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WELL COMPLETION REPORT

PORT CAMPBELL-2 W463

2 Referred to	3 Date	4 Clearing Officer's Initials	1 Folio No.	2 Referred to	3 Date	4 Clearing Officer's Initials

73 Pages
INCLUDES PLATES

FROME-BROKEN HILL COMPANY PTY. LTD.

Report No. 7200-G-77

WELL COMPLETION REPORT

PORT CAMPBELL NO. 2

SOUTHWEST VICTORIA

by

R. L. Wood and J. S. Bain

Melbourne

February, 1961

2/73

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CONTENTS

APPENDICES

ILLUSTRATIONS

Figure

1. Faunal Chart of Lower Cretaceous Section in No. 2 Well

Plates

1. Locality Map
2. Stratigraphic Column Prior to Drilling
3. Geological Cross Section Prior to Drilling Through Site of Port Campbell No. 2
4. Geological Cross Section Through Port Campbell No. 1 - No. 2 Wells
5. Stratigraphic Column After Drilling
6. Composite Well Log

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I SUMMARY

The Port Campbell No. 2 exploration well was drilled to a depth of 8846 feet for Frome-Broken Hill Co. Pty. Ltd. in the southeastern part of the Otway Basin.

The well penetrated the Tertiary section and bottomed in sediments of the Otway Group. Although time boundaries are still indefinite, the well showed evidence of the presence of at least 2700 feet of Cretaceous sediments. Upper Tertiary (Miocene and Oligocene) is 1214 feet thick while the Lower Tertiary (Eocene and Palaeocene) is of the order of 3800 feet thick.

Two unconformities appear to be present in the well. One between the Waarre Formation and the Belfast Mudstone and the other between the Otway Group and the Waarre Formation. The former of these is the major one and, with approximately 770 feet of basal Belfast and topmost Waarre Formation from this well missing from the Port Campbell No. 1 well, a greater hiatus between these two formations is concluded for the No. 1 well. The other break, between the Waarre Formation and the Otway Group, is not well defined and further drilling should help clarify the nature of this unconformity.

The well did not show any evidence of free gas or oil, the gas obtained from testing being only minor and derived from solution in the formation water.

II INTRODUCTION

Port Campbell No. 2 well was drilled by Frome-Broken Hill Co. Pty. Ltd. to further evaluate the petroleum possibilities of the eastern part of the Otway Basin.

Port Campbell No. 1 was located near the crest of a seismic high while Port Campbell No. 2 was positioned down dip from the first well. Seismic sections showed a marked increase in thickness of sediments at the Port Campbell No. 2 site down to the top of the Otway Group and pinchout was evident. The structure was bounded on the northwest by a roughly north-south trending fault downthrown to the east, and the well was located within the closure against this fault, and on the downthrown side of it.

The Commonwealth Government agreed to share the cost of drilling of sediments which were stratigraphically lower than those cut in the No. 1 hole.

III WELL HISTORY

(1) GENERAL DATA

(a) Well Name and Number:

Port Campbell No. 2

(b) Location:

490 feet north 66° west of southeast corner of allotment 13(b) of 7, Parish Paaratte, County of Heytesbury. Approximately 1½ miles north of township of Port Campbell.
Latitude 38°36'S, longitude 142°59'E. 38° 36' 03"
142° 59' 20"

(c) Name and Address of Tenement Holder:

Frome-Broken Hill Co. Pty. Ltd.,
53 Flemington Road,
NORTH MELBOURNE, N.1.

(d) Details of Petroleum Tenement:

Petroleum Exploration Permit No. 6 issued by the State of Victoria.

(e) District:

Southwest Victoria

(f) Total Depth:

8846 feet

(g) Date Drilling Commenced:

July 12, 1960.

(h) Date Drilling Completed:

December 1, 1960.

(i) Date Well Suspended:

January 12, 1961

(j) Date Rig Released:

Rig not released - moved to Port Campbell No. 3 location.

(k) Drilling Time in Days to Total Depth:

143 days

(l) Elevation:

Ground Level	266 feet
Derrick Floor	281 "
Rotary Table	282 "
Kelly Bushing	284 "

(m) Status:

Well completed as a water well for State Authorities.
$5\frac{1}{2}$ inch casing recovered to 5650 feet.
$9\frac{5}{8}$ inch casing recovered to 1050 feet
Cement plug at 3050 feet and $9\frac{5}{8}$ inch casing perforated at 2214 to 2220 feet and 2810 to 2816 feet for water production.

(n) Cost of Well:

Road construction, site preparation	£12,362
Store and laboratory building, laboratory supplies, on-site accommodation, telephone	878
Transportation of materials and personnel	7,902
Rigging up, rigging down	8,500
Water supply	227
Drilling bits	12,276
Core heads	1,483
Drilling fluid	29,829
Fuel	13,399
Casing	31,713
Cement	2,739
Miscellaneous supplies (spare parts etc.)	6,635
Contract time	115,923
Logging and formation tests, perforating of well for handing over to Department of Mines	29,752
Technical supervision at wellsite	23,970
Rental of drilling equipment, cementing services	6,205
Depreciation, motor vehicles, tubing, wellhead, testing and laboratory equipment	1,555
Miscellaneous charges - administration, depreciation, loss of in-hole equipment, insurance etc.	8,799
TOTAL COSTS (TO MAY 31, 1961)	£314,147

(2) DRILLING DATA

(a) Name and Address of Drilling Contractors:

Oil Drilling and Exploration Limited,
93 York Street,
SYDNEY, N.S.W.

(b) Drilling Plant:

Make	National
Type	55

Rated Capacity with $4\frac{1}{2}$" drill pipe - 10,000 feet
" " " $3\frac{1}{2}$" " " - 14,000 "

Motors:

Make	Caterpillar
Type	D375
B.H.P.	284

(c) Mast/Derrick:

Make	Muskogee Standard Derrick
Type	136' x 30' base
Rated Capacity	800,000 lbs.

(d) Pumps:

Make	Gardner-Denver
Type	GR-GXP
Size	$7\frac{3}{4}$" x 16"
Motors	Caterpillar D375

(e) Blowout Preventor Equipment:

Make	Cameron (2) QR.C
Size	12"
Series (A.P.I.)	900

(f) Holes Sizes and Depths:

Original Hole
(1) 24" hole to 78 feet
20" conductor pipe at 78 feet.

(2) $17\frac{1}{2}$" hole to 1182 feet
(i) Drilled $12\frac{1}{4}$" hole to 1176 feet.
(ii) Reamed with $17\frac{1}{2}$" hole opener to 1182 feet.
(iii) Set $13\frac{3}{8}$" casing at 1182 feet.

(3) $12\frac{1}{2}$" hole to 5650 feet
(i) Drilled $12\frac{1}{4}$" hole to 5650 feet.
(ii) Set $9\frac{5}{8}$" intermediate string at 5650 feet.

(4) $8\frac{1}{2}$" hole to 8364 feet.

Deviated Hole
(1) (i) $8\frac{3}{4}$" hole from 5650 to 8846 feet (T.D.).
(ii) Set $5\frac{1}{2}$" casing at 8846 feet.

(g) Casing and Liner Details:

Size	$13\frac{3}{8}$"
Weight	48 lbs/ft.
Grade	H40
Range	2
Setting Depth	1182 feet

Casing and Liner Details (Cont'd)

Size	$9\frac{5}{8}$"
Weight	36 lb/ft.
Grade	J55
Range	2
Setting Depth	5650 feet

Size	$5\frac{1}{2}$"
Weight	17 lbs/ft.
Grade	N80
Range	2
Setting Depth	8846 feet

(h) Casing and Liner Cementing Details:

Size	20" conductor
Setting Depth	78 feet
Quantity Cement used	68 sacks
Cemented to	Surface
Method Used	Pumped by O.D.E. cementing truck into annulus through 2" line.

Size	$13\frac{3}{8}$"
Setting Depth	1182 feet
Quantity Cement Used	778 sacks
Cemented to	Surface
Method Used	Circulated with plugs by O.D.E. cementing truck.

Size	$9\frac{5}{8}$"
Setting Depth	5650 feet
Quantity Cement Used	915 sacks with 112 gallons D4 Retarder
Cemented to	1080 feet with channelling to 1030 feet
Method Used	Circulated with plugs by O.D.E. cementing truck.

Size	$5\frac{1}{2}$"
Setting Depth	8846 feet
Quantity Cement Used	550 sacks with 75 gallons D4 Retarder
Cemented to	6615 feet
Method Used	Circulated with plugs by O.D.E. cementing truck.

(i) Drilling Fluid:

The well was spudded with a bentonite mud of weight 7.0 to 7.2 lbs/gal and 30 to 50 secs. viscosity. To $9\frac{5}{8}$" casing point at 5650 feet mud was conditioned with water and minor amounts of myrtan and caustic soda to control viscosity. Sand content through the sand section was up to 14%, but was reduced to 5 to 6% by cleaning out the tanks periodically. The sand content decreased to less than 1% during the drilling of the mudstone sections.

After drilling out from the shoe of the $9\frac{5}{8}$" casing, the native mud was treated with bentonite, myrtan, caustic soda and Calgon. On drilling the Belfast Mudstone the hole started to cave badly due to filtrate invasion. Raising the mud weight to 11.5 to 12 lbs/gal failed to alleviate the problem. Water loss was 6 to 7 ccs. and, although C.M.C. was added to decrease this, little reduction was effected. This caving hole condition prevented open hole drill stem testing and made coring risky. After becoming stuck at 8364 feet it was decided to change the mud in the hole. The mud was then broken over to a lime-oil emulsion type.

At the time of the breakover there was approximately 950 barrels of mud in the system and, after pilot testing, the following mud was planned:

4½ lbs/bbl.	Myrtan
2 "	Lime (hydrated)
2 "	Caustic soda
45% by volume	Water
10% " "	Diesel oil

After normal drilling operations were resumed the average tourly treatments of the mud system were as follows: 140 lbs. myrtan, 100 lbs. lime, 100 lbs. caustic soda and 28 lbs. of C.M.C. Over each 24-hour period an average of 350 gallons of diesel oil was added to the system to keep the oil content at 10% by volume.

With these addiditions, and barytes to increase weight, the mud characteristics were kept within the following limits to total depth:

Weight	: 11.5 to 13.5 lbs/gal
Viscosity (funnel)	: 45 to 68 secs.
Viscosity (stormer)	: 34 to 100 cp at 600 rpm
Filtrate	: 2.2 to 4 ccs.
Cake thickness	: 2/32"
pH	: 12.5
Initial and 10 minute gels	: Zero
Excess lime in the system	: 2 to 3 lbs/bbl.

(j) Water Supply:

Water was pumped to the well from Port Campbell Creek and was stored in a 20,000 gallon tank on site. Chloride content of this water was 250 to 300 ppm.

(k) Perforation and Shooting Record:

Casing Perforation (See Plate No. 6)

(a) For testing:

(1) 8725 to 8735 feet
(2) 8586 to 8592 "
(3) 8395 to 8405 "
(4) 8338 to 8350 "
(5) 8294 to 8299 "
(6) 8188 to 8196 "
and later 8188 to 8192 feet
" " 8188 to 8194 "
" " 8188 to 8194 "
(7) 7910 to 7918 feet
and later 7910 to 7916 feet
(8) 5349 to 5355 feet
(9) 2810 to 2816 " } Perforation for water production
(10) 2214 to 2220 " }

(b) For cementing purposes:

(1) 8214 to 8216 feet
(2) 8170 to 8172 "

Perforations were made with Schlumberger 4" shaped charge gun at a density of 4 shots per foot.

No open hole shooting was undertaken.

(1) Plugging Back and Squeeze Cementation Jobs (See Plate No. 6)

(1) In conjunction with side-tracking in original hole

(a) 200 sack and 2% calcium chloride plug set from 6500 to 6399 feet. Dressed off to 6401 feet.

(b) 485 sack plug set from 6400 to 5803 feet. Dressed off to 5806 feet.

(c) 120 sack plug set from 5806 to 5541 feet. Dressed off to 5635 feet.

(d) Replugged from 6300 to 5935 feet with 146 sacks after sidetracking not successful. Dressed off to 5948 feet.

(2) In conjunction with testing

(a) 20 sack plug set from 8755 to 8537 feet.

(b) Set 'K' Retainer at 8386 feet. Attempted squeeze without being able to break down formation.

(c) Set 'K' Retainer at 8317 feet. Attempted squeeze over 8338 to 8350 feet perforations without breaking down formation with 4500 psi.

(d) Set 'K' Retainer at 8243 feet. Attempted 6 sack squeeze over 8294 to 8299 feet without breaking down formation. Left plug from 8317 to 8243 feet. (Later drilled out).

(e) Set retrievable cementer at 8243 feet. Attempted 25 sack squeeze over 8188 to 8196 feet perforations after pulling up to 8166 feet. Squeezed $5\frac{1}{2}$ barrels with 4000 psi. Drilled out plug to 8226 feet.

(f) Set 'K' Retainer at 8205 feet. Attempted squeeze 8214 to 8216 feet with 15 sacks. Circulating joint leaked cement on top of retainer and squeezed 8188 to 8194 feet.

(g) Set 'K' Retainer at 8180 feet. Pressured 8188 to 8194 feet to 5500 psi without squeezing any fluid.

(h) Set 'RT' Cementer at 8165 feet. Pressured perforations 8170 to 8172 feet without taking fluid at 5500 psi. Ran RT Cementer to 8177 feet. Spotted 10 sack plug from 8177 to 8162 feet. Checked perforations 8170 to 8172 feet with 5200 psi without losing fluid.

(i) Attempted 18 sack squeeze over 8188 to 8194 feet perforations with RT Cementer. Squeezed $\frac{1}{2}$ barrel and left plug 8196 to 8121 feet.

(j) 35 sack plug set from 5677 to 5620 feet.

(k) 35 sack plug set from 5370 to 5255 feet.

(l) 35 sack plug set from 3165 to 3050 feet.

(m) Fishing Operations:

(See Appendix 6 for details)

(i) On bottom at 1182 feet.

While installing B.O.P's on 13 " casing a nut was dropped in the hole but was recovered in the cones of a bit when drilled out cement.

(ii) On bottom at 7930 feet.

When reaming a core hole circulation was lost and pipe became stuck. The string was freed after working for five hours.

(iii) On bottom at 8346 feet.

When reaming undergauge hole pipe became stuck after making a connection although circulation was maintained. A free point indicator showed that the string was free to the bit and, after many operations involving string shots, backing off, working pipe, acidising and jarring, five drill collars and the bit were left in the hole and by-passed.

(iv) After a drill stem test with packer at 4550 feet the packer assembly was backed off at the slips. The fish was recovered with a tapered tap.

(n) Side-tracked Hole:

Following the fishing operations in which a part of the drill string was left in the hole, it was decided to make new hole from below the shoe of the $9\frac{5}{8}$" casing at 5650 feet.

The cement was drilled out from the shoe of the $9\frac{5}{8}$" casing by using 3-$6\frac{1}{2}$" drill collars and $8\frac{3}{4}$" bit. The side-tracking program was based on the assumption that as the original hole had a high deviation, the new hole with controlled low deviation would bypass it. To control the deviation $6\frac{1}{2}$" drill collars were used, 1-$7\frac{3}{4}$" drill collar, 1-$8\frac{5}{8}$" stabiliser and 1-$8\frac{3}{4}$" string reamer. The side-tracking attempt was carried from the $9\frac{5}{8}$" shoe at 5650 feet, but tools ran back into the old hole at approximately 6300 feet. The side hole was plugged back and dressed off to 5948 feet.

A knuckle joint was used for the next side-tracking. Drilled rat hole with knuckle joint from 5948 to 6034 feet. After the rat hole had been reamed out, drilled rat hole again from 6034 to 6059 feet+ and this rat hole was reamed out. Drilled ahead with $8\frac{1}{2}$" bit to 6061 feet, and from there knuckle joint rat hole was drilled to 6103 feet. This rat hole was reamed out and drilled to 6122 feet. The Eastman Whipstock was used to drill rat hole from 6122 to 6147 feet and this was reamed out and drilled to 6152 feet. The whipstock was used to drill from 6152 to 6167 feet. The deviation survey showed that the new hole was in a N10^{O}W direction and 6 to 7^{O} average deviation.

The whipstock was set again and drilled off from 6164 to 6189 feet and the rat hole was reamed out and drilled to 6177 feet. Whipstock was run again and drilled off to 6193 feet. The rat hole was reamed out, and $8\frac{1}{2}$" hole was drilled to 6190 feet. The whipstock was set at 6190 feet with Hae bit 8 feet above at 6182 feet and rat hole drilled off from whipstock to 6210 feet The hole was opened up to $8\frac{3}{4}$" and drilled ahead.

(3) LOGGING AND TESTING

(a) Ditch Cuttings:

Cuttings were taken over a normal shale shaker. Interval sampled was every 10 feet to 7650 feet and thence every 5 feet to total depth 8846 feet.

(b) Coring:

Original coring program outlined cores to be taken at "lithological change, significant drilling break, distinctly porous bed, sudden increase of chloride content as well as all oil and gas shows". In addition, routine stratigraphic cores were to be taken at a maximum interval of 500 feet from the depth where the Commonwealth Subsidy Agreement was applicable. No deviation occurred from the original program laid down.

Eighteen cores were cut for a total footage of 191 feet. Recovery was 136 feet, or 71%.

Coring equipment used was a conventional Hughes Type J core barrel with $7\frac{7}{8}$" and $8\frac{3}{4}$" Hughes Hard Formation core heads.

One core (No. 14) was taken with an 8-11/16" Treyfus type diamond core head with the above barrel.

Diameter of core recovered in all cases was $3\frac{1}{2}$". (See Appendix No. 3 for detailed core descriptions).

(c) Side Wall Sampling:

No sidewall cores were attempted in Port Campbell No. 2 well.

