEMPTED 51 RECEIVED 51 MISSFIRES ____ NO RECOVERY ____

RUN No. 1 GEOLOGIST Murray/Garrity

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
760	1.75	Calcarenite: Light grey, fine grained calcite grains, calcareous clay size matrix, matrix is less than 15% of sample, friable, minor very fine grained quartz grains, no fossils, no sedimentary structure, homogeneous.	-	-	-	-
815	2.0	Calcarenite: Light grey to cream, fine grained calcite grains, calcareous clay size matrix, friable, minor very fine grained quartz grains, no fossils, no sedimentary structure sucrosic texture.	-	-	-	-
869.5	1.75	Calcarenite: Light grey to cream, very fine grained to fine grained calcite grains, calcareous clay size matrix, friable, matrix about 15% of sample, minor very fine grained quartz grains, no fossils, no sedimentary structure, sucrosic texture.	-	-	-	-
875	2.0	Calcarenite: Light grey to cream, very fine grained calcite grains, calcareous clay size matrix, friable, minor very fine grained quartz grains, no fossils, no sedimentary sucrosic texture.	-	-	-	-
890	2.0	Calcarenite: Light grey to cream, very fine grained calcite grains, calcareous clay size matrix, friable, minor very fine grained quartz grains, no fossils, no sedimentary structure, sucrosic texture, minor glauconite.	-	-	-	-
905	1.5	Calcarenite: Light grey to cream, very fine grained to fine grained calcite grains, very calcareous, clay size matrix, friable, minor very fine grained quartz grains, no fossils, no sedimentary structure, sucrosic texture.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 350 m to 1330 m DATE 8/11/82 PAGE 4
SWC ATTEMPTED 51 RECEIVED 51 MISSFIRES ____ NO RECOVERY ____
RUN No. 1 GEOLOGIST Murray/Garrity

DEPTH in metres	LENGTH REC'VD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
919	1.75	Calcarenite: Light grey to cream, very fine grained to fine grained calcite grains, very calcareous, clay size matrix, friable, minor very fine grained quartz grains, no fossils, no sedimentary structure,	-	-	-	-
935	2.0	Calcarenite: Light grey to cream, very fine grained to fine grained calcite grains, very calcareous, clay size matrix, friable, minor very fine grained quartz grains, no fossils, no sedimentary structure, sucrosic texture, sample is more than 90%.	-	-	-	-
950	2.5	Calcarenite: Light grey, fine grained calcite grains, very calcareous, clay size matrix, friable, minor very fine grained quartz grains about 10% of sample, no fossils, no sedimentary structure, homogeneous sucrosic texture, matrix less than 20% of sample.	-	-	-	-
965	3.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 50%. Calcarenite: Light grey, microcrystalline, calcite cement. 50%.	-	-	-	-
983	2.5	Marl: Light grey, clay size grains calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 50%. Calcarenite: Light grey, microcrystalline, calcite cement. 50%.	-	-	-	-
995	3.0	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 50%. Calcarenite: Light grey, microcrystalline, calcite cement. 50%.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 350 m to 1330 m DATE 8/11/82 PAGE 5

SWC ATTEMPTED 51 RECEIVED 51 MISSFIRES ______ NO RECOVERY ______

RUN No. 1 GEOLOGIST Murray/Garrity

DEPTH in metres	LENGTH REC'VD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
1010	3.0	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 50%. Calcarenite: Light grey, micro-crystalline, calcite cement, 50%.	-	-	-	-
1025	2.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 50%. Calcarenite: Light grey, micro-crystalline, calcite cement. 50%.	-	-	-	-
1040	3.0	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 50%. Calcarenite: Light grey, micro-crystalline, calcite cement. 50%.	-	-	-	-
1055	2.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 50%. Calcarenite: Light grey, micro-crystalline, calcite cement. 50%.	-	-	-	-
1070	2.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, micro-crystalline, calcite cement. 40%.	-	-	-	-
1085	3.0	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, micro-crystalline, calcite cement. 40%.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 350 m to 1330 m DATE 8/11/82 PAGE 6

SWC ATTEMPTED 51 RECEIVED 51 MISSFIRES ______ NO RECOVERY ______

RUN No. 1 GEOLOGIST Murray/Garrity

DEPTH in metres	LENGTH REC'VD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
1100	2.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, micro-crystalline, calcite cement. 40%.	-	-	-	-
1115	2.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, micro-crystalline, calcite cement, 40%.	-	-	-	-
1130	2.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, micro-crystalline, calcite cement. 40%.	-	-	-	-
1145	2.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, micro-crystalline, calcite cement. 40%.	-	-	-	-
1158.5	1.25	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, micro-crystalline, calcite cement. 40%.	-	-	-	-
1170	2.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, micro-crystalline, calcite cement. 40%.	-	-	-	-
1185	2.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, micro-crystalline, calcite cement. 40%.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 350 m to 1330 m DATE 8/11/82 PAGE 7

SWC ATTEMPTED 51 RECEIVED 51 MISSFIRES NO RECOVERY 4

RUN No. 1 GEOLOGIST Murray/Garrity

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
1200	1.25	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, micro-crystalline, calcite cement. 40%.	-	-	-	-
1215	2.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, micro-crystalline, calcite cement, 40%.	-	-	-	-
1230	1.25	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 50%. Calcarenite: Light grey, micro-crystalline, calcite cement. 50%.	-	-	-	-
1245	1.25	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 50%. Calcarenite: Light grey, micro-crystalline, calcite cement. 50%.	-	-	-	-
1260	1.25	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 50%. Calcarenite: Light grey, micro-crystalline, calcite cement. 50%.	-	-	-	-
1276	1.25	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show. 50%. Calcarenite: Light grey, micro-crystalline, calcite cement. 50%.	-	-	-	-
1278	1.25	Marl: Light grey, clay size grains, calcite cement, fossil fragments, no sedimentary structure, no porosity, no oil show, no fluorescence. 65%. Calcarenite: Light grey, micro-crystalline, calcite cement. 35%.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY

SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 350 m to 1330 m DATE 8/11/82 PAGE 8

SWC ATTEMPTED 51 RECEIVED 51 MISSFIRES NO RECOVERY

RUN No. 1 GEOLOGIST Murray/Garrity

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
1280	2.5	Marl: Light grey, clay size grains, calcite cement, fossil fragments, no sedimentary structure, no porosity, no oil show, no fluorescence. 75%. Calcarenite: Light grey, microcrystalline, calcite cement. 25%.	-	-	-	-
1282	1.25	Marl: Light grey, clay size grains, calcite cement, fossil fragments, no sedimentary structure, no porosity, no oil show, no fluorescence. 75%. Calcarenite: Light grey, microcrystalline, calcite cement, 25%.	-	-	-	-
1284	2.5	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 70%. Calcarenite: Light grey, microcrystalline, calcite cement. 30%.	-	-	-	-
1286	1.25	Marl: Light grey, clay size grains, calcite cement, no fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 60%. Calcarenite: Light grey, microcrystalline, calcite cement. 40%.	-	-	-	-
1300	1.25	Calcarenite: Light grey, microcrystalline, calcite cement, no sedimentary structure, no porosity, no oil show, no fluorescence. 50%. Marl: Light grey, clay size grains, calcite cement, no fossils. 50%.	-	-	-	-
1315	2.5	Calcarenite: Light grey, microcrystalline, calcite cement, fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 70%. Marl: Light grey clay size grains, calcite cement. 30%.	-	-	-	-
1330	1.25	Calcarenite: Light grey, microcrystalline, calcite cement, fossils, no sedimentary structure, no porosity, no oil show, no fluorescence. 70%. Marl: Light grey, clay size grains, calcite cement. 30%.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1345 m to 2900 m DATE 22/11/82 PAGE 1

SWC ATTEMPTED 51 RECEIVED 48 MISSFIRES 0 NO RECOVERY 3

RUN No. 1 SUITE 2 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
1345	2.0	Claystone: Dark grey, calcareous, as above, grading into a Marl. Poor visible porosity.	-	-	-	-
1442	3.5	Claystone: Dark grey, massive, homogeneous, moderately soft to moderately hard, firm, calcareous grading into a Marl. Poor visible porosity, non fissile.	-	-	-	-
1640	2.7	Siltstone: Dark grey, massive, homogeneous, moderately hard to moderately soft, firm, sub fissile in part, carbonaceous, calcareous, highly argillaceous with clay matrix throughout. Also minor disseminated very fine grained quartz throughout. Poor visible porosity.	-	-	-	-
1740	2.00	Siltstone: Dark grey to brown, massive, homogeneous, moderately soft, firm, platy, sub fissile in part, carbonaceous, calcareous, highly argillaceous, with clay matrix throughout, poor visible porosity.	-	-	-	-
1840	2.30	Silty Claystone: As above, no fossils apparent, poor visible porosity.	-	-	-	-
1940	3.20	Silty Claystone: Light to dark grey to brown, massive, moderately soft to hard, homogeneous, firm, very calcareous in part, highly argillaceous, carbonaceous specks throughout, also sub fissile in part, poor visible porosity.	-	-	-	-
2040	3.60	Silty Claystone: Dark grey to black, moderately soft, firm, massive, calcareous in part, poor visible porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1345 m to 2900 m DATE 22/11/82 PAGE 2

SWC ATTEMPTED 51 RECEIVED 48 MISSFIRES 0 NO RECOVERY 3

RUN No. 1 SUITE 2 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH REC'VD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2116	2.60	Siltstone: Light to dark grey, moderately hard to soft in part, firm, sub fissile and platy in part, calcareous, with clay matrix throughout, streaks carbonaceous material throughout matrix, poor visible porosity.	-	-	-	-
2145	3.10	Siltstone: Light to dark grey, moderately hard to hard, firm sub fissile, platy, calcareous in part, argillaceous, with clay matrix throughout, minor glauconite, carbonaceous material disseminated throughout matrix, poor visible porosity.	-	-	-	-
2155	3.40	Siltstone: Light to dark grey, moderately hard to hard, firm, sub fissile, platy, calcareous in part, argillaceous, with clay matrix, poor visible porosity.	-	-	-	-
2172	2.50	Siltstone: Medium to dark grey, moderately hard to moderately soft, firm, homogeneous, massive, calcareous, platy in part, with clay matrix and disseminated very fine grained quartz in matrix, also common glauconite and minor carbonaceous matrix, trace pyrite, poor visible porosity.	-	-	-	-
2255	3.30	Siltstone: Medium to dark grey to black, moderately hard to firm, homogeneous, massive, calcareous, platy in part, with common clay matrix, very rare carbonaceous material, poor visible porosity.	-	-	-	-
2302	3.20	Siltstone: Medium to dark grey, moderately hard to firm, homogeneous, massive, highly calcareous in part, with common clay matrix, very rare glauconite and carbonaceous specks in matrix, poor visible porosity.	-	-	-	-
2326	2.50	Siltstone: Dark to light grey and brown in part, firm to moderately soft, massive, homogeneous, calcareous in part, highly argillaceous, with clay matrix throughout, poor visible porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1345 m to 2900 m DATE 22/11/82 PAGE 3

SWC ATTEMPTED 51 RECEIVED 48 MISSFIRES 0 NO RECOVERY 3

RUN No. 1 SUITE 2 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2404	2.20	Siltstone: Dark to light grey, firm, moderately soft to moderately hard, homogeneous, massive, highly calcareous in part, highly argillaceous, with clear matrix throughout, trace carbonaceous in part, black specks in matrix, poor visible porosity.	-	-	-	-
2440	3.10	Siltstone: Light brown to dark grey, homogeneous, moderately hard to moderately soft, slightly calcareous, highly argillaceous, with clay matrix and quartz grains, white to clear, fine to medium grained, subangular to subrounded scattered throughout, minor trace of glauconite and carbonaceous material, black streak.	-	-	-	-
2500	2.10	Siltstone: Light to dark grey, homogeneous, hard, massive, slightly calcareous, highly argillaceous with clay matrix, poor visible porosity.	-	-	-	-
2510	2.30	Siltstone: Light to dark grey, homogeneous, moderately hard to hard, massive, slightly calcareous argillaceous clay matrix in part with moderate fragments of very fine grained quartz, well rounded, clear to translucent, yellow to brown ironstone, apparently poor visible porosity.	-	-	-	-
2555	2.60	Siltstone: Light to dark grey, homogeneous, soft to moderately hard, massive, slightly calcareous, argillaceous, clay matrix in part, with occasional coarse grained quartz, grey to white, translucent, subangular throughout, poor visible porosity.	-	-	-	-
2565	3.10	Siltstone: light to dark grey, homogeneous, soft, massive, calcareous, with occasional very fine grained quartz throughout and occasional glauconite pellets, dark green, fine to medium grained, poor visible porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1345 m to 2900 m DATE 22/11/82 PAGE 4

SWC ATTEMPTED 51 RECEIVED 48 MISSFIRES 0 NO RECOVERY 3

RUN No. 1 SUITE 2 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2571	2.00	Sandstone: Quartz, light to dark grey, very fine to fine grained, subangular to rounded, moderately well sorted, high sphericity, abundant silty matrix dark brown to grey, very calcareous in parts, with common glauconite pellets and subangular fine grained sand size grains, dark green moderate to poor visible porosity.	-	-	-	-
2580	2.00	Sandstone: Quartz, dark grey to translucent white, very fine to fine grained, subangular to subrounded, moderately well sorted, very argillaceous with abundant silty matrix, brown to grey, very calcareous, occasional glauconite, good to poor porosity.	-	-	-	-
2593	3.10	Sandstone: Quartz, dark grey to translucent, very fine to fine grained, subangular to subrounded, moderately well sorted, very argillaceous, minor non calcareous cement, with abundant silty matrix, brown to grey, very calcareous. Poor porosity, occasional glauconite.	-	-	-	-
2596	3.25	Siltstone: Dark brown with abundant clear fine grains, subrounded quartz throughout matrix, very clayey in parts, very calcareous, occasional glauconite, occasional mica, occasional medium grained, subrounded quartz grains. Poor porosity.	-	-	-	-
2602	2.75	Sandstone: Quartz, dark green, many grains with brown coating, very fine grained with occasional medium grains, angular to subangular, moderately well sorted, firm, fair sphericity, non calcareous cement, very abundant glauconite, occasional mica, very silty matrix, fair porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1345 m to 2900 m DATE 22/11/82 PAGE 5

SWC ATTEMPTED 51 RECEIVED 48 MISSFIRES 0 NO RECOVERY 3

RUN No. 1 SUITE 3 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2610		No recovery				
2622.5	1.50	Sandstone: Light grey, clear to translucent, fine grained, subangular to subrounded, well sorted, high sphericity, calcareous cement, abundant glauconite, abundant mica, good porosity.	-	-	-	-
2630	2.50	Siltstone: Dark brown with very fine clear to translucent, subangular to subrounded quartz grains abundant throughout matrix, occasional glauconite, abundant mica, poor porosity.	-	-	-	-
2643	3.00	Sandstone: Dark grey to dark brown, clear to translucent, very fine grained, subangular to subrounded, moderately well sorted, very silty matrix, non calcareous cement, abundant glauconite, abundant mica, poor porosity.	-	-	-	-
2652	3.00	Siltstone: Dark brown, with very fine, clear to translucent, subangular to subrounded quartz grains abundant throughout matrix, abundant glauconite, occasional mica, poor porosity.	-	-	-	-
2659	2.75	Sandstone: Quartz, orange to dark brown, clear to translucent very fine to fine grained, very silty and dirty looking. Fair sorting, slightly calcareous cement, abundant brown clay in matrix, very abundant glauconite, moderately abundant muscovite? Sediments look weathered, fair porosity.	-	-	-	-
2662	3.00	Sandstone: Quartz, light grey, clear to translucent, fine grained, subangular to subrounded, well sorted, high sphericity, non calcareous cement, abundant glauconite pellets, occasional muscovite? Good porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1345 m to 2900 m DATE 22/11/82 PAGE 6

SWC ATTEMPTED 51 RECEIVED 48 MISSFIRES 0 NO RECOVERY 3

RUN No. 1 SUITE 2 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2665	3.00	Sandstone: Quartz, light grey, clear to translucent, fine grained, subangular to subrounded, well sorted, high sphericity, non calcareous cement, abundant glauconite pellets, occasional muscovite? Good porosity.	-	-	-	-
2670	2.75	Sandstone: Quartz, white to light brown, clear to translucent, fine grained, subangular to subrounded, well sorted, high sphericity, non calcareous cement, moderately abundant glauconite, trace mica, trace pyrite, good porosity.	-	-	-	-
2680	3.00	Sandstone: Quartz, white, clear to translucent, fine grained, subangular to subrounded, well sorted, high sphericity, with occasional medium to very coarse, subangular to subrounded quartz grains floating in matrix, non calcareous cement, very abundant glauconite, mostly pellets, occasional muscovite?	-	-	-	-
2686	3.25	Sandstone: Quartz, white to light grey, clear to translucent, fine grained, subangular to subrounded, high spericity, well sorted, with occasional medium to coarse grains, subangular quartz floating in matrix, abundant glauconite pellets, occasional mica?	-	-	-	-
2702	3.00	Sandstone: Quartz, white to brown, fine grained, clear to translucent, mostly clear, subangular to subrounded, moderately high sphericity, well sorted, non calcareous cement, occasional medium round quartz floating in matrix, very abundant glauconite, trace mica. Good porosity.	-	-	-	-
2717	3.25	Sandstone: Quartz, white, clear to translucent, fine grained, subangular to subrounded with occasional coarse quartz grains, subangular to subrounded floating in matrix, non calcareous cement, very abundant glauconite to 30% of sample both pellets and intergranular, very abundant pyrite, good porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1345 m to 2900 m DATE 22/11/82 PAGE 7

SWC ATTEMPTED 51 RECEIVED 48 MISSFIRES 0 NO RECOVERY 3

RUN No. 2 SUITE 2 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH REC'VD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2727	2.50	Sandstone: Quartz, medium grey to brown, clear to translucent, very fine to fine grained, moderately light: spherical, subangular to subrounded, well sorted, non calcareous cement, abundant plant and spore exines. Good porosity.	-	-	-	-
2735	2.00	Sandstone: Quartz, light grey, clear to translucent, medium to very coarse grained with pebbles to 5 mm diameter, very poorly sorted, subangular to subrounded, non calcareous cement, occasional white clay in matrix - kaolinite? Abundant glauconite, abrupt contact with claystone: medium grey, homogeneous, firm, slightly calcareous, occasional glauconite pellets, occasional carbonaceous material, fair porosity in sandstone.	-	-	-	-
2746	2.75	Sandstone: Quartz, light grey to white, clear to translucent, fine grained to very coarse, with pebbles to 5 mm, very poorly sorted, angular to rounded, non calcareous cement, white clay in matrix - kaolinite? Very abundant glauconite mostly in pellets, abrupt contact with claystone, medium gray, homogeneous, firm, slightly calcareous, occasional glauconite pellets, occasional carbonaceous material, good porosity in parts.	-	-	-	-
2750	2.75	Claystone: Medium grey, homogeneous, firm, slightly calcareous, occasional glauconite pellets, occasional carbonaceous material, abrupt contact with Sandstone: quartz, white, clear to opaque, fine to very coarse, angular to subangular, very silty matrix, slightly calcareous, occasional pyrite, occasional black carbonaceous material adhering to coarse grains, fair porosity in sandstone.	-	-	-	-
2782.5	3.00	Sandstone: Quartz, light grey, fine grained, occasional medium grains, subangular to subrounded, well sorted, non calcareous cement, occasional black carbonaceous material, occasional plant and spore exines? Rare glauconite, good porosity.		-	-	-

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PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1345 m to 2900 m DATE 22/11/82 PAGE 8

SWC ATTEMPTED 51 RECEIVED 48 MISSFIRES 0 NO RECOVERY 3

RUN No. 1 SUITE 2 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2801		No recovery				
2817.5	2.00	Sandstone: Quartz, light grey, very fine to fine grained, subangular to subrounded, well sorted, non calcareous cement, occasional black carbonaceous material, occasional plant and spore exines? Good porosity.	-	-	-	-
2835	3.25	Sandstone: Light grey, quartz, fine grained, subangular to subrounded, well sorted, non calcareous cement, occasionally carbonaceous, black, occasional plant and spore exines? Good porosity.	-	-	-	-
2855	1.25	Sandstone: Quartz, white to light grey, very fine to fine grained, occasional medium grains, clear to translucent, subangular to subrounded, moderately well sorted, non calcareous cement, matrix choked with white clay in part kaolinite?, trace glauconite, trace mica, trace carbonaceous material, good porosity in parts.	-	-	-	-
2875		No recovery				
2889	1.75	Sandstone: Quartz, White to brown, very fine to fine grained, clear to translucent, subangular to subrounded, moderately well sorted, non calcareous matrix, abundant brown material, may be muscovite mica or plant and spore exines appear to be either at times, abundant clear mica biotite? Good porosity.	-	-	-	-
2900	1.25	Sandstone: Tan to brown, very fine grained, subangular to subrounded, poorly sorted, very silty, very clayey in parts, with medium very coarse quartz grains floating in matrix, subangular to subrounded, abundant glauconite, mostly in pellets, occasional coal fragments, black, soft, occasional mica flakes, matrix shaly, calcareous, poor porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY

SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1400 m to 2998 m DATE 25/11/82 PAGE 1

SWC ATTEMPTED 30 RECEIVED 27 MISSFIRES 0 NO RECOVERY 3

RUN No. 1 SUITE 3 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
1400	2.0	Claystone: Dark grey, massive homogeneous , moderately soft to moderately hard, firm calcareous grading into marl, non-fissile, poor visible porosity.	-	-	-	-
1500	3.1	Siltstone: Dark to light grey, massive, homogeneous, moderately hard, very firm, very calcareous, non fossiliferous, platy to sub fissile, poor visible porosity.	-	-	-	-
1700	3.1	Siltstone: Dark to light grey, massive, homogeneous, moderately hard to hard, very firm, calcareous, non fossiliferous, highly argillaceous, calcareous in part, very slightly carbonaceous, poor visible porosity.	-	-	-	-
1885	3.9	Silty Claystone: Light to dark grey, massive, moderately soft to hard, homogeneous, firm, very calcareous in part, argillaceous, some carbonaceous specks, sub fissile, platy in part, poor visible porosity.	-	-	-	-
1985	4.9	Silty Claystone: Light to dark grey, very hard, sub fissile, very firm, homogeneous, massive, argillaceous, calcareous in part, platy, poor visible porosity.	-	-	-	-
2075	2.5	Silty Claystone: Light to dark grey, very hard to moderately soft in part, argillaceous but slightly calcareous in part, sub fissile, platy, poor visible porosity.	-	-	-	-
2205	3.5	Siltstone: Light to medium grey, firm to medium hard to medium soft, highly argillaceous, partly calcareous, sub fissile, platy with clay matrix apparent, homogeneous, massive, poor visible porosity.	-	-	-	-
2378	3.8	Siltstone: Dark to light grey, firm, moderately hard to moderately soft, homogeneous, massive, highly calcareous in part, highly argillaceous, with clay matrix throughout, non fossiliferous, poor visible porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY

SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1400 m to 2998 m DATE 25/11/82 PAGE 2

