8 / TAM
6 ENCLOSURES.

ESSO NAUTILUS A-1

FINAL COMPLETION REPORT

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ESSO NAUTILUS A-1

FINAL WELL REPORT

by

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and

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I. SUMMARY

(a) Drilling

This well was drilled in Victorian waters approximately 35 miles off Warrnambool, Victoria and 28 miles off the nearest land. The well drilled in 327 feet of water was spudded at 0700 hours 13 April 1968. The well was abandoned at a depth of 6597 feet at 0800 hours 10 May 1968. This was a total of 27.04 days from spud or 30.53 days from rig release on Prawn A-1-C. The Ocean Digger was towed from the Prawn location, a distance of approximately 54 miles, in 15.25 hours using the Smit-Lloyd 12 and 14. The first anchor was dropped on the Nautilus location at 2100 hours on 11 April 1968.

The Smit-Lloyd work boats supplied the rig from the Portland terminal approximately 60 miles away. Helicopter operations were based at the Warrnambool airport 43 miles distant. Bell 47J helicopters were utilized. As many as three helicopters were used to make crew changes but adverse flying conditions necessitatedtwo crew changes by boat.

Down time was cut to a minimum on the Nautilus location, with only 4.25 hours spent on rig repair, 16.74 hours spent waiting on weather and 24.00 hours on repairs to the under sea gear. Twenty seven hours were lost in restoring the location marker buoys on the Nautilus location. The location buoys originally installed were lost in the storm which caused considerable delay in the abandonment of Prawn A-1-C. There were no significant delays directly attributable to the Cameron sub sea gear on this location, although 36.75 hours were spent trying to obtain a seal on the 13 3/8" hanger and seal assembly, and subsequent tests on the 13 3/8" casing for possible collapse due to failure of the seal assembly. Modification to the riser slings amounted to another 1.50 hours downtime.

(b) Geological

The Nautilus A-1 exploratory test was drilled to test a discrete "fan shaped wedge" which was believed to be lower Oligocene in age and from amplitude and frequency, seismic character was believed to contain an interbedded sand-shale sequence.

At the anticipated interval of this "fan-shaped wedge", the Nautilus A-1 drill encountered a hard, grey to dark grey brown, skeletal limestone interbedded with dark grey, hard, calcareous shale. The presence of up to 20% sponge spicules for most of this interval of interest is the only unique geologic occurrence noted which would serve to differentiate the so-called "fan-shaped wedge" from the sediments above and below. There were no coarse clastics in the zone of interest, and likewise no effective porosity or permeability was observed.

Nautilus A-1 probably penetrated Miocene Port Campbell Limestone at 420' (sea floor depth). Samples were not recovered until depth 1000', so that the Port Campbell Limestone is known to extend from 1000' to 1250'. The Miocene-Oligocene Gellibrand Marl Equivalent extends from 1250' to 5653' and although marly at the top, becomes mainly micritic limestone and shale in the lower part. The top of the Oligocene is placed at 4500' on the basis of the attached micropaleontological report and does not represent a perceptable change in lithology.

A poorly developed Basal Tertiary Sand was noted from 5653' to 5720'. This sand could represent the basal Paleocene Pebble Point Formation, but is more likely to be the basinal edge of the Eocene (Mepunga formation) sand as known in Port Campbell area.

II. INTRODUCTION

(a) Concept of the Prospect

The concept of the prospect was for a discrete and local wedge of sediments, thought to be of Lower Oligocene age, to pinch out updip against older and more regionally distributed basin margin deposits. Numerous reflection events of high amplitude within the wedge indicated the presence of many acoustic boundaries which were thought to be from interbedded sands and shales.

Above and below the wedge widely spaced low amplitude reflection events indicated enclosure by more homogeneous rocks, probably fine grained, transgressive sediments.

The Nautilus A-1 was designed to test the updip edge of this geologically unique wedge of sediments.

(b) Structure

The Nautilus A-1 was located on a small Tertiary structure near the up dip end of the "fan shaped" wedge. (See structure maps, Nautilus A-1, Subsidy Request).
Structure contours on the top of the "fan-shaped" wedge show regional northwest-southeast strike with a southwest dip of 150 feet per mile. There is 100 to 130 feet of closure on this 15 square mile area of minor Tertiary structure. The Nautilus A-1 location was designed to test the structural high crest as well as the depositional thick. The structural high reflected on the top of the wedge is carried on through the wedge on individual beds; the structure on the base of the wedge is complicated by erosional topography.

There are three large channel systems which appeared on seismic to erode into, or through, the "fan-shaped" wedge. They were designated the East Channel, Central Channel and the West Channel. These Channels were outlined and described in the Application for Subsidy, Nautilus A-1.

The East Channel, which is the nearest to the Nautilus prospect, cuts a minimum 500 feet into the top of the 'fan-shaped' wedge. An updip seal for the Nautilus prospect was provided in part by the pinchout of the wedge unit, but mainly by proposed tight channel facies. The Marlin Field in the Gippsland area owes most of its trapping mechanism to such a subsurface channel. Using a minimum channel depth of 500 feet there are 77 square miles of closure with an average of 300 feet vertical section, available at the Nautilus prospect.

III. WELL HISTORY

1. General Data

(a) Well Name and Number: Esso Nautilus A-1

(b) Name and Address of Operator:
Esso Exploration & Production
(Australia) Inc.
G.P.O. Box 4249,
Sydney, N.S.W.

(c) Name and Address of Tenement Holder:
Hematite Explorations Pty. Ltd,
440 Collins Street
Melbourne, Victoria.

(d) Details of Petroleum Tenement: PEP-49 issued by the State of Victoria covering an area of 1,690 square miles. Farmed in by Esso Exploration (Australia) Inc. from Hematite Exploration Pty. Ltd.

(e) District: Otway - Offshore S.W. Victoria

(f) **Location:**	Latitude 38° 58' 40.972 South Longitude 142° 32' 45.744 East At shot point 6550, Line EP-22. Zone 6
(g) **Elevation Permanent Datum:**	Mean sea level Kelly Bushing 93 feet above mean sea level.
(h) **Total Depth:**	6,597 feet
(i) **Date Drilling Commenced:**	April 13, 1968
(j) **Date Drilling Completed:**	May 5, 1968.
(k) **Date Well Abandoned:**	May 10,1968.
(l) **Date Rig Released:**	May 10, 1968.
(m) **Drilling Time to Total Depth:**	23 days (27 days to abandonment)
(n) **Status**	Plugged and abandoned.
(o) **Total Cost:**	To be furnished later.

2. DRILLING DATA

(a) **Drilling Contractor:**	Ocean Drilling & Exploration Co. (Aust.) Ltd. 180 Russell Street, Melbourne, Victoria, 3000.
(b) **Drilling Plant:**	Make: EMSCO Type: A1500E Rated Capacity: 20,000 feet with 5" D.P. Motors: 2-1000 HP D.C. electric motors, also Dynamatic 6032 brake
(c) **Derrick:**	Lee C. Moore 40' x 40' x 142' Cantilever mast, 1,000,000 hook load capacity. (in pounds)
(d)(i)**Pumps:** (4)	Make: EMSCO Type: D-1350 Size: 8" x 18" Motor: D.C. electric direct drive, 1350 HP.
(ii)**Electric Power:**	Two (2) Fairbanks-Morse Model 38 D-8-1/8 O.P. diesel engines, each rated 1800 HP at 720 RPM each driving 2-1200 KW D.C. generators and one 300 KVA volt alternator. One (1) Fairbanks-Morse Model 38 D-8-1/8 O.P. diesel engine rated at 1800 HP at 720 RPM driving 3-1200 KW D.C. generators and one 300 KVA 440 volt alternator.
(e) **B.O.P. Equipment:**	Make: Hydril Cameron Triple "U" Size: 16-3/4" (G.K.) Working Pressure: 5000 psi.
(f) **Hole Sizes and Depths:**	36" to 576' 26" to 1000' 17½" to 2170' 12¼" to 6572' 8 5/16" to 6597'

(g) Casing and Cementing Details

Size	30"	20"	13 3/8"
Weight	30' 300 lb/ft Remainder 196 lb/ft	30' of 167 lb/ft Remainder 105 lb/ft	54.5 lb/ft
Grades	S.S.L.P.	S.S.L.P.	J.55
Range	3	3	3
Set	539' (124' of pipe)	950' (539' pipe)	2137'
Shoes	539'	950'	2137'
Collars	NA	NA	2058'
Centralizes	NA	NA	1st, 2nd and 3rd JTS

Note: Cemented 13 3/8" casing with 1450 sx Australian Portland 6% gel - average slurry 13.7 pounds/gallon followed with 500 sx Australian Portland neat cement average 15.7 pounds/gallon slurry. Displaced with 320 barrels sea water. The plug was bumped with 1000 psi and the float held.

Cemented 20" with 1200 sx Australian Portland cement, with 6% Gel; average slurry 13.5 pounds/gallon. The delivery line from the cement pod failed, so were not able to follow with neat cement tail.

Cemented 30" with 500 sx Australian Portland cement with 6% gel and 3% Ca Cl_2 mixed with sea water. Average slurry 13.5 pounds/gallon.

Weekly Summaries of Mud properties

	Week of April 19th	Week of April 26	Week of May 2
WT	9.5 pounds/gallon	10 pounds/gallon	10.2 pounds/gal.
Viscosity	47 seconds	41 seconds	54 seconds
Fluid loss	9 cc	9.6 cc	8.3 cc
Filter Cake	2/32"	2/32"	2/32"
% Sand	2%	.5%	.5%
% Solid	10%	12%	15%
Oil	NA	NA	NA
P.H.	8	10	10
NaCl	2560 ppm	6600	3300
AlK	0.50	0.28	0.19

(i) Water supply: Fresh water was transported by Smit-Lloyd vessels No. 12 and 14 from Portland.

(j) Perforation Record: No perforations

(k) Plugs

Depth:	2350'-1850'	650'-460'
Cement Sacks:	265	148
Type:	Aust "N" with 3% $CaCl_2$	Aust "N"

(l) Fishing Operations: None

(m) Side-Tracked Hole: None

3. LOGGING AND TESTING

(a) Ditch Cuttings: Cuttings were taken over a normal shale shaker at 10 foot intervals from 1000' to total depth 6597' and at 5 foot intervals during coring if any sample was recovered. All samples were lagged and caught by the mud logging personnel under the supervision of the Esso geologists and are representative of the labelled depths. Representative suites of samples are stored with the Bureau of Mineral Resources, the Victoria Mines Department, Hematite Explorations Pty. Ltd. and with Esso Exploration (Australia) Inc.

(b) Coring: The original coring programme called for the taking of 14 cores - every 300 feet from approximately 2750' to the predicted total depth of 6500 feet. It was later agreed by all concerned to extend this interval to 500 feet.

A total of 10 cores were taken between 2772' and the actual total depth of 6597 feet.

Core	Interval Cored	Feet Cut	Recovery (feet)	Recovery (%)
1	2772-2780	8	8	100
2	2780-2810	30	20	66.2/3
3	3122-3152	30	30	100
4	3656-3672	16	16	100
5	4133-4149	16	16	100
6	4640-4670	30	30	100
7	5175-5205	30	26	87
8	5674-5691	17	4.3/4	28
9	6102-6117	15	15	100
10	6572-6597	25	25	100

A total of 217 feet of core was cut and 190.3/4 feet were recovered.

The coreswere slabbed into three parts. One slab from each core is stored at the Bureau of Mineral Resources, the Victorian Mines Department and with Esso in Melbourne.

(c) Sidewall Sampling: Two runs for sidewall cores were made between 999 and 6377 feet. Of the 60 cores attempted 50 were recovered.

(d) Electrical and Other Logging: Wireline logging was carried out by Schlumberger Seaco. The following logs were run on the Nautilus A-1:-

IES	Interval
Run 1	950'-2209'
Run 2	2137'-6566'
SGRC	
Run 1	950'-2200'
Run 2	2137'-6566'
FDC	
Run 1	2137'-6566'
CDM	
Run 1	2137'-6560'

A wave compensating device was used during all logging operations, to compensate for movement of the platform.

(e) Penetration Rate Log: A record of penetration rate was kept at all times during drilling and is included in this report. (figure 6)

(f) Mud Gas Log: Mud gas logging services were carried out by Exploration Logging Inc. under the supervision of Esso geologists. In addition to the continuous hot wire, a chromatograph was used to detail all mud gas shows. Also a CO_2 analyser was in operation during drilling of the well. Cuttings gas was measured with a Waring blender and recorded.

The cuttings were examined for stain and fluorescence.

The mud gas log is included as part of the composite well log. (figure 4)

(g) Formation Testing: No formation tests were performed.

(h) Deviation Surveys: Deviation surveys were carried out with an Eastman instrument, and the results are plotted on the composite log. Deviations did not exceed 2.5° during drilling of the well.

(i) Temperature Surveys: None, except thermometer run on Schlumberger logs.

(j) Velocity Surveys: A velocity survey was performed at 6597 feet on May 7, 1968, by United Geophysical Corporation. The results are included as an appendix. (figure 5)

(k) Other Well Surveys: None.

(l) Production Testing: None.

IV. GEOLOGY

1. SUMMARY OF PREVIOUS WORK

The search for petroleum has been carried out in the Otway Basin for many years and, although no commercial occurrences of hydrocarbons have been discovered to date, several wells have recorded shows of gas and oil. For example, the Frome-Broken Hill Pty. Limited Port Campbell No. 1 recorded an initial gas flow of 4.2 MMCFD with some condensate from what is believed to be the Upper Cretaceous Waarre Formation. Rapidly declining pressure, however, proved the interval to be non-commercial in this well. An offset Port Campbell No. 4 produced small quantities of oil emulsion with gas cut salt water. More recently, the Shell Development (Australia) Pty. Ltd. Pecten 1A flowed gas at the rate of 90 MCFD plus salt water from a 42' interval of the Waarre Formation.

Other gas shows are of a minor nature except at Alliance Oil Development Caroline No. 1 which produced carbon dioxide from both the Lower and Upper Cretaceous.

Hematite Petroleum Pty. Ltd.

1. Aeromagnetic Survey completed in 1962.
2. 743 miles of single-fold seismic coverage in 1963
3. 1554 miles of 3-fold CDP and 321 miles of single-fold seismic coverage completed in 1965.

Esso Exploration and Production Australia

1. 2364 miles of 6-fold seismic coverage completed in 1966 and early 1967.
2. 970 miles of 6-fold seismic coverage shot in late 1967 early 1968.

Existing Geological Work

A considerable amount of geological work has been done onshore in the Otway Basin (see list of selected references at the end of this section). However, offshore information has come mainly from seismic control in conjunction with geological and geophysical data from the Crayfish A-1, Prawn A-1 drilled by Esso and the Pecten 1A, Nerita 1A and Voluta 1A drilled by Shell Development (Aust.) Ltd.

2. SUMMARY OF REGIONAL GEOLOGY - OTWAY BASIN (Refer figure 1)

The Otway Basin is mesozoic to Late Tertiary, trending east-west across southwestern Victoria into South Australia, almost at right angles to the major trend in the underlying basement rocks, which are probably Paleozoic metasediments deposited in the Tasman Geosyncline.

The Otway Basin encompasses a 33,000 square mile area, and as such is relatively small in size when compared with the similar aged Great Artesian and Murray Basin downwarps.

Otway Basin sedimentation was initiated by sporadic deposition of thick Lower Cretaceous, non-marine, clastics which are locally known as the Pretty Hill sand, and/or the Crayfish sand facies of the Otway Group. At the termination of coarse clastic deposition, these sediments were uplifted and truncated. Typical Merino-Otway Group finer sediments overly the older coarse clastics. Typical Otway Group consists of non-marine greywackes, mudstones and coal deposited in a northwest-southeast trending trough which was parallel to the present coast of Victoria and South Australia from Gippsland to Cape Jaffa.

The Otway Group is unconformably overlain by paralic clastics of the Sherbrook Group of Upper Cretaceous age. At the close of the Upper Cretaceous time the pre-Tertiary rocks were subjected to uplift and erosion and a widespread regional unconformity developed in the Otway Basin.

During Paleocene through to Upper Eocene time gentle subsidence took place in the Otway Basin and up to 4000 feet of predominantly clastic sediments were deposited in an environment ranging from paralic to neritic. In Upper Eocene through Lower Pliocene time, marls and limestones were deposited in the Otway Basin by an overall transgressive sea. Marine conditions persisted into late Miocene time when the transgression reached its fullest extent. During Pliocene time the Otway Basin was subjected to regional uplift which was probably accompained by some gentle folding and faulting. Volcanism was widespread during this time in Tasmania and west-central Victoria. In late Pliocene and Pleistocene time the sea assumed its present position.

Generalized Stratigraphy of the Otway Basin

Paleozoic Rocks

Marine and non-marine Paleozoic sediments, metasediments, metamorphics, intrusive and extrusive volcanics were deposited in the north-south trending Tasman Geosyncline and underlie sediments of the Mesozoic and Tertiary Otway Basin. Four onshore wells, Frome-Broken Hill Ferguson's Hill-1, Pretty Hill-1, Alliance Kalangadoo-1 and Robertson-1 have encountered Paleozoic rocks without a show of hydrocarbons.

The western portion of the old Tasman Geosyncline received up to 10,000 feet of Devonian continental and paralic deposits whereas in western Victoria limestone is predominant. Middle Devonian and older sediments in the Tasman Geosyncline area were highly folded by the Tabberabberan Orogeny.

Permian strata consisting of paralic sediments associated with glacial tillites and cutting across earlier trends attain thicknesses of 2000 to 3000 feet in South Australia. In the Gidgealpa Field of northeastern South Australia gas and condensate are produced from beds of Permian age. The Arco-Woodside Duck Bay-1 well in the Gippsland Basin penetrated approximately 624 feet of sediments which, on the basis of palynological evidence, are considered Permian. These sediments consist of non-marine sandstones interbedded with shale. Most of Tasmania during the late Carboniferous or early Permian was covered by ice. After ice withdrawal during the Artinskian, the sea covered most of Tasmania. By the end of Permian time the seas for the most part had receded. In the Strahan-Point Hibbs area in central westernmost Tasmania over 1400 feet of Permian sediments are exposed and these consist of basal tillites, siltstones and sandstones.

Mesozoic Rocks

Non-marine clastics of Triassic age are fairly widespread onshore in Tasmania. There, Triassic clastics reach a thickness of approximately 4000 feet and contain numerous coal beds. During Jurassic time volcanic activity in Tasmania resulted in local dolerite intrusions which attain thicknesses of up to 1500 feet.

One onshore well, on mainland of Victoria, Planet Oil's Casterton-1, in the Otway Basin, may have encountered a section of Jurassic (?) clastics and dolerites some 1262 feet thick, unconformably overlying Paleozoic slate. This Jurassic consisted of 490 feet of sub-greywacke underlain by dark grey carbonaceous siltstones and chloritic mudstones. The sandstones usually contain abundant matrix material, resulting in very low permeabilities. A clean quartzose sandstone of Lower Cretaceous age was however encountered in the Frome-Broken Hill Pretty Hill-1 well, which exhibited excellent reservoir characteristics. This sandstone unit is 1910 feet thick with measured porosities of 19 to 25%. The permeabilities were very high, ranging from 198 to 2756 millidarcies. More recently, Esso Crayfish A-1 encountered over 5200' of Lower Cretaceous age sands within the Otway Group

The Upper Cretaceous sequence in the Otway Basin was deposited during a major marine transgression and is represented by the Sherbrooke Group. This sequence consists of basal sandstone called the Waarre Formation, an overlying ferruginous sandstone called the Flaxman's Formation which in turn is overlain by carbonaceous mudstones of the Belfast Formation. This mudstone grades upward into shallow water sandstones and siltstone of the Paaratte Formation which facies into the overlying non-marine sandstones of the Curdies Formation.

Tertiary Rocks

The Tertiary section in the Otway Basin attains thicknesses in excess of 6000 feet.

Paleocene to Upper Eocene (Wangerrip Group & Mepunga Fm).

A marine clastic regression deposited lagoonal to shallow neritic mudstones, sandstones and conglomerates during Paleocene to Upper Eocene time. The Wangerrip Group at the base of the Tertiary consists of the Pebble Point Formation, and the Rivernook mudstone member within the Dilwyn Formation, in ascending order. At the top of the Wangerrip Group a regional unconformity is generally recognized and is diachronous from Upper Paleocene to Middle Eocene in age. The Mepunga sands overlying this unconformity represent the last phase of marine regression before the major transgression of the overlying marl limestone sequence. This terminology is primarily for the Port Campbell area, but overall unconformity, clastic deposition and transgression relationships exist throughout the basin. This Paleocene to Upper Eocene section can get up to 4000 feet thick, but was interpreted to be absent in the immediate area of the Nautilus A-1 location.

Upper Eocene to Pliocene

During Upper Eocene to Pliocene time the overall transgression of the sea covers the sandy regressive phase with a thick marl and limestone sequence.

Pliocene to Recent

During Pliocene time, tectonic movement uplifted south-eastern Australia and the sea began to regress. Extensive volcanism also occurred during Pliocene time, resulting in extensive lava flows which now cover large areas of the onshore Otway Basin.

3a STRATIGRAPHIC TABLE

The following stratigraphic nomenclature suggested for Nautilus A-1 is similar to the nomenclature accepted in the Port Campbell area, and correlated on figure 2b.

Water Depth 327'

(Depths Relative to Kelly Bushing - subtract 93' for M.S.L.)

