Natural Resources and Environment

AGRICULTURE • RESOURCES • CONSERVATION • LAND MANAGEMENT

WCR EUMERALLA-1 (W472)

ONSHORE OTWAY BASIN

1 Folio No	2 Referred to	3 Date	4 Clearing Officer's Initials	1 Folio No.	2 Referred to	3 Date	4 Clearing Officer's Initials
	PEP/5						
	10,308'						
	BY				J.S.BAIN		

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(1) FOLIO NUMBERS: Each subject paper attached to a file is to be given a consecutive number by the attaching officer. Papers must not be removed from or attached to a file without approval.

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LOCATION

FROME-BROKEN HILL COMPANY PTY. LTD.

Pag 1960.

INCLUDING ENCLOSURES 1 TO 5.
+ Well Composite Log.

Report No. 7200-W-21

WELL COMPLETION REPORT

EUMERALLA NO. 1, SOUTHWEST VICTORIA

by

J. S. Bain

SEE : "LITHOFACIES DATA SHEET (B)" PREPARED BY CUNDILL MEYERS & ASSOC. FOR SHELL DEV. AUST. PTY. LTD. 1967.

Melbourne

February, 1963

CONTENTS

ILLUSTRATIONS

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I SUMMARY

Eumeralla No. 1 well was drilled to a total depth of 10,308 feet within the southwestern part of the Otway Basin.

The well penetrated the Tertiary succession, and showed that the Merino Group section, south of the regional east-west normal fault downthrown to the south, is very much thicker than at Pretty Hill on the upside of this fault. No typical basal sandstone, as seen in Pretty Hill No. 1, was present in Eumeralla, but the section from 9100 to 10,308 feet T.D. is tentatively correlated, on a lithological basis, as a facies change equivalent to this basal sandstone unit. It is apparent that the regional fault was very active during Merino Group deposition, and that sedimentation on the south side of this fault may have been continuous from the lowest sediments cut at 10,308 feet up to the top of the Merino Group.

The Flaxman's Beds, as seen in Pretty Hill No. 1, are not present in Eumeralla and the reason for this is not yet apparent.

It appears that the Waarre Formation, as known in the Port Campbell area, is not developed in most of the Tyrendarra-Port Fairy area.

Some of the Merino Group section drilled evidenced slight shows but, due to the very low porosity and permeability throughout this section, no hydrocarbons were obtained on testing. It is probable that most of the gas shows recorded are due to the presence of methane derived from the carbonaceous intervals which occur throughout the section.

II INTRODUCTION

Eumeralla No. 1 was drilled by Frome-Broken Hill Company Pty. Ltd. to further evaluate the petroleum possibilities of the Otway Basin.

The well was located by seismic methods to the south of a regional east-west normal fault downthrown to the south. The immediate area has regional south dip with good east-west relief and the shallow horizons evidenced north dip into this major fault. This north dip decreased with depth, and in the deeper horizons dips were to the south, and north closure was dependent on the fault.

The Commonwealth Government agreed to subsidise the well, on a footage basis, to total depth.

III WELL HISTORY

1. General

(a) Well Name and Number:

Eumeralla No. 1

(b) Location:

Parish of Bessiebelle, County of Normanby, Shire of Minhamite.
Reference on 1 mile military map of Heywood: 895885.
Latitude: 38° 12' 43" S; Longitude: 141° 56' 01" E.

(c) Name and Address of Tenement Holder:

Frome-Broken Hill Co. Pty. Ltd.,
95 Collins Street,
Melbourne, C.1.

(d) Details of Petroleum Tenement:

Petroleum Exploration Permit No. 5 issued by the State of Victoria.

(e) District:

Southwest Victoria

(f) Total Depth:

10,308 feet

(g) Date Drilling Commenced:

November 7, 1962

(h) Date Drilling Completed:

January 5, 1963

(i) Date Well Abandoned:

January 7, 1963

(j) Date Rig Released:

January 8, 1963

(k) Drilling Time in Days to Total Depth:

60 days

(l) Elevation:

Ground Level	154 feet
Derrick Floor	166 feet
Rotary Table	167 feet (Datum)
Kelly Bushing	168 feet

(m) Status:

Well abandoned. Set 50 sack cement plugs between 3000 and 2931 feet, and between 1034 and 965 feet, and 10 sack plug at surface.

2. Drilling Data

(a) Name and Address of Drilling Contractor:

Drilling Contractors (Australia) Pty. Ltd.,
383 George Street,
SYDNEY, N.S.W.

(b) Drilling Plant:

Make:	National
Type:	Ideal 80-B
Rated Capacity with 4½" drill pipe:	12,000 feet

Motors:

Make:	Waukesha
Type:	Model LRDBSU
B.H.P.:	526
Number:	3

(c) Mast/Derrick:

Make:	Lee C. Moore
Type:	136 feet
Rated Capacity:	700,000 lbs.

(d) Pumps:

Make:	Emsco	National
Type:	D850	G700
Size:	8¼" x 18"	8" x 14"

(e) Blowout Preventor Equipment:

	(1)	(2)	(3)
Make:	Cameron	Hydril	Hydril
Type:	SS	GK	Accumulator
Size:	12"	12" flanged	
Series:	900	900	

(f) Hole Sizes and Depths:

(1) 20" conductor set at 28 feet by hand.

(2) (i) Drilled 17½" hole to 1000 feet.
(ii) Set 13⅜" casing at 987 feet.

(3) (i) Drilled 12¼" hole to 4285 feet
(ii) Drilled 8⅝" hole from 4285 to 10,308 feet T.D.

(g) Casing Details:

Size:	$13\frac{3}{8}$"
Weight:	48 lb/ft.
Grade:	H.40
Range:	2
Setting Depth:	987 feet

(h) Casing Cementing Details:

Size:	$13\frac{3}{8}$"
Setting Depth:	987 feet
Quantity Cement Used:	668 sacks
Cemented to:	Surface
Method Used:	Single stage cementing with plugs, by Halliburton cementing truck.

(i) Drilling Fluid:

A freshwater native mud was used to drill the hole to the depth of setting the $13\frac{3}{8}$" casing. This mud was dumped on drilling out cement and a freshwater-bentonite system was used to a depth of 4285 feet when this mud was converted to a low pH Spersene system. This mud was then used to total depth.

A de-sander was used to great advantage after conversion to the Spersene system, sand content dropping from about 10% to 1% and less throughout the remainder of the hole.

Properties of the Spersene system to approximately 8400 feet were as follows:

Weight:	9.8 to 10.6 lb/gal.
Viscosity:	37 to 60 secs.
Water Loss:	8 to 10 cc
Filter Cake:	2/32" to 3/32"
pH:	8 to 10
Sand Content:	$\frac{1}{2}$% to 10%

Below 8400 feet the section was noted to be washing out to a greater extent than higher in the hole, and mud weight was allowed to increase to 11 lb/gal. in an attempt to reduce this washing out. With the increased mud weight (due to high solids content), it was difficult to lower the water loss below 8 cc.

Properties of the system from approximately 8,400 to 10,308 feet total depth were as follows:

Weight:	10.5 to 11.2 lb/gal.
Viscosity:	41 to 67 secs.
Water Loss:	8.2 to 9.8 cc
Filter Cake:	2/32" to 3/32"
pH:	8.5 to 10
Sand Content:	1% approximately

(j) Water Supply

A water well was drilled to 92 feet and a 2-stage Model 6K1LA K.L. Berkeley vertical turbine pump installed. Salinity of this water was 400 ppm. chlorides, and capacity of the well was estimated at approximately 4,800 gallons per hour.

(k) Perforation and Shooting Record:

No perforating was carried out.

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

(a) Spotted 50 sack plug from 3000 to 2931 feet.
(b) Spotted 50 sack plug from 1034 to 965 feet.
(c) Spotted 10 sack plug at surface.

(m) Fishing Operations:

At T.D. of 9583 feet lost cone in the hole. Ran magnet in attempt to recover cone without success. Drilled up cone and drilled ahead.

(n) Side-tracked Hole:

None.

3. Logging and Testing:

(a) Ditch Cuttings:

Cuttings were taken over a normal shale shaker. Interval sampled was every 10 feet to 5940 feet, thence every 5 feet to total depth, with bottom hole samples circulated at various depths.

(b) Coring: (See Appendix 4 for Core Description)

Original coring program outlined cores to be taken on the occurrence of hydrocarbon shows, indications of prospective reservoirs, at formation changes and drilling breaks, and at fossiliferous marker beds. In addition, Commonwealth Government subsidy agreement stipulated routine cores to be taken at 300 foot intervals, these intervals being extended to 500 feet for drilling within a section of uniform lithology.

Twentyfive cores were cut for a total footage of 312 feet. Recovery was 232 feet, or 74%.

All cores were cut by a Reed Korking barrel with soft and hard formation coreheads. Core diameters were $3\frac{1}{2}$".

(c) Sidewall Sampling: (See Appendix No. 4)

Sidewall sampling was carried out using Schlumberger C.S.T. equipment. Sixty cores were attempted with recovery obtained in forty. Recovery varied from $\frac{1}{2}$ inch up to 2 inches and diameter of cores was approximately 1 inch. Soft formation heads were found satisfactory in the top part of the hole but were inferior to the hard formation heads in the deeper parts of the hole.

(d) Electrical and Other Logging:

Logging was carried out by Schlumberger Seaco Inc., the engineer being M. G. Guigues. Logs were run as follows:

Electrical Log	Microlog	Sonic Log
110 to 1181 feet	1000 to 4800 feet	1000 to 4690 feet
1000 to 4800 "	4600 to 7410 "	4490 to 7404 "
4600 to 7410 "	7230 to 9586 "	7200 to 9582 "
7200 to 9586 "	9500 to 10,307 "	7170 to 10,303 "
7200 to 10,307 "		

Continuous Dipmeter

2400 to 4285 feet

Scales of all the logs run except the Continuous Dipmeter were 1" = 100 feet and 5" = 100 feet. The Continuous Dipmeter run was recorded at scales 1" = 100 feet and 1" = 2 feet.

(e) Drilling Time and Gas Log:

A Geolograph continuous time-depth recorder was used during the drilling of Eumeralla No. 1 which recorded the time taken for each foot penetrated. A drilling time log was drawn up from the Geolograph records and is included in the Composite Log.

An Atlas continuous gas detector monitored the mud throughout the drilling and the gas log obtained from this instrument is included in the Composite Graphic Well Log.

(f) Formation Testing:

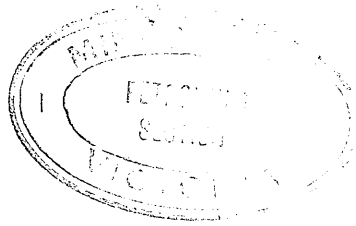
Testing was carried out by Halliburton Ltd. All the tests were carried out in $8\frac{5}{8}$" open hole using a Halliburton No. 2 wall packer assembly with $7\frac{3}{4}$" rubbers and regular 5" Hydrospring Tester.

D.S.T. No. 1 5822 to 6034 feet
Bottom choke $\frac{5}{8}$". Set packer at 5822 feet. Tool open for 32 minutes. Fair blow throughout flow period. No shut-in pressures taken. Recovered 390 feet of mud and 90 feet of muddy water. Salinity of water 11,300 ppm. Cl.

I.H.P.	3220 psi	F.H.P.	3220 psi
I.F.P.	300 "	F.F.P.	380 "
No S.I.P's			

D.S.T. No. 2 6226 to 6257 feet
Bottom choke $\frac{5}{8}$". Packer set at 6226 feet. Tool open for 30 minutes. Slight blow decreasing throughout flow period. Recovered 180 feet of mud and 90 feet of slightly water-cut mud. Salinity 9,100 ppm. Cl.

I.H.P.	3340 psi	F.H.P.	3340 psi
I.F.P.	50 "	F.F.P.	110 "
No S.I.P's			



D.S.T. No. 3 8653 to 8718 feet
Packer failed to hold.

D.S.T. No. 4 8624 to 8718 feet
Packer failed to hold.

(g) Deviation Surveys:

Deviation surveys were carried out with the Totco instrument and in conjunction with the Schlumberger Continuous Dipmeter run. In general, under 1° deviation was maintained to 4800 feet; between 1° and 2° to 6250 feet; back to less than 1° by 7700 feet and then between 3° and $4\frac{3}{4}$° to total depth.

4800' 1°
6250' 1½°
7700' 1°
10307' 4°

(h) Other Well Surveys:

A well geophone velocity survey was run in conjunction with Namco International to total depth in the well.

