MAGELLAN PETROLEUM AUSTRALIA LIMITED

PALM VALLEY No. 6, A, B

P.L. 3 NORTHERN TERRITORY

WELL COMPLETION REPORT

BY

R. Do ROZARIO
M. BERRY

JULY 1986

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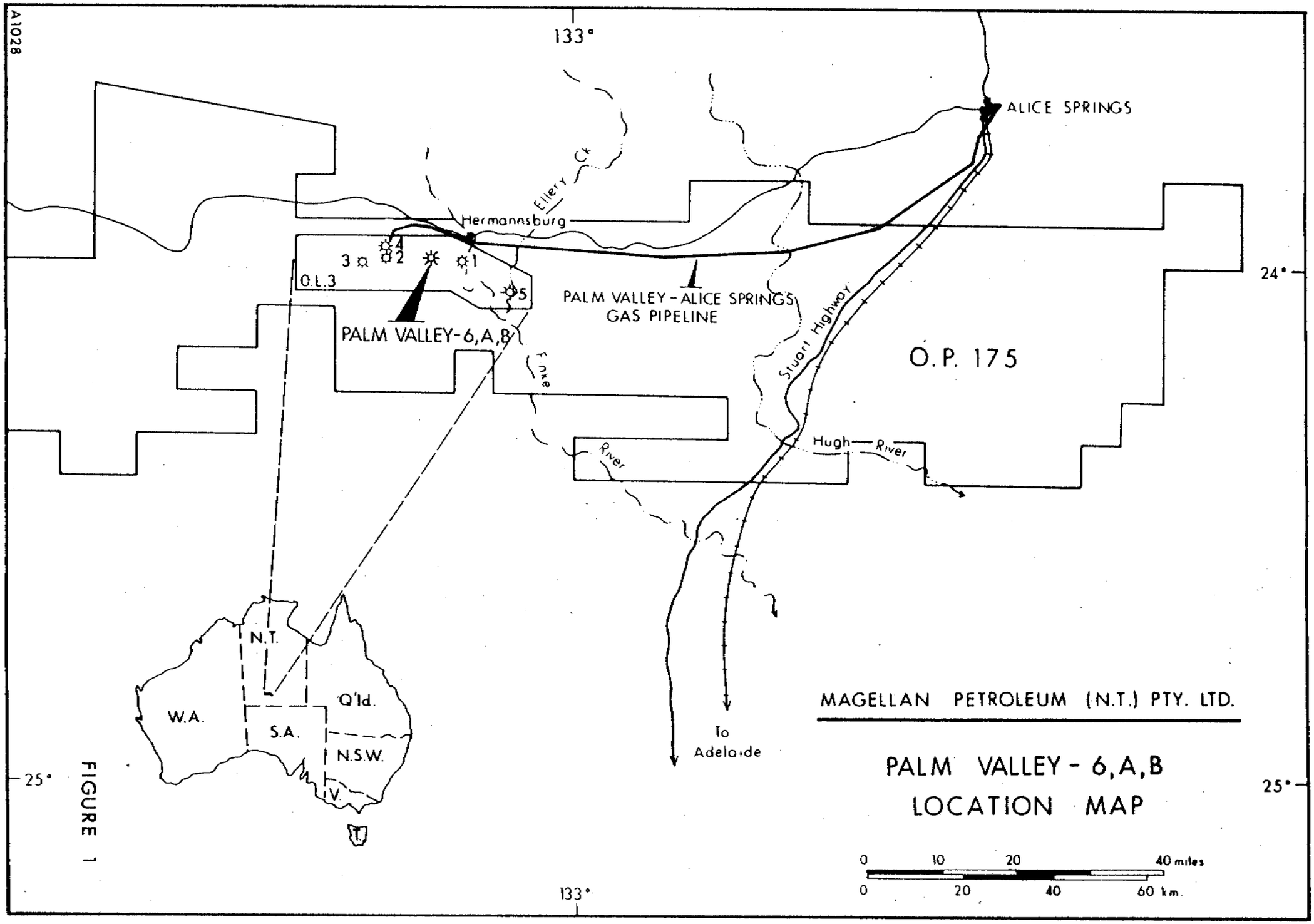
A1028
133°
ALICE SPRINGS
Ellery Ck
Hermannsburg
3
4
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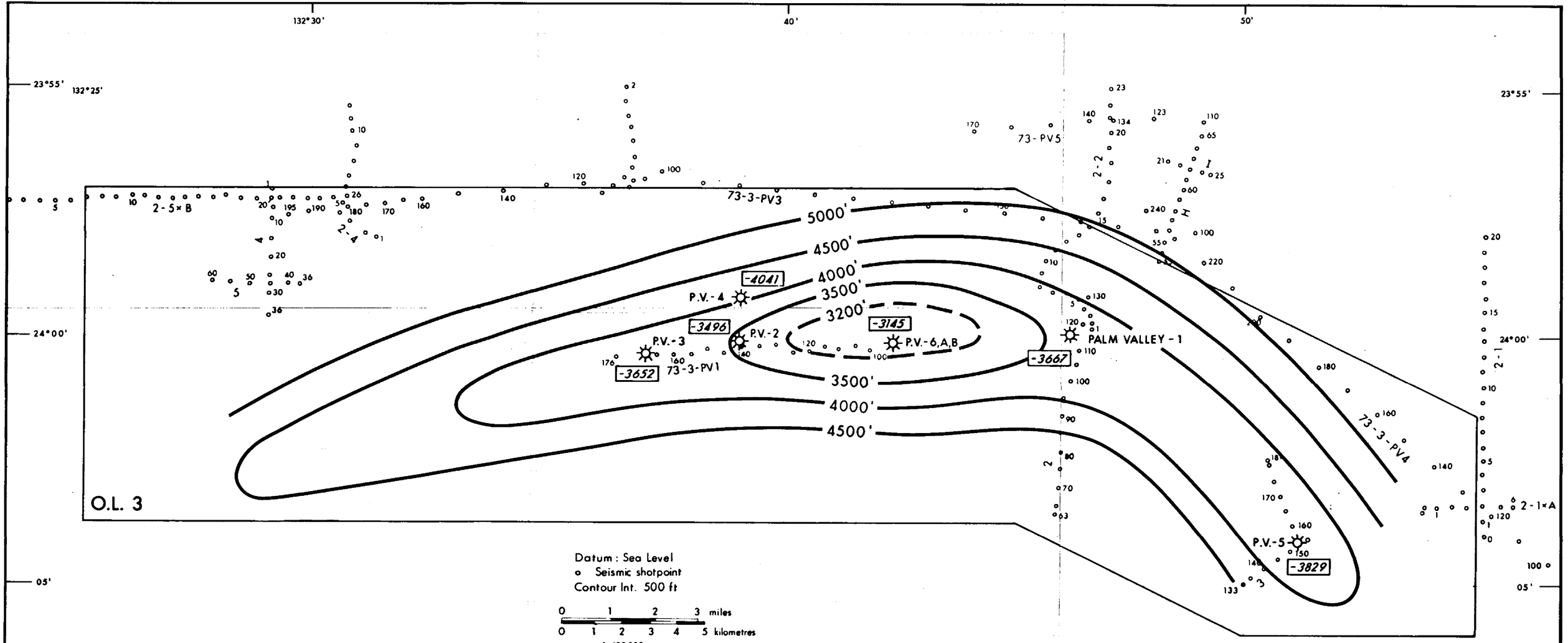
PALM VALLEY-6,A,B
PALM VALLEY - ALICE SPRINGS GAS PIPELINE
Finke River
Stuart Highway
O.P. 175
Hugh River
24°
25°
N.T.
W.A.
S.A.
Q'ld.
N.S.W.
V.
T
To Adelaide
MAGELLAN PETROLEUM (N.T.) PTY. LTD.
PALM VALLEY - 6,A,B
LOCATION MAP
0 10 20 40 miles
0 20 40 60 km.
133°

FIGURE 1



PALM VALLEY FIELD
TOP PACOOTA STRUCTURE CONTOURS

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

APRIL, 1986 - L.Roe

FIGURE 2

C 7058

1. INTRODUCTION

The Palm Valley gas field lies approximately 120 kilometers southwest of Alice Springs, Northern Territory, in the northern central part of the Amadeus Basin (Figure 1), and was first discovered in 1965 when Palm Valley No. 1 tested up to 11.7 MMCFGD from Ordovician sediments. Four further wells were drilled, Palm Valley No's 2 (1970) and 3 (1973), located along the axis of the anticline, Palm Valley No. 4 (1984/85), located on the northern flank, and Palm Valley No. 5 (1985) located down the south eastern plunge of the field's axis. These yielded respective flow rates of up to 69.7 MMCFGD, 3.0 MMCFGD, 1.5 MMCFGD, and at a rate too small to measure.

Gas is contained primarily within low porosity sandstones of the Ordovician Pacoota and Stairway Formations, and interference tests carried out in 1974 confirmed the presence of an extensive fracture system contributing to reservoir producibility.

Palm Valley No. 6 was the sixth well drilled by Magellan Petroleum Australia Ltd. on the field, and was located in a crestal position along the axis of the anticline, 5.7 kilometres east of Palm Valley No. 2. The objectives of the well were to increase gas deliverability from the field, and provide additional data on reservoir parameters and potential hydrocarbon reserves.

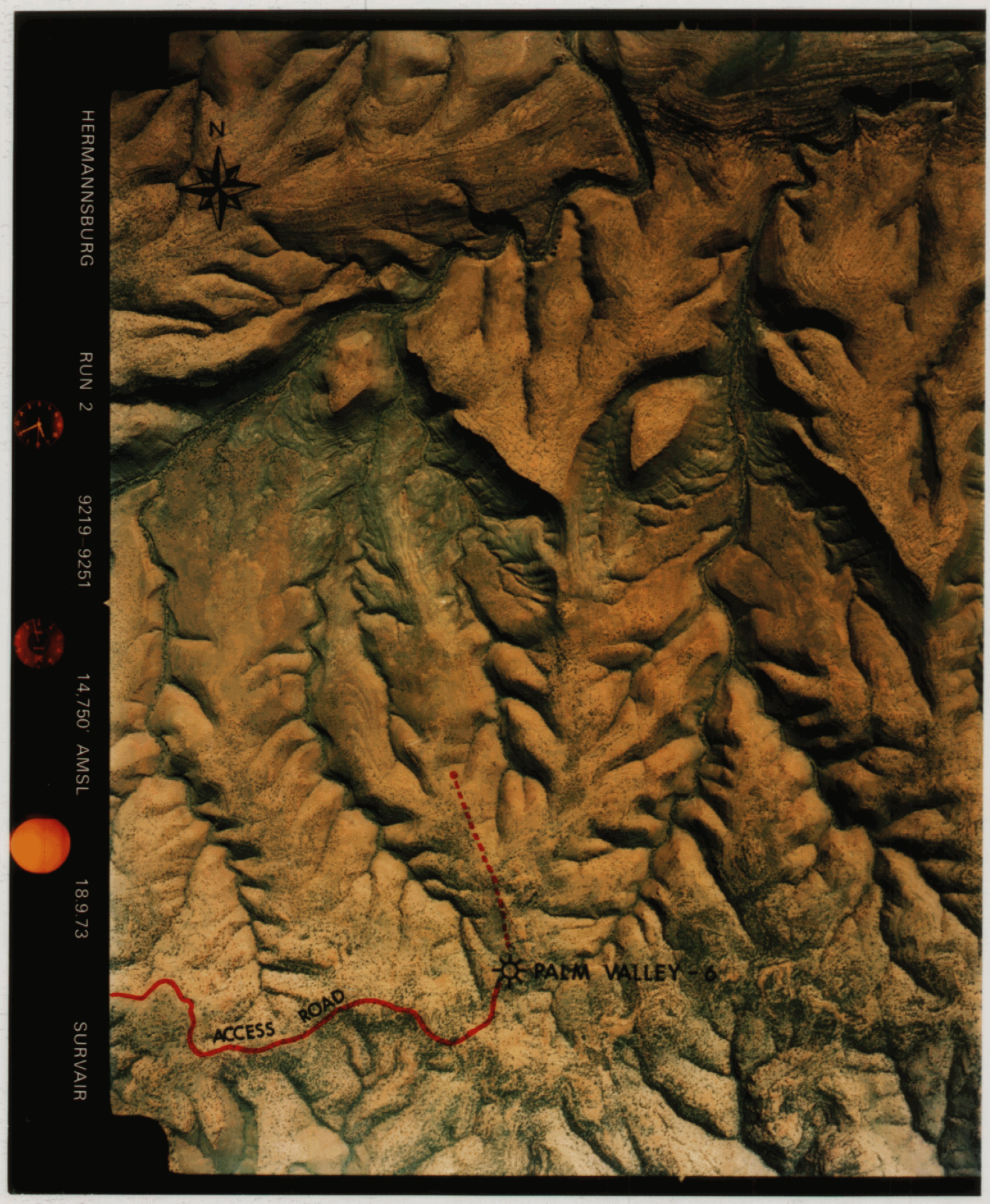
The well was spudded on November 7th 1985, using Haffner Pty. Ltd. Mereenie Rig 1, and was drilled with air to a total depth of 2347.0 metres (7700 feet) on December 12th 1985. A maximum flow rate of 1.82 MMCFGD was encountered from this vertical hole. The

1. **INTRODUCTION** cont'd

well was then plugged back to 1262.2 metres (4141 feet) and deviated as Palm Valley No. 6A, in an attempt to better intersect the northeast-southwest trending major fractures which are well developed along the central axis of the anticline. However, by 1749.9 metres (5741 feet) in the Lower Stairway Sandstone, the hole inclination had reached only 9-1/4°, insufficient to attain the proposed minimum angle of 45° required at the top Pacoota structural level. After reaching a total depth of 1779.7 metres (5839 feet), in the Horn Valley Siltstone, the well was plugged back a second time to 1373.7 metres (4507 feet), and deviated again as Palm Valley No. 6B, in order to obtain the required deviation buildup. This second deviation was successful, and a total depth of 2005.9 metres (6581 feet), in the Pacoota Sandstone 'P1' unit, was reached on January 8th, 1986. Final deviation was 48.75°, providing a horizontal displacement of 361.6 metres (1186.4 feet) at an orientation north 15.77° west of the surface location. (From HOFCO computations).

This deviation also achieved the desired result of intersecting a more strongly fractured zone, and substantially increased gas flows were encountered in both the Lower Stairway Sandstone (12.1 MMCFGD at 1798.6 metres (5901 feet)), and Pacoota Sandstone 'P1' Unit, (maximum flow of 137 MMCFGD at 1983.6 metres (6508 feet)).

Palm Valley No. 6B was completed as a shut-in gas well from the Pacoota Sandstone P1 Unit, and the rig released on January 17th, 1986, a total of 72 days from spud.



AERIAL PHOTOGRAPH

SHOWING

SURFACE LOCATION OF PALM VALLEY - 6

AND

RELATIVE POSITION OF P.V. - 6B AT 6581'

0 200 600 1000 metres

FIGURE 3

2. SUMMARY

2.1 Drilling

Palm Valley No. 6 was spudded at 0200 hours on November 7th 1985, using an O.I.M.E. SL-5 rotary drilling rig (Haffner Pty. Ltd. - Mereenie Rig No. 1). After setting 20" conductor pipe at 18.0 metres (59 feet), a 17-1/2" hole was air-hammer drilled to 167.6 metres (550 feet). 13-3/8" casing was subsequently run and set at 167.3 metres (549 feet).

A 12-1/4" hole was then air drilled to 1244.8 metres (4084 feet). Wireline logs were then run prior to running 9-5/8" casing, which was set at 1243.7 metres (4080.54 feet).

An 8-1/2" hole was then air drilled to 2163.8 metres (7099 feet). At this depth the hole was displaced with KCL-Baracarb mud, in order to free pipe that had become stuck at 2154.3 metres (7068 feet) while reaming back to bottom. Mud drilling then continued to 2178.7 metres (7148 feet), where the hole was displaced with air, and air drilled until a total depth of 2347.0 metres (7700 feet) was reached on December 12th 1985. The hole was then displaced with a KCL-Baracarb mud, and wireline logs were run.

Three cement plugs were then set in place, with tops at 2013.2 metres (6605 feet), 1624.6 metres (5330 feet), and 1243.6 metres (4080 feet), the top plug being finally dressed to 1262.2 metres (4141 feet).

2.1 **Drilling** cont'd

The well was then side-tracked as Palm Valley No. 6A, initially with mud, using a dyna-drill to a depth of 1347.8 metres (4422 feet). Below this depth the hole was air-drilled using both a conventional build-up assembly, and a dyna-drill, until a total depth of 1779.7 metres (5839 feet) was reached on December 23rd 1985.

A 91.4 metre (300 feet) cement plug was then set in place with a top at 1373.7 metres (4507 feet).

The well was then side-tracked a second time as Palm Valley No. 6B, initially with mud, using both a dyna-drill and a conventional build-up assembly. Air drilling continued from below 1492.3 metres (4896 feet) using a conventional build up assembly, until 1983.6 metres (6508 feet), where a large gas flow was encountered.

The hole was then displaced with water followed by mud, however difficulty was experienced in reducing gas cutting of the mud to acceptable safety levels. A total of 900 bbls of mud were lost to the formation before the well was stabilised. The well was finally mud drilled to a total depth of 2005.9 metres (6581 feet), reached on January 8th 1986, 63 days after spud.

Final wireline logs were then run prior to running the 7" production casing, which was set and cemented at 2005.9 metres (6581 feet).

2.1 **Drilling** cont'd

After cleaning out the casing, the hole was displaced with KCL-corrosion inhibited completion fluid, and 2-7/8" production tubing run. The 7" casing was then perforated with tubing conveyed Schlumberger guns, and the well flow tested through a 3" orifice plate.

The rig was finally released at 1600 hours on January 17th 1986, 72 days from spud-in.

2.2 **Geology**

Palm Valley No. 6 was drilled to increase gas deliverability from the Palm Valley Gas Field, as well as providing additional data on reservoir parameters and potential hydrocarbon reserves. The field is located in the northern central part of the Amadeus Basin (Figure 1), and encompasses an area of approximately 195 square kilometres (75.3 square miles) at a top Pacoota Sandstone closing contour level of 1304.5 metres (4280 feet) sub-sea.

The structural configuration of the field is of an asymetric arcuate anticline with steeper dips on the northern flank (Figure 2). Whilst only limited seismic work has been done because of rough terrain, the axis of the doubly plunging anticline can be traced from surface geology over at least 40 kilometers. Palm Valley No's. 1, 2, 3, and 5 were drilled along the structural axis of the field, whereas Palm Valley No. 4 was located on the northern flank, 1.6 kilometers from Palm Valley No. 2. Palm Valley No. 6 was located in a crestal position along the structural axis of the field, 5.7 kilometers east of Palm Valley No. 2.

2.2 **Geology** cont'd

The stratigraphy encountered was very similar to that of Palm Valley No's. 1, 2, 3, 4, and 5, with the well spudding in the outcropping late Devonian Hermannsburg Sandstone of the Pertnjara Group, and drilling through a sequence of sandstones, siltstones, minor shales and carbonates to the Lower Pacoota Sandstones of the Early Ordovician Larapinta Group.

Formation gas was first noted in Palm Valley No. 6 in the Middle Stairway Sandstone, where minor peaks were observed on the total gas detector after connections. This increased through the Lower Stairway Sandstone, with gas flaring at connections below approximately 1722.1 metres (5650 feet). At 1755.3 metres (5759 feet), just below the base of the formation, a flow rate of 69,000 CFGD was measured through a 1/4" choke, however, no additional influx was observed while drilling through the Horn Valley Siltstone and Pacoota Sandstone 'P1' Unit. At 2088.5 metres (6852 feet), in the lower Pacoota 'P2' Unit, a significant increase in flow to 1.3 MMCFGD was measured, followed by a further increase to 1.82 MMCFGD at 2144.6 metres (7036 feet), just below the top of the Pacoota 'P3' Unit. Below this depth, the gas flow stabilised at 1.58 MMCFGD, with no measurable change down to the well's total depth of 2347.0 metres (7700 feet), in the top of the Pacoota 'P4' Unit.

The first side-tracked hole, Palm Valley No. 6A, was deviated from a depth of 1262.2 metres (4141 feet), in the Stokes Siltstone, to a depth of 1779.7 metres (5839 feet), only 21.6 metres (71 feet) into the Horn Valley Siltstone. Formation

2.2 Geology cont'd

gas was detected throughout this section as gas peaks on the total gas detector, and as flares after trips and connections. A measurable gas flow of 58,000 CFD was recorded at the base of the Lower Stairway Sandstone, however, this was slightly less than in the vertical hole.

The second side-tracked hole, Palm Valley No. 6B, was deviated from a depth of 1373.7 metres (4507 feet), in the Lower Stokes Siltstone, with gas being detected initially as peaks on the total gas detector followed later by flares, after trips and connections. The first significant flow was encountered at 1782.8 metres (5849 feet) in the Lower Stairway Sandstone, with a rate of 2.1 MMCFGD. This increased substantially towards the base of the Lower Stairway, and a flow rate of 12.1 MMCFGD was measured at 1798.6 metres (5901 feet).

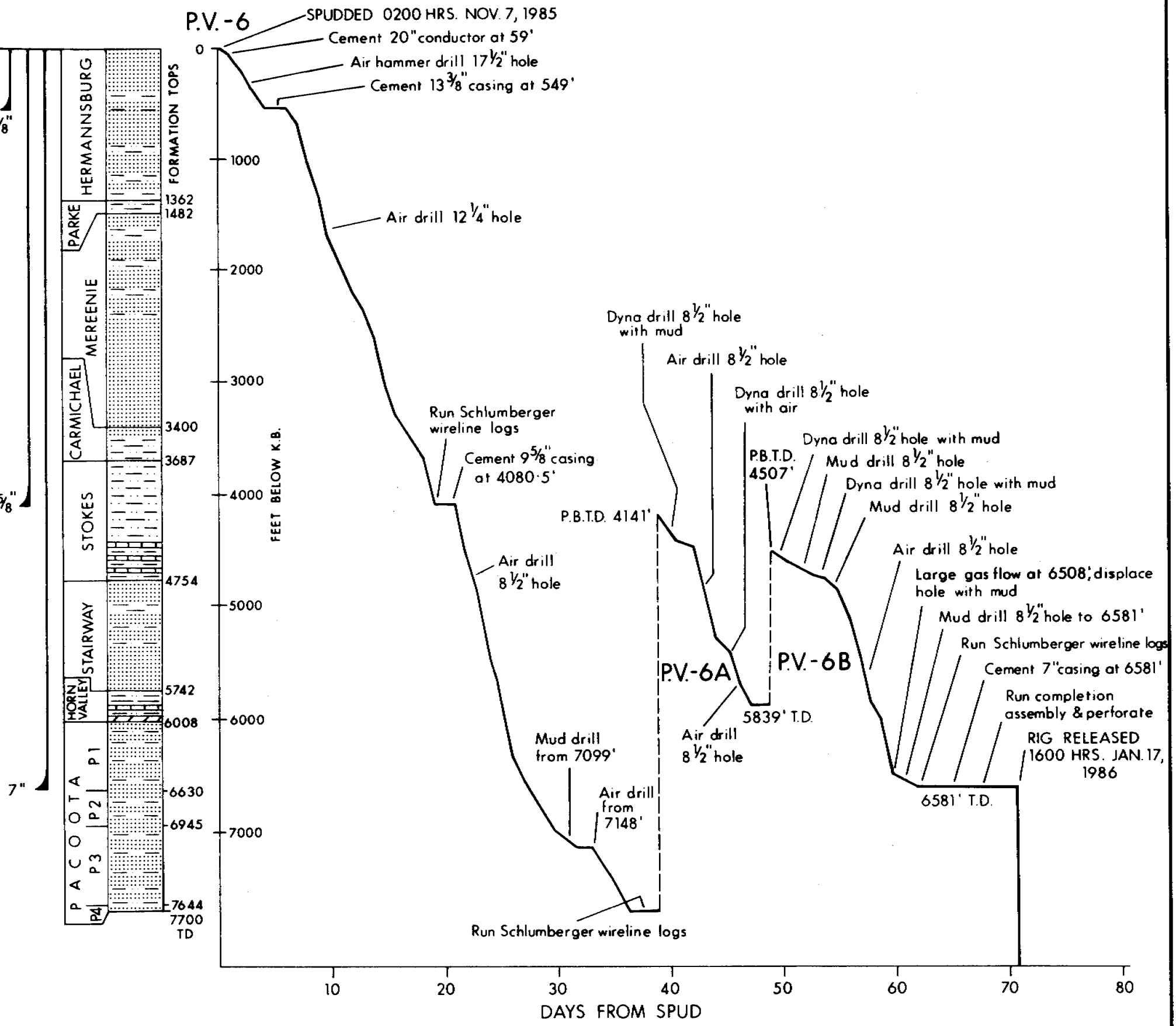
No further gas influxes occurred while drilling through the Horn Valley Siltstone and top Pacoota 'P1' unit, and subsequent tests indicated that the flow rate had stabilised at 7.7 MMCFGD, most likely due to drawdown.

