

## I N T R O D U C T I O N

The objectives of the Mt. Charlotte No. 1 well in Oil Permit No. 72 Northern Territory were to establish the stratigraphic succession at this location and to test for any accumulation of hydrocarbons. Besides penetrating the prospective Ordovician and Cambrian marine sediments, the well was programmed to test the Upper Proterozoic and to determine the nature of these beds.

## W E L L H I S T O R Y

### GENERAL DATA:

Well Name and Number: Mt. Charlotte No. 1

Location: 24°52'03"S, 133°59'11"E See Figure 1

Name and Address of Tenement Holder:

Finke Oil Company Pty. Ltd.,  
C/- Hiley, Jarrott and Doggett,  
T. & G. Building,  
137 Queen Street,  
BRISBANE. Queensland.

### Details of Petroleum Tenement:

Area M.C. (220 square miles) is a farmout area in Oil Permit 72 (9,693 square miles), Northern Territory. It is described in the Primary Agreement between Finke Oil Company Pty. Ltd. and Mid-Eastern Oil Co. Ltd., Farmout Drillers No Liability, Transoil (N.T.) Pty. Ltd., Woodside (Lakes Entrance) Oil Company No Liability, dated 9th October, 1964. The farmout area M.C. is shown in Figure 1. Under the terms and conditions of the Agreement the four participating companies could, by drilling a well to 5,000 feet or prior basement, earn in equal portions an undivided 50 percent interest in area M.C. It was a condition of the Primary Agreement signed and agreed to by the other three participants that Transoil (N.T.) Pty. Ltd. would be the operator for Mt. Charlotte No. 1, and would apply for subsidies payable to and for the benefit of the participants.

Permission to Drill:

Agreement between Finke Oil Company Pty. Ltd. and  
Transoil (N.T.) Pty. Ltd.

District: Finke

Total Depth: 6,943 feet (Driller)  
6,939 feet (Welex)

Date Drilling Commenced: 12th December, 1964.

Date Drilling Completed: 6th February, 1965.

Date Well Abandoned: 7th February, 1965.

Date Rig Released: Midnight 6th February, 1965.

Drilling Time in Days to Total Depth: 57 days

Elevation: Ground 1246' a.s.l. Kelly Bushing 1260' a.s.l.

Status: Well was plugged and 9 $\frac{1}{2}$ " casing was perforated,  
1540' - 1545', for completion as a water well.

Cost:

DRILLING DATA:

Name and Address of Drilling Contractor:

Oil Drilling and Exploration Limited,  
93 York Street,  
Sydney.  
New South Wales.

Drilling Plant:

Make: National

Type: T-32

Rated Capacity with 4 $\frac{1}{2}$ " drill pipe: 7,500 feet

Engines (4): 3 Cummins, Type N.H. 1600, each 200 h.p.

1 G.M.C. Twin, Model 671, 300 h.p.

Mast:

Make: Ideco

Type: Junior Fulview

Rated Capacity: 490,000 lbs.

Pumps (2):

Make: Ideal Ideal

Type: C.250 C.150

Size: 7 $\frac{1}{4}$ " x 15" 7 $\frac{1}{4}$ " x 12"

Cost:

DRILLING DATA:

Name and Address of Drilling Contractor:

Oil Drilling and Exploration Limited,  
93 York Street,  
Sydney.  
New South Wales.

Drilling Plant:

Make: National

Type: T-32

Rated Capacity with 4½" drill pipe: 7,500 feet

Engines (4): 3 Cummins, Type N.H. 1600, each 200 h.p.

1 G.M.C. Twin, Model 671, 300 h.p.

Mast:

Make: Ideco

Type: Junior Fulview

Rated Capacity: 490,000 lbs.

