COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Petroleum Search Subsidy Acts

PUBLICATION No. 76

Esso Gippsland Shelf No. 1 Well

Victoria

OF

ESSO EXPLORATION AUSTRALIA, INC.

Issued under the Authority of the Hon. David Fairbairn

Minister for National Development

1966

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

MINISTER: THE HON. DAVID FAIRBAIRN, D.F.C., M.P.

SECRETARY: R. W. BOSWELL

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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Canberra A.C.T.

FOREWORD

Under the Petroleum Search Subsidy Act 1959-1964, agreements relating to subsidized operations provide that the information obtained may be published by the Commonwealth Government six months after the completion of field work.

The Bureau of Mineral Resources, Geology and Geophysics is required, on behalf of the Department of National Development, to examine the applications, maintain surveillance of the operations, and in due course prepare the reports for publication. The growth of the exploration effort has greatly increased the number of subsidized projects and this increase has led to delays in publishing the results of operations.

The detailed results of subsidized operations may be examined at the office of the Bureau of Mineral Resources in Canberra (after the agreed period) and copies of the reports may be purchased.

Esso Gippsland Shelf No. 1 was drilled under the Petroleum Search Subsidy Act 1959-1964, in Petroleum Exploration Permit No. 38, Victoria. The well is located at latitude 38°16'41" S., longitude 147°42'45"E., about 38 miles east-south-east of Sale, in the Gippsland Basin, off the south-eastern coast of Victoria. It was Australia's first offshore well, and was drilled for Esso Exploration Australia, Inc., by Global Marine Australasia Pty Ltd, using the floating drilling rig Glomar III.

This Publication deals with the results of this drilling operation, and contains information furnished by Esso Exploration Australia, Inc., and edited in the Petroleum Exploration Branch of the Bureau of Mineral Resources. The final report was written by Esso Exploration Australia, Inc., in September, 1965. The methods employed in the drilling operation and the results obtained are presented in detail.

J. M. RAYNER
DIRECTOR

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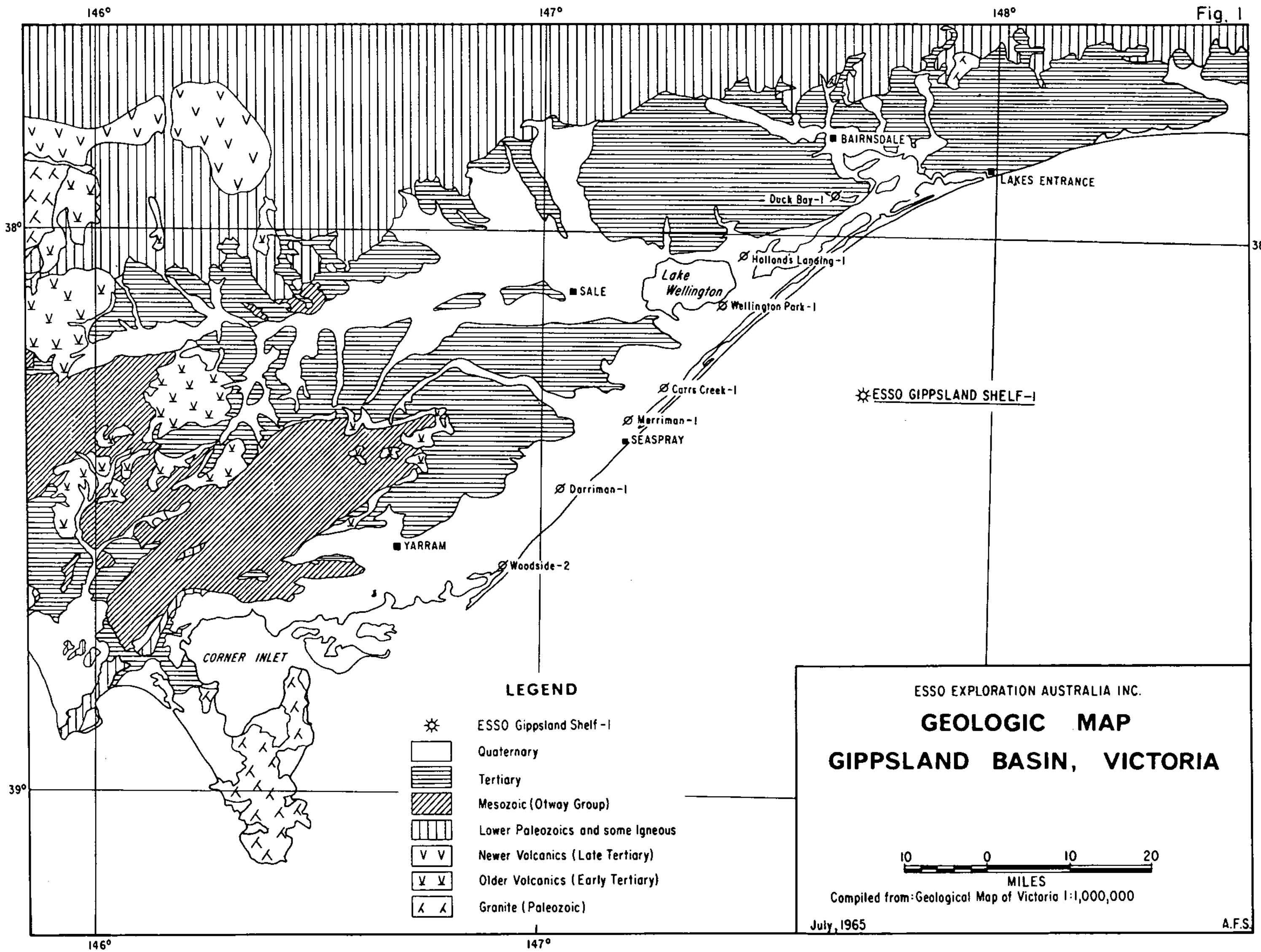


ESSO EXPLORATION AUSTRALIA INC.

GEOLOGIC MAP
GIPPSLAND BASIN, VICTORIA

Compiled from: Geological Map of Victoria 1:1,000,000

July, 1965

A.F.S.

SUMMARY

Esso Gippsland Shelf No. 1, Australia's first offshore well, was drilled by Esso Exploration Australia, Inc., in the Gippsland Basin, about sixteen miles off the Ninety Mile Beach, south-eastern Victoria.

Gippsland Shelf No. 1 was spudded on 27th December, 1964, reached a total depth of 8701 feet on 31st May, 1965, and was completed as a suspended gas well on 5th June, 1965. The 268-foot drilling vessel "Glomar III" owned and operated by Global Marine Australasia Pty Ltd was used to drill the well.

The well penetrated a Tertiary section to 5378 feet and an Upper Cretaceous section from 5378 feet to 8701 feet, total depth. 353 feet of gas column was logged in the top of the Eocene Latrobe Valley Coal Measures, which proved to be productive by subsequent tests. Minor hydrocarbon shows in the Upper Cretaceous section are considered to be non-commercial.

Three production tests were made through perforations opposite sandstones in the Latrobe Valley Coal Measures; one to confirm the gas-water contact and two for reservoir evaluation. On the first and lowermost test from 3809 to 3814 feet the well flowed gas at the maximum rate of 1.63 MMcf/D and fresh water at the rate of 750 barrels a day. On the other tests the maximum flow rates were 6.85 MMcf/D plus 75 barrels of consensate a day, and 5.36 MMcf/D plus 79 barrels of condensate a day.

The well was the first offshore discovery in Australia, and gave the first significant production from the Latrobe Valley Coal Measures. It was also the first occurrence of a porous sandstone member in the Gippsland Limestone; the first occurrence of porous sandstone members in the Upper Cretaceous section; and the first occurrence of a Mesozoic section younger than the Strzelecki Group in the Gippsland Basin.

A new and unknown sandstone section some 369 feet thick was encountered in the lower part of the Gippsland Limestone. The areal extent of this section is as yet unknown. Otherwise the lithology of the Tertiary sequence was as expected.

The stratigraphic drilling operation at Esso Gippsland Shelf No. 1 was subidized under the Petroleum Search Subsidy Act 1959-1964, from surface to total depth.

INTRODUCTION

Esso Gippsland Shelf No. 1 was drilled near the crest of a closed anticline mapped from seismic data. The objectives were to ascertain the stratigraphy and to test any prospective reservoirs on the structure.

Expected stratigraphy and structure within the Cretaceous section was not as predictable from seismic work as was the Tertiary section. Therefore, a further objective was to obtain stratigraphic and structural information, and to evaluate the petroleum possibilities of this Cretaceous section.

WELL HISTORY

General Data

Well name and number:	Esso Gippsland Shelf No. 1
Name and address of Operator:	Esso Exploration Australia, Inc., 280 George Street, SYDNEY, N.S.W.
Name and address of Tenement Holder:	Haematite Explorations Pty Ltd, 500 Bourke Street, MELBOURNE, VICTORIA
Details of Petroleum Tenement:	Petroleum Exploration Permit No. 38 issued by the State of Victoria and covering an area of 4450 square miles. Subsequent farm-in by Esso Exploration Australia, Inc. from Haematite Explorations Pty Ltd
District:	Offshore Gippsland, Eastern Victoria waters; Sale 4-mile Sheet
Location:	Latitude $38^{o}16'41''$S. Longitude $147^{o}42'45''$E.
Elevation:	Permanent Datum: Mean Sea Level Rotary Table: 31 feet above sea level (datum for depths)
Total Depth:	8701 feet (water depth 148 feet)
Date drilling commenced:	27th December, 1964
Date drilling completed:	31st May, 1965
Date well suspended:	5th June, 1965
Date rig released:	5th June, 1965

Drilling time to total depth:	154 days
Status:	Suspended gas well
Total Cost:	£1,188,189

Drilling Data

Name and address of Drilling Contractor:	Global Marine Australasia Pty Ltd, 360 Lonsdale Street, MELBOURNE, VICTORIA
Drilling Plant:	
Make:	National
Type:	1625 DE
Rated capacity:	20,000 feet with 5" drill pipe
Motors:	Cummins VT-12-GA-30 for electric power
Derrick:	136' x 58' x 34' special design, galvanized, 1,000,000 lb. hookload capacity
Pumps:	
Make:	National
Type:	G-1000-C Duplex (2)
Size:	7 3/4" x 16"
Motors:	Dual electric independent drives from above motors

BOP Equipment:

Make:	Hydril	Hydril	Cameron Triple U
Size:	20" (MSP)	13 5/8" (GK)	13 5/8"
Working Pressure (psi):	12,000	5000	5000

Hole sizes and depths (related to RT):

36"	to	302 feet
26"	to	741 feet
17 1/2"	to	3017 feet
12 1/4"	to	6109 feet
8 1/2"	to	8678 feet
7 3/4"	to	8701 feet

Casing and cementing details:

Size (in.):	30	20	13 3/8	9 5/8
Weight (lb./ft):	310/196	104/167	54	36/40/47
Grade:	B	B	J-55 Butt	J-55 & N-80
Range:	3	3	3	3
Setting depth (ft):	284	687	2974	6081

Location of shoe, collar, centralisers (ft):	Shoe 284	Shoe 687 Collar 685 Angle Iron Centralisers at: 218, 243	Shoe 2974 Collar 2895 Centralisers at: 2778 2855 2959 2934	Shoe 6081 Collar 6011 Centralisers at: 923, 963 1004, 1046 1084, 3433 3471, 3514 3556, 3596 3637, 3680 3719, 3798 3839, 5881 6041, 6060
Cement (sacks):	440 + 2% Cal. Chloride	1200 + 2% Cal. Chloride	2600	800 + 8% Gel + 0.3% HR-4
Cemented to:	Ocean floor	Ocean floor	Ocean floor	3244' (Bond log)
Method used:	Displacement through DP	Displacement through DP	Two-plug displacement	Two-plug displacement

Drilling Mud:

Salt water with returns to ocean floor was used to drill to 741 feet before setting 20" casing. The remainder of the hole was drilled with a fresh water, Spersene, XP-20, Bentonite, mud with Caustic Soda used for pH control and barytes for weight material.

Mud and Chemicals used:

Item	Pounds	Item	Pounds
Magcophos	1,800	Magcogel	50,000
CausticSoda	24,416	Volclay	36,800
C.M.C.	750	Aquagel	209,500
Fine Nut Plug	3,250	Spersene	50,550
Halliburton Halad Containers	100	Chipseal	1,480
Halliburton CFR	100	Fibreseal	1,380
Salt Gel	33,600	Coarse Nut Plug	2,000
Magobar Barytes	412,400	Medium Nut Plug	3,250
Local Barytes	149,800	Anhydrous $CaCl_2$	800
XP-20	26,650	Halliburton HR-4 Retarder	909

Weekly properties while drilling are summarized in the following table:

DRILLING MUD PROPERTIES

	Jan. 10 Jan. 16	Jan. 17 Jan. 23	Jan. 24 Jan. 30	Jan. 31 Feb. 6	Feb. 7 Feb. 13	Feb. 14 Feb. 20	Feb. 28 Mar. 6	Mar. 7 Mar. 13	Mar. 14 Mar. 20	Mar. 21 Mar. 27	Apr. 25 May 1	May 2 May 8	May 9 May 15	May 16 May 22	May 23 May 29	May 30 June 5
Wt/Gal.	9.4	9.5	9.7	10.0	9.9	9.7	12.1	12.1	11.6	11.5	11.3	11.1	11.3	11.3	11.3	11.1
Viscosity	42	43	45	52	55	40	50	53	55	53	50	42	40	45	43	41
F.L.	12.0	13.0	11.0	10.0	12.5	11.0	4.5	5.2	5.5	5.4	5.0	9.0	10.0	4.5	3.7	4.3
Filter Cake	2/32	2/32	2/32	2/32	2/32	2/32	2/32	3/32	2/32	2/32	2/32	2/32	3/32	2/32	2/32	2/32
% Sand		3/4	1	1	1/2	1	1/2	2	1	1		1/2	1/4	1/2	1/2	1/3
% Solids		10	12	13	8	6	10	14	15.5	16		11	9.5	13	13	14
pH	9.5	8.0	9.0	9.2	8.5	7.8	10.8	11.8	10.6	10.7	11.1	12.0	12.3	12.7	10.7	10.8
NaCl	5000	6100	6700	9000	9500	9200	4450	4620	3750	3350	4300	5150	5200	4100	4200	5450
App. Vis.		22	19	24	24	15	33	38	41	27	36	19	19	27	25	19
Plas. Vis.		15	18	16	19	13	32	34	40	25	34	19	18	26	24	19
Yield		12	9	16	17	10	4	9	4	4	3	0	1	1	1	0
Init. Gel.		12	7	9	10	9	4	4	3.7	4.5	2	3	3	3	3	3
10 min Gel.		26	35	43	32	30	5	6.5	6	7	4	9	4	6	5	4
Rmf & Temp		0.55 at 67°F.			0.55 at 66°F.	0.55 at 78°F.				1.0 at 60°F.				0.55 at 66°F.	0.63 at 70°F.	0.77 at 65°F.
Cal.				180	160	200	200	180	188	153	240	300	220	170	220	240
Alk.				0.15			0.5	0.8	0.32	0.38	0.5	0.3	0.6	0.6	0.2	0.0

Water Supply: Fresh drilling water was transported to the "Glomar III" by the M/V Point Coupee from Port Welshpool. Salinity of this water was less than 700-800 ppm. chloride.

Perforation Record: Three zones were perforated for production testing through 9-5/8" casing. The zones perforated were 3492-3497, 3752-3756, and 3809-3814 feet. Schlumberger Magnajets 1-11/16" through-tubing guns were used at a perforation density of one shot per foot.

Plugs:						
	Depth(ft):	8497-8697	6620-6820	5980-6180	3350-3820	205-330
	Cement (sacks):	70+4%HR4	70+4%HR4	80+4%HR4	190+2% Calcium Chloride	50+2% Calcium Chloride
	Checked:	No	No	No	Yes, with 40,000 lb.	Yes

Fishing Operations: While cutting Core No. 11 (4346 to 4351 feet) the well came in blowing gas. The 13-5/8" GK Hydril, Upper Cameron Iron Works Pipe Rams, and Lower Pipe Rams were closed and a weighted mud pumped: these measures failed to control the gas flow. The Blind Rams were closed on the drill pipe which was then pulled apart. Next the well was cemented through the Kill Line. Later, sea water and gel mud were pumped through the Kill Line. Another cement squeeze was performed through the Choke Line. Fish left in the hole included 130 joints of 5" drill pipe; two 7-3/4"OD. Bumper Subs, and sub; three 7-3/4"OD. drill collars, and sub; 65' x 6-3/4"OD. Christensen core barrel and drag bit. Top of the fish was located 174 feet below the rotary table. A 13-3/8" Baker Model "C" Retrievable Bridge Plug was set on top of fish.

The 16" Marine Conductor and 13-5/8" BOP stack were pulled to the surface and reconditioned. Necessary repairs were made to the rig. The equipment was rerun; landed on the casing-head near the ocean floor, and tested; the Retrievable Bridge Plug was then pulled. The blowout preventers were tested on the ocean floor with a retrievable test tool.

A rotary shoe was used to dress the top of the fish at 174 feet. A Bowen overshot would not engage the 5" drill pipe on the first trip and the fish required additional dressing with a rotary shoe. Schlumberger sinker bars would not pass the top of the fish. The fishing string was backed off one joint above the overshot, pulled to the surface, and strap welded. The fishing string was then screwed into the fish and the top joint and 52 joints of drill pipe backed off.

Open-end drill pipe was run to the top of the fish and mud was circulated. The drill pipe was screwed into the fish and Schlumberger sinker bars run to 4263 feet. A free point indicator was run and indicated pipe to be free to 4250 feet. A string shot was used to back off the fish at 2710 feet. The mud system was then circulated and conditioned and the drill pipe was again screwed into the fish. Another string shot was run and the fish backed off at 2925 feet. Thirty-seven joints of drill pipe were recovered.

A fishing string of 5" drill pipe, two Bumper Subs, J-Joint, and 15 joints of 7-5/8" wash pipe and rotary shoe was then run. A bridge was encountered at 2735 feet and the fish washed over to 3549 feet. A back-off shot was then run to 3525 feet and the fish backed off: 20 joints of 5" drill pipe were recovered. The mud was then circulated and conditioned.

The fish was washed over from 3525 to 3867 feet and the mud circulated and conditioned with the same string as described above. After washing over to 4131 feet, mud was lost. This operation was temporarily suspended because of the weather.

When the weather improved the fishing string was picked up and run in the hole and washed over the fish to 4155 feet. Lost circulation material was added to the mud system. After an unsuccessful attempt to engage the J-Joint, the string was pulled to the surface.

A fishing string composed of a 7-7/8" x 6 1/4" Bowen Overshot, two Bumper Subs, and 5" drill pipe was strap welded. This was run to the top of fish at 3535 feet. A string shot was used to back-off at 4051 feet. A 12 1/4" bit was run in the hole to 3187 feet where cement was encountered; the hole was reamed to 4051 feet (the top of the 5" drill pipe fish). After conditioning the mud, the string was pulled to the surface.

Another fishing string consisting of a 9-5/8" rotary shoe, six joints 9-5/8" wash pipe, 9-5/8" control bushing, two joints 9-5/8" wash pipe, safety joint, washover spear and J-Joint, and 5" drill pipe was made up and washed over fish to 4347 feet. The pipe was worked and pulled free. The fish recovered included three joints of 5" drill pipe, two 7-3/4" OD. Bumper Subs, sub, one 7-3/4" OD. drill collar, stabilizer, two 7-3/4" OD. drill collars, sub, and 65-foot core assembly. A 12-1/4" bit was then run to bottom of the original hole and the mud conditioned for further drilling. All fish previously left in the hole was recovered.

Side-Tracked Hole: Nil

Logging and Testing

Ditch Cuttings: Cuttings were taken over a normal shale shaker at ten-foot intervals while drilling and five-foot intervals while coring. All samples were logged and caught by the mud logging personnel under the supervision of Esso geologists and are representative of the labelled depth. Representative suites of cuttings are stored with the BMR, the Victorian Mines Department, and with Esso in Melbourne.

Coring: The original coring programme was for cores to be taken at major formation changes, significant shows of oil and gas, and at 500-foot intervals in accordance with the requirements of the BMR. In general, this was carried out. Routine coring requirements were waived by the BMR because of uniform lithology.

A total of twenty-one cores, tabulated below, was cut in the well, for a total footage of 476 feet. Recovery was 260.5 feet. Christensen coring equipment was used exclusively with both drag type and diamond core bits.

Core No.	Interval Cored (feet)	Feet Cut	Recovery (feet)	Recovery (%)
1	1000-1028	28	14	50
2	1501-1528	27	10	37
3	2024-2037	13	5	38
4	2326-2352	26	21	81
5	2630-2655	25	23	92
6	2876-2896	20	10	50
7	3020-3050	30	9	30
8	3342-3385.5	43.5	7	16
9	3465-3513	48	2	4
10	3800-3825	25	Nil	0
11	4346-4351	5	2	40
12	4740-4760	20	12	60

Core No.	Interval Cored (feet)	Feet Cut	Recovery (feet)	Recovery (%)
(Continued)				
13	5256-5274	18	15	83
14	5656-5685	29	29	100
15	6124-6139	15	2	11
16	6447-6460.5	13.5	13.5	100
17	6747-6773	26	23	88
18	7233-7251	18	18	100
19	7708-7731	23	23	100
20	8678-8693	15	15	100
21	8693-8701	8	7	88

Representative pieces of these cores are stored with the BMR, the Victorian Mines Department, and Esso in Melbourne.

Detailed lithological descriptions of each core are given in Appendix 1.

Sidewall Sampling: One run for sidewall cores was attempted using Schlumberger C.S.T. equipment. A total of 16 cores was attempted but only three samples recovered; at 3760, 5836 and 6015 feet. This poor recovery was due to the loose nature of the sands. These sidewall cores were used for core analyses.

Electrical and other logging: Wire line logging was carried out by Schlumberger Seaco Inc. The following logs were run:

Induction Electrical Log	687 to 8690 ft (6 runs)
Sonic-Gamma Ray-Caliper Log	688 to 8685 ft (6 runs)
Microlaterolog	688 to 8700 ft (6 runs)
Laterolog	2974 to 8699 ft (2 runs)
Continuous Dipmeter	688 to 8685 ft (4 runs)
Cement Bond Log	2604 to 5988 ft (2 runs)
Gamma Ray-Collar Locator	3000 to 5997 ft (1 run)

A specially designed device was used in the majority of log runs to compensate for movement of the vessel while logging.

Penetration Rate Log:	A Drilling Time Log is included as part of the Composite Well Log, and also as part of Appendix 7.
Gas Log:	In addition to the continuous hot wire mud gas recorder, a chromatograph was used to detail mud gas shows. Cuttings gas was measured in a Waring blender and recorder. The cuttings were examined for stain and fluorescence. The gas log is included as part of the Composite Well Log and also as part of Appendix 7.
Formation Testing:	No conventional drillstem tests were run. See below for production tests.
Deviation Surveys:	These surveys were carried out with a Totco instrument and results are plotted on the Composite Well Log. The well had little deviation to 7200 feet, increased to 5-1/4° at 7625 feet, and was at 2-3/4° at total depth. Schlumberger deviation recordings taken in conjunction with the Dipmeter Survey indicated that no doglegs were present.
Temperature Survey:	No temperature logs were run. A Cement Bond Log was used for casing cement bonding and cement top.
Velocity Survey:	A velocity survey was run on 22nd May, 1965, by Western Geophysical Company. Results are included in Appendix 9.
Other Well Surveys:	Nil
Production Testing:	Three intervals opposite the gas-bearing sandstone within the Latrobe Valley Coal Measures were production tested through perforations and various chokes with the following results:

Zone No. 1: Perforations from 3809 to 3814 feet with one jet shot per foot.

Flow Period	Time	Choke (in.)	Rate (MMcf/D)	Surface Flow Pressure (psig.)	Fluid (BPD)
1	1 hr 55 min.	1/8	0.69	1050	345 water
2	2 hr 35 min.	32.5/64	1.63	670	750 water

Extrapolated bottom hole pressure at 3810 feet was 1693 psi.

Zone No. 2: Perforations from 3752 to 3756 feet with one jet shot per foot.

Flow Period	Time	Choke (in.)	Rate (MMcf/D)	Surface Flow Pressure (psig.)	Fluid (BPD)
1	1 hr 02 min.	16/64	0.96	1350	17.0 cond.
2	1 hr 05 min.	20/64	2.475	1140	68.0 cond.
3	1 hr 02 min.	16/64	2.54	1340	48.7 cond.
4	1 hr 25 min.	18/64	3.67	1090	75.0 cond.
5	1 hr 17 min.	22/64	4.87	920	74.0 cond.
6	2 hr 48 min.	28/64	6.85	850	73.5 cond.

Extrapolated bottom hole pressure at 3750 feet was 1642 psi.

Zone No. 3: Perforations from 3492 to 3497 feet with one jet shot per foot.

Flow Period	Time	Choke (in.)	Rate (MMcf/D)	Surface Flow Pressure (psig.)	Fluid (BPD)
1	2 hr 45 min.	3/8	3.77	1200	57.6 cond.
2	1 hr 21 min.	3/16	0.985	1480	16.0 cond.
3	1 hr 51 min.	3/8	3.86	1318	34.1 cond.
4	2 hr 48 min.	30.5/64	5.36	1075	79.4 cond.
5	2 hr 24 min.	26.5/64	4.92	1228	50.3 cond.

Extrapolated bottom hole pressure at 3350 feet was 1652 psi.

The first flow period of each zone represents the clean-up period.

The API gravity of the condensate ranged from 65.8^{o} to 81.4^{o} from all tests.

Further details of production tests are given in Appendix 10.

GEOLOGY

History of Exploration

Geological and Drilling:

Onshore, exploration for various minerals, especially coal, has been going on in this region for about a century. In 1886, one bore was drilled to 224 feet for gold. Over 60 coal bores from 200 to 2100 feet deep have been drilled in the area. Many shallow water wells, and about half a dozen deep ones, ranging from 1300 to 2000 feet deep, have been drilled.

Since 1924, about 100 test wells have been drilled in the region by Commonwealth or State Government agencies, and by private firms. More than 50 tests were drilled around Lakes Entrance, including a 10-foot diameter shaft dug to 1156 feet.

An oil boom started in 1924, after a small oil and gas show was encountered in a water well from an Oligocene greensand aquifer. Small amounts of crude measurable in gallons were intermittently produced along with fresh water by over 30 individual Lakes Entrance field wells until the complete cessation of production in 1957.

Over 8000 barrels total of asphaltic, 15.7^{o} API crude were produced. Gas production, all methane, was insignificant.

Since 1954, drilling has been carried out onshore by Woodside, Frome Lakes, and Arco. None of these operators found commercial accumulations, although some hydrocarbon shows were recorded.

The Victoria State Mines Department and to a less extent the Bureau of Mineral Resources have mapped the surface geology of the Gippsland region, with emphasis on the Palaeozoics. Subsurface geological maps and sections have been prepared by previous operators from data on the many old cable tool and rotary wells drilled in the basin.

Geophysical:

Gravity and Magnetics: The Bureau of Mineral Resources regional gravity covers the onshore Gippsland Basin; gravity anomalies and trends are correlatable with major regional structural features. Much of the basin has been covered by aeromagnetic work. The BMR conducted most of the older work but a portion of the offshore basin was flown in 1961 by Aero Service Ltd for Haematite Explorations Pty Ltd. These were reconnaissance surveys but gave a good approximation of the basin edges.

