VOLUME 1 of 4

TENT HILL Nº1

WELL COMPLETION REPORT

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TENT HILL NO. 1

OP 175, AMADEUS BASIN, NORTHERN TERRITORY

by

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PANCONTINENTAL PETROLEUM LIMITED
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1. SUMMARY

1.1 Drilling

Tent Hill No. 1, located approximately 195 kilometres west of Alice Springs and 15 kilometres southeast of the West Walker gas discovery (Figure 1), was spudded on June 8, 1983 using Rockdril Rig No. 19. The well was drilled in Oil Permit 175 of the Northern Territory. Partners in the well included:-

Pancontinental Petroleum Limited (Operator)
Magellan Petroleum (N.T.) Pty. Limited (Permit Holder)
International Oil Proprietary
Amadeus Oil N.L.
Apollo International Minerals N.L.
Farmout Drillers N.L.
Oilmin N.L.
Transoil N.L.
Petromin N.L.
Canada Southern Petroleum Limited
International Energy Development Corporation of Australia Pty. Ltd.
C.D. Resources Pty. Ltd.

A 15" hole was augered to 6.4 metres where 13-3/8" conductor was set. A 12" hole was then hammered to 70 metres where 9-5/8" casing was run and cemented. Drilling continued with an 8" hammer to 247 metres where water influx increased and a 7-7/8" roller bit was used to drill to 574.37 metres. At this depth, 7" casing was run and cemented.

The Blow Out Preventors were installed and tested, and a 6" bit drilled out the cement prior to completing a leak-off test. An attempt to run a 6" air hammer was not successful and a 6" roller bit was used to drill to 873 metres where

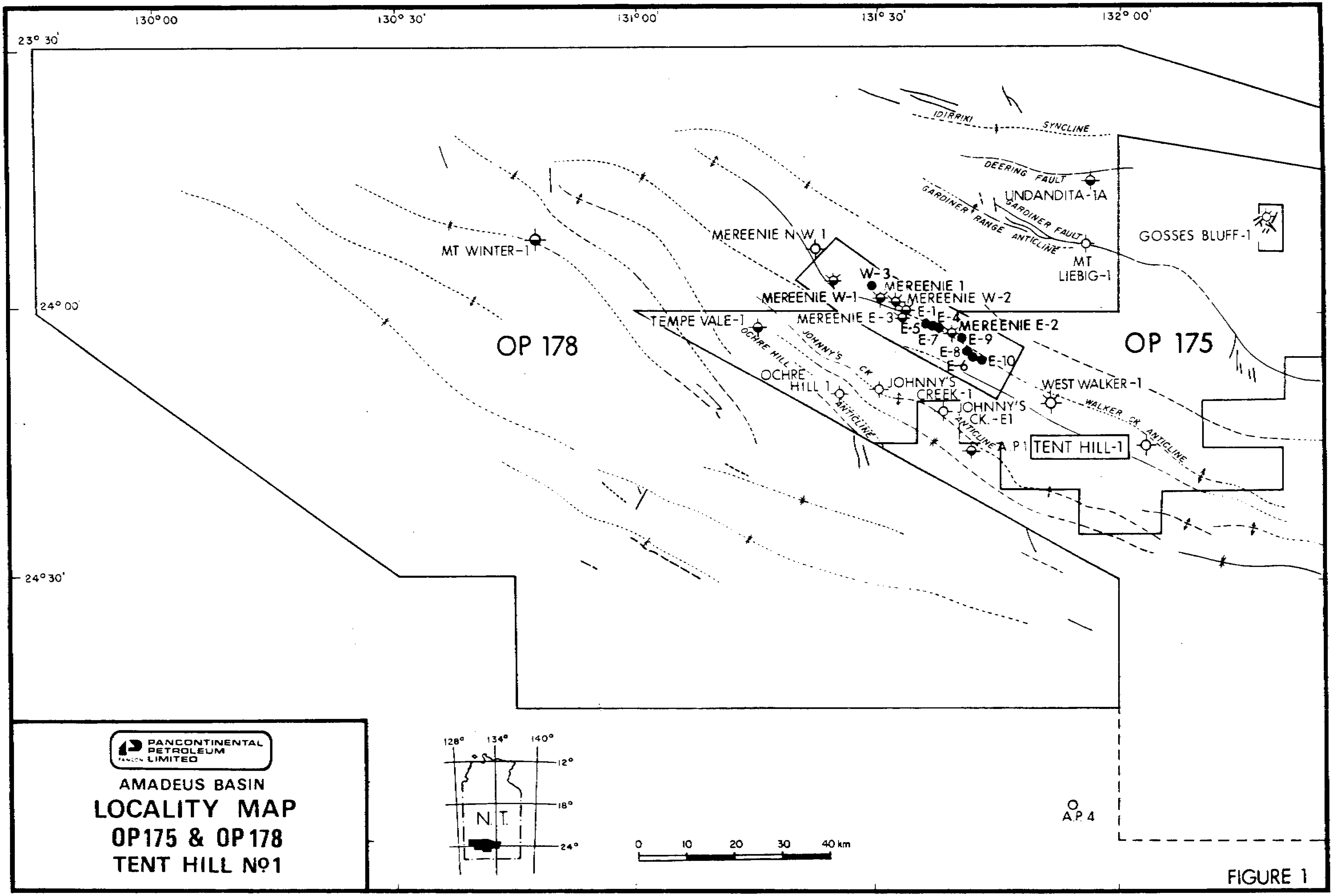
130°00
130° 30'
131°00'
131° 30'
132° 00'
23° 30'
24° 00'
24° 30'
IDIRRIKI
SYNCLINE
DEERING FAULT
UNDANDITA-1A
GARDINER RANGE ANTICLINE
GARDINER FAULT
GOSSES BLUFF-1
MT LIEBIG-1
MT WINTER-1
MEREENIE N W 1
W-3
MEREENIE 1
MEREENIE W-1
MEREENIE W-2
MEREENIE E-3
E-1
E-4
MEREENIE E-2
E-5
E-7
E-9
E-8
E-6
E-10
TEMPE VALE-1
OCHRE HILL
JOHNNY'S CK
OCHRE HILL 1
ANTICLINE
JOHNNY'S CREEK-1
JOHNNY'S CK.-E1
A.P 1
TENT HILL-1
WEST WALKER-1
WALKER CK ANTICLINE
OP 178
OP 175
A.P 4
128°
134°
140°
12°
18°
24°
N.T.
0 10 20 30 40 km
PANCONTINENTAL PETROLEUM LIMITED
AMADEUS BASIN
LOCALITY MAP
OP175 & OP178
TENT HILL No 1

FIGURE 1

the well would not hold pressure, and electric logs were completed. Five inch casing was run and cemented to 873 metres.

After drilling out to 876 metres, with a 4.365" bit, a formation leak-off test was completed successfully. Coring commenced at 876 metres and continued to 906 metres, where the well was found to be significantly deviated. After repeated attempts to alleviate this problem were unsuccessful, the well was continuously cored with an average deviation of 7-1/2^{o} to 1111 metres, where DST No. 1 was run. At 1146.8 metres, high pressure gas was encountered. The mud weight was gradually increased to 11.2 ppg by 1194 metres, when DST No. 2 was run.

Coring continued to 1238 metres where DST No. 3 was run. The result of this DST suggested the mud weight be decreased to 9.25 ppg. At 1309 metres the winch drive system broke down, and a diamond bit was used to drill to 1337 metres. After repairs, a 4.365" diamond core bit was used to drill to total depth (1387.36 metres). After minor problems with the hydraulic drive and winch drive systems, DST No. 4 was run. Electric logs and a velocity survey were completed and the well was plugged and abandoned.

1.2 Geological

Tent Hill No. 1 was drilled to a total depth of 1387.36 metres between June and August, 1983. The well was drilled primarily to assess the hydrocarbon potential of the Cambro-Ordovician Pacoota Sandstone in a geophysically defined anticline. The stratigraphic succession in the well was predicted to be similar to that penetrated at West Walker No. 1, which bottomed in the Late Cambrian Petermann Sandstone, and also in outcrop at measured section HYR-1 (Ranford et al., 1965) to the southeast of the well site.

Tent Hill No. 1 penetrated 335 metres of Devonian sandstone, unconformably above 850 metres of Ordovician sandstone, siltstone, shale and dolomite, and 202 metres of Cambro-Ordovician sandstone, siltstone and shale. The well was terminated in Cambro-Ordovician sandstones.

The well encountered minor gas shows in the lower Stairway Sandstone, Horn Valley Siltstone and Pacoota Sandstone, but only minor hydrocarbons were recovered in DST No. 1 over the lower Stairway Sandstone.

Tent Hill No. 1 was plugged and abandoned after failing to intersect commercial hydrocarbons in the target reservoirs.

2. INTRODUCTION

Tent Hill No. 1 was the sixth well drilled by Pancontinental Petroleum Limited in OP 175 of the Amadeus Basin under a farmout agreement with the Permit Holder, Magellan Petroleum (N.T.) Pty. Limited.

The well, located 195 kilometres west of Alice Springs (Figure 1) was drilled to test a seismically defined anticline en-echelon to the West Walker gas discovery and the breached Walker Creek Anticline. The stratigraphic succession at Tent Hill No. 1 was anticipated to be similar to that penetrated at West Walker No. 1, 15 kilometres to the northwest. West Walker No. 1 flowed gas at rates up to 3 MMcfgd from the P1 unit of the Pacoota Sandstone.