At 1983.6 metres (6508 feet), however, in the upper Pacoota 'P1' unit, a substantial increase in gas flow was encountered requiring immediate killing of the well. The measured rate through a 3" flare line was approximately 137 MMCFGD, surpassing the fields previous best flow rate of 69.7 MMCFGD from Palm Valley No. 2 in 1970. Wireline logs run over this

2.2 **Geology** cont'd

zone show a heavily fractured 2.1 metres (7 feet) thick sand (TVD) below 1983.6 metres (6508 feet).

No further gas influxes were apparent while mud drilling below 1983.6 metres (6508 feet) to the well's total depth of 2005.9 metres (6581 feet), in the upper Pacoota 'P1' unit.



PALM VALLEY - 6, 6A, 6B

TIME / DEPTH GRAPH

FIGURE 4

3. WELL HISTORY

3.1 General Data

Well Name and Number:	Palm Valley No. 6, 6A and 6B.	
Operator:	Magellan Petroleum (N.T.) Pty. Ltd. 8th Floor, National Australia Bank Building 420 George Street, BRISBANE 4000	
Tenement Holders:	Magellan Petroleum (N.T.) Pty. Ltd	50.775%
	Canso Resources Limited	15.375%
	Farmout Drillers N.L.	9.375%
	C.D. Resources Pty. Ltd	9.375%
	Southern Alloys Venture Pty. Ltd.	6.100%
	International Oil Proprietary	3.504%
	Pancontinental Petroleum Limited	3.000%
	I.E.D.C. Australia Pty. Limited	1.248%
	Amadeus Oil N.L.	1.248%
Beneficial Interest Holders:	Magellan Petroleum Australia Limited	50.775%
	Flinders Petroleum N.L.	24.750%
	Charles Davis Limited	9.375%
	Australian Industry Development Corp.	6.100%
	The Moonie Oil Co. Limited	3.504%
	Pancontinental Petroleum Limited	3.000%
	I.E.D.C. Australia Pty Limited	1.248%
	Amadeus Oil N.L.	1.248%
Supervision:	Operations Manager: D. Benbow Wellsite Geologists: R. Do Rozario M. Berry J. Deckelman G. Norton Reservoir Engineer: L. Franks Drilling Supervisors: W. Steblyk C. Davidson	
Petroleum Title:	Petroleum Lease No. 3, Northern Territory	
District:	Henbury, Northern Territory.	
Location:	Palm Valley Field, Amadeus Basin, Northern Territory.	
Seismic Location:	874 mtrs N 80.86° E of SP 100, Line 73-3-PV1	
Geographical Co-Ordinates:	Latitude: 24° 00' 10.0839" South Longitude: 132° 42' 20.3815" East	
Australian Map Grid (A.M.G.) Co-Ordinates:	E: 266 602.554 N: 7 343 552.568	

3. WELL HISTORY

3.1 General Data cont'd

Elevation:	Ground Level:	866.670 metres (surveyed) (2843.4 feet) A.M.S.L.
	Kelly Bushing:	872.766 metres (2863.4 feet) A.M.S.L.
Total Depth:		Palm Valley No. 6 2347.0 metres (7700 feet) (Driller) 2347.6 metres (7702 feet) (Logger) Palm Valley No. 6A 1779.7 metres (5839 feet) (Driller) Palm Valley No. 6B 2005.9 metres (6581 feet) (Driller) 2004.7 metres (6577 feet) (Logger)
Plug Back Depth:		Palm Valley No. 6 1262.2 metres (4141 feet) Palm Valley No. 6A 1373.7 metres (4507 feet) Palm Valley No. 6B (Top Cement) 1992.8 metres (6538 feet)
Drilling Commenced:		Palm Valley No. 6 02.00 hours, November 7, 1985. Palm Valley No. 6A 20.30 hours, December 15, 1985. Palm Valley No. 6B 22.30 hours, December 25, 1985.
Total Depth Reached:		Palm Valley No. 6 24.00 hours, December 12, 1985. Palm Valley No. 6A 14.00 hours, December 23, 1985. Palm Valley No. 6B 13.00 hours, January 8, 1986.
Rig Released:		16.00 hours, January 17th, 1986.
Total Drilling Time:		72 days.
Well Status (PV-6B):		Completed as a shut-in gas well.
Total Cost:		$3,174,244

3. WELL HISTORY

3.1 General Data cont'd

Geological Formation Tops. Measured Depths from R.K.B.:

PALM VALLEY No. 6

	METRES	FEET
Hermannsburg Sandstone	Surface	Surface
Parke Siltstone	415.1	1362
Mereenie Sandstone	451.7	1482
Carmichael Sandstone	1036.3	3400
Stokes Siltstone	1123.8	3687
Upper Stairway Sandstone	1449.0	4754
Middle Stairway Sandstone	1473.4	4834
Lower Stairway Sandstone	1658.7	5442
Horn Valley Siltstone	1750.2	5742
Pacoota Sandstone P1 Unit	1831.2	6008
P2 Unit	2020.8	6630
P3 Unit	2116.8	6945
P4 Unit	2329.9	7644

PALM VALLEY No. 6A

	METRES	FEET
Upper Stairway Sandstone	1452.4	4765
Middle Stairway Sandstone	1477.4	4847
Lower Stairway Sandstone	1664.8	5462
Horn Valley Siltstone	1757.8	5767

PALM VALLEY No. 6B

Upper Stairway Sandstone	1453.0	4767
Middle Stairway Sandstone	1478.9	4852
Lower Stairway Sandstone	1688.3	5539
Horn Valley Siltstone	1805.6	5924
Pacoota Sandstone P1 Unit	1919.6	6298

3.2 Drilling Data

3.2.1 Rig Data

Drilling Contractor: Haffner Pty. Ltd.
21st Floor
12 Creek Street
BRISBANE 4000

Drilling Plant: Draw works: 'OIME' Model SL-5, with 'PARMAC' Model 342 hydromatic brake, and air operated make-up and break-out catheads. Driven off compound.

3.2 Drilling Data

3.2.1 Rig Data cont'd

Drilling Plant: (cont'd)	Compound:	'OIME' Compound Drive.
	Motors:	3 'Caterpillar' Model D-3408 P.C.T.A. Diesel Turbocharged engines. Rated at 385 HP for pumping.
Mast:	Make and Specifications:	'PARCO' Model P-131 Cantilever mast. Rated at 550,000 lbs. 131' high with 18' 6" x 7' base. Racking for 13,500' of 4-1/2" OD Drill Pipe. Crown Frame Assembly has 5 x 42" OD Cluster Sheaves, and 1 x 55" OD Fastline Sheave. Grooved for 1-1/8" wireline.
Pumps:	Make:	2 'Continental Emsco' Triplex
	Type:	F-800 Skid Mounted. V-Belt Driven from Compound.
	Size:	6-3/4" x 9"
Substructure:	Specifications:	Type SL Substructure, 23' 8" x 46' 1". Working floor elevation of 18'. Casing capacity is 467,000 lbs simultaneous with setback capacity of 357,000 lbs.
Rotary Table:	Make:	'IDECO' 27-1/2" LR-275
	Capacity:	570 Ton Dead Load.
Block:	Make:	'Continental EMSCO' RA-36-5-H250 Hook Block Assembly.
	Capacity:	250 Ton.
Swivel:	Make:	'Oilwell' PC-300
	Capacity:	300 Ton Dead Load.
Kellys:	Type:	2 'Drilco' 5-1/4" x 40' Hexagonal kellys. 1 'Drilco' 3-1/2" x 40' hexagonal Kelly.
Kelly Drive:	Type:	'Varco' MSPC Solid Pin Drive
Mixing Pump:	Type:	1 'Mission' Magnum 1 Centrifugal Pump (5 x 6 x 14) Powered by 60 HP 'Reliance' Electric Induction Motor.
Mud Agitators:	Type:	4 'Brandt' MDL MA7-5 with 32" diameter blades. Powered by 7.5 HP 'Toshiba' electric induction motors.

3.2 Drilling Data

3.2.1 Rig Data cont'd

Mud Tanks:	Type & Size:	a) Shaker Tank 25' x 8'9" x 6' b) Settling Tank 34' x 8'9" x 6' c) Suction Tank 30' x 8'9" x 6'
	Capacity:	a) 205 BBL b) 291 BBL c) 256 BBL Total Capacity of 752 BBL
Shale Shakers:	Type:	'Brandt' Single Tandem. Powered by 5 HP 'Toshiba' Electric Induction Motor.
Desander:	Make: Specifications:	'Demco' MDL. 84 4 x 8" Cones, Charged by 'Mission' Magnum 1 Centrifugal Pump, 5 x 6 x 14, Powered by 60 HP. 'Reliance' Electric Induction Motor.
Desilter:	Make: Specifications:	'Demco' MDL 412H 12 x 4" Cones, Charged by 'Mission' Magnum 1 Centrifugal Pump, 5 x 6 x 14, Powered by 60 HP. 'Reliance' Electric Induction Motor.
Centrifuge:	Type:	'NL Baroid' Standard Mud Centrifuge. 18 x 28 Decanting Centrifuge. Powered by 40 HP 'Siemens Allis' Electric Induction Motor.
Degasser:	Type:	Vertical 20" (O.D.) x 12', Mounted on Shaker Tank.
Generators:	Type: Output:	2 'Caterpillar' 3408 PCTA Generator Sets. Each 265 KW.
BOP and Accumulator:	Ram Type:	'Cameron' Type "U" Double Gate Unit 13-5/8" Bore - 5000 WP with Blind 2-3/8", 2-7/8", 4-1/2", 5-1/2", 7", and 8-5/8" Super Trim Rams.
	Hydril:	'Cameron' Type "D" Super Trim Annular Preventer. 13-5/8". 3000 WP.
	Accumulator:	'Koomey' MA080 11SB3 Blowout Preventer Control Unit. 3000 WP Accumulator. 80 Gallon Capacity. 4 Station.

3.2 Drilling Data

3.2.1 Rig Data cont'd

Choke:	Type:	3" - 5000 psi Working Pressure 'McEvoy' Choke and Kill Manifold, and 'Cameron' 3" - 5000 HCR Flanged Valve.
Drill Pipe:	Type:	12,000', 4-1/2" OD, 16.60 lbs/ft, API Grade "E", IEUE Seamless Drill Pipe, 6-1/4" OD, by 3-1/2" I.D. Tool Joints, (Hard Banded), 4" IF Connections.
Heavy Weight Drill Pipe:	Type:	15 Joints 4-1/2" OD Heavy Wall Range 2. 6-1/4" OD by 2-7/8" ID Tool Joints. 5" OD Centre Upset. 4" IF Box/Pin Connections with Hard Banding on Tool Joints and Centre Upset.
Drill Collars:	Type:	2 - 12-3/4" Square x 2-3/4" I.D. 6-5/8" Reg. Box/Box Conn. 7 - 'Drilco' 8" OD x 2-13/16" ID x 31'. Hard Banded 6-5/8" Reg. Pin/Box Conn. 1 - 'Drilco' 8" OD x 2-13/16" ID x 10' Hard Banded 6-5/8" Reg. Box/Box Conn. with 5F-6R Float Recess. 2 - 7-3/4" Square x 2-3/4" ID. 4-1/2" IF Box/Box Conn. 12 - 'Drilco' 7" OD x 2-13/16" ID x 31' Hard Banded, 4-1/2" IF Pin/Box Conn. 27 - 'Drilco' 6-1/2" OD x 2-1/4" ID x 31' Hard Banded. 4" IF Pin/Box Conn. 1 - 'Drilco' 6-1/2" OD x 2-1/4" ID x 10' Hard Banded. 4" IF Box/Box Conn. with 4R Float Recess. 3 - 'Drilco', 4-1/8" OD x 2" ID x 31', 3-1/2" Reg Pin/Box Conn. 12 - 'Drilco' 4-1/8" OD x 2-1/16" ID x 31', 2-7/8" IF Pin/Box Conn.

3.2 Drilling Data

3.2.2 Air Drilling Equipment

INTAIRDRILL

Air Compressors:	Make:	2 x Gardner WEN Compressors
	Model:	860/350
	Capacity:	860 CFM at 350 psi each.
	Power:	2 x GMC 12V-71 Diesel Engines
	Make:	2 x Sullair Compressors
	Model:	900/350
	Capacity:	900 CFM at 350 psi each.
	Power:	2 x GM 8V-92 Diesel Engines
Air Compressor Boosters:	Make:	2 x Gardner Denver RLD Boosters. Capable of Boosting Pressure to 1,000 psi.
	Power:	2 x GM 8V-71 Diesel Engines
Injection Pump:	Make:	1 x GD Triplex High Pressure Positive Displacement Injection Pump.
Rotating B.O.P.:	Make:	Shaffer Rotating B.O.P.
	Size:	20", and 12".

3.2.3 Deviation Drilling Equipment

HOFCO

Downhole Motors:	Type:	2 x 6-1/2" "Dyna Drill" Downhole Motors.
Drill Collar:	Type:	1 x 6-1/2", 30' "Monel" Non Magnetic Drill Collar.
Stabilisers:	Type:	3 x 8-1/2" "S" Type Stabilisers 5 x 8-1/2" Weld Blade Stabilisers
Roller Reamer:	Type:	1 x 8-1/2" Roller Reamer
Bent Subs:	Type:	3 x "Dyna Drill" Bent Subs 1-1/2°, 2°, 2-1/2°
Survey Tools:	Type:	2 x Magnetic Single Shot Instrument Kits, complete with Running Gear.
		1 x U.B.H.O. Mule Shoe Orienting Assembly
		1 x Non Magnetic Sensor

3.2 Drilling Data

3.2.4 Hole Sizes

26" Hole: Surface to 18.0 metres (59 feet)

17-1/2" Hole: 18.0 to 167.6 metres (59-550 feet)

12-1/4" Hole: 167.6 to 1244.8 metres (550-4084 feet)

8-1/2" Hole: Palm Valley No. 6:-
1244.8 to 2347.0 metres (4084-7700 feet)

Palm Valley No. 6A:-
1262.2 to 1779.7 metres (4141-5839 feet)

Palm Valley No. 6B:-
1373.7 to 2005.9 metres (4507-6581 feet)

3.2.5 Deviation Record

Deviation surveys taken while drilling, using the rig survey tool (Palm Valley #6), and while directional drilling, using HOFCO OILFIELD SERVICES PTY LTD's survey tool (Palm Valley #6A and #6B), are tabulated below.

TABLE 1 - DEVIATION RECORD - PALM VALLEY No. 6

DEPTH (FEET)	DEVIATION (DEGREES)	DEPTH (FEET)	DEVIATION (DEGREES)
109	0.75	3677	0.50
230	0.00	4056	1.75
355	0.00	4295	1.25
530	0.75	4580	1.50
833	0.75	4864	1.50
1116	0.00	5210	1.75
1430	0.50	5431	2.00
1747	0.50	5747	2.00
2036	0.25	6063	2.00
2350	0.25	6347	2.00
2665	1.00	6644	2.00
2960	1.25	7090	1.50
3110	1.00	7675	0.25
3425	0.25		

3.2 Drilling Data

3.2.5 Deviation Record cont'd

TABLE 2 - DEVIATION RECORD - PALM VALLEY No. 6A

DEPTH (FEET)	DEVIATION (DEGREES)	AZIMUTH (DEGREES)	DEPTH (FEET)	DEVIATION (DEGREES)	AZIMUTH (DEGREES)
4096	1.00	N 50 E	4517	12.50	N 2 W
4128	1.00	N 36 E	4643	13.00	N 8 W
4160	1.50	N 4 E	4706	13.50	N 13 W
4173	2.00	N 4 W	4797	12.00	N 16 W
4204	3.75	N 6 E	4897	11.00	N 16 W
4236	4.25	N 9 W	4928	10.00	N 19 W
4268	5.00	N 19 W	5077	9.00	N 19 W
4298	5.75	N 20 W	5236	9.00	N 19 W
4330	7.50	N 18 W	5362	9.00	N 19 W
4362	9.50	N 16 W	5551	10.00	N 11 W
4453	11.75	N 2 W	5741	9.25	N 12 W

TABLE 3 - DEVIATION RECORD - PALM VALLEY No. 6B

DEPTH (FEET)	DEVIATION (DEGREES)	AZIMUTH (DEGREES)	DEPTH (FEET)	DEVIATION (DEGREES)	AZIMUTH (DEGREES)
4096*	1.00	N 50 E	4643	18.30	N 2 W
4128*	1.00	N 36 E	4706	18.80	N 2 W
4160*	1.50	N 4 E	4769	19.60	N 8 W
4173*	2.00	N 4 W	4863	21.50	N 8 W
4204*	3.75	N 6 E	4920	22.75	N 9 W
4236*	4.25	N 9 W	5077	25.90	N 11 W
4268*	5.00	N 19 W	5267	30.50	N 14 W
4298*	5.75	N 20 W	5425	31.90	N 16 W
4330*	7.50	N 18 W	5582	35.25	N 19 W
4362*	9.50	N 16 W	5709	37.90	N 21 W
4453*	11.75	N 2 W	5835	40.00	N 22 W
4461	12.00	N 3 W	6087	44.50	N 19.5 W
4525	13.00	N 2 E	6246	47.90	N 18 W
4555	14.75	N 2 E	6435	48.80	N 18 W
4587	16.75	N 2 E	6529	48.75	N 17.5 W

* Hole Section Is The Same As For Palm Valley No. 6A.

A detailed table and plot of the deviated part of the hole by HOFCO OILFIELD SERVICES PTY. LTD. appears in Appendix A, and Schlumberger's directional survey data, and large scale plots appear in Appendix M, and Enclosure 15.

OFFSET (FEET)

0 500 1000

4000

9⅝" CASING SHOE AT 4080·5'

4141' START OF DEVIATION

FEET

4500

STOKES

4754' 4752' TVD

UPPER STAIRWAY

4834' 4831' TVD

5000

MIDDLE STAIRWAY SS.

5442' 5435' TVD

5500

LOWER STAIRWAY SS.

5660'-5670' GAS INCREASE

DRILL BREAK 5723-5727'

CONTINUOUS FLARE 5847'

5849' 2·1 MMCFD

5901' 12·1 MMCFD

DRILL BREAK 5899'-5900'

5737' TVD

5742'

5759' 69,000 CFD

5776' 58,000 CFD

5839' T.D. (6A) (DRILLER)

6118' 8·4 MMCFD

HORN VALLEY SILTSTONE

6276' 7·7 MMCFD

6000 6008

6002' TVD

6392' 7·7 MMCFD

6075' 69,000 CFD

6508' 13·7 MMCFD

DRILL BREAK 6513'-6514'

7" CASING SHOE AT 6581'

6581' T.D. (6B) (DRILLER)

PACOOTA P1 SANDSTONE UNIT

6313'-6315' DRILL BREAK

6359' 69,000 CFD

6500

6630' 6656' 105,000 CFD

P2 UNIT

6820'-6822' DRILL BREAK

6826'-6827' DRILL BREAK

6852' 1·3 MMCFD

6945'

7000

6982'-6983' DRILL BREAK

7036' 1·82 MMCFD

7099' 1·43 MMCFD

P3 UNIT

7307' 1·53 MMCFD

7346-7348' DRILL BREAK

7371' 1·57 MMCFD

7500

7560' 1·58 MMCFD

7644'

P4 UNIT

7700 T.D. 1·58 MMCFD

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

MAGELLAN

DEVIATION PLOT
PALM VALLEY - 6, 6A, 6B

FIGURE 5

AUTHOR : M. BERRY	DRAFTED BY : GWH
DATE : JAN. 1986	REPLACES MAP DATED : —
MAP REF. No. : A 1094	

LEGEND

6820'-6822' GAS PRODUCTION ZONE

GAS FLOW MEASUREMENT

BIT RECORD

WELL NAME: PALM VALLEY - 6	FIELD: PALM VALLEY	PERMIT: P.L. 3	STATE: NORTHERN TERRITORY	LOCATION: LATITUDE: 24°00'10.08" SOUTH LONGITUDE: 132°42'20.38" EAST	
OPERATOR: MAGELLAN PETROLEUM (N.T.) PTY. LTD.	CONTRACTOR: HAFFNER PTY. LTD.	RIG: MEREENIE RIG No. 1	RIG SUPERVISOR: W. STEBLYK	COMPILED BY: M. BERRY	SPUD: NOVEMBER 7, 1985 — REACHED T.D.: DECEMBER 12, 1985
PUMPS: 2 × CONT. EMSCO TRIPLEX — TYPE: F-800 — LINER: 6¾" × 9"	PUMP POWER: COMPOUND	AIR COMP.: 2 × WEN 2 × SULLAIR	CAPACITY: 2 × 860 CFM at 350 PSI, 2 × 900 CFM at 350 PSI	AIR BOOSTER: 2 × G.D. RLD	CAPACITY: BOOST TO 1000 PSI — DRILLING FLUID: AIR, AIR/FOAM, MUD
DRILL PIPE: 4½" OD, GRADE 'E', 4" IF CONNECTIONS	DRILL COLLARS: O.D. 2/8/2/12/28	12¾"/8"/7¾"/7"/6½"	CONNECTIONS 6⅝" REG./6⅝" REG./4½" IF/4½" IF/4" IF	DRAWWORKS POWER: 3 × 'CATERPILLAR' MODEL D-3408	