(d) Electrical and Other Logging:

Logging was done by Schlumberger Seaco Inc., Schlumberger site engineer being Mr. John White. Logs run were as follows:

Electric Logs

		Deviated Hole (from 6230 feet)	
1176 to 116	feet	7916 to 5650	feet
2952 to 1183	"	8256 to 7716	"
4476 to 2752	"	8544 to 8056	"
5614 to 4276	"	8838 to 8344	"
7924 to 5650	"		

Microlog

		Deviated Hole	
79 to 1175	feet	7915 to 5652	feet
2940 to 1183	"	8254 to 6200	"
4476 to 2741	"	8542 to 7780	"
5606 to 4256	"	8836 to 8342	"
7921 to 5648	"		

Laterolog

		Deviated Hole	
5610 to 1186	feet	7914 to 5652	feet
		8253 to 7714	"
		8542 to 8049	"
		8835 to 8341	"

Section Gauge

6402 to 5650 feet

Temperature Log

145 to 5616	feet
5000 to 8810	"

Electrical and Other Logging (Cont'd)

Directional Log

7900 to 5652 feet
6224 to 5640 "
6046 to 6000 "
6162 to 5900 "
6211 to 5900 "
} While side-tracking

Deviated Hole
6534 to 6150 feet

Interval Dipmeter
5650 to 7930 feet - selected intervals

Scales of Electric Logs, Micrologs and Laterologs were 1" = 100 feet and 5" = 100 feet, while the other logs were of the scale warranted for their use.

(e) Drilling Time Log:

A Geolograph Continuous Time Depth Recorder was used during the drilling of Port Campbell No. 2, which recorded the time taken for each foot penetrated. A Drilling Time Log was drawn up from the Geolograph charts.

(f) Formation Testing:

(For details see Appendix No. 4).

D.S.T. Nos. 1 and 2 were carried out with a Johnston $5\frac{3}{4}$" Open Hole Tester assembly.

D.S.T. Nos. 3 and 4 were tests of the open hole with Johnston B.O.E. 9 casing hookwall type packer set in the $9\frac{5}{8}$" casing.

D.S.T. No. 1. Attempted test interval 7891 to 7930 feet. The open hole packer failed to seat.

D.S.T. No. 2. Attempted interval 7900 to 7930 feet. The open hole packer failed to seat.

D.S.T. No. 3. Interval 5650 to 5874 feet. Open hole test packer seated in $9\frac{5}{8}$" shoe. Recovered only drilling mud.

D.S.T. No. 4. Interval 5650 to 5874 feet. Recovered drilling mud and muddy water.

Intervals tested through casing:

D.S.T. Nos. 5 to 29 were carried out with a Johnston $5\frac{1}{2}$" B.O.E. 5 casing hookwall packer.

D.S.T. No. 5	8725 to 8735	feet	Packer failed to hold.
D.S.T. No. 6	8725 to 8735	"	Packer failed to hold.
D.S.T. No. 7	8725 to 8735	"	Packer failed to hold.
D.S.T. No. 8	8725 to 8735	"	Formation considered as very tight and impermeable.
D.S.T. No. 9	8586 to 8592	"	Recovered gas-cut water.
D.S.T. No. 10	8395 to 8405	"	Tool failed to open.
D.S.T. No. 11	8395 to 8405	"	Recovered gas-cut water.
D.S.T. No. 12	8338 to 8350	"	Recovered gas-cut water.
D.S.T. No. 13	8338 to 8350	"	Tool failed to open.
D.S.T. No. 14	8338 to 8350	"	Recovered gas-cut water.
D.S.T. No. 15	8254 to 8299	"	Packer failed to hold.
D.S.T. No. 16	8254 to 8299	"	Recovered mud contaminated gas-cut water.
D.S.T. No. 17	8254 to 8299	"	Packer failed to hold.
D.S.T. No. 18	8254 to 8299	"	Small amount of free gas and gas-cut water.

Formation Testing (Cont'd)

D.S.T. No. 19	8188 to 8196 feet	Packer failed to hold.
D.S.T. No. 20	8188 to 8196 "	Packer failed to hold.
D.S.T. No. 21	8188 to 8196 "	Packer failed to hold.
D.S.T. No. 22	8188 to 8196 "	Small amount of free gas and gas-cut water.
D.S.T. No. 23	8188 to 8192 "	Recovered gas-cut water.
D.S.T. No. 24	8188 to 8194 "	Recovered gas-cut muddy water.
D.S.T. No. 25	8188 to 8194 "	Recovered brackish dirty water.
D.S.T. No. 26	8188 to 8194 "	Recovered water with small amount of dissolved gas.
D.S.T. No. 27	7910 to 7918 "	Packer was set too low.
D.S.T. No. 28	7910 to 7918 "	Recovered slightly gas-cut water.
D.S.T. No. 29	7910 to 7918 "	Slight flow of water.

D.S.T. Nos. 30, 31 and 32 were carried out with a Johnston B.O.E.9 $9\frac{5}{8}$" casing hookwall packer.

D.S.T. No. 30	5349 to 5355 feet	On first run packer failed. On second run fluid was lost from the pipe.
D.S.T. No. 31	5349 to 5355 "	Recovered gas-cut mud.
D.S.T. No. 32	5349 to 5355 "	Recovered water.

(g) Deviation Surveys:

Deviation surveys were carried out with the Totco instrument and in conjunction with Schlumberger Deviation Log.

To 5600 feet deviation was 1 degree or less and rose sharply to 5 degrees at 6190 to 6412 feet and then to more than 7 degrees below 6690 feet. In the deviated hole deviations were irregular ranging from $2\frac{1}{4}$ to 7 degrees.

See Appendix 7 for details of hole deviation.

(h) Temperature Surveys:

Temperature surveys were carried out after cementing both the $9\frac{5}{8}$" and $5\frac{1}{2}$" casing strings to determine the top of the cement. Top of cement behind the $9\frac{5}{8}$" casing was at 1036 feet approximately, while top of cement behind the $5\frac{1}{2}$" casing was shown at 6615 feet. Bottom hole temperature at 8838 feet was 188°F.

(i) Other Well Surveys:

Two well geophone velocity surveys were run in conjunction with the Robert H. Ray seismic party operating in the area. The first at depth 8251 feet and the second at 8338 feet were both in the deviated hole. Readings were taken at formation breaks and at 500 foot intervals.

IV GEOLOGY

(1) SUMMARY OF PREVIOUS WORK

(a) Geological:

Previous geological work in the eastern part of the Otway Basin has been carried out by Baker, Reeves and Evans, and Bain, and this has been summarised in Frome-Broken Hill's Port Campbell No. 1 Well Completion Report.

Since the time of drilling Port Campbell No. 1, Benedek (1) examined Otway Group sediments in the Otway Ranges without being able to add to previous knowledge. Weegar (3) and Geotechnics and Resources Inc. (2) made further photogeological interpretations in the Otway Basin.

(b) Geophysical:

Since the drilling of Port Campbell No. 1, a Robert H. Ray contract seismic party continued work in the area confirming previous reflection horizons. The area was surveyed in fair detail and from the results it was apparent that faulting played a major part in the development of the basin.

Seismic sections showed a much greater thickness of sediments down to the Otway Group at the No. 2 site and stratigraphic pinchout was evident. The structure at this locality was closed against two faults, one trending roughly northeast-southwest and downthrown to the southeast and the second a northwest-southeast fault downthrown to the southwest.

(c) Drilling:

Prior to drilling of the Port Campbell No. 1 well, the only significant subsurface information relating to the eastern part of the Otway Basin was that derived from drilling of the Mines Department Timboon No. 1 water well. This reached a depth of 2695 feet and cut Tertiary rocks. At Port Fairy, about 40 miles northwest of Port Campbell, the Mines Department Belfast No. 4 bore cut a section of 435 feet of black siltstone, probably of Upper Cretaceous age. The Port Campbell No. 1 bore cut the equivalent of this siltstone in a mudstone facies and with an increased thickness of 726 feet. This formation was named Belfast Mudstone. At Timboon, 6½ miles north of Port Campbell, the Mines Department Timboon No. 5 bore was drilled into Otway Group sediments without cutting Belfast Mudstone. The occurrence of petroliferous gas in a porous sandstone beneath the Belfast Mudstone in the Port Campbell well enhanced the prospects of the area and warranted investigation of a thick section of sediments indicated by seismic survey to the east of Port Campbell. Although a large fault which could contribute to a closed structure was suspected between the deeper part of the section and the Port Campbell well, it was also considered desirable to penetrate the thick sediments for stratigraphic information, and the Port Campbell No. 2 well was drilled with this intention.

(2) STRATIGRAPHY

Apart from the more disseminated sand in the basal Belfast Mudstone, the lithology of the section cut in Port Campbell No. 2 well is very similar to that of Port Campbell No. 1 down to the top of the Waarre Formation. This latter formation, as identified in Port Campbell No. 2, is slightly different in parts from its equivalent in No. 1. Part of the Otway Group section was penetrated in the No. 2 hole, whereas it was not reached in the No. 1 well.

The section can be subdivided as follows:

Surface to 1230 feet	Heytesbury Group Dominantly soft, argillaceous marl with thin limestone bands and becoming more sandy towards the base.
1230 to 5000 "	Wangerrip Group Dominantly quartz sandstone and sand with interbedded siltstones and conglomerate with some coal and dolomite (ankerite) towards the base.
5000 to 5810 "	Paaratte Formation Transition zone consisting of siltstone, sandstone and mudstone with minor dolomite (ankerite) and carbonaceous material.
5810 to 7910 "	Belfast Mudstone Dark grey to black fossiliferous and glauconitic mudstone, slickensidedin places, with ankerite in parts and with some disseminated sand increasing towards the base.
7910 to 8514 feet	Waarre Formation 7910 to 8110 feet - Grey-green sandstone and siltstone and greywacke, conglomeratic in part, with some ankerite and coal, having ?chloritic matrix and containing weathered feldspar and mica (not seen in No. 1). 8110 to 8514 feet - White to light grey, hard quartz sandstones, conglomeratic in part, and grey to dark grey carbonaceous siltstones and mudstones with gypsum, mica, pyrite and some ankerite.
8514 to 8846 "	Otway Group Grey-green to green and blue-green feldspathic and micaceous sandstone and sandy mudstone. Chloritic and with abundant dark rock fragments. Top of the group appears to be weathered.

Palaeontological studies (Taylor, see Appendix 1) show that the highest occurrence of Cretaceous fossils is in Core No. 1 at 5340 feet, and from this depth to 7910 feet, five distinct upper Albian faunules have been recognised as follows:

(a) 5300 to 5900 feet Haplophragmoides dickinsoni Faunule

(b) 5900 to 6250 " Haplophragmoides gigas - Praeglobotruncana deliqua Faunule

(c) 6250 to 7050 " Haplophragmoides gigas - H. chapmani Transition Faunule

(d) 7050 to 7340 " Haplophragmoides chapmani - Pleurostomella gelatus Faunule

(e) 7340 to 7910 " Haplophragmoides chapmani - Textularia pediculis Faunule

All of these faunules, except the lowest one (e), are present in the Port Campbell No. 1 bore. This lower section, the basal Belfast Mudstone, is slightly different lithologically from the upper Belfast section, having as it does dispersed sand grains and limonite.

Examination of a leaf impression from Core No. 8 (8838 to 8840 feet) by Mary E. White of the Commonwealth Bureau of Mineral Resources, Geology and Geophysics (see Appendix 1) has resulted in it being determined as Noeggerathiopsis hislopi (Bunb.). This form is reported to be very common in Australian Permian rocks but has also been recorded from beds of probable middle Triassic age in India. At the contact of the Belfast Mudstone and Waarre Formation in the No. 2 well occurs a ferruginous siltstone with limonite pellets, pyrite and yellow-brown stained quartz fragments and some chert pebble fragments. Soft, grey clay was also recorded from this apparently oxidised zone. These features possibly indicate an unconformity surface between these two units.

A second unconformity has been postulated at 8514 feet between the Waarre Formation and the Otway Group. The samples at this depth contained an unusual soft, brown calcareous material, apparently weathered ankerite, which is restricted to that depth and may be reworked older sediments. The section of Waarre from 7910 to 8110 feet, consisting of grey to green sandstones, is not present in Port Campbell No. 1 whereas the section from 8110 to 8514 feet is similar to the Waarre Formation in the No. 1 well except that the clean light grey quartz sandstones of No. 2 well are more siliceous and harder.

A correlation of the formations in the No. 2 and No. 1 wells is summarised below, the figures in brackets being depths below sea level -

	Port Campbell No. 2	Port Campbell No. 1
Thickness of Heytesbury Group	1214 feet	1365 feet
Top of Wangerrip Group	1230 (-948) feet	1375 (-1028) feet
Thickness of Wangerrip Group	3770 feet	2870 feet
Top of Paaratte Formation	5000 (-4712) feet	4245 (-3898) feet
Thickness of Paaratte Formation	810 feet	685 feet
Top of Belfast Mudstone	5810 (-5528) feet)	4930 (-4583) feet
Thickness of Belfast Mudstone	2100 feet	726 feet
Top of Waarre Formation	7910 (-7628) feet	5656 feet
Thickness of Waarre Formation	604 feet	309+ feet
Top of Otway Group	8514 (-8232) feet	-
Thickness of Otway Group	332+ feet	-

(3) STRUCTURE

As mentioned under Geophysics in the Summary of Previous Work in this report, the well was drilled down dip from No. 1 well and the structure depended on faulting or pinchouts for its closure.

The Schlumberger Interval Dipmeter (Resistivity) was run successfully over three intervals in the hole, viz. (a) 5658 to 5681 feet; (b) 5764 to 5787 feet; (c) 5858 to 5878 feet. The results of these were (a) no appreciable dip; (b) dip of 11° direction S 3°E, and (c) dip of 9° direction S 68°W. Seismic reflection in the deeper horizons showed the dip to be of the order of 10° towards the southeast, so that (b) above is probably a fairly true dip. The deviation of the hole is another feature which has some relation to dip. Deviation was up to 8° in a general northwest direction at 7650 feet in the original hole. As holes generally deviate up dip, the direction of dip would be southeast, as was shown from the seismic work.

Cores Nos. 15, 16 and 17, within the Waarre and Otway formations, gave evidence of an apparent dip of 15° to 20° but, due to the possibility of cross bedding and faulting, they are not regarded as reliable. A Schlumberger dipmeter survey on the deeper horizons was not successful.

(4) RELEVANCE TO OCCURRENCE OF PETROLEUM

Drill stem tests showed that a small amount of hydrocarbon gas was dissolved in the formation water, but no free gas or oil was apparent in the formations drilled.

Waarre Form. Core No. 11 (8339 to 8346 feet), as well as yielding gas, contained a shiny black bituminous material which was considered by Vacuum Oil Company chemists to be of an asphaltic pyrobitumen nature rather than coal or oil shale. Whether this dead oil is a remnant after migration or is indigenous to the rock is not clear.

The gas from this cored interval contained saturated hydrocarbons up to hexane and only very little unsaturated hydrocarbons and hence was similar to that recovered from the Port Campbell No. 1 well.

The failure of the well to produce hydrocarbons other than gas in solution in saline water suggests that it was located too far down dip on the Port Campbell structure and that the anticipated fault trap does not exist or is too small to include this location. Alternatively, it has been suggested that, since the Belfast mudstones are the most likely source rocks in the section, the absence of free hydrocarbons in the well is due mainly to the occurrence between that formation and Waarre sandstones of a thick section of tight sandstones and mudstones which are not present in Port Campbell No. 1. This is undoubtedly a possibility but, since the water recovered from the Waarre sandstone in Port Campbell No. 2 contained a considerable amount of gas in solution, structural position would also appear to be important.

The No. 2 well penetrated the full section of Waarre Formation in this locality and showed it to contain a thick section of porous quartz sandstone which, favourably located on a structure, could be a good oil or gas reservoir.

(5) POROSITY AND PERMEABILITY OF SEDIMENTS PENETRATED

Apart from the selected analysed cores, porosity and permeability of the sediments cut in Port Campbell No. 2 were estimated qualitatively by the wellsite geologists.

The following are analyses of Cores Nos. 6, 7, 10 and 11 from the Waarre Formation:

Core	No. 6	No. 7	No. 10	No. 11
Depth (feet)	7904	7930	8306-11	8345
Average Effective Porosity	14.6%	13.8%	11%	8.4%
Absolute Permeability				
(i) horizontal	Negligible	0	83 md	19 md
(ii) vertical	"	0	91 md	3 md

Cores Nos. 10 and 11 are from the hard, light grey, siliceous sandstones which appeared to be the best reservoir rocks in the Waarre section. As can be seen from the analyses the porosities are fair and permeabilities are low with the exception of No. 10 which is only fair. This is in marked contrast to the gas sand at 5656 feet in Port Campbell No. 1 which had a porosity of 26.5% and permeabilities of 2985 md horizontal and 1695 md vertical.

Log interpretations on other sands not analysed showed only low to medium porosities and the S.P. log did not give very much evidence of good permeability through the Waarre section. Drill stem testing of these sands substantiated this.

The Otway Group sediments were in general tight as evidenced by the amount of matrix and results of drill stem testing.

(6) CONTRIBUTION TO GEOLOGICAL CONCEPTS RESULTING FROM DRILLING

Port Campbell No. 2 showed the Wangerrip Group and the Belfast Mudstone to be much thicker at that locality than at Port Campbell No. 1. In addition to a general thinning of section between Port Campbell wells 2 and 1, the lower part of the Belfast Mudstone cut in Port Campbell No. 2 is absent from Port Campbell No. 1 as also is the 200 foot section of greenish-grey silty sandstone and mudstone lying between the Belfast and the typical quartz sandstone of the Waarre Formation.

These thickness changes are consistent with the seismic reflection survey results which indicate that Port Campbell No. 2 lies down flank on the Port Campbell structure and is separated from Port Campbell No. 1 by a large north-trending fault downthrown to the east. The seismic data also suggest that the thickness changes take place mainly across the fault which apparently was active during deposition of the Belfast-Wangerrip sediments.

The Port Campbell structure was obviously growing during Cretaceous and lower Tertiary time. It is not clear at present whether the absence of section in the Port Campbell No. 1 area was due wholly to erosion during periods of emergence above sea level or partly to non-deposition. Indications of weathering at the top of the Waarre Formation in Port Campbell No. 2 favour erosion as a contributory cause at least. Possibly both erosion and non-deposition played a part.

The lowest 350 feet penetrated in Port Campbell No. 2, greenish feldspathic sandstones and sandy mudstones, are correlated with the Otway Group on lithological resemblance although they contain rather more quartz. The top of this section has a weathered appearance which, together which the sharp lithologic change from the overlying Waarre formation, suggests the possibility of an unconformity. So far we have no information to indicate whether this also is associated with local structural highs or whether it is of regional importance.