SWC ATTEMPTED 30 RECEIVED 27 MISSFIRES 0 NO RECOVERY 3

RUN No. 1 SUITE 3 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2360	2.6	Siltstone: Dark to medium grey, homogeneous , moderately soft to moderately hard, firm calcareous grading into marl, non-fissile, poor visible porosity.	-	-	-	-
2440	3.5	Siltstone: Light to dark brown/grey, homogeneous, hard to medium hard, slightly calcareous, highly argillaceous, with clay matrix, platy and sub fissile in part, poor visible porosity.	-	-	-	-
2525	1.9	Siltstone: Light to dark grey to light brown, moderately hard to moderately soft, homogeneous, slightly calcareous, argillaceous, with clay matrix throughout, non fossiliferous in part, platy and sub fissile, poor visible porosity.	-	-	-	-
2608	2.3	Sandstone: Quartz, black to dark brown, very fine grained to occasional fine grained, subangular to subrounded, moderate sphericity, fair sorting, non calcareous cement, slightly silty matrix, with abundant glauconite, medium grained to coarse grained, with muddy pellets in part, brown coating on grains, apparent non calcareous, trace pyrite, fair visible porosity.	-	-	-	-
2688	4.0	Sandstone: Quartz, white to light grey, clear to opaque, very fine to fine grained, subrounded to rounded, well sorted, moderate sphericity with abundant brown mica (biotite?) and medium grained quartz, glauconite pellets, fair to good visible porosity.	-	-	-	-
2803	2.0	Sandstone: Quartz, white to light grey, clear to translucent, fine to medium grained, sucrosic, subangular to subrounded, moderate well sorted, high sphericity, non calcareous, no apparent cement, with streaks very fine grained carbonaceous material, clay, black to very dark grey, glauconite throughout with trace pyrite and trace mica? Good visible porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1400 m to 2998 m DATE 25/11/82 PAGE 3
SWC ATTEMPTED 30 RECEIVED 27 MISSFIRES 0 NO RECOVERY 3
RUN No. 1 SUITE 3 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2873	2.5	Sandstone: Quartz, white to grey, clear to translucent, fine to medium grained, sucrosic, subangular to subrounded, well sorted, high sphericity, granular, non calcareous, slightly argillaceous with silty matrix throughout, glauconite common and abundant, brown mica type material? Good visible porosity.	-	-	-	-
2905		No recovery				
2912.5		No recovery				
2915.3		No recovery				
2917	1.0	Claystone: Black, moderately soft to hard, very silty, homogeneous, massive, non calcareous with occasional well-rounded fine grained quartz, grains throughout, no cement, white to translucent, poor visible porosity.	-	-	-	-
2920	1.0	Sandstone: Quartz, clear to translucent, extremey poorly sorted, ranging from granule to very fine grained, angular to subangular, low sphericity, often prismatic quartz laths (granule size), quartz is often fractured, conchoidal, irregular, indicative of volcanic origin? with possible degraded fissile laths soft, massive, homogeneous, white, non calcareous, fluorescence (purple), clay possibly kaolin, or some other clay derived from volcanic degradation/igneous with abundant black material, possible biotite? or carbonaceous material (need analysis to tell), with trace muscovite.	-	-	Purple/ Mauve (white clay)	-
2933	3.5	Sandstone: Quartz, clear to light grey, fine grained with wide range of quartz, irregular prismatic and laths up to coarse grain sized, angular to subangular, low sphericity as in sample 2920 m, little white clay matrix apparent, with mica (muscovite) and common black unidentified material. Low/fair visible porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY

SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1400 m to 2998 m DATE 25/11/82 PAGE 4

SWC ATTEMPTED 30 RECEIVED 27 MISSFIRES 0 NO RECOVERY 3

RUN No. 1 SUITE 3 GEOLOGIST Whibley/See

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2937	1.0	Sandstone: Quartz, white to light to dark grey, fine grained to granule size, very poorly sorted, angular to subangular, low sphericity, non calcareous, no cement, prismatic quartz grains common, (same as 2920 m), white clay matrix (as in 2920 m) homogeneous, soft, massive, fluorescence (purple), mud of decomposition of volcanics?/ igneous? with minor black mica or carbonaceous type matter. Fair visible porosity.	-	-	-	-
2953.5	3.0	Sandstone: Quartz, white to light to dark grey, fine grained, very poorly sorted (as above in 2937 m), homogeneous, soft, massive, fair visible porosity.	-	-	-	-
2961	1.8	Silty Sandstone: Quartz, very fine grained to silt size, light to dark grey to blue, subangular to subrounded, non calcareous, no cement, argillaceous with common silt matrix, with common muscovite and black specks throughout? non carbonaceous, possibly volcanic?	-	-	-	-
2965.2	1.8	Siltstone: Blue, moderately soft to moderately hard, homogeneous, non calcareous, massive, carbonaceous matrial abundant, possibly coal? with abundant white fine grained quartz throughout angular to rounded, with clay traces of mica flakes (muscovite) within silt matrix. Poor visible porosity.	-	-	-	-
2966.3	2.0	Sandstone: Quartz, identical to sample 2937 m above.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY

SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 1400 m to 2998 m DATE 25/11/82 PAGE 5

SWC ATTEMPTED 30 RECEIVED 27 MISSFIRES 0 NO RECOVERY 3

RUN No. 1 SUITE 3 GEOLOGIST B. See

DEPTH in metres	LENGTH REC'VD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
2974	1.0	Sandstone: Quartz, clear to translucent, extremely poorly sorted ranging from granule to very fine grained, sucrosic, angular to well rounded abundant larger well rounded quartz grains and other acute angular and prismatic quartz grains low sphericity with white clay (kaolinite?) matrix, massive. Non calcareous with black clayey unidentified matrix as before in #11, 10, 9, 7, 5 sucrosic, low visible porosity.	-	-	Purple (white clay)	-
2983	2.0	Sandstone: Quartz, white to light grey to blue, very fine grained, angular to subrounded, sucrosic granules with abundant white clay matrix and black clay matrix, as above (2974 m), (average), fair visible porosity.	-	-	Purple (white clay)	-
2990	2.0	Sandstone: Quartz, white, very poorly sorted, fine to coarse grained, angular to rounded grains set in abundant white clay material, friable, sucrosic, homogeneous, as above. Low/fair visible porosity.	-	-	Purple (white clay)	-
2998	5.0	Claystone: Dark grey-brown, very soft, homogeneous, massive, silty calcareous, very plastic - ductile, slightly platy with white soft homogeneous friable clay (kaolinite? or volcanic clay?) with occasional embedded coarse grains with rounded high sphericity quartz granules in clay and occasional sandstone pods, quartz, brown, very fine to fine grained, subangular to subrounded, moderate sphericity, moderately sorted, non calcareous with trace pyrite, glauconite.	-	-	Bright Yellow-Green	Milky-white - wet

PHILLIPS AUSTRALIAN OIL COMPANY

SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 3020.5 to 3497 m DATE 7/12/82 PAGE 1

SWC ATTEMPTED 30 RECEIVED 22* MISSFIRES 0 NO RECOVERY 8

RUN No. 1 of 2 LOG SUITE 4 *Only 12 of acceptable size GEOLOGIST Via/Whibley

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
3020.5	2.0	Sandstone to Sandy Siltstone: Dark grey, very fine grained, with occasional coarse grains, subangular to subrounded, moderately to well sorted, non calcareous, silty matrix, carbonaceous in part, very fine grained mica, trace glauconite?, trace pyrite, fair to good visible porosity.	-	-	-	-
3045.0	1.5	Siltstone: Dark grey, non calcareous, very carbonaceous, sandy, with very fine grained mica, pyrite, fair to poor visible porosity.	-	-	-	-
3063.0	0.5	Very poor sample, mainly mudcake: quartz, very coarse grained, angular to subrounded, white to milky, kaolinite? (weathered feldspar?). Sandstone?	-	-	-	-
3100.5	2.5	Claystone: Dark grey to black, firm, massive, homogeneous, carbonaceous, non calcareous, silty to sandy, micaceous, trace very fine grained pyrite, no visible porosity.	-	-	-	-
3133.0	2.0	Claystone: Black, firm, massive, carbonaceous, non calcareous, silty to sandy, very fine grained mica, pyrite, no visible porosity.	-	-	Pinpoint	-
3147.5		No recovery				
3167.0	1.5	Claystone: Black, soft, massive, non calcareous, very carbonaceous to coal partings, silty to sandy, mica, trace pyrite, no visible porosity.	-	-	Tr Min	-
3181.0	2.5	Sandstone: Light grey, fine grained to coarse grained, subangular to subrounded, poor sorting, silty matrix, non calcareous, friable, abundant very fine grained pyrite, micaceous, good visible porosity.	-	-	-	-
3195.5	0.5	Claystone: Dark grey, massive, soft, non calcareous, silty, very carbonaceous, micaceous, no visible porosity.	-	-	Tr	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 3020.5 to 3497 m DATE 7/12/82 PAGE 2

SWC ATTEMPTED 30 RECEIVED 22* MISSFIRES 0 NO RECOVERY 8

RUN No. 1 of 2 LOG SUITE 4 *Only 12 of acceptable size GEOLOGIST Via/Whibley

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
3214.0	0.5	Claystone: Dark grey to black, soft, non-calcareous, silty, micaceous, with very thin carbonaceous laminas.	-	-	Tr Clay	-
3248.5	1.5	Claystone: Dark grey, soft, non-calcareous, carbonaceous, silty, with very thin sandstone laminas, white, very fine grained, micaceous; and coal fragments, black vitreous. No visible porosity.	-	-	Tr	-
3256.0	2.5	Sandstone: Light grey, fine grained, subrounded, well sorted, non-calcaneous, silty matrix, with carbonaceous laminas as fine X-805. Fair to good porosity.	-	-	-	-
3267.0	1.5	Sandstone: Light grey, medium to coarse grained with some very coarse to pebble grains, subrounded, poor sorting, low-high-sphericity, silty argillaceous matrix, mica, very fine pyrite. Fair visible porosity.	-	-	-	-
3287.5	0	NO RECOVERY				
3309.0	0.5	Shale: dark brown, non-calcareous, silty, with abundant organic debris and coal along bedding, very carbonaceous.	-	-	-	-
3316.5	0	NO RECOVERY				
3319.0	0	NO RECOVERY				
3333.5	0	NO RECOVERY				
3350.5	3.0	Sandstone: Light grey, medium coarse grained, poorly sorted, argillaceous matrix kaolinite). Altered volcanics? ained pyrite. No visible porosity. Subrounded, Light -dark grey, moderately (diagenetic massive, non-calcareous, Very fine gr, silty. No visible porosity.	-	-	-	-
3380.5	2.0	Claystone: Light-dark grey, moderately soft, firm, masive, non-calcereous, silty. No visible porosity.	-	-	-	-
3391.0	0	NO RECOVERY				
3399.0	0	NO RECOVERY				

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 3020.5 to 3497 m DATE 7/12/82 PAGE 3

SWC ATTEMPTED 30 RECEIVED 22* MISSFIRES 0 NO RECOVERY 8

RUN No. 1 of 2 LOG SUITE 4 *Only 12 of acceptable size GEOLOGIST Via/Whibley

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
3417.0	2.0	Sandstone: Quartz, dark grey-light grey, fine - very fine grained subangular - subrounded, well sorted, moderate sphericity, argillaceous, silty matrix, non-calcareous with laminas of siltstone, black, carbonaceous, argillaceous, silty throughout, non-calcareous, moderately soft - moderately hard, with common pyrite. Fair visable porosity.	-	-	-	-
3430.0	0.2	Sandstone: Quartz, dark grey, white, clear translucent, fine grained, with occasional pebble size in fine grained quartz matrix, angular-subrounded, moderately sorted, argillaceous, slightly silty matrix, non-calcerous, non-carbonaceous. Fair visible porosity.	-	-	-	-
3437.0	0.5	Claystone: Dark brown, massive, homogeneous, plastic, very soft, slightly calcerous, very carbonaceous, with slightly black very hard, non-calcerous, massive, fragments, very argillaceous. No visible porosity.	-	-	-	-
3445.0	0.5	Claystone: Dark brown, massive, homogeneous, plastic, very soft, slightly calcerous, very carbonaceous with slightly blue, very hard, non-calcareous, massive, fragments, very argillaceous. No visible porosity.	-	-	-	-
3465.5	2.5	Siltstone: Black-dark grey, massive, sub-fissile in part, non-calcareous, argillaceous. Highly carbonaceous, moderate to moderately soft; very poor sample, small. No visible porosity.	-	-	-	-
3481.5	0.5	Coal: Black - very dark brown, hard, brittle, fracture, lignitic.				
3492.0	0	NO RECOVERY				

PHILLIPS AUSTRALIAN OIL COMPANY

SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 3020.5 to 3497 m DATE 7/12/82 PAGE 4

SWC ATTEMPTED 30 RECEIVED 22* MISSFIRES 0 NO RECOVERY 8

RUN No. 1 of 2 LOG SUITE 4 *Only 12 of acceptable size GEOLOGIST Via/Whibley

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
3497.0	1.0	Siltstone: Light grey, massive, moderately soft, argillaceous lamina, slightly calcareous, slightly carbonaceous, with inter laminas of siltstone, black, massive, moderately soft, argillaceous, slightly calcareous, highly carbonaceous. No visible porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 3020.5 to 3497 m DATE 7/12/82 PAGE 1

SWC ATTEMPTED 20 RECEIVED 18* MISSFIRES 0 NO RECOVERY 2

RUN No. 2 of 2 LOG SUITE 4 GEOLOGIST Via/

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
3030.0	2.5	Sandstone: Quartz, light grey - fine grained - very coarse grained, subrounded, moderate-poorly sorted, non-calcareous, argillaceous, silty matrix, poorly cemented, friable with thin laminas of carbonaceous siltstone - shale, soft, non-calcareous, pyrite associated with carbonaceous laminas (1-5 mm). Fair visible porosity.	-	-	-	-
3039.0	2.0	Sandstone: Quartz, light grey, fine grained, subrounded well sorted, moderate high sphericity, non-calcareous, argillaceous, silty matrix, friable, with 1-2mm laminas of carbonaceous siltstone and associated pyrite, carbonaceous filled micro fractures perpendicular to bedding, Fair visible porosity.	-	-	-	-
3065.5	3.0	Sandstone: Medium grey, medium-coarse grained with occasional very coarse pebbly grains, sorting, low-high sphericity, angular-subrounded, loosely cemented, friable, argillaceous - silty matrix including white clay (kaolinite), non-calcareous, abundant very fine disseminated pyrite, the kaolinite (?) gives appearance of altered volcaniclastics. Fair visible porosity.	-	-	Tr min	-
3093.0	2.0	Sandstone: Quartz, dark grey, very fine grained, subrounded, well sorted, non-calcareous, very silty matrix with occasional pebble-sized quartz grains; with 2-3mm laminas of carbonaceous siltstone, local lignitic - coal as micro beds within laminas. Fair visible porosity.	-	-	-	-
3117.0	3.0	Sandstone: Quartz, very fine grained, with some very coarse pebble size quartz grain fragments, sub-angular - subrounded, fair sorting, silty matrix, non-calcareous, loosely cemented, friable with indistinct clay (kaolinite). Diagenetic? Volcaniclastics?	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 3020.5 to 3497 m DATE 7/12/82 PAGE 2
SWC ATTEMPTED 20 RECEIVED 18* MISSFIRES 0 NO RECOVERY 2
RUN No. 2 of 2 LOG SUITE 4 GEOLOGIST Via/

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
3117.1	2.0	Siltstone: Quartz, medium - very coarse grained, subangular-subrounded, fair sorting, moderate high-moderate low sphericity, silty matrix, loosely cemented, friable, non-calcareous with intersticies clay (kaolinite) Diagenetic? Volcaniclastics? Fair visible porosity.	-	-	-	-
3168.0	2.0	Claystone: Dark grey-black, massive, soft, silty, non-calcareous, homogenous, micaceous, with minor vugs, concretions or pods of sandstone, white, very fine grain, loosely to non-cemented. No visible porosity.	-	-	Mnr flu w/in sm sst vugs	-
3195.0	0	NO RECOVERY				
3222.5	2.0	Claystone: Dark brown, massive, homogenous, soft, non-calcareous, silty-sandy, very carbonaceous, with minor coal partings (less than 1mm). No visible porosity.	-	-	-	-
3268.0	2.0	Sandstone: Light grey, medium-very coarse grained, angular-subrounded, fair sorting, moderate low-moderate-high sphericity. Argillaceous-silty matrix (including clay, white, kaolinite?), non-calcareous, loosely cemented, micaceous, minor pyrite, pyrite looks like weathered volcaniclastics. Fair visible porosity.	-	-	-	-
3268.0	1.0	Sandstone: Dark green, coarse grained, subrounded well sorted, moderate sphericity, non-calcareous, with abundant pyrite (approximately 50% of sample), pyrite cement, sample is completely pyritized (shot at same depth as 39). Poor visible porosity.	-	-	-	-
3311.0	3.0	Claystone: Dark brown, massive, soft, homogeneous, non-calcareous, silty, micaceous with thin (less than 2mm) carbonaceous-lignite-coal partings and reworked coal debris. No visible porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 3020.5 to 3497 m DATE 7/12/82 PAGE 3

SWC ATTEMPTED 20 RECEIVED 18* MISSFIRES 0 NO RECOVERY 2

RUN No. 2 of 2 LOG SUITE 4 GEOLOGIST Via/

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
3325.0	1.0	Claystone: Dark brown, massive, soft, homogeneous, non-calcareous, carbonaceous, silty-sandy, micaceous (biotite), with minor fe-oxide (weathered pyrite) and abundant reworked carbonaceous material, lignite, coal. No visible porosity.	-	-	-	-
3337.0	2.0	Sandstone: Quartz, white, medium - very coarse grained, moderately well - well sorted, subangular - sub-rounded, silty-argillaceous matrix, non-calcareous, loosely cemented, friable, fe-oxides (weathered pyrite). Altered volcanics. Fair visible porosity.	-	-	-	-
3362.0	2.0	Claystone: Dark brown, massive, soft, homogeneous, non-calcareous, silty, carbonaceous, micaceous (biotite) minor fe-oxide (weathered pyrite), trace micro-stringers of coal.	-	-	-	-
3367.0	2.0	Claystone: Dark brown, massive, soft, homogeneous, non-calcareous, silty, carbonaceous, biotite, fe-oxide.	-	-	-	-
3390.0	2.0	Coal: Black, hard, brittle, vitreous, conchoidal, fracture with minor lower rank partings, brown.	-	-	-	-
3410.0	0	NO RECOVERY				
3413.0	2.0	Claystone: Dark brown, massive, soft, non-calcareous, silty, micaceous, with minor sandstone; white, very fine grained, uncemented. No visible porosity.	-	-	-	-
3429.0	2.0	Sandstone: Light grey, medium-coarse grained, sub-rounded, moderate sphericity, moderately well sorted, non-calcareous, silty-argillaceous, friable. Poor visible porosity.	-	-	-	-

PHILLIPS AUSTRALIAN OIL COMPANY
SIDEWALL CORE DESCRIPTION

WELL HELIOS-1 INTERVAL 3020.5 to 3497 m DATE 7/12/82 PAGE 4

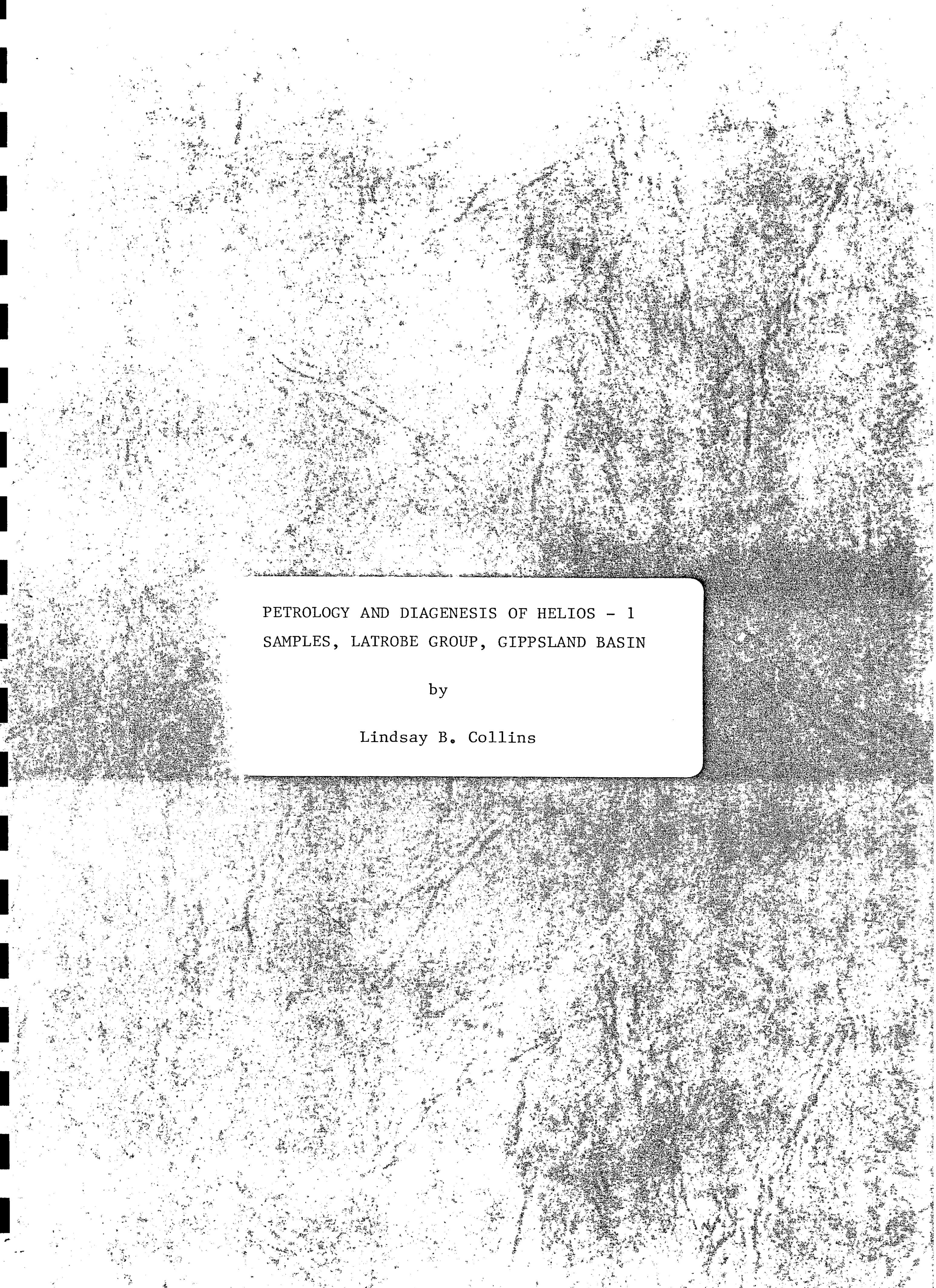
SWC ATTEMPTED 20 RECEIVED 18* MISSFIRES 0 NO RECOVERY 2

RUN No. 2 of 2 LOG SUITE 4 GEOLOGIST Via/

DEPTH in metres	LENGTH RECVD	DESCRIPTION	ODOR	STAIN	FLUORESCENCE Brightness Colour	CUT Type Colour
3446.0	1.5	Claystone: Dark brown, soft, massive, non-calcareous, sandy, with silstone partings or vugs (turbulent bedding). Carbonaceous trash. No visible porosity.	-	-	-	-
3450.0	1.5	Claystone: Dark brown, soft, massive, homogeneous, non-calcareous, sandy with thin laminas or partings (less than 3mm) of siltstone, very fine grained, white, moderately well sorted, subrounded, unconsolidated. No visible porosity.	-	-	-	-

APPENDIX NO. 5

PETROGRAPHIC DESCRIPTIONS



PETROLOGY AND DIAGENESIS OF HELIOS - 1 SAMPLES, LATROBE GROUP, GIPPSLAND BASIN

by

Lindsay B. Collins

PETROLOGY AND DIAGENESIS OF HELIOS - 1 SAMPLES, LATROBE GROUP, GIPPSLAND BASIN

BY

LINDSAY B. COLLINS

REPORT TO PHILLIPS AUSTRALIAN OIL COMPANY

DECEMBER, 1982.

CONTENTS

INTRODUCTION

The following samples were examined by petrography, Xray diffraction and SEM :-

HELIOS - 1

15 , 2686 m

13 , 2717 m

7 , 2961 m

Small, friable sidewall core splits were provided for study. XRD analysis of the silt-clay fraction, and thin section study of plastic impregnated samples was undertaken. Coated samples were examined by SEM, with the exception of HELIOS - 1 # 15, 2686 m whose friability caused coating difficulties.

(NOTE: X-ray diffractograms have been retained on file; copies are available on request.)

PETROLOGY AND X-RAY DIFFRACTION ANALYSIS

Sample:

HELIOS - 1 # 15, 2686 m sidewall core; small sample.

Hand Specimen:

Grey-green, friable, clayey very fine grained glauconitic sand. Rare, very coarse and medium sand grains present.

Log:

Siltstone (2686-2692 m) underlying glauconitic, well sorted, medium-very coarse sandstone below top Latrobe unconformity at 2659 m.

Thin Section:

Poorly sorted, silty glauconitic very fine sand, with abundant matrix and minor muscovite and glauconite; minor calcite intergranular cement.

Texture:

Angular to subangular grains, predominantly fine sand with frequent coarse to medium grains, poorly sorted; silt size particles abundant. Grain support, and matrix support fabric in parts of the rock. Voids are matrix-filled; a texturally immature sediment.

Mineralogy:

Quartz: monocrystalline, angular, coarse to fine sand and silt ...	60%
Feldspar: microcline; untwinned feldspar with minor alteration ...	5%
Glauconite: peloidal grains; also altered mica and platy minerals	15%
Biotite, muscovite: platy, detrital	5%
Matrix: clay minerals, silt-clay size quartz, mica	15%
Cement: minor calcite void-filling intergranular cement	trace
Other: lithic fragments (chert)	trace

heavy minerals	trace
organic matter	trace

Interpretation:

Source area: Most detritus derived from quartz dominated rocks with minor fresh feldspar; monocrystalline quartz (abundant) and chert (rare) are probably from a sedimentary source. Rare polycrystalline quartz, and quartz with abundant mica inclusions, are probably from a metamorphic source.

