MAGELLAN PETROLEUM (N.T.) PTY. LTD.

ORANGE NO. 1

NORTHERN TERRITORY

FINAL WELL REPORT

by

Magellan Petroleum (N.T.) Pty. Ltd.

February, 1967
February 10, 1967

The Director,
Bureau of Mineral Resources,
Geology and Geophysics
P. O. Box 378
Canberra City, A.C.T.
Australia

Dear Sir:

Re: Final Well Report, Orange
No. 1, Northern Territory.

This final well report for Orange No. 1 is submitted in fulfillment of clause 8(c) of the agreement under the Petroleum Search Subsidy Act 1959-1964 between The Commonwealth of Australia and Magellan Petroleum (N.T.) Pty. Ltd., dated September 13, 1966. The report was prepared in accordance with Annex "C" of the agreement.

Positive film copies of all illustrations used in the report are available from our files in Brisbane.

Very truly yours,

MAGELLAN PETROLEUM (N.T.) PTY. LTD.

[Signature]

R. M. Hopkins
Assistant to Chairman (Technical)
MAGELLAN PETROLEUM (N.T.) PTY. LTD.

ORANGE NO. 1

REPORT
AND
APPENDICES
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</table>
A. DRILLING

Orange No. 1, located about 25 miles south of Alice Springs, Northern Territory, was spudded on 19th June, 1966 with a percussion drilling rig. After making 30 feet of hole, drilling was suspended until 13th August, 1966, at which time rotary rig operations commenced and the well was drilled to total depth of 8,886 feet. Air, mist, and aerated water were used as drilling fluid to 7,593 feet, and saturated salt water was used below that depth. Ten cores, totaling 226 feet 9 inches, were cut, of which 75 percent was recovered. Only one of 25 sidewall cores attempted was recovered. Electrical, radioactivity, acoustical, and caliper logs and a velocity survey were made of the hole. Casing was cemented in the hole as follows: 16 inch to 334 feet, 10-3/4 inch to 2,410 feet, and 8-5/8 inch to 4,360 feet. While running in the hole, with total depth at 8,886 feet, the drill pipe stuck. After fishing for eight days the hole was plugged back to 7,653 feet, leaving 817 feet of casing cemented below the plug. A drillstem test of the interval 7,461 feet to 7,653 feet recovered salt water with gas pockets in the upper part of the fluid column. The well was plugged and abandoned on 19th October, 1966.

B. GEOLOGICAL

The Orange anticline is situated in the northeastern part of the Amaudus basin. Inasmuch as there is no surface expression of the structure, the location selected for the test well was on the apex of the anticline as defined by seismic surveying. Flat dips in cores indicate Orange No. 1 was drilled near the crest.

The continental Pernjara (Devonian ?) and Mereenie (Devonian ?) formations penetrated by the Orange well are approximately as expected. However, the Larapinta group (Cambrian-Ordovician) is surprisingly thick, having 353 feet of undifferentiated Stairway and Horn Valley deposits and a full section (1,487 feet) of the Pacoota formation. Below the Pacoota the Cambrian formations penetrated are almost as predicted. The Goyder contains more dolomite than was anticipated from examination of outcrops, the Jay Creek-Hugh River-Giles succession conforms to the regional facies trend in being shallier than it is farther east, the salt section in the Chandler is somewhat thicker than predicted, and the portion of the Arumbera that was penetrated lacks the porous sandstones that occur in the upper part of the formation in wells and outcrops to the east. It is unfortunate that the hole was lost before reaching the portion of the Arumbera where massive porous sandstones should be present.

The occurrence of fresh water in the Pacoota and Goyder indicates that meteoric waters have penetrated along vertical fractures to considerable depth on the Orange structure. Below the Goyder the section contains sufficient shale beds to effectively segregate reservoir beds from the overlying zones of fresh water. However, the Orange well encountered very little porous rock below the Pacoota. Show of gas were recorded while drilling the upper part of the Chandler but tests indicate the zone lacks sufficient permeability for commercial rates of production.
INTRODUCTION

Orange No. 1 was drilled by Magellan Petroleum (N.T.) Pty. Ltd. as a stratigraphic test of a large seismically defined anticline located in the eastern portion of the Amadeus basin, about 25 miles south of the City of Alice Springs.

Objectives of the Orange project were to determine the reservoir characteristics and fluid content of the strata penetrated, to obtain subsurface information regarding the sequential relationships and lateral variations of the sedimentary units encountered, and to obtain control for interpretation of geophysical data.

Operations were conducted by Mr. J. E. Banks, Wellsite Geologist, and Mr. H. P. Kerr, Drilling Engineer, under the supervision of Mr. A. J. Froelich, Chief Geologist.
WELL HISTORY

GENERAL DATA.

Well. - Orange Number 1.


Petroleum Tenement. - Oil Permit No. 43, Petroleum (Prospecting and Mining) Ordinance of Northern Territory.

District. - Rodinga, Northern Territory.

Location. - 24° 02' 34" South Latitude, 133° 46' 32" East Longitude.

Elevation. - Ground - 1,925 feet above sea level, Kelly Bushing Datum - 1,938 feet above sea level.

Total Depth. - 8,886 feet.


Drilling Completed. - October 8, 1966.

Well Abandoned. - October 19, 1966.

Rig Released. - October 20, 1966.

Drilling Time to Total Depth. - 79 days (includes 23 days drilling conductor hole with percussion rig).

Status. - Abandoned with cement plugs at 7,652 feet, 7,215 feet, and 4,205 feet and a steel plate equipped with needle valve welded across the top of the 8-5/8" casing. At the time the rig was released it was contemplated that work on the well might be resumed after temporary abandonment. However, reevaluation indicates re-entry and deepening of Orange No. 1 is not technically feasible. The condition of the well is such that it can be completed as a water well in one or more of the fresh water zones above 4,203 feet.

Total Cost. - To be submitted when all invoices are available.

DRILLING DATA.

Drilling Contractor. - Oil Drilling and Exploration (N.T.) Pty. Ltd., 93 York Street, Sydney, New South Wales.

Drilling Plant. -

Make: National.
Type: Ideal 55.
Rated Capacity: 9,000 feet with 4-1/2" drillpipe.
Motors: (3) Caterpillar D375, 334 BHP.

Mast. -

Make: Ideco.
Type: F.M. 136-450 F.V.
Rated Capacity: 700,000 lbs.
### Pumps and Compressors

**Mud Pumps:**
- Make: Gardner-Denver.
- Type: CR-GXP.
- Size: 7-3/4" x 16".
- Motors: Compound drive from draw works motors.

**Air Compressors:**
- Make: Ingersoll Rand.
- Type: H.H.E.
- Size: 1,500 cfm(2) and 1,500 psi(1).
- Motors: Waukesha LRD, 400 HP.

### Blowout Preventers

<table>
<thead>
<tr>
<th>Make</th>
<th>Size</th>
<th>Series (A.P.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydriil Model G</td>
<td>16&quot;</td>
<td>600</td>
</tr>
<tr>
<td>Single QRC</td>
<td>16&quot;</td>
<td>600</td>
</tr>
<tr>
<td>Sheaffer Model B</td>
<td>12&quot;</td>
<td>900</td>
</tr>
<tr>
<td>Hydriil Model G</td>
<td>12&quot;</td>
<td>900</td>
</tr>
<tr>
<td>Sheaffer Rotating Head</td>
<td>12&quot;</td>
<td>900</td>
</tr>
</tbody>
</table>

### Hole Sizes and Depths

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>20&quot;</td>
<td>344 feet</td>
</tr>
<tr>
<td>13-3/4&quot;</td>
<td>2415 feet</td>
</tr>
<tr>
<td>9-7/8&quot;</td>
<td>4371 feet</td>
</tr>
<tr>
<td>7-7/8&quot;</td>
<td>8886 feet</td>
</tr>
</tbody>
</table>

### Casing, Liner, and Cementing Details

<table>
<thead>
<tr>
<th>Size (per foot)</th>
<th>Conductor</th>
<th>Surface</th>
<th>Intermediate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>16&quot;</td>
<td>40.5 Lb.</td>
<td>28 Lb.</td>
</tr>
<tr>
<td>Grade</td>
<td>H-40STC</td>
<td>H-40STC</td>
<td>Mixed*</td>
</tr>
<tr>
<td>Range</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Setting Depth</td>
<td>334'</td>
<td>2410'</td>
<td>4360'</td>
</tr>
<tr>
<td>Shoe Type</td>
<td>Float</td>
<td>Float</td>
<td>None</td>
</tr>
<tr>
<td>Shoe Depth</td>
<td>334'</td>
<td>2410'</td>
<td>4360'</td>
</tr>
<tr>
<td>Collar Type</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Collar Depth</td>
<td>-</td>
<td>-</td>
<td>4327'</td>
</tr>
<tr>
<td>Centralizers</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Scratchers</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Cement (sacks)</td>
<td>320</td>
<td>735</td>
<td>200</td>
</tr>
<tr>
<td>Est. Top of Cement</td>
<td>Surface</td>
<td>250'</td>
<td>3000'</td>
</tr>
<tr>
<td>Method Used</td>
<td>Single Plug</td>
<td>Single Plug</td>
<td>Double Plug</td>
</tr>
</tbody>
</table>

*H-40 STC to 2,393 feet and J55 FJ40 to 4,360 feet.

### Drilling Fluid

<table>
<thead>
<tr>
<th>Depth</th>
<th>Fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 345'</td>
<td>Air</td>
</tr>
<tr>
<td>345 - 4377'</td>
<td>Mist</td>
</tr>
<tr>
<td>4377 - 5266'</td>
<td>Aerated Water</td>
</tr>
<tr>
<td>5266 - 5590'</td>
<td>Mist</td>
</tr>
<tr>
<td>5590 - 5900'</td>
<td>Aerated Water</td>
</tr>
<tr>
<td>5900 - 7593'</td>
<td>Mist</td>
</tr>
<tr>
<td>7593 - 8886'</td>
<td>Saturated Salt Water</td>
</tr>
</tbody>
</table>

During all drilling from 345 feet to 8886 feet the injected or circulated water, including the saturated salt water, was treated with sodium bichromate and caustic soda for corrosion inhibition. The average pH was eleven. The weight of the saturated salt water was in the range of 10.0 to 10.8 pounds per gallon, depending on the amount of suspended drill solids.
<table>
<thead>
<tr>
<th>Chemicals Used</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totoam TF-2 Foamer</td>
<td>583 gal.</td>
</tr>
<tr>
<td>Toepol Foamer</td>
<td>277 gal.</td>
</tr>
<tr>
<td>Comprox Foamer</td>
<td>94 gal.</td>
</tr>
<tr>
<td>Sodium Dichromate</td>
<td>4,890 lbs.</td>
</tr>
<tr>
<td>Caustic Soda</td>
<td>4,788 lbs.</td>
</tr>
<tr>
<td>Salt</td>
<td>84,040 lb.</td>
</tr>
</tbody>
</table>

**Water Supply.** - It was originally planned that water for the operation would be hauled from Mulga Dam, located approximately 10 miles north of the location. Because of an impassable road between the Flinders Highway and Mulga Dam, it was necessary to haul water from Alice Springs from 10th August to 31st August, 1966. After that time water was hauled from Mulga Dam. In addition, a large water storage sump was used to conserve and utilize water produced from the various formations during mist drilling.

**Perforation and Shooting Record.** - Perforated open hole intervals 7513-7523 feet and 7570-7580 feet with Welex 1-11/16 inch link jets, two shots per foot, prior to making drill stem test.

**Plugging Back and Squeeze Cementation Jobs.**

**Squeeze No. 1.**

**Purpose:** To shut off water influx that occurred after cleaning out shoe of 8-5/8" casing cemented at 4360 feet.

**Procedure:** Mixed 100 sacks cement containing calcium chloride. Slurry volume 21 barrels. Spotted on bottom and pressured up to 2000 pounds. Very little, if any, cement pumped away. Tagged top of cement at 4028 feet at 5:45 A.M. 6.9.66.

**Plug No. 1.**

**Purpose:** To provide footing for drillstem testing gas-bearing zone between 7,500' and 7,600'.

**Procedure:** Mixed 160 sacks of construction cement with 5.2 gal. of saturated salt water per sack. Slurry volume was 182 cu. ft. Slurry weight was 16.1 lbs. per gal. pH of slurry was 12+. Spotted with open-ended drill pipe at 7,663' (6' below top of fish). Finished displacing at 7:45 P.M. 14.10.66. Pulled up to 7,592' (6' above top of salt) and circulated out to cut off any cement above that point.

Checked top of plug with 20,000 lbs. of drill pipe weight at 7,652' at 11:00 A.M. 15.10.66.

**Plug No. 2.**

**Purpose:** To isolate the gas-bearing zone between 7,500' and 7,600' from the water-bearing zones above, and to provide a base for possible future sidetrack operations.

**Procedure:** Mixed 100 sacks construction cement with 5.2 gal. of fresh water per sack. Slurry volume was 120 cubic feet. Slurry weight was 15.6 lbs. per gal. pH of slurry was 12+. pH of displacement water was 11 (treated with caustic soda and sodium dichromate). Spotted with open-ended drill pipe at 7,500'. Finished displacing at 3:34 a.m. 19.10.66.

Checked plug at 7,215' with 10,000 lbs. of drill pipe weight at 1:35 p.m. 19.10.66.
Plug No. 3. -
Purpose: To isolate the 8-5/8" casing at 4,360' from water-bearing zones below and leave the hole in condition for re-entry in the event of future side-track operations or for completion as a water well from the Pacoota or Mereenie sandstones.

Procedure: Mixed 75 sacks of construction cement (accelerated with 2 percent calcium chloride) with 5.2 gal of fresh water per sack.
Slurry volume was 90 cu. ft.
Slurry weight was 15.6 lbs. per gal.
PH of slurry was 12.4.
pH of displacement water was 11. (Treated with caustic soda and sodium bichromate).

Spotted with open-ended drill pipe at 4,348'.
Finished displacing at 3:10 p.m. 19.10.66.

Checked plug at 4,205' with 12,000 lbs of drill pipe weight at 8:35 p.m. 19.10.66.

Fishing Operations. -

Fishing Job No. 1. - At 10:00 a.m. 8 October, 1966 the drill collars stuck while making a trip in the hole with a new bit. The bit was at 8489' and total depth was 8886'. Unable to rotate, work or pump collars loose. Spotted fresh water in attempt to dissolve salt bridges. Unsuccessful. Spotted 50 barrels diesel fuel mixed with 55 gallons Pipelax. Unsuccessful. Started compressors and aerated fluid column to relieve hydrostatic head. Still unable to work loose. Backed off safety joint on top of drill collars at 7657'. Ran overshot and jars. Unable to feel top of fish. Ran string with bent single between overshot and jars. Unable to touch top of fish. Ran string with overshot and knuckle joint separated by one joint of drill pipe. Unable to feel top of fish. Spotted 160 sack cement plug leaving bit, 24 6-1/2" drill collars, 3 6-1/4" drill collars and lower half of safety joint in hole. After waiting on cement, tagged top of plug at 7652'.

Fishing Job No. 2. - Ran DST with anchor on plug at 7652" and packer at 7461'. At conclusion of test tailpipe was stuck. Tail pipe consisted of six 6-1/4" drill collars, one 5' x 3" OD perforated nipple and one Halliburton pressure gauge and case. Unable to jar loose. Backed off safety joint below test tool. Recovered tool. Ran overshot and jars and tied on to fish. Ran freepoint indicator, tail pipe free to lower part of bottom drill collar. Attempted to jar loose. Jarred overshot loose from top of fish twice without moving fish. Ran string shot and backed tail pipe off at top of bottom drill collar. Left pressure gauge perforated nipple and one drill collar in hole.

Side-Tracked Hole. - None.

Drilling Observations. -

Excellent penetration rates were obtained in the air, mist and water drilling of Orange No. 1. However, unanticipated difficulties were encountered from salt flow in the section between 7594 feet and 8210 feet. Even though some trouble with running logging tools through the same salt section had
been experienced previously in the Exoil Alice No. 1 well, it was not suspected that this difficulty was caused by actual salt flowage, since ordinarily salt does not develop a high degree of mobility except at greater depth and higher temperature that was the case in this part of the Amadeus basin.

Investigations by others who have been attempting to find means of combatting salt flows such as have been encountered in East Texas, Utah and other western areas in the United States and also in Canada, Northern Germany, Iran and Ethiopia have indicated that the degree of salt mobility is dependent on the grain size of the salt as well as on depth, temperature, the relationship of the hydrostatic head of the drilling fluid to the overburden gradient, and the length of time the salt is exposed to differential pressure conditions. Laboratory experiments confirm that the creep rate of salt is related to grain size, confining pressure, stress difference and temperature (Le Conte, 1965).

There is no presently known way of predicting that a particular salt bed will or will not flow in the subsurface except by laboratory determinations on a representative sample from the salt bed tested in a simulated subsurface environment.

It is known that very high mud weights are usually required to inhibit salt flow. For example, in Iran it has been necessary to weight the mud up to 18.7 pounds per gallon, and in East Texas weights in excess of 19 pounds per gallon have been required.

Use of such heavy mud at Orange No. 1 would have required setting a string of 6-5/8 inch or smaller casing to the top of the salt in order to prevent lost circulation up the hole. In turn, setting another string of casing would have necessitated use of such small drilling tools that penetration rates in the hard formations below the salt would have been too slow to be practical.

The experience gained in drilling Orange No. 1 will be very valuable in programming future Amadeus basin wells that are expected to penetrate salt at depths where flowage may occur.
LOGGING AND TESTING

Ditch Cuttings. - Cuttings from Orange No. 1 were collected and examined every ten feet from surface to total depth, except during coring when samples were collected at five foot intervals. Spot check samples were collected for specific supplementary information at intermediate intervals below 7370 feet. Flexibility in sampling procedures was required and the samples were collected in a variety of ways which depended on the method of drilling. Different techniques of collection were employed while the well was dusting, misting, blowing or flowing. The average size of cuttings from bottom ranged between 1 and 2 millimeters regardless of drilling method used. Samples were lagged when salt water drilling below 7593 feet. A tabular summary of collection methods follows:

<table>
<thead>
<tr>
<th>Interval</th>
<th>Drilling Method</th>
<th>Samples Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 45'</td>
<td>Cable tool drilled.</td>
<td>In bailer.</td>
</tr>
<tr>
<td>45 - 345'</td>
<td>Rotary air drilled.</td>
<td>Dust samples caught in corebox under hole in derrick at air outlet.</td>
</tr>
<tr>
<td>345 - 1000'</td>
<td>Rotary mist drilled.</td>
<td>In tilted corebox at end of 100' discharge line.</td>
</tr>
<tr>
<td>1000 - 4776'</td>
<td>Rotary mist and aerated water drilled.</td>
<td>In container at 2 inch extension outlet from middle of discharge line.</td>
</tr>
<tr>
<td>4776 - 7593'</td>
<td>Rotary aerated water and mist drilled.</td>
<td>In container from 2 inch outlet before gate valve outlet to water tank or discharge line.</td>
</tr>
<tr>
<td>7593 - 8354'</td>
<td>Rotary saturated salt water drilled.</td>
<td>In container at end of 2 inch flow line to water tank (samples lagged).</td>
</tr>
<tr>
<td>8354 - 8886'</td>
<td>Rotary saturated salt water drilled.</td>
<td>Over shale shaker with screen (samples lagged).</td>
</tr>
</tbody>
</table>

Representative samples of each interval were washed, dried on an electric hot plate and divided into five (5) sets. One set of samples was sent to Core and Cuttings Laboratory, Bureau of Mineral Resources, Fyshwick A.C.T., one set was delivered to Bureau of Mineral Resources Northern Territory in Alice Springs, and three (3) sets are stored by the operator in Alice Springs.

Coring. - The original programme provided for nine full diameter cores, of which five were to be routine ten foot cores and four were to be 50 to 60 foot continuous cores in the prospective Ordovician and Cambrian formations. The longer cores were believed to offer the best direct control for: definitions of cyclic deposition; wire-line log correlations and formation evaluation.

Most of the objectives of the original core programme were accomplished. Core barrel jamming on Core No. 10 prevented cutting a long core in the Arumbera and the ten foot terminal core could not be cut because of the operational condition of the hole which ultimately resulted in the untimely and unexpected suspension of drilling.

Core No. 8 is taken as an example of the superiority of single long cores over several short cores in enabling precise wire-line log correlation where a substantial amount of core was lost. Ten cores
were cut for a total footage of 226 feet nine inches. Total core recovery was 169 feet two inches or 75 percent. One long Cambrian core in the salt had no recovery, which lowered the recovery percentage appreciably. Discounting the lost core, recovery percentage would have been 90 percent.

Hughes HTC HF 7-7/8 inch conventional core bits were used to cut the first three cores. The remaining cores were cut with Christensen 7-13/16 inch diamond bits. Conventional core barrels were used for all cores.

<table>
<thead>
<tr>
<th>Core Number</th>
<th>Interval Cored</th>
<th>Amount Cut</th>
<th>Amount Recovered</th>
<th>Percent Recovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>615 - 625'</td>
<td>10'</td>
<td>8' 6-1/2&quot;</td>
<td>85.80</td>
</tr>
<tr>
<td>2</td>
<td>1498 - 1507'</td>
<td>9'</td>
<td>9' 100.00</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2415 - 2416' (jammed)</td>
<td>9&quot;</td>
<td>0' 2&quot;</td>
<td>22.20</td>
</tr>
<tr>
<td>4</td>
<td>2846 - 2861'</td>
<td>15'</td>
<td>15' 100.00</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3160 - 3173'</td>
<td>13'</td>
<td>12' 92.00</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>4041 - 4085'</td>
<td>44'</td>
<td>44' 100.00</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>5226 - 5266'</td>
<td>40'</td>
<td>39' 97.00</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>7050 - 7095'</td>
<td>45'</td>
<td>38' 85.00</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>7640 - 7687'</td>
<td>38'</td>
<td>0' 0.00</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>8712 - 8724' (jammed)</td>
<td>12'</td>
<td>3' 6&quot;</td>
<td>34.30</td>
</tr>
</tbody>
</table>

Representative portions of each core were forwarded to Core and Cuttings Laboratory, Bureau of Mineral Resources, Fishwick A.C.T. The remaining portions are stored in Alice Springs by the operator.

**Side Wall Sampling** - Twenty-five side wall core samples were attempted in the interval 7140 to 7960 feet. Unfortunately, only one sample was recovered. Of the twenty-four missing shots: three had no mark on the barrel, which was probably due to enlarged bore hole in the salt series; four barrels were lost; one misfired; and sixteen had broken barrels, suggesting that the carbonate and cherty shale formations were too hard to permit recovery by this technique.

**SIDEWALL SAMPLING**

<table>
<thead>
<tr>
<th>Number</th>
<th>Depth</th>
<th>Recovery</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>7610'</td>
<td>NIL</td>
<td>No mark on barrel.</td>
</tr>
<tr>
<td>2.</td>
<td>7607'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>7598'</td>
<td>-</td>
<td>Misfire</td>
</tr>
<tr>
<td>4.</td>
<td>7596'</td>
<td>NIL</td>
<td>No mark on barrel.</td>
</tr>
<tr>
<td>5.</td>
<td>7594'</td>
<td>&quot;</td>
<td>Broken barrel.</td>
</tr>
<tr>
<td>6.</td>
<td>7590'</td>
<td>Dolomitic siltstone</td>
<td>&quot;</td>
</tr>
<tr>
<td>7.</td>
<td>7587'</td>
<td>NIL</td>
<td>&quot;</td>
</tr>
<tr>
<td>8.</td>
<td>7582'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>9.</td>
<td>7581'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>10.</td>
<td>7578'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>11.</td>
<td>7573'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>12.</td>
<td>7568'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>13.</td>
<td>7564'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>14.</td>
<td>7562'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>15.</td>
<td>7547'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>16.</td>
<td>7529'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>17.</td>
<td>7526'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>18.</td>
<td>7517'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>19.</td>
<td>7514'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>20.</td>
<td>7512'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>21.</td>
<td>7486'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>22.</td>
<td>7436'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>23.</td>
<td>7276'</td>
<td>&quot;</td>
<td>Lost Barrel</td>
</tr>
<tr>
<td>24.</td>
<td>7151'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>25.</td>
<td>7140'</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
</tbody>
</table>
A representative chip from the sample at 7590 feet was forwarded to Core and Cuttings Laboratory, Bureau of Mineral Resources, Fyshwick A.C.T. The remaining portion is stored in Alice Springs by the operator.

LOGGING AND SURVEYS

Electrical and Other Logging. - Welex wireline logs were run on six different occasions.

The total intervals covered by the various types of logs are as follows:

- GammaRay-Guard: 20' - 7913'
- GammaRay (inside pipe): 7440' - 8491'
- Neutron: 1600' - 7913'
- Acoustic-Velocity: 334' - 7913'
- Caliper: 20' - 7682'
- Microseismogram: 4300' - 7682'

Penetration Rate and Gas Logs. - Penetration rates were recorded by Geolograph and are presented graphically herein on Enclosure 5.

While drilling with air or mist to 5,562 feet a pilot flare was kept burning at the end of the discharge line. The gas analyzer was connected on 12th September, 1966. Its operations are summarized in Appendix 2.

Deviation Surveys. - The hole was surveyed periodically for deviation. Average deviation was approximately one degree and the maximum change in deviation between surveys was two degrees. The following table lists the individual surveys.

<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Deviation (degrees)</th>
<th>Depth (feet)</th>
<th>Deviation (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>0</td>
<td>4041</td>
<td>0</td>
</tr>
<tr>
<td>140</td>
<td>0</td>
<td>4361</td>
<td>3/4</td>
</tr>
<tr>
<td>220</td>
<td>1/2</td>
<td>4885</td>
<td>1</td>
</tr>
<tr>
<td>310</td>
<td>1/2</td>
<td>5480</td>
<td>1-1/2</td>
</tr>
<tr>
<td>464</td>
<td>1/4</td>
<td>5875</td>
<td>1</td>
</tr>
<tr>
<td>585</td>
<td>3/4</td>
<td>6180</td>
<td>1-1/4</td>
</tr>
<tr>
<td>805</td>
<td>1</td>
<td>6604</td>
<td>1-1/4</td>
</tr>
<tr>
<td>1405</td>
<td>1-1/2</td>
<td>6740</td>
<td>3</td>
</tr>
<tr>
<td>1987</td>
<td>2</td>
<td>7350</td>
<td>1</td>
</tr>
<tr>
<td>2400</td>
<td>1</td>
<td>7870</td>
<td>1</td>
</tr>
<tr>
<td>2836</td>
<td>2</td>
<td>8364</td>
<td>1</td>
</tr>
<tr>
<td>3160</td>
<td>1-1/2</td>
<td>8690</td>
<td>3/4</td>
</tr>
<tr>
<td>3475</td>
<td>1-1/4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Temperature Surveys. - Hole temperatures recorded in conjunction with electrical logging are as follows:

<table>
<thead>
<tr>
<th>Log Run</th>
<th>Depth (feet)</th>
<th>Temperature (degrees F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,413</td>
<td>111</td>
</tr>
<tr>
<td>2</td>
<td>4,368</td>
<td>130</td>
</tr>
<tr>
<td>3</td>
<td>7,265</td>
<td>190</td>
</tr>
<tr>
<td>4</td>
<td>7,913</td>
<td>198</td>
</tr>
</tbody>
</table>

Other Well Surveys. - A velocity survey of the well was conducted by United Geophysical Corporation. A copy of the report of this survey is included in Enclosure 6.

An integration and calibration of the Acoustic Velocity log was made by Welex and was used in conjunction with the velocity survey by United Geophysical Corporation.
**TESTING**

**Formation Testing.** - Air and mist drilling provided continuous testing of the hole to a depth of 7,593 feet. Sufficient gas was encountered while drilling from 7,507 feet to 7,593 feet to be intermittently flared but the amounts of gas were too small to measure.

After changing to salt water as drilling fluid at 7,593 feet, one drillstem test was conducted in open hole of the interval 7,661 feet to 7,653 feet. A steady faint blow of air occurred throughout the flow period. After the test it was necessary to back off the safety joint in order to pull the test tool, leaving the tail pipe and lower pressure gauge in the hole. An unmeasured amount of salty water resembling drilling fluid and having gas pockets in the upper portion was reverse circulated out of the test string. A sample of the gas was collected for analysis.

**Production Testing.** - None.
GEOLOGY

SUMMARY OF PREVIOUS WORK.

Geological. - Surface geologic mapping on a regional scale in the eastern Amadeus basin has been carried out by Magellan Petroleum (N.T.) Pty. Ltd. (McNaughton, 1962) and by the Bureau of Mineral Resources (Pritchard and Quinlan, 1962; Wells et al, 1965). The structure on which the Orange No. 1 well was drilled has no surface expression. It is situated in the sand and alluvium covered Brewer Plain midway between the Ooraminta and Waterhouse surface anticlines as shown on Enclosure 1. Magellan Petroleum has compiled semi-detailed geologic maps and measured stratigraphic sections in both surface anticlines where the stratigraphic succession penetrated at Orange is fairly well exposed (McNaughton, 1962). In addition, relevant outcrop sections in the Macdonnell Ranges and Mt. Peachy, north and south of Orange respectively, have been studied and measured by Magellan geologists.

Geophysical. - In 1961 the Geophysical Branch of the Bureau of Mineral Resources carried out a regional helicopter reconnaissance gravity survey (Lonsdale and Flavelle, 1963). In 1961 Century Geophysical Corporation conducted a ground gravity meter survey which covered part of this area for Magellan Petroleum Corporation (Century Geophysical Corp., 1961). In 1961 the Geophysical Branch of the Bureau of Mineral Resources performed a seismic traverse along the railroad 10 miles east of the Orange area. In 1966 Geophysical Associates International commenced the Mt. Rennie-Ooraminta Seismic and Gravity Survey for Magellan Petroleum (N.T.) Pty. Ltd.. The Orange structure was discovered and delineated by means of this reflection seismic survey. The seismic feature is approximately 16 miles long, 5 miles wide, with a minimum vertical closure of about 900 feet.

Drilling. - No drilling had been done on or near the Orange subsurface anticline prior to Orange No. 1. The Orange No. 1 well is about 16 miles east of Centralia Waterhouse No. 1 and 16 miles southwest of Exoil Alice No. 1, the nearest control wells (Enclosure 1).

SUMMARY OF THE REGIONAL GEOLOGY.

The Orange structure is situated in the northeastern part of the Amadeus basin. This basin is an easterly trending structural depression covering about 80,000 square miles and containing up to 30,000 feet of Upper Proterozoic and Paleozoic sedimentary rocks.

Marine sedimentation started in late Proterozoic time and terminated in the late Ordovician, with the deposits consisting chiefly of clastics and carbonates. Thick salt deposits in the Proterozoic Bitter Springs and Cambrian Chandler formations, together with Proterozoic and Ordovician black pyritic shales, indicate that silled basins with restricted circulation of marine waters existed from time to time. The marine cycle of deposition terminated in the late Ordovician or early Devonian. In some areas, the contact between marine and continental deposits is transitional whereas in other areas there is a depositional break marked by an angular unconformity (Enclosure 4).

The morphology of the Amadeus depositional basin changed during the Alice Springs orogeny of probable Devonian age. A welt located north of the present basin rose and a foredeep located along the present northern margin of the basin was formed. Thick aprons of coarse clastic debris eroded from the rising welt were transported short distances to the south and dumped on the south flank of the welt.
Finer grained and better sorted clastic sediments were deposited in the foredeep and in the area to the south. These continental deposits attain their maximum thickness in the foredeep and thin gradually to the south.

The marine and continental deposits were folded into an arcuate system of westerly to northwesterly trending anticlines and synclines during the orogeny. Wave lengths of these folds decrease from north to south, i.e., in the same direction as the decrease in thickness of the continental cover on the marine sediments, thereby suggesting that the weight of the cover on the marine sediments influenced the spacing of folds.

Erosion accompanying and following the orogeny stripped most of the sediments from the basement rocks on the west and removed the continental capping on most anticlines with the notable exception of several structures which escaped deep erosion (see varying depth of erosion shown on Enclosure 4). These less eroded structures now appear to be the most favorable petroleum prospects in the basin.