R. L. WOOD
J. S. BAIN

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2. Benedek, S. — Notes on the Geology of the Otway District, Southwest Victoria. Frome Report 7200-G-68, July, 1960.

3. Geotechnics and Resources Inc. — Photogeomorphic Investigation of Southwest Victoria, Australia. Filed as Frome Report 7200-GP/H-5, October, 1960.

4. Weegar, A. A. — Notes on the Geology of the Otway Basin, Southwest Victoria. Frome Report No. 7200-G-66, July, 1960.

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APPENDIX 1

PALAEONTOLOGICAL REPORTS

by

Commonwealth Bureau of Mineral Resources, Geology and Geophysics

and

Department of Mines, Victoria

Department of Mines
Treasury Gardens,
MELBOURNE, C.2.

7th October, 1960

PALYNOLOGICAL EXAMINATION OF COAL SAMPLES FROM FROME-BROKEN HILL CO. PTY. LTD. PORT CAMPBELL NO. 2 BORE

Coal from two horizons in the Port Campbell No. 2 bore was treated by the Hydrofluoric acid -Schulzes Solution method, and the residue examined under the microscope.

Sample 1 Depth: 8140' - 43'
Type: Cuttings

This sample consisted of drill cuttings and contained much contaminant from higher horizons. Few diagnostic microspores were isolated, but as the treatment schedule was shortened to facilitate quick examination this may not be a true indication of the microfossil content of the coal. Kuylisporites sp., Cyathidites sp., Gleichenia cf. cerinidites, Cookson, along with Gymnosperm pollens, justify a Mesozoic age determination, but any more specific determination is difficult because of the contaminant.

Sample 2 Depth: 8339' - 46'
Type: Core

Many slides were prepared for examination, but no microfossils were isolated, with the exception of cellular fragments of no stratigraphic value. The sample consisted primarily of amorphous material probably derived from the breakdown of humic acids etc.

Footnote: Subsequent examination of sediments from nearby and deeper horizons has revealed Mesozoic marine microplankton and plant microfossils, confirming the Mesozoic age of the coals sampled.

(Signed) J. Douglas

Geologist.

24/73

8.7.60

Memorandum - Chief Government Geologist

Micropalaeontological Examination of Rotary Cuttings from Port Campbell No. 2 Well -
Depths: 5130 to 5615 feet

A detailed micropalaeontological examination of the interval 5130 feet to 5615 feet has been conducted on samples submitted by Frome-Broken Hill Co. Pty. Ltd., on the 4th August. The basic results of this investigation are as follows:-

(i) Foraminifera regarded as being of Cretaceous age first appear at 5500 feet and persist down to the deepest sample submitted (5615 feet). The fauna is very sparse. The most characteristic species are Haplophragmoides dickinsoni Crespin, and Textularia anacooraensis Crespin. These two species were found in the interval 4400 feet to 5025 feet in Port Campbell No. 1, but were associated with more abundant fauna below 4695 feet. I believe that in Port Campbell No. 1, the faunal assemblage above 4695 feet is of brackish water origin and must be regarded as a distinct faunal assemblage from that below 4695 feet, which is definitely marine. Thus I would correlate the interval below 5500 feet in Port Campbell No. 2 with that interval between 4400 feet and 4695 feet in Port Campbell No. 1. The age of this highest faunal assemblage is definitely Cretaceous but may be slightly younger than the Upper Albian age (upmost Lower Cretaceous) which can now be confidently assigned to the interval from 4695 feet to 5025 feet, in Port Campbell No. 1.

(ii) Upper Eocene foraminifera are common in samples down to 5440 feet (Port Campbell No. 2). An occasional Tertiary foraminifer is found with the Cretaceous ones below 5500 feet, but must be regarded as contamination. However, as contamination within the Cretaceous is very slight, the more abundant occurrence of Upper Eocene fossils above 5440 feet suggests an Upper Eocene age for the beds above 5440 feet. If the possibility of contamination from higher beds was dismissed, I would point out that there must be a disconformity between the Upper Eocene beds at 5440 feet and the Albian or immediate post Albian beds below 5500 feet.

I have been informed by Mr. McQueen of Frome-Broken Hill Co., that the wellsite geologists working for Frome-Broken hill, have placed the top of the "Belfast Formation" in Port Campbell No. 2 at 5606 feet. In other words they have correlated the beds at 5606 feet in Port Campbell No. 2 with those at 4930 feet in Port Campbell No. 1. On the evidence cited above I must dispute this correlation on palaeontological grounds. I fully realise that the "Belfast Mudstone" is a Rock Stratigraphic Unit (as defined in the Aust. Geol. Soc. Code of Geological Nomenclature). Surely over a distance of less than two miles (between Well No. 1 and No. 2) palaeontological evidence for correlation of Rock Units cannot be dismissed. Not only is the fauna different at 5606 feet in Well No. 2, but the environment is brackish compared with the good marine conditions of the "Belfast Mudstone" in Well No. 1.

I am of the opinion that the true "Belfast Mudstone" (as defined by Frome-Broken Hill geologists) will not be encountered until another 500 feet is drilled in Port Campbell No. 2 Well, below the bottom hole depth of August 3rd (5615 feet). I would also like to emphasise that in Port Campbell No. 1 Well the marine Cretaceous mudstones occur above the "Belfast Mudstone" up to 4695 feet. The marine Cretaceous core at 4649-55 feet in Belfast No. 4 bore has been correlated with a marine Cretaceous mudstone core at 4757 feet in Port Campbell No. 1 by both Kenley (1959 - Mines Dept. unpublished report) and myself. Therefore I postulate that Marine Cretaceous beds (mudstones?) will probably be drilled at a depth, some 250 feet below 5615 feet in Port Campbell No. 2 well.

Sgd. David Taylor
Geologist

PLANT FOSSIL IN CORE 18, PORT CAMPBELL NO. 2 BORE

Core No. 18 from a depth of 8838 to 8840 feet in the Port Campbell No. 2 bore (Frome-Broken Hill Co. Pty. Ltd.) contains one leaf impression. Repeated splitting of the core has failed to reveal any other fossils.

The impression is of part of a lamina of Noeggerathiopsis hislopi (Bunb). Although the leaf is incomplete, its elongated form, the number of veins per cm. and its general appearance leave little doubt as to its identity.

Noeggerathiopsis hislopi is a predominantly Permian form. It is of common occurrence in Australia in Permian horizons. It is probable that it is an unimportant member of early Mesozoic floras. There is no evidence of its abrupt extinction at the end of the Permian era. In India it has been recorded with Glossopteris browniana, Pterophyllum and Taeniopteris in Parsora beds of probably Middle Triassic age. (Lele, 1955).

Reference:

Lele, K. M., 1955 Plant Fossils from Parsora in the South Rewa Gondwana Basin, India. Palaeobotanist 4, 23-33.

(M. E. WHITE)

February, 1961

Bureau of Mineral Resources,
Geology and Geophysics,
Childers Street, Turner,
CANBERRA, A.C.T.

EXTRACT FROM PALAEONTOLOGICAL REPORT

by D. J. Taylor December 16, 1960.

Port Campbell No. 2 Section

This well provides the greatest thickness of sediments containing Cretaceous foraminifera and relatively uncontaminated rotary cuttings with cores at convenient intervals and this makes it an excellent section for study.

Definite Cretaceous foraminifera were first encountered in a core at 5340 feet. The fauna was predominantly arenaceous with Marsonella oxycona (Reuss) present. From here to the base of the section at 7904 feet there is an alternation of predominantly arenaceous "assemblages", and assemblages in which calcareous foraminifera (sometimes as high as 40%) are associated with the arenaceous forms. Five distinct "assemblages" cannot be regarded as Oppelian zones. Unfortunately the term assemblage could be confusing in view of the current usage of the term Assemblage zones, so the term faunule (Fenton, 1928) will be used in this and further discussions. Each faunule has been named according to the characteristic species or association of species that it contains. The ranges of the diagnostic species are illustrated diagrammatically on the correlation chart, which is a synopsis of the faunal distribution charts which have been prepared for each well, but not included in this Interim Report.

In descending stratigraphic order, the five faunules are as follows:

(a) Haplophragmoides dickinsoni Faunule: 5300 to 5900 feet: This faunule is predominantly arenaceous. The involute Haplophragmoides dickinsoni Crespin is the most persistent species, and in some samples is the only species. The partly evolute sigmoidally sutured H. gigas Cushman is present very rarely.

(b) Haplophragmoides gigas - Praeglobotruncana deliqua Faunule: 5900 to 6250 feet. Marked by a numerical explosion of both species and individuals in the core sample at 5910 feet. This faunule is featured by an increased percentage of calcareous species. H. gigas is the most abundant species. Textularia washitensis Carsey (both meglospheric and microspheric forms) is also abundant. The calcareous species includes A. mawsoni Crespin, Gyroidina katherine sp. nov., Gumbelina dionysio sp. nov., and Valvulineria tangenta sp. nov., all of which are restricted to this faunule. Lagenids are relatively common including a group of forms which can be included within the species Lenticulalina australiaensis Crespin. The globigerinid Praeglobotruncana deliqua sp. nov. which exhibts an abrupt change in chamber growth is regarded as the characteristic calcareous species.

(c) Haplophragmoides gigas - H. chapmani Transition Faunule: 6250 to 7050 feet. Another predominantly arenaceous faunule characterised by the first appearance (descending) of H. chapmani Crespin and the relative decline of H. gigas. It can be shown that H. gigas is a time variant of H. chapmani as the straight sutures of H. chapmani become sigmoidal. Thus this faunule is characterised by the transition of one form into the other. H. dickinsoni is not present in or below this faunule. Textularia washitensis is still present.

(d) Haplophragmoides chapmani - Pleurostomella gelatus Faunule: 7050 to 7340 feet. Marked by another numerical explosion of the calcareous species, most of which (apart from the lagenids) are restricted to this faunule. The cone shaped Pleurostomella gelatus sp. nov., and Anomalina sp. nov. are diagnostic and easily recognised species. Gyroidinoides irenea sp. nov. occurs in abundance, but it also occurs spasmodically higher in the sequence. H. chapmani is the most abundant species, and Textularia pediculus sp. nov. (with the aperture on the apertural face and an overlapping final chamber) has its first appearance. T. washitensis is absent. The robust Ammobacculites australe (Howchin) is common and does not range far above this faunule. The more fragile and elongate A. subcretacea Cushman and Alexander occurs throughout the section.

(e) Haplophragmoides chapmani - Textularia pediculus Faunule: 7340 to 7904-14 feet. This is poor arenaceous fauna in which the two faunule indices are prominent. The base of the section is at 7904 feet (first cut hole) and 7914 feet (diverted hole). A core directly below this provided petrological evidence of an erosional unconformity. The predominance of arenaceous foraminifera in three of the five faunules suggests facies influence. The lowest arenaceous faunule occurs in a typical poorly sorted, feebly bedded turbidite bearing varying amounts of sand and pebbles. This implies unsettled benthonic conditions and turbid water. The two arenaceous-calcareous faunules lie above and below the middle arenaceous faunule; all three are within the same lithologically constant unit - the Belfast Mudstone - yet no facies change appears to be reflected in its lithology, though a facies alternation is reflected in the faunas. Doubtless environmental disturbances caused these alternations. The highest arenaceous faunule occurs at the base of the Paaratte Formation; a suspected deltaic sequence of siltstones, sandy siltstones and sandstones with plant remains. It has been concluded by others (e.g. Stainforth, 1952) that neither depth, salinity, nor temperature are major factors in the development of an arenaceous micro-fauna. Turbid water, so deleterious to calcareous foraminifera, seems to be the important factor. It is clear that the three arenaceous faunules are recurrent, as are the two arenaceous-calcareous faunules. Despite the fact that the facies changes are also recurrent, the faunules are of use in local stratigraphic correlation, even though these facies need not be ubiquitous. The ranges of certain arenaceous species are restricted (see Correlation Chart), and there are differences in calcareous specific content between the two arenaceous-calcareous faunules.

APPENDIX 2

ANALYSES OF FLUID SAMPLES

by

Standard Vacuum Refinery Pty. Ltd.

Vacuum Oil Company Pty. Ltd.

State Laboratories

STATE LABORATORIES

31st August, 1960

Report on Samples Nos. 914, 915/60.

Samples - Bore cores
Locality - Port Campbell
Sender - Dr. D. E. Thomas,
Chief Government Geologist,
Mines Department.

Two samples of bore core resulting from drilling operations at Port Campbell by Frome-Broken Hill Co. Pty. Ltd., were received for testing.

The samples were obtained from Bore No. 2 at a depth of 7904-7913 feet and were considered to contain some interstitial gases.

The following analytical information was obtained through the courtesy of the Research Division of the Gas and Fuel Corporation of Victoria.

Description of Samples

No. 914 Core 6. 7904 - 7913 feet, rec. 9 feet. Top foot, sealed. Hydrocarbon fraction comprised approximately 0.20% of the gas evolved from this core.

No. 915 Core 6. 7904 - 7913 feet, rec. 9 feet. Bottom foot sealed. Hydrocarbon fraction comprised approximately 0.13% of the gas evolved from this core.

Results (Hydrocarbon Fraction)

No.	914	915
	%	%
Methane	74.8	58.2
Ethane	11.4	5.4
Ethylene	3.2	1.2
Propane	3.2	1.7
Propylene	0.14	0.23
Isobutane	0.30	0.76
n-Butane	0.60	1.3
Butylenes	0.30	0.53
Isopentane	0.05	0.15
n-Pentane	0.15	0.83
Benzene	5.5	23.4
Toluene	0.25	6.2
C_6 and C_7	0.1	0.1
Xylenes	-	Traces

Evolved Gas from No. 915

	%
Hydrocarbons	0.13
Oxygen	2.9
Nitrogen	30.4
Carbon Dioxide	66.5

Hydrogen and Helium were not determined

Comments

The constituents of the hydrocarbon mixture differ in one essential aspect from those obtained from Bore No. 1 in that the above analysis shows the presence of unsaturateds such as propylene, butylenes etc., and, in addition, benzene and other ring-type compounds.

While remembering that these figures are obtained from one core and the amount of gas recovered was remarkably little, the evidence of the analytical figures indicates the possibility of the gas being derived, in part at least, from solid carbonaceous fuel such as coal.

The continued presence of the paraffinic hydrocarbons still points to a petroliferous origin.

(Signed) John C. Kennedy, Senior Chemist

STATE LABORATORIES

20th September, 1960

Report on Sample No. 963/60

Sample Bore Core
Locality Port Campbell
Sender Dr. D. E. Thomas
Chief Government Geologist
Mines Department

One sample of bore core resulting from drilling operations at Port Campbell by Frome-Broken Hill Co. Pty. Ltd., was received for testing.

The sample consisted of a section from Core No. 11 from 8340 to 8341 feet in Port Campbell No. 2 bore. Other sections of this core contained bituminous material and are being tested by the Vacuum Oil Company.

The following analytical information was obtained through the courtesy of the Research Division of the Gas and Fuel Corporation of Victoria.

Results:

1. The section of core, which was sealed at the wellsite, contained gas.

2. The gas consisted mainly of saturated hydrocarbons up to hexane at least. Some unsaturated hydrocarbons were present, but in quite small amount, and in this respect the gas differed from the previous samples from this bore (our Report on Samples Nos. 914, 915/60), but resembled the gas obtained from cores in No. 1 bore.

3. Methane amounted to about 0.2% of the gas collected.

(Signed) John C. Kennedy
Senior Chemist
Mines Department

Water Analyses:

		D.S.T. No. 14 8338 to 8350 feet Bottom of 91 Bbls.		D.S.T. No. 18 8294 to 8299 feet Above tool		D.S.T. No 22 8188 to 8196 feet After 65 Bbls.		D.S.T. No. 23 8188 to 8192 feet Above tool	
		p.p.m.	me/l	p.p.m.	me/l	p.p.m.	me/l	p.p.m.	me/l
HCO_3^-		2820	46	1910	31.3	1830	30	1930	31.6
$CO_3^=$		Nil		Nil		Nil		Nil	
$SO_4^=$		154	3.2	173	3.6	258	5.4	345	7.2
Cl^-		8650	244	8650	244	8830	249	9230	260
SiO_2		50	-	40	-	70	-	80	-
Total anions		11670	293	10670	279	10790	284	11580	299
Na^+		6060	263	5740	250	5590	243	6060	263
Ca^{++}		86	4.3	51	2.5	146	7.3	181	9.0
Mg^{++}		25	2.1	29	2.4	27	2.2	41	3.4
Fe^{+++}		3	0.16	4	0.21	10	0 54	8	0.43
Total cations		6170	269	5820	255	5770	253	6290	276
Total ions		17840		16490		16560		17870	
Dissolved non-volatile (105^oC) solids at N.T.P.		16050		15830		16400		17470	
Insoluble solids at N.T.P.		310		430		400		1610	
Suspension-free samples	pH at $2Y^oC$	8.0		8.05		8.05		8.0	
	Conductivity at 24^oC inhos/cm	2.5×10^{-2}		2.51×10^{-2}		2.54×10^{-2}		2.67×10^{-2}	

ANALYSES BY BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Water Analyses:

	D.S.T. [redacted] 24 8188 to 8194 feet Above tool		D.S.T. No. 25 8188 to 8194 feet Drill stem above packer		D.S.T. No. 26 8188 to 8194 feet 82 - Stand		D.S.T. No. 29 7910 to 7918 feet Single above tool	
	p.p.m.	me/l	p.p.m.	me/l	p.p.m.	me/l	p.p.m.	me/l
HCO_3^-	2130	35	1440	23.6	1600	26.2	262	4.3
$CO_3^=$	Nil		Nil		Nil		225	7.5
$SO_4^=$	370	7.7	248	5.2	285	5.9	785	16.4
Cl^-	8440	238	9460	267	8930	251	695	19.6
SiO_2	80	-	70	-	40	-	Nil	
Total anions	11020	281	11220	296	10850	283	1970	47.8
Na^+	5740	250	5740	250	6220	270	1100	48
Ca^{++}	186	9.3	176	8.8	131	6.5	Nil	
Mg^{++}	25	2.1	26	2.2	32	2.7	Nil	
Fe^{+++}	14	0.75	1		Nil		Nil	
Total cations	5960	262	5940	261	6380	279	1100	48
Total ions	16980		17160		17230		3070	
Dissolved non-volatile (105°C) solids at N.T.P.	16990		17540		16540		3460	
Insoluble solids at N.T.P.	1690		1420		1280		420	
Suspension-free samples: pH at 24°C	8.1		7.75		7.4		10.8	
Suspension-free samples: Conductivity at 24°C inhos/cm	2.6×10^{-2}		2.73×10^{-2}		2.58×10^{-2}		0.40×10^{-2}	

ANALYSES BY BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

33/13

PORT CAMPBELL NO. 2

Gas Analyses

	DST No. 9 8586 - 8594 ft. %	DST No. 11 8395 - 8405 ft. %	DST No. 12 8338 - 8350 ft. %	DST No. 14 8338 - 8350 ft. %	DST No. 16 8294 - 8299 ft. %	DST No. 18 8294 - 8299 ft. %	DST No. 22 8188 - 8196 ft. %
Air	8.0	0.4	0.3	11.2	5.9	21.0	2.0
Methane	76.6	93.1	94.6	72.4	81.8	63.4	93.2
Ethane	3.2	2.9	2.5	2.8	3.4	2.1	2.2
Propane	0.4	0.4	0.2	0.4	0.8	0.2	0.2
Isobutane	-	-	-	-	0.2	-	-
Butane	-	-	-	-	0.2	-	-
CO_2	9.4	0.8	Nil	10.8	5.3	10.9	Nil
Water Vapour	2.4	2.4	2.4	2.4	2.8	2.4	2.4

ANALYSIS BY STANDARD VACUUM REFINING COMPANY

33/73

PORT CAMPBELL NO. 2

Date Submitted:	12.12.60	12.12.60
Sample Labelled:	DST No. 9 - 8586-8592 Fluid from 3rd stand above tool (2 sample bottles)	DST No. 9 - 8586-8592 Above Tool
Specific Gravity	1.001	1.001
Steam Distillable Oil	Nil	Nil
Hexane Extract	Nil	Nil
Explosive Gases	Nil	Nil
Chloride as Cl gms.litre	8.20	5.60
as NaCl gms/litre	13.4	9.2
Sulphate gms/litre	.057	.044
Alkalinity (Methyl Orange) gms/litre	1.36	2.20
Calcium gms/litre	1.70	1.20
Magnesium gms/litre	Nil	Trace
Total Dissolved Solids gms/litre	13.4	11.0

ANALYSIS BY VACUUM OIL COMPANY PTY. LTD.

