MOYNE FALLS 1

SHELL DEVELOPMENT

(AUSTRALIA)

PTY. LTD.

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Moyne Falls
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SHELL/FROME-BROKEN HILL

MOYNE FALLS NO. 1

OTWAY BASIN - VICTORIA

WELL COMPLETION REPORT

by

Shell Development (Australia) Pty. Ltd.

(Dr. J.J.K. Poll)

Melbourne.
February, 1970.

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I SUMMARY

1.1 Drilling

The Shell/Frome Moyne Falls No. 1 well, located approximately 27 miles Northwest of Warrnambool in the Otway Basin of South-western Victoria, was drilled to a total depth of 3,308 feet with a Brewster N-4 rig by Richter Bawden Drilling Pty. Ltd. for the operator Shell Development (Australia) Pty. Ltd.

The well site is located approximately 1.5 miles from a sealed main road. A private farm road leads from the main road to about 200 yards from the well site.

Drilling commenced on 15th November, 1969 and was completed on 26th November, 1969. The well was deepened beyond 2,700 feet (programmed depth) to ensure that Palaeozoic basement (one of the objectives of the well) was reached.

Four conventional cores were cut of which only the fourth (in basement) recovered true core. The first three coring attempts recovered mainly cavings resulting from reaming while running in and only a few larger rock fragments probably from the interval cored. Thirty sidewall cores were attempted of which 26 were accepted. The wire line logging program consisted of Induction - Electrical, Gamma Ray - Sonic and Continuous Dipmeter logs. No drill stem tests were carried out.

The well was plugged back and abandoned as a dry hole on 28th November, 1969.

1.2 Geological

Moyne Falls No. 1 is located on a structurally high basement block defined by gravity and seismic in the northern part of the Tyrendarra Embayment in the proximity of the northern margin of the Otway Basin.

This high shows a structural closure of some 15 square miles at the level of basement (horizon D) and a vertical closure of about 1000 feet.

Moyne Falls No. 1 was designed to test hydrocarbon prospects of a suspected porous sand development at the base of the Otway group immediately overlying basement and of fractured and/or weathered basement.

The sequence penetrated consisted of 168 feet of recent to Pleistocene volcanics, 919 feet of carbonates of the Middle Miocene to (?) Upper Oligocene Heytesbury group, 1256 feet of lithic sands, silts and clays of the Lower Cretaceous Eumeralla formation, 724 feet of volcanics of the (?) Upper Jurassic Basal unit and 280 feet of quartz-mica schist of the Palaeozoic basement.

No significant reservoir rocks were encountered in the section overlying the basement and no porosity due to weathering or fracturing was encountered in the latter.

No hydrocarbon shows were encountered, although moderately high background readings were recorded on the Gas Chromatograph while drilling in basement.

On the basement high drilled by the Moyne Falls No. 1 well the Eumeralla formation was expected to immediately overlie basement and it was not anticipated that the Basal unit of the Otway group would be preserved.

The well achieved its objectives by drilling through the Otway group into Palaeozoic basement. The well data established that no porous sand development is present at the base of the Otway group here and that basement lacks reservoir characteristics.

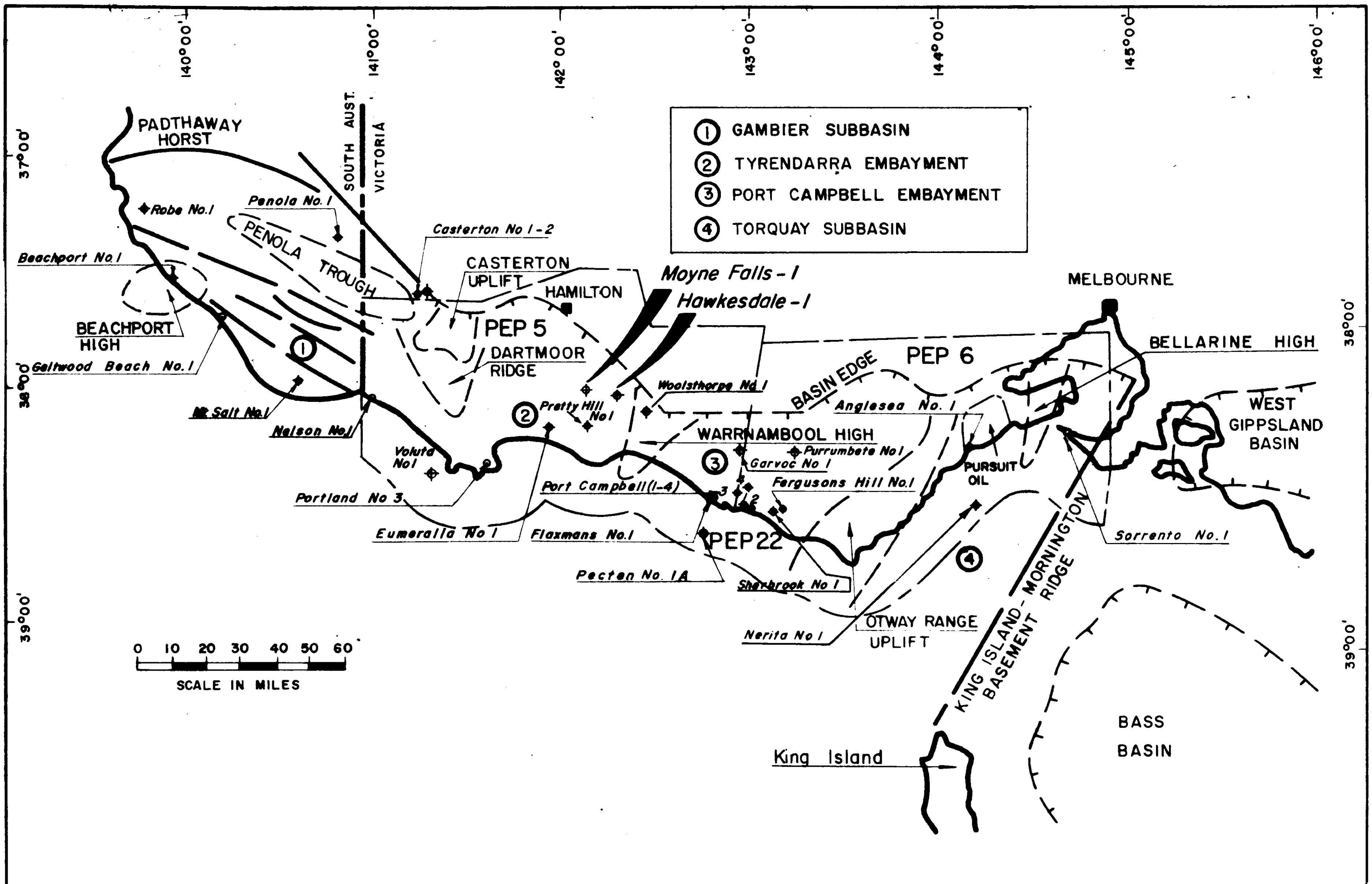

Fig 2

KEY MAP OF THE OTWAY BASIN

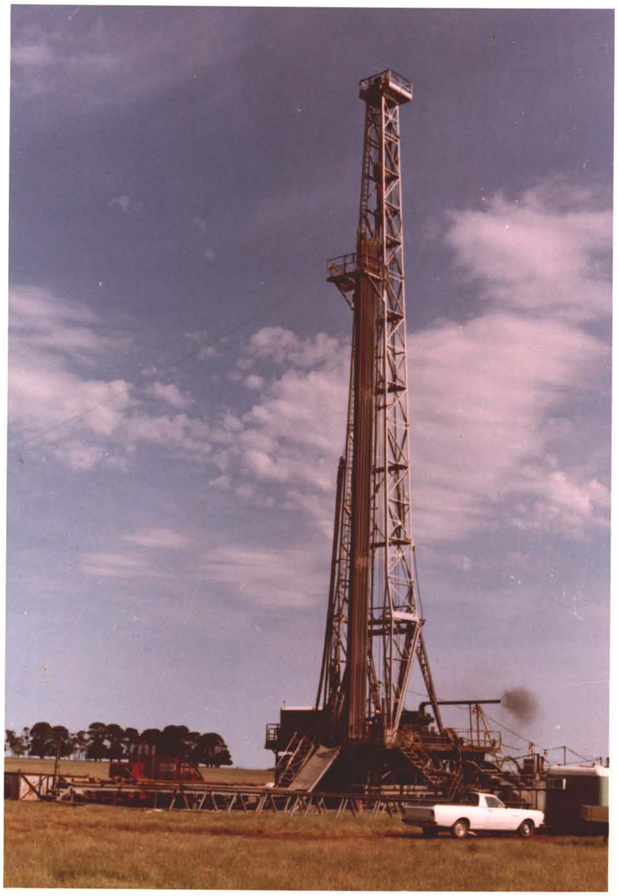

Fig. 1 The Brewster N-4 rig on the Moyne Falls No.1 location.

2. INTRODUCTION

Moyne Falls No. 1 was the first of two wells drilled by the Shell/Frome partnership in the northern part of the Tyrendarra Embayment, close to the northern margin of the Otway Basin.

Significant but non-commercial shows of oil and wet gas have been encountered elsewhere within the Eumeralla formation of the Otway group. Most of these shows occurred in wells drilled in the onshore Port Campbell Embayment. The Eumeralla formation, however, generally lacks reservoir properties.

The drilling of Woolsthorpe No. 1 and Garvoc No. 1 in 1968 proved an extension of the Pretty Hill Sandstone of the Otway group to the east. The porous and permeable quartz sands of the Pretty Hill Sandstone constitute an excellent reservoir and since this formation is underlain by the Basal Unit which has source rock potential in shale samples in the Casterton No. 1 well, the Pretty Hill Sandstone was considered to be a valid exploration target in the Tyrendarra Embayment. A geophysical programme was initiated in 1968 with the objective of outlining drillable prospects in the Otway group.

The geophysical programme in the Hawkesdale area started with a detailed gravity survey in order to select gravity anomalies for subsequent seismic surveying. Three pronounced positive anomalies were surveyed by seismic, followed by a geochemical survey in selected areas covering the block faulted basement highs and lower Otway group pinchouts.

Seismic interpretation indicates the Pretty Hill Sandstone to be absent on these three highs, thus discounting earlier hopes of drape structures at Pretty Hill Sandstone level on the highs. It was felt, however, that a shallow test on the crest of one of the basement highs was required to investigate the possibility of a porous sand development at the base of the Otway group immediately overlying and draped over basement. Moyne Falls No. 1 would also test the possibility of an accumulation of hydrocarbons in fractured or weathered basement.