Salt tectonics antedating and accompanying the Alice Springs orogeny left their imprint on some of the structures in the basin. Sedimentary loading of the plastic Bitter Springs evaporites produced flowage and initiated structures in the marine sediments long before the orogenic episode as is shown by crestal stratigraphic convergence of Cambrian and Ordovician sediments on several structures in the basin.

Gravity tectonics also may have contributed to the structural pattern in the Amadeus basin. Evaporites in the Bitter Springs formation and to a lesser extent evaporites in the Chandler formation provided "lubricated layers" between competent sequences of sediments. The uplift of the west accompanied by tectonic and sedimentary loading on the southern flank of the west created an environment conducive to down-slope mass transport of crustal blocks. However, separating structures formed as the result of gravitational sliding from structures formed by compressive forces associated with crustal shortening is subject to some uncertainty in most areas and the Amadeus basin is no exception.

Subsidence arising from solution and removal of salt from outcrops of the Bitter Springs and Chandler formations modified structural attitudes in beds overlying these formations. The extent of these modifications and their importance in structural interpretations based on outcrop work have not yet been determined.
STRATIGRAPHIC TABLE.

The section penetrated by Orange No. 1 is compared with the predicted section on Enclosure 2 and with Exxon's Alice No. 1 on Enclosure 3. The following table shows the depths of the various formations relative to the Kelly bushing datum and to sea level.

<table>
<thead>
<tr>
<th>Age</th>
<th>Formation</th>
<th>Depths (feet)</th>
<th>Thickness (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devonian (?)</td>
<td>Purnjara</td>
<td>Surface (+1922)</td>
<td>928+</td>
</tr>
<tr>
<td></td>
<td>-Unconformity-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devonian (?)</td>
<td>Mereenie</td>
<td>940 (+995)</td>
<td>1120</td>
</tr>
<tr>
<td></td>
<td>-Unconformity-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Larapinta Group</td>
<td></td>
<td>1820</td>
</tr>
<tr>
<td>Ordovician (?)</td>
<td>Larapinta</td>
<td>2060 (-135)</td>
<td>353</td>
</tr>
<tr>
<td></td>
<td>Undifferentiated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambro-Ordovician</td>
<td>Pocoota</td>
<td>2413 (-478)</td>
<td>1467</td>
</tr>
<tr>
<td></td>
<td>Pertaaorta Group</td>
<td></td>
<td>5006+</td>
</tr>
<tr>
<td>Upper Cambrian</td>
<td>Goyder</td>
<td>3880 (-1945)</td>
<td>923</td>
</tr>
<tr>
<td>Upper to Middle Cambrian</td>
<td>Jay Creek</td>
<td>4803 (-2868)</td>
<td>851</td>
</tr>
<tr>
<td>Middle Cambrian</td>
<td>Hugh River</td>
<td>5654 (-3719)</td>
<td>966</td>
</tr>
<tr>
<td>Middle Cambrian</td>
<td>Giles Creek</td>
<td>6620 (-4685)</td>
<td>842</td>
</tr>
<tr>
<td>Lower (?) Cambrian</td>
<td>Chandler</td>
<td>7462 (-5527)</td>
<td>748</td>
</tr>
<tr>
<td></td>
<td>[Chandler Salt]</td>
<td>7594 (-5659)</td>
<td>616</td>
</tr>
<tr>
<td>Lower (?) Cambrian</td>
<td>Todd River</td>
<td>8210 (-6275)</td>
<td>84</td>
</tr>
<tr>
<td>Lower (?) Cambrian</td>
<td>Arumbera</td>
<td>8294 (-6359)</td>
<td>592+</td>
</tr>
<tr>
<td></td>
<td>Total Depth</td>
<td>8886 (-6951)</td>
<td></td>
</tr>
</tbody>
</table>

STRATIGRAPHY.

Purnjara formation. - Surface to 940 feet.

Age: Paleozoic (Devonian ?)

The Purnjara formation at Orange consists mainly of sandstone which is red-brown to orange-brown, angular to subrounded, mainly fine-grained, poorly to fairly well-sorted, hard, dense and tough. It is fine-to medium-grained below 670 feet, commonly silty, argillaceous, calcareous, dolomitic and is somewhat siliceous below 750 feet. Although most of the grains are quartz, lithic grains, rare feldspars and micas, opaques and metallic grains are also present. Minor amounts of orange-brown, sandy siltstone, and red, grey and greenish shales are interbedded with the sandstone, and a radioactive, predominantly shale and siltstone zone is present between 342 and 435 feet.

Sandstone recovered in Core No. 1 between 615 and 620 feet was slightly porous, and slight porosity was present in cuttings in the interval 750 to 910 feet. The hole was damp immediately below the conductor pipe at 334 feet, and minor amounts of fresh water were
present to the base of the formation.

The lower contact with the underlying Mereenie sandstone is not marked by a distinct lithologic change and could be picked considerably higher. Although an unconformity is probable on the basis of regional stratigraphic relations, the only lithologic indication is the bimodal character of fine- and medium-grained sandstone between 910 and 930 feet. The contact is picked at 940 feet on the basis of: (1) a marked drilling break; (2) a change to predominantly medium-grained, subrounded sandstone; (3) a distinct decrease in electrical resistivity; and (4) a marked decrease in acoustic velocity reflecting increased porosity.

No fossils were recognized, bedding in the core at 615' to 625' was flat lying with faint cross-laminations, there were no shows of oil or gas, and the slight porosity present appeared to be wet with fresh water.

On the basis of lithology and stratigraphic position, the Pertnjara at Orange is tentatively assigned to the Pzp (S) ("Hermannsburg") member of the Devonian (?) Pertnjara formation.

Mereenie sandstone. - Interval 940 to 2060 feet.

Age: Paleozoic (Devonian ?)

The Mereenie at Orange consists mainly of soft, clean, porous sandstone. It is orange-brown to pinkish-brown, subrounded to well-rounded, fine- to medium-grained, and fairly well sorted. The chief matrix components are silt and clay with minor calcareous, dolomitic and siliceous cements which tend to reduce the intergranular porosity somewhat. The porous sandstone is almost continuous between 940 and 1460 feet and penetration rates in this interval were very fast. From 1460 to 1800 feet the sandstone is mainly orange-brown, more indurated, slightly welded, with more argillaceous and dolomitic cement and contains occasional thin shale and siltstone layers and porous streaks rather than continuous porosity. Core No. 2 in the interval 1498 to 1507 feet consists of interbedded porous and dense sandstone. From 1800 to 2060 feet the sandstone is mainly light tan with decreasing amounts of calcareous cement and more nearly continuous fair to good intergranular porosity. Influxes of fresh water were noted from the top to the base of the formation.

The basal contact with the underlying undifferentiated Laranpinta (?) group is not marked by a distinct lithologic change and could be picked at higher or lower points. Although an unconformity at the contact is probable on the basis of regional stratigraphic relations, the only lithologic indication is the presence of 5 to 10% of loose coarse quartz grains in the interval 2050 to 2060 feet. The contact is picked at 2060 feet on the basis of: (1) a change to a markedly more silicified or welded sandstone; (2) traces of glauconite in the cuttings below 2060 feet; (3) a marked decrease in the drilling rate and change in the drilling characteristics; (4) an abrupt and striking increase in electrical resistivity; (5) a marked increase in acoustic velocity reflecting decreased porosity.

No fossils were recognized, bedding in the core at 1498 to 1507 feet was essentially flat, there were no shows of oil or gas, and the fair to good porosity is wet with fresh water.

On the basis of lithology and stratigraphic position, the Mereenie at Orange is assigned to the mainly non-marine or transitional upper member (Pzm 2) of the Devonian (?) Mereenie formation.
Larapinta Group Undifferentiated. - Interval 2060 to 2413 feet.

Age: Paleozoic (Ordovician ?)

The undifferentiated Larapinta at Orange consists mainly of hard, partly welded, calcareous sandstone. It is orange-brown, sub-rounded, fairly well-sorted, silty, argillaceous and fine-grained. The sandstone is interbedded with minor amounts of black, grey and white sandy limestone. The sandstone is fine-to medium-grained below 2350 feet, and is associated with red, dark brown, and grey shale below 2380 feet. A prominent glauconite-bearing dense red dolomite bed occurs at 2400 feet.

The sequence is generally indurated, dense and tight, but minor zones of streaky poor intergranular porosity occur throughout. Traces of siltstone, kaolin, calcite and white and black chert are also present. The lower contact with the upper Pacoota is sharp but apparently conformable, and is picked where the dolomite and siltstone of the basal Horn Valley (?) overlies the orthoquartzitic sandstone of the upper Pacoota formation.

It is not possible with present information to be certain of precise correlation or identification of the formation or formations present in this undifferentiated interval. No cores were taken and no fossils recognized. It is possible that only the basal twenty five feet of the Horn Valley is preserved, overlain unconformably by either Stairway sandstone and/or lower Mereenie ("Carmichael") sandstone. It is also possible that a thin but full section of Horn Valley is present overlain by part of the Stairway sandstone, but that most of the characteristic siltstone-shale facies of the Horn Valley has graded laterally to a sandstone facies representing a near-shore clastic environment of deposition. It is almost certain that the sequence is marine, since it contains glauconite and limestone, and it is most probable that it is an Ordovician sequence which overlies the Pacoota formation conformably.

There were no shows of oil or gas and the slight porosity present is apparently wet with fresh water.

Pacoota formation. - Interval 2413 to 3880 feet.

Age: Paleozoic (Cambro - Ordovician ?)

The Pacoota formation at Orange consists mainly of fine to medium-grained siliceous welded sandstone. It is thin-beded, white, pink, grey, to red-brown, angular to rounded, fairly well sorted and is interbedded with siltstone and red and grey shale. From 2413 to 2540 feet the sandstone is hard and tight, partly bimodal and generally fine-to medium-grained. From 2540 to 2840 feet the sandstone is thin-beded, fine-grained, glauconitic and interbedded with white siltstone, and red, grey, and green silty shale. From 2840 to 3285 feet the sequence is mainly fine-to medium-grained, welded sandstone with scattered intergranular porosity. From 3285 to 3718 feet the sandstone is similar to that above, but is interbedded with several distinct grey pyritic shale beds. From 3718 to 3880 feet the Pacoota is a massive thick-beded sandstone which is white to pink, dolomitic as well as silicified, medium-grained, well sorted and moderately porous. The lower contact with the Goyder formation is sharp but conformable, and is picked where sandy dolomite is more prominent than sandstone, as it was at the Alice No. 1 well.

Three cores were cut in the Pacoota. Core No. 3 recovered only two inches of tight welded grey quartzitic sandstone at 2415 to 2416 feet. Core No. 4 from 2846 to 2861 feet consists of fine-to coarse-grained, quartzose, welded sandstone with rare red and green shale laminations. It is sparsely fossiliferous with rare fragments of shell and poorly defined worm tubes. The dip is nearly flat, but there were some open vertical fractures, but no shows of oil or gas. Core No. 5 from 3160 to 3173 feet consists of reddish-brown to white, mottled, fine-to medium-grained, partly welded sandstone with some
beds of porous cross-bedded sandstone and several short vertical fractures. Dip is nearly flat and the porosity was wet with fresh water.

The upper several hundred feet of the Pacoota is tight and air drilling operations yielded duct between 2410 and 2710 feet, where damp returns began. At 2960 feet an influx of fresh water was noted which gradually increased in volume to 3850 feet where the booster was required to unload the hole at connections and during mist-drilling operations.

There were no shows of oil or gas and the discontinuous porosity present was wet with fresh water.

On the basis of stratigraphic position, lithology and electric-log comparison the top of the massive dolomitic sandstone at 3718 feet at Orange is correlated with a similar sandstone at 2808 feet in the Alice No. 1 well. There is about 8% thinning from Alice to Orange in correlative units in the Pacoota. The eroded Pacoota at 2115 feet at Alice is equivalent to a zone at about 3050 feet at Orange, indicating that more than 600 feet of Pacoota, missing because of erosion at Alice, is preserved at Orange. It is believed that the full Ordovician to Upper Cambrian marine Pacoota formation is present.

Goyder formation. - Interval 3880 to 4803 feet.

Age: Paleozoic (Upper Cambrian ?)

The Goyder formation at Orange consists mainly of interbedded dolomite and sandstone with minor amounts of limestone, siltstone and shale. The dolomites, which comprise about 60% of the formation, are white to grey-brown, calcareous, finely crystalline, generally dense, occasionally sandy, oolitic, fossiliferous, anhydritic and glauconitic. The sandstones, which comprise about 25% of the Goyder, are white to grey, dolomitic and siliceous, occasionally silty and glauconitic, and generally tight although rare sandstone beds are fairly porous. The remainder of the Goyder (15%) is composed of thin beds of siltstone, limestone, and grey, green and red shale, all of which are somewhat sandy and dolomitic.

Core No. 6 from 4041 to 4085 feet consists of interbedded dolomite and sandstone, which occur in beds from 1 to 5 feet thick containing abundant wavy shale partings and laminae. The sandstone is grey, fine-grained, dolomitic, glauconitic, in part argillaceous, silty and micaceous. The dolomite is grey, glauconitic, fine-to coarse-crystalline, occasionally sandy, silty and argillaceous with some beds containing abundant recrystallized pellets, oolites and relict shelly fossils. Bedding is occasionally wavy and distorted with indications of organic reworking. Coarsely crystalline anhydrite and dolomite occurs in pods, seams and lenses and minor amounts of pyrite occur in some layers. The dip is nearly flat, there is no porosity and there were no shows of oil or gas.

Fresh water is present in the Goyder formation but it is probably confined mainly to fractures since intergranular porosities are low in this formational unit. Water was present immediately below the casing at 4370 feet. The rate of water entry below this point increased gradually throughout the unit.

The lower contact with the Jay Creek limestone (Shannon) is gradational and is picked where sandy lithologies typical of the Goyder give way to predominantly oolitic carbonate and siltstone of the Jay Creek. From 4690 to 4803 feet the interval consists of interbedded silty dolomite and dolomitic sandstone with minor beds of oolitic limestone and grey shale. This unit appears to be a transition zone containing lithologies far more representative of the Goyder than
of the underlying Jay Creek. The top 120 feet of Jay Creek at the Alice No. 1 well contains similar sandstone and carbonate lithologies and should probably also be assigned to the Goyder, which would put the top of the Jay Creek at 3963 feet at Alice. Alternatively, the Jay Creek at Orange could be placed at 4690 feet at the first appearance of oolitic limestone, despite typical Goyder lithologies below.

**Jay Creek (Shannon) formation. - Interval 4803 to 5654 feet.**

**Age:** Paleozoic (Middle to Upper Cambrian ?)

The Jay Creek (Shannon) formation at Orange consists mainly of interbedded limestone, dolomite, dolomitic siltstone and dolomitic shale and minor amounts of sandstone. The dolomites and limestones, which are gradational to one-another, comprise about 60% of the formation, are white to grey, sparsely fossiliferous, commonly oolitic, silty, dense and tight. Siltstone, which comprises about 20% of the formation is very dolomitic and calcareous and is gradational to silty carbonates. Grey, green and reddish-brown, silty dolomitic, anhydritic shale and minor sandstones comprise the remainder of the formation.

From 4803 to 5170 feet the sequence is predominately dolomite and limestone with minor interbeds of shale and siltstone. From 5170 to 5490 feet the predominant lithology is dolomitic siltstone which is gradational to silty carbonates with minor interbeds of shale, dolomite and limestone. Core No. 7 from 5226 to 5266 feet consists mainly of interbedded dolomitic siltstone, silty dolomitic shale and minor silty anhydritic dolomite. The dip is essentially flat. No porosity and no shows of oil or gas were found. From 5490 to 5654 feet the interval consists mainly of limestone and dolomite with minor shale and siltstone intercalations.

The lower contact with the Hugh River is gradational and is arbitrarily picked at a distinct lithologic and electric-log break where reddish-brown shale and siltstone predominate over carbonates. Although most of the Jay Creek is tight, several zones with fractures are present and a water influx was noted below 5500 feet.

**Hugh River Shale. - Interval 5654 to 6620 feet.**

**Age:** Paleozoic (Middle Cambrian ?)

The term Hugh River shale is used in a restricted sense in this report and applies to the predominantly shale and siltstone sequence between the overlying Jay Creek carbonates and the underlying Giles Creek carbonates. Shale, which comprises about 80% of the formation, is predominantly reddish-brown, silty, dolomitic, micromicaceous and anhydritic. Minor amounts of grey, brown and green shale are also present. Red, grey and brown siltstone comprises about 10% of the unit and thin beds of dense white and grey silty dolomite comprise the balance (10%).

From 5654 to 5950 feet the sequence consists of interbedded silty shale, siltstone, and silty dense dolomites in equal proportions. From 5950 to 6320 feet the sequence is mainly red-brown, silty, dolomitic, anhydritic shale; from 6320 to 6620 feet thin beds of tight silty dolomite and green-grey shale are interbedded with the red-brown shale. The sequence is dense and tight throughout. No cores were cut and no influx of water occurred.

The lower contact with the Giles Creek dolomite is sharp but conformable and is picked where dense dolomite predominates over shale and siltstone.
Giles Creek Dolomite. - Interval 6620 to 7462 feet.

Age: Paleozoic (Middle Cambrian ?)

The Giles Creek dolomite at Orange consists mainly of thin to medium beds of dolomite interbedded with slightly lesser amounts of dolomitic shale. The dolomite is white, grey and brown, micro-crystalline to very finely crystalline, occasionally silty, anhydritic or cherty and generally subresinous, fluorescent, dense and tight. Shales are reddish-brown, grey, and green, and rarely black, dark brown and bituminous, generally silty, dolomitic, and anhydritic. From 6620 to 7128 feet the sequence consists of equal amounts of thin-bedded (average 6 feet thick) dolomite and dolomitic shale; from 7128 to 7462 feet the dolomite is about three times as abundant as dolomitic shale, is cherty and subresinous and occurs in thicker beds (averaging 15 feet thick). Core No. 8 from 7050 to 7095 feet consists mainly of hard dolomitic, anhydritic, silty shale with thin beds of anhydritic dolomite and dolomitic anhydrite. The dip is essentially flat. There were no shows of oil or gas and only traces of porosity; however, bright mineral (?) fluorescence was common in this dolomite in contrast to overlying Jay Creek carbonates which did not fluoresce.

The contact with the underlying Chandler is picked at a distinct lithologic and electric-log break where dolomites overlie highly radioactive shale.

Chandler formation. - Interval 7462 - 8210 feet.

Age: Paleozoic (Lower Cambrian ?)

The Chandler formation at Orange consists mainly of salt overlain by shale with minor intercalations of dolomite and limestone. Although a 38 foot core was cut, there was no recovery, and sample quality was very poor throughout this interval. Thus the presence of salt is based on very fast drilling rates coincident with an abrupt increase in water salinity. The rare salt recovered was fine-to-coarse-crystalline, clear to light grey and pale orange with prominent cubic cleavage and striated planes. From 7462 to 7562 feet the Chandler consists mainly of reddish-brown, dark brown, and waxy greenish-grey pyritic and silty shale with less than 10% silty, tight, fluorescent dolomite. From 7562 to 7594 feet samples were very poor and consist of a small volume of shale and silty dolomite; however, electric-log correlations indicate the possibility of a porous carbonate (?) from 7562 to 7582 feet. From 7594 to 8210 feet the interval is believed to be mainly salt (halite) with interbedded impure carbonate, anhydrite and shales in the intervals 7665 to 7718 feet and 7880 to 7940 feet, and thin shale and mudstones between 8050 and 8210 feet. A sidewall core taken at 7590 feet recovered siltstone which is grey-brown, argillaceous, dolomitic, pyritic, fossiliferous (?), sandy, dense and tight. Cavings below 7580 feet contain limestone and dolomite with fair to good porosity, which could be from the indicated porous intervals 7562 to 7582 feet and 7675 to 7718 feet or could represent original porosity infilled by salt which was leached out upon drilling. There were significant gas detector anomalies between 7500 and 7600 feet and trip gas was ignited and burned intermittently at 7529 feet.

The lower contact of the Chandler is picked on the basis of a change in gamma ray characteristics where a slow drilling break indicated the base of the salt series and top of the hard dolomitic siltstone. The Chandler is 748 feet thick at Orange and 532 feet thick at Alice No. 1. Most of the thickness variation is in the salt series, which is 616 feet thick at Orange and 435 feet thick at Alice No. 1.
Todd River Dolomite (?). - Interval 8210 to 8294 feet.

Age: Paleozoic (Lower Cambrian ?)

The Todd River dolomite (?) at Orange consists predominantly of orange-brown and white calcareous and dolomitic siltstone with interbedded white to light brown silty dolomite. The Todd (?) is hard and dense and there were no shows of oil or gas.

The lower contact is picked at an abrupt change in the gamma ray log characteristics where the fine-grained dolomitic sandstone of the upper Arumbera is topped. The Todd River is very tentatively identified mainly on the basis of stratigraphic position; it could be considerably thicker or it could be totally absent at Orange. Typical Todd River lithologies are not present, but a similar sequence is present between the Chandler salt and the Arumbera sandstone at Alice No. 1, where it has been included in the upper Arumbera (Fehr, A, 1966/7, P.2).

Arumbera Sandstone. - Interval 8294 to 8866 feet.

Age: (Paleozoic - Lower Cambrian ?)

The Arumbera sandstone at Orange consists mainly of interbedded dolomitic siltstone, fine-grained dolomitic sandstone and reddish-brown shale with minor amounts of argillaceous silty dolomite and limestone. The siltstone is orange-brown, argillaceous, sandy, dolomitic and mico-micaceous. The sandstone is white to light orange-brown, very fine-to fine-and medium-grained, generally poorly sorted, subangular, silty, argillaceous, dolomitic, siliceous, rarely glauconitic, dense and tight. Shales are reddish-brown to dark brown, silty, dolomitic and micro-micaceous. The minor amounts of limestone and dolomite (which may be caved) are grey, micro-crystalline and silty. From 8294 to 8523 feet the interval consists mainly of siltstone and fine-grained sandstone with very minor amounts of shale and carbonates. Fast drilling breaks occurred in the intervals 8456 to 8471 feet, 8472 to 8494 feet and 8519 to 8523 feet. There were no shows of oil or gas. The sandstones in these samples had only a trace of questionable porosity which did not appear effective, and they were identical to sandstone samples from previous intervals that drilled at very slow rates. From 8523 to total depth at 8866 feet the sequence penetrated was predominantly siltstone and shale with minor thin sandstone layers between 8630 and 8850 feet. Core No. 10 consists of interbedded siltstone and shale with minor sandstone intercalations with rare pinpoints of blue-white fluorescence. Dip was essentially flat, there was no effective porosity, and no significant show.

The full Arumbera sequence was not penetrated, the upper sandstone member was silty with apparently no effective porosity, and the well bottomed in tight siltstone about 300 feet below the correlative horizon at total depth in the Alice No. 1 well.

STRUCTURE.

Orange No. 1 was drilled on the crest of a large seismically-defined anticline about 14 miles long and 5 miles wide with a minimum vertical closure of about 900 feet. Flat bedding in cores indicate that the well is close to the crest of the structure from the surface down to the lowest core between 8712 and 8724 feet.

The Orange anticline appears to be a "young" structure formed during the Alice Springs orogeny as is indicated by the absence of crestal stratigraphic convergence on seismic profiles across the structure. This conclusion, based on seismic evidence, cannot be proved or disproved by subsurface geologic information from Orange No. 1.
The Larapinta group penetrated by Orange No. 1 is much thicker than in Alice No. 1 where the upper Larapinta is missing as the result of erosion prior to the deposition of the Mereenie formation as is shown on Enclosure 3. However, the lower Larapinta and upper Cambrian successions are about 8 percent thinner in Orange No. 1 than in Alice No. 1. Although this southwesterly thinning probably reflects regional thinning in this direction, the possibility of local stratigraphic convergence on the Orange structure cannot be eliminated by comparing unit thicknesses in the two wells.

RELEVANCE TO OCCURRENCE OF PETROLEUM.

Orange No. 1 encountered fresh to brackish water in aquifers above the Hugh River shale (Enclosures 3 and 4) and methane in the only porous zone penetrated below the shale.

Orange No. 1 is the sixth wildcat well which has penetrated the Larapinta group of sediments in the Amadeus basin. Enclosure 4 summarizes the results of five of these tests -- Gosses Bluff No. 1 which encountered a gas show in the Larapinta is omitted from the sketch because it was spudded and abandoned in vertical Larapinta sediments on a structure having unique morphology.

The two field discoveries made to date in the Amadeus basin are both in geologic environments where thick shale and siltstone members cap the productive sequence. The remaining tests completed as dry holes are on structures where shale and siltstone cappings are thin or absent.

East Johnny's Creek No. 1 encountered fresh water with residual oil shows in Pacoota aquifers. It was drilled on a structure which is more deeply eroded than the Mereenie and Palm Valley fields as shown on Enclosure 4. Before flushing Pacoota and Goyder (?) reservoirs contained a large accumulation of oil.

Alice No. 1 encountered "sand on sand" sequences in the Pertnjara, Mereenie and Pacoota formations. Residual oil shows were found in sandy facies of the Goyder formation thereby suggesting that the Alice structure contained oil in the Goyder formation prior to flushing. The two unconformities present in the Alice structure indicate that the structure was eroded prior to the deposition of the Mereenie formation and prior to the deposition of the Pertnjara formation.

Surface waters percolating downward from these old erosion surfaces and/or alternatively surface waters percolating downward from the present erosion surface were responsible for flushing the reservoir rocks on the Alice structure.

Orange No. 1 encountered a thicker Larapinta sequence than Alice No. 1 but it was still essentially a "sand on sand" sequence. Although the character of the sequence was not a surprise, it was disappointing since shales are present in Larapinta outcrops located about 20 miles south of Orange No. 1 (Enclosure No. 1).

Geological explanations other than flushing have been advanced for the absence of hydrocarbons in the Larapinta sequence on the Orange structure. Specifically, it has been suggested that the Orange structure was formed after the migration of oil and gas in the Orange area. Since no residual oil shows were found in the Larapinta sequence, there is negative geologic evidence to support this explanation. However, the negative geologic evidence is far from definitive since residual oil shows could have been overlooked during mist drilling, flushing by meteoric waters could have removed all oil from Larapinta reservoirs, or gas rather than oil was present in the Larapinta reservoirs.

The geologic evidence for flushing is more definitive since
the salt water which was present originally in the Larapinta marine sequence has been partly to completely replaced by fresh water. This was the fatal blow regardless of the effects of any earlier geological deficiencies that may have influenced petroleum accumulation on the structure.

Fresh water was not encountered in the well below the Hugh River shale facies. This, together with the presence of rock salt and gas in the Chandler formation, confirm the impermeable nature of the Hugh River shale on the Orange structure.

Carbonates overlying the salt in the Chandler formation were known to be petrolierous from chemical analyses of samples obtained from outcrops on the northeastern flank of the Ooraminna anticline. Furthermore, oil shows were discovered in the same general stratigraphic interval in Exoil's wildcat well, Alice No. 1. For these reasons, the gas shows encountered between 7,500 and 7,600 feet in Orange No. 1 and the appearance of sufficient trip gas to ignite a flare at 7,529 feet were not entirely unexpected. Nevertheless, they were a very welcome confirmation of the petrolierous character of this stratigraphic zone and also a stimulus to test this zone on other structures where thicker reservoir facies may be present.

POROSITY AND PERMEABILITY OF SEDIMENTS PENETRATED.

Cuttings and cores from Orange No. 1 were microscopically examined by wellsite geologists and visual determinations of porosity were reported in descriptions of the cutting samples. Specific core chips were selected for thin-section examinations and description. The results of these studies are summarized in Appendix 1.

Intervals of fair to poor porosity and poor permeability in the Pertnjara sandstones are indicated by samples, cores and log data, and by small incursions of water necessitating mist-drilling below 342 feet with influxes of fresh water at 870 feet and 900 feet. Intervals of fair to good porosity and good permeability throughout the Merenlie sandstone are indicated by samples, cores and log data, and by influxes of fresh water at 940, 1,135 and a major influx below 1,660 feet. Estimated flow rates increased at that depth from about 40 to about 200 barrels of fresh water per hour.

The undifferentiated Larapinta and the upper Pacoota to 2,960 feet are mainly tight with scattered minor zones of poor streaky porosity and fractures throughout, as indicated by samples and electric-log data. Below 2,960 feet the Pacoota contains zones of fair to good porosity and permeability on the basis of log data, and there was a gradually increasing flow of water from 2,960 to 3,880 feet.

Most of the Goyder carbonates are tight, although some appear to be fractured, but several sandstones in the Goyder are porous and apparently contributed to the influxes of brackish water.

Although most of the Jay Creek carbonates appear tight on the basis of logs, cuttings and cores, some appear to be fractured, which accounts for influxes of water to 5,550 feet.

There were no indications of porosity or permeability and no water influxes in the Hugh River, which is an effective cap rock at Orange. There were traces of slight inter-oolite porosity in the Giles Creek dolomite samples, but little or no effective permeability, no influxes of fluids, and inconsequential traces of porosity from log analysis.

Although cuttings examination during drilling the Chandler indicated no porous zones, log analysis indicated the presence of porous intervals from 7,562 to 7,582 feet and 7,675 to 7,718 feet
in beds associated with the salt series.

The Arumbera sandstone contained no recognizable porous and permeable beds on the basis of sample and core data; there were no influxes of water and no shows of hydrocarbons.

CONTRIBUTION TO GEOLOGICAL CONCEPTS.

Orange No. 1 has provided a great deal of new subsurface information about Ordovician and Cambrian stratigraphy of the northeaster portion of the Amadeus basin.

The combined thickness and lithologies of the Pertnjara and Mereenie formations in Orange were approximately as predicted (Enclosure 2).

From surface sections of the Larapinta exposed in the eastern Waterhouse and western Orominna anticlines and on the basis of the section in the Alice No. 1 well, a thin eroded Pacoota section was anticipated beneath the Mereenie at Orange. The presence of a full Pacoota section, 1,467 feet thick apparently conformably overlain by 353 feet of undifferentiated sandy Larapinta beds has necessitated a radical modification of the pre-Mereenie subcrop interpretation in this area. That this much section is preserved on the crest of the highest amplitude subsurface anticline discovered is highly significant to both the erosional history and to the possible age of folding. The sub-Mereenie erosion surface cuts deeply into the Pacoota between Orange No. 1 where 1,820 feet of Larapinta is present, and Alice No. 1 where 889 feet of Larapinta remains (Enclosure 3). However, log correlations in the lower Pacoota between the two wells indicate a thinning of about 8% in correlative units from Alice to Orange. It is not presently possible to be certain of precise correlation or identification of the undifferentiated Larapinta which overlies the Pacoota; however, possibly a spare or conodont analysis of the sample cuttings of this interval might resolve this problem, particularly if suitable samples for comparison with outcrops are available in Canberra.

The combined thicknesses and lithologies of the Pertoaorta group (Goyer, Jay Creek, Hugh River, Giles Creek, Chandler, Todd River and Arumbera stratigraphic units) are not greatly different than predicted (Enclosure 2).

The Goyer section was very similar to that penetrated at Alice No. 1 with possibly more and thicker dolomite beds. This is surprising in view of the paucity of carbonate on the outcrop in the Jay Creek - Alice Springs area and in the Waterhouse Range (Wells et al., 1965/108, p.40) and suggests a radical lithologic change between Orange and Waterhouse. It is suggested that the basal contact at Alice No. 1 be lowered from 3,850 to 3,963 feet in order to include a transition zone of sandy carbonates and sandstone indistinguishable from overlying Goyer beds and distinctly different from typical Jay Creek lithologies. The Goyer at Orange is 923 feet thick compared to the revised Goyer at Alice which is 959 feet thick, indicating that the thinning of correlative units from Alice to Orange in the Pacoota continues into the Goyer but at a lesser rate (4%).

Some aspects of the lateral relationships of Shannon formation and Giles dolomite on the east to Jay Creek limestone - Hugh River shale on the west were clarified. The base Goyer to base Giles interval at Alice is 2,755 feet thick, whereas the comparable interval at Orange is 2,659 feet. The revised Shannon at Alice No. 1 is 1,184 feet thick, whereas the Jay Creek (Shannon) at Orange is 851 feet thick; the Giles at Alice is 1,471 feet thick whereas the Giles dolomite at Orange is 842 feet thick. The Hugh River shale section is 966 feet thick at Orange and occurs between Jay Creek and Giles
carbonates. It is thus a lateral equivalent to both lower Jay Creek and upper Giles carbonates which grade westerly to a silty shale clastic facies. Electric-log correlations indicate that the Jay Creek section at Orange No. 1 is slightly thinner to 6,580 feet than the correlative section at Alice No. 1, but below that point the Orange section thickens slightly relative to Alice. The validity of these minor thickness variations is questionable, since there is a possibility of elimination of part of the section by means of a small fault at about 5,800 feet at Alice No. 1 and a small fault at 7,420 feet in Orange No. 1. In any case, the upper Cambrian to Ordovician depositional history of thinning between Orange and Alice is apparently reversed in the lower and middle Cambrian.