Depositional basin: Deposition of poorly sorted detrital grains and silt to clay took place in a marine environment below wave-base with negligible traction currents, indicated by matrix content, lack of sorting, and presence of glauconite.

Diagenetic history:

1. Alteration of mica, in the presence of organic matter, to glauconite, which is peloidal and structureless or has platy habit and 001 mica-type cleavage.

2. Minor development of calcite spar as a void-filling intergranular cement in parts of the rock.

X-Ray Diffraction Analysis:

Minerals identified in the silt-clay fraction by XRD analysis were: Quartz, plagioclase, glauconite, chlorite, biotite, muscovite. Calcite, present as a cement, was not detected on traces. All minerals identified on traces are primary detrital minerals.

Sample:

HELIOS - 1 # 13; 2717 m sidewall core; small sample.

Hand Specimen:

Green, friable, glauconitic, clayey very fine sand; medium sand-size quartz common to rare.

Log:

From medium - coarse sand, moderately sorted, and minor siltstone, upward fining sequence (2692-2745m), Latrobe Group.

Thin Section:

Abstract: Green, poorly sorted, friable, silty glauconitic very find sand with pyritized matrix, abundant glauconite, and minor calcite cement.

Texture:

Subangular grains, predominantly fine - very fine sand to silt size, with common coarse grained quartz sand; poorly sorted. Matrix fills integranular voids; both grain and matrix support fabric are present. A texturally immature rock.

Mineralogy:

Quartz: monocrystalline grains	50%
Feldspar: untwinned, zoned	5%
Muscovite, biotite: platy, silt size particles	5%
Glauconite: peloidal, platy with cleavage traces and "lamellar" structure	25%
Matrix: clays and organic matter, pyritized	15%
Cement: calcite spar intergranular cement, occasionally filling voids	trace
Other: Lithic fragments (chert)	trace

Interpretation:

Source area: Quartz and chert grains are probably from a sedimentary source; zoned feldspars from a volcanic source.

Depositional basin: Deposition of poorly sorted detrital grains, (sand and silt to clay), and organic matter took place in a below wave-base marine environment with reducing conditions and negligible traction currents, indicated by texture, matrix content, pyritized organics and glauconite.

Diagenesis:

1. Pyritization of organic-rich matrix fraction (reducing environment).

2. Glauconitization of matrix fraction and mica minerals, generating peloidal glauconite, and platy glauconite with 001 mica-like cleavage traces. Glauconite partly encloses pyritized matrix fraction.

3. Development of intergranular void filling calcite spar cement, which postdates and encloses some glauconitic grains. Cement development is minor and selective within the rock.

X-Ray Diffraction Analysis:

Minerals identified by XRD were: quartz, glauconite, and halite. No halite was observed in thin section, thus halite may be an artifact of laboratory processing. Micas, pyrite and calcite, present in thin section, were not present in XRD traces of the silt-clay fraction.

Sample:

HELIOS - 1 # 7; 2961 m sidewall core; small sample.

Hand Specimen:

Grey-white, friable, fine - medium clayey sand.

Log:

Siltstone 8m thick; within sand section.

Thin Section:

Abstract: Very poorly sorted sand; variable grain size (medium, fine - very fine sand predominant); micaceous, with minor organic material and glauconite.

Texture:

Angular to subangular grains, very poorly sorted; medium to fine, very fine sand and silt size particles common; occasional coarse to very coarse sand grains present. Grain support fabric, with minor (< 10%) matrix. Texturally immature.

Mineralogy:

Quartz: monocrystalline grains	70%
Feldspar: plagioclase; untwinned feldspar, microcline	15%
Biotite, muscovite:	10%
Matrix: clays - organics	5%
Glauconite:	trace
Other: Chert fragments	trace
Sandstone Lithic fragments	trace

Interpretation:

Source Area: Quartz and chert grains probably from a sedimentary source. Rare polycrystalline quartz is probably from a metamorphic source.

Depositional basin: Deposition of poorly sorted grains, micas, and clay matrix probably occurred in a below wave-base marine environment with negligible traction currents, indicated by poor sorting, matrix content, and traces of glauconite.

Diagenetic history:

1. Minor buckling of mica plates and development of long contacts between quartz grains during compaction.

2. Minor glauconite development, probably by diagenetic reactions between matrix clays, organics and seawater. Black organic blebs in matrix indicate reducing conditions.

X-Ray Diffraction Analysis:

Minerals identified by X-ray diffraction of the silt-clay fraction were quartz, chlorite, glauconite, plagioclase and orthoclase. No trace of phosphate minerals was found, thus the fluorescence reported in this interval remains unexplained. Minerals identified on traces are primary detrital minerals.

SEM STUDIES

HELIOS - 1 # 13, 2717 m (Figure 1: 0012; Figure 2: 0013.

The detrital grain framework and primary intergranular voids are shown in Figure 1. Subhedral grain terminations are probably due to authigenic overgrowths, for example, those on the quartz grain beneath the scale bar on Figure 1. Primary intergranular voids (centre of field, Figure 1) when viewed at high magnification (Figure 2) are partially filled by tabular calcite crystals of diameter up to 50 μm.

HELIOS - 1 # 7, 2961 m (Figure 3: 0014; Figure 4: 0015).

Detrital grains with euhedral terminations, and primary voids are shown in Figure 3. At higher magnification (Figure 4) void space is incompletely filled by tabular calcite crystals (upper centre, Figure 4). Remnant voids are commonly 10 μm across.

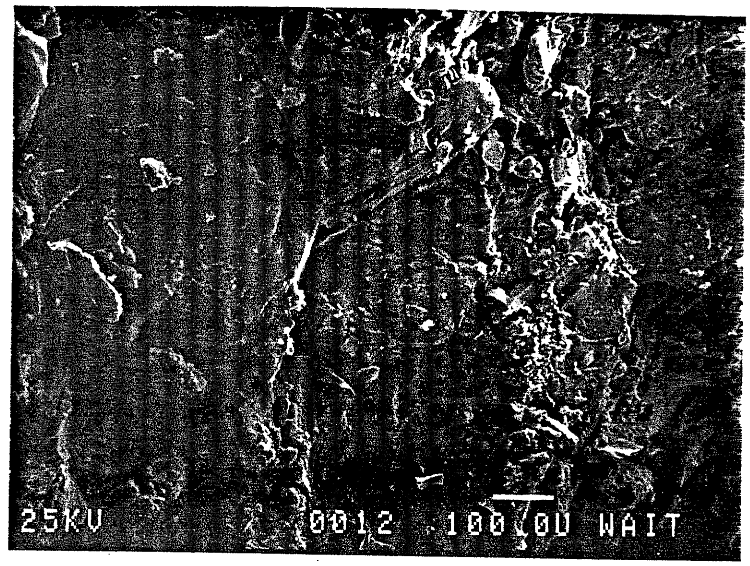


FIGURE 1. Electron micrograph, HELIOS - 1 # 13, 2717 m.

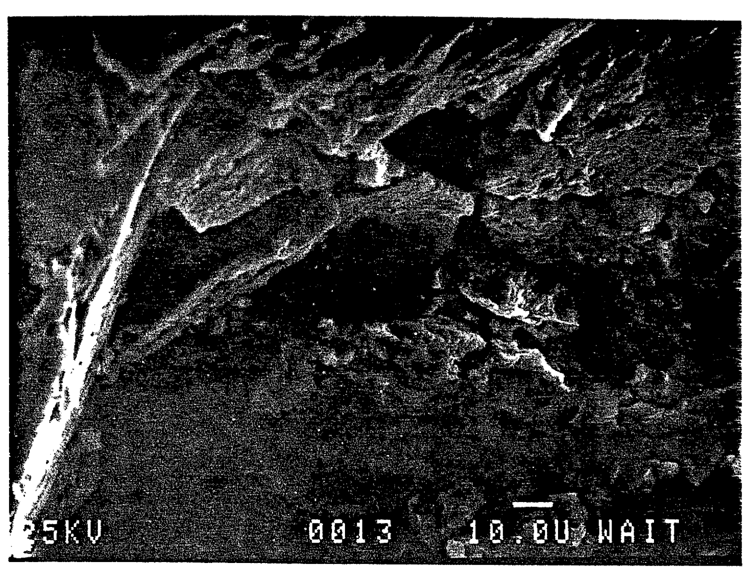


FIGURE 2. Electron micrograph, calcite - filled void at centre of Figure 1. HELIOS - 1, # 13, 2717 m.

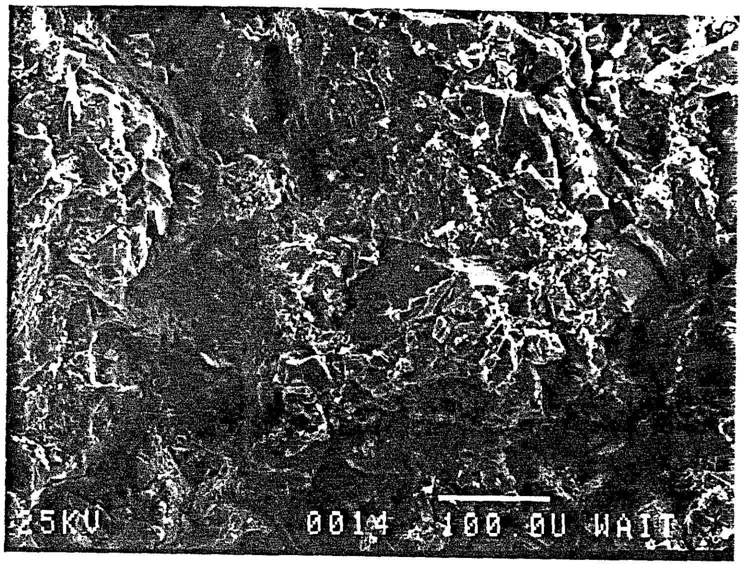


FIGURE 3. Electron micrograph, HELIOS - 1 # 7, 2961 m.

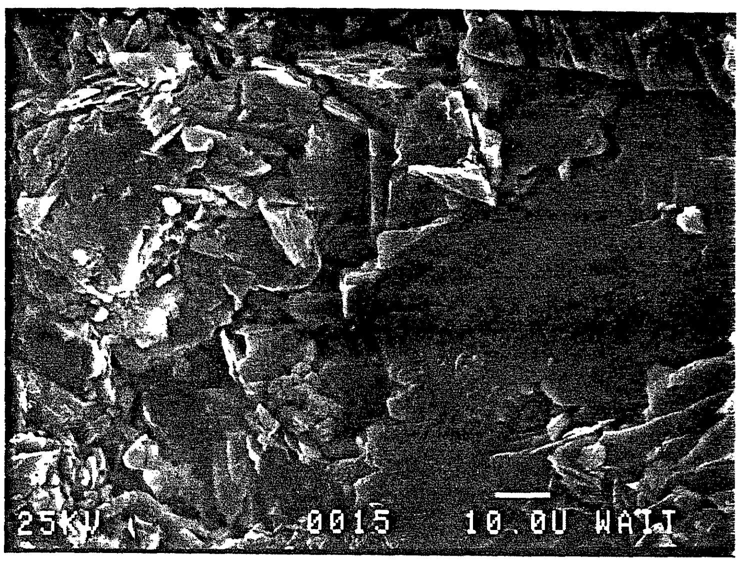


FIGURE 4. Electron micrograph, calcite - filled void space at centre of Figure 3. HELIOS - 1 # 7, 2961 m.

CONCLUSIONS

Stratigraphy:

The Upper Eocene - Cretaceous Latrobe Group is 15000 feet thick and consists mainly of lacustrine and fluviatile clastics. The sequence includes channel - fill sediments (Flounder and Turrum Formations) and a latest Eocene destructive marine phase, the glauconitic Gurnard Formation (James and Evans, 1971).

The Latrobe Group sequence in HELIOS - 1 below the unconformity basal to the Flounder Formation at 2659 m is characterised by sand sections, 26 - 70 m thick, composed of medium, coarse and very coarse sand, variably sorted and sometimes glauconitic, and siltstone sections, 2 - 8 m thick, to the progress total depth of 3000 m. Samples at 2686 m and 2961 m are from siltstone intervals (2695 - 2692 m and 2957 - 2965 m respectively) whilst a sample at 2712 m is from within a 47 m thick section (2692 - 2745 m) of moderately sorted medium - coarse sand.

Lithology, Diagenesis, Environment:

1. All samples are friable, texturally immature, poorly sorted, micaceous, glauconitic, matrix-rich, fine - very fine grained sands.

2. Pyritized organic matter is abundant at 2717 m, rare at 2961 m, and absent at 2686 m.

3. Glauconite is abundant at 2717 m (where it postdates pyritization of organics) and present at 2686 m and 2961 m. Glauconite probably formed by marine diagenetic reactions near the sediment - water interface, involving alteration of clays and mica minerals in the presence of organic matter.

4. Minor calcite spar cement (at 2686 m and 2717 m) is present in void spaces, postdating glauconitization.

5. A marine shelf, below wave-base environment, characterised by slow sedimentation, reducing conditions (2717 m and 2961 m) and negligible traction currents is indicated by 1 - 3 above. The presence of very poorly sorted sand which is occasionally medium and coarse grained, and the stratigraphic position of thin, fine grained units, basal to (and within) sand sections, suggest that sand may have been supplied by grain flow from a delta front (e.g. Reading, 1978, Figure 12.53) to the adjacent low energy shelf.

Glauconite Genesis

Several review papers are available on glauconite. The following summary is taken from McConchie et al (1979). "Glauconite forms almost exclusively in marine environments with a very low to negative sedimentation rate, and in water depths from the sublittoral to the Upper Continental Slope. A periodically agitated low energy environment appears to be necessary but in many occurrences, current generated structures probably reflect reworking after glauconite formation. A pH of 7 to 8 and slightly reducing conditions ($Eh < 0$) are generally considered most favourable, although reducing conditions may be confined to the immediate vicinity of proto-glauconite, while overall conditions remain slightly oxidising. The association of authigenic glauconite with organic matter is well known. Organic matter may be involved in producing required Eh conditions, and/or it may be involved in the degradation of phyllosilicate progenitors. However, too much organic matter may be as undesirable as too little, in that (1) chelation may limit the availability of Fe; (2) the Eh may become too negative; (3) an over-supply of organic acids may be able to degrade the glauconite faster than it can form, or (4) an abundance of organic sulphur may result in the formation of iron sulphides in preference to glauconite. Whereas some glauconites appear to have precipitated in voids (e.g. foraminiferal tests), some replaces organic hard parts, some formed as alteration products of silicate minerals such a feldspars; others formed fine grained phyllosilicates aggregated as fecal pellets. Because virtually no potential phyllosilicate progenitor contains as much Fe as glauconite, the uptake of Fe must be the fundamental reaction in the glauconitization process. Biotite appears to be the only abundant phyllosilicate that may contain as much Fe as glauconite, but most workers agree that only a small portion of glauconites appear to have formed from biotite."

With respect to HELIOS - 1 samples studied, peloidal galuconite may have formed from fine grained phyllosilicates, and platy glauconite with 001-type cleavage traces probably formed from biotite and muscovite. In sample # , 2717 m, which has abundant pyritized matrix, and probably had strongly reducing conditions, glauconite has not been precluded and is abundant. Though Fe availability may have been limited, biotite, the probable progenitor phyllosilicate, may have supplied Fe.

Glauconite authigenesis and alteration should be monitored closely. A study of Cenomian glauconitic sediments from the Great Burgan Oil field, Kuwait, has shown that (1) unconformities can be recognised by studying the chemical weathering of glauconite, which results in the precipitation of hydrated iron oxides and alunite, and (2) in the subsurface , close to oil reservoirs, the reduction of the hydrated iron oxide dust in glauconite pellets results in the development of black magnetic siderite (El-Sharkawi and Al-Awadi, 1982).

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APPENDIX NO. 6

MICROPALEONTOLOGICAL REPORT

STRATIGRAPHY
of the
FORAMINIFERAL SEQUENCE
in
HELIOS # 1,
GIPPSLAND BASIN.

for: PHILLIPS AUSTRALIAN OIL COMPANY.

February 8th, 1983.

David Taylor,
23 Ballast Point Road, Birchgrove, 2041.
AUSTRALIA. (02) 82 5643.

BIOSTRATIGRAPHY.

MID EOCENE - 2630.0m to 2596.0m:-

The planktonic foraminiferal sequence in Helios # 1 commenced in the mid Eocene with a series of marine ingressions; represented in three sidewall cores at 2630.0, 3608.0 and 2569.0m. As the range of *Globigerina frontosa* was restricted to the lower half of the mid Eocene Zones N10 and N11 of Blow (1979) and as no associated species were confined in range to the basal mid Eocene or early Eocene, an Assemblage Zone O designation is given for this interval. Zone O implies that the Unit was deposited above the base of the mid Eocene (= Zone P) but not in the upper half of the mid Eocene (= Zone N) even though associated species such as *Globigerina primitiva* range to the top of the mid Eocene. Apart from *Globigerina linaperta*, none of the species in this association range above the mid Eocene Zone N in southern Australia.

LATE EOCENE - 2593.0m and the EOCENE HIATUS at 2593m:-

As *Globigerina linaperta* is not regarded to extend above the top of the Eocene in the Tasman Sea Region (Kennett, 1980), the low diversity planktonic fauna at 2593m is regarded as representing Assemblage Zone K at the top of the late Eocene.

This Zone K determination at 2593.0m, just 3 metres above the early Mid Eocene Zone O fauna at 2596.0m, indicates that a hiatus of some 8 million years in duration occurred. The E-logs suggest that the unconformity surface marking this event was at 2593.0m.

EARLY OLIGOCENE - 2580.0 to 2571.0m and the OLIGOCENE HIATUS at 2580.0m:-

The association in these two sidewall cores is that of Assemblage Zone J-2; confirmed by the presence of *Globigerina brevis* which was restricted to this assemblage at the base of the Oligocene. Also *Globorotalia gemma* does not range above the basal Oligocene in the Tasman Sea Region (Kennett, 1980).

A hiatus is not discernible between the late Eocene and early Oligocene in Helios, though apparent in other sequences (refer discussion on Paleo-environment). However, the widespread Oligocene Hiatus of the *COBIA EVENT* (refer Taylor, 1983) was clearly evident at 2565m (E-log) with the Early Miocene, Zone H-1 present in the sidewall core at 2565m. The time span of this hiatus was of the order of 12 million years.

MIOCENE - 2565.0 to 511.0m:-

A thick sequence of mainly deep water Miocene carbonates was penetrated. The sequence appears to have been continuous. Zone E-1 was not identified, but it

HELIOS # 1
STRATIGRAPHIC SUMMARY.

Sample† Depth m	ZONE*	AGE*	STRAT-UNIT¶ & PALEOENVIRONMENT	E-LOG PICK
345.0 to 350.0	?	? LATE MIOCENE/ PLIOCENE	JEMMYS POINT FORMATION mid-inner shelf (<100m)	
511.0 to 1040.0	B-1 to D-1	LATE to MID MIOCENE	GIPPSLAND LIMESTONE Outer to mid Shelf (200-100m)	
1100.0 to 1330.0	D-1	MID MIOCENE	CANYON FILL MEMBER of Gippsland 1st - Upper Slope with slumping (200-400m)	1340
1345.0 to 1840.0	D-1 to D-2	MID MIOCENE	TASMAN SEA CARBONATES with deep water oozes. Paleo-depth increased up-section from (≃200m) at 2593 to (≃400m) at 1345m.	
1940.0 to 2565.0	E-2 to H-1	EARLY MIOCENE	Evidence of anoxic deposition at and above 2116m / as above but oxic conditions	?2142
∿∿∿ (12 m.y.) ∿∿∿				2567
2571.0 to 2580.0	J-2	EARLY OLIGOCENE	LAKES ENTRANCE MARL equivalent mid shelf (<100m) increasing paleo-depth up-section to outer shelf (<200m)	2580
2593.0	K	LATE EOCENE	COLQUHOUN FORMATION inner shelf (<40m)	
∿∿∿ (8 m.y.) ∿∿∿				2593
2596.0 to 2630.0	O	MID EOCENE	FLOUNDER FORMATION Estuarine/tidal marsh with marine ingressions	
2643.0 to 2659.0	?	?	bearing planktonic forams at 2596.0; 2608.0 & 2630.0.	
?	?	?	?	2659
2662 to 2764	?	?	? Marginal marine glauconitic sandy siltstone	

† Summary of results from examination of sixty three sidewall cores as listed in full on Tables 2 to 5.

* Planktonic foraminiferal assemblage zones only - PALYNOLOGY NOT AVAILABLE at time of compilation. Detailed planktonic foraminiferal distribution from 2630.0 to 2255.0m given on TABLE 2 and from 2205.0 to 345.0m on TABLE 4. Reliability of zonal determinations are on Data Sheet - TABLE 1.

¶ Interpretations based on distribution of benthonic micro-fossils and other sediment grains (>.075mm). Refer TABLE 3 for data from 2746.0 to 2255.0m and to TABLE 5 from 2205.0 to 345.0m. For Rock Stratigraphic nomenclature refer this report and to Taylor (1983).

∿∿ (8 m.y.) ∿∿ Hiatus with time span in parentheses.

was very thin elsewhere, and so thereis no doubt present between E-2 at 1940.0m, where there was a sampling gap.

The 500m interval occupied by Zone D-1 appears disproportionally thicker in comparison with the rest of the Miocene sequence; especially as the time span of D-1 was only 1.5 million years compared with 19 million years for the 2200 metres of Miocene in Helios # 1. However, this acceleration in accumulation rate during Zone D-1 times can be explained in terms of slope slumping and submarine canyon filling (refer Table 5).

No diagnostic planktonic fauna was found above the B-1 assemblage at 511.0m, so the interval above this could be either Late Miocene and/or early Pliocene. Sedimentological evidence suggests deposition above 511.0m was during a regressive phase which is well documented at the top of the Miocene.

PALEOENVIRONMENT and ROCK STRATIGRAPHY.

2764.0 to 2662.0m -

As samples examined in this interval were barren of foraminifera, little comment can be made, save that the presence of glauconite suggests marginal marine conditions.

2659.0 to 2596.0m - FLOUNDER FORMATION -

An interval of siltstones and fine quartz sandstones; glauconitic at the base and sporadically pyritic towards the top. Apart from the basal sample at 2659.0, all other samples were faunally dominated by the arenaceous benthonic foraminifera *Haplophragmoides* spp, which being euryhaline, can withstand fluctuations in salinity. Fish fragments, worm tubes and evidence of bioturbation were frequent throughout the unit. Such a benthonic association strongly supports an estuarine environment with tidal delta conditions in the lower part of the interval (2659.0 to 2643.0m). Periodic flooding of normal salinity, sea-water, into the estuary is evidenced by the presence of planktonic foraminifera at 2630.0, 2608.0 and 2596.0m. Both the litho and bio facies, as well as the mid Eocene age (planktonic foraminiferal Assemblage Zone C), indicates that this unit was a correlate of the Flounder Formation.

EOCENE HIATUS at 2593.0m.

Facies equivalents of either the Turrum or the Gurnard Formation were not identified in the Helios # 1 sequence; such units may have been removed as a consequence of the succeeding late Eocene Transgression.

2593.0 to 2580.0m - COLQUHOUN FORMATION.

A calcareous clayey polymodal quartz sandstone at 2593.0m contained an abundance of glauconite and pyrite with a very sparse foraminiferal fauna with an uppermost Eocene, Zone K planktonic association. This sample represents the initiation of the widespread late Eocene/early Oligocene transgression onto the Gippsland Basin margins. This facies can be equated with the quartz, glauconitic sandy Colquhoun Formation (refer Taylor, 1983). Deposition of the sample at 2593.0m was in a very shallow inner continental shelf situation; possibly under litteral conditions.

2580.0 to 2571.0m - LAKES ENTRANCE MARL EQUIVALENT.

The fine quartz sandy biogenic marls of this interval are very similar in lithofacies to the LAKES ENTRANCE MARLS of the Basin Margins, however the benthonic foraminiferal faunas and high planktonic percentage at 2571.0 indicate deeper paleo-depths of deposition. The depth increase appears to have been gradational across the Eo/Oligocene boundary from the Colquhoun Formation to those Lakes Entrance Marls. Sudden paleoenvironmental disruption, apparent in other offshore sections, was not evident across the Eo/Oligocene boundary in Helios # 1 (refer Taylor, 1983).

2565.0 to 1340.0m - THE MIOCENE TASMAN SEA CARBONATES & OOZES.

