SOUTH AUSTRALIA

DEPARTMENT OF MINES AND ENERGY

OPEN FILE ENVELOPE NO. 645

OEL 33, EUCLA BASIN and OFFICER BASIN

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT:

WELL COMPLETION REPORTS

Submitted by

Outback Oil Company NL

1966

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ENVELOPE 645

TENEMENT: OEL 33; Onshore and adjacent offshore area, Eucla Basin, South Australia.

TENEMENT HOLDER: Outback Oil Company NL (operator).

CONTENTS

REPORT: **Laws, R.A., 1966.** Eucla Basin Stratigraphic Drilling Project, OEL 33, South Australia - well completion reports. (for Hughes (R.S.) 1, Hughes (NW) 2, Hughes (NE) 3 and Denman 1). (consultant's report for Outback Oil Company NL by Geosurveys of Australia Pty Ltd, dated August 1966). Pgs 3-29

PLANS		**Scale**	**Company drwg no.**	**SADME plan no.**	
Encl. 1	Locality map.		OB-1a	Pg. 29	A4
Encl. 2	Tentative stratigraphic correlation.	1:200	OB-30	645-1	
Encl. 3	Composite well logs:				
Encl. 3 (a)	Hughes (R.S.) 1.	1:600	OB-31	645-2	
Encl. 3 (b)	Hughes (NW) 2.	1:600	OB-32	645-3	
Encl. 3 (c)	Hughes (NE) 3.	1:600	OB-33	645-4	
Encl. 3 (d)	Denman 1.	1:600	OB-34	645-5	

APPENDIX 1: Water and bitumen analyses. Pgs 30-33
APPENDIX 2: Bit records. Pgs 34-39
APPENDIX 3: Discussion of electric logs. Pgs 40-41

PLANS **South Australian Department of Mines, Geophysics Branch, 1966.** Electric well log prints (for Outback's Eucla Basin stratigraphic wells):

Well	**Log type**	**Scale**	**SADME plan no.**
Hughes (R.S.) 1	16" normal: 64" normal resistivity.	1:240	Missing
	Self potential: point resistivity	1:240	Missing
Hughes (NW) 2	Gamma ray: 6' lateral resistivity	1:240	645-6
	16" normal: 64" normal resistivity.	1:240	645-7
	Self potential: point resistivity	1:240	645-8
Hughes (NE) 3	Gamma ray: 6' lateral resistivity	1:240	645-9
	16" normal: 64" normal resistivity.	1:240	645-10
	Self potential: point resistivity	1:240	645-11
Denman 1	Composite print of:		
	SP, 16" and 64" normal resistivity	1:240	645-12

APPENDIX 4: Core descriptions. Pgs 42-52

REPORTS: **Laws, R.A., 1966.** Lithological descriptions (of Outback's Eucla Basin stratigraphic wells). (submitted by Geosurveys of Australia Pty Ltd to Outback Oil Company NL in weekly drilling reports dating from 16/2/66 to 15/7/66):

Hughes (R.S.) 1 - 0 to 1080' (10' intervals). Pgs 53-64
Hughes (NW) 2 - 0 to 760' (10' intervals). Pgs 65-73
Hughes (NE) 3 - 0 to 917' (10' intervals). Pgs 74-87
Denman 1 - 0 to 1800' (10' intervals). Pgs 88-108

REPORT:	**Ludbrook, N.H., 1966.** Hughes - Denman Stratigraphic Drilling Project of Outback Oil Company NL: subsurface stratigraphy and micropalaeontological study. *South Australia. Department of Mines. Report Book, 731, and Palaeontological Report 10/66.*			Pgs 109-123
PLAN		**Scale**	**Company drwg no.**	**SADME plan no.**
Encl. 1	Correlation diagram, Hughes - Denman Stratigraphic Drilling Project.	1:1 200	L66-94	645-13
APPENDIX 1:	**Harris, W.K., 1966.** Outback Oil Hughes and Denman wells: palynological report. *South Australia. Department of Mines. Palynological Report 5/66.*			Pgs 124-125

END OF CONTENTS

COPY No. 1

OUTBACK OIL COMPANY N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT

O.E.L. 33, SOUTH AUSTRALIA

WELL COMPLETION REPORTS

by

R.A. Laws
Geosurveys of Australia Pty. Ltd.
August, 1966

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LIST OF CONTENTS

		Page
I.	INTRODUCTION	1.
II.	WELL HISTORY	1.
	1. General Data	1.
	2. Drilling Data	3.
	3. Logging and Testing	7.
III.	GEOLOGY	9.
	1. Summary of Previous Work	9.
	2. Summary of the Regional Geology	9.
	3. Stratigraphic Tables	12.
	4. Stratigraphy	14.
	5. Structure	18.
	6. Relevance to occurrence of petroleum	19.
	7. Porosity and Permeability of sediments penetrated	22.
IV.	REFERENCES	24.

APPENDICES

1. Water and Bitumen Analyses
2. Bit Records
3. Discussion of Electric Logs
4. Core Descriptions

ENCLOSURES

1.	Locality Map	OB. 1A
2.	Tentative Stratigraphic Correlation	OB. 30
3.	Composite Well Logs (Not yet available)	

I. SUMMARY AND INTRODUCTION

The Eucla Basin Stratigraphic Drilling Project was located in the south-western portion of South Australia. The wells were located at or within 20 miles of Hughes and Denman Railway Sidings on the Transcontinental Railway.

A total of four wells was drilled with a Failing 1500, under contract with W. L. Sides and Son Pty. Ltd., to depths varying between 797 and 1800 feet. The wells were originally programmed to reach 1400 feet, but due to drilling difficulties, two wells did not reach the vicinity of this depth. In consequence the last well, Denman No. 1, was drilled to 1800 feet. Drilling commenced on the 14th February, 1966 and the last well was abandoned on the 17th July, 1966.

All wells were commenced using air as the drilling fluid and penetrated a maximum thickness of 367 feet of Tertiary limestones and sands before passing into Cretaceous silty clays and claystones. Seven inch casing was set at the top of these clays and drilling continued using mud.

Varying thicknesses from 83 to 367 feet of claystone were encountered before passing into the underlying gravels, sands, silts and clays up to 194 feet thick. These latter are Cretaceous and possibly partly Permian in age.

A maximum thickness of 812 feet of these post Palaeozoic sediments was penetrated before encountering (?) Cambrian red-beds, dolomites and evaporites.

All four wells were abandoned in this sequence.

Traces of black soft bituminous material were detected in Hughes (N. W.) No. 2 Well from 640 to 650 and 690 to 700 feet, and also in Denman No. 1 Well from 1310 to 1730 feet. Occasional oil stained quartz grains were noted in a sand from 1241 to 1300 feet in this latter well.

All four wells were electric logged, plugged and abandoned.

II. WELL HISTORY

1. General Data

(a) Names and Numbers of Stratigraphic Holes

Listed in the order in which they were drilled:-

Hughes (R. S.) No. 1 Well
Hughes (N. W.) No. 2 Well
Hughes (N.E) No. 3 Well
Denman No. 1 Well

(b) Location

The Stratigraphic Drilling Project was carried out in the vicinity of

Hughes and Denman, situated in the south western portion of South Australia.

A map showing the location of the wells is attached as Enclosure 1, the co-ordinates and elevations being listed below in Table I.

TABLE I

Well Name and No.	Ground Elevation Feet *	Co-ordinates	
		Latitude	Longitude
Hughes (R.S.) No. 1	467	30° 42'50"S	129° 30'44"E
Hughes (N.W.) No. 2	493	30° 31'14"S	129° 14'45"E
Hughes (N.W.) No. 3	460	30° 29'45"S	129° 38'07"E
Denman No. 1	462	30° 39'20"S	129° 58'47"E

*Above Mean Sea Level Port Augusta

(c) Name and Address of Tenement Holder

The holder of the petroleum tenement is Outback Oil Company N. L. of 6-7 Dequetteville Terrace, Kent Town, South Australia.

(d) Details of Petroleum Tenement

The stratigraphic wells are located within the area covered by Oil Exploration Licence No. 33, South Australia. The area of the licence is 49,000 square miles and the expiry date is the 19th of January, 1969.

(e) Elevation, Total Depths, Dates and Times of Drilling Operations

TABLE II

Well No.	Elev. (Feet)	Total Depth (Feet)	Date Drilling commenced	Date Drilling suspended	Date Drilling recom.	Date Drilling comp.	Date Logged & abandoned
Hughes(R.S.)No. 1	467	1370	16/2/66	2/3/66	14/3/66	1/4/66	4/4/66
Hughes(N.W)No. 2	493	797	3/3/66	10/3/66	5/4/66	28/4/66	3/6/66
Hughes (N.E)No. 3	460	918	6/5/66			26/5/66	3/6/66
Denman No. 1	462	1800	6/6/66			13/7/66	17/7/66

Note: 1. All elevations are referred to Mean Sea Level Port Augusta.

2. Depths are from ground level.

3. Denman No. 1 Well was logged on 15-16/7/66 and abandoned on 17/7/66.

(f) Status

TABLE III

Well Name and No.	7" casing set at (feet)	Cement plug interval	No. of sacks of cement	Weight of Slurry
Hughes (R.S.) No. 1	400	398 - 410	5	105lbs/cu.ft
Hughes (N.W.) No. 2	242	234 - 250	4	108lbs/cu.ft
Hughes (N.W.) No. 3	256	250 - 266	4	108lbs/cu.ft
Denman No. 1	256	0 - 16	4	
		250 - 266	4	

For each well a ¼" plate has been welded over the top of the casing and a 3 foot long steel pipe welded to the cap plate as a marker.

2. Drilling Data

(a) Name and Address of Drilling Contractor

W. L. Sides and Son Pty. Ltd.,
Wellington Road,
Clayton. Victoria.

(b) Drilling Plant

Drawworks:

Make:	Failing
Type:	1500 Holemaster
Rated Capacity:	1500 ft. with 2⅜" drill pipe

Mast:

Make:	Failing
Type:	Welded Tubular Steel
Rated Capacity:	40,000 lbs.

Note: The mast was damaged in moving from the site of Hughes (N. W.) No. 2 Well and a replacement mast was fitted to drill Hughes (N. E.) No. 3 and Denman No. 1 Wells.

Rig Motor:

Make:	Bedford
Type:	Diesel
Rated H.P.:	32 at 2,100 R.P.M.

Mud Pump:

Make:	Gardner Denver
Type:	FF-FXF
Liner Size:	4½"
Stroke:	5"

Compressors:

Make:	Holman Bros.
Capacity:	600 c.f.m. at 110 lbs/sq.in.
Number:	2

Air Hammers:

Make:	Ingersoll-Rand
Size:	8½"
Type:	325A
Number:	2

Kelly:

Make:	Failing
Type:	Fluted
Overall length:	27'4"
O.D.	2⅞"

Drill Pipe:

1.

Type:	Failing Exploration
O.D.:	2⅜"
Weight:	5.5 lbs/ft.
Number of lengths:	40
Average length:	20 feet

2. Type: Internal Flush
O.D.: 2⅜"
Weight: 8 lb/ft.
Number of lengths: 21
Average length: 20 feet

3. Type: Mayhew
O.D.: 2⅜"
Number of lengths: 10
Average length: 20 feet
Weight: 33 lbs/ft.

(c) Hole Sizes and Depths

TABLE IV

Well Name & No.	Hole Size (ins)	Interval feet		Hole Size (ins)	Interval feet		Hole Size (ins)	Interval feet		Hole Size (ins)	Interval feet	
		From	To		From	To		From	To		From	To
Hughes (R.S.)No. 1	8½	0	356				4¾	356	TD			
Hughes (N.W.)No. 2	8½	0	242	6¼	242	275	4¾	275	794	NX	794	TD
Hughes (N.E.)No. 3	8½	0	250	6¼	250	286	4¾	286	917	NX	917	TD
Denman No. 1	8½	0	254	6¼	254	913	4¾	913	TD			

(d) Casing Details

Size: 7" O.D.
Weight per ft: 20 lbs
Type: Oil well type J55
Make: Japanese

The setting depths are listed in Table III, the casing was not cemented, although a cement plug was set over the casing shoe on abandonment of each well.

(e) Drilling Fluid

Air was used as the drilling fluid in the top section of each hole and continued as long as possible. Two, 600 cubic feet per minute compressors were used, circulation often being lost in the cavernous Nullarbor Limestone. Attempts to regain circulation by water and detergent injection were not always completely successful.

Table V below lists the depths to which air was used.

TABLE V

Well Name and No.	Interval air used		Interval mud used	
	From	To	From	To
Hughes (R.S.) No. 1	0	607	607	T.D.
Hughes (N.W.) No. 2	0	275	275	T.D.
Hughes (N.E.) No. 3	0	250	250	T.D.
Denman No. 1	0	293	293	T.D.

A normal fresh water-bentonite mud was used in each hole, quebracho, caustic soda and distillate being used to control rheological properties within desirable limits.

Average properties of the mud would approximate the following.

Viscosity:	45 seconds (Marsh)
Water Loss:	6.5 cc. A.P.I.
Filter Cake:	1/32"
Weight:	8.8 lbs per gallon

Caving formations were always a problem, samples taken in the (?)Cambrian section often containing up to 95% cavings of the overlying Cretaceous claystone.

Gypsum and very water soluble shales encountered below 1388 feet in Denman No. 1 Well resulted in an unsatisfactory mud and specially refined quebracho had to be obtained. It was found necessary to discard the mud at intervals and mix a fresh batch.

The lack of water storage on site and the 8 hours necessary to cart 2,000 gallons of water from the water bore, often resulted in the temporary suspension of drilling, until the mud properties could be improved.

A typical analysis of mud below 1,400 feet in Denman No. 1 Well had the following properties:-

Viscosity:	Over 50 (Marsh)
Water loss:	22 A.P.I.
Filter Cake:	5/32"
Weight:	9.0 lbs/gallon
pH	8.5

Partial loss of circulation occurred in Hughes (N.E.) No. 3 from 284 to 286 feet. Circulation was regained after 7 sacks of sawdust and 18 sacks of bentonite were added to the mud.

Circulation was partially to completely lost in Denman No. 1 between 786 and 849 feet. Full returns were eventually regained after 66 sacks of bentonite, 8 sacks of sawdust, 88 gallons of distillate and 20,000 gallons of water had been used.

The following quantities of mud material were used in the drilling of the wells.

	Bentonite (sacks)	Caustic Soda (lbs)	Quebracho (sacks)	Distillate (gallons)	Sawdust (sacks)
Hughes (R.S.)No. 1	54				
Hughes (N.W.)No. 2	32	5	1		
Hughes (N.E.)No. 3	42	124	8		7
Denman No. 1	118	275	47	264	8

(f) Water Supply

A water bore was drilled in between the sites of Hughes (N.W.) No. 2 and Hughes (N.E.) No. 3 Wells (position marked Enclosure 1).

Fresh water was struck from 185 to 216 feet (T.D.) in the Wilson Bluff Limestone. Supply was in excess of 600 gallons per hour. Casing, pump rods, pump jack and engine were installed and withdrawn on completion of the project. A full analysis of the bore water is appended (Appendix 1).

(g) Bit Records

See Appendix 2.

(h) Plugging Back

In all four wells a cement plug was positioned so as to cover the casing shoe. Details of intervals plugged are listed in Table III.

(i) Fishing Operations

Hughes (R.S.) No. 1

At 607 feet the drill pipe slipped through the break out jaws while pulling out. Open ended drill pipe was run and connected onto the fish which was recovered successfully.

Hughes (N.E.) No. 3

At 115 feet the back head broke on the air hammer, leaving the base of the hammer in the hole. The fish was recovered with a spear after a number of attempts.

(j) Early Abandonment of Wells

Hughes (N.W.) No. 2 Well

Due to the extremely hard nature of chert nodules encountered below 759 feet this well was abandoned at 797 feet, 600 feet short of the planned target depth. The nodules and

lenses occurred within dolomite and were up to 5 inches thick. Normal hard formation bits (e.g. Williams W4W) were completely worn out after drilling only 6 inches in this formation.

A total of 7 hard formation bits and two diamond core heads were used to drill the interval 751 to 797 feet. At this point it was realised that it was impractical to continue, and the well was abandoned at 797 feet.

Hughes (N.E.) No. 3 Well

This well encountered extremely hard oolitic cherts 780 to 807 feet and 913 to 918 feet and was abandoned at this latter depth, for similar reasons as outlined above for Hughes (N.W.) No. 2 Well.

3. Logging and Testing

(a) Ditch cutting samples

Ditch cutting samples were collected at 10 foot intervals throughout the section of each hole. A complete set of cuttings was despatched to the South Australian Mines Department for palaeontological investigation and a further set despatched to Bible Geophysical Co. Inc. of Houston Texas for density determinations.

(b) Coring

Cores were cut at approximately 400 foot intervals, except in the case of Hughes (N.W.) No. 2 Well, where diamond coring was the only practical method of penetrating the extremely hard chert nodules encountered. Details are listed below:-

HUGHES (R.S.) NO. 1 WELL

Core No.	Interval	Footage Cut	Amount Recovered	Percent Recovery	Bit	Time (Hrs)
1	585- 594	8	5'2"	65	4¾ Reed SF	1¾
2	850- 859	9	9"	8	4¾ Reed HF	3
3	1080-1089	9	3'1"	34	4¾ Reed HF	2½
4	1360-1370	10	3'1"	31	4¾ Reed HF	4

HUGHES (N.W.) NO. 2 WELL

Core No.	Interval	Footage Cut	Amount Recovered	Percent Recovery	Bit	Time (Hrs)
1	420- 430	10	2'4"	23	Reed SF	5
2	751- 757	6	1'1"	18	Reed HF	6½
3	760-761'2"	1'2"	3"	21	NX Smit Diamond	4½
4	794'6"-797'3"	2'9"	2'6"	90	NX Smit Diamond	6¾

HUGHES (N.E.) NO. 3 WELL

Core No.	Interval	Footage Cut	Amount Recovered	Percent Recovery	Bit	Time (Hrs)
1	521- 531	10'	1'6"	15	4¾ Reed SF	1½
2	791- 793	2'	1'10"	92	4¾ Reed HF	3¼
3	917- 917'8"	8"	7½"	94	NX Smit Diamond	1½

DENMAN NO. 1 WELL

Core No.	Interval	Footage Cut	Amount Recovered	Percent Recovery	Bit	Time (Hrs)
1	503- 513	10'	10'	100	4¾ Reed SF	¾
2	913- 923	10'	5'8"	57	4¾ Reed HF	1½
3	1186-1193	7'	5'9"	82	4¾ Reed HF	2½
4	1597-1607	10'	9'10"	99	4¾ Reed HF	2¾

Cores were cut with a 10 foot Reed Kor King K-437 core barrel or a 5 foot Mindrill NX core barrel.

A total of 105 feet 7 inches was cored for a total recovery of 53 feet 5½ inches (51%).

(c) Electric and other logs

All logging was performed by the South Australian Department of Mines, using a Failing Logmaster unit. All logs were recorded at a scale of 1" equals 20 feet.

	Hughes(R.S.) No. 1		Hughes(N.W.) No. 2		Hughes(N.E.) No. 3		Denman No. 1	
LOG	Interval		Interval		Interval		Interval	
	From	To	From	To	From	To	From	To
S.P.&P.R.	405 ft.	T.D. 1376	250 ft.	T.D. 800	254 ft.	T.D. 919	262 ft.	T.D. 180
SN & LN	406 ft.	T.D.	252 ft.	T.D.	254 ft.	T.D.	262 ft.	T.D.
6'LL			251 ft.	T.D.	255 ft.	T.D.	260 ft.	T.D.
Gamma Ray			0 ft.	T.D.	2 ft.	T.D.	3 ft.	T.D.
Temperature							5 ft.	748 ft

SP = Spontaneous Potential P.R. = Point Resistivity
SN = 16" Normal Resistivity LN = 64" Normal Resistivity
6'LL = 6' Lateral Resistivity

(d) Formation Testing

The drilling programme did not provide for the testing of any formation. However, water samples were obtained from Hughes (R.S.) No. 1 Well while air drilling was in progress. Water samples were obtained from 500 feet and from the interval 256 to 328 feet. The results of analysis are appended (Appendix 1), together with the full

analysis of the water from the Wilson Bluff Limestone in the water bore (position marked Enclosure 1).

III. GEOLOGY

1. Summary of Previous Work

Very little geophysical or sub-surface geological exploration has been carried out in the Eucla Basin. Surface geological investigation is hindered by the blanketting cover of the flat lying Nullarbor Limestone of Lower Miocene age. Outcrops of pre-Tertiary formations are limited to the basin margins.

A photogeological evaluation of the area was undertaken by the Photogravity Company Inc., of Houston, Texas. Field investigations of photogeological features by Geosurveys of Australia Pty. Ltd., could not confirm most of the interpreted lineaments and fold structures. Cuttings from sparsely distributed water bores have provided the most valuable of the existing geological information. Outback Oil Company N. L.'s Cook No. 1 Well, drilled 23 miles south-east of Cook, was the first well drilled in the licence area, with the object of examining the geological succession and evaluating the hydrocarbon potential of the basin.

Geophysical surveys include a number of aeromagnetic and reconnaissance gravity traverses by the Bureau of Mineral Resources and a refraction seismic survey by the South Australian Department of Mines along the Eyre Highway in the southern portion of the basin and from Cook south to the highway. A regional gravity survey was conducted by Geosurveys of Australia Pty. Ltd. in the southwest portion of the licence area. Results from this latter survey were used in the selection of the drill sites in the stratigraphic drilling programme.

2. Summary of the Regional Geology

O. E. L. 33, consists of that portion of the Eucla Basin which extends into South Australia. The Eucla Basin is a large, relatively shallow and predominantly marine sedimentary basin, covering some 70,000 square miles and straddling the southern portion of the South Australian - Western Australian border. Sediments in the basin are predominantly flat lying or gently undulating and include Upper Proterozoic, red, chocolate and green shales, (?)Cambrian dolomites, red-beds, evaporites and sandstones, Permian claystones, Cretaceous claystones and sands and Tertiary limestones and sands.

(a) Stratigraphy

(i) Archaean

Basement rocks consist of Archaean or Lower Proterozoic granitic gneisses and meta-sediments together with intrusive granitic rocks. They outcrop on the eastern and western margins of the basin.

(ii) Upper Proterozoic

Flat lying and unmetamorphosed Upper Proterozoic sandstones and shales have been recognised in cuttings from many of the bores. They are thought to have been deposited under continental conditions. Some doubt exists in certain of the bores as to whether they bottomed in Upper Proterozoic or younger sediments.

Feldspar porphyry intersected in Nullarbor No. 8 (Yangoonabbie Bore) below 1387 feet could possibly be of Upper Proterozoic age. The porphyry has been correlated with the Moonabie and Gawler Range porphyries on petrological grounds. The age and nature of emplacement of these porphyries is not known and estimates range from Upper to Lower Proterozoic.

(iii) Cambrian (?)

A tentative (?) Cambrian age has been placed on limestones and sands encountered from 525 to 915 feet (Total Depth) in Outback Oil Company N. L.'s Cook No. 1 Well (Ludbrook 1965). It is predicted that sediments of this age reach considerable thicknesses in troughs and embayments in the Archaean basement surface.

(iv) Permian

Sediments of definite Permian age have been identified in cuttings from Nullarbor No. 8 Bore. They consist of 255 feet of grey claystones, intersected below 1132 feet, and directly overlying feldspar porphyry of probable Precambrian age. An assemblage of foraminifera and microflora have been identified by Ludbrook and Harris (1966) and a Lower Permian age assigned to the claystone. They suggest from the clayey nature of the section and the limited foraminiferal assemblage present, that deposition has occurred in a lagoonal environment with restricted access to open marine conditions.

(v) Cretaceous

Two main units are recognisable within the basin, namely a basal gravel and an overlying unit consisting of grey claystones and siltstones.

The gravel has been named the Loongana Conglomerate in the Western Australian portion of the basin. It is not certain whether all basal Cretaceous gravels can be correlated with this conglomerate. The gravel thickens generally to the north and reaches a maximum known thickness of about 200 feet.

The uppermost unit consists of grey glauconitic, pyritic and carbonaceous claystones and siltstones deposited under marine conditions.

(vi) Tertiary

Tertiary sediments occurring within the Eucla Basin include:-

(a) Pidinga Sands and Clays (Eocene)

These consist of a sequence of pyritic sands and carbonaceous and glauconitic siltstones and clays. They outcrop to the east near Pidinga, where they directly overlie basement metamorphics. A salty swamp environment is postulated for their deposition.

(b) Wilson Bluff Limestone (Middle to Upper Eocene)

The Wilson Bluff Limestone outcrops along the coast at the base of the coastal cliffs, and is encountered in most of the bores. It is a marine porous chalky bryozoal calcarenite, cream to yellow in colour.

(c) Nullarbor Limestone (Lower Miocene)

Flat lying, kunkarised Nullarbor Limestone outcrops over all of the Nullarbor Plain, and forms the precipitous cliffs along the coast line. It is very uniform in character and consists of a grey and cream hard, dense crystalline limestone, fossiliferous and of marine origin. Sinkholes and caves have been developed within this limestone in many localities.

(vii) Pleistocene

Sand dunes and calcareous sandstones of Pleistocene age overly the Tertiary Limestones along the southern coastline, along the eastern and northern fringes of the basin and also as a thin veneer over extensive areas of the basin in Western

Australia.

(b) Structure

Structurally, very little is known about the Eucla Basin.

The Nullarbor Limestone has a very gentle regional dip to the south, and few positive dips have been obtained. It is thought that gentle north-west trending lineaments revealed on aerial photographs may be related to structural developments in depth. However, field study of these lineaments and other postulated fold structures has only revealed occasional correlation with topographic features.

Gravity and refraction seismic evidence, points to the existence of an east facing basement escarpment or monocline trending generally north-northwest from the vicinity of Koonalda Homestead, to just west of Hughes Railway Siding. Two major gravity troughs are delineated, one trends northeast from Nullarbor Number 8 Bore, and is intersected by another minima trending generally west-southwest through Denman Railway Siding. It is thought that these troughs contain at least 4,000 feet of sediment at their maximum development.

3. Stratigraphic Tables

Ages assigned to lithologic units in the tables below are tentative only. Limits of thickness of the units have been corrected to drilling rate and electric logs.

HUGHES (R.S.) NO. 1 WELL

Interval	Thickness	Lithology	Tentative Formation, Age
0 - 4	4	Surface soil	Recent
4 - 159?	155	Yellow, crystalline limestone	Nullarbor Limestone Lower Miocene
?159 - 328	169	Cream, chalky, bryozoal limestone	Wilson Bluff Limestone M.-U. Eocene
328 - 367	39	Brown, medium to coarse sand	Hampton Conglomerate? Eocene
367 - 620	253	Grey soft clays and claystones	Cretaceous (1)
620 - 726	106	Fine to medium granule gravel	Cretaceous
726 - 812	86	Interbedded silty clays and claystones	Cretaceous? Permian?
812 - 853	41	White fine sandstone	?Cambrian
853 - 1370	517	Red beds, dolomites, limestones	(?)Cambrian (1),(3),(4)

HUGHES (N.W.) NO. 2 WELL

Interval	Thickness	Lithology	Tentative Formation, Age
0 - 70?	70	Yellow hard limestone	Nullarbor Limestone Lower Miocene
?70 - 208	138	Cream hard to chalky bryozoal limestone	Wilson Bluff Limestone M.-U. Eocene
208 - 240	32	Brown, medium to coarse sand	Hampton Conglomerate? Eocene
240 - 558	318	Grey silty clays and claystones	Cretaceous
558 - 708	150	Fine to medium granule gravel	Cretaceous + b.l.m.
708 - 748	40	White soft clay-sand	Cretaceous? Permian?
748 - 797	49	Grey cherty dolomite	Lower Cambrian (?)