The Chandler formation penetrated at Orange was very similar lithologically to that at Alice No. 1, except that the salt series at Orange was about 200 feet thicker (616 feet) than at Alice (390 feet). Salinity and potassium tests of input brine compared to the brines which had washed past the exposed salt series indicated that whereas sodium chloride was being washed from the formation, potassium was not absorbed. This suggests that the Chandler salt is not a source of commercial potash in this area (see Appendix 2).

The Arumbera penetrated at Orange is similar lithologically to that on the outcrop and in Alice No. 1, except that it is essentially tight. The porous upper Arumbera sandstone in Alice No. 1 and on the outcrop at Oorammina anticline is probably represented in the interval 8,300 to 8,520 feet, but it has largely graded to siltstone and silty sandstone. The main Arumbera porous sandstone encountered in Oorammina No. 1 was not reached.
REFERENCES


APPENDIX 1

PETROLOGICAL REPORT

ORANGE NO. 1 CORE SAMPLES
FOR THIN SECTIONS

Hand Specimen Descriptions
by
G. K. Williams

Thin Section Descriptions
by
W. Layton
Core No. 1, 615' (Pertnjara Formation)

Hand Specimen

Sandstone. - reddish-orange; mainly fine-grained, fair sorting (silt to 1 mm); 10% non-quartz: dark and greenish rock fragments, light weathered feldspar (?), trace of heavy mineral; calcareous; some grain interpenetration; little secondary silica. Trace of porosity.

Thin Section Or-1

The rock is an orange-red, medium-grained, stratified sandstone. In thin section sometimes elongated, sub-rounded to angular quartz grains make up 80% of the total. About 10% each of kaolinized orthoclase and limonite cement are present. The limonite is clearly seen rimming quartz grains. A little argillaceous material is suspected in the cement.

Stratification is emphasized by variations in grain size. The finer portions are richer in iron oxides. The rock appears well cemented and voids are absent.

Core No. 1, 624' (Pertnjara Formation)

Hand Specimen

Silty Sandstone. - reddish-orange; fine-grained (silt to 1/4 mm); 15% non-quartz; dark rock fragments, feldspar, abundant heavy mineral grains; calcareous; tight.

Thin Section Or-2

This rock is essentially similar to Or-1; a red, medium-grained, stratified sandstone. It is, however, massive and more homogeneous. Quartz occurs as sub-rounded to angular grains. Many show parallel elongation. 70% of the rock is quartz and the balance kaolinized orthoclase and a few lithic fragments. A few small grains of haematite are present but the main cement is limonite. This rims the grains and fills the voids.

Core No. 2, 1498' (Mereenie Formation)

Hand Specimen

Sandstone. - orange; mainly fine-grained, fair sorting (coarse silt to 1/2 mm); trace of weathered feldspar and heavy mineral grains; interpenetration of most grains, little secondary silica; several 1 mm leached spherical cavities; 10% porosity.

Thin Section Or-3

A medium-grained orange-red sandstone. A faint stratification is present but the rock is essentially massive and homogenous. Small holes are present in the hand specimen. In thin section the quartz is generally in rounded to sub-rounded grains. There are some secondary quartz overgrowths and a number of the grains show sligth fractures and strain extinction. About 15% of the section consists of kaolinized rounded feldspar. The clastics are cemented by limonite. Voids make up an estimated 5% of the rock.

Core No. 2, 1502' (Mereenie Formation)

Hand Specimen

Sandstone. - orange, interlayered very fine-and fine-grained; slightly calcareous; trace of porosity - otherwise as at 1498'.
Thick Section Or-4

Orange-red, medium-grained sandstone. Lamination is present as black bands along finer grained quartz layers. Most quartz grains are rounded to sub-rounded in form and they make up 85% of the rock. Some secondary overgrowths are present. About 5% kaolinitized feldspar is present, some of the fresher grains are andesine. The cement is limonite with fine quartz fragments and some argillaceous material. The lamination is emphasized by variations in quartz grain size. The rock is fairly porous along elongated voids parallel to the stratification.

Core No. 2, 1506' (Mereenie Formation)

Hand Specimen

Sandstone. - orange; mainly fine-grained, fair sorting (silt to 1/2 mm); 5% non-quartz; light feldspar (?) grains; abundant secondary silica. Trace of porosity.

Thin Section Or-5

Medium-to fine-grained, orange-red sandstone. Faint stratification may be observed but the rock is essentially massive and homogeneous. In section subrounded quartz grains make up 90%. Secondary overgrowths usually fill the intergranular spaces. Kaolinitized potash feldspar and the occasional limonitized mafic mineral are present. Limonite cement makes up less than 5% of the section. Despite the pronounced secondary overgrowths, a few elongated voids parallel to the bedding occur.

Core No. 3, 2415' (Upper Pacoota-Horn Valley (?) Formation)

Hand Specimen

Sandstone. - light grey; fine-grained, well sorted except for scattered coarse grains; nearly all quartz, abundant heavy mineral grains; very fine mica; welded; tight.

Thin Section Or-6

This rock is light green to mauve in colour. It is a fine-grained, well cemented sandstone, massive and homogeneous. The quartz grains, about 1 micron in diameter, are well sorted, subrounded to angular and overgrown. They make up 90% of the section. The feldspar is kaolinitized and the inter-grain spaces are filled with mafic clusters of iron oxides. Secondary quartz overgrowth, iron oxides and kaolinitized feldspar have filled most spaces although a few voids are still present.

Core No. 4, 2847' (Pacoota Formation)

Hand Specimen

Sandstone. - light grey, patches reddish; mainly fine-grained, fair sorting (silt to 1/2 mm), trace of light clay grains, trace of heavy mineral grains; welded, tight. In red patches there is a trace of red shale as matrix and as grains; patches with a green shale film (shale pebble cast ?); trace of slightly calcareous shell fragments.

Thin Section Or-7

The rock is a pale buff colored, poorly sorted, medium-grained, well stratified sandstone with mauve colored bands. In thin section subrounded quartz makes up 90% of the total. The grains show marked secondary overgrowths. Highly kaolinitized feldspar makes up 5% of the section. The limonite cement is peppered with small ferruginous minerals.
Core No. 4, 2854' (Pacoota Formation)

Hand Specimen

Sandstone. - red; mainly fine-grained, poor sorting (coarse silt to 1 mm); trace of clay grains, 5-10% red and light grey clay matrix - all grains interpenetrated but outlined by the clay; patches and rare grains of green waxy shale; trace of porosity.

Thin Section Or-8

The core is a red and grey spotted, coarse-to-medium-grained sandstone. In thin section sub-rounded to angular quartz of variable grain size (but usually 2-3 microns in diameter) make up 80% of the section. Finer and more angular grains along with ferruginous detritus fill up most of the intergranular spaces. Kaolinitized feldspar is present and the limonite cement includes fine ferruginous grains. Voids amount to about 3% of the rock.

Core No. 4, 2858' (Pacoota Formation)

Hand Specimen

Sandstone. - white; mainly medium-grained, fair sorting (coarse silt to 1 mm); moderate welding; 5% pale green clay matrix; 5 to 10% porosity.

Thin Section Or-9

The core is a white, medium to coarse, massive, homogeneous sandstone. It is poorly cemented but not crumbly. In section sub-rounded quartz (70%) and kaolinitized orthoclase (30%) are poorly cemented by limonite and argillaceous material. The section appears to indicate a very porous rock showing voids in about 15% of the section.

Core No. 5, 3160' (Pacoota Formation)

Hand Specimen

Sandstone - patchy red and pale green to light grey; mainly medium-grained, fair sorting (1/8 to 1 mm); trace of white and pale green clay grains, trace of heavy mineral grains, trace of feldspar; trace of calcareous cement; moderate welding (all grains interpenetrated, little secondary silica). Trace of porosity.

Thin Section Or-10

The rock is a well cemented, medium-grained, reddish-brown, massive sandstone. A few spots of white in limonitized sandstone are present. The quartz, about 90% of the section, is rounded to sub-rounded in f.r.m. Some embayment features are present but rare; secondary overgrowth and pore filling is common. Many quartz grains are cracked. Some kaolinitized feldspar is present. A little limonite rims the quartz grains and porosity is low.

Core No. 5, 3165' (Pacoota Formation)

Hand Specimen

Sandstone - white; mainly fine-grained, fair sorting (1/16 to 1 mm); nearly all quartz, trace of heavy mineral grains; 5% clay matrix, mostly pale green with patches of red clay; only slightly welded, fairly friable; 5 to 10% porosity, one layer about 1 mm thick of sorted, medium-grained, very porous sand.

Thin Section Or-11

The core is a medium-grained, cross-bedded (?), white to grey,
porous sandstone. In section sub-rounded to sub-angular quartz of 2-3 microns makes up 60%, in addition small 1/2 micron angular quartz makes up 30% of the rock. A small amount of sub-rounded kaolinized orthoclase is present. The cement is an argillaceous limonite which fills most of the intergranular spaces. However, remaining voids make up about 2% of the section. Stratification is observed as continuous bands of small angular quartz.

Core No. 5, 3171' (Pacoota Formation)

Hand Specimen

Sandstone - light grey; mainly fine-grained; fair sorting (1/16 to 1 mm); trace of heavy mineral grains; trace of mica; vari-colored flat shale pebbles; welded (vitreous); tight.

Thin Section Or-12

The rock is a medium-grained, grey, stratified sandstone with included red and green angular shale fragments. In thin section quartz shows as cracked, poorly sorted, sub-rounded grains sometimes showing embayment features. Strain extinction and secondary overgrowths are common. Potasial feldspar shows alteration to kaolin. Ferruginous, argillaceous material is present interstitially, small fragments of various sizes are present. Voids are absent.

Core No. 6, 4043' (Goyder Formation)

Hand Specimen

Sandstone - greenish-grey; fine-grained; well sorted; 25% glauconite in fine and medium grains; abundant flat fossil debris -- both non and slightly calcareous; the fossil debris and glauconite cause laminations; patches and laminae with abundant disseminated pyrite.

Thin Section Or-13

The rock is a medium-grained, well stratified, well cemented, homogeneous, glauconitic sandstone. A shale contact is present. In section the rounded quartz grains are overgrown. Pore filling and embayment features are common. The glauconite, about 25% of the slide, occurs as rounded, cryptocrystalline, dark green grains. A light brown collophane mineraloid occurs parallel to the stratification. Calcite makes up 5% of the total and a small amount of iron oxide occurs interstitially.

Core No. 6, 4064' (Goyder Formation)

Hand Specimen

Dolomite - grey; fine-to medium-crystalline; faint medium to coarse oolite or pellet texture; trace of pyrite, trace of glauconite; about 20% silt, rare shale pebbles; one irregular parting of dark brownish-grey, silty shale.

Thin Section Or-14

The core is a medium-to coarse-grained, impure, carbonate rock. It is homogeneous with a slight stratification accentuated by dark colored bands. In section the carbonate(1) appears as small (1-3 microns)

(1) Some of the samples described in this report are limestones. Microscopic determination of dolomite is uncertain; accordingly calcite and dolomite has been termed carbonate.
grains, and is the product of a recrystallized oolitic limestone. Small amounts of iron oxides are present, sometimes associated with an apple-green chlorite. Voids are absent.

Core No. 6, 4083' (Goyder Formation)

**Hand Specimen**

Dolomite - grey; fine-to-coarse-crystalline; very glauconitic, the glauconite pellets are in part altered to (or from) a copper-red, shaly, micritic material; trace of fossil debris; one small pebble of coarse siltstone, very silty and sandy. (Nearly 50% of rock is dolomite, remainder is a welded porous skeleton of silt and fine sand).

**Thin Section Or-15**

The rock is a medium to coarse, impure, recrystallized limestone. It is massive and homogeneous. In section interlocking coarse-and fine-grained carbonate makes up 80% of the slide. Similar amounts of glauconite and haematite are present together with a small amount of collophane. Fluid passage through the rock has produced minute stylostyles in the carbonate; iron oxides, probably haematite (?), and argillaceous material being left behind.

Core No. 7, 5237.5' (Jay Creek Formation)

**Hand Specimen**

Dolomitic Siltstone or Silty Dolomite - light grey; about 50% is silt, residue is a partly welded porous mass of coarse silt. (Although technically probably a siltstone, it has the appearance of a microcrystalline carbonate and would be logged as such by many geologists; probably in the surface rock, the carbonate would be leached and it would be logged as a siltstone). About 10% of rock is clear crystalline anhydrite filling small vugs; irregular patches (flow structure (?)) of green silty shale; faint laminae.

**Thin Section Or-16**

The rock is a fine-to medium-grained, grey, stratified limestone. In thin section alternate laminations of very fine-grained and coarser grained carbonate occur. Considerable amounts of quartz and feldspar occur in the coarser bands. Voids are filled with secondary gypsum. Fine-grained anhydrite is possible with the fine-grained calcite.

Core No. 7, 5248.3' (Jay Creek Formation)

**Hand Specimen**

Dolomite - light grey; micro-crystalline; silty (25% silt); about 10% clear crystalline anhydrite in small vugs - much of the anhydrite has the same crystal orientation throughout the specimen.

**Thin Section Or-17**

The rock is a well stratified, very fine-grained, pale grey limestone. Gypsum crystals, a few millimetres long, occur. In this section fine and coarser grained carbonate granules alternate. Elongate crystals of gypsum grow perpendicular to the laminations. (Note this is a poor slide).

Core No. 7, 5261' (Jay Creek Formation)

**Hand Specimen**

Dolomitic Siltstone - grey, greenish tinge; micriticaceeous;
laminated, caused by variations in the dolomite and limy dolomite content, also laminae of micaceous shale.

**Thin Section Or-18**

The core is a very fine-grained, light grey and dark grey, laminated limestone. The laminations are discontinuous and wedge out. In section mineral identification is difficult owing to fine grain. However, carbonate may be assumed to make up 95% of the rock with a small amount of detrital quartz. Limonite (?) occurs between lamellae separating very fine from fine calcite. An occasional very small elongated gypsum crystal may be seen.

**Core No. 8, 7055' (Giles Creek Formation)**

**Hand Specimen**

Dolomite - light brownish-grey, crypto-to micro-crystalline, silty, many patches of clear crystalline anhydrite (10% of specimen), faint lamination.

**Thin Section Or-19**

The rock is a very fine-grained, unevenly laminated, grey limestone. A small amount of salt appears to be present. In section the carbonate is fine-grained. Gypsum, probably secondary, occurs in cracks perpendicular to the stratification and makes up about 5% of the rock. Limonite is present and the rock shows no pore spaces.

**Core No. 8, 7065' (Giles Creek Formation)**

**Hand Specimen**

Dolomite - brownish-grey, crypto-to microcrystalline, very silty, anhydritic: laminae of black shale; faint relict medium-grained texture (?); abundant pyrite in small crystals, mostly in the shale laminae.

**Thin Section Or-20**

The rock is a very fine-grained limestone. Wavy laminations are easily visible and due to thin bands of dark grey slightly coarser carbonate. In section most of the rock is fine-grained carbonate but about 5% gypsum is scattered through the mass in small isolated spots. It appears to be penecontemporaneous with deposition. A little quartz is present and the dark streaks may be due to deposition from circulating fluids.

**Core No. 8, 7067' (Giles Creek Formation)**

**Hand Specimen**

Anhydritic dolomite - brownish-grey, micro-crystalline, 50% crystalline anhydrite in small to large blobs and in seams.

**Thin Section Or-21**

The core is a very fine-grained, grey, massive limestone with a faint wavy stratification. The carbonate appears as peppered grains in large optically continuous crystals of syngenetic gypsum and as separate powder-sized grain accumulation. Secondary gypsum veins, 1 mm. wide, cut the rock. A shale fragment, 2 mm long, is incorporated in the section.

**Core No. 8, 7071' (Giles Creek Formation)**

**Hand Specimen**

Silty shale - mottled red and green. Some flow structure, some
concentric color bands, anhydritic inclusions.

**Thin Section Or-22**

The rock is a very fine-grained, grey-green shale mottled with chocolate-brown and red coloration. Small round white bodies of crypto-crystalline gypsum are present. Some of the gypsum has been lost during slide making. The shale is clearly showing various degrees of limonization.

**Core No. 10, 8712-24' (Arumbera Formation)**

**Hand Specimen**

Sandy siltstone - red-brown; unsorted mixture of shale, silt and sand grains up to 1 mm. Grains mostly quartz, trace of feldspar and very fine heavy mineral grains; subangular to rounded. Abundant mica, very slightly calcareous.

**Thin Section**

Fine-grained, poorly sorted, feldspathic, micaceous sandstone. Most quartz grains although subangular are elongated parallel to the bedding. Many show strain extinction features not related to the formation of the sandstone. The feldspar grains are normally moderately well rounded and range in composition from microcline to albite-oligoclase. Generally the feldspar shows similar size ranges to the quartz grains although it is rarely elongate. Mica occurs in thin plates but is common. The grains are often widely spaced with pore spaces filled with carbonate and limonite cements. Overall the rock shows some alternate fine and coarse laminations.
APPENDIX 2

OIL, GAS AND WATER ANALYSES

and

GAS DETECTOR OPERATIONS
OIL, GAS AND WATER ANALYSES

No oil was encountered at Orange No. 1 and the flows of gas encountered while drill ing and tripping were too small and erratic to permit sampling. As stated in the report on the Gas Analyzer operations, part A of this appendix, all of the gas detected was entirely methane.

A list of water samples collected while drilling and testing is summarized in part B of this appendix. These samples were sent to Analytical Section, Australian Mineral Development Laboratories, Cowyngham Street, Frawville, South Australia. When received, the results of their analysis will be submitted as an addendum to this report.

The only water analyses available are of samples from 8,673 feet. A comparison of input brine to returned brine after washing past the exposed Chandler salt series was made for total salt content and potassium content. The results are summarized in part C of this appendix.

A. GAS DETECTOR OPERATIONS

Chart No. 1 Review by T. H. Middleton, Core Laboratories, Brisbane

Gas detector operated and serviced by P. Scott from September 12th to 17th. By well site geologists Banks and Menzel from September 17th to October 9th, 1966.

12.9.66. Gas detector turned on - apparently tested and zeroed using the 20 graduation on the chart as zero. This position maintained with slight fluctuations of the pen for approximately 43 hours. Impossible to put even approximate time to this period due to complete absence of information.

(Depths and Times that follow are accurately fixed from Geolograph Records).

14.9.66. 5562' gas detector registered between 0.25 and 0.5 units of gas. Probably Filament drift or fiddling!

This condition maintained until:

14.9.66 5615' Violent fluctuations apparently due to mist and aerated water drilling. Salt mist seems to have affected the filament causing sharp negative drift of pen.

15.9.66. 5627' Results of powerful carbide test. No indication of whether carbide was in hole or trap.

12.02 a.m. Connection 5620 at 11.25 p.m.

12.50 a.m. 5637' End of carbide influence. Gas curve continues on mildly erratic course on and around zero.

2.30 a.m. 5661' Trip. Detector apparently left on maintaining reasonably straight zero - no drift.

15.9.66. 8.00 a.m. Detector turned on or set for trip gas (?). Erratic trip gas curve recorded varying from 2 units to zero. Unreliable.

Approx. 5680' to 5728' (11.15 a.m.) - Violent and erratic behavior of Detector - uninterpretable.
11.20 a.m. 5730' Detector maintains level unresponsive line on zero units until:

16.9.66. 3.30 a.m. 5875' Following Trip, Slip and Cut Line and Blowing hole. Drilling was resumed at 3:30 a.m. Erratic zero indicated.

3.56 a.m. 5890' Smooth curve began rising to 14 units on X25 (?) taking 12 minutes.

4.08 a.m. 5892' (Connection) Scale changed to X100 (?) indicating immediately 14 units and continued rising to:

4.11 a.m. 5892' (Still on Connection)
Instrument apparently switched to 0.65 volts indicating from 20 units back to 2 units. Apparently 18 units of Methane in the 20 units gas. Switched back to 1-15v gas curve continued to rise to:

16.9.66. 5900' Gas curve flattened out at a peak of 60 units.

4.42 a.m. Thereafter gradually dropping off to level out at:

5.33 a.m. 5920' 6 units on X100 range.
5.40 a.m. 5922' (Connection) 7 units.
6.15 a.m. 5932' 3 units.
6.33 a.m. 5940' 7 units.
6.45 a.m. 5945' 7 units.
6.58 a.m. 5950' 8 units.
7.10 a.m. 5952' (Connection) 11 units.
7.26 a.m. 5956' 9 units.
8.00 a.m. 5960' 6 units.
8.22 a.m. 5970' 2 units

Here the scale is still X100 and Detector is fluctuating on and around zero. Further interpretation is impossible until 6020'. Information supplied by Peter Scott shows that this curve is due to carbide introduced into the sampling system and being extended over a great period of time by water in the gas lines.

16.9.66. 6020' Detector appears to be maintaining a mildly erratic but consistent course on and around zero until:

7.32 p.m. 6120' After some violent erratic behavior caused by operators interference (probably zeroing), the gas curve moved suddenly to a position indicating 1 unit and settled down at 1.5 units.

12.23 a.m. 6130' 1.5 units.
The curve maintains a gently fluctuating course between 1.5 units and 3 units until:

8.30 a.m. 6310' TRIP - During this 8 hour period it appears 3 attempts were made to establish methane content in each case indicating 100% methane. However, the Detector was left running for the duration of the trip and continued to indicate around 2 units of gas. This throws doubt on the validity of the readings.

17.9.66. 6310' Drilling resumed - Detector maintaining previous doubtful reading of 2.5 units gradually tapering off to 1.5 units at 8.53 p.m. (6485'). At this point the instrument was apparently zeroed and followed an irregular zero course until 2.20 a.m. 18th September, at 6590' when the pen seems to have run out of ink.
Uninterpretable and unreliable from 6590' to connection at 6944', following which the results of a carbide check are evident.

Chart continues uninterpretable until the beginning of cutting Core No. 8 at 7050' on September 20th at approximately 5.10 p.m.

20.9.66  7052' Detector indicating 5 units of gas 100% methane apparently genuine.

This position maintained through 7065' at 8.24 p.m.

8.30 p.m. 7065' Violent and erratic behavior - reason not evident.

9.15 p.m. Note on chart "carbide" - no evident result.

9.30 p.m. Result of Butane test.

9.40 p.m. 7070' Curve maintains 5 unit level, two subsequent checks indicated 100% Methane.

21.9.66  2.00 a.m. Instrument apparently reset for zero. No gas indications. Previous 5 unit indication highly unreliable in view of this. TRIP at 7095 with Core No. 8.

12.20 p.m. 7095' Resume Drilling - gas Detector unreliable apparently - chart uninterpretable.

3.00 p.m. 7144' Pipe stuck - TRIP at 7144'.

22.9.66  1.47 a.m. 7151' Detector on! Maintained zero below zero grad. until:-

3.25 a.m. 7179' Connection - large carbide test reaching 30 units taking until 4.42 a.m. to completely clear. No indication whether carbide in hole or large trap.

Detector maintains unproductive course until 10.15 a.m. at 7263' when results of another carbide test are evident.

TRIP and logging at 7263'.

23.9.66 7264' Drilling resumed. P.D. chart uninterpretable seems to be drifting off scale negatively - probably due to salt mist in sample. This condition continues with some anomalies until the Trip at 7500' on September 24th at 4.45 a.m.

24.9.66 11.17 a.m. Resumed drilling - gas curve drifting negatively until:-

11.45 a.m. Zeroed - resumed slight drift.

12.24 p.m. Sharp gas kick to peak of 5 units at 12.27 p.m. during connection. Gradual taper off of curve to zero units (?). Perhaps from 7507'?

1.15 p.m. Cease drilling to blow hole.

1.40 p.m. Peak 6 units of gas - could be a repetition of first kick which may have originated at 7507'?

2.07 p.m. 7529' curve indicates negative reading. Could be due to drift of zero or salt mist effect.
2.37 p.m. 7529' small kick of approx. 2 units before trip. Peak is 30 mins. after drilling ceased. Curve then falls off rapidly to below marked zero.

TRIP from 2.45 p.m. until 9.00 p.m. approx.

9.20 p.m. Zeroed - indicated 2.5 units gas.

9.21 p.m. Apparently switched to 0.65 indicating 100% CH4.

9.26 p.m. 2 units indicated.

9.30 p.m. 3 units - rising sharply.

9.35 p.m. 7.5 units - rising sharply.

9.40 p.m. 13.5 units - rising sharply.

9.42 p.m. 20 units still rising, scale switched to X100.

9.45 p.m. 30 units still rising.

9.50 p.m. 57 units still rising.

9.53 p.m. 62 units reaches a small peak, levels off and rises again.

9.55 p.m. 61 units slight drop after above peak.

9.57 p.m. 102 units (on X250) still rising very sharply.

9.58 p.m. 195 units - attains very acute peak and begins drop. (Flare lit).

24.9.66. 113 units - stops falling off and rises sharply again.

10.00 p.m. 197 units - PEAK - drops again sharply.

10.05 p.m. 20 units - Fall off starting to show (X100 scale)

10.10 p.m. 7 units - 0.65v indicate 100% methane.

10.15 p.m. 5-1/2 units. Curve levels off.

10.18 p.m. 7537' - 6 units. Drilling ahead.

10.30 p.m. 7539' - 6 units. Rising.

10.34 p.m. 7540' - 7 units - 0.65v = 100% methane.

10.38 p.m. 7541' - 9 units - rising.

10.40 p.m. 11 units - peak.

10.42 p.m. 10.5 units - begins rising again.

10.45 p.m. 12.5 units - peak - drops off to: -

11.06 p.m. 7542' - 3.5 units.

11.08 p.m. 7543' - 4.5 units - Curve tails off from here to zero. 1 unit steady until:-

25.9.66. 7555' - Curve at 1 unit commences to rise.

12.05 a.m.
12.08 a.m. Peak at 6.5 units falls over 5 min. period to:-
12.13 a.m. 3 units.
12.53 a.m. 7569' - 6 unit kick.
1.53 a.m. 7586' - 9.5 unit kick - possibly from connection at 7569'.

END OF MISTING.

11.48 a.m. 7597' - 68 unit peak.
Drops to zero after 20 minutes and maintains this position.

7640' TRIP.

7.15 p.m. 7643' - 105 unit acute kick following trip.
Maintains a steady negative reading of 1.5 units during cutting of Core No. 9 (7640' - 7678').

26.9.66.

8.50 a.m. 16 unit gas kick following trip. Detector returns to zero and remains there except for small 2 unit kick at
10.00 a.m. at 7700'. Slight negative drift until zero correction at

3.12 p.m. 7830' - zero - steady on zero.

4.15 p.m. Carbide.
5.10 p.m. Carbide.
6.40 p.m. Large carbide result.

Chart from here is unproductive of information except for the occasional carbide kick noted until Trip gas from 7500' while Reaming is noted. This seems to correspond with Geograph Chart for 28.9.66.

For the rest of the chart, it is in the main devoid of information; penetration marks cease at 8508' and thus the only means of correlating with regard to time and depth are missing.

The chart seems to consist mostly of frequent carbide checks and one queried Trip gas kick which seems to be from the trip on October 3rd at 8668'.

For the most part the remainder of the chart I find un-interpretable inasmuch as it cannot be correlated to depth.
Chart No. 2 Summary by T. H. Middleton, Core Laboratories, Brisbane

Gas detector operated and serviced by T. H. Middleton of Core Laboratories from October 5th onwards.

5.10.66. 6.30 p.m. Checked out gas detector, adjusted and zeroed and set running with range set at X100. Instrument maintained reasonably steady course on zero.

I made several small checks prior to cutting Core No. 10. Re-connected drilling rate pen.

9.40 p.m. Commenced cutting Core No. 10 from 8712'. Instrument maintained zero until 11.30 p.m. when I changed scale to X25 indicating 0.5 units.

11.45 p.m. Trap blocked - gas reading fell off to zero. 8718' Cleared trap, zeroed Detector 0.5 units recorded.

12.00 p.m. 1.0 units.
Curve maintaining steady course.

6.10.66 6.00 a.m. 8721' 0.5 units.
Curve falling gradually towards zero.

2.53 a.m. 8724' - Gas Detector recording slightly below zero.
TRIP

N.B. The tendency to record a negative value when the detector was sampling from the trap I suspected at the time to be due to some sulphur compounds in the formation or to a damp salt sample. When the drying agent Ethylene Glycol arrived, and was incorporated as a "bubble bottle" the tendency to record negatively was eliminated.

During trip I once again checked out the instrument and changed the filament. Due to tendency of Silica Gel to absorb hydrocarbons when used as a drier, I also disconnected the Silica Gel chamber incorporated in the sampling setup.

I made several tests prior to drilling, the results of which indicated the gas detector was functioning satisfactorily as a detector, yet maintaining the tendency to record negatively when trap sample was used.

No information of any value was recorded until the installation of Ethylene Glycol.

7.10.66. 2.08 a.m. Installed Ethylene Glycol in sampling line. Time taken now to record kick after placing butane in line at trap is 1 min 10 secs. This is due to repairing Dyno Pump and eliminating two knockout jars.

2.10 a.m. 8778' - Curve rises to 1 unit and remains there while circulating prior to trip until turned off.

9.20 a.m. Detector turned on by Geologist while reaming rat hole, but no record kept as instrument was switched on meter position.

10.15 a.m. 2 units.
I arrived at this stage and switched to Recorder position.

10.18 a.m. Checked zero. o.k.

10.25 a.m. 1 unit.

11.20 a.m. 8779' - 0.5 units.
Background gas of 0.5 units maintained throughout the remainder of drilling to 8886'.

9.10.66 Hooked up to misting trap and prepared for blowing the hole.
7.55 p.m.

8.00 p.m. Mud flowing - 0.5 units.

8.10 p.m. Mud flowing - 1.0 units.

8.15 p.m. Change Voltage 0.65 - 0.5 units methane.

8.20 p.m. Change Voltage 1.15 - 1.0 units.

8.20 p.m. 1.75 units gas (1.25 units methane).

8.40 p.m. 2.0 units gas.

9.00 p.m. 2.0 units gas.

9.20 p.m. 1.5 units gas.

9.30 p.m. 1.5 units gas.

9.33 p.m. 2.0 units gas. Started blowing air in trap.

9.35 p.m. 0.5 units gas.

No more gas shows were recorded during blowing of the hole or subsequently.
<table>
<thead>
<tr>
<th>NO.</th>
<th>DEPTH</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>395'</td>
<td>Pertonja ss (after cond. pipe set).</td>
</tr>
<tr>
<td>2.</td>
<td>2060'</td>
<td>Mereenie ss (after trip).</td>
</tr>
<tr>
<td>3.</td>
<td>2145'</td>
<td>Mereenie ss (after trip).</td>
</tr>
<tr>
<td>4.</td>
<td>3173'</td>
<td>Pacoota ss (after Core No. 5) after Mereenie cased off.</td>
</tr>
<tr>
<td>5.</td>
<td>3478'</td>
<td>Pacoota ss (after trip).</td>
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<tr>
<td>6.</td>
<td>3794'</td>
<td>Pacoota ss (after trip).</td>
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<td>7.</td>
<td>4085'</td>
<td>Goyder formation (after trip).</td>
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<tr>
<td>8.</td>
<td>4377'</td>
<td>Goyder formation (below 8-5/8&quot; casingshoe at 4360').</td>
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<tr>
<td>9.</td>
<td>6310'</td>
<td>Hugh River - Representative of all water from 4360 - 5550'.</td>
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<tr>
<td>10.</td>
<td>6832'</td>
<td>Giles Creek.</td>
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<tr>
<td>11.</td>
<td>7461 - 7653'</td>
<td>D.S.T. No. 1 (Chandler).</td>
</tr>
<tr>
<td>12.</td>
<td>7461 - 7653'</td>
<td>D.S.T. No. 1 (Chandler).</td>
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<tr>
<td>13.</td>
<td>Surface</td>
<td>Mud Pit Control for comparison.</td>
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</tbody>
</table>
C. BRINE ANALYSES

NORTHERN TERRITORY ADMINISTRATION
ANIMAL INDUSTRY BRANCH
LABORATORY REPORT

File No. 61/8/1

Sample: Brine Solution
Submitted by: Magellan Petroleum Corporation
Date sampled: 4/10/66
Date received: 4/10/66
Analysis required: Chemical
Reference: S.A.N. No. 669

RESULTS OF ANALYSIS:

Samples:
(1) Water before being in hole (brine).
(2) Water after being in hole (mud pit) (brine), 8673'

Result:

<table>
<thead>
<tr>
<th></th>
<th>Sample (1)</th>
<th>Sample (2)</th>
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</thead>
<tbody>
<tr>
<td>Potassium - ppm</td>
<td>925</td>
<td>450</td>
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<tr>
<td>Total Salts - ppm</td>
<td>316,800</td>
<td>322,200</td>
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</table>

Magellan Petroleum Company
File 61/8/1,
S.N.