Seismic: Previous Control - Regional seismic control was obtained from the reconnaissance survey conducted by Western Geophysical Company for Haematite Explorations Pty Ltd in 1962-63. Generally, the record quality was fair to good down to the first strong coal reflection; below this mainly multiples were recorded. Where no strong coal reflection was present, deeper legitimate events were recorded, although these were generally discontinuous and weak. Western Geophysical Company carried out additional detailed seismic work, subsidized by the Commonwealth Government, for Esso before the spudding of Gippsland Shelf No. 1.

Regional Geology

The small Gippsland Tertiary-Mesozoic Basin lies within, and near the southern extremity of, the Palaeozoic Tasman Geosyncline which stretched 2500 miles through eastern Australia from New Guinea to Tasmania. Tens of thousands of feet of Cambrian to Carboniferous sediments, metasediments, intrusives, and effusives are consequently exposed around its northern rim in Victoria. In addition Permian rocks are present in Tasmania to the south-west. Palaeozoic rocks undoubtedly underlie all of the Gippsland Basin, at shallow depth near its margins directly below a thin Tertiary veneer, and at great depth, of the order of 20,000 feet, within the central area where a thick Lower Cretaceous-Jurassic section intervenes and the Tertiary alone reaches a thickness of 7000+ feet.

Triassic sediments are known in Tasmania but the oldest Mesozoic beds recognized in Gippsland are of Jurassic age. Continental types of sandstone, arkose, siltstone, greywacke, mudstone, and minor amounts of coal were deposited during the Jurassic and Lower Cretaceous within a large graben or half-graben depression. Upper Cretaceous sediments are apparently absent onshore. Locally, pre-Tertiary uplift and deformation were considerable and erosion occurred regionally for a long period. Weathering and an angular unconformity at the top of the Strzelecki Group are pronounced.

During Eocene time, gentle regional downwarp occurred in the basin. Volcanism occurred in the west followed by widespread limnic to paralic swamp conditions with the deposition of peat, clay, and much coarse continental sand. The great thickness and characteristics of the brown coal in the west suggest that the deposits were autochthonous. Large volumes of freshwater must have consistently debouched into the basin from the surrounding highlands since it is only in the east that the Latrobe Valley Coal Measures contain traces of any carbonate or shells or marine fauna which would suggest more normal marine salinity. In the west, over 2000 feet of the mainly continental Latrobe Valley Coal Measures were deposited. A thinner but slightly more brackish sequence containing less lignite was laid down to the east and south-east. Uplift and gentle deformation took place after the Eocene; the Latrobe Valley Coal Measures were then truncated.

The Gippsland Basin acquired its general present shape with a marine transgression from the east and south-east during Lower Oligocene time. The Lakes Entrance calcareous shale was the first true marine rock to be laid down. A single important period of local shoreline or littoral sand deposition with winnowing action interrupted shale deposition, during a brief halt in the transgression. Then came further onlapping and more shale deposition.

Shallow and quiescent marine conditions continued without major interruption through the Miocene into the Lower Pliocene with further slow transgression of the sea: overlapping deposits of marl and argillaceous limestone were laid down, but these became sandier towards the end of this time, as marine regression began, completing the full cycle. By mid-Pliocene, regional uplift, probably accompanied by gentle deformation and small-scale faulting, occurred. The sea then regressed to its present limits. Deposition of fluvial clays, sands, and gravels took place onshore from the Upper Pliocene to the Holocene.

Possibly during the period of erosion after the Eocene and certainly during the Quaternary, large volumes of fresh water have entered all permeable horizons known onshore.

Stratigraphy

Age	Formation	Depth Intervals (feet)	Thickness (feet)
Miocene	Gippsland Limestone	767-3270	2503+
Oligocene	Lakes Entrance Formation	3270-3458	188
Eocene	Latrobe Valley Coal Measures	3458-5378	1920
Upper Cretaceous	Unnamed	5378-8701(T.D.)	3323+

Note: The lithological top of the Lakes Entrance Formation at 3270 feet has been used in this report to coincide with the seismic mapping horizon. A palaeontological disconformity however is present at 3084 feet. It is possible that the section from 3084 to 3458 feet should be included in the Lakes Entrance Formation. Additional control is needed to establish this formation boundary firmly.

Detailed:

Note: No sample returns above 767 feet. Ocean floor sample consisted of shell fragments and fine to medium-grained, quartz sand grains.

Gippsland Limestone (Miocene): 767 to 3270 feet (2503 feet +)

767 to 2615 feet: Marl: light grey, medium grey to olive-grey, very fossiliferous, soft, firm, massive, glauconitic, dense.

Limestone: light, medium to dark grey, skeletal, very fossiliferous, glauconitic, pyritic, fairly hard.

2615 to 3084 feet: Sandstone: calcareous, light, medium to olive-grey, made up of clear, white, and light grey, coarse to very coarse, subrounded to rounded, fairly well-sorted quartz grains set in a calcareous matrix. Fairly friable with abundant fossils, and with fair porosity and permeability.

Limestone: sandy, or calcareous sandstone, but carbonate dominant.

Marl: as described above, minor percentage.

3084 to 3270 feet: (Possible Lakes Entrance Formation)
Marl: light olive, olive, medium to dark grey, very fossiliferous, very glauconitic, pyritic, slightly sandy - scattered quartz grains.

Lakes Entrance Formation (Oligocene): 3270 to 3458 feet (188 feet)

3270 to 3458 feet:	Shale: calcareous, green-grey, olive-grey, glauconitic, fossiliferous, pyritic, random quartz grains. This section is lithologically distinct from the section from 3084 to 3270 feet, and ties with the seismic top. It is possible, due to a palaeontological disconformity at 3084 feet, that the whole section between 3084 and 3458 feet is a single time rock unit.

Latrobe Valley Coal Measures (Upper Eocene): 3458 to 5378 feet (1920 feet)

3458 to 5378 feet:	Sand: clear-milky-light grey, medium-granule, subrounded to well-rounded, fairly well-sorted quartz (99%) grains, dominantly loose and unconsolidated; extremely porous, minor coal fragments, few muscovite flakes.
	Sandstone: same constituents as above but generally very fine-medium, slightly dolomitic in places.
	Coal: brown and black.
	Siltstone: brown-grey, finely pyritic and micaceous, very carbonaceous.
	Shale: (minor), light, medium and brown-grey, argillaceous and dense, grading into siltstone as above.

Unnamed unit (Upper Cretaceous): 5378 to 8701 feet (3323 feet +)

5378 to 5707 feet:	Siltstone: brown-grey, medium to dark grey and grey-black, carbonaceous, micaceous and pyritic.
	Shale: green-grey, medium to dark grey, grading into siltstone as above.
	Sandstone: light grey, very fine to medium, subangular to subrounded, soft, friable, carbonaceous, micaceous, slightly dolomitic in spots. Minor clean, loose, unconsolidated, medium to coarse grains (quartz).
	Coal: thin bands, brown-black to black.
5707 to 6755 feet:	Sandstone: light to medium grey and light green-grey and brown-grey, very fine to medium, angular to subrounded, fairly clean with quartz making up 95% of sandstone. Minor constituents are coal fragments, mica flakes, and few lithic fragments.
	Siltstone: brown-grey, carbonaceous and micaceous, finely pyritic, grading into shale as below.

	Shale: medium to dark grey and green-grey, dense, carbonaceous and micaceous.
	Coal: black, dense, with good conchoidal fracture.
6755 to 7020 feet:	Same lithology as for 5707 to 6755 feet, but sands are much coarser, up to granule and occasionally pebble conglomerate in grain size. The grains are also angular to subangular. Quartz still makes up about 95% of the sandstone.
7020 to 7260 feet:	As for 6755 to 7020 feet, but kaolinitic matrix present in sandstones.
7260 to 8701 feet: (T.D.)	As for 6755 to 7020 feet, but matrix appears to be weathered feldspar. Quartz 85-90%, remainder feldspar (5-10%), coal fragments, trace of mica, dark rock fragments, and pyrite. The overall section from 5378 to 8701 feet is considered to be Upper Cretaceous. Typical Strzelecki Group lithologies were not encountered in this well.

Structure

The Esso Gippsland Shelf No. 1 Well was drilled on a local culmination along a regional anticlinal feature trending generally east-west. This trend appears to be genetically related to the onshore Balook High. Maximum closure along this trend is about 1100 feet.

The local culmination or closure tested by Gippsland Shelf No. 1 is an almost symmetrical anticline approximately 15 miles long and 2 miles wide with steeply-dipping flanks. The structure is probably cut by a transverse fault. Maximum vertical closure on this particular feature, as mapped on the unconformity at the top of the Latrobe Valley Coal Measures, is about 600 feet.

A structure map on the unconformity at the top of the Latrobe Valley Coal Measures was the basis for selecting the location (see Fig. 3). Continuous Dipmeter results confirm that the Tertiary section was encountered on or near the crest of the structure. The actual formation tops coincided closely to the seismic prediction.

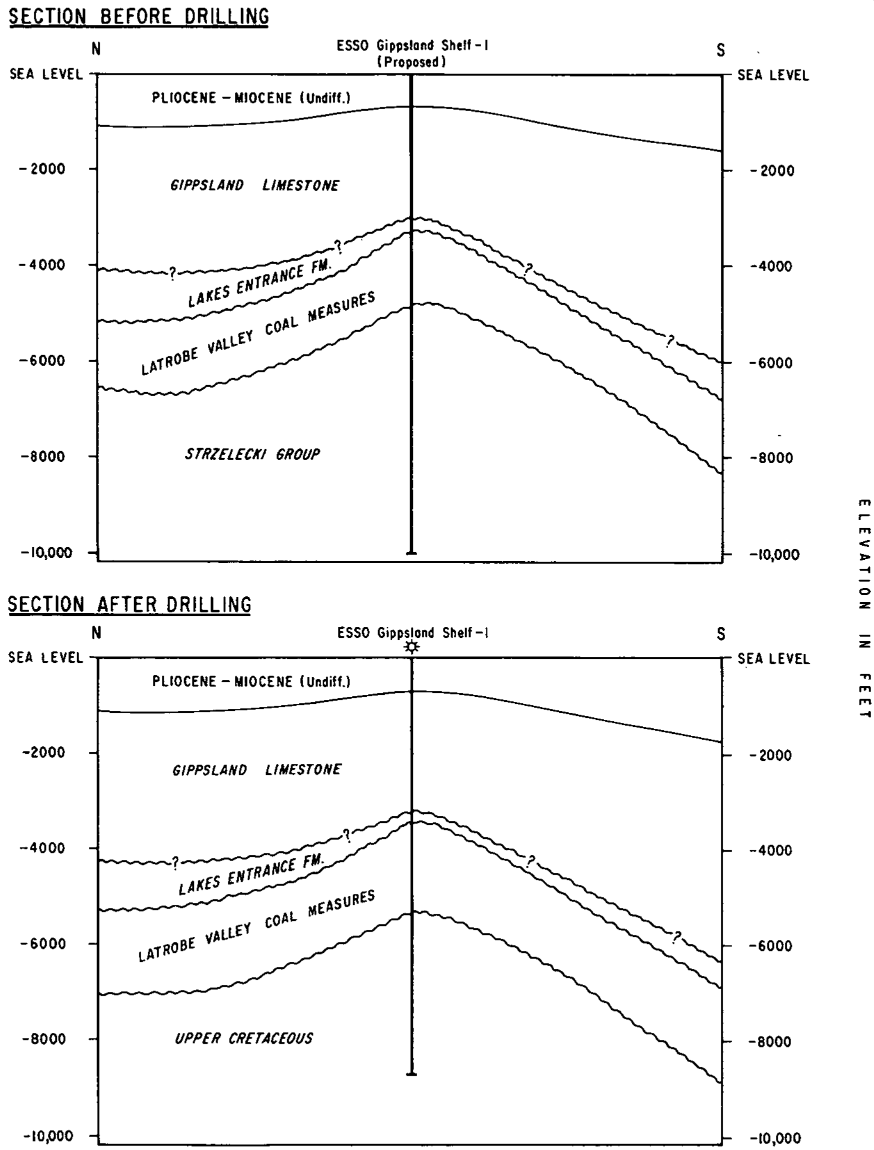
Structural configuration below the Tertiary, within the Upper Cretaceous section, is not well-known. Few valid seismic reflections were recorded in this interval. Dips from cores and the dipmeter survey suggest a possible regional dip of less than 10°, generally between north-east and north-west, in this section.

No faulting was evident in the well.

Relevance to Occurrence of Petroleum

A gas column of 353 feet was encountered in the top of the Latrobe Valley Coal Measures in the interval from 3458 to 3811 feet. Subsequent production tests proved the gas column and established the gas-water contact. This is the first potentially commercial hydrocarbon reservoir found in the Latrobe Valley Coal Measures.

Fig. 2



ESSO EXPLORATION AUST. INC.

CROSS - SECTIONS BEFORE AND AFTER DRILLING
ESSO GIPPSLAND SHELF - I

Gas shows were logged by the mud logging unit in the sands from 5707 to 6030 feet. However, electric log analysis rules out commercial hydrocarbons in these sands.

Additional shows were logged below 7800 feet, some with fluorescence and cut, but all were deemed non-commercial. The best of these minor shows were in the interval from 7834 to 7846 feet and at 8687 to 8693 feet in Core No. 20.

The show from 7834 to 7846 feet is based on the mud gas detector, sample examination, and log analysis. A maximum gas reading of 120 units was recorded in this section. The lithology is described from samples as follows:

> Sandstone: light grey-brown, very fine to medium-grained, angular to subrounded, fair sorting, poor porosity and permeability, with a trace of interbedded brown-grey carbonaceous siltstone. A trace of light gold fluorescence was noted.

Log analysis indicates a slight hydrocarbon show. The porosity was calculated to be 19%.

The show at 8687 feet and 8693 feet is based on visual examination of cores. Brown oil staining was observed in a light grey, coarse to granule-grained, angular, feldspathic sandstone with occasional pebbles and cobbles. The staining was erratic and limited to a 6-inch vertical interval in each case. The porosity from core analyses was 17%.

Porosity and Permeability of Sediments Penetrated

Porosity and permeabilities were measured by Core Laboratories, Inc., on the various cores and results are included in Appendix 7.

Log analyses generally confirmed the range of measured porosities. No cores of the loose gas sand in the Latrobe Valley Coal Measures were recovered, therefore log porosity values are the only ones available. The porosities range up to about 35% and it is obvious by their loose nature that the sands are extremely permeable.

The Gippsland Limestone sandstone member had porosities up to 36% and permeabilities to 2300 md on core analyses. Sandstones within the Eocene-Upper Cretaceous section had porosities ranging up to 25% and permeabilities up to 300 md.

Contribution to Geological Concepts Resulting from Drilling

Gippsland Shelf No. 1 was the first well drilled in the offshore Gippsland Basin. The Tertiary section to the base of the Latrobe Valley Coal Measures was essentially as predicted before drilling with one exception. The calcareous sandstone unit from 2615 to 3084 feet within the Gippsland Limestone had not previously been seen in onshore wells. Its areal extent is not yet known. The remainder of the section to the top of the Upper Cretaceous at 5378 feet was correlated without difficulty with the onshore section.

Based on palaeontological control, the section from 3084 to 3270 feet could be included in the Lakes Entrance Formation. However, there is a good Electric Log and Sonic Log marker at 3270 feet that can be correlated with the onshore wells and which coincides with an extensive mappable seismic reflection. Calling this lithologic marker the top of the

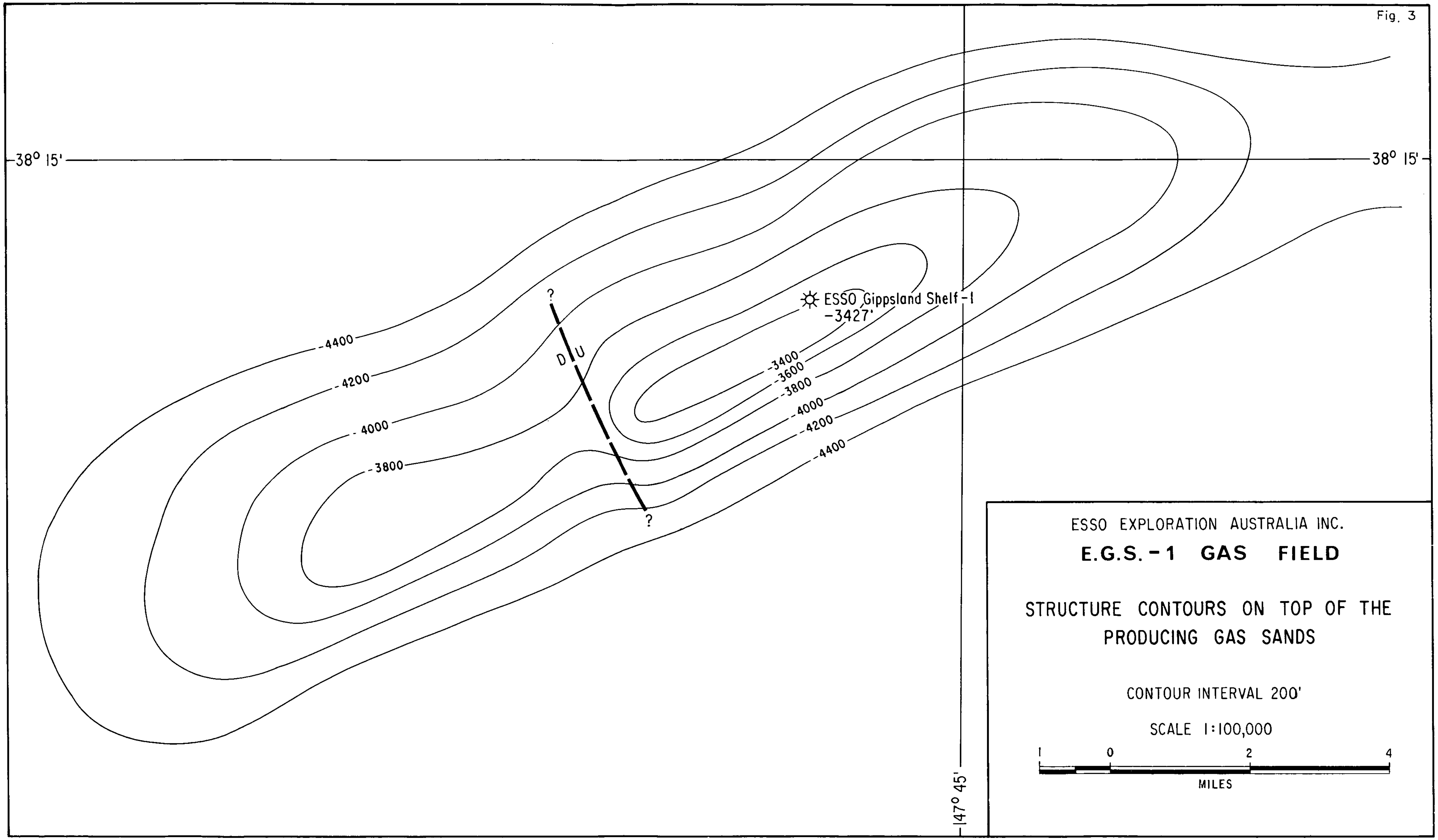


Fig. 3
38° 15'
38° 15'
147° 45'
ESSO Gippsland Shelf - 1
-3427'
-3400
-3600
-3800
-4000
-4200
-4400
D
U
?
?
ESSO EXPLORATION AUSTRALIA INC.
E.G.S. - 1 GAS FIELD
STRUCTURE CONTOURS ON TOP OF THE PRODUCING GAS SANDS
CONTOUR INTERVAL 200'
SCALE 1:100,000
1 0 2 4
MILES

Lakes Entrance Formation is advantageous for structural mapping. In addition, the top of the Lakes Entrance Formation, based on palaeontology, would be difficult to pick on Electric Logs if the Gippsland Limestone sandstone member was not present as is the case in the onshore wells. Additional well control will solve the problem, but for the present the E-Log marker is being retained as the top of the Lakes Entrance Formation for practical usage.

The Upper Cretaceous section consists of sandstones, siltstones, shales, and thin coal bands lithologically distinct from Strzelecki Group sediments seen onshore.

The very high percentage of quartz sandstone, the grain size, angularity, porosity, and the relative lack of dark rock fragments and other lithic constituents is in marked contrast to the sub-greywacke type of Strzelecki Group sediments onshore. Structure within this Upper Cretaceous section is unknown at present. Although this section appears devoid of marine fauna, it is noticeable that formation water salinities are very high throughout the unit suggesting marine conditions of deposition.

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APPENDIX 1

ESSO GIPPSLAND SHELF NO. 1

CORE DESCRIPTIONS

Core No. 1 1000 to 1028 feet. Cut 28 feet Recovered 14 feet (50%)

1000 to 1004 feet:	Limestone: medium grey to light olive-grey, finely crystalline, glauconitic, fossil fragments, soft argillaceous matrix.
1004 to 1014 feet:	Marl: medium grey to olive-grey, dense, soft, glauconitic, very fossiliferous, with thin interbeds of limestone. No distinguishable dip.

Core No. 2 1501 to 1528 feet. Cut 27 feet Recovered 10 feet (37%)

1501 to 1504 feet:	Marl: light grey, soft, few fossils, scattered crystals of calcite.
1504 to 1511 feet:	Marl: light grey, soft, few fossils, scattered calcite crystals, more argillaceous than above. Poor porosity and permeability. No discernible dip.

Core No. 3 2024 to 2037 feet. Cut 13 feet Recovered 5 feet (38%)

2024 to 2029 feet:	Marl: medium to dark grey, sparsely glauconitic, firm, few scattered fossil fragments, calcite crystals, few pyrite grains. Poor porosity and permeability. No discernible dip.

Core No. 4 2326 to 2352 feet. Cut 26 feet Recovered 21 feet (81%)

2326 to 2327 feet:	Marl: medium dark grey, few scattered glauconitic grains, abundant fossil fragments, tight, firm, no show.
2327 to 2327 1/2 feet:	Limestone: medium grey, bioclastic, abundant microfossils and fossil fragments, in fine crystalline argillaceous matrix, tight, fairly hard, trace glauconite, no show.
2327 1/2 to 2331 1/2 feet:	Marl: as above, very abundant microfossils and fossil fragments, glauconitic.
2331 1/2 to 2338 feet:	Limestone: as above, glauconite, sparse to abundant, occasional thin argillaceous streaks.
2338 to 2340 1/2 feet:	Marl: as above, abundant glauconite.
2340 1/2 to 2343 1/2 feet:	Limestone: as above, interbedded with thin marly streaks, abundant sponge spicules and echinoid spines.

2343 1/2 to 2344 1/2 feet: Marl: as above.

2344 1/2 to 2347 feet: Limestone: medium grey, finely crystalline, slightly argillaceous, scattered small fossil fragments, trace glauconite, hard, dense, no show.

Core No. 5 2630 to 2655 feet. Cut 25 feet Recovered 23 feet (92%)

2630 to 2646 feet: Calcareous Sandstone: light olive-grey, coarse to very coarse, subrounded, white clear quartz, white calcareous matrix, abundant glauconite, friable, abundant fossil fragments. Fair permeability and porosity. No show.

2646 to 2653 feet: Sandy Limestone: light olive-grey, finely crystalline, abundant glauconite and fossil fragments. White clear quartz grains (10% to 40% of rock is quartz grains). Fair porosity and permeability. No show.

Core No. 6 2876 to 2896 feet. Cut 20 feet Recovered 10 feet (50%)

2876 to 2886 feet: Calcareous Sandstone: light to medium grey, coarse to very coarse, subrounded, light to clear quartz grains. Finely crystalline, bioclastic calcareous matrix, fair porosity and permeability. Slightly glauconitic, slightly brackish taste (sand 50% to 80% of rock).

Core No. 7 3020 to 3050 feet. Cut 30 feet Recovered 9 feet (30%)

3020 to 3022 1/2 feet: Calcareous Sandstone: light to medium grey, clear white to cloudy, few tan, coarse to very coarse, subrounded to rounded, fairly well-sorted quartz grains in calcareous matrix; glauconitic and fossiliferous. Fair porosity and permeability. Grades into sandy limestone in bottom six inches; limestone is more glauconitic and fossiliferous and tighter.

3022 1/2 to 3027 feet: Calcareous Siltstone to Marl: medium to dark grey, olive-grey, slightly glauconitic, fossiliferous, tight.

3027 to 3029 feet: Calcareous Sandstone: to sandy limestone (generally finer grained), fine to coarse, very poorly sorted quartz grains, light tan, very dirty, fossiliferous, and glauconitic. No show, slight brackish taste. No apparent dip.

Core No. 8 3342 to 3385.5 feet. Cut 43.5 feet Recovered 7 feet (16%)

3342 to 3349 feet: Shale: calcareous, olive-grey to medium grey, dense, soft, glauconitic, fossiliferous, (not abundantly), trace pyrite, and few random medium to coarse, round sand grains throughout. No apparent dip; a few gas bubbles and some pitting on mud sheath. No other hydrocarbons.

<u>Core No. 9</u> 3465 to 3513 feet. Cut 48 feet Recovered 2 feet (4%)

3465 to 3513 feet:	<u>Coal</u>: all brown, slightly dolomitic (?sideritic) with trace pyrite, very hard bottom three inches, has two inch bands (lenses) of dolomitic (?sideritic) sandstone made up of medium to very coarse, subrounded to rounded, fairly well-sorted quartz grains set in a fine, brown-grey to pale brown, dolomitic (?sideritic) sandstone matrix. This sandstone is tight and has no pore space at all. No fluorescence in core or stain or cut. However a hydrocarbon odour is present through the core. This part of the core is assumed to be the bottom two feet where the drilling ceased. The remainder of the core is probably loose, clean, unconsolidated medium to very coarse and granule quartz sand as in the coring cuttings, which washed away.

<u>Core No. 10</u> 3800 to 3825 feet. Cut 25 feet Recovered Nil

<u>Core No. 11</u> 4346 to 4351 feet. Cut 5 feet Recovered 2 feet (40%)

4346 to 4351 feet:	<u>Sandstone</u>: loose unconsolidated, very fine to coarse, dominantly fine to medium, well sorted, subangular to rounded, clear and white quartz grains, no matrix. Quartz grains: 95% of the sample, rest calcite grains, coal fragments, glauconitic pellets, pyrite, few marl fragments. Few pieces brown to black coal, possibly cavings from fishing operation. Gas reading on sample - eight units on high, zero units on low. Distinct hydrocarbon odour present when core fell out of barrel. No fluorescence or cut on sample.

<u>Core No. 12</u> 4740 to 4760 feet. Cut 20 feet Recovered 12 feet (60%)

4740 to 4748 feet:	<u>Sand</u>: unconsolidated to slightly consolidated, medium to coarse grain, subangular to rounded, quartz making up 99% of sand - friable, non-calcareous. 1% coal, muscovite flakes, few chert and quartzite fragments.
4748 to 4750 feet:	<u>Sand</u>: as above, but very fine to medium quartz grains.
4750 to 4750 1/2 feet:	<u>Gravel</u>: quartz as above.
4750 1/2 to 4751 1/2 feet:	<u>Sand</u>: as 4740 to 4748, with thin coal bands.
4751 1/2 to 4752 feet:	<u>Coal</u>: black to brown-black, no fluorescence or cut, slight odour probably from coal.