Pumps (2):

Make: Ideal Ideal

Type: C.250 C.150

Size: 7¼" x 15" 7¼" x 12"

Air Drilling Equipment:

<u>Unit</u>	<u>Make</u>	<u>Type</u>	<u>Size</u>	<u>Motors</u>
Compressor	Ingersoll-Rand	HHE-3 Stage	1500 c.f.m. 300 p.s.i.	Waukesha 405 h.p.
Booster Compressor	Ingersoll-Rand	HHE-2 Stage	3000 c.f.m. 1500 p.s.i.	Waukesha 405 h.p.
Injection Pump	Aldrich	Triplex HS-3B	1" x 2½"	Wisconsin 30 h.p.

Blow-out Preventer Equipment:

Make:	Hydril	Shaffer	Shaffer
Model:	G.K.	E.F. Double Gate	Rotating
Size:	12"	12"	12"
Working Pressure:	3000 p.s.i.	3000 p.s.i.	3000 p.s.i.

Hole Sizes and Depths:

17½" hole from surface to 308 feet  
 12¼" hole from 308 feet to 1849 feet  
 8¾" hole from 1849 feet to 6937 feet  
 7<sup>13</sup>/<sub>16</sub>" hole from 6937 feet to 6943 feet

Casing and Cementing Details:

Size:	13 <sup>3</sup> / <sub>8</sub> "	9 <sup>5</sup> / <sub>8</sub> "
Weight:	48 lbs./ft.	36 lbs./ft.
Grade:	H-40	J-55, S.T.C.
Setting Depth:	303 feet	1831 feet
Quantity of Cement Used:	220 sacks and 2% Calcium Chloride	465 sacks
Cemented to:	Surface	Surface
Method Used:	Plug	Plug

No problems were encountered during these two casing cementations; in each case cement returns were obtained at surface.

Drilling Fluid:

The fluid circulation programme was supervised by the Toolpusher, in conjunction with the wellsite geologist. A water base bentonite attapulgitic mud was used, treated with Spersene and XP20. As shown in Figure 2, the well was drilled with the following types of fluid circulation.

Surface to 345 feet	Mud Drilling
345 to 1369 feet	Air Drilling
1369 to 1849 feet	Mist Drilling
1849 to 4858 feet	Air Drilling
4858 to 6943 feet	Mud Drilling. At 4858 feet, circulating was converted to mud drilling, due to moisture in the hole and mist drilling was considered risky because of a long salt column up the hole. The first definite gas indications were at 5411 feet

Throughout the drilling of the well, the hole condition was generally good. The following table shows the weekly averages of the mud characteristics.

WEEKLY AVERAGES OF MUD CHARACTERISTICS

Week Ended	Depth Feet	Mud Weight lb./U.S. Gal.	Viscosity (Sec. Marsh)	Water Loss ml./30 min.	ph	Sand Content %
<u>1964</u>						
<u>Dec.</u>						
19	1369	7.4	40	6.0	-	-
This mud was in use only on 13th and 14th December, to 345 feet, and then air drilling was used.						
26	2425	Mist drilling to 1369 feet and then air drilling				
<u>1965</u>						
<u>Jan.</u>						
2	4682	Air drilling				
9	5121	Air drilling to 4858 feet				
9	5121	10.3	31	50+	6.5	0.25
16	5514	10.4	31	100+	6.5	0.25
23	5950	10.8	31	100+	7.0	0.25
30	6565	10.8	31	100+	6.0	0.25
<u>Feb.</u>						
6	6943	10.8	33	100+	6.0	0.25

Mud Additives Used:

The following total quantities of mud additives were used on the Mt. Charlotte No. 1 well:-

Supercol (high-yield bentonite)	9,800 lbs.
Saltgel (attapulgite)	20,250 lbs.
Caustic	4,980 lbs.
XP20	2,375 lbs.
Soda Ash	186 lbs.
Bichromate	125 lbs.
Tolfoam	124 $\frac{3}{4}$ gallons

Water Supply:

A water bore was drilled for Transoil by Geophysical Associates to 530 feet using a Mayhew 1000 rig. An adequate supply of salty water was encountered. The rig was supplied by a motor-driven pump-jack, via a 2" water line.

