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ESSO

CLAM-1

WELL COMPLETION REPORT

By

C.K. Lunt

Punch Carded By J. Thorne 9/12/69

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I SUMMARY

(a) Drilling

Clam-1 was spudded in at 10.15 hours on July 19, 1969. A $17\frac{1}{2}$" hole was drilled to 484 feet and then reamed to this depth using a 36" bit. A 26" bit was then used to drill to 1055 feet. The 20" casing was cemented at 1023 feet with a 30" pile joint screwed to the top of the string and $16\frac{3}{4}$" BOP was installed. The hole was then drilled to 2050 feet and 13 3/8" casing cemented at 1990 feet. From 2050 feet to 5316 feet the well was drilled with a $12\frac{1}{4}$" bit, and from 5316 feet to total depth (5323 feet) the well was cored with an 8 5/16" core bit. Two abandonment plugs were set at 2032 feet and 700 feet.

Figure 5 is a well history chart showing the main operations.

(b) Geological

The Clam-1 well was drilled in the King Island Sub-basin of the Otway Basin, a sedimentary trough located off-shore between King Island and north western Tasmania. It extends some 40 miles in an east northeast direction and 20 miles in a west southwest direction (800 square miles in area) and is connected to the main Otway Basin by a linear graben-like feature trending in a northeast-southwest direction.

Clam-1 was designed to test Tertiary and Cretaceous sediments deposited over a basement "high" mapped within the sub basin. Younger movement of this basement high resulted in structural closure of basal Tertiary beds while the Cretaceous prospect was a clearly defined updip pinchout against the basement high. The well was located to test both trapping mechanisms.

Clam-1 probably commenced drilling in the Port Campbell Limestone Formation at 427 feet. Cuttings, however, were first collected at 1055 feet. The Tertiary section as known in the Port Campbell area was represented in the Clam well. At 2788 feet a cobble conglomerate was encountered which is similar to Tertiary occurrences known on shore Tasmania. Seismically this conglomerate appears to correlate with the basal Tertiary Pebble Point Formation of the Otway Basin. Palynological evidence, however, indicates an uppermost Upper Cretaceous age.

Upper Cretaceous Sherbrook Group sediments as recognized in the Otway Basin proper were also represented in Clam-1. The top of the Sherbrook Group was picked at 3133 feet coinciding well with original predictions.

"Red beds" disconformably underlying the basal Upper Cretaceous Waarre Formation were encountered at 4272 feet, instead of the anticipated Lower Cretaceous Otway Formation. These deposits are 624 feet thick in Clam-1 and are composed of non-porous conglomerate and massive red siltstone. The age of these beds is most probably Upper Devonian-Lower Carboniferous. At 4896 feet a hard grey shaly siltstone was penetrated before reaching low grade metamorphic Pre-Cambrian phyllite basement at 5053 feet.

II INTRODUCTION

Clam-1 was drilled to test a thick sedimentary section deposited in an 800 square mile area comprising the King Island Sub-basin (see figure 1). The thickness of the sediments exceeds 10,000 feet which is adequate to source large quantities of hydrocarbons. Cretaceous beds were observed to pinch out updip onto high basement, while substantial drape is evident on the flanks. Later structural movement resulted in closure at the base of the Tertiary sequence (see structure maps, Clam-1 Subsidy Request).

The location for Clam-1 was chosen on a seismic shot point where the maximum sedimentary section could be tested while remaining well within the basal Tertiary closure and at the same time providing the greatest possibility of penetrating a Cretaceous pinchout trap.

The original prognosis for Clam-1 was based on good seismic data but acknowledged difficult seismic-geological correlations because of the distance and partial separation by high basement of the King Island Sub-basin from the main Otway Basin. In spite of this, the original prognosis and the actual results of drilling are in very close agreement (see figure 1). The only major lithologic discrepancy was the appearance of non-porous "red beds" of questionable age consisting of red conglomerate and massive red siltstone instead of the anticipated siltstone and greywackes of the Lower Cretaceous.

III WELL HISTORY

1. General Data

(a) Well Name and Number

Esso Clam-1

(b) Name and Address of Operator

Esso Exploration and Production Australia Inc.
G.P.O. Box 4249,
SYDNEY, N.S.W. 2001

(c) Name and Address of Tenement Holder

Hematite Petroleum Pty. Ltd.,
G.P.O. Box 2752,
MELBOURNE, VIC. 3001

(d) Petroleum Tenement

Tasmanian petroleum tenement T/P5 held by Hematite Petroleum Pty. Ltd.

(e) District

The Clam-1 test was located approximately 24 miles west of the north-west tip of Tasmania and 43 miles south of King Island.

(f) Location

Latitude	40° 51' 52.419"	south
Longitude	144° 12' 55.153"	east

(g) Elevation

Kelly Bushing (permanent datum)

(h) Water Depth

334' 101.87

(i) Total Depth

5323'

(j) Date Drilling Commenced

July 19, 1969.

(k) Date Total Depth Reached

August 3, 1969.

(l) Date Well Abandoned

August 5, 1969.

(m) Date Rig Released

August 15, 1969.

(n) Drilling Time in Days to Total Depth

15.2 days (17.2 days to abandonment)

(o) Status

Plugged and abandoned

(p) Total Cost

To be submitted at a later date

2. Drilling Data

(a) Name and Address of Drilling Contractor

Ocean Drilling and Exploration Company (Aust.) Ltd.
180 Russell Street.,
MELBOURNE VIC 3000.

(b) Drilling Plant

Make:	EMSCO
Type:	A1500E
Rate Capacity:	20,000 feet with 5" drill pipe.
Motors:	2-1000 HPDC. Electric Motors with Dynamtic 6032 brake.

(c) Mast/derrick

Lee C. Moore 40' x 40' x 142' Cantilever mast, 1,000,000 lb. hook load capacity.

(d) Pumps

Make:	EMSCO
Type:	D1350
Size:	8" x 18"
Motor:	D.C. electric direct drive, 1350 H.P.

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 KVA volt alternator. One (1) Fairbanks Morse Model 38 D-8-1/8 O.P. Diesel engine rated at 18-0 H.P. 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" (GK)
Working Pressure:	5,000 P.S.I.

(f) Hole Sizes and Depths

(Kelly Bushing Measurements)

36"	to	489'
26"	to	1055'
17½"	to	2050'
12¼"	to	5316'
8-5/16"	to	5323'

(g) Casing and Cementing Details

Size	30"	20"	13-3/8"
Weight	30' of 300 lb./ft.	60' of 167 lb./ft. Remainder 105 lb./ft.	54.5 lb./ft.
Grade	B	B	J-55
Range	3	3	3
Set	464'	1023	1990
Shoes	None	1023	1990
Collars	None	None	1869
Centralizers	None	None	1st, 2nd, 3rd, 5th & 7th jt.

2-(g) Casing and Cementing Details Cont.

Note: Cemented 20" with 30" pile joint attached with 1050 sx. Australian Portland Cement with 1.5% pre-hydrated gel followed by 500 sx. Australian Portland cement with 2% Calcium chloride.

Cemented 13-3/8" with 400 sx. Australian Portland cement followed by 350 sx. Australian Portland with 2% calcium chloride. Average slurry density 15.6 ppg.

(h) Weekly Summaries of Mud Properties

	Week of July 19	Week of July 26	Week of August 3
Wt.	11.5 ppg.	11.2 ppg.	11.4 ppg
Visc.	46 sec.	39 sec.	44 sec.
Fluid loss	12.0 cc	14.8 cc	13.4 cc
% Sand	1	4	0.75
% Solid	10	13	12
Oil	-	-	-
P.H.	11.0	12.5	10.0
Alk.	0.60	0.35	0.25

(i) Water Supply

Fresh water transported by smit-Lloyd vessels Nos.12, 14 and 33 from Barry Beach Marine Terminal.

(j) Perforations

None

(k) Plugs

Depth	2032-1822	700-550
Cement sacks	225	110
Type	Aust "N" with 2% $CaCl_2$	Aust."N" with 2% $CaCl_2$

(l) Fishing Operations

None

(m) Side Tracked Hole

None

3. Logging and Testing

(a) Ditch Cuttings: Four samples were taken and preserved for every 10' interval (except cored intervals) from 1050' to total depth. One set of samples were dried, bagged, packed in boxes and despatched to the Bureau of Mineral Resources in Canberra; one set was sent to the Tasmanian Mines Department; one set was sent to Hematite Petroleum Pty.Ltd., and one set was retained by Esso.

3. (b) Coring:

Core Number	Interval Cored	Footage Cut	Recovery In Feet	Recovery %
1	1366-1370	4	0	0
2	1370-1394	24	0	0
3	2846-2849	3	2	66
4	3157-3167	10	9½	95
5	4478-4508	30	11	27
6	5316-5323	7	7	100
1-6		78	29.5	37.8

Repositories of Core Material

Centre slab of each core retained at Esso Spotswood Warehouse, Melbourne, Victoria.

Side slabs of each core retained by the Tasmanian Mines Department, Hobart and the Bureau of Mineral Resources, Canberra.

(c) Sidewall Sampling

All sidewall cores by Schlumberger wire line chronological sample taker.

Depth (in feet)	Recovery (in inches)	Depth (in feet)	Recovery (in inches)	Depth (in feet)	Recovery (in inches)
1050	2	3353	1¼	4424	1¼
1200	2¼	3355	1¼	4427	1½
1350	2	3362	1½	4535	3/4
1360	2	3364	1½	4559	1
1801	1	3366	1½	4677	¼
1802	1	3368	1½	4780	1
1804	1	3455	1	4783	3/4
1806	1	3637	1¼	4787	1¼
1807	1	3961	1	4790	1½
1808	1	4017	1½	4793	3/4
1809	2	4130	1½	4797	1
1959	2	4132	1½	4895	¼
2203	1 3/4	4134	1½	4898	1
2254	1 3/4	4136	1½	4902	1¼
2345	1¼	4138	1½	4905	1
2347	1½	4140	3/4	4908	3/4
2355	1	4142	1½	4911	1
2385	1¼	4144	1½	5012	1½
2522	½	4203	½	5015	1½
2562	3/4	4205	1	5017	1½
2605	1	4213	1	5019	3/4
2705	1¼	4222	1¼	5021	½
2747	1¼	4227	1	5023	3/4
2751	1	4232	1	5025	½
2753	1	4244	1¼	5027	½
2775	1¼	4273	1	5045	1
2777	1¼	4285	1½	5047	N/R
2778	1	4336	1½	5050	N/R
2781	2	4355	1½	5052	N/R
2784	1 3/4	4367	1	5055	½
2786	1¼	4415	1	5066	N/R
2902	3/4	4417	1 3/4	5071	½
3015	½	4419	1¼	5226	1
3099	1 3/4	4421	3/4	5244	N/R

(N/R = No Recovery)

The above side wall core residues will be retained by Esso's Spotswood Warehouse, Melbourne, Victoria, although in some cases the preparation of palynological, micro paleontological samples and chemical analyses may destroy the small core sample.

4. Electrical and other logging surveys

(a) Schlumberger Logs

	Run 1	Run 2
Induction Electric Log.	1023-2015'	1982-5323'
Compensated Formation Density-Gamma-Ray Log.	1982-5318'	
Bore-hole Compensated Sonic-Gamma-Ray Log (Gamma-Ray run to surface)	1023-2015'	
Bore-hole Compensated Sonic-Log with SP	1982-5318'	
Continuous Dipmeter (3 arm)	1981-5314'	
Continuous Dipmeter (4 arm)	1981-5314'	

(b) Penetration rate and gas logs

A record of penetration rate was kept at all times during drilling and is included in this report. (figure 3)

(c) Deviation Surveys

Sonde position showing hole deviation from vertical was recorded every 100 feet from 1982 feet to 5317 feet on the continuous dipmeter log. Maximum hole deviation did not exceed 4 degrees.

(d) Temperature Surveys

Schlumberger log temperatures

90°F. at 2015'
136°F. at 5318'

(e) Other Well Surveys

A Velocity Survey was carried out at 5323 feet on August 3, 1969 by United Geophysical Corp. The results are included as an appendix (figure 4).

5. Testing

(i) Formation Testing - none

(ii) Production Testing - none

6. Potassium-Argon Age Determination

One core sample was analysed by Geochron Laboratories in Cambridge, Massachusetts U.S.A. using the potassium-Argon method. The results of this analysis are found in Appendix 4 of this report.

IV GEOLOGY

1. Summary of Previous Work

The drilling of Clam-1 was the first direct attempt at finding hydrocarbons in the King Island Sub-basin. Prior to this test three seismic surveys were carried out encompassing this area. These are as follows :

Hematite Petroleum Pty.Ltd.

Survey K (1965), 138 miles of single fold coverage.

Esso Exploration and Production Australia

Survey EO (1966-67) 364 miles of six fold coverage
Survey EP (1967) 123 miles of six fold coverage

The King Island Sub-basin was not covered by airborne magnetometer although two surveys did include part of the fringe area. These were carried out by Hematite Exploration Pty.Ltd. in 1961-62 and Esso Exploration and Production in 1966-67.

In the Otway Basin proper hydrocarbon exploration has been carried out for many years. Although no commercial discoveries have been made to date, several shows of gas and oil have been recorded. The most significant indication of hydrocarbons occurred in the Port Campbell-1 well which yielded 4.2 MMCFGD with some condensate on drillstem test.