The Pacoota Sandstone was the prime target of the Tent Hill No. 1 well, with a secondary target in the Stairway Sandstone.

3. WELL HISTORY

3.1 General Data

Well Name:	Tent Hill No. 1
Petroleum Tenement:	Oil Permit 175, Northern Territory
Operator:	Pancontinental Petroleum Limited, 11th Floor, 20 Bond Street, Sydney, N.S.W., 2000.
Permit Holder:	Magellan Petroleum (N.T.) Pty. Limited, 420 George Street, Brisbane, Qld., 4000.
District:	Henbury, Northern Territory
Location:	24° 13' 45"S, 132° 02' 30"E
Water Supply:	Drilling water and camp water were obtained from the water bore, approximately 400 metres SSE of the well site.
Elevations:	Ground Level - 575 metres a.s.l. Drill Floor - 577.3 metres a.s.l.
Total Depth:	1387.36 metres DF (Driller) 1387.00 metres DF (Logger)
Well Spudded:	15.00 hours, June 8, 1983
T.D. Reached:	02.15 hours, August 20, 1983
Rig Released:	16.00 hours, August 23, 1983
Total Time Drilling:	72 days 11-1/4 hours
Spud to Rig Release:	75 days 1 hour (Figure 2)
Well Status:	Plugged and abandoned.

3.2 Drilling Plant

Drilling Contractor:	Rockdril Contractors Pty. Limited, 1 Jijaws Street, Sumner Park, Qld., 4074.
Drilling Rig:	Rockdril Rig 19
Make:	Longyear HD-600

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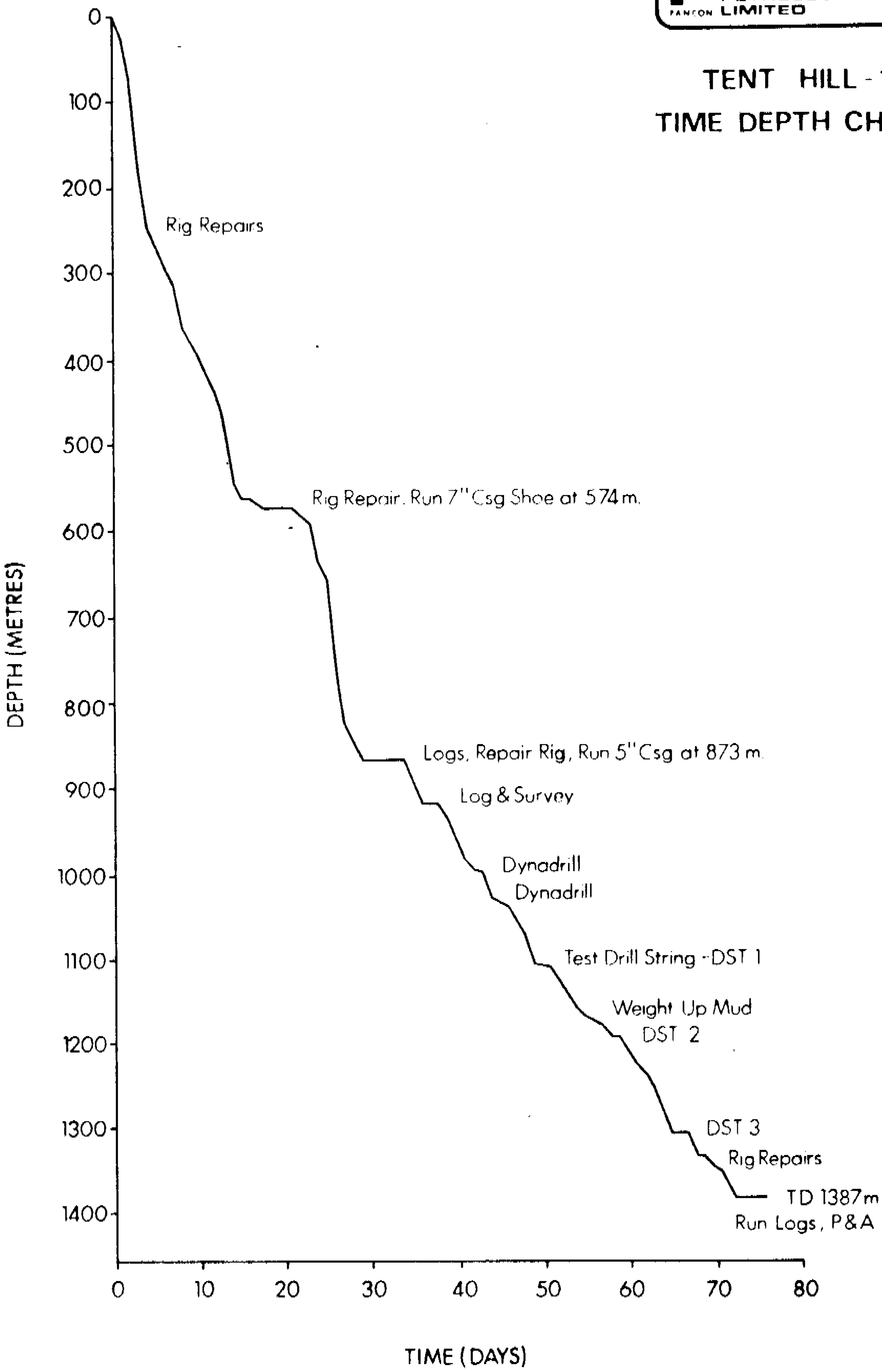
TENT HILL - 1
TIME DEPTH CHART



Author G R M	Date. Feb '84
Drawn D J P	Figure 2

Rated Depth:	1800 metres
Power:	Caterpillar 3306T Diesel engine (210 HP at 2000 RPM)
Mast:	Longyear 53 ft
Mast Capacity:	150,000 lbs
Pumps:	1 5" x 6" Gardner Denver 2 Longyear 435 Bean Pumps
Rotary Power:	Retractable 14" Power Head Hydraulic 3 jaw chuck
Drill Pipe:	800 m PQ rods (4-1/2" OD) 1800 m CHD 101 rods (3.70" OD) 1800 m CHD 76 rods (2.98" OD)
Well Control Equipment:	Annular preventor - Hydril Type 9K 6" rated at 3000 psi (Bore 7-1/16") BOP - Shaffer Double 6" (Bore 7-1/16") rated at 3000 psi, complete with the following ram assemblies: Blind, 2-7/8", 3-1/2", 4-1/2", 4-5/8" and 3.7".

3.3 Drilling Data

3.3.1 Well Configuration

Hole Size	Depth	Casing and Cementing Details
12"	70m	Ran 6 joints 9-5/8" casing. Cemented with 69 sacks Class "A" cement with 2% $CaCl_2$ and 1% CFR-2. Returns to surface.
7-7/8"	574.37m	Ran 49 joints 7" (N-80, 29 lb, WP) casing. Cemented with 97 sacks Class "G" cement (Slurry weight 15.7 ppg). Full returns during job, slight cement returns.

6"	873m	Ran 78 joints 5" (F/J6 Atlas Bradford F1-45, 13 lb) casing. Cemented with 105 sacks Class "G" cement with 0.25 Halad 22A and 0.6% CFR-2 (Slurry weight 15.7 ppg). Full returns to surface.
4.365"	1387.36m	T.D.

3.3.2 Drilling Description

A 15" hole was augered down to 6.4 metres, where the blades became worn. 13-3/8' conductor pipe was set and cemented. A 12" hammer assembly was made up and the hole was drilled to a depth of 70 metres, where 9-5/8" casing was run and cemented.

Drilling continued to 239 metres with an 8" air hammer, but water influx made drilling slow. At 239 metres, a 7-7/8" hammer was run, and this drilled to 247 metres, where air drilling was temporarily suspended. A 7-7/8" roller bit was used to drill to 398 metres utilising LCM in the circulating system until a twist off occurred between the drill collars. The fish was successfully retrieved and drilling continued to 564 metres where the drawworks drive ring gear broke down. After repairs drilling continued to 576 metres where the hydraulic drawworks failed.

After repairs to the drawworks, 7" casing was run to 574.37 metres and cemented. The BOP's were installed and pressure tested and the cement was drilled out using a 6" diamond bit and a leak-off test was completed. A 6" hammer was attempted, but due to high water influx, this was aborted, and drilling commenced with a 6" roller bit using air and foam as the circulating fluid. The well was drilled ahead to 873 metres where electric logs were run and 5" casing was run and cemented.

The cement was drilled out to 876 metres and a leak-off test was performed. Drilling ahead to 906 metres with a 4.365" bit, it was noted that the hole deviation had increased to 8-3/4^{o}. Surveying up the hole indicated that the previously used survey tool was reading incorrectly. Attempts were then made to remedy the situation. After BPB ran a verticality survey attempts to ream the hole straight were ineffective. Drilling continued to 998 metres with reduced weight on bit, but surveys indicated that the hole was still deviated. Attempts to use a dynadrill at 998 metres and at 1036 metres failed and the well was eventually drilled ahead using a conventional bottom hole assembly. At 1059 metres the drill string was tested but failed to hold pressure and a trip was run to tighten all joints. The well then cored ahead to 1111 metres where DST No. 1 was run.