<u>Core No. 13</u> 5256 to 5274 feet. Cut 18 feet Recovered 15 feet (83%)

5256 to 5261 feet:	<u>Sand</u>: light grey to light brown-grey, medium to coarse, subangular to subrounded, well sorted, friable, two streaks brown to black coal, calcareous.

5261 to 5262 feet: <u>Sand:</u> as above but finer grained, thin laminations of brown coal, cross bedding of 10^{o}, less porosity than top.

5262 to 5271 feet: <u>Sand:</u> as 5261 to 5262, thin, brown to black coal seams 1/2" thick, pyrite crystals. No fluorescence or cut, slightly salty taste.

<u>Core No. 14</u> 5656 to 5685 feet. Cut 29 feet Recovered 29 feet (100%)

5656 to 5685 feet: <u>Siltstone and Shale</u>: predominantly medium to grey, to light olive-grey, light green-grey, with thin beds medium to dark grey, brown-grey, micaceous, carbonaceous siltstone and thin laminated coal seams, some cross bedding, mostly flat, few stringers of thin, grey, fine sandstone, tight, pyritic, non-calcareous, coal one foot thick at 5661 to 5662 feet and 5679 to 5680 feet; no fluorescence or cut.

<u>Core No. 15</u> 6124 to 6139 feet. Cut 15 feet Recovered 2 feet (11%) (Core rabbit jammed)

6124 to 6139 feet: <u>Shale (Mudstone)</u>: medium grey, dominantly medium dark grey (olive-grey), uniform, compact, with abundant plant fragments, fair hardness. Bottom six inches: thin laminations of black coal in brown-grey shale mudstone: pyrite associated with coal; gas bleeding from coal. Abundant plant impressions on rough bedding surfaces (concentrated on bottom six inches interval). Interval similar to shale of Otway Group (?).

<u>Core No. 16</u> 6447 to 6460.5 feet. Cut 13.5 feet Recovered 13.5 feet (100%)

6447 to 6450 feet: <u>Sandstone</u>: light grey to light brown-grey, fine and medium-grained, fairly well compacted, slightly argillaceous, micaceous, pyritic, occasional grains of glauconite, and sparse black coal fragments. Small scale cross bedding with dips to 5^{o} (porosity approximately 18%; permeability fair).

6450 to 6451 feet: <u>Argillaceous Siltstone</u>: brown-grey, contains abundant thin (to 1/16"), carbonaceous streaks and lenses, finely disseminated pyrite associated with coaly streaks, micromicaceous, sparse pyrite nodules to 1/8", irregular fracture. Coaly plant impressions on irregular bedding surfaces.

6451 to 6452 1/2 feet: <u>Argillaceous Siltstone</u>: as above with light grey to white, irregular sandy to silty lenses to 3/4" thick.

6452 1/2 to 6460 1/2 feet:	Siltstone: olive-grey, argillaceous and micaceous, contains irregular brown to grey carbonaceous patches to 3/4" thick, finely disseminated pyrite, irregular pyrite nodules to 1/4" thick, contains vague, discontinuous, light grey, fine-grained, sandy streaks to 1/2" thick. At 6453 1/2 feet, slickensided interface dipping at 45° to the axis of core.

Core No. 17 6747 to 6773 feet. Cut 26 feet Recovered 23 feet (88%)

6747 to 6748 feet:	Sandstone (quartzose): light grey to light grey-green, fine-grained, fairly well sorted, slightly argillaceous, micaceous, non-calcareous, contains fine, black coal fragments and brown-grey, carbonaceous streaks - minor grains glauconite - finely disseminated pyrite (no dip). Porosity 16% to 18%; permeability fair.
6748 to 6750 feet:	Siltstone: olive-grey, argillaceous and micaceous, thin, irregular, black coal streaks to 1/2" thick, and irregular, brown to grey, carbonaceous patches, irregular, fine-grained, sand lenses and bands. Disseminated pyrite and nodules (to 1/4").
6750 to 6759 feet:	Sandstone: as above with abundant thin irregular coal streaks (slight petroliferous odour).
6759 to 6766 feet:	Sandstone: as above - predominantly medium-grained, cleaner than above. Porosity 20%; permeability fair.
6766 to 6770 feet:	Sandstone: as above, predominantly coarse-grained, cleaner than fine-grained sandstone. Porosity 20%; permeability good.

Core No. 18 7233 to 7251 feet. Cut 18 feet Recovered 18 feet (100%)

7233 to 7234 1/2 feet:	Sandstone (quartzose): light grey to light grey-green, fine to coarse-grained, granular; predominantly coarse-grained to granular. Very poorly sorted, kaolinitic matrix, flecks of mica throughout, pyrite, finely disseminated in fine fraction and as grains to 1/16", grains and flecks of black coal; porosity is 20% or 20%+, permeability good, drilling fluid stains completely through core. (Few scattered grains dark grey mineral, fairly hard, chloritic?).
7234 1/2 to 7240 1/2 feet:	Sandstone: as above - alternating bands of medium to coarse-grained sandstone and very coarse-grained to granular sandstone to 0.8" thick. Finer grained material, more carbonaceous and dirtier, alternate bands outline cross-bedding dipping to 10° with respect to axis of core.

7240 1/2 to 7246 feet:	Sandstone: as above, but predominantly very coarse-grained to granular, irregular, thin outlines marked by dark brown and black coal. (Plant impressions noted at 7243 feet). Pebble of quartzite noted at 7242.5 feet.
7246 to 7249 1/2 feet:	Sandstone: as above, with alternating very coarse-grained and granular beds and finer grained bands, finer grained streaks, much more carbonaceous than micaceous. Dip to 10°.
7249 1/2 to 7250 1/2 feet:	Sandstone: as above, very coarse-grained throughout, cleaner than finer grained interval.
7250 1/2 to 7251 feet:	Sandstone: as above, granular, more matrix clay minerals, dark grey, altered grains (clay mineral), and a relative abundance of smoky quartz grains.

Core No. 19 7708 to 7731 feet. Cut 23 feet Recovered 23 feet (100%)
Note: depth correction from 7712 to 7708 feet

7708 to 7709 feet:	Siltstone-Shale: medium dark grey to dark grey, carbonaceous, micaceous, dense, hard, finely laminated with light to medium grey, very fine sandstone-siltstone. Pyrite common as nodules. Plant fragments.
7709 to 7710 feet:	Sandstone: light grey to pale yellow-brown to brown-grey, very fine to coarse, angular to subangular, with thin laminae of dark grey siltstone-shale, fairly hard, cross bedding, apparent dip 10°.
7710 to 7717 feet:	Sandstone: light grey to very light grey to light olive-grey, fine to granular (coarser than 0.9-1.0 mm), angular to subangular, very poorly sorted, fairly friable, non-calcareous, made up of 85% to 90% quartz. Rest feldspar (5% to 10%), pyrite, coal fragments (chlorite?). Thin carbonaceous beds, very porous. At 7713 feet, very well rounded, black shale pebble. Apparent dip 20° at 7715 feet. Possible repeated graded bedding - fine to coarse going deeper.
7717 to 7721 1/2 feet:	Sandstone: as for 7710 to 7717 feet, but more thin, fine bands of siltstone, medium to dark grey, present. Dip 20°. At base few pebbles present and carbonaceous matter. Foreset bedding.
7721 1/2 to 7722 feet:	Sandstone : as for 7710 to 7717 feet, and broken fragments of pyrite and coal. Good gold fluorescence in two-inch section which has strong yellow cut and hydrocarbon odour.

7722 to 7723 feet:	Siltstone-Shale: as for 7708 to 7709 feet. Very minor, very fine, light grey sandstone, and carbonaceous.
7723 to 7724 feet:	Sandstone: as for 7710 to 7717 feet.
7724 to 7726 feet:	Sandstone: consolidated gravel-pebble conglomerate, pale yellow-brown to brown-grey to brown. Pebbles very poorly sorted, dominant angular to subangular, but few with round pebbles of dark grey shale and quartzite. Higher feldspar percent than previously, very high porosity, brown colour due to filtrate.
7726 to 7727 feet:	Sandstone: as for 7709 to 7710 feet, with few coal bands.
7727 to 7730 1/2 feet:	Sandstone: as for 7724 to 7726 feet, with thin pyrite bands at 7727.5 feet and 7729.5 feet. Pebbles dominant at base.
7730 1/2 to 7731 feet:	Sandstone: as for 7710 to 7717 feet, but very much harder and denser. Possibly siliceous matrix. Thin, dark grey, siltstone bands, very low porosity.

Core No. 20 8678 to 8693 feet. Cut 15 feet Recovered 15 feet (100%)

8678 to 8680 feet:	Siltstone (argillaceous): brown-grey, very tough and compact, contains irregular, light brown-grey, kaolinitic, sandy lenses to one inch thick, pyrite occurs finely disseminated and as irregular nodules to 3/4" thick, black coal streaks to 1/16" thick, and scattered fine flecks of black coal. Black coal plant impressions on bedding surfaces: micromicaceous, sparse, fine and medium angular grains of light grey to white quartz.
8680 to 8682 feet:	Sandstone: (grit) light grey, conglomeratic; predominantly fine to medium-grained with bands of coarse grains, angular to subrounded quartzose sandstone to six inches thick; few pebbles of light grey quartz and dark grey greywacke, subangular to subrounded, to 3/4" diameter. Pyrite finely disseminated throughout and as small irregular nodules; abundant very light grey to white kaolinite in matrix plugs porosity. Discontinuous brown-grey, argillaceous-micaceous-carbonaceous streaks to 1/2" thick; biotite, tourmaline (?), muscovite, dark grey rock grains.

8682 to 8687 feet:

Conglomeratic Sandstone: light grey, angular, granules, pebbles, and occasional subrounded cobbles of light grey and white quartz, light grey-green, fine-grained, compact sandstone, dark grey to green greywacke, and dark grey argillite, in a poorly sorted, predominantly coarse-grained, kaolinitic, quartzose sand matrix. Pyrite disseminated finely and as irregular nodules, grains of dark rock fragments, tourmaline (?), and flecks of mica and black coal; very fine-grained streaks outline small scale cross bedding to maximum dip of 10^{o}; low effective porosity and permeability due to plugging by kaolinite.

8687 to 8687 1/2 feet:

Conglomeratic Sandstone: as above - oil stained with good odour; abrupt light yellow cut; fluorescence on vertical one-third of core.

8687 1/2 to 8692 feet:

Conglomerate: light grey, granules, pebbles and occasional cobbles of light grey and white quartz, grey-green, and dark grey-green greywacke, dark brown to grey with compacted pyritic argillite and light grey-green, very fine-grained, well compacted (quartzitic?) sandstone in a poorly sorted quartzose, kaolinitic, sandy matrix (similar to above) (flecks of biotite, etc.).

8692 to 8693 feet:

Conglomerate: similar to above - few scattered pebbles of quartz-veined dark grey chloritic schist - and grey-green, well compacted argillite and white quartz, etc. as above - in matrix similar to above - only rock much more friable to crumbly (better porosity?). Good stain throughout, good strong odour when freshly broken, instant cut, light yellow, good light fluorescence.

Core No. 21   8693 to 8701 feet.   Cut 8 feet   Recovered 7 feet (88%)

8693 to 8694 feet:

Conglomerate: light and medium grey, granules to pebbles and cobbles of white and grey quartz, dark grey, compact, fine-grained greywacke, light grey-green shale in very poorly sorted kaolinitic sandy matrix (as in base of Core No. 20). Fluorescence not as extensive (small scale cross bedding dips to 10^{o}), fluorescence with good cut as in Core No. 20.

8694 to 8697 feet:

Siltstone (argillaceous): brown to grey, very tough and compact, very carbonaceous, containing abundant discontinuous and irregular streaks of black anthracitic coal - coaly plant impressions on bedding surfaces; bedding interfaces wavy and irregular (compaction phenomena); some shiny slickensided stylolite-like interfaces. Irregular pyrite nodules to 1/2" thick.

8697 to 8700 feet:

Siltstone: brown-grey to light brown-grey, very tough and compact, slightly argillaceous, very carbonaceous, irregular vein-like streaks of anthracitic coal to 1/4" thick; pyrite finely disseminated and irregular nodules to 3/4" thick; few light grey and white quartz grains, subangular, fine granule size. From 8699 to 8700 feet - irregular discontinuous lense-like bands of very fine-grained, light brown to grey, kaolinitic, micaceous sandstone. No apparent dip.

APPENDIX 2

ESSO GIPPSLAND SHELF NO. 1

THE MID-TERTIARY FORAMINIFERAL SEQUENCE

by

David J. Taylor*

CONTENTS

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* Geological Survey of Victoria, 1965.

INTRODUCTION

General

This investigation was conducted on behalf of Esso Exploration Australia, Inc., and Haematite Explorations Pty Ltd. At their request the section was examined in detail in order to establish a standard foraminiferal sequence for further correlation in the offshore Gippsland area. The geological staff of both companies gave the author considerable assistance and complied with requests regarding sampling.

Sample Detail

The well was drilled in 148 feet of water, some 15 miles south of the Gippsland coastline. Rotary cutting samples were submitted from 780 feet to total depth at 8701 feet. Rotary cutting contamination was minimal between 780 and 4300 feet apart from the interval 3050 to 3200 feet. Below 4300 feet contamination was sporadically heavy down to 8400 feet. It is noted that the 13 3/8" casing was set at 2974 feet and the 9 5/8" casing at 6081 feet. Much of the contamination below 4300 feet came from the interval 3400 to 3500 feet where a "wash out" was noted on the Caliper Log.

Eighteen cores were recovered and these were slabbed at the well site, so that a complete section of each core was received. The position of cores from 1000 to 4000 feet is shown on Fig. 4.

The datum for all sample depths was the rotary table given as 31 feet above M.S.L. All depths discussed here are those shown on the submitted samples and no adjustment has been made on E-log interpretations, etc.

All cores were sampled at two-foot intervals and cutting samples were examined every 50 feet with reduction of sampling interval where necessary. Normal microfossil preparation techniques were employed. Prepared samples were exhaustively handpicked for foraminifera and other microfossils. If good faunas were found the fossils were sorted on to grid slides before specific determination of foraminifera was conducted. A comprehensive distribution chart of some 300 species was assembled and this was later abridged to the form shown on Fig. 4. Where specific identity was uncertain or new species suspected, species numbers were applied and representative specimens were mounted on species slides.

FAUNAL SEQUENCE

Cores Nos 1 to 8 contained Tertiary foraminifera and the new species were recorded down to 3800 feet. The new fauna at 3800 feet is regarded as uppermost Eocene, so that the Tertiary foraminiferal sequence extends from above 780 feet (first sample) to about 3800 feet. No older diagnostic faunas were found, although a sample of Core No. 16 (sample interval 6450 to 6451 feet) contained a sparse fauna of minute, nondescript rotalid forms. This fauna was not found in any other of ten samples examined from Core No. 16.

In recent years several Tertiary sections in the Gippsland Basin have been studied in considerable detail by foraminiferal workers. Jenkins (1960) studied the Tertiary planktonic foraminifera in the Lakes Entrance Oil Shaft; a vertical, hand-sampled section.

Carter (1964) built up a composite sequence, consisting of both outcrop and bore material from the Longford, Bairnsdale, and Lakes Entrance areas. Carter's work is an application of his faunal unit scheme, which was based on the Aire Coast sections in Western Victoria (Carter, 1958). Wade (1964) has subsequently discussed the Tertiary planktonic foraminiferal zonation in southern Australia and has co-ordinated the work of Carter and Jenkins.

This previous work provided a firm basis on which to establish a foraminiferal sequence for the Gippsland Shelf No. 1 Well. However Carter, Jenkins, and Wade all use the first appearance of forms in evolutionary sequence. Theoretically this is the ideal approach as it is in the direction of evolution, that is "up-sequence". But subsurface sections are drilled "down-sequence". Where rotary cuttings have to be used for biostratigraphic determination, the first appearance of a species is the only reliable point in its range, because of rotary cutting contamination. This first appearance is in fact the level of extinction of the species in the section. Obviously the "up-sequence" schemes have to be adapted to a "down-sequence" approach.

The author has been working on this problem for several years, especially in regard to the onshore Gippsland Basin. A less empirical "down-sequence" approach has been tested by using the range and points of fragmentation and bifurcation in a number of linearly evolving species groups. The planktonic series discussed by Wade can be utilized by this approach. The classic Orbulina universa lineage poses difficulties in that the globular shape provides almost maximum buoyancy and may be constantly recirculated as a mud contaminant.

Uvigerinid and bolivinid forms are common in the Gippsland Shelf sequence, though they are not common onshore, apparently for environmental reasons. Vella (1964) has stressed the significance of linear development within these groups in the Tertiary of New Zealand. Similar, though not identical, lineages are recognized in the Gippsland Shelf sequence and these lineages have been detailed. It is thought that the bolivinid and uvigerinid lineages will be important factors in correlating subsequent Gippsland offshore sections.

Gippsland Shelf No. 1 Tertiary Foraminiferal Sequence

Vertical distribution of species groups will be discussed "down-sequence" with reference to summarized distribution of selected species as shown on Fig. 4.

(i) Planktonic species: Little change in the Globigerina spp. till 3400 feet where G. euapertura first appears coinciding with the virtual disappearance of G.woodi and G.apertura. G. euapertura clearly develops from G.ampliapertura and this latter form is present below 3700 feet. The apparent lineage is G.ampliapertura to G.euapertura to G.apertura (s.l.). Jenkins (1960) shows that G.woodi replaces G.euapertura, and he includes (pers. comm.) G.apertura (s.l.) within G.woodi. Wade (1964) does not recognize G.woodi and uses G.apertura. The author feels that the two species can be distinguished and that G.woodi is not in the direct G.ampliapertura to apertura lineage.

The closely related species G.linaperta and G.angipora appear in association below 3800 feet. In New Zealand the range of the latter extends higher than that of the former (Hornibrook, 1961).

Most members of Blow's (1956) Globigerinoides triloba - Orbulina universa bioseries are present in the sequence. Orbulina universa is present in Cores Nos 1 to 5, whilst O.suturalis is present in Cores Nos 6 and 7. Such a distribution would be anticipated.

However below Core No. 7 there is no verified recording of G.transitoria, G.bispherica or G. triloba, although Blow shows these species to be ancestral to O.suturalis and would be expected to occur below O.suturalis. As subsequent authors, including Carter, Jenkins, and Wade, have substantiated Blow's bioseries, it can only be concluded that the lineage is interrupted in this section before the initial appearance of the mature form of G.triloba. The immature form of G.triloba (either G.triloba immatura or Globigerina woodi connecta Jenkins) is present below 3080 feet.

Globorotalia spp. do not occur above 1060 feet. The highest occurring species are mainly the keeled forms referable to G.menardii. G.mayeri is not present above 1700 feet and G.barisanensis and G.conica are not above 2300 feet. This is the specific distribution pattern shown by Jenkins (1960) and all these species are within range of Orbulina universa and O.suturalis. Wade (1964) places G.barisanensis and G.menardii miotumida within the G.fohsi lineage so that the latter replaces the former as is demonstrated in this section. The presence of G.lenguaensis near the top of the range of G.mayeri and well above the top of the range of G.barisanensis is consistent with the findings of Bolli (1957) in Trinidad.

Below 3400 feet G.opima opima and G.extans are associated with the coarse-pored G.testarugosa not present till 3540 feet and becoming more abundant down the section. These three forms show a relative distribution in agreement with Jenkins (1960).

The Gippsland Shelf sequence reaches the top of the range of Chiloguembelina cubensis at 3540 feet with rare Guembelitria sp. below 3800 feet. Although this order of occurrence is similar to that in Trinidad and New Zealand, it is the reverse of Wade's (1964) observations for southern Australia.

(ii) Bolivinid species: Four lineages of bolivinids are recognized in the sequence.

One lineage is within a group of elongate forms which exhibit thickening and initial widening of the test, accompanied by peripheral rounding and facial flattening. The ultimate form, Bolivina sp.2 is present down to 2100 feet and its range overlaps the thinner, more tapered B. sp.8, which is recognized at 1900 feet. B. sp.8 is not encountered below 2700 feet. A probably related form, B. sp.12 occurs below 3300 feet. There is an apparent gap in the lineage.

An outstanding element of the higher part of the sequence is a robust keeled bolivinid referable to Bolivinita, probably comparable with B.compressa of the New Zealand upper Tertiary.

This form, Bolivinita sp. 1, is present down to 1600 feet and a less strongly carinate form, B. sp.2, replaces it. The chambering of B. sp.1 and sp.2 is similar to that of Bolivina sp.2 and the less carinate nature of Bolivinita sp.2 suggests that the Bolivinita sp.2 to sp.1 lineage branches off at the fragmentation level (i.e. 1900 to 2100 feet) of the Bolivina sp.8 to sp.2 lineage. This Bolivinita lineage is obviously parallel to the B.quadrilatera lineage in New Zealand, but Hornibrook (1953, p.440) suggests that the New Zealand group were immigrants and he does not indicate development from a Bolivina stock.

Bolivina sp.1 is a compressed elongate form with carinate later chambers and raised sutural ribs. Below 1500 feet, the broader, more triangular form B. sp.4 is present.

A similar form, B. sp.9, with elongate ribs occurs below 2300 feet. These three species are within a definite linear development. The range overlap of species, though broad, is significant.

Below 3540 feet, the Bolivina pontis to B. anastomosa group is recognized. The former is clearly distinguished below 3800 feet. The development is similar to that described by Hornibrook (1961) and Vella (1964) from New Zealand. The highest appearange of B. anastomosa is stratigraphically lower than that recorded in New Zealand and slightly lower than other Gippsland Basin sections. Vella shows that B. affiliata is the descendant of B. anastomosa and that the lineage may be surviving as B. robusta. B. affiliata is not recognized in the Gippsland Shelf sequence, but the Bolivina sp.9 to B. sp.1 lineage exhibits similarities to B. robusta.

(iii) Uvigerinids: Vella (1961 and 1964) has made an extensive study of New Zealand uvigerinid lineages. Vella's approach is to place the species of one lineage within a distinct higher taxon. This has led to the erection of a number of new genera and sub-genera within the family Uvigerinidae. This is the modern taxonomic approach, yet Vella's proposed genera and sub-genera have not been generally accepted and probably require greater verification, especially with regard to apertural and internal chamber characteristics. Also Vella stresses the endemic nature of his species. For the above reasons, the author has refrained at this stage from using Vella's nomenclature. The author has generalized the generic concept of Uvigerina, but will attempt to place numbered species within Vella's lineages; that is within his proposed higher taxa.

The Hofkeruva (Trigonouva) group are common throughout most of the Tertiary section. The first form encountered, Uvigerina sp. 1, is elongate and moderately costate. Subsequent forms (down section) are U. sp.2, U. sp.4, and U. sp.8. The latter species is markedly triangular in cross-section and very similar to the New Zealand species "U". miozea. This form appears at 2300 feet and is still present at 3000 feet. The general shape and plate like costae of the large U. sp.9 suggests affinity with the New Zealand species "U". dorreeni. As U. sp.9 is present at 3080 feet and U. sp.8 persists to at least 3000 feet, then there is apparent disruption of Vella's (1961, Text fig. 3) proposed lineage if U. sp.8 equals "U". miozea and U. sp.9 equals "U". dorreeni.

U. sp.3, U. sp.7, and U. sp.10 are all hispid forms probably within the genus Neouvigerina as explained by Vella. The three Gippsland Shelf species do not appear related.

(iv) Gyroidinoides: A definite series of the G. zealandica group is recognized in New Zealand. G. sp.1 and G. sp.2 appear unrelated to this group. But below 2200 feet there is a form, G. sp.3, which resembles G. subzealandica, while below 3080 feet it is replaced by the more angular form G. sp.4 equalling G. zealandica (s.s). This is the New Zealand order of occurrence although Hornibrook (1961) shows that the ranges of the two species overlap considerably.

(v) Cibicides: Lineages within this group probably exist in the section but have not been studied. Common species down to 2700 feet include C. cygnorum, C. mediocris, C. subhaidingeri, and C. vortex. C. victoriensis is not recorded till 1500 feet and its presence below 3080 feet may be due to contamination. C. vortex probably forms a lineage group as a C. 'vortex form B' can be distinguished below 2400 feet. There is a marked change in the Cibicides fauna at 3080 feet, with the appearance of C. brevolalis, C. perforatus, and C. novozealandica. This change is anticipated from Carter's (1964) and other Gippsland sections.

(vi) Elphidium: The order of occurrence of the five recorded species of Elphidium are of significance, as four of them retain the order as recorded by Carter, although E.crespinae would be expected to range higher. The fifth species, E.arenea (syn. Discorotalia arenea Hornibrook), is a new recording for Victoria, but is of limited range in New Zealand.

Biostratigraphic Units for Gippsland Shelf No. 1 Sequence

From the above discussion it is now possible to subdivide the sequence into a number of biostratigraphic units, which are comparable with previously established biostratigraphic units, but are not completely equivalent to previous schemes, as, by necessity, this scheme is a "down-sequence" scheme. The biostratigraphic units applied are named zonules as they comprise associations of species of various foraminiferal groups and are intended only for purposes of local correlation.

Zonule A - ? to 1060 feet: As samples were not collected above 780 feet, the top of this zonule is not known. The complete absence of Globorotalia spp. identifies it but this absence is probably due to environmental factors. The only species restricted to this unit is Uvigerina sp. 1 which obviously develops from U. sp.2 in Zonule B.

Zonule B - 1060 to 1700 feet: The highest ranges of Globorotalia acostaensis, G.menardii miotumida, miocenica, and praemenardii are within this interval, but these species could easily range higher in other sections. The related species Bolivina sp.2 and B. sp.4 overlap in range. Bolivinita sp.1 is associated with Bolivina sp.1 and characterizes this unit, although both species occur rarely in the higher unit. The hispid Uvigerina sp.3 appears limited to this unit, and Cibicides victoriensis does not range above the base of the unit.

Zonule C - 1700 to 2300 feet: Marked by the highest appearance of Globorotalia mayeri and the limited appearance of G.lenguaensis. Within this unit is the fragmentation of the Bolivina sp.8 to sp.1 lineage with bifurcation to the primitive Bolivinita sp.2. The highest appearance of Uvigerina sp.4 overlaps U. sp.2 and the hispid form U. sp.7 does not range above the base of the unit. The ranges of such species as Elphidium pseudoinflatum, Gyroidinoides sp.2 and G.sp.3 extend upwards into this zonule and Textularia sp.3 appears limited to it.

Zonule D - 2300 to 2700 feet: Characterized by the highest appearances of Globorotalia barisanensis and G. conica. The two cores within this interval contain few Orbulina universa, though higher in the sequence this form is abundant. Bolivina sp.9 is restricted to this unit and clearly develops into Bolivina sp.4. The uvigerinid fauna consists mainly of the hispid Uvigerina sp.7 and the triangular U. sp.8. Elphidium arenea is restricted to this unit.

Zonule E - 2700 to 3080 feet: Has sparse faunas throughout, apart from obvious contamination below 3050 feet. Except for Haplophragmoides cf. paupera, all species recorded occur higher in the sequence. However the zonule criterion is established on core samples which contain Orbulina suturalis without associated O.universa. Just above this zonule, Core No. 5 contains rare O.universa, whilst O.suturalis is more common. Thus, 2700 feet is taken as the level of initial appearance of O.universa.

