COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Petroleum Search Subsidy Acts

PUBLICATION No. 73

Delhi-Santos Gidgealpa No. 1 Well South Australia

OF

DELHI AUSTRALIAN PETROLEUM LTD

AND

SANTOS LIMITED

Issued under the Authority of the Hon. David Fairbairn
Minister for National Development

1966

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

MINISTER: THE HON. DAVID FAIRBAIRN, D.F.C., M.P.

SECRETARY: R. W. BOSWELL

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

DIRECTOR: J. M. RAYNER

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ASSISTANT DIRECTOR: M. A. CONDON

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FOREWORD

Under the Petroleum Search Subsidy Act 1959-1961, agreements relating to subsidized operations provide that the information obtained may be published by the Commonwealth Government six months after the completion of field work.

The Bureau of Mineral Resources, Geology and Geophysics is required, on behalf of the Department of National Development, to examine the applications, maintain surveillance of the operations, and in due course prepare the reports for publication. The growth of the exploration effort has greatly increased the number of subsidized projects and this increase has led to delays in publishing the results of operations.

The detailed results of subsidized operations may be examined at the office of the Bureau of Mineral Resources in Canberra (after the agreed period) and copies of the reports may be purchased.

Delhi - Santos Gidgealpa No. 1 was drilled under the Petroleum Search Subsidy Act 1959-1961, in Oil Exploration Licences Nos 20 and 21, South Australia. The well was located at latitude 27°56'46"S., longitude 140°04'56"E., about 60 miles south-west of Innamincka No. 1 Well, and was drilled for Delhi Australian Petroleum Ltd and Santos Limited by Drilling Contractors (Australia) Pty Ltd of Sydney, N.S.W., using a National 80-B drilling rig.

This Publication deals with the results of this drilling operation, and contains information furnished by Delhi Australian Petroleum Ltd and edited in the Petroleum Exploration Branch of the Bureau of Mineral Resources. The well completion report was written by J. Harrison and G.T. Higginbotham of Delhi Australian Petroleum Ltd, in April, 1964. The methods employed in the drilling operation and the results obtained are presented in detail.

J. M. RAYNER
DIRECTOR

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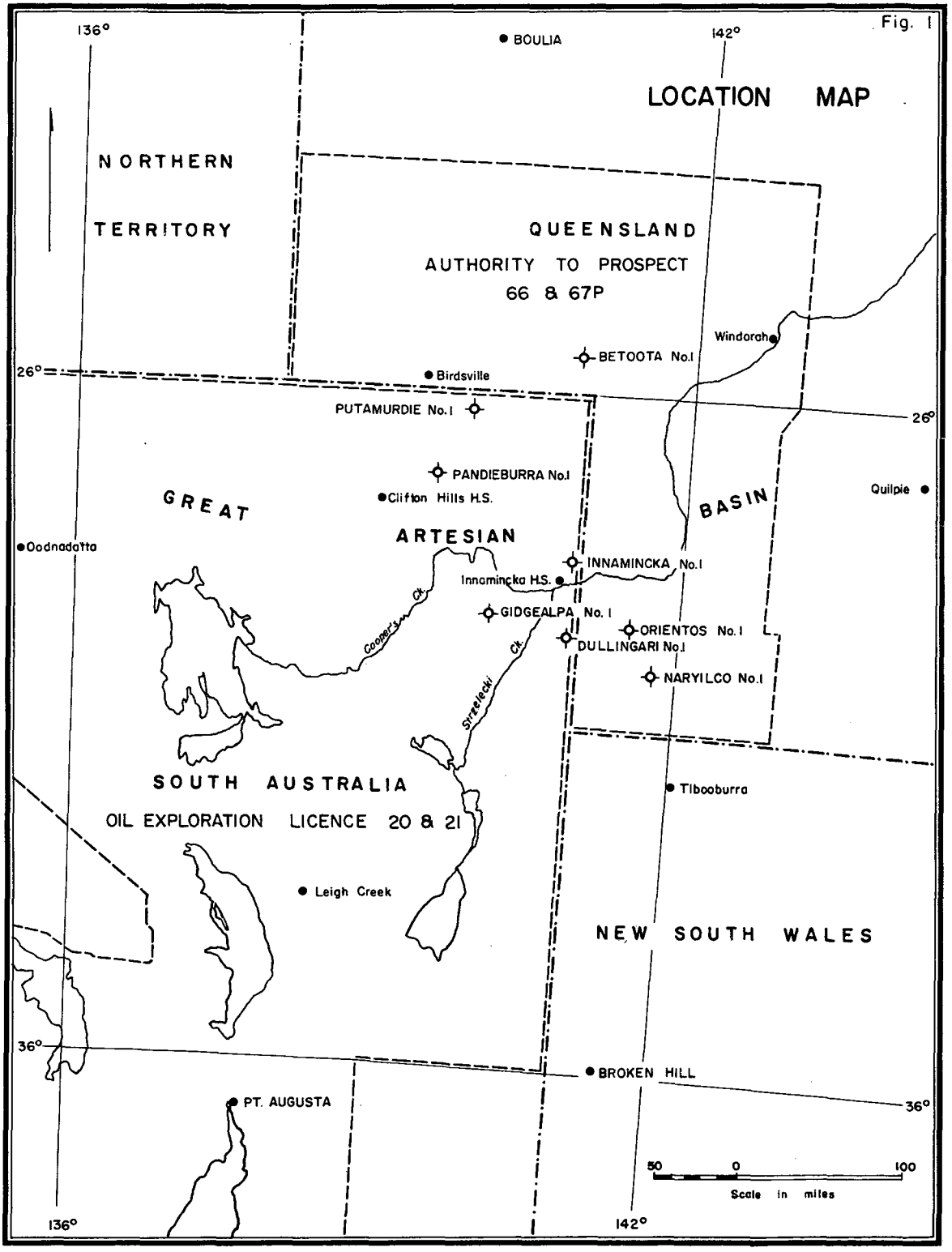


Fig. 1
LOCATION MAP
136°
142°
BOULIA
NORTHERN
TERRITORY
QUEENSLAND
AUTHORITY TO PROSPECT
66 & 67P
Windorah
BETOOTA No.1
26°
Birdsville
PUTAMURDIE No.1
26°
PANDIEBURRA No.1
Clifton Hills H.S.
GREAT
ARTESIAN
BASIN
Quilpie
Oodnadatta
INNAMINCKA No.1
Innamincka H.S.
Cooper's Ck.
GIDGEALPA No.1
ORIENTOS No.1
DULLINGARI No.1
Strzelecki Ck.
NARYILCO No.1
SOUTH AUSTRALIA
OIL EXPLORATION LICENCE 20 & 21
Tibooburra
Leigh Creek
NEW SOUTH WALES
36°
BROKEN HILL
PT. AUGUSTA
36°
50 0 100
Scale in miles
136°
142°

SUMMARY

Delhi-Santos Gidgealpa No. 1 Well was drilled in the north-eastern corner of South Australia by Delhi Australian Petroleum Ltd, as operator, and Santos Limited. The well is 60 miles south-west of Innamincka No. 1 and 50 miles west-north-west of Dullingari No. 1.

Gidgealpa No. 1 was spudded on 28th August, 1963, reached a total depth of 13,114 feet on 27th November, 1963, and was completed as a water well flowing from the Mooga Sandstone on 6th December, 1963. A National 80-B rig, owned and operated by Drilling Contractors (Australia) Pty Ltd, was used to drill the well.

Gidgealpa No. 1 was drilled as an off-structure well on the flank of a prominent closed anticline. The Mesozoic sequence was the thickest yet encountered in wells in the western part of the Great Artesian Basin, and very similar to that found in Innamincka No. 1. The overall lithology of the Permian in Gidgealpa No. 1 resembles that in Dullingari No. 1 although detailed correlation is not possible. Below the regional angular unconformity at the base of the Permian, a thick sequence of Cambrian marine carbonates and tuffaceous sediments was penetrated. This was the first encounter of Cambrian rocks in the subsurface of the Great Artesian Basin.

More hydrocarbon shows were encountered in the Permian sequence in this well than in any other drilled to date in this region. Unfortunately the sandstones exhibited very low porosity. A deep zone of porous dolomite, some 400 feet thick, was also discovered in the Middle Cambrian, and on test, flowed very gassy salt water. Thus Delhi-Santos Gidgealpa No. 1, in addition to providing much new geological information, gave most encouraging indications that, under favourable conditions, the Permian and the newly discovered Middle Cambrian dolomite could produce hydrocarbons.

The off-structure drilling operation at Delhi-Santos Gidgealpa No. 1 was subsidized under the Petroleum Search Subsidy Act 1959-1961, from surface to total depth.

12942-2

INTRODUCTION

From well and seismic data acquired since 1958, it had become apparent that across the crests of large anticlines Permian sediments are very much thinner than on the flanks. West of the Dullingari No. 1 Well, which found the thickest Permian section to date, reconnaissance seismic work indicated a deepening of the basin, a fact substantiated by aeromagnetic surveys which showed depths of 20,000 feet to magnetic basement in places west of the Strzelecki Creek. Seismic work west of the Strzelecki and south of Coopers Creek revealed a prominent structural trend running southwest-northeast and consisting of a series of roughly en echelon folds. In this area, too, for the first time strong and continuous seismic events were recorded from below what was indicated to be Permian strata. Reconnaissance seismic surveys delineated the Gidgealpa structure as an anticline with 700 feet of vertical closure over a length of 12 miles and width of 3 1/2 miles, at the 'P' seismic horizon.

Because the basin as a whole apparently deepened in this area, and particularly because the Permian thickened rapidly down the flank of the Gidgealpa structure, a deep test well far down the flank was likely to provide important new geological information. Mesozoic strata about 7800 feet thick overlying 4000 feet of Permian rocks could be expected above the regional angular unconformity. Below the unconformity the Lower Palaeozoic sequence might still be investigated for some thousands of feet with the rig available.

Delhi-Santos Gidgealpa No. 1 was thus proposed as an off-structure well on the eastern flank of the Gidgealpa anticline.

WELL HISTORY

General Data

Well name and number:	Delhi-Santos Gidgealpa No. 1
Location:	Latitude 27°56'46"S. Longitude 140°04'55.9"E.
Name and address of Tenement Holders:	Delhi Australian Petroleum Ltd, 32 Grenfell Street, Adelaide, South Australia Santos Limited, 44 Grenfell Street, Adelaide, South Australia
Details of Petroleum Tenement:	Oil Exploration Licences Nos 20 and 21, issued by the State of South Australia
Total Depth:	13,114 feet
Date drilling commenced:	28th August, 1963
Date drilling completed:	27th November, 1963

Date well abandoned:	6th December, 1963
Date rig released:	6th December, 1963
Drilling time in days to total depth:	92 days
Elevation (ground):	165 feet
Elevation (K.B.):	181 feet (datum for depths)
Status:	Completed as a flowing water well from the Upper Jurassic Mooga Sandstone
Cost:	£236,005

Drilling Data

Name and address of drilling contractor:	Drilling Contractors (Australia) Pty Ltd, 383 George Street, Sydney, New South Wales
Drilling Plant:	
Make:	National
Type:	80-B
Rated capacity with 4 1/2" drill pipe:	8000/14,000 feet
Mast:	
Make:	Lee C. Moore
Type:	136 feet
Rated capacity:	830,000 lb.
Rotary Table:	
Make:	Oilwell
Type:	Model 26" H.D.
Size:	26-inch opening
Motors:	
Make:	Superior
Type:	PTD6, Number: 2 PTDS6, Number: 2
H.P..	1750
Pumps:	
Make:	National
Type:	G-700, 8" x 14" (2) C-250, 7 1/4" x 15" (1)

Blowout Preventer Equipment:

Make:	Shaffer	Hydril
Model:	Double Hydraulic	GK
Size:	12" x 900 series	12" x 900 series
Working pressure :	3000 psi.	3000 psi.

(Both units hydraulically operated by Hydril Model 80 accumulator with remote control)

Hole sizes and depths:

17 1/2" to 514 feet
12 1/4" to 7208 feet
8 1/2" to 13114 feet (T.D.)

Casing details:

Size (in.):	13 3/8	9 5/8
Weight (lb./ft):	48	36
Grade:	H.40	J.55
Setting depth (ft):	514	7207
Cement (sacks):	375	600

Drilling Fluid:

A "spud mud" of bentonite and water was mixed for use while drilling the surface hole to 514 feet. Clear water was used while drilling the intermediate hole to the top of the Transition Zone above the Mooga Sandstone. At this point a Spersene XP-20 low solids mud system was built using bentonite, caustic soda, Spersene and XP-20. This type of system was maintained to total depth. No mud or hole problems were encountered throughout the drilling. The mud characteristics are summarized graphically in Figures 2 and 3. The quantities of components used were as follows:

Bentonite	93,636 pounds
Caustic Soda	15,260 "
Spersene	52,750 "
XP-20	25,550 "

Water Supply:

Water was obtained from a depth of 250 feet in a well drilled close to the rig. However, the water was too saline for a good drilling mud with the chemicals available, and consequently fresh water was trucked about ten miles from Gidgealpa waterhole, an overflow channel of Coopers Creek.

Perforations:

6490 to 6525 feet (Walloon Formation)

After reaching total depth at 13,114 feet the well was plugged back to 7200 feet and the 9 5/8" casing perforated between 6490 and 6525 feet with four jets per foot. A test of these perforations flowed water to the surface.

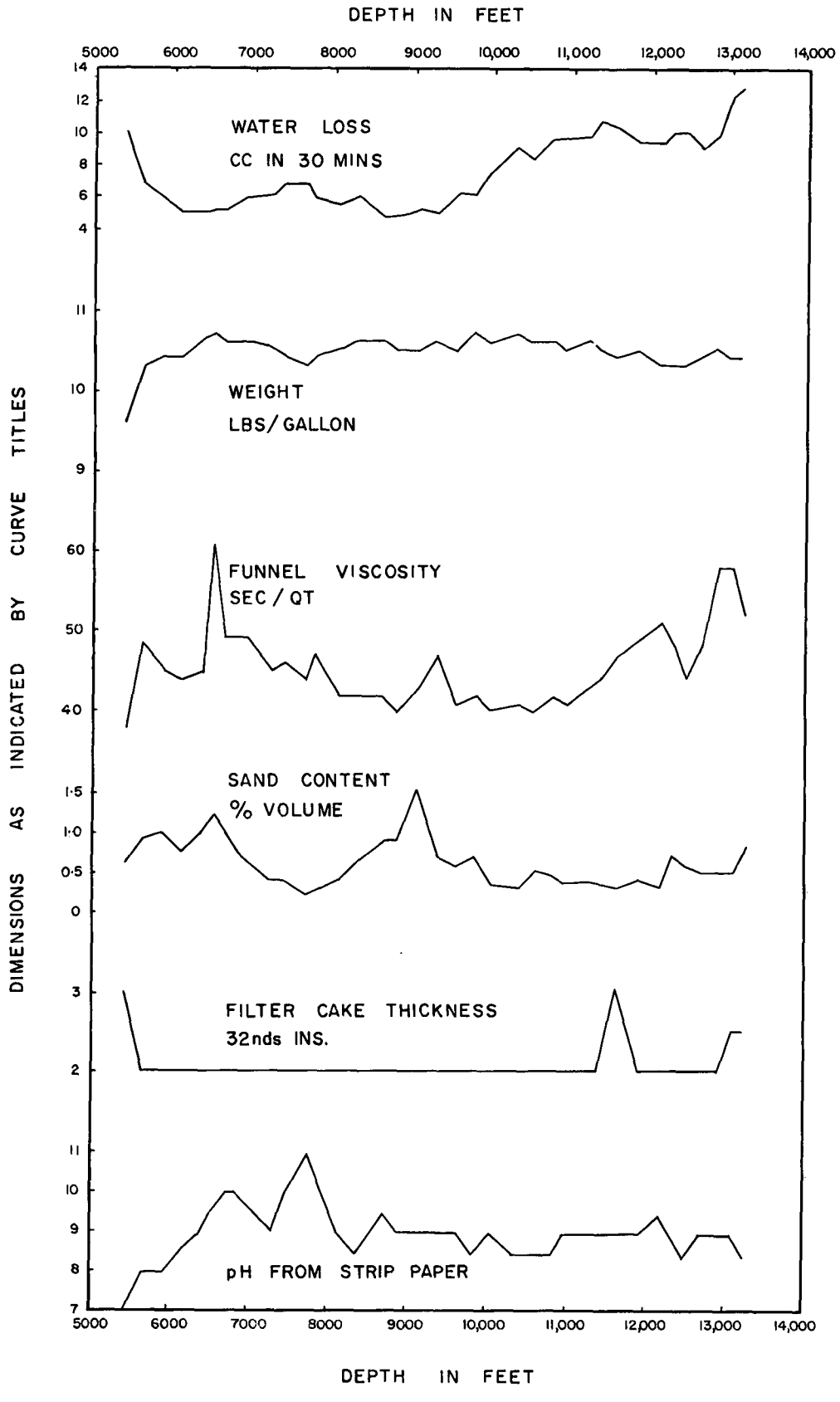
Fig. 2

DELHI - SANTOS

GIDGEALPA No.1

SOUTH AUSTRALIA

MUD PROPERTIES VERSUS DEPTH

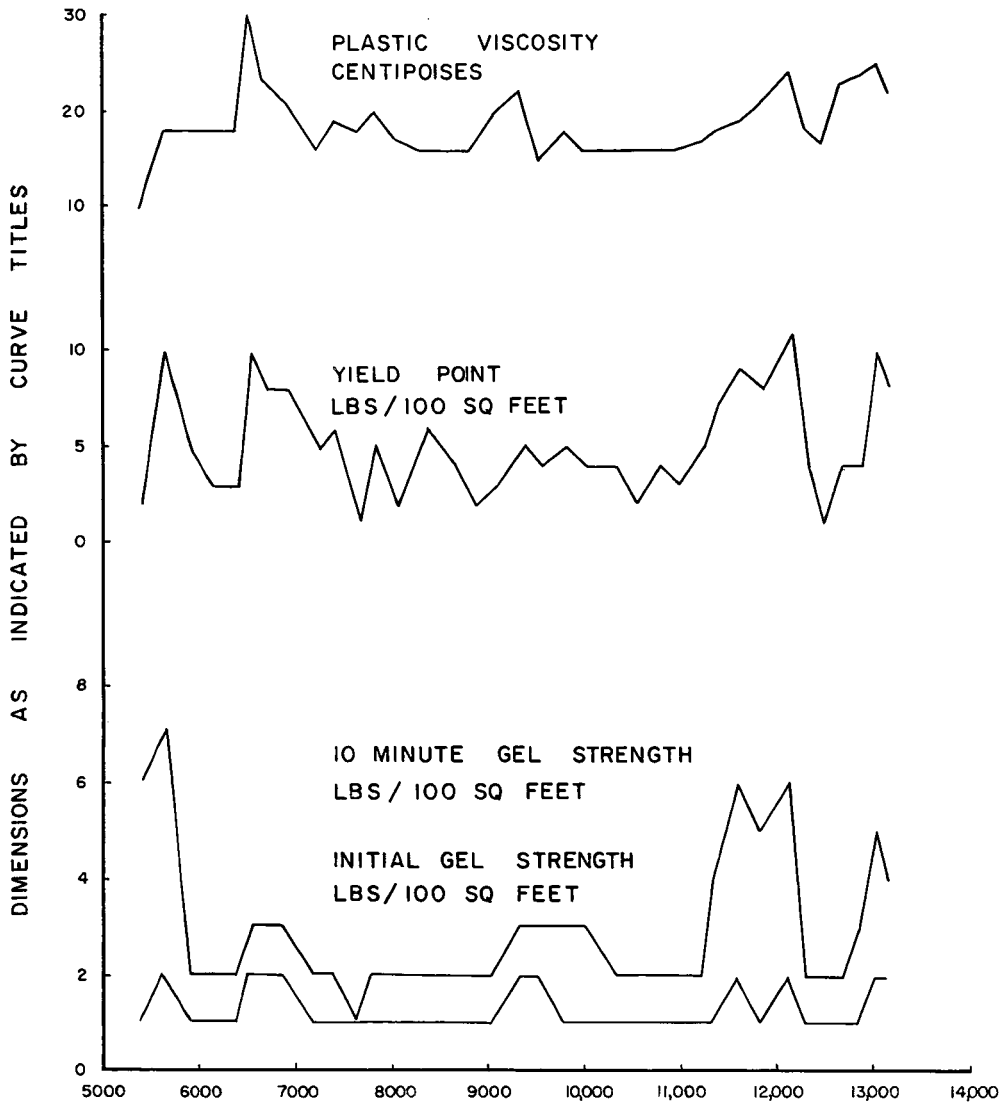


DELHI - SANTOS

GIDGEALPA No.1

SOUTH AUSTRALIA

GRAPH OF MUD FLOW PROPERTIES



5631 to 5670 feet (Mooga Sandstone)

After setting a cement plug above the previous perforations the interval 5631 to 5670 feet was perforated with four jets per foot. The well was completed as a water well flowing through these perforations at a rate of 3700 gallons per hour.

Plugs:

No. 1: 12,400 to 12,675 feet with 100 sacks cement

No. 2: 7,200 to 7,300 feet with 125 sacks cement

No. 3: 6,617 to 6,200 feet with 155 sacks cement

Fishing Operations: Nil

Logging and Testing

Ditch Cuttings: Samples were caught at 30-foot intervals from surface to the top of the Mooga Sandstone at 5450 feet. From 5450 feet to total depth the sampling interval was ten feet. During coring, samples were taken at five-foot intervals. The washed, sieved, and dried samples were made up into sets complete with core chips and distributed to the Bureau of Mineral Resources and the South Australian Department of Mines. Complete sets are also held by Santos Limited and Delhi Australian Petroleum Ltd in Adelaide, and Delhi-Taylor Oil Corporation in Dallas.

Coring: A total of 30 cores was cut, all but one with a Hycalog barrel and Hycalog diamond coring head. Core No. 28 was cut with a Reed "Kor-King" K550 barrel and hard formation head in an attempt to improve the recovery in the Middle Cambrian fractured dolomite unit, but without success. Of 371 feet of formation cored, 256 feet, or 69 percent, were recovered. Detailed lithological description and graphic representation of each core are given in Appendix 1. Petrological, palaeontological, and core analysis studies comprise Appendices 2, 3, and 4.

Sidewall Sampling: On two runs of the sampling gun 51 sidewall sample takers were fired, with a recovery of 38 samples.

Sidewall Sample Number	Depth (feet)	Formation	Description
1	4243	Tambo Formation	Shale, grey, firm, silty.
2	4402	Toolebuc Member	Siltstone, dark grey, firm, shaly, slightly calcareous.
3	4484	Roma Formation	Shale, dark grey, fissile, firm, silty.
4	5340	"Transition Beds"	Siltstone, light grey, hard, micaceous, with fine laminae of shale, dark grey, carbonaceous.
5	5483	Mooga Sandstone	Siltstone to very fine-grained sandstone, light grey, with very fine partings of shale, dark grey.
6	6377	Walloon Formation	Sandstone, white, medium-grained, angular, quartz and kaolin, carbonaceous specks throughout, tight.
7	6471	Walloon Formation	Sandstone, white, very fine to fine-grained, angular, quartz and kaolin, carbonaceous specks, tight.
8	6502	Walloon Formation	Sandstone, white, fine-grained, angular, fair sorting, quartz, kaolin, spotty gold fluorescence, strong cut with CCl_4.
9	6504	Walloon Formation	Sandstone, as in 6502 feet, very weak cut with CCl_4.
10	6506	Walloon Formation	Sandstone, light brown, fine-grained, angular, quartz, kaolin, carbonaceous partings, weak cut with CCl_4.

Sidewall Sample Number	Depth (feet)	Formation	Description
11	6508	Walloon Formation	Sandstone, white, fine to medium-grained, angular, fair sorting, quartz, kaolin, fair porosity, weak cut with CCl_4.
12	6512	Walloon Formation	Sandstone as in 6508 feet, poor porosity.
13	6514	Walloon Formation	Sandstone, brown, very fine-grained, shaly, very carbonaceous, very poor porosity, weak cut with CCl_4.
14	6516	Walloon Formation	Sandstone, white, very fine to fine-grained, angular, quartz, kaolin, trace carbonaceous material, trace pyrite, very poor porosity, weak cut with CCl_4.
15	6520	Walloon Formation	Sandstone, as for 6516 feet, no cut.
16	6564	Walloon Formation	Shale, grey-brown, very carbonaceous, very silty.
17	6640	Walloon Formation	Shale, dark brown, very carbonaceous.
18	6794	Hutton Sandstone	Sandstone, light grey, medium to coarse-grained, subangular to subround, quartz, kaolin, silica, carbonaceous fragments common, fair porosity.
19	6870	Hutton Sandstone	Sandstone as in 6794 feet, but angular to subangular.

Sidewall Sample Number	Depth (feet)	Formation	Description
20	6950	Hutton Sandstone	Sandstone, light grey, fine to medium-grained, angular, quartz, abundant kaolin cement, carbonaceous partings, very poor porosity.
21	6990	Hutton Sandstone	Sandstone, cream, fine to medium-grained, angular, quartz, kaolin, fragments of carbonaceous material common, tight.
22	7025	Hutton Sandstone	Sandstone, brown to white, fine to medium-grained, angular, quartz, kaolin, very poor porosity.
23	7167	Hutton Sandstone	Sandstone, fine to medium-grained, angular, quartz, kaolin, poor porosity.
24	7195	Lower Triassic	Siltstone, dark brown, hard, shaly, slightly dolomitic.
25	7796	Permian	Shale, dark grey to black, fissile, carbonaceous, micaceous.
26	7828	Permian	Sandstone, white, fine-grained, angular to subangular, quartz and kaolin, tight.
27	7832	Permian	Sandstone, as in 7828 feet.
28	7840	Permian	Sandstone, pale grey, fine to coarse-grained, angular to subround, quartz, with kaolin and silica cement, very poor porosity.

Sidewall Sample Number	Depth (feet)	Formation	Description
29	7856	Permian	Sandstone, as in 7840 feet.
30	8424	Permian	Sandstone, as in 7840 feet, but finer grained.
31	8430	Permian	Sandstone, as in 8424 feet.
32	8528	Permian	Sandstone, pale grey, fine to very fine-grained, quartz, with kaolin, very thin shale partings, tight.
33	8530	Permian	Sandstone, as in 8528 feet, tiny carbonaceous specks.
34	8532	Permian	Sandstone, as in 8530 feet, but fine to medium-grained, trace poor porosity.
35	8534	Permian	Sandstone, as in 8530 feet.
36	8706	Palaeozoic undifferentiated	Sandstone, mid-grey, fine to medium-grained, angular to sub-angular, quartz, kaolin, thin shale partings, tight.
37	8708	Palaeozoic undifferentiated	Sandstone, as in 8706 feet, but medium to coarse-grained.
38	8712	Palaeozoic undifferentiated	Sandstone, as in 8708 feet.

Core analyses were carried out on suitable Permian samples; the results are tabulated in Appendix 4.

Electric and other logging: The following Schlumberger logs were run:

Electrical Log	514 to 13,114 feet
Microlog - Caliper	514 to 9,988 feet
Microlaterolog - Microcaliper	7,207 to 13,114 feet
Microlaterolog	7,300 to 7,950 feet 8,400 to 9,000 feet 12,600 to 13,114 feet
Laterolog	7,207 to 13,110 feet
Neutron Log	6,500 to 13,115 feet
Gamma Ray - Sonic Log	
Gamma Ray Log	20 to 13,100 feet
Sonic Log	514 to 13,100 feet
Continuous Dipmeter Log	7,210 to 13,100 feet
Gamma Ray - Collar Locator	6,300 to 7,210 feet

The Microcaliper Log run in conjunction with the Microlaterolog is unreliable.

The Spontaneous Potential curve through the Mooga Sandstone is reversed because of the freshness of the artesian water in this sandstone.

The Electrical Log forms part of the Composite Well Log (Plate 1), on which the dip values and directions from the continuous dip meter analysis are recorded.

Drilling Time and Gas Log: A Geograph was used to record the rate of penetration, the charts from which were used to construct the drilling time curve on the Composite Well Log (Plate 1).

A Caran OB-100-B mud gas detector was in operation during drilling and coring. The mud gas curve shown on the Composite Well Log was reproduced from the charts.

Formation Testing: Six drillstem tests were conducted in open hole and three through perforations in the 9 5/8" casing after drilling. Halliburton testing assemblies were used in each case. The complete Halliburton report with pressure charts for each test are available for inspection at BMR, Canberra. A brief description of each test is given below:

DST No. 1 7758 to 7782 feet (Permian)

Run to evaluate very poorly porous sandstone with weak gold fluorescence and cut in carbon tetrachloride.

Bottom choke 5/8" - Top choke 3/8" - No water cushion
Misrun - mechanical failure in tool.

DST No. 2 7757 to 7782 feet (Permian)

Re-test of interval of DST No. 1
Bottom choke 5/8" - Top choke 1" - No water cushion

Initial flow period	15 minutes
Initial shut-in period	30 minutes
Final flow period	120 minutes
Final shut-in period	60 minutes

Good blow throughout initial flow period. Fair blow decreasing to slight at end of final flow period. Recovered 20 feet of drilling mud.

	Top Recorder (7747 feet)	Bottom Recorder (7782 feet)
I.H.H.	4224 psig.	4264 psig.
I.F.P.*	9 "	38 "
I.S.I.P.	207 "	233 "
F.F.P.	3 "	35 "
F.S.I.P.	72 "	100 "
F.H.H.	4204 "	4251 "

*I.F.P. = Pressure at end of first flow period

DST No. 3 8180 to 8218 feet (Permian)

Run to evaluate very poorly porous sandstone showing weak gold fluorescence and weak cut in carbon tetrachloride.

Bottom choke 5/8" - Top choke 3/8" - No water cushion

Initial flow period	15 minutes
Initial shut-in period	30 minutes
Final flow period	120 minutes
Final shut-in period	60 minutes

Good blow throughout initial flow period. Good blow decreasing to zero after 45 minutes of final flow period. Recovered 15 feet of drilling mud.

	Top Recorder (8180 feet)	Bottom Recorder (8214 feet)
I.H.H.	4536 psig.	4501 psig.
I.F.P.	35 "	27 "
I.S.I.P.	81 "	69 "
F.F.P.	35 "	27 "
F.S.I.P.	89 "	75 "
F.H.H.	4525 "	4501 "

DST No. 4 8570 to 8610 feet (Permian)

Run to evaluate poorly porous sandstone with strong golden fluorescence and weak cut in carbon tetrachloride.

Misrun - leaking tool joint in drill pipe.

DST No. 5 8570 to 8620 feet (Permian)

Re-test of interval of DST No. 4
Bottom choke 5/8" - Top choke 1/4" - No water cushion

Initial flow period	15 minutes
Initial shut-in period	30 minutes
Final flow period	120 minutes
Final shut-in period	60 minutes

Fair blow throughout initial flow period. Good blow decreasing to slight at the end of final flow period. Recovered 100 feet salt water-cut mud, chlorides 2500 ppm. (normal drilling mud chlorides 1600 ppm.).

	Top Recorder (8572 feet)	Bottom Recorder (8616 feet)
I.H.H.	4635 psig.	4700 psig.
I.F.P.	38 "	45 "
I.S.I.P.	263 "	263 "
F.F.P.	51 "	63 "
F.S.I.P.	453 "	455 "
F.H.H.	4616 "	4682 "

DST No. 6 12,757 to 12,783 feet (Middle Cambrian)

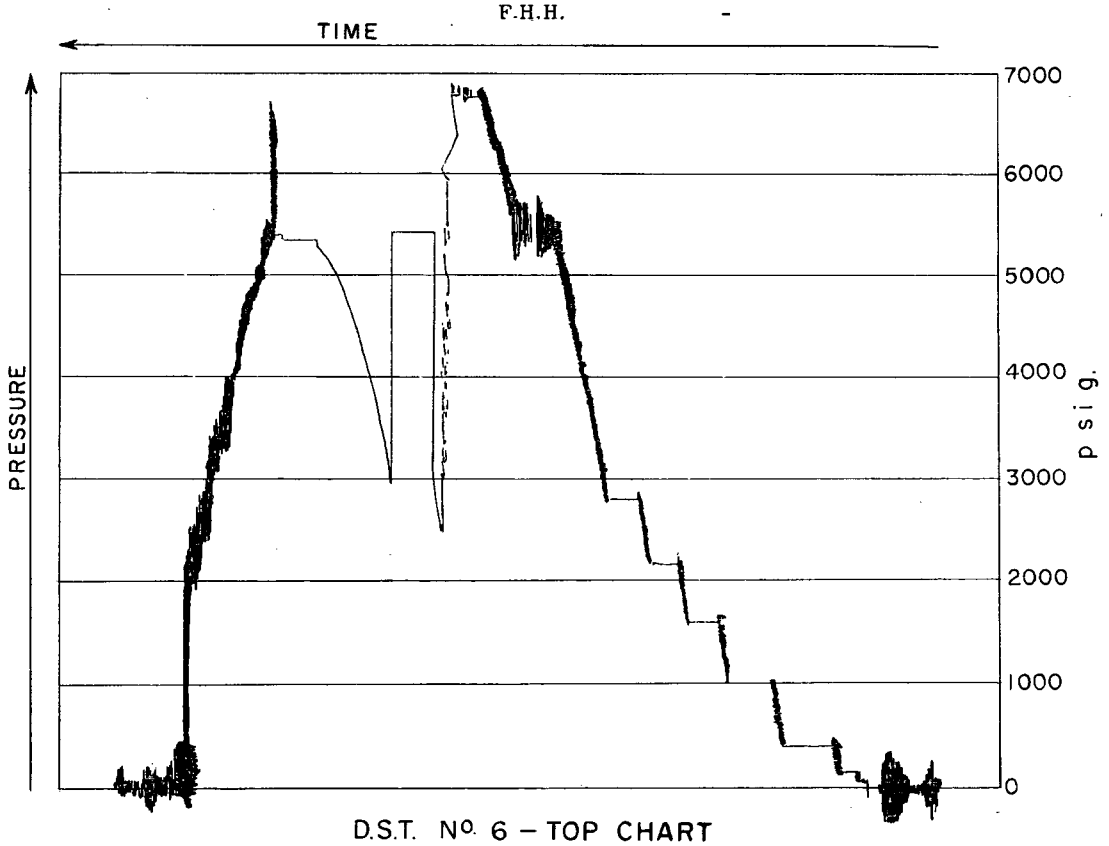
Run to evaluate good vuggy and fracture porosity in dolomite with dull gold fluorescence and pale yellow cut in carbon tetrachloride.