2. Summary of Regional Geology

The geology of the Otway Basin proper has been previously described in detail in the Well Completion Reports of Esso-BHP's Crayfish-1, Prawn-1, Argonaut-1 and Nautilus-1. The structural-stratigraphic information gained from the drilling of Clam-1 has in no way altered any of these geological concepts, although a series of events are recognised, prior to Cretaceous deposition, which are at present unique to the King Island Sub-basin. These are recognized to have been influenced by geological events effecting north-western portion of Tasmania. The following summary relates primarily to the King Island Sub-basin.

Pre-Cambrian

Both metamorphic and unmetamorphic Pre-Cambrian rocks are widely distributed over northwestern Tasmania and King Island. It is thought that the two rock types are separated from each other by the Frenchman Orogeny which occurred between the Lower and Upper Pre-Cambrian. Separating the Pre-Cambrian and Cambrian was the Penguin Movement.

Cambrian

During Cambrian times Tasmania lay within the Tasman Geosynclinal Zone consisting of a multitude of sedimentary basins subsiding intermittently and eratically. Sedimentation was extremely varied, accompanied by wide-spread volcanic activity. Outcrops of Cambrian rocks in northwestern Tasmania attain thicknesses of up to 5000 feet as at Smithton, suggesting possible distribution offshore. The section here is represented by a wide variety of both marine and non-marine sedimentary rocks in part with tuffaceous matrix overlain by tuffs, siltstone, greywacke, breccias and basic lavas. Occurring on King Island are over 4,000 feet of Cambrian rocks consisting mainly of basic lavas, basalts, pyroclastics and conglomerate.

Cambrian to Devonian

Moderate deposition may have continued in northwestern Tasmania up until the Mid-Devonian Tabberabberan Orogeny which greatly effected the western portion of the state. Rocks of this time interval, however, are unknown in the northwestern tip of the island. This may be due to non deposition during this period, although erosion as a result of uplift seems more likely. Accompanying the Mid-Devonian Tabberabberan techtonics were large out-pourings of granite extending from King Island all the way down the west

2. Cambrian to Devonian Cont.

coast of Tasmania. This granite is significant in that it may be a source for the Cretaceous sandstones encountered both in the Otway Basin west of King Island and the King Island Sub-basin.

Deposits were penetrated in Clam-1 which are believed to be of Upper Devonian or Lower Carboniferous age although conclusive age determination has not been possible.

Carboniferous to Tertiary

Sedimentation after the Tabberabberan Orogeny continued on Tasmania until the Permian glaciation period. Deposition evidently did not extend into the northwestern extremity of Tasmania. By late Triassic or Lower Jurassic times, sedimentation virtually ceased on Tasmania. Dominating the geological history of this span of time were the tremendous extrusions of dolerite which spread over the entire eastern half of the island.

Tertiary

Non marine Tertiary beds are known in the Tamar Graben located in the Launceston-Devonport area. These deposits consist of clays, silts, greywackes agglomerates of Paleocene-Eocene in age and most probably extend westward into the northwest most tip of Tasmania.

Marine Tertiary beds(pink limestones). occur in the Smithton area and are equivalent to limestones present on King Island. These are probably Oligocene (Jan Juc) in age. Apparently marine transgression took place in the northwest during Oligocene times withdrawing after the Middle Miocene, as no younger marine tertiary beds are known in this area.

Tasmania during the Cenozoic underwent major tensional stresses which resulted in the formation of large graben and horst blocks. Accompnaying these movements was widespread outpouring of basalt. Lava fields are particularly extensive along the northwest coast where extrusions are seen to have occurred as early as Middle Oligocene and lasting probably into the Pliocene.

3. Stratigraphic Table

The stratigraphy of the Clam-1 well corresponds to that recognised on shore Tasmania from the Pre-Cambrian basement to the Upper Cretaceous beds. From the beginning of the Upper Cretaceous through the Miocene the stratigraphy correlates with that of the Port Campbell area in the Otway Basin proper.

(Depths relative to Kelly bushing - subtract 99 feet from M.S.L.)

		Interval	Thickness
Tertiary	Water	99' ~~ASL~~-433	(334')
Miocene-Oligocene			
Port Campbell Limestone Equivalent * Note: first samples recovered at 1050'		433*-1060'	(627')
Jan Juc (Gellibrand Equivalent)		1060-1368'	(308')
Eocene			
Brown's Creek Group Equivalent		1368-1783'	(415')
Paleocene			
Wangerrip Group			
Rivernook Fm		1783-2070'	(287')
Dilwyn Fm.		2070-2788'	(718')
Upper Cretaceous			
Basal conglomerate		2788-3133'	(345')
Sherbrook Group			
Curdies-Paaratte Fms. undifferentiated		3133-4110'	(997')

Belfast Equivalent	4110-4200'	(90')
Waarre Equivalent	4200-4272'	(72')
Devonian (?)		
"Red beds"	4272-4896'	(624')
Lower Paleozoic		
Siltstone	4896-5053'	(157')
Upper Pre-Cambrian		
Rocky Cape Group	5053'	

4. Stratigraphy in Clam-1

(a) Tertiary - 433-2788'

Deposition during Tertiary times appears, for the most part, continuous from the main basin into the King Island Sub-basin. Dipmeter data indicates sedimentation from the north northeast.

Miocene - approx. 427-1060'

The first deposit encountered below 1050 feet was described as a white to light reddish brown hard, fossiliferous limestone containing abundant bryozoan and echinoid fragments and foraminifera. In age it is equivalent to the Port Campbell Limestone formation and is probably about 600 feet thick.

Oligocene - 1060-1368'

Jan Juc (Gellibrand Equivalent) Marl was picked at 1060 feet on the basis of its first appearance and on electric log interpretation. Large amounts of limestone cavings occur in the cuttings making it difficult to distinguish these from the interbedded limestone occurring within the marl. The fossil assemblage here is similar to the overlying limestone, consisting mainly of fragmented bryozoa, echinoids and foraminifera.

The lowermost 38 feet of this 308 foot thick section is composed of reddish brown, medium soft mudstone containing scattered loose quartz grains and traces of glauconite. This probably represents a transitio: zone between the Oligocene and the underlying Eocene sandstone.

Eocene - 1368-1783'

Unconsolidated clean quartz sandstone of the Brown's Creek Group was encountered at 1368 feet and extends for 415 feet to a depth 1783 feet. D.J. Taylor recognized indeterminate glauconite moulds of calcareous foraminifera, but otherwise the section is devoid of marine fossils. Lithologically the section resembles the Mepunga Formation and on that basis lower Upper Eocene age is inferred.

Paleocene - 1783-2788'

Because of the total absence of fossils from the Eocene through the Paleocene, it was necessary to rely solely on lithology and electric log characteristics for estimating the stratigraphy of the remaining Tertiary section.

Mudstone, interbedded with loose, silty, fine grained quartz sandstone was encountered at 1783 feet. This 287 foot section is distinguishabl: from the Brown's Creek Group above by noticably increased sonic velocities and is correlated with the Rivernook Formation of the Otway Basin.

Sandstone of the Dilwyn Formation was encountered at 2070 feet. This sandstone sequence is massive containing few thin argillaceous interbeds. Grain sizes range from fine to medium and porosities generally exceed 25% as calculated from electric logs. Traces of pyrite occur throughout this sequence which attains a thickness of 718 feet.

(b) Upper Cretaceous - 2788-4272'

Basal Conglomerate - 2788-3133'

A 345 foot section of conglomerate was encountered at 2788'. A core was cut in this formation between 2846 and 2849 feet which recovered 2' of unconsolidated well rounded, pebble to cobble sized grains of very hard quartzite and cherty quartzite. Similar material of Tertiary age is known in northern and northwestern Tasmania. Also from its high amplitude, low frequency character on seismic records it appears to correlate with basal Tertiary deposits of the Otway Basin. Palynological evidence (see Appendix-1 by P.R. Evans) based on sidewall cores immediately above the conglomerate, however, give strong evidence of uppermost Upper Cretaceous age. A possible explanation for this could be the reworking of older material in the conglomerate but, as similar time and rock correlations occur in the Esso Prawn-1 well, this is unlikely. At the same time, it is most improbable that this conglomerate would underly a large regional unconformity such as is recognised between the Upper Cretaceous and Lower Tertiary in the western and central Otway Basins. Thus it is suggested that the conglomerate immediately overlies this same regional unconformity, but that the Upper Cretaceous - Tertiary hiatus of the Otway Basin proper transgresses time to the east such that at Clam-1 it occurs within the Upper Cretaceous. Moreover, it is reasonable to assume, as is substantiated by dipmeter data, that the source area for this conglomerate was from the east (i.e. northwestern Tasmania). The basal Tertiary beds of the Otway Basin were sourced from the North.

Sherbrook Group - 3133-4272'

No distinction is observed between the deposition of Sherbrook Group beds in the King Island Sub-basin and that of the Otway Basin proper.

Curdies - Paaratte Undiff.- 3133-4110'

Typical Upper Cretaceous sandstones of the Curdies-Paaratte formations, as recognised in the main Otway Basin, were encountered between 3133' and 4110'. This section is composed mainly of relatively loose, porous, fine to medium quartz grains with varying amounts of silt matrix. A core cut in this interval between 3157' and 3167' recovered 9½ feet of silty, fine to coarse grained, slightly porous to porous sandstone, interbedded with non-calcareous, medium hard siltstone.

Palynological investigations (see Appendix 1) have placed this interval in the N. senectus/T. lilliei zonule thus establishing equal age with that of the Curdies and Paaratte formations in the Otway Basin proper.

Belfast - 4110-4200'

The 90 foot section of Belfast underlying the Curdies-Paaratte sandstone and composed of light grey and medium grey-brown calcareous and non calcareous mudstone, is also correlated lithologically and palynologically with the same formation in the main Otway Basin. Based on spore-pollen occurrences (see Appendix 1) the Belfast is of Turonian age.

Waarre - 4200-4272'

Below the Belfast mudstone, 72 feet of sandy siltstone and silty sandstone of very low porosity were encountered. By inference, mainly on electric log character, this formation is thought to be Waarre equivalent. It is highly probable that this relatively thin occurrence represents the gradual silting and pinching out extremity of the Waarre formation.

(c) Devonian - Carboniferous (?)

"Red beds" - 4272-4896'

A 624 foot section of sediments higherto unknown either on Tasmania or on the southeastern mainland, was encountered at 4272 feet. These beds which are tentatively referred to as "red beds", are composed of conglomerate, composed of vari-coloured siltstones ranging from pebble to cobble in size, in a brick-red siltstone matrix and also unbedded brick-red siltstone.

Both core samples and thin-sections of the material were examined by various authorities in an attempt to identify and age date this material. Their findings are included in Appendix 2 of this report. The general opinion is that they are of Paleozoic origin and that the constituents are derived from Pre-Cambrian metamorphosed silt-stones prevalent in northwestern Tasmania. Further evidence is given by P.R. Evans (verbal communication) who postulates a Pre-Permian origin based on the total absence of plant cuticle material which is normally found in younger beds. The most important orogenic movement in Paleozoic times was the Tabberabberan Uplift during Middle Devonian. It is quite possible that this thick sequence was associated with that event.

(d) Lower Paleozoic Siltstone - 4896-5053'

Overlying the Pre-Cambrian Rocky Cape Group, 157 feet of light to medium grey, medium hard stilstone was penetrated differing from Rocky Cape Group only in its induration. It is assumed that this section represents a post Pre-Cambrian erosional surface occurring possibly during lowermost Paleozoic times. This zone is also devoid of fossil remains, thus dating is uncertain.

(e) Pre-Cambrian

Rocky Cape Group - 5053' +

Low grade metamorphic phyllite with associated pyrite and thin veins filled with carbonate were encountered at 5053'. This material was identified by workers in Tasmania as belonging to the Pre-Cambrian Rocky Cape Group.

5. Structure

Clam-1 was drilled on the southeastern flank of a large basement "high" and tested simultaneously basal Tertiary structural closure and a thick wedge of sediments pinching out updip against basement. Pre-drilling prognosis indicated Tertiary closure of approximately 60 square miles with vertical relief of 40 square miles. Drilling results show that the structural frame-work prognosed prior to drilling were correct.

6. Relevance to the Occurrence of Hydrocarbons

During the drilling of Clam-1 no significant shows of hydrocarbons were encountered. Figure 6 presents, in the form of Magnolia plot, the results of resistivity vs. porosity.

7. Porosity and Permeability of the Section Penetrated

In the Tertiary section of Clam-1 a total of 1478 feet of porous and permeable sands were penetrated. These include the following:

1. Brown's Creek (Eocene) with porosities calculated from the sonic log far in excess of 30%. Two cores were attempted in this formation, but due to the unconsolidated nature of the sand there was no discovery.

2. Dilwyn (Paleocene) with the average porosity calculated from the formation density log at 30%.

In the Upper Cretaceous section, a total of 977 feet of porous sands were penetrated.

1. Conglomerate with the average density log calculated porosity of 18-19%. A core was cut in this section between 2846 and 2849 feet in which the pebble and cobble grains were recovered in a totally unconsolidated state.

2. Undifferentiated Curdies and Paaratte Formation porosities (calculated

from the density log) ranging from 23 to 26% in the upper and lowermost part of the sequence to well over 30% in the 650 foot middle section.