3. WELL HISTORY

3.1 General Data

(i)	Well name and number	: Moyne Falls No. 1
(ii)	Name and address of Operator	: Shell Development (Australia) Pty. Ltd. 155 William Street, Melbourne, Vic. 3000.
(iii)	Name and address of joint tenement holders	: Frome-Broken Hill Company Mobil Centre, 2 City Road, South Melbourne, Vic. 3205. and Shell Development (Australia) Pty. Ltd. 155 William Street, Melbourne, Vic. 3000.
(iv)	Petroleum tenement	: Petroleum Exploration Permit No. 5
(v)	District	: Portland (1:250,000; SJ - 54/11)
(vi)	Location	: Latitude : 38° 04' 09"S Longitude :142° 11' 35"E
(vii)	Elevation	: Ground 480' ASL RT 492' ASL (Datum for depth measurements)
(viii)	Total Depth	: 3308' Driller 3311' Schlumberger
(ix)	Date drilling commenced	: 15.11.1969
(x)	Date total depth reached	: 26.11.1969
(xi)	Date well abandoned	: 28.11.1969
(xii)	Date rig released	: 28.11.1969
(xiii)	Drilling time in days to total depth	: 12
(xiv)	Status	: Plugged and abandoned plugs 1 2,000-1,700' 120 sacks 2 1,350-1,070' 120 sacks 3 800- 535' 120 sacks All set by conventional displacement.
(xv)	Total cost	: Approximately $A70,000.

3.2 Drilling Data

(i) Name and address of Drilling Contractor	:	Richter Bawden Drilling Pty. Ltd Perry House, Elizabeth Street, Brisbane, Qld. 4000.
(ii) Drilling Plant	:	Make : Brewster Type : N.4 Rated Capacity : 6000 ft 4½" dp 7500 ft 3½"dp Motors: Make : General Motors Type : Twin 6-71, Model 12103 BHP : 356
(iii) Mast	:	Make : Lee C. Moore Type : 126 ft Cantilever Cap. : 360.000 lbs
(iv) Pumps	:	Make : Oilwell Type : 214 P (2) Size : 7¼" x 14" Motors: Make : General Motors Type : Twin 6-71, Model 12103 BHP : 356
(v) Blow out preventer equipment	:	Make : (1) Regan (1) Cameron Size : 10" 12" Type : K SS Series(API) : 900 900 Operating Unit: Payne accumulator Model NSSUA - 80 - 3
(vi) Hole sizes	:	12¼" surface to 1284 feet, 8-3/4" from 1284 feet to Total Depth
(vii) Casing and cementing details	:	Size : 9-5/8" Weight : 36 lbs/ft. Grade : J55 Range : 2 Set at : 1270 feet A Baker float shoe was run on the bottom of the first joint

of casing, with a Larkin Baffle Collar between first and second joint of casing.

Top and bottom plugs : Howco. No centralizers or scratchers were used.

Quantity of cement used :

450 sacks and 2% $CaCL_2$ over last 50 sacks

Cemented : To surface

Method used : Plugs

(viii) Drilling fluid : Type : Fresh water bentonite
Average weight : 10 lbs/gal.

Treatment:
Mud weight was kept at about the above weight by adding water and dumping mud. Fluid loss was controlled by both Cellex and Q'broxin. Viscosity was maintained in the right order of magnitude by adding Q'broxin and water. PH was controlled by caustic soda.

Average weekly analysis :

Week ending	Weight	Viscosity	Fluidloss	Filtercake	Sand	PH
22/11	9.6	39	7.9	1/32	1-3/4%	9.3
29/11	10	42	9.4	2/32	4%	8.5

Total Materials consumed:

Aquagel	:	54 x 100 lbs
Cellex	:	18 x 50 lbs
Q'broxin	:	37 x 50 lbs
Caustic Soda	:	240 lbs
CC.16	:	2 x 50 lbs

(ix) Water supply : Water was supplied by the Landowner by extending his waterline from a nearby dam to the wellsite.

(x) Perforating : No perforating or shooting was carried out.

(xi) Plugging back and squeeze cementing jobs :

Plug No.	Length	Sacks	Tested
1	2000-1700(300')	120	No
2	1350-1070(280')	120	Yes
3	800- 535(265')	120	Yes

(xii) Fishing operations : None

(xiii) Side tracks : None

3.3 <u>Formation sampling</u>

(i) Ditch cuttings : Cuttings were collected from the shale shaker, washed through a coarse sieve and retained and washed in a bucket. Samples were collected at 30 feet intervals from surface to 2370 feet; and thereafter at 10 feet intervals. The samples were treated as follows:

1 sample washed and dried for Bureau of Mineral Resources

1 sample washed and dried for Victorian Mines Department

1 sample washed and dried for Shell Development (Australia)Pty.Ltd.

1 sample unwashed and dried for Shell Development (Australia) Pty. Ltd.

1 sample washed and dried for well reference for the wellsite geologist.

The samples were placed in labelled polythene bags and stored at the following locations:

(A) Bureau of Mineral Resources,
Core and Cuttings Laboratory,
Collie Street,
<u>Fyshwick</u>, Canberra A.C.T.

(B) Victorian Mines Department,
Core Laboratories,
Cook Street,
<u>Port Melbourne</u>, Vic.

(C) Shell Development (Australia)
Pty. Ltd.,
155 William STreet,
<u>Melbourne</u>, Vic.

3. WELL HISTORY (Cont'd)

3.3 Formation Sampling (Cont'd)

(ii) Coring:

Core No.	Interval Cored	Feed Cored	Recovery (in ft.)	%
1	2413 - 2424'	11	*	*
2	2424 - 2429'	5	*	*
3	2814 - 2833'	19	*	*
4	3288 - 3308'	20	6	30

* The first three coring attempts recovered mainly cavings resulting from reaming while running in with the core barrel (conventional tool)

2 inches of every foot of cores No. 1, 2 and 3; and 4 inches of every 2 feet of core no. 4 were sent to (A) and (B).
The remainder of the core is stored at (C)

(iii) Sidewall sampling : After reaching total depth Schlumberger shot 30 sidewall cores of which 26 were accepted by the wellsite geologist. Listed below are the depths at which these sidewall cores were taken and the recoveries:

Depth in ft.	Recovery in inches	Depth in ft.	Recovery in inches
1289	2	2271	2
1300	2	2301	2
1385	2	2324	1-3/4
1449	2	2330	2
1576	2	2362	2½
1677	2	2371	1½
1732	2	2422	1½
1802	2	2450	0
1902	2	2505	2
1952	2	2530	2
2022	2	2600	0
2079	2	2750	0
2104	2	2926	½
2166	2	3050	2
2201	2	3175	0

Following lithological description, part of the sidewall cores were used for petrographic and palynological determinations.

3. WELL HISTORY (Cont'd)

3.3 Formation Sampling (Cont'd)

(4) Logging and Surveys

(i) Wire line logging : Performed by Schlumberger.

Logs run:

Type of Log	Interval (in ft.)		
Induction Electrical Log +SP	2,814 - 1,271	3,311 - 2,814	2 runs
Gamma-ray Sonic Log	2,806 - 1,271	3,294 - 2,806	2 runs
Continuous Dipmeter	2,811 - 1,271		

(ii) Penetration rate and gas logs : Penetration rate:

Drilling time was taken from the geolograph and plotted in minutes per 10 feet on the composite log.

Gas Log:

Casing shoe to total depth. A continuous record of mud gas was kept using a Hot Wire Detector and Gas Chromatograph (equipment supplied by Data Analysis Pty. Ltd.).

(iii) Deviation surveys : A Totco 8° double recorder was used. Results are tabulated below. For more detailed information see dipmeter results.

Depth in ft.	Deviation in degrees	Depth in ft.	Deviation in degrees
100	1/16	900	¼
213	¼	1000	¼
306	¼	2380	½
490	¼	2413	½
590	¼	2803	2¼
700	¼	2920	2¼
800	¼		

(iv) Temperature surveys : None

(v) Other surveys : None

(5) Testing

(i) Formation testing : None

(ii) Production testing : None

IV GEOLOGY

4.1 History of Exploration

The search for petroleum has been carried out in the Otway Basin for many years and several companies hold exploration permits granted by the Victorian and South Australian Governments both onshore and offshore.

Following a Farm-in Agreement in 1965 with Frome-Broken Hill Company Pty. Ltd., Shell Development (Australia) Pty. Ltd. became the operator in Petroleum Exploration Permits 5, 6 and 22 and earned a 50% interest for a total expenditure of $A 4,000,000 including seismic and drilling obligations. During 1966 land seismic surveys were completed in the Yambuk, Portland and Nelson areas and two marine seismic surveys were carried out. In 1967 a short geological survey was carried out in the Torquay and Port Campbell areas and a short experimental refraction survey offshore Cape Bridgewater. In that year three offshore wells were drilled. During 1968 a geological survey was carried out in the Otway Ranges and in the Casterton - Merino area, three wells were drilled onshore, a gravity survey was made of the Hawkesdale - Hamilton area and a land seismic survey started in the Hawkesdale area. Following the 1969 seismic survey in the Hawkesdale area, a geochemical survey was carried out and two wells (Moyne Falls -1 and Hawkesdale -1) were drilled in this area.

Up to January, 1970 a total of 37 petroleum exploration wells have been drilled in the Otway Basin. A number of hydrocarbon indications have been reported but as yet no commercial accumulation has been found.

4.2 Geology

4.2.1 Summary of the geology of the Hawkesdale area.

The Hawkesdale area forms part of the northern margin of the Tyrendarra Embayment in the Otway Basin (Fig. 1). The area is bounded to the east and west by palaeoridges (the Warrnambool High and the Dartmoor Ridge respectively) which emerged at the end of the Lower Cretaceous after the Otway group deposition.

During the Lower Cretaceous, several phases of movement occurred which resulted in the uplift of basement blocks within the embayments: the Woolsthorpe high, the Hawkesdale high complex and the Branxholme high. Subsequent deep erosion removed most or all of the Basal unit, the Pretty Hill Sandstone and Unit 2 of the Eumeralla formation from the basement highs (Encl, 1a, b and 2a).

The Hawkesdale area is north of the present Upper Cretaceous Sherbrook group pinch-out, although it is likely that at least the southern part of the area was originally covered by thin Upper Cretaceous deposits.