Check shots were taken at some of the formation breaks and also at 500 and 100 foot intervals as selected from data obtained from the Sonic Log.

IV GEOLOGY

1. Summary of Previous Work

(a) Geological:

The surface of the Otway Basin has extensive basalt and clastic cover and, in the Tyrendarra area, nothing of subsurface value can be learned from outcrops. However, detailed photogeological and geomorphic studies of the area, with field checks, have shown some surface anomalies in both drainage and linear features. Some of these anomalies are attributable to the influence of intrusive rocks, while others are believed to be related to folding and/or faulting of the sedimentary section.

(b) Geophysical

The Eumeralla No. 1 location was selected from the results of a seismic survey carried out by Ray Geophysics (Aust.) Pty. Ltd.

The structure is dominated by a roughly east-west major normal fault with downthrow to the south. Pretty Hill No. 1 was drilled just north of this fault while Eumeralla was drilled on the southern downthrown side. Good south dip with east-west closure was evident in all horizons, and north closure in the shallow horizons, and the mapped target horizon, before drilling, appeared to be independent of closure against this fault. The structure mapped on the deep reflector, which proved to be basement in the Pretty Hill well, depended on the fault for its north closure.

(c) Drilling

Three water wells have been drilled in the general area by the Victorian Mines Department. The first, Belfast No. 4 in the neighbourhood of Port Fairy, 19 miles southeast of Eumeralla No. 1, reached a total depth of 5522 feet and penetrated 1650 feet of Glenelg Group, 1925 feet of Knight Group, 975 feet of Paaratte Formation, 435 feet of Belfast Mudstone and 537 feet of Merino Group in which it bottomed. The second well, Yangery No. 1, in the vicinity of Koroit, approximately 20 miles to the east of Eumeralla No. 1, penetrated 1786 feet of Glenelg Group, 764 feet of Knight Group, 395 feet of Paaratte Formation and 385 feet of Merino Group to a total depth of 4330 feet.

The third well was Heywood No. 10, 18 miles to the west-northwest of Eumeralla No. 1, drilled to a total depth of 5390 feet. This well penetrated 1521 feet of Paaratte Formation and 108 feet of Belfast Mudstone.

Previous to Eumeralla No. 1, this Company had drilled Pretty Hill No. 1, 10½ miles to the east, to a total depth of 8129 feet. This well penetrated 1243 feet of Glenelg Group, 1114 feet of Knight Group, 228 feet of Paaratte Formation, 172 feet of Belfast Mudstone, 152 feet of Flaxmans Beds, 3042 feet of Merino Group, 1910 feet of a new basal sandstone section, and bottomed in igneous rocks of the Cambrian basement complex.

2. Summary of the Regional Geology

The Otway Basin, which extends across southwest Victoria and southeastern South Australia, contains Mesozoic and Tertiary sediments. To the north Palaeozoic rocks ranging from Cambrian to Permian age and comprising conglomerates, sandstones, shales, mudstones, glacial deposits, volcanic rocks, igneous and metamorphic rocks crop out. Pretty Hill No. 1 bottomed in igneous rock thought to be equivalent of the outcropping Cambrian basement complex. In the western part of the basin, in South Australia, some granites are present along the margin. The eastern limit of the basin is not well defined but includes the Mesozoic rocks of the Otway Ranges. Mesozoic rocks crop out around Casterton and Merino in the northwestern part of the basin, but many of the recognised sub-surface units are not known in outcrop.

The basin is largely covered by Tertiary sediments and lava flows and Quaternary deposits which overlap large areas of the older sediments.

The area, as a whole, contained non-marine and marine ?Jurassic to Upper Tertiary strata having an aggregate thickness in excess of 12,000 feet. As far as is known, the lower part of the succession was laid down under predominantly freshwater conditions. Upward through the Mesozoic succession, conditions changed from a shallow water, brackish environment through a definite marine phase and then back to shallow water, brackish conditions. In the wells drilled to date these latter conditions graded vertically upwards into predominantly paralic conditions during the Lower Tertiary which are transitional to the open marine conditions of the Middle Tertiary.

The major structural features within the basin are closely related to normal faulting rather than primary compressional forces. The faulting appears to have been active during sedimentation, resulting in radical thickness changes, and the development of local unconformities. This contemporaneous faulting dies out in the uppermost Cretaceous after which stable conditions existed until uplift began in the late Tertiary. This latter uplift resulted in some post-depositional normal faulting in restricted areas and was responsible for the formation of some very shallow broad folds in the younger Tertiary strata. It appears that rapid lateral facies occur complicating the geological picture.

3. Stratigraphic Table - Eumeralla No. 1

Unit	Age	Subsurface Top (Feet)	Thickness (Feet)
Glenelg Group (≡ Heytesbury Group)	Oligocene	-	1255
Knight Group (≡ Wangerrip Group)	Eocene-Upper Cretaceous	1268(-1101)	1472
Paaratte Formation	Upper Cretaceous	2740(-2573)	220
Belfast Mudstone	Upper Cretaceous	2960(-2793)	148
Merino Group	Lower Cretaceous-?Jurassic	3108(-2941)	7200 +

Note: Figures in brackets refer to depth below sea level of the various horizons.
The section below 9100 feet contains sandstones lithologically similar to the basal sandstone in Pretty Hill No. 1 and may be equivalent to that unit.

4. Stratigraphy

General descriptions of the lithology cut in Eumeralla No. 1 are as follows:

Surface to 1268 feet — Glenelg Group ≡ Heytesbury Group

Portland Limestone ≡

Surface to 550 feet. Limestone, light grey, porous, fossiliferous, freshwater bearing.

Heywood Marl ≡

550 to 1107 feet. Marl, light to medium grey puggy, soft, fossiliferous with limestone bands at base.

Nelson Formation ≡

1107 to 1268 feet. Sandy siltstone to silty marl, brown, fossiliferous, very calcareous and limonitic.

1268 to 2740 feet — Knight Group ≡ Wangerrip Group

Sandstone and siltstone. Dominantly medium to coarse grained, clear and iron stained quartz sandstones interbedded with medium dark grey and brown micaceous siltstones. Pyrite, coal and limonite present with dolomitic bands towards base. Sparsely fossiliferous.

2740 to 2960 feet — Paaratte Formation

Siltstone and sandstone. Interbedded dark grey to brown grey, sandy siltstones, glauconitic in parts, and fine to medium grained porous quartz sandstones, dolomitic in parts and sparsely fossiliferous.

2960 to 3108 feet — Belfast Mudstone

Siltstone. Medium to dark grey sandy siltstones, very fossiliferous, very glauconitic towards base.

3108 to 10,308 feet — Merino Group ≡ Otway Group

Sandstones, siltstones and mudstones. Interbedded light greenish grey to medium grey and brown-grey, micaceous, very fine to medium grained, felspathic, tight, calcareous in parts with medium to dark grey, dense, carbonaceous siltstones and mudstones.

Below 9100 feet the sandstones become cleaner with a high percentage of quartz and distinctive garnets.

The section cut to 1107 feet, consisting of limestones to 550 feet and grey marls below, is typical of the upper parts of the Glenelg Group (≡ Heytesbury Group) throughout the basin. From 1107 to 1268 feet the lithology was one of brown limonitic calcareous, fossiliferous, compacted sandy siltstone and silty marl, which was not encountered in the Pretty Hill well. On fossil evidence this section is equivalent to the Nelson Formation noted in other wells to the west. In type section (Nelson Bore) this unit is glauconitic but in Dumeralla this is not the case, although the limonite may be altered glauconite.

Below 1268 feet the typical loose, coarse quartz sandstones with interbedded medium dark grey siltstones of the Knight Group were cut to a depth of 2740 feet. Dolomitic bands were present towards the base and carbonaceous matter was evident in the sections. Fossils were sparse and as only one core was taken in this interval no attempt was made to divide this group into the Dartmoor and Bahgallah Formations and certainly no apparent lithological breaks occurred throughout the Knight Group.

The Paaratte Formation, which was drilled from 2740 to 2960 feet, appeared to be more sandy in this well than the equivalent in Pretty Hill No. 1. Fossils were sparse and the section was alternatively sandy siltstone and silty sandstone with bands of dolomite and abundant glauconite in

parts. This sequence graded into the Belfast Mudstone which also was more sandy than its equivalent in Pretty Hill No. 1. The Belfast Mudstone was present from 2960 to 3108 feet and consisted of medium to dark grey, very fossiliferous and glauconitic sandy siltstones.

There was no evidence of the Flaxmans beds in this well, typical Merino Group sediments being cut directly below the Belfast Mudstone. The Merino Group consisted of interbedded greenish grey and bluish grey, light and dark grey sandstones, siltstones and mudstones. In general the sandstones near the top of the succession have some porosity although permeability appears to be low. Composition of these rocks is quartz, feldspar, dark rock fragments, mica and chlorite; they are generally medium grained, finer and poorly sorted.

Below 6300 feet in Eumeralla No. 1 the section becomes a monotonous sequence of siltstone-mudstone facies, with minor development of sandstone beds as is evident on the S.P. log. It is considered that the equivalent of this section which persisted to a depth of approximately 9100 feet, was not encountered in Pretty Hill No. 1. Below 9100 feet cleaner, light grey sandstones with some porosity and permeability were present, interbedded with the tight, dense siltstone and mudstone section. These sandstones, although generally only fine grained, appeared to be lithologically similar to the lower parts of the basal sandstone unit cut in Pretty Hill No. 1. It is assumed that the section from 9100 feet to 10,308 feet is probably a facies equivalent of the basal sandstone noted in Pretty Hill. This assumption is illustrated diagrammatically in Plate 5.

5. Structure

As mentioned under 'Geophysical', the structure in the shallow horizons and the mapped target horizon at approximately 6000 feet had north closure independent of faulting. The mapped deep reflector, however, depended on the fault for north closure. It is possible that this deeper horizon is the top of the section mentioned in 'Stratigraphy' as being a facies change equivalent to the basal sandstone which occurs in Pretty Hill No. 1.

Cross bedding was apparent in most of the Merino Group cores and dip appeared to be of the order of 10° to 15°. The dipmeter survey was run only in the shallow parts of the hole and, while results were not good, it suggested dips down to 4200 feet in the Merino Group to be generally towards the southwest at angles of 10° or less. The vertical cleavage noted in some of the cores appears to be due to relief of stress on reduction of pressure, and whether this is a structural or mechanical condition is not known.

6. Relevance to Occurrence of Petroleum

Eumeralla No. 1 yielded fluorescence and cut in cuttings over quite a few zones, but these zones were generally fairly tight. The low permeability within the Merino Group sediments was confirmed by D.S.T's Nos. 1 and 2 which were made as a result of the occurrence of fluorescence in cuttings.

Gas could be seen emanating from coal fragments in cores and cuttings and the gas readings on the gas detector are probably due to these coal sections. Most of the cores exhibited a good cut on soxhlet extraction, although there were no hydrocarbons evident in the visual examination of the core. There were no other indications of hydrocarbons in Eumeralla No. 1 and log analyses on various sandstones indicates water saturations of 78% to 100%.

7. Porosity and Permeability of Sediments Penetrated

Porosity and permeability were estimated qualitatively at the wellsite from cores and cuttings, and quantitatively from log and core analyses.

Sediments down to the top of the Merino Group had porosities and permeabilities similar to their equivalents in Pretty Hill and the Port Campbell area. Merino Group sandstones down to 6300 feet appeared to be similar to the sands cut in Pretty Hill to a depth of approximately 5900 feet. However, the sandstones in the section from 6300 to 9100 feet in Eumeralla were generally of very low porosity and permeability as is indicated on the composite log. Log analysis on some of the sandstones below 9100 feet showed porosities ranging from 7% to 10%. The sandstones in the section from 9100 feet to T.D. appear to have much lower porosities and permeabilities than the basal sandstone in Pretty Hill No. 1 with which they are correlated. Appendix 4 shows porosities and permeabilities as determined by the Bureau of Mineral Resources.

8. Contribution to Geological Concepts Resulting from Drilling

Eumeralla No. 1 was drilled south of a major normal fault, running roughly northwest-southeast and downthrown to the south. The previous well in the area, Pretty Hill No. 1, was drilled on the north (upthrown) side of this fault. From information gained from the Eumeralla No. 1 well it appears that this fault has played a major part in the depositional history of the area.

The principle differences noted between the two wells are:

(1) There does not appear to be any Nelson sandstone unit developed in the Pretty Hill well.