No.	Size (inches)	Make	Type	Jets 32 nd Inch	Serial No.	Depth Out	Feet	Hours	Ft/Hr	Accum Drlg. Hours	WT 1000 lbs	RPM	Vert Dev. (deg)	Pump Press (psi)	Pump Opm.	S.P.M. 1	S.P.M. 2	Mud WT	Mud VIS	Mud WL	Dull Bit Cond. T	Dull Bit Cond. B	Dull Bit Cond. G	Dull Bit Cond. Other	Formation Remarks
1	17-1/2	SEC	H8J	Open	436131	62	62	6.5	9.5	6.5	5	50	-	50	Air	-	-	Air	-	-	2	2	In	-	Hermannsburg Sst.
RR1	17-1/2	SEC	H8J	Open	436131	(Open 17-1/2" Hole to 26")					-	50	-	50	Air	-	-	Air	-	-	-	-	-	-	" "
"	26	STC	Hole Opener	Open	AH01013	(From Surface to 59')					5	50	-	50	Air	-	-	Air	-	-	3	2	In	-	" "
RR1	17-1/2	SEC	H8J	Open	436131	488	426	31.5	13.5	38	15	55	0.75	320	Air	-	-	Air	-	-	One	Cone	Missing		" "
2	17-1/2	REED	S62J	Open	T55047	550	62	6	10.3	44	10	55	0.75	320	Air	-	-	Air	-	-	7	5	Cracked Shanks		" "
3	12-1/4	HTC	HH77	Open	ZW366	1,217	667	40	16.7	84	28	80	0	100	Air	-	-	Air	-	-	2	3	In	-	" "
4	12-1/4	HTC	HH77	3 x 24	ZX173	1,863	646	40.5	16.0	124.5	25	70	0.5	150	Air	-	-	Air	-	-	1	2	In	-	Parke/Mereenie
5	12-1/4	HTC	HH77	3 x 24	ZZ485	2,409	546	59	9.3	183.5	55	60	0.25	250	Air	-	-	Air/Foam		-	8	8	1/8"	-	Mereenie
6	12-1/4	HTC	HH77	Open	AF546	3,151	742	36	20.6	219.5	45	50	1.25	350	Air	-	-	Air/Foam		-	3	3	In	-	Mereenie
7	12-1/4	HTC	HH77	Open	ZZ482	3,701	550	51.5	10.7	271	55	52	0.5	450	Air	-	-	Air/Foam		-	8	8	1/8"	-	Carmichael/Stokes
RR4	12-1/4	HTC	HH77	Open	ZX173	4,084	383	20.5	18.7	291.5	50	55	1.75	450	Air	-	-	Air/Foam		-	3	5	In	-	Stokes
8	8-1/2	STC	F57	Open	EN5389	4,878	794	28.5	27.9	320	25	60	1.5	175	Air	-	-	Air	-	-	3	3	1/8"	-	Stokes/Stairway
9	8-1/2	STC	F7	Open	CP2099	5,455	577	25	23.1	345	25	60	2.0	175	Air	-	-	Air	-	-	3	4	1/8"	-	Stairway
10	8-1/2	STC	F9	Open	CC2438	6,400	945	42	22.5	387	25	60	2.0	180	Air	-	-	Air	-	-	4	3	1/8"	-	Horn Valley/Pacoota
11	8-1/2	STC	F9	Open	BJ4540	6,687	287	20.5	14.0	407.5	30	60	2.0	200	Air	-	-	Air	-	-	4	4	1/16"	-	Pacoota
12	8-1/2	HTC	J99	Open	HJ020	6,852	165	13	12.7	420.5	28	60	-	185	Air	-	-	Air	-	-	4	3	In	-	"
13	8-1/2	SEC	H100F	Open	179593	7,099	247	31	8.0	451.5	34	60	1.5	195	Air	-	-	Air	-	-	8	8	1"	-	"
14	8-1/2	HTC	J99	Open	HJ073	7,146	47	17.5	2.7	469	35	70	-	750	Mud	-	90	8.9	61	4.0	8	8	3/4"	-	"
15	8-1/2	SEC	H100F	Open	179566	7,148	2	1	2	470	40	60	-	750	Mud	-	90	8.9	61	4.0	3	3	In	-	"
16	8-1/2	HTC	J99	Open	HJ018	7,426	278	22.5	12.4	492.5	32	60	-	190	Air	-	-	Air	-	-	8	8	3/16"	-	"
17	8-1/2	HTC	J99	Open	HJ136	7,700	274	18	15.2	510.5	35	60	0.25	200	Air	-	-	Air	-	-	6	5	In	-	"

TABLE 4

3.2.6.1

BIT RECORD

3.2.6.2

WELL NAME: PALM VALLEY - 6A	FIELD: PALM VALLEY	PERMIT: P.L. 3	STATE: NORTHERN TERRITORY	LOCATION: LATITUDE: 24°00'10·08" SOUTH LONGITUDE: 132°42'20·38" EAST
OPERATOR: MAGELLAN PETROLEUM (N.T.) PTY. LTD.	CONTRACTOR: HAFFNER PTY. LTD.	RIG: MEREENIE RIG No. 1	RIG SUPERVISOR: W. STEBLYK	COMPILED BY: M. BERRY
SPUD: DECEMBER 15, 1985	REACHED T.D.: DECEMBER 23, 1985			
PUMPS: 2 × CONT. EMSCO TRIPLEX	TYPE: F-800	LINER: 6¾" × 9"	PUMP POWER: COMPOUND	AIR COMP.: 2 × WEN 2 × SULLAIR
CAPACITY: 2 × 860 CFM at 350 PSI, 2 × 900 CFM at 350 PSI	AIR BOOSTER: 2 × G.D. RLD.	CAPACITY: BOOST TO 1000 PSI	DRILLING FLUID: MUD, AIR	
DRILL PIPE: 4½" OD, GRADE 'E', 4" IF CONNECTIONS	DRILL COLLARS: 2/8/2/12/28	O.D.: 12¾"/8"/7¾"/7"/6½"	CONNECTIONS: 6⅝" REG./6⅝" REG./4½" IF/4½" IF/4" IF	DRAWWORKS POWER: 3 × 'CATERPILLAR' MODEL D-3408

No.	Size (inches)	Make	Type	Jets 32nd inch	Serial No.	Depth Out	Feet	Hours	Ft/Hr	Accum Drlg. hours	WT 1000 lbs	RPM	Vert Dev. (deg)	Pump Press (psi)	Pump Opm.	S.P.M. 1	S.P.M. 2	Mud WT	Mud VIS	Mud WL	Dull Bit Cond. T	Dull Bit Cond. B	Dull Bit Cond. G	Dull Bit Cond. Other	Formation Remarks
18	8-1/2	HTC	J22	3 x 18	213 SL	4,200	59	10.5	5.6	10.5	0	300	2.0	900	Mud	-	95	8.9	53	3.4	2	3	In	-	Stokes. Dyna Drill PBTD 4141'
RR18	8-1/2	HTC	J22	3 x 18	213 SL	4,326	126	13.5	9.3	24	0	300	7.5	900	Mud	-	90	8.9	52	3.5	3	2	In	-	Stokes. Dyna Drill
19	8-1/2	HTC	J22	3 x 18	149 SL	4,422	96	18.5	5.2	42.5	0	300	9.5	900	Mud	-	90	8.9	51	3.4	2	2	In	-	Stokes. Dyna Drill
20	8-1/2	STC	F7	Open	CP2044	4,736	314	5.5	57.1	48	30/50	60/90	13.5	200	Air	-	-	Air	-	-	1	1	In	-	Stokes
RR20	8-1/2	STC	F7	Open	CP2044	4,837	101	4	25.3	52	30	90	12.0	220	Air	-	-	Air	-	-	2	2	In	-	Stokes/Stairway
RR20	8-1/2	STC	F7	Open	CP2044	4,968	131	3.5	37.4	55.5	30	90	10.0	220	Air	-	-	Air	-	-	2	2	In	-	Stairway
RR20	8-1/2	STC	F7	Open	CP2044	5,401	433	11.5	37.7	67	35	85	9.0	220	Air	-	-	Air	-	-	4	3	1/32"	-	Stairway
RR19	8-1/2	HTC	J22	Open	149 SL	5,424	23	1.5	15.3	68.5	5	?	-	300	Air	-	-	Air	-	-	8	8	1 1/2"	-	Stairway. Dyna Drill
21	8-1/2	HTC	J99	Open	HJ138	5,601	177	6	29.5	74.5	40	70	10.0	175	Air	-	-	Air	-	-	3	3	In	-	Stairway
RR21	8-1/2	HTC	J99	Open	HJ138	5,839	238	8	29.8	82.5	40	50	9.25	200	Air	-	-	Air	-	-	4	4	In	-	Stairway/Horn Valley

TABLE 5

BIT RECORD

3.2.6.3

WELL NAME: PALM VALLEY - 6B	FIELD: PALM VALLEY	PERMIT: P.L. 3	STATE: NORTHERN TERRITORY	LOCATION: LATITUDE: 24°00'10·08" SOUTH LONGITUDE: 132°42'20·38" EAST
OPERATOR: MAGELLAN PETROLEUM (N.T.) PTY. LTD.	CONTRACTOR: HAFFNER PTY. LTD.	RIG: MEREENIE RIG No. 1	RIG SUPERVISOR: W. STEBLYK	COMPILED BY: M. BERRY
SPUD: DECEMBER 25, 1985	REACHED T.D.: JANUARY 8, 1986			
PUMPS: 2 × CONT. EMSCO TRIPLEX	TYPE: F-800	LINER: 6¾" × 9"	PUMP POWER: COMPOUND	AIR COMP.: 2 × WEN 2 × SULLAIR
CAPACITY: 2 × 860 CFM at 350 PSI, 2 × 900 CFM at 350 PSI	AIR BOOSTER: 2 × G.D. RLD.	CAPACITY: BOOST TO 1000 PSI	DRILLING FLUID: MUD, AIR	
DRILL PIPE: 4½" OD, GRADE 'E', 4" IF CONNECTIONS	DRILL COLLARS: 2/8/2/12/28	O.D.: 12¾"/8"/7¾"/7"/6½"	CONNECTIONS: 6⅝" REG./6⅝" REG./4½" IF/4½" IF/4" IF	DRAWWORKS POWER: 3 × 'CATERPILLAR' MODEL D-3408

No.	Size (inches)	Make	Type	Jets 32nd Inch	Serial No.	Depth Out	Feet	Hours	Ft/Hr	Accum Drlg hours	WT 1000 lbs	RPM	Vert Dev. (deg)	Pump Press (psi)	Pump Opm.	S.P.M. 1	S.P.M. 2	Mud WT	Mud VIS	Mud WL	Dull Bit Cond. T	Dull Bit Cond. B	Dull Bit Cond. G	Dull Bit Cond. Other	Formation Remarks
RR18	8-1/2	HTC	J22	3 x 18	213 SL	4,631	124	45	2.8	45	7/9	300	16.75	900	Mud	-	80	9.7	46	2.7	3	7	In	-	PBTD 4507' Dyna Drill
22	8-1/2	STC	F57	Open	EN5145	4,739	108	34.5	3.1	79.5	46	55	18.8	750	Mud	-	90	9.8	48	3.3	2	2	In	-	Stokes
RR22	8-1/2	STC	F57	3 x 18	EN5145	4,781	42	10.5	4	90	26	-	-	850	Mud	-	80	9.8	48	3.6	2	2	In	-	Stokes/Stairway Dyna Drill
23	8-1/2	STC	F5	3 x 11	CJ1458	4,896	115	29	4	119	46	60	21.5	1600	Mud	-	90	9.8	48	2.6	6	4	In	-	Stairway
RR22	8-1/2	STC	F57	Open	EN5145	5,455	559	22.5	24.8	141.5	25/40	100	31.9	150	Air	-	-	Air	-	-	6	4	1/8"	-	Stairway
24	8-1/2	STC	F7	Open	FC4791	5,897	442	13	34	154.5	45	60	40.0	150	Air	-	-	Air	-	-	5	4	1/8"	-	Stairway
25	8-1/2	STC	F7	Open	CR0901	6,581	684	53	12.9	207.5	40	60	48.75	150	Air	-	-	Air	-	-	6	7	1/8"	-	Stairway/Pacoota
														450	Mud	60	-	9.9	46	2.8					Mud Drill 8-1/2" Hole From 6508'

TABLE 6

3.2.7.1.

PALM VALLEY - 6 DRILLING FLUIDS SUMMARY

DATE	MIDNIGHT DEPTH (FEET)	WT. (PPG)	VIS. (SEC)	PL VIS (cP)	YP $lb/100'^2$	GEL STR $lb/100'^2$	FTR (cm^3)	FC (32nd)	SLD (%)	SND (%)	pH	CHL (000's mg/l)	HD (mg/l of Ca^{++})	KCL (%)	REMARKS
07/11/85	62														Air Hammer Drill
08/11/85	116														" " "
09/11/85	320														" " "
10/11/85	488														" " "
11/11/85	550														Air Hammer Drill/Set 13-3/8" Csg.
12/11/85	550														Welding/Pressure Testing
13/11/85	560														Nipple Up/Pressure Test/Air Drill
14/11/85	925														Air Drill
15/11/85	1217														" "
16/11/85	1637														" "
17/11/85	1863														" "
18/11/85	2120	Add 1200 Litres Quick Foam, 200 kgs Lime, 200 kgs Caustic													Air/Foam Drill
19/11/85	2310	Add 400 Litres Quick Foam, 120 kgs Caustic													" " "
20/11/85	2475	Add 400 Litres Quick Foam, 120 kgs Caustic													" " "
21/11/85	2962	Add 400 Litres Quick Foam, 200 kgs Caustic													" " "
22/11/85	3275	Add 200 Litres Quick Foam, 80 kgs Caustic													" " "
23/11/85	3489	Add 400 Litres Quick Foam, 120 kgs Caustic													" " "
24/11/85	3701	Add 400 Litres Quick Foam, 120 kgs Caustic													" " "
25/11/85	3971	Add 200 Litres Quick Foam, 160 kgs Caustic													" " "
26/11/85	4084	Add 257 Litres Quick Foam, 40 kgs Caustic													" " " /Run Logs
27/11/85	4084														Set 9-5/8" Casing
28/11/85	4306														Pressure Test/Air Drill
29/11/85	4878														Air Drill
30/11/85	5262														" "
01/12/85	5610														" "
02/12/85	6104														" "
03/12/85	6444														" "
04/12/85	6687														" "
05/12/85	6852														" "
06/12/85	6970														" "
07/12/85	7099														" "
08/12/85	7134	8.8	63	23	36	3	3.9	1	3.8	TR	10.8	25.5	100	5.3	Displ. Hole w/ Mud. Free Stuck Pipe/Mud Drill
09/12/85	7148	8.9	61	22	39	3	4.0	1	4.2	TR	10.7	23.0	60	4.8	Mud Drill
10/12/85	7196														Unload Hole w/ Air. Air Drill
11/12/85	7426														Air Drill
12/12/85	7700														" "
13/12/85	7700	8.9	69	24	43	3	3.0	1	4.2	TR	10.8	22.0	40	4.6	Displ. Hole w/ mud. Run Logs
14/12/85	7700	8.9	63	22	34	3	3.8	1	4.2	TR	10.6	21.5	60	4.5	Run Logs. Set 3 Cement Plugs

TABLE 7

3.2.7.2. PALM VALLEY - 6A DRILLING FLUIDS SUMMARY

DATE	MIDNIGHT DEPTH (FEET)	WT. (PPG)	VIS. (SEC)	PL VIS (cP)	YP $lb/100'^2$	GEL STR $lb/100'^2$	FTR (cm^3)	FC (32nd)	SLD (%)	SND (%)	pH	CHL (000's mg/l)	HD (mg/l of Ca^{++})	KCL (%)	REMARKS
15/12/85	4144	8.9	56	25	25	2	3.6	1	4.2	0.12	11.5	20.5	60	4.3	PBTD 4141' Dyna Drill w/ Mud
16/12/85	4276	8.9	54	23	21	3	3.4	1	4.2	TR	11.3	24.0	120	5.0	Dyna Drill with Mud
17/12/85	4383	8.9	47	21	15	3	3.9	1	4.2	TR	11.0	24.0	60	5.0	" " " "
18/12/85	4422	8.9	51	20	20	3	3.4	1	4.2	TR	11.0	24.5	80	5.0	" " " "
19/12/85	4791														Unload Hole w/ Air. Air Drill
20/12/85	5048														Air Drill
21/12/85	5416														Air Drill. Dyna Drill w/ Air
22/12/85	5601														Dyna Drill with Air. Air Drill
23/12/85	5839	8.9	50	20	21	3	3.2	1	4.2	TR	11.0	24.5	80	5.0	Air Drill/Displ. Hole w/ Mud
24/12/85	5839	9.7	50	25	21	3	3.4	1	10.0	TR	11.0	24.5	120	5.0	Set 300' Cement Plug

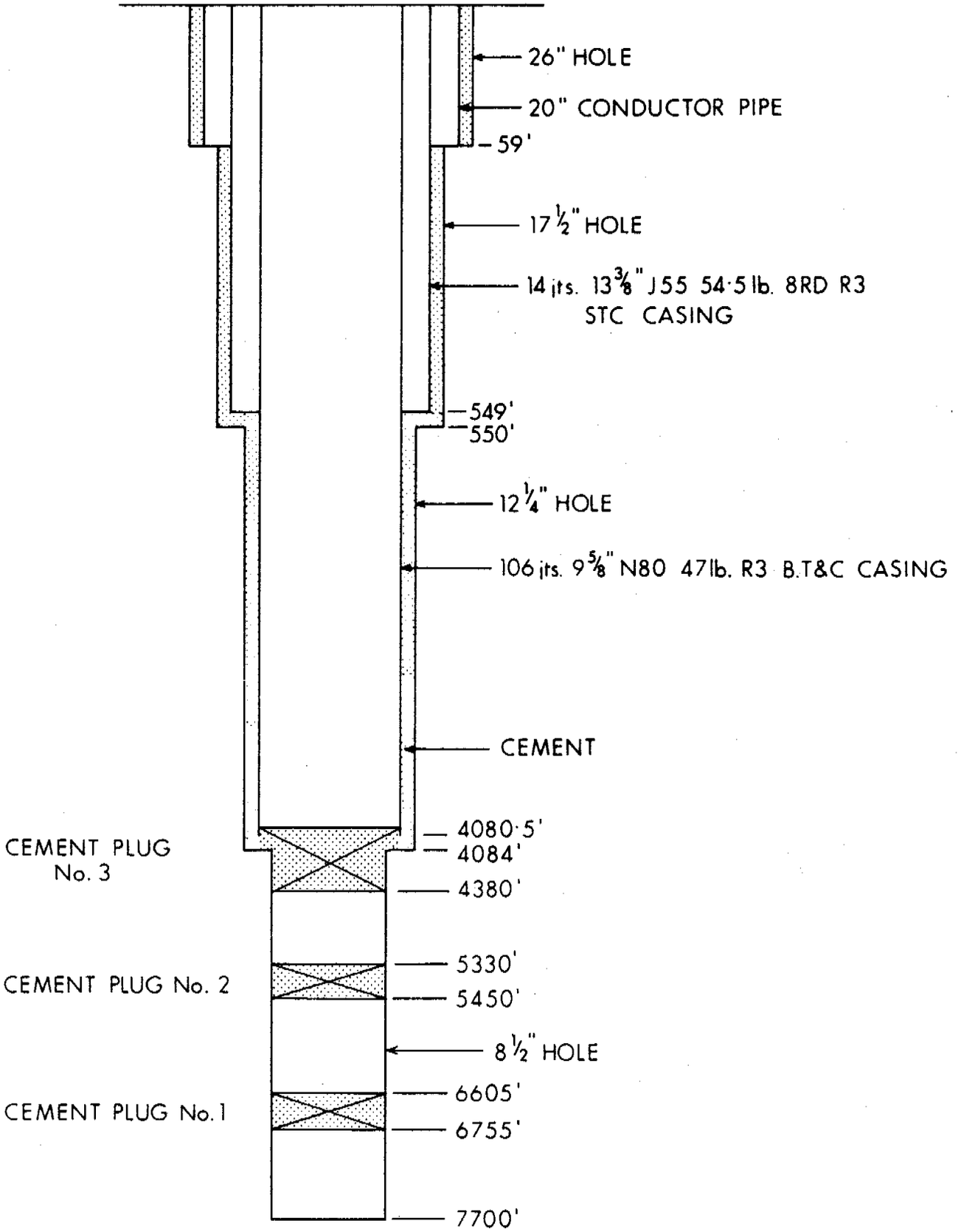
TABLE 8

3.2.7.3. PALM VALLEY - 6B DRILLING FLUIDS SUMMARY

DATE	MIDNIGHT DEPTH (FEET)	WT. (PPG)	VIS. (SEC)	PL VIS (cP)	YP $lb/100'^2$	GEL STR $lb/100'^2$	FTR (cm^3)	FC (32nd)	SLD (%)	SND (%)	pH	CHL (000's mg/l	HD (mg/l of Ca^{++})	KCL (%)	REMARKS
25/12/85	4508	9.6	49	22	19	3	3.3	2	9	0.25	10.7	24.5	100	5	PBTD 4507' Dyna Drill w/ Mud
26/12/85	4554	9.6	50	22	19	3	2.4	1	9	TR	11.5	24.5	400	5	Dyna Drill with Mud
27/12/85	4620	9.5	47	20	19	3	2.8	1	9	TR	11.5	24.5	140	5	" " " "
28/12/85	4655	9.7	47	19	19	3	3.2	1	9	TR	11.5	24.5	80	5	" "/Mud Drill
29/12/85	4733	9.7	48	20	19	3	3.5	1	10	TR	11.5	24.5	80	5	Mud Drill
30/12/85	4781	9.8	48	21	19	3	3.3	1	10	TR	11.5	24.5	100	5	" "/Dyna Drill w/ Mud
31/12/85	4849	9.8	47	19	19	3	3.4	1	10	TR	11.0	24.5	80	5	Mud Drill
01/01/86	4950	9.8	48	18	20	3	2.6	1	9	TR	10.5	24.0	80	5	Mud Drill. Unload Hole with Air. Air Drill.
02/01/86	5423	Add 300 Litres Quick Foam, 40 kgs Caustic													Air Drill/Air Foam/Air
03/01/86	5739														" "
04/01/86	5901														" "
05/01/86	6307														" "
06/01/86	6508	8.8	44	15	20	2	4.0	1	4	TR	11.0	20.0	90	4.1	Air Drill. Displ. Hole w/ Mud
07/01/86	6563	9.4	51	16	24	3	2.9	1	5	TR	11.0	19.5	90	4	Mud Drill and Cond., Gas Cut Mud
08/01/86	6581	9.6	48	18	22	3	2.8	1	7	TR	10.5	27.0	90	5.8	Mud Drill. Circ. & Cond., G.C.M.
09/01/86	6581	9.8	46	17	25	3	2.8	1	5	TR	10.5	89.6	5000	6	Run Logs
10/01/86	6581	9.9	45	18	24	3	2.8	1	5	TR	10.5	69.0	3000	6	Run Logs. Condition Hole
11/01/86	6581	9.9	45	19	23	3	3.0	1	5	TR	10.5	69.0	3000	6	Run 7" Csg. Set Stage 1 Cement
12/01/86	6581	9.9	44	18	21	3	3.0	1	5	TR	10.5	69.0	3000	6	Set Stage 2 Cement
13/01/86	6581	9.9	43	18	20	3	3.0	1	5	TR	10.5	69.0	3600	6	Drill Cement to float Collar, and Clean Hole.
14/01/86	6581														Displ. Hole w/ KCL Compl. Fluid
15/01/86	6581														Run 2-7/8" Tubing. Run CCL Log. Perforate Well.
16/01/86	6581														Flush Perfs. and Flow Well
17/01/86	6581														Flow Well to Clean. Rig Released at 1600 Hours.