Several phases of deposition, uplift and erosion during the Lower Tertiary resulted in the present day situation of very thin and irregularly preserved sequences of Wangerrip and Nirranda groups. The marine upper Tertiary Heytesbury group covers the area uniformly. Thin, irregular, recent to Pleistocene volcanics outcrop all over the area.

Stratigraphic control for the Tertiary and Mesozoic sequence in this is based on the Woolsthorpe -1, Moyne Falls -1 and Hawkesdale -1 exploration wells and additional control for the Tertiary and the top of the Otway group is provided by the Kangerton-5 (TD 1150 ft.), MacArthur-3 (TD 2507 ft) and Branxholme-1 (TD 1510 ft) waterbores. The seismic horizons tied in with the Woolsthorpe-1 well could be correlated over the Woolsthorpe and Hawkesdale area and are also recognised on the seismic sections of the Branxholme area. No reliable correlation of the Lower Cretaceous reflections could be made between the northern margin of the embayment and the old, poor quality seismic data in the Pretty Hill-Eumeralla area to the south.

4.2.2 Target zones and correlations

The target zones in the Moyne Falls No. 1 well were the basal part of the Otway group overlying Palaeozoic basement and the upper part of the basement. It was anticipated that porous and permeable sands could have been deposited as a basal wash overlying basement. This well would also test the possibility of hydrocarbon accumulation in weathered or fractured basement.

Moyne Falls No. 1 encountered 1256 feet of generally unconsolidated lithic sands, silts and clays of the Eumeralla formation with very low permeabilities. The Eumeralla formation is not overlying Palaeozoic basement as prognosticated, but rests on 724 feet of volcanics attributed to the (?) Jurassic Basal Unit of the Otway group. This volcanic sequence is devoid of reservoir characteristics and is not associated with Basal Unit shales as encountered in the Woolsthorpe No. 1 and Casterton No. 1 wells. The 405 feet and 505 feet of Basal Unit shales overlying the volcanics in the Woolsthorpe No. 1 and Casterton No. 1 respectively, are either removed or not deposited in the Moyne Falls and Hawkesdale areas which are situated on the crest and on the slope respectively of a basement high which could have originated as an early Cretaceous palaeohigh.

The well prognosis and the actual section encountered are shown on Enclosure 2b. The correlations between Moyne Falls No. 1 and Pretty Hill No. 1, Hawkesdale No. 1 and Woolsthorpe No. 1 are illustrated in the cross section included as Enclosure No. 2a.

Enclosures 1b and 1c show the location of Moyne Falls No. 1 in relation to the structural contours of seismic horizons P and D which are correlated with the base of the Eumeralla formation and the top of the Palaeozoic basement respectively.

4.3 Stratigraphic Table - Moyne Falls No. 1

Age	Rock Unit	Top (feet below R.T.)	Thickness (feet)
Recent to (?) Pleistocene	Newer Volcanics	12(surface)	168
	Unconformity		
Middle Miocene to (?) Upper Oligocene	Heytesbury group	181	919
Middle Miocene	Port Campbell Limestone	181	219
Middle to Lower Miocene	Gellibrand Marl	400	630
Lower Miocene to (?) Upper Oligocene	Clifton formation	1030	70
	Unconformity		
Lower Cretaceous to (?) Jurassic	Otway group	1100	1980
Lower Cretaceous	Eumeralla formation	1100	1256
Lower Cretaceous	Eumeralla fm-unit 1	1100	693
	Unconformity (?)		
Lower Cretaceous	Eumeralla fm-unit 2	1793	563
	Unconformity		
(?) Jurassic	Basal unit	2356	724
	Unconformity		
(?) Ordovician	Basement	3080	280+

T.D. 3308 feet

4.4 Lithologic Description

Newer Volcanics		(Recent to ? Pleistocene)
Surface - 181 feet	:	Basalt, dark greenish-grey, vesicular, fine to medium crystalline, very weathered to red-brown especially in upper 50 feet.
Heytesbury Group		(Middle Miocene to ? Upper Oligocene)
181 - 400 feet	:	Port Campbell Limestone (Middle Miocene) Limestone, Packstone, partly Wackestone, partly Grainstone, very porous and permeable, buff and grey-white, bioclastic, coarse, crumbly break, unconsolidated to slightly cemented, very friable.
400 - 1030 feet	:	Gellibrand Marl (Middle to Lower Miocene) Marl, very argillaceous, slightly silty, greenish grey, very fossiliferous, unconsolidated, plastic, (minor glauconite). Clay, greenish grey, slightly calcareous, fossiliferous, slightly silty, unconsolidated, plastic, (minor glauconite).
1030 - 1100 feet	:	Clifton formation (Lower Miocene - (?) Upper Oligocene) Limestone, Grainstone, very porous and permeable, white-buff and red-brown, iron stained bioclastic (predominantly Bryozoa fragments), unconsolidated to slightly cemented, very friable (minor quartz and chert grains, transparent to yellow-brown, medium to coarse, subrounded)

Otway group		(Lower Cretaceous to ? Jurassic)
1100 - 2356 feet	:	Eumeralla formation (Lower Cretaceous)
1100 - 1793 feet	:	Eumeralla formation - Unit 1 (Lower Cretaceous)
1100 - 1346 feet	:	50% Clay, grey-brown to green-grey, up to 10% silt and fine sand in part, chloritic, slightly carbonaceous, soft, plastic. 30% Silt, grey-brown, to grey green, argillaceous, fine sandy, slightly lithic, chloritic, slightly carbonaceous, unconsolidated to slightly consolidated in part, soft to plastic (minor pyrite). 20% Sand, light grey-brown, very tight, very lithic, quartzose, silty, slightly micaceous, very fine to fine, angular to subangular, sorted, crumbly break, tightly cemented (zeolite and chlorite), very friable.
1346 - 1365 feet	:	Coal, dark grey to black, argillaceous in part.
1365 - 1793 feet	:	50% Sand, light grey to greenish-brown, low porosity (estimate 5-10%) and low permeability, very fine to fine, sorted, angular, lithic to sublithic, quartzose, silty, slightly argillaceous, thin carbonaceous laminae, slightly micaceous, cemented, very friable. 30% Silt, light greenish-grey, very argillaceous, slightly lithic and fine sandy, slightly consolidated, soft to plastic, (minor coal, chlorite, mica and pyrite). 20% Clay, light greenish-grey, silty, chloritic, carbonaceous, slightly consolidated, plastic (minor pyrite).
1793 - 1820 feet	:	description as interval 1365 - 1793 feet.

1820 - 1972 feet : 50% Silt to Siltstone, light brown-grey and blue-grey, tight, very argillaceous, minor very fine sand fraction (quartzose and lithic), slightly consolidated, soft to plastic, (minor carbonaceous matter and chlorite).

: 30% Sand to Sandstone, light grey-brown, tight with very low porosity and permeability, lithic, silty, carbonaceous, very fine, well sorted, crumbly break, tightly cemented, very friable.

: 20% Clay, light greenish grey-brown, silty, chloritic, carbonaceous, slightly consolidated, plastic.

1972 - 2243 feet : 50% Sand(Sandstone) to Silt (Siltstone), light to medium grey-brown, very tight, sand fraction very fine lithic to sublithic, well sorted, angular, silty, argillaceous, carbonaceous, crumbly break, well cemented (zeolite), very friable to loose, (minor chlorite and mica).

30% Silt to Clay, light brownish-grey, chloritic, carbonaceous, slightly consolidated, plastic, (minor mica).

20% Sand to Sandstone, light grey, low to medium porosity and permeability, fine to medium, sorted, angular, lithic to sublithic and quartzose in part, micaceous, carbonaceous, crumbly break, cemented, very friable to loose.

2243 - 2356 feet : 70% Clay, greenish-grey, silty and slightly fine sandy in part, slightly carbonaceous, chloritic, soft to firm, slightly consolidated.

20% Silt to Siltstone, greenish grey-brown, argillaceous, fine sandy in part, lithic, carbonaceous, slightly consolidated (minor chlorite and mica).

10% Sand to Sandstone, light grey-brown, lithic, silty, very fine to medium, loose to crumbly break, slightly consolidated.

2356 - 3080 feet : Basal unit (? Jurassic)

2356 - 2367 feet (718.3 - 721.6 m) : Volcanic, blue-green to light green, very chloritic, moderately soft and plastic, very weathered or altered.

2367 - 2986 feet (721.6 - 910.4 m) : Volcanic sequence, basic, mainly Basalts, relatively fresh (brownish black to greenish black) to very altered (light to dark blue-green, red-brown, grey-brown, purple-brown etc), vesicular, glassy in part with colourless and green phenocrysts (augite, epidote(?)etc), minor quartz. and some calcite veining throughout.

: Some brown clayey and tuffaceous horizons probably separate different flows.

2986 - 3080 feet : Tuff, medium grey-brown to red-brown (ironstained) feldspathic, clayey, coarse, sorted, altered or weathered, tightly cemented, soft.

3080 - 3308 feet (T.D.) : Basement (? Ordovician)

Quartz - Mica Schist, light to dark grey, medium to coarse crystalline, almost entirely quartz and biotite, strongly foliated, white quartz veins.

Total Depth 3308 feet

4.5 Contribution to geological concepts resulting from drilling:

Moyne Falls No. 1 was located on one of several structurally high basement blocks indicated by gravity and seismic along the northern margin of the Otway Basin. The results of Moyne Falls No. 1 contribute to an understanding of the palaeogeography and the geology of the northern part of the Tyrendarra Embayment. The more important factors are summarized as follows:

(a) The 1,256 feet of Eumeralla formation (unit 1 and 2) penetrated in Moyne Falls No. 1 are almost entirely soft and friable, as reflected by the extremely fast penetration rates and the very low velocities recorded on the integrated sonic log. The sediments are soft and friable although they are moderately to tightly cemented by chlorite and zeolite. The lack of induration of the sediments may indicate a lack of appreciable overburden after their deposition (Lower Cretaceous). It is likely that the structurally high area on which Moyne Falls No. 1 is located, has been a palaeohigh area during part of the Lower Cretaceous and has probably remained high since then. The absence of the Sherbrook group (KU), the Wangerrip group (Pc) and the Nirranda group (EU) is probably due to a restricted supply of sediments or non deposition rather than erosion.

