

S U M M A R Y

The Alice No. 1 Well, approximately 17 miles south-east of Alice Springs, Northern Territory of Australia, was drilled to a total depth of 7,518 feet. It penetrated 1,165 feet of ?Silurian sediments, 1,839 feet of Ordovician sediments and 4,514 feet of Cambrian sediments. It bottomed in the Arumbera Sandstone of Lower Cambrian age.

The well was drilled to test a seismically anomalous area that portrayed both structural closure and events characteristic of reef-type development in the lower Jay Creek Limestone Formation of the Pertaoorrtta Group.

The well encountered a small amount of asphaltic oil in the Upper Cambrian Goyder Formation. Non-commercial oil bled from an impermeable zone in the middle Cambrian Jay Creek Limestone. The latter was the first liquid hydrocarbon to be found in the Amadeus Basin. A zone of porosity 1,240 feet thick was penetrated in the Ordovician-?Silurian sandstones and 300 feet of salt was found in the lower Pertaoorrtta Group. Porous sands were found at depth in the Arumbera Formation.

Secondary anhydrite infilling took place in the suspected reef zone and insufficient evidence has been obtained to determine conclusively that a reef facies exists.

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

The Alice No. 1 Well was the second oil exploratory test to be drilled in the Amadeus Basin. It was drilled in Oil Permit No. 43 issued by the Administrator of the Northern Territory of Australia to Magellan Petroleum Corporation. The operation was conducted under farmout arrangements between Magellan Petroleum Corporation and Exoil (N.T.) Pty. Ltd.

The well, situated 17 miles south-east of Alice Springs in a farmout area designated as "Area C", was drilled as a structural and stratigraphic test of Cambrian and Ordovician sediments. The Cambrian sediments revealed a seismically anomalous zone indicative of biohermal development. There was 140 feet of structural closure over the anomalous zone. The well was drilled on the crest of the structure. The main targets were Lower Ordovician and Lower Cambrian sandstones and middle Cambrian bioherms.

W E L L H I S T O R Y

GENERAL DATA:

Well Name and Number: Exoil et al Alice No. 1.

Location: 23°54'47" South, 133°58'00" East (see Fig. 1),
National Grid Sheet F53/14, Alice Springs.

Name and Address of Tenement Holder:

Magellan Petroleum Corporation,
276 Edward Street,
BRISBANE.

Details of Petroleum Tenement: Permit No. 43, Northern
Territory.

Area: 6,950 square miles.

Permission to Drill: Agreement between Exoil
(N.T.) Pty. Ltd. and Magellan Petroleum
Corporation.

District: Alice Springs.

Total Depth: 7,518' Driller; 7,503 Schlumberger.

Date Drilling Commenced: 21st June, 1963.
Date Drilling Completed: 17th September, 1963.
Date Well Abandoned: 23rd September, 1963.
Date Rig Released: 23rd September, 1963.
Drilling Time in days to Total Depth: 90 days.
Elevation: Ground 1,742' a.s.l.; Kelly Bushing, 1,753' a.s.l.
Status: Capped water well.

Cost:

DRILLING DATA:

Name and Address of Drilling Contractor:

Oil Drilling and Exploration Limited,
93 York Street,
SYDNEY. N.S.W.

Drilling Plant:

Make: National
Type: T 32.
Rated Capacity with 4½" drill pipe: 7,000 feet.
Motors (2): G.M.C. Twin Model 471, 225 h.p.

Mast:

Make: Emsco.
Type: Serial 12.
Rated Capacity: 416,000 lbs.

Pumps (2):

Make: National	Emsco
Type: C-250	D-300
Size: 7½" x 15"	7½" x 14"
Motors: National - powered by 1 Twin G.M.C. 671 and 1 Twin G.M.C. 471.	
Emsco - powered by 1 Twin G.M.C. 671.	

Blow-out Preventor Equipment:

Make: Schaffer	Hydril
Model: "B"	G.K.
Size: 12" Series 900	12" Series 900
Working Pressure: 3000 p.s.i.	3000 p.s.i.