Haplophragmoides spp. are common within the zonule.

A significant feature of this zonule is the presence of worn Lepidocyclina sp., Gypsina sp., and Amphistegina sp., with decayed fragments of bryozoa. The sediment is a sandy one and is not comparable with the typical Victorian lepidocyclinal limestones (e.g. the Glencoe Limestone of Gippsland). Furthermore, Carter (1964) demonstrates that Orbulina suturalis appears above and not in association with Lepidocyclina sp. in Victoria. It is considered that these Lepidocyclina and other larger foraminifera are derived.

Zonules F and G are missing in this sequence. As already stated the Globigerinoides triloba to Orbulina universa bioseries is interrupted before the appearance of the mature form of G.triloba and is recommended with O.suturalis. The two significant missing events are the appearance ("up-sequence") of G.triloba and of G.bispherica. It is also noted that several bolivinid and uvigerinid lineages appear to be interrupted. Moreover, fresh specimens of Lepidocyclina sp. and other larger foraminifera are not present, although they would be expected immediately below O.suturalis.

The absence of the expected Zonules F and G indicates a hiatus within the sequence.

Zonule H - 3080 to 3400 feet: Despite contamination down to 3200 feet, the fauna is impressively different. Globigerina apertura, and G.woodi, are still present with immature and dubious specimens of Globigerinoides triloba. At the top of and within the zonule, such forms as Cibicides brevolalis, C.perforatus, C.novozealandica, Uvigerina sp. 9, U. sp.10, U. sp.11, Astrononion centroplax, and Anomalinoides vitrinoda occur. Arenaceous species are common with Textularia spp., Dorothia spp., Haplophragmoides spp., and Karreriella sp. The appearance of Karreriella sp. and Haplophragmoides rotundata within the unit may be biostratigraphic rather than a purely environmental feature, as these two species have not been noted at relatively higher levels in Gippsland sections.

Zonule I - 3400 to 3540 feet: Globigerina euapertura is positively identified at 3400 feet, and G.apertura and G. woodi are both extremely rare. Globorotalia opima opima and G.extans are rare though important elements of the planktonic fauna. The benthonic fauna is similar to that of Zonule H, except for the presence of Vaginulinopsis gippslandicus and the arenaceous Vulvulina sp. (probably referable to the New Zealand V.granulosa). There is a rich arenaceous fauna.

Zonule J - 3540 to 3800 feet: A strikingly different fauna because of the small size of specimens compared with the robust Zonule I fauna. The planktonic elements are similar to Zonule H apart from the presence of Globorotalia testarugosa and Chiloguembelina cubensis. There is a notable reduction in specimen size of the benthonic species which also occur in the two preceding zonules. Arenaceous species are rare. The highest occurrences of Bolivina anastomosa and the arenaceous Bolivinopsis cubensis are noted at 3540 feet.

Zonule K - 3800 feet to ? : Fauna generally similar to Zonule J, but mixtures of Globigerina euapertura with the ancestral form G.ampliapertura, and of Bolivina anastomosa with the ancestral form B.pontis, indicate specific fragmentation in these two lineages. This level also contains the highest appearance of the planktonic Globigerina angipora and G.linaperta as well as the rare occurrence of Guembelitria sp.

Below 3800 feet: No new species were found below this level and all cores were barren of foraminifera. Foraminifera were found sporadically in cutting samples below

4400 to 6000 feet, but all species are referable to those found in Zonules H and I. Obviously these foraminifera are contamination and the fact that Vulvulina sp. and Vaginulinopsis gippslandicus are present suggests that the contamination came from the vicinity of 3500 feet.

CORRELATION OF GIPPSLAND SHELF SEQUENCE

Biostratigraphic Correlation with other Victorian Sequences

A comparison can now be made between the Gippsland Shelf No. 1 zonule scheme and the biostratigraphic schemes of Carter (1958 and 1964), Jenkins (1960), and Wade (1964). This comparison is summarized on Fig. 4.

Zonule A - appears to be in a higher position than the top unit of either Jenkins' or Carter's schemes. In fact none of the proposed schemes have a defined top. The fauna of Zonule A is probably environmentally controlled.

Zonule B - is within Carter's definition of Faunal Unit 11 as it contains abundant planktonic fauna. The presence of Globorotalia menardii miotumida and miocenica with the highest appearance of G.menardii praemenardii within the Zonule and G.mayeri at its base, is indicative of Jenkins' G.menardii miotumida Zone (Zone 11).

Zonule C - the highest range of Jenkins' G.mayeri supports comparison with Jenkins' G.mayeri Zone (Zone 10). The occurrence of G.lenguaensis implies that this is also Wade's G.mayeri Zone.

Zonule D - the base of the zonule is designated to be at the initial appearance of Orbulina universa, thus this unit corresponds with the defined base of Carter's Faunal Unit 11. This unit is the equivalent of both Jenkins' and Wade's O.universa Zone and the presence of Globorotalia conica and G.barisanensis is in agreement with Jenkins' findings.

Zonule E - the presence of O.suturalis without O.universa is the criterion of Carter's Faunal Unit 10 and Wade's suturalis Zone. This zonule is probably within Jenkins' Zones 8 and 7. At this stage in the sequence, Jenkins' zonation is too subtle to be achieved in a normally drilled sequence.

Zonules F and G - missing in the Gippsland Shelf sequence, but if present would contain the events of Wade's quadrilobatus quadrilobatus Zone (= Zonule G) and bisphericus Zone (= Zonule F). Carter has three units (9 to 7) and Jenkins has four (7 to 4) in this biostratigraphic interval, but in view of Wade's findings, it is felt that only two units should be reserved in this down-sequence scheme. Carter diagnoses Faunal Unit 9 by the larger foraminiferal association (including Lepidocyclina) and clearly demonstrates its position relative to the planktonic sequence. The author considers the association as one of the benthonic markers of Zonule F.

Zonule H - the apparent absence of Globigerinoides triloba but the presence of immature forms (?Globigerina woodi immatura) with G.woodi is indicative of Jenkins' G.woodi Zone. This zone is the equivalent of Carter's Faunal Unit 6.

Zonule I - the highest appearance of Globorotalia extans and G.opima opima with the positive appearance of G.euapertura equates this with Jenkins' Globoquadrina dehiscens Zone (Zone 2). This is the equivalent of Faunal Unit 5, but Carter's main indicator, the adherent Victoriella conoidea is not present in this sequence.

Zonule J - Chiloguembelina cubensis without Globigerina linaperta is the planktonic criterion of Carter's Faunal Unit 4. Although Carter did not positively identify this unit in Gippsland, he suspected its presence and lately Hocking and Taylor (1964) have recognized it in limited areas. The highest appearance of Globorotalia testarugosa conforms with Jenkins lowest zone, but Zonule J probably represents a larger biostratigraphic interval than this zone. Jenkins recorded only five specimens of G.testarugosa at the base of his Lakes Entrance Oil Shaft sequence, suggesting that this was the extinction level of the species.

Zonule K - Carter's Faunal Unit 3 is at the top of the range of Globigerina linaperta so that Zonule K is probably at the top of Faunal Unit 3.

Correlation with Victorian Tertiary Stages

Carter (1964) has shown the relationship of his faunal units to a revised Victorian Tertiary Stage Classification. As the Gippsland Shelf sequence zonules are equated with Carter's faunal units, then the zonules are made to fit the classification, although the author does not consider them to have any significance in discussion or future correlation of the sequence. For instance, Carter differentiates the Mitchellian from the underlying Bairnsdalian on a faunal change which resulted from shallowing water. With regard to water depth, one would expect "facies step out" during mid-Tertiary times from the present onshore and offshore areas. As this is evident in the recognized Bairnsdalian (= Zonules D and ?C) it would be expected in the Mitchellian. Recognition of the Mitchellian can only be achieved by determining upper Miocene. Direct faunal correlation is not possible.

Crespin's (1943) stage classification for the Gippsland Basin appears to be a more workable one, but is dependent on facies without real biostratigraphic consideration. In the Gippsland Basin, Crespin's work did not suggest time-transgressive sedimentation, whilst an application of Carter's faunal unit scheme did, as shown by Hocking and Taylor (1964). It is evident that Crespin's scheme is in reality a rock-stratigraphic one and will be discussed later as such.

Intercontinental Correlation

The sequence can be discussed in terms of accepted world-wide division of the Tertiary period. Wade's (1964) thorough study of both the actual faunas and the massive literature, has placed the southern Australian planktonic sequence within the framework of the European Standard Stage Classification of the Tertiary. More recent overseas literature supports her contentions. Discussion on these matters will be limited to comment on the Gippsland Shelf sequence.

Following Wade's evidence, Zonule K is obviously at the top of the Eocene, Zonule J is lowermost Oligocene, whilst Zonule I occupies the rest of the Oligocene (Chattian). Glaessner (1959) and Wade (1964) both argue that Carter's Faunal Unit 6 can be correlated with the Aquitanian (lowermost Miocene) on its relative position in the planktonic sequence and thus the Oligocene-Miocene boundary is below the general emergence of the distinct "Globigerinoides form". Zonule H is considered as basal Miocene.

The absence of Wade's quadrilobatus quadrilobatus Zone (= Zonule G) and bisphericus Zone (= Zonule G) indicates the absence in the sequence of most of the lower Miocene (Burdigalian). Wade places her suturalis and universa Zones within the Helvetian and her "mayeri" Zone within the Tortonian. Thus Zonules E to C are middle Miocene. Wade's mayeri Zone is equated with Bolli's (1957) mayeri Zone, which marks the highest appearance of Globorotalia mayeri and the incoming of G.lenguaensis. The top of Zonule C is marked by the highest appearance of G.mayeri and the presence of G.lenguaensis. Therefore, Zonules B and A are probably within Bolli's menardii Zone and are taken to represent the upper Miocene.

From studies of Carter, Jenkins, and Wade, it can be concluded that a marine Tertiary sequence is present from the upper Eocene to at least the middle Miocene in southern Australia. In the case of the Gippsland Shelf No. 1 Well a sequence has been shown which extends from the uppermost Eocene to highest Miocene, with a break during the lower Miocene.

Trans-Tasman Correlation

The proximity of New Zealand would suggest that correlation should be attempted with the Gippsland Shelf sequence. Jenkins (pers.comm.) is currently working on a correlation between the New Zealand Tertiary planktonic sequence and that of the Lakes Entrance Oil Shaft. At this stage comment is premature, but certain features are obvious. It would appear from the descriptions of Hornibrook (1961) and Vella (1964) that Zonules K and J contain Whaingaroan planktonic and benthonic faunas. A characteristic planktonic species of the Whaingaroan is Globigerina reticulata which may be con-specific with Globorotalia testarugosa. Jenkins (1963) places the Whaingaroan astride the Eocene-Oligocene boundary, which is the correlated position of Zonules K and J. Similarities also exist between the planktonic faunas of Zonule H and the Waitakian Stage which Jenkins (1964) suggests as the base of the Miocene.

Another correlation is the fact that the New Zealand Upper Miocene is characterized by the entry of Bolivinita spp. of the B.quadrilatera Gp. Hornibrook (1958) points out that this event occurs slightly earlier in New Guinea. However, the presence of Bolivinita sp.1 correlates Zonule B with the Tongaporutuan Stage of New Zealand.

DEPOSITIONAL HISTORY

Depositional Environments

The generic and specific content of the Gippsland Shelf foraminiferal sequence has permitted biostratigraphic breakdown, but also gives some key to the depositional environment at the time of sedimentation, especially if all facies (bio and litho) are interpreted together. Detailed sedimentology has not been conducted on the sediments, so that a more complete story must await this work. The palaeoecological significance of the faunas in the zonules will be discussed in ascending order.

Zonules K and J (uppermost Eocene to lower Oligocene):

These lie within a sandy interval which contains thin bands of carbonaceous material (lignite and brown coal). Only sporadic faunas are recorded, but, when present, specimens are fairly abundant. The outstanding feature is the small size of the specimens and the dominance of planktonic species. One thousand specimens were counted in each of three samples with regard to the planktonic percentage. The results were: at 3560 to 3570 feet: 70%; at 3730 to 3740 feet: 83%; at 3805 to 3810 feet: 87%. Throughout the zonule the average size of specimens was less than 0.25 mm. The benthonic fauna consisted predominantly of uvigerinids and bolivinids with a small percentage of arenaceous forms.

Such a high percentage of planktonic forms would suggest an open ocean environment, whilst bolivinid and uvigerinid forms are fairly dominant benthonic constituents of outer shelf deposits. These conclusions do not account for the nature of the sediment, nor the abnormally small size of individual specimens. The explanation is probably that the faunas are "displaced", in that the tests have been washed into an alien environment. The sediments suggest shallow water, marginal marine conditions (lagoonal or swamp). If this environment were separated from the sea by a narrow barrier, then any marked sea-level rise (due to storms or abnormal tides) could cause flooding by marine waters. Strong onshore winds would bring in the oceanic plankton and could cause turbulence on the sea floor, suspending empty benthonic tests as described by Murray (1965). Under such conditions Murray shows size sorting operates on the foraminiferal tests, thus accounting for the small specimen size in the faunas. The sporadic distribution of the faunas within the interval indicates that the marine connections were not constant throughout the interval. This contention is supported by the lack of any obviously endemic fauna, which would not be established if sea water were diluted by coastal run-off, when the cause of marine flooding desisted. Such conditions exist today in the lagoons on the Gippsland seaboard.

It should be recorded that the delicate tests and the fairly homogeneous nature of the fauna do not indicate that it is reworked. The "displacement" is environmental and not stratigraphic, which is substantiated by previous discussions which show that the faunas are not misplaced in the Victorian Tertiary planktonic sequence.

Zonules I and H (upper Oligocene and lowest Miocene):

The sediment is a marl, glauconitic at the base, with a marked faunal change. Planktonic, arenaceous, and lagenid species with robust species of Cibicides are the dominant elements. Even at the base of the interval the arenaceous forms reflect an absence of quartz sand as their tests are composed of smaller particle size material. Fairly shallow water conditions, open to the ocean, are evident with slow sediment accumulation.

Zonule E (middle Miocene):

Calcareous sandstone with sparse arenaceous and miliolid faunas with occasional planktonic species. Obviously a shallow water, swiftly accumulating sediment.

Zonule D (middle to upper Miocene):

Sand content decreases up the section, with marls and limestones present above 2500 feet. With the decrease in sand the faunas are larger and the planktonic percentage increases as does the percentage of uvigerinid and bolivinid forms. A deepening of the depositional environment is suspected.

Zonules C and B (middle to upper Miocene):

Faunas and sediments similar to that at the top of Zonule D. Shelf conditions are indicated.

Zonule A (upper Miocene):

The sediments are mainly calcareous, but are richly bryozoal. The percentage of planktonic forms is reduced with a marked absence of Globorotalia spp. There is an increase of miliolid and arenaceous forms (virtually absent in Zonules C and B). Shallowing water is evident. The environment is probably an inner shelf one, but certainly not littoral.

Biohermal accumulations are not present within the sequence.

Sequence of Depositional Events

This is illustrated on Fig. 5 for the Gippsland Shelf Tertiary foraminiferal sequence (from 3800 to 780 feet).

The base of the sequence is of uppermost Eocene age. Sedimentation took place in a marginal marine environment (ex lagoons) with periodic marine ingressions. During the Oligocene there was a general marine transgression covering the depositional area with shallow water. The fine-grained nature of the marl and the formation of glauconite suggest slow sedimentation and isolation from sources of detrital material. This transgression was in fact a basin wide event which extended well into the present onshore area (probable source areas). During the lower Miocene there was a hiatus which has not yet been recognized onshore. Sedimentation was resumed in the middle Miocene with the deposition of sand and detrital limestone material. The limestone detritus contains worn bryozoa and larger foraminifera and is suspected to have been reworked from the Glencoe Limestone (refer Carter, 1964) of the Longford District. There was a gradual deepening of water during the middle Miocene, with an apparent reversal of the trend in the upper Miocene. The post-Miocene history is not known because of lack of samples.

Palaeogeography

Throughout this foraminiferal sequence the climate appears to have been a temperate one with current circulation as today. This is the opinion of Wade (1964) for southern Australia. Reed (1964) on the study of the Heywood No. 10 bore (western Victoria) feels that planktonic faunas described by Jenkins (1960) indicate warmer water conditions for Gippsland than those of western Victoria. Reed's conclusions are not borne out by the author's study of any Victorian Tertiary sequence, and certainly not in the Gippsland Shelf sequence, where the combined percentage of Globoquadrina dehiscens and keeled Globorotalia spp. is never more than five percent of the total planktonic fauna in any sample. There are inherent differences between the western Victorian and Gippsland mid-Tertiary faunas, but the author believes these to be palaeogeographic, as Hopkins's (1965) information suggests that Bass Strait may not have been a "through-way" between the Otway Basin (western Victoria) and the Gippsland Basin during mid-Tertiary times. Reed's figure 3 clearly shows that "west wind drift" currents moved south of Tasmania and that the Gippsland Basin would have been fed only by the "east Australian current" which also influences the west coast of New Zealand. It has been stated already that the Gippsland Shelf faunas are strongly "New Zealandic" in aspect.

The direction of marine influence was from the south and east throughout the Gippsland Shelf Tertiary sequence.

GEOLOGICAL SETTING WITHIN THE GIPPSLAND BASIN

Jenkins (1960) has demonstrated a continuous sequence from lower Oligocene to probably upper Miocene in the Lakes Entrance area. Hocking and Taylor (1964, summarized on figure 4) show that the initial marine Tertiary transgression was of a diachronous nature, being oldest in the then structurally deeper parts of the basin and becoming progressively younger up the flanks of structural "highs" (e.g. the "Baragwanath Anticline"). This transgression extended from the Eocene-Oligocene boundary to lowermost Miocene. Sedimentation on the "Baragwanath Anticline" probably took place only during lower Miocene and may not have covered the entire structure. In other parts of the Gippsland Basin marine sedimentation apparently continued uninterrupted till upper Miocene and even Pliocene times. Thus on the "Baragwanath Anticline", two hiati are evident in marine deposition. They are (i) a hiatus from uppermost Eocene throughout most of the Oligocene, and (ii) a post-lower Miocene hiatus.

The Gippsland Shelf No. 1 Well is drilled on the culmination of a seismic structure and the results of drilling do not alter any of the general interpretations. However, foraminiferal evidence shows that marine influence commenced in the upper Eocene and continued throughout the Oligocene. But there was a hiatus during the lower Miocene and then marine sedimentation resumed in the middle Miocene and continued to at least the upper Miocene.

The "Baragwanath Anticline" and the "Gippsland Shelf Structure" are roughly parallel with their axes some 30 miles apart, yet sedimentation took place on them at different times. For instance, lepidocyclinal limestones were deposited on the "Baragwanath Anticline"(as are seen at Brock's Quarry) at a time when a hiatus is evident on the "Gippsland Shelf Structure". Immediately following this, reworked lepidocyclinal limestone is present on the "Gippsland Shelf Structure" during a hiatus on the "Baragwanath Anticline". Other differences are illustrated on Fig. 5. It must be pointed out that this figure illustrates only the differences between the two structures and is not intended to imply these features in any other part of the Gippsland Basin. The depositional environment has been drawn relative to sea level on the basis of information discussed here and on unpublished work.

Envisaging these two structures as vertically moving blocks (as on Fig. 5), then the direction of movement must have been opposed throughout the period in order to account for differences in the Tertiary sequence on each structure.

With regard to lithological correlation within the Gippsland Basin, the following conclusion can be drawn on facies similarities.

The facies which contains Zonules K and J are almost identical to those of the sandy unit at the base of the Lakes Entrance Formation in the Lake Wellington Trough (Hocking and Taylor, 1964). This unit is the time equivalent of the Greensand and Colquhoun Gravel Members in the Lakes Entrance area, although the facies are slightly different due to thicker accumulations of glauconite in the latter, which the author regards as an "estuarine backwater".

The faunal elements of Zonules H and I are identical with those of Crespin's (1943) "Janjukian faunas" of the Gippsland Basin and especially of the Micaceous Marl Member of the Lakes Entrance Formation in the type sections. Crespin's "zonal" foraminifera of her "Janjukian" is Cyclammina incisa (= Haplophragmoides cf. incisa) and the fauna is characterized by arenaceous species. This is one of the faults in Crespin's Stage classification as here "zonal features" are really facies features, yet it affords a quick identification of the facies of the Micaceous Marl. The author would place the top of the Lakes Entrance Formation at 3080 feet in the Gippsland Shelf Well. The base of the Lakes Entrance Formation (sandy unit) is difficult to pick because it is a sand on sand contact with the top of the Latrobe Valley Coal Measures and only cuttings are available, but it must be below 3540 feet. Hocking and Taylor (1964) suspected intertonguing of this contact in the Wurruk Wurruk bore, but Carter (1964) gives evidence of erosion at this contact in Woodside No. 2 Well.

The calcareous sandstone (3080 to 2600 feet approx.) containing detrital limestone material is not known elsewhere in the Gippsland Basin but is here explained on structural grounds. It could be considered as a new member of the Gippsland Limestone. The rest of the section to 780 feet is regarded as a deeper water facies of the Gippsland Limestone. Its top is younger than that of the onshore unit but this is obvious because of "facies stepping out".

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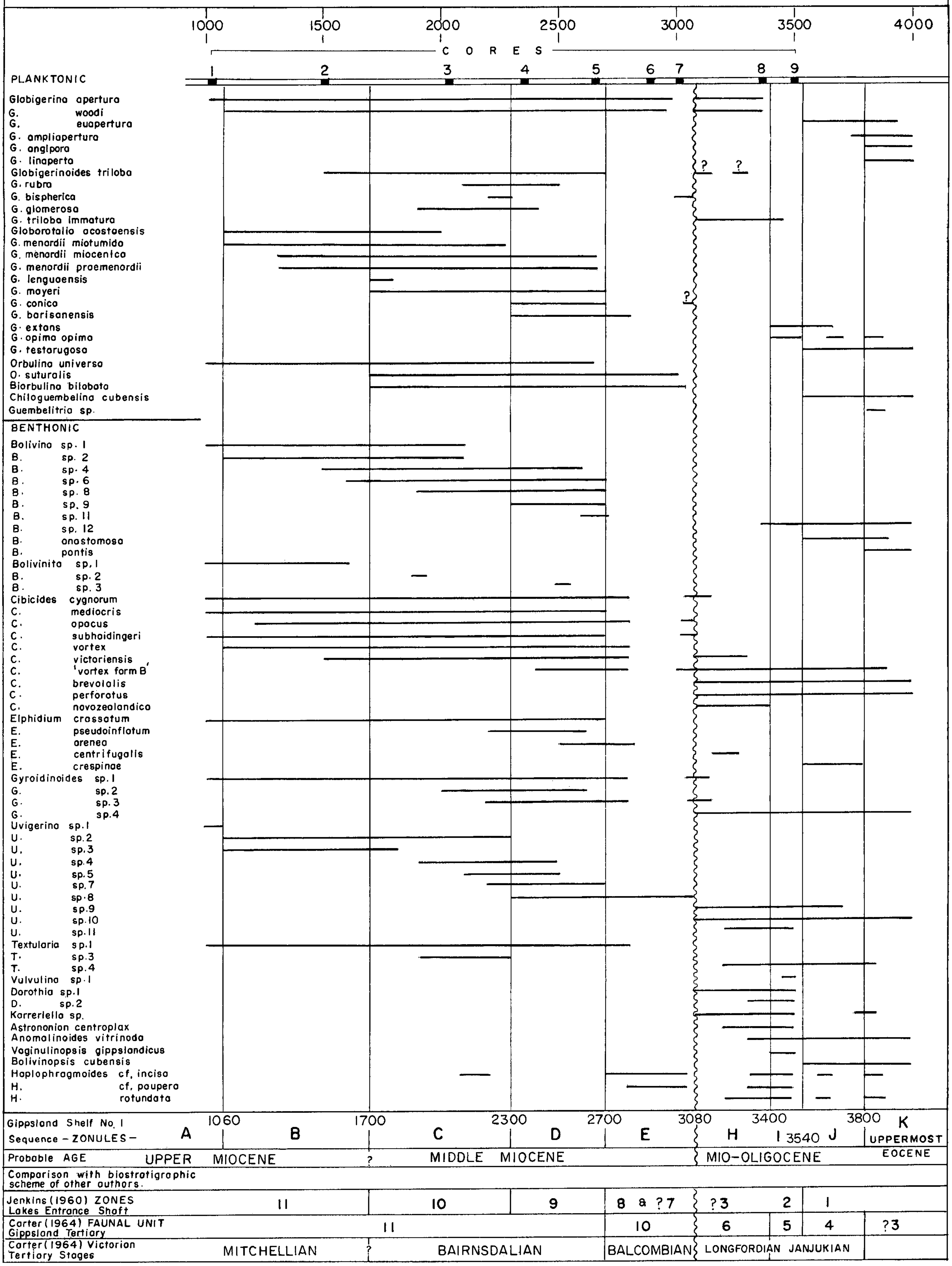
Fig. 4

TERTIARY FORAMINIFERAL DISTRIBUTION
ESSO GIPPSLAND SHELF No I WELL
(Obvious contaminants and remanie forms eliminated)



To accompany Appendix 2 by D.J. Taylor

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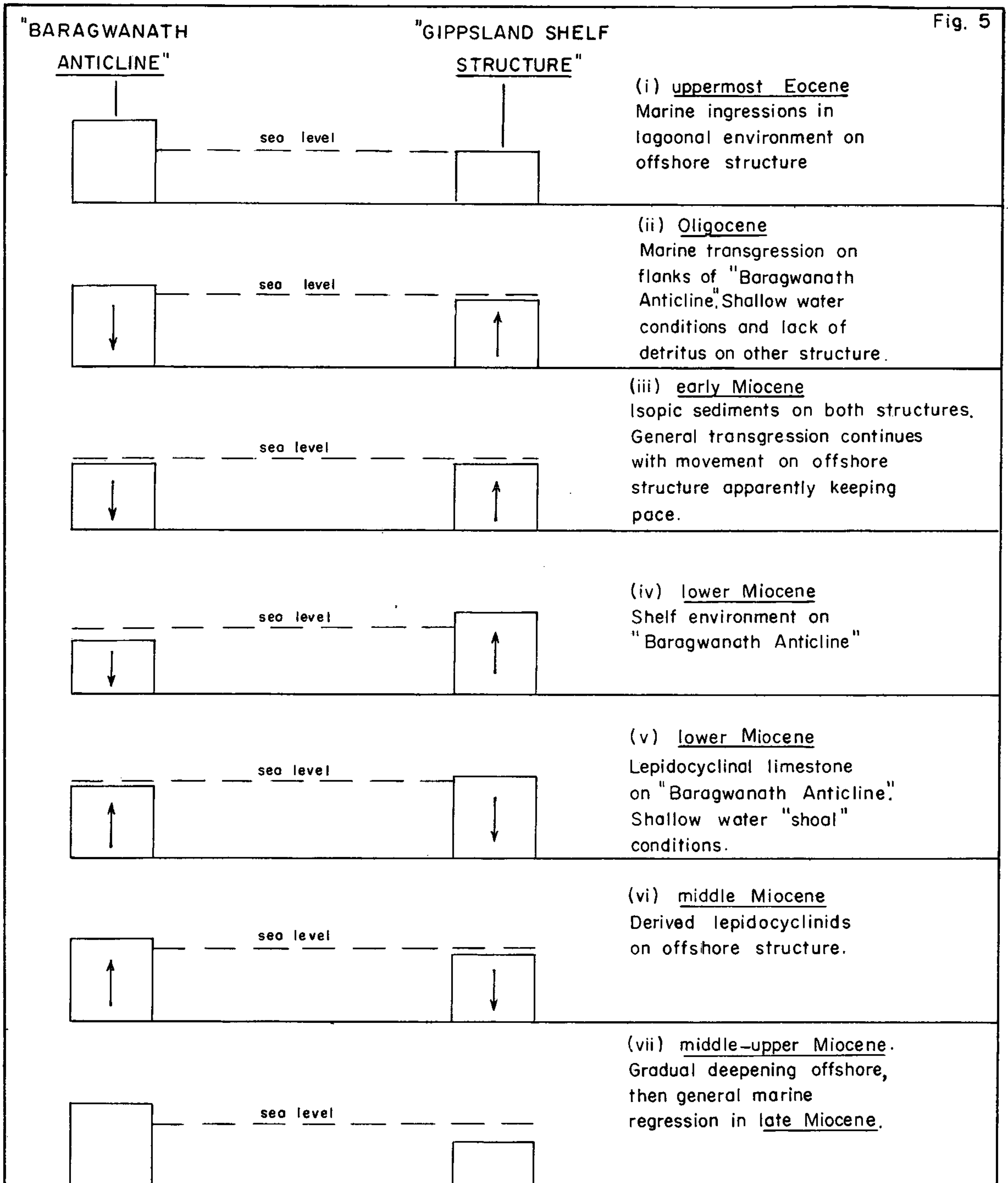

DIAGRAMMATIC COMPARISON OF STRATIGRAPHIC AND ENVIRONMENTAL SITUATIONS ON BARAGWANATH ANTICLINE AND OFFSHORE STRUCTURE DURING MID-TERTIARY

To accompany Appendix 2 by D.J. Taylor

APPENDIX 3

ESSO GIPPSLAND SHELF NO. 1

PALYNOLOGICAL REPORT

by

John Douglas*

Plant remains found in Cores Nos 14, 15, 16, 19, 20 and 21 from Esso Gippsland Shelf No. 1 Well were examined. The samples were macerated by the hydrofluoric acid-Schulz solution method, and the residues examined under the microscope for acid insoluble microfossils.