TABLE 9

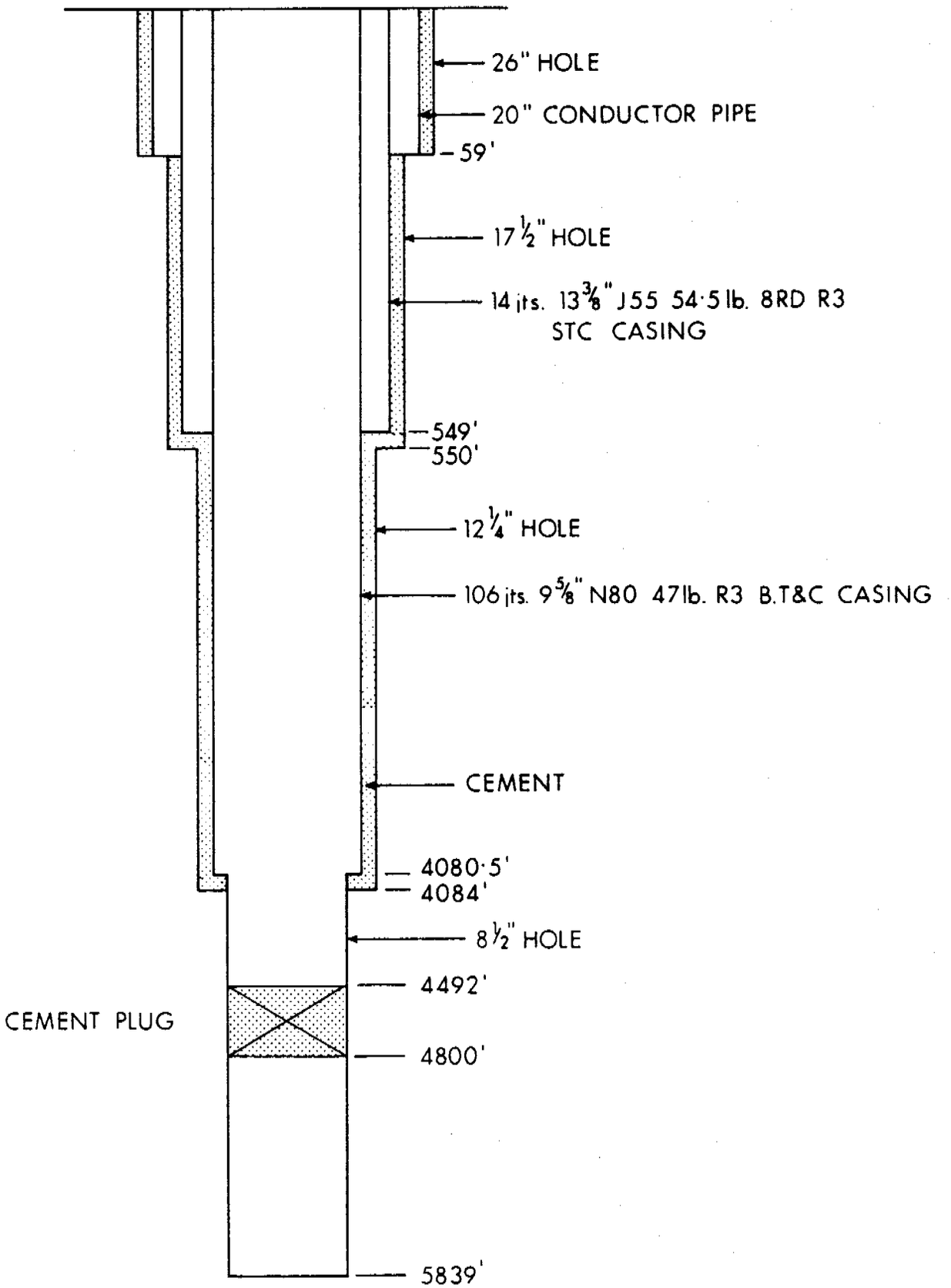
PALM VALLEY - 6
WELL COMPLETION DIAGRAM



DIAGRAMMATIC ONLY
NOT TO SCALE

FIGURE 6

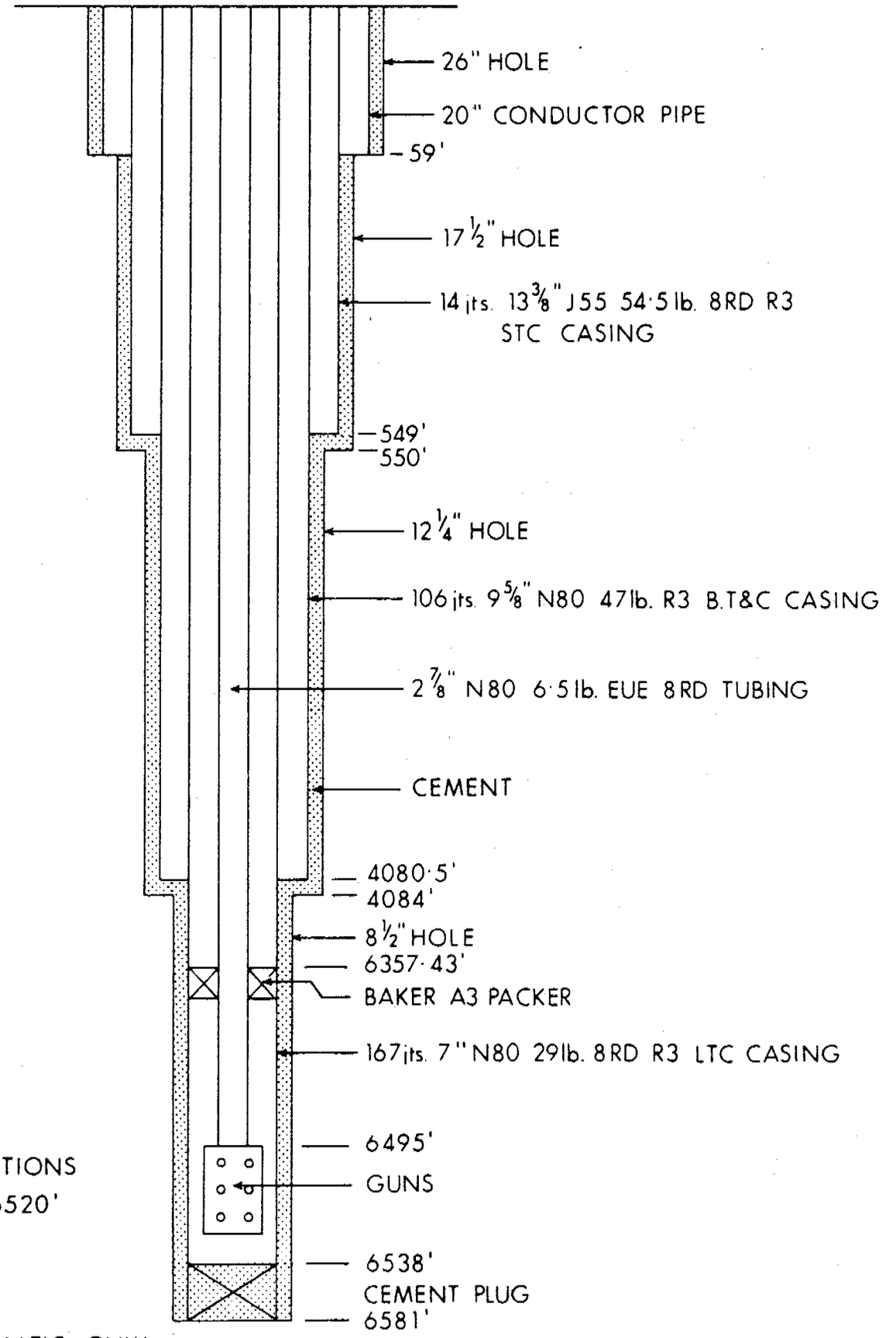
PALM VALLEY - 6A
WELL COMPLETION DIAGRAM



DIAGRAMMATIC ONLY
NOT TO SCALE

FIGURE 7

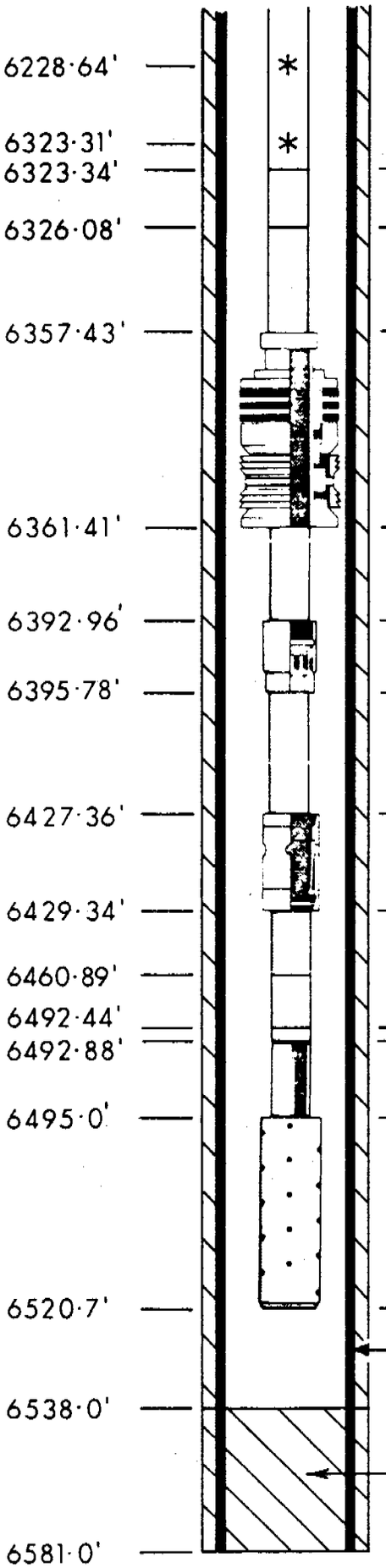
PALM VALLEY - 6B
WELL COMPLETION DIAGRAM



DIAGRAMMATIC ONLY
NOT TO SCALE

FIGURE 8

PALM VALLEY - 6B
COMPLETION ASSEMBLY DETAIL



6228·64' — GAMMA-RAY SOURCE

6323·31' — GAMMA-RAY SOURCE

6323·34'

6326·08' — SLIDING SLEEVE

TUBING JOINT

6357·43'

BAKER 47B2 A3 PACKER

6361·41'

TUBING JOINT

6392·96'

PRODUCTION VALVE

6395·78'

TUBING JOINT

6427·36'

DROP OFF SUB (OTIS 'B' TYPE 2 7/8" SHIFTING TOOL)

6429·34'

6460·89' — 2 TUBING JOINTS

6492·44'

6492·88' — TUBING COLLAR

MECHANICAL FIRING HEAD

6495·0'

GUNS — TOP SHOT AT 6508'
BOTTOM SHOT AT 6520'
5 SHOTS PER FOOT
37 gm. CHARGES

6520·7'

7" CASING

6538·0'

CEMENT

6581·0'

DIAGRAMMATIC ONLY
NOT TO SCALE

FIGURE 9

PV-6 COMPLETION ASSEMBLY

ITEM (DEPTH TO BOTTOM OF ITEM IN K.B.)	INT DIA inch	INT DIA mm	LENGTH feet	LENGTH meters	DEPTH feet	DEPTH meters	T. V. D. feet	T. V. D. meters
WELLHEAD:								
Rig KB to Wireline KB			1.30	.40	1.30	.40		
KB to Tubing Hanger			16.40	5.00	17.70	5.39		
Tubing Stretch			4.43	1.35	22.13	6.75		
Tubing Hanger	2.441	62.001	.90	.27	23.03	7.02		
TUBING:								
Tubing Pup Joint	2.441	62.001	9.69	2.95	32.72	9.97		
Tubing Pup Joint	2.441	62.001	12.05	3.67	44.77	13.65		
199JTS 2 7/8 EUE N80 6.5#	2.441	62.001	6278.57	1913.71	6323.34	1927.35	6018.50	1834.44
BOTTOM HOLE ASSEMBLY:								
Sliding Sleeve	2.312	58.725	2.74	.84	6326.08	1928.19		
Tubing Joint	2.441	62.001	31.35	9.56	6357.43	1937.74		
BAKER 47B2 A3 Packer	2.440	61.976	3.98	1.21	6361.41	1938.96	6043.80	1842.15
Tubing Joint	2.441	62.001	31.55	9.62	6392.96	1948.57		
Production Valve	2.440	61.976	2.82	.86	6395.78	1949.43	6066.60	1849.10
Tubing Joint	2.441	62.001	31.58	9.63	6427.36	1959.06		
Drop Off Sub	2.205	56.007	1.98	.60	6429.34	1959.66		
Tubing Joint	2.441	62.001	31.55	9.62	6460.89	1969.28		
Tubing Joint	2.441	62.001	31.55	9.62	6492.44	1978.90	6130.60	1868.61
Tubing Collar	2.441	62.001	.44	.13	6492.88	1979.03		
Mechanical Firing Head	0	0	2.12	.65	6495	1979.68		
Schlumberger Guns	0	0	25.70	7.83	6520.70	1987.51		
TOP PERFORATION					6508	1983.64	6140.80	1871.72
BOTTOM PERFORATION			12	3.66	6520	1987.30	6148.70	1874.12
BOTTOM OF PRODUCTION STRING					6520.70	1987.51	6149.20	1874.28
GAMMA-RAY SOURCE					6228.64	1898.49	5955.10	1815.11
GAMMA-RAY SOURCE					6323.31	1927.34	6018.50	1834.44
TD					6538	1992.78	6160.60	1877.75

TABLE 10

PALM VALLEY - 6
WELL HEAD DIAGRAM

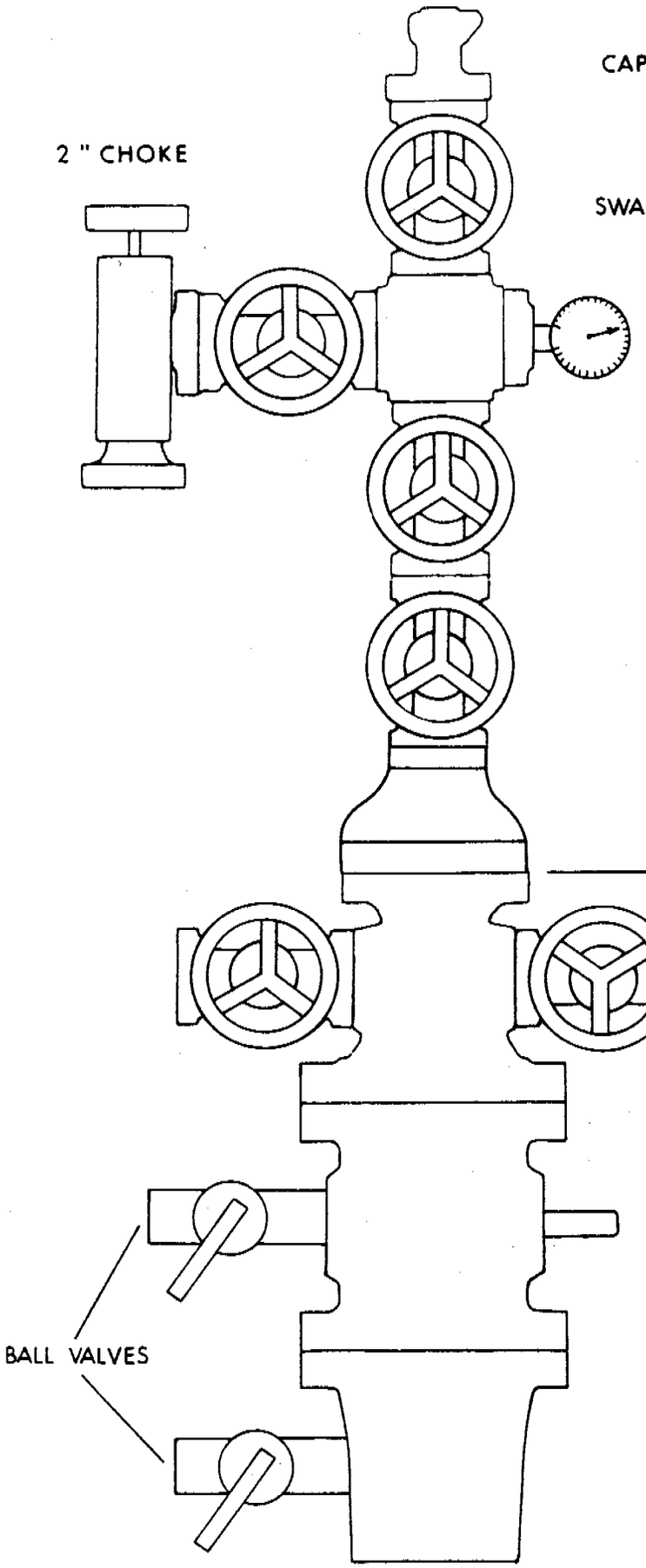


FIGURE 10

3.2 Drilling Data

3.2.8 Casing and Cementing Record

PALM VALLEY No. 6

CASING SIZE	SHOE DEPTH	CASING AND CEMENTING DETAILS	
20" Conductor	Open Ended at 18 metres (59 feet)	Length:	12.3 metres (40.5 ft)
		Weight:	94 lb/ft
		Grade/Connections:	F-25
		No. of Joints:	1
		Cement Used:	72 sacks, Class 'A'
		Additives:	2% $CaCl_2$
		Slurry Weight:	15.6 ppg
		Pre-Slurry Spot:	Nil
		Displaced With:	Nil
13-3/8"	167.3 metres (549 feet)	Length:	167.2 metres (548.7 ft)
		Weight:	54.5 lb/ft
		Grade/Connections:	J55 (8 rnd) R3. S.T.C.
		No. of Joints:	14
		Cement Used:	504 sacks, Class 'A'
		Additives:	Neat (68% of mix) 2% $CaCl_2$ (32% of mix)
		Slurry Weight:	15.6 ppg
		Pre-Slurry Spot:	100 bbls water
		Displaced With:	78 bbls water
		Remarks:	Annulus Topped up with 120 sacks Class 'A' cement (2% $CaCl_2$) until good returns at surface.
9-5/8"	1243.7 metres (4080.5 feet)	Length:	1243.1 metres (4078.5 ft)
		Weight:	47 lb/ft
		Grade/Connections:	N80. R3. B.T. & C.
		No. of Joints:	106
		Cement Used:	624 sacks, Class'A'
		Additives:	Neat
		Slurry Weight:	15.6 ppg
		Pre-Slurry Spot:	10 bbls $CaCl_2$ Mix 20 bbls water 20 bbls Flo-Check 20 bbls water
		Displaced With:	296 bbls water

PALM VALLEY No. 6A

No casing was run in this part of the Well.

3.2 Drilling Data

3.2.8 Casing and Cementing Record cont'd

PALM VALLEY No. 6B

CASING SIZE	SHOE DEPTH	CASING AND CEMENTING DETAILS	
7"	2005.9 metres (6581 feet)	Length:	2010.7 metres (6596.7 ft)
		Weight:	29 lb/ft
		Grade/Connections:	N80 (8 rnd) R3 L.T.C.
		No. of Joints:	167
		STAGE ONE CEMENT:	(Float Shoe at 2005.9 metres (6581 ft)).
		Mix One:	
		Cement Used:	95 sacks, Class 'G'
		Additives:	0.5% Thix-Set 'A'
			0.25% Thix-Set 'B'
			0.3% HR-4
		Slurry Weight:	13 ppg.
		Mix Two:	
		Cement Used:	28 sacks, Class 'G'
		Additives:	0.25% Thix-Set 'A'
			0.13% Thix-Set 'B'
			0.13% HR-4
		Slurry Weight:	15.6 ppg.
		Pre-Slurry Spot:	15 bbls water
			20 bbls Class 'G' cement (11 ppg, with 0.5% HR-4)
		Displaced With:	10 bbls water
			233 bbls mud
		STAGE TWO CEMENT:	(D.V. Stage Cementer at 1378.3 metres (4522 ft))
		Cement Used:	225 sacks, Class 'G'
		Additives:	0.5% CFR-2
			0.2% HR-4
		Slurry Weight:	15.6 ppg
		Pre-Slurry Spot:	15 bbls water
		Displaced With:	10 bbls water
			157 bbls mud.

3.2 Drilling Data

3.2.9 Plug Back Program

A number of cement plugs were set in Palm Valley No. 6, and one cement plug was set in Palm Valley No. 6A, before sidetracking. A cement plug was also left at the base of Palm Valley No. 6B prior to completion. These are shown diagrammatically in the Well Completion Diagrams (Figures 6 to 8), and the details are as follows:-

Palm Valley No. 6

Cement Plug No. 1:	Interval:	2058.9 - 2013.2 metres (6755 - 6605 feet)
	Cement:	56 Sacks Class 'A', neat
	Displaced with:	91.8 BBLS Water
Cement Plug No. 2:	Interval:	1661.2 - 1624.6 metres (5450 - 5330 feet)
	Cement:	45 Sacks Class 'A', neat
	Displaced with:	75.7 BBLS Water
Cement Plug No. 3:	Interval:	1335.0 - 1243.6 metres (4380 - 4080 feet)
	Cement:	140 Sacks Class 'A', neat 16 ppg Slurry Weight
	Displaced with:	58 BBLS Water

Palm Valley No. 6A

Cement Plug:	Interval:	1463.0 - 1369.2 metres (4800 - 4492 feet)
	Cement:	144 Sacks Class 'A', neat 14.5 ppg Slurry Weight
	Displaced with:	63 BBLS Water

Palm Valley No. 6B

Cement Plug:	Interval:	2005.9 - 1992.8 metres (6581 - 6538 feet)

3.2.10 Completion Program

Palm Valley No. 6B was completed as a shut-in gas well from the Upper Pacoota Sandstone P1 Unit.

3.2 Drilling Data

3.2.10 Completion Program cont'd

The 7" production casing was set at 2005.9 metres (6581 feet), and the well was completed with 2-7/8" N80 6.5 lb EUE (8rnd) tubing. A Cameron 2-7/8" ID, 5000 Wellhead was installed, and perforation was carried out using tubing conveyed Schlumberger guns.

A well completion diagram for Palm Valley No. 6B, completion assembly detail, well head diagram, and completion assembly table are shown in Figures 8, 9, & 10, and Table 10, and the Weatherford 7" production casing tally and 2-7/8" tubing tally appear in Appendix B.

3.2.11 Perforating Record

Palm Valley No. 6B was perforated at 1430 hours on January 15th 1986, with 5", 37 gram casing guns, at 5 shots per foot. The perforating was performed underbalanced with a 500 foot water cushion to prevent the drop bar from damaging the firing head.