		Interval	Thickness
Water		93'-420'	(327')
Miocene Oligocene			
Port Campbell Limestone fm.		420'*-1250'	(830')
* Note: samples only recovered below 1,000'			
Gellibrand Marl fm		381 1250'-5653'	(4403')
Basal Tertiary Sand		1723 5653'-5720'	(67')
Upper Cretaceous	T.W.T		
Sherbrook Group	(1.285) 5627	5720'-6597'	(877'+)
Belfast Shale fm.		5720'-6597'	(877'+)

3b GENERALIZED LITHOLOGY

Port Campbell Limestone 1000'-1250'

100'-1250'	Calcarenite, fine to coarse grained, white to light grey, fossiliferous, in part Coquina. Traces glauconite lithic sand grains and siltstone. The calcarenite and sand grains represent in general, porous and permeable reservoirs.

Gellibrand Marl Equivalent 1250' (38dm)

1250'-1370'	Calcareous, hard siltstone, light grey to buff. The total rock is believed marly, but the clay fines are washed out.
1370'-1610'	Clayey siltstone with traces fine grained sandstone. Minor traces coal 1470'-1500', 1540'-1550'. Minor traces glauconite.
1610'-2210'	Siltstone, light grey to buff with about 20% loose fossiliferous fragments, mostly very fine bryozoa, becoming very clayey by 1950'.
2210'-2710'	Marl, light grey, soft sticky, very fossiliferous with bryozoans, forams, etc. 20-40% Limestone, buff to light grey; silty, hard, skeletal and micritic.

2710'-2840'	75 to 90% Limestone, micritic-skeletal, to grey hard. The remainder is shale, micritic-skeletal, firm to hard and brittle. Note: D. J. Taylor's report in Appendix (1) notes up to 20% sponge spicules 2800'-4029'.
2840'-3520'	40-60% Limestone, white to light brown to grey, hard, micritic to micritic skeletal. The remainder is shale dark grey, micritic, hard to brittle, micritic skeletal.
3520'-4040'	75-100% Shale, micritic, skeletal, dark grey, brittle to slightly friable. Remainder is Limestone, light grey to greyish brown, micritic-micritic skeletal.
4040'-4080'	Shale, hard to brittle, dark grey brown, micritic, fossiliferous, brittle to friable.
4080'-4550'	50-90% Shale dark grey to dark grey brown; hard to slightly brittle. The remainder is Limestone, light grey, to dark grey brown; micritic and and hard.
4550'-4790'	75-90% Shale, becoming more friable, grey to dark brownish grey, micritic to micritic skeletal. The remainder is Limestone, light grey to greyish brown, micritic to micritic skeletal. The shale below 4600' becomes hard and brittle once again.
4790'-5300'	60-90% Shale, as above, but with more silt to clay sized material. The remainder is Limestone, grey brown to dark grey, micritc.
5300'-5653'	50-100% Limestone, light grey, mainly very finely granular, very hard, skeletal fragments, bryozoans and forams. The remainder is shale, medium grey, very hard and calcareous in part.
	Basal Tertiary Sand 5653'-5720'
5653'-5720'	70-80% Limestone as above 20-30% Sand, clayey, very fine grained to medium grained, subangular to subrounded, with traces glauconite
	Top Upper Cretaceous (Belfast Formation) 5720'-6597' FTD
5720'-6597'	Shale, dark brown to black, non calcareous, medium hard with traces pyrite.

4. STRATIGRAPHY IN NAUTILUS A-1

Miocene

Port Campbell Limestone 1000'-1250' depth

The first sediments encountered below depth 1000' were white to light grey, medium to coarse grained calcarenite which towards the bottom of the section at 1250 feet grades into a marly coquina composed of loose calcareous skeletal debris (mainly bryozoa, echinoid radioles and fragments and foraminifera). Traces of siltstone and sand grains ranging from fine to pebble size indicate occasional thin stringers of sandy siltstone within the limestone.

Gellibrand Marl Equivalent 1250'-5653' depth

The Gellibrand Marl was picked at 1250' on cuttings descriptions. The Upper Gellibrand Marl (1250'-2710') contains thin stringers of hard calcareous siltstone and traces of fine grained sand grains.

It contains abundant fossil fragments as the overlying limestone, with bryozoa dominant. Towards 2700' stringers of buff to light grey skeletal, micritic limestones are interbedded with the marl. The sample descriptions indicate mainly hard calcareous siltstone between 1250'-2700'. However, it was ascertained that much of the clayey material of the marl was washed out of the samples leaving mainly silt material. Very occasional traces of coal were encountered. The Lower to Middle Miocene, Gellibrand Marl, Port Campbell Limestone represent the youngest transgressive sediments in the basin.

At 2707', within the Gellibrand Marl equivalent, a minor lithologic change to hard, grey to dark grey brown, micritic, skeletal limestone interbedded with hard grey brown calcareous shale was noted. This minor lithologic change coincides with a velocity change on the sonic log, and is probably the top of the "fan-shaped wedge" conceived in the Nautilus A-1 pre-drill Subsidy Request.

As noted in D. J. Taylor's Report in Appendix 1, the section from 2800' to 4029' was conspicuous for the presence of up to 20% sponge spicules. The presence of the spicules in this interval is theorized to be a function of differential settling. There is no true base "fan shaped wedge" be picked at or near the pre-drill estimated base. Lithologically, the Gellibrand Marl equivalent consists of interbedded skeletal limestone and shales down to 5653', although the sediments seem less hard and brittle below 4200'.

The Miocene-Oligocene boundary was placed at 4500' on the basis of the attached foraminiferal study by D. J. Taylor. There is no perceptable lithologic change at this boundary.

Basal Tertiary Sandstone 5653'-5720'

A 67 foot thick sandstone body was encountered at 5653 feet; very fine to medium grained, unconsolidated, subangular to subrounded with very fine to fine grains of glauconite. 4 3/4 feet of core was recovered from a zone of siltstone within the section exhibiting a dark brown to black, very shaly non calcareous medium hard siltstone with pyrite (see Appendix 3). The age and correlation of this sandstone body is questionable. Possibly it is a thin seaward extension of the Pebble Point Formation (Paleocene).

It is possible that the sandstone represents Upper Cretaceous sandstone (Upper Sherbrooke Group) as the Upper Cretaceous shale lies beneath it. More probably, this sand represents the seaward edge of the Eocene sand as it clinoforms down onto the Upper Cretaceous unconformity (see Figure 2b).

This sandstone is interpreted to have ineffective porosity and permeability in the Nautilus A-1 well.

Upper Cretaceous

Belfast Fm. 5720'-6597' Total depth

Underlying the Basal Tertiaty Sandstone an erosional unconformity exists. Immediately below this the Belfast Mudstone Formation is penetrated indicating truncation of the Curdies and Paaratte Formations of the Upper Sherbrooke Group. At the Nautilus A-1 location the Belfast Mudstone is composed of dark brown to black shale, non calcareous medium hard with traces of pyrite and mica.

5. STRUCTURE

Nautilus A-1 was located on the crest of a minor domal closure with 100' to 130' effective closure over an area of 15 square miles. This closure was mapped on a horizon which approximates bedding at depth 2700' in the Nautilus A-1 well, on the top of the originally conceived "wedge".

From the results of the dip log (CDM), low angle northerly dips are in evidence from depth 5580' up to depth 4950'. Since northerly dips are opposed to the normal southerly regional dips in the areas, the Nautilus A-1 well must have been located on the north flank of the domal structure, and the northerly dips are probably caused by drape into the East Channel (refer original Nautilus Subsidy Request).

A lack of porosity and permeability within the Tertiary section down grades the significance of the structural aspect.

6. Relevance to the Occurrence of Petroleum

During drilling of the Nautilus A-1 well no significant shows of hydrocarbon were encountered in the mud. Also from the cores and cutting samples no evidence of hydrocarbons was observed.

7. Porosity and Permeability of Section Penetrated

With the exception of 67' of basal Tertiary sandstone no porous sediments were penetrated. One core from the sandstone body 5674'-5691' was cut in a zone exhibiting no porosity or permeability. Log calculations indicate 25-30% porosity in the upper 20 feet of this sandstone and the sand was calculated to be saturated with saltwater. However the section is impermeable judging from sample description and more subtle E-log character.

8. Contributions to Geological Concepts Resulting from Drilling

Prior to drilling the Nautilus A-1 prospect it was inferred from good seismic data that the so-called "fan-shaped" wedge contained interbedded coarse and fine clastic sediments, sealed above and below by fine transgressive marls and shales of Oligocene age. As a result of drilling it was found that the wedge, instead of containing the expected interbedded sands and shales consists of interbedded calcareous shales and limestone and is Miocene in age. As is obvious from the previous discussion, the term "wedge: is no longer applicable to the seismic events mapped, since the base appears gradational.

The documentation of the Oligocene basinal facies, overlying Upper Cretaceous shales, is a signficant contribution to the geology of the Otway Basin resulting from Nautilus A-1 test. The thin sandy zone at the base of the Tertiary is a good regional "fix" for the near pinchout edge of the Tertiary sands documented by many less basinward tests. The shale facies of the Upper Cretaceous points out a basin pinchout of sands and associated porosity and permeability within the Upper Cretaceous rocks.

The new stratigraphic contributions are presented on the figure 2b, (after drilling) section, with further ideas and interpretation by D.J. Taylor (Appendix 1).

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APPENDIX 2

SAMPLE DESCRIPTION

NAUTILUS A-1

SAMPLE DESCRIPTIONS

1000-1010	100%	Calcarenite, white, medium-coarse grain, porous and permeable slight mineral fluorescence, trace glauconite and fine -medium angular, clear quartz grains.
1010-1020		As above.
1020-1030	90%	Calcarenite as above
	10%	Non calcareous grey brown, sandy siltstone with medium quartz grains. Non porous, non permeable. Trace very coarse lithics (very occasional pebble)
1030-1040		As above, cut but probably pipe dope or contamination.
1040-1050	100%	Calcarenite (coquina), very fossiliferous (corals?, bryozoa? shell fragments? forams.) Trace very coarse to pebble, angular, clear, quartz and lithics.
1050-1060		As above.
1060-1070		As above.
1070-1080		As above. Strong trace calcareous siltstone with coarse fossiliferous fragments.
1080-1090	40%	Coquina
	60%	fine grained calcareous arenite, trace calcareous siltstone, with coarse fossiliferous fragments. Very minor glauconite particles. Strong trace lithics as above. Minor fluorescence only.
1090-1100	100%	fine to coarse calcarenite as above. Loosely cemented, porous and permeable, with large fossiliferous fragments. Strong trace glauconite. Trace lithics and quartz. Minor fluorescence only.
1100-1110		As above.
1110-1120	60%	Coquina as above
	40%	Calcarenite as above Trace lithics as above.
1120-1130		As above
1130-1140		As above
1140-1150		As above
1150-1160	90%	Calcarenite as above.
	10%	Calcareous mudstone, light grey, with some fossiliferous fragments and medium clear quartz and lithic grains cemented in; minor fluorescence and strong cut but no stain and no cuttings gas; considered to be contaminated.
1160-1170	90%	Calcarenite as above
	10%	Non calcareous mudstone, light grey. Minor fluorescence
1170-1180	100%	Light grey, medium hard - hard calcareous siltstone, to fine grained calcareous sandstone with larger fossiliferous fragments - shells, corals, mainly porous, permeability fair. Glauconitic. Minor fluorescence only.
1180-1190		As above but mainly medium grained, very fossiliferous, trace lithics and occasional fragments of non calcareous cemented angular clear quartz and lithic grains. Minor fluorescence only.

1190-1120		As for 1170-1180
1200-1210		As above
1210-1220		As above with strong trace of very coarse sandstone with angular quartz and lithic fragments and a light brown muddy matrix. Trace lithics. Strong contamination with pipe dope.
1120-1230	100%	white very fine to medium calcarenite, fossiliferous, glauconitic, porous and permeable. Trace light brown marl. Trace lithics Minor fluorescence only.
1230-1240		As above, no marl.
1240-1250		As above, very fossiliferous, echinoid radioles, corals, bryozoa.
1250-1260		Trace calcareous brown mudstone.
1260-1270		As above, but becoming much siltier, fossiliferous and change in fossil type (a flattened bryozoa).
1270-1280		Calcareous hard siltstone, trace fine grained sandstone, light grey to buff with large fossiliferous fragments, (shells, echinoid radioles, byrozoa, forams.) Trace glauconite, lithics. Minor fluorescence. Porosity and permeability still fair.
1280-1290		As above.
1290-1300		As above
1300-1310		As above.
1310-1320		As above, trace pyrite.
1320-1330		As above, no pyrite.
1330-1340		As above.
1340-1350		As above
1350-1370		As above.
1370-1380		As above, becoming a little finer, more clay fraction so probably less porous and permeable.
1380-1390		As above.
1390-1400		As above.
1400-1420		As above.
1420-1430		As above.
1430-1440		As above, less fossiliferous, no glauconite, slight carbonaceous
1440-1450		As above, very fossiliferous (numerous echinoid radioles) in parts glauconitic, slightly carbonaceous.
1450-1460		As above, less fossiliferous, slight trace glauconite.
1460-1470		As above.

1470-1500		As above, very fossiliferous, bryozoa, corals? echinoid radioles, no glauconite, slight trace pyrite, slight trace coal.
1500-1510		As above, trace glauconite.
1510-1520		As above, no glauconite, trace lithics (chert) and angular, clear quartz.
1520-1530		As above, trace glauconite, strong trace of angular clear quartz pebbles (probably broken up rounded pebbles)
1530-1540		As above.
1540-1550		As above, no pyrite observed, trace coal.
1550-1560		As above.
1560-1570		As above.
1570-1580		As above.
15801590		As above.
1590-1610		As above.
1610-1620	15%	Echinoid radioles. Increase in forams and bryzoa. Total discrete fossiliferous fragments about 25-30%.
1620-1630		As above.
1630-1650		As above.
1650-1660		As above.
1660-1670		As above.
1670-1680		As above.
1680-1690		As above.
1690-1700		As above. About 15-20% fossiliferous fragments mostly bryozoa. Trace of calcareous and chloritic siltstone and trace of brown, non calcareous siltstone.
1700-1710		As above.
1710-1720		As above.
1720-1730		As above, i.e. light grey to buff calcareous siltstone with about 20-25% loose fossiliferous fragments - mostly very fine bryozoa.
1730-1740		As above.
1740-1750		As above.
1750-1760		As above.
1770-1780		As above.
1780-1790		As above.
1790-1800		As above.
1800-1810		As above, trace coal.
1810-1820		As above.
1820-1830		As above.

1830-1840	As above.
1840-1850	As above.
1850-1860	As above.
1860-1870	As above.
1870-1880	As above.
1880-1890	As above.
1890-1900	As above.
1900-1910	As above.
1910-1920	As above, trace pyrite.
1920-1930	As above.
1930-1940	As above.
1940-1950	As above.
1950-1960	Light grey to buff calcareous siltstone and claystone. Samples are very sticky and clayey and show few consolidated grains. Porosity and permeability should be very low, Still contains about 20% loose fossiliferous fragments - mainly bryzoa with occasional echinoid radioles.
1960-1970	As above, difficult to describe because sample consists mainly of loose fossiliferous fragments - as above in sticky clay. Fragments have been broken up in washing.
1970-1980	As above.
1980-1990	As above.
1990-2000	Light grey to buff calcareous siltstone and fine grained sandstone medium hard to hard, fairly porous and permeable, well sorted, fossiliferous. Contains aout 20% loose fossils, mainly fine bryzoal fragments and occasional echinoid radioles. Mineral fluorescence.
2000-2010	As for 1950-1960
2010-2020	As above.
2020-2030	As for 1990-2000 but with a little more clay material.
2030-2040	As above.
2040-2050	As above
2050-2060	As for 1960-1970
2060-2070	Calcareous siltstone and loose fossiliferous fragments, as for 2040-2050.
2070-2080	As above.
2080-2090	As above.
2090-2100	Calcareous siltstone in sticky clay as in 2050-2060 porosity and permeability should be very low.
2100-2110	As above.
2110-2120	As for 2060-2090, calcareous siltstone and loose fossiliferous fragments.

2120-2140	As above.
2140-2150	Calcareous siltstone and clay as in 2090-2110.
2150-2160	As above.
2160-2180	As above.
2180-2200	As above (Clay material does not appear bentonitic.)

2210-2220	100% Marl - light grey, soft, sticky, very fossiliferous with bryozoans, forams, etc. (also high percentage of grey cement)
2220-2230	100% Marl - as above Note: screaming yellow cut believed caused by spersene contaminatio No show on mudlogger.
2230-2240	100% Marl - as above. Not badly contaminated
2240-2250	100% Marl - light grey, very soft, very fossiliferous (bryozoans, echinoid spines, foraminifera etc.)
2250-2260	80% Marl - as above 20% Sand - light grey, friable very calcareous, silty to very fine-grained, soft calcareous clay matrix.
2260-2270	100% Marl; as above, silty becoming silty, buff, skeletal micritic grey limestone
2270-2280	100% Marl - as above, very sticky, "gluey"
2280-2290	100% Marl - as above
2290-2300	50% Marl - light grey, very fossil, soft, silty, "slightly sticky" 50% Limestone - buff to light grey; silty, hard, skeletal, micritic (very fine skeletal material and silt)
2300-2310	75% Marl - as above but "non sticky" 25% Limestone - as above
2310-2320	80% Marl - as above 20% Limestone - as above
2320-2330	100% Marl - light grey, soft and "soupy", scattered fragments of grey silty skeletal micritic limestone.
2330-2340	100% Marl - light grey, soft; very sticky; very fossiliferous; with scattered fragments of silty light grey skeletal micritic limestone.
2340-2350	100% Marl - as above, soft; with scattered fragments of limestone - as above
2350-2360	75% Marl - as above 25% Limestone - buff to light grey, skeletal-micritic, hard
2360-2370	90% Marl - as above "very soupy" 10% Limestone - skeletal micritic, buff hard
2370-2380	90% Marl - as above 10% Limestone - as above
2380-2390	60% Marl - as above 40% Limestone - as above buff-light grey, hard, skeletal micritic
2390-2400	60% Marl - light grey, soft, silty, very fossiliferous 40% Limestone - buff brown to light grey, silty; skeletal micritic hard
2400-2410	75% Marl - as above 25% Limestone - as above
2410-2420	60% Marl - as above 40% Limestone - as above
2420-2430	60% Marl - as above 40% Limestone - as above

2430-2440	50% Marl - as above 50% Limestone - as above, slightly sandy, large fragments
2440-2450	60% Limestone - white to light grey, skeletal micritic, fragments 40% Marl - as above
2450-2460	50% Limestone - white-buff grey, skeletal micritic, hard fragments silty with occasional chloritic mixed. 50% Marl - as above
2460-2470	60% Limestone - as above, very skeletal, hard fragments, occasional chloritic mineral 40% Marl: as above
2470-2480	50% Marl - as above 50% Limestone - as above
2480-2490	70% Marl - as above grey, silty, very fossiliferous 30% Limestone - as above
2490-2500	60% Marl 40% Limestone
2500-2510	70% Limestone - white to light grey, skeletal micritic limestone, very fossiliferous, large fragments and unconsolidated fossils. 30% Marl - as above
2510-2520	60% Marl - as above 40% Limestone - as above
2520-2530	60% Marl - as above 40% Limestone - as above
2530-2540	60% Limestone - as above; 1 fragment of limestone has specks of pyrite 40% Marl - as above
2540-2550	90% Marl - grey; soft; sticky; very fossiliferous 10% Limestone - white to buff grey; skeletal micritic; large fragments of limestone and loose unconsolidated fossiliferous fragments.
2550-2560	75% Marl - as above 25% Limestone - as above
2560-2570	60% Limestone - light grey to brown, very hard large fragments, skeletal micritic, silty 40% Marl - as above
2570-2580	70% Marl - as above 30% Limestone - as above but large fragments of white skeletal micritic hard limestone with "chlorite" streaks present
2580-2590	80% Marl - as above 20% Limestone - as above
2590-2600	80% Marl - as above 20% Limestone - as above
2600-2610	75% Marl - as above 25% Limestone - as above
2610-2620	75% Marl - as above 25% Limestone - as above
2620-2630	80% Marl - as above 20% Limestone - as above and unconsolidated fossiliferous fragment; 1 large fragment of orange chert and another of black chert.
2630-2640	75% Marl - as above 25% Limestone - as above