Core No. 14

Microfloras present include Proteacidites sp. a, b, and c, and Nothofagus species including Nediminuta Cookson. Upper and lower leaf surface cuticular fragments from angiosperm leaves were also common.

Core No. 15

Microfloras include Proteacidites sp. a and b; Cyathidites sp., Tseugaepollenites sp., Alesporites sp., and unidentified gymnosperm pollen.

Megaplant remains identified as Pagiophyllum sp. were compared in the author's preliminary report to P.chambersi n.sp. (Douglas MS), from Arco-Woodside Merriman No. 1 at 5070 to 5081 feet.

Core No. 16

Plant mega-remains from this core were tentatively identified in the preliminary report as sphenopsid stems or rhizomes.

Core No. 19

Microfloras include Lycopodiumsporites sp., Protracidites sp. a and b, Triorites cf. T.edwardsi, Rugulatisporites sp.

Core No. 20

No diagnostic microfloras were isolated.

Core No. 21

A very rich microflora was isolated from this core including Nothofagus cf. N. aspera, Nothofagus sp. a and b, Triorites cf. T.edwardsi, Rugulatisporites sp., Ginkgocycadophytus sp., Triorites sp. a. Conifer pollens were most infrequent.

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*Geological Survey of Victoria, 1965.

Age of the Sediments

Two main points can be made:

(i) No distinction can be made in age between any of the samples studied.

(ii) A continental depositional environment is indicated by the apparent absence of marine microfossils.

In the preliminary report on Core No. 14 it was stated that the age of the sample was lower Miocene-Upper Cretaceous, and all microfloras examined from subsequent cores fall into this category, although certain species, for example Rugulatisporites sp., indicate that an Eocene-Upper Cretaceous age is most likely for Cores Nos 19, 20 and 21. Precise time ranges of many Victorian Upper Cretaceous and lower Tertiary microspores are not known. As no marine fossils indicating Upper Cretaceous age appear to have been found, and western Victorian Upper Cretaceous sediments are predominantly marine, it is thought that the sediments intersected by Cores Nos 19, 20 and 21 would be best regarded as Eocene or Palaeocene in age.

APPENDIX 4

ESSO GIPPSLAND SHELF NO. 1

GAS ANALYSES

by

J. Puchel*

Component \ Sample	Production Test No. 1 From Perforations 3809 to 3814 feet
H and He	Trace
O and Ar	0.122%
N	1.30 %
CO	Nil
CO_2	0.59 %
Methane	86.70 %
Ethane	6.15 %
Propane	2.81 %
Isobutane	1.00 %
Butane	0.447%
Isopentane	0.607%
Pentane	0.108%
Neohexane	0.024%
Isohexanes	0.138%
Hexanes	Trace
H_2S	Nil
Note: Analysis by gas chromatography, April, 1965.	

* Bureau of Mineral Resources.

Component \ Sample	Production Test No. 2	
	Flow: 3 MMcf/D Depth: 3752 to 3756 feet Time: 1300 hrs Date: 12.4.65	Flow: 3 MMcf/D Separator Press: 615 psig. Separator Temp: 62 ^{o}F Time: 1315 hrs Date: 12.4.65
H and He	Trace	N.Dc.
O and Ar	0.102%	0.09 %
N	1.30 %	1.50 %
CO	N.Dc.	N.Dc.
CO_2	0.59 %	0.83 %
Methane	86.7 %	87.1 %
Ethane	6.15 %	5.38 %
Propane	2.83 %	2.98 %
Isobutane	1.00 %	1.03 %
Butane	0.447%	0.484%
Isopentane	0.607%	0.490%
Pentane	0.018%	0.015%
Neohexane	0.024%	N.Dc.
Other Hexanes and Higher	0.238%	0.174%
H_2S	Nil	Nil

Notes: N.Dc. - Not Detected

Analysis by gas chromatography, April, 1965.

Component \ Sample	Production Test No. 3 Depth: 3492 to 3497 feet Sample No. 2 Flow Rate No. 2 Separator Press: 610 psig. Separator Temp: 46 °F Date: 21.4.65 Time: 0806 hrs
H and He	N.Dc.
O and Ar	Trace
N	2.0 %
CO	N.Dc.
CO_2	0.55 %
Methane	85.9 %
Ethane	5.78 %
Propane	3.03 %
Isobutane	1.17 %
Butane	0.52 %
Isopentane	0.62 %
Pentane	0.26 %
Dimethylbutanes	0.01 %
3-Methylpentane	0.08 %
2-Methylpentane	0.06 %
Hexane	N.Dc.
Heptanes and Higher	Traces
H_2S	N.Dc.

Notes:
(1) N.Dc. - Not Detected
(2) Composition of the gas, as above, is quoted for the sample on hand at the time of testing only.
(3) Analysis by gas chromatography, 14th May, 1965.

APPENDIX 5

ESSO GIPPSLAND SHELF NO. 1

CONDENSATE ANALYSES

by

J. Puchel*

Production Test No. 2

Sample: Depth: 3752 to 3756 feet Flow Rate: 3 MMcf/D
Time: 1300 hrs Date: 12.4.65
Sample Container: One gallon screw-cap tin

Component	(%)	Component	(%)
N + O	0.01	2,2,3,3-Tetramethylbutane) Trimethylpentanes)	0.26
CO_2	N.Dc.	Benzene + 2,2,4 - Trimethylpentane	2.69
Methane	N.Dc.	Methylethylpentanes + Methyl-cyclohexane)	1.06
Ethane	0.27	Ethylhexanes + Dimethylhexanes	0.69
Propane	0.45	Dimethylhexanes + Cycloheptane	1.10
Isobutane	8.97	Methylheptane	2.21
Butane	7.39	Octane	1.83
Isopentane	25.60	C_9 Isoaliphatics + Toluene + C_8 Cycloaliphatics)	9.80
Pentane	0.92	C_9 Aliphatics + C_8 Aromatics + C_9 Cycloaliphatics + Higher)	8.16
Dimethylbutanes	1.15		
3-Methylpentane	5.78		
2-Methylpentane	9.32		
Hexane	0.48		
3-Ethylpentane) 2, 4-Dimethylpentane)	2.55		
3, 3-Dimethylpentane + Methyl-cyclopentane +2,2,3-Trimethylbutane)	0.30		
2,2- and 2,3-Dimethylpentanes) Cyclohexane)	0.79		
Methylhexanes	6.22		
Heptane	2.01		

Additional characteristics: Results from F.I.A. Chromatography indicate ratio

$$\frac{\text{ALIPHATICS}}{\text{AROMATICS}} = 2 \text{ (approx.)}$$

Note: N.Dc. - Not Detected

* Bureau of Mineral Resources.

Production Test No. 3

Sample: Depth: 3492 to 3497 feet; Sample No. 2: Date 21.4.65

Component \ Samples Detail	Time: ? Sample No.2 Flow Rate No.1 (%)	Time: 0740 Sample No.2 Flow Rate No.2 (%)	Time: 1050 Sample No.2 Flow Rate No.3 (%)	Time: 1550 Sample No.2 Flow Rate No.4 (%)	Time: 2340 Sample No.2 Flow Rate No.5 (%)
Permanent Non-Hydrocarbon Gases + Methane	0.11	0.03	0.02	0.04	0.02
Ethane	N.Dc.	0.11	0.02	0.03	0.03
Propane	0.32	3.37	3.06	2.48	3.17
Isobutane	3.78	8.07	9.53	8.32	8.69
Butane	4.75	6.85	8.51	7.07	7.64
Isopentane	29.5	27.9	29.3	29.4	29.5
Pentane	1.43	0.88	0.89	0.90	0.90
Dimethylbutanes	1.49	1.14	1.15	1.27	1.21
2-Methylpentane	6.65	6.23	6.02	5.84	5.94
3-Methylpentane + Cyclopentane	10.95	9.72	9.45	9.40	9.54
Hexane	Dc.	0.35	0.33	0.37	0.28
3-Ethylpentane + 2,4-Dimethylbutane	3.28	2.55	2.18	2.43	2.38
3,3-Dimethylpentane + Methyl-Cyclopentane + 2,2,3-Trimethylbutane	0.92	0.35	0.23	0.37	0.21
2,2- and 2,3-Dimethylpentanes + Cyclohexane + Methylhexanes	5.75	9.52	6.82	9.92	9.60
Heptane	Dc.	Dc.	Dc.	0.37	0.27
2,2,4-Trimethylpentane + Tetramethylbutanes	0.32	0.35	0.19	0.22	0.23
Tetramethylbutanes + Benzene	3.77	3.21	2.66	2.98	2.92
Dimethylhexanes + Methylcyclohexane + Methylethylpentanes	2.34	2.19	1.54	1.82	1.83
Ethylhexanes + Dimethylhexanes	4.36	3.55	2.79	3.30	3.49
Dimethylhexane + Methylheptanes + Cycloheptane	2.74	1.95	1.88	1.64	1.97
Methylheptanes	2.91	1.75	2.75	1.59	2.05
Octane	Dc.	Dc.	Dc.	Dc.	Dc.
C_9 Iso-Alkanes (Trimethyl- + Ethyl-) + Toluene	5.97	4.35	4.93	4.03	3.76
Other C_9 and Higher	8.70	5.55	5.78	6.20	4.34

Notes:
(1) N.Dc. Not Detected
(2) Dc. Detected but unable to estimate
(3) a. Samples were supplied in loosely-sealed tin containers.
b. Composition of condensates, as above, is quoted for the samples on hand at the time of testing only.
(4) Analysis by chromatography, 16th June, 1965.

APPENDIX 6

ESSO GIPPSLAND SHELF NO. 1

WATER ANALYSIS

by

Altona Petrochemical Company Pty Ltd

A bulk sediment and water test was requested for each of the four dump-tank samples.

Results were:

Sample	1	2	3	4
Rate No.	1	2	3	4
B.S. & W. % vol.	32	30	30	30.5

The above test was carried out by adding 50 ml. of toluene to 50 ml. of sample, shaking, and then centrifuging. The B.S. & W. result was determined from the volume of separated water and heavier materials. In each case there were distinct layers of "clay", dark grey emulsion and water (in order of decreasing density). The hydrocarbon layer in each case contained considerable light emulsion. The percentage represented by the various layers were:

Sample	1	2	3	4
"Clay" (as vol. percent of the original 50 ml. sample)	7.5	8	7	6.5
Dark grey emulsion (as vol. percent of the original 50 ml. sample)	18.5	12	13	10
Water (as vol. percent of the original 50 ml. sample)	6	10	10	14
Emulsion in Hydro carbon Layer (as % of the total 100 ml. volume in the centrifuge tube)	24	40	55	50

Additional tests to those previously reported have been carried out on the water sample submitted on 6th April, 1965.

The additional results are:

Carbonate	6 ppm.
Bicarbonate	540 ppm.
Total dissolved solids	1380 ppm.
Cl	430 ppm.
Cl as NaCl	710 ppm.
Ca	34 ppm.
Mg	25 ppm.

APPENDIX 7

ESSO GIPPSLAND SHELF NO. 1

CORE AND MUD ANALYSIS

by

Core Laboratories Australia Ltd

General

A Core Laboratories Australia Ltd combination drill cuttings and core analysis unit was present at the well site during drilling operations from 767 feet to total depth of 8701 feet.

Using standard equipment plus a Programmed Hydrocarbon Detector (rapid sampling gas chromatograph) the drilling fluid was monitored continuously for hydrocarbon content and the drill cuttings were checked at regular intervals for gas and oil content and lithology. Core analysis was performed by conventional procedures. The results of these operations are shown on the accompanying Grapholog and Coregraph (Plates 3 and 4). Core descriptions are shown on the Grapholog.

Hydrocarbon Shows and Core Analysis

There were no shows of gas or oil from 767 to 3450 feet. From 3450 through 3800 feet high mud gas readings, consisting primarily of methane with some ethane, propane, and butane were logged. Cuttings gas readings were generally low during this interval suggesting a highly permeable reservoir.

From 4800 to 6109 feet samples were generally poor and the gas increases in this interval might be worth further testing if found to be from sand sections. The gas increases from 6550 to 6575 feet and 7825 to 7860 feet appear to be significant and worthy of further investigation. All gas increases from 7860 feet to total depth appear to be of coal and siltstone origin.

Good oil fluorescence was noted only in one-half foot from 8692.5 to 8693 feet. This sample gave an excellent cut in carbon tetrachloride; however, core analysis indicated low permeability.

APPENDIX 8

ESSO GIPPSLAND SHELF NO. 1

LIST AND INTERPRETATION OF ELECTRICAL LOGS

Run No.	Interval (feet)
Induction-Electrical Log	
1	687 - 1599
2	1400 - 3052
3	2974 - 4327
4	2976 - 6103
5	6086 - 7621
6	7421 - 8690
Microlaterolog	
1	688 - 2008
2	1800 - 3050
3	2976 - 4330
4	2974 - 6100
5	6087 - 7622
6	7422 - 8700
Sonic-Gamma Ray-Caliper Log	
1	688 - 2011
2	1800 - 3039
3	2973 - 4318
4	2973 - 6092
5	6085 - 7612
6	7560 - 8685
Laterolog	
1	2974 - 6100
2	6087 - 8699
Continuous Dipmeter	
1	688 - 3049
2	2976 - 6100
3	6086 - 7620
4	7500 - 8685
Cement Bond Log	
1	2604 - 5988
2	3100 - 3478
Gamma Ray-Collar Locator	
1	3000 - 5997

ELECTRIC LOG ANALYSIS

Interval (feet)	Porosity (%)	Rwa Ohms	Fluid Content	Lithology
Gippsland Limestone				
3040-3046	22	0.03	Water	Sandstone
3046-3051	14	0.03	Water	Sandstone
3143-3147	10	0.035	Water	Limestone
Lakes Entrance Formation				
3290-3296	37	0.225(?)	Water	Shale-marl
Latrobe Valley Coal Measures				
3459-3467	30	3.8	Hydrocarbon	Sandstone
3467-3471	31	3.8	Hydrocarbon	Sandstone
3471-3478	33	3.8	Hydrocarbon	Sandstone
3527-3532	35	5.0	Hydrocarbon	Sandstone
3544-3558	2	5.0	Tight	Dolomite
3564-3656	35	5.0	Hydrocarbon	Sandstone
3707-3718	32	8.0	Hydrocarbon	Sandstone
3749-3759	28	8.0	Hydrocarbon	Sandstone
3772-3778	28	7.5	Hydrocarbon	Sandstone
3799-3803	35	8.5	Hydrocarbon	Sandstone
3809-3815	30	9.0	Hydrocarbon/ water	Sandstone
3846-3855	32	2.0	Water	Sandstone
3924-3932	27	2.0	Water	Sandstone
4045-4068	28	1.6	Water	Sandstone
4309-4318	26	1.0	Water	Sandstone
5473-5496	25	1.5	Water	Sandstone
5759-5799	30	1.9	Water/HC?	Sandstone
5935-5943	27	1.7	Water	Sandstone
6300-6311	26	0.045	Water	Sandstone
6731-6757	24	0.045	Water	Sandstone
7199-7261	20	0.045	Water	Sandstone
7514-7570	20	0.045	Water	Sandstone
7845-7854	19	0.045	? HC	Sandstone
8281-8360	20	0.045	Water	Sandstone
8660-8666	20	0.045	Water	Sandstone

APPENDIX 9

ESSO GIPPSLAND SHELF NO. 1

WELL VELOCITY SURVEY

by

K.A. Richards*

Introduction

In anticipation of the short notice which would be given prior to the actual date of the velocity survey of Esso Gippsland Shelf No. 1, Esso entered into an agreement with Western Geophysical Company in January, 1965. In effect, Esso agreed to pay Western a standby fee on the basis that Western would furnish and maintain, at Sale, Victoria, the following equipment:

Two Model GCE101 Pressure Sensitive Well Geophones.

One S.I.E. P-11 Amplifier (12 channels) with Input Switching Unit.

Test Oscillator, and Power Supply.

One Portable Camera (12 trace).

Necessary Batteries and Battery Charger.

Portable Developing System.

Two Blasters (Battery Type 300 volts).

Three Kaar TR 327 Radios (C.B. Type).

Two RC-5 Remote Control Units for Shooters Radio.

Two TA-12 Amplifier Units for Radio Time Break Recording.

Spare parts for above.

In addition Western furnished one instrument operator and one marine shooter five days in advance of the actual planned shooting date. Western also chartered a fishing boat (approximately 50 feet in length) from F.H. Stevens Pty Ltd to act as a shooting boat.

The survey was set up and then cancelled several times due to both operational problems on the Glomar III and bad weather. These cancellations added considerably to the cost of the survey.

Survey Procedures

The survey was eventually carried out on 22nd May, 1965. Weather conditions were very marginal at the start and deteriorated even further during the course of the survey.

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* Esso Exploration Australia, Inc.

Shot Positioning:

Prior to the start of the survey, buoys were placed on both sides of Glomar III at distances of approximately 1000 feet and 1500 feet from the well site. Glomar III was anchored with an approximate north-south orientation and the buoys were on an approximate east-west line passing through the well site. Due to rough weather, several of the buoys broke away, but they were replaced just prior to the survey.

A reference geophone was lowered 25 feet below the water in the moonpool and was used to record the water break.

It had been planned to shoot from the eastern shot points during the run into the hole and the western shot points on the way out. However, the Glomar III provided sufficient protection from the rough weather only for the 1000-foot eastern shot point, thus this was by far the best shot point to use. In fact, during the survey the other shot points, especially on the western side, were considered to be too dangerous to shoot with such a small boat and improvised equipment.

All nine shots were thus taken from the 1000-foot east shot point. Unfortunately the first shot destroyed the buoy at this location, and the distances had to be guessed by the shooter, a task which he performed remarkably well. Actual distances were calculated from the water break, which was the original intention, whether the buoy had remained in position or not.

Charge Size:

It was intended to shoot 25 lb. charges from the 1000-foot positions and heavier charges from the 1500-foot positions. An attempt was made to use the 1500-foot east shot point for a 50 lb. shot but conditions at the time proved too rough.

The whole survey was thus shot with 25 lb. charges in the vicinity of the 1000-foot east shot point.

Well Geophone Positioning:

Schlumberger had been using a specially designed motion compensating device to keep logging tools from moving up and down severely with the motion of the drilling vessel. This device was used during the velocity survey and as far as could be judged, worked well. Schlumberger depths were used in the velocity survey.

Instrument Set Up:

The seismic instruments were set up in a hold of the ship adjacent to the Schlumberger Laboratory. This afforded protection from the wind and spray but resulted in some communications difficulty, and interfered somewhat with the general operation of the Glomar III. Shots were fired in the normal manner.

Instrument Settings:

Seven traces were utilized on the survey records. Traces (1) to (4) recorded the well geophone break. Trace (4) had the highest gain level followed by trace (2), then (1), then (3) which had the lowest. Traces (1) and (2) were recorded with a slightly higher filter setting than (3) and (4).

Traces (5) and (6) recorded the reference phone break. Trace (6) had a higher gain level than (5). Both had a high frequency filter setting.

The time break was recorded on trace (7). The well geophone broke down and the reference geophone broke up.

Results

Nine shots and a polarity check were taken (Fig. 6). Six levels were recorded, the 3458, 5372 and 7550-foot levels being repeated. Copies of the records are available for inspection at the office of the Bureau of Mineral Resources, Canberra.

Fair and certainly reliable breaks were recorded at the 2500-foot level on one run and at the 3458-foot level on both runs. An apparently fair break was also recorded at the 4500-foot level. Below 4500 feet the signal to noise level was very poor and an obvious break could not be identified. However, the choice of a legitimate break narrowed itself down to two or three choices. Each possibility was calculated and plotted.

The noise level was high on all records and got worse as the survey progressed, due undoubtedly to the worsening weather.

The velocity survey results have been plotted on Figure 7. The integrated Sonic Log curve has been tied to the 3458-foot level and also plotted on Figure 7. It is apparent that the 2500-foot level falls very close to the subsequent curve. Also if velocity data from nearest land wells (e.g. Wellington Park No. 1) are used to tie the integrated sonic curve then they also give a close fit to the curve of Figure 7. Thus we are confident that the integrated Sonic Log curve can be tied to an absolute time value using the 3458-foot level.

Unfortunately there our confidence ends. Despite our grading of the quality of the 4500-foot level record, this point falls so far off the curve that it cannot possibly be correct. There is a possibility that 4500 feet was not the depth of the well geophone at this shot. Unfortunately this was one of the two depths at which Schlumberger was not checked by Esso personnel.

As stated above, the deeper levels have poor signal to noise ratios and two of three possible breaks can be chosen. The presence of two records at both the 7550 and 5372-foot levels helps narrow the choice considerably. One of the possibilities from the 7000 and 7550-foot level record falls close to the plotted curve so that in all probability a true break was recorded here.

Conclusions

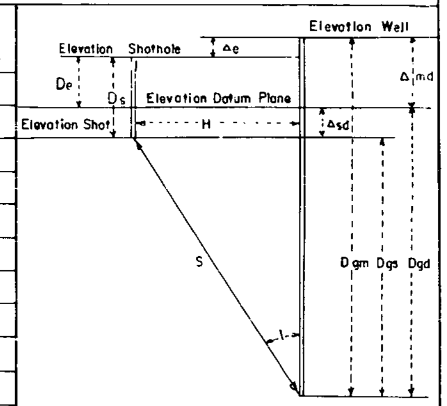
The velocity survey was successful in tying the integrated Sonic Log into absolute time values.

The velocity survey was not sufficiently accurate to check the exactness of the correlation of each individual Sonic Log run.

Fig. 6

	Shothole information:- Elevation, Distance & Direction from Well	Company	Well	Elevation (Derrick Floor)	Total Depth	LOCATION
	④ ③ < 500 × 1000 (×) 1000 × 500 > ② ① → E	ESSO EXPLORATION AUSTRALIA INC.	GIPPSLAND SHELF NO. 1	31 ft.		Coordinates: Lat. 38°16'41"S Long. 147°42'45"E; Section, Township, Range; County; Area or Field

Record Number	Shothole Number	Time of Shot	Dgm	Ds	tus	tr	T Reading	T Polarity	T Grade	Dgs	H	∠ i	log cos i	Tgs	Δsd	Δsd/V	Tgd	Tgd Average	Dgd	Δ Dgd	Δ Tgd	Vi Interval Velocity	Va Average Velocity
9	2	1325	2500	0		0.167	0.334		F	2469	835	18° 41'	$\bar{1}.9764$	0.316			0.316	0.316	2469				7807
1	2	1100	3458	0		0.216	0.463		F	3427	1130	18° 15'	$\bar{1}.9776$	0.440			0.440	0.440	3427	958			7793
8	2	1310	3458	0		0.220	0.462		F	3427	1100	17° 48'	$\bar{1}.9787$	0.440			0.440						
7	2	1300	4500	0		0.211	0.644		F	4469	1055	13° 17'	$\bar{1}.9882$	0.627			0.627	0.627	4469	1042			7131
	Positive break identification was not possible on any level below 4500 ft. due to a reduction ~~in the signal~~																						
	to noise level - However in most cases the choice of a break could be narrowed down to two possibilities -																						
	Because a statistical analysis of these possibilities is enlightening each has been calculated ~~- For a further~~																						
	discussion read the accompanying report.																						
3	2	1135	5372	0		0.221	0.621			5341	1105	11° 41'	$\bar{1}.9909$	0.608			0.608	0.611	5341	872			
"	"	"	"	"		"	0.720			"	"	"	"	0.705			0.705	0.702	"				
2	2	1125	5372	0		0.212	0.625			5341	1060	11° 14'	$\bar{1}.9915$	0.613			0.613						
"	"	"	"	"		"	0.713			"	"	"	"	0.699			0.699						
																				1628			
5	2	1215	7000	0		0.222	0.710			6969	1110	9° 3'	$\bar{1}.9946$	0.701			0.701	0.701	6969				
"	"	"	"	"		"	0.799			"	"	"	"	0.789			0.789	0.789	"				
																				550			
4	2	1155	7550	0		0.235	0.840			7519	1175	8° 53'	$\bar{1}.9947$	0.830			0.830	0.846	7519				
"	"	"	"	"		"	0.910			"	"	"	"	0.899			0.899	0.894	"				
"	"	"	"	"		"	0.749			"	"	"	"	0.740			0.740	0.736	"				
6	2	1225	7550	0		0.204	0.869			7519	1020	7° 43'	$\bar{1}.9961$	0.861			0.861						
"	"	"	"	"		"	0.896			"	"	"	"	0.889			0.889						
"	"	"	"	"		"	0.739			"	"	"	"	0.732			0.732						
10		1345	POLARITY CHECK - T.B. -DOWN; REFERENCE PHONE-UP; WELL PHONE - DOWN.																				