PORT CAMPBELL NO. 2

Water Analysis

Date Submitted:	15.12.60	15.12.60	20.12.60	20.12.60	23.12.60
Samples Labelled:	DST No. 11 8395 - 8405 ft.	DST No. 12 8338 - 8350 ft.	DST No. 14 8338 - 8350 ft. Fluid from bottom of 91 barrels recovered.	DST No. 18 8294 - 8299 ft. Water above tool.	DST No. 22 8188 - 8196 ft. Fluid after 61 barrels recovered.
Steam Distillable Oil	Nil	Nil	Nil	Nil	Nil
Hexane Extract	Nil	Nil	Nil	Nil	Nil
Explosive Gases	Nil	Present	Present	Present	Present
Chloride gms/litre	7.3	7.5	8.75	8.55	9.20
Sodium Chloride gms/litre	12.0	12.3	14.4	14.0	14.9
Sulphate gms/litre	.47	-	.26	.30	-
Alkalinity Methyl Orange gms/litre	1.63	-	.85	.78	-

ANALYSES BY VACUUM OIL COMPANY PTY. LTD.

35/73

PORT CAMPBELL NO. 2

Date Submitted: 9.1.61. (6 samples)

Sample Labelled:	DST. No. 23 8188 - 8192 ft. Fluid from above tool	DST No. 24 8188 - 8194 ft. Fluid from above tool	DST No. 25 8188 - 8194 ft. Fluid from drill stem above packer	DST No. 26 8188 - 8194 ft. Fluid from 49th stand	DST No. 28 7910 - 7918 ft. Water from stand above tool	DST No. 29 7910 - 7918 ft. Water from single above tool
Steam Distillable Oil %	Trace	Nil	Nil	Nil	Nil	Nil
Hexane Texract	Trace	Nil	Nil	Nil	Nil	Nil
Explosive Gases	Trace	Present	Present	Present	Present	Absent
Chloride gm/litre	9.05	8.76	9.50	7.71	1.06	0.78
Sodium Chloride gm/litre	14.9	14.4	15.6	13.6	1.74	1.28

The oil recovered by steam distillation and hexane extract from DST No. 23 was light brown in colour and waxy when cooled. A benzene solution of this oil dropped the refractive index of benzene from 1.4955 to 1.4935 indicating possibly a paraffinic base oil. This oil could probably have been obtained from the drilling mud.

ANALYSES BY VACUUM OIL COMPANY PTY. LTD.

36/73

PORT CAMPBELL NO. 2

Date Submitted:	19.1.61	19.1.61
Sample Labelled:	DST No. 31 5349-5356' Fluid from 50th Stand	DST No. 32 5349-5355' Fluid from 52nd Stand
Steam Distillable Oil %	Nil	9.5% (by volume)
Hexane Extract	Nil	7.0%
Explosive Gases	Present	Present
Chloride gm/litre	10.1	4.80
Sodium Chloride gm/litre	16.6	7.9

The pour point of the oil recovered from DST No. 32 was 20°F, specific gravity 0.828, refractive index 1.464. These figures are also characteristic of the type of A.D.O. and I.D.O. available in that area and it is understood to have originated from the drilling mud. The sample itself contained a large quantity of mud.

ANALYSES BY VACUUM OIL COMPANY PTY. LTD.

VACUUM OIL COMPANY PTY. LTD.

Sample - Core No. 14, Port Campbell No. 2 D-2

Deviated Hole 8313-8319 Rec. 4' Depth 8313-8314

Submitted 18/11/1960

Results of Examination:

	Sample Submitted	I.D.O. (Altona)
Recovery by Steam Distillation	0.1%	0.2% (from 0.7 gms I.D.O. in sand)
Hexane Extract of Core	0.71%	-
Nature of Hexane Extract	Light brown oil Low viscosity Not waxy	Dark brown to black (Normal Product)
Specific Gravity @ 60°F	0.835	0.853
Refractive Index 20°C	1.467	1.465

Test for Volatiles

50 grams of the sample submitted was placed in a glass tube connected to a combustible gas detector calibrated in ppm for petroleum vapours. Air was drawn over the sample at 70°F and again at higher temperatures up to 240°F.

Results obtained were as follows:

	Meter Reading ppm Vapour	
	Sample	I.D.O. on Sand
Temperature 70°F	50 ppm	50 ppm
" 120°F (approx.)	60	120
" 200/240°F	1000	450

Presence of Salt

Chloride was present in a water extract of the sample submitted.

Conclusions:

Steam distillation does not confirm the presence of volatiles in the core sample. The 0.1% recovered is expected to be obtained from I.D.O. which was known to be present in the drilling mud and the odour of the core sample submitted confirmed this. Since I.D.O. often incorporates steam distillable kerosene fractions it is most likely that the 0.1% recovery was from I.D.O. Tests carried out on I.D.O. mixed with sand gave the equivalent of 0.2% steam distillable material.

Specific gravity of the Hexane extract is lower than that of the normal Altona product; but it is line with the product often supplied by Geelong Refinery and which is supplied to that area. Refractive index of the extract is very close to that of I.D.O.

Tests for volatiles using a combustible gas indicator did not confirm the presence of petroleum vapours in excess of those expected from I.D.O.

(Signed) F. Provera

STATE LABORATORIES

8th March, 1961

REPORT ON SAMPLES NOS. 1376-1378/60

U.W.R.S. 2182-2184

Sample : Waters

Locality : Parish of Paaratte

Sender : Dr. D. E. Thomas,
Director of Geological Survey,
Mines Department.

Three samples of water were received for analysis. The samples were obtained from oil bore No. 2 at Port Campbell being drilled by Frome-Broken Hill Co. Pty. Ltd.

Details of Samples :

Laboratory No.	1376	1377	1378
U.W.R.S.	2182	2183	2184
Bore	2	2	2
Sample	53	60	70
Drill Stem Test	12	12	12
Depth (feet)	8338-8350	8338-8350	8338-8350
Date	13.12.60	13.12.60	13.12.60

Results: In parts per million

Total solids in solution (by evaporation)		16,960	16,760	16,720
Chloride	(Cl)	7534	7704	8098
Carbonate	(CO_3)	316	326	252
Bicarbonate	(HCO_3)	2300	1962	1673
Sulphate	(SO_4)	Present	Present	Present
pH		8.8	8.8	8.8

Appearance etc.

The samples were dark brown in colour and were contaminated with oil used in the testing operations.

Filtration made no difference to the colour of the water.

(Signed) John C. Kennedy
Senior Chemist
Mines Department

STATE LABORATORIES

8th March, 1961

REPORT ON SAMPLE NO. 1387/60

U.W.R.S. 2185

Sample : Water

Locality : Parish of Paaratte

Sender : Dr. D. E. Thomas,
Director of Geological Survey,
Mines Department

One sample of water was received for analysis. The sample was obtained from Oil Bore No. 2 at Port Campbell being drilled by Frome-Broken Hill Co. Pty. Ltd.

Particulars:

No.	1387
U.W.R.S.	2185
Bore	2
Depth (feet)	8338-8350

Drill Stem Test No. 14
Fluid from bottom of 91 bbls.
recovered.

Results:

In parts per million

Total solids in solution (by evaporation)		16,820
Chloride	(Cl)	9142
Carbonate	(CO_3)	147
Bicarbonate	(HCO_3)	1330
Sulphate		Present

Appearance etc.

The water was light brown in colour with a yellow opalescence after filtering. There was a little sediment and the water smelt of oil.

(Signed) John C. Kennedy
Senior Chemist
Department of Mines

STATE LABORATORIES

4/73

22nd May, 1961

REPORT ON SAMPLES NOS. 87,88/61

U.W.R.S. 2235, 2236

Sample : Waters

Locality : Parish of Paaratte

Sender : Dr. D. E. Thomas,
Director of Geological Survey,
Mines Department.

Two samples of water were received for analysis. The samples were obtained from Oil Bore No. 2 at Port Campbell being drilled by Frome-Broken Hill Co. Pty. Ltd.

Particulars:

No.	87	88
U.W.R.S.	2235	2236
Test	DST No. 31	DST No. 32
Depth (feet)	5349-5355	5349-5355
Date	8.1.61	8.1.61

Results:

		Parts per million	
Total solids in solution		13,188	15,793
Chloride	(Cl)	7424	9390
Carbonate	(CO_3)	222	Nil
Bicarbonate	(HCO_3)	396	234
Sulphate	(SO_4)	28	263
Nitrate	(NO_3)	Nil	Nil
Calcium	(Ca)	87	531
Magnesium	(Mg)	9	355
Iron - total	(Fe)	204	24
Iron - soluble	(Fe)	2.9	5.1
Total Hardness (as $CaCO_3$)		255	2785
pH		9.2	7.6

Hypothetical combinations are given as follows:

		ppm	
		87	88
Calcium bicarbonate	$Ca(HCO_3)_2$	352	296
Magnesium bicarbonate	$Mg(HCO_3)_2$	44	-
Ferrous bicarbonate	$Fe(HCO_3)_2$	9	16
Sodium bicarbonate	$NaHCO_3$	110	-
Calcium sulphate	$CaSO_4$	-	373
Calcium chloride	$CaCl_2$	-	966
Magnesium chloride	$MgCl_2$	-	1392
Sodium carbonate	Na_2CO_3	392	-
Sodium sulphate	Na_2SO_4	41	-
Sodium chloride	NaCl	12230	12750

(Signed) John C. Kennedy
Senior Chemist
Mines Department

APPENDIX 3

CORE DESCRIPTION AND ANALYSES

CORE DESCRIPTION

Core No. 1 5340 to 5343 feet. Recovery 1 foot 8 inches.

Top 1½" siltstone to very fine sandstone, grey coloured quartz, mica, carbonaceous material. Medium hard, compact, unsorted, argillaceous matrix.
1'6½" siltstone to very fine sandstone, grey to dark grey coloured. Quartz, angular, subrounded grains, slightly glauconitic, micaceous in dark grey argillaceous matrix. Unsorted, medium hard, compact carbonaceous material, plant remains? replaced by pyrite. Finely pyritic, small quartz pebbles, dolomitic concretions.
Bottom 5½" as above, coarser grained and more unsorted.
Density: 2.39.

Core No. 2 5355 to 5361 feet. Recovery 3 inches.

Sandstone; grey coloured, made up of white, clear, light grey, fine to very coarse, angular to rounded, poorly sorted sand grains. Black carbonaceous patches and pyrite, clayey matrix very slightly calcareous. Few glauconite grains.
Density: 2.35. No fluorescence. Acetone test negative.

Core No. 3 5910 to 5919 feet. Recovery 7 feet.

Mudstone to siltstone, dark grey, micaceous, glauconitic, sandy. Small pockets of highly glauconitic sands. Thin bands of brown dolomite. Pyritic, very fine pyrite crystals partly replace plant remains. Fossiliferous with pearly shell fragments. Biotite and muscovite mica, compact.
Density: 2.5. Acetone test: Very weak. Ultra Violet: Negative on core, slight fluorescence on acetone solution, and pale yellow on soxhlet solution. Soxhlet: Slightly greasy cut.

Core No. 4 7403 to 7409 feet. Recovery 5 feet.

Top 1 foot ankerite; brown to dark brown, very hard, dense, heavy, very glauconitic. Very shattered in places and replaced with calcite.
Bottom 4 feet mudstone; black, compact, very glauconitic, very shattered and slickensided with calcite along the planes. Fossiliferous, shark tooth and few shell fragments.
Density: 2.53. Soxhlet: Greasy cut, pale yellow fluorescence.

Core No. 5 7885 to 7897 feet. Recovery 5 feet.

Top 4" dolomite; brown, very hard, dense, very slightly glauconitic.
4'8" dark grey to black sandy, limonitic and pyritic mudstone. Dense with a little glauconite, limonite is light brown, very fine texture and probable oxidised glauconite. Minor slickensiding with calcite. The sand is white to brown, fine to coarse with a few granules, rounded and very rounded.
Density: 2.64. Acetone Test: Negative, no fluorescence.
Soxhlet: Slight greasy cut and pale yellow fluorescence.

Core No. 6 — 7904 to 7913 feet. Recovery 9 feet.

Dark green clayey sandstone. Clear, white to light brown, fine to granule, angular to rounded and some well rounded grains. Very poorly sorted in a clayey matrix. Green colour is due to green clay and claystone fragments. Weathered feldspar?. Matrix is argillaceous and is probably feldspathic. Few pieces are very lightly carbonaceous and few fragments of mica and coal particles. Also black siltstone matrix in parts.
Density: 2.65. Acetone Test: Negative.
Porosity: 14.6%. Permeability: 0+ md.
Water Content: 2.3% by weight
" " 15.8% by porosity
Soluble Hydrocarbons: 0.36% by weight
" " 2.70% by porosity
Chloride of Water: 590 ppm. Trace of carbonate.

Core No. 7 — 7913 to 7930 feet. Recovery 17 feet.

Top 8 feet greywacke; greenish-grey, well sorted, fine to medium grained. Subrounded to rounded quartz grains. Subrounded to angular pale green to deep green clay? fragments. Grey siltstone matrix. Dark minerals, red and pink grains of chert. Biotite, occasional coarse quartz grains, small lenses of siltstone. Very slightly calcareous. Plant remains, very well preserved fossiliferous wood, partly carbonised, poorly pyrified.
Bottom 9 feet greywacke as above; finer grained with increasing amount of siltstone, angular, coarse quartz grains. Pyrite nodules and pyritic cementation in parts.
Density: 2.63. Acetone Test: Negative. Slight fluorescence on acetone solution.

Average effective porosity:	13.8%
Absolute permeability, horizontal:	0
" " vertical:	0
Residual water content by weight:	3.15%
" " " in % of porosity as above:	23% ≡ 52% of pore space
Residual (non-gaseous) hydrocarbon content by weight:	0.35% ≡ 6% of pore space
Residual (non-gaseous) hydrocarbon content in % of porosity as above:	2.5%
Fluorescence of the hydrocarbon extract as above	Yellowish white

Core No. 8 — 8096 to 8110 feet. Recovery 10 feet.

Conglomeratic argillaceous siltstone with very fine to fine sandstone stringers, grading into a conglomeratic sandstone in the bottom 5 feet. Siltstone is grey, dark grey to greenish-grey, hard, dense and compact, not very well sorted. Conglomeratic fragments are nearly all quartz, white, clear to light brown, ranging up to pebble size, mainly rounded to well rounded.
Green flakes appear to be mainly green clay fragments (chlorite?) but glauconite could be present. Trace of pyrite, mica, calcite, and dolomite concretions are also present in the core.
Density: 2.65. Density of dolomite: 3.28.
No bedding, no oil and gas, and no fluorescence.
Soxhlet: Slight greasy cut with pale yellow fluorescence.

Core No. 9

8174 to 8188 feet. Recovery 8 feet

Top 2" dolomite; brown, glauconitic, crystalline, fractured with calcite filling. Probable cave in from higher beds. 7'8" mudstone to siltstone, dark grey, micaceous, (muscovite) with carbonaceous material, containing pyrite nodules and resin. Laminated with white, fine to medium grained quartz sandstone, well sorted, subrounded. The amount of sandstones increases towards bottom, and is interbedded, interlensed and slightly crossbedded. Bottom 2" sandstone white quartz, fine to medium. Well sorted, subrounded, noncalcareous, with dark grey mudstone pellets. Density: 2.53. Acetone Test: Slightly positive. Slight fluorescence. Soxhlet: slight greasy cut with yellow fluorescence.

Core No. 10

8306 to 8311 feet. Recovery 3 feet.

Top foot in barrel not counted in recovery. Several cobbles well rounded glauconitic mudstones and dolomites caved from above.

Core: Sandstone, white to light grey, fine to mainly coarse, mostly angular to subangular, slightly porous, carbonaceous, slightly pyritic. Hard quartz sandstone with quartz siltstone matrix. Poorly sorted.