At 1146.8 metres, high pressure gas was encountered and necessitated increasing the mud weight to 10.6 ppg. With gas still seeping into the hole, the mud weight was increased to 11.2 ppg until 1194 metres, where DST No. 2 was run to investigate flowing pressure. After drilling ahead to 1238 metres, with minor gas shows indicated, DST No. 3 was run. The lack of recoverable hydrocarbons in both these tests suggested the mud weight be decreased.

At 1309 metres, the winch drive shaft broke down, which led to extremely slow bit changes. Consequently rotary drilling was initiated. After drilling ahead to 1337 metres with the diamond bit, repairs were completed, and coring was resumed to 1357 metres after reaming from 1309-1337 metres. While recovering the inner barrel at 1357.36 metres, the top end parted, and after fishing unsuccessfully, the bottom hole assembly was tripped out to recover the inner barrel.

After again repairing the hydraulic system, the well was drilled ahead to 1387.36 metres, where DST No. 4 was run. BPB Instruments ran a full suite of electric logs to total depth, and a velocity survey was undertaken. The well was then plugged and abandoned in accordance with the regulations of the Northern Territory Department of Mines and Energy.

3.3.3 Abandonment Programme

The well was plugged and abandoned using the following cement plugs.

Plug No. 1	1130-1200 metres with 32 sacks Class A cement (Slurry weight 15.5 ppg)
Plug No. 2	830-900 metres with 29 sacks Class A cement (Slurry weight 15.6 ppg)
Plug No. 3	Surface-30 metres with 11 sacks Class A cement (Slurry weight 15.4 ppg).

3.3.4 Drilling Fluid

Drilling fluid materials and engineering services were supplied by Baroid Australia Pty. Limited. The 12" and 8" hole were drilled to 281 metres utilizing air as the circulating fluid, but due to wash outs and high water flows, an 8.5 ppg mud was mixed and placed in the hole as a circulating medium. Due to the porous formation, LCM was utilized in the mud system from 313 metres to 440 metres.

Minor gas shows were evident within the middle Stairway Sandstone so the mud weight was increased to 9.2 ppg, and a corrosion inhibitor used because of the high chloride values.

At 1046 metres, gas shows were recorded and DST No. 1 was conducted at 1111 metres. Upon recovery of minor gas, the mud weight was raised to 9.5 ppg utilizing $CaCl_2$. While drilling ahead, high pressure/low volume gas was encountered at 1147 metres, which led to an increase in mud weight to the optimum level of 11.2 ppg.

However, testing of the gas shows in the upper part of the Pacoota Sandstone and Horn Valley Siltstone indicated that no hydrocarbons were present and the mud weight was gradually decreased to 9.2 ppg.

A summary of the drilling fluid properties is given in Appendix E.

3.3.5 Deviation Surveys

metres	Deviation	metres	Deviation
16	0	498	3/4
33	0	547	3/4
51	0	570	misrun
64	0	580	1/2
79	0	616	misrun
109	0	635	1
139	1/2	748	2-1/2

169	0	749	2-3/4
221	1/2	778	2-1/4
270	0	802	5
379	1	873	2
409	1	900	8-3/4
439	1-1/4	906	8-3/4
468	1	912	9

At this point it was realised that the well was significantly deviated, and a number of survey readings were taken to determine the extent of the deviation.

metres	Deviation	metres	Deviation
873	8-1/2	530	1-1/2
835	8-1/2	438	1
750	7-1/4	270	1/2
786	7-1/2	237	1-1/4
816	7-1/4	873	8
720	6	873	8
690	4-3/4	917	8-1/4
630	2	ran BPB Verticality survey (see Appendix O).	

Controlled drilling continued through this section with lower W.O.B. and surveys every three minutes.

metres	Deviation	metres	Deviation
926	9	944	8-1/2
929	9	950	8-1/2
932	9	956	8-1/4
938	9-1/4	962	8
939	9	968	misrun

An Eastman Survey unit was utilized from 974 metres to total depth. This enabled the direction of deviation to be obtained.

metres	Deviation			metres	Deviation		
974	8	towards	065	1107	7	towards	054
980	7-3/4	"	059	1119	6-3/4	"	054
992	7-3/4	"	059	1131	6-1/2	"	050
998	7-3/4	"	056	1143	6-3/4	"	051
1004	7-3/4	"	059	1161	7-1/2	"	049
1010	7-3/4	"	058	1173	7-1/4	"	047
1016	8	"	058	1184	7-1/4	"	051
1022	7-1/2	"	059	1194	6	"	049
1028	7-1/2	"	059	1202	7	"	049
1034	7-1/2	"	056	1214	6-3/4	"	045
1041	7-1/2	"	056	1226	7-1/4	"	049
1053	7-1/4	"	054	1251	7-1/2		
1065	7-1/4	"	054	1269	misrun		
1077	7	"	053	1275	7-1/2		
1089	7	"	055	1299	7-3/4		
1101	7			1334	8-1/4		

3.3.6 Conventional Coring

Continuous cores were taken from 873 metres to 1309 metres and 1337 metres to 1387 metres (T.D.). All cores taken were drilled with a 4.365" bit.

3.3.7 Formation Sampling

Drilled cuttings were collected at 5 metre intervals from 70 metres to 873 metres, and 1309 metres to 1337 metres. Sample distribution is as follows:-

1 Northern Territory Department of Mines and Energy
1 Bureau of Mineral Resources
1 Magellan Petroleum (N.T.) Pty. Limited
3 Pancontinental Petroleum Limited

3.3.8 Gas Detection and Penetration Rate

A continuous reading hotwire detector and gas chromatograph were used from 70 metres to total depth. Samples were checked for fluorescence and the drilling rate was recorded. Sample descriptions, gas readings and drilling rates are shown in Enclosures 1 and 2, and in Appendices A and C.

3.3.9 Sidewall Coring

No sidewall cores were attempted in this well.

3.3.10 Drill Stem Testing

Four conventional drill stem tests (Halliburton) were run in Tent Hill No. 1. All four tests were conventional open hole tests utilizing Halliburton's 3" test string in the 4.365" hole.

Drill stem test reports are summarised in Table 1, and the Halliburton DST reports are given in Appendix F. Amdel gas analyses for DST No. 1 is given in Appendix G. Amdel standard water analyses for DST No.s 1 to 4 are given in Appendix H.

3.3.11 Wireline Logging

Wireline logs were run by British Plaster Board in the following hole sizes:-

TABLE 1 : TENT HILL No. 1 DRILL STEM TEST RESULTS

NO.	DATE	INTERVAL	DURATIONS (MINS)				PRESSURES (PSI)						RECOVERY	COMMENTS
			IF	ISI	FF	FSI		HYD	IF	FF	FSI	HYD		
1	29/7/83	1091.83 - 1111.06 m Lower Stairway	5	25	150	180	1st	1806	107	120	N/A		363 metres (12 bbls) of gas and condensate cut formation water.	Recovery at 110 bbls/day. Calculated flow permeability from horner plot - 3.97 md.
							2nd		147	637	1615	1799		
2	6/8/83	1161.23 - 1194.16 m Horn Valley - P1	10	25	60	120	1st	2261	99	100	120		11 metres (0.37 bbls) of drilling fluid 11.1 ppg.	Charts indicate no fluid recovery.
							2nd		106	101	107	2264		
3	9/8/83	1205.11 - 1238 m Pacoota - P1	10	31	90	240	1st	2214	92	103	1728		135 metres (4.47 bbls) of formation water.	Recovery at 64.4 bbls/day. Permeability 4.4 md.
							2nd		123	270	1743	2214		
4	20/8/83	1354.4 - 1387.36 m Pacoota - P2	15	32	90	180	1st	2188	124	199	1842		390 metres (13.1 bbls) of formation water.	Recovery at 188.4 Bwpd. Permeability 4.7 md.
							2nd		229	653	1845	2182		

6"	Sonic	873-574 m
	Density, Caliper	873-574 m
	Gamma Ray	873-Surface
	Neutron-Neutron	873-574 m
	F.E.	873-574 m
	Temperature	851-574 m
4.365"	Inclinometer Survey	875-Surface
	Sonic	1384-873 m
	Density	1385-873 m
	Gamma Ray, Caliper	1385-873 m
	Neutron-Neutron	1384-873 m
	F.E.	1383-873 m
	S.P.	1387-873 m

3.3.12 Velocity Survey

A well velocity survey was carried out by Velocity Data Pty. Ltd. on August 23, 1983. Details of this survey are given in Appendix L.

4. GEOLOGY

4.1 Summary of Previous Work

Geology

Regional geological mapping of the Amadeus Basin was carried out by the Bureau of Mineral Resources (BMR), Frome-Broken Hill Co. Proprietary Limited and Magellan Petroleum (N.T.) Pty. Limited in the late 1950s and early 1960s. This mapping culminated in the discovery of the Palm Valley Gas Field and the Mereenie Oil and Gas Field.

Since the discovery of the Mereenie Field in the mid 1960s, the western end of the Walker Creek anticlinal trend has been recognised as being very similar in surface configuration to the Mereenie anticline (Huckaba, 1979). Structural closure is not obvious at the surface over either fold, yet Mereenie Field is known to have about 230 metres of structural closure at Pacoota reservoir depth.

Magellan Petroleum made a detailed survey of the surface geology in the West Walker Creek area. A theodolite survey of the contact between the Hermannsburg Sandstone and the Parke Siltstone indicated that the West Walker structure was a separate en echelon anticline to the Walker Creek Anticline (Huckaba, 1979).

