3. GEOLOGY

3.1 OBJECTIVES

Murphy No. 1 was a rank wildcat petroleum well drilled as part of the work program for EP26, Curtin Springs, Northern Territory.

The well location was selected after interpretation of the reprocessed Weeks Australia 1982 Amadeus Seismic Survey and Pacifics 1989 Murphy Seismic Survey. Mapping of a reflector interpreted as the top of the Bitter Springs salt sequence showed areal closure of at least 50 square kilometres along a NW trending anticline. The well was sited to test the shallowest of three culminations on the structure with an interpreted areal closure of 14 square kilometres and a vertical closure of 380m.

The purpose of the well was to determine the potential for commercial quantities of hydrocarbons to occur in Proterozoic rocks of the southern Amadeus Basin. The well was designed to test potential reservoir facies in a structure formed sufficiently early in the basin's history to trap hydrocarbons generated by Proterozoic source rocks.

The primary objective of Murphy 1 was the intersection of possible reservoir quality rocks in the Heavitree Quartzite. Identification of source rocks in the Gillen Member of the Bitter Springs Formation formed the secondary objective.

3.2 REGIONAL SETTING AND STRUCTURE

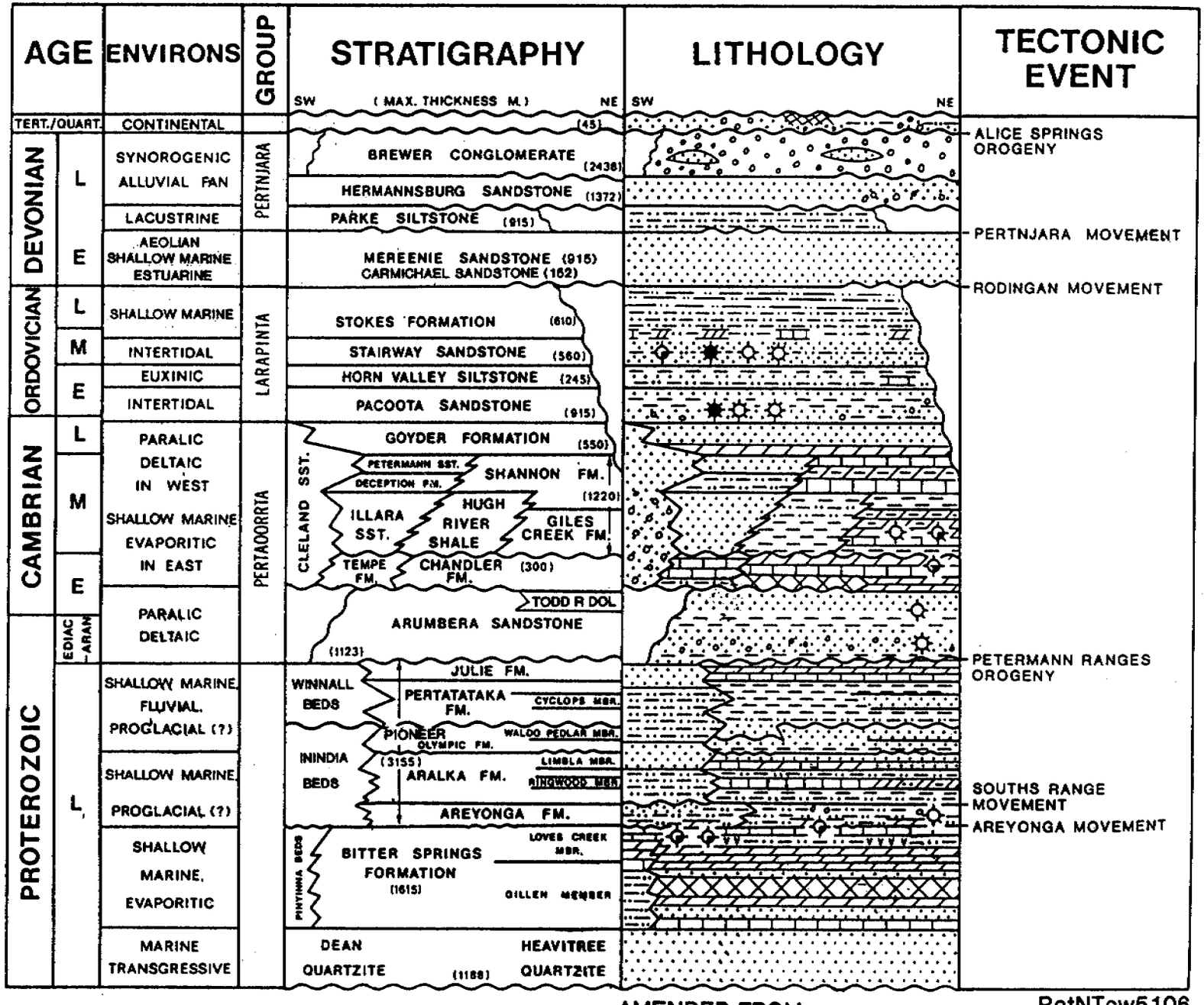
The Amadeus Basin is an asymmetrical, east-west trending, intracratonic depression covering 155 000 sq km of central Australia.