Bottom choke 5/8" - Top choke 1/4" - 5000 feet water cushion.

Initial flow period	10 minutes
Initial shut-in period	45 minutes
Final flow period	125 minutes
Final shut-in period	60 minutes

Good blow throughout initial flow period. Weak blow increasing to strong blow during final flow period. Water cushion to surface in 85 minutes. Recovered 4000 feet of water cushion and 8650 feet of heavily gas-cut salt water (13,728 ppm. total salts). Sampling of every second stand, after water cushion recovered, yielded salt water.

	Top Recorder (12,759 feet)	Bottom Recorder (12,779 feet)
I.H.H.	6760 psig.	
I.F.P.	2974 "	
I.S.I.P.	5459 "	
F.F.P.	5299 "	Chart drum jammed
F.S.I.P.	5365 "	
F.H.H.	-	



D.S.T. NO. 6 – TOP CHART

DST No. 7 Perforations 6490 to 6525 feet, 4 per foot
(Walloon Formation)

Plugged back total depth 7077 feet. Packer set at 6475 feet.

Run to evaluate good porosity in sandstone showing fair oil stain, yellow fluorescence and cut in carbon tetrachloride.

Bottom choke 5/8" - Top choke 1/4" - No water cushion

Initial flow period	7 minutes
Initial shut-in period	45 minutes
Final flow period	120 minutes
Final shut-in period	60 minutes

Weak blow throughout
Misrun - tool plugged

DST No. 8 Perforations 6490 to 6525 feet, 4 per foot (Walloon Formation)

Re-test of interval of DST No. 7

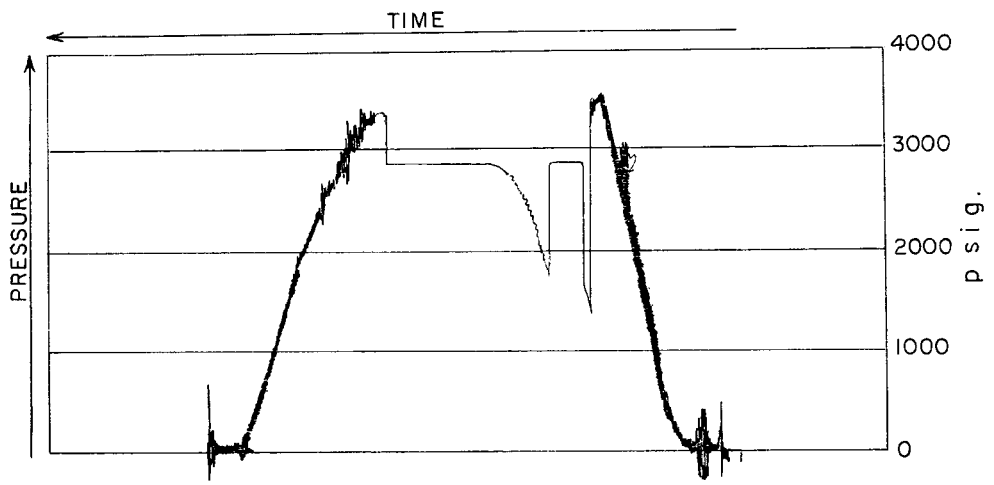
Plugged back total depth 7077 feet. Packer set at 6445 feet.

Bottom choke 5/8" - Top choke 1/4" - No water cushion

Initial flow period	7 minutes
Initial shut-in period	45 minutes
Final flow period	120 minutes
Final shut-in period	60 minutes

Good blow throughout initial flow period. Good blow decreasing to zero after 40 minutes of final flow period. Recovered 1095 feet of drilling mud, 455 feet of gas-cut muddy water, and 4570 feet of gas-cut fresh water (chlorides 1900 ppm.).

	Top Recorder (6437 feet)	Bottom Recorder (6453 feet)
I.H.H.	3515 psig.	3480 psig.
I.F.P.	1592 "	1711 "
I.S.I.P.	2880 "	2860 "
F.F.P.	2883 "	2849 "
F.S.I.P.	2883 "	2854 "
F.H.H.	3409 "	3403 "



D.S.T. No. 8 – BOTTOM CHART

DST No. 9 Perforations 6490 to 6525 feet, 4 per foot (Walloon Formation)

Run in attempt to determine if apparent casing collapse below 6600 feet was contributing fluid to DST No. 8, after spotting plug above point of casing obstruction.

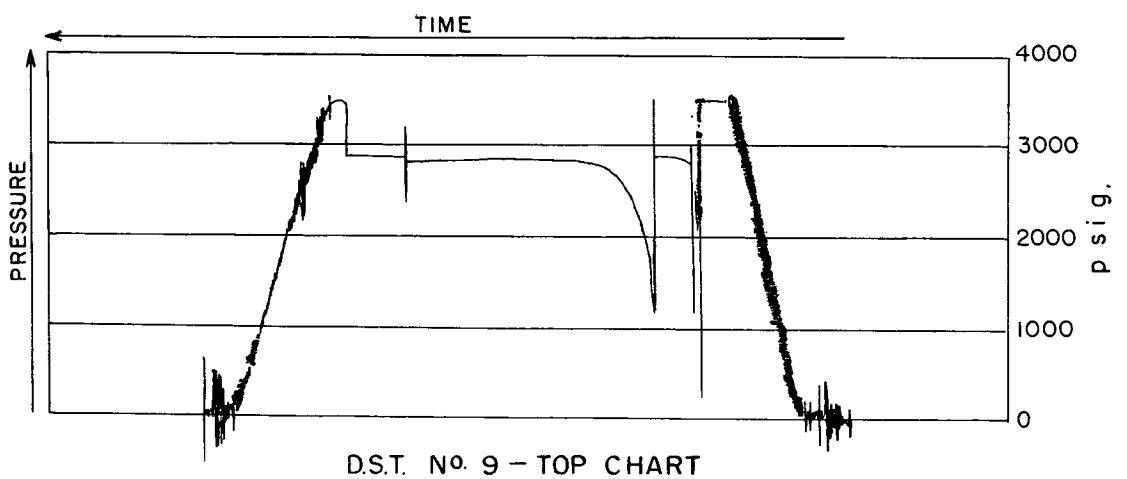
Plugged back total depth 7077 feet. Packer set at 6455 feet.

Bottom choke 5/8" - Top choke 1/4" - No water cushion

Initial flow period	7 minutes
Initial shut-in period	45 minutes
Final flow period	282 minutes
Final shut-in period	70 minutes

Strong blow throughout initial flow period. Strong blow gradually weakening during final flow period. Flowed mud to surface in 103 minutes. Recovered 60 feet of drilling mud, 1638 feet of clear water and 4760 feet of muddy water (chlorides 1800 ppm.).

	Top Recorder (6447 feet)	Bottom Recorder (6460 feet)
I.H.H.	3500 psig.	3448 psig.
I.F.P.	1359 "	1377 "
I.S.I.P.	2857 "	2847 "
F.F.P.	2807 "	2772 "
F.S.I.P.	2871 "	2849 "
F.H.H.	3471 "	3435 "



D.S.T. No. 9 – TOP CHART

Fig. 4

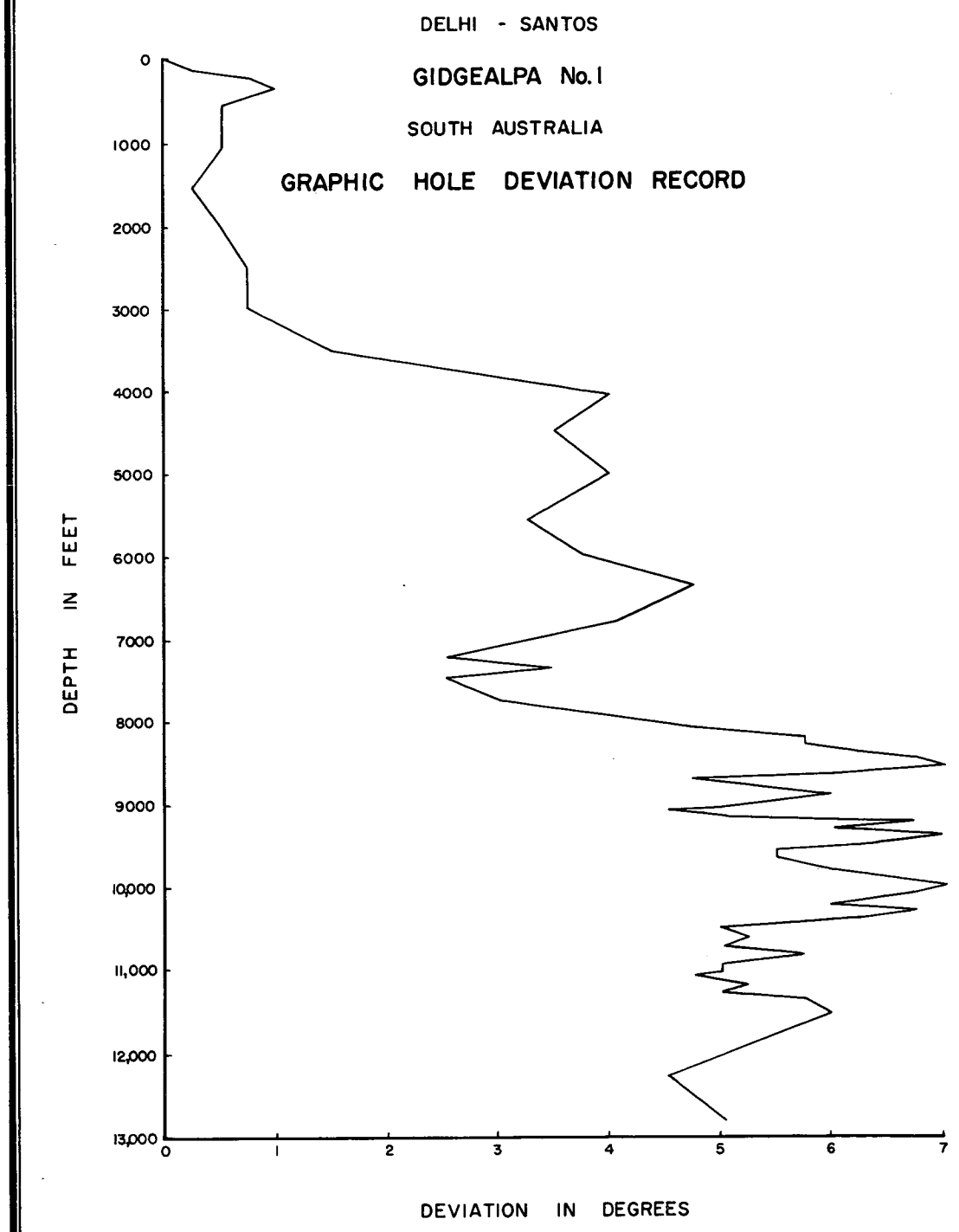
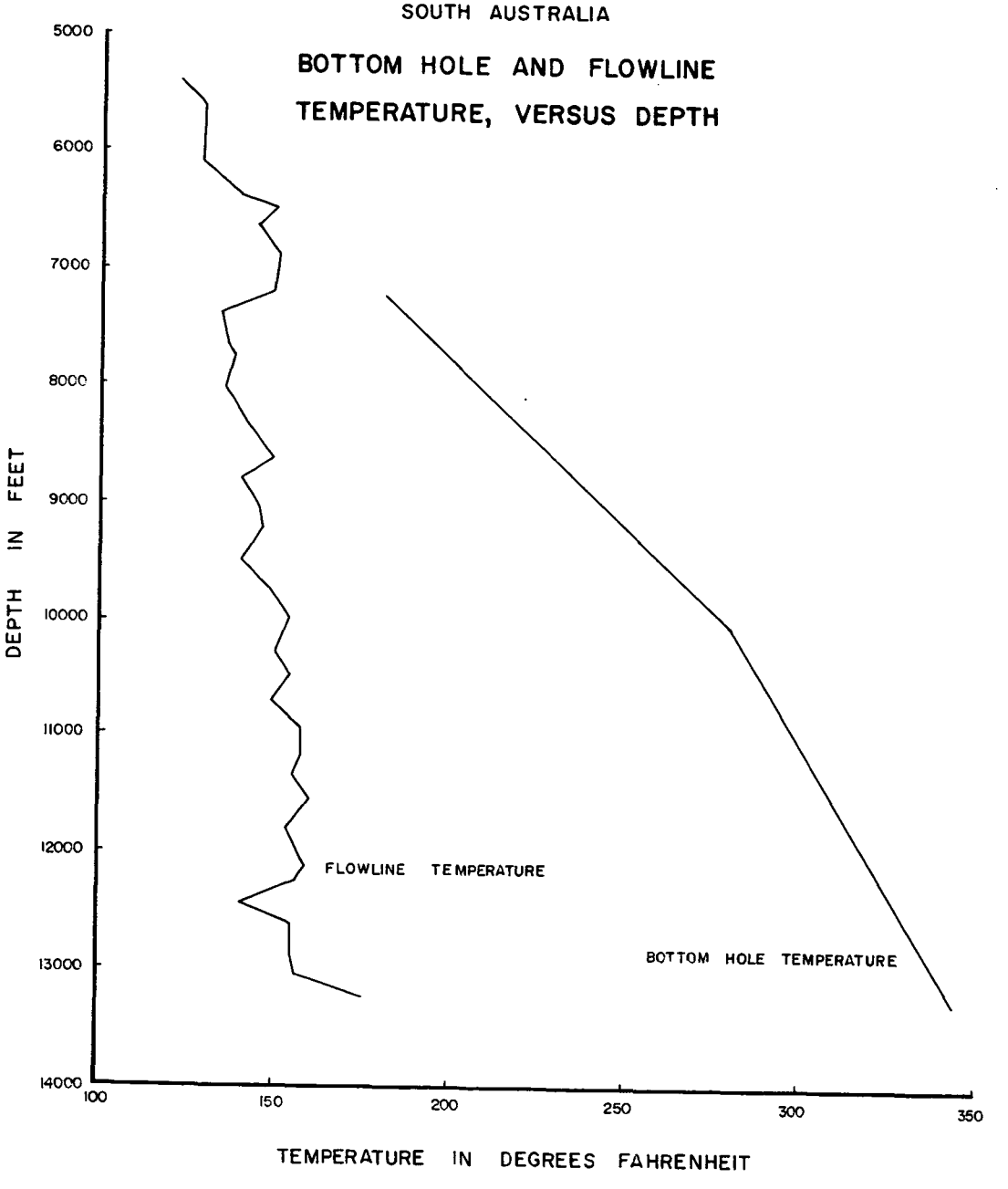

DELHI - SANTOS
GIDGEALPA No. 1
SOUTH AUSTRALIA
GRAPHIC HOLE DEVIATION RECORD
DEPTH IN FEET
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10,000
11,000
12,000
13,000
0
1
2
3
4
5
6
7
DEVIATION IN DEGREES

Fig. 5

DELHI - SANTOS

GIDGEALPA No.1

SOUTH AUSTRALIA



Deviation Survey: The "Totco" device was used at regular intervals to determine the hole deviation. Readings are recorded on the Composite Well Log and are also shown graphically in Figure 4. Maximum hole deviation was 7^{o}.

Temperature Survey: No temperature logs were run. The mud temperature at the flowline was recorded each day. At each run of logs the bottom hole temperature was recorded on a maximum reading thermometer. Bottom hole and flowline temperatures are shown graphically in Figure 5.

Velocity Survey: When the well had reached a depth of 11,195 feet a velocity survey was run by United Geophysical Corporation Party 133 using the Schlumberger cable to lower the well geophone. United Geophysical Corporation's report on the survey forms Appendix 7.

GEOLOGY

Summary of Previous Work

The Gidgealpa structure has no surface expression, the topography of the region being alternating sand ridges and clay pans. The location was chosen on local geophysical mapping, with consideration of regional geology.

The results of Innamincka No. 1, Dullingari No. 1, and Orientos No. 1, as well as seismic information, showed that the thickness of the Permian was greatly affected by structure, it being thin on the tops of large structures and thick in deep synclines. Areally, the limit of the Permian sediments is probably delineated by the presence or absence of the seismic 'P' event approximately at the top of the Permian, and the Permian thickness by the conformable 'Pre-P' events. West of the Innamincka-Dullingari-Orientos area the sequence probably thickens and more marine conditions occur, as studies of the lithology suggest, as well as the more basinward position.

All the wells in this region bottomed in marine Lower Palaeozoic and, although everywhere these beds dipped fairly steeply, the rocks were not metamorphosed more than would be normal for that age and depth of burial. From surface studies of the Cambrian rocks around the south-western and north-western edges of the Great Artesian Basin, it is reasonable to expect that these rocks exist at depth in the centre of the basin.

The stratigraphy of the Mesozoic sediments was better understood than that of earlier strata, and although the Mesozoic has not given much encouragement for its hydro-

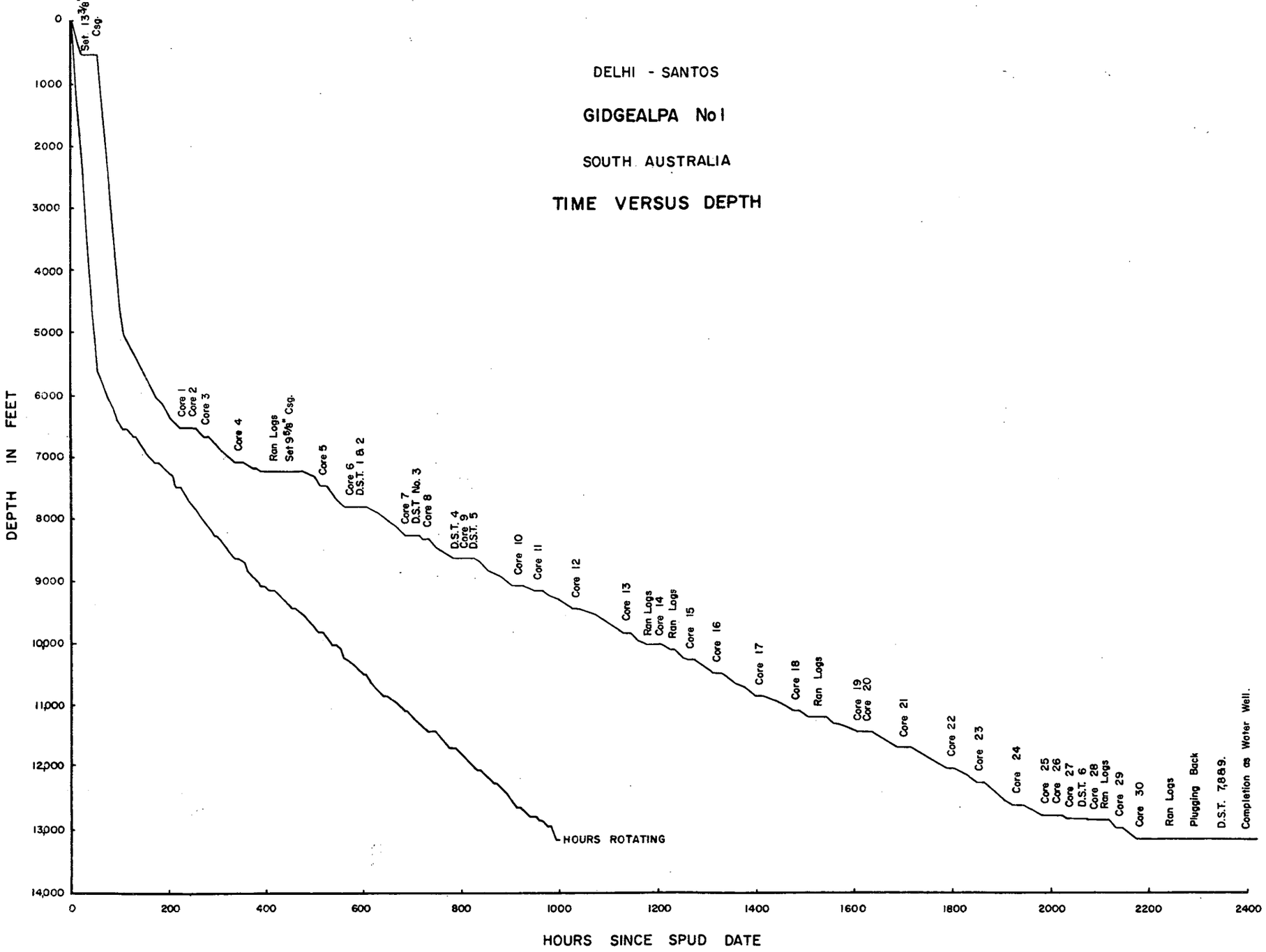
Fig. 6

DELHI - SANTOS

GIDGEALPA No 1

SOUTH AUSTRALIA

TIME VERSUS DEPTH



carbon possibilities, all the porous sandstones being water bearing, nevertheless under suitable trap conditions they too could be prospective.

Reconnaissance aeromagnetic and gravity surveys indicated a deep basinal area west of the Strzelecki Creek and south of the very large northward loop of Coopers Creek. Aeromagnetic data showed a depth to basement in some areas greater than 20,000 feet. Preliminary seismic work confirmed this and later work outlined strong trends of folding in a roughly northeast-southwest direction. One of these folds, the Gidgealpa structure, was found to be a north-east trending closed anticline, 12 miles long, 3 1/2 miles wide, with a vertical closure on the 'P' horizon of more than 700 feet. The Permian appeared to thin from 5000 feet in the adjacent syncline to 1800 feet on the crest of the structure, a distance of approximately five miles. For the first time definite continuous seismic events had been obtained from beneath the sub-Permian unconformity.

The Gidgealpa structure thus appeared as the best locality in which to test the thickest Permian yet mapped, the underlying moderately dipping Lower Palaeozoic rocks, and the overlying thick Mesozoic section. By drilling low down on the eastern flank, 7800 feet of Mesozoic beds and 4000 feet of Permian strata were expected before reaching the Lower Palaeozoic, some of which could still be penetrated with the rig available.

The actual thickness of Mesozoic sediments was 6942 feet, and of Permian 1000 feet. The remainder included 420 feet of undifferentiated Palaeozoic sediments and 4004 feet of Cambrian sediments.

Stratigraphy

General:

The stratigraphic succession in Delhi-Santos Gidgealpa No. 1 is described below. Naming of the Mesozoic units follows the revised correlation system described in the well completion report for Delhi-Santos Pandieburra No. 1. Spores, lithology, and correlation with Innamincka No. 1 and Dullingari No. 1 wells were all used to determine the boundaries of the Permian. The Upper and Middle Cambrian age below 9110 feet was determined palaeontologically. The age of the sandstone unit below the Permian and above the known Middle Cambrian is doubtful because no fossils were found in it. This unit is more akin to the Cambrian than to the Permian as there is evidence of angular unconformity between the sandstone unit and the Permian, whereas between the sandstone and the underlying Middle Cambrian rocks there is only slight angular discordance. The age of this unit is probably Upper Cambrian or Lower Ordovician, but for purposes of this report and until definite evidence comes to hand, it is designated as "Palaeozoic undifferentiated".

The stratigraphic sequence was as follows:

Age	Formation	Depth Intervals (feet)	Thickness (feet)
Recent and Tertiary		16 - 748	732
Upper Cretaceous	Winton Formation	748 - 3357	2609
Lower Cretaceous	Tambo Formation	3357 - 4362	1005
	Toolebuc Member, Tambo Formation	4362 - 4477	115
	Roma Formation	4477 - 5211	734
	"Transition Beds"	5211 - 5450	239
Upper Jurassic	Mooga Sandstone	5450 - 6372	922
Upper to Middle Jurassic	Walloon Formation	6372 - 6780	408
Middle to Lower Jurassic	Hutton Sandstone (Equiv.)	6780 - 7185	405
——— Hiatus ———			
Lower Triassic	Unnamed	7185 - 7690	505
Permian	Unnamed	7690 - 8690	1000
———(?) Angular Unconformity———			
Palaeozoic (undifferentiated)	Sandstone unit (Unnamed)	8690 - 9110	420
———Angular Unconformity———			
Upper and Middle Cambrian	Unnamed	9110 -13114 (T.D.)	4004+

Detailed:

Recent and Tertiary: 16 to 748 feet (732 feet)

Unconsolidated, tan to white, iron stained, medium to coarse-grained sand, soft, yellow-buff clay, light grey mudstone, and poorly consolidated, white, medium to very coarse-grained, quartz sandstone, usually water bearing. At 600 feet, distinctive white, soft, arenaceous limestone.

Winton Formation (Upper Cretaceous, Cenomanian): 748 to 3357 feet (2609 feet)

Light grey, very soft, silty, carbonaceous shale with interbeds of "salt and pepper", fine to coarse-grained, angular to subangular, poorly sorted, soft, carbonaceous, tight sandstone with argillaceous, in places calcareous, matrix. Sandstone increases in prominence toward base. Few thin bands of lignite. Few thin bands of grey-brown, microcrystalline limestone.

Tambo Formation (Lower Cretaceous, Albian): 3357 to 4362 feet (1005 feet)

Mainly grey, fissile, soft, micromicaceous, slightly silty, bentonitic shale with minor interbeds of grey, soft siltstone, and very few bands of brown, microcrystalline limestone. Pelecypod fragments and Inoceramus prisms abundant throughout.

Toolebuc Member, Tambo Formation (Albian): 4362 to 4477 feet (115 feet)

Grey, fissile, silty shale and dark brown carbonaceous (?) shale. Minor grey, slightly calcareous siltstone. Rare fish scales and spines.

Roma Formation (Lower Cretaceous, Aptian): 4477 to 5211 feet (734 feet)

Dark grey, fissile, micromicaceous, in part silty shale with minor interbeds of grey-green, fine to medium-grained subangular, shaly, very glauconitic sandstone. Few thin bands of light brown, arenaceous, microcrystalline limestone. Pelecypod and Inoceramus prisms common.

"Transition Beds" (Lower Cretaceous, Aptian-Neocomian): 5211 to 5450 feet (239 feet)

Light grey to white, fine to coarse-grained, angular to subrounded, carbonaceous, tight to poorly porous sandstone with kaolin cement. Minor interbeds of dark grey, fissile, micaceous, carbonaceous shale.

Mooga Sandstone (Upper Jurassic): 5450 to 6372 feet (922 feet)

5450 to 5610 feet: Brown-grey, fine to very fine-grained, micaceous, argillaceous, carbonaceous, very poorly porous sandstone with interbeds of dark grey, fissile, micaceous, carbonaceous shale.

5610 to 6372 feet: Predominantly white, fine to very coarse-grained, conglomeratic in part, angular to subangular, poorly sorted, poorly consolidated, clear quartz sandstone with good porosity. Minor interbeds of dark grey, fissile, micaceous, carbonaceous shale.

Walloon Formation (Upper to Middle Jurassic): 6372 to 6780 feet (408 feet)

6372 to 6462 feet: Brown to grey, fissile, silty, carbonaceous shale and minor interbeds of white, very fine to fine-grained, carbonaceous shaly sandstone.

6462 to 6780 feet: White, fine to very coarse-grained, in part conglomeratic, poorly sorted, angular to subrounded, carbonaceous quartz sandstone with kaolin cement and good porosity. A few pink garnets. Minor interbeds of dark grey, fissile, micaceous, carbonaceous shale.

Hutton Sandstone (Equivalent) (Middle to Lower Jurassic): 6780 to 7185 feet (405 feet)

White, light brown near base, fine to coarse-grained, in part conglomeratic, angular to subangular, poorly sorted, fairly porous quartz sandstone with kaolin and siliceous cement. Minor interbeds of dark grey, fissile, micaceous, carbonaceous shale. At base of unit trace of rounded granules of red-brown siltstone.

Unnamed unit (Lower Triassic): 7185 to 7690 feet (505 feet)

White, light grey to light brown, very fine-grained, rarely coarse-grained, angular to subrounded, poorly sorted, micaceous, slightly dolomitic, tight, quartz sandstone with argillaceous cement, trace of glauconite and tiny red-brown patches of ferruginous material throughout. Very minor thin beds and laminae of dark grey, fissile, micaceous, slightly carbonaceous shale.

Unnamed unit (Permian): 7690 to 8690 feet (1000 feet)

White, grey and light brown, fine to very coarse-grained, angular to subangular, poorly sorted, slightly carbonaceous, quartz sandstone, generally tight, but with several zones of low porosity. Common interbeds of dark grey to black, fissile, micaceous, very carbonaceous shale with abundant plant fossils. Coal seams numerous, up to 15 feet thick.

Unnamed sandstone unit (Palaeozoic undifferentiated): 8690 to 9110 feet (420 feet)

White, very fine to coarse-grained, subangular to rounded, fairly well sorted quartz sandstone with mainly calcareous but some kaolinitic and siliceous cement; grains of rose quartz and garnet common, pyrite and glauconite rare; a few white chert pebbles; tiny carbonaceous(?) specks throughout; tight except for poor porosity in top 50 feet. Very minor thin bands of mid-grey, silty, pyritic, micaceous, slightly (?) carbonaceous shale.

Unnamed unit (Middle Cambrian): 9110 to 10,000? feet (890 feet)

9110 to 9390 feet: Interbedded pale to mid-grey, microcrystalline to saccharoidal, pyritic, argillaceous to silty, laminated, hard, tight limestone and dark grey to black, fissile, laminated, pyritic, very calcareous shale. Trilobites and brachiopods common throughout.

9390 to 9535 feet: Intermixed grey-green, hard, calcareous, tuffaceous shale; conglomerate of volcanic rock fragments and tuffaceous sandstone, and irregular bands of grey, coarsely crystalline, tuffaceous, fossiliferous limestone.

9535 to 9780 feet: Interbedded limestone and shale as for 9110 to 9390 feet.

9780 to 9900 feet: Laminated dark grey to black, fissile, micaceous, slightly calcareous shale, and grey-green, hard, tuffaceous, slightly calcareous siltstone.

9900 to 10,000 feet: Grey-green, fine to coarse-grained, angular, tuffaceous, calcareous, tight sandstone with minor dark grey, fissile, slightly calcareous, pyritic shale.

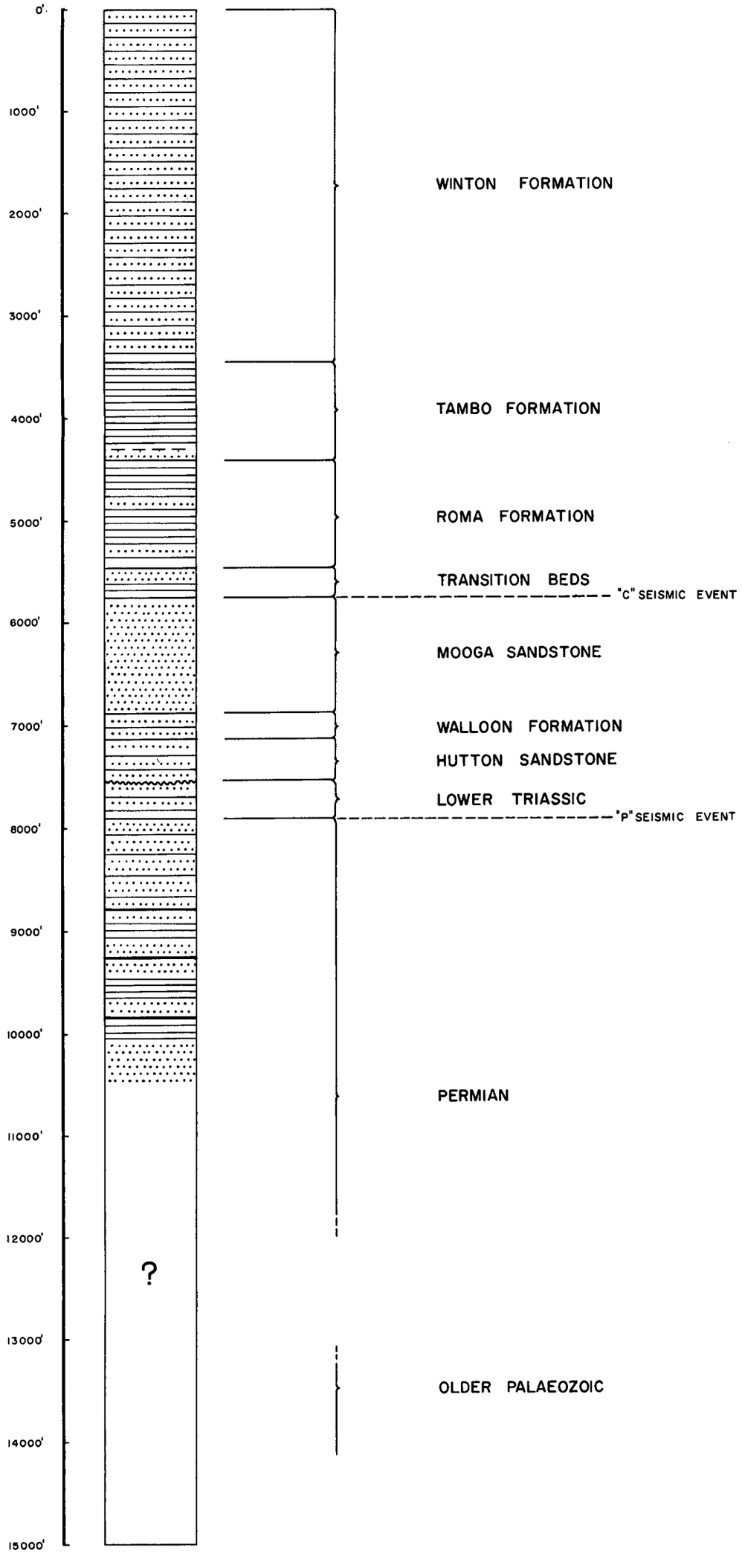
Unnamed unit (Upper to Middle Cambrian): 10,000? to 13,114 feet (3114 feet+)

10,000 to 10,435 feet: Dark grey, hard, fissile, brittle, finely laminated, micromicaceous, slightly calcareous, pyritic, slightly silty shale with very minor dark grey, shaly limestone.