HUGHES (N.E.) NO. 3 WELL

Interval	Thickness	Lithology	Tentative Formation, Age
0 - 157?	157	Yellow hard limestone	Nullarbor Limestone Lower Miocene
?157 - 178	21	Yellow chalky limestone	Wilson Bluff Limestone M.-U. Eocene
178 - 251	73	Fine to medium brown sand	Hampton Conglomerate? Eocene
251 - 448	197	Grey clays and claystones	Cretaceous
448 - 513	65	Fine to medium granule gravel	Cretaceous
513 - 535	22	Grey silty claystones and siltstones	Cretaceous? Permian?
535 - 570	35	Fine quartz sand and silt	Permian?
570 - 918	348	Red-beds, dolomites, sandstones	(?)Cambrian

DENMAN NO. 1 WELL

Interval	Thickness	Lithology	Tentative Formation, Age
0 - 80?	80	Cr eam hard limestone	Nullarbor Limestone Lower Miocene
?80 - 205	125	Yellow chalky bryozoal limestone	Wilson Bluff Limestone M.-U. Eocene
205 - 226	21	Brown fine to medium sand	Hampton Conglomerate? Eocene

Denman No. 1 Well (continued)

Interval	Thickness	Lithology	Tentative Formation, Age
226 - 250	24	Interbedded khaki siltstone and claystone	?Cretaceous
250 - 592	342	Grey silty clays and claystones	Cretaceous
592 - 628	136	Medium to coarse granule gravel	Cretaceous
628 - 784	156	White claysand and sandy clays	Cretaceous? Permian?
784 - 957	173	White and green fine sandstone	?Cambrian
957 - 1800	843	Red-beds, evaporites, sands, dolomites	(?)Cambrian

4. Stratigraphy

Micropalaeontological examination of samples from all the wells is still in progress by the South Australian Department of Mines. No information will be released until the report is published some time in October, 1966.

(a) Lower Miocene Nullarbor Limestone

The Nullarbor Limestone is typically a cream, white, yellow occasionally red, hard, dense, crystalline limestone. Foraminifera and bivalve molluscs are common.

(b) Middle to Upper Eocene Wilson Bluff Limestone

This limestone varies from soft and chalky to reasonably hard and arenaceous. It is usually white, cream, or yellow, bryozoal and glauconitic and is more a bryozoal calcarenite, than a limestone.

The Nullarbor and Wilson Bluff limestones collectively form the Eucla Group.

Maximum Thickness: 324 feet, Hughes (R.S.) No. 1
Minimum Thickness: 178 feet, Hughes (N.W.) No. 2

(c) Eocene? Hampton Conglomerate?

Immediately underlying the Wilson Bluff Limestone, occurs a brown quartz sand. Lithologically it is a sand, light brown, medium to coarse grained, consisting of fairly well sorted subrounded to subangular, polished clear and milky quartz grains. The quartz commonly contains ragged or zoned inclusions and has been derived from a metamorphic source area. The sand is tentatively correlated with 10 feet of gritty sand occupying a similar position in Yangoonabbie Bore.

Maximum thickness: 73 feet, Hughes (N.E.) No. 3
Minimum thickness: 21 feet, Denman No. 1

(d) Cretaceous Silty Clays and Claystones

Beneath the Tertiary, grey silty clays and claystones are encountered. Some of this sequence may belong to the Tertiary, especially in Denman No. 1 Well, where 24 feet of thinly interbedded khaki siltstone and grey claystone immediately underlies the ?Hampton Conglomerate.

The top of the unit consists of a soft, grey, very silty, glauconitic clay, with white kaolinitic specks, carbonaceous and occasionally lignitic material, and finely divided mica. A maximum of about 60 feet of clay is penetrated before interbeds of claystone occur. The claystone gradually predominates over the clay with depth. Lithologically it is claystone, grey, soft, firm, brittle, fissile, predominantly finely silty, occasionally extremely silty, grading to a siltstone with abundant green soft glauconite pellets, carbonaceous specks, pyrite finely divided or as crystalline aggregates, clear subangular quartz grains and common muscovite and biotite mica flakes.

The presence of glauconite in association with biotite mica and pyrite, indicates a shallow water open marine environment for the deposition of the claystones and siltstones. Deposition is believed to have occurred slowly under slightly reducing conditions at a depth of about 100 fathoms.

Maximum thickness: 366 feet, Denman No. 1
Minimum thickness: 197 feet, Hughes (N.E.) No. 3

(e) Lower? Cretaceous Granule Gravel

Basal Cretaceous gravels were penetrated in each well. In the Western Australian portion of the basin, the name Loongana Conglomerate has been applied to similarly situated gravels. However, the definition is rather vague and no attempt at correlation has been made.

The granule gravel is fine to medium grained and consists of moderately well sorted, clear and milky, subangular to subrounded quartz grains containing common inclusions, with minor grey anhydrite, feldspar, quartzite and other lithic grains. A metasediment source area is predicted for the gravel.

The electric logs show definite evidence of shaley streaks within the gravels. These consist of claystones of the same

lithology as in the unit above. Due to the caving nature of the claystones in the uppermost Cretaceous unit represented, the presence of the claystone interbeds within the gravel cannot be determined from the cutting samples alone.

Maximum thickness: 150 feet, Hughes (N.W.) No. 2
Minimum thickness: 36 feet, Denman No. 1

(f) ?Permian Sandy clays and clayey sands

In all four wells a zone of poor cutting returns occurred beneath the Cretaceous gravels. Samples from this interval contained up to 90% cavings. However, the S.P. curve assumes a typical shape in each case. In Hughes (R.S.) No. 1 Well the lithology is interbedded white soft very sandy clay, and grey-green to green-grey firm, silty, micaceous claystone, 86 feet thick in all. In Hughes (N.W.) No. 2 Well it is 40 feet of white soft, friable claysand with white clay interbeds. Twenty two feet of grey, micaceous and carbonaceous claystones and siltstones, underlain by 35 feet of well sorted very fine quartz sands was intersected over the similar interval of Hughes (N.E.) No. 3 Well. In Denman No. 1 Well the equivalent interval was 156 feet thick and consisted of white, soft claysand grading downwards into sandy clay, pyritic in part.

Assuming that the Cretaceous gravels are basal, this interval is possibly equivalent to 255 feet of soft grey claystones of Permian age encountered beneath 1132 feet in Yangoonabbie Bore.

(g) ?Cambrian Fine Quartz Sandstone

In Hughes (R.S.) No. 1 and Denman No. 1 Wells, sandstone overlies the dolomite-red-bed-evaporite association. The sandstone is white, green or pink, moderately hard, friable, of low porosity, fine grained, well sorted, and consists of subrounded lightly frosted clear quartz grains, with very minor dark lithic grains, glauconite, rare muscovite mica and small crystals of pyrite in an argillaceous, sometimes siliceous and rarely pyritic cement. The sandstone is cross-bedded in part.

In Hughes (R.S.) No. 1 the sandstone is 41 feet thick and in Denman No. 1, 173 feet thick. A 5 foot thick interbed of soft, silty, red-brown claystone occurs within the sandstone at Denman. For this reason, and the fact that the sandstone overlies Cambrian (?) red-brown and green shales and siltstones in both cases, the sandstone is thought to be conformable with the underlying (?) Cambrian red-bed association.

(h) (?)Cambrian Red-beds, evaporites, dolomites

(i) Hughes (R.S.) No. 1 Well

Green, red-brown, and purple mottled shales, dolomitic in part, with interbedded buff hard dolomites and green micaceous dolomitic siltstones occur below 853 feet and continue to total depth. Thin interbeds and lenses of gypsum occur sporadically. Interbeds of silicified oolitic calcarenite and brown, hard argillaceous limestone occur from 1210 to 1224 feet.

(ii) Hughes (N.W.) No. 2 Well

Light grey, hard, dense, vugular dolomite was intersected from 748 feet to 797 feet (T.D.) Thin interbeds and laminae of white anhydrite occur at the top of the dolomite, while numerous extremely hard, grey, chert nodules occur below 759 feet. The nodules are irregularly shaped and display faint relicts of the original bedding and detrital nature of the replaced dolomite.

(iii) Hughes (N.E.) No. 3 Well

348 feet of sediments of tentative (?)Cambrian age were encountered in this well and were not bottomed. Below 570 feet occurs 12 feet of soft, white and red fine grained clayey sandstone, regarded as the uppermost (?)Cambrian unit present. Red-brown, purple, green and cream silty shales, dolomitic in part, underlie the sandstone. Buff, brown, purple and grey hard dense argillaceous dolomite is interbedded with, and grades into the shale. Nodules of very hard chert were encountered over the intervals 780 to 804 feet and 900 to 918 feet. The chert nodules in the former interval contained abundant clearly defined oolites. Dolomites occurring in association with the nodules were also very oolitic and contained large crystal lined vugs over 2 inches in diameter.

Beneath 800 feet brown and green fine grained micaceous and ?glauconitic sandstone interbeds are common.

(iv) Denman No. 1 Well

A total of 843 feet of sediments of tentative (?)Cambrian age were intersected in this well from 957 feet to T.D. at 1800 feet. If the overlying sandstones are included a total of 1016 feet of (?)Cambrian is present.

From 957 to 1241 feet the lithology was interbedded red-brown, green-grey and purple dolomitic shales, fine sandstones and siltstones. Occasional soft green pellets of glauconite within the sandstone indicate the presence of organic matter at the original environment of deposition.

Below 1241 feet occurred 59 feet of light brown, well sorted, medium grained quartz sand, interbedded at the base with soft red-brown sandstones and claystones.

Underlying the sand occurred 12 ft. of interbedded, red-brown, micaceous and dolomitic shales and siltstones. At 1312 feet the well passed into buff and pink hard argillaceous dolomite, interbedded with and grading into red-brown and green silty shales. These continued to 1388 feet, where a sequence of red-bed shales, gypsum and dolomites with minor sandy interbeds continued to the total depth of the well.

(i) (?)Cambrian - General

The presence of gypsum with thin beds of dense vuggy dolomite in the red-bed association, points to an unstable shelf environment of deposition. Recurrent invasions of the sea onto an environment under dominant evaporitive conditions is envisaged. Oolites, as occurring in Hughes (R.S.) No. 1 and Hughes (N.E.) No. 3 Wells, are commonly associated with the shallow water, super-saline and current agitated conditions usual for evaporite deposition. The occasional pellets of glauconite found in the thin sandstone interbeds, also demonstrates a shallow water marine environment of deposition.

The white and green, partly current-bedded sandstone which overlies the red-bed association in the two most southerly wells, attests to a change to more stable shelf conditions. Reworking of some of the red-beds possibly took place, as evidenced by an inter-bed of red-brown claystone, within the sandstone in Denman No. 1.

5. Structure

The only previous information available on structure within the stratigraphic drilling project area, was provided by the reconnaissance aeromagnetic and gravity surveys. Aeromagnetometer results indicated a thickening of the sedimentary section towards the northern central portion of the permit area. The interpretative Bouguer Anomaly Map suggested an east facing basement escarpment or monocline just west of Hughes and a basement trough at Denman, trending west-north-west. Hughes (R.S.) No. 1 and Hughes (N.W.) No. 2 Wells were sited

at the base of the basement escarpment, Hughes (N.E.) No. 3 and Denman No. 1 Wells were drilled in the centre of the gravity trough.

It can be seen from the wells that the Tertiary, Cretaceous and ?Permian thicken generally to the south and south-east.

Assuming that the ?Cambrian sandstone - red-bed contact is conformable, then the (?)Cambrian is 109 feet lower stratigraphically at Denman No. 1, compared to Hughes (R.S.) No. 1. This is in agreement with the gravity picture.

The most complete (?)Cambrian section was intersected at the Denman well. It appears that erosion has removed varying amounts of the (?)Cambrian in the other three wells. Of 174 feet of (?)Cambrian sandstone present at Denman, only 41 feet remains at Hughes No. 1 and none whatever in the other two wells.

Possible correlations within the (?)Cambrian sediments, suggest that these are dipping gently south-east within the project area. Dips in the (?)Cambrian as indicated from cores are low.

6. Relevance to occurrence of petroleum

Shows in the wells included traces of bituminous material and oil stained cuttings. Details of shows are listed below.

(a) Hughes (N.W.) No. 2 Well

A few small fragments of bituminous material were observed in the cutting samples 640 to 650 feet and 690 to 700 feet. The bitumen gave a bright yellow cut in 1.1.1 trichloroethane under ultra violet light.

(b) Denman No. 1 Well

Interval	Nature of Material	Nature of cut in 1.1.1 trichloroethane
798 - 799	Black soft bituminous material of uncertain origin noted in the pits. This is a zone of lost circulation.	Strong
1240 - 1250	Oil stained quartz grains.	Medium
1250 - 1260	"	"
1260 - 1270	"	"
1280 - 1290	"	"
1300 - 1310	Small fragments of black, soft bituminous material	Strong
1310 - 1320	"	"
1400 - 1410	"	"

Interval	Nature of Material	Nature of cut in 1.1.1 trichloroethane
1420 - 1430	Small fragments of black, soft bituminous material	Strong
1430 - 1440	"	"
1480 - 1490	A few oil stained cuttings of shale and gypsum	Weak
1510 - 1520	"	"
1520 - 1530	"	"
1530 - 1540	"	"
1540 - 1550	A few oil stained cuttings of shale and gypsum	"
1550 - 1560	"	"
1560 - 1570	Trace of black bituminous material	Strong
1630 - 1640	"	"
1670 - 1680	"	"
1680 - 1690	"	"
1690 - 1700	Fragments of bituminous material up to 1" x 3/4" x 1/10"	"
1700 - 1710	"	"
1710 - 1720	Trace of black bituminous material	"
1720 - 1730	"	"
1760 - 1770	A few oil stained cuttings of shale	Weak
1780 - 1790	A few oil stained cuttings of shale and sandstone	"
1790 - 1800	"	"

Note: 1.1.1 trichloroethane was used as the solvent, a yellow cut under ultraviolet light was observed in all cases.

An analysis of bitumen obtained from Denman No. 1 Well is appended (Appendix 1).

Unfortunately there was no provision for testing these intervals catered for in the drilling contract. However, the presence of hydrocarbons within the Eucla Basin has been demonstrated and the presence of adequate reservoir beds and cap rock is evident.

The four wells were drilled virtually randomly with regard to, and with no available evidence on, potential hydrocarbon trapping conditions.

The fact that traces of bituminous material were encountered under these conditions, must be regarded as extremely encouraging.

The $^{(?)}$Cambrian almost certainly provides the source beds. Traces of

dessicated hydrocarbons are common in the (?) Cambrian of southern and central Australia. For example, bitumen is known from the Cambrian(?) of the Georgina and Amadeus Basins, from the Gidgealpa field and the (?) Cambrian limestones north of Port Augusta. The presence of hydrocarbons within the Cretaceous gravels of Hughes (N. W.) No. 2 well proves that migration of oil continued into the Cretaceous, and not all of the oil which has migrated from the (?) Cambrian was lost in the hiatus before the Cretaceous was deposited. The presence of Permian sediments has been proven in Yangoonabbie Bore, and although distribution is unknown, the possibility exists that other Palaeozoic sediments may overlie the Cambrian(?) in deeper parts of the basin.

No movement of oil from its original source rock would have occurred until sufficient overburden was deposited to initiate expulsion into carrier and reservoir beds. It has been estimated by Gussow and others, that at least 2,000 feet of overburden is necessary to initiate flushing of oil from the source bed and flushing continues until there is up to 6,000 feet of overburden. These conditions for flushing and secondary migration of oil may not have occurred until Cretaceous or Tertiary time, and relatively little oil expelled from the (?) Cambrian until the Mesozoic.

The Cretaceous gravels display good reservoir characteristics and are overlain by impermeable claystones. The calculation of formation water resistivities from the electric logs, gives values of up to 20,000 ppm of NaCl. The gravels were deposited in a salty swamp environment and these values of salt saturation indicate that flushing of connate water has probably not taken place within the gravel.

The ?Cambrian sandstones, although the intergranular porosity and permeability are low, display excellent fracture permeability. Circulation was lost in these sandstones at 798 feet, and after partial recovery of circulation, a trace of black soft bituminous material was noted in the pits. Calculation of water resistivity from the S.P. curve, indicates that the formation water contains the equivalent of 28,000 ppm NaCl. The electric logs indicate high resistivities in the lost circulation zone, but this could be due to the deep invasion by mud and lost circulation material.

Dolomites within the (?) Cambrian display good vugular porosity and cores indicate that not all of the fractures are healed, providing excellent permeability. The lenticular nature of the dolomites provides the possibility for stratigraphic traps.

7. Porosity and Permeability of Sediments Penetrated

No measurements of porosity or permeability were made, and no porosity tools included in the logging programme.

(a) Nullarbor Limestone

The Nullarbor Limestone has enormous local porosity due to the cavernous nature of the limestone.

(b) Wilson Bluff Limestone

The Wilson Bluff Limestone generally has good porosity and permeability, due to its friable chalky nature.

(c) ?Hampton Conglomerate

The sand has good porosity and permeability, over 1000 gallons per hour of water was air lifted from this sand at Hughes (R.S.) No. 1 Well.

(d) Cretaceous Claystones

Predominantly very poor porosity and permeability. However, about 150 gallons per hour flowed from the claystones at 500 feet in Hughes (R.S.) No. 1 Well while air drilling was in progress, pointing to a degree of fracture porosity.

(e) Cretaceous gravels

Fair to good porosity and permeability is evident in these gravels. The S.P. curve shows definite porosity, this interval being very clearly defined on the S.P. curves for all the wells. The Gamma Ray indicates claystone interbeds and perhaps a clayey matrix in places.

(f) ?Permian silty clays and siltstones

Mostly of very low porosity and permeability, thin quartz silt interbeds probably provide poor to fair porosity as indicated on the electric logs, especially in Hughes (N.E.) No. 3 where 30 feet of quartz silt was present from 535 to 570 feet.

(g) ?Cambrian Sandstones

Porosities and permeabilities are poor only as indicated from core samples. Partial to complete loss of circulation experienced in the upper portion of the sandstone in Denman No. 1 proves extensive fracture porosity and permeability is present.

(h) (?)Cambrian red-beds

The (?)Cambrian dolomites have at least fair porosity. Vugs are common in all dolomites cores and ranged in size from 0.5 mm to 6 cm in diameter. Fractures were not all healed and these would provide excellent permeability. Fractured zones within the shales were noted in some of the cores.

IV. REFERENCES

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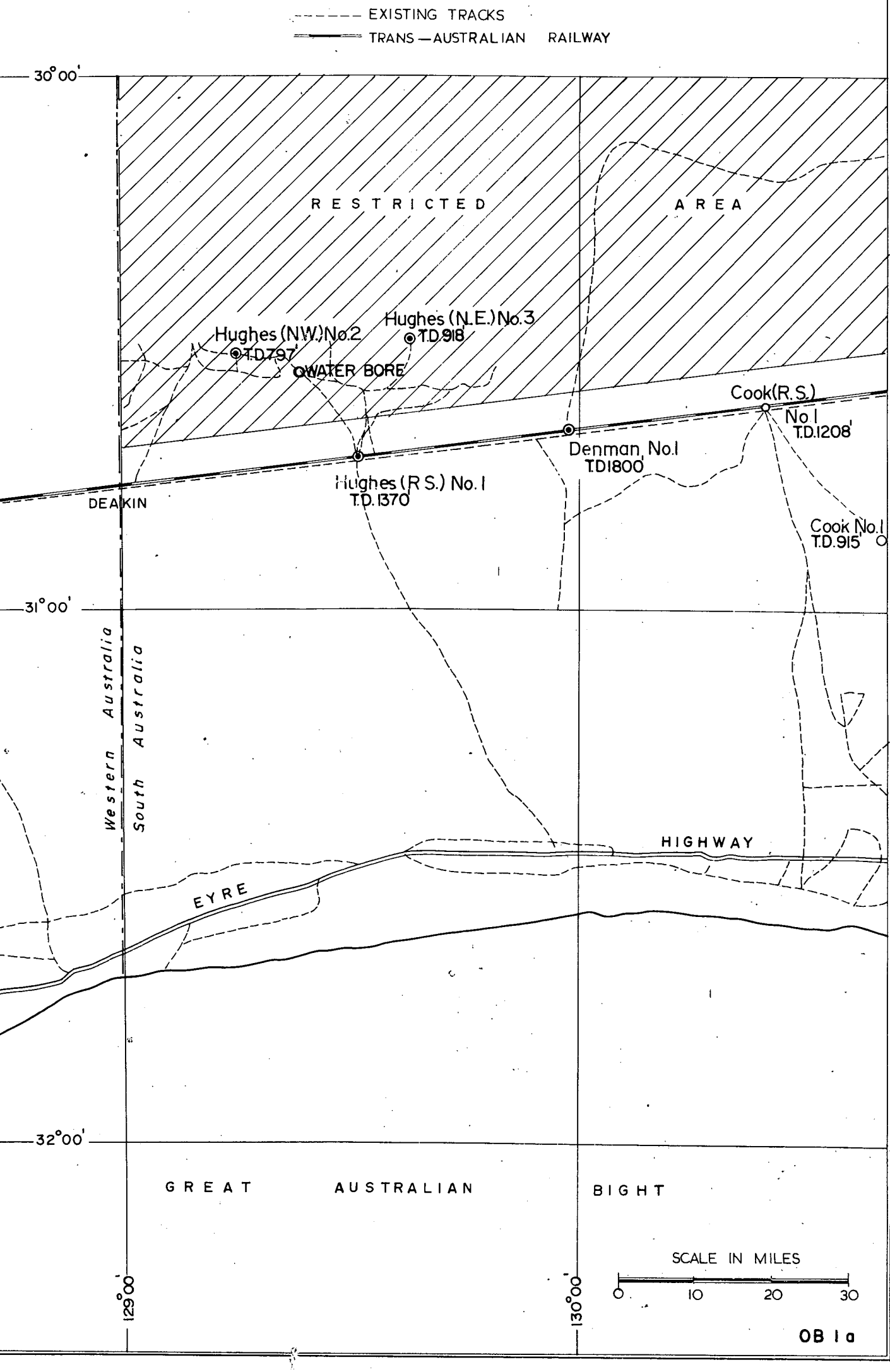
029

MAP PORTION O.E.L. 33 SHOWING LOCATION OF STRATIGRAPHIC DRILLING PROJECT



OB 1a

APPENDIX 1

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

AN 3/36/1/0

12th April, 1966.

O/N 13059

The Manager,
Geosurveys of Australia Pty. Ltd.,
68 Grenfell Street,
ADELAIDE.

REPORT AN2163/66 - WATER ANALYSIS

	PARTS PER MILLION	ASSUMED COMPOSITION OF SALTS	PARTS PER MILLION
Chloride, Cl	240	Calcium carbonate	67
Sulphate, SO_4	60	Calcium sulphate	-
Carbonate, CO_3	120	Calcium chloride	-
Nitrate, NO_3	Nil	Magnesium carbonate	52
Sodium, Na	218	Magnesium sulphate	-
Potassium, K	-	Magnesium chloride	-
Calcium, Ca	27	Sodium carbonate	76
Magnesium, Mg	15	Sodium sulphate	89
Total saline matter	680	Sodium chloride	396

HARDNESS (as Calcium Carbonate)			
Total	129	Water Bore No.1	
Temporary	129	Water Cut: 185' - 216'	
Permanent	-	Supply : > 600 G.P.H.	
Due to calcium	67		
Due to magnesium	62		

(Signed) P.A. YOUNG
DIRECTOR

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

AN 293/67

19th August, 1966.

O/N 13938
3/36/1/0

The Manager,

Geosurveys of Australia Pty. Ltd.,
68 Grenfell Street,
ADELAIDE.

	PARTS PER MILLION	ASSUMED COMPOSITION OF SALTS	PARTS PER MILLION
Chloride, Cl	4082	Calcium bicarbonate	238
Sulphate, SO_4	745	Calcium sulphate	1056
Bicarbonate, HCO_3	179	Calcium chloride	105
Nitrate, NO_3	trace	Magnesium bicarbonate	-
Sodium, Na	2179	Magnesium sulphate	-
Potassium, K	-	Magnesium chloride	881
Calcium, Ca	408	Sodium bicarbonate	-
Magnesium, Mg	225	Sodium sulphate	-
Silica, SiO_2	-	Sodium chloride	5538
Total	7818		

HARDNESS (as Calcium Carbonate)	
Total	1944
Temporary	147
Permanent	1797
Due to calcium	1018
Due to magnesium	926

Name:	Outback Oil N.L. Hughes RS
Hole No.:	1
Water Cut:	328' - 356'
Supply:	+ 500 gph

(Signed) P.A. YOUNG
DIRECTOR

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

AN 293/67

19th August, 1966.

O/N 13938
3/36/1/0

The Manager,
Geosurveys of Australia Pty. Ltd.,
68 Grenfell Street,
ADELAIDE.

	PARTS PER MILLION	ASSUMED COMPOSITION OF SALTS	PARTS PER MILLION
Chloride, Cl	4310	Calcium bicarbonate	316
Sulphate, SO_4	716	Calcium sulphate	917
Bicarbonate, HCO_3	238	Calcium chloride	-
Nitrate, NO_3	trace	Magnesium bicarbonate	-
Sodium, Na	2393	Magnesium sulphate	86
Potassium, K	-	Magnesium chloride	834
Calcium, Ca	348	Sodium bicarbonate	-
Magnesium, Mg	230	Sodium sulphate	-
Total	8235	Sodium chloride	6082

HARDNESS
(as Calcium Carbonate)

Total	1815
Temporary	195
Permanent	1620
Due to calcium	869
Due to magnesium	946

Name:	Outback Oil N.L. Hughes RS
Hole No.:	1
Water Cut:	500'
Supply:	150 gph

(Signed) P.A. YOUNG
DIRECTOR

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

AN 3/0/0 11th August, 1966.

Mr. R.C. Sprigg,
Managing Director,
Geosurveys of Australia Pty. Ltd.,
G.P.O. Box 1479L,
ADELAIDE, S.A.

REPORT AN176/67

YOUR REFERENCE:	Letter dated 18/7/66
MATERIAL:	Bituminous sample
IDENTIFICATION:	Outback Oil N.L.'s account
DATE RECEIVED:	20/7/66

Please quote report number (AN176/67) in any equiries.

Analysis by: H.W. Sears

Officer in Charge, Analytical Section: A.B. Timms

(Signed) P.A. YOUNG
DIRECTOR

ANALYSIS

Denman No.1 Well - 1690' - 1710'

Bituminous Sample

The sample consisted of a black solid bituminous material soluble in benzene and chlorinated solvents but only slightly soluble in n-Hexane.

Heating the sample in a closed tube gave a distillate brown-black in colour. Analysis of this distillate by Infra-red Spectroscopy showed it to be mainly a paraffinic hydrocarbon with some aromatics present.

Both distillate and original material exhibit a yellow-blue fluorescence in solution under ultraviolet light.

There was insufficient sample for estimation of trace lead and iron and it is therefore not possible to say whether the material is natural or processed.

The sample is a Bitumen of mineral origin which may or may not have been subject to industrial processing.