Up to 14km of sediments are locally preserved, ranging in age from Late Proterozoic to Late Devonian (PetNTcw5106). The sediments are almost entirely shallow marine and terrestrial, including two episodes of evaporite deposition and minor glacial deposits.

The basin is one of a number of similar intracratonic Australian basins initiated during the Late Proterozoic, probably as the result of the break-up of a Proterozoic supercontinent (Lindsay & Korsch, 1989).

The earliest Proterozoic units of the Amadeus Basin are very restricted in their known extent. These units consist of clastic sedimentary rocks and basalts along the south-western margin of the basin (Mount Harris Basalt, Bloods Range Beds, Dixon Range Beds) and an unnamed succession of sedimentary rocks, basalt and

STRATIGRAPHY OF THE AMADEUS BASIN



PetNTcw5106

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(PETROLEUM IN AUSTRALIA: THE FIRST CENTURY)

dacite near Kintore in the north-west. The units have been interpreted as a rift sequence marking the opening of the Amadeus Basin (Lindsay & Korsch, 1989).

The fluvio-volcanic rift sediments are unconformably overlain by epeirogenic clastics of the Heavitree /Dean Quartzites, followed by carbonates and evaporites of the Bitter Springs Formation.

The Bitter Springs Formation is terminated by an erosional surface upon which shallow marine and glacigene sediments of the Inindia Beds and its equivalents in the northern Amadeus Basin were deposited.

The top of the Inindia Beds is marked by a flooding surface upon which deeper water pelagic and turbiditic sediments accumulated. This deeper marine sequence is known as the Winnall Beds in the south and the Pertatataka Formation in the north. It shallows upward into shallow marine and fluvial clastics in the south-west and oolitic platform carbonates of the Julie Formation in the north.

The Late Proterozoic phase of deposition was terminated in the south by the Petermann Ranges Orogeny, a period of mountain building, recumbent folding and northward overthrusting (Wells et al. 1970). Molasse sediments were shed north and north-east from uplifted areas and accumulated in a foreland style basin immediately before the range (Mt Currie Conglomerate, Ayers Rock Arkose), bypassed the middle of the basin, and accumulated as a prograding deltaic sequence in the north (Arumbera Sandstone).

The Petermann Ranges Orogeny shaped the framework of the Palaeozoic basin, and a northern trough initiated at this time persisted through most of the Palaeozoic.

During the early Cambrian, continental sedimentation persisted in the north-west (Cleland Sandstone) while shallow marine shales, carbonates and evaporites were deposited in the north east (Shannon, Giles Creek and Chandler Formations). A widespread transgressive cycle in the Late Cambrian resulted in the deposition of the Goyder Formation.

Two transgressive cycles during the Ordovician resulted in the alternating deposition of tidal flat/barrier bar sands and deeper marine, euxinic muds and silts (Pacoota Sandstone, Horn Valley Siltstone, Stairway Sandstone, Stokes Siltstone). These sediments form the source-reservoir-seal sequence of the Mereenie and Palm Valley hydrocarbon fields in the north-western Amadeus Basin.

Marine deposition was terminated by the Late Ordovician Rodingan Movement.