3. The 72 foot Waarre section at the base of the Upper Cretaceous is a prospective formation in the main Otway Basin. Here, however, porosities of this section generally calculate to be between 10 and 16% with only few very thin sandstone stringers (less than 10 feet thick) ranging from 17 to 20%.

8. Contributions to Geological Concepts Resulting from Drilling

Clam-1 proved the presence of a sedimentary section of almost 5000 feet thick in the southeasternmost portion of the Otway Basin. Thereby it significantly extended the stratigraphic control into a new and heretofore unexplored area. The results of drilling Clam-1 are shown graphically on the Cross-sections (figure 1).

Below the Oligocene marine deposits, 2900 feet of Tertiary and Upper Cretaceous age sediments conformed lighologically and structurally to predictions. The section is composed mainly of porous sandstones with little interbedding of siltstone and shales. Palynological evidence, however, indicates that the large unconformity, occurring between the top of the Upper Cretaceous and lowermost Tertiary as observed in the central and western portion of the Otway Basin, occurs within the Upper Cretaceous in the eastern extremity of the basin.

Below the Upper Cretaceous, instead of the anticipated mudstones, siltstones and greywackes of the Lower Cretaceous, "red beds" were encountered which were hitherto unknown in the region. Various authorities have inspected this material (see Appendix 2), and it is believed that it is Paleozoic in age, probably late Devonian.

Petrographical studies and potassium-argon age determinations were made on the basement material. It was identified as belonging to the Rocky Cape Group recognized on shore Tasmania and is of Upper Pre-Cambrian age.

The Upper Cretaceous basal conglomerate which exhibited structural closure on seismic records lacked an overlying seal. The lowermost Upper Cretaceous Waarre Formation which is a highly prospective porous sandstone unit in the Otway Basin is observed to have become very silty in Clam-1. Although the anticipated overlying seal (Belfast Formation) is present, the Waarre here lacks reservoir capability.

V REFERENCES

1. Journal of the Geological Society of Australia Volume 9, Part 2 Adelaide, S.A. 1962.

2. Prawn-1 Well Completion Report
Esso Exploration and Production 1968.

FORAMINIFERAL SEQUENCE - CLAM-1 WELL

OTWAY BASIN

TASMANIA

D.J. Taylor

FORAMINIFERAL SEQUENCE - CLAM-1 WELL

OTWAY BASIN - TASMANIA

Marine fauna on which definite age dating of the Tertiary and Upper Cretaceous marine sequences could be based were virtually non existant in Clam-1. In the interval 1150-1350 feet sidewall cores yeilded occasional specimens of *Hoplophragmoides* sp., an arenaceous foraminifera not indicative of any particular Tertiary Zone. Also a few indeterminate glauconite moulds of calcareous foraminifera were found.

Samples and sidewall cores were examined to a depth of 4535 feet, but apart from down-hole contamination no marine fauna were observed.

PETROGRAPHICAL STUDY OF CORES FROM ESSO CLAM-1

By D. Gee

NOTE.—All communications on Departmental business to be Addressed to the Director of Mines, Box 124 B, G.P.O., Hobart.

Department of Mines, Tasmania

Hobart, 11th September, 1969.

TELEPHONES:

Administration and Accounts ....
Mines Inspection ....
Explosives and Inflammable Liquids ....
Geological Survey .... } Hobart 30 5011

Assaying and Metallurgical Research .... Launceston 4 2431

Chief Geologist,
HOBART.

The core from ESSO-BHP Clam No. 1 has been examined with the object of indicating similarities with other rock types in NW Tasmania.

Core 3, 2846'-2848' : This consists of free pebbles of well rounded vein quartz and quartzite. Gravel layers containing such pebbles are common in the Tertiary Terrestrial deposits of N and NW Tasmania. A thin section of a quartzite with a granular texture shows it to be an orthoquartzite, consisting of well rounded and well sorted quartz grains with a quartz cement in optical continuity. Such material forms a large part of the Proterozoic Rocky Cape Group in NW Tasmania, and a Precambrian basement provenance is indicated.

Core 4, 3158'-3166' : This is a carbonaceous sandstone and siltstone, in part lignite, containing abundant carbonised plant stem fragments. Similar material occurs in the Tertiary in N Tasmania where it is usually beneath the Miocene basalts and is considered to be a lacustrine deposit.

Core 5, 4479'-4484' : Conglomeratic red-beds. No material of this nature is known from anywhere in Tasmania.

4485'-4489' : Similar material to previous red beds. Some of the fragments are of deeply weathered medium-grained igneous rocks, but these are unlike the Devonian granites, Jurassic dolerites or the Tertiary basalts of Tasmania. A thin section of one rounded fragment is a greywacke containing clastic fragments of quartz, quartzite, chert, sericitised feldspar, claystone fragments and muscovite flakes. This is again unlike anything in NW Tasmania.

Appendix 1.

PALYNOLOGY OF ESSO CLAM-1

by

P.R. Evans & Robin D. Mulholland

Palyn. Rept. 1969/15

November 25, 1969.

INTRODUCTION

All available sidewall cores from Clam-1 were examined with a view to extracting spores, pollen and dinoflagellates (Table 1). Those from rocks unlikely to yield useful assemblages (e.g. red-beds and coarse sandstones) or which had collapsed and become impregnated with drilling mud were not processed. The degree to which study of the processed assemblages was taken varies with the position in the section and not every assemblage listed below should be regarded as comprehensive. However, the fossils listed below are the species which influenced conclusions as to the age of the section sampled.

The Paleocene and Upper Cretaceous is divided according to zone schemes proposed by Harris (1965), Evans (1966) and Dettmann & Playford (in press).

A. 1050-1350 feet. Probably Eocene-Oligocene.

Little information is yet available on the pollen and dinoflagellate assemblages of Oligocene age in south-eastern Australia and the age of the assemblages listed in this section must be regarded as tentative. The pollen assemblages consist mainly of species of Nothofagidites of the N. emarcidus-heterus and to a lesser extent of the N. vansteenisii-deminutus groups. N. falcatus, N. goniatus and N. brachyspinulosus are present in rare numbers. Myrtaceidites spp. form a large proportion of the remaining components of the assemblages. Badly corroded specimens of Malvacipollis cf. M. diversus and Proteacidites incurvatus, present at 1050 feet, might be recycled. Likewise, one well preserved specimen of Wetzeliella "coleothrypta" at the same depth may also be recycled or a contaminant.

Sidewall core 15, 1050 feet.

Nothofagidites spp.	dominant
N. emercidus-heterus	
N. vansteenisii-deminutus	
N. brachyspinulosus	
N. falcatus	
N. goniatus	
Malvacipollis	
cf. M. diversus*	
Proteacidites incurvatus*	
Wetzeliella symmetrica	
Wetzeliella "coleothrypta"*	
Hystrichokolpoma spp. incl. H. rigaudae	
Hystrichosphaera spp.	

Sidewall core 14, 1200 feet.

Mainly dinoflagellates (75%). Of the pollen and spores:

Nothofagidites spp.	dominant (60%)
N. emarcidus-heterus	
N. vansteenisii-deminutus	
N. asperus	
Myrtaceidites parvus	
Triorites harrisii	
Proteacidites annularis	
Cyathidites minor	

Sidewall core 13, 1350 feet.

Abundant microflora with a lower dinoflagellate content than preceding samples (13%). Pollen and spores include:

Nothofagidites spp.	dominant (54%)
N. emarcidus-heterus	

* Probably recycled

N. vansteenisii-deminutus

N. goniatus

N. brachyspinulosus

Myrtaceidites spp. incl. M. mesonesus and M. parvus

Periporopollenites polyoratus

Proteacidites cf. P. annularis (larger than type)

? Monulcipollenites sp.

Gothanipollis sp.

Araucariacites australis

Bisaccate pollen undiff. rare

Cupaneidites reticularis

Cyathidites australis

B. 1809 feet. Lower Eocene

The age of this sample is based on the presence of Wetzeliella "coleothrypta" Downie & Williams identified by Wilson (1967) from the Lower Eocene of New Zealand. The species has not been recorded previously from Australian sediments. There is some doubt whether the Australian and New Zealand forms are in fact conspecific with the type W. coleothrypta from the Eocene of England, but there is little doubt that the Australian forms match those from New Zealand described by Wilson. The pollen assemblage from the same sample also generally supports a Lower Eocene age in that it appears to be somewhat younger than the Uppermost Paleocene Princetown Member of the Dilwyn Clay in western Victoria. Fossils recognized include:

Camarozonosporites sp.

Cyathidites splendens

Dictyophyllidites concavus

Verrucosisporites kopukuensis

Classopollis sp.

Parasaccites sp.

Stereisporites antiquasporites

Laevigatosporites ovatus

Anacalosisporites sp.

Cupaneidites reticularis

Dacrydiumites mawsonii

Dacrydiumites florinii

Dilwynites granulatus

Malvacipollis diversus

Myrtaceidites parvus

Myrt. tenuis

Nothofagidites spp. - N. emarcidus-heterus type (not common)

Proteacidites annularis

Prot. incurvatus reticuloscarbiatus

Prot. pachypolus

Santalumidites cainozoicus

Simplicopollis meridianus

Wetzeliella "coleothrypta" acc. Wilson 1967

Wetzeliella symmetrica

Hystrichosphaera sp.

Hystrichokolpoma rigaudae

"Gymnodinium australiense" Deflandre & Cookson 1955

Achomosphaera sp.

Deflandrea sp.

Chordosphaeridium sp.

C. 2203-2704 feet. Paleocene. T. edwardsii Assemblage.

The five sidewall cores from this interval contain varied assemblages. Only those at 2203, 2347 and 2704 feet yielded appreciable numbers of fossils. The presence of Triorites edwardsii throughout the section and of Latrobosporites crassus, "Dacrydiumites" balmei, Camarozonosporites bullatus and Periporopollenites polyoratus at the base indicate that the section lies within the Paleocene. Most of the dinoflagellates are referrable to Epicephalopyxis indentata and the genus Deflandrea. Of the latter only specimens from the base of the section, at 2704 feet, are referrable to previously described species of Deflandrea-D. obliques: the remainder appear to be new species.

Sidewall core 90, 2203 feet.

Cyathidites minor

Clavifera triplex

Ceratosporites cf. C. equalis

Stereisporites antiquasporites

Ster. regium

Triplanosporites pseudoreticulatus

Dilwynites granulatus

Dil. tuberculatus

Dacrydiumites mawsonii

Dacrydiumites reticulosaccatus

Disaccate pollen undiff. (common)

Australopollis obscurus

Nothofagidites spp. esp. N. brachyspinulosus

Myrtaceidites parvus

Proteacidites adenanthoides

Periporopollenites polyoratus

Triorites harrisii

Triorites edwardsii

Triorites minor

Epicephalopyxis indentata

Deflandrea sp.

Sidewall core 89, 2254 feet.

A very low yield of palynomorphs but including:

Clavifera triplex

Stereisporites antiquasporites

Lycopodiumsporites sp.

Periporopollenites polyoratus

Triorites edwardsii

Microcachryidites antarcticus

"Dacrydiumites" ellipticus

Svalbardella australina

Deflandrea sp.

Hystrichosphaera sp.

Sidewall core 88, 2345 feet.

A very small yield of fossils including:

Dictyophyllidites concavus

Ischyosporites sp.

Dacrydiumites mawsonii

Nothofagidites spp. incl. *N. brachyspinulosus*

Periporopollenites polvoratus

Proteacidites spp.

Epicephalopyxis indentata

Sidewall core 87, 2347 feet.

An abundant yield, mainly of spores and pollen, including:

Cyathidites australis & *minor*

Lycopodiumsporites sp.

Latrobosporites crassus

Dictyophyllidites concavus

Neoraistrickia truncata

Stereisporites antiquasporites

Ster. (*Tripunctisporis* sp.)

Gleicheniidites spp. undiff.

Clavifera triplex

Trilites tuberculiformis

Laevigatosporites ovatus

Microcachryidites antarcticus

Disaccate spp. undiff.

Nothofagidites spp. (rare)

"Dacridiumites" florinii

"Dacridiumites" balmei

"Dacridiumites" ellipticus

Dacrydiumites mawsonii

D. mawsonii verrúcosus

Australopollis obscurus

Ericipites scabratus

Periporopollenites polyoratus

?Proteacidites annularis

Triorites edwardsii

?Triorites harrisii

Tricolpites gillii

Simplicepollis meridianus

Deflandrea sp.

Hystrichosphaera sp.

Epicephalopyxis indentata.

Sidewall core 86, 2355 feet.

A small yield of few species, including:

Trilites tuberculiformis

Gleicheniidites spp.

Microcachrvidites antarcticus

Disaccate pollen undiff. (rel. common)

Periporopollenites polvoratus

?Triorites harrisii

Epicephalopvxis indentata

Deflandrea sp.

Sidewall core 81, 2704 feet. L. balmei zone)

Cyathidites australis & *minor*

Clavifera triplex

Gleicheniidites spp. undiff.

Stereisporites antiquasporites

Ster. regium

Ster. (Tripunctisporis) sp.

Cicatricosisporites sp.*

Camarozonosporites bullatus

Cam. bullatus acc. Playford & Dettmann 1968

Neoraistrickia truncata

Latrobosporites crassus

Laevigatosporites ovatus

Peromonoletes sp.

Microcachryidites antarcticus.

"Dacrydiumites" balmei

"Dacrydiumites" ellipticus

Dacrydiumites mawsonii

Triorites edwardsii

Triorites minor

Tricolpites gillii

Nothofagidites spp. undiff.