APPENDIX 2

BIT RECORD

HUGHES (R.S.) NO.1 WELL

Bit No.	In	Out	Total	Size (inches)	Make	Type	Serial No.	Hours Dlg.	Rate/ hr. (ft.)	Condition
1	0	45	45	8 1/2	Ingersoll Rand	Air Hammer		8 1/2	10	Good
2	45	356	311	8 1/2	Hughes	W7R	86324	23	13 1/2	Good
3	356	585	229	4 3/4	Williams	W4W	1659	5 1/2	51	
CB1	585	593	8	4 3/4	Reed			1 3/4	4	
3RR	593	630	37	4 3/4	Williams	W4W	1659	3	12	
4	630	850	220	4 3/4	Williams	W4D	1789	18	12	U/S
CB2	850	859	9	4 3/4	Reed	H.F.		3	3	
5	859	867	8	4 3/4	Williàms	W4W	538	3	3	Good
6	867	958	91	4 3/4	BlueDemon	DRAG		6 1/4	13 1/2	
7	958	1080	122	4 3/4	Hughes	OSC	22954	7 3/4	15 1/2	
CB3	1080	1089	9	4 3/4	Reed	H.F.		2 1/2	3 1/2	
8	1089	1160	71	4 3/4	Hughes	OSC	22956	5	14	
9	1160	1214	54	4 3/4	Williams	W4W	1669	16 1/4	3	U/S
10	1214	1312	98	4 3/4	Williams	W4D	980	18	5	
11	1312	1360	48	4 3/4	Hughes	OSC	22858	7 1/4	7	
CB4	1360	1370	10	4 3/4	Reed	H.F.		4	2 1/2	

BIT RECORD

Appendix 2

HUGHES (N.W.) NO.2 WELL

Bit No.	In	Out	Total	Size (inches)	Make	Type	Serial No.	Hrs. Dlg.	Rate/ hr.(ft.)	Condition
1	0	200	200	8 1/2	Ingersoll Rand	Air Hammer		25 1/2	9	Good
2	200	242	42	8 1/2	Hughes	W7R	86324	2	21	O.K.
3	242	275	33	6 1/4	Hughes	W7R	98082	2	17	
4	275	420	145	4 3/4	Hughes	OSC	22915	7	21	
CB1	420	430	10	4 3/4	Reed			5	2	
4RR	430	560	130	4 3/4	Hughes	OSC	22915	19 3/4	6 1/2	
5	560	751	191	4 3/4	Williams	W4D	992	6 1/2	55	U/S
CB2	751	757	6	4 3/4	Reed	H.F.		6 1/2	1	U/S
6	757	759' 9"	2' 9"	4 3/4	Williams	W4W	545	7	5"	U/S
7	759' 9"	760	3"	4 3/4	Williams	W4W	338	9	4"	U/S
CB3	760	760	0	4 3/4	Reed	H.F.		7		U/S
CB4	760	761' 2"	1' 2"	NX	Smith	Diamond		4 1/2	3"	U/S
8	761' 2"	765	4	4 3/4	Williams	W4W	542	2	2	U/S
9	765	778	13	4 3/4	Williams	W4W	540	10	1	U/S
10	778	794	16	4 3/4	Williams	W4D	917	13	1	U/S
11	794	794' 6"	6"	4 3/4	Williams	W4W	543	15	1/2"	U/S
CB5	794' 6"	797' 3"	2' 9"	NX	Smith	Diamond	2224/1	6 3/4	5"	U/S

U35

Appendix 2

BIT RECORD

HUGHES (N.E.) NO.3 WELL

Bit No.	In	Out	Total	Size (inches)	Make	Type	Serial No.	Hours Dlg.	Rate/ hr.(ft.)	Condition
1	0	14	14	8 1/2	Hughes	W7R	36324	6 1/4	2	O.K.
2	14	115	101	8 1/2	Ingersoll Rand	Air Hammer		6	16	O.K.
IRR	115	134	19	8 1/2	Hughes	W7R	86324	13	1 1/2	O.K.
2RR	134	209	75	8 1/2	I.R.	Air Hammer		2 3/4	27	O.K.
IRR(2)	209	250	41	8 1/2	Hughes	W7R	86324	5 1/2	7	O.K.
3	250	286	36	6 1/4	Hughes	OSC	75610	4 1/2	8	1/4 Worn
4	286	521	235	4 3/4	Hughes	OSC	22913	20 1/2	12	2/3 Worn
CB1	521	531	10	4 3/4	Reed	S.F.		1 1/2	7	O.K.
5	531	658	127	4 3/4	Williams	W4D	978	19 1/4	6	U/S
6	658	704	54	4 3/4	W.M.	WM-IH	40675	19	3	U/S
7	704	758	54	4 3/4	Williams	W4D	1287	23	2 1/2	U/S
8	758	782	24	4 3/4	Williams	W4W	548	12 3/4	2	U/S
9	782	791	9	4 3/4	Williams	W4W	560	10 1/2	1	U/S
CB2	791	793	2	4 3/4	Reed	H.F.		3 1/4	2/3	U/S
10	793	799	6	4 3/4	W.M.	WM-IH	40674	9	2/3	U/S
11	799	807	8	4 3/4	W.M.	WM-IH	40671	5 1/2	1 1/2	U/S

BIT RECORD

Appendix 2

HUGHES (N.E.) NO.3 WELL

Bit No.	In	Out	Total	Size (inches)	Make	Type	Serial No.	Hours Dlg.	Rate/ hr.(ft.)	Condition
12	807	833	26	4 3/4	Williams	W4D	991	15	2	U/S
13	833	891	58	4 3/4	Williams	W4D	990	16	3 1/2	U/S
14	891	913	22	4 3/4	Williams	W4D	973	8 1/2	2 1/2	U/S
15	913	917	4	4 3/4	Williams	W4W	559	8 1/2	1/2	U/S
CB3	917	917'8"	8"	NX	Smit	Diamond		1 1/2	1/2	U/S

NOTE: W.M. = Walker-MacDonald

BIT RECORD

Appendix 2

DENMAN NO.1 WELL

Bit No.	In	Out	Total	Size (inches)	Make	Type	Serial No.	Hours Dlg.	Rate/ hr.(ft.)	Condition
1	0	5	5	8 1/2	Hughes	W7R	86324			
2	5	225	220	8 1/2	I.R.	Air Hammer		22 3/4	10	
1RR	225	254	29	8 1/2	Hughes	W7R	86324	5	6	O.K.
3	254	283	29	4 3/4	Hughes	OSC	22918	1 1/2	20	O.K.
4	283	503	220	6 1/4	Hughes	OSC	75610	18	12	O.K.
CB1	503	513	10	4 3/4	Reed	S.F.		3/4	12	O.K.
4RR	513	746	233	6 1/4	Hughes	OSC	75610	24	10	U/S
5	746	795	49	6 1/4	Hughes	W7R	98079	16 1/2	3	U/S
6	795	827	32	6 1/4	Hughes	W7R	98083	10	3	U/S
7	827	866	39	6 1/4	Hughes	OSC	75608	18 1/2	2	U/S
8	866	913	47	6 1/4	Hughes	OSC	75612	22 3/4	2	U/S
CB2	913	923	10	4 3/4	Reed	H.F.	106	1 1/2	6	O.K.
9	923	990	67	4 3/4	Williams	W4D	975	12 3/4	5	U/S
10	990	1003	13	4 3/4	Hughes	OSC	22921	9 1/2	1 1/2	U/S
11	1003	1066	63	4 3/4	Williams	W4W	558	22 1/2	3	U/S
12	1066	1186	120	4 3/4	Williams	W4D	971	26	4 1/2	U/S
CB3	1186	1193	7	4 3/4	Reed	H.F.	106	2 1/2	3	U/S
13	1193	1240	47	4 3/4	W.M.	I.H.	17253	15	3	U/S
14	1240	1312	72	4 3/4	W.M.	I.H.	17254	17 1/2	4	3/4

0138

BIT RECORD

Appendix 2

DENMAN NO.1 WELL

Bit No.	In	Out	Total	Size (inches)	Make	Type	Serial No.	Hours Dlg.	Rate/ hr.(ft.)	Condition
15	1312	1325	13	4 3/4	W.M.	I.H.	17255	12	1	3/4
16	1325	1597	272	4 3/4	W.M.	I.	38870	47	5 1/2	U/S
CB4	1597	1607	10	4 3/4	Reed	H.F.	2868	2 3/4	3 1/2	U/S
17	1607	1732	125	4 3/4	Hughes	OSC	22916	29	4	U/S
18	1732	1800	68	4 3/4	W.M.	I.	38876	20	3 1/2	1/2

039

APPENDIX 3

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT

DISCUSSION OF ELECTRIC LOGS

The suite of logs run in the holes, consists of short and long normals, 6 foot lateral, point resistivity, S.P. and gamma ray, with the exception of Hughes (R.S.) No.1, where only short and long normals and S.P. were run. A temperature log was run to 748 feet in Denman No.1.

Due to the highly resistive nature of the red-bed association, the S.P. and normal resistivity curves are of little value. Interpretation is further hindered by the inability of the logging unit to record on more than one scale at a time, resulting in poor definition in some sections. A statistical check was omitted on all the gamma ray curves. There appears to have been malfunction of equipment when the S.P. curve for Denman No.1 Well was recorded. There are 2 very resistive zones within the ?Cambrian sandstone in Denman No.1 well. The zones are from 784 to 808 and 816 to 840 feet. The gamma ray indicates the sandstone is fairly clean, but this was a zone of lost circulation and the high resistivities are probably due to the large invaded zone and the lost circulation material (sawdust and distillate) within the invaded zone.

It is recommended that the following suite of logs be run in future wells in the permit area:- S.P., short normal resistivity, induction log, microlog-caliper, and sonic log. If salty muds are used, then the laterolog and microlaterolog substituted for the short normal and microlog.

HUGHES (N.W.) NO.2 WELL

CALCULATION OF RW

Interval 560 to 708 feet

Rm	=	4.8 ohm.m. @ $60^{\circ}F$
	=	3.7 ohm.m. @ $80^{\circ}F$ (700 feet)
Rmf	=	3.4 ohm.m. @ $80^{\circ}F$ from charts
S.P.	=	-80 m.v.
$\frac{Rmf}{(Rw)e}$	=	14 from charts
$\therefore (Rw)e$	=	0.24
and Rw	=	0.27 @ $80^{\circ}F$
		equivalent to 20,000 ppm of NaCl

DENMAN NO.1 WELL

CALCULATION OF RW

1. 1220 to 1286 feet (E. log datum)

Rm = 1.2 ohm.m. @ 59°F

= 0.78 ohm.m. @ 91½°F

∴ Rmf = 0.55 ohm.m. @ formation temperature

S.P. = -28 m.v.

$\frac{Rmf}{(Rw)e}$ = 2.5 from charts

∴(Rw)e = 0.22 ohm.m.

and Rw = 0.24 ohm.m.

Equivalent to 21,000 ppm. NaCl, however due to the shaley nature of the sand as indicated on the gamma ray, this value is too low.

2. 820 to 860 feet

Rmf = 0.65 ohm.m. @ formation temperature

SSP = 37 m.v.

$\frac{Rmf}{(Rw)e}$ = 3.4 (Rw)e = 0.19 ohm.m.

Rw = 0.20 ohm.m. equivalent to 28,000 ppm NaCl

APPENDIX 4

CORE DESCRIPTIONS
HUGHES (R.S.) NO.1 WELL

Core No.1

585'- 593' Recovered 5 ft. 2 ins. (65%). Consists of claystone, silty in part, minor siltstone and very minor sandstone the boundaries between these lithologies are sometimes sharp, sometimes gradational. The claystone predominates with the silty claystone, siltstone and sandstone as thin interbeds, laminations, lenses and lense-like bodies and rounded inclusions. The claystone is light to dark grey when dry, black when wet, soft to moderately hard, brittle, slightly fissile very micaceous with brown biotite and white muscovite flakes, the flakes having no preferred orientation. Very silty in part grading to a siltstone, with subangular quartz grains, black carbonaceous specks, sparsely scattered green glauconite pellets, crystalline pyrite aggregates. Rounded to angular quartz grains occur scattered randomly through out the core, some 5 mm. in diameter, the larger grains appearing to have been derived from a metamorphic source. The sandstone is white to grey occasionally greenish, fine grained, poorly sorted, soft, porous, consisting of angular and subangular clear quartz, numerous soft green glauconite pellets, black carbonaceous material and minor brown and white mica flakes. The sandstone occurs in thin interbeds to 2 cm. wide. The porosity and permeability of the claystone and siltstone is very low, the possibility exists for some small amount of fracture porosity.
The presence of glauconite in association with biotite mica and pyrite indicates a shallow water open marine origin for the claystones and siltstones. They were deposited at a slow rate under slightly reducing conditions, probably at a depth of less than 100 fathoms.

Core No.2

850'- 859' 850-859 Recovery 9" = 8.3%
Depths: 850-853 Quartz sandstone.
(from drilling rate) 853-859 Claystone.
Lithology
(850-853) Quartz sandstone (Orthoquartzite), white to brown white, generally fine grained and well sorted but with numerous colourless, pale yellow, pink and red translucent grains scattered throughout, these coarser grains sometimes form a poorly sorted very coarse grained sandstone with grain sizes varying from fine to very coarse grained, the coarse grains are well rounded and frequently subspherical, the sandstone as a whole is hard, massive and generally appears tight except for the coarse grained parts which have visible porosity; vertical fracturing is present.

(853-859) Claystone pale green, in part mottled with red, finely micaceous, exhibits very imperfect fissility, contains coarse well rounded quartz grains some of which are red and yellow, these grains sometimes form lenses of very sandy claystone, the claystone tends to disintegrate in water.

Core No.3

1080-1089'

Recovered 3'1" = 34.4%
Depths: 1080-1089 Claystone with bands of Gypsum replacement near base.
Lithology:
Claystone, red brown, some green mottling, micaceous, uneven break along poorly developed subhorizontal fissility, in parts has occasional hair line vertical fractures. The claystone has been replaced by Gypsum near the base of the core. The gypsum is generally massive in appearance and has a satin to dull lustre. However, there are also lenses of fibrous gypsum. The replacement is directed along the fissility of the claystone The fibrous crystals seem to be the first to develop along near horizontal planes as small lenses which widen into zones of apparently unoriented massive gypsum up to 1" thick and separated by ragged lenses of red brown and some green siltstone which in turn contain thin (1-10 mm) lenses of fibrous gypsum.

Core No.4

1360'- 1370'
(Total Depth)

Recovery 3 ft. 1 inch - 31%
Consists of interbedded purple, green and minor brown shales and thin laminae and inclusions of gypsum. The shale interbeds vary from one foot to less than one millimetre thick.
The purple shale is hard, brittle, and laminated in part, while non silty interbeds are softer and have a soapy lustre. Occasional thin bands of soft, slightly silty brown shale occur within the purple shale.
The bright green shale is moderately soft to soft, slightly silty and very gypsiferous.
The gypsum occurs throughout the length of the core as thin laminae 0.25 mm. to 3 mm. wide, as large euhedral crystals and as irregular crystalline aggregates. The gypsum varies in colour from clear to translucent orange and is more commonly associated with the green shale, finely divided gypsum probably being one of the shales major constituents. Together with the gypsum, the green shale has partly replaced the softer purple shale along bedding planes and poorly developed vertical fractures. This replacement has been accompanied by minor contortion

of bedding on a small scale, probably due to the increase in volume caused by the hydration of anhydrite to gypsum. A number of thin bands of anhydrite were noted near the base of the core. Both the anhydrite and gypsum appear to be of authigenic origin.
Bedding is horizontal throughout the core.
No traces of oil or gas were noted.
Porosities are low throughout the length of the core.

HUGHES (N.W.) NO.2 WELL

Core No.1

420'- 430' Recovered 2 ft. 4 inches (23%)
The Core has been compacted and irregularly forced into the barrel, destroying all traces of bedding and structure.
The lithology is claystone, light to mid grey, fairly soft, brittle, predominantly finely silty, but occasionally very silty and sandy with abundant soft green glauconite pellets, common biotite and muscovite mica flakes soft black carbonaceous specks, unidentified soft white flecks and irregular to ovoidal crystalline aggregates of pyrite.

Core No.2

751'- 757' Recovered 13" (18%)
The Top 9 inches consists of Dolomite, light grey with a brownish tinge, very hard and dense, mostly microcrystalline with a pseudoporphyritic texture having clear anhedral and subhedral crystals in a microcrystalline "groundmass". Bedding is represented as poorly developed horizontal lineations. Vertical fractures to 1mm. wide are fairly common, and filled with clear crystalline dolomite.
The next 2 inches consists of Dolomite, off white in colour, hard, dense, macrocrystalline with occasional clear and purplish euhedral crystals to 5 mm. long.
The bottom 2 inches consists also of Dolomite, blackish in colour, hard, dense, equigranular, almost saccaroidal. Mesocrystalline texture, argillaceous. The dolomite is impermeable and poor porosity is associated with a number of small crystal lined vugs.

Core No.3

760'- 761'2" Recovered 3 inches (21%)
The core consists of Chert; light grey, translucent in thin chips, extremely hard, compact, dense and brittle. Much of the original detrital texture has been lost during silification. Silica lined vugs to 5 mm. across are common, as are irregular non-directional healed fractures. Porosity of the quartzite is poor, permeability virtually non-existent. The unrecovered portion of the core consisted of dolomite as in Core No.2 (indicated by cutting samples during coring).

Core No.4

794' 6" - 797' 3" Recovered 30" (90%).
The Top 1 inch consists of Chert; grey, translucent in thin chips, extremely hard, dense and brittle, very fine grained and faintly laminated. Poorly developed sub-vertical fractures are common, the fracture surfaces coated with ?anhydrite and irregular patches of dark red hard iron oxide. Porosity and permeability are virtually nil.
The Remainder of the Core consists of Dolomite with Chert nodules and minor dark brown and black argillaceous material.

The dolomite is grey and buff coloured, cryptocrystalline and microcrystalline, hard, and dense, rarely as clear subhedral crystals. The dolomite is delicately laminated in places, showing alternating light and dark bands. Styolitic seams are common throughout the length of the core, with an average amplitude of 1 cm., the residue on the seams consists of black and dark brown, very silty argillaceous material. The seams are subhorizontal, but as they are a post consolidation feature they are not indicative of dip. One seam, 9 inches from the top of the core divides into 2 seams 2 cm. apart enclosing the black silty clay and irregularly shaped nodules of chert. Chert nodules occur randomly throughout the core, occupying 15-20% of the volume of the core.

12 inches from the top of the core occurs a very irregular band $1\frac{1}{2}$ to 5 cm. wide of brown very silty argillaceous material and irregular masses of chert. Beneath this band occurs a 9 inch zone of quite intense intraformational folding and deformation. One fold has an amplitude of 6 cm., with vertical dips near the crest. A styolitic seam has also undergone folding showing that the folding occurred after consolidation.

A number of quartz spherulites occur within the core of the fold and elsewhere; probably the quartz has replaced what once were calcareous oolites.

Beneath this zone of intense folding the intensity decreases, but small and micro folds are common within the laminated dolomite.
Porosity and permeability of the dolomite is virtually nonexisten

HUGHES (N.E.) NO.3 WELL

Core No.1

521'- 531'

Recovered 18" (15%)
The Top 17½ inches consists of claystone; light grey, soft, very silty with scattered carbonaceous specks, clear quartz grains, and mica flakes. The latter extremely abundant in part. Towards the base of this interval, occur thin interbeds of dark grey claystone, and siltstone, between 1mm and 2 cm thick. The dark grey claystone is soft, brittle, slightly silty with carbonaceous specks, quartz grains and occasional pyrite aggregates. The siltstone is white soft, and consists of clear quartz grains, with minor black carbonaceous material and argillaceous and occasionally gypsiferous cement, extremely micaceous in places, the flakes appear to have no preferred orientation.
Bedding planes were horizontal, but have been distorted during coring.
The Bottom ½ inch consists of claystone; white, banded, very soft, gypsiferous? Very silty with scattered black carbonaceous specks and abundant clear quartz grains.

Fifteen inches from the top of the core occurs pyrite; as a yellow, hard, lense-like microcrystalline mass, over 2 cm wide and 2 cm thick. The pyrite is associated with black sulphide rich argillaceous material.

Porosity and permeability throughout the core is very low.

No traces of oil or gas.

Core No.2

791'- 793'

Recovered 22" (92%)
The Top 3½ inches consists of Dolomite; brownish-grey, moderately hard, brittle, dense, predominently mesocrystalline, common white and dark mottling, the white mottling probably ghosts of original structures in the limestone, which was of a clastic nature. The dark mottling is due to small accumulations of dark brown argillaceous material. The dolomite becomes silty towards the base of this interval. Vertical fractures are common, and are filled with mesocrystalline dolomite.
The Next 1 inch consists of siltstone; grey-green, soft to moderately hard, friable, very dolomitic, grading to a sandstone in thin bands, the siltstone is composed of rounded clear quartz grains in a dolomitic and argillaceous matrix.
The Next 1½ inches consists of shale; grey-green, soft, dolomitic, common thin (to 5 mm) lighter coloured silty lenses, showing evidence of current action.

The Next 11 inches consists of dolomite, grey-green, hard, brittle, argillaceous to very argillaceous, microcrystalline, slightly fissile in part. Common subvertical, subhorizontal and acutely angled fractures, the surfaces coated with deposits from percolating formation waters. The deposits consist of redeposited dolomite, coloured red or greenish-grey and grey very finely divided argillaceous material.

Fracture porosity and permeability only.

The Next 4 inches consists of oolitic dolomite; dull greenish-grey, white in patches, hard mesocrystalline, the oolites compose over 60% of the dolomite and occasionally reach 1 mm in diameter. A vug, 3 cm wide, and lined with rhombs of clear dolomite crystals occurs in this interval. Minor amounts of massive as well as crystalline chalcopyrite occur as brassy encrustations on the dolomite rhombs, and as a patchy coating on vertical fracture surfaces.

The Bottom 1 inch consists of siliceous oolite (chert); dark brownish-grey, extremely hard, and is derived from the silicification of oolitic dolomite as in the interval above. A large vug (2 x 2 x 2 cm) occurs in this interval, and is lined with clear euhedral crystals and rhombs of calcite up to 1 cm in length, as well as rhombs of clear crystalline dolomite.

The siliceous oolites are, in the main, clearly defined, and the original microstructure preserved during silicification.

Bedding planes throughout the core are mostly poorly defined, but are subhorizontal.

Porosity and permeability due to vugs and fractures only.

No traces of oil or gas were observed.

Core No.3

917' - 917' 8" Recovered 7½ inches (94%). Consists of Dolomite with chert nodules.

The Dolomite predominates and is buff coloured, hard, brittle, tight and banded with alternating light and dark brown bands, and common styolitic seams which have soft black argillaceous material coating the seam surfaces. There are common, small (0.5 to 1 mm) irregular and lense like vugs, many filled with clear crystalline dolomite. These vugs provide the only form of porosity within the dolomite. Permeability is due to fractures only.

The Dolomite is of clastic origin, faint ghosts of detrital grains can be observed. The dolomite was probably deposited as a calcarenite.

The chert is very hardy black when dry, and has a speckled appearance when wet due to ghosts of the original detrital grains. The chert is still slightly dolomitic, due to incomplete silicification and is interlaced with a network of randomly oriented, fine microscopic fractures.

DENMAN NO.1 WELL

Core No.1

503' - 513'

Recovered 10 feet (100%)

Consists of claystone; mid to light grey, soft, very brittle, subconchoidal fracture, tends to disintegrate on exposure to the air. Silty, with mica flakes white argillaceous specks, black carbonaceous material, clear quartz silt, finely divided and disseminated pyrite and rare soft green glauconite pellets, the mica flakes appear to have no preferred orientation. Pyrite also occurs as finely granular aggregates in the form of lenses and lense like inclusions to 5 mm thick.

Interbedded with the brittle claystone occur bands and interbeds to one foot thick, of soft, "puggy" claystone which are very glauconitic and very coarsely silty - grading to a siltstone in places.

Dip is horizontal.

Porosity and permeability negligible.

No traces of oil or gas noted.

Core No.2

913' - 923'

Recovered 5 feet 8 inches (57%).

Consists of sandstone (orthoquartzite), light green with the coarser grained and more porous interbeds stained pinkish purple by tannin thinners in the drilling mud, soft to moderately hard, friable, very fine to medium grained, and well sorted. Consists predominantly of rounded to subrounded lightly frosted, clear quartz grains, with very minor dark lithic grains, very rare muscovite mica flakes and fairly common pyrite as small euhedral crystals, crystalline aggregates and o occasionally as cementing material, the predominant cementing material being of a siliceous and argillaceous nature.

The bedding is horizontal, although there is occasional evidence of cross bedding dipping at 60°. Faintly banded in part due to finer and coarser grained interbeds. The porosity and permeability varies from poor, to quite fair in the coarser grained interbeds.

Core No.4

1186' - 1193'

Recovered 5 feet 9 inches (82%).

Shale; red-brown, soft to moderately hard, very silty, with quartz silt and common mica flakes. Dolomitic,

clayey in part, trace of gypsum as soft thin translucent plates along bedding planes. Common bands, lenses and irregular masses of green and light purple shale to $\frac{1}{2}$ inch thick. Siltstone also occurs as interbeds to $\frac{1}{2}$ inch thick as irregular thin lenses and as rounded to irregular 'granules' 2 mm in diameter. The siltstone interbeds become more common towards the base of this interval. The siltstone is white and light green, hard to occasionally soft, friable, composed of clear quartz grains, and silvery grey and greenish mica flakes in a dolomitic and calcareous cement. A fractured zone 7 inches thick in this portion of the core, shows evidence of connate water movement, the shale in this zone is fractured, soft and clayey, the siltstone eroded and pitted.

Bedding is essentially horizontal in this portion of the core.

The Next 9 inches consists of Sandstone; white and light green, moderately hard, friable, very fine to coarse grained, fairly well sorted, consists of finely pitted clear quartz grains and minor soft bright green rounded pellets of ?glauconite. The medium to coarse grained quartz is well rounded but the finer grained quartz is subangular to subrounded. The cement is dolomitic and calcareous, a matrix of fine quartz silt is common especially towards the base of the unit, where the grain size becomes coarser. Poor to fair porosity and permeability. A few thin green and white siltstone bands occur towards the top of this unit.

The Next 2 feet 4 inches consists of Sandstone; red brown, brownish-purple, light grey and grey-green, mottled, fine to medium grained, poorly sorted, poor to fair porosity.

The red-brown sandstone is soft and consists of quartz as in the unit above, in a red-brown, soft argillaceous and calcareous cement, with a matrix of fine silt sized quartz. The proportion of matrix and cement occasionally predominate and the sandstone grades to a sandy, silty shale, or sandy siltstone. In the top portion of this unit, occurs the light grey, white and green-grey sandstones, occuring as, thin lenses, interbeds, rounded granules, and also as bands 2 to 3 mm thick, lining fractures, which lie at an angle of 75° to 90° to the horizontal.

The light coloured sandstones predominate in the lower half of this unit of the core. The sandstone generally becomes coarser grained and less well sorted with depth, with occasional interbeds up to $\frac{1}{2}$ inch thick of white quartz siltstone.

A tight fold with an amplitude of 3 ins. occurs at the base of the sandstone. The fold is probably due to slumping, but possibly derives from the results of differential compaction over the irregular contact between the sandstone and the underlying shale.

052

The Bottom 9 inches consists of Shale; red-brown, hard, brittle, very silty with common mica and quartz, dolomitic and calcareous. Occasional lenses, thin interbeds and irregular masses of siltstone occur in this unit. The siltstone is green-grey, hard, tight, quartzose and richly micaceous. A trace of gypsum as thin translucent plates occur within the shale, on bedding planes and vertical fracture surfaces.