Fresh water for the camp was hauled from a station bore approximately nine miles from the wellsite. Water supply was always sufficient for rig and camp needs.

Perforation and Shooting Record:

No perforation or shooting was required during drilling and testing. The well was completed by perforating at 1540 - 1545 feet for conversion to a water well for the use of the property owner.

Plugging Back and Squeeze Cementation Jobs:

No squeeze cementation jobs were required. In plugging the well for abandonment, three cement plugs were set at the depth intervals listed below. The average slurry weight was 14.4 lbs./gallon U.S., 4 percent of calcium chloride was added as an accelerator.

<u>Plug No.</u>	<u>Length</u> (feet)	<u>Depth Range</u> (feet)	<u>Confirmed Plug</u> <u>Top (feet)</u>	<u>Cement</u> (sacks)
1	133	5317 - 5450	5339	60
2	216	4534 - 4750	4558	80
3	230	1770 - 2000	1683	75

Fishing Operations:

After 8 $\frac{3}{4}$ " hole had been drilled to 5977 feet, and tools pulled to run a drill-stem test, a stabilizer rubber and sleeve were left in the hole. This fish was milled up on 25th January 1965, the operation requiring 7 $\frac{1}{2}$  hours rig time, which represented 0.6 percent of the total operational time.

Side-tracked hole:

The hole was not side-tracked.

Logging and Testing - Ditch Cuttings:

Ditch cuttings were collected at 10 foot intervals during drilling and at 5 foot intervals while coring. Three sample cuts were collected - one for the Bureau of Mineral Resources, Canberra, one for the Northern Territory Administration and one for Transoil No Liability and the other participants.

Coring:

The following cores were taken:-

<u>Core No.</u>	<u>Core Depths</u> (feet)	<u>Amount</u>		<u>Percent</u> <u>Recovered</u>
		<u>Cored</u> (feet)	<u>Recovered</u> (feet)	
1	345 - 355	10	9	90
2	990 - 1000	10	9	90
3	1369 - 1381	12	9	75
4	1565 - 1575	10	9'6"	95
5	1832 - 1849	17	16	94
6	2203 - 2223	20	18'9"	94
7	2303 - 2308	5	2'9"	55
8	2609 - 2629	20	4	20
9	2905 - 2925	20	6	30
10	3177 - 3192	15	3	20
11	3508 - 3522	14	6	43
12	4020 - 4032	12	5	42
13	4530 - 4542	12	5	42
14	4766 - 4768	2	2	100
16 (Diamond)	5025 - 5050	25	25	100
17 (Diamond)	5137 - 5147	10	10	100
18 (Diamond)	5292 - 5313	21	12	57
19 (Diamond)	5416 - 5429	13	13	100
20 (Diamond)	5677 - 5677'6"	6"	-	-

<u>Core No.</u>	<u>Core Depths</u> (feet)	<u>Amount</u>		<u>Percent</u> <u>Recovered</u>
		<u>Cored</u> (feet)	<u>Recovered</u> (feet)	
21 (Diamond)	5815 - 5827	12	12	100
22	6135 - 6148	13	13	100
23	6381 - 6389	8	6'7"	82
24	6703 - 6714	11	10'6"	95
25	6745 - 6761	16	14'6"	91
26	6937 - 6943	6	5	83

Total footage cored = 315 ft. 6 ins.

Total footage recovered = 226 ft. 7 ins.

Overall percentage recovered = 72%

Coring Equipment Consisted of:-

(1) A Hughes Tool Co. type "J" conventional 20 foot core barrel using  $7\frac{7}{8}$ " hard formation core heads, cutting a  $3\frac{1}{2}$ " diameter core.

(2) Christensen 60' x  $6\frac{1}{4}$ " and 60' x  $5\frac{3}{4}$ " Diamond core barrels using  $7\frac{13}{16}$ " Diamond core heads, cutting a  $3\frac{1}{2}$ " diameter core.