Uplift of the north-eastern basin resulted in the erosion of up to 3000m of Cambro-Ordovician sediments. This area became the source region for the Early Devonian Carmichael and Mereenie Sandstones. Arid climatic conditions prevailed with sediments transported by both aeolian and fluvial action into a shallow sea transgressing from the west.

Major uplift of the Arunta block along the present northern margin of the basin commenced in the Middle Devonian. Continental deposition continued as thick molasse sediments accumulated south of the uplifted area.

A lacustrine siltstone (Parke Siltstone) was laid down conformably on the Mereenie Sandstone, and after uplift coarser sediments were deposited (Hermannsburg Sandstone, Brewer Conglomerate). These three units, comprising the Pertnjara Group, thin and become finer grained to the south.

Uplift of the Musgrave Province and deformation of the southern Amadeus sequence culminated in the Early-Middle Devonian Pertnjara Movement (Polly Conglomerate), after which fluvial sands of the Langra Formation and estuarine silts of the Horseshoe Bend Shale accumulated. These sediments comprise the Finke Group, which is the southern equivalent of the Pertnjara Group, although the former sequence fines upward in contrast.

Regional deposition was terminated in the Late Devonian-Early Carboniferous by the Alice Springs Orogeny. Some earlier structures were reactivated during this period of deformation.

3.3 RESULTS OF DRILLING

3.3.1 Stratigraphic Prognosis

Formation tops were selected at vibration point 531 on line M89-107 after tying the 1989 Murphy Seismic Survey into the Weeks 1982 Amadeus Seismic Survey and Exoil **Erldunda 1.**

A comparison between the prognosed stratigraphy and that actually encountered at the Murphy location is given in Table 1.

The thickness of the Palaeozoic section intersected by the **Murphy 1** well was essentially as expected. The main stratigraphic variation was that the section interpreted to be the Cambro-Ordovician Larapinta Group was found to be the Cambrian Pertaoorrta Group.

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Table 1 - Comparison of Prognosed and Actual Formation Tops and Thicknesses for Murphy No. 1

Formation Name	Prognosed Top (m KB)	Actual Top (Logger m KB)	Diff. to Prognosed Top (m)	Prognosed Thickness (m)	Actual Thickness (m)	Thickness Difference (m)
Surface Sand	NP	"Surface"	NP	NP	4.3	+6
Horseshoe Bend Shale	Surface	10.0	-10.0	640	566	-74
Carmichael Sandstone & Larapinta Group	640	576	-64	315	151.5	-163.5
Pertaoorrta Group	NP	727.5	NP	NP	150.9	+150.9
Inindia Beds	955	878.4	-76.6	100	354.6	+254.6
Bitter Springs FM -Pre salt sequence	1055	1233.0	+178.0	150	811.4m	+661.4
Salt Sequence	1205	2044.4	+839.4	210	840.1+	+630.1+
Sub-salt sequence	1415	-	-	50	-	-
Heavitree Quartzite	1465	-	-	180	-	-
Basement unconformity	1645	-	-	-	-	-

Anticipated formation tops were in reasonable agreement with those selected from seismic and varied by 10 to 64m from seismic picks.

The Proterozoic section intersected by the Murphy 1 well was considerably thicker than prognosed.

The Inindia Beds had thickened from Erldunda 1 and less section had been eroded from the structure than had been predicted.

An angular unconformity, interpreted on seismic to be the base of the Amadeus Basin sequence, was found to be a previously unrecognised unconformity within the Bitter Springs Formation. Thus the Bitter Springs Formation was +1241.5m thicker than prognosed and the well terminated in this unit.

The Heavitree Quartzite and Basement horizons are not seismically imaged as insufficient seismic energy has penetrated the interbedded Bitter Springs evaporites. The depth to the Heavitree Quartzite horizon at the Murphy location is now estimated at between 3400m and 3900m.

3.3.2 Stratigraphy and Depositional Environment

The Murphy 1 well intersected 868.9m of Paleozoic and 2006.1m of Proterozoic section.

Table 2 shows the formation tops intersected together with thicknesses and depths relative to mean sea level.

All figures given are loggers depths, measured from kelly bushing (KB).

A brief stratigraphic summary based on wellsite lithologic descriptions and wireline log characteristics is presented below.