Original signed by: D.M.R. Newman
Chemist
APPENDIX 3

ORANGE NO. 1

SAMPLE DESCRIPTION
Cable Tool Samples.

10 - 20' SANDSTONE - hard, dense, massive, orange-brown, with fine-grained, medium-sorted framework of orange, angular quartz and green, rounded lithic grains. The framework is completely filled with a silty, argillaceous, calcareous, tight matrix. Accessory minerals include white mica, soft white grains and opaque black grains.

20 - 30' SANDSTONE - As above.

30 - 40' SANDSTONE - As above - with a few grey brown lithic fragments.

Rotary Samples - Dust Drilling.

40 - 50' No samples.

50 - 60' SANDSTONE - dense, massive, red-brown to orange-brown with a framework of fine-grained, medium-sorted, angular quartz grains and a few rounded lithic particles. The framework is filled with a tight matrix of red clay, silt and very fine-grained quartz particles. Calcite and dolomite, as well as a very fine-grained, rounded, black mineral, are present in minor amounts. The carbonate minerals occur predominantly in matrix and as cement.

60 - 70' SANDSTONE - As above. Majority of black grains are probably ilmenite.

70 - 80' SANDSTONE - As above. Carbonate also occurs as lithic grains.

80 - 90' SANDSTONE - dense, massive, red-brown and orange-brown, with a framework of fine-grained, medium-sorted, subangular quartz grains and a few rounded calcite and dolomite grains. The framework is filled with a tight matrix of red clay, silt and very fine grained quartz particles. Ilmenite, mica, feldspar and a variety of sedimentary rock fragments are present in minor quantities.

90 - 100' SANDSTONE - As above.

100 - 110' SANDSTONE - dense, massive, orange-brown with a framework of fine-to very fine-grained, medium-sorted, subangular quartz grains and a few rounded calcite and dolomite grains. The framework is filled with a calcareous and dolomitic, clayey, silty, tight matrix which also includes a high proportion of very fine-grained quartz particles. Ilmenite, mica, feldspar and a variety of sedimentary rock fragments are present in minor quantities.
<table>
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<tr>
<td>110 - 120'</td>
<td>SANDSTONE - As above.</td>
</tr>
<tr>
<td>120 - 130'</td>
<td>SANDSTONE - As above.</td>
</tr>
<tr>
<td>130 - 140'</td>
<td>SANDSTONE - As above.</td>
</tr>
<tr>
<td>140 - 150'</td>
<td>SANDSTONE - As above.</td>
</tr>
<tr>
<td>150 - 160'</td>
<td>SANDSTONE - As above with slightly higher proportion of very fine quartz grains.</td>
</tr>
<tr>
<td>160 - 170'</td>
<td>SANDSTONE - As in interval 100' - 110'.</td>
</tr>
<tr>
<td>170 - 180'</td>
<td>SANDSTONE - As above.</td>
</tr>
<tr>
<td>180 - 190'</td>
<td>SANDSTONE - As above but of finer grain size.</td>
</tr>
<tr>
<td>190 - 200'</td>
<td>SANDSTONE - As above in interval 170 - 180'.</td>
</tr>
<tr>
<td>200 - 210'</td>
<td>No sample ) Flow line blocked.</td>
</tr>
<tr>
<td>210 - 220'</td>
<td>No sample )</td>
</tr>
<tr>
<td>220 - 230'</td>
<td>SANDSTONE - As above, tight with trace of white cement, with SILTSTONE (less than 5%) - green, micaceous, calcareous and dolomitic and with SHALE (less than 10%) - red, fissile, micaceous, calcareous and dolomitic.</td>
</tr>
<tr>
<td>230 - 240'</td>
<td>SANDSTONE - As above. SILTSTONE (less than 5%) as above. SHALE (less than 5%) as above.</td>
</tr>
<tr>
<td>240 - 250'</td>
<td>SANDSTONE - As above. SHALE (Less than 5%) as above with a trace of SILTSTONE as above.</td>
</tr>
<tr>
<td>250 - 260'</td>
<td>SANDSTONE - As above. SHALE (less than 5%) as above with a trace of SHALE which is green, micaceous and dolomitic.</td>
</tr>
<tr>
<td>260 - 280'</td>
<td>No samples</td>
</tr>
<tr>
<td>280 - 290'</td>
<td>SANDSTONE - As above, with SHALE (less than 10%); both green and red varieties being present.</td>
</tr>
<tr>
<td>290 - 300'</td>
<td>SANDSTONE - As above and SHALE as above.</td>
</tr>
<tr>
<td>300 - 310'</td>
<td>SANDSTONE - As above and SHALE (less than 10%) as above.</td>
</tr>
<tr>
<td>310 - 320'</td>
<td>SANDSTONE - As above with a few green, very fine, sand grains, and SHALE which is red, micaceous, dolomitic and fissile.</td>
</tr>
<tr>
<td>320 - 330'</td>
<td>SANDSTONE - As above, with SHALE as above.</td>
</tr>
<tr>
<td>330 - 340'</td>
<td>SANDSTONE - As above with slightly lower % dolomite in matrix, and SHALE as above.</td>
</tr>
<tr>
<td>340 - 350'</td>
<td>SANDSTONE - As above and SHALE (less than 20%) as above.</td>
</tr>
<tr>
<td>350 - 416'</td>
<td>No sample returns - small amount of water, 1 gallon per hour est. at 395'. Started mist drilling at 416' with 1-1/2 barrels per hour.</td>
</tr>
</tbody>
</table>
416 - 420' No sample returns - increased injection rate to 5 barrels per hour.

420 - 430' SANDSTONE - Orange-brown predominantly, with grey-green and white mottling, framework of fine-grained, medium-sorted, sub-rounded quartz grains with a few calcite grains. The framework is filled with a clayey, calcitic and dolomitic silty matrix and a calcite cement which fills all remaining interstices. Mica and black opaque mineral grains occur in minor amounts.

430 - 440' SANDSTONE - As above.

440 - 450' SANDSTONE - As above with approximately 10% of a grey variety of above sandstone. SHALE (less than 5%) which is grey, fissile and slightly micaceous.

450 - 460' SANDSTONE - As above. SHALE (less than 5%) which is fissile, red and grey, and slightly micaceous.

460 - 470' SANDSTONE - As above, with SHALE (less than 5%) as above.

470 - 480' SANDSTONE - As above with less than 10% of white variety of above sandstone. The white sandstone is micaceous in part. SHALE (less than 5%) as above.

480 - 490' SANDSTONE - Red-brown, with a framework of sub-angular quartz grains which are medium to well sorted. The framework is filled with an argillaceous calcitic and dolomitic, silty matrix. All remaining interstices are filled with a white and, sometimes, pink cement which is calcareous. Mica and black opaque minerals occur in minor amounts.

490 - 500' SANDSTONE - As above. The cement in this sand appears to have increased when compared to above sandstone. Matrix appears to consist of a higher proportion of finer material. SHALE (less than 5%) as above - predominantly red.

500 - 510' SANDSTONE - As in interval 480 - 490', and SHALE (less than 5%) which is red, fissile and slightly micaceous.

510 - 520' SANDSTONE - Orange-brown to light-brown, framework consists of medium to fine quartz grains which are sub-rounded, and a few grains of calcite. The framework is filled with (a) a silty, argillaceous, calcitic and dolomitic matrix and (b) a white cement which is predominately calcite, muscovite, biotite and rare fragments of garnet. Crystal faces on quartz grains and some partial welding noticeable.

520 - 530' SANDSTONE - As above, with SHALE as above.

530 - 540' SANDSTONE - As above, and SHALE (less than 5%) as above.
540 - 550' SANDSTONE - As above, and SHALE (less than 5%) which is predominantly red but also a trace of green, slightly micaceous, fissile shale.

550 - 560' SANDSTONE - 50% as above.

SHALE - 50% red, green, grey, micaceous, slightly calcitic and dolomitic, fissile.

560 - 570' SANDSTONE - As above, and SHALE (less than 20%) which is red, fissile, calcitic and dolomitic and slightly micaceous.

570 - 580' SANDSTONE - As above, with SHALE (less than 10%) which is red, fissile, slightly calcitic, dolomitic and micaceous.

580 - 590' SANDSTONE - As above, with a trace of chert, tight, with SHALE (less than 5%) as above.

590 - 600' SANDSTONE - As above.

600 - 610' SANDSTONE - As above with trace of dolomite chips. SHALE (less than 5%) as above.

610 - 615' SANDSTONE - As above, and SHALE as above (trace).

615 - 625' CORE No. 1- Recovered 8' 6-1/2".

615 - 620' SANDSTONE - As above, and SHALE (trace) as above.

620 - 624' SANDSTONE - As above, and SHALE (trace) as above.

624 - 630' SANDSTONE - As above, and SHALE (less than 5%) which is red, green, micaceous, fissile, slightly dolomitic and calcitic.

630 - 640' SANDSTONE - As above, with SHALE (less than 5%) as in interval 624 - 630'.

640 - 650' SANDSTONE - As above, with SHALE (less than 5%) as above.

650 - 660' SANDSTONE - Pinkish-brown, hard, with a framework of sub-rounded medium-grained, partially welded quartz grains and a matrix which is argillaceous, silty, dolomitic and calcitic. A flesh pink, partly dolomitic and calcitic cement fills all remaining voids, thus rendering the sandstone tight. SHALE (less than 5%) as above.

660 - 670' SANDSTONE - As above - micaceous in part, and SHALE (less than 5%), light red-grey, slightly micaceous, silty in part, dolomitic, and slightly calcitic.

670 - 680' SANDSTONE - As above - A much higher proportion of rounded and well rounded, medium quartz grains, and SHALE (less than 15%), red and green as in interval 620 - 630'.


680 - 690' SANDSTONE - As above. Tending to a thinly laminated character, and SHALE (less than 5%) as above.

690 - 700' SANDSTONE - As above. Possesses a very thinly laminated appearance. SHALE (less than 5%) as above.

700 - 710' SANDSTONE - As above, and SHALE (less than 5%) as above.

710 - 720' SANDSTONE - As above, and SHALE (less than 5%) as above.

720 - 730' SANDSTONE - As above, and SHALE (trace) as above.

730 - 740' SANDSTONE - As above, and SHALE (trace) as above.

740 - 750' SANDSTONE - As above, and SHALE (trace) as above.

750 - 760' SANDSTONE - As above with silica cement present. Crystal faces on quartz overgrowths. Calcite cement diminishes overall porosity.

760 - 770' SANDSTONE - As above, and SHALE (less than 5%) which is red, green, slightly dolomitic, calcitic, fissile and micaeous.

770 - 780' SANDSTONE - As above, and SHALE (trace) as above.

780 - 790' SANDSTONE - As above, and SHALE (less than 5%) as above.

790 - 800' SANDSTONE - As above, and SHALE (trace) as above.

800 - 810' SANDSTONE - As above, and SHALE (trace) as above.

810 - 820' SANDSTONE - As above, and SHALE (trace) as above.

820 - 830' SANDSTONE - As above, but welded to a slightly lesser degree, with a few slightly porous fragments.

830 - 840' SANDSTONE - As above.

840 - 850' SANDSTONE - As above.

850 - 860' SANDSTONE - Pinkish-brown, hard, dense, with a framework of sub-angular to sub-rounded, medium-sorted, medium-sized quartz grains. The framework is filled with two types of cement (a) calcitic, dolomitic cement which is in minor quantities when compared to (b) siliceous cement, which, through crystal growth, has resulted in the rock having a slightly porous character. The majority of the interstices are filled with a silty, argillaceous, calcitic and dolomitic matrix, but the ratio of cement to matrix indicates that the rock had fair original porosity (less than 10%).

860 - 870' SANDSTONE - As above.
870 - 880'  SANDSTONE  -  As above.
880 - 890'  SANDSTONE  -  As above. Trace of feldspar.
890 - 900'  SANDSTONE  -  As above.
900 - 910'  SANDSTONE  -  As above.
910 - 920'  SANDSTONE  -  As in interval 890 - 900'. (Bimodal between medium and fine size grades), but silica cement not as widespread and matrix is in higher proportion.
920 - 930'  SANDSTONE  -  As above.
930 - 1160'  SANDSTONE  -  Pink-brown, with a fine-to medium-grained, sub-rounded, medium-sorted framework of quartz grains. Matrix is very argillaceous, calcitic, dolomitic and silty and predominates over the siliceous and calcitic cements. Porosity is low due to cementation (at 1130' water began to come into hole).
1160 - 1200'  SANDSTONE  -  As above.
1200 - 1210'  NO SAMPLE
1210 - 1470'  SANDSTONE  -  As above, welded partly with few lithic grains,
1470 - 1500'  SANDSTONE  -  As above, with SHALE which is red, fissile and micaceous.
1498 - 1506 1/2'  CORE NO. 2  -  100% Recovery.
1506 1/2 - 1900'  SANDSTONE  -  Orange-brown and pink-brown with fine-to medium-grained framework of clear to slightly orange quartz grains which are medium-sorted. Majority of interstices are filled with (a) silty, calcareous, argillaceous matrix (b) siliceous cement (c) calcareous cement. Porosity grades between 4% and 10%. Strong water flows were encountered in this interval.
1900 - 2060'  SANDSTONE  -  As above, but calcareous cement is very minor. 5% - 10% of framework grains range between 1 mm and 2 mm.
2060 - 2200'  SANDSTONE  -  As above but with silicification increasing slightly, thus lessening porosity. Matrix is silty and slightly kaolinitic. Glaucnite is present in very minor quantities.
2200 - 2210'  SANDSTONE  -  As above, but porosity has decreased due to heavy calcite cementation.
2210 - 2350'  SANDSTONE  -  Orange-brown, composed of medium-sorted, sub-rounded quartz framework grains and a matrix of calcitic, argillaceous, silty material. A high proportion of calcite cement is present, thus decreasing the porosity. Approximately 5% of the framework grains lie in a size range of 1-2 mm.
2210 - 2350' LIMESTONE - Black, slightly sandy. Black colouration may possibly be due to oxide of manganese. Also present is white, slightly sandy limestone (less than 5%). Both limestone types are mixed with the sandstone as interbeds, nodules or pods.

2350 - 2370' SANDSTONE - As above.

2370 - 2380' SANDSTONE - Orange-brown, moderately hard. Fine-grained, sub-rounded, medium-sorted framework of semi-transparent quartz grains is filled, in small part, by slightly calcareous matrix, and, in large part, by calcite and silica cements. The cements and partial welding reduce porosity to less than 3%. A trace of black chert and fragments of quartz up to 3 mm in length are present.

2380 - 2400' SHALE - Red to dark brown, slightly micaceous, and SANDSTONE as above, and red lithic QUARTZITE with fragments less than 3 mm. Also, white chert and coarse quartz fragments occur in trace quantities.

2400 - 2410' DOLOMITE - Which is red, coarsely crystalline, dense, no porosity. Glaucnolite is present in amounts up to 30% and SHALE (less than 10%) which is grey, slightly micaceous, and slightly calcareous, SANDSTONE (less than 20%) which is white and heavily silicified.

2410 - 2420' SANDSTONE - White, dense, hard, with a framework of medium-grained, medium-sorted, sub-rounded quartz grains and a matrix of silt and calcite and silica cements. The framework is partially welded, and this, together with the cements, causes very low porosity. SILLSTONE grey, green and black, slightly micaceous and slightly calcareous.

2415 - 2416' CORE NO. 3 - Cut 9" recovered 2".

2420 - 2440' SANDSTONE - As above.

2440 - 2450' SANDSTONE - As above, and SILLSTONE as above.

2450 - 2460' SANDSTONE - As above but with rounded framework grains and a few large (less than 3 mm) bimodal quartz grains incorporated in framework, and SILLSTONE as above.

2460 - 2470' SANDSTONE - As above, but with an increasing proportion of red and green mottled SANDSTONE, which, like all sandstones mentioned in the last 70' could be called a "Quartzite" (Bimodal within coarse grade size), and SILLSTONE which is green, micaceous, blocky, and very slightly calcareous.
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2470 - 2480'</td>
<td>SANDSTONE - As above. Interbedded fine- and medium-grained sandstone, and SILTSTONE as above, and SHALE (less than 5%), which is red, micaceous and fissile.</td>
</tr>
<tr>
<td>2480 - 2490'</td>
<td>SANDSTONE - As above.</td>
</tr>
<tr>
<td>2490 - 2500'</td>
<td>SANDSTONE - As above, with traces of red, splintery SHALE.</td>
</tr>
<tr>
<td>2500 - 2510'</td>
<td>SANDSTONE - Red-brown and white as above. Change in colour occurs at approximately 2505'. Less than 15% SILTSTONE which is green, micaceous and blocky.</td>
</tr>
<tr>
<td>2510 - 2530'</td>
<td>SANDSTONE - As above.</td>
</tr>
<tr>
<td>2530 - 2560'</td>
<td>SANDSTONE - As above with a trace of glauconite. Trace of SHALE which is fissile, green and very slightly micaceous, and SILTSTONE as above.</td>
</tr>
<tr>
<td>2560 - 2570'</td>
<td>SANDSTONE - Red-brown to white, with a framework of fine-grained, medium-sorted, sub-rounded quartz grains with a matrix of red clay and with a major proportion of siliceous cement. Porosity is nil. Very glauconitic. SHALE (less than 5%) which is brown and green, slightly micaceous and fissile.</td>
</tr>
<tr>
<td>2570 - 2590'</td>
<td>SANDSTONE - As above, with SHALE (50%) which is red, fissile and micaceous.</td>
</tr>
<tr>
<td>2590 - 2600'</td>
<td>NO SAMPLE.</td>
</tr>
<tr>
<td>2600 - 2610'</td>
<td>SHALE - Green and grey, micaceous, fissile and silty to a small degree, and SANDSTONE (less than 10%) as above.</td>
</tr>
<tr>
<td>2610 - 2630'</td>
<td>SHALE - Dark grey to medium grey, micaceous and fissile, and SILTSTONE which is hard, white and blocky.</td>
</tr>
<tr>
<td>2630 - 2650'</td>
<td>SANDSTONE - Red-brown and white, hard, dense, with a framework of sub-angular, medium-sorted quartz grains which show some ferruginous colouring. Bonding of rock is due to siliceous cement and a little clay matrix. SHALE (35%) and SILTSTONE (30%) as above.</td>
</tr>
<tr>
<td>2650 - 2660'</td>
<td>SANDSTONE - As above, and SILTSTONE (less than 20%) which is green, blocky and slightly micaceous.</td>
</tr>
<tr>
<td>2660 - 2670'</td>
<td>SANDSTONE - As above, and SHALE which is red and grey, micaceous and fissile.</td>
</tr>
<tr>
<td>2670 - 2680'</td>
<td>SANDSTONE - As above, with SHALE which is grey, micaceous and fissile.</td>
</tr>
<tr>
<td>2680 - 2690'</td>
<td>SANDSTONE - As above (framework grains up to 1 mm), and SHALE (less than 30%) which is red, green, micaceous and fissile.</td>
</tr>
<tr>
<td>2690 - 2700'</td>
<td>SANDSTONE - As above, and SHALE (5%) as above, and SILTSTONE which is brown, micaceous, blocky and dolomitic.</td>
</tr>
<tr>
<td>Depth</td>
<td>Description</td>
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</tr>
<tr>
<td>2700 - 2760' SANDSTONE</td>
<td>White and brown, hard, with a framework of sub-angular to angular, medium-sorted, red-stained quartz grains (ranging up to 1 mm) which are held together by a minor amount of calcareous, clayey matrix and siliceous and calcite cements. Owing to partial cementation, porosity is evident. SHALE (less than 10%) which is green, fissile, micaceous and slightly dolomitic.</td>
</tr>
<tr>
<td>2760 - 2800' SANDSTONE</td>
<td>As above, and SHALE (less than 25%) which is red, green, micaceous and fissile.</td>
</tr>
<tr>
<td>2800 - 2846' SANDSTONE</td>
<td>As above, with SHALE as above.</td>
</tr>
<tr>
<td>2846 - 2861' CORE No. 4</td>
<td>Recovered 15'.</td>
</tr>
<tr>
<td>2860 - 2870' SANDSTONE</td>
<td>As above, and SHALE (less than 5%) as above.</td>
</tr>
<tr>
<td>2870 - 2980' SANDSTONE</td>
<td>White and brown, hard, with a framework of sub-angular to angular, medium-sorted, stained quartz grains which are bonded by a high proportion of siliceous cement which effectively eliminates porosity. A minor amount of clay matrix is also present.</td>
</tr>
<tr>
<td>2980 - 3000' SANDSTONE</td>
<td>As above, with SHALE (less than 5%) which is red, slightly micaceous and fissile. A trace of green shale is also present.</td>
</tr>
<tr>
<td>3000 - 3050' SANDSTONE</td>
<td>As above.</td>
</tr>
<tr>
<td>3050 - 3070' SANDSTONE</td>
<td>As above, and SHALE (less than 5%) which is red, micaceous and blocky.</td>
</tr>
<tr>
<td>3070 - 3080' SANDSTONE</td>
<td>As above, and SILTSTONE (less than 15%) which is red and green, micaceous and blocky.</td>
</tr>
<tr>
<td>3080 - 3090' SANDSTONE</td>
<td>As above, and SHALE as above, and SILTSTONE as above.</td>
</tr>
<tr>
<td>3090 - 3160' SANDSTONE</td>
<td>As above, with the brown sandstone possessing less than 5% of pink, dolomitic cement.</td>
</tr>
<tr>
<td>3160 - 3173' CORE NO. 5</td>
<td>Recovered 12'.</td>
</tr>
<tr>
<td>3160 - 3210' SANDSTONE</td>
<td>As above (trace of dolomite cement occurs at 3170'), and SHALE which is red, slightly micaceous, and blocky.</td>
</tr>
<tr>
<td>3210 - 3240' SANDSTONE</td>
<td>White, hard, with a framework of angular to sub-angular, medium-sorted, quartz grains which fall within the fine grade size. The framework is cemented with a silica cement and a trace of dolomite cement.</td>
</tr>
<tr>
<td>3240 - 3300' SANDSTONE</td>
<td>As above, with SHALE which is red, micaceous and blocky.</td>
</tr>
</tbody>
</table>
3300 - 3310' NO SAMPLE.

3310 - 3320' SHALE - Which is grey-green, micaceous and blocky, with a trace of pyrite, and SANDSTONE (less than 30%) as above.

3320 - 3350' SHALE - As above (varying from less than 5% to less than 20%), and SANDSTONE as above.

3350 - 3360' SHALE - As above, and SANDSTONE (less than 30%) as above.

3360 - 3380' SANDSTONE - As above, and SHALE (less than 10%) as above.

3380 - 3400' SANDSTONE - As above.

3400 - 3410' SANDSTONE - As above.

3410 - 3460' SANDSTONE - As above, and SHALE (20%) which is grey, green, micaceous and fissile.

3460 - 3500' SANDSTONE - White, hard ('quartzitic'), with a framework of medium-to fine-grained, sub-angular, medium-sorted quartz grains, and a large proportion of silica cement. A trace to less than 5% of dolomite cement and minor amount of clay matrix also present.

3500 - 3540' SANDSTONE - As above, and SHALE grey-green, micaceous, silty and blocky.

3540 - 3570' SANDSTONE - As above.

3570 - 3630' SANDSTONE - As above, and SHALE as above.

3630 - 3650' SANDSTONE - As above.

3650 - 3680' SANDSTONE - As above, and SHALE (less than 5%) as above.

3680 - 3700' SANDSTONE - As above, but becoming micaceous, and SHALE (50%) as above but becoming slightly calcareous.

3700 - 3720' SHALE - As above, varying from 50% at 3700' to 0% at 3730'. SANDSTONE as above, dolomite cement accounts for approximately 5% of the rock, while traces of calcite cement are also present.

3720 - 3870' SANDSTONE - White-pink, hard, dense, with a framework of angular to sub-angular medium-sorted, fine and medium quartz grains. Matrix is white, silty, very slightly clayey, and is very minor compared to the dolomite, calcite and silica cements which effectively block most of the original porosity. Red, brown, and black stains occur on grains plus traces of asphaltic residue.

3870 - 3880' SANDSTONE - As above, with traces of pyrite, and small amount of SHALE which is dark grey, slightly micaceous, slightly dolomitic and blocky.
3880 - 3920' DOLOMITE - Dark to light grey, dense, hard, finely crystalline, with only a trace of lime content. Pyrite fossil replacement is evident and possible pyritic oolites may also occur but only small fragments were seen. No porosity was evident. SANDSTONE (less than 30%) as above.

3920 - 3970' DOLOMITE - As above, with dark grey pellets and brown relics of oolites (to 1 mm).

3970 - 4000' SANDSTONE - Grey, fine-grained, dolomitic, with trace glauconite, interbedded with (50%) DOLOMITE, grey, silty, sandy, with a few relic oolites.

4000 - 4041' SANDSTONE & DOLOMITE - As above, but with more glauconite, interbeds of grey dolomitic SHALE, and traces of pyrite.

4041 - 4085' CORE NO. 6.- Recovered 44'.

4085 - 4110' SANDSTONE - Grey, fine-grained, dolomitic, tight, with traces of mica, pyrite, glauconite, and few interbeds of DOLOMITE & SHALE.

4110 - 4130' SANDSTONE - As above, but with many interbeds of dark grey, dolomitic SHALE.

4130 - 4170' DOLOMITE - Brown, medium-crystalline, silty, sandy, well cemented.

4170 - 4210' DOLOMITE - Light brown, fine-crystalline, silty, sandy, well-cemented, with interbeds of dolomitic SANDSTONE with traces of glauconite and mica.

4210 - 4230' SANDSTONE - Grey, dolomitic, fine-grained, with coarse quartz grains and dolomitic cement.

4230 - 4320' SANDSTONE - Grey, medium-grained, dolomitic, tight, with pink to red cement, few interbeds of DOLOMITE and many beds of red-grey, green-gray and dark grey, micaceous, dolomitic SHALE.

4320 - 4350' SANDSTONE - Orange, medium-grained, dolomitic, with few holes, few crystal faces on quartz grains and traces of pyrite.

4350 - 4390' SILTSTONE - Grey, dolomitic, with interbeds of black, micaceous SHALE, and fine grains of dolomitic, tight sandstone.

4390 - 4400' No sample.

4400 - 4430' SILTSTONE - Grey, dolomitic, with many (40%) beds of red-grey and grey, micaceous SHALE, and a few beds of silty DOLOMITE.

4430 - 4470' DOLOMITE - Brown, spotted, silty, sandy, with pellets and relic oolites. Also interbeds (30%) of dolomitic, fine-grained SANDSTONE with some porosity. No shows.
4470 - 4490' SILTSTONE - Brown, dolomitic, dense, with grey SHALE beds.

4490 - 4520' DOLOMITE - Brown, silty, sandy, fine-crystalline, with many pellets.

4520 - 4580' DOLOMITE - As above, but with few pellets and many (40%) interbeds of grey, dolomitic, fine-grained, tight SANDSTONE. No show of oil or gas.

4580 - 4590' DOLOMITE - Light grey, silty, very fine-crystalline.

4590 - 4610' DOLOMITE - (90%) white, fine-to very fine-crystalline, hard, dense and tight. Sand and silt content varies between less than 20% and less than 40%, and SHALE (Less than 10%), grey and green, slightly dolomitic, silty and micaceous, and SANDSTONE (less than 5%), white, dense, hard, with a framework of sub-angular, medium-sorted quartz grains cemented with a large proportion of dolomitic cement. A silty, dolomitic matrix is also present in small part.

4610 - 4620' SANDSTONE - As above and SHALE (30%) as above.

4620 - 4630' DOLOMITE - (80%) as above, and SHALE, dark grey, very slightly dolomitic, silty, micaceous and fissile.

4630 - 4640' SANDSTONE - As above, and SHALE (less than 10%) as above with a trace of pyrite.

4640 - 4650' SANDSTONE - As above, and SHALE (less than 5%) as above, and DOLOMITE (less than 5%) grey, and black, sandy, finely crystalline, dense and tight.

4650 - 4660' SANDSTONE - As above, and SHALE as above.

4660 - 4670' DOLOMITE - Hard, dense, white, finely crystalline with no visible porosity. Sandy to very sandy in places.

4670 - 4680' SANDSTONE - As above.

4680 - 4700' DOLOMITE - (50%) as above, and LIMESTONE (40%), white and grey, very fine-to fine-crystalline, sandy, hard, dense and tight, and SANDSTONE as above, and SHALE as above.

4700 - 4710' DOLOMITE - As above, and LIMESTONE (10% as above, and SHALE (10%) as above.

4710 - 4720' DOLOMITE - As above, and SANDSTONE (10%) as above, and SHALE (10%) as above.

4720 - 4730' SANDSTONE - (80%) as above, arc' DOLOMITE (10%), white, finely crystalline, hard, dense, tight and limy, and SHALE (10%) as above.

4730 - 4740' SANDSTONE - (40%) as above, DOLOMITE (40%) as above (but only slightly limy), and SHALE (20%) as above.
4740 - 4750' DOLOMITE - White-grey, hard, dense, sandy, slightly silty, finely crystalline, with a trace of lime content, and SHALE, grey, dolomitic, slightly pyritic and micaceous.

4750 - 4760' SANDSTONE - White, dense, hard, with a framework of medium-sorted, sub-angular quartz grains which is cemented very heavily with a white dolomitic cement. A small proportion of silty matrix is also present. Original porosity was very high but present porosity is non-existent. Glaucnite is present in trace amounts. SHALE (15%) as above, and DOLOMITE (20%) as above.

4760 - 4800' DOLOMITE - (Varying from 60%-30%) as above, and SHALE (varying from 30% to less than 5%) as above, but becoming black in last 10', and SANDSTONE (varying from 40%-60%) as above and LIMESTONE (in interval 4770'-4780') as above.

4800 - 4820' DOLOMITE - White and grey, limy in part, finely crystalline, dense, slightly oolitic, sandy and tight.

4820 - 4860' DOLOMITE - (80%), as above with no oolites, and SHALE (less than 20%), dark grey, dolomitic, silty, slightly micaceous and blocky.

4860 - 4870' DOLOMITE - (60%) as above, LIMESTONE (20%) as above, and SHALE (20%) as above with traces anhydrite.

4870 - 4880' NO SAMPLE

4880 - 4890' LIMESTONE - (50%) as above and DOLOMITE (30%) as above, and SHALE (20%) as above.

4890 - 4900' DOLOMITE - (40%), LIMESTONE (15%), SHALE (5%) as above, and SANDSTONE (40%) as above.

4900 - 4920' DOLOMITE - (20% - 50%), LIMESTONE (40%), and SHALE (40%-10%) as above.

4920 - 4930' LIMESTONE - (60%), white to grey, fine-to very fine-crystalline, oolitic, dolomitic, dense and tight, and SHALE (40%) as above.

4930 - 4950' SHALE - (60%-40%) dark grey, slightly micaceous, slightly dolomitic, silty, slightly pyritic, and SANDSTONE (40%-60%), white, abundant calcite cement and little silty matrix.

4950 - 4990' LIMESTONE - As above, becoming silty in interval 4970 - 4980', and SHALE (less than 5% to 60%) as above. Fracture filling material was noted in interval 4960-4970'.