Detailed descriptions of the cores are given in Appendix 1.

A 4" sample from each 2 feet core interval recovered was forwarded to the Bureau of Mineral Resources. The remaining cores were delivered to the Resident Geologist of the Bureau of Mineral Resources, Alice Springs.

Side-wall Sampling:

No side-wall samples were taken.

Electrical and other Logs:

The following Welex logs were run:-

<u>Run No.</u>	<u>Type of Log</u>	<u>Depth Interval</u> (feet)
1	Induction-Electric	304 - 1828
1	Guard	1830 - 4998
2	Guard	4900 - 6931
1	Forxo-Caliper	1830 - 4999
2	Forxo-Caliper	4900 - 6936
1	Acoustic-Caliper	304 - 1818
2	Acoustic-Caliper	1830 - 4995
3	Acoustic-Caliper	4900 - 6931
1	Gamma Ray	304 - 1818



The logs were run on the scale of 2" = 100' and 5" = 100'.

Logging run No. 1 was made at 1849 feet. The hole had been air drilled and the fluid in the hole when it was logged was a natural fill-up of formation water. Logging run No. 2 at 5005 feet, was recorded with salt water mud in the hole, after air drilling had been used to 4858 feet. Logging run No. 3 was made with salt water mud in the hole at final depth of 6943 feet.

Quantitative log estimations of the hydrocarbon content of the formation were hampered by such factors as the presence of salt beds in the stratigraphic succession. Consequently values for water saturation cannot be reliably computed. However, throughout the entire drilling operation, a very close scrutiny was maintained for the presence of hydrocarbons, and any significant showings were drill-stem tested.

Low porosity values are indicated from the logs. The Acoustic log indicates a travel time of some 50 to 60 microseconds per foot throughout zones of possible interest. The matrix velocities in this stratigraphic succession would probably vary considerably with so much dolomite present. Therefore, one cannot assume a normal matrix velocity of the order of 18,500 feet per second, i.e. 54 microseconds per foot, with nil compaction correction. However, even for variable matrix velocities, these formation porosities would seem to be less than 5 percent.

A well geophone survey was also run. Results of this survey are given in Appendix 8.

#### Drilling Time and Gas Log:

Rates of penetration were continuously recorded while drilling. Air drilling techniques are most suitable for rapid penetration of much of the lithological

sequence in the Amadeus Basin. Air Drilling ensures faster rates of penetration and increased bit life.

A Corelab hot wire gas detector was used to detect and record gas in drilling mud. All gas recorded is shown on the Composite Well Log. The first definite gas indications were noted at 5411 feet.

Figure 2 shows the Time Versus Depth Graph.

Formation Testing:

Air and mist drilling between 345 feet and 4858 feet provided continuous open-hole evaluation over this interval. No hydrocarbon shows were encountered before conversion to mud drilling. While mud drilling, four open-hole drill stem tests were run to evaluate small gas shows recorded on the hot wire gas detector. These are given in Appendix 7.

Drill Stem Test No. 1: Interval 5400' - 5429'

Purpose: To test a 7 unit gas kick at 5411' with a drilling break at 5411' - 5413', and wet gas from pulverized cuttings.

Results: Chokes: Bottom - open, Top - open  
I.S.I. 21 mins.      Flowing 26 mins.      F.S.I. Nil  
I.H.P. 3062 p.s.i.      I.S.I.P. 95 p.s.i.  
I.F.P. 95 p.s.i.      F.F.P. 95 p.s.i.  
F.S.I.P. Not recorded      F.H.P. 3062 p.s.i.  
Blow: Nil

Recovery: Nil

Pressure Chart: Figure 5.

Conclusions: Test mechanically successful. Interval tight. No F.S.I. taken because no flow occurred.