These are a thick sequence of biogenic carbonates, varying in $CaCO_3$ purity and degree of diagenesis. On criteria given by Hayward & Buzas (1979), the benthonic foraminiferal assemblages demonstrated an up-sequence increase in paleo-depth with progradation of the shelf edge, down slope. A regional seismic event within this unit corresponds with a change in oxygen supply between samples at 2145.0 and 2116.0m. At and below 2145.0m, pyrite was not present and faunas suggested reasonable oxygenation. But at and above 2116.0m pyrite (and limonite after pyrite) was generally abundant and benthonic distribution sporadic. Therefore the depositional surface below ?2142.0m (E-log) is regarded as having been oxic, whilst that above ?2142.0m was decidedly anoxic. Reasons for this change in oxygenation may have been related to sudden changes in bottom water mass characteristics during the early Miocene Zone F; for instance, a dramatic paleotemperature increase is noted in Tasman Sea sediment at around 17 million years (refer Kennett, 1980, Fig. 5). Sediment with Zone F planktonics deposited on the Gippsland Basin margins show records of this oceanic warming by the presence of tropical, benthonic larger foraminifera (e.g. *Lepidocyclina* spp.) In fact this was the only time in the foraminiferal sequence when warm water benthonic species inhabited Gippsland waters.

TASMAN SEA CARBONATES and OOZES is the term used here and by Taylor (1983) for a unit which is usually labelled as the Lakes Entrance Formation in the offshore Gippsland Basin. The persistent sedimentation of this deep water, biogenic carbonate from late Oligocene to the Recent, contrasts with the short time span of the rapidly transgressive Lakes Entrance Formation (late Oligocene to earliest Miocene Zones I to H). The Tasman Sea Carbonates and Oozes are accumulating today seaward of the Gippsland continental shelf edge. They are predominantly globigerinid and nannoplankton oozes with very little terrigineous clay or sand, whilst the Lakes Entrance Formation was deposited on an inner continental shelf platform and contained a high proportion of quartz and clay as the sea transgressed over an exposed eroded surface of granite and Latrobe Groups, sands and silts (refer Hocking & Taylor, 1964). For these reasons, I regard the Lakes Entrance Formation as a misnomer when applied to sediment deposited in the Gippsland Basin Deep.

1330.0 to 1130.0m - CANYON FILL MEMBER of the GIPPSLAND LIMESTONE.

At 1340.0 metres, there was a sudden increase in biogenic debris of shallow water origin (benthonic foraminifera, bryozoa and siliceous sponge spicules). This influx of detrital material also resulted in an overall increase in grain size, though seldom to calcarenite grade. Episodic slumping from the shelf down slope were noted in a number of samples (see Table 5). Such down slope displacement of fauna is common during the Miocene on both sides of the Tasman (Hayward & Buzas, 1979, p.24). Most of the criteria of Gippsland submarine canyon fill sedimentation were present in this interval of Helios # 1. The E-log character change at 1340.0 is taken as base Gippsland Limestone reflecting the sharp break from pelagic carbonates to the more detrital biogenic carbonates above 1340.0

1100.0 to 511.0m - GIPPSLAND LIMESTONE.

Rapid filling of the canyon (refer Page 3) and eustatic regression during Zone D-1, was followed by deposition of the continental shelf with gradual decrease in depositional depth in the late Miocene (refer Table 5).

350.0 to 345.0m - JEMMYS POINT FORMATION.

Marked by shallow water, high energy sedimentation with very poor fauna and a high content of terrigineous silt. The calcareous cement may be dolomitic.

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SIDEWALL CORES Depth in metres	PLANKTONIC FORAMINIFERA																									PLANKTONIC FORAMINIFERAL ASSEMBLAGE		AGE
	EOCENE					EO/OLIGOCENE									EARLY MIOCENE													
	G'alia turgida	*G'ina senni*	*G'ina frontosa*	*G'ina angiporoides minima*	*G'ina primitiva*	*G'ina linaperta*	*G'ina angiporoides* (S.S.)	*G'ina brevis*	*G'alia munda*	*G'ina & G'alia* indet	*G'ina tripartita*	*G'ina praebulloides*	*G'ina labiacrassata*	*G'alia gemma*	*G'ina woodi connecta*	*G'ina woodi woodi*	*G'alia continuosa*	*G'alia siakensis*	*Cat. dissimilis*	*G'quad dehiscens* (S.L.)	*G'ina & G'alia* indet (<.2mm)	*G'quad dehiscens* (S.S.)	*G'ina bulloides*	*G'oides trilobus*	*G'alia bella*	ZONE	Depth at Base	
2255.0→															°	x							x	°		G		EARLY MIOCENE
2302.0→															x	x					D		°	x	°			
2326.0→															°	°	°						°	°				
2404.0→															x	x	°	°	°			°	°	x	°		2404	
2440.0→															°	x			°			°	x			H-1		
2470.0→															°						D	?						
2500.0→															°	°					D							
2510.0→																					D							
2525.0→															°	°				°	D							
2555.0→															x	x	x	x	°									
2565.0→															°	x	°	°	°								2565	
2571.0→							x	x	°		°	x	°	°												J-2		EARLY OLIGOCENE
2580.0→							x	°	°	D																	2580	
2593.0→						x	x																			K	2593	LATE EOCENE
2596.0→		°	x			x																				O		MID EOCENE
2602.0→	N.P.																											
2608.0→		°	x	°	?	x																						
2622.5→	N.P.																											
2630.0→	°	°	x	x	?	x																				?	2630	?
2643.0→	N.P.																											
2652.0→	N.P.																											
2659.0→	N.F.F.																									?		?
2662.0→																												
2688.0→																												
2702.0→																												
2717.0→																												
2735.0→																												
2746.0→																												

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

N.P. = No planktonic foraminifera
N.F.F. = No foraminifera found

TABLE 2: EOCENE, OLIGOCENE to EARLY MIOCENE PLANKTONIC DISTRIBUTION - HELIOS # 1.

refer Table 3 for Miocene Planktonic Foraminiferal Distribution above 2255m.

David Taylor, 3/2/83

[redacted] [redacted]KTO[redacted]FOR[redacted]IFE[redacted] [redacted] [redacted] RES[redacted] LI[redacted]OGY[redacted] [redacted] ¶[redacted]-ENVIRONMENT ASSESSMENT [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

PLANKTONIC FORAMINIFERA (benthonic species)

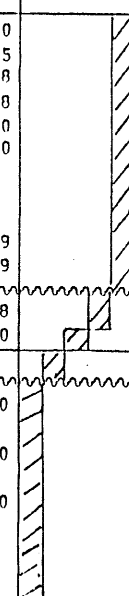
SIDEWALL CORES Depth in metres	*Haplophragmoides* spp.	*Bathysiphon angleseaensis*	*Ammosphearoidina* sp.	*Schenckiella* sp.	*Pseudoclavulina rudis*	*Sphearoidina bulloides*	*Pullenia* spp.	*Cibicides perforatus*	*C. subhaidingeri*	*Anomalina macroglabra*	*Lenticulina* spp.	*Nodosaria & Lagena* spp.	*Cibicides temporata*	*Bathysiphon* (porcelainous)	*Siphonina australis*	*Gyroidina subzelanica*	*Oolina* spp.	*Fissurina quadrata*	*Discorbinella berthelotti*
2255.0												x					°	°	°
2302.0												°		°	°		°	°	
2326.0												°			°		°		
2404.0														°	°	°			
2440.0											°	°	°	°	°	°			
2470.0									?	°									
2500.0								°	°										
2510.0								?	?										
2525.0								°											
2555.0									?										
2565.0								?											
2571.0								°	°	°	°	°							
2580.0	x			°	°	°	°	°											
2593.0	x			°															
2596.0	D	x																	
2602.0	D		x																
2608.0	D																		
2662.5	D	x																	
2630.0	D	x																	
2643.0	D																		
2652.0	D																		
2659.0	N.F.F.																		
2662.0	N.F.F.																		
2688.0	N.F.F.																		
2702.0	N.F.F.																		
2717.0	N.F.F.																		
2735.0	N.F.F.																		
2746.0	N.F.F.																		

LITHOLOGY

MAJOR COMPONENTS: f = planktonic forams; Ψ = recrystallised biomicrite & marl; .. = f qtz; .÷.= f qtz sandy marl; .-.= f qtz sandy siltst.; GG = pellet glauc; .0- = silt/clay polymodal qtz sdst; p = pyrite; q = glauconitic clay

SIDEWALL CORES Depth in metres	MAJOR COMPONENTS	Glauconitic clay	pyrite	m-c ang qtz	volcanogenic minerals	rock frags - pitted	mica	glauconite pellets	limonitic pellets & clay	fish fragments	worm tubes	worm bryozoa	echinoid spines
2255.0	ΨΨΨΨΨΨΨΨ fffffff												
2302.0	ΨΨΨΨΨΨΨΨΨ ffffff												
2326.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨ											A	
2404.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨ												
2440.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨ												
2470.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨ												
2500.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨ												
2510.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨ											A	r
2525.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨΨ												
2555.0	ΨΨΨΨΨΨΨΨ ffffffff												
2565.0	...ΨΨΨΨ ffffffff												
2571.0	.÷. ffffffffffff												
2580.0	÷÷÷÷÷÷÷÷÷÷÷÷÷÷÷÷÷												
2593.0	.0-.0-.0-.0-.0-.0							A	A				
2596.0	.-.-.-.-.-.-.-.-.		r	A						A			
2602.0	-.-.-.-.-.-.-.-.-			A				A		A	A		
2608.0	.-.-.-.-.-.-.-.-.			A			A	A					
2662.5	-.-.-.-.-.-.-.-.-		A					A					
2630.0	....							A		A	A		
2643.0	....	A											
2652.0	.... GGG			A			A			A			
2659.0	-.-.-.-.-.-.- GGG	A	A							A			
2662.0	.0-.0-.0-.0-.0-.0	A				A							
2688.0	0-.0-.0-.0-.0-.0-	A			?	A							
2702.0	.... q		r										
2717.0	.... pp q			A									
2735.0	.0-.0-.0-.0-.0-.0	r	r										
2746.0	0-.0-.0-.0-.0-.0-	A	A										

SIDEWALL CORES Depth in metres	Foram Count	Plank Foram %	¶PALEO-ENVIRONMENT ASSESSMENT (ESTUARINE (<10m), INNER SHELF (<40m), MID SHELF (<100m), OUTER SHELF (<200m), SHELF/SLOPE BREAK (≈200m))	MAJOR E-LOG CHARACTER CHANGE	ROCK STRAT-UNITS (refer Taylor,1983)	PLANKTONIC FORAMINIFERAL BIO-STRAT (refer Table 2): ZONE	Depth at base	AGE
2255.0	100	80						
2302.0	200	95						
2326.0	?200	?98				G		EARLY MIOCENE
2404.0	?200	?98					240	
2440.0	100	90						
2470.0	?100	?100			TASMAN SEA CARBONATE			
2500.0	?	?						
2510.0	?	?				H-1		
2525.0	?	?						
2555.0	500	99						
2565.0	500	99		2567			256	
2571.0	2000	98			LAKES ENTRANCE MARL	J-2		EARLY OLIGOCENE
2580.0	?200	?60		2585			258	
2593.0	?	?		2593	COLQUHOUN FM.	K	259	LATE EOCENE
2596.0	100	40						
2602.0	10	-						
2608.0	100	40						MID EOCENE
2662.5	100	-			FLOUNDER FORMATION	O		
2630.0	200	50				?	2630	? — ? — ? — ?
2643.0	10	-						
2652.0	10	-				?		?MID EOCENE?
2659.0	-	-		2659			265	
2662.0	-	-	?					
2688.0	-	-						
2702.0	-	-	?					
2717.0	-	-			?	?		?
2735.0	-	-						
2746.0	-	-						



KEY: ° = <20 specimens
x = >20 specimens
D = Dominant >60% specimens
N.F.F. = no foraminifera found

A = abundant 1-5% grains
r = rare <20 grains
? = identification queried

¶paleo-water depth in parentheses

TABLE 3: PALEOENVIRONMENTS - EOCENE to EARLY MIOCENE - HELIOS # 1

refer Table 5 for Miocene Paleoenvironments above 2255m.

David Taylor 4/2/1983.

SIDEWALL CORES Depth in metres	G'oides bisphericus	G'oides trilobus	G'ina woodi connecta	G'ina woodi woodi	G'ina bulloides	G'alia bella	G'alia miozea miozea	G'alia praescitula	G'alia peripheronda	G'alia siakensis/mayeri	Cat. dissimilis	G'quad altispira	G'quad dehiscens (S.S.)	G'alia zealandica (S.S.)	G'alia continuosa	Praeorb. glomerosa	G'alia conica	Orb. universa	G'alia praemenardii	G'ina & G'alia indet (<.2mm)	G'quad advena	G'alia miozea conoidea	G'alia foshi Gp.	G'ina ciperoensis	G'ella aequilateralis	G'alia acostaensis	G'alia scitula	G'alia conomiozea	G'alia miotumida miotumida	G'ina decoraperta	PLANKTONIC FORAMINIFERAL ASSEMBLAGE	ZONE Depth at Base	AGE
345.0→	N.F.F.																																
350.0→				?	°																	?								?	?		
511.0→				x	x										°							x											
645.0→				x	x																	x				x	x	x	°	x	B-1	645	
708.0→				x	x										°			x								x	°						MID / LATE MIOCENE
890.0→				x	x										x							x		x	x	x					B-2	890	
950.0→				x	x					°					°			°		D		x									C	950	
965.0→				x	x					°							°	x		D		x		x	°								
1010.0→				x	x					°							°	x		D	°			x	x								
1040.0→		°		°						°							°			D													
1100.0→		x		x	x					x					x		x	x		D		x		x									
1130.0→		x		x	x										x		x	x		D		x		x									
1215.0→		x		x	x					x							°	x				x											
1260.0→				°													°					°											
1276.0→				x														x													D-1		
1278.0→																				D													
1280.0→				x						°							°																
1282.0→					x					°							°	x				°											
1286.0→				x			°			x							x					x											
1289.0→				°													°			D													
1300.0→				x	x		x	x	?								°	x		D		x	°	x		x							
1315.0→																				D													
1330.0→				x	x			x	?	x								x		D		x											
1345.0→				°	°												°	D				x											
1442.0→				x	x		x			x							°	x	x	D		x										1442	MID MIOCENE
1540.0→	x	x		x	x		x	x	x	x		°	x	°	x		°	x	°	D	°												
1640.0→	x	x		x	x		x	x	x	x				°	x		°	x	°	D											D-2		
1740.0→	°	°		°	x		°	°										x	°														
1840.0→	x	x		x	x		°	°										x	x													1840	
1940.0→	x	x		x		°	°		°					x		x	°														E-2	1940	EARLY MIOCENE
2040.0→	°	°	x	x	x	°	°	x	°	x				°	°																		
2116.0→	°	x	x	x		x	x	°	°	x		°	x	°	x																		
2145.0→		°		°										°																			
2155.0→	°	°	x	x	x	°	x	°	°	°	x	°	x																		F		
2205.0→	x	x	x	x	x	°	°	°	°	x	°	°	x																			2205	

KEY: ° = <20 specimens
x = >20 specimens
D = Dominant >60% specimens
? = doubtful indent.

N.F.F. = no foraminifera found

TABLE 4: MIOCENE PLANKTONIC FORAMINIFERAL DISTRIBUTION - HELIOS # 1.
refer Table 1 for Eocene to Early Miocene below 2205.

David Taylor, 3/2/1983.

[redacted]ECT[redacted]ENT[redacted]C FO[redacted]NIF[redacted]

SIDEWALL CORES Depth in metres	Opalina & Fissurina spp.	Nodosaria & Lagena spp.	Siphorina australis	Sigmoides pacifica	Bathysiphon (porcelainous)	"Cyclammina" spp.	Bolivina thalmani	Oridoralis tenera	Osangularia bengalensis	Anomalina procolligera	Ceratobulimina clifdenensis	Cibicides subhaidingeri	C. mediocris & temporata	Globobulimina spp.	Cassidulina leavigata	Siphouvigerina proboscidea	Euuvigerina pickii	Discammina compressa
345.0	N.F.F.																	
350.0																		
511.0														x				
645.0														x	°			
708.0	°													°				
890.0										x			x					
950.0		°																
965.0		°								°			x	x	x			
1010.0		x								x			x	°	x			
1040.0												x			x			
1100.0	°	°								°				°				
1130.0	°	x								°				°				
1215.0		x								x				°				
1260.0	°	°																
1276.0																		
1278.0	indet																	
1280.0															x			
1282.0															x			
1286.0															x			
1289.0																		
1300.0		°																
1315.0	indet																	
1330.0																		
1345.0												°						
1442.0		°													x		x	
1540.0	°									°		x	x	x	x	x		
1640.0														x	x		x	°
1740.0										°	°	°						
1840.0												x	x		x	x		
1940.0												x	°	x				
2040.0		x							°		°							
2116.0		x				°			x		x							
2145.0		x																
2155.0	x		°							°								
2205.0	x	x	°	°	°	°	°	°	x									

SIDEWALL CORES Depth in metres	Martinotiella communis	Tritarina bradyi	Lenticulina spp.	Cib. opacus & Pseudoungerranus	Bulimina spp.	Euuvigerina maynii	Gyroidina soldanii	Cibicides vortex	Textularia carinata	Euuv. miozea & peregrina	Anomalina macroglabra	Bolivinita quadrillata	Bolivina alata	Karreria cygnorum	Elphidium advenum	Rosalina australis	Cibicides lobatulus	Spiroloculina sp.
345.0																		
350.0																		x
511.0				x										x			x	
645.0					°										x	x		
708.0										x			x		x	x		
890.0										D			x	°	x	x		
950.0				°						x								
965.0								x		x		°	x					
1010.0										x		°						
1040.0							°											
1100.0				x	°			x										
1130.0				x	°			X										
1215.0				°				°										
1260.0																		
1276.0					x													
1278.0																		
1280.0				x														
1282.0				x														
1286.0				x			°	°		x	w							
1289.0							°											
1300.0			w	x					°									
1315.0																		
1330.0			w	w	°					x	W							
1345.0				°				x	°									
1442.0		°	x	x	x	x	°											
1540.0		°																
1640.0	°																	
1740.0																		
1840.0																		
1940.0																		
2040.0																		
2116.0																		
2145.0																		
2155.0																		
2205.0																		

[redacted]RES[redacted] LIT[redacted]GY [redacted]

Depth in metres	MAJOR COMPONENTS (-ϕ=calc. siltst. ? dolomitic; Ψ=recrystall. biomicrite; m =biomicrite)	MINOR COMPONENTS: limonite	pyrite - biogenic	ang qtz	gastropods	echinoid spines	bryozoa - very worn	sponge spicules	ostracods	foram count	planktonic %	[redacted] ¶PALEO-ENVIRONMENT (MID SHELF (<100m); OUTER/MID SHELF (=100m); OUTER SHELF (<200m); UPPER SLOPE CANYON (>200m); UPPER SLOPE (200-400m))	MAJOR E-LOG CHARACTER CHANGE
345.0	-ϕ-ϕ-ϕ-ϕ-ϕ-ϕ-			Λ						?	?		
350.0	ϕ-ϕ-ϕ-ϕ-ϕ-ϕ-ϕ			Λ						?	?		
511.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ					Λ			Λ	300	40		
645.0	mmmmmmmmmmmmmmm					Λ	Λ		Λ	1000	150		
708.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ					r	Λ		Λ	500	50		
890.0	mmmmmmmmmmmmmmm					Λ				1000	60		
950.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ			r		r				?	?		
965.0	mmmmmmmmmmmmmmm					r	Λ		r	2000	80		
1010.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ									2000	80		
1040.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ	Λ				r				?	?		
1100.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ					r				2000	90		
1130.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ					Λ		Λ		1000	90		
1215.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ					Λ	Λ	D		500	90		
1260.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ									?	?		
1276.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ									?	?		
1278.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ						D			?	?		
1280.0	mmmmmmmmmmmmmmm						D			?	?		
1282.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ					Λ				100	50		
1286.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ					Λ				1000	90	→	
1289.0	mmmmmmmmmmmmmmm						D	D		?	?	SLUMPS	
1300.0	mmmmmmmmmmmmmmm							D		3000	98	→	
1315.0	mmmmmmmmmmmmmmm						D	D		?	?	SLUMPS	
1330.0	mmmmmmmmmmmmmmm			r				D		2000	98	→	1340
1345.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ					Λ	Λ			?200	?95		
1442.0	mmmmmmmmmmmmmmm		Λ							2000	90		
1540.0	mmmmmmmmmmmmmmm		Λ		Λ			Λ		1500	90		
1640.0	mmmmmmmmmmmmmmm	Λ						Λ		1000	95		
1740.0	ΨΨΨΨΨΨΨΨΨΨΨΨΨ	Λ					Λ			200	95	ANOXIC→	
1840.0	mmmmmmmmmmmmmmm	Λ								500	95		
1940.0	mmmmmmmmmmmmmmm	Λ					Λ			250	95		
2040.0	mmmmmmmmmmmmmmm					Λ				500	90		
2116.0	mmmmmmmmmmmmmmm	Λ			Λ					500	90		?2142
2145.0	mmmmmmmmmmmmmmm									10	?		
2155.0	mmmmmmmmmmmmmmm									1000	90	OXIC →	
2205.0	mmmmmmmmmmmmmmm									1000	90		

refer Table 3 for below 2205

STRATIGRAPHY

ROCK STRAT-UNITS	ZONE	Depth at Base
JEMMYS POINT FM.	?	
GIPPSLAND LIMESTONE	B-1	645
	B-2	890
	C	950
CANYON FILL MEMBER of Gippsland Limestone	D-1	1442
TASMAN SEA CARBONATE	D-2	1840
	E-2	1940
	F	

KEY: ° = <20 specimens
x = >20 specimens
D = Dominant >60% specimens
N.F.F. = no foraminifera found
w = worn shallow water specimens - displaced

D = 5%-10% of biogenic grains other than forams
Λ = 1%-5% grains
r = rare <20 grains

¶paleo-water depth in parentheses

TABLE 5: PALEOENVIRONMENTS - MIOCENE - HELIOS # 1

refer Table 1 for Eocene to Early Miocene below 2205.

APPENDIX NO. 7

PALYNOLOGICAL REPORT

THE STRATIGRAPHIC PALYNOLOGY

of

HELIOS # 1,

GIPPSLAND BASIN.

for: PHILLIPS AUSTRALIAN OIL COMPANY,

May 26th, 1983.

Helene A Martin,
School of Botany,
University of New South Wales,
Box 1, P.O.,
Kensington, 2033
AUSTRALIA. (02) 662 2954

HELIOS # 1
STRATIGRAPHIC PALYNOLOGY SUMMARY

Depth (m)	Spore/Pollen Zone	Dinoflagellate Zone	Age	Palaeoenvironment
2596 to 2602	Lower *N. asperus*	? [1]	Mid Eocene	Marginal marine
2608		*A. diktyoplokus*		
2630 to 2670	*M. diversus*	?	Early Eocene	Marine to Marginal marine
2688		none		Non marine
2702	*L. balmei*	?	Paleocene	Marginal marine
2727		*E. crassitabulata*		
2746 to 2782	*T. longus*	?	Maastrichtian	
2803 to 2855		none		Non marine
2873		?		Marginal marine
2889 to 2900		*I. druggii*		
2917		?		
2933 to 2966.3		none		Non marine
2998	SAMPLE MIX-UP		EOCENE	
3045 to 3195	*T. longus*	none	Maastrichtian	Non marine
3214 to 3465.5	*T. lilliei*	none	Campanian	Non marine

1. Dinoflagellates present but they do not constitute any of the named zones.

Helene A Martin, May 1983.

SPORES and POLLEN

The spores and pollen identified are listed in Table 1 and the ranges of diagnostic species are shown on Figure 1 with species in Table 1 grouped into three categories:-

1) Spores, mostly from ferns and their allies.
2) Gymnosperm pollen: pines e.g. hoop pine, Huon pine etc. These would have been mostly forest trees. Their relatives are found today in forests of Tasmania, New Zealand, New Caledonia and New Guinea. Only a few grow on the Australian Mainland and they are restricted to rainforests and the wetter climates.
3) Angiosperm pollen: flowering plants. These may have been trees or shrubs.

The ranges of diagnostic species and zonation follows Stover & Partridge (1973) as ammended by Partridge (1976). Experience has shown that subsequent publications on the same period extend the ranges of some diagnostic species. This is seen especially for the Early and Middle Cretaceous where three groups of authors have published on this time range. For this reason, if the ranges of some species fall slightly outside of those given in the references, then it is not considered serious. Sometimes there is conflicting evidence, and the method adopted then is to add up all the pros and cons before making a decision.

1. *T. lilliei* Zone - Campanian, 3465.5 to 3214m.