Details of the perforated interval are shown below:-

DEPTH FROM		DEPTH TO		PERFORATED	
METRES	**FEET**	**METRES**	**FEET**	**METRES**	**FEET**
1983.6	6508	1987.3	6520	3.7	12

3.3 Daily Drilling Operation

DATE	MIDNIGHT DEPTH (FEET)	OPERATIONS SUMMARY
		PALM VALLEY No. 6
07/11/85	62	Spud Palm Valley No. 6 at 0200 hours. Air hammer drill 17-1/2" hole to 62'. Pull out of hole (P.O.O.H.), make up 26" hole opener, and open hole to 59'. Run 20" conductor, and set with 72 sacks of Class A cement. Weld conductor and housing flange.
08/11/85	116	Hook up 20" Rotating Blow Out Preventer (R.B.O.P.) and blooie line. Drill mouse hole. Make up 17-1/2" Bottom Hole Assembly (B.H.A.) and blow hole dry. Drill out cement and air hammer drill 17-1/2" hole to 116'.
09/11/85	320	Air hammer drill 17-1/2" hole to 179'. POOH. Replace 3 joints of Heavy Weight Drill Pipe (HWDP) with 3 Drill Collars (D.C.'s). Air hammer drill 17-1/2" hole to 242'. Ream at 207' on connection. POOH to check bit. Ream from 178-188'. Air hammer drill to 303'. Replace 4 joints HWDP for 4 DC's. Air hammer drill 17-1/2" hole to 320'.
10/11/85	488	Air hammer drill 17-1/2" hole to 488'. POOH. Lost one cone and 3" of shank off Bit No. 1. Manufacture Poor Boy junk basket, and Run In Hole (R.I.H.) with same. Work over fish. POOH. Recovered fish. Lay out junk basket. Wait on 17-1/2" bit from Alice Springs.
11/11/85	550	Make up Bit No. 2 and hammer. RIH and air hammer drill 17-1/2" hole to 550'. Check trip to 8" DC's. RIH. No fill. POOH. Run 14 joints of 13-3/8" casing. Pump 100 barrels (BBLS) water. Mix and displace 504 sacks Class "A" cement. Fill 13-3/8" x 17-1/2" annulus with water. Level dropping. Mix 7 BBL high viscosity (VIS) pill and spot in Annulus. Cement Annulus with 96 sacks cement. Clean out cellar, and cut casing. Install and weld 13-3/8" 'A' section.

DATE	MIDNIGHT DEPTH (FEET)	OPERATIONS SUMMARY
12/11/85	550	Weld Casing Bowl, pressure test. Test failed. Grind out and reweld 'A' section. Pressure test failed. Grind out old welds. Install 4-1/2" pipe rams. Lay flare line. Wait on welder from Alice Springs. Pressure test choke manifold to 2800 psi. Reweld 'A' section and tested to 500 psi OK. Nipple up BOP.
13/11/85	560	Nipple up BOP. Pressure test blind rams and casing to 1500 psi, 4-1/2" pipe rams and auxilliary equipment to 1500 psi, and Annular BOP to 1000 psi. Redrill mouse hole. Make up Bit No. 3 and BHA. Tag cement at 445'. Dry hole. Drill out cement, plug (at 452') and cement to 487'. High torque. POOH. Lay out 12" DC. Make up bit, bit sub and RIH. Drill cement to 547', Shoe at 549'. Air drill 12-1/4" hole from 550-560'.
14/11/85	925	Air drill 12-1/4" hole to 630'. POOH. Replace 6 joints of HWDP with 6 DC's. Air drill 12-1/4" hole to 925'.
15/11/85	1217	Air drill 12-1/4" hole to 1217'. POOH. Change out 6 joints HWDP for 6 DC's. Make up Bit No. 4, and pick up reamer.
16/11/85	1637	Air drill 12-1/4" hole to 1637'.
17/11/85	1863	Air drill 12-1/4" hole to 1863'. POOH. Make up Bit No. 5 pick up stabiliser. RIH to 1858' (5' of fill). Mist and unload hole.
18/11/85	2120	Air foam drill 12-1/4" hole to 2120'.
19/11/85	2310	Air foam drill 12-1/4" hole to 2310'.
20/11/85	2475	Air foam drill 12-1/4" hole to 2409'. POOH. Make up Bit No. 6. RIH. Ream undergauge hole from 2295-2409'. Air foam drill 12-1/4" hole to 2475'.
21/11/85	2962	Air foam drill 12-1/4" hole to 2962'.
22/11/85	3275	Air foam drill 12-1/4" hole to 3151'. POOH. Make up Bit No. 7. Lay out reamer, pick up stabiliser. RIH. No fill. Unload hole. Air foam drill 12-1/4" hole to 3275'.
23/11/85	3489	Air foam drill 12-1/4" hole to 3489'.
24/11/85	3701	Air foam drill 12-1/4" hole to 3701'.

DATE	MIDNIGHT DEPTH (FEET)	OPERATIONS SUMMARY
25/11/85	3971	POOH. RIH with re-run (RR) Bit No. 4 to shoe. Slip and cut drill line. RIH. Unload hole. Ream undergauge hole from 3645-3701'. Air foam drill 12-1/4" hole to 3971'.
26/11/85	4084	Air foam drill 12-1/4" hole to 4084'. Circulate and blow hole. Pump 60 BBL high vis pill. POOH. Break and lay out stabilisers. Run Schlumberger GR/Sonic logs. Make up RR Bit No. 4 and RIH to 4062'. 22' of fill. Circulate and clean to 4084'. Pump 75 BBL high vis pill. POOH. Lay out cross over sub (XO sub) and 7" DC.
27/11/85	4084	Lay out 7" and 8" DC's. Rig to run, and run 106 joints of 9-5/8" casing. Mix and pump 624 sacks Class 'A' cement, and displace with 296 BBLS water. Nipple down BOP's. Cut casing, pressure test to 2600 psi, OK. Nipple up BOP's.
28/11/85	4306	Reweld blooie line flange. Pressure test pipe rams. Leaking. Change out seal. Pressure test pipe rams and choke manifold to 2800 psi, Annular BOP to 1500 psi, blind rams and casing to 2500 psi, upper kelly valve to 2500 psi, swabbing valve to 2800 psi, and flare line to 1000 psi. Make up Bit No. 8 and BHA. RIH unloading hole every 1000'. Drill out cement and shoe. Air drill 8-1/2" hole to 4306'.
29/11/85	4878	Air drill 8-1/2" hole to 4878'. POOH for new bit.
30/11/85	5262	Function test BOP's and RIH with Bit No. 9. Ream undergauge hole from 4803-4878'. Air drill 8-1/2" hole to 5262'.
01/12/85	5610	Air drill 8-1/2" hole to 5455'. POOH. Test BOP. Make up Bit No. 10 and RIH. Ream undergauge hole from 5390-5455'. Air drill 8-1/2" hole to 5610'.
02/12/85	6104	Air drill 8-1/2" hole to 6104'.
03/12/85	6444	Air drill 8-1/2" hole to 6400'. Strip out through RBOP. Lay out square DC, pick up reamer, bit sub and 6-1/2" DC. RIH with Bit No. 11. Ream undergauge hole from 6366-6400'. Air drill 8-1/2" hole to 6444'.
04/12/85	6687	Air drill 8-1/2" hole to 6687'. POOH Change cutters on reamer, change out bent DC. Make up Bit No. 12. RIH.

DATE	MIDNIGHT DEPTH (FEET)	OPERATIONS SUMMARY
05/12/85	6852	RIH to casing shoe. Slip and cut drill line. RIH. Ream undergauge hole from 6616-6687'. Air drill 8-1/2" hole to 6852'. POOH for new bit, stripping out through RBOP.
06/12/85	6970	Make up Bit No. 13. RIH. Air drill 8-1/2" hole to 6970'.
07/12/85	7099	Air drill 8-1/2" hole to 7099'. POOH stripping out through RBOP. Lay out reamer, pick up junk sub. Make up Bit No. 14. RIH. Ream undergauge hole from 6909-7058'.
08/12/85	7134	Ream undergauge hole from 7058-7068'. Work stuck pipe at 7068'. Fill hole with 8.8 lb per gallon (PPG) mud, and circulate out gas through choke and degasser. Work pipe free at 08.30 hours. Ream and re-ream tight hole at 7068'. Ream undergauge hole from 7068 - 7099'. Mud drill 8-1/2" hole to 7134'.
09/12/85	7148	Mud drill 8-1/2" hole to 7146'. POOH. Lay out junk sub, pick up reamer and 3 x 6-1/2" DC's. RIH with Bit No. 15. Ream undergauge hole from 7070-7146'. Mud drill 8-1/2" hole to 7148'. POOH to casing shoe. Slip drill line. POOH. Bit and reamer in gauge.
10/12/85	7196	Lay out reamer. Make up Bit No. 16. RIH filling string every 2000'. Circulate out gas cut mud, and displace mud with water. POOH. Strip out to 2122'. Unload hole with air. RIH, unloading hole with air every 1000'. Blow hole dry. Air drill 8-1/2" hole to 7196'.
11/12/85	7426	Air drill 8-1/2" hole to 7426'. POOH. Stripping out through RBOP. Make up Bit No. 17. RIH.
12/12/85	7700	RIH. Ream undergauge hole from 7310-7426'. Air drill 8-1/2" hole to 7700'.
13/12/85	7700	Flow test at 7700'. T.D. Pump 300 BBLS water & displace hole with 8.8 PPG mud. Circulate out gas cut mud until system balanced. Strap out. Rig up and run Schlumberger logs. Run No. 1, DLL/MSFL/GR/CAL. Run No. 2, LDL/CNL/NGT/EPT/CAL Run No. 3, LSS/WAVEFORM

DATE	MIDNIGHT DEPTH (FEET)	OPERATIONS SUMMARY
14/12/85	7700	Run No.3 continued. Run No. 4 HDT/FIL. Rig down Schlumberger. RIH with open ended drill pipe (D.P.) to 6758'. Circulate and condition mud. Set plug No. 1, from 6755-6605', with 56 sacks of Class 'A' cement, and displace with 91.8 BBLS of water. Set plug No. 2 from 5450-5330', with 45 sacks of Class 'A' cement, and displace with 75.7 BBLS of water. Set plug No. 3, from 4380-4080', with 140 sacks of Class 'A' cement, and displace with 58 BBLS of water. POOH laying out excess DP.
		PALM VALLEY No. 6A
15/12/85	4144	Pressure test blind rams, choke manifold, and all auxilliary equipment to 2800 psi. Pressure test 4-1/2" pipe rams to 2800 psi and Annular preventer to 1250 psi. Make up Bit No. 18. RIH. Tag cement at 4106'. Circulate at 4100'. Wait on cement (WOC). Wash cement to 4134'. WOC at 4130'. Wash cement to 4139'. Cement holding. POOH. Pick up Dyna drill, 2^{o} bent sub, and RIH. Polish cement to 4141'. Orientate tool. Dyna drill 8-1/2" hole with mud to 4144'.
16/12/85	4276	Dyna drill 8-1/2" hole with mud to 4200'. POOH. Change to $1\text{-}1/2^{o}$ bent sub. RIH with RR Bit No. 18. Orientate tool. Dyna drill 8-1/2" hole with mud to 4276'.
17/12/85	4383	Dyna Drill 8-1/2" hole with mud to 4326'. POOH. Change to 2^{o} bent sub. Make up Bit No. 19. RIH. Orientate tool. Dyna Drill 8-1/2" hole with mud to 4383'.
18/12/85	4422	Dyna Drill 8-1/2" hole with mud to 4422'. POOH. Lay out dyna drill, bent sub, reamers, and 7 singles. RIH picking up 4 HWDP and laying out 8 singles DP. Ream dyna drilled hole from 4141' to 4422'. Displace hole with water. POOH. Lay out 12 singles DP and 6 point reamer. Make up Bit No. 20. RIH.
19/12/85	4791	RIH, unloading hole with air every 1000'. Blow hole dry. Air drill 8-1/2" hole to 4736'. POOH. Change BHA. Lay out 3 point reamer. Pick up 10' pup joint. RIH with RR Bit No. 20. Air drill 8-1/2" hole to 4791'.

DATE	MIDNIGHT DEPTH (FEET)	OPERATIONS SUMMARY
20/12/85	5048	Air drill 8-1/2" hole to 4837'. POOH. Pick up string stabiliser at 60' above the bit. RIH with RR Bit No. 20. Air drill 8-1/2" hole to 4968'. POOH. Lay out stabiliser and 10' pup joint. RIH with RR Bit No. 20. Air drill 8-1/2" hole to 5048'.
21/12/85	5416	Air drill 8-1/2" hole to 5401'. POOH. Lay out stabiliser, jars, and cross-over subs. Make up Dyna drill, 2^{o} bent sub, and RR Bit No. 19. Function test Dyna Drill with air. Pick up 17 singles of DP. Orientate tool. Dyna drill 8-1/2" hole with air to 5416'. Ream to bottom after connection.
22/12/85	5601	Dyna drill 8-1/2" hole with air to 5424'. Dyna drill motor stalling. POOH lay out Dyna Drill. Make up Bit No. 21 and BHA. RIH. Ream tight hole from 5236'-5424'. Air drill 8-1/2" hole to 5601'. (very high rotary torque). POOH.
23/12/85	5839	POOH. Lay out stabiliser and subs. Make up near bit reamer, subs, and RR Bit No. 21. RIH. Air drill 8-1/2" hole to 5839'. Blow hole clean and displace with 8.9 ppg mud. Circulate and condition gas cut mud. Gas readings 300 units. Pump pill. POOH. Lay out reamer and subs. RIH with open ended DP to 4832'.
24/12/85	5839	RIH. Circulate and condition gas cut mud. Background gas (BG) 200 units, peaks at 600 units, RIH to 5480'. Circulate through choke and degasser. Increase mud weight from 8.9 ppg to 9.2 ppg. BG averaging 250 units. Increase mud weight to 9.7 ppg. BG dropped from 400 to 40 units. POOH to 4800'. Set 300' plug with 144 sacks of Class 'A' cement and displace with 63 BBLS water. POOH slowly.
		PALM VALLEY No. 6B
25/12/85	4508	POOH. Make up RR Bit No. 18 and RIH to 4400' Circulate. RIH and tag cement at 4492'. Polish cement to 4502'. Plug held OK. Circulate bottoms up. POOH. Make up Dyna drill, 2^{o} bent sub, and RR Bit No. 18. RIH. Polish cement plug with dyna drill to 4507'. Orientate tool. Dyna drill 8-1/2" hole to 4508'.
26/12/85	4554	Pump pill. POOH. Change out Dyna drill. RIH. Orientate tool. Dyna drill 8-1/2" hole to 4554'.

DATE	MIDNIGHT DEPTH (FEET)	OPERATIONS SUMMARY
27/12/85	4620	Dyna drill 8-1/2" hole to 4620'.
28/12/85	4655	Dyna drill 8-1/2" hole to 4631'. Pump pill. POOH. Lay out dyna drill and bent sub. Make up Bit No. 22 and BHA. Pick up near bit stabiliser, jars, and reamer. RIH. Ream sidetrack hole from 4507' to 4631'. Mud drill 8-1/2" hole to 4655'.
29/12/85	4733	Mud drill 8-1/2" hole to 4733'.
30/12/85	4781	Mud drill 8-1/2" hole to 4739'. POOH. Lay out build-up assembly. Make up Dyna drill, 2^{o} bent sub and RR Bit No. 22. RIH. Orientate tool. Dyna drill 8-1/2" hole to 4781'. Pump pill and POOH.
31/12/85	4849	POOH. lay out Dyna drill. Make up conventional build-up assembly with Bit No. 23. RIH. Ream from 4736' - 4781'. Mud drill 8-1/2" hole to 4849'.
01/01/86	4950	Mud drill 8-1/2" hole to 4896'. Displace mud in hole with water. POOH. Lay out reamer. Make up RR Bit No. 22. RIH to 2130'. Unload hole with air. RIH unloading hole with air every 1000'. Dry hole. Air drill 8-1/2" hole to 4950', and dry hole.
02/01/86	5423	Air drill 8-1/2" hole to 4982'. Blow hole and attempt to dry. Air foam drill 8-1/2" hole to 5107'. Blow hole dry. Air drill 8-1/2" hole to 5423'.
03/01/86	5739	Air drill 8-1/2" hole to 5455'. POOH. Lay out 54 joints excess DP in derrick. Make up Bit No. 24 and near bit stabiliser. RIH. Ream undergauge hole from 5319' - 5455'. Air drill 8-1/2" hole to 5739'.
04/01/86	5901	Air drill 8-1/2" hole to 5897'. POOH. Strip out through RBOP. Make up Bit No. 25 and RIH. Ream undergauge hole from 5444' - 5897' Air drill 8-1/2" hole to 5901'.
05/01/86	6307	Air drill 8-1/2" hole to 6307'.
06/01/86	6508	Air drill 8-1/2" hole to 6508'. Large gas flow encountered at 6508'. Flow through 3" choke manifold and 3" flare line with 650 psi back pressure. Pump 904 BBLS water and 714 BBLS 9.8 ppg mud. Losing mud to formation. Mix and pump 192 BBLS 9.4 ppg mud. Gas cut water returns. Mix and pump 187 BBLS 9.0 ppg mud. Gas cut water returns. Mix and pump 339 BBLS 8.7 ppg

DATE	MIDNIGHT DEPTH (FEET)	OPERATIONS SUMMARY
06/01/86 cont'd	6508	mud. Circulate returns through choke and poor boy degasser. Mixing mud to maintain mud properties.
07/01/86	6563	Mixing mud to increase weight to 9.3 ppg. Mud drill 8-1/2" hole to 6560'. Circulate through shaker box. Mixing mud. Mud drill 8-1/2" hole to 6563'.
08/01/86	6581	Mud drill 8-1/2" hole to 6565'. POOH 30 stands for check trip. Observe well. RIH. clean out 3' of fill on bottom. Mud drill 8-1/2" hole to 6581'. Circulate and condition mud, mixing mud and Lost Circulation Material (LCM). Observe well. Circulate.
09/01/86	6581	Circulate and condition mud. Observe well. Gas peaked at 400 units. Increase mud weight to 9.9 ppg. POOH for 15 stand check trip. RIH to 6581'. No fill. Circulate. Gas peaked at 380 units. POOH. Rig up Schlumberger, and run logs. Run No. 1 HDT.
10/01/86	6581	Run logs. Run No. 2 LDT, CNL. Rig down Schlumberger. Lay out DC's. Rig down RBOP. RIH. with bit and reamer and condition hole. Ream from 5812' to 6578', and clean out 3' of fill to 6581'. Circulate. POOH, laying out DP.
11/01/86	6581	POOH laying out DP, DC's and HWDP. Rig to run, and run 167 joints 7" casing. Rig up cement head. Circulate mud. Maximum gas 3900 units. Screen out LCM. Mix and pump 123 sacks Class 'G' cement (Stage 1) and displace with 10 BBLS water and 233 BBLS mud.
12/01/86	6581	Drop free fall opening plug, and open ports on D.V. Collar with 950 psi. Circulate through ports. Mix and pump 225 sacks Class 'G' cement (Stage 2), and displace with 10 BBLS water and 157 BBLS mud. Rig down and lift BOP. Set casing slips. Cut casing, and install "C" section. Pressure test to 2500 psi. Rig to pick up DC's and tubing.
13/01/86	6581	Nipple up BOP and flow line. RIH with 6" bit picking up 12 x 4-1/8" DC's and 2-7/8" tubing. Tag cement at 4506'. Drill cement, plugs, and multiple stage cementer. RIH picking up tubing. Tag cement at 6506'. Drill cement from 6506' - 6535', drill plug and cement to float collar at 6538'. Circulate.

DATE	MIDNIGHT DEPTH (FEET)	OPERATIONS SUMMARY
14/01/86	6581	Circulate. POOH. Pressure test ports on multiple cementer, and casing to 2500 psi. OK. RIH with 6" bit and 7" casing scraper to 6538'. Circulate clean. Displace with clean water. Displace with KCL corrosion inhibited completion fluid. POOH. lay out DC's and scraper. Rig up Schlumberger, and run CBL. Lay out BOP. Make up completion assembly.
15/01/86	6581	Make up completion assembly and fill 500' with water cushion. RIH, checking each tubing connection. Rig up and run Schlumberger CCL log. Lay out 5' pup joint and re-space assembly. Run Schlumberger CCL log. Set packer at 6357.43'. Run Schlumberger CCL log. Nipple up Xmas tree. Pressure test 'C' section adaptor, and Xmas tree to 2500 psi. OK. Drop perforating firing bar. Perforate well and observe. Very slight initial build -up to 50 psi.
16/01/86	6581	Observe well. Pump 38 BBLS diesel down tubing to flush perforations. Flowed 36 BBLS diesel back to tanks. Pump 2 BBLS diesel and flow back 2 BBLS. Drop 2 soap sticks, and pump 18-1/2 BBLS diesel. Flowed back 19-1/2 BBLS. Shut well in and observe. 20 psi after 1 hour. Open and flow well. Flow diesel cut water initially, clearing to straight water.
17/01/86	6581	Observe well. Work Slick line. Well commenced flowing gas at 0930 hours, surging gas and mud. Flow well to clean.
		Rig released at 1600 hours.

3.4 Formation Sampling

3.4.1 Ditch Cuttings

Cuttings samples in Palm Valley No. 6 were initially taken at 30 feet intervals from 18.9 metres (62 feet) to the 13-3/8" casing point at 167.6 metres (550 feet). Sampling then continued from below the 13-3/8" casing at 10 feet intervals. All samples were washed, air dried, and split four ways as shown below:-

3 sets to: Magellan Petroleum Australia Limited
1 set to : Northern Territory Department of Mines and Energy

A further composite sample, unwashed and air dried, was taken at 30 feet intervals from 18.9 metres (62 feet) to total depth, for Magellan Petroleum Australia Limited.

A one litre can of unwashed cuttings sample was taken at 50 feet intervals from below the top of the Stokes Siltstone, except for the Horn Valley Siltstone, where the sampling interval was increased to every 30 feet. This was sealed air-tight together with a measured quantity of bacteriacide, inverted, and stored pending geochemical analysis.

While air, and air/foam drilling, samples were collected using a specially designed sample trap in the blooie line. During mud drilling samples were obtained across the shale shaker.

3.4 Formation Sampling

3.4.1 Ditch Cuttings cont'd

No composite, geochemical or split samples were obtained during the drilling of Palm Valley No's 6A and 6B, only the usual cuttings observation sample at 10 feet intervals was taken. Collection of this ceased in Palm Valley No. 6B at 1798.3 metres (5900 feet) because of safety considerations due to the high gas levels being reached.

Cuttings sample descriptions over the following depths appear in Appendices C, D and E: Palm Valley No. 6, from 18.9 metres (62 feet) to 2347.0 metres (7700 feet), Palm Valley No. 6A from 1262.2 metres (4141 feet) to 1779.7 metres (5839 feet), and Palm Valley No. 6B from 1373.7 metres (4507 feet) to 1798.3 metres (5900 feet).

3.4.2 Coring

No conventional or side-wall cores were cut in Palm Valley No.'s 6, 6A or 6B.

3.4.3 Formation Water Sampling

Formation water influx was noted during the drilling of Palm Valley No. 6, and the resistivities taken are shown in tabulated form below.