(b) The 1,256 feet of Eumeralla formation in the Moyne Falls No. 1 well comprises almost all spore-pollen zones known to occur in this formation in the Otway Basin. In most wells however, the zones cover far thicker sedimentary sequences and seldom occur together in the one well. Hence, the sequence penetrated in Moyne Falls No. 1 is a very condensed one without significant breaks (due to non deposition and/or erosion) which points to growing palaeohigh conditions of the area.

(c) The presence of the Basal unit (724 ft) of the Otway group in the Moyne Falls No. 1 well was not prognosticated. The unit consists entirely of volcanics without the carbonaceous shales and siltstones (potential source rocks) which were encountered in the Casterton No. 1 and Woolsthorpe No. 1 wells. The Eumeralla formation overlies the Basal unit directly as in the Robertson No. 1 and 2 wells in the South Australian part of the Otway Basin.

(d) The objectives of Moyne Falls No. 1 were to test the possibility of porous sand development at the base of the Otway group sediments immediately overlying basement and the possibility of a hydrocarbon accumulation in fractured or weathered basement. In the well however, tight volcanics form the base of the Otway group and no porosity due to weathering or fractures was encountered in the top of the basement. The result of Moyne Falls No. 1 downgrades the prospectivity of similarly developed basement highs along the northern basin margin.

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APPENDIX I

LIST OF SCHLUMBERGER LOGS

RUN IN MOYNE FALLS NO.1

LOG	RUN NO.	DATE-1969	INTERVAL (in ft.)	SCALE (ins./100 ft)
IES	1	24 Nov.	2,814-1,271	1 and 5
	2	27 Nov.	3,311-2,814	1 and 5
BSGRC	1	24 Nov.	2,806-1,271	1 and 5
	2	27 Nov.	3,294-2,806	1 and 5
CDM	1	24 Nov.	2,811-1,271	2 and 5

APPENDIX IA

INTERPRETATION COMMENTS ON WELL LOGS OF MOYNE FALLS NO. 1

by

Schlumberger Seaco Inc.

CONTENTS

INTERPRETATION COMMENTS WELL LOGS OF MOYNE FALLS NO. I

LOGS AVAILABLE

Induction Electrical Log	Run 1	2814' - 1271'
	Run 2	3311' - 2814'
B.H. Comp Sonic Gamma Ray	Run 1	2806' - 1271'
	Run 2	3294' - 1271'
Continuous Dipmeter	Run 1	2811' - 1271'

BOREHOLE FLUIDS

Run 1 Freshwater Q broxin mud

R_m = 3.5 at 86 = 2.6 at 119°F
R_{mf} = 3.7 at 70 = 2.2 at 119°F
R_{mc} = 3.9 at 70 = 2.3 at 119°F

Run 2 Freshwater Q broxin mud

R_m = 3.34 at 52 = 1.4 at 124°F
R_{mf} = 3.2 at 47 = 1.3 at 124°F
R_{mc} = 3.84 at 47 = 1.6 at 124°F

METHOD

With available logs limited to Induction and Sonic we may only make the usual crossplot of these readings.

We have selected readings where bed thickness exceeds 5' and where the gamma ray indicates relatively clean formations. Where possible this is supported by the SP but usually the SP is almost neglible probably due to a low salinity contrast between formation waters and mud filtrate. Table 1 gives values for runs 1 and 2.

DISCUSSION

Figure 1 is the crossplot of Ril versus Δt for run 1 set of logs. A good trend line is developed and we can be quite confident that only water zones are involved. Point 7 may possibly contain some hydrocarbons but we incline to believe that the higher resistivity is due to boundary effects due to the resistive bed immediately above it.

Figure 2 is a similar plot for run 2. Another good trend line is developed. With Δt of 145 we are certain that compaction has not been reached. This is supported by the Δtsh at 3000' of 125 m secs/ft. Consequently ϕs values are optimistic. We note that point 13 is anomalous and may contain some hydrocarbons, but we believe that this merely represents a slight change towards more quartzitic sands. (Δtm change). Anyway the hydrocarbon saturation even if Δtm does not change must be very small and neglible.

We note that Δtm of run 1 is 47 m secs/ft and for run 2 is 40 m secs/ft; these values are very low for quartzitic sands. However they probably may be used to determine ϕs and we have tabulated these values. We appreciate that these ϕs values are probably optimistic since no allowance has been made for compaction.

<u>DIPMETER</u>

We have made the conventional coloured interpretation of consistent dips and anotated the plot where we feel that possible structural or stratigraphic interpretation is warranted. However the dipmeter should never be considered alone but only in the context of other geological information since usually several possible interpretations exist. Therefore, please consider these suggestions as tentative and only a guide to interpretation. With such interesting features it is regretted that the higher precision and detailed High Resolution Dipmeter was not available.

CONCLUSION

1. These formations contain only water

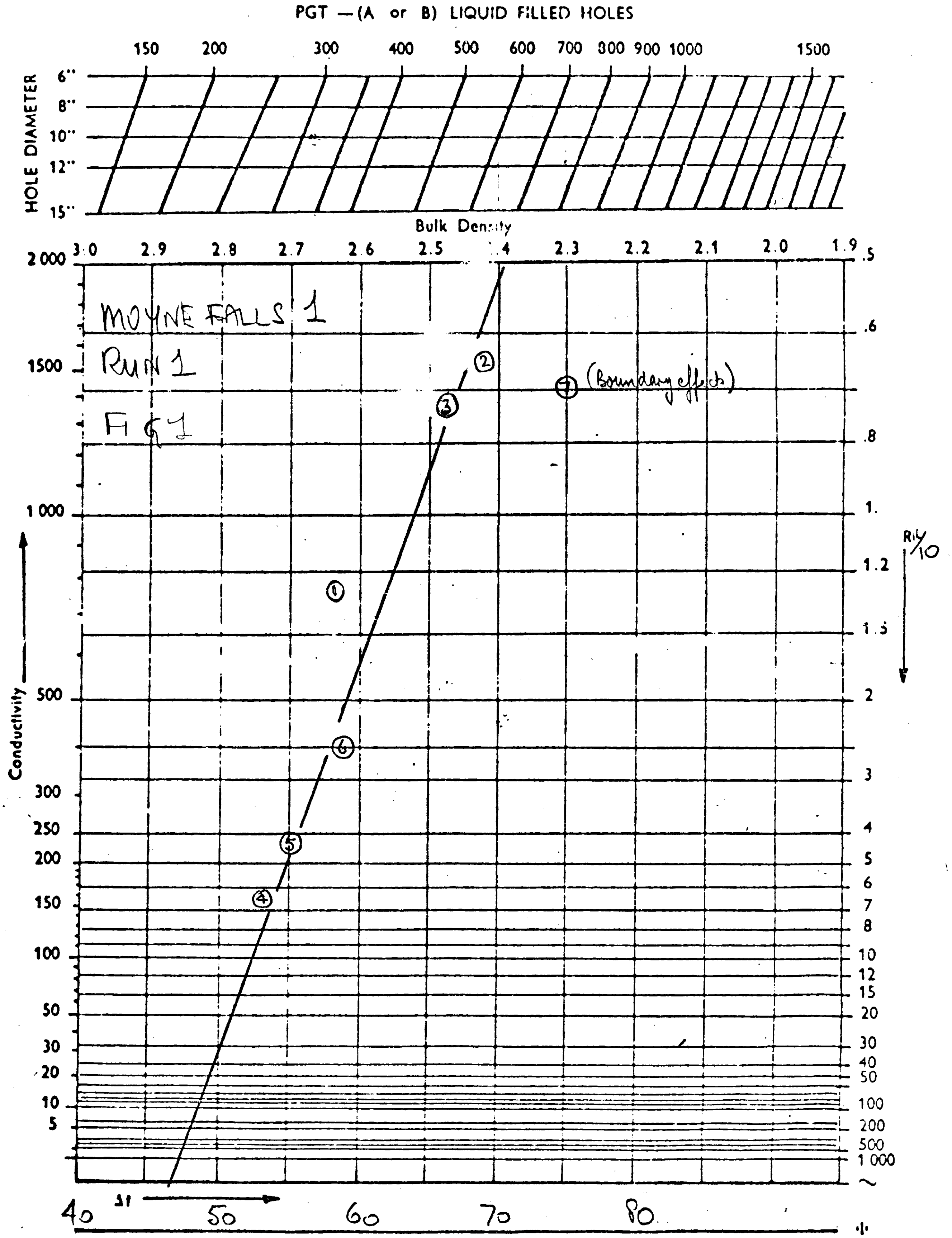
2. The Sonic is ill suited to porosity determination since these formations are clearly uncompacted. A density log is to be preferred.

3. The dipmeter gives useful geological information on structure and stratigraphy.

HUGH CROCKER

HC/dm.