D_{gm} = Geophone depth measured from well elevation

D_{gs} = " " " " shot "

D_{gd} = " " " " datum "

D_s = Depth of shot

D_e = Shothole elevation to datum plane

H = Horizontal distance from well to shotpoint

S = Straight line travel path from shot to well geophone

t_{ue} = Uphole time of shotpoint

T = Observed time from shotpoint to well geophone.

t_r = " " to reference geophone.

Δe = Difference in elevation between well & shotpoint.

Δsd = " " " " shot & datum plane

$\Delta sd = D_s - D_e$

$D_{gs} = D_{gm} - D_s \pm \Delta e$; $\tan i = \frac{H}{D_{gs}}$

$T_{gs} = \cos i\ T$ = Vert. travel time from shot elev. to geophone

$T_{gd} = T_{gs} \pm \frac{\Delta sd}{V}$ = " " " " datum plane " "

$D_{gd} = D_{gm} - \Delta md$

V_i = Interval velocity = $\frac{\Delta D_{gd}}{\Delta T_{gd}}$

V_a = Average = $\frac{D_{gd}}{T_{gd}}$

Surveyed by: Western Geophysical Co.

Date: 22/5/65

Weathering Data:

Casing Record 6081 ft.

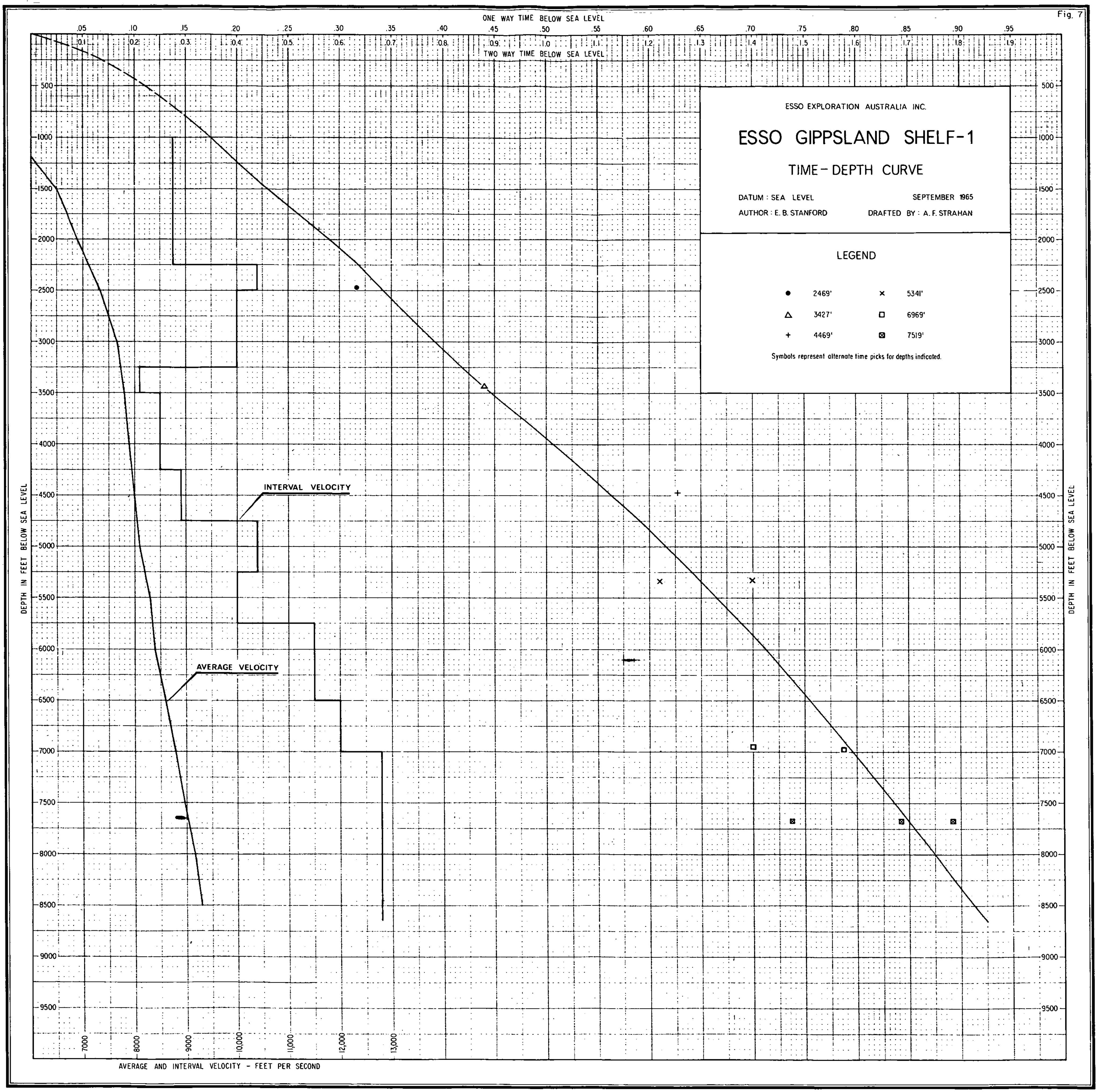


Fig. 7
ESSO EXPLORATION AUSTRALIA INC.
ESSO GIPPSLAND SHELF-1
TIME-DEPTH CURVE
DATUM: SEA LEVEL
SEPTEMBER 1965
AUTHOR: E. B. STANFORD
DRAFTED BY: A. F. STRAHAN
LEGEND
2469'
5341'
3427'
6969'
4469'
7519'
Symbols represent alternate time picks for depths indicated.
ONE WAY TIME BELOW SEA LEVEL
TWO WAY TIME BELOW SEA LEVEL
DEPTH IN FEET BELOW SEA LEVEL
INTERVAL VELOCITY
AVERAGE VELOCITY
AVERAGE AND INTERVAL VELOCITY - FEET PER SECOND

APPENDIX 10

ESSO GIPPSLAND SHELF NO. 1

PRODUCTION TEST RESULTS

Zone No. 1 - Perforated with one jet shot per foot from 3809 to 3814 feet

1. Clean-up Test through Separator

Time (1 hr 55 min.)	1630-1825 hrs
Average Temperature	81.6°F.
Average Differential - Inches of W.C. (Corrected)	22.93"
Average Static Pressure	640 psig.
Range of Separator Pressure	640-670 psig.
Choke Size	1/8" positive
Orifice Plate	1.0"
Range of Flowing Tubing Pressure	1050-1100 psig.
Fluid Recovery (Oil Meter Volumes)	
Rate per last hour of test	345.6 BPD.
During test recovered 35.9 bbl of water (14.9 bbl out of formation)	
Gas per Day	0.69 MMcf.

2. Production Test

Time (2 hr 35 min.)	0825-1100 hrs
Average Temperature	99.4°F.
Average Differential - Inches of W.C. (Corrected)	9.71"
Average Static Pressure	441 psig.
Choke Size	$\frac{32.5''}{64}$
Orifice Plate	2.0"
Range of Flowing Tubing Pressure	670-750 psig.
Fluid Recovery - 750 BPD (Water with trace of distillate)	
Gas per Day	1.63 MMcf.

Zone No. 2 - Perforated with one jet shot per foot from 3752 to 3756 feet

1. Clean-up Test

Time (1 hr 02 min.)	1910-2012 hrs
Average Temperature	55 ^{o}F.
Average Differential - Inches of W.C. (Corrected)	7.8"
Average Static Pressure (Corrected)	597 psig.
Range of Separator Pressure	570-660 psig.
Range of Flowing Tubing Pressure	1350-1480 psig.
Choke Size	16/64"
Orifice Plate	1.50"
Fluid Recovery	
Rate per day at this Gas Rate	17.0 BPD.
Rate per day/MMcf.	17.7 BPD.
Gas per Day	0.96 MMcf.

2. Time (1 hr 05 min.) — 0503-0608 hrs

Average Temperature	54.2 ^{o}F.
Average Differential - Inches of W.C. (Corrected)	48.17"
Average Static Pressure (Corrected)	611 psig.
Range of Separator Pressure	630-740 psig.
Choke Size	20/64"
Orifice Plate	1.50"
Range of Flowing Tubing Pressure	1140-1260 psig.
Fluid Recovery (Oil Meter Volumes)	
Rate per day at this Gas Rate	68.0 BPD.
Rate per day/MMcf.	27.5 BPD.
Gas per Day	2.475 MMcf.

3. Time (1 hr 02 min.) — 0608-0710 hrs

Average Temperature	45.9 ^{o}F.
Average Differential - Inches of W.C. (Corrected)	58.6"
Average Static Pressure (Corrected)	567 psig.
Range of Separator Pressure	560-650 psig.
Choke Size	16/64"

Orifice Plate	1.50"
Range of Flowing Tubing Pressure	1340-1370 psig.
Fluid Recovery (Oil Meter Volumes)	
Rate per day at this Gas Rate	48.7 BPD.
Rate per day/MMcf.	19.2 BPD.
Gas per Day	2.54 MMcf.
4. Time (1 hr 25 min.)	0915-1040 hrs
Average Temperature	50.1°F.
Average Differential - Inches of W.C. (Corrected)	33.5"
Average Static Pressure (Corrected)	583 psig.
Range of Separator Pressure	580-660 psig.
Choke Size	18/64"
Orifice Plate	2.0"
Range of Flowing Tubing Pressure	1090-1290 psig.
Fluid Recovery (Oil Meter Volumes)	
Rate per day at this Gas Rate	75.0 BPD.
Rate per day/MMcf.	20.4 BPD.
Gas per Day	3.67 MMcf.
5. Time (1 hr 17 min.)	1225-1342 hrs
Average Temperature	59°F.
Average Differential - Inches of W.C. (Corrected)	59.7"
Average Static Pressure (Corrected)	603 psig.
Range of Separator Pressure	630-670 psig.
Choke Size	22/64"
Orifice Plate	2.0"
Range of Flowing Tubing Pressure	920-1000 psig.
Fluid Recovery (Oil Meter Volumes)	
Rate per day at this Gas Rate	74.0 BPD.
Rate per day/MMcf.	15.2 BPD.
Gas per Day	4.87 MMcf.
6. Time (2 hr 48 min.)	1512-1800 hrs
Average Temperature	68°F.
Average Differential - Inches of W.C. (Corrected)	17.65"

Average Static Pressure (Corrected)	601 psig.
Range of Separator Pressure	575-660 psig.
Choke Size	28/64"
Orifice Plate	3.0"
Range of Flowing Tubing Pressure	850-1030 psig.
Fluid Recovery (Oil Meter Volumes)	
Rate per day at this Gas Rate	73.5 BPD.
Rate per day/MMcf.	10.7 BPD.
Gas per Day	6.85 MMcf.

Zone No. 3 - Perforated with one jet shot per foot from 3492 to 3497 feet

1. Clean-up Test through Separator

Time (2 hr 45 min.)	1915-2200 hrs
Average Temperature	44.6°F.
Average Differential - Inches of W.C. (Corrected)	34.3"
Average Static Pressure (Corrected)	614 psig.
Average Separator Pressure	635 psig.
Choke Size	3/8" positive
Orifice Plate	2.0"
Average Flowing Tubing Pressure (Range 1200-1300 psig)	1260 psig.
Fluid Recovery (Oil Meter Volumes)	
1900-1930 hrs - fill Separator	
1930-2200 hrs - recovered 6.0 bbl in 2.5 hours	
Rate per day at this Gas Rate	57.6 BPD.
Rate per day/MMcf. (Seas rough. Tank gauges not accurate)	15.4 BPD.
Gas per Day	3.77 MMcf.

2.

Time (1 hr 21 min.)	0654-0815 hrs
Average Temperature	48.9°F.
Average Differential - Inches of W.C. (Corrected)	8.3"
Average Static Pressure (Corrected)	604 psig.
Average Separator Pressure	623 psig.

Choke Size	3/16" positive
Orifice Plate Size	1.50"
Average Flowing Tubing Pressure (Corrected) (Range 1480-1490 psig)	1484 psig.
Fluid Recovery (Oil Meter Volumes)	
0654-0815 hrs - recovered 0.9 bbl in 1 hr 21 min.	
Rate per day at this Gas Rate	16.0 BPD.
Rate per day/MMcf. (Seas rough. Tank gauges not accurate)	16.2 BPD.
Gas per Day	0.985 MMcf.

<u>Summary of Test - Best period of Test</u>

Time (45 min.)	0730-0815 hrs
Average Temperature	45.5^{o}F.
Average Differential - Inches of W.C. (Corrected)	7.7"
Average Static Pressure (Corrected)	607 psig.
Average Separator Pressure	617 psig.
Choke Size	3/16" positive
Orifice Plate Size	1.50"
Average Flowing Tubing Pressure (Corrected) (Range 1485-1490 psig)	1486 psig.
Fluid Recovery (Oil Meter Volumes)	Use same rate as above
Gas per Day	0.948 MMcf.

3\.

Time (1 hr 51 min.)	0950-1141 hrs
Average Temperature	40^{o}F.
Average Differential - Inches of W.C. (Corrected)	35.6"
Average Static Pressure (Corrected)	628 psig.
Average Separator Pressure	642 psig.
Choke Size	3/8" positive
Orifice Plate Size	2.0"
Average Flowing Tubing Pressure (Corrected) (Range 1318-1323 psig)	1321 psig.
Fluid Recovery (Oil Meter Volumes)	
0950-1141 hrs - recovered 2.63 bbl in 1 hr 51 min.	

Rate per day at this Gas Rate	34.1 BPD.
Rate per day/MMcf. (Seas rough. Gauge not accurate)	8.8 BPD.
Gas per Day	3.86 MMcf.

<u>Summary of Test - Best period of Test</u>

Time (56 min.)	1045-1141 hrs
Average Temperature	41°F.
Average Differential - Inches of W.C. (Corrected)	35.2"
Average Static Pressure (Corrected)	636 psig.
Average Separator Pressure	650 psig.
Choke Size	3/8" positive
Orifice Plate Size	2.0"
Average Flowing Tubing Pressure (Corrected) (Range 1318-1323 psig)	1321 psig.
Fluid Recovery (Oil Meter Volumes)	Use same rate as above
Gas per Day	3.89 MMcf.

4. Time (2 hr 48 min.)	1515-1803 hrs
Average Temperature	36.2°F.
Average Differential - Inches of W.C. (Corrected)	15.0"
Average Static Pressure (Corrected)	406 psig.
Average Separator Pressure	435 psig.
Choke Size	$\frac{30.5"}{64}$ adjustable
Orifice Plate Size	3.0"
Average Flowing Tubing Pressure (Corrected) (Range 1075-1250 psig)	1110 psig.

Fluid Recovery (Tank Gauge Volumes)

During the test the Oil Dump Valve cut out. Gas and fluid throttled through valve causing freezing in oil meter. Fairly accurate gauges taken on tank.

1515-1803 hrs - recovered 8.6 bbl of fluid

Rate per day at this Gas Rate	79.4 BPD.
Rate per day/MMcf.	14.8 BPD.
Gas per Day	5.36 MMcf.

Summary of Test - Best period of Test

Time (28 min.)	1735-1803 hrs
Average Temperature	43^{o}F.
Average Differential - Inches of W.C. (Corrected)	17.0"
Average Static Pressure (Corrected)	417 psig.
Average Separator Pressure	446 psig.
Choke Size	$\frac{30.5"}{64}$ adjustable
Orifice Plate Size	3.0"
Average Flowing Tubing Pressure (Corrected) (Range 1105-1115 psig)	1110 psig.
Fluid Recovery (Tank Gauge Volumes)	Use same rate as above
Gas per Day	5.69 MMcf.

5. Time (2 hr 24 min.) — 2232-0056 hrs

Average Temperature	36.5^{o}F.
Average Differential - Inches of W.C. (Corrected)	12.6"
Average Static Pressure (Corrected)	406 psig.
Average Separator Pressure	437 psig.
Choke Size	$\frac{26.5"}{64}$ adjustable
Orifice Plate Size	3.0"
Average Flowing Tubing Pressure (Corrected) (Range 1228-1243 psig.)	1235 psig.

Fuild Recovery (Oil Meter Volumes)

Oil meter placed back in service. Separator was dumped manually during test.

2232-2317 hrs - fill Separator to low dump mark.

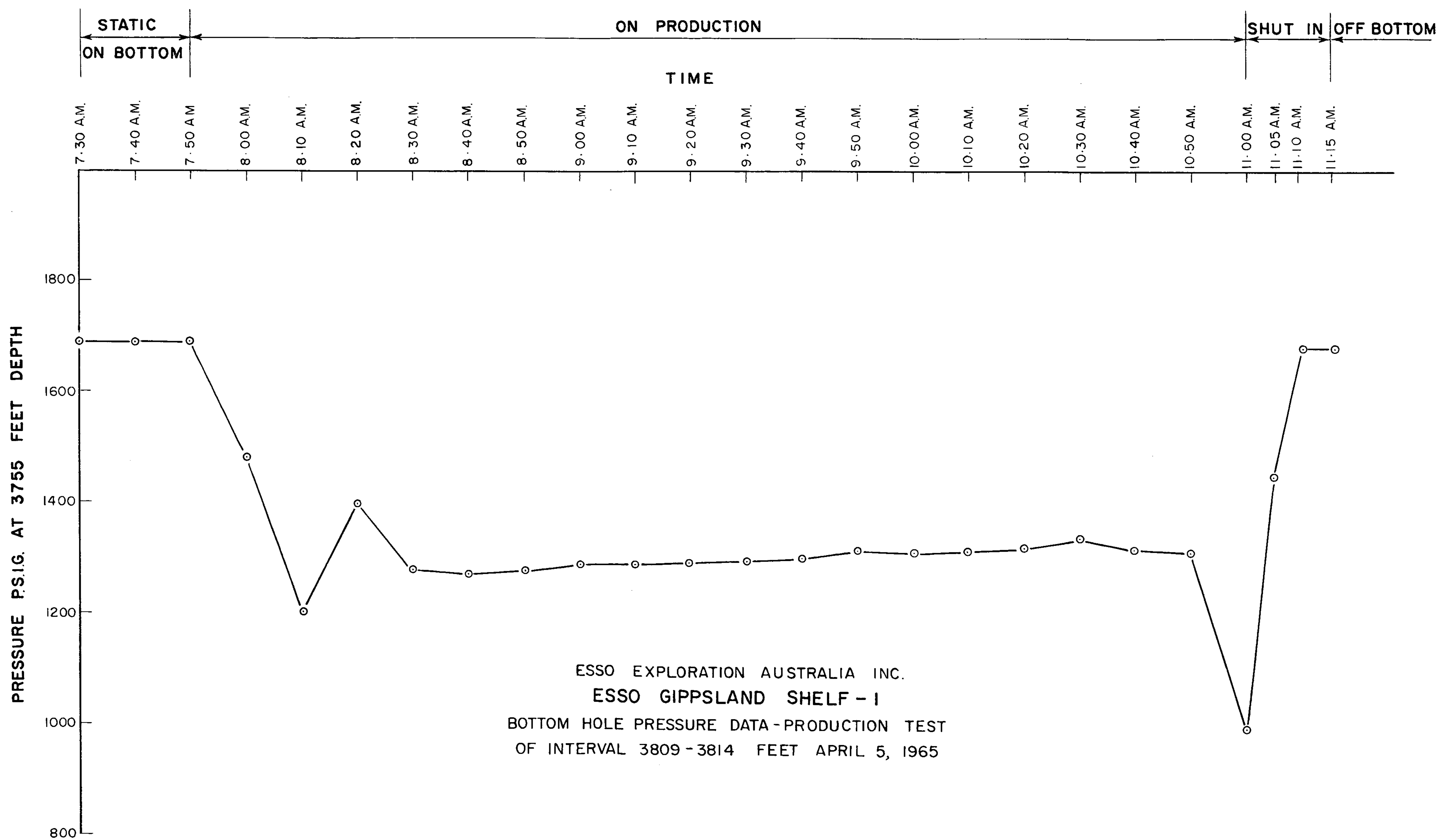
2317-0056 hrs - recovered	3.46 bbl fluid	
End of test dumped to low d. mark	2.02 bbl fluid	
Recovered in 1 hr 39 min.	5.48 bbl fluid	
Rate per day at this Gas Rate		50.3 BPD.
Rate per day/MMcf.		10.2 BPD.

Gas per Day — 4.92 MMcf.

Summary of Test - Best period of Test

Time (31 min.)	0025-0056 hrs
Average Temperature	35.8°F.
Average Differential - Inches of W.C. (Corrected)	12.6"
Average Static Pressure (Corrected)	416 psig.
Average Separator Pressure	445 psig.
Choke Size	$\frac{26.5}{64}$" adjustable
Orifice Plate Size	3.0"
Average Flowing Tubing Pressure (Corrected) (Range 1238-1243 psig.)	1242 psig.
Fluid Recovery (Oil Meter Volumes)	Use same rate as above
Gas per Day	4.92 MMcf.

Fig. 8



ESSO EXPLORATION AUSTRALIA INC.

ESSO GIPPSLAND SHELF - I

BOTTOM HOLE PRESSURE DATA - PRODUCTION TEST
OF INTERVAL 3809 - 3814 FEET APRIL 5, 1965

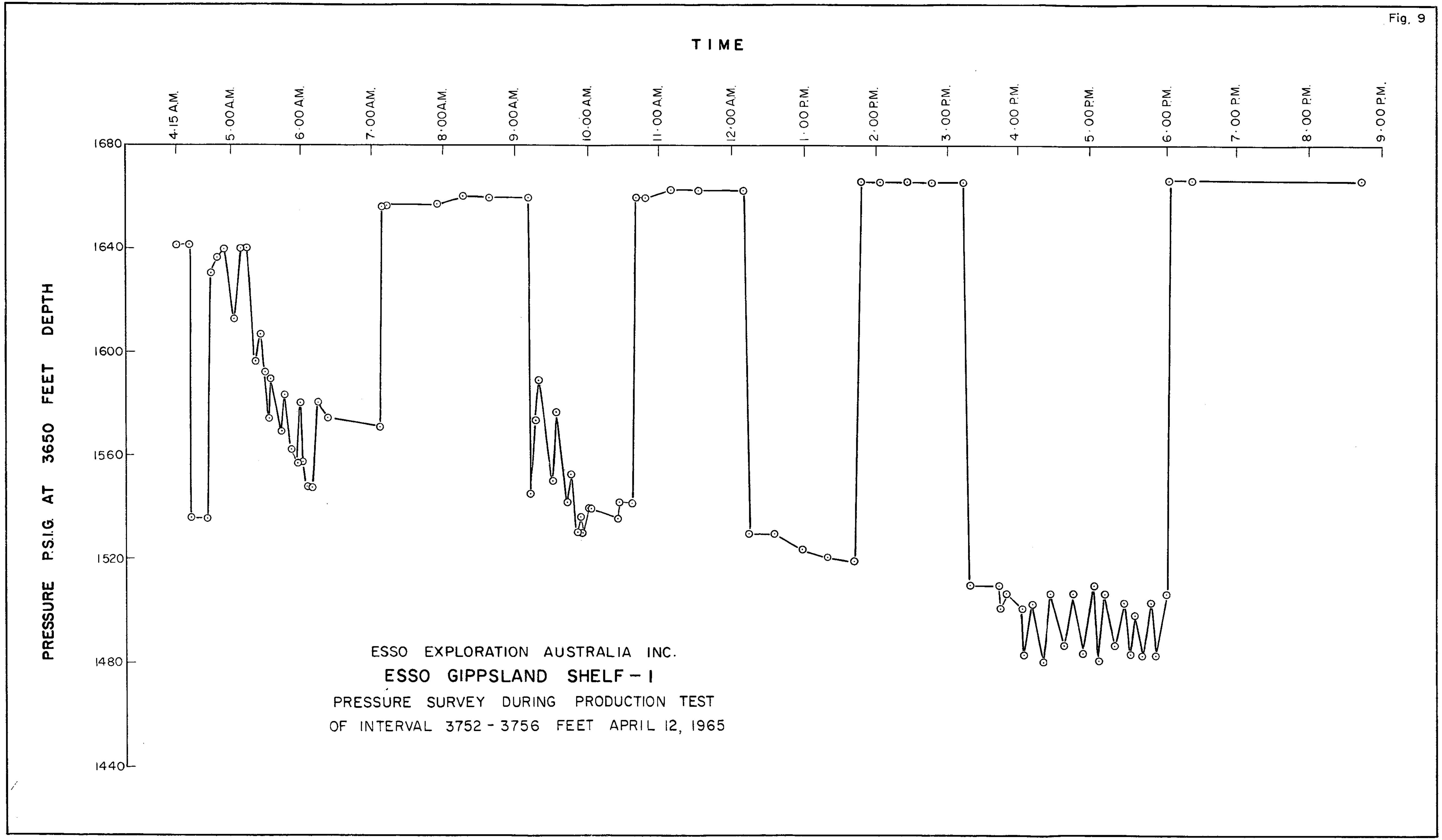
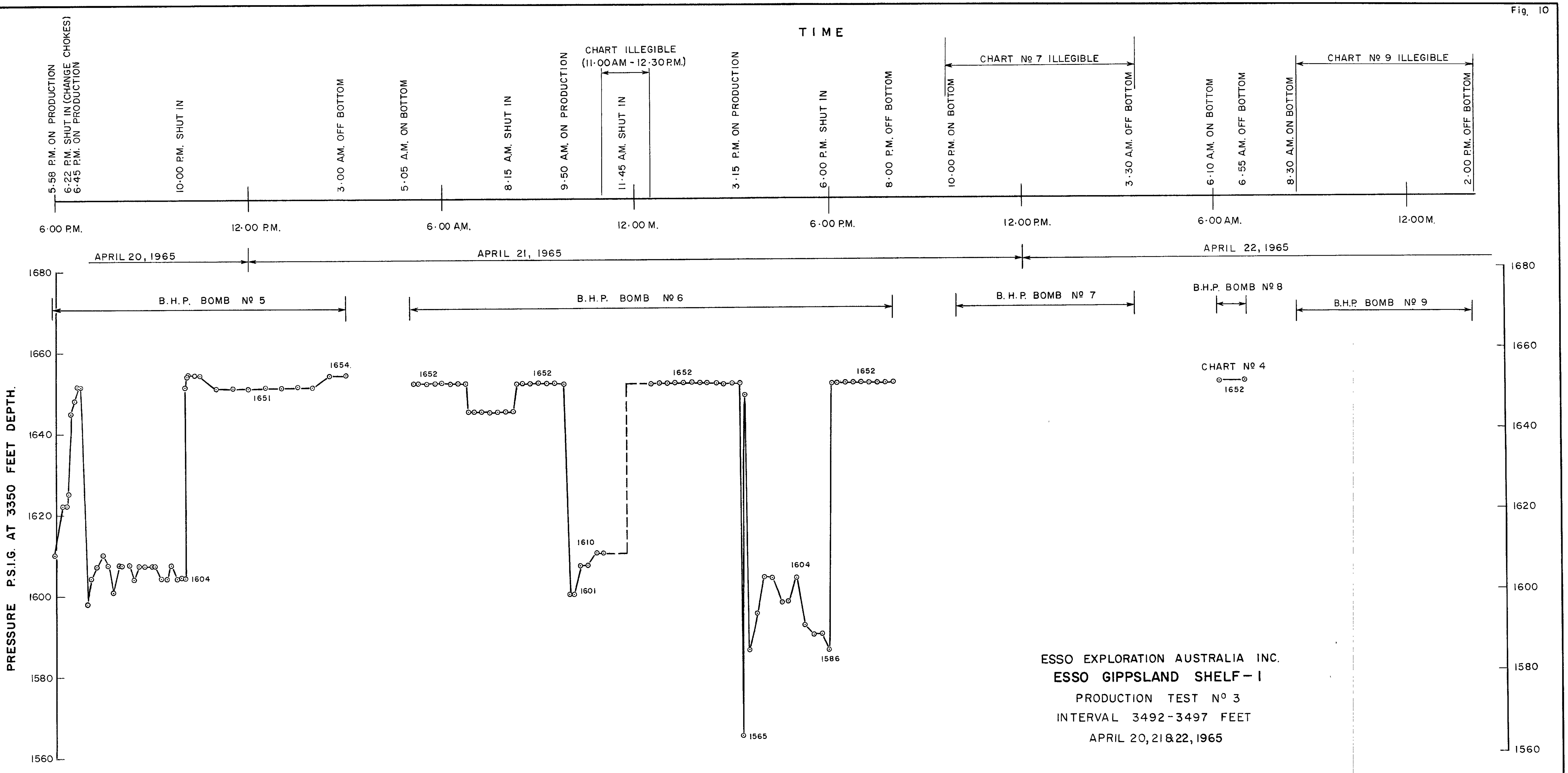


Fig. 9
TIME
4·15 A.M.
5·00 A.M.
6·00 A.M.
7·00 A.M.
8·00 A.M.
9·00 A.M.
10·00 A.M.
11·00 A.M.
12·00 A.M.
1·00 P.M.
2·00 P.M.
3·00 P.M.
4·00 P.M.
5·00 P.M.
6·00 P.M.
7·00 P.M.
8·00 P.M.
9·00 P.M.
PRESSURE P.S.I.G. AT 3650 FEET DEPTH
1680
1640
1600
1560
1520
1480
1440
ESSO EXPLORATION AUSTRALIA INC.
ESSO GIPPSLAND SHELF - I
PRESSURE SURVEY DURING PRODUCTION TEST
OF INTERVAL 3752 - 3756 FEET APRIL 12, 1965

Fig. 10



ESSO EXPLORATION AUSTRALIA INC.