In the two deepest samples, species which first appear at the base of the *T. lilliei* Zone, viz. *Latrobosporites amplus, L. ohaiensis, Nothofagidites endurus, Proteacidites scaboratus, Tricolporites lilliei* and *Tricolporopollenites sectilis* are present. *Lygistepollites florinii* (in 3450m) and *Tricolpites longus* (in 3446m) both first appear within the *T. lilliei* Zone and suggest the upper part of this zone (see Table 1 and Figure 1). There is variation in presence and abundance of some species but no trends, i.e. the overall aspects of the assemblages remain much the same up to 3214m.

Wood, cuticles and other plant tissue fragments occur throughout in variable quantities. Abundant plant tissue fragments is thought to indicate a swamp environment. Where wood is conspicuous, the gymnosperm pollen is usually more abundant, particularly *Phyllocladidites mawsonii* (living relative, Huon Pine) and this could indicate a swamp-forest environment. There is an exceptional abundance of pollen at 3390.5m and most of it is *Ph. mawsonii*.

There are some reworked Early Cretaceous and one Permian species in both this zone and the one directly above it (see Table 1). Most of the species are large, thick walled and tough and are able to survive reworking. Usually, only one or two specimens are seen in a sample and they are quite distinctive.

2. *T. longus* Zone - Maastrichtian, 3195 to 2746m.

The overall characteristics of the assemblages here are much the same as those of the *T. lilliei* Zone. Stover & Partridge designated the top of the older zone by the introduction of some five diagnostic species which mark the base of the younger zone, i.e. negative evidence. Of these five species, only two have been seen in Helios, viz. *Tetracolporites verrucosus* and *Proteacidites angulatus*, and they only occur sporadically. Stover & Partridge show *Australopollis obscurus* appearing about half way through the zone, but it is found here below *T. verrucosus*, in the deepest of the *T. longus* Zone (see Table 1 and Figure 1).

Wood, cuticles and other plant tissue occur throughout, just the same as in the *T. lilliei* Zone. *Ph. mawsonii* is common in some of the samples but not as abundant as at 3390.5m in the *T. lilliei* Zone.

A puzzling feature is the extension of the *T. longus* Zone above the dinoflagellate *Isabelidinium druggii* Zone top at 2889m (discussed further below). According to Stover, Helby and Partridge (1979), the *I. druggii* Zone occurs at the top of the *T. longus* Zone and the top of the Maastrichtian (see Figure 2). There is no doubt that the *T. longus* Zone extends above the *I. druggii* Zone for three reasons, viz. (1) the overall aspects of the assemblages above the *I. druggii* Zone are much the same as those below; (2) species whose ranges terminate at the top of the *T. longus* Zone are found above the *I. druggii* Zone and (3) None of the species which first appear in the overlying *Lygistepollenites balmei* Zone are found here.

3. *L. balmei* Zone - Palaeocene, 2727 to 2702m.

Species found here which define the base of this zone are *Lygistepollenites allipticus*, *Nothofagidites brachyspinulosus*. *Nothofagidites flemingii* and *Proteacidites adenanthoides* first appear within the zone (see Table 1 and Figure 1). None of the species which terminate their range at the end of the *T. longus* Zone are found here. As well, the overall characteristics of the assemblages are quite different to those of the *T. longus* Zone. Here, *L. balmei* is common. Plant tissue is present also.

The *L. balmei* Zone has been divided into Lower and Upper by Partridge (1976) and Stover et al (1979) but they have not defined the basis of this sub-division. Consequently, this zone is not sub-divided here.

4. *M. diversus* Zone - Early Eocene, 2688 to 2630m.

The appearance of *Banksieaeidites arcuatus*, *Proteacidites grandis* and *P. latrobensis* at 2688m mark the *M. diversus* Zone. Other samples of this zone contain *Proteacidites leightonii*, *P. reticuloscabratus*, *P. pachypolus* and *Cupanieidites orthoteichus* which all first appear within this zone (see Figure 1 and Table 1). The overall aspects are quite distinctive with *Dilwynites granulatus* the most common species. *Myrtaceidites parvus* is sometimes common as well.

The pollen content and abundance of plant tissue debris decrease up the section within this zone and dinoflagellate abundance increases (discussed further below).

Stover, Helby and Partridge (1979) have divided the *M. diversus* Zone into Lower, Middle and Upper, but they have not described the diagnosis of this subdivision. Consequently, this zone is not subdivided here.

5. Lower *N. asperus* Zone - Mid Eocene, 2608 to 2596m.

The introduction of *Nothofagidites vansteenisii* and *Tricolporites angurium* denote the Lower *N. asperus* Zone. The overall characteristics of the assemblages are quite different to those of the *M. diversus* Zone. Here, species of *Nothofagidites* are abundant and this is also one of the diagnostic features of the zone (Stover & Partridge, 1973).

Stover and Partridge (1973) define both Lower and Upper *N. asperus* Zones. At a conference in July, 1975, Partridge (unpublished) had interposed a *Triorites magnificus* Subzone between the Upper and Lower. The subsequent publication (Partridge, 1976) has the Middle *N. asperus* Zone between the Upper and Lower, without any description or diagnosis of the middle zone. However, it is thought that the middle zone may be diagnosed on the presence of *T. magnificus*, and if this is so, then these assemblages, lacking *T. magnificus,* fit the modified Lower *N. asperus* Zone shown on Figures 1 and 2.

DINOFLAGELLATES.

Dinoflagellate distribution in Helios is shown on Table 1 with ranges tabulated on Figure 2.

Dinoflagellate zones have been named in Partridge (1976) and Stover et al (1979) but they have not been described, so the diagnostic features of the zones are not known. For the present purpose, it is assumed that the species after which the zone is named is common therein. It should be noted that the ranges of these species usually extend beyond the zone. As with the spores and pollen, experience may show that the ranges require modification.

1. *I. druggii* Zone - Maastrichtian, 2889 to 2900m.

Here *I. druggii* is the most common dinoflagellate. The samples immediately above and below this zone, viz. 2873 and 2917 contain some dinoflagellates but *I. druggii* is not present. One specimen of *I. druggii* was seen at 2835m, but as it was the only dinoflagellate seen, it is regarded as a trace and not sufficient evidence of the zone. *Apectodinium homomorphum* occurs at 2917m, below the *I. druggii* Zone and this is outside of its range given by Stover et al (1979). See Figure 2.

2. 2746 to 2782m.

Here, there are some dinoflagellates which do not fit any named zone. These samples occur at the top of the *T. longus* Zone. As discussed previously, Stover et al (1979) place the *I. druggii* Zone at the top of the *T. longus* Zone but here it occurs well within this zone.

3. *E. crassitabulata* Zone, Paleocene, 2727m.

Here, *E. crassitabulata* is the most common. The other species identified are consistent with the Paleocene age.

4. 2702m - Paleocene

This sample, immediately above the *E. crassitabulata* Zone and still within the *L. balmei* Zone contains *Achomosphaera septata* as the most common dinoflagellate. *E. crassitabulata* was not found here and this assemblage does not fit any of the named zones.

5. 2630 to 2670m - Early Eocene.

These samples all fall within the *M. diversus* Zone. The pollen content decreases up the section as dinoflagellate abundance and diversity increases. Both *Apectodinium homomorphum* and *Spiniferites ramosus* are abundant in 2659m, but this early Eocene assemblage in the *M. diversus* Zone cannot be put in the *A. homomorphum* Zone of Stover et al (1979) which is placed in the Paleocene Upper *L. balmei* Zone. At 2652m, *Spiniferites ramosus* is the most abundant. Two species of *Hystrichosphaeridium* are abundant in the assemblages at 2643m and 2630m. *Glaphrocysta retiintexta* is also common in the latter. None of the assemblages found here can be placed in a named dinoflagellate zone.

6. *A. diktyoplokus* Zone - Mid Eocene, 2608m.

The assemblage here has a low content of dinoflagellates and *Areosphaeridium diktyoplokus* is most abundant. A few dinoflagellates are found above this level at 2602m and 2596m, and although *A. diktyoplokus* does not occur in these assemblages, they conform to a mid Eocene age.

PALAEOECOLOGY.

Late Cretaceous deposition was completely non marine up to 2933m. The low content of dinoflagellates and good pollen assemblages at 2917m to 2873m indicate only a slight marine influence. Marginal marine conditions reappeared at 2702m to 2782m. The lowermost assemblage of the Early Eocene *M. diversus* Zone, 2688m was non marine. The assemblage above it, at 2670m has a few dinoflagellates which increase in frequency up-section. This, coupled with the frequency decline of pollen and plant tissue indicate increasing marine conditions throughout the *M. diversus* Zone. In the Mid Eocene Lower *N. asperus* Zone, there were good pollen assemblages with only a few dinoflagellates, indicating a return to marginal marine conditions.

RECONCILIATION with FORAMINIFERAL SEQUENCE

Comments by David Taylor.

CRETACEOUS - TERTIARY BOUNDARY.

Although no Cretaceous or Paleocene foraminifera were found in Helios, comment is made regarding the placement of this boundary on palynological criteria and correlation with planktonic foraminiferal biostratigraphy. Dr. Martin demonstrates that the impression given by Partridge (1976) and Stover et al (1979) is misleading in that the top of the *T. longus* spore/ pollen Zone and the *I. druggii* dinoflagellate Zone were not coeval. In Helios # 1, the *T. longus* Zone extends some 140m above the top of the *I. druggii* Zone. Stover et al (1979) tabulate the coeval zonal tops as corresponding with "Top Cretaceous", yet in earlier publications (e.g. Stover & Partridge, 1973) the *T. longus* zone was placed entirely within the Paleocene.

Another assumption has been that the *I. druggii* Zone was the expression of the marine transgression in late Maastrichtian and its top corresponds with the regressive event in the basal Paleocene. However, in New Zealand *I. druggii* has been reported both below and above unconformable contact between late Maastrichtian and early/mid Paleocene in a single, well documented outcrop section (refer Strong, 1977 re. planktonic foraminifera and Wilson, 1978 re, dinoflagellates). Moreover, *I. druggii* occurs in the type Danian of Denmark (Wilson, l.c.).

In Helios, the *T. longus* interval (from 2873 to 2764m) above the *I. druggii* Zone may well be of early Paleocene age. This infers that non-marine sedimentation persisted in some deltaic situations during an early Paleocene hiatus effecting more marine situations; such as the carbonate shelf environments in New Zealand. Much more data is therefore required regarding the whole question of the stratigraphic relationships of the *T. longus* and *I. druggii* Zonal tops, and the Cretaceous/Tertiary boundary. For the time being, in search of both convenience and consistency, the *T. longus/L. balmei* boundary should be accepted as approximating the Cretaceous/Tertiary boundary. But the possibility of diachronuity of this "Top Cretaceous"; over some 5 million years, should not be overlooked in regional geological assessment in the Gippsland Basin.

EOCENE.

One slight discrepancy is that palynological determinations suggest that 2630m was at the top of early Eocene, whilst planktonic foraminiferal evidence indicates a mid Eocene age. A similar discrepancy is discussed in the Selene # 1 palynology report.

Probably a more significant discrepancy is that relative frequency of plant debris suggests a decline in marine influence from early to mid Eocene, whilst distribution of planktonic foraminifera demonstrates the reverse trend with marine influence increasing up-section. Increase in plant debris may have been due to rejuvenation of supply of terrigenous material, caused by tectonic uplift and/or increased precipitation in the hinterland, rather than because of a marine regression.

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A7 Figure 1 to follow

PE900499

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The enclosure PE900499 is enclosed within the container PE902616 at this location in this document.

The enclosure PE900499 has the following characteristics:

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BASIN =	GIPPSLAND
PERMIT =	VIC/P18
TYPE =	WELL
SUBTYPE =	DIAGRAM
DESCRIPTION =	Helios-1 Spore Pollen Range Chart compiled from Stover & partridge, 1973. From appendix 7 of WCR volume 1.
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	23/06/83
W_NO =	W787
WELL_NAME =	Helios-1
CONTRACTOR =	
CLIENT_OP_CO =	Phillips Australian Oil Company

(Inserted by DNRE - Vic Govt Mines Dept)

PE903184

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The enclosure PE903184 is enclosed within the container PE902616 at this location in this document.

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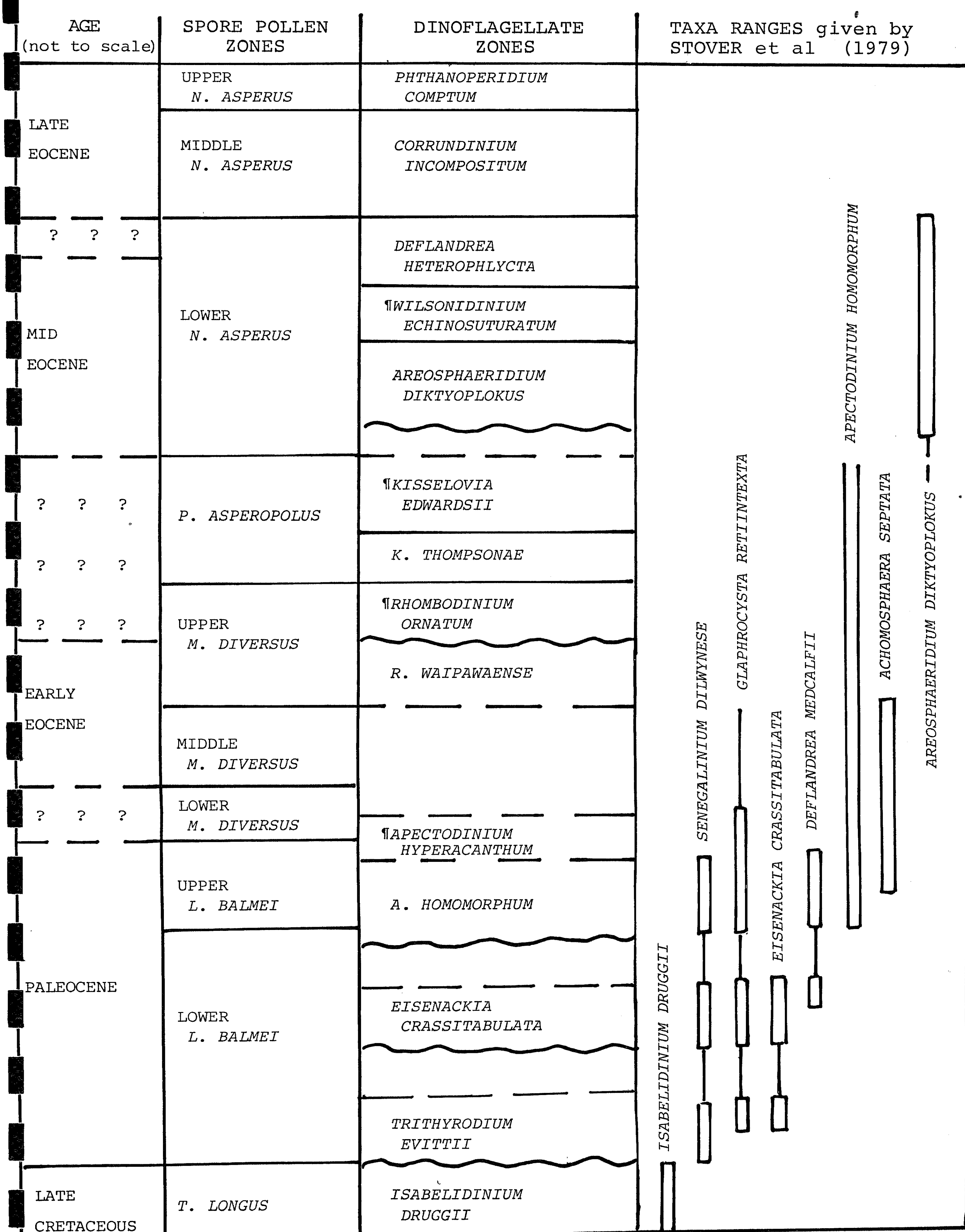
BASIN =	GIPPSLAND
PERMIT =	VIC/P18
TYPE =	WELL
SUBTYPE =	DIAGRAM
DESCRIPTION =	Spores, pollens and dinoflagellates identified in Helios 1 (from WCR)
REMARKS =	
DATE_CREATED =	31/05/83
DATE_RECEIVED =	
W_NO =	W787
WELL_NAME =	Helios-1
CONTRACTOR =	University of New South Wales
CLIENT_OP_CO =	Phillips Australian Oil Company

(Inserted by DNRE - Vic Govt Mines Dept)



¶ FORMER GENERIC DESIGNATION - *WETZELIELLA*

* former *Deflandrea*

Helene A. Martin, May 1983.

FIGURE 2: HELIOS # 1 - DINOFLAGELLATE RANGES.

APPENDIX NO. 8

PETROLEUM GEOCHEMISTRY EVALUATION

PETROLEUM GEOCHEMISTRY

HYDROCARBON SOURCE ROCK EVALUATION

STUDY OF THE

PHILLIPS HELIOS No. 1

Prepared for
PHILLIPS AUSTRALIAN OIL CO.

January 1983.

ANALABS
A Division of MacDonald Hamilton & Co. Pty. Ltd.
52 MURRAY ROAD, WELSHPOOL, W.A. 6106.
Telephone (09) 458 7999 Telex: ANALAB AA92560

HYDROCARBON SOURCE ROCK EVALUATION

STUDY OF THE

PHILLIPS HELIOS No. 1

SUMMARY

Organic geochemical analyses performed on samples from the Phillips Helios No. 1 well have indicated the following:

- Well interval 2550m to 2670m contain poor amounts of C_1 - C_7 light hydrocarbon, and consequently they have a poor hydrocarbon source character.

- Sediments from 3020m to 3160m contain fair to good amounts of organic matter with corresponding favourable S_2 values. However, they gave low free hydrocarbon yields, and as a result these rocks have probably only generated biogenic methane gas.

- Sediments from 3170m - 3500m are very organic rich with high S_2 values and occasional favourable S_1 values. However, the percentage of this volatile hydrocarbon (S_1) to the total pyrolysed hydrocarbon (S_1 + S_2) is very low (P.I). This suggests these rocks have not experienced sufficient time and temperature to have generated and effectively expelled significant quantities of hydrocarbon.

- The oil fluorescence observed in the side wall core taken at 2998m represents diesel contamination.

Paul Tybor

PAUL TYBOR

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INTRODUCTION

Organic geochemical analyses have been carried out on fifty two (52) samples from well intervals 2550m to 2670m, and 3020m to 3500m, in the Phillips Helios No. 1 well.

The purpose of this study is to evaluate the hydrocarbon source rock characteristics of the sediments penetrated and analyzed from this well.

Analytical

Upon arrival at the lab the following analytical program was conducted on the samples:

Type of Analysis	Table	Figure
Well cuttings from 2550m to 2670m		
C_1 - C_7 light hydrocarbon gas chromatography	I	1
Well cuttings from 3020m to 3500m		
% Total organic carbon determination	II	1, 2
Pyrolysis	II	2
Side wall core and Diesel Sample		
Extraction, C_{12}+ saturate gc	III	3 - 6

A description of the analyses performed in this study is presented in Appendix I, located at the back of this report.

General Information

Copies of this report have been mailed to Mr. Gale Yarrow of the Phillips Australian Oil Co., Perth, Western Australia.

Any questions relating to this study maybe directed to either Paul Tybor or Garry Woodhouse of Analabs, in Perth, Western Australia.

All data and interpretations contained herein is proprietary to the Phillips Australian Oil Co.and is treated as highly confidential material by all Analabs personnel.

****

RESULTS AND INTERPRETATIONS

A. Hydrocarbon Source Rock Characterization

Well interval 2550m to 2670m

C_1 - C_7 light hydrocarbon gas chromatography was performed on the sediments between well interval 2550m to 2670m (Figure 1; Table I). These results indicate that this interval is lean in gas and condensate. As a result, further analytical evaluation was unwarranted, and these sediments appear non prospective for any significant quantities of indigenously generated hydrocarbon.

Well interval 3020m to 3500m

The rocks between 3020m to 3160m contain fair to good amounts of organic matter (% TOC; Figure 2; Table II). They were analyzed to contain moderate to good amounts of S_2, however, the amount of volatile hydrocarbon (S_1) is low and indicates that these sediments are thermally immature and have not commenced hydrocarbon generation. This is further evidenced by the low Production Index and Tmax values obtained from these samples.

Well interval 3170m to 3500m contains rocks which have very good to excellent amounts of organic matter, with corresponding very good to excellent hydrocarbon generating potential yields (S_2; Figure 1; Table I). The volatile hydrocarbon yields (S_1) of these rocks, reaches moderate to good values, however this amounts to only 3% to 5% (PI; Figure 1; Table I) of the total pyrolyzed hydrocarbon (S_1 + S_2; Figure 1; Table I) for these samples. This low hydrocarbon conversion percentage probably reflects an immature thermal maturation for these organic-rich rocks. Consequently these sediments contain moderate to good amounts of free hydrocarbon due to the high concentrations of organic carbon present. However, it is doubtful that any significant quantities of this hydrocarbon has been expelled into available reservoirs.

B. Comparison of diesel to the hydrocarbon extracted from sidewall core at 2998m.

Oil fluorescence was observed in the side wall core taken from 2998m. Analyses were conducted on this sample as well as on diesel utilized in the rig. Comparison of these results indicate that the oil observed in the core is diesel contamination. This is evidenced by the nearly identical configurations of the C_{12}+ saturate gas chromatograms of these samples.