Drill Stem Test No. 2: Interval 5435' - 5594'

Purpose: To evaluate the following gas shows:

5442' - 5443' - 2 units  
5468' - 5472' - 13 units  
5562' - 5563' - 5 units

Results: Chokes: Bottom - open, Top - open  
I.S.I. Not taken      Flowing 33 mins.      F.S.I. 33 mins.  
I.H.P. 3088 p.s.i.      I.S.I.P. Not recorded  
I.F.P. 95 p.s.i.      F.F.P. 95 p.s.i.

Formation Testing:

Air and mist drilling between 345 feet and 4858 feet provided continuous open-hole evaluation over this interval. No hydrocarbon shows were encountered before conversion to mud drilling. While mud drilling, four open-hole drill stem tests were run to evaluate small gas shows recorded on the hot wire gas detector. These are given in Appendix 7.

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Purpose: To test a 7 unit gas kick at 5411' with a drilling break at 5411' - 5413', and wet gas from pulverized cuttings.

Results: Chokes: Bottom - open, Top - open  
I.S.I. 21 mins. Flowing 26 mins. F.S.I. Nil  
I.H.P. 3062 p.s.i. I.S.I.P. 95 p.s.i.  
I.F.P. 95 p.s.i. F.F.P. 95 p.s.i.  
F.S.I.P. Not recorded F.H.P. 3062 p.s.i.

Blow: Nil

Recovery: Nil

Pressure Chart: Figure 5.

Conclusions: Test mechanically successful. Interval tight. No F.S.I. taken because no flow occurred.

Drill Stem Test No. 2: Interval 5435' - 5594'

Purpose: To evaluate the following gas shows:

5442' - 5443' - 2 units

5468' - 5472' - 13 units

5562' - 5563' - 5 units

Results: Chokes: Bottom - open, Top - open  
I.S.I. Not taken Flowing 33 mins. F.S.I. 33 mins.  
I.H.P. 3088 p.s.i. I.S.I.P. Not recorded  
I.F.P. 95 p.s.i. F.F.P. 95 p.s.i.

Drill Stem Test No. 2: (cont.)

F.S.I.P. 114 p.s.i.      F.H.P. 3100 p.s.i.  
Blow: Weak air blow, dying in 5 minutes.  
Recovery: 40 feet of drilling fluid.  
Pressure Chart: Figure 6.

Conclusions: Test mechanically successful. Interval tight. Disk valve was damaged on D.S.T. NO. 1, not used on this test.

Drill Stem Test No. 3: Interval 5847' - 5976'

Purpose: To evaluate the following gas shows:-

5854' - 5855' - 4 units  
5890' - 5892' - 4 units

Results: Chokes: Bottom - open, Top - open  
I.S.I. Not taken      Flowing 15 mins.      F.S.I. 15 mins.  
I.H.P. 3281 p.s.i.      I.S.I. Not recorded  
I.F.P. 0 p.s.i.      F.F.P. 0 p.s.i.  
F.S.I.P. 5 p.s.i.      F.H.P. 3268 p.s.i.  
Blow: Weak air blow, dying immediately.  
Recovery: 10 feet of drilling fluid.  
Pressure Chart: Figure 7.

Conclusions: Test mechanically successful. Interval tight. No I.S.I. taken as disk valve previously damaged.

Drill Stem Test No. 4: Interval 6709' - 6761'

Purpose: To evaluate gas shows between 6714' and 6745' reading a maximum of 20 units at 6730'.

Results: Chokes: Bottom -  $\frac{5}{8}$ ", Top - open  
I.S.I. Not taken      Flowing 60 mins.      F.S.I. 45 mins.  
I.H.P. 3861 p.s.i.      I.S.I.P. Not recorded  
I.F.P. 31 p.s.i.      F.F.P. 224 p.s.i.  
F.S.I.P. 508 p.s.i.      F.H.P. 3861 p.s.i.  
Blow: Good air blow increasing for 30 minutes, then dying to nothing over 30 minutes.  
Recovery: 300 feet of drilling fluid.  
Pressure Chart: Figure 8.

Conclusions: Test mechanically successful. Interval very slightly permeable. No hydrocarbons present.