2640-2650	60% <u>Marl</u> - as above 40% <u>Limestone</u> - as above with large limestone fragments partially coated with manganese.
2650-2660	75% <u>Marl</u> - as above 25% <u>Limestone</u> - as above
2660-2670	90% <u>Marl</u> - as above 10% <u>Limestone</u> - as above
2670-2680	60% <u>Marl</u> - light grey, very fossiliferous, soft 40% <u>Limestone</u> - light grey, to buff brown, micritic skeletal, hard large fragment and unconsolidated shells.
2680-2690	75% <u>Marl</u> - as above 25% <u>Limestone</u> - as above
2690-2700	75% <u>Marl</u> - as above 25% <u>Limestone</u> - as above
2700-2710	90% <u>Marl</u> - as above 10% <u>Limestone</u> - as above
2710-2720	60% <u>Limestone</u> - grey to dark grey, micritic to micritic skeletal, <u>hard, less fossiliferous</u>; one "huge" large textularia 40% <u>Marl</u> - as above
2720-2730	60% <u>Limestone</u> - as above 40% <u>Marl</u> - as above
	All above samples examined from Blend er
2730-2740	75% <u>Limestone</u> - grey to dark grey brown, finely crystalline, micritic-skeletal, hard large fragment, numerous textularias, silty, almost calcareous mudstone 25% <u>Marl</u> - grey, soft, very fossiliferous Note: The white to buff skeletal-micritic limestone seems to be absent now. Section is changing.
2740-2750	75% <u>Micritic-skeletal limestone to micritic shale</u> - dark grey as above; brittle, hard, fewer fossils; as above 25% <u>Marl</u> - as above
	Last two samples definitely different; marl is almost gone. The last 2 samples washed up very well
2750-2760	90% <u>Micritic shale and micritic skeletal limestone</u> - as above 10% <u>Marl</u> - as above
2760-2770	90% <u>Micritic skeletal and micritic shale</u> - as above 10% <u>Marl</u> - as above
2770-2772	90% <u>Micritic skeletal limestone and micritic shale</u> - as above 10% <u>Marl</u> - as above See Core No. 1 and Core No. 2 Description
2800-2810	100% <u>Micritic-shale and micritic skeletal limestone</u> - dark grey to grey brown, hard limestone fragment, brittle shale fragment slightly pyritic.
2810-2820	50% <u>Limestone</u> - micritic-skeletal to micritic; grey; hard 50% <u>Shale</u> - micritic-skeletal; firm to hard, brittle
2820-2830	75% <u>Limestone</u> - as above - very micritic; few fossils 25% <u>Shale</u> - as above
2830-2840	75% <u>Limestone</u> - as above, very micritic; few fossils 25% - <u>Shale</u> - as above

2840-2850	60% Shale -grey to green-grey; very fossiliferous and calcerous 40% Limestone - grey to white, micritic to skeletal-micritic hard large fragments
2850-2860	50% Shale - dark grey to brown-grey, hard-brittle, micritic-skeletal 50% Limestone - grey to brown grey, micritic to micritic-skeletal; hard
2860-2870	60% Shale - as above 40% Limestone - as above
2870-2880	60% Shale - as above 40% Limestone - as above
2880-2890	60% Limestone - as above 40% Shale - as above
2890-2900	60% Shale - as above 40% Limestone - as above
2900-2910	75% Shale - dark grey, micritic, hard-slightly brittle 25% Limestone - light grey to brown grey; micritic-micritic skeletal very hard; occasional fragment of white micritic limestone - hard
2910-2920	60% Limestone - white to light grey brown; micritic, few fossils, very hard, large fragment; abundant white limestone fragments. 40% Shale - dark grey, hard to brittle, micritic, occasional fossils
2920-2930	50% Limestone - as above 50% Shale - as above
2930-2940	60% Limestone - as above less white limestone 40% Shale - as above
2940-2950	60% Shale- as above 40% Limestone - as above
2950-2960	60% Limestone - white to light brown grey; hard, micritic to micritic skeletal 40% Shale - dark grey, micritic, hard to brittle; micritic skeletal
2960-2970	60% Limestone - as above 40% Shale - as above
2970-2980	50% Limestone - as above 50% Shale - as above Note: No pyrite observed
2980-2990	60% Limestone - as above 40% Shale - as above
29903000	50% Limestone - as above 50% Shale - as above
3000-3010	50% Limestone - as above 50% Shale - as above
3010-3020	60% Shale - as above 40% Limestone - as above
3020-3030	50% Shale - as above 50% Limestone - as above
3030-3040	60% Shale - as above 40% Limestone - as above
3040-3050	75% Shale - dark grey; micritic to micritic skeletal, hard to brittle 25% Limestone - as above
3050-3060	60% Shale - as above 40% Limestone - as above, one fragment streaked with pyrite

3060-3070	60% Shale - as above 40% Limestone - white-light grey brown; micritic to micritic skeletal. The white limestone is micritic-skeletal while dark limestone is micritic, very hard large fragments.
3070-3080	60% Shale - dark grey, micritic to micritic skeletal, hard to brittle; more soft clay in sample 40% Limestone - as above
3080-3090	75% Shale - as above but soft clay becoming abundant 25% Limestone - as above
3090-3100	90% Shale - as above, abundant sticky clay 10% Limestone - as above
3100-3110	90% Shale - dark grey; calcareous, very fossiliferous, brittle to friable abundant clay 10% Limestone - as above
3110-3120	75% Shale - dark grey to light grey; micritic skeletal, hard to brittle, occasionally soft to friable 25% Limestone - as above
	See Core No. 3 Description
3150-3160	50% Micritic Shale - dark grey to grey-brown, slightly skeletal (bryozoans) hard to brittle 50% Micritic Limestone - light grey to brown grey; very hard
3160-3170	60% Shale - as above 40% - Limestone - as above
3170-3180	75% Shale - dark grey to brownish grey; micritic; slightly skeletal with numerous bryozoans; very hard to brittle; large fragments. 25% Limestone - light grey to greybrown; micritic to micritic skeletal very hard large fragments.
3180-3190	75% Shale - as above slightly more brittle and softer 25% Limestone - as above
3190-3200	75% Shale - as above 25% Limestone - as above
3200 -3210	60% Shale - as above 40% Limestone - as above
3210-3220	60% Shale - as above 40% Limestone - as above
3220-3230	50% Shale - as above 50% Limestone - as above
3230-3240	50% Shale - as above 50% Limestone - as above
3240-3250	60% Limestone - white to light grey brown; micritic; slightly skelet very hard 40% Shale - dark grey, micritic to micritic skeletal, hard to brittl
3250-3260	60% Limestone - as above 40% Shale - as above
3260-3270	50% Limestone - as above 50% Shale - as above
3270-3280	60% Limestone - as above, more white micritic skeletal limestone 40% Shale - as above
3280-3290	50% Limestone - as above; large fragments of bryozoan fragments, with glauconitic flecks present 50% Shale - as above micritic skeletal etc. Note increase of C_1 to 240 ppm

Number	Depth	Recovery	Description
1	670.56 2200'	2"	Marl, greenish grey, medium hard, very fossiliferous, tight, clayey. No fluorescence. no cut.
2	2199'	2"	As above.
3	2016'		No Recovery
4	2015'	2"	Calcarenite, buff, fairly friable, fine - medium grain, fossiliferous, good porosity, and permeability. No odour, no stain, no fluorescence, no cut.
5	1965'	2"	Marl, greenish grey, medium hard, very fossiliferous, tight, clayey, no fluorescence, no cut.
6	1964'	2"	As for no. 5.
7	1800'	2"	As for no. 5.
8	1799'	2"	As for no. 5.
9	1690'	2"	Calcarenite, buff, friable, silty,- fine grained, fossiliferous, trace glauconite, good porosity and permeability. No odour, no stain, no fluorescence, no cut.
10	1689	2"	Calcisiltite; as above but finer and containing a greater clay fraction.
11	1570	2"	As for no. 5.
12	1569	2"	As for no. 5.
13	1430		No Recovery
14	1429	2"	Calcarenite as for no. 9.
15	1385	2"	Marly calcarenite, green grey, medium hard, moderately friable, probably fairly tight, appears silt chocked, silty to fine grained, No odour, staining, fluorescence or cut.
16	1384	2"	As for no. 15
17	1175	2"	Calcarenite, buff, very friable, soft, fine to medium grained, fossiliferous, very porous and permeable. No odour, staining, fluorescence or cut.
18	1174	2"	As above.
19	1097	2"	Coquina, white, porous, friable, soft, composed of organic debris, up to coarse grained size, trace glauconite. No odour, stain, fluorescence or cut.

APPENDIX 3

CORE DESCRIPTION ANALYSES

Number	Depth	Recovery	Description
20	1096	2"	As above.
21	1000	2"	Coquina as for No. 19 but silty to medium grained.
22	999	2"	As for No. 19.

3290-3300	50% Limestone - as above 50% Shale - as above
3300-3310	60% Shale - as above 40% Limestone - as above
3310-3320	60% Shale - as above 40% Limestone - as above
3320-3330	60% Limestone - white to light brownish grey; micritic to micritic skeletal; very hard large fragments and abundant small unconsolidated fossils 40% Shale - dark grey; micritic; slightly skeletal; hard to brittle; occasionally soft.
3330-3340	50% Limestone - as above 50% Shale - as above
3340-3350	75% Shale - as above with occasional large fragments of light green firm to friable fossiliferous shale 25% Limestone - as above
3350-3360	60% Shale - as above 40% Limestone - as above
3360-3370	60% Shale - as above 40% Limestone - as above
3370-3380	75% Shale - as above 25% Limestone - as above
3380-3390	90% Shale - as above 10% Limestone - as above
3390-3400	90% Shale - as above brittle to hard 10% Limestone - as above
3400-3410	75% Shale - as above 25% Limestone - as above
3410-3420	90% Shale - light grey to dark grey; fossiliferous; brittle to soft; abundant sticky clay 10% Limestone - light grey to brown-grey; micritic-skeletal,very hard
3420-3430	90% Shale - as above 10% Limestone - as above
3430-3440	90% Shale - as above 10% Limestone - as above
3440-3450	90% Shale - as above some light grey green and soft 10% Limestone - as above; 1 angular quartz grain
3450-3460	100% Shale - dark grey; micritic skeletal, hard to brittle and fairly soft; not much sticky clay
3460-3470	75% Limestone - buff to light grey; micritic, very hard large fragments;, slightly skeletal 25% Shale - as above
3470-3480	50% Limestone - as above 50% Shale - as above
3480-3490	60% Limestone - as above 40% Shale - as above
3490-3500	50% Limestone - as above 50% Shale - as above
3500-3510	60% Shale-micritic - as above 40% Limestone - as above also cement fragments

3510-3520	60% Shale - as above 40% Limestone - as above dark to light grey; micritic-skeletal, hard
3520-3530	75% Shale - as above 25% Limestone - as above
3530-3540	75% Shale - micritic-skeletal; dark grey; brittle to slightly friable 25% Limestone - light grey to greyish brown; micritic-micritic skeletal, hard large fragments
3540-3550	75% Shale - as above 25% Limestone - as above
3550-3560	90% Shale - as above 10% Limestone - as above
3560-3570	90% Shale - as above more soft grey clay; softer shale 10% Limestone - as above
3570-3580	90% Shale - as above 10% Limestone - as above
3580-3590	90% Shale - dark grey; micritic-skeletal, hard to brittle and soft 10% Limestone - as above
3590-3600	90% Shale - as above 10% Limestone - as above
3600-3610	90% Shale - dark grey; micritic to micritic-skeletal, hard to brittle and slightly soft. 10% Limestone - as above
3610-3620	100% Shale - micritic to micritic skeletal; dark grey, brittle and slightly friable to hard, silty
3620-3630	100% Shale - dark grey; micritic to micritic skeletal; brittle to soft; not as calcareous.
3630-3640	75% Shale - as above 25% Limestone - as above
3640-3650	75% Shale - as above 25% Limestone - as above
3650-3660	75% Shale - as above 25% Limestone - as above; limestone is white to grey-brown; micritic to micritic-skeletal; very hard large fragments, white fragments of limestone appear speckled with chlorite or glauconite
3660-3670	See Core Description No. 4
3670-3680	75% Shale - as above 25% Limestone - as above
3680-3690	90% Shale - as above 10% Limestone - as above
3690-3700	90% Shale - as above; micritic; few fossils; hard to brittle 10% Limestone - as above
3700-3710	90% Shale - as above 10% Limestone - as above
3710-3720	90% Shale - as above 10% Limestone - as above

3720-3730	75% Shale - as above 25% Limestone - as above
3730-3740	90% Shale - as above grading to micritic limestone, hard 10% Limestone - as above
3740-3750	75% Shale - as above 25% Limestone - as above
3750-3760	90% Shale - as above 10% Limestone - as above
3760-3770	60% Shale - as above 40% Limestone - as above
3770-3780	50% Shale - as above 50% Limestone - as above
3780-3790	90% Shale - grey to dark greyish brown; micritic, slightly skeletal; hard to brittle 10% Limestone - light grey to dark grey; micritic to micritic skeletal; very hard; occasional fragments of clear calcite
3790-3800	75% Shale - as above 25% Limestone - as above
3800-3810	75% Shale - as above - occasional fragments of soft calcareous shale 25% Limestone - as above
3810-3820	90% Shale - dark grey brown, micritic; occasionally micritic-skeletal; very hard grading to micritic limestone; occasionally soft fragments. 10% Limestone - as above
3820-3830	75% Shale - as above 25% Limestone - as above with occasionally large white-light grey micritic limestone fragments; very hard
3830-3840	90% Shale - as above, darker grey 10% Limestone - as above
3840-3850	90% Shale - as above 10% Limestone - as above
3850-3860	90% Shale - as above 10% Limestone - as above
3860-3870	90% Shale - as above 10% Limestone - as above
3870-3880	75% Shale - dark grey to grey brown; hard to brittle, micritic to micritic skeletal 25% Limestone - grey to dark grey-brown; micritic to slightly skeletal; very hard large fragments.
3880-3890	75% Shale - as above 25% Limestone - as above
3890-3900	75% Shale - as above 25% Limestone - as above
3900-3910	75% Shale - as above; abundant soft grey calcareous clay 25% Limestone - as above
3910-3920	50% Shale - as above 50% Limestone - as above
3920-3930	90% Shale - as above; abundant soft clay 10% Limestone - as above

3930-3940	90% Shale - as above occasional soft grey clay 10% Limestone - as above occasional soft grey clay
3940-3950	90% Shale - as above occasional soft grey clay 10% Limestone - as above
3950-3960	90% Shale - as above occasional soft grey clay 10% Limestone - as above
3960-3970	75% Shale - as above occasional soft grey clay 25% Limestone - as above
3970-3980	90% Shale - as above 10% Limestone - as above
3980-3990	90% Shale - as above, very dark grey brown as above 10% Limestone - as above but white-light grey
3990-4000	90% Shale - as above becoming very micritic to micritic - skeletal limestone 10% Limestone - as above
4000-4010	90% Shale - as above; micritic-slightly skeletal, hard to brittle 10% Limestone - white-grey brown; micritic to micritic skeletal; hard and dense.
4010-4020	80% Shale - as above 20% Limestone - as above; abundant loose fossil material
4020-4030	90% Shale - dark greyish brown; micritic, fossiliferous; brittle to friable 10% Limestone - dark brownish grey; micritic to micritic skeletal; very hard
4030-4040	90% Shale - as above 10% Limestone - as above
4040-4050	100% Shale - as above, hard to brittle to friable with occasional limestone fragments as above
4050-4060	100% Shale - as above
4060-4070	100% Shale - as above
4070-4080	100% Shale - as above
4080-4090	90% Shale - dark grey-brown; micritic, very slightly fossiliferous; hard to brittle and slightly friable. 10% Limestone - grey, micritic, very hard, occasionally fossiliferou
4090-4100	90% Shale - as above with occasional fragments of soft friable marly clay; grades into 10% Limestone - as above
4100-4110	100% Shale - as above ; occasional limestone fragments, as above
4110-4120	90% Shale - as above micritic to micritic skeletal; abundant sticky soft grey clay 10% Limestone - light grey; micritic to micritic skeletal; very hard.
4120-4130	90% Shale - as above 10% Limestone - as above
4130-4133	100% Shale - as above; occasional grey-brown hard micritic to micritic skeletal limestone and abundant soft grey calcareous clay; abundant loose fossil material.

4133-4159	See Description Core No. 5
4150-4160	90% Shale - As above 10% Limestone - as above
4160-41	90% Shale - as above 10% Limestone - as above
4170-4180	90% Shale - as above 10% Limestone - as above
4180-4190	75% Shale - as above 25% Limestone - as above
4190-4200	75% Shale - dark grey to greyish brown; micritic, slightly skeletal; hard to brittle 25% Limestone - grey to bronw grey; micritic to micritic-skeletal; very hard
4200-4210	90% Shale - as above; very few fossils 10%.Limestone - as above; very few fossils light grey to grey brown
4210-4220	90% Shale - as above " " 10% Limestone - as above
4220-4230	90% Shale - as above " " 10% Limestone - as above "
4230-4230	80% Shale - " " 20% Limestone - "
4240-4250	80% Shale - as above 20% Limestone - as above
4250-4260	60% Shale - dark grey to dark grey brown; hard to slightly brittle slightly glauconitic, slightly silty 40% Limestone - light grey to dark grey brown; micritic; hard slightly glauconitic
4260-4270	60% Shale - as above 40% Limestone - as above
4270-4280	60% Shale - as above 40% Limestone - as above
4280-4290	50% Shale - as above 50% Limestone - as above predominantly dark greyish brown
4290-4300	50% Shale - as above 50% Limestone - as above
4300-4310	60% Shale - as above with occasional fragments of light green marl brittle to soft silty 40% Limestone - as above
4310-4320	50% Shale - as above 50% Limestone - as above
4320-4330	60% Shale - as above 40% Limestone - as above
4330-4340	75% Shale - as above 25% Limestone - as above
4340-4350	75% Shale - as above dark grey-brown; micritic to slightly skeletal; hard to slightly brittle 25% Limestone - as above dark grey to dark grey brown; micritic; silty scattered faint specks of glauconite; hard
4350-4360	90% Shale - as above more brittle 10% Limestone - as above

4360-4370	75% Shale - as above 25% Limestone - as above; occasional fragments of light grey micritic limestone - very hard
4370-4380	90% Shale - as above 10% Limestone - as above dark grey-grey brown; micritic, hard
4380-4390	90% Shale - as above 10% Limestone - as above
4390-4400	75% Shale - as above 25% Limestone - as above
4400-4410	90% Shale-micritic - as above 10% Limestone - as above
4410-4420	90% Shale - as above 10% Limestone - as above
4420-4430	90% Shale - as above but more brittle and soft 10% Limestone - as above
4430-4440	90% Shale - as above " 10% Limestone - as above
4440-4450	90% Shale - as above " 10% Limestone - as above
4450-4460	90% Shale - as above harder 10% Limestone - as above
4460-4470	90% Shale - as above 10% Limestone - as above
4470-4480	80% Shale - as above; softer 20% Limestone - as above
4480-4490	80% Shale - as above " 20% Limestone - white-greyish brown; hard, micritic to micritic-skeletal; faint trace glauconite.
4490-4500	80% Shale - as above relatively soft 20% Limestone - as above
4500-4510	75% Shale - grey to dark brownish grey; micritic to micritic-skeletal, hard to brittle and slightly soft. 25% Limestone - light grey to greyish brown; micritic to micritic skeletal; very hard; trace of glauconite.
4510-4520	80% Shale - as above 20% Limestone - as above with occasional fragments of buff white limestone
4520-4530	75% Shale - as above with occasional fragment of light grey green marl - soft 25% Limestone - as above
4530-4540	75% Shale - as above;brittle to friable; rare light green marl (soft) fragments. 25% Limestone - buff grey to greyish brown; micritic to micritic skeletal; hard
4540-4550	50% Limestone - grey to greyish brown; micritic, to micritic skeleta hard 50% Shale - dark grey to greyish brown, micritic-skeletal; brittle to friable; occasional grey=green marl fragments - soft
4550-4560	90% Shale - as above but getting more friable; occasional grey green marl fragments 10% Limestone - as above
4560-4570	90% Shale - as above " 10% Limestone

4570-4580	90% Shale - as above but getting more friable; occasional grey green marl fragments. 10% Limestone - as above
4580-4590	80% Shale - as above; harder 20% Limestone - as above with occasional light grey micritic very hard fragments of micritic limestone.
4590-4600	90% Shale - as above 10% Limestone - as above
4600-4610	90% Shale - as above but hard to brittle; occasionally slightly friable 10% Limestone - as above; occasionally cyrstalline of calcite
4610-4620	90% Shale - as above 10% Limestone - as above
4620-4630	90% Shale - as above 10% Limestone - as above
4630-4640	90% Shale - as above 10% Limestone - as above
4640-4670	See Core Description No. 6
4670-4680	90% Shale - as above 10% Limestone - as above
4680-4690	75% Shale - dark grey-brown; micritic to slightly micritic-skeletal; hard to brittle; 25% Limestone - light grey brown; micritic; slightly micritic-skeletal; very hard, occasional dark grey and white very dense fragments of micritic limestone.
4690-4700	75% Shale - as above 25% Limestone - as above
4700-4710	80% Shale - as above 20% Limestone - grey-greyish brown; micritic to micritic-skeletal hard
4710-4720	75% Shale - as above 25% Limestone - as above but occasional fragments of micritic hard white limestone.
4720-4730	75% Shale - as above 25% Limestone - as above "
4730-4740	75% Shale - as above 25% Limestone - as above "
4740-4750	90% Shale - as above 10% Limestone - as above grey to greysih brown
4750-4760	90% Shale - as above 10% Limestone - as above
4760-4770	90% Shale - as above 10% Limestone - as above with occasional dark grey smooth micritic limestone fragments.
4770-4780	90% Shale - as above 10% Limestone - as above
4780-4790	90% Shale - as above 10% Limestone - as above
4790-4800	90% Shale - as above; possibly more clay 10% Limestone - as above