Hole Sizes and Depth:

- (1) 17½" hole from surface to 837'
- (2) 12¼" hole from 837' to 2,357'
- (3) 8¾" hole from 2,357' to 7,513'
- (4) 7⁷/₈" hole from 7,513' to 7,518'.

Casing and Cementing Details:

Size:	13 ³ / ₈ "	9 ⁵ / ₈ "
Weight:	48 lbs.	36 lbs.
Grade:	H-40 Jap.	H-40 Jap.
Setting Depth:	829'	2,323'
Cement used:	710 sacks	300 sacks.
Cemented to:	Surface	-
Method used:	Plug - used rig pump.	Plug - used rig pump.

Drilling Fluid:

The mud programme was supervised by J.D. Hodgkinson, toolpusher. A water-base bentonite mud with Spersene and XP20 was used to 6,774 feet where salt beds were encountered. The remainder of the hole to total depth was then drilled with water, it being uneconomical to convert the mud to salt base. Lost circulation problems persisted from 6,392' to total depth.

The average mud properties for the Alice No. 1 Well are listed below:-

Average weight:	9.3 lbs./U.S. gal.
Average Viscosity:	39 sec. (Marsh)
Average Water Loss:	10.6
Average pH:	9.4
Average Sand Content:	0.75%

Hole condition remained good throughout the drilling operation with no trouble being experienced due to caving or sloughing during drilling. Some bridging and caving did occur during final logging, resulting in no logging tool getting to total depth.

A total of 264 hours was lost in fighting lost circulation. Lost circulation zones are tabled below:-

<u>Depth</u>	<u>Operation</u>	<u>Remedy</u>
697'	reaming 17½" hole	Mixed lost circulation material.
706'	drilling 8¾" hole	Set cement plug, 120 sacks.
2,900'	drilling 8¾" hole	Mixed lost circulation material
6,392')		Mixed lost circulation material,
and)	drilling 8¾" hole	set 11 cement plugs totalling
below)		1,280 sacks, added 800 empty beer cans and 14 cubic yards of gravel.

Average Weekly Mud Reports

<u>Week Ended</u>	<u>Depth feet</u>	<u>Weight lbs./ U.S. Gal.</u>	<u>Viscosity (sec.Marsh)</u>	<u>Water Loss (c.c. 30 mins)</u>	<u>pH</u>	<u>Sand Content %</u>
June 22	282	8.7	43	7.2	-	-
	28 830	10.2	50	8.8	8.1	-
July 6	2219	9.2	37	15.6	9.5	2.5
	13 3005	8.9	38	10.4	9.3	0.5
	20 3665	8.9	40	10.0	8.9	0.25
	27 4417	9.2	38	9.0	10.0	0.5
Aug. 3	5339	9.5	40	10.3	9.0	0.5
	10 6015	9.8	41	10.5	10.0	0.25
	17 6171	9.7	37	11.4	10.0	0.25
	24 6392	9.4	39	11.8	10.0	0.75
	31 6399	9.3	40	9.9	11.0	1.0
Sep. 7	6710	9.0	37	12.8	11.0	-
	14 7416	9.3	39	-	-	-
	21 7518	9.9	34	-	-	-

Mud Salinities:

D.S.T. No. 1:	3,481' - 3,530'	-	300 p.p.m.
D.S.T. No. 2:	6,068' - 6,119'	-	450 p.p.m.
D.S.T. No. 3:	6,090' - 6,137'	-	450 p.p.m.
D.S.T. No. 4:	6,371' - 6,392'	-	10,100 p.p.m.
D.S.T. No. 5:	7,205' - 7,518'	-	123,921 p.p.m.
D.S.T. No. 6:	7,285' - 7,518'	-	135,370 p.p.m.
D.S.T. No. 7:	6,549' - 7,205'	-	185,220 p.p.m.
D.S.T. No. 9:	6,544' - 7,141'	-	183,770 p.p.m.