No traces of oil or gas were noted although contamination by rig oils was observed.

Core No.4

1597' - 1607' Recovered 9 feet 10 inches (99%)

Consists of shale; red-brown, brown, minor green, soft to moderately hard, brittle, fissile, micaceous, dolomitic, tight. The majority of the shale is reddish-brown, probably due to the finely divided ferric oxide (oxidizing environment), with green shale occuring as lenses, interbeds to 18 inches thick, and as small rounded and irregular 'spots' from over an inch to less than 0.1 inches in diameter, giving a mottled appearance in places. The green shale is slightly harder, more dolomitic, and less soluble in water than the red-brown shale.

White gypsum occurs throughout the core as small lenses and interbeds, of soft microcrystalline aggregates. Vertical and sub-vertical fractures occur sporadically, and are filled with yellowish translucent gypsum, which occurs as a fibrous fracture filling to 1/8 inch thick.

Bedding is horizontal, although there is minor gentle folding due to slumping towards the base of the core.

LITHOLOGICAL DESCRIPTIONS

HUGHES NO. 1

Feet	
0 - 4	40% Limestone, white, cryptocrystalline, slightly dolomitised, dense, occasional small calcite lined vugs. 60% Limestone, brownish-red, soft, kunkarised, sandy, containing common fine sand sized, iron stained quartz grains.
4 - 10	Limestone, light cream, occasionally brown and sandy, cryptocrystalline to mesocrystalline, dense to sometimes porous, recrystallised, common fossil remains including corals and foraminifera, a minority of cuttings show porosity due to fine calcite and dolomite lined solution cavities and channels but the majority of cuttings are dense and non porous.
10 - 20	Limestone, light cream, as above but predominantly microcrystalline, occasionally cuttings stained red (iron oxide?) slight contamination by grease and copper based tool joint compound.
20 - 30	Limestone, as above.
30 - 40	Limestone, as above but softer, coarser grained, porous, common iron oxide stained cuttings, scattered foraminifera.
40 - 50	Limestone, as above.
50 - 60	Limestone, as above, more than 50% of the cuttings have a patchy reddish to yellow coating due to iron oxide staining. Common crystalline calcite from fracture fillings. Occasional foraminifera, lace corals, ?bryozoa. Trace diesel oil contamination. Common tool joint compound contamination. A number of bands of hard cryptocrystalline Limestone to 2 feet thick are present in this interval but cuttings from these bands are reduced to powder and little is caught.
60 - 70	Limestone, as above. Rare mollusc fragments to 2 cm. Abundant contamination with grease. Trace of Claystone, brown, brittle, finely laminated, compact, disintergrates in water - "Heaving Shale".

70 - 95% Limestone, as above, but less porous, crypto-microcrystalline. 5% Claystone, as above. Contaminated with diesel oil and grease.

80 - 90 90% Limestone, as above, grading to a Calcarenite, predominantly yellowish in colour. Diesel Oil Contamination.

90 - 100 Limestone grading to a calcarenite, as above, common fine sand sized, soft rounded granules of glauconite, occasionally occupying openings in foraminifera and coral fragments. 5-10% Claystone, as above. The occurrence of glauconite suggests that the limestone is more aptly named a calcarenite, the subrounded to subangular cuttings also point to this. The calcareous cement is winnowed out by the air stream during drilling.

100 - 110 Calcarenite, as above, medium grained, poorly sorted consists of subangular to rounded grains of white and yellow, occasionally clear or iron stained calcite, fossil fragments, including foraminifera, corals, bryozoans and ?sponge spicules, and occasional pellets of soft green glauconite.
Trace of claystone as above.

110 - 120 95% Calcarenite, as above.
5% Claystone, as above.

120 - 130 70% Calcarenite, as above.
30% Claystone, as above but silty in part.

130 - 135 40% Calcarenite, as above.
60% Claystone, as above.

135 - 140 90% Calcarenite, as above.
10% Claystone, as above.

140 - 150 95% Calcarenite, as above, abundant glauconite, occasional clear and milky, angular quartz grains to 1 mm.
5% Claystone as above. Drilling Break 145 feet.

150 - 160 90% Calcarenite, as above, white, predominantly medium grained, consists of poorly sorted, rounded and subrounded calcite, limestone and fossil fragments, soft glauconite pellets and rare angular quartz grains.
10% Limestone, white, medium hard, dense.
Trace claystone, as above.

160 - 5% Calcarenite, as above.
95% Limestone, as above, white medium hard, dense, crypto-crystalline scattered bryozoa.

170 - 180 Bryozoal limestone, as above.

180 - 190 Bryozoal limestone, as above, scattered glauconite pellets and inclusions.

190 - 200 Bryozoal limestone, as above, but glauconite not so abundant, grades to a calcarenite in part.

200 - 210 95% Bryozoal limestone; as above, rare angular quartz grains
5% cavings of Calcarenite and Claystone.

210 - 336 No cuttings - lost circulation.

Drilling Break 328 feet.

336 At 336 feet water was blown to the surface carrying fragments to 2 inches of Calcarenite, cream, recrystallised in part, medium grained, poorly sorted, bryozoal, very porous, consists of angular to subangular white calcite, fossil fragments and pellets of glauconite, calcareous cement, shows deposition of calcite in vugs and cavities by percolating ground water. This calcarenite probably represents the base of the Wilson Bluff Limestone.
Also blown up with the limestone was 90% Sand, medium grained, poorly sorted, consisting of subangular to rounded predominantly clear and polished quartz grains, from coarse silt to coarse sand size.
10% Clay, mid brown, soft, sometimes as partly consolidated soft rounded grains to $\frac{1}{2}$ mm. diameter, carbonaceous.

336 - 346 80% Sand, as above, but slightly finer grained.
20% Clay, as above, more than half in the form of rounded grains.

346 - 356 80% Sand, as above.
20% Clay, as above.

356 - 360 80% sand, coarse grained, poorly sorted, consisting of subrounded, polished, clear and milky quartz grains, occasionally cemented with iron oxide.
20% Clay, brown, soft, micaceous, silty. Contamination includes rust scales from casing, diesel oil and tool joint compound.

360 - 370 10% Sand, as above.
10% Clay, as above.
80% Claystone, grey, plastic, soft, very silty, slightly sandy, contains common bright green glauconite pellets.

370 - 380 10% Sand, as above.
10% Clay, as above.
80% Claystone, as above, as alternating light and dark grey bands to 1 cm. thick. The light grey bands are glauconitic and soft when wet, the dark grey bands are sandy, silty, plastic and carbonaceous.

380 - 390 90% Claystone, as above.
10% Clay and sand, as above.

390 - 400 Claystone, as above, very soft when wet, brittle when dry, light to dark grey, very sandy in part, occasional crystalline aggregates of pyrite, grades to a siltstone in places.

400 - 410 Claystone, as above, very glauconitic.

410 - 420 Claystone, as above, so glauconitic, that the claystone grades to a greensand in 10% of the cuttings, the glauconite is in the form of soft green rounded granules to $\frac{1}{2}$ mm. in diameter. Pyrite aggregates are common and rare specimens of pyrite cemented sandstone range up to 3 cm. across.

420 - 430 50% Claystone, very silty, as above.
50% Claystone, black and brittle when wet, grey when dry, moderately hard, grades to a shale, abundant silt sized glauconite pellets in patches, common silt sized white flecks, ?carbonaceous; rarely very dark green, perhaps due to finely divided glauconite.

430 - 440 20% Claystone, soft, as above, water soluble, occurs as large fragments, probably cavings.
80% Claystone, grading to shale, as above, common pyrite.

440 - 450 50% Claystone, soft, as above, cavings.
50% Claystone, dark grey, hard, silty as above.

450 - 460 70% Claystone, dark grey as above.
30% Claystone, soft, as cavings, as above.

460 - 470 70% Claystone, black to dark grey as above, brittle, glauconitic. 30% cavings of soft claystone.

470 - 480 Claystone, as above, shows slight fissility, moderately hard. 10% of the cuttings are soft claystone cavings.

480 - 490 Claystone, as above, very silty.

490 - 500 Claystone, as above.

500 - 510 Claystone, as above, becoming increasingly silty.

510 - 520 Claystone, as above, very silty, containing abundant clear subangular quartz grains, grades to a siltstone.

520 - 530 Siltstone, black when wet, dark grey when dry brittle, argillaceous micaceous, composed of subangular quartz grains, black ?carbonaceous specks, white clay flecks, small pyrite aggregates, occasional glauconite pellets. Trace of soft, poorly cemented sandstone, fine grained, composed of equal quantities of clear subangular quartz grains and soft, green, glauconite pellets.

530 - 540 Siltstone, as above, but slightly softer, more water soluble.

540 - 550 Siltstone, as above, very sandy with scattered fine sand size clear quartz, and abundant glauconite pellets, common carbonaceous flecks. Trace of sandstone, as above. Trace of pyrite as cryptocrystalline aggregates.

550 - 560 Siltstone, as above, coarse grained, trace sandstone, as above.

560 - 570 Siltstone, as above, grades in part to a fine grained sandstone, micaceous, abundant glauconite as soft green pellets mostly 0.25 mm. across, common clear andyellow subangular quartz grains mostly fine sand size but occasionally to 2 mm. in diameter, the siltstone is becoming less well cemented, 20% of the cuttings consist of quartz and glauconite sandy silt.

570 - 585 Siltstone, as above.

585 - 593 Core Number One. Recovered 5 ft. 2 ins. (65%)
Consists of claystone, silty in part, minor siltstone and very minor sandstone the boundaries between these lithologies are sometimes

sharp, sometimes gradational. The claystone predominates with the silty claystone, siltstone and sandstone as thin interbeds, laminations, lenses and lense-like bodies and rounded inclusions.
The claystone is light to dark grey when dry, black when wet, soft to moderately hard, brittle, slightly fissile very micaceous with brown biotite and white muscovite flakes, the flakes having no preferred orientation. Very silty in part grading to a siltstone, with subangular quartz grains, black carbonaceous specks, sparsely scattered green glauconite pellets, crystalline pyrite aggregates. Rounded to angular quartz grains occur scattered randomly throughout the core, some 5 mm. in diameter, the larger grains appearing to have been derived from a metamorphic source.
The sandstone is white to grey occasionally greenish, fine grained, poorly sorted, soft, porous, consisting of angular and subangular clear quartz, numerous soft green glauconite pellets, black carbonaceous material and minor brown and white mica flakes. The sandstone occurs in thin interbeds to 2 cm. wide. The porosity and permeability of the claystone and siltstone is very low, the possibility exists for some small amount of fracture porosity.
The presence of glauconite in association with biotite mica and pyrite indicates a shallow water open marine origin for the claystones and siltstones. They were deposited at a slow rate under slightly reducing conditions, probably at a depth of less than 100 fathoms.

Note: Fluorescence cut was obtained from cuttings from most of the section drilled but in all cases fluorescence was due to calcite or contamination by diesel oil, or tool joint compound (Kopr Kote) etc.

Postulated Stratigraphy

0 - 4	Surface Soil
4 - 159	Nullarbor Limestone
159 - 328	Wilson Bluff Limestone
328 - 367	Sand Eocene
367 - 425	Claystone (soft) Eocene
425 - 593	Claystones and siltstones, Eocene ? Lower Cretaceous?

593' - 600 Siltstone, grey, dark grey when wet, soft, very micaceous, occasional very fine glauconite grains, numerous very fine carbonaceous flecks (plant remains) medium to coarse grained subrounded colourless and milky quartz grains scattered throughout.

600 - 610	Siltstone as above, grades to claystone, black, soft, waxy, pyritic.
610 - 620	95% Siltstone as above. 5% Quartz sand, coarse grained.
620 - 630	40% Siltstone as above (Cave in material?) 50% Quartz sand, unconsolidated, coarse to very coarse, subrounded to subangular quartz grains, generally colourless to whitish, some bluish, poorly sorted. 10% White, subangular coarse grained mineral; satin lustre, brittle granular when crushed, translucent in splinters, perfect cleavage, hardness approximately 4 - probably ANHYDRITE.
630 - 640	90% Siltstone as above (Cave In?) 10% Quartz sand as above. Trace ?Anhydrite.
640 - 650	40% Siltstone and black waxy claystone as above. (Cave In). 50% Quartz sand as above. 10% ?Anhydrite.
650 - 660	10% Siltstone and claystone - mainly claystone with pyrite (Cave In). 75% Quartz sand, as above, some has coating of pyrite and is possibly from overlying claystone. 15% ?Anhydrite.
660 - 670	15% Siltstone and claystone as above (Cave In). 75% Quartz sand as above. 10% ?Anhydrite.
670 - 680	Trace Claystone and Siltstone as above (?Cave in). 90% Quartz sand as above. 10% ?Anhydrite. Trace pyrite.
680 - 690	As above (670-680).
690 - 700	10% Siltstone and claystone as above (?Cave in). 90% Quartz sand as above. Trace ?Anhydrite. (Note: Cuttings coated with white paste - possibly ?anhydrite crushed during drilling).
700 - 710	As for 690-700.

710 - 720 As for 690-700.
Trace ?Anhydrite and pyrite, rave fresh feldspar.

720 - 730 As for 690-700.

730 - 740 As for 690-700.

740 - 750 As for 690-700.

750 - 760 As for 690-700.
Cuttings coated with brown? lignitic mud also darkening of drilling mud. Claystone or clay band estimated 750-758.

760 - 770 As for 750-760.
Flecks of carbonaceous matter. Trace pyrite.

770 - 780 As for 750-760.
Trace light brown very soft claystone.

780 - 790 As for 750 - 760.

790 - 800 As for 750 - 760.

800 - 810 20% Claystone, dark grey, pyritic (?Cave in).
80% Quartz sand with white paste coating (?anhydrite).
Trace light brown soft claystone.

810 - 820 80% Claystone, black, as above (?Cave in)
10% Quartz sand as above.
10% Quartz sandstone (Orthoquartzite) white to brownish white, fine grained, generally very well sorted with occasional well rounded medium to coarse colourless, orange, and red ?quartz grains, few mica flakes, some very fine dark brown to black undetermined grains, occasional pyrite.
(Drilling rate change 812').

820 - 830 90% Claystone as above with some light grey very sandy siltstone stringers (?Cave in).
5% Quartz sand as above.
5% Quartz sandstone as above.

830 - 840 80% Claystone as above (?Cave in).
20% Quartz sandstone as above.
Trace Quartz sand. Trace soft brown claystone.

840 - 850 20% Claystone as above (?Cave in).
10% Quartz sand as above.
70% Quartz sandstone as above. Trace pyrite.

850 - 859 Core Number Two. 850-859 Recovery 9" = 8.3%
Depths: 850 - 853 Quartz sandstone.
(from drilling rate) 853-859 Claystone.
Lithology
(850 - 853) Quartz sandstone (Orthoquartzite), white to brown white, generally fine grained and well sorted but with numerous colourless, pale yellow, pink and red translucent grains scattered throughout, these coarser grains sometimes form a poorly sorted very coarse grained sandstone with grain sizes varying from fine to very coarse grained, the coarse grains are well rounded and frequently sub-spherical, the sandstone as a whole is hard, massive and generally appears tight except for the coarse grained parts which have visible porosity; vertical fracturing is present.
(853 - 859) Claystone pale green, in part mottled with red, finely micaceous, exhibits very imperfect fissility, contains coarse well rounded quartz grains some of which are red and yellow, these grains sometimes form lenses of very sandy claystone, the claystone tends to disintegrate in water.

859 - 860 10% Siltstone and claystone, dark grey (Cave in)
40% Quartz sand, medium to very coarse grained, very well rounded, possibly from a coarse sandstone lense in the overlying sandstone.
30% Quartz sandstone, white to brown white.
20% Claystone, green with red mottling.

860 - 870 50% Claystone, black, waxy, (Cave in).
5% Quartz grains.
5% Quartz sandstone.
40% Claystone, pale green to green, rarely white, with red mottling.
Trace pyrite.
Trace orange calcarenite with shell fragments (Cave In).

870 - 880 20% Claystone, black, waxy, (Cave In).
20% Claystone, green with red mottling (Note: Much of claystone lost during washing and drilling as it readily disintegrates in water).
60% Dolomite, white to very light brown grey white, hard, dense, cryptocrystalline grades into a dull white Dolomitic Siltstone.
Trace Quartz sandstone.

880 - 890 10% Claystone, black, waxy (Cave In).
10% Claystone, green, mottled red in part.
80% Dolomite and Dolomitic Sandstone.

890 - 900 10% Claystone, black (Cave in).
10% Claystone, green.
20% Claystone, red and red mud.
60% Dolomite and Dolomitic Siltstone.

900 - 910 75% Claystone, mainly red brown, soft, with some green mottling, micaceous, contains few fine to medium grained quartz grains.
25% Dolomitic Siltstone, white, brownish white, greenish white, micaceous, generally sandy, some pyrite, also dolomite as above.
Trace Claystone, black, waxy.
Trace Quartz sandstone.

910 - 920 70% Claystone, generally red brown as above, very silty in part, some green mottled fragments contain pyrite.
30% Siltstone, greenish white to light green in part, very micaceous in part, slightly calcareous, grades from the claystone.

920 - 930 80% Claystone, green and red, green.
20% Siltstone, white micaceous, pyritic, grades from the claystone.
Trace Dolomite. Trace Quartz sandstone.

930 - 940 85% Claystone, mottled green and red, micaceous, pyritic, the pyrite appears to be confined to the green parts, occasional quartz grains.
15% Siltstone, dull white, calcareous, grade from the claystone.
Trace dolomite.

940 - 950 85% Claystone, mottled green and red to red brown, purple in part, very micaceous in part, pyritic in green parts.
15% Siltstone, white to greenish white, micaceous, frequent pyrite, calcareous, grades from the claystone.
Trace Dolomite.

950 - 960 As for 940 - 950 - claystone dominantly green.

960 - 970 20% Claystone, black, waxy. The cuttings are well rounded and probably recirculated.
15% Quartz grains, fine to medium grained, subangular, recirculated.
55% Claystone, mottled red and green, mainly green, the green claystone is frequently pyritic.

10% Siltstone, greenish white, pyritic, grades from the claystone.
Trace Dolomite.
Trace Quartz sandstone.
Trace orange Calcarenite - recirculated or cave in.

970 - 980 15% Recirculated quartz sand.
85% Claystone, mottled red and green, the green parts are frequently silty and pyritic.
Trace Dolomite.
Trace Claystone, black.

980 - 990 80% Claystone, mottled red brown to red and green, purple in part, green claystone pyritic in part.
20% Siltstone, white to greenish white, frequent pyrite, in part weakly calcareous.
Trace claystone, black. Trace Quartz sand.

990 - 1000 85% Claystone, generally red brown with green mottling, micaceous, pyrite in some of the green parts. The green shale grades into the greenish white Siltstone.
10% Claystone, black (Cave In).
5% Quartz sand, medium grained, recirculation.

1000 - 1010 As for 990 - 1000.

1010 - 1020 95% Claystone, red brown to purple, green mottling, pyrite crystals in green parts.
5% Quartz sand.
Trace Claystone, black (Cave In).

1020 - 1030 100% Claystone, mottled red and green, mainly red, silty in part, pyrite in green parts, few micro-stringers of quartz, grades to white Siltstone.
Trace Claystone, black.
Trace Dolomite (Cave In).

1030 - 1040 As for 1020 - 1030.

1040 - 1050 As for 1020 - 1030.

1050 - 1060 As for 1020 - 1030 but with more black claystone cave in.

10[illegible] 1070 As for 1020 - 1030 but with more white silty to sandy claystone with pyrite crystals.

1070 - 1080 As for 1020 - 1030.

LITHOLOGICAL DESCRIPTIONS

HUGHES NO. 2

Feet	
0 - 10	80% Limestone, variously yellow, pink, white or grey, hard, recrystallised, cryptocrystalline, fossiliferous with foraminifera and bivalve molloscs. 20% Red-brown sandy surface soil.
10 - 20	Limestone, as above, cream, pink or yellow, dense cryptocrystalline to mesocrystalline, partially recrystallised.
20 - 40	No samples.
40 - 50	Limestone, grades from white to yellow, hard, dense, occasional foraminifera, mostly cryptocrystalline, scattered clear angular quartz grains.
50 - 60	Limestone, as above. Rare ?Bryozoans.
60 - 70	Limestone, as above, rare green glauconite pellets sometimes filling interstices in foraminifera.
70 - 80	Limestone, as above, scattered angular quartz grains, green soft glauconite pellets, grades to a calcarenite in part.
80 - 90	Limestone, as above, common bryozoa, scattered red stained calcite cuttings.
90 - 100	Limestone, as above grades into a calcarenite, trace of chalcedony as angular grains, common glauconite pellets.
100 - 110	Calcarenite, as above, white, light cream and occasionally red grains, predominantly angular, medium sand size grains of calcite quartz, fossil and limestone fragments and rounded glauconite pellets.
110 - 120	Calcarenite as above.

120 - 130 Calcarenite, as above, common glauconite as dark green pellets and finely disseminated in soft rounded amorphous grains to 1 mm. in diameter.

130 - 140 Calcarenite, as above, predominantly white, only occasional glauconite.

140 - 150 Calcarenite, as above.

150 - 160 Calcarenite, as above, white to yellow, hard, medium to coarse grained, consists of fairly well sorted generally subrounded grains. Fossiliferous with both foraminifera and bryozoans.

160 - 170 Calcarenite, as above, white to light cream.

170 - 180 Calcarenite, as above, common bryozoans, rare glauconite.

180 - 190 Calcarenite, as above.

190 - 200 Calcarenite, as above, white, medium grained, reasonably well sorted, common clear angular quartz grains, $\frac{1}{4}$ to 1mm. in diameter, occasional bryozoans only.

200 - 208 No circulation.

208 - 210 Sand, light brown, medium to coarse grained, consists of fairly well sorted, subrounded to rounded quartz, polished and sometimes pitted, clear, brown and milky grains, occasional rounded lithic grains. The quartz often has ragged brown inclusions and appears to be of metamorphic origin, also exhibits common inclusions of a black mineral up to 0.25 mm. across.
Trace of light brown clay.

210 - 220 Sand, as above.

220 - 230 Sand, as above, slightly finer grained, with predominantly subangular to subrounded grains.

230 - 240 Sand, as above.

240 - 250 (Drilling break 242 feet).
Clay, black, occasionally green-grey and silty, slightly sticky when wet, highly carbonaceous, contains thin interbeds of brittle, black, lignite.

250 - 260 Clay, as above, light grey to black very carbonaceous in part, occasional lignitic bands, silty to very silty, micaceous, trace of ?pyrite occasional cuttings of an orange brown mineral in aggregates to 2mm. in diameter.
Cavings of quartz sand common.

260 - 270 Clay, as above.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT
OUTBACK OIL COMPANY N.L.
WEEKLY REPORT
4.4.66 - 10.4.66

HUGHES (N.W.) NO. 2 WELL, CUTTING DESCRIPTIONS
270-420 FEET

270 - 280 — 95% Claystone, light to dark grey, soft, poorly consolidated, water soluble, very silty with abundant soft green glauconite pellets, mica flakes, scattered black soft carbonaceous specks. Occasional cuttings of red-brown richly glauconitic clayey material.
5% Sandstone, light cream to light green, soft, brittle, consists of soft green glauconite pellets, black carbonaceous specks and mica flakes in a finely granular matrix of a soft translucent mineral which has no reaction with cold HCl but effervesces vigorously in hot acid.

280 - 290 — 80% Claystone, as above, very silty and sandy, grades to a siltstone in part.
20% Sandstone, as above. Rare radiating crystals of a soft clear mineral, probably gypsum.

290 - 300 — 90% Claystone, as above, trace of pyrite.
10% Sandstone, as above, fine grained. Scattered coarse sand size quartz grains, probably cavings.

300 - 310 — 90% Claystone, as above, abundant glauconite pellets, scattered pyrite.
10% Sandstone, as above.

310 - 320 — 95% Claystone, as above, becoming more firmly consolidated, extremely glauconitic, grading to a greensand in part, the glauconite pellets are often coated with finely crystalline pyrite.
5% Sandstone, as above.
Trace of red-brown glauconitic clay, as above.
Scattered quartz grains - cavings.

320 - 330 — Claystone, as above, extremely silty with glauconite, mica, unidentified white flecks, pyrite and quartz as silt sized grains.
Trace sandstone, as above.

330 - 340 — Claystone, as above, but less glauconitic.
Trace of Sandstone, as above.

340 - 350 90% Claystone, as above, grades to a greensand in places.
10% Sandstone, as above.

350 - 360 90% Claystone, as above, richly glauconitic, trace of pyrite.
10% Sandstone, as above.

360 - 370 95% Claystone, as above, but less silty.
5% Sandstone, as above. Trace of anhydrite as clear radiating and crystals.

370 - 380 Claystone, as above, predominantly non silty, or very finely silty cuttings which cleave into subparallel sheets on the addition of water to the dry cuttings. Trace of Sandstone, as above.

380 - 390 Claystone, as above.

390 - 400 Claystone, as above, grey, brittle predominantly non silty.

400 - 410 Claystone, as above.

410 - 420 Claystone, as above.

420 - 430 Core No. 1.
Recovered 2 ft. 4 inches (23%)
The Core has been compacted and irregularly forced into the barrel, destroying all traces of bedding and structure.
The lithology is claystone, light to mid grey, fairly soft, brittle, predominantly finely silty, but occasionally very silty and sandy with abundant soft green glauconite pellets, common biotite and muscovite mica flakes soft black carbonaceous specks, unidentified soft white flecks and irregular to ovoidal crystalline aggregates of pyrite.

Hughes (N.W.) No. 2, Postulated Stratigraphy

0 - 4	Surface Soil	Recent
4 - 208	Nullarbor Limestone	Lower Miocene
208 - 245	Quartz sand	Eocene
245 - 430	Grey Claystones	?Lower Cretaceous

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HUGHES (N.W.) NO.2 WELL

Cutting Descriptions 430-760 feet, core description Core No. 2 751-757 feet.

430 - 440	90% Claystone, light to mid grey, soft, brittle predominently slightly silty, occasionally very silty containing abundant glauconite, carbonaceous specks, mica flakes and pyrite as crystalline aggregates or finely divided and disseminated crystals. 10% Siltstone, buff, light cream to light green, soft, brittle, glauconitic, carbonaceous and micaceous. Trace of Claystone, red-brown, soft, glauconitic micaceous.
440 - 450	Claystone, as above. Trace siltstone, as above.
450 - 460	90% Claystone, as above, becoming less water soluble, very glauconitic and pyritic in part. 10% Siltstone, as above, occasionally red-brown in colour, but usually buff coloured.
460 - 470	Claystone, as above, but becoming siltier.
470 - 480	Claystone, as above but less silty.
480 - 490	Claystone, as above, the dry cuttings cleave on the addition of water - "Heaving Shale".
490 - 500	Claystone, as above. Rare cuttings of an orange-brown ferrous mineral cementing clear quartz grains.
500 - 510	Claystone, as above.
510 - 520	Claystone, as above, occasional pyrite aggregates and fine dissiminated crystals.
520 - 530	Claystone, as above, occasional rounded clear quartz grains occur randomly scattered throughout the claystone. Extremely glauconitic in part.

530 - 540 Claystone, as above.

540 - 550 Claystone, as above, common finely crystalline masses of pyrite, scattered glauconite, occasional clear and milky quartz grains to medium sand size, trace of white anhydrite.