PE604126

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BASIN =	GIPPSLAND
PERMIT =	VIC/P18
TYPE =	WELL
SUBTYPE =	WELL_LOG
DESCRIPTION =	Helios 1 ANA-Log. Hydrocarbon Source Rock Evaluation. Figure 1 of 5. From appendix 8 of WCR volume 1.
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	23/06/83
W_NO =	W787
WELL_NAME =	Helios-1
CONTRACTOR =	Analabs Oil and Gas Division
CLIENT_OP_CO =	Phillips Australian Oil Company

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PE604127

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      DESCRIPTION = Helios 1 ANA-Log. Hydrocarbon Source
                    Rock Evaluation. Figure 2 of 5. From
                    appendix 8 of WCR volume 1.
          REMARKS =
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    DATE_RECEIVED = 23/06/83
             W_NO = W787
        WELL_NAME = Helios-1
       CONTRACTOR = Analabs Oil and Gas Division
     CLIENT_OP_CO = Phillips Australian Oil Company
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FIGURE 3

HELIOS #1 2998m SWC

SATURATED FRACTION

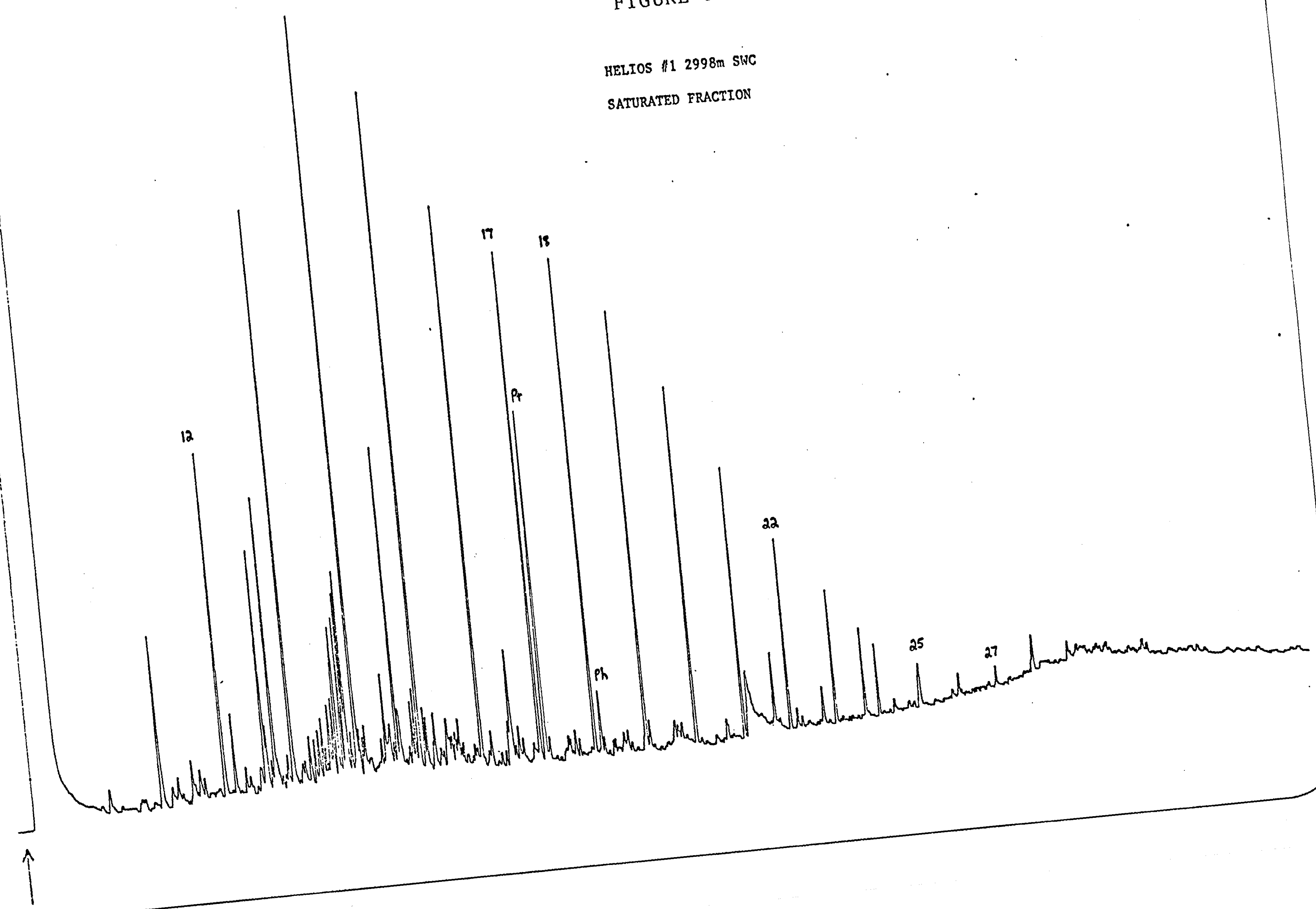


FIGURE 4

HELIOS #1

DIESEL

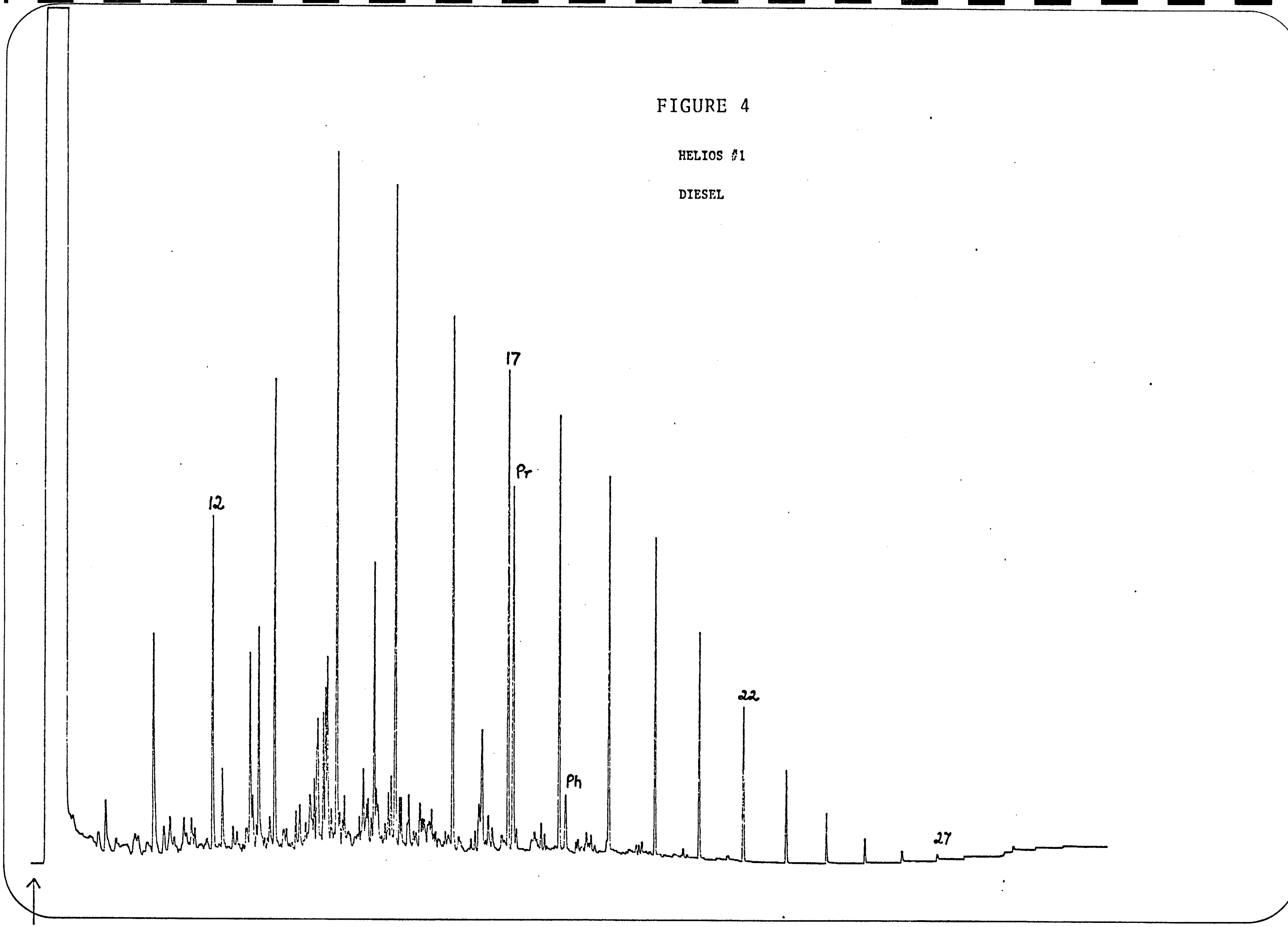
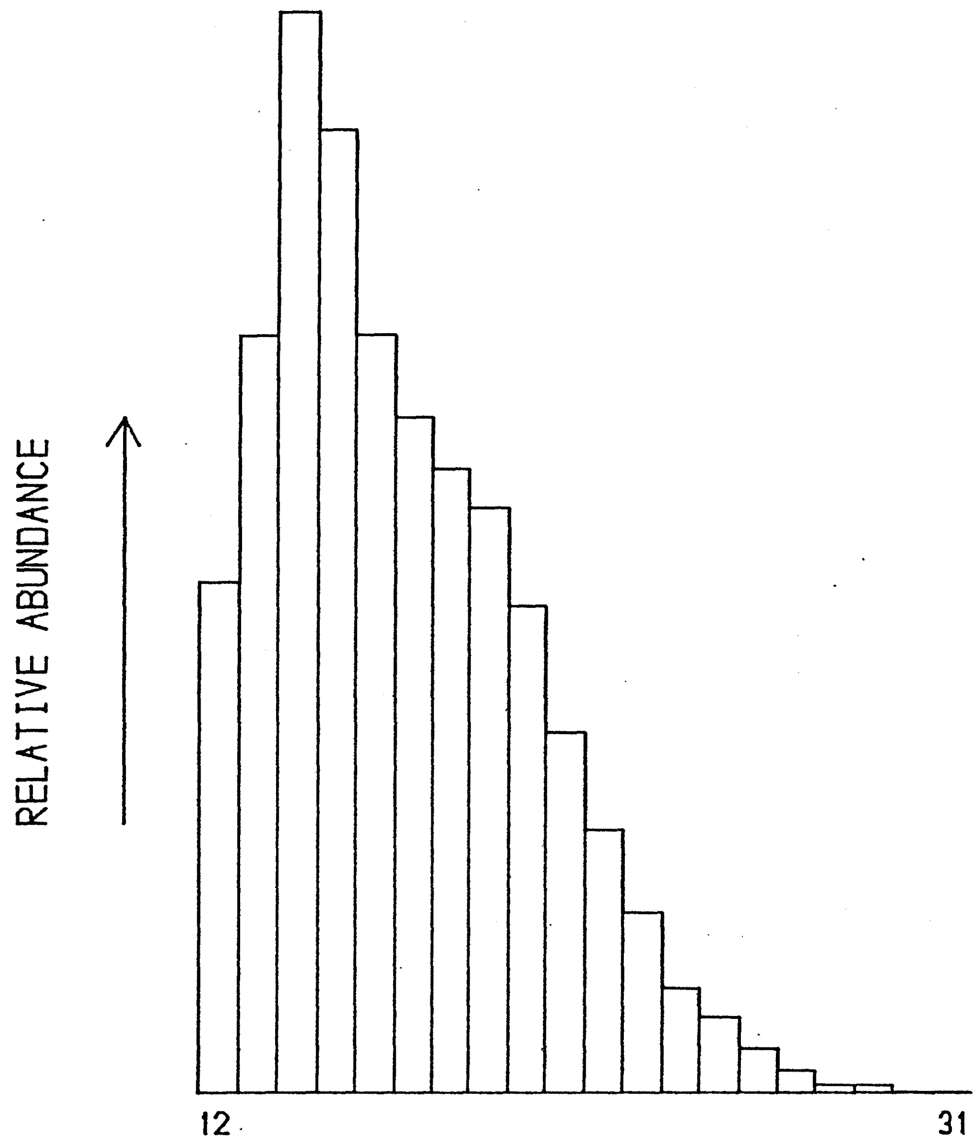
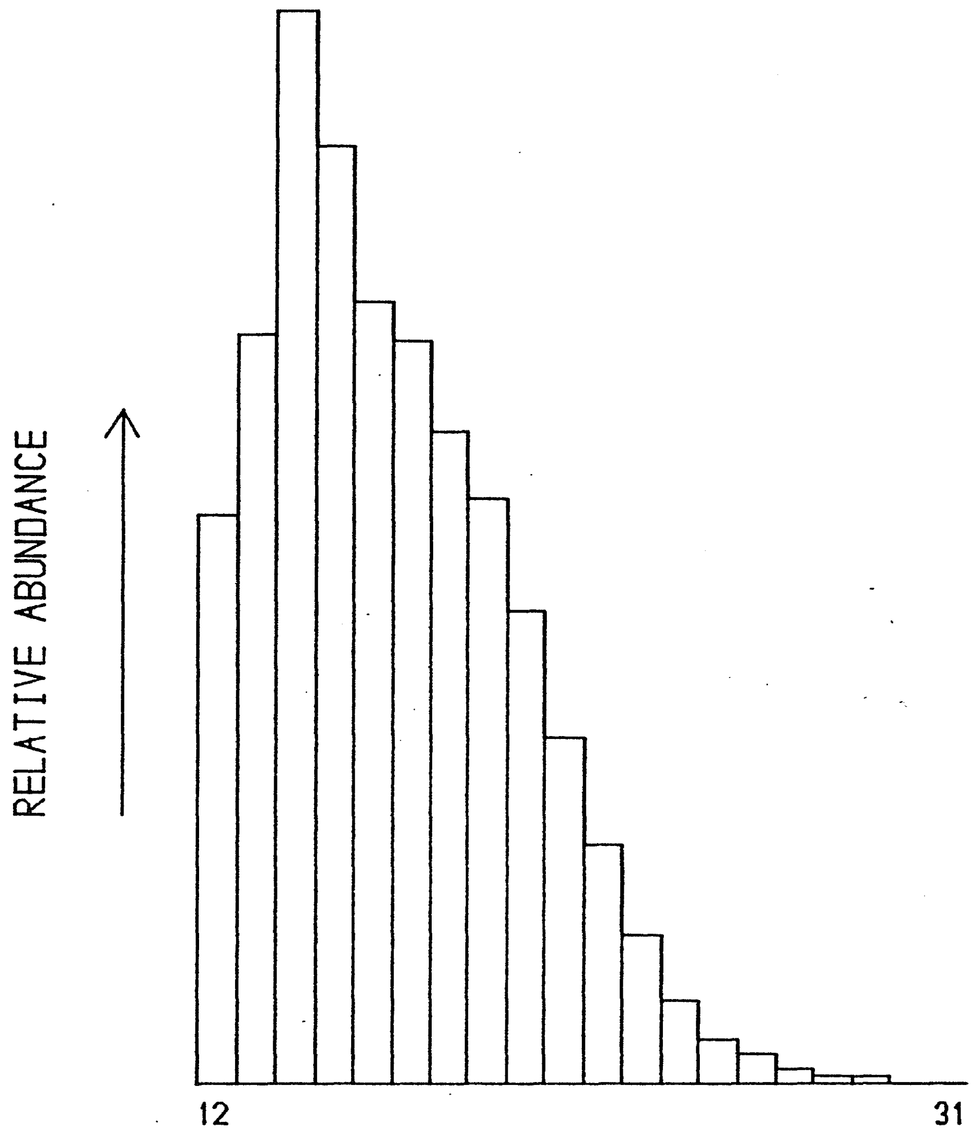


FIGURE 5



HELIOS #1 2998M SWC

FIGURE 6



HELIOS #1 DIESEL

TABLE I

WELLNAME = HELIOS #1

DATE OF JOB = JANUARY, 1983

HEADSPACE ANALYSIS DATA

DEPTH(m)	METHANE	ETHANE	PROPANE	ISOBUTANE	BUTANE	C1-C4	C2-C4	%WETNESS	C5-C7	i-C4/n-C4
2550.0	1731.3	284.2	48.0	14.8	8.8	2087.1	355.8	17.0	15.0	1.67
2560.0	1854.8	312.8	44.5	12.8	7.4	2232.3	377.6	16.9	12.9	1.72
2570.0	557.1	81.9	25.8	9.8	5.2	679.8	122.8	18.1	8.3	1.87
2580.0	720.6	75.8	46.2	18.0	10.9	871.4	150.8	17.3	17.2	1.66
2590.0	402.3	33.7	28.4	11.7	7.1	483.1	80.8	16.7	11.2	1.65
2590.0 Mud	1199.0	40.7	10.9	4.3	3.1	1258.1	59.1	4.7	1.8	1.38
2595.0 Mud	1019.1	25.9	8.9	2.6	2.5	1059.1	40.0	3.8	1.3	1.06
2600.0 Mud	539.3	13.6	4.0	1.2	1.0	558.9	19.7	3.5	0.5	1.17
2610.0	264.4	22.3	23.5	6.5	5.0	321.7	57.3	17.8	6.6	1.30
2620.0	381.7	39.6	49.2	15.0	10.6	496.2	114.5	23.1	14.5	1.41
2640.0	334.8	22.0	23.3	11.2	8.0	399.3	64.5	16.2	10.6	1.39
2650.0	276.0	19.8	29.6	14.3	13.1	352.8	76.8	21.8	13.5	1.09
2660.0	776.0	52.2	58.8	30.6	25.3	942.9	166.9	17.7	35.6	1.21
2670.0	621.8	41.9	47.7	24.5	20.0	755.7	134.0	17.7	26.7	1.23

N.B. 1. GAS CONCENTRATIONS EXPRESSED IN PPM (VOL. GAS/VOL. SEDIMENT)
2. bdl = BELOW DETECTION LIMIT

TABLE II

WELLNAME = HELIOS #1

DATE OF JOB = JANUARY, 1983

ROCK-EVAL PYROLYSIS DATA

DEPTH(m)	TMAX	S1	S2	S3	S1+S2	S2/S3	PI	PC	TOC	HI	OI
3020.0	nd	nd	nd	nd	nd	nd	nd	nd	0.33	nd	nd
3030.0	427	0.26	2.63	0.78	2.89	3.37	0.09	0.24	1.27	207	61
3040.0	427	0.20	1.71	0.66	1.91	2.59	0.10	0.16	0.93	183	70
3050.0	426	0.20	1.57	1.00	1.77	1.57	0.11	0.15	0.91	172	109
3090.0	nd	nd	nd	nd	nd	nd	nd	nd	0.26	nd	nd
3100.0	427	0.10	1.60	0.52	1.70	3.08	0.06	0.14	1.08	148	48
3110.0	428	0.10	1.43	0.67	1.53	2.13	0.07	0.13	1.08	132	62
3120.0	427	0.17	2.24	0.52	2.41	4.31	0.07	0.20	1.58	141	32
3130.0	429	0.14	1.11	1.33	1.25	0.83	0.11	0.10	0.60	184	221
3140.0	427	0.19	4.49	1.01	4.68	4.45	0.04	0.39	2.45	183	41
3150.0	428	0.20	5.15	0.57	5.35	9.04	0.04	0.44	1.81	284	31
3160.0	425	0.07	1.16	1.49	1.23	0.78	0.06	0.10	0.56	207	266
3170.0	425	0.30	6.50	1.08	6.80	6.02	0.04	0.56	2.78	233	38
3180.0	427	0.14	2.81	1.73	2.95	1.62	0.05	0.24	1.22	230	141
3200.0	427	0.34	11.81	1.57	12.15	7.52	0.03	1.01	4.45	265	35
3210.0	423	0.18	6.20	1.75	6.38	3.54	0.03	0.53	2.24	276	78
3220.0	425	0.37	12.76	1.52	13.13	8.39	0.03	1.09	4.73	269	32
3230.0	429	0.15	4.05	1.65	4.20	2.45	0.04	0.35	2.00	202	82
3240.0	430	0.28	5.56	1.71	5.84	3.25	0.05	0.48	2.59	214	66
3250.0	430	0.22	3.83	1.71	4.05	2.24	0.05	0.34	1.99	192	85
3260.0	426	0.22	5.15	1.62	5.37	3.18	0.04	0.45	2.52	204	64
3290.0	426	0.37	7.51	1.37	7.88	5.48	0.05	0.65	3.26	230	42
3350.0	418	0.19	6.07	2.14	6.26	2.84	0.03	0.52	2.19	277	97
3360.0	424	0.53	10.79	2.05	11.32	5.26	0.05	0.94	3.84	280	53
3370.0	422	0.33	6.23	1.46	6.56	4.27	0.05	0.54	2.54	245	57
3380.0	422	1.05	54.06	14.90	55.11	3.63	0.02	4.57	22.03	245	67
3390.0	422	0.33	17.19	2.27	17.52	7.57	0.02	1.45	6.44	266	35
3400.0	423	0.25	8.89	1.92	9.14	4.63	0.03	0.76	3.78	235	50
3410.0	425	0.42	21.94	5.05	22.36	4.34	0.02	1.86	7.65	286	66
3420.0	423	0.37	18.16	1.99	18.53	9.13	0.02	1.54	6.88	263	28
3430.0	420	0.46	11.31	1.97	11.77	5.74	0.04	0.98	4.30	263	45
3440.0	421	0.18	6.90	1.86	7.08	3.71	0.03	0.59	3.33	207	55
3450.0	425	0.31	8.81	1.69	9.12	5.21	0.03	0.76	3.75	234	45
3460.0	424	0.35	13.48	2.81	13.83	4.80	0.03	1.15	4.20	320	66
3470.0	419	0.70	18.41	2.33	19.11	7.90	0.04	1.59	6.25	294	37
3480.0	416	1.03	20.26	3.04	21.29	6.66	0.05	1.77	7.98	253	38
3490.0	423	0.54	17.76	1.78	18.30	9.98	0.03	1.52	6.88	258	25
3500.0	425	0.37	9.64	1.43	10.01	6.74	0.04	0.83	3.41	282	41

TMAX = Max. temperature S2 S1 = Volatile hydrocarbons (HC) S2 = HC generating potential
S1+S2 = Potential yield S3 = Organic carbon dioxide PI = Production index
PC = Pyrolysable carbon TOC = Total organic carbon HI = Hydrogen index OI = Oxygen index

TABLE III

ORGANIC CONTENT OF SEDIMENTS

SAMPLE	%SOM	%TOC	SOM(mg)/TOC(g)	SAT(mg)/TOC(g)	%SaOM
HELIOS #1 2998M SWC	.175	nd	nd	nd	nd

COMPOSITIONAL DATA

SAMPLE	%SAT	%AROM	%NSO	PRIST/PHYT	PRIST/NC17	PHYT/NC18	PAP	AROM/SAT	CPI(1)	CPI(2)	21+22/28+29
HELIOS #1 2998M SWC	nd	nd	nd	5.92	.97	.18	nd	nd	nd	1.17	37.79
HELIOS #1 DIESEL	nd	nd	nd	5.90	1.00	.19	nd	nd	nd	1.15	40.75

N-ALKANE DISTRIBUTIONS

SAMPLE	CN12	CN13	CN14	CN15	CN16	CN17	CN18	CN19	CN20	CN21	CN22	CN23	CN24	CN25	CN26	CN27	CN28	CN29	CN30	CN31
HELIOS #1 2998M SWC	6.8	10.1	14.4	12.8	10.1	9.0	8.3	7.8	6.5	4.8	3.5	2.4	1.4	1.0	0.6	0.3	0.1	0.1	0.0	0.0
HELIOS #1 DIESEL	7.6	10.0	14.3	12.5	10.4	9.9	8.7	7.8	6.3	4.6	3.2	2.0	1.1	0.6	0.4	0.2	0.1	0.1	0.0	0.0

APPENDIX I

THEORY AND METHOD

1. PREPARATION OF SEDIMENT SAMPLES FOR EXTRACTION

The samples provided for geochemical studies are firstly, where necessary, carefully air dried. Then the samples 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. EXTRACTION OF SEDIMENT SAMPLES

Crushed sediment (maximum of 250g) and 320 mls of purified dichloromethane: methanol (10:1) were placed in a 500 ml conical flask. A double surface condenser was fitted to the flask, and the sample was then extracted under the influence of ultra-sonic vibration (60-70^{o}C) using a Buehler Ultramet II sonic bath for 2 hours. The solvent was then separated from the sediment using a large Buchner filtration system. The extract was recovered by careful evaporation of the solvent on a steam bath and weighed. The weight of extract was used to calculate %SOM(UNC) using the following formula:

$$\%SOM(UNC) = \frac{\text{Wt. extract}}{\text{Wt. sediment extracted}} \times \frac{100}{1}$$

3. SEPARATION OF PETROLEUM INTO CONSTITUENT FRACTIONS

The extracts were separated into saturated, aromatic and NSO (asphaltenes plus resins) fractions by column chromatography on silicic acid. The crude extract was applied to the top of a silicic acid column (sample to adsorbent ratio 1:50) and the saturated compounds were eluted with n-pentane, aromatic compounds with a 50:50 mixture of ether and n-pentane, and finally the NSO fraction was eluted with a 20:1 mixture of methanol and dichloromethane. The neat fractions were recovered by careful removal of the solvent by fractional distillation and weighed.

The sum weight of the three fractions was used to calculate the %SOM using the following formula:

$$\%SOM = \frac{\text{Wt. AROM.} + \text{Wt. SAT.} + \text{Wt. NSO}}{\text{Wt. SEDIMENT EXTRACTED}} \times \frac{100}{1}$$

This parameter can be used to assess the suitability of the sediments as source rocks according to the classification shown (later in this section) in the table "Classification of Source Rock Richness".

The weight of saturated compounds was used to calculate the percentage of saturated compounds in the sediment according to the following formula:

$$\%SaOM = \frac{\text{Wt. Saturates}}{\text{Wt. Sediment Extracted}} \times \frac{100}{1}$$

This parameter can be used to assess the suitability of the sediments as oil source rocks according to the classification shown in the table "Classification of Source Rock Richness".

The weight of each fraction was used to calculate the % by weight of each fraction in the extract according to the following formula:

$$\%\ \text{Fraction} = \frac{\text{Wt. Fraction}}{\text{Wt. All Fractions}} \times \frac{100}{1}$$

The composition of the extracts can provide information about their levels of maturity and/or source type (LeTran et al., 1974; Philippi, 1974). Generally, marine extracts have relatively low concentrations of saturated and NSO compounds at low levels of maturity, but these concentrations increase with increased maturation. Terrestrially derived organic matter usually has a low level of saturates and large amount of aromatic and NSO compounds irrespective of the level of maturity.

4. GLC ANALYSIS OF SATURATED COMPOUNDS

Capillary GLC traces were recorded for each saturate fraction. The following information was obtained from these traces:

(a) n-Alkane Distribution - The C_{12}-C_{31} n-alkane distribution was determined from the area under peaks representing each of these n-alkanes. This distribution can yield information about both the level of maturity and the source type (LeTran et al., 1974).

(b) Carbon Preference Index - Two values were determined:

$$CPI(1) = \frac{(C_{23} + C_{25} + C_{27} + C_{29})Wt\% + (C_{25} + C_{27} + C_{29} + C_{31})Wt\%}{2 \times (C_{24} + C_{26} + C_{28} + C_{30})Wt\%}$$

$$CPI(2) = \frac{(C_{23} + C_{25} + C_{27})Wt\% + (C_{25} + C_{27} + C_{29})Wt\%}{2 \times (C_{24} + C_{26} + C_{28})Wt\%}$$

The CPI is believed to be a function of both the level of maturity (Cooper and Bray, 1963; Scalan and Smith, 1970) and the source type (Tissot and Welte, 1978). Marine extracts tend to have values close to 1 irrespective of maturity whereas values for terrestrial extracts decrease with maturity from values as high as 20 but don't usually reach a value of 1.