4990 - 5000' LIMESTONE - (95%) as above, and SHALE (5%) as above.

5000 - 5040' SHALE - (80% - 10%), grey, micaceous, dolomitic, silty, blocky and slightly pyritic, and DOLOMITE (20 - 80%), white and grey, sandy, dense, fine-to very fine-grained, limy and tight.
5040 - 5070' SHALE - (50% - 80%) as above, and SHALE (50% - 20%), red, micaceous, blocky, silty, slightly pyritic and dolomitic, with SANDSTONE (5% - 10%), pink and grey. Fine-grained, sub-angular, medium-sorted framework of quartz grains with siliceous, dolomitic and calcitic cements and a small amount of argillaceous, silty matrix.

5070 - 5140' DOLOMITE - (100% - 20%) as above, and SHALE (80%), grey, as above.

5140 - 5150' SHALE - Red and green, micaceous, dolomitic with a trace of pyrite, and DOLOMITE (20%), white and grey, very calcitic, very sandy in part, argillaceous, silty, dense, finely crystalline and tight.

5150 - 5180' SHALE - (60% - 0%), grey, as above, and DOLOMITE (100% - 40%) as above.

5180 - 5200' SILTSTONE - (80%), white, dolomitic, limy, slightly sandy, slightly anhydritic, dense and tight, and SHALE, grey and red, micaceous, silty and dolomitic.

5200 - 5226' SHALE - (70% - 80%), grey, as above, and SHALE (15 - 20%), red, as above, with less than 10% SILTSTONE as above.

5226 - 5266' CORE NO. 7 - Recovered 39'.

5266 - 5310' SILTSTONE - (60% - 10%) as above, and SHALE (grey 30% - 50% and red, 60% - 40%) as above.

5310 - 5320' LIMESTONE - (70%), white and grey, sandy, silty, slightly oolitic, partly dolomitized, dense and tight, and SHALE (30%) as above.

5320 - 5340' SILTSTONE - As above.

5340 - 5350' SANDSTONE - (60%), white, hard, dense, with a medium-sorted framework of white and clear, sub-angular quartz grains which are heavily cemented with dolomite. No porosity. SHALE (grey 30%, red 10%) as above.

5350 - 5420' SILTSTONE - (80% - 20%) as above, and SHALE (grey, 15% - 90% and red, 5% - 10%) as above.

5420 - 5430' SILTSTONE - (80% - 10%), white and grey, dolomitic, calcitic, anhydritic and very sandy in part, and SHALE, both red and grey varities which are silty (very silty in part), micaceous and dolomitic.

5430 - 5470' SILTSTONE - As above with algal and oolitic material also present, and SHALE (20% - 40%), grey, as above.

5470 - 5480' SHALE - (60% grey and 30% red) as above, with SILTSTONE (10%) as above.
5480 - 5530' LIMESTONE - (100% - 80%) white and grey, light brown dolomitic in part, finely crystalline, silty to very silty, and ooitic, and SHALE (0 - 20%) which is grey, silty and micaceous.

5530 - 5570' DOLOMITE - Light brown and grey, micro-crystalline, silty to very silty with traces of anhydrite. No visible porosity.

5570 - 5650' DOLOMITE - (50%) as above, and LIMESTONE (40%) as in interval 5480 - 5530'. SILTSTONE (less than 20%), grey, dolomitic and slightly micaceous, and SHALE (less than 70%) in interval 5610 - 5620', red, micaceous, silty and dolomitic.

5650 - 5720' SHALE - (90% - 80%), grey, micaceous, silty and dolomitic, and SHALE (red) in quantities up to 20%, with minor interbeds of SILTSTONE, white, grey, pink, red, slightly micaceous, pyritic, slightly calcitic and dolomitic.

5720 - 5740' SILTSTONE - As above.

5740 - 5760' SILTSTONE - (80% - 90%) as above, and SHALE (20% - 10%), red, pyritic, micaceous, silty, calcitic and dolomitic.

5760 - 5810' SILTSTONE - (90% - 40%) as above, and DOLOMITE (50% - 70% - 10%), white, micro-crystalline, very calcitic and silty, slightly pyritic in part, and SHALE (red up to 90% and grey up to 50%) as above.

5810 - 5870' SHALE - Red (10% - 95%) as above, and DOLOMITE (less than 10%) as above, and SILTSTONE (less than 30%) which is white and grey, dolomitic, limy, pyritic and slightly micaceous.

5870 - 5950' DOLOMITE - (100% - 10%) as above, and red SHALE (90% - 50% - 0%) as above, and SILTSTONE (5920 - 5930') (60%) as above.

5950 - 6000' SHALE - Red as above.

6000 - 6010' SHALE - (50%), red, as above, and SILTSTONE (50%) as above.

6010 - 6020' SHALE - (40%), grey as above, and SHALE (30%), red, as above, and SILTSTONE (30%) as above.

6020 - 6050' SHALE - (90%), red, as above, and SHALE (10%), grey, very silty, dolomitic, hard and dense, tending to a siltstone.

6050 - 6060' SHALE - (90%), reddish-brown, micaceous, silty dolomitic, with trace of white gypsum. SILTSTONE (10%), grey, micaceous, dolomitic and non-porous.
6060 - 6070' SHALE - (50%) as above with traces of gypsum. DOLOMITE (40%), white to light brown, fine-crystalline and very silty. SILTSTONE (10%) as above.

6070 - 6080' SHALE - (50%) as above, but with minor green colour. DOLOMITE (40%) as above. SILTSTONE (10%) as above.

6080 - 6090' SHALE - (80%) as above with trace of white gypsum. DOLOMITE (20%) as above.

6090 - 6100' SHALE - (80%) as above, DOLOMITE (15%) as above, SILTSTONE (5%), grey, micaceous and dolomitic.

6100 - 6110' SHALE - (80%) as above with traces of gypsum. DOLOMITE (20%) as above.

6110 - 6120' SHALE - (70%), reddish-brown, micaceous, very silty, dolomitic, with minor green colour and traces of gypsum. DOLOMITE (30%), white to light brown, very silty, with less than 5% clay and minor pink and grey colour, very fine-crystalline, non-porous, trace sulphide mineral.

6120 - 6130' SHALE - (80%) as above. DOLOMITE (20%) as above.

6130 - 6140' SHALE - (90%) as above. DOLOMITE (10%) as above.

6140 - 6150' SHALE - (80%) as above, with pink gypsum in pods and fractures. DOLOMITE (10%) as above. SILTSTONE (10%), grey, micaceous, dolomitic and non-porous.

6150 - 6160' SHALE - As above.

6160 - 6170' SHALE - (95%) as above. DOLOMITE (5%) as above. SILTSTONE (less than 5%) as above.

6170 - 6180' SHALE - As above (dolomite, siltstone and gypsum each less than 5%).

6180 - 6190' SHALE - Reddish-brown, micaceous, silty, dolomitic, with white gypsum in pods and fractures.

6190 - 6200' SHALE - As above.

6200 - 6220' SHALE - (80%), reddish-brown, micaceous, silty, dolomitic, with minor green, grey and dark grey colours, and with white gypsum in fractures. DOLOMITE (20%), light brown, very silty, very fine-crystalline, with trace of mica and minor red-brown colour.

6220 - 6230' SHALE - (90%) as above. DOLOMITE (10%) as above.

6230 - 6260' SHALE - As above.
6260 - 6270' SHALE - (80%) as above, and SHALE (10%), grey and green, dolomitic and very silty, and DOLOMITE (10%) as above.

6270 - 6280' SHALE - Red-brown, micaceous, dolomitic, very silty, with traces of gypsum, dolomite and green shale.

6280 - 6290' SHALE - (85%), dark reddish-brown, poorly bedded, with fractures and cavities filled with white gypsum, brittle, micaceous, very silty, dolomitic. DOLOMITE (15%), white, light grey, grey, light brown and pink, fine to very fine-crystalline, lithographic textures, silty, no visible porosity.

6290 - 6300' NO SAMPLE

6300 - 6310' SHALE - (80%) as above, and SHALE (10%), light greenish grey and dolomitic, and DOLOMITE (10%) as above.

6310 - 6320' SHALE - Dark reddish-brown, poorly bedded, slightly micaceous, dolomitic, with traces of white gypsum and with few interbeds (less than 10%) of dolomite and green-grey dolomitic shale.

6320 - 6520' SHALE - As above, with interbedded, white, silty DOLOMITE (less than 20%), and interbedded, green, silty, dolomitic, slightly micaceous SHALE (increasing to 60% in some places).

6520 - 6530' SHALE - (90%), dark reddish-brown, minor interbedded greenish-grey and grey, blocky, poorly bedded, with fractures and cavities filled with gypsum, hard, very silty, micaceous, dolomitic and trace anhydrite. DOLOMITE (10%) white, light grey and light brown, very fine-crystalline, resinous lustre in part, silty in part, no visible porosity.

6530 - 6540' SHALE - (90%) as above. DOLOMITE (10%) as above.

6540 - 6550' SHALE - (85%) as above. DOLOMITE (15%) as above.

6550 - 6560' SHALE - (90%) dark reddish-brown, minor reddish-brown and greenish-grey, blocky, poorly bedded, with fractures and cavities filled with gypsum, hard, very silty, clayey in part, micaceous and dolomitic. DOLOMITE (10%) as above.

6560 - 6570' SHALE - (75%), dark reddish-brown, minor reddish-brown and greenish-grey, blocky, poorly bedded, with fractures and cavities filled with gypsum, very silty in part, micaceous, dolomitic, clayey in part. DOLOMITE (25%) as above.
6570 - 6580' SHALE - (90%) as above, dark reddish-brown (60%), greenish-grey and grey (30%), minor reddish-brown. DOLOMITE (10%) as above.

6580 - 6590' SHALE - (90%) as above. DOLOMITE (10%) as above.

6590 - 6600' SHALE - (70%), as above, dark brown, dark reddish-brown, greenish-grey and grey. DOLOMITE (30%) as above.

6600 - 6610' SHALE - (90%) as above, dark reddish-brown, minor greenish grey and grey, DOLOMITE (10%) as above.

6614 - 6620' SHALE - (80%), dark reddish-brown, dark greenish-grey, grey and minor very dark brown, blocky, poorly bedded, with fractures and cavities filled with gypsum, hard, very silty, micaceous and dolomitic. DOLOMITE (20%) as above.

6620 - 6645' NO SAMPLES

6645 - 6650' DOLOMITE - White, light grey and light brown, silty, very fine-crystalline, dense, fluorescent, trace of black shale (much less silty than dolomites above).

6650 - 6660' DOLOMITE - (50%) as above. SHALE (20%) green-grey, part dolomitic and silty. SHALE (20%), reddish-brown, dolomitic and silty. SHALE (10%) brown, silty and dolomitic.

6660 - 6670' DOLOMITE - (60%) as above. SHALE, reddish-brown (20%), as above. SHALE, green-grey (20%), as above.

6670 - 6690' SHALE - (70%), green-grey and grey, silty, dolomitic, part very dolomitic. SHALE (20%), reddish-brown, silty, dolomitic with gypsum. DOLOMITE (10%) as above.

6690 - 6700' SHALE - (40%), reddish-brown, as above. SHALE (40%), greenish-grey, as above. DOLOMITE (20%) as above.

6700 - 6710' SHALE - (80%) as above, reddish-brown. SHALE (10%) as above, green-grey. DOLOMITE (10%) as above.

6710 - 6720 SHALE - Reddish-brown, silty, dolomitic, micaceous, with gypsum in fractures.

6720 - 6740' SHALE - (80%) as above with white gypsum crystals. DOLOMITE (20%), light grey and light brown, silty, fluorescent, with clear anhydrite crystals, pyritic, very fine-crystalline and dense.

6740 - 6750' SHALE - (60%) as above. DOLOMITE (40%) as above. Trace of black shale.

6750 - 6760' SHALE - (70%) as above. SHALE (10%), grey and dolomitic. DOLOMITE (20%), grey and light brown, silty, fluorescent, very fine-crystalline and dense. Trace of clear chert (less than 5%).
<table>
<thead>
<tr>
<th>Depth Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6760 - 6770' SHALE</td>
<td>(80%) as above, reddish-brown, SHALE (10%), green-grey and very dolomitic. DOLOMITE (10%) as above. Trace of red chert (jasper) (less than 5%).</td>
</tr>
<tr>
<td>6770 - 6790' SHALE</td>
<td>(80%) as above. DOLOMITE (20%) dark red, grey and light brown, silty, fluorescent, very fine-crystalline, with cherty inclusions.</td>
</tr>
<tr>
<td>6790 - 6800' DOLOMITE</td>
<td>(80%) as above, with chert inclusions. SHALE (10%), grey, as above, and SHALE (10%), red, as above.</td>
</tr>
<tr>
<td>6800 - 6810' DOLOMITE</td>
<td>(70%) as above, but lacking chert inclusions, and SHALE (20%), red, as above and SHALE (10%), grey, as above.</td>
</tr>
<tr>
<td>6810 - 6820' SHALE</td>
<td>(60%), red, as above, and DOLOMITE (30%) which is grey, very fine to fine-crystalline, fluorescent, very silty, dense and tight, and SHALE (10%), grey, as above.</td>
</tr>
<tr>
<td>6820 - 6830' SHALE</td>
<td>(50%), red, as above, and SHALE (30%), grey, as above, and DOLOMITE (20%), pyritic, with only a trace of chert.</td>
</tr>
<tr>
<td>6830 - 6840' SHALE</td>
<td>(30%), dark reddish-brown and SHALE (30%), dark grey, DOLOMITE (40%), silty, very fine-crystalline, with Chert (less than 5%).</td>
</tr>
<tr>
<td>6840 - 6850' SHALE</td>
<td>(70%), dark reddish-brown (50%), dark grey and grey (20%), blocky, poorly bedded, with fractures and cavities filled with gypsum, very silty, mica-ceous and dolomitic. DOLOMITE (30%), white and grey, minor light brown, occasionally pink, very fine-crystalline in part, microcrystalline in part, sily in part, slightly resinous lustres, no visible porosity, some mineral fluorescence.</td>
</tr>
<tr>
<td>6850 - 6860' SHALE</td>
<td>(80%), dark reddish-brown (50%), and dark grey, greenish-grey and grey (30%) as above. DOLOMITE (20%) as above.</td>
</tr>
<tr>
<td>6860 - 6870' SHALE</td>
<td>(80%), dark reddish-brown, minor dark brown and light reddish-brown (60%), dark grey, greenish-grey and grey (20%), as above. DOLOMITE (20%) as above.</td>
</tr>
<tr>
<td>6870 - 6880' SHALE</td>
<td>(80%) as above. DOLOMITE (20%) as above.</td>
</tr>
<tr>
<td>6880 - 6890' SHALE</td>
<td>(70%) as above. DOLOMITE (30%) as above.</td>
</tr>
<tr>
<td>6890 - 6900' SHALE</td>
<td>(60%), dark reddish-brown, minor dark brown and light reddish-brown (40%) dark grey, greenish-grey and grey (20%), as above. DOLOMITE (40%) as above.</td>
</tr>
</tbody>
</table>
6900 - 6910' DOLOMITE - (50%), grey, light brown and brown. Very finely crystalline with coarse-crystalline spots, silit, fluorescent, few coarse sulphate crystals. SHALE, dark reddish-brown (40%) with gypsum (less than 5%).

6910 - 6920' DOLOMITE - (50%) as above. SHALE (30%) dark reddish-brown and (20%) green-grey.

6920 - 6930' DOLOMITE - (50%) as above with major brown colour. SHALE (40%) dark reddish-brown and (10%), green-grey with trace black.

6930 - 6940' SHALE - (60%), dark reddish-brown, SHALE (10%), green-grey and trace black, DOLOMITE (30%) as above.

6940 - 6950' SHALE - (80%), dark reddish-brown, part very micaceous, slightly dolomitic, fine and silit. DOLOMITE (20%) as above.

6950 - 6960' SHALE - (70%) as above. DOLOMITE (30%) as above but with traces of pyrite.

6960 - 6970' SHALE - (60%) as above. DOLOMITE (40%) as above.

6970 - 6980' SHALE - (40%), reddish-brown, silit, with trace gypsum. SHALE (30%) green-grey and dolomitic. DOLOMITE (30%) as above.

6980 - 6990' DOLOMITE - (60%), light brown, silit, fluorescent, fine-crystalline with few longer crystals in spots, trace of porosity. No shows. SHALE (30%), reddish, as above. SHALE (10%), green-grey, as above.

6990 - 7020' SHALE - (60% - 40%), red, silit, moderately hard, dolomitic and micro-micaceous, with traces of gypsum and anhydrite. SHALE (15% - 30%), light and dark grey, slightly dolomitic, slightly micaceous, very silit, with traces of chert. DOLOMITE (20% - 40%), light brown and white, silit, fluorescent, finely crystalline with a few coarse-crystalline areas, no porosity visible.

7020 - 7050' DOLOMITE - (50%) as above, but showing mineral fluorescence and rare bituminous (?) partings with traces of oolites. SHALE (10% - 40%), red, as above. SHALE (20% - 40%), grey-green, dolomitic, with a waxy, earthy, lustre.

7050 - 7095' CORE NO. 8 - Recovered 38 feet.

7095 - 7100' SHALE - (70%), dark red-brown and dark brown (40%), dark grey, grey and greenish-grey (30%), blocky, poorly bedded, hard, silit, micaceous, dolomitic.
7095 - 7100' SHALE
(continued)

DOLOMITE (30%) white, light grey and grey, very fine-crystalline in part, microcrystalline in part, slight resinous lustre, silty in part, no visible porosity, some mineral fluorescence. Trace fine to medium grained quartzose sandstone (caved?).

7100 - 7110' SHALE

(80%) as above. DOLOMITE (20%) as above. Trace medium grained quartz sand (caved?).

7110 - 7120' SHALE

(80%), dark reddish-brown and dark brown (50%), dark grey, greenish grey, and grey (30%), as above, trace gypsum. DOLOMITE (20%) as above.

7120 - 7130' SHALE

(70%), dark grey and grey (30%), dark reddish-brown (20%), blocky, poorly bedded, hard, silty, micaceous in small part, dolomite, trace pyrite. DOLOMITE (30%) as above.

7130 - 7140' SHALE

(70%), dark grey and grey (60%), dark reddish-brown (10%), as above. DOLOMITE (30%) as above.

7140 - 7150' SHALE

(70%), dark grey, greenish-grey and grey (60%), dark reddish-brown (10%), blocky, poorly bedded, hard, silty, micaceous in small part, dolomite, with partings and inclusions of anhydrite. DOLOMITE (30%) as above, with few inclusions of anhydrite.

7150 - 7160' SHALE

(75%), dark reddish-brown and reddish-brown (40%), dark grey, greenish-grey, and grey (35%), as above. DOLOMITE (25%) as above.

7160 - 7170' SHALE

(75%), dark reddish-brown (40%), dark grey, greenish-grey and grey (35%), micaceous, as above. DOLOMITE (25%).

7170 - 7180' SHALE

(50%), dark grey, grey and greenish-grey, blocky, poorly bedded, hard, silty, micaceous in small part, dolomite, with partings and inclusions of anhydrite, trace pyrite. DOLOMITE (50%), white and light grey, very fine-crystalline in part, microcrystalline in part, slight resinous lustre, silty, a few laminae and inclusions of anhydrite, no visible porosity.

7180 - 7190' SHALE

(80%), dark reddish-brown (50%), dark grey greenish-grey and grey (30%), as above, trace gypsum. DOLOMITE (20%) as above.

7190 - 7200' SHALE

(75%), dark reddish-brown and dark brown (50%), dark grey, greenish-grey and grey (25%), micaceous, as above. DOLOMITE (25%) as above, trace pyrite.
7200 - 7210' SHALE - (70%), dark reddish-brown (50%), dark grey, greenish-grey and grey (20%), as above. DOLOMITE (30%) as above but grey and dark grey as well as white and light grey colours, crystals and inclusions of sulphate minerals (5%).

7210 - 7220' SHALE - (75%) as above. DOLOMITE (25%) as above.

7220 - 7230' SHALE - (90%) as above, but very dolomitic. DOLOMITE (10%) as above including sulphate minerals.

7230 - 7240' SHALE - (90%) as above. DOLOMITE (10%) as above including sulphate minerals.

7240 - 7250' SHALE - (20%), dark grey, greenish-grey and grey (10%), dark reddish-brown and reddish-brown (10%), as above. SHALE (40%), brown, very silty, very dolomitic. DOLOMITE (30%), grey, silty, very fine-crystalline, (10% sulphate minerals), traces of pyrite.

7250 - 7260' SHALE - (75%), dark reddish-brown and reddish-brown (40%), dark grey, greenish-grey and grey (35%), blocky, poorly bedded, hard, silty, micaceous in part, dolomitic inclusions, and lenses of clear, white and pale pink sulphate minerals (probably anhydrite and gypsum). No fluorescence. DOLOMITE (25%), white, light grey and grey, very fine-crystalline in part, microcrystalline in part, silty, with included grains and crystals of sulphate minerals (probably anhydrite and gypsum), no visible porosity, some mineral fluorescence, trace of pyrite.

7260 - 7270' SHALE - (60%), dark reddish-brown and reddish-brown (50%), dark grey and greenish-grey (10%), as above. DOLOMITE (35%) as above, calcitic. SULPHATE MINERAL (5%), crystals and grains, anhydrite and possibly some gypsum.

7270 - 7280' SHALE - (50%) as above, no fluorescence. DOLOMITE (50%), white, light grey and grey, very fine-crystalline in part, microcrystalline in part, silty in part with included grains and crystals of sulphate mineral, calcitic, trace of intercrystalline porosity in very fine-crystalline types, some mineral fluorescence.

7280 - 7290' SHALE - (90%), dark reddish-brown and dark brown (80%), dark grey and greenish-grey (10%), as above. DOLOMITE (10%) as above.

7290 - 7300' SHALE - (85%) dark reddish-brown and minor dark brown (70%), dark grey and greenish-grey (10%), blocky, poorly bedded, hard, silty, micaceous, dolomitic, inclusions and patches of white to orange-pink sulphate minerals (5%), no fluorescence. DOLOMITE (15%) as above, but dark grey.
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>7300 - 7310' SHALE</td>
<td>(50%), dark reddish-brown, minor reddish-brown and trace black (40%), dark grey and greenish-grey (10%), as above. DOLOMITE (50%), white, grey and dark grey, very fine-crystalline in part, microcrystalline in part, occasional fine-crystalline, silty in part, calcitic, included grains and crystals of sulphate minerals, no visible porosity, some mineral fluorescence.</td>
</tr>
<tr>
<td>7310 - 7320' DOLOMITE</td>
<td>(80%) as above. SHALE (20%), dark reddish-brown and reddish-brown, as above.</td>
</tr>
<tr>
<td>7320 - 7330' DOLOMITE</td>
<td>(90%) as above, but light brown with 5 - 10% white, colourless and light brown chert. SHALE (10%), dark reddish-brown.</td>
</tr>
<tr>
<td>7330 - 7340' DOLOMITE</td>
<td>(90%), light brown, dark grey and brown, very fine-crystalline, very silty, calcitic, with 5 - 10% white, colourless and light brown chert and crystals of anhydrite. No porosity, no cut, no oil fluorescence, but with mineral fluorescence. SHALE (10%) as above.</td>
</tr>
<tr>
<td>7340 - 7350' SHALE</td>
<td>(30%), reddish-brown, silty, dolomitic, with anhydrite. SHALE (30%) dark grey, silty and dolomitic. DOLOMITE (40%), dark grey and light brown, very fine-crystalline, silty, no porosity.</td>
</tr>
<tr>
<td>7350 - 7360' SHALE</td>
<td>(40%), reddish-brown, silty, dolomitic and anhydritic. DOLOMITE (60%), grey, dark grey and light brown, anhydritic, silty, very fine-crystalline.</td>
</tr>
<tr>
<td>7360 - 6370' DOLOMITE</td>
<td>(50%) as above. DOLOMITE (20%), dark brown, very fine-crystalline and bituminous (?) SHALE (30%) as above.</td>
</tr>
<tr>
<td>7375 Spot Sample SHALE</td>
<td>(100%), dark grey, micaceous, dolomitic, fine and silty.</td>
</tr>
<tr>
<td>7370 - 7380' SHALE</td>
<td>(100%), dark grey, micaceous, dolomitic, silty, trace calcitic dolomite and anhydrite.</td>
</tr>
<tr>
<td>7385 Spot Sample SHALE</td>
<td>(100%) as above.</td>
</tr>
<tr>
<td>7380 - 7390' SHALE</td>
<td>(70%) as above. DOLOMITE (30%), brown and grey, very fine-crystalline, anhydritic and silty.</td>
</tr>
<tr>
<td>7397' Spot Sample SHALE</td>
<td>As above, plus reddish-brown, calcitic, silty shale.</td>
</tr>
<tr>
<td>7390 - 7400' SHALE</td>
<td>(40%), dark grey as above. SHALE (20%), reddish-brown, calcareous and silty. DOLOMITE (20%), light brown, very fine-crystalline, anhydritic. DOLOMITE (20%), brown and dark grey, fine-crystalline, anhydritic.</td>
</tr>
</tbody>
</table>
7405' Spot Sample
SHALE  - (60%), red-brown, micaceous and calcitic. SHALE (10%), dark reddish-brown. SHALE (30%), light brown, very fine-crystalline, calcitic and dolomitic.

7410' Spot Sample
SHALE  - As above, plus red shale (5%).

7400 - 7410' SHALE  - (80%), reddish-brown. SHALE (10%), dark reddish-brown and dark green-grey. DOLOMITE (10%), light brown, very fine-crystalline, no porosity.

7417' Spot Sample
SHALE  - (50%), green-grey. SHALE (20%) reddish-brown, calcitic. Trace black shale. DOLOMITE (30%), calcitic.

7410 - 7420' SHALE  - (60%), red-brown, calcitic and micaceous. SHALE (10%), dark reddish-brown. SHALE (10%), green-grey, dolomitic. DOLOMITE (20%), light brown, very fine-crystalline.

7425' Spot Sample
DOLOMITE - brown, fine-crystalline, trace pyrite. CHERT (5%).

7420 - 7430' SHALE  - (30%), reddish-brown, anhydritic, dolomitic and silty. SHALE (20%), green-grey. SHALE (trace) black. DOLOMITE (20%), light brown, very fine-crystalline. DOLOMITE (20%), brown, fine-crystalline. CHERT (10%), white, brown and black.

7435' Spot Sample
DOLOMITE - brown and dark brown, fine-crystalline, anhydritic, silty, welded, cherty (10%). Trace red, green and black SHALE. Trace pyrite and trace porosity.

7430 - 7440' DOLOMITE  - (80%), brown and grey, fine-crystalline, anhydritic, cherty with trace of porosity in spots. SHALE (20%) as above.

7440 - 7450' DOLOMITE  - As above with trace of porosity.

7450 - 7460' SHALE  - (70% dark grey, 10% red), micaceous, dolomitic, silty, with trace of pyrite. DOLOMITE 20% as above, with traces of brown chert.

7460 - 7470' SHALE  - Dark reddish-brown, micaceous, dolomitic, silty, with few medium, rounded, frosted quartz grains. SHALE dark grey, micaceous. DOLOMITE grey as above.

7470 - 7480' SHALE  - (80%) dark reddish-brown, micaceous, silty, dolomitic, with few medium size quartz grains. SHALE dark grey. DOLOMITE grey, as above, with trace of pyrite.

7480 - 7490' SHALE  - (90%) dark reddish-brown, micaceous, silty, dolomitic, with few anhydrite inclusions. SHALE (10%) dark grey.
7490 - 7500' SHALE - Dark reddish-brown, as above with rare medium sand grains.

7505' Spot Sample SHALE - (90%), dark reddish-brown, minor dark grey, grey, greenish-grey and occasionally black, as above. DOLOMITE (10%), white, grey and dark grey, as above.

7500 - 7510' SHALE - (95%), dark reddish-brown and dark brown, occasionally black (90%), greenish-grey and grey (5%), blocky, poorly bedded, hard, silty, micaceous, dolomitic in part, only a few small inclusions of sulphate mineral, no fluorescence. DOLOMITE (50%), white, light grey, and grey, microcrystalline, silty, calcitic, no visible porosity.

7515' Spot Sample SHALE - (90%), dark reddish-brown, dark brown and occasionally black (80%), and greenish-grey, grey and dark grey (10%), as above. DOLOMITE (10%) as above.

7510 - 7520' SHALE - (85%) as above. DOLOMITE (15%) as above.

7520 - 7529' SHALE - (90%) dark reddish-brown and dark brown (80%), greenish-grey (10%), as above. DOLOMITE (10%) as above, trace of included chert. Drilling water turned red. Flared trip gas intermittently. Gas Detector anomaly 200 units.

7533' Spot Sample SHALE - Red iron, also chert and fine quartz grains.

7534' Spot Sample SHALE - Red-brown, micaceous, very silty, some chert (5% (?)).

7530 - 7540' SHALE - (80%), reddish-brown, micaceous, silty. SHALE (10%) green and grey, micaceous. DOLOMITE, light brown, very fine crystalline, cherty and dense (micrite).

7547' Spot Sample SHALE - Red-brown, micaceous and silty. Traces of dolomite, quartzite, shale and chert.

7540 - 7550' SHALE - As above but with 10% more green-grey shale.

7555' Spot Sample SHALE - Green, pyritic (5%). Also clay shale and red shale.

7550 - 7560' SHALE - (80%), dark reddish-brown (40%), greenish-grey and grey (40%), blocky, poorly bedded, hard, reddish-brown type silty, greenish-grey type claystone, micaceous in part, slightly dolomitic, calcareous in part, pyritic (5%). DOLOMITE (20%), white and light grey, microcrystalline, calcitic, silty, trace of chert, pyritic, no visible porosity.
<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7560 - 7570' SHALE</td>
<td>(80%), dark reddish-brown (35%), greenish-grey and grey (45%), as above. Pyrite and trace of gypsum. DOLOMITE (20%) as above.</td>
</tr>
<tr>
<td>7570 - 7580' SHALE</td>
<td>(80%), dark reddish-brown (40%), greenish-grey and grey (40%), pyritic as above. DOLOMITE (20%) as above.</td>
</tr>
<tr>
<td>7580 - 7590' DOLOMITE</td>
<td>(70%), grey, argillaceous, very silty, very fine-crystalline. SHALE (10%), green-grey, pyritic, clay shale. SHALE (20%), reddish-brown, silty and fine-sandy, with scarce quartz crystals.</td>
</tr>
<tr>
<td>7593' Spot Sample</td>
<td>SHALE</td>
</tr>
<tr>
<td>7590 - 7600' (very small vol. returns)</td>
<td>SHALE</td>
</tr>
<tr>
<td>7600 - 7610' (Very small vol. returns)</td>
<td>SHALE</td>
</tr>
<tr>
<td>7610 - 7620' (Very small vol. returns)</td>
<td>SHALE</td>
</tr>
<tr>
<td>7620 - 7630' No Sample</td>
<td></td>
</tr>
<tr>
<td>7630 - 7640' SHALE</td>
<td>(80%) as above. Shale with pyrite (5%). Gypsum (5%). Calcite (5%). DOLOMITE (5%), white, microcrystalline, calcitic.</td>
</tr>
<tr>
<td>7640 - 7678' Core No. 9</td>
<td>No recovery.</td>
</tr>
<tr>
<td>7640 - 7650' No Sample.</td>
<td></td>
</tr>
<tr>
<td>7650 - 7660' SHALE</td>
<td>Light brown, silty, very dolomitic. Trace pyrite. Double-ended quartz crystals.</td>
</tr>
<tr>
<td>7660 - 7665' SHALE</td>
<td>(70%) as above, with (20%) black, (5%) red, and (5%) chert. Abundant clear anhydritic crystals.</td>
</tr>
</tbody>
</table>
7665 - 7670' LIMESTONE - (40%) grey and silty. SHALE (30%) as above with double-ended quartz crystal. Black shale (10%).

7670 - 7690' LIMESTONE - (65%), white and light grey, micro-crystalline, silty, dolomitic in part, no visible porosity. Gypsum (5%). Trace pyrite, clear quartz crystals and anhydrite. Trace fluorescence. SHALE (30%), grey and dark grey, minor reddish-brown and dark reddish-brown, also greenish-grey, blocky, poorly bedded, soft in part, silty and micaceous in part, dolomitic and calcareous in parts.