Deflandrea obliques

Deflandrea spp.

Epicephalopyxis indentata

Hystrichosphaera sp.

Hystrichosphaeridium sp.

D. 2778-3164 feet. Upper Cretaceous Nothofagidites microflora.

Represented by only two samples, both of which yielded numerous spores and pollen, many of which await description. Two coarse, clastic samples within the zone at depths of 2902 and 3015 feet were not examined. In contrast to the overlying Paleocene and the underlying Upper Cretaceous, the fossiliferous samples of the Nothofagidites microflora in the well lack dinoflagellates. The upper limit of the zone is determined by the presence of Tricolpites lilliei and Proteacidites amolosexinus at 2778 feet and its lower limit by the presence of Nothofagidites spp. at 3164 feet. The association of T. lilliei and D. balmei at 2778 feet suggests an horizon very close to the top of the Upper Cretaceous was samples. If section is missing between the Upper Cretaceous at 2778 feet and the Paleocene at 2704 feet, it would be largely of Paleocene age.

Microfloras identified in the zone include:

Sidewall core 75, 2778 feet.

Tricolpites lilliei

Triorites edwardsii

Tricolpites gillii

Dacrydiumites mawsonii

* Probably recycled.

D. mawsonii verrucosus

Dacridiumites reticulosaccatus

"D". balmei

Camarozonosporites ohaiensis

Proteacidites amolosexinus

Periporopollenites cf. *P. polvoratus*

Ericipites sp.

Gleicheniidites spp. undiff.

Lycopodiumsporites sp.

Nothofagidites spp. incl. *N. senectus*

Core 4, 3159 feet.

Tricolpites gillii

Tricolpites pachyexinus

Tricolpites sabulosus

Proteacidites amolosexinus

Nothofagidites senectus

Dacrydiumites mawsonii

Crybelosporites sp.*

*Cicatricosisporites ludbrookii**

Parasaccites sp.*

Podosporites microsaccatus

Cyathidites minor & *australis*

Perotrilites jubatus

Stereisporites antiquasporites

Cycadopites spp. undiff.

*Dulhuntyispora parvithola**

* *Ceratosporites equalis*

Simplicepollis cf. *meridianus*

Araucariacites australis

Osmundacidites wellmannii

Core 4, 3164 feet.

Nothofagidites spp. incl. *N. senectus*

Tricolpites gillii

T. sabulosus

* Probably recycled.

Triorites edwardsii

Aequitriradites sp.*

Ilexpollenites sp.

Laevigatosporites ovatus

Microcachryidites antarcticus

Podosporites microsaccatus

Araucariacites australis

Proteacidites sp. cf. P. amolosexinus

Striatiti spp. undiff.*

Cycadopites sp.

Liliacidites sp.

Dacridiumites mawsonii

E. 3455-3637 feet. Upper Cretaceous. Tricolpites pachyexinus Zone.

Represented by only two samples, the T. pachyexinus Zone differs markedly from the overlying Nothofagidites microflora by a sharp drop in the relative abundance of spores and pollen, particularly of angiosperm pollen and by the dominance of dinoflagellate cysts. In spite of the number of dinoflagellates the zone fossils Nelsoniella aceras and Deflandrea victoriensis, Hexagonifera vermiculata and H. glabra, Odontochitina porifera, O. cribropoda and O. striatoperforata are present in fair abundance. The section is assigned to the T. pachyexinus Zone because of the presence of Ornamentifera sentosa and Tricolpites gillii, the apparent absence of Nothofagidites spp. and the presence of the dinoflagellates listed above.

Sidewall core 62, 3455 feet.

Fossils are relatively well preserved and include:

Classopollis sp.

Podosporites microsaccatus

Camarozonosporites cf. amplus

Cam. bullatus acc. Playford & Dettman

Laevigatosporites ovatus

Simplicepollis meridianus

Dacrydiumites mawsonii

Appendicisporites distocarinatus *

Ornamentifera sentosa

"Triorites edwardsii" acc. Evans (1966, Pl. 11fig. 18).

Amosopollis ?cruciformis

Deflandrea sp. aff. D. cretacea

Defl. belfastensis

Cyclonephelium sp.

Hexagonifera vermiculata

* Probably recycled.

The specimen referred to "Triorites edwardsii" differs from the typical representatives of the species, but may be of stratigraphic significance since it was originally recorded from the T. pachyexinus Zone of Port Campbell No. 1. According to Playford & Dettman (in press) the T. pachyexinus Zone is too high for the occurrence of A. distocarinatus and therefore the specimen present in this sample might possibly be recycled. Alternatively it is evidence of the upwards extension of the range of the species.

Sidewall core 61, 3637 feet.

Forms identified include:

Tricolpites gillii

"Triorites edwardsii" acc. Evans (see above)

Classopollis sp.

Dacrydiumites mawsonii

Ceratosporites sp.

Odontochitina porifera

Odont. cribopoda

Odont. striatoperforata

Deflandrea victoriensis

Defl. belfastensis

Hexagonifera glabra

The appearance of H. glabra and O. cribropoda at this level below beds with H. vermiculata parallels the relative order of occurrence of these species in Flaxmans No. 1, onshore Otway Basin, in the Belfast Mudstone between cores 15 (5543 feet) and 16 (5950 feet).

F. 4017 feet. Upper Cretaceous undifferentiated.

Sidewall core at 4017 feet yielded extremely few fossils which were insufficient to indicate the sample's relative position within the Upper Cretaceous. By stratigraphic position it should lie within the range of the T. pachyexinus - A. distocarinatus Zones.

G. 4130-4144 feet. Upper Cretaceous. Probably A. Distocarinatus & A. parvum Zones

Portions of five closely spaced sidewall cores within the interval were processed and examined, but only the observations on the top and bottom samples are reported below. They bear very rareangiosperm pollen including Australopollis obscurus. In the apparent absence of Dacrydiumites mawsonii and Clavifera triplex, they are assigned to the A. distocarinatus Zone. Microplankton present are mostly undescribed, but specimens of Deflandrea acuminata, Ascodinium cf. A. acrophorum and Amosopollis cruciformis while not definitive suggest affinity with the Ascodinium parvum dinoflagellate Zone. If the correct age of these horizons differs from the ages postulated, they probably are younger, rather than older than the A. parvum Zone.

Sidewall core 58, 4130 feet.

Cyathidites australis & minor

Araucariacites australis

Alisporites granidis

Classopollis sp.

Pilosisporites notensis*

* Probably recycled.

Microcachrvidites antarcticus

Australopollis obscurus

Triporate pollen indet.

Parassacites sp.*

Aratrisporites sp.*

Camarozonosporites cf. C. amplus

Osmundacities wellmannii

Deflandrea spp. nov.

Cyclonephelium sp.

Sidewall core 51, 4144 feet.

Perotrilites majus

Vitreisporites pallidus

Densoisporites velatus

Tricolpites spp.

Amosopollis cruciformis

Microcachrvidites antarcticus

Striatiti spp.*

Cicatricosisporites cuneiformis

Lycopodiumsporites sporites sp.

Osmundacidites wellmannii

Sterisporites antiquasporites

Cyathidites australis

Classopollis sp.

Gleicheniidites spp. undiff.

Ascodinium sp. cf. A. acrophorum

Deflandrea acuminata

Deflandrea sp.

H. 4213 feet. Upper Cretaceous undifferentiated.

The sidewall core at 4213 feet is the deepest sample to produce fossils. Spores and pollen are few within a residue composed mainly of cuticle and cortex tissue. However, sufficient specimens were identified to adcertain that the Cretaceous is represented, probably the Upper Cretaceous, no older than the Tricolpites pannosus Zone. Specimens recorded include:

Microcachrvidites antarcticus

Cyathidites australis & minor (rel. common)

Laevigatosporites ovatus

?Amosopollis

* Probably recycled.

Perotrilites majus

Podocarpidites ellipticus

Osmundacidites wellmannii

Tricolpate angiosperm pollen (very rare)

Circulisporites parvus

Dictyophyllidites crenatus

Schizosporis sp.

Podosporites microsaccatus

Stereisporites antiquasporites

Vitreisporites pallidus

Araucariacites australis

From Department of Mines, Tasmania, to Chief Geologist,

Core 6. 5317'-5323' : The hole has bottomed on basement of a similar nature to the Proterozoic in NW Tasmania. The core consists of finely laminated (vertically dipping) siliceous, pyritic and carbonaceous siltstone. Most of the rocks consists of cryptocrystalline silica and no clastic textures are visible. These rocks therefore have affinities with cherts. Authigenic chlorite (chamosite ?), sericite and tourmaline are common. Small concretions consisting of more coarsely cryptoscrystalline chert, pyrite sericite and chamosite (?) are present. Pyritic cherty siltstone also with pyrite-chamosite concretions occurs in the Cowrie Siltstone in the Proterozoic Rocky Cape Group of NW Tasmania.

D. Gee.
GEOLOGIST.

PETROGRAPHICAL STUDY OF CORES FROM ESSO CLAM-1

By Dr. D. Spencer-Jones

ALL COMMUNICATIONS SHOULD BE ADDRESSED TO
SECRETARY FOR MINES

TELEPHONE: 654 4388

MINES DEPARTMENT
WEST TOWER, PRINCES GATE
171 FLINDERS STREET
MELBOURNE, VIC. 3000

DSJ/BS

30th September, 1969

Mr. K.A. Richards,
Exploration Manager,
Esso Standard Oil (Australia) Ltd.,
G.P.O. Box 4047,
SYDNEY, N.S.W. 2001

Attention: Mr. G.K. Lunt

Dear Sir,

Re. Core samples (No. 5.) from Clam No.1. bore.

The three samples of this core appear to be typical "red bed" type sediments: red siltstone, bedded siltstone and fine sandstone, conglomerate. In Victoria the following formations include red bed-type sediments:

Formation	Location	Age
Snowy River Volcanics	Wulgulmerang	Lower Devonian
Cathedral and Koala Creek Beds	Central Victoria	Lower Devonian
Avon River Group	Northern Gippsland	Upper Devonian-Lower Carboniferous
Mansfield Beds	Mansfield	Carboniferous
Grampians Group	Grampian Ranges	Upper Devoniam - Lower Carboniferous
Genoa River Beds	Eastern Victoria	Upper Devonian
Merimbula Group Equivalents	Bemm, Conbienbar and Cann Rivers	Upper Devonian

The specimen of red siltstone could be matched with lithogies in units 2 and 4 of the Red Man Bluff Formation of the Grampians Group of Western Victoria. The bedded sample resembles units within the Silverband Formation of the above Group.

The sample conglomerate consists of pebbles of metamorphosed sediments obviously derived from a terrain composed of the phyllitic rock cored between 5316 and 5323 feet. The matrix of this conglomerate appears to be mainly redistributed fine debris from the rocks, but stained by the red iron oxide. Small pebbles of reddish sediments are also included resembling stained versions of the phyllitic rock.

I appreciate that any attempt to correlate rocks by lithology alone is tenuous without adequate stratigraphic control. Red bed-type sediments only indicate that a particular sedimentary environment obtained at the time of deposition. However most geologists familiar with the stratigraphy of southeast Australia would probably assign a tentative Upper Devonian - Lower Carboniferous age to the samples from core No. 5.

These sediments in Victoria are particularly characteristic whether they are found within the Grampians Group, Avon River Group or in the three small areas of Upper Devonian Sediments (Merimbula Group equivalents) in Eastern Victoria.

I am sorry that I cannot give you a more positive age determination but with the exception of the conglomerate the sediments closely resemble in state of lithification, mineral composition and texture, rocks found within the Upper Devonian - Lower Carboniferous successions in Victoria.

I will arrange for the specimens to be returned by air freight.

Yours faithfully,

D. SPENCER-JONES
Director of Geological Survey.

REPORT ON STRATA CORED IN CLAM-1
OFF N.W. TASMANIA

By F. L. Sutherland

REPORT ON STRATA CORED IN CLAM - 1 WELL OFF N.W. TASMANIA.

Two horizons were examined specifically as requested, (1) 5316-5323 ft., (2) 4478 - 4489 ft.

(1) This consists of cherty pyritic siltstone showing near - vertical bedding (?) lamination and an oblique cleavage. Similar rocks to these have been observed by the writer on the adjacent Tasmanian coast S. of Marrawah in the Younger Precambrian basement, below the Bryant Hill Quartzite and Smithton Dolomite. These rocks are mapped by Longman and Matthews (1962), striking N.W. out to sea towards Clam - 1 Well site, and are probably equivalents of the Cowrie Siltstone of the Rocky Cape Group (Gee, 1968).

(2) This is interbedded conglomerates and fine reddish siltstones. The conglomerates contain rounded to subrounded pebbles of light to dark green to grey sandstone and siltstone, commonly glauconitic in nature and sometimes micaceous, approaching sub-greywacke types. The pebbles range to over 4 inches across and tend to be only moderately sorted. Some of the pebbles show weathered hematitic margins, and some smaller fragments are completely altered to reddish or yellowish ochrous material.

The reddish siltstones contain sporadic glauconite grains and owe their colour to dispersed iron oxide, mainly hematite. The conglomerates are undoubtedly made up of marine fragments as indicated by their glauconitic nature, but whether the enclosing siltstone is marine or non-marine with derived glauconite is difficult to ascertain. The conglomerates may be near-allochthanous deposits shed from a submarine scarp or shoreline. Bedding is shallow and no cleavage or close jointing was observed. There is no obvious volcanic material in these beds.