4800-4810	90% Shale - as above; possibly more clay 10% Limestone - as above
4810-4820	80% Shale - as above 20% Limestone - as above
4820-4830	90% Shale - dark grey-brown; micritic to micritic skeletal; hard to brittle 10% Limestone - buff to light grey brown; micritic to micritic-skeletal; very hard.
4830-4840	90% Shale - as above 10% Limestone - as above
4840-4850	80% Shale - as above 20% Limestone - as above with rare white micritic limestone fragments, very hard
4850-4860	80% Shale - as above 20% Limestone - as above
4860-4870	90% Shale - as above with occasional grey fragments of soft marl 10% Limestone - as above
4870-4880	90% Shale - as above; abundant soft grey calcareous clay 10% Limestone - as above
4880-4890	60% Shale - dark grey brown, hard to brittle; micritic-skeletal 40% Limestone - grey brown to dark grey; micritic; hard,slightly skeletal
4890-4900	90% Shale - as above 10% Limestone - as above; 1 fragment of calcite replacement of a bryozoan fragment believed to be dolomitic - brown angular, hard.
4900-4910	50% Shale - as above 50% Limestone - as above
4910-4920	50% Shale - as above 50% Limestone - as above, very hard and angular, grey, micritic
4920-4930	60% Shale - as above 40% Limestone - as above, grey to grey-brown, micritic, slightly skeletal, hard.
4930-4940	75% Shale - as above 25% Limestone - as above
4940-4950	75% Shale - as above 25% Limestone - as above
4950-4960	90% Shale - as above 10% Limestone - as above
4960-4970	90% Shale - as above 10% Limestone - as above
4970-4980	90% Shale - as above - very hard to slightly brittle, very micritic 10% Limestone - dark greyish brown; micritic, very hard
4980-4990	90% Shale - dark grey to dark greyish brown; miciritic to micritic-skeletal; hard to brittle; slightly silty. 10% Limestone - dark grey to brownish grey, micritic, very hard slightly glauconitic (faint trace).
4990-5000	90% Shale - as above 10% Limestone - as above
5000-5010	90% Shale - as above 10% Limestone - as above

5010-5020	90% Shale - as above occasional grey marl fragments (cavings) 10% Limestone - as above
5020-5030	90% Shale - as above 10% Limestone - as above
5030-5040	90% Shale - grey to dark grey-brown; becoming very brittle 10% Limestone - as above
5040-5050	80% Shale - as above " 20% Limestone - as above
5050-5060	90% Shale - as above 10% Limestone - as above 1 or 2 quartz grains subangular
5060-5070	90% Shale - as above 10% Limestone - as above "
5070-5080	90% Shale - as above 10% Limestone - as above "
5080-5090	90% Shale - as above 10% Limestone - as above

5090-5100	90%	Shale as above
	10%	Limestone as above - no sand
5100-5110	100%	Shale - dark grey to greyish brown, micritic to micritic skeletal, brittle to hard,
5110-5120	100%	Shale as above
5120-5130	100%	Shale as above. occasional fragments of limestone
5130-5140	90%	Shale, medium dark grey, micritic with frequent bryozoans and forams.
	10%	limestone , tan - light brown, micritic, finely granular
5140-5150		As above
5150-5160		As above
5160-5170		As above
5175-5205		Core # 7 see descriptions
5210-5220	100%	Shale, medium grey, very hard, very calcareous
5220-5230		As above, frequent bryozoan and forams
5230-5240		As above
5240-5250	90%	Shale as above
	10%	Limestone, light grey, micritic to very finely granular. very hard, skeletal, shaly.
5250-5260	80%	Shale asabove
	20%	Limestone as above
5260-5270		As above
5270-5280	75%	Shale as above
	25%	Limestone as above
5280-5290		As above
5290-5300		As above
5300-5310	50%	Shale as above
	50%	Limestone, light grey, mainly very finely granular, very hard, skeletal fragments, bryozoans and forams.
5310-5320		As above
5320-5330	30%	Shale as above
	70%	Limestone as above
5330-5340	20%	Shale as ;above frequent forams, ocasional bryozoans
	80%	Limestone; as above " " " "
5340-5350		As above
5350-5360		As above
5360-5370	100%	Limestone as above, occasional glauconite grains in limestone
5370-5380		As above
5380-5390		As above.

5390-5400	As above
5400-5410	As above
5410-5420	As above
5420-5430	As above
5430-5440	As above
5440-5450	As above
5450-5460	As above
5460-5470	As above
5470-5480	As above, light grey and tan withe several grains coated with pyrite.
5480-5490	As above
5490-5500	As above
5500-5510	As above with only trace pyritec, occasional glauconite grains.
5510-5520	As above
5520-5530	As above
5530-5540	As above, finely granular - many fragments showing abundant fine forams. scattered glauconite grains.
5540-5550	As above
5550-5560	As above
5560-5570	As above
5570-5580	As above
5580-5590	As above
5590-5600	As above
5600-5610	As above
5610-5620	As above
5620-5630	As above
5630-5640	As above
5640-5650	As above
5650-5660	80% limestone as above 20% sand, clay,, very fine - medium grain, unconsolidated, subangular - subrounded, with frequent very fine - fine grains of glauconite.
5660-5670	70% limestone as above 30% sand as above
5674-5691	Core No. 8 see descriptions.
5690-5700	100% shale - dark brown - black, non calcareous, medium hard with trace pyrite.
5700-5710	As above, abundant cavings.
5710-5720	As above

NAUTILUS A-1 SIDEWALL CORES

1.	1943.709M 6377	1½"	Shale; medium dark grey, non-calcareous, medium hard, massive, slightly micaceous.
5.	1738.884 5705	1¼"	Siltstone; medium grey brown, slightly calcareous, medium hard, non porous, massive.
7.	1729.13 5673	2"	Sandstone; medium brown grey, non porous, very fine - coarse grained, subangular - subrounded, well sorted, very silty, very calcareous, glauconitic.
8.	5662	1½"	Sandstone; light green - white, non porous, very fine - medium grain, fair sorting, subangular - surbrounded, calcareous, clay choked, with abundant glauconite.
9.	5657	1½"	Sandstone; as above.
10.	5385	1"	Siltstone; light grey brown, non porous, medium hard, very calcareous, massive.
11.	5365	1½"	Siltstone; as above.
13,	4884	3/4"	Shale; light grey, medium hard, very silty, very calcareous, massive, as above.
14.	4434	3/4"	Shale; as above.
15.	4340	1¼"	Shale; light grey, silty, very calcareous, medium hard, with very thin white laminae of calcareous material, trace fossil remains.
16.	4246	1"	Shale; as above.
17.	4077	1½"	Shale; as above.
18.	4029	1½"	Shale, light grey, very calcareous, silty, medium soft, massive.
19.	3825	1-3/4"	Siltstone; light brown grey, very calcareous, medium soft, with abundant fossil remains, massive.
21.	3791	1"	Mudstone; light grey, very calcareous, hard, with abundant fossil fragments.
22.	3471	1"	Mudstone; as above.
24.	3417	1"	Mudstone; as above.
27.	2940	2"	Marl, white - light grey, medium soft, very calcareous, massive.
28.	2845	2"	Marl; as above, with silty texture.

APPENDIX 4

SIDE WALL CORE DESCRIPTION

6390-6410	As above
6410-6430	As above
6430-6450	As above
6450-6480	As above
6480-6510	As above
6510-6520	As above
6520-6530	As above
6530-6560	As above
6560-6570	As above
6572-6597	Core No. 10 (see description)

5720-5730	As above
5730-5740	As above
5740-5750	As above
5750-5780	As above
5780-5790	As above
5790-5800	As above
5800-5810	As above
5810-5820	As above
5820-5830	As above
5830-5850	As above
5850-5880	As above
5880-5900	As above
5900-5920	As above
5920-5950	As above
5950-5970	As above
5970-5990	As above
5990-6010	As above
6010-6030	As above
6030-6040	As above
6040-6060	As above
6060-6090	As above
6090-6110	As above Core No. 9 6102'-6117'
6110-6130	As above
6130-6160	As above
6160-6190	As above
6190-6220	As above
6220-6240	As above
6240-6250	As above
6250-6270	As above
6270-6300	As above
6300-6320	Shale dark brown - black, non calcareous, medium hard, trace pyrite, trace mica.
6320-6350	As above
6350-6380	As above, abundant calcareous shale cavings.
6380-6390	As above

ESSO STANDARD OIL (AUSTRALIA) LTD.

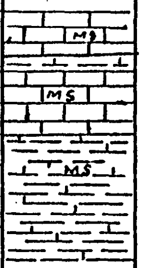
CORE DESCRIPTION

Core No. 1

WELL: Nautilus A-1

Interval Cored 2772 - 2780 ft., Cut 8 ft., Recovered 8 ft., (100 %) Fm. Narrawaturk

it Type C-14 A, Bit Size 8 5/16 in., Desc. by B. L. Culp Date April 25, 1968

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 2772			2772 - 2773½	Limestone - gray to dark brownish gray; micritic skeletal; argillaceous; hard; impermeable
			2773½ - 2774	Shale - dark gray to brownish gray, micritic skeletal, firm to hard
2780			2774 - 2776	Limestone - as above
			2776 - 2780	Shale - as above

REMARKS: No oil fluorescence or cut observed

ESSO STANDARD OIL (AUSTRALIA) LTD.

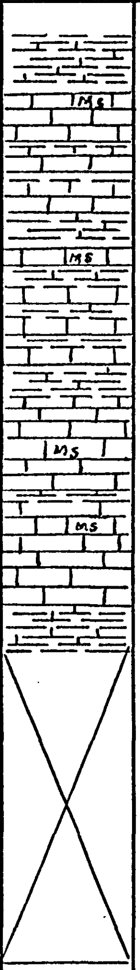
CORE DESCRIPTION

Core No. 2

WELL: Nautilus A-1

Interval Cored 2780 - 2810 ft., Cut 30 ft., Recovered 20 ft., (66⅔%) Fm. Narrawaturk

it Type C-20, Bit Size 8 5/16 in., Desc. by B.L. Culp, Date April 25, 1968



Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 2780			2780 - 2800	Alternating thin beds of micritic skeletal limestone and micritic shale. The limestone beds are gray to dark grayish brown and very hard and impermeable. The micritic shale is also gray to dark gray brown; skeletal (abundant bryozoa); and slightly silty; slightly pyritic; carbonaceous hard to brittle. The contacts between the limestone and shale are gradational. The silty nature of the shale causes it to appear softer.
2800			2800 - 2810	No Recovery
2810				

REMARKS: No oil fluorescence or cut present.

ESSO STANDARD OIL (AUSTRALIA) LTD.

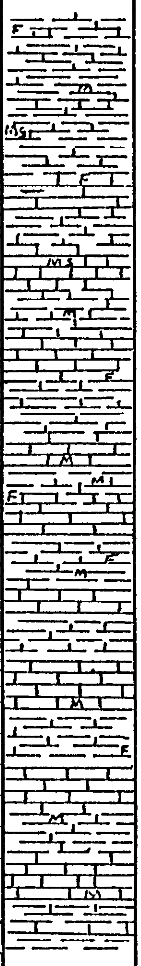
CORE DESCRIPTION

Core No. 3

WELL: Nautilus A-1

Interval Cored 3122-3152 ft., Cut 30 ft., Recovered 30 ft., (100 %) Fm. Oligocene

it Type C-20A, Bit Size 8 5/16 in., Desc. by B.L. Culp Date April 26, 1968

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 3122			3122-3128	Shale- light to dark brownish gray; micritic; slightly skeletal with scattered bryozoan fragments most abundant; hard to brittle; occasionally silty.
3152			3128-3152	Alternating thin beds of shale as above and limestone. The limestone is light gray to brownish gray, micritic to micritic-skeletal, very hard and impermeable. Lithologic contacts between the shale and limestone beds is for the most part gradational. Occasional faint traces of carbonaceous material.

REMARKS: No oil fluorescence or cut present.

ESSO STANDARD OIL (AUSTRALIA) LTD.

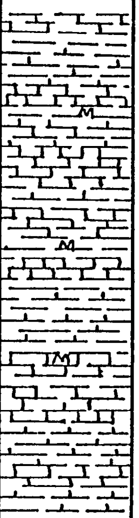
CORE DESCRIPTION

Core No. 4

WELL: Nautilus A-1

Interval Cored 3656-3672 ft., Cut 16 ft., Recovered 16 ft., (100 %) Fm. Oligocene

it Type C-20, Bit Size 8 5/16 in., Desc. by B.L. Culp Date April 27, 1968

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 3656 3672			3656-3672	Shale - dark grey; very micritic to micritic skalata (scattered bryozoans and abundant small foraminifera); very hard to brittle; grades into thin interbeds of micritic limestone which is lighter grey and fossiliferous. The limestone is very hard. Occasional rare carbonaceous material present.

REMARKS: No oil fluorescence or cut visible.

ESSO STANDARD OIL (AUSTRALIA) LTD.

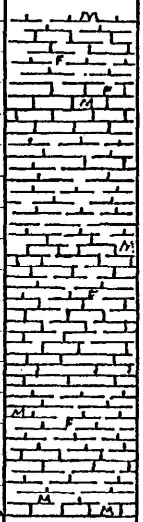
CORE DESCRIPTION

Core No. 5

WELL: Nautilus A-1

Interval Cored 4133-4149 ft., Cut 16 ft., Recovered 16 ft., (100 %) Fm. Oligocene

Bit Type C-20A, Bit Size 8 5/16 in., Desc. by B. L. Culp Date April 29, 1968

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 4133 4149			4133-4149	Shale - micritic; almost micritic limestone; dark gray to dark grayish-brown; very hard to slightly brittle; scattered bryozoan fragments and abundant small foraminifera; faint trace of glauconite, scattered throughout core; interbedded gradationally with gray to grayish brown micritic limestone which is very hard and dense; occasional very thin vein of calcite and dark gray shale parting or clast; faint rare trace of pyrite

REMARKS: No oil fluorescence on cut visible.

ESSO STANDARD OIL (AUSTRALIA) LTD.

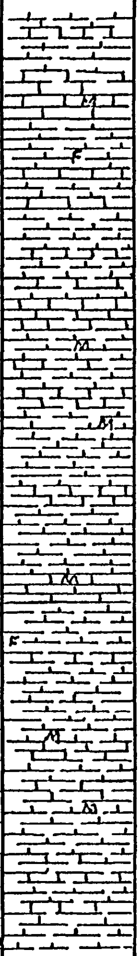
CORE DESCRIPTION

Core No. 6

WELL: Nautilus A-1

Interval Cored 4640-4670 ft., Cut 30 ft., Recovered 30 ft., (100 %) Fm. Oligocene

it Type C-20, Bit Size 8 $\frac{5}{16}$ in., Desc. by B. L. Culp Date April 30, 1968

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 4640 4670			4640-4670	Micritic shale and micritic limestone.- Light gray to dark grayish-brown; very few large bryozoan frag; fossil material is extremely fine-grained; limestone is very hard and impermeable; shale is hard to slightly brittle. Entire core appears to be densely laminated with very thin relatively even parallel laminae of dark colored micritic shale and lighter colored micritic limestone. The contacts between laminae are for the most part fairly distinct. Discontinuous laminae are also present.

REMARKS: No oil fluorescence or cut visible.

ESSO STANDARD OIL (AUSTRALIA) LTD.

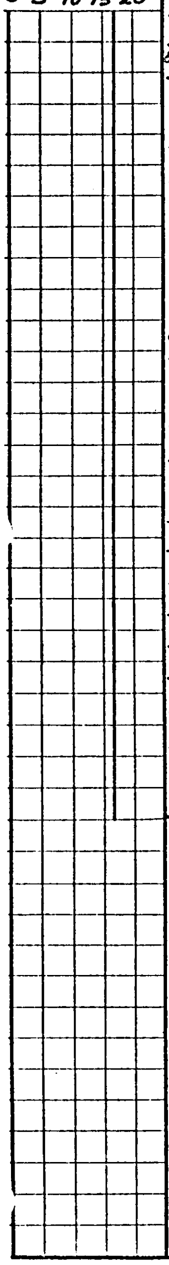
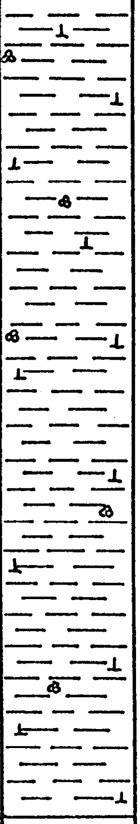
CORE DESCRIPTION

Core No. 7

WELL: NAUTILUS A-1

Interval Cored 5175-5205 ft., Cut 30 ft., Recovered 26 ft., (87 %) Fm.

it Type C-20, Bit Size 8 5/16 in., Desc. by C.K. LUNT Date 3 MAY 1968

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 5 10 15 20 			5175 - 5182'	7' SHALE: m. gry., hd. dense, very calcareous w/occas. small well preserved forams. Mudflow lamination - extremely contorted.
			5182 - 5205	19' SHALE: as above w/fine parallel, horizontal and occas. cross lamination

REMARKS:

ESSO STANDARD OIL (AUSTRALIA) LTD.

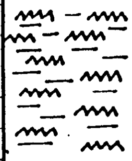
CORE DESCRIPTION

Core No. 8

WELL: NAUTILUS A-1

Interval Cored 5674-91 ft., Cut 13 ft., Recovered 4¾ ft., (36 %) Fm.

it Type C-20, Bit Size 8 5/16 in., Desc. by C.K.LUNT Date 4 MAY 1968

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 5 10 15 20			5674 - 5678¼'	4¾' SILTSTONE - dk. brn.-blk. very shaly, non calcareous, m. hd. w/abund. pyrite occurring as cm. size accumulations and as replacement of foss. shells (?). Glauc. grains v. abundant in some zones, espec. assoc. w/pyrite. Glauconite shows horiz. deposition. Very finely dissem. carb. material (?) in some places. Mica sparsly scattered throughout. No sedimentary structure

REMARKS:

ESSO STANDARD OIL (AUSTRALIA) LTD.

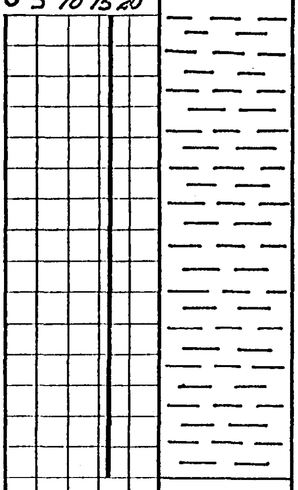
CORE DESCRIPTION

Core No. 9

WELL: NAUTILUS A-1

Interval Cored 6102-17 ft., Cut 15' ft., Recovered 15 ft., (%) Fm. Eocene

it Type C-20, Bit Size 8 5/16 in., Desc. by C. K. LUNT Date 5 MAY 1968

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 5 10 15 20				
			6102-17'	15' <u>SHALE</u>: dk. gry., hd. brittle "ringtail", non calc. silty, massive, w/frequent bivalve shells, foram, gastropods, seaweed remains; some pyritized fossils. No sed struct. - breaks parallel and conchoidally. Core shattered and broken up.

REMARKS:

ESSO STANDARD OIL (AUSTRALIA) LTD.

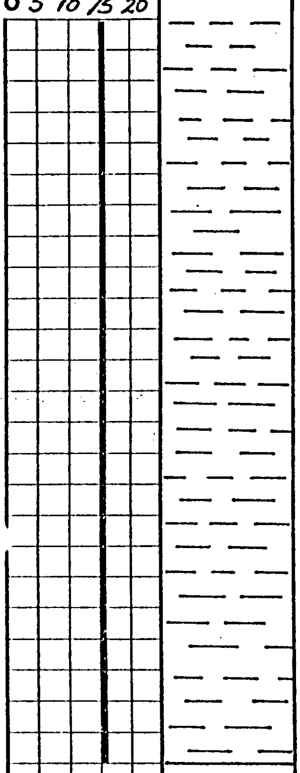
CORE DESCRIPTION

Core No. 10

WELL: NAUTILUS A-1

Interval Cored 6572-97 ft., Cut 25 ft., Recovered 25 ft., (100 %) Fm. Belfast

it Type C-20, Bit Size 8 5/16 in., Desc. by C.K. Lunt Date 6 MAY 1968

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 5 10 15 20			6572-97'	25' SHALE: dk.gry., hd., massive in part "ringtail" non calcareous sli micaceous w/v. occas. lt.gry. crs. grained to cobble sized well rounded limestone frags embedded within. No sed struct. Breaks in part conchoidally and in part evenly horizontal.

REMARKS:

EXPLORATION LOGGING OF AUST[illegible] INC.