Geologists from Pancontinental Petroleum Limited studied the Larapinta Group sediments in the breached Walker Creek Anticline, and by projecting the measured dip values to the west, concluded that a saddle must be present between the outcropping Pacoota Sandstone and the predicted level of the formation at Tent Hill No. 1. This conclusion, incorporated with seismic evidence, suggested that the Tent Hill anticline is a separate en echelon feature along the Mereenie Trend.

Geophysics

The West Walker Creek Seismic Survey by Namco in 1965 obtained extremely poor single fold records. In 1981 Pancontinental Petroleum Limited shot 86 kilometres of 12 fold vibroseis in the West Walker Creek area to determine the existence of valid structural closure at Pacoota Sandstone level.

West Walker No. 1 was drilled on the western-most culmination indicated by this survey. Using the West Walker No. 1 velocity data, a high degree of confidence was assigned to the seismic correlation with the Tent Hill area.

The survey shows the Tent Hill structure to be a separate en echelon anticline along the West Walker/Walker Creek Trend, with a vertical closure of 100 metres and an areal closure of approximately 16 square kilometres. The closure depends on the interpretation of a saddle to the east of the Tent Hill site to separate the culmination from the breached Walker Creek Anticline.

Drilling

The nearest wells to Tent Hill No. 1 are West Walker No. 1, 15 kilometres to the northwest, and East Mereenie No. 10, 40 kilometres to the northwest.

West Walker No. 1 was drilled by Pancontinental Petroleum Limited to a total depth of 2011 metres in 1982. The well bottomed in Cambrian age sediments of the Petermann Sandstone. The Pacoota P1 yielded an open hole flow of 2.5

to 3 MMcfgd. Upon testing, the interval 1392 - 1419 metres flowed at 600 Mcfgd and the well was completed as a suspended gas well (Gorter et al., 1982).

East Mereenie No. 10 was drilled by Oilmin to a total depth of 1779 metres in 1982. The well was an 800 metre step-out from East Mereenie No. 6, which discovered oil in the P1 unit of the Pacoota Sandstone. East Mereenie No. 10 bottomed in the Cambro-Ordovician Pacoota Sandstone. The lower part of the Stairway Sandstone flowed gas at 3 MMcfd with minor condensate, while the reservoirs in the Pacoota Sandstone were found to be below the oil-water contact and produced water only. East Mereenie No. 10 was completed as a gas producer from the lower Stairway Sandstone.

4.2 Summary of Regional Geology

The Amadeus Basin is an 800 kilometre long, east-west oriented intracratonic depression lying in the southern part of the Northern Territory and extending partly into Western Australia. Commencing with Late Proterozoic clastics, which rest on an older Precambrian basement of metamorphic and igneous rocks, the basin has had a long and diversified history of sedimentation (Figure 3). Following Late Proterozoic sedimentation, rocks of Cambrian, Ordovician, possibly Silurian, Devonian and Permian age were laid down. Depositional and climatic conditions varied greatly in space and time throughout this long history. The Late Proterozoic, Cambrian and Ordovician were largely times of marine sedimentation resulting in the accumulation of great thicknesses of sandstone, shale, limestone and dolomite, with periods of evaporite (salt) deposition in the Late Proterozoic and Cambrian. Two periods of glaciation also occurred in the Late Proterozoic. Silurian?-Devonian sandstones, which were deposited during a period of aridity, are partly fluviatile and aeolian. Mountain building

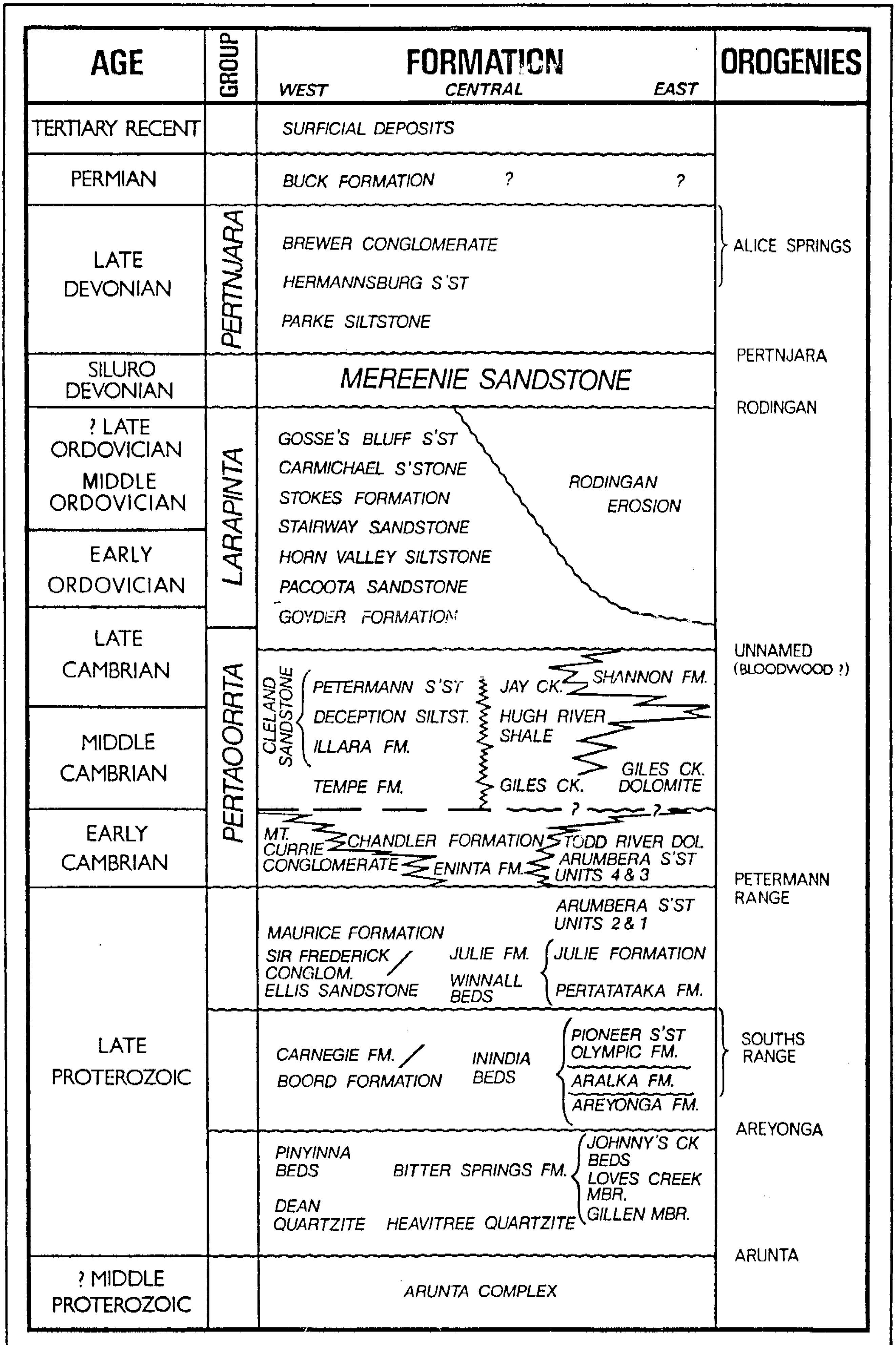

AGE
GROUP
FORMATION
WEST
CENTRAL
EAST
OROGENIES
TERTIARY RECENT
SURFICIAL DEPOSITS
PERMIAN
BUCK FORMATION ? ?
LATE DEVONIAN
PERTNJARA
BREWER CONGLOMERATE
HERMANNSBURG S'ST
PARKE SILTSTONE
ALICE SPRINGS
PERTNJARA
SILURO DEVONIAN
MEREENIE SANDSTONE
RODINGAN
? LATE ORDOVICIAN
MIDDLE ORDOVICIAN
EARLY ORDOVICIAN
LARAPINTA
GOSSE'S BLUFF S'ST
CARMICHAEL S'STONE
STOKES FORMATION
STAIRWAY SANDSTONE
HORN VALLEY SILTSTONE
PACOOTA SANDSTONE
GOYDER FORMATION
RODINGAN EROSION
LATE CAMBRIAN
MIDDLE CAMBRIAN
EARLY CAMBRIAN
PERTAOORRTA
UNNAMED (BLOODWOOD ?)
CLELAND SANDSTONE
PETERMANN S'ST
DECEPTION SILTST.
ILLARA FM.
TEMPE FM.
JAY CK.
SHANNON FM.
HUGH RIVER SHALE
GILES CK.
GILES CK. DOLOMITE
? ?
MT. CURRIE CONGLOMERATE
CHANDLER FORMATION
ENINTA FM.
TODD RIVER DOL.
ARUMBERA S'ST UNITS 4 & 3
PETERMANN RANGE
LATE PROTEROZOIC
ARUMBERA S'ST UNITS 2 & 1
MAURICE FORMATION
SIR FREDERICK CONGLOM.
ELLIS SANDSTONE
JULIE FM.
WINNALL BEDS
JULIE FORMATION
PERTATATAKA FM.
CARNEGIE FM.
BOORD FORMATION
ININDIA BEDS
PIONEER S'ST
OLYMPIC FM.
ARALKA FM.
AREYONGA FM.
SOUTHS RANGE
AREYONGA
PINYINNA BEDS
DEAN QUARTZITE
BITTER SPRINGS FM.
HEAVITREE QUARTZITE
JOHNNY'S CK BEDS
LOVES CREEK MBR.
GILLEN MBR.
ARUNTA
? MIDDLE PROTEROZOIC
ARUNTA COMPLEX

Figure 3

movements along the northern rim of the basin provided material for a thick wedge of fluviatile sediments in the Late Devonian. Minor fluviatile and lacustrine deposition in the Permian and again in the Tertiary concluded the sedimentary history of the Amadeus Basin.