Discussion on age of the red siltstones and conglomerates.

The strata below this horizon can be referred to the Upper Precambrian basement of Tasmania. Beds above this horizon were not examined in detail, but are sands and carbonaceous clays resembling the non-marine Upper Cretaceous/Mid-Eocene beds in Bass Basin, about 90 miles N.E. at a lower but generally similar level (Esso Exploration Inc., 1966). They also resemble the non-marine Palaeocene-Eocene beds underlying Upper Eocene to Mid-Tertiary basalts on northern Tasmania (Sutherland, 1969) and the non-marine Palaeocene beds in Macquarie Harbour trough in western Tasmania (Cookson, 1967); these beds extend to unknown depths from 560 feet below present sea level. It is interesting to note that the Macquarie Harbour trough, if continued northwards along trends reflecting the general shape of the Tasmanian coast, would pass near the site of Clam - 1 Well. These considerations infer Upper Precambrian/pre-Oligocene, probably pre-Tertiary, age limits for the red siltstones and conglomerates.

The general degree of consolidation, lack of noticeable cleavage and close jointing, and absence of steep bedding, combined, tend to suggest that the red horizon post-dates the Mid-Devonian orogeny of Tasmania. The beds cannot be easily matched with known successions on the Tasmanian mainland, and with the absence of Upper Carboniferous - Lower Jurassic strata with Mid-Jurassic dolerite intrusions on the far N.W. Tasmanian coast, this suggests a tentative Mesozoic-basal Tertiary age, probably post-Mid Jurassic/basal Palaeocene. No strata of this age are known to outcrop on mainland Tasmania.

Glauconitic sands and silts similar to those in the conglomerate pebbles in the red horizon are known in Upper Cretaceous-basal Palaeocene beds on the S. coast of Victoria (Taylor, 1964; Bock and Glenie, 1965) and may be approximately equivalent in age. Hematite in the red horizon indicates oxidation, probably either representing material washed in from nearby terrestrial sources during lowered sea-level or oxidation of the beds during later marine regression. Evidence of land surfaces of appropriate age extending below present sea-level is known in Tasmania below probable Mid-Upper Mesozoic andesites at Cape Portland (Jennings and Sutherland, 1969) and below the non-marine Palaeocene beds in north Tasmania.

Palynological dating of the sediments above the red horizon, and also examination of the red horizon itself for possible suitable palynological material, will be necessary for confirmation and greater refinement of its postulated Mid-Mesozoic/basal Tertiary age limits.

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F.L. SUTHERLAND, 2nd Oct. 1969.

3/178/0

REPORT MP 844/70
September, 1969

FIVE CORE SAMPLES FROM AN OIL EXPLORATION WELL (CLAM I)

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES
Adelaide South Australia

CONYNGHAM ST. FREWVILLE SOUTH AUSTRALIA 5063 TELEPHONE 79 1662 TELEGRAMS 'AMDEL' ADELAIDE

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: MP 3/178/0
YOUR REFERENCE:

11th September, 1969

Lib./File No.
Please return to:-
ESSO STANDARD OIL (AUST.) LTD.

The Director,
Esso Standard Oil (Australia) Ltd,
G.P.O. Box 4047,
SYDNEY, N.S.W. 2001

REPORT MP 844/70

YOUR REFERENCE:	31.11/3240 CKL. Letter dated 28/8/69.
MATERIAL:	Core samples (5). CLAM-1
IDENTIFICATION:	S-1, S-2, S-3, S-4, S-5. (Cores 5 & 6)
DATE RECEIVED:	1/9/69.
WORK REQUIRED:	Thin Section preparation and petrographic description.

Investigation and Report by: D. Smale.

Services Manager: Dr A.H. Spry.

[signature]

for N. Draper
Director.

FIVE CORE SAMPLES FROM AN OIL EXPLORATION WELL

INTRODUCTION

The samples consist of three unmetamorphosed sediments, S-1 (TS 23662) a sandy siltstone, S-2 (TS 23663) a ferruginous conglomerate and S-3 (TS 23664) a laminated siltstone, together with two low grade metamorphic rocks S-4 (TS 23665 and S-5 (TS 23666).

The last two rocks are low grade metamorphics derived from clay-rich mudstones. They contain the mineral assemblage quartz-muscovite-biotite-chlorite and have a very weak cleavage. The spots, composed of aggregates of chlorite surrounded by a rim rich in muscovite resemble the texture found in thermally metamorphosed hornfelses.

Sample: S-1: TS 23662 Core 5 (4478-4489')

Rock Name:
Ferruginous sandy siltstone

Hand Specimen:
A reddish brown (10R 4/3) massive siltstone.

Thin Section:
An optical estimate of the constituents gives the following:

	%
Framework:	
Quartz	40
Mica	2
Opaques	3
Matrix:	
Clay	10
Iron oxide	35

The rock consists mainly of a poorly sorted framework of quartz and rock fragments in a fine-grained ferruginous matrix.

The framework grains are mostly less than 0.06 mm across, but some sand grains up to 0.6 mm across are present. The smaller grains are mostly quartz, and the coarser grains are invariably rock fragments, commonly very micaceous, of slate or sericitic siltstone. Some fragments of chert and sandstone are also present. The opaque grains in the framework appear to be of the same type as the material in the matrix. Minor chloritic debris is also present.

Most of the matrix is dark brown and nearly opaque; little can be distinguished in it because of its colour and the finer detrital grains in the poorly sorted framework.

There are clearly two detrital populations in the framework, namely the quartz and the coarser rock fragments. Their completely different compositions and size ranges suggest that they must have had different provenances, and that the rock fragments were derived from near at hand, if not actually being intraformational.

Sample: S-2: TS 23663 Core 5 (4478-4489')

Rock Name:

Ferruginous conglomerate

Hand Specimen:

Ferruginous conglomerate, in which the matrix is similar in colour to S-1, and the pebbles tend to be grey.

Thin Section:

An optical estimate of the constituents gives the following:

	%
Pebbles:	
Claystone	15
Sericitic siltstone and fine sandstone	20
?Schist	5
Biotite schist	10
Ferruginous siltstone	5
Quartzite	5

Matrix:	
Clay	5
Iron oxides	25
Mica	5
Quartz	5

This could well be a coarser facies of the rock represented by S-1. The rock fragments are of considerably greater variety than in S-1, but this is only to be expected in a rock of much coarser grain size. The pebbles are up to 2 or 3 cms across.

The claystone pebbles are generally fairly homogeneous, and the clay shows varying degrees of alignment in different pebbles.

The sericitic siltstone and fine sandstone pebbles are of varying grain sizes though in each individual pebble the grain size is generally very uniform. The sericite is generally well aligned, especially in those pebbles in which it is in higher proportion, and these grade into possible schist pebbles.

The biotite schist pebbles consist almost entirely of quartz and biotite. The quartz appears to be in largely detrital grains of uniform size but the biotite is a product of recrystallization and appears to occupy what was probably originally matrix. The disposition of the quartz also suggests that it still has much of its detrital form.

The ferruginous siltstone fragments are very similar to S-1, though more micaceous and containing fewer rock fragments.

The quartzite has apparently been considerably recrystallized, and consists of a mosaic with complex intergranular boundaries. Its grain size is slightly more variable than in the siltstones and fine sandstones, and a marked streaking and alignment of elongate grains clearly indicates a metamorphic origin.

The matrix is very similar to that in S-1. There is no sign of any diagenetic recrystallization and the quartz and mica appear detrital.

Sample: S-3: TS 23664 Core 5 (4478-4489')

Rock Name:
Laminated silty shale

Hand Specimen:
A pale reddish-brown (10R 6/4), highly argillaceous laminated ferruginous siltstone.

Thin Section:
An optical estimate of the constituents gives the following:

	%
Framework:	
Quartz	35
Muscovite	Trace
Clay-fraction:	
Clay	55
Iron oxide	10
Other opaque material	1

The most prominent feature of this rock is not its framework, but the ferruginous and argillaceous laminations. These vary in thickness up to a few millimetres, but most are much less than 1 mm. Some consist almost entirely of iron oxide, but in others there is very little iron oxide, and the matrix is almost entirely clay. The laminations containing other opaque material do not contain any brown iron oxide, and the material is black. It is probably manganiferous, but may be carbonaceous or iron oxide.

The framework consists of well sorted silt grains of quartz generally between 0.03 and 0.07 mm across. These occur in most of the laminations in similar proportions, but they are very sparse in a few laminations.

The laminations are not completely even, and some microfaulting of a few laminations has taken place. They have been given a wavy appearance in parts by the transport of small lumps of intraformationally derived material, or very rarely possible detrital grains of fine sandstone resembling some in S-1 and S-2.

Conditions during the deposition of this rock appear not to have been as stable as for most laminated shales, as shown by the microfaulting and intraformationally derived fragments. It is possible that occasional slight slumping may have occurred, producing the microfaulting and slight currents that could have caused the irregularities of the laminations. The mineralogy of this rock suggest that it is part of the same depositional sequence as S-1 and S-2.

Sample: S-4: TS 23665 Core 6(5316-5323')

Rock Name:
Spotted argillite

Hand Specimen:
A medium dark grey (N4) siltstone with sulphide minerals along cleavage surfaces. Metamorphic spots visible in thin section could not be detected in hand specimen.

Thin Section:
An optical estimate of the constituents gives the following:

	%
Quartz	75
Muscovite	15
Biotite	5
Chlorite	3
Opaques	2

This rock has a fairly even texture and a grain size of 0.005 to 0.02 mm. It was originally a sedimentary rock, and relict bedding can be clearly seen indicated by slight variations in grain size. However, considerable recrystallization has taken place, probably under low-grade metamorphic conditions.
The quartz forms a mosaic through which the micas are scattered, generally as small flakes. The biotite is much less clearly defined than the muscovite, though rare fresh flakes are present; most of it is in poorly crystallized masses amongst the quartz grains. There is at most only a very weak alignment of the mica flakes at a high angle to the bedding, forming no more than an incipient foliation. Some of the opaques are scattered

through the body of the rock, but they are more prominent as aggregates of small grains forming streaks parallel to the incipient foliation. The "spots" are randomly scattered through the rock and form 5 to 10% of it. They consist mainly of chlorite with some opaque material, and are surrounded by greater concentrations of muscovite than are present in the body of the rock, but of the same type. The spots show a slight tendency to be elongate, and the direction of elongation is parallel to the incipient foliation.
As the rock is so fine-grained it is possible that feldspar could be present, but remained undetected amongst the quartz.

Sample: S-5: TS 23666 Core 5 (4478-4489')

Rock Name:
Spotted argillite

Hand Specimen:
A rock very similar to S-4. Relict bedding can be seen parallel to the length of the core on sawn surfaces (that is presumably dipping vertically).

Thin Section:
This is very similar to TS 23665 except that the "spots" are larger and better defined.

The duplicate thin sections have been prepared as requested, and were despatched by IPEC on 5/9/69.

ct.6

ESSO STANDARD OIL (AUSTRALIA) LTD.

CORE DESCRIPTION

Core No. 1

WELL: Clam - 1

Interval Cored 1366 - [illegible] ft., Cut 4 ft., Recovered 0 ft., (0 %) Fm. [illegible]

Bit Type , Bit Size in., Desc. by [illegible] Date [illegible]

Depth & Coring Rate (/ft.)hr)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 50 100			No Recovery	
			1366	
			1370	

REMARKS: Bumper Subs not working.

ESSO STANDARD OIL (AUSTRALIA) LTD.

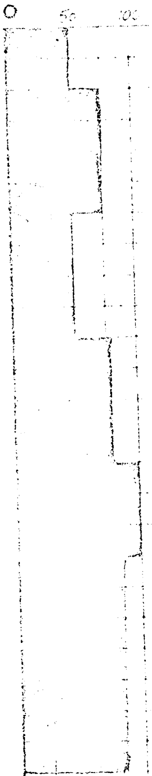
CORE DESCRIPTION

Core No. 2

WELL: Clam - 1

Interval Cored 346 - 370 ft., Cut 24 ft., Recovered 0 ft., (0 %) Fm. [illegible]

Bit Type , Bit Size in., Desc. by [illegible] Date 24/7/69

Depth & Coring Rate (min/ft.)hr)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 50 100			346	No Recovery
			370	

REMARKS:

ESSO STANDARD OIL (AUSTRALIA) LTD.

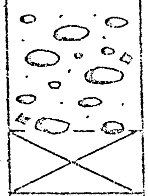
CORE DESCRIPTION

Core No. 3

WELL: CLAM-1

Interval Cored 2846-49 ft., Cut 3' ft., Recovered 2 ft., (66 %) Fm.

Bit Type C-8 , Bit Size 8 5/16 in., Desc. by C.K. LUNT Date 29 July '69

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 15 30			2846-49'	2' CONGLOMERATE (SHINGLE) Loose, well rounded pebbles and cobbles up to 6"+ diam. Composed of QUARTZITE: white to light grey, extremely hard, frequenty finely banded, occasionally speckled with red ferrous (?) oxide coloration. Small, well-developed pyrite crystals frequent. CHERT: medium to dark grey. Small amounts of light grey, slightly consolidated fine sandstone adhering to pebble and cobble surfaces suggests 10-20% sandstone matrix

REMARKS:

ESSO STANDARD OIL (AUSTRALIA) LTD.