DELHI AUSTRALIAN PETROLEUM LTD.

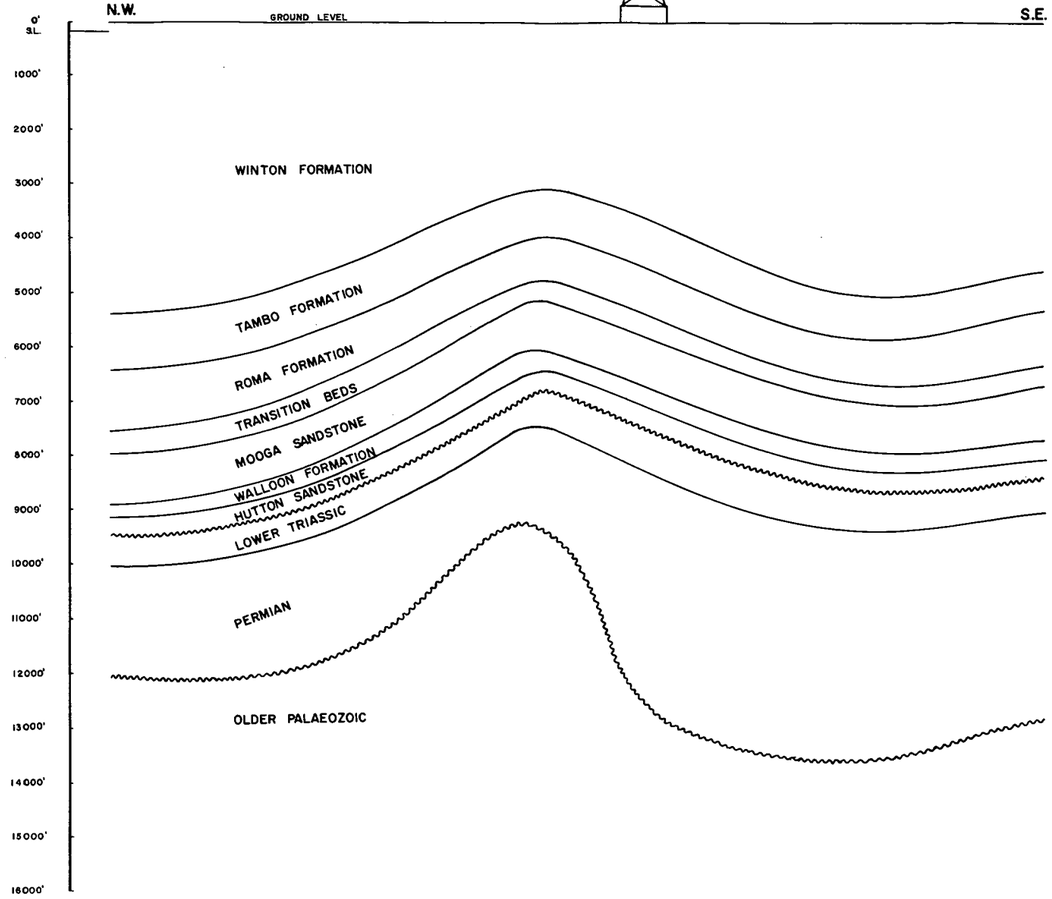
GIDGEALPA No. 1

STRATIGRAPHIC COLUMN AS INFERRED BEFORE DRILLING



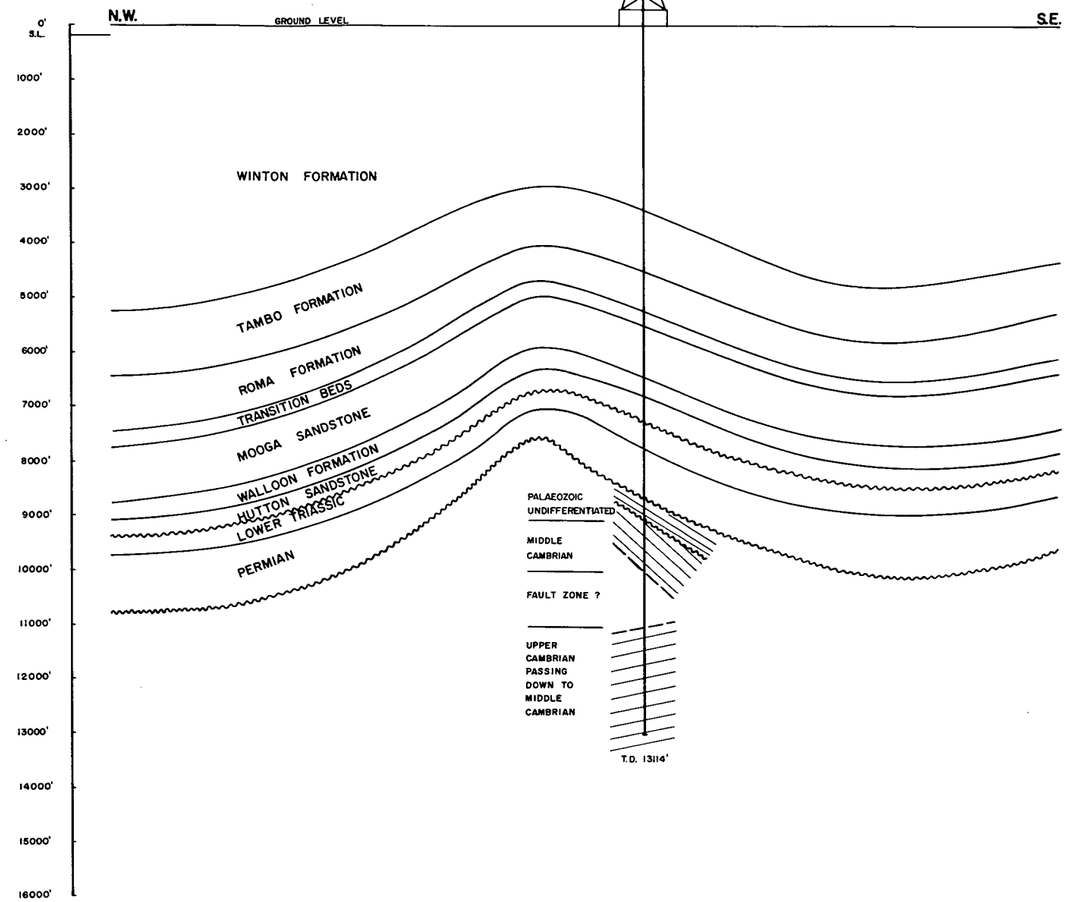
BEFORE DRILLING

GIDGEALPA No.1



AFTER DRILLING

GIDGEALPA No.1



DELHI AUSTRALIAN PETROLEUM LTD.

STRUCTURE AND STRATIGRAPHY

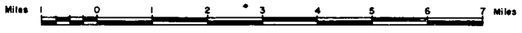
OF THE

GIDGEALPA ANTICLINE

AS INTERPRETED

BEFORE AND AFTER DRILLING

HORIZONTAL SCALE



10,435 to 11,040 feet: Grey-green, massive, tuffaceous limestone to calcareous agglomerate composed of subrounded blocks, up to 1/2" across, of partly kaolinized volcanic rock in calcareous to dolomitic, finely crystalline to microcrystalline matrix.

11,040 to 11,270 feet: Mottled grey-green and cream agglomerate of volcanic rock fragments embedded in a matrix of volcanic ash, fine sandstone, and finely crystalline calcite.

11,270 to 11,880 feet: Thickly interbedded, grey, microcrystalline, slightly dolomitic, pyritic, arenaceous and slightly tuffaceous limestone; dark grey, slightly calcareous, micromicaceous, pyritic, fissile, brittle shale; mottled grey-green and white agglomerate of volcanic rock fragments in matrix of calcareous volcanic ash.

11,880 to 12,200 feet: Grey to grey-green, hard, brittle, fissile, micromicaceous, slightly calcareous, pyritic shale and minor laminae of pale grey-green, microcrystalline to granular, hard, very shaly, slightly dolomitic, tight limestone.

12,200 to 12,575 feet: Dark grey, medium to coarsely crystalline, silty, fossiliferous, argillaceous, slightly dolomitic, tight limestone, and minor laminae of black, hard, fissile, silty, calcareous, bituminous(?) shale.

12,575 to 12,670 feet: Interbedded, pale grey, micromicaceous, fissile, calcareous shale; black, fissile, slightly calcareous, bituminous(?), fossiliferous shale; grey, coarsely crystalline, pyritic, very fossiliferous, tight limestone.

12,670 to 13,100 feet: Cream, grey, pink and red breccia of dolomite blocks up to 2" across cemented with fine to very coarsely crystalline dolomite; good vuggy, intercrystalline and fracture porosity; faint, dull gold fluorescence in vugs, faint, pale yellow cut, trace dead oil stain. Bottom 70 feet dark grey, fine to coarsely crystalline, argillaceous, pyritic, mainly tight, bedded dolomite.

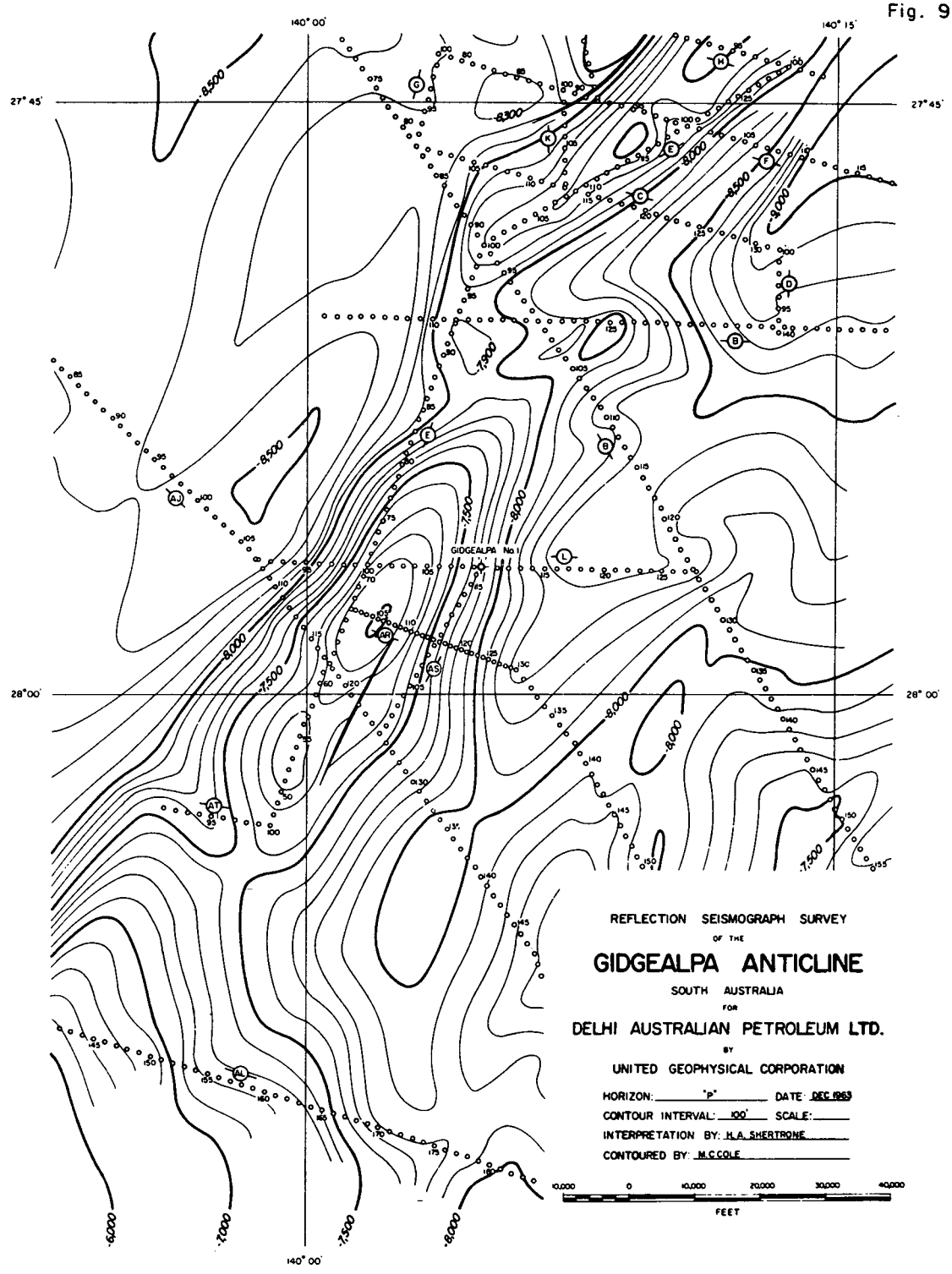
13,100 to 13,114 feet: Grey-green and brown agglomerate of angular to subrounded fragments of volcanic rock up to 3" across, and cherty, fossiliferous dolomite pebbles cemented by dolomite.

Structure

Delhi-Santos Gidgealpa No. 1 Well was drilled down the flank of a strongly developed northeast-southwest trending anticline, one of a group of similar structures occurring in the western Strzelecki Creek area outlined by seismic methods. The Gidgealpa structure is 12 miles long by 3 1/2 miles wide within the lowest closing contour on the 'P' seismic horizon and has a vertical closure of more than 700 feet on that horizon (see Figure 9). The well is located approximately 3 1/4 miles east-north-east of the highest point on the structure and 1340 feet structurally below the crest of the structure on the 'P' horizon contour map (approximate top of Permian). The anticline appears asymmetrical, the western limb being much steeper than the eastern one. Dips on the 'Pre-P' events, shown on the profile section along the line 'L' of the seismic survey, are approximately the same on either flank being of the order of 20^{o} to 25^{o}.

Dips from cores from the Mesozoic sequence are horizontal. Continuous dipmeter results over roughly the same interval show easterly dips of 5^{o} to 10^{o}, which is

Fig. 9


140° 00'
140° 15'
27° 45'
28° 00'
GIDGEALPA No.1
-8,500
-8,000
-7,500
-7,000
-6,000
REFLECTION SEISMOGRAPH SURVEY
OF THE
GIDGEALPA ANTICLINE
SOUTH AUSTRALIA
FOR
DELHI AUSTRALIAN PETROLEUM LTD.
BY
UNITED GEOPHYSICAL CORPORATION
HORIZON: "P" DATE: DEC 1963
CONTOUR INTERVAL: 100' SCALE:
INTERPRETATION BY: H.A. SHERTRONE
CONTOURED BY: M.C COLE
10,000 0 10,000 20,000 30,000 40,000
FEET

consistent with the seismic picture. Within the Permian no reliable dips were obtained from cores due to cross bedding, a condition also demonstrated by the abrupt changes in direction of the dipmeter values. Still it is fairly certain that the Permian strata have a similar attitude to the Mesozoic with probably a slightly higher angle of dip. The one core taken in the pre-Permian sandstone unit showed dips of 5^{o} to 10^{o} while the dipmeter shows roughly east dips of 20^{o} to 25^{o}. This evidence, together with the fact that the porosity at the top of this unit is attributed to erosion, indicates an angular unconformity between the older Palaeozoic rocks and the Permian, a condition which is known in other wells in this region. In the top of the proved Middle Cambrian, the cores had reliable dips of 30^{o} while the dipmeter gave general south dips of 30^{o} to 40^{o}.

These dipmeter results imply an angular unconformity between the sandstone unit and the Middle Cambrian limestone and shale, although not so strong as the one at the base of the Permian. In the interval 10,000 to 11,300 feet, core dips range from 40^{o} to 56^{o}. Dipmeter results are erratic, and, in fact, there is a gap from 10,000 to 10,500 feet where no dipmeter information was obtained. Below 11,300 feet to the bottom of the hole the dip is consistently east-north-east at an average of 50^{o}. Core dips vary from 30^{o} to 50^{o}. The true significance of these dips cannot be determined from only one hole.

However, palaeontological evidence which proved that Core No. 12 (9415 to 9425 feet) is late Middle Cambrian and Core No. 17 (10,828 to 10,838 feet) is early Upper Cambrian shows that Middle Cambrian rocks are thrust over Upper Cambrian. This would explain the erratic dipmeter readings from the interval 10,000 to 11,300 feet and also the swing from a south-east dip above to a north-east dip below this interval. It is not yet possible to determine the exact location of the fault in the well, nor its hade nor throw but since, in a downward direction, consistent dips stop at 10,000 feet and also about this depth there is an abrupt change in lithology, and characteristics of the logs, the well probably cut the plane of the fault at or just below 10,000 feet. Probably a fault zone several hundred feet thick extends downward from this depth. Below Core No. 17 palaeontology indicates a normal succession passing from early Upper to late Middle Cambrian. The faunal assemblage in Core No. 21 (11,675 to 11,719 feet) is similar to that in Core No. 12 which implies a repetition of some of the late Middle Cambrian section although no definite evidence of this can be detected on the logs.

Porosity and Permeability

The usual good porosity was encountered in the Mooga Sandstone (15% to 25%), Walloon Formation (20%), and Hutton Sandstone Equivalent (15%). All these were water bearing but minor amounts of hydrocarbons were noted in the Walloon Formation (see Relevance to Occurrence of Petroleum). Within the Lower Triassic several thin zones of poor porosity, less than 10%, and probably very low permeability occurred. Log analysis showed them to be water bearing. The Permian sequence in this well contained more porous sandstones than any of the previous wells drilled in this region. Frequent porous intervals occur in the top 250 feet and the bottom 300 feet, the middle section of the Permian consisting of shales and tight, fine-grained sandstones. Porosity determinations from sidewall samples vary from 22% to 36% (see Appendix 4), but these values are excessively high as the highest porosity from numerous log computations is 15% with the average about 10%. Unfortunately, the sidewall samples were too small for determinations of permeability but because of the kaolinitic and siliceous nature of the cement in these sandstones the permeability is probably low. The sandstone below the Permian has a 50-foot porous section at the top with porosities of 15% from log computation and 24% to 30% from sidewall samples. Again there is no direct information on the permeability but it is believed to be low.

The most interesting porosity found in this well occurred in a dolomite in the Middle Cambrian sequence. This brecciated dolomite showed good vuggy, intercrystalline and fracture porosity throughout. The figure for porosity from a core was 6.2% which is in agreement with Neutron Log computations which vary from 1% to 7.7%. Permeability was calculated as 2.6 millidarcys from the core. However, this figure is misleading as it does not take into account permeability due to fractures which must be very considerable judging by the water flow on DST No. 6.

Core analyses are tabulated in Appendix 4.

Relevance to Occurrence of Petroleum

The first hydrocarbon show encountered in the well was in the Walloon Formation sandstone between 6500 and 6520 feet. This was a light, patchy oil stain with bright yellow fluorescence and immediate good cut with carbon tetrachloride. This zone was evaluated through perforations in the 9 5/8" casing after drilling. The water recovered contained gas composed of up to 57% methane, 3.7% ethane, and several hundred parts per million of higher hydrocarbons up to iso-octane. This is conclusive proof that parts of the Mesozoic in this region contain fluid hydrocarbons and it is possible that, under more favourable conditions of entrapment, the Walloon Formation sandstones may hold commercial hydrocarbons.

No shows occurred in the Hutton Sandstone Equivalent or the Lower Triassic but the Permian sequence had scattered shows throughout as weak golden fluorescence and very weak to no cut with carbon tetrachloride. Drillstem tests proved the sandstones to have low porosity and permeability, giving up small quantities of water only. Analysis of the watery mud recovered on DST No. 5 (8570 to 8620 feet), showed 4.8% methane and very minor amounts of higher hydrocarbons up to N-butane. As shows have been recorded from the Permian in other wells, strata of this age are regarded as most prospective. Lack of good porosity and permeability has been the disadvantage of this unit. Very probably Permian sandstones will produce hydrocarbons in quantity where adequate porosity and permeability are developed in a suitable entrapment.

Although no shows occurred in the porous zone at the top of the sandstone unit below the Permian, the zone could be most promising as it apparently represents a weathered unconformable surface. Similar geological conditions are often abundantly productive.

The Middle Cambrian dolomite is the oldest, deepest and thickest porous zone encountered in any well drilled in the western part of the Great Artesian Basin. With good porosity and permeability, dull gold fluorescence and dead oil staining, and high flowing pressures on the drillstem test which produced very gassy salt water containing higher hydrocarbons, this discovery is most significant. Given a more favourable structure situation, this dolomite zone would most probably produce hydrocarbons in considerable volume.

Delhi-Santos Gidgealpa No. 1 is, by far, the most encouraging well in the western part of the Great Artesian Basin, because porosity occurred in rocks of widely different age, oil shows were found throughout the section, and the Walloon Formation, Permian, and Middle Cambrian contained possible source beds.

Contribution to Geological Concepts resulting from Drilling

The Delhi-Santos Gidgealpa No. 1 Well added very little to the knowledge of the stratigraphic sequence of the Mesozoic in the western part of the Great Artesian Basin. The

strata down to the Mooga Sandstone are well known from previous drilling, the one feature of note in Gidgealpa No.1 being the considerable increase in thickness of the Winton Formation, 2609 feet, as opposed to 2061 feet at Dullingari No. 1, the next thickest. The Walloon Formation and Hutton Sandstone Equivalent correlated very well with these units in the surrounding wells. Lower Triassic rocks were, in general, similar to those found in Orientos No. 1, Innamincka No. 1, and Dullingari No. 1, although not coloured red and green. The surface of the Lower Triassic was again noted to be eroded.

From seismic evidence the Permian was thought to be more than 4000 feet thick. However, drilling proved it to be 1000 feet thick. Generally the Permian lithology of Gidgealpa No. 1 was similar to that found in the Innamincka No. 1, Dullingari No. 1, and Orientos No. 1 wells, both in rock types present and in conditions of deposition, although individual rock units could not be precisely correlated.

Although expected for a long time, Cambrian rocks were discovered for the first time in Gidgealpa No. 1. They were a marine, fossiliferous, predominantly carbonate series with much volcanic detritus, and agglomerate. The drilled thickness of Upper and Middle Cambrian rocks was 4004 feet but the true thickness is probably considerably less due to the dip of the beds and the suspected repetition by faulting of some of the late Middle Cambrian. Curiously enough the faunal zones found in these rocks are much more closely related to the Cambrian in the Georgina Basin, 320 miles to the north, than to those in the Flinders Ranges only 210 miles to the south. In fact, the faunal zones in Gidgealpa No. 1 are younger, being in the upper part of the Middle Cambrian and lower part of the Upper Cambrian, than any yet found in the Flinders Ranges. As the well was still in Middle Cambrian at total depth, the total thickness of these rocks is not known, but could well be many more thousands of feet.

The discovery of this Cambrian sequence makes the Lower Palaeozoic geology of this region more difficult. The Pandieburra, Putamurdie, Naryilco, Orientos, and Dullingari wells bottomed in certain or presumed Ordovician shales or quartzites. The oldest rocks in Innamincka No. 1 are probably Devonian, and in Betoota No. 1 probably Proterozoic. All these wells form a ring round Gidgealpa No. 1 but were completed in rocks of different age, though possibly the 420-foot "Palaeozoic undifferentiated" sandstone in Gidgealpa No.1 may be of Ordovician to Devonian age.

Although the data are not adequate for a detailed assessment, it is possible that Cambrian seas extended down to the Gidgealpa area from the Georgina Basin with, perhaps, a shoreline with active volcanoes to the south or west of Gidgealpa. At the end of the Cambrian, tectonic movement thrust the Middle Cambrian over the Upper Cambrian in the immediate vicinity of Gidgealpa, and subsequent erosion removed the uppermost Cambrian. During the Ordovician marine quiet water deposition was widespread. A severe Devonian to Carboniferous orogeny with subsequent erosion affected the whole region and produced a complex pattern of older Palaeozoic outcrop. On this eroded surface Permian brackish or partly marine sediments were laid down. The Permian sedimentary basin evidently extended from east of Orientos No. 1 to west of Gidgealpa No. 1 but not as far as Pandieburra No. 1. Its north-south extent has not been defined. Sedimentation over most of the Permian basin continued into the Lower Triassic with no appreciable break. At the end of Lower Triassic sedimentation an epeirogenic movement took place and some Triassic strata were eroded. On this surface Hutton Sandstone Equivalents were laid, initiating a long period of sedimentation which only ended with the Winton Formation. Renewed movements in Tertiary times along the old Palaeozoic structural trends resulted in gentle folding of the late Palaeozoic and Mesozoic strata.

REFERENCES

DELHI AUSTRALIAN PETROLEUM LTD, 1961a: D.F.S. Innamincka No. 1 Well, South Australia. Bur. Min. Resour. Aust. Petrol. Search Subs. Acts Publ. 9.

DELHI AUSTRALIAN PETROLEUM LTD, 1961b: D.F.S. No. 1 Betoota, Queensland. Bur. Min. Resour. Aust. Petrol. Search Subs. Acts Publ. 10.

DELHI AUSTRALIAN PETROLEUM LTD, 1961c: Final report, Innamincka-Betoota aeromagnetic survey (Unpubl.).

DELHI AUSTRALIAN PETROLEUM LTD, 1962 : Well completion report, Delhi-Santos Dullingari No. 1, South Australia (Unpubl.).

DELHI AUSTRALIAN PETROLEUM LTD, 1963a: Final report, Diamantina - McGregor seismic survey (Unpubl.).

DELHI AUSTRALIAN PETROLEUM LTD, 1963b: Well completion report, Delhi-Santos Orientos No. 1, Queensland (Unpubl.).

DELHI AUSTRALIAN PETROLEUM LTD, 1963c: Well completion report, Delhi-Santos Pandieburra No. 1, South Australia (Unpubl.).

APPENDIX 1

DELHI-SANTOS GIDGEALPA NO. 1

CORE DESCRIPTIONS

Thirty cores were cut for stratigraphic information. A total of 371 feet of formation was cored, and 256 feet (69%) recovered.

In the following pages a graphic representation of each core is shown as well as a detailed lithological description.

Palaeontological and petrological studies and core analyses on these cores are recorded in Appendices 2, 3, and 4.

CORE DESCRIPTION

DATE September 7, 1963 CORE NO. 1

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 6500 - 6510

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 1 ft. or 10%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Walloon

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
6500			6500 - 6501 (1 ft.) Predominantly shale with minor thin irregular beds of fine and medium grained sandstone at the bottom. Shale, grey to dark grey and slightly brownish-grey, silty in part, micaceous, carbonaceous, fissile, hard. Sandstone, white to pale grey, fine and medium grained, quartzose, clayey, rare mica, carbonaceous flakes throughout, angular to sub-angular, poor porosity (visual estimate less than 10%). Ss:Sh = 5:95. Bedding angle - unreliable but possibly on the order of 10°. Shows: No odour. Very light, patchy stain irregularly through the sandstone. Good, bright yellow fluorescence wherever stain is present, and also patchy in some areas of sandstone with no stain. Immediate cut in CCl_4 from rock carrying fluorescence. Percentage of sandstone showing fluorescence = 30%.
6501		30	
6502		27	
6503		17	
6504		18	
6505		26	6501 - 6510 (9 ft.) No recovery.
6506		20	
6507		18	
6508		15	
6509		11	
6510		10	

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

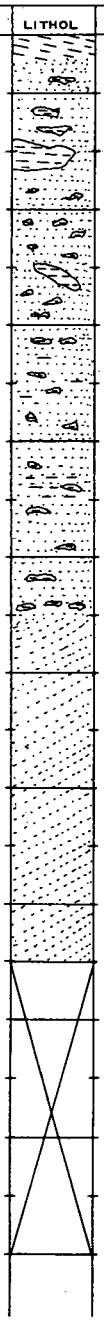
DATE September 7, 1963 — CORE NO. 2

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 6515 - 6525

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 7½ ft. or 75%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Walloon

ELEVATION G.L. 165ft.; K.B. = 181ft. — GEOLOGIST I.R. Campbell



DEPTH	Coring Rate Min./Ft.	DESCRIPTION
6515		6515 - 6515¼ (¼ ft.) Thinly interbedded shale and sandstone. Shale, dark grey, silty, slightly micaceous,
	31	carbonaceous, fissile. Sandstone, white, fine and occasionally medium grained, quartzose, sub-angular, clay cement,
6516		poor porosity, carrying flecks of carbon. Bedding angle 25°, very questionable.
	25	6515¼ - 6519½ (4¼ ft.) Intraformational conglomerate consisting of shale pellets and fragments embedded in sandstone.
6517		Ss:Sh = 60:40. Sandstone, white to pale grey, medium grained and occasionally conglomeratic, quartzose, flecks of
	25	carbon, good clay cement, angular to sub-angular, porosity less than 15%. Shale pellets and fragments ranging up to 6" in
6518		largest dimension (generally tabular), dark grey and brown-grey, carbonaceous. Occasionally showing thin bedding.
	20	Shows: In sandstone 1/32" thick fluorescence along contact with some, but not all, shale
6519		fragments. Fluorescence bright yellow, good cut with CCl_4. No discernible stain or odour. Only 2% of sandstone exhibits fluorescence.
	20	6519½ - 6522½ (3 ft.) Sandstone, stained pale brown with mud filtrate,
6520		coarse grained, quartzose, very poor clay cement, rounded to sub-rounded, well sorted, excellent
	18	visual porosity (20% - 25%) and good permeability. Faint bedding angle 25°, very questionable.
6521		
	32	
6522		6522½ - 6525 (2½ ft.) No recovery.
	22	
6523		
	23	
6524		
	16	
6525		

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

DELHI AUSTRALIAN PETROLEUM LTD. PAGE 1 OF 1

CORE DESCRIPTION

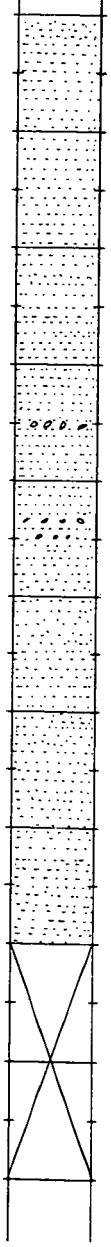
DATE September 9, 1963 CORE NO. 3

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 6657 - 6667

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 8 ft. or 80%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Walloon

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
6657			6657 - 6665 (8 ft.)
		77	Sandstone, pale brown, (filtrate stain) quartzose, medium grained, occasional thin lenses grade to very coarse and conglomeratic, trace mica, minor clay filling interstices, generally cemented with silica, but in part friable with only minor weak silica cement. Porosity generally low, but in coarser streaks and where silica cement is light porosity ranges up to 15%.
6658		44	Very rare thin shaly and carbonaceous partings. Bedding angles not reliable - possibly gently current bedded.
6659		21	No stain, odour or fluorescence.
6660		17	
6661		22	
6662		45	
6663		28	
6664		29	
6665			6665 - 6667 (2 ft.)
		35	No recovery.
6666			
		39	
6667			

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

DATE September 11, 1963 — CORE NO. 4

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 7078 - 7086

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 5 ft. or 62.5%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Hutton Sandstone

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
7078			7078 - 7082'9" (4¾ ft.) Sandstone with rare thin partings of black, carbonaceous, shaly and micaceous material.
		29	Sandstone, white (stained brown with mud filtrate), quartzose, medium grained, occasionally coarse grained, rare mica, trace flecks of carbon, cement is silica and clay and rare (?) chlorite (soft pale green cement seen in small patches throughout core) poor porosity (visual estimate less than 10%), very hard. Cross bedding evident in sandstone. Shaly partings, however, are flat.
7079			
		13	
7080			
		18	
7081			
		30	
7082			7082'9" - 7083 (¼ ft.) Conglomeratic sandstone, white, quartzose, grainsize ranges from coarse sand to pebbles up to 1 cm, cemented with silica, fair to good porosity (15% - 20%), very hard.
		32	
7083			7083 - 7086 (3 ft.) No recovery.
		39	
7084			No stain, odour or fluorescence.
		47	
7085			
		65	
7086			