7690 - 7700' LIMESTONE - (65%) as above, with pyrite, gypsum (5%). Trace clear quartz crystals. SHALE (30%), grey, dark grey, reddish-brown, and greyish-green, as above.

7700 - 7710' LIMESTONE - (55%) as above. Gypsum (5%). Pyrite. SHALE (40%), grey, dark grey, black, and minor reddish-brown, as above.

7710 - 7720' Very small sample
SALT (?)

7720 - 7730' Very small sample
SALT (?)

7730 - 7740' Very small sample
SALT (?) and LIMESTONE - grey, silty. Light brown, silty, dolomitic shale. Black shale and red shale, (5%). Pyrite. Anhydrite (10%). Few double ended quartz crystals and quartz grains.

7740 - 7750' Very small sample
SALT (?) and LIMESTONE as above.

7750 - 7760' LIMESTONE - (60%), white, grey and light greyish-brown, silty, micro-crystalline, dolomitic in part, no visible porosity. SHALE (25%), grey, dark grey, black, reddish-brown and minor greenish-grey, as above. Gypsum and anhydrite (10%), clear crystals. Pyrite (5%). Trace double ended quartz crystals.

7760 - 7770' Very small returns
SALT (?) Limestone (60%) as above. Gypsum and anhydrite (10%). Pyrite (5%). SHALE (25%) as above.

7770 - 7780' Very small returns
SALT (?) LIMESTONE (60%) as above. SHALE (25%) as above. Gypsum and anhydrite (10%). Pyrite (5%).

7780 - 7790' Very small returns
SALT (?) LIMESTONE (60%) as above. SHALE (25%) as above. Gypsum and anhydrite (10%). Pyrite (5%). Trace double ended quartz crystals.
7790 - 7800' Very small returns
SALT (?) LIMESTONE (50%) as above. SHALE (40%) as above. Gypsum and anhydrite (10%). Trace pyrite. Double ended quartz crystals.

7800 - 7810' Very small returns
SALT (?) LIMESTONE (60%), dolomitic in part, as above. SHALE (30%), grey, dark grey, dark reddish-brown, black and greenish-grey, as above. Gypsum and anhydrite (10%) clear crystals. Trace pyrite.

7810 - 7850' Very small returns
SALT (?) Orange clay and salt, plus as above, plus small new salt crystals.

7850 - 7860' SALT (?) Orange clay and salt 30%, clear, fibrous, plus as above, plus small new salt crystals.

7860 - 7870' SALT (?) No sample.

7870 - 7880' No sample.

7880 - 7887' No sample.

7887 - 7893' No sample.

7893 - 7900' SALT - (50%). SILTSTONE (20%, light orange, limy, argillaceous, dolomitic, with traces of pyrite. LIMESTONE (20%), white and grey, slightly dolomitic, slightly pyritic, anhydritic with traces of gypsum. No visible porosity. CLAYSTONE, (less than 10%) white and tan, slightly dolomitic, with anhydrite and gypsum. SHALE (less than 5%), black, pyritic, slightly dolomitic, with anhydrite and gypsum.

7900 - 7920' DOLOMITE - (10%), white and grey, very finely crystalline, slightly limy, dense and tight. LIMESTONE (10%), white, as above but very dolomitic. SILTSTONE (10%) as above. CLAYSTONE as above. (Inferred major portion of interval is SALT.)

7920 - 8040' SALT - Inferred from increase in salinity of circulating fluid.

8040 - 8050' SALT - (90%) as above. SHALE (10%), red, dolomitic, silty, slightly micaceous and argillaceous.

8050 - 8600' Very small sample SALT - (95%), clear irregular shaped fragments. SHALE (3%), reddish-brown.

8060 - 8070' SALT - (90%), clear, irregular shaped fragments. SHALE (10%), orange-brown and minor black.

8070 - 8080' SALT - (90%) as above. SHALE (10%) as above.
8080 - 8090° Very small sample
SALT - (90%) as above. SHALE (10%) as above. Yellow colouration in drill fluid accompanying sample.

8090 - 8100° SALT - (90%), clear, irregular shaped, elongated in part, larger fragments than above with parallel striations (probably cleavage lines) within the fragments; some fragments are bonded in part by cleavage planes. SHALE (10%) as above, trace greenish-grey. Sample is covered with a yellow coating, which washes off in water (Bichromate additive).

8100 - 8110° Very small sample
SHALE - (85%), orange brown (80%), black (10%), calcareous and dolomitic. SALT (10%) as above. Trace gypsum. DOLOMITE (5%), very light brown, micro-crystalline, calcitic.

8110 - 8120° Very small sample
SHALE - (90%), orange brown (80%), black, white and light grey (10%), poorly bedded, micaceous in part. SALT (5%). DOLOMITE (5%) as above.

8120 - 8130° Very small sample
SHALE - (45%) as above. SALT (50%), very fine fragments, with few larger, irregularly shaped fragments. DOLOMITE (5%) as above.

8130 - 8150° Very small sample
SALT (?)

8150 - 8160° Small sample
SALT - (90%) coarse salt (clear (2mm) fragments of single halite crystals). SHALE (10%), orange-brown.

8160 - 8170° SALT - As above. (SALT put in drilling water contains clear, striated and cross hatched fragments of coarse crystals just like SALT out of hole).

8170 - 8180° Small sample
SALT (65%). SHALE (30%), orange-brown, minor very light grey and black, as above. DOLOMITE (5%) as above.

8180 - 8190° Small sample
SALT - (80%) clear crystals, some elongate, other irregular; average 1 mm across. SHALE (20%), orange-brown and minor black, micaceous and soft.

8190 - 8200° Very small sample
SALT - (90%), clear crystals, fine fragments mixed with larger ones (range 1/10 mm to 2+ mm). SHALE (10%) as above.

8200 - 8210° SALT - (80%), translucent and clear crystals, average size 1-1/2 mm across, irregular shaped, some elongate and platy. SHALE (20%) as above.
8210 - 8220' Very small sample
SILTSTONE - (80%), orange-brown and light orange-brown (75%), white and light grey (10%), poorly bedded, soft, argillaceous, micaceous, with few dark coloured grains, calcareous, trace gypsum. SALT (10%). SHALE (5%), black, dark reddish-brown and greenish-grey. LIMESTONE (5%), white and very light brown, micro-crystalline, silty.

8220 - 8230' Small sample
SILTSTONE - (90%) as above. SHALE (5%) as above. LIMESTONE (5%) as above. Trace salt.

8230 - 8240' SILTSTONE - (90%) as above, with clear SALT (10%).

8240 - 8250' SILTSTONE - Orange-brown and argillaceous.

8250 - 8260' No sample

8260 - 8270' Very small sample
SILTSTONE - (80%) as above. SHALE (15%), black, grey, brownish-grey and dark reddish-brown. LIMESTONE (5%) as above. Trace dolomite.

8270 - 8280' SILTSTONE - (60%), orange-brown, light orange-brown, minor light grey and grey, poorly bedded, soft, argillaceous in part, sandy in part (including quartz sand grains up to 1/2 mm across), micaceous, few dark coloured grains, dolomitic. One double ended quartz crystal. DOLOMITE (30%), white, very light brown, light orange-brown and occasionally very dark brown, very fine-crystalline in large part, microcrystalline in minor part, silty, calcitic in part, no visible porosity. SHALE (10%), orange-brown, reddish-brown, black and grey, silty, micaceous, calcareous.

8280 - 8290' SILTSTONE - (50%) as above, grading to silty shale in places. DOLOMITE (50%) as above.

8290 - 8300' SILTSTONE - (90%) reddish-brown, silty, micaceous, argillaceous, dolomitic and sandy. CAVINGS such as dolomite, salt, sandstone, green shale, black shale, etc.

8300 - 8310' SILTSTONE - (60%) as above. DOLOMITE (35%) white, very light brown and very light orange-brown, very fine-crystalline in part, microcrystalline in minor part, silty, no visible porosity. SHALE (5%), greenish-grey and black, silty, micaceous.

8310 - 8320' SANDSTONE - (65%), very light orange-brown and light greyish-brown, fine and very fine-grained, subangular, well sorted, quartzose, with few dark coloured grains, firmly bonded, partly dolomitic, partly siliceous, no visible porosity. Framework-matrix ratio 10:0. SILTSTONE (20%) as above.
8310 - 8320' SANDSTONE - SHALE (10%), reddish-brown, orange brown, black, grey and white, as above. DOLOMITE (5%) as above.

8320 - 8330' SANDSTONE - (50%) as above. SILTSTONE (35%) as above. SHALE (10%) as above. DOLOMITE (5%) as above.

8330 - 8340' SILTSTONE - (70%) as above. SANDSTONE (20%) as above. SHALE (10%) as above.

8340 - 8350' SILTSTONE - (70%), orange-brown, light orange-brown and very minor light grey, blocky, flaky in part, soft in part, argillaceous, micaceous, dolomitic, few included sand grains. SANDSTONE (10%) as above. SHALE (10%), black, reddish-brown, grey and greenish-grey, as above. DOLOMITE (10%) as above.

8350 - 8360' SILTSTONE - (70%) as above. SHALE (15%) as above. SANDSTONE (10%) as above. DOLOMITE (5%) as above.

8360 - 8370' SILTSTONE - (85%), orange-brown and light orange-brown (75%), brown, grey, light grey and white (10%), flaky in part, soft in large part, argillaceous, micaceous in part, dolomitic, calcareous, few dark coloured grains, some included sand grains (up to 3/4 mm across). SHALE (10%), black, greyish brown and white, poorly bedded, silty in part, dolomitic. DOLOMITE (5%), white, grey, light greyish-brown and greenish-brown, microcrystalline and cryptocrystalline, silty, porcelainous lustre in part, traces gypsum crystals and calcite.

8370 - 8380' SILTSTONE - (90%) as above, no fluorescence. SHALE (50%), black, greenish-grey, light greyish-brown and white, as above. DOLOMITE (5%) as above. Trace very light orange-brown, fine-grained, dolomitic SANDSTONE, composed of sub-angular, well-sorted clear and reddish-brown, translucent quartz grains, no visible porosity.

8380 - 8390' SILTSTONE - (50%), orange-brown, light orange-brown, dark brown, light greyish-brown and white, as above. SHALE (10%), black, dark grey, greenish-grey, light grey and white. SHALE (20%) reddish-brown. DOLOMITE (10%) as above. SANDSTONE (10%), very light orange-brown, fine and very fine-grained, subangular, well sorted, with quartz grains and few dark coloured grains, firmly bonded, dolomitic in part, argillaceous in small part, siliceous in part, no visible porosity. Framework-Matrix filler ratio 9:1.
8395' Spot sample SILTSTONE - (50%), orange-brown, argillaceous, micaceous. SHALE (30%) orange-brown, argillaceous, micaceous. SANDSTONE (20%), orange-brown, silty, argillaceous, dolomitic. CAVINGS, trace medium quartz grains and quartz crystals.

8390 - 8400' SILTSTONE - (30%), orange-brown. SANDSTONE (30%), orange-brown and light grey, very fine- and fine-grained with trace medium-grained, silty, argillaceous, dolomitic, tight. SHALE (40%), orange-brown. CAVINGS includes dolomite and limestone, medium to dark grey, in part earthy and sucrosic, with micro-vugs. Also microcrystalline to very finely crystalline with fair inter-crystalline porosity of 5 to 15%. Also scattered medium crystals of calcite lining dense limestone and dolomite, probably cavity and vug lining. Trace black bitumen (?) in inter-crystalline porosity. This porous unit could represent one bed of unknown thickness from somewhere in the interval 7580' - 8390', but no traces occur above this depth.

8400 - 8410' SILTSTONE - (60%) orange-brown, poorly bedded, soft, argillaceous, micaceous in part, dolomitic and calcareous with numerous included quartz and dark coloured sand grains. SHALE (20%), dark brown, reddish-brown, black and orange-brown, poorly bedded, blocky in part, soft in part, silty, dolomitic. SANDSTONE (15%) as above, no porosity visible. DOLOMITE (5%), white and very light grey-brown, silty, trace calcite.

8410 - 8420' SILTSTONE - (45%), orange-brown, grey, very light grey and off-white, as above. SHALE (40%) as above. SANDSTONE (15%) as above, no porosity visible. Trace anhydrite crystals.

8420 - 8430' SILTSTONE - (50%), orange-brown, greyish-brown, and light grey, as above. SANDSTONE (30%), dark orange-brown, orange-brown, greyish-brown, light greyish-brown and white, very fine to fine-grained, subangular, well sorted grains, well bonded, dolomitic in part, siliceous in part, quartzose, with few dark coloured grains, trace galumite, no visible porosity. Framework-filler ratio 9:1. SHALE (20%) as above.

8430 - 8440' SILTSTONE - (50%) as above. SHALE (30%) as above. SANDSTONE (20%) as above. Trace anhydrite crystals.
8440 - 8450' SILTSTONE - (40%) as above, with included quartz grains (up to 1/2 mm across). SHALE (30%) as above. SANDSTONE (30%) as above, no visible porosity. Trace greyish-brown, translucent anhydrite crystals.

8450 - 8460' SANDSTONE - (40%) as above, no visible porosity. SILTSTONE (30%), orange-brown, dark brown, greyish-brown and light grey, as above with included quartz grains up to 1 mm across. SHALE (30%), dark brown, reddish-brown, greyish-brown, and black, as above. Trace gypsum and/or anhydrite crystals.

8460 - 8470' SANDSTONE - (60%) as above, slight trace intergranular porosity. SILTSTONE (20%) as above. SHALE (20%) as above.

8470 - 8480' SANDSTONE - (50%), light orange-brown, orange-brown and light greyish-brown, fine-to very fine-grained, subangular, few subrounded grains, well sorted, well bonded, quartzose, few dark coloured and reddish-brown grains, dolomitic in part, siliceous in part, slightly argillaceous. Framework-filler matrix ratio 9:1. No porosity visible. No fluorescence. SILTSTONE (30%), light orange-brown, orange-brown, very light brown, brown and greyish-brown, flaky in part, dolomitic, calcareous, micaceous in part, argillaceous, few included fine sand grains. SHALE (15%), reddish-brown, orange-brown, light orange-brown, very light brown, black and greenish-grey, blocky, hard, micaceous in part, silty, slightly dolomitic. DOLOMITE (5%), white and very light brown, cryptocrystalline to microcrystalline, silty, calcitic.

8480 - 8490' SANDSTONE - (50%) as above, no fluorescence. SILTSTONE (25%) as above. SHALE (20%) as above. DOLOMITE (5%) as above.

8490 - 8500' SANDSTONE - (40%) as above, no visible porosity. Matrix-filler ratio 9:1. No fluorescence. SILTSTONE (35%) as above. SHALE (20%) as above with trace pyrite. DOLOMITE (5%) as above. Trace black and light grey limestone.

8508' - In junk sub SANDSTONE - reddish-brown, laminated with shale pebbles, very hard, fractured, welded, dolomitic, with trace of green mineral (Glaucophane (7)), porosity in cracks. SHALE, hard, reddish-brown, micaceous. SILTSTONE (7), firm, not hard, argillaceous, sandy, salty, orange-brown. CLAYSTONE (7), firm, orange-brown, with salt and salt casts.
8500 - 8510' SANDSTONE - (40%) orange-brown, silty, argillaceous, dolomitic, tight, with quartz framework of very firm, fine grains, filled with silty-clay carbonate matrix (7-3). Many fragments are broken through grains (Quartzitic texture). Trace coarse quartz grains, few mica and glauconite grains. SHALE (60%), orange-brown, very silty, dolomitic.

8510 - 8520' SANDSTONE - (40%), orange-brown, light brownish-grey and very light brownish-grey, very fine-grained, well bonded, argillaceous in part, dolomitic in part, siliceous in part, quartzose, no porosity visible. Framework-matrix filler ratio 9:1. SILTSTONE (30%), orange-brown, and minor light grey, soft, argillaceous, dolomitic, micaceous in part. SHALE (20%), orange-brown and reddish-brown. Cavings, black and greenish-grey, soft micaceous in part, dolomitic, silty, shale. DOLOMITE (5%), white, light brownish-grey and black, micro-crystalline to cryptocrystalline, silty, no porosity visible, may be caved. LIMESTONE (5%), light brownish-grey, oolitic, no porosity visible, may be caved.

8520 - 8530' SILTSTONE - (40%), orange-brown, light orange-brown, minor dark reddish-brown and very light greyish-brown, poorly bedded, soft, argillaceous, dolomitic, micaceous in part, few included sand grains, and dark coloured silt grains. SHALE (30%), orange-brown and reddish-brown. Cavings - black, greenish-grey, and orange-brown, very soft, micaceous in part, dolomitic, shale. LIMESTONE (30%) (Cavings (?)). white, greyish brown and black, silty, micro-crystalline to crypto-crystalline, partly dolomitic, trace pyrite. Traces calcite and anhydrite.

8530 - 8540' No sample.

8540 - 8550' Very small sample SILTSTONE - (50%) as above. SHALE (30%) as above (Cavings 10%). LIMESTONE (20%) as above (Cavings (?)).

8550 - 8560' Very small sample SILTSTONE - (40%) as above. SHALE (30%), orange-brown. Cavings, reddish-brown, greenish-grey, light greyish-brown and black. Shale. LIMESTONE (20%) as above (Cavings ?). SANDSTONE (10%), light greyish-brown, very fine-grained, quartzose, with few dark coloured grains, dolomitic in part, siliceous in part, no porosity visible.
8560 - 8570' Siltstone - (40%), orange-brown, minor light greyish-brown and off-white, as above. Shale (30%), orange-brown, casings, reddish-brown, greenish-grey, black and orange-brown, very soft, micaceous, dolomitic, silty shale. Limestone (30%), white, light brownish-grey and black, silty, partly dolomitic (cavings (?)).

8575' Spot sample salt

8570 - 8580' salt - (50%) (from drilling fluid (?)). Salt crystals from 1/4 to 1/2 mm in clusters. Shale (10%), orange-brown, silty, micaceous. Shale (10%), black (cavings). Dolomite (10%), light brown, very fine-crystalline (cavings (?)). Limestone (trace), light brown, oolitic, dense (cavings (?)). Siltstone (10%), very light brown, silt, dolomitic (cavings (?)). Dolomite (trace), black (cavings (?)). Shale (10%), red.

8580 - 8590' siltstone - (70%), orange-brown, as above. Shale (20%), orange-brown and reddish-brown (cavings - black and greenish-grey), as above, no fluorescence. Dolomite, white. Brownish-grey and black, as above (caved (?)). Limestone, white, brownish-grey and black, oolitic in part, as above (caved (?)).

8600' Spot sample salt

Abundant return.

8590 - 8600' siltstone - (25%), orange-brown and grey, micaceous, argillaceous, dolomitic. Shale (10%), orange-brown. Cavings (15% (?)) salt (50%) from drilling fluid (?).

8600 - 8610' salt - (75%) (from drilling fluid (?)). Siltstone (15%), orange-brown, argillaceous, dolomitic. Cavings (5%). Shale (5%), orange-brown, micaceous.

8612' Spot sample

Siltstone - As above, with sandstone (5%) and few coarse quartz grains.

8617' Spot sample

Salt - (90%). Siltstone (8%) as above. Shale (2%) as above.

8610 - 8620' salt - (90%). Cavings 10%.

8626' Spot sample salt

- (90%). Siltstone (8%) as above, shale (2%) as above.

8620 - 8630' salt - (40%). Siltstone (40%), orange-brown, argillaceous. Shale (10%), reddish-brown. Cavings (10%).

8636' Spot sample salt

- (90%). Siltstone (8%) as above. Shale (2%) as above. Traces of black and green shale cavings.
8630 - 8640' SALT

- (70%) (from drilling fluid (?)).
  SILTSTONE (20%), orange-brown, minor reddish-brown, grey and light greyish-brown, poorly bedded, soft, micaceous in part, argillaceous, very dolomitic. SHALE (3%), orange-brown, micaceous, dolomitic in part, silty. SANDSTONE (4%), orange-brown, reddish-brown and light brownish-grey, fine- and very fine-grained, subangular, well sorted, well bonded, quartzose, dolomitic in part, siliceous in part, slightly argillaceous, no porosity visible. Framework-matrix filler ratio 9:1. Cavings limestone and dolomite as above. SHALE (2%), green, grey and black, as above.

8646' Spot Sample

SALT

- (80%). Cuttings (20%).

8640 - 8650 SHALE

- (45%), orange-brown and minor reddish-brown, as above. SILTSTONE (30%) as above. SANDSTONE (10%) as above. Limestone and dolomite (10%) as above (caved (?)). SHALE (5%) black and greenish-grey. SALT (30%) (from drilling fluid).

8651' Spot Sample

SALT

- (10%). Cuttings (90%).

8655' Spot Sample

SALT

- very little. SHALE (50%) and SILTSTONE (50%). High percentage of rock flour, "bit squeezings", trace of coarse sand with grains cracked through.

8650 - 8660' SHALE

- (60%) orange-brown, fissile, in part soft, micaceous in part, silty, slightly dolomitic in part only. SILTSTONE (15%), orange-brown and light brownish-grey, soft, argillaceous, very dolomitic. SANDSTONE (10%), orange-brown, light orange-brown and light brownish-grey, very fine-grained, very dolomitic in part, siliceous in part, slightly argillaceous, quartzose, well bonded, no visible porosity. Framework-matrix filler ratio 9:1. Caved (?). LIMESTONE and DOLOMITE (10%), white, very light brownish-grey and black, as above. SHALE (5%), black, as above.

8660 - 8668' SHALE

- (75%), orange-brown, minor very light orange-brown, and white (80%), light and very light brownish-grey claystone (20%), in flakes due to bit action, silty, dolomitic. SILTSTONE (10%), orange-brown, as above. SANDSTONE (10%) as above. DOLOMITE (5%), white and brownish-grey, microcrystalline, silty.

8677 Spot Sample

SILTSTONE

- (90%). SHALE (10%).
8670 - 8680 SHALE - (50%) orange-brown, minor very light orange-brown and white (90%), light and very light brownish-grey claystone (10%), soft, poorly bedded, silty, micaceous in part, dolomitic. SILTSTONE (30%), orange-brown, minor light and very light brownish-grey, soft, argillaceous, micaceous in part, very dolomitic. SANDSTONE (20%), clear, orange-brown and minor reddish-brown, fine-and very fine-grained, a few medium sized grains and occasionally coarse grains up to 1 mm across, subangular, well sorted, well bonded, quartzose with few dark coloured grains, siliceous cement, slightly dolomitic in part, slightly argillaceous in part. No porosity visible. Framework-matrix filler ratio 9:1. Chips break across quartz grains. No fluorescence.

8687' Spot Sample
SILTSTONE - and SHALE (80%) as above. SANDSTONE (15%) as above. DOLOMITE (5%), white, cryptocrystalline.

8680 - 8690' SHALE - (40%), orange-brown, minor very light orange and white (90%), light and very light brownish-grey claystone, (10%), as above. SILTSTONE (35%) as above, with few included quartz sand grains. SANDSTONE (20%) as above. No fluorescence. LIMESTONE and DOLOMITE (5%) black, brownish-grey and white, dolomitic in part (white and brownish grey varities (Caved (?)). SHALE (trace), greenish-grey and black, one single ended quartz crystal 2 mm long (Caved (?)).

8692' Spot Sample
SILTSTONE - and SHALE (80%) as above. SANDSTONE (20%) as above.

8696' Spot Sample
SILTSTONE - and SHALE (70%) as above. SANDSTONE (30%) as above. Trace white and black limestone and dolomite (caved (?)}, white variety dolomitic.

8690 - 8697' SILTSTONE - (50%) as above with included quartz sand grains up to 1/2 mm across, dolomitic (but less than above). SHALE (25%), orange-brown (90%), light and very light brownish-grey claystone (10%), as above. SANDSTONE (20%) as above. Few pinpoints of fluorescence. LIMESTONE and DOLOMITE (5%), black, brownish-grey and white, white and brownish-grey varieties dolomitic (Caved (?). SHALE (trace), greenish-grey (Caved (?). Observations: Siltstones and shales are soft, and sandstone are quartzitic and hard -- hence erratic drilling times. Gas kick (3 units methane above 1 unit background).
8705' Spot Sample

**DOLOMITE** - (60%), white and cream, silty, argillaceous, pyritic, with trace vugular porosity (Caved (?)).
SILTSTONE (20%) as above. SANDSTONE (10%), white and grey, as above. SHALE (10%) as above.
Pinpoints of blue fluorescence. This sample contains fragments of clear and white quartz crystals which are covered in part by a black (perhaps bituminous (?)) coating. GAS DETECTOR: Apparently a constant background of 1/4 unit of gas. CAVINGS predominantly DOLOMITE, black, very porous, with minor black SHALE.

8710' Spot Sample

**SILTSTONE** - (20%), orange-brown and light orange-brown; as above. SHALE (20%), orange-brown, as above. SILTSTONE (30%), white, very light brownish-grey and orange, very soft, argillaceous, pyritic, small cubic cavities of clear mineral crystals, numerous vugs, very dolomitic and calcareous (caved (?)). LIMESTONE (25%), white, light orange-grey, light brownish-grey and minor black, silty, cryptocrystalline, pyritic, vuggy in parts, dolomitic in part (caved (?)). SHALE (5%), black (caved (?)).

8712' Spot Sample

**SILTSTONE** - (20%) as above. SHALE (25%) as above. SILTSTONE (25%) as above (caved (?)). LIMESTONE (20%) as above (caved (?)). SHALE (10%) as above (caved (?)).

8700 - 8712' SILTSTONE - (25%) as above. SHALE (25%) as above. SILTSTONE (25%) as above (caved (?)). LIMESTONE (20%) as above, some mineral fluorescence (caved (?)). SHALE (5%) as above (caved (?)). No hydrocarbon fluorescence.

8712 - 8724' CORE NO. 10 - Recovered 3'4". (Cutting samples 100% cavings).

8724' - 8730' No samples.

8730 - 8740' SALT - (80%). Cavings (20%).

8740 - 8750' SALT - (80%). Cavings (20%).

8755' Spot Sample

**SALT** - As above.

8750 - 8760' SALT - With 10% cavings as above.

8765' Spot Sample

**SALT** - As above.

8760 - 8770' SALT - With 10% cavings as above.

8775' Spot Sample

**SALT** - As above.
8080 - 8090' Very small sample
SALT - (90%) as above. SHALE (10%) as above. Yellow colouration in drill fluid accompanying sample.

8090 - 8100' SALT - (90%), clear, irregular shaped, elongated in part, larger fragments than above with parallel striations (probably cleavage lines) within the fragments; some fragments are bonded in part by cleavage planes. SHALE (10%) as above, trace greenish-grey. Sample is covered with a yellow coating, which washes off in water (Bichromate additive).

8100 - 8110' Very small sample
SHALE - (85%), orange brown (80%), black (10%), calcareous and dolomitic. SALT (10%) as above. Trace gypsum. DOLOMITE (5%), very light brown, micro-crystalline, calcitic.

8110 - 8120' Very small sample
SHALE - (90%), orange brown (80%), black, white and light grey (10%), poorly bedded, micaceous in part. SALT (5%). DOLOMITE (5%) as above.

8120 - 8130' Very small sample
SHALE - (45%) as above. SALT (50%), very fine fragments, with few larger, irregularly shaped fragments. DOLOMITE (5%) as above.

8130 - 8150' Very small sample
SALT (?)

8150 - 8160' Small sample
SALT - (90%) coarse salt (clear (2mm) fragments of single halite crystals). SHALE (10%), orange-brown.

8160 - 8170' SALT - As above. (SALT put in drilling water contains clear, striated and cross hatched fragments of coarse crystals just like SALT out of hole).

8170 - 8180' Small sample
SALT (65%). SHALE (30%), orange-brown, minor very light grey and black, as above. DOLOMITE (5%) as above.

8180 - 8190' Small sample
SALT - (80%) clear crystals, some elongate, other irregular; average 1 mm across. SHALE (20%), orange-brown and minor black, micaceous and soft.

8190 - 8200' Very small sample
APPENDIX 4

ORANGE NO. 1

CORE DESCRIPTION
CORE NO. 1. Pertnjara sandstone.

Cored Interval 615' - 625', cut 10', recovered 8'6-1/2'' (85.8%).

The dip is apparently horizontal. No show of oil, gas or water. No fractures were observed.

SANDSTONE
615' - 619.6''
(4'6'')

Red-brown, firm, porous, fine-grained rock with matrix and cement filling most of the quartz and lithic framework, leaving approximately 6% - 8% porosity. A few pores are visible and water migrates along these voids at grain boundaries. Soft lithic grains are squeezed into the framework interstices.

The attitude of the bedding is nearly flat, while cross laminations are faintly visible. A few, thin, red, clay pebbles occur at base of this interval.

There is no show of oil or gas, and no taste of salt water; however, this interval appears to be wet with fresh water.

SANDSTONE
619' 6'' - 623'6''
(4'1'')

Hard, red-brown, grey and green-grey, dense, fine-grained rock with matrix and calcite-dolomite cement filling the framework completely. Micaceous laminations and faint cross laminations are present. At top and base of this interval there are thin clay pebbles up to 1-1/2'' long - the planes of their long axis lying parallel to the bedding planes.


Cored Interval 1498' - 1507', cut 9', recovery of 100%.

Coring Time: 10, 4, 3, 2, 2, 3, 5, 9, 25.

No shows. Dip is nearly flat.

SANDSTONE
1498' - 1499'
(1'')

Orange-brown, medium-grained medium-sorted, porous rock with a framework of rounded and euhedral quartz grains with a trace of a black mineral.

Porosity is water-wet and occurs as .25 mm holes scattered in sandstone cemented with silica. No trace of oil or gas.

SANDSTONE
1499' - 1507'
(8'')

Orange-brown, medium-grained, medium-sorted rock with rounded and euhedral grains, with trace of red clay and silt matrix, and with calcite and dolomite cement. It is for the most part dense but with streaks of low porosity that is water-wet. The dense layers tend to be grey to grey-green in colour while layers with porosity tend to be reddish. Laminated bedding is recorded by vague wavy intersecting planes of iron staining.

CORE NO. 3 Pacoota sandstone.

Cored Interval 2415 - 2416'. Cut 9'' - recovered 2'' (22.2%).

(Core barrel jammed).

GREY QUARTZITE
2415' - 2415'2''
(2'')

No show.
CORE NO. 4. Pacoota sandstone.

Cored Interval 2846' - 2861', cut 15', recovered 15' (100%).

Coring Time: 16, 19, 18, 13, 14, 26, 17, 25, 17, 37, 48, 13, 8, 12, 49.

Dip nearly flat. No show of oil or gas.

SANDSTONE
2846' - 2850' (4')
Reddish-brown, fine-grained rock with framework of jagged quartz with silty clay matrix, silica cement, and scarce shell fragments. There are a few red and green shale laminations and several open vertical fractures.

SANDSTONE
2850' - 2855' (5')
Reddish-brown, medium-grained, cross-laminated sandstone with framework of colourless and orange (iron stained) jagged quartz grains. A few red shale grains are also present, as well as shale pebbles. There is a silty clay matrix, silica-dolomite cement, closed vertical fracture having marginal bleached zones, poorly outlined worm tubes, and a few red and green shale laminations.

SANDSTONE
2855' - 2861' (6')
White, fine-to coarse-grained rock with framework of jagged quartz, with white silt matrix, silica cement, a few calcareous streaks, and few red shale laminations.

CORE NO. 5. Pacoota sandstone.

Cored Interval 3160' - 3173', cut 13', recovered 12' (92%).

Coring Time: 47, 50, 27, 12, 28, 12, 7, 7, 8, 8, 27, 27, 56.

Dip nearly flat. Porosity wet, no show of oil or gas.

SANDSTONE
3160' - 3163' (3')
Reddish-brown, fine-to medium-grained rock with mottle of white areas, red, green and grey micaceous shale partings, clay pebbles and grains. The framework is mostly jagged quartz grains (cemented with silica and with minor amounts of rounded quartz) embedded in a red, silty clay matrix. Pores are present but scarce. Short vertical, tight fractures, containing calcite, are present. When broken by hammer, grains as well as core chips result. Accessory minerals include trace amounts of glauconite and pink dolomite. Bedding is thin to laminated, in part ruptured, wavy, and cross laminated.