3.4 Formation Sampling

3.4.3 Formation Water Sampling cont'd

TABLE 11 - FORMATION WATER SAMPLES

Sample No	Depth (feet)	Resistivity (Ohm/Mtrs)	Temperature (^{o}C)	Equivalent PPM NaCl
1	2109	2.20	20.6	2700
2	2166	2.90	18.9	2100
3	2193	4.00	20.6	1400
4	2260	4.70	20.6	1200
5	2400	7.00	21.1	775
6	2658	8.00	20.6	675
7	3151	8.75	20.0	640
8	3541	9.00	20.0	625
9	3750	9.00	21.1	600
10	4084	4.00	18.9	1450

The maximum estimated flow rate was 450 Barrels/hour at a depth of 960.4 metres (3151 feet).

Formation water samples were taken at all the above depths, and sample Nos. 1, 3, and 6 were sent to Amdel laboratories for analysis, the results of which appear in Appendix F.

3.4.4 Gas Sampling

A gas sample was taken upon completion of drilling and sent to Amdel laboratories for analysis. The results indicate a dominantly methane composition, and appear in full in Appendix G.

3.5 Mud Logging

Palm Valley No's 6, 6A, and 6B were logged by Welltech International Pty. Ltd., with a standard skid mounted logging unit.

A depth recorder linked to the rig geolograph line gave rates of penetration in minutes per foot. This was monitored from surface, and the resultant plot of this data is shown on the Welltech Hydrocarbon Well Logs, (Enclosures 1, 2, & 3) and the Composite Well Logs, (Enclosures 4, 5, & 6). The complete range of drilling parameters are displayed on the rig geolograph charts, copies of which are retained in Magellan Petroleum's Alice Springs Office.

The full logging operation in Palm Valley No. 6 began from 18.9 metres (62 feet) to total depth at 2347.0 metres (7700 feet). With the exception of a full set of cuttings samples, this operation continued in Palm Valley No. 6A from 1262.2 metres (4141 feet) to 1779.7 metres (5839 feet), and in Palm Valley No. 6B from 1373.7 metres (4507 feet) to 1798.3 metres (5900 feet). At this depth cuttings sampling ceased, and the gas sampling line was disconnected from the blooie line due to safety considerations. Gas sampling resumed when the hole was displaced with KCL-Baracarb mud at 1983.6 metres (6508 feet), and continued to total depth at 2005.9 metres (6581 feet). However, no further cuttings samples were taken as the shale shaker was by-passed to maintain a high mica concentration in the mud.

3.5 **Mud Logging** cont'd

The gas sample was taken directly from the top of the blooie line while air drilling, and from the "possum belly" using a standard gas trap, while mud drilling.

Gas detection and analysis were by total gas detector (catalytic combustion) and hydrogen flame gas chromatograph, the latter determining composition of gaseous hydrocarbons in the range C1 to C5.

In addition, a portable hydrogen sulphide detector was at hand at all times, although no such gas was detected, and a pit volume totaliser continually monitored the volume of drilling fluid while mud drilling. All data sheets and charts are held at Magellan Petroleum's Brisbane Office.

A detailed description of mud logging operations is given in the Welltech Hydrocarbon Well Logging Report (Appendix H).

3.6 **Wireline Logging**

Palm Valley No. 6

Intermediate Logging Run (12-1/4" Hole Size)

Schlumberger Australia wireline logs were run at 1400 hours on November 26, 1985, at a depth of 1244.8 metres (4084 Feet).

LOG DESCRIPTION & ABBREVIATION	DEPTH FROM	DEPTH TO
Borehole Compensated Sonic/ Gamma Ray (BHC-GR)	1237.5 metres (4060 feet) (Sonic to 512.1 metres (1680 Feet), top fluid).	13.7 metres (45 feet)

3.6 **Wireline Logging** cont'd

Final Logging Run (8-1/2" Hole Size)

Schlumberger Australia wireline logs were run from 1200 hours on December 13, 1985, to 1130 hours on December 14, 1985, at a depth of 2347.0 metres (7700 feet). Details of the runs are tabulated below:-

LOG DESCRIPTION & ABBREVIATION	DEPTH FROM TO	BOTTOM HOLE TEMP
Dual Latero/Micro Spherically Focused/Gamma Ray (DLL-MSFL-GR)	2343.3-1243.6 metres (7688-4080 feet)	66.7°C
Litho Density/Compensated Neutron/Natural Gamma Ray/ Electromagnetic Propagation (LDT-CNL-NGT-EPT)	2344.5-1243.6 metres (7692-4080 feet)	70.0°C
Borehole Compensated Sonic/ Gamma Ray (DDBHC-GR)	2344.5-1243.6 metres (7692-4080 feet)	70.0°C
Borehole Compensated Sonic/ Waveform (DDBHC-WFT)	2344.5-1243.6 metres (7692-4080 feet)	70.0°C
High Resolution Dipmeter (HDT)	2347.6-1615.4 metres (7702-5300 feet)	70.0°C
Fracture Identification (FIL)	2347.6-1615.4 metres (7702-5300 feet)	70.0°C

Computer Processed Logs

- CYBERLOOK
- CYBERDIP
- NGT replay with Th, K, U % and Th/U, Th/K ratios
- EPT porosity replay
- GLOBAL
- LITHOFACIES LOG
- FRACTURE COMPOSITE DISPLAY
- GEODIP
- HDT CONDUCTIVE ANOMALIES LOG AND FREQUENCY PLOTS
- MECHANICAL PROPERTIES LOG
- CLUSTER

3.6 **Wireline Logging** cont'd

Palm Valley No. 6A

No Wireline Logs were run in this part of the well.

Palm Valley No. 6B

Final Logging Run (8-1/2" Hole Size)

Schlumberger Australia wireline logs were run from 1900 hours on January 9, 1986, to 0600 hours January 10, 1986, and again at 0630 hours on January 15, 1986 (CBL-VDL-GR-CCL) at a final depth of 2005.9 metres (6581 feet). Details of the runs are tabulated below:-

LOG DESCRIPTION & ABBREVIATION	DEPTH FROM TO	BOTTOM HOLE TEMP
Litho Density/Compensated Neutron/Gamma Ray (LDT-CNL-GR)	2000.7-1238.7 metres (6564-4064 feet)	55.6°C
High Resolution Dipmeter (HDT)	2004.1-1243.6 metres (6575-4080 feet)	54.4°C
Fracture Identification (FIL)	2004.1-1709.9 metres (6575-5610 feet)	54.4°C
Cement Bond/Variable Density/ Gamma Ray/Casing Collar Locater (CBL-VDL-GR-CCL)	1991.0-1066.8 metres (6532-3500 feet)	60.0°C

Computer Processed Logs

- CYBERDIP
- LDT QUICKLOOK
- TVD of LDT-CNL-GR
- TVD of FIL/GR
- FRACTURE COMPOSITE DISPLAY
- GEODIP
- CLUSTER
- HDT CONDUCTIVE ANOMALIES LOG AND FREQUENCY PLOTS

3.7 Well Velocity Survey

No well velocity survey was carried out on Palm Valley No. 6, 6A or 6B.

3.8 Formation Testing

No Drill Stem Tests were carried out on Palm Valley No. 6, 6A or 6B.

There were however, a series of open hole tests performed while air drilling in the Lower Stairway Sandstone, Horn Valley Siltstone, and Pacoota Sandstone sequences, the results of which are tabulated below. Note that during open hole tests all formations below the 9-5/8" casing shoe were open to testing. Measurements were made through either a 1/4" or 1-1/2" orifice open to a 3" flare line.

Palm Valley No. 6

	DEPTH METRES	DEPTH FEET	FLOW RATE	REMARKS
	1755.3	5759	69 MCFGD	Flaring on Connections, 1/4" orifice
	1851.7	6075	69 MCFGD	- 1/4" orifice
	1938.2	6359	69 MCFGD	- 1/4" orifice
	2028.7	6656	105 MCFGD	Flaring Continuously, 1/4" orifice
*	2086.7	6846	218 MCFGD	Not True Reading, 1/4" orifice
	2088.5	6852	1.3 MMCFGD	- 1-1/2" orifice
	2144.6	7036	1.82 MMCFGD	- 1-1/2" orifice
	2163.8	7099	1.43 MMCFGD	- 1-1/2" orifice
	2227.2	7307	1.53 MMCFGD	- 1-1/2" orifice
	2246.7	7371	1.57 MMCFGD	- 1-1/2" orifice
	2304.3	7560	1.58 MMCFGD	- 1-1/2" orifice
	2347.0	7700	1.58 MMCFGD	- 1-1/2" orifice

* Not a valid reading as the flow was beyond the capability of the 1/4" orifice.

3.8 **Formation Testing** cont'd

Palm Valley No. 6A

DEPTH METRES	FEET	FLOW RATE	REMARKS
1760.5	5776	58 MCFGD	Rising Steadily

Palm Valley No. 6B

DEPTH METRES	FEET	FLOW RATE	REMARKS
1782.8	5849	2.1 MMCFGD	- 1-1/2" orifice
1798.6	5901	12.1 MMCFGD	- 1-1/2" orifice
1864.8	6118	8.4 MMCFGD	- 1-1/2" orifice
1912.9	6276	7.7 MMCFGD	- 1-1/2" orifice
1948.3	6392	7.7 MMCFGD	- 1-1/2" orifice
1983.6	6508	137.0 MMCFGD	- 3" choke manifold

3.9 **Completion Testing**

At 2200 hours on January 16, 1986, after clearing the perforations with diesel, the well was shut-in and a pressure build up of 20 psi was noted after 1 hour. At 2300 hours the well was opened and began flowing diesel cut water which gradually changed to clear water.

The well commenced flowing gas at 09.30 hours on January 17, 1986, surging both gas and mud, and a semi-stabilised gas flow rate of 15.2 MMCFD was established, measured through a 3" plate in a 4" critical flow prover, with a final cleanup flow of 9.7 MMCFD after a period of 5 days.

4. GEOLOGY

4.1 Structure

The structural control in the Palm Valley Field is provided by surface geology, well control, and limited unconnected seismic lines which have been contoured at the Stairway, Pacoota, and Goyder levels. All three horizons show a very similar overall structural configuration of an assymetric arcuate anticline with steeper dips on the northern flank (Figure 2). The western and eastern plunges of the anticline are poorly defined, however, the axis of the anticline can be traced from surface geology over at least 40 kilometres.

Palm Valley No's 1, 2, 3, and 5 were drilled along the structural axis of the field, whereas Palm Valley No. 4 was located on its northern flank, approximately 1.6 kilometres from the axis. Palm Valley No. 6 was again located along the structural axis of the field, close to its mapped crest, 5.7 kilometres east of Palm Valley No. 2. The well is 107.0 metres (351 feet) structurally higher than Palm Valley No. 2, and 159.1 metres (522 feet) structurally higher than Palm Valley No. 1 at the top Pacoota Sandstone structural level.

Dipmeter analysis from the final logging run in Palm Valley No. 6 shows fairly uniform formation dips in the order of $2\text{-}3^{o}$ to the south from the top of the Lower Stairway to total depth in the Pacoota P4 Unit, confirming the near crestal position of the well. The sidetrack Palm Valley 6A/6B was drilled in a north-north westerly direction, and the slightly higher formation tops in Palm Valley No. 6B is in accord with the well being updip from Palm Valley No. 6. Whereas

4.1 **Structure** cont'd

analysis also shows similar dips in the basal Lower Stokes Siltstone in Palm Valley No. 6B to those seen in Palm Valley No. 6, they gradually increase in magnitude and scatter with depth, reaching approximately 6-8^{o} by the top of the Horn Valley Siltstone, and are almost random below this level.

As lithological correlations are expected to be almost identical in the side-tracked hole to the vertical, it appears that either (a) the tool is being adversely affected by increasing hole deviation, or (b) the well is being drilled slightly across the dips rather than updip towards the north northeast, or (c) there have been changes in lateral continuity due to subsurface faulting or fracturing. Because the increase in dip and dip scatter is almost consistent with increasing depth and hole deviation, the first explanation appears more probable. Dipmeter interpretation results are explained in greater detail in Schlumberger's Log Interpretation Report, Appendix I.

Aerial photograph analyses (Geophoto Services 1973) over the field have detailed a major fracture system oriented east northeast to west southwest with a conjugate set oriented subparallel to its axis. Results of a stress drilling programme and performance data from wells drilled to date indicate that this surface fracture system is reflected at depth by extensive fracturing at the Stairway Sandstone, Horn Valley Siltstone, and Pacoota Sandstone stratigraphic levels.

4.1 **Structure** cont'd

The Palm Valley No. 6 wellsite was chosen because of the high probability of intersecting one of the east northeast-west southwest trending major fractures which are well developed along the central axis of the anticline, and which are most likely responsible for the high flow rate (69.7 MMCFGD) encountered in the upper Pacoota in Palm Valley No. 2. The large gas flows (up to 137 MMCFD) seen in Palm Valley No. 6B and strong fracturing identified from wireline logs substantiates the validity of this approach.

4.2 **Geophysics**

Seismic coverage over the Palm Valley area has been limited owing to difficult terrain conditions resulting from the deeply dissected topography. In 1961 the Bureau of Mineral Resources carried out a gravity survey of the Hermannsburg and Henbury areas and made three short traverses near the eastern end of the structure (Figure 2). Three further surveys were run between 1966 and 1973 totalling 13 lines, however, only one line, line 2-2, on which Palm Valley No. 1 was drilled, crosses the axis of the anticline. Due to the high degree of conformity between the surface structure at Palm Valley and the structure at depth, no further seismic is considered necessary at this stage. This conformity has been validated by the drilling to date.

4.3 **Previous Drilling**

Palm Valley No. 1 was drilled from January to May 1965 and was completed as a shut-in gas well after reaching a total depth of 2,029.4 metres (6658 feet) in the Pacoota Sandstone 'P3' unit. The well is located close to the surface

4.3 **Previous Drilling**

Palm Valley No. 1 cont'd

structural axis in the eastern part of the anticline but downdip from the apex of the structure. Gas was encountered in the Lower Stairway Sandstone, the basal Horn Valley Siltstone, and the Pacoota Sandstone (Enclosure 5). The maximum flow recorded was 0.33 million cubic metres per day (11.7 million cubic feet) from an open hole test while drilling with air just below the basal Horn Valley Siltstone dolomite marker bed.

Palm Valley No. 2 is located 12.2 kilometres west of Palm Valley No. 1 along the field's structural axis, and was drilled from December 1969 to February 1970. Total depth reached was 1,999.2 metres (6559 feet) in the upper Pacoota Sandstone 'P1' unit, which was penetrated 52.1 metres (171 feet) higher than in Palm Valley No. 1. The well was completed as a shut-in gas well after encountering gas in both the Lower Stairway Sandstone and upper Pacoota Sandstone, with a maximum flow rate of 1.97 million cubic metres (69.7 million cubic feet) of gas per day after penetrating 0.6 metre (2 feet) into the first Pacoota 'P1' sandstone.

Palm Valley No. 3 is located 3.4 kilometres west-southwest of Palm Valley No. 2 on the western plunge of the anticline, close to the structural axis, and was drilled from January to March 1973 to a total depth of 2,408.2 metres (7901 feet) in the Pacoota Sandstone 'P3' unit. The well is 47.5 metres (156 feet) structurally lower than Palm Valley No. 2, and 4.6 metres (15 feet) structurally higher than Palm Valley No. 1

4.3 **Previous Drilling**

Palm Valley No. 3 cont'd

at the top of the Pacoota Sandstone. Only minor flows of gas on connections were recorded through the Lower Stairway Sandstone with the first major flow occurring in the upper Pacoota Sandstone 'P1' unit. Maximum flow rate was 0.08 million cubic metres (3.0 million cubic feet) of gas per day, and the well was completed as a shut-in gas well.

Palm Valley No. 4 is located 1.6 kilometres north of Palm Valley No. 2 on the northern flank of the anticline, and was drilled from December 1984 to January 1985 to a total depth of 2522.8 metres (8277 feet) in the Pacoota Sandstone 'P4' unit. (Identification uncertain). The well is 166.1 metres (545 feet) structurally lower than Palm Valley No. 2 at the top of the Pacoota Sandstone. No measurable gas flows were recorded from either the Lower Stairway Sandstone or Horn Valley Siltstone, however a small flow was encountered in the upper Pacoota Sandstone 'P1' Unit. Maximum flow rate was 0.04 million cubic metres (1.5 million cubic feet) of gas per day, and the well was completed as a shut-in gas well.

Palm Valley No. 5 is located along the south-eastern nose of the field in an axial position 11.5 kilometres from, and 49.4 metres (162 feet) structurally lower (at top Pacoota Sandstone) than the nearest well, Palm Valley No. 1. The well was drilled from February to March 1985, and reached a total depth of 2,275.6 metres (7466 feet) in the Pacoota Sandstone 'P4' unit. Gas was encountered in the upper Pacoota 'P1' Sandstone unit but did not flow at a measurable rate. No flows were recorded from either the Stairway Sandstone or

4.3 **Previous Drilling**

Palm Valley No. 5 cont'd

Horn Valley Siltstone, and the well was completed as a shut-in, non commercial gas well.

4.4 **Stratigraphy**

The stratigraphic sequence intersected in all Palm Valley wells drilled to date ranges from the outcropping late Devonian Hermannsburg Sandstone of the Pertnjara Group to the Early Ordovician Pacoota Sandstone of the Larapinta Group. A brief description of the stratigraphic succession followed by a more detailed stratigraphy by formation is given below.

Hermannsburg Sandstone and Parke Siltstone lie unconformably on the massive, Early Devonian Mereenie Sandstone. This is dominantly a porous sandstone unit of aeolian/shallow marine origin, and is an aquifer throughout the Amadeus Basin. It unconformably overlies the Carmichael Sandstone, an estuarine sequence of sandstones, siltstones, and shales, which in turn grades basally into the shallow marine sequence of the Stokes Siltstone. Lying conformably below the Stokes Siltstone is the Stairway Sandstone, a shallow, intertidal marine sequence of sandstones, siltstones, and shales. Underlying the Stairway Sandstone is the Horn Valley Siltstone, which together with the Stokes Siltstone, is considered to be primary cap rock. It is dominantly composed of euxinic dark grey to black, pyritic siltstone and shale, with lesser interbeds of limestone and dolomite deposited on an open shelf. The Pacoota Sandstone, the main gas bearing reservoir, lies conformably below the Horn Valley Siltstone, and consists of nearshore marine interbedded sandstones, siltstones, and shales.

4.4 **Stratigraphy** cont'd

A stratigraphic column (Figure 11), stratigraphic tables for Palm Valley No's 6, 6A, and 6B, (Tables 12, 13, & 14), predicted verses actual section, Palm Valley No. 6 (Figure 12), and detailed stratigraphic description taken from Palm Valley No. 6, are given below.

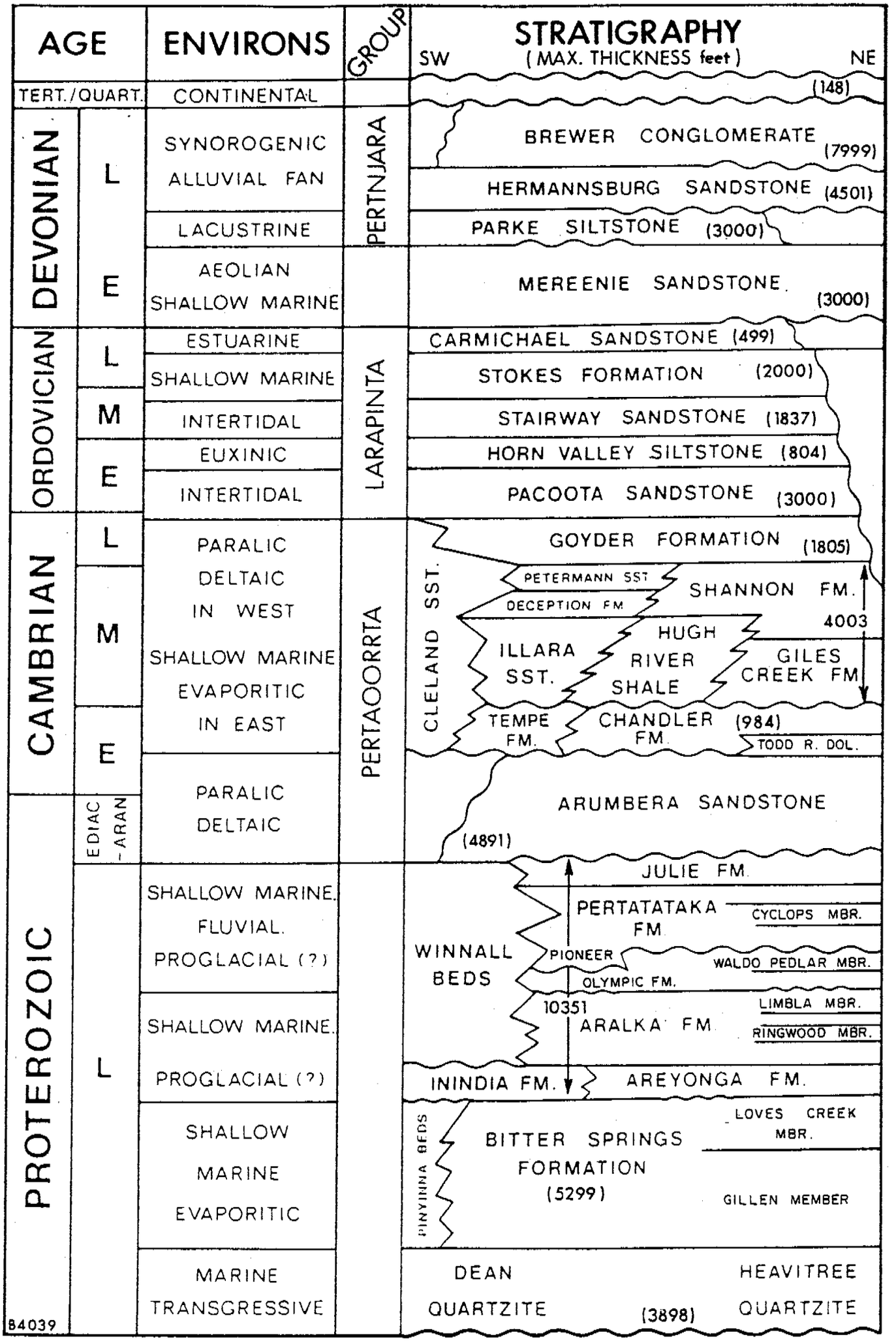
HERMANNSBURG SANDSTONE

Surface to 415.1 metres
(Surface to 1362 feet)
THICKNESS: 408.4 metres +
(1340 feet +)
AGE: LATE DEVONIAN

The Hermannsburg Sandstone represents a non-marine sequence of alluvial fan deposits reaching a thickness of approximately 408.4 metres (1340 feet) at the Palm Valley No. 6 location. The Formation lies unconformably in part, on the Parke Siltstone.

The sequence, which consists of interbedded sandstones and siltstones, becomes progressively more argillaceous with depth, with siltstone dominating towards the base of the unit.

The sandstones are clear, light to medium orange, pale yellow, and occasionally milky, very fine to medium grained, sub-angular to sub-rounded, sometimes angular, and generally moderately sorted. They are quartzose with occasional dark lithic grains, and locally have ferruginous grain coatings. The grains are predominantly well cemented with silica, making the sandstones hard, although locally minor clay occurs in the matrix.