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

DATE September 18, 1963 | CORE NO. 5

WELL Delhi-Santos Gidgealpa No. 1 | INTERVAL 7462 - 7472

COMPANY Delhi Australian Petroleum Ltd. | RECOVERY 4½ ft. or 45%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. | FORMATION Lower Triassic

ELEVATION G.L. = 165ft.; K.B. 181 ft. | GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
7462			7462 - 7466½ (4½ ft.)
		17	Siltstone to very fine grained sandstone, mid-grey, mottled orange to red-brown, occasional grains of fine grainsize, sub-angular to subrounded, massive, brittle, quartz with argillaceous cement, micaceous, trace glauconite, small red-brown patches distributed throughout occasionally forming fine laminae, slightly dolomitic: very minor, fine lenses and laminae of shale, dark grey, platy, soapy lustre, showing evidence of very gentle cross-bedding. No fossils apparent.
7463		10	
7464		18	No stain, odour, fluorescence or porosity.
7465		13	Dip: Indeterminate.
7466		15	7466½ - 7472 (5½ ft.) No recovery.
7467		13	
7468		16	Barrel: Hycalog Bit: 8⅜" Diamond Hycalog Core Dia: 4⅜"
7469		15	
7470		14	
7471		17	
7472			

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

DATE September 21, 1963 — CORE NO. 6

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 7772 - 7782

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 9 ft. or 90%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Permian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
7772			7772 - 7772'9" (¾ ft.) Predominantly dark grey to black, very carbonaceous shale, micaceous, fossiliferous, fissile, with thin beds of fine grain pale grey sandstone with weak gold fluorescence. No cut. Bedding angle unreliable.
		13	
7773			7772'9" - 7774 (1¼ ft.) Sandstone with minor shale, dark grey. Ss, pale grey to buff, fine grained quartz, micaceous, good clay cement, fairly well sorted, very low porosity (less than 10%), very slight trace weak golden fluorescence throughout. No stain, no cut. No reliable bedding.
		20	
7774			7774 - 7775 (1 ft.) Shale, dark grey to black, very carbonaceous, (grading to coal), slightly micaceous, silty. No reliable bedding.
		24	
7775			7775 - 7776'10" (1' 10") Shale, with very thin laminae of sandstone. Sh:Ss ≈ 90 : 10. Shale: dark grey to black, very carbonaceous, silty, slightly micaceous, fissile. Sandstone, white-pale grey, very fine to fine grain, quartz, clay cement, very low porosity (less than 10%). No visible stain, weak gold fluorescence throughout, no cut. Bedding angle approximately 5° - 10°.
		20	
7776			
		21	
7777			7776'10" - 7777'2" (4") Shale, dark grey to black.
			7777'2" - 7777'10" (8") Irregularly intermingled Ss and Sh. Sh as above and Ss, white-pale grey, fine grained, quartz, clay cement, very low porosity (less than 10%), no stain, weak fluorescence, no cut, no reliable bedding.
		24	
7778			
		19	7777'10" - 7778'5" (7") Thinly interbedded (1/16") dark grey, carbonaceous shale, and sandstone, white-pale grey, fine grained, quartz, clay cement, no stain, weak fluorescence, no cut. Bedding angle - flat.
7779			
		12	7778'5" - 7779'4" (11") Sandstone, with minor pellets of dark grey shale. Ss as above with fluorescence as above.
7780			
			7779'4" - 7779'11" (7") Thinly interbedded Ss and Sh as in 7777'10" - 7778'5". Bedding angle - approximately 5°.
		14	7779'11" - 7781 (1' 1") Irregularly intermingled Ss and Sh and some shale pellets embedded in sandstone. Fluorescence as above, no stain, no cut, no reliable bedding.
7781			
		15	7781 - 7782 (1 ft.) No recovery.
7782			

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

DELHI AUSTRALIAN PETROLEUM LTD. PAGE 1 OF 1

CORE DESCRIPTION

DATE September 26, 1963 CORE NO. 7

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 8208 - 8218

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 1 ft. or 10%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Permian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
8208			8208 - 8209 (1 ft.)
		35	Shale, dark grey to black, very carbonaceous, leaf and other plant fossils, slightly micaceous, massive, fissile, grades to coal in bottom 1".
8209			No stain, odour or fluorescence.
		13	8209 - 8218 (9 ft.)
8210			No recovery.
		15	
8211			
		11	
8212			
		13	
8213			
		14	
8214			
		15	
8215			
		14	
8216			
		11	
8217			
		10	
8218			

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

DATE September 27, 1963 — CORE NO. 8

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 8297 - 8307

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 10 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Permian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
8297			8297 - 8303 (6 ft.) Predominantly shale with thin irregular interbeds of sandstone.
		33	Shale, dark grey to black, very carbonaceous and carrying plant fossils, slightly micaceous, fissile.
8298			Sandstone, white to pale grey and pale brownish-grey, fine to very fine grained, sub-angular quartz, strong silica and clay cement, porosity very low (nil to less than 10%). Bedding angle - sub-horizontal.
		35	
8299			
		29	
8300			
		34	
8301			
		32	
8302			
		26	
8303			8303 - 8307 (4 ft.) Sandstone, with irregular interbeds, lenses and laminae of shale.
		28	Sandstone, pale grey to pale brownish-grey, fine grained, sub-rounded quartz, cement is clay and silica with a trace of a carbonate, occasionally slightly carbonaceous, very low porosity (nil to less than 10%).
8304			Shale, dark grey to black, very carbonaceous, slightly micaceous, fissile. Bedding angle - unreliable.
		31	
8305			No stain, odour or fluorescence.
		33	
8306			
		30	
8307			

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

DATE September 30, 1963 — CORE NO. 9

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 8610 - 8620

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 7 ft. or 70%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Permian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
8610			8610 - 8610½ (½ ft.) Predominantly shale with minor interbeds of coal near the top. Shale, dark grey-black, very
		20	carbonaceous, with plant fossils, silty, micaceous, fissile; flat bedded; core bled gas from coal-shale interfaces.
8611			8610½ - 8614½ (4 ft.) Predominantly sandstone with irregular thin wavy
		39	beds of shale. Sandstone, pale grey to pale brownish-grey, fine and medium grained quartz, strongly cemented with
8612			silica, micaceous, and porosity poor; visual estimate nil to less than 10%. In parts stained with (?) hydrocarbons. Varying strength of golden
		40	fluorescence throughout sandstone, no discernible cut in CCl_4, which, on drying, leaves very faint pale brown ring. Fluorescence strength generally
8613			better near Sh-Ss interfaces. Rare bleeding gas from some of these interfaces. No odour. Shale, dark grey to brownish-grey, very carbonaceous,
		34	micaceous, fissile. Bedding angle wavy but near flat.
8614			
		34	8614½ - 8616 (1½ ft.) Predominantly shale with minor very thin beds of sandstone.
8615			Shale, dark grey to black and brownish-grey, silty, occasionally sandy (medium - coarse), very carbona-
		25	ceous, abundant plant impressions. Sandstone, pale grey to brownish-grey, fine grain quartz, silica cement, shows as above.
8616			8616 - 8617 (1 ft.) Thinly and irregularly interbedded sandstone and shale.
		29	Sandstone, as above; shale, as above: shows as above. Bedding angle essentially flat.
8617			
		28	1 to 2 units of gas (total) on high scale throughout coring.
8618			8617 - 8620 (3 ft.) No recovery.
		32	
8619			
		27	
8620			

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

DATE October 5, 1963 — CORE NO. 10

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 9052 - 9062

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 10 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Lower Ordovician (?)

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
9052			9052 - 9062 (10 ft.)
		50	Sandstone, white, very fine to fine to medium grained, subangular to rounded, fair sorting, clear quartz, some rose quartz and garnet (?), trace of glauconite, trace pyrite, tiny carbonaceous specks common, mainly calcareous cement with minor kaolin and siliceous cement. Occasional circular patches of pyrites (fossil replacement ?). Fine bands, laminae and
9053		30	lenses of shale, mid-grey silty, pyritic, micaceous, slightly carbonaceous showing very gentle cross-bedding. Tight. No definite fossils.
9054		42	No stain, odour or fluorescence.
9055		41	Dip: Uncertain but possibly 5° to 10°.
9056		49	
9057		55	
9058		52	Barrel: Hycalog Bit: 8⅜" Hycalog Diamond
9059		40	Core Dia: 4⅜"
9060		41	
9061		47	
9062			

CORE DESCRIPTION

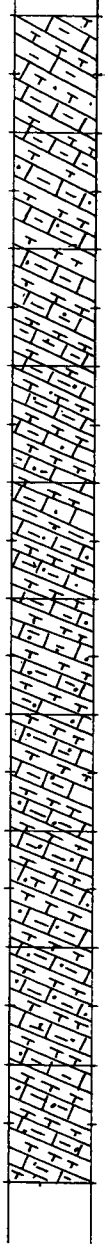
DATE October 7, 1963 CORE NO. 11

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 9140 - 9151

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 11 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
9140		40	9140 - 9151 (11 ft.) Intimate intercalcations of limestone, pale to mid-grey (mottled cream to dark grey on surface), microcrystalline to saccharoidal, pyritic, argillaceous to silty, laminated, hard, tight, and shale, dark grey to black, fissile, finely laminated, pyritic, very calcareous, fine calcite veins common throughout core. Very gentle current bedding. Very fossiliferous - fragments of small brachiopods, trilobite fragments and hyolithes (?).
9141		48	
9142		39	No stain, odour or fluorescence.
9143		45	Dip: 27° to 30° reliable.
9144		42	
9145		48	Barrel: Hycalog Bit: 8⅜" Diamond Hycalog Core Dia: 4⅜"
9146		48	
9147		42	
9148		42	
9149		44	
9150			

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

DATE October 7, 1963

WELL Delhi-Santos Gidgealpa No. 1

COMPANY Delhi Australian Petroleum Ltd.

LOCATION 27° 56' 46" S; 140° 04' 55.9" E.

ELEVATION G.L. = 165 ft.; K.B. = 181 ft.

CORE NO. 11 (Continued)

INTERVAL 9140 - 9151

RECOVERY 11 ft. or 100%

FORMATION Middle Cambrian

GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
9150			
		60	As above.
9151			

DELHI AUSTRALIAN PETROLEUM LTD. PAGE 1 OF 1

CORE DESCRIPTION

DATE October 10, 1963 CORE NO. 12

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 9415 - 9425

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 10 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
9415			9415 - 9419 (4 ft.)
		75	Shale, dark, mid and pale grey-green and cream, finely laminated, very calcareous - some bands more calcareous than others, pyritic, hard, thin unoriented calcite veins numerous, few thin re-cemented fracture breccia zones, lenses and pinching out common, some "cut and fill" structures. Small irregular fractures with ¼" - ½" displacement. Fossil fragments.
9416		60	
9417		58	
9418			9419 - 9424 (5 ft.)
		52	Conglomerate, mid grey-green with orange tinge, angular to subangular fragments of quartz and deep green ferromagnesian mineral in very calcareous cement, perfect very coarsely crystalline calcite in cement, massive, fossiliferous. Irregular, lenses of limestone, grey to orange, coarsely crystalline, very fossiliferous, pyritic. Few thin bands of shale, green-grey, very calcareous, fossiliferous. "Cut and fill" structures, evidence of turbidity currents.
9419		53	
9420		54	
9421			9424 - 9425 (1 ft.)
		52	Sandstone, mid grey-green, fine to coarse grained, angular to subangular, quartz and green ferromagnesian mineral with fine to coarsely crystalline calcite cement, massive, some thin calcite veins. Fossiliferous.
9422		48	No porosity, stain, odour or fluorescence.
9423			Dip: 30° reliable.
		43	Barrel: Hycalog
9424			Bit: 8⅜" Diamond Hycalog
		47	Core Dia: 4⅛"
9425			

DELHI AUSTRALIAN PETROLEUM LTD. PAGE 1 OF 1

CORE DESCRIPTION

DATE October 14, 1963 CORE NO. 13

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 9798 - 9808

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 10 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
9798			9798 - 9808 (10 ft.)
		38	Intimately interlaminated shale and siltstone. Shale, dark grey to black, fissile, brittle, micromicaceous, slightly calcareous, finely laminated, waxy lustre, pyritic.
9799			Siltstone, mid-grey-green (tan to orange on surface of core), hard, slightly calcareous, grading in part to very fine sandstone, thinly bedded to laminated, also has lenses and irregular
		32	patches, fine, gentle cross-bedding, fine ripple marks on bedding planes, some "cut and fill" structures. Thin irregular veins and disconnected
9800			patches of calcite with greenish caste common throughout. Few irregular fractures with displace-
		34	ment of up to 1". Fractures calcite filled. Doubtful fossil fragments.
9801			No porosity, stain, odour or fluorescence.
		30	
9802			Dip: 30° reliable.
		32	
9803			
		34	
9804			Barrel: Hycalog
		24	Bit: 8⅜" Diamond Hycalog
9805			Core Dia: 4⅜"
		30	
9806			
		27	
9807			
		28	
9808			

CORE DESCRIPTION

DATE October 17, 1963 CORE NO. 14

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 9989 - 9999

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 10 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Middle Cambrian

ELEVATION G.L. 165 ft.; K.B. = 181 ft. GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
9989			9989 - 9999 (10 ft.)
		42	Shale, dark grey to black with slight greenish caste, fissile, micromicaceous, finely laminated, pyritic, in part slightly calcareous, brittle, small irregular patches and streaks of shiny black material on bedding planes (fossil impressions?). Minor
9990			siltstone, mid-grey to dark grey with greenish caste, micaceous, slightly calcareous, occurring as thin
		38	laminae and lenses, very gently current bedded. Numerous fine veins, lenses and patches of calcite, some containing chlorite - no preferred orientation.
9991			Irregular fractures with displacements of up to ½".
		38	No porosity, stain, odour or fluorescence.
9992			
			Dip: 30° reliable.
		36	
9993			
		32	
9994			
		31	
9995			
		32	
9996			
		34	
9997			
		35	
9998			
		31	
9999			

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

DATE October 19, 1963 — CORE NO. 15

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 10,280 - 10,290

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 10 ft. (100%)

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST R.N. Freeman

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
10,280			10,280 - 10,290 (10 ft.)
		42	Shale, dark grey, hard, platy-chunky, brittle, slightly fissile, pyritic, micromicaceous, occasionally slightly calcareous, finely laminated. Abundant laminae shale, light grey,
10,281			silty, rarely contain grains very fine grained quartz, very calcareous grading to calcite and shaly limestone, firm to hard, disseminated crystals of pyrite, laminae commonly. 5 mm but
		47	grade up to 6 mm thick.
10,282			Bottom 5 feet of core fractured and shattered, top 5 feet contains many incipient fractures. Two systems prominent, one parallel to bedding and other approximately normal to bedding.
		40	Other abundant fractures with no preferred orientation. Displacements up to 1 cm on fractured laminae. Distorted laminae common.
10,283			No readily apparent fossils.
		35	No porosity, stain, odour or fluorescence.
10,284			
		33	Dip: 45° to 65° averaging 55°.
10,285			
		31	
10,286			Barrel: Hycalog
		33	Bit: 8⅜" Diamond Hycalog
10,287			Core Dia: 4⅜"
		27	
10,288			
		29	
10,289			
		28	
10,290			

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

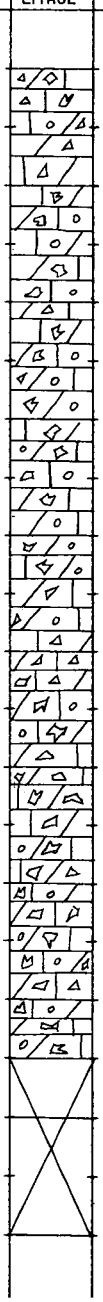
DATE October 22, 1963 — CORE NO. 16

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 10,488 - 10,498

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 8½ ft. or 85%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST R.N. Freeman



DEPTH	Coring Rate Min./Ft.	DESCRIPTION
10,488		10,488 - 10,496½ (8½ ft.)
	41	Limestone, grey-green, tuffaceous, conglomeratic, matrix limestone, very dolomitic, milky white, transluscent, finely crystalline to micro-crystalline, hard, abundant, pyrite.
10,489		Contains fragments tuff, dark grey-green, firm to hard, very calcareous, grading to tuffaceous, dark grey-green limestone. Commonly angular, occasionally sub-rounded, grade in size from
	29	microscopic to 1 cm.
		Also fragments limestone, same lithology as matrix, angular, grade in size up to 2 cm.
10,490		60% matrix - 40% fragments.
	34	Lacks sorting in gross aspect although locally displays poor sorting.
10,491		
		No porosity, odour, stain or fluorescence.
	29	
10,492		Dip: Indeterminate due to lack of bedding.
	30	
10,493		10,496½ - 10,498 (1½ ft.)
		No recovery.
	31	
10,494		
		Barrel: Hycalog
	29	Bit: 8⅜" Diamond Hycalog
10,495		Core Dia: 4⅜"
	31	
10,496		
	30	
10,497		
	35	
10,498		

CORE DESCRIPTION

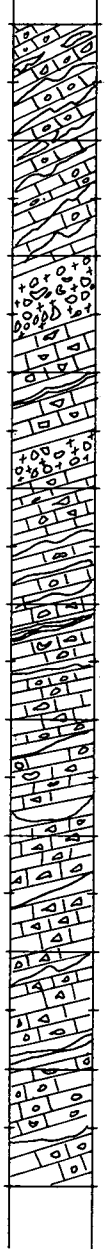
DATE October 26, 1963 CORE NO. 17

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 10,828 - 10,838

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 10 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./ft.	DESCRIPTION
10,828			10,828 - 10,830 (2 ft.) Predominantly tuffaceous limestone with irregular wavy interbedded slightly tuffaceous shale.
		42	Limestone, grey to grey-brown, fragments of volcanic ejecta embedded in microcrystalline calcite framework. No porosity.
10,829			Shale, dark grey, streaked with white and greenish concentrations of tuffaceous material, slightly calcareous, fissile.
		41	
10,830			10,830 - 10,838 (8 ft.) Predominantly tuffaceous limestone (varying to limy agglomerate) fawn, to light brownish-grey,
		31	with abundant fragments of volcanic rock and ash embedded in limy matrix. No porosity. No definite fossils except at 10,831½ feet - embedded
10,831			in limestone are clear fragments that may be feldspar laths or fossils.
		34	With minor interbeds of shale, (up to ½" thick) dark grey to grey, slightly calcareous, with varying tuffaceous content.
10,832			Reliable bedding angle = 45°.
		36	Fractures throughout. Some displacing shale beds up to ½". Some infilled with calcite (⅛" wide). Two major sets: one parallel to core axis, one normal to bedding.
10,833			Other fractures with no preferred orientation.
		37	
10,834			No stain or odour and only faint mineral fluorescence.
		41	
10,835			
		32	Barrel: Hycalog Bit: 8⅜" Diamond Hycalog Core Dia: 4⅜"
10,836			
		32	
10,837			
		35	
10,838			

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

DATE October 29, 1963 — CORE NO. 18

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 11,068 - 11,078

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 10 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
11,068			Interbedded calcareous, tuffaceous quartzitic sandstone (or quartzite) and volcanic agglomerate.
		44	Quartzitic sandstone, grey to grey-green, pale grey and dark grey-green, fine to medium and occasionally coarse grained, angular quartz grains, poorly sorted, occasional fragments of volcanic ejecta and ash (green and white), varying degrees of calcareous cement. Very hard, no porosity, fairly well bedded, grading into beds of volcanic agglomerate, mottled grey-greens and cream, varying sized volcanic (?) rock fragments (.5 mm - 15 mm) embedded in grey-green and cream matrix of volcanic ash, minor sand grains and very fine grained calcite.
11,069			
		50	
11,070			
		49	No fossils observed in the field.
11,071			Calcite veins common. Some up to 1" wide and parallel to bedding (?similar to lit-par-lit injection) majority infilling systems of fractures (non-preferred orientation).
		41	
11,072			Bedding angle reliable: 50° to 55°.
		39	No stain or odour and only faint mineral fluorescence.
11,073			
		40	
11,074			Barrel: Hycalog
		43	Bit: 8⅜" Diamond Hycalog
11,075			Core Dia: 4⅜"
		34	
11,076			
		37	
11,077			
		40	
11,078			

Legend: Volcanic fragments; Volcanic ash

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

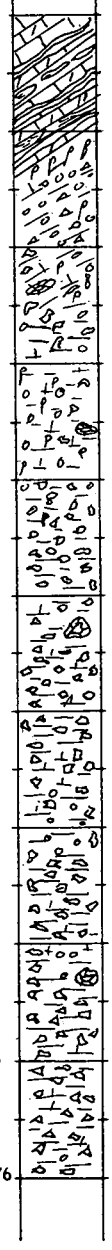
DATE November 3, 1963 — CORE NO. 19

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 11,366 - 11,391

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 13½ ft. or 54%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
11,366			Predominantly volcanic tuff or agglomerate with minor interbedded limestone and shale.
		44	11,366 - 11,367¼ Interbedded dark grey shale and grey limestone.
11,367			Shale, dark grey pyritic, slightly calcareous (? dolomitic) brittle, hard.
		48	Limestone, grey, micro-crystalline, pyritic, (?) dolomitic, (?) siliceous, very hard, no porosity.
11,368			Bedding angle - 30° to 35°. No fossils recognised in the field.
		29	11,367¼ - 11,377½ Volcanic tuff or agglomerate. Speckled greens and white and occasionally pinks. Fragments (up to 5 mm) and very small particles of volcanic rock embedded in volcanic ash with slightly calcareous cement. Occasional fragments of dark
11,369			
		22	green mineral or rock "floating" in tuff with reaction halo of white carbonate completely surrounding the phenoclast (?Xenoclast) pink tinges due to areas of a crystalline carbonate (? calcite). No porosity. Massive.
11,370			Strong fracture pattern transverse to core axis in top 3 ft.
		32	Faint, irregular and indistinct veinlets of calcite.
11,371			
		31	No stain or odour and only mineral fluorescence from the calcite.
11,372			
		51	
11,373			
		67	
11,374			
		15	
11,375			
		17	
11,376			

CORE DESCRIPTION

DATE November 3, 1963 CORE NO. 19 (Continued)

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 11,366 - 11,391

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 13½ ft. or 54%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
11,376			
		27	11,377¼ - 11,379½ Interbedded dark grey shale and limestone as in 11,366 - 11,367¼ ft. No fossils. Reliable bedding angle 35°. No porosity.
11,377			
		21	11,379½ - 11,379½ Volcanic tuff or agglomerate as in 11,367¼ - 11,377¼ ft.
11,378			
		31	No stain, odour. Only faint mineral fluorescence from the calcite.
11,379			11,379½ - 11,391 No recovery.
		18	
11,380			
		17	
11,381			
		27	
11,382			
		12	
11,383			
		19	
11,384			
		19	
11,385			
		16	
11,386			

CORE DESCRIPTION

DATE November 3, 1963 — CORE NO. 19 (Continued)

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 11,366 - 11,391

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 13½ ft. or 54%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
11,386			11,379½ - 11,391
		21	No recovery.
11,387			
		19	
11,388			
		19	
11,389			Barrel: Hycalog
		18	Bit: 8⅝" Diamond Hycalog
11,390			Core Dia: 4⅜"
		20	
11,391			

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

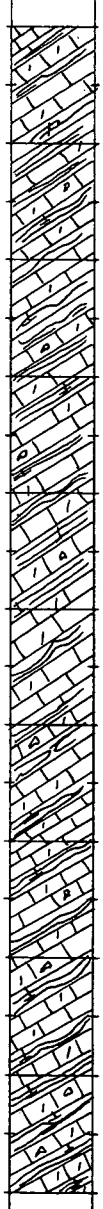
DATE November 4, 1963 — CORE NO. 20

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 11,391 - 11,407

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 16 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Upper to Middle Cambrian

ELEVATION G.L.=165 ft.; K.B. = 181 ft. — GEOLOGIST I.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
11,391			11,391 - 11,407 Interbedded dark grey shale and grey limestone,
		34	fairly evenly interbedded, with some evidence of "plastic flow" in both shale, and limestone, occasional very thin beds of tuffaceous sandstone.
11,392			Shale, dark grey, slightly calcareous, finely micaceous, slightly pyritic, (?) siliceous,
		24	occasionally slickensided, hard, brittle, fissile.
11,393			Limestone, grey (on outside of core, where abraded by corehead, colour is cream to pale grey). Slightly dolomitic, (?) slightly siliceous,
		22	occasionally pyritic, very hard, no porosity, occasionally tuffaceous particles.
11,394			Thin (½") beds of Sandstone, grey to pale grey, rounded medium grains of quartz, set in pale grey volcanic ash and calcareous matrix. No porosity.
		33	Dip: 11,392 ft. = 25°; 11,398 ft. = 30°.
11,395			No stain or odour, only faint mineral fluorescence.
		18	
11,396			
		22	
11,397			
		27	
11,398			
		18	
11,399			
		19	
11,400			
		19	
11,401			

CORE DESCRIPTION

DATE November 4, 1963 CORE NO. 20 (Continued)

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 11,391 - 11,407

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 16 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Upper to Middle Cambrian

ELEVATION G.L.=165 ft.; K.B. = 181 ft. GEOLOGIST L.R. Campbell

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
11,401			
		19	
11,402			
		27	
11,403			
		27	
11,404			
		32	
11,405			
		22	
11,406			
		55	
11,407			

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

CORE DESCRIPTION

DATE November 7, 1963 | CORE NO. 21

WELL Delhi-Santos Gidgealpa No. 1 | INTERVAL 11,675 - 11,719

COMPANY Delhi Australian Petroleum Ltd. | RECOVERY 40½ ft. or 92%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. | FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. | GEOLOGIST R.N. Freeman

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
11,675			11,675 - 11,685½ Interbedded shale and limestone, (60% shale, 40% limestone).
		32	Shale intervals up to 6" thick, limestone intervals up to 4" thick.
11,676			
		18	Shale, dark grey, micro-micaceous, hard, brittle, slightly fissile, calcareous, siliceous, pyritic, rarely tuffaceous, fine to coarsely laminated.
11,677			
		22	Limestone, grey to dark grey, abraded to light grey on core exterior by corehead, hard, micro-crystalline, occasionally dolomitic, siliceous, pyritic, rarely tuffaceous, rarely silty. No porosity.
11,678			
		18	Few thin beds (up to 1" thick) limestone, light green-grey, micro-crystalline to granular, hard, dense, very tuffaceous, very finely laminated.
11,679			Slump structure common, with distortion in limestone beds.
		20	
11,680			
		20	
11,681			
		22	
11,682			
		16	
11,683			
		20	
11,684			
		16	
11,685			

CORE DESCRIPTION

DATE November 7, 1963 CORE NO. 21 (Continued)

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 11,675 - 11,719

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 40½ ft. or 92%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST R.N. Freeman

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
11,685			
		18	11,685½ - 11,688 Subaqueous limestone agglomerate resulting from slump structure. Extremely distorted and attenuated pods and biscuits of limestone as in 11,675-11,685½ feet; and limestone, light green-grey, hard, dense, microcrystalline to granular, very tuffaceous, very finely laminated.
11,686		23	
11,687			Matrix limestone, dark grey, finely crystalline to granular, shaly, sandy, with subangular grains of very fine grained quartz, hard, pyritic, rarely tuffaceous. No porosity. 30% matrix, 70% unsorted pods and biscuits up to 3".
		20	
11,688			11,688 - 11,689 Limestone, light green-grey, tuffaceous, very finely laminated, otherwise similar to limestone in 11,685½-11,688 feet. No porosity.
		20	
11,689			11,689 - 11,690 Interbedded shale and limestone as in 11,675 - 11,685½ feet.
		20	
11,690			
		23	
11,691			
		22	11,691½ - 11,700 Subaqueous limestone agglomerate as in 11,685½ - 11,688 feet. In addition to matrix and pods and biscuits of same lithologies, contains pods of limestone, dark grey; round particles (probably recrystallised oolites) of limestone, dark grey, rough surfaces; cemented by limestone, dark grey abrading to brown-grey on core surface, hard, no porosity.
11,692		23	
11,693			
		26	
11,694			
		24	
11,695			

CORE DESCRIPTION

DATE November 7, 1963 CORE NO. 21 (Continued)

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 11,675 - 11,719

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 40½ ft. or 92%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST R.N. Freeman

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
11,695			
		18	
11,696			
		23	
11,697			
		25	
11,698			
		25	
11,699			
		22	
11,700			11,700 - 11,700½ Tuffaceous limestone as in 11,688 - 11,689 ft., but grading in colour to pale grey.
		23	11,700½ - 11,715½ Interbedded shale and limestone as in 11,675 - 11,685½ ft. Locally limestone lenses out; large discontinuous pods and biscuits of limestone parallel to bedding.
11,701			
		18	
11,702			
		23	
11,703			
		18	
11,704			
		20	
11,705			

CORE DESCRIPTION

DATE November 7, 1963 CORE NO. 21 (Continued)

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 11,675 - 11,719

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 40½ ft. or 92%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST R.N. Freeman

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
11,705			
		18	
11,706			
		22	
11,707			
		14	
11,708		Conn.	
		33	
11,709			
		54	
11,710			
		17	
11,711			
		20	
11,712			
		13	
11,713			
		24	
11,714			
		23	
11,715			

CORE DESCRIPTION

DATE November 7, 1963 — CORE NO. 21 (Continued)

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 11,675 - 11,719

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 40½ ft. or 92%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. — FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST R.N. Freeman

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
11,715			
		22	**General Comments:**
			Nodules of crystalline pyrite up to 1½" common.
11,716			Occasional fractures in three systems:
			parallel to bedding (possible cleavage),
		28	45° to core axis,
			65° to core axis.
			Fractures commonly filled with calcite vein material.
11,717			
	NO RECOVERY		Fossiliferous - brachiopod and trilobite cross
		33	sectional traces on core exterior.
11,718			
			Dip: reliable, 30° to 33° in top of core,
		63	32° to 37° in bottom of core.
			No odour, taste, stain, or fluorescence.
11,719	Bottom of Core		

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

CORE DESCRIPTION

DATE November 10, 1963 CORE NO. 22

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 12,021 - 12,031

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 10 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST R.N. Freeman

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
12,021			Broken core in bottom half.
		28	Interlaminated shale (70%) and limestone (30%).
12,022			Shale, medium grey to medium green-grey, slightly translucent, hard, brittle, fissile, micro-micaceous, slightly calcareous, disseminated ferromagnesian mineral, pyritic.
		24	Limestone, dolomitic, pale grey to pale green-grey, micro-crystalline to granular, hard, very shaly, no porosity.
12,023			Intimately laminated. Shale and limestone commonly finely laminated, but varying up to ¼" thick.
		28	Some fair grading of laminae. Rare distortions of laminae.
12,024			Persistent cleavage parallel to laminations. One prominent fracture system 65° to core axis. Laminae occasionally offset on fractures.
		25	
12,025			Dip: reliable, 30° to 32°.
		22	No readily apparent fossils.
			No odour, taste, stain or fluorescence.
12,026			
		23	
12,027			
		24	
12,028			
		32	
12,029			
		36	
12,030			
		31	
12,031			

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅛"

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

DATE November 13, 1963 CORE NO. 23

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 12,239 - 12,264

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 11½ ft. or 46%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST R.N. Freeman

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
12,239			12,239 - 12,242
		23	Dolomite, medium grey, granular, hard, silty, slightly kaolinitic, slightly pyritic; with laminae and thin beds up to 3/16" of shale, black, hard, brittle, fissile, silty, very carbonaceous, calcareous.
12,240			95% dolomite, 5% shale.
		18	Laminae show slight amount of flow structure, and locally some fair grading.
12,241			
		30	Conformable contact.
12,242			12,242 - 12,250½
		19	Limestone, dark grey abraded to light tan-grey on core exterior due to rubbing by corehead and reaction with drilling mud, medium to coarsely crystalline with some disseminated granular
12,243			limestone, kaolinitic, slightly silty, slightly carbonaceous; with abundant laminae and
		19	bifurcating interbeds up to 1" of shale, black, hard, brittle, fissile, silty, very carbonaceous, calcareous.
12,244			70% limestone, 30% shale.
		20	Laminae and interbeds show strongly developed flow structure.
12,245			
		22	
12,246			
		20	
12,247			
		16	
12,248			
		17	
12,249			

CORE DESCRIPTION

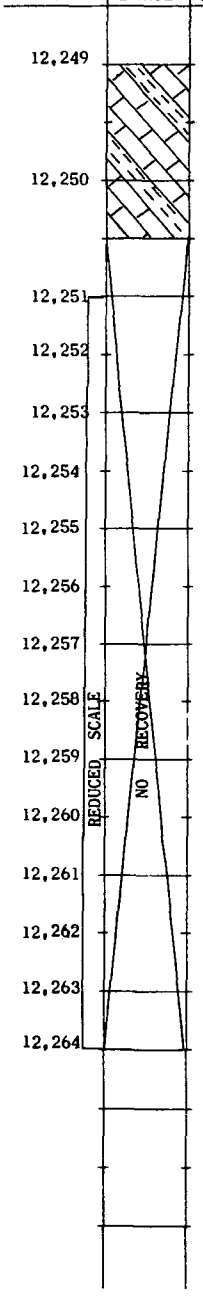
DATE November 13, 1963 CORE NO. 23 (Continued)

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 12,239 - 12,264

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 11½ ft. or 46%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Upper to Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST R.N. Freeman



DESCRIPTION

No porosity.