Detailed descriptions of cuttings and core are given in Appendix I, sections (a) and (b).

Electric logs may be found in Enclosure III.

Surface Sand (5.6 - 10.0m)

Iron stained quartz sand of aeolian origin.

Horseshoe Bend Shale (10.0 - 576.0m)

The Horseshoe Bend Shale is a thick sequence of brown to grey shale and siltstone widely distributed in the central part of the KULGERA and FINKE 1:250 000 map sheet areas.

TABLE 2 - Stratigraphy of Murphy No. 1

AGE	GROUP	STRATIGRAPHY		FORMATION TOPS (m) KELLY BUSHING	GROUND LEVEL	RELATIVE TO MSL	THICKNESS(m)	
				5.6	0	+450.0		
QUARTERNARY	UNASSIGNED	UNDIFFERENTIATED					4.3	
				10.0	4.4	+445.6		
MID-LATE DEVONIAN	FINKE	HORSESHOE BEND SHALE					566.0	
				576.0	570.4	-120.4		
EARLY DEVONIAN	UNASSIGNED	CARMICHAEL SANDSTONE					152.0	
				727.5	721.9	-271.9		
CAMBRIAN	PERTAOORRTA	UNDIFFERENTIATED					150.9	
				878.4	872.8	-422.8		
LATE PROTEROZOIC	UNASSIGNED	ININDIA BEDS	UNIT 1				82.0	354.6
				960.4	954.8	-504.8		
			UNIT 2				135.6	
				1096.0	1090.4	-640.4		
			UNIT 3				137.0	
				1233.0	1227.4	-777.4		
		BITTER SPRINGS FORM.	LOVES CK "LACUSTRINE" MEMBER				239.3	+1651.5
				1472.3	1466.7	-1016.7		
			LOVES CK "MARINE" MEMBER				169.0	
				1580.3	1574.7	-1124.7		
			GILLEN MEMBER				+1243.2	
				2884.5TD	2878.9TD	-2428.9TD		

Biotite, gypsum, pseudomorphs after halite, ripple marks and mud cracks are present in outcrop and Wells et al (1970) believe the sequence was probably deposited in a fluviatile or estuarine environment, the abundance of mica indicating the sediments were sourced from Precambrian crystalline rocks.

The Horseshoe Bend Shale in Murphy 1 is a monotonous moderate brown and grey, calcareous, micromicaceous siltstone occasionally grading to claystone. Rare coarse quartz grains with biotite inclusions suggest the sediments were derived from a granitic/metamorphic terrain, probably the Musgrave region to the south which was exposed during deposition of the Mid-Late Devonian Horseshoe Bend Shale by uplift associated with the Early-Middle Devonian Pertnjara Movement.

Carmichael Sandstone (576.0 - 727.5m)

The Carmichael Sandstone was originally included in the Cambro-Ordovician Larapinta Group (Wells et al, 1970), however Lindsay and Korsch (1989) associate the Carmichael Sandstone with the younger Mereenie Sandstone. The latter seems more reasonable as the distribution of the Carmichael Sandstone in the southern Amadeus is different to that of the Larapinta Group, and it more closely resembles the Mereenie Sandstone in outcrop.

Lindsay and Korsch (1989) believe the Mereenie and Carmichael sandstones are Late Devonian in age. However the Murphy seismic data shows that the Carmichael Sandstone underlies the Horseshoe Bend Shale with angular unconformity. This suggests the Carmichael Sandstone was deposited prior to the Early-Middle Devonian Pertnjara Movement and must therefore be Early Devonian in age.

The Carmichael Sandstone in Murphy 1 is a pale reddish brown to greyish pink, very fine to medium grained, moderate to well sorted quartz sandstone cemented by silica and calcite.

Fair to good porosity through most of the sequence was indicated by the flow of saline formation waters into the borehole.

The top of the Carmichael Sandstone is picked on electrical logs where readings averaging 150 GAPI units fall to 90 GAPI units on the Gamma Ray curve. The Carmichael Sandstone is finer grained with an argillaceous matrix above 606.3m resulting in a high Gamma Ray response. Between 606.3 and

712.4m the sequence is cleaner and coarser, and this is reflected in a lower Gamma Ray response averaging about 30 GAPI units. Below 712.4m in the sandstone is again finer with a significant siltstone content. The top of the Carmichael Sandstone is also marked by a sharp fall in resistivity, and porosity in the unit is highlighted by separation of the resistivity curves.