(c) $C_{21}+C_{22}/C_{28}+C_{29}$ - This parameter provides information about the source of the organic matter (Philippi, 1974). Generally, a terrestrial source gives values <1.2 whereas a marine source results in values >1.5.

(d) Pristane/Phytane Ratio - This value was determined from the areas of peaks representing these compounds. The ratio renders information about the depositional environment according to the following scale (Powell and McKirdy, 1975):

<3.0	Marine depositional environment (i.e. reducing environment)
3.0-4.5	Mixed depositional environment (i.e. reducing/oxidising environment)
>4.5	Terrestrial depositional environment (i.e. oxidising environment)

(e) Pristane/$\underline{n}$-C_{17} Ratio - This ratio was determined from the areas of peaks representing these compounds. The value can provide information about both the source type and the level of maturation (Lijmbach, 1975). Very immature crude oil has a pristane/$\underline{n}$-C_{17} ratio >1.0, irrespective of the source type. However, the following classification can be applied to mature crude oil:

<0.5	Marine source
0.5-1.0	Mixed source
>1.0	Terrestrial source

In the case of sediment extracts these values are significantly higher and the following classification is used:

<1.0	Marine source
1.0-1.5	Mixed source
>1.5	Terrestrial source

(f) Phytane/n-C_{18} Ratio - This ratio was determined from the areas of peaks representing these compounds. The value usually only provides information about the level of maturity of petroleum. The value decreases with increased maturation.

(g) Relative Amounts of n-Alkanes and Naphthenes - Since n-alkanes and naphthenes are the two dominant classes of compounds in the saturate fraction, a semi-quantitative estimate of the relative amounts of these compounds was made. This information can be used to assess the degree of maturation and/or the source type of the petroleum (Philippi, 1974; Tissot and Welte, 1978). Very immature petroleum has only small proportions of n-alkanes, but as maturity increases the relative amount of n-alkanes increases. In addition, terrestrial petroleum has a greater proportion of high molecular weight naphthenes than marine petroleum.

5. 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 $1700^{\circ}C$ (Leco Induction Furnace) in a atmosphere of pure oxygen. The carbon dioxide produced was adsorbed on a "Carbosorb" tower. The weight of carbon dioxide produced was then used to calculate %TOC in the sediment.

6. SOLUBLE/TOTAL ORGANIC CARBON RATIOS

The ratios of SOM(mg)/TOC(g) and SAT(mg)/TOC(g) were determined from the appropriate data. The SOM(mg)/TOC(g) ratio can be used as a maturation indicator, especially if the parameter is plotted against depth for a given sedimentary sequence. In an absolute sense it is less reliable as a maturation indicator, although previous work (Tissot et. al., 1971; LeTran et. al., 1974) suggest that the following criteria can be used to determine maturity with this parameter:

<50	Low maturity
50- 100	Moderate maturity
>100	High maturity

The ratios of SOM(mg)/TOC(g) and SAT(mg)/TOC(g) can be used collectively to provide information about source type. For example, if SOM(mg)/ TOC(g) is >100, suggesting a high level of maturity, but the SAT(mg)/

TOC(g) <20 it is very likely that the organic matter is terrestrial. Conversely, the same SOM(mg)/TOC(g) value with a SAT(mg)/TOC(g) value >40 suggests a marine source type.

7. 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°C for 3 minutes to liberate free petroleum (S_1 peak);

Stage (iii)- Sample heated from 300°C to 550°C at 25°C/minute to produce petroleum from kerogen (S_2 peak). The furnace is maintained at 550°C for one minute. Carbon dioxide produced during this pyrolysis up to 390°C (550°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} = °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 ($[S_2 x100]/TOC$) and oxygen ($[S_3 x100]/TOC$) indices when plotted against one another provide information about the type of kerogen contained in the sample and the maturity of the sample.

8. WHOLE OIL GAS CHROMATOGRAPHIC ANALYSIS

This analysis was carried out under the following conditions: Instrument = Varain Aerograph 2740; coloumn = 25m x 0.2mm I.D. WCOT capillary column with SP2100 stationary phase; temperature program = 2 mins at $-20^{o}C$ then programmed to $280^{o}C$ at $4^{o}C/min$; detector temperature = $310^{o}C$; injector temperature = $300^{o}C$; injection mode 80:1 split; carrier gas = hydrogen at 35 cm/sec.

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APPENDIX NO. 9

BASIC HYDROCARBON SOURCE ROCK POTENTIAL

AND

VITRINITE REFLECTANCE ANALYSIS

January 20, 1983

INTER-OFFICE CORRESPONDENCE / SUBJECT:
BARTLESVILLE, OKLAHOMA

Basic Hydrocarbon Source Rock Potential Analysis of the PPCo Helios No. 1 Well, Gippsland Basin, Offshore Australia.
Charge No. RA4058
EPS Report No. 2442L

BVP-018-83

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

As telexed to your office January 12, 1983, no significant liquid hydrocarbon source rock potential is indicated, at existing well site maturity levels, in 15 sidewall cores submitted for analysis from the captioned well. Two coal samples near TD, however, should have generated and are probably now generating biogenic gas to some degree. Given greater depth of burial, and subsequent higher thermal maturity, several samples would have excellent to secondary source rock potential for oil generation.

This work was requested in N. C. Tallis' letter to H. A. Kuehnert of December 23, 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. Visual kerogen and pyrolysis data on all samples are also included on 2 attached printouts. To better display the data, each sample was assigned a 10 meter thickness with the upper value being the actual sidewall core depth. This display expands the bars on the source rock plot to show the relative abundance of the various kerogen types. Also, our plotting program only recognizes depths to the nearest foot or meter; therefore, the tenths of a meter were dropped. You will notice on the kerogen data printout that 4 vitrinite reflectance values are regarded as questionable. It is believed that the mean values were depressed either from uphole contamination (mudcake in the sample), or some oxidized vitrinite particles were inadvertently read along with the unoxidized vitrinite. Either possibility would lower the mean Ro values.

<u>Interval 1500-2565 meters</u> (7 samples)

No significant hydrocarbon source rock potential is indicated in these samples. Although 4 samples are in the "fair" range of total organic carbon content (TOC), vitrinite reflectance (Ro) and spore coloration index (TAI) indicate that this interval is thermally immature for liquid hydrocarbon generation (see source rock plot and kerogen data). The size of sample 2440 was insufficient for doing all analyses; therefore, visual kerogen was performed, but not TOC nor pyrolysis. All of these samples have dominant abundances (> 50%) of the oil prone kerogens alginite and exinite. However, even where found in peak oil generation phase of thermal maturity (Ro values ±.65 to 1.0) these samples probably would not have significant hydrocarbon source rock potential. Low hydrogen index values (see pyrolysis data) associated with immature oil prone kerogen suggest oxidation of the organics prior to, or during, burial. This event probably destroyed the oil potential.

Interval 2652-3311 meters (6 samples)

No significant hydrocarbon source rock potential is indicated at existing maturity levels of Ro ?.47 to .51. This maturity value is at the marginally earliest stage for oil generation. Given greater depth of burial, however, 3 samples would have significant liquid hydrocarbon source rock potential. Favorable oil prone kerogen content, "rich" TOC levels and higher hydrogen index values indicate that the sample at 3311 meters would have excellent oil source rock potential, the sample at 2965.2 meters might have somewhat less, and the sample from 3167 meters could have secondary source rock potential for oil generation. These source rock estimates would be the potential, that is, where these rocks are found in peak range maturity for oil generation. One other sample, collected at 2652 meters, had favorable organic carbon and visual kerogen characteristics, but pyrolysis (hydrogen index) indicates it was probably subjected to oxidation prior to or during burial which destroyed the kerogen's oil potential.

Interval 3390.5-3481.5 meters (2 samples)

These samples, being essentially coals and only at early stage maturity for oil generation (Ro values of .56 and .54), could only have generated biogenic gas unrelated to thermal alteration. This factor may not be significant, however, because no major gas shows were recorded in this well. Given greater depth of burial and gas phase thermal maturity (Ro values of ±1.3 to 3.0), significant dry gas would be generated from these samples.

D. J. Warwick (LA-A, B'ville) advises that bottom hole formation temperatures in this well are approximately 200°F. This temperature, when considered with our results, indicates that present day temperature is apparently the maximum paleotemperature the rocks have been subjected to. As mentioned in the telex of 1/12/83, these temperature data are compatible with the model of a present day subsiding basin which is progressively carrying potential source rocks into the oil and gas generating thermal regimes. This scenario is discussed by J. D. Saxby, of the CSIRO Fuel Science Unit, Sydney, in the Australian Petroleum Exploration Ass'n. Journal, 1978, who gives an overview of the Gippsland Basin. It appears, however, that the geothermal gradient in Saxby's example (the Kingfish #1 well) is considerably higher than in our Helios well. His "present geothermal gradient of 3.79° centigrade/100 meters" would have a temperature of 200°F (±94°C) occurring at approximately 2000 meters in our Helios well, instead of at 3482 meters as the actual bottom hole formation temperature indicates.

Dennis R. Logan

Approved: E. A. Stanley

DRS/sjv

Attachments

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

PE904991

This is an enclosure indicator page.
The enclosure PE904991 is enclosed within the container PE902616 at this location in this document.

The enclosure PE904991 has the following characteristics:

ITEM_BARCODE = PE904991
CONTAINER_BARCODE = PE902616
NAME = Helios 1 Pyrolysis Data
BASIN = GIPPSLAND
PERMIT = VIC/P18
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Helios 1 Pyrolysis Data. From appendix 9 of WCR volume 1.
REMARKS =
DATE_CREATED =
DATE_RECEIVED = 23/06/83
W_NO = W787
WELL_NAME = Helios-1
CONTRACTOR =
CLIENT_OP_CO = Phillips Australian Oil Company

(Inserted by DNRE - Vic Govt Mines Dept)

PE904992

This is an enclosure indicator page.
The enclosure PE904992 is enclosed within the container PE902616 at this location in this document.

The enclosure PE904992 has the following characteristics:

ITEM_BARCODE =	PE904992
CONTAINER_BARCODE =	PE902616
NAME =	Source Rock Potential
BASIN =	GIPPSLAND
PERMIT =	VIC/P18
TYPE =	WELL
SUBTYPE =	DIAGRAM
DESCRIPTION =	Helios 1 Thermal Alteration and Source Rock Potential. From appendix 9 of WCR volume 1.
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	23/06/83
W_NO =	W787
WELL_NAME =	Helios-1
CONTRACTOR =	
CLIENT_OP_CO =	Phillips Australian Oil Company

(Inserted by DNRE - Vic Govt Mines Dept)

HELIOS #1, OFFSHORE VICTORIA, AUSTRALIA

EPS REPORT # 2442L
TABLE

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		
1500- 1510	0.59	0.090	0.530	0.15	15.3	84.7	SWC	EP83ABI
1700- 1710	0.57	0.100	0.750	0.12	17.5	131.6	SWC	EP83ABJ
1885- 1895	0.64	0.100	0.600	0.14	15.6	93.8	SWC	EP83ABK
2075- 2085	0.57	0.080	0.560	0.12	14.0	98.2	SWC	EP83ABL
2255- 2265	0.43	0.070	0.370	0.16	16.3	86.0	SWC	EP83ABM
2565- 2575	0.41	0.060	0.280	0.18	14.6	68.3	SWC	EP83ABO
2652- 2662	1.64	0.080	0.420	0.16	4.9	25.6	SWC	EP83ABP
2889- 2899	0.75	0.080	0.200	0.29	10.7	26.7	SWC	EP83ABQ
2965- 2975	3.64	0.240	10.780	0.02	6.6	296.2	SWC	EP83ABR
3020- 3030	0.48	0.090	0.400	0.18	18.7	83.3	SWC	EP83ABS
3167- 3177	1.89	0.110	2.920	0.04	5.8	154.5	SWC	EP83ABT
3311- 3321	1.45	0.110	6.290	0.02	7.6	433.8	SWC	EP83ABU
3390- 3400	67.10	5.550	182.110	0.03	8.3	271.4	SWC	EP83ABV
3481- 3491	49.16	5.800	197.160	0.03	11.8	401.1	SWC	EP83ABW

INTERVAL (METERS) TOP	BASE	TYPE	TAI	NORMALIZED TO 100% BY VOLUME (LIQUID PRONE) EXI-NITE	ALGI-NITE	(GAS PRONE) VITRI-NITE	INERTI-NITE	RO MEAN	STND. DEV	MODE	RANGE LOW	RANGE HIGH	NO. OF VIT. READINGS	TOTAL ORGANIC CARBON (WT %)	EXTR ORG MAT (PP
[illegible]	1510.	SW	2	5.	55.	20.	20.	0.44	0.05	0.40	0.35	0.54	28	0.59	
[illegible]	1710.	SW	2	5.	55.	15.	15.	0.47	0.05	0.44	0.39	0.59	37	0.57	
1685.	1695.	SW	2	5.	65.	15.	15.	?0.46	0.04	0.46	0.37	0.55	25	0.64	
[illegible]	[illegible]	SW	2	5.	70.	10.	15.	0.47	0.05	0.46	0.38	0.58	46	0.57	
2255.	2265.	SW	2	10.	60.	15.	15.							0.43	
[illegible]	[illegible]	SW		[illegible]	55.	20.	25.								
2565.	2575.	SW	2	5.	70.	15.	10.							0.41	
2652.	2662.	SW		0.	75.	15.	10.	0.51	0.02	0.53	0.48	0.54	49	1.64	
[illegible]	[illegible]	SW	2+	5.	10.	35.	50.							0.75	
[illegible]	[illegible]	SW	2+	10.	50.	20.	20.	?0.47	0.04	0.48	0.39	0.56	55	3.64	
3020.	3030.	SW	2+	10.	15.	30.	45.	0.51	0.03	0.50	0.44	0.58	92	0.48	
3167.	3177.	SW	2+	15.	35.	25.	25.	?0.48			0.38	0.60	92	1.89	
3311.	3321.	SW	2+	15.	65.	10.	10.	?0.49	0.04	0.50	0.41	0.58	70	1.45	
[illegible]	[illegible]	SW	2+	5.	5.	60.	30.	0.56	0.03	0.54	0.50	0.62	87	67.10	
[illegible]	3491.	SW	2+	5.	20.	45.	30.	0.54	0.03	0.55	0.49	0.49	80	49.16	

TERMINOLOGY USED FOR SOURCE ROCK PLOT

TAI = THERMAL ALTERATION INDEX (SPORE COLOR) (1-2 YELLOW) (2-3 BROWN) (3-4 DARK BROWN) (5 BLACK)
EXINITE = POLLEN AND SPORE EXINE + PLANT CUTICLES + RESINS + OTHER STRONGLY FLUORESCENT ORGANIC MATERIALS + AMORPHOUS HERBACEOUS (IF RECOGNIZABLE AS FROM TERRESTRIAL SOURCE - IF NOT IT IS RECORDED UNDER ALGINITE)
ALGINITE = (ALGAL DEBRIS - CYSTS AND BODIES) + AMORPHOUS SAPROPEL
VITRINITE = WOODY TISSUE (ALTERED TO HUMIC COMPOUNDS) + NONFLUORESCENT STRUCTURED TRANSLUCENT MATERIAL
INERTINITE = COALY MATERIAL INCLUDING FUSINITE, SEMIFUSINITE, PSEUDOVITRINITE, MACRINITE, & INERTODETRINITE
* RATIO = EOM / (1.25 * TOC)

APPENDIX NO. 10

LOG ANALYSIS

Table 1 lists all the wireline logs run in the Helios No. 1. The final Computer Well Log Plot (CPI), computed over the interval 2400 metres to 3500 metres indicates no potential hydrocarbon productive zones (Enclosure 6).

The primary water saturation parameters for this analysis are:

a Rw = 0.065 ohm/m at 93°C (199.4°F),
where "a" is the Formation Resistivity Factor Constant = 1
Cementation Exponent (m) = 1.8 (Sandstones), 2 (Limestones)
Saturation Exponent (n) = 2.0

Very minor residual hydrocarbons are recorded sporadically from 2887 metres to the total depth of the well (3500 metres). Water saturations for these individual zones are in the 80-90% range.

TABLE NO. 1

HELIOS NO. 1 WIRELINE LOGS

TYPE	INTERVAL	SCALE
Suite 1		
DIL-SLS-GR	340m - 1341.5m	1:200, 1:500
Suite 2		
DIL-SLS-NGT	1179m - 2898m	1:200, 1:500
LDT-CNL-GR	2100m - 2898m	1:200, 1:500
HDT	2100m - 2898m	1:200
Suite 3		
DIL-SLS-GR	2800m - 2997m	1:200, 1:500
LDT-CNL-GR	2800m - 2997m	1:200, 1:500
Suite 4		
DIL-SLS-GR	2994m - 3495m	1:200, 1:500
LDT-CNL-GR	2975m - 3499m	1:200, 1:500
HDT	2975m - 3499m	1:200

APPENDIX NO. 11

DIPMETER INTERPRETATION

APPENDIX NO. 11

DIPMETER ANALYSIS, HELIOS NO. 1

The dipmeter was run over the interval 2100 metres to 3499 metres with the exception of a 95-metre interval from 2900 metres and 2995 metres. The dipmeter data include 466 metres of Early Miocene, all of the Early Oligocene, Eocene, Paleocene and 765 metres of the Upper Cretaceous to T.D. Dipmeter analysis of sandstones within the section is useful in determining the main paleocurrent directions of each formation and their respective depositional environments. The units studied are the lower part of Lakes Entrance, Colquhoun, Flounder, and intra-Latrobe Formations.

In order to study the sedimentary dips a correlation interval of 1 metre, step distance of 0.5 metre and search angle of 35 degrees were used. The standard removal of structural dip was not necessary as it remained at less than 2 degrees throughout the sedimentary section at an azimuth from the east-southeast.

The sands used in the dipmeter analysis were those found within the Latrobe Group from 2728.5 metres - 2873.2 metres, 3055.3 metres - 3088.3 metres, and 3090.7 metres - 3500 metres (T.D.).

Polar plots were constructed to display depositional information which is unique for each situation. Three basic types of plots were made, namely, one including all dip values, another plotting dip values greater than or equal to a standard such as 5 degrees, and lastly a plot based on confidence of all dipmeter data. The polar plot which includes all dip values is used to determine the general sedimentary dip direction. The plot which used dip values greater than or equal to a standard determines any trend in larger dip values which may be particularly relevant in fluvio-deltaic environments. Polar plots based on high confidence dipmeter data are used to eliminate data of poor quality which may be misleading or erroneous. Dip azimuths were grouped into 10-degree intervals for plotting purposes.

Polar plots representing the interval 2728.5 metres - 2873.2 metres which includes sands of the stacked beach barrier sequence (Figures 1A, 1B and 1C) indicate sedimentary dips ranging from the northeast to the southeast with strongest dip direction concentrating in an east-south-east direction. Slight bimodality is indicated to the southwest, indicative of some tidal washing as would be expected in lagoonal washover areas. A unit between 2728 metres - 2745 metres is presumed to be a fining-upward sand dune sequence. Directly below the dune and between 2745 metres - 2757 metres is a coarsening-upward barrier bar. The remainder of the sequence is thought to be a series of marine shelf sands or possibly offshore bars. Figure 1C indicates that 77.2 percent of all dips have a confidence level of C or higher (A is best, D is eliminated) which indicates good confidence in the data. The data indicates that Paleocene and Cretaceous sedimentation in this area of the Gippsland Basin was generally from the west with some reworking by a possibly transgressing sea.

The sands of the Upper Cretaceous portion of the Latrobe Group extend from 2735 metres - 3500 metres (T.D.). For purposes of further analysis the sands were divided into units from 3055.3 metres - 3088.3 metres and from 3090.7 metres - 3500 metres (T.D.). There was no dipmeter data for the interval 2900 metres - 2995 metres but through the use of Gamma Ray and the Neutron-Density log data incorporated with lithologic data it is believed that this interval is comprised of stacked beach barrier sands.

The sands between 3055.3 metres - 3088.3 metres are representative of strand plain or possible beach washover deposits. When all dips are plotted (Figure 2A), dipmeter readings indicate a southeast sedimentary dip direction. When dips of 5 degrees or greater are plotted (Figure 2B), they support the sedimentary dip direction being to the southeast. The dipmeter confidence level plot (Figure 2C) indicates that sedimentary dip is to the southeast. The confidence level is 76.3 percent, with A type plots accounting for 60.5 percent. Both are indicative of the data being of good quality.

The final group of sands studied using dipmeter techniques were those penetrated in the paludal deposits between 3090.7 metres - 3500 metres. These sands are generally thin (1 metre - 6 metres), deposited by minor stream systems, and are carbonaceous. There are, however, three relatively massive sand bodies within this section which exceed 10 metres in thickness. These sands are believed to represent point bars or channel lag deposits. Dipmeter results are very good in this sequence of sands and have a confidence level of 89.9 percent (Figure 3C). When all dips are plotted, a random series of dip direction is evident (Figure 3A). Dips which equal or are greater than 5 degrees also exhibit a random dip pattern (Figure 3B), however, the pattern is strongest to the north-northeast. The randomness of the sedimentary dip is attributed to deposition by minor meandering stream systems.

Dipmeter Summary

Dipmeter data, when used with wireline log and lithological information has proved useful in environmental interpretation of the section penetrated in Helios No. 1. The inferred environmental history of Helios No. 1 is as follows:

1) During Campanian time, represented by the interval 3212 metres - 3500 metres the Helios area was dominanted by a minor meandering stream system which flowed over paludal marsh and coal swamp deposits which were dammed behind a beach barrier system (Figure 4B).

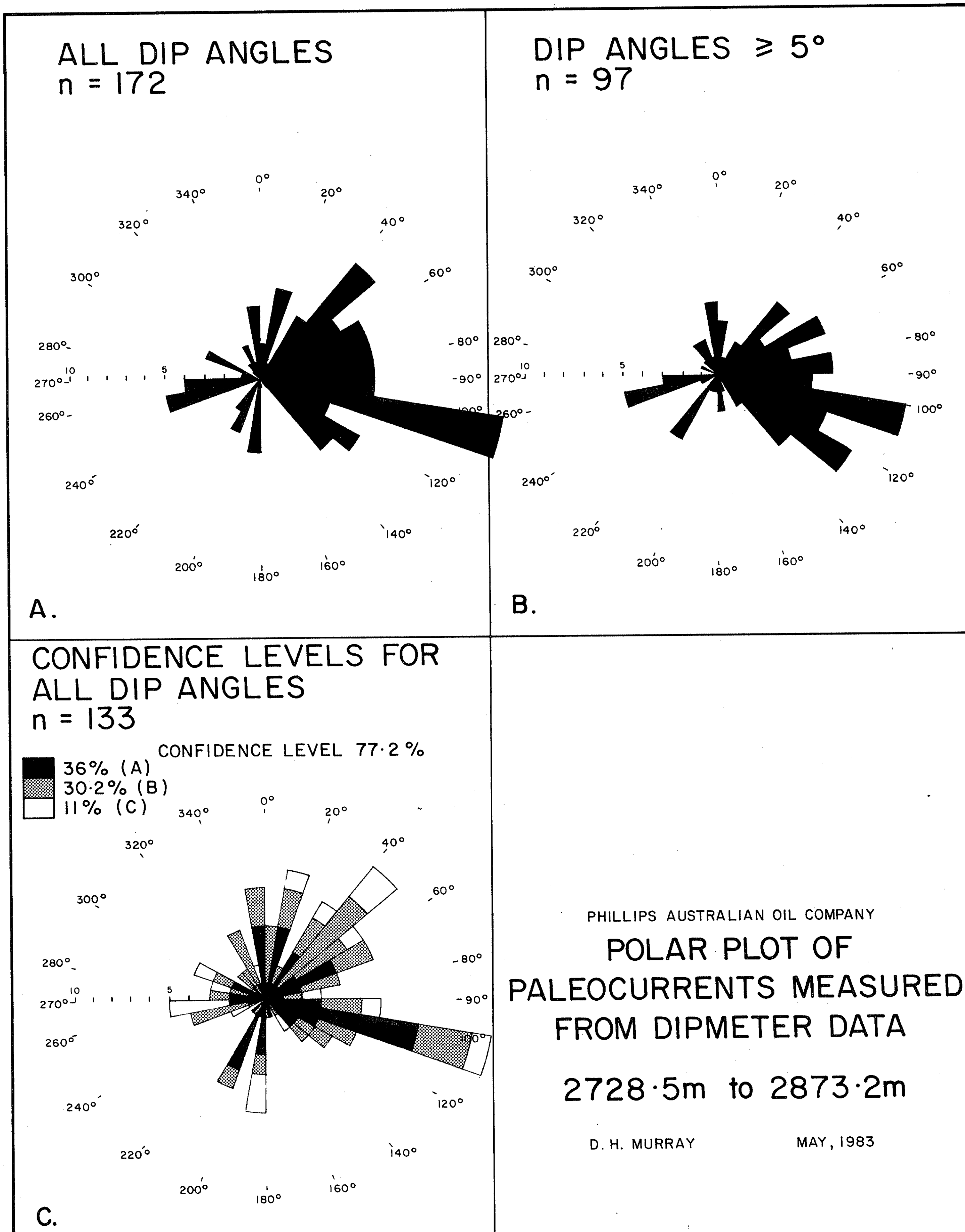
2) Later in the Cretaceous, during Early Maastrichtian time as represented by the interval 2728 metres - 3212 metres, the environment changed from a predominantly paludal system with minor streams to one of strand plain deposits or beach washovers. This change resulted from the onset of a marine transgression. The inferred beach strand line, further seaward, was generally trending from southwest to northeast with sediment supply from the northwest (Figure 4A). Towards the middle of Maastrichtian time with the continuing marine transgression, the stacked beach barrier system replaced the washover zone. Because of the lack of dipmeter data (2900 metres - 2995 metres) representative of this time it is inferred that the stacked beach barrier system continued along a line trending southwest to northeast with the sedimentation flow being southeasterly.