A Geological-Engineering Service

PERTH ADDRESS: 69 GREAT EASTERN HIGHWAY VICTORIA PARK, WESTERN AUSTRALIA
PHONE 61 4437
CABLE EXLOGG PERTH

CORE ANALYSIS REPORT

OMPANY ESSO
ELL NAUTILUS A-1
OCATION/FIELD OFFSHORE OTWAY BASIN
OUNTY ______ STATE VICTORIA
OUNTRY AUSTRALIA

DATE 4/25/68
DEPTH 2722 TO 2780
GEO-ENGINEER WATT

EMARKS CUT 8' RECOVERED 8' LIMESTONE: LIGHT ROWN, FINE-MICRO CRYSTALLINE, SUCROSIC IN ART, SOME FOSSILS / SHALE: MEDIUM BROWN, ERY CALCAREOUS, SILTY, CLAYEY, FOSSILIFEROUS

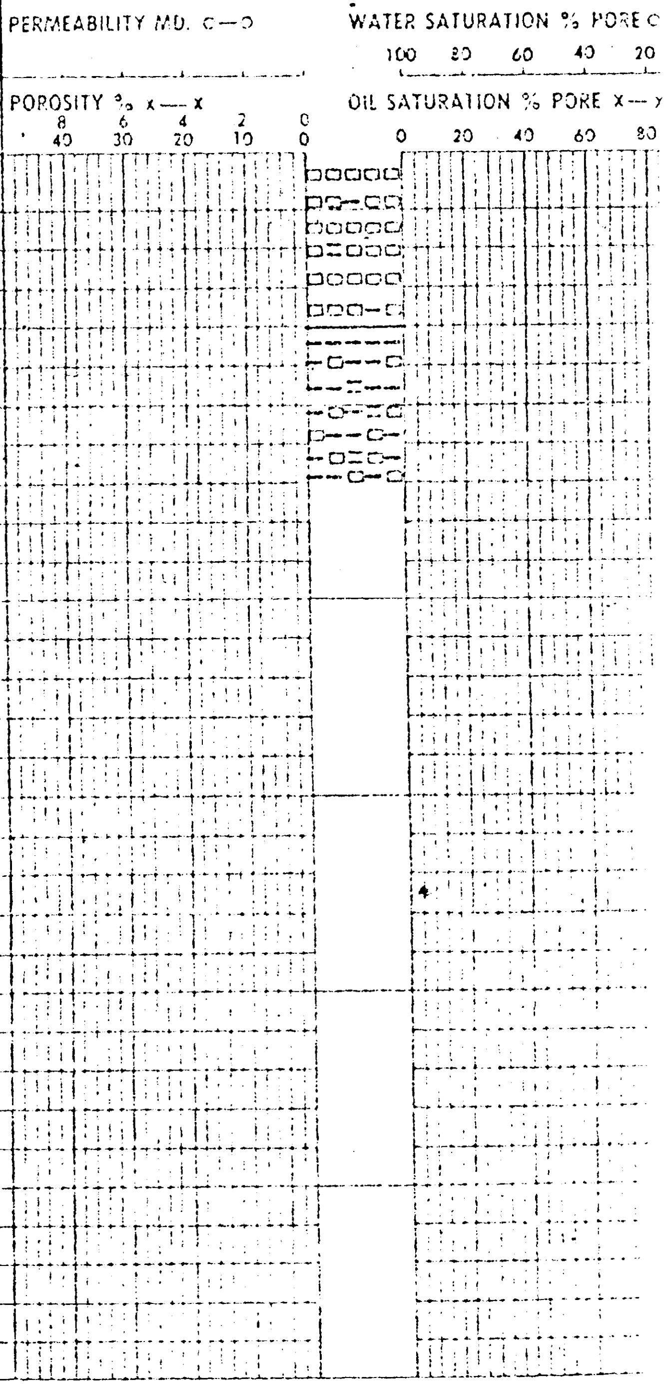
⋯	SAND	▭	LIME
⋯	SILTY SAND	○	CONGL.
☰	SILTST.	☐	
☰	SHALE	☐	

IO SHOWS

TABULAR DATA

NUMBER	DEPTH FEET	AIR PERM. MD.	POROSITY PERCENT	FLUID SATURATION % PORE VOLUME		GRAVITY OIL °API	TOTAL CL⁻ G/G	REMARKS
				OIL	WATER			
	2722							
	CORE VERY HARD AND TIGHT, NO CORE ANALYSIS							
	REQUIRED.							
	2776							
	2780							

ANALYSIS GRAPH



NTLS 1 / PE900446 / P55

ORE #2

EXPLORATION LOGGING OF AUSTRALIA, INC.

A Geological-Engineering Service

PERTH ADDRESS 69 GREAT EASTERN HIGHWAY, VICTORIA PARK WESTERN AUSTRALIA
PHONE 61 4437
CABLE EXLOGO PERTH

CORE ANALYSIS REPORT

PANY ESSO
NAUTILUS A-1
TION/FIELD OFFSHORE / OTWAY BASIN
TY STATE VICTORIA
NTRY AUSTRALIA
RKS CUT 30', REC. 20' LIMESTONE: LIGHT N, HARD, FOSSILIFEROUS, ARGILLACEOUS IN WITH INTERBEDDED MEDIUM BROWN, VERY ILIFEROUS, VERY CALCAREOUS SHALE
HOWS

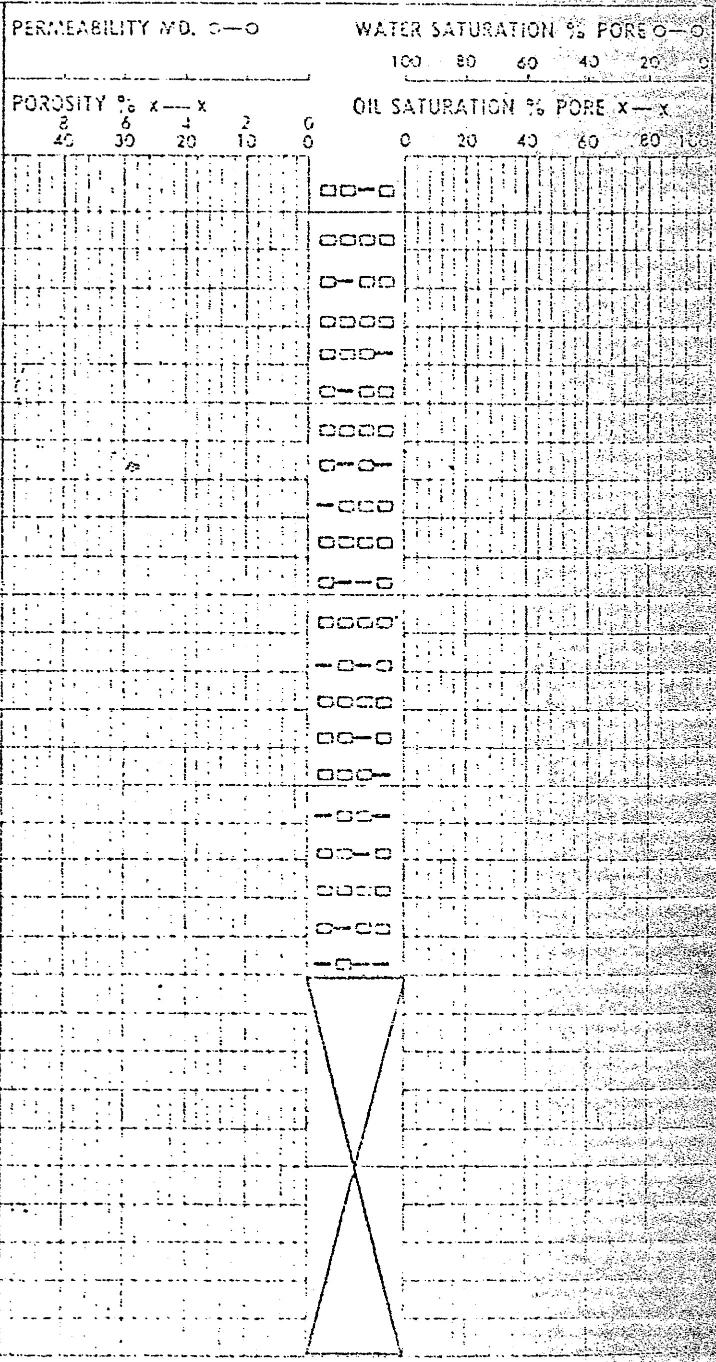
DATE 4/25/68
DEPTH 2780 TO 2810
GEO-ENGINEER WATT

⬚	SAND	⬚	LIME
⬚	SILTY SAND	⬚	CONGL.
⬚	SILTST.	☐	
⬚	SHALE	☐	

TABULAR DATA

DEPTH FEET	AIR PERM. MD.	POROSITY PERCENT	FLUID SATURATION % PORE VOLUME		GRAVITY OIL °API	TOTAL CL⁻ G/G	REMARKS
			OIL	WATER			
2780	HARD TO VERY HARD AND VERY TIGHT,						
	NO CORE ANALYSIS REQUIRED						
2790							
2800							
	NO RECOVERY						
2810							

ANALYSIS GRAPH



NTLS/PE900446/P56

CORE #3

EXPLORATION LOGGING OF AUSTRALIA, INC.

A Geological-Engineering Service

PERTH ADDRESS 59 GREAT EASTERN HIGHWAY VICTORIA PARK WESTERN AUSTRALIA
PHONE 81 4437
CABLE EXLOGG PERTH

CORE ANALYSIS REPORT

PANY ESSO
NAUTILUS A- 1
TION/FIELD OFFSHORE / OTWAY BASIN
ITY STATE VICTORIA
TRY AUSTRALIA
RKS CUT 30', REC. 30' LIMSTONE: LIGHT
RK GREY, HARD, LIME MUD. SHALE: BLACK,
Y, ABUNDANT BRYOZOA. NO SHOWS.

DATE 4/26/68
DEPTH 3122 TO 3152
GEO-ENGINEER MACGILL

▤	SAND	▤	LIME
▤	SILTY SAND	▤	CONGL.
▤	SILTST.	☐	
▤	SHALE	☐	

TABULAR DATA

DEPTH FEET	AIR PERM. MD.	POROSITY PERCENT	FLUID SATURATION % PORE VOLUME		GRAVITY OIL °API	TOTAL CL⁻ G/G	REMARKS
			OIL	WATER			
3122	HARD, TIGHT, NO CORE ANALYSIS, REQUIRED.						
132							

ANALYSIS GRAPH

PERMEABILITY MD. o—o

POROSITY % x—x
2 6 4 2 0
40 30 20 10 0

WATER SATURATION % PORE o—o
100 80 60 40 20 0

OIL SATURATION % PORE x—x
0 20 40 60 80 100

CORE #4

EXPLORATION LOGGING OF AUSTRALIA, INC.
A Geological-Engineering Service

PERTH ADDRESS 69 GREAT EASTERN HIGHWAY VICTORIA PARK WESTERN AUSTRALIA
PHONE: 61 4437
CABLE EXLOGG PERTH

CORE ANALYSIS REPORT

COMPANY ESSO
WELL NAUTILUS A-1
LOCATION/FIELD OFFSHORE/OTWAY BASIN
COUNTY
STATE VICTORIA
COUNTRY AUSTRALIA
REMARKS CUT 16', REC. 16': SHALE, HIGHLY CALCAREOUS, DARK GREY, WITH PALE GREY STREAKS ICRITIC LIMESTONE. FORAMS & BRYOZOANS FAIRLY BUNDANT. NO SHOWS.

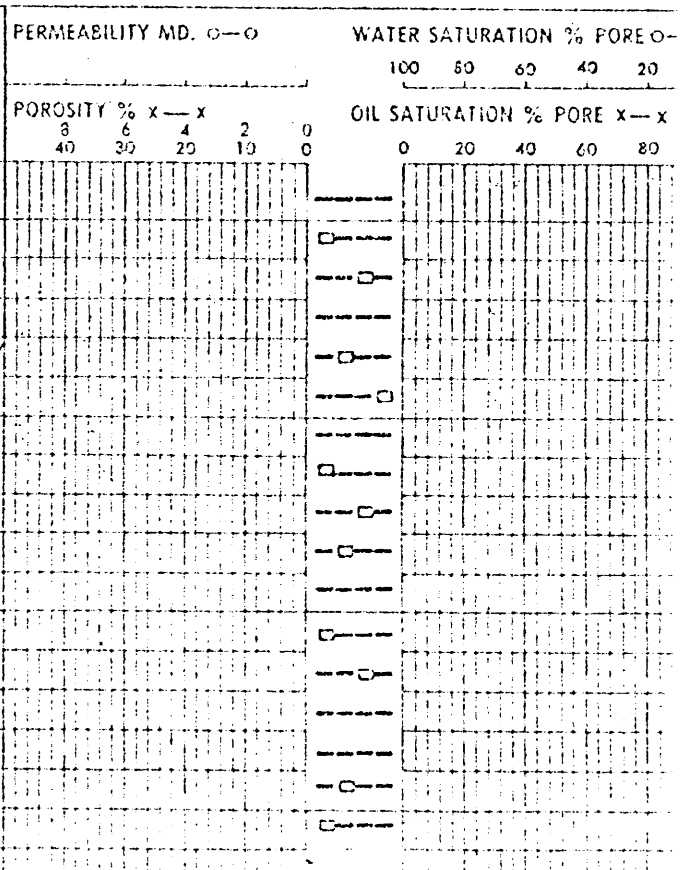
DATE 4/28/68
DEPTH 3656 TO 3672
GEO-ENGINEER MACGILL

SAND
SILTY SAND
SILTST.
SHALE
LIME
CONGL.

TABULAR DATA

SAMPLE NUMBER	DEPTH FEET	AIR PERM. MD.	POROSITY PERCENT	FLUID SATURATION % PORE VOLUME		GRAVITY OIL °API	TOTAL Cl⁻ G/G	REMARKS
				OIL	WATER			
	3656		CORE	HARD,	TIGHT.	NO	ANALYSIS	
			REQU	IRED.				
	3660							
	3670							
	3672							

ANALYSIS GRAPH



CORE #5

EXPLORATION LOGGING OF AUSTRALIA, INC.

A Geological-Engineering Service

PERTH ADDRESS 69 GREAT EASTERN HIGHWAY VICTORIA PARK WESTERN AUSTRALIA
PHONE 81 4437 CABLE EXLOGG PERTH

CORE ANALYSIS REPORT

COMPANY ESSO
WELL "NAUTILUS A-1"
LOCATION/FIELD OFFSHORE / OTWAY BASIN
COUNTY STATE VICTORIA
COUNTRY AUSTRALIA

DATE 4/29/68
DEPTH 4133 TO 4149
GEO-ENGINEER WATT

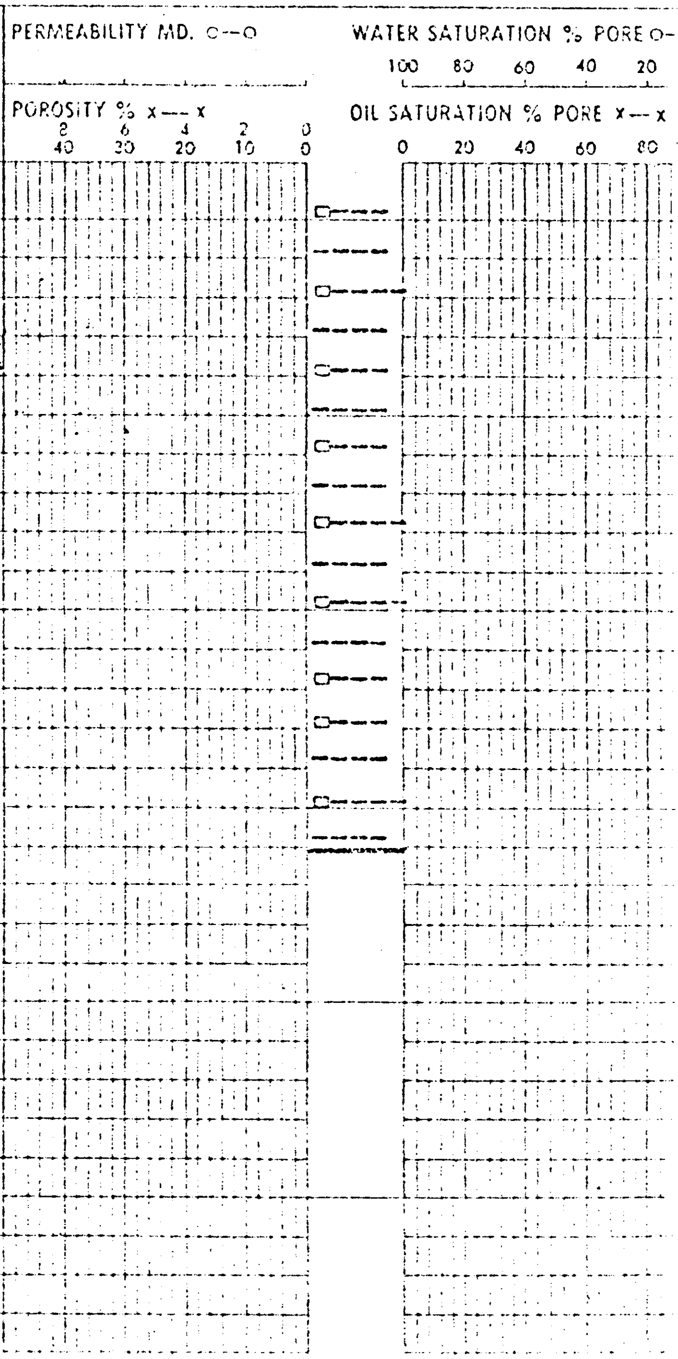
REMARKS CUT 16' REC. 16' LIME MUD: LIGHT BROWN, ERY FINELY LAMINATED, MICROCRYSTALLINE, WITH BUNDANT FORAMS AND SOME BRYOZOA& OTHER FOSSILS OME DARK GRAY CLAY BLEBS WITH DARK BROWN STRKS. ERY HARD & TIGHT.

⋯	SAND	▭	LIME
⋯	SILTY SAND	○○○○	CONGL.
⋯	SILTST.	▭	
⋯	SHALE	▭	

TABULAR DATA NO SHOWS.

SAMPLE NUMBER	DEPTH FEET	AIR PERM. MD.	POROSITY PERCENT	FLUID SATURATION % PORE VOLUME OIL	FLUID SATURATION % PORE VOLUME WATER	GRAVITY OIL °API	TOTAL CL⁻ G/G	REMARKS
	4133							
		VERY TIGHT AND DENSE, NO CORE						
	4135	ANALYSIS REQUIRED.						
	4140							
	4145							
	4149							

ANALYSIS GRAPH



CORE #6

EXPLORATION LOGGING OF AUSTRALIA, INC.
A Geological-Engineering Service

PERTH ADDRESS 69 GREAT EASTERN HIGHWAY VICTORIA PARK, WESTERN AUSTRALIA
PHONE 61 4437
CABLE EXLOGG PERTH

CORE ANALYSIS REPORT

COMPANY ESSO

WELL NAUTILUS A1

LOCATION/FIELD OFFSHORE/OTWAY BASIN

COUNTY

STATE VICTORIA

COUNTRY AUSTRALIA

REMARKS CUT 30', REC. 30' : CARBONATE SHALE - PALE TO DARK GREY MICRITE; FINELY (0.5MM) BEDDED, MAINLY HORIZONTAL, SOME CROSS-BEDDING & COMPACTION DISTORTION; ABUNDANT FORAMS; NO SHOWS.

DATE 4/30/68

DEPTH 4640 TO 4670

GEO-ENGINEER MACGILL

SAND

SILTY SAND

SILTST.

SHALE

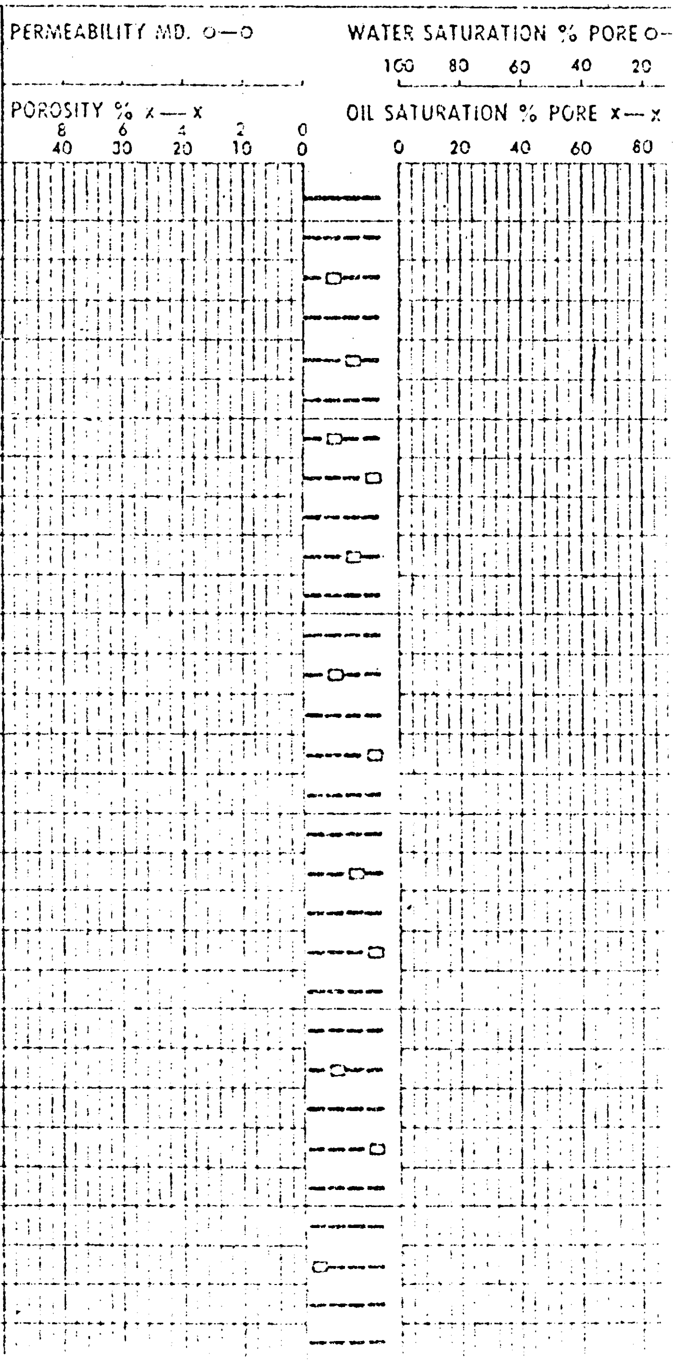
LIME

CONGL.