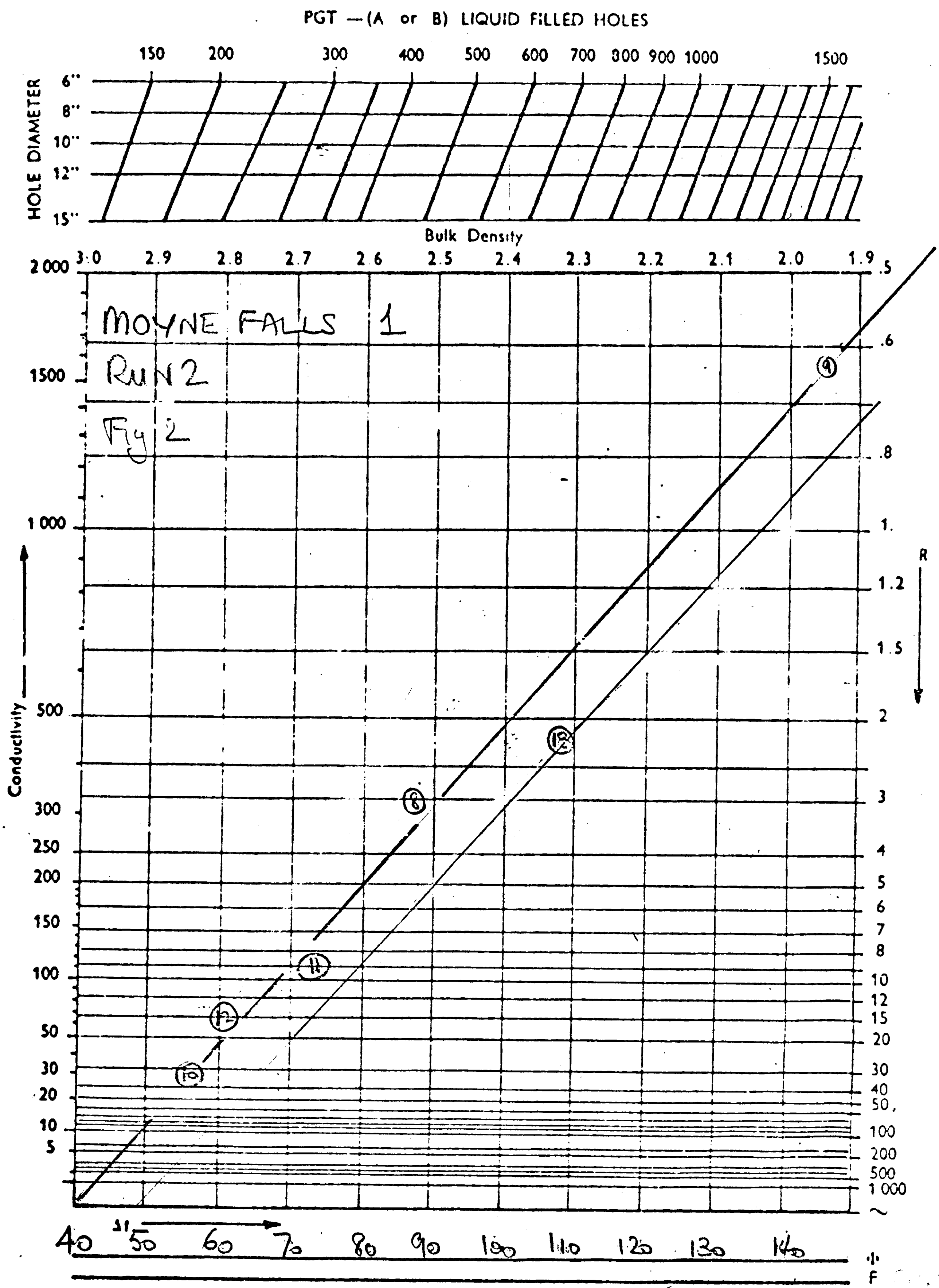
GRID FOR SONIC — RESISTIVITY OR FD — RESISTIVITY PLOTS



Grid for Resistivity vs Sonic or vs Formation Density Plot

F = .62

GRID FOR SONIC — RESISTIVITY OR FD — RESISTIVITY PLOTS



Grid for Resistivity vs Sonic or vs Formation Density Plot

F = .62

INTERPRETATION : MOYNE FALLS 1.

TABLE 1

			Nº	IES DEPTH	R_{IL}	Δt	Φ_s ($\Delta t_m = 47$)
			1	2470	.13	58	7.5
			2	2530	6.5	69	15
			3	2536	7.2	66	13
			4	2600	65	53.5	4
			5	2664	42	55	5
			6	2754	25	59	8
		Run 1	7	2773	7	75	19.5
		Run 2	8	2790	3	87	31
			9	2842	0.64	145	–
			10	2930	32	56	11.5
			11	2966	9	73	22
			12	2974	15	60	13.5
			13	3020	2.2	109	–
							$\Delta t_m = 40$

TABLE IA.1.

CORE AND SIDEWALL CORE DESCRIPTIONS
MOYNE FALLS NO. 1

by Shell Development (Australia) Pty. Ltd.

Fig. II-1 Cores 1 and 2 of Moyne Falls No. 1

DESCRIPTION OF CORES:

Core No. 1 — 2413 to 2424 feet. Cored 11 feet, recovered no true core*

Recovered 1 ft of reaming material, mostly clay, and a few large rock fragments probably derived from the cored interval. Description of these fragments:
Volcanic, light to dark grey-green, very fine crystalline, very chloritic, 10 to 20% medium size phenocrysts and crystal fragments. Vesicular, very altered.

Core No. 2 — 2424 to 2429 feet. Cored 5 feet, recovered no true core*

Recovered 7 ft of reaming material, mostly clay and a few rock fragments, probably derived from the cored interval. Description of these fragments:
Volcanic, light to dark grey-green, same altered rock type as Core No. 1.

Core No. 3 — 2814 to 2833 feet. Cored 19 feet, recovered no true core*

Recovered 5 ft of reaming material, mostly clay and a few rock fragments, probably derived from the cored interval. Description of these fragments:
Volcanic, light to dark grey-green, same altered rock type as Core No. 1 and 2.

Core No. 4 — 3288 to 3308 feet. Cored 20 feet, recovered 6 ft (30%)

Quartz-Biotite Schist, medium to dark grey, medium to coarse crystalline, foliated, foliation dip 30 to 70° from core axis (hole deviation 2¼°).
Quartz veins up to 1 inch thick.

* Cores No. 1, 2 and 3 consisted mainly of cavings, probably due to the fact that some reaming was necessary while running in with the core barrel (conventional tool). A few larger rock fragment were recovered and these are of the same rock type as the ditch cuttings immediately above and below the interval cored. It is therefore assumed

that these larger fragments represent true core. The recoveries indicated in feet represent the total amount of material taken from the core barrel.

DESCRIPTION OF SIDEWALL CORES

1289 feet 393.0	Clay, dark grey-brown, sandy, silty, unconsolidated, very soft.
1300 feet 396.3	Sandstone, no visible porosity and permeability, light grey, lithic, some quartz grains, fine, angular, sorted, tightly cemented very friable.
1385 feet 422.3	Sandstone, low porosity (10%) and permeability, light grey, fine to medium, angular, moderately sorted, cemented, very friable.
1449 feet 441.7	Sandstone, low porosity (10%) and permeability, light grey, sublithic, very fine, well sorted, angular, slightly consolidated, very friable, contains abundant quartz grains and carbonaceous laminae.
1576 feet 480.5	Sandstone, no visible porosity and permeability, light grey, lithic, very carbonaceous, very fine, sorted, angular, laminated, grades to silt, tightly cemented, very friable, contains quartz grains and 20% carbonaceous material.
1677 feet 511.3	Siltstone, light bluish-grey to light yellow-grey, sandy, carbonaceous, micaceous, slightly consolidated, soft.
1732 feet 528.0	Clay, medium grey, silty, slightly carbonaceous, slightly consolidated, soft.
1802 feet 549.4	Siltstone and Clay, light bluish-grey, slightly consolidated, soft.
1902 feet 579.9	Sandstone, no visible porosity and permeability, light grey, lithic, carbonaceous, very fine, well sorted, angular, tightly cemented, very friable.
1952 feet 595.1	Siltstone, light grey-green, sandy, argillaceous, slightly carbonaceous, slightly consolidated, moderately soft.

2022 feet 564.8	Sandstone, light to medium grey, quartzose to lithic, silty in part, very carbonaceous, tightly cemented without visible porosity, thin less cemented laminae with 10-15% porosity in part, very friable.
2079 feet 633.8	Sandstone, 10-15% porosity, light grey, sublithic, very carbonaceous, fine to medium, angular, sorted, moderately cemented, very friable, with abundant quartz grains.
2104 feet 641.5	Sandstone, no visible porosity, medium grey, silty argillaceous, carbonaceous, very fine to fine, sorted, with thin clean sandstone laminae, very friable.
2166 feet 660.4	Siltstone, light grey, sandy, slightly consolidated, soft.
2201 feet 671 0	Sandstone, 10% porosity, light grey, lithic, quartz grains, medium, very well sorted, angular to subrounded, abundant cement, some red staining of minerals, very friable.
2271 feet 692.4	Siltstone, light to medium grey, lithic, sandy, grades to very fine sandstone in part, slightly consolidated, soft.
2301 feet 701.5	Clay, light greenish-grey, silty, sandy, chloritic, slightly consolidated, soft.
2324 feet 708.5 m	Clay, medium green-grey, silty, chloritic, slightly consolidated, soft.
2330 feet 710.4 m	Clay, medium green-grey, chloritic, consolidated, moderately hard.
2362 feet 720.1 m	Volcanic, blue-green, very weathered or altered basic volcanic, moderately hard.
2371 feet 722.87 m	Basalt, medium to dark grey-green, vesicular, with secondary minerals filling veins and vugs, very altered, hard.
2422 feet 738.4 m	Basalt, dark green, phenocrysts of ? epidote, altered, hard.
2505 feet 763.7 m	Basalt, dark blue-green, vesicular with secondary dark green vein minerals, hard.

2530 feet 771.3 m	Basalt, dark green, glassy, altered to fresh, possibly tuffaceous in part, hard.
2926 feet 892.0 m	Basalt, dark green, weathered, glassy, hard.
3050 feet 929.9 m	Tuff, red-brown iron stained, feldspathic, coarse, very well sorted, tightly cemented, has weathered appearance.

PALAEONTOLOGICAL REPORT

SHELL/FROME MOYNE FALLS NO. 1 WELL

by

Shell Development (Australia) Pty. Ltd.

Geological Laboratory

CONTENTS

1. SUMMARY

Moyne Falls-1 encountered Middle Miocene limestones and marls of the Heytesbury group from 181 to 700 feet, and Lower Miocene marls from 700 to 1,030 feet.

The following zonules could be recognised

Zonule D	210-± 500	feet
" E	± 500- 700	feet
" F	700- 840	feet
" G	840- 1,020	feet
" ? H	1,020- 1,050	feet

The Clifton formation (basal unit of the Heytesbury group) appears to be of Zonule H age, the lowest sample (1,080-1,100 feet) being possibly as old as uppermost Zonule I-1.

No in situ foraminifera were found in samples below 1,100 feet.

2. INTRODUCTION

Selected cutting samples between 150 and 2,380 feet in Moyne Falls-1 were examined for foraminifera; the stratigraphically significant species are documented below. The zonation used is that of Taylor (1966) for the Gippsland, Bass and Otway Basins, which has been outlined in SDA Report 96 (see references).

Mud contamination and caving was severe while drilling through the Heytesbury group and resulted in mixing of faunas and blurring of faunal boundaries. Few precise time boundaries can be given in the Heytesbury group. No foraminifera were found in situ in the interval 1,100-2,380 feet which is assigned to the Otway group. Faunas found in this interval are entirely derived from Heytesbury group caving.

3. THE FORAMINIFERAL SUCCESSION

<u>210-240 feet</u>. <u>Zonule D</u>. A shallow water grainstone containing few foraminifera. Based on the presence of <u>Orbulina universa</u>, the sample is no older than Zonule D (Middle Miocene). <u>O. universa</u> ranges from this zonule to the Recent, but no Heytesbury group carbonates younger than Zonule D have been found in the Otway Basin, so that a Zonule D age seems very probable.