(2) There are no Flaxmans Beds present in Eumeralla No. 1

(3) No basal sandstone, which was 1910 feet thick in Pretty Hill No. 1, is developed to total depth drilled in Eumeralla No. 1

(4) Allowing for the section below 9100 feet in Eumeralla No. 1 to be a facies equivalent of this basal sandstone in Pretty Hill, there appears to be approximately 3000 feet of additional Merino Group section in Eumeralla No. 1 compared with Pretty Hill No. 1.

It appears that the fault was probably very active during Merino Group deposition, but died out in intensity in the marine Cretaceous, as the Paaratte Formation and Belfast Mudstone in the two wells have similar thicknesses and subsurface tops.

The suggestion that the section below 9100 feet in Eumeralla No. 1 is a facies equivalent of the basal sandstone present in the Pretty Hill No. 1 well, has added support from the fact that the seismic reflector representing the top of this unit at Pretty Hill cannot be traced on the south side of the fault. Unfortunately, fossils are sparse in the Merino Group, and correlation between wells on this basis has not been made.

No obvious unconformities appeared to be evident in Eumeralla No. 1, although the absence of the Flaxmans Beds suggests an hiatus between the Merino Group and Belfast Mudstone.

Melbourne

February, 1963

J. S. BAIN

V REFERENCES

1. Bain, J. S. — Well Completion Report, Pretty Hill No. 1, Southwest Victoria. Frome Report No. 7200-W-20.

2. Dunbar, Carl O. and Rogers, John — PRINCIPLES OF STRATIGRAPHY John Wiley & Sons Inc.

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APPENDIX 1

PETROLOGICAL REPORT

BY

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

FROME-BROKEN HILL CORE SAMPLES

Eumeralla No. 1

Core No. 8 4796 to 4814 feet

This rock is a well-sorted, medium grained sub greywacke. Average grain size is 0.20-0.25 mm, and the grains are subangular to subrounded. Very little matrix material occurs. The main group of grains comprises a variety of rock-types, including sericite-schists, chert, quartz-chlorite rocks, granitoid rocks, trachyte, felsitic rocks and other extrusives, possible volcanic glass, and other types. Quartz fragments are not abundant; feldspar is abundant, as fresh cleavage fragments mainly of twinned plagioclase.

The provenance of the rock fragments and the feldspar was an area of probably intermediate igneous rocks, mainly extrusive, and an area of low-grade metamorphism.

Core No. 16 7225 to 7240 feet

This also is a sub greywacke. It is finer grained than the previous rock, the angular to subangular grains being 0.07-0.12 mm across. The detrital constituents of this rock are similar to those of Core 8, but lithic fragments are less prominent. In addition, a calcitic cement is present, in contrast to Core 8. The rocks shows weak bedding, due to a sub-parallel alignment of the long axes of the grains. This rock is thus finer grained, not as well-sorted, with less abraded grains; and has a calcitic cement.

Core No. 20 8459 to 8465 feet

The coarser portions of this rock are almost identical to Core 8, except for the presence of small amounts of calcitic cement. The rock is thus a sub greywacke. However, it also contains layers of much finer material of silt grade, consisting of quartz-fragments, argillaceous and sericitic components, and abundant carbonaceous matter.

The sequence in this core thus consists of coarser and finer lithic greywackes, in part calcitic, with intercalations of silty layers with conspicuous carbonaceous material. The rocks are typical of torrential deposits quickly buried, with abundant igneous rocks and minerals from fairly near sources.

APPENDIX NO. 2.

PALAEONTOLOGICAL REPORTS

DEPARTMENT OF MINES

VICTORIA.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

CANBERRA.

COMMENTS ON FAUNA IN EUMERALLA NO. 1 WELL

A detailed examination has been made on cores, sidewall cores and cuttings below 900 feet in Frome-Broken Hill's Eumeralla No. 1 well. The faunas obtained from the rotary cutting samples were difficult and often impossible to interpret due to extreme contamination. This contamination occurred because the marl section (above 1000 feet) was not cased off when the lower Tertiary and marine Cretaceous section was being drilled. This contamination could have been reduced if the mud had been successfully treated.

Core No. 1 at 941 to 961 feet contained a fauna assignable to Carter's (1958) Faunal Unit 6. Globoquadrina dehiscens and Globigerina ciperoensis are present but other planktonic forms which appear higher in the sequence are absent. This core consists of a grey bryozoal marl.

Core No. 2 at 1160 to 1180 feet consists of a highly fossiliferous clayey siltstone, brown in colour. The rich planktonic fauna is mainly of the Globigerina ouachitaensis - G. bulloides Group. The benthonic fauna includes Anomalina perthensis, Ceratobulimina westraliensis and Cibicides pseudoconvexus. The biostratigraphic position of this fauna is problematical. The first appearance of Globigerina sp. of the G. ouachitaensis - G. bulloides Group marks the base of Carter's Faunal Unit 4. However, the listed benthonic species were not found by Carter above Faunal Unit 3. Victoriella conoidea was not found in this fauna. The planktonic content of this fauna suggests that it represents Faunal Unit 4 or 5 and is definitely no older than 4.

Rotary cuttings below 1400 feet contain Globigerina linaperta indicating that Faunal Unit 3 (or earlier faunal units) is present below 1400 feet.

Rotary cuttings at 2000 feet contain Globorotalia chapmani which is a characteristic planktonic form in the Victorian Palaeocene.

Core No. 3 at 2101 to 2121 feet consisted of grey unconsolidated sand which was barren of fauna.

Sidewall cores at 2765 feet and 2780 feet contained purely arenaceous foraminiferal faunas consisting of typical Victorian Cretaceous species of Haplophragmoides (described in manuscript by Taylor, 1962).

Such a fauna is typical of the highest marginal-marine Cretaceous sediments in the Port Campbell wells.

Core No. 4 at 2835 to 2849 feet consists of a green-grey silty sand in which no fauna was found.

Sidewall core at 2970 feet was also barren of fauna.
Sidewall core at 3000 feet consisted of a dark grey mudstone which contained little glauconite. The fauna comprised Ostracoda, Gastropoda, and molluscan fragments, as well as foraminifera including Marssonella oxycona Hoeglundina supracretacea, Lenticulina sp., and the Victorian Cretaceous Haplophragmoides spp.

Sidewall cores at 3030 feet and 3050 feet are lithologically similar to the sidewall core at 3000 feet but contain more abundant foraminiferal faunas. The species present includes Alabamina australis, Ceratobulimina sp. nov. (described in manuscript by Taylor, 1962) Dorothia filiformis, Frondicularia cf. mucronata, Gyroidinoides nitida, Lenticulina (Robulus) navarroensis, Textularia anceps, T. semicomplanata, Valvulineria lenticula as well as the species noted from the sidewall core at 2970 feet. A gastropod present is similar to the species listed as Eriptcha by Kenley (1959) from the marine Cretaceous of the Belfast No. 4 Bore.

No fauna was found in cores (or sidewall cores) below 3050 feet, although Miocene foraminifera are abundant, in rotary cutting samples down to and below 3500 feet.

Suggested lithological correlations :-
It is difficult to delineate accurate lithological or biostratigraphic boundaries because of the contaminated cutting samples.

The same lithological unit names are used for this well as were used by Glenie and Taylor (1962) for the Pretty Hill No. 1 well.

Heywood Marl Member is certainly present at 961 feet where the fauna represents the Longfordian stage.

Nelson Formation may be present as the sediment of core No. 2 (1160 to 1180 feet) is fairly typical of this formation. It is noted that in Pretty Hill No. 1 the equivalent of the Nelson Formation was apparently missing as were the faunas indicative of the Janjukian Stage. Janjukian faunas are probably present in Eumeralla No. 1 well.

Knight Group is present below 1400 feet. Ludbrook (1961) records Globigerina linaperta at the top of the Knight Group in the Gambier sub-basin. G. linaperta first appears at 1400 feet in the Eumeralla well. It is impossible to subdivide this unit into formations. The Dartmoor Formation is certainly present and the record of the Palaeocene species Globorotalia chapmani at 2000 feet indicates that the Bahgallah Formation is represented.

Paaratte Formation is within this section. Arenaceous foraminiferal faunas of Cretaceous age are in sidewall cores 2835 and 2849 feet. These faunas as well as the sediments which contain them, are typical of this formation.

Belfast Mudstone is definitely identified at and below 3000 feet. The fauna is similar to that of the upper part of the Belfast Mudstone in the Port Campbell wells, the Flaxman's well and the Belfast No. 4 bore, but the facies differs. The Eumeralla faunas suggest that water circulation was restricted in the depositional environment, as planktonic faunas are absent and the percentage of calcareous foraminifera to arenaceous forms is low. The upper part of the Belfast Mudstone in the other bores listed was deposited in an open marine environment. In Eumeralla the fauna at 3000 feet is a shallow water fauna, whilst that at 3030 and 3050 feet suggests deeper water (between 60 and 100 fathoms). The sidewall core at 3100 feet consisted mainly of quartz and glauconite. No fauna was found. This sediment is identical to that in a core from 5383 feet in Heywood No. 10 bore. This sediment is regarded as being part of the Belfast Mudstone.

The top of the non-marine Mesozoic is believed to be at 3108 feet in Eumeralla No. 1, whilst it is at 2922 feet in Pretty Hill No. 1. Adjusting these to drilled depths (datum being height of rotary table) to sea level, the top of the non-marine Mesozoic is 2941 feet below sea level in Eumeralla and 2720 feet below sea level in Pretty Hill No. 1. Therefore the top of the non-marine Mesozoic section is 221 feet deeper in Eumeralla No. 1. The presence of the Nelson Fromation in Eumeralla No. 1 could account for the thicker section in this well as this formation is absent in Pretty Hill No. 1.

December 5, 1962

D. J. Taylor
Geologist

References

Carter, A. N. 1958 Tertiary Foraminifera from the Aire District, Victoria. Geol. Surv. Vict. Bull. 55

Glenie, R. C. and Taylor, D. J. 1962 Comments on the rock stratigraphy in Pretty Hill No. 1 well. Unpublished Report Geol. Surv. Vict.

Kenley, P. R. 1959 The Occurrence of marine Cretaceous sediments in the Belfast No. 4 Bore, Port Fairy. Vict. Mining & Geol. J. 6 (3). 55-56.

Ludbrook, N. L. 1961 Stratigraphy of the Murray Basin in South Australia. Geol. Surv. South Aust. Bull. 36.

Taylor, D. J. 1962 Foraminifera and the stratigraphy of the western Victorian Cretaceous sediments. M.Sc. Thesis Uni. of Adelaide (unpublished)

DEPARTMENT OF MINES, VICTORIA

Melbourne, C.2.

Frome-Broken Hill Eumeralla No. 1 Bore
Preliminary Examination for Acid Insoluble Microfossils

Core samples from the Frome-Broken Hill Co. Pty. Ltd. Eumeralla No. 1 bore were treated by the hydrofluoric acid - Schulze's solution method, and the acid insoluble residue examined under the microscope for microfossils.

Samples Treated

Core No.	Depth (feet)	
1	941 - 961	Hystrichospheres including Hystrichosphaera ramosa Hystrichosphaera furcata cf. Hystrichosphaera cingulata Hystrichokolpoma rigaudae; and Foraminifera (embryonic).
2	1160 - 1180	Hystrichosphaeridium sp.
4	2835 - 2837	Dinoflagellates including Deflandrea cretacea, Deflandrea sp. hystrichospheres.
5	3311 - 3313	None isolated.
6	3800 - 3812	None isolated.
7	4285 - 4300	A few trilete Pteridophyte spores, and Gymnosperm pollens.
8	4790 - 4798	None isolated.
9	5297 - 5299	None isolated.

Comments:

The hystrichosphere assemblage from Core 1 (941 - 961 ft.) consists of species identical with those isolated from core at 730 feet in the Glenelg (Nelson) No. 1 bore, and 656 feet in the Carpendeit No. 1 bore.

The species with the exception of H. rigaudae have been recorded from the Glenelg bore at 992 feet, regarded by Deflandre and Cookson (1955) as ? Lower Eocene. As H. rigaudae is more typical of the Birregurra No. 1 bore at 514 - 516 feet it may be that this Eumeralla core from 941 - 961 feet represents sediments somewhat younger than the Lower Eocene.

Hystrichospaeridium sp. from core 2 (1160 - 1180 ft.) represents a different microplankton assemblage within the Tertiary period.

The presence of D. cretacea in core 4 (2835 - 2837 ft.) indicates that this is from Upper Cretaceous sediments, although the microplankton assemblage isolated was very sparse.