Mud Additives Used:

The following quantities of mud additives were used in the Alice No. 1 Well:-

Gel	195,200 lbs.
Caustic	7,030 lbs.
Spersene	11,050 lbs.
Tannathin	1,050 lbs.
Myrtan	6,470 lbs.
XP 20	4,050 lbs.
C.M.C.	884 lbs.
Driscose	1,312 lbs.

Quebracho	250 lbs.
Bicarb.	2,300 lbs.
Soda Ash	1,122 lbs.
L.C.M.	620 sacks.

Total weight of mud material used was 230,738 pounds plus 620 sacks of L.C.M.

Water Supply:

Water was hauled by truck from a Government Stock Bore six miles east of the wellsite. During the drilling operation the antiquated government pump-jack was replaced by a motor-driven pump-jack. Water supply was at all times adequate, even during periods of lost circulation when large supplies were required over short periods of time.

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Perforation and Shooting Record:

No perforation or shooting was required on the well operation.

Plugging Back and Squeeze Cementation Jobs:

No squeeze jobs were carried out. In plugging the well seven plugs were set at depth intervals listed below. The top plug was set in 9⁵/₈" casing. The 13³/₈" casing was formed on to the 9⁵/₈" casing a few feet below ground level and a cap welded on top of the 9⁵/₈" casing bearing the inscription "Exoil Alice No. 1 7518'".

Plug No.	Depth	Sacks Cement
1	7,205' - 7,300'	50
1A	7,141' - 7,205'	50
2	6,500' - 6,600'	35
3	6,200' - 6,300'	35
4	5,900' - 6,000'	35
5	2,280' - 2,380'	50
5A	2,150' - 2,280'	40

A total of 295 sacks of cement was used to plug the Alice No. 1 Well.

Fishing Operations:

Seven fishing jobs were required in the Alice No. 1 Well. They are listed below:-

1. 457' - twisted off six drill-collars. Recovered. first trip with overshot.

2. 554' - twisted off six drill-collars. Recovered first trip with overshot.
3. 2,377' - twisted off seven drill-collars. Survey barrel lodged beside collars. Recovered collars first trip with overshot. Recovered survey barrel first trip with modified core basket.
4. 2,584' - twisted off four drill-collars. Recovered first trip with overshot.
5. 2,354' - lost one 12¼" reamer cutter. Recovered third trip with magnet.
6. 2,253' - twisted off top joint of drill pipe above drill-collars. Recovered first trip with overshot.
7. 7,320' - lost Schlumberger Gamma-Ray sonde. Recovered first trip with core-basket.

Time lost on fishing operations represented 1.8% of the total time to drill the well.

Side-tracked Hole:

The hole was not side-tracked.

Logging and Testing:

Ditch Cuttings:

Ditch cuttings were collected at 10 foot intervals during drilling from surface to 3,520 feet and at 5 foot intervals from 3,520 feet to total depth. Four cuts of samples were collected - one for the Bureau of Mineral Resources, Canberra; one for the Bureau of Mineral Resources, Alice Springs; one for Magellan Petroleum Corporation and one set for Exoil (N.T. Pty. Ltd. Samples were corrected for lag time.

Coring: The following cores were taken:-

Core No.	Core Depth.	Amount		% Recovered
		Cored	Recovered	
1	520' - 530'	10'	10'	100
2	820' - 830'	10'	10'	100
3	1,124' - 1,131'	7'	4'8"	67
4	1,428' - 1,438'	10'	6'4"	63
5	1,760' - 1,770'	10'	7'2"	72
6	2,153' - 2,163'	10'	10'	100

(Contd.)

Coring (Contd.)