Irregular fractures with no preferred orientation. Calcite as vein filling in fractures. Occasional fractures show slight amount of offset of laminae.

No odour, taste, stain or fluorescence.

Dip: reliable in dolomite, 50°.

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

CORE DESCRIPTION

DATE November 16, 1963 CORE NO. 24

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 12,605 - 12,615

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 10 ft. or 100%

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
12,605			12,605 - 12,615 Closely interbedded limestone (30%), pale grey shale (30%) and black shale (40%).
		34	
12,606			Limestone, light to dark grey, very coarsely crystalline, slightly argillaceous, pyritic, thin irregular veins and lenses of calcite. Bands up to 6" thick showing gentle wavy bedding and "cut and fill" structures. Richly fossiliferous - very abundant small black brachiopods, numerous trilobites.
		43	
12,607			Shale, pale grey, fissile, abundantly micro-micaceous, pyritic, calcareous, silty, tuffaceous. No definite fossils. In bands from fine laminae up to 5". Occasional gentle wavy bedding and "cut and fill" structures. Associated with black shale - not seen in contact with limestone. Borders of beds usually clear cut.
		40	
12,608			
		31	Shale, black, fissile, micro-micaceous, pyritic, silty, slightly calcareous, bituminous(?), richly fossiliferous - trilobites and small black brachiopods. In bands from fine laminae to 6" thick. Associated with and sometimes gradational into limestone as above.
12,609			
		44	
12,610			General remarks:
		59	Two systems of weak fractures at 10° and 60° to axis of core. Fractures filled with calcite. No displacement of beds, but slickensiding common.
12,611			
		53	No stain, porosity, odour or fluorescence.
12,612			Dip: 32° reliable.
		49	
12,613			Barrel: Hycalog Bit: 8⅜" Diamond Hycalog Core Dia: 4⅜"
		42	
12,614			
		39	
12,615			

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CORE DESCRIPTION

DATE November 18, 1963 CORE NO. 25

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 12,740 - 12,750

COMPANY Delhi Australian Petroleum Ltd. RECOVERY Nil

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION --

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
12,740			12,740 - 12,750 No recovery.
		50	
12,741			
		47	
12,742			
		38	
12,743			
		25	
12,744			
		35	
12,745			
		27	
12,746			
		29	
12,747			
		44	
12,748			
		25	
12,749			
		28	
12,750			

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

CORE DESCRIPTION

DATE November 20, 1963 CORE NO. 26

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 12,750 - 12,770

COMPANY Delhi Australian Petroleum Ltd. RECOVERY Nil

LOCATION 27° 56' 46" S; 140° 04' 55.9" E. FORMATION --

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
12,750			12,750 - 12,770 No recovery.
		23	
12,751			
		24	
12,752			N.B. Much reduced coring time from 12,759 ft. to 12,770 ft. indicates some change in formation. Samples from 12,765 ft. to 12,770 ft. taken during coring show trace of vuggy porosity in red dolomite, also trace brown oil stain, doubtful fluorescence and weak pale yellow cut.
		28	
12,753			
		26	
12,754			
		27	
12,755			Barrel: Hycalog
		31	Bit: 8¾" Diamond Hycalog
12,756			Core Dia: 4⅜"
		31	
12,757			
		45	
12,758			
		100	
12,759			(Note coring time break)
		16	
12,760			

CORE DESCRIPTION

DATE November 20, 1963 CORE NO. 26 (Continued)

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 12,750 - 12,770

COMPANY Delhi Australian Petroleum Ltd. RECOVERY Nil

LOCATION 27° 56' 46" S.; 140° 04' 55.9" E. FORMATION --

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
12,760			
		15	
12,761			
		13	
12,762			
		14	
12,763			
		12	
12,764			
		13	
12,765			
		14	
12,766			
		14	
12,767			
		13	
12,768			
		11	
12,769			
		15	
12,770			

DELHI AUSTRALIAN PETROLEUM LTD. PAGE 1 OF 1

CORE DESCRIPTION

DATE November 21, 1963 CORE NO. 27

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 12,773 - 12,783

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 2 ft. or 20%

LOCATION 27° 56' 46" S.; 140° 04' 55.9" E. FORMATION Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. 181 ft. GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
12,773			12,773 - 12,775 (2 ft.) Breccia, recemented, mottled cream, light grey, pink and deep red, composed of subangular to subround blocks of dolomite up to 2" across, assorted and without bedding, very friable - breaks readily into original blocks. Dolomite is fine to coarsely crystalline, recrystallised, showing vague traces of fossil fragments or oolites. Blocks loosely recemented with dolomite and minor calcite. Deep red dolomite confined to vughs and fractures (percolating iron-rich? solutions). Extremely abundant fractures - no calcite or dolomite veining. Poor to fair vugular porosity - vughs up to ½" across with drusy lining of red dolomite rhombs, some inter-crystalline porosity, good fracture porosity. Intercommunication between vughs through fractures common.
		38	
12,774			
		17	
12,775			
		14	
12,776			Dull gold fluorescence round vughs and along fractures. Also bright gold fluorescence on fracture surfaces (mineral fluorescence). Very pale yellow cut. No odour. Doubtful oil staining (dark brown) in vughs and fractures. Heavy mud invasion in vughs and fractures.
		11	
12,777			
		10	
12,778			Dip: indeterminate.
		11	
12,779			
		13	
12,780			Barrel: Hycalog
		12	Bit: 8⅜" Diamond Hycalog
12,781			Core Dia: 4⅜"
		11	
12,782			
		18	
12,783			

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

DATE November 23, 1963

WELL Delhi-Santos Gidgealpa No. 1

COMPANY Delhi Australian Petroleum Ltd.

LOCATION 27° 56' 46" S.; 140° 04' 55.9" E.

ELEVATION G.L. = 165 ft.; K.B.=181 ft.

CORE NO. 28

INTERVAL 12,800 - 12,804

RECOVERY Nil

FORMATION --

GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
12,800			12,800 - 12,804 (4 ft.)
		35	No recovery.
12,801			
		46	
12,802			
		36	
12,803			
		23	
12,804			

Barrel: Reed Kor-King

Bit: 7½" H.F.

Core Dia: 2¾"

DELHI AUSTRALIAN PETROLEUM LTD. PAGE 1 OF 1

CORE DESCRIPTION

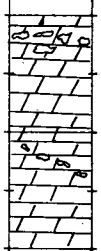
DATE November 25, 1963 CORE NO. 29

WELL Delhi-Santos Gidgealpa No. 1 INTERVAL 12,950 - 12,960

COMPANY Delhi Australian Petroleum Ltd. RECOVERY 2 ft. or 20%

LOCATION 27° 56' 46" S.; 140° 04' 55.9" E. FORMATION Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
12,950			12,950 - 12,952 (2 ft.) Dolomite, cream, light grey, pink and deep red, fine to very coarsely crystalline, in part
		11	brecciated but mainly massive with vague traces of bedding, recrystallised, vague outlines of
12,951			fossils? Brecciated parts consist of blocks, subangular to subround, of dolomite cemented with dolomite. Whole core criss-crossed by numerous hairline fractures, some larger
		12	fractures filled with recemented breccia. Deep red dolomite confined to some fractures and some vughs (due to percolating iron bearing? solutions).
12,952			Fair to good vugular and intercrystalline porosity. Vughs up to 1" across and lined with dolomite rhombs.
		9	Good fracture porosity. Vughs commonly connected by fractures. Some fractures calcite filled.
12,953			Dull gold fluorescence in vughs and some fractures. Faint pale yellow cut. Sulphurous? odour when broken. No positive oil staining due to very
		10	heavy mud invasion in vughs and fractures.
12,954			12,952 - 12,960 (8 ft.)
		12	No recovery.
12,955			
		13	
			Dip: Indeterminate.
12,956			
		13	
			N.B. Core surface contaminated with core barrel lubricant - bright pale blue fluorescence.
12,957			
		9	
12,958			Barrel: Hycalog
			Bit: 8⅜" Diamond Hycalog
		9	Core Dia: 4⅜"
12,959			
		8	
12,960			

12942-6

DELHI AUSTRALIAN PETROLEUM LTD.

CORE DESCRIPTION

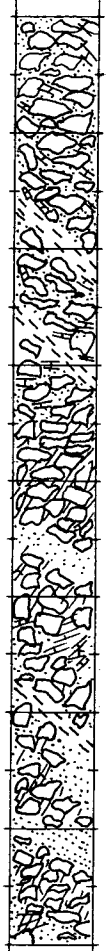
DATE November 26, 1963 — CORE NO. 30

WELL Delhi-Santos Gidgealpa No. 1 — INTERVAL 13,106 - 13,114 (T.D.)

COMPANY Delhi Australian Petroleum Ltd. — RECOVERY 8 ft. or 100%

LOCATION 27° 56' 46" S.; 140° 04' 55.9" E. — FORMATION Middle Cambrian

ELEVATION G.L. = 165 ft.; K.B. = 181 ft. — GEOLOGIST J. Harrison

DEPTH	LITHOL	Coring Rate Min./Ft.	DESCRIPTION
13,106			13,106 - 13,114 (8 ft.) Agglomerate, mottled cream, light grey, dark grey, black, light brown and green, composed of volcanic ejectamenta, and sedimentary rocks cemented by dolomite.
		27	
13,107			Volcanic material: ranges from silt grade to blocks 3" across, angular to subround, massive to thinly bedded, unsorted, composed of kaolin, feldspar lathes, silica shards, volcanic glass, streaks and perfect spheres of brilliant green chlorite, and irregular fragments of quartz.
		25	
13,108			Sedimentary rock: occasional blocks of dolomite, dark grey to black, subangular, up to ¾" across, fine to medium crystalline, argillaceous pyritic, trace fossils?
		27	
13,109			Cement: dolomite, light grey, fine to coarsely crystalline with minor calcite. No fossils apparent.
		24	
13,110			No stain, porosity, odour or fluorescence but trace of gas bleeding from core at random points.
		25	
13,111			Dip: 31° - 33° reliable.
		24	
13,112			
		31	
13,113			
		37	
13,114			

Barrel: Hycalog

Bit: 8⅜" Diamond Hycalog

Core Dia: 4⅜"

APPENDIX 2

DELHI-SANTOS GIDGEALPA NO. 1

PETROLOGY

All the cores from Delhi-Santos Gidgealpa No. 1 were examined petrologically by H.W. Fander and H.R. McCarthy of the Australian Mineral Development Laboratories. Their report on each core constitutes Part A of this Appendix. The "TS" number is A.M.D.L.'s own index number to the thin sections which are permanently filed at the Laboratories.

Doctor M.F. Glaessner and Doctor R.L. Oliver of the University of Adelaide examined four of the cores from this well. Their report forms Part B of this Appendix.

APPENDIX 2

PART A

DELHI-SANTOS GIDGEALPA NO. 1

PETROLOGY

Core No. 1. 6500 to 6510 feet (Walloon Formation)

One portion of this core is a highly carbonaceous, fine-grained, silty, micaceous slate, containing irregular lenses of much coarser material; these lenses consist of grains of quartz of fine to medium-sand grade, often enlarged by mantles of secondary quartz. Moreover, this mantling has occurred before the load deformation and metamorphism which converted the original rock into a slate. Interstitial material between the coarse grains is kaolin and occasional organic matter.

The other portion of this core is virtually identical to the sandstone lenses already described. Irregular wisps and stringers of organic matter are common. (TS12729-12730)

Core No. 2. 6515 to 6525 feet (Walloon Formation)

6515 feet:

A closely-layered carbonaceous and micaceous, sandy siltstone. Sorting is poor, grain sizes range from clay grade (less than 0.0039 mm) to medium-sand grade (0.25 mm to 1.0 mm). The main constituents are quartz, occasional feldspar, large laths of muscovite and interstitial sericitic and chloritic matter. (TS12731)

Layers of organic debris and other carbonaceous matter are very abundant and conspicuous; they are often accompanied by patches of fine-grained carbonate, possibly ankerite or siderite.

6517 feet:

This is a well-sorted, medium-grained sandstone with a kaolin cement. It contains irregular, flat fragments, or carbonaceous silty shale, which were evidently plastic when deposited and incorporated in the host rock. The sand grains are mantled and cemented by secondary quartz in optical continuity. (TS12732)

6522 feet:

This is a medium-grained sandstone, very similar to the sandstone component from 6517 feet; carbonaceous material is largely absent except at the upper fracture surface of the specimen. Secondary quartz in optical continuity with the original grains has resulted in a marked crystalline appearance of the rock in hand-specimen. (TS12733)

Core No. 3. 6657 to 6667 feet (Walloon Formation)

6660 feet:

This section is very similar to the core at 6522 feet. The quartz grains are somewhat coarser, though the rock is still a medium-grained sandstone. Secondary quartz in optical continuity, with its tendency to produce euhedral quartz crystals with a rounded nucleus, is again conspicuous and imparts a crystalline or "twinkling" effect to the hand-specimen. Despite this, the rock appears to be fairly porous. (TS12734)

Core No. 4. 7078 to 7086 feet (Hutton Sandstone Equivalent)

7079 feet:

A medium-grained sandstone, very similar to the previous core (at 6660 feet), but with well-defined, micaceous, carbonaceous partings along which the rock splits easily into thin wafers or layers. (TS12735)

Core No. 5. 7462 to 7472 feet (Lower Triassic)

A series of eleven thin-sections was prepared from various portions of this core, from 7462 feet 2 inches to 7466 feet 6 inches. Several X-radiographs were also prepared in order to gain a better understanding of the structures present. Any information which would help to decide whether this section of core was deposited under terriginous or aqueous conditions, and information about the environment, were considered to be vital.

There are a number of features of interest and significance; these are listed below:

(i) They are, in general, poorly-sorted; most thin sections show a range from clay grade (below 0.0039 mm diameter) to fine-sand grade (0.0625 mm to 0.25 mm), though the majority of the grains are in the silt grade (between 0.0039 mm and 0.0625 mm). The exception is the lowermost portion of core, (7466 feet 2 inches) which is a recrystallized mudstone.

(ii) Most sections show irregular bodies of finer-grade material set in coarser material. The shapes of these bodies show that they were probably in a plastic state when incorporated in the host rock; many of the bodies are clay-pellets. Some have a streamlined tear-drop shape, others are folded, contorted, lens-like, and many other shapes. The boundaries between one of these bodies and the coarser-grained host maybe gradational in parts (especially at points parallel to bedding) and abrupt in others. In polished slabs and in X-radiographs these features are clearly shown.

(iii) Irregular spots of dolomite or ankerite are common in all the rocks, especially in the lowest section (7466 feet 2 inches) of mudstone. Particularly in this latter section, it is very likely that these spots, with their radiating-fibrous habit and general lack of marked sieve-texture, grew and developedin an unconsolidated or semi-consolidated sediment.

(iv) Despite comparatively poor sorting and relatively high angularity of the grains (mainly of quartz), bedding is quite noticeable. General parallelism of elongate grains and the long axes of clay pellets and other bodies described in paragraph (ii) represent the bedding. Detrital mica, while not abundant, also shows the same direction of lineation. The carbonate spots or patches also follow this trend.

(v) Heavy-minerals are sparingly present throughout. They are generally well-rounded and consist mainly of zircon, tourmaline, and apatite.

(vi) The interstitial and other recrystallized clay minerals appear to be quite fresh and unoxidized; the general colour of the core is light to medium grey, indicating that the sediment was not deposited under oxidizing conditions. Moreover, minute specks of pyrite are widespread though not abundant. They may be detected by using special techniques recently developed.

Altogether, the evidence favours deposition under aqueous conditions, in a neutral or reducing environment. Conditions must have been favourable for slump-structures and associated phenomena to have developed. (TS12764-12768)

Core No. 6. 7772 to 7782 feet (Permian)

This is predominantly a coarse, micaceous siltstone. Wisps of carbonaceous matter are abundant.

The rock consists mostly of subangular grains of quartz of silt grade, with bedded laths of muscovite, and interstitial recrystallized clay minerals as sericite, kaolin, and chlorite.

There are impersistent layers and lenses of coarser-grained sandstone, containing little or no carbonaceous matter, of pale colour in hand-specimen. (TS12769)

Core No. 7. 8208 to 8218 feet (Permian)

This rock is mostly coaly material, containing layers and lenses of highly carbonaceous siltstone. (TS12770)

Core No. 8. 8297 to 8307 feet (Permian)

This is a well-sorted, fine-grained sandstone. Interstitial films of kaolin and sericite occur, and wisps of carbonaceous material are seen.

The quartz grains were subangular to subrounded, and averaged 0.12 mm across. Subsequent moderate silicification has modified grain-shapes and sizes to some extent. Thin heavy-mineral layers occur, consisting principally of zircon, with some tourmaline.

A few patches of late-stage dolomite-ankerite are distributed through the rock. (TS12815)

Core No. 9. 8610 to 8620 feet (Permian)

8612 1/2 feet:

This is a finely laminated, sideritic siltstone or an impure carbonate rock which shows well-defined current bedding. Laminae mostly of angular quartz and feldspar grains alternate with laminae containing siderite, fine-grained mica, and irregularly distributed carbonaceous matter. Cryptocrystalline silica is a minor constituent of both and commonly acts as a cement. Siderite comprises about 50 percent of the rock. The grains of quartz and feldspar range from 0.03 to 0.13 mm in diameter. Overgrowths of silica on quartz grains occur rarely and there is no evidence that secondary silicification occurred after hydrocarbon accumulation. (TS12828-9)

Core No. 10. 9052 to 9062 feet (Pre-Permian ?)

9058 feet:

This is a fine-grained lithic sandstone. The grain-size ranges from 0.08 to 0.24 mm and most grains are subrounded or rounded in shape. Sericite and probably a carbonate mineral occur sparsely in the matrix. Sericite often rims the quartz grains and carbonate is usually interstitial. Rock fragments of siltstone, quartzite, chert, and fine-grained volcanic rocks are quite abundant in this rock and probably comprise 15 to 20 percent. Cryptocrystalline silica occurs in minor amount cementing many grains. (TS12830)

Core No. 11. 9140 to 9151 feet (Middle Cambrian)

This core consists of alternating layers of indurated, micaceous siltstone, and of fine-grained limestone.

The most interesting feature of the rock is the clear evidence of folding and boudinage of the limestone layers before the final consolidation of the rock; the silty layers are moulded around the ends of the boudins and are conformable with the folds in the limestone; while the silty layers between are apparently undisturbed. Similar features are seen in the Dullingari Palaeozoic section (especially Core No. 26).

The layers of indurated micaceous siltstone are slightly coarser-grained equivalents of the slates more commonly seen in other cores (Dullingari, Orientos). Conformable layers of pyrite, as minute euhedral crystals, are present and probably syngenetic. Variable amounts of calcite are present in the silty layers, though the transition to limestone layers is fairly abrupt.

The limestone layers are even-grained, and contain finely-divided carbonaceous and detrital matter. Small pyrite euhedra are also seen. A few small patches suggest the former presence of fossils, and one area suggests the cross-section of a bivalve fossil. (TS12816)

Core No. 12. 9415 to 9425 feet (Middle Cambrian)

9417 feet:

This is a tuffaceous siltstone composed predominantly of fine-grained chlorite, sericite, feldspar, quartz, and carbonate. The rock is finely laminated and shows current

bedding. Several thin fractures which cut the rock displace the laminae. Grey-green laminae contain abundant sericite and chlorite while the lighter laminae, which commonly lens out, contain abundant quartz and feldspar or abundant carbonate. Quartz and feldspar (mostly plagioclase) are usually very angular in shape - often lath or shard-like. (TS12817)

9419 1/2 feet:

This is a fossiliferous limestone which contains abundant, small fossil fragments. The surrounding carbonate is generally fine to medium-grained. The fossil fragments are now composed predominantly of carbonate, which is often coarser-grained than the surrounding carbonate matrix, and have tests which are thin walled and siliceous. Palaeontological examination would be required for their identification. (TS12847)

9420 feet:

This is a banded tuffaceous limestone. Generally the bands contain either fine-grained volcanic material or carbonate as major constituents. A short description of the prominent bands of this section of core is given below.

(i) Green band at base - fine to medium-grained plagioclase (albite) laths in a fine-grained groundmass of plagioclase and chlorite. Occasionally coarser plagioclase grains are present and generally the plagioclase is sericitized. Some chlorite occurs as round vesicle-like aggregates. Sphene (leucoxene) is abundant.

(ii) Pinkish band - coarse-grained carbonate with scattered euhedral pyrite grains. Some finer-grained patches of carbonate occur.

(iii) Greenish band - this grades from the coarse carbonate and consists of alternating bands of fine-grained carbonate and volcanic material with occasional large aggregates of feldspar laths and abundant, fine-grained aggregates of sphene (leucoxene).

(iv) Grey-white band - this is comprised of carbonate and volcanic material with abundant aggregates, 1 to 2 mm in diameter, of entirely volcanic material distributed throughout the band. Chlorite is not abundant, but large angular feldspar grains occur.

(v) Greenish-white band - this is carbonate with incorporated volcanic fragments. The plagioclase laths are generally larger than those in the previous bands and the fragments are darker containing abundant chlorite and sphene (leucoxene).

(vi) White band - coarse-grained carbonate.

(vii) Dark green band at top - volcanic material incorporating large irregular carbonate aggregates and a few coarse feldspar fragments. (TS12818-12820)

9423 feet:

This is a tuffaceous limestone which is petrologically quite similar to one of the bands (band iv) described above. Volcanic fragments up to several millimeters in diameter

are embedded in a calcite matrix. There is a general increase in the size of the fragments towards the bottom of the core. Overall calcite is more abundant than the volcanic material. Plagioclase laths and chlorite are the predominant constituents of the volcanic fragments. (TS12831-3)

Core No. 13. 9798 to 9808 feet (Middle Cambrian)

9803 feet:

This is a brecciated, laminated slate. The laminae are at an angle of approximately 75° to the core axis and alternate laminae are distinguished by an abundance of argillaceous minerals or silt-sized quartz and feldspar grains. Sericite and muscovite are abundant. A strong slaty cleavage which has developed from the foliation of the micas is parallel to the lamination. A carbonate mineral fills the fractures in the slate. Fine pyrite grains occur throughout. (TS12844)

Core No. 14. 9989 to 9999 feet (Middle Cambrian)

9994 feet:

This is a finely laminated slate. Mineralogically it is quite similar to the slate from 9803 feet. Structurally, a slaty cleavage has developed parallel to the laminations but there is no intense brecciation of this rock as in Core No. 13. The laminae lie at approximately right angles to the length of the core. (TS12846)

Core No. 15. 10,280 to 10,290 feet (Middle Cambrian)

10,281 feet:

This is a laminated slate which possibly shows more brecciation than Core No. 13. Again a carbonate mineral fills the fractures. Lighter coloured laminae in the slate are richer in calcite than the darker laminae. The laminae generally lie at approximately 40° to the length of the core. The prominent slaty cleavage is parallel to the laminations.

Mineralogically these three cores are very similar. The only differences that exist appear to be in the attitude of the bedding and the degree of brecciation. Cores 13 and 15 are more brecciated than Core No. 14. Assuming the hole is vertical, the dip of the bedding in Core No. 15 is greater than in Cores 13 and 14. (TS12845)

(i) Comparison with Cores 26 to 30, Dullingari No. 1. Cores 13, 14, and 15 are most like Core No. 27 from Dullingari No. 1. Core No. 27 is a siltstone which has undergone slight metamorphism (less than 13, 14, or 15). However the slaty cleavage is parallel to the bedding.

Core No. 28 consists of interlaminated coarser and finer material, the finer being similar to Core No. 27. Core No. 29 is a conglomerate and thus not similar. Cores 30 and 31 are slates of similar appearance but the slaty cleavage shown by them is at an angle of 10-15° to the bedding.

(ii) Identification of carbonate mineral in limey laminae. The light-coloured material was removed and subjected to X-ray diffraction analysis. The carbonate mineral present is calcite.

Core No. 16. 10,488 to 10,498 feet (Middle Cambrian)

10,494 1/2 feet:

This is a tuffaceous limestone similar in appearance to those observed in previous cores. Carbonate and volcanic fragments are present in about equal amounts. In thin section the volcanic fragments are observed to have more irregular boundaries and to be more altered than before. Most have been converted to aggregates of chlorite, cryptocrystalline silica, sericite, quartz, and opaques (sphene and/or leucoxene) with only the original shape of the feldspar laths preserved. Carbonate present is probably calcite and occurs with cryptocrystalline silica and sericite as irregular aggregates surrounding or replacing the volcanic fragments. The rock is cut by numerous, irregular fractures containing abundant cryptocrystalline silica. (TS12908)

Core No. 17. 10,828 to 10,838 feet (Middle Cambrian)

10,837 feet:

This is a tuffaceous limestone in which rounded volcanic fragments are set in fine to medium-grained calcite. The volcanic fragments are dark coloured and most of the original constituents have been replaced by carbonate and/or crytocrystalline silica. The fragments now show spherical and arcuate structures which have probably formed as a result of the replacement. Dark coloured bands are finer-grained - mostly silt-sized grains - and consist predominantly of carbonate, quartz, opaques, and scattered sericite flakes. The banding is caused by the abundance of fine opaques in some laminae. Several arcuate fossil fragments, similar to those seen in Core No. 12, were observed in some carbonate-rich areas. (TS12911)

Core No. 18. 11,068 to 11,078 feet (Middle Cambrian)

11,072 feet:

This is a well-laminated, extremely altered volcanic tuff. Altered fine-grained feldspars, aggregates of carbonate and sphene (leucoxene?) are scattered through a fine-grained chloritic or cryptocrystalline silica groundmass. The laminae can be distinguished easily because they are rich in one or another of the constituents. Spherical or arcuate structures which are abundant throughout the groundmass are outlined by fine opaques or sphene around aggregates of chlorite or silica. These structures have most probably been produced during recrystallization and alteration but could possibly represent structures in an original glassy matrix since devitrified. The carbonate aggregates may represent replacement of the rock by carbonate or may have been rock fragments. Some of the rock is brecciated and the fractures have been filled by coarser-grained, milky-white carbonate. (TS12912-13)

Core No. 19. 11,366 to 11,391 feet (Middle Cambrian)

11,378 feet:

This is a completely altered, medium-grained igneous rock which shows a sub-ophitic texture. Originally laths of plagioclase, ferromagnesian grains, and opaques were the predominant constituents. Apatite and sphene are abundant accessories. Now, however, plagioclase has been almost completely replaced by calcite, ferromagnesians have been altered

to aggregates of chlorite or antigorite and opaques to sphene. Antigorite aggregates probably represent original olivine. Some chlorite aggregates have pyroxene or amphibole outlines. Coarse aggregates of potash feldspar (probably microcline) occur throughout the rock. These appear as vesicle-like or vein-like aggregates which are late-stage alteration products similar to the calcite.

This is probably an altered microdiorite or microgabbro. If the body had sill-like field relationships microdiorite would be the better name. (TS12917)

11,378 1/2 feet:

This specimen is an intraformational or pelletoid conglomerate. Rather irregular or rounded lenticular fragments of argillaceous limestone are surrounded by a slightly more argillaceous, banded, and also fine-grained matrix. Fine opaques give a fine banding to the matrix. The minerals present are calcite, quartz, sericite, and chlorite. (TS12918)

Core No. 20. 11,391 to 11,407 feet (Middle Cambrian)

11,391 feet:

This is a fine-grained, laminated limestone. Calcite is the predominant constituent. Silt-sized quartz, sericite, and fine opaques occur in minor amount. Calcite-rich bands are often rather lenticular in shape. Darker bands which alternate with these show very fine laminations, are more argillaceous, and contain abundant fine opaques (mainly iron oxide). (TS12919)

Core No. 21. 11,675 to 11,719 feet (Middle Cambrian)

11,683 feet:

This is a highly-calcareous, indurated, layered siltstone with carbonaceous matter and finely-divided pyrite, alternating with much paler, fine-grained limestone.

Re-crystallization of the calcite has given rise to more coarsely-crystalline patches and cross-cutting veinlets. The core differs very little from Core No. 20; the silty layers of Core No. 21 are wider and more prominent. (TS12982)

11,684 1/2 feet:

This is a silty, micaceous, fine-grained limestone. Carbonaceous and pyritic matter occurs in some layers, and may even be quite abundant in some of the dark, glassy-looking layers with splintery fracture. Iron sulphides and carbon were found by heating tests.

Secondary, coarsely-crystalline calcite occurs along bedding planes and as small veinlets. (TS12983)

11,688 1/2 feet:

This section is particularly interesting because it contains an intraformational conglomerate. The constituent pebbles and matrix clearly show plastic deformation; they were

still soft or semi-consolidated at the time of deposition. In the Dullingari section (Core No. 29) similar conditions existed, except that the fossiliferous limestone pebbles were consolidated, and indeed abraded, at the time of deposition. The existence of the fossiliferous limestone section at Gidgealpa supports the original theory that, at Dullingari, the influx of the limestone pebbles may have "triggered off" the sliding movements responsible for the intraformational conglomerate. The age-relation of the two sections (Lower Ordovician of Dullingari and Middle Cambrian of Gidgealpa) appears to fit in well with the general picture.

The conglomerate is composed of deformed fragments of limestone, both fossiliferous and oolitic, and of calcareous fragments of fossils, in a dark, carbonaceous and sulphidic, silty, calcareous matrix. The matrix was subjected to heating tests, but no petroliferous or bituminous odours could be detected.

Other thin sections of this core show the silty limestone and more carbonaceous, pyritic layers, very similar to sections at 11,683 to 11,684 feet. (TS12984-5-6)

Core No. 22. 12,021 to 12,031 feet (Middle Cambrian)

A well-indurated, argillaceous, micaceous siltstone, showing some graded bedding. The grain size ranges from very fine silt to coarse silt and some layers are predominantly argillaceous; the individual flakes of micaceous minerals all show parallel alignment, giving rise to mass optical effects.

Granular calcite is present in layers, but is not nearly as abundant as in previous cores. (TS12987)

Core No. 23. 12,239 to 12,264 feet (Middle Cambrian)

12,240 feet:

This may be termed a calcitized crystal-tuff. The rock consists predominantly of well-defined, fresh laths and angular fragments of sodic plagioclase (oligoclase to albite). The crystals occur as individuals and also as aggregates with interstitial opaque white or cryptocrystalline colourless material. Little quartz is visible, and the tuff is intermediate rather than acid or basic; the rock fragments may best be described as trachytic.

The interstitial and cementing material which is probably calcite, appears to be of late-stage or secondary origin, though it may be recrystallized material deposited at the same time. (TS12990)

12,248 feet:

This section consists of alternating fossiliferous limestone and carbonaceous, pyritic siltstone and sandstone.

The limestone contains numerous fossil fragments, often consisting of cryptocrystalline silica, in recrystallized calcite. The siltstone-sandstone is strongly tuffaceous, containing many fragments and crystals of completely altered feldspar, and grading into a tuff.

The dips steepen strongly from Core No. 21 to Core No. 23.

Some of the limestone was dissolved in dilute hydrochloric acid; the residue contained many siliceous casts of trilobite fragments. (TS12991)

Core No. 24. 12,605 to 12,615 feet (Middle Cambrian)

12,608 feet:

This is a well-laminated, conspicuously layered, fine-sand grade rock. Well-marked carbonaceous layers and partings occur, and there are highly fossiliferous layers of limestone.

The bulk of this core section consists of abundant muscovite laths, angular fragments of quartz and feldspar, and recrystallized calcite; carbonaceous matter is conspicuous in some layers, commonly finer-grained. The rock may be termed a calcitic, micaceous, laminated, fine-grained sandstone, with fossil layers. (TS13000-3)

Core No. 27. 12,773 to 12,783 feet (Middle Cambrian)

12,773 feet:

The rock is composed entirely of dolomite, as fine to coarsely crystalline aggregates. Brecciation of the rock was followed by crystallization of coarse rhombohedra of dolomite with iron-staining, causing the fragments to "heal" together. There is no evidence of bituminous material in interstices; isolated grains of pyrite were seen. (TS13001)

Core No. 29. 12,950 to 12,960 feet (Middle Cambrian)

12,950 feet:

This is a coarsely-crystalline dolomite, similar to a marble; the term marble, however, cannot be used unless there is definite evidence of formation under metamorphic conditions. Such evidence is lacking here, and recrystallization of the dolomite is diagenetic. Small breccia zones traverse the rock and show iron-staining as well as recrystallization of dolomite to form large rhombohedra. This core is very similar to Core No. 27. (TS13020)

Core No. 30. 13,106 to 13,114 feet (Middle Cambrian)

This entire core section consists of bedded agglomerates and lapilli-tuffs.

At least some of the volcanic fragments probably solidified "in flight", as they have chilled margins. The core is generally unsorted, containing 5 cm diameter fragments side-by-side with 2 to 3 mm fragments. However, in places some sorting has occurred.