550 - 560 70% Claystone, as above.
30% Sand, medium to coarse grained, consists of fairly well sorted, angular to subrounded clear, milky and green stained, frosted quartz grains. The quartz commonly contains zoned and oriented inclusions and undoubtedly derives from a metamorphic province.

560 - 570 30% Sand, as above.
70% Claystone, as above - cavings.

570 - 580 70% Sand, as above.
30% Claystone, as above, cavings.

580 - 590 90% Sand, as above, pyrite inclusions in quartz grains are common, the sand is not as well sorted.
10% Claystone, as above, cavings.

590 - 600 80% Sand, as above, coarser grained more aptly termed a granule gravel than a sand, with occasional grains ranging up to 8 mm. across.
20% Claystone, as above, cavings.

600 - 610 80% Granule Gravel, as above.
20% Claystone, as above, cavings.

610 - 620 70% Granule Gravel, as above.
30% Claystone, as above, cavings.

620 - 630 70% Granule Gravel, as above.
30% Claystone, as above, cavings.

630 - 640 50% Granule Gravel, as above.
50% Claystone, as above, occasional black, brittle lignitic fragments to 5mm. cavings.

640 - 650 50% Granule Gravel, as above.
50% Claystone, as above, cavings trace sandstone, white to cream soft, fine grained, well sorted consists of angular to subangular clear and milky quartz grains in a soft argillaceous matrix.

650 - 660 — 60% Granule Gravel, as above, rare lithic grains.
40% Claystone, as above, cavings.

660 - 670 — 50% Granule Gravel, as above.
50% Claystone, as above, cavings.

670 - 680 — 80% Granule Gravel, as above.
20% Claystone, as above, cavings.
Trace of gypsum.

680 - 690 — 60% Granule Gravel, as above.
40% Claystone, as above, cavings.

690 - 700 — 70% Granule Gravel, as above.
30% Claystone, as above, cavings.

700 - 710 — 5% Sand, as above, grades to granule gravel.
95% Claystone, as above, cavings trace Claystone, milky green, soft, poorly consolidated, silty, micaceous.

710 - 720 — 5% Sand, as above, cavings?
95% Claystone, as above, cavings.
Trace of white amorphous anhydrite.
Trace of green claystone, as above.

720 - 730 — 5% Sand, as above, cavings?
95% Claystone, as above, cavings. Trace of claystone, green, as above. Trace Gypsum or anhydrite, reduced to powder.

730 - 740 — 5% Sand, as above, cavings?
90% Claystone, as above, cavings.
3% Anhydrite, as translucent pinkish and brownish white, hard cryptocrystalline cuttings.
2% Sandstone, white to greenish white, very fine grained, soft, consists of subangular hard clear grains in a white ?gypsiferous cement micaceous, carbonaceous?
Trace of green claystone, as above.

740 - 750 — 5% Sand, as above, but less well sorted, very fine to very coarse grained.
25% Claystone, as above, cavings.
60% Anhydrite, pinkish white.
10% Sandstone, as above. Trace of green claystone, as above.

751- 7 Core Number 2.

757 - 760 75% Anhydrite, as above, greyish brown, white, pink, yellow. Extremely hard and dense.
25% Claystone, as above, cavings.
Trace Sandstone, as above, very fine grained. Trace of crystalline chalcopyrite.

Note: 6 hours were taken to drill 12", from 759-760.

OUTBACK OIL COMPANY N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT

WEEKLY REPORT - 1.5.66 - 7.5.66

HUGHES (N.E.) NO. 3 WELL

SPUDDED 11 a.m. 6.5.66

R.L. 460 feet above Mean Sea Level

RECEIVED
17 MAY 1966
DEPT. OF MINES
REGISTRY

Sample Descriptions 0 - 110 feet.

0 - 10 60% Limestone, white to light cream, hard, compact, cavernous (cavities to 3 feet across and larger), meso to macrocrystalline, siliceous in part, highly fossiliferous with mollusc fragments, corals and foraminifera.
40% Limestone, red brown, hard, very sandy and silty with clear rounded quartz grains, argillaceous, black carbonaceous streaks, banded in part.

10 - 20 40% Limestone, white and light cream, as above, also light yellow.
60% Limestone, red-brown, as above, clear crystalline quartz in vugs and small cavities.

20 - 30 Omitted from description.

30 - 40 10% Limestone, white to yellow, as above.
90% Limestone, red-brown, as above, very silty and sandy, very argillaceous grading to a calcareous claystone which disintergrates on the addition of water - "Heaving Shale".

40 - 50 50% Limestone, white, as above.
50% Limestone, red-brown, as above.

50 - 60 60% Limestone, white, as above, predominantly mesocrystalline, composed primarily of white fossil fragments in a clear calcareous matrix.
40% Limestone, red-brown, as above.

60 - 70 80% Limestone, white as above, occasionally clear crystalline quartz cements fossil and calcareous fragments.
20% Limestone, red-brown, as above, grades to a calcareous claystone.

70 - 80 70% Limestone, white, as above, extremely fossiliferous, common foraminifera, corals, mollusc and other fragments, calcareous and occasionally argillaceous or siliceous cement.
30% Limestone and claystone, red-brown, as above, very silty and

sandy containing abundant, clear rounded to angular clear quartz grains.

80 - 90 40% Limestone, white, as above.
60% Limestone and Claystone, red-brown, as above.

90 - 100 90% Limestone, white and yellow, as above, but predominently meso to microcrystalline, with abundant glauconite as soft green pellets and filling. Interstices in corals and foraminifera.
10% Limestone and claystone, red-brown as above.

100 - 110 70% Limestone, white toyellow, as above, predominently light yellow, rare glauconite pellets.
30% Limestone and minor claystone, red-brown, as above.

OUTBACK OIL COMPANY N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT

WEEKLY REPORT 8.5.66 - 14.5.66

HUGHES (N.E.) NO.3 WELL

Cutting Descriptions 110-280 ft.

110 - 120	95% Limestone, white and light cream, as above (see previous weekly report), hard, extremely glauconitic. 5% Limestone and Claystone, red-brown, as above, extremely silty with abundant quartz and glauconite.
120 - 130	50% Limestone, white, as above, hard to soft, only slightly glauconitic. 10% Limestone and Claystone, red-brown, as above. 40% Claystone, light green, very soft and poorly consolidated, slightly calcareous and very glauconitic.
130 - 140	95% Limestone, white, as above, hard to soft and chalky. Moderately glauconitic, silty with abundant small unidentified red specks. 5% Claystone, light green, as above.
140 - 150	Limestone, white and light cream, as above predominently soft and chalky, trace of glauconite. Trace of Claystone, light green as above. Note: The limestone in this sample commonly displays bright blue fluorescence and gives a blue cut in 1.1.1 trichlopoethane, probably due to hydraulic oil contamination.
150 - 160	20% Limestone, white as above. 80% Limestone, white and light yellow, very chalky, soft, porous, scattered bryozoa, rare glauconite. Note: Drilling break 157 feet.
160 - 170	Limestone, chalky as above, abundant bryozoa, scattered glauconite pellets and glauconite filling interstices in fossil fragments. The limestone cuttings have the appearance of a medium grained calcareous sand, but this is due to the soft porous chalky nature of the limestone.
170 - 180	80% Limestone, chalky, as above, common glauconite, pellets occasionally to 1 mm. across. 20% Sand, fine to medium grained composed of well sorted clear subangular quartz grains.

180 - 186 No circulation.

186 - 190 20% Limestone, as above.
80% Sand, as above, brown fine to medium grained, fairly well sorted, composed of angular to occasionally subrounded, clear and polished quartz grains. Brown and black inclusions within the quartz are common and each grain is lightly coated with brown argillaceous material Also present are scattered dark brown, rounded, brittle grains, possibly laminae.

190 - 200 95% Sand, as above, fine to coarse grained, occasional grains to 2mm., predominently angular to subangular, the sand contains 5% to 10% light brown argillaceous material, probably iron rich which occasionally cements the quartz grains to form irregular soft nodules of sandstone, within the sand.

200 - 210 Sand, as above, contains common soft light green glauconite pellets. A bit sample from 209 feet indicates that there are thin interbeds of white and light green silty non calcareous clay, within the sand.

210 - 220 Sand, as above, much of the detrital quartz is derived from a metamorphic source area as indicated by inclusions within the quartz, and the low sphericity of many of the grains.

220 - 230 Sand, as above.

230 - 240 Sand, as above, the clay is darker brown and more common - up to 20% of the sample. The sand is finer grained and non glauconitic.

240 - 250 Sand, as above, fine to medium grained scattered light green glauconite pellets.

250 - 270 50% Sand, as above.
10% Sandstone, brown, fairly soft, consisting of sand as above, cemented by brown iron-rich argillaceous material.
30% Clay, light blueish-grey, very soft, silty, occasionally dark brown and carbonaceous.
10% Pyrite, as microcrystalline aggregates, occasionally cementing quartz sand grains.
The sample is contaminated by paint flakes, rust scales, wood, distillate and graphite grease.

270 - 290 80% Clay, as above, silty, slightly carbonaceous, micaceous.
15% Sand, as above.
5% Pyrite, as above. Rare bryozoa and white limestone cuttings - cavings.

R.A. Laws
WELL SITE GEOLOGIST
GEOSURVEYS OF AUSTRALIA PTY. LTD.

OUTBACK OIL COMPANY N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT
WEEKLY REPORT 15.5.66 - 21.5.66.

HUGHES (N.E.) NO. 3 WELL
CUTTING & CORE DESCRIPTIONS 280-

280-300 Note: Circulation was completely lost at 284 feet and regained using sawdust resulting in sample contamination.
90% Sawdust.
8% Clay. as above (see previous weekly report).
2% Sand; as above - cavings common pyrite as microcrystalline aggregates.

300-310 40% Sawdust.
60% Clay . as above, common carbonaceous specks, glauconite pellets, pyrite and mica flakes.
Trace sand; as above - cavings.

310-320 20% Sawdust.
80% Clay; as above, very silty in part, becoming better consolidated and grading to a claystone in part.
Trace of hard black brittle calcareous argillite.

320-330 Clay; as above. very common carbonaceous specks, soft white specks, mica, pyrite and glavconite.
Trace of sand; as above - cavings.
Sawdust contamination.

330-340 Clay; as above.
Sawdust contamination.

340-350 Clay; as above.
Sawdust contamination.

350-360 Clay; as above, very soft and silty.
Sawdust contamination.

360-370 70% Clay; as above.
30% Claystone, grey, soft, brittle slightly silty, sub-conchoidal fracture.

370-380 60% Clay; as above.
40% Claystone; as above.
Sawdust contamination.

380-390 80% Clay; as above.
20% Claystone; as above.
Sawdust contamination.

390-400 40% Clay; as above, the majority probably cavings.
60% Claystone; as above.
Sawdust contamination.

400-410 50% Clay; as above.
50% Claystone; as above, soft brittle, slightly silty, occassionally small, very glauconitic and carbonaceous lenses.
Sawdust contamination.

410-420 50% Clay; as above.
50% Claystone; as above.
Sawdust contamination.

420-430 80% Clay; as above.
20% Claystone; as above, pyrite in part.
Sawdust contamination.

430-440 80% Clay; as above.
20% Claystone; as above.
Trace quartz sand
Sawdust contamination.

440-450 40% Clay; as above,
60% Claystone; as above, common subconchoidal fracture, contains fairly common micro and mesocrystalline pyrite aggregates.
Trace quartz sand.
Sawdust contmination.
Drilling break 442 feet.

450-460 Clay & Claystone; as above, cavings.
Granule gravel; grey, very fine to medium grained, consisting of fairly well sorted clear and milky subangular to subrounded quartz grains, and rounded grey anhydrite grains with minor feldspar and lithic grains - sand - stone and quartzite. The quartz grains are commonly coated with microcrystalline pyrite, inclusions within the grains are also common.

460-470 Granule Gravel; as above.
Clay & Claystone; as above - cavings.

470-480 Granule Gravel; as above, or rare green stained quartz grains.
Clay & Claystone; as above - cavings.

480-490 Granule Gravel; as above.
Clay & Claystone; as above - cavings.

490-500 Granule Gravel; as above, the quartz is derived from a metamorphic source area, as evidenced by zoned inclusions, stawing, fracture pattern, and sphericity.
Clay & Claystone; as above - cavings.

500-510 Granule Gravel; as above. The anhydrite is very brittle and partly converted to gypsum in part.
Clay & Claystone; as above - cavings.

510-520 50% Granule Gravel; as above.
30% Clay: as above, very silty in part.
20% Claystone; as above, but predominently siltier grading to a siltstone in part.
Drilling break 513 feet.

521-531 Core number one.

531-540 30% Granule Gravel; as above - cavings.
20% Clay; as above.
50% Claystone; as above, very silty in part.
Note: Fine quartz silt passing through the seives.

540-550 20% Granule Gravel; as above - cavings.
30% Clay; as above - cavings.
50% Claystone; as above - cavings.
Fine quartz silt passing through the seives.

550-560 20% Granule Gravel; as above - cavings.
60% Clay & Claystone; as above - cavings.
20% Sand; Grades from a coarse silt to a very fine sand, and consists of well sorted rounded clear and polished occassionally pinkish quartz grains. In situ as a lightly cemented quartz sandstone, but much of the argillaceous cement has been removed by the drilling mud.

560-570 95% Sand; as above, very fine grained, consists of quartz and minor angular to rounded white to grey grains of cleaved anhydrite and very minor angular microcrystalline pyrite aggregates rare quartz grains contain numerous green inclusions.
5% Cavings of clay, claystone, etc., as above.

570-580 50% Sand; as above, rare glauconite pellets.
15% Sandstone; white, soft, poorly consolidated, fine to very fine grained, composed of rounded, clear quartz, and minor anhydrite, in a matrix of white gypsiferous material.
10% Sandstone; red to brownish red, soft, poorly consolidated, fine grained composed of clear quartz and minor anhydrite in a matrix of red argillaceous cement.
5% Anhydrite; as angular cream and white cleavage fragments.
Trace of chalcedony, red, translucent.
20% Claystone and other cavings; as above.

580-590 15% Sandstone; red and white, as above.
15% Cavings; of claystone, gravel, as above.
70% Shale; purple and green, hard brittle, fissile, very silty and sandy, dolomitic.
Trace of challedony; as above, flinty fracture.

590-600 10% Sandstone; red and white, as above.
60% Shale; as above, the colour varying from light to dark green, light to dark purple, and brownish-red, occassional mica flakes. The shale grades to a dolomite in part, and sandy interbeds grade to a dolomitic argillaceous sandstone.
30% Cavings of claystone etc., as above.

600-610 10% Sandstone; as above, cavings.
40% Shale, dolomitic; as above, the shale is extremely silty, and grades to a dolomitic siltstone containing quartz, white and green specks and brassy coloured mica flakes.
50% Cavings of claystone, etc., as above.
Trace of challedony; as above.

610-620 60% Shale; as above, purple and green, as above.
40% Cavings of claystone, sandstone, gravel, etc. as above.
Trace challedony; as above.

620-630 60% Shale, Dolomitic; as above, becoming less silty.
40% Cavings; as above.
Trace challedony; as above.

630-640 60% Shale, Dolomitic; as above, predominently purple, becoming increasingly dolomitic.
40% Cavings; as above.
Trace challedony; as above.

640-650 75% Shale and Dolomite; as above, purple, white, minor green and brown, occassionally mottled. The dolomite has been partly replaced by Ankerite (ferriferous dolomite).
25% Cavings; as above.

650-660 70% Shale and Dolomitic; as above, very silty in part.
30% Cavings; as above.
Trace of challedony, yellow, red and transparent, very hard, flinty fracture, it appears to fill small vugs within the dolomite.

660-670 80% Shale and Dolomite; as above, partly replaced by ankerite.
20% Cavings; as above.
Trace of challedony; as above.

670-680 80% Shale and Dolomite; as above, predominently light to dark purple, minor green, white, rarely brown, common dark mottling due to small crystalline masses of dolomite, hard, brittle, very silty in part with abundant rounded quartz.
20% Cavings; as above.

680-690 90% Shale and Dolomite; as above, becoming harder and more dolomitic.
10% Cavings; as above.
Trace of challedony, as above, partly derived from the silicification of a calcareous oolite.

690-700 40% Shale and Dolomite; as above. Light to dark purple, off white cream occassionally green or brown, very silty and sandy in part with abundant clear rounded quartz grains.
60% Cavings; as above, claystone, gravel, sandstone.
Trace of challedony; as above, occassional oolitle cuttings.

700-710 75% Dolomitic shale and Dolomite; As above, grades to a sandstone in part.
25% Cavings; as above.

710-720 60% Shale and Dolomite; as above. rare microcrystalline pyrite aggregates, interbedded with:-
15% Sandstone; grey, light brown, white, moderately hard, very fine grained, consists of quartz grains soft black and green specks, rare mica, dolomitic cement, partly silicified.
25% Cavings; as above.
Trace challedony; as above.

720-730 50% Shale and Dolomite; as above.
10% Sandstone; as above.
40% Cavings; as above.
Scattered cuttings of challedony, brown and yellow translucent, and sometimes transparent, banded very hard, flinty fracture, consists of cryptocrystalline quartz replacing an oolitic carbonate.

730-740 75% Shale and Dolomite; as above, predominently pink and light purple, also brown, red-brown, green, off white, and grey.
25% Cavings; as above.
Trace Sandstone; as above.
Trace challedony; as above.

740-750 75% Dolomitic shale and dolomite; as above.
20% Cavings; as above.
5% Challedony; as above, becoming increasingly oolitic.

750-760 85% Dolomitic shale and Dolomite; as above, predominently light pink, light buff and light purple, dolomite predominates, trace of microcrystalline pyrite.
10% Cavings; as above.
5% challedony; as above, occassionally red, occassional chips of silicified oolite.

760-770 50% Dolomite; as above, light buff, light pink, grey, hard, brittle, partly ankeritised, microcrystalline argillaceous.
25% Dolomitic shale; as above, light purple, pink, green.
25% Cavings; as above.
Trace of challedony and siliceous oolite; as above.

770-780 50% Dolomite; as above.
20% Dolomitic shale; as above.
25% Cavings; as above.
5% challedony and siliceous oolite; as above.

780-790 80% Dolomite and Dolomitic shale; as above, dolomite predominating pink, light purple and buff, oolitic in part, the oolites poorly defined due to dolomitisation.
20% Siliceous oolite; as above. Brown, very hard, brittle tight, partly to completely silicified, derived from the silicification on an oolitic carbonate, the oolites are spherical to elliptical, and predominenry 0.5mm in diameter. The oolites are well to poorly defined, depending on the amount of silicification.

OUTBACK OIL COMPANY N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT
WEEKLY REPORT 22/5/66 - 28/5/66

HUGHES (N.E.) NO. 3 WELL
CUTTING AND CORE DESCRIPTIONS 790 - 917 FT.

790 - 800

85% Dolomite and Dolomitic Shale; As above (See previous weekly report). Light brownish grey and buff, minor light pink and light greenish grey. Dolomite predomiates and is hard, brittle. Rarely oolotic.
10% Cavings; As above, claystone and gravel.
5% Siliceous oolite; as above.
Trace of pyrite and chalcopyrite.

800 - 810

80% Dolomite; As above, but more coarsely crystalline.
10% Cavings; as above.
10% Sandstone; light brownish-grey, soft, friable, very fine grained, consists of rounded clear quartz grains, dolomite fragments and mica flakes in a dolomitic and argillaceous matrix.
Trace of siliceous oolite; as above.
Trace of pyrite and chalcopyrite.

810 - 820

85% Dolomite and dolomitic shale; as above, the shale is predominently greenish-grey occassionally dark brown, sandy in part.
5% Sandstone; as above.
10% Cavings; as above.
Trace of red and white banded chalcedony, pyrite and chalcopyrite.

820 - 830

70% Dolomite and dolomitic shale; as above, predominently mesocrystalline to macrocrystalline, buff, pink, light brownish grey, brown, green, hard, brittle.
20% Sandstone; as above, light brown, light buff, light green, very fine grained to occassionally medium grained, fairly well sorted, consist of clear and coloured quartz, and dolomite grains, brassy and silvery mica flakes, soft green and orange clayey specks, dolomitic cement.
10% Cavings; as above.
Traces of pyrite, chalcopyrite and chalcedony; as above.

830 - 840 75% Dolomite; As above, very sandy in part, grading to a sandstone, in part, common small lense-like and irregular accumulations of clear dolomite crystals.
20% Sandstone; as above, dark purple, greenish, light buff, off-white.
5% Cavings; as above,
Trace chalcedony, pyrite and chalcopyrite as above.

840 - 850 75% Dolomite; as above, light pink, very light brown off white. thin ($\frac{1}{2}$mm) crystalline dolomite filled fractures are common.
25% Sandstone; as above, soft to quite hard, grades from a well sorted sandstone with little cement, to a poorly sorted sandstone with abundant cement.
Trace of cavings; as above.

850 - 860 60% Dolomite and dolomitic shale; as above.
40% Sandstone; as above, brown, green, buff, red-brown, slightly to very dolomitic cement, very micaceous along partings.
Trace of cavings; as above.

860 - 870 70% Dolomite and dolomitic shale; as above, the shale percentage is increasing, although it is still the minor consitvent, it is brown, light purplish-red, buff, green, banded, moderately hard to hard, very brittle, very silty and micaceous in places. The shale occurs in thin interbeds, some only 2mm thick.
30% Sandstone; as above, red, brown, grey, off-white, thinly banded and mottled in part, moderately hard, very fine grained, tight, occassional soft green grains - glauconite?
Trace of cavings; as above.

870 - 880 40% Dolomite and dolomitic shale; as above.
60% Sandstone; as above.
Trace chalcedony, pyrite, chalcopyrite and cavings; (Grey brittle claystone); as above.

880 - 890 20% Dolomite and dolomitic shale; as above, white, purple, brown, green.
80% Sandstone, as above, predominently off-white, brown orange.
Trace chalcopyrite and cavings; as above.

890 - 900 30% Dolomitie and dolomitic shale; as above, partly ankeritised, occassional poorly preserved oolites.
60% Sandstone; as above.
Trace chalcopyrite, chalcedony; as above.
10% Cavings; as above, grey brittle claystone and quartz gravel.

900 - 910 10% Dolomite and dolomitic shale; as above.
90% Sandstone; as above.
Traces of chalcopyrite and chalcedony, as above.

910 - 917 Drilling break 913 feet.
5% Dolomite and dolomitic shale; as above and sandstone; as above.
80% Dolomite; light brown, hard, brittle, microcrystalline, interbedded with:-
15% Quartzite; brown, translucent to transparent, very hard, speckled appearence due to abundant, small (o.1Too 5mm) brown subspherical to diffuse, patches, set in a clear transparent 'background', scattered to rare, white dolomite grains.

OUTBACK OIL COMPANY N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT

WEEKLY REPORT

6/6/66 --12/6/66

DENMAN NO. ONE WELL

CUTTING AND CORE DESCRIPTIONS 0 - 780 FT.

0 - 10	70% Limestone; cream to white, rarely black, very hard, partly silicified and recrystallised. 30% Clay; red-brown, soft, calcareous silty.
10 - 20	70% Limestone; as above. 30% Limestone; red-brown, occassionally orange, soft to moderately hard, brittle argillaceous, silty and sandy, with rounded clear quartz and black carbonaceous specks and accumulations.
20 - 30	90% Limestone; white to cream, as above. 10% Limestone; red brown and orange; as above.
30 - 40	80% Limestone; white to cream; as above, occassionally buff. 10% Limestone; red-brown, as above, extremely silty and sandy, grades to a fine grained sandstone in part. 10% Clear crystalline calcite.
40 - 50	Limestone; white, as above, common clear calcite cementing detrital grains, thelimestone is predominantly hard, but fairly soft, chalky and porous in part. Trace limestone, red brown; as above.
50 --60	Limestone; as above, predominantly white and light pink, commonly chalky.
60 - 70	Limestone; as above, and occassionally yellow.
70 - 80	Limestone; as above, white, pink, yellow and orange.
80 - 90	Limestone; as above, rare bryozoa.
90 - 100	Limestone; as above.

100 - 110 Limestone; as above, common soft olive green glauconite as pellets and also filling interstices in fossil fragments, scattered bryozoa.

110 - 120 Limestone; as above, white and cream, scattered glauconite, common bryozoa.

120 - 130 Limestone; as above, slightly glauconitic, common bryozoa, sponge spicules.

130 - 140 Limestone; as above, chalky, bryozoal.

140 - 150 Limestone; as above, predominantly white, common dark green glauconite.

150 - 160 Limestone; as above, rare clear calcite, cementing detritus, rare rounded quartz grains.

160 - 170 Limestone; as above, white, minor cream and light green, grades from soft and marly, to soft and chalky, the latter being very porous.

170 - 180 Limestone; as above, occassionally light pink.

180 - 190 Limestone; as above, white to cream with minor light green, light orange and pink.

190 - 200 Limestone; as above.

200 - 210 50% Limestone; as above.
50% Sand; brown, fine to medium grained, fairly well sorted, consists of clear subrounded to subangular quartz grains, commonly stained with a reddish-brown coating; with minor soft to moderately hard, brittle, light to dark brown grains of an iron rich mineral.

210 - 220 90% Sand; as above, the quartz appears to be derived from a metamorphic source area.
10% Limestone; as above - cavings.

220 - 230 20% Sand; as above.
70% Siltstone; light khaki, very soft, very argillaceous, consists of subangular clear and milky quartz grains, minor white calcareous grains and brown iron rich minerals in an argillaceous matrix.
10% Limestone; as above - cavings.

230 - 240 50% Siltstone; as above, which is interbedded and laminated with;-
40% Claystone; dark to mid grey, soft, very silty, slightly calcareous.
10% Limestone; as above - cavings.

240 - 250 30% Siltstone; predominantly brown, moderately hard and brittle, consisting of quartz grains cemented by brown iron rich material.
50% Claystone; as above, grey, very silty, trace of glauconite.
15% Limestone; as above - cavings.
5% Quartz sand; as above - cavings.

250 - 260 Claystone; as above, light to mid grey, soft, silty with mica flakes quartz grains from fine silt to occassionally coarse sand size, and white and orange specks.
Trace of siltstone; as above.

260 - 270 Claystone; as above.
Cavings of sand and limestone; as above.

270 - 280 Claystone; as above, very silty in part, rare glauconite.

280 - 290 Claystone; as above.

290 - 300 Claystone; as above. light to mid grey, soft, common mica flakes, black carbonaceous specks, occassional glauconite, minor pink buff and grey silty harder and brittle claystone common pyrite as small irregular crystalline aggregates, trace of limestone as worn and pitted opaque grains.

300 - 310 Claystone; as above, predominently mid grey, soft, carbonaceous, micaceous.
Trace of siltstone; as in 240 - 250.

310 - 320 Claystone; as above, very silty in part, grading to a siltstone.
Trace siltstone; as above.

320 - 330 Claystone; as above.

330 - 340 Claystone; as above, common finely divided pyrite, also as aggregates.

340 - 350 Claystone; as above; very silty with quartz grains, carbonaceous specks, glauconite pellets, mica flakes, soft white specks and pyrite.

350 - 360 Claystone; as above.

360 - 370 Claystone; as above.

370 - 380 Claystone; as above, rare white to orange eroded calcareous grains.