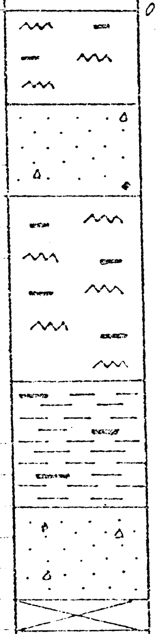
CORE DESCRIPTION

Core No. 4

WELL: CLAM-1

Interval Cored 3157-67 ft., Cut 10 ft., Recovered 9½ ft., (95 %) Fm.

Bit Type C-8, Bit Size 8 5/16 in., Desc. by C.K. LUNT Date 29 July 1969

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 1 2 3 4 5		0' – 9½'		

3157-58½' 1½' SILTSTONE: lt gry, med hd., non calc. w/ v. thin discont. carbonaceous laminae widely scattered throughout

3158½-60' 1½' SANDSTONE: lt. gry, porous, firm, friable, silty, vf - pebble size. Composed of quartz, quartzite, chert, and some green, brn, & blk. silicates

3160-63' 3' SILTSTONE: as in interval 3157-58½'

3163-65' 2' CLAYSTONE: lt. gry, firm non calc. w/ thin discont. laminae of carbonaceous material throughout & slickensided. Lowermost ½' w/ bands of soft blk. vitreous coal up to 2" thick

3165-66½' 1½' SANDSTONE: lt gry, sli porous, silty, v.f. - crs. gr., fair sorting, composed primarily of quartz, some quartzite & chert. Some colored silicates. Bottom ¼' w/ solution pyrite 3" in diameter containing abund. v.f.-med. quartz grains.

REMARKS:

ESSO STANDARD OIL (AUSTRALIA) LTD.

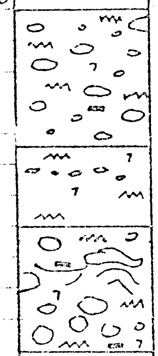
CORE DESCRIPTION

Core No. 5

WELL: CLAM-1

Interval Cored 4478-4508 ft., Cut 30. ft., Recovered 11 ft., (27 %) Fm.

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

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 — 10			4478 - 82½'	4½' <u>CONGLOMERATE</u>: composed of varicolored poorly sorted pebbles & cobbles (up to 3½") consisting of siltstone mudstone & occasional carbonaceous fragments. Lt - dk grey, green-grey, yellow, and brick red pebbles & cobbles in a non porous, rust red, med. hard matrix of siltstone w/some minute mica grains
			4482½ - 85'	2½' <u>SILTSTONE</u>: rust red, med. hard, micaceous. 6" below top a 5" band of pebbles as above. No other sedimentary structures.
			4485 - 89'	4' <u>CONGLOMERATE</u>: as in interval 4478-82½ w/silt & claystone pebbles & cobbles (>5"), v. poorly sorted. One 6" zone of multicolored silt & claystone shows chaotic bedding.

REMARKS:

ESSO STANDARD OIL (AUSTRALIA) LTD.

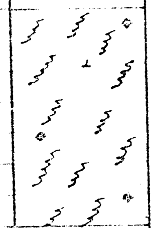
CORE DESCRIPTION

Core No. 6

WELL: CLAM-1

Interval Cored 5316-23' ft., Cut 7' ft., Recovered 7' ft., (100 %) Fm.

Bit Type C-20, Bit Size 8 5/16 in., Desc. by C.K. LUNT Date 3 Aug. 1969

Depth & Coring Rate (min./ft.)	Graphic (1" = 5')	Shows	Interval (ft.)	Descriptive Lithology
0 10 15			5316-23'	METAMORPHOSED SILTSTONE (PHYLLITE): m. gry, dense, extremely hard, fractured, with veins and fracture cracks filled with pyrite and bluish green-grey clay material, also accasionally with light greenish white calcite. No sedimentary structures. Numerous minute veins oriented at approx. 45° occur throughout core.

REMARKS:

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-BHP
WELL: CLAM 1
LOCATION/FIELD: OFFSHORE/OTWAY BASIN
COUNTY:
STATE: TASMANIA
COUNTRY: AUSTRALIA

DATE: JULY 31, 1969
DEPTH: 3157 FT TO 3167 FT
GEO-ENGINEER: CRAIG

REMARKS: CUT 10'; RECOVERED 9½': 3FT LIGHT GREY, FRIABLE, VERY FINE-PEBBLE SIZE, QUARTZITIC SANDSTONE; 4½FT LIGHT GREY, MEDIUM HARD SILTSTONE; 2FT LIGHT GREY, FIRM CLAYSTONE. CARBONACEOUS LAMINAE IN SILTSTONE AND CLAYSTONE. NO SHOWS; NO FLUOR.

Legend: SAND, SILTY SAND, SILTST., SHALE, LIME, CONG

TABULAR DATA

SAMPLE NUMBER	CORE #4 DEPTH FEET	AIR PERM. MD.	POROSITY PERCENT	FLUID SATURATION % PORE VOLUME: OIL	FLUID SATURATION % PORE VOLUME: WATER	DRY BULK DENSITY	LITH.	REMARKS GRAIN DENSITY
1	3158	126	20.3			2.07	SS	2.60

ANALYSIS GRAPH

PERMEABILITY MD. o—o
POROSITY % x—x 40 30 20 10 0
WATER SATURATION % PORE 100 80 60 40
OIL SATURATION % PORE 0 20 40 60

Geochron Laboratories, Inc.

24 Blackstone Street, Cambridge, Mass. 02139
Telephone TRowbridge 6-3691

REPORT OF ANALYTICAL WORK

POTASSIUM-ARGON AGE DETERMINATION

Our Sample No.R -1348

Your Reference: S-2 (CLAM-1 Core 6) 5316-5323'

Submitted by:

K. A. Richards
Esso Standard OIl (Australia) Ltd.
G.P.O. Box 4047
Sydney 2001, Australia

Date Received: 9 September 1969

Date Reported: 15 September 1969

Sample Description & Locality: Highly pyritic, basalt (or basic volcanic rock).

Material Analyzed: Whole rock, crushed to -20/+200.

Ar^{40*}/K^{40} = 0.0438

AGE = 630 (±21) x 10^6 years.

Argon Analyses:

Ar^{40*}, ppm.	Ar^{40*}/ Total Ar^{40}	Ave. Ar^{40*}, ppm.
0.1229	0.906	0.1243
0.1257	0.967	

Potassium Analyses:

% K	Ave. %K	K^{40}, ppm
2.302	2.326	2.838
2.349		

Constants Used:

$\lambda_\beta = 4.72 \times 10^{-10}$/ year
$\lambda_e = 0.585 \times 10^{-10}$/ year
$K^{40}/K = 1.22 \times 10^{-4}$ g./g.

$$AGE = \frac{1}{\lambda_e + \lambda_\beta} \ln\left[\frac{\lambda_\beta + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1\right]$$

Note: Ar^{40*} refers to radiogenic Ar^{40}.

69/2016

ESSO STANDARD OIL (AUSTRALIA) LIMITED

PROPOSED RIG ANCHORAGE
CLAM LOCATION
OTWAY BASIN

REPORT ON SITE INVESTIGATION

GEORGE WIMPEY & CO. LIMITED,
Australia Laboratory,
197 Coward St.,
MASCOT,
N.S.W. 2020

ESSO STANDARD OIL (AUSTRALIA) LIMITED.

PROPOSED RIG ANCHORAGE

CLAM LOCATION

OTWAY BASIN

REPORT ON SITE INVESTIGATION

Lab. Ref. No. LA 650 July, 1969.

ESSO STANDARD OIL (AUSTRALIA) LIMITED.

PROPOSED RIG ANCHORAGE

CLAM LOCATION

OTWAY BASIN

REPORT ON SITE INVESTIGATION

Lab. Ref. No.: LA 650 July, 1969.

1. Introduction

It is proposed to anchor the oil drilling vessel "Ocean Digger" on the "Clam" location in the Otway Basin. On the instructions of Esso Standard Oil (Australia) Limited an investigation was carried out to determine the composition of the sea bed by coring at anchorage locations specified by the client.

It should be noted that in the absence of any geophysical investigation, the results obtained from the coring work are representative only of the locations themselves, and that consequently no generalisation can be made concerning the geology of the area as a whole.

The investigation was carried out during the period 20th to 22nd June 1969, using the M.V. "Ratanui", a 150 ft steel-hulled vessel of 515 ton displacement.

2. Position Fixing

Location of the vessel was by means of the "Shoran" system provided by the client. At each location the stern anchor was dropped first. The vessel then steamed over the location and dropped the forward anchor. Minor corrections of position were then made using the anchor winches. The positions of all boreholes, in relation to the proposed Clam location, are given in Fig. 1.

3. Sea Bed Coring

The sea bed coring was carried out using an electrically operated underwater rotary core drill capable of penetrating and recovering core of consolidated material from depths up to 15 ft below the sea bed.

The machine was fitted with a hydraulic sensing device which indicated continuously the penetration of the core barrel beneath the sea bed, and which also permitted the bit pressure to be varied. Drilling fluid was sea water pumped under pressure from the ship.

The rig is designed to operate with a 15 ft NMLC core barrel fitted with either a standard diamond core bit or a tungsten bit.

All operations were controlled from the ship via the supply lines.

The results of the sea bed coring, together with the depth of water, at each anchor location are given in Table 1.

4. Comments on Sub-bottom Conditions in Relation to Anchoring

The results of the sea bed coring indicate that sub-bottom conditions generally consist of a limestone caprock underlain by a stiff to very stiff grey silty clay with occasional shell and coral fragments. The caprock was not always encountered at sea bed level and was found to be overlain by sand and gravel (boreholes 1 to 3) or clay (borehole 7).

The limestone caprock was found to vary in thickness from 2 in (borehole 3) to 20 in (borehole 2). Nowhere was it found to be thick enough to warrant the consideration of drilled-in piles for anchorages.

Consideration should therefore be given to the use of conventional anchoring techniques in this area. Where unconsolidated deposits are encountered at sea bed level, such as were found in boreholes 1, 2, 3 and 7 adequate "holding" should be obtainable. In areas where thin limestone layers were encountered at sea bed level (boreholes 4 and 6) it may be possible to use the impact of the anchor on the sea bed to shatter the caprock so that the anchor can gain holding in the underlying material.

Elsewhere, where thicker layers of limestone exist at or near sea bed level (borehole 5) it may prove more difficult to obtain adequate holding and it may be necessary to make several attempts before the anchor finally digs into the sea bed.

RRA/NWM/KMcK

AUSTRALIA LABORATORY.

Site : Otway Basin, Clam Location.
Lab. Ref. No.: LA 650

TABLE 1

RECORDS OF SEABED CORING

Position No.	Approx. Water Depth (ft)	Total Penetration below sea bed (in)	Depth below Seabed (in)	Description of Soil
BH 1	330	122	0 - 42	Traces of fine SAND recovered.
			42 - 56	Traces of SAND and silty CLAY.
			56 - 122	Very stiff to hard grey silty CLAY with occasional fine shell and coral fragments.
BH 2	348	102	0 - 28	Traces of shell fragments and gravel recovered.
			28 - 38	Grey LIMESTONE.
			38 - 96	Very stiff to hard grey silty CLAY with occasional fine shell and coral fragments.
BH 3	336	84	0 - 30	Traces of SAND and GRAVEL recovered.
			30 - 32	Brown LIMESTONE.
			32 - 84	Firm to stiff, or very stiff, grey silty CLAY with occasional fine shell and coral fragments.
BH 4	348	92	0 - 7	Brown LIMESTONE.
			7 - 12	Brown and grey silty CLAY with limestone fragments.
			12 - 92	Stiff to very stiff, or hard, grey silty CLAY with occasional shell and coral fragments.
BH 5	360	62	0 - 4	No recovery.
			4 - 24	Grey LIMESTONE with thin bands of hard grey silty clay.
			24 - 62	Very stiff to hard grey silty CLAY with occasional fine shell and coral fragments.

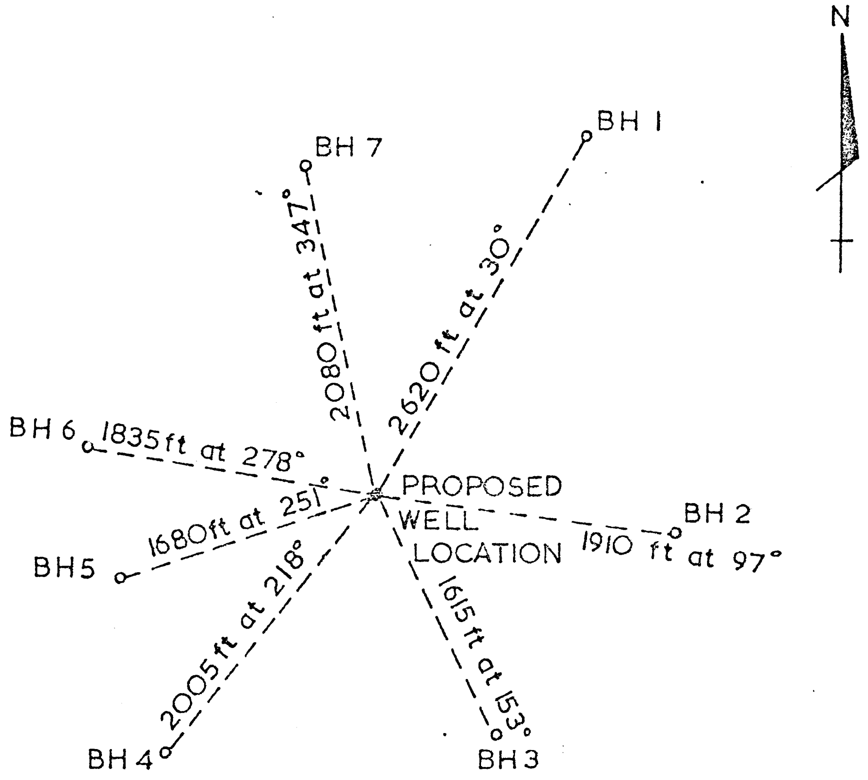
Site: Otway Basin, Clam Location.