TABULAR DATA

SAMPLE NUMBER	DEPTH FEET	AIR PERM. MD.	POROSITY PERCENT	FLUID SATURATION % PORE VOLUME		GRAVITY OIL °API	TOTAL CL⁻ G/G	REMARKS
				OIL	WATER			
	4640							
			CORE HARD AND TIGHT; NO CORE ANALYSES REQUIRED.					
	4650							
	4660							

ANALYSIS GRAPH



CORE # 7

EXPLORATION LOGGING OF AUSTRALIA, INC.
A Geological-Engineering Service

PERTH ADDRESS 69 GREAT EASTERN HIGHWAY VICTORIA PARK WESTERN AUSTRALIA
PHONE 61 4437
CABLE EXLOG PERTH

CORE ANALYSIS REPORT

OMPANY Esso
/ELL NAUTILUS A-1
OCATION/FIELD OFFSHORE/OTWAY BASIN
OUNTY STATE VICTORIA
OUNTRY AUSTRALIA
EMARKS CUT 30', REC. 26': CARBONATE SHALE-
RK GREY-BROWN MICRITE; FINE, MAINLY HORIZONTAL
DDING, SOME CROSS-BEDDING, COMPACTION & SLUMP
RUCTURES; ABUNDANT FORAMS; NO SHOWS.

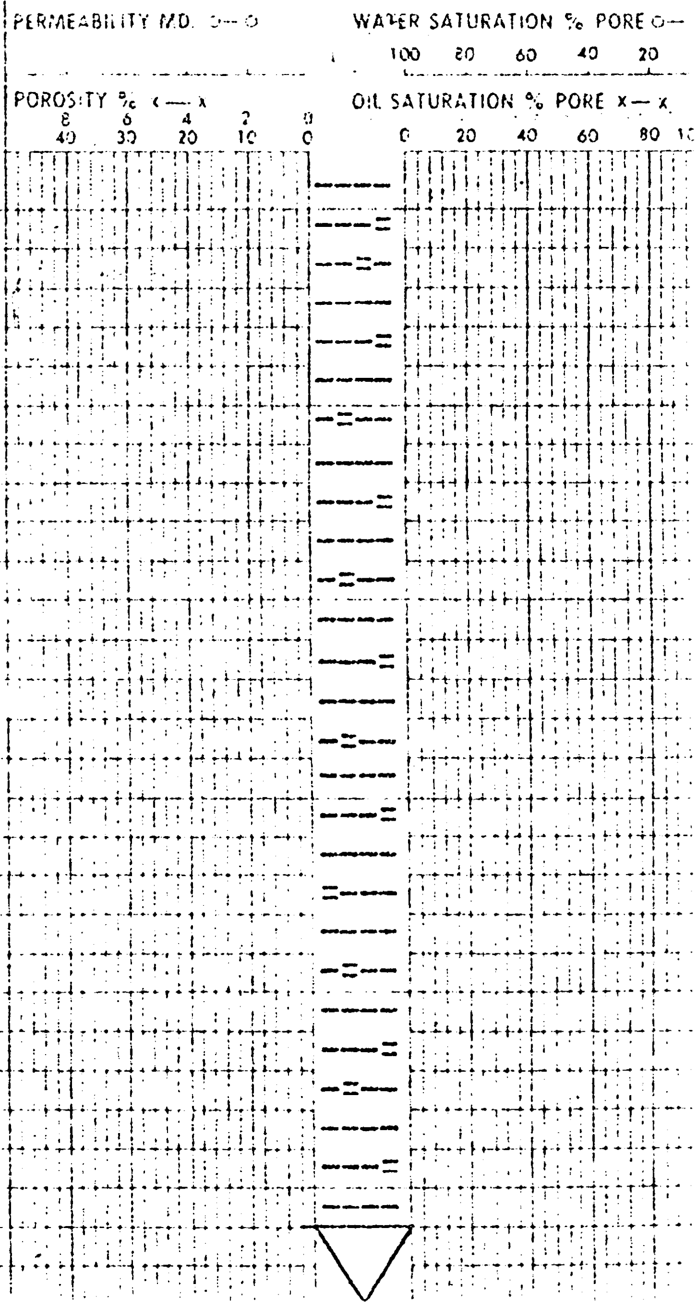
DATE 5/2/68
DEPTH 5175 TO 5205
GEO-ENGINEER MACGILL

⋯	SAND	▭	LIME
⋯	SILTY SAND	○○○○	CONGL.
⋯	SILTST.	▭	
---	SHALE	▭	

TABULAR DATA

DEPTH FEET	AIR PERM. MD.	POROSITY PERCENT	FLUID SATURATION % PORE VOLUME		GRAVITY OIL °API	TOTAL CL G/G	REMARKS
			OIL	WATER			
5175							
		CORE HARD, TIGHT; NO CORE					
		ANALYSES REQUIRED.					
5180							
5190							
5200							
5201							
}		NO RECOVERY					

ANALYSIS GRAPH



ORE #8

EXPLORATION LOGGING OF AUSTRALIA, INC.

A Geological-Engineering Service

PERTH ADDRESS 69 GREAT EASTERN HIGHWAY VICTORIA PARK WESTERN AUSTRALIA
PHONE [illegible] CABLE [illegible] PERTH

CORE ANALYSIS REPORT

OMPANY Esso
/ELL NAUTILUS A-1
OCATION/FIELD OFFSHORE/OTWAY BASIN
OUNTY STATE VICTORIA
OUNTRY AUSTRALIA
EMARKS CUT 17', REC. 5': SANDY SILTSTONE; DARK OWN, POORLY LAMINATED TO MASSIVE; MICACEOUS; ND, QUARTZ, VERY FINE TO FINE-GRAINED; PYRITE GLAUCONITE THROUGHOUT, LOCALLY ABUNDANT.

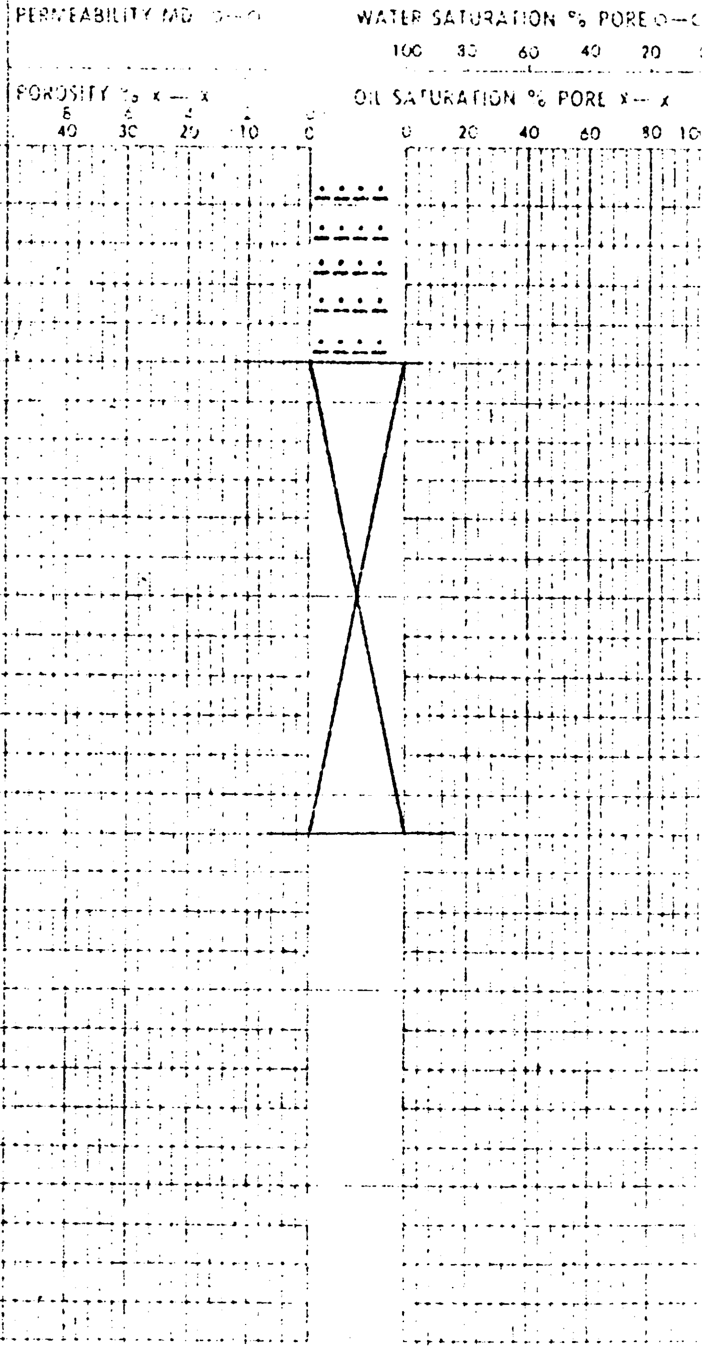
DATE 5/3/68
DEPTH 5674 TO 5691
GEO-ENGINEER MACGILL

SAND	LIME
SILTY SAND	CONGL.
SILTST.	
SHALE	

TABULAR DATA

DEPTH FEET	AIR PERM. MD.	POROSITY PERCENT	FLUID SATURATION % PORE VOLUME		GRAVITY OIL °API	TOTAL CL G/G	REMARKS
			OIL	WATER			
5674							
		CORE HARD, TIGHT; NO CORE ANALYSES REQUIRED.					
5679							
		NO RECOVERY					
5691							

ANALYSIS GRAPH



CORE #9

EXPLORATION LOGGING OF AUSTRALIA, INC.

A Geological-Engineering Service

PERTH ADDRESS 5? GREAT EASTERN [illegible] PARK WESTERN AUSTRALIA
PHONE 61 4437 CABLE [illegible] PERTH

CORE ANALYSIS REPORT

OMPANY ESSO
ELL NAUTILUS A-1
CATION/FIELD OFFSHORE/OTWAY BASIN
OUNTY ______ STATE VICTORIA
OUNTRY AUSTRALIA
MARKS CUT 15', REC. 15' SHALE: BLACK, HARD, ENSE, CARBONACEOUS, MICROMICACEOUS, CONCHOI-AL FRACTURES (HAIRLINE) INTERSECTING BEDDING LANES, APPROACHING ARGILLITE, ABUNDANT WHITE ALCAREOUS SHELLS COMMONLY PYRITIZED; NO SHOWS.

DATE 5/5/68
DEPTH 6102' TO 6117'
GEO ENGINEER CLARKE

▨	SAND	▨	LIME
▨	SILTY SAND	▨	CONGL.
▨	SILTST	☐	
▨	SHALE	☐	

TABULAR DATA

DEPTH FEET	AIR PERM. MD.	POROSITY PERCENT	FLUID SATURATION % PORE VOLUME		GRAVITY OIL °API	TOTAL Cl G/G	REMARKS
			OIL	WATER			
CORE VERY HARD & TIGHT; NO CORE ANALYSIS REQUIRED.							
6102							
6117							

ANALYSIS GRAPH

PERMEABILITY MD. ○---○
POROSITY % x---x
40 30 20 10 0

WATER SATURATION % PORE ○---○
100 80 60 40 20 0
OIL SATURATION % PORE x---x
0 20 40 60 80 100

CORE #10

EXPLORATION LOGGING OF AUSTRALIA, INC.

A Geological-Engineering Service

PERTH ADDRESS 69 GREAT EASTERN HIGHWAY [illegible] WESTERN AUSTRALIA
PHONE 81 4437

CORE ANALYSIS REPORT

MPANY Esso
ELL NAUTILUS A-1
CATION/FIELD OFFSHORE-OTWAY BASIN
UNTY STATE VICTORIA
UNTRY AUSTRALIA
MARKS CUT 25', REC. 25': SILTSTONE: DARK BROWN,
SIVE; MULTIPLE "RINGTAIL" FRACTURED; MICACEOUS,
BONACEOUS, NON-CALC.; MINUTE PYRITE SPHERES
OUGHOUT SPARSE FORAMS, RARE 2" CALC. CONCRETIONS.
SHOWS.

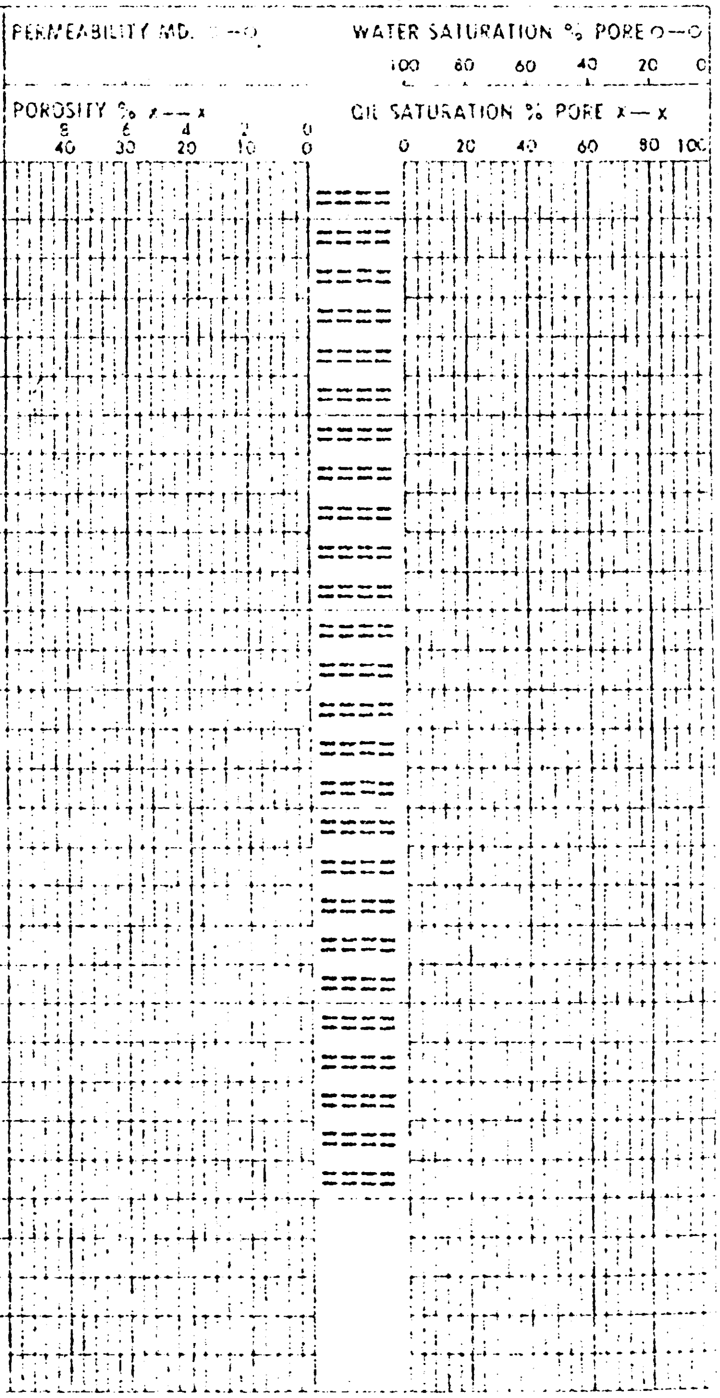
DATE 5/6/68.
DEPTH 6572 TO 6597
GEO-ENGINEER MACGILL

⁝ SAND
▤ SILTY SAND
▤ SILTST
▭ SHALE
▦ LIME
○ CONGL.

TABULAR DATA

DEPTH FEET	AIR PERM. MD.	POROSITY PERCENT	FLUID SATURATION % PORE VOLUME		GRAVITY OIL °API	TOTAL CL G/G	REMARKS
			OIL	WATER			
6572							
6580							
6590							
6597							

ANALYSIS GRAPH



APPENDIX 1

MICROPALEONTOLOGY

FORAMINIFERAL SEQUENCE - NAUTILUS A-1 WELL

OTWAY BASIN

VICTORIA.

David J. Taylor
July, 1968.

FORAMINIFERAL SEQUENCE - NAUTILUS A-1 WELL - OTWAY BASIN - VICTORIA.

Nautilus A-1 was drilled in the central portion of the Otway Basin, 40 miles in a southerly direction offshore from Warrnambool.

Samples were examined from 999' to total depth at 6597'; ie. rotary cutting samples at 50' or less interval: 29 side wall cores and 8 conventional cores. Contamination in rotary cuttingswas sporadic and varied in intensity. All depths quoted were those on submitted samples and were related to datum; Kelly Bushing at +95' M.S.L. Water depth at the site was 327' M.S.L.

An upper Tertiary calcareous sequence recorded from first returns down to 5650' where lower Oligocene planktonic faunas were reported. Between 5650' and 5720' sandy glauconitic siltstones were present with rare Oligocene planktonic foraminifera. At 5720', dark mudstones were penetrated, which contained Upper Cretaceous faunas and the drilling terminated at 6597', still in Upper Cretaceous dark mudstones. The faunas suggest that the uppermost Cretaceous was not represented. For a summary of the sequence see fig. 1.

The drilled sequence was almost completely marine. Apart from the interval between 5650' and 5720' (see fig. 2), abundant foraminiferal faunas afforded adequate biostratigraphic and environmental control. To this extent the Nautilus sequence is atypical for the Otway Basin where the thicker sections contain at least 3000' of Eocene to uppermost Cretaceous sands and silts (see figs 3 and 5), with faunas occupying less than 10% of the total thickness. The summary of biostratigraphy on fig. 1 and facies diagram on fig. 4 shows clearly that the normal lower Tertiary to uppermost Cretaceous interval is absent in the Nautilus section.

.../2

THE UPPER TERTIARY SEQUENCE

At 1500' the well penetrated the Orbulina surface (see Glaessner 1967, P.3) passing from middle Miocene (= upper Miocene of Glaessner) into the lower Miocene with a planktonic fauna of Globigerinoides bisphericus, G. trilobus and G. glomerosus curvus in cuttings and sidewall core at 1570'. This fauna is the immediate precurser to the development of Orbulina suturalis, marking the top of Taylor's (1966) Zonule F and the Praeorbulina glomerosa curva Zone of Jenkins (1967). The sequence of planktonic events throughout the lower Miocene is normal with that in sequences in the Otway, Bass and Gippsland Basins and is expressed in terms of Taylor's (1966) down sequence zonal scheme (see fig. 1). The sequence also agrees with the zonation of the New Zealand lower Miocene by Jenkins (1967) although Taylor differs in detail due to the necessity of using rotary cutting samples. The significant point in the Nautilus sequence is that there is no biostratigraphic break at the Orbulina surface, when comparing with the Barracouta (Taylor, 1966) and other Gippsland sequences where Zonules Fand G are absent.

The Miocene/Oligocene boundary has been placed at 4500' on the initial appearance of Globigerina euapertura which indicates the top of Zonule I. Jenkins' (1965) work suggests that this event is still in the lower Miocene. But here the complete reliance on rotary cuttings makes this determination a matter of convenience for consistency in local correlation. A conventional core sample at 4640' contains a poor fauna with G. euapertura without G. woodi or other lower Miocene planktonics, thus corresponding with Jenkins' Globigerina euapertura Zone which he places at the top of the Oligocene.

The highest appearance of Globorotalia testarugosa equates the top of Taylor's (1966) Zonule J with the 5170' level in Nautilus. The highest appearance of Globigerina angioporoides is in cutting samples at 5250' thus correlating with the top of Jenkins' (1965) Globigerina angioporoides angioporoides Zone. Once again there is a discrepancy between the observed southern Australian and

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New Zealand sequences in that *Globorotalia testarugosa* persists throughout Jenkins Globigerina euapertura Zone and not just for a few feet above the extinction of *Globigerina angioporoides* as is illustrated here, also in the Gippsland and by Lindsay (1967) in South Australia zoned sequence. Zonule J = the Chiloguembelina cubensis Zone of Lindsay (i.e. fig. 2), although Lindsay's Zonal indicator *Chiloguembelina cubensis* is only present in one sample well below the top of Zonule J in Nautilus. *C. cubensis* is also uncommon in the Gippsland sequences. On the other hand *Globigerina angioporoides* is much more common in the Nautilus sequence than in Lindsay's sequence (compare fig. 2 this report with fig. 2 of Lindsay). In the New Zealand sequence (Jenkins, 1965, fig. 2) *Chiloguembelina cubensis* is shown as an important form in this part of the sequence.

In correlating from Nautilus to a land section in the proximity, one finds that *C. cubensis* becomes more frequent whilst *Globigerina angioporoides* is less abundant and taxonomically more nondescript. For instance in the Narrawaturk-2 section (Vict. Mines Dept. water bore at Peterborough; see fig. 5) the interval between 1804' and 1847' was constantly cored (37 feet recovered), with a coring gap 1847-1894', thence another core. The sequence is as follows:-

	-1804		
Clifton Fm.		*Globigerina euapertura* common	I-1
	-1821	--Extinction of *Guembelitra stavensis*------------	
			I-2
1830--------	-1829	--Extinction of *Chiloguembelina cubensis*+-------- *Globigerina testarugosa*	
	-1835	--Extinction of *Globigerina angioporoides*,----- *Guembelitra*, *Chiloguembelina* & *Globigerina euapertura* common.	J-1
Narrawaturk Marls	-1847	--	
		no core - cuttings inadequate.	?
	-1894	--	
		Highest record of *Globigerina linaperta*, *G. ampliapertura*, *G. pseudoampliapertura*. *Chiloguembelina* common.	K

This agrees with Lindsay's sequence and Zonule I-2 is an obvious correlate of his Guembelitra stavensis Zone. The question of why Chiloguembelina sp. is very rare and Guembelitra sp. absent in Nautilus is possibly a function of depositional depth. It is either ecological, related to water mass movement and preferred depth habitat, or to selective solution of calcium carbonate at depth. The tests of both species are extremely delicate in the Narrawaturk and other faunas whilst the Nautilus planktonic faunas below 5000' are thick and robust. This suggests that selective solution may be the answer upon considering the evidence put forward by Berger (1968). This question of depth will be discussed later.