380 = 390	Claystone; as above, grades to a glauconitic siltstone in part.
390 - 400	Claystone; as above, light to dark grey, soft, brittle in part.
400 - 410	Claystone, as above.
410 - 420	Claystone, as above, carbonaceous, glauconitic, micaceous, pyritic, quartzose.
420 - 430	Claystone; as above.
430 - 440	Claystone; as above.
440 - 450	Claystone; as above.
450 - 460	Claystone; as above.
460 - 470	Claystone; as above. extremely silty with abundant quartz, mica glauconite, carbonaceous material and pyrite as finely divided crystals and aggregates.
470 - 480	Claystone; as above, grades to a siltstone.
480 - 490	Claystone and siltstone; as above.
490 - 500	Claystone; and siltstone; as above. Trace of calcareous grain' s as rounded, pitted white and orange grains to 5mm across.
503 - 513	Core No.1.
513 - 520	Claystone and siltstone; as above, light to mid grey, either brittle and slightly silty or puggy and very silty grading to a siltstone.
520 - 530	Claystone and siltstone; as above, but not so silty.
530 - 540	Claystone and siltstone; as above.
540 - 550	Claystone and siltstone; as above the brittle claystone has a subconchoidal fracture.
550 - 560	Claystone and siltstone; as above, trace of pyrite.
560 - 570	Claystone and siltstone; as above.
570 - 580	Claystone and siltstone; as above, light to mid grey, rarely brownish due to finely divided and disseminated pyrite, rare clean quartz siltstone.

580 - 590 Claystone and siltstone; as above, fairly common carbonaceous material, common mica and quartz, scattered pyrite, rare glauconite.

590 - 600 60% Claystone and siltstone; as above, interbedded with:-
40% Granule gravel, medium to coarse grained, well sorted, consist of subangular to angular clear and milky quartz, occassionally green or pink stained, common inclusions; with minor white and grey anhydrite, quartzite feldspar and lithic grains. Derived from a metamorphic source area.

600 - 610 50% Claystone and siltstone; as above.
50% Granule gravel; as above.

610 - 620 30% Claystone; as above.
70% Granule gravel; as above. Grades from fine sand to coarse granule size.

620 - 630 30% Claystone; as above.
70% Granule gravel; as above.

630 - 640 30% Granule gravel; as above, cavings.
10% Claystone; as above, cavings.
60% Sand; white, poorly sorted, consisting of very fine to coarse grained, clear subangular to angular quartz in a white soft argillaceous matrix, much of which is dissolved in the drilling mud.

640 - 650 50% Cavings of claystone and granule gravel.
50% Sand; as above, abundant white argillaceous matrix, grades to a sandy clay.

650 - 660 30% Cavings; as above.
70% Sand; as above, very fine to coarse grained, grades to a sandy clay due to the abundance of the soft white argillaceous matrix.

660 - 670 40% Cavings; as above.
60% Claystone; as above, common pyrite cementing quartz.

670 - 680 30% Cavings; as above.
70% Claystone; as above.

680 - 690 20% Cavings; as above.
80% Claystone; as above. originally white, stained brown by drilling mud.

690 - 700
15% Cavings; as above.
80% Claystone; as above, becoming coarser grained, predominently coarse sand sized angular to subangular clear quartz.
5% Pyrite; cementing quartz grains, as crystalline aggregates and replacing woody material.

700 - 710
75% Claystone; as above, finely micaceous.
25% Cavings; as above.

710 - 720
60% Claystone; as above, very poorly sorted, with quartz from silt to coarse sand, size.
40% Cavings; as above, claystone and granule gravel.

720 - 730
70% Claystone; as above.
30% Cavings; as above.

730 - 740
60% Claystone; as above.
40% Cavings; as above.

740 - 750
40% Clay; grey, soft, silty and sandy.
60% Cavings; as above.

750 - 760
50% Clay; as above, very sandy, abundant clear angular quartz.
50% Cavings; as above.

760 - 770
50% Clay; as above.
50% Cavings; as above.

770 - 780
60% Clay; as above, very sandy, grades to a clay sand.
40% Cavings; as above.

OUTBACK OIL COMPANY N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT

WEEKLY REPORT 13/6/66 - 19/6/66.

DENMAN NO.1 WELL
CUTTING AND CORE DESCRIPTIONS 780 - 923 FEET.

780 - 795	20% Sandstone; white, light grey, pink, soft to moderately hard, friable, clean, well sorted, fine grained to very fine grained, consists of subangular to angular clear lightly frosted quartz grains in a silicic and rarely pyritic cement. 80% Cavings; predominantly grey, brittle, claystone, granule gravel, sawdust contamination.
795 - 800	50% Sandstone; white, as above. Also very light green, fairly soft and friable to hard and brittle. 50% Cavings;and sawdust; As above. Note. Circulation was lost 798 - 799 Feet and at various intervals down to 850 feet.
800 - 810	25% Sandstone; as above, porosity and permeability low to fair. 10% Shale; light green, soft, fissile silty with mica and clear quartz grains. 5% Quartzite, white, opaque, very hard, microcrystalline. 60% Cavings; as above.
810 - 820	25% Sandstone; as above, very fine to medium grained. 75% Cavings; as above. Traces of shale and quartzite; as above.
820 - 830	50% Sandstone; as above, rare muscouite mica flakes. 50% Cavings; as above. Traces of shale and quartzite; as above.
830 - 840	80% Sandstone; as above, white, light pink, light green. 20% Cavings; as above. Traces of green and white shale and quartzite; as above.
840 - 850	50% Sandstone; as above. 45% Cavings; as above. 5% Limestone; orange, hard, brittle containing common fine sand sized orange quartz grains.

850 - 860 — 80% Sandstone; as above, white, very light green, very light pink very fine to occassionally medium grained.
20% Cavings; and sawdust; as above.
Trace Limestone; as above.

860 - 870 — 90% Sandstone; as above, silicic and rarely pyritic cement.
10% Cavings and sawdust; as above.
Trace of Limestone; as above.

870 - 880 — 80% Sandstone; as above, composed of rounded to subangular quartz grains, and rare mica and dark green to dark brown hard lithic grains, pyritic cement becoming more common.
20% Cavings and sawdust; as above.

880 - 890 — 50% Sandstone; as above.
30% Claystone; brownish --red. Minor blue, and white, poorly consolidated water soluble, silty, micaceous.
20% Cavings and sawdust; as above.

890 - 900 — 90% Sandstone; as above.
10% Cavings and sawdust; as above.

900 - 910 — 90% Sandstone; as above, predominantly light pink, light green, occassionally grey.
10% Cavings and sawdust; as above.
Trace ankerite; (Ferriferous dolomite) buff, hard, brittle, silty with common black specks, argillaceous.

Note: A trace of black, soft bituminous material was noticed in the ditch after circulation was lost, and then regained in the interval 798 to 799 feet. The material had a yellow fluorescence and yellow cut in 1.1.1 trichloroethane and is probably associated with the sawdust which was used to regain circulation.

OUTBACK OIL COMPANY N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT

WEEKLY REPORT 20/6/66 - 26/6/66

DENMAN NO. 1 WELL

CUTTING AND CORE DESCRIPTIONS 923 - 1250 feet.

923 - 930	95% Sandstone; as above (see previous report). Predominantly medium grained. 5% Cavings and sawdust; as above. Trace of ankerite and orange limestone; as above.
930 - 940	90% Sandstone; as above, light green, white, light pink. 10% Cavings and sawdust; as above. Note. Cavings of grey brittle claystone, and sawdust contamination are present in all samples 923 - 1250 and will not be noted under individual descriptions.
940 - 950	Sandstone; as above, friable, trace of pyrite as cement.
950 - 960	75% Sandstone; as above. 15% Shale; reddish-brown, soft to moderately hard, brittle, very silty with common quartz grains and mica flakes, with siltstone, as below, as interbeds, lenses, and rounded inclusions to 1mm in diameter. 10% Siltstone; greenish-grey, brown, soft, friable, composed of clear quartz grains and mica flakes in a dolomitic cement.
960 - 970	50% Sandstone; as above, Cavings. 40% Shale; as above, reddish-brown. 10% Siltstone; as above.
970 - 980	60% Shale; as above. 30% Siltstone; as above, grey-green, green-grey, light brown, buff, quite well sorted. 10% Sandstone; as above, cavings.
980 - 990	70% Shale; as above. 30% Siltstone; as above, very sandy, bimodal distribution, consists predominantly of medium silt sized quartz with an admixture of rounded, clear and milky, quartz grains to medium sand size. Trace sandstone; as above.

990 - 1000 20% Shale; as above, red-brown, purple, sandy in part with common rounded clear quartz grains to 0.5mm, rare soft green glauconite? Pellets.
40% Siltstone; as above, very hard to hard, very micaceous in part, grades to a silty sandstone in places.
40% Sandstone; as in sample 950 - 960, white, light green, soft, friable, medium grained, well sorted.

1000 - 1010 50% Shale; as above, very silty with quartz mica and ?glauconite.
50% Sandstone; red-brown, purple, hard, brittle, very fine grained, tight, fair sorting consists of subangular, translucent orange-brown quartz grains, mica flakes and abundant soft dark green ?glauconite pellets.
Trace sandstone, white, light green, as above.
Trace siltstone; as above.

1010 - 1020 Interbedded shale and sandstone; as above, and siltstone as below. The shale is red-brown, brown, grey-green, very sandy grading to a sandstone.
The sandstone is red-brown very fine grained grading to a siltstone in places, glauconitic to very glauconitic.
The siltstone is green, green-grey, red-brown, light purple, micaceous to very micaceous, dolomitic.

1020 - 1030 Interbedded shale, sandstone and siltstone; as above.

1030 - 1040 Interbedded shale, sandstone and siltstone; as above.
The siltstone is red-brown, grey, green, very micaceous, dolomitic cement, glauconitic in part.

1040 - 1050 Interbedded shale, sandstone and siltstone; as above, the siltstone predominating.

1050 - 1060 60% interbedded sandstone and siltstone; as above.
15% Shale; light chocolate brown, soft to moderately hard, silty fissile, dolomitic.
25% Dolomite; light creamy-white, hard, brittle, silty and sandy.

1060 - 1070 90% Shale; as above.
10% interbedded sandstone and siltstone; as above.

1070 - 1080 80% Shale; red brown, brown; as above.
20% Siltstone; light greenish-grey, moderately hard, brittle, fine grained, sandy to very sandy with common subangular to subrounded quartz grains to 0.5mm, very dolomitic and grades to a dolomite.

1080 - 1090	75% Shale; as above, common spotted appearance due to ovoids to 3mm across of dolomitic siltstone. 25% Siltstone; as above.
1090 - 1100	80% Shale; as above. 20% Siltstone; as above, sandy to very sandy grading to a sandstone, bimodal distribution, poorly sorted.
1100 - 1110	50% Shale; as above, very sandy. 25% siltstone and sandstone; as above. 25% Clay, red-brown, soft, silty.
1110 - 1120	50% Shale; as above. 20% Siltstone; as above, grey, grey-green, occassionally very micaceous. 30% Clay; as above. Trace of siltstone; buff, hard, friable, composed of subangular clear quartz grains and mica flakes.
1120 - 1130	40% Shale; as above, red-brown, moderately hard, brittle, fissile, micaceous, silty, dolomitic. 25% Siltstone; yellow, grey, brown, hard. med to coarse grained. Consists of mica and clear quartz in a dolomitic cement. 5% Siltstone and sandstone as in 1100 - 1110. 30% Clay; as above.
1130 - 1140	40% Clay; as above. 40% Shale; as above. 20% Siltstone; as above, green, yellow, grey, brown, micaceous to very micaceous.
1140 - 1150	40% Clay; as above, red-brown, minor dark brown, white. 25% Shale; as above. 20% Siltstone; as above. 15% Sandstone; white, light cream, soft to moderately hard, friable, poor to fair porosity, composed of clear pitted quartz grains, occassionally very silty, medium grained, poor to fair sorting, sparse dolomitic and rarely pyritic cement.
1150 - 1160	40% Clay; as above, silty and sandy. 30% Shale; as above, red-brown, rarely green, silty and sandy, occassional ?glauconite pellets, very dolomitic. 25% Siltstone; as above. 5% Sandstone; as above. Trace Dolomite; as above, white, purple red-brown, hard, brittle, silty.

1160 - 1170 25% Clay; as above.
25% Shale; as above, very silty.
50% Siltstone; as above, white, grey, light green, purple brown, yellow, hard, micaceous, sandy dolomitic to very dolomitic fine to coarse grained.
Trace of sandstone and dolomite; as above.

1170 - 1180 20% Clay; as above.
10% Shale; as above.
70% Siltstone; as above, soft to moderately hard, friable.
Trace of sandstone and dolomite; as above.

1186 - 1193 Core Number 3.

1193 - 1200 25% Clay: as above.
10% Shale; as above, red-brown.
60% Siltstone; as above, white, light grey, red-brown, grey-green, hard friable, composed of clear quartz and mica in a carbonate cement argillaceous and red-brown in part, occassional rounded clear quartz grains to medium sand size.
5% Sandstone; as above.

1200 - 1210 25% Clay; as above.
5% Shale; as above.
60% Siltstone; as above.
10% Sandstone; as above. white to occassionally red-brown, very fine grained.

1210 - 1220 60% Clay; as above.
5% Shale; as above.
25% Siltstone; as above.
10% Sandstone; as above, very fine to medium grained.

1220 - 1230 10% Shale; as above.
50% Siltstone; as above.
40% Sandstone; white, red-brown, very fine to medium grained friable, consists of clear and milky rounded quartz grains, poorly sorted, often in a matrix of quartz silt and red-brown argillaceous material, micaceous in part, carbonate cement.

1230 - 1240 60% Siltstone; as above, grey-green, red-brown, light grey, yellowish, soft and friable to moderately hard, medium to coarse grained, grading to a sandstone, composed predominantly of clear quartz grains, the red-brown siltstone is very argillaceous other colours are very micaceous, dolomitic cement.
40% Sandstone; as above.
Trace of Shale; as above. red-brown, brown, moderately hard, brittle, fissile, silty, micaceous, dolomitic.
Trace of gypsum, as soft white cuttings.

1240 - 1250 Sand; light brown, medium to coarse grained, well sorted, consists of quartz grains, which are well rounded of high sphericity, frosted pitted, and clear milky and opaque in colour. Perhaps as a poorly consolidated sandstone in situ. Trace of sandstone and siltstone; as above.

OUTBACK OIL COMPANY N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT

WEEKLY REPORT 27/6/66 - 3/7/66

DENMAN NO. 1 WELL

CUTTING DESCRIPTIONS 1250 - 1430

1250 - 1260 70% Sand; as above (See previous report) not as well sorted.
30% Sandstone; red-brown, fairly soft friable, well sorted, fine to very fine grained, consists of subrounded to rounded, orange and brown stained quartz grains in an argillaceous matrix, contains scattered well rounded quartz grains to coarse sand size.

1260 - 1270 30% Clay; brown, finely silty and micaceous.
30% Sand; as above, occassional lithic grains of dark red very hard quartzite and hard orange coloured silty dolomite.
40% Sandstone; as above, red-brown, light brown, cream.

1270 - 1280 60% Clay; dark brown, as above.
12% Sand; as above, quartz grains strongly stained and encrusted in part.
25% Sandstone; as above, micaceous.
3% Shale; green, brown, soft, fissile, extremely micaceous in places. (up to 90% mica content)

1280 - 1290 70% Clay; as above.
10% Sand; as above, but finer grained
20% Sandstone; as above, very fine grained and grades to a coarse siltstone.
Trace of shale; as above.

1290 - 1300 50% Clay; as above.
20% Sand; as above.
5% Sandstone; as above.
10% Shale; as above, red-brown, brown, light purple, very silty in part, mottled, occassionally very dolomitic.
15% Siltstone; grey, grey-green, red-brown, soft, friable, occassionally hard, brittle, composed of clear quartz grains and mica flakes in an argillaceous and dolomitic cement.
Trace of hard, white dolomite.
Trace of pyrtte.

1300 - 1310 80% Siltstone; as above, red-brown, white, yellowish, light brown, hard to very hard, argillaceous and occassionally dolomitic cement.
20% Shale; as above, silty, micaceous dolomitic.
Abundant cavings of quartz sand.

1310 - 1320 Dolomite; light buff, occassionally pink, very hard, calcitic, micro to mesocrystalline, argillaceous and grades to a dolomitic shale in places, sandy with scattered rounded and frosted quartz grains, common small crystal lined vugs.
Traces of shale and siltstone; as above.

1320 - 1330 Dolomite; as above, light buff, light green, light pink, light brown.
Trace of Shale, sandstone, siltstone and sand, as above - cavings.

1330 - 1340 Dolomite; as above, also white and oranged, interbedded with and grading into:-
Shale; brown, red-brown, oranged, light purple, light green, moderately hard to hard, dolomitic, finely silty.
Cavings, as above.

1340 - 1350 Interbedded dolomite and shale; as above.
Trace sandstone; white, soft, friable, very fine grained, consists of clear quartz grains in a carbonate matrix and cement.

1350 - 1360 95% interbedded dolomite and shale; as above, white, cream, brown, red-brown, orange, purple, green. The shale is moderately hard, silty, micaceous dolomitic, water soluble in part.
5% Siltstone; white, moderately hard, friable, fine to very coarse grained, consists of clear quartz grains in a carbonate cement.

1360 - 1370 95% Interbedded dolomite and shale; as above.
5% Siltstone; as above.
Trace Gypsum? as soft white cuttings.

1370 - 1380 interbedded dolomite and shale; as above; white, pink, grey-green, brown, buff, orange. The dolomite is commonly porous with common small (o.5mm diameter) vugs and cavities.
Trace siltstone; as above.

1380 - 1390 Interbedded dolomite and shale; as above, the dolomite is also white and translucent.
Trace siltstone; as above.

1390 - 1400 60% Dolomite; clear, pink, white translucent, soft (hardness = 3 on moh's scale), very brittle, appears to be too soft for dolomite, but gives typical ddomite reaction to acid and to alizarin and caustic soda.

1390 - 1400 15% Interbedded moderately hard to hard dolomite and shale; as above. (cavings)
25% Shale; light brown, soft to moderately hard, very dolomitic silty, veined with crystalline dolomite, porous with small vugs.

1400 - 1410 10% Dolomite, soft, translucent; as above.
90% Shale; brown, as above. but also minor red, orange-brown, predominantely brown, brown-grey, hard, brittle, very dolomitic and grades to a dolomite.

1410 - 1420 30% Dolomite; as above, grey, grey-brown, white, translucent, soft.
70% Shale; as above.

1420 - 1430 30% Dolomite; as above.
70% Shale; as above, brown, grey-brown, minor chocolate, brown, green and red, soft to hard, dolomitic.
Trace siltstone; white; hard, quartzose micaceous.

OUTBACK OIL COMPANY N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT

WEEKLY REPORT 4/7/66 - 10/7/66

DENMAN NO. 1 WELL

CUTTING DESCRIPTIONS 1430 TO FEET

1430 - 1440	50% Dolomite; as above (see previous report) white, buff, pinkish, translucent, soft, very brittle, micro to mesocrystalline, occassionally finely saccaroidal texture, argillaceous in part, occassional calcareous cuttings show that dolomitisation is not complete. 50% Shale; as above, light brown, mid brown, rarely grey, grades from moderately hard to hard, very dolomitic, silty.
1440 - 1450	90% Dolomite; as above. 10% Shale; as above.
1450 - 1460	90% Dolomite; as above. 10% Shale; as above.
1460 - 1470	90% Dolomite; as above, trace of calcareous material, arenaceous in part. 10% Shale; as above.
1470 - 1480	75% Dolomite; as above, banded in part. 25% Shale; as above, brown, orange, soft to hard, very dolomitic. Trace of fine white quartz sandstone - probably cavings.
1480 - 1490	20% Dolomite; as above, grades from soft to moderately hard. 5% Shale; as above. 75% Shale; red-brown, brown, light green, mottled, soft to moderately hard, brittle, silty to very silty, much of the shale is water soluble and has dissolved in or been partially dissolved by, the drilling mud.
1490 - 1500	15% Dolomite; as above, grades from soft to hard, argillaceous in part. 85% Shale; mottled; as above, predominantly red-brown, minor light green, brown, mottled in part. Having rounded and lenselike green 'spots' and patches within the red-brown shale, the shale is very water soluble, soft, micaceous, silty and slightly sandy, with occassional rounded clear quartz grains, dolomitic.
1500 - 1510	5% Dolomite; as above. 95% Shale; as above.

1510 - 1520	5% Dolomite; as above. 85% Shale; as above, very silty in places with quartz, mica and brittle black specks. 10% Siltstone; buff, red-brown, white, green, moderately hard, brittle, medium to coarse grained, dolomitic.
1520 - 1530	10% Dolomite; as above. 40% Shale; as above, mottled, silty, dolomitic, micaceous. 50% Siltstone; as above, white, cream, buff, light green, moderately hard, friable, dolomitic.
1530 - 1540	5% Dolomite; as above. 75% Shale; as above, predominantly light to mid brown, green mottling, hard and brittle in part. 20% Siltstone; as above.
1540 - 1550	20% Dolomite; as above, white, buff, light green, translucent to transparent predominantly hard, brittle, microcrystalline. 75% Shale; as above, brown, green, soft and water soluble to hard and brittle dolomitic, silty micaceous, dolomite occurs as thin veins and interbeds. 5% Siltstone; as above.
1550 - 1560	25% Dolomite; as above. 75% Shale; as above, brown, red-brown green, rarely dark brown. Trace Siltstone; as above.
1560 - 1570	20% Dolomite; as above. 80% Shale; as above. Trace siltstone; as above.
1570 - 1580	10% Dolomite; as above. 90% Shale; as above. Trace siltstone; as above, white, red-brown, fairly hard, medium to coarse grained, micaceous, dolomitic.
1580 - 1590	10% Dolomite; as above. 90% Shale; as above, red-brown, brown, green, rarely purplish, dark brown, soft to hard, silty, micaceous, dolomitic. Trace siltstone; as above. Trace sandstone; white, fine grained, consists of rounded clear quartz in a dolomitic cement. Trace of pyrite, micro to mesocrystalline aggregates.
1597 - 1607	Core Number four.

1607 - 1620 90% Shale; as above, the percentage of red-brown shale in the sample is not the true percentage, as much of it dissolved in the drilling mud, increasing the apparent percentages of the less soluble green shale and dolomite.

10% Dolomite; as above, clear, light green, buff.

1620 - 1630 85% Shale; as above.
15% Dolomite; as above.

1630 - 1640 90% Shale; as above.
10% Dolomite; as above.
Trace of siltstone; white, cream, moderately hard, medium grained, dolomitic.

1640 - 1650 90% Shale; grey-green, minor brown, occassionally mottled, occassionally translucent in thin chips, hard, brittle, finely silty in part.
10% Undentified Mineral; transparent white, yellowish, light greenish, translucent, hardness of 3 (Moh's scale.) very brittle occassionally forms thin plates, rarely fibrous, cubic? cleavage (3? cleavage planes at right angles?)
no effervescence with hot or cold HCl, turns purple when boiled with alizarin red 's' and sodium hydroxide (typical of dolomite) probably of evaporitic origin.

1650 - 1660 80% Sahle; as above.
15% Unidentified mineral; as above.
5% Sandstone; white, fairly soft, friable, fine grained composed of angular to subangular clear quartz grains, rare pyrite.

1660 - 1670 90% Shale; as above, grey-green, light and mid brown, minor green, red-brown.
10% Unidentified mineral; as above.

OUTBACK OIL COMPANY N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT

WEEKLY REPORT 11/7/66 - 15/7/66

DENMAN NO. 1 WELL CUTTING DESCRIPTIONS

1670 TO 1800 FEET.

1670 - 1680	60% Shale; as above (see previous report) also grey. 40% Unidentified Minerial; as above, probably gypsum. Trace Sandstone; red, soft, friable quartzose, common rounded soft friable green pellets of ?glauconite. Trace bituminous material; black, soft, rubbery, strong yellow cut in solvent. Trace sandstone; white, as above.
1680 - 1690	40% Shale; as above, grey, grey-green brown, often translucent in thin chips, fairly hard, brittle, finely silty to silty. 60% Gypsum; as above, white, buff, transparent to translucent, typically as thin plates. Trace sandstone; red, as above. Trace bituminous material; as above.
1690 - 1700	50% Shale; as above. 50% Gypsum; as above. Traces of sandstone; red and white; as above. Trace of bituminous Material; as above.
1700 - 1710	40% Shale; as above. 55% Gypsum; as above, argillaceous in part. 5% Sandstone; red, black, white, soft to moderately hard, fine grained, argillaceous, dolomitic, composed predominantly of clear quartz, minor mica flakes. Trace bituminous material; as above.
1710 - 1720	40% Shale; as above, dolomitic in part. 30% Gypsum; as above. 30% Sandstone; as above. white, brown, red-brown, green-grey, well sorted, very dolomitic when white, tight, slightly to very argillaceous, fine grained to very fine grained. Trace bituminous material; as above. Trace Dolomite; brown, hard, brittle.

1720 - 1730

50% Shale; as above, grey, grey-green, minor brown, dolomitic in part.
20% Gypsum; as above.
30% Sandstone; as above, commonly grades to a siltstone; scattered white argillaceous specks, dolomitic to very dolomitic.
Trace bituminous material; as above.
Trace dolomite; as above.

1730 - 174.0

15% Shale, siltstone and sandstone; as above.
10% Gypsum; as above.
75% Dolomite; dark brown to light brown, translucent, appears to be grey when viewed without the microscope, hard, brittle argillaceous, micro to mesocrystalline.

1740 - 1750

90% Dolomite; as above, light, to mid, to dark brown, accassionall as clear rhombs.
10% Shale; as above.
Trace of sandstone and siltstone; as above.
Trace of gypsum; as above.

1750 - 1760

20% Shale; as above, predominantly grey-green, brown, minor red.
5% Gypsum; as above, rarely fibrous.
75% Dolomite; as above.

1760 - 1770

60% Shale; as above, green, brown, rarely red, water soluble.
up to 5% gypsum: as above.
40% Dolomite; as above.
Trace quartzite, very light brown, transparent to translucent, very hard, brittle.