Core No.	Core Depth.	Cored	Amount Recovered	% Recovered.
7	2,710' - 2,716'	6'	3'4"	56
8	2,977' - 2,982'	5'	1'6"	30
9	3,125' - 3,130'	5'	4'6"	90
10	3,410' - 3,415'	5'	4'	80
11	3,573' - 3,596'	23'	22'5"	98
12	3,885' - 3,891'	6'	5'6"	92
13	4,157' - 4,159'	2'	nil	0
14	4,191' - 4,196'	5'	2'9"	55
15	4,525' - 4,530'	5'	4'	80
16	4,843' - 4,850'	7'	5'	71
17	5,165' - 5,174'	9'	9'	100
18	5,449' - 5,456'	7'	7'	100
19	5,723' - 5,728'	5'	5'	100
20	6,062' - 6,066'	4'	4'	100
21	6,096' - 6,101'	5'	3'2"	63
22	6,116' - 6,119'	3'	3'	100
23	6,119' - 6,137'	18'	16'	89
24	6,443' - 6,446'	3'	2'8"	92
25	6,758' - 6,764'	6'	5'3"	88
26	6,876' - 6,898'	22'	9'7"	43
27	7,305' - 7,307'	2'	2'	100
28	7,513' - 7,518'	5'	3'	60

Total footage cored 215'
 Total footage recovered 170'10"
 % recovered 83%.

The coring interval was to be approximately 300 feet, at convenient bit-change depths, and when hydro-carbon shows or porosity were encountered. In the Pacoota, the interval was extended to 500 feet while drilling a monotonous sand-shale sequence.

Coring equipment consisted of a Hughes 20' Type "J" barrel and Hughes Tool Co. conventional hard formation and soft formation core-heads cutting a 3½" diameter core; also, a 60' core-barrel with 8¹¹/₁₆" diamond core-head was used.

Details of the cores are given in Appendix "A". A 4" sample from each 2' interval was forwarded to the Bureau of Mineral Resources, Canberra. The remaining cores were delivered to the Resident Geologist of the B.M.R. at Alice Springs.

Side-wall Sampling:

No side-wall samples were taken.

Electrical and Other Logs:

The following logs were run:-

Schlumberger Electrical Log	827' - 4,118'
" Micro-Caliper Log	827' - 4,116'
" Laterolog	3,400' - 7,498'
" Microlaterolog	3,400' - 7,490'
" Gamma Ray Log	10' - 6,932'
" Sonic Log	828' - 6,812'

Logs were run on scales of 2" = 100' and 5" = 100'. Copies of the complete logs are held at the Bureau of Mineral Resources, Canberra, and are available for inspection.

Drilling Time and Gas Log:

One-foot drilling times were recorded on a Geolograph while drilling.

Mud logging was done by Core Laboratories using a one-man unit, aided by the wellsite geologist. Two Core Laboratories engineers were employed on a continuous basis while drilling the Jay Creek and Arumbera.

Five foot drilling times and gas detector readings are recorded on the composite log. Fig. 2 shows the time-depth graph.

Formation Testing:

Nine formation tests were run on the Alice No. 1 Well.

D.S.T. No. 1 - Interval 3,481' - 3,530'.

Choke: top - open; bottom $\frac{5}{8}$ "

Pressure: Initial Hydrostatic 1660 p.s.i.
Initial Shutin 1795-1610 p.s.i.
Initial Flow 185 p.s.i.
Final Flow 340 p.s.i.
Final Hydrostatic 1680 p.s.i.

Pressure Chart: Fig. 5

Blow: Good air blow steady throughout test.

Fluid Recovery: 570' of muddy fresh water. Chloride 300 p.p.m.

Comments: Test mechanically successful. ISIP drop may be due to squeeze pressure below packer being greater than formation pressure, forcing mud out into formation.

D.S.T. No. 2 - Interval 6,068' - 6,119'

Choke: top - open; bottom $\frac{5}{8}$ "

Pressure: Initial Hydrostatic 3075 p.s.i.

Initial Shutin	3220 p.s.i. squeeze
Initial Flow	110 p.s.i.
Final Flow	110 p.s.i.
Final Hydrostatic	3075 p.s.i.

Pressure Chart: Fig. 6

Blow: Fair initial puff, weak, dying to zero in 42 minutes.

Fluid Recovery: 100' drilling mud. Chlorides \pm 450 p.p.m.

Comments: Test mechanically successful. Formation impermeable. ISIP is false, only squeeze pressure is recorded indicating main valve opened on trip in.