Sedimentation was modified by tectonic movements which occurred intermittently from Late Proterozoic to Late Devonian. Tectonic movements in the Proterozoic established the shape of the basin, and formed the structural framework within which subsequent movement took place (Figure 3).

Two major cycles of sedimentation associated with tectonism are evident. The older cycle began in the Proterozoic with mature orthoquartzite and carbonate rocks and finished with relatively immature fluviatile sandstone in the early Cambrian (Petermann Range Orogeny). The second cycle commenced later in the Cambrian with marine sedimentation predominating and ended in the Late Devonian with the Alice Springs Orogeny. Smaller local cycles are associated with the movements that have been named on Figure 3.

Folding and faulting in the southwestern area initiated in the Proterozoic, sometimes associated with salt tectonics, produced east-west striking anticlines, often faulted along the flanks and showing thinning of Late Proterozoic sediments over the crest. These structures were modified and new ones created by the Alice Springs Orogeny in Late Devonian time - the final major tectonism in the Amadeus Basin. An important precursor to the Alice Springs Orogeny was the Late Ordovician Rodingan Movement. The low angle unconformity that indicates this movement is best developed in the north and northwest, where the earlier deposited Ordovician sediments were progressively eroded eastwards. The total sediment thickness and the stratigraphy of sediments preserved over any structure depend on the amount of Rodingan erosion to which that has been subjected. Thus more western structures, such as at Palm Valley and Mereenie, are more likely to have a more complete sedimentary section preserved over them than eastern structures, such as the Dingo structure.

Structures may be further complicated by the occurrence of salt diapirs, emanating from the Bitter Springs Formation or Chandler Formation, flowing into the cores of structures, as for example at the Goyder Pass Structure. The salt cored structures are known to have grown intermittently from Late Proterozoic to Devonian time, as shown by local thinning of units.

At least two generations of thrust faulting are present in the Amadeus Basin, with thrusting from both north and southwest. Thrusting events probably took place during the Petermann Range Orogeny (Late Proterozoic - Early Cambrian) in the southwest and during the Alice Springs Orogeny. These thrusting movements further complicate the geology and have lead to thickened section, overthrust anticlines and possibly the development of fracture porosity.

4.3 Stratigraphy

The section penetrated at Tent Hill No. 1 is compared with the predicted sequence in Enclosure 4, and with the sections drilled at East Mereenie No. 4, West Walker No. 1 and Palm Valley No. 1 in Enclosure 5. Table 2 shows the depth of the various formations penetrated in Tent Hill No. 1 relative to K.B., and the thickness of each of those formations.

Table 2. Stratigraphy at Tent Hill No. 1

Formation		Top (metres KB)	Thickness (metres)
Harajica Sandstone		0	34
Mereenie Sandstone		34	299
Gosses Bluff Sandstone		333	142
Carmichael Sandstone		475	90
Stokes Formation		565	349
Stairway Sandstone		914	199
Horn Valley Siltstone		1113	72
Pacoota Sandstone	P1	1185	93
	P2	1278	71.5
	P3	1349.5	37.8+
Total Depth:		1387.3	

Harajica Sandstone 0-34 m (Thickness 34 m)
Age - Late Devonian

The Harajica Sandstone is the central of the three members of the Parke Siltstone described by Jones (1972). In the Tent Hill well only the Harajica Sandstone is present, the Dare Siltstone being eroded and the Deering Siltstone absent, although present to the west at Mereenie Field.

At Tent Hill No. 1, the Harajica Sandstone is an orange, yellow, red brown, very fine to fine, occasionally medium grained sandstone, which is unconsolidated to poorly cemented, siliceous, non calcareous, poorly to moderately sorted, friable, sub angular to sub rounded, and moderately silty in part. Minor red brown, slightly calcareous siltstone is also present. The siltstone is thinly laminated, firm to blocky, sub fissile, and is gradational to the very fine grained sandstone.

Mereenie Sandstone 34-333 m (Thickness 299 m)
Age - ?Middle Devonian

At Tent Hill No. 1, the Mereenie Sandstone consists of sandstone and subordinate siltstone. The top of the Mereenie Sandstone is selected on gamma ray correlation with West Walker No. 1.

At Tent Hill No. 1, the sandstones are white, yellow, orange, red, red brown, fine to medium grained, rarely coarse, sub angular to sub rounded, occasionally well rounded, moderately to well sorted, occasionally friable, with occasional frosted and pitted grain surfaces on the well rounded grains. The intervals 205-225 and 305-330 metres contain two types of sandstone. Firstly, the more typical white to pale orange sandstones, and secondly a highly haematitic sandstone where red brown and orange sandstone predominates. Minor kaolinite is present in the matrix of these latter sandstones, and an increased proportion of the grains are frosted.

The siltstone is red brown to brick red, rarely light brown, arenaceous in part, extremely to moderately ferruginous, hard to brittle, finely micaceous and predominantly non calcareous. The siltstone occurs as thin beds (especially in a zone between 128-137 metres) and in the matrix of the fine grained sandstone.

Visible porosity in the Mereenie Sandstone is generally fair to good, but decreases to poor in the more ferruginous zones due to the extensive clay-filled matrix.

Gosses Bluff Sandstone 333-475 m (Thickness 142 m)
Age - ?Late Ordovician

The name Gosses Bluff Sandstone was first coined by Gorter et al. (1982) for the clean, tight sandstone section unconformably below the Mereenie Sandstone in the West Walker No. 1 well. In outcrop at Gosses Bluff, the Gosses Bluff Sandstone consists of a clean, white sandstone, containing low angle cross beds underlying the Mereenie Sandstone (Milton, 1974). A similar unit, in excess of 110 metres, was measured near Walker Gorge, 25 kilometres to the southeast of Tent Hill No. 1, but was included as the basal part of the Mereenie Sandstone (Marsden, 1982).

At Tent Hill No. 1, the Gosses Bluff Sandstone consists of sandstone only. The top of the unit is easily recognised on the gamma ray log as a sequence of extremely non-radioactive sediments.

The sandstone is clear to white, rarely pale orange, fine to coarse grained, commonly bimodal, angular to sub rounded, commonly frosted, moderately to rarely poorly sorted, siliceous, hard and abrasive, with poor to tight porosity.

The Gosses Bluff Sandstone is approximately 33 metres thicker at Tent Hill No. 1 than at West Walker No. 1, however this variation is consistent with a provenance from the south, as suggested by Wells et al. (1970) for the upper unit in the Larapinta Group.

Carmichael Sandstone 475-565 m (Thickness 90 m)
Age - ?Late Ordovician

At Tent Hill No. 1, the top of the Carmichael Sandstone is marked by an increase in the amount of red brown sandstone and siltstone coincidental with a slight increase on the gamma ray log. The Carmichael Sandstone consists of sandstone and siltstone, with minor shale and dolomite evident towards the base. The base of the Carmichael Sandstone is gradational to the Stokes Formation.

The sandstone is red brown, red, chocolate brown, orange, pale pink and cream to white at the top, extremely fine to fine grained, moderately to poorly sorted, rarely well sorted, siliceous, ferruginous, with poor visible porosity. The sands grade from highly siliceous at the top to extremely ferruginous at the base where the red brown sandstone and siltstone are more common.

The siltstone is red brown, purple brown, extremely micaceous, firm, non calcareous, ferruginous, with the characteristic grey/green mottling common in the underlying Stokes Formation evident below 500 metres.

The shale is brown to red brown, micromicaceous, sub fissile to fissile, relatively hard, occasionally glauconitic, and gradational to the siltstone throughout. The dolomites, present below 500 metres, are light red to red brown, brittle and sucrosic.

Stokes Formation 565-914 m (Thickness 349 m)
Age - Middle to Late Ordovician

At Tent Hill No. 1, the top of the Stokes Formation is marked by the incoming of dominantly siltstone lithology. A slight change in gamma ray is also noted, but is somewhat dampened by the 7" casing. Three units are apparent, as defined in the nearby West Walker No. 1 well (Gorter et al., 1982), and are easily correlated to the Mereenie area.

The upper unit (565-619 metres) consists of siltstone, sandstone, shale and minor dolomite.

The siltstone is light brown, red brown, chocolate brown, frequently mottled light grey and grey green, dolomitic in part, micromicaceous, hard, blocky to sub fissile, and gradational to sandstone in part.

The sandstones are white to pale grey, pale red brown, fine to very fine grained, sub angular to sub rounded, moderately sorted, locally silty, moderately ferruginous, with tight to very poor visible porosity.

The shales are red brown to chocolate brown, occasionally orange, in part dolomitic, slightly arenaceous, soft to gummy and moderately to extremely ferruginous.

Dolomite is present only in minor amounts in the upper unit at Tent Hill No. 1. It is light grey to white, mauve, hard, dense, cryptocrystalline and locally sandy.