Cutting samples below 5400' contain Globigerina brevis and Globorotalia gemma. The former species has not been recognised before in Southern Australia by either Lindsay (1967) or myself. The short and restricted range of Globigerina brevis allowed Jenkins (1965) to establish the G. brevis Zone for the entire biostratigraphic range of the species. Globorotalia gemma has an identical range in New Zealand. Jenkins shows that Globigerina ampliapertura ranges through the G. brevis Zone into the overlying G. angioporoides angioporoides Zone. Lindsay (1967, fig. 2) does not extend G. ampliapertura above the range of G. linaperta and a similar situation occurs in Narrawaturk-2 (see above). In Nautilus a form associated with G. brevis is regarded as the transitional morphotype G. ampliapertura-euapertura.

The interval from 5400' to at least 5650' in Nautilus, is equates with Jenkins' Globigerina brevis Zone of the New Zealand sequence. This is obviously the lower part of Taylor's (1966) Zonule J as it is above the highest appearance of G. linaperta (= Zonule K). Therefore Zonule J can be split into the upper biostratigraphical interval -

J-1 = G. angioporoides angoiporoides Zone of Jenkins and the lower J-2 = G.brevis Zone of Jenkins.
The faunal constituents of these intervals in Nautilus are shown on Fig. 2.

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Zonule J-2 was first recognised in Esso's Prawn A-1 well (Otway Basin - offshore Tasmania) by Taylor (appendix in Esso's completion report), though Globigerina brevis cannot be recognised probably due to facies. It may be present in Narrawaturk-2 (see above), but unfortunately samples are inadequate between 1847'; i.e.between J-1 and K.

Below 5650' the calcareous sequence changes suddenly to sandy glauconitic siltstones. No faunas were isolated from sidewall cores at 5657', 5662', 5673' and 5705' but one sample from core 8 (5674-91') contained very small specimens of Globigerina ampliapertura - euapertura. The interval between 5650' and 5720' is believed to be lowermost Oligocene as the single morphotype would suggest a lineage fragmentation interval equating with Zonule J-2. This statement requires further verification.

Because of evidence discussed both above and below the base of the upper Tertiary sequence is placed at 5720' on the faunas contained in submitted samples. The base of the upper Tertiary sequence is regarded as lowermost Oligocene, although from Jenkins' (1965) discussion it could be placed in the uppermost Eocene.

THE LOWER TERTIARY SEQUENCE

No lower Tertiary foraminiferal species (either planktonic or benthonic) were identified in the Nautilus sequence, nor were such forms present as mud-contaminants in rotary cuttings lower in the sequence. Apart from the fact that Zonule J-2 (equated with Jenkins G. brevis Zone) may straddle the Oligocene/Eocene boundary, Eocene and Paleocene sediments are not apparent in the Nautilus section.

THE UPPER CRETACEOUS SEQUENCE

Distribution of all upper Cretaceous species is shown on Fig.2. The discussion is on the species isolated in Nautilus but not recorded by Taylor (1964).

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The fauna in cutting samples below 5650-5720' changes dramatically from a dominance of thick tested, robust planktonic forms to a sudden appearance of fine grained arenaceous species. This is demonstrated on both fig. 2 and fig. 4. The arenaceous species (listed on fig. 2) are those of Taylor's (1964) upper Cretaceous fauna and are not of the lower Tertiary arenaceous assemblages (Taylor 1965 and manuscript). At 5800' the cutting samples contain benthonic calcareous species referable to Taylor's (1964) Victorian upper Cretaceous sequence and not to the Victorian Paleocene species monographed by McGowran (1965).

The benthonic species <u>Stensioeina exsculpta</u> is recorded at 5950'. Morphologically the 2 specimens are probably assignable to <u>S. exsculpta granulata</u>. Cita (1966, pp. 249-250) would limit the genus to the Upper Cretaceous (Turonian-Maastrichtain), showing (l.c., tab.-1) a range of Coniacian to Campanian for <u>S. exsculpta</u> (sensu lato) and limiting <u>S. exsculpta granulata</u> to the Santonian. The associated benthonic forms at 5950' are amongst those recorded by Taylor (1964) in his Victorian upper Cretaceous Zonule A.

The highest appearance of upper Cretaceous planktonic species is in the core between 6102-17'; <u>Hedbergella trocoidea</u> being present. At 6200' <u>Globigerinelloides asperus</u> is associated with Taylor's Zonule A benthonic species. Pessagno's (1967) recent study of Upper Cretaceous planktonics from the Gulf Coast plain and Carribbean Areas, shows that <u>G. asperus</u> ranges from the Coniacian, through the Santonian into the early Campanian (l.c., text fig. 4 and p. 275). In Western Australia Belford (1960) found the species in both Santonian and Campanian sediments. Belford does not record Coniacian or upper Turonian faunas, as discussed by Burckle et al (1967).

In Nautilus the side wall core at 6377' contains a planktonic range overlap with the lowest appearance of <u>Globigerinelloides asperus</u> and the highest appearance of <u>Hedbergella brittonensis</u>. On refering to Pessagno (1967, text. fig. 4), a

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time correlation is suggested, close to the Coniacian/Turonian boundary. This suggestion is supported by the highest appearance of Stensioeina praeexsculpta, which is the oldest representative of the genus and is regarded by Cita (1966, tab.-1) as signifying a Turonian age. The presence of endemic arenaceous benthonic species Textularia trilobita shows that the sidewall core at 6377' marks the top of Taylor's upper Cretaceous Zonule B.

The new evidence presented here supports Taylor's (1964, pp. 547-549) original contention that Zonule A has strong Santonian affinities and that Zonule B was Turonian. It is shown here and on fig. 2 that :-

(i) the interval between 5800-6117' contains Santonian faunas which are assignable to Zonule A;

(ii) the fauna at 6200' could be either Santonian or Coniacian but yet represents Zonule A;

(iii) the sparse arenaceous faunas between 6200' to 6377' are of Zonule A and are probably Coniacian on superposition. A similar sparse fauna exists in the same stratigraphic position on shore (refer Taylor, l.c., fig. 3 and 5);

(iv) the top of Zonule B (at 6377') corresponds with the Coniacian/Turonian boundary;

(v) Zonule B continued to total depth (at 6597') so that the Nautilus section was terminated whilst still in Turonian (probably upper Turonian) sediment.

Local biostratigraphic correlation has been achieved for the Nautilus Upper Cretaceous sequence between 5800' and total depth (6597'). This correlation can be extended to the terms of the standard Cretaceous stage classification with an increased degree of accuracy. However, the highest horizon of the upper Cretaceous in Nautilus (5800-5720') presents a problem in that the fauna is purely arenaceous, although it would be assigned to Taylor's Zonule A. In other Otway Basin wells (see Taylor,

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l.c. and Shell Development's Pecten and Voluta well completion reports) there are mainly arenaceous faunas above the faunas equivalent to those at 5800-6117' in Nautilus. In Flaxmans-1 this upper interval reaches a thickness of 1800' and is considered to extend above the Santonian to at least Campanian (see fig. 3). The interval above 5800' in Flaxmans-1 is informally referred to as Zonule Z. The Upper Cretaceous Zonule A of Taylor (1964) (sensu stricto) is below 5800' in Flaxmans-1 and is referred to as Zonule XA in the extension of Taylor's (1966) down sequence classification from Upper Tertiary to Upper Cretaceous. Thus the interval 5800-5720' in Nautilus could be referred to as the base of Z or top of XA.

THE CORRELATION OF THE NAUTILUS SEQUENCE

Correlation between Nautilus A-1, Shell's Pecten 1A and Frome-Broken Hill's Flaxmans-1 are demonstrated on fig. 3, from the comparison of the foraminiferal sequence. It is noted that the Pecten 1A sequence has been reinterpreted slightly from that given in the completion report.

From all five figures presented in this report it is obvious that there is a dramatic change in sedimentation at 5720' in Nautilus. The facies analysis diagram on fig. 4 shows that the Upper Cretaceous sequence of alternating anaerobic and aerobic dark mudstones (= Belfast mudstones) is identical to the diagram given for Port Campbell-2 by Taylor (1964, fig. 5), apart from the silty sandstone interval which contains the highest arenaceous fauna in Port Campbell (= Paaratte Formation). But this highest arenaceous fauna is only 80' thick in Nautilus and as it is contained in dark mudstone this may support Taylor's contention that the detrital inundation (= base of Paaratte Formation) of the Upper Cretaceous marine embayment was diachronous.

At 5720' the sediment is a detrital sandy siltstone to silty sandstone containing rare Oligocene planktonic foraminifera. 70' higher (at 5650' - see fig. 4) skeletal micrites contain an abundance of Lower Oligocene planktonic foraminifera

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and the original sediment would best be described as a globigerinid ooze.

The section on fig. 3-A is drawn to demonstrate the relationship between time and thickness of sedimentation, taking into account that the Lower Oligocene Zonule J is absent in both Pecten-1A and Flaxmans-1. All three sections are drawn from a datum taken as the base of Oligocene (base J) or top of Eocene (top K), irrespective of drilled depths relative to sea level. Biostratigraphic correlation points are joined where possible. It can then be read off the diagram that a maximum thickness of 3600' Eocene to uppermost Cretaceous sediment is absent in Nautilus when compared with Pecten and Flaxmans.

The normal section on fig. 3-B shows that the missing 3600' maximum time/thickness gap was rapidly filled during Oligocene and Lower Miocene times by marine calcareous sediment. The Oligocene to Lower Miocene sediment in Nautilus is considerably thicker than that in Pecten and Flaxmans (see fig. 3-B), Narrawaturk-2 (see fig. 5) or any other section drilled in the Otway Basin, partially due to an Oligocene hiatus in many sections.

The correlations demonstrate that the Nautilus sequence is anomalous when compared with any other known sections in the Otway Basin. The apparent unconformity in Nautilus (fig. 3-A and B) requires more consideration as to its significance. On evidence so far presented it could be either a subaqueous erosional unconformity, a structural or even faulted unconformity, or a hiatus due to sediment starvation.

FACIES OF OLIGOCENE/MIOCENE FILL

Section fig. 3-B and section fig. 5 shows that rapid Oligocene/Lower Miocene sediment filled the time thickness gap when comparing Nautilus with other sections. In the section of fig. 5 Narrawaturk-2 has been used instead of Flaxmans-5 ?! due to the more detailed information regarding the Upper Tertiary (see earlier discussion). Fig. 5 was compiled by quantitatively

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selecting the dominant lithological and faunal constituents of samples and assessing the significance of the benthonic foraminifera.

The following facies sequence in Nautilus can be demonstrated in fig. 5 together with the detail in fig. 4 over a more limited interval:

(i) 5720-5650' - Initial sediment of glauconitic silty sands and sandy silts, which may be reworked older material, although no recycled fauna was present.

(ii) 5650-5400' - The analysis on fig. 4 (based on 10 gms of sediment) support the contention that this was a globigerinid ooze. As already mentioned, the planktonic specimens are all large, (>.3 mm) robust and thick tested without the delicate species of equivalent horizons on-shore. Berger (1968) ranks calcium carbonate solution susceptibility with specific character, habitat depth and total water depth. An empirical depth figure cannot be given, even for recent oceans, because of the coincidence between increased solution and top of Antarctic Bottom waters. The associated benthonic species (fig. 2) would indicate a depth of at least 3000'.

(iii) 5400-4900' - A pelagic limestone rather than a globigerinid ooze with more calcareous (inorganic mud) than above, (fig. 4).

(iv) 4900-4500' - is dominantly a pelagic limestone but containing up to 10% of detrital elements. These elements are fragments of carbonate cemented quartz and glauconite grains, together with "battered Robulus". The worn Robulus spp. are from .3 - .6 mm diameter lens and are nondescript because of lack of ornament. Both detrital elements are common constituents of the Clifton Formation (seen in Pecten - 22 miles away). The Clifton Formation and the Nautilus interval between 4900 - 4500' are synchronous as both contain Zonule I planktonics. This

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interval is considered relatively shallower than that of 5650-5400' because of the presence of detrital material and an autochthonous benthonic foraminifera fauna rich in fine grained arenaceous species including Gaudyrina heywoodensis, Vulvulineria granulose and Textularia spp; the oldest recording of arenaceous Tertiary species in the section.

(v) 4500 - 4209' - a palagic limestone with additional elements of quartz and glauconite of size range <.15mm, thus differing from the coarser detritus between 4900 - 4500'. Benthonic and planktonic foraminifera are rare and all speciments <.3 mm; in many samples the foraminifera are only in the <.15 mm fraction. This suggests size sorting and differential size settling and that the benthonic fauna is completely allochthonous. The difference between interval (iv) and this interval may be more a function of current velocity and angle of sediment repose rather than of depth. But if it is a function of the repose angle, then interval (v) must be further upslope than interval (iv).

(vi) 4029-2800' - The sediment contains a high proportion of sponge spicules (up to 20% of total sediment). These rod-shaped hollow spicules would tend to be held in suspension longer than the material in intervals (iv) and (v). Thus differential size sorting and settling are once again evoked with a suspicion of grading from the coarser (iv) to the slow settling (vi), when compared with Connolly and Von der Borch's (1967) examples from recent sediments on the southern Australian sea-floor. But Connolly and Von der Borch's graded beds are measured in less than 10 cm. units, whilst those of Nautilus are measured in hundreds of feet. The fine sedimentation of this interval was interrupted at least once (3825') by the introduction of coarser detritus, including bryozoal fragments and "battered" Robulus spp.

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(vii) A bryozoal rich marly limestone and marls containing planktonic foraminiferal faunas, which correlate with the bryozoal Gellibrand Marl of the Port Campbell Embayment, e.g. Pecten, Flaxmans, Narrawaturk, etc.). In Nautilus the benthonic foraminiferal fauna is rich in Cibicides refulgens, C. mediocris, Diocidicides biserialis and Karreria maoria which were probably adherent on seaweed, as were the bryozoa. The site of the seaweed growth would be on the continental shelf and the Gellibrand Marls (e.g. in Narrawaturk or in outcrop) are inner continental shelf deposits. Reed (1965, p.55) reaches this conclusion in respect to the Heywood Marl (= the Gellibrand Marl in the western part of the Basin). The 2800-1800' interval in Nautilus may represent inner continental shelf deposits, but the entire fauna could be allochthonous, having been rafted on seaweed onto the outer shelf or slope.

(viii) 1800 - ?' A white rubbly limestone with occasional bryozoal marls. The benthonic fauna includes the species from 2800-1800' with Cassidulina subglobossa, Rosalina australia and Patellina corrugata. This fauna is similar to that of the present day continental shelf, where there is considerable current and wave base action.

Much of the faunal constituent of these calcareous sediments is either pelagic, or apparently allochthonous material which can be traced to synchronous sediments which were deposited in shallow water. The record of this sequence cannot be considered complete, because of inadequate samples, so that the account given above is very simplified. Yet there is a definite up-sequence trend from deep water sediments to shallow water. The sedimentation can be described as fill, in that the continental shelf has been built out from a position near Pecten in Oligocene to the position of Nautilus by mid Miocene times (see fig. 5). The amount of allochthonous material suggests that it was

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carried over the edge of the shelf by slumping or current action (in the case of seaweed rafting). Inorganic material (including calcareous clays) would have been accumulated by the same mechanisms. The nature of the sediment particles in recent deep sea sediments off southern Australia support this view (Connolly and Von der Borch, 1967).

Difficulty exists in explaining the thickness of pelagic limestones in the sequence (5650-5170') with 480' of lower Oligocene sediment. In Narrawaturk-2 the same interval occupies 65' of shallow water sediment. A possible explanation is that with the Oligocene transgression nutrient rich cold waters upwelled onto the edge of the continental shelf stimulating the growth of a large plankton stock. Any large scale slumping would have muddied the water and killed vast quantities of plankton.

THE NAUTILUS UNCONFORMITY

The outstanding feature of the Nautilus section is the total absence of uppermost Cretaceous to Eocene sediment (approximating 3500' in sediment thickness in other sections) and the presence of a thick Oligocene to Miocene sediment fill which is approximately 3500' thicker than in other sections. The situation is compensatory and the coincidence of relative thicknesses is too close to imply structural movement and then readjustment. The apparent upper Cretaceous to Oligocene unconformity is not considered to be the result of exposure then sinking.

The Lower Oligocene sediment in Nautilus is approximately 3500' lower than any other known section in the Otway Basin. In three other sections the Lower Oligocene is represented by shallow water deposits or are absent. The Nautilus Lower Oligocene is globigerinid ooze with associated benthonic species indicating a water depth of greater than 3000'. Thus there is a coincidence between assumed water depth and present elevation differences. This is shown on the scale in fig. 5.

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The immediate conclusion is that an approximate 3500' thickness of sediment was moved by slumping into deeper water, exposing Santonian sediment at the Nautilus site. This slumping must have occurred in later Eocene or early Oligocene times. Sedimentation would therefore have resumed at a depth of 3500', which is consistent with all data presented here. Under these circumstances an unconformity due to sub-aqueous erosion is postulated at 5720' in Nautilus.

Coring projects reveal that unconformities in deep-sea sediments are the rule rather than the exception especially on the continental slope and marginal plateaux. Unconformities and missing Tertiary time units are shown by JOIDES, (1965, figs. 3 and 4) on the Florida-Hatteras slope and the Blake plateau. An interesting local example is a core taken in 3000 metres of water in the Naturaliste plateau off south western Australia. In this core Burckle et al (1967) reports:-

9 - 119 cm	Pleistocene planktonic foraminifera deposited in >1000m of water;
119 - 222 cm	Upper Cretaceous (Mid-Turonian) planktonic foraminifera deposited in >1000m of water.

The core exhibits a clear cut time break, though angularity of the unconformity could not be clearly demonstrated on the seismic profiles (Burckle et al, l.c., fig. 4). The time break may have been due to sediment and plankton starvation at the site.

Sediment starvation may be the explanation for the Nautilus unconformity although Esso's seismic profiles do exhibit angularity. In the Naturaliste model, deep-sea sediment rests on deep-sea sediment after a time break. In Nautilus, deep-water pelagic Oligocene sediments rests on fairly shallow water Upper Cretaceous deposits which have an extremely low planktonic count (<1%). The benthonic constituents of the Nautilus Upper Cretaceous faunas are those of the Otway Basin dark mudstones which Taylor (1964, p.552) regarded as indicating a maximum

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depth of 200m. Thus there is marked change in sedimentary environment on either side of the unconformity (refer fig. 4), which can only be accounted for in terms of structural or sediment movement.

Abbreviation of sedimentation cannot be completely dismissed in considering the Nautilus section as coring was not constant over the interval between definite Upper Cretaceous and definite lowermost Oligocene (i.e. between 5720' and 5650'). Coring was carried out between 5674' and 5691' and 4 sidewall cores were taken. It has been emphasised that 3500' of uppermost Cretaceous to Upper Eocene sediment is absent in Nautilus. Abbreviation into 70' of sparsely fossiliferous silts and sands (between 5720' and 5650') is difficult to comprehend especially as the only foraminifera present suggest a lower Oligocene age. The lack of any recycled material suggests that exposure of older (pre-Oligocene) material was sudden and the exposures were quickly sealed by slumped or suspended clays or silts. The 70' of sands and silts in Nautilus are probable remnants of the slumped material captured in a subaqueous erosional hollow. The Oligocene planktonic fauna was added ("salt and pepper" addition) at the time of slumping.

The preferred explanation of the Nautilus unconformity is that sudden slumping removed 3500' of loosely consolidated sands and silts. The base of the slumping was the lithologically homogeneous dark mudstone (= Belfast Mudstone - drilled thickness of 880') which is now indurated. Surely with 3500' of overburden, induration would have taken place by Oligocene times. This lithological unit would have been more resistent to slumping and scouring than the units above.

The data produced validates the argument that the Nautilus unconformity was in fact the continental slope in Oligocene times. The Oligocene sequence is complete in the Nautilus section but this is not so in many other Otway Basins sections as shown on fig. 3, and in the data compiled by Taylor (in press). A lower Oligocene hiatus was suggested originally by Carter's

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(1958) Aire Coast (eastern Otway Basin) foraminiferal sequence. Following the subaerial exposure, a shallow water sandy calcarenite was deposited. This Upper Oligocene unit, the Clifton Formation, is rich in bryozoal fragments, is cemented by iron carbonates and hydrates and contains phosphatic nodules. Baker's (1962) description of the sediment and mineral content shows clearly that it was the result of an unconformity in an area of low relief. Thus there was slumping and deep water deposition in one part of the basin corresponding with subaerial exposure in the marginal areas. Even in marginal areas where Oligocene sedimentation was continuous in some sections (e.g. Narrawaturk - fig. 5) the Lower Oligocene marls were shallow water deposits and the Upper Oligocene is represented by the typical Clifton Formation lithology. From fig. 5 it appears that Narrawaturk was in a lower structural position than Pecten where the Lower Oligocene is absent.

A Lower Oligocene structural adjustment is obvious with two apparently simultaneous events; uplift in the northern part of the basin; down-warp on the southern extension of the continental shelf resulting in slumping and formation of a new continental slope. The Nautilus section shows that sediment built up during Oligocene to Miocene times so that the continental shelf was extending southward to establish its present position.