SANDSTONE
3163' - 3167' (4')
White, medium-grained, poorly sorted sandstone with few orange (iron stained) quartz grains, a few red and green clay pebbles and trace amounts of finely divided pyrite. The rock is mottled by areas of white or reddish-brown matrix. On breaking with hammer, many grains result and chips can be crushed with fingers. Pores are
numerous and were wet with water after remainder of core dried. There are parallel and cross laminations of sand grains. The quartz grains are mostly subrounded but many are welded and have jagged outlines.

**SANDSTONE**

3167' - 3172'  
(5')

Red-brown, white mottled, fine-grained, laminated sandstone with framework of subrounded quartz filled with silty clay matrix and silica cement. Lower half of interval has 15% red and green shale as very thin disrupted beds and lumps. One short vertical fracture is tight.

**CORE NO. 6. Goyder formation.**

Cored Interval 4041' - 4085', cut 44', recovery 44' (100%).

Coring Time:  
24, 5, 7, 7, 5, 5, 4, 4, 5, 6, 8, 8, 9, 10, 12, 17, 17, 20, 20, 25, 25, 20, 15, 28, 16, 15, 13, 15, 18, 25, 32, 22, 26, 36, 27, 23, 27, 34, 35, 38, 29, 43, 46.

Dips nearly flat, no porosity. No shows.

**SANDSTONE**  
4041' - 4042'  
(1')

Interbedded, grey, very dolomitic, argillaceous, glauconitic, fine-grained sandstone, and dark grey finely micaceous shale. Shale is also present as laminae in the sandstone. Bedding is wavy.

**DOLOMITE**  
4042' - 4045'  
(3')

Grey, silty, fine to coarse-crystalline, glauconitic, dense rock with many relic structures of pellets from 1-8 mm in size, brown oolites near 1 mm and pelecypod (?) shell fragments, all floating in dolomite spar and recrystallized into dolomite. The rock is slightly argillaceous, and contains small amounts of white anhydrite and traces of pyrite. Bedding is irregular and intersecting.

**SANDSTONE**  
4045' - 4047'  
(2')

Interbedded, dark grey, micaceous shale, grey, dolomitic sandstone, and grey, very silty, argillaceous, crystalline (1-1 mm) dolomite with abundant glauconite grains and trace of pyrite.

**DOLOMITE**  
4047' - 4048'  
(1')

Grey, fine to coarse-crystalline carbonate with floating brown oolite relicts up to 3 mm in size, all of which are recrystallized with dolomite and a few replaced by pyrite.

**DOLOMITE**  
4048' - 4049'  
(1')

Dark grey, silty, argillaceous, glauconitic, fine-crystalline dolomite with many irregular, intersecting shale laminae (almost stylolitic). Many broken brachiopod shells of a very small linguloid. 1/2 inch black shale at base.
DOLOMITE
4049' - 4063'
(14')
Grey, silty, micaceous dolomite with very thin beds and laminae of dark grey, micaceous shale. Bedding is folded, distorted, and reworked by organisms, planes have grooves and marks, glauconite occurs in thin beds and pink coarse-crystalline anhydrite in pods.

SANDSTONE
4063' - 4066'
(3')
Top 4" is a dark green, medium-grained rock with framework of quartz and glauconite and glauconitic cement. The remainder is a grey, laminated, glauconitic, micaceous, fine-grained sandstone with areas of red clay matrix that grades downward into glauconitic, dolomitic, medium-grained sandstone with small amount of red clay matrix and white, coarse-crystalline, anhydrite cement. 1/2 inch black shale with glauconite at 4064 feet.

DOLOMITE
4066' - 4071'
(5')
Grey, silty, sandy, argillaceous, glauconitic, fine-to coarse-crystalline (up to 1 mm) dolomite with very irregular shale laminae, some of which are vertical and others intersecting, with trace of pyrite and few pods of pink anhydrite laths.

SANDSTONE
4071' - 4073'
(2')
Grey, dolomitic, glauconitic, fine-grained rock.

SANDSTONE
4073' - 4077'
(4')
Grey, dolomitic, glauconitic, fine-grained sandstone with many thin, dark grey, micaceous shale interbeds, with few shale beds mixed with sand by organisms, many bedding plan marks and grooves, abundant glauconite at 4075', and two 1/2 inch beds of black shale associated with abundant glauconite.

DOLOMITE
4077' - 4079'
(2')
Reddish-grey, argillaceous, micaceous, fine-to coarse-crystalline (up to 1 mm) carbonate with beds of dark, reddish-grey finely micaceous shale.

SANDSTONE
4079' - 4081'
(2')
Grey, dolomitic, glauconitic, fine-grained rock with thin, dark grey shale beds and laminae.

DOLOMITE
4081' - 4083'
(2')
Grey, glauconitic, sandy, medium-crystalline carbonate with very thin, dark grey shale beds and irregular, micaceous, shale laminae.

DOLOMITE
4083' - 4085'
(2')
Grey, glauconitic, micaceous, silty, sandy, medium-crystalline carbonate with faint micaceous shale laminae.

Cored Interval 5226' - 5266', cut 40', recovered 39' (97%).
Coring time: 11, 12, 10, 14, 12, 13, 12, 13, 13, 11, 13, 15, 10, 11, 10, 10, 13, 26, 9, 13, 12, 12, 11, 11, 12, 15, 13, 14, 11, 13, 18, 20, 16, 18, 18, 21, 22.
No porosity, no shows oil or gas. Dips nearly flat.
<table>
<thead>
<tr>
<th>STRATUM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOLOMITIC SILTSTONE</td>
<td>Medium grey, slightly greenish, micaceous, pyritic, in part shaly, faint motting and lamination from variations in shale and dolomite content, some gentle flow structure, trace of cross-lamination.</td>
</tr>
<tr>
<td>5226' - 5228'</td>
<td>(2'†)</td>
</tr>
<tr>
<td>SILTY SHALE</td>
<td>Dark red-brown, slightly micaceous, a few irregular small lenses of above type siltstone, massive, with faint wavy laminae.</td>
</tr>
<tr>
<td>5228' - 5234'3&quot;</td>
<td>(6'3&quot;)</td>
</tr>
<tr>
<td>DOLOMITIC SILTSTONE</td>
<td>As above. Two layers 6' and 1' thick of anhydritic dolomite that is grey, micro-crystalline and silty. Anhydrite is clear, crystalline, in blebs to 2 mm. Silty shale (red in upper part, grey in lower part) is inter-laminated throughout the section; these laminae vary from flat, wavy and stylolitic to slightly brecciated. A few small irregular fractures with probably some permeability.</td>
</tr>
<tr>
<td>5234'3&quot; - 5245'6&quot;</td>
<td>(11'3&quot;)</td>
</tr>
<tr>
<td>RED SILTY SHALE</td>
<td>As above. Abundant small lenses of grey siltstone which show flow structure and some brecciation.</td>
</tr>
<tr>
<td>5245'6&quot; - 5248'3&quot;</td>
<td>(2'9&quot;)</td>
</tr>
<tr>
<td>ANHYDritic DOLOMITE</td>
<td>Grey, micro-crystalline and silty. Anhydrite crystals occur throughout the core. Sharp upper contact. Fairly intricate flow structure dipping about 20°.</td>
</tr>
<tr>
<td>5248'3&quot; - 5249'6&quot;</td>
<td>(1'3&quot;)</td>
</tr>
<tr>
<td>RED SILTY SHALE</td>
<td>As above. Small lenses and laminae of grey siltstone.</td>
</tr>
<tr>
<td>5249'6&quot; - 5252'3&quot;</td>
<td>(2'9&quot;)</td>
</tr>
<tr>
<td>DOLOMITIC SILTSTONE</td>
<td>and SILTY DOLOMITE (gradational) as above, trace of anhydrite. About 10% is SHALE, medium-grey with trace red, in laminae to lenses or layers up to 1&quot; thick. Three near-vertical open fractures.</td>
</tr>
<tr>
<td>5252'3&quot; - 5265'</td>
<td>(12'9&quot;)</td>
</tr>
</tbody>
</table>

NOTE: Reference to anhydrite may be gypsum.

CORE NO. 8. Giles Creek Dolomite.

Cored Interval 7050' - 7095', cut 45', recovered 38' (85%). Comparison with Acoustic Velocity log indicates 7'2 missing at top.

Coring Time: 2, 11, 10, 11, 14, 11, 12, 14, 14, 14, 14, 14, 11, 15, 14, 13, 15, 15, 17, 15, 21, 9, 12, 13, 13, 11, 11, 14, 14, 14, 14, 12, 17, 14, 17, 17, 16, 16, 17, 19, 16, 9, 16, 14.

Dips nearly flat, no porosity, no shows of oil or gas.

MISSING
7050' - 7057'
(7')

SHALE
7057' - 7062'
(3')

100%. Dark reddish-brown and dark brown, with 5" greenish-grey, shale (at 705'8'9"), poorly bedded, with laminae and irregular inclusions of sulphate mineral crystals (anhydrite and gypsum) lying roughly parallel to the bedding, hard, silty, micaceous in parts, dolomitic.
DOLOMITE  
7062' - 7062'9"  
(9"
)  
100%. Light grey, grey and dark grey, bedding laminated and platy (1/16" - 1"), slightly contorted in places, hard, very fine -- crystalline to cryptocrystalline, silty, with thin lenses and laminae of pale pink and grey sulphate mineral crystals, no visible porosity.

SHALE  
7062'9" - 7070'8"  
(7'11"
)  
100%. Dark reddish-brown and dark brown, with thin greenish-grey shale bands (at top, and at 7065'9'') having contorted contacts (the lower band abounds in small irregularly shaped reddish brown shale inclusions), poorly bedded with slumped structures in places, hard, silty, micaceous in parts, dolomitic, numerous small inclusions of sulphate mineral crystals.

DOLOMITE  
7070'8" - 7071'11"  
(1'3"
)  
100%. Light grey, grey and dark grey, bedding slumped in places, hard, very fine-cryptocrystalline to cryptocrystalline, silty, with lenses (slumped in places) and small inclusions of pale pink sulphate mineral crystals and numerous black shale partings. No visible porosity.

SHALE  
7071'11" - 7074'1"  
(2'2"
)  
100%. Interbedded, dark reddish-brown, grey and greenish-grey, bedding slumped in places, hard, silty, micaceous in parts, dolomitic, numerous small inclusions of sulphate mineral crystals.

DOLOMITIC ANHYDRITE  
7074'1" - 7075'5"  
(1'4"
)  
Probably 21 minute foot and at 7077' on Acoustic log.  
100%. Layers of light greyish-brown and orange-pink, very fine and fine-cryptocrystalline dolomitic anhydrite and veins of clear, white and orange-pink, fine-to medium-crystalline anhydrite with numerous irregular, argillaceous, dolomitic inclusions, and black shaly partings.

SHALE  
7075'5" - 7079'8"  
(4'3"
)  
100%. Interbedded dark reddish-brown and greenish-grey, bedding contorted, thin fractures in dark reddish-brown shale filled with greenish-grey shale, hard, silty, micaceous in part, dolomitic, numerous small inclusions of sulphate mineral crystals.

DOLOMITE  
7079'8" - 7080'3"  
(7"
)  
100%. Grey and dark grey, bedding slumped in places, hard, very fine-cryptocrystalline to cryptocrystalline, silty, an irregular vertical fracture, no visible porosity. Irregularly bedded layer (maximum thickness 1") of sulphate mineral crystals below base.

SHALE  
7080'3" - 7082'4"  
(2'1"
)  
100%. Black, poorly bedded, hard, slightly micaceous, pyritic, numerous large irregularly shaped inclusions of sulphate mineral crystals near base.

SHALE  
7082'4" - 7095'4"  
(13"
)  
100%. Dark reddish-brown and dark brown (80%), dark grey and greenish-grey (20%), poorly bedded, hard, silty, micaceous in part, dolomitic, several irregular bands and numerous small white inclusions of sulphate mineral crystals and a few thin dark grey dolomite bands (less than 5%).

Cored Interval 7640' - 7678', cut 38', recovered 0'(0%).

Coring Time: ?, 5, 5, 9, 7, 5, 6, 5, 7, 6, 6, 5, 7, 6, 6, 6, 6, 5, 6, 6, 5, 7, 6, 12, 12, 7, 6, 10, 10, 10, 10, 10, 10, 6, 7.

No core recovery probably due in part to wash out and erosion of salt and to balance of core slipping through core catchers. There was little or no wear on diamond bit. Upon next trip with bit, fill on bottom suggests broken core had fallen out of barrel.

CORE NO. 10. Arumbera Sandstone.

Cored Interval 8712' - 8724', cut 12', recovered 3'4" (28%).


Dip apparently flat. Non-fossiliferous. No porosity, scattered pinpoint fluorescence only.

NOTE: Core spilled on derrick floor on removal from core barrel.

SHALE
8712' - 8713'
(1')

(45%) inter laminated with SILTSTONE (40%), and SANDSTONE (15%).

SHALE is reddish-brown and dark brown, bedding surfaces reworked in places (organically), with few fractures parallel to bedding and joined in places by short (1/4") vertical fractures, tough, silty, and micaceous particularly along bedding planes).

SILTSTONE is reddish-brown, reworked bedding in places, with few thin shaly partings, few fractures parallel to bedding and joined in places by short (1/4") vertical fractures, tough, micaceous, few included quartz grains (up to 1/4mm) concentrated along bedding planes, grades in places into very fine sandstone.

SANDSTONE is in layers in bottom 2". Reddish-brown, graded bedding from fine- to very fine-grained beds with numerous included medium, coarse and very coarse grains (up to 1-1/2 mm), and a few medium-grained stringers, sorting fair, subangular to subrounded grains, larger grains rounded, quartzose, micaceous, few dark coloured grains, argillaceous, well bonded by siliceous cement, slightly dolomitic, a few thin shaly inclusions, no porosity visible, some pin point blue fluorescence, framework matrix filler ratio 8:2.

SHALE
8713' - 8714'1"
(1'1")

(70%) with inter bedded laminae and thin lenses of SILTSTONE (30%), and with 1/4" stringer of fine-grained, light greenish-brown, dolomitic quartzite 8" from top.

SHALE is reddish-brown and dark brown, bedding surfaces reworked in places, tough, silty and micaceous. An included anhydrite pod 10" from top.
SHALE
8713' - 8714'1"
(1'1"
(continued)
SILTSTONE is reddish-brown, reworked bedding in places, with few thin shaly partings, tough, micaceous, few included quartz sand grains.

SHALE
8714'1" - 8714'5"
(4"
(50%) interlaminated with SILTSTONE (40%), grading into SANDSTONE (10%).

SHALE is reddish-brown and dark brown, reworked bedding in places, tough, silty and micaceous.

SILTOON is reddish-brown, reworked bedding in places, with few thin shaly partings, tough and micaceous.

SANDSTONE is reddish-brown, graded bedding, very fine-grained, sorting good, subangular grains, quartzose, micaceous, few dark coloured grains, argillaceous, well bonded by siliceous cement, slightly dolomitic, no porosity visible, framework-matrix filler ratio 8:2.

SANDSTONE
8714'5" - 8714'7"
(2"
Reddish-brown, fine-to very fine-grained with included grains (up to 1/4 mm), sorting fair, subangular to subrounded grains, quartzose, few dark coloured grains, well bonded by siliceous cement, argillaceous, no porosity visible, framework-matrix filler ratio 8:2. An irregular fracture trends parallel with bedding.

SHALE
8714'7" - 8715'4"
(9"
(60%) interlaminated with SILTSTONE (40%).

SHALE is reddish-brown and dark brown, bedding surfaces reworked in places, tough, silty and micaceous.

SILTON is reddish-brown, reworked bedding in places, with few thin shaly partings, tough and micaceous.

SIDEWALL CORE AT 7590'
SILTON
Grey, hard, very argillaceous, dolomitic, slightly calcareous, with a few included, very fine, semi-transparent, quartz grains.

Fossiliferous material of probable algal origin is present as light grey laths, partly pyritized. Pyrite content is very high, occurring predominantly as isolated blebs up to 1 mm in diameter.

Treated with cold 10% hydrochloric acid, sample gives off an hydrogen sulphide odour caused, possibly, by reaction of the acid with marcasite that is associated with the pyrite inclusions.

Fractured. No matrix porosity indicated. Blue fluorescence. No cut with carbon tetrachloride.
### Core Analysis Results

1. Unless otherwise stated, the porosities and permeabilities were determined on two small plugs (1/8") cut at right angles from the core.
2. Rocks permeable and permeable core were used with air at 25-30 psig, and dry nitrogen respectively, as the saturating and flowing media.
3. Residual oil and water saturations were determined using standard type apparatus. (iii) Acetone test precipitates are recorded as nil, trace, faint, strong or very strong.

#### WELL NAME AND NO. OIL/GAS No. 1

<table>
<thead>
<tr>
<th>Core No.</th>
<th>Depth From-To</th>
<th>Lithology</th>
<th>Average Effective Permeability from two plugs (V bulk vol.)</th>
<th>Absolute Permeability (Millidarcy)</th>
<th>Average Density (g/cc)</th>
<th>Fluid Saturation (% of pore space)</th>
<th>Acetone Test</th>
<th>Core Water Sat. (P.P.M. W.C.)</th>
<th>Solubility in MSE WC</th>
<th>Fluorescence of freshly broken core</th>
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<tr>
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<td>6020' - 6060'</td>
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<td>H.D. H11</td>
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<td>H.D. H.D.</td>
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<td>5232' - 5232'</td>
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<td>7072' - 7072'</td>
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<td>7083' - 7083'</td>
<td>Shale</td>
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Remarks: Core 10 8712'-9724', recovery 3-5", no sample received by B.H.R.

General File No. 423990
Well File No. 567/4977
APPENDIX 5

LIST AND INTERPRETATION OF

ELECTRICAL LOGS AND OTHER SURVEYS
A. WIREFLINE LOGS BY WELEX

<table>
<thead>
<tr>
<th>Log</th>
<th>Run</th>
<th>Date</th>
<th>Interval (feet)</th>
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<tr>
<td></td>
<td>3.</td>
<td>22/9/66</td>
<td>7263</td>
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<td>4.</td>
<td>1/10/66</td>
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<td>Radioactivity (Gamma) Inside Pipe</td>
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<tr>
<td>Acoustic Velocity</td>
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<td>24/8/66</td>
<td>2241</td>
</tr>
<tr>
<td></td>
<td>2.</td>
<td>3/9/66</td>
<td>4368</td>
</tr>
<tr>
<td></td>
<td>3.</td>
<td>22/9/66</td>
<td>7257</td>
</tr>
<tr>
<td></td>
<td>4.</td>
<td>1/10/66</td>
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<tr>
<td>Radioactivity (Neutron)</td>
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<td>7682</td>
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</table>

NOTE: Logging runs through September 22nd were in fresh or brackish water drilling fluids, those in October were in saturated salt water.

B. VELOCITY SURVEY BY UNITED GEOPHYSICAL CORPORATION

Details of velocity surveying and interpretation are covered in the report included herein as (enclosure 6(b)).
APPENDIX 6

FORMATION TESTING AND RESULTS
One drill stem test was made in the Orange No. 1 well. Shows of gas were encountered while drilling the interval 7,500 feet to 7,600 feet. After reaching total depth, the well was plugged back to 7,653 feet and jet perforated open hole at 7,513 feet to 7,523 feet and 7,570 feet to 7,580 feet. The test tool failed on the first run with the packer set at 7,485 feet. On the second run the packer was set at 7,461 feet. The tool was opened for a short initial flow period, closed for initial shut-in pressure measurement, and then reopened for the final flow test. On final flow the blow was very faint at first, increasing to a steady faint blow of air for the remainder of the 13 hours 5 minute flow period. The tool was closed for final shut-in pressure measurement. After the test the tool could not be pulled. The safety joint below the tool was backed off, leaving the tail pipe and lower pressure gauge in the hole. All of the tool, including the upper pressure gauge which was equipped with a 12-hour clock, was recovered.

Fluid recovered by reverse circulation was salty water, resembling drilling fluid, with pockets of gas having a natural gas odor near the top of the column. The volume of fluid recovered could not be determined. Samples of liquid and gas were collected for analysis.

Readings from the upper pressure gauge are as follows:

- Initial hydrostatic: 3634 psi
- Initial flow (15 minutes): 498 psi
- Initial Shut-in (30 minutes): 1706 psi
- First final flow: 558 psi
- Second final flow (9 hours): 1297 psi

* Still climbing after 30 minutes.
** Clock ran down after 9 hours of final flow.
Figure 1.

See image file Attached.
Core Samples for Thin Section.

Description of mud specimens. G. K. Williams.

Core No. 1. Portnjara formation.

615' Sandstone — reddish orange; fine grained, fair sorting (silt to 1 mm); 10% non-quartz: dark and greenish rock fragments, light weathered feldspar; trace of heavy mineral; calcareous; fine grain interpenetration; little secondary silica. Trace of porosity.

624' Silty Sandstone — reddish orange; fine grained (silt to 1/2 mm); 15% non-quartz: dark rock fragments, feldspar; abundant heavy mineral grains; calcareous; tight.

Core No. 2. Mereenie formation.

1498' Sandstone — orange; fine grained, fair sorting (coarse silt to 1/2 mm); trace of weathered feldspar and heavy mineral grains; interpenetration of most grains, little secondary silica; several 1 mm leached spherical cavities; 10% — porosity.

1502' Sandstone — orange, interlayered very fine and fine grained; slightly calcareous; trace of porosity — otherwise as at 1498'.

1506' Sandstone — orange; fine grained, fair sorting (silt to 1/2 mm); 5% non-quartz; light feldspar? grains; abundant secondary silica. Trace of porosity.

Core No. 3. Upper Pacoota — Horn Valley? formation.

2415' Sandstone — light grey; fine grained, well sorted except for scattered coarse grains; nearly all quartz, abundant heavy mineral grains; very fine mica; welded; tight.
Core No. 4. Pacoota formation.

2847
Sandstone - light grey, patches reddish; fine grained fair sorting (silt to 1/16 in.), trace of light clay grains, trace of heavy mineral grains; welded, tight. In red patches there is a trace of red shale as matrix and as grains; patches with a green shale film (shale pebble cast?); trace of slightly calcareous shell fragments.

2854
Sandstone - red; fine grained, poor sorting (course silt to 1 mm); trace of clay grains, 5-10% red and light clay matrix - all grains interpenetrated but outlined by the clay; patches and rare grains of green waxy shale; trace of porosity.

2858
Sandstone - white; medium grained, fair sorting (course silt to 1 mm); moderate welding; 5% pale green clay matrix; 5 to 10% porosity.

Core No. 5. Pacoota formation.

3160
Sandstone - patchy red and pale green to light grey; medium grained, fair sorting (1/16 to 1 mm); trace of white and pale green clay grains, trace of heavy mineral grains, trace of feldspar; trace of calcareous cement; moderate welding (all grains interpenetrated, little secondary silica). Trace of porosity.

3165
Sandstone - white; fine grained, fair sorting (1/16 to 1 mm); nearly all quartz, trace of heavy mineral grains; 5% clay matrix, mostly pale green with patches of red clay; only slightly welded, fairly friable; 5 to 10% porosity, one layer about 1 mm thick of sorted medium grained, very porous sand.

3171
Sandstone - light grey; fine grained fair sorting (1/16 to 1 mm); trace of heavy mineral grains, trace of mica; varicoloured flat shale pebbles; welded (vitreous); tight.
Core No. 6.  Goyder Formation.

4043'  Sandstone - greyish grey; fine grained; well sorted; 25% glauconite in fine and medium grains; abundant flat fossil debris - both non and slightly calcareous; the fossil debris and glauconite cause laminations; patches and laminae with abundant disseminated pyrite.

4064'  Dolomite - grey; fine to medium crystalline; faint medium to coarse colite or pellet texture; trace of pyrite; trace of glauconite; about 20% silt, rare shale pebble; one irregular parting of dark brownish grey silty shale.

4083'  Dolomite - grey; fine to coarse crystalline; very glauconitic, the glauconite pellets are in part altered to (or from) a copper-red shaly micro-micaceous material; trace of fossil debris; one small pebble of coarse siltstone, very silty and sandy. (Nearly 50% of rock, residue is a welded porous skeleton of silt and fine sand).

Core No. 7.  Jay Creek.

5237' 6"  Dolomitic Siltstone or Silty Dolomite - light grey; about 50% is silt, residue is a partly welded porous mass of coarse silt. (Although technically probably a siltstone, it has the appearance of a micro-crystalline carbonate and would be logged as such by many geologists; probably in the surface rock, the carbonate would be leached and it would be logged as a siltstone). About 10% of rock is clear crystalline anhydrite filling small vugs; irregular patches (flow structure?) of green silty shale; faint laminae.

5248' 3"  Dolomite - light grey; micro-crystalline; silty (25% silt); about 10% clear crystalline anhydrite in small vugs - much of the anhydrite has the same crystal orientation throughout the specimen.
5361: Dolomitic Siltstone - medium; grey, greenish-grey; micritic; laminated, caused by variations in the dolomite and tiny dolomite content, also laminae of micaceous shale.

Cone No. 8: Giles Creek Dolomite and shale.

7055: Dolomite - light brownish grey, cryptocrystalline, silty many patches of clear crystalline anhydrite (10% of specimen), faint lamination.

7065: Dolomite - brownish grey, cryptocrystalline, very silty, anhydritic, laminae of black shale; faint relief medium grained texture? abundant pyrite in small crystals, mostly in the shale laminae.

7067: Anhydritic dolomite - brownish grey, micro-crystalline, 50% = crystalline anhydrite in small to large blobs and in seams.

7071: Silty shale - mottled red and green. Some flow structure, some concentric colour bands, anhydritic inclusions.

Cone No. 10:

8712: Sandy siltstone - red-brown, unsorted mixture of shale, silt and sand grains up to 1 mm. Grains mostly quartz, trace of feldspar and very fine heavy mineral grains; subangular to rounded. Abundant mica, very slightly calcareous.
SILTSTONE

Grey, hard, very argillaceous, dolomitic, slightly calcareous with a few very fine inclusions, semi-transparent quartz grains.

Fossiliferous material of probable epiphytic origin is present as light grey laths, partly pyritized. Pyrite content is very high, occurring predominantly as isolated laths up to 1 mm in diameter.

Treated with cold, 10% hydrochloric acid, sample gives off an hydrogen sulphide odour, caused possibly, by reaction of the acid and arsenic, associated with the pyrite inclusions.

Although fractured, no matrix porosity indicated and a blue fluorescence gave no cut with carbon tetrachloride (CCl₄).
CORE NO. 1

Cored Interval 615' - 625', 10" cut, 8'6½" recovered.
Recovery = 85.8% Pernjara sandstone.

The dip is apparently horizontal.
No show of oil, gas or water.
No fractures were observed.

SANDSTONE (4.5')
Red-brown, firm, porous, fine-grained rock with matrix and cement filling most of the quartz and lithic framework, leaving approximately 6% - 6% porosity. A few pores are visible and water migrates along these voids at grain boundaries. Soft lithic grains are squeezed into the framework interstices.

The attitude of the bedding is nearly flat, while cross lamination are faintly visible. A few, thin, red, clay pebbles occur at base of this interval.

There is no show of oil or gas, and no taste of salt water; however, this interval appears to be wet with fresh water.

SANDSTONE (41')
Hard, red-brown, grey and green-grey, dense, fine-grained rock with matrix and calcite-dolomite cement filling the framework completely. Micaceous lamination and faint cross lamination are present. At top and base of this interval there are thin clay pebbles up to 1½" long - the planes of their long axis lying parallel to the bedding planes.

Cored Interval 1498' - 1507'. Cut 9'. Recovery 100%.

Coring Time: 10 - 4 - 3 - 2 - 2 - 3 - 5 - 9 - 25.

(Core cones separated from bit and left in hole).

No shows. Dip is nearly flat.

1498' - 1499' (Upper 1') SANDSTONE - Orange-brown, medium-grained medium-sorted rock with a framework of rounded and cubic quartz grains with a trace of a black mineral.

Porosity is water-wet and occurs as .25 mm holes scattered in sandstone cemented with silica. No trace of oil or gas.

1499' - 1507' SANDSTONE - Orange-brown, medium-grained, medium-sorted rock with rounded and cubic grains, with trace of red clay and silt matrix, and with calcite and dolomite cement. It is for the most part dense but with streaks of low porosity that is water-wet. The dense layers tend to be grey to grey-green in colour while layers with porosity to be reddish. Laminated bedding is recorded by vague wavy intersecting planes of iron staining.


Cored Interval 2415' - 2416'. Cut 9". Recovered 2".

Recovery = 22.2%

GREY QUARTZITE - No show.
CORE NO. 4. Pacoota sandstone.

Cored Interval 2,843 - 2,861' Cut 15', recovered 15', Recovery = 100%.

Coring Time: 16, 19, 18, 13, 14, 26, 17, 25, 17, 37, 48, 13, 8, 12, 49.

Dip nearly flat. No show of oil or gas.

SANDSTONE (4')

Reddish-brown, fine grained rock with framework of jagged quartz with silty clay matrix, silica cement, and scarce shell fragments. There are a few red and green shale laminations and several open vertical fractures.

SANDSTONE (5')

Reddish-brown, medium grained, cross laminated sandstone with framework of colourless and orange (iron stained) jagged quartz grains. A few red shale grains are also present, as well as shale pebbles. There is a silty clay matrix, silica-dolomite cement, closed vertical fractured having marginal bleached zones, poorly outlined worm tubes, and a few red and green shale laminations.

SANDSTONE (6')

White, fine to coarse grained rock with framework of jagged quartz, with white silt matrix, silica cement, a few calcareous streaks, and few red shale laminations.
CASE NO. 5. Pascoota sandstone.

Cored Interval 3160 – 3173; Cut 12; Recovered 12;
Recovery 92%.

Coring Time: 47, 50, 27, 12, 12, 7, 7, 8, 8, 27, 27, 56.

Dip nearly flat. Permeability wet, no show of oil or gas.

SANDSTONE (3') Reddish-brown, fine to medium grained, rock with mottle of white areas, red, green and grey micaceous shale parts, clay pebbles and grains. The framework is mostly jagged quartz grains cemented with silica with minor amounts of rounded quartz, embedded in red, silty clay matrix. Pores are present but scarce. Short vertical fractures are slightly calcareous and tight. When broken by hammer grains as well as core chips result. Accessory minerals include trace amounts of glauconite and pink dolomite. Bedding is thin to laminated, in part ruptured, wavy, and cross laminated.

SANDSTONE (4') White, medium-grained poorly sorted sandstone with few orange (iron stained) quartz grains, a few red and green clay pebbles and trace amounts of finely divided pyrite. The rock is mottled by areas of white or reddish brown matrix, on breaking with hammer many grains result and chips can be crushed with fingers. Pores are numerous and it was wet with water after remainder of core dried. There are parallel and cross laminations of sand grains. The quartz grains are mostly subrounded but many are welded and have jagged outlines.

SANDSTONE (5') Red brown, white mottled, fine-grained, laminated sandstone with framework of subrounded quartz filled with silty clay matrix and silica cement. Lower half of interval has 15% red and green shale as very thin disrupted beds and lumps. One short vertical fracture is tight.
CORE NO. 6  
Goyder formation.

Cored Interval 4041 - 4053  
Cut 44:4, Recovery 44:4  100%.

Coring Time:  24, 5, 7, 7, 5, 5, 5, 5, 5, 6, 8, 9, 10, 22, 27, 27, 20, 20, 25, 25, 20, 15, 15, ..., 15, 13, 15, 18, 25, 32, 22, 23, 30, 37, 27, 23, 27, 34, 35, 38, 29, 5, 6, 46.

Dips nearly flat, no porosity.  No shows.

SANDSTONE - 4041-4042 (1')  
Incubbed grey very dolomitic argillaceous, glauconite, fine-grained sandstone and dark grey finely micaceous shale.  Shale is also present as laminae in the sandstone.  Bedding is wavy.

DOLOMITE - 4042-4045 (3')  
Grey, silty fine to coarse crystalline, glauconitic dense rock with many relic structures of pellets from 1-8 mm in size, brown calcites near 1 mm and pelocyto? shell fragments all floating in dolomite spar and recrystallized into dolomite.  The rock is slightly argillaceous, contains small amounts of white anhydrite and traces of pyrite.  Bedding is irregular and intersecting.

SANDSTONE - 4045-4047 (2')  
Interbedded dark grey micaceous shale, grey dolomitic sandstone, and grey very silty, argillaceous crystalline (1-1 mm) dolomite with abundant glauconite grains and trace of pyrite.