Porosity, from the Sonic and Density logs, in the upper Stokes Formation ranges from 19 to 25.5%. Neutron porosity is calculated between 10.5 and 16%, the upper values calculated from extremely low density sandstones between 578 and 617 metres. These extremely low density values are also present at West Walker No. 1 between 725 and 835 metres.

The middle unit (619-847 metres) consists predominantly of siltstone with minor dolomite. The top of the unit is picked at the base of the last sand in the upper unit of the Stokes Formation.

The siltstone is reddish brown, chocolate brown, occasionally mottled grey green, light grey, extremely micromicaceous, blocky, moderately hard, slightly to extremely dolomitic and very finely arenaceous. Minor amounts of crystalline gypsum are also present as vein and fracture infilling in the siltstone. The gypsum is white to soft, brittle, with a commonly euhedral crystal form.

The dolomites are coral red, yellow, occasionally mauve, cryptocrystalline, blocky, hard, with minor dark mineral inclusions. They are finely interbedded throughout the unit, as indicated on the gamma ray and density logs.

Visible porosity in the middle Stokes Formation is poor. This poor porosity development is also confirmed by log interpretation.

The lower unit (847-914 metres) consists of limestone, calcareous siltstone and minor shale. This unit is readily recognisable on the density and gamma ray logs as a thinly interbedded unit below the more massive siltstone of the middle unit. The lower unit also contains a higher percentage of calcareous material than the middle unit.

The limestone is white, clear, light grey, coral red, cryptocrystalline, moderately hard, locally brittle, and gradational to calcareous siltstone.

The calcareous siltstone is brown grey, mauve grey, rarely grey green, micromicaceous and rarely to moderately ferruginous.

Porosity in the lower Stokes Formation is limited, as indicated by visual examination of cuttings and electric log interpretation.

Stairway Sandstone 914-1113 m (Thickness 199 m)
Age - Middle Ordovician

At Tent Hill No. 1, the top of the Stairway Sandstone is placed at the incoming of the first major sandstone beneath the calcareous siltstone and limestone of the Stokes Formation. The section is divided into an upper sandstone, a middle siltstone, and a lower sandstone (after Cook, 1972).

Upper Stairway 914-939.5 metres

At Tent Hill No. 1, the upper part of the Stairway Sandstone consists of sandstone with subordinate siltstone.

The sandstone is light grey to clear, occasionally grey green to dark grey, very fine to fine grained, hard, moderately to locally well sorted, sub rounded to sub angular, rarely angular, siliceous, and locally dolomitic, with occasional dark mineral flecks. The sandstone is silty in part, and frequently bioturbated, with minor compaction features also evident. Porosity is very poor to tight, due to extensive cementation by silica, and rarely by dolomite.

The siltstone is dark grey, hard, brittle in part, fissile to sub fissile, finely micaceous, rarely dolomitic, and form thin laminations within the sandstone.

Visible porosity in the upper Stairway Sandstone is poor, due to extensive silicification. Maximum measured porosity in the upper Stairway Sandstone is 2.4% at 929.10 metres. However, detailed porosity calculations from the sonic and density logs indicate higher values. Sonic/Density crossplots indicate a range of porosities from 5.5% to 13%, while calculated porosity from the neutron log ranges between 9% and 15%.

Middle Stairway (939.5-1046 metres)

The top of the middle Stairway Sandstone is picked on a gamma ray change at the base of the major sand in the upper

Stairway Sandstone. This pick coincides with an increase in the amount of siltstone and shale.

At Tent Hill No. 1, the middle unit of the Stairway Sandstone consists predominantly of siltstone, with minor sandstone and thin irregular rudaceous (microconglomeratic) bands.

The siltstone is light to dark grey, hard to brittle, shaly or gradational to very fine sandstone in part, non calcareous, micromicaceous, in part carbonaceous, heavily bioturbated, and pyritic in places with small nodular disseminations. The siltstone is commonly contorted, displaying flaser and planar bedding, and frequently microfractured with occasional poorly developed slickensides.

The sandstone is thinly bedded and interbioturbated within the siltstone. The sandstone is pale grey, white, buff grey, extremely fine to fine grained, silty throughout, moderately to poorly sorted, siliceous, rarely dolomitic, with tight to very poor porosity.

The microconglomerates consist of dark grey, well rounded phosphatic pellets within a white to light grey, dolomitic matrix. These rudaceous bands are up to 5 cm thick and are irregular in appearance with a sharp (erosional?) base and a gradational upper contact into the argillaceous sediments. Below 1025 metres, bivalve fragments are common within the rudites.

Porosity in the middle Stairway Sandstone is poor, with a highest measured value of 5.7%. Log analysis indicates values much lower than the measured values.

Lower Stairway (1046-1113 metres)

The top of the lower Stairway Sandstone is gradational with the overlying unit, and is marked by the increased relative abundance of sandstone over the siltstone of the middle Stairway Sandstone, and is picked by gamma ray correlation with West Walker No. 1.

At Tent Hill No. 1, the lower unit of the Stairway Sandstone may be divided into two sub-units as defined at Tempe Vale (Marsden et al., 1983).

1046-1100 metres: The upper sub-unit consists of sandstone and siltstone, with minor shale.

The sandstone is white, clear, pale grey, pale buff grey, very fine to very coarse, but predominantly very fine to fine, bimodally distributed when coarse and very coarse, well sorted, sub angular to sub rounded when fine grained and sub rounded to well rounded when coarse grained. The sandstone is hard and siliceous, with rare dolomitic/calcareous cement and is frequently cross bedded, rarely massive, heavily bioturbated, and frequently gradational to siltstone.

The siltstone is dark grey, black, carbonaceous in part, micromicaceous throughout, sub fissile to blocky, with occasional pelletal and disseminated pyrite. The siltstone is heavily interbioturbated with the sandstone, and increases in dominance towards the base of the sub-unit, where it is thinly bedded, and occasionally cross bedded.

The shale is dark brown to black, fissile to sub fissile, carbonaceous, firm, and frequently slickensided. The shale occurs in bands up to 40 cm thick and also as thin interlaminae within the siltstone bands, near the base of the sub-unit.

1100-1113 metres: This lower sub-unit consists predominantly of sandstone, and is characterised by very low gamma ray readings.

The sandstone is light grey, clear, white, rarely medium grey, fine to medium grained, rarely coarse, moderately to well sorted, sub angular to sub rounded, siliceous, weakly dolomitic in part, hard and occasionally friable. It is moderately to heavily bioturbated, often gradational to siltier sandstone, and contains some carbonaceous and gilsonitic grain coatings.

Minor dull yellow, pale blue, and white fluorescence and weak solvent cut were present in the interval 1100-1109.8 metres. A strong petroliferous odour was associated with the fluorescence and a maximum of 40 units of total gas was recorded at a depth of 1107.8 metres.

DST No. 1 tested the above show over the interval 1091.83-1111.06 metres and recovered 12 barrels of gas cut mud and formation water (see Appendix F).

Detailed porosity and permeability measurements were undertaken by Amdel in the interval 1100-1111 metres, where the fluorescence and cut were detected. Measured porosity varies from 3.2% to 6.4% in the zone (Appendix B, Part 1), but permeability throughout is poor. Sonic/Density crossplots indicate a maximum porosity of 9.5% at 1110 metres.

However, neutron porosity values range from 6.5 to 3.5% in the lower sandstone, compared with significantly higher values of Sonic/Density crossplot porosity. Due to the extremely low V_{sh} values in the lower sandstone, the neutron porosity values are favoured. These neutron porosities are also in close agreement with the measured values.

Sealed samples from 1100-1111 metres were sent to Amdel for fluid saturation determination, but analyses indicated no detectable hydrocarbons. However, this is contrary to the recovery from DST No. 1 (Appendix B, Part 1) in which minor gas was present.

A possible gas-water contact was initially inferred from the mud log at 1109 metres. Subsequent analysis of the resistivity data is inconclusive, and no such hydrocarbon contact can be inferred.

<u>Horn Valley Siltstone</u> 1113-1185 m (Thickness 72 m)
Age - Early Ordovician (Arenigian)

The top of the Horn Valley Siltstone is picked on the incoming of dark grey siltstone and shale at the base of the lower Stairway Sandstone.

At Tent Hill No. 1, the Horn Valley Siltstone consists of shale, siltstone, dolomite and limestone.

The shale is dark grey to black, rarely to extremely carbonaceous, moderately hard to firm, locally brittle, sub fissile to fissile, frequently pyritic, rarely dolomitic, micromicaceous in part, and occasionally silty.

The siltstone is grey to grey green, micromicaceous, often pyritic as nodules and disseminations, and moderately hard. Frequently shaly, the siltstone forms thin irregular zones within the more massive shale.

The dolomite is light grey to tan grey, cryptocrystalline to crystalline, moderately hard to firm, locally brittle, with minor poorly sorted, sub angular quartz grains held in a dolomitic matrix. The dolomite occurs irregularly throughout the Horn Valley Siltstone, and also occurs as more regular beds in the intervals 1120-1126 metres and 1183-1185 metres. The basal of the two massive dolomites contains an abundance of glauconite. This glauconitic dolomite indicates the base of the Horn Valley Siltstone.