AFTER JACKSON, Mc.KIRDY & DECKELMAN, 1984

FIGURE 11

TABLE 12: STRATIGRAPHIC TABLE DRILLED IN PALM VALLEY NO. 6

AGE	FORMATION	MEASURED DEPTH (FROM KB)		DEPTH KB=2863'	AMSL AMSL	BED THICKNESS	
		METRES	FEET	METRES	FEET	METRES	FEET
Late Devonian	Hermannsburg Sandstone	6.1	20	+ 866.7	+2843	408.4+	1340+
Early Devonian (?)	Parke Siltstone	415.1	1362	+ 457.5	+1501	36.6	120
Early Devonian	Mereenie Sandstone	451.7	1482	+ 420.9	+1381	583.7	1915
Late Ordovician	Carmichael Sandstone	1036.3	3400	- 163.7	- 537	87.5	287
Middle to Late Ordovician	Stokes Siltstone	1123.8	3687	- 251.2	- 824	324.9	1066
Middle Ordovician	Upper Stairway Sandstone	1449.0	4754	- 576.4	-1891	24.4	80
Middle Ordovician	Middle Stairway Sandstone	1473.4	4834	- 600.8	-1971	185.0	607
Middle Ordovician	Lower Stairway Sandstone	1658.7	5442	- 786.1	-2579	91.4	300
Early Ordovician	Horn Valley Siltstone	1750.2	5742	- 877.5	-2879	81.1	266
Early Ordovician	Pacoota Sandstone P1 Unit	1831.2	6008	- 958.6	-3145	189.3	621
Early Ordovician	Pacoota Sandstone P2 Unit	2020.8	6630	-1148.2	-3767	96.0	315
Early Ordovician	Pacoota Sandstone P3 Unit	2116.8	6945	-1244.2	-4082	212.8	698
Early Ordovician	Pacoota Sandstone P4 Unit	2329.9	7644	-1457.2	-4781	17.1+	56+
	TOTAL DEPTH	2347.0	7700	-1474.3	-4837		

Formation Dip = 3^{o}
Maximum Hole Deviation = 2^{o}
Bed Thickness = Apparent Thickness x Cos 3^{o}

K.B. = Kelly Bushing
A.M.S.L. = Above Mean Sea Level

TABLE 13: STRATIGRAPHIC TABLE DRILLED IN PALM VALLEY NO. 6A

AGE	FORMATION	MEASURED DEPTH (FROM KB)		TRUE VERTICAL DEPTH		DEPTH AMSL KB=2863' AMSL		STRAIGHT HOLE DEPTH		TRUE BED THICKNESS	
		METRES	FEET	METRES	FEET	METRES	FEET	METRES	FEET	METRES	FEET
M. Ord	U. Stairway SST	1452.4	4765	1449.3	4755	- 576.7	-1892	1450.8	4760	24.7	81
M. Ord	M. Stairway SST	1477.4	4847	1473.7	4835	- 601.1	-1972	1475.5	4841	186.2	611
M. Ord	L. Stairway SST	1664.8	5462	1658.7	5442	- 786.1	-2579	1662.1	5453	92.4	303
E. Ord	Horn Valley SLST	1757.8	5767	1750.2	5742	- 877.5	-2879	1754.4	5756	21.9+	72+
	TOTAL DEPTH	1779.7	5839	1771.8	5813	- 899.2	-2950	1776.4	5828		

Formation Dip = 3^{o}
Maximum Hole deviation was 13.5^{o}

K.B. = Kelly Bushing
A.M.S.L. = Above Mean Sea Level

Depth A.M.S.L. is calculated from the true vertical depth of the formation top.

Straight Hole Depth is the depth of the formation top projected downdip to a position vertically below the surface location of the well.

True Bed Thickness = Apparent thickness (from straight hole depth) x Cos 3^{o}

TABLE 14: **STRATIGRAPHIC TABLE** **DRILLED IN PALM VALLEY NO. 6B**

AGE	FORMATION	MEASURED DEPTH (FROM KB)		TRUE VERTICAL DEPTH		DEPTH AMSL KB=2863' AMSL		BED * THICKNESS	
		METRES	FEET	METRES	FEET	METRES	FEET	METRES	FEET
Middle Ordovician	Upper Stairway Sandstone	1453.0	4767	1448.4	4752	- 575.8	-1889	24.1	79
Middle Ordovician	Middle Stairway Sandstone	1478.9	4852	1472.5	4831	- 599.8	-1968	184.1	604
Middle Ordovician	Lower Stairway Sandstone	1688.3	5539	1656.6	5435	- 783.9	-2572	92.0	302
Early Ordovician	Horn Valley Siltstone	1805.6	5924	1748.6	5737	- 876.0	-2874	80.8	265
Early Ordovician	Pacoota Sandstone P1 Unit	1919.6	6298	1829.4	6002	- 956.8	-3139	57.0+	187+
	TOTAL DEPTH	2005.9	6581	1886.4	6189	-1013.8	-3326		

Maximum Hole deviation was 48.8 degrees.

K.B. = Kelly Bushing
A.M.S.L. = Above Mean Sea Level

* Bed Thickness was calculated from True Vertical Depth, assuming negligible Formation Dip.

Note: Dipmeter computations unreliable. (see Schlumberger Log Interpretation Report. Appendix I)

PALM VALLEY - 6 PREDICTED vs ACTUAL SECTION

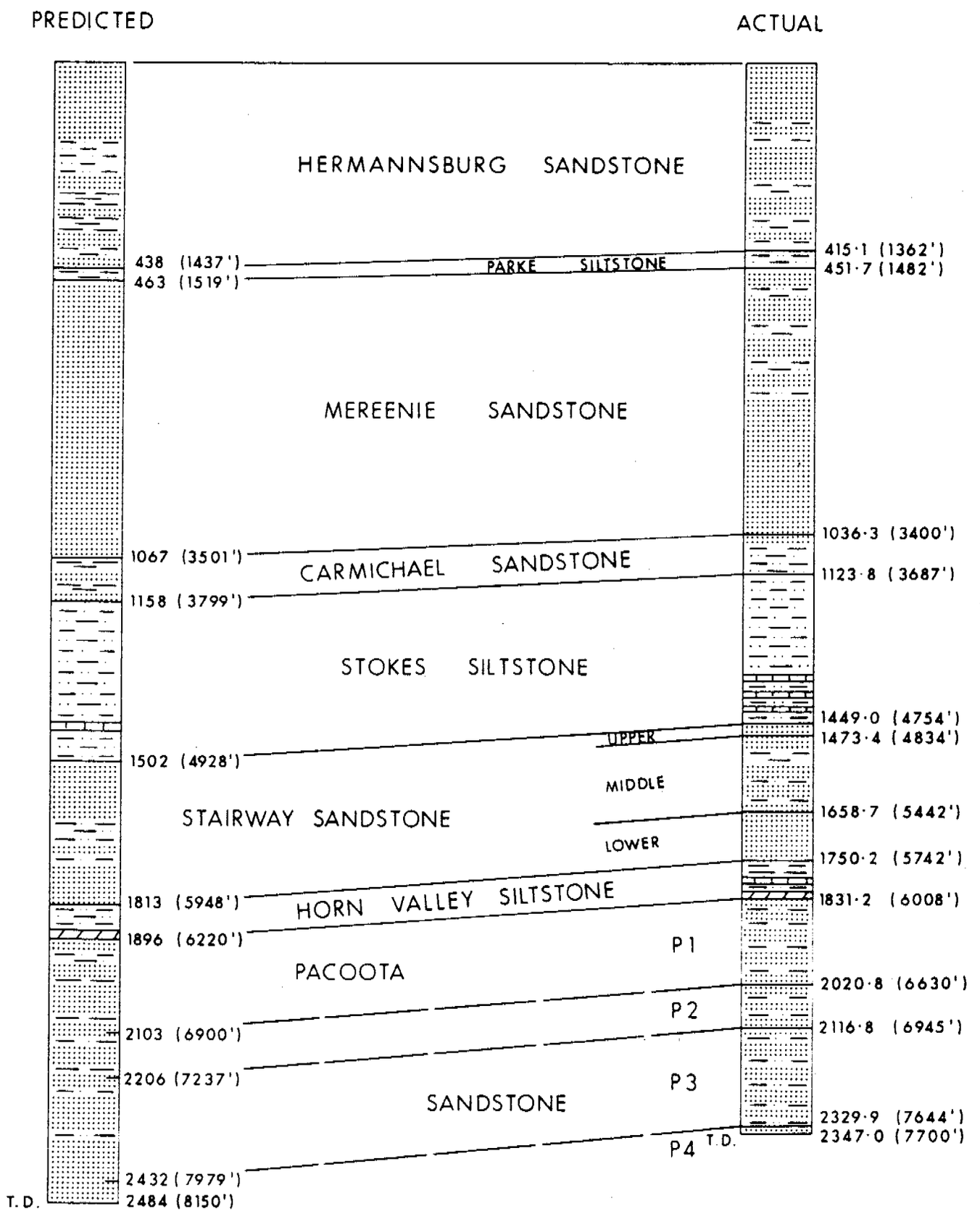


FIGURE 12

4.4 **Stratigraphy** cont'd

Grain size, shape, and diagenetic cementation result in generally low porosity, ranging from tight to poor. There was no influx of formation water in this section.

The siltstones are medium to dark red/brown, becoming locally mottled with grey/green at depth, well indurated, hard, blocky, siliceous, non-calcareous, and generally micro-micaceous. Throughout the formation they grade into very fine sandstones, although towards the base they become locally more argillaceous, sub-fissile, and slightly to very dolomitic.

Gypsum is a common trace mineral at the base of the sequence, appearing as clear to pale orange tabular crystals, fibrous crystals, and in white massive form.

PARKE SILTSTONE

415.1 to 451.7 metres
(1362 to 1482 feet)
THICKNESS: 36.6 metres
(120 feet)
AGE: EARLY DEVONIAN

The Parke Siltstone is composed of 36.6 metres (120 feet) of lacustrine siltstones and shales with minor sandstones at Palm Valley No. 6.

The siltstones are brown, red/brown, and locally mottled grey/green. They are hard, blocky, siliceous, and slightly to moderately dolomitic at the top, becoming predominantly very argillaceous, micromicaceous, and sub-fissile with depth.

4.4 **Stratigraphy** cont'd

The shales appear as thin interbeds with the siltstone, and are red/brown, grey/brown, and locally mottled with grey/green. They are very argillaceous, firm to hard, sub-fissile to fissile, micromicaceous, and slightly dolomitic.

The sandstones appear as very discrete horizons towards the base of the unit, and although no trace was recorded from sampling over the interval, their position can be seen on the drill rate and gamma-ray log.

The locally evaporitic nature of the section is reflected in the traces of fibrous and tabular gypsum crystals present throughout.

MEREENIE SANDSTONE

451.7 to 1036.3 metres
(1482 to 3400 feet)
THICKNESS: 583.7 metres
(1915 feet)
AGE: EARLY DEVONIAN

The Mereenie Sandstone is a dominantly sandstone unit of early Devonian age, and is 583.7 metres (1915 feet) thick at the Palm Valley No. 6 location. It is of aeolian and shallow marine origin, and has been suggested to represent wind blown sand deposited (in part) in a shallow sea, which may have been transgressing across the area from the west.

The top of the Mereenie Sandstone is very well marked by a sharp decrease on the gamma ray log, indicating a change from the overlying Parke siltstones to the first appearance of sandstones.

4.4 **Stratigraphy** cont'd

From 451.7 to 754.4 metres (1482 to 2475 feet), the sequence is primarily sandstone with minor shales and siltstones. The sandstones are clear to white and light grey, light brown, and light to dark yellowish orange, fine to medium, and locally coarse grained, are sub-angular to well rounded, and generally well sorted. They are predominantly quartzose, locally feldspathic, and contain black and light grey lithics.

They are hard, variably cemented with quartz, calcite, and haematite, and locally have a pale yellowish orange clay matrix. However, they become poorly consolidated with depth as is seen from the abundance of disaggregated grains, which is reflected in the general increase in porosity from fair to good.

From the gamma ray log the siltstones and shales can be seen as very discrete horizons down to 640.1 metres (2100 feet). At this point they are more massively interbedded with the sandstones, with individual bed thicknesses of up to 10.4 metres (34 feet).

The siltstones are light brown, and moderate to dark yellowish brown, hard, arenaceous, and locally micro-micaceous, calcareous, and dolomitic. At depth they become very sandy, grading into very fine grained sandstones. The shales are light brown and yellowish brown, hard, micromicaceous, sub-fissile, locally calcareous, and appear very finely interlaminated with the sandstones.

4.4 **Stratigraphy** cont'd

From 754.4 to 1036.3 metres (2475 to 3400 feet) the lithology consists of massive sandstone, representing a fairly uniform phase of deposition. The sandstones are light brown, and clear to very pale grey, with minor orange/pink, very fine to coarse grained, sub-rounded to well rounded, and moderately to well sorted. They are quartzose, locally feldspathic, contain black and red lithics, and locally the opaque oxide minerals haematite and magnetite (diagenetic).

The variable drill rate through this section reflects the degree of quartz and haematite cementation, and porosity development, which ranges from fair to good.

At the base of the Mereenie Sandstone, from 997.9 to 1036.3 metres (3274 to 3400 feet), is a distinctive massive sandstone unit which has been informally named the Gosses Bluff Sandstone. It is clear to white, very fine to coarse grained, rounded to well rounded, and moderately to very well sorted. The sandstone is clean, being predominantly quartzose with only minor lithics, and well cemented with silica, resulting in a generally poor to fair visual porosity.

The Mereenie Sandstone first produced formation water from 642.8 metres (2109 feet) at a rate of 30 barrels per hour, and continued to do so throughout the rest of the sequence, reaching a maximum flow of 450 barrels per hour at 960.4 metres (3151 feet).

4.4 **Stratigraphy** cont'd

CARMICHAEL SANDSTONE

1036.3 to 1123.8 metres
(3400 to 3687 feet
THICKNESS: 87.5 metres
(287 feet)
AGE: LATE ORDOVICIAN

The Carmichael Sandstone is 87.5 metres (287 feet) thick at Palm Valley No. 6, and represents an estuarine sequence of sandstones and siltstones which conformably overlie the Stokes Siltstone. Its lower limit is placed at the base of the first major sandstone that appears after the extensive Stokes Siltstone sequence, and its upper limit is taken at the base of the massive sandstones of the Mereenie formation.

From 1036.3 to 1066.8 metres (3400 to 3500 feet) there are a series of alternating sandstones and siltstones.

The sandstones are clear, tan and white, very fine to fine, and occasionally medium grained, sub-angular to sub-rounded, quartzose with a predominantly siliceous cement, and generally have tight to poor porosity.

The siltstones are medium to dark red/brown and brown, argillaceous, firm to hard, blocky, and locally dolomitic, sub-fissile and micromicaceous.

From 1066.8 to 1074.1 metres (3500 to 3524 feet) a clear to pale orange/brown quartzitic sandstone occurs. The sandstone is fine to medium grained, sub-angular to sub-rounded, moderately sorted, and has a predominantly silica cement, resulting in poor visual porosity.

4.4 **Stratigraphy** cont'd

The sequence from 1074.1 to 1123.8 metres (3524 to 3687 feet) is predominantly siltstone with sandstone interbeds at the bottom.

The siltstone is dark red/brown to brown, and light grey to grey/green, well indurated, firm to hard, locally brittle, blocky, contains dark lithic flecks, and grades in part to a very fine sandstone.

The basal sandstones are white to light tan and orange, very fine to fine grained, angular to sub-angular, moderately to well sorted, quartzose, and are well cemented with silica, resulting in tight to poor visual porosity.

STOKES SILTSTONE

1123.8 to 1449.0 metres
(3687 to 4754 feet)
THICKNESS: 324.9 metres
(1066 feet)
AGE: MIDDLE-LATE ORDOVICIAN

The Stokes Siltstone is a shallow marine predominantly siltstone sequence, with minor sandstone and limestone horizons. The formation is 324.9 metres (1066 feet) thick at Palm Valley No. 6, and conformably overlies the Stairway Sandstone.

The siltstones are light to dark red/brown, orange/brown, and brown, and occasionally grey/green. They are well indurated, blocky to sub-fissile, firm to hard, argillaceous, micromica-ceous, and locally have traces of dark lithic fragments and

4.4 **Stratigraphy** cont'd

glauconite. They grade locally to red/brown, fissile, splintery shales, and where slightly sandy, grade into a very fine grained sandstone. The siltstones are increasingly dolomitic with depth, becoming moderately to very dolomitic at the base of the sequence. A possible thin band or nodular horizon of dolomite occurs at 1310.6 metres (4300 feet).

Minor sandstone horizons are present in the upper part of the sequence and towards the base. These are generally white to grey, very fine grained, moderately sorted, hard, quartzose, with poor visual porosity.

Below 1357.9 metres (4455 feet) the siltstones become thinly interbedded with a series of limestones, which in places attain thicknesses in excess of 3.0 metres (10 feet). They are clear to white, occasionally grey/green, hard, crypto-crystalline, and locally arenaceous.

STAIRWAY SANDSTONE

1449.0 to 1750.2 metres
(4754 to 5742 feet)
THICKNESS: 300.8 metres
(987 feet)
AGE: MIDDLE ORDOVICIAN

The Stairway Sandstone represents a beach/intertidal sequence lying conformably on the Horn Valley Siltstone, and is subdivided into 3 units on the basis of lithology and electric log character.

4.4 **Stratigraphy** cont'd

A progressive beach build up at the base of the formation is characterised by massive sandstones which grade to alternating transgressive phases of finer grained clastics in the middle unit, probably representing littoral zone advances, or the depositional phases of a Barrier Island Lagoon (Wells et al., 1970). A beach environment again predominated at the top, before the area was inundated by the shallow sea in which the Stokes Siltstone was deposited.

UPPER STAIRWAY SANDSTONE UNIT

1449.0 to 1473.4 metres
(4754 to 4834 feet)
THICKNESS: 24.4 metres
(80 feet)
AGE: MIDDLE ORDOVICIAN

The Upper Stairway unit is a predominantly sandstone sequence, which appears from the wireline logs to be partially gradational with the overlying Stokes Siltstone. The sandstones are clear to white, very fine grained, sub-angular to sub-rounded, moderately sorted, quartzose, with occasional loose quartz grains. They are generally hard and well cemented with silica, resulting in very poor to poor porosity.

Minor siltstones and thin shale bands, similar in character to the overlying formation, are also present in the unit's upper section.

4.4 **Stratigraphy** cont'd

MIDDLE STAIRWAY SANDSTONE UNIT 1473.4 to 1658.7 metres (4834 to 5442 feet)
THICKNESS: 185.0 metres (607 feet)
AGE: MIDDLE ORDOVICIAN

The Middle Stairway Sandstone can be divided into two distinctly seperate zones, on the basis of lithology and electric log character.

From 1473.4 metres (4834 feet) to 1567.6 metres (5143 feet) the sequence is variably interbedded siltstone and sandstone with very minor shales, and becomes progressively more arenaceous with depth, with sandstones predominating at the base. This general sequence is again repeated from 1567.6 metres (5143 feet) to 1658.7 metres (5442 feet).

The siltstones are dark grey, dark grey/green, and locally dark red/brown, firm to hard, blocky to sub-fissile, argillaceous, micromicaceous, and slightly dolomitic in part. They are locally very finely sandy, glauconitic, pyritic, and carbonaceous.

The sandstones are predominantly clear, and white to light grey, with minor pale to medium orange sandstones occuring between 1545.3 metres (5070 feet) and 1551.4 metres (5090 feet). They are very fine to fine grained, angular to sub-angular, well sorted, quartzose, with minor black lithic grains, carbonaceous partings, and local aggregates of pyrite. The angular nature of the grains, good silica cement, and locally occuring clay matrix, result in generally very poor porosity in these sandstones.

4.4 **Stratigraphy** cont'd

Minor horizons of white to medium grey, microcrystalline limestone, and dark grey, hard, fissile shale also occur through this unit.

LOWER STAIRWAY SANDSTONE UNIT 1658.7 to 1750.2 metres (5442 to 5742 feet)
THICKNESS: 91.4 metres (300 feet)
AGE: MIDDLE ORDOVICIAN

The Lower Stairway Sandstone is a dominantly massive sandstone sequence, with lesser interbeds of siltstone. The unit conformably overlies the Horn Valley Siltstone, and is 91.4 metres (300 feet) thick at Palm Valley No. 6.

The sandstones are clear, white to light grey, and pale grey/green, very fine to fine grained, hard, angular to sub-angular, well sorted, and well cemented with silica. Together with these clean, tight aggregates, are loose, medium to coarse grains, which are often broken, and display frosted and pitted surfaces. Their presence increases with depth, until loose grains dominate in the lower portion of the unit. The 'basal' sand in this lower portion is characterised on the Schlumberger lithology log (Enclosure 8) as being highly quartzitic compared to the graywacke and arkose composition of most other Stairway sandstones.

Below 1373 metres (5700 feet) however, wireline logs indicate the presence of both carbonates (dolomite and limestone) and heavy minerals, although no evidence of these was seen in cuttings samples. The interval probably represents restricted shelfal deposition compared to the more open 'barrier' bar environment of the overlying unit.

4.4 **Stratigraphy** cont'd

Interbedded siltstones are dark grey to black, hard, blocky to sub-fissile, argillaceous, micromicaceous, very finely sandy in part, and occasionally slightly dolomitic. They are also locally fissile, and grade into dark grey to black, hard, micromicaceous shales.

Minor horizons of white to pale brown, hard, microcrystalline limestone have also been recorded from this unit.

The lower formational contact with the Horn Valley Siltstone is quite sharp, representing a change from the shallow marine/intertidal environment in which the Stairway Sandstone was deposited to relatively deeper marine conditions.

HORN VALLEY SILTSTONE

1750.2 to 1831.2 metres
(5742 to 6008 feet)
THICKNESS: 81.1 metres
(266 feet)
AGE: EARLY ORDOVICIAN

The Horn Valley Siltstone is a sequence of interbedded siltstones, shales, limestones and dolomites, deposited in a shelfal marine environment, and is conformable with the underlying Pacoota Sandstone.

The siltstones are dark brown, and very dark grey to black, argillaceous, hard, micromicaceous, and slightly to moderately dolomitic. They are predominantly sub-fissile, but become fissile and platy below 1804.4 metres (5920 feet), grading to dark grey to black shales. The composition of these shales and most others seen in the lower part of the well, has been identified as dominantly illitic from Schlumberger's lithology log.

4.4 **Stratigraphy** cont'd

The limestones form thin beds of up to 4.3 metres (14 feet) in thickness, and are white to very pale grey, pale to medium brown, hard, microcrystalline, and locally chalky in nature.

The characteristic basal Horn Valley marker horizon consists of dolomite with lesser limestone in Palm Valley No. 6, and is present from 1825.1 metres (5988 feet) to the top of the Pacoota Sandstone, a total thickness of 6.1 metres (20 feet). The dolomite is pale to medium grey/brown, hard, crypto-crystalline to microcrystalline, locally argillaceous, grading basaly to pale to medium brown, micro to very finely crystalline limestone.

Pyrite is a common trace mineral throughout the sequence, and its presence, together with the dark grey to black colour of the shales, suggests a strongly reducing environment of deposition.