Deviation Surveys:

Deviation surveys were run at convenient stages of the drilling operation. The following table records the deviation readings:

<u>Feet</u>	<u>Degrees</u>	<u>Feet</u>	<u>Degrees</u>
305	2	2900	$\frac{1}{4}$
308	$1\frac{1}{4}$	3170	1
450	1	3508	$1\frac{1}{4}$
540	1	3750	$2\frac{1}{2}$
700	$1\frac{1}{2}$	5000	$2\frac{1}{4}$
800	$1\frac{1}{2}$	5220	2
1000	1	5388	Misrun
1190	$\frac{1}{2}$	5594	3
1350	1	5800	Misrun
1560	$\frac{1}{2}$	5918	$5\frac{1}{4}$
1770	$\frac{1}{2}$	6370	$4\frac{1}{2}$
2000	$\frac{1}{2}$	6700	$4\frac{1}{4}$
2303	0	6890	$1\frac{1}{2}$
2600	$\frac{3}{4}$		

Temperature Surveys:

No temperature surveys were run.

Drilling Observations:

Figure 2 shows rig time plotted against depth. A total of 1347 hours (56 days) was required to drill the well. The table below gives a breakdown of the time.

<u>Operation</u>	<u>Hours</u>	<u>% of Total Hours</u>
Drilling (a) on bottom	683	50.8
(b) trips	172	12.6
Coring (a) on bottom	$80\frac{1}{4}$	6.0
(b) trips	$105\frac{1}{2}$	7.8
Deviation Surveys	10	0.7
Rig Service	$68\frac{1}{4}$	5.1
Breakdown Time	21	1.6
Testing	33	2.5
Logging	$46\frac{1}{4}$	3.4
Casing	$56\frac{1}{2}$	4.2
Other	<u><math>71\frac{1}{4}</math></u>	<u>5.3</u>
Total	<u>1347</u>	<u>100.0</u>

Thirty three drill bits, four conventional core heads, and one diamond core head were used. Average overall penetration rate was 9.1 feet per hour.

The table below illustrates the sharp increase in penetration rates and bit footage when air and mist were used as circulating fluids.

<u>Drilling Method</u>	<u>Footage</u>	<u>Hours Required</u>	<u>No. of Hours</u>	<u>Ft./hr.</u>	<u>Ft./Bit</u>
Mud Drilling 12 $\frac{1}{4}$ " surface hole	292	19	1	15.4	292
Mist Drilling 12 $\frac{1}{4}$ " hole	1529	74	4	20.6	382
Air Drilling 8 $\frac{3}{4}$ " hole (a) without hammerdril	2548	84 $\frac{1}{2}$	5	30.2	510
(b) with hammerdril	479	43	2	11.1	240
Mud and Water Drilling 8 $\frac{3}{4}$ " hole	2079	427 $\frac{1}{2}$	21	4.9	99

Note: Does not include coring runs.

### G E O L O G Y

#### Summary of Previous Work:

Geological - Several reconnaissance and locally detailed surveys have been carried out in the Rodinga-Finke area notably by the Horn Expedition (1896, 1897), David and Howchin (1924), Chewings (1914, 1928, 1935) and Ward (1925). No regional stratigraphic mapping of the area was attempted until 1959 and 1960 when Leslie, MacLeod and Wulff of Frome-Broken Hill Ltd. compiled comprehensive reports and maps on the southern and eastern margins of the Amadeus Basin. Since 1960 the Bureau of Mineral Resources has been mapping the Amadeus Basin on National Grid 1:250,000 series but as yet the Rodinga Sheet, in which Mt. Charlotte No. 1 was located, remains unpublished.

Geophysical - The first geophysical work within the present boundaries of Oil Permit No. 72 was a helicopter gravity survey by Mines Administration for Flamingo Petroleum Pty. Ltd. in the south eastern part of the area in 1960. A survey by the Bureau of Mineral Resources over the remainder of the area was carried out in 1961. In 1962,