ESSO GIPPSLAND SHELF - 1

PRODUCTION TEST Nº 3

INTERVAL 3492-3497 FEET

APRIL 20, 21 & 22, 1965

APPENDIX 11

ESSO GIPPSLAND SHELF NO. 1

ADDITIONAL DATA FILED IN THE BUREAU OF MINERAL RESOURCES

The following additional data relating to Esso Gippsland Shelf No. 1 Well have been filed in the Bureau of Mineral Resources, Canberra, and are available for reference:

(i) Daily drilling reports for period 19th December, 1964 to 4th June, 1965.

(ii) Schlumberger well logs including the following:

(a) Induction Electrical Log
Run 1, 687 - 1599 feet (2", 5" = 100 ft)
Run 2, 1400 - 3052 feet (2", 5" = 100 ft)
Run 3, 2974 - 4327 feet (2", 5" = 100 ft)
Run 4, 2976 - 6103 feet (2", 5" = 100 ft)
Run 5, 6086 - 7621 feet (2", 5" = 100 ft)
Run 6, 7421 - 8690 feet (2", 5" = 100 ft)
Calibration Curves (2", 5" = 100 ft)

(b) Microlaterolog
Run 1, 688 - 2008 feet (2", 5" = 100 ft)
Run 2, 1800 - 3050 feet (2", 5" = 100 ft)
Run 3, 2976 - 4330 feet (2", 5" = 100 ft)
Run 4, 2974 - 6100 feet (2", 5" = 100 ft)
Run 5, 6087 - 7622 feet (2", 5" = 100 ft)
Run 6, 7422 - 8700 feet (2", 5" = 100 ft)
Calibration Curves (2", 5" = 100 ft)

(c) Sonic-Gamma Ray-Caliper Log
Run 1, 688 - 2011 feet (2", 5" = 100 ft)
Run 2, 1800 - 3039 feet (2", 5" = 100 ft)
Run 3, 2973 - 4318 feet (2", 5" = 100 ft)
Run 4, 2973 - 6092 feet (2", 5" = 100 ft)
Run 5, 6085 - 7612 feet (2", 5" = 100 ft)
Run 6, 7560 - 8685 feet (2", 5" = 100 ft)
Calibration Curves (2", 5" = 100 ft)

(d) Laterolog
Run 1, 2974 - 6100 feet (2", 5" = 100 ft)
Run 2, 6087 - 8699 feet (2", 5" = 100 ft)

(e) Continuous Dipmeter
Run 1, 688 - 3049 feet (2" = 100 ft)
Run 2, 2976 - 6100 feet (2" = 100 ft)
Run 3, 6086 - 7620 feet (2" = 100 ft)
Run 4, 7500 - 8685 feet (2" = 100 ft)

(f) Cement Bond Log
Run 1, 2604 - 5988 feet (2", 5" = 100 ft)

(g) Gamma Ray-Collar Locator
Run 1, 3000 - 5997 feet (2", 5" = 100 ft)

PLATE 1
SHEET 1

ESSO EXPLORATION AUSTRALIA INC., SYDNEY, NEW SOUTH WALES

COMPOSITE WELL LOG OF ESSO GIPPSLAND SHELF-1

PETROLEUM TENEMENT : P.E.P. 38 STATE : VICTORIA 4 MI. SHEET : SALE BASIN : GIPPSLAND WELL STATUS : SUSPENDED GAS WELL

LOCATION : Lat. 38° 16' 41" S Long. 147° 42' 45" E **ELEVATION :** 31' above M.S.L. (Reference point R.T.) Permanent datum M S L. Water Depth 148' **DATE SPUDDED :** December 27, 1964 **DATE DRILLING STOPPED :** May 31, 1965 **DATE RIG OFF :** June 4, 1965 **TOTAL DEPTH :** 8701' (Driller) 8691' (I.E.S.)

DRILLED BY : GLOBAL MARINE AUSTRALASIA PTY LTD. GLOMAR III
DRILLING METHOD : ROTARY
MUD LOGGING CORE LAB
LOGGED BY SCHLUMBERGER
CEMENTED BY HALLIBURTON
WELL HEAD FITTINGS · 13⅝ x 5000 lbs W P Well head cap
W/2" 5000 lbs W.P. valve and marker buoy

HOLE SIZE

SIZE	FROM	TO
36"	RT	302'
26"	302'	741'
17½"	741'	3017'
12¼"	3017'	6109'
8½"	6109'	8678'
7¾"	8678'	8701'

CASING

SIZE	WEIGHT	GRADE	DEPTH	CEMENT	CEMENTED TO
30"	310 lbs 196 "	B-SS	284'	440 Sks. +2% $CaCl_2$	Ocean Floor
20"	104 lbs 167 "	B-SS	687'	1200 Sks. +2% $CaCl_2$	Ocean Floor
13⅜"	54/ lbs	J-55 Butt	2974'	2600 Sks	Ocean Floor
9⅝"	36,40,47 lbs	J-55 N-80	6081'	800 Sks +8% Gel. +0 3% H.R.4	3244' (Bond Log)

PERFORATIONS

TYPE	FROM	TO	No./Ft
Magnajet	3492'	3497'	1
Magnajet	3752'	3756'	1
Magnajet	3809'	3814'	1

CEMENT PLUGS

FROM	TO	CEMENT
205'	330'	50 Sks, 2% $CaCl_2$
3350'	3820'	190 Sks, 2% $CaCl_2$
5980'	6180'	80 Sks, 4% H.R 4
6620'	6820'	70 Sks, 4% H R 4
8497'	8697'	70 Sks, 4% H.R 4

INDUCTION LOG DATA

RUN NUMBER	1	2	4	5	6
DATE	19 JAN, 1965	24 JAN, 1965	26 MAR, 1965	22 MAY, 1965	30 MAY, 1965
FOOTAGE LOGGED	912	1652	3127	1535	1269
LOGGED FROM	1599	3052	6103	7621	8690
LOGGED TO	687	1400	2976	6086	7421
TOTAL DEPTH-ELECTRIC LOG	1600	3053	6104	7622	8691
TOTAL DEPTH-DRILLER	2018	3050	6109	7627	8693
CASING SHOE - ELECTRIC LOG	687	688	2976	6086	6086
CASING SHOE - DRILLER	687	687	2974	6081	6081
BIT SIZE	12¼"	12¼"-8⅝"	12¼"	8½"	8½"
MUD-TYPE		Bentonite	Spersene XP-20 Caustic		
TREATMENT			AS ABOVE		
WATER LOSS ccs/30 min.	15	12·8	6·3	4·1	4
WEIGHT lbs/cu ft	9 7	9 6	11·4	11·4	11 1
VISCOSITY (Marsh) sec.	59	45	42	50	42
ph	7	8	10 7	12·8	10 8
RESISTIVITY Ω m²/m and TEMP °F Rm	0·70 at 64	0 59 at 63	1 77 at 60	0·69 at 80	0 92 at 63
	0 55 at 92	0 36 at 109	0 56 at 190	0 28 at 221	0·25 at 231
Rmf	0·30 at 92	0 38 at 65	0·76 at 64	0·58 at 62	0·7 at 62
Rmc	1 25 at 92	0 46 at 65	0·75 at 190	0 60 at 221	3·45 at 62
MAX RECORDED TEMP °F.	92	109	190	221	231
RECORDED BY	J P.Olivreau	J.P.Olivreau	J P Olivreau	I Strecker	I Strecker

OTHER LOGS

SONIC GAMMA RAY CALIPER (688' TO 8685' RUNS 1 THRU 6)
MICROLATEROLOG (688' TO 8700' RUNS 1 THRU 6)
LATEROLOG (2974' TO 8699' RUNS 1 & 2)
CONTINUOUS DIPMETER (688' TO T D. RUNS 1 THRU 4)
CEMENT BOND LOG (2604' TO 5988' & 3100' TO 3478')

WELL SYMBOLS

Gas show
Oil show
Fluorescence
1·3 v Circulation loss, partial, and s.g mud
1·3 vv Circulation loss, complete, and s.g. mud
1·3 Flow into well and s.g. mud
5 Core, interval, number and recovery
Casing shoe
Perforated interval
Sidewall core
Plugged interval
Blowout
Macro
Micro
Plant
Spore, pollen

LITHOLOGY

Conglomerate
Breccia
Tillite
Quartz sandstone
Arkose
Greywacke
Siltstone
Claystone
Shale
Limestone
Dolomite
Calcarenite
Calcilutite
Marl
Evaporite
Coal
Igneous rocks
Volcanic rocks
Metamorphic rocks
mi Micaceous
cal Calcareous
gl Glauconitic
py Pyritic
c Carbonaceous
ch Cherty

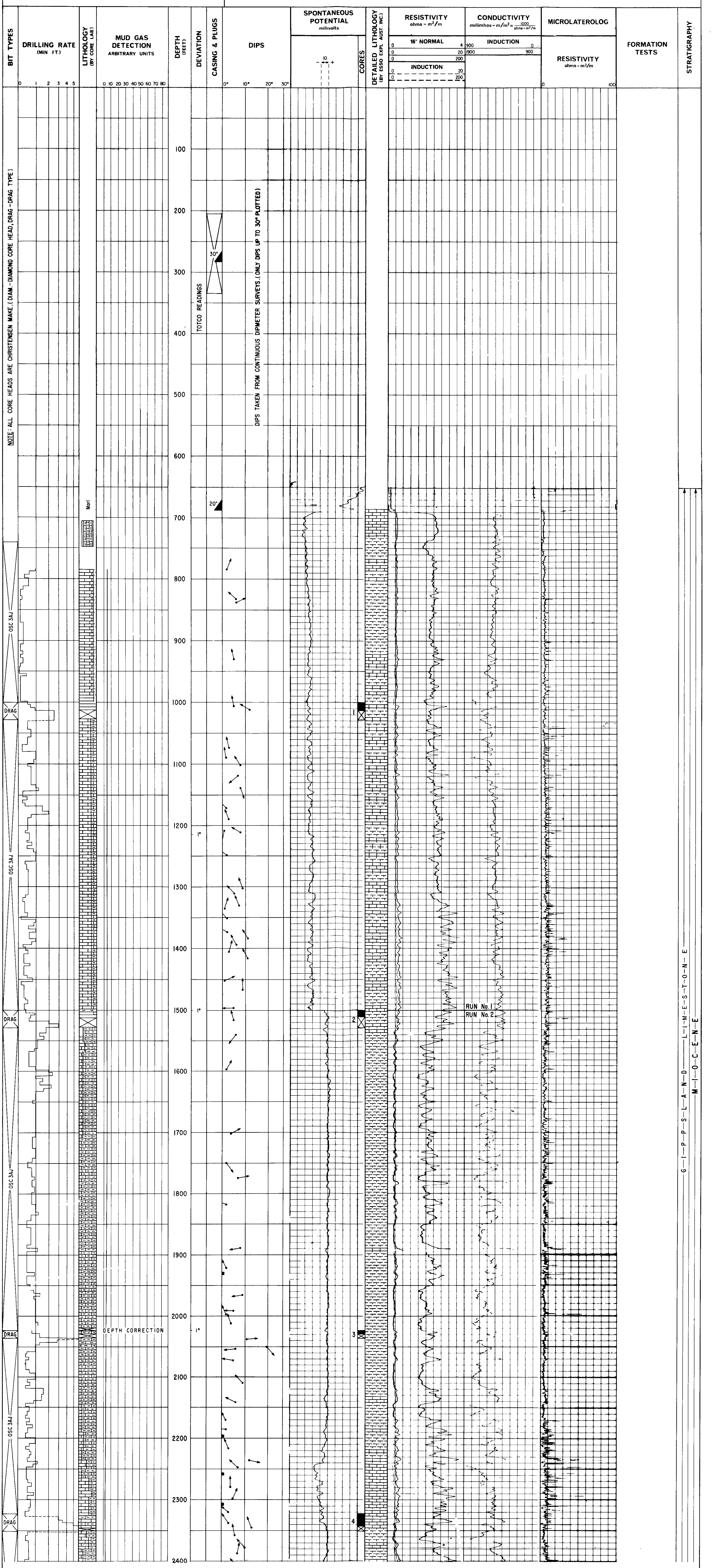


PLATE 1
SHEET 2

ESSO GIPPSLAND SHELF - 1

PLATE 1
SHEET 3

ESSO GIPPSLAND SHELF-1

PLATE 2

ESSO GIPPSLAND SHELF - 1

GLOMAR III

DAILY DRILLING GRAPH

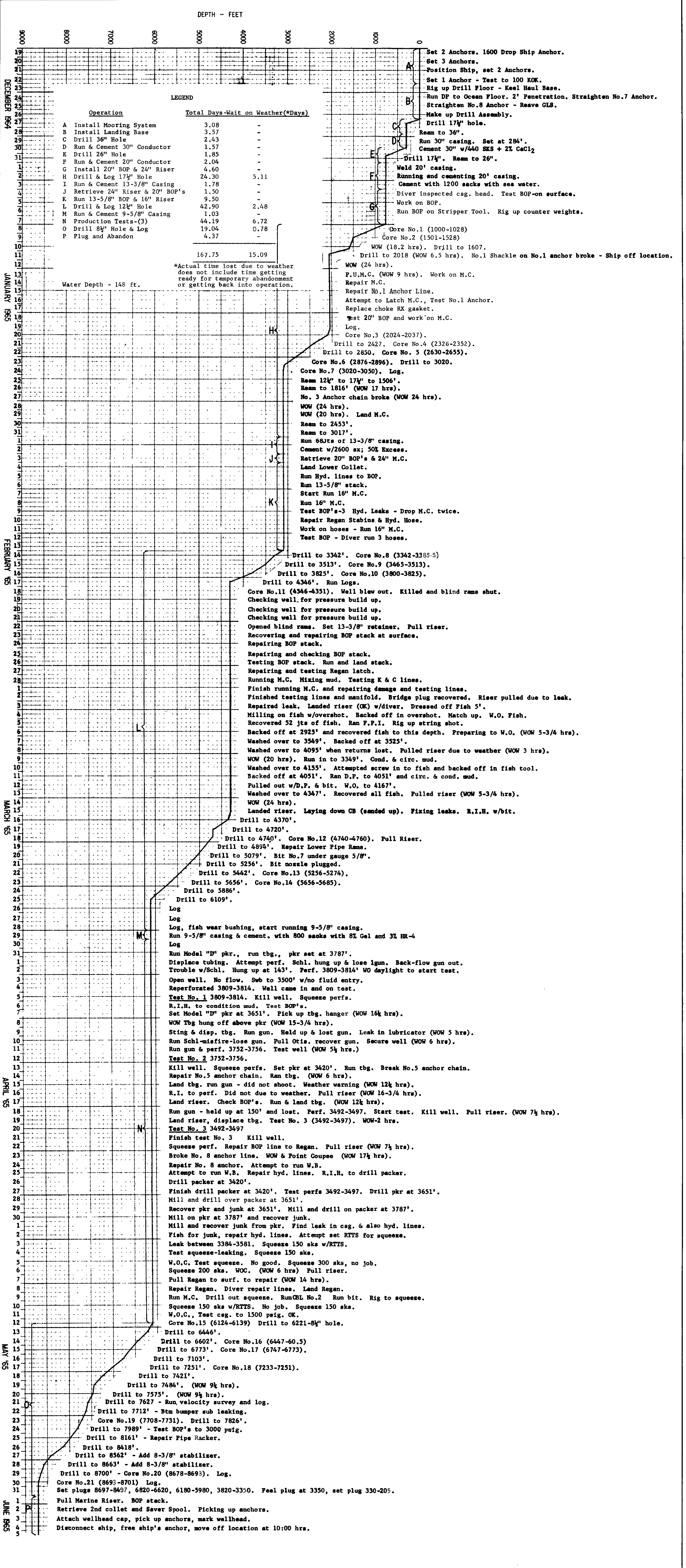


PLATE 3
SHEET 1

CORE LAB Grapholog

CORE LABORATORIES, INC.

COMPANY ESSO EXPLORATION AUSTRALIA, INC.
WELL GIPPSLAND SHELF NO. 1
FIELD WILDCAT
COUNTY
STATE VICTORIA
LOCATION LAT 38° 16' 41 SEC S. ELEVATION 31' K.B.
LONG 147° 42' 45 SEC E.

DEPTH LOGGED FROM 767' TO 8701' FT
DATE LOGGED JANUARY 8, 1965 TO MAY 31, 1965
CREW CHIEF G. JACKMAN-T. HUDSON FILE NO FL-115-1L
DRLG FLUID BENTONITE-WATER TO 782
XP 20-SPERSENE TO 8701 FT

LEGEND

ABBREVIATIONS

NB = NEW BIT
NCB = NEW CORE BIT
CO = CIRCULATED OUT
DST = DRILL STEM TEST
LAT = LOGGED AFTER TRIP
TG = TRIP GAS
NR = NO RETURNS
DS = DIRECTIONAL SURVEY
DC = DEPTH CORRECTION
DEPTHS CORRESPOND TO DRILL PIPE MEASUREMENTS
MEASURED FROM KELLY BUSHING

RESISTIVITY, OHM-METERS
Rm = MUD
Rmc = MUD CAKE
Rmf = MUD FILTRATE

MUD DATA
CK = CAKE THICKNESS 32nds
V = VISCOSITY API SECONDS
F = FILTRATE API CC'S
W = WEIGHT
S = SALINITY, ppm Cl

LITHOLOGY

SAND, SALT, COAL, MARL, CONG, CLAY, DOLOMITE, FELDSPAR, ANHYDRITE OR GYPSUM, SHALE, CHERT, LIMESTONE, CHALK, SILTSTONE

DRILLING RATE MIN/FT [X] FT/HR [ ]

DRILLING ACTIVITY — LITHOLOGY — DEPTH

HYDROCARBON ANALYSIS

HOT WIRE Total Gas — Methane (by difference)
ELECTRONIC Methane (1) Ethane (2) Propane (3) Butane (4) Pentane (5) Hexane (6)

DRILLING MUD: Units/Div. Mol %/Div. — Butane & Pentane 5; Ethane & Propane 10; Methane 50; Total Gas & Methane 10 Units/Div.; Hot Wire

DRILL CUTTINGS: Units/Div. Mol %/Div. — Butane & Pentane; Ethane & Propane; Methane; Total Gas & Methane 10 Units/Div.; Hot Wire

REMARKS

FORMATION DESCRIPTION, MUD DATA, DRILL STEM TESTS, etc.

DRILLING RATE SCALE CHANGES AT 7362'

CHANGES OF GAS SCALE OCCUR AT 3425', 5260'

30" CASING SET AT 284'

20" CASING SET AT 687'

13⅜" CASING SET AT 2974'

9⅝" CASING SET AT 6081'

NB #1 HTC
OSC 3AJ 12¼"

SANDSTONE LT-MED GRY, MED-CRSE GRN, SUB-ROUNDED TO ANGULAR, FRIABLE, VERY CALCAREOUS.

LIMESTONE LT-MED GRY, MICRITIC, POORLY CONSOLIDATED, V FOSS, WITH VARYING TRACE SILT, CLAY, GLAUCONITE.

MARL MED GRY, SOFT, V FOSS, WITH VARYING AMOUNTS OF SILT, CLAY, & LIMESTONE STRINGERS AS ABOVE.

CORE #1 1000-1028'
REC: 14'

NCB 1 CHRISTENSEN DRAG CORE HEAD.

1028-1501'
LIMESTONE AS BEFORE; LT-MED GRY, MICRITIC, SOFT, V FOSS, WITH VARYING TRACE CLAY, SILT, GLAUCONITE. OCCASIONAL QUARTZ, AS COARSE ANGULAR TO SUB-ROUNDED GRAINS.

MARL: AS BEFORE, LT-MED GRY, V SOFT, GUMMY, DENSE, MODERATELY FOSS, CUTTINGS ARE NOT COHERENT AND OCCUR CHIEFLY AS CLAYEY PELLETS.

MUD DATA
MIDNIGHT 9-1-65
W 9.1, V 40, CK 1
WL 17, PH 8, SAND 0.5%
S 7400.

CORE #2 1501-1528'
RECOVERED 10'

MUD DATA
6AM 10-1-65
W-9.4 V-40
F-16 PH-7.6
SD-.5% CK-2
S-7810 APV -12.5
PV-9 YD - 7
INITIAL GEL - 5
10 MIN GEL - 11
%WATER 90
%OIL 0.0
%SOLIDS 10
RMF 0.58 AT 66°F

1528-1710'
LIMESTONE: AS BEFORE.

1528-2018'
MARL: LT TAN-LT OLIVE, V SOFT, DENSE, TRACE FOSS, CUTTINGS NOT COHERENT, MORE CLAY & DECREASING CARBONATE CONTENT WITH DEPTH.

MUD DATA
7AM 11-1-65
W-9.4 V-37
F-12.8 PH-8
SD-4% CK-2
S-8875 APV-10.5
PV-8 YD-7
INITIAL GEL-5
10 MINUTE GEL-12
%WATER 90
%OIL 0.0
%SOLIDS 10
RMF 0.38 AT 76°F

2018-2024'
CORRECTED FOR DRILLER'S DEPTH.

CORE # 3 2024-2037'
RECOVERED 5'

CB#2 CHRISTENSEN DRAG CORE HEAD.

2034-2351'
MARL: LT-MED GRY, AND OLIVE GRY, SOFT, GUMMY-FIRM, TRACE TO VERY FOSS, TIGHT, TRC GLAUCONITE.

2120-2351'
LIMESTONE: VERY LIGHT-MED GRY, SPECKLED, FIRM TO MOD HD, BIOCLASTIC, FINELY CRYSTALLINE CALCITE CEMENT, TRC GLAUC & ARGILLACEOUS, TIGHT, NO SHOWS.

MUD DATA
4.30PM 21-1-65
W-9.2 V-45
F-18 PH-7.2
SD-0.5% CK-2
S-8946 APV-22
PV-18 YD-9
INITIAL GEL -11
10 MIN GEL -25
%WATER-94 %OIL-0.0
%SOLIDS -6
RMF 0.58 AT 68°F

CORE #4 2326-2352'
RECOVERED 21'
B#2 HTC
OSC 3AJ 12¼"

CORE NO. 1 1000-28 CUT 28' REC 14'
TOP 4': Ls, med-lt gy fx, glauc, foss
NEXT 10': Marl, med-lt gy, dse, glauc, foss

CORE NO. 2 1501-28 CUT 27' REC 10'
4' Marl, lt gy, foss
6' Marl, lt gy, sft, sl foss,
LOST BOTTOM 17'

CORE NO. 3 2024-37 CUT 13' REC 5' of Marl, med-dk gy, sl glauc. firm, sl fos
Lost Bottom 8'

CORE NO. 4 2326-52 CUT 26' REC 21'

1'	Marl, med dk gy, sl Glauc
0.5'	Ls, med gy, vy foss tite, hd, tr glauc
4'	Marl, as above
6.5'	Ls, as above, sl arg
2.5'	Marl, as above
3'	Ls, as above
1'	Marl, as above
2.5'	Ls, med gy, fx, sl arg, sl foss tr glauc, hd, dse, N.S.

Lost bottom 5'

PLATE 3
SHEET 2

DRILLING RATE MIN/FT [X] FT/HR [ ]

HYDROCARBON ANALYSIS

REMARKS

FORMATION DESCRIPTION, MUD DATA, DRILL STEM TESTS, etc.

2351-2630'
MARL: AS ABOVE.

2351-2630'
LIMESTONE: AS ABOVE

MUD DATA
5.30AM 22-1-65
W-9.5 V-44
F-16.8 PH-8
SD-0.5% CK-2
S-7100 APV-20
PV-12 YD-16
INITIAL GEL-20
10 MIN GEL-32
%WATER-90 %OIL 0.0
%SOLIDS-10
RMF 0.40 AT 68F°

CORE#5 2630-2655'
RECOVERED 23'

LIMY SANDSTONE: (2630-46'); LT OLIVE GRY; COARSE-V CRSE, SUB ROUNDED, QTZ GRAINS IN 30% WHITE LIMY MATRIX; FAIRLY FRIABLE, TRC GLAUC & FOSS FRAGS
GRADING TO (2646-53)
SANDY LIMESTONE: GRY WH-MED DK GRY, SPECKLED, FIRM, FAIR ARGILL, SLIGHTLY FRIABLE, ABUNDANT FOSS FRAGS.
SANDSTONE: LT-MED DK GRY, V FN-CRSE GRN, FRIABLE, WITH VARIABLE LIMY, SILTY, & ARGILL MATRIX, TRC FOSS FRAGS & GLAUCONITE.

CORE#6 2876-2896'
RECOVERED 10'

2834-2876' ADJUSTED FOR DRILLERS DEPTH

2876-3050'
LIMY SANDSTONE: LT WH GRY-MED GRY; CRSE-V CRSE, SUB ROUNDED-RNDED QTZ; FAIR SORTING, FRIABLE, IN CRYPTOXLLINE LIME MATRIX, VARIABLE GLAUCONITE & FOSS FRAGS, & TRC HEAVY MINERAL GRAINS:
GRADING TO:
LIMY MARL; MED-DK GRY, DENSE: LIMY SILTSTONE: & SANDY LIMESTONE.