PACOOTA SANDSTONE

1831.2 to 2347.0 metres
(6008 to 7700 feet)
THICKNESS: 515.2 metres
(1690 feet)
AGE: EARLY ORDOVICIAN

The Pacoota Sandstone is a variably interbedded sequence of sandstones and siltstones with minor shales, deposited in an intertidal/shallow marine environment. The formation can generally be subdivided into four distinct units, P1, P2, P3 and P4, on the basis of lithology and log character. All four units were penetrated in Palm Valley No. 6, descriptions of which follow.

4.4 **Stratigraphy** cont'd

PACOOTA SANDSTONE P1 UNIT 1831.2 to 2020.8 metres (6008 to 6630 feet)
THICKNESS: 189.3 metres (621 feet)
AGE: EARLY ORDOVICIAN

The P1 unit is a thinly interbedded sequence of sandstones and siltstones, with its upper boundary taken at the base of the thick dolomite marker bed in the overlying Horn Valley Siltstone. The unit becomes progressively more arenaceous with depth, with its lower boundary taken at the top of a major silty interval which is marked by a sharp increase in the gamma ray response.

The sandstones are pale to medium grey/brown, and light to medium grey, very fine to fine grained, angular to sub-angular, well sorted, well cemented with silica with no visible clay matrix, and are locally silty grading in part to siltstone. Below 1944.6 metres (6380 feet) the sandstones become predominantly composed of loose, medium to coarse, sub-rounded to rounded quartz grains. They are clear to pale yellow, orange, and rose in colour, and display frosted and pitted grain surfaces. Visual porosity increases fraction-ally with depth, reflecting the degree of cementation.

The siltstones in this unit are dark grey/brown to dark grey, and red/brown, blocky to sub-fissile, argillaceous, slightly dolomitic, locally micromicaceous, and very finely sandy grading to very fine sandstone.

Minor discrete shale horizons have been interpreted from the wireline logs as being present in the upper half of the unit, although no trace was recorded from sampling over the interval.

4.4 **Stratigraphy** cont'd

PACOOTA SANDSTONE P2 UNIT

2020.8 to 2116.8 metres
(6630 to 6945 feet)
THICKNESS: 96.0 metres
(315 feet)
AGE: EARLY ORDOVICIAN

The P2 unit consists of an upper thick dominantly siltstone unit and a lower interbedded sequence of sandstones and siltstones, that becomes progressively more arenaceous with depth.

The sandstones are light to medium grey and grey/brown, very fine to fine grained, only slightly dolomitic, and well cemented with silica, resulting in generally low porosities. They are silty, contain fragments of dark grey shale, minor black lithic grains, and are locally very glauconitic, decreasing with depth.

Below 2069.6 metres (6790 feet) the sandstones are predominantly composed of loose, medium to coarse, sub-angular to sub-rounded grains. They are clear to milky, and very pale yellow, and generally display frosted and pitted grain surfaces.

The siltstones are predominantly dark grey to brown, hard, sub-fissile to occasionally fissile, argillaceous to very finely sandy, and locally contain pyrite as disseminations and aggregates. An orange/brown to orange siltstone is also present below 2081.8 metres (6830 feet), which is hard, argillaceous, locally sandy, and slightly to moderately dolomitic.

4.4 **Stratigraphy** cont'd

Minor discrete shale horizons have been interpreted from the wireline logs as being present in the upper half of this unit, although no trace was recorded from sampling over the interval.

PACOOTA SANDSTONE P3 UNIT

2116.8 to 2329.9 metres
(6945 to 7644 feet)
THICKNESS: 212.8 metres
(698 feet)
AGE: EARLY ORDOVICIAN

The top of the P3 unit is not clearly defined, either lithologically, or from electric logs. However, from correlations with other wells, it occurs where the sandstones become more massively bedded, and in Palm Valley No. 6 this is at 2116.8 metres (6945 feet). This depth marks as well, the approximate level below which glauconite is no longer seen in the formation.

The P3 unit is predominantly sandstone, with lesser interbeds of siltstone and minor shale. The sandstones are clear, and white to light grey, with minor pale pink to red/brown, and pale yellow. They are generally loose, medium to coarse, sub-angular to rounded, moderately well sorted, and quartzose, with occasional frosted grain surfaces. The sandstones also form very fine to medium grained aggregates which are well cemented with silica resulting in a visual porosity range of nil to poor. A red/brown, possibly ferruginous clay matrix is commonly found coating grains, and locally the sandstones become silty. The P3 interval is quite distinctive on the Schlumberger lithology log, as the sandstones are more quartzitic and arkosic in composition than the overlying P2 and P1 units.

4.4 **Stratigraphy** cont'd

The siltstones are medium grey/green, dark grey to black, orange brown and red/brown, argillaceous, blocky to sub-fissile, and locally fissile and brittle, grading in part to shale. They are slightly to moderately dolomitic, locally sandy, variably micaceous, and become soft and friable towards the base of the sequence.

The shales are dark grey to black, red/brown, and light to dark grey/green, fissile, hard, brittle, splintery, slightly to moderately dolomitic, and are locally silty, micaceous, and very finely pyritic.

Minor traces of dark grey, hard, very finely crystalline dolomite, and medium to dark grey and cream, cryptocrystalline to microcrystalline limestone have also been noted through this unit.

PACOOTA SANDSTONE P4 UNIT

2329.9 to 2347.0 metres
(7644 to 7700 feet)
THICKNESS: 17.1 + metres
(56 + feet)
AGE: EARLY ORDOVICIAN

Palm Valley No. 6 penetrated 17.1 metres (56 feet) of clean, hard, quartzitic sandstone at the base of the well. This has been positively identified as P4 owing to the similar lithological characteristics seen in the unit to other areas of the basin, such as very low gamma ray values, the white colour of the sandstone, and the very hard, resistive nature of the beds.

4.4 **Stratigraphy** cont'd

The sandstones described are clear, milky, and light grey, loose, medium to coarse, sub-angular to rounded, well sorted, and have frosted grain surfaces in part. They also occur as sub-angular, very fine to medium, predominantly fine grained white aggregates. These are well cemented with silica, very clean with only rare traces of black lithics, and have nil to very poor visible porosity. From the Schlumberger lithology log, the P4 unit appears as dominantly quartzitic below 2333.5 metres (7656 feet).

Orange/brown, and pale grey/green siltstones are also present in very discrete horizons in this unit. They are blocky, hard, argillaceous, and are locally slightly to moderately dolomitic.

A shale also occurs 3.0 betres (10 feet) below the top of the unit at a depth of 2332.9 metres (7654 feet), and is grey/green, and dark grey to black, hard, fissile to sub-fissile, and locally slightly dolomitic.

4.5 Porosity and Permeability of Sediments

Visual estimations of porosity were made from cuttings in Palm Valley No's. 6, 6A and 6B, and these appear in the Sample Descriptions (Appendices C, D and E) and Well Logs (Enclosures 1 to 6). Porosities for Palm Valley No. 6 were also computed using Schlumberger's 'Global' log interpretation program, and results appear graphically on the Global and Lithofacies Logs (Enclosures 11 and 8), and as a listing on a 1 foot interval (Appendix J). No wireline logs were run in Palm Valley No. 6A, however neutron/density porosities are available for Palm Valley No. 6B, and the data has been displayed on the Fracture Composite Log (Enclosure 10).

Except for the Mereenie Sandstone which flowed up to 450 barrels/hour of formation water, porosities encountered were generally very poor to poor in all three wells, owing predominantly to both authigenic and diagenetic silica cementation. A description of porosities for each formation intersected is given below.

In the Hermannsburg Sandstone which outcrops at surface, tight to very poor visual porosity was observed from cuttings. No wireline log porosity is available over this interval though, as the sonic tool run was inoperative above 512 metres (1680 feet).

The underlying Parke Siltstone consisted predominantly of siltstone and minor shale with no visible porosity. Again, no wireline porosity was attainable.

4.5 **Porosity and Permeability of Sediments** cont'd

Porosities in the Mereenie Sandstone were very variable, ranging from fair to good from cuttings descriptions. The sonic log run over most of this formation is badly affected by foam used to facilitate unloading of formation water, however, where valid, porosities range from 12 to 21%. The influx of formation water below 642.8 metres (2109 feet) confirms the presence of high porosity/permeability. Near the base of the formation below 998 metres (3274 feet), the sandstone is dominantly white in colour and more strongly cemented with silica, with correspondingly reduced porosity (poor to fair from cuttings descriptions). This is the informally named 'Gosses Bluff Sandstone'.

The Carmichael Sandstone is predominantly siltstone and lesser interbedded sandstone with generally poor porosities. Sonic porosities valid below 1094 metres (3590 feet) in these sands are in the order of 4-9%. No further increase in formation water influx was noted through this interval.

The Stokes and Horn Valley Siltstones have, as their names suggest, a dominantly siltstone lithology with minor thin interbeds of sandstone and carbonate. Effective porosity in these units seen from visual inspection of cuttings was essentially nil, and this is confirmed by wireline logs.

Porosities in the Stairway Sandstone were generally very poor to fair ranging from approximately 0 to 9%, and averaging 4 to 5% in the sands. Porosities in the gas productive Lower Stairway Sandstone were only poor to fair (average 5%,

4.5 **Porosity and Permeability of Sediments** cont'd

maximum 9%) in both Palm Valley No. 6 and 6B, with no significant differences between the two wells. Although no wireline logs were run in Palm Valley No. 6A, cuttings descriptions indicate similar values. Inferred permeabilities, except where fractures occur, must generally be very low, as only minor gas flares were observed while drilling through zones exhibiting fair porosities of up to 9%.

Within the Pacoota Sandstone interval penetrated in Palm Valley No. 6 and 6B, porosities were generally very poor to poor with a few zones of fair porosity. Sandstone porosities ranged from 0 to close to 9%, generally averaging 3 to 4%. Porosities in clean sandstones of the upper P1 unit were in the order of 4 to 8%, however permeabilities, except where major fractures occur, must be very low as no significant increase in gas flow was observed that could be directly related to matrix porosity. Over the remaining Pacoota P2, P3 and P4 units penetrated only in Palm Valley No. 6, matrix permeabilities must similarly be very low despite porosities of up to 7%.

(N.B.: Porosities quoted in the Stairway and Pacoota Sandstones are from Schlumberger's 'Global' log analysis in the case of Palm Valley No. 6, and from the density/neutron log in Palm Valley No. 6B. Occasional high porosities computed by Global, particularly at 5565, 5584, 5731, 6142 and 7350 feet are most likely due to washouts).

4.6 Relevance to the Occurrence of Hydrocarbons

No significant hydrocarbon shows were observed while air drilling above the Lower Stairway Sandstone in Palm Valley No. 6, and it can be concluded that these upper formations are tight or contain high water saturations. Global log analysis run in Palm Valley No. 6 (Enclosure 11) from total depth in the top of the Pacoota Sandstone 'P4' unit up to the base of the Stokes Siltstone, shows water saturations in the range of 70 to 100% over the Middle to Upper Stairway Sandstone section, which is in agreement with the absence of shows. In the Mereenie Sandstone which overlies the Stokes and Carmichael Formations, there were also large influxes of formation water, although once cased off no subsequent flows were noted.

In Palm Valley No's. 6A and 6B high gas readings were recorded through the Stokes Siltstone and Upper to Middle Stairway Sandstone intervals, however these are most likely attributable to gas leaking from around the cement plugs set prior to side-tracking.

The first significant gas show in Palm Valley No. 6 occurred just below the top of the Lower Stairway when a 15 second flare was observed after tripping to change the bit at 1662.7 metres (5455 feet). Background gas also increased from close to zero to an average of 10 units. Below the top of the 'basal' sand at approximately 1713 metres (5620 feet), total gas readings increased markedly to an average of 650 units and gas flares of up to 5 minutes duration were observed on connection.

4.6 **Relevance to the Occurrence of Hydrocarbons** cont'd

Finally at 1755.3 metres (5759 feet) just below the base of the unit, a sustainable flow of 69,000 cubic feet of gas per day was measured. This is most likely attributable to small fractures identified on the FIL log at 1715.7 metres (5629 feet) and at 1716.3 metres (5631 feet). (For a detailed review of fractures refer to the Schlumberger Log Interpretation Report, Appendix I). Log analysis based on an Rw of .045 indicate water saturations are relatively high (44 to 100%, average 70%) over the upper Lower Stairway, but decrease to an average of close to 50% below 1717.9 metres (5636 feet). Values in the basal, possibly 'pyritic' sandy carbonate below 1743.5 metres (5720 feet) are uncertain due to the complex mineralogy identified from wireline logs.

In Palm Valley No. 6A, which had deviated horizontally only approximately 61 metres (200 feet) by the top of the Lower Stairway Sandstone, gas shows were very similar to the vertical hole, with a flow of 58,000 cubic feet per day measured at 1760.5 metres (5776 feet), again just below the unit's base. Although no wireline logs were run, porosities and water saturations should closely match those seen in Palm Valley No. 6, with small fractures most probably responsible for the observed gas flow.

In Palm Valley No. 6B horizontal deviation was significantly greater, approximately 145.1 metres (476 feet), at the top of the Lower Stairway Sandstone. Gas shows were again very similar through the upper part of this unit but increased substantially below the top of the 'basal' sand at 1756.9

4.6 Relevance to the Occurrence of Hydrocarbons cont'd

metres (5764 feet), where total gas readings increased from an average of 40 units to over 15,000 units. (Note however, sampling is from the blooie line while air drilling and quantitative interwell comparisons may not be accurate). At 1782.8 metres (5849 feet) after intermittant gas flaring, a flow rate of 2.1 million cubic feet of gas per day (MMCFGD) was measured, followed by a large increase to 12.1 MMCFGD at 1798.6 metres (5901 feet). As no significant difference in porosity between Palm Valley No. 6 and 6B is observable from wireline logs, the first flow is most likely attributable to small, possible fractures seen on the FIL log at 1779.4 metres (5838 feet) and at 1781.6 metres (5845 feet). The second larger flow was associated with a drilling break from 1798 to 1798.3 metres (5899 to 5900 feet), and more pronounced fracturing is clearly evident on the FIL log at this level.

No further increases in gas flow were observed while drilling through the Horn Valley Siltstone in either Palm Valley No. 6 or 6B (Palm Valley No. 6A T.D.'d approximately 21.9 metres (72 feet) into this unit). Several anomalies appear on the FIL log over this interval, although, if fractures, are not open.

The usually highly gas productive upper Pacoota Sandstone 'P1' unit failed to produce any significant increase in flow in Palm Valley No. 6 despite porosities of up to 8%, as well as a large fracture or fractured zone in the identical sand to that which produced a large flow in Palm Valley No. 6B. A smaller increase however, to 105,000 cubic feet per day, was

4.6 **Relevance to the Occurrence of Hydrocarbons** cont'd

noted when the well was flow tested at 2028.7 metres (6656 feet), just below the base of the P1 unit. This appears to be due to matrix permeability as there is no evidence of fracturing in the zone immediately above. Log analysis using an RW of .022 shows hydrocarbon saturation (Sh) averaging approximately 30% in the cleanest zones of best porosity. However, for the remainder of the section Sh is very variable, most likely due to the effects of such factors as low porosity, varying 'm' (cementation factor) and/or clay content.

In Palm Valley No. 6B drilling in the upper P1 unit was marked by a substantial increase in gas flow at 1983.6 metres (6508 feet), just at the top of a 2.1 metre (7 feet) thick (TVD) clean sandstone. This was tested at 137 MMCFGD and the well was then drilled with mud to its total depth of 2005.9 metres (6581 feet), still in the upper P1 unit. Although partly washed out, density/neutron porosities over this sand do not appear to be high (approximately 8% average), and the large gas influx seen is undoubtedly due to excellent fracture permeability. Strong fracturing is indeed clearly evident on the FIL over this zone, and whereas no noticeable drill break occurred on first encountering the flow, there was one from 1985.2 to 1985.5 metres (6513 to 6514 feet), in the middle of the sandstone unit.

The Pacoota 'P2' and underlying units were only penetrated by Palm Valley No. 6 which T.D.'d at 2347 metres (7700 feet), just below the top of the 'P4' unit. Sandstone porosities in the 'P2' unit were extremely poor, generally ranging from 0

4.6 **Relevance to the Occurrence of Hydrocarbons** cont'd

to 3%, and there were no increases in gas influx prior to intersecting two drilling breaks from 2078.7 to 2079.3 metres (6820 to 6822 feet) and from 2080.6 to 2080.9 metres (6826 to 6827 feet), in the unit's lower sandy section. An open hole test performed at 2088.5 metres (6852 feet) recorded a flow rate of 1.3 MMCFGD, substantially higher than the previous measured rate of 105,000 cubic feet of gas per day, and the FIL log confirms the presence of a probable fracture at 2078.4 metres (6819 feet). From log analysis, hydrocarbon saturations over the lower sandy section vary from 0 to close to 40%, though these again are uncertain owing to the very low porosities.

On drilling into the Pacoota 'P3' unit a moderate drill break occurred from 2128.1 to 2128.4 metres (6982 to 6983 feet), and an open hole test performed shortly after at 2144.6 metres (7036 feet) recorded a flow rate of 1.82 MMCFGD, an increase of 0.52 MMCFD. No fractures can be identified from wireline logs close to this depth, nevertheless they may still be present but undetected. There is also the possibility that (a) anomalies seen in the basal 'P2' unit are responsible for the flow increase and that the drill break observed was due to a lithological change e.g. a brittle thin shale bed, or (b) the sandstones close to the top of the 'P3' unit have sufficient permeability for matrix flow, or (c) a combination of the above.

There were no further increases in flow over the remainder of the 'P3' unit despite porosities of up to 7% and a pronounced drill break from 2239.1 to 2239.7 metres (7346 to 7348 feet).

4.6 **Relevance to the Occurrence of Hydrocarbons** cont'd

Calculated hydrocarbon saturations were again very variable ranging from 23 to 100%, although close to the top of the unit, above 2132.4 metres (6996 feet), they average approximately 40%.

The 17 metre (56 feet) of Pacoota 'P4' unit penetrated in Palm Valley No. 6 displayed very poor porosities (range 1 to 5%) with no flow increase and no fractures identified from wireline logs. Calculated hydrocarbon saturations ranged from 60 to 100%.

In spite of the intermittent high water saturations computed from log analysis throughout the Pacoota Sandstone interval, there is no conclusive evidence for a gas/water contact as no formation water influx was observed. The Sw values are themselves also suspect because of the low porosities, uncertainty of RW, and other variables mentioned previously. There is also the possibility of numerous gas/water contacts if sands have been separately charged by the presence of a complex, irregular fracture network. Most probably only by further drilling and testing will the true situation be clarified.

4.7 **Fracture Identification**

As the Palm Valley Gas Field is a known fractured reservoir, a comprehensive suite of electric logs was again run with the aim of identifying the location and orientation of fractures intersecting the well bore. In addition to the normal resistivity and porosity logs, a dipmeter was run both in

4.7 **Fracture Identification** cont'd

conventional and fracture identification mode, and the sonic waveform recorded using a long spaced sonic tool. In addition, an electromagnetic propagation tool (EPT) was run for the first time in the Palm Valley Field as a possible aid in identifying the hydrocarbon zones. However, as the tool is very sensitive to hole conditions, it was also valuable for fracture detection. A comprehensive study of the data acquired was undertaken by Schlumberger Australia (see Appendix I) and Magellan Petroleum Australia Limited, and the conclusions reached are summarized below. Fracture composite logs (Enclosures 9 and 10), large scale (1:60) Geodip plots (Enclosures 12 and 13), and HDT conductive Anomalies Logs and Frequency Plots (Enclosures 18 and 19) were also generated over the zones of interest to aid in the identification and study of fractured zones.

Results indicate that almost all the gas influxes seen in Palm Valley No's. 6 and 6B can be directly related to fractures identified from wireline logs and/or drilling breaks. Moreover, the number of fractures observed in Palm Valley No. 6B is greater than in Palm Valley No. 6 by a factor of 7 or more which would undoubtedly explain the much higher production from the deviated well. The fractures themselves vary from being correlatable across the borehole, and in fact correlatable between Palm Valley No. 6 and Palm Valley No. 6B, to vertical or semi-vertical fractures. As seen from the wireline logs run in Palm Valley #4, the width of zones with horizontal fractures is in the order of approximately 0.3 metres (1 foot), which may be caused by

4.7 **Fracture Identification** cont'd

preferential movement along bedding planes or multifracturing in a more brittle lithology.

Investigations also show that in Palm Valley No. 6B, vertical fractures are orientated primarily in a 35^{o} west of north direction, and at 90^{o} to this in Palm Valley No. 6. This agrees with the direction of fracturing as seen on the surface from photogeology and may partly explain why one well location is much more gas productive than another if one set of fractures is more 'open' and highly permeable. A detailed discussion of fracture orientation and the location of conductive anomalies for each formation is given in Appendix I.

4.8 **Contributions to Geological Concepts**

The objectives of the Palm Valley No. 6 well were to increase gas deliverability from the Palm Valley Field as well as provide additional data on reservoir parameters and potential hydrocarbon reserves. Although side-tracking was necessary (Palm Valley No's. 6A and 6B), these aims were achieved, with strong gas flows being encountered in both the Lower Stairway and upper Pacoota (P1 Unit) Formations, as well as a smaller flow from the middle Pacoota P2 Unit. In addition, the running of a comprehensive suite of wireline logs combined with good hole conditions enabled a more thorough and reliable log interpretation study to be undertaken. The following are contributions to geological concepts acquired from the drilling and evaluation of Palm Valley No's. 6, 6A and 6B which are pertinent to the Palm Valley Field.

4.8 **Contributions to Geological Concepts** cont'd

1. Fractures seen in the subsurface at the Palm Valley No. 6/6B location are orientated as a conjugate set with a direction primarily 55° east of north in Palm Valley No. 6 and 90° to this in Palm Valley No. 6B. This parallels directions of major fracturing seen at the surface.

2. Fracture occurrence varies from zones of fracturing that parallel bedding planes and may be correlatable from one well to another, to vertical or semi-vertical fractures that do not cross the borehole.

3. The higher concentration of fractures in the Palm Valley No. 6B well supports the assumption that fracturing is more intensely developed close to the axis of the anticline.

4. Well performance appears to depend not only on the intersection of fractures but on the concentration of horizontal and vertical fracturing at or close to the borehole. Fractures in one orientation may also be more 'open' than another and consequently result in far higher productivity if intersected, as was the case in Palm Valley No. 6B.

5. The success of Palm Valley No. 6B in intersecting a more highly fractured and gas productive section proves the viability of drilling deviated wells in the Palm Valley Field, particularly in a crestal direction.

4.8 **Contributions to Geological Concepts** cont'd

6. Palm Valley No. 6 recorded the first measurable gas flow from the Pacoota P2 Unit, confirming that fractures can occur at any stratigraphic level, although to date the strongest fracturing has been mainly confined to upper Pacoota Pl Unit Sandstones.

7. Again, no water influx was observed in the Pacoota Sandstone interval despite high calculated water saturations in numerous zones, and it is possible that hydrocarbon saturation extends to the base of the Pacoota section, with the log derived water saturations a result of changing reservoir parameters. It is also a possibility that there may be a series of gas and water saturated sands charged by an irregular fracture network and separated by zones of low porosity and associated low permeability.