Pertaoorrta Group (727.5 - 878.4m)

The Pertaoorrta Group is defined by Wells et al (1963) as a "sequence of interbedded siltstone, sandstone, dolomitic limestone, shale and quartz greywacke which lies conformably beneath the Pacoota Sandstone and both conformably and unconformably above the Pertatataka Formation".

The depositional axis of the Pertaoorrta sequence coincides with the present day northern margin of the Amadeus Basin. Only a thin sequence of Cambrian sediments was deposited in the southern Amadeus and outcrops are generally poor.

The section described by Wells et al (1964) from the Mt Sunday Range most closely resembles that intersected in Murphy 1. They describe a sequence of "predominantly red-brown, chocolate, green, grey, purple-brown and grey-brown siltstone and grey-green siltstone, with thin interbeds of grey and white, fine-grained, slightly calcareous dolomite".

The Pertaoorrta Group in Murphy 1 is predominantly siltstone and claystone, with minor dolostone and sandstone. The siltstone and claystone are dark reddish brown and grey, and blackish red in colour. The claystone tends to be hygroturgid to hygroclastic in character and was locally washed out in the drill hole to 24 inches.

The sequence becomes calcareous between 766.0m and 811.0m with thin beds of light grey and light brownish grey arenaceous dolostone, and pale red argillaceous dolostone. A sample of siltstone and dolostone from 800m was sent to International Stratigraphic Consultants for age determination. Unfortunately the sample was barren of datable material.

Below 822.3m beds of fine to coarse grained quartz sandstone up to 7m thick are present.

The vertical transition from possible shoreline (sandstones) to marine sedimentation (siltstones, claystones, carbonates) suggests Murphy 1 was drilled near the margin of Cambrian marine sedimentation.

It would appear that the sea transgressed southward toward the exposed Musgrave region during deposition of the Pertaoorrta Group in this area.

Inindia Beds (878.4 - 1233.0m)

The Proterozoic Inindia Beds unconformably underlie the Cambrian Pertaoorrta Group sediments. As Murphy 1 was drilled on the crest of a Petermann Ranges Orogeny structure this would suggest the Proterozoic Winnall Beds and the very top of the Inindia Beds have been removed by erosion.

The Inindia Beds have been informally divided into three units. These units can be correlated to three formations defined by Preiss et al (1978) in the north-eastern Amadeus Basin. 'Unit 1' of the Inindia Beds can be correlated to the Pioneer Sandstone, 'Unit 2' to the Aralka Formation, and 'Unit 3' to the Areyonga Formation.

Informal Units 1, 2 and 3 of the Inindia Beds are recognised in Exoil Erldunda 1 although each unit is thinner than at Murphy 1.

The Inindia Beds are absent in Transoil Mt Charlotte 1 to the north east.

Wells et al (1964) estimate at least 1400m of the sequence at Mt Conner to the west, indicating a general east to west syndepositional thickening of the Inindia Beds.

Unit 1 (878.4 - 960.4m)

Unit 1 is composed predominantly of fine to medium grained quartz sandstone with minor siltstone and claystone. The thick, fairly massive nature of the coarse clastic sequence, and its petrophysical log character suggest deposition in a braided fluvial environment.

The top of the unit is clearly indicated in cuttings as the sandstones near the base of the Pertaoorrta Group are weakly to moderately silica cemented with little pressure solution effect, while sandstones of Unit 1 are densely silica cemented with extensive pressure solution effect.

The lower boundary is picked on the Gamma Ray curve at the top of the last significant siltstone peak.

Unit 2 (960.4 - 1096.0m)

Unit 2 is composed of predominantly siltstone and claystone with minor dolostone and sandstone above 1045.0m.

A greyish black to black, carbonaceous claystone between 1045.4m and 1058.0m yielded traces of cuttings gas. This interval correlates directly with an organic rich claystone which produced 50 units of cuttings gas in Exoil **Erldunda 1.** The very fine, foetid nature of the clastics suggests they were deposited in a restricted, deeper marine environment.