DOLOMITE - 4047-4048 (1')  
Dolomite, grey fine to coarse crystalline carbonate with floating brown calcite relics up to 3 mm in size, all of which are recrystallized with dolomite and a few replaced by pyrite.

DOLOMITE - 4048-4049 (1')  
Dolomite, dark grey, silty argillaceous glauconitic fine crystalline dolomite with many irregular, intersecting shale laminae (almost stylolitic).  Many broken breecipod shells of a very small linguloid, 1/4 inch black shale at base.
DOLOMITE - 4049-4063 (14') Dolomite, grey silty micaceous dolomite with very thin beds and laminae of dark grey micaceous shale. Bedding is folded, distorted and remodeled by organisms, planes have grooves and marks, glauconite occurs in thin beds and pink coarse crystalline anhydrite in pods.

SANDSTONE - 4063-4066 (3') Top 4" is a dark green medium-grained rock with framework of quartz and glauconite and glauconitic cement. The remainder is a grey laminated, glauconitic, micaceous fine-grained sandstone with areas of red clay matrix that grades downward into glauconitic, dolomitic, medium-grained sandstone with small amount of red clay matrix and white coarse crystalline anhydrite cement. ½ inch black shale with glauconite at 4064 feet.

DOLOMITE - 4066-4071 (5') Grey silty, sandy, argillaceous, glauconitic fine to coarse crystalline (up to 1 mm) dolomite with very irregular shale laminae some of which are vertical, others intersecting, with trace of pyrite and few pods of pink anhydrite laths.

SANDSTONE - 4071-4073 (2') Grey dolomitic, glauconitic fine-grained rock.

SANDSTONE - 4073-4077 (4') Grey dolomitic, glauconitic fine-grained sandstone with very thin dark grey micaceous shale inter-beds, with few shale beds mixed with sand by organisms, many bedding plane marks and grooves, and with abundant glauconite at 4075, and two ½ inch beds of black shale associated with abundant glauconite.
DOLomite - 4077-4079 (2"
Reddish grey argillaceous, micaceous fine to coarse crystalline (up to 1 mm) carbonate with beds of dark reddish grey finely micaceous shale.

SANDSTONE - 4079-4081 (2"
Grey dolomitic, glauconitic, fine-grained rock with thin dark grey shale beds and laminae.

DOLomite - 4081-4083 (2"
Grey glauconitic sandy micaceous crystalline carbonate with very thin dark grey shale beds and irregular micaceous shale laminae.

DOLomite - 4083-4085 (2"
Grey glauconitic micaceous silty, sandy, medium crystalline carbonate with faint micaceous shale laminae.

CORE NO. 7 Jay Creek - Shannon.

Cored Interval 5226 - 5266'. Cut 40' Recovered 39'. Recovery 97%. No porosity, no shows oil or gas. Does nearly flat.

Cutting time: 11,12,10,10,10,10,12,12,13,13,13,11,13,13,10,11,10,10,13,13,13,9,13,12,12,11,11,12,15,13,14,11,13,18,20,16,18,18,21,22.

DOLOMITIC 5226-5228 (2"
SILTSTONE
Medium grey, slightly greenish micaceous, pyritic, in part shaly; faint netting and lamination from variations in shale and dolomite content; some gentle flow structure, trace of cross-lamination.

Silty SHALE 5228-5234'3 (6'3"
Dark red brown, slightly micaceous, a few irregular small lenses of above type siltstone; massive with faint wavy laminae.
DOLOMITIC SILTSTONE 5234'3-5245'6  (11'-3'"")
as above. Two layers 6" and 1'
thick of anhydritic dolomite -
grey micro-crystalline, silty;
anhydrite is clear, crystalline,
in blobs to 2 mm.
Silty shale (red in upper part,
grey in lower part) is inter-
laminated throughout the section;
these laminae vary from flat,
vavy, stylolitic to slightly
brecciated. A few small
irregular fractures with probably
some permeability.

RED SILTY SHALE 5245'6-5248'3  (2'9'"")
as above, abundant small lenses
of grey siltstone which show
flow structure and some
brecciation.

ANHYDRITIC DOLOMITE 5248'3-5249'6  (1'3'"")
grey, micro-crystalline, silty;
anhydrite crystals are oriented
throughout the core. Sharp
upper contact, fairly intricate
flow structure dipping about 20°.

RED SILTY SHALE 5249'6-5252'3  (2'9'"")
as above, small lenses and
laminae of grey siltstone.

DOLOMITE SILTSTONE 5252'3-5265  (12'9'"")
and SHINY DOLOMITE (gradational)
as above, trace of anhydrite.
About 10% is SHALE - medium grey,
trace red, in laminae to lenses
or layers up to 1" thick. Three
near-vertical open fractures.

References to anhydrite may be gypsum.

CORE NO. 8  Giles Creek Dolomite.

Cored Interval 7053 - 7060' Cut 45. Recovered 38' Recovery 85%
Comparison with Acoustic Velocity log suggests 7'" missing
at top and all depths should be 10; lower.

Coring Time: 2,11,10,11,14,11,11,11,12,14,14,14,14,14,14,11,15,14,15,
15,15,17,15,21,9,12,13,13,11,11,11,14,14,13,14,12,17,
14,17,17,16,16,17,19,16,9,16,14.

Dips nearly flat, no porosity, no shows of oil or gas.

7053 - 7060' Missing.
SHALE 7060 - 7065 100%. Dark reddish-brown and dark brown, with 5" greenish-grey shale (at 7051'8"), poorly bedded, with laminae and irregular inclusions of sulphate mineral crystals (anhydrite and gypsum) lying roughly parallel to the bedding; hard, silty, micaceous in parts, dolomitic.

DOLOMITE 7065 - 7065'9" 100%. Light grey, grey and dark grey, bedding laminated and pitted (1/8" - 1"), slightly contorted in places, hard, very fine crystalline to cryptocrystalline, silty, with thin lenses and laminae of pale pink and grey sulphate mineral crystals, no visible porosity.

SHALE 7065'9"-7074'8" 100%. Dark reddish brown and dark brown, with thin greenish grey shale bands (at top, and at 7058'9") having contorted contacts the lower band abounds in small irregularly shaped reddish brown shale inclusions; poorly bedded with slumped structures in places; hard, silty, micaceous in parts, dolomitic, numerous small inclusions of sulphate mineral crystals.

DOLOMITE 7073'8"-7074'11" 100%. Light grey, grey and dark grey, bedding slumped in places, hard, very fine crystalline to cryptocrystalline, silty, with lenses, slumped in places, and small inclusions of pale pink sulphate mineral crystals and numerous black shale partings. No visible porosity.

SHALE 7074'11"-7077'1" 100%. Interbedded dark reddish brown grey and greenish grey, bedding slumped in places, hard, silty micaceous in parts, dolomitic, numerous small inclusions of sulphate mineral crystals.
DOLOMITIC 7077'1" - 7078'5"

100%. Layers of light grayish brown and orange pink very fine and fine crystalline dolomitic anhydrite, and veins of clear white and orange pink, fine to medium crystalline anhydrite with numerous irregular, argillaceous, dolomitic inclusions, and black shaly partings.

SHALE  7078'5"-7082'8"

100%. Interbedded dark reddish brown and greenish grey; bedding contorted thin fractures in dark reddish brown shale filled with greenish grey shale; hard and silty, micaceous in part, dolomitic, numerous small inclusions of sulphate mineral crystals.

DOLOMITE  7082'8"-7083'3"

100%. Grey and dark grey; bedding slumped in places; hard, very fine crystalline to crypto-crystalline; silty; an irregular vertical fracture; no visible porosity. Irregularly bedded layer (maximum thickness 1") of sulphate mineral crystals below base.

SHALE  7083'3"-7085'4"

100%. Black, poorly bedded, hard, slightly micaceous, pyritic, numerous large irregularly shaped inclusions of sulphate mineral crystals near base.

SHALE  7085'4"-7098'4"

100%. Dark reddish brown and dark brown (80%), dark grey and greenish grey (20%), poorly bedded, hard silty, micaceous in part, dolomitic, several irregular bands and numerous small white inclusions of sulphate mineral crystals, and a few thin dark grey dolomite bands (less than 5%).

Cored Interval 7640 - 7675 ft. Cut 18 ft. Recovered 0 (ml.) 0%

Coring Time: 5, 5, 9, 7, 5, 4, 6, 6, 5, 7, 6, 6, 6, 6, 5, 7, 6, 7, 6, 6, 6, 5, 7, 6, 7.

No core recovered probably due to wash out and erosion of salt and to balance of core slipping through core catchers. There was little or no wear on diamond bit. Upon next trip with bit fill on bottom suggests broken core had fallen out of barrel.

CORE NO. 10.  Arumbersa Sandstone.

Dip apparently flat non-fossiliferous.
No porosity, scattered pinpoint fluorescence only.

Cored Interval 8712 - 8724 ft. Cut 12 ft. Recovered 3 4/\(\text{\textfrac{1}{4}}\)”. Recovery 28%.

Corrected Depth 8706½ - 8720½.


Note: Core spilled on derrick floor on removal from core barrel.

1½ 0” Interlaminated SHALE (45%) and SILTSTONE (40%), with some SANDSTONE (15%) layers in bottom 2”. Dip 0°.

SHALE

Reddish-brown and dark brown; bedding surfaces reworked in places (organically with few fractures parallel to bedding and joined in places by short (½") vertical fractures; tough; silty, micaceous, particularly along bedding planes.

SILTSTONE

Reddish-brown; reworked bedding in places, with few thin shaly partings; few fractures parallel to bedding and joined in places by short (¼") vertical fractures, tough; micaceous, few included quartz grains up to 2 mm across concentrated along bedding planes; grades in places into very fine sandstone.
SANDSTONE

- Reddish-brown; graded bedding from fine-to very-fine-grained beds with numerous included medium, coarse and very coarse grains up to 1/3 mm across, and a few medium-grained stringers; sorting fair; subangular to subrounded grains, larger grains rounded; quartzose, micaceous, but dark coloured grains, epidoteaceous, well bonded by siliceous cement, slightly diomitic, a few thin shaly inclusions; no porosity visible.
- Framework: matrix filler - 0:2

1'1"

- SHALE (70%) with interbedded thin bands and thin lenses of SILTSTONE (30%), with 1/8" stringer of fine-grained, light greenish-brown, diomitic quartzite at 8" from top. Dip 0°.

SHALE

- Reddish-brown and dark brown; bedding surfaces reworked in places; tough; silty, micaceous. An included anhydrite pod at 10" from top.

SILTSTONE

- Reddish-brown; reworked bedding in places, with few thin shaly partings; tough; micaceous, few included quartz sand grains.

0'4"

- Interlaminated SHALE (50%) and SILTSTONE (40%), grading into SANDSTONE (10%). Dip 0°.

SHALE

- Reddish-brown and dark brown; reworked bedding in places; tough; silty, micaceous.

SILTSTONE

- Reddish-brown; reworked bedding in places, with few thin shaly partings; tough; micaceous.
SANDSTONE

Reddish-brown; graded bedding; very fine-grained; sorting good; subangular grains; quartzose, micaceous, few dark coloured grains, argillaceous, well bonded by siliceous cement, slightly dolomitic; no porosity visible; framework: matrix filler 5:2

SANDSTONE 0.12"

Reddish-brown; fine-to very fine-grained with included grains up to 1 mm across; sorting fair; subangular to subrounded grains; quartzose, few dark coloured grains, well bonded by siliceous cement, argillaceous; no porosity visible; framework: matrix filler 5:2; an irregular fracture trends parallel with bedding.

SANDSTONE 0.19"

Interlaminated SHALE (60%) and SILTSTONE (40%) Dip 0°.

SHALE

Reddish-brown and dark brown; bedding surfaces reworked in places; tough; silty, micaceous.

SILTSTONE

Reddish-brown; reworked bedding in places, with few thin shaly partings; tough; micaceous.
REPORT ON 22 THIN SECTIONS
FOR
MACELLAN PETROLEUM CORPORATION
The rock is an orange-red, medium grained, stratified sandstone. In thin section sometimes elongated, sub-rounded to angular quartz grains make up 80% of the total. About 10% each of kaolinized orthoclase and limonite cement are present. The limonite is clearly seen rimming quartz grains. A little argillaceous material is suspected in the cement. Stratification is emphasized by variations in grain size. The finer portions are richer in iron oxides. The rock appears well cemented and voids are absent.

This rock is essentially similar to Or - 1; a red medium grained stratified sandstone. It is however massive and more homogeneous. Quartz occurs as sub-rounded to angular grains. Many show parallel elongation. 70% of the rock is quartz and the balance kaolinized orthoclase and a few lithic fragments. A few small grains of haematite are present but the main cement is limonite. This rims the grains and fills the voids.

A medium grained orange-red sandstone. A faint stratification is present but the rock is essentially massive and homogeneous. Small holes are present in the hand specimen. In thin section the quartz is generally in rounded to sub-rounded grains. There

N.B. Some of the samples described in this report are limestones. Microscopic determination of dolomite is uncertain; accordingly calcite and dolomite has been termed 'carbonate.
are some secondary quartz overgrowths and a number of the 
grains show slight fractures and strain extinction. About 
15% of the section consists of kaolinized rounded feldspar. 
The clastics are cemented by limonite. Voids make up an 
estimated 5% of the rock.

Or - 4

Orange-red medium grained sandstone. Lamination is 
present as black bands along finer grained quartz layers. 
Most quartz grains are rounded to sub-rounded in form and 
they make up 35% of the rock. Some secondary overgrowths are 
present. About 5% kaolinized feldspar is present, some of 
the fresher grains are andesine. The cement is limonite 
with fine quartz fragments and some argillaceous material. 
The lamination is emphasized by variations in quartz grain 
size. The rock is fairly porous along elongated voids parallel 
to the stratification.

Or - 5

Medium to fine-grained orange-red sandstone. Faint 
stratification may be observed but the rock is essentially 
massive and homogeneous. In section subrounded quartz grains 
make up 90%. Secondary overgrowths usually fill the inter-
granular spaces. Kaolinized potash feldspar and the occasional 
limonitized mafic mineral are present. Limonite cement makes 
up less than 5% of the section. Despite the pronounced
secondary overgrowths, a few elongated voids parallel to the bedding occur.

Or - 6

This rock is light green to mauve in colour. It is a fine-grained well cemented sandstone, massive and homogeneous. The quartz grains, about 144 in diameter, are well sorted sub-rounded to angular and overgrown. They make up 90% of the section. The feldspar is kaolinized and the inter-grain spaces are filled with acic clusters of iron oxides. Secondary quartz overgrowth, iron oxides and kaolinized feldspar have filled most spaces although a few voids are still present.

Or - 7

The rock is a pale buff coloured, poorly sorted, medium grained well stratified sandstone with mauve coloured bands. In thin section sub-rounded quartz makes up 90% of the total. The grains show marked secondary overgrowths. Highly kaolinized feldspar makes up 5% of the section. The limonite cement is peppered with small ferruginous minerals.

Or - 8

The core is a red and grey spotted, coarse to medium grained sandstone. In thin section sub-rounded to angular quartz of variable grain size (but usually 2 - 3 m in diameter) make up 80% of the section. Finer and more angular grains
along with ferruginous detritus fill up most of the inter-
granular spaces. Kaolinitized feldspar is present and the
limonite cement includes fine ferruginous grains. Voids
amount to about 3% of the rock.

Or - 9

The core is a white medium to coarse massive homogeneous
sandstone. It is poorly cemented but not crumbly. In section
subrounded quartz (70%) and kaolinitized orthoclase (30%) are
poorly cemented by limonite and argillaceous material. The
section appears to indicate a very porous rock showing voids
in about 15% of the section.

Or - 10

The rock is a well cemented medium grained reddish
brown massive sandstone. A few spots of white in limonitized
sandstone are present. The quartz, about 90% of the section,
is rounded to sub-rounded in form. Some embayment features
are present but rare; secondary overgrowth and pore filling
is common. Many quartz grains are cracked. Some kaolinitized
feldspar is present. A little limonite rims the quartz grains
and porosity is low.
The core is a medium grained cross bedded (?) white to grey porous sandstone. In section subrounded to sub-angular quartz of 2 - 3 μ makes up 60%, in addition small 1/2 μ angular quartz makes up 30% of the rock. A small amount of sub-rounded kaolinized orthoclase is present. The cement is an argillaceous limonite which fills most of the intergranular spaces. However remaining voids make up about 2% of the section. Stratification is observed as continuous bands of small angular quartz.

The rock is a medium grained grey stratified sandstone with included red and green angular shale fragments. In thin section quartz shows as cracked rather poorly sorted sub-rounded grains sometimes showing embayment features. Strain extinction and secondary overgrowths are common. Potash feldspar shows alteration to kaolin. Ferruginous argillaceous material is present interstitially, small fragments of various sizes are present. Voids are absent.

The rock is a medium grained, well stratified, well cemented, homogeneous glauconitic sandstone. A shale content is present. In section the rounded quartz grains are overgrown. Pore filling and embayment features are common. The glauconite
about 25% of the slide, occurs as rounded cryptocrystalline dark green grains. A light brown collophane mineraloid occurs parallel to the stratification. Calcite makes up 5% of the total and a small amount of iron oxide occurs interstitially.

Cr - 14

The core is a medium to coarse grained impure carbonate rock. It is homogeneous with a slight stratification accentuated by dark coloured bands. In section the carbonate appears as small (1 - 3 μ) grains, and is the product of a recrystallized oolithic limestone. Small amounts of iron oxides are present, sometimes associated with an apple-green chlorite. Voids are absent.

Cr - 15

The rock is a medium to coarse impure recrystallised limestone. It is massive and homogeneous. In section interlocking coarse and fine grained carbonate makes up 80% of the slide. Similar amounts of glauconphane and haematite are present together with a small amount of collophane. Fluid passage through the rock has produced minute stylolites in the carbonate; iron oxides probably haematite (?) and argillaceous material being left behind.
Or - 16

The rock is a fine to medium grained grey stratified limestone. In thin section alternate laminations of very fine grained and coarser grained carbonate occur. Considerable amounts of quartz and feldspar occur in the coarser bands. Voids are filled with secondary gypsum. Fine grained anhydrite is possible with the fine grained calcite.

Or - 17

The rock is a well stratified, very fine grained, pale grey limestone. Gypsum crystals, a few millimetres long, occur. In this section fine and coarser grained carbonate granules alternate. Elongate crystals of gypsum grow perpendicular to the laminations. (Note this is a poor slide).

Or - 18

The core is a very fine grained light grey and dark grey laminated limestone. The laminations are discontinuous and wedge out. In section mineral identification is difficult owing to fine grain. However carbonate may be assumed to make up 95% of the rock with a small amount of detrital quartz. Limonite (?) occurs between lamellae separating very fine from fine calcite. An occasional very small elongated gypsum crystal may be seen.
The rock is a very fine grained unevenly laminated grey limestone. A small amount of salt appears to be present. In section the carbonate is fine grained. Gypsum, probably secondary, occurs in cracks perpendicular to the stratification and makes up about 5% of the rock. Limonite is present and the rock shows no pore spaces.

The rock is a very fine grained limestone. Wavy laminations are easily visible and due to thin bands of dark grey slightly coarser carbonate. In section most of the rock is fine grained carbonate but about 5% gypsum is scattered through the mass in small isolated spots. It appears to be penecontemporaneous with deposition. A little quartz is present and the dark streaks may be due to deposition from circulating fluids.

The core is a very fine grained grey massive limestone with a faint wavy stratification. The carbonate appears as peppered grains in large optically continuous crystals of syngenetic gypsum and as separate powder-sized grain accumulation. Secondary gypsum veins, 1 mm. wide, cut the rock. A shale fragment 2 cm. long is incorporated in the section.
The rock is a very fine grained grey-green shale mottled with chocolate brown and red colouration. Small round, white bodies of crypto-crystalline gypsum are present. Some of the gypsum has been lost during slide making. The shale is clearly showing various degrees of limonitization.
LEGEND

QUATERNARY-TERTIARY
ALLUVIUM, SAND, GRAVEL, ETC. INCLUDES SOME NEOZOIC DEPOSITS.

DEVONIAN
PERTHINTA FORMATION.

ORDOVICIAN
HERALD SANDSTONE, STOKES SHALE, STIRLING SANDSTONE, HERRA VALLEY BISTONE & PAGOTA SANDSTONE.

CAMBRIAN
PERTHAINTA GROUP

QUATERNARY-TERTIARY
ALLUVIUM, SAND, GRAVEL, ETC. INCLUDES SOME NEOZOIC DEPOSITS.

DEVONIAN
PERTHINTA FORMATION.

ORDOVICIAN
HERALD SANDSTONE, STOKES SHALE, STIRLING SANDSTONE, HERRA VALLEY BISTONE & PAGOTA SANDSTONE.

CAMBRIAN
PERTHAINTA GROUP

RU
UPPER PROTEROZOIC
PERTHINTA FORMATION, ARETHURA FORMATION, BITTER SPRINGS FORMATION & HERMITAGE QUARZITE.

PC
PRECAMBRIAN
IDEOCITE & METAMORPHIC ROCKS.

ANTICLINE
SYNCLINE
FAULT

SOURCES OF INFORMATION
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, PUBLICATIONS AND WARMAN PETROLEUM CORPORATION MAPS.

ORANGE NO. 1 LOCALITY MAP
AMADEUS BASIN, NORTHERN TERRITORY

ENCLOSURE I
### Predicted

<table>
<thead>
<tr>
<th>Depth</th>
<th>Formation</th>
<th>Type</th>
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<tbody>
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<td>0'</td>
<td>PERNJARA</td>
<td>Ss (1400')</td>
</tr>
<tr>
<td>1400'</td>
<td>MERNEENIE</td>
<td>Ss (1120')</td>
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<tr>
<td>2300'</td>
<td>LARAPINTA</td>
<td>PAcoota (950')</td>
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<tr>
<td>3250'</td>
<td>Goyder Fm</td>
<td>(1000')</td>
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<tr>
<td>4250'</td>
<td>JAY CREEK</td>
<td>Ls (850') (Shannon)</td>
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<tr>
<td>5100'</td>
<td>BRANDEAM</td>
<td>Ss (850')</td>
</tr>
<tr>
<td>6400'</td>
<td>HUGH RIVER</td>
<td>Sisst (1300')</td>
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### Penetrated

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<td>PERNJARA</td>
<td>Ss (940'+)</td>
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<td>2060'</td>
<td>MERNEENIE</td>
<td>Ss (1120')</td>
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<tr>
<td>2413'</td>
<td>LARAPINTA</td>
<td>Ss (353')</td>
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<td>3880'</td>
<td>Goyder Fm</td>
<td>(923')</td>
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<td>4803'</td>
<td>JAY CREEK</td>
<td>Ls (880')</td>
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<tr>
<td>5654'</td>
<td>HUGH RIVER</td>
<td>Sisst (966')</td>
</tr>
</tbody>
</table>

**PROGRAMMED T. D.**

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**ENCLOSURE 2**
MAGELLAN PETROLEUM (N.T.) PTY. LTD.

GRAPHIC GEOLOGICAL SECTION COMPARISON, N.E. AMADEUS BASIN
ORANGE NO I. & ALICE NO I.
NORTHERN TERRITORY, AUSTRALIA

ORANGE NO I. (K.B.1935')

ALICE NO I. (K.B.1753')

S.L. 940' 1165' S.L.
2060' 2115'
2413' 2806'
S.L. 3004'
3718' 2904'
3880' 3963'
3804'
4690' 5147'
4803'
5654'
6620'
6618'
6750'
7462' 6618'
7594' 7740'
7518' 7270'
8210' 7140'
8294' 7270'
8520' T.O.D., S.L. 7270'
T.D. 8896' 7518'

ENClOsure 3
ORANGE NO. 1

COMPOSITE WELL LOG

ENCLOSURE 5
ORANGE NO. 1

ELECTRICAL LOGS AND OTHER SURVEYS

(a) Electrical, Radioactivity, and Acoustical Logs by Welex (Enclosed under separate cover).

(b) Velocity Survey by United Geophysical Corporation.
PARTY 114
UNITED GEOFYSICAL CORPORATION
by
MAGELLAN RESEARCH (N.Z.) P.L.T.D.
for
CHANGE NO. 1
MAGELLAN RESEARCH

S
VELOCity SURVEY

ENCLOSURE 6(9)
WELL INFORMATION

Name of well Magellan Orange No. 1.
Date of Survey 15th and 17th October, 1966.
Location 28 miles southwest of Alice Springs
township in southern central
Northern Territory, in Oil Permit
(0.P.) 43.
Co-ordinates Latitude 24° 02' 34'' S.
Longitude 133° 46' 32'' E.
Seismograph profile Intersection of Line 3-1 S.P. 69,
and Line 3-A S.P. 18.
Total depth of well 8525 feet below Kelly Bushing.
Casing 4360 feet " " "
Kelly Bushing elevation 1935 feet above sea level.
Ground level elevation 1922 feet A.S.L.

OPERATIONS

Recording instruments S.S.C. GCE-101 pressure sensitive
well geophone.
Welex cable and reel truck.
1 Uphole and 2 reference geophones,
20 cycle critically damped.
Electro-Tech camera, with 125 cycle
galvanometers.
Well geophone arrival times recorded
at 3 levels of sensitivity.
Well geophone depths by Welex.
Surveyed interval 995 feet to 7400 feet below K.B.
Number of horizons surveyed Six (6)
Total number of records Fourteen (14)
Explosives used 2905 lbs. (Gelatin)

The recording instruments and pressure geophone were transported to the well site by plane from Toowoomba, Q'ld.

The original 22 shotholes were located mainly east and west of the well, with well bottom check shotpoints to the north and south. Distances from well to shotholes ranged from 700 feet to 900 feet, with hole depths of approximately 20 feet.

A nearsurface layer of Duracrust prevented the shotholes from being drilled deeper, and apparently hindered the penetration of energy. Each shothole collapsed after one shot, and subsequent reloads were shot on the surface. Charge sizes were substantially increased for surface shooting, because of the high level electrical noise.

An uphole geophone 10 feet from the shothole, and a reference geophone 50 feet north of the well were used for charges loaded beneath the surface. For surface charges, reference geophones were situated 50 feet north and 150 feet east of the well.
RESULTS:

Of the fourteen (14) shots taken, 5 records were used for computational purposes. A usable record was obtained at all levels except the 5950 foot level. The generally poor record quality may be attributed to several factors. Surface shooting and the presence of near surface Duracrust resulted in poor energy transmission. The highly saline water in Orange No. 1 created a high level of "well noise", which could not be handled with the combination of the S.S.C. pressure geophone and the Welex cable system.

The S.S.C. pressure geophone is designed to operate with both detector leads having infinite insulation to earth. However with the Welex single insulated conductor, and earthed sheath return, it is unavoidable to have one of the detector leads at earth potential. The detector element has an impedance of 700 ohms at 20 cycles per second. It therefore appears likely that electrolytic actions and spontaneous potentials developed in the saline solution, and applied through the earthed side of the detector element have adversely affected the signal to noise ratio. Circulating currents of several milliamps were measured.

The pressure geophone arrival times are normally recorded at three levels of sensitivity: with attenuation steps of -15 decibels between High, Medium and Low sensitivity trace settings. In the case of Orange No. 1, well noise necessitated high sensitivity trace settings of between -30 and -40 db. The resulting trace arrivals although weak on
most of the records used for computations, are nevertheless considered reliable. A comparison of velocity and sonic log time intervals agree at all shots within a small margin of error.

When determining the arrival times for weak or low sensitivity breaks, the times have been weighed .002 seconds to approximate high sensitivity arrivals. At the level at 5950 feet below kelly bushing, an unreliable record has made it necessary to use the time interval from the sonic log.

The arrival times to the principle horizons are as follows:

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Depth below a datum of +1800' A.S.L.</th>
<th>Arrival times (one way time)</th>
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<td>Jay Creek (Limestone)</td>
<td>4668'</td>
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<tr>
<td>Hugh River (Shale &amp; Siltstone)</td>
<td>5519'</td>
<td>.353</td>
</tr>
<tr>
<td>Giles Creek (Dolomite)</td>
<td>6485'</td>
<td>.408</td>
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A weathering correction of 2400'/sec. to approximately 20 feet was determined, and a datum reduction velocity of 10,000 feet per second was supplied by Magellan Petroleum Company.
Two velocity functions were computed to give the required fit to the time-depth curve for Orange No. 1. From datum to 4400 feet below datum $V = 12,590 + 1.26h$, while for depths below 4400 feet $V = \text{constant velocity of 17,800 feet per second.}$

The function $V = 12590 + 1.26h$ was computed with respect to an 1800 foot datum plane, employing the Nash Miller method of computation.

A plot of the velocity functions computed for Magellan Orange No. 1, is included in the appendix of this report for comparison purposes.

Respectfully submitted,

[Signature]

United Geophysical Corp.
Party 141.

[Signature]
Supervisor.
AE1-3 DISTANCE FROM WELL = 700'
BE1-7 DIST. = 900'
BW1-7 = 900'
AW1-3 = 700'
AW 2 S 74° 00' W 700'
AW S 74° 00' W 750'
DW S 74° 00' W 800'
BN 1 N 16° 30' W 900'
BS 1 S 16° 30' E 900'
REFERENCE PHONE (1) 50° NORTH
REFERENCE PHONE (2) 150° EAST

SURVEY PLAT
VELOCITY SURVEY
MAGELLAN PETROLEUM
ORANGE N°1

BY
PARTY 141 UNITED GEOPHYSICAL CORP.

SCALE: 1 INCH = 350 FT.
DATE: 15-17 OCTOBER 1968

FIG. 2
| Shot | Elevation | Distance | Shot Hole | Elevation | Distance | Shot Hole | Elevation | Distance | Shot Hole | Elevation | Distance | Shot Hole |
|------|-----------|----------|-----------|-----------|----------|-----------|-----------|----------|----------|-----------|-----------|----------|-----------|
| Rw1  | 1919      | 720      | Rw        | 1918      | 720      | Rw1       | 1919      | 720      | Rw1      | 1918      | 720      | Rw1      | 1919      |
| Rw2  | 1919      | 1800     | Rw2       | 1918      | 1800     | Rw2       | 1919      | 1800     | Rw2      | 1918      | 1800     | Rw2      | 1919      |
| Rw3  | 1900      | 800      | Rw3       | 1903      | 900      | Rw3       | 1903      | 800      | Rw3      | 1903      | 900      | Rw3      | 1903      |

**Shot Hole Elevations**

- **Kelly Bush**: 1935
- **Rotary Tool**: 1992
- **Drill Flare**: 1992

**Formation**

- **Gyne River**: 6520
- **Galilee**: 5519
- **Hogan River**: 5519
- **Jays Creek**: 4880
- **Palo Duro**: 2418
- **Laramie**: 2060
- **Merrinie**: 1440

**Survey Details**

- **Surveyed by**: U.G.C. Party 141
- **Complied by**: L.W. Pfizers \& W.J. Larsen
- **Date Surveyed**: 9-20-66
- **Casing**: 4360'
- **Heating**: 0.20' = 2400' / SEC
- **Datum Velocity**: 10,000' / SEC
ORANGE NO. 1

FORMATION TEST CHARTS
Bottom Gauge Lost in Hole

No Chart

Each Horizontal Line Equal to 1000 p.s.i.
<table>
<thead>
<tr>
<th>Flow Time</th>
<th>1st Min.</th>
<th>2nd Min.</th>
<th>3rd Min.</th>
<th>4th Min.</th>
<th>5th Min.</th>
<th>6th Min.</th>
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<td>Drilling Contractor</td>
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<tr>
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**FORMATION TEST DATA**

- **Date:** 10-17-66
- **Ticket Number:** 441982 S
- **Drilling Contractor:** O.D. & E.
- **Geologist:** J.E. CROUGHTERS
- **Witness:** HENRY KERR
- **Elevation:** 1922'
- **Top Pecker:** 7461'
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<thead>
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Reading Interval: 3 3 3 * Minutes

REMARKS: * Chart time expired at approximately 485 minutes of final flow.

SPECIAL PRESSURE DATA
WELL HISTORY CHART
MAGELLAN PETROLEUM (N.T.) PTY., LTD.

ORANGE NO. 1
O.P. 43, NORTHERN TERRITORY

ENCLOSURE 8