Non marine pre Upper Cretaceous sediments appear to have been penetrated between cores 4 and 5 (3311 - 3313 ft.) and the typical Lower Cretaceous sporomorph assemblage of Cicatricosisporites and associated forms was present in the sample from core 10 (5803 - 5805 feet).

References

Deflandre, G. and Cookson, Isabel C., 1955 Fossil microplankton from Australian late Mesozoic and Tertiary sediments. Aust. Jour. Mar. Freshw. Res. 6. 2. p 242 - 313.

John Douglas

Geologist.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

NOTES ON THE MICROFLORA OF F.B.H. EUMERALLA NO. 1, OTWAY BASIN

INTRODUCTION

Samples of thirteen cores from Frome-Broken Hill Company Pty. Ltd. Eumeralla No. 1 Well have been examined for their content of microspores and microplankton, mainly with the object of comparing the Eumeralla section with that encountered in F.B.H. Pretty Hill No. 1 ten miles to the east (Bain, 1962). Pretty Hill No. 1 penetrated a "basal sandstone" between 5964 and 7874 feet, two cores from which yielded Lower Cretaceous or Upper Jurassic spores (Evans, Appendix 2 in Bain, 1962). A comparable section was anticipated in Eumeralla No. 1 but no part of the well seems to be identifiable as such by lithological or electric log characteristics. The spore content of the cores from Eumeralla No.1 shows that that well may have penetrated a correlate of the "basal sandstone" of Pretty Hill No. 1, but the alternative possibility, that a correlate of the "basal sandstone" was not encountered before the well was abandoned, is not ruled out.

Cores from top to bottom of the Lower Cretaceous of Eumeralla No. 1 have been examined as they have produced the closest comparisons yet seen in the central Otway Basin to the spore sequence of the Robe Bore (Cookson and Dettmann, 1958) and of O.D.N.L. Penola No. 1 (Evans, 1961a).

OBSERVATIONS

The cores and depths from which samples were taken and the forms of spores pollen and microplankton encountered within them are listed in Table I.

The microfossils were generally well preserved, even to total depth. The excesses of organic matter that frequently obscured detail in the Port Campbell and Flaxman's wells were not present at Eumeralla.

The Lower Cretaceous of Eumeralla No. 1 below Core 10 (5803-5805 feet) is non-marine; the hystrichosphere Micrhystridium sp. and the pterospermopsid Cymatiosphaera sp. between o.5 and o.10 indicate possible marine or brackish water conditions of deposition over the interval 3313 - 5805 feet.

Age Determination

Forms such as Cyathidites australis, Sphagnumsporites. spp. Baculatisporites comaumensis, Leptolepidites verrucatus, Cicatricosisporites cooksonii, Lycopodiumsporites austroclavatidites, "Ginkocycadophytus" nitidus and Vitreisporites pallidus commenced their life ranges in Jurassic or earlier times and they have no bearing on stratigraphical sub-divisions of Eumeralla No. 1. The presence of Cicatricosisporites dorogensis (al. australiensis) and Aequitriradites verrucosus at total depth indicates that the well finished in beds of Lower Cretaceous age.

The association of Dictyotosporites speciosus and Lycopodium-sporites circolumenus with C.dorogensis (in c.19 and below) may be taken to indicate the Aptian.

Perotrilites striatus, Balmeisporites holodictyus and Cingulatisporites euskirchensoides in core 8 signify an Albian age for the core. The spores observed between core 8 and core 19 have no meaning in terms of the accepted stage divisions of the Lower Cretaceous, partly because the Eumeralla section modifies knowledge of the ranges of certain species, and partly because there are variations in assemblage from one sample to another that have no stratigraphic significance when the ranges of their component species elsewhere are considered. Core 19, for example, contains an assemblage that was not repeated elsewhere in Eumeralla, but which is composed of species that range through thick sections at Robe and Penola. Until more work is done on the palynological meaning of the Aptian and the Albian any one of these terms will bear little precision. However, at least certain locally recognisable units are becoming apparent within the Lower Cretaceous, indications of which are demonstrated in the following discussion.

Comparison with Pretty Hill No. 1.

F.B.H. Pretty Hill No. 1 is the nearest deep well to Eumeralla No. 1. Pretty Hill No. 1 core 20 (7200 - 7214 feet) contained fairly common Cythathiids with L. circolumenus, D. speciosus (Evans, 1962b) and Cyclosporites hughesi (new observation). L. circolumenus was also present in core 19 of the Pretty Hill cores with horizons somewhere between Core 19 and Core 21 (8151 - 8918 feet) of Eumeralla No. 1. However, all these species occurred as low as the base of the marine Cretaceous of the Great Artesian Basin (Cookson and Dettmann, 1958), i.e. very close to the level at which C. dorogensis first appears. It is then feasible, on the basis of these comparable points of first appearance, that Pretty Hill No. 1 Core 20 could be as old as or older than the base of the Eumeralla section. Palynological data from the wells is insufficient for a decision of which of these alternative correlations is correct.

Comparison with Flaxman's No. 1

F.B.H. Flaxman's No. 1 well, drilled into the eastern part of the Otway Basin, penetrated an horizon from which Core 41 (10,801 - 10,817 feet) was cut and that contains relatively abundant C. dorogensis (Evans, 1962). As this epibole was not repeated at any other horizon in Flaxman's No. 1 and as it appeared at only one horizon in Eumeralla No. 1, in Core 13 (6254 - 6257 feet), it is possible that these horizons may be correlated. A similar abundance of C. dorogensis was observed in outcrop sample W - 37 from the Merino Group at Merino (Evans, 1961b).

Comparison with Penola No. 1

O.D.N.L. Penola No. 1 was drilled to the west of the outcropping Merino Group through a sequence that is directly comparable with that in Eumeralla No. 1. A twofold division of the Lower Cretaceous of Penola was possible (Evans, 1961a), based on the change occurring between Core 8 (2586 - 2596 feet) and Core 12 (3363 - 3373 feet). Unfortunately, inconclusive results from the intervening cores (9 - 11) prevented any attempt at refining the limits of this change. The same change occurs between Core 8 and Core 15 (4814 - 6716 feet) of Eumeralla No. 1 if the range of D. speciosus is taken as a common denominator in the lower division.

Correlation between Penola and Eumeralla may also be expressed in terms of the observed limits of ranges of species as in Figure 1. It is perhaps significant that this correlation places Eumeralla No. 1, Core 5 and Core 8, and Penola No. 1, Core 8, that all contained hystrichospheres into the same unit. It also links Eumeralla No. 1 Core 10 and Penola No. 1 Core 9 - Core 11, none of which yielded spores in abundance.

11th March, 1963

P. R. EVANS
Geologist

References:

Bain, J. S. 1962 Well completion report, Pretty Hill No. 1, South West Victoria. Frome-Broken Hill Co. Pty. Ltd. Rep. No. 7200-W-20 (unpubl.)

Cookson, I. C. and Dettmann, M. E. 1958 Some trilete spores from Upper Mesozoic deposits in the eastern Australian region. Proc. Roy. Soc. Vic. 70(2), 95-128.

Evans, P. R. 1961a A palynological report on Oil Development N.L. Penola No. 1 Well, South Australia. Bur. Min. Resour. Aust. Rec. 1961/76 (unpubl.)

Evans, P. R. 1961b A palynological examination of samples from the Merino Group, Victoria. Ibid. 1961/155 (unpubl.)

Evans, P. R. 1962 Palynological observations on F.B.H. Flaxman's Hill No. 1 Well. Ibid. 1962/57 (unpubl.)

APPENDIX 3.

WATER ANALYSES

STATE LABORATORIES
Macarthur Street,
Melbourne, C.2.

JCK/JW

An. JA, PS, 12/12

23rd January, 1963

Report on Sample No. 1256/62
U.W.R.S. 2767

Sample : Water form Oil Bore

Locality : Port Fairy

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

Particulars :

No.	1526
U.W.R.S.	2767
Bore	Oil Bore Eumeralla No. 1
Sample	Drill Stem Test No. 1
Depth (feet)	5822-6034 (Sample from 62nd stand)
Date	20.11.62
Owner	Frome-Broken Hill Co. Pty. Ltd.
Position	Port Fairy

Results :		Parts per million
Total solids in solution		19166
Chloride	(Cl)	11170
Carbonate	(CO_3)	Nil
Bicarbonate	(HCO_3)	366
Sulphate	(SO_4)	487
Nitrate	(NO_3)	Nil
Calcium	(Ca)	3110
Magnesium	(Mg)	13
Iron - Total	(Fe)	n.d.
Iron - Soluble	(Fe)	3.0
Silica - Soluble	(SiO_2)	14.0
Total hardness (as $CaCO_3$)		7820
pH		7.9

A hypothetical combination is given as follows: -

		p.p.m.	
Calcium bicarbonate	$Ca(HCO_3)_2$	477	4
Ferrous bicarbonate	$Fe(HCO_3)_2$	10	
Calcium sulphate	$CaSO_4$	690	3
Calcium chloride	$CaCl_2$	7739	2
Magnesium chloride	$MgCl_2$	51	
Sodium chloride	NaCl	10185	1

Signed: John G. Kennedy

Senior Chemist

Mines Department

STATE LABORATORIES
Macarthur Street,
Melbourne, C.2.

JCK:PD

An. JA, PS, 12/12

23rd January, 1963

Report on Sample No. 1527/62
U.W.R.S. 2768

Sample : Water from Oil Bore

Locality: Port Fairy

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

Particulars :

No.	1527
U.W.R.S.	2768
Bore	Oil Bore Eumeralla No. 1.
Sample	Drill Stem Test No. 2.
Depth (feet)	6226-6257 (Sample from test tool)
Date	22.11.62
Owner	Frome-Broken Hill Co. Pty. Ltd.
Position	Port Fairy

Results :		Parts per million
Total solids in solution		15687
Chloride	(Cl)	9072
Carbonate	(CO_3)	Nil
Bicarbonate	(HCO_3)	1306
Sulphate	(SO_4)	4586
Nitrate	(NO_3)	Nil
Calcium	(Ca)	2506
Magnesium	(Mg)	6
Iron - Total	(Fe)	n.d.
Iron - Soluble	(Fe)	2.0
Silica - Soluble	(SiO_2)	18
Total hardness (as $CaCO_3$)		6271
pH		7.9

A hypothetical combination is given as follows:-

		p.p.m.	
Calcium bicarbonate	$Ca(HCO_3)_2$	400	4
Ferrous bicarbonate	$Fe(HCO_3)_2$	7	
Calcium sulphate	$CaSO_4$	649	3
Calcium chloride	$CaCl_2$	6132	2
Magnesium chloride	$MgCl_2$	24	
Sodium chloride	NaCl	8457	1

Signed: John G. Kennedy

Senior Chemist
Mines Department

APPENDIX NO. 4

CORE DESCRIPTIONS AND ANALYSES

EUMERALLA-1

CORE DESCRIPTIONS

Core No. 1

941 to 961 feet. Recovered 15 feet
Marl; olive grey to greenish grey, very soft, very fossiliferous, slightly slickensided.

Core No. 2

1160 to 1180 feet. Recovered 12 feet.
Marly sand to sandy and silty marl; very fossiliferous, pyritic, sand grains are iron stained to clear, very fine to coarse grained, subangular to rounded, few grains of altered glauconite pellets and limonite. At top of core a nodule of cream skeletal limestone - possibly caving from above.

Core No. 3

2109 to 2121 feet. Recovered 6 feet.
Sand; medium grey to green, clear, few milky grains, often with inclusions and coating of pyrite. Fairly clean, mixed with some brownish silt. Loose, fine to granule size with a few pebbles, but mainly coarse grained, sub-angular to well rounded, and polished, poorly sorted. Very porous. Some pyrite and mica present.

Core No. 4

2835 to 2849 feet. Recovered 11 feet.
Top 4 feet sandstone; greenish to brownish grey. Quartz grains are clear to white, fine to very coarse grained, poorly sorted, angular to subrounded. Very glauconitic. In places bands contain up to 20% to 30% glauconite. Few red rock fragments. Generally calcareous, with brownish coloured dolomite cement in parts. Soft, friable, porous, cross bedded.
Remainder of core is sand to slightly consolidated sand-stone; dark green, very glauconitic, noncalcareous, with some calcareous cemented nodules. Quartz grains are clear to white, fine to very coarse grained, poorly sorted, angular to rounded. Glauconite is medium to pale green in pellet form. Matrix is light brown, soft. Large muscovite flakes.