Lab. Ref. No.: LA 650

TABLE 1

RECORDS OF SEABED CORING

Position No.	Approx. Water Depth (ft)	Total Penetration below sea bed (in)	Depth below Sea bed (in)	Description of Soil
BH 6	354	72	0 - 12	Grey LIMESTONE with a surface layer of shells.
			12 - 72	Stiff to very stiff grey silty CLAY with occasional fine shell fragments.
BH 7	360	64	0 - 5	Hard brown and grey silty CLAY with occasional coral fragments.
			5 - 30	Stiff to very stiff grey silty CLAY with occasional fine shell and coral fragments.
			30 - 42	Grey LIMESTONE.
			42 - 64	No recovery.



Scale: 1in = 1000 ft

SITE PLAN

OTWAY BASIN, VICTORIA
CLAM LOCATION

Soils No. LA650

Fig No. 1

GEORGE WIMPEY & CO. LTD AUSTRALIA LABORATORY, SYDNEY

P-252 (11-60)

RESISTIVITY VELOCITY LOG - GULF COAST TYPE

Well: CLAM-1

No.	Depth	No.	Depth
1	2104	16	
2	2407	17	
3	2615	18	
4	2796	19	
5	2847	20	
6	2909	21	
7	3125	22	
8	4202	23	
9	4213	24	
10	4895	25	
11		26	
12		27	
13		28	
14		29	
15		30	

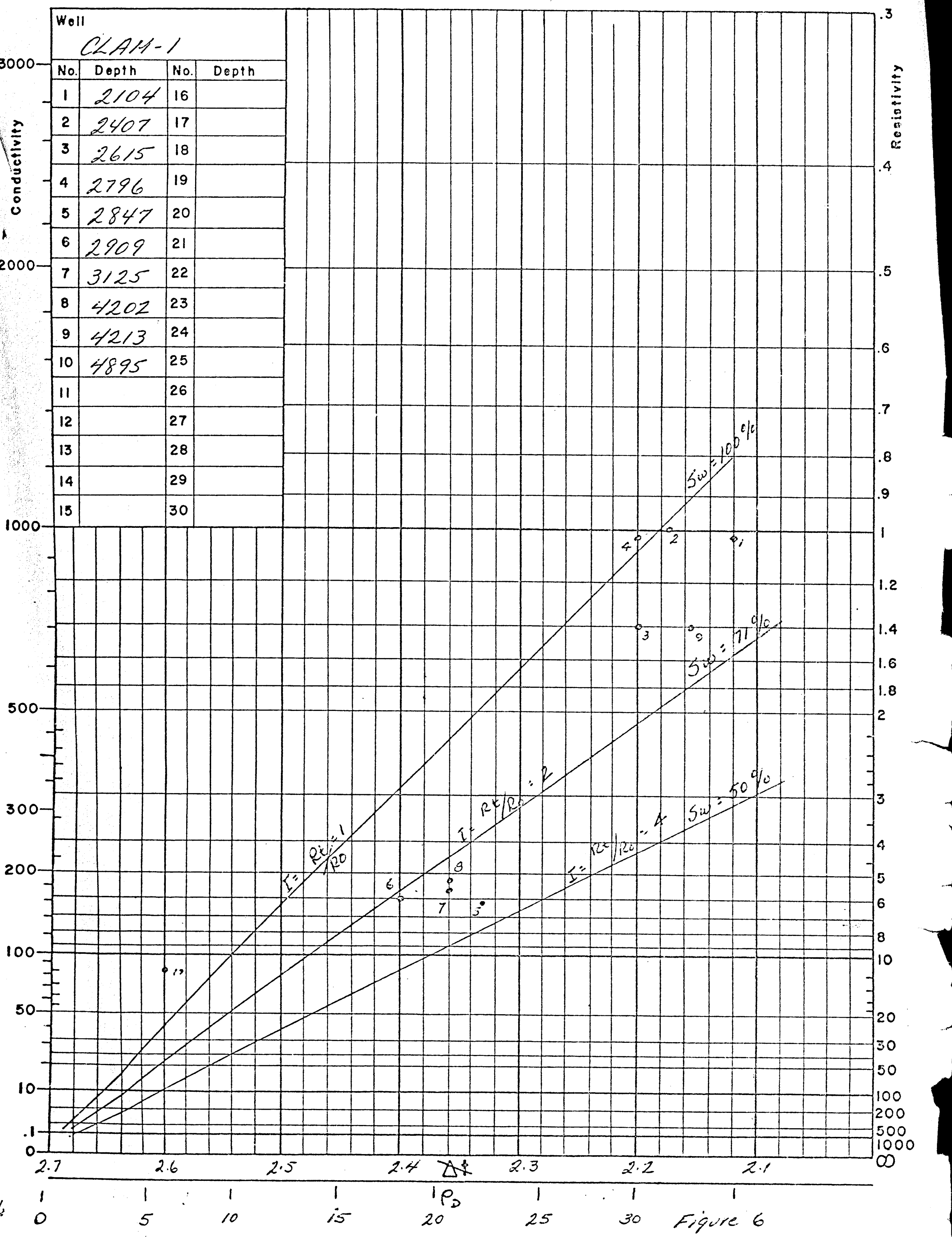
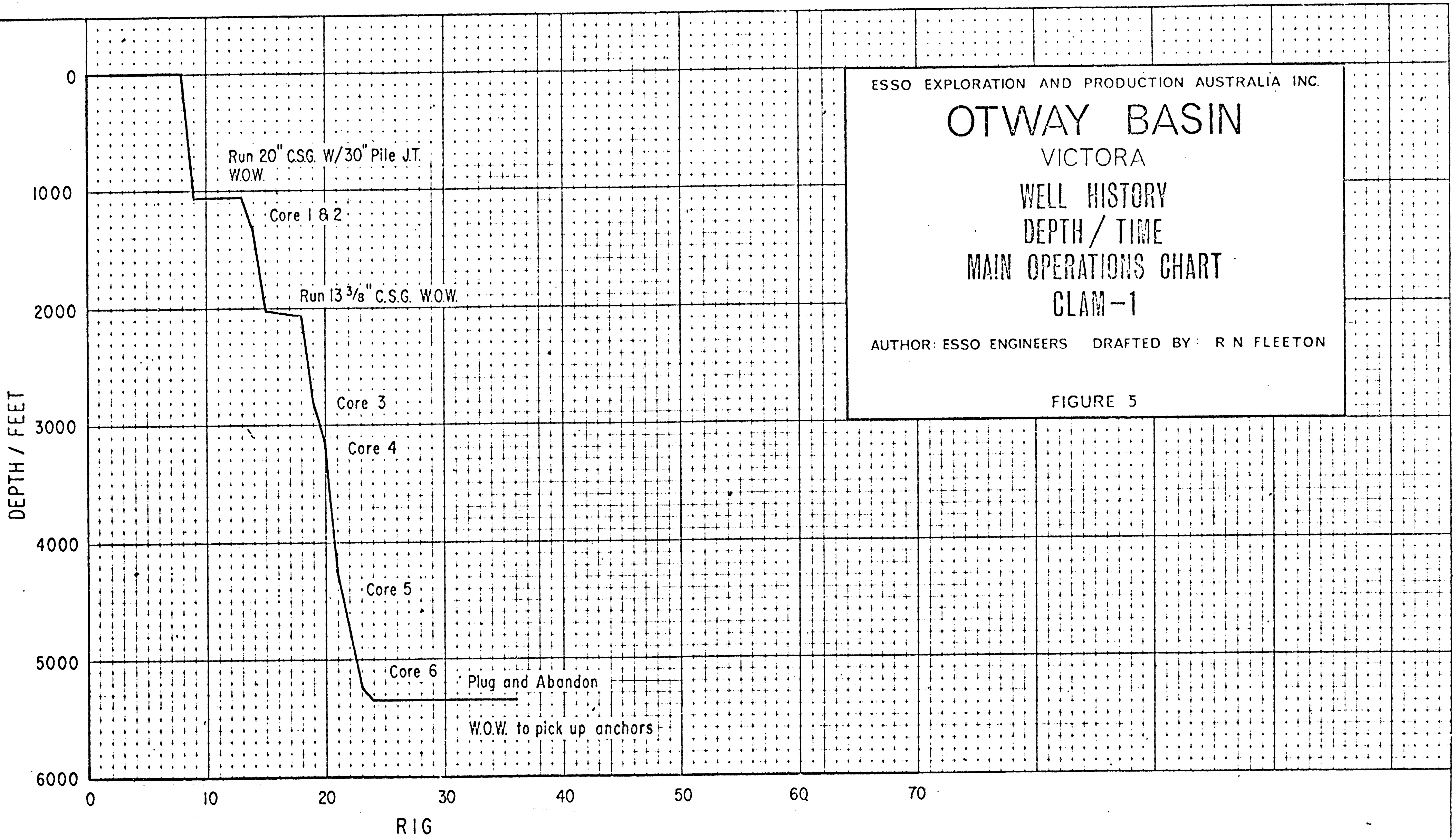


Figure 6



ESSO EXPLORATION AND PRODUCTION AUSTRALIA INC.