The limestone occurs as conspicuous light grey to white bands up to 3 centimetres thick between dark grey shale and in bands up to 12 centimetres thick. The limestone is light grey, white, cryptocrystalline, moderately hard, brittle in part and discontinuous within the dark grey shale.

A gas peak of 670 units occurred while drilling at a depth of 1146.8 metres. The gas was reservoired in tight shales, with no fracture porosity indicated within the cores. A flow check established that the gas was of a very low volume, but was under extremely high pressure. The lack of visible porosity in the cores indicated no immediate need to test the interval.

Because of continued high mud gas readings below 1146.8 metres a DST was run to investigate the reservoir characteristics of the lower Horn Valley Siltstone interval. DST No. 2 tested the interval 1161.23-1194.16 metres, over the basal Horn Valley Siltstone and upper part of the Pl Pacoota Sandstone. DST No. 2 recovered 0.05 barrels of drilling mud, thus indicating poor porosity in both formations.

Porosity development in the Horn Valley Siltstone is extremely limited. The maximum measured porosity is 1.3% in the upper dolomitic section at 1122.70 metres.

Pacoota Sandstone 1185-1387.3 m TD (Thickness 202 m)
Age - Late Cambrian to Early Ordovician

The Pacoota Sandstone at Tent Hill No. 1 can be subdivided into three of the four units defined at Mereenie Oil and Gas Field (Huckaba, 1970). Slight modifications to Huckaba's subdivisions are made, as defined by Gorter et al. (1982).

Pacoota P1 1185-1273 metres (Thickness 88 m)

The top of the Pacoota P1 is picked at the base of the glauconitic dolomite discussed above.

At Tent Hill No. 1 the Pacoota P1 consists of siltstone, sandstone and shale.

The siltstone is medium to dark grey, dark grey brown, rarely black, occasionally slightly dolomitic, extremely to moderately glauconitic, commonly micromicaceous, slightly calcareous towards the top, locally pyritic and commonly gradational to, and bioturbated with, very fine grained sandstone.

The sandstone occurs as two types. Firstly as thinly laminated and bioturbated zones within the siltstones. These sandstone zones are light to medium grey, grey brown, silty, generally poorly sorted, angular to sub rounded, extremely fine to fine grained, siliceous, moderately glauconitic, non calcareous, and have very poor porosity. Secondly, the sandstone occurs as distinct bands between the interbioturbated units. These bands are white, clear, light grey, very fine to coarse grained, but generally fine grained, commonly bimodal when coarse grained, poorly to moderately sorted, sub angular to sub rounded, siliceous, with poor to occasionally fair visible porosity.

The beds are massive, between 2 and 9 metres thick, frequently cross bedded, and occasionally contain fragmentary shell and clay balls. The beds thicken towards the base of the P1, culminating in a basal 9 metre sandstone which contains abundant vertical Skolithus tubes.

The shale is medium grey, dark grey, medium grey green, fissile to sub fissile, firm, rarely brittle, with an occasional pearly lustre on the slickensided and sheared surfaces. The shale occurs within the highly bioturbated sections and is frequently gradational to siltstone.

Porosity in the P1 Pacoota Sandstone varies from poor to rarely fair. Maximum measured porosity in the P1 is 7.1% at 1222.30 metres.

Calculated porosities in the P1 Pacoota Sandstone are between 6 and 11.5%, with a fair degree of consistency between Sonic/Density and Neutron log derived values.

DST No. 3 covered the interval 1205.11 to 1238 metres in the P1 of the Pacoota Sandstone. The test recovered 4.46 barrels of mud and formation water.

Pacoota P2 1273-1349.5 metres (Thickness 76.5 metres)

At Tent Hill No. 1, the top of the P2 Pacoota is picked on log correlation with the Mereenie Field at the base of the sand containing the abundant vertical Skolithus tubes. The P2 consists of sandstone, siltstone and shale, with the basal part containing a high proportion of glauconite.

The sandstone is clear, white, red brown, grey green, very fine to medium grained, predominantly very fine to fine, moderately to poorly sorted, siliceous, rarely to extremely glauconitic, sub angular to sub rounded, with poor to very poor intergranular porosity. Minor poorly defined Skolithus tubes are present.

Below 1324.5 metres, the sandstone is light green to apple green, with small granular glauconitic grains becoming a major component of the sandstones. This glauconitic sandstone marker is persistent basinwide as the lower sub-unit of the P2 Pacoota Sandstone.

The siltstone is medium to dark grey, pale grey, pale green grey, very finely micromicaceous, rarely bioturbated, non calcareous, firm, sub fissile to blocky and finely arenaceous in part. The siltstone occurs as thin laminae and interbeds within the sandstone, and as interbioturbated zones with the sandstone.

The shale is pale grey to dark grey, soft to firm, pyritic, locally chloritic, sub fissile to blocky, non calcareous, micromicaceous and silty in part.

Porosities in the P2 Pacoota Sandstone are generally poor to fair, as indicated by the calculated values of between 7.5 and 11% from the Sonic/Density logs. Neutron log derived porosities are somewhat unreliable due to the high glauconitic content, which masks the correct value for V_{sh}. A single measured porosity of 5.2% was recorded in the Pacoota P2. Overall, visible porosity is poorly developed.

Pacoota P3 1349.5-1387.3 metres T.D.(Thickness 37.8 m+)

At Tent Hill No. 1, the top of the P3 is picked immediately below the glauconitic sandstone horizon at the base of the P2. In the Mereenie area, the P3 is divided into an upper sandstone and a lower interbedded sandstone and siltstone sequence, but at Tent Hill No. 1, total depth was reached near the upper sandstone sub-unit. The P3 consists of sandstone with minor siltstone.

The sandstone is white to clear, pale pink, white, fine to coarse grained, predominantly medium grained, sub angular to sub rounded, moderately to well sorted, with minor fine lithic shale clasts and rare pyritic disseminations. The sandstone shows very fine cross bedding and minor Skolithus tubes. Visibile porosity is predominantly poor, with minor fair to good bands locally, the pores being frequently occluded with secondary silica overgrowths.

The siltstone is dark grey, grey brown, grey green, very finely micaceous, firm, sub fissile to blocky, non calcareous, and very pyritic. The siltstone forms as thin bands and laminae within the massive sandstone, and is well defined on the gamma log although usually less than 15 cm thick.

Sonic/Density log calculated porosity values in the Pacoota P3 range from 3.5 to 12%. More realistic values were derived from the Neutron log, with a calculated range in porosities from 3.5 to 8%. Measured porosities in the P3 are between 5.6 - 7.4%, with the latter indicative of the best visible porosity.

DST No. 4 covered the interval 1354.4 to 1387.36 metres in the upper part of the P3 Pacoota Sandstone. The test recovered 13.08 barrels of mud and salt water.

4.4 Structure

The Tent Hill Prospect is located in an isolated valley, 195 kilometres west of Alice Springs and about 35 kilometres east of the Mereenie Oil and Gas Field. No direct seismic tie to well control in the Mereenie Field was possible as the valley is surrounded by steep incised ridges of Pertnjara Group. Like the Mereenie Anticline, no surface closure can be identified but the possibility of separate culminations along the Walker Creek Anticline had been proposed by earlier workers. The 1981 Walker Creek Seismic Survey was shot to investigate this possibility. Three culminations were located.

Although there was no direct tie to well control, jump correlations to 1973 vintage lines from Mereenie Field proved reliable. The Tent Hill prospect is best illustrated by seismic line P81-WC2 (Enclosure 6) through the Tent Hill No. 1 location. Domal culminations of the Pacoota Sandstone along the plunging nose of the Walker Creek Anticline were not obvious on time structure maps, but depth conversion using smoothed seismic velocities showed that at the West Walker No. 1 location an anticlinal closure in excess of 3.5 square kilometres area and 60 metres relief lay en echelon to the main anticlinal trend (Enclosure 3).

Isopach studies based upon seismic data and the results of West Walker No. 1 showed that the Walker Creek Anticline grew during the Cambro-Ordovician along trends compatible with the en echelon direction recognised above.