Density: 2.48. Acetone and Soxhlet:	Negative.
Average effective porosity:	11%
Absolute permeability, vertical:	91 md
horizontal:	83 md
Residual Water content:	2.4% by weight
	21.82% of porosity
Residual (non-gaseous) hydrocarbon content:	0.7% by weight
	7.2% of porosity
Salinity (NaCl content of the water)	120 ppm
Fluorescence of hydrocarbon extract	Bright milky white.

Core No. 11

8339 to 8346 feet. Recovery 6 feet.

Siliceous, quartzitic sandstone, light grey, medium to very coarse grained, subangular to subrounded. Hard, very slightly porous in parts. Granules and pebbles of quartz. Fractures are filled with carbonaceous material and pyrite. Pyrite occurs as nodules and crystals. Also finely disseminated and as lumps or nodules is a solid black bituminous material with conchoidal fracture, that cuts and fluoresces only after treatment with toluene. Fluorescence is yellow. There is an apparent lineation of black material in fractures 27-30°. Density: 2.51.
Acetone Test: Negative. Soxhlet: Good film with yellow fluorescence. Toluene treated core fluoresces in parts yellow.

Average effective porosity:	8.4%
Absolute permeability, horizontal:	19 md
vertical:	3 md
Residual water content:	2.3% by weight
	27.3% of porosity
Residual (non-gaseous) hydrocarbon content:	0.23% by weight
	2.7 % of porosity
Fluorescence of hydrocarbon extract:	Blueish white.

The gas from the core contained saturated hydrocarbons up to hexane at least. Some small amount of unsaturated hydrocarbons was also present. Methane amounted to about 0.2% of the gas collected.

Core No. 12 (Deviated Hole)
7093 to 7103 feet. Recovery 10 feet.

Top 6'9" mudstone; dark grey to dark brown, very fine textured, slightly carbonaceous, finely micaceous, pyritic, (small nodules) non-glauconitic. Very brittle, hard, compact. Core snaps and pops as it dries, breaking into curved sharp shards. Minor micro faults with slickensides.
6" ankerite concretions, brown to dark brown, very finely crystalline, hard, tight, dense, with calcite fillings in tiny fractures.
2' mudstone as above with 1" ankerite concretion.
6" ankerite concretion as above.
3" mudstone as above but completely shattered and slickensided. Core has fracture lineation or bedding? of 11° apparent. If bedding with 4° Totco added, would give 15° dip.
Density Mudstone: 2.50. Ankerite: 3.52.
Acetone Test: Negative.

Core No. 13 (Deviated Hole)
7683 to 7694 feet. Recovery 10 feet.
Top 1" ankerite; brown to dark brown, very hard, dense, with calcite in fractures, glauconitic. Probably cavings.
Rest of core is sandy mudstone grading into clayey sandstone in places. Dark grey, black, hard, dense, micaceous. Sand is clear, white, very fine to very coarse in spots, mainly fine to medium, poorly sorted and set in a black clayey matrix. Also green mineral is prevalent throughout the core. Pyrite concretions and carbonaceous matter is also present. Six feet from the top of core is a 1" coal band, with pyrite inclusions and pyrite-filled veins within the coal. Three or four sandy ankerite concretions through core. Evidence of slickensiding mainly in bottom 3' with some calcite.
Density: 2.72. Acetone Test: Negative.

Core No. 14 8313 to 8319 feet. Recovery 4 feet.

Sandstone; white, light grey, discoloured to a dirty brown colour due to myrtan and diesel oil penetration. Medium to granule, and pebble conglomerate in places. Angular to rounded, not very well sorted, medium porosity but not very high permeability. Very hard, dense carbonaceous material and pyrite scattered through core. Also some coal fragments and pyrite nodules. In parts siliceous cement.
Density: 2.48. Acetone Test: Negative.
Soxhlet: Yellow cut. Fluoresces with toluene.

Core No. 15 8409 to 8418 feet. Recovery 8 feet.

Top 5' mudstone; dark grey to black to dark brown. Very fine texture, slightly micaceous (muscovite), very slightly sandy in streaks. Carbonaceous material (plant remains) and pyrite nodules. Core contains several slickensided zones, but not badly fractured. Thin edges of fragments are dark brown in colour. Not glauconitic.
2'10" mudstone as above, but very highly pyritic sandy streaks and pyrite nodules.
Bottom 2" sandstone; light grey, very coarse to granule, subrounded to subangular, hard, tight, pyritic quartz sandstone. Pyrite is cementing agent.
Density: 2.6. Apparent dip of sandstone streaks: 16°.

Core No. 16 — 8556 to 8570 feet. Recovery 8 feet.

Silty mudstone, grey to dark grey to greenish-grey, very fine sandstones in a few parts. Dense, tight with very fine texture, with pyrite and a few coal fragments, traces of amber.
Apparent dip: 18 to 22°.
Density: 2.60.

Core No. 17 — 8605 to 8624 feet. Recovery 8 feet.

4" on top are ankerite cavings.
Top 3' light grey to greenish-grey sandstone of white and light grey quartz grains. Fine to very coarse, with granules mainly subangular to subrounded, poorly sorted, friable. Abundant grey subangular to subrounded rock fragments, with angular matrix, with abundant chlorite and pyrite, biotite, muscovite. Also stringers of black carbonaceous material and silty mudstone. Medium porous.
Bottom 5' light grey to greenish-grey sandstone with abundant black siltstone with carbonaceous lenses and stringers. Constituents the same as for top 3 feet but sandstone is very much harder and lighter, better sorted and not friable. Lenses and stringers through core are contorted. Suggestion of dip is approximately 15°.
Density: Top of core is 2.37, bottom of core 2.54.

Core No. 18 — 8826 to 8846 feet. Recovery 16 feet

Mudstone, light green to blueish-green, very micaceous (biotite) slightly carbonaceous, chloritic, silty, with tiny red rock fragments.
Density: 2.50.

PORT CAMPBELL NO. 2 - CORE NO. 11

8344 to 8345 feet

ANALYSIS BY VACUUM OIL COMPANY September, 1960

Greyish sandstone containing shiny blackish material heterogeneously dispersed but concentrated mainly towards the centre of the core.

Black Material

Analysis of the shiny black material gave the following results:

Ash Content	65% of sample
Solvency:	
Benzene/alcohol/acetone 70/15/15%	13% of sample (37% of volatile matter)
Carbon Tetrachloride	20% of sample (57% of volatile matter)

Nature of Carbon Tetrachloride extract:

Hard and resinous with melting point	greater than 210°F
Specific Gravity	0.86
Elemental Analysis:	
Carbon	81.9
Hydrogen	9.9
H/C Atomic ratio	1.46

The black material begins to decompose and swell when heated to 400°C with evolution of combustible gases. This behaviour was similar to that of coal and also oil bearing shale from N.S.W.

Proximate analysis of the black material gave:

Moisture	3.6%
Volatile Matter	25.8%
Fixed Carbon	3.3%
Ash	67.3%

The ratio of Volatile Matter to Fixed Carbon is 7.4 which is of the order of that obtained from oil bearing shale while similar ratios for coal are in the order of 0.5.

On comparison of the H/C Atomic Ratio with other similar naturally occurring deposits the following results are obtained:

C Cl_4 Extract of Sample Submitted	1.46
Oil Bearing Shale	1.49
Crude Oil	1.66 to 1.92
Asphaltenes and Pyrobitumens	1.27 to 1.52
Coal - Bituminous	0.86
Brown	0.845
Anthracite	0.38

Conclusion:

The high temperature to which the black material can be heated before decomposition takes place indicates either coal, oil shale or pyrobitumens. The high ratio of Volatile Matter to Fixed Carbon and also H/C atomic ratio in the C Cl_4 extract, however, indicate that this matter is of an asphaltic pyrobitumen nature or an oil shale. In view of the slight solubility of oil shale in solvents used in this examination compared with the solubility of the sample examined the tests and comparisons outlined above favour the opinion of the material being of an asphaltic pyrobitumen nature.

Inorganic Matter

Analysis of Inorganic Matter (next to shiny black material):

Volatiles	7.8%
Si O_2	18.8%
Fe	34.3%
Sulphur	38.7%
Ca	<0.3%
Na_2O	0.4%

The atomic ratio of Fe and S is 1 : 1.97 which approximates the ratio in pyrites. This is also confirmed by the yellowish appearance of the inorganic matter adjacent to the black organic material. The Si O_2 indicates the remainder of the inorganic material is sand.

APPENDIX 4

FORMATION TESTING

(See also Plate 6)

FORMATION TESTING

1. OPEN HOLE TESTING

D.S.T. No. 1 - 7891 to 7930 feet

Test failed. Packer failed to hold.

D.S.T. No. 2 - 7900 to 7930 feet

Test failed. Packer failed to hold.

D.S.T. No. 3 - 5660 to 5874 feet

Casing hookwall packer set at 5630 feet in $9\frac{5}{8}$" casing. $\frac{1}{2}$" choke in tool. No water cushion. Open for 45 minutes. Initial slight blow decreasing to steady, surging in 10 minutes and further decreased to weak for rest of flowing period. Shut in for 35 minutes.

Recovered 1295 feet drilling mud, salinity 1300 ppm chlorides.

I.H.P.	4070 psi	F.H.P.	4020 psi
I.F.P.	560 "	F.F.P.	900 "
I.S.I.P.	-	F.S.I.P.	1800 "

D.S.T. No. 4 - 5650 to 5874 feet

Casing hookwall as for D.S.T. No. 3. $\frac{1}{2}$" choke in tool. No water cushion. First test failed. Second test at 5645 feet - open 45 minutes - received fair blow decreasing through remainder of flowing period. Shut in for 35 minutes. Recovered 1020 feet drilling mud and 370 feet muddy water. Salinity of water 4300 ppm chlorides. Resistivity 0.80 @ 52°F.

I.H.P.	4080 psi	F.H.P.	3960 psi
I.F.P.	600 "	F.F.P.	1000 "

S.I.P's not shown on chart (tool failed to close).

2. TESTS THROUGH CASING PERFORATIONS

D.S.T. No. 5 - 8725 to 8735 feet

Test failed. Packer rubbers torn off and packer failed to seat.

D.S.T. No. 6. - 8725 to 8735 feet

Test failed same reason as for D.S.T. No. 5.

D.S.T. No. 7 - 8725 to 8735 feet

Test failed as for D.S.T.'s Nos. 5 and 6.

D.S.T. No. 8 - 8725 to 8735 feet

Packer set at 8689 feet. $\frac{1}{4}$" choke in tool. Test appeared to be open for 12 minutes before seat failed, but no flowing pressures recorded on the chart.

D.S.T. No. 9 - 8586 to 8592 feet

Packer set at 8577 feet. $\frac{1}{4}$" choke in tool. No water cushion. Open for 68 minutes. Slight blow increasing until 45 minutes, then decreased to nil at 68 minutes. Shut in 45 minutes. Recovered 270 feet mud and 180 feet muddy water and 3070 feet gas-cut water, and 180 feet mud. Salinity of water 8500 ppm chlorides. Resistivity 0.4 ohms @ 80°F.

I.H.P. 4700 psi	F.H.P. 4500 psi
I.F.P. 200 "	F.F.P. 1400 "
No S.I.P's recorded.	

D.S.T. No. 10 - 8395 to 8405 feet

Test failed as disc did not break after 3 bars had been dropped.

D.S.T. No. 11 - 8395 to 8405 feet

Packer set at 8372 feet. Open 87 minutes. Received fair blow decreasing throughout flowing period. Shut in for 33 minutes. Recovered 90 feet mud, 7050 feet gas-cut water and 1230 feet gas-cut mud. Salinity of water 7600 ppm chlorides.

I.H.P. 4500 psi	F.H.P. 4420 psi
I.F.P. 250 "	F.F.P. 3330 "
I.S.I.P. 3510 "	F.S.I.P. 3510 "

D.S.T. No. 12 - 8338 to 8350 feet

Packer set at 8328 feet. Open 78 minutes. Received good blow after 2 minutes which decreased to slight at end of flowing period. Shut in for 42 minutes. Recovered 180 feet gas-cut mud and 7308 feet gas-cut water and 840 feet gas cut mud. Salinity of water 7500 to 8000 ppm chlorides.

I.H.P. 4400 psi	F.H.P. 4370 psi
I.F.P. 200 "	F.F.P. 3380 "
I.S.I.P. 3670 "	F.S.I.P. 3640 "

D.S.T. No. 13 - 8338 to 8350 feet

Test failed as disc did not break. Leak in tubing gave 120 feet drilling mud.

D.S.T. No. 14 - 8338 to 8350 feet

Packer set at 8333 feet. Open for 120 minutes. Received good blow decreasing to nothing by end of flowing period. Shut in for 34 minutes. Swabbed 60 barrels gas-cut water. Salinity 8000 ppm chlorides. Recovered 31 barrels gas-cut water, same salinity from string.

I.H.P. 4225 psi	F.H.P. 4275 psi
I.F.P. 700 "	F.F.P. 3300 "
No S.I.P's recorded.	

D.S.T. No. 15 - 8294 to 8299 feet

Test failed. Rubbers on packer failed after 15 minutes and recovered only drilling mud.

D.S.T. No. 16 - 8244 to 8299 feet

Packer set at 8282 feet. Open for 99 minutes. Received very faint blow in 2 minutes increasing for 30 minutes and then decreased to nothing by end of flow period. Shut in for 18 minutes. Swabbed 60 barrels gas-cut muddy water. Salinity 7940 ppm clorides. Recovered 30 barrels gas-cut muddy water. Salinity 7800 ppm chlorides. Small leak in rubber seal above packer allowed the mud to contaminate the water.

I.H.P.	4100 psi	F.H.P.	4100 psi
I.F.P.	500 "	F.F.P.	3650 "
I.S.I.P.	3700 "	F.S.I.P.	3700 "

D.S.T. No. 17 - 8294 to 8299 feet

Test failed. Rubbers on packer failed and recovered only drilling mud.

D.S.T. No. 18 - 8294 to 8299 feet

Packer set at 8282 feet. Open for 86 minutes. Received good blow - strong in 20 minutes - gas to surface in 25 minutes. Blow decreased to nothing by end of flow period. Swabbed 40 barrels gas-cut water. Salinity 8000 ppm chlorides. Shut in for 45 minutes. Recovered 32 barrels gas-cut water, salinity 8000 ppm chlorides.

R_w = 0.47 at 64°F (See Composite log)

I.H.P.	3840 psi	F.H.P.	3840 psi
I.F.P.	460 "	F.F.P.	3430 "
I.S.I.P.	3410 "	F.S.I.P.	3450 "

D.S.T. No. 19 - 8188 to 8196 feet

Test failed. Rubbers on packer failed after 16 minutes and recovered only drilling mud.

D.S.T. Nos. 20 and 21 - 8188 to 8196 feet.

Rubbers on packer failed after 10 minutes and 3 minutes respectively.

D.S.T. No. 22 - 8188 to 8196 feet

Packer set at 8151 feet. Open for 158 minutes. Received good blow. Gas to surface after 33 minutes. Blow dead by 113 minutes. Swabbed 40 barrels gas-cut water. Salinity 8300 ppm chlorides. Shut in for 60 minutes. Recovered 28.5 barrels gas-cut water and 3 barrels gas-cut muddy water.

I.H.P.	3780 psi	F.H.P.	3780 psi
I.F.P.	200 "	F.F.P.	3330 "
I.S.I.P.	2280 "	F.S.I.P.	3250 "

D.S.T. No. 23 - 8188 to 8192 feet

Packer set at 8170 feet. Open for 210 minutes. Received slight blow decreasing after 40 minutes. Slight increase after 60 minutes and then died before swabbing. Swabbed 14 barrels gas-cut water. Shut in for 30 minutes. Recovered 18.5 barrels gas-cut water from string. Salinity 8500 ppm chlorides.

I.H.P.	3700 psi	F.H.P.	3680 psi
I.F.P.	450 "	F.F.P.	1590 "
I.S.I.P.	-	F.S.I.P.	2030 "

D.S.T. No. 24 - 8188 to 8194 feet

Packer set at 8164 feet. Open for 37 minutes. Received fair blow decreasing through flow period. Shut in for 38 minutes. Swabbed 1 barrel gas-cut muddy water and recovered 21.5 barrels gas-cut muddy water from string. Salinity 8500 ppm chlorides.

I.H.P. 3670 psi F.H.P. 3650 psi
I.F.P. - F.F.P. 870 "
No S.I.P's recorded.

D.S.T. No. 25 - 8188 to 8194 feet

Packer set at 8107 feet. Open for 63 minutes. Fair blow decreasing through flowing period. Shut in for 12 minutes. Swabbed 2 barrels of mud and recovered 21 barrels of gas-cut water. Salinity 9000 to 9200 ppm chlorides from string.

No pressures recorded as clock had stopped.

D.S.T. No. 26 - 8188 to 8194 feet

Packer set at 8133 feet. Open for 330 minutes. Slight blow - ceased after 30 minutes. Swabbed 1 barrel of water and recovered 1810 feet of water from the string. Salinity 9230 ppm chlorides. Bottom 900 feet contained small amount of dissolved gas.

No flowing pressures recorded on chart.
Only 3500 psi - hydrostatic pressure.

D.S.T. No. 27 - 7910 to 7918 feet

Test failed. Packer set below perforations.

D.S.T. No. 28 - 7910 to 7918 feet

Packer set at 7896 feet. Open for 90 minutes. Received very faint blow - died after 7 minutes. Recovered 750 feet of slightly gas-cut water, salinity 1050 ppm chlorides.

I.H.P. 3250 psi F.H.P. 3310 psi
I.F.P. - F.F.P. 190 "

D.S.T. No. 29 - 7910 to 7918 feet

Packer set at 7894 feet. Open for 167 minutes. Slight blow ceased after 25 minutes. Swabbed without recovery. Recovered 480 feet of water from string. Salinity 900 to 1000 ppm chlorides.

No pressures recorded on chart.

D.S.T. No. 30 - 5349 to 5355 feet

1st run - test failed, as packer seat failed.
2nd run - packer set at 5326 feet. Open for 300 minutes - received good blow throughout flowing period. No fluid recovery as ball valve of tool failed to close and fluid lost from pipe.
No pressures recorded.