4) Later, during the upper part of the Maastrichtian as represented by the interval 2757 metres - 2900 metres, the environment changed from the stacked beach barrier system to one of offshore marine bars. By this time sedimentation was generally from the west but the sands were being reworked by a continuing transgressive sea (Figure 5).

5) During latest Maastrichtian time and earliest Paleocene time, represented by the interval 2728 metres - 2757 metres, the environment again changed to one with lagoon deposits capped by a regressive system of barrier bars which in turn were capped by a sequence of sand dunes. Sedimentation during this period was primarily from the north-northwest (Figure 5).

6) The seas continued in a regressive pattern as shown by the interval 2659 metres - 2728 metres during which a washover area was developed. This pattern culminated at the top of the Latrobe clastics at 2659 metres.

7) An estuarine facies then developed, represented by the Colquhoun-Flounder Formations from 2580 metres- 2659 metres, replacing the dune system. This was the result of a slight marine transgression into a widening Gippsland Basin with a greatly reduced provenance area, heralding a change from the semi-enclosed paludal-beach environment to an estuarine-tidal system.



PHILLIPS AUSTRALIAN OIL COMPANY

POLAR PLOT OF PALEOCURRENTS MEASURED FROM DIPMETER DATA

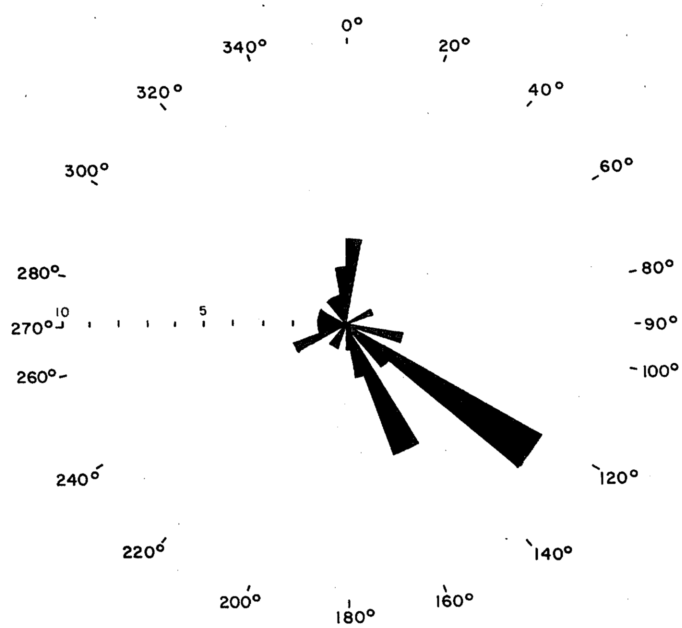
2728·5m to 2873·2m

D. H. MURRAY MAY, 1983

A-5756-3

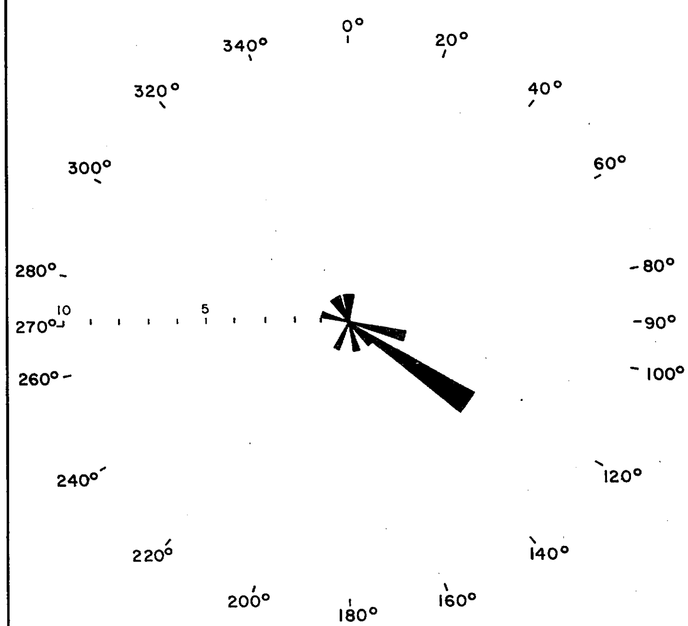
FIGURE 1

ALL DIP ANGLES
n = 38



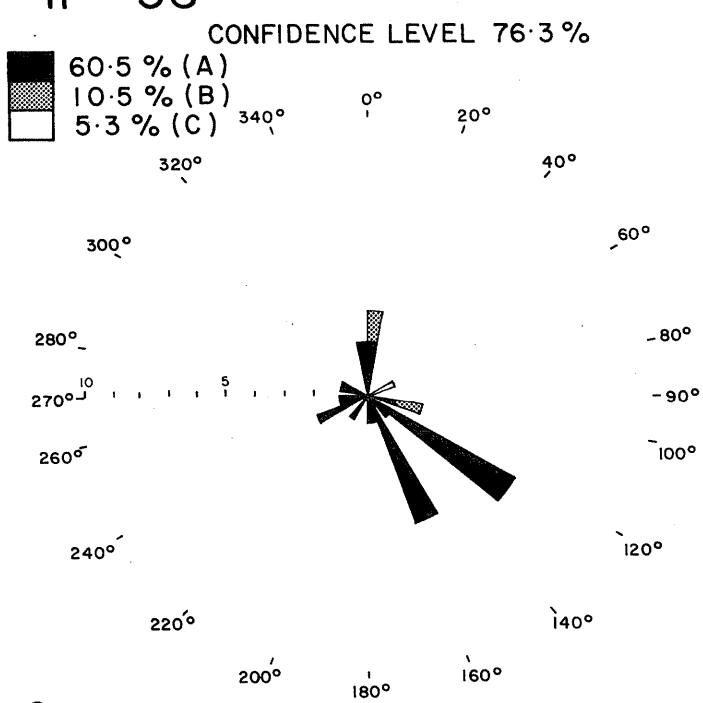
A.

DIP ANGLES ≥ 5°
n = 15



B.

CONFIDENCE LEVELS FOR
ALL DIP ANGLES
n = 38



C.

PHILLIPS AUSTRALIAN OIL COMPANY

POLAR PLOT OF PALEOCURRENTS MEASURED FROM DIPMETER DATA

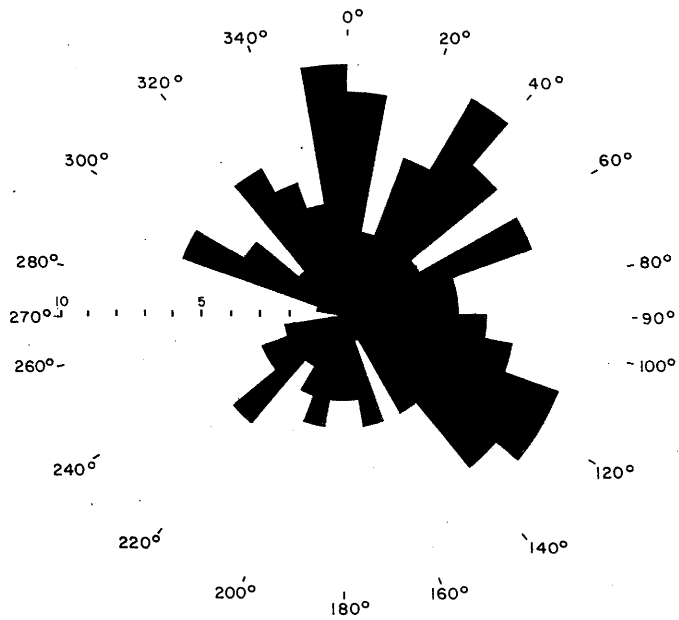
3055·3m to 3088·3m

D. H. MURRAY MAY, 1983

A·5756·4

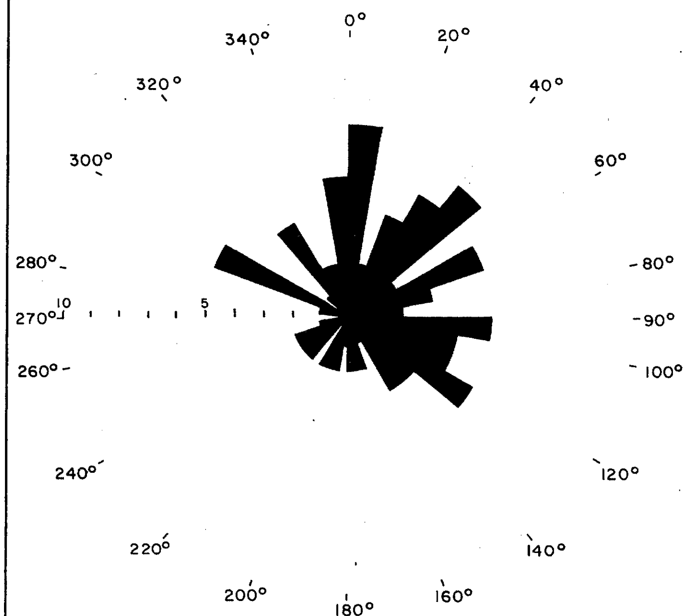
FIGURE 2

ALL DIP ANGLES
n = 159



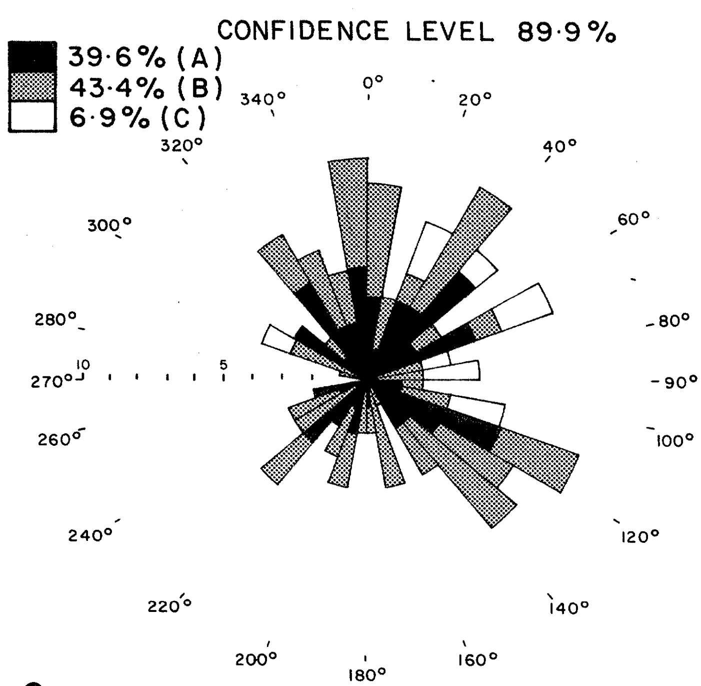
A.

DIP ANGLES ≥ 5°
n = 97



B.

CONFIDENCE LEVELS FOR ALL DIP ANGLES
n = 143



C.

PHILLIPS AUSTRALIAN OIL COMPANY

POLAR PLOT OF PALEOCURRENTS MEASURED FROM DIPMETER DATA

3090·7m to 3500·0m

D. H. MURRAY MAY, 1983

A-5756-5
FIGURE 3

A 17 Figures 4 & 5 to follow.

PE604137

This is an enclosure indicator page.
The enclosure PE604137 is enclosed within the container PE902616 at this location in this document.

The enclosure PE604137 has the following characteristics:

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CONTAINER_BARCODE =	PE902616
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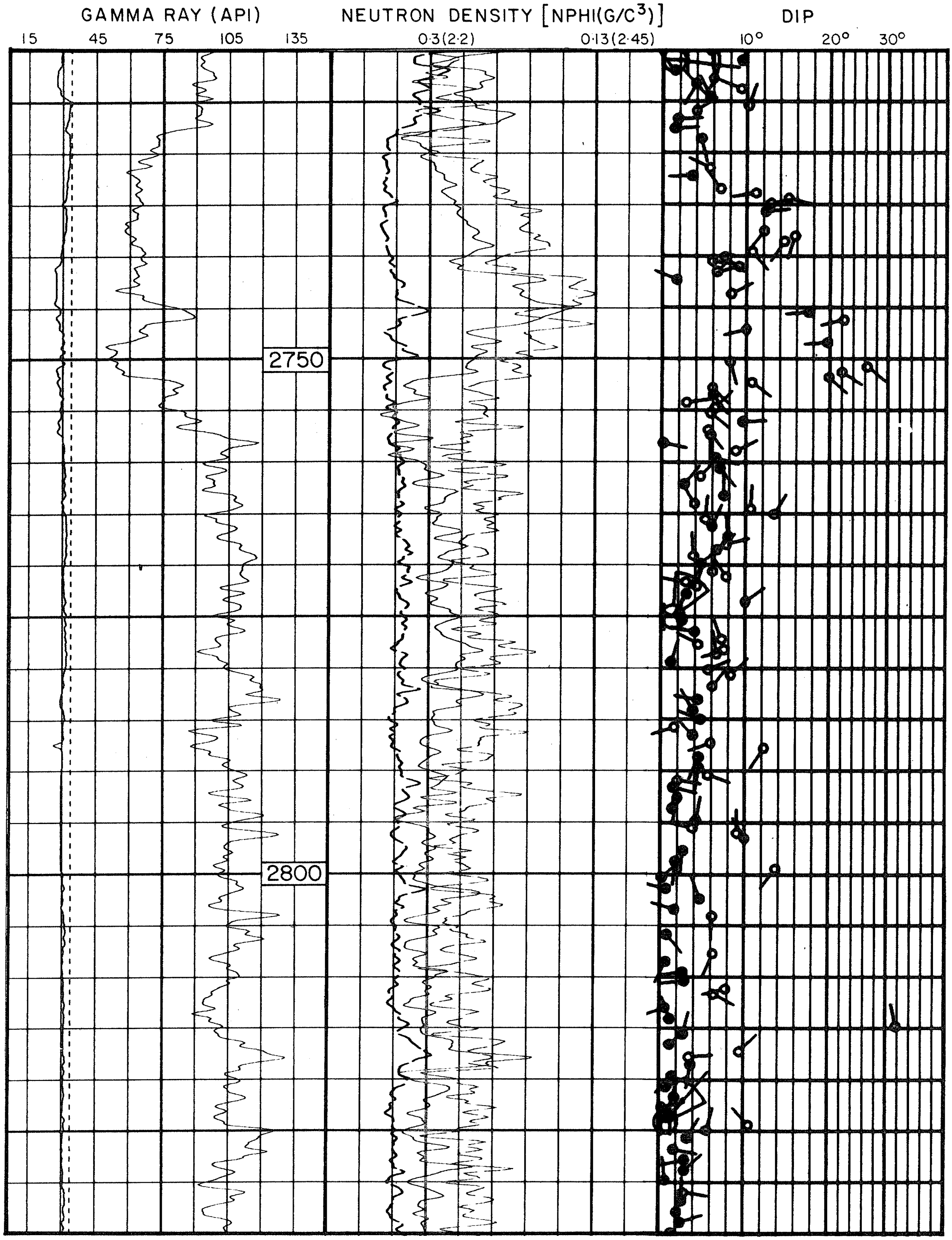
BASIN =	GIPPSLAND
PERMIT =	VIC/P18
TYPE =	WELL
SUBTYPE =	WELL_LOG
DESCRIPTION =	Helios 1 Dipmeter, Gamma Ray Log Shape and Porosity Relationships. Figure 5 from appendix 11 of WCR.
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	23/06/83
W_NO =	W787
WELL_NAME =	Helios-1
CONTRACTOR =	
CLIENT_OP_CO =	Phillips Australian Oil Company

(Inserted by DNRE - Vic Govt Mines Dept)



LATROBE GROUP - MARINE SHELF SANDS WITH BARRIER BAR AND DUNAL SYSTEM

DIPMETER, GAMMA RAY LOG SHAPE AND POROSITY RELATIONSHIPS.

A-5865

FIGURE 5

PE604136

This is an enclosure indicator page.
The enclosure PE604136 is enclosed within the container PE902616 at this location in this document.

The enclosure PE604136 has the following characteristics:

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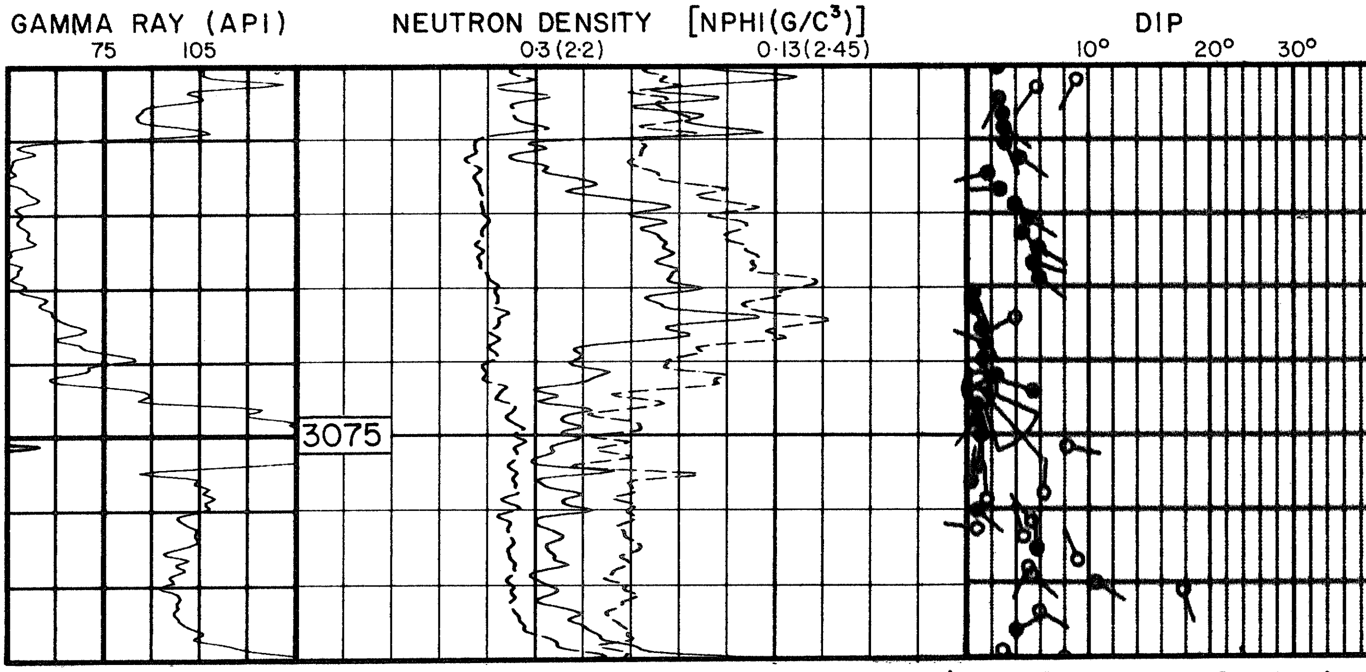
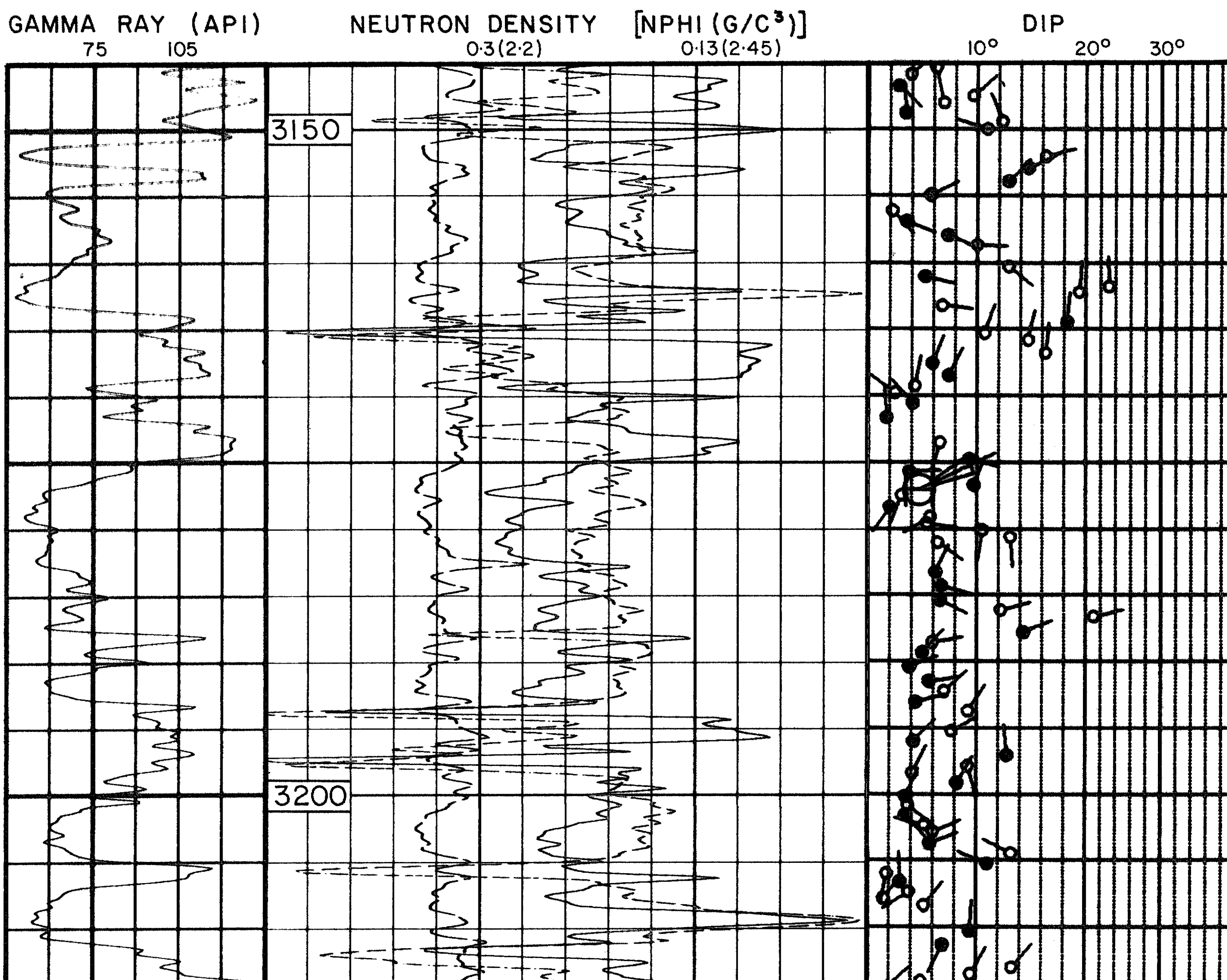
NAME =	Dipmeter, Gamma Ray and Porosity
BASIN =	GIPPSLAND
PERMIT =	VIC/P18
TYPE =	WELL
SUBTYPE =	WELL_LOG
DESCRIPTION =	Helios 1 Dipmeter, Gamma Ray Log Shape and Porosity Relationships. Figure 4 from appendix 11 of WCR.
REMARKS =	
DATE_CREATED =	
DATE_RECEIVED =	23/06/83
W_NO =	W787
WELL_NAME =	Helios-1
CONTRACTOR =	
CLIENT_OP_CO =	Phillips Australian Oil Company

(Inserted by DNRE - Vic Govt Mines Dept)



A. LATROBE GROUP - STRAND PLAIN DEPOSITS (BEACH WASHOVER)



B. LATROBE GROUP - PALUDAL MARSH WITH BEACH BARRIER SYSTEM AND MINOR STREAM SYSTEM

DIPMETER, GAMMA RAY LOG SHAPE AND POROSITY RELATIONSHIPS.

A-5864

FIGURE 4