The top of the unit is quite pronounced on petrophysical logs. The boundary is marked by a sharp increase from 30 to 150 GAPI units on the Gamma Ray curve, a sharp decrease in resistivity and a change in sonic log character

Unit 3 (1096.0 - 1233.0m)

Unit 3 is composed of sandstones and dolostones with minor siltstone. Traces of glauconite were recognised toward the base of the sequence between 1192.0 and 1199.2m overlying an interval containing possible weathered schist fragments.

The glauconitic sandstone may be interpreted as representing a flooding event following a glacial episode indicated by possible ice-rafted metamorphics.

Again the top of the unit is clearly indicated on petrophysical logs. The boundary between units 2 and 3 is sharp and is marked by a sudden decrease from 180 to 30 GAPI units on the Gamma Ray curve, and a sharp increase in resistivity and sonic travel time.

Bitter Springs Formation (1233.0m - TD)

Wells et al (1967) subdivided the Bitter Springs Formation into the Gillen and Loves Creek Members.

In outcrop the Gillen Member consists mainly of dolomite with subordinate sandstone, siltstone and shale. Evaporite minerals are encountered in petroleum wells that intersect the sequence.

The Loves Creek Member consists mainly of siltstone with interbeds of chert, dolomite and rare limestone (Wells et al, 1970).

Wells described the Loves Creek Member as resting conformably on the Gillen Member. Southgate (1991) has interpreted a disconformity between the two members in outcrops north-west of Bluebush Dam on the RODINGA sheet. Recent seismic data from the southern Amadeus Basin (reprocessed Weeks 1982 Amadeus Seismic Survey, Pacifics 1989 Murphy Seismic Survey) shows an angular unconformity within the Bitter Springs sequence. The unconformity was interpreted as the base of the Amadeus Basin sequence prior to drilling **Murphy** 1, as an angular unconformity had not previously been recognised within the Bitter Springs Formation.

The drilling of **Murphy** 1 indicates that there is an angular unconformity at the contact of the Gillen and Loves Creek members, and possibly the two members should be elevated to formation status. It appears that deposition of the Gillen Member was followed by a period of extension and uplift, with faults soleing out along decollement surfaces within the evaporites.

Loves Creek Member (1233.0 - 1580.3m)

Southgate (1986) subdivided the Loves Creek Member into two assemblages of sediments.

The basal assemblage consists of stromatolitic carbonates deposited in shallow submerged to semi-emergent marine environments.

Above this assemblage is a sequence of lacustrine carbonates and cherts, interbedded with terrestrial red shales, siltstones and calcareous sandstones.

Southgate (1991) further subdivided the basal assemblage, however the units cannot be differentiated in cuttings or on petrophysical logs from **Murphy** 1, and Southgate's 1986 subdivision has been used in this report.

The two assemblages are informally referred to as the 'marine' and 'lacustrine' units.

The 'lacustrine unit' consists of dark reddish brown and greyish red dolomitic siltstones with greenish grey reduction spots, and thin interbeds (1-10m) of pale red and light grey arenaceous dolostone. The top of the unit is marked by an

increase from 20 to 200 GAPI units on the Gamma Ray curve, and a decrease in sonic velocity and resistivity.

The 'marine unit' consists of arenaceous dolostone becoming calcareous below 1570.3m, with traces of siltstone and chert. The top of the unit is designated to be the base of the last dolomitic siltstone of the Loves Creek Member.

Gillen Member (1580.3m - TD)

The Gillen Member consists of dolostone, calcitic dolostone, dolomitic limestone, dolomitic siltstone, halite, anhydrite and traces of chert.

The sequence in **Murphy 1** is composed of carbonates, siltstone and anhydrite above 2044.4m, predominantly halite between 2044.4m and 2547.0m, and evaporites, siltstone and carbonate below 2547.0m.

The top of the Gillen Member is picked at the first appearance of significant amounts of anhydrite.

Anhydrite is often difficult to detect in cuttings as it tends to be ground to a paste by the bit and then washed out when cuttings are cleaned. However geochemical assays of the cuttings show an increase in % sulphur at 1584.5m, probably indicating an increase in calcium sulphate.