D.S.T. No. 3 - Interval 6,090' - 6,137'

Choke: top - open; bottom $5/8$ "

Pressure:	Initial Hydrostatic	3115 p.s.i.
	Initial Shutin	-
	Initial Flow	90 p.s.i.
	Final Flow	90 p.s.i.
	Final Hydrostatic	3115 p.s.i.

Pressure Chart: Fig. 7

Blow: faint air blow dying to zero in 10 minutes.

Fluid Recovery: 60' dead mud.

Comments: Test mechanically successful. Main valve opened on trip in hole. Impermeable formation indicated.

D.S.T. No. 4 - Interval 6,371' - 6,392'

Choke: top - open; bottom $5/8$ "

Pressure:	Initial Hydrostatic	2700 p.s.i.
	Initial Flow	1820 p.s.i.
	Final Flow	2685 p.s.i.
	Final Hydrostatic	2715 p.s.i.

Pressure Chart: Fig. 8.

Blow: Strong air blow decreasing slightly throughout test.

Fluid Recovery: 5,897' watery mud and salt water.

Comments: A Halliburton "T.C." valve was used in place of a disk valve. It was inadvertently run in in the open position, hence no initial shut-in. Unable to close "T.C." valve for final shut-in. Test successful in evaluating formation.

D.S.T. No. 5 - Interval 7,205' - 7,518'

Choke: top - open; bottom $5/8$ "

Pressure: Initial Hydrostatic 3712 p.s.i.
Initial Flow 2487 p.s.i.
Final Flow 2780 p.s.i.
Final Hydrostatic 3405 p.s.i.

Pressure Chart: Fig. 9

Blow: Strong air blow, steady, decreasing slightly throughout test.

Fluid Recovery: 5,000' drilling fluid and salt water.

Comments: "T.C." valve mechanically inoperative, thus no shut-in pressures were taken. Main valve opened while running in hole, allowing fluid into pipe. No indications of hydrocarbons were found.

D.S.T. No. 6 - Interval 7,285' - 7,518'

Choke: top - open; bottom $\frac{3}{8}$ "

Pressure: Initial Hydrostatic 3740 p.s.i.
Initial Flow 1267 p.s.i.
Final Flow 2205 p.s.i.
Final Shut-in 2655 p.s.i.
Final Hydrostatic 3445 p.s.i.

Pressure Chart: Fig. 10.

Blow: good air blow steady throughout test

Fluid Recovery: 3,760' salt water drilling fluid and salt water.

Comments: Test mechanically successful. Rapid pressure build-up during flow and final shut-in indicate good porosity. No indications of oil or gas.

D.S.T. No. 7 - Interval 6,549' - 7,205'

Choke: top - open; bottom $\frac{5}{8}$ "

Pressure: Initial Hydrostatic 3725 p.s.i.
Final Hydrostatic 3512 p.s.i.

Pressure Chart: Fig. 11.

Blow: weak initial puff increasing to good air blow steady through test.

Fluid Recovery: 4,990' salt water drilling fluid and salt water.

Comments: Test was run to evaluate 4' of Microlaterolog porosity and small gas show. Misrun: disk-valve failed to break. Blow caused by cutting out of disk and disk sub.

D.S.T. No. 8 - Interval 6,533' - 7,205'

Choke: top - open; bottom $\frac{5}{8}$ ".

Pressure: Initial Hydrostatic 3645 p.s.i.
 Initial Flow 1530 p.s.i.
 Final Hydrostatic 3340 p.s.i.

Pressure Chart: Fig. 12.

Blow: weak initial puff increasing to strong, steady throughout test.

Fluid Recovery: 100' salt water drilling fluid.

Comments: Disk-valve damaged, was not run. Packer held initially then skidded 5' into cement plug. Difference between I.H.P. and F.H.P. due to hole taking mud during test.

D.S.T. No. 9 - Interval 6,455' - 7,141'

Choke: top - open; bottom $\frac{5}{8}$ "

Pressure: Initial Hydrostatic 3645 p.s.i.
 Initial Flow 2540 p.s.i.
 Final Flow 2645 p.s.i.
 Final Hydrostatic 3180 p.s.i.