1770 - 1780

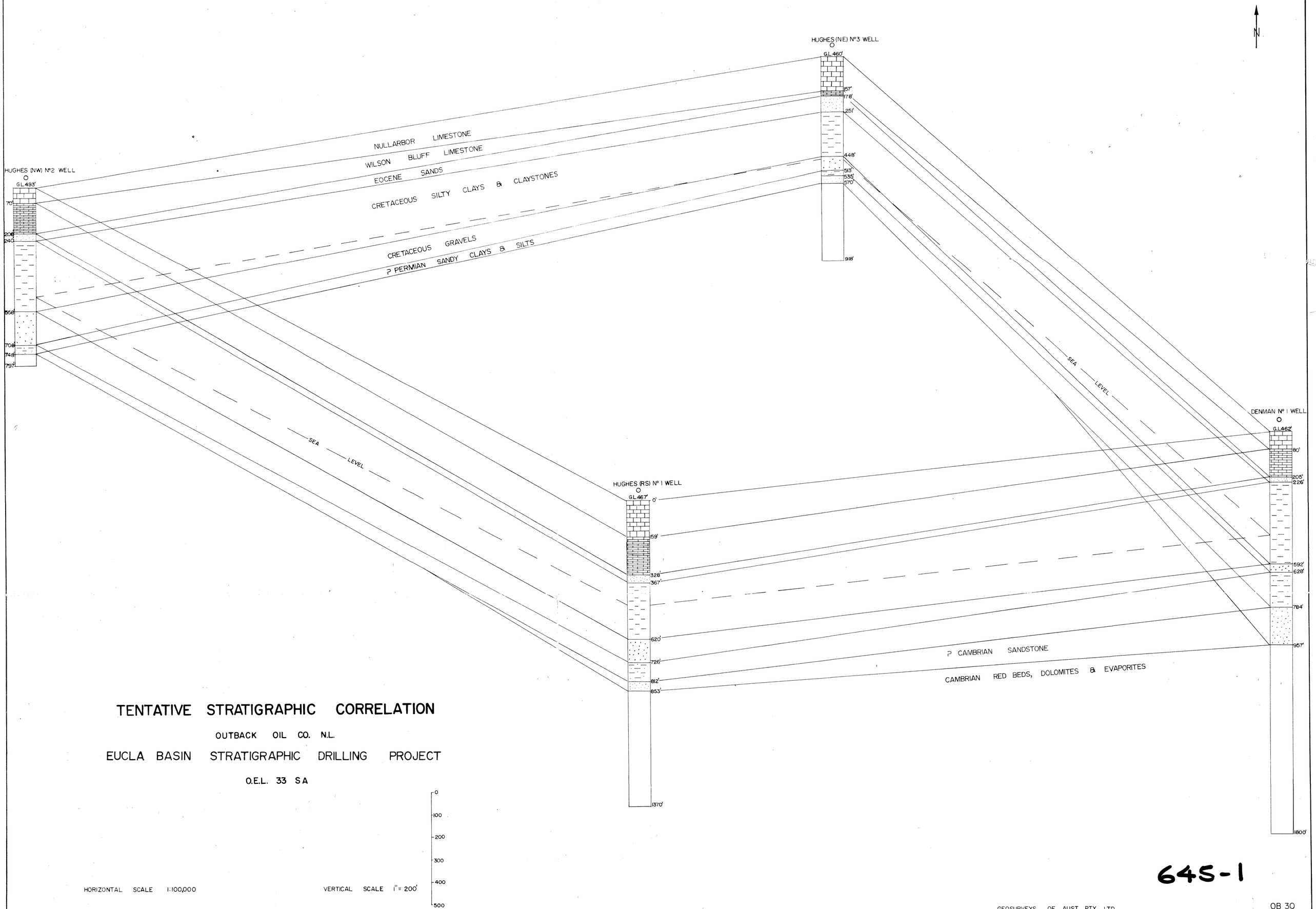
95% Shale; as above.
5% Dolomite; as above - cavings.
Trace gypsum; as above.

1780 - 1790

80% Shale; as above, brown, red-brown, red, grey-green, green, white.
20% Siltstone; white, light grey-green. fairly hard, brittle, fine to occassionally coarse grained, consists of quartz and mica in a dolomitic cement, very dolomitic in part.
Trace dolomite; as above.
Trace gypsum; as above.

1790 - 1800

80% Shale; as above.
20% Siltstone; as above.
Trace dolomite; as above.
Trace gypsum; as above.



TENTATIVE STRATIGRAPHIC CORRELATION

OUTBACK OIL CO. N.L.

EUCLA BASIN STRATIGRAPHIC DRILLING PROJECT

O.E.L. 33 SA

0
100
200
300
400
500

HORIZONTAL SCALE 1:100,000

VERTICAL SCALE 1" = 200'

645-1

GEOSURVEYS OF AUST. PTY. LTD.

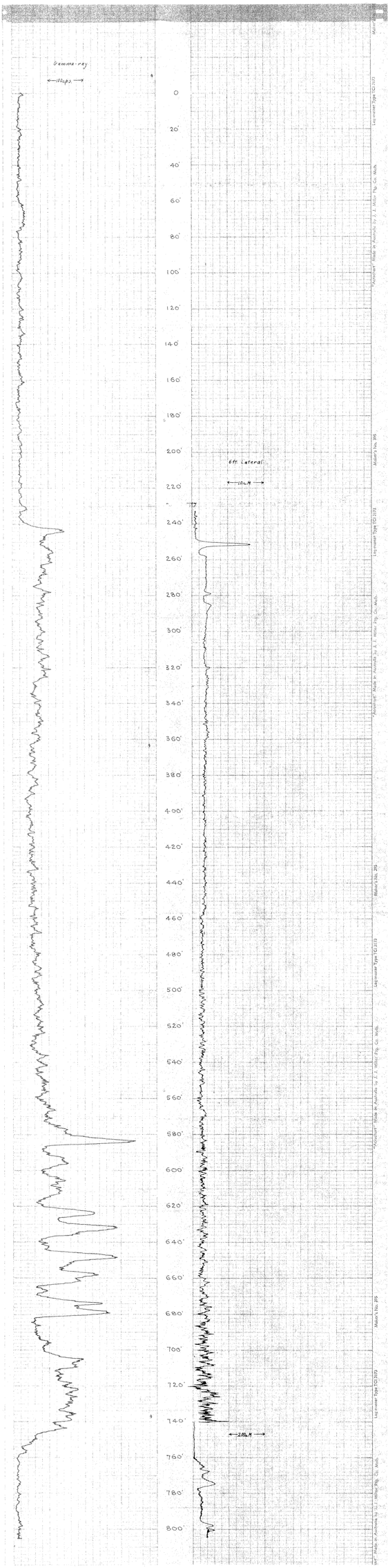
OB 30

Petroleum Division

645-6

SOUTH AUSTRALIAN DEPARTMENT OF MINES
GEOLOGICAL SURVEY

TYPE OF LOG(S): Gamma-ray; 6' LATERAL RESISTIVITY
DATE: 7/6/66 / / / TIME: 1.45 p.m./5.30 p.m./ /
AREA: LOBEFIN LOCATION: Lat. Long.
WELL: BH No. 2
ELEVATION G.L.: 495' A.S.L. Log From 1 feet above G.L. DEPTH SCALE: 20'/inch
RUN NUMBER: 1 / 2 / / / / /
FIRST READING: 800' / 601' / / LAST READING: 0 / 251' / /
CASING SHOE DEPTH (7"): LOG 251 feet DRILL 253 feet TOTAL DEPTH: LOG 801 feet DRILL 797 feet
" LOG feet DRILL feet " LOG feet DRILL feet
" LOG feet DRILL feet " LOG feet DRILL feet
Mud: Type Bentonite Density Viscosity Resistivity 4.6 @ 60 °F MST @ °F
pH Mixis Loss 66/30 Min. Filter Cake /32" R_{MF} @ °F R_{MC} @ °F
BIT SIZE " CONTINUAL CASING(S): " set at feet (2) " set at feet
OPERATING TIME: 15 hours / / / / /
RECORDED BY: B. T. Taylor.
REMARKS:



Petroleum Division

645-7

SOUTH AUSTRALIAN DEPARTMENT OF MINES
GEOLOGICAL SURVEY

TYPE OF LOG(S): 16" Normal; 64" Normal Resistivity
DATE: 3/6/66 / / / TIME: 3.15 p.m/ 4 p.m. / /
AREA: HUGHES LOCATION: Lat. Long.
WELL: NW No. 2
ELEVATION G.L.: 493' Log from 1 feet above G.L. DEPTH SCALE: 20'/inch
RUN NUMBER: 1 / 1 / / / / /
DEPTH DRILLER: 800' / 799' / / LAST READING: 252' / 254' / /
CASING SIZE DEPTH (7") LOG 252 feet DRILL 243 feet TOTAL DEPTH LOG 800 feet DRILL 797 feet
LOG feet DRILL feet " LOG feet DRILL feet
LOG feet DRILL feet " LOG feet DRILL feet
LOG feet DRILL feet " LOG feet DRILL feet
MUD Type Bentonite Density Viscosity Resistivity 4.8 Ω-m 60°F BHT °F
LOGGING TIME: 1½ hrs. / / / / / /
RECORDED BY: B.P. Taylor
REMARKS: Slip ring assembly shorted at 702'. Re-recorded that section.

Petroleum Division

645-8

SOUTH AUSTRALIAN DEPARTMENT OF MINES
GEOLOGICAL SURVEY

TYPE OF LOG(S): Self Potential; Point Resistivity

DATE: 3/6/66 / / / TIME: 2.30 p.m./ / /

AREA: HUGHES LOCATION: Lat. Long.

WELL: NW No. 2

ELEVATION G.L.: 493' K.B. Log from 1 feet above G.L. DEPTH SCALE: 20'/inch

RUN NUMBER: 1 / / / / / /

FIRST READING: 802' / / / LAST READING: 250' / / /

CASING SHOE DEPTH (7"): LOG 250 feet DRILL 243 feet TOTAL DEPTH: LOG 802 feet DRILL 797 feet

" LOG feet DRILL feet " LOG feet DRILL feet

" LOG feet DRILL feet " LOG feet DRILL feet

MUD: Type Bentonite Density Viscosity Resistivity 1.8 @ 60 °F DST @ °F

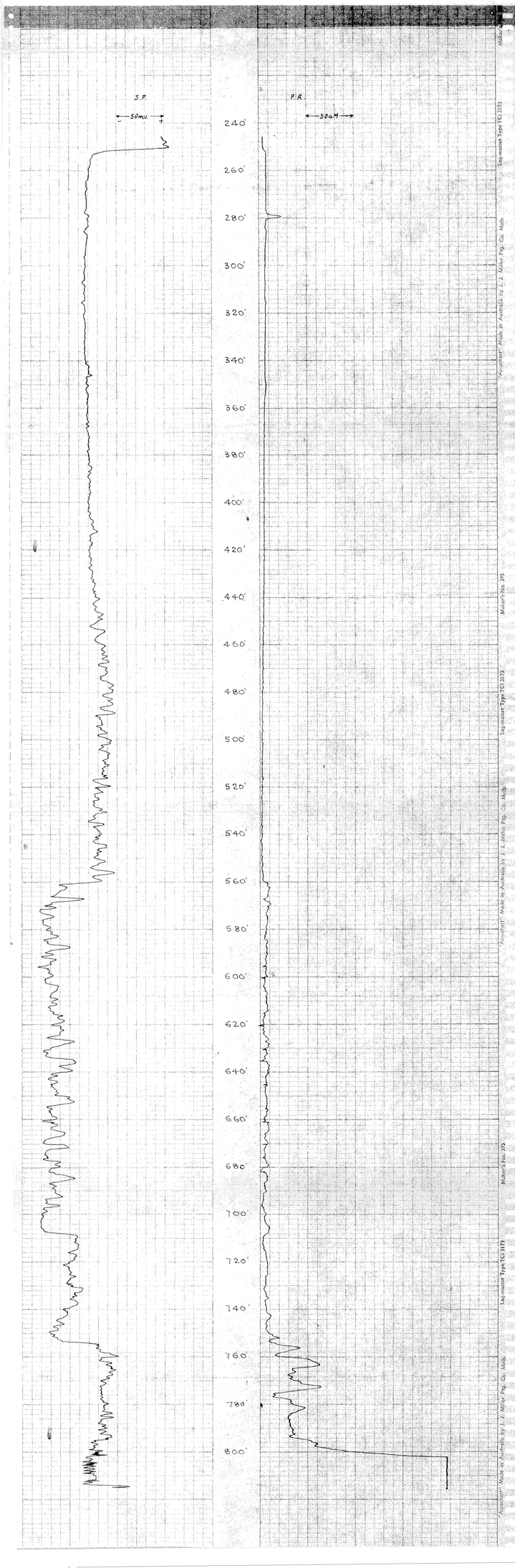
ph Fluid Loss cc/30 min. Filter Cake /32" R_{mf} @ °F R_{mc} @ °F

BIT SIZE: " ADDITIONAL CASING: (1) " set at feet (2) " set at feet

OPERATING TIME: ¾ hr. / / / / /

RECORDED BY: B.P. Taylor

REMARKS:



Petroleum Division

645-9

SOUTH AUSTRALIAN DEPARTMENT OF MINES
GEOLOGICAL SURVEY

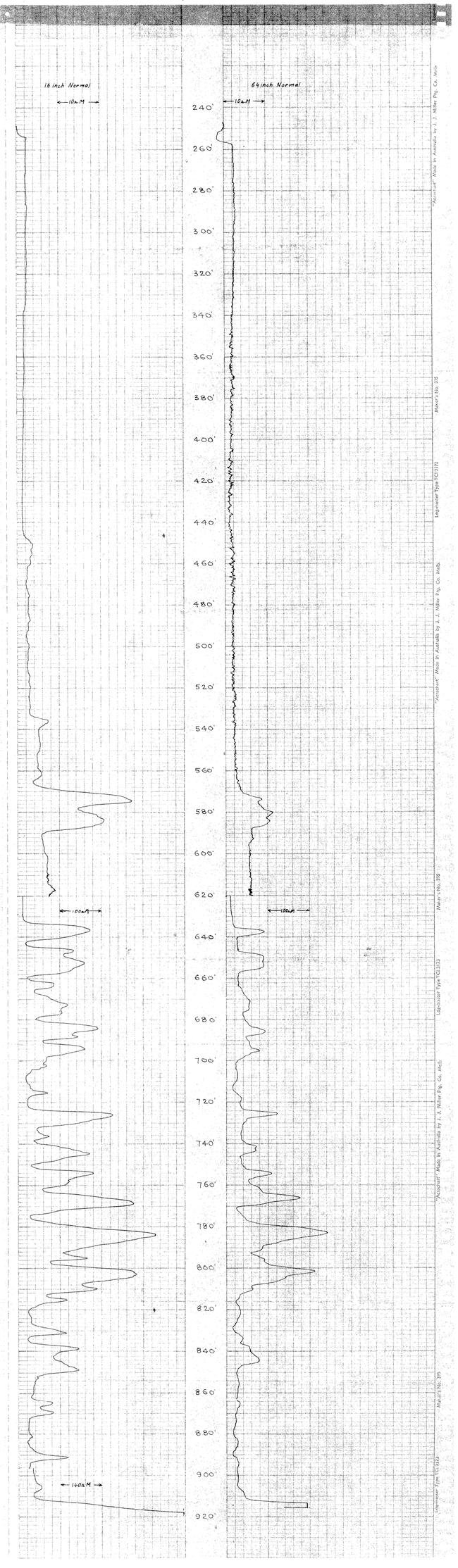
TYPE OF LOG(S): Gamma Ray; 6' Lateral Resistivity
DATE: 3/6/66 / / / TIME: 11 a.m. / 12 noon / /
AREA: HUGHES LOCATION: Lat. Long.
WELL: NE No. 3
ELEVATION G.L.: 460' K.B. Log from 1 feet above G.L. DEPTH SCALE: 20'/inch
RUN NUMBER: 1 / 1 / / / / /
FIRST READING: 919' / 919' / / LAST READING: 2' / 255' / /
CASING SHOE DEPTH (7"): LOG 255 feet DRILL 255 feet TOTAL DEPTH: LOG 919 feet DRILL 918 feet
" LOG feet DRILL feet " LOG feet DRILL feet
" LOG feet DRILL feet " LOG feet DRILL feet
" LOG feet DRILL feet " LOG feet DRILL feet
MUD: Type Bentonite Density Viscosity Resistivity 3.7 Ωm @ 58 °F BHT @ °F
ph Fluid Loss cc/30 min. Filter Cake /32" R_{mf} @ °F R_{mc} @ °F
BIT SIZE: " ADDITIONAL CASING: (1) " set at feet (2) " set at feet
OPERATING TIME: 2 hrs. / / / / / /
RECORDED BY: B P Taylor
REMARKS:

SOUTH AUSTRALIAN DEPARTMENT OF MINES
SPECIAL BILL SURVEY

Petroleum Division

645-10

TYPE OF LOG(S): 16" Normal; 64" Normal Resistivity
DATE: 5/6/46 / / / TIME: 9 a.m. / 10 a.m. / /
AREA: HUGHES LOCATION: Plat. Long.
WELL: NE No. 3
ELEVATION: Derr.: 460' a.s.l. Log from f feet above a.s.l. DEPTH SCALE: 20'/inch
CASING RECORD: 1 / 1 / / / / /
FINAL READING: 918' / 913' / / / LAST READING: 258' / 257' / /
CASING SHOE DEPTH (7"): LOG 254 feet DRILL 255 feet TOTAL DEPTH: LOG 918 feet DRILL 918 feet
" LOG feet DRILL feet " LOG feet DRILL feet
" LOG feet DRILL feet " LOG feet DRILL feet
MUD: Type Sertomite Density Viscosity Resistivity 3.7 @ 58°F mud @ °F
pH Fluid Loss cc/30 min. Filter Cake /32" @ °F mud @ °F
PIT READY: " ADDITIONAL CASING: (1) " set at feet (2) " set at feet
OPERATING TIME: 2 hrs. / / / / / /
RECORDED BY: B.P. Taylor
REMARKS:

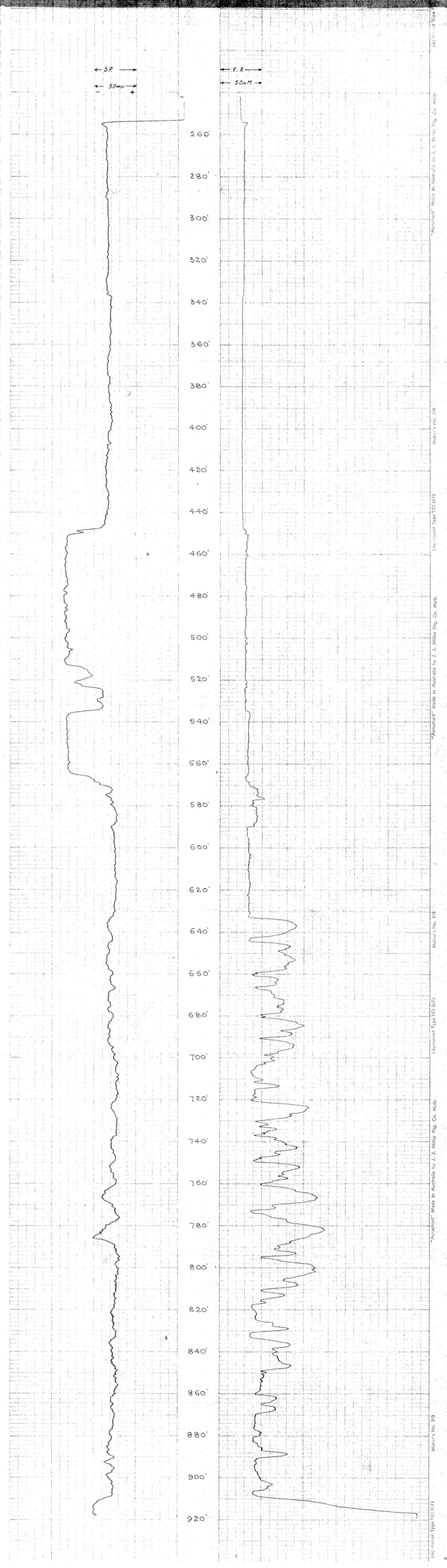


SOUTH AUSTRALIAN DEPARTMENT OF MINES
GEOLOGICAL SURVEY

Petroleum Division

645-11

TYPE OF LOG(S): Self Potential; Point Resistivity
DATE: 3/6/66 / / / TIME: 8 a.m. / / /
AREA: HUGHES LOCATION: Lat. Long.
WELL: NE No. 3
ELEVATION G.L.: 460' K.B.: Log from 1 feet above G.L. DEPTH SCALE: 20'/inch
RUN NUMBER 1 / / / / / /
FIRST READING: 918' / / / LAST READING: 254' / / /
CASING SHOE DEPTH (7"): LOG 254 feet DRILL feet TOTAL DEPTH: LOG 918 feet DRILL feet
" LOG feet DRILL feet " LOG feet DRILL feet
" LOG feet DRILL feet " LOG feet DRILL feet
MUD: Type Bentonite Density Viscosity Resistivity 3.7 @ 58 °F BHT @ °F
pH Fluid Loss cc/30 min. Filter Cake /32" R_{mf} @ °F R_{mc} @ °F
BIT SIZE " ADDITIONAL CASING: (1) " set at feet (2) " set at feet
OPERATING TIME: 1 hr. / / / / /
RECORDED BY: B.P. Taylor
REMARKS:



645-12

SOUTH AUSTRALIAN DEPARTMENT OF MINES

GEOLOGICAL SURVEY

TYPE OF LOG(S): 1. SP 2. 16" NORMAL RESISTIVITY 3. 64" NORMAL RESISTIVITY

DATE: 4/4/66 TIME: 1. 11.30 a.m. 2. 12.30 p.m. 3. 1.30 p.m.

AREA: HUGHES (Coolunga) LOCATION: Lat. Long.

HOLE: No. 1

ELEVATION G.L.: 467' K.B.: Log from 2.5' above G.L. DEPTH SCALE: 20'/inch

RUN NUMBER: 1

FIRST READING: 1376' / 1376' / 1301' LAST READING: 405' / 406' / 411'

CASING SHOE DEPTH ("): LOG 404.5 feet DRILL 400 feet TOTAL DEPTH: LOG 1376 feet DRILL 1372 feet

LOG 406 feet DRILL 400 feet LOG 1376 feet DRILL 1372 feet

LOG 411 feet DRILL 400 feet LOG 1381 feet DRILL 1372 feet

MUD: Type Bentonite Density Viscosity Resistivity 2.4 @ 70°F BHT @ °F

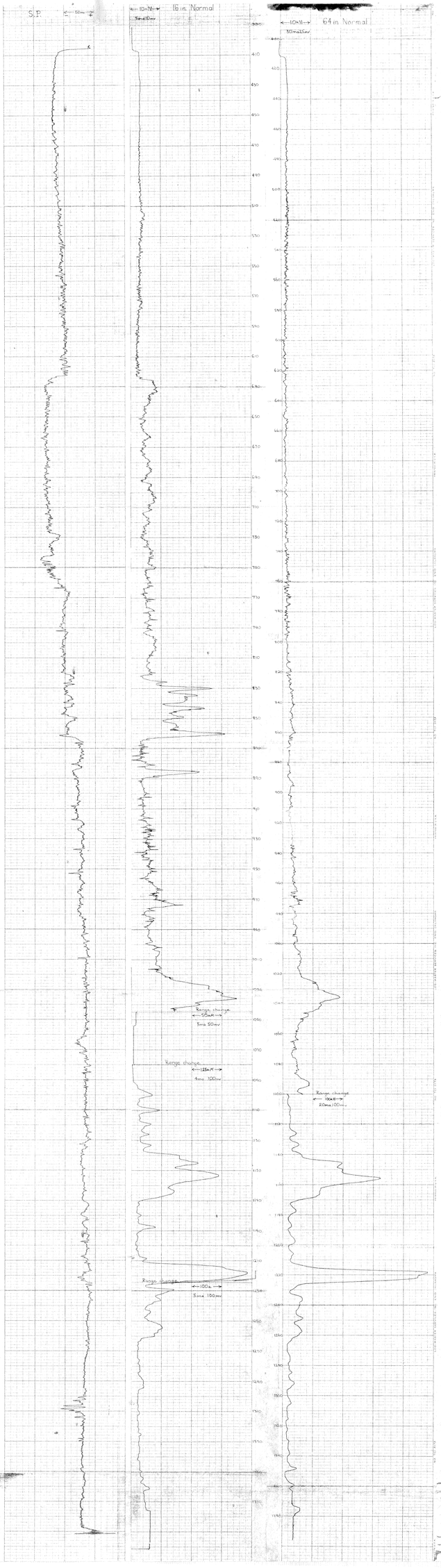
pH Fluid loss cc/30 min. Filter Cake /32" R_{mf} @ °F R_{mc} @ °F

BIT SIZE: " ADDITIONAL CASING:(1) " set at feet (2) " set at feet

OPERATING TIME: 1. 1 hr. 2. 1 hr. 3. 1 hr.

RECORDED BY: B.P. Taylor

REMARKS:



DEPARTMENT OF MINES
SOUTH AUSTRALIA

HUGHES-DENMAN STRATIGRAPHIC DRILLING PROJECT OF OUTBACK OIL COMPANY N.L.

SUBSURFACE STRATIGRAPHY AND MICROPALAEONTOLOGICAL STUDY

by

N. H. Ludbrook
Senior Palaeontologist

CONTENTS

	Page
ABSTRACT	1
INTRODUCTION	1
STRATIGRAPHIC SUMMARY	2
STRATIGRAPHY	3
Nullarbor Limestone	3
Wilson Bluff Limestone	3
Hampton "Conglomerate"	3
Lower Cretaceous siltstones	3
Lower Cretaceous mudstone	4
Lower Cretaceous sandstone and grit	4
?Lower Cretaceous siltstone	4
?Palaeozoic sandstone	4
?Palaeozoic (Lower Cambrian) dolomite	5
Red-beds ?Lower Palaeozoic-Upper Proterozoic	5
DESCRIPTION OF CORES AND CUTTINGS	6
Hughes No. 1	6
Hughes No. 2	8
Hughes No. 3	10
Denman No. 1	11
Correlation diagram	Plan No. L 66-94
APPENDIX Palynological Report 5/66	

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G.S. No. 3584(2)
S.R. 11/5/170(2)
Pal. Rep. 10/66

9th November, 1966.

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept. Bk. No. 731
G.S. No. 3584
S.R.No.11/5/170(2)
Pal.Rep.10/66

HUGHES-DENMAN STRATIGRAPHIC DRILLING PROJECT OF OUTBACK OIL COMPANY N.L.

SUBSURFACE STRATIGRAPHY AND MICROPALAEONTOLOGICAL STUDY

ABSTRACT

The four stratigraphic wells in the Eucla Basin within 20 miles of Hughes and Denman Railway Sidings intersected a sequence of Tertiary, Lower Cretaceous, probable Palaeozoic, and possibly some Proterozoic rocks. The ages of the dolomite and red beds in which drilling ceased is not known with certainty. In the absence of any palaeontological data an attempt has been made to present mineralogical evidence on which correlation with known red-bed sequences may be based.

INTRODUCTION

Four stratigraphic wells, Hughes (R.S.) No. 1, Hughes (N.W.) No. 2, Hughes (N.E.) No. 3, and Denman No. 1, were drilled under O.E.L. No. 33 in the Eucla Basin between 16th February and 17th July 1966. The wells were located within 20 miles of Hughes and Denman Railway Sidings on the Transcontinental Railway in the west of South Australia. Their coordinates are:

	Latitude	Longitude
Hughes (R.S.) No.1 at Hughes R.S.	30°42'50"S,	129°30'44"E
Hughes (N.W.) No.2, 20 miles NW of Hughes R.S.	30°31'42"S,	129°14'45"E
Hughes (N.E.) No. 3, 18 miles NNE of Hughes R.S.	30°29'45"S,	129°38'07"E
Denman No. 1, at Denman R.S.	30°39'20"S,	129°58'47"E

This report presents stratigraphic data based on micropalaeontological examination of all cores and cuttings. Owing to other commitments this could not be completed before the Well Completion Report by R.A. Laws was issued. Use has therefore been made of the electric logs and of the geologist's

STRATIGRAPHIC SUMMARY

Stratigraphic units intersected in the four wells are as follows (thickness in brackets)

Unit	Hughes No.1	Hughes No.2	Hughes No.3	Denman No.1
Nullarbor Limestone	0- 160	0 - 80	0 - 130	0 - 82
(Miocene)	(160)	(80)	(130)	(82)
Wilson Bluff Limestone	160- 328	80 - 208	130 - 178	82 - 205
(Eocene)	(168)	(128)	(48)	(123)
Hampton "Conglomerate"	328- 380	208 - 250	178 - 251	205 - 220
(Eocene)	(52)	(42)	(73)	(15)
Lower Cretaceous siltstones	380- 570 (190)	250 - 490 (240)	251 - 448 (197)	220 - 503 (283)
Lower Cretaceous mudstone	570- 620 (50)	490 - 550 (60)	- -	503 - 590 (87)
Lower Cretaceous gritty sand	620- 817 (197)	550 - 708 (158)	448 - 513 (65)	590 - 784 (194)
Lower Cretaceous siltstone	- -	708 - 730 (22)	513 - 535 (22)	- -
Sandstone (Palaeozoic)	817- 853 (36)	730 - 748 (18)	535 - 570 (35)	784 - 800 (16)
Siltstone and sandstone (Palaeozoic)	853- 870 (17)	- -	570 - 630 (60)	800 - 957 (157)
Dolomite (?Cambrian)	870- 890 (20)	748 - 797 (49)	630 - 710 (80)	- -
Red beds (?Cambrian)	890-1088 (198)	- -	710 - 918 (208)	957 -1270 (313)
Red beds (?Cambrian / ?Proterozoic)	1088-1372 (284)	- -	- -	1270 -1800 (530)
Total Depth	1372	797'3"	918	1800

STRATIGRAPHY

Nullarbor Limestone

All four wells commenced in the Nullarbor Limestone with a maximum thickness of 160 feet in Hughes No. 1 and similar thicknesses of 80 and 82 feet in Hughes No. 2 and Denman No. 1 respectively. The limestone is a dense recrystallized limestone with Marginopora vertebralis, Flosculinella bontangensis and Ammonia beccarii commonly represented. It is glauconitic near the base. The age is Lower Miocene (Batesfordian - Balcombian).