D.S.T. No. 31 - 5349 to 5355 feet

Packer set at 5326 feet. Open for 80 minutes. Received good blow throughout flow period. Shut in for 60 minutes. Recovered 15.3 barrels gas-cut mud and 1.1. barrel gas-cut water. Salinity 6350 ppm chlorides. Pressure bomb not operating correctly.

I.H.P.	2670 psi	F.H.P.	2540 psi
I.F.P.	560 "	F.F.P.	560 "
I.S.I.P.	560 "	F.S.I.P.	1580 "

D.S.T. No. 32 - 5349 to 5355 feet

Packer set at 5323 feet. Open for 300 minutes - received fair blow almost dead before shut in. Shut in for 60 minutes. Recovered 17.9 barrels water. Salinity 9685 ppm chlorides. Pressure bomb not working correctly.

I.H.P.	1560 psi	F.H.P.	2000 psi
I.F.P.	500 "	F.F.P.	500 "

No S.I.P's recorded.

APPENDIX 5

DETAILED LITHOLOGICAL DESCRIPTION

DETAILED LITHOLOGICAL DESCRIPTION

Heytesbury Group	Surface to 880 feet	Marl; light grey to grey, soft, highly fossiliferous.
	880 to 920 "	Sand; orange-brown, medium to coarse grained, rounded to sub-rounded, highly polished, oxidised, limonite-stained quartz grains. Grey, soft, sticky, fossiliferous marl and cream to yellow skeletal limestone with limonite and fossil fragments.
	920 to 940 "	Limestone; sandy, yellow to brown, crystalline with very fine to fine rounded limonite pellets and sand grains.
	940 to 1230 "	Marl; grey to brown, soft, sticky, fossiliferous, glauconitic. Shell fragments, Turritella, Bryozoa.
Wangerrip Group	1230 to 1450 "	Sand; yellow to brown, iron coated, subrounded to angular with polished quartz grains. Inter-bedded with marl, sandy limestone and siltstone.
	1450 to 2850 "	Sand; white, clear to yellow stained quartz, fine to very coarse, subrounded to rounded, polished, interbedded with hard pyritic sandstone bands and soft silty brown mudstones.
	2850 to 3274 "	Sand; yellow to brown, iron stained, polished, fine to very coarse to granule, angular to subrounded with hard pyritic sandstone bands. Interbedded with siltstone, grey to greenish-grey to brown, sandy, limonitic, glauconitic, pyritic, micaceous.
	3274 to 3570 "	Sand to pebble conglomerate; light grey to clear to yellow stained, angular to subrounded fragments of quartz chert and igneous rock.
	3570 to 3590 "	Sand as above interbedded with black slightly pyritic coal.
	3590 to 4290 "	Sand; white to clear, medium to coarse, subrounded to angular, pyritic. Interbedded with silt-stone, grey, soft, finely micaceous, glauconitic with streaks of black carbonaceous material and bands of soft, slightly pyritic coal.
	4290 to 5000 "	Sand to sandstone; light grey, fine to coarse grained, angular, slightly calcareous and dolomitic, interbedded with siltstone to silty mudstone, dark brown to black, slightly micaceous, very fine textured, pyritic with streaks of coal.

Paaratte Formation	5000 to 5260 feet	Sand to sandstone; white to clear to iron stained, medium to very coarse grained, angular to rounded quartz grains, some polished with bands of calcareous, dolomitic, glauconitic and pyritic sandstones. Interbedded with silty mudstones, black, finely micaceous.
	5260 to 5810 "	Siltstone to silty mudstone; grey to dark grey, micaceous, pyritic, slightly glauconitic with bands of hard, tight, sandy, dolomitic mudstones, carbonaceous in parts.
Belfast Mudstone	5810 to 7910 "	Mudstone; dark grey to black, very fine textured, slightly micaceous, pyritic, glauconitic sands in parts with bands of ankerite. Fossiliferous, slicken sided, fractures with calcite fillings.
Waarre Formation	7910 to 8096 "	Sandstone, argillaceous to greywacke, greenish-grey, well sorted, fine to medium grained, subrounded to rounded quartz grains and subrounded to angular green clay fragments in a grey silt matrix. Sandstone contains many dark minerals, biotite. Interbedded with siltstone, dark grey to greenish-grey, composed from mostly the same minerals as sandstone above.
	8096 to 8143 "	Conglomeratic sandstone and siltstone; grey, dark grey to greenish-grey. Glauconitic, pyritic with ankerite bands.
	8143 to 8188 "	Siltstone to mudstone, dark grey, carbonaceous, micaceous, pyritic with nodules of resin, with thin band of coal and sandstone.
	8188 to 8514 "	Sandstone; white, fine to very coarse grained, subangular to subrounded, well sorted to poorly sorted, noncalcareous in a white quartz silt and gypsum matrix, pyritic. Interbedded with dark grey micaceous, pyritic, carbonaceous siltstone to mudstone
Otway Group	8514 to 8846 "	Sandstone, light grey to greenish-grey, fine to medium grained, subangular to subrounded, slightly calcareous, tight, argillaceous, pyritic, chloritic, biotitic, feldspathic. Interbedded siltstone to silty mudstone, dark grey, greenish-grey, carbonaceous, pyritic, chloritic, feldspathic.

APPENDIX 6

FISHING OPERATIONS

FISHING OPERATIONS

(i) On bottom at 1182 feet.

While installing B.O.P's on $13\frac{3}{8}$" casing head, one $1\frac{3}{8}$" nut was lost in the casing. Nut recovered in cones of bit when drilling out cement.

(ii) On bottom at 7930 feet.

While reaming core hole, pump pressure increased suddenly to over 2000 psi shearing the safety valve. After replacing safety valve circulation was lost and pipe was stuck. Regained circulation with 2400 to 2600 psi mud pressure and pipe freed in 5 hours.

(iii) On bottom at 8346 feet.

During reaming a slightly under gauge hole after a bit change, pipe was pulled up from 8345 feet for a new connection. When the kelly was replaced normal circulation was established but the pipe could not be moved either up or down.

Drilling assembly in the hole was as follows:

19 x $6\frac{1}{2}$" x $2\frac{3}{4}$"	drill collars	547.63 feet
85	Stands $4\frac{1}{2}$" drill pipe and double	7754.78 "
	Subs	3.35 "
	Bit	0.75 "
	Position of Bit	8306.51 feet

Attempted to work pipe but the pull of 280,000 lbs. was not able to move it. A Homco Free Point indicator showed that the string was free down to the bit. Ran string shot and attempted to back off at the third collar above bit. The shot fired without results. Attempted to back off at the fourth collar. The shot did not fire. Free point indicator was run with string shot and showed questionable freeness, shot and F.P. indicator was pulled up to the seventh collar which was recently broken. Indicator showed it free but shot did not fire. Current trouble in the instrument did not allow enough current to ignite the explosives. Using 5 foot long 70 grain per foot primer cord, shot was fired at seventh collar and backed off. Top of fish at 8096 feet. Ran single action upstroke jar, cleaned out hole to the top of fish, screwed into fish and opened circulation normally. Jarred for 105 minutes when the jar ceased functioning. The wash pipe of the jar was washed out. Ran drill collars open ended, washed down to fish, screwed in and opened circulation normally. Ran free point indicator which indicated free pipe to 8300 feet. Prepared and ran down stroke hydraulic jar with no results. It was decided to spot hydrochloric acid. Eighty-four gallons of Nerosene inhibited acid was diluted and pumped into the pipe, moving the acid 0.5 barrel further each hour, while the pipe was worked and jarred. This operation brought no result and it was discovered later that the markings on the tanks of the cementing unit which were used were faulty, and the acid never left the pipe except when it was circulated out. After the acid was circulated out and the mud conditioned, 7 barrels of oil were spotted in similar circumstances and with the same result. Ran free point indicator which got stuck in the jars. Pressuring from the annulus freed it. After a round trip the free point indicator was run again to determine the lowest possible point for backing off. Two unsuccessful attempts were made and at the third attempt, when the instrument worked, commenced to check free points from 8096 feet down. However, the instrument ceased sending signals to the surface.

It was pulled out and found that the free point instrument had become detached. The instrument was salvaged without damage with improvised tools. Two attempts were made unsuccessfully to fire string shots at the fourth collar. The third one did fire but the string did not back off. One shot did not fire on top of the fifth collar, but the second shot fired and back off was achieved, leaving 5 drill collars and the bit in the hole. At this stage the mud was changed over to lime base oil emulsion type. During circulation, and reaming bridges at 7330 feet, cavings sloughed over the tool stopping circulation and sticking the pipe. After five hours working the pipe was freed and circulation regained. During further reaming at 7396 feet the hole caved in again. The rotary table stopped and pump pressure increased to 2600 lbs. After 2 hours, 30 minutes the pipe was freed again and circulation regained.

It was decided to leave the fish in the hole, plug back and side track. Top of fish at 8154 feet. To prepare for the plugging it was necessary to ream out tight spots and clean out the hole. During this operation when reaming from 6557 to 6770 feet, a cone was sheared off from a Security M-3 8½" type bit and left in the hole. After cleaning the hole one unsuccessful attempt was made with junk basket to recover the lost cone. The hole was plugged back from 7370 feet in four steps to 5541 feet, using 1265 sacks of cement.

(iv) While driller was attempting to unseat packer at 4550 feet he backed off from the slip portion of a production packer. The fish was picked up and pulled out with a tapered tap.

APPENDIX 7

HOLE DEVIATION

by

Totco and Schlumberger Methods

DEVIATION SURVEYS

Totco Readings

Depth (feet)	Deviation (degrees)
100	1/8
195	0
430	3/4
740	1/8
950	1/8
1165	1/2
1700	1/8
2925	1/4
3154	1/2
3264	3/4
3500	1/2
3890	3/4
4190	3/4
4379	3/4
4748	3/4
4960	1/2
5245	1
5600	1
6190	5
6412	5
6690	7 1/2
6832	8
6855	8
7025	7 3/4
7225	8
7403	7 3/4
7491	8
7615	8
7719	8 1/2
7800	7 1/2
8095	6 1/2
8170	6 1/2
8284	6 1/2

Depth (feet)	Deviation (degrees)
Deviated Hole	
5739	1 1/2 - 2
5762	1 1/2
5835	1 3/4
5896	1 3/4
5995	2
6105	3 - 3 1/2
6142	3
6190	4
6220	4
6292	5
5927	1 1/2 - 2
5988	2
6034	3 - 3 1/4
6140	2 1/4
6185	4
6190	3
6195	6 3/4
6210	2 3/4
6232	3
6300	2 3/4
6490	3
6760	2 1/4
6830	3
7090	4
7360	5 1/2
7540	6
7683	7
7830	6 1/2
7938	6 3/4
8110	6 1/2
8140	6
8197	5 3/4
8245	6
8375	6
8721	3 - 3 1/4

Schlumberger Readings

Date	Depth	Deviation	Azimuth
27.8.60	5658	1.45	306
	5681	1.45	316
	5764	1.45	315
	5787	1.45	308
	5858	2	313
	5878	2	311
	6250	4	321
	6450	5.30	316
	6650	6.15	321
	6850	7	321
	7050	7	316
	7250	7.15	315
	7450	7.45	309
	7650	8	303
	7900	7	311
7.10.60	5640	1.15	Cased
	5700	1.00	311
	5750	0.45	330
	5800	1.00	328
	5850	1.00	301
	5900	1.15	311
	5950	1.30	328
	6000	1.30	329
	6050	1.45	331
	6100	2.00	326
	6150	3.30	326
	6200	3.15	326
	6224	4.30	324
12.10.60	6000	1.15	316
	6030	2.30	329
	6042	1.30	256
	6044	1.30	251
	6046	2.00	266
14.10.60	6000	1.15	321
	6050	1.30	321
	6100	3.00	336
	6120	3.00	331
	6130	2.45	326
	6140	4.00	336
	6150	4.30	326
	6160	4.00	328
	6162	3.30	334

Date	Depth	Deviation	Azimuth
16.10.60	6100	3.00	331
	6150	4.30	336
	6180	2.45	024
	6190	5.00	011
	6200	6.30	002
	6210	8.00	003
	6211	8.00	001
21.10.60	6150	5.00	339
	6200	2.30	009
	6250	2.00	039
	6300	2.00	029
	6350	2.00	023
	6400	2.00	006
	6450	2.15	016
	6500	2.30	354
	6534	2.30	356

APPENDIX 8

Velocity Survey

(is an attachment to the WCR)

is a Separate Report

APPENDIX 9

Geochemistry
(added by DNRE 01/08/00)

BEACH PETROLEUM

NO LIABILITY

(Incorporated in South Australia)

POSTAL ADDRESS:
P.O. BOX 360, CAMBERWELL, VICTORIA. 3124
TELEPHONE: (03) 813 3311
TELEGRAPHIC ADDRESS: 'BEACHPET'
TELEX: AA 36500 BEAPET

4TH FLOOR
685 BURKE ROAD
CAMBERWELL, VICTORIA. 3124
AUSTRALIA

RECD 14/9/83 RW.

1st September 1983

OIL and GAS DIVISION

14 SEP 1983

The Minister for Minerals and Energy
Department of Minerals and Energy
Princes Gate East
151 Flinders Street
MELBOURNE Vic 3000

Attention: The Director - Oil and Gas Division

Dear Sir

Re: Beach Petroleum Source Rock Study - Otway Basin

Now that the results of the source rock analyses have become available they can be passed on to you. Thirty-five samples were collected from five wells. Those wells were:-

Garvoc-1
Ferguson Hill-1
Woolsthorp-1
Ross Creek-1
Port Campbell-2

Further, please find (i) specific gravity measurement
(ii) petrographic description for a basement sample of Moyne Falls Well No. 1.

Yours faithfully
BEACH PETROLEUM NO LIABILITY

DG Langton
EXPLORATION MANAGER

SG:cs

REFERRED TO OGD
FOR COMMENT
TO NOTE
FOR REPLY BY
NECESSARY ACTION

O.I.C. CENTRAL REGISTRY
14/9/83

Port Campbell No. 2

K.K. No.	Depth (m)	$\bar{R}_v$max	Range	N	Exinite Fluorescence (Remarks)
					Belfast Mudstone
18104	1778 Ctgs	0.45	0.36-0.62	19	Sparse sporinite, yellow to orange, rare to sparse cutinite, orange, rare resinite, yellow. (Siltstone> claystone>limestone. D.o.m. abundant, I>E>V. Inertinite abundant, vitrinite and exinite sparse. Abundant iron oxides and pyrite.)
18105	1955 Ctgs	0.53	0.43-0.63	18	Sparse sporinite and rare ?phytoplankton, yellow to orange, rare cutinite, dull orange. (Claystone> limestone. D.o.m. abundant, I>E>V. Inertinite abundant, vitinite and exinite sparse. Abundant carbonate, ?glauconite and pyrite.)
18106	2138 Ctgs	0.52	0.44-0.64	17	Sparse sporinite, yellow/orange to orange, rare cutinite, orange to dull orange and rare phkytoplankton, yellow to orange. (Claystone>>sandstone>limestone. D.o.m. abundant, I>E>or=V. Inertinite abundant, vitrinite and exinite sparse. Abundant carbonate, ?glauconite and pyrite.)
18107	2321 Ctgs	0.58	0.44-0.75	12	Sparse sporinite, yellow/orange to orange, rare cutinite, orange, rare phytoplankton, green/yellow to yellow. (Claystone>sandstone>limestone>coal. Coal rare, vitrite. D.o.m. abundant, I>E>V. Inertinite abundant, exinite sparse, vitrinite rare. Common carbonate. Abundant ?glauconite and pyrite.)
					Eumeralla Formation
18108	2681 Ctgs	0.75	0.61-0.92	12	Sparse sporinite and rare cutinite, orange, rare to sparse phytoplankton, yellow to orange. (Siltstone> claystone>coal. Coal rare, duroclarite. D.o.m. common, I>E>or=V. Inertinite common, vitrinite and exinite sparse. Limestone present. Abundant ?glauconite and pyrite.)

PORT CAMPBELL No. 2

Sample No.	Depth (m)	Total Organic Carbon
18104	1778 Ctgs	1.86
18105	1955 Ctgs	1.32
18106	2138 Ctgs	1.56
18107	2321 Ctgs	1.30
18108	2681 Ctgs	1.08

Petroleum Technology Laboratory, Bureau of Mineral Resources, Geology and Geophysics, Canberra.

Date: 1st MARCH 1965

CORE ANALYSIS RESULTS

Notes:- (i) Unless otherwise stated, the porosities and permeabilities were determined on two small plugs (V & H) cut at right angles from the core or sample. Ruska porosimeter and permeameter were used, with air at 30 p.s.i.g. and dry nitrogen, respectively, as the saturating and flowing media. (ii) Residual oil and water saturations were determined using Sozhlet type apparatus. (iii) Acetone test precipitates and fluorescence of solvent after extraction are recorded as, nil, trace, fair, strong or very strong.

Well or Area	Core or Sample No.	Depth in ft. From:- To:-	Lithology	Effective Porosity in % by Vol.		Absolute Permeability in Millidarcys		Avg. density in gms./cc.		Fluid Saturation in % Pore Space		Acetone Test		Solvent after Extraction		Remarks
				V	H	V	H	Dry Bulk	Apparent Grain	Water	Oil	Colour	Precip-itate	Colour	Fluor.	
Port Campbell No. 2	12	7099' 7101'	SHALE	1		N.D.		3.39*	3.42*	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	* Rechecked. Small pieces only.
"	13	7689' 7691'	SANDSTONE	14	14	5	4	2.54	2.94	21	Nil	Trace	Nil	Nil	Nil	
"	14	8315' 8317'	SANDSTONE	10	10	49	80	2.37	2.63	Nil	Trace only	Trace	Strong	Trace	Fair	Fluorescence of core: Some yellow specks.
"	15	8409' 8411'	SHALE WITH COALY MATERIAL	8	3	Nil	Nil	2.43	2.57	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
"	16	8560' 8562'	SHALE	15		N.D.		2.48	2.92	"	"	"	"	"	"	Small broken pieces only.
"	17	8611' 8613'	SANDSTONE, SILT-STONE CARB.BANDS	ND	8	N.D.	1	2.55	2.78	15	Trace only	Pale Yellow	Fair	Trace	Trace	
"	18	8840' 8842'	SILTSTONE	23	21	1	3	2.36	3.02	49	Nil	Nil	Nil	Nil	Nil	

Additional Information:

General File No. 62/399
Well File No. 62/1064

Petroleum Technology Laboratory, Bureau of Mineral Resources, Geology and Geophysics, Canberra.