Pressure: Fig. 13

Blow: No initial blow then weak blow increasing to very strong.

Comments: "T.C." valve inadvertently run in "open" position. Unable to close during test. Main valve was plugged with sand and lost circulation material, then began clearing itself, the main valve washing out. High flow pressures are due to only partial clearing of main valve. No indications of oil or gas.

Deviation Surveys:

Deviation surveys were run before trips using a Lane Wells instrument dropped down the drill pipe and recovered during bit changes. Deviation readings are tabled below:-

100'	$\frac{1}{8}^\circ$	2,318'	$1\frac{1}{2}^\circ$	4,525'	6°
180'	$\frac{1}{2}^\circ$	3,000'	3°	4,670'	6°
239'	0°	3,110'	$3\frac{1}{4}^\circ$	4,833'	6°
415'	$\frac{1}{2}^\circ$	3,260'	$4\frac{3}{4}^\circ$	5,300'	$5\frac{3}{4}^\circ$
485'	$\frac{1}{2}^\circ$	3,410'	$4\frac{7}{8}^\circ$	5,439'	6°
660'	1°	3,530'	$5\frac{3}{4}^\circ$	5,575'	6°
685'	$\frac{3}{4}^\circ$	3,470'	$5\frac{1}{4}^\circ$	5,720'	$5\frac{1}{2}^\circ$

820'	$\frac{1}{4}^{\circ}$	3,785'	5°	5,828'	$5\frac{1}{2}^{\circ}$
1,120'	$\frac{1}{2}^{\circ}$	3,880'	$5\frac{1}{2}^{\circ}$	6,062'	$5\frac{1}{2}^{\circ}$
1,430'	1°	3,960'	$5\frac{1}{4}^{\circ}$	6,166'	$5\frac{1}{2}^{\circ}$
1,485'	1°	4,000'	$5\frac{1}{4}^{\circ}$	6,280'	5°
1,760'	1°	4,125'	5°	6,360'	$5\frac{1}{2}^{\circ}$
2,100'	misrun	4,155'	5°	6,644'	$6\frac{3}{4}^{\circ}$
2,150'	$1\frac{3}{4}^{\circ}$	4,180'	$4\frac{3}{4}^{\circ}$	6,750'	$6\frac{1}{2}^{\circ}$
2,235'	2°	4,415'	$4\frac{3}{4}^{\circ}$	6,870'	$6\frac{3}{4}^{\circ}$
				7,300'	$6\frac{1}{2}^{\circ}$

Temperature Surveys:

No temperature surveys were run.

Drilling Observations:

Fig. 2 shows average drilling time plotted against drilling depth. 2,260 $\frac{1}{4}$ hours were required to drill the Alice No. 1 Well, from spudding to rig release.

Seventeen coreheads were used to core 215 feet for an average of 12.6 feet per corehead. 210 hours, or 10.8% of total time, were used in coring operations. Coring costs are estimated at £9,390, or nearly £5 an inch for cores.

Fifty-seven drill bits were used to drill 7,518 feet of hole (including reaming core hole for intermediate casing) for an average of 132 feet per bit. The overall average penetration rate for the hole was 6.2 feet per hour. A total of 102 $\frac{1}{2}$ hours was used to ream the hole for surface and intermediate casing.

G E O L O G Y

PREVIOUS WORK

Geological:

Surface geological mapping on a regional scale has been carried out in the Amadeus Basin by the Bureau of Mineral Resources, Frome-Broken Hill Co. Pty. Ltd. and Magellan Petroleum Corporation. The structure on which the Alice No. 1 Well was drilled is not a surface feature.

Geophysical:

A semi-regional gravity survey was conducted over the area by Century Geophysical Corporation for Magellan Petroleum Corporation in 1961. Regional seismic lines by the Bureau of Mineral Resources pass east and west of the prospect. The gravity survey showed a gravity minimum, suggesting a salt anticline and further seismic surveys in 1962 and 1963 by Exoil delineated an area of about