Wilson Bluff Limestone

This chalky bryozoal limestone has a maximum thickness of 168 feet in Hughes No. 1 and similar thicknesses of 128 and 123 feet in Hughes No. 2 and Denman No. 1 respectively. Maslinella chapmani is usually present. Only the Upper Eocene part of the Limestone is present in the Hughes Wells, the lower part extending into the Middle Eocene is missing probably as a result of transgression towards the northerly margin of the Eucla Basin.

Hampton "Conglomerate"

Brown limonitic quartz sand is typical of the sand given the name Hampton Conglomerate in Madura Well in Western Australia. It varies in thickness from 15 feet in Denman No. 1 to 73 feet in Hughes No. 3 Well. The age is approximately Middle Eocene.

Lower Cretaceous siltstones

Below the Tertiary a formation of highly glauconitic siliceous and pyritic siltstones with bands carrying abundant radiolaria and some cone-in-cone calcite. Thickness varies from 190 feet in Hughes No. 1 to 283 feet in Denman No. 1. The siltstones, of Aptian age, may possibly be the equivalent of the

Windalia Radiolarite.

Lower Cretaceous (Aptian) mudstone

A thin mudstone bed 50 to 70 feet thick and missing in Hughes No. 3 carries Textularia anacooraensis, a zone fossil of the lowest part of the Aptian shales elsewhere in South Australia.

Lower Cretaceous sandstone and grit

Below Lower Cretaceous mudstones is a gritty feldspathic sandstone sequence with clay interbeds characterized by a high percentage of microcline. Pyrite is abundant, porphyry grains are occasionally present with coaly fragments and chloritic material. Cuttings from the base of this formation in Hughes No. 2 Well contain Aptian foraminifera, but it is doubtful whether the mudstone containing them is in place as it does not appear to be indicated by the electric logs. In other respects the sandstone may be equated with the sandstones at Mt. Anna, of Upper Jurassic - Lower Cretaceous age.

?Lower Cretaceous siltstone

Hughes No. 3 intersected between 521 and 535 feet (cut in Core 1) green grey highly micaceous chloritic siltstone with fragments of coaly matter. This is presumed to be of Lower Cretaceous age, although no confirmatory palaeontological or palynological evidence was obtained.

?Palaeozoic sandstone

A fine-grained sandstone with scattered coarse quartz grains which are rounded and pitted occurs below the Cretaceous gritty sands and siltstones. The fine angular quartz grains are tightly packed with little cement, some pyrite and well rounded black opaque mineral grains. This appears to be the same

sandstone as that outcropping in the Officer Basin and weathering into a characteristic "worm burrow" pattern. No fossil evidence has been found to permit dating of the formation, which its stratigraphical position in these wells indicates is of Palaeozoic age. It is pre-Cretaceous and post ?Lower Cambrian. None of the typical minerals, e.g. pink garnet, of South Australian Permian sediments appear to be present.

Palaeozoic (Lower Cambrian) dolomite

Hughes No. 2 bottomed in grey and light grey banded dolomite and cherty dolomite with stylolites and some fine oolitic structures. The absence of fossils precludes a firm dating for the dolomite which appears to bear a lithological resemblance to the Kulpara Limestone. If this correlation is correct, the stylolitic dolomite on Hughes Nos. 1, 2, and 3 is of Lower Cambrian age.

Red-beds ?Lower Palaeozoic - Upper Proterozoic

The lowest beds entered in Hughes No. 1 and Denman No. 1 belong to a red-bed sequence of red and grey mottled interbedded siltstones, sandstones, and dolomite. The age of this sequence is uncertain. In the absence of fossils the following data may be considered for purposes of correlation:

(1) the presence of evaporites in the lower part of the sequence, i.e. below 1088 feet in Hughes No. 1 and below 1186 feet in Denman No. 1. Evaporites are common in Cambrian red-beds on Yorke Peninsula and correlation with these clastics would favour Lower Cambrian age. On the other hand, little is known of the possible occurrence of evaporites in the Upper Proterozoic on the shelf area.

(2) the occurrence of the bright green mineral around the 1000-foot level in Denman No. 1. The nature of this mineral is being investigated by AMDEL. Chemical work is not yet complete but verbal information supplied by AMDEL is that the mineral is not

chlorophaeite, identified in volcanics recently discovered on the Kulyong Sheet, near the Western Australian border. Investigations so far indicate that the mineral is the same as that occurring in core submitted by the writer from Woomera No. 1 Well at 140 feet. If the stratigraphical distribution of the green mineral is restricted in sedimentary rocks of the red bed sequence in the west of South Australia, then the red beds in Denman No. 1 are at least partly equivalent to the Woomera Shale.

(3) Isotopic age reported on 3 samples for Outback Oil Company N.L. by Isotopes, Inc. The two dates, 930 ± 30 m.y. for Hughes No. 1 at 1362 - 1372 and 860 ± 30 m.y. for Denman No. 1 at 1604 - 1605 feet are not inconsistent with the suggested correlation of the lower part at least of the red bed sequence with the Woomera Shale, of Upper Proterozoic (Marinoan) age. The 1900 ± 100 m.y. for the dolomite in Hughes No. 2 at 794 - 797 feet appears to be anachronistic.

DESCRIPTION OF CORES AND CUTTINGS

Hughes No. 1

Depth (feet)	
0 - 90	Dense recrystallized limestone, fauna obscured between 70 ft. and 90 ft. but elsewhere containing Marginopora vertebralis, Crespinella umbonifera, Flosculinella bontangensis, Dendritina sp.
9 - 160	Glauconitic limestone, with glauconite replacement and infilling of small foraminifera, bryozoa.
160 - 210	White bryozoal limestone with patches of chalcedony.
336 - 380	Light brown fine to coarse limonitic gritty quartz sand, with angular to subangular quartz having polished surfaces. Brownish-green glauconite ovoids, pyritic in part, with some rutile, coaly fragments, shark's tooth.
380 - 400	Grey siltstone, richly glauconitic, pyritic, with ovoids of pale green glauconite.
400 - 430	As above, with Lingula fragments, rare radiolaria and molluscs.
430 - 440	Grey siltstone with minute mica flecks, pyrite, abundant radiolaria.

Depth (feet)	
440 - 450	Lingula fragment.
450 - 510	Grey siltstone; radiolaria rare or absent.
510 - 520	Grey siltstone with cone-in-cone calcite, abundant radiolaria.
520 - 530	As above, with cf. Dictyomitra and other radiolaria, sponge spicules, Haplophragmoides.
530 - 550	As above, with few radiolaria.
550 - 560	As above, with abundant radiolaria; patches of very fine sandy silt with glauconite and finely disseminated pyrite.
560 - 570	As above, with few radiolaria.
570 - 585	Grey mudstone with sandy patches, having angular quartz, glauconite, pyrite, scattered coarse subangular quartz grains with fractured surfaces, carbonized plant fragments; pyrite replacements of stems, occasional garnet grain. Jaw fragment, megaspore.
585 - 593	Core 1, recovered 5'2" Grey mudstone with angular quartz grains, abundant pyrite.
593 - 620	Mudstone as above, with abundant pyrite, opaques, garnet, zircon.
620 - 817	Grey feldspathic gritty sand with coarse microcline grains, quartz, opaques, garnet, intergrowths of pyrite and calcite, occasional coaly plant fragments.
817 - 853	Fine grained quartz sandstone with even sized fine angular quartz grains, fairly tightly packed with little cement; pyrite, opaque grains, tourmaline, occasional coarse rounded quartz grains, chlorite.
853 - 859	Core 2, recovered 9". Top 4". Light grey quartz sandstone with a fine groundmass of angular interlocking grains in which are scattered coarse rounded grains with pitted surfaces, fine opaque grains and tourmaline. Bottom 5". Siltstone with coarse grains as above, groundmass of pale greenish-grey silt material, pyrite.
859 - 870	Green grey micaceous siltstone with light-brown dolomite nodules, pyrite.
870 - 890	Light grey dense dolomitic limestone with small pyrite nodules, vugs.
890 - 920	Red and green-grey siltstone, finely micaceous, calcareous, pyritic, with some microscopic quartz veins.
920 - 980	Siltstone as above showing clay laminae.
980 - 990	Dolomitic limestone with pyrite crystals, chlorite, mica, minute pyrite veinlets, calcite and gypsum veins.

Depth (feet)	
990 - 1080	Siltstone and limestone as above.
1080 - 1089	Core 3, recovered 3'1". Top 15". Red-brown soft siltstone and claystone with gypsum veins. Middle 14". As above, soft clayey. Bottom 8". Hard dense, banded green and red siltstone with gypsum bands.
1089 - 1180	Chocolate and grey mottled micaceous siltstone with pockets of calcite and gypsum; thin sandstone interbeds.
1180 - 1210	Oolitic partly silicified dolomitic limestone. Brown oolites.
1210 - 1220	Oolitic dolomite, partly silicified, splashes of galena.
1220 - 1300	Green and chocolate siltstone with some gypsum.
1300 - 1362	Green grey siltstone with scattered rounded quartz grains.
1362 - 1372	Core 4, recovered 28". Top 9". Chocolate siltstone, hard, finely irregularly laminated, slightly calcareous, some gypsum. Middle 11". Green-grey siltstone as above, hard. Bottom 8". Chocolate siltstone, hard.

Hughes No. 2

0 - 80	Dense pink-cream limestone, oolitic in parts, richly fossiliferous with Ammonia beccarii, Marginopora vertebralis, Discorbis sp. cf. Pararotalia verriculata. Glauconitic from 60 - 80 ft.
80 - 208	Cream recrystallized bryozoal limestone with Maslinella chapmani, glauconitic, sandy with angular quartz grains 190-208 ft.
208 - 240	Light brown sand with ill-sorted coarse sub-angular yellow and clear quartz grains, limonite.
240 - 250	Brown ferruginous clay with scattered quartz grains and pyrite.
250 - 270	Grey glauconitic siltstone, partly limonitized, with biotite, carbonaceous matter.
270 - 290	Hard siltstone as above with abundant light green glauconite, rare foraminifera, radiolaria.
290 - 310	As above, with abundant radiolaria, Lingula, fragments of Bigenerina loeblichae and other foraminifera, tooth, pyritized discs.
310 - 360	Green-grey glauconitic siltstone with radiolaria,

Depth (feet)	
360 - 420	Green-grey siltstone with less glauconite, fine muscovite, plant fragments.
420 - 430	Core 1, recovered 2'4". Grey siltstone.
430 - 440	As above.
440 - 460	As above, with dolomite grains.
460 - 480	Grey siltstone.
480 - 490	Highly pyritic mudstone and glauconitic siltstone with radiolaria.
490 - 550	Grey mudstone with muscovite flecks, carbonaceous fragments, pyrite.
550 - 570	Grey feldspathic quartz sandstone, with tightly packed blue-grey quartz, angular quartz grains, feldspar, abundant microcline and pyrite, porphyry grain, chloritic material.
570 - 600	Rare foraminifera. Feldspathic grit with abundant white feldspar, grey quartz, pyrite, andalusite, angular quartz with pitted surfaces.
600 - 610	As above, some opaline quartz.
610 - 620	As above; ostracode.
620 - 630	Grit as above.
630 - 640	As above; coal fragments.
640 - 680	Grit as above.
680 - 708	As above; porphyry grain 680 - 690 ft.
708 - 730	Grey mudstone with carbonaceous flecks, finely pyritic; dolomite globules.
730 - 748	Yellowish fine angular quartz sandstone, with chlorite, rounded opaque grains, green mineral.
748 - 751	Oolitic dolomite, partly silicified.
751 - 757	Core 2, recovered 13". Grey dolomite.
757 - 760	As above.
760 - 761'2"	Core 3, recovered 3". Cherty dolomite with solution cavities.
761 - 794	Chert, dolomite with stylolites, some fine oolitic structures.
794'6" - 797'3"	Core 4, recovered 30". Grey and light grey banded dolomite with stylolites.

Hughes No. 3

Depth (feet)	
0 - 90	Dense recrystallized limestone with Miliolidae, ferruginized somewhat sandy band 20-30 ft.
90 - 120	Glauconitic limestone with glauconite infillings of foraminifera.
120 - 130	Limestone and green glauconitic marl.
130 - 178	Grey white bryozoal limestone, recalcified, fauna poorly preserved contains Maslinella chapmani.
178 - 251	Yellow subangular quartz sand and grit.
251 - 270	Grey carbonaceous siltstone with pyritized and carbonized woody material.
270 - 300	Grey carbonaceous siltstone, glauconitic, pyritic.
300 - 320	As above, with abundant bright green glauconite; radiolaria, vertebrate fragments.
320 - 360	As above; abundant radiolaria.
360 - 370	Grey carbonaceous siltstone.
370 - 380	Grey siltstone with abundant glauconite; radiolaria, tooth.
380 - 448	Grey glauconitic siltstone.
448 - 521	Grey feldspathic gritty sandstone with coarse grains of microcline and quartz, siltstone interbeds.
521 - 531	Core 1, recovered 18" Green-grey highly micaceous siltstone with chlorite, muscovite, fine angular quartz and feldspar, occasional fragments of carbonaceous matter.
531 - 535	As above.
535 - 570	Yellowish sandstone with subrounded quartz grains having pitted surfaces, red feldspar grains, small amount of cement, some pyrite, well-rounded opaque minerals.
570 - 580	Red brown feldspathic sandstone, chalcedony, greenish white sandstone with feldspathic matrix, oolitic rock. ?Conglomerate.
580 - 630	Grey and purple calcareous siltstone and sandstone, limestone. Chips of coarse sandstone with red feldspar, pink garnet, biotite. Grains of chalcedony in the sandstone, well rounded black opaque grains, pyrite.
630 - 660	Light grey dolomite, mottled purple and grey dolomite with finely divided pyrite.
660 - 710	Grey and purplish grey dolomite showing evidence of stylolites.
710 - 720	Reddish and grey sandy calcareous siltstone with grains of dolomite, swirls of opaque grains.
720 - 730	Reddish and light grey dense dolomitic limestone.

Depth (feet)	
730 - 740	Dark grey calcareous siltstone.
740 - 770	Grey limestone, red chert, oolites.
770 - 790	Abundant oolitic structures, mainly brown oolites in white matrix.
791 - 793	Core 2, recovered 22". Top one foot: grey dolomite and dolomitic siltstone. Bottom 10": oolitic grey dolomite, dolomite crystals in vugs, siliceous oolites.
793 - 820	Granular dolomite in which the grains are set in a dark grey matrix; light grey oolitic limestone, pink limestone and yellow dolomite globules.
820 - 830	Greenish fine-grained sandstone with chlorite.
830 - 890	Sandstone, siltstone and dolomitic limestone with abundant chlorite, biotite, some rounded heavy minerals, red feldspar grains.
890 - 900	Pink limestone, sandstone with biotite and green minerals, greenish siltstone matrix.
900 - 910	Fine sandstone.
917 - 917'8"	Core 3, recovered 7½" Grey dolomite with stylolites, chert.

Denman No. 1

0 - 82	Pink-cream dense crystalline limestone with Marginopora vertebralis.
82 - 205	Recrystallized bryozoal limestone, some flint. All the material is heavily recrystallized and fossils poorly preserved. Maslinella chapmani present.
205 - 220	Brownish quartz sand, subangular, some pellets of limonite or brownish green glauconite.
220 - 230	Ferruginized glauconitic sandy silt with light green glauconite.
230 - 290	Sandy silt, finely pyritic with abundant pale green glauconite, rare foraminifera, fish tooth.
290 - 320	Grey dolomitic siltstone with fine muscovite, carbonaceous material, glauconite, pyrite, siderite. Trochammina minuta.
320 - 340	Siltstone with cone-in-cone calcite.
340 - 370	Siltstone and mudstone with abundant foraminifera and radiolaria.
370 - 450	Grey siltstone with abundant green glauconite and radiolaria.

Depth (feet)	
450 - 503	As above; fewer radiolaria.
503 - 513	Core 1, recovered 10 feet. Grey mudstone.
513 - 560	Mudstone as above.
560 - 570	Pyritic mudstone, some quartz grains.
570 - 590	As above, with quartz grains, Trochammina raggatti and Textularia anacooraensis.
590 - 660	Quartz and microcline grit; angular sandstone with quartz grains, pyrite, glauconite in feldspathic matrix.
660 - 750	As above, with carbonized wood fragments.
750 - 784	Grey sandstone with coarse angular quartz grains, feldspar, pyrite matrix, pyritised wood.
784 - 800	Sandstone with fine to medium grains of interlocking quartz, tightly packed in parts but porous in others; little cement, some pyrite and worn grains of opaque mineral.
800 - 880	Pale green siltstone with light brown dolomite, some coarse rounded grains with pitted surfaces.
880 - 913	Chips of red sandy siltstone and green siltstone.
913 - 923	Core 2, recovered 5'8". (1) Top 1 foot. Grey white sandstone with medium to fine angular to subangular quartz, some feldspathic matrix, pyrite crystals and interstitial pyrite, rounded grains of opaque mineral, smoky quartz, tourmaline, pale green mineral. (2) 1-3 feet. As above. Core is cut by 1.5 cm. white vein in which matrix is anhydrite. (3) 3-5 feet 8 inches. As top 1 foot.
923 - 957	As above.
957 - 990	Red siltstone, mottled with greenish grey, with coarse rounded quartz grains in the silt matrix.
990 - 1020	Red sandstone with very abundant green mineral.
1020 - 1030	Siltstone and sandstone with fine quartz grains in a silty matrix, chlorite, biotite, muscovite.
1030 - 1050	Red micaceous siltstone.
1050 - 1060	Pink dolomite, dolomitic siltstone; sandstone and siltstone with green mineral as 990 - 1020 ft.
1060 - 1080	Red siltstone.
1080 - 1090	Red siltstone with occasional grit patches.
1090 - 1120	Red siltstone with scattered quartz grains.

Depth (feet)	
1120 - 1140	Red siltstone and sandstone.
1140 - 1186	Red siltstone; abundant loose rounded quartz grains.
1186 - 1193	Core 3, recovered 5'9". Top 2 feet. Red and green irregularly banded and mottled micaceous siltstone, calcareous in parts. 2 - 3 feet. Red and buff banded sandstone with coarse angular to subrounded quartz, red feldspar grains, soft gypseous matrix with biotite, some carbonate mineral. 3 - 4 feet. As above, with small rounded grains of opaque mineral. 4 - 5 feet. 2" sandstone, 10" siltstone as above. Bottom 9". Red and green-grey banded and mottled siltstone with gypsum vein.
1193 - 1240	Red sandstone grading to coarse sandstone.
1240 - 1270	Loose iron-stained reddish quartz grit with subrounded quartz grains having pitted or fractured surfaces embedded in red sandstone.
1270 - 1310	Reddish sandstone with fine angular quartz grains, silt material, scattered coarse rounded grains.
1310 - 1330	Light greenish grey mottled pink dolomitic limestone.
1330 - 1350	Mottled pink and light greenish grey dolomitic limestone.
1350 - 1380	Dolomitic limestone and red siltstone.
1380 - 1400	Light greenish grey dolomitic limestone, porous in places with gypsum and anhydrite, halite moulds.
1400 - 1420	Dark grey dolomitic limestone with anhydrite veins.
1420 - 1480	Dark and light grey and pink dolomitic limestone with anhydrite and gypsum; grey white calcite 1450 - 1460.
1480 - 1540	Red siltstone with grey spotted mottlings; calcite veins.
1540 - 1597	Light grey and pinkish mottled sandy calcareous siltstone.
1597 - 1607	Core 4, recovered 9'10". Top 2 feet. Red siltstone spotted green, with thin gypsum veins. 2-3 feet. As above, veins zigzag and irregular. 3-4 feet. Green and red banded and mottled siltstone with irregular bands and swirls. 4-5 feet. Green siltstone with gypsum bands. 5-9 feet. Red and green mottled siltstone with irregular gypsum veins. Bottom 10". Green and red dolomitic siltstone.

Depth (feet)	
1607 - 1650	Siltstone as above.
1650 - 1790	Light grey dolomite; cherty 1730-1740.
1790 - 1800	Dolomite and red and green siltstone.

W H Shattock

PALYNOLOGICAL REPORT 5/66

by

W. K. Harris
Palynologist

OUTBACK OIL HUGHES AND DENMAN WELLS

Cores and cuttings from three wells drilled in the Eucla Basin by Outback Oil, have been examined for spores and pollen.

Cores and cuttings examined:

Hughes No. 2 Well - cuttings 700 - 710 ft. and 720 - 730 ft.

Hughes No. 3 Well - Core 1 521 - 531 ft. at 522 ft.

Denman No. 1 Well - Core 1 503 - 513 ft. at 504 ft.

Results:

Cores from these wells in the Cretaceous failed to yield any pollens or spores when prepared.

Core 1 from Denman No. 1 yielded few indeterminate microplankton.

Hughes No. 2 Well - at 700-710' yielded the following assemblage:

Alisporites grandis
Classopollis cf. C. torosus
Cingutrilites clavatus
Ceratosporites equalis
Cicatricosisporites australiensis
C. ludbrooki
Dictyophyllidites cf. D. asper
Gleicheniidites circinidites
Lycopodiumsporites austroclavatidites
L. circolumenis
Neoraistrickia truncatus
Pilosisporites notensis
Podosporites microsaccatus
Podocarpidites ellipticus
Reticulatisporites pudens
Sestrosporites pseudoalveolatus
Stereisporites antiquasporites
Tsugaepollenites dampieri

Microplankton:

Odontochitina operculata

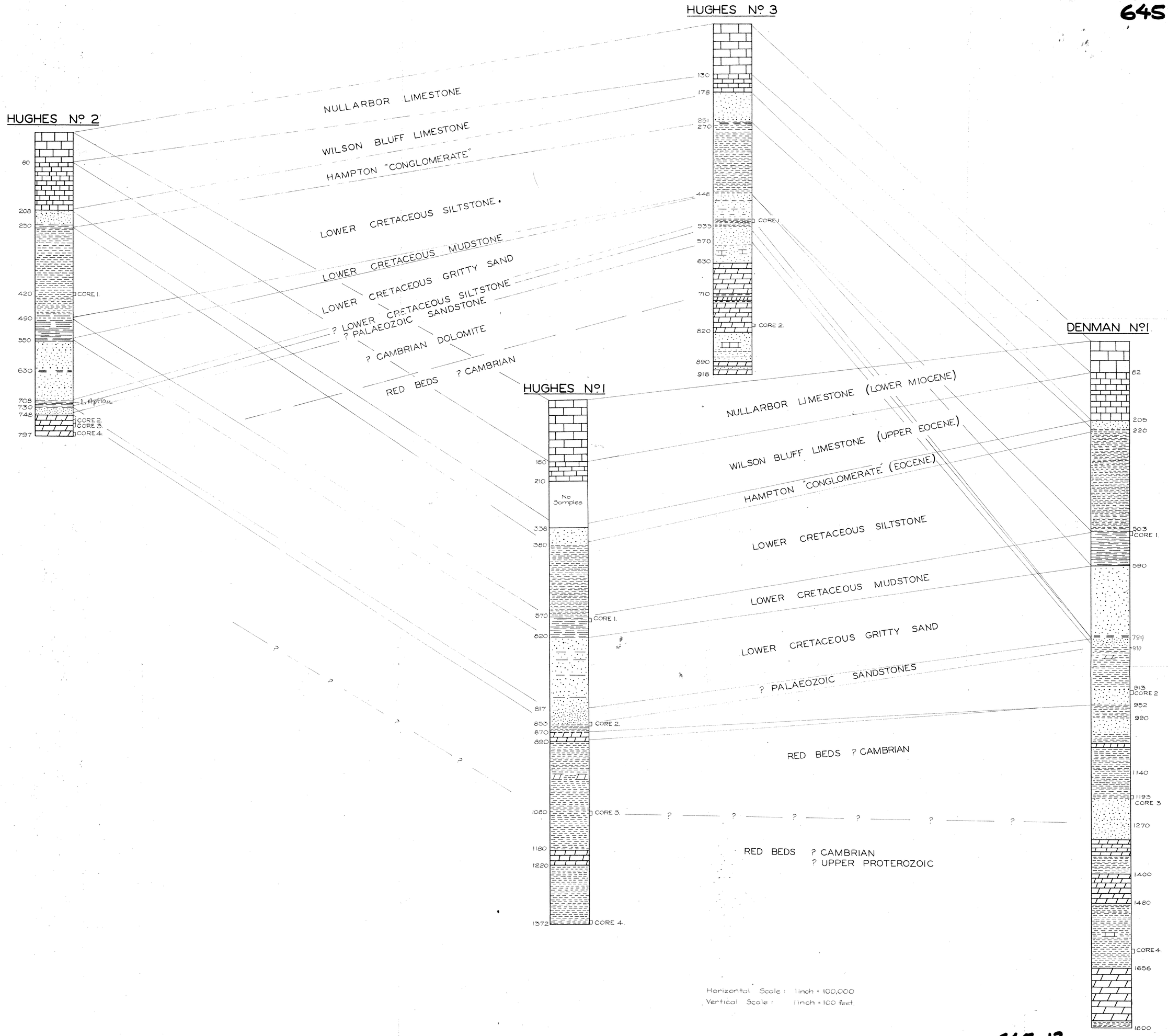
Acritarcha and Dinophyceae indet.

The assemblage from cuttings at 720 - 730 ft. was similar but less well preserved and was dominated by microplankton

Diagnostic species characteristic of Dettmann's microfloral assemblage have not been identified in this microflora. However the assemblage suggests a correlation with her Speciosus Assemblage of Aptian age. The presence of R. pudens and L. circolumenis would probably indicate a time low in the Speciosus Assemblage and low in the Aptian.

Reference: Dettmann, M.E., 1963.
Roy. Soc. Vict. Proc. 77 (1): 1-148.

645-13



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

645-13

DEPARTMENT OF MINES – SOUTH AUSTRALIA

CORRELATION DIAGRAM
OUTBACK OIL CO. N.L. HUGHES – DENMAN
STRATIGRAPHIC DRILLING PROJECT

Drn. N.H.L. | SCALE: As shown
Tod. A.M.c.D. | L 66-94 Ad
Ckd. L.V.W.
Exd.
Director of Mines | DATE: 31-10-66