MUD DATA
4.30PM 23-1-65
W-9.6 V-40
F-17 PH-7.6
SD-0.75% CK-1
S-7668 APV-13
PV-9 YD-8
INITIAL GEL- 3
10 MIN GEL-20
%WATER-90 %OIL-0.0
%SOLIDS-10 CA++ 320
RMF 0.2 AT 73F°

CORE#7 3020-3050'
RECOVERED 9'

SANDSTONE: LT-MED GRY, MED-CRSE GRN, SUB-ROUNDED-RNDED, AS BEFORE; WITH FINE LIMY MATRIX DOMINANT; LARGELY WASHED OUT.

MARL: AS BEFORE; VERY CALCAREOUS & GLAUCONITIC.

3260-3280'
SHALE: MED GRY-GRY GREEN, SOFT, VERY CALCAREOUS & GLAUC.

MUD DATA
12.30PM 14-2-65
W-9.5 V-41
F-14 PH-8.7
SD-0.5% CK-2
S-11,100 CA++-100
APV-15 PV-10
YD-10 INIT GEL-12
10 MIN GEL-41
%WATER-94 %OIL-0.0
%SOLIDS-6
RMF-0.62 AT 72F°

NCB 3 CHRISTENSEN DRAG CORE HEAD.

CORE #8 3342-3385.5'
RECOVERED 7'

NB#3 HTC
OSC 3AJ 12¼"

SHALE: AS ABOVE, LT GREENISH GRY, V CALC, BUT FIRM, V PYRITIC & GLAUCONITIC. SOME LIME PRESENT AS VEINS & FOSS FRAGS.

CORE #9 3465-3513'
RECOVERED 2'
CUTTINGS FROM THIS INTERVAL SUGGEST FRIABLE SANDSTONE, SHALE, INTERBEDDED WITH MINOR COAL.

NB #4 HTC
OSC 3J 12¼"

*-*GAS CHROMATOGRAPH BREAKDOWN

SANDSTONE: LT WH GRY-V LT GRY; LOOSE & FRIABLE; LOCALLY HARD; MED-V COARSE, SUB RNDED-RNDED, WELL SORTED, GRAINS; WH LIMY CEMENT, LARGELY WASHED OUT, LOCALLY CEMENT IS HARD, DOLOMITIC & POSSIBLY SIDERITIC.

COAL: BRN-BLK, FIRM, VARIABLY SILTY.

MUD DATA
10AM 16-2-65
W-9.7 V-38
F-12 PH-7.5
SD-1% CK-2
S-10,725 CA++-480
APV-15 PV-10
YD-10 INIT GEL-3
10 MIN GEL-20
%WATER-94 %OIL 0.0
%SOLIDS-6
RMF-0.56 AT 80F°

CORE #10 3800-3825'
NO RECOVERY
CUTTINGS FROM THIS INTERVAL SUGGEST LOOSE SANDSTONE, WITH SOME COAL IN THE BOTTOM 10'.

NB #5 HTC
OSC 3GJ 12¼"

MARL: V LT-MED GRY, FIRM, DENSE, TRACE SILT, GLAUCONITE, & PYRITE ESPECIALLY AS FOSSIL CASTS.

COAL: AS BEFORE.

SANDSTONE: AS BEFORE, WH, CLEAR, & TAN, RNDED & SUBRNDED, CRSE-V CRSE GRAINS; WITH CEMENT WASHED OUT.

MUD DATA
10AM 17-2-65
W-9.6 V-37
F-10.0 PH-8
SD-2.25% CK-2
S-9075 CA++-320
APV-12 PV-10
YD-2 INIT GEL-4
10 MIN GEL-12
% WATER-89 %OIL-0.0
% SOLIDS-11
RMF-0.52 AT 70F°

SILTSTONE: MED TAN-BROWN BLACK, FIRM, FISSILE, V CARBONACEOUS, V MICACEOUS.

NCB #4 CHRISTENSEN DRAG CORE HEAD 8⅝"

+ NO RETURNS: WELL BLEW OUT; KILLED WITH CEMENT.

CORE#11 4346-4351'
REC: 2' AGGREGATE OF SAND: V FN-V CRSE, UNCONSOLIDATED; AND COAL: BLACK, WITH BROWNISH STREAK, BLOCKY.

NB#6 HTC
OSC 1GJ 12¼"

SAMPLES THROUGHOUT THE INTERVAL 2655-2834' PROBABLY 42 FEET HIGH

CHANGE OF SCALE UNITS/DIV

4316-4346' CORRECTED TO DRILLERS DEPTH.

CORE NO. 5 2630-55 CUT 25' REC 23'
16' Ss, Calc, lt gy, cse to vy cse, sub-rounded white, clr qtz, glauc
7' Ls, sdy, lt gy, fx, arg glauc, foss & Wh-clr qtz grns (10-40%)

CORE NO. 6 2876-96 CUT 20' REC 10'. calc Ss, lt-med gy, cse-vy cse, sub-rnd, lt-clr qtz grns, fx fair poro perm.

CORE NO. 7 3020-50 CUT 30' REC 9'

2.5'	Ss, Calc, lt-med gy, Clr-wh-cldy, cse-vy cse, glauc, foss
4.5'	Calc Sltstone to marl, med-dk gy, sl foss, sl glauc
2'	Calc Ss-sdy Ls, fx-cse, dirty, foss, glauc

CORE NO. 8 3342-3385.5 CUT 43½' REC 7' of Sh, calc gy-med grn, dse, glauc, sl foss. sme sd grns

CORE NO. 9 3465-3513 CUT 48' REC 2' of brn Coal

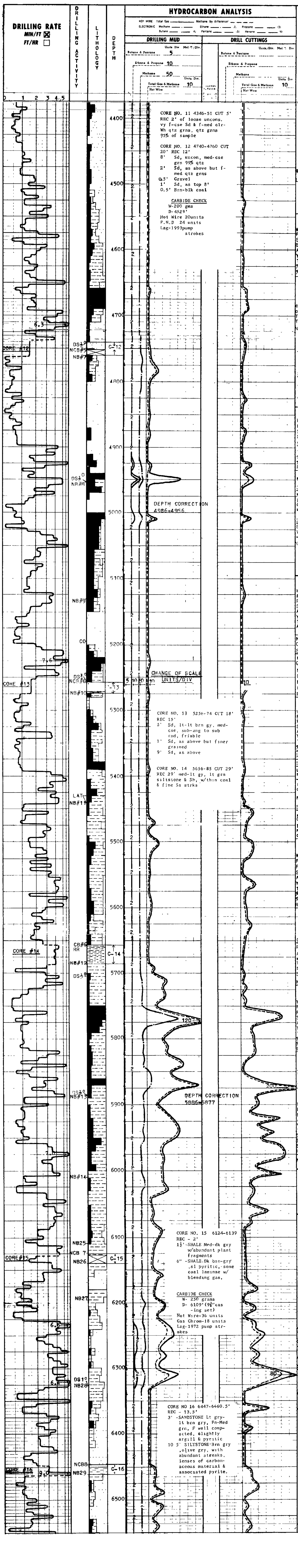
CORE NO. 10 3800-25 CUT 25' REC 0'

PLATE 3
SHEET 3

DRILLING RATE MIN/FT ☒ FT/HR ☐

DRILLING ACTIVITY | LITHOLOGY | DEPTH

HYDROCARBON ANALYSIS



REMARKS
FORMATION DESCRIPTION, MUD DATA, DRILL STEM TESTS, etc.

SAND: CLEAR-WHITE, FN-V CRSE & OCCAS GRANULES, SUB-RNDED-WELL RNDED GRNS; WITHOUT MATRIX.

COAL: AS ABOVE, BLK, BROWNISH STREAK, FIRM; WITH VARIABLE CLAY & SILT CONTENT GRADATIONAL TO V CARBONACEOUS, FNLY LAMINATED, SHALE

SHALE: V LT-MED TAN, V SOFT & PUGGY IN PART, VAR CARBON & GRAD TO COAL.

MUD DATA
3 PM 17-3-65
W-11.5 V-59
F-5 PH-10.8
SD-1% CK-1
S-3795 CA++-200
APV-48 PV-46
YD-4 INIT GEL-4
10 MIN GEL-7
%WATER-83 %OIL-0.0
%SOLIDS-17 ALK-0.35

CORE#12 4740-4760'
RECOVERED 12'
SAND: AS ABOVE, WITH COARSE MICA FLAKES, OCC CARB STREAKS, TRC CLAY MATRIX, & TRC PYRITE.
NCB #5 CHRISTENSEN DRAG CORE HEAD

4760-4800' CAVINGS, (SHALE & COAL), APPEAR HALF+ OF CUTTINGS VOLUME.
SHALE: PALE GRY TO TAN, SOFT (PALE GRY VARIETY HAS SOAPY TEXT), VARIABLE CARB, TRACE PYRITE.

MUD DATA
5AM 20-3-65
W-11.4 V-44
F-5.4 PH-10.8
SD-1% CK-2
S-3300 CA++-160
APV-25 PV-25
YD-0 INIT GEL-2
10 MIN GEL-4
%WATER-85 %OIL-0.0
%SOLIDS 15 ALK 0.45
RMF-0.87 AT 72F°

NB#8 SECURITY M4L
SAND: AS BEFORE, WITH MINOR DEV OF MATRIX; CALCAREOUS, FN GRN, GOOD WH-YELLOW MINERAL FLUORESCENCE
SILTSTONE: BRN-DK BRN, LAMINATED, FIRM, VARIABLY CARBONAC'-EOUS.
NB#7 HTC OSC 1GJ 12¼"

MUD DATA
21-3-65 4.30PM
W-11.6 V-50
F-3.6 CK-2
PH-11.5 SD-2%
S-4332 CA+±160
APV-31 PV-30
YD-1 INIT GEL-4
10 MIN GEL-9
ALK-0.6 RMF-.75 AT 77F°

NB#9 HTC OWV-J 12¼"
SAND: AS ABOVE, WITH INCREASED HARD, FINE GRNED, CALC, MATRIX.
NCB#6 CHRISTENSEN DIAMOND 8⅝
NB#10 HTC OWV-J
CORE#13 5256-5274'
RECOVERED 15'

MUD DATA
7.15AM 22-7-65
W-11.6 V-53
F-4.2 CK-2
PH-10.7 SD-½%
S-3960 CA+±140
APV-37 PV-36
YD-2 INIT GEL-5
10 MIN GEL-5
%WATER-84 %OIL-0.0
%SOLIDS-16 ALK-.45
RMF-0.79 AT 67F°

SAND: AS ABOVE, LOCALLY HARDENED BY INCREASED ARGILLACEOUS AND ESPECIALLY PYRITE CONTENT.
NB#11 HTC OWV-J
SHALE: GRY-GREEN GRY, SOFT, DENSE, TRACE CALC & GLAUCONITIC; ALSO; BRN-DK BRN, FIRM, LAMINATED WITH CARBONACEOUS MAT.

MUD DATA
7.30 PM 23-3-65
W-11.6 V-48
F-5.1 CK-2
PH-10.7 SD-1%
S-3747 CA+±160
APV-26 PV-26
YD-0 INIT GEL-5
10 MIN GEL-9
%WATER-84 %OIL-0.0
%SOLIDS-16 ALK-.45
RMF-0.95 AT 66F°

CORE#14 5656-5685'
RECOVERED: 29' SHALE
AS BEFORE, MED GRY, WITH V MINOR GRAD TO BRN-DK BRN BLK SHALY COAL; & CARB SILTSTONE.
NB#12 HTC OWV-J

MUD DATA
6AM 24-3-65
W-11.6 V-48
F-4.9 CK-2
PH-10.7 SD-½%
S-3795 CA+±140
APV-31 PV-31
YD-0 INIT GEL-4
10 MIN GEL-5
%WATER-83 %OIL-0.0
%SOLIDS-17 ALK 0.4
RMF-0.88 AT 70F°

SHALE: WH GRY-GRN GRY, & TAN-DK BRN BLK, AS ABOVE, PYRITE VARIABLE UP TO 5%.

MUD DATA
10.30AM 25-3-65
W-11.6 V-49
F-5.4 CK-2
PH-10.7 SD-1%
APV-28 PV-28
YD-0 INIT GEL-3
10 MIN GEL-6
%WATER-83 %OIL-0.0
%SOLIDS-17
S-3135 CA±160
RMF-1.02 AT 68F°

NB#13 SEC S6-J 12¼"
NB#14 HTC OSC 1G-J

CARBIDE CHECK
W- 300 GRAMS
D- 6066'
HOT WIRE-20UNITS
GAS CHROMATOGRAPH -30 UNITS
LAG-74 MINUTES (4322 PUMP STROKES)

BITS 15-24(INC)- DRILLED UP PACKERS
NB#25,26,&27 -HTC OWC-J 8½"
NCB#7 CHRISTENSEN CD14
SANDSTONE: LT-MED DK GRY, V FN GRN-FN GRN, FRIABLE, W/ V MINOR ARGILL MATRIX (LATTER IS LARGELY WASHED OUT)

MUD DATA
6.45PM 13-5-65
W-11.2 V-38
F-14.8 CK-2
APV-15 PV-15
YD-0 INIT GEL-3
10 MIN GEL-11
CA+±200 S-6206
%SOLIDS-11 PH-12.3

SHALE: AS BEFORE, LT-MED DK GRY & BRN, TRC TO VERY PYRITIC & CARBONACEOUS.
SANDSTONE: AS BEFORE, BUT LOCALLY MATRIX IS VIRTUALLY ABSENT; V FN-CRSE, SUB ANG, UNCONSOLIDATED GRNS, DOMINANTLY.
NB#28 HTC OWV 8½"
NB#29 HTC OWS
NCB#8 CHRISTENSEN DIAMOND CORE HEAD
SHALE: AS BEFORE, & SILTY IN PART.
6530-6550'
DULL GOLD FLUOR/NO... FROM SANDSTONE, FAIR CUT, IN THIS INTERVAL

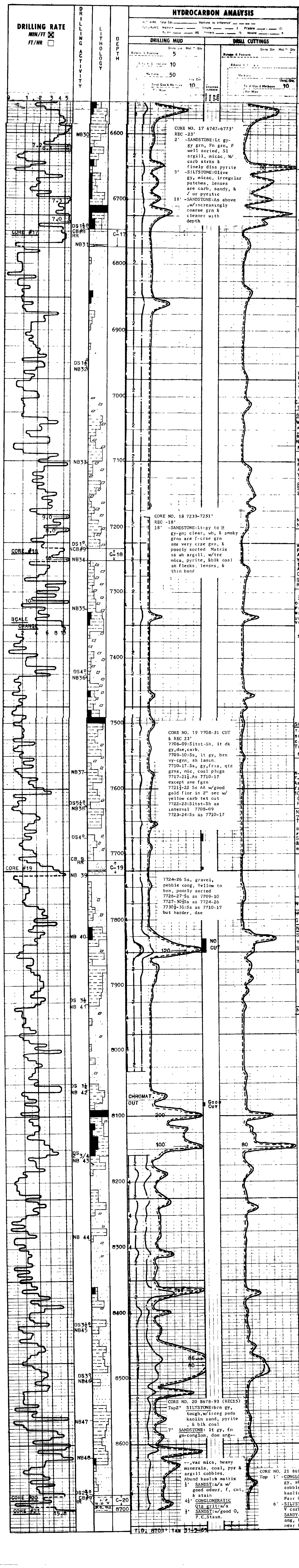
MUD DATA
7.30AM 15-5-65
W-11.4 V-41
F-10.0 CK-3
APV-18 PV-18
YD-0 INIT GEL-1
10 MIN GEL-2
ALK-0.2 CA-160
S-5500 %SOLIDS-10
SD-.2% PH-12.3
RMF 0.52 AT 69F°

PLATE 3
SHEET 4

DRILLING RATE MIN/FT ☒ FT/HR ☐

DRILLING ACTIVITY | LITHOLOGY | DEPTH

HYDROCARBON ANALYSIS



REMARKS
FORMATION DESCRIPTION, MUD DATA, DRILL STEM TESTS, etc.

NB #30 HTC OWV 8½"
NB #31 HTC OWS

MUD DATA
16-5-65 11.30AM
W-11.3 V-40
F-4.7 CK-2
APV-40 PV-40
YD-0 INIT GEL-1
10 MIN GEL-2
ALK-1.0 PH-12.3
CA±+120 S-5500
%SOLIDS-11 SD-0.5%
RMF-0.89 AT 69F°

SANDSTONE: LARGELY UNCONSOLIDATED AS BEFORE; FN TO COARSE GRN & DOMINANTLY COARSE, VARIABLE TRC PYRITE, MICA, & ARGILLACEOUS.

CARBIDE CHECK
W- 300GRAM
D- 7057'
HOT WIRE- 70UNITS
P.H.D.-36UNITS
LAG- 2321PUMP STROKES

MUD DATA
9PM 17/5/65
W-11.5 V-45
F-6.2 CK-2
APV-25 PV-25
YD-0 INIT GEL-6
10 MIN GEL-9
ALK-1.5 PH-12.5
CA+±130 S-3513
%SOLIDS-11 SD-⅛%

SANDSTONE: AS BEFORE W/ADDITIONALLY, ASSOCIATED FELSPAR, WEATHERED, SOFT, & BRITTLE.
NB #32 HTC OSC-J
NB #33 HTC OWC-J

MUD DATA
W-11.5 V-50
F-5.2 CK-1
APV-31 PV-31
YD-0 INIT GEL-4
10 MIN GEL-5
PH-12.8 CA+±120
S-4216 %SOLIDS-15
SD-.4% RMF-.53 AT 70F°
3.30PM 18-5-65

NB #34 HTC OWC-J
NB #35 HTC OWC-J

MUD DATA
12.30PM 19-5-65
W-11.3 V-45
F-4.8 CK-2
APV-23.5 PV-23.5
YD-1 INIT GEL-3
10 MIN GEL-5
ALK-1.0 PH-12.5
CA±90 S-3864
SD-½% SOLIDS-15%
RMF- 0.58 AT 68F°

SANDSTONE: AS BEFORE, WASHED OUT, W/ FELDSPAR, SOFT & WEATHERED, VARYING UP TO 20% SAMPLE VOLUME

NB #36 HTC OWS-J

SHALE: LT-MED DK GY, TAN-BRN BLK; AS BEFORE, VARYING W/ CARBONACEOUS CONTENT TRC PYR, FIRM.
NB #37 HTC OWS-J

MUD DATA
5.45AM 22-5-65
W-11.3 V-50
F-4.1 CK-2
APV-31.5 PV-31
YD-1 INIT GEL-3
10MIN GEL-5 PH-12.8
CA±+200 S-4100
RMF-0.52 AT 68F°

NB #38 HTC OWS-J
7670-7680
TRACE OF BRN CARB, DULL YELLOW FLUOR, FAIR CUT; (DEAD OIL?) SOME SHELL FRAGS, & VUGHS OCCUR, SLOW REACTION TO HCL.

CARBIDE CHECK
W- 300 GRAM
D- 7800'
HOT WIRE 90 UNITS
P.H.D. 40 UNITS
LAG 2550 PUMP STROKES

N.B. #39 OWC
HVY TR. FREE PYRITE GY-BRN SH, SLTST.
N.B. #40 OWS
SLTST: BRN CARB
TR PYRITE
SS: FINE, CONS, ARG, FRIABLE
TR FELDSPAR-PYRITE
SLTST: BRN TO GY CARB
SS; MED TO COARSE SUB ANG-SUB RNDED
N.B. #41 OWC
SS: SME CONS. VF GRN LOOSE MED TO CRSE ANG TO SUB RNDED, CLR QTZ GRNS
SLTST: BRN, GRY, CARB
N.B. #42 OWC.
TR LT GOLD TO YELLOW FLOR W/GOOD CUT
SH, SLTST: GY, BRN, CARB
N.B. #43 OWC
SS: CLR TO WH, FINE TO CRSE, ANG TO SUB-RNDED, UNCON

MUD DATA
W-11.1 V-40
F-3.7 CK-2
APV-19.5 PV-19
YD-1 PH-10.7
GEL 3/4 S-4800
CA-200
RMF-.80 AT 65F°

N.B. #44 OWS
HVY TR COAL
SS: CLR TO WH ANG SUB ANG LOOSE QTZ
TR PYRITE
TR GY SH-TR COAL
SS: AS ABOVE
SS: " " & GY FGRN, BRN SLTY SHLY

NB #45 HTC W7R
SHALE: TAN, BRN-BRN BLK, CARB, PYR, INTERGRADES W/SILTSTONE & V FN GRN SAND.
NB #46 HTC OWS
SANDSTONE AS ABOVE, DOM V COARSE GRN, ANG-SUB ANG.
NB #47 HTC W7R
NB #48 HTC W7R

MUD DATA
W-11.2 V-41
F-3.7 CK-2
APV-18 PV-18
YD-2 INIT GEL-5
10 MIN GEL-6
ALK-0.2 PH-11
CA±+120 S-4684
SD-½% RMF.66 AT 65F°
10PM 29-5-65

CORE NO. 21 8693-8701 (REC 7')
Top 1' -CONGLOMERATE: Lt & med gy, sh & dominant qtz cobbles, in V poorly sort kaolin sandy matrix
Fair O,F,C,S as base C20
6' -SILTSTONE: Brn gy, V tough, V carbon, trc tyr, becoming SANDY-v fn-gran, ang-sub ang, kaol, micac-in lenses near base of interval

PLATE 4
SHEET 1

CORE LABORATORIES, INC. CORE LAB *Petroleum Reservoir Engineering*

COMPANY	ESSO EXPLORATION AUSTRALIA, INC.	FILE NO	FL 115-1L
WELL	GIPPSLAND SHELF NO. 1	DATE JAN 8--MAY 31, 1965	ENGRS T.H.-A.M.-D.N.
FIELD	WILDCAT	FORMATION	ELEV 31' K.B.
COUNTY	STATE VICTORIA	DRLG FLD. XP20-SPERSENE	CORES #4-5-6-7-12-13
LOCATION	LAT 38° 16" 41 SEC. So.	REMARKS	16-17-18-19-20
	LONG 147° 42" 45 SEC. E.		

COMPLETION COREGRAPH

These analyses, opinions or interpretations are based on observations and material supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representations as to the productivity, proper operation, or profitableness of any oil, gas or other mineral well or sand in connection with which such report is used or relied upon.

SAND — LIMESTONE — CONGLOMERATE — CHERT — ANHYDRITE
SHALE — DOLOMITE — OOLITES — MARL — SILTSTONE — COAL

SAMPLE CHARACTERISTICS: F=Fractured L=Laminated FG, MG, CG Type Grain Size S=Stylolitic V=Vuggy

PROBABLE PRODUCTION: O=Oil W=Water G=Gas T=Transitional

*NO PLUG FOR ANALYSIS

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MD (* = Horizontal Perm Plug)	POROSITY %	RESIDUAL SATURATION % PORE SPACE: OIL	RESIDUAL SATURATION % PORE SPACE: TOTAL WATER
1	2327	<.1	9.2	0	53
2	2334	<.1	9.4	0	55
3	2346	<.1	6.8	0	91
4	2631	*	35	0	74
5	2637	598	34	0	72
6	2645	1590	35	0	70
7	2652	132	32	0	87
8	2878	1965	32	0	76
9	2882	2340	37	0	76
10	2885	885	30	0	87
11	3021	135	26	0	87
12	3022	210	20	0	85
13	3029	2	19	0	85
14	4743	*	26	1.9	80
15	4745	*	27	0.7	80
16	4748	3694	30	1.7	79
17	5257	*	30	0	85
18	5259	*	35	1.4	88
19	5261	88	28	1.1	91
20	5263	5	22	0	85
21	5265	54	18	0	69
22	5267	80	24	0	68
23	5269	54	22	3.0	79
24	5271	52	20	0	75

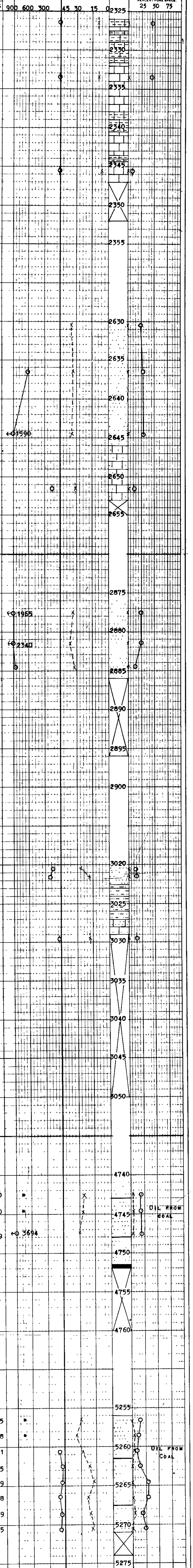


PLATE 4
SHEET 2

CORE LABORATORIES, INC. CORE LAB *Petroleum Reservoir Engineering*

COMPANY	ESSO EXPLORATION AUSTRALIA, INC.	FILE NO	FL 115-1L
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PROBABLE PRODUCTION: O=Oil W=Water G=Gas T=Transitional

*NO PLUG FOR ANALYSIS

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MD (* = Horizontal Perm Plug)	POROSITY %	RESIDUAL SATURATION % PORE SPACE: OIL	RESIDUAL SATURATION % PORE SPACE: TOTAL WATER
25	6448	204	22	0	68
26	6449	476	24	0	77
27	6450	155	20	0	73
28	6752.5	3	10	5.0	80
29	6754.5	2	11	2.2	64
30	6756.5	5	18	1.2	64
31	6757.5	5	13	2.4	68
32	6759.5	*	*	*	*
33	6760.5	4	13	1.8	62
34	6761.5	16	17	0	57
35	6762.5	345	22	0	63
36	6763.5	620	24	0	75
37	6764.5	538	24	0	60
38	6765.5	418	25	0	68
39	6766.5	485	22	0	68
40	6767.5	575	25	0	67
41	6768.5	300	23	0	69
42	6769.5	390	24	0	66
43	7234	16	17	0	59
44	7235	9	18	0	50
45	7236	32	19	0	75
46	7237	250	20	0	73
47	7238	141	21	0	76
48	7239	188	20	0	73
49	7240	137	21	0	73
50	7241	38	19	0	69
51	7242	130	15	0	68
52	7243	8	13	0	52
53	7244	370	17	0	67
54	7245	24	16	0	62
55	7246	58	16	0	56
56	7247	58	13	0	54
57	7248	180	15	0	67
58	7249	109	16	0	69
59	7250	120	18	0	73
60	7251	226	17	0	59
61	7710	6	15	0	77
62	7712	275	21	0	81
63	7713	18	19	0	75
64	7714	156	19	0	68
65	7715	110	20	0	71
66	7716	2	16	0	54
67	7717	20	17	0	72
68	7718	5	16	0	65
69	7719	6	19	0	62
70	7720	66	20	0	71
71	7721	110	20	0	77
72	7722	1	13	0	54
73	7724	11	13	0	55
74	7726	11	7	0	52
75	7727	120	14	0	75
76	7728	78	16	0	79
77	7729	182	18	0	75
78	7730	188	17	0	75
79	8681	7	16	0	55
80	8682	7	18	0	51
81	8683	6	15	0	51
82	8684	1	17	0	55
83	8685	3	17	0	55
84	8686	7	17	0	60
85	8687	1	17	0	55
86	8688	12	17	0	42
87	8689	NOT SUITABLE FOR ANALYSIS			
88	8690	5	19	0	59
89	8691	4	18	0	64
90	8692	5	19	0	54
91	8693	128	18	3.3	52