The rock fragments are all highly vesicular and extensively altered, and accurate classification is not possible. Some altered feldspar phenocrysts are recognizable, and the rocks are intermediate to acid. Post-depositional alteration has been severe. Silica, sericite, and pale chlorite have filled vesicles and completely replaced phenocrysts. Interstices between pyroclastic fragments have been lined with the same minerals and filled with coarsely crystalline calcite.

It appears that from Core No. 12 to Core No. 30, there is a thick sequence of intercalated pyroclastic and more normal shales, silts, and limestones with fossiliferous horizons. Probably all the pyroclastics have a common origin; they are more important lower in the sequence. (TS13010-13013)

APPENDIX 2

PART B

DELHI-SANTOS GIDGEALPA NO. 1

PETROLOGY

Core No. 10. 9052 to 9062 feet (Pre-Permian)

This is a white sandstone with calcareous cement and with spheroidal pyrite concretions 6-10 mm in diameter. The quartz grains are angular. No fossils are recognizable and none can be expected. There is no evidence for dating. If the heavy mineral suite of the Permian were well known, an attempt could be made to obtain heavy minerals from the sandstone for comparison, and if they proved to be different, an Ordovician age of the sandstone could be possible.

Core No. 11. 9140 to 9151 feet (Middle Cambrian)

This is a black, impure, nodular pyritic limestone and calcareous shale with fragmentary fossils. A sample was treated with monochloracetic acid and the insoluble residue was found to contain numerous well-preserved shells of the brachiopod Acrotreta sp. (Cambrian-Ordovician). As the species of this genus are confused and require revision, specific identification was not attempted. A fragmentary agnostid trilobite and various other trilobite fragments were seen in the matrix.

Core No. 13. 9800 feet (Middle Cambrian)

A dark pyritic shale. On the sectioned core the dip is clearly 30°. The rock is distinctly laminated with minor cross-bedding. It is also fractured with almost complete calcite cementation of fractures. No fossils were seen.

Core No. 16. 10,492 to 10,493 feet (Middle Cambrian)

In hand specimen the rock consists of irregularly shaped, angular, dense, dark green fragments in a fine-grained, light grey matrix. The fragments range in size from 0.6 cm to less than a pin-head in diameter. Fragments and matrix each constitute approximately 50% of the rock volume. The matrix effervesces very slowly with cold dilute hydrochloric acid.

In thin section the "fragments" show as ragged patches consisting of a pale green chloritic base throughout which are scattered lath and diamond-shaped pseudomorphs up to 0.25 mm long presumably after feldspar, and scattered ragged granules, 0.02-0.07 mm diameter, after ilmenite. The feldspar has been altered to a fine sericitic aggregate, and the ilmenite to leucoxene. From X-ray examination the leucoxene is possibly anatase, and some feldspar (plagioclase) is still present as such.

The refractive index Alpha-Beta - 1.611 of the chloritic base is not irreconcilable with the mineral amesite which X-rays indicate is the most likely chloritic type.

In several "fragments" are spherulitic aggregates, 0.1 mm diameter, of probable colourless mica (R.I. less than R.I. chlorite); ellipsoidal spherulites in a few other "fragments" are of chlorite. The latter certainly are a development of the crystallizing secondary product; whether the "mica" spherulites also are a secondary development or whether they are amygdales in originally vesicular lava is uncertain.

The rock matrix is a carbonate, probably dolomite because it effervesces slowly with acid. Rhombohedral cleavage is apparent in places. Chloritic fragments and ill-defined patches of quartz and some sericitic mica occur in the carbonate. The origin of this quartz and sericite is uncertain; some of the quartz may be derived from the breakdown of original ferromagnesian minerals (eg. pyroxene) to the chlorite; the sericite may represent original clay.

The whole rock is decidedly "messy", due to considerable alteration of the original constituents and some mobilization of the alteration products.

The rock appears to have been a basic lapilli tuff the fragments of which have settled into soft carbonate sediment on the sea floor.

The rock can be called an altered submarine lithic tuff deposited in an environment of carbonate sedimentation. The absence of sorting or grading is difficult to understand and could indicate violent disturbance of sediment by volcanic action with rapid settling of a carbonate-tuff slurry. A full interpretation from a single borehole is impossible, as lateral changes (to pure tuff or a graded bed or a pillow lava or an agglomerate vent) cannot be observed. In the absence of evidence for faulting a repetition of this lithology would indicate a repetition of the volcanic event.

APPENDIX 3

DELHI-SANTOS GIDGEALPA NO. 1

PALAEONTOLOGY

Palaeontological studies carried out on the cores, cuttings, and sidewall samples from Delhi-Santos Gidgealpa No. 1 are presented in two separate sections.

Part A: Report by Mr. W.K. Harris, Department of Mines, Geological Survey, South Australia, (Mesozoic and Permian sediments).

Part B: Report by Dr B. Daily, University of Adelaide, Department of Geology, (Cambrian sediments).

APPENDIX 3

PART A

DELHI-SANTOS GIDGEALPA NO. 1

PALYNOLOGICAL EXAMINATION OF CORES AND SIDEWALL CORES

Introduction

Delhi-Santos Gidgealpa No. 1 Well located 45 miles south-west of Innamincka Homestead (Latitude 27°56'46"S, Longitude 140°04'55.9" E) was drilled to a total depth of 13,114 feet in Cambrian sediments.

This report presents observations on the microfloral assemblages from four core samples in the Permian sequence and nine core and sidewall core samples from the Jurassic-Cretaceous sequence.

All samples below the sidewall core at 5483 feet yielded very poorly preserved microfloras which are consequently of little stratigraphic value. All cores and sidewall cores above the Cambrian sequences were prepared for examination. A sample from Core No. 11 in the Cambrian was found to be barren. The sidewall cores are numbered 1 to 7 for use in Table 1.

Observations on the Microfloras and Stratigraphic Implications

Permian:

The following assemblages from four cores were obtained:

Core No. 6 at 7780 feet

Acanthotriletes sp.
Nuskoisporites sp.
Vesicaspora sp.
Verrucosisporites sp.

Core No. 7 at 8208 feet

Acanthotriletes sp.
Camptotriletes sp.
Nuskoisporites sp.
Vesicaspora sp.

Core No. 8 at 8298 feet

Acanthotriletes sp.
Cirratriradites splendens
Nuskoisporites sp.
Vesicaspora sp.

Core No. 9 at 8616 feet

Acanthotriletes ericianus
Cirratriradites splendens
Neoraistrickia ramosus
Nuskoisporites gondwanensis
Verrucosisporites sp.
Vesicaspora sp.

These microfloras were extremely poorly preserved and little can be said regarding their stratigraphic use within the Permian. The presence of C. splendens and N. gondwanensis and the absence of striate pollen suggest a Lower Permian age.

Jurassic:

Sidewall core 1 at 7167 feet

Cyathidites sp.
Callialasporites dampieri
Lycopodiumsporites sp.
Laricoidites reidi

Sidewall core 2 at 6564 feet

Cyathidites australis
Callialasporites dampieri
Laricoidites reidi

Core No. 2 at 6516 feet

Callialasporites dampieri
C. segmentatus
Cyathidites australis
Laricoidites reidi
Lycopodiumsporites rosewoodensis
Podocarpidites ellipticus
Osmundacidites comaumensis
Sphagnumsporites australis

Core No. 1 at 6501 feet

Cyathidites australis
Callialasporites segmentatus
Laricoidites reidi
Lycopodiumsporites rosewoodensis
Podocarpidites ellipticus
Sphagnumsporites australis

Again these assemblages were very poorly preserved. The assemblages are typically Jurassic but further subdivision of this is not possible on microfloral evidence. All species are long ranging in the Jurassic and some range into the Cretaceous.

Cretaceous:

Sidewall core 3 at 5483 feet

Acanthotriletes levidensis
Cicatricosisporites cooksonii
C. australiensis
Cyathidites australis
C. crassiangularis
Callialasporites dampieri
Classopollis torosus
Foveosporites canalis
Gleicheniidites circinidites
Ischyosporites scaberis
Lycopodiumsporites circolumenus
L. austroclavatidites
Murospora florida
Osmundacidites comaumensis
Podocarpidites ellipticus
Cyclosporites hughesi
Taurocusporites sp.

Because C. australiensis is present, the assemblage is of Cretaceous age. In other respects the assemblage has affinities with both the Lower Cretaceous and the Upper Jurassic. The assemblage is regarded as basal Cretaceous.

Sidewall core 4 at 5340 feet

Acanthotriletes levidensis
Acquitriradites spinulosus
Alsophilidites cf. kerguelensis
Callialasporites trilobatus
C. dampieri
Classopollis torosus
Cyathidites australis
C. crassiangularis
Cicatricosisporites cooksonii
C. australiensis
Cyclosporites hughesi
Ginkgocycadophytus sp.
Lycopodiumsporites austroclavatidites
L. circolumenus
Leptolepidites verrucosus
Osmundacidites comaumensis
Podocarpidites ellipticus
Perotriletes sp.
Verrucosisporites sp.

The presence of L. circolumenus indicates an Aptian or older age for this assemblage.

Sidewall core 5 at 4484 feet

Araucariacites australis
Cyathidites australis
Classopollis torosus
Cicatricosisporites australiensis
C. cooksonii
C. sp. nov.
Cingulatisporites euskirchensoides
Gleicheniidites circinidites
Hystrichosphaeridae
Lycopodiumsporites austroclavatidites
Microreticulatisporites parviretus
Pilosisporites notensis
Podocarpidites ellipticus
Sphagnumsporites australis

The assemblage is characterized by several Albian and post-Albian species of the Great Artesian Basin, namely C. euskirchensoides and Cicatricosisporites sp. nov. These species, however, may extend into the upper Aptian. The Aptian-Albian boundary is at present not definable on palynological evidence.

Sidewall core 6 at 4402 feet

Araucariacites australis
Acanthotriletes levidensis
Annulispora sp.
Balmeisporites holodictyus
Classopollis torosus
Cyathidites australis
Ceratosporites equalis
Cicatricosisporites australiensis
Concavisporites sp.
Cingulatisporites sp.
C. euskirchensoides
Foveosporites canalis
Gleicheniidites circinidites
Gonyaulax cf. edwardsi
Hystrichosphaeridium sp.
Ischyosporites scaberis
Lycopodiumsporites austroclavatidites
Lygodioisporites adriennis
Microcachryidites antarcticus
Osmundacidites comaumensis
Pilosisporites notensis
Pityosporites grandis
Podocarpidites ellipticus
Perotriletes striatus
Pseudoceratium turneri
Sphagnumsporites australis
Taurocusporites sp.
Trilobosporites trioreticulatus

Sidewall core 7 at 4243 feet

Araucariacites australis
Acanthotriletes levidensis
Balmeisporites holodictyus
Cyathidites australis
Classopollis torosus
Concavisporites sp.
Cicatricosisporites australiensis
Gleicheniidites circinidites
Gonyaulax sp.
Hystrichosphaeridae
Lycopodiumsporites austroclavatidites
Osmundacidites comaumensis
Pilosisporites notensis
Podocarpidites ellipticus
Pityosporites grandis
Sphagnumsporites australis
Trilobosporites trioreticulatus

The presence of C. euskirchensoides and B. holodicytus in sidewall cores 6 and 7 indicate definite Albian age. Support for this age is given by the microplankton species Gonyaulax cf. edwardsi and Pseudoceratium turneri.

References

BALME, B.E., 1957: Spores and pollen grains from the Mesozoic of Western Australia. C.S.I.R.O. Coal Res. Sect. Ref. T.C. 25, 1 - 48.

BALME, B.E., and HENNELLY, J.P.H., 1956: Trilete Sporomorphs from Australian Permian sediments. Aust. J. Bot., 4 (3), 280.

COOKSON, I.C., and DETTMANN, M.E., 1958: Some trilete spores from Upper Mesozoic deposits in the eastern Australian region. Proc. Roy. Soc. Vic., 70 (2), 45 - 128.

TABLE 1

DISTRIBUTION OF SELECTED SPECIES

Species	Core No. (7)	(6)	(5)	(4)	(3)	1	2	(2)	(1)	6	7	8	9
Araucariacites australis	X	X	X										
Acanthotriletes levidensis	X	X		X									
Balmeisporites holodictyus	X	X											
Ceratosporites equalis		X											
Cic. australiensis	X	X	X	X	X								
Cing. euskirchensoides		X	X										
Foveosporites canalis		X			X								
Lycopod. austroclavatidites	X	X	X	X	X								
Pilosisporites notensis	X	X	X										
Trilobo. trioreticulatus	X	X											
Microretic. parviretus			X										
Acquitriradites spinulosus				X									
Callialasporites trilobatus				X									
C. dampieri				X	X		X	X	X				
Cyclosporites hughesi				X	X								
Lycopod. circolumenus				X	X								
Murospora florida					X								
Laricoidites reidi						X	X	X	X				
Callialasporites segmentatus						X	X						
Lycopod. rosewoodensis						X	X						
Nuskoisporites sp.										X	X	X	X
Acanthotriletes ericianus										X	X	X	X
Cirratriradites splendens												X	X
Neoraistrickia ramosus													X
Vesicaspora sp.										X	X	X	X
Verrucosisporites sp.										X			X
Camptotriletes sp.											X		

Note: Sidewall core numbers denoted thus: (6)

APPENDIX 3

PART B

DELHI-SANTOS GIDGEALPA NO. 1

PALAEONTOLOGICAL REPORT ON CORES NOS 12 to 22

Core No. 12. 9415 to 9425 feet

Rock types include (1) richly fossiliferous, grey, argillaceous limestone with pale green chert patches scattered through the rock, and (2) partially recrystallized, calcareous layers interstratified with calcareous tuffaceous layers.

A. Several species of polymerid trilobites occur in the light grey limestone. Numerous sections of tests occur on the surface of the core. Most of these trilobites cannot be assigned to known genera and are probably new. Pygidia and fragmentary cranidia of Dorypyge occur but none of this material is conspecific with that described by Whitehouse (1945). An upper Middle Cambrian age was originally suggested for this material. The commonest trilobite is a small species of a solenopleurid. The brachiopod Acrotreta and the gastropod Helcionella are also present.

B. The following silicified agnostid trilobites were obtained from the rock type (2) above at a depth of 9420 feet:

(i) Leiopyge laevigata - abundant fragments.

(ii) Leiopyge laevigata armata - this is represented by a fragmentary cephalon with part of the glabella, basal lobes, and the left posterolateral spine. Another fragment found in the same piece of rock consisted of the two thoracic segments articulated with the anterior one-third of the pygidium. The material is now partly disarticulated but it was noted that only the posterior thoracic segment carries long spines directed upwards and posteriorly as figured in Westergaard (1946), pl. 13, fig. 33.

(iii) Agnostus sp. - a single cephalon, possibly new, but combining features of neglectus and pisiformis. However, it clearly differs from those figured by Westergaard (1946), pl. 13, figs 7 and 10.

(iv) Peronopsis sp. - an incomplete pygidium with axis damaged, is probably Peronopsis. A node opposite the waist is present and there is a suggestion of a shallow transverse furrow behind the node. The axis reaches the marginal furrow and so divides the pleurae. The posterior part of the rim is sharply truncated but its anterior portion is directed slightly forward so that it touches the posterior part of the axis. The base of the left posterolateral spine is preserved.

(v) Delagnostus dilemma - two imperfect pygidia of presumably immature specimens. In the larger specimen there is what might be called a vestigial border furrow of about the same length as the anterior lateral furrow which does not cut the edge of the test. This is the only trace of a "marginal furrow" which could questionably be said to mark off a "border".

It is continued towards the rear as a faint line. As these specimens have no definite marginal furrow they are easily distinguished from other agnostids. Further, they seem to be within the range of variation for the species as discussed in the addendum to the description given by Öpik (1961), p. 90.

(vi) Pseudophalacroma dubium - the posterior portion of the cephalon is damaged but it appears to be this species.

(vii) ?Hypagnostus - portion of a pygidium.

(viii) Agnostid fragments - unidentified because too fragmentary.

From these widely distributed pelagic agnostids the age of these rocks is definitely uppermost Middle Cambrian, or the zone of L. laevigata of the Swedish agnostid scale.

Öpik (1961) has discussed the time of Leiopyge laevigata in Australia. His biostratigraphic chart (fig. 15) summarizes the known data for the Selwyn Range and Sweden. A comparison of the well material with the data for the Selwyn Range indicates that:

(a) None of the polymerid species indicated in the chart has yet been recognized in the well material.

(b) Of the agnostids, Delagnostus dilemma in particular and L. laevigata armata indicate that the age is the zone of L. laevigata of the Swedish scale or top of laevigata II or bottom of laevigata III of the tri-fold zone of L. laevigata of Öpik (1960). Actually Delagnostus dilemma might have a greater range than in Öpik's chart. It might range to the level of D21 or higher instead of Holteria arepo being extended down to overlap its range. Only additional material can improve this correlation but with the material in hand a laevigata II/III age must be given, i.e. uppermost Middle Cambrian in age. However, an age high in laevigata III might be indicated by additional material. A correlation with the upper part of the Devoncourt Limestone and Steamboat Sandstone in Queensland is indicated. This new occurrence of the laevigata fauna substantially extends the area of the laevigata seas in Australia.

Core No. 13. 9798 to 9808 feet

Trilobite tracks only are present on bedding planes of dark grey shale.

Core No. 14. 9989 to 9999 feet

No fossils seen, but examination only cursory.

Core No. 15. 10,280 to 10,290 feet

Possible trilobite tracks on bedding planes in dark grey shale (dip steep, and considerable fracturing of rock in core).

Core No.16. 10,488 to 10,498 feet

No fossils found. Carbonate content small and dolomitic. Essentially a tuffaceous rock.

Core No. 17. 10,828 to 10,838 feet

Graded tuffs, agglomerates, and small amounts of mottled limestone with tuffaceous portions. Scanty trilobite remains occur in the more calcareous layers. None was obtained under the hammer, but after acid leaching fragments were isolated by further preparation. The rock contained three fragments of cranidia of a species of a solenopleurid (near Solenopleura) and fragments of indeterminate species. Age is Middle Cambrian - no further determination possible with the material in hand. (See footnote at end of Appendix).

Core No. 18. 11,068 to 11,078 feet

No fossils found.

Core No. 19. 11,366 to 11,391 feet

At 11,366 feet, a dark coloured nodular to mottled limestone and calcareous shale; no fossils observed.

At 11,378 feet to 11,378 1/2 feet, the rock varies from a mottled, argillaceous limestone with thin laminated calcareous siltstone to alternating and well-bedded siltstone and silty limestone. There is a considerable amount of tuffaceous clastics within the rock as well as abundant pyrite. Only cross-sections of trilobites and brachiopods seen on splitting this scantily fossiliferous rock. In an acid preparation a poorly preserved pygidium of an agnostid was found. This may possibly be referred to Hypagnostus which would indicate a Middle Cambrian age. An associated fragmentary pygidium of a possible Dorypyge also suggests an upper Middle Cambrian age. The material recovered is poorly preserved, but a Middle Cambrian age is indicated and an upper Middle Cambrian age may be possible.

Core No. 20. 11,391 to 11,407 feet

The rock is a dark grey to black shale with some calc-shale interbeds. Sparse brachiopod and trilobite fragments are visible but no material was isolated from the piece of core examined. No age determination is possible.

Core No. 21. 11,675 to 11,719 feet

Both rock types and internal structures are variable. Rock types include light coloured crystalline and dark blue-grey argillaceous limestone and black shale to siltstone. Intraformational limestone breccias and conglomerates with oolitic limestone and pale grey dolomite pebbles alternate with well-bedded limestones and calc-shale between 11,686 and 11,690 feet. Abundant oolitic limestone also occurs in intraformational conglomerates between 11,692 feet and 11,700 feet. Periodic strong current action is also indicated by marked cut and fill structures between shale and underlying limestone beds. Pale grey, well-bedded, dolomitic limestone (unfossiliferous) occurs at 11,691 feet.

Grains of igneous material (tuff fragments) occur scattered within some of the limestone beds, but especially in the shale or siltstone. Pyrite is an abundant accessory and even replaces tests of some fossils. It occurs in all rock types.

Fossils occur in both limestone and shale or siltstone and some parts of the core are very fossiliferous.

Many species of polymerid trilobites occur but the majority have yet to be identified. The following forms have been recognized in material prepared so far:

Dorypyge sp.

Pygidia and other fragments were found at 11,713 feet and 11,715 feet. The fourth and fifth pygidial spines are thicker and longer than the rest, and so it recalls the Dorypyge sp. from Core No. 12. However, there are differences in the degree of furrowing of the pleural lobes. At any rate they are closely allied forms.

Solenopleuridae

A fragmentary cranidium of the same genus of solenopleurid that is the commonest polymerid in Core No. 12: it is possible that they are conspecific. In addition there is a single, damaged cranidium of another species of a possibly small solenopleurid, probably very close to one which occurs in Core No. 12.

Dolichometopidae

Several forms are present including Amphoton.

(?)Tosotychia sors

There is a poorly preserved and fragmentary cranidium which is tentatively referred to this species.

The following agnostids were obtained from this core:

Grandagnostus sp.

This is a species of Grandagnostus best compared with G. imitans (Öpik) and G. marginatus (Brogger) but differing from both. On the cephalon of one specimen from 11,713 feet there seems to be a very short and faint posterior axial furrow. (Basal lobes are not present). The length of the cephalon is slightly greater than the width but one specimen shows the reverse. Where a node is seen it is more posterior to that in the figured imitans. The thin border when viewed from above almost disappears towards the posterior part of the cephalon. Overall the cephalon is not unlike that of marginatus (Westergaard, 1946, p. 45, fig. 1).

On the best preserved pygidia there are faint traces of the axis and perhaps a terminal node. The width of the border is variable and specimens are present in which the border, widest at the rear, is much wider than in the figured imitans. The species is probably new.

(?)Grandagnostus sp.

From 11,688 feet, there is a pygidium (immature form) with axis faintly outlined. It reaches the marginal furrow which marks off a very wide convex border of subequal width. The axis bears an elongated or keeled node but no terminal node is visible.

The pygidium is tentatively assigned to Grandagnostus despite the unusual width of the border. Thus it is to be compared with Phalacroma sp. (Westergaard, pl. 16, fig. 3, 1946) which it somewhat resembles.

cf. Agnostus neglectus

There are two cephala, neither complete, of an agnostid which compares with this species. In the absence of associated pygidia the material is tentatively assigned to this species.

Hypagnostus sp.

A fragmentary cephalon (11,688 feet) best compared with H. exsculptus and H. sulcifer.

Phosphatic brachiopods occur abundantly in limestone but especially in the black siltstone. None has been determined so far.

Fragments of a shell replaced by pyrite occur at 11,688 feet. They are peculiar in that they are ornamented with rows of chevron shaped structures. Its affinity is unknown. Calcareous rods, L-shaped in cross-section, and longitudinally striated, up to a centimetre long, occur in dark coloured, argillaceous limestone at 11,703 feet. Their affinities are unknown.

From the trilobites listed it would seem that the core is late Middle Cambrian in age. Of the polymerids discussed, the Dorypyge sp. and two species of solenopleuridae are similar to their representative of uppermost Middle Cambrian in Core No. 12. Tosotychia sors occurs in the Roaring Siltstone and the lower half of the Devoncourt Limestone of the Selwyn Range. The range covers the Swedish zones of Solenopleura brachymetopa and the lower part of Leiopyge laevigata.

The Grandagnostus sp. belongs to the species group of Grandagnostus with celpahlic border. Two species of this group have been recorded by Öpik (1961), one from the V-Creek Limestone and the other from the Roaring Siltstone. G. imitans from the V-Creek Limestone is different from the Core No. 21 species. The species from the Roaring Siltstone cannot be determined because of poor preservation but its age is the zone of Ptychagnostus lundgreni-Goniagnostus nathorsti. The species from Core No. 21 may have a similar age.

G. marginatus with which the present form has also been compared occurs in both the P. lundgreni - G. nathorsti zone and the S. brachymetopa zone in Sweden.

Agnostus neglectus occurs in Sweden in the laevigata and brachymetopa zones and Öpik (1961) has figured a pygidium Agnostus sp. L. cf. neglectus from the top of the laevigata zone of the Selwyn Range.

Hypagnostus exsculptus and H. sulcifer occur in the brachymetopa and laevigata zones respectively.

Summing up, it would seem that the age of the fauna is probably late Middle Cambrian, with a strong preference for the brachymetopa zone of the Swedish scale. However, it could belong to either laevigata or nathorsti zone. Additional material may decide this.

Core No. 22. 12,021 to 12,031 feet

The rocks are well laminated, pale grey shale or siltstone. No fossils were observed. Age unknown.

REFERENCES

ÖPIK, A.A., 1956: Cambrian geology of Queensland. In El Sistema Cambrico, Su Palaeogeografia y El Problema de Su Base, 2, 1-24. 20th int. geol. Cong. Mexico. Reprinted in Öpik, A.A., and others, 1957: Bur.Min.Resour.Aust.Bull. 49.

ÖPIK, A.A., 1960: Cambrian and Ordovician geology (of Queensland). J. geol. Soc. Aust., 7, 91-103.

ÖPIK, A.A., 1961: The geology and palaeontology of the headwaters of the Burke River, Queensland. Bur.Min.Resour.Aust.Bull. 53.

ÖPIK, A.A., 1963: Early Upper Cambrian fossils from Queensland. Bur.Min.Resour.Aust.Bull. 64.

WESTERGAARD, A.H., 1946: Agnostidea of the Middle Cambrian of Sweden. Avh. sver. geol. Unders., Ser. C, 394, 1-66.

WESTERGAARD, A.H., 1947: Supplementary notes on the Upper Cambrian trilobites of Sweden. Avh. sver. geol. Unders., Ser. C, 489, 1-30.

WHITEHOUSE, F.W., 1939: The Cambrian faunas of north-eastern Queensland: Part 3, the polymerid trilobites. Mem.Qld Mus., 11(3), 179-282.

WHITEHOUSE, F.W., 1945: The Cambrian faunas of north-eastern Queensland: Part 5, the trilobite genus Dorypyge. Mem.Qld Mus., 12(3), 117-123.

Footnote:

Dr A.A. Öpik, Bureau of Mineral Resources, Canberra, says the age of Core No. 17 is early Upper Cambrian, referring it to the late Mindyallan zone of Glyptagnostus stolidotus of Queensland. All the fossils recovered from this core are known from this zone. Of the trilobites, three species belong to the known genera Blackwelderia, Liostracina, and Meteoraspis. Two others belong to new genera of the families Nenomoniidae and Cedariidae. The solenopleurid trilobites mentioned by Dr Daily from this core are stated by Dr Öpik to belong to an unpublished genus of the family Solenopleuridae. They, too, are known from the G. stolidotus zone of Queensland.

ADDENDUM TO APPENDIX 3 - PART B

DELHI-SANTOS GIDGEALPA NO. 1

PALAEONTOLOGICAL REPORT

ON CORES NOS 11, 23, 24, 27, 29, AND 30

Core No. 11. 9140 to 9151 feet

The rock is a black siltstone with thin, interbedded lenticular bands of dark blue-grey silty limestone. The siltstone is very finely laminated and shows abundant sericite on the bedding planes. A few bands of pyrite occur in the siltstones.

The beds are scantily fossiliferous and contain:

(i) About five specimens of agnostid trilobite, possibly a Ptychagnostus, all in siltstone. These could not be determined because of the poor preservation. Only one species is involved.

(ii) An indeterminate fragmentary thoracic segment of a polymerid trilobite.

(iii) Phosphatic brachiopods in both siltstone and limestone. They include Lingulella and Acrotreta, both of which are long-ranging.

No definite age for this core can be determined from this material.

As it is stratigraphically above the upper Middle Cambrian of Core No. 12 it is assumed that it is either of uppermost Middle Cambrian or early Upper Cambrian age. If the agnostid is a Ptychagnostus, then a Middle Cambrian age is likely.

Re-examination of Core No. 13. 9798 to 9808 feet;
Core No. 14. 9989 to 9999 feet; Core No. 15. 10,280 to 10,290 feet

Trilobite tracks are abundant in Core No. 13, particularly in the coarser grained parts. No other fossils were seen.

No fossils were found in Cores 14 and 15. Core No. 15 was so badly fractured that it was almost impossible to split the rock along the bedding. Chips labelled "Mainly Core No. 15, some Core No. 14" were examined under the microscope. Definite trilobite tracks were found on a small chip of rock different from most of the sample, which is dominantly a chlorite rich rock.

The age of the interval cannot be given but a Cambrian rather than an Ordovician age seems more likely.

The fault postulated to explain the presence of Upper Cambrian rocks below the Middle Cambrian probably occurs in the interval between Cores 14 and 15, the latter being at or just below the fault zone. This seems likely because of the much steeper dips observed in Core No. 15 and below.

Core No. 23. 12,239 to 12,264 feet; Recovered 11 1/2 feet

At 12,239 feet, the rock was an alternating thin and wavy bedded, recrystallized, light grey, tuffaceous limestone and dark grey, tuffaceous siltstone. Green tuff fragments were common in the limestone. The rock is fossiliferous and in some parts the fossils are silicified. At 12,247 feet, the rock was a medium grey limestone. At 12,249 feet, the lithology was comparable to that at 12,239 feet. The interval 12,247 to 12,249 feet is exceedingly fossiliferous and much of the contained fossils are silicified. About half of the fossiliferous material discussed below was etched out by officers of Australian Mineral Development Laboratories, and supplied to the author.

The following agnostid trilobites were obtained:

(1) Ptychagnostus gibbus

This is represented by about ten cephala, mainly immature specimens. All have the posterolateral spines characteristic of gibbus and agree with that species in general shape and appearance. They agree with Whitehouse's description for the Queensland form (Whitehouse, 1936, p.85). The most noticeable differences from the forms figured by Westergaard (1946) is that the posterior lobe of the glabella is strongly pointed at the rear in all except one of the specimens and actually overlaps the posterior margin. However, in more mature cephala the rear is more rounded and does not overlap the margin as in the figured material. Basal lobes are either entire or separated. Both furrowed and smooth cheeked forms are present.

There is another immature cephalon, at first glance a peronopsid, which is a Ptychagnostus with a very weak preglabellar furrow. Its posterior lobe is bluntly pointed at the rear as in one of the cephala allocated to gibbus above. It differs from this in that the posterolateral spines which are complete are only rudimentary, otherwise it is close to gibbus. As well, the basal lobes are long and narrow. Whitehouse's figures of Ptychagnostus purus are not good enough to allow full comparison, but perhaps the specimen can be regarded as belonging to the gibbus complex, possibly as a sub-species.

In the pygidium the overall aspect is of gibbus, but there are several notable differences from Westergaard's figured material.

(i) In lateral view the anterior half of the second axial segment is seen to be nearly horizontal with result that the diagnostic axial spine is derived directly from the posterior half of the segment and not as is shown in plate 9, figure 18b.

(ii) In lateral view the course of the furrow between the second and third lobes is quite different from the figure 18b, plate 9. It issues from the axial furrow, is directed upwards at a steep angle, but is inclined to the rear. At a height level with the top of the first segment it is directed almost horizontally or upwards at a low angle to the rear, causing the second lobe to overlap the third segment for almost half the total length of lobe 2. In one specimen the axial spine is completely preserved. It is directed up and back at an angle of about 45^{o}. The spine is compressed

laterally (also seen in another specimen). Midway between the tip and its origin there is an anterior constriction so that the spine narrows to about half its former width. The curvature of the upper and posterior part of the spine is slightly convex to the rear. The length of the spine between its apex and the furrow delineating its rear portion is slightly less than the length of the third lobe between the same point and the termination of the axis.

(iii) The posterior axial lobe is consistently more pointed and narrower and is not expanded anteriorly as is shown for all Westergaard's figured material. However, Whitehouse's figures of gibbus show the normal expansion.

(iv) The anterior part of the posterior border is curved forward to meet the posterior median furrow which divides the pleurae.

(v) Very small but distinct posterolateral pygidial spines are present. According to Öpik (1956), a form of gibbus with pygidial spines was described by Whitehouse as Goniagnostus purus. However, the posterior part of the axis of Ptychagnostus purus (Whitehouse) is expanded and in this regard is different from the narrow axis of the material from the well.

Only three pygidia are sufficiently well preserved to show these differences from Westergaard's figured specimens of gibbus. It is not known how constant these characters are.

Summing up, the material from the well can be placed in the Ptychagnostus gibbus species complex. It would seem that the variant Ptychagnostus purus is present. Whitehouse (1939, p.259) states that purus is from a slightly higher horizon than gibbus which he figured earlier and also that purus "is hardly to be distinguished from that species". If this is correct, then the material from the well would be from high in the gibbus zone.

(2) Ptychagnostus sp. cf. Ptychagnostus seminula (Whitehouse)

This is a species of Ptychagnostus represented by two imperfect cranidia referable neither to gibbus nor to purus as the glabella tubercle is centrally placed. It might be seminula which appears to have a centrally positioned tubercle in Whitehouse's figure, although in his description this is not mentioned. Ptychagnostus seminula occurs high in the gibbus zone and is an associate of Ptychagnostus purus.

(3) Hypagnostus spp.

(i) Hypagnostus cf. truncatus

There are several large cephala and fragments of a species of Hypagnostus of the truncatus type. The species bears an elongated node on the anterior part of the glabella. At least one specimen shows weakly furrowed cheeks. Vague suggestions of remnant glabellar structures anterior to

the present lobe occur on some specimens. In the pygidium assigned to this species there is considerable variability in the length of the axis, the pointed terminal end of which may be depressed when posterior to a weak transverse furrow. The pleurae are separated.