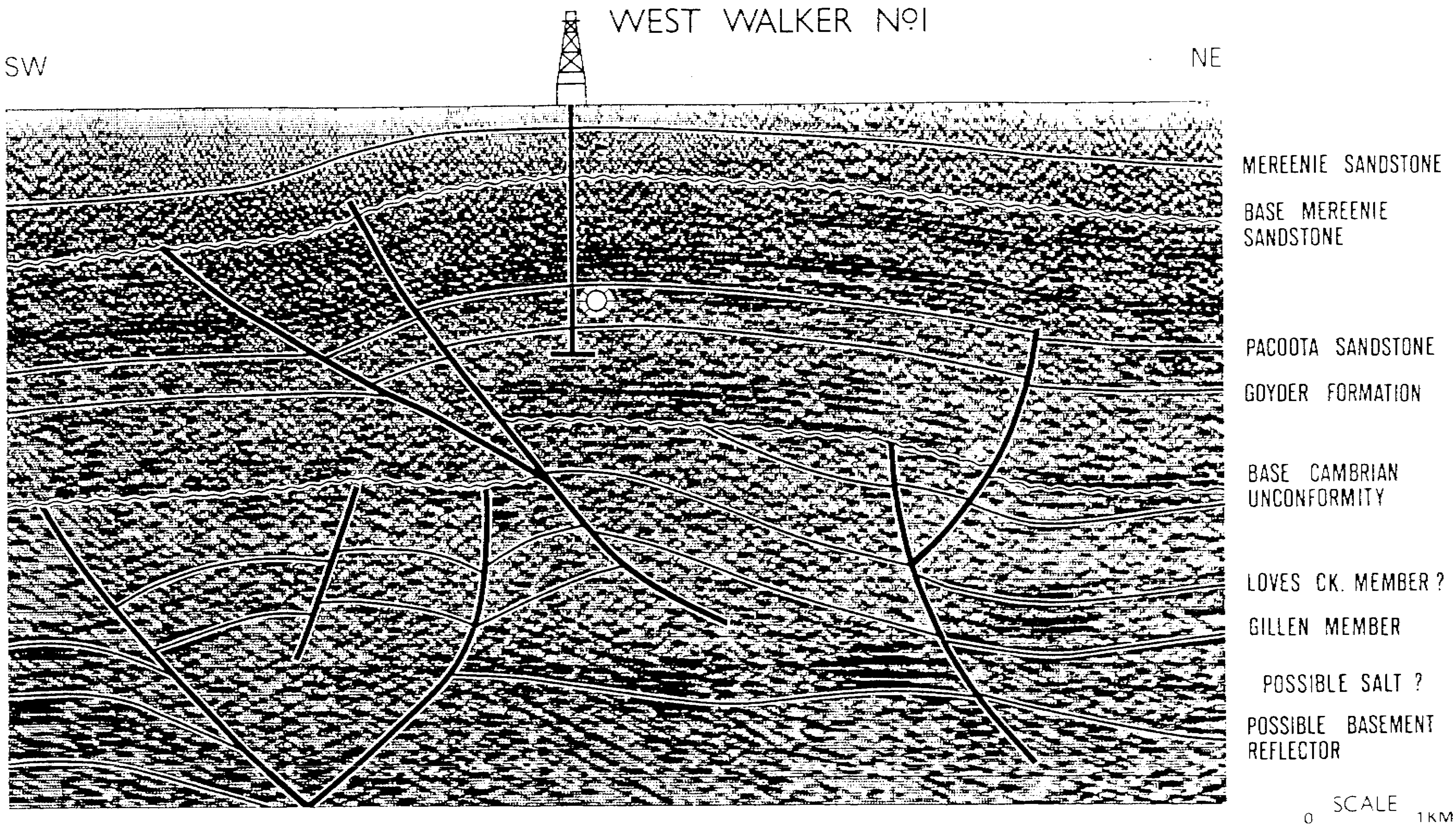
The post drill seismic interpretation confirmed that West Walker No. 1 was a separate closed structure, and that at Pacoota Sandstone level three culminations could be interpreted. The Tent Hill Prospect was the larger of the two and was controlled by seismic to its north, south and west. The inaccessable terrain in the east prohibited seismic acquisition but a saddle separating Tent Hill from the breached Walker Creek Anticline was inferred from: (1) the projection of dips measured from outcrop of the Pacoota Sandstone on the plunging nose of the Walker Creek Anticline; and (2) the orientation of isopach trends in

Ordovician formations which suggested that the Cambro-Ordovician anticline grew on a different axis to the current surface structure. Tent Hill No. 1 was spudded at the eastern end of the West Walker Valley, on the largest of the three along-trend culminations. The Tent Hill Prospect had 100 metres vertical closure and 16 square kilometres areal closure.

Figure 4 shows that the West Walker structure was formed during the Alice Springs Orogeny. However, the Rodingan Movement was responsible for the southerly truncation of the Ordovician at the base Mereenie horizon; similar truncation of the upper Larapinta Group is seen in outcrop in the Walker Creek Anticline to the east. There has been growth during the Cambro-Ordovician. The development of the Tent Hill Structure is directly comparable to the West Walker feature.

Severe truncation during the Early Cambrian or Late Proterozoic is coincident with uplift during the Petermann Ranges Orogeny which has had widespread effect over anticlines throughout the southern Amadeus Basin. The Petermann Ranges faulting may have been a rejuvenation of older horst-like structures that can be inferred from seismic data or a rejuvenation of Late Proterozoic salt features for which there is evidence in the seismic-stratigraphic record south of Mereenie Anticline.

Tent Hill No. 1 bottomed within the P3 unit, historically the best reservoir within the Pacoota Sandstone. Isopach variations recognised from seismic data were confirmed and the Pacoota Sandstone reservoir was 193.5 metres shallower than West Walker No. 1.



SEISMIC LINE P82-WC2

Author : R.J.S.	Date : Feb'84
Drawn : D.P.	Figure : 4

4.5 Porosity, Permeability and Formation Fluids

Porosity was determined while drilling by visual examination of lagged cuttings samples. Porosity determination was also undertaken utilizing the Sonic, Density and Neutron logs, and also from core analysis completed by Amdel and U.T.S.. Permeability measurements were calculated from pressure buildups during testing, and also from core analysis. Formation fluids were sampled from the blooie line while air drilling, and from drill stem test recoveries.

Porosity in the Mereenie Sandstone is fair to good, but decreases with depth into the Gosses Bluff Sandstone, where secondary silicification and diagenetic effects largely occlude the pore spaces. Porosity in the Carmichael Sandstone is poor due to the high volumes of ferruginous and argillaceous material.

Visible porosity in the upper Stokes Formation is poor, but log derived values are in the vicinity of 22%. The density logs show anomalously low values (ranging 2.2 - 2.25 gm/cc) which is also noted at a similar stratigraphic level at West Walker No. 1. Permeability in the upper Stokes Formation is best illustrated by the water flow rates while drilling with air. These upper sands produced formation water at rates up to 285 barrels per hour. The water was fresh, with resistivities varying from 2.2 to 5.5 ohm metres (approximately 1,100-2,500 ppm) chlorides.

Porosity in the middle and lower sections of the Stokes Formation was poor, as indicated by core data (Appendix B) and log analyses.

Typically, the upper Stairway Sandstone has poor visible porosity. The maximum measured porosity from cores is only 2.4%. However, Sonic/Density crossplots indicate porosities up to 13% in the upper Stairway Sandstone. These higher porosities are possibly due to microporosities within the clays.

Porosity in the lower Stairway Sandstone is poor to fair, with the maximum measured value of 6.4%. Permeability in this zone is generally poor, with a maximum of 50 millidarcies measured. While no hydrocarbon saturation was detected in the cores, recovery on testing indicated minor gas saturations (Appendix G). Estimated permeability from DST No. 1 is 4 millidarcies. Fluid recovered from DST No. 1 was salty, (Appenidx G) and of similar salinity to the connate water recovered from West Walker No. 1.

Porosity in the Pacoota Sandstone is poor to fair, with a maximum measured porosity of 10.5% within the haematitic sandstone at 1228.54 metres. Log calculated porosity values in the Pacoota Sandstone range from 5.5 to 12% and support the log derived values. Maximum permeability values are noted in the upper part of the P3 sand (Appendix B). DST No. 4, conducted over the P3 zone, showed a maximum permeability of 4.7 millidarcies, compared with 25 millidarcies from core analyses (Appendix B).

Water samples taken from DST's 3 and 4 indicate saline water within the pore systems. The recovery of water from the upper sands in the Pacoota Sandstone ascertained that no significant hydrocarbons were present and led to the abandonment of the well.

4.6 Relevance to the Occurrence of Hydrocarbons

DST No. 1 in the lower Stairway Sandstone of Tent Hill No. 1 recovered minor amounts of hydrocarbons. Chromatograph readings while drilling this interval indicated that the contained hydrocarbons were gas (Appendix J). Subsequent source rock analyses of the probable source of the gas, the underlying Horn Valley Siltstone, indicated that the Horn Valley is predominantly gas prone (Gorter, in press).

High pressure, low volume gas was liberated at 1146.8 metres from the Horn Valley Siltstone, although no obvious fracturing was evident from the cores taken at this depth. The hydrocarbons are thought to be locally sourced, but unable to migrate due to the compacted sediments. The tight nature of these cores is indicated by the gas "bubbling" from bedding plane fissility when at atmospheric pressure.

The thermal alteration of conodonts contained in the Horn Valley Siltstone indicate a mature source rock (Appendix I). Hydrogen indices and pyrolysis data crossplots indicate post-mature Horn Valley sediments in the Tent Hill No. 1 well. This conclusion is consistent with those interpretations made after the drilling of West Walker No. 1 (Gorter et al., 1982).

4.7 Contribution to Geological Concepts

Tent Hill No. 1 was drilled to test an independent closure along the Mereenie Walker Creek Trend, approximately 15 kilometres to the southeast of West Walker No. 1. The prognosed formation tops were close to the actual tops, so that no reappraisal of geological or geochemical models was necessary.

The well successfully penetrated a separate, closed culmination along the Mereenie Trend, as indicated by the saline water recovered from DST's 1, 3 and 4, and the minor hydrocarbons in DST No. 1. The Tent Hill anticline also showed thinning of Pacoota Sandstone units, consistent with contemporaneous growth during deposition.

The reservoir quality of the Pacoota Sandstone at Tent Hill No. 1 showed a marginal increase with respect to West Walker No. 1, possibly due to winnowing of sediments over the postulated growth structure or a slight decrease in diagenetic effects as a consequence of a decrease in the depth of burial.

Geochemical studies confirmed the eastward trend to poorer source beds within the Horn Valley Siltstone.

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