Core No. 5

3311 to 3321 feet. Recovered 7 feet.
Sandy siltstone with sandy claystone; bluish-grey, with few lenses of sandstone. Minerals comprise about 40% to 50% quartz, with feldspar, dark rock fragments, chlorite and some distinctive orange, red and pink grains. Fine to medium grained, well sorted, fairly tight, micaceous, soft. Siltstone is bluish grey and has the same minerals, only finer grained and more clayey. No evidence of hydrocarbons, no fluorescence. Density: 2.2.

Core No. 6 — 3800 to 3812 feet. Recovered 12 feet.
Mudstone to siltstone; medium to bluish grey, micaceous, with dispersed carbonaceous material. Soft, tight, laminated, with odd coarse grained quartz and feldspar, containing lenses of white calcareous, clayey material in the sixth foot from top. Conchoidal fracture and slightly slickensided in places. Grades into very fine sandstone in the third foot. Lamination is horizontal but in the seventh foot from top is contorted. No evidence of hydrocarbons. No fluorescence. Density: 2.2.

Core No. 7 — 4285 to 4300 feet. Recovered 15 feet.
Top 3 feet sandstone; greenish to bluish grey, very fine to fine grained, fairly tight and compact. Composed of approximately 60% quartz and feldspar which are clear to light grey, angular to subrounded; 40% dark rock fragments, abundant magnetite, chlorite, biotite. Some grains, which are colourless to light pinkish with fairly high refractive index may be garnet. Matrix is silty, siliceous, feldspathic, chloritic and adheres tightly to grains.
Next 5 feet mudstone; medium grey, tight, dense, compact. Composed of quartz, feldspar, chlorite.
Rest of core sandstone as for the top three feet. No apparent bedding. No evidence of hydrocarbons. No fluorescence. Soxhlet extraction yielded slight yellow greasy film with yellowish blue fluorescence. Density sandstone: 2.25. Mudstone: 2.35.

Core No. 8 — 4796 to 4814 feet. Recovered 18 feet.
Sandstone; light grey, mottled, very fine to fine grained, crossbedded, grading occasionally into siltstone. Composed of clear to light grey, angular to rounded quartz and feldspar (approximately 60%) and dark rock fragments, chlorite, biotite, magnetite. Some pink garnets and yellow to light brown heavy mineral are fairly common. Matrix is chloritic clay. Carbonaceous matter is present and increases in the thirteenth foot which is coarse sandstone. No apparent dip. No evidence of hydrocarbon. No fluorescence. Soxhlet: light yellow cut with faint yellow fluorescence. Density: 2.2.

Core No. 9 — 5297 to 5309 feet. Recovered 5 feet.
Sandstone; grey, mottled, composed of quartz, feldspar, dark rock fragments, chlorite, mica. Matrix is very fine, soft, white, noncalcareous material. Grains are angular to subangular, mainly medium grained, fairly well sorted. The amount of matrix varies from place to place, and the porosity changes accordingly. The bottom two-thirds of core has carbonaceous plant remains and vitreous coal fragments. Plant remains are slightly bituminous. The core becomes finer grained and tighter towards the bottom. Noncalcareous, slightly crossbedded. No hydrocarbons. No fluorescence. Soxhlet: no visible film, very weak fluorescence. Density: 2.35.

Core No. 10 — 5799 to 5816 feet. Recovered 12 feet.
Top 18 inches mudstone to siltstone; grey, slickensided with large flakes of golden mica.
Next 18 inches mudstone; greenish grey, to siltstone, grey, as above, with carbonaceous material which increases towards base. Conchoidal fracture, slickensided, with soft white material on slickensided surface.
24 inches mudstone to siltstone; grey, micaceous.
12 inches mudstone; greenish grey, very slickensided.
4 feet 6 inches siltstone to mudstone; grey, micaceous, with disseminated carbonaceous fragments, laminated, with very thin lighter coloured siltstone lenses, slightly crossbedded.
1 foot 6 inches sandstone; grey, slightly greenish grey, composed of quartz, feldspar, dark rock fragments, chlorite, mica. Tight, with very fine white matrix. Towards bottom laminated bands of mica and coal concentrations occur. No fluorescence. Soxhlet: weak cut with good fluorescence. Density: 2.43.

Core No. 11 — 6034 to 6054 feet. Recovered 14 feet 6 inches.
Siltstone to mudstone; greenish grey. Composed of quartz, feldspar, dark fragments, chlorite, mica. Dense, tight, fractured, with some carbonaceous material, slightly crossbedded. No fluorescence. Soxhlet: greasy film with bluish white fluorescence. Density: 2.5.

Core No. 12 — 6242 to 6252 feet. Recovered 6 feet.
Top 2 feet sandstone; light greenish to mottled grey. Quartz, feldspar, dark rock fragments, mica, carbonaceous material, non-calcareous, tight, crossbedded.
Remainder of core is medium to dark grey siltstone to mudstone; compact, dense, with thin bands of sandstone as above. No evidence of hydrocarbon. Density: sandstone 2.43. Mudstone: 2.48.

Core No. 13 — 6252 to 6257 feet. Recovered 5 feet.
Siltstone to mudstone as for bottom of core No. 12, with thin bands of very fine to fine sandstone as for top of core No. 12.

Core No. 14 — 6478 to 6488 feet. No recovery.

Core No. 15 — 6704 to 6720 feet. Recovered 14 feet.
13 feet sandstone; grey to greenish grey, dominantly quartz, with feldspar, dark rock fragments, chlorite, red fragments, mica. Very fine to fine grained, angular to subrounded; fairly well sorted. White matrix, calcareous. Dark siltstone fragments, hard, at 5 to 6 feet from top, very hard calcareous cement, carbonaceous fragments and streaks. Very tight, slightly crossbedded. Dip 10° to 13°.
1 foot siltstone-sandstone; grey to brown grey, with carbonaceous material and plant remains, $\frac{1}{2}$ inch of coal with some resin at bottom of core. No fluorescence. Soxhlet: No visible film, bluish white fluorescence.
Density: sandstone 2.4, siltstone 2.4.

Core No. 16 — 7225 to 7240 feet. Recovered 6 feet.
18 inches sandstone; light grey, very fine grained, composed of quartz, feldspar, dark rock fragments, chlorite, muscovite, biotite. Angular, poorly sorted, tight. Streaks of carbonaceous material. Very crossbedded.
3 feet 6 inches sandstone; light grey, fine grained. Made up of quartz, feldspar, dark rock fragments, chlorite, muscovite, biotite, coal fragments and carbonaceous streaks. Tight, with very fine, white, slightly calcareous matrix. Angular to subangular, poorly sorted, crossbedded.
1 foot siltstone to mudstone; light brown with the same mineral assemblage, carbonaceous material, plant remains, streaks and thin lenses of black coal, crossbedded. No fluorescence. Soxhlet: greasy film, bright yellow fluorescence. Density: 2.4.

Core No. 17 — 7697 to 7712 feet. Recovered 15 feet.
Siltstone to mudstone; light to medium grey, very micaceous, laminated. Carbonaceous material disseminated evenly throughout the core. Dense, tight, soft. Lenses and thin bands of very fine sandstone are common in some places. Apparent dip 10°. Soxhlet: yellow cut with yellow fluorescence.

Core No. 18 — 7712 to 7717 feet. Recovered 5 feet.
Siltstone to mudstone; medium to dark to greenish grey, dense, compact, with mica and carbonaceous material, thin bedded, laminated. Very tight. Density: 2.64. No evidence of hydrocarbons.

Core No. 19 — 8143 to 8156 feet. Recovered 11 feet 6 inches.
Interbedded siltstone and very fine grained sandstone; light to medium grey with numerous thin laminae of carbonaceous material, and few thin inclusions of black coal. Sandstone is micaceous, and generally calcareous. Three feet above bottom is intraformational breccia with fragments up to 1/3 inch diameter. Inclusions consist of light greenish grey, very fine sandstones, grading into coarse sandstone. Gas bubbles were noted emanating from black coal fragments in core.

Core No. 20 — 8459 to 8465 feet. Recovered 6 feet.
18 inches siltstone; grey to green-grey to brown-grey. Very fine to fine quartz, slightly coarser feldspar, carbonaceous fragments, slickensided. Core becomes coarser grained towards base.
4 feet 6 inches sandstone, greenish grey, 80% to 90% clear, angular quartz grains. Smaller grains of feldspar, some biotite, chlorite, carbonaceous fragments, very fine silt matrix. Slightly calcareous, very tight, hard. Small bands and lenses of siltstone as on top of core. Small fault appears on core with few inches of displacement, also some indication of intraformational siltstone conglomerate. Crossbedded and has vertical cleavage through centre of the core. No fluorescence. Density: 2.56.

Core No. 21 — 8914 to 8924 feet. Recovered 10 feet.
Top 2 feet sandstone; light greenish grey, calcareous. Composed mainly of very fine to fine grained quartz and some feldspar. Chlorite and biotite common, white to light tan grains or coatings of ?calcic feldspar. Sandstone is tight with low porosity. Rest of core siltstone-mudstone; light grey, calcareous, micaceous, chloritic, carbonaceous, with minor sandstone made up of quartz, feldspar, very fine to medium grained. Density: 2.6.

Core No. 22 — 9373 to 9385 feet. Recovered 12 feet.
Top 6 feet siltstone to mudstone; dark grey, hard, tight. Bottom 6 feet interbedded very fine grained sandstone, siltstone and minor mudstone. Calcareous, finely cross bedded. No good dip but bedding indicates generally low dip. Disseminated carbonaceous material. No fluorescence. Density: 2.54.

Core No. 23 — 9767 to 9774 feet. Recovered 5 feet.
Siltstone to very fine sandstone; medium to greenish to brownish-grey, tight. Core is very uniform, made up of siltstone which grades in some places to very fine sandstone, micaceous, with abundant carbonaceous material, mainly as fine particles. Cross bedding present but not dominant. No fluorescence. Density: 2.6.

Core No. 24 — 9881 to 9890 feet. Recovered 4 feet.
Top 4 inches sandstone, light grey to greenish grey, interbedded with seams of carbonaceous matter nearly parallel, partly cross bedded, bedding plane approx. 35° to 40°. Composed of very fine to fine quartz and feldspar, with abundant biotite, common chlorite and chloritic clayey matrix. The rest of top foot consists of breccia of medium to dark grey siltstone to very fine sandstone, very micaceous and tight.
Second foot is sandstone composed of light grey, very fine to medium grained quartz, angular to subrounded, with feldspar, mica, dark rock fragments, chlorite, some garnets and/or zircon, magnetite. In the middle of second foot there is a two inch thick dark grey siltstone with apparent dip of 35° to 40°.
Bottom 2 feet quartz sandstone, fine to coarse, angular to subrounded with secondary crystallisation. Fair amount of pink garnet, biotite, dark rock fragments, feldspar, chlorite, trace of graphite. Sandstone appears to be very similar to basal sandstone of Pretty Hill No. 1. Apparent dip 35° to 40°. No fluorescence. Soxhlet: light yellow cut. Density: 2.5.

Core No. 25 10,300 to 10,308 feet. Recovered 5 feet.
Top 2 feet 6 inches sandstone; very light grey, compact, and tight, calcareous, crossbedded, medium grained, interbedded with laminae and lenses of fine to very fine carbonaceous sandstone and siltstone, and with dark, rounded, brecciated mudstone-siltstone material, mixed with coarse sand grains. Lenses of coarse sandstone are present in places. Composition of sandstone is fine to medium grained, angular to subrounded quartz, some dark rock fragments, biotite, chlorite and possible feldspar. Matrix and cement is crystalline calcite. Pink garnet is common. Rest of core is siltstone to very fine sandstone, micaceous, very tight, compact. No fluorescence. Density: Sandstone 2.59. Siltstone 2.63.