(ii) There are several small cephala of a Hypagnostus different from (i). The convexity of the shields is variable as well as the width and slope of the border and depth of furrows. The glabella is relatively wider and less truncate than that of species (i). Whitehouse's figure of H. vortex is not good enough to allow comparison with this material.

The pygidia assigned to the cephala are quite characteristic. The axis is very wide, about half the total width, is almost parallel sided to slightly bulbous and bears an elongated node in front of its centre. In one specimen this is drawn out into a keel. Faint lateral furrows are visible on the anterior part of the axis. The pleurae are short and narrow, widely separated as in Kormagnostus and have their posterior extremities situated just behind the widest portion of the axis which extends to the flattened wide border. This tapers rapidly to the anterolateral corners where it is very narrow. If the cephala and pygidia are correctly associated, then the species cannot be H. vortex if Whitehouse's combination of cephalon and pygidium is true.

(iii) Hypagnostus sp. cf. H. vortex

There is a single immature cephalon, compressed on its right side, that is referable to Hypagnostus.

The glabella is "sub-circular" and appears to have a small central node. Whitehouse's figure of vortex is too poor to be used for direct comparison. However, the overall aspect recalls vortex and this is where the specimen might finally be placed. H. vortex is an associate of both gibbus and atavus (Öpik, 1956).

(iv) (?)Hypagnostus sp.

Two characteristic pygidia, longer than wide, were found at the depth 12,247 to 12,248 feet. The axis is narrow, widest anterior to short lateral furrows, compressed and weakly keeled. Apart from an elevated central node, there is a terminal node.

The pleurae are divided by a short posterior furrow into which the anterior part of the posterior border is directed. The material is tentatively identified as Hypagnostus sp.

(4) (i) Peronopsis cf. Peronopsis fallax group

Whitehouse figured a Peronopsis from his Dinesus Stage as Diplorhina normata, but this species has not so far been found in Core No. 23. There are about 15 to 20 cephala, mainly very immature specimens which are comparable with Peronopsis fallax. The pygidia assigned to

the cephala are quite variable, but the general aspect is of fallax. Posterolateral spines are always present, but on several specimens there is in addition either a tendency to a rudimentary posterior spine caused by a posterior flaring of the border or a well developed posterior spine is present. One specimen, an immature form, appears to have a terminal axial node.

(ii) Peronopsis sp.

Three imperfectly preserved cephala of another species of Peronopsis differ from the last mainly by having a much larger and less depressed anterior glabellar lobe and by having the highest point on the cephalon at the slightly elongated sub-central node. There are two pygidia of a two-spined Peronopsis with a depressed axial terminus and a posterior furrow separating the pleurae which may represent this species.

(5) (?) Tomagnostus sp.

There are two fragmentary pygidia whose pygidial axis recalls Tomagnostus fissus. However, the transverse furrows are weaker than in T. fissus and the axis also narrower. The species has two short posterolateral spines and a posterior median spine (or tendency to a spine as in one specimen) on the border which is divided at the rear. The axis almost reaches the posterior border. These are identified as doubtful Tomagnostus sp. especially because no cephala have been found.

There are more polymerid than agnostid trilobites. The following is a summary of this study.

(i) Nepeidae

This is a new genus and species of a nepeid. Öpik (1963) recorded that two genera of nepeids have been found in the Middle Cambrian; Nepea and a new genus, the latter appearing in the zone of Ptychagnostus gibbus. The material from the well, a single cranidium, may be congeneric and even conspecific with the Northern Australian species.

(ii) Solenopleurids

(a) A strongly tuberculate solenopleurid is represented by two cranidia and a fragmentary pygidium referred to the same species.

(b) There are several immature and other cranidia and three free cheeks of a species of solenopleurid. The cranidia appear to represent the common solenopleurid genus of Cores 12 and 21. The species from this core differs from the younger species. All specimens are from 12,244 feet or 12,239 feet.

(iii) Dorypyge sp.

About thirty pygidia, numerous free cheeks, hypostoma, and several cranidia of a species of Dorypyge have been examined. The species is

distinct from those figured by Whitehouse from the late Middle Cambrian of Queensland.

(iv) Amphoton (Sunia) sp.

Numerous cranidia, free cheeks, pygidia and hypostoma, and other parts of two species of Amphoton (Sunia) occur within the interval sampled. A number of immature forms are present.

(v) (?)Anomocaridid

An anomocaridid-like trilobite is the most abundant trilobite species in the core. It is characterized by having extremely narrow fixigenae, either narrower or about equal in width to the palpebral lobes. These almost touch the glabella at the level of the occipital furrow.

In addition to the above there are several fragments of polymerid trilobites which have not been identified.

Other members of the fauna are:

(i) Sponges

Enormous numbers of sponge spicules are found in the acid residues. Some bands contain about five percent or more of the volume of the rock. Spicule types include curved stauracts with split tips, rectangular and aberrant pentacts as well as pentacts with split tips. Hexact spicules also occur and one specimen has a split tip. Similar spicules have been described by Öpik (1961) as Pleodioria from late Middle Cambrian rocks of Queensland.

Other types of spicules undoubtedly represent other types of sponges. A most characteristic form is a pentact consisting of a small simple cross with a greatly thickened torpedo-shaped vertical ray. One example with a short and thick lateral branching off the vertical ray at about 45° was found. Chancelloria spicules are also present but rare.

(ii) Helcionella sp.

A single specimen has been found.

(iii) Brachiopoda

Several genera are well represented. They include Acrotreta sp.

Conclusions

The age of the fauna is the zone of Ptychagnostus gibbus of the Swedish scale.

The significant fossils for dating, with known published ranges are:

(i) Ptychagnostus gibbus (Goniagnostus purus) high in gibbus zone.

(ii) Ptychagnostus sp. cf. P. seminula - P. seminula top of the gibbus zone, bottom of the atavus zone.

(iii) Hypagnostus cf. truncatus - H. truncatus in the atavus and parvifrons zones in Sweden.

(iv) Hypagnostus cf. vortex - H. vortex occurs in both the gibbus and atavus zones.

(v) Peronopsis cf. P. fallax - P. fallax ranges from the Paradoxides pinus zone immediately below the gibbus zone to the parvifrons zone.

(vi) (?)Tomagnostus sp. - Tomagnostus ranges from the gibbus to the parvifrons zone.

(vii) Nepeidae - ranges from the gibbus zone.

From this, a position high in the gibbus zone of the Middle Cambrian is warranted. This should correspond to the atavus-gibbus zone of Öpik's Australian scale, i.e. the overlap of the Ptychagnostus gibbus and P. atavus zones of the Swedish scale.

Core No. 24: 12,605 to 12,615 feet

Two samples from 12,607 feet and 12,609 feet were received.

1. The small piece of core from 12,607 feet was a light grey, somewhat crystalline, silty limestone, possibly dolomitic, as it broke down slowly in acid. Thin black silt partings occur within the rock. The limestone is fossiliferous and contains the following:

(i) Agnostids (two fragments).

One specimen is a fragmentary cephalon which at first glance appears to be a species of Phalacroma with a wide border and a posteriorly placed elongated node. However, vestigial furrows are just discernible - outlining anterior and posterior glabellar lobes, a pre-glabellar furrow and vestigial basal lobes. This suggests an effaced Ptychagnostus cephalon, evenly convex from side to side. Öpik (1956) mentions a form "intermediate between Ptychagnostus and Phalacroma" from the gibbus and atavus zones of the Camooweal region, Queensland. This fragment is probably referable to his "no-basal-lobes" ("Specialite de la maison").

(ii) Fragments of polymerid trilobites. After digestion in acid the rock is seen to contain abundant material, but none at present has been further treated for study. The only fragment identified is an incomplete pygidium of a dolichometopid.

(iii) Brachiopods; common in this part of the core. A large calcareous orthoid brachiopod cf. Eoorthis is particularly common but phosphatic shelled forms are also present.

(iv) Hyolithids. Abundant; species have heart-shaped, circular, triangular and sub-triangular cross-sections. Longitudinally grooved and ridged forms are common.

(v) Pelagiella-like gastropods. As internal moulds in rock treated with acid.

In this section of the hole the fossils are difficult to prepare for study as the matrix is too hard for the needles used in preparation.

2. A small piece of core about three inches long from a depth of 12,609 feet was richly fossiliferous. Two lithologies occur. One is a black, calcareous and pyritic siltstone interbedded with coarsely crystalline, dark grey limestone. In the siltstone poor imprints of brachiopods and trilobites are common. Bedding plane slip (slickensides) is noticeable. The limestone is richly fossiliferous. The fauna obtained is as follows:

(i) Peronopsis cf. P. scutalis

There are several fragmentary pygidia and cephala referable to Peronopsis. The axis of the pygidium bears an oval shaped node just in front of the mid-point. It has a waist and its posterior end almost reaches the border furrow but just fails to separate the pleurae. Pygidial spines are apparently lacking. The axis is narrower and more pointed than in Whitehouse's figures of P. elkedraensis and P. normata, and so it is similar to P. scutalis. The fragmentary cephala are unlike those of P. scutalis. A weak and short preglabellar furrow is present. Without better material, the specimens are tentatively placed in the P. scutalis group.

(ii) Another very fragmentary cephalon has a complete and well developed preglabellar furrow which entirely divides the cheeks, and is similar to a Ptychagnostus. The specimen may represent a species of that genus.

(iii) Pagetia cf. P. significans

There is a species of Pagetia represented by a number of crushed cephala and pygidia in the black siltstone, and two fragmentary pygidia in limestone. Its specific identity with P. significans (Etheridge) cannot be proved but generally it looks like significans. The terminus of the pygidium lacks the long spine of some species of Pagetia and instead bears a median tubercle as in significans. Öpik (1956) has noted that there are several species of Pagetia in Northern Australia which belong to a close group. The range of Pagetia is shown on Öpik's chart as extending from the gibbus zone down to the upper part of the Redlichia zone.*

*Footnote:

After this was written a complete cephalon of a Pagetia was found in the limestone from 12,609 feet. This is very close to P. significans but as the described material is poorly figured identification is not certain. Palpebral ridges are present in the cephalon from the well. Both Whitehouse and Etheridge omit this in their remarks on the type material although in Whitehouse's photograph of the lectotype a suggestion of a palpebral ridge is seen.

(iv) Dolichometopidae

Species "a". There are at least two cranidia of a species which combines features of a dolichometopid and Zacanthoides. It has prominent metafixigenal spines and four pairs of glabellar furrows, only the posterior pair being strong and trifid. Pygidia assumed to belong to this species are fragmentary. The border is moderately wide and the axis has three rings and a terminus, the posterior lower part of which is connected to the anterior half of the border by a low raised, broad and convex ridge. The pygidium recalls Poliella. Öpik (1956) said under the title "bathyuriscids" that "some of them recall Poliella (Walcott), but represent what is probably an endemic development (with intergenal spines) together with Fouchouia, mentioned by Whitehouse as occurring in the Thorntonia area". He also said that they range from the base of the gibbus zone.

The same can be said about the species above, but this can only be confirmed by comparison with the Queensland material, which cannot be carried out at present.

Species "b". There are several partly prepared specimens of another species with four pairs of glabellar furrows, the posterior pair being the strongest and perhaps trifid. However, they lack both the metafixigenal spines and occipital spine of species "a" discussed above. They also differ in other details and recall Bathyuriscus but probably belong to another genus of dolichometopidae. Only one other common type of pygidium is found in this part of the core and this may belong to Bathyuriscus. It recalls Fouchouia.

(v) Nepea sp.

A single fragmentary cranidium of a Nepea occurs in the black siltstone. Öpik (1963) said that Nepea is confined to the Middle Cambrian, appearing first in Central Australia with Xystridura. Only one species, N. narinosa, has been described but this occurs high in the Middle Cambrian and is clearly different from the material from the well.

(vi) Brachiopoda

Numerous black phosphatic shelled brachiopods occur in the limestone at 12,609 feet. Acrotreta is exceedingly abundant. Iphidella and Lingulella are some of the other forms present. A characteristic four-horned or spinose species is also common.

3. A black coloured species of conodont in Core No. 24 at 12,609 feet. The specimen is incomplete, broken and possibly compressed laterally. It can be placed in the Distacodontidae. There are possibly two separate basal cavities (flattening may have produced this effect) which seem to extend to the oral region as in many Cambrian conodonts. This is the first record of conodonts found in South Australia.

Conclusions

The age of the fauna is the Ptychagnostus gibbus zone of the Middle Cambrian.

The fossils which are useful for dating are given below, together with their known ranges as given by Öpik (1956) and other sources.

(i) "No-basal-lobes" - from the lower part of the gibbus into the atavus zone.

(ii) Peronopsis cf. P. scutalis - P. scutalis in Sweden ranges from the gibbus into the atavus zone. Öpik (1956) has extended its range on his chart down into the underlying Xystridura zone.

(iii) Pagetia cf. P. significans - Pagetia ranges from the upper part of the Redlichia zone up to the overlap of the gibbus and atavus zones (i.e. atavus-gibbus zone of Öpik, 1960).

(iv) Nepea sp. - Nepea ranges from the Xystridura zone to the upper part of the Middle Cambrian.

(v) Dolichometopidae - species "a" with intergenal spines. Such Poliella-like forms range down to the base of the gibbus zone.

Thus the fauna is probably that of the lower part of the Ptychagnostus gibbus zone.

Core No. 27. 12,773 to 12,783 feet

The rock is a pale grey to pink dolomite, vuggy and highly fractured with slickensides. Rhombs of dolomite and siderite are found in the vugs. The rock resembles a fault breccia.

No fossils were seen although there are possible organic structures. No age determination is possible.

Core No. 29. 12,950 to 12,960 feet

The rock has the same lithology as in Core No. 27. No fossils were found although there are vague outlines of rounded structures which could be organic. Possible oolites were noted. Acid preparations for both Cores 27 and 29 gave no results.

Core No. 30. 13,106 to 13,114 feet

Three samples from 13,109, 13,112, and 13,113 1/2 feet were examined. The rock is an agglomerate with fragments up to 2" across of volcanic and minor sedimentary rocks cemented by pale coloured dolomite and some calcite. Grains of pale green chlorite, ragged to rounded in outline, are conspicuous in many of the volcanic fragments. Blebs of chalcopyrite occur sporadically. Thin bands of pale grey, tuffaceous material are interbedded with the agglomerate. Numerous slickensides with sericitization are mainly confined to the finer bands. No fossils were seen in the matrix or tuff bands.

The included sedimentary rocks are black chert up to two inches across, dark blue-grey limestone, and pale grey dolomite. All are ragged in outline. Some of the chert nodules contain cores of dark blue-grey limestone.

In some of the chert fragments numerous circular cross-sections of the hyolithid "Biconulites" showing cone in cone structure occurred. Several longitudinal sections were seen and show the characteristic septa towards the apical end of the shell. The septal chambers are filled with silicified material. Sections of polymerid trilobites are also present. In some of the limestones associated with the chert these tribolite fragments are silicified. Fragmentary thoracic segments and an almost complete free cheek were obtained after treatment. This material is unidentified. The only other fossil found was a single elongated nodule of (?)Girvanella. No fossils were noted in the dolomite pebbles.

Biconulites is common in early Middle Cambrian faunas in Northern Australia, ranging up to the lower part of the Ptychagnostus gibbus zone. It also occurs in the early Middle Cambrian limestone of the Flinders Ranges and Yorke Peninsula. It also occurs in the Lower Cambrian of the Mount Lofty and Flinders Ranges.

Girvanella is unknown from the Lower Cambrian in South Australia but is common with Biconulites in the Middle Cambrian of southern and northern Australia.

The material from the well is probably low Middle Cambrian in age. This dating, of course, only applies to the included fragments. The agglomerates are somewhat younger.

APPENDIX 4

DELHI-SANTOS GIDGEALPA NO. 1

CORE ANALYSIS

Core analyses on cores and sidewall samples from Delhi-Santos Gidgealpa No. 1 were carried out by the Petroleum Technology Laboratory, Bureau of Mineral Resources, and by Core Laboratories, Incorporated. Since each of these organisations presents their results in a somewhat different manner the appendix has been presented in two parts.

Part A: Core analysis, by Bureau of Mineral Resources, of Cores Numbers 1 to 4. Porosities and permeabilities were determined using the Ruska apparatus with air at 30 psi. and dry nitrogen respectively as the saturating and flowing media. Oil and water saturations were obtained using the Soxhlet type apparatus.

Part B: Core analysis, by Core Laboratories, Incorporated, of Cores Numbers 9 and 27, and nine sidewall samples.

APPENDIX 4

PART A

Core No.	Depth From: To:	Lithology and (Formation)	Effective Porosity (% by vol.)		Absolute Permeability (millidarcys)		Avg. Density (gm/cc)		Fluid Saturation (% Pore Space)		Acetone Test		Solvent after Extraction		Remarks
			V.	H.	V.	H.	Dry Bulk	Grain	Water	Oil	Colour	Precipitate	Colour	Fluor.	
1	6500' 6501'	Fine Sandstone (Walloon)	N.D.	19	N.D.	Nil	2.25	2.76	6	1	Pale Yellow	Fair	Strong Yellow	Strong	Small sample only
2	6520'7" 6521'	Sandstone (Walloon)	19	19	192	196	2.19	2.72	55	Nil	Nil	Nil	Trace	Fair	
2	6521' 6522'	Sandstone (Walloon)	23	21	93	777	2.14	2.75	40	Nil	Faint Trace	Nil	Pale Yellow	Fair	Carbonaceous laminations present
3	6660' 6660'4"	Sandstone (Walloon)	21	20	40	99	2.17	2.74	46	Nil	Faint Trace	Nil	Nil	Fair	
3	6661'2" 6661'7"	Sandstone (Walloon)	21	19	93	44	2.18	2.72	46	Nil	Faint Trace	Nil	Trace	Fair	
4	7079' 7079'5"	Sandstone (Hutton)	18	19	27	57	2.24	2.77	31	Nil	Faint Trace	Nil	Trace	Fair	
4	7081' 7081 5"	Sandstone (Hutton)	17	16	9	11	2.28	2.73	33	Nil	Trace	Nil	Yellow	Fair	Carbonaceous laminations present
4	7082'4" 7082'9"	Sandstone (Hutton)	17	16	17	37	2.29	2.74	38	Nil	Trace	Nil	Yellow	Fair	Carbonaceous laminations present

N.B. Core No. 1: Freshly broken core piece showed abundant bright, bluish-white fluorescence and rare bright orange fluorescence.

APPENDIX 4

PART B

Core No.	Depth (feet)	Lithology and (Formation)	Permeability (Millidarcys)		Porosity (%)	Residual Saturation			Remarks
						Oil		Water	
			Hor.	Vert.		(% Vol.)	(% Pore)	(% Pore)	
9	8,613	Siltstone (Permian)	0.1	0.1	3.3	0.6	17.8	60.6	Dull brown fluorescence and very slight odour
27	12,773	Dolomite, vuggy and fractured (M. Cambrian)	2.6		6.2	-	0.0	63.0	Intergranular porosity = 2.7%) = 6.2% Vugs, fractures, etc. = 3.5%)
Sidewall Samples	7,796	Black shale (Permian)	-	-	-	-	-	-	Trace oil recovered on retorting
	7,840	Sandstone (Permian)	-	-	26.8	0.0	0.0	78.8	
	8,424	Sandstone (Permian)	-	-	36.5	0.0	0.0	94.8	
	8,528	-	-	-	-	-	-	-	Sample disintegrated in mud cake
	8,530	Sandstone (Permian)	-	-	22.2	0.0	0.0	92.9	
	8,532	Sandstone (Permian)	-	-	23.8	0.0	0.0	89.4	
	8,534	-	-	-	-	-	-	-	Sample disintegrated in mud cake
	8,706	Sandstone (Pre-Permian)	-	-	30.7	0.0	0.0	93.3	
	8,708	Sandstone (Pre-Permian)	-	-	24.5	0.0	0.0	92.3	

N.B. All sidewall samples too small for permeability determination.

APPENDIX 5

DELHI-SANTOS GIDGEALPA NO. 1

GAS ANALYSIS

The gasses dissolved in drillstem test recovery fluids from Delhi-Santos Gidgealpa No. 1 Well were analysed by gas chromatography by H.W. Sears of the Australian Mineral Development Laboratories.

Results of the analyses are tabulated in the following pages.

APPENDIX 5

GAS ANALYSIS

Gas	DST No. 3	DST No. 5	DST No. 5	DST No. 6, 12,757-12,783', Gassy Salt Water			
	8180-8218' Mud	8570-8620' Watery Mud	Sample just above tool	Gas Sample 800' above tool	Water and Gas 7000' above tool	Water and Gas 7700' above tool	Water and Gas 3260' above tool
Methane CH_4	10 ppm	10 ppm	4.8%	7.2%	13%	10%	11%
Ethane C_2H_6	x 1 ppm	1 ppm	620 ppm	0.19%	0.3%	0.3%	0.25%
Propane C_3H_8	x 1 ppm	3 ppm	30 ppm	55 ppm	300 ppm	300 ppm	200 ppm
iso-Butane C_4H_{10}	x 1 ppm	1 ppm	3 ppm	2 ppm	18 ppm	20 ppm	10 ppm
n-Butane C_4H_{10}	NDx0.2 ppm	NDx0.2 ppm	3 ppm	4 ppm	25 ppm	26 ppm	15 ppm

ND indicates not detected x indicates less than

APPENDIX 5

GAS ANALYSIS

Gas		DST No. 8, 6490-6525', Gassy Water		DST No. 9, 6490-6525', Gassy Water		
		1675' above tool	5035' above tool	3475' above tool	1292' above tool	273' above tool
Methane	CH_4	26.50%	31.00%	40.50%	39.00%	40.00%
Ethane	C_2H_6	2.45%	2.80%	3.00%	3.00%	3.10%
Propane	C_3H_8	0.57%	0.65%	0.59%	0.59%	0.57%
Propene	C_3H_6	x 5 ppm	x 5 ppm	x 5 ppm	NDx 2 ppm	NDx 2 ppm
iso-Butane	C_4H_{10}	0.15%	0.12%	0.14%	0.12%	0.29%
n-Butane	C_4H_{10}	0.20%	0.17%	0.10%	0.15%	0.41%
*1-Butene	C_4H_8	NDx 2 ppm	NDx 2 ppm	NDx 2 ppm	NDx 2 ppm	NDx 2 ppm
*2-Butenes	C_4H_8	10 ppm	x 5 ppm	15 ppm	x 5 ppm	20 ppm
iso-Pentane	C_5H_{12}	900 ppm	900 ppm	900 ppm	930 ppm	1000 ppm
n-Pentane	C_5H_{12}	750 ppm	700 ppm	800 ppm	730 ppm	920 ppm
*di-Methyl Butane	C_6H_{14}	35 ppm	30 ppm	35 ppm	40 ppm	50 ppm
*2-Methyl Pentane	C_6H_{14}	540 ppm	480 ppm	530 ppm	680 ppm	700 ppm
*3-Methyl Pentane	C_6H_{14}	200 ppm	165 ppm	200 ppm	240 ppm	290 ppm
n-Hexane	C_6H_{14}	340 ppm	290 ppm	300 ppm	400 ppm	455 ppm
+iso-Heptanes	C_7H_{16}	1030 ppm	885 ppm	1040 ppm	1440 ppm	1360 ppm
n-Heptane	C_7H_{16}	110 ppm	75 ppm	65 ppm	100 ppm	115 ppm
*iso-Octane	C_8H_{18}	680 ppm	500 ppm	540 ppm	700 ppm	860 ppm

ND indicates not detected x indicates less than

Balance of sample is nitrogen plus oxygen in each case.

* The accurate identification of this constituent is not certain because of the lack of a reference standard, but from the relative position of the elution peak, the assumed composition is most probable.

\+ This group consist of four separate isomers and the figure given is the sum of these.

APPENDIX 6

DELHI-SANTOS GIDGEALPA NO. 1

WATER ANALYSIS

Water recovered on drillstem tests and samples obtained from the Mooga Sandstone after completion as a water well were analysed by the Australian Mineral Development Laboratories. The results are given in tabular form on the following pages.

APPENDIX 6

DELHI-SANTOS GIDGEALPA NO. 1

WATER ANALYSIS

ARTESIAN WATER FROM MOOGA SANDSTONE

	Parts per Million	Assumed Composition of Salts	Parts per Million
Chloride, Cl	160	Calcium carbonate	12
Sulphate, SO_4	8	Calcium sulphate	-
Carbonate, CO_3	909	Calcium chloride	-
Nitrate, NO_3	Nil	Magnesium carbonate	7
Sodium, Na	796	Magnesium sulphate	-
Potassium, K	-	Magnesium chloride	-
Calcium, Ca	5	Sodium carbonate	1585
Magnesium, Mg	2	Sodium sulphate	12
Silica, SiO_2	-	Sodium chloride	264
Total saline matter	1880	Sodium nitrate	Nil
		Potassium chloride	Nil

Hardness

(as Calcium Carbonate)

Total	20
Temporary	20
Permanent	Nil
Due to calcium	12
Due to magnesium	8

APPENDIX 6

DELHI-SANTOS GIDGEALPA NO. 1

WATER ANALYSIS

DST No. 6, 12,757 - 12,783 feet

	Parts per Million	Assumed Composition of Salts	Parts per Million
Chloride, Cl	7,430	Calcium carbonate	137
Sulphate, SO_4	44	Calcium sulphate	-
Carbonate, CO_3	941	Calcium chloride	-
Nitrate, NO_3	Nil	Magnesium carbonate	39
Sodium, Na	5,412	Magnesium sulphate	-
Potassium, K	-	Magnesium chloride	-
Calcium, Ca	55	Sodium carbonate	1,316
Magnesium, Mg	12	Sodium sulphate	65
Silica, SiO_2	-	Sodium chloride	12,250
Iron, Fe	81	Sodium nitrate	Nil
Total saline matter	13,975	Potassium chloride	-
		Ferrous carbonate	168

Hardness

(as Calcium Carbonate)

Total	331
Temporary	331
Permanent	Nil
Due to calcium	137
Due to magnesium	49
Due to iron	145

APPENDIX 6

DELHI-SANTOS GIDGEALPA NO. 1

WATER ANALYSIS

DST No. 8, 6490 - 6525 feet
(through perforations in 9 5/8" casing)

	Parts per Million	Assumed Composition of Salts	Parts per Million
Chloride, Cl	767	Calcium carbonate	40
Sulphate, SO_4	64	Calcium sulphate	-
Carbonate, CO_3	1054	Calcium chloride	-
Nitrate, NO_3	-	Magnesium carbonate	14
Sodium, Na	1310	Magnesium sulphate	-
Potassium, K	-	Magnesium chloride	-
Calcium, Ca	16	Sodium carbonate	1802
Magnesium, Mg	4	Sodium sulphate	95
Silica, SiO_2	-	Sodium chloride	1264
Total saline matter	3215	Sodium nitrate	-
		Potassium chloride	-

Hardness

(as Calcium Carbonate)

Total	56
Temporary	56
Permanent	Nil
Due to calcium	40
Due to magnesium	16

APPENDIX 7

DELHI-SANTOS GIDGEALPA NO. 1

WELL VELOCITY SURVEY

for

DELHI AUSTRALIAN PETROLEUM LTD

Surveyed by

UNITED GEOPHYSICAL CORPORATION

PARTY 133

30th October, 1963

APPENDIX 7

DELHI-SANTOS GIDGEALPA NO. 1

WELL VELOCITY SURVEY

A velocity survey of the Delhi-Santos Gidgealpa No. 1 Well, located in South Australia at latitude 27° 56'46" South, and longitude 140° 04'56" East, was conducted by United Geophysical Corporation Party 133 on 30th October, 1963.

The well was surveyed from 7228 to 11,170 feet and a Schlumberger truck and cable were used to lower the geophone and measure depths. A Gulf Research Pressure Sensitive Geophone Model GCE-101 was used to record breaks.

A total of sixteen holes was laid out as shown on the survey plan. All holes were 1000 feet from the well. Holes north, east, south, and west of the well were shot.

The recordings were made through United Geophysical 1-27 Amplifiers. The first three traces record the geophone break with high, medium and low sensitivity respectively. Traces four and five show reference geophone breaks. Trace six is the time break and uphole trace. Radio time breaks were used. The time break is a sharp down-break on this trace and the uphole is shown as a subsequent up-break on the same trace.

The hole was cased to 7207 feet at the time of the survey and no shots were taken above this level.

Breaks were generally good and the recorded times are considered reliable. This well is a flank well and steep dips (up to 30°) are present. It should be noticed that a fairly wide spread in times for the same depths is present. This is due to the dip present in section. Times from the south shot points are consistently short while times from the north shot points are long.

An integrated Sonic Log was run and the results integrated with the seismic. The sonic was tied to the seismic points at the 8200-foot level. Only fair agreement between sonic and seismic times is present. Sonic times from 9800 to 10,400 feet are considered questionable.

If a dipmeter and directional survey are run on this well, integration of the velocity data with dipmeter data should give more concise velocity information. The results of the survey are considered reliable and consistent with known geological and structural data.

Fig. 10

SURVEY PLAT

WELL VELOCITY SURVEY

DELHI-SANTOS GIDGEALPA NO. 1

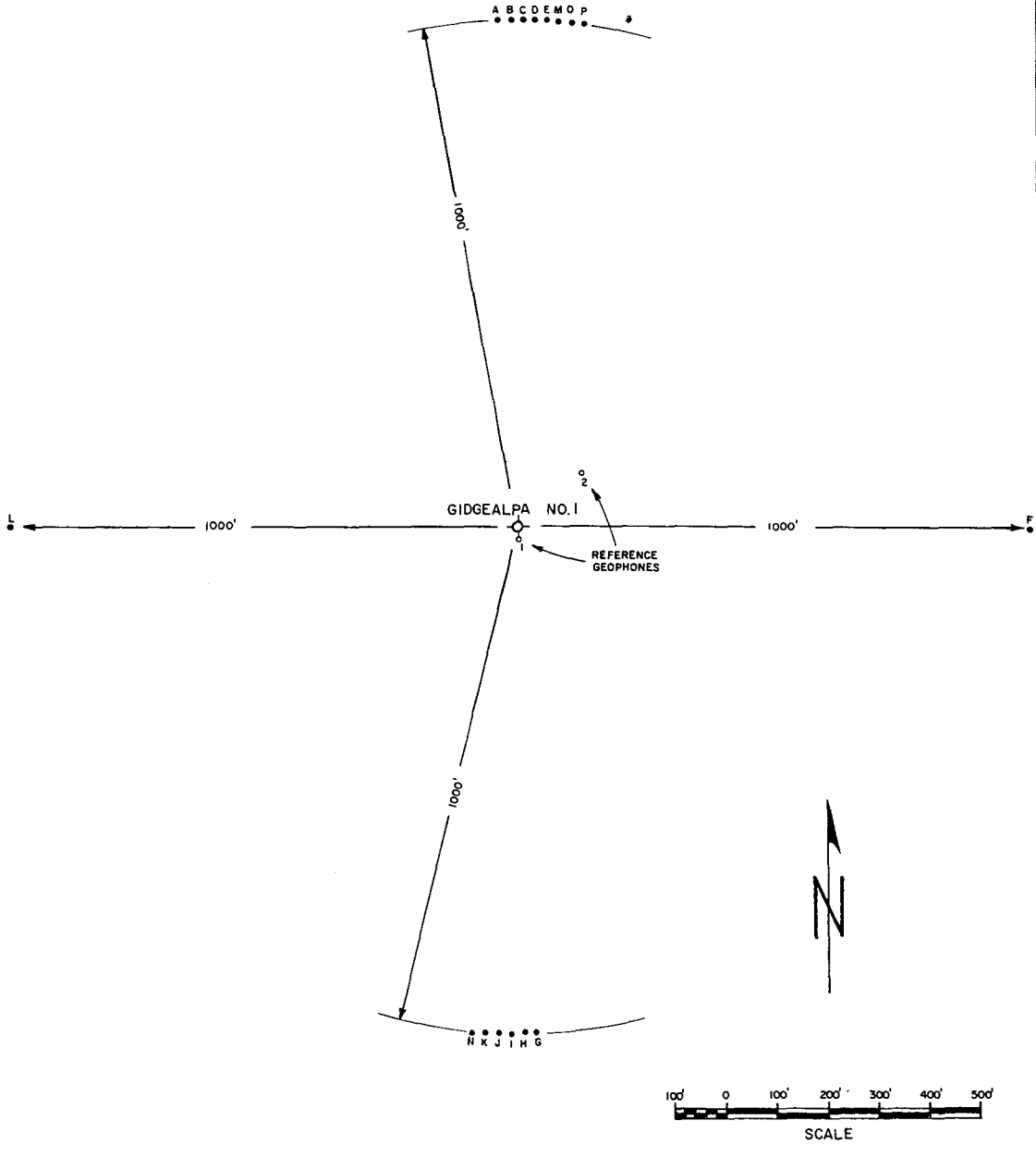


Fig. 11

COMPANY: DELHI AUSTRALIAN PETROLEUM LTD.

WELL: DELHI-SANTOS GIDGEALPA NO.1

LOCATION: O.E.L. 20 &21 South Australia

LATITUDE: 27° 56' 46" S.