The top of the Gillen Member is chosen at a change in petrophysical log character which occurs at 1580.3m.

3.3.3 Porosity and Hydrocarbon Show Summary

Continuous monitoring of hydrocarbons and H_2S gas was maintained throughout the drilling of **Murphy 1** using a gas detector/chromatograph.

All ditch cuttings were routinely examined for hydrocarbon fluorescence using ultraviolet light.

Two zones (reported using drillers depths) of fluorescence were observed in **Murphy 1** with, both zones occurring in the Gillen Member of the Bitter Springs Formation.

The first zone between 1650 and 1656m had associated slightly elevated gas readings and corresponded to a drilling break.

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The first zone between 1650 and 1656m had associated slightly elevated gas readings and corresponded to a drilling break.

The second zone between 1797 and 1803m had no associated elevated gas readings or drilling break and pipe dope contamination is suspected.

Four zones (reported using drillers depths) of slightly elevated gas readings were recorded in Murphy 1.

The first zone was encountered in 'Unit 2' of the Inindia Beds, between 1050 and 1061m. The zone correlates directly to an organic rich shale which produced 50 units of cuttings gas in Exoil Erldunda 1.

The second zone was encountered in 'Unit 3' of the Inindia Beds between 1098 and 1114m. The tight dolostone intersected contained a trace of gas which may have migrated from the potential source horizons of 'Unit 2'.

The third zone between 1643 and 1658m was associated with a drilling break into slightly more porous carbonates in the Gillen Member of the Bitter Springs Formation.

The fourth zone between 2707 and 2718m, was encountered in an anhydritic dolostone in the Gillen Member of the Bitter Springs Formation. The zone is believed to be overpressured.

The maximum gas recorded in the well was only 1.84 units comprising C_1 to C_3 gases (methane to propane) in detectable concentrations.

The only significant porosity encountered in the well was in the Carmichael Sandstone which flowed significant quantities of saline formation water. No gas was detected in the unit and no hydrocarbon fluorescence was observed in the cuttings samples.

No significant zones of hydrocarbon occurrence were observed in Murphy 1.

No drill stem tests were performed and no net pay is interpreted from wireline logs.

Hydrocarbon shows are presented in Table 3 and are summarised graphically on the Composite Log and Halliburton Geodata Mudlog (Enclosures I and II respectively).

3.3.4 Discussion

Interpretation of the reprocessed Weeks 1982 Amadeus Seismic Survey, and Pacifics 1989 Murphy Seismic Survey resulted in the definition of a seismically defined closure with three

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3.3.4 Discussion

Interpretation of the reprocessed Weeks 1982 Amadeus Seismic Survey, and Pacifics 1989 Murphy Seismic Survey resulted in the definition of a seismically defined closure with three

culminations. The shallowest structure had 160ms of vertical closure and an areal extent of 14km^2 at the pre-drill 'top Bitter Springs salt' horizon. Pacific's Murphy 1 well was sited at shotpoint 531, line M89-107 on the crest of the culmination.

The primary objective of the well was the intersection of an anticipated hydrocarbon reservoir in the basal clastics of the Amadeus sequence, the Heavitree Quartzite. A secondary target was potential source rocks at the base of the Gillen Member.

The well was unable to satisfy its proposed objectives. Murphy 1 terminated in evaporites of the Gillen Member over 1200m past its anticipated TD of 1670m. Post-drill analysis of seismic data suggests the Heavitree Quartzite horizon at the well-site lies at between 3400 and 3900m.

Murphy 1 intersected approximately 868m of Palaeozoic section comprised of the Horseshoe Bend Shale (Mid-Late Devonian), the Carmichael Sandstone (Early Devonian) and the Pertaoorrta Group (Cambrian), separated by unconformities.

A pronounced angular unconformity separates the Palaeozoic and Proterozoic sequences. Approximately 2006m of Proterozoic sediments were intersected comprised of the Inindia Beds and the Bitter Springs Formation.

The Inindia Beds are divided into three units which have equivalents in Exoil Erldunda 1 and can be correlated to formations in the northern Amadeus Basin.