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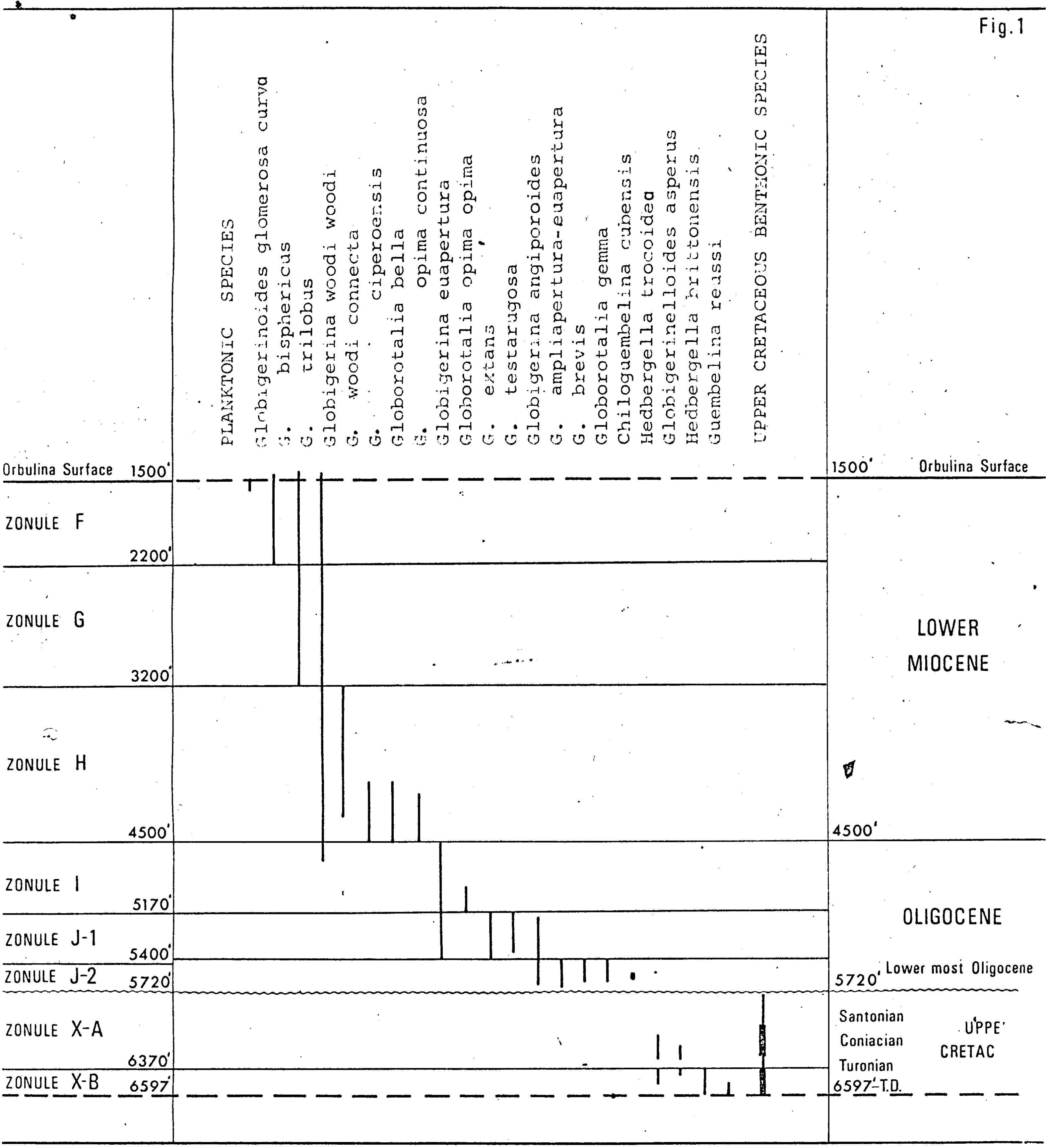
Fig.1

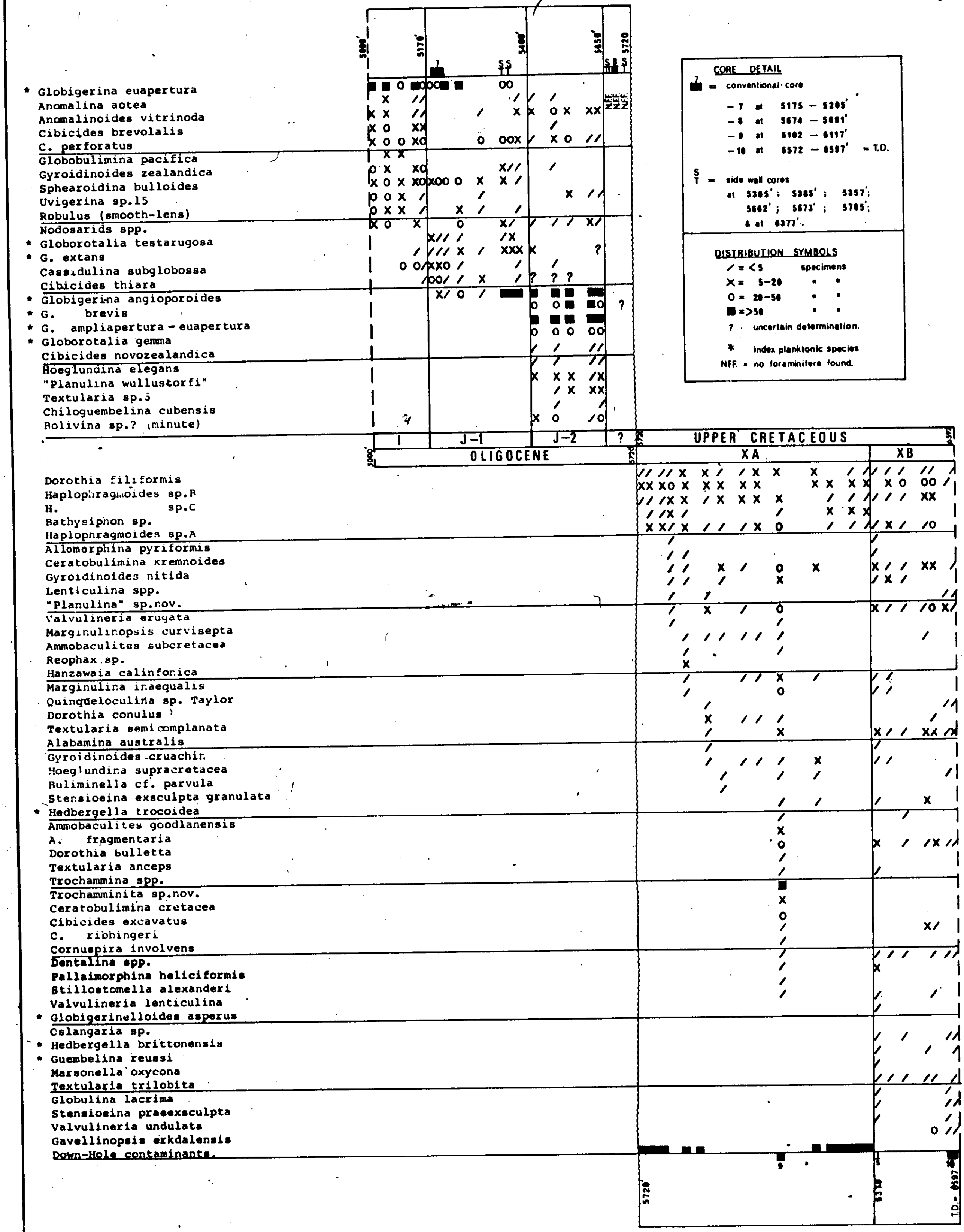


NAUTILUS A-1
Summary Biostratigraphy

DATUM 95' M.S.L.

REFER FIGURE 2 FOR DETAILED DISTRIBUTION 5000-6597

Fig. 2



CORE DETAIL

■ = conventional core

- 7 at 5175 – 5205'
- 8 at 5674 – 5691'
- 9 at 6102 – 6117'
- 10 at 6572 – 6597' = T.D.

S T = side wall cores
at 5365' ; 5385' ; 5357';
5662' ; 5673' ; 5705';
& at 6377'.

DISTRIBUTION SYMBOLS

/ = <5 specimens
X = 5–20 " "
O = 20–50 " "
■ = >50 " "
? · uncertain determination.
* index planktonic species
NFF. = no foraminifera found.

Foraminiferal distribution chart – Nautilus–A-1
from 5000' to 6590'.

PE900447

This is an enclosure indicator page.
The enclosure PE900447 is enclosure within the
container PE900446 at this location in this document.

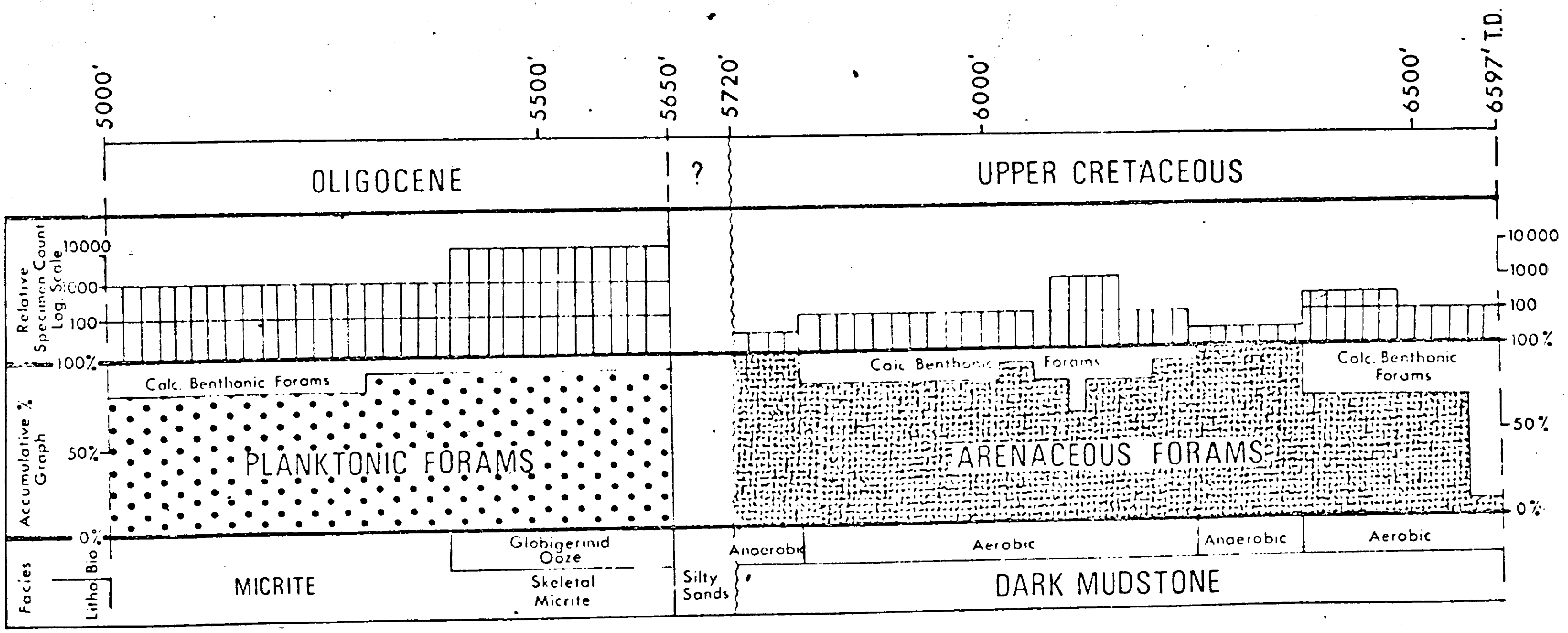
The enclosure PE900447 has the following characteristics:
ITEM_BARCODE = PE900447
CO NTAINER_BARCODE = PE900446
NAME = Nautilus 1 Figure 3 Cross section Flaxmans to Pecten to Nautilus

BASIN = OTWAY
PERMIT =
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Nautilus 1 Figure 3 Cross section Flaxmans to Pecten to Nautilus

DATE_CREATED =
DATE_RECEIVED =
W_NO = W516
WELL_NAME = Nautilus 1
CONTRATOR = Esso
CLIENT_OP_CO = Esso

FIG 4

Fig. 4



Facies analysis across the Nautilus unconformity in Nautilus A-1 Well Datum 95' M.S.L.

REFER FIGURE 2 FOR
DETAILED DISTRIBUTION
OF FORAMINIFORA

PE900448

This is an enclosure indicator page.
The enclosure PE900448 is enclosure within the
container PE900446 at this location in this document.

The enclosure PE900448 has the following characteristics:

ITEM_BARCODE = PE900448
CO NTAINER_BARCODE = PE900446
NAME = Nautilus 1 Figure 4 Vertical facies sequence Oligocene to lower Miocene
BASIN = OTWAY
PERMIT =
TYPE = WELL
SUBTYPE = DIAGRAM
DESCRIPTION = Nautilus 1 Figure 4 Vertical facies sequence Oligocene to lower Miocene
DATE_CREATED =
DATE_RECEIVED =
W_NO = W516
WELL_NAME = Nautilus 1
CONTRATOR = Esso
CLIENT_OP_CO = Esso

PE600319

This is an enclosure indicator page.
The enclosure PE600319 is enclosed within the container PE900446 at this location in this document.

The enclosure PE600319 has the following characteristics:

ITEM-BARCODE = PE600319
CONTAINER-BARCODE = PE900446
NAME = Nautilus 1 Mudlog, Figure 4
BASIN = OTWAY
PERMIT = PEP 49
TYPE = WELL
SUBTYPE = MUD-LOG
DESCRIPTION = Nautilus 1 Mudlog, Figure 4
REMARKS =
DATE-CREATED = 19/04/68
DATE-RECEIVED = *
W_NO = W516
WELL-NAME = Nautilus 1
CONTRACTOR = Exploration Logging Inc
CLIENT_OP_CO = Esso

(Inserted by DNRE - Vic Govt Mines Dept)

PE600324

This is an enclosure indicator page.
The enclosure PE600324 is enclosed within the container PE900446 at this location in this document.

The enclosure PE600324 has the following characteristics:

ITEM-BARCODE = PE600324
CONTAINER_BARCODE = PE900446
NAME = Nautilus 1 Well Completion Log, Figure 3
BASIN = OTWAY
PERMIT = PEP 49
TYPE = WELL
SUBTYPE = COMPOSITE_LOG
DESCRIPTION = Nautilus 1 Well Completion Log, Figure 3
REMARKS =
DATE-CREATED = *
DATE-RECEIVED = *
W_NO = W516
WELL-NAME = Nautilus 1
CONTRACTOR = Esso
CLIENT_OP_CO = Esso

(Inserted by DNRE - Vic Govt Mines Dept)

PE900449

This is an enclosure indicator page.
The enclosure PE900449 is enclosed within the container PE900446 at this location in this document.

The enclosure PE900449 has the following characteristics:

ITEM-BARCODE = PE900449
CONTAINER_BARCODE = PE900446
NAME = Nautilus 1 Locality Map, Figure 1
BASIN = OTWAY
PERMIT = PEP 49
TYPE = GENERAL
SUBTYPE = PROSPECT-MAP
DESCRIPTION = Nautilus 1 Locality Map Showing Significant Tests and Principal Offshore Geologic Provinces, Figure 1
REMARKS =
DATE-CREATED = *
DATE-RECEIVED = *
W_NO = W516
WELL-NAME = Nautilus 1
CONTRACTOR = Esso
CLIENT_OP_CO = Esso

(Inserted by DNRE - Vic Govt Mines Dept)

PE900450

This is an enclosure indicator page.
The enclosure PE900450 is enclosed within the container PE900446 at this location in this document.

The enclosure PE900450 has the following characteristics

ITEM-BARCODE = PE900450
CONTAINER_BARCODE = PE900446
NAME = Nautilus 1 Time-Depth Curve, Figure 5
BASIN = OTWAY
PERMIT = PEP 49
TYPE = WELL
SUBTYPE = VELOCITY_CHART
DESCRIPTION = Nautilus 1 Time-Depth Curve, Figure 5
REMARKS =
DATE-CREATED = 1/09/68
DATE-RECEIVED = *
W_NO = W516
WELL-NAME = Nautilus 1
CONTRACTOR = Esso
CLIENT_OP_CO = Esso

(Inserted by DNRE - Vic Govt Mines Dept)

PE900451

This is an enclosure indicator page.
The enclosure PE900451 is enclosed within the container PE900446 at this location in this document.

The enclosure PE900451 has the following characteristics:

```
     ITEM-BARCODE = PE900451
CONTAINER_BARCODE = PE900446
             NAME = Nautilus 1 Rig Performance Ocean
                    Digger, Figure 6
            BASIN = OTWAY
           PERMIT = PEP 49
             TYPE = WELL
          SUBTYPE = DIAGRAM
      DESCRIPTION = Nautilus 1 Rig Performance Ocean
                    Digger, Figure 6
          REMARKS =
     DATE-CREATED'= 1/09/68
    DATE-RECEIVED =
             W_NO = W516
        WELL-NAME = Nautilus 1
       CONTRACTOR = Esso
     CLIENT_OP_CO = Esso
```

(Inserted by DNRE - Vic Govt Mines Dept)

PE900452

This is an enclosure indicator page.
The enclosure PE900452 is enclosed within the container PE900446 at this location in this document.

The enclosure PE900452 has the following characteristics:

ITEM-BARCODE = PE900452
CONTAINER_BARCODE = PE900446
NAME = Nautilus 1 Stratigraphic Cross Section A-A' Showing ESSO Nautilus A-l, Figure 2b
BASIN = OTWAY
PERMIT = PEP 49
TYPE = WELL
SUBTYPE = CROSS_SECTION
DESCRIPTION = Nautilus 1 Stratigraphic Cross Section A-A' Showing ESSO Nautilus A-l, Figure 2b
REMARKS =
DATE-CREATED = 1/09/68
DATE-RECEIVED = *
W_NO **= W516**
WELL-NAME = Nautilus 1
CONTRACTOR = Esso
CLIENT_OP_CO = Esso

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

PE900556

This is an enclosure indicator page.
The enclosure PE900556 is enclosed within the container PE900446 at this location in this document.

The enclosure PE900556 has the following characteristics:
ITEM-BARCODE = PE900556
CONTAINER_BARCODE = PE900446
NAME = Nautilus 1 Stratigraphic Cross Section A-A' Showing Proposed Nautilus A-l, Figure 2a
BASIN = OTWAY
PERMIT = PEP 49
TYPE = WELL
SUBTYPE = CROSS_SECTION
DESCRIPTION = Nautilus 1 Stratigraphic Cross Section A-A' Showing Proposed Nautilus A-l, Figure 2a
REMARKS =
DATE-CREATED = 1/09/68
DATE-RECEIVED =
W_NO = W516
WELL-NAME = Nautilus 1
CONTRACTOR = Esso
CLIENT_OP_CO = Esso

(Inserted by DNRE - Vic Govt Mines Dept)

PE904305

This is an enclosure indicator page.
The enclosure PE904305 is enclosed within the container PE900446 at this location in this document.

The enclosure PE904305 has the following characteristics:

ITEM-BARCODE = **PE904305**
CONTAINER_BARCODE = **PE900446**
NAME = **Nautilus 1 GC-MS Analysis of Saturates From Core Samples**
BASIN = **Otway**
PERMIT = **PEP 49**
TYPE = **WELL**
SUBTYPE = GEOCHEM_RPT
DESCRIPTION = **Nautilus 1, Core 8: 5688'5.5"" -** 5688’11"", **CG-MS saturates**
REMARKS =
DATE-CREATED =
DATE-RECEIVED =
W_NO =
WELL-NAME =
CONTRACTOR =
CLIENT_OP_CO =

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

PE904306

This is an enclosure indicator page.
The enclosure PE904306 is enclosed within the container PE900446 at this location in this document.

The enclosure PE904306 has the following characteristics:
ITEM-BARCODE = PE904306
CONTAINER_BARCODE = PE900446
NAME = Nautilus 1 GC-MS Analysis of Saturates From Core Samples
BASIN = Otway
PERMIT = PEP 49
TYPE = WELL
SUBTYPE = GEOCHEM_RPT
DESCRIPTION = Nautilus 1, Core 9: 6103'6"" - 6104', CG-MS saturates
REMARKS =
DATE-CREATED =
DATE-RECEIVED =
W_NO =
WELL-NAME =
CONTRACTOR =
CLIENT_OP_CO =

(Inserted by DNRE - Vic Govt Mines Dept)

PE904307

This is an enclosure indicator page.
The enclosure PE904307 is enclosed within the container PE900446 at this location in this document.

The enclosure PE904307 has the following characteristics:

```
     ITEM-BARCODE = PE904307
CONTAINER_BARCODE = PE900446
             NAME = Nautilus 1 GC-MS Analysis of Saturates
                    From Core Samples
            BASIN = Otway
           PERMIT = PEP 49
             TYPE = WELL
          SUBTYPE = GEOCHEM_RPT
      DESCRIPTION = Nautilus 1, Core 10: 6589'6"" – 6590',
                    CG-MS saturates
          REMARKS =
     DATE-CREATED =
    DATE-RECEIVED =
             W_NO =
        WELL-NAME =
       CONTRACTOR =
     CLIENT_OP_CO =
```

(Inserted by DNRE – Vic Govt Mines Dept)