LONGITUDE: 140° 04' 56" E.

SHOT HOLE	ELEVATION	DISTANCE	SHOT HOLE	ELEVATION	DISTANCE	SHOT HOLE	ELEVATION	DISTANCE	SHOT HOLE	ELEVATION	DISTANCE	SHOT HOLE	ELEVATION	DISTANCE	SHOT HOLE	ELEVATION	DISTANCE	SHOT HOLE	ELEVATION	DISTANCE	SHOT HOLE	ELEVATION	DISTANCE	SHOT HOLE	ELEVATION	DISTANCE
A	170	1000'N				E	173	1000'N				I	166	1000'S				M	169	1000'N						
B	172	" N				F	178	" E				J	166	" S				N	166	" S						
C	170	" N				G	166	" S				K	166	" S				O	175	" N						
D	172	" N				H	166	" S				L	166	" W				P	176	" N						

ELEVATION

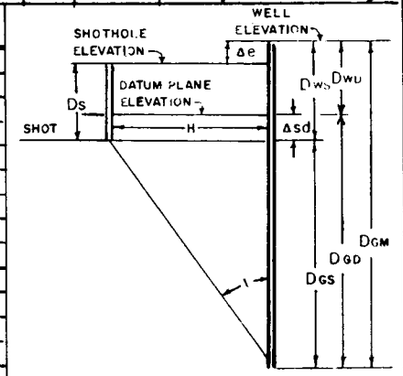
KELLY BUSH 181

ROTARY TBL

DERRICK FL

GROUND 165

RECORD NO.	SHOT HOLE NO	DGM	TOS	TC	DS	ΔE	DWS	ΔSD	DGS	H	TAN I	COS I	T	GRADE	TGS	ΔSD/VI	TGD	DGD	ΔDGD	ΔTGD	VI INTERVAL VELOCITY	VA AVERAGE VELOCITY
1	A	7228		028	75	11	86	5	7142	1000	.14002	.99034	.863	G	.855	.001	.856					
2	I	7228		026	75	15	90	9	7138	"	.14010	.99033	.850	G	.842	.001	.843	7147				
3	F	7228		027	78	3	81	0	7147	"	.13992	.99035	.856	G	.848	.000	.848	NOT USED				
4	L	7228		027	75	15	90	9	7138	"	.14010	.99033	.849	G	.841	.001	.842					8410
21	M	7690		027	75	12	87	6	7603	"	.13153	.99145	.890	G	.882	.001	.883	7609	462	.0275	16800	
22	N	7690		028	75	15	90	9	7600	"	.13158	.99144	.878	G	.870	.001	.871					8680
19	O	8200		027	75	6	81	0	8119	"	.12317	.99250	.929	G	.922	.000	.922	8119	510	.0415	12290	
20	K	8200		029	60	15	75	-6	8125	"	.12308	.99251	.923	G	.916	-.001	.915					8840
17	E	8690		029	75	8	83	2	8607	"	.11618	.99332	.978	G	.971	.000	.971	8609	490	.0440	11140	
18	K	8690		027	68	15	83	2	8607	"	.11618	.99332	.960	G	.954	.000	.954					8940
15	E	9110		027	75	8	83	2	9027	"	.11078	.99392	1.002	G	.996	.000	.996	9029	420	.0270	15560	
16	H	9110		022	60	15	75	-6	9035	"	.11068	.99393	.990	G	.984	-.001	.983					9120
14	E	9600		028	75	8	83	2	9517	"	.10508	.99452	1.027	G	1.021	.000	1.021	9519	490	.0275	17820	
13	J	9600		029	75	15	90	9	9510	"	.10515	.99452	1.018	G	1.012	.001	1.013					9360
11	C	10200		022	67	11	78	-3	10122	"	.09879	.99515	1.071	G	1.066	.000	1.066	10119	600	.0445	13480	
12	I	10200		015	30	15	45	-36	10155	"	.09847	.99519	1.071	G	1.066	-.009	1.057					9520
10	A	10700		019	57	11	68	-13	10632	"	.09407	.99561	1.099	P	1.094	-.002	1.092	10619	500	.0240	20830	
9	G	10700		028	60	15	75	-6	10625	"	.09412	.99560	1.085	G	1.080	-.001	1.079					9780
5	F	11170		009	30	3	33	-48	11137	"	.08979	.99599	1.133	P	1.128	-.012	1.114	NOT USED	470	.0215	21860	
6	L	11170		024	65	15	70	-11	11100	"	.09009	.99596	1.110	P	1.106	-.002	1.104					10020
8	C	11170		026	75	11	86	5	11095	"	.09013	.99596	1.115	G	1.110	.001	1.111	11089				
7	G	11170		026	75	15	90	9	11080	"	.09025	.99595	1.106	G	1.102	.001	1.103					



DWD = KELLY ELEVATION MINUS DATUM ELEVATION

DGM = SEISMOMETER DEPTH BELOW KELLY ELEVATION

TOS = TIME TO OFFSET GEOPHONE

TC = TIME CORRECTION (FROM REFLECTION, REFRACTION, OR UPHOLE TIME)

DS = DEPTH OF SHOT

ΔE = KELLY ELEVATION MINUS SHOTHOLE ELEVATION

DWS = DS + ΔE

ΔSD = DWS − DWD

DGS = DGM − DWS

H = HORIZONTAL DISTANCE, WELL TO SHOTHOLE

TAN I = H/DGS

T = WELL SEISMOMETER TIME FROM TIME BREAK

TGS = T COS I

TGD = TGS + ΔSD/VI = VERTICAL TRAVEL TIME, WELL SEISMOMETER TO DATUM PLANE

DGD = DGM − DWD = VERTICAL DISTANCE, WELL SEISMOMETER TO DATUM PLANE

VI = INTERVAL VELOCITY = Δ DGD/Δ TGD

VA = AVERAGE VELOCITY = DGD/TGD

Datum = 100' above S.L.

V_e = 6500'/"

SURVEYED FOR: Delhi Aust. Pet.

SURVEYED BY: United Geophysical Party 133

DATE SURVEYED: Oct. 30, 1963

CASING: 7207' (K.B.)

WEATHERING:

DATUM VELOCITY:

Fig. 12

ONE WAY TIME IN SECONDS

+100 – DATUM – 0

0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1.0 1.1 1.2 1.3

K.B.+181

– SEA LEVEL –

T. Winton – 567

T. Tambo – 3176

T. Roma – 4296

Transition – 5030

T. Mooga – 5269

T. Walloon – 6191

T. Hutton Equiv. – 6599

T. Triassic (Lower) – 7004

Bottom Casing

T. Permian – 7509

T. Lower Sandstone – 8509

Unconformity (Cambrian) – 8929

T. Porous Dolomite – 12 494

ELEVATION

-1000 -2000 -3000 -4000 -5000 -6000 -7000 -8000 -9000 -10 000 -11 000 -12 000 -13000

DEPTH BELOW DATUM

1000 2000 3000 4000 5000 6000 7000 8000 9000 10 000 11 000 12 000 13 000

AVERAGE VELOCITY

Seismic Sonic

INTERVAL VELOCITY

Sonic Seismic

TIME – DEPTH

Shotpoint West of well (.842) Shotpoint East of well (.848)

Sonic Seismic

? Timing (Sonic)

Shotpoint West of well (1.104) Shotpoint East of well (1.114)

6000 8000 10 000 12 000 14 000 16 000 18 000 20 000 22 000 24 000

VELOCITY IN FEET PER SECOND

WELL VELOCITY SURVEY

DELHI – SANTOS GIDGEALPA No. 1

FOR

DELHI AUSTRALIAN PETROLEUM LTD.

BY

UNITED GEOPHYSICAL CORPORATION

PARTY 133

Reference

△ *Shotpoint north of well*

⊡ *Shotpoint south of well*

⊙ *Integrated sonic log*

× *Sonic log tie*

NOVEMBER 1963

APPENDIX 8

DELHI-SANTOS GIDGEALPA NO. 1

ADDITIONAL DATA FILED IN THE BUREAU OF MINERAL RESOURCES

The following additional data relating to Delhi-Santos Gidgealpa No. 1 have been filed in the Bureau of Mineral Resources, Canberra, and are available for reference:

(i) Daily drilling reports for period 15th August, 1963 to 6th December, 1963.

(ii) Schlumberger well logs including the following:

(a) Electrical Log

Run 1, 514- 7198 feet (2", 5" = 100 ft)
Run 2, 7208- 9992 feet (2", 5" = 100 ft)
Run 3, 9892-13114 feet (2", 5" = 100 ft)

(b) Microlog - Caliper

Run 1, 514- 7194 feet (2", 5" = 100 ft)
Run 2, 7208- 9988 feet (2", 5" = 100 ft)

(c) Microlaterolog - Microcaliper

Run 1, 7207-13114 feet (2", 5" = 100 ft)

(d) Microlaterolog

Run 1, 7300- 7950 feet (2", 5" = 100 ft)
Run 2, 8400- 9000 feet (2", 5" = 100 ft)
Run 3, 12600-13114 feet (2", 5" = 100 ft)

(e) Laterolog

Run 1, 7207-10108 feet (2", 5" = 100 ft)
Run 2, 10000-13110 feet (2", 5" = 100 ft)

(f) Neutron Log

Run 1, 6500-13115 feet (2", 5" = 100 ft)

(g) Sonic-Gamma Ray Log

Run 1, 20- 7188 feet (2", 5" = 100 ft)
Run 2, 7209- 9984 feet (2", 5" = 100 ft)
Run 3, 9884-13100 feet (2", 5" = 100 ft)

(h) Continuous Dipmeter Log

Run 1, 7210-13100 feet (1.2" = 100 ft)

(i) Gamma Ray-Collar Locator

Run 1, 6300- 7210 feet (2" = 100 ft)

(iii) Halliburton formation test data sheets and charts.

COMPOSITE WELL LOG

DELHI AUSTRALIAN PETROLEUM LTD. & SANTOS LIMITED

GIDGEALPA No.1

OIL EXPLORATION LICENCE 20, SOUTH AUSTRALIA — 4 MILE SHEET: INNAMINCKA — WELL STATUS: ARTESIAN WATER BORE.

LOCATION

Lat 27°56'46" S. Long 140°04'55·9"E

ELEVATION

G.L. 165' K.B. 181' A.S.L.

Date Spudded	August 28, 1963
Date Drilling Stopped	November 27, 1963
Date Rig Off	December 6, 1963
Total Depth Driller	13114'
Well Head Fittings	4" valve fitted on 9⅝" casing
Drilled by	Drilling Contractors (Aust) Pty. Ltd.
Drilling method	Rotary
Logged by	Schlumberger
Cemented by	Halliburton

RESISTIVITY LOG DATA

TYPE OF LOG	ELECTRIC LOG	ELECTRIC LOG	ELECTRIC LOG
RUN NUMBER	1	2	3
DATE	13-9-63	16-10-63	27-11-63
FOOTAGE LOGGED	6684'	2784'	3222'
LOGGED FROM	7198'	9992'	13114'
LOGGED TO	514'	7208'	9892'
TOTAL DEPTH - ELECTRIC LOG	7199'	9993'	13115'
TOTAL DEPTH - DRILLER	7208'	9989'	13114'
CASING SHOE - ELECTRIC LOG	514'	7208'	
CASING SHOE - DRILLER	514'	7207'	7207'
BIT SIZE	12¼"	8½"	8½"
MUD KIND	Water base	Water base	Water base
MUD TREATMENT	Bentonite	Sper. XP20	Sper. XP20
MUD WATER LOSS cc/30 mins	6	8	12
MUD WEIGHT lbs/gal	10·5	10·5	10
MUD VISCOSITY	44	40	68
MUD pH	10	9	9·5
MUD Rm	1 at 98° F	0·85 at 92° F	0·5 at 105° F
MUD RESISTIVITY Rmf	0·8 at 82° F	0·65 at 95° F	0·4 at 100° F
MUD BHT / DEPTH	180° at 7199'	280° at 9993'	343° at 13115'
RECORDED BY	P. Maso	P. Maso.	P. Maso. - G. Mechin.

OTHER LOGS RUN

SONIC - GAMMA RAY	514' - 13100'
LATEROLOG	7207' - 13110'
G.R. COLLAR LOCATOR	6300' - 7210'
NEUTRON LOG	6500' - 13115'
CONTINUOUS DIPMETER	7210' - 13100'
MICROLOG	514' - 9988'
MICROLATEROLOG -	
MICROCALIPER	7207' - 13114'
MICROLATEROG	12600' - 13114'
	8400' - 9000'
	7300' - 7950'

SYMBOLS

- Core number and recovery
- Sidewall core, recovery
- Sidewall core, no recovery.
- Plugged interval
- Formation test and interval
- Perforated interval
- Casing Shoe

LITHOLOGIC REFERENCE

Sandstone, Coal, Limestone, Shale, Dolomite, Calcareous, Conglomerate, Igneous, Volcanic, Agglomerate, Siltstone, Tuffaceous

CASING

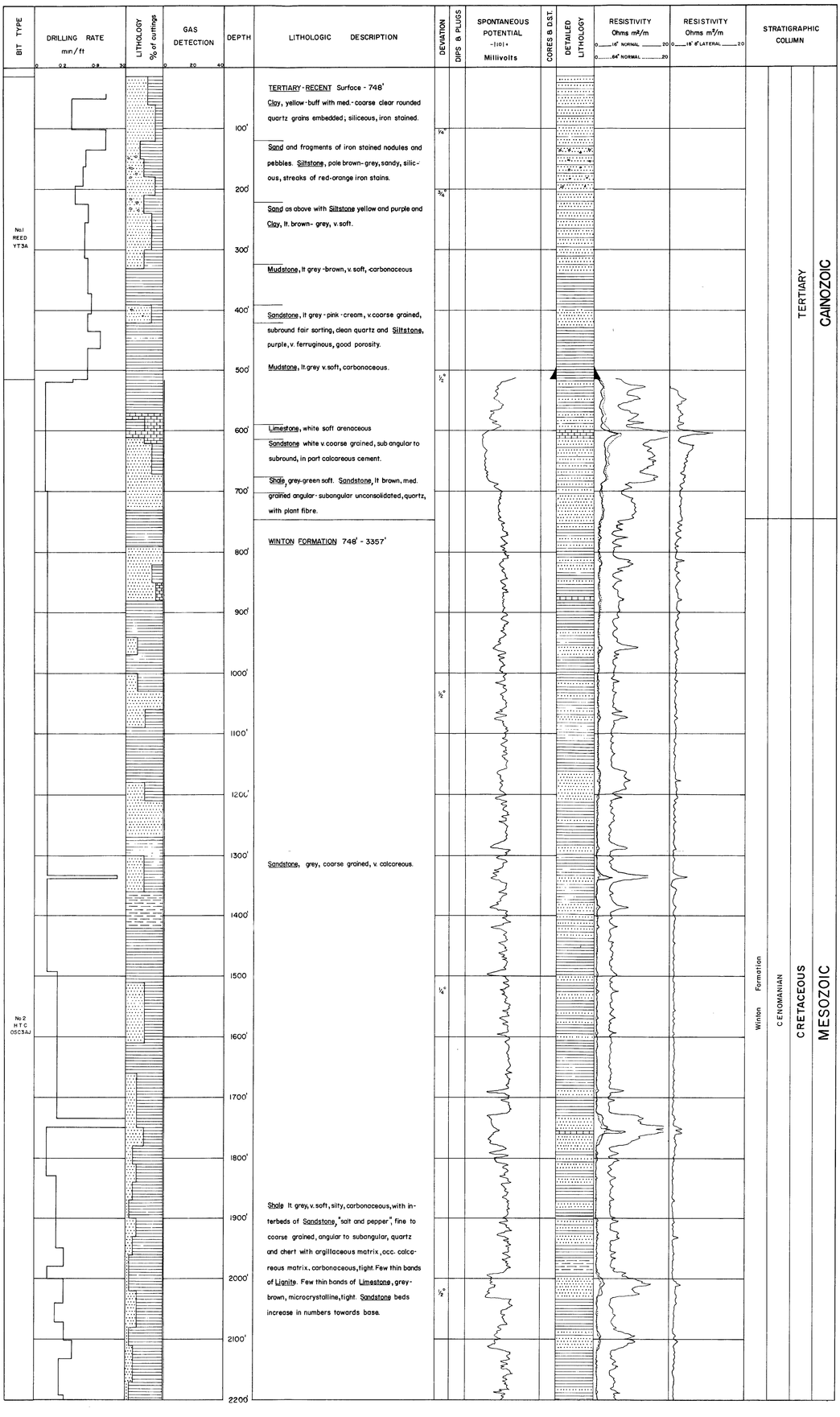
In.	Wt.	Gr.	Depth	Cmt.	Cmt'd to
13⅜	48	H40	514'	375sks	Surface
9⅝	36	J55	7207'	600sks	

HOLE SIZE / CEMENT PLUGS

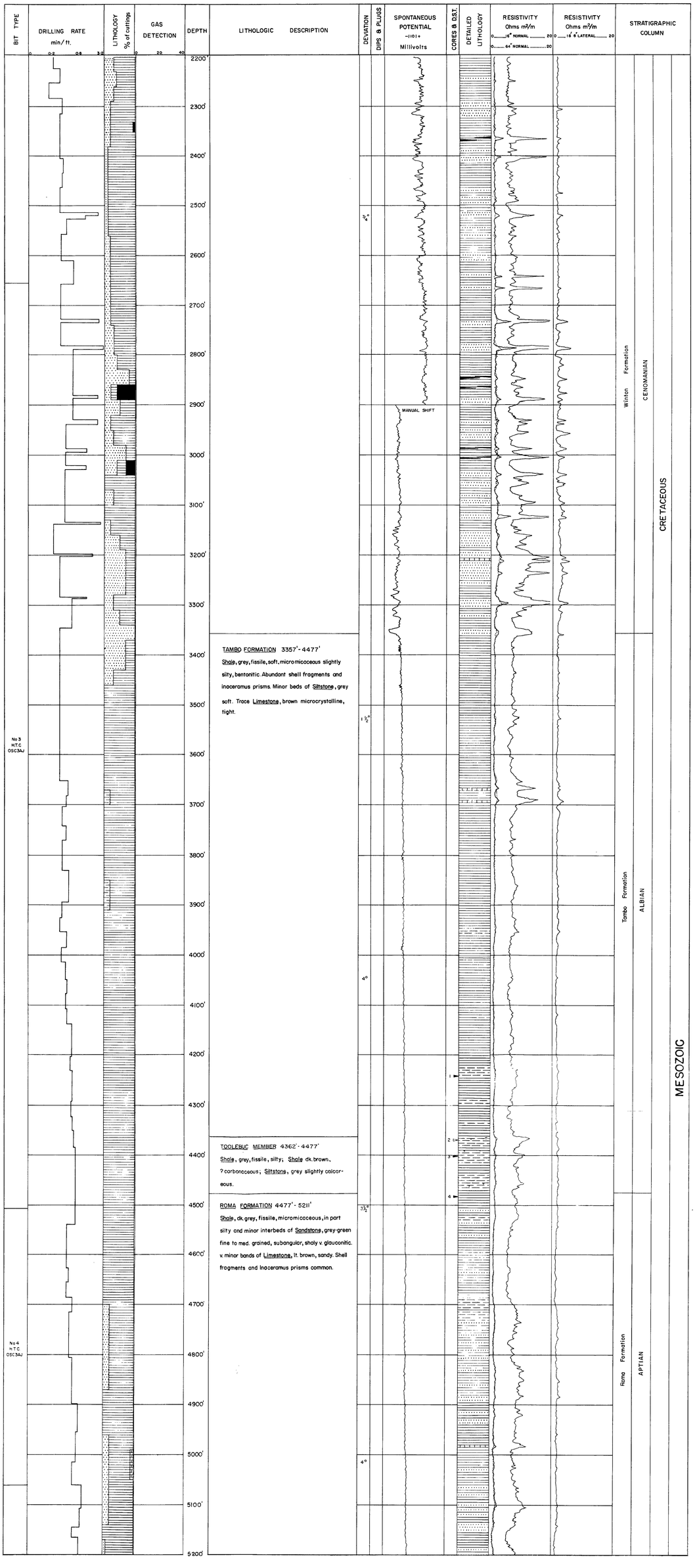
In.	From	To	From	To	Sacks
17½	0'	514'	6617'	6200'	155
12¼	514'	7208'	7300'	7200'	125
8½	7208'	13114'	12675'	12400'	100

LITHOLOGY BY: J. Harrison.

COMPILED BY: M.C. Cole.



DELHI – SANTOS GIDGEALPA No. 1



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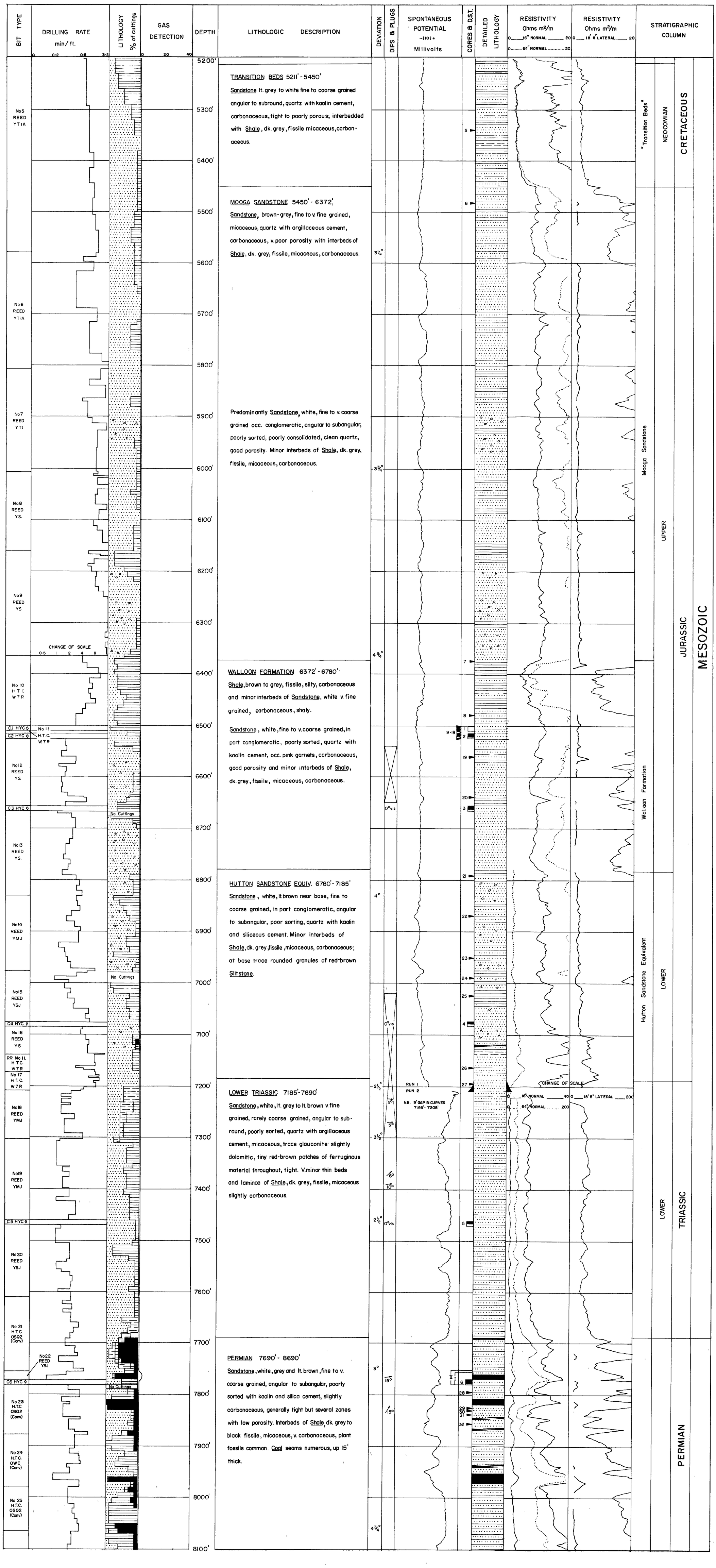

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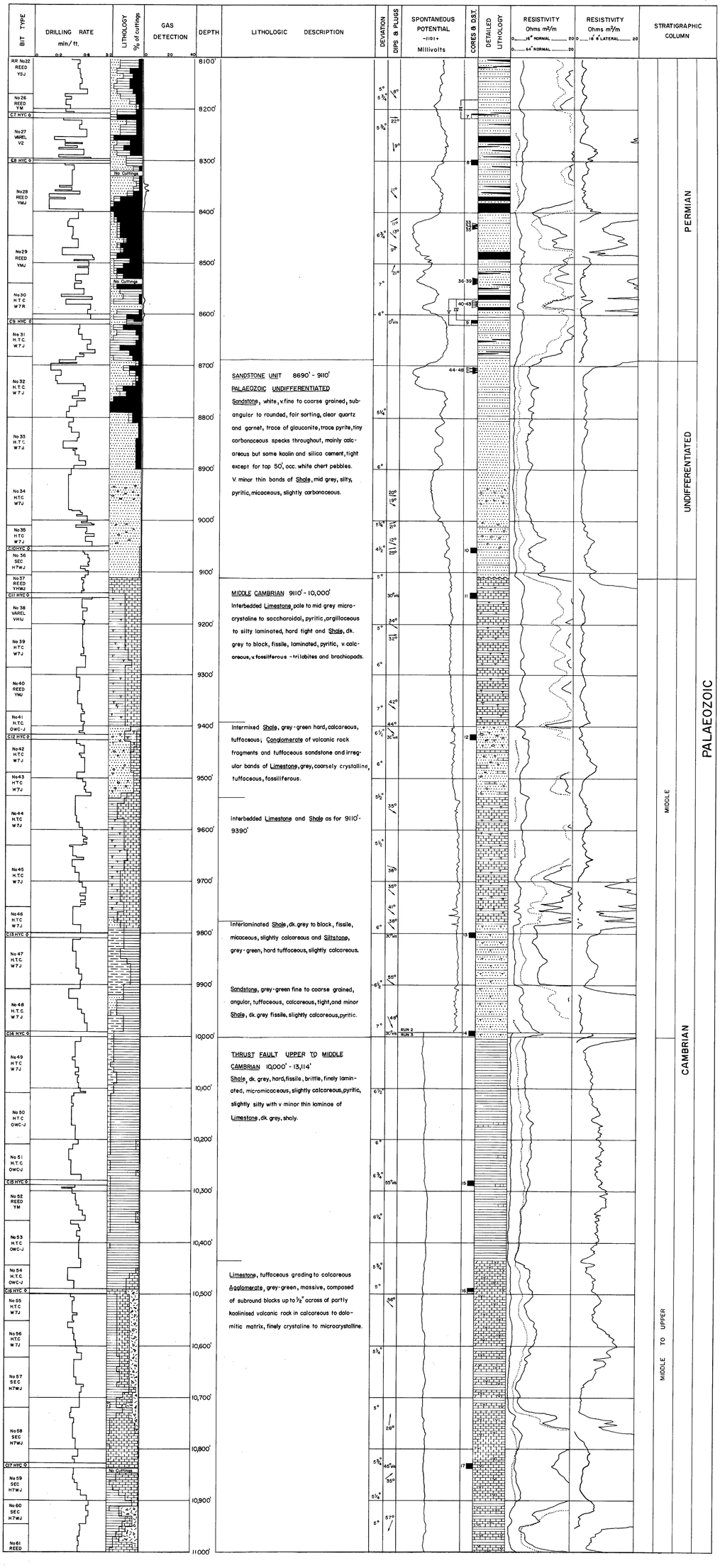

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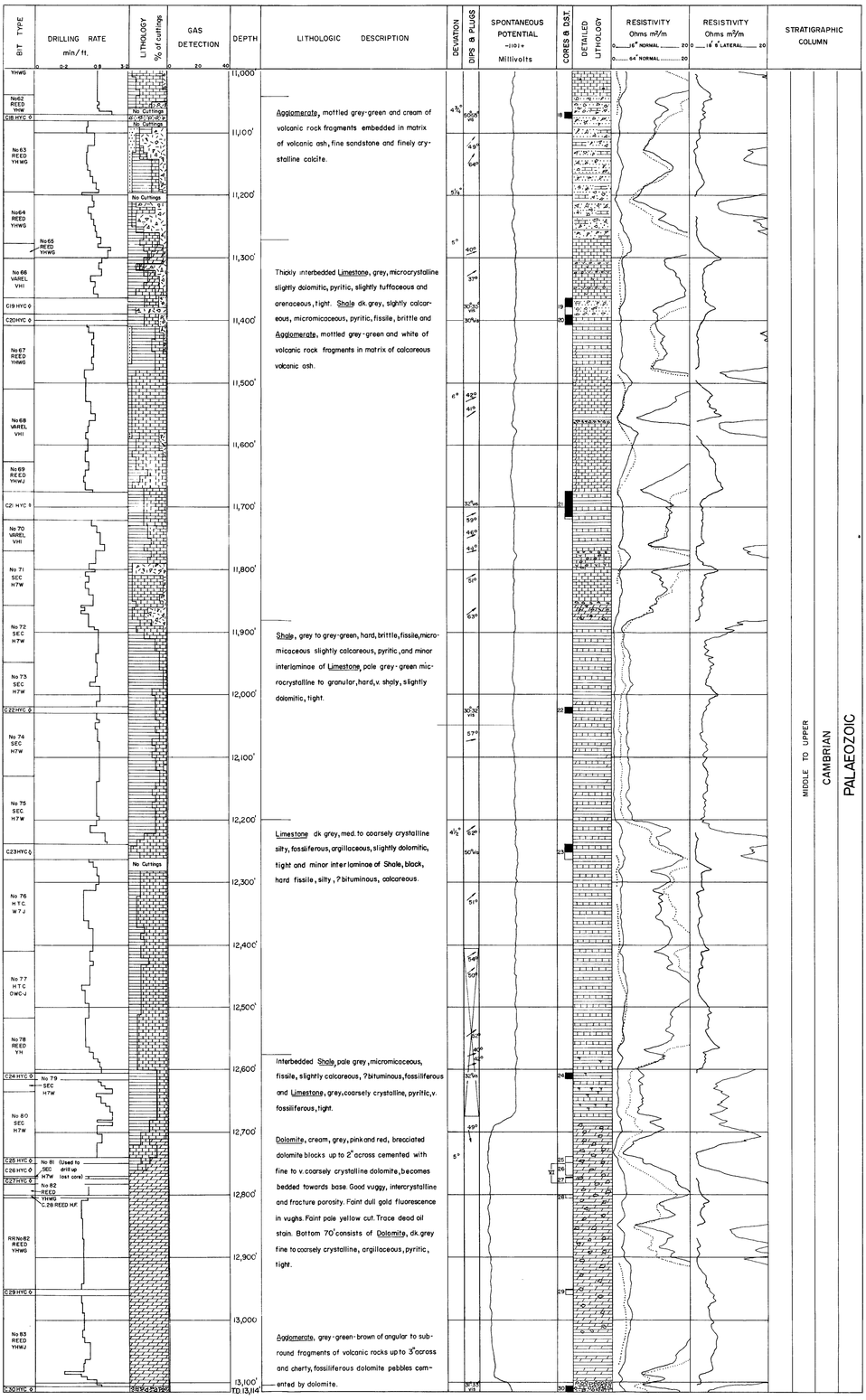

FORMATION TESTS

I D.S.T. No.1 7758' - 7782' Misrun, tool failed.

II D.S.T. No.2 7757' - 7782' Recovered 20 ft. mud.

IHH	4270	IFP	55	ISIP	270
FHH	4270	FFP	55	FSIP	110

III D.S.T. No.3 8180' - 8218' Recovered 15 ft. mud.

IHH	4530	IFP	41	ISIP	110
FHH	4515	FFP	55	FSIP	110

IV D.S.T No.4 Before packer set mud dropped in annulus - leaking tool joint.

V D.S.T. No.5 8570' - 8620' Recovered 100 ft salt water cut mud (2,500 ppm chlorides)

IHH	5666'	IFP	41	ISIP	272
FHH	4653	FFP	57	FSIP	463

VI D.S.T. No. 6. 12,757' - 12,783' 5,000' water cushion, flowed to surface in 1hr. 25 mins. Recovered 4000' water cushion and 8650' of very gas cut salt water (13,728 ppm total salts)

IHH	6860	IFP	2949	ISIP	5521
FHH	6810	FFP	5340	FSIP	5419

VII D.S.T. No.7 6490' - 6525' (plugged back), four perforations per foot. Misrun - tool partly plugged. Recovered 380' of slightly gas cut rat hole mud.

IHH	3475	IFP	150	ISIP	2830
FHH	3420	FFP	180	FSIP	2790

VIII D.S.T. No 8 6490' - 6525' Recovered 1095' mud, 275' slightly gas cut mud, 455' slightly gas cut muddy water, and 4570' of slightly gas cut water (1900 ppm chloride)

IHH	3425	IFP	1350	ISIP	2864
FHH	3410	FFP	2864	FSIP	2864

IX D.S.T. No.9 6490' - 6525' Flowed mud and water to surface in 103 mins. Recovered 60' mud, 1638' clear water, and 4760' of muddy water (1800 ppm chlorides)

IHH	3501	IFP	1185	ISIP	2891
FHH	3501	FFP	2830	FSIP	2891