SIDEWALL CORES

2764	feet	Mudstone to siltstone; brown, dense, tight.
2765	"	Mudstone to siltstone; brown, dense, tight, with few quartz grains and mica.
2770	"	Mudstone to siltstone; brown, dense, tight,
2775	"	Mudstone to siltstone. brown, dense, tight.
2780	"	Mudstone to siltstone; brown, dense, tight, sandy, glauconitic, fossiliferous, with a pocket of clear sand.
2818	"	Sand; clear quartz, subangular to rounded, medium grained, fairly well sorted.
2820	"	Sand; clear quartz, subangular to rounded, medium grained, fairly well sorted, with some dark rock fragments.
2822	"	Sand as above.
2824	"	Sand as above.
2826	"	Mud cake with some silty sand.
2960	"	Siltstone; sandy brown glauconitic,pyritic, with large muscovite flakes.
2970	"	Same as 2960 feet sample.
2980	"	Mudstone; brown, sandy, pyritic, tight.
2990	"	Mudstone; brown, sandy, pyritic, tight, with fossil fragments.
3000	"	Mudstone; brown, tight, with fossil fragments.
3010	"	Mud cake.
3020	"	Mudstone, brown, tight.
3030	"	Mudstone; sandy, brown, tight.
3040	"	Mudstone; brown, silty, micaceous, pyritic, with patches of light grey, very fine sand.
3050	"	Mudstone; brown, silty.
3070	"	Mudstone; brown, tight, glauconitic, plant remains replaced by pyrite.
3080	"	Mudstone; brown, tight, very glauconitic. Glauconite is in the form of dark green to black pellets.
3090	"	Same as 3080 feet.
3100	"	Same as 3080 feet.
3110	"	Sandstone; quartz, feldspar, dark rock fragments, red fragments, medium to coarse grained, mainly medium, poorly sorted, porous. Quartz grains are angular to subrounded.
3116	"	Siltstone; grey, tight, with carbonaceous material.
3118	"	Siltstone; grey, tight, with laminated carbonaceous material.
3120	"	Mudstone; grey, tight, dense.
8217	"	Siltstone; grey, with thin laminae of carbonaceous material.

8640 feet	Sandstone; white to light grey, clear quartz, mica, very fine crystalline pyrite, garnet, disseminated carbonaceous material. Sand grains are angular, unsorted, white matrix, slightly calcareous, tightly packed.
8660 "	Sandstone; white to light grey, clear to white quartz, mica, chlorite, dark rock fragments, garnet. Quartz grains are angular, dark rock fragments are rounded. Very fine to fine grained, unsorted, calcareous. Slight fluorescence, some porosity.
9123 "	Sandstone; white to light grey, quartz grains are clear to white and angular. Garnet, chlorite, very fine to fine grained, poorly sorted, with carbonaceous material. Weak fluorescence.
9123 "	Mudstone to siltstone; brownish grey, micaceous, with plant remains, carbonaceous material. Small lens of light grey to white sandstone, composed of quartz, garnet, chlorite, dark rock fragments, very fine to fine grained poorly sorted, angular. Very slight fluorescence in sandstone.
9133 "	Sandstone; light grey, white to clear quartz, garnet, dark rock fragments, chlorite, very fine to fine grained, calcareous.
9145 "	Sandstone; white, clear, angular quartz grains, garnet, disseminated coal, with very fine white matrix. Very fine grained, noncalcareous. Weak fluorescence.
9314 "	Sandstone; light grey, quartz, dark rock fragments, very fine white matrix.
10,026 "	Sandstone; light grey to white, quartz, very fine to fine grained, angular disseminated carbonaceous material. Very fine, white matrix.
10,063 "	Siltstone; sandy, grey, quartz, feldspar, chlorite, carbonaceous material, mica.
10,165 "	Siltstone; brown-grey, with very fine disseminated carbonaceous material, micaceous.
10,071 "	Siltstone; brown-grey, micaceous, feldspathic.

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

Date: 26th March, 1963

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 field porometer and permeameter were used, with air and dry nitrogen, respectively, as the saturating and flowing media. (ii) Oil and water saturations were determined using Soxhlet type extraction apparatus. (iii) Acid solubilities were determined using 15% commercial hydrochloric acid (iv) N.D. means Not Determined.

Well or Area	Core or sample number	Depth in ft. From: To:	Effective porosity % by Vol.		Absolute permeability millidarcys.		Avg. density in gms/cc.		Fluid saturation			Acid solubility % by vol.	Oil Characteristics		
			V.	H.	V.	H.	Dry Bulk	Grain	Water: % pore space	Oil: % pore space	Oil: Metric tons/ acre ft.		Fluorescence in solvent	Colour of extracted oil.	Fluorescence of extracted oil.
EUMERALLA NO. 1	1	941 961	Very Friable, could not analyse												
"	2	1162 1164	32	31	100	84	1.89	2.75	45	Nil	Nil	N.D.	Trace	Nil oil	Nil oil
"	3	2110 2112	Sample Received in Powdered Form									-	-	-	-
"	4	2839 2841	N.D.	18	N.D.	100	2.34	2.86	63	Nil	Nil	N.D.	Trace	Nil oil	Nil oil
"	5	3311 3313	32	32	Nil	Nil	1.94	2.70	40	"	"	"	Faint Trace	"	"
"	6	3810 3812	26	26	Nil	Nil	1.94	2.61	46	"	"	"	Strong	"	"
"	7	4295 4297	30	28	20	3	2.04	2.87	22	"	"	"	Trace	"	"
"	8	4800 4804	19	19	Nil	Nil	2.18	2.68	50	"	"	"	Strong	"	"

Additional information:

General file no. 62/399

Well file no. 62/1308

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

Date: 6th March. 1963

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 field porometer and permeameter were used, with air and dry nitrogen, respectively, as the saturating and flowing media. (ii) Oil and water saturations were determined using Soxhlet type extraction apparatus. (iii) Acid solubilities were determined using 15% commercial hydrochloric acid (iv) N.D. means Not Determined.

Well or Area	Core or sample number	Depth in ft. From: To:	Effective porosity % by Vol.		Absolute permeability millidarcys.		Avg. density in gms/ cc.		Fluid saturation			Acid solubility % by vol.	Oil Characteristics		
			V.	H.	V.	H.	Dry Bulk	Grain	Water: % pore space	Oil: % pore space	Oil: Metric tons/ acre ft.		Fluorescence in solvent	Colour of extracted oil.	Fluorescence of extraced oil.
EUMERALLA No. 1	9	5299 5302	21	23	Nil	Nil	2.05	2.63	22	Nil	Nil	N.D.	Faint Trace	Nil oil	Nil oil
"	10	5809 5811	21	13	Nil	Nil	2.29	2.76	34	"	"	"	Strong	"	"
"	11	6046' 6048'6"	17	16	Nil	Nil	2.19	2.63	32	"	"	"	Strong	"	"
"	12	6242 6244	16	15	2	2	2.21	2.61	34	"	"	"	Strong	"	"
"	13	6252 6254	10	11	Nil	Nil	2.22	2.54	69	"	"	"	Strong	"	"
"	14		No Core Available					-	-	-	-	-	-	-	-
"	15	6712 6714	11	11	Nil	Nil	2.34	2.63	61	Nil	Nil	N.D.	Strong	Nil oil	Nil oil
"	16	7227 7229	8	5	Nil	Nil	2.49	2.66	58	"	"	"	Strong	"	"

Additional information:

General file no. 62/399

Well file no. 62/1308

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

Date:- 6th March, 1963

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 field porometer and permeameter were used, with air and dry nitrogen, respectively, as the saturating and flowing media. (ii) Oil and water saturations were determined using Soxhlet type extraction apparatus. (iii) Acid solubilities were determined using 15% commercial hydrochloric acid (iv) N.D. means Not Determined.

Well or Area	Core or sample number	Depth in ft. From: To:	Effective porosity % by Vol.		Absolute permeability millidarcys.		Avg. density in gms/cc.		Fluid saturation			Acid solubility % by vol.	Oil Characteristics		
			V.	H.	V.	H.	Dry Bulk	Grain	Water: % pore space	Oil: % pore space	Oil: Metric tons/ acre ft.		Fluorescence in solvent	Colour of extracted oil.	Fluorescence of extracted oil.
EUMERALLA No. 1	17	7709 7712	4	2	Nil	Nil	2.48	2.55	100	Nil	Nil	N.D.	Strong	Nil oil	Nil oil
"	18	7716 7717	5	5	"	"	2.41	2.55	99	"	"	"	Strong	"	"
"	19	8147 8149	3	3	"	"	2.48	2.55	100	"	"	"	Strong	"	"
"	20	8463 8465	4	5	"	"	2.52	2.64	78	"	"	"	Strong	"	"
"	21	8914 8916	3	2	"	"	2.57	2.63	100	"	"	"	Trace	"	"
"	22	9383 9385	2	2	"	"	2.51	2.55	100	"	"	"	Trace	"	"
"	23	9769 9772	3	3	"	"	2.53	2.61	100	"	"	"	Trace	"	"
"	24	9881 9890	13	12	2	2	2.37	2.67	49	Not Measurable		N.D.	Good	Not Extracted. Trace Only	

Additional information: Core No. 24 was received in a sealed condition. Salinity for extracted water - 4740 p.p.m. NaCl.
All cores which gave "strong" fluorescence in solvent contained coal or carbonaceous partings and pieces.

General file No. 62/399

Well file no. 62/1308

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

Date: 6th March, 1963

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 field porometer and permeameter were used, with air and dry nitrogen, respectively, as the saturating and flowing media. (ii) Oil and water saturations were determined using Soxhlet type extraction apparatus. (iii) Acid solubilities were determined using 15% commercial hydrochloric acid (iv) N.D. means Not Determined.

Well or Area	Core or sample number	Depth in ft. From: To:	Effective porosity % by Vol.		Absolute permeability millidarcys.		Avg. density in gms/cc.		Fluid saturation			Acid solubility % by vol.	Oil Characteristics		
			V.	H.	V.	H.	Dry Bulk	Grain	Water: % pore space	Oil: % pore space	Oil: Metric tons/ acre ft.		Fluorescence in solvent	Colour of extracted oil.	Fluorescence of extracted oil.
EUMERALLA No. 1	25	10,300 10,302	5	5	Nil	Nil	2.52	2.61	20	Nil	Nil	N.D.	Trace	Nil oil	Nil oil

Additional information:

General file no. 62/399

Well file no. 62/1308

APPENDIX 5:

FROME-BROKEN HILL COMPANY PTY. LTD.

Report No. 7200-P-50

VELOCITY SURVEY OF EUMERALLA NO. 1.

By

K. A. RICHARDS

Melbourne,
March, 1963.

CONTENTS

2. DISCUSSION OF SURVEY

No seismic crew was working for Frome at the time of drilling Eumeralla No. 1 so that the velocity survey was organised in two stages. The shot holes were drilled and cased prior to the survey and no rig was available when the survey was actually being carried out. The holes did not stand up too well despite the casing, and for this reason not every level was shot from both sides of the well and a number of the shots were fairly shallow.

Namco International supplied a set of recording instruments, shooting truck, plus an observer, a shooter and a computer, to record the data. A T.I.C. standard 24l W well geophone, serial no. 113 was supplied by the Bureau of Mineral Resources. A reflection spread was not shot across the location. It was hoped that records from line 99 would suffice for comparison purposes.

Shot hole charges varied from 10 to 40 lb of dynamite, in from one to three holes and at depths from 15 to 70 feet. Most of the breaks are fair to good with a few poor in quality. Since the hole was only cased to 987 feet, casing kicks were no problem and only possible occurrences of cable kick interfering with the true break were at 5000 and 6500 feet.

Comparison Sonic Log and Check Shot Data

Depth below Datum	Average Vertical Time	T Check Shots	T Sonic	Difference	Interval Depth	Microsec per ft. error
1000	0.153					
		0.140	0.142	-0.002	1000	-2.0
2000	0.293					
		0.134	0.124	+0.010	1000	+10.0
3000	0.427					
		0.167	0.164	+0.003	1500	+2.0
4500	0.594					
		0.050	0.049	+0.001	500	+2.0
5000	0.644					
		0.232	0.217	+0.015	2500	+6.0
7500	0.876					
		0.197	0.201	-0.004	2750	-1.4
10250	1.073					

Though the errors are not very significant and despite the fact that there is probably a small amount of inherent error in the check shot it was decided to apply a slight correction to the integrated sonic log.

Using the correction formula :-

$$\Delta T \text{ check shots} = A \times \Delta T \text{ sonic} + B$$

it was calculated that using A = 1.025 and

$$B = 0$$

will adequately correct the integrated time curve to fit the check shots.

K. A. RICHARDS.

PE905753

This is an enclosure indicator page.
The enclosure PE905753 is enclosed within the container PE905755 at this location in this document.

The enclosure PE905753 has the following characteristics:

ITEM_BARCODE	= PE905753
CONTAINER_BARCODE	= PE905755
NAME	= Shot Point Locality Plan
BASIN	= OTWAY
PERMIT	= PEP/5
TYPE	= WELL
SUBTYPE	= DIAGRAM
DESCRIPTION	= Shot Point Locality Plan(from WCR) for Eumeralla-1
REMARKS	=
DATE_CREATED	= 31/03/63
DATE_RECEIVED	=
W_NO	= W472
WELL_NAME	= EUMERALLA-1
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL CO. PTY. LTD.