The Bitter Springs Formation is divided into the Loves Creek and Gillen members separated by an angular unconformity. The Loves Creek Member is composed of a marine carbonate sequence overlain by terrestrial redbeds and lacustrine carbonates. The Gillen Member is a restricted marine evaporitic sequence. Percent sulphur from the elemental analysis of cuttings was useful for determining the boundary between the Loves Creek and Gillen members.

Visual inspection of cuttings indicates that primary and secondary porosity is generally absent in the Proterozoic sequence. Zones of very poor to fair intercrystalline porosity were occasionally noted in the Gillen Member of the

TABLE 3: HYDROCARBON SHOWS - MURPHY NO. 1

DRILLERS DEPTH (m)	FORMATION	LITHOLOGY	POROSITY	SHOW DESCRIPTION	TOT	C_1 (ppm)	C_2 (ppm)	C_3 (ppm)	COMMENTS
1055	Inindia Beds	Black Shale	Nil		0.3	40.6	8	1.3	
1057	Inindia Beds	Black Shale	Nil	-	0.12	17.5	3.1	0.5	
1098 to 1114	Inindia Beds	Microcryst. argillaceous dolostone	Nil	-	0.24	-	-		Maximum Total Gas reading 0.24 units at 1098m. C_1 only
1650 to 1653	Bitter Springs Form. Gillen Mbr.	Finely Crystalline arenaceous, calcitic dolostone, sucrosic texture	Poor to fair intercryst?	Trace to 5% spotted, mod. bright violet blue fluor. slow weak streaming cut, faint film residue	0.2	47.4	0.8		
1656 to 1659	Bitter Springs form. Gillen Mbr.	Finely crystalline arenaceous, dolomitic limestone, sucrosic texture	Poor to fair intercryst?	5% spotted, mod. bright violet blue fluorescence. Mod. slow weak streaming cut, faint film residue	0.12	40	tr		
1797 to 1800	Bitter Springs form. Gillen Mbr.	Microcryst. argillaceous dolostone anhydritic	Nil	30-40% spotted, patchy fluorescence, dull-dim violet blue fast streaming cut, thick residual ring. Pale straw colour under normal light.	-	-	-		Fluorescence following bit trip. Probable pipe dope contamination.
1800 to 1803	Bitter Springs form. Gillen Mbr.	Microcryst. argillaceous dolostone anhydritic	Nil	20% fluorescence as above.	-	-	-		Diminishing fluorescence following bit trip. Probable pipe dope contamination.
2707	Bitter Springs Form. Gillen Mbr.	Microcryst. to very finely crystalline dolostone, anhydritic	Nil to very poor intercryst?		1.7	340	-		Kelly gas and 20 units of trip gas were recorded
2708					1.03	205	-		after this zone was intersected suggesting the formation is overpressured.
2710					0.94	188			
2712					0.36	72	-		
2715					1.84	345	11	tr	
2718					1.44	273	7		

NB: Traces of dull yellow mineral fluorescence were locally identified in Gillen Member carbonates

Bitter Springs Formation, but these were not significant. Sandstones of the Palaeozoic sequence exhibited somewhat better porosity in places. The best porosity was encountered in the Carmichael Sandstone which flowed saline formation water at a significant rate.

Several very minor hydrocarbon shows were observed in the Inindia Beds and the Gillen Member of the Bitter Springs Formation. No drill stem tests were performed due to the combination of poor shows and the lack of reasonable porosity.

The proposed source rocks at the base of the Gillen Member were a secondary objective of the well. Unfortunately the base of the Gillen Member was not penetrated. However rocks which appeared to be organic rich through the Gillen Member were sent to Amdel for TOC evaluation and rock-eval pyrolysis, and to International Stratigraphic Consultants for palynological analysis.

The samples were characterised by particularly low TOC values indicating very poor source potential. Palynological results suggested the Proterozoic sequence is post mature, although one pyrolised sample had indications of migrated hydrocarbons suggesting the sequence lies within the oil preservation window.

Analyses indicate a low maturation gradient through the Proterozoic sequence which is probably the result of a very low geothermal gradient through the evaporitic Bitter Springs Formation.

Murphy 1 was plugged and abandoned as a dry hole in compliance with Northern Territory Government regulations on 28 January, 1991.