<u>300-330 feet</u>. <u>Zonule D</u>. The fauna includes <u>Orbulina universa</u> and rare <u>Globigerinoides glomerosus glomerosus -- circularis</u>. The latter indicates a position in the lower part of Zonule D.

<u>390-420 feet</u>. <u>Zonule D</u>. Same species as above, with two dubious specimens of <u>Globigerinoides glomerosus glomerosus</u>. Other components of the fauna include <u>Globigerinoides glomerosus circularis</u>, <u>Orbulina universa</u>, <u>O. suturalis</u>, <u>Globorotalia barisanensis</u>, <u>G. mayeri</u>, <u>Globigerinoides ruber</u>, <u>G. trilobus</u>, <u>Globerigerina woodi</u>, <u>G. apertura</u> and <u>Globoquadrina dehiscens</u>.

<u>480-510 feet</u>. <u>Zonules D-E</u>. Problematical in age, since the fauna is essentially the same as that listed above. However, <u>Globigerinoides glomerosus glomerosus</u>

3. THE FORAMINIFERAL SUCCESSION (Cont'd)

(one of the index species for Zonule E) is present in very small numbers, with moderately abundant Globigerinoides glomerosus circularis. The presence of Globorotalia sp.-5 (=G. cf. conica Jenkins) also suggests that this sample may be close to the Zonule D-E boundary.

570-600 feet. Zonule E (Middle Miocene). Globoratalia conica (restricted to Zonule E) and Globigerinoides glomerosus glomerosus are present.

660-690 feet. Zonule E (low). Globigerinoides bisphericus is abundant for the first time. The fauna is dominated by different species than those in younger samples. Globigerinoides trilobus is the most abundant species. Globigerinoides bisphericus, Globigerinoides glomerosus curvus, Globigerina woodi, G. bulloides, Globigerinoides immaturus, Globigerina cf. venezuelana and Uvigerina cf. canariensis assume new importance. Globigerina apertura, Globigerinoides ruber, Globoquadrina dehiscens, Globorotalia conica, and Orbulina suturalis continue from above; the last named is contamination. The early stage of the glomerosus lineage (Globigerinoides glomerosus curvus) indicates a position fairly low in Zonule E.

690-720 feet. This is a mixed and heavily contaminated sample which cannot be assigned to either Zonule E or F with any confidence.

720-750 feet. Zonule F. The sample is dominated by Globigerinoides bisphericus without significant numbers of the Globigerinoides glomerosus group, and can be assigned to Zonule F (see footnote).

Footnote:

"Zonule F was originally placed at the top of the Lower Miocene by Taylor, (1966). Subsequently he eliminated the usage of the term Middle Miocene, and subdivided the Miocene into Upper and Lower, the boundary being placed at the base of Zonule D (personal communication). In this report the old usage of Upper, Middle and Lower Miocene is retained, to conform with the zonation presented in SDA Report 96."

3. THE FORAMINIFERAL SUCCESSION (Cont'd)

810-840 feet. Zonule F. The abundance of Globigerinoides trilobus, Globigerina woodi and to a lesser degree, Globigerinoides bisphericus, indicates Zonule F. The relative rarity of the Globigerinoides glomerosus lineage probably indicates a position low in the zonule.

840-870 feet. Zonule G (Lower Miocene). Dominated by Globigerinoides trilobus, Globigerina woodi, and G. apertura. A further decrease in the numbers of the glomerosus group, and a decrease in the abundance of Globigerinoides bisphericus, indicates the probable top of the zonule.

900-930 feet and 990-1,020 feet. Zonule G. The greater part of the fauna here comprises varieties of Globigerinoides trilobus, with abundant Globigerina woodi.

1,020-1,050 feet. This sample may represent Zonule H (at the present considered to be basal Miocene). However the caving of Globigerinoides trilobus from Zonule G above makes this difficult to determine, as Zonule H is largely defined on the absence of this species. Globigerina cf. euapertura has been recorded before in the Lower Miocene. It is rare in this sample, and in the absence of other definite Zonule I indicators such as true G. euapertura and Victoriella conoidea, it is preferred to regard this sample as probable Zonule H.

1,080-1,100 feet. This basal sample of the Heytesbury group is difficult to date. Globigerina cf. euapertura is again present. The increased relative abundance of Globigerina bulloides and G. apertura may indicate that the sample belongs in uppermost Zonule I-1 (at present thought to be Oligocene). The sample is either low in Zonule H, or very high in Zonule I-1.

Samples below the Heytesbury group were picked at 1,140-1,170', 1,230-1,260', 1,420-1,450', 1,450-1,480', 1,540-1,570', 1,690-1,720', 1,810-1,840', 1,900-1,930', 1,930-1,960', 1,960-1,990', 2,020-2,050', 2,110-2,140', 2,170-2,200', 2,200-2,230', 2,230-2,260', 2,260-2,290', 2,290-2,320', 2,330-2,350' and 2,350-2,380'. No foraminifera were found in situ although Miocene contaminants from the Heytesbury group were fairly common.

4. ENVIRONMENT OF DEPOSITION

The Clifton formation, which forms the basal transgressive unit of the Heytesbury group, is generally a shallow water deposit. Because of the severe caving in this well, much of the fauna is masked and shallow water faunas are not obvious. There are, however, numerous fragments of bryozoa which probably indicate transgression over a moderately shallow rocky substrate .

Following deposition of the Clifton formation, the depositional environment rapidly deepens, resulting in deposition of middle and outer neritic marls which characterize most of the Heytesbury group deposits. The youngest limestones (approximately 150-250 feet) are shallow-water high energy grainstones, deposited as a result of the rapid regression of the Heytesbury group which occurred at the end of Zonule D time.

5. CONCLUSIONS

The marine sequence in Moyne Falls-1 appears to be almost entirely Miocene in age, indicating the gradual advance of the Heytesbury transgression northwards across the basin. The absence of the Lower Tertiary Nirranda and Wangerrip groups and of the Upper Cretaceous Sherbrook group is either due to erosion which took place at various levels (in the Otway Basin all groups are bounded by unconformities) or to non-deposition in this area, which could have been located north of the marine transgression.

6. REFERENCES

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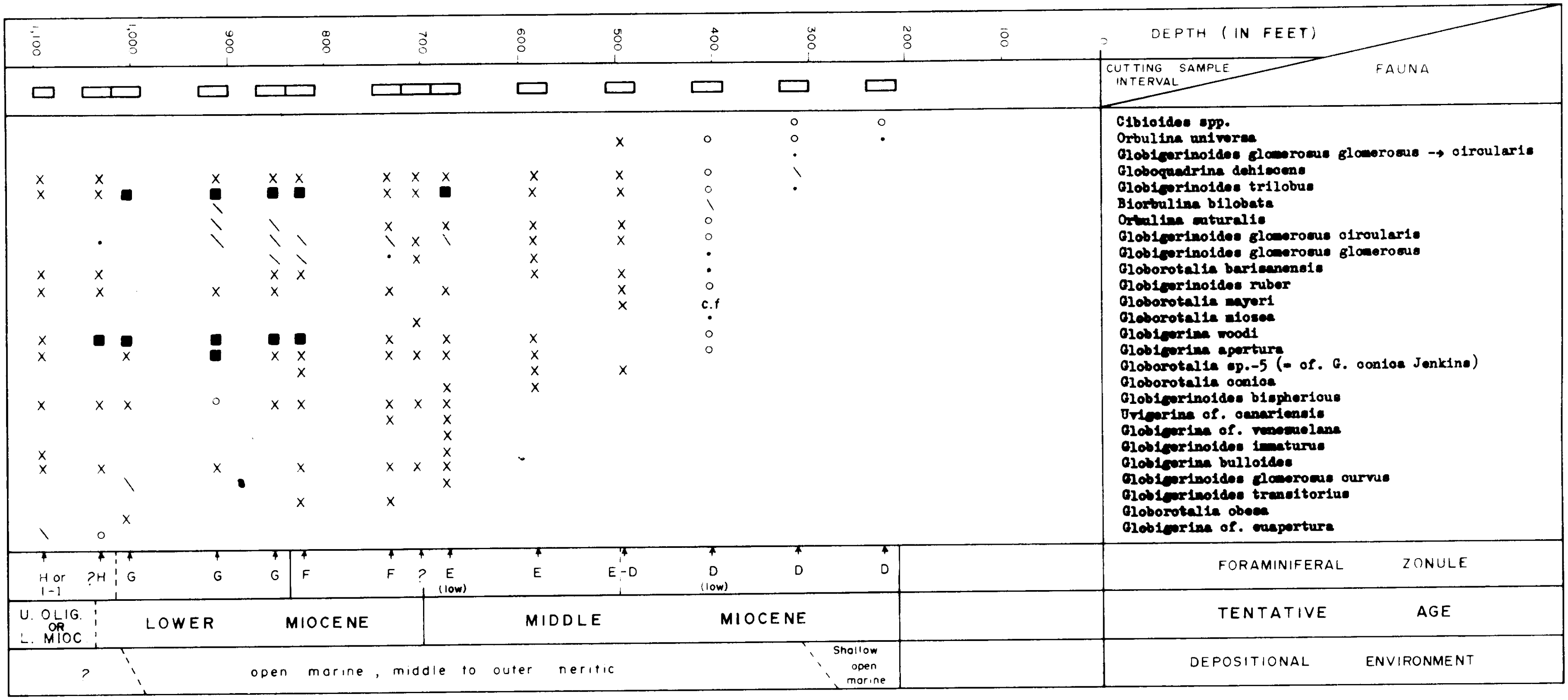

LEGEND

Specimen frequency

- • 1 specimen
- \ 2-5 specimens
- ○ 6-20 specimens
- ● 21-100 specimens
- ■ > 100 specimens
- x qualitative determination only

SHELL DEVELOPMENT (AUSTRALIA) PTY LTD

OTWAY BASIN

MOYNE FALLS - 1

DISTRIBUTION OF FORAMINIFERA

Author M. Apthorpe	Date January 1970
Report W.C.R. Fig III-1	Drawing No 4034

PALYNOLOGICAL REPORT

MOYNE FALLS NO.1, 1,289-3,050 FEET

by

Dr. M.E. Dettmann - University of Queensland

CONTENTS

PALYNOLOGICAL REPORT ON MOYNE FALLS No.1 WELL, 1289 - 3050 FEET

1. Introduction

The present account details the results obtained from a palynological examination of selected sidewall cores taken from Moyne Falls -1 well, 1289 - 3050 feet. The study, carried out at the request of Shell Development (Australia) Pty. Ltd., was made possible through the courtesy of, and the facilities offered by, the Mines Department of Victoria and the Department of Geology in the University of Queensland; and through the technical assistance of Mr. C. Lennie of Shell Development (Australia) Pty. Ltd. Acknowledgment to these persons and organisations is gratefully recorded.