(Inserted by DNRE - Vic Govt Mines Dept)

PE905754

This is an enclosure indicator page.
The enclosure PE905754 is enclosed within the container PE905755 at this location in this document.

The enclosure PE905754 has the following characteristics:

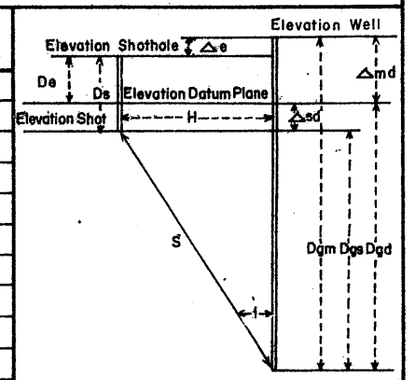
ITEM_BARCODE	= PE905754
CONTAINER_BARCODE	= PE905755
NAME	= Well Velocity Survey Summary Sheet
BASIN	= OTWAY
PERMIT	= PEP/5
TYPE	= WELL
SUBTYPE	= VELOCITY_CHART
DESCRIPTION	= Well Velocity Survey Summary Sheet
REMARKS	=
DATE_CREATED	= 7/01/63
DATE_RECEIVED	=
W_NO	= W472
WELL_NAME	= EUMERALLA-1
CONTRACTOR	=
CLIENT_OP_CO	= NAMCO INT.

(Inserted by DNRE - Vic Govt Mines Dept)

(2)

Shothole information : Elevation, Dist, & Dirn from Well	Company	Well	Elevation. (Derrick floor.)	Total Depth	Location
SP1 — 151 ft — 11,00ft W SP2 — 150ft — 500ft W SP3 — 154ft — 500ft E SP4 — 159ft — 11,00ft E	Frome-Broken Hill	Eumeralla No1	166	10,308	Co ordinates: Lat 38°12'43"S, Long 141°56'01"E; Section Township Range: OTWAY BASIN; Country: AUSTRALIA; Area or field

Record Number	Shothole Number	Formation	Dgm	Ds	tus	tr	T Reading	T Polarity	T Grade	Dgs	H	tan i	cos i	Tgs	Δsd	Δsd/V	Tgd	Tgd Average	Dgd	Δ Dgd	ΔTgd	Vi Interval Velocity	Va Average Velocity
1	3		1000	70	016	088	159		F	918	500	28°	35'	140	82	013	153						
2	2		1000	57	013	063	160		F	927	500	28°	21'	141	73	011	152	153	1000				
19	3		2000	29	010	084	297		F	1959	500	14°	19'	288	41	006	294						
18	2		2000	13	006	067	297		F	1971	500	14°	14'	288	29	004	292	293	2000				
17	1		3000	26	010	169	449		F	2959	1100	20°	24'	421	41	006	427						
16	4		3000	19	012	183	450		G	2974	1100	20°	18'	422	26	004	426	427	3000				
14	1		4500	51	015	169	594		G	4434	1100	13°	56'	577	66	010	587						
15	4		4500	20	010	188	615		F	4473	1100	13°	49'	597	27	004	601	594	4500				
3	1		5000	52	017	168	643		P	4933	1100	12°	34'	628	67	010	638						
4	4		5000	72	017	183	651		P	4921	1100	12°	36'	637	79	012	649	644	5000				
13	1		5500	22	009	175	709		F	5463	1100	11°	23'	695	37	006	701		5500				
12	1		6500	25	009	170	796		P	6460	1100	9°	40'	785	40	006	791		6500				
10	1		7500	72	016	171	877		P	7413	1100	8°	26'	868	87	013	881						
11	4		7500	75	017	183	867		F	7418	1100	8°	26'	858	82	013	871	876	7500				
9	1		7997	25	010	173	901		F	7957	1100	7°	52'	893	40	006	899		7997				
8	1		8997	25	009	176	999		P	8957	1100	7°	00'	992	40	006	998		8997				
7	1		10,250	25	009	177	1072		P	10,210	1100	6°	09'	1066	40	006	1072						
6	4		10,250	15	010	188	1077		P	10,228	1100	6°	08'	1070	22	003	1073	1073	10,250				
5	4		10,250	12	008	188	1080?		VP		1100				0								

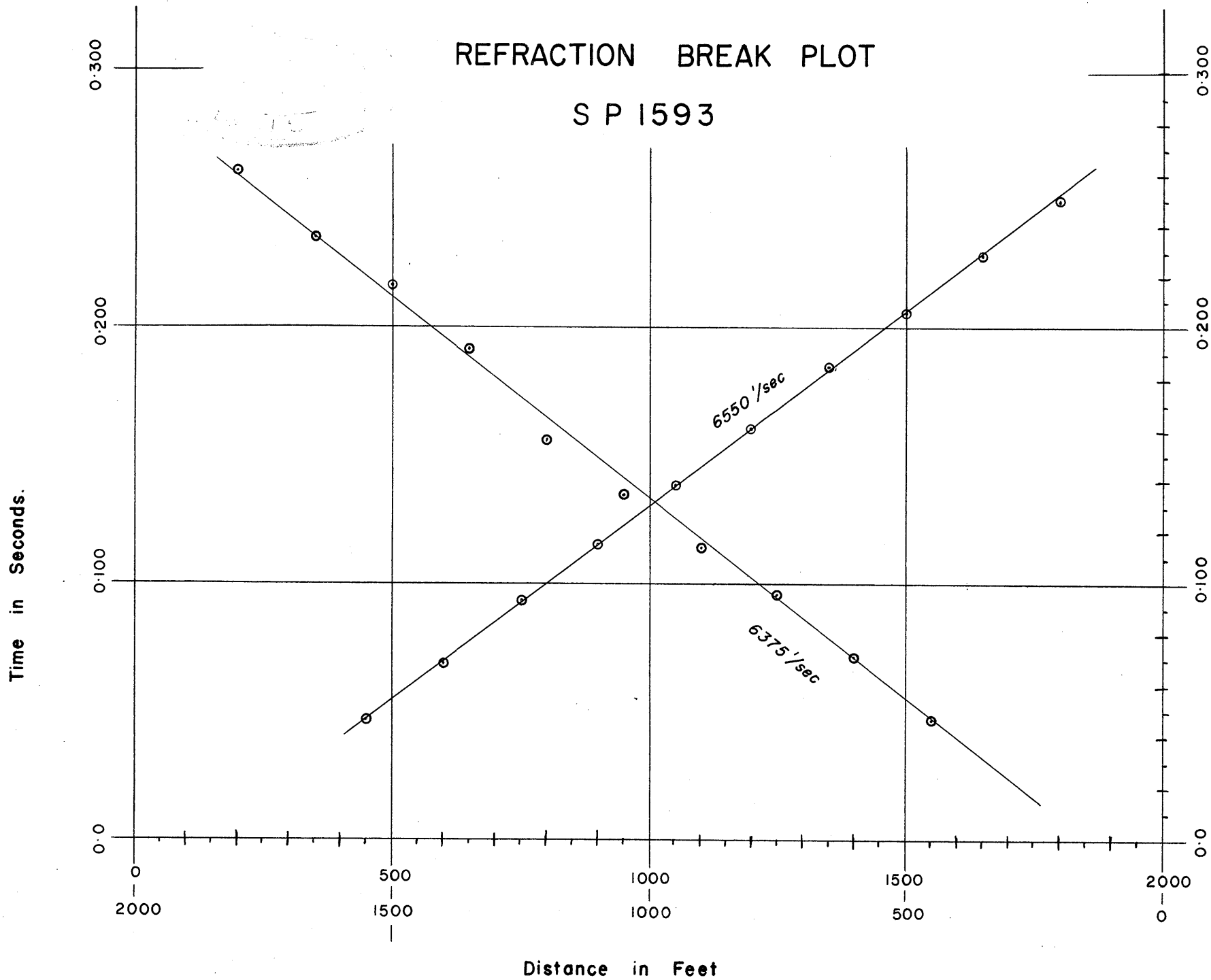


Dgm = Geophone depth measured from well elevation.
Dgs = " " " " shot "
Dgd = " " " " datum "
Ds = Depth of shot.
De = Shothole elevation to datum plane.
H = Horizontal distance from well to shotpoint.
S = Straight line travel path from shot to well geophone
tus = Uphole time at shotpoint.
T = Observed time from shotpoint to well geophone.
tr = " " to reference geophone.
Δe = Difference in elevation between well & shotpoint.
Δsd = " " " " shot & datum plane
Δsd = Ds − De.
Dgs = Dgm − Dg ± Δe; $\tan i = \frac{H}{Dgs}$
Tgs = cos i T = vertical trav. time from shot elev. to geophone.
Tgd = Tgs ± $\frac{\Delta sd}{V}$ = vert. trav. time from datum plane to geophone.
Dgd = Dgm − Δmd.
Vi = Interval velocity = $\frac{\Delta Dgd}{\Delta Tgd}$.
Va = Average = $\frac{Dgd}{Tgd}$.

Surveyed by NAMCO
Date 7 JAN. 1963
Weathering Data
V = 6500

Casing Record
Cased to 987'

MAR. '63



MAR. 1963

7200-P-50

AMERICAN OVERSEAS PETROLEUM LIMITED

1ST FLOOR, "GLEN CRAG"
119-123 LEICHHARDT STREET, BRISBANE
QUEENSLAND

PHONE: 23327
BOX 1086N, G.P.O., BRISBANE

June 27, 1967.

EXPLORATION GEOLOGY

Source Rock Analysis

The General Manager,
Frome-Broken Hill Company Pty. Ltd.
31 Queen Street,
MELBOURNE, C.1., Victoria

Dear Sir:

We have received the following source rock analyses from the Chevron Research Company, for samples from your Eumeralla 1, Pretty Hill 1 and Port Campbell 1 wells in the Otway basin.

Well	Core No.	Depth Feet	Weight Percent of Bitumen Carbon	Weight Percent of Bitumen-free organic carbon	Total Organ. content Vol %	Petroleum Source Index
Eumeralla	22	9384	0.01	0.19	0.60	0.32
Pretty Hill 1	6	2825-32	0.01	1.04	3.15	0.90
Pretty Hill 1	12	4640-57	0.02	0.54	1.68	0.89
Port Campbell	8	2915-33	0.09	1.92	6.05	0.95
Port Campbell	15	4293	0.02	2.07	2.27	0.98
Port Campbell	21	5223-33	0.02	1.13	3.45	0.95
Port Campbell	23	5700-18	0.05	2.85	8.71	0.98

An evaluation of the source potential of a sample can be made by referring to the attached chart. For example, a shale containing 3.15% organic matter with a source index of 0.90 would rate very highly as opposed to one with 0.60% organic matter and an index of 0.32.

We wish to thank you for permission to sample the wells and hope the above information will be of value.

Yours very truly,

AMERICAN OVERSEAS PETROLEUM LIMITED.

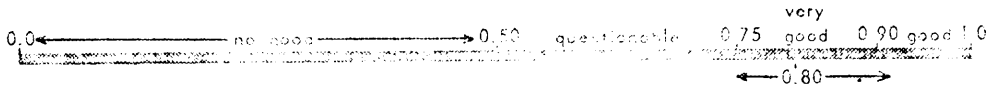
E.R. LOCKE,
Manager

NWH:CDS.
cc. Victoria Dept. of Mines
Encl.1

SOURCE ROCK POTENTIAL

Quantity – Volume of Organic Matter in Rock (to be included in future CRC reports)
(See Table I and II in text)

Source Potential
or Index*
(0 to 10)



*Needs consistency in several samples to be rated

Source Potential results from the volume of organic matter (quantity) and its relation to the potential or index (quality).

Eocene
Eumeralla

EUMERALLA 1
EUM-1
Otway Basin 38 13 s. lat. 141 56 e. long.