Date: 1st MARCH 1965

CORE ANALYSIS RESULTS

Notes:- (i) Unless otherwise stated, the porosities and permeabilities were determined on two small plugs (V & H) cut at right angles from the core or sample. Ruska porosimeter and permeameter were used, with air at 30 p.s.i.g. and dry nitrogen, respectively, as the saturating and flowing media. (ii) Residual oil and water saturations were determined using Sozhlet type apparatus. (iii) Acetone test precipitates and fluorescence of solvent after extraction are recorded as, nil, trace, fair, strong or very strong.

Well or Area	Core or Sample No.	Depth in ft. From:- To:-	Lithology	Effective Porosity in % by Vol.		Absolute Permeability in Millidarcys		Avg. density in gms./cc.		Fluid Saturation in % Pore Space		Acetone Test		Solvent after Extraction		Remarks
				V	H	V	H	Dry Bulk	Apparent Grain	Water	Oil	Colour	Precip-itate	Colour	Fluor.	
Port Campbell No. 2	CORES NOS. 1 to 4. NO SAMPLES.		WELL NOT SUBSIDISED ABOVE 7,500 FEET.													
"	5	7885' 7887'	SILTSTONE	18	19	Nil	Nil	2.60	3.19	23	Nil	Nil	Nil	Nil	Trace	
"	6	7910' 7913'	SANDSTONE	20	20	"	"	2.52	3.13	15	"	"	"	"	"	
"	7	7919' 7921'	SANDSTONE & SILTSTONE	17	16	"	"	2.58	3.09	16	"	"	"	"	"	
"	8	8096' 8098'	SILTSTONE & CONGLOMERATE	7	6	4*	Nil	2.53	2.71	38	Trace only	Yellow	Trace	"	"	* Fractures obvious
"	9	8178' 8180'	SANDSTONE	9	8	1	11	2.44	2.67	12	Trace only	Yellow	Fair	"	"	
"	10	8306' 8309'	SANDSTONE	11	9	79	80	2.37	2.64	Nil	Nil	Nil	Nil	"	Nil	
"	11	8343' 8346'	SANDSTONE WITH COALY MATERIAL	7	6	9	12	2.47	2.64	9	5*	Yellow	Very strong	Deep Orange Brown	Very strong	* Believed to be derived from coaly material.

Additional Information: Core No. 11:- Oil extract immobile, dark brownish-black. Fluorescence very dark yellowish-brown. Rare orange specks under U.V. light in freshly broken core.

General File No. 62/399
Well File No. 62/1064

FROME BROKEN HILL CO. PTY. LTD.

FAUNAL CHART OF LOWER CRETACEOUS SECTION IN PORT CAMPBELL N°2 WELL

By D.J. TAYLOR

Port Campbell N°2

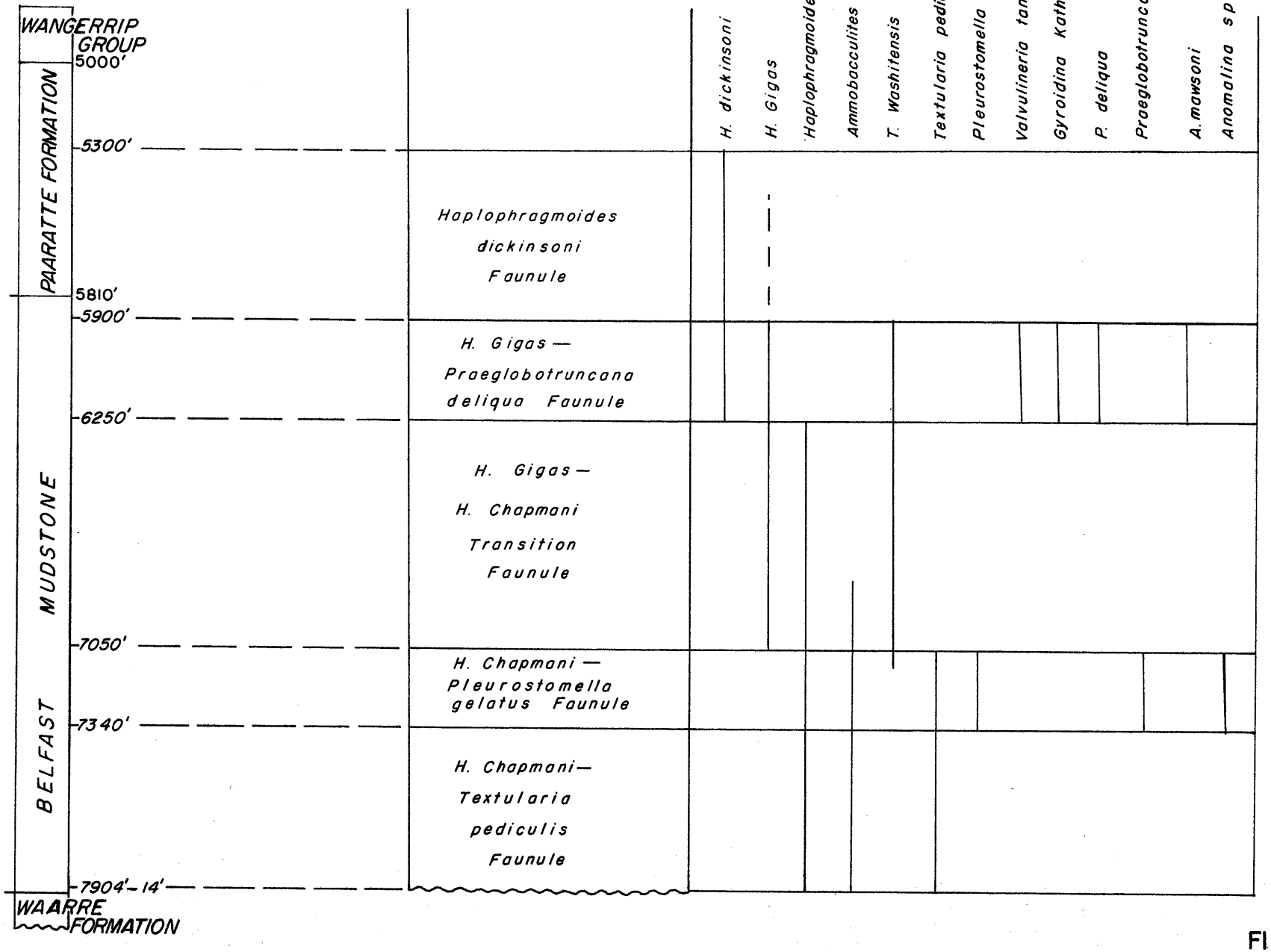
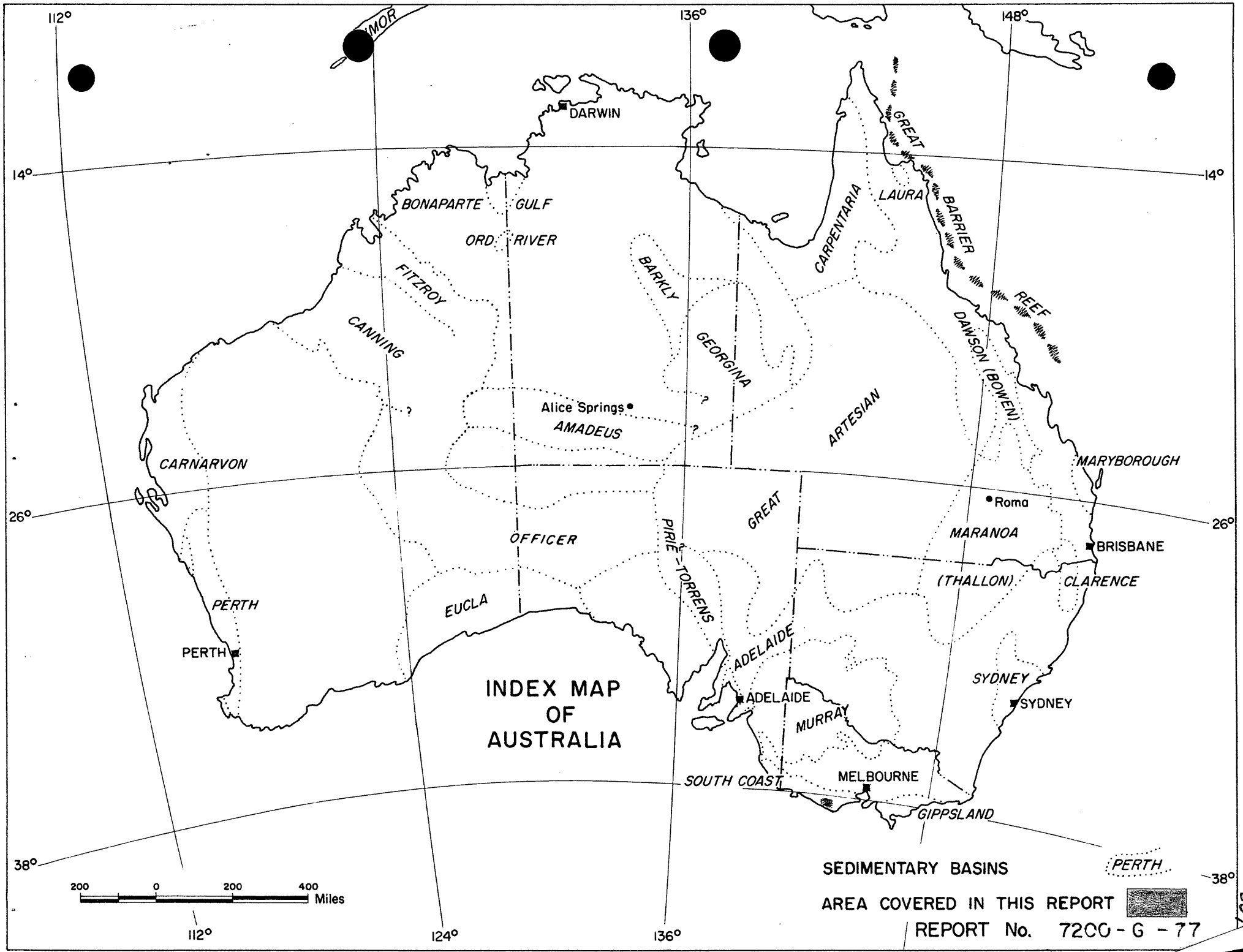


FIG. 1

March 1961

SCALE: 1 INCH = 500 FEET

7200-C


112°
136°
148°
14°
26°
38°
TIMOR
DARWIN
BONAPARTE GULF
ORD RIVER
FITZROY
CANNING
BARKLY
GEORGINA
CARPENTARIA
LAURA
GREAT BARRIER REEF
DAWSON (BOWEN)
Alice Springs
AMADEUS
ARTESIAN
CARNARVON
MARYBOROUGH
Roma
GREAT
MARANOA
BRISBANE
(THALLON)
CLARENCE
OFFICER
PIRIE-TORRENS
PERTH
EUCLA
PERTH
ADELAIDE
ADELAIDE
SYDNEY
SYDNEY
MURRAY
SOUTH COAST
MELBOURNE
GIPPSLAND
PERTH
200 0 200 400 Miles
112°
124°
136°
INDEX MAP OF AUSTRALIA
SEDIMENTARY BASINS
AREA COVERED IN THIS REPORT
REPORT No. 7200-G-77

Petroleum Technology Laboratory, Bureau of Mineral Resources, Geology and Geophysics, Canberra.

Date: 1st MARCH 1965

CORE ANALYSIS RESULTS

Notes:- (i) Unless otherwise stated, the porosities and permeabilities were determined on two small plugs (V & H) cut at right angles from the core or sample. Ruska porosimeter and permeameter were used, with air at 30 p.s.i.g. and dry nitrogen, respectively, as the saturating and flowing media. (ii) Residual oil and water saturations were determined using Sozhlet type apparatus. (iii) Acetone test precipitates and fluorescence of solvent after extraction are recorded as, nil, trace, fair, strong or very strong.

Well or Area	Core or Sample No.	Depth in ft. From:- To:-	Lithology	Effective Porosity in % by Vol.		Absolute Permeability in Millidarcys		Avg. density in gms./cc.		Fluid Saturation in % Pore Space		Acetone Test		Solvent after Extraction		Remarks
				V	H	V	H	Dry Bulk	Apparent Grain	Water	Oil	Colour	Precipitate	Colour	Fluor.	
Port Campbell No. 2	12	7099' 7101'	SHALE	1		N.D.		3.39*	3.42*	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	* Rechecked. Small pieces only.
"	13	7689' 7691'	SANDSTONE	14	14	5	4	2.54	2.94	21	Nil	Trace	Nil	Nil	Nil	
"	14	8315' 8317'	SANDSTONE	10	10	49	80	2.37	2.63	Nil	Trace only	Trace	Strong	Trace	Fair	Fluorescence of core:- Some yellow specks.
"	15	8409' 8411'	SHALE WITH COALY MATERIAL	8	3	Nil	Nil	2.43	2.57	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
"	16	8560' 8562'	SHALE	15		N.D.		2.48	2.92	"	"	"	"	"	"	Small broken pieces only.
"	17	8611' 8613'	SANDSTONE, SILTSTONE CARB. BANDS	ND	8	N.D.	1	2.55	2.78	15	Trace only	Pale Yellow	Fair	Trace	Trace	
"	18	8840' 8842'	SILTSTONE	23	21	1	3	2.36	3.02	49	Nil	Nil	Nil	Nil	Nil	

Additional Information:

General File No. 62/399
Well File No. 62/1064

73/22

Petroleum Technology Laboratory, Bureau of Mineral Resources, Geology and Geophysics, Canberra.

Date: 1st MARCH 1965

CORE ANALYSIS RESULTS

Notes:- (i) Unless otherwise stated, the porosities and permeabilities were determined on two small plugs (V & H) cut at right angles from the core or sample. Ruska porosimeter and permeameter were used, with air at 30 p.s.i.g. and dry nitrogen, respectively, as the saturating and flowing media. (ii) Residual oil and water saturations were determined using Sozhlet type apparatus. (iii) Acetone test precipitates and fluorescence of solvent after extraction are recorded as, nil, trace, fair, strong or very strong.

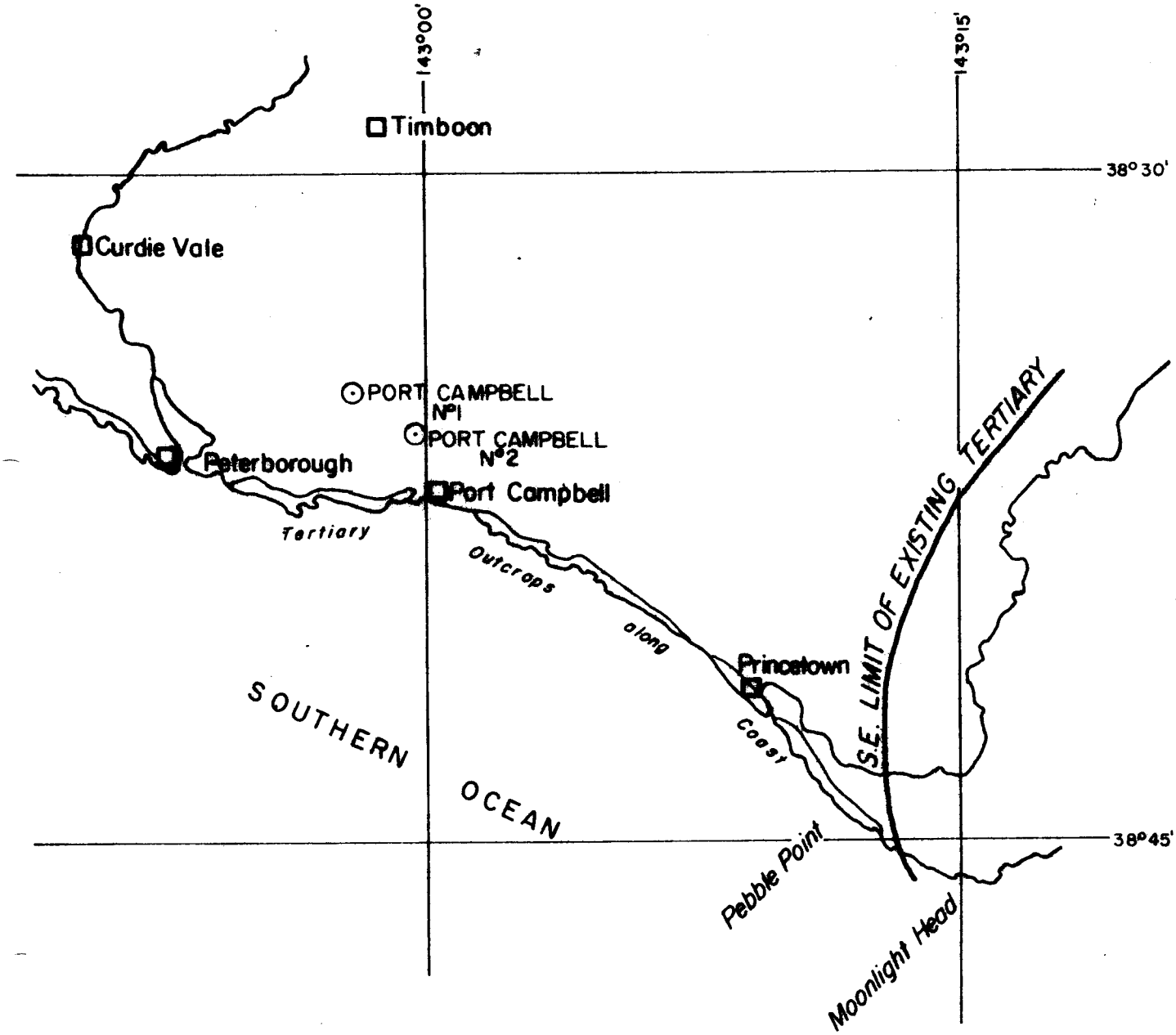
Well or Area	Core or Sample No.	Depth in ft. From:- To:-	Lithology	Effective Porosity in % by Vol.		Absolute Permeability in Millidarcys		Avg. density in gms./cc.		Fluid Saturation in % Pore Space		Acetone Test		Solvent after Extraction		Remarks
				V	H	V	H	Dry Bulk	Apparent Grain	Water	Oil	Colour	Precipitate	Colour	Fluor.	
Port Campbell No. 2	CORES NOS. 1 to 4. NO SAMPLES.			WELL NOT SUBSIDISED ABOVE 7,500 FEET.												
"	5	7885' 7887'	SILTSTONE	18	19	Nil	Nil	2.60	3.19	23	Nil	Nil	Nil	Nil	Trace	
"	6	7910' 7913'	SANDSTONE	20	20	"	"	2.52	3.13	15	"	"	"	"	"	
"	7	7919' 7921'	SANDSTONE & SILTSTONE	17	16	"	"	2.58	3.09	16	"	"	"	"	"	
"	8	8096' 8098'	SILTSTONE & CONGLOMERATE	7	6	4*	Nil	2.53	2.71	38	Trace only	Yellow	Trace	"	"	* Fractures obvious
"	9	8178' 8180'	SANDSTONE	9	8	1	11	2.44	2.67	12	Trace only	Yellow	Fair	"	"	
"	10	8306' 8309'	SANDSTONE	11	9	79	80	2.37	2.64	Nil	Nil	Nil	Nil	"	Nil	
"	11	8343' 8346'	SANDSTONE WITH COALY MATERIAL	7	6	9	12	2.47	2.64	9	5*	Yellow	Very strong	Deep Orange Brown	Very strong	* Believed to be derived from coaly material.