The samples were prepared for palynological examination by a method (see Dettmann 1968) involving the use of hydrofluoric acid, zinc bromide, and ultrasonic vibration. Portions of the resultant residues were mounted in glycerine jelly and the preservation quality of the plant microfossils assessed (Table 1). The remainder of the residues were further treated with Schulze solution for two minutes followed by washing in weak alkaly (1% ammonium hydroxide) before specific analysis of the microfloras was carried out.

All but the lowest sample yielded plant microfossils including spores, pollen grains, and wood and cuticular material. The microfossils are mainly fairly preserved, showing slight decrease in preservation quality with increase in depth (see Table 1). As evidence below, the plant microfossil assemblages are of Lower Cretaceous age and contain species indicative of the following spore-pollen biostratigraphic units delineated by Dettmann and Playford (1969) and Dettmann (1969a,b); the *Coptospora paradoxa* Zone; the *Crybelosporites striatus* Subzone; and the *Cyclosporites hughesi* Subzone (in which the *Foraminisporis asymmetricus* and the *Rouseisporites reticulatus* Units are represented). Thus, the strata examined range in age from Neocomian-Aptian to Albian.

2. MICROFLORAL CONTENT AND AGE OF SAMPLES

The spore-pollen assemblages identified in the samples are tabulated below with reference to their qualitative and quantitative content; the quantitative estimates are expressed in the following terms:- Ab (abundant) - numerical representation of a particular species totals at least 5% of total microflora, C (common) - numerical representation of a species forms 1 - 5% of total microflora, and R (rare) - numerical representation of a species is less than 1% of total microflora.

A. 1289 feet

Plant material extracted from the sample is fairly preserved and includes commonly occurring spores and pollen grains together with wood and cuticular tissue. Species identified include:

Spores:	*Baculatisporites comaumensis* (Cookson)	C
	Balmeisporites holodictyus Cookson & Dettmann	R
	Cicatricosisporites australiensis (Cookson)	Ab
	Crybelosporites striatus (Cookson & Dettmann)	C
	Cyathidites asper (Bolkhovitina)	R
	C. australis Couper	C
	C. minor Couper	Ab
	Gleicheniidites circinidites (Cookson)	C
	Kraeuselisporites majus (Cookson & Dettmann)	R

	Lycopodiumsporites austroclavatidites (Cookson)	C
	Rouseisporites reticulatus Pocock	R
	Stereisporites antiquasporites (Wilson & Webster)	Ab
	Trilobosporites trioreticulosus Cookson & Dettmann	C
	T. tribotrys Dettmann	R
Pollen:	Alisporites similis (Balme)	C
	Classopollis cf. classoides Pflug	C
	Microcachryidites antarcticus Cookson	C
	Podocarpidites cf. ellipticus Cookson	Ab

The content of Trilobosporites trioreticulosus, T. tribotrys, and Kraeuselisporites majus indicates that the sample is from the Coptospora paradoxa Zone (unnamed unit) and thus of Albian age (see Dettmann 1969a).

B. 1385 - 1576 feet

1385 feet

The sparse microflora obtained from the sample is composed of one to several examples of the following species:

Spores: Baculatisporites comaumensis (Cookson)
Cicatricosisporites australiensis (Cookson)
Coptospora striata Dettmann
Cyathidites australis Couper
Foraminisporis asymmetricus (Cookson & Dettmann)
Leptolepidites verrucatus Couper
Rouseisporites reticulatus Pocock
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

1444 feet

A small residue containing rare spores and pollen grains was extracted from the sample. Examples of the following species were observed:

Spores: Baculatisporites comaumensis (Cookson)
Cicatricosisporites australiensis (Cookson)
Coptospora striata Dettmann
Rouseisporites reticulatus Pocock

Pollen:	Classopollis cf. classoides Pflug	
	Microcachryidites antarcticus Cookson	

1576 feet

Plant material extracted from the sample includes abundant woody tissue and a restricted spore-pollen suite. Types identified include:

Spores:	Aequitriradites spinulosus (Cookson & Dettmann)	R
	Baculatisporites comaumensis (Cookson)	Ab
	Cicatricosisporites australiensis (Cookson)	Ab
	Cyathidites asper (Bolkhovitina)	C
	C. australis Couper	Ab
	C. minor Couper	C
	Foraminisporis asymmetricus (Cookson & Dettmann)	R
	F. wonthaggiensis (Cookson & Dettmann)	R
	Lycopodiumsporites austroclavatidites (Cookson)	Ab
	Rouseisporites reticulatus Pocock	R
	Stereisporites antiquasporites (Wilson & Webster)	Ab
Pollen:	Alisporites grandis (Cookson)	C
	Araucariacites australis Cookson	Ab
	Classopollis cf. classoides Pflug	C
	Cycadopites nitidus (Balme)	R
	Microcachryidites antarcticus Cookson	Ab
	Podocarpidites cf. ellipticus Cookson	Ab

Insufficient representation of diagnostic species precludes precise zonal attribution of sediments between 1385 feet and 1576 feet. However the presence of Coptospora striata at 1385 feet and 1444 feet indicates that the sediments belong to the Dictyotosporites filosus Unit or the Crybelosporites striatus Subzone (see Dettmann 1969a).

C. 1732 feet

The following diverse assemblage of spores and pollen grains occurs in the sample:

Spores:	Aequitriradites spinulosus (Cookson & Dettmann)	R
	Baculatisporites comaumensis (Cookson)	Ab
	Ceratosporites equalis Cookson & Dettmann	C
	Cicatricosisporites australiensis (Cookson)	Ab

	Crybelosporites striatus (Cookson & Dettmann)	R
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab
	Dictyotosporites speciosus Cookson & Dettmann	R
	Foraminisporis asymmetricus (Cookson & Dettmann)	R
	F. wonthaggiensis (Cookson & Dettmann)	C
	Klukisporites scaberis (Cookson & Dettmann)	R
	Leptolepidites verrucatus Couper	Ab
	Lycopodiumsporites austroclavatidites (Cookson)	Ab
	L. eminulus Dettmann	R
	L. facetus Dettmann	R
	Rouseisporites reticulatus Pocock	R
	Stereisporites antiquasporites (Wilson & Webster)	Ab
	Velosporites triquetrus (Lantz)	R
Pollen:	*Araucariacites australis* Cookson	R
	Alisporites grandis (Cookson)	C
	A. similis (Balme)	C
	Classpollis cf. *classoides* Pflug	Ab
	Cycadopites nitidus (Balme)	C
	Podocarpidites cf. *ellipticus* Cookson	Ab
	Tsugaepollenites dampieri (Balme)	R
Remanié:	*Aratrisporites* sp. - Triassic	R
	Lundbladispora denmeadi (de Jersey) - Triassic	R

The sediment contains *Dictyotosporites speciosus* and *Crybelosporites striatus* and is thus probably from within the *Crybelosporites striatus* Subzone but may be as young as the *Dictyotosporites filosus* Unit. Remanié types observed are of rare occurrence and are of Triassic origin.

D. 1802 - 2022 feet

1802 feet

A diverse assemblage of spores and pollen grains was extracted from the sample. Species identified include:

Spores:	*Aequitriradites spinulosus* (Cookson & Dettmann)	Ab
	Baculatisporites comaumensis (Cookson)	Ab
	Cicatricosisporites australiensis (Cookson)	R
	Cooksonites variabilis Pocock	C
	Cyathidites australis Couper	Ab
	C. minor Couper	C
	C. punctatus (Delcourt & Sprumont)	Ab
	Foraminisporis asymmetricus (Cookson & Dettmann)	R
	F. wonthaggiensis (Cookson & Dettmann)	C
	Gleicheniidites cf. *circinidites* (Cookson)	R

	Ischyosporites punctatus Cookson & Dettmann	C
	Lycopodiumsporites austroclavatidites (Cookson)	C
	L. circolumenus Cookson & Dettmann	R
	Klukisporites scaberis (Cookson & Dettmann)	R
	Matonisporites cooksonii Dettmann	R
	Pilosisporites notensis Cookson & Dettmann	R
	P. parvispinosus Dettmann	R
	Trilobosporites purverulentus (Verbitskaya)	R
	Rouseisporites reticulatus Pocock	R
Pollen:	Alisporites grandis(Cookson)	C
	Classopollis cf. classoides Pflug	R
	Microcachryidites antarcticus Cookson	C
	Podocarpidites cf. ellipticus Cookson	Ab
	Tsugaepollenites dampieri (Balme)	R
Remanié:	Dulhuntyspora sp. - Permian	R
	Lundbladispora denmeadi (de Jersey) - Triassic	R

1902 feet

Plant matter extracted from the sample includes abundant wood and cuticular fragments and less frequent spores and pollen grains. Species identified include:

Spores:	Baculatisporites comaumensis (Cookson)	Ab
	Ceratosporites equalis Cookson & Dettmann	C
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab
	Dictyotosporites speciosus Cookson & Dettmann	R
	Klukisporites scaberis (Cookson & Dettmann)	C
	Leptolepidites verrucatus Couper	R
	L. major Couper	R
	Lycopodiacidites asperatus Dettmann	R
	Lycopodiumsporites austroclavatidites (Cookson)	Ab
	Pilosisporites parvispinosus Dettmann	C
Pollen:	Alisporites similis (Balme)	C
	Classpollis cf. classoides Pflug	C
	Microcachryidites antarcticus Cookson	C
	Podocarpidites cf. ellipticus Cookson	Ab
	Tsugaepollenites dampieri (Balme)	C
Incertae Sedis:	Schizosporis reticulatus Cookson & Dettmann	R
	S. spriggi Cookson & Dettmann	R

1952 feet

An abundant and diverse assemblage of spores and pollen grains occurs in the sample. The following species were observed:

Spores:	*Aequitriradites spinulosus* (Cookson & Dettmann)	R
	Baculatisporites comaumensis (Cookson)	Ab
	Ceratosporites equalis Cookson & Dettmann	C
	Cicatricosisporites australiensis (Cookson)	C
	Cooksonites variabilis Pocock	R
	Cyclosporites hughesi (Cookson & Dettmann)	C
	Cyathidites australis Couper	Ab
	C. asper (Bolkhovitina)	R
	C. minor Couper	Ab
	Dictyotosporites complex Cookson & Dettmann	R
	D. speciosus Cookson & Dettmann	C
	Dictyophyllidites crenatus Dettmann	R
	Couperisporites tabulatus Dettmann	R
	Foraminisporis dailyi (Cookson & Dettmann)	R
	F. wonthaggiensis (Cookson & Dettmann)	R
	Klukisporites scaberis (Cookson & Dettmann)	R
	Leptolepidites major Couper	C
	L. verrucatus Couper	C
	Lycopodiumsporites austroclavatidites (Cookson)	Ab
	L. eminulus Dettmann	Ab
	Neoraistrickia truncata (Cookson)	C
	Stereisporites antiquasporites (Wilson & Webster)	Ab
Pollen:	*Alisporites grandis* (Cookson)	R
	Araucariacites australis Cookson	C
	Classopollis cf. *classoides* Pflug	C
	Cycadopites nitidus (Balme)	C
	Microcachryidites antarcticus Cookson	C
	Podocarpidites cf. *ellipticus* Cookson	Ab
	Vitreisporites pallidus Reissinger	R
Incertae Sedis:	*Spheripollenites psilatus* Couper	C
Remanie:	*Aratrisporites* sp. - Triassic	R

2022 feet

The following diverse assemblage of spores and pollen grains was extracted from the sample:

Spores:	*Baculatisporites comaumensis* (Cookson)	Ab
	Ceratosporites equalis Cookson & Dettmann	R
	Cicatricosisporites australiensis Cookson	C
	Cooksonites variabilis Pocock	R
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab
	Dictyotosporites speciosus Cookson & Dettmann	R
	Foraminisporis asymmetricus (Cookson & Dettmann)	R
	F. wonthaggiensis (Cookson & Dettmann)	R
	Klukisporites scaberis (Cookson & Dettmann)	R
	Leptolepidites verrucatus Couper	R

	Lycopodiumsporites austroclavatidites (Cookson)	Ab
	L. nodosus Dettmann	R
	Neoraistrickia truncata (Cookson)	C
	Pilosisporites notensis Cookson & Dettmann	R
	Rouseisporites reticulatus Pocock	R
	Stereisporites antiquasporites (Wilson & Webster)	Ab
Pollen:	Alisporites grandis (Cookson)	R
	A. similis (Balme)	C
	Araucariacites australis Cookson	C
	Classopollis cf. classoides Pflug	R
	Cycadopites nitidus (Balme)	C
	Microcachryidites antarcticus Cookson	Ab
	Podocarpidites cf. ellipticus Cookson	Ab
	Podosporites microsaccatus (Couper)	R

Samples from between 1802 feet and 2022 feet are referred to the Foraminisporis asymmetricus Unit because of their content of Dictyotosporites speciosus, Cyclosporites hughesi, Foraminisporis asymmetricus, and Cooksonites variabilis. Moreover, the last-named species indicates that the sediments are from the basal portion of the Foraminisporis asymmetricus Unit (see Dettmann 1969a).

E. 2166 - 2330 feet

2166 feet

Abundant spores and pollen grains extracted from the sample comprise the following diverse assemblage:

Spores:	Aequitriradites verrucosus (Cookson & Dettmann)	R
	Baculatisporites comaumensis (Cookson)	Ab
	Ceratosporites equalis Cookson & Dettmann	R
	Cicatricosisporites australiensis (Cookson)	C
	Couperisporites tabulatus Dettmann	R
	Cyclosporites hughesi (Cookson & Dettmann)	R
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab
	Dictyotosporites complex (Cookson & Dettmann)	R
	D. speciosus (Cookson & Dettmann)	R
	Dictyophyllidites crematus Dettmann	C
	Foraminisporis wonthaggiensis (Cookson & Dettmann)	R
	Klukisporites scaberis (Cookson & Dettmann)	R
	Leptolepidites verrucatus Couper	C
	Lycopodiumsporites austroclavatidites (Cookson)	Ab

	L. circulumenus (Cookson & Dettmann)	R
	L. eminulus Dettmann	Ab
	Neoraistrickia truncata (Cookson)	R
	Rouseisporites reticulatus Pocock	R
	Stereisporites antiquasporites (Wilson & Webster)	Ab
Pollen:	Alisporites grandis (Cookson)	C
	Araucariacites australis Cookson	C
	Classopollis cf. classoides Pflug	C
	Cycadopites nitidus (Balme)	C
	Microcachryidites antarcticus Cookson	Ab
	Podocarpidites cf. ellipticus Cookson	C
Acritarcha:	Micrhystridium sp.	R
Remanie:	Nuskoisporites sp. - Permian	R

2330 feet

Spores and pollen grains occur commonly in the sample and constitute the following restricted assemblage:

Spores:	Baculatisporites comaumensis (Cookson)	C
	Cicatricosisporites australiensis (Cookson)	C
	Cyclosporites hughesi (Cookson & Dettmann)	R
	Ceratosporites equalis Cookson & Dettmann	R
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab
	Dictyotosporites speciosus Cookson & Dettmann	R
	Dictyophyllidites crenatus Dettmann	R
	Foraminisporis dailyi (Cookson & Dettmann)	R
	Leptolepidites major Couper	R
	L. verrucatus Couper	Ab
	Lycopodiumsporites austroclavatidites (Cookson)	Ab
	L. eminulus Dettmann	Ab
	L. nodosus Dettmann	R
	Neoraistrickia truncata (Cookson)	C
	Rouseisporites reticulatus Pocock	R
Pollen:	Classopollis cf. classoides Pflug	C
	Microcachryidites antarcticus Cookson	C
	Podosporites microsaccatus (Couper)	R
	Podocarpidites cf. ellipticus Cookson	Ab

Samples from 2166 feet and 2330 feet contain the continued presence (down section) of Dictyotosporites speciosus, Cyclosporites hughesi, and Rouseisporites reticulatus and lack Foraminisporis asymmetricus. They are accordingly referred to the Rouseisporites reticulatus Unit (see Dettmann 1969a). Rare examples of Micrhystridium sp., referable to the Acritarcha, and of the Permian genus Nuskoisporites were recovered from the sample at 2166 feet.

F. 3050 feet

The sample failed to yield plant material of any description.

3. CONCLUSIONS

Palynological evidence indicates that the strata investigated in Moyne Falls -1 well include horizons of the Coptospora paradoxa Zone, the Crybelosporites striatus Subzone, and the Foraminisporis asymmetricus and Rouseisporites reticulatus Units of the Cyclosporites hughesi Subzone. Thus the section ranges in age from Neocomian-Aptian to Albian (Dettmann and Playford 1969, Dettmann 1969a). A microfloral unconformity may occur between 1732 feet and 1802 feet, since the upper horizon is referable at the oldest to the Crybelosporites striatus Subzone and the lower to the basal portion of the Foraminisporis asymmetricus Unit.

Remanie types of Triassic and Permian origin occur in horizons of the Crybelosporites striatus Subzone and in stratigraphically lower samples. Plant microfossils of uncertain derivation but possibly referable to the Acritarcha were observed in samples of the Foraminisporis asymmetricus and Rouseisporites reticulatus Units.

Comparison of the Moyne Falls section with the Lower Cretaceous developments in Eumeralla No.1 and Pretty Hill No.1 wells (see Dettmann 1969a) indicates that:

1) the youngest Lower Cretaceous horizons developed in Eumeralla No.1 and Pretty Hill No.1 (Tricolpites pannosus Zone and a portion of Coptospora paradoxa Zone, unnamed unit) are not represented in Moyne Falls -1.

2) the possible unconformity in Moyne Falls -1 does not appear to embrace the same time interval as the unconformities occurring between Units 1 and 2 of the Eumeralla Formation in both Pretty Hill No.1 and Eumeralla No.1 wells.

3) the oldest productive horizons investigated in Moyne Falls -1 well are within the Rouseisporites reticulatus Unit and are thus younger than, or equivalent in age to the lower intersections of the Eumeralla Formation in Eumeralla No.1 well and older than basal horizons of the same formation in Pretty Hill No.1 well.

4. REFERENCES

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EXPLANATION OF TABLE 1

Preservation ana zonal attribution of plant microfossil assemblages in sidewall cores of Moyne Falls -1 well, 1289 - 3050 feet.

Abbreviations:

Yield expresses frequency of spores and pollen grains in the palynological residues as follows:-

Ab = abundant
C = common
Sp = sparse
B = barren

Colour and Preservation. Spores, pollen, wood and cuticle present in the residues are denoted by their colour (col.) and quality of preservation (pres.) thus:-

DY = dark yellow
Br = brown
Bl = black
fair = fairly preserved
poor = poorly preserved

Spore-pollen Zones are those defined by Dettmann and Playford (1969) and Dettmann (1969a,b).

TABLE 1

Depth (feet)	Yield	Spore-Pollen Col.	Spore-Pollen Pres.	Wood Col.	Wood Pres.	Cuticle Col.	Cuticle Pres.	Spore-Pollen Zone	STRATIGRAPHY		
1289	C	DY-Br	fair	Br-Bl	fair	Y-Br	fair	*Coptospora paradoxa* (unnamed unit)	EUMERALLA FM UNIT 1	OTWAY GROUP	Upper-Middle Ab
1385	Sp	"	"	"	"	"	"	*Dictyotosporites filosus* or *Crybelosporites striatus*	"	"	Lower Albian
1444	"	"	"	"	"	"	"	"	"	"	"
1576	C	"	"	"	"	"	"	"	"	"	"
1732	"	"	"	"	"	"	"	*Crybelosporites striatus*	"	"	"
1802	"	"	"	"	"	"	"	*Foraminisporis asymmetricus*	f? EUMERALLA FM UNIT 2	"	Neocomian - Aptian
1902	"	"	"	"	"	"	"	"	"	"	"
1952	Ab	"	"	"	"	"	"	"	"	"	"
2022	C	"	"	"	"	"	"	*Rouseisporites reticulatus*	"	"	"
2166	Ab	"	"	"	fair-poor	"	poor	"	"	"	"
2330	C	"	"	"	"	"	"	"	"	"	"
3050	B	—	—	—	—	—	—	indet.	BASAL UNIT	"	