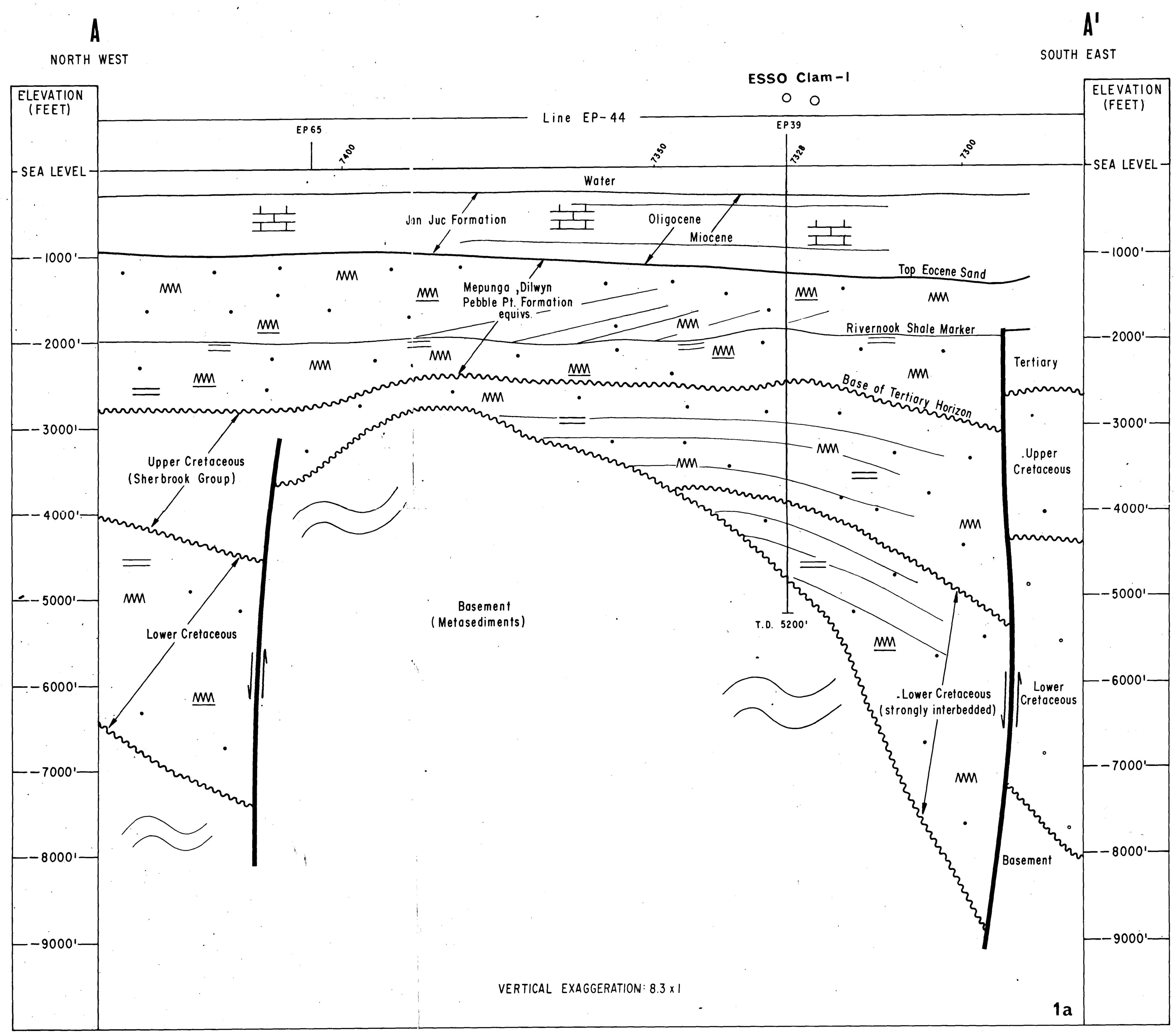
OTWAY BASIN

VICTORA

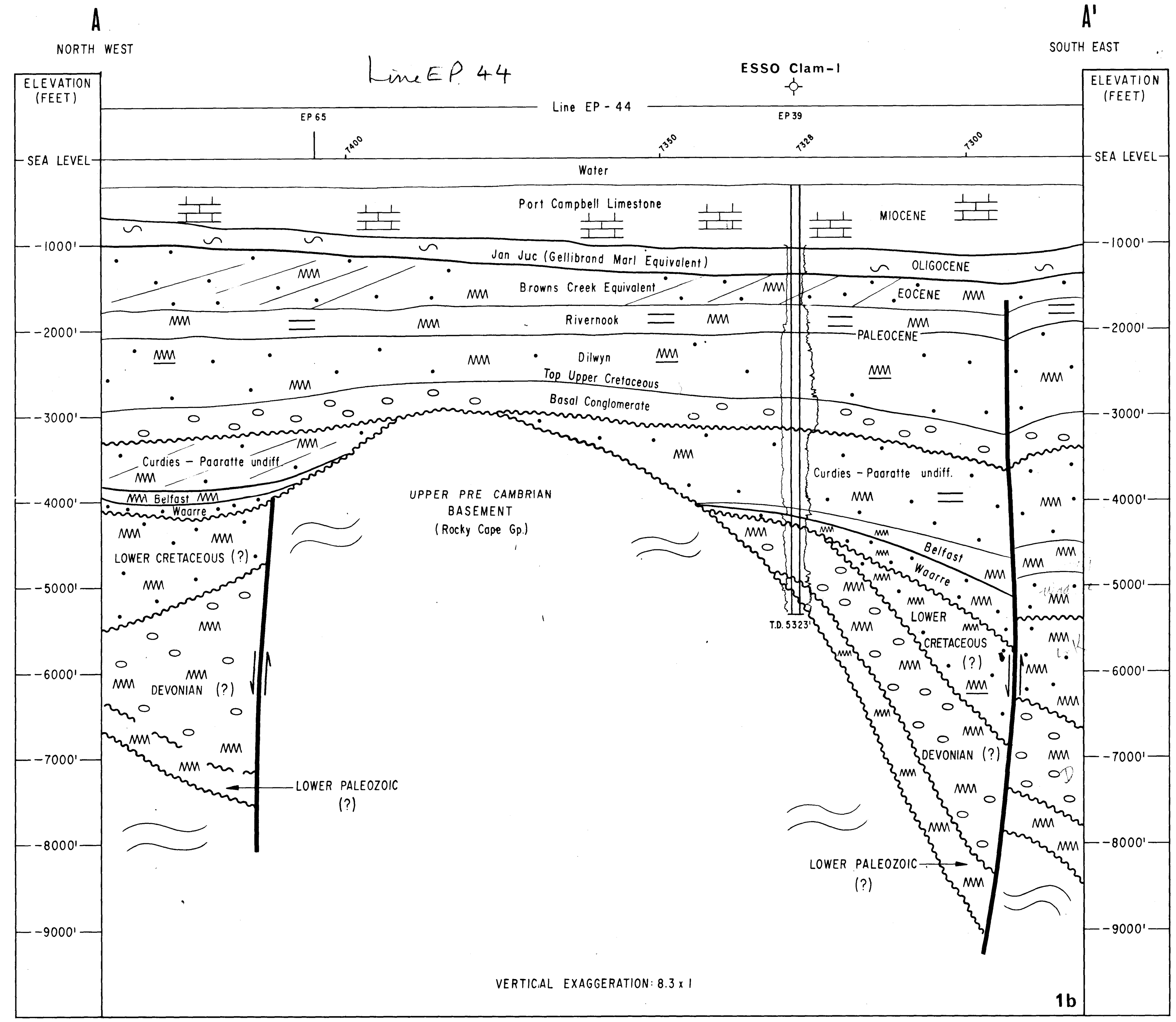
WELL HISTORY
DEPTH / TIME
MAIN OPERATIONS CHART
CLAM-1

AUTHOR: ESSO ENGINEERS   DRAFTED BY: R N FLEETON

FIGURE 5

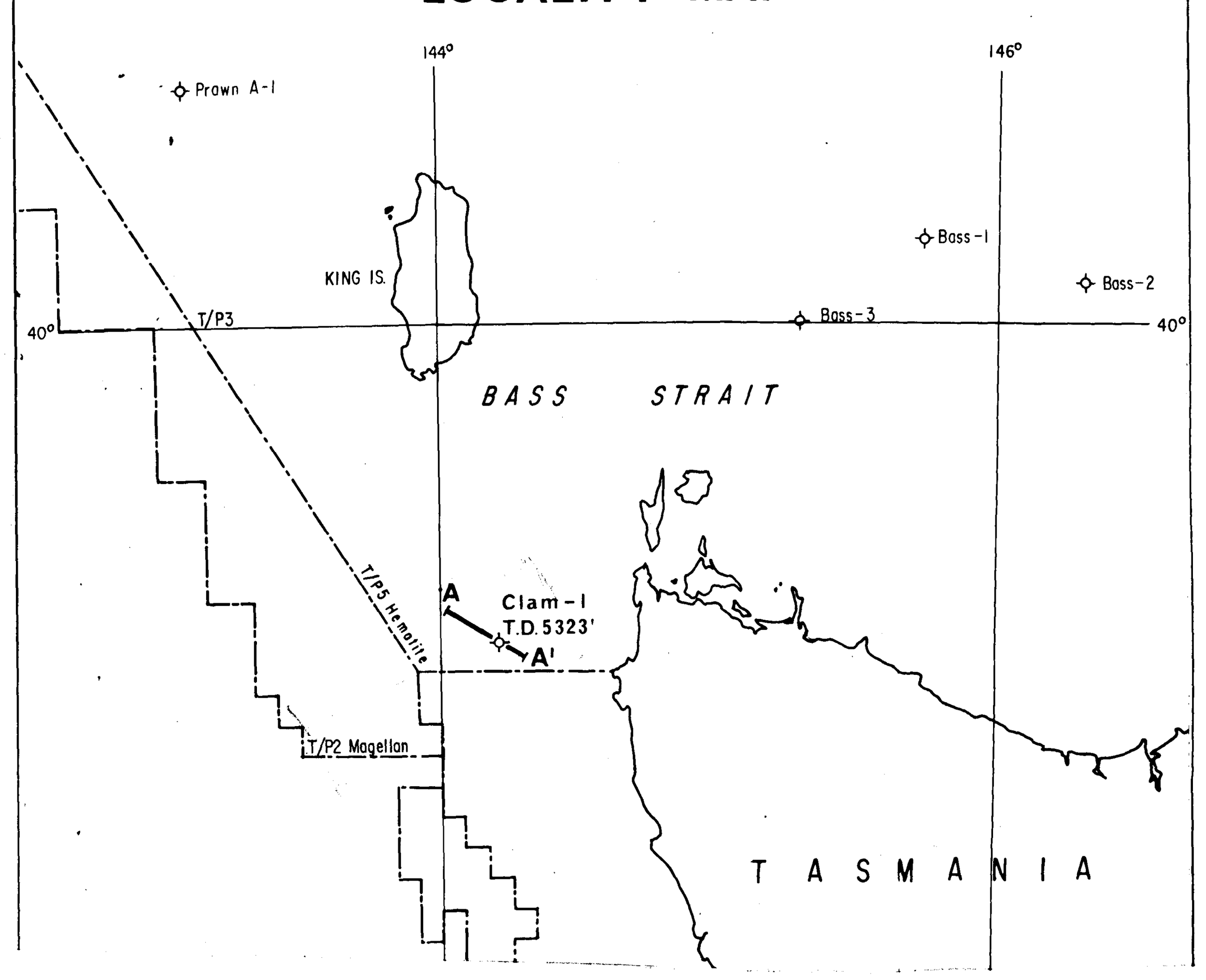


CROSS SECTION BEFORE DRILLING



CROSS SECTION AFTER DRILLING

LOCALITY MAP



LEGEND

- ○ Drilling Location
- Dry and Abandoned
- Line of Fault
- Petroleum Tenement Boundary
- A——A' Line of Cross Section

LITHOLOGY

- Limestone
- Sandstone
- Conglomerate
- Siltstone
- Mudstone
- Shale
- Basement (Metasediments)

ESSO EXPLORATION AND PRODUCTION AUSTRALIA INC.

CLAM PROSPECT

OTWAY BASIN – TASMANIA

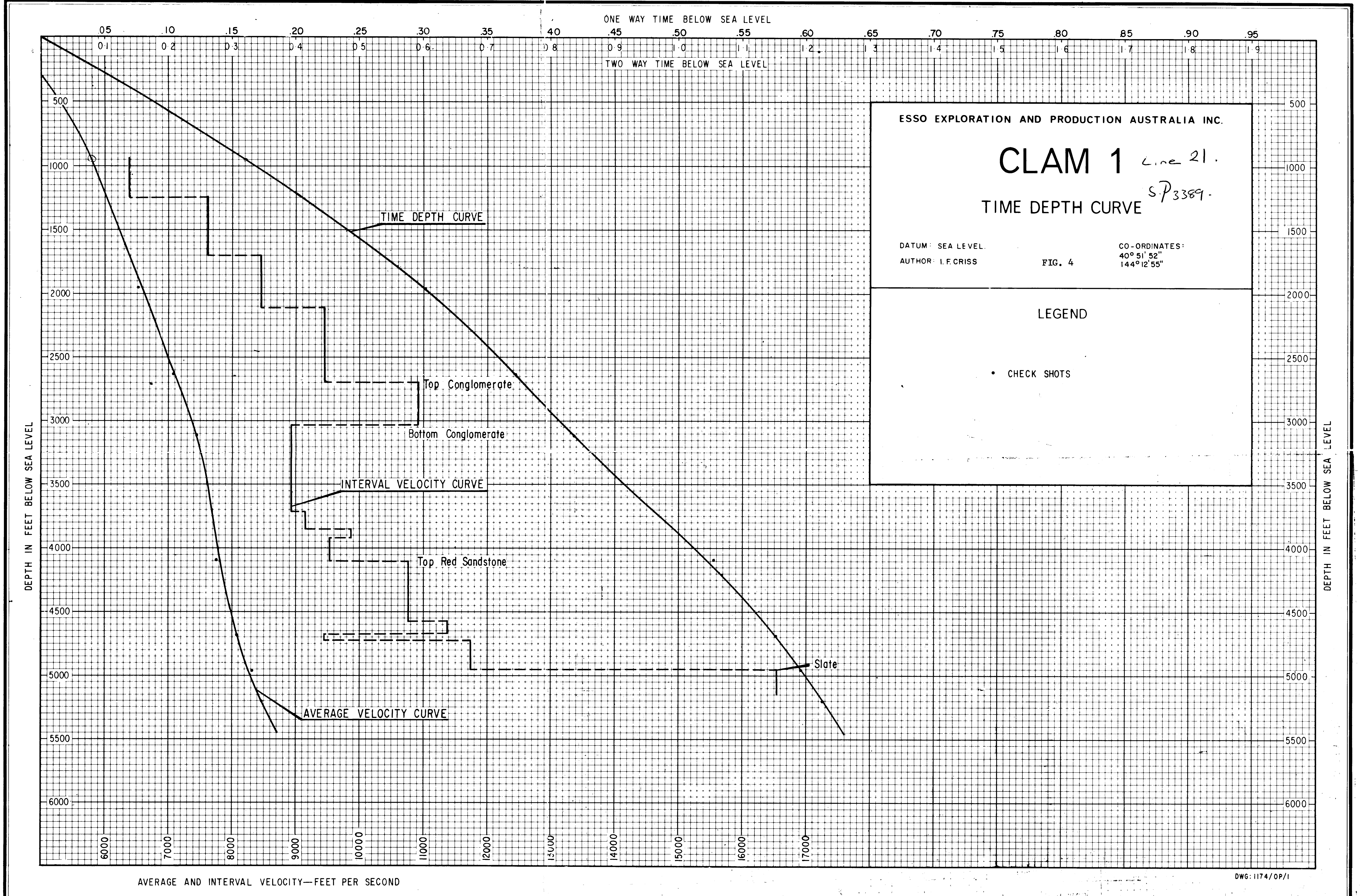
GEOLOGICAL CROSS SECTIONS A–A' BEFORE AND AFTER DRILLING

Vertical Scale 1 inch = 1000 feet
Horizontal Scale 1:100,000

2 1 0 2 4
MILES

AUTHOR: C.C. HORGAN, C.K. LUNT
DRAFTED BY: J. TOPPLER
TO ACCOMPANY WELL COMPLETION REPORT CLAM-I
DATE: NOVEMBER, 1969

Clam #1 69/2016.



ESSO EXPLORATION AND PRODUCTION AUSTRALIA INC.

CLAM 1

Line 21.

S.P 3389.

TIME DEPTH CURVE

DATUM: SEA LEVEL.

AUTHOR: I. F. CRISS

FIG. 4

CO-ORDINATES:
40° 51' 52"
144° 12' 55"

LEGEND

• CHECK SHOTS

DWG: 1174/OP/1