Additional Information: Core No. 11:- Oil extract immobile, dark brownish-black. Fluorescence very dark yellowish-brown. Rare orange specks under U.V. light in freshly broken core.

General File No. 62/399
Well File No. 62/1064

72/13

LOCALITY MAP



FROME BROKEN HILL CO. PTY. LTD.

WELL COMPLETION REPORT

PORT CAMPBELL N° 2

By R.L. WOOD and J.S. BAIN

7200-G-77

PLATE I

March 1961

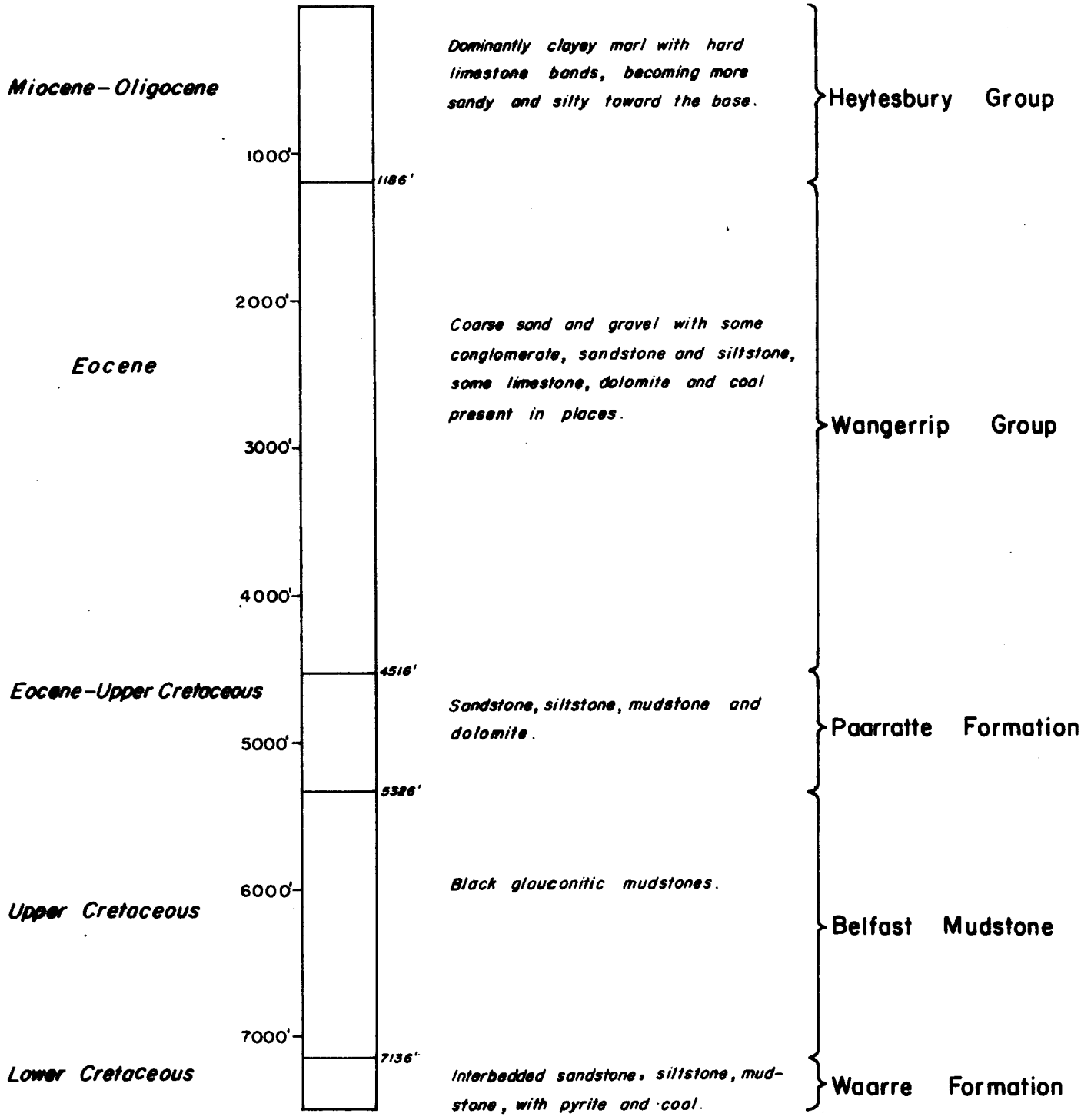
68/73

FROME BROKEN HILL CO. PTY. LTD.

PORT CAMPBELL N°2

STRATIGRAPHIC COLUMN PRIOR TO DRILLING

SCALE: 1 INCH = 1000 FEET



This was expected section from information based on seismic work.

By R.L.WOOD and J.S.BAIN

March 1961

7200-G-77
PLATE 2.

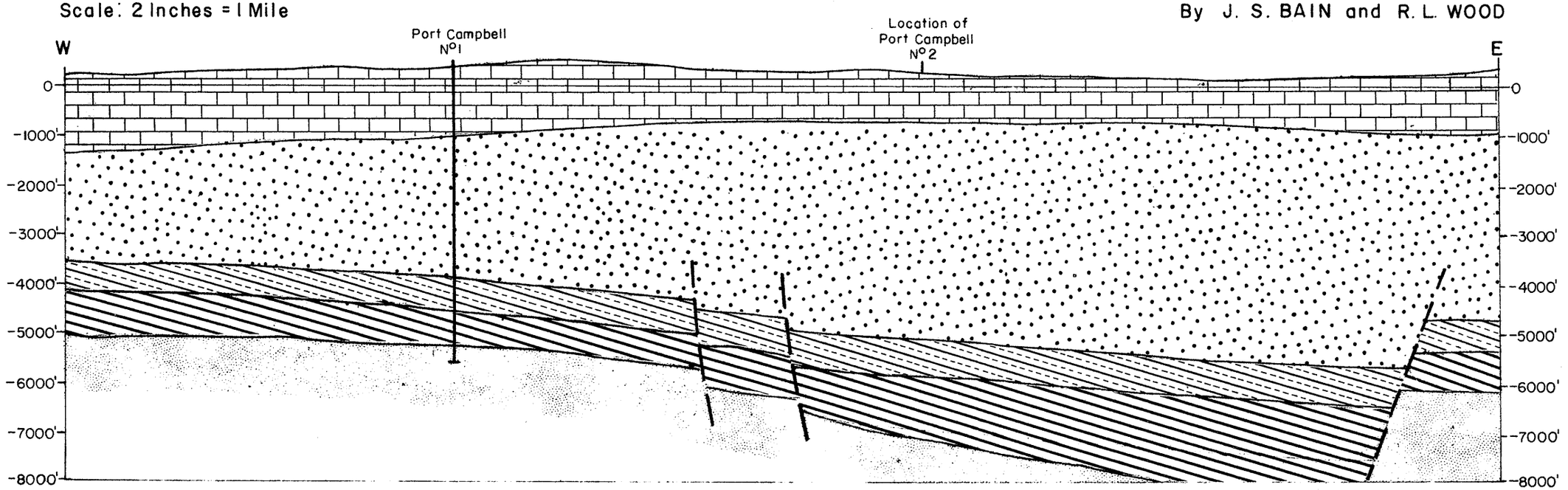
FROME BROKEN HILL CO. PTY. LTD.

PORT CAMPBELL STRUCTURE

GEOLOGICAL CROSS SECTION, PRIOR TO DRILLING, THROUGH SITE OF PORT CAMPBELL N° 2

Scale: 2 Inches = 1 Mile

By J. S. BAIN and R. L. WOOD



LEGEND

Miocene – Oligocene		Heytesbury Group	*Upper Cretaceous*		Belfast Mudstone
Eocene		Wangerrip Group	*Lower Cretaceous*		Waarre Formation
Eocene — Upper Cretaceous		Paaratte Formation			

This was expected section from information based on seismic work.

PLATE 3

7200-G-77

691/63

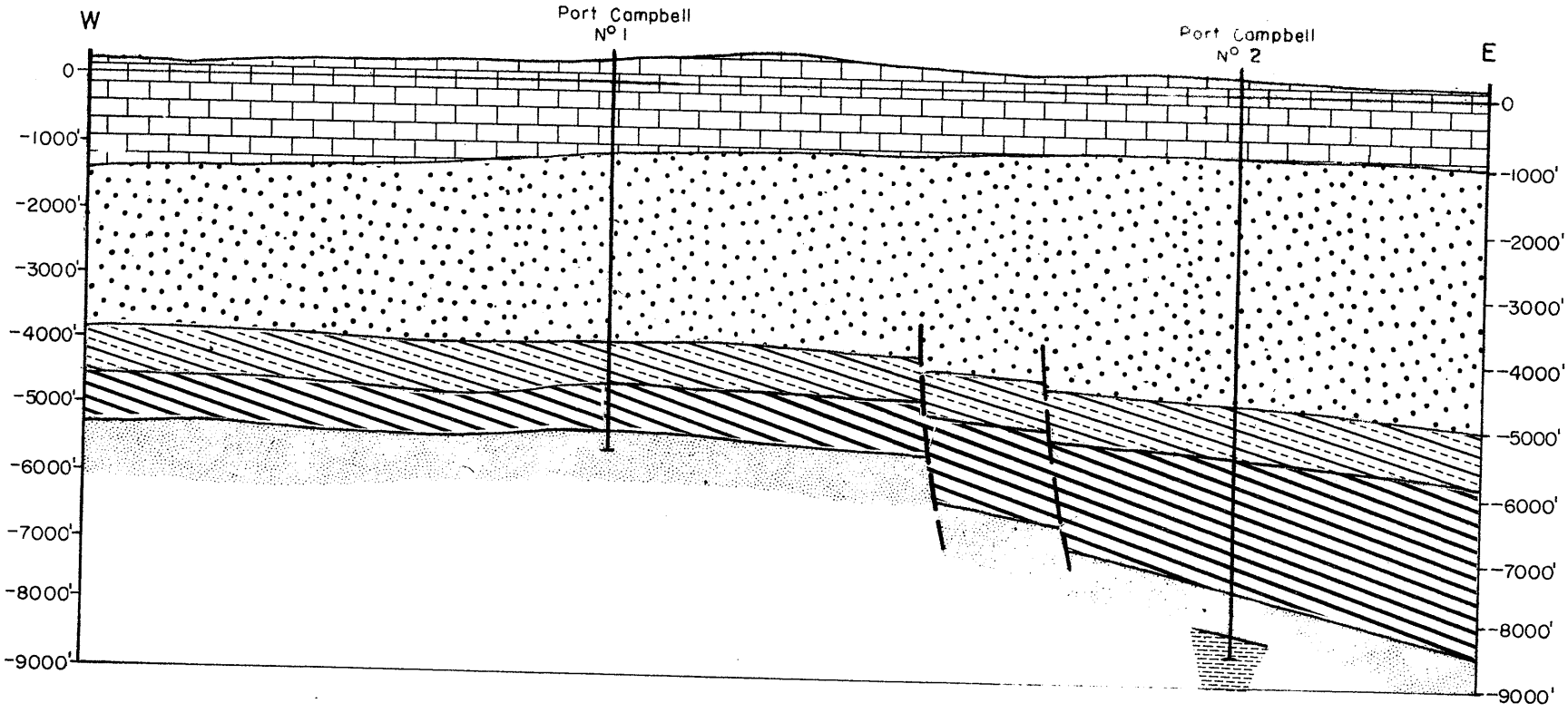
FROME BROKEN HILL CO PTY LTD

PORT CAMPBELL STRUCTURE

GEOLOGICAL CROSS SECTION THROUGH PORT CAMPBELL N°1 – N°2 WELLS

Scale 2 Inches = 1 Mile

By J S BAIN and R. L. WOOD



LEGEND

Miocene – Oligocene	Heytesbury Group	*Upper Cretaceous*	Belfast Mudstone
Eocene	Wangerrip Group	*Lower Cretaceous*	Waarre Formation
Eocene — Upper Cretaceous	Paaratte Formation	*Lower Cretaceous ? Jurassic*	Otway Group

PLATE 4
7200–G–77

76/73

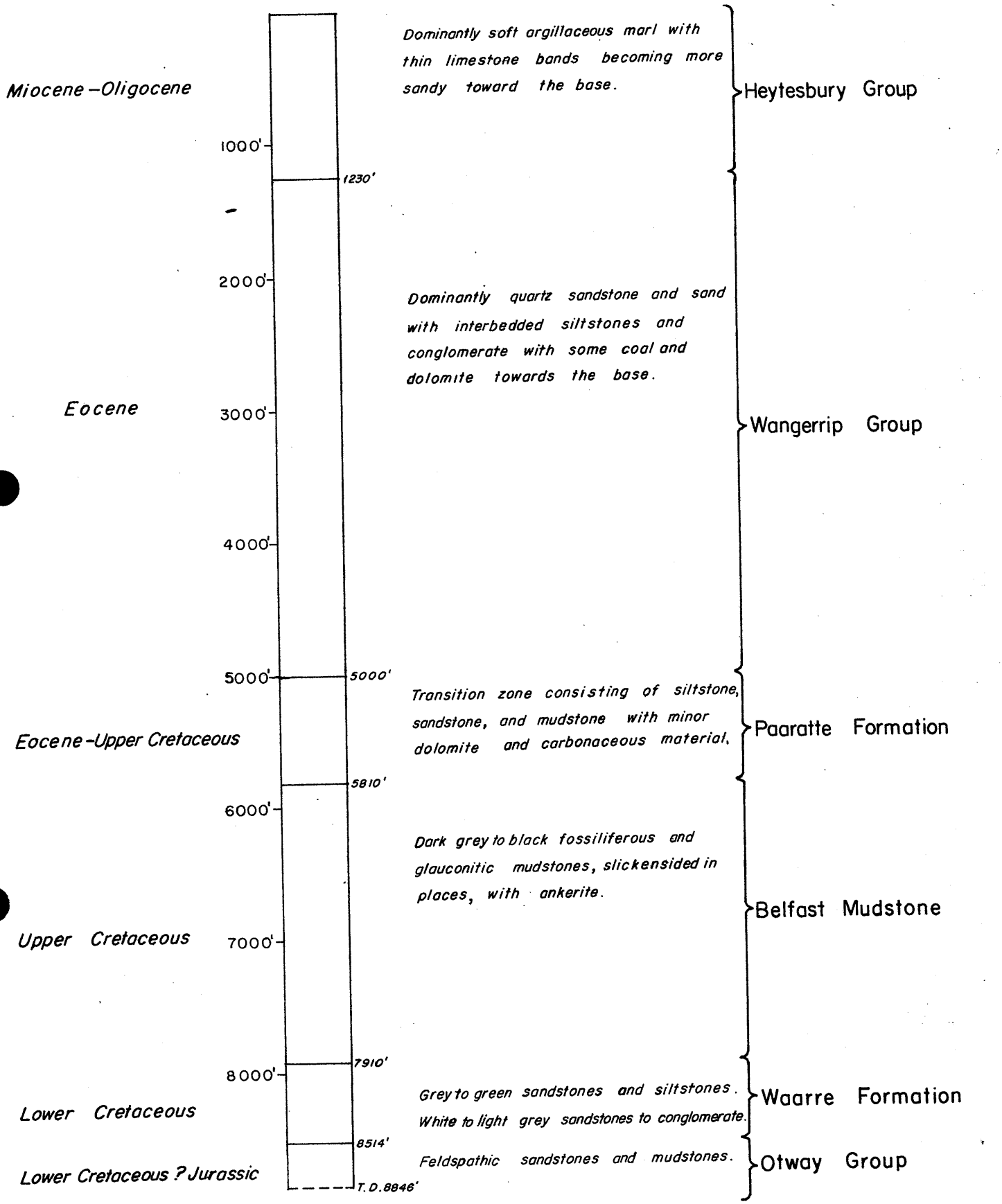
71/23

PORT CAMPBELL N°2

STRATIGRAPHIC COLUMN AFTER DRILLING

SCALE : 1 INCH = 1000 FEET.

By R.L. WOOD and J.S. BAIN.



FROME BROKEN HILL CO. PTY. LTD. March 1961 7200-G-77 PLATE 5.

PE604797

This is an enclosure indicator page.
The enclosure PE604797 is enclosed within the container PE907148 at this location in this document.

The enclosure PE604797 has the following characteristics:

ITEM_BARCODE	= PE604797
CONTAINER_BARCODE	= PE907148
NAME	= Composite Well Log
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= COMPOSITE_LOG
DESCRIPTION	= Composite Well Log, (Enclosure from WCR), 1" = 100', Frome-Broken Hill Co. Pty. Ltd., January 1961, for Port Campbell-2
REMARKS	=
DATE_CREATED	= 12/01/61
DATE_RECEIVED	=
W_NO	= W463
WELL_NAME	= PORT CAMPBELL-2
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY PTY LTD

(Inserted by DNRE - Vic Govt Mines Dept)