#	M	FT	%I-C	%O-C	%N	%H	S1	S2	TMAX	PI	HI	GP
1	355	1166	8.3	0.02	bdl	0.37	bdl	0.2	ndm	---	29	0.2
2	506	1660	13.0	0.81	bdl	0.25	bdl	bdl	ndm	---	---	---
3	655	2150	4.8	0.64	bdl	0.14	bdl	bdl	ndm	---	---	---
4	811	2660	12.9	0.23	bdl	0.12	bdl	bdl	ndm	---	---	---
5	1189	3900	3.8	0.56	bdl	0.44	0.05	0.2	463	0.20	39	0.3
6	1396	4580	5.9	0.63	bdl	0.46	bdl	0.3	432	---	48	0.3
7	1710	5610	2.7	0.77	bdl	0.43	bdl	0.6	462	---	72	0.6
8	1784	5850	2.5	1.11	bdl	0.51	bdl	0.4	465	---	36	0.4
9	1832	6010	1.5	5.86	0.15	0.92	0.43	17.5	467	0.02	299	17.9
10	1845	6050	0.5	0.79	0.05	0.56	0.18	0.3	458	0.36	40	0.5
11	2024	6640	0.9	0.83	0.06	0.62	bdl	0.4	460	---	48	0.4
12	2048	6716	bdl	20.09	0.36	1.84	1.09	68.1	452	0.02	339	69.2
13	2415	7920	1.7	3.02	0.14	0.61	0.30	1.6	459	0.16	54	1.9
14	2579	8459	0.3	0.42	0.06	0.47	0.16	0.5	461	0.26	108	0.6
15	2604	8540	1.7	2.27	0.09	0.59	0.25	1.8	465	0.12	80	2.1
16	2619	8590	2.5	4.19	0.16	0.74	0.74	7.8	464	0.09	185	8.5
17	2643	8670	2.2	13.24	0.39	1.23	3.20	36.9	438	0.08	279	40.1
18	2738	8980	2.0	1.99	0.10	0.58	0.30	3.1	497	0.09	154	3.4
19	2774	9100	2.3	1.53	0.10	0.53	0.18	2.1	465	0.08	135	2.2
20	2902	9520	1.8	0.85	0.08	0.50	0.19	0.8	473	0.19	93	1.0
21	2977	9764	0.1	0.48	0.08	0.50	0.08	0.3	473	0.24	54	0.3
22	3003	9850	1.2	0.48	0.05	0.41	0.17	0.5	464	0.25	110	0.7
23	3070	10070	1.7	0.54	0.06	0.39	0.31	0.7	464	0.30	133	1.0
24	3122	10240	1.0	0.92	0.08	0.54	0.11	0.5	464	0.20	49	0.6

Pyrolysis run with CDS Pyroprobe and modified interface: TMAX inaccurate.
M is sample depth in meters.
FT is sample depth in feet.
%I-C is inorganic carbon as % calcium carbonate in rock.
%O-C is organic carbon as % carbon in rock.
%N is % nitrogen in rock.
%H is % hydrogen in rock.
S1 is pyrolysis free-hydrocarbon signal (mg hydrocarbons/g rock).
S2 is pyrolysis kerogen signal (mg S2 hydrocarbons/g rock).
PI is production index [S1/(S1+S2)].
TMAX is temperature at which S2 signal is maximum (deg C).
HI is hydrogen index (mg hydrocarbons/g O-C).
GP is genetic potential (kg hydrocarbons/ton rock) (S1+S2).
'bdl' means 'below detection limit'; '---' means 'not determined'.
'ndm' means 'no definitive maximum'.

ENCLOSURES:

PE904004

This is an enclosure indicator page.
The enclosure PE904004 is enclosed within the container PE905755 at this location in this document.

The enclosure PE904004 has the following characteristics:

ITEM_BARCODE	= PE904004
CONTAINER_BARCODE	= PE905755
NAME	= Location Map
BASIN	= OTWAY
PERMIT	= PEP 5
TYPE	= WELL
SUBTYPE	= MAP
DESCRIPTION	= Location Map (plate 1 from WCR) for Eumeralla No 1
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	=
W_NO	= W472
WELL_NAME	= Eumeralla-1
CONTRACTOR	=
CLIENT_OP_CO	= Frome Broken Hill Co P/L

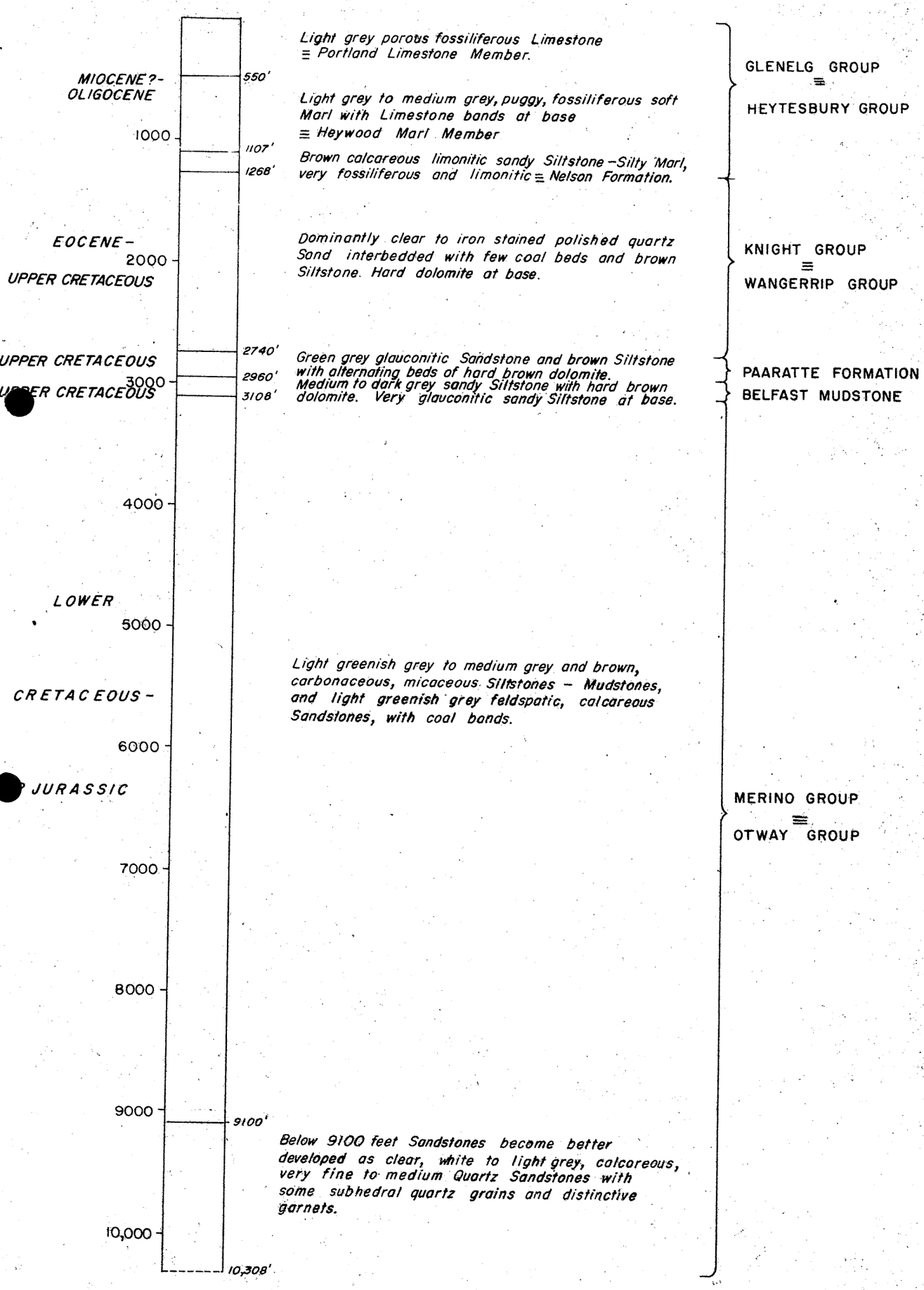
(Inserted by DNRE - Vic Govt Mines Dept)

FROME-BROKEN HILL CO. PTY. LTD.

EUMERALLA NO.1.

STRATIGRAPHIC COLUMN AFTER DRILLING.

SCALE: 1 INCH = 1000 FEET



By J.S. BAIN.
MAR. 1963

W472

PLATE 4

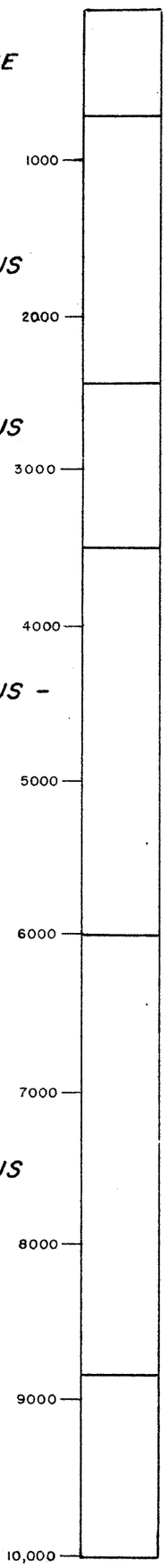
7200 - W - 21

FROME-BROKEN HILL CO. PTY. LTD.

EUMERALLA No. 1

STRATIGRAPHIC COLUMN PRIOR TO DRILLING

SCALE: 1 INCH = 1000 FEET



MIOCENE? - OLIGOCENE	710'	Marl fossiliferous and clayey and bryozoal limestone	GLENELG GROUP = HEYTESBURY GROUP
EOCENE - UPPER CRETACEOUS	2450'	Dominantly quartz sandstone and sand with interbedded siltstones. Some coal and dolomite towards the base.	KNIGHT GROUP = WANGERRIP GROUP
UPPER CRETACEOUS	3490'	Siltstone, sandstone and mudstone with dolomite and carbonaceous material. Dark grey fossiliferous glauconitic siltstones and mudstones.	PAARATTE FORMATION to MERINO GROUP
LOWER CRETACEOUS - ? JURASSIC	6010'	Light to greenish grey feldspathic sandstones and sub greywackes interbedded with siltstones and mudstones.	MERINO GROUP = OTWAY GROUP
? MESOZOIC (LOWER CRETACEOUS - JURASSIC)	8850'	White - light grey very porous quartz sandstone with siliceous and clay matrix. Distinctive garnets.	BASAL SANDSTONE
CAMBRIAN		Altered diabase or other igneous rock.	BASEMENT COMPLEX

By J. S. BAIN.

MAR. 1963

PLATE 2

7200-W-21

PE904007

This is an enclosure indicator page.
The enclosure PE904007 is enclosed within the container PE905755 at this location in this document.

The enclosure PE904007 has the following characteristics:

ITEM_BARCODE	= PE904007
CONTAINER_BARCODE	= PE905755
NAME	= Geological Cross section
BASIN	= OTWAY
PERMIT	= PEP 5
TYPE	= WELL
SUBTYPE	= CROSS_SECTION
DESCRIPTION	= Geological Cross Section after drilling (enclosure from WCR) for Eumeralla-1
REMARKS	=
DATE_CREATED	= 31/03/63
DATE_RECEIVED	=
W_NO	= W472
WELL_NAME	= Eumeralla-1
CONTRACTOR	=
CLIENT_OP_CO	= Frome Broken Hill Co P/L

(Inserted by DNRE - Vic Govt Mines Dept)

PE904008

This is an enclosure indicator page.
The enclosure PE904008 is enclosed within the container PE905755 at this location in this document.

The enclosure PE904008 has the following characteristics:

ITEM_BARCODE	= PE904008
CONTAINER_BARCODE	= PE905755
NAME	= Geological Cross section
BASIN	= OTWAY
PERMIT	= PEP 5
TYPE	= WELL
SUBTYPE	= CROSS_SECTION
DESCRIPTION	= Geological Cross Section prior to drilling (enclosure from WCR) for Eumeralla-1
REMARKS	=
DATE_CREATED	= 31/03/63
DATE_RECEIVED	=
W_NO	= W472
WELL_NAME	= Eumeralla-1
CONTRACTOR	=
CLIENT_OP_CO	= Frome Broken Hill Co P/L

(Inserted by DNRE - Vic Govt Mines Dept)

PE604414

This is an enclosure indicator page.
The enclosure PE604414 is enclosed within the container PE905755 at this location in this document.

The enclosure PE604414 has the following characteristics:

ITEM_BARCODE	= PE604414
CONTAINER_BARCODE	= PE905755
NAME	= Composite Well Log
BASIN	= OTWAY
PERMIT	= PEP/5
TYPE	= WELL
SUBTYPE	= COMPOSITE_LOG
DESCRIPTION	= Composite Well Log (enclosure 6 of WCR) for Eumeralla-1
REMARKS	=
DATE_CREATED	= 8/01/63
DATE_RECEIVED	=
W_NO	= W472
WELL_NAME	= EUMERALLA-1
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL CO. PTY. LTD.

(Inserted by DNRE